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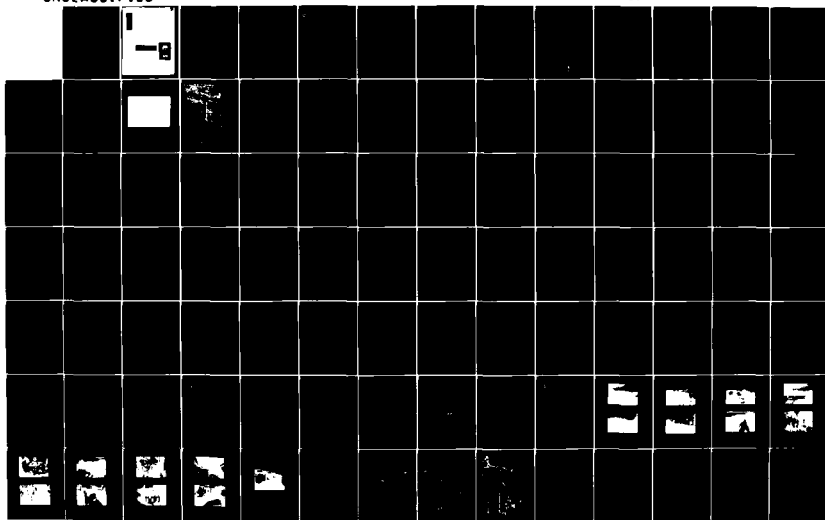
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
FLAT RIVER RESERVOIR..(U) CORPS OF ENGINEERS WALTHAM MA
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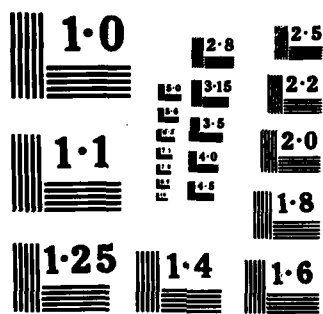
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Mass/RI Coastal Basin Cranston Rhode Island South Branch of the Pawtuxet River		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) -The dam is comprised of two earth embankments separated by a section of higher natural ground. It is 24 ft. high and 750 ft. long. The dam is considered to be intermediate in size with a high hazard potential. It is in very poor condition due to serious seepage problems which could lead to piping failure. There are various recommendations which must be undertaken by the owner, <i>Should</i>		

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

REPLY TO
ATTENTION OF:
NEDED

APR 28 1981

Honorable J. Joseph Garrahy
Governor of the State of Rhode Island
and Providence Plantations
State House
Providence, Rhode Island 02903

Dear Governor Garrahy:

Inclosed is a copy of the Flat River Reservoir Dam (RI-00601) 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.

The visual inspection conducted at the site has revealed serious seepage problems with the earth dike comprising the right portion of the project that could effect its stability. The State Department of Environmental Management was notified of these problems and has recommended to the owner of the dam that the reservoir be maintained at a level 4 feet below spillway crest. As a result of the serious nature of the seepage this dam has been assessed as unsafe-emergency until corrective measures are completed as outlined in Section 7 of the report.

It is recommended that the following be done immediately upon receipt of the report. The reservoir be lowered and maintained at a low level and the seepage be monitored for any changes. The owner engage the services of a registered professional engineer to design and supervise the construction of some method of embankment stabilization along the toe of the dike. That a detailed emergency operation plan and warning system be developed and a program of round-the-clock surveillance during and after periods of heavy precipitation be provided.

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.

APR 28 1981

NEDED

Honorable J. Joseph Garrahy

A copy of this report has been forwarded to the Department of Environmental Management, the cooperating agency for the State of Rhode Island. In addition, a copy of the report has also been furnished the owner, the Quidnick Reservoir Company, West Warwick, Rhode Island.

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 Management for your cooperation in carrying out this program.

Sincerely,



C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

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FLAT RIVER RESERVOIR DAM

RI 00601

MA/RI COASTAL BASIN

COVENTRY, RHODE ISLAND

PHASE 1 INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION REPORT

PHASE 1 INSPECTION REPORT

IDENTIFICATION NO: RI 00601
NAME OF DAM: Flat River Reservoir Dam
COUNTY AND STATE: Kent County, Rhode Island
STREAM: South Branch of the Pawtuxet River
DATE OF INSPECTION: 26 November 1980

Brief Assessment

Flat River Reservoir Dam is comprised of two earth embankments separated by a section of higher natural ground. The north or left side of the dam is an earth embankment with a concrete core wall. It is 13 feet wide at the crest, 24 feet high, and 750 feet in length including a 195 foot long spillway section on its left end. This section also contains the three, 48"-diameter outlet conduits with gates and structures on both the upstream and downstream ends. To the right or south end is a 1,000 foot long earth dike with an 11 foot wide crest and a 23 foot height.

Flat River Reservoir is used to store water for process use and formerly for power generation by the downstream industries which make up the Quidnick Reservoir Company and own the dam and reservoir. The reservoir is also used for recreation and has a heavily developed shoreline. Storage capacity of the reservoir is 12,650 Ac-Ft at the Top of the Dam (elevation 255.0).

The dam is classified as INTERMEDIATE in size and a HIGH hazard structure in accordance with recommended guidelines established by the Corps of Engineers. Based on the size and hazard classifications, the adopted test flood for this structure is equal to the full Probable Maximum Flood (PMF) which is estimated from the Corps of Engineers PMF curves to be 375 CSM, or 21,600 CFS, from the 57.5 square mile drainage basin when reduced by 25% for storage in the drainage basin. This test flood has a routed outflow discharge equal to 18,750 CFS and would overtop the dam by 1.0 foot. The maximum spillway capacity is equal to 12,000 CFS which represents 64% of the test flood outflow.

Based on a visual inspection of the site, the main dam embankment and appurtenances are considered to be in FAIR condition. The earth dike comprising the right portion of the dam, however, is considered to be in VERY POOR condition due to serious seepage problems which could lead to a piping failure.

It is recommended that the reservoir level be lowered immediately and that the owner engage the services of a registered professional engineer experienced in the design of dams to design and supervise the construction of a pervious counterweight along the toe of the dike or to design and supervise the construction of some other embankment stabilization measure. Such a temporary measure is required to minimize the chances of a piping failure. The recommendation to lower the reservoir was made to the owner by the State of Rhode Island Department of Environmental Management in a letter dated March 9, 1981.

It is also recommended that the owner engage the services of a registered engineer experienced in the design of dams to accomplish the following:

1. Perform a detailed hydrologic/hydraulic investigation of the potential downstream hazard to determine the level at which the reservoir can be maintained in order to minimize the downstream damages in the event of a failure.
2. Evaluate the need for more permanent repairs to correct the seepage and stability problems of the dike.
3. Perform a detailed hydrologic/hydraulic investigation to assess further the potential of overtopping the dam and the need for and the means to increase the project discharge capacity.
4. Evaluate the seepage along the downstream toe of the main dam embankment and beneath the spillway weir.
5. Recommend a program to remove the trees and brush and their root systems on the spillway weir, apron and training walls, and on the slopes and at the toe of the dam and dike which obscure seepage, may provide paths of seepage along root systems, and may dislodge stones in the masonry structures.
6. Further investigate the poor condition of the outlet gate structure and design the repairs or replacement necessary to restore it to an operable condition, if required.
7. Evaluate the erosion of slopes and the upstream riprap protection and recommend required repairs.
8. Evaluate the deterioration of the service bridge over the spillway, which provides the most rapid access route to the gate structures and recommend repairs to return the bridge to a satisfactory condition.

These and other recommendations and remedial measures as described in Section 7 should be implemented by the owner within one year after receipt of this Phase 1 Inspection Report.

NEW ENGLAND ENGINEERING, INC.

BY:

David A. Sluter
David A. Sluter, P. E.
President



This Phase I Inspection Report on Flat River Reservoir Dam (RI-00601) 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 judgement and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joe W. Finegan

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering 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 1 Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, DC 20314. The purpose of a Phase 1 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, sub-surface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase 1 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 the 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 1 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. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

The Phase 1 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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to detect irregularities which could indicate movement or settlement (Photo C-4). Large trees were growing at the downstream toe of the dike, and piles of cut brush obscured much of the downstream toe. A 2 foot diameter animal burrow was observed at Station 15+50.

Flowing clear seepage was observed at two locations on the downstream toe of the dike, and soft ground was encountered along the full length of the toe of the dike and on the downstream slope up to 4 feet above the toe. The downstream toe from Station 15+30 to Station 18+20 was swampy with some ponded water. A small seep flowing clear at less than 1 gpm was observed at the downstream toe at Station 18+15. A small rust-colored silt delta was observed at the base of the seep. It is possible that the silt was eroded from the dam when seepage flowed at a higher rate. It appeared that the entire swampy area was supplied by seepage through or beneath the dike.

Water was ponded to a depth of 6 to 8 inches from Station 18+20 to Station 19+05 at the toe of the dike. A stream draining this ponded area was observed to flow clear at an estimated rate of 5 to 10 gpm. The elevation of this seepage area was about 8.5 feet below the reservoir elevation. (The reservoir elevation was about 11.3 feet below the crest of the dike at the time of inspection.)

Water ponded 1 to 2 feet deep was observed from Station 19+35 to Station 19+90. Continuous clear seepage was observed to enter the ponded area from the toe of the dike at a total rate of 10 to 20 gpm (Photo C-9). The seeps were concentrated locally where they emerged from the bases of large trees at the downstream toe. The seep that was observed to emerge from the base of the tree at Station 19-35 and shown in Photos C-9 and C-10 contained a delta of silt and fine sand, but the seep was flowing clear at the time of inspection. The elevation of this seep was about 9.4 feet below the reservoir elevation.

- c. Appurtenant Structures. See the General Plan in Appendix B for the locations of appurtenant structures on the dam.
 - 1. Spillway. At the left abutment of the dam is a 192 foot long spillway in fair to poor condition (Photo C-17). The spillway weir and training walls are of stone masonry construction and exhibit extensive

- b. Crest. The crest of the main embankment (Photo C-5) is gravel covered and approximately 13 feet wide. Minor erosion was observed at several locations along the crest. No lateral movement or misalignment was observed. The concrete core wall does not extend to the crest and is not observable.
- c. Downstream Face and Toe. The downstream face is an earth slope. The slope and toe are heavily covered with brush and trees. Several areas of minor erosion were observed along the top of the downstream slope. Thick brush, trees, and piles of cut brush obscured the lower slope and made it difficult to detect any seepage or other irregularities. Most of the downstream toe was also difficult to inspect because of the thick brush. The ground in the area was mostly soft and wet and ponded water was observed from Station 3+35 to 3+95.

2. Dike.

- a. Upstream Face. The upstream slope of the dike (Photo C-2) is brush covered above the riprap. Riprap protection on the upstream slope was absent at the left abutment and from Station 19+50 to the right abutment. A wave-cut erosion scarp was observed to extend about 1 foot above the riprap from the left abutment to about Station 19+00, and about 2 feet above the riprap from Station 19+00 to Station 19+50, where the riprap cover was less extensive. Minor erosion was also observed at the right abutment (Photo C-2). A large erosion gully was observed on the upstream slope at Station 17+10 (Photo C-11). This gully extended from the crest into the riprap protection and was about 5 feet wide and 3 feet deep. Several smaller gullies also were observed at other locations on the upstream slope.
- b. Crest. The crest of the dike (Photo C-6) is gravel covered and approximately 11 feet wide. Minor erosion was observed at several locations along the crest as were motor bike paths across the crest leading to trails up and down the slopes. No lateral movement or misalignment was observed.
- c. Downstream Face and Toe. The downstream face of the dike is an earth slope. Heavy growth of brush on the downstream slope obscured the surface of the dike and made it difficult

SECTION 3

VISUAL INSPECTION

3.1 Findings

- a. General. The Phase 1 visual inspection of the Flat River Reservoir Dam was conducted on November 26, 1980 by representatives of New England Engineering, Inc. and Geotechnical Engineers, Inc. A visual checklist and photographic record of that inspection have been included in Appendix A and C, respectively, of this report. At the time of the inspection, the water level was 4.2 feet below the spillway crest.

Based on the visual inspection, the main dam embankment and appurtenances are judged to be in FAIR condition. The earth dike comprising the right portion of the dam is judged to be in VERY POOR condition.

- b. Dam. Flat River Reservoir Dam is an earth embankment with concrete core wall. The embankment is divided into two sections by an area of higher natural ground near the middle of the dam. To the left is the main dam embankment which is 750 feet in length and contains the spillway section and the outlet works for the dam. To the right is a dike which is 1,000 feet long.

1. Main Dam

- a. Upstream Face. The upstream face (Photo C-1) is an earth slope and is brush covered from the top of the riprap to the crest. This heavy brush growth made inspection difficult. Several erosion gullies were observed on the upstream slopes above the riprap. The gullies were as large as 3 feet wide by 1 foot deep exposing a sandy soil which is susceptible to continued erosion. The riprap protection on the upstream face extended from seven feet below the crest down the slope to below the water level as far as could be seen. Several areas on the upstream face, however, were without riprap protection. Those areas are from right of the spillway to Station 2+50, just right of the intake structure at Station 6+00, and at the right abutment at Station 7+35. Minor erosion of the upstream face was observed at these locations.

SECTION 2
ENGINEERING DATA

2.1 Design

There is no available documentation regarding the design of this facility.

2.2 Construction

No formal records of construction or subsequent repairs are available for this dam. The State of Rhode Island's dam inspection reports are included in Appendix B.

2.3 Operation

The only operational records maintained are daily recordings of the reservoir water level. Discharge through the gates is controlled by the resident gate keeper at a flow level sufficient to meet the downstream water needs of the member companies of the Quidnick Reservoir Company and maintain the water level below the spillway crest.

2.4 Evaluation

- a. Availability. There is no information available.
- b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance and sound engineering judgement.
- c. Validity. No data is available to require verification.

3. Height 23 feet
4. Top width 11 feet
5. Side slopes U/S 2.2:1
D/S 2.4:1
6. Zoning None known
7. Impervious Core Unknown whether core wall exists in dike section or not.
8. Cutoff None known
9. Grout Curtain None known
10. Other No comment
- i. Diversion and Regulating Tunnel N/A
- j. Spillway
1. Type Broad-crested with free overflow vertical fall
2. Length of weir
- a. Total (Gross) 192 feet including piers
- b. Net 176 feet
3. Crest elevation 247.9 feet NVGD
4. Gates None
5. U/S Channel Natural bed of reservoir and cobblestone approach
6. D/S Channel Natural bedrock channel to Pawtuxet River
7. General No comment
- k. Regulating Outlets
1. Invert 231.0 feet
2. Size 48" diameter - 3 pipes
3. Description Cast Iron Pipe
4. Control Mechanism 3 gates on U/S and D/S ends
5. Other No comment.

e. Storage (acre-feet)

1. Normal pool	4,195
2. Flood control pool	N/A
3. Spillway crest pool	6,000
4. Top of dam	12,650
5. Test flood pool	13,600

f. Reservoir Surface Area (Acres)

1. Normal pool	950
2. Flood control pool	N/A
3. Spillway crest	950
4. Top of dam	950
5. Test flood pool	950

g. Main Dam Embankment

1. Type	Earth embankment
2. Length	750 feet including spillway.
3. Height	24 feet
4. Top width	13 feet
5. Side slopes	U/S top 7 feet 2h:1v, below 2.7h:1v. D/S 1.6h:1v.
6. Zoning	None known
7. Impervious Core	Past inspection report and drawing from 1904 indicate a concrete core wall. Core wall not observed during this inspection.
8. Cutoff	None known
9. Grout Curtain	None known
10. Other	No comment

h. Dike

1. Type	Earth embankment
2. Length	1,000 feet

2.	Maximum known flood at damsite	29 inches above spillway crest - March 1936 (El. 250.3 NGVD) with 3 gates open.
3.	Ungated spillway capa- city at top of dam.	12,000 CFS
4.	Ungated spillway capa- city at test flood ele- vation	14,630 CFS
5.	Gated spillway capa- city at normal pool elevation	N/A
6.	Gated spillway capacity at test flood elevation	N/A
7.	Total spillway capacity at test flood elevation	14,630 CFS
8.	Total project discharge at top of dam	12,790 CFS
9.	Total project discharge at test flood elevation	18,750 CFS

c. Elevations (Datum = NGVD)

1.	Streambed at toe of dam	231.0
2.	Bottom of cutoff	Unknown
3.	Maximum tailwater	Unknown
4.	Normal pool	246 ₊
5.	Full flood control pool	N/A
6.	Spillway crest	247.9
7.	Design surcharge (Original Design)	Unknown
8.	Top of dam	255.0
9.	Test flood	256.0

d. Reservoir Lengths (in feet)

1.	Normal pool	18,000
2.	Flood control pool	N/A
3.	Spillway crest pool	18,000
4.	Top of dam	18,000
5.	Test flood pool	18,000

these still use process water from the river but it is no longer used for power. The reservoir is also used for recreation and has a heavily developed shoreline.

- h. Design and Construction History. The original Johnson's Pond dam and mill which existed on this site was breached in 1873. That same year the dam was rebuilt by the Quidnick Reservoir Company adding 3 feet to its height, expanding the spillway from 2 to 5 bays, building a completely new outlet works, and changing the name to Flat River Reservoir. No design or construction records are available for this or any subsequent modifications.
- i. Normal Operating Procedures. The outlet discharge is normally regulated between $1/4$ and $3/4$ open on one of the three 48 inch outlets to maintain downstream flow and hold the reservoir at 1 to 2 feet below the spillway crest in accordance with a recommendation by the State of Rhode Island in June 1973. The suggestion to maintain a lower pond level was recommended because of seepage at the downstream toe of the dike.

1.3 Pertinent Data

- a. Drainage Area. The Flat River Reservoir drainage basin is oval in shape with an average length of approximately 6 miles, a width of 10 miles and a total drainage area of 57.5 square miles (See Appendix D for the basin map). Approximately 25 percent of the basin is man-made or natural storage. The topography consists of rolling to flat terrain with elevations ranging from a high of 680 feet to 248 feet at the spillway crest. Basin slopes are considered flat to moderate.
- b. Discharge at Damsite. There are no discharge records available for this dam. Calculated discharge data for the dam is listed below.

1. Outlet Works

- a. Conduit & Size Three 48" diameter CI outlet pipes. Invert Elevation = 231.0.
- b. Discharge Capacity
 with pond at spill-
 way crest elevation
 = 247.9. (3 pipes) 630 CFS
- c. Discharge Capacity
 with pond at top of
 dam elevation=255.0
 (3 pipes) 790 CFS
- d. Discharge capacity
 at test flood ele-
 vation = 256.0
 (3 pipes) 810 CFS

- b. Description of the Dam and Appurtenances. Flat River Reservoir Dam is an earth embankment which is divided into two sections by an area of higher natural ground near the middle of the dam. The main dam embankment is located to the left of the area of natural ground and has a length of 750 feet and a crest elevation of 255.0 NGVD. The embankment has a concrete core wall and the upstream slope is 2.7:1 and the downstream slope is 1.6:1. The main embankment contains a 192 foot long stone masonry spillway and the outlet works. The spillway is located at the left abutment and has a broadcrested weir with a crest elevation of 247.9 NGVD. The spillway weir length of 192 feet is reduced to an effective length of 176 feet because of four 4 foot wide bridge support piers located on the crest. The outlet works consist of three 48" diameter cast iron pipes with gatehouses on the upstream and downstream ends. The right section of the dam is a 23 foot high earth dike which is 1,000 feet long and has a crest elevation of 255.0 NGVD. The dike has an upstream slope of 2.2:1 and a downstream slope of 2.4:1.
- c. Size Classification. The dam at Flat River Reservoir has an impoundment capacity at the top of the dam (elevation 255.0 NGVD) equal to 12,650 Ac-Ft and a height of 24.0 feet. In accordance with the Corps of Engineers guidelines for dams with between 1,000 and 50,000 Ac-Ft of storage, this dam is classified as an INTERMEDIATE size structure based on its impoundment capacity.
- d. Hazard Classification. The dam at Flat River Reservoir is classified a HIGH hazard potential because its failure could result in the loss of more than a few lives and the inundation of numerous dwellings, commercial and industrial structures. It is estimated that a dam failure would cause an additional 2-4 feet of flooding in the overbank areas of the failure impact area. Pre-failure flooding would range from 1-6 feet deep in the overbank areas. Dam failure and subsequent flooding with high water velocities will also carry trees, brush and other debris downstream increasing the damage potential.
- e. Ownership. The dam and reservoir are owned by: The Quidnick Reservoir Company, c/o Mr. Joel Westerman, Westerman Realty Company, 20 Remington, West Warwick, Rhode Island, phone - (401) 821-3880.
- f. Operator. Operation is at the direction of the Quidnick Reservoir Company and is carried out by their gatekeeper who lives at the dam site; Mr. Edward Cloutier, RR3, Box 2979, Coventry, Rhode Island, phone - (401) 828-5760.
- g. Purpose of Dam. The dam and reservoir were originally used to store water for power generation and process use by the member industries of the Quidnick Reservoir Company located downstream of the dam. Several of

NATIONAL DAM INSPECTION PROGRAM

PHASE 1 - INSPECTION PROGRAM

FLAT RIVER RESERVOIR DAM

SECTION 1

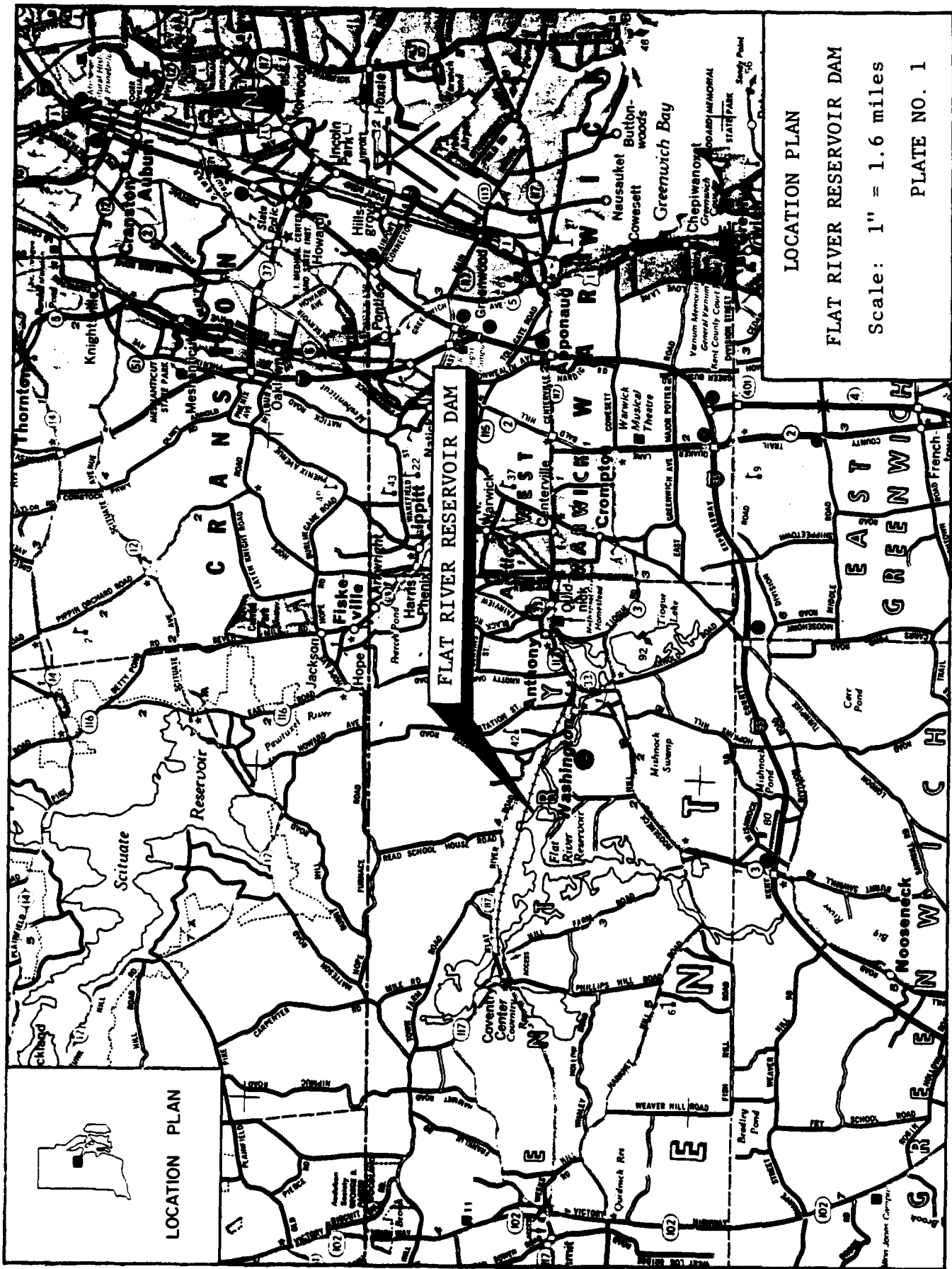
PROJECT INFORMATION

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. New England Engineering, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Rhode Island. Authorization and notice to proceed was issued to New England Engineering, Inc. under a letter from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-81-C-0007 has been assigned by the Corps of Engineers for this work.
- b. Purpose of Inspection.
 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 State 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. Flat River Reservoir Dam is located in Coventry, Kent County, Rhode Island on the South Branch of the Pawtuxet River 8 miles upstream from the confluence with the Pawtuxet River. It is shown on the Crompton, Rhode Island U.S.G.S. quadrangle sheet. Coordinates of the dam are approximately 41 degrees, 41.7' North Latitude and 71 degrees, 35.7' West Longitude. The dam impounds water from the South Branch of the Pawtuxet River which drains a 57.5 square mile drainage area. The axis of the dam is in a north-south direction with the impoundment to the west.





