AD-A143 743 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/2
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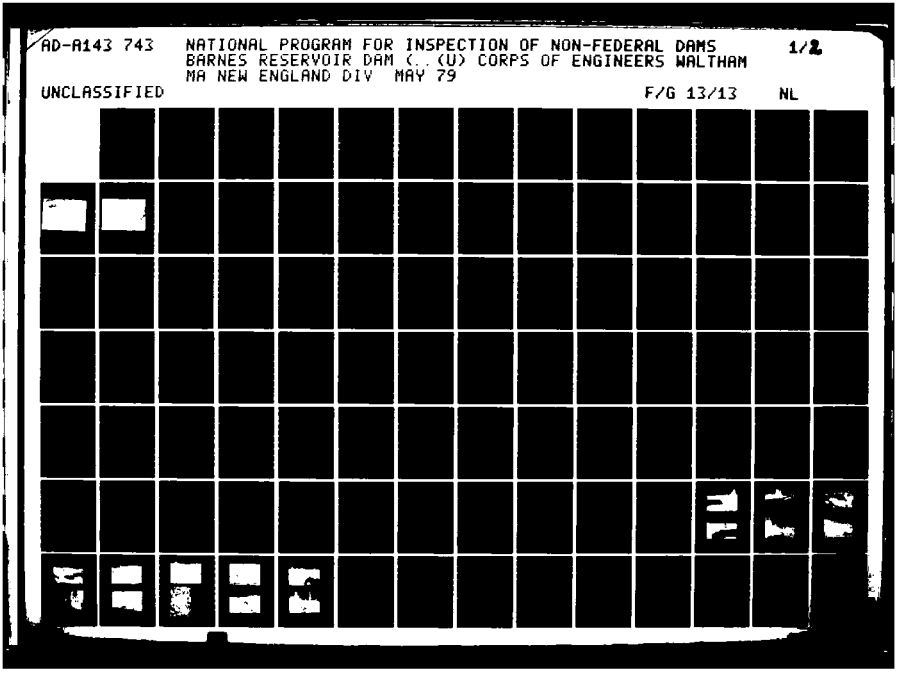

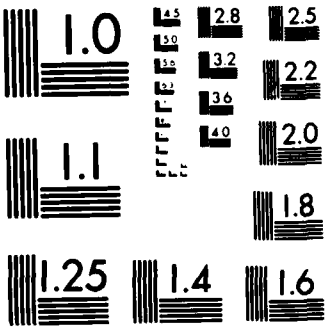

COASTAL BASIN
SALEM-MONTVILLE, CONNECTICUT

BARNES RESERVOIR DAM
CT 00236

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

MAY 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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

DAMS, INSPECTION, DAM SAFETY,

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

The dam at Barnes Reservoir is an earth embankment approximately 1,200 feet long, 28 feet high with an average crest width of 15 feet. As a result of the visual inspection and the review of limited available data regarding this facility, the dam is considered to be in FAIR condition. This dam is classified as SMALL in size and a LOW hazard structure in accordance with the recommended guidelines established by the Corps of Engineers.

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

REPLY TO
ATTENTION OF
NEDED

AUG 16 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 Barnes Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, City of New London, Water Supply Department, New London, Connecticut 06320.

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,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

COASTAL BASIN

SALEM-MONTVILLE, CONNECTICUT

BARNES RESERVOIR DAM

CT 00236

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I -INSPECTION REPORT

Identification No.:	CT 00236
Name of Dam:	Barnes Reservoir Dam
Town:	Salem - Montville
County and State:	New London County, Connecticut
Stream:	Toad Hollow Brook
Date of Inspection:	December 15, 1979

Brief Assessment:

The dam at Barnes Reservoir is an earth embankment approximately 1,200 feet long, 28 feet high with an average crest width of 15 feet. It was constructed about 1902 by the City of New London, its present owner, and is operated as a water supply for the water system of the City. An uncontrolled stone masonry spillway is constructed integrally with the embankment and its discharges flow through a curved converging chute to the stream below the dam. The outlet works and control tower are located near the left abutment of the dam and discharges from the tower's wet well flow through a 24-inch diameter conduit beneath the dam. An earth embankment dike 385 feet long similar in shape to the main dam is located to the east of the dam.

As a result of the visual inspection and the review of limited available data regarding this facility, the dam is considered to be in FAIR condition. To assure the long-term performance of this structure, several items of concern require attention: The apparent seepage beneath the spillway slab, a localized depression area in the crest of the dike, the extensive overgrowth of the embankments, spillway and downstream channel, and the inoperability of the upper intake gate to the control tower.

This dam is classified as SMALL in size and a LOW hazard structure in accordance with the recommended guidelines established by the Corps of Engineers. The test flood for this dam is equal to the 100-year frequency. The test flood has an outflow discharge equal to 800 CFS and will not overtop the dam in a stillwater condition. The maximum outflow capacity of the spillway under a stillwater

condition is equal to 1,200 CFS which represents more than 100 percent of the test flood. However, this discharge will produce a water surface level in the reservoir that has a freeboard allowance of only 1.2 feet below the top of the dam.

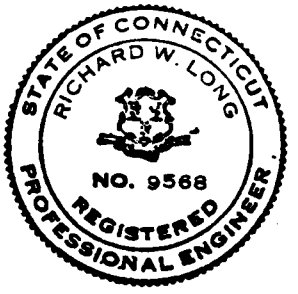
It is recommended that the Owner engage the services of an engineer experienced in the design of earth dams to accomplish the following: monitor and evaluate the seepage discharges noted at the toe of the dam and develop appropriate measures to reduce the flow; clear and maintain the dam of vegetal growth; investigate seepage flows beneath the overflow spillway slab; restore the dam and dike crests to their original grade, redress the stone armor protection on the upstream face of the dam and repair and restore to service the inoperable control gate of the outlet works.

Recommendations and remedial measures that should be implemented by the Owner within a one year period after receipt of this Phase I Inspection Report are further described in Section 7.

C-E Maguire, Inc.

Richard W. Long

Richard W. Long, P.E.
Vice President



This Phase I Inspection Report on Barnes 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.

Joseph A. McElroy

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

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

JOSEPH W. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
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, DC 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or to 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 continud to represent the condition of the dam at some point in the fiture. Only through continued care and inspection can there by any opportunity to detect unsafe conditions.

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 reasonable 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 and serves as an aide in determing 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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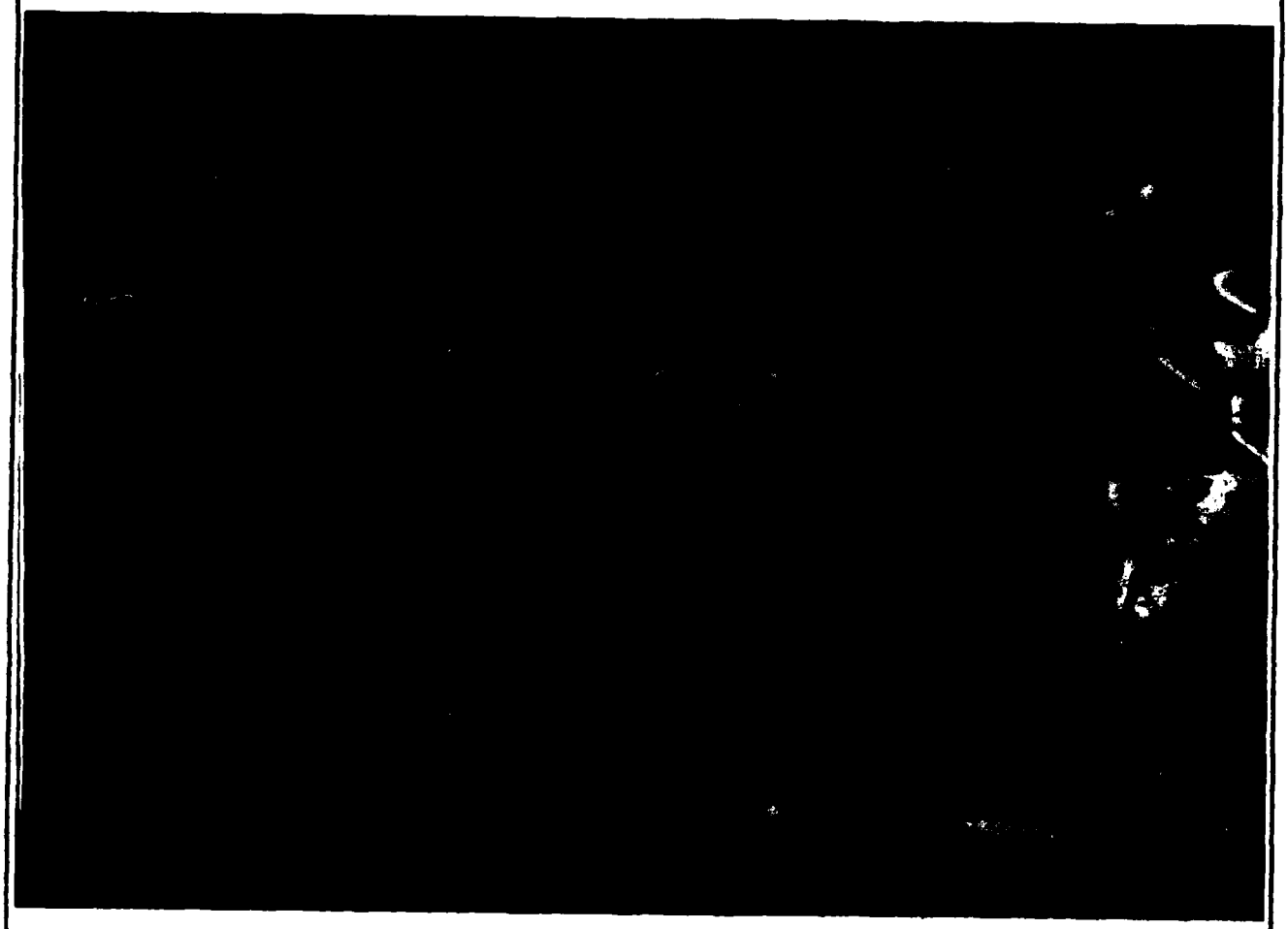
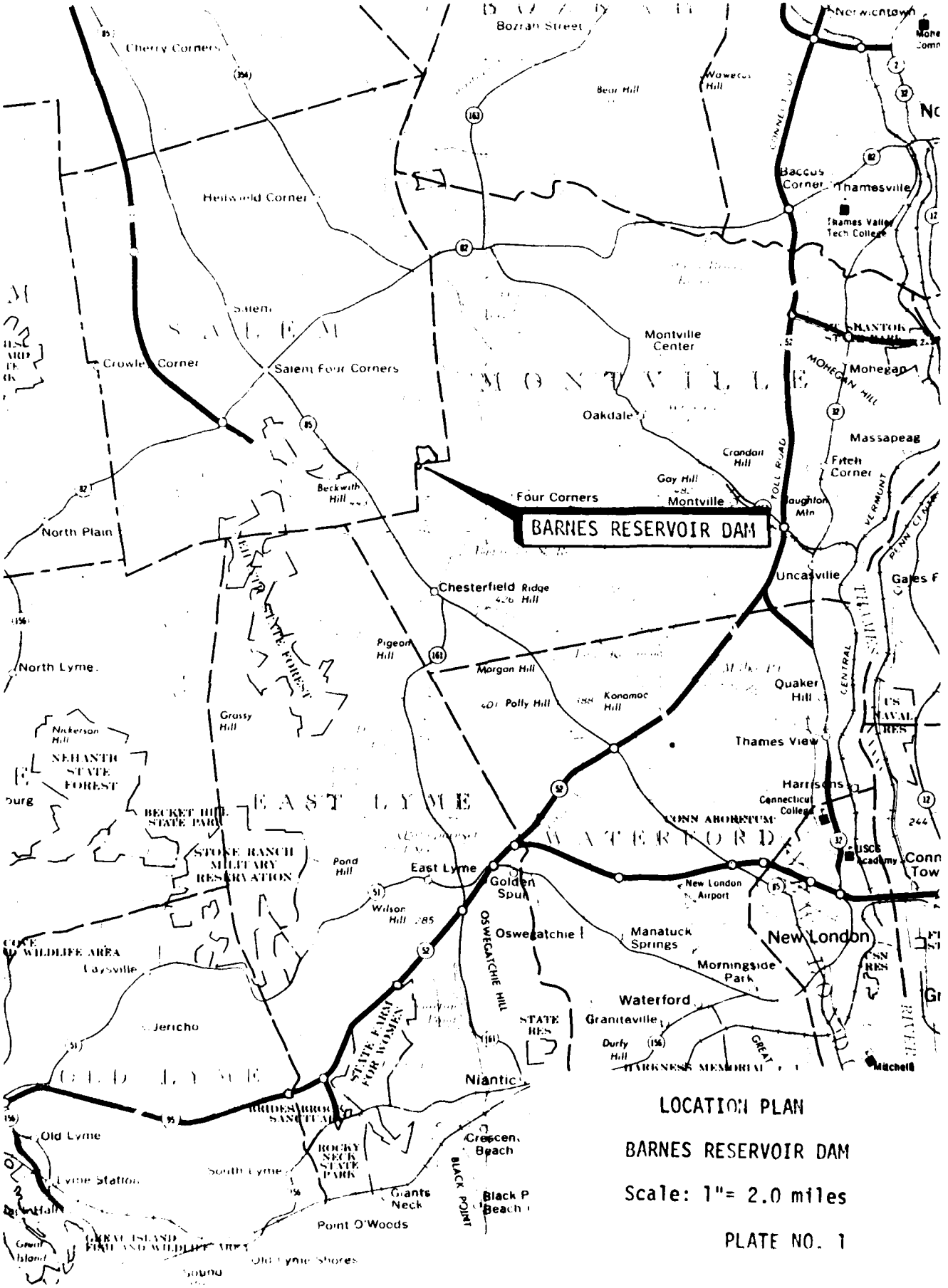
OVERVIEW PHOTO 1 - BARNES RESERVOIR DAM



OVERVIEW PHOTO 2 - BARNES RESERVOIR DAM



LOCATION PLAN

BARNES RESERVOIR DAM

Scale: 1"= 2.0 miles

PLATE NO. 1

NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

NAME OF DAM: BARNES RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army through the Corps of Engineers to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. 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 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0015 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 the Project

a. Location. Barnes Reservoir Dam is located in New London County, Connecticut, approximately two miles west of the City of Montville, Connecticut (See Plate No. 1). The dam impounds water from Toad Hollow Brook which drains a 2.7 square mile watershed of rolling to steep terrain. The reservoir is formed into two connecting bodies of water with a total surface area of 47

acres at the spillway crest elevation of 211.24 The impoundment is aligned in a north-south axis, with the dam located at the southern portion of the reservoir.

b. Description of Dam and Appurtenances. Barnes Reservoir Dam is an earth embankment, 1,200 feet long, 28.0 feet high, with a width of 15.0 feet and a crest elevation of 215.7 feet National Geodetic Vertical Datum (NGVD). The upstream face of the embankment is sloped at 2.0 H to 1.0V. The downstream slope is approximately 1.5H to 1.0V, and is grassed. A grassed surface roadway extends across the length of the embankment (See overview photo, C-3, 4). An earth dike is located to the east of the main dam and is 385 long and similar in configuration to the dam and has a top of dike elevation equal to 215.7.

The outlet works control structure, (see Appendix B-3) constructed of stone masonry, is located near the left abutment of the earth embankment on the upstream slope in the reservoir. Water is withdrawn from the reservoir through 2-24"x24" inlets located 16.5 and 27 feet below the top of the dam to the wet well chamber of this structure. A 24-inch diameter cast iron pipe conduit carries flows by gravity to the pumping station at Beckwith Pond, south of Barnes Reservoir. Water may also be by-passed from the outlet structure to Latimer Brook directly through a 24-inch diameter cast iron pipe into Latimer Brook. The 24 inch diameter conduit leading to Beckwith Pond is reduced to 16 inch diameter size at some unknown distance downstream from the dam.

c. Size Classification. The dam is classified as a SMALL structure because the impoundment storage at the top of the dam is 757 Ac-Ft., and the maximum height of the dam is 28.0 feet.

d. Hazard Classification. The dam is classified as a LOW hazard potential structure because it is located in a rural area where failure discharge can damage, due to high velocity impact from debris and flooding, 1 to 3 dwellings, limited agricultural land, and Beckwith Road. Loss of this surface water supply could cause severe economic hardships and potential health problems to the City of New London. The estimated water depth due to the possible dam failure discharge of 19070 cfs may range from 15.0 feet at the dam to 7.0 feet at a distance of 6000 feet.

e. Ownership. Barnes Reservoir Dam was constructed about 1902 by its present owner, the City of New London, Connecticut. The reservoir is maintained and operated by the New London Water Supply Department.

f. Operator. The operator and caretaker for Barnes Reservoir Dam is:

Mr. Henry Hayes
(203) 443-2861
(203) 442-3616

g. Purpose of Dam. Barnes Reservoir Dam impounds water from Toad Hollow Brook, that is used in the water supply system of the City of New London, Connecticut.

h. Design and Construction History. This facility was constructed about 1902 for the City of New London. W. H. Richards and R. W. Chaffee, Engineers (address unknown) designed the dam and its appurtenances. No modifications to the dam have occurred since its initial construction as shown by record drawings (See Appendix B-3).

i. Normal Operating Procedures Barnes Reservoir is operated as part of the water supply system of the City of New London, Connecticut. Water is withdrawn by gravity from the impoundment on demand through a 24-inch diameter pipe to Beckwith Pond, where it flows by gravity into Lake Konomac, the main storage facility for the City of New London water supply. Water can also be by-passed to Latimer Brook below the dam through a blow-off pipe located on the outlet conduit.

1.3 Pertinent Data

a. Drainage Area. Barnes Reservoir is located in New London County, Connecticut. The drainage basin lies 4.5 miles east of the village of Montville. The basin is generally rectangular in shape with a length of approximately 2.84 miles, an average width of 1.1 miles, resulting in a total drainage area of 2.7 square miles (See Drainage Basin Map in Appendix D.) The topography is generally rolling to steep terrain, with elevations ranging from a high of 612.0 feet to a low of 211.24 feet at the spillway crest. Stream and basin slopes are moderate to steep, having average grades of 0.035 to 0.06, respectively. The average time of concentration for the overall drainage basin is estimated to be about 60 minutes. This relatively moderate concentration period increases the probability that all surface run-off will peak simultaneously at the dam site during a high intensity rainfall event. The normal reservoir stage is elevation 211.24 and at that pool level will impound a supply of 522 Ac.-Ft. and have a water surface area equal to 47 acres. The available storage from this reservoir is 170 million gallons.

b. Discharge at Dam Site

There are no specific discharge records available for this dam. Listed below are calculated discharge values for the spillway and outlet works:

1. Outlet Works: a 24-inch diameter conduit through the dam is reduced to 16 inches and leads to the pumping station at Beckwith Pond. A blow-off valve on this line allows flows to be by-passed into Latimer Brook below the dam.

2. Maximum Known Flood at Dam Site - calculated as 34 CFS and occurred on January 9, 1978 (when the reservoir stage was five inches above spillway).

3. Overflow spillway capacity @ top of dam - 1,264 CFS at Elevation 215.74.

4. Overflow spillway capacity at "Test Flood Level" - 800 CFS @ Elevation 214.68.

5. Gated outlet capacity at normal pool level spillway crest elevation 211.24 — 30 cfs

6. Gated outlet capacity at maximum pool level Top of Dam — 34 cfs

7. Gated outlet capacity at "test flood" level — 32 cfs

8. Total project capacity at "top of dam" - 1298 CFS @ Elevation 215.74.

9. Total project discharge at "Test Flood Level" - 832 CFS @ Elevation 214.68.

c. Elevations (Feet above National Geodetic Vertical Datum, NGVD).

