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MIDDLE RESERVOIR DAM (U) CORPS OF ENGINEERS WALTHAM
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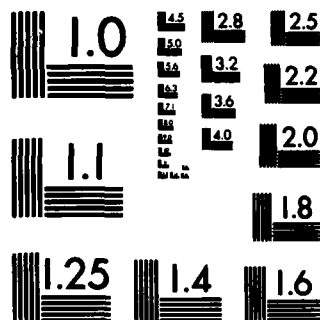
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AD-A144 565

**HOUSATONIC RIVER BASIN
SEYMOUR, CONNECTICUT**

**MIDDLE RESERVOIR DAM
CT 00590**

**PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**

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**DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
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HOUSATONIC RIVER BASIN

SEYMOUR, CONNECTICUT

MIDDLE RESERVOIR DAM

CT 00590

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

Identification No.:	CT 00590
Name of Dam:	Middle Reservoir Dam
Town:	Seymour
County and State:	New Haven, Connecticut
Stream:	Beaver Brook
Date of Inspection:	November 16, 1979

BRIEF ASSESSMENT

The dam of the Middle Reservoir is a concrete and masonry structure. It is approximately 300 feet long, 27 feet high and has an average top width of 8 feet. The Middle Reservoir Dam was probably constructed in the late 1800s with subsequent improvements in 1905. The Ansonia - Derby Water Company presently owns and operates the dam and appurtenant structures.

Based on visual inspection and past operational performance, the dam is judged to be in FAIR condition. Seepage and vegetation was noted on the downstream face and the crest is chipped and spalled due to an unfinished rehabilitation project.

The dam is classified as SMALL in size and a SIGNIFICANT hazard potential structure in accordance with the Recommended Guidelines for Safety Inspection of Dams, established by the Corps of Engineers. The impoundment storage at the top of the dam is 36 ac.-ft. and the maximum height of the dam is 27 feet. Failure of the dam would result in the loss of a few lives and damage to a fluoridation house.

The test flood for this dam is 1/2 the Probable Maximum Flood (PMF). The test flood has an inflow equal to 770 cfs and an outflow discharge equal to 765 cfs with a stillwater elevation of 269.4 which will overtop the dam by 1.0 feet.

These values represent no flood storage in the upstream Beaver Lake. If use is made of the storage capacity of Beaver Lake, the flood inflow to the Middle Reservoir can be greatly reduced. The dam was not overtopped in the 1955 flood because Beaver Lake was low.

The maximum outflow capacity of the spillways under a stillwater condition is 132 cfs, which is 17 percent of the test flood.

It is recommended that the following items be studied further: The downstream leakage, the upstream face, the spillway capacity, the removal of trees on the embankment below the dam, and the completion of the 1975 crest rehabilitation program.

The following remedial measures should be taken: The removal of vegetation from the face and crest of the dam, repointing of joints, monitoring of seepage on the downstream face, development of a downstream warning plan and an annual inspection program.

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

JAMES P. PURCELL ASSOCIATES, INC.

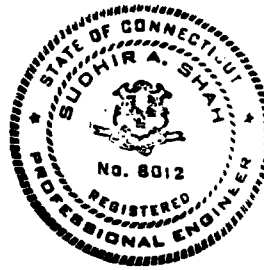
Sudhir A. Shah

Sudhir A. Shah, P.E.
Vice-President
Connecticut P.E. No. 8012

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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 need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and downstream damage potential.

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

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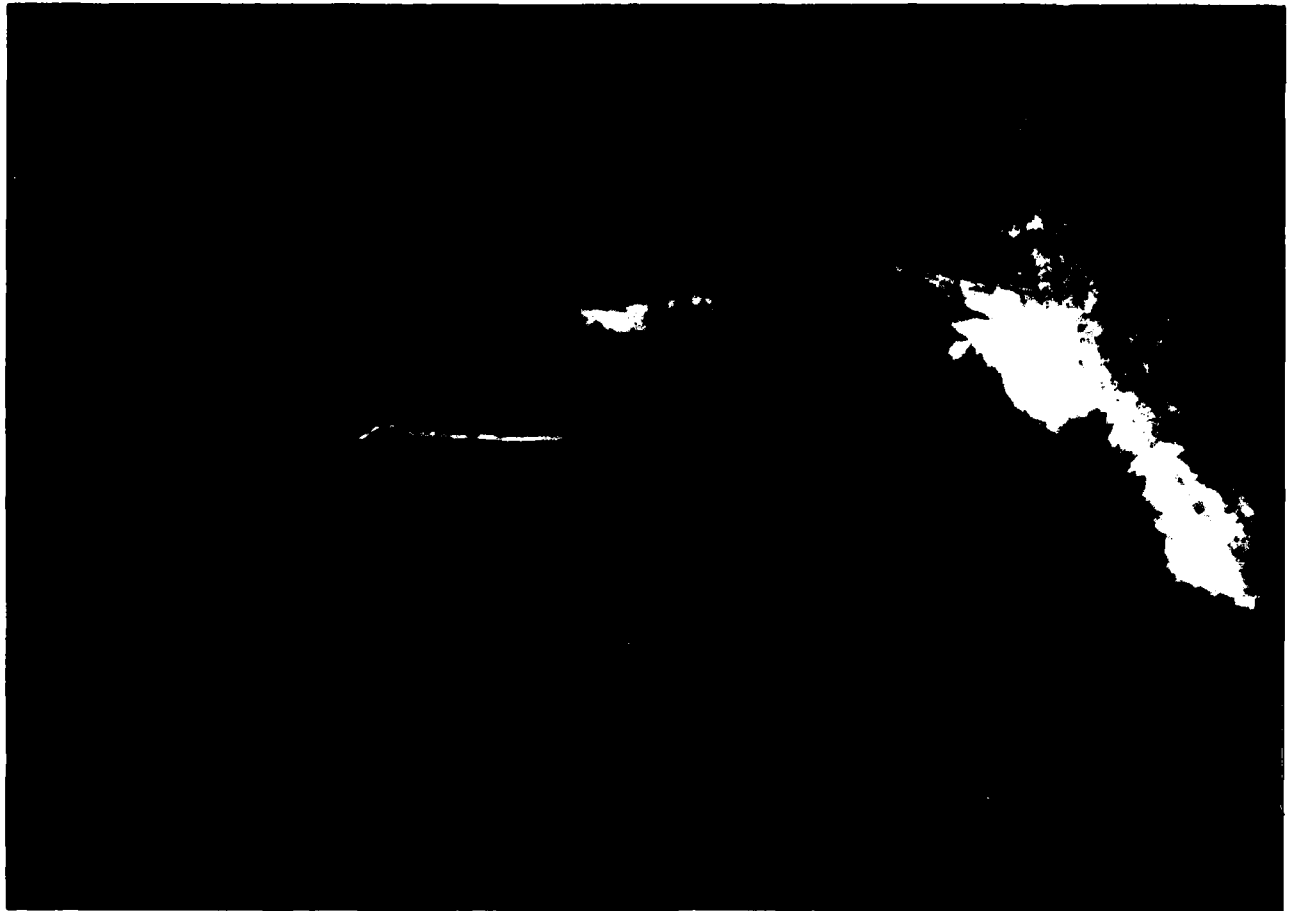
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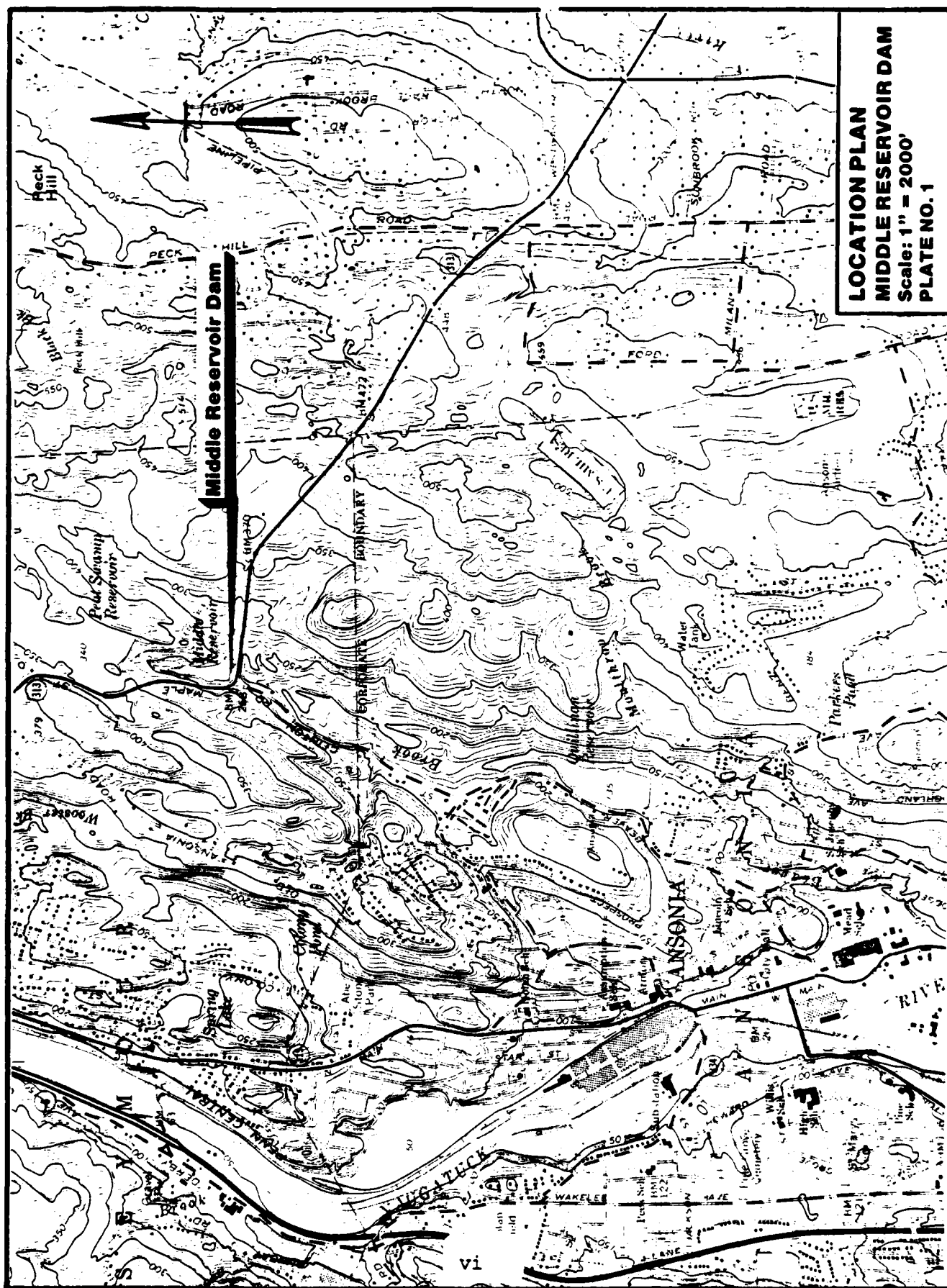
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OVERVIEW PHOTO - MIDDLE RESERVOIR DAM



NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

NAME OF DAM: MIDDLE 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. James P. Purcell Associates, 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 James P. Purcell Associates, Inc., under a letter from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0002 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 prepare 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:

Middle Reservoir Dam is located in the Town of Seymour at the intersection of Clinton Road and Route 313 (see Plate No. 1). The dam impounds water from Beaver Brook and is located approximately 11,500 feet above the confluence with the Naugatuck River, and 5,000 feet upstream of the Quillian Reservoir Dam.

The Beaver Lake Dam (also known as Peat Swamp Reservoir) is located 1700 feet upstream of the Middle Reservoir Dam. The Middle Reservoir is situated in a north/south direction, with the dam at the south end. The latitude is $41^{\circ}-21'-56''$ and the longitude is $73^{\circ}-03'-41''$.

All elevations used in this report are based on the National Geodetic Vertical Datum (NGVD).

b. Description of Dam and Appurtenances:

Middle Reservoir Dam is a concrete and stone masonry structure, approximately 300 feet long, 27 feet high, and with an average top width of 8 feet. The stone masonry downstream face is battered; the batter varies from 1H:5V to 1H:7V. In plan, the face is arched with a radius of approximately 160 feet. The downstream face is partially covered below the dam's west crest with an earth embankment at a slope of approximately 2H:1V. This embankment is heavily vegetated with large evergreen trees. The upstream face is concrete and is stepped in cross section.

The primary spillway is located in the center of the dam. It is 28 feet long, has a concrete invert at elevation 267.4 and is 8.5 feet wide. A 12 foot long auxiliary spillway is located at the east abutment at an elevation of 266.9.

The outlet works consist of a 30 inch cast iron intake pipe into the wet well of the gate house, which is located on the dam's west crest and is equipped with two hand wheel operated gate valves. One valve controls the flow into the 30 inch intake pipe and the other valve controls the discharge from the wet well to a 24 inch pipe. The 24 inch discharge pipe carries the flow by gravity through the dam to a fluoridation house downstream of the dam and then to the water distribution system.

An 8 inch blowoff pipe extends through the base of the dam and outlets to the spillway discharge channel below the dam. This blowoff is regulated by a control hydrant which is operated once a year.

The Middle Reservoir Dam impounds water from Beaver Lake (also known as Peat Swamp Reservoir), located 1700 feet upstream, via a pipe and Beaver Brook.

c. Size Classification:

The size classification of this dam is SMALL as per the criteria set forth in the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers. The impoundment storage at the top of the dam is 36 ac.-ft. (range 50 to 1000 ac.-ft.) and the maximum height of the dam is 27 feet (within the range

of 25 to 40 feet). The size classification is based on both the height and storage criteria.

d. Hazard Classification:

The hazard classification of this dam is SIGNIFICANT as per the criteria set forth in the Recommended Guidelines for Safety Inspection of Dams, by the Corps of Engineers. The dam is located upstream of the Quillinan Reservoir, Route 313, and a fluoridation house where failure discharge may cause the loss of a few lives, at the fluoridation house, and cause damage due to high velocity impact from debris and flooding. The estimated water depth due to the assumed dam failure may range from 27 feet at the dam to 3 feet, 5000 feet downstream at the Quillinan Reservoir.

Loss of the Middle Reservoir and the fluoridation house would impact a hardship on the Water Company.

e. Ownership:

The Middle Reservoir Dam is presently owned and maintained by the Ansonia - Derby Water Company, 230 Beaver Street, Ansonia, Connecticut, 06401.

f. Operator:

The operator and caretaker of the dam is:

Mr. Wilbur Clark
Ansonia - Derby Water Company
230 Beaver Street
Ansonia, CT 06401
Telephone: (203) 735-1888 (office)
(203) 734-6641 (home)

g. Purpose:

Middle Reservoir Dam impounds water from Beaver Brook and is used for supplying water to the distribution system of the Ansonia - Derby Water Company.

h. Design and Construction History:

The Middle Reservoir Dam was probably constructed in the late 1800s. The original dam was constructed only of grouted stone masonry. In 1905, improvements to the dam were made; this involved placement of concrete against the upstream face, probably an attempt to increase overturning stability of dam section and to

limit leakage. Subsequent to the 1905 improvements, the east crest of the dam has been raised approximately 1.5 feet by the addition of a masonry and concrete wall, and the auxiliary spillway constructed. A crest rehabilitation program was undertaken in about 1975, including mechanical removal of spalled concrete, but was not completed leaving the crest in a severely spalled condition.

i. Normal Operational Procedures:

Water is withdrawn from the reservoir into the gate house wet well via the 30 inch pipe and continues to the distribution system via the 24 inch pipe.