OVERVIEW PHOTO - Flat River Reservoir Dam

December 12, 1980

APPENDICES

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spalling of mortar from between the stones. The right training wall contains several loose stones, and cracks and loose stones were observed in the piers supporting the service bridge over the spillway.

The right side of the downstream channel from the spillway contains a granite stone masonry apron which is approximately horizontal and is about 2 feet below the spillway crest. It extends about 50 feet downstream from the weir on the right portion of the spillway (Note: The length of the spillway was extended from 2 to 5 bays when the dam was rebuilt in 1873). The surface of the apron contains many cracks through which brush and trees up to 4 inch diameter were growing. Brush also grows in the downstream end of the apron, but no seepage was visible. The left side of the downstream channel of the spillway consists of a natural stream channel with a bedrock floor about 6.5 feet below the spillway crest. Although the reservoir level was about 4.2 feet below the spillway crest (Photo C-7), a large area of ponded water was observed in the downstream channel. A stream draining the ponded area was observed to flow continuously at a rate of 2 to 3 gpm. Seepage was observed to emerge from the contact between the spillway weir and bedrock on the downstream face of the weir (Photo C-16) and to seep slowly (one or two drops per second) through the left side of the downstream face of the weir. The elevation of this seepage was only 0.5 feet below the reservoir elevation at the time of inspection. The shore of the reservoir was about 200 feet upstream from the crest of the spillway at this time.

2. Service Bridge. The service bridge (Photo C-7) over the spillway is in poor condition. Many of the wooden beams beneath the deck of the bridge are rotted and no longer provide support for the deck (Photo C-15). Most of the boards forming the decking for the bridge are loose and rotting. Plywood sheets have been placed over this decking. The granite stone masonry abutments are in fair condition and contain some loose stones and spalled mortar. The bridge can presently support pedestrian traffic, but is probably unsafe for vehicular traffic. Only pedestrian traffic is required during emergencies to provide access to the gates.
3. Intake Structure and Gates. The intake gatehouse (Photos C-1 and C-5) is a wooden superstructure on a concrete slab supported by a stone masonry foundation. The structure houses the control mechanisms for the three intake gates on the upstream

side of the dam. These gates control the flow into the three 48" conduits through the dam. The center gate is motor or handwheel operated. The two outside gates are both handwheel operated. All three gates are in good operating order. The wiring inside the gatehouse appears in generally poor condition and the lighting is inoperable. The trash rack on the upstream side of the gates is rotting and in need of repair as is the decking over the rack (Photo C-12). The intake gatehouse is generally in fair condition, except for some cracking and slight movement observed in the stone masonry foundation and concrete slab on the left side of the building. Because of inadequate riprap protection, erosion has partly undermined the left upstream corner of the structure.

4. Outlet Structure and Gates. The outlet gate structure is located at the downstream toe of the dam (Photo C-14) and is in poor condition. Only the floor remains of the original wooden superstructure that housed the controls for the outlet gates. The wooden floor boards are rotted and unsupported on the right downstream side. Concrete on the downstream face of the outlet structure is spalled up to 3 inches into the face, and several cracks were observed in construction joints at the bottom of the structure. Access to the outlet structure is difficult. Loose plywood planking forms a crude bridge to the elevated structure and is in poor condition. An unanchored wooden step-ladder provides the only access to the control mechanisms for the outlet gates which are located at the downstream end of the outlet pipes. The left gate is inoperable. Just above the outlet gatehouse, each conduit has a short 48" diameter surge tank with a rotten wooden cover. Should the outlet gates be closed with the inlets open, the tank covers would be washed away by flow out of the top of the surge tanks. The outlet gatehouse cannot control outflow from the reservoir because of the condition of the surge tank covers.
- d. Reservoir Area. No specific detrimental features in the reservoir area were observed during the visual inspection.
- e. Downstream Channel. The downstream channel from the spillway (Photo C-8) consists of natural stream bed in bedrock. Many trees overhang and grow in the channel area. The spillway channel joins the outlet channel approximately 400 feet downstream. The downstream channel from the outlet structure (Photo C-14) is the natural stream bed of the south branch of the Pawtuxet River.

3.2 Evaluation

- a. Based on the visual inspection, the main dam embankment (Station 0+00 to 7+50) appears to be in FAIR condition, however, the following features could adversely affect the future performance of the dam and should be investigated:
1. Seepage at the downstream toe, which could increase during higher reservoir levels.
 2. Heavy growth of brush and trees on the upstream and downstream slopes and toe of the dam and on the spillway weir, apron and training walls, which may provide paths of seepage along root systems, obscure the presence of seepage from visual inspection, and dislodge stones from masonry structures.
 3. The source and potential effects of seepage through and beneath the spillway weir.
 4. The poor condition of the outlet gate structure and surge tanks including an evaluation of need and improvements as required.
 5. Deterioration of the service bridge over the spillway, which provides the most rapid access route to the gate structures.
 6. Lack of slope protection on the upstream slope from Station 1+95 to Station 2+50, and adjacent to the intake gatehouse. In addition, the top of the riprap protection should be raised as required.
- b. The condition of the dike (Station 10+60 to 20+60) is VERY POOR. The following aspects of the dike should be investigated and repaired as necessary.
1. Seepage at the downstream toe of the dike, which could increase during higher reservoir levels. At Stations 18+15 and 19+35 delta deposits were noted downstream from the seeps.
 2. Severe erosion of the upstream slope at Station 17+10.
 3. Heavy growth of brush and trees on the upstream and downstream slopes and toe which may provide paths of seepage along root systems or obscure the extent of seepage from visual inspection.
 4. Inadequate riprap protection on the upstream slope, which has permitted the formation of an erosion scarp above the present riprap.
 5. The animal burrow at Station 15+50.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

- a. General. Flat River Reservoir is used by the owner, the Quidnick Reservoir Company to store water for use by the mills of the member companies along the South Branch of the Pawtuxet River downstream from the dam. Originally this water was used for power and now as a source of process water. Operational control is exercised through a gatekeeper who lives on the site of the dam and is responsible for the operation of the gates, daily recording of the reservoir level and such minor maintenance as is performed. The normal procedure is to keep one of the 48" upstream gates 3/4 open. In periods of low flow, such as the summer and autumn prior to this inspection, the gate opening is reduced to as little as 1/4 open. They generally try to keep the reservoir level 1 to 2 feet below the spillway elevation.
- b. Warning System. There is no warning system in effect at Flat River Reservoir Dam. There is no formalized emergency action plan for the dam.

4.2 Maintenance Procedures

- a. General. The dam and appurtenances are not well maintained. Heavy brush covers the upstream and downstream slopes and brush and trees grow heavily on the toe. Brush from previous cuttings is piled along the toe obscuring it from adequate observation. The outlet gate structure is badly deteriorated and the inlet structure needs electrical maintenance.
- b. Operating Facilities. The inlet gates appear to be in good working order. Only two of the three outlet gates are in working order and they are all exposed to the weather and further deterioration. The deterioration of the standpipe covers renders the outlet controls of limited usefulness. The flow through outlet can still be controlled by the inlet gates regardless of the condition of the outlet gates.

4.3 Evaluation

- a. Trees and brush are present over the embankment and dike. The stone masonry on the spillway, piers, and training walls is in deteriorating condition.

- 7
- b. There is inadequate regularly scheduled maintenance for this dam. There are numerous maintenance deficiencies as described above. A systematic inspection and rehabilitation program should be developed and implemented. The outlet structures should be evaluated and rehabilitated, if required.
 - c. An emergency action plan should also be developed and implemented that includes reservoir dewatering procedures, locations of emergency equipment, materials or manpower to reduce or minimize dam failure damage, authorities to be contacted in emergency situations and a program of surveillance during unusual storm events.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The dam at Flat River Reservoir was reconstructed in 1873 to store water for power generation and process uses by the downstream factories. The dam is located on the South Branch of the Pawtuxet River in the MA/RI Coastal Basin. The watershed for the reservoir is 57.5 square miles with approximately 25% of this basin man-made or natural storage.

The net spillway length is 176 feet. The maximum height of the dam is 24 feet and, the total length of the dam, dike, and spillway is 1,750 feet. The reservoir has a storage capacity at the spillway crest of 6,000 Ac-Ft and can accommodate 1.96 inches of runoff from the watershed. Each foot of depth above the spillway level can accommodate 950 Ac-Ft of water equivalent to 0.31 inches of runoff from the watershed.

It will take 18 hours to lower the reservoir 1 foot based on a surface area of 950 acres and an outflow of 630 CFS. For the 6,000 Ac-Ft of storage below the spillway it is estimated that it would take 6 to 10 days to drain the reservoir.

5.2 Design Data

Little specific data is available for this watershed or structure. In lieu of existing complete design information, U.S.G.S. topographic maps (scale 1" 2,000 ft.) were utilized to develop hydrologic parameters such as drainage area, reservoir surface areas, basin slopes, and other runoff characteristics. Elevation-storage relationships for the reservoir were approximated. Some of the pertinent hydraulic data was obtained and/or confirmed by actual field measurements at the time of the visual inspection. Test flood inflows and outflows and dam failure flows were determined in accordance with the Corps of Engineers guidelines.

5.3 Experience Data

The highest reservoir level indicated in the available records is 29 inches over the spillway crest in 1936.

5.4 Test Flood Analysis

Recommended guidelines for the Safety Inspection of Dams by the Corps of Engineers were used for selection of the Test Flood. This dam is classified under those guidelines as a HIGH hazard and INTERMEDIATE in size. Guidelines indicate

that a storm event equal to the PMF be used as a test flood for such a classification. The watershed has a total drainage area equal to 57.5 square miles of which approximately 25% is man-made or natural storage. This drainage area is moderately populated, fairly wooded, with rolling to flat topography.

A test flood equal to the PMF was taken from Corps of Engineers curves at 500 CSM and reduced for storage to 375 CSM, equal to 21,600 CFS and was adopted for this analysis. The routed outflow discharge for the test flood inflow was 18,750 CFS. The spillway and outlet rating curves are illustrated in Appendix D. Flood routing was performed assuming an initial reservoir level at the spillway crest elevation of 247.9.

The analysis indicated that the capacity of the spillways is hydraulically inadequate to pass the test flood outflow and this outflow would overtop the dam by approximately 1.0 foot assuming the overflow length of dam and dike (excluding the spillway) to be 1,300 feet. The maximum outflow capacity of the spillway to the top of dam elevation 255.0 is 12,000 CFS or 64% of the peak test flood outflow.

One-half the PMF was calculated to be 10,800 CFS. The routed outflow discharge was 8,720 CFS with an elevation of 253.2 NGVD. The dam has a freeboard equal to 1.8 feet for one-half the PMF.

5.5 Dam Failure Analysis

The dam failure analysis was based on a full depth, partial width breach. The breach width was assumed to be 60 feet. The dam failure discharge was calculated to be 23,850 CFS of which 12,000 CFS was the spillway discharge at the time of failure. The reservoir level was assumed to be equal to the top of dam (elevation 255.0) just prior to failure. Failure of this dam will result in additional flooding along the entire reach of the South Branch of the Pawtuxet River to the confluence with the main stem. There are 10 dams between Flat River Reservoir Dam and the confluence with the Pawtuxet River approximately 8 miles downstream. The prefailure discharge of 12,000 CFS will result in flood stages ranging from 1 to 6 feet above the tops of the dams. The failure discharge will result in an additional 2 to 3 feet of flooding in the overbank areas. A large number of homes, businesses and industries are located within the dam failure impact area as shown in Appendix D.

The dam failure flood stages in the impact area could cause the loss of more than a few lives. As a result of the failure analysis, the dam has been classified as a HIGH hazard structure.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

Visual examination of the geotechnical and structural aspects indicate that the dam at Flat River Reservoir could be subject to piping failure from seepage through the dam at several locations. There is no known filter protection on the downstream slope and the large stumps and the roots of trees that currently grow on the slope probably provide paths for much of the current seepage. There are no scarps or other movements observable that would indicate past sliding surfaces.

The dike is in more serious condition than the main dam embankment. Delta deposits were observed downstream from seeps at Stations 18+15 and 19+35, although the water was flowing clear at the time of inspection. Because these deltas indicate the movement of fine material from within the dike, the reservoir elevation should be limited to a low enough level to minimize downstream damage in the event of failure.

6.2 Design and Construction Data

No design or construction data is available that influences the evaluation of stability.

6.3 Post-Construction Changes

According to information provided in a State of Rhode Island Special Inspection Report dated 10/21/46, it appears that the dike was breached approximately in the center (Station 16+80+) during a storm in 1873. That same year the entire dam was rebuilt raising the height of the dam 3 feet, replacing the former mill with the current outlet pipes and gate houses, and expanding the spillway from 2 to 5 bays. The same 10/21/46 report makes note of a leak located 100 feet north of the former breach (approximately Station 15+80). At this location the ground was wet and mushy during the current inspection.

During an inspection on August 26, 1972, seepage on the downstream side of the dike was noted. At Station 18+75 and at Station 19+50 there were "large amounts of water leaking through the dam". It was also noted that the velocity was high "and some evidence of fines are visible". The water was flowing from under large trees.

Subsequently, on April 2, 1973, an inspection was made by personnel of the R. I. Department of Natural Resources. The leaks noted above were observed again and were estimated to

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be flowing at a total of 5 gpm. Three locations of water movement were noted and they were all associated with large, old trees. At that time it was suggested that a clay blanket be installed upstream.

A further inspection was made on September 23, 1973 when the reservoir had been drawn down "with water in channels only". Only one leak in the dike remained. This leak was under a large maple tree adjacent to the downstream pond and swamp and it was estimated to be flowing at the same rate as during the April 2 inspection. It is probably this leak that is the one referred to in Section 3.1.b.(2) herein at Station 19+35, which is at the base of a large, dead maple tree. Based on this 1973 inspection it was recommended at that time that the pond be kept 12 to 29 inches below the spillway. No other recommendations were made for repairs related to this leak.

Based on the above history, leakage from the dike has been occurring for more than 35 years. Also, evidence of fines having been moved was noted in 1972 and during the current inspection. Such seepage and movement of fines causes continual deterioration of the condition of an earth dam and may lead to a breach at any time. It is more likely that a breach due to piping will occur during high water. This history confirms the conclusion reached based on visual inspection that the level of the reservoir should be maintained low enough to minimize any downstream hazard.

6.4 Seismic Stability

The dam is located in Seismic Zone 1 and, in accordance with Corps of Engineers guidelines, does not warrant seismic stability analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition. Based on the visual inspection, the main dam appears to be in fair condition but the dike is in very poor condition resulting in a net rating for the Flat River Reservoir Dam of VERY POOR. Features which adversely affect the condition of the dike are:
1. Seepage along the downstream toe of the earth dike with evidence of movement of fines from within the dike.
 2. Trees and brush on the downstream slope and toe of the earth dike, particularly those large trees at the toe providing probable paths of seepage.
 3. Erosion on the upstream slope.

Features which could adversely affect the condition of the main dam embankment in the future are:

1. Heavy growth of brush on the slopes and large trees and brush at the downstream toe.
 2. Apparent seepage along downstream toe of the embankment and downstream of the spillway section.
 3. The deteriorating condition of the service bridge over the spillway.
- b. Adequacy of Information. The available information is such that the assessment of the condition of the dam must be based on visual observation.
- c. Urgency. The reservoir level should be lowered immediately to reduce the downstream hazard if a breach were to occur. The Rhode Island Department of Environmental Management recommended that the level of the reservoir be lowered in a letter to the owner dated March 9, 1981. Also, the dike embankment should be stabilized immediately to minimize the chances of a piping failure.

The recommendations and remedial measures described below should be implemented by the Owner within one year after receipt of the Phase I report.

7.2 Recommendations

The reservoir level should be lowered immediately to reduce the downstream hazard. The owner should also immediately engage the services of a registered professional engineer experienced in the design of dams to design and supervise the construction of a pervious counterweight along the toe of the dike or to design and supervise the construction of some other embankment stabilization measure.

The following items should be carried out under the direction of a registered engineer qualified in the design of dams and the recommendation resulting should be implemented by the Owner:

a. Dam.

1. Perform a detailed hydrologic/hydraulic investigation of the potential downstream hazard to determine the level at which the reservoir can be maintained in order to minimize the downstream damage in the event of a failure.
2. Perform a detailed hydrologic/hydraulic investigation to assess further the potential for overtopping the dam and the need for and means to increase the project discharge capacity.
3. Remove all trees including roots from upstream and downstream slopes in the spillway apron area, and within 20 feet of the downstream toe and fill root depressions with suitable compacted material.
4. Inspect carefully the elevation, quantity and turbidity of seepage at the downstream toe, and periodically monitor seepage through the dam and spillway. Assess the need for control of the seepage.
5. Evaluate the necessity and purpose of the downstream outlet structure and design and construct improvements deemed required.
6. Design the necessary repairs of the service bridge and observe construction.
7. Backfill all erosion gullies on the slopes with appropriate compacted soil and provide erosion control.
8. Design and repair riprap on upstream slope and raise the top elevation of the riprap above the spillway crest elevation. Also provide riprap in unprotected areas.
9. Investigate and repair spalled areas of the spillway training walls and access bridge piers.

b. Dike.

1. Evaluate the need for more permanent repairs to correct the seepage and stability problems of the dike.
2. Remove all trees including roots from the upstream and downstream slopes and within 20 feet of the downstream toe and fill root depressions with appropriate compacted material.
3. Backfill severe erosion gully on the upstream slope at Station 17+40 and other erosion gullies on the dike slopes with appropriate compacted soil.
4. Design and repair riprap on the upstream slope, extending riprap up the slope above the wave-cut scarp. Also provide riprap in unprotected areas.

7.3 Remedial Measures

a. Operation and Maintenance Procedures

1. Establish a program of regular surveillance, especially during and after periods of heavy precipitation.
2. Implement and intensify a program of diligent and periodic maintenance including, but not limited to: removing brush on slopes, providing protective grass cover on exposed areas, backfilling animal burrows or tire ruts with suitable well tamped material, and cleaning debris from spillways and slopes.
3. Develop an "Emergency Action Plan" that will include an effective preplanned downstream warning and evacuation system, locations of emergency equipment, materials and manpower, authorities to contact and potential areas that require evacuation.
4. Institute a program of annual technical inspection by a qualified registered engineer.
5. Develop a system for the recording of data with regard to items such as: water levels, discharges, time and drawdown to assist those responsible for monitoring of the structure.
6. Repair the electrical and lighting system in the intake gatehouse.

7. Repair the trash rack maintenance platform at the intake gatehouse.

7.4 Alternatives

There are no practical alternatives to the recommendations of Sections 7.2 and 7.3.

APPENDIX A

INSPECTION CHECKLIST

October 18, 1973

Quidneck Reservoir Company
c/o Mr. Robert Galvin
Natco Products Corporation
33 Factory Street
West Warwick, Rhode Island

Gentlemen:

An inspection of R. I. Dam #167 (Johnson's Pond - Coventry) by Departmental representatives on October 10, 1973 revealed no conditions which would alter the evaluations and recommendations made to you in the letter from this Department dated June 13, 1973.

A copy of the inspection report of October 10, 1973 is enclosed for your information.

Very truly yours,

Calvin B. Dunwoody
Chief
Division of Planning and Development

CBD:cc

Enclosure

cc: Arnold Blasbaig, President
Coventry Town Council

APPENDIX B

ENGINEERING DATA

PERIODIC INSPECTION CHECKLIST

PROJECT FLAT RIVER RESERVOIR DAM DATE Nov. 26, 1980
 PROJECT FEATURE Bridge NAME _____
 DISCIPLINE Structural Engineering NAME Sluter/Fodor

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE OVER</u> <u>SPILLWAY</u>	
a. <u>Super Structure</u>	
Bearings	None
Anchor Bolts	Satisfactory
Bridge Seat	Steel H-section columns and angles satisfactory.
Longitudinal Members	6" x 12" wood beams in generally poor condition. Several split and rotted giving no support.
Underside of Deck	Wood on underside of deck rotten in many places.
Secondary Bracing	Wood cross-bracing at piers rotted and missing in many locations, generally poor condition.
Deck	3" x 8" boards loose and rotted, covered by 4' x 8' plywood sheets in fair condition.
Drainage System	N/A.
Railings	Steel cables attached to pipe braced to generally rotted cross-bracing - intact but loose.
Expansion Joints	N/A.
Paint	None.
Abutment & Piers	
General Condition of Stone Masonry	Fair - some loose stones and spalled mortar.
Alignment of Abutment	Right abutment - granite stone on top loose and partly rotated. Left abutment - satisfactory.
Approach to Bridge	Sand and gravel roadway in satisfactory condition.
Condition of Seat & Backwall	Backwalls for left and right abutments have some loose stones - no significant movement observed, generally fair condition. 1' x 1' x 2' Concrete bridge seats: Left side - corners spalled off 3" into seat. Right side - minor erosion, fair condition.

