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NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON  
NATIONAL DAM SAFETY PROGRAM. FOXS LAKE DAM (NJ00342), PASSAIC R--ETC(U)  
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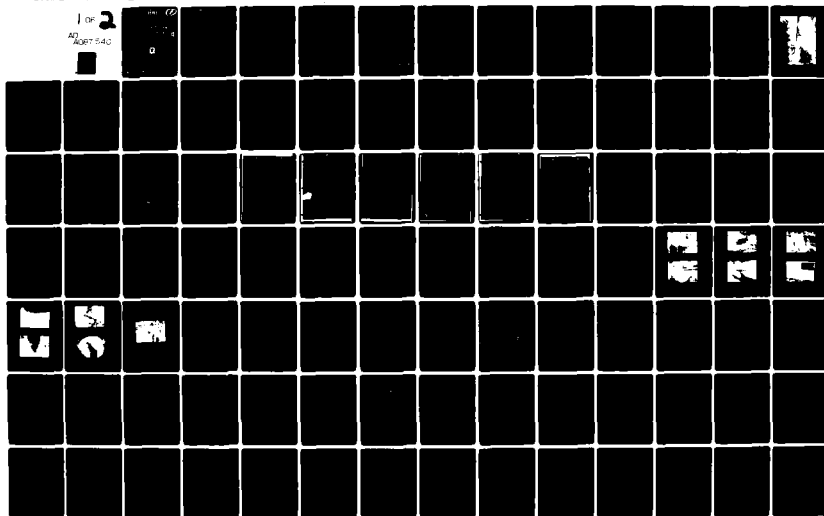
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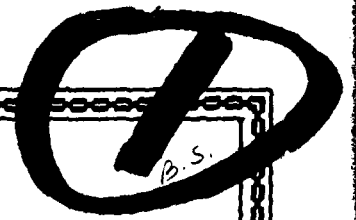
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**LEVEL II**



ADA 087540

PASSAIC RIVER BASIN  
FOXES BROOK, MORRIS COUNTY  
NEW JERSEY

**FOXES LAKE DAM**

**NJ 00342**

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

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| 1. REPORT NUMBER<br>NJ00342                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2. GOVT ACCESSION NO.<br>AD-A087540 | 3. RECIPIENT'S CATALOG NUMBER                                                                                                                         |
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| 7. AUTHOR(s)<br>WARREN A. GUINAN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                     | 6. PERFORMING ORG. REPORT NUMBER                                                                                                                      |
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| 11. CONTROLLING OFFICE NAME AND ADDRESS<br>NJ Department of Environmental Protection ✓<br>Division of Water Resources<br>P.O. Box CN029<br>Trenton, NJ 08625                                                                                                                                                                                                                                                                                                                                                                                                     |                                     | 10. PROGRAM ELEMENT, PROJECT, TASK<br>AREA & WORK UNIT NUMBERS                                                                                        |
| 14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)<br>U.S. Army Engineer District, Philadelphia<br>Custom House, 2d & Chestnut Streets<br>Philadelphia, PA 19106                                                                                                                                                                                                                                                                                                                                                                        |                                     | 12. REPORT DATE<br>Jan. 1980                                                                                                                          |
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| 18. SUPPLEMENTARY NOTES<br>Copies are obtainable from National Technical Information Service,<br>Springfield, Virginia 22151.                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                     |                                                                                                                                                       |
| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number)<br>Dams National Dam Safety Program<br>Embankments Foxs Lake Dam, New Jersey<br>Visual Inspection Erosion<br>Structural Analysis Riprap                                                                                                                                                                                                                                                                                                                                       |                                     |                                                                                                                                                       |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br>This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report. |                                     |                                                                                                                                                       |

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6) National Dam Safety Program.  
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IN REPLY REFER TO  
NAPEN-N

29 JUL 1980

Honorable Brendan T. Byrne  
Governor of New Jersey  
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Foxs Lake Dam in Morris County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Foxs Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to six percent of the Spillway Design Flood--SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design or specify and oversee repairs for the erosion that has occurred on the upstream slope and on the west abutment.

(2) Design or specify and oversee the installation of riprap or other erosion protection on the upstream face of the dam.

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- Honorable Brendan T. Byrne

(3) Design or specify and oversee the establishment of grassy vegetation for erosion protection on the crest of the embankment.

(4) Design or specify and oversee repairs to the eroded, spalled and cracked concrete on the ogee spillway, spillway walls and downstream concrete retaining walls.

(5) Specify and oversee procedures for removing trees from the upstream slope of the dam.

(6) Investigate the cause of the unevenness of the crest and design and implement remedial measures if necessary.

c. Within thirty days from the date of approval of this report, the following remedial actions should be initiated:

(1) Start a program of periodically checking the condition of the dam.

(2) Control trespassing on the dam to reduce erosion.

d. The following remedial actions should be initiated within six months from the date of approval of this report.

(1) Clear trees and brush from either side of the downstream channel for a distance of at least 50 feet downstream of the dam or to the nearest property line, whichever is closer to the dam.

(2) Establish a surveillance program for use during and after periods of heavy rainfall and also a warning program to follow in case of emergency conditions.

(3) Expose and clean out valve boxes to the outlet pipes.

(4) Remove the debris at the downstream toe of the spillway.

e. The following remedial actions should be initiated within one year from the date of the report:

(1) The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

(2) The outlet valves should be exercised periodically to ensure proper operation and flush any sediment that has collected in the pipes.

NAPEN-N

Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



1 Incl  
As stated

JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

Copies furnished:  
Mr. Dirk C. Hofman, P.E., Deputy Director  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief  
Bureau of Flood Plain Regulation  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

FOXES LAKE DAM (NJ00342)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 9 November 1979 by Anderson-Nichols & Co., Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Foxes Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to six percent of the Spillway Design Flood--SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design or specify and oversee repairs for the erosion that has occurred on the upstream slope and on the west abutment.

(2) Design or specify and oversee the installation of riprap or other erosion protection on the upstream face of the dam.

(3) Design or specify and oversee the establishment of grassy vegetation for erosion protection on the crest of the embankment.

(4) Design or specify and oversee repairs to the eroded, spalled and cracked concrete on the ogee spillway, spillway walls and downstream concrete retaining walls.

(5) Specify and oversee procedures for removing trees from the upstream slope of the dam.

(6) Investigate the cause of the unevenness of the crest and design and implement remedial measures if necessary.

c. Within thirty days from the date of approval of this report, the following remedial actions should be initiated:

(1) Start a program of periodically checking the condition of the dam.

(2) Control trespassing on the dam to reduce erