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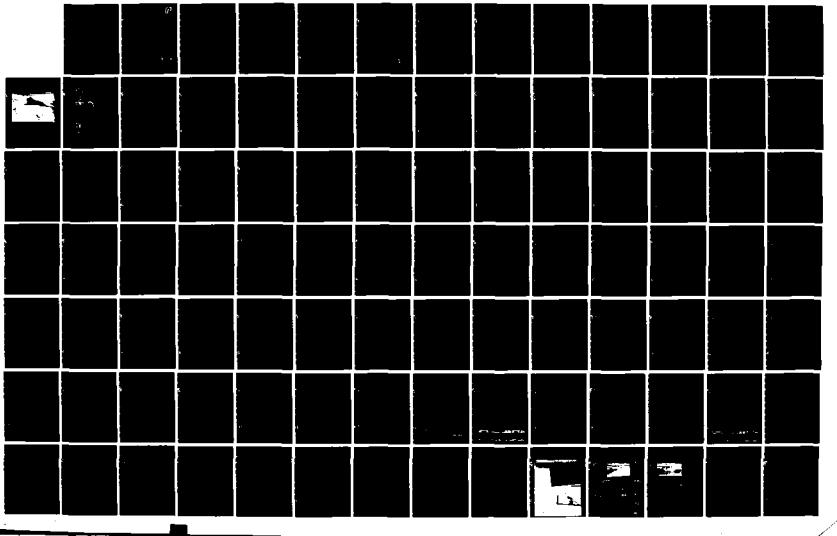

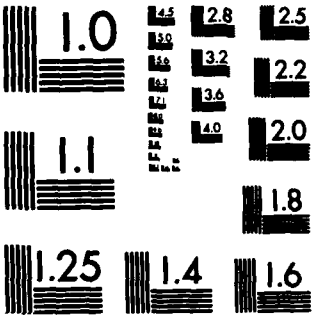

CONNECTICUT RIVER BASIN
HADDAM, CONNECTICUT

HIGGANUM RESERVOIR DAM
CT 00430

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NEW EN

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CT 00430	2. GOVT ACCESSION NO. AD-A144 667	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Higganum Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE July 1978 13. NUMBER OF PAGES 100
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

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

18. SUPPLEMENTARY NOTES

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

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

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin
Haddam, Connecticut

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

Higganum Reservoir Dam has a maximum height of 48 feet and a total length of embankment (including the spillway) of approximately 875 feet. This dam is considered to be in poor condition. In accordance with the Corps of Engineers' guidelines, the test flood for this dam is the Probable Maximum Flood (PMF).

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
NEDED-E	Dam Inspection Final Report

TO: Chief, Design Branch
Chief, F & M Branch
Chief, Water Control Branch

FROM: Chairman,
Dam Safety Review Board

DATE 14 Nov 1978 CMT 1

1. Attached is a single copy of the final report for Higganum Reservoir Dam, Identity No. CT00430.

2. Please ascertain that the report is acceptable in accordance with your Branch comments or instructions given to the Architect-Engineer at the Review Board Meeting.

3. If acceptable, retain the copy for your files and be prepared to sign the (master) approval sheet on 27 Nov.

4. If the report requires further work or correction, notify the undersigned as soon as the determination is made.

5. The cost code for this review is ABA0 0700000000.

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Incl
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DA FORM 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE.

☆GPO-1975-665-422/1063

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED

JAN 2 . 1979

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

Dear Governor Grasso:

I am forwarding to you a copy of the Higganum Reservoir 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.

The State Department of Environmental Protection was notified of the poor condition of the dam at the time of the field inspection. At that time the department took steps to lower the reservoir and lessen the immediate hazard. Currently the department has a detailed evaluation program underway which will develop specific recommendations for repairs or modifications as required.

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, the State of Connecticut, Department of Environmental Protection, State Office Building, Hartford, Connecticut 06115, ATTN: Mr. Stanley J. Pac, Commissioner.

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 yours,

N P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

HIGGANUM RESERVOIR DAM

CT 00430

CONNECTICUT RIVER BASIN

HADDAM, CONNECTICUT

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE 1 INSPECTION REPORT

Identification No.:	CT 00430
Name of Dam:	Higganum Reservoir Dam
Town:	Haddam
County and State:	Middlesex County, Connecticut
Stream:	Ponset Brook
Date of Inspection:	24 July, 1978

BRIEF ASSESSMENT

Higganum Reservoir Dam is an earth dam constructed in 1868. The dam has a maximum height of 48 feet and a total length of embankment (including the spillway) of approximately 875 feet. An overall view of the dam can be seen in Photo C-1. The embankment slopes are approximately 1.5H:1.0V downstream and 3.0H:1.0V upstream. The crest is generally grassy and the downstream slope is heavily overgrown with trees and shrubs. The upstream face is riprapped above water level and to a depth of about 3.0 feet below the normal water surface. The spillway is located in the center of the embankment and is roughly semicircular and contained between vertical masonry walls. The spillway is constructed of cut stone masonry and flows discharge onto a

slab paved with stone blocks leading to a natural stream bed. Approximately 500 feet below the dam the stream flows under Route 81 through a bridge opening.

Due to its age, Higganum Reservoir Dam was neither designed nor constructed by present state of the art methods. Based upon the visual inspection at the site, and the lack of engineering data available, there are areas of concern which must be corrected to assure the long term performance of this dam. This dam is considered to be in POOR condition. The visible signs of distress which indicate a potential hazard at this site are: large, wet, spongy areas generally along the entire right toe and lower slope of the dam embankment indicative of seepage (See Photo C-13); an extremely steep downstream slope; a dense large growth of trees and shrubs on the downstream slope; the small storage capacity of the reservoir relative to its drainage area; the close proximity of the populated area immediately downstream; seepage through the spillway masonry joints and a general lack of proper, regular maintenance.

In accordance with Corps of Engineers' guidelines, the test flood for this dam is the Probable Maximum Flood (PMF).

A PMF test flood outflow of 11742 cfs (1745 csm) would overtop the dam by about 2.14 feet; therefore, the spillway is considered to be inadequate in size. The maximum spillway

discharge of 5710 cfs represents 48.5 percent of the test flood outflow. Overtopping could result in the failure of the dam.

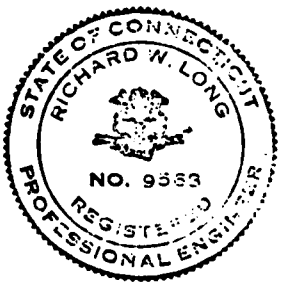
Specific recommendations and remedial measures that should be implemented by the Owner within 1 year after receipt of this Phase I Inspection Report are described in Section 7.

The alternative to these recommendations would be to partially drain the reservoir and maintain and monitor the water surface at a reduced level.

Due to the large areas of seepage observed during the 24 July, 1978 inspection, the following recommendations have already been made to the Governor of Connecticut. First, the Owner should immediately institute a program of 24 hour surveillance of the dam during periods of intense rain. Second, on a weekly basis, the toe of the dam should be examined to observe any change in volume, turbidity, or extent of seepage. In addition, it was recommended and has been implemented that the water level in the Higganum Reservoir be lowered until such time as all of the remedial measures have been performed.

C-E MAGUIRE, INC.

BY: Richard W. Long
Richard W. Long, P.E.
Vice President



This Phase I Inspection Report on Higganum 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.

Charles G. Tiersch

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

Fred J. Ravens Jr

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

Saul Cooper

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an 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.

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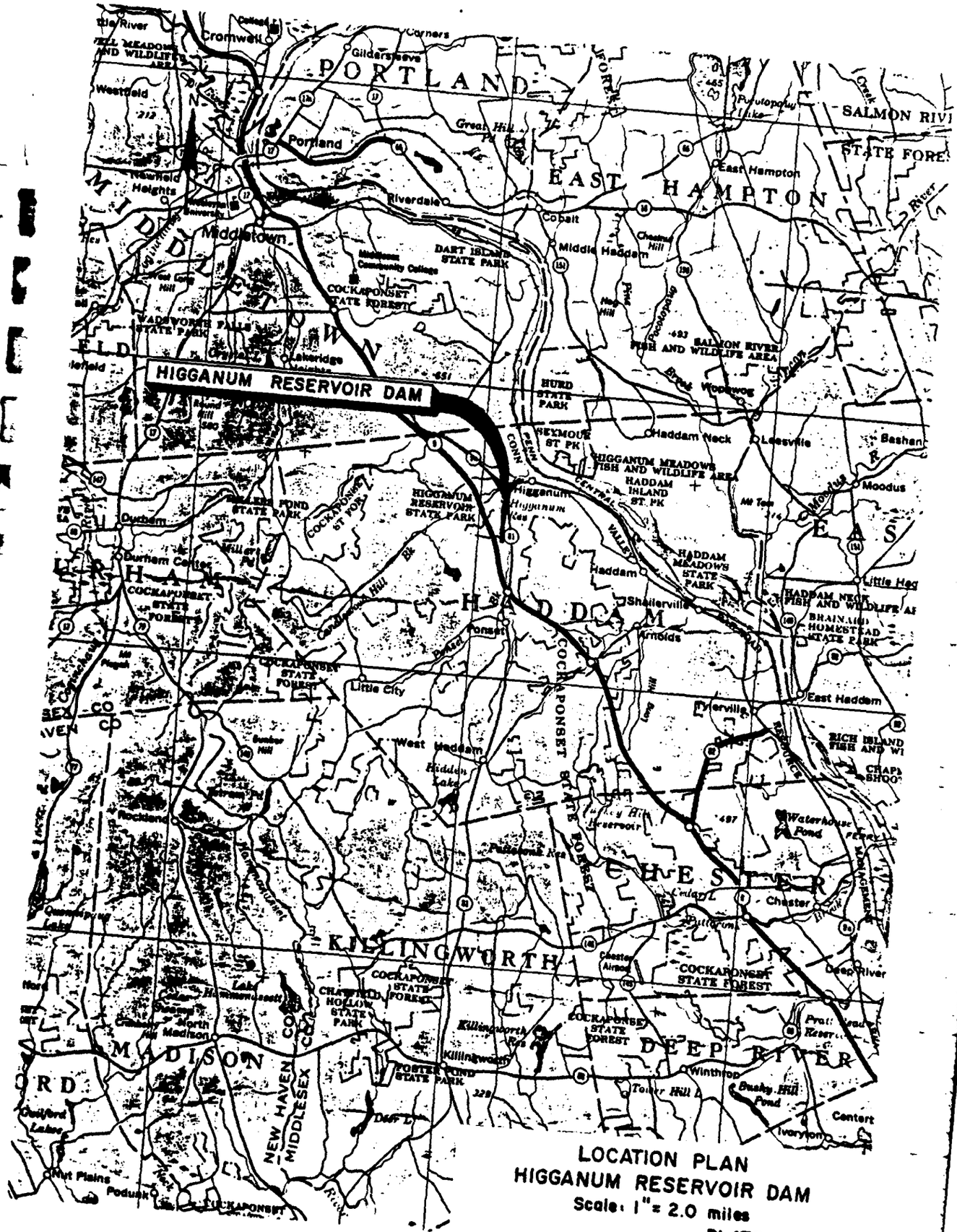
C-1 HIGGANUM RESERVOIR - LOOKING UPSTREAM



LOCATION PLAN
HIGGANUM RESERVOIR DAM
Scale: 1" = 2.0 miles
PLATE NO. 1

PHASE 1 INSPECTION REPORT

HIGGANUM RESERVOIR DAM CT 00430

SECTION 1

PROJECT INFORMATION

1.1 GENERAL

a. Authority: Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. C-E Maguire, 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 was issued to C-E Maguire, Inc., under a letter of 26 April, 1978, from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0300 has been assigned by the Corps of Engineers for this work.

b. Purpose

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions

which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

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

1.2 DESCRIPTION OF PROJECT:

a. Location: Higganum Reservoir is located in the Ponset Brook watershed of the Connecticut River Basin, approximately 0.3 miles southwest of the village of Higganum in Haddam, Connecticut (See Location Plan on Plate Number 1). Higganum Reservoir has a surface area of approximately 30 acres, an average depth of 12.6 feet and a shoreline length of about 1.6 miles. The dam is located at the northern end of the lake, perpendicular to, and adjoining, Connecticut Route 81.

b. Description of Dam and Appurtenances: Based on the visual inspection, the dam is a curved earth embankment with a crest length of 875 feet (including the spillway). The upstream slope is approximately 3H : 1V, and the downstream slope

is 1.5H:1.0V and is heavily overgrown with trees and shrubs. The upstream slope is riprapped above water level and to a depth of about 3 feet below the water surface. At the time of the inspection, the water level was at the spillway crest.

The spillway is located in the dam embankment and is roughly semicircular, contained between vertical masonry walls. An overall view of the spillway can be seen in Photos C-2, C-3 and C-4.

The spillway is constructed of cut stone masonry. The crest has cap stones approximately 4 feet in width forming an arc length of 65.0 feet and a chord length of 42.0 feet. A concrete training wall approximately 6 feet in height is to the right of the spillway. To the left of the spillway is the abandoned gatehouse, with the new 8 ft. x 8 ft. gate house located about 20 feet further toward the left. A concrete retaining wall 6 feet in height and 55 feet in length extends from the abandoned gate house toward the left end of the dam. A reinforced concrete walkway spans approximately 6 feet from the top of this wall to the new gatehouse. The down-

stream face of the cut stone masonry spillway is generally vertical at the top and on each side. In the center it becomes less steep towards the bottom producing a stair-like appearance with a generally parabolic shape as shown in Photo C-5. At the base of the spillway and for a distance of about 40 feet downstream, the discharge channel is paved with cut stone blocks. The outlet conduit, as seen in Photo C-9, discharges toward the left side of the spillway near its base. The downstream channel beyond the limits of paving is a natural cobble and boulder bed partially blocked with fallen trees and debris (See Photo C-8).

The channel is confined by vertical faced rubble masonry walls that have a curved alignment that narrows slightly from a minimum width of 42 feet at the base of the spillway. The average height of the walls is 5 feet. These walls extend approximately 120 feet downstream from the toe of the spillway.

A masonry arched foot bridge spans between the spillway abutments approximately 20 feet downstream of the spillway, as shown on Photos C-6 and C-7. The arch rises about 23 feet above the downstream channel with the walkway 9 feet higher or at a level 5.8 feet below the reservoir

water level. Stone stairways lead from and are perpendicular to the dam crest down to the foot bridge and continue from the footbridge another 18 feet downstream. Rubble masonry wing walls are present at the foot of the stairs. The walls are 35 feet in length and vary from 4 to 12 feet in height. The left wall is parallel to the centerline of the dam embankment while the right wall forms an angle of about 20 degrees from this centerline.

According to the 1967 "as-built" drawings, the intake for the gatehouse is located 84 feet south of the gatehouse. The conduit is a 36-inch, reinforced concrete pipe supported on concrete piers 8'-0" on center. The intake structure consists of a concrete headwall with steel grating and has an invert elevation of 65.0. The conduit reportedly enters the gate house at Elevation 64.0. A 36-inch rising stem type sluice gate is used to manually control the flow.

From the gatehouse, the 36 inch concrete pipe extends northeasterly passing through the base of the abandoned gate house terminating a few feet from the downstream base of the spill-

way. At this point the concrete pipe transitions to a culvert approximately 4 feet square.

A spillway approach apron, paved with stone blocks for a distance of 8 feet and a concrete slab for an additional 10 feet, extends upstream. A strip of riprap 15 feet in width extends along the upstream shoreline for about 180 feet on each side of the spillway. The top of riprap is approximately 2 feet above the spillway crest.

c. Size Classification: The dam is classified as INTERMEDIATE in size because the maximum height of the dam is 48.0 feet.

d. Hazard Classification: The dam is classified as a HIGH hazard structure because it is located just upstream of the Village of Higganum, Connecticut. The failure of this dam could cause loss of life and excessive economic damage by washing out an electric substation, roads, commercial buildings, and dwellings. See Appendix D for failure analysis.

e. Ownership: State of Connecticut
Department of Environmental Protection
Parks and Recreation
State Office Building
Hartford, Connecticut 06115
(203)-566-2304

f. Gate Tender: Mr. William Miller
Parks and Recreation Dept.
(203)-566-2304
or
Mr. Peter Houle
Region 3 - Staff

g. Purpose of Dam: Higganum Reservoir is presently used for recreation.

h. Design and Construction History: Higganum Reservoir was constructed to provide water power for the Higganum Manufacturing Company, a manufacturer of plows. The date of construction was reported to be about 1868 to 1871.

No construction or maintenance records are available for the dam for the period prior to 1938. The earliest record available is a newspaper clipping from the Middletown Press Newspaper reporting sandbagging operations during the September 1938 hurricane.

Specifications were issued in October, 1958 for the following work:

1. Lower central portion of spillway.
2. Gunnite open joints.
3. Repair of upstream wingwalls, arch and abutment walls, downstream retaining walls, tailrace walls.

4. Gunnite apron around spillway.

5. Gate repair.

6. Build gatehouse over existing operating mechanism.

The 2 ft. penstock to the mill was apparently plugged as part of this contract. The work under this contract was completed by mid 1963.

Correspondence indicates that in November, 1964 settlement of the earth embankment near the gatehouse required immediate action. Emergency work was initiated to open the gate and drain the reservoir because of this settlement in December, 1964.

In December of 1965, a contract was issued for repair work at the dam consisting of the following items:

1. New gatehouse with 36 inch gate.

2. New pipelines to and from the new gatehouse.

3. Flattening of the upstream slopes of the main embankment through placement of fill.

The earthwork specifications called for placement of a 30 percent clay, 70 percent fine sand mix, in 6 inch layers. Compaction of the

fill was to be achieved by using bulldozers, tampers, or sheepfoot rollers. The clay-sand mix was specified for its imperviousness.

The "As-Built" drawings, dated January 1967 have been included in Appendix B. These drawings indicate that the upstream slope was flattened to a 3H : 1V slope.

Construction correspondence for the 1965 work on record at the State of Connecticut indicates some information worthy of note include the following:

1. The new gatehouse is founded upon very coarse hardpan (glacial till).
2. Cracking was observed and monitored in the west (left) spillway wingwall during construction.
3. Rock excavation was performed for the 36 inch pipe cradle foundations. Rock excavation was accomplished by drilling and wedging since blasting was prohibited.
4. Some muck was reported in the bottom of the cutoff wall excavation between the old and the new gatehouses. This was removed and replaced with 2 inch crushed rock.

5. A large void was reported near the old gatehouse. The Contractor was directed to fill this void with concrete. It is unknown whether this void was related to the embankment settlements which precipitated this work.

Work on this contract was completed in August of 1966.

Subsequent construction in 1966 was performed to upgrade the structural condition of the spillway training walls.

Leaking through the old gatehouse continued and in October, 1968, it was recommended by Chandler and Palmer, Consulting Engineers, of Norwich, Connecticut, that the old gatehouse be partially filled with concrete to seal the leakage. The outlet from the new gatehouse was extended through the old gatehouse with a section of 36 inch corrugated metal pipe. The old structure was filled with concrete and leaking reportedly stopped. This operation was completed in November of 1969.

i. Normal Operational Procedures: Water levels in Higganum Reservoir are normally uncontrolled. The gate is not generally operated to regulate the water level.

1.3 PERTINENT DATA

a. Drainage Area: The Higganum Reservoir drainage basin, located in central Connecticut, is generally elongated in shape and has a length of about 4.5 miles, an average width of 1.5 miles, and a total drainage area of 6.7 square miles. The topography is rolling hills with hilltops at Elevation 600±. Basin slopes are moderate in the southeastern portion and moderate to steep in the remainder of the watershed. Swamps in the upper reaches of the watershed tend to dampen the surge of surface run-off from the steeper slopes of the wooded hillsides. Watershed characteristics warranted the adoption of a "Test Flood" of 1750 CSM, equal to the probable maximum flood (PMF). This storm event gives an inflow value of 11774 cfs for this drainage area of 6.73 square miles. A general basin map is enclosed, see Appendix D.

b. Discharge at Dam Site: The largest storm experienced at the Higganum Reservoir Dam was reportedly the September, 1938 hurricane. Many areas were flooded downstream due to the large overflows from the dam.

No records are available of flow or water surface elevations for computation of quantitative values of discharge at the dam site.

Listed below are discharge data for spillway and outlet works:

c. Spillway and Outlet Works:

1. Outlet works (conduit) size 36 inch diameter. Invert Elev. 66.0±.
2. Maximum flood discharge at damsite: Unknown
3. Spillway capacity at maximum pool level (Top of Dam) (Elevation 106.0) - 5710 cfs.
4. Gated outlet capacity at normal pool level (Spillway Crest) (Elevation 96.5) - 219 cfs
5. Gated outlet capacity at maximum pool level (Top of Dam) (Elevation 106.0) - 229 cfs
6. Total discharge (spillway and outlet) capacity at maximum pool level - (Elevation 106.0) 5939 cfs.

d. Elevations: (feet above NGVD)

1. Top of Dam - Elevation 106.0
2. Test flood pool - Elevation 108.14
3. Flood control pool - N/A
4. Recreation pool - N/A
5. Spillway crest - Elevation 96.5
6. Upstream invert of intake structure - Elevation 66.0 (estimated)
7. Invert of streambed at centerline of dam, downstream Elevation 58.0 (estimated).