1. Streambed at centerline of dam - downstream - 188.0.

2. Maximum Tailwater — Unknown

3. Upstream Inlet Invert — 2-24" inlets upper 199.24 & 188.74 lower.

4.	Recreation Pool	N/A
5.	Flood Control Pool	N/A
6.	Spillway Crest	211.24
7.	Top of Dam	215.74
8.	Test Flood Level	214.68

d. Reservoir (Length in feet)

1.	Maximum Pool	1,600
2.	Recreation Pool	N/A
3.	Flood Control Pool	N/A

e. Storage (Ac.-Ft.)

1.	Water Supply Pool	522
2.	Flood Control Pool	N/A
3.	Test Flood Pool	684
4.	Spillway Crest Pool	522
5.	Top of Dam	757

6. Net storage between top of dam and spillway crest is 235 Ac.-Ft. and represents 1.63 inches of runoff from the drainage area of 2.70 square miles.

7. One foot of surcharge storage equals 0.33 inches of runoff from the drainage area of 2.70 square miles.

f. Reservoir Surface (Acres)

1.	Top of Dam	47
2.	Test Flood Pool	47
3.	Flood Control Pool	N/A
4.	Recreation Pool	N/A

5.	Spillway Crest	47

g. Dam

1.	Type	Earth Embankment
2.	Length	1200 feet
3.	Height	28.0 feet
4.	Top Width	15.0 feet
5.	Side Slopes	Upstream Elevation 2.0H : 1.0V Downstream Elevation 1.5H : 1.0V
6.	Zoning	Unknown
7.	Impervious Core	Concrete corewall
8.	Cutoff	4" timber sheet pile cut-off
9.	Grout curtain	Unknown
10.	Other (toe drain)	6" diameter tile drain

h. Dikes

1.	Type	Earth embankment, type of soil unknown
2.	Length	385 Feet
3.	Height	Varies from 14.6 to 5.0 feet.
4.	Top Width	11.0 feet
5.	Side Slopes	Upstream Elevation 2.0H : 10V Downstream Elevation 1.5H : 1.0V
6.	Zoning	Unknown

7.	Impervious Core	Concrete corewall
8.	Cutoff	None
9.	Grout curtain	None
10.	Other (toe drain)	6" diameter tile drain

i. Diversion and Regulating Tunnel — N/A

j. Spillway

1.	Type	Overflow, broad crested, uncontrolled weir.
2.	Length	40.0 feet
3.	Crest Elevation	211.24 feet
4.	Gates	None
5.	U/S Channel	Natural Bed
6.	D/S Channel	Curved - converging stone masonry channel approximately 3.0 feet deep. Width ranging from 43.0 to 24.5 feet in a length of 255 feet.
7.	Design Surcharge	Unknown
8.	General	----

k. Regulating Outlets

Refer to Paragraph 1.2b - "Description of Dam and Appurtenances" for description of Outlet Works.

1.	Intake Invert	Elevation 199.24 & 188.74
2.	Size	24" diameter
3.	Description	Cast Iron Pipe
4.	Control Mechanism	Hand operated gear mechanism within masonry gatehouse.

5.	Other	Outlet structure has a 24-inch cast iron pipe bypass to divert flows back to Latimer Brook.

SECTION 2

ENGINEERING DATA

2.1 Design

The following documents which contain the principal information regarding this dam and its appurtenances were reviewed in the preparation of this report.

Drawings

1. Barnes Reservoir, New London Water Works, Profile of Dams and Corewall in 4 Sections and Sectional Evaluation of Dam at Effluent Chamber Constructed 1901, 2, by W. H. Richards and R. W. Chaffee Engineers.

2.2 Construction

There are no available records of the construction or subsequent repairs to this dam. It is assumed that the above referenced drawings illustrate the "as built" condition.

2.3 Operation

No formal records of operation are maintained for this facility. Reservoir water surface levels are recorded once each day and there is a limited historical record of this information. No other data is recorded.

2.4 Evaluation

a. Availability. The information noted above for this facility is available in the files of the Department of Enviornmental Protection, Dam Safety Engineers, State Office Building, Hartford, Connecticut, and City of New London, Department of Water.

b. Adequacy. The lack of indepth engineering did not allow 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 the visual inspection, the dam's past performance, and sound engineering judgment.

c. Validity. The validity of the limited information available must be verified.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. Based on the visual inspection in December 1978, the dam at Barnes Reservoir and its appurtenances appear to be in FAIR condition. The main embankment showed no indications of misalignment or settlement. The slopes of the dam and dike were covered with trees and brush but were being trimmed and cleared at the time of the inspection. On a subsequent inspection on 9 April 1979, the slopes of the main embankment had been cleared, except for the section to the right of the spillway. The upstream slopes were riprapped with stone up to a level just slightly above the waterline. Plans indicate that tile toe drains were installed at the time of construction at Stations 5+33, 9+46 and 10+46 in the main embankment and Station 15+52 in the dike and the discharge from the main embankment drain was observed; however, the dike discharge appeared to be located in a wet inaccessible area and was therefore not inspected. On the 9 April inspection, discharges were observed near the toe of the downstream slope at approximate Stations 10+46 and 15+52 of the dam and dike, respectively. These discharges appear to be associated with the locations of the toe drain outlets; however, no direct evidence of the existence of these drains was visible. It was also noted that the crest of the dike was slightly lower than the main dam for a short distance.

The outlet works for this facility consisted of a gatehouse and wet well intake structure and a 24-inch diameter conduit through the embankment leading to Beckwith Pond below the dam. The control mechanisms for the wet well were housed in a masonry gatehouse that was locked. One of the two gates was noted as being inoperable.

The spillway was constructed of rubble masonry and had a broad crested weir section that drops flows into a curved converging chute spillway leading to the brook below the dam. The bed of the spillway was overgrown with vegetation including small diameter trees and flowing water was observed beneath the stonework of the base slab.

The reservoir and dam site was fenced, locked and located well off the highway reducing the potential for trespass and vandalism.

b. Dam

1. Crest. In general, the crest of the dam is level with no evidence of settlement or misalignment. A gravel service road runs the entire length of the crest and is rutted from use. A reinforced concrete bridge spans the 40.0-foot wide spillway and supports the service road at that location (Photos C-3, 4, 5, 7, & 9). The crest had an average width of 13.0 feet.

2. Upstream Slope. The upstream face of the dam was stone armored to slightly above the water level at the time of the inspection. The armor protection provided was in general 12-inch cobbles and in some locations requires reshaping. Above the riprap, the slope was grassed and covered with brush. The upstream face was sloped approximately 2H:1V. At the time of the inspection, the reservoir pool was about 5.5 feet below the crest of the embankment. Photos C-1, 2 and 3 illustrate the condition. See Appendix B for typical sketches. On April 9, 1979, the upstream slope had been cleared of brush, except for the section to the right of the spillway. Two trees remain on the upstream slope after clearing (approximately Stas. 0+50 and 7+00). A few isolated erosion gullies, up to 1 ft. wide and 6 in. deep, were found on the upstream slope near Stas. 1+50 and 9+50. A small erosion scarp was found above the riprap on the upstream slope in some areas. In general, the erosion on the upstream slope can be described as slight to moderate.

3. Downstream Slope. The downstream slope of the dam is typically 1.5H:1:V and is grassed (See Photos C-4,5,6). The slope was covered extensively with vegetation which was being cleared and trimmed at the time of the inspection. On April 9, 1979, the downstream slope has been largely cleared of brush, except for the section to the right of the spillway. A few large trees were found growing within 10 ft. of the toe of the slope. A few isolated erosion gullies were found, similar to the upstream slope. A discharge of flowing water was observed at about Sta. 6+60 approximately 12 ft. from the toe of the slope. The discharge area was about 1 ft. in diameter. The discharge contained trace amounts of sand and freshly deposited sand was found surrounding the area. Representatives of the Owner and plans indicate a toe drain outlet is located in this area and the discharge may be associated with the toe drain outlet buried below the ground surface; however, no direct evidence of the existence of a drain outlet was visible in the field.

c. Dike.

1. Crest. The crest of the dike is level except for a leng of approximately 25 feet at the left abutment which appears to be about one foot lower. The crest supports a gravel service road across its entire length. The road surface is rutted and irregular from use. (See photo C-14). The crest has an average width of 11.0 feet.

2. Upstream Slope. The upstream slope of the East Dike is inclined at the same slope as the main dam 2H:1V. Small brush was growing in scattered locations across the face in that zone between the top of the riprap and the shoul of the crest. The pool level at the time of the inspection was level with the top of the cobble riprap. The riprap extended across the entire length of the dike but had minor windows, depressions and signs of movement fro ice or wind action. The armor stone requires minor redressing. (See Photo C-15). On the second inspection, two large trees, approximately 2 ft. in diameter, were found growing on the upstream slope at the right and lef abutments. A small erosion scarp was observed above the riprap on the toe upstream slope in some areas.

3. Downstream Slope. The downstream slope of the dike is 1.5H:1V and densely covered with brush and small trees. At the toe near the approximate center of the embankment large seepage pond exists about at the location that the record plans indicate the outlet for a 6-inch diameter tile toe drain. This ponding could be the result of that outlet. There was no apparent sloughing of the slope noted and the slope appeared to have a reasonable line a grade without depressions or undulations. (See Photo C-16). A flowing discharge was observed during the secc inspection at about Sta. 15+52 approximately 7 ft. from the toe of the slope. The discharge was about 1 ft. in diameter and contained trace amounts of sand and freshly deposited sand was found surrounding the area. Plans indicate a toe drain outlet is located in this area and the discharge may be associated with a toe drain outlet buried below the ground surface; however, no direct evidence of the existence of a drain outlet was visible in the field.

d. Appurtenant Structures.

1. Spillway. The overflow spillway at Barnes Reservoir has 40-foot wide broad crested weir with a 3-foot drop to a converging curved chute which carries flows below the da The entire structure including approach apron, training

walls, weir and chute are constructed of random coursed rubble (See Photos C-9,10,11). Record drawings indicate that the stone work is constructed on concrete footings and that the weir location is centered over and continuous with the concrete corewall. The approach apron and bed slab of the chute consists of 12 to 24-inch size cobble pavement. A reinforced concrete deck bridge is constructed above the spillway at the weir and supports the service road mentioned earlier.

The approach channel and chute of the spillway was overgrown with vegetation. Stonework was dislodged and there were large voids apparent. Some stones were also misaligned or dislodged from the downstream training walls.

Water was flowing beneath the spillway bed at the point of tangency of the curved training wall. This flow apparently is seepage leaking through the spillway structure. At the downstream end of the chute at the stilling basin, the training wall stone work on both sides was in disrepair.

2. Outlet Works. The outlet works for Barnes Reservoir is located at sta 9+55 along the main dam and consists of an approach channel within submerged rubble masonry approach wingwalls, control tower with wet well and outlet conduit. The approach channel is recessed into the upstream slope of the dam and is defined by sloping concrete retaining walls spaced 8.0 feet apart. The approach channel bed is cobble paved and approximately 28.0 feet below the crest of the dam.

The control tower (Photo C-7) is a rubble masonry structure constructed within the embankment such that the rear wall of the tower abuts the embankment corewall. The wet well chamber is 6.0 feet square with two gated intakes and is divided into two compartments by screens. The control tower has two 24 inch x 24 inch inlets to the wet well - one 16.5 feet and the second 27.0 feet below the top of dam. The upstream invert elevations of these 2-24"x24" inlets are El. 199.25 and 188.74. The sluice gate controls are housed in a masonry gatehouse atop the tower.

The outlet conduit is a 24-inch diameter (extra strength) cast iron pipe. The approach channel to the wet well was underwater and hence not observable. Water was being withdrawn from the reservoir at the time of the inspection through one intake only, the other intake was noted as inoperable (See Photo C-8).

e. Reservoir Area. The reservoir is formed into two bodies of water by a causeway supporting the service road leading to upstream storages. The combined surface area of these two bodies is about 47 acres. No specific detrimental features in the reservoir area were observed during the visual inspection. The shoreline of the reservoir is well-covered with vegetal growth to preclude sloughing of shoreline material or extensive erosion (See Overview Photos 1,2).

f. Downstream Channel. The downstream channel is naturally meandering and confined, but is now additionally restricted with vegetal growth. This growth should be removed to prevent obstructed flow and a backwater condition.

3.2 Evaluation.

Based on the visual inspection, the dam appears to be in fair condition overall; however, there are areas of concern that should be monitored or corrected.

Trees and shrubs on the upstream and downstream slopes of the embankments can create future seepage problems. The tree roots provide seepage paths for water if allowed to grow. Uprooting of large trees can also cause serious "piping" problems by creating pathways through the embankments. An area should be cleared below the toe of the dam for approximately 30 feet in order to allow monitoring of seepage or discharges from the toe drains.

The possible existence of toe drain outlets buried below the ground surface at the locations of the observed discharges needs to be verified.

The seepage noted beneath the spillway chute slab should be investigated further to determine its source, magnitude and corrective measures required.

Repairs to the outlet works control gates should be implemented to provide maximum regulation of the pool water surface for operation and maintenance purposes.

Riprap along the upstream face of the embankments should be redressed and supplemented with additional armor material to establish more uniform grades and reduce the potential for erosion of bedding materials. The downstream channel should be cleared and opened to assure unobstructed flows.

The crest of the dike embankment must be restored to its original design grade.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

The Barnes Reservoir is a surface water supply storage facility for the New London Water Department. Located in the upper reaches of the chain of watersheds that serves the water system, it is operated as a reserve or supplemental supply to Lake Konomoc, the main source of water for the system. Water is withdrawn through the control tower at the reservoir and flows through a 16-inch cast iron pipeline to Beckwith Pond where it is pumped to the main storage. As a rule, water is withdrawn from Barnes Reservoir when demands on the system are dictated by consumption or weather. No other regulation of the pool level occurs. There are no records available indicating releases for downstream low flow augmentation.

4.2 Maintenance of the Dam.

As discussed in Section 3 of this report, the embankments, spillway and downstream channel were overgrown extensively with vegetation. This vegetation was being trimmed at the time of the visual inspection. Apparently, maintenance at the damsite is limited, not implemented on a regular basis nor programmed, but rather accomplished when staff resources will permit.

4.3 Maintenance of the Operating Facilities.

At the time of the inspection one gate at the control tower was open and water was flowing to the pumping station below the dam; however, the second gate was reportedly broken and inoperable. It is unknown if the inoperable gate is the upper or lower inlet. Water department personnel periodically exercise the valve below the dam to discharge water back to the stream.

4.4 Description of Any Warning System in Effect.

Emergency action and/or warning would be coordinated through the Water Department main office in New London and the field personnel at Lake Konomoc. No formal emergency or contingency plan is in effect to reduce or minimize downstream damage in emergency situations.

Monitoring of the approach of intense storm activity is normally through the U.S. Weather Service, or local weather forecasts.

4.5 Evaluation.

The operational procedures for this water supply are a direct function of the demands placed on the overall system and therefore cannot be regulated; however, the maintenance for both the dam and its appurtenance is apparently not on a "regular" basis and therefore, intermittent. It is important to maintain the water supply and assure a consistent long-term performance of the facility that a regular monitoring, inspection and maintenance program be developed and implemented.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. Barnes Reservoir Dam, constructed by the City of New London in 1902, is located in New London County, Connecticut on Toad Hollow Brook, approximately 2.0 miles north along Route 85 from the village of Chesterfield. Access to the reservoir from Route 85 is along Beckwith Road and a private gravel surface way. The impoundment has a total storage capacity of 170 million gallons (522 Ac.-Ft.) at elevation 211.24, the overflow spillway crest that is equivalent to 3.62 inches of runoff from a drainage area of 2.70 square miles. Each foot of depth in the reservoir above spillway crest can accommodate 47 Ac.-Ft. of volume which represents 0.33 inches of runoff from the watershed. The spillway length of 40 feet is equal to 2.6 percent of the total length of the embankments for the facility. Because the total surcharge storage capacity is only 235 Ac.-Ft. or 1.63 inches of runoff, the dam is basically a low storage facility. The maximum spillway capacity is equal to 1200 CFS which is more than 100 percent of the test flood and therefore is judged to be a high spillage reservoir. The dam being an earthen type structure is less stable against overtopping due to the potential for erosion.

b. Design Data.

1. No specific design data is available for this watershed or the structures of Barnes Reservoir Dam. In lieu of existing design information, U.S.G.S Topographic Maps (Scale 1" = 2000') were utilized to develop hydrologic parameters such as drainage areas, reservoir surface areas, basin slopes, time of concentration and other runoff characteristics. Elevation - storage relationships for the reservoir were approximated. Surcharge storage was computed assuming that the surface area remained constant above the spillway crest. Some of the pertinent hydraulic design data was obtained and/or confirmed by actual field measurements at the time of the visual field inspection.

2. Outflow values (routing procedures) and dam failure profiles were computed in accordance with the guidelines developed by the Corps of Engineers. Judgment was used in calculating final values outlined in this report, which are quite approximate and should not be considered a substitute for actual detail analysis.

c. Experience Data. Historical data for recorded discharges is not available for this dam. Limited records of water surface elevations are maintained by the Water Department of the City of New London. The recent maximum discharge over the spillway was recorded on January 9, 1978 and calculated to be 34 CFS.

d. Visual Observations.

1. The overflow spillway constructed of stone masonry has loose joints, some dislodged stonework and missing grout. Both the approach and outlet channels were overgrown with vegetation. Seepage was flowing beneath the stonework of the spillway bed.

2. One of the two control gates for the outlet works was reportedly broken and unusable. It was not determined whether the inoperable gate serviced the upper or lower inlet.

3. The crest of the dike is lower than the main embankment at several locations.

4. Seepage was noted along the downstream toe of the dike section.

e. Test Flood Analysis. Recommended guidelines for the Safety Inspection of Dams by the Corps of Engineers were used for the selection of the "Test Flood". This dam is classified as a Low hazard and Small size structure. Guidelines indicate that a 50-year to 100-year frequency flood event be used as the range of test flood for such classifications. The watershed has a total drainage area of 2.7 square miles of which 0.27 square miles (10 percent) is swampy or covered by storage reservoirs. The basin slopes averages 0.06 feet/feet which is judged as steep and the terrain is considered as rolling. A "test flood" equal to the 100-year frequency event was calculated to be 407 CSM, equal to 1100 CFS for this drainage area and was adopted as the "test flood." Outflow discharges were also developed using Corps of Engineer's criteria for approximate routing methods. The outflow discharge for the test flood inflow was 800 CFS. Additional design data developed for this investigation has been tabulated at the end of this section.

The spillway capacity is hydraulically adequate to pass the "test flood" (100-year frequency event) and overtopping would not occur. The inflow and outflow discharge values for this test flood are 1100 CFS and 800 CFS, respectively. The maximum outflow capacity of the spillway, in a still reservoir condition

without overtopping of the dam is 1200 CFS, which is more than 100 percent of the test flood overflow discharge. However, the freeboard allowance remaining for this discharge is estimated to be only 0.6 feet from the top of the dam. The overtopping potential for discharges of lesser magnitude and frequency are computed approximately and are tabulated at the end of this Section. A spillway rating curve and outlet rating curve are also included in Appendix D of this report.

At the spillway crest elevation of 211.24, the capacity of the outlet structure is 30 CFS. It will require 19 hours to lower the reservoir level the first foot assuming a surface area of 47 acres and considering the use of the outlet works to regulate the pool level for expected inflows. Storage for an impending intense rainfall cannot be provided quickly by use of the outlet works if the pool level is high.

f. Dam Failure Analysis

This dam is classified as a low hazard structure. Its failure discharge can cause damage due to high velocity, impact from debris and flooding to isolated homes (1 to 3); limited agricultural land, and Beckwith Road. Loss of this water supply could impose serious health and economic problems to the City of New London.