PERIODIC INSPECTION CHECKLIST

PROJECT FLAT RIVER RESERVOIR DAM DATE Nov. 26, 1980
 PROJECT FEATURE Spillway NAME Sluter/Fodor
 DISCIPLINE Hydraulic/Civil/Geotechnical NAME Poulos/Stetkar

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	
General Condition	Fair. Channel constricted somewhat by dumped fill on left side and sand bar on right side.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	None
Floor of Approach Channel	6" to 8" cobble pavement covered in many places with up to 12" of sand.
b. Weir and Training Walls	
General Condition of Stone Masonry	Fair to poor. Loose and dislodged stone on right training wall. Trees up to 4" diameter growing from right training wall. Cracks in weir where mortar is missing provide paths of seepage into weir. Brush and grass growing in weir.
Rust or Staining	None.
Spalling	Mortar generally spalled from joints between stones.
Any Visible Reinforcing	N/A.
Any Seepage or Efflorescence	Standing water downstream right side of spillway, no flowing water observed. Seepage from downstream face of weir up to 6" above toe on left side of spillway forming ponded water. Flow from ponded water 2 to 3 gpm.
Drain Holes	N/A.
c. Discharge Channel	
General Condition	Poor.
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Downstream channel is forested.
Floor of Channel	Right side of spillway - stone masonry apron 4 feet high extending 50 feet downstream. Left side of spillway - bedrock floor immediately downstream from weir.
Other Obstructions	None.
Other Comments	None.

PERIODIC INSPECTION CHECKLIST

PROJECT FLAT RIVER RESERVOIR DAM DATE Nov. 26, 1980
 PROJECT FEATURE Outlet Gatehouse NAME Poulos/Stetkar
 DISCIPLINE Structural Engineering NAME Sluter/Fodor

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET GATEHOUSE</u>	
a. Concrete and Structural	
General Condition	Poor condition. Only floor remains of original wooden building enclosing outlet gate controls. Floor supported by wooden columns on concrete footings on downstream end. Concrete footing on left side severely cracked; concrete footing and column on right side is missing.
Any Seepage or Efflorescence	None observed.
Joint Alignment	See comments above.
Unusual Seepage or Leaks in Gate Chamber	None observed
Cracks	See comments above.
Rusting or Corrosion of Steel	Minor corrosion of steel on gates.
b. Mechanical and Electrical	
Air Vents	N/A.
Float Wells	None
Crane Hoist	None
Elevator	None
Hydraulic System	None
Service Gates	Left gate inoperable, center and right gates satisfactory. Exposed to weather and continued deterioration.
Emergency Gates	None.
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System	None

PERIODIC INSPECTION CHECKLIST

7 PROJECT FLAT RIVER RESERVOIR DAM DATE Nov. 26, 1980
 PROJECT FEATURE Outlet Structure NAME Sluter/Fodor
 DISCIPLINE Civil/Geotechnical NAME Poulos/Stetkar

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition of Concrete	Fair.
Rust or Staining	Concrete facing over masonry stained where cracked.
Spalling	Concrete facing over masonry spalled at top of downstream face of structure up to 3 inches into face.
Erosion or Cavitation	
Visible Reinforcing	None.
Any Seepage or Efflorescence	None.
Condition at Joints	Hairline cracks along joints at bottom of structure.
Drain holes	None.
Channel	Submerged and not observable.
Loose Rock or Trees Overhanging Channel	None
Condition of Discharge Channel	Satisfactory.

PERIODIC INSPECTION CHECKLIST

PROJECT FLAT RIVER RESERVOIR DAM DATE Nov. 26, 1980
 PROJECT FEATURE Outlet Piping NAME Poulos/Stetkar
 DISCIPLINE Civil/Structural Engineering NAME Sluter/Fodor

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - TRANSITION AND CONDUIT</u></p> <p>General Condition of Concrete</p> <p>Rust or Staining on Concrete</p> <p>Spalling</p> <p>Erosion or Cavitation</p> <p>Cracking</p> <p>Alignment of Monoliths</p> <p>Alignment of Joints</p> <p>Numbering of Monoliths</p> <p>Other</p>	<p>Three 48" pipes through dam not observable.</p> <p>Concrete slab covering route of transition conduit to outlet gates on downstream toe of dam cracked and broken along edge. Purpose of slab not known.</p> <p>Three surge tanks, 4 feet in diameter. Wooden covers are in poor shape. One nearly completely rotted.</p>

PERIODIC INSPECTION CHECKLIST

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PROJECT FLAT RIVER RESERVOIR DAM DATE Nov. 26, 1980
 PROJECT FEATURE Intake Gatehouse NAME Poulos/Stetkar
 DISCIPLINE Civil/Structural Engineering NAME Sluter/Fodor

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE GATEHOUSE</u>	
a. Concrete and Structural	
General Condition	Satisfactory.
Condition of Joints	Satisfactory.
Spalling	Minor spalling of mortar from between stones in building foundation.
Visible Reinforcing	None.
Rusting or Staining of Concrete	None observed.
Any Seepage or Efflorescence	None observed.
Joint Alignment	Crack in foundation on right side with outward movement less than 1/4 inch. Wooden deck on upstream side partly settled due to undermining by erosion on right side.
Unusual Seepage or Leaks in Gate Chamber	None observed.
Cracks	Noted above in foundation and upstream deck. Concrete slab on downstream side shows several hairline cracks transverse to embankment axis.
Rusting or Corrosion of Steel	No significant corrosion.
b. Mechanical and Electrical	
Air Vents	None
Float Wells	None
Crane Hoist	None
Elevator	None
Hydraulic System	None
Service Gates	Satisfactory condition.
Emergency Gates	None
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System	Motor operation of counter gate functional. Lighting not operable.

PERIODIC INSPECTION CHECKLIST

PROJECT FLAT RIVER RESERVOIR DAM

DATE Nov. 26, 1980

PROJECT FEATURE Intake Structure

NAME Sluter/Fodor

DISCIPLINE Hydraulic/Civil/Geotechnical

NAME Poulos/Stetkar

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u></p> <p>a. Approach Channel</p> <p>Slope Conditions</p> <p>Bottom Conditions</p> <p>Rock Slides or Falls</p> <p>Log Boom</p> <p>Debris</p> <p>Condition of Concrete Lining</p> <p>Drains or Weep Holes</p> <p>b. Intake Structure</p> <p>Condition of Concrete</p> <p>Stop Logs and Slots</p> <p>Trash Racks</p>	<p>Upstream training walls of channel constructed of stone masonry submerged and not closely observable. Appear to be in satisfactory condition.</p> <p>Submerged and not observable.</p> <p>None.</p> <p>None.</p> <p>None observed.</p> <p>Not observable.</p> <p>Not applicable.</p> <p>Satisfactory. Minor surface spalling 3 inch from top of upstream end of intake gate.</p> <p>None.</p> <p>Poor condition. Top of wooden racks rotted and loose, in need of repair.</p>

PERIODIC INSPECTION CHECKLIST

PROJECT FLAT RIVER RESERVOIR DAM DATE Nov. 26, 1980
 PROJECT FEATURE Dike Embankment NAME Sluter/Fodor
 DISCIPLINE Geotechnical/Civil NAME Poulos/Stetkar

AREA EVALUATED	CONDITION
<p><u>DIKE EMBANKMENT (Cont.)</u></p> <p>Rock Slope Protection - Riprap Failures</p> <p>Unusual Movement or Cracking at or Near Toes</p> <p>Unusual Embankment or Downstream Seepage</p> <p>Piping or Boils</p> <p>Foundation Drainage Features</p> <p>Toe Drains</p> <p>Instrumentation System</p> <p>Vegetation</p>	<p>No riprap at abutments. Mostly 30 to 80 lb. stone with some riprap up to 500 lb. Generally good condition. Wave action extends above riprap on upstream slope.</p> <p>None observed - toe obscured by heavy growth of brush.</p> <p>Mushy ground along entire downstream toe and on downstream slope up to 4 feet above toe. Wet area from 15+30 to Station 18+20. Very slow seep observed at Station 18+15 flowing clear at time of inspection. Rust-stained silt delta observed at location of this seep. Wet area Station 18+70 to 19+05. Stream draining wet area flows at 5 to 10 gpm. Ponded water Station 19+35 to 19+90. Seepage from beneath roots of large tree at toe at Station 19+35 entering ponded water at rate of 10 to 20 gpm flowing clear. Silt delta observed at location of this seep.</p> <p>No active piping or boils observed. Small silt deltas observed at downstream toe at Station 18+15 and 19+35.</p> <p>None.</p> <p>None.</p> <p>None.</p> <p>Brush on upstream and downstream slopes up to 5 feet high. Trees up to 20 inch diameter growing at downstream toe of dike.</p>

PERIODIC INSPECTION CHECKLIST

PROJECT FLAT RIVER RESERVOIR DAM DATE Nov. 26, 1980
 PROJECT FEATURE Dike Embankment NAME Sluter/Fodor
 DISCIPLINE Geotechnical/Civil NAME Poulos/Stetkar

AREA EVALUATED	CONDITION
<p><u>DIKE EMBANKMENT</u></p> <p>Crest Elevation 255.0 ± feet Current Pool Elevation 243.7 feet Maximum Impoundment to Date Surface Cracks Pavement Condition Movement or Settlement of Crest Lateral Movement Vertical Alignment Horizontal Alignment Condition at Abutment and at Concrete Structures</p> <p>Indications of Movement of Structural Items on Slopes</p> <p>Trespassing on Slopes</p> <p>Sloughing or Erosion of Slopes or Abutments</p>	<p>Natural ground is central portion of dam from Station 7+35 to Station 13+00. Dike embankment on right side of dam from Station 13+00 to Station 20+60.</p> <p>None observed</p> <p>Sand and gravel roadway 10 feet wide on crest.</p> <p>None observed. Crest of dam irregular with local variations in elevation up to 0.3 feet. None observed.</p> <p>No misalignment observed.</p> <p>No misalignment observed.</p> <p>No concrete structures. No upstream riprap protection on left or right abutments. Left abutment contact obscured downstream by rubbish pile. Right abutment contact covered with brush and leaves downstream. Wet area observed 4 feet above downstream toe at right abutment contact.</p> <p>No structural items on slopes.</p> <p>Free access to slopes and crest. Many footpaths on upstream and downstream slopes. Animal burrow 18 inch diameter at least 5 feet deep on downstream slope at Station 15+50.</p> <p><u>Upstream Slope:</u> Wave cut up to 2 feet above riprap. Station 16+20 to 16+40 - Erosion on upstream edge of crest. Station 17+05 to 17+25 - Severe gully erosion 4 feet wide extending 3 feet into crest. Station 18+00 - 1.5 foot deep erosion gully.</p> <p><u>Downstream Slope:</u> Footpaths 2 to 3 feet wide and 1 to 1.5 feet deep at Station 19+90 and 20+90.</p>

PERIODIC INSPECTION CHECKLIST

PROJECT FLAT RIVER RESERVOIR DAMDATE Nov. 26, 1980PROJECT FEATURE Dam EmbankmentNAME Poulos/StetkarDISCIPLINE Geotechnical/CivilNAME Sluter/Fodor

AREA EVALUATED	CONDITION
<p><u>DAM EMBANKMENT (Cont.)</u></p> <p>Unusual Movement or Cracking at or Near Toe</p> <p>Unusual Embankment or Downstream Seepage</p> <p>Piping or Boils</p> <p>Foundation Drainage Features</p> <p>Toe Drains</p> <p>Instrumentation System</p> <p>Vegetation</p>	<p>Toe covered by heavy brush growth. Not observable.</p> <p>Much of downstream toe not observable because of heavy brush growth. Wet area at downstream toe from Station 3+35 to Station 3+95.</p> <p>None observed.</p> <p>None.</p> <p>None.</p> <p>None.</p> <p>Small brush on upstream slope. Stumps above riprap on upstream slope. Dense brush cover on downstream slope. Piles of cut brush obscure observation of downstream toe. Tree stumps up to 14 in. diameter on downstream slope. Trees up to 20 in. diameter growing at downstream toe.</p>

PERIODIC INSPECTION CHECKLIST

PROJECT FLAT RIVER RESERVOIR DAMDATE Nov. 26, 1980PROJECT FEATURE Dam EmbankmentNAME Poulos/StetkarDISCIPLINE Geotechnical/CivilNAME Slurer/Eodor

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	Main dam embankment; Station 1+95 (left abutment) to Station 7+35.
Crest Elevation	255.0 feet
Current Pool Elevation	243.7 feet
Maximum Impoundment to Date	250.3 feet (1936)
Surface Cracks	None observed.
Pavement Condition	Sand and gravel roadway, 12' wide on crest.
Movement or Settlement of Crest	No significant movement or settlement observed. Crest surface irregular with local variations in elevation from 0.1 to 0.5 feet.
Lateral Movement	None observed
Vertical Alignment	No misalignment observed
Horizontal Alignment	No misalignment observed
Condition at Abutment and at Concrete Structures	Satisfactory
Indications of Movement of Structural Items on Slopes	No significant movements observed.
Sloughing or Erosion of Slopes or Abutments	Downstream slope: Station 3+20 erosion gully. Station 4+50 to 5+50 - several washouts and erosion gullies. Upstream Slope: Station 4+00 to 4+40 - footpaths and erosion gully eroded up to crest. Station 4+90 - minor erosion near water level.
Rock Slope Protection - Riprap Failures	Right abutment of spillway (Station 1+95) to Station 2+50 - no riprap protection. Station 2+50 to 4+50 - 30 to 100 lb stone in good condition. Station 4+50 to gatehouse - 200 to 600 lb stone generally good condition. Irregular cover at Station 4+90. Gatehouse to Station 7+35 - 30 to 100 lb stone in fair condition, some dislodged riprap.
Trespassing on Slopes	Free access to crest and slopes despite posting. Several footpaths on upstream on upstream and downstream slopes.

VISUAL INSPECTION CHECKLIST PARTY ORGANIZATION

PROJECT FLAT RIVER RESERVOIR DAM
RI-601

DATE NOV. 26, 1980

TIME 8:00 a.m.

WEATHER Sunny, 45 degrees F.

W.S. ELEV. 243.7 U.S. 233.0 DN.S.
NGVD

PARTY:

1. David Sluter - New England Engineering 6. _____
2. Stephen Fodor - New England Engineering 7. _____
3. Steve J. Poulos - GEI 8. _____
4. Robert E. Stetkar - GEI 9. _____
5. _____ 10. _____

PROJECT FEATURE	INSPECTED BY	REMARKS
1. <u>Hydrology & Hydraulics</u>	<u>D. Sluter</u>	
2. <u>Civil</u>	<u>S. Fodor</u>	
3. <u>Geotechnical</u>	<u>S. Poulos, R. Stetkar</u>	
4. _____		
5. _____		
6. _____		
7. _____		
8. _____		
9. _____		
10. _____		

Memo For Record:

1 Oct 73

IN TALKING TO GERRY GRAF TODAY I FOUND THAT THE QUIDNICK RESERVOIR CO. WILL PROBABLY START RAISING THE WATER @ JOHNSON'S POND WITHIN TWO WEEKS. GERRY SAID THAT TO DATE ONLY NORMAL MAINTENANCE HAS BEEN DONE ON THE DAM (PULLING SHRUBS etc) AND THE FACE OF THE DAM PROBABLY WON'T BE SEALED FOR 3 OR 4 YRS (DEPENDING ON AVAILABLE MONEY). HE WILL CALL ME WITHIN TWO WEEKS TO INSPECT THE SITE TOGETHER BEFORE THE POND IS REFILLED.

PETER M. JANARD

June 13, 1973

Quidnick Reservoir Company
% Mr. Robert Galkin
Natco Products Corporation
33 Factory Street
West Warwick, Rhode Island

Gentlemen:

After consultation with Mr. Gerhard Graf and a field inspection of RI Dam #167 (Johnson's Pond--Coventry) on April 2, 1973 by Departmental Representatives, it is the opinion of this Department that the dam is in essentially sound condition, despite some observed seepage at the southerly end of the embankment.

The long standing existence of this seepage (per Mr. Graf) would indicate that the pond may be maintained at near normal levels with little or no probability of danger. It is recommended, however, by Mr. Graf, that the pond be allowed to rise only to within approximately one to two feet of the spillway level. This Department concurs in that recommendation.

Very truly yours,

Dennis J. Murphy, Jr.
Director
Department of Natural Resources

DJM/WBB:bb

cc: GERHARD GRAF, D.E.

PMJ

INTERIM DAM INSPECTION
FLAT RIVER RESERVOIR

An inspection of the previously recorded dam leaks was made on September 23, 1973. At the time, the pond level was in a draw down condition with water in the channels only.

All of the previously recorded leaks were inspected and no water was observed except one. The one remaining leak is under a large maple tree adjacent to the downstream pond and the swamp. The flow is approximately the same as previously recorded. One possibility for this is that water is not leaking through the dam but from the swamp area instead. This can possibly be verified by dye testing.

The above information was directed to:

Department of Natural Resources
Mr. Peter M. Janaros
Senior Civil Engineer

Mr. Janaros made a subsequent inspection of the dam and verified the findings. It was mutually felt that the pond could be brought back to nearly full condition. It is recommended that the pond be kept 12 to 29 inches below spillway and run according to your normal procedures. It is believed that the leaks are proportion to the pond head and are weeping in character. There were no direct piping holes found in the pond bottom. It is suggested that the previous mentioned maintenance program be instituted. Mr. Janaros noted that only major repair or construction must be approved by his office.

cc: Department of Natural Resources
Mr. Peter M. Janaros



(PMJ)

DEPARTMENT OF NATURAL RESOURCES

DAM INSPECTION REPORT

DAM: #167

RIVER: FLAT RIVER

WATERSHED: PAWTUXET (SOUTH

NAME: Flat River Reservoir TOWN: Coventry
(Johnson's Pond)

OWNER: Quidnick Reservoir Co.
c/o Mr. E. Fraser (Secty.)
821-0832

Engineer: Jerry Graf
272-1730

REPORT ON: General condition

REASON FOR INSPECTION: Follow-up to inspection of 2 April, 1973

INSPECTION BY: P. Janaros
W. Brinson

DATE OF INSPECTION: 10 Oct. 1973
REF: Memo 1 Oct. 1973

REPORT:

EMBANKMENT: Shrubbery has been cut, leakage on downstream face at southerly end of dam is still very minor. Eroded sections have been filled.

SPILLWAY: Repairs have been made to bridge supports at spillway.

IMPROVEMENT: Very low--near original streambed.

Note: 15 October 1973

P. Janaros phoned Jerry Graf, requesting info on time-schedule for refilling pond. Owner will wait for heavy frost to kill weeds, then begin to refill. Mr. Janaros stated that any plans to seal upstream face will require Department of Natural Resources' approval. Mr. Graf indicated that a statement to this effect will be included in his report to the owners.

Property line confusion may lead to difficulties as many water-front property owners desire to build retaining walls.

DEPARTMENT OF NATURAL RESOURCES

DAM INSPECTION REPORT

DAM: #167

RIVER: Flat River

WATERSHED: Pawtuxet-Flat
(South)

NAME: Flat River Reservoir TOWN: Coventry, RI
(Johnson's Pond)

OWNER: Quidneck Reservoir Company
c/o Mr. E. Fraser (Secretary) 821-0832

JERRY GRAF, P.E.
c/o ROBINSON, GREEN & BERETTA
272-1730

REPORT ON: Possible seepage through embankment

REASON FOR INSPECTION: Request by Mr. Fraser

INSPECTION BY: P. M. Janaros
W. B. Brinson

DATE OF INSPECTION: April 2, 1973

REPORT: Met with Mr. Fraser, several members of the Board of Directors of the Quidneck Reservoir Company, the gatekeeper and Mr. Jerry Graf of Robinson, Green & Beretta. Mr. Graf, as a professional engineer, conducted a general engineering inspection of the dam and, on August 26, 1972, he and another engineer made a detailed investigation of the structural integrity of the dam. The most significant revelation of that investigation was of possible seepage at the extreme southerly end of the earthen embankment. (See attached copies of report)

Mr. Graf estimated this seepage at no more than 5 gallons per minute total. He also speculated, based on the coloration and rate of flow of the seepage water, that it was not ground water, nor was it carrying fines with it. He said the light yellow-orange color probably indicated de-oxygenated water, which in turn would indicate a very slow rate of seepage from a non-point source.

Three probable points of outflow were identified by visible water movement. All three were directly associated with large old trees, at least one of which is nearly dead.

Weather and high standing water conditions prevented actual observation of the seepage on April 2, 1973. Another inspection will be made late in the summer when the standing water on the downstream side of the dam is lower. No immediate danger is apparent.

The embankment itself should be cleared of all brush and small trees and gravel placed at points where runoff erosion has occurred.

Mr. Graf recommends the placement of a clay blanket on the pond bottom along the areas of seepage. No final action has been decided upon.

The pond is now at an unusually low level for this time of year, for inspection and repair purposes. Minor repair work will be done on the bridge over the spillway and the pond allowed to rise to normal level. It will be necessary to draw it down again in the late summer, in order to again observe the seepage

MARCH 22, 1973
PROVIDENCE JOURNAL

Leak Found In Pond Dam; Situation Termed Not Serious

Johnson's Pond dam is leaking, officials have discovered, and although the leak is not considered serious, the Coventry pond is at an all-time low for this time of year.

Earle Fraser, secretary of the Quiddick Reservoir Company which owns Johnson's Pond, acknowledged the water level is low, but that's intentional, he said. There are several repairs to be done to the middle dam and the water level had to be adjusted, he explained.

Mr. Fraser added that the pond, a local recreation center, will be refilled in time for summer with little trouble.

The leak under the old portion of the dam, where the spillway used to be, was dis-

covered recently by engineers who were surveying the dam to locate the original walls. The original dam is now covered by several feet of earth and brush and the spillway has been shifted to the northern shore of the pond.

"From what we can tell so far, the leak's been there quite a long time," said Mr. Fraser. Reports of the leak, coupled with the visibly lower water level, prompted several persons to call the Journal-Bulletin.

The engineers are returning early next week to complete their survey and recommend a repair. Also scheduled for repair is the bridge over the spillway, which has one of its

Suburban News

dam jacked up for support. "Ordinarily, the pond would be filled by now," said Mr. Fraser. "I guess that's what's got everyone upset. Just tell them the gates are all right. All we need is one good storm and it'll be filled right up again."

67.000014
212-175

PRELIMINARY INVESTIGATION
QUIDNICK RESERVOIR COMPANY
DAM AT FLAT RIVER RESERVOIR

A preliminary engineering inspection and investigation was made of the dam for Flat River Reservoir located near Route 117 east of Abbotts Crossing. The upstream downstream banks were inspected on foot and the following noticed:

A. Spillway

1. North Abutment wall - In very good condition, some very minor areas have mortar spalled off. There is no evidence of any water passing around behind the abutment. Freeboard from spillway to top of end abutment is approximately 6'. See pictures #1 and 2.
2. Spillway Surface - The lip and backup stones are all in good condition. Most of the mortar is remaining between the joints. The pond at this time is down approximately 12" from lip of spillway. There were no noticeable eddys or whirlpools visible in the shallow water surfaces behind the spillway.
3. Vertical Face of Spillway, Picture #4 - The Northern half has 6 to 8 very small weeping sections where the water is going behind the spillway lip stones and out the vertical spillway surface. There is no evidence in the small pools that fines are being washed through.
4. Paved Spillway Runout, Pictures #6 and #7 - The southern half of the spillway has a granite runout area. This runout area is in good condition. Some mortar joints are deteriorated and the complete area is covered with vegetation and small trees. This vegetation should be removed and kept clean. This is generally regarded as good housekeeping. The trees, if allowed to continue to grow, could possibly heave some stones. This has no effect however on the performance of the dam. The presence of vegetation indicates low and infrequent water going over.
5. South Abutment of Spilling #8 - This abutment is in fair condition. The area is overgrown with very dense vegetation. There is no evidence of water by-passing behind the wing walls. This abutment has small wing walls probably due to the core of the dam being tied directly into the abutment.
6. Bridge - The bridge over the spillway is deteriorating. This report does not cover any structural analysis, however it appears the bridge should be questioned and vehicles kept off it. One of the new columns has been knocked out of plumb and is in a very critical condition.