8. Recorded maximum tailwater - Unknown

e. Reservoir Lengths: (feet)

1. Length of maximum pool - 3800
2. Length of recreational pool - 3800
3. Length of flood control pool - N/A

f. Reservoir Storage: (acre-feet)

1. Test flood elevation - 836 @ Elev. 108.14
2. Top of dam - 771 @ Elev. 106.0
3. Recreation pool - 486 @ Elevation 96.5
4. Flood control pool - N/A
5. Net storage between top of dam (Elev.106.0) and Spillway Crest (Elev. 96.5) is 285 Ac-ft, which represents 0.79 inches of runoff from the 6.73 square mile of drainage area.
6. One foot of surcharge storage = 0.08 inches of runoff from the drainage area of 6.73 square miles.

g. Reservoir Surface: (acres)

1. Top of dam - 30 which equals 0.7% of total drainage area of 6.73 square miles.
2. Maximum pool - 30
3. Flood-control pool - N/A

4. Recreational pool - 30

5. Spillway crest - 30

h. Dam

1. Type - Probably homogeneous earth

2. Length - 875 feet (including spillway)

3. Height - 48 feet from streambed (downstream)

4. Top Width - varies 25-40 feet

5. Side slopes - upstream 1 vertical on 3 horizontal - downstream 1 vertical on 1-1/2 horizontal

6. Zoning - Unknown

7. Impervious Core - Unknown

8. Cutoff - Unknown

9. Grout curtain - Unknown

i. Spillway

1. Type - Semicircular, broad-crested, overflow spillway

2. Length of weir - 65.0 feet arc length.

3. Crest elevation - Elevation 96.5

4. Gates - None

5. Upstream Channel - Straight, natural bed

6. Downstream Channel - Stone masonry rectangular channel with natural bed

j. Regulating Outlet

1. Refer to Paragraph 1.2 b "Description of Dam Appurtenances, for description of outlet works

   Invert - 66.0±

2. Size - 36 inch diameter concrete pipe

3. Description - Manually operated hoist system in a covered and locked gatehouse structure

SECTION 2

ENGINEERING DATA

2.1 DESIGN

There are no design documents available regarding the original construction of this dam which reportedly occurred about 1868.

Several post construction alterations to the dam occurred in 1958 and 1966. The engineering data available for this period are as follows:

a. State of Connecticut, Public Works Department Contract Drawings Nos. 1 through 5 of 5, "Repairs to Dam and Control Gate - Higganum Reservoir Dam - As Built Drawings, Benjamin H. Palmer, January 5, 1967."

b. State of Connecticut, Park and Forests, "Dam Structure," Contract No. 73P3, February, 1958.

c. State of Connecticut, Park and Forests, "Higganum Reservoir," Contract No. 73-P7, April, 1959.

d. Miscellaneous correspondence pertaining to the dam from 1958 to 1975.

2.2 CONSTRUCTION

Some post construction documentation is included in the miscellaneous correspondence cited under Subsection 2.1. No data is available on the original construction.

In general, the repair work performed in 1966-1967 consisted of flattening the upstream slope of the dam to 3.0H:1.0V and the construction of a new gate house and intake structure.

2.3 OPERATION

No operating records are maintained for this facility.

2.4 EVALUATION

a. Availability

The above-cited references and documents are available at the offices of the Connecticut Department of Environmental Protection

b. Adequacy

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

c. Validity

Available plans itemized in 2.1 were not verified.

SECTION 3

VISUAL INSPECTION

3.1 FINDINGS

a. General: At the time of the inspection the dam was in POOR condition. Extreme tree and brush growth is present on the downstream slope and to a lesser degree on the crest and upstream slope. The quantity of vegetation impaired a systematic inspection of the dam. It was observed that the intake structure was recently repaired, and although some improvements to the upstream slope have been recently completed, the condition of that slope, at the waterline, was typically poor. In general, it appeared that the condition of the dam was neglected and not properly maintained.

b. Dam: The top surface of the embankment on both sides of the spillway is grassed with a worn footpath along the entire length, see Photo C-1. There is an apparent small 12 inch deep path along the top of the dam between Sta 5+0 and 7+0 (Refer to Appendix B-3 for stationing).
Riprap appears to be absent at many locations along the upstream face. Many trees and brush are growing on the upstream face, as well. An example of this growth on the upstream face of the dam is shown in Photo C-4.

A large zone of erosion, that occurred at some time in the past, was located near Sta 9+0 on the upstream face. The erosion covers most of the upstream face for a width of approximately 30 feet and to a depth of 6 to 12 inches. There is no riprap at this location.

A large erosion gully has formed on the downstream face near Sta 5+80 due to trespassing and surface runoff from the crest. The gully is approximately 5 feet wide and extends from the crest of the dam to the toe.

The downstream slope is covered with extensive vegetation including heavy brush and trees up to 2 feet in diameter. Along the right side of the dam, there is a large, swamp-like vegetation zone which includes skunk cabbage and willows, the upper limit of which was approximately 26 feet below the level of the water in the reservoir, at the time of the inspection. The ground was noticeably wet and spongy where this vegetation was growing, with flow apparent in some areas. The extensive seepage and vegetation can be seen in Photos C-11 through C-16.

Immediately downstream from the dam the ground is wet and soggy in most places. There was evidence of seepage discharging at the time of the inspection, but the water was clear and there appeared to be no movement of fines suspended in the water associated with this flow.

Along the left side of the dam, near the spillway channel, there was a small wet area, near the end of the 11 foot high masonry retaining wall, which is located at the bottom of the stairs leading down from the foot bridge, which may indicate seepage along that wall. There appeared to be a slight amount of water flow from the junction of the end of the wall and the embankment.

A chamber 3 feet square by 6 feet deep was located approximately 10 feet north of the end of this retaining wall. An 18-inch diameter pipe enters this chamber from the east. Due to the profuse growth of extensive vegetation, the size of the outlet on the west side of the chamber was not identified, but was noted to be rectangular in shape.

An opening 3 feet high by 4 feet wide was observed in the downstream channel training wall.

The chamber is approximately 8 feet west of the training wall. Approximately 15 feet north of the chamber, in a direction parallel to the downstream channel, a large wet zone approximately 10 feet long and 5 feet wide was observed. There was no apparent flow from this area.

The downstream end of the downstream training wall on the left side of the channel has been broken due to the uprooting of a large tree which has fallen across the spillway channel at this location. A seep was apparent in the cavity formed by the uprooted tree. Along the toe of both the right and left training walls, there is evidence of both seepage and iron staining at or slightly above the elevation of the tailwater in the spillway channel. Most of the mortar between the stone masonry has been eroded, and there is evidence of relative displacement.

c. Appurtenant Structures: Seepage was observed emanating from a joint in the right spillway abutment just upstream from the footbridge approximately 35 feet down from the dam crest. Seepage was also observed along the base of contact of the right and left spillway abutment with the channel floor. Extensive iron staining is evi-

dent. Some dislodgement of stones had apparently occurred in the downstream training walls and retaining walls.

d. Reservoir Area: Banks of the reservoir appear to be moderate in slope and overgrown with vegetation. No bedrock was observed. The heavy growth of vegetation should preclude slides or sloughs and resulting sedimentation. However, this vegetation should be monitored to insure that wind felled trees not clog the spillway or downstream channels causing unnecessary "localized" flooding and debris build-up.

e. Downstream Channel: Brush, trees and miscellaneous debris were observed in spillway discharge channel. Some masonry had fallen into the channel, at the end of the left training wall as the result of the uprooting of a large tree.

3.2 EVALUATION

Visual observations made during the course of the inspection indicated several serious conditions that require attention.. Several of the deficiencies observed and discussed above require attention and should be corrected before further deterioration develops a hazardous condition. Recommended measures are discussed in Section 7. In general, the visual inspection

indicates that the dam is in POOR condition and the maintenance of the Dam and its appurtenances has been seriously neglected.

SECTION 4

OPERATIONAL PROCEDURES

4.1 PROCEDURES

a Normal Operating Procedures: Higganum Reservoir is used for recreational purposes and regulation of the water level does not occur. The water surface elevation is controlled generally by weir flow over the spillway.

b. Emergency Operating Procedures: The Hartford office of the Department of Environmental Protection notifies their Region 3 Headquarters in Marlborough, Connecticut when storm warnings are in effect. Higganum Reservoir is monitored by the D.E.P. personnel assigned to this region.

Any emergency action required would be directed from the Hartford office. These directives would include operation of the outlet gate or notification of authorities for alert situations or evacuation. Emergency operating procedures are not posted. Keys for the gatehouse and operating handle for the gate lift mechanism are stored at the Region 3 (area 2) D.E.P. office at the Cockaponset State Forest.

4.2 MAINTENANCE OF DAM

Removal of brush on the dam embankment was reportedly last performed in 1972. Brush cutting at that time was apparently confined to the crest and upstream slopes since the downstream slope is heavily overgrown.

Correspondence indicates that brush cutting on the downstream slope last occurred in 1958.

There is no regular maintenance program for the embankment.

4.3 MAINTENANCE OF OPERATING FACILITIES

All gate operations at the dam are directed by the Hartford office of the Department of Environmental Protection (D.E.P.). The gate, reportedly, has not been operated since 1972. An operational check of the gate was performed at the time of the visual inspection and the mechanism and gate functioned satisfactorily. The gatehouse and lift mechanism appeared to be in good condition.

4.4 DESCRIPTION OF ANY WARNING SYSTEMS IN EFFECT

There is no formal warning system at the Higganum Reservoir Dam. If emergency action or an alert for the Village of Higganum was required, the State Police would be notified by the Department of Environmental Protection.

It is imperative that a well organized, formal emergency action plan be developed and posted for the operating personnel responsible for the dam.

4.5 EVALUATION

The dam embankment has been seriously neglected. Routine scheduled maintenance and inspection programs are not in evidence. A formal emergency action plan for expedient action or notification and evacuation of downstream areas has not been developed.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data: No specific design data is available for Higganum Reservoir Dam. In lieu of existing design information, the USGS topographic mapping (Haddam quadrangle - scale 1" = 2000') was used to develop hydrologic parameters such as drainage area, basin slope, reservoir surface area, runoff characteristics and time of concentration. Inflow and outflow discharges were developed using the Corps of Engineers' criteria assuming the initial reservoir level at the spillway crest elevation (see Appendix D). The "Test Flood" discharge equal to the Probable Maximum Flood (PMF) was determined to be 1750 csm, which represents 11774 cfs for a drainage area of 6.73 square miles. Surcharge storage was approximated assuming that the surface area remained constant above the spillway crest.

Elevation-storage relationships for the reservoir were also estimated. Some hydraulic design data was obtained and/or confirmed by a limited field survey at the time of the visual

field inspection. Higganum Reservoir Dam was classified as INTERMEDIATE in size having a maximum height of 48.0 feet. To determine the hazard classification for this dam, the impact of its failure at maximum pool (top of dam) was assessed. As a result of the analysis, Higganum Reservoir Dam was classified as a HIGH hazard structure as detailed in Appendix D. The dam failure discharge was computed to be 69276 cfs and an approximate dam failure profile was developed (See Appendix D). It is estimated that the failure discharge of 69276 cfs will produce a flow of approximately 6.3 feet in depth at the intersection of Ponset Brook with the Connecticut River. Additional design data developed for this investigation is as follows:

b. Experience Data;

1. Spillway: No definitive and quantitative flood flow data is available. However, it was reported that the September, 1938 hurricane was the largest storm experienced at the damsite.

c. Visual Observations:

1. A large, mushy area indicative of large seepage through the embankment is present

along the right-side, downstream toe of the embankment.

2. Extremely steep downstream slope of the embankment (1.5H:1.0V) estimated.
3. Intense and large growth of trees and brush and trees on downstream slopes.
4. Populated areas located just downstream.
5. Seepage through the joints of the stone masonry spillway.

d. Overtopping Potential: The spillway is hydraulically inadequate to pass the "test flood" (PMF). The test flood would overtop the dam approximately 2.14 feet. The inflow and outflow discharge values for the test flood are 11774 and 11742 cfs respectively, indicating that the reservoir has negligible surcharge storage capacity. The calculated maximum outflow discharge of the spillway if 5710 cfs which represents 48.6% of the test flood discharge. For more data including the spillway rating curve, see Appendix D. The footbridge located just downstream from the spillway does not affect the discharge outflows from the spillway or over the top of the dam.

e. Dam Failure Analysis: The calculated dam failure discharge of 69276 cfs, assuming an impounded

water level at the top of the dam (See Appendix D) will produce an approximate water surface of elevation 84.0 immediately downstream from the dam. This discharge will raise the water surface approximately 20 feet above the depth existing just prior to failure when the discharge is 5710 cfs. Normal uniform flow will occur approximately 10,000 feet downstream from the dam and produce a depth of flow equal to 6.3 feet. The probable consequences of the dam failure, determination of hazard classification and additional details of the dam failure profile are included in Appendix D.

FREQUENCY IN YEARS	24-HOUR TOTAL RAINFALL IN INCHES	24-HOUR* EFFECTIVE RAINFALL IN INCHES	MAXIMUM INFLOW IN C.F.S.	MAXIMUM** OUTFLOW IN C.F.S.	SURCHARGE HEIGHT IN FEET	SURCHARGE STORAGE ELEVATION
10	5.0	2.6	1040	983	2.94	99.44
50	6.5	4.1	1640	1571	4.02	100.52
100	7.0	4.6	1840	1763	4.34	100.84
1/2 MPF	11.9	9.5	5887	5860	9.57	106.07
TEST FLOOD =PMF	21.4	19.0	11774	11742	11.64	108.14

*Infiltration assumed as 0.1"/hour
**Lake assumed initially full at spillway crest elevation 96.50
(Top of dam = 106.00

NOTES:

1. Q_{10}; Q_{50};Q_{100}; inflow discharges computed by approximate methodology of Soil Conservation Service.

2. 1/2 PMF and "test flood" computation based on COE instructions and guidelines.

3. Maximum capacity of spillway without overtopping the top of the dam elevation 106.0 is equal to 5710 C.F.S.

4. All discharges indicated are dependent upon the continued integrity of upstream storage reservoirs.

5. Surcharge storage is allowed to overtop the dam when exceeding the spillway capacity.

6. Test flood (PMF) = 1750 CSM = 11774 CFS (drainage area = 6.73 sq. mi.)

SECTION 6

STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations: There were several signs of structural distress evident during the visual inspection that are discussed in various sections of this report (seepage, trespassing, erosion, vegetation and tree growth, etc.) and recommended actions are in Section 7.2.

b. Design and Construction Data: No such data is available with regard to the original construction and an evaluation cannot be made.

c. Operating Records: None

d. Post-construction Changes

Based on the visual inspection and a review of the documentation previously cited, a new gatehouse has been constructed on the upstream slope of the right embankment and a new 36-inch diameter concrete pipe outlet conduit installed. It appears that a conduit which passed underneath the left side of the dam may have been plugged at some time in the past. The embankment was apparently raised 3 feet to provide additional free board. In addition, the upstream slopes were flattened to approximately 3.0H:1.0V, and riprap

placed along most of the upstream face of the dam at the normal water level. No other major post-construction changes are known or evident.

e. Seismic Stability

The dam is located in seismic zone No. 1 and, in accordance with recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition: Based on the visual inspection, records available of the site and past operational performance, the dam is judged to be in POOR condition. A review of the limited data available reveals that there are areas of concern which must be corrected in order to assure the long term performance of this dam. These concerns are as follows:

1. Significant seepage was observed exiting from several locations along the downstream toe of the dam and from the abutments in the areas outlined below.

   (a) A large area of apparent seepage along the downstream toe of the right side of the dam.

   (b) Two areas of seepage near the masonry retaining wall perpendicular to the spillway channel on the left side of the dam.

   (c) Seepage flowing from the joints of the spillway abutments adjacent to the foot bridge about 25 feet from the crest.

Seepage was also present along the contact of the abutments and the spillway channel. Although these seepage conditions may have been occurring for many years, continued seepage aggravated by any rise in the water level behind this dam may, over a period of time, lead to internal erosion in the dam.

2. Heavy tree growth is present on the downstream slope and trees and shrubs also occur on the crest and upstream slope. Some trees, particularly on the downstream slope, are of sufficient size (24-inch diameter), that should they be uprooted in a storm, the embankment would be seriously weakened. In addition, the roots of dead trees and stumps on both the upstream and downstream dam slopes continuously rot and form increasingly dangerous discontinuities in the embankment where seepage and erosion may concentrate. These stumps should be given special attention during future inspections to monitor any signs of developing seepage, until a program for their subsequent removal has been developed. It is particularly

important that embankment slopes be well maintained in order that inspectors can closely discern changes that may occur.

3. Trespassing has caused gullying on the downstream slope and the grass cover on the dam crest has been worn thin in many places. Erosion has also occurred on the southern end of the dike. Riprap at the waterline on the upstream slope is generally in poor condition.

4. The spillway capacity does not satisfy the screening criteria established by the Corps of Engineers for the Test Flood. The adopted test flood (Probable Maximum Flood) overtops this dam.

5. There is no proper and regular maintenance and inspection program for the dam, nor is there a formal warning system for emergency situations.

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

c. Urgency: It is considered imperative that a program of 24-hour surveillance be initiated immediately during periods of high-intensity rainfall. In addition, on a weekly basis, the toe of the dam should be inspected to observe any change in volume, turbidity or extent of seepage. Other recommendations listed below should be implemented within one year of receipt of this Phase 1 Inspection Report.

d. Need for Additional Investigation: There is no evidence that formal engineering analyses were ever performed for this dam. The visual inspection and operational history indicate that attention should be given to the collection of current data in order that the recommendations listed below may be implemented.

7.2 RECOMMENDATIONS

Engage the services of an engineer experienced in the design of earth dams to accomplish these recommendations.

1. Institute immediately a program of monitoring seepage and a program of 24-hour surveillance during periods of high-intensity rainfall.

   Examine the present seepage emanating from the downstream toe and design a system

for collection and monitoring this flow in order that changes in flow quantity and sediment transport can be detected.

2. Investigate the cause and correct the surface erosion occurring along the upstream shoreline as well as correcting and instituting measures to prevent further erosion caused by trespassing.

3. Redesign and reconstruct the dam to provide adequate spillway capacity, surcharge storage capability, freeboard, slope protection and outlet works capacity using current hydraulic criteria.

4. Analyze the structural stability of the dam embankment and spillway.

5. Implement immediately a limited subsurface boring and testing program to accomplish the above items.

7.3. REMEDIAL MEASURES

a. Operating and Maintenance Procedures: Although the dam has had some maintenance, it is considered essential that the following items be accomplished:

1. Develop and commence a regular maintenance inspection schedule for the facility.

2. Incorporate in the above program monitoring of the seepage and examination of the tree stumps on the slopes. Once a procedure has been developed for the removal of existing trees, rotting stumps and roots, incorporate this procedure into the regular maintenance program.

3. Develop a system for the recording of data with regard to items such as: water levels, discharges, time and drawdown to assist those responsible for the monitoring of the structure.

4. Prepare an "Emergency Action Plan" to prevent or minimize the failure of the dam, listing the expedient action to be taken and the authorities to be contacted. The owner should develop a warning system with local authorities for alerting downstream residents in case of emergency.

5. Develop and implement a proper maintenance program for care of the slopes, removal of vegetation and debris from the downstream channel. The crest, upstream slope, and downstream slope, and an area up to 50 feet downstream of the dam should be maintained free of trees and brush.

6. Continue the technical periodic inspection of this facility on an annual frequency.

7.4. ALTERNATIVES: As an alternate to the immediate commencement of studies to upgrade the structure Higganum Reservoir water surface levels should be lowered and maintained at a level well below the spillway crest. That reduced level should be controlled to provide storage for storm events. This measure is not considered to be a long term solution, however, in view of the relatively small reservoir capacity as compared to the drainage area. Relatively frequent storm events, with an effective rainfall of only 1.35 inches falling on the 6.73 square mile catchment area, will fill the reservoir capacity (486 Ac.-ft) quite rapidly.

APPENDIX A

VISUAL INSPECTION CHECK LIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Higganum Reservoir Dam
Haddam, CT

DATE 24 July 78

TIME 0900-1600

WEATHER Clear

W.S.ELEV. _____ U.S. _____ D.S.