The calculated dam failure discharge of 19070 CFS assuming the reservoir pool level at the top of the dam will produce an approximate water surface level of 15.0 feet immediately downstream from the dam. This discharge will raise the water surface approximately 10.0 feet above the depth just prior to failure when the discharge is 1200 CFS and the depth of flow is 5.0 feet. Normal uniform flow, based on Manning's formula will occur approximately 6000 feet downstream from the dam with a depth of flow equal to 7 feet when it enters Beckwith Pond. For a distance of 6000 feet from the dam, the depth of flow will decrease from 15.0 feet to 7.0 feet. Water surface elevations due to the failure of the dam are computed and are listed in Appendix D. Probable consequences including the prime impact areas, if the dam were to fail, are also listed at Appendix D.

Barnes Reservoir Dam

Inflow, Outflow and Surcharge Data

FREQUENCY IN YEARS	24-HOUR TOTAL RAINFALL IN INCHES	24-HOUR* EFFECTIVE RAINFALL IN INCHES	MAXIMUM INFLOW IN CFS	MAXIMUM*** OUTFLOW IN CFS	SURCHARGE HEIGHT IN FEET	SURCHARGE STORAGE ELEVATION
10	5.0	2.6	622	446	2.33	213.57
50	6.5	4.1	980	736	3.25	214.49
Test Flood = 100	7.0	4.6	1100	800	3.44	214.68
1/2 PMF	11.9	9.5	2270	2228	5.60	216.84

* Infiltration assumed as 0.1"/hour.
**Lake assumed initially full at spillway crest elevation 211.24
(top of dam = 215.74).

NOTES:

1. Q_{10}; Q_{50}; Q_{100}; inflow discharges were computed by the approximate methodology of the Soil Conservation Service.
2. 1/2 PMF computation based on COE instructions and guidelines.
3. All discharges indicated are dependent upon the continued integrity of upstream storage reservoirs.
4. Surcharge storage is allowed to overtop the dam when exceeding the spillway capacity.
5. Test flood = 100-year frequency = 407 CSM = 1100 CFS (D.A. = 2.70 square miles.)

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation. At the time of the second inspection, the brush and small trees had not been cleared from the dike slopes and the section of the main dam to the right of the spillway. There are a few isolated trees growing on the upstream slope of the main dam, within 10 ft. of the donwstream toe of the main dam, and on the upstream slope of the dike at the abutments.

The discharges observed near the downstream toe of the main dam and dike showed some evidence of sediment transport and warrant further investigation. The possible association of these discharges with the toe drain outlets indicated in the plans needs to be verified.

b. Design and Construction Data. There is insufficient design and construction data to permit a formal evaluation of stability.

c. Operating Records. No design information is available about the operation insofar as being pertinent to the embankment or foundations.

d. Post-Construction Changes. No post construction design data pertinent to the embankment or foundation is available.

e. Seismic Stability. This dam is in Seismic Zone 2 and hence does not require evaluation for seismic stability according to the USCE Recommended Guidelines.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Condition. Based on the visual inspection, available records of the site and past operational performance, the dam and its appurtenances at Barnes Reservoir is judged to be in FAIR condition. Items of concern which must be corrected in order to assure the long-term performance of this structure are listed in Sections 7.2 and 7.3.

b. Adequacy of Information. 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 engineering judgment.

c. Urgency. The recommendations and remedial measures described below should be implemented by the Owner within one year after receipt of this Phase I Inspection Report.

d. Need for Additional Investigations. A comprehensive investigation is not required for this facility at this time. However, additional engineering input is required to conduct the analysis and designs outlined in Sections 7.2 and 7.3.

7.2 Recommendations.

It is recommended that the Owner engage the services of an engineer experienced in the design of earth dams to conduct and implement the following recommendations:

a. The discharges observed near the downstream toe of the main dam and dike should be investigated immediately by the Owner to verify the possible association of the discharges with the toe drain outlets indicated on the plans. If the discharge is outflow from toe drains, these toe drains should be extended in order that their discharges will exit above grade and they should be monitored. If the discharges are not associated with the toe drain outlets, then the source of the flows must be investigated and appropriate recommendations developed. The investigation should also determine the quantity of seepage and turbidity associated with the discharges.

b. The complete removal of the overgrowth of vegetation from the embankments, spillway and downstream channel should be undertaken. Particular care and planning of the removal of large diameter trees and their attendent root systems and the restoration of the dam cross- section by suitable backfill and compaction techniques should be programmed.

c. The seepage flow beneath the spillway masonry slab should be investigated in detail. This investigation should determine its source, quantity and alternative measures to control or eliminate its occurrence.

d. Because freeboard allowances for this dam are minimal and the present stone armor is irregular, dislodged or missing, designs should be developed for the installation of suitable eorsion protection to supplement the existing riprap. Preparation of these designs should make maximum use of the existing stone.

e. The crest of the dam and the dike should be restored to its original grade consistent with the design drawings noted in Section 2.

7.3 Remedial Measures.

a. Operation and Maintenance Procedures.

1. Brush, vegetation and trees should be removed from the spillway, embankments and downstream channel on a regular basis. Further, this clearing should include an area 30 feet below the toe of the embankments to provide access and observation for the regular monitoring and inspection of the facility. This monitoring program should develop records of the quantity, location, color and solids content should be obtained.

2. A regular program for the collection of base data such as water surface levels, discharges, time of drawdown, etc., to assist those responsible for the monitoring and operation of the facility should be implemented.

3. Conduct a topographic survey of the dam and its appurtenances to provide current information to be used in the development of drawings for the facility. These drawings can then be used in the above analysis and as a current record to the Owner. Consider during this survey, the installation of reference marks to be used to monitor changes in vertical or horizontal alignment of the embankments.

4. Repair the inoperable gate at the control tower to assure the continued ability to regulate the water surface for maintenance purposes and to provide a water supply to the system.

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

7.4 Alternatives.

None

APPENDIX A

INSPECTION CHECK LIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Barnes Reservoir Dam

DATE December 15, 1979 & A

TIME 9:30 A.M.

WEATHER Overcast

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

PARTY :

1. A. Reed
2. S. Khanna
3. R. Brown
4. _____
5. _____
6. H. Hayes, City of New Londo
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARK
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir Dam DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation (Spillway)	E.L. 211.24
Current Pool Elevation	E.L. 210.24
Maximum Impoundment to Date	
Surface Cracks	None observed.
Pavement Condition	Grasses and gravel surface roadway (rutted and uneven)
Movement or Settlement of Crest	None observed.
Lateral Movement	None observed.
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good (Spring observed flowing out of right abutment into reservoir).
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	None observed.
Sloughing or Erosion of Slopes or Abutments	Few erosion gullies on upstream and downstream slopes.
Rock Slope Protection - Riprap Failures	No failures observed. Riprap need redressing, due to ice action
Unusual Movement or Cracking at or Near Toe	None observed.
Unusual Embankment or Downstream Seepage	Seepage noted at toe drain location, Considerable flow.
Piping or Boils	Boil located about 120 ft. left of spillway and about 12 ft. from downstream toe.
Foundation Drainage Features	Toe drains noted on drawings but not observed in field.

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DAM EMBANKMENT (Continued)	
Toe drain	6" Tile drain outlets @ Sta. 5+33, 9+46.2, 10+45.7
Instrumentation System	None observed.
Vegetation	Extensive growth of brush and small trees on slope. Workers clearing some at time of inspection. Brush and small trees on slopes in section to right of spillway. Two trees on upstream slope and a few large trees within 10 ft. of downstream slope.

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	Same as main dam. Left abutment area checked by survey and was about 1.0 ft. low.
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	None observed
Pavement Condition	Service road across dike--gravel grassed and rutted.
Movement or Settlement at Crest	Left abutment area low.
Lateral Movement	None observed.
Vertical Alignment	Left abutment area low.
Horizontal Alignment	Good
Condition at abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slope	None observed.
Trespassing on Slopes	No evidence of unusual trespass.
Sloughing or Erosion of Slopes or Abutments	None observed.
Rock Slope Protection--Riprap Failures	Riprap requires redressing and supplemental stone.
Unusual Movement or Cracking at Toe	None observed
Unusual Embankment or Downstream Seepage	Seepage pond noted at approximate location of toe drain outlet.
Piping or Boils	Boil located about 150 ft. down from right abutment and about 7 ft. from toe.

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Foundation Drainage Features	Toe Drains
Toe Drains	6" tile drain outlets @ Sta. 15+52. shown on plans not observed in field.
Instrumentation	None
Vegetation	Extensive growth of brush, trees, etc. on slopes.

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURES	
a. Approach Channel	Sloping masonry rubble retaining walls 6 to 8 ft. apart extending out into the reservoir pool. Apron is cobble paved. Entire structure under water and not observable.
b. Intake Structure	

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Masonry and Structure	Control is a masonry rubble structure, constructed integrally with the embankment. Contains a 6'-0"sq. wet well divided by screens. Two intakes--one at 16.5 ft., and the other at 27.0 ft. below the crest of the dam.
General Condition	Good
Condition of Joints	Good
Spalling	None observed.
Visible Reinforcing	None observed.
Rusting or Staining of Stonework	None observed
Any Seepage or Efflorescence	None observed
Joint Alignment	N/A
Unusual Seepage or Leaks in Gate Chamber	Wet well full--not observable
Cracks	None observed.
Rusing or Corrosion of Steel	None observed.
b. Mechanical and Electrical	
Gates	Gates are manually operated vertical sluice gate. One gate was inoperable; other gate was opened and water was being withdrawn at the time of the inspection.

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER (Cont.)	
b. Mechanical and Electrical (Cont.)	
Crane Hoist	Manual chain fall hoist appeared to be working.
Screens	Screens in use at time were not raised for inspection.

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT Conduit	Record drawings indicate that a 24 inch diameter cast iron pipe leads from the wet well through the embankment. At some point below the dam, the conduit is reduced in size to 16 inch and leads to the Beckwith Pumping Station wet well. A blowoff on the line allows water to be discharged back to Latimer Brook.

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL.	Conduit below dam with blow out valve to return water to Latimer Brook - No structure present.

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS.	
a. Approach Channel	
General Condition	Fair - Brush and stumps growing in approach.
Loose Roch Overhanging Channels	None
Trees Overhanging Channel	None
Floor of Approach Channel	See above.
b. Weir	
General Condition of Stonework	Good
Rust or Staining	None observed
Spalling	None observed
Any Visible Reinforcing	None observed
Any seepage or Efflorescence	None observed
Drain Holes	None
c. Discharge Channel	
General Condition	Poor
Loose Roch Overhanging Channel	None
Trees Overhanging Channel	Yes
Floor of Channel	Loose stonework, vegetation growing through voids; seepage noted flowing beneath slab at point of curvatuve of training wall.

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS (Continued)	
d. Training Walls	
Seepage	Noted through some locations

PERIODIC INSPECTION CHECK LIST

PROJECT Barnes Reservoir DATE _____

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
SERVICE BRIDGE	
a. Superstructure	Reinforced concrete deck supported by stone masonry abutments carries service road on crust of dam across the spillway chute. Span is approximately 40 feet. No cracks, spalling, or other signs of distress noted.

APPENDIX B

ENGINEERING DATA

APPENDIX B-1

DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS AND LOCAT

Victor J. Galgowski, Dam Safety Engineer
Department of Environmental Protection
State Office Building
165 Capital Avenue
Hartford, Connecticut 06115

New London Water Supply Department
City of New London
New London, Connecticut

APPENDIX B-2

COPIES OF PAST INSPECTION REPORTS

3

No. MV-19

WATER RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

CT 236

Inventoried By WPS

Date 12 NOVEMBER 1964

Name of Dam or Pond BARNES RESERVOIR

Code No. NI 3.9 LT 8.4

Nearest Street Location BECKWITH ROAD

Town MONTVILLE Lon 72-13-12

U.S.G.S. Quad. MONTVILLE

Name of Stream LATIMER BROOK LAT 41-27-3

Owner CITY OF NEW LONDON

Address NEW LONDON

Pond Used For WATER SUPPLY

Dimensions of Pond: Width 1200 FEET Length 1200 FEET Area ~~35~~ 46.5 ACRES

Total Length of Dam ~~1300~~ 1200 FEET Length of Spillway 40 FEET

Location of Spillway WEST END OF DAM

Height of Pond Above Stream Bed ~~15~~ 12.5 FEET

Height of Embankment Above Spillway ~~5~~ 4.5 FEET

Type of Spillway Construction MASONRY

Type of Dike Construction EARTH

Downstream Conditions WOODS CULVERT UNDER ROUTE 85

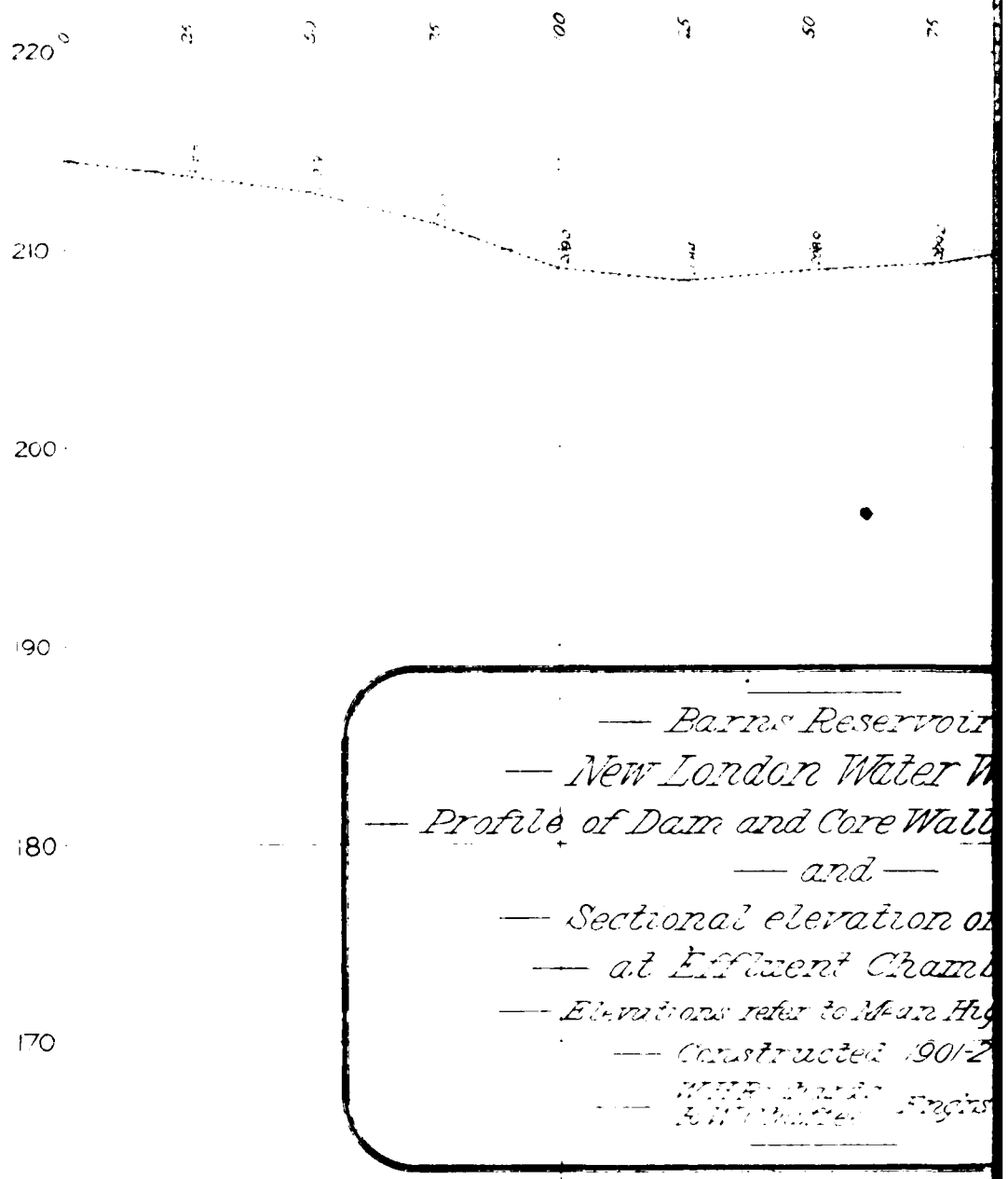
Summary of File Data

1901-02 Remarks DAM BUILT IN 1912

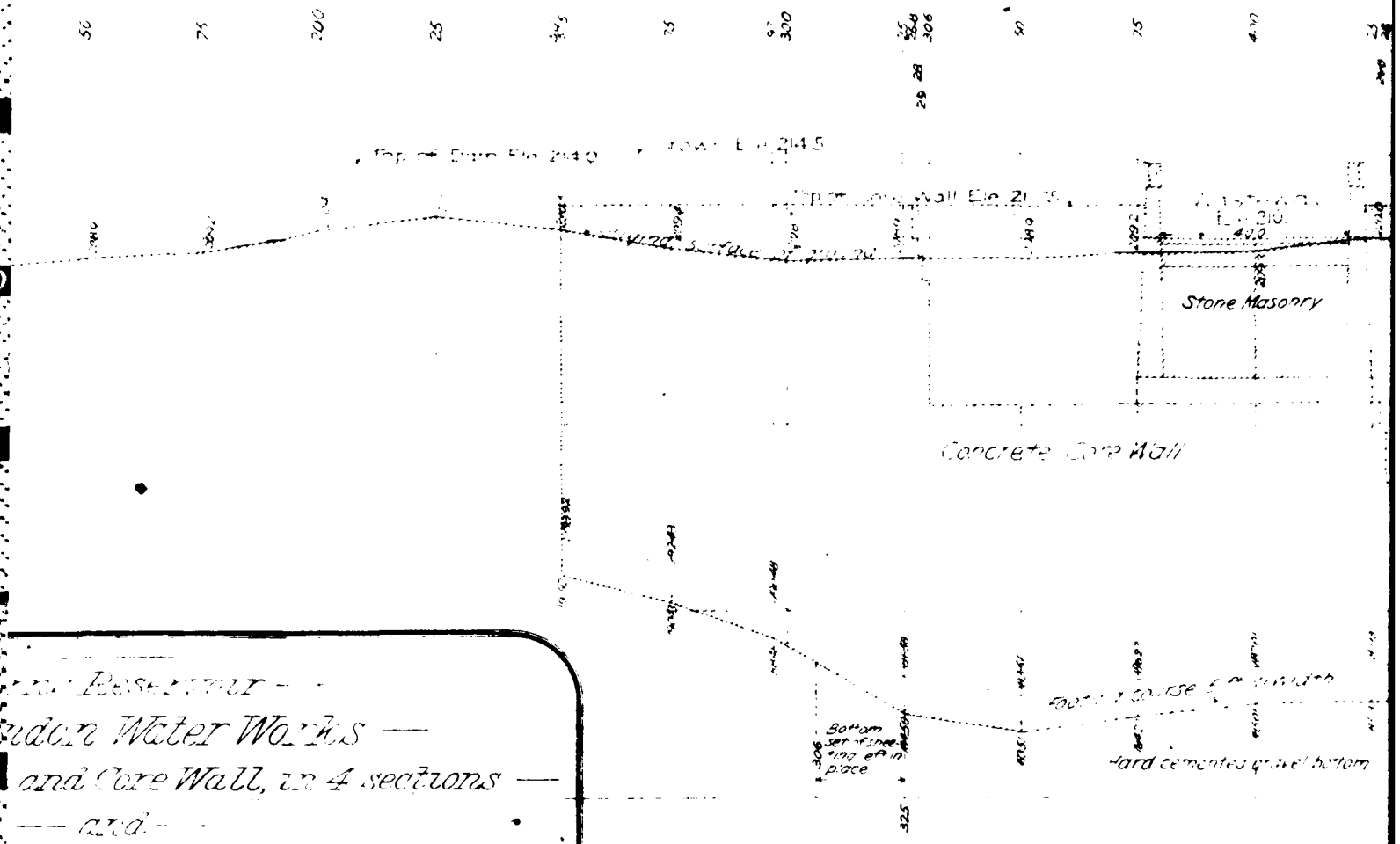
Would Failure Cause Damage? YES Class B

APPENDIX B-3

RECORD DRAWINGS AND SKETCHES


220
210
200
190
180
170
160
150
— Barns Reservoir
— New London Water W
— Profile of Dam and Core Wall
— and —
— Sectional elevation o
— at Effluent Chamb
— Elevations refer to Mean Hig
— Constructed 1901-2
— Engin