1.3 Pertinent Data

a. Drainage Area:

The Middle Reservoir drainage basin is generally triangular in shape with a length of 1.5 miles and an average width of 0.45 miles resulting in a total drainage area of .68 square miles (see drainage basin map in Appendix D). The topography is generally moderate to steep terrain, with elevations ranging from a high of 550 feet to a low of 266.9 feet at the auxiliary spillway crest. Stream and basin slopes are steep, 8 percent and 15 percent respectively. The reservoir has a normal surface area of 3.0 acres which is 0.7 percent of the watershed. The upstream Beaver Lake has a normal surface area of 77 acres which is 18 percent of the watershed. Eighty-eight percent of the watershed drains into Beaver Lake.

b. Discharge at Dam Site:

There is no specific discharge records available for this dam. Listed below are calculated discharge values for the spillway and outlet works (24 inch pipe and 8 inch blowoff pipe):

1. Outlet works: A 24 inch pipe with an intake at elevation 248.2 and a discharge capacity of 65 cfs at elevation 267.4. An 8 inch blowoff with an intake at approximately 234 and a discharge capacity of 10 cfs at elevation 267.4.
2. Maximum known flood at dam site: Calculated to have been approximately 40 cfs based on a reported flow of 3 to 4 inches over the primary spillway. Flood flows have been mitigated by the upstream Beaver Lake.
3. Spillway capacity at top of dam: 78 cfs (primary) and 54 cfs (auxiliary) at elevation 268.4.
4. Spillway capacity at test flood elevation: 340 cfs at elevation 269.4.

5. Gated outlet capacity at normal pool elevation: 64 cfs (24 inch) and 10 cfs (8 inch) at elevation 266.9.
6. Gated outlet capacity at test flood elevation: 69 cfs (24 inch) and 10 cfs (8 inch) at elevation 269.4.
7. Gated outlet capacity at top of dam elevation: 66 cfs (24 inch) and 10 cfs (8 inch) at elevation 268.4.
8. Total project discharge at top of dam: 208 cfs at elevation 268.4.
9. Total project discharge at test flood level: 844 cfs at elevation 269.4.

c. Elevation (Feet above NGVD):

1. Stream bed at toe of dam	241.4
2. Bottom of cutoff	226.4
3. Maximum tailwater	N/A
4. Recreation pool	N/A
5. Full flood control pool	N/A
6. Spillway crest (normal pool)	267.4 (primary) 266.9 (auxiliary)
7. Design surcharge (Original Design)	Unknown
8. Top of dam	268.4 (west) 269.5 (east)
9. Test flood level	269.4

765
1000
2000

d. Reservoir (Length in feet)

1. Normal pool	750
2. Flood control pool	N/A
3. Spillway crest pool	750
4. Top of dam	800

5.	Test flood pool	900
e. Storage (acre-feet)		
1.	Normal pool	33
2.	Flood control pool	N/A
3.	Spillway crest pool (primary)	33
4.	Top of dam	36
5.	Test flood pool	40
f. Reservoir Surface (acres)		
1.	Normal pool	3.0
2.	Flood control pool	N/A
3.	Spillway crest (primary)	3.0
4.	Test flood pool	3.8
5.	Top of dam	3.5
g. Dam		
1.	Type	Stone masonry and concrete
2.	Length	300 feet
3.	Height	27 feet
4.	Top width	8 feet
5.	Side slopes	Upstream - stepped Downstream - 1H:5V to 1H:7V
6.	Zoning	Unknown
7.	Impervious core	Masonry

8. Cutoff	Concrete
9. Grout curtain	Unknown
10. Other	-- --
h. Diversion and Regulating Tunnel	N/A
i. Spillway	
1. Type	Overflow, broad crested uncontrolled weirs
2. Length of weir	29.0 feet (primary) 12.0 feet (auxiliary)
3. Crest elevation	267.4 (primary) 266.9 (auxiliary)
4. Gates	None
5. U/S Channel	Natural bed
6. D/S Channel (primary spillway)	Overgrown gravel and rock channel
D/S Channel (auxiliary spillway)	Riprap and rock, joins primary spillway channel below dam.
j. Regulating Outlets	
Refer to Paragraph 1.2b - "Description of Dam and Appurtenances" for description of Outlet Works.	
1. Inverts and size	24 inch pipe - 248.2 feet 8 inch pipe - 234+/- feet
2. Description	Cast iron pipes

3. Control Mechanisms

**24 inch — hand
operated gear
mechanisms with
masonry gate house**

**8 inch — control
hydrant below
dam**

SECTION 2

ENGINEERING DATA

2.1 Design

There are limited available records presenting design information for the construction of the Middle Reservoir Dam. A 1905 plan, cross sections, elevation of the dam, and an undated sketch of the outlet works have been included in Appendix B of this report.

Other data concerning the dam was destroyed during past flooding of the Water Company offices.

2.2 Construction

There are no available records of the construction of this dam.

2.3 Operation

No formal records of operation are kept for this facility.

2.4 Evaluation

- a. **Availability:** The information noted above for this facility is available in the files of the Department of Environmental Protection, Water and Related Resources Unit, Dam Safety Engineers, State Office Building, Hartford, Connecticut, and the Ansonia - Derby Water Company, Ansonia, Connecticut.
- 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 alone, 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 could not be verified.

SECTION 3

VISUAL INSPECTION

3.1 Findings

- a. **General:** The visual inspection of the Middle Reservoir Dam was conducted on November 16, 1979 and a copy of the visual inspection check list is contained in Appendix A of this report.

The following procedure was used:

1. Inspection of the upstream area of the reservoir which is impounded by the dam.
2. Visual inspection of the face and top of the dam and spillways for cracks, loose stones, leakage, etc.
3. Inspection of the outlet works and other appurtenances as to their existence, location, and operability.
4. Review of procedures that could be utilized in the event of an emergency situation.
5. A check of the downstream area for seepage, piping, boils or other indications of abnormal conditions. The downstream hazard potential in the event of dam failure was investigated.
6. Photographs of the general area of the dam and of specific items of note were taken and are included in Appendix C of this report.

Before the inspection, the available existing data and aerial photographs were studied and reviewed.

b. **Dam**

1. **Crest:** The top of the dam is constructed of granite stones with a concrete cap and shows no evidence of settlement or misalignment. The dam's crest has a low 6 inch wall along the upstream edge (Photos C-3, C-12). The dam's east crest (labeled wingwall on the record drawing) has a 30 inch concrete capped stone wall along the downstream edge (Photo C-4). Grass is growing on the west crest except in the immediate area of the spillway. In this area and the entire east crest, spalling concrete was mechanically

removed in about 1975 as part of a crest rehabilitation project. The project has not been completed and further spalling has occurred. The top is approximately 8 feet wide.

2. **Upstream Face:** The upstream face of the dam is stepped concrete over the original masonry. The face above the water level on the day of the inspection, 12 inches below the dam's west crest, is also spalled and chipped.
3. **Downstream Face:** The downstream face is stone masonry with a slope varying from 1H:5V to 1H:7V. See Appendix B for sections through the dam. Considerable vegetative growth exists on the face including grass, vines and small shrubs (Photo C-1, C-2, C-9). Mortar is missing from most of the joints creating voids and there is leakage from several joints (Photo C-7) and from the ground at the toe (Photo C-8). Trees are growing on the earthen embankment below the western side of the dam (Photo C-12).

c. Appurtenant Structures

1. **Primary Spillway:** The primary spillway is a 29 foot long and 8 foot wide broad crested weir located in the central portion of the dam (Photo C-1, C-2). It is constructed of a concrete cap over stone masonry, and is also chipped and spalled (Photos C-3 and C-4). Water was not flowing over this spillway at the time of the inspection.
2. **Auxiliary Spillway:** The auxiliary spillway is a 12 foot long opening in the top of dam at the east abutment. The concrete crest of the spillway is at the same level as the beginning of the discharge channel (Photo C-5). A slight flow was occurring from this spillway which is approximately 6 inches lower than the primary spillway.
3. **24 Inch Pipe:** A 24 inch pipe extends from the gate house, through the dam, and continues downstream approximately 700 feet to a fluoridation house and on to the water distribution system. The pipe is controlled at the gate house by a 24 inch gate valve which is usually open. This valve was reportedly operational.
4. **6 Inch Drain:** Record drawings indicate a 6 inch drain for the gate house, which discharges below the dam. The control valve is located and operated from inside the gate house. The discharge point could not be determined and it is not known if the valve is operable.
5. **8 Inch Blowoff:** An 8 inch low level blowoff extends from an intake upstream of the dam, through the base of the dam, to an outlet below the dam, at the discharge channel. The blowoff is controlled by a hydrant and is reportedly exercised once a year.

6. **Gate House:** The gate house is a brick and concrete structure and is located on the dam's west crest (Photo C-12). The house is generally in good condition with a few minor cracks in the concrete. A single 30 inch pipe admits water into the wet well and is controlled by a 30 inch gate valve which is reportedly operational (Photo C-11).
- d. **Reservoir Area:** The reservoir is formed by the flooding of a portion of the Beaver Brook Valley. The sides of the forested valley have gentle slopes bordering the reservoir. No geologic features were detected that could be expected to adversely affect the dam or its appurtenant structures.

Trespassing on the dam is not permitted.

The Beaver Lake (Peat Swamp Reservoir) is located approximately 1700 feet upstream of the dam and failure of this upstream dam would create a potential hazard on the Middle Reservoir Dam.

- e. **Downstream Channel:** The downstream channel is a meandering stream in a natural condition. The discharge channel for the auxiliary spillway (Photo C-6) is a small rock channel which joins the primary spillway channel below the dam. There is a 46 inch wide by 60 inch high concrete box culvert below Route 313 (Photo C-14) approximately 100 feet below the dam. The roadway is at elevation 260+/- or approximately 27 feet above the streambed. A small pond and dam are approximately 400 feet below the Middle Reservoir Dam.

There was seepage from the ground approximately 50 feet below the west abutment of the Middle Reservoir Dam (Photo C-10) at the toe of the highway embankment.

3.2 Evaluation

Based on the visual inspection, the Middle Reservoir Dam appears to be in fair condition overall, and there were no major areas of distress noted. Specific areas of concern that were noted are:

The presence of leakage and vegetative growth on the downstream face and embankment.

The spalling and chipped condition of the crest and spillway due to the unfinished rehabilitation project.

The missing mortar and voids between stones on the downstream face.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

The Middle Reservoir is a surface water supply storage facility for the Ansonia - Derby Water Company. Water flows by gravity from the gate house, located on the dam, to the fluoridation house, located downstream of the dam, through a 24 inch cast iron pipe. Water is then supplied to the water distribution system. The 8 inch blowoff is operated annually.

4.2 Maintenance of the Dam

There is no regular maintenance schedule for this dam. An uncompleted rehabilitation project has resulted in the present chipped and spalled condition of the crest and spillway.

4.3 Maintenance of the Operating Facilities

No regular maintenance of the gate house valves was reported. The lift mechanisms appear in good working condition. The control hydrant used to discharge water from the 8 inch blowoff is operated on an annual basis.

4.4 Description of Any Warning System in Effect

No formal emergency or contingency plan is in effect to reduce or minimize downstream damage in emergency situations.

4.5 Evaluation

To insure the safety of the residents downstream a regular inspection and maintenance program should be developed and implemented.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The Middle Reservoir Dam creates an impoundment with a total storage capacity of 33 ac.-ft. at elevation 267.4, the primary spillway crest elevation. Each foot of depth in the reservoir above the spillway crest can accommodate approximately 3 ac.-ft. The primary spillway is a 29 foot long by 8 foot wide broad crested uncontrolled weir. The auxiliary spillway is a 12 foot long opening in the crest at the east abutment. 88 percent of the drainage area drains to the upstream Beaver Lake. Stream and basin slopes are steep, 8 percent and 15 percent, respectively.

5.2 Design Data

- a. No specific design data is available for this watershed or the structures of the Middle Reservoir Dam. In lieu of existing design information, USGS topographic maps (scale 1"=2000') were utilized to develop hydrologic parameters such as drainage area, basin length, time of concentration, and other runoff characteristics. Elevation-storage relations for the reservoir were approximated. Reservoir surface area and surcharge storage were computed using the USGS maps. Some of the pertinent hydraulic design data was obtained and/or confirmed by actual field measurements at the time of the visual inspection.
- b. Outflow values (routing procedures) and dam overtopping analyses 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 detailed analysis.

5.3 Experience Data

Historical data for recorded discharges is not available for this dam. The maximum discharge over the spillways to date was calculated to be approximately 40 cfs corresponding to a water level of 3 to 4 inches over the primary spillway.

The existence of Beaver Lake (Peat Swamp Reservoir) 1700 feet upstream of the dam has a pronounced effect on flood flows to the Middle Reservoir. During the 1955 flood, the water level in Beaver Lake was low and outflow was substantially curtailed, and reportedly, the Middle Reservoir Dam was not overtopped.

5.4 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 SIGNIFICANT hazard and SMALL size structure. Guidelines indicate that a range of the 100 year flood to 1/2 times the Probable Maximum Flood (PMF) be used as the "Test Flood" for these classifications. A test flood of 1/2 PMF was chosen to yield conservative values in light of the approximate nature of the analysis. The watershed has a total area of .68 square miles. Snyder's lag was calculated to be 2.25 hours and a Snyder peaking coefficient of 0.625 was used. The 200 square mile - 24 hour Probable Maximum Precipitation (PMP) is 22 inches. The flood hydrograph package, HEC-1 computer program developed by the Corps of Engineers was utilized to develop the inflow hydrograph, route the flood through the reservoir, and for the dam overtopping analysis. A test flood inflow equal to 1/2 PMF was calculated to be 770 cfs.

This test flood analysis assumes that the outlet works are closed and that Beaver Lake (Peat Swamp Reservoir) is full and is providing no reduction in flood flows.

The spillway capacity is hydraulically inadequate to pass the test flood (1/2 PMF) and overtopping of the dam will occur. The maximum outflow capacity of the spillways without overtopping the dam is 132 cfs. This corresponds to approximately 17 percent of the test flood and a storage above the primary spillway level of 3 ac.-ft. The maximum outflow discharge value for the test flood is 765 cfs corresponding to a depth of flow over the top of the dam of 1.0 foot and a storage above the spillway level of 7 ac.-ft. A spillway rating curve, an outlet rating curve, and a reservoir surface area-capacity curve, are included in Appendix D of this report.

At the primary spillway elevation of 267.4, the capacity of the 8 inch outlet structure is 10 cfs, and 65 cfs can be withdrawn via the 24 inch supply main. It will require approximately 1/2 hour to lower the water level the first foot assuming a water surface area of 3 acres, normal inflow conditions, and use of the outlet works to regulate the water level for expected inflows.

5.5 Dam Failure Analysis

This dam is classified as a significant hazard structure. Failure discharge can cause damage due to high velocities, impact from debris, and flooding to the fluoridation house along the downstream channel and two roads.

The calculated dam failure discharge is 8000 cfs at a pool level equal to the top of the dam. At this level the pre-failure flow in the downstream channel will be equal to the full spillway's capacity of 132 cfs corresponding to a depth of flow of less than 1 foot. Failure will produce a water surface level approximately 27 feet immediately downstream from the dam due to the Route 313 embankment. This roadway is approximately at elevation 260 and the embankment is assumed to wash out in the event of a dam failure. The fluoridation house located approximately 750 feet downstream

of the dam may be inundated by 2 to 3 feet of water. The failure discharge will effect downstream areas for a distance of 5000 feet from the dam.

At this distance, the water surface level will be approximately 3 feet above normal observations as it enters the Quillian Reservoir. Beyond 5000 feet, the effects of the failure discharge will be reduced as it enters the Quillian Reservoir. Water surface elevations due to the failure of the dam are listed in Appendix D. Probable consequences including the prime impact areas are also listed in Appendix D.

D-14

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observation

The visual inspection revealed no signs of major physical distress in the structure. However, leakage was noted on the downstream face and below the dam.

6.2 Design and Construction Data

There is insufficient design and construction data to permit a formal evaluation of stability.

6.3 Post-Construction Changes

The stepped concrete wall was placed against the upstream face in 1905.

The east crest was modified by the creation of a 1.5 foot stone masonry and concrete wall on the top of the crest, and the auxiliary spillway was constructed subsequent to 1905.

An uncompleted 1975 crest rehabilitation project has resulted in the spalled condition of the crest.

6.4 Seismic Stability

The dam is in Seismic Zone 1 and hence does not require evaluation for seismic stability according to the Corps of Engineers Recommended Guidelines.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. **Condition:** Based on the visual inspection, past performance and hydraulic/hydrologic evaluation, the Middle Reservoir Dam and appurtenances are judged to be generally in FAIR condition. Items of concern that should be addressed as a result of this inspection are listed in Section 7.2 and 7.3.
- b. **Adequacy of Information:** The limited engineering data did not allow for a definitive review. Therefore, the adequacy of the dam is based 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.