PARTY:

1. A. Reed - CEM
2. J. Maynard-CEM
3. S. Khanna- CEM
4. R. Brown - CEM
5. R. Valles -CEM
6. R. Murdock- GEI
7. J. Engels - GEI
8. V. Galgowski - CT DEP
9. R. Altomare - CT DEP
10. C. Berger - CT DEP

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Party cont.		
2.	D. Berry - CT DEP		
3.	R. Harlow - CT DEP		
4.	D. Sluter - CEM		
5.			
6.			
7.	Note: A second inspection was made on 4 Aug 78		
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	Varies - 102 to 106
Current Pool Elevation	At crest of spillway 96.56
Maximum Impoundment to Date	
Surface Cracks	None observed
Pavement Condition	None
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	No deviations observed. Observation difficult due to brush growth.
Horizontal Alignment	
Condition at Abutment and at Concrete and Stone Masonry Structures	Good, some surface erosion near upstream training wall, left side
Indications of Movement of Structural Items on Slopes	Some cracking and dislodgement of stone and concrete training walls.
Trespassing on Slopes	Large erosion channel from crest to downstream toe, Sta. 5 + 60
Sloughing or Erosion of Slopes or Abutements	Considerable erosion on upstream slopes on both the rt. and lt. sides of embankment.
Rock Slope Protection - Riprap Failures	Many windows evident in riprap
Unusual Movement or Cracking at or near Toes	None observed
Unusual Embankment or Downstream Seepage	Seepage evident along the entire length of right side of embankment at toe and partway up slope. Some seepage along toe and slope of left embankment.
Piping or Boils	None observed

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation Systems	None observed
Vegetation	Extensive vegetation and trees to 2 ft. diameter on both upstream and downstream slopes

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	Not Applicable

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Natural bed straight approach
Slope Conditions	Not observable (underwater)
Bottom Conditions	Not observable (underwater)
Rock Slides or Falls	None
Log Boom	None
Debris	Not observable (underwater)
Condition of Concrete Lining	N.A.
Drains or Weep Holes	N.A.
b. Intake Structure	Not observable, underwater
Condition of Concrete	
Stop Logs and Slots	

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - GATE HOUSE	
a. Concrete and Structural	Concrete block structure on concrete foundation. Concrete roof slab.
General Condition	Good
Condition of Joints	Satisfactory
Spalling	None observed
Visible Reinforcing	Yes - on roof slab
Rusting or Staining of Concrete	Yes - on roof slab
Any Seepage or Efflorescence	None observed
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	Not observable
Cracks	None observed
Rusting or Corrosion of Steel	Exposed reinforcing on roof slab corners and edges.
b. Mechanical and Electrical	Manually operated vertical hoist gate mechanism. Mechanism in good working condition. Gatehouse is kept locked. Operation handle for mechanism and key for gatehouse are at D.E.P. office Region 3, Area 2 (Cockaponset)

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Not observable
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	See note below*
General Condition of Stone Masonry	Fair - some debris visible inside conduit
Rust or Staining	N.A.
Spalling	None observed
Erosion or Cavitation	None observed
Visible Reinforcing	N.A.
Any Seepage	Seepage observed
Condition at Joints	Leaking - may be in poor condition
Drain holes	None observed
Channel	Outlet channel for outlet works is the same as for spillway. See notes for spillway discharge channel
Loose Rock or Trees Overhanging Channel	
Condition of Discharge Channel	
	*Outlat consists of a circular conduit transitioned to rectangular section at the downstream opening. Transition from circular to rectangular section is abrupt and occurs within a few feet of the downstream opening.

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Straight, stony bed
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Stony bed
b. Weir	Semicircular, broad crest overflow, uncontrolled weir. D.S. face stepped. The D.S. face appears to have a plaster coating of black color. It may be either asphaltic or cement grout.
General Condition of Stone Masonry	Fair to good
Rust or Staining	Staining noted
Spalling	N.A.
Any Visible Reinforcing	N.A.
Any Seepage or Efflorescence	Seepage noted at various heights throughout the stone masonry joints
Drain Holes	None
b' Training Walls	
General Condition	Fair to good with cracks in stone masonry joints. Joints recently grouted. Cracks are through new grout.
Staining	Yes
Spalling	None observed
Any Seepage at Efflorescence	Seepage and efflorescence observed in both left and right walls
Drain holes	None observed

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Straight, stony bed
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Stony bed
b. Weir	Semicircular, broad crest overflow, uncontrolled weir. D.S. face stepped. The D.S. face appears to have a plaster coating of black color. It may be either asphaltic or cement grout.
General Condition of Stone Masonry	Fair to good
Rust or Staining	Staining noted
Spalling	N.A.
Any Visible Reinforcing	N.A.
Any Seepage or Efflorescence	Seepage noted at various heights throughout the stone masonry joints
Drain Holes	None
b' Training Walls	
General Condition	Fair to good with cracks in stone masonry joints. Joints recently grouted. Cracks are through new grout.
Staining	Yes
Spalling	None observed
Any Seepage at Efflorescence	Seepage and efflorescence observed in both left and right walls
Drain holes	None observed

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (cont.)	
c. Discharge Channel	Rectangular stone masonry channel.
General Condition	Poor, obstructed by trees and debris.
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Many
Floor of Channel	Stony floor obstructed by loose stones and fallen trees
Other Obstructions	Stone arch bridge with semicircular opening immediately D.S. of spillway. Height of opening is 30 ft., chord at bed of channel is 40 ft. Bridge is 10 ft. from US face to DS face.

PERIODIC INSPECTION CHECK LIST

PROJECT Higganum Reservoir Dam DATE 24 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	Small slab linking left dam embankment to gatehouse. Generally in good condition, crack noted at junction with gatehouse.
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

APPENDIX B

1. Listing of Locations for Available Correspondence Data
2. Copies of Past Inspection Reports
3. Plans, Sections, Details

APPENDIX B-1

Records consisting of specifications, memoranda, drawings, inspections and reports (about 200 items) which relate to maintenance since 1958 are on file at:

Department of Environmental Protection
State of Connecticut
State Office Building
Hartford, Connecticut 06115
Attention: Mr. Victor Galgowski
Dam Safety Engineer
Water and Related Resources

And: Mr. William Miller
Director
Parks and Recreation

APPENDIX B-2

Selected inspection reports:

1. 23 Jan 58, George Douglass to E.P. Bronson, Sup. of State Parks, State of CT.

2. 31 Mar 58, Henry Wolcott Buck to Water Resources Commission, State of CT.

3. 18 Aug 59, Henry Wolcott Buck to Water Resources Commission, State of CT.

4. 27 Mar 58 through 10 Jul 61 twenty-two inspections by Henry Wolcott Buck to Water Resources Commission, State of CT.

5. 17 Jul 63, William P. Sanders, Engineer-Geologist Water Resources, to William S. Wise, Director, Water Resources State of CT.

6. 10 Nov 64, B.H. Palmer to Milton Case, D.P.W., State of CT.

7. 23 Nov 64 John J. Curry, Chief Engineer, Water Resources to Timothy J. Murphy, Jr. Commis. D.P.W. State of CT.

8. 9 Feb 65, William P. Sander, Geologist, to file, Water Resources Commission, State of CT.

9. 25 Aug 66, James A. Thompson, Buck & Buck Engineers, to William H. O'Brien III, Water Resources Commission, State of CT.

10. 18 Oct 68, B.H. Palmer to Mr. Warner, D.P.W. State of CT.

11. Several dates to 27 Oct 77 - State of CT inventory sheet listing various inspections.

FOR STD 291

110

INTERDEPARTMENT MAIL

DATE January 23, 1958

Mr. E. P. Bronson, Superintendent of	DEPARTMENT State Parks
FROM George Douglass	DEPARTMENT

SUBJECT HIGGANUM RESERVOIR

Complying with your instructions of January 21, 1958.

On January 22, 1958, Mr. Martin and I made an inspection of the dam at Higganum Reservoir. As far as we were able to determine, there are no detailed plans of the dam extant. There are several seepage points in the stone work on both sides below the spillway.

From the information we obtained from Mr. Novtney, formerly maintenance man for Orkil, Inc., there are two gates in the dam; one, a 24" gate valve, and one, Draw Gate. The gate valve is on the 2 ft. pen stock leading to the Mill. This pipe is now broken, and as the State has no responsibility according to our Deed (H.L.R. Vol. 83 Pages 211-213) to furnish water to any of the parties now or formerly concerned with said line, it would be well to plug this opening and remove the valve which has been sprung and therefore leaks. About 30 ft. below the spillway, there is a 2 ft. square opening which is supposed to connect with a blow out pressure plug in the penstock. Water is leaking through this opening,(plugging the line should cure this leak).

The draw gate is connected with a 4 ft. square opening through the spillway and is held in place by the pressure head. To open this gate with the pond full, it is necessary to jack the gate open from the downstream side breaking the seal, as otherwise the head works and linkage is not heavy enough to draw the gate. We are informed that even with this gate open the draw down on the pond is slow except during a low water period.

M PUR STO 201

INTERDEPARTMENT MAIL

DATE January 23, 1958

Mr. E. P. Bronson — DEPARTMENT

G. Douglass — DEPARTMENT

SUBJECT HIGGANUM RESERVOIR

A different type of gate should be installed which would permit opening and closing at any time as, under existing circumstances, with a 10" head of water over the spillway it would be extremely difficult to open this gate.

A stone structure should be built from the top of the existing shaft housing, which is approximately at spillway level to the top of the dam 6 ft. plus or minus, a stone gate house should be constructed enclosing the gate headworks to prevent the public from operating the gate at will.

The pond will have to be drawn to permit a detailed examination of the upstream face of the dam before recommendations can be made in regard to sealing the small leaks now apparent.

I do not think that any work should be done on the down stream side of the dam which would change in any way the attractiveness of this rather unique structure with its horseshoe shaped spillway and true arch masonry supported walkway, though some maintenance work is indicated. With a little work in the wooded ravine below the dam to facilitate the taking of pictures, this area could well become one of our better known state parks.

G. Douglass

George T. Douglass

Ext 2313

BUCK & BUCK
ENGINEERS
650 MAIN STREET HARTFORD 3, CONNECTICUT

HENRY WOLCOTT BUCK
ROBINSON B. BUCK

COMM. 5713

MARCH 31, 1958

WATER RESOURCES COMMISSION
317 STATE OFFICE BUILDING
HARTFORD 15, CONNECTICUT

RE: STATE PARK AND FOREST COMMISSION
HIGGANUM RESERVOIR
HADDAM

GENTLEMEN:

WE HAVE REVIEWED THE PLANS SUBMITTED WITH THE FOREGOING APPLICATION, HAVE INSPECTED THE SITE OF THE WORK, AND HAVE COMPUTED THE RUN-OFF AND DISCHARGE CAPACITY. IT APPEARS THAT SOME TIME IN THE PAST THE FREEBOARD AT THE STRUCTURE WAS INCREASED BY ADDING MASONRY WING WALLS APPROXIMATELY 3 FEET HIGH, RUNNING BACK FROM EACH ABUTMENT INTO THE DYKE. THIS ADDITIONAL FREEBOARD IS NECESSARY AND THESE WING WALLS SHOULD BE REPAIRED AND THE DYKE THROUGHOUT ITS LENGTH RAISED TO THEIR ELEVATION. THE DAM HAS AN UPSTREAM SLOPE OF 1-1/2:1, RATHER STEEP IN THIS AREA BUT THERE ARE NO INDICATIONS OF DISTRESS. HOWEVER, THE DAM IS COVERED WITH TREES, MANY OF THEM OF LARGE DIAMETER AND ALTHOUGH RECOGNIZING THE ESTHETIC VALUE OF THIS GROWTH, WE MUST RECOMMEND AS A MATTER OF SAFETY THAT THE TREES BE REMOVED FROM THE DAM TOGETHER WITH THEIR STUMPS AND ALL LARGE ROOTS. OUR EXPERIENCE IN THE PAST HAS SHOWN THAT MANY FAILURES HAVE RESULTED FROM THE UP-ROOTING OF TREES IN DAMS. WE DO NOT FEEL THAT THE FACT THAT THESE TREES HAVE WITHSTOOD PREVIOUS HURRICANES IS SUFFICIENT JUSTIFICATION FOR WAIVING WHAT IN OUR OPINION IS A VERY IMPORTANT MATTER CONSIDERING THE VULNERABILITY OF THE DEVELOPMENT IMMEDIATELY DOWNSTREAM IN THE CENTER OF HIGGANUM.

SUBJECT TO THE FOREGOING EXCEPTIONS WE WOULD RECOMMEND THE ISSUANCE OF THE CONSTRUCTION PERMIT IN ACCORDANCE WITH THE APPLICATIO

SINCERELY YOURS,

BUCK & BUCK

HENRY WOLCOTT BUCK

BUCK & BUCK
ENGINEERS
650 MAIN STREET HARTFORD 3, CONNECTICUT

HENRY WOLCOTT BUCK

COMM. 5713-9

AUGUST 18, 1959

WATER RESOURCES COMMISSION
317 STATE OFFICE BUILDING
HARTFORD 15, CONNECTICUT

RE: STATE PARK & FOREST COMMISSION
HIGGANUM RESERVOIR
HADDAM

GENTLEMEN:

I VISITED THE ABOVE PROJECT YESTERDAY AND FOUND THE POND FULL TO SPILLWAY ELEVATION. THE WORK ON THE SPILLWAY IS COMPLETED AND APPEARS ENTIRELY SATISFACTORY EXCEPT FOR A FEW MINOR LEAKS WHICH WILL CAUSE NO TROUBLE DURING THE PRESENT WEATHER BUT WHICH SHOULD BE REPAIRED BEFORE FREEZING.

NOTHING HAS BEEN DONE TO STABILIZE THE DYKES ON THIS PROJECT. REFERRING TO MY LETTER OF NOVEMBER 5, 1958 OUTLINING MY CONFERENCE AT THE SITE WITH MR. BRONSON AND MR. DOUGLAS, IN THE THIRD PARAGRAPH I REFER IN SOME DETAIL TO THE PROCEDURES WHICH WERE AGREED UPON FOR THIS WORK. AT THE PRESENT TIME, THE MAJORITY OF THE TOP SURFACE OF THE DYKE IS RAW SAND, AND THE SLOPES CONTAIN PATCHES OF RAW EARTH BUT ARE GENERALLY COVERED WITH ANNUAL WEEDS TOGETHER WITH A LOT OF SPROUTS FROM THE STUMPS WHICH APPARENTLY HAVE NOT DIED.

I CANNOT RECOMMEND ISSUING A CERTIFICATE OF APPROVAL ON THIS STRUCTURE UNTIL ADEQUATE COVER HAS BEEN ESTABLISHED ON THE EARTH SECTIONS OF THIS DAM, THE SLOPES OF WHICH ARE VERY STEEP.

SINCERELY YOURS,

HENRY WOLCOTT BUCK

88 3113-7
STATE PARK & FOREST COM'

ALCANUM
~~Haddam~~ RESERVOIR
PONSET BROOK
HADDAM

MAR 27 '58 — Called Geo. Douglas. They have not computed watershed runoff or spillway capacity.

MAR 28 '58 — Inspected dam. Trees in dyke, many of them large, must come out, stumps and all. Remove rail on spillway. Dyke very steep downstream. Freeboard is about 6', 4' in abutments & 2' in added wing walls. Dyke settled below wing walls.
Called Hupfer: He agrees trees must come out.

JUN 24 '58 H.W.B. — Called Bronson - will do nothing till after Labor Day. Then draw down pond and inspect. Will advise date of inspection.

SEP 19 '58 H.W.B. — Called Hupfer & advised of status.

OCT 22 '58 H.W.B. — Called Bronson: Pond empty & will stay empty for some time. Plan to lower center 16' of spillway 3 feet. Will grout its entire dam and repair gate. Will send three letter outlining program and submit revised hydraulics for approval. I am to visit. Called Jack Curry: Reviewed & discussed. They have revised plans they will send over. Should issue new permit.

OCT 23 '58 H.W.B. — Discussion w Hupfer & Staff re: stability of end spillway after 3' cut in center.

OCT 31 '58 H.W.B. — Job insp & Report.

NOV - 5 '58 H.W.B. — Job insp & Report which see.

NOV 13 '58 H.W.B. — Job Insp - Douglas & Supt - Report which see.

NOV 21 '58 H.W.B. — Job Insp: Spillway built in - gate house & grouting toe - six men

DEC [illegible] H.W.B. — Job Insp - Work substantially complete - no one on job - Stream still passing - [illegible]

MAR - 8 '59 H.W.B. — Job Insp - No change since last visit

COMM. 5713-9
WATER RESOURCES COMM. - STATE PARK & FOREST,
HIGGANUM

3/8 '59 HWB JOB INSPECTION. WALKED DOWN AND INSPECTED THE SPILLWAY AND LOOKED OVER BOTH FACES OF THE DAM IN DETAIL. NOTHING HAS BEEN DONE SINCE MY LAST VISIT. MAR 11 '59 H.W.B.

8/17/59 HWB SITE INSPECTION. POND IS FULL. THERE ARE A FEW LEAKS. NOTHING HAS BEEN DONE TO STABILIZE THE EARTHWORK. IT IS NOW COVERED IN PART BY WEEDS AND SHOOTS FROM THE OLD STUMPS WHICH ARE NOT DYING. AUG 18 '59 H.W.B.

9/26/59 HWB SITE INSPECTION. NOTHING DONE SINCE MY PREVIOUS INSPECTION. SEP 29 '59 R.S.B.

9/28/59 HWB SAW WISE AND HUPFER. THEY REREAD MY LETTER FOLLOWING MY LAST INSPECTION. TOLD THEM NOTHING HAD BEEN DONE AND I FELT THE MATTER WAS SERIOUS. THEY WILL BRING THE MATTER UP FOR CONSIDERATION AT THE COMMISSION MEETING THIS AFTERNOON. SEP 29 '59 R.S.B. SEP 29 '59 H.W.B.

10/20/59 HWB HUPFER CALLED. HE HAS HAD WORD FROM BRONSON OF THE PARK & FOREST COMMISSION THAT THEY HAVE DRESSED AND SEEDED THE HIGGANUM DAM BUT ARE LETTING THE REST OF IT GO UNTIL NEXT SPRING WHEN THEY WILL SEE WHAT KIND OF A CATCH THEY GET. THEY WOULD LIKE TO HAVE ME INSPECT. OCT 22 '59 R.S.B. OCT 22 '59 H.W.B.

10-28-59 HWB SITE INSPECTION. THE WEEDS AND SPROUTS [illegible] OVER THE DAM HAVE BEE SYTHED OFF. AS FAR AS I CAN TELL NOTHING FURTHER HAS BEEN DONE. OCT 29 '59 R.S.B. OCT 30 '59 H.W.B.

8/15/60 HWB JOB INSPECTION. THE SUCKERS AND WEEDS HAVE BEEN KILLED OFF WITH A CHEMICAL TREATMENT BUT NOTHING HAS BEEN DONE TO ESTABLISH A GROWTH OF GRASS TO RESTRICT EROSION ON THE SLOPES. AUG 16 '60 H.W.B. AUG 16 '60 R.S.B.

9/13/60 HWB JOB INSPECTION. NOTHING HAS BEEN DONE SINCE MY PREVIOUS INSPECTION BUT NO WASHOUTS DURING THE FLOOD WATERS. THERE WILL BE NO BILL FOR THIS TIME. SEP 24 '60 H.W.B. SEP 17 '60 R.S.B.

9/14/60 HWB CALLED HUPFER AND REPORTED MY INSPECTION OF YESTERDAY. HE SAID THAT DEL WENT DOWN TO BRONSON IMMEDIATELY AFTER MY LAST LETTER CAME IN AND BRONSON PROMISED TO HAVE SOMETHING DONE ABOUT IT IMMEDIATELY. SEP 24 '60 H.W.B. SEP 17 '60 R.S.B.

10/22/60 HWB JOB INSPECTION. THE ENTIRE TOP, EXCEPT FOR A ROADWAY DOWN THE CENTER, AND THE ADJACENT SLOPES, BUT NOT THE FULL DOWNSTREAM SLOPE HAVE BEEN LOAMED, SEEDED AND MULCHED. IT APPEARS VERY IMPROBABLE THAT THE SEED WILL CATCH THIS FALL AND CERTAINLY WILL NOT GET FULL COVER UNTIL NEXT SPRING. OCT 26 '60 H.W.B. OCT 25 60 R.S.B.

7/10/61 HWB DROVE BY JOB. GRASS HAS TAKEN HOLD IN MANY AREAS BUT THERE ARE STILL A LOT OF BARE GRAVEL SPOTS. IT SEEMS BEST TO WAIT UNTIL FALL AND FIND OUT HOW SEVERE THE DAMAGE OF SWIMMING AREA HAS BEEN. AT THAT TIME WE WILL REPORT AGAIN TO THE STATE REGARDING GETTING A CATCH ON THIS EMBANKMNET. JUL 11 '61 H.W.B. JUL 11 '61 R.S.B.