Section

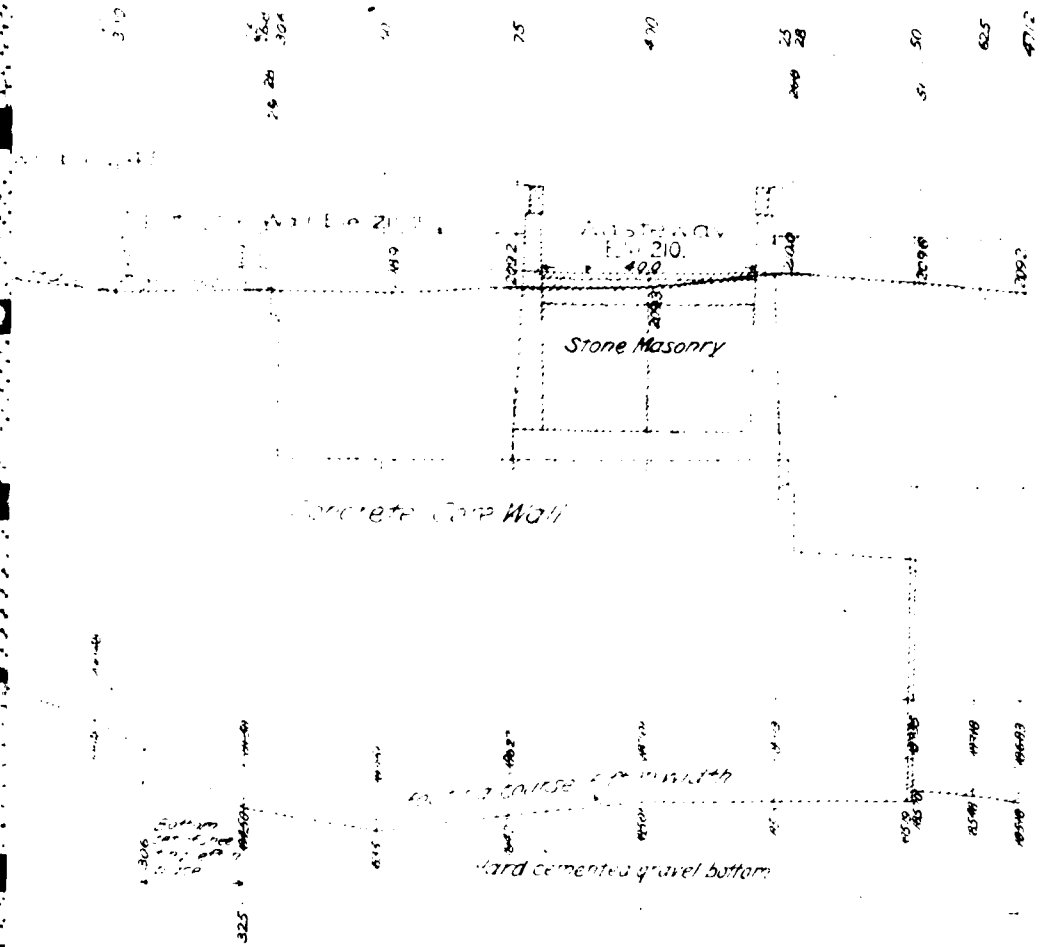


...ran Reservoir —
...udan Water Works —
and Core Wall, in 4 sections —
— and —
...levation of Dam —
...ntake Chamber —
...ear to Mean High Water —
...structed 1902 —
...Right Angles —

Scale Horizontal
Vertical 3

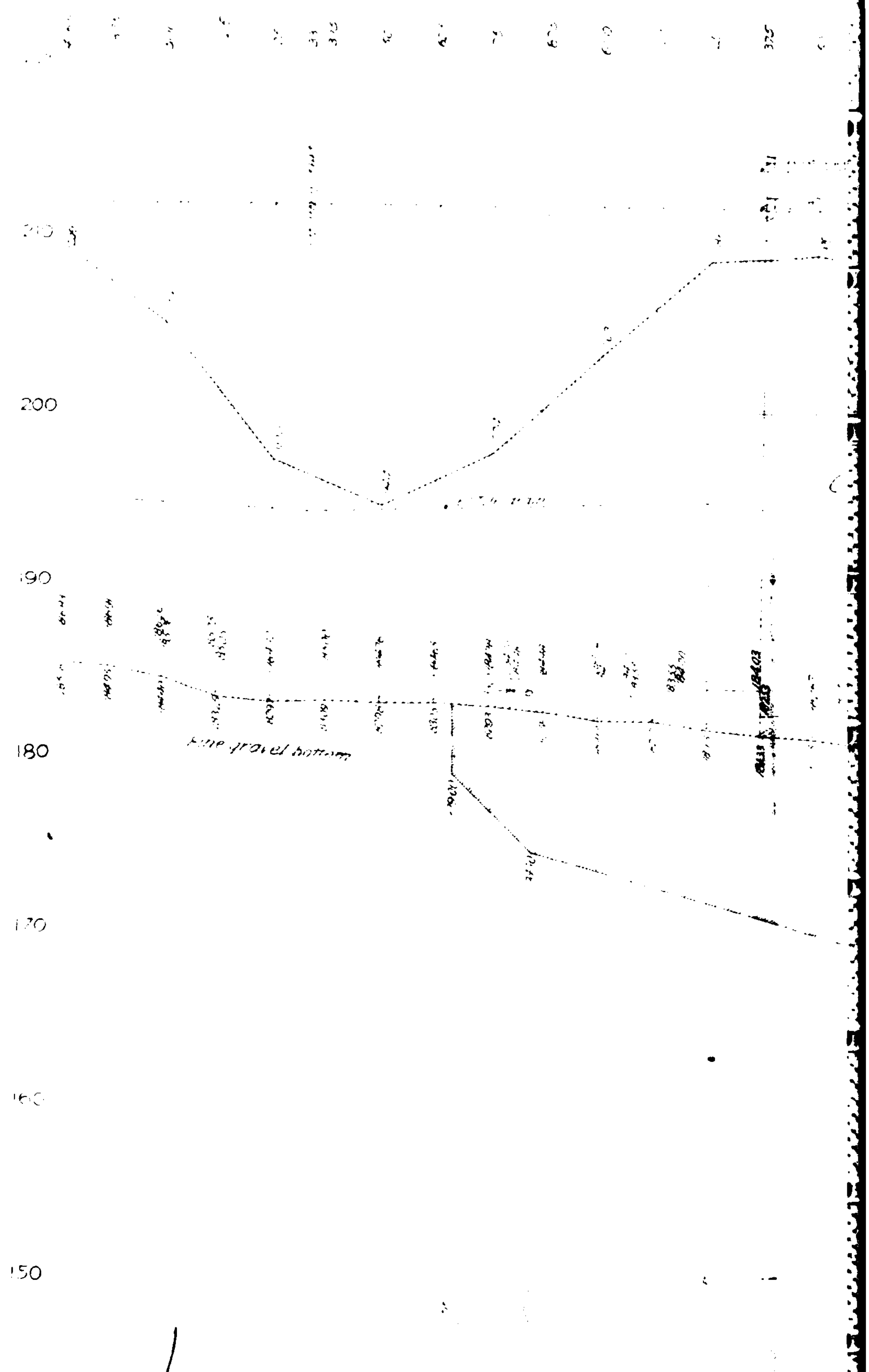
2

Section No. 1

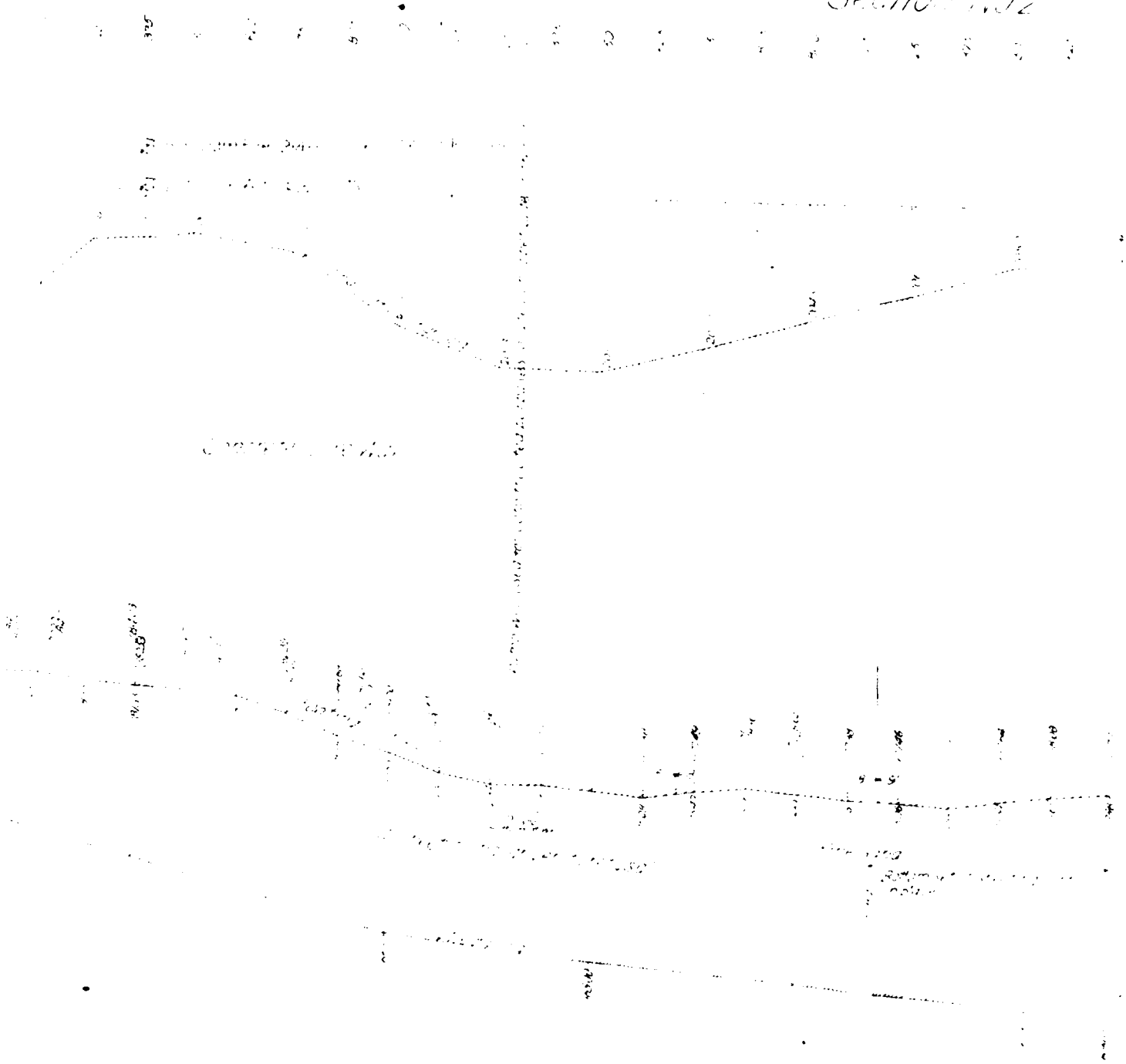


Scale Horizontal 20 ft to 1 in.
Vertical 5 . . 1 .

REDUCED


200
190
180
150
Fine gravel bottom

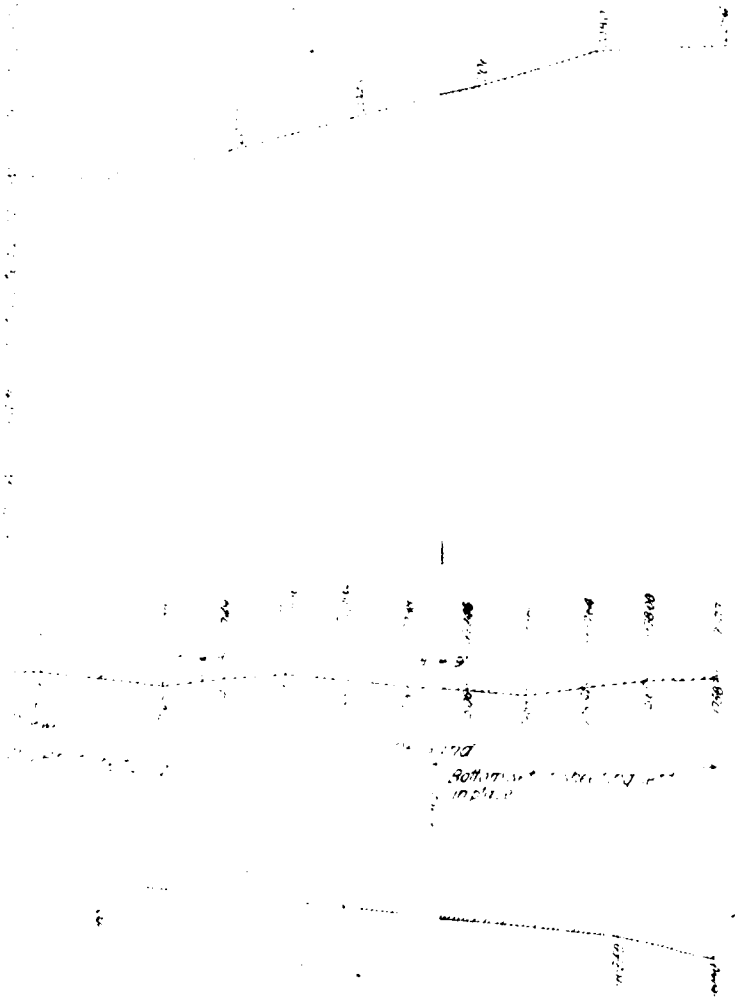
Section No. 2



Scale Horizontal 20 ft to 1 in
Vertical 5 " 1 "

2

Section No 2

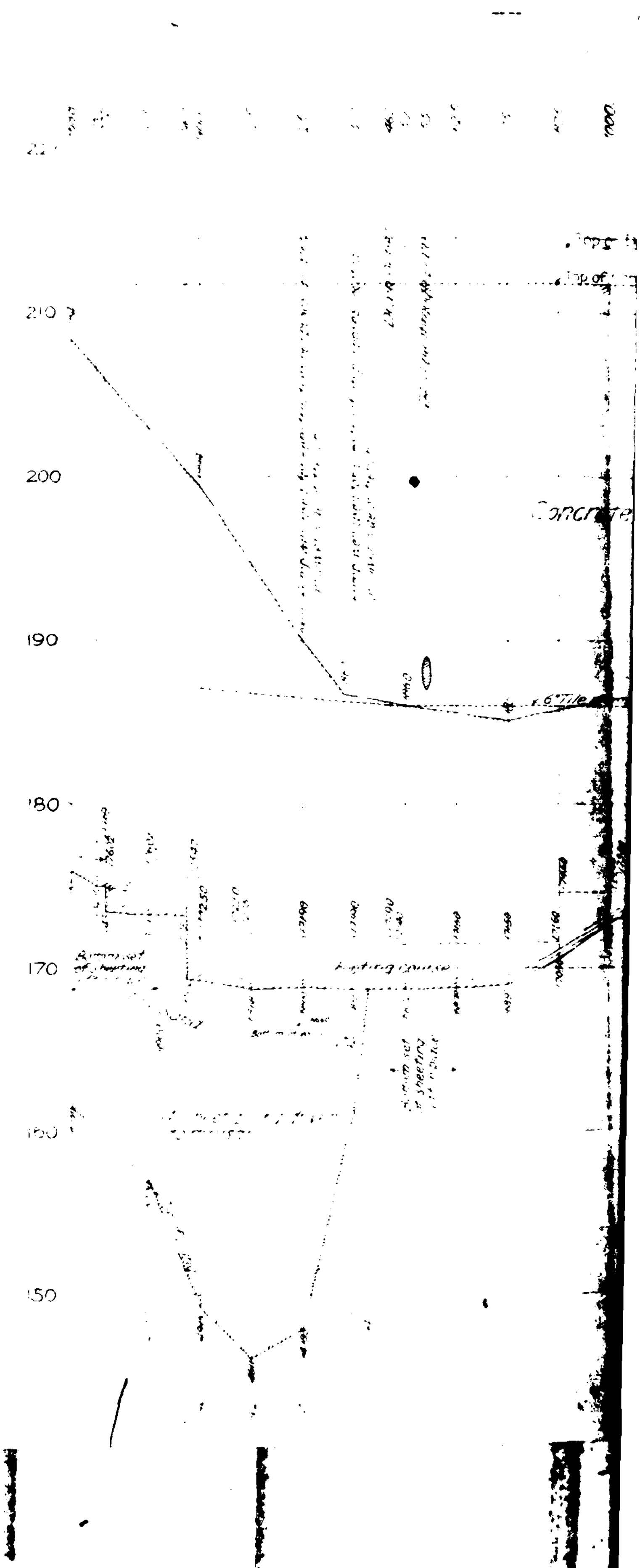


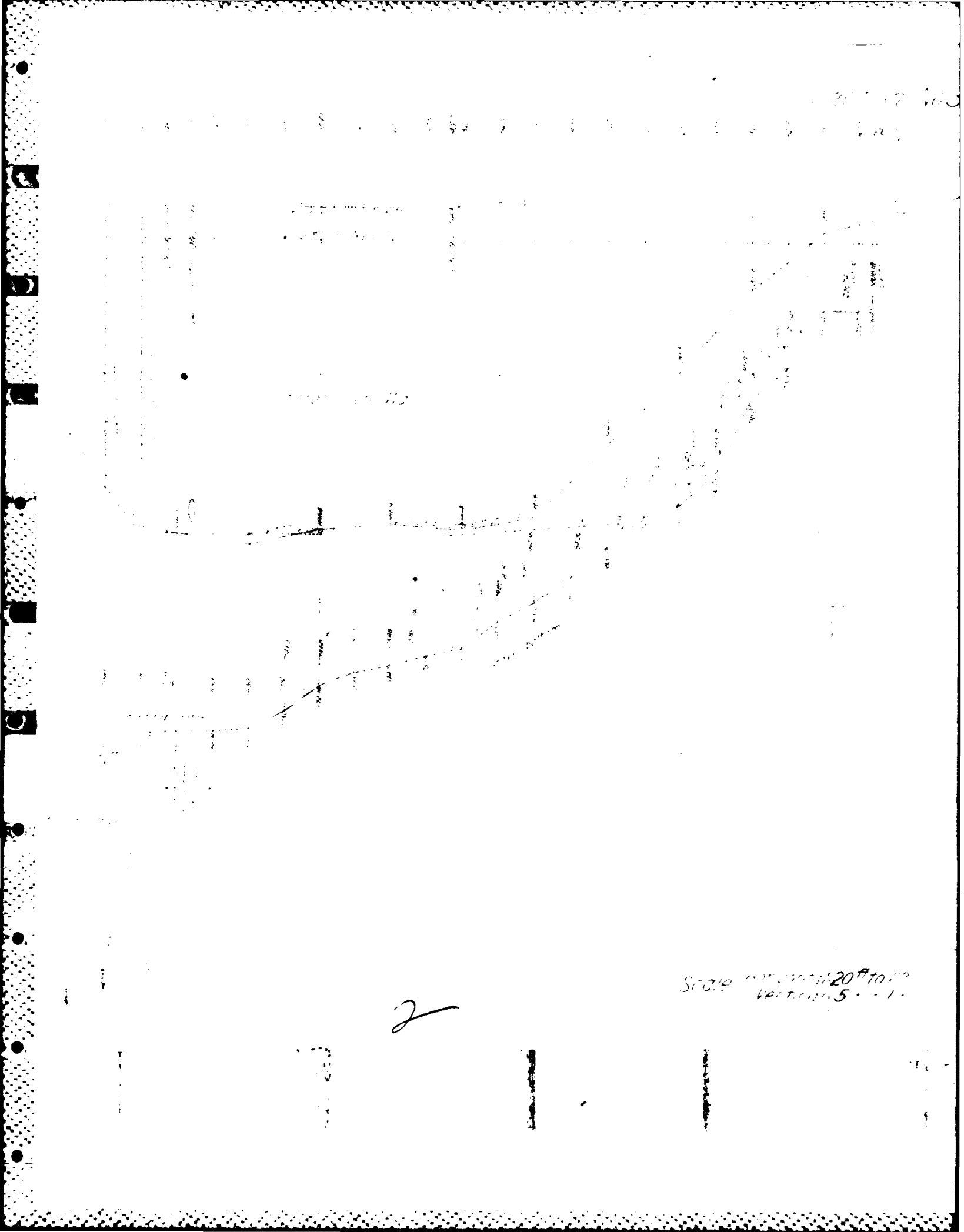
Scale Horizontal 20 ft to 1 in
Vertical 5 " " 1 "