7.2 Recommendations

It is recommended that the owner engage a qualified registered engineer to carry out the following actions and that his recommendations be implemented.

- a. A detailed hydrologic/hydraulic investigation to determine the need and means of increasing the discharge capacity of the project.
- b. A plan be developed for the removal of the trees on the embankment below the western side of the dam to prevent piping.
- c. The upstream face be visually inspected.
- d. The crest rehabilitation project should be completed.

7.3 Remedial Measures

- a. **Operational and Maintenance Procedures**
 - 1. The vegetation should be removed from the joints and the joints repointed on the downstream face of the dam.
 - 2. The remaining vegetation should be removed from the crest.

3. The seepage on the downstream face should be monitored to note any change from the existing conditions.
4. Insure the operability of all valves for the outlet works.
5. The cracks in the concrete on the gate house should be repaired.
6. Develop a downstream warning and surveillance plan, including round-the-clock monitoring during heavy precipitation.
7. Institute a program of annual periodic technical inspection.

7.4 Alternatives

None.

APPENDIX A
INSPECTION CHECK LIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Middle Reservoir Dam

DATE November 16, 1979

TIME 1:00 - 2:30 P.M.

WEATHER Clear

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

PARTY:

1. R. Johnston, JPPA

6. B. Clark, Ansonia - Derby
Water Company

2. R. Lyon, JPPA

7. _____

3. J. Chastanet, CWDD

8. _____

4. _____

9. _____

5. _____

10. _____

PROJECT FEATURE

INSPECTED BY

REMARKS

1. Hydraulics R. Johnston

2. Structural R. Lyon

3. Geotechnical J. Chastanet

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam

DATE November 16, 1979

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED

CONDITION

DAM EMBANKMENT

Crest Elevation 268.4

Fair - Spalled concrete removed in 1975+ but not replaced.

Current Pool Elevation 266.9

Crest of auxiliary spillway.

Maximum Impoundment to Date

Approximately 4 inches over primary spillway.

Surface Cracks

Cracks in grout and joints.

Pavement Condition

N/A

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

Indications of Movement of Structural Items on Slopes

None observed

Trespassing on Slopes

Not permitted

Vegetation on Slopes

Considerable growth on dam.

Sloughing or Erosion of Slopes or Abutments

Minor deterioration of concrete joints.

Rock Slope Protection - Riprap Failures

N/A

Unusual Movement or Cracking at or near Toes

None observed

Unusual Embankment or Downstream Seepage

Seepage on downstream face and from ground below dam.

Piping or Boils

None observed

Foundation Drainage Features

None observed

Toe Drains

None observed

Instrumentation System

None observed

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam

DATE November 16, 1979

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u> a. Approach Channel b. Intake Structures 24 inch pipe and 6 inch drain 8 inch blowoff	Entire lake bed - under water. Water enters the gate house wet well via a 30 inch pipe controlled by a gate valve. Record drawing indicates a free access pipe inlet.

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam

DATE November 16, 1979

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED

CONDITION

OUTLET WORKS - CONTROL TOWER

a. Concrete and Structural

General Condition

Good

Condition of Joints

Good

Spalling

Minor

Visible Reinforcing

None observed

Rusting or Staining of
Concrete

None observed

Any Seepage or Efflorescence

None observed

Joint Alignment

Good

Unusual Seepage or Leaks in
Gate Chamber

None observed

Cracks

Minor on exterior concrete.

Rusting or Corrosion of Steel

None observed

b. Mechanical and Electrical

Air Vents

4 inch vent into gate house from
24 inch pipe.

Float Wells

N/A

Crane Hoist

N/A

Elevator

N/A

Hydraulic System

N/A

Service Gates

See Intake Structures

Emergency Gates

See Intake Structures

Lightning Protection System

None observed

Emergency Power System

N/A

Wiring and Lighting System
in Gate Chamber

None observed

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam

DATE November 16, 1979

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED

CONDITION

OUTLET WORKS - TRANSITION AND CONDUIT

24 Inch Pipe

A 24 inch sluice gate in the gate house controls flow into the 24 inch pipe. The 24 inch pipe extends through the dam and runs approximately 750 feet to a fluoridation house. The pipe then continues to the water distribution system.

6 Inch Drain

A 6 inch gate valve in the gate house controls flow into the 6 inch drain. The 6 inch drain extends through and discharges below the dam.

8 Inch Blowoff

The 8 inch pipe extends from the inlet upstream of the dam, through the embankment, and continues to a control hydrant downstream of the dam.

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam

DATE November 16, 1979

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u> 24 Inch Pipe 6 Inch Drain 8 Inch Blowoff A-6	The outlet for this pipe is the water distribution system. Water can also be blown off at the fluoridation house. The outlet for the 6 inch drain could not be determined. An 8 inch pipe extends from the control hydrant to the spillway discharge channel below the dam. This system is operated annually.

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam

DATE November 16, 1979

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED

CONDITION

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNFLS

PRIMARY SPILLWAY

a. Approach Channel

Reservoir Bed - Under water

General Condition

Loose Rock Overhanging Channel

Trees Overhanging Channel

Floor of Approach Channel

b. Weir

General Condition of Concrete

Fair to Good

Rust or Staining

None Observed

Spalling

Minor

Any Visible Reinforcing

None Observed

Any Seepage or Efflorescence

None Observed

Drain Holes

None Observed

c. Discharge Channel

General Condition

Fair

Loose Rock Overhanging Channel

None Observed

Trees Overhanging Channel

Yes

Floor of Channel

Overgrown and Marshy

Other Obstructions

A 46 inch wide by 60 inch high
concrete box culvert under
Poute 313, approximately 100 feet
below the dam.

INSPECTION CHECK LIST

PROJECT Middle Reservoir Dam DATE November 16, 1979
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	AUXILIARY SPILLWAY
a. Approach Channel	Reservoir Bed - Underwater
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	
General Condition of Concrete	Good
Rust or Staining	None Observed
Spalling	None Observed
Any Visible Reinforcing	None Observed
Any Seepage or Efflorescence	Possible seepage to discharge channel.
Drain Holes	None Observed
c. Discharge Channel	Joins primary spillway channel below dam.
General Condition	Good
Loose Rock Overhanging Channel	None Observed
Trees Overhanging Channel	Yes
Floor of Channel	Rip-rap and rock
Other Obstructions	A 46 inch wide by 60 inch high concrete box culvert under Route 313, approximately 100 feet below the dam.

APPENDIX B
ENGINEERING DATA

APPENDIX B-1

DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS AND LOCATION

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

**Ansonia-Derby Water Company
230 Beaver Street
Ansonia, Connecticut 06401**

APPENDIX B-2
COPIES OF PAST INSPECTION REPORTS

No. SL 7

WATER RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

3
IT 590

Inventoried
By WVS

Date 12 MAY 1964

Name of Dam or Pond MIDDLE RESERVOIR

Code No. H 118 N 16 BV 2.4

Nearest Street Location MAILE STREET

Town SEYMOUR

U.S.G.S. Quad. ANSONIA

Name of Stream BEAVER BROOK

Owner THE ANSONIA WATER COMPANY

Address 354 MAIN STREET

ANSONIA

LAT. $41^{\circ} 21.9'$
LONG. $73^{\circ} 03.7'$

MA
7/27

Pond Used For WATER SUPPLY DA 0.575M

Dimensions of Pond: Width 200 FEET Length 600 FEET Area 3 ACRES

Total Length of Dam 300 FEET Length of Spillway 20 FEET

Location of Spillway CENTER OF DAM

Height of Pond Above Stream Bed 30 FEET

Height of Embankment Above Spillway 2 FEET

Type of Spillway Construction CONCRETE

Type of Dike Construction MASONRY

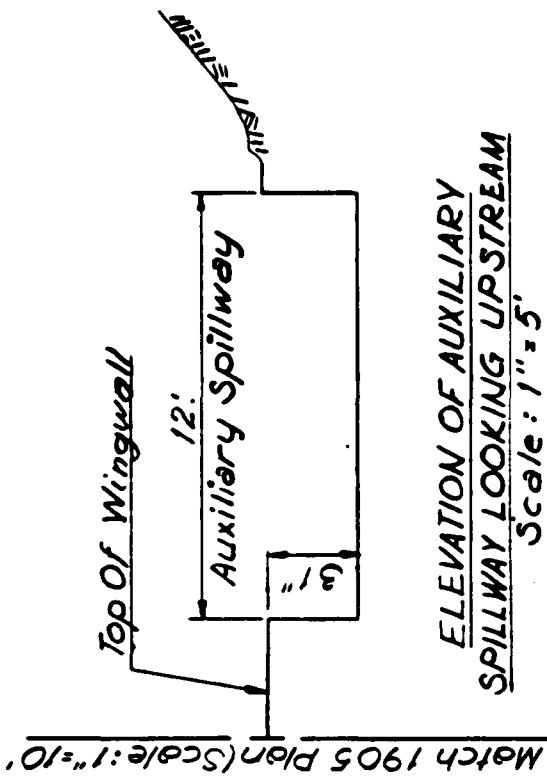
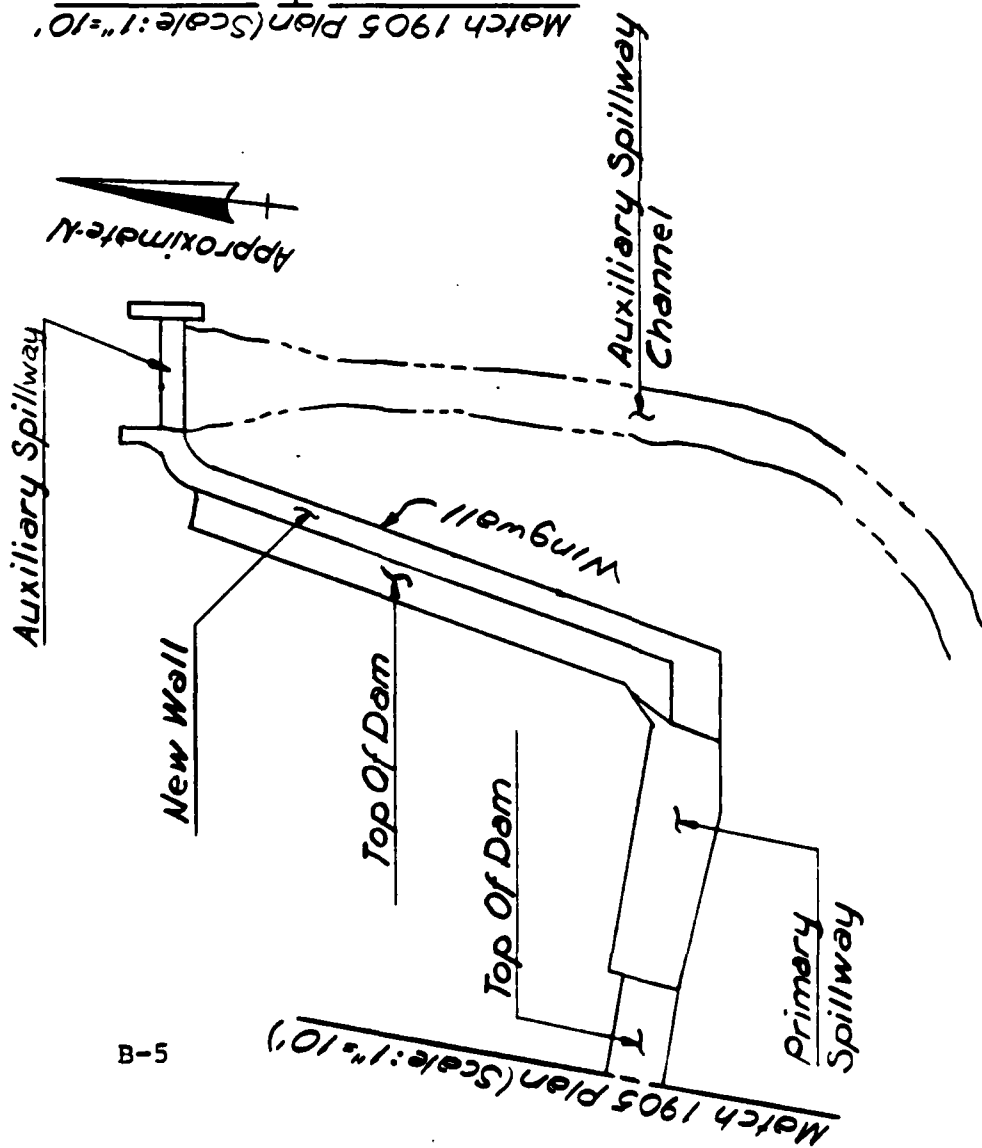
Downstream Conditions RIMMON ROAD

Summary of File Data

Remarks SLIGHT LEAKAGE AT BASE OF DAM

Would Failure Cause Damage? YES Class B

APPENDIX B-3
RECORD DRAWINGS AND SKETCHES



ELEVATION OF AUXILIARY
SPILLWAY LOOKING UPSTREAM
Scale: 1"=5'

NOTE:
All Dimensions Shown
Are Plus Or Minus.

PLAN OF SPILLWAYS
Scale: 1"=20'

MIDDLE RESERVOIR DAM



JAMES P. PURCELL ASSOCIATES, INC.
ENGINEERS • ARCHITECTS • PLANNERS

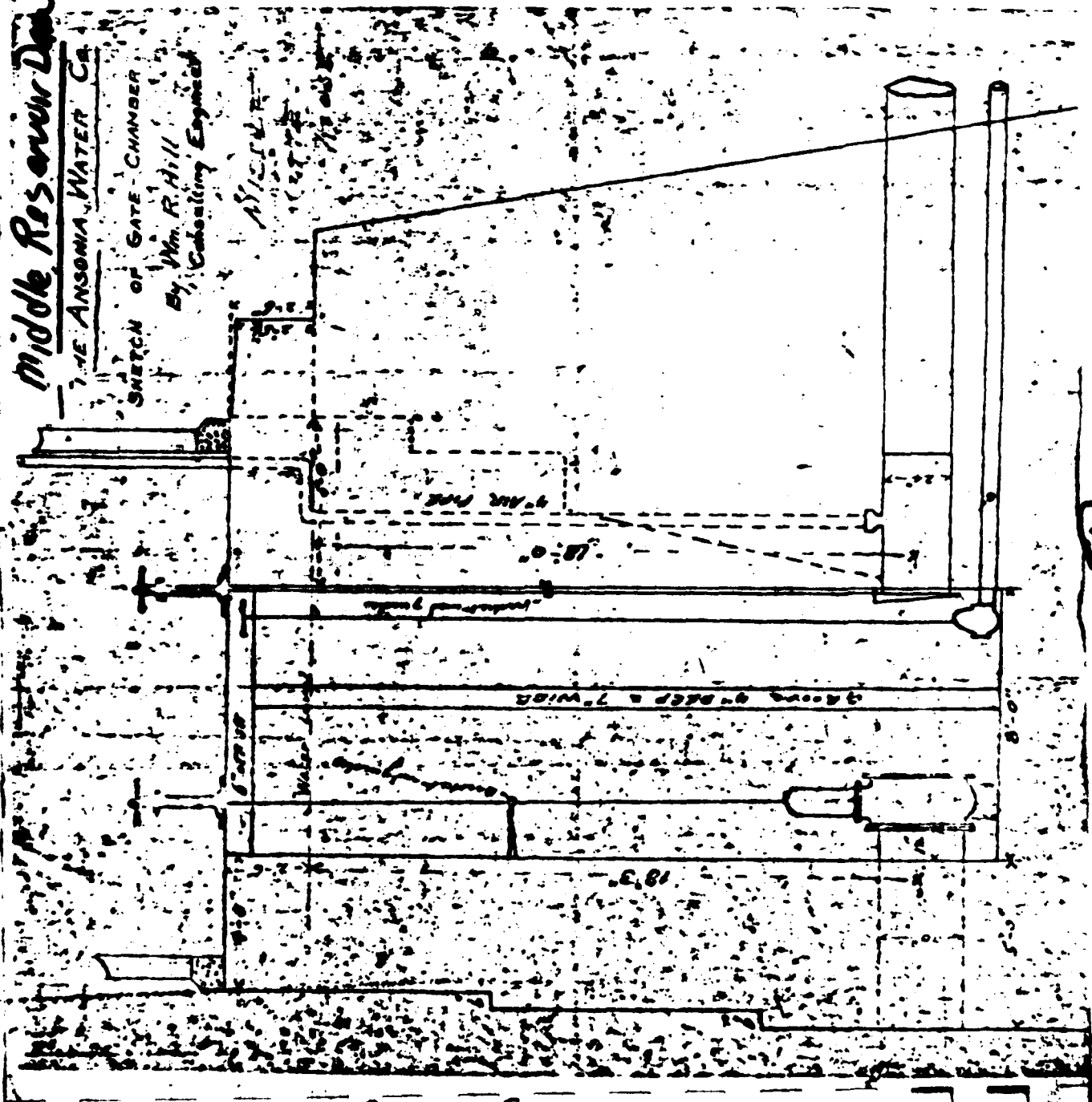
Middle Reservoir Dam

THE ANSONIA WATER CO.