FORM PUR STO 500

INTERDEPARTMENT MAIL

DATE: July 17, 1963

TO: William S. Wise, Director
DEPARTMENT: Water Resources Commission

FROM: William P. Sander, Engineer-Geologist
DEPARTMENT: Water Resources Commission

SUBJECT: Dam at Higganum Reservoir State Park

I inspected the Higganum Dam on July 16, and found that there are several leaks, but that these leaks are not to serious. I would suggest that you answer Mr. Mathews memorandum by saying that while this condition is not critical, it should be repaired at an early opportunity.

William P. Sander
Engineer - Geologist

WPS;dlp

November 10, 1964

Re: Project GF-T-68
Higganum Reservoir Dam

State Department of Public Works
State Office Building
Hartford, Connecticut

Attention: Mr. Milton Case

Dear Sir:-

This morning a meeting was held at 9:30 at the Higganum Dam. Present were Messrs. John Curry of the State Water Commission, Henry Buck, Consulting Engineer, Mr. Bates and Mr. Chase of the Park and Forest Commission and the writer.

The pond is about 3 feet lower than last week and the settlement of the embankment near the gate house is much more pronounced than last week. A full and lengthy discussion was held and all persons were in agreement with the following items:

(1) It is necessary to build at once a coffer dam around the end of the inlet pipe and this dam should be built to a height of approximately 8 feet below present crest of dam. This dam would be a minimum of 150 feet long, would consist of 2 rows of steel sheeting with fill between and in places would be around 30 feet high. A temporary pipe and gate through this dam would allow water through the dam after pipe is cleared and gate opened.

(2) When coffer dam is finished, the roof of gate house should be removed and the present flap gate opened and conditions in the culvert and gate house examined.

(3) Some excavation should be made where the present settlement has occurred to determine the cause of settlement.

(4) Temporary gate through coffer dam may be opened and water allowed to pass through the present culvert during balance of Winter.

(5) I think the above work may run to $30,000. The coffer dam work is expensive.

(6) After the above work is done a reappraisal of the situation should be made. Then additional day work may be authorized by you or it may be possible to prepare a plan and specifications for bidding. In any event the dam will be safe through the Winter.

(7) The total expenditure on the dam, including new gate, draw down pipe, repairing of leaks in dam, repair of wing walls and flattening the upstream slope of dam will run to a very substantial figure. This can be estimated more closely at a later time and you can then determine how much to authorize.

Items #1-5 should be done at once. I suggest the name of Contractors Fred Benvemuti of New London and Drew Construction Co. of East Hartford as being competent to do this type of work. You undoubtedly have others.

Will you please instruct me as to what you wish me to do now.

Very truly yours,

CHANDLER & PALMER

BHP/ew

c.c.: Mr. Henry Buck, Consulting Engineer
Mr. John Curry, State Water Commission
Mr. Thayer Chase, Park & Forest Commission

November 23, 19

Timothy J. Murphy, Jr., Commissioner — Public Works

John J. Curry, Chief Engineer — Water Resources Commission

Attention: Milton Case

On Tuesday, November 10th, I inspected the Higganum Reservoir Dam in the company of representatives of the Park and Forest Department and Mr. Palmer, Engineer assigned by your agency. Because of the location and the type of construction of the dam, failure could be a catastrophe. The noticeable movement of the material in the upstream face apparently is due to a failure of the drew-down culvert and should be a matter of great concern. Such a movement of materials if progressive to the point of a masonry failure would endanger the dam.

On the basis of our previous knowledge of the dam, it appears that a coffer dam placed around the inlet of the culvert and to an elevation almost as high as the spillway would be practical to construct. In the dewatered area the condition of the culvert could be determined and repairs made. At that time the original job of repairing the gate could be also accomplished. The coffer dam should be placed and the repair work done as soon as possible. After determining the condition of the dam, plans should be made to make the whole structure safe and leak proof.

The coffer dam should be substantial because the safety of the structure may be dependent upon it for a period as long as one year during which flows will very likely occur that will substantially raise the level of the reservoir.

Chief Engineer

JJC:dlp

cc: Park & Forest

FORM PUR STO 200

INTERDEPARTMENT MAIL

DATE: February 9, 1965

TO: File

DEPARTMENT:

FROM: William P. Sander, Engineer - Geologist

DEPARTMENT: Water Resources Commission

SUBJECT: Higganum Reservoir Dam - Haddam

On the above date I inspected the Higganum Reservoir Dam and found that it continued to be drained. The temperature was about 40° and the snow was melting rapidly. Streams and rivers in the area were running bank full. Even under these conditions, the open gate was able to carry the runoff with about 3 feet of the intake structure above the present water level.

The area of subsidence on the west side of the spillway was examined and it appeared to be less than it appeared when the reservoir was full.

WPS:js

BUCK & BUCK
ENGINEERS
71 CAPITOL AVENUE, HARTFORD, CONNECTICUT 06103

[illegible]

CLIFFORD G. ENGSTROM
[illegible]
JAMES A. THOMPSON
ROBINSON W. BUCK

COMM. 5713-9

AUGUST 25, 1966

WATER RESOURCES COMMISSION
STATE OFFICE BUILDING
HARTFORD, CONNECTICUT 06115

ATTENTION: MR. WILLIAM H. O'BRIEN III

RE: HIGGANUM DAM

GENTLEMEN:

ON AUGUST 23RD WE MADE AN INSPECTION OF THE COMPLETE REPAIRS TO THE HIGGANUM DAM AND HEREWITH REPORT ON THE INSPECTION.

1. THERE ARE SEVERAL LARGE OPEN JOINTS IN THE STONE MASONRY OF THE EASTERLY WING WALL BELOW THE WATER LEVEL. THESE OPENINGS WILL GIVE WATER EASY ACCESS TO THE HEART OF THE STRUCTURE AND SHOULD BE PLUGGED. THERE ARE ALSO OPEN JOINTS IN THE WESTERLY WING WALL THAT SHOULD BE MORTARED.

2. THE RIPRAP ON THE EASTERLY HALF OF THE EMBANKMENT SHOULD BE "ANCHORED" WITH LARGE STONES TO PREVENT WAVE AND WATER ACTION FROM WORKING THE RIPRAP DOWN THE FACE OF THE DAM.

3. THE RESULTS OF OUR MEASUREMENT OF CRACKS IN THE WEST WING WALL ARE AS FOLLOWS:

DATE	WIDTH OF CRACKS			
	#1	#2	#3	#4
5/14/66	4-27/32	1-20/32	1-3/32	2-11/64
6/9/66	5-0/32	1-22/32	1-6/32	2-16/64
8/22/66	5-7/32	(MARKINGS OBLITERATED)	1-6/32	2-16/64

THE CRACKS HAD BEEN POINTED PRIOR TO OUR INSPECTION AND THE CRACK AT LOCATION #1 HAS OPENED SLIGHTLY. THE MEASUREMENTS INDICATE THAT SETTLEMENT IN THIS AREA HAS NOT STOPPED. WE REC-

OMMEND THAT CONTINUING MONTHLY MEASUREMENTS BE TAKEN AT AREA #1 AND THE CRACK BE REPOINTED ONLY AFTER SETTLEMENT HAS STOPPED.

WE ALSO RECOMMEND THAT IMPOUNDMENT OF WATER BE PERMITTED ONLY AFTER THE OPEN JOINTS IN THE WING WALLS ARE SEALED AND THE RIPRAP ON THE EASTERLY HALF OF THE DAM IS IMPROVED.

SINCERELY YOURS,

BUCK & BUCK

James A Thompson

JAMES A. THOMPSON

CHANDLER & PALMER
CIVIL ENGINEERS
114-116 THAYER BUILDING
TELEPHONE 887-5640

BENJAMIN H. PALMER
SHEPARD B. PALMER

MEMBERS AMERICAN AND CONNECTICUT SOCIETIES
OF CIVIL ENGINEERS

DAMS
WATER SUPPLIES
SEWERAGE
APPRAISALS
REPORTS
SURVEYS

NORWICH, CONN. 06360

October 18, 1968

State of Connecticut
Public Works Department
State Office Building
Hartford, Connecticut - 06115

Attention: Mr. Warner

Re: Inspection and Report
Higganum Reservoir Dam
Higganum, Connecticut
Project BI-T-71A

Dear Mr. Warner:

Several times during the past Summer I have visited the Higganum Dam. During some of these visits there was so much water coming over the spillway it did not seem practical to make a detailed inspection.

On yesterday, October 17th, I made a detailed inspection using ladders and lights and going down to the bottom of the old gatehouse.

The pond yesterday was just about full, with a small amount of water coming over the spillway. There was a considerable amount of water coming through the sluiceway leading from the gatehouse. I am enclosing a blueprint showing work that was done in 1965 when a new gatehouse and new concrete intake pipe was installed. You will note that the 36 inch concrete pipe leads from the new gatehouse into the old existing gatehouse, thence discharging through a stone culvert to a point below the Dam.

Yesterday with the help of ladders and lights I went down to the bottom of the old gatehouse, which is a considerable distance below the surface of the pond. The new gate which was installed in the gatehouse was closed and I noted particularly that there was no water coming through the 36 inch concrete pipe. This indicates there was no fault with the construction work which was carried on about two years ago, and there is no leakage through the gate as it was very tight. The leaks that are

coming in are coming through the stone work in the old gatehouse, and they exist from the bottom of the gatehouse up for a height of around 14 feet. I have indicated on the blue print in yellow crayon where the leaks are coming through and there are two or three substantial leaks in the lower area. The water of course drops down to the bottom of the gatehouse and runs out the stone culvert which discharges below the Dam. I do not consider any danger is involved insofar as Dam failure is concerned, but I can see in a dry season that there might be leaks which would tend to keep the pond below full pond. There didn't appear to be any leaks around the upper portion of the gatehouse and they were all from the bottom up to about 14 feet.

It would seem to me that the best way to correct this condition, if you decide it should be done, would be to extend the 36 inch pipe through the old gatehouse and down the old sluiceway for a total distance of perhaps 14 feet. It would be easier to do this with a corrugated metal pipe rather than a concrete pipe. The 36 inch concrete pipe measures about 42 inches in outside diameter and it would be difficult to get this in place through the existing sluiceway without a great deal of work, since in some places it only measures 40 inches square. I do think it would be possible to get a 36 inch metal pipe in there without too much of a problem. After this pipe is in place and joined to the end of the existing concrete pipe I think the old gatehouse shouldbe filled in with concrete for at least a depth of about 16 feet. The old gatehouse really serves no useful purpose now and I think it would be almost impossible to stop the leaks from the inside except by filling it in with concrete.

As far as leaks in the spillway are concerned, these are much less than they were several years ago. There are no leaks up near the top of the Dam, but there are some few leaks lower down particularly on the easterly side. I think it would be very difficult to stop all of these leaks and I don't think they are sufficiently bad to cause any trouble.

My conclusion is that there is no immediate danger as far as the safety of the Dam is concerned because of the leaks mentioned. If you decide you want the work done on the old gate-

house, then I think that the pond should be drawn down when the work is done and it would be much easier to work when the leaks were less prominent in the old gate-house. Work could be done next Spring sometime and I am sure the pond would fill up again in the matter of a couple of weeks.

I would estimate the cost of putting in the steel pipe described above and the concrete mentioned would be in the vicinity of $3,000.00. When the pond is drawn down some additional clay and tight material could be spread on the embankment on the easterly side of the Dam which would help to seal off the joints and I would suggest that $1500.00 be allowed for this additional work.

If you need any further information please get in touch with me.

Very truly yours,

B. H Palmer

Chandler & Palmer

BEP:mds

~~HD-E~~

CLASS B 6

6 MAY 1963
LWS

STATE BOARD FOR THE SUPERVISION OF DAMS
INVENTORY DATA

D.T. 1130

Name of Dam or Pond HIGGANUM RESERVOIR

Code No. [illegible]

Location of Structure

Town HADDAM

Name of Stream PONSET BROOK

U.S.G.S. Quad. HADDAM

Owner STATE PARK AND FOREST COMMISSION

Address HARTFORD

OR 7/23

Pond Used For RECREATION

Dimensions of Pond: Width ± 400 FEET Length ± 3700 FEET Area 32.0 ACRES

Total Length of Dam ± 400 FEET Length of Spillway ± 45 FEET

Depth of Water Below Spillway Level (Downstream) ± 35 FEET

Height of Abutments Above Spillway ± 16 FEET

Type of Spillway Construction ROCK ARCH

Type of Dike Construction EARTH

Downstream Conditions TOWN OF HIGGANUM 0.2 MILE

1868

Summary of File Data ONE FILE OF CORRESPONDENCE. D-5 ISSUED ON 4-25-58.

Remarks LARGE DAM, FAILURE WOULD CAUSE DAMAGE TO TOWN OF HIGGANUM.

REGION III

TOWNSHIP Haddam NAME OF IMPOUNDMENT Higganum Res.

NEAREST STREET LOCATION Rt. 81

U.S.G.S. QUAD. SHOWING LOCATION OF DAM Haddam

NAME OF STREAM Ponset Brook

POND USED FOR

TYPE OF SPILLWAY CONSTRUCTION Rock Arch

TYPE OF DIKE CONSTRUCTION Earth

TYPE OF DRAWDOWN CONSTRUCTION Gate Valve

OPERABLE: YES X NO EQUIPMENT NEEDED TO OPERATE Gillette Castle

EQUIPMENT LOCATED WHERE Gillette Castle

KEYS REQUIRED: YES X NO LOCATION OF KEYS: ENTRANCE Gillette Castle

CONTROLS

PERSON TO CONTACT Donald Grant

TELEPHONE # OFFICE 526-2336 HOME 526-2015

DOWNSTREAM CONDITIONS THAT COULD RESTRAIN OPERATION OF GATES

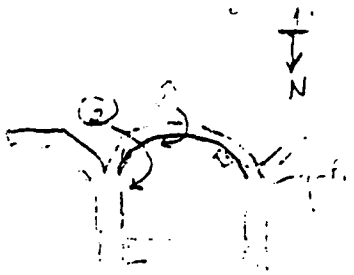
Believe gates can be safely opened wide.

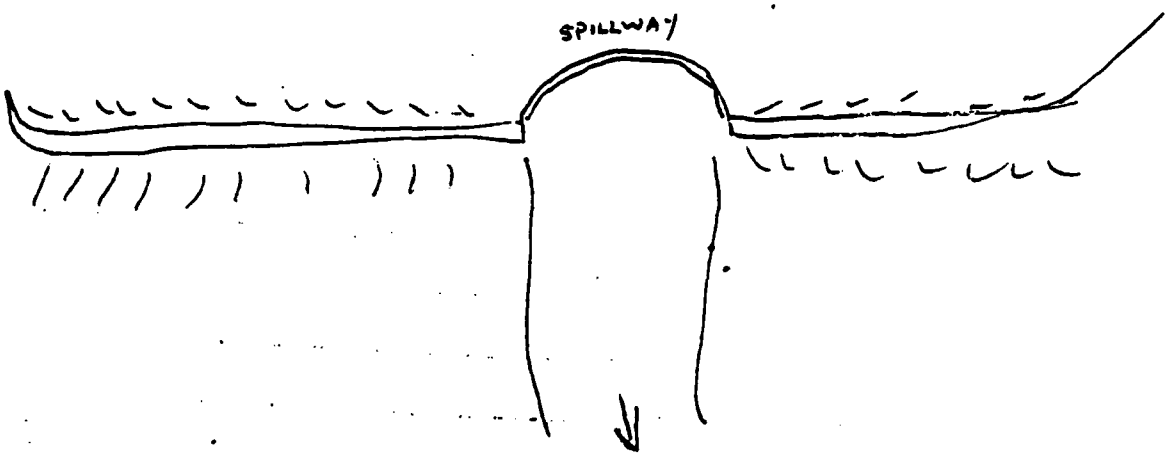
POTENTIAL BENEFIT OF LOWERING DURING FLOOD WATCH

DESCRIBE DAMAGE THAT WOULD RESULT FROM DAM FAILURE

Dam sits directly above village of Higganum. Would cause property damage if it fails.

7/12/72





10-27-77 BRUSH ON SLOPES. SEEPAGE ALONG TOE E OF OUTLET & ABOUT HALF WAY UP SLOPE ON WEST SIDE SHOULD BE MONITORED.

III-22

Dam Inspection Report

Town: Haddam - Higganum

Date of Inspection: July 8, 1974

Name of Impoundment: Higganum Reservoir

Remarks: Face has been capped before but not for some time - quite sturdy looking - there were kids climbing up the face the day I was there very dangerous spot

Recommendations: needs little maintenance in the course of a year but should be inspected annually

Owner Notified: Phone _____ (date) Letter: _____ (date)

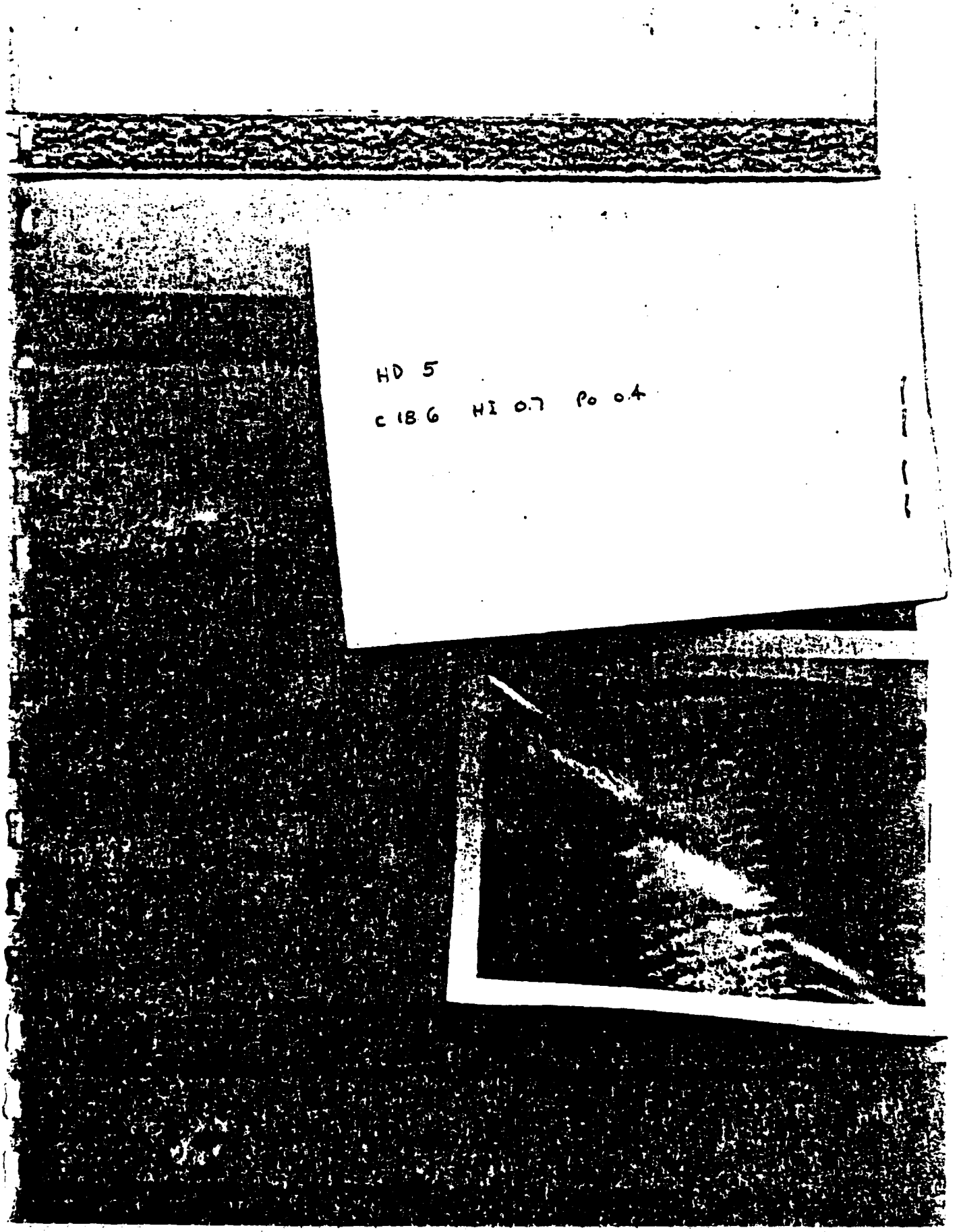
Robert E Somerville
(Inspector's Signature)

12-11-7?