B. Dam Section from South Abutment of Spillway Upstream

Reference from here on will be Sta 0 +00 at South abutment.

1. Upstream Bank Roadway and Pond Floor to Island - The inspection carried to a water depth of 3' which is 4' below spillway elevation. Horizontal distance varied from 10 to 30 feet. Area has low brush (being recently cut 2-3 years).
 - a. Very small and old washout from roadway water near abutment.
 - b. Roadway washout at Sta 0 + 42. Should have a load of gravel.
 - c. Very small start of roadway washout at Sta 1 + 62.
 - d. Ant hill at Sta 1 +90 4' above water level.
 - e. From Sta 1 + 00 to gatehouse water edge has stone rip-rap in various conditions.
 - f. Sta 2 + 37 and 2 + 72 small roadway washouts started
 - g. Small washouts at gatehouse Sta 3 + 25.
 - h. Brush from gatehouse to Island Sta 5 + 00 heavy and not cut for some years.
2. Island Sta 5 + 00 to 12 + 00 Upstream side
 1. Low spot at Southern end no evidence of any distress.
 2. Pond side of island is in a natural and stabilized condition.
3. Dam Upstream Sta 12 + 00 to 18 + 00
 1. 0 + 45 old animal burrow near top, no problem.
 2. Water interface in a natural and stable condition.
 3. Most of interface has boulders at w. line.
 4. Severe road water erosion at 15 + 20.

C. Downstream Dam Face

Downstream dam face from 0 + 00 to Gatehouse

1. 30' of wet area Sta 1 + 25 should be investigated Very wet, damp, with skunk cabbage, ferns. Water is stagnant no visible running water. There is a gully leading from top of dam. Could be run-off. See #22.
2. Erosion near gatehouse.
3. Vegetation very heavy.
4. Covers of cleanouts need replacing #23, 24.
5. Exit tubes - clean, good condition, exit gates not operable.
6. Large energy - absorp. pond no damage #25 and #26.
7. Southwest corner of stilling pond - major weeping.

Downstream from Gatchouse to Island

1. Waterchuck hole 100' past q.h., no problem above high water.

Downstream Island

1. Very wide flat not wet, too wide to weep.

Island To End

- | | |
|----------------|--|
| 13 + 50 | Water flowing towards dam
Very dense foliage |
| 13 + 55 | Foxhole or woodchuck hole
8' below water |
| 13 + 65 | Water seepage slowly |
| 14 + 30 | Water 18" \pm slowly weeping |
| <u>14 + 50</u> | <u>Large wet swamp acres</u> |
| 14 + 75 | Evidence of drainage swale at toe of dam 200' |
| 15 + 20 | Fox hole 6' below road elevation |
| <u>16 + 75</u> | <u>Large swampy pool Benford to observe</u>
<u>with fish</u> |
| <u>17 + 50</u> | <u>Large wet area or pool with running water -</u>
<u>Benford to observe at 17 + 70</u> |

7

On August 26, 1972, a more detailed inspection was made of areas found questionable. This inspection was performed by William R. Benford, P.E. and Gerhard H. Graf, P.E.

1. The downstream dam area at Sta 1 + 25 indicated possible small amounts of seepage or natural ground water. The condition as observed does not appear as any major problem.
2. South edge of settling basin:
It appears the dam is weeping water through at this area. It should be allowed to continue and a crushed stone filter should be placed to avoid any deterioration.
3. Downstream Gatehouse:
The covers are broken and rotted. These should be replaced as they are very dangerous.
4. Some minor water appears to be weeping through at Sta 14 + 50. The amount is insignificant.
5. Sta 16 + 75 and 17 + 50 (at small ponds near old river beds)
Both areas show large amounts of water leaking through the dam. The water velocity is high and some evidence of fines are visible. The water is flowing from under large trees. This area is the most critical noted and although apparently stable should not be neglected.

SUMMARY

The dam appears in reasonably good condition. The leaking at the south end should be repaired. Further testing should be done to determine if a core is present at the south section. Also, several good housekeeping practices should be followed:

1. Remove brush on spillway
2. Repaint piers
3. Pressure grout area behind 1st bay
4. Fix dislodged column
5. Institute program for removing wooded growth and planting grasses.
6. Backhoe work to find core in south section.

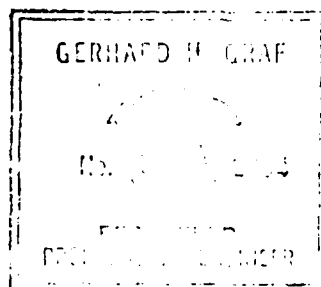
I trust the above report and accompanying photographs portray an accurate condition of your dam. I strongly recommend repairing the major leaking and instituting a good maintenance program.

Respectfully submitted,

Gerhard H. Graf, P.E.
Consulting Engineer

GHG/js

Enclosures/photographs



DIVISION OF HARBORS AND RIVERS

SURVEY OF DAMS IN RHODE ISLAND

Pawtuxet River Basin (North Branch) #167 Flat River Reservoir

Drainage Area 57.5 sq. mi.

February 1948

Spillway 176.5' net x 6' deep, capacity 10,575. c.f.s.

Draw-off pipes 3 - 48" diam with 21' head
 on center line 1,012.5 " *

11,587.5 c.f.s.

Estimated extreme freshet 4025 c.f.s.

* Gates open full will create destructive velocity.

FEBRUARY 1948

R. I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS AND RIVERS
SPECIAL INSPECTION REPORT

DAM NO. 167

INSPECTED BY

DAM NO 167 NAME FLAT RIVER RESERVOIR

OWNER *Quincy Res. Co.*

ADDRESS *712 Hospital Trust Bldg, Prov., R.I.*

REPORT ON—NEW CONSTRUCTION

PLANS BY

APPROVED

CONTRACTOR

BROOK-
RIVER
TRENCH

WATERSHED *75 B*

REPAIRS

INSPECTION ONLY ☒

INSPECTION REPORT BY *Healey*

REASON *Reconstruction*

DATE 10/21/46

DICKLER

RECORDS KEPT SINCE 1914 BY MR. E. J. ADAMS, SUPT. OF DAMS; LIVES ON PREMISES

SPILLWAY

TYPE

BREAK IN DAM IN 1873. DAM RAISED AND ROLLWAY WIDENED FROM 2 TO 5 SPANS. ORIGINAL HAD APRON IN FRONT; BALANCE ON LEDGE (N END.)

CONDITION

DATE 1873 (IN STONE ON DOWN-STREAM FACE OF PIER) AS DATE OF RECONSTRUCTION OF SPILLWAY

DRAW-OFF GATES

NUMBER

1913 - BRIDGE RAISED ABOUT TWO FEET TO GIVE BETTER CLEARANCE OVER ROLLWAY.

CONDITION

→ 1913 - FROM LOG BOOK OF MR. ADAMS, RESIDENT CARETAKER. RECORD OF LEVELS AT DAM AT TIME OF FLOODS

TRENCHES & WHEELS

EMBANKMENT

TYPE

1932 - SEPT. 16, 1932, FRICAY, RAINFALL 10.53; FROM -123" TO +3" ON MONDAY THE 18TH; BEL AND ABOVE SPILLWAY LEVEL.

CONDITION

1936 - BAD FLOOD. SALISBURY DAM BROKEN (NOW NARRAGANSETT GUN CLUB); WENT TO 29" PLUS ABOVE SPILLWAY WITH THREE GATES OPEN.

APPROACHES

EROSION

BRUSHES & TREES

RIPRAP

PRESENT USE

1946 - DURING MR. ADAMS' RESIDENCE ON FARM, SLOPE ON DAM HAS BEEN FILLED OUT AND LEAK ESPECIALLY ON SECOND SECTION SOUTH OF DRAW-OFF GATE. THIS SECTION WAS BREACHED IN CENTER IN STORM OF 1873 AND REFILLED WITH EARTH NO LEAK IN THIS PARTICULAR AREA SINCE. THERE IS NOW A SIZEABLE LEAK AT HIGH WATER ABOUT 100 FEET NORTH OF THIS FORMER BREACH, BUT THIS WAS NOT EVIDENT TO-DAY AS THE WATER WAS 46" BELOW SPILLWAY LEVEL. MR. ADAMS CLAIMS THAT A SECTION OF THE EARTH EMBANKMENT WILL HAVE TO BE TAKEN OUT AND REBUILT TO CORRECT THIS LEAK FOR IT IS DIFFICULT TO FIND ON THE POND SIDE OF THE EMBANKMENT

WHO CONTROLS

MAXIMUM KEPT TO 12" OR 15" OVER SPILLWAY BY OPENING GATES; ALWAYS PROVIDE FOR NEXT FLOOD

WHO CONTACTED
AT SITE

INSTRUCTIONS LEFT

IN EMERGENCY
CALL



PHOTO C-7: Spillway approach and service bridge spanning the spillway openings.



PHOTO C-8: Spillway discharge channel.



PHOTO C-5: Crest of dam embankment looking north and upstream gate house on left.



PHOTO C-6: Crest of dike looking north towards island of natural ground separating the dike from the dam embankment.



PHOTO C-3: Downstream slope of dam looking north.



PHOTO C-4: Downstream slope of dike looking north.



PHOTO C-1: Upstream face of dam from left side.



PHOTO C-2: Upstream face of dike from right side.



+ 0

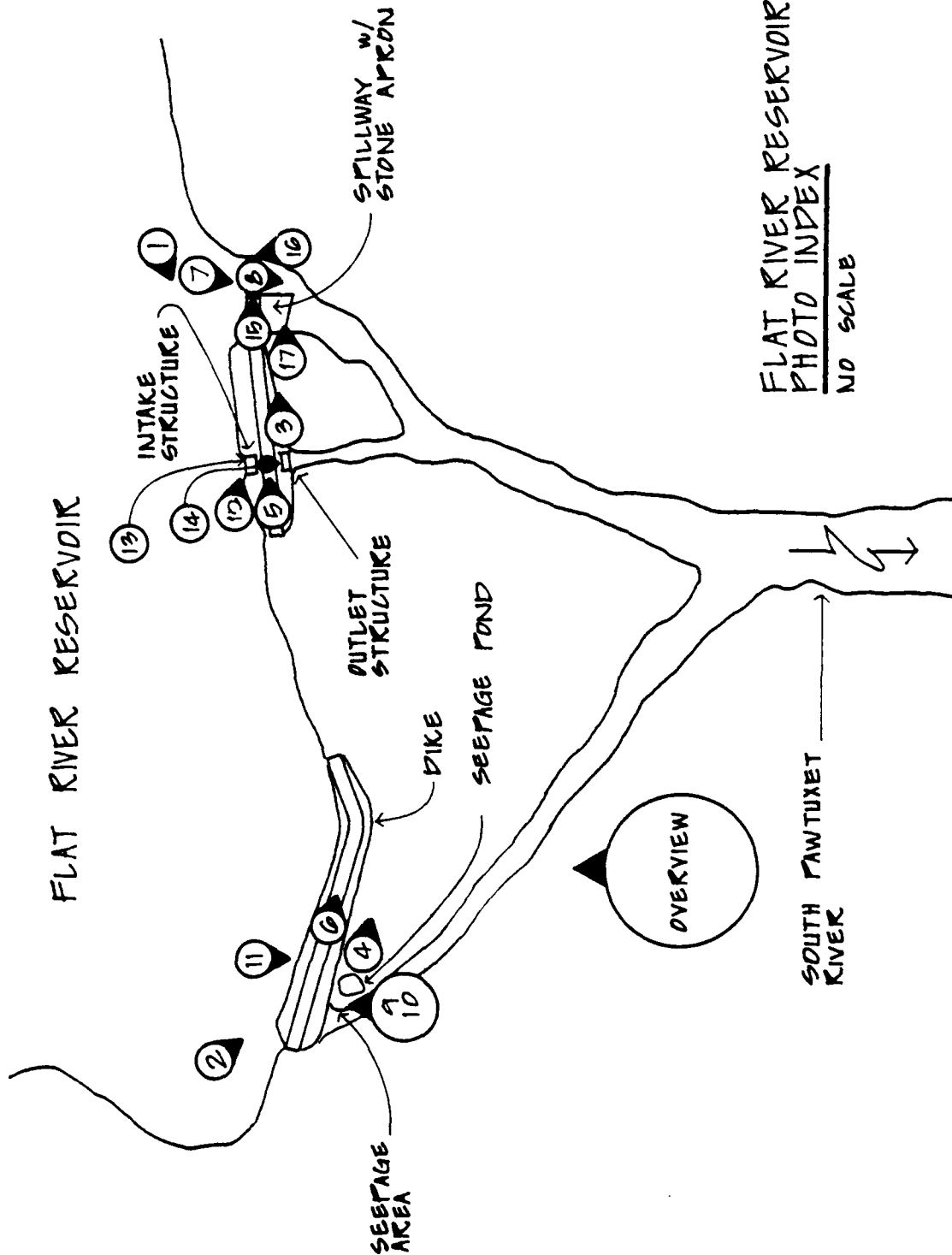
+ 15

+ 01

+ 51

+ 20

FLAT RIVER RESERVOIR



FLAT RIVER RESERVOIR DAM
PHOTO INDEX
NO SCALE

OVERVIEW

SOUTH FAWTUXET
RIVER

7

APPENDIX C
PHOTOGRAPHS



2

NEW YORK, NEW HAVEN AND HARTFORD R.R.

PROVIDENCE AND WILLIMANTIC BRANCH

Top of embankment

Surface of water - full pond

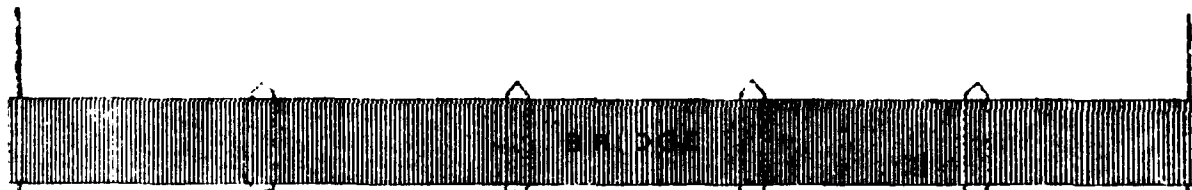
Elevation of top of upper dam Washington Village

LINE OF DAM

100 Ft to an Inch

20

(Scale)



192.25
Net length of railway 176.25

MASONRY APRON

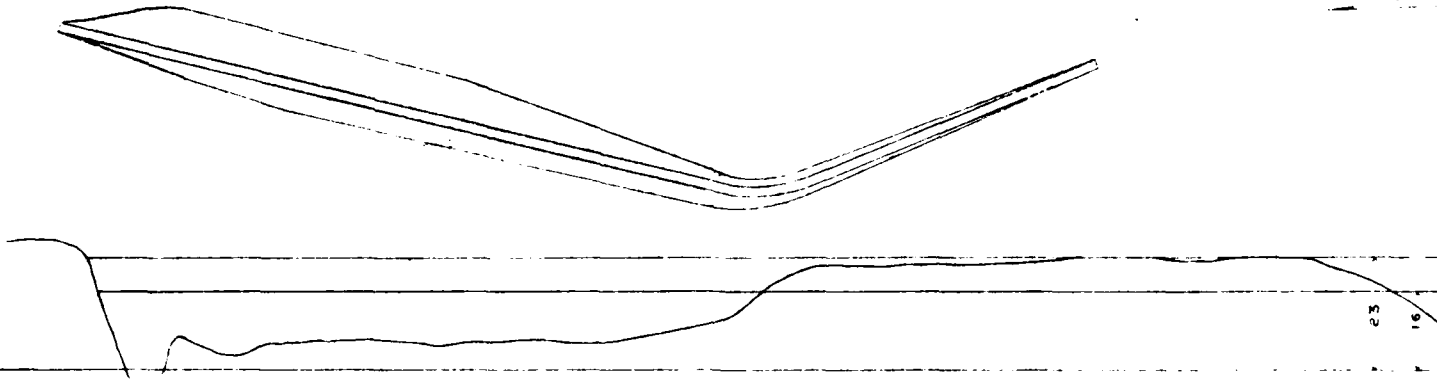
ENLARGED PLAN OF ROLLWAY

Scale 16 Ft to an Inch
(Not to Scale)

Source: Quidnick Reservoir Co
Property Plat Book
Flat River Reservoir

PLAN OF FLAT RIVER DAM

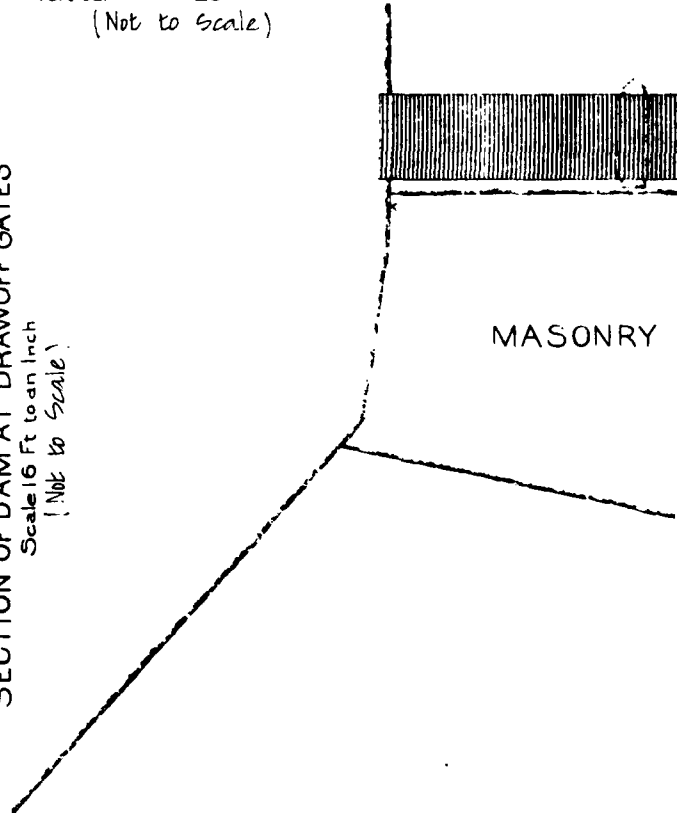
Scale 100 Feet to an Inch
(Not to Scale)



PROFILE ON LINE OF DAM

Horizontal Scale 100 Ft to an Inch
Vertical 20

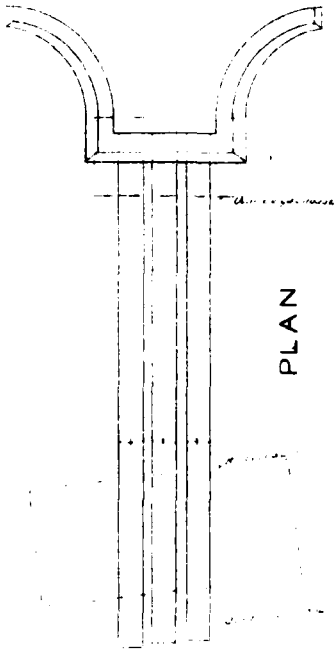
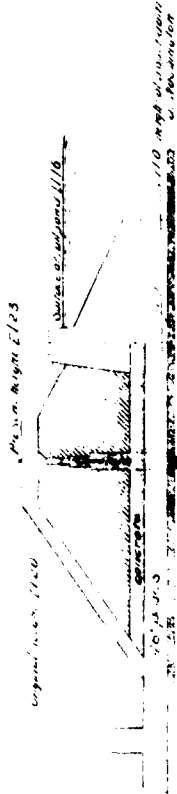
(Not to Scale)



SECTION OF DAM AT DRAW-OFF GATES

Scale 16 Ft to an Inch

(Not to Scale)

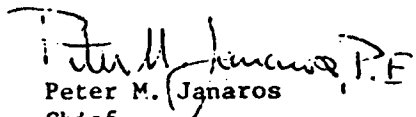


PLAN

MASONRY

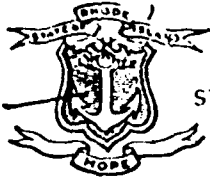
This Department will be happy to furnish you with all assistance possible within its available resources. Please contact my office (277-2797 or 277-6820) within 5 working days of the receipt of this letter to advise me on the progress you've made in lowering the water level and engaging an engineering firm to study the Dam.

Very truly yours,


Peter M. Janaros
Chief
Division of Land Resources

E.F.P./P.M.J./cfm

cc: W. Edward Wood, Director
Carlton Maine
C.P. Asprinio
Todd Byran



STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

75 Davis Street
Providence, R. I. 02908

9 March 1981

Mr. Joel Westerman, President
The Quidnick Reservoir Association
c/o Westerman Realty Company
20 Remington Street
West Warwick, R.I. 02893

Dear Mr. Westerman:

This letter is in reference to a recent inspection of the Flat River Reservoir Dam (P.I. Dam #167) and the assessed condition of its current structural integrity. I also wish to advise you of a condition which this department believes warrants your immediate attention.

During the month of November, 1980 the engineering firm of New England Engineering, Inc., under contract with the U.S. Army Corps of Engineers, performed a Phase 1 inspection of the subject dam. In February, the Corps of Engineers contacted this office to advise us of a condition which it feels presents a threat to the public safety. Specifically, a substantial volume of water was observed flowing from under a large tree-root system on the downstream toe of the embankment, about 100 feet from Reservoir Avenue.

Personnel from this office, in company with representatives of the inspecting engineering firm, visited the site in an effort to observe first-hand the situation and to assess the need for corrective action. Our examination of the downstream condition confirmed that some sediment (sand and gravel fines) is being carried through the leaks, indicating an internal erosion problem. This condition could become quite serious if the earthen portion of the dike becomes undermined at an accelerated rate.

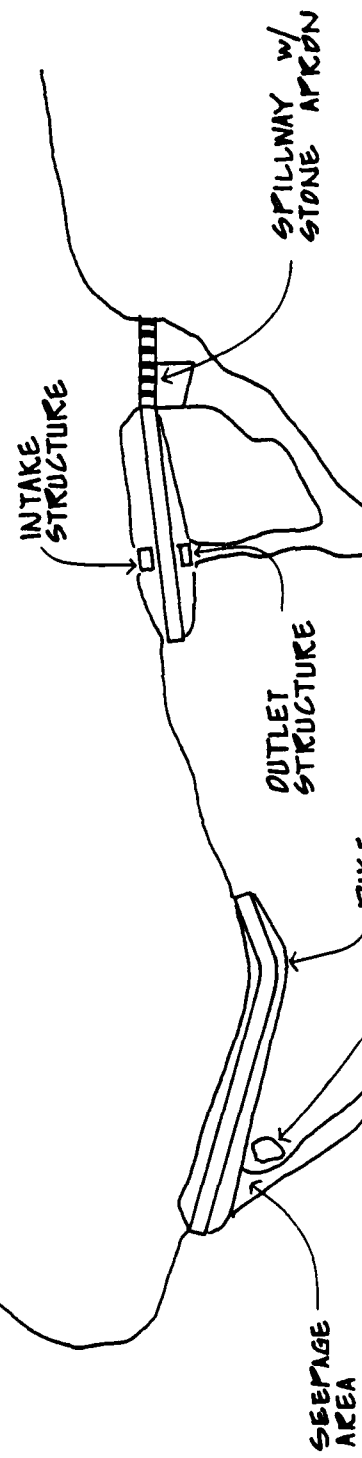
The inspecting firm could not determine the exact origin of these leaks on the upstream portion and a determination could not be made as to how long these leaks have existed. Also, the severity of these conditions could not be determined since the Corps of Engineers contract does not provide for comprehensive "in-depth" analysis. Therefore, it is necessary that your Association, within 15 days of the receipt of this letter, seek professional assistance to determine the cause of these leaks and establish some procedures for corrective action to preclude breaching and potential damage to downstream property.