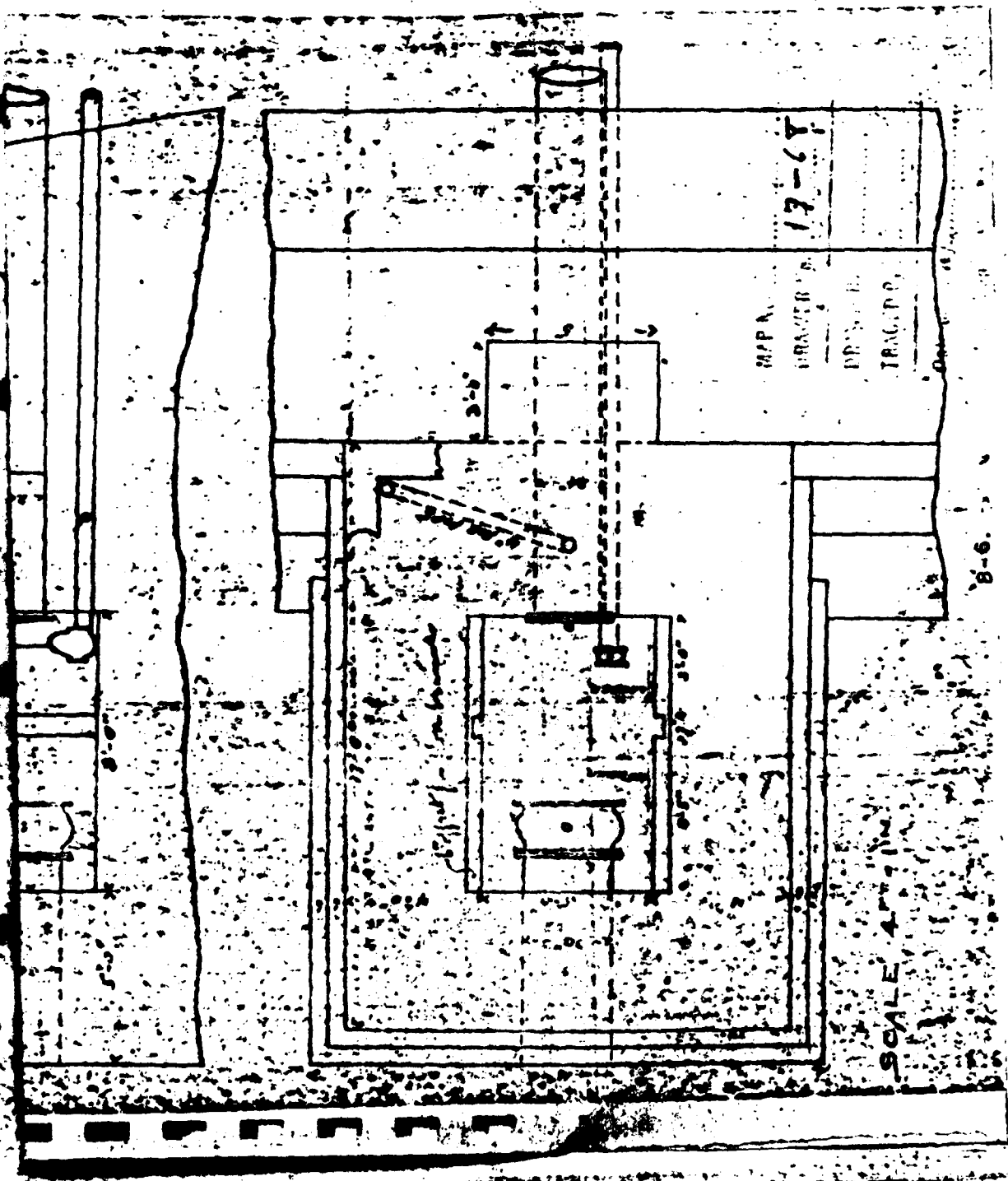
SKETCH OF GATE CHAMBER

By Wm. R. Hill
Civil Engineering

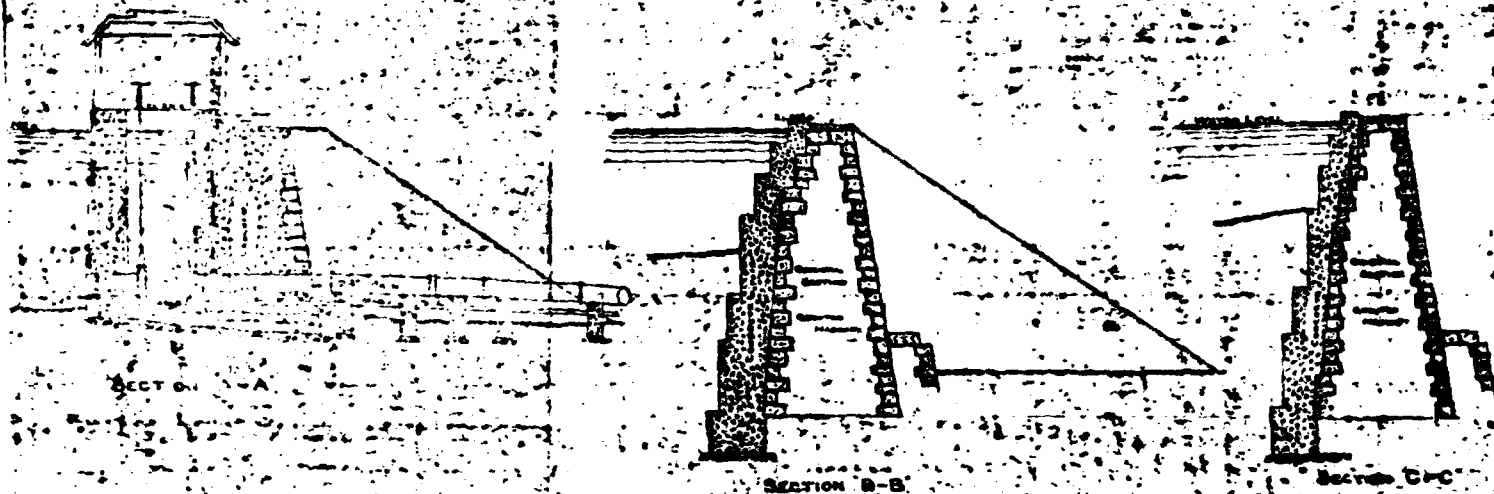
SECTION



11



2



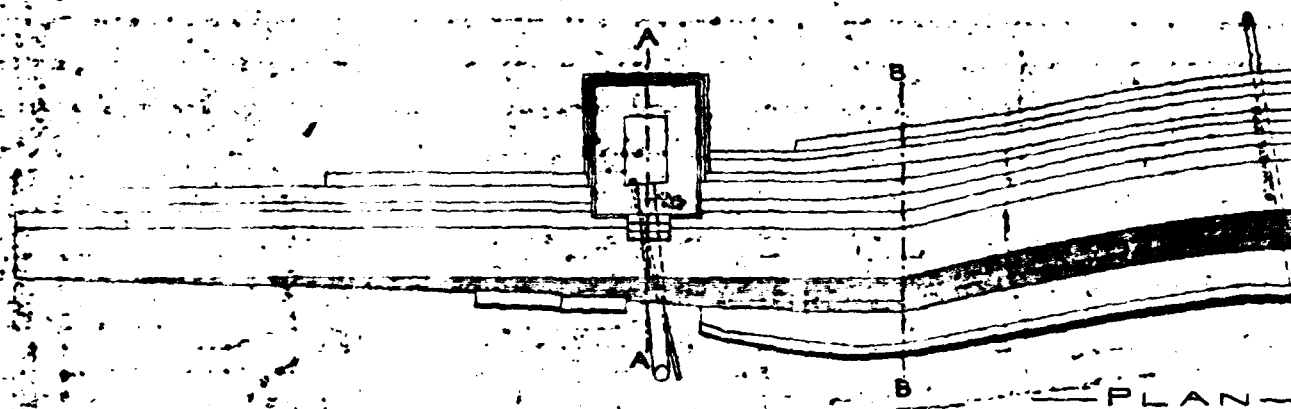
THE ANSONIA WATER CO.

IMPROVEMENT OF DAM AT MIDDLE RESERVOIR

TOWN OF SEYMOUR, CONN.

SCALE 1"=10' JUNE - OCT 1905.

CHARLES H. MICHAEL

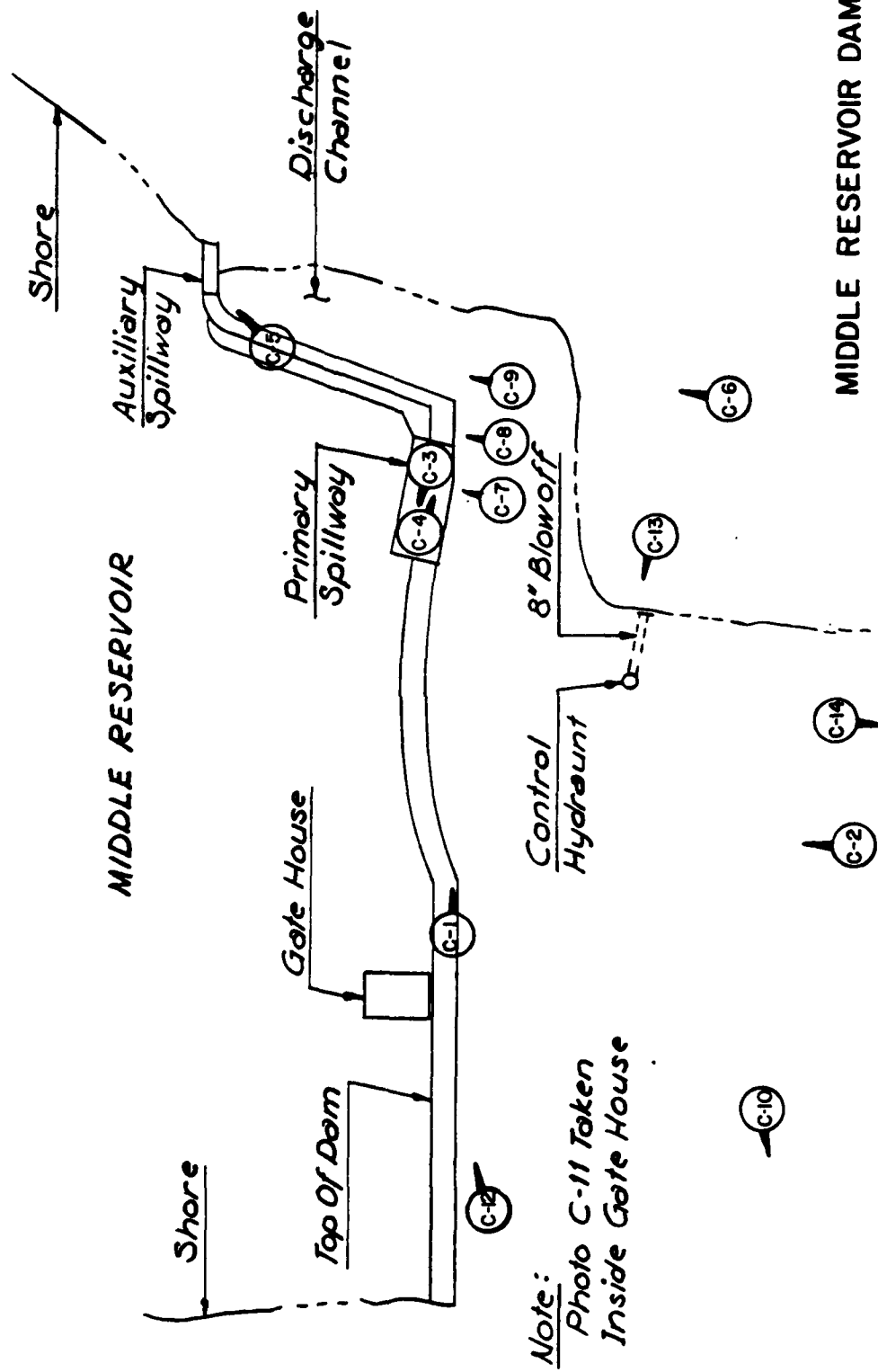


①



APPENDIX C
PHOTOGRAPHS

Approximate N



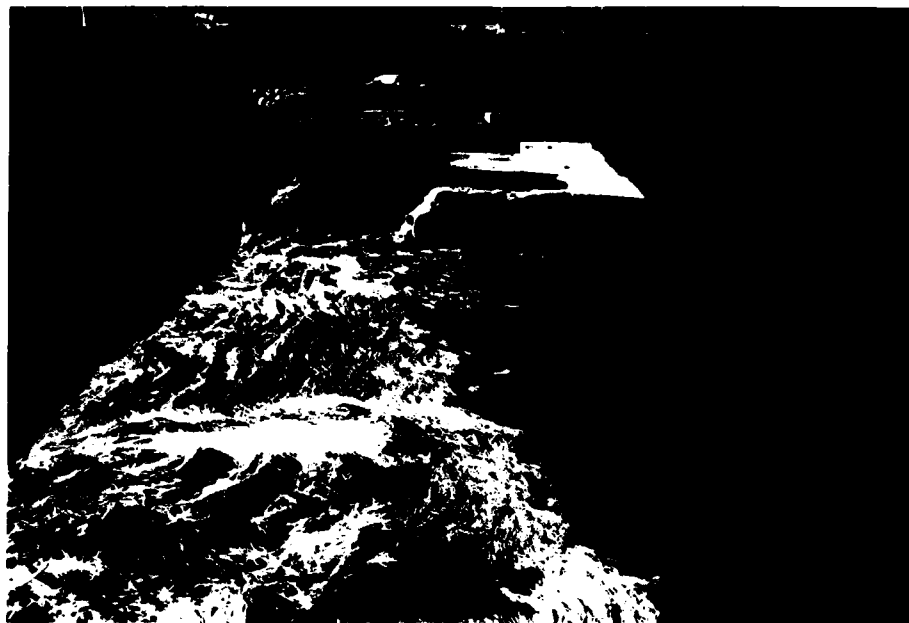
MIDDLE RESERVOIR DAM
PHOTO INDEX



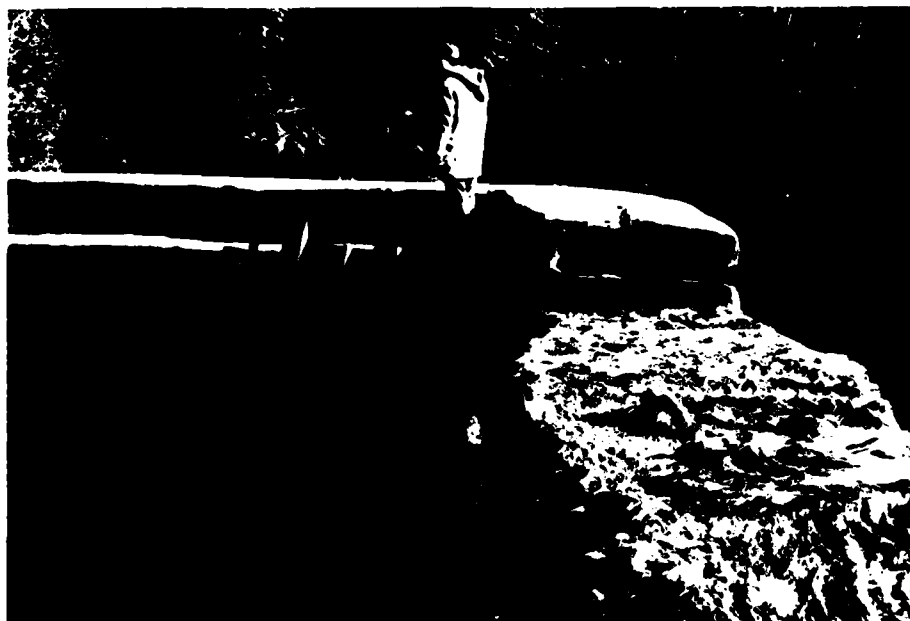
C-1 SPILLWAY AND DOWNSTREAM
FACE OF DAM - LOOKING
EAST