Response to M. [illegible] Co. [illegible] Heppinna [illegible]

spillway elev.	96.56
drainage area	6.73 sq miles
discharge	2450 CFS
cap [illegible]	[illegible] A
[illegible]	25'
[illegible]	12.6'

12/28/4 ?3


HD 5
C 1B 6 HI 0.7 Po 0.4

8/10/73
Higganum Res. #1
Photo taken from
East end of dam
on RT 81

MAY 63

9/8/74
Driggers Reservoir

CA13561RE

APPENDIX B-3

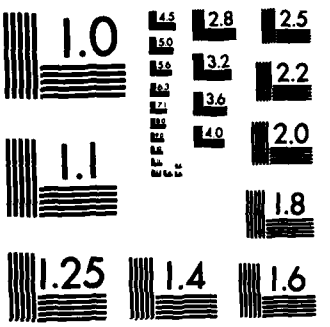
PLANS, SECTIONS, DETAILS

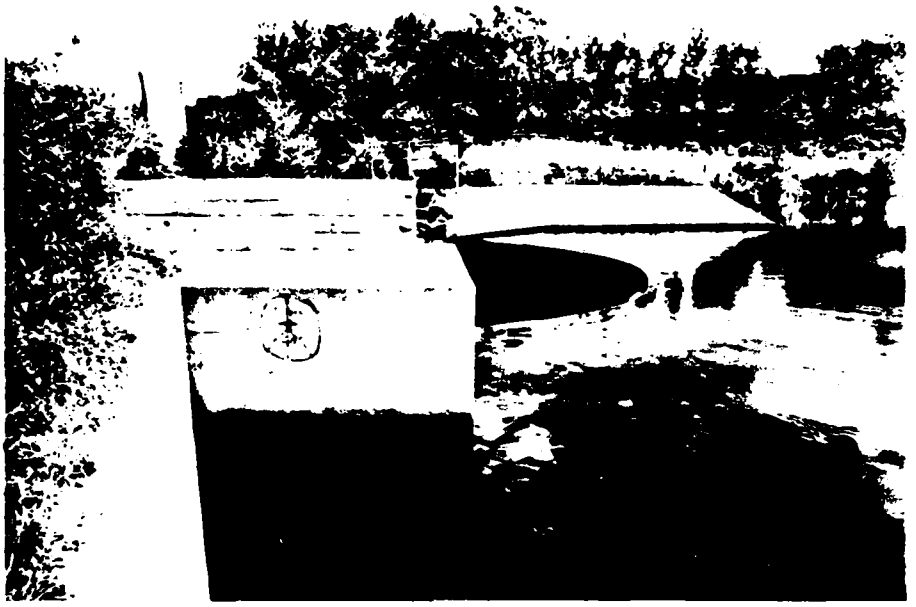
APPENDIX C

SELECTED PHOTOS

AD-A144 667 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
HIGGANUM RESERVOIR DA.. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUL 78

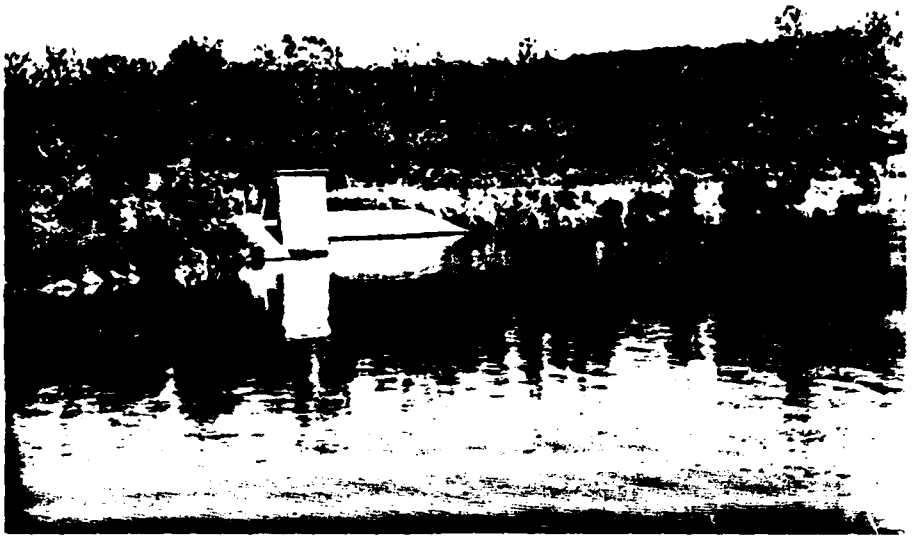
UNCLASSIFIED F/G 13/13 NL



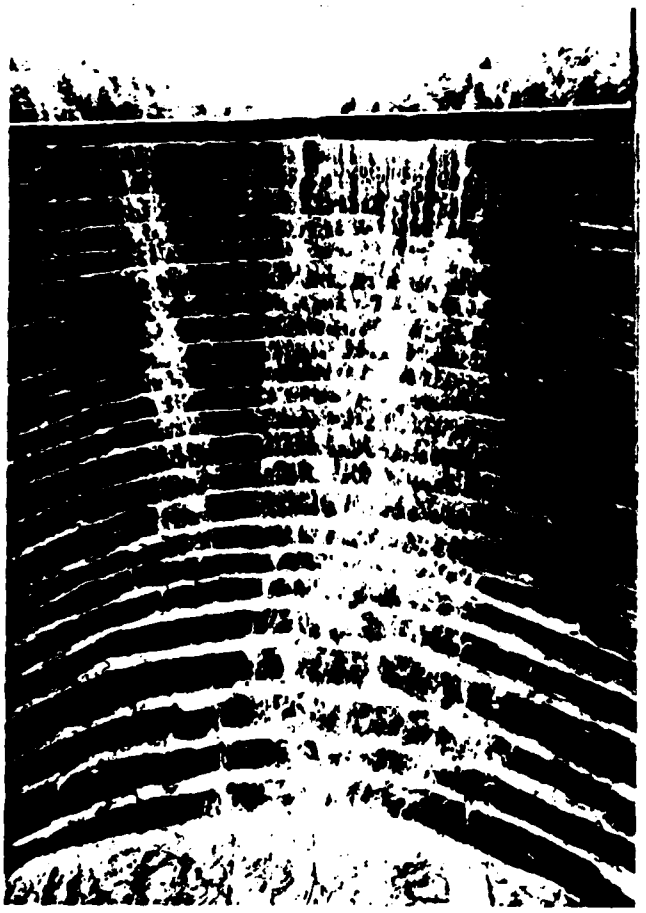


C-2 OVERALL VIEW OF SPILLWAY FROM LEFT EMBANKMENT

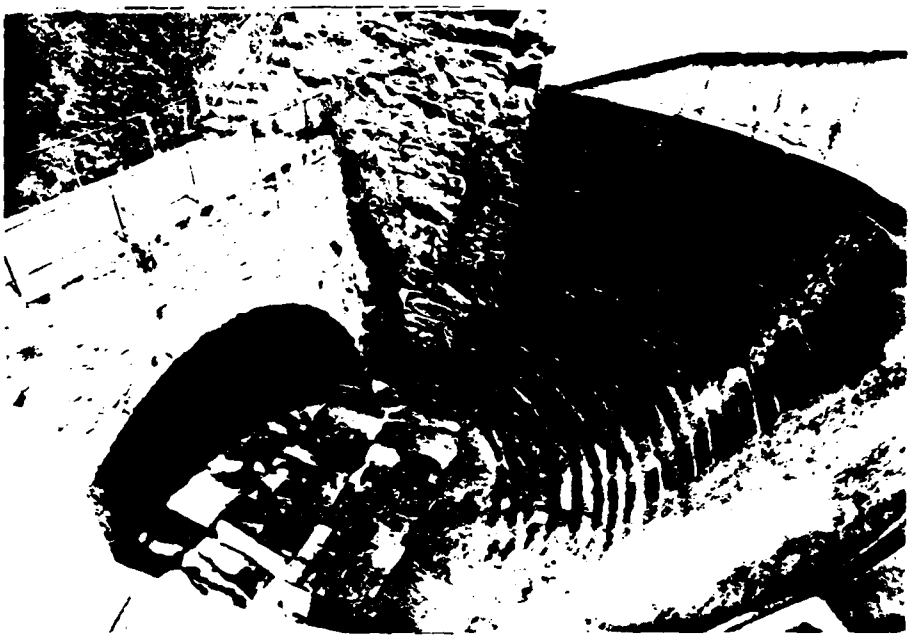
C-3 OVERALL VIEW OF SPILLWAY AND GATEHOUSE FROM RIGHT EMBANKMENT



C-4 OVERALL VIEW OF DAM FROM RIGHT SIDE OF RESERVOIR SHOWING EARTH EMBANKMENTS AND GATEHOUSE.



C-5 VIEW OF FACE OF SPILLWAY

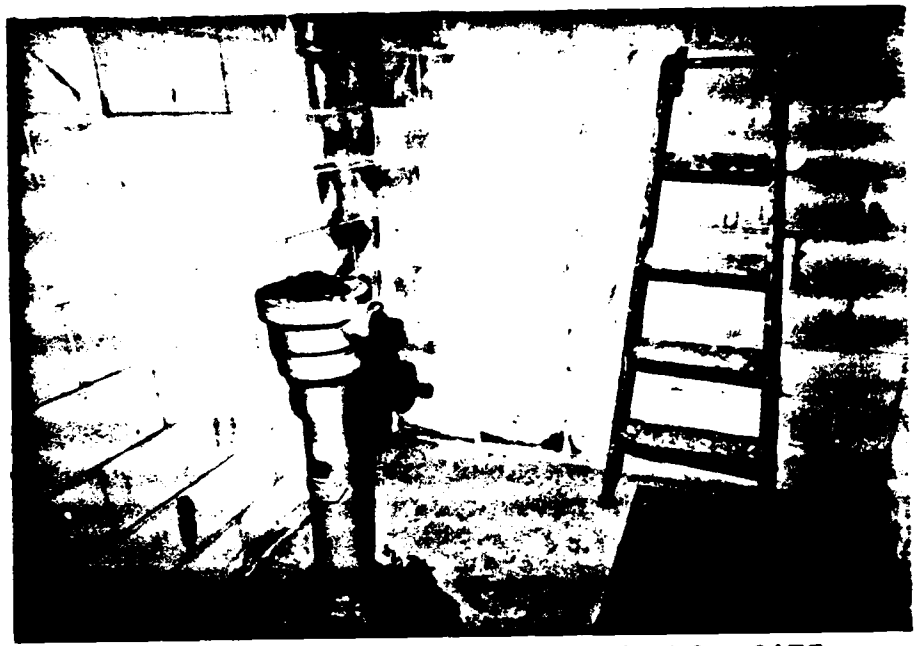


C-6 VIEW SHOWING RELATIONSHIP OF SPILLWAY TO STONE ARCH BRIDGE AND RIGHT TRAINING WALL. (NOTE LEAK IN TRAINING WALL AT BRIDGE.)

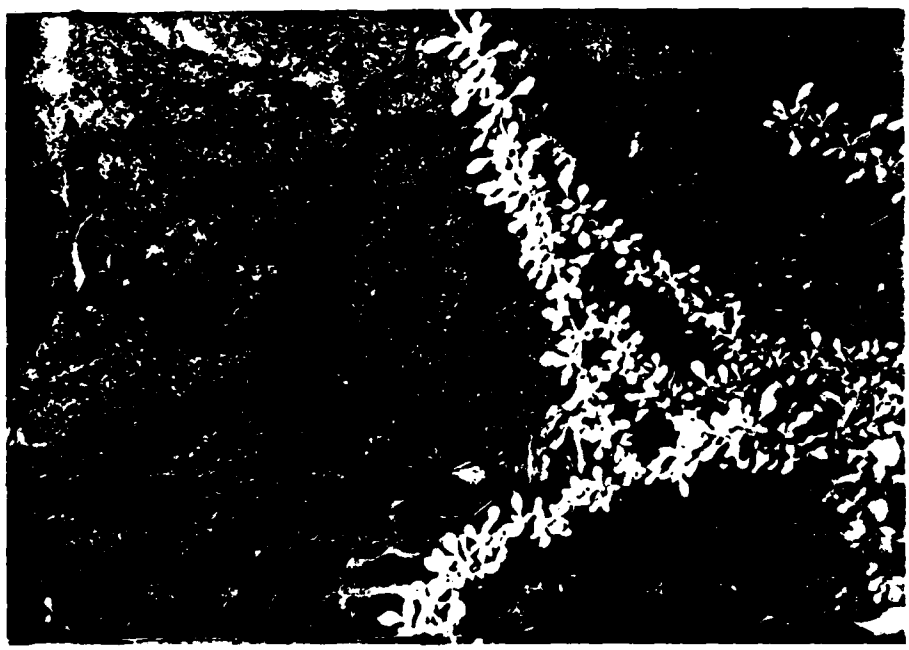
C-7 VIEW OF BRIDGE, SPILLWAY AND DISCHARGE CHANNEL

C-8 VIEW OF DISCHARGE CHANNEL TAKEN FROM ARCH BRIDGE. (NOTE OBSTRUCTIONS AND OVERHANGING TREE GROWTH.

C-9 OUTLET CONDUIT



C-10 INTERIOR OF GATEHOUSE SHOWING GATE OPERATING MECHANISM



C-11 SEEPAGE EMANATING FROM DOWNSTREAM FACE OF WALL - LEFT EMBANKMENT

C-12 SEEPAGE EMANATING FROM DOWNSTREAM FACE OF WALL - LEFT EMBANKMENT

C-13 EXTENSIVE AREA OF SEEPAGE - RIGHT EMBANKMENT

C-14 SEEPAGE AREA DOWN-STREAM FROM WALL LEFT EMBANKMENT

C-15 SEEPAGE AREA ALONG TOE OF RIGHT EMBANKMENT

C-16 SEEPAGE AREA ALONG TOE OF RIGHT EMBANKMENT

APPENDIX D

HYDRAULIC/HYDROLOGIC COMPUTATIONS

A. Size Classification

Height of Dam = 48.0 feet; Hence INTERMEDIATE

at crest elevation reservoir storage = 486 AC-ft., hence SMALL

adopted size category INTERMEDIATE

B. Hazard Potential

DAM IS LOCATED JUST UPSTREAM OF THE TOWN OF HIGGANUM. FAILURE OF THIS DAM MAY CAUSE DAMAGE TO LIFE, HOMES AND EXTENSIVE ECONOMIC LOSS DUE TO WASHING OUT OF ROADS AND THE UTILITIES ADJACENT TO THEM (POWER HOUSE TRANSFORMER STATION.) CONSEQUENTLY IT IS CONSIDERED A HIGH "HAZARD" DAM.

It is estimated from the rule of "thumb" failure hydrograph as follows:

Category	Loss of Life	Economic Loss
		Homes = YES (50+)
		Buildings = YES (50+)
HIGH	YES	Farms = —
		Miscellaneous = YES
		Highways or roads = YES
		UTILITIES = YES (ELEC. SUBSTATION)

C. Hazard: HIGH Size: INTERMEDIATE "Test Flood" or Spillway Design Flood: PMF

Adopted S.D.F. (test flood) = PMF

Adopted value of test flood due to watershed characteristics = 1750 CSM

Estimating Maximum Probable Discharges - Inflow and Outflow Values Date of Inspection: 7/24/78

Name of Dam HIGGANUM DAM; Location of Dam PONSET BROOK Town HIGGANUM, CT.

Watershed Characterization ROLLING HILLS WITH WOODED AREAS AND SWAMPS

Adopted "test" flood = FULL PMF = 1750 CSM = 11777 C.F.S.

D.A. = Drainage Area = 6.73 Square Miles = 4306 Acres

S.A. = Surface Area of Reservoir = 0.0469 Square Miles = 30 Acres

Shape and Type of Spillway = BROAD CRESTED - UNGATED - OVERFLOW - SEMI-CIRCULAR

B = Width of Spillway = 65 feet; C = Coefficient of Discharge = (3.09 — Friction) = 3.00

Maximum Capacity of Spillway Without Overstopping = 5710 C.F.S. = 48.5 % of test flood

Top of Dam Elevation = 106.00; Spillway Crest Elevation = 96.56 = 96.50

Length of Dam = 640 feet

Name of Dam	Test Flood Qp_1		Inflow Characteristics		Outflow Characteristics First Approximation			Outflow Characteristics Second Approximation			Outflow Characteristics Third Approximation		
	CSM	CFS	h_1 in feet	S_1 in inc.	Qp_2 CFS	h_2 in feet	S_2 in inc	S_3 in inc	h_3 in ft.	C	S_4 in inc.	h_4 in ft.	Qp_4 CFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14
HIGGANUM DAM	PMF = 1750	11774	11.65	0.97	11774	11.65	0.97	0.97	11.63	11710	0.97	11.64	11742
	½PMF = 875	5887	9.59	0.80	5887	9.59	0.80	0.79	9.55	5850	0.79	9.57	5860

Qp = Discharge; h = surcharge height S = Storage in inches

NOTE: Out[illegible] discha[illegible]ge values are computed as per C.O.E. guidelines bu[illegible] with due consideration given to storage in reservoir and maximum spillway capacity.

Overtopping Potential

Spillway crest elevation = 96.50 M.S.L.

Top of dam elevation = 106.00 M.S.L.

Maximum discharge capacity of Spillway without overtopping = 5710 C.F.S.

"Test flood" outflow discharge = 11742 C.F.S.

% of "Test flood" carried by Spillway without overtopping = 48.6 % 1

"Test flood" outflow discharge which flows over the dam = 6032 C.F.S.

= 51.4 % of "Test flood" 2

1 + 2 = 100%

"Rule of Thumb Guidance for Estimating
Downstream Dam Failure Hydrograph"

BASIC DATA

Name of dam Higganum Reservoir Dam Name of town Haddam, Ct.

Drainage area = 6.73 sq.m. Top of dam 106

Spillway type = Overflow, broad crest, semi-circular Crest of spillway 96.5 NGVD

Surface area at crest elevation = 30 acres

Assumed side slopes of embankments = 2:1

Reservoir bottom near dam = 58 NGVD

Depth of reservoir at dam site 40 ft = y_o = 40 ft.

Mid-height elevation of dam = 84.0

Length of dam at crest = 875 feet

Length of dam at mid-height = 544 feet

30% of dam length at mid-height = w_b = 163 feet

Step 1:

Elevation	Reservoir Estimated Storage In AC-ft.	Remarks
96.5	486	
98.5	546	
100.5	606	
102.5	666	
104.5	726	
106.5	786	

Step 2:

$$Q_{pl} = \frac{8}{27} W_b \sqrt{g} \; y_o^{3/2}$$

$$= 1.68 \; w_b \; y^{3/2} = 69{,}276 \text{ CFS}$$

Notes:
1. The reservoir will be drained in six minutes.
2. Failure of dam is assumed to be instantaneous when pool reaches top of dam.