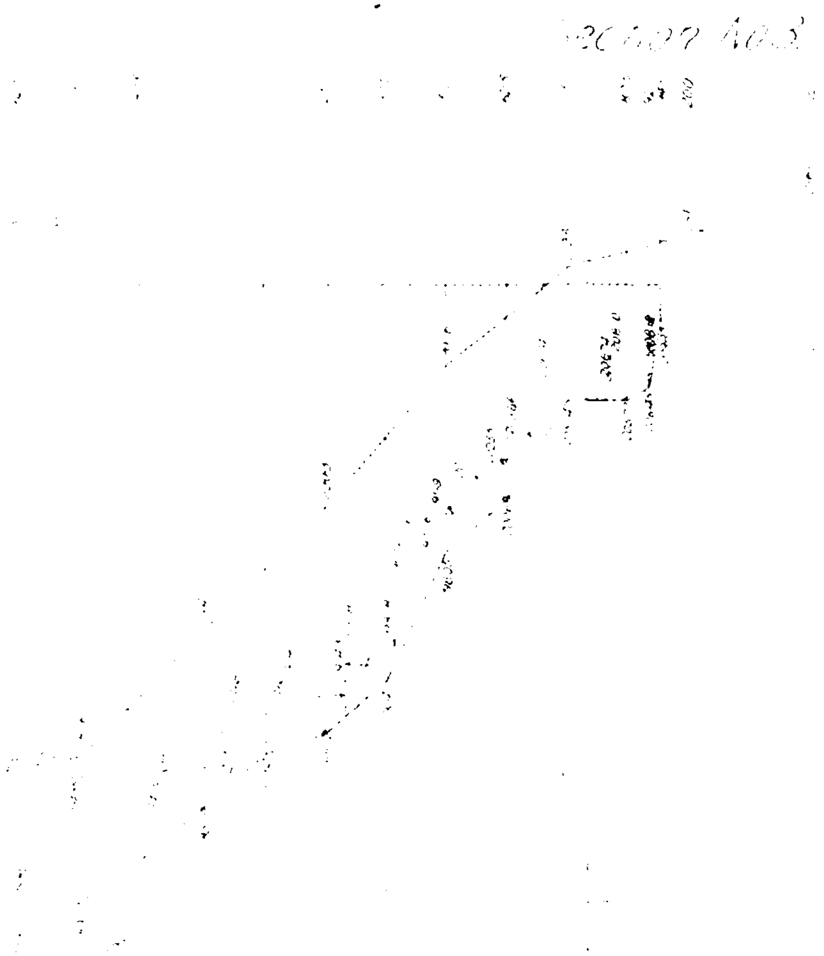
2

3

4

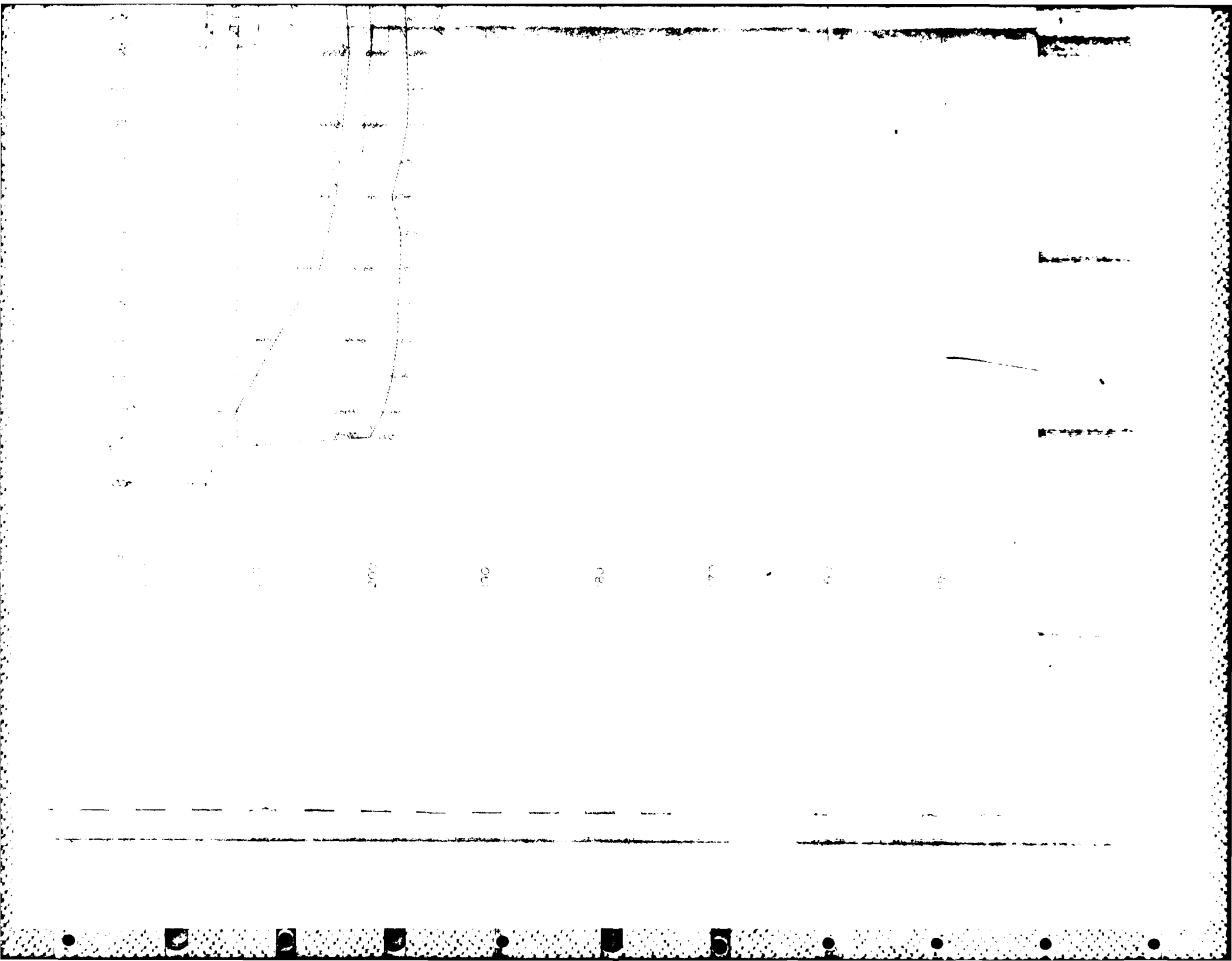

210
200
190
180
170
150
Concrete
6" Tile

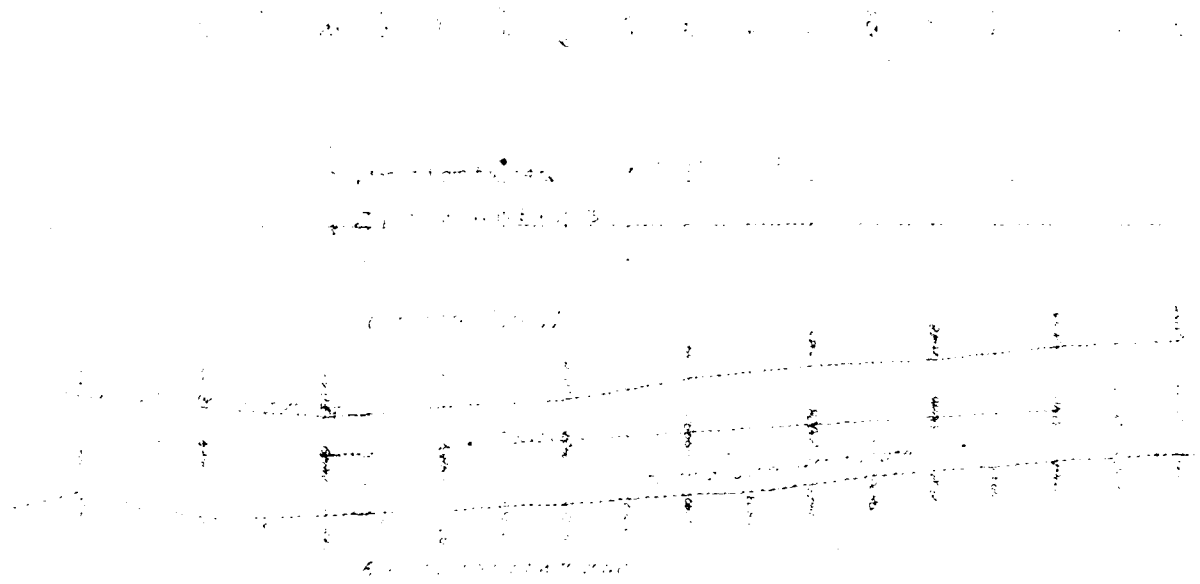

Scale
20 ft to
Vertical .5 - 1.