C-2 SPILLWAY AND DOWNSTREAM FACE OF DAM -
LOOKING NORTH



C-3 TOP OF DAM AND SPILLWAY - LOOKING WEST



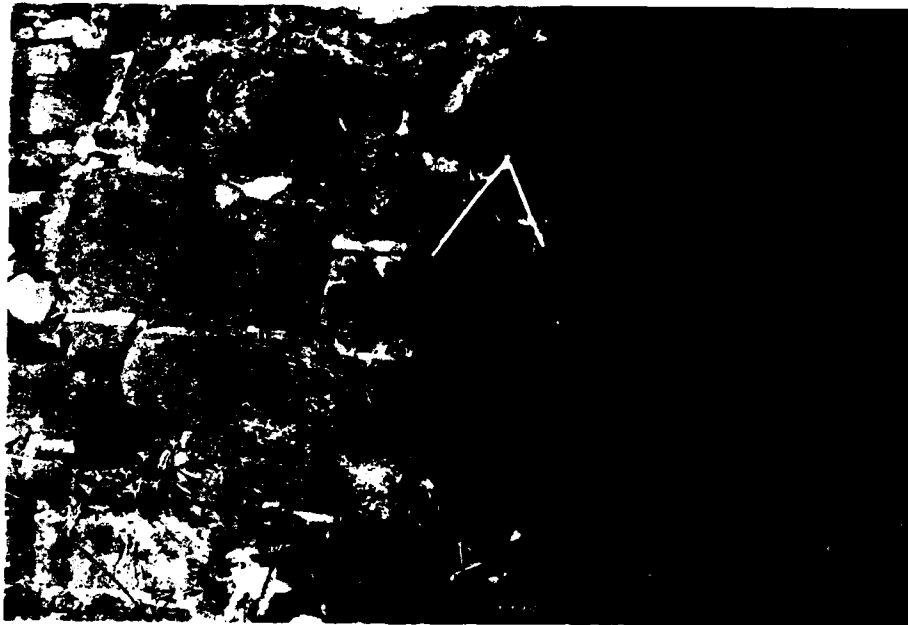
C-4 TOP OF DAM AND SPILLWAY - LOOKING EAST



C-5 AUXILIARY SPILLWAY AT EASTERN ABUTMENT



C-6 AUXILIARY SPILLWAY DISCHARGE CHANNEL.



C-7 SEEPAGE THROUGH DOWNSTREAM FACE OF DAM



C-8 SEEPAGE FROM GROUND AT TOE OF DOWNSTREAM
FACE OF DAM



C-9 VEGETATION ON EASTERN DOWNSTREAM FACE OF
DAM



C-10 FLOW FROM GROUND DOWNSTREAM OF DAM



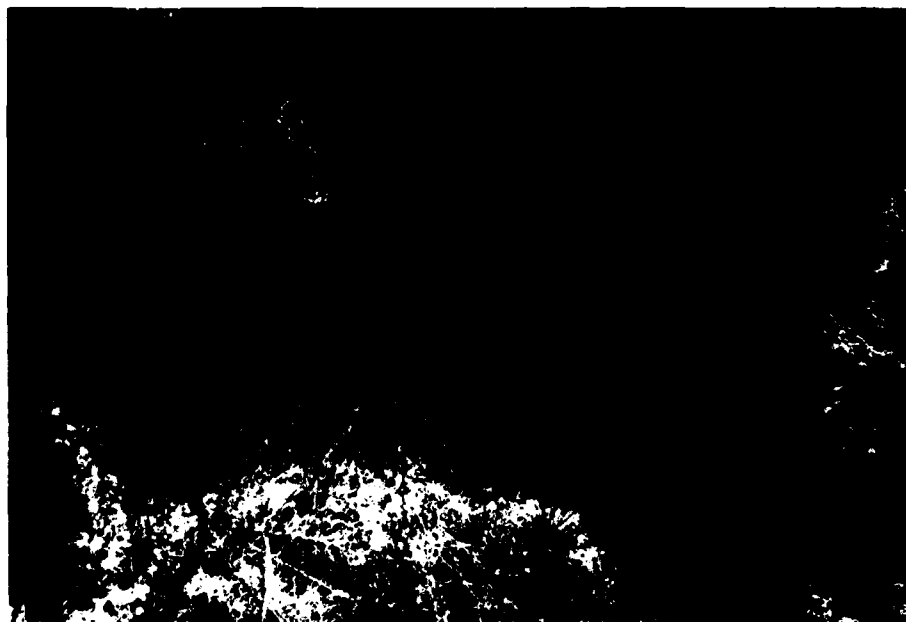
C-11 LIFT MECHANISM FOR
30 INCH GATE VALVE --
INSIDE GATE HOUSE



C-12 GATE HOUSE



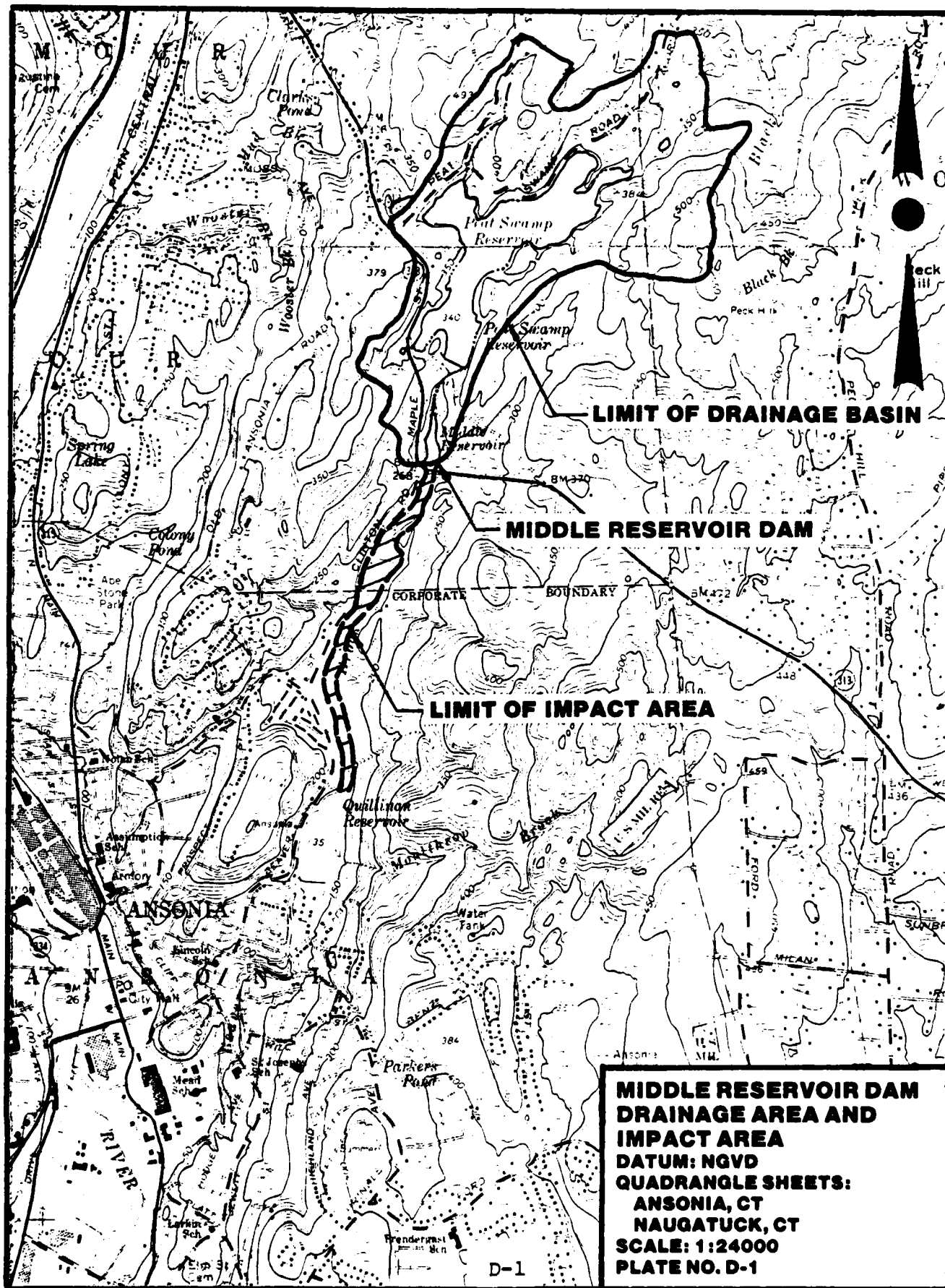
C-13 CONTROL HYDRANT AND
8 INCH BLOWOFF



C-14 DOWNSTREAM CHANNEL AND BOX CULVERT
BENEATH ROUTE 313

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



HYDROLOGIC AND HYDRAULIC ANALYSIS
SUMMARY SHEET

Dam Middle Reservoir Dam

Test Flood 1/2 PMF

INFLOW HYDROGRAPH DEVELOPMENT

Drainage Area 0.68 sq. mi.

Probable Maximum Precipitation
24 hour - 200 square mile PMP 22 inches

Initial Rairfall Loss 0 Inch
Uniform Rairfall loss .1 Inch

Snyder's Lag 2.25 hours
Snyder's Peaking Coefficient .625

Test Flood Inflow 770 CFS

PMF Inflow 1540 CFS

RESERVOIR ROUTING AND DAM OVERTOPPING

Test Flood Outflow 765 CFS

Spillway Capacity at Top of Dam	<u>132</u>	CFS
(Primary and Auxiliary)	<u>17</u>	% of Test Flood

Flow Over Spillway at Test Flood	<u>340</u>	CFS
----------------------------------	------------	-----

Spillway Crest Elevation	<u>267.4</u>	Feet (Primary Spillway)
Top of Dam Elevation	<u>268.4</u>	Feet
Test Flood Elevation	<u>269.4</u>	Feet

PROJECT SUMMARY
LAST MODIFICATION 26 FEB 79

DAM SAFETY ANALYSIS-JOB NO. 79-905/09 EHJ
MIDDLE RESERVOIR DAM-SEYMOUR-CONN.
1-22-80

1	A1	75	1	0	0	0	0	0	0	0
2	A2	5	1	0	0	0	0	0	0	0
3	A3	1	2	1	0	0	0	0	0	0
4	H	5	1	0	0	0	0	0	0	0
5	B1	1	1	0	0	0	0	0	0	0
6	J	5	1	0	0	0	0	0	0	0
7	J1	5	1	0	0	0	0	0	0	0
8	K	0	1	0	0	0	0	0	0	0
9	K1	0	1	0	0	0	0	0	0	0
10	M	1	1	.68	0	.68	0	0	0	1
11	P	0	22	110	124	133	142	0	0	0
12	T	0	0	0	0	0	0	0	0	.1
13	W	2.25	.625	2.0	0	0	0	0	0	0
14	X	1.9	.05	2.0	0	0	0	0	0	0
15	K	1	1	0	0	0	0	0	0	1
16	K1	1	1	0	0	0	0	0	0	1
17	Y	0	0	0	0	1	1	0	0	-1
18	Y1	1	0	0	0	0	0	0	0	-1
19	SA	3.0	3.5	4.0	5.0	0	0	0	0	-1
20	SE	267.4	268.4	270.0	272.0	0	0	0	0	-1
21	SS	267.4	41	2.7	1.5	0	0	0	0	-1
22	SD	268.4	2.7	1.5	169.0	0	0	0	0	-1
23	K	99								

 LAST MODIFICATION 26 FEB 79

RUN DATE 01/24/80.
 TIME 07.47.32.

DAM SAFETY ANALYSIS-JOB NO. 79-905/09 ERJ
 MIDDLE RESERVOIR DAM-SEYMOUR-COON.
 1-22-80

JOB SPECIFICATION										
NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLY	IPRT	INSTAN	
75	1	0	0	0	0	0	2	0	0	
			JOPER	NMT	LROPT	TRACE				
			5	0	0	0				

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRTIO= 2 LRATIO= 1

RTIOS= .50 1.00

SUB-AREA RUNOFF COMPUTATION

COMPUTATION OF PMF-DEVELOPMENT OF INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLY	JPRY	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

THYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.68	0.00	.68	0.00	0.000	0	1	0

PRECIP DATA

SPEE	PMS	H6	H12	H24	H48	H72	R96
0.00	22.00	110.00	124.00	133.00	142.00	0.00	0.00

INSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

IROPT	STARR	DLTKM	RTIOL	ERAIN	STRS	RTIOK	STMTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

IP= 2.25 CP= .63 NTA= 0

RECESSION DATA

STIOL= 1.90 GRCSN= .05 RTIOR= 2.00
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 2.70 AND H= 1.94 INTERVALS

UNIT HYDROGRAPH 12 END-OF-PERIOD ORIGINATES, LAG= 2.26 HOURS, CP= .63 VOL= 1.00
 29. 90. 114. 84. 50. 29. 17. 10. 6. 4.
 2. 1.

END-OF-PERIOD FLOW									
MO.DA	HR.MM	PERIOD	RAIN	EXCS	LOSS	COMP	MO.DA	HR.MM	PERIOD

COMP 0

1.01	6.00	.01	0.00	.01	1.02	19.00	.43	.16	.06	.10	1336.
1.01	7.00	.03	0.00	.03	1.02	20.00	44	.16	.06	.10	964.
1.01	8.00	.03	0.00	.03	1.02	21.00	45	.16	.06	.10	613.
1.01	9.00	.03	0.00	.03	1.02	22.00	46	.16	.06	.10	372.
1.01	10.00	.03	0.00	.03	1.02	23.00	47	.16	.06	.10	230.
1.01	11.00	.03	0.00	.03	1.03	0.00	48	.16	.06	.10	146.
1.01	12.00	.03	0.00	.03	1.03	1.00	49	0.00	0.00	0.00	94.
1.01	13.00	.13	.03	.10	1.03	2.00	50	0.00	0.00	0.00	58.
1.01	14.00	.16	.06	.10	1.03	3.00	51	0.00	0.00	0.00	33.
1.01	15.00	.20	.10	.10	1.03	4.00	52	0.00	0.00	0.00	14.
1.01	16.00	.50	.40	.10	1.03	5.00	53	0.00	0.00	0.00	7.
1.01	17.00	.18	.08	.10	1.03	6.00	54	0.00	0.00	0.00	2.
1.01	18.00	.14	.04	.10	1.03	7.00	55	0.00	0.00	0.00	1.
1.01	19.00	.01	0.00	.01	1.03	8.00	56	0.00	0.00	0.00	1.
1.01	20.00	.01	0.00	.01	1.03	9.00	57	0.00	0.00	0.00	0.
1.01	21.00	.01	0.00	.01	1.03	10.00	58	0.00	0.00	0.00	0.
1.01	22.00	.01	0.00	.01	1.03	11.00	59	0.00	0.00	0.00	0.
1.01	23.00	.01	0.00	.01	1.03	12.00	60	0.00	0.00	0.00	0.
1.02	0.00	.01	0.00	.01	1.03	13.00	61	0.00	0.00	0.00	0.
1.02	1.00	.11	.01	.10	1.03	14.00	62	0.00	0.00	0.00	0.
1.02	2.00	.11	.01	.10	1.03	15.00	63	0.00	0.00	0.00	0.
1.02	3.00	.11	.01	.10	1.03	16.00	64	0.00	0.00	0.00	0.
1.02	4.00	.11	.01	.10	1.03	17.00	65	0.00	0.00	0.00	0.
1.02	5.00	.11	.01	.10	1.03	18.00	66	0.00	0.00	0.00	0.
1.02	6.00	.11	.01	.10	1.03	19.00	67	0.00	0.00	0.00	0.
1.02	7.00	.41	.31	.10	1.03	20.00	68	0.00	0.00	0.00	0.
1.02	8.00	.41	.31	.10	1.03	21.00	69	0.00	0.00	0.00	0.
1.02	9.00	.41	.31	.10	1.03	22.00	70	0.00	0.00	0.00	0.
1.02	10.00	.41	.31	.10	1.03	23.00	71	0.00	0.00	0.00	0.
1.02	11.00	.41	.31	.10	1.04	0.00	72	0.00	0.00	0.00	0.
1.02	12.00	.41	.31	.10	1.04	1.00	73	0.00	0.00	0.00	0.
1.02	13.00	1.94	1.84	.10	1.04	2.00	74	0.00	0.00	0.00	0.
					1.04	3.00	75	0.00	0.00	0.00	0.