Dam Failure Analysis

Higganum Reservoir Dam

1. Failure discharge with pool at top of dam = 69276 CFS
2. Depth of water in Reservoir at time of failure = 40 feet
3. Maximum depth of flow downstream of dam at time of failure = 26 feet
4. Water surface elevation just downstream of dam at time of failure = 84.0

The failure discharge of 69276 CFS will flow downstream for 10,000 feet until it joins the Connecticut River. The Valley Storage will reduce the discharge to approximately 50000 CFS in this two mile length of channel. Also due to the roughness characteristics and slope of the brook, it is assumed that all wave and kinetic energy will be dissipated in this two miles. Consequently, unsteady flow conditions will change to steady and uniform flow. The failure flow will have the following hydraulic characteristics:

Distance from Dam in feet	Water Surface Elevation	Remarks
0	96	Upstream of dam
100	84	Downstream of dam
1000	78	
3000	72	
4500	66	
6000	60	
7000	54	
8000	48	
9000	42	
10,000	36	Junction with Connecticut River

Note: Near the junction with the Connecticut River:

$S = 0.004$
$N = 0.055\pm$
$Q = 50{,}000$ CFS
$b = 30$ ft $\pm$
$d = 6.3$ ft
side slopes = 2H : 1V

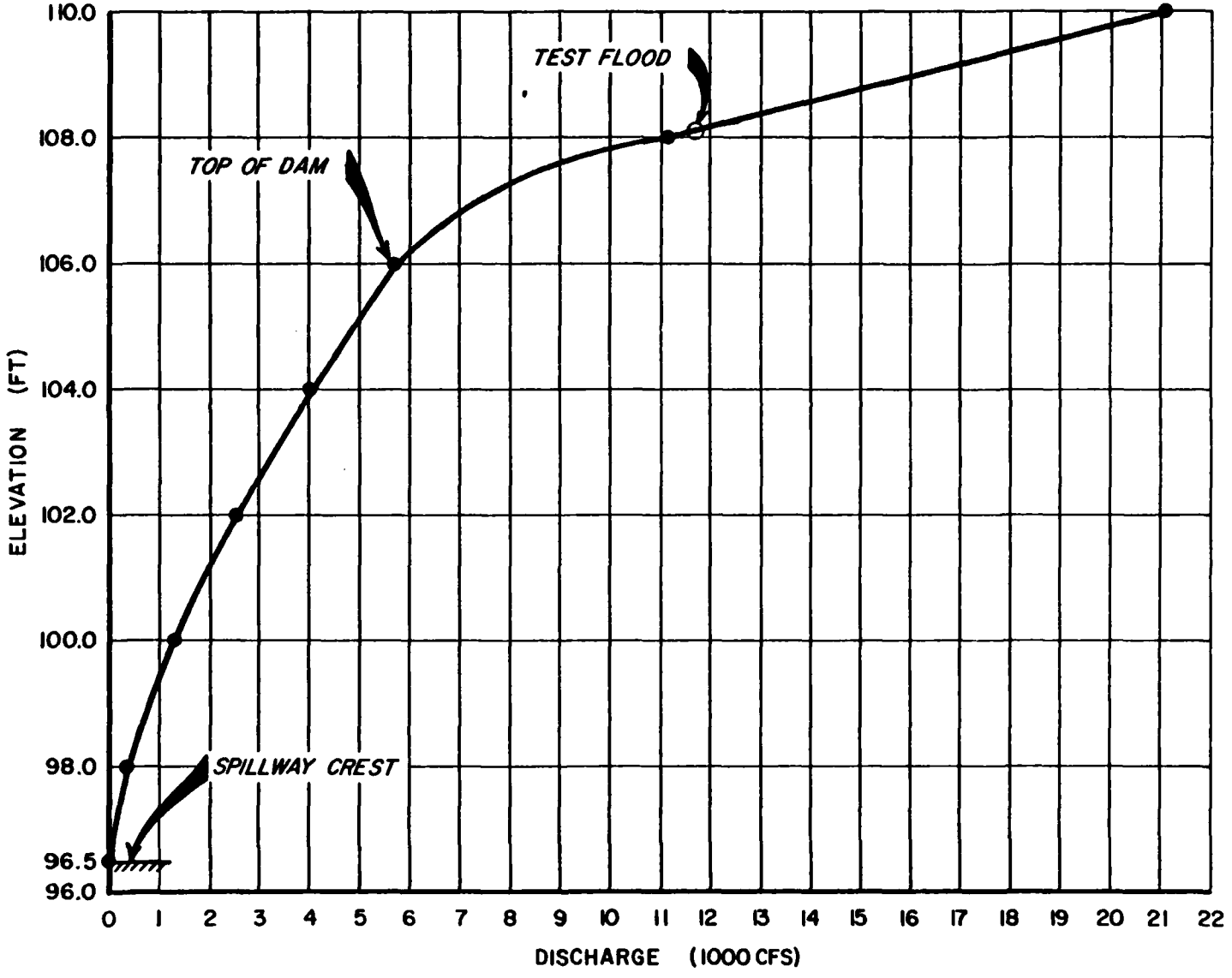
Spillway Rating Curve Computations
Higganum Reservoir Dam

Spillway width = 65.0 feet
Length of dam = 875 feet
C = 3.00 feet

Spillway Crest Elevation = 96.50
Top of dam Elevation = 106.00
($Q = C\ L\ H^{3/2}$)

Elevation (ft) NGVD	Discharge (CFS)	Remarks
96.5	0	Spillway Crest
98.0	358	
100.0	1277	
102.0	2515	
104.0	4005	
106.0	5709	Top of dam
108.0	11,139	
110.0	21,069	

Frequency and Discharge (CFS)	Elevation (ft)
Q_{10} = 983	99.44
Q_{50} = 1,571	100.52
Q_{100} = 1,763	100.84
$Q_{1/2\ PMF}$ = 5,860	106.07
Q PMF = 11,742 (Test Flood)	108.10



SPILLWAY RATING CURVE
HIGGANUM DAM

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	830	NED	CT	007	02				HIGGANUM RESERVOIR DAM	4129.6	7233.6	00NOV78

POPULAR NAME	NAME OF IMPOUNDMENT
	HIGGANUM RESERVOIR

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	08	PONSET BROOK	HIGGANUM	0	

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
CRHEPC	1868	R	48	48	771	486	NED	N	N	N	N	

REMARKS

O/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	875	U	65	5710												

OWNER	ENGINEERING BY	CONSTRUCTION BY
STATE OF CONNECTICUT		

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	STATE CONN DEP

INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
C-E MAGUIRE INC.	28JUL78	PL 92-367

REMARKS

This Phase I Inspection Report on Higganum 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.

Charles G. Tiersch

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

Fred J. Ravens Jr.

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

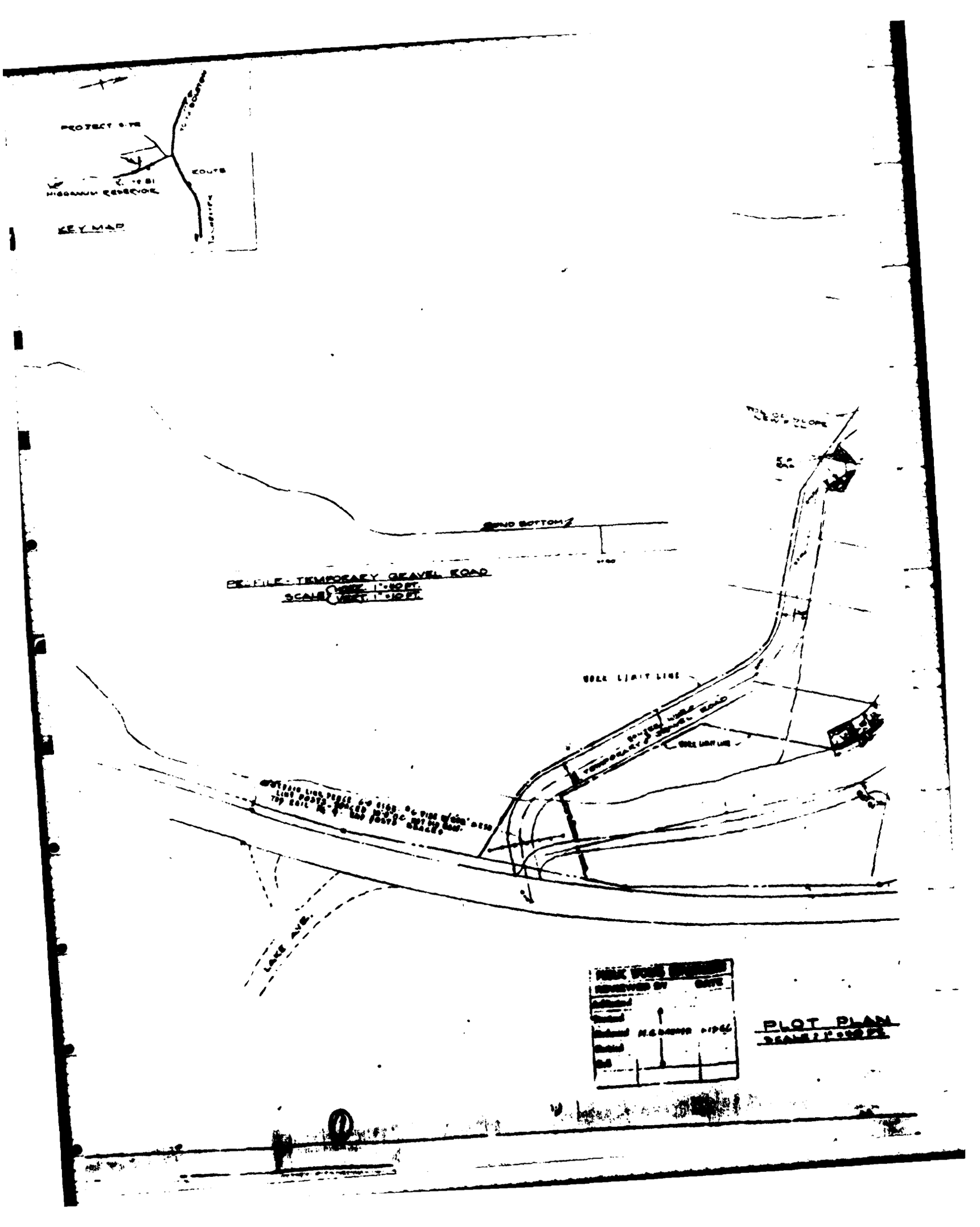
Saul Cooper

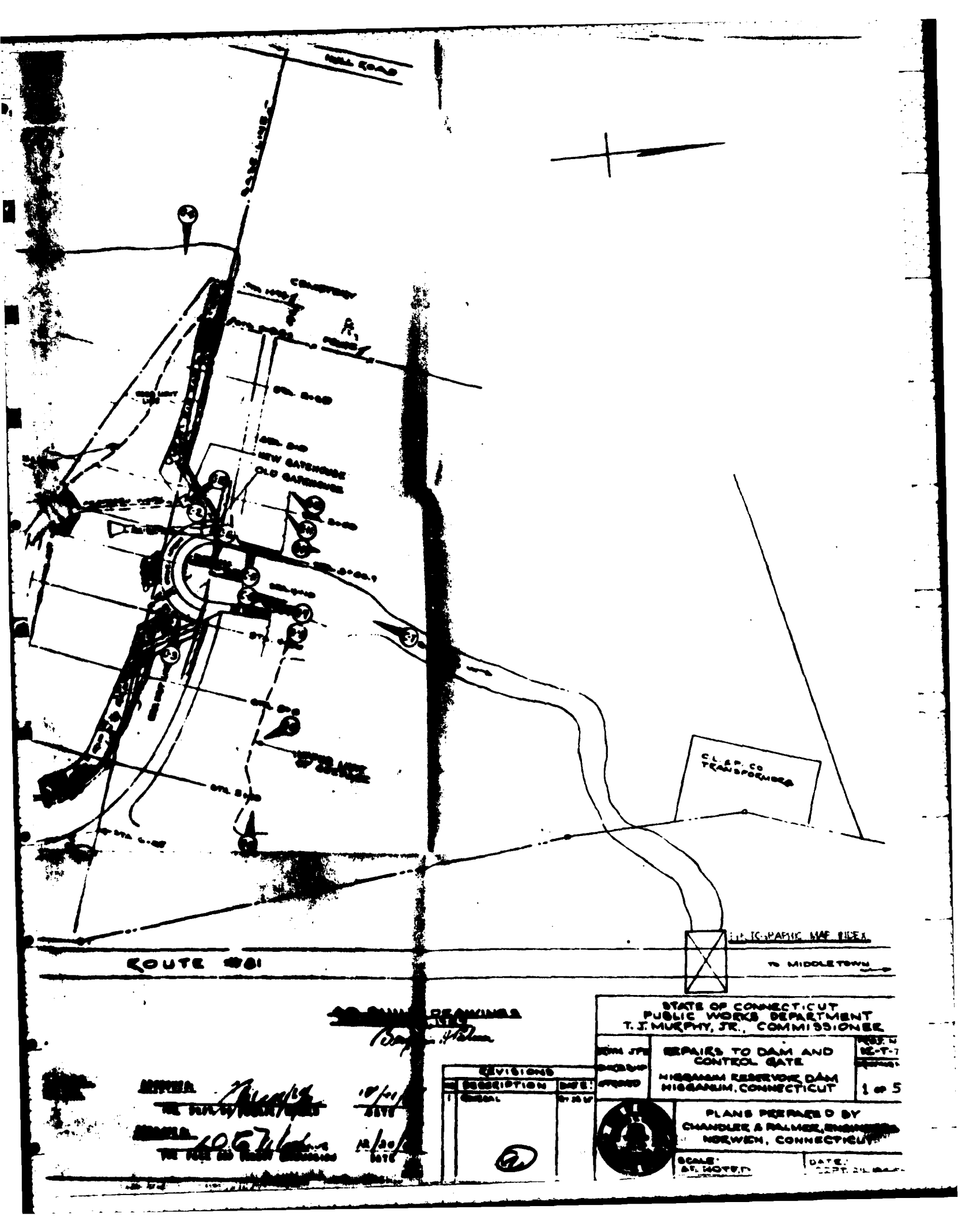
SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

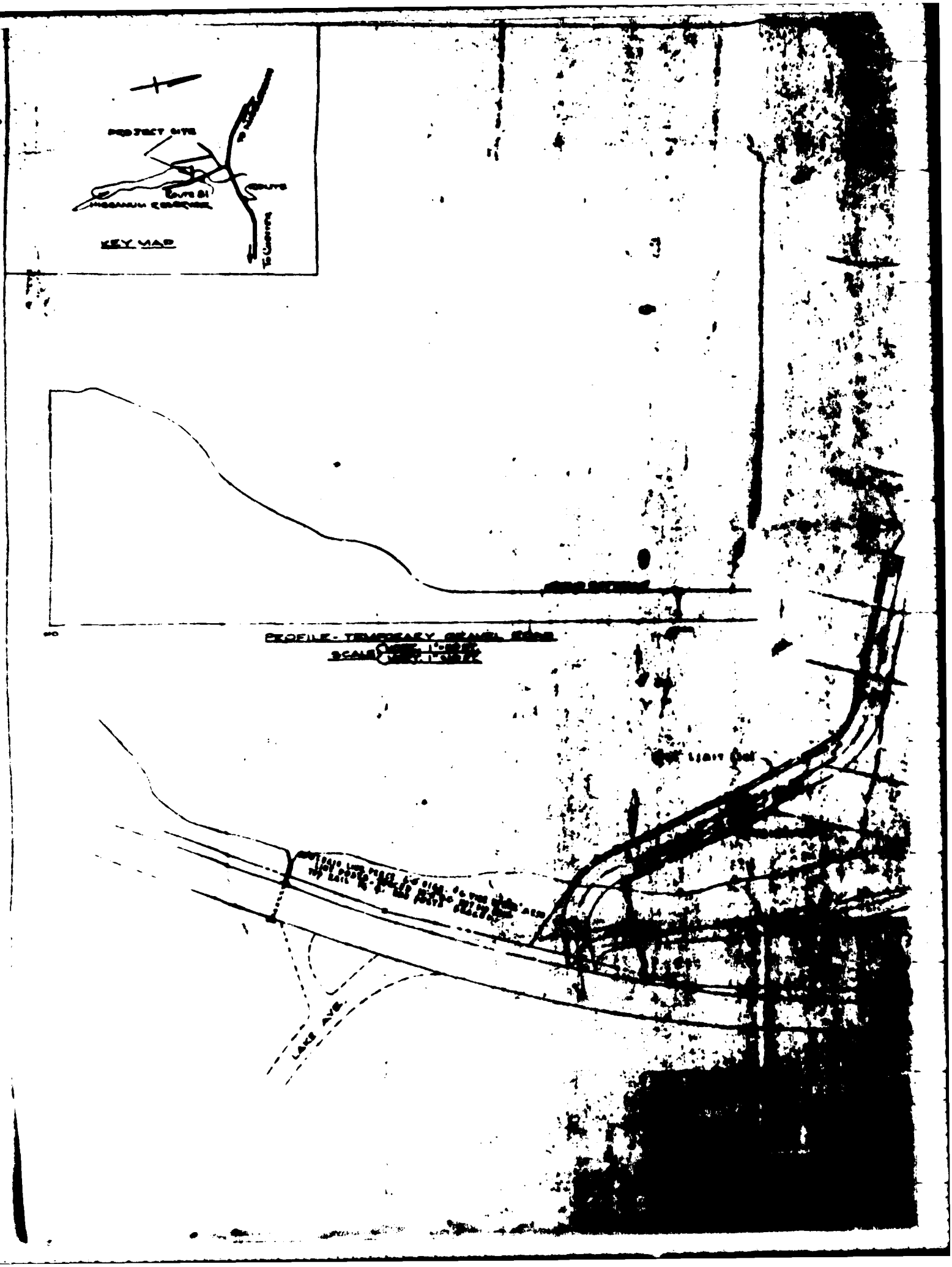
APPROVAL RECOMMENDED:

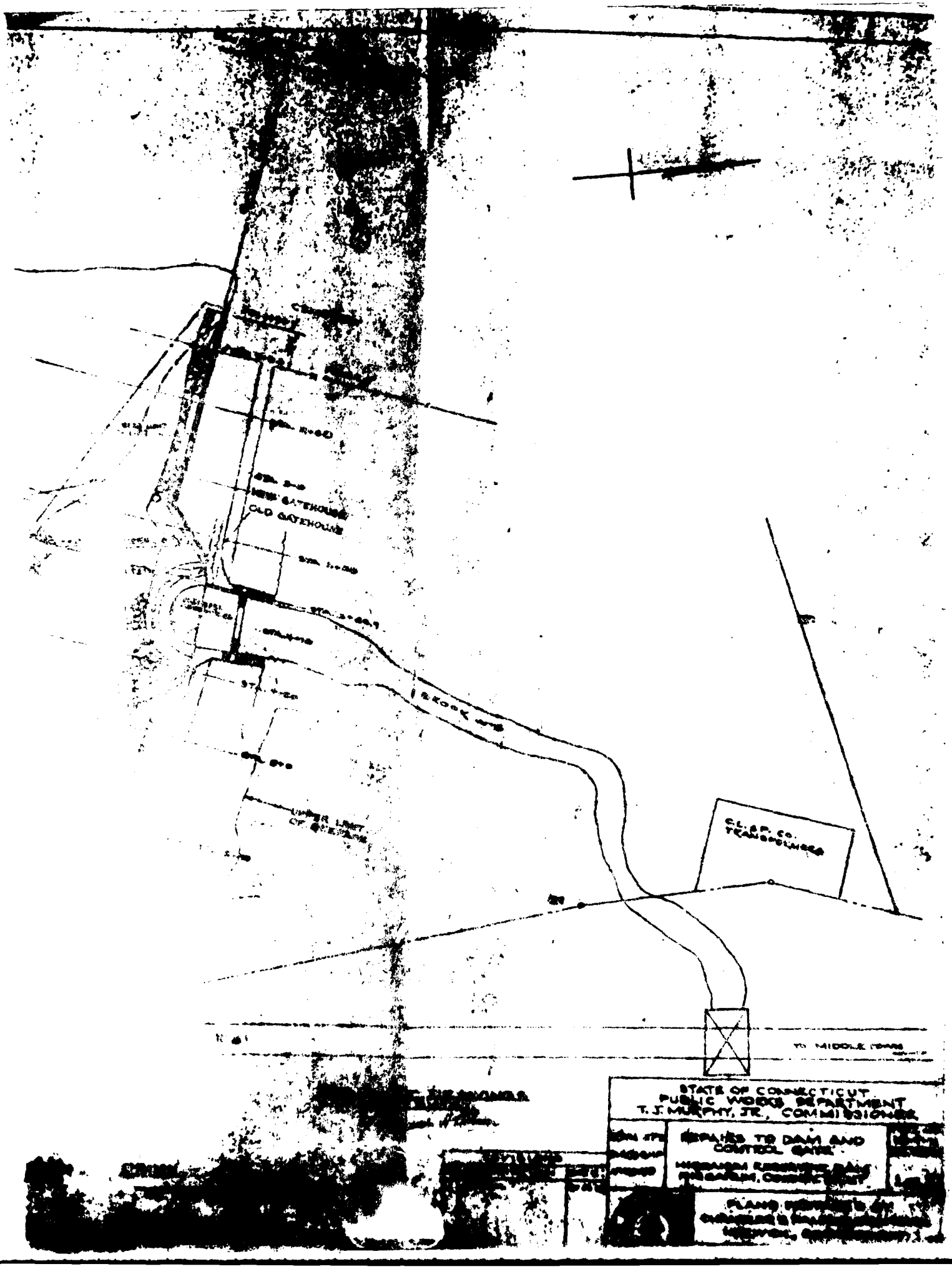
Joe B. Fryar

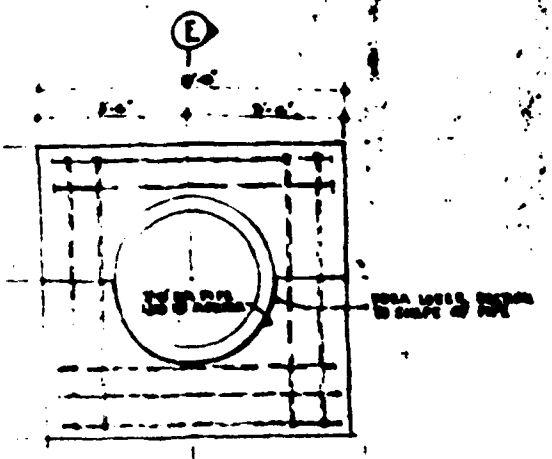
JOE B. FRYAR
Chief, Engineering Division


PROJECT SITE
ROUTE
KEY MAP
SAND BOTTOM
PROFILE - TEMPORARY GRAVEL ROAD
SCALE HORIZ. 1"=10 FT.
SCALE VERT. 1"=10 FT.
WORK LIMIT LINE
TEMPORARY GRAVEL ROAD
WORK LIMIT LINE
LAKE AREA
PLOT PLAN