Finally, it is the recommendation of the inspecting firm, which both the Corps of Engineers and this office concur that the water level of the reservoir should be lowered as soon as possible to a total of 4 feet below the spillway crest elevation to eliminate any potential downstream hazard to public safety. This lower water level will also serve to facilitate a detailed engineering investigation of the structure. It is further recommended by this office that the water level be kept at the lower level until corrective measures are completed or a professional study indicates that the reservoir can be safely refilled.



+ 0
+ 5
+ 10
+ 15
+ 20

FLAT RIVER RESERVOIR



FLAT RIVER RESERVOIR DAM
GENERAL PLAN
NO SCALE



SOUTH PANTUXET
RIVER

PRESENT USE

WATER STORAGE: YES, FOR MILLS; CAREFULLY CONTROLLED

POWER: NONE AT THIS LOCATION; 11 MILLS DOWN STREAM

BREACHED: NO

WHO CONTROLS LEVEL OF WATER: ERNEST ADAMS, RESIDENT WATCHMAN, UNDER ORDERS OF ANDREW GOUGH, QUINICK RESERVOIR CO. INC.

EXISTENCE OF GAGES:

RECORDS KEPT BY:

WHO WAS CONTACTED AT SITE:

INSTRUCTIONS LEFT WERE AS FOLLOWS:

CONSTANT MAINTENANCE KEEPS DIKE IN GOOD CONDITION, BRUSH CUT, ETC.

PLAN FOR DETERMINATION OF CAPACITY (PROV. WATER SUP. BOARD) DI-53

SEE CHART FOR CAPACITY (PROV. WATER SUP. BOARD) DI-53A

ORIGINAL PLAN OF ROLLWAY, GATEHOUSE AND DRAW-OFF PIPE DI-53B

SKETCHES OF SPECIAL CONDITIONS AT TIME OF INSPECTION:

Damd

area 976 A ±

Gate-House



Rollway
Earth Emb.

M. W. L. 2

INSPECTED BY:

TITLE:

DATE:

12' ±

spillway

slope 1 on 1/2

section

Earth Emb. & spillway

DIVISION OF HARBORS & RIVERS

OFFICIAL INSPECTION REPORT

DATE: 3/27/46

INSPECTED BY: JOHN V. KEILY

DAM NO. 67 NAME: FLAT RIVER RESERVOIR

WATKINS RIVER
WATKINS PANTUXET (SOUTH BRANCH)

TOWN OR CITY COVENTRY

ON PAWTUXET SOUTH BRANCH

WATERSHED

OWNER: DUPONICK RESERVOIR CO., INC.

ADDRESS: 714 N. High St. Bldg

% Mr. Handman
Box 8011

IN EMERGENCY CALL (1) ANDY GOUGH

ADDRESS: 37 Standard Bldg. W. Va.

TEL. NO. Va. 197

(2) ERNEST ADAMS

ADDRESS: on site of Lower Coventry

TEL. NO. Va. 262

(3)

ADDRESS:

TEL. NO.

SPILLWAY-TYPE

Masonry; ^{Not} BETWEEN LENGTH OF ROLLWAY 176.25 TOTAL LENGTH (AND 4 PIERS) 196.45

CONDITION:

GOOD

DRAW-OFF GATES-NUMBER TWO SETS OF 3 GATES; 45" C I PIPES EACH

CONDITION:

TRENCH GATES-NUMBER

CONDITION

EMBANKMENT

MAXIMUM HEIGHT 23'; SURFACE WATER (FULL POND) 16'

CONDITION:

EARTH, OK. CORE IN CENTER; CONCRETE

APPROACHES

EROSION

BUSH & TREES

RIP-RAP

R.I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS AND RIVERS

DAM NO. 167

SPECIAL INSPECTION REPORT

INSPECTED BY J. J. KEILY

TOWN - COVENTRY
DAM NO 167 NAME FLAT RIVER RESERVOIR ON RIVER PAWTUXET RIVER
OWNER QUIDNICK RESERVOIR COMPANY 282828
ADDRESS 712 HOSP. TR. BLDG., PROVIDENCE, R.I. (FRUIT OF THE LOOM, INC.) TEL COV 2639 & DE 8011
REPORT ON—NEW CONSTRUCTION REPAIRS INSPECTION ONLY X
PLANS BY APPROVED CONTRACTOR

PICKLER

SPILLWAY

TYPE

CONDITION

DRAW-OFF GATES

NUMBER

CONDITION

TRENCHES & WHEELS

EMBANKMENT

TYPE

CONDITION

APPROACHES

EROSION

BRUSHES & TREES

RIPRAP

PRESENT USE

WHO CONTROLS

WHO CONTACTED

AT SITE

INSTRUCTIONS LEFT

IN EMERGENCY
CALL

INSPECTION REPORT BY JOHN V. KEILY REASON ROUTINE

DATE 3/27/46

EMERGENCY: AGENT FOR QUIDNICK RES. CO.

1. ANDY GOUGH 37 STANDARD AVE., WEST WARWICK TEL. VAL. 1-1383 J OR C/O W. WARWICK SE
2. ERNEST ADAMS, SUPT. AT DAM, LIVES AT SITE TEL. COV 2639 DISPOSAL P
3. RECORDS KEPT AT 712 HOSP. TR. BLDG., PROV., R.I. (FRUIT OF THE LOOM) TEL. VA 1-447

3/27/46

CONDITION FAIR. EXTENSIVE RESERVOIR (710 ACRES PLUS) RETAINED BY EARTH DAM OF MEDIUM HEIGHT (23' MAX.) LARGE MASONRY SPILLWAY ON NORTH END IN GOOD CONDITION. (SEE PLAN FOR NEW CUT-OFF WALLS).

THREE 48" C.I. PIPES (CONTROLLED BY GATE HOUSE AT CENTER OF DAM) IS UNDER CONSTANT SUPERVISION OF QUIDNICK RESERVOIR COMPANY WHO MAINTAINS A SUPERINTENDENT ON THE PREMISES AT ALL TIMES. SEE REPORT 10/21/46 FOR EXISTENCE OF LEAK IN SOUTH SECTION. SEVEN FEET OF FREEBOARD GENERALLY MAINTAINED ON EMBANKMENT. THIS RESERVOIR PROVIDES MOST OF WATER FOR THE MILLS IN THE SOUTH BRANCH OF THE PAWTUXET RIVER AND IS CLOSELY CONTROLLED TO PROVIDE THE MAXIMUM USE OF WATER. THE GATES ARE OPENED DAILY TO ALLOW WATER TO REACH MILLS AND CLOSED AGAIN AS SOON AS DAILY QUOTA HAS BEEN FURNISHED. THE AMOUNT OF WATER SENT DOWN THE RIVER IS GOVERNED BY THE AMOUNT AVAILABLE. THE MILLS ALL BELONG TO AN ASSOCIATION (QUIDNICK RESERVOIR COMPANY) AND MR. ANDREW B. GOUGH IS SUPERINTENDENT. RESIDENCE 37 STANDARD AVE., WEST WARWICK, TEL. VAL. 18930J OR C/O WEST WARWICK SEWERAGE DISPOSAL PLANT, FONTIAC, WES WARWICK. TEL. VAL. 1141

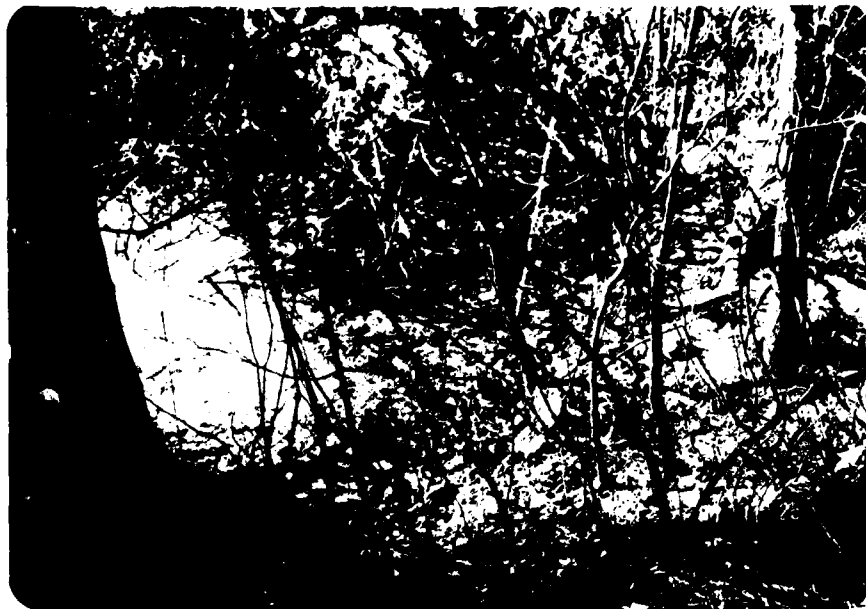


PHOTO C-9: Large seepage area and silt delta at Station 19+35 on downstream toe of the dike.



PHOTO C-10: Closeup view of flowing seep and silt delta above.



PHOTO C-11: Large erosion area on upstream slope of dike.

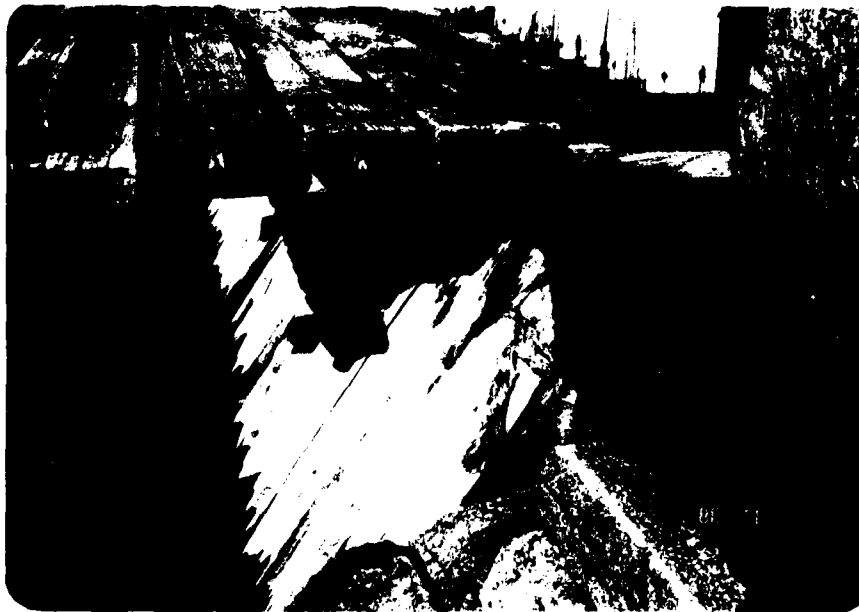


PHOTO C-12: Intake structure trash rack and maintenance platform showing deteriorating condition.

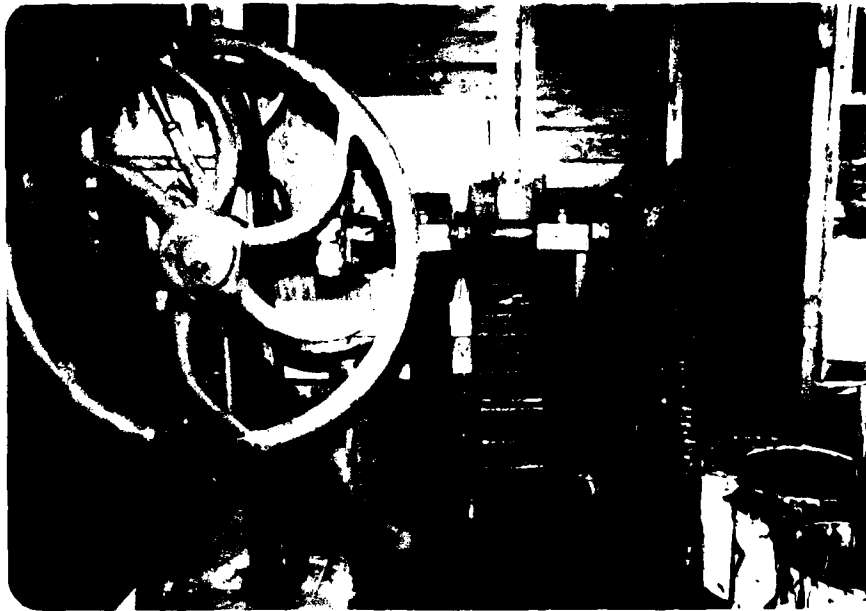


PHOTO C-13: Control mechanism for middle gate of intake structure.

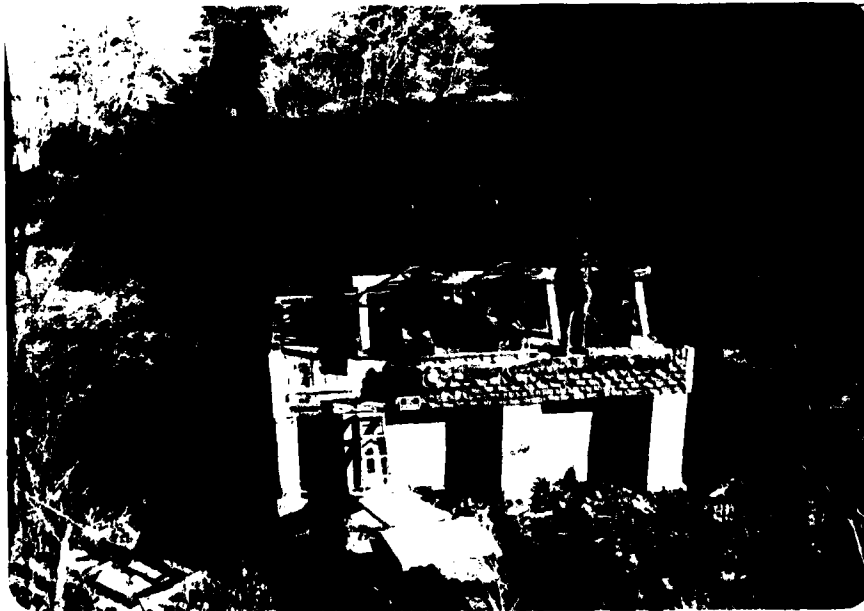


PHOTO C-14: Outlet structure and downstream channel from crest of dam.

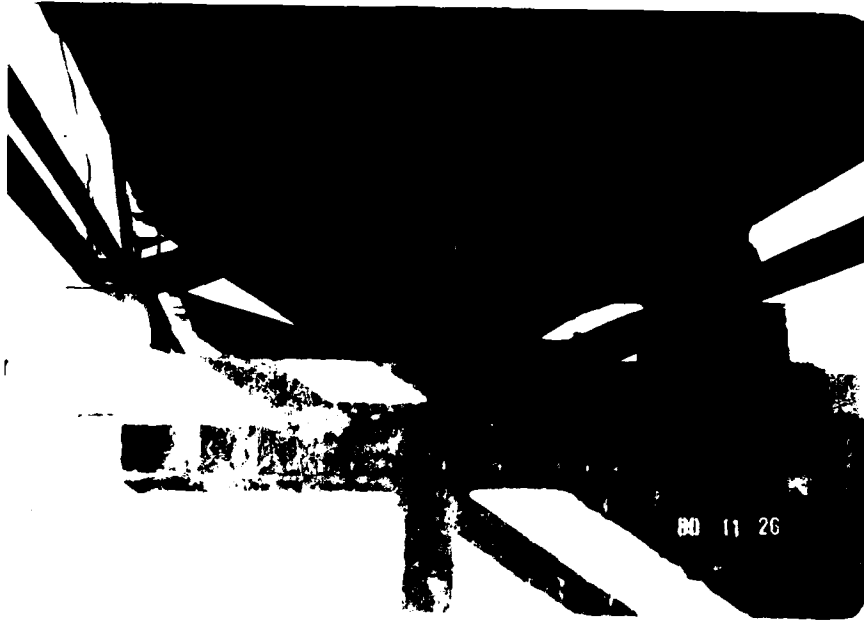


PHOTO C-15: Underside of service bridge showing rotted and broken timbers.



PHOTO C-16: Weep and ponded water at downstream face of spillway weir.

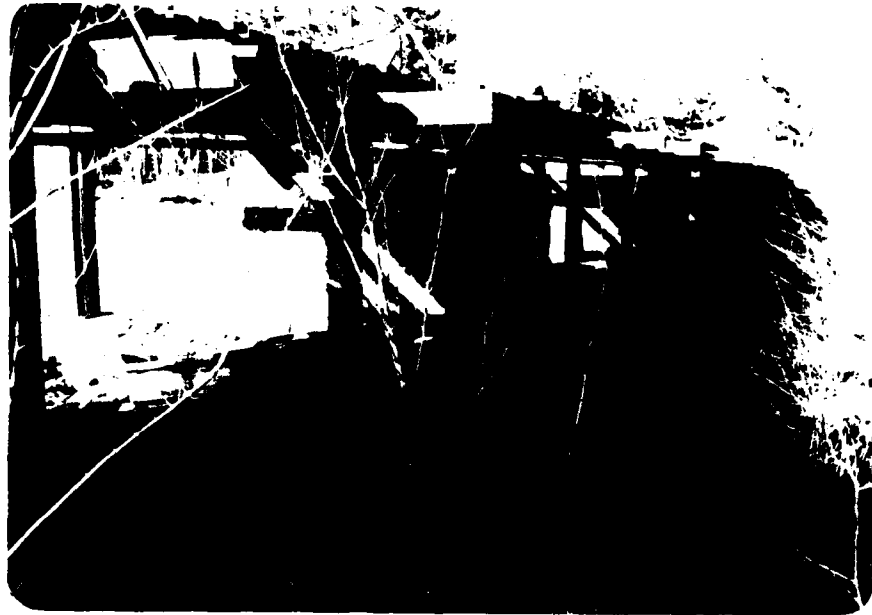
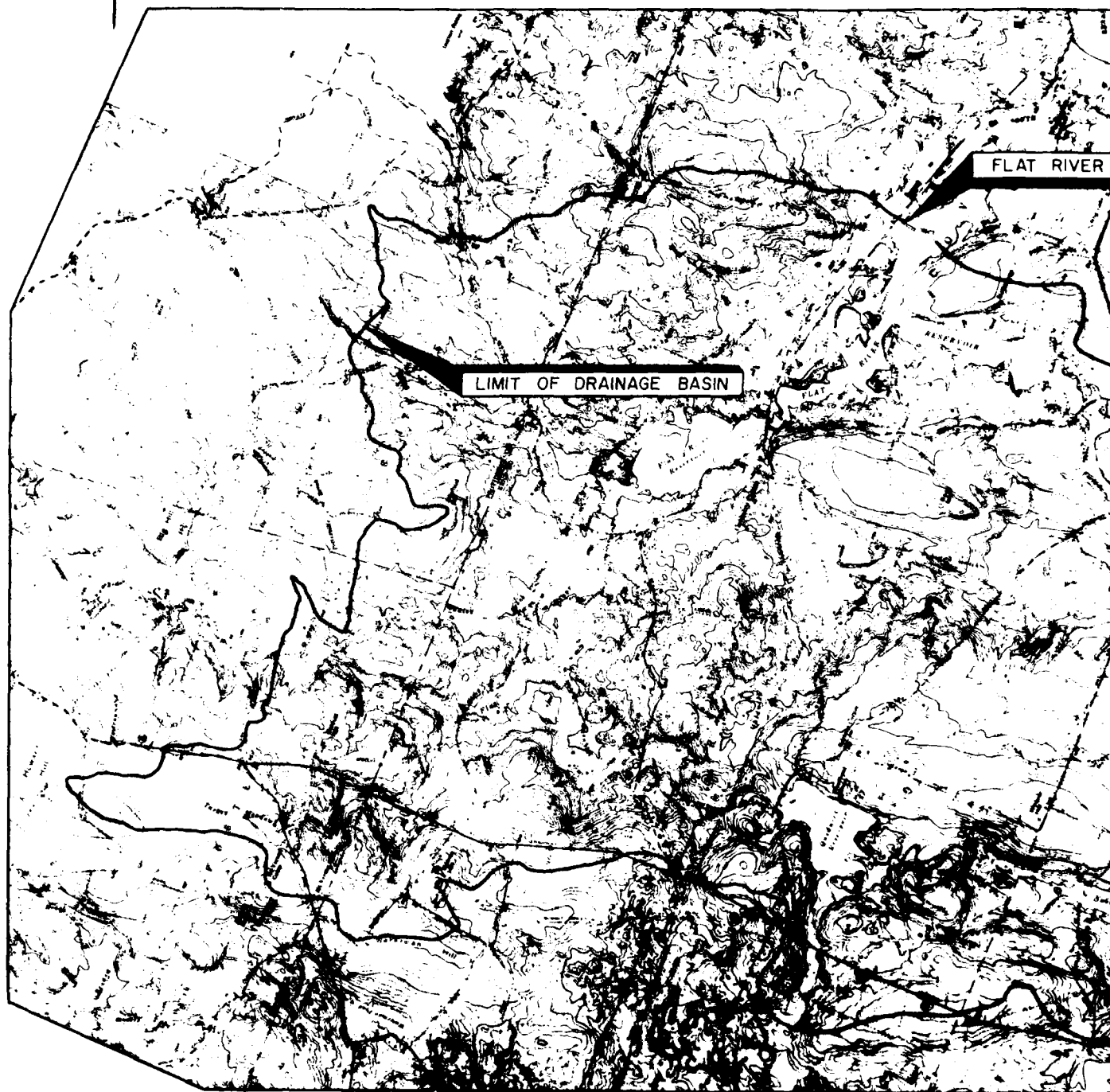
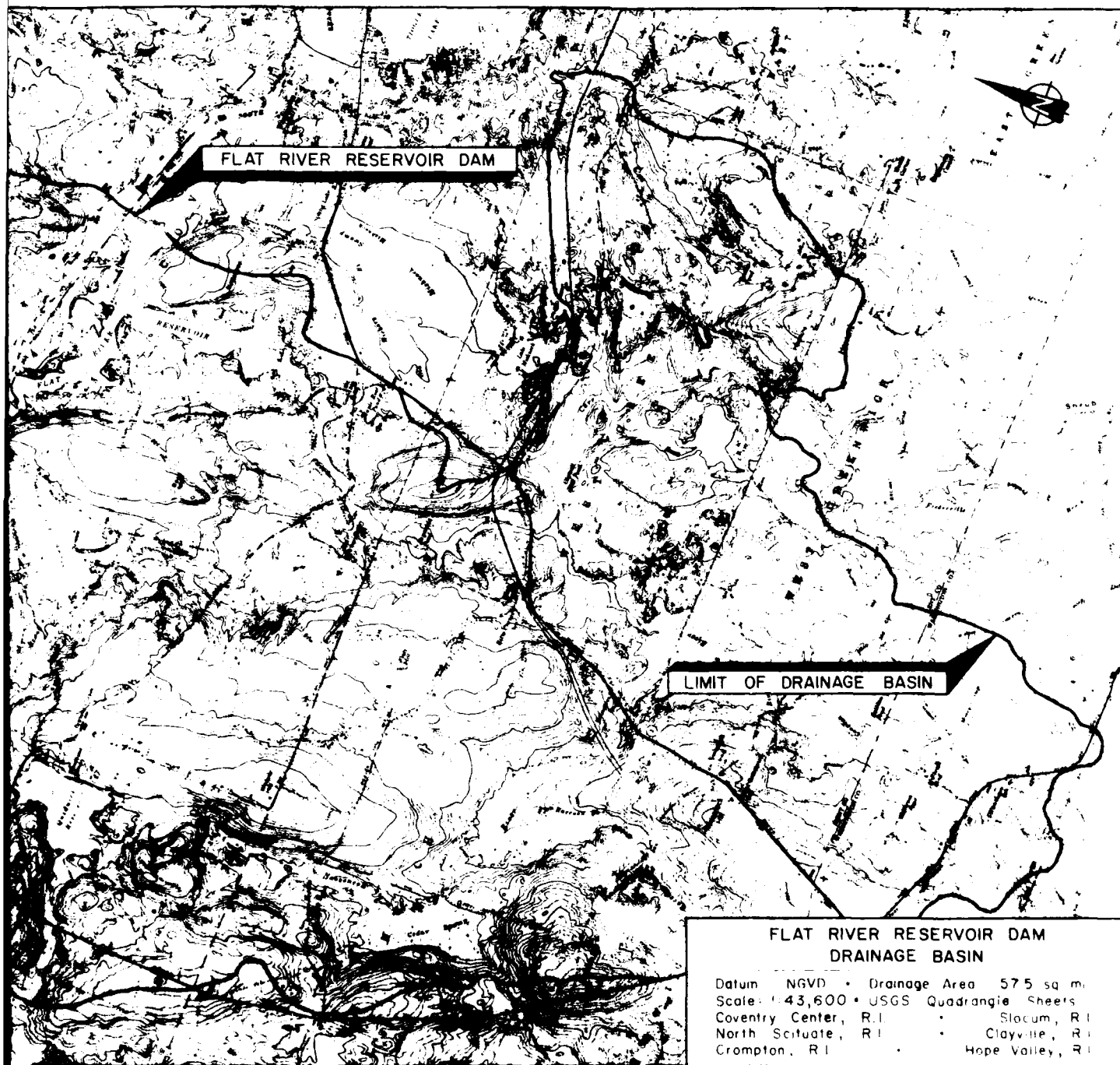