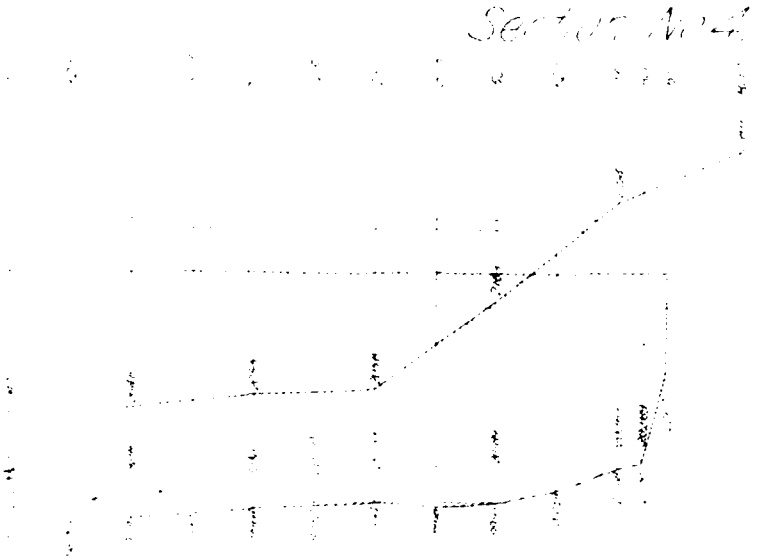


Scale Horiz 20 ft to 1 in
Vertical 5

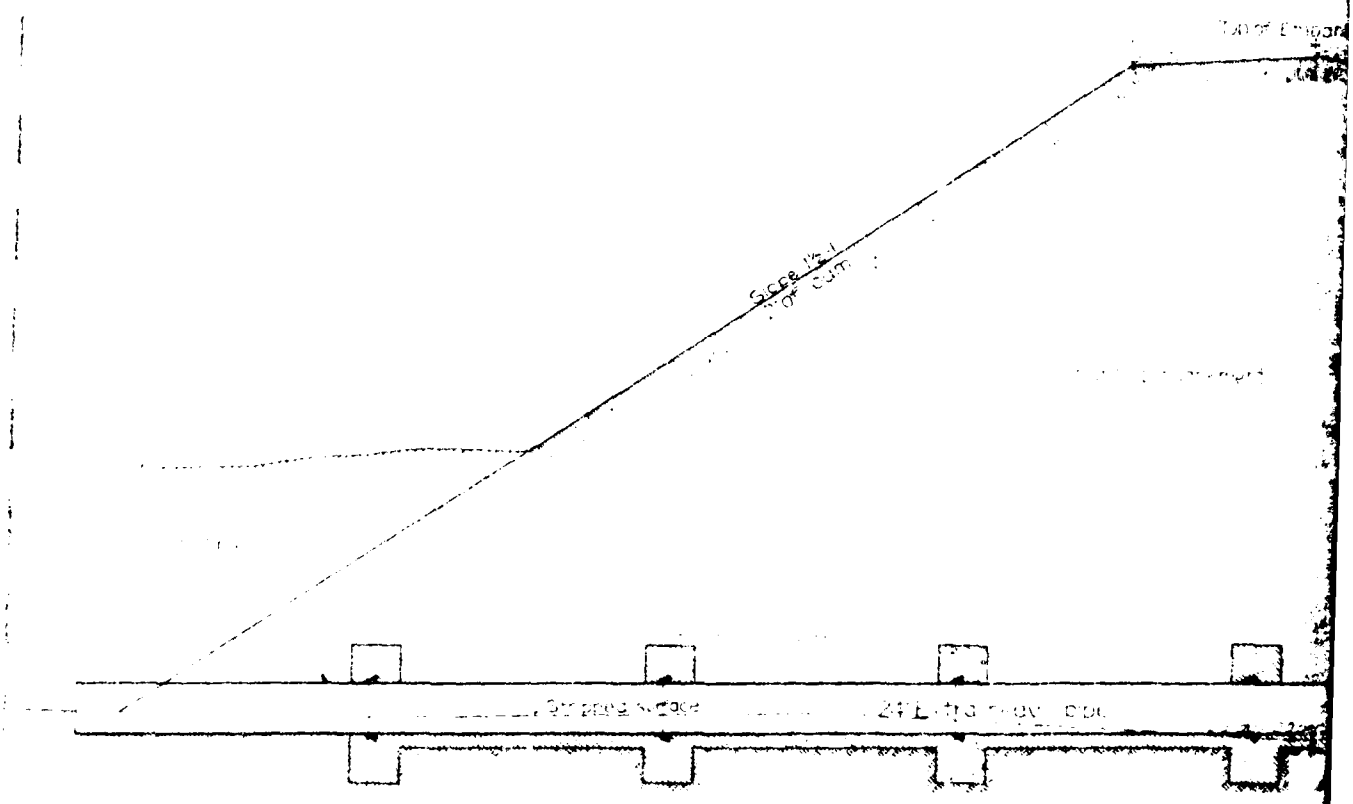
3



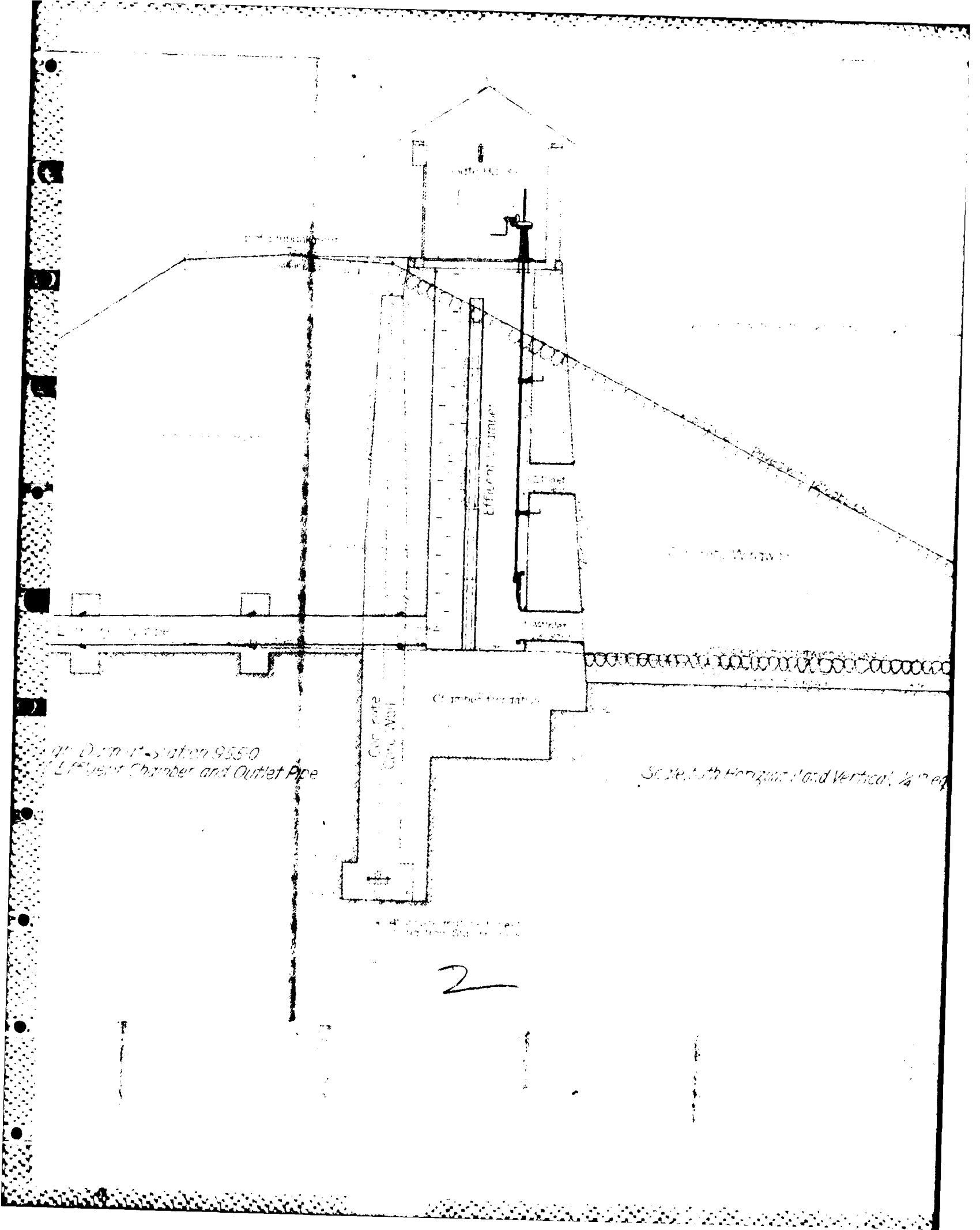




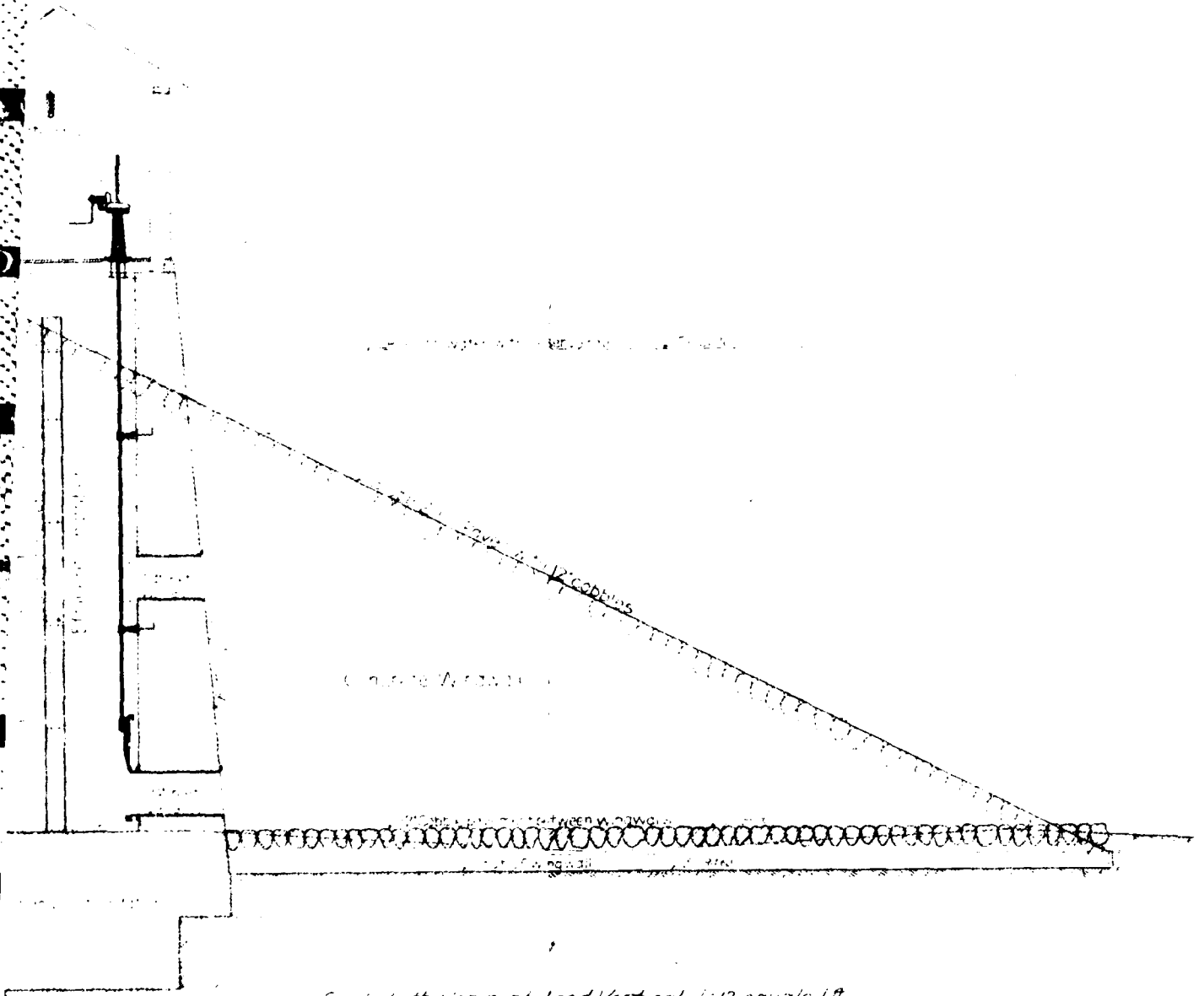
Scale Horizontal 20 ft. to 1 in.
Vertical 5 . . 1 .



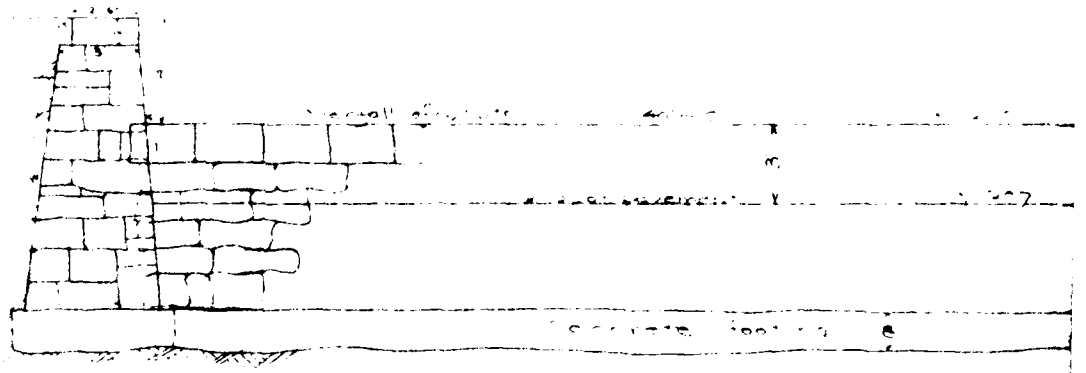
Cross Section through Dam at Station 9550
being on center line of Effluent Chamber and Outlet

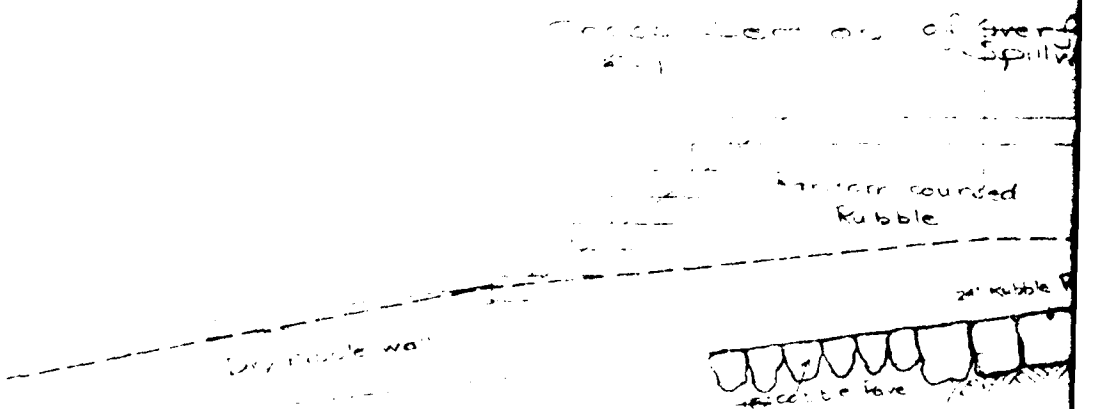

Effluent Chamber
Chamber Wall
Station 9550
Effluent Chamber and Outlet Pipe
Scale: both Horizontal and Vertical 1/4"

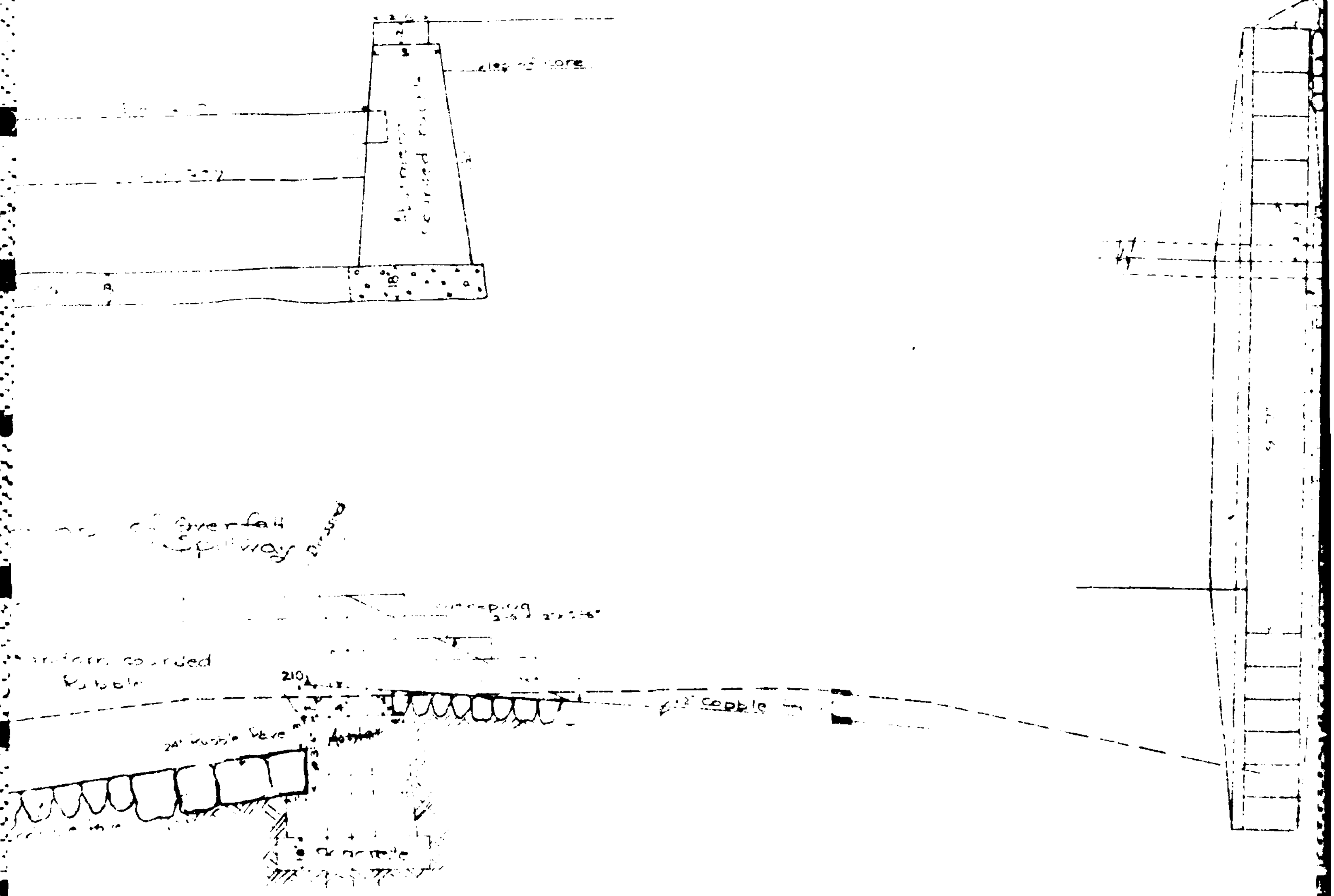
2



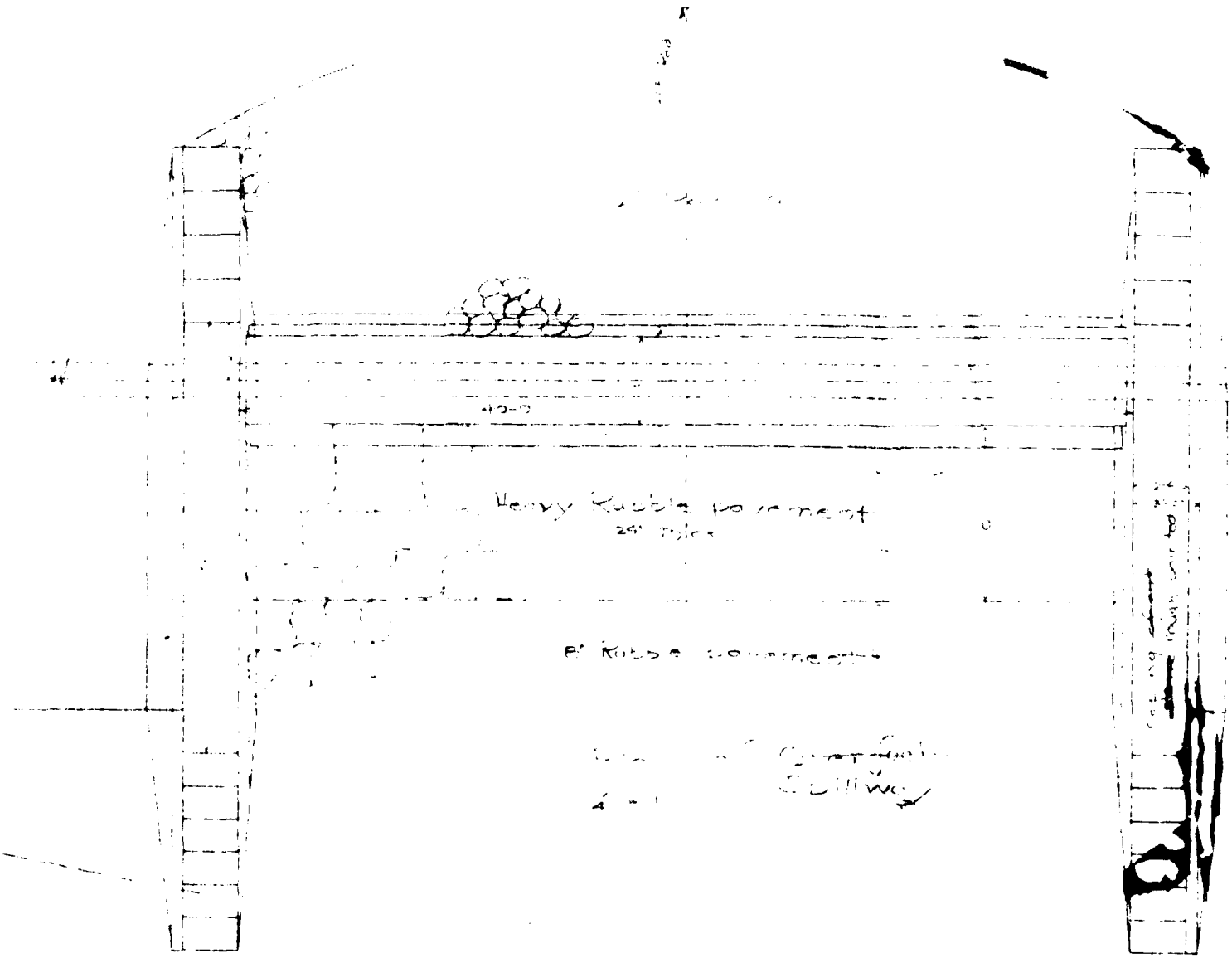
Scale, both Horizontal and Vertical, ¼" equals 1'