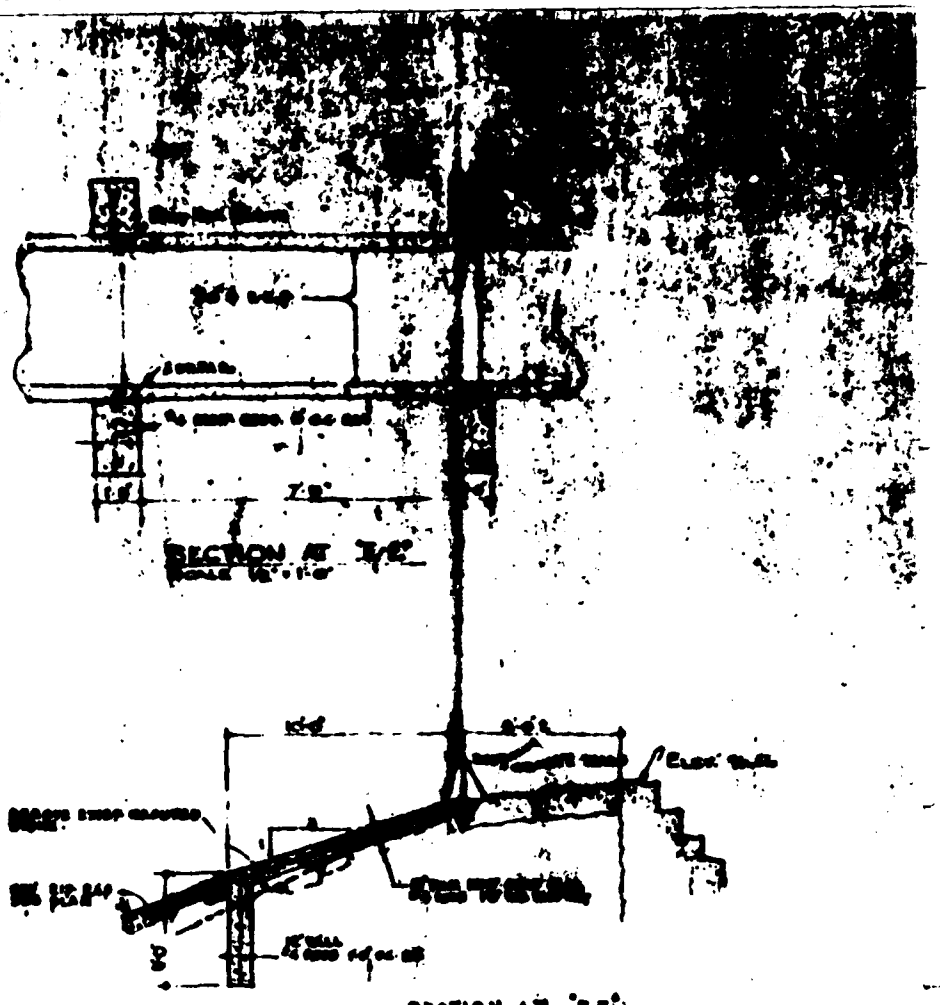

ROUTE 81
TO MIDDLETOWN
C.L.&P. CO TRANSFORMER
NEW GATEHOUSE
OLD GATEHOUSE
STATE OF CONNECTICUT
PUBLIC WORKS DEPARTMENT
T. J. MURPHY, JR., COMMISSIONER
REPAIRS TO DAM AND CONTROL GATE
HIGGANUM RESERVOIR DAM
HIGGANUM, CONNECTICUT
1 of 5
PLANS PREPARED BY
CHANDLER & PALMER, ENGINEERS
NORWICH, CONNECTICUT
REVISIONS
DESCRIPTION
DATE


PROJECT SITE
KEY MAP


NEW GATEHOUSE
OLD GATEHOUSE
BROOK
LOWER LIMIT OF RESERVOIR
C.L.&P. CO. TRANSFORMER
TO MIDDLE TOWN
STATE OF CONNECTICUT
PUBLIC WORKS DEPARTMENT
T. J. MURPHY, JR., COMMISSIONER
REPAIRS TO DAM AND CONTROL GATE
MISERY SWAMP RESERVOIR DAM
PORTLAND, CONNECTICUT

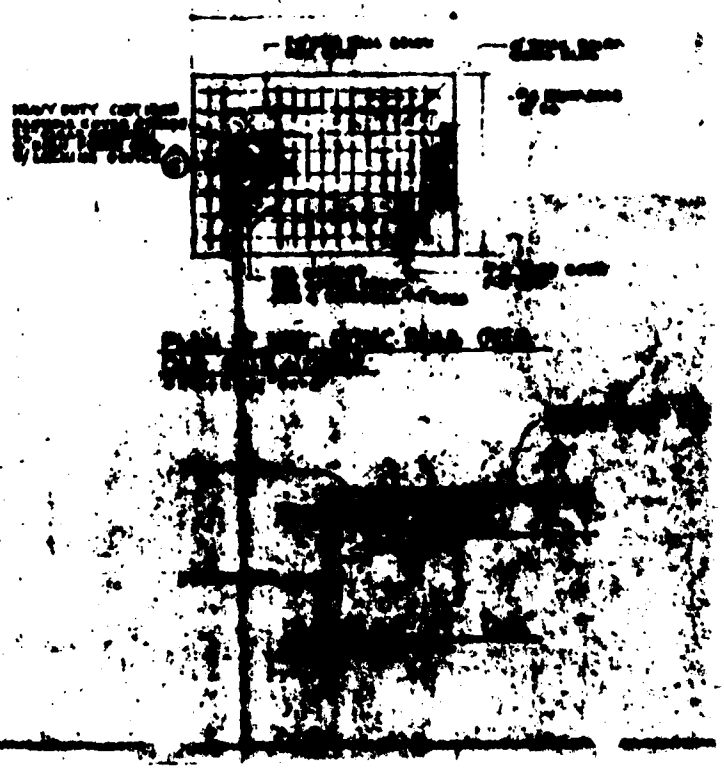


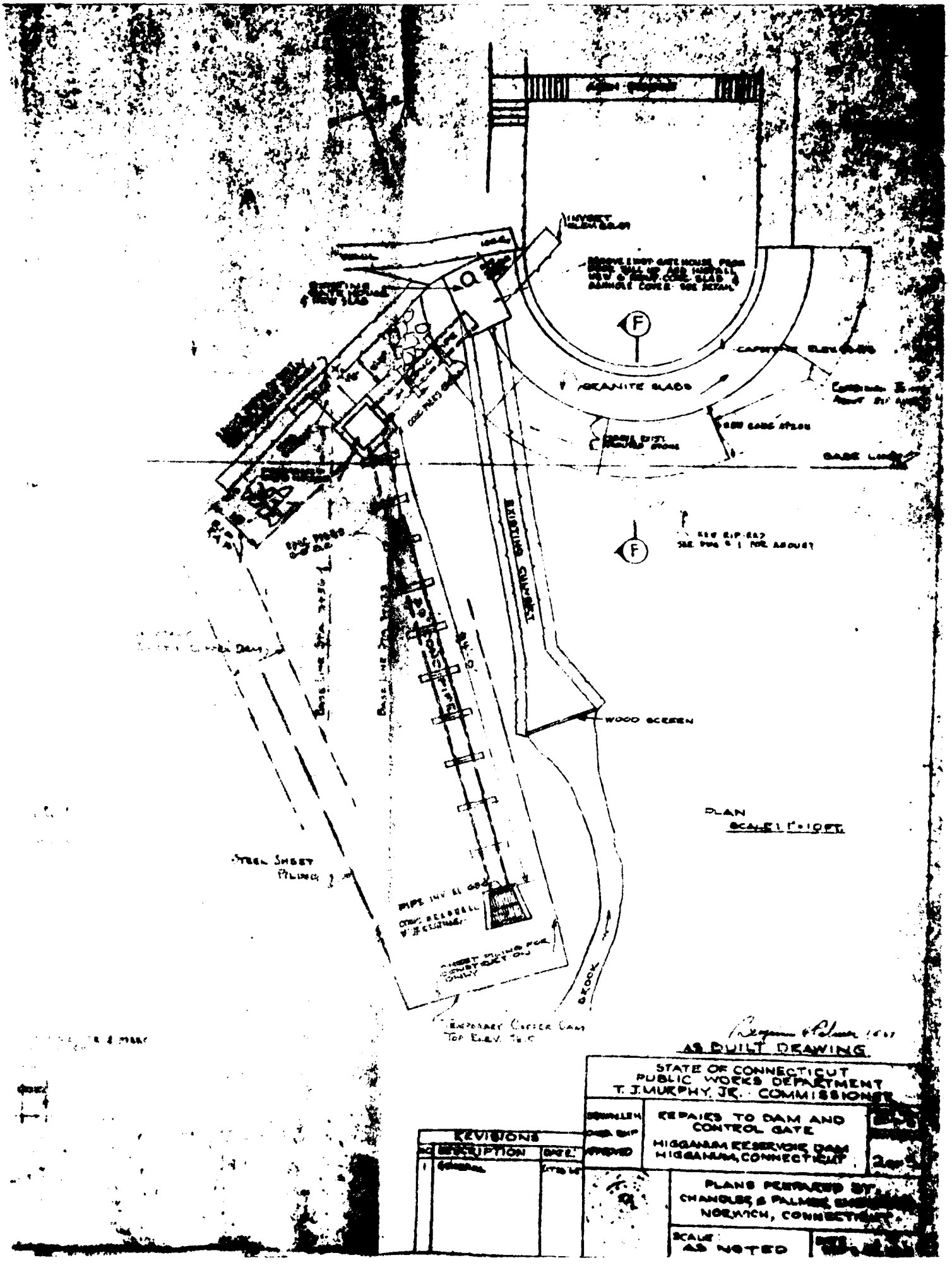
TYPICAL ELEVATION OF SCAG PIER AT PIPELINE

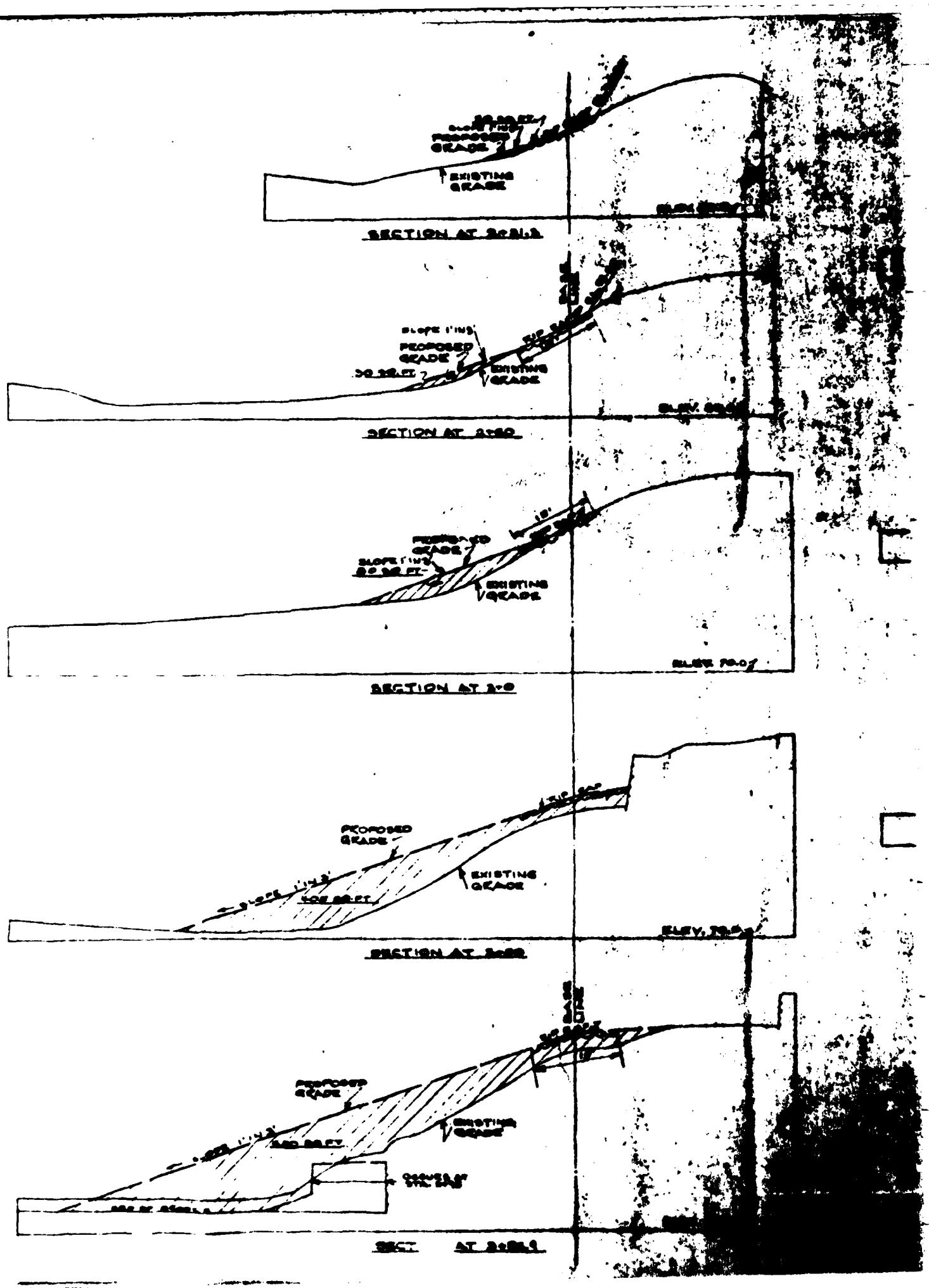


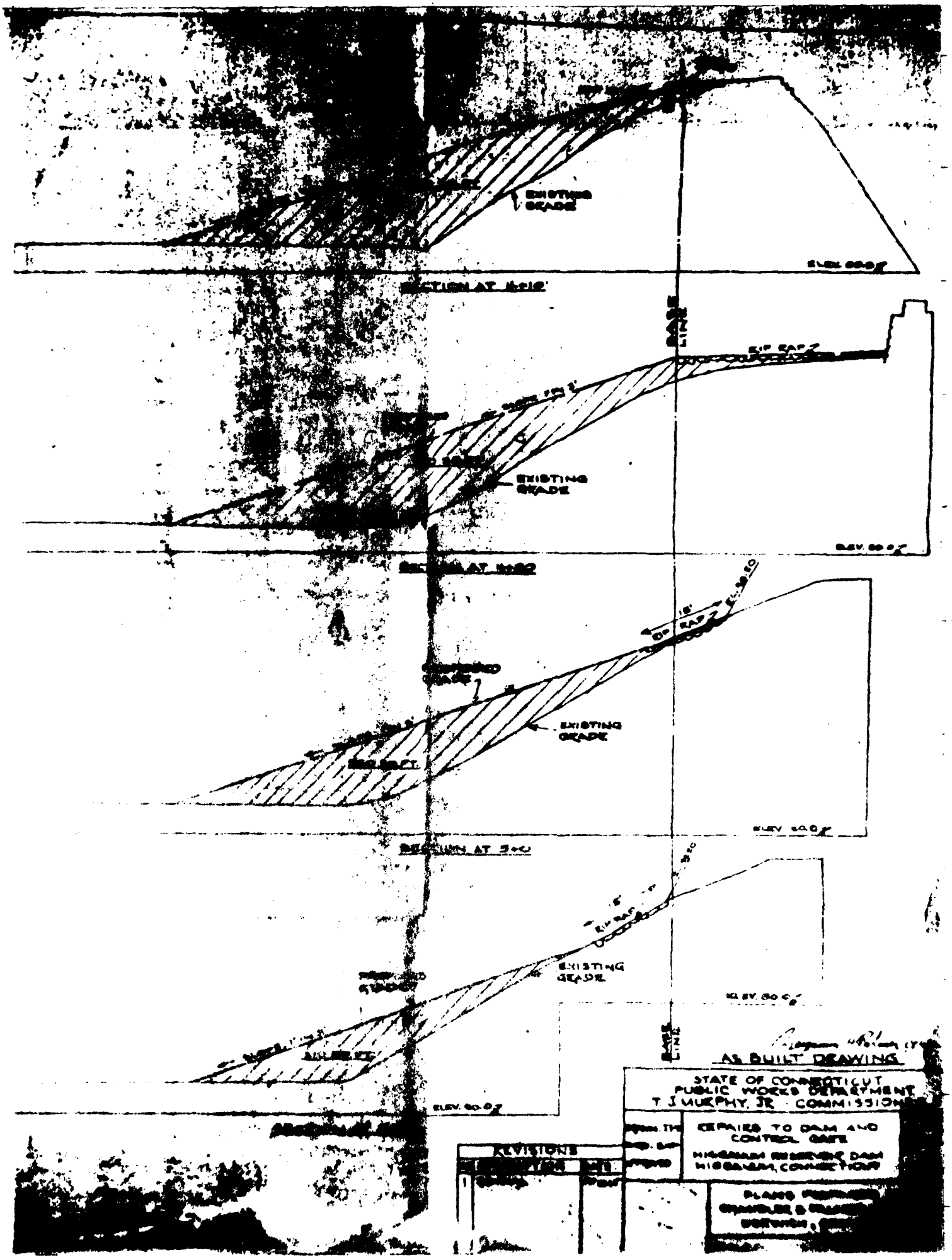
SECTION AT E-E

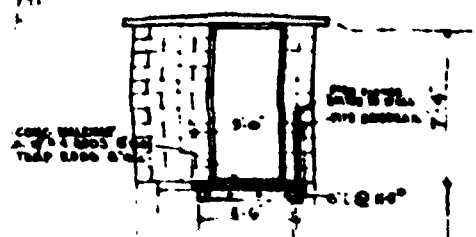
SECTION AT F-F



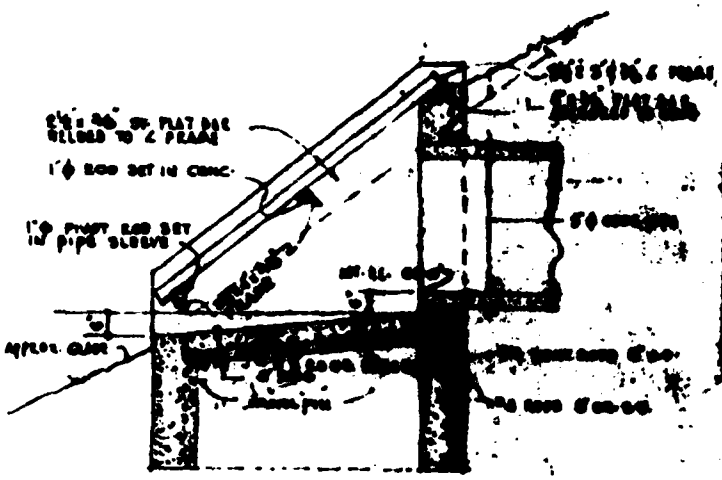

GRANITE SLABS
EXISTING CONCRETE
WOOD SCREEN
PLAN
SCALE 1"=10'-0"
STEEL SHEET PILING
BROOK
AS BUILT DRAWING
STATE OF CONNECTICUT
PUBLIC WORKS DEPARTMENT
T. J. MURPHY, JR. COMMISSIONER
REPAIRS TO DAM AND CONTROL GATE
HIGGANUM RESERVOIR DAM
HIGGANUM, CONNECTICUT
REVISIONS
DESCRIPTION
DATE
PLANS PREPARED BY
CHANDLER & PALMER
NORWICH, CONNECTICUT
SCALE
AS NOTED


EXISTING GRADE
SECTION AT
SLOPE LINE
PROPOSED GRADE
EXISTING GRADE
SECTION AT
PROPOSED GRADE
SLOPE LINE
EXISTING GRADE
SECTION AT
PROPOSED GRADE
EXISTING GRADE
SECTION AT
PROPOSED GRADE
EXISTING GRADE
SECT AT

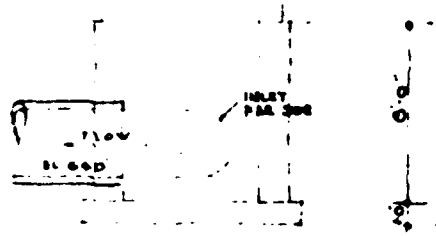

EXISTING GRADE
EXISTING GRADE
EXISTING GRADE
EXISTING GRADE
AS BUILT DRAWING
STATE OF CONNECTICUT
PUBLIC WORKS DEPARTMENT
T. J. MURPHY, JR. COMMISSIONER
REPAIRS TO DAM AND CONTROL GATE
HIGGANUM RESERVOIR DAM
HIGGANUM, CONNECTICUT
REVISIONS