SUM 24.99 21.72 3.27 9509.
(635.1 (552.1 (83.1 (269.26)

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
1536.	1112.	382.	132.	9512.
43.	31.	11.	4.	269.
	15.21	20.90	21.69	21.69
	386.37	530.94	550.86	550.86
	551.	758.	786.	786.
	680.	935.	970.	970.

CFS
CMS
INCHES
MM
AC-FT
THOUS CU M

INFLU(I), OUTFLOW(O) AND OBSERVED FLOW(*)									
0.	200.	400.	600.	800.	1000.	1200.	1400.	1600.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	PRECIP(I) AND EXCESS(I)
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.00 11	.	.	.	.	.	.	.	.	.
2.00 21	.	.	.	.	.	.	.	.	.
3.00 31	.	.	.	.	.	.	.	.	.
4.00 41	.	.	.	.	.	.	.	.	.
5.00 51	.	.	.	.	.	.	.	.	.
6.00 61	.	.	.	.	.	.	.	.	.
7.00 71	.	.	.	.	.	.	.	.	.
8.00 81	.	.	.	.	.	.	.	.	.
9.00 91	.	.	.	.	.	.	.	.	.
10.00 101	.	.	.	.	.	.	.	.	.
11.00 111	.	.	.	.	.	.	.	.	.
12.00 121	.	.	.	.	.	.	.	.	.
13.00 131	.	.	.	.	.	.	.	.	.
14.00 141	.	.	.	.	.	.	.	.	.
15.00 151	.	.	.	.	.	.	.	.	.
16.00 161	.	.	.	.	.	.	.	.	.
17.00 171	.	.	.	.	.	.	.	.	.
18.00 181	.	.	.	.	.	.	.	.	.
19.00 191	.	.	.	.	.	.	.	.	.
20.00 201	.	.	.	.	.	.	.	.	.
21.00 211	.	.	.	.	.	.	.	.	.
22.00 221	.	.	.	.	.	.	.	.	.
23.00 231	.	.	.	.	.	.	.	.	.
0.00 241	.	.	.	.	.	.	.	.	.
1.00 251	.	.	.	.	.	.	.	.	.
2.00 261	.	.	.	.	.	.	.	.	.
3.00 271	.	.	.	.	.	.	.	.	.
4.00 281	.	.	.	.	.	.	.	.	.
5.00 291	.	.	.	.	.	.	.	.	.
6.00 301	.	.	.	.	.	.	.	.	.
7.00 311	.	.	.	.	.	.	.	.	.
8.00 321	.	.	.	.	.	.	.	.	.
9.00 331	.	.	.	.	.	.	.	.	.
10.00 341	.	.	.	.	.	.	.	.	.
11.00 351	.	.	.	.	.	.	.	.	.
12.00 361	.	.	.	.	.	.	.	.	.
13.00 371	.	.	.	.	.	.	.	.	.
14.00 381	.	.	.	.	.	.	.	.	.
15.00 391	.	.	.	.	.	.	.	.	.
16.00 401	.	.	.	.	.	.	.	.	.
17.00 411	.	.	.	.	.	.	.	.	.
18.00 421	.	.	.	.	.	.	.	.	.
19.00 431	.	.	.	.	.	.	.	.	.
20.00 441	.	.	.	.	.	.	.	.	.
21.00 451	.	.	.	.	.	.	.	.	.
22.00 461	.	.	.	.	.	.	.	.	.
23.00 471	.	.	.	.	.	.	.	.	.
0.00 481	.	.	.	.	.	.	.	.	.
1.00 491	.	.	.	.	.	.	.	.	.
2.00 501	.	.	.	.	.	.	.	.	.
3.00 511	.	.	.	.	.	.	.	.	.
4.00 521	.	.	.	.	.	.	.	.	.
5.00 531	.	.	.	.	.	.	.	.	.
6.00 541	.	.	.	.	.	.	.	.	.
7.00 551	.	.	.	.	.	.	.	.	.
8.00 561	.	.	.	.	.	.	.	.	.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1									
1.	1.	1.	1.	1.	1.	1.	1.	1.	0.
0.	1.	3.	6.	15.	28.	33.	27.	18.	1.
11.	4.	2.	2.	1.	1.	1.	1.	1.	1.
6.	37.	50.	57.	62.	86.	162.	276.	452.	24.
674.	669.	482.	306.	186.	115.	73.	47.	0.	0.
17.	3.	1.	1.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PEAK									
768.									
22.									
CFS									
768.									
22.									
CMS									
16.									
INCHES									
7.61									
10.45									
MM									
193.19									
265.47									
AC-FT									
276.									
THOUS CU M									
340.									
467.									
TOTAL VOLUME									
4756.									
135.									
10.84									
275.43									
393.									
485.									

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2									
2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	5.	12.	30.	56.	67.	55.	37.	37.
22.	8.	5.	3.	3.	2.	2.	2.	2.	2.
13.	74.	99.	115.	123.	172.	324.	551.	904.	58.
11.	1338.	964.	613.	372.	230.	146.	94.	0.	0.
1347.	14.	2.	1.	1.	0.	0.	0.	0.	0.
33.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PEAK									
1536.									
43.									
CFS									
1112.									
382.									
CMS									
31.									
INCHES									
15.21									
20.90									
MM									
386.37									
530.94									
AC-FT									
551.									
THOUS CU M									
680.									
935.									
TOTAL VOLUME									
9512.									
269.									
21.69									
550.86									
786.									
970.									

ROUTING INFLOW HYDROGRAPH THRU LAKE-OVERTOPPING ANALYSIS

HYDROGRAPH ROUTING									
1.	1.	1.	1.	1.	1.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11.	4.	2.	2.	1.	1.	1.	1.	1.	1.
6.	37.	50.	57.	62.	86.	162.	276.	452.	24.
674.	669.	482.	306.	186.	115.	73.	47.	0.	0.
17.	3.	1.	1.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PEAK									
768.									
22.									
CFS									
768.									
22.									
CMS									
16.									
INCHES									
7.61									
10.45									
MM									
193.19									
265.47									
AC-FT									
276.									
THOUS CU M									
340.									
467.									
TOTAL VOLUME									
4756.									
135.									
10.84									
275.43									
393.									
485.									

SURFACE AREA= 3. 4. 4. 5.

CAPACITY= 0. 3. 9. 18.

STATION 1. PLAN 1.0. RATIO 1.0

END-OF-PERIOD HYDROGRAPH ORDINATES

[illegible]

PEAK OUTFLOW IS 766. AT TIME 42.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	766.	555.	191.	66.		4758.
CMS	22.	16.	5.	2.		135.
INCHES		7.60	10.45	10.85		10.85
MM		193.00	265.40	275.55		275.55
AC-FT		275.	379.	343.		393.
THOUS CU M		340.	467.	485.		485.

9.	100.	200.	300.	400.	500.	600.	700.	800.	900.
1.00									
11									
2.00									
21									
3.00									
31									
4.00									
41									
5.00									
51									
6.00									
61									
7.00									
71									
8.00									
81									
9.00									
91									
10.00									
101									
11.00									
111									
12.00									
121									
13.00									
131									
14.00									
141									
15.00									
1501									
16.00									
16.1									
17.00									
17. 01									
18.00									
18. 1									
19.00									
19. 1									
20.00									
20. 1									
21.00									
21. 1									
22.00									
22. 1									
23.00									
2310									
24.00									
241									
25.00									
251									
26.00									
261									
27.00									
271									
28.00									
281									
29.00									
291									
30.00									
301									
31.00									
3101									
32.00									
32.01									
33.00									
33. 01									
34.00									
34. 1									
35.00									
35. 1									
36.00									
36. 1									
37.00									
37. 01									
38.00									
38. 01									
39.00									
39. 01									
40.00									
40. 01									

Principles

[illegible]

STAGE					
267.5	267.5	267.5	267.5	267.5	267.4
267.4	267.5	267.5	268.0	268.1	269.1
267.7	267.6	267.5	267.5	267.5	267.5
267.8	268.3	268.4	268.6	268.8	269.5
270.1	269.6	269.2	268.9	268.5	268.1
267.7	267.5	267.5	267.5	267.4	267.4
267.4	267.4	267.4	267.4	267.4	267.4
267.4	267.4	267.4	267.4	267.4	267.4

PEAK OUTFLOW IS 1536. AT TIME 42.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	1536.	1111.	382.	132.		9514.
CMS	44.	31.	11.	4.		249.
INCHES		15.20	20.90	21.69		21.69
MM		386.08	530.84	550.98		550.99
AC-FT		551.	758.	766.		786.
CU M		680.	934.	970.		970.

INFLUX(I), OUTFLOW(O) AND OBSERVED FLOW(*)										
	0.	200.	400.	600.	800.	1000.	1200.	1400.	1600.	0.
1.00	11									0.
2.00	21									0.
3.00	31									0.
4.00	41									0.
5.00	51									0.
6.00	61									0.
7.00	71									0.
8.00	81									0.
9.00	91									0.
10.00	101									0.
11.00	111									0.
12.00	121									0.
13.00	131									0.
14.00	141									0.
15.00	1501									0.
16.00	16.1									0.
17.00	17. 01									0.
18.00	18. 1									0.
19.00	19. 1									0.
20.00	20. 1									0.
21.00	21.1									0.
22.00	22.1									0.
23.00	2310									0.
0.00	241									0.
1.00	251									0.
2.00	261									0.
3.00	271									0.
4.00	281									0.
5.00	291									0.
6.00	301									0.
7.00	3101									0.
8.00	32.01									0.
9.00	33. 01									0.
10.00	34. 1									0.
11.00	35. 1									0.
12.00	36. 1									0.
13.00	37. 01									0.
14.00	38. 01									0.
15.00	39. 01									0.
16.00	40. 01									0.
17.00	41. 01									0.
18.00	42. 10									0.
19.00	43. 10									0.
20.00	44. 10									0.
21.00	45. 1									0.
22.00	46. 1									0.
23.00	47. 1									0.
0.00	48. 10									0.
1.00	49. 1									0.
2.00	50. 1									0.
3.00	51. 1									0.
4.00	52.1									0.
5.00	531									0.
6.00	541									0.
7.00	551									0.
8.00	561									0.
9.00	571									0.
0.00	581									0.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2
				.50	1.00
HYDROGRAPH AT	1	.68	1	768.	1536.
	(	1.76)	(	21.74)	43.48)
ROUTED TO	1	.68	1	768.	1536.
	(	1.76)	(	21.68)	43.51)

PLAN 1

.....	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 267.40 0. 0.	SPILLWAY CHEST 267.40 0. 0.	TOP OF DAM 268.40 3. 111.			
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	269.40	1.00	7.	766.	10.00	42.00	0.00
1.00	270.13	1.73	10.	1536.	14.00	42.00	0.00

MIDDLE RESERVOIR DAM

A. Size Classification

Height of dam = 27 ft.; hence Small

Storage capacity at top of dam (elev. 268.4) = 36 AC-FT.; hence Small

Adopted size classification Small

B.i) Hazard Potential

The Dam is located upstream of the Quillinan Reservoir which may be affected by the failure of the Middle Reservoir Dam.

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 homes 0;
- b) Loss of buildings 1;
- c) Loss of highways or roads 2;
- d) Loss of bridges 0;

The failure profile can affect a distance of 5000 feet from the dam.

C. Hazard Potential Classifications

<u>HAZARD</u>	<u>SIZE</u>	<u>TEST FLOOD RANGE</u>
<u>Significant</u>	<u>Small</u>	<u>100 year to 1/2 PMF</u>
Adopted Test Flood = <u>1/2 PMF</u> = <u>N/A</u> CSM		
= <u>770</u> CFS		

D. Overtopping Potential

Drainage Area 435 = .68 sq. miles

Spillway crest elevation = (Primary Spillway) 267.4 NGVD

Top of Dam Elevation = 268.4 NGVD

Maximum spillway discharge

Capacity without overtopping of dam = 132 CFS
 "test flood" inflow discharge = 770 CFS
 "test flood" outflow discharge = 765 CFS

MIDDLE RESERVOIR DAM

Dam Failure Analysis

1. Failure discharge with pool at top of dam (elev. 268.4) = 8000 CFS
2. Depth of water in reservoir at time of failure = 27 ft.
3. Maximum depth of flow downstream of dam = 27 ft.
4. Water surface elevation just downstream) of dam at time of failure) = 268 NGVD

The failure discharge of 8000 CFS will enter and flow downstream 5000 feet until the brook enters Quillinan Reservoir. Valley storage in this 5000 feet length of brook is substantial in reducing the discharge. 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 5000 feet downstream. The failure profile will have the following hydraulic characteristics:

DISTANCE FROM THE DAM	WATER SURFACE ELEVATION NGVD	REMARKS
0	268.4	Upstream of Dam
0	268 ±	Downstream of Dam
200	235.0	Downstream of Dam
1000	195.9	
2000	183.0	
3000	166.0	
4000	153.4	
5000	142.9	Quillinan Res.

Beyond 5000 feet, The discharge enters Quillinan Reservoir failure discharge will flow in the below given channel characteristics:

Q = 1180 CFS; S = N/A

n = N/A; b = N/A; d = 3±

Side slopes = N/A

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

DATA

Name of Dam Middle Reservoir Dam
Location Town of Seymour, Connecticut
Drainage Area 0.68 sq. mi., Top of Dam 268.4 NGVD
Spillway Type overflow, broadcrested Crest of Spillway 267.4 NGVD
Surface Area @ Crest Elev. 3 Acres = .01 sq. mi.
Pool Bottom Near Dam = 241 NGVD
Assumed Side Slopes of Embankments = 1:1
Depth of Pool at Dam (Y_o) = 27 Feet
Mid-Height Elev. 255 NGVD
Length of Dam at Crest = 135 Feet *
Length of Dam at Mid-Height = 135 Feet *
25 % of Dam Length at Mid-Height = W_b = 34 Feet

Step 1

Storage (S) at time of failure 36 Ac-FT
(Equal to top of dam)

Step 2

Peak Failure Discharge
 $Q_{pl} = 8/27 W_b \sqrt{Y_o}^{3/2}$
 $= 1.68 W_b Y_o^{3/2} = 8000$ cfs

Failure is assumed to coincide with pool elevation at top of dam.

* Length from wingwall to gatehouse.

The Quillinan Reservoir is located 5000 feet downstream of the Middle Reservoir dam. There is a 98 foot drop into the Quillinan Reservoir which will cause the dissipation of wave and kinetic energy of the failure discharge. Approximately, the water surface elevations between the Middle Reservoir dam and the Quillinan Reservoir will be as given on Dam Failure Analysis. The increase of depth in the Quillinan Reservoir due to failure of the Middle Reservoir dam is estimated to be 3 feet.