PHOTO C-17: Spillway viewed from right downstream training wall.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



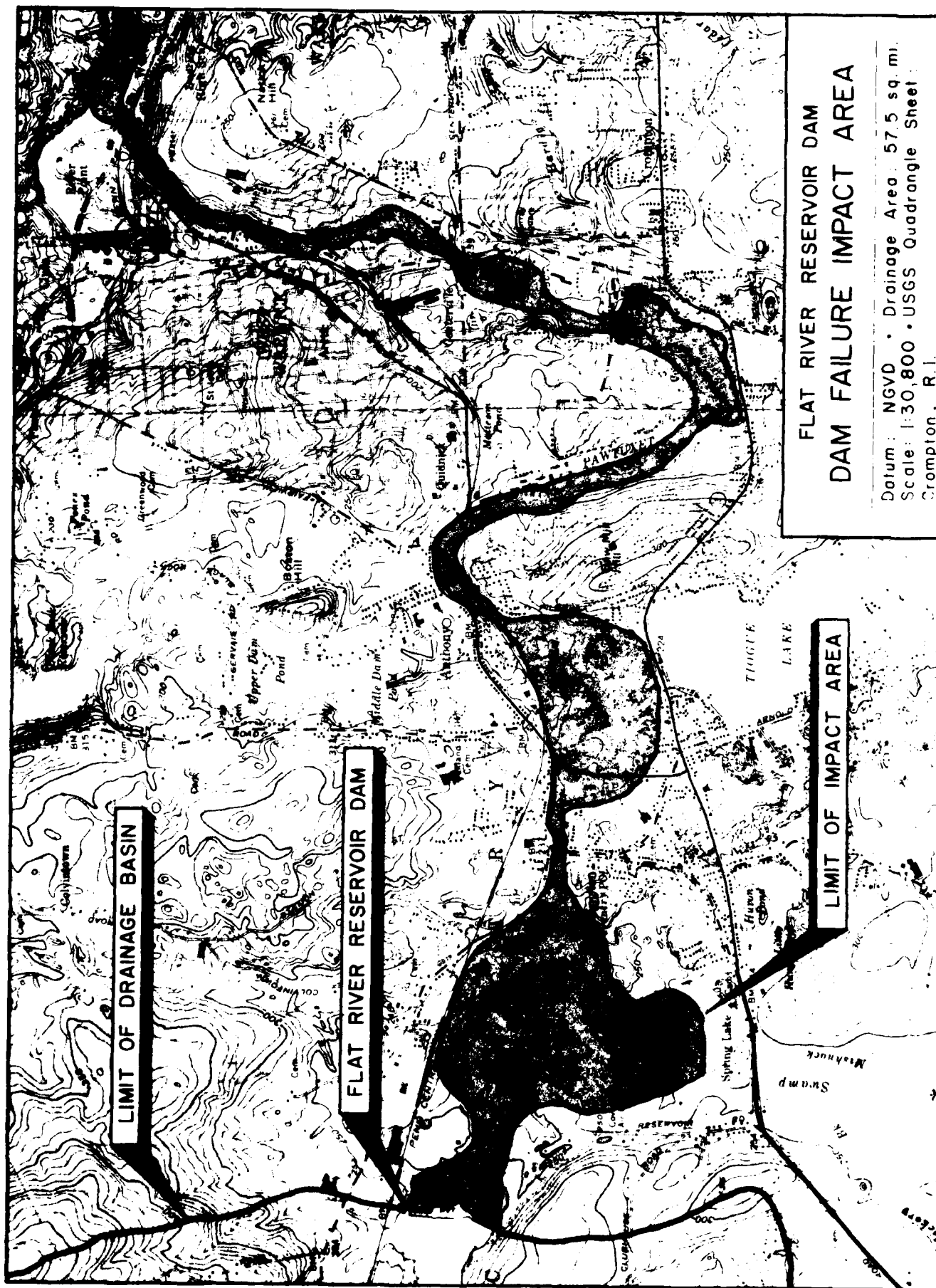


FLAT RIVER RESERVOIR DAM

LIMIT OF DRAINAGE BASIN

**FLAT RIVER RESERVOIR DAM
DRAINAGE BASIN**

Datum NGVD • Drainage Area 575 sq. mi.
Scale 1:43,600 • USGS Quadrangle Sheets
Coventry Center, R.I. • Slocum, R.I.
North Scituate, R.I. • Clayville, R.I.
Crompton, R.I. • Hope Valley, R.I.



Job No. FLAT RIVER RESERVOIR DAM B0106 Sheet 1 of 19
Project _____ Date 2/4/81
Subject HYDRAULIC / IDEALIZED CALCULATIONS By DS Ch'k. by _____

BASIC DATA

DRAINAGE AREA = 57.5 SQ. MI.
SPILLWAY POOL ELEV. = 247.9 NGVD
MAX POOL ELEV. = 255.0

RESERVOIR

- ① SPILLWAY POOL - AREA = 950 ACRES
STORAGE = 4000 AC-FT
② MAX POOL - AREA = 950 ACRES
STORAGE = 12,650 AC-FT

DAM : EARTHFILL W/ CONCRETE COREWALL
MAX. HEIGHT = 24 FT
LENGTH = 2000 FT.

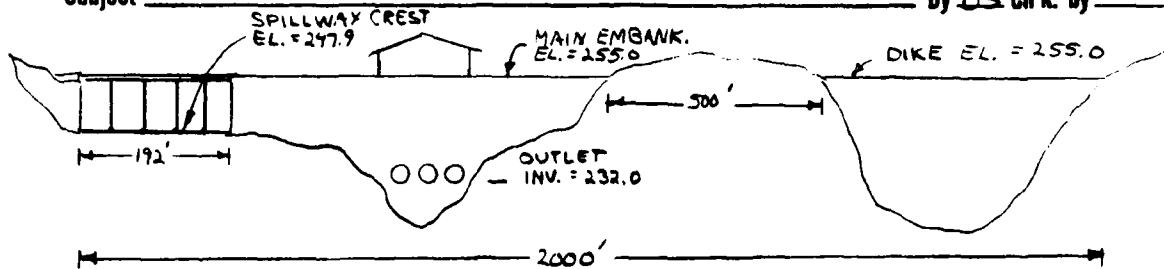
SPILLWAY : STONE MASONRY, BROAD CRESTED, FREE OVERFLOW
CREST = 247.9 NGVD
LENGTH = 192.25 FT OVERALL
- 16.0 PIER LENGTH (4 @ 4.0 EA.)
176.25 NET.

OUTLET : 3 - 48 IN. DIA. CAST IRON PIPES
INVERT = 232.0 NGVD
GATES : UPSTREAM - GEARED RACK & PINION, VERT. LIFT.,
MECH. OPERATED
DOWNSTREAM - MAN. OPERATED, VERT. LIFT.,
RACK & PINION.

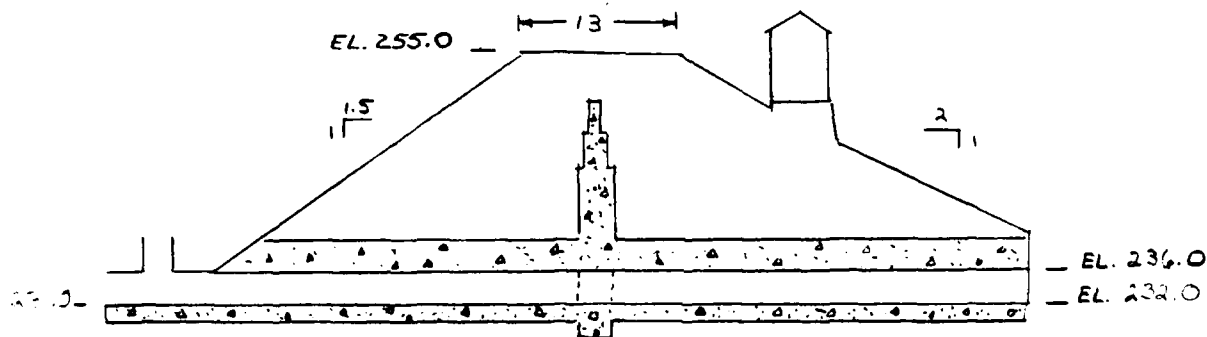
New England Engineering, Inc.

PROVIDENCE, R.I. 02903

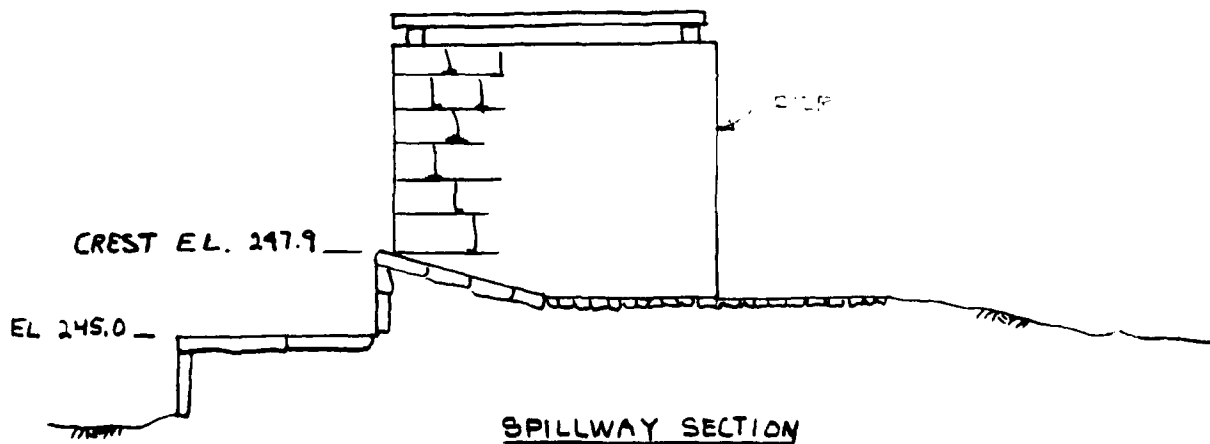
Job No. 80106 Sheet 3 of 19
Project FLAT RIVER RESERVOIR DAM Date 2/9/81
Subject _____ By D.S. Ch'k. by



LONGITUDINAL SECTION ALONG DAM - LOOKING DOWNSTREAM



SECTION THRU OUTLET



SPILLWAY SECTION

Job No. 80106 Sheet 3 of 19
 Project FLAT RIVER RESERVOIR DAM Date 2/9/81
 Subject _____ By DS. Ch'k. by

CALCULATE TEST FLOOD

CLASSIFICATION: INTERMEDIATE

HAZZARD: HIGH

∴ USE FULL PMF

BASIN SLOPE: FLAT

FROM PMF CURVE @ DA = 57.5 SQ MI, PMF = 500 CSM

REDUCE BY 25% FOR BASIN STORAGE = 375 CSM

PMF = $375 \times 57.5 = 21563$ CFS, SAY 21,600 CFSCALCULATE DAM RATING CURVEDAM & SPILLWAY $Q = CLH^{3/2}$ SPILLWAY $C = 3.6$ = TRAPEZOIDAL WEIR, VERT. D.S. FACE, $L = 170.25$ DAM $C = 2.6$ = BROADCRESTED WEIR, $L = 1300$ FTOUTLET $Q = CA\sqrt{2gh}$ $C = 0.6$ (H MEAS. FROM 1 FT ABOVE TOP OF OUTLET & TW ELEV.) $A = 12.6$ SQ FT X 3 OUTLETS

ELEV	H _{spill.}	Q _{spill.}	H _{out.}	Q _{out.}	H _{dam}	Q _{dam}	Σ Q
247.9	-	-	11.9	630	-	-	630
249.0	1.1	730	13.0	655	-	-	1385
250.0	2.1	1930	14.0	680	-	-	2610
252.0	4.1	5270	16.0	725	-	-	5995
254.0	6.1	9560	18.0	770	-	-	10330
255.0	7.1	12,000	19.0	790	-	-	12,790
256.0	8.1	14,630	20.0	810	1.0	3380	18,820
256.5	8.6	16,000	20.5	820	1.5	6210	23,030

@ TOP DAM = 255.0

SPILLWAY CAPACITY = 12,000 CFS

OUTLET CAPACITY = 790 CFS

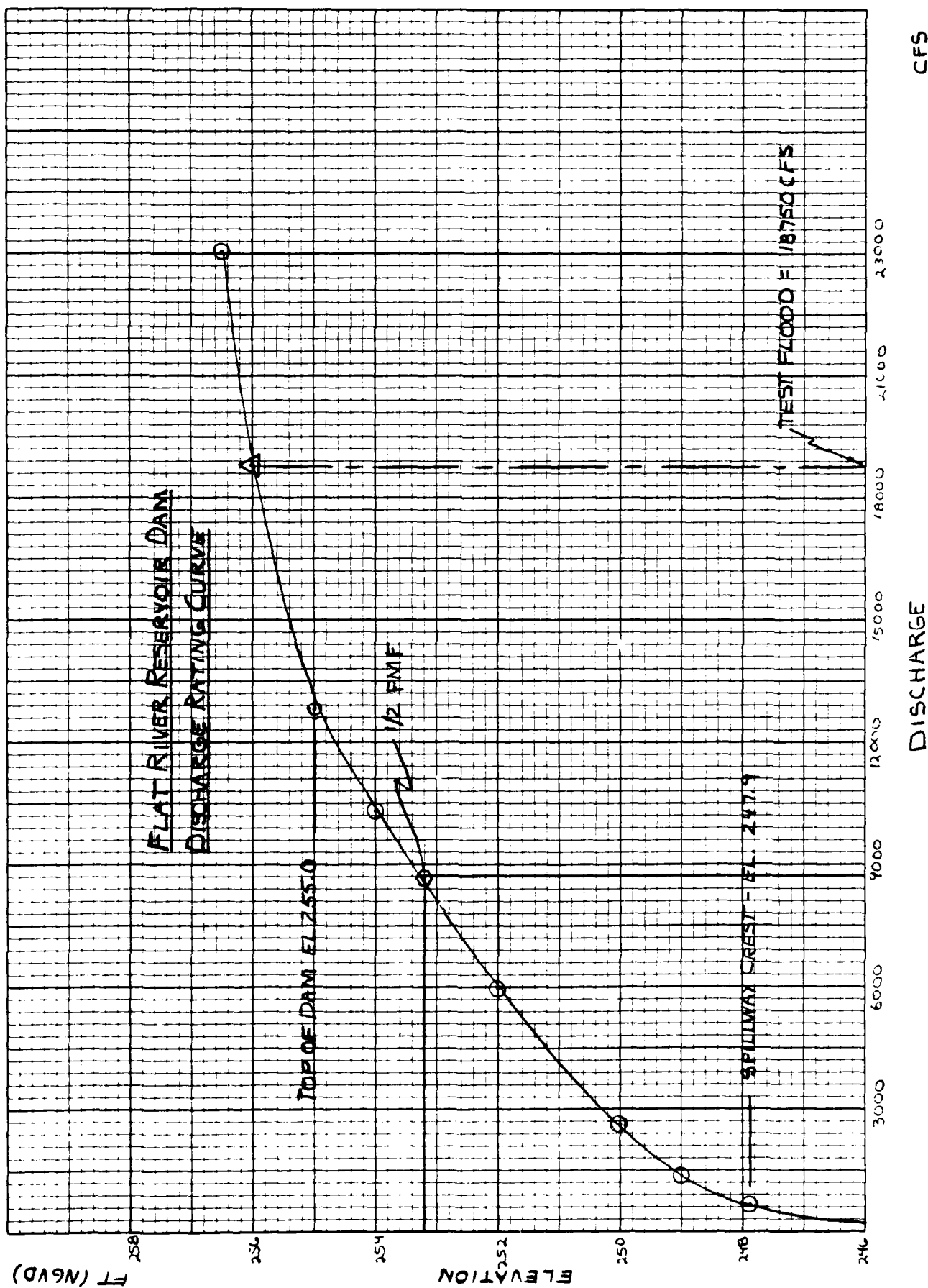
@ TEST FLOOD ELEV. = 256.0

SPILLWAY CAPACITY = 14,630 CFS

OUTLET CAPACITY = 810 CFS

4/19

CFS

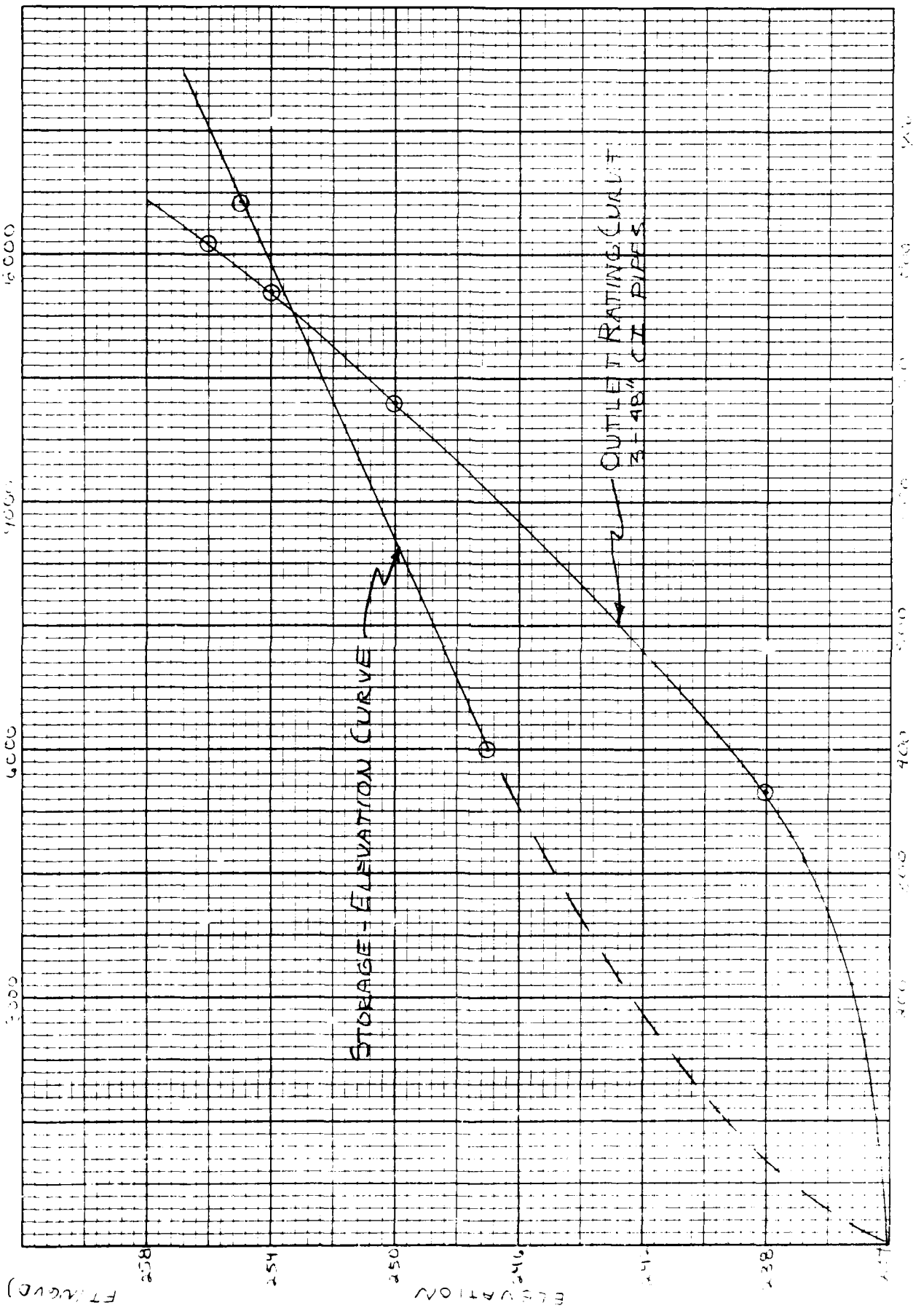


5/19

CFS

FIG-F7

STORAGE



DISCHARGE

OUTLET RATING CURVE
3-48\"/>

STORAGE - ELEVATION CURVE

AD-A156 843

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
FLAT RIVER RESERVOIR..(U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV FEB 81

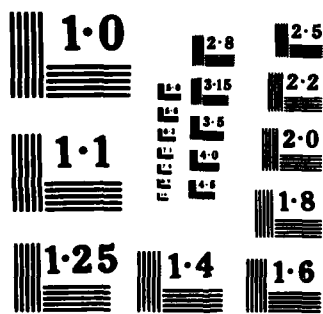
22

UNCLASSIFIED

F/G 13/13

NL

END
FILE
8-90



Job No. 80106 FLAT RIVER RESERVOIR DAM Sheet 6 of 19
 Project _____ Date _____
 Subject _____ By DS Ch'k. by _____

CALCULATE EFFECT OF SURCHARGE STORAGE

PEAK INFLOW = 21,600 CFS, SURCHARGE = $256.3 - 247.9 = 8.4'$
 VOL = $8.4' \times 950 \text{ AC} = 7980 \text{ AC-FT}$

$$V_1 = \frac{7980 \text{ AC-FT} \times 12 \text{ IN/FT}}{57.5 \times 640} = 2.6 \text{ IN.}$$

$$Q_{P1} = \left(1 - \frac{2.6}{19}\right) 21,600 = 18,640 \text{ CFS}, \quad \text{STAGE} = 256.0$$

$$V_2 = \frac{8.1 \times 950 \times 12}{57.5 \times 640} = 2.51 \text{ IN.} \quad V_{\text{AVG}} = \frac{2.51 + 2.6}{2} =$$

$$Q_{P2} = \left(1 - \frac{2.51}{19}\right) 21,600 = \underline{\underline{18,750 \text{ CFS}}}$$

1. STORAGE WILL REDUCE THE TEST FLOOD DISCHARGE BY 2850 CFS OR 13 %
2. THE SPILLWAY CAN PASS 12,000 CFS OR 64 % OF THE TEST FLOOD
3. AT THE TEST FLOOD DISCHARGE OF 18,750 CFS, THE DAM WILL BE OVERTOPPED BY 1.0 FT.