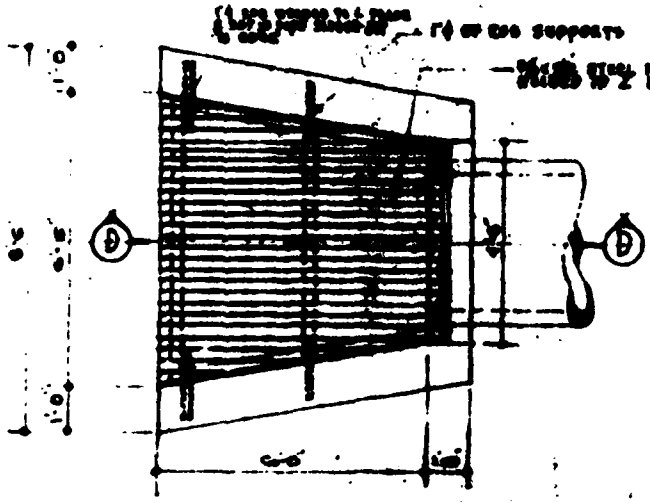
SIDE ELEVATION



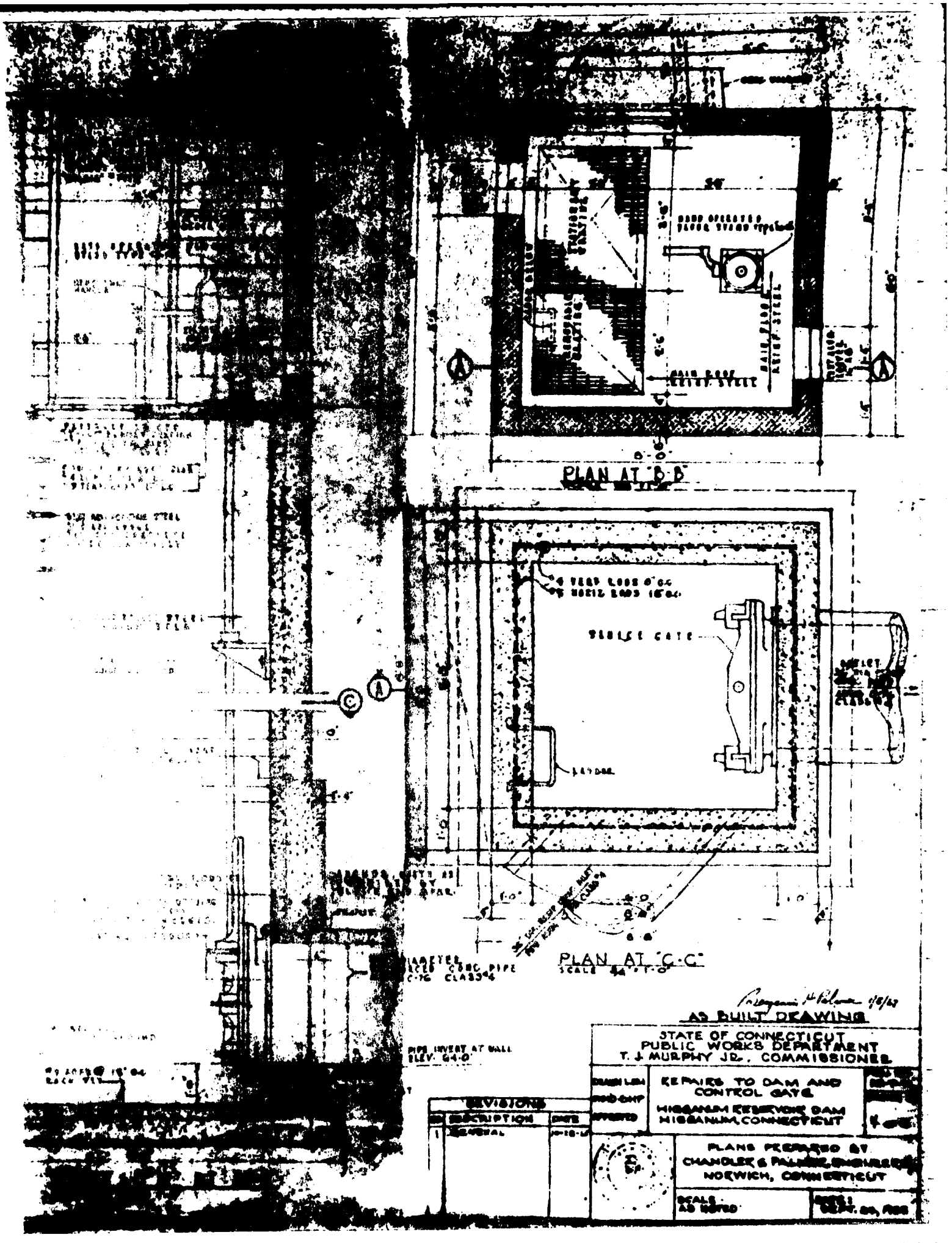
SECTION AT D-D'



NORTH ELEVATION



PLAN AT HEADWALL


PLAN AT B-B
SLUICE GATE
PLAN AT C-C
AS BUILT DRAWING
STATE OF CONNECTICUT
PUBLIC WORKS DEPARTMENT
T. J. MURPHY JR., COMMISSIONER
REPAIRS TO DAM AND CONTROL GATE
HIGGANUM RESERVOIR DAM
HIGGANUM, CONNECTICUT
PLANS PREPARED BY
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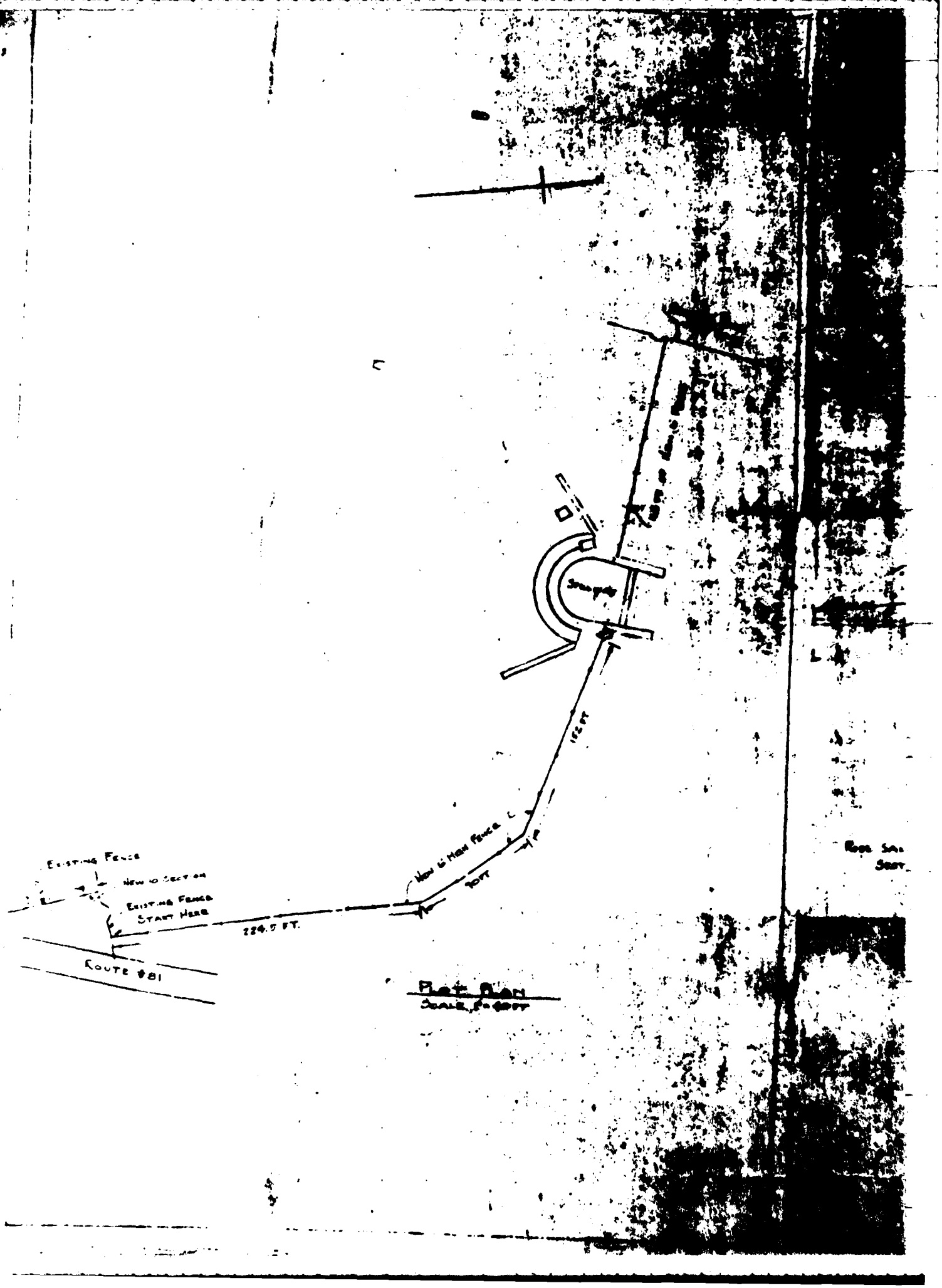
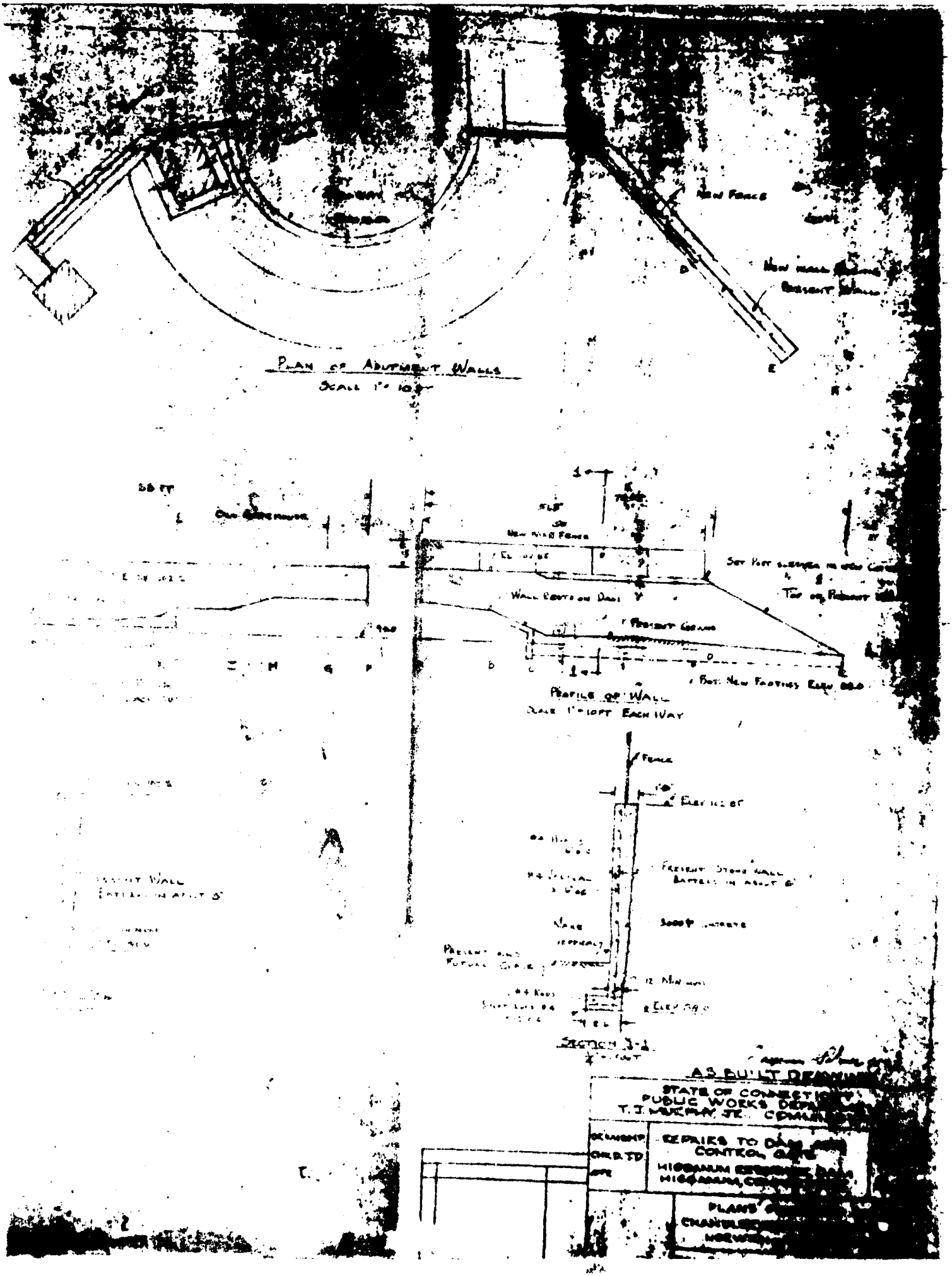
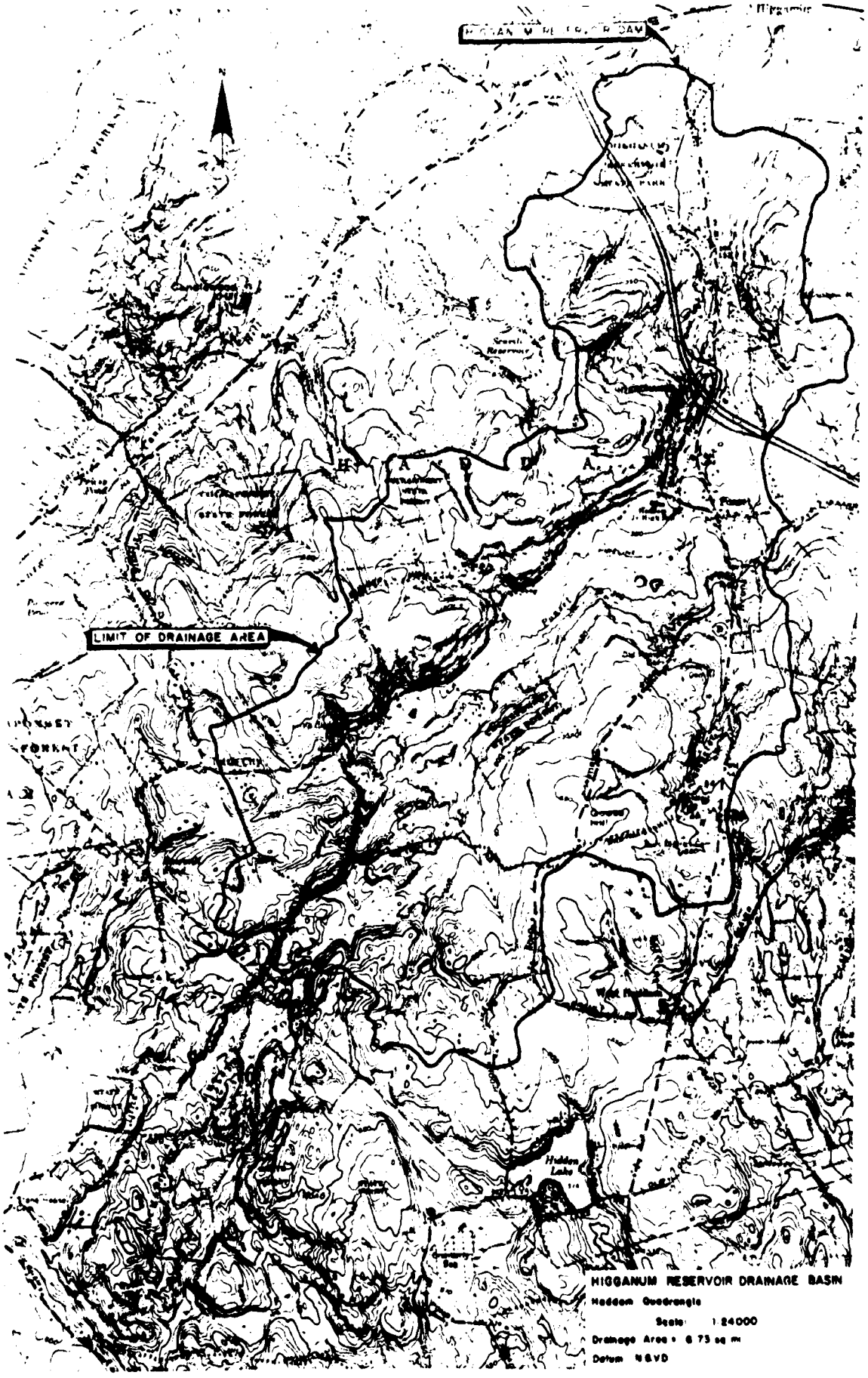
DESCRIPTION
DATE


Existing Fence
New Section
Existing Fence
Start Here
224.5 FT.
New 6' High Fence
Route #81
Plat Plan


New Fence
Present Wall
Plan of Abutment Walls
Scale 1" = 10'-0"
Present Ground
Profile of Wall
Scale 1" = 10'-0" Each Way
Fence
Present Stone Wall
Section 3-3
AS BUILT
PUBLIC WORKS
REPAIRS TO DAM
CONTROL GATE



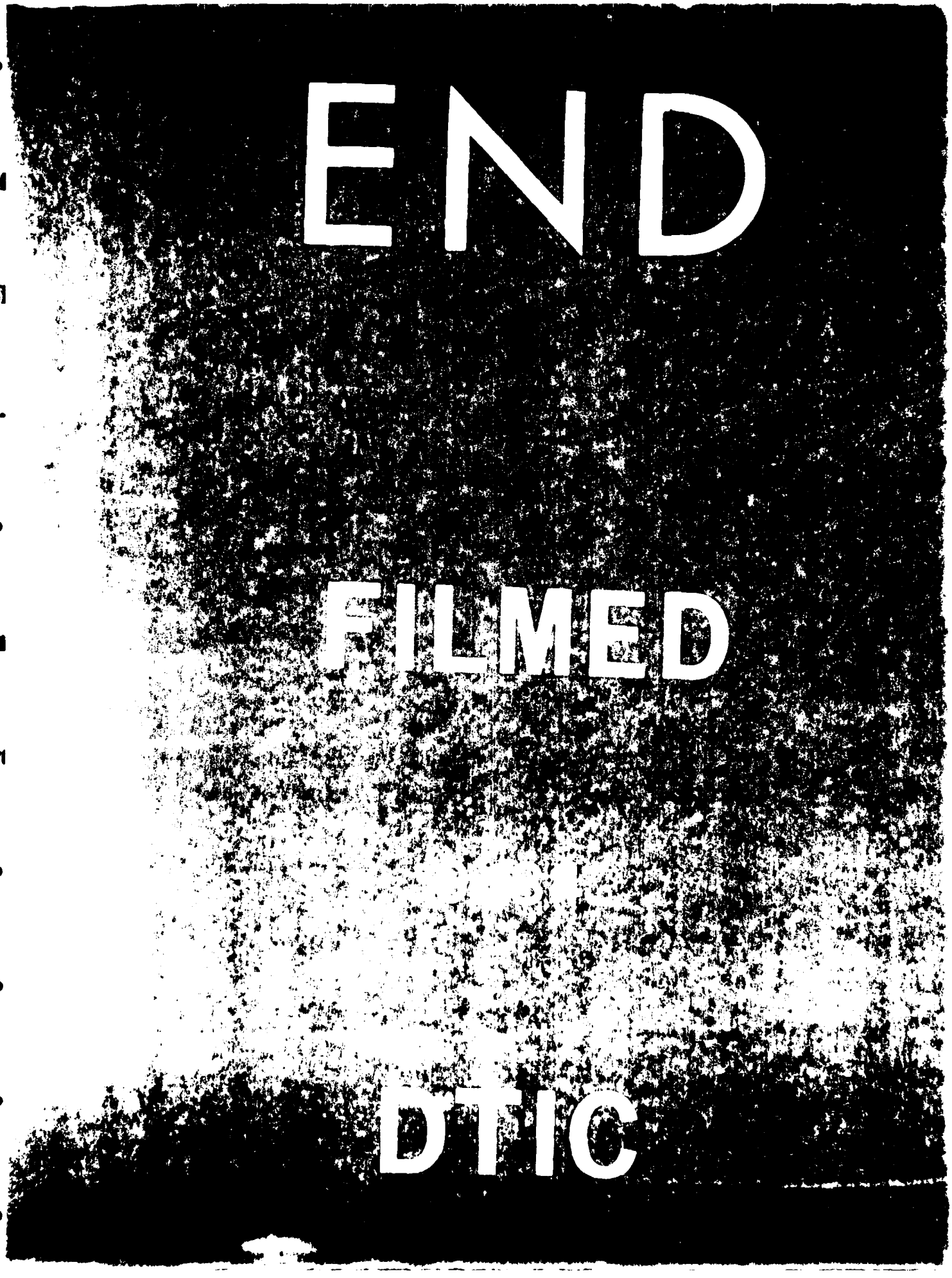
HIGGANUM RESERVOIR DRAINAGE BASIN

Haddam Quadrangle

Scale: 1:24000

Drainage Area = 6.73 sq mi

Datum NGVD


END
FILMED
DTIC