BY FCB DATE 1/27/79 SUBJECT DAM INSPECTION
 CHKD. BY ERJ DATE 1/15/80 STUDIES

SHEET NO. 1 OF 6
 JOB NO. 77-905

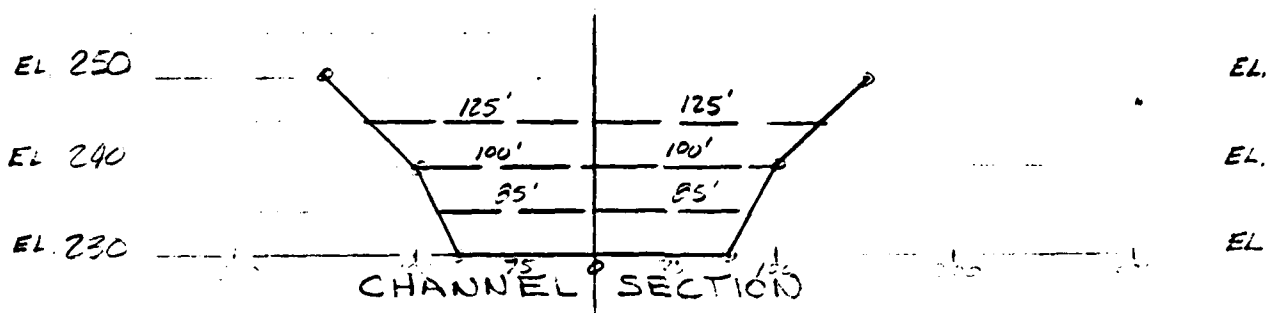
DOWNSTREAM W.S. EL. COMPUTATIONS

NAME OF DAM: Mingo River Dam

SECTION LOCATION: 200' DOWNSTREAM OF DAM

USING: $Q = 1.486/n A R^{2/3} S^{1/2}$

WHERE: $n = 0.05$ $S = \text{SLOPE} = .0143 \text{ } \text{ft}^{-1}$



$Q_R = 7974$ STORAGE (S) 33 AC-FT.

ELEV.	AREA	WP	R	$R^{2/3}$	$S^{1/2}$	$1.486/n$	Q	DEPTH
235	900	170	4.70	2.81	.12	29.72	8017	
240	1725	200	8.62	4.20	.12	29.72	25315	
245	2850	250	11.4	5.06	.12	29.72	51131	
EL. 240								
EL. 235								
EL.								

STAGE DISCHARGE 7974 ELEV: 235 OR A D = 5

D-18 NEXT DOWNSTREAM SECTION 5' T.

PURCELL ASSOCIATES

200' OF MAIN CHANNEL

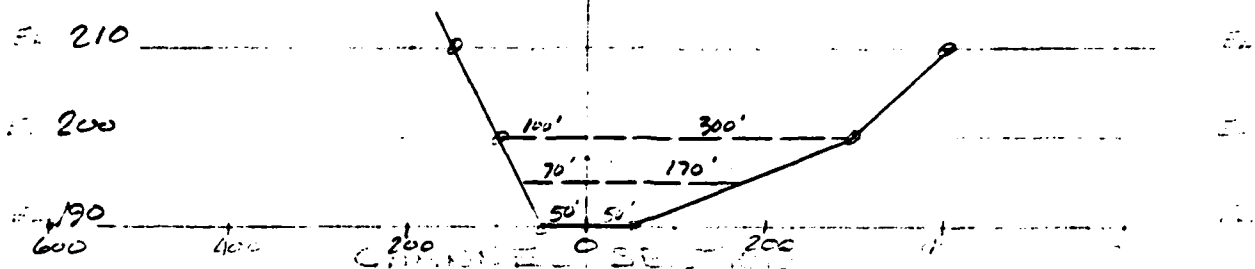
NAME OF DAM: Mills Ferry

SECTION LOCATION: 1000 DISTANCE FROM DAM

USING: $C = 1.486 / n A R^{2/3} S^{1/2}$

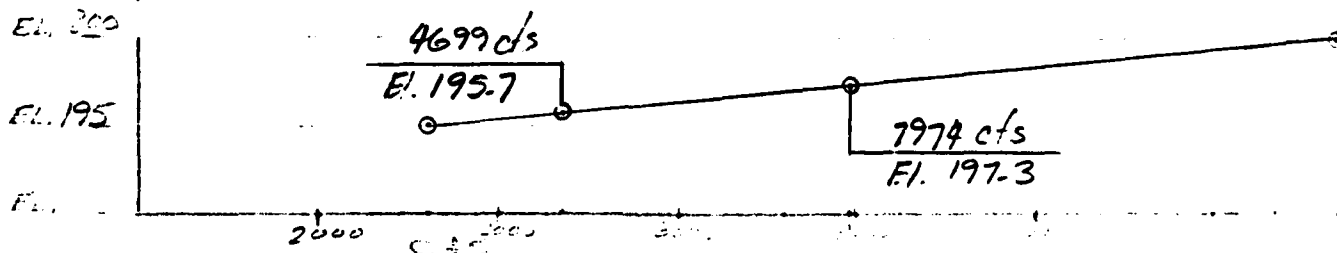
WHERE: $n = 0.05$

S = SLOPE = .003 1/4



Q = 7774 cfs STORAGE (S) 33 ft

ELEV.	AREA	WP	P	R ^{2/3}	C ₁₂	486/P ^{3/2}	C	DEPTH
195	850	240	3.54	2.32	.055	29.72	3223	5'
200	2450	400	6.12	3.35	.055	29.72	13416	10'
						29.72		



$$V_1 = \frac{5+7.3}{2} \times (170+310 + 500 + 43,060) \frac{1}{2} = 13.6 \text{ sec-ft}$$

$$Q_{PR} = C \times (1 - V_1/P) = 46.99 \text{ cfs}$$

$$V_2 = \frac{5+5.7}{2} \times (170+250 \times 800 + 43,560) \frac{1}{2} = 10.3 \text{ sec-ft } V_{12} = 11.9$$

$$Q_{PR} = C \times (1 - V_2/P) = 50.84 \text{ cfs}$$

STAGE DISCHARGE 5084 cfs ELEV 195.9 OR A S 5.9

CHAD ER7 DATE 1/15/80

3 6

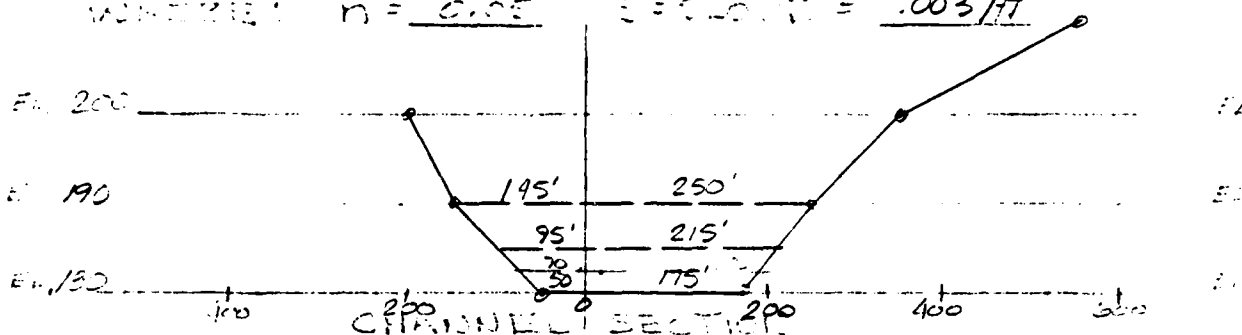
LOCATION: STATION 11+00

NAME OF DAM: Mill Creek Dam

SECTION: 2000' DISTANCE OF DAM

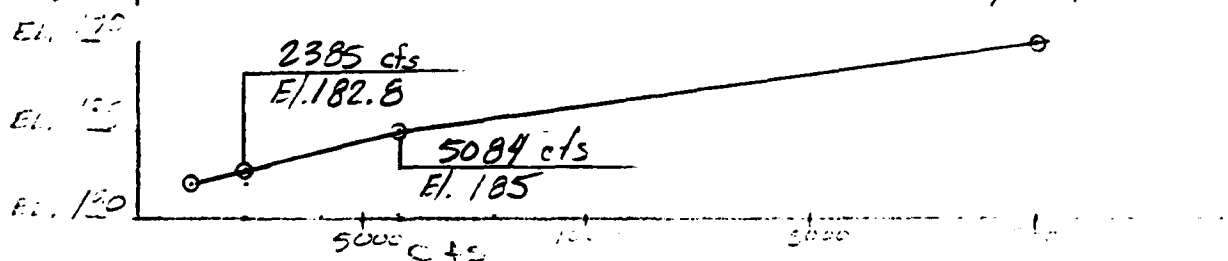
USING: $G = \frac{1.486}{n} A R^{4/3} S^{1/2}$

WHERE: $n = 0.05$ $S = 0.001 = .003/14$



$G = 5084$ cfs STORAGE (S) 33 AC-FT

EL. 185	AREA	WP	R	$R^{4/3}$	$C^{1/2}$	$\frac{1.486}{n}$	G	11+00
185	1333	310	1.316	2.65	.055	20.72	5796	5
190	3100	395	1.843	5.95	.055	20.72	22012	0
182	485	260	1.825	1.51	.055	20.72	1197	



$V_1 = \frac{5.9+5}{2} \times \left(\frac{250+310}{2} \times 1000 \div 43,560 \right)^{1/2} = 17.5$ cfs

$Q_{P2} = G \cdot (1 - V_1/V_2) = 2385$ cfs

$V_2 = \frac{5.9+2.8}{2} \times \left(\frac{250+280}{2} \times 1000 \div 43,560 \right)^{1/2} = 13.2$ cfs $V_{10} = 15.4$

$G_{P2} = G \cdot (1 - V_1/V_2) = 2717$ cfs

STAGE: 2717 cfs EL. 183

D-20

DATE: 1/15/80

Case # of record 11111111

CONG: $C = 1.48/n A R^{3/2} S^{1/2}$

2015

170

152
600

CHANNEL SECTION

$C_R = 2717$ c/s STORAGE (s) 33 AC-FIT

FLY	WEN	W/P	R	5 1/2	3 1/2	486/n	G	...
165	282	15	2.50	1.84	.055	29.72	366	5
170	1133	205	5.06	2.95	.055	29.72	545	10
						49.72		

54. 12

En. 165

152

1677 cfs

E. 165,9

2717 cfs

El. 167

$$4 - \frac{31.7}{2} \times \left(\frac{280 + 160}{2} \times 1000 \div 43,560 \right) \frac{1}{2} = \underline{12.6} \text{ ac-ft}$$

Gr. 1 - 1677

$$V_2 = \frac{3+5.9}{2} \times \left(\frac{2.90+1.40}{2} \times 100 + 435 \pm 0 \right)^{1/2} = 10.7 \text{ sec} \quad V = 11.6$$

1762

STATION NO. 1762 - 166 - 0117 6

D-21

1000

DATE 1/15/80

5 6

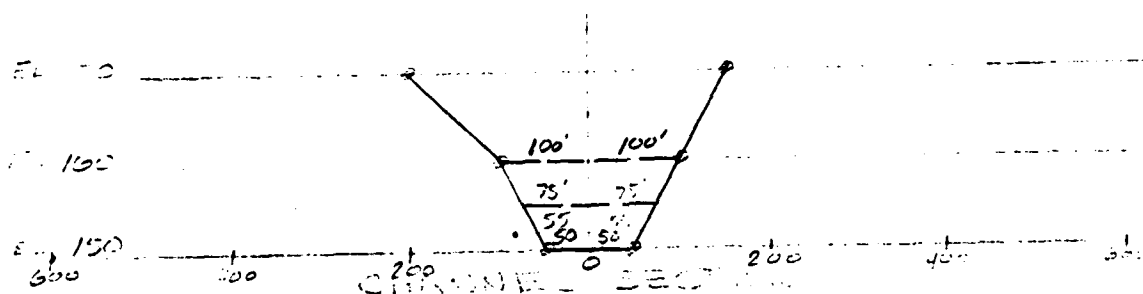
2. OF THE ...

NAME OF DAM: High River

SECTION LOCATION: for ...

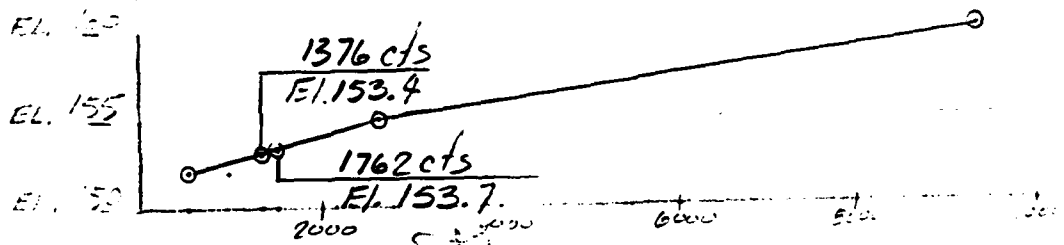
USING: $Q = 1.484 / n A R^{4/3}$

WHERE: $n = 0.05$ $S = 0.0014$



$Q_p = 1762$ cfs STORAGE (cu ft) 33

EL.	AREA	W.P.	R	$R^{4/3}$	C_{12}	$1.484/n$	Q	STORAGE
155	625	150	4.167	2.59	.055	29.72	2625	0
150	1500	200	7.50	3.93	.050	29.72	3300	0
152	210	110	1.91	1.54	.055	29.72	520	0



$$1. \frac{6+3.7}{2} \times \left(\frac{140+120}{2} \times 1000 \div 42560 \right)^{1/2} = 7.2 \text{ sec-ft}$$

$$Q_p = C_p (1 - V_p) = 1376 \text{ cfs}$$

$$1.05 \frac{6+3.7}{2} \times \left(\frac{140+120}{2} \times 1000 \div 42560 \right)^{1/2} = 7.0 \text{ sec-ft} \quad 7.1$$

$$C_p = C_p (1 - V_p) = 1393$$

STAGE: 1393 153.4 3.4

ERJ 1/15/80

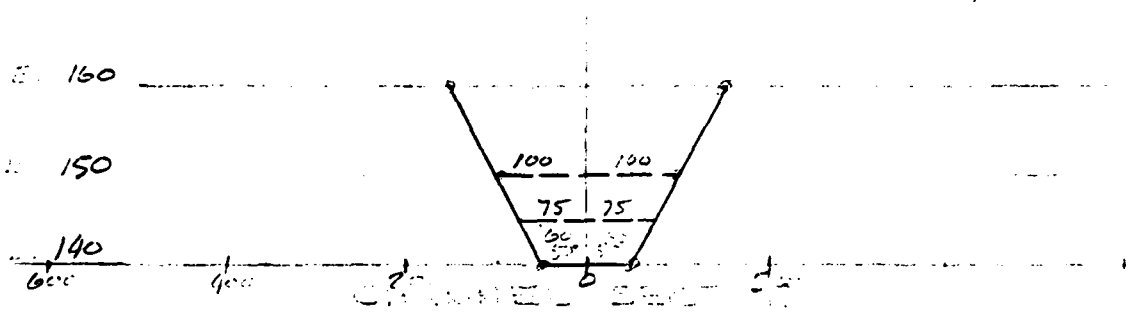
6 6

2. CHANNEL SECTION

CHANNEL LENGTH 5000'

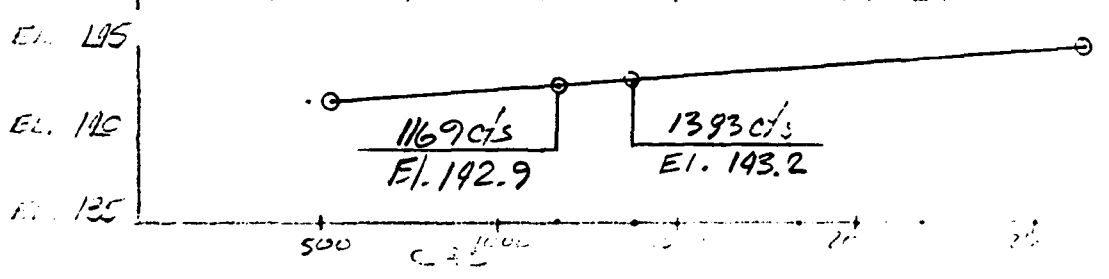
$C = 149 \sqrt{A} = 3.5$

$R = 5.05 \quad S = 0.001$



$C = 1383$ STORAGE 33

EL.	AREA	H.P.	F	F ^{1/2}	C ₁	C ₂	S
142	220	120	1.833	1.50	.055		540
145	625	150	4.57	2.57	.100	22.72	2345



1. $\frac{3.4+3.2}{2} \times (140+130 \times 1000 + 42.5 \times 1000) = 5.1$

2. $\frac{3.4+2.9}{2} \times 3.1 \times \frac{1}{2} = 4.9$

3. $\frac{3.4+2.9}{2} \times 3.1 \times \frac{1}{2} = 4.9$

D-23 1173 142.9 2.9

15' x 20' 2.4'

RATING CURVE DEVELOPMENT

Middle Reservoir Dam

Spillways

$$Q = C L H^{3/2}$$

$$C = 2.7$$

$$L = \begin{array}{l} 29 \text{ feet (primary)} \\ 12 \text{ feet (auxiliary)} \end{array}$$

24 Inch Pipe

$$Q = c a (2gh)^{1/2}$$

$$c = .6$$

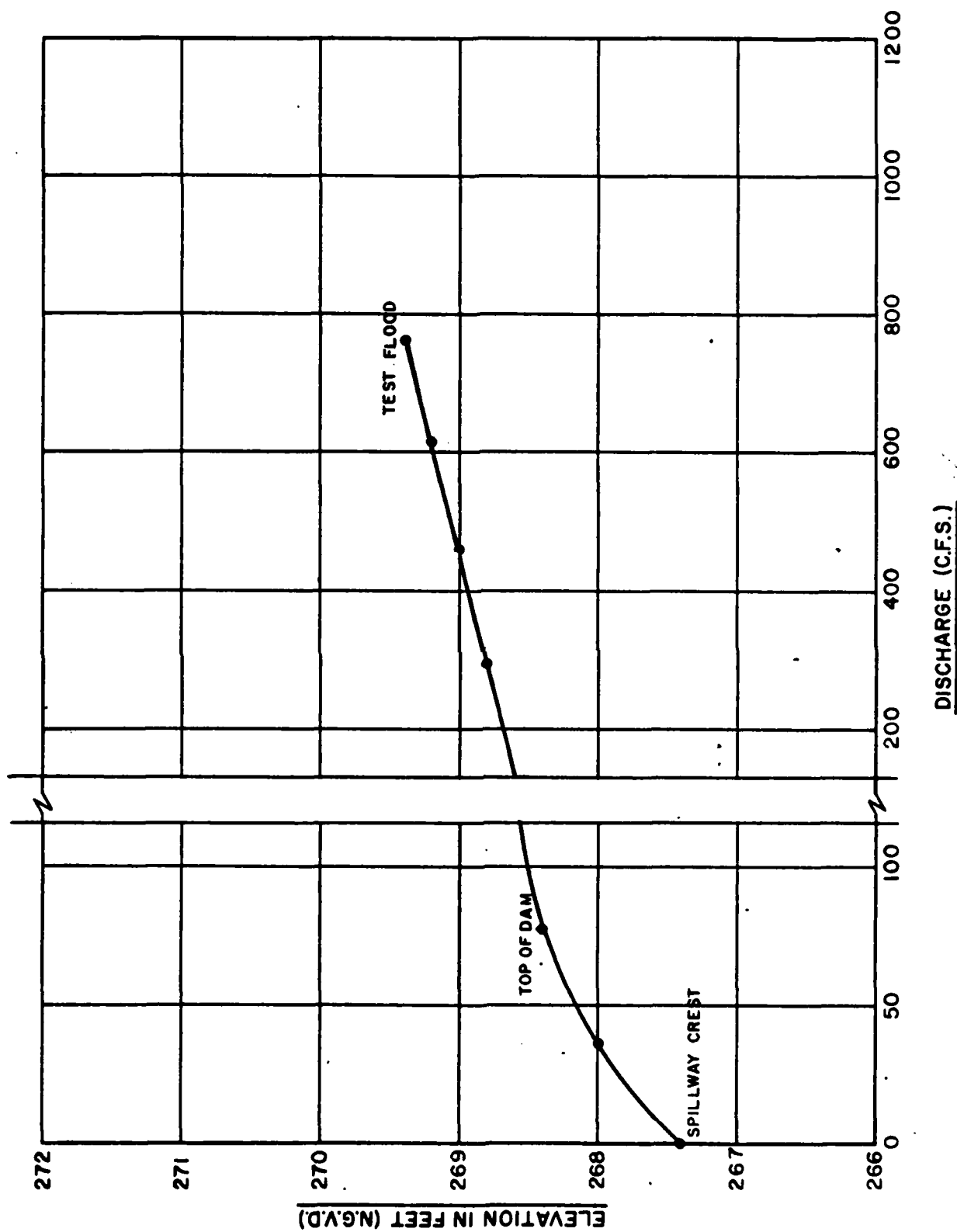
$$a = 3.14 \text{ square feet}$$

8 Inch Blowoff

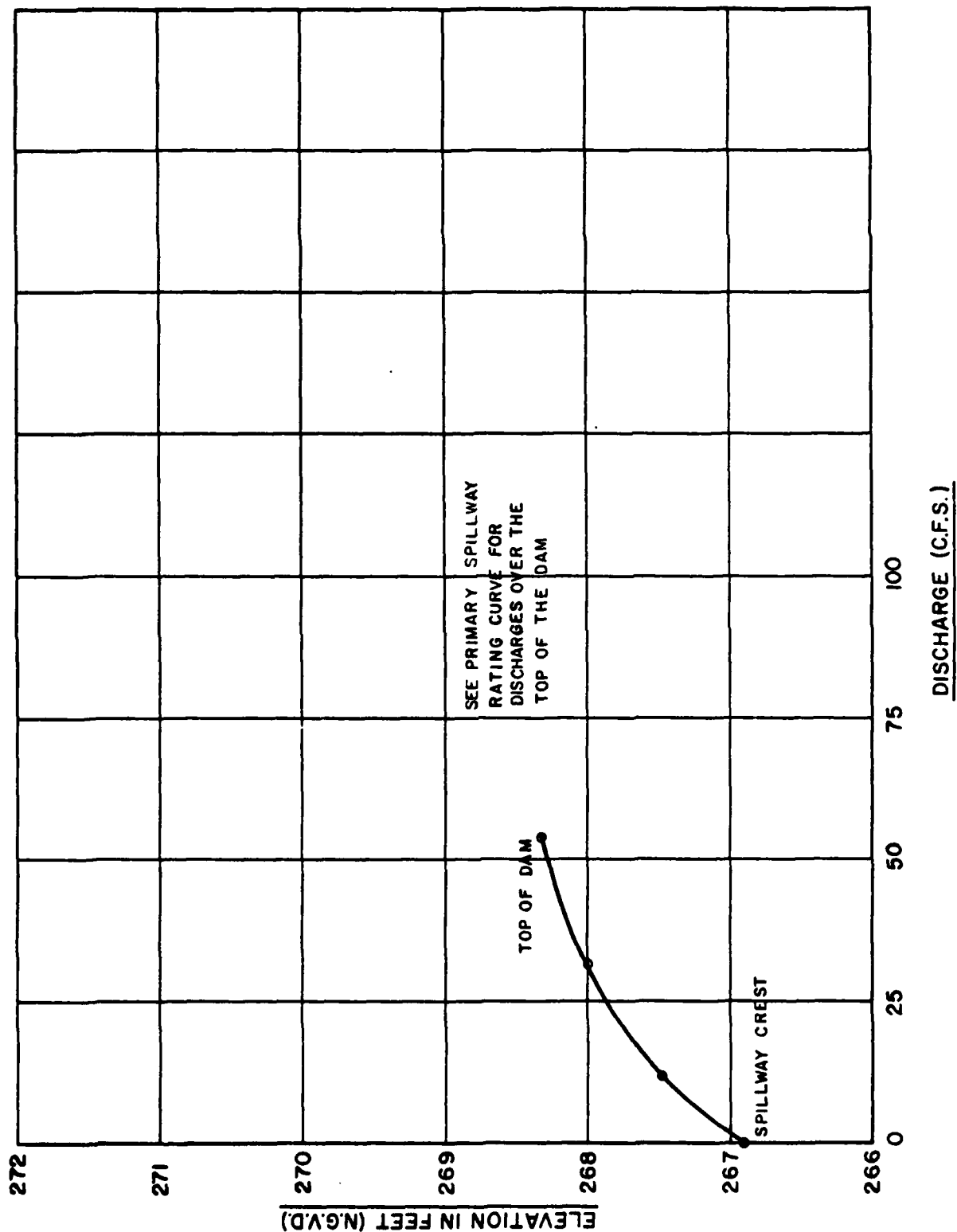
$$Q = c a (2gh)^{1/2}$$

$$c = .6$$

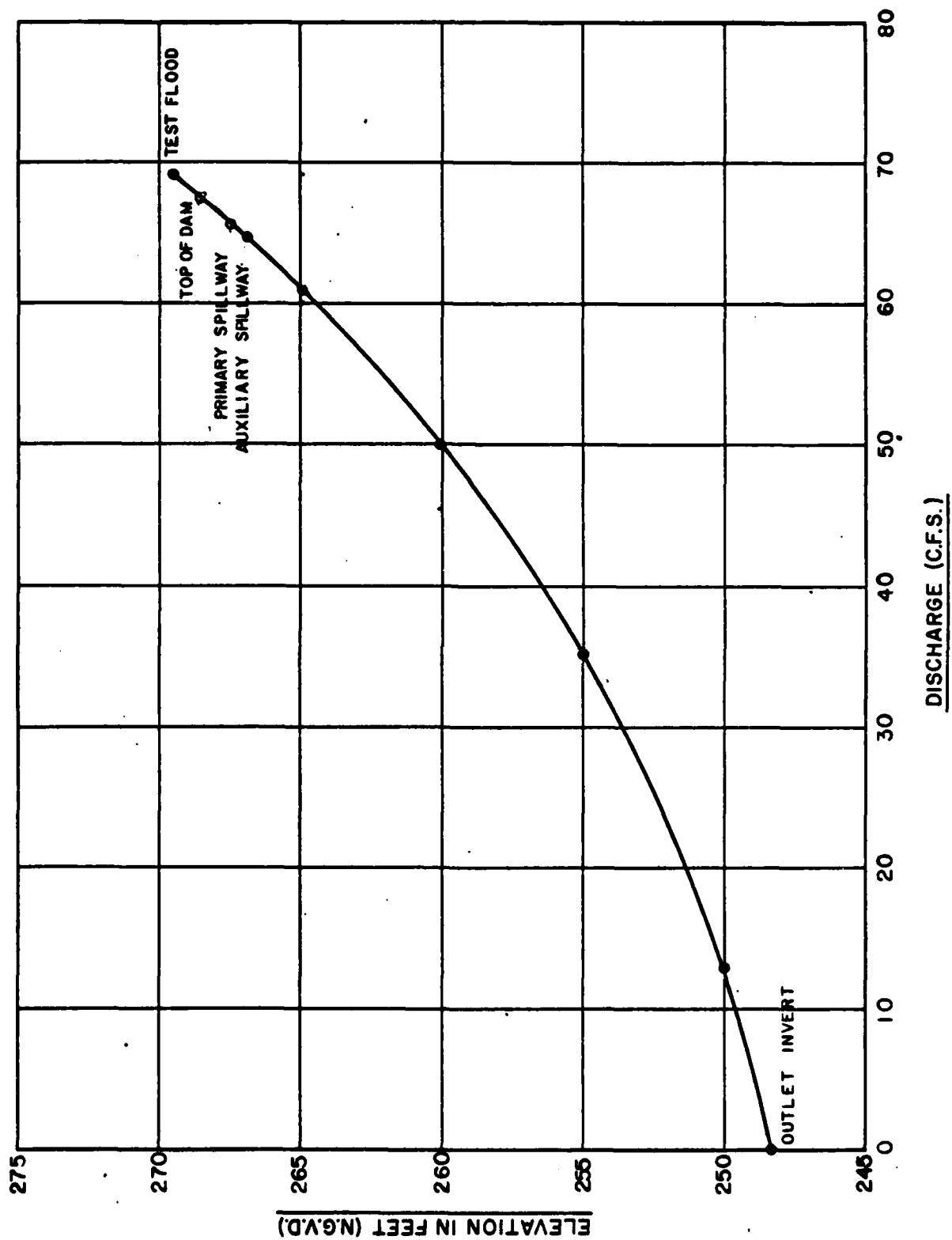
$$a = .35 \text{ square feet}$$



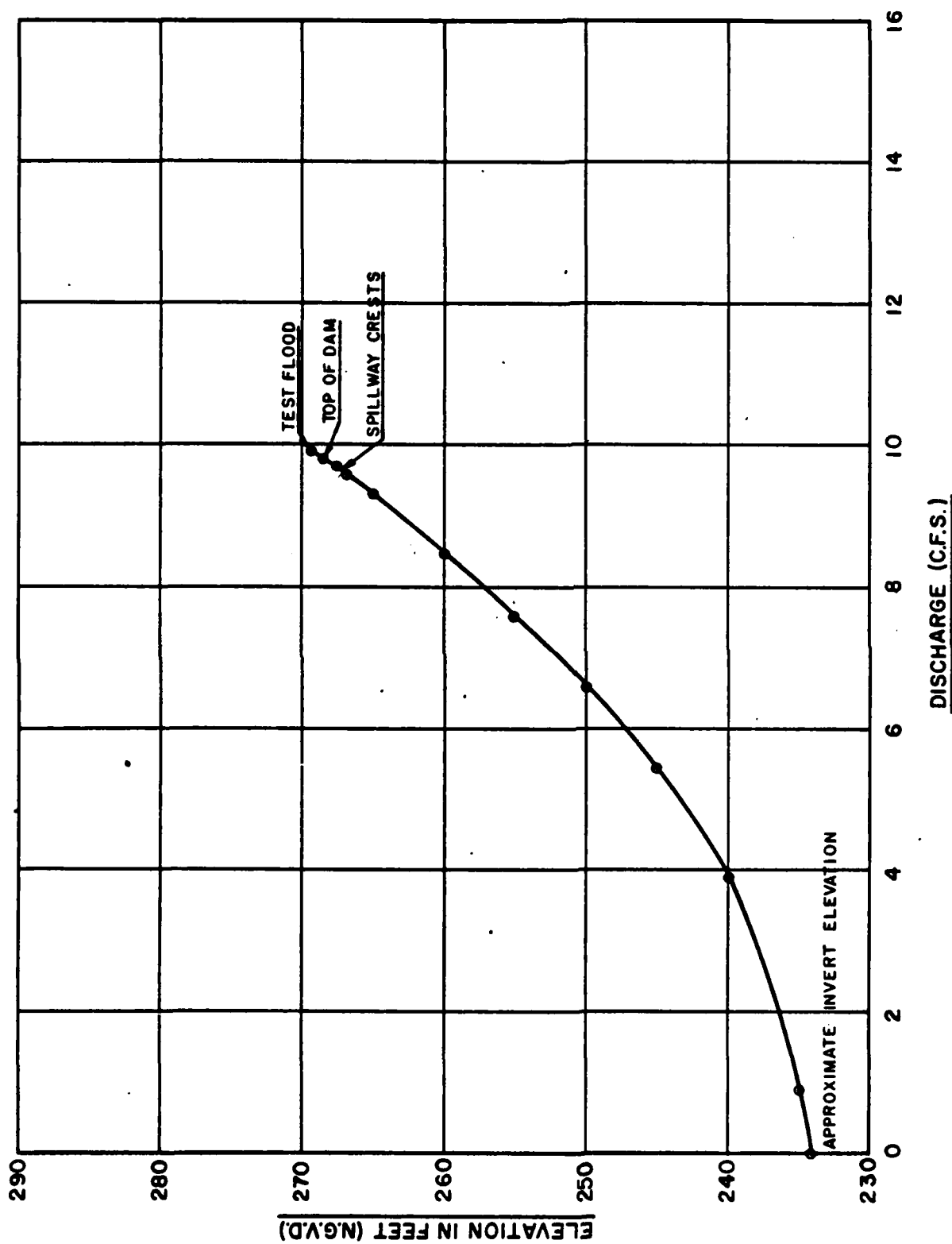
MIDDLE RESERVOIR DAM
PRIMARY SPILLWAY RATING CURVE



D-26 MIDDLE RESERVOIR DAM
AUXILIARY SPILLWAY RATING CURVE



MIDDLE RESERVOIR DAM
24. INCH PIPE
OUTLET WORKS RATING CURVE



MIDDLE RESERVOIR DAM
8 INCH BLOWOFF
OUTLET WORKS RATING CURVE

D-28

E

APPENDIX E
INFORMATION AS CONTAINED IN THE
NATIONAL INVENTORY OF DAMS

END

FILMED

10-84

DTIC