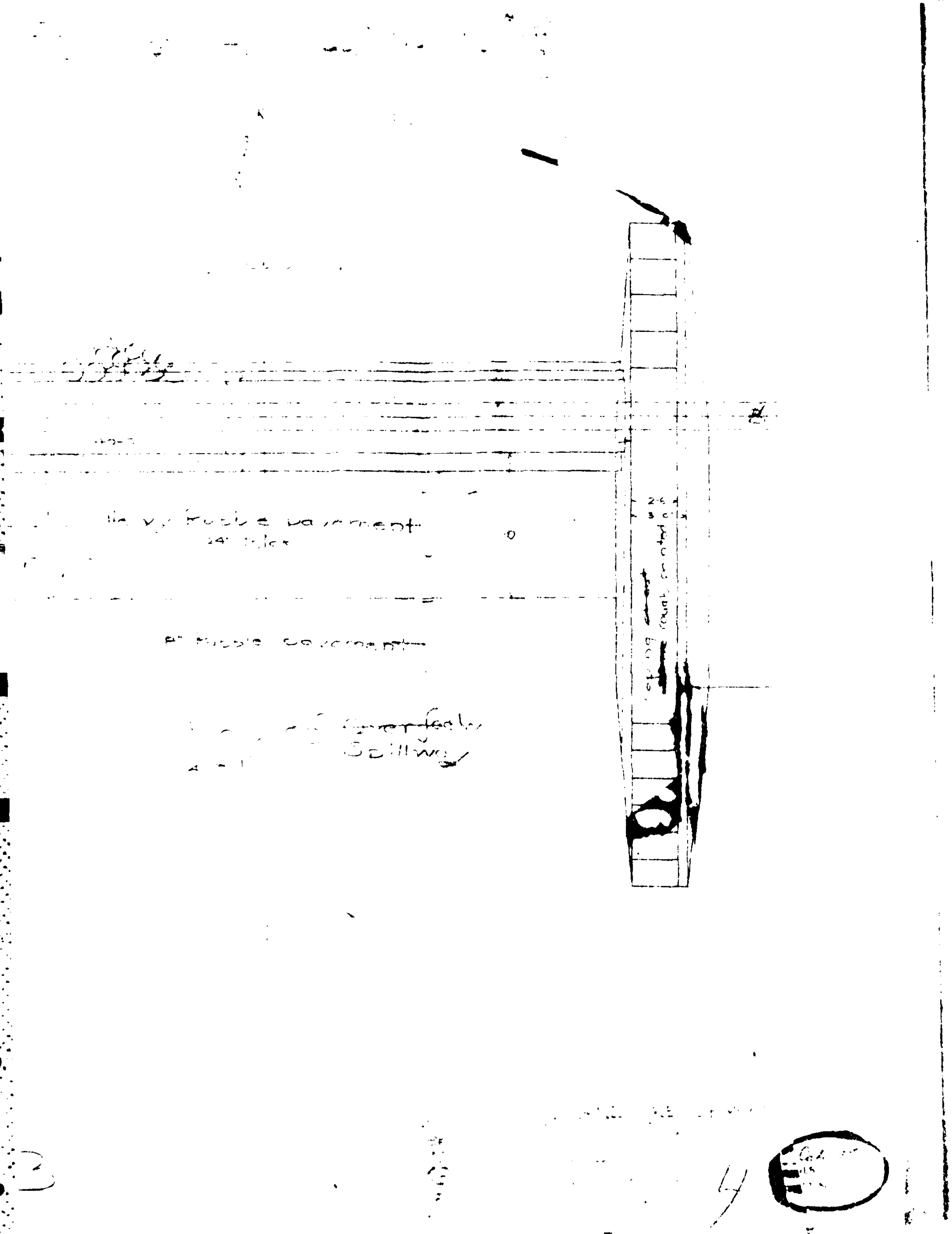



Rubble


Overfall
Spillway
Rubble
210
24" Rubble Pave
12" Cobble
Concrete

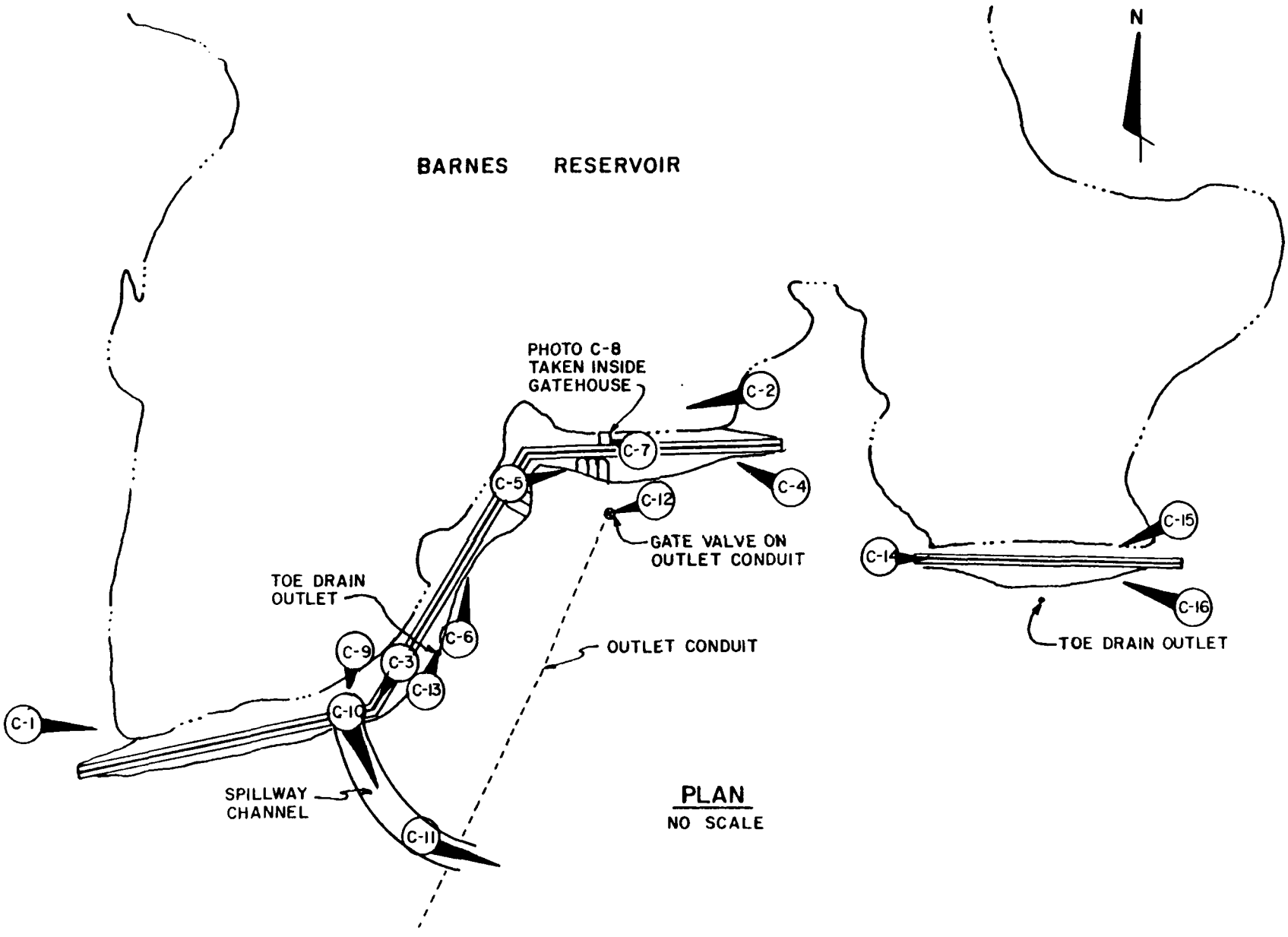
2


Heavy Rubble pavement

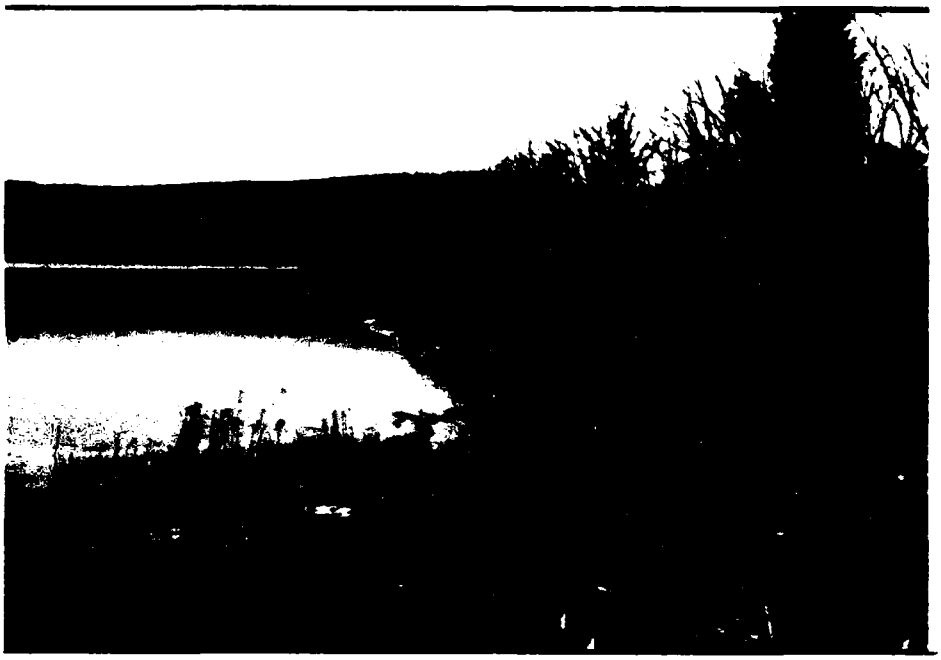

Rubble pavement
Spillway

APPENDIX C

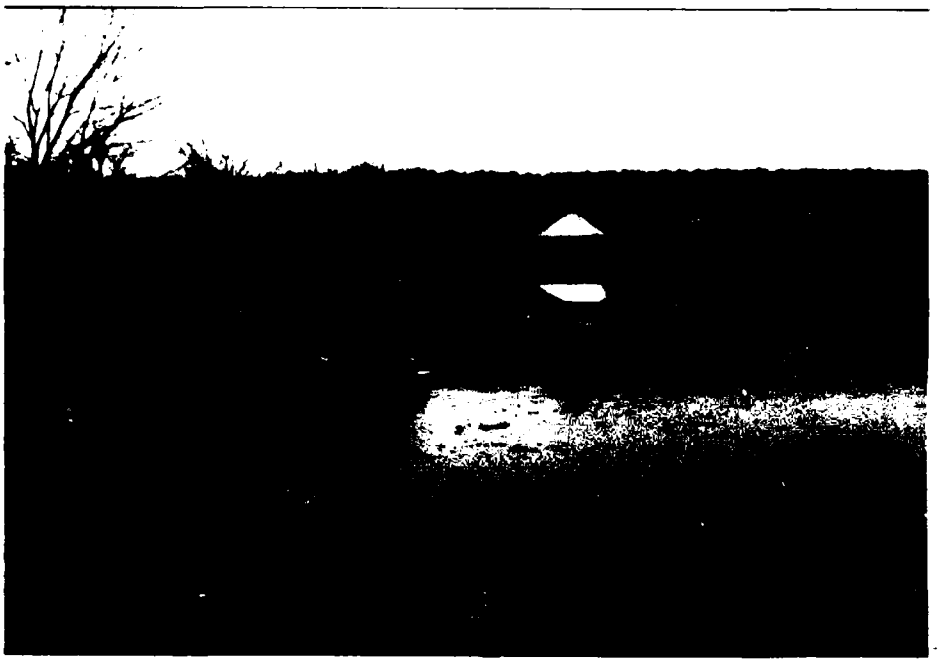
PHOTOGRAPHS



BARNES RESERVOIR DAM
PHOTO INDEX



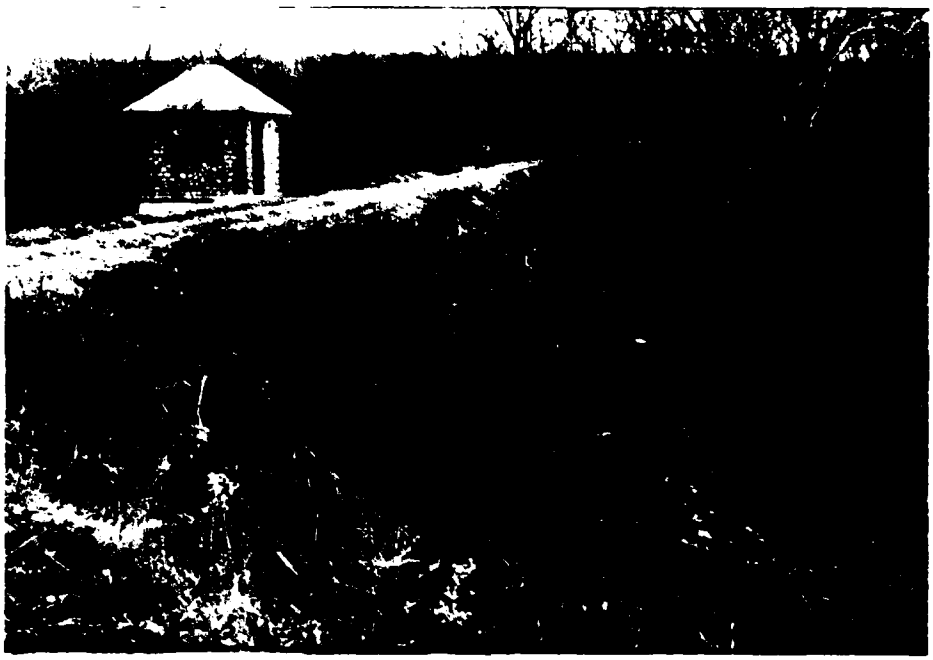
C-1 UPSTREAM SLOPE OF MAIN EMBANKMENT - LOOKING FROM RIGHT ABUTMENT



C-2 UPSTREAM SLOPE OF MAIN EMBANKMENT - LOOKING FROM LEFT ABUTMENT

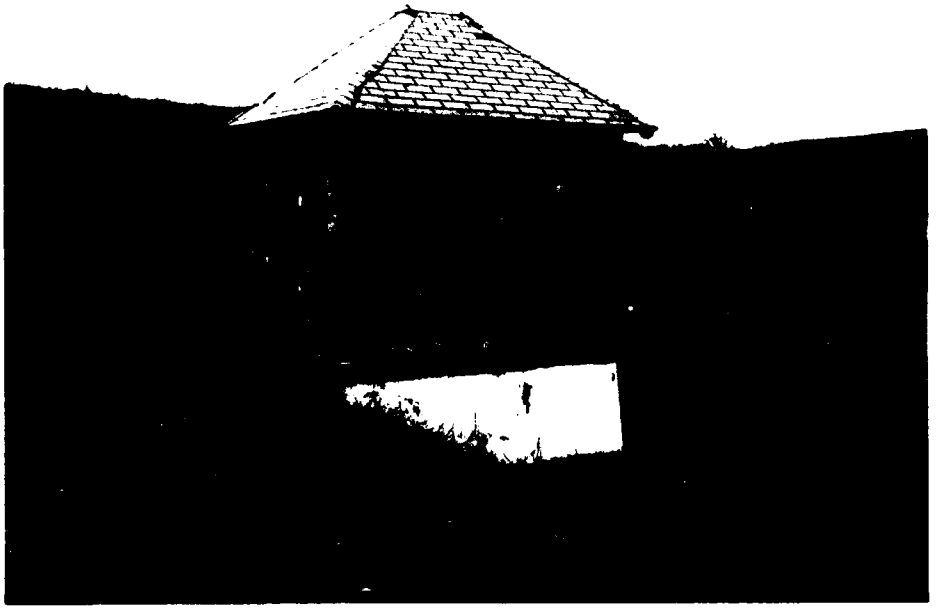
C-3 CREST AND UPSTREAM SLOPE OF MAIN EMBANKMENT AT SPILLWAY

C-4 DOWNSTREAM SLOPE OF MAIN EMBANKMENT - LOOKING FROM LEFT ABUTMENT



C-5 DOWNSTREAM SLOPE OF MAIN EMBANKMENT AT GATEHOUSE

C-6 TYPICAL BRUSH OVERGROWTH ON DOWNSTREAM SLOPE OF MAIN EMBANKMENT

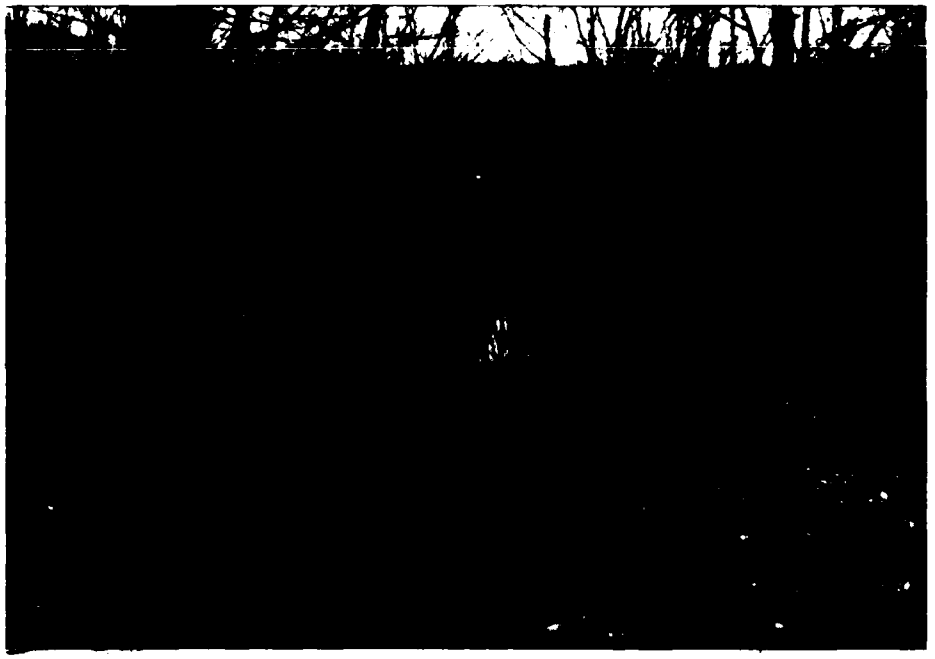


C-7 GATEHOUSE

C-8 INTERIOR OF GATEHOUSE

C-9 APPROACH TO SPILLWAY CREST - R/C ACCESS BRIDGE OVER SPILLWAY

C-10 CONVERGING CURVED CHUTE OF SPILLWAY - LOOKING FROM SERVICE BRIDGE



C-11 DOWNSTREAM CHUTE OF SPILLWAY

C-12 GATE VALVE ON OUTLET CONDUIT

C-13 TOE DRAIN OUTLET OF MAIN EMBANKMENT

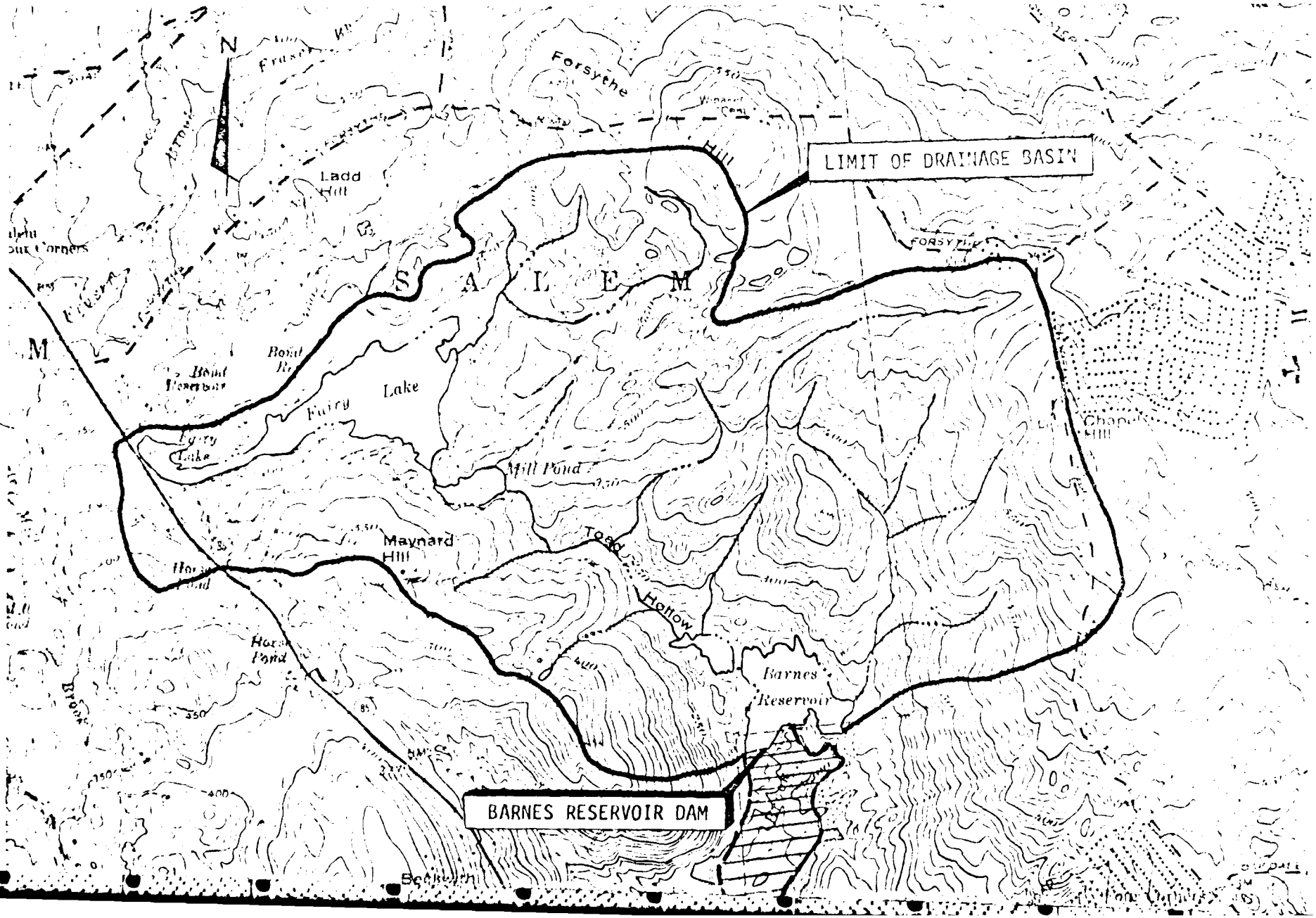
C-14 CREST OF EAST DIKE

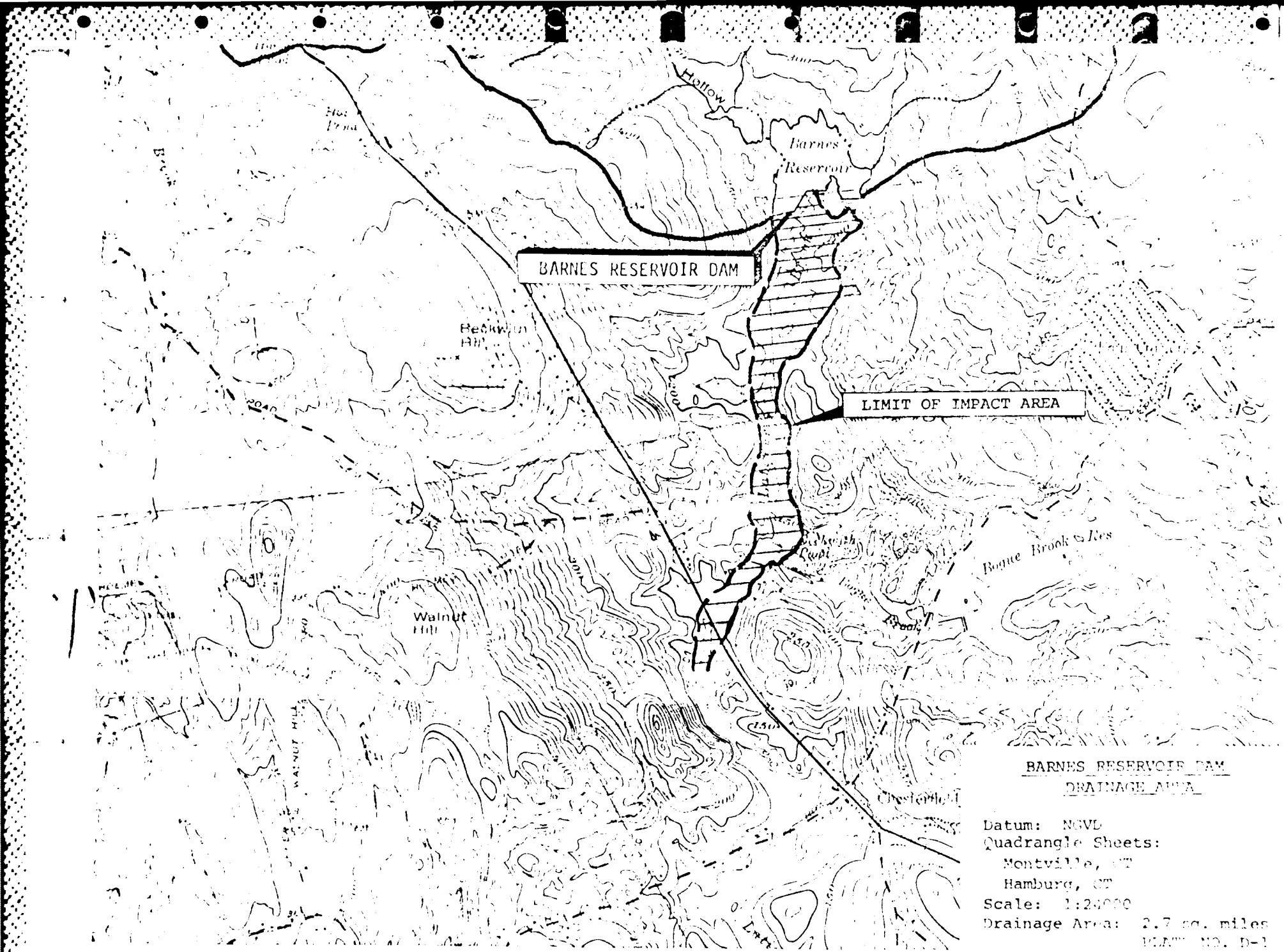
C-15 UPSTREAM SLOPE OF EAST DIKE - LOOKING FROM LEFT ABUTMENT

C-16 DOWNSTREAM SLOPE OF EAST DIKE - LOOKING FROM LEFT ABUTMENT.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS


LIMIT OF DRAINAGE BASIN
BARNES RESERVOIR DAM
S A L E M
Forsythe
Ladd Hill
Bond Reservoir
Fairy Lake
Mill Pond
Maynard Hill
Todd Hollow
Barnes Reservoir
Horse Pond
Chapel Hill


BARNES RESERVOIR DAM
LIMIT OF IMPACT AREA
Barnes Reservoir
Hollow
Walnut Hill
Bogue Brook
Res
Brook
Chesterfield
BARNES RESERVOIR DAM
DRAINAGE AREA
Datum: NGVD
Quadrangle Sheets:
Montville, CT
Hamburg, CT
Scale: 1:24000
Drainage Area: 2.7 sq. miles
PLATE NO. D-1

Barnes Reservoir Dam

Dam Failure Analysis

1. Failure discharge with pool at top of dam (elev. 215.74) = 19070 CFS

2. Depth of water in reservoir at time of failure = 22.0 ft.

3. Maximum depth of flow downstream of dam) at time of failure) = 15.0 ft.

4. Water surface elevation just downstream) of dam at time of failure) = 212.0 NGVD

The failure discharge of 19070 CFS will enter Latimer Brook and flow downstream 6000 feet until the brook joins Beckwith Pond. There is significant valley storage in this 6000 feet length of brook to reduce the discharge substantially. Also due to roughness characteristics, obstructions and frictional losses, it is very likely that the unsteady dam failure flow will dissipate its wave and kinetic energy and thus convert to steady and uniform flow obeying Manning's formulae 6,000 feet downstream. The failure profile will have the following hydraulic characteristics:

DISTANCE FROM THE DAM	WATER SURFACE ELEVATION NGVD	REMARKS
0 + 00	215.74	Upstream of dam
0 + 00	208.74	Downstream of dam
10 + 00	200.0	
20 + 00	190.0	
30 + 00	182.0	
40 + 00	174.0	
50 + 00	166.0	
60 + 00	157.0	

Beyond 6000 feet and until the brook crosses Route 85, the failure discharge will flow in the below given channel characteristics:

Q = 18000 CFS; S = 0.035

n = 0.05; b = 126 feet; d = 7.0

Side slopes = 1V or 2H.

Estimating Maximum Probable Discharges - Inflow and Outflow Values Date of Inspection: 11/30/78

Name of Dam Barnes Reservoir Dam; Location of Dam Latimer Brook; Town Montville - Salem

Watershed Characterization Wooded with steep slopes; storages upstream; 0.27 sq. miles of drainage area is swampy or occupied by storage reservoirs

Adopted "test" flood = 100-year Frequency = 407 CSM = 1100 CFS; Re = Effective Rainfall = 4.6 inches

D.A. = Drainage Area (Gross) = 2.70 Square Miles; Basin Slope = 0.06 ft/ft. hence; Moderate to Steep

S.A. = Surface Area of Reservoir = 0.073 Square Miles; Time of Concentration 60 minutes

Shape and Type of Spillway = Overflow, vertical fall; broad crest uncontrolled weir up to elevation 214.24 and an orifice up to elevation 215.74

B = Width of Spillway = (40.3-2.3)=38.0 feet; C = Coefficient of Discharge = (3.33-Friction) = 3.30

[See sketch attached for spillway]

Maximum Capacity of Spillway Without Overtopping = 1200 CFS = 100 % of test flood

Top of Dam Elevation = 215.74; Spillway Crest Elevation = 211.24

Overflow portion of Length of Dam = 350.0; C = Coefficient of discharge for Dam = 3.00

Name of Dam	Test Flood Q_p		Inflow Characteristics		Outflow Characteristics First Approximation			Outflow Characteristics Second Approximation			Outflow Characteristics Third Approximation (Adopted)		
	CSM	CFS	h_0 in feet	S_0 in in.	Q_{p1} CFS	h_1 in ft.	S_1 in in.	S_2 in in.	h_2 in ft.	Q_{p2} CFS	S_3 in in.	h_3 in ft.	Q_{p3} CFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	100-yr. =407	1100	4.1	1.33	1100	4.1	1.33	1.11	3.44	800	1.11	3.44	800
	½PMF =841	2270	6.65	2.15	2270	6.65	2.15	1.32	5.6	2228	1.32	5.6	2228

Q_p = Discharge; h= Surcharge height; S = Storage in inches

NOTE: Outflow discharge values are computed as per COE guidelines.

A. Size Classification

Barnes Reservoir Dam

Height of dam = 22.0 ft.; hence Small

Storage capacity at top of dam (elev. 215.74) = 757 AC-FT.; hence Small

Adopted size classification SMALL

B.i) Hazard Potential

This dam is located in a rural wooded area, with little habitation for 6000 feet downstream. A 24-inch diameter reduced to 16 in pipe supplies water to Beckwith Pond for use in New London Water Supply System.

ii) Impact of Failure of Dam at Maximum Pool (Top of Dam)

It is estimated from the rule of "thumb" failure hydrograph, that the following adverse impacts are a possibility by the failure of this dam.

a)	Loss of life	;	____ to ____ lives can be lost.
b)	Loss of homes	Yes ;	1 to 3 homes can be lost.
c)	Loss of buildings	Yes ;	1 to 3 buildings can be lost.
d)	Loss of highways or roads	Yes ;	1 roads can be damaged.
e)	Loss of bridges	No ;	____ to ____ bridges can be lost.
f)	Miscellaneous	Yes ;	Water supply system and pumping station at Beckwith Pond can be affected.

The failure profile can affect a distance of 6000 feet from the dam. For water surface elevation, see next page in Appendix D.

C. Adopted Classifications

HAZARD	SIZE	TEST FLOOD RANGE
LOW	SMALL	50-100 Year Frequency

Adopted Test Flood = 100-year Frequency = 407 CSM

= 1100 CFS

D. Overtopping Potential

Drainage Area = 2.70 sq. miles

Spillway crest elevation = 211.24 NGVD

Top of Dam Elevation = 215.74 Top of Dike elevation = 215.34 NGVD

Maximum spillway discharge (dike)
Capacity without overtopping of dam = 1200 CFS
"test flood" inflow discharge = 1100 CFS
"test flood" outflow discharge = 800 CFS
% of "test flood" overflow carried by spillway without overtopping = 100%
"test flood" outflow discharge portion which overflows over the dam = 0
% of test flood which overflows over the dam = 0

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

BASIC DATA

Name of dam Barnes Reservoir Dam Name of town Salem, Montville

Drainage area = 2.70 sq. mi., Top of dam 215.74 NGVD

Spillway type = Overflow - Broad Crest Crest of spillway 211.24 NGVD

Surface area at crest elevation = 47 Acres = 0.073 square miles

Reservoir bottom near dam = 188.24 NGVD

Assumed side slopes of embankments 2:1

Depth of reservoir at dam site = Y_o = 22.0 ft.

Mid-height elevation of dam = 202.0 NGVD

Length of dam at crest = 1170 feet

Length of dam at mid-height = 1100 feet

10% of dam length at mid-height = W_b = 110 feet

Step 1:

Elevation (NGVD)	Estimated Storage in AC-FT
211.24	522
212.24	569
213.24	616
214.24	663
215.24	710
215.74	757

Step 2:

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

$$= 1.68\ W_b\ y\ 3/2 = 19070 \text{ CFS}$$

NOTE: Failure of dam is assumed to be instantaneous when pool reaches top of dam.

Beckwith Pond is located 6000 ± feet downstream of Barnes Reservoir dam. Valley storage between Barnes Reservoir dam and Beckwith pond is not significant in reducing the discharge. There is a 60.0 foot drop into Beckwith pond which will cause the dissipation of wave and kinetic energy of the failure discharge. Approximately, the water surface elevations between Barnes Reservoir dam and Beckwith pond will be as given on Dam Failure Analysis. The increase of depth in Beckwith pond due to failure of Barnes Reservoir dam is estimated to be 7.0 feet.

COMPUTATIONS FOR
SPILLWAY RATING CURVE

(40.3 - obstructions)
Spillway width = 38.0 feet; Spillway crest elevation = 211.24 NGVD

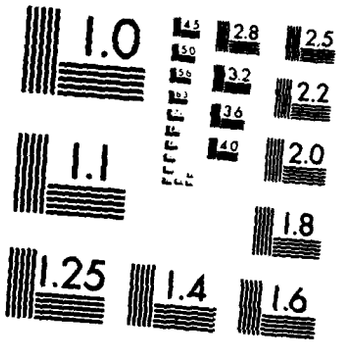
Length of dam = 1170 feet; Top of dam elevation = 215.74 NGVD
(overflow length of dam or dike = 350.0 feet at elevation 215.34)
C = 3.30 for overflow spillway; C = 3.0 for overflow portion of dam and/or dike.

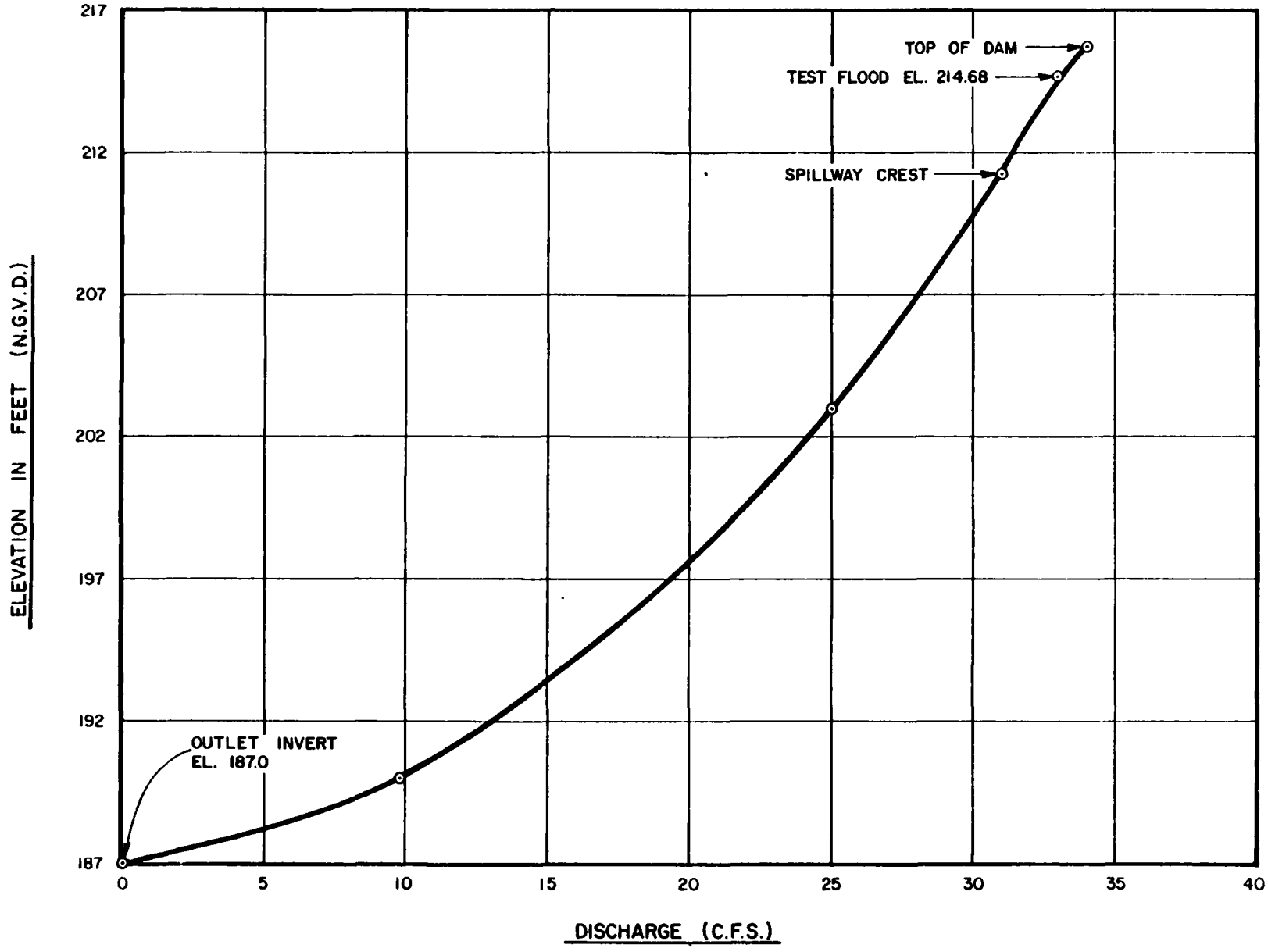
i) SPILLWAY RATING CURVE COMPUTATIONS

Elevation (ft.) NGVD	Spillway Discharge (CFS)	Remarks
211.24	o	Crest of Spillway
212.24	125	
213.24	355	
214.24	652	
214.34	684	
214.67	800	Test Flood Discharge
215.24	1003	Overflow portion of dam and dike
215.74	1264	Top of Dam

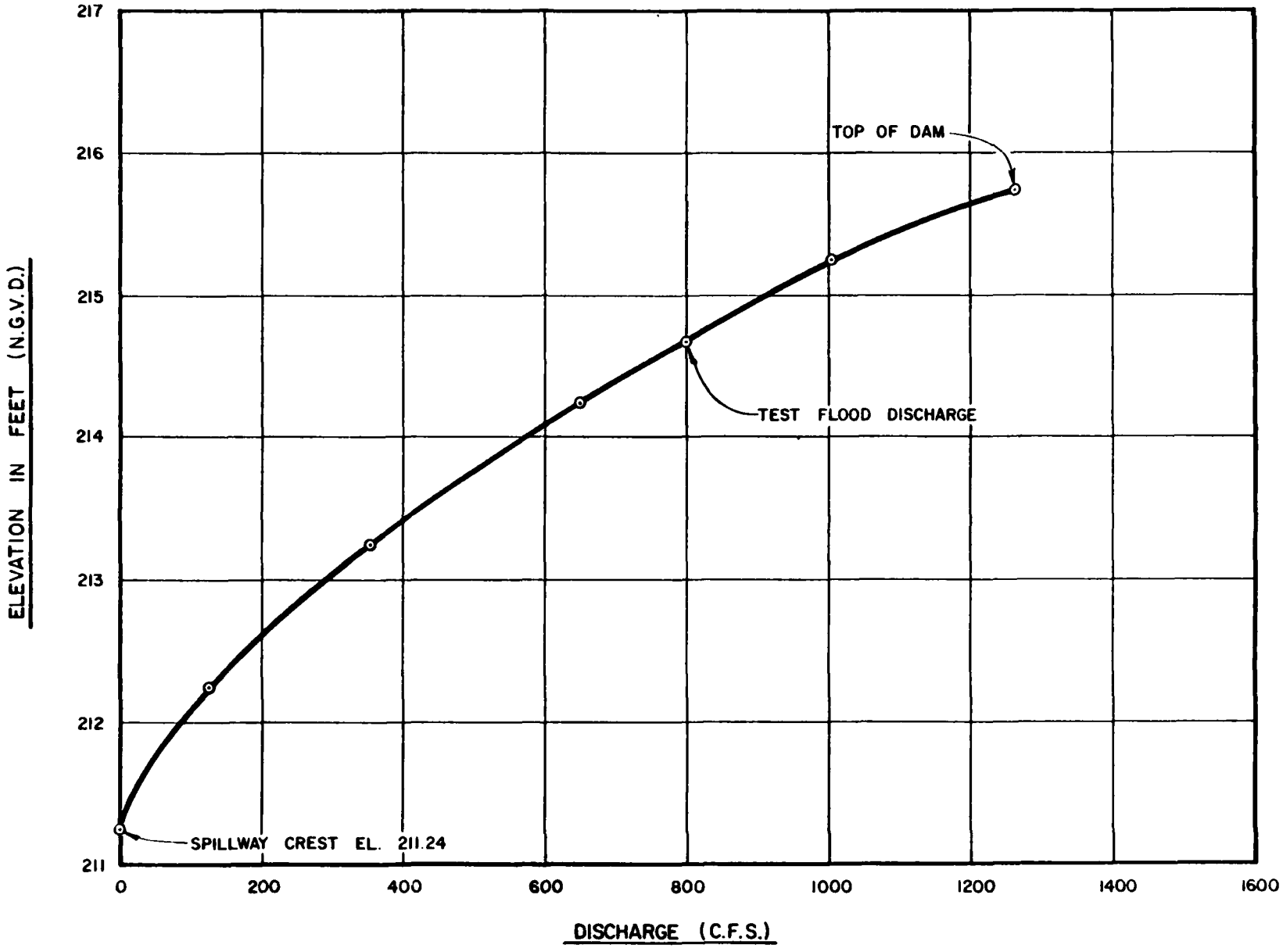
AD-A143 743 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
BARNES RESERVOIR DAM (... (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV MAY 79 2/2

UNCLASSIFIED F/G 13/13 NL





BARNES RESERVOIR
OUTLET WORKS RATING CURVE



BARNES RESERVOIR DAM
SPILLWAY RATING CURVE

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY | MO | YR
CT	236	NED	CT	011	02				BARNES RESERVOIR DAM	4127.3	7215.2	20APR79

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	BARNES RESERVOIR

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	07	TOAD HOLLOW BROOK	CHESTERFIELD	2	1000

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE–FT.)	(27) NORMAL (ACRE–FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REGHPG	1902	S	28	26	757	522	NED	N	N	N	N	20APR79

(28) REMARKS
17 LATIMER BROOK BELOW DAM

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	(31) SPILLWAY TYPE	(32) SPILLWAY WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) POWER CAPACITY PROPOSED (MW)	(37) NAVIGATION LOCKS NO.	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
3	1200	U	40	1264	36500											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
CITY OF NEW LONDON	WM RICHARDS & RW CHAFEE	UNKNOWN

(49) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	CT DEP

(50) INSPECTION BY	(51) INSPECTION DATE DAY | MO | YR	(52) AUTHORITY FOR INSPECTION
CE MAGUIRE INC	15DEC78	PL 92-367

(53) REMARKS
54 ALSO 9 APR 79

END

FILMED

DTIC