DAM FAILURE ANALYSIS

$$\text{DAM FAILURE } Q = 8/27 W_B \sqrt{g} Y_o^{3/2} \quad Y_o = 24 \text{ FT}$$

USE $W_B = 5\%$ OF DAM LENGTH @ MID HEIGHT = $.05 \times 1200 = 60 \text{ FT}$

$$\begin{aligned} Q_{\text{FAIL.}} &= 8/27 (60) \sqrt{32.2} 24^{3/2} \\ &= 11,850 \text{ CFS} \\ &\quad + 12,000 \text{ CFS (SPILLWAY } Q) \end{aligned}$$

$$\text{TOTAL } Q_{\text{FAIL.}} = 23,850 \text{ CFS}$$

ESTIMATE DOWNSTREAM IMPACT

THE S. BRANCH OF THE PAWTUCKET RIVER IS CONTROLLED BY A SERIES OF 10 DAMS BETWEEN FLAT RIVER RESERVOIR DAM AND THE MAIN STEM OF THE PAWTUCKET RIVER (APPROX. 8 MILES)

- ESTABLISH DISCHARGE RATING AT EACH DAM TO DETERMINE FLOOD STAGES
- THE ONLY SIGNIFICANT FLOOD PLAIN STORAGE IS FORMED BETWEEN THE LITTLE WASHINGTON DAM, 8500 FT DOWNSTREAM. FOR ROUTING PURPOSES, USE ONLY 2 REACHES; REACH 1 - FLAT RIVER TO WASHINGTON DAM, REACH 2 - WASHINGTON TO CONFLUENCE WITH PAWTUCKET R.

Job No. 8006 FLAT RIVER ESTERIDGESheet 7 of 19

Project _____

Date _____

Subject _____

By DS Ch'k. by _____

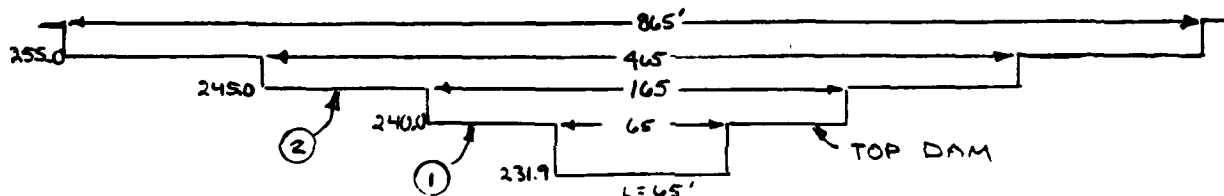
SPILLWAY CREST						
DAM	ELEV.	L	'C'	TOP DAM	TOE DAM	REACH L.
WASHINGTON	237.9	65	3.6	237.0	212.0	8500
ANTHONY	222.0	76	3.6	229.0	210.0	9000
QUIDNECK UPPER	194.0	110	3.6	198.0	180.0	2000
QUIDNECK LOWER	170.0	175	3.6	173.0	160.0	1800
CROMPTON UPPER	156.0	175	3.6	160.0	150.0	3500
CROMPTON LOWER	144.0	170	3.6	146.0	134.0	3500
CENTERVILLE	120.0	150	3.6	127.0	104.0	5000
ARCTIC	110.5	200	3.4	113.5	86.5	4800
RIVER PT. UPPER	79.1	100	3.6	84.1	65.1	2500
RIVER PT. LOWER	57.3	100	3.6	62.3	48.3	1400
						<u>42,500</u>

REACH 1 - FLAT RIVER → WASHINGTON

AVG. FLOOD PLAIN WIDTH = 2000 FT.

Q_{FAIL} = 23850

REACH = 8500



ELEV.	H _{spill}	Q	H ₀	Q	H ₀	Q	Σ Q
240.0	8.1	5400	-	-	-	-	5400
245.0	13.1	11100	5.0	2900	-	-	14000
247.0	15.1	13730	7.0	4800	2.0	2200	20730
249.0	17.1	16550	9.0	7000	4.0	6250	29,800

@ Q = 23,850 CFS, STAGE = 14 FT @ Q = 12,000, STAGE = 12 FT

$$\text{STOR}_1 = \frac{4 \times 2000 \times 8500}{43560} = 1561 \text{ AC-FT}$$

$$Q_{P1} = \left(1 - \frac{1561}{12,000}\right) 23850 = 20,900 \rightarrow \text{STAGE} = 15 \text{ FT}$$

$$\text{STOR}_2 = \frac{2.7 \times 2000 \times 8500}{43560} = 1054 \text{ AC-FT, STOR. AVG} = \frac{1054 + 1561}{2} = 1307$$

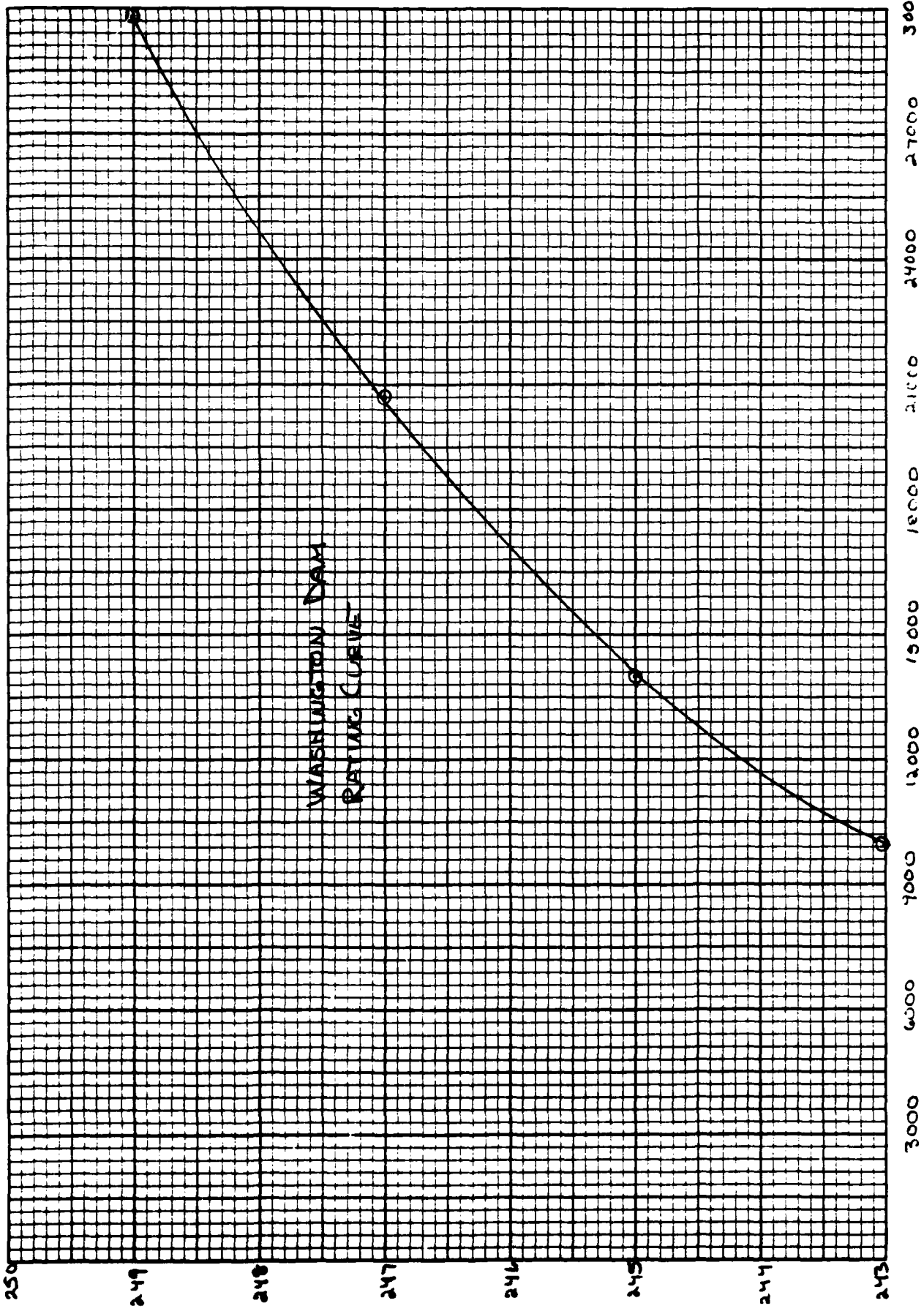
$$Q_{P2} = \left(1 - \frac{1307}{12,000}\right) 23850 = 21,400 \text{ CFS, STAGE} = 14.3 \text{ FT ABOVE CREST}$$

$$\text{PREFAILURE: } Q = 12000 \text{ CFS STAGE} = 4.2 \text{ FT ABOVE DAM} = 6.2 \text{ FT ABOVE CREST}$$

$$\therefore \text{NET INCREASE IN OVERBAUNGS} = \underline{\underline{2 \text{ FT}}}$$

8/19

CFS



Job No. FLAT RIVER RESERVOIR DAM 80106 Sheet 9 of 19
 Project _____ Date _____
 Subject _____ By PS Ch'k. by

REACH 2 - WASHINGTON → CONFLUENCE W/ PAWTUCKET R.

L = 33,500 FT AVG. FLOOD PLAIN WIDTH = 500 FT.

AVG. INCREASE IN FLOOD STAGE (FAILURE - PREFAILURE) = 4 FT

$$\text{STOR} = \frac{4 \times 33,500 \times 500}{43,560} = 1540 \text{ AC-FT}$$

$$Q_{P1} = \left(\frac{1 - 1540}{12,650} \right) 21,400 = \underline{18,800 \text{ CFS}}$$

$$\text{NET REDUCTION W } Q_{\text{FAIL}} = 21,400 - 18,800 = 2,600 \text{ CFS}$$

$$= \frac{2,600}{33,500} = .0776 \text{ CFS/FT OF REACH}$$

ESTABLISH FLOOD STAGES AT EACH DAM (SEE ATTACHED RATING CURVES)

<u>DAM</u>	<u>Q_{FAIL}</u>	<u>FAIL STAGE*</u>	<u>PREFAIL STAGE*</u>	<u>NET INCREASE (FT.)</u>
ANTHONY	20,700	4.9	3.4	1.5
QUIDNICK UPPER	20,550	5.6	3.8	1.8
QUIDNICK LOWER	20,400	4.8	3.0	1.8
CROMPTON UPPER	20,135	4.0	2.4	1.6
CROMPTON LOWER	19,860	6.0	4.0	2.0
CENTERVILLE	19,475	3.7	1.0	2.7
ARTIC	19,100	4.5	2.1	2.4
RIVER FT. UPPER	18,900	5.1	3.1	2.0
RIVER FT LOWER	18,800	6.5	4.2	2.3

* STAGE ABOVE TOP OF DAM

SUMMARY

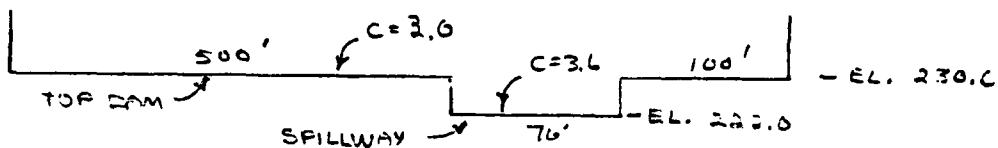
@ PREFAILURE DISCHARGE = 18,000 CFS FLOOD STAGES
 WILL RANGE FROM 1-6 FT. ABOVE TOP OF DAM

@ FAILURE DISCHARGE, FLOOD STAGES WILL INCREASE
 2-3 FT.

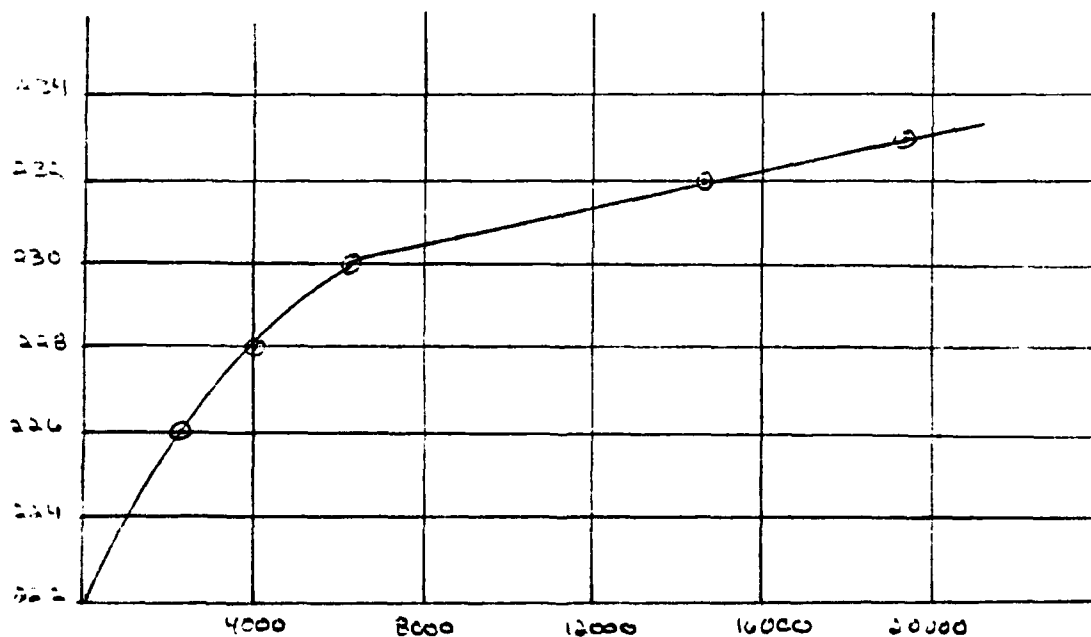
Job No. FLAT RIVER RESERVOIR DAM Sheet 10 of 19
 Project _____ Date _____
 Subject _____ By DS Ch'k. by _____

ANTHONY DAM

SPILLWAY = 76' X 9' C = 3.6



ELEV.	H _{SPILL}	Q _{SPILL}	H _{DAM}	Q _{DAM}	Σ Q
226	4	2200	-	-	2200
228	6	4000	-	-	4000
230	8	6200	-	-	6200
232	10	8650	2	6000	14650
234	12	11400	4	14400	25800



Job No. ELST RIVER RESERVOIR DAM

Sheet 11 of 19

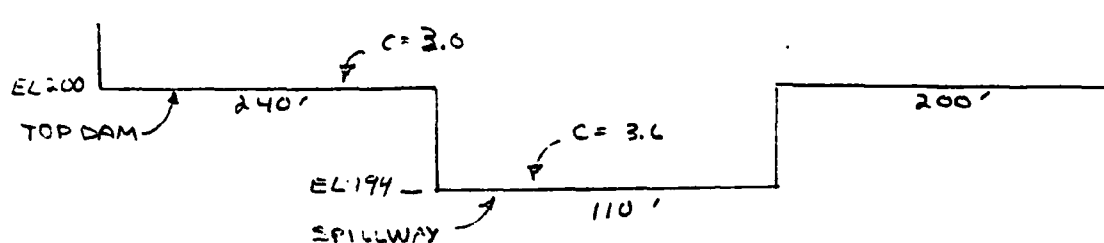
Project _____

Date _____

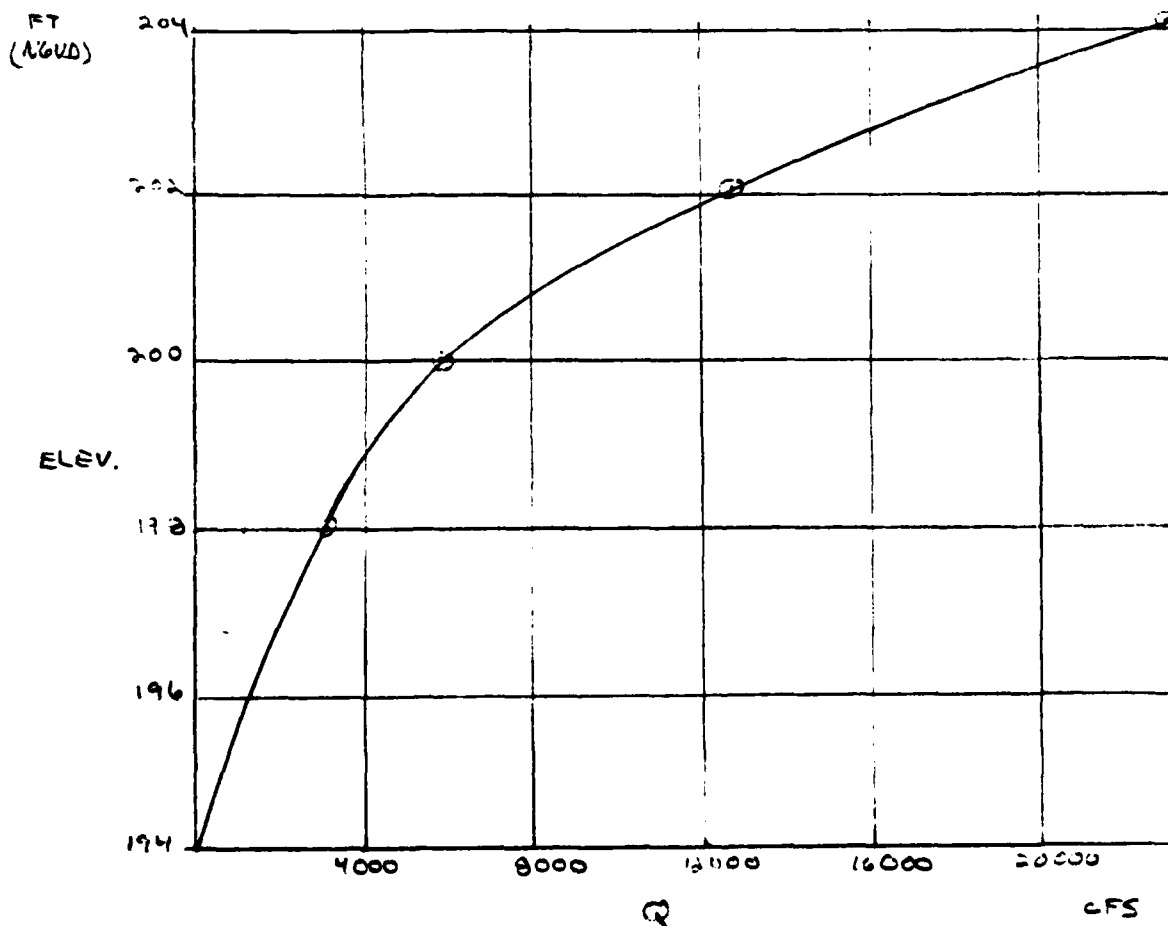
Subject _____

By SS Ch'k. by _____

QUICKNICK UPPER DAM



ELEV	H SPILL	Q SPILL	H DAM	Q DAM	ΣQ
198.	4	3170	-	-	3170
200	6	5820	-	-	5820
202	8	8960	2	3730	12690
204	10	12500	4	10500	23000



Job No. FLAT RIVER RETENTION DAM

Sheet 12 of 19

Project

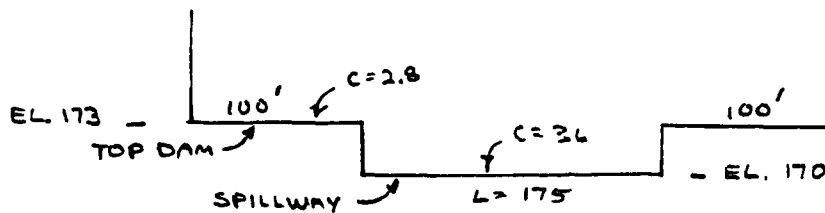
Date

Subject

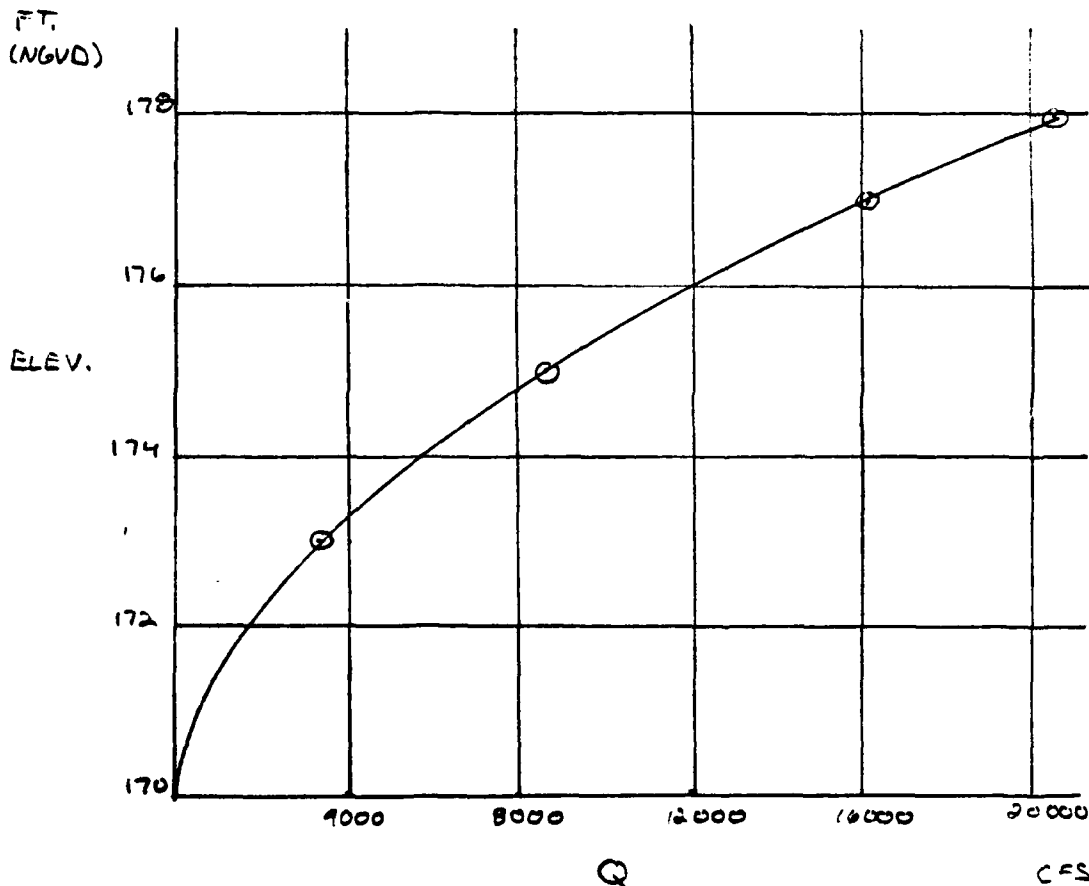
By DC Ch'k. by

QUIDNICK LOWER DAM

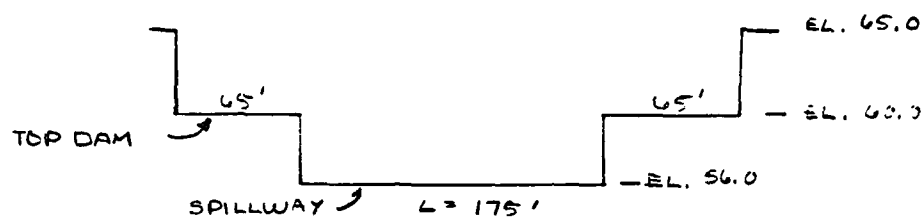
SPILLWAY = 175 FT x 3 FT. $C = 3.6$



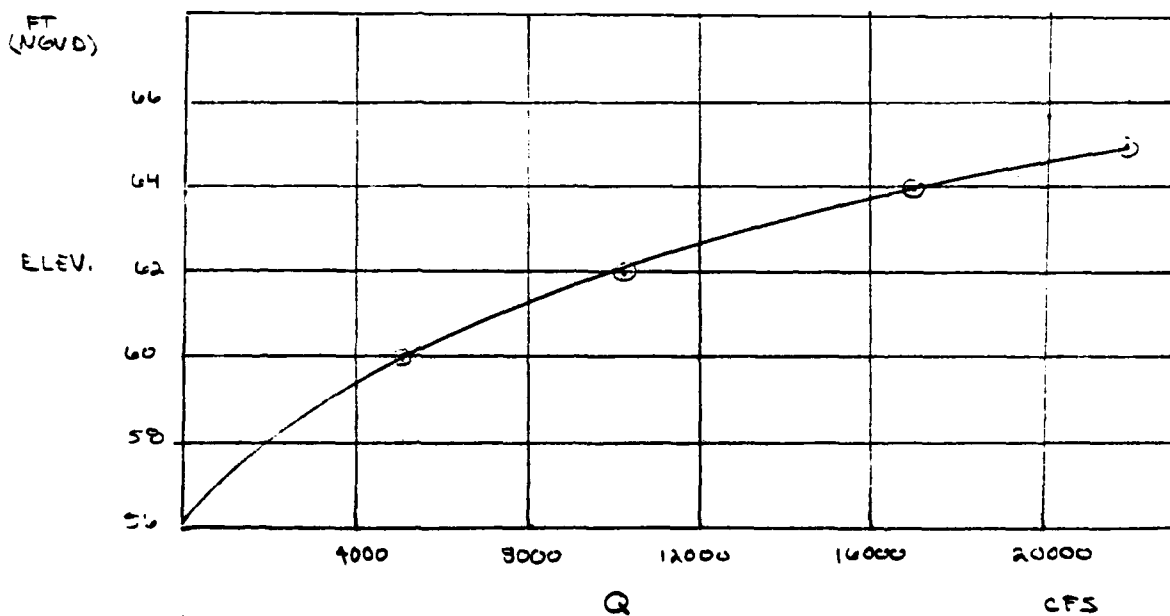
ELEV	H _{spill}	C _D -SPILL	H _{DAM}	Q _{DAM}	Σ Q
173	3	3275	-	-	3275
175	5	7050	2	1580	8630
177	7	11670	4	4480	16150
178	8	14255	5	6260	20515



Job No. EL-11-1050 RESERVOIR DAM Sheet 12 of 19
 Project _____ Date _____
 Subject _____ By CS Ch'k. by _____

CROMPTON UPPER DAMSPILLWAY = 175 FT X 4 FT $C = 3.6$ 

ELEV.	H _{SPILL}	Q _{SPILL}	H _{DAM}	Q _{DAM}	Σ Q
60	4	5040	-	-	5040
62	6	9260	2	990	10250
64	8	14295	4	2800	17095
65	9	17010	5	4090	22000



Job No. FLETCHER RESERVOIR DAM

Sheet 14 of 19

Project _____

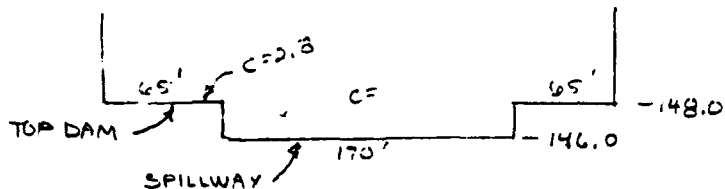
Date _____

Subject _____

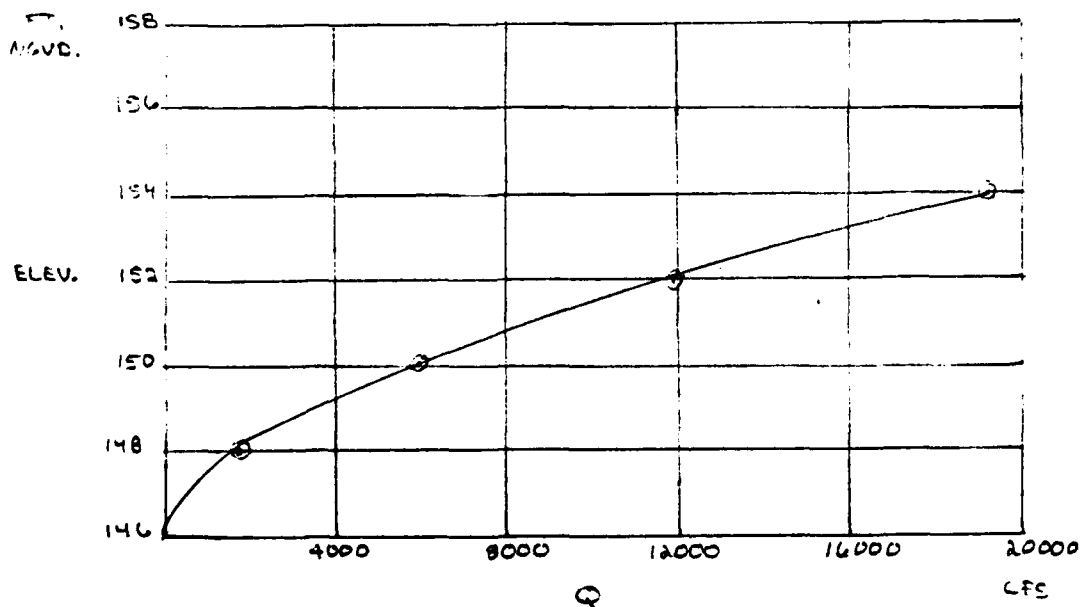
By D. Ch'k. by

CREMATON LOWER DAM

SPILLWAY = 170 FT X 2 FT HIGH $C = 3.6$



ELEV	H_{SPILL}	Q_{SPILL}	H_{DAM}	Q_{DAM}	ΣQ
148.0	2	1730	-	-	1730
150.0	4	4900	2	1030	5930
152.0	6	9000	4	2900	11900
154.0	8	13,850	6	5350	19,200

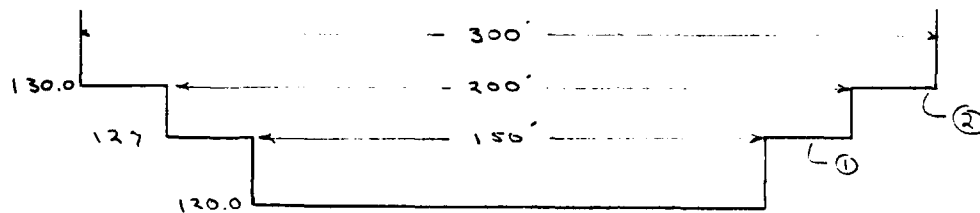


Job No. _____ Sheet 15 of 19
 Project FLAT RIVER Date 2/11/81
 Subject _____ By SAF Ch'k. by _____

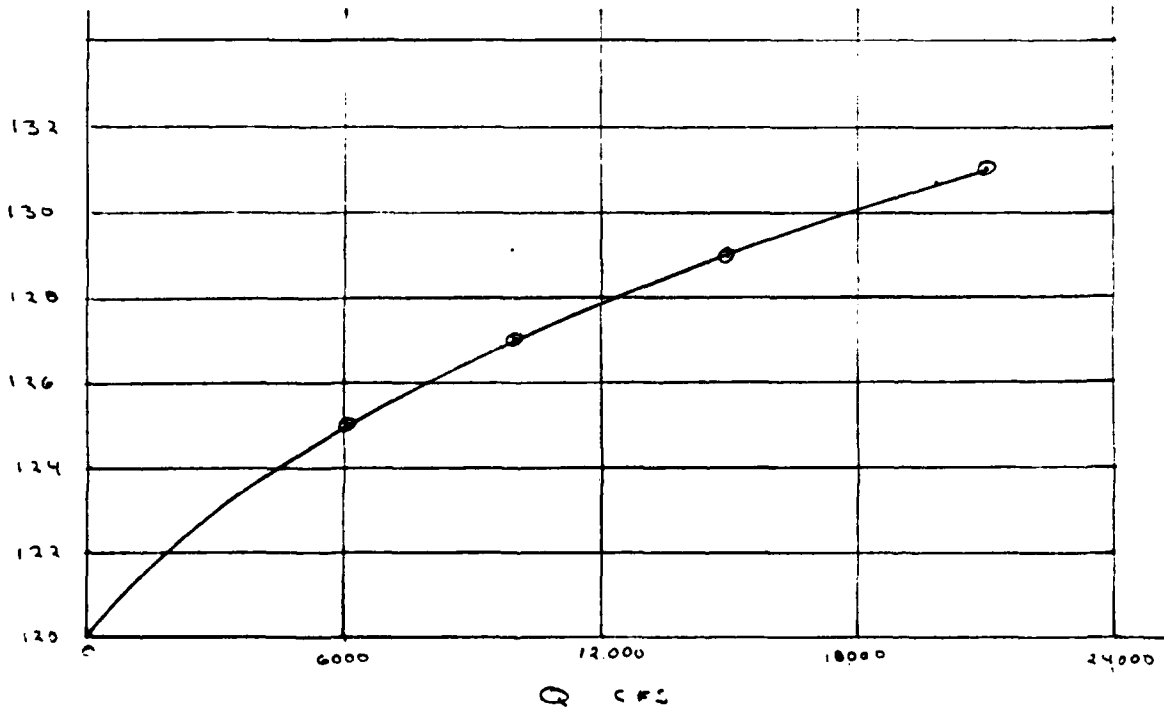
CENTERVILLE DAM

SPILL WAY 4 L = 150 EL = 120.0' TOP OF DAM 127.0'

Q = CLH^{5/2} C = 3.6 (SPILL) C = 2.6 (OVERLAKE)



ELEV	H SPILL	Q SP	H O	Q O	H O	Q 2	Σ Q
1250	5.0	6040	-	-	-	-	6040
1270	7.0	10,000	-	-	-	-	10,000
1290	9.0	14,580	2.0	370	-	-	14,950
1310	11.0	19,700	4.0	1040	1.0	260	21,000



Job No.

Project

Subject

FLAT RIVER

Sheet 16 of 17

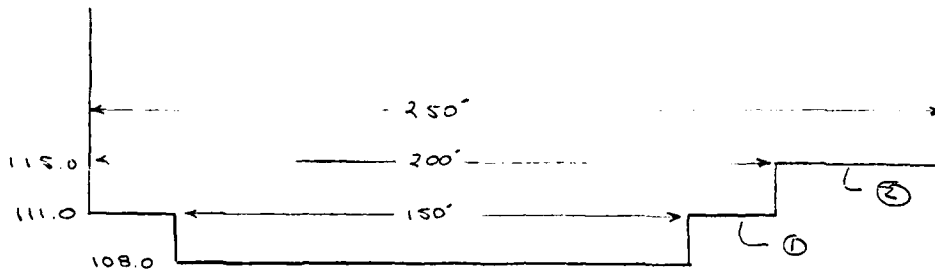
Date 2/11/81

By SMF Ch'k. by

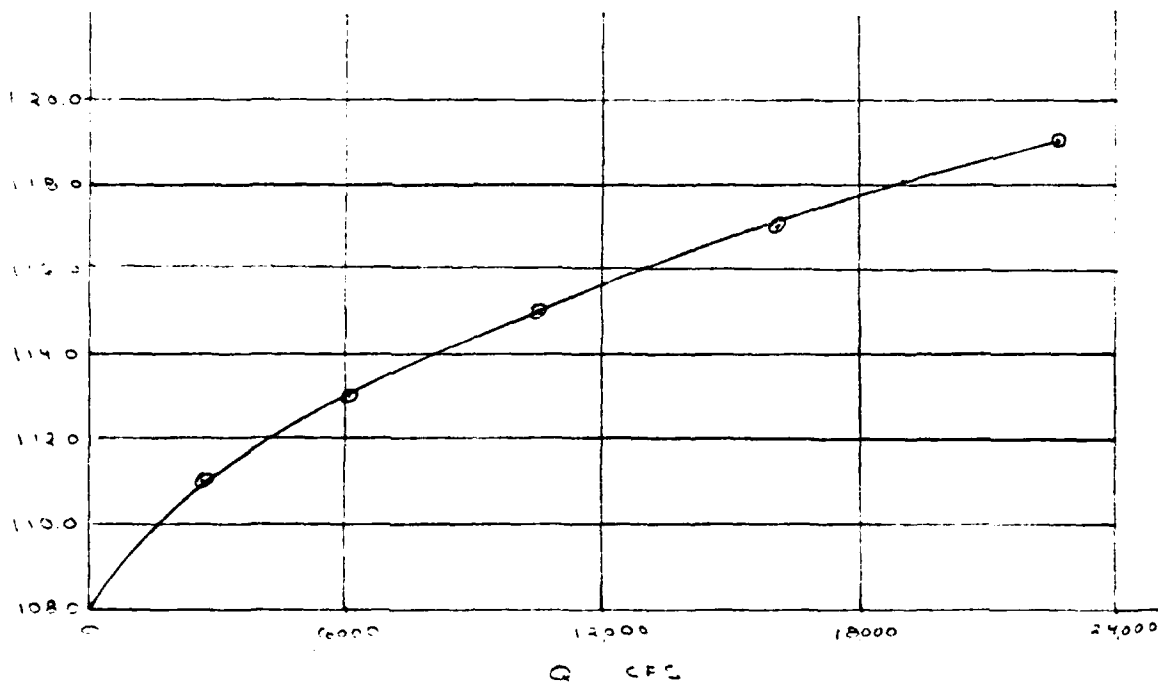
ARCTIC DAM

SPILLWAY L = 150' ELEV 108.0

Q = CL H^{3/2} C = 3.4 (SPILL) 2.6 (OUPREANKS)



ELEV	H SPILL	Q SP	H D	Q D	H 2	Q 2	Σ Q
111.0	3	2650	-	-	-	-	2650
112.0	5	5700	2	370	-	-	6070
115.0	7	9440	4	1040	-	-	10480
117.0	9	13770	6	1910	2	370	16050
119.0	11	18610	8	2940	4	1040	22590

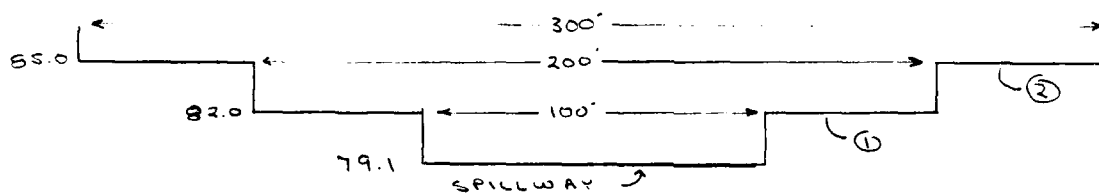


Job No. _____ Sheet 17 of 19
 Project FLAT RIVER Date 2/11/81
 Subject _____ By _____ Ch'k. by _____

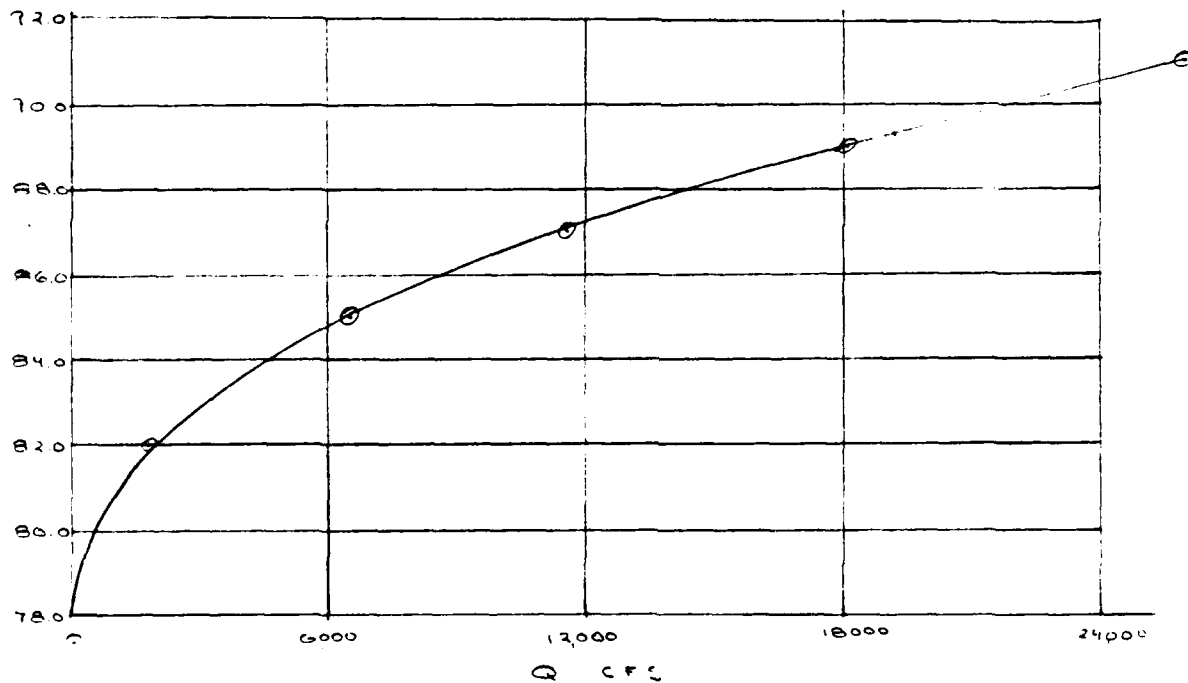
RIVERPOINT UPPER DAM

SPILLWAY 100' W 15' H EL 79.1

$Q = CLH^{3/2}$ $C = 3.6$ (SPILL) 2.6 (OVERBANKS)



ELEV	H SPILL	Q SPILL	H O	Q ₁	H _L	Q ₂	E Q
82.0	2.9	1780	-	-	-	-	1,781
85.0	5.9	5160	3.0	1350	-	-	6,510
87.0	7.9	7970	5.0	2910	2.0	740	11,620
89.0	9.9	11210	7.0	4820	4.0	2080	18,110
91.0	11.9	14780	9.0	7020	6.0	4190	25,990



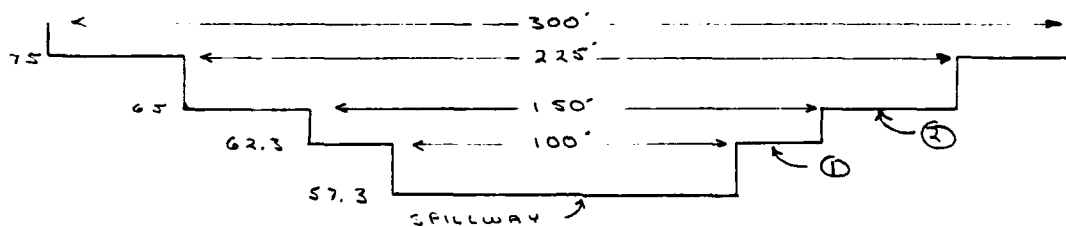
Job No. _____ Sheet 19 of 14
 Project FLAT RIVER Date 2/11/81
 Subject _____ By SAP Ch'k. by _____

RIVERPOINT LOWER DAM

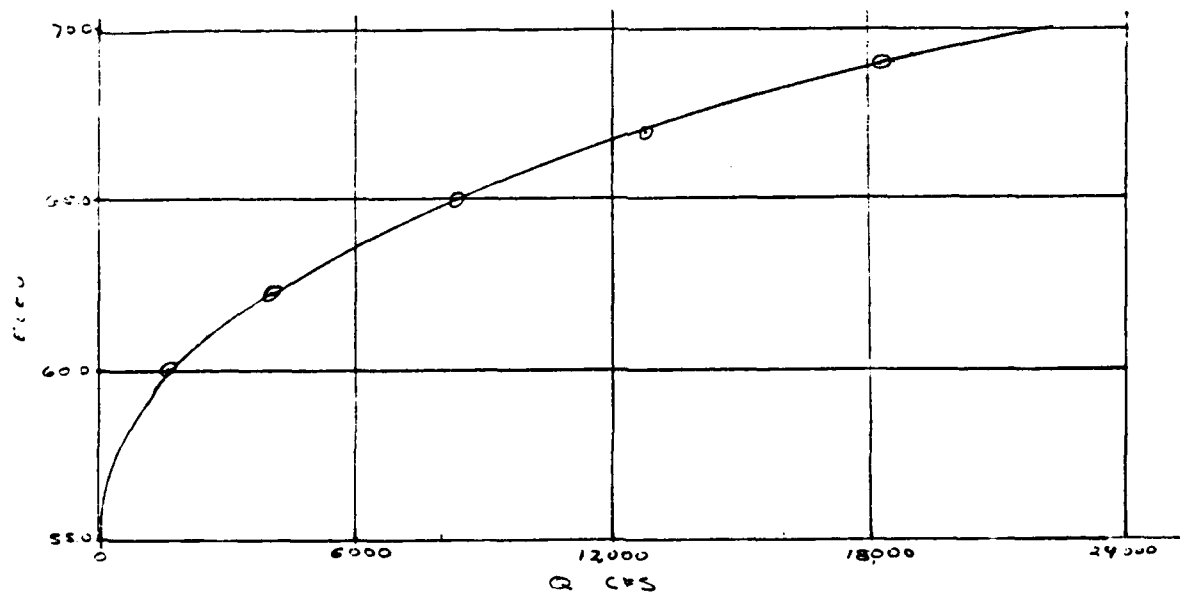
SPILLWAY 100' x 5' EL 57.3

$$Q = CLH^{3/2}$$

C = 3.6 SPILL 2.6 OVERRANK



ELEV	H _{SPILL}	Q _{SPILL}	H _O	Q _O	H _L	Q _L	Σ Q
60.0	2.7	1600	-	-	-	-	1,600
62.3	5.0	4020	-	-	-	-	4,020
65.0	7.7	7690	2.7	580	-	-	8,270
67.0	9.7	10880	4.7	1320	2.0	550	12,750
69.0	11.7	14400	6.7	2250	4.0	1560	18,210



Job No. _____ Sheet 9 of 9
 Project FLAT RIVER Date 3/21/81
 Subject _____ By JS Ch'k. by _____

EVALUATE 1/2 PMF

$$1/2 \text{ PMF} = 10800 \text{ CFS}$$

$$@ 11,800 \text{ CFS, ELEV.} = 254.4 \quad \text{SURCHARGE} = 4.7 \text{ FT}$$

$$\text{STORAGE} = 12300 \text{ AC-FT} \quad \text{STORAGE @ SPILLWAY} = 6000 \text{ AC-FT}$$

$$V_1 = \frac{4172 \times 12}{57.5 \times 640} = 2.01$$

$$Q_{P1} = \left(1 - \frac{2.01}{9.5}\right) 10800 = 8510 \rightarrow \text{STAGE} = 253.2$$

$$V_2 = \frac{5.3 \times 950 \times 12}{57.5 \times 640} = 1.64 \quad V_{\text{AVG}} = \frac{1.64 + 2.01}{2} = 1.83$$

$$Q_{P2} = \left(1 - \frac{1.83}{9.5}\right) 10800 = \underline{\underline{8720 \text{ CFS}}}$$

1. STORAGE WILL REDUCE 1/2 PMF BY 2080 CFS OR 19%
2. THE SPILLWAY CAN PASS THE 1/2 PMF SAFELY
3. THE DAM WILL NOT BE OVERTOPPED BY THE 1/2 PMF

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL
INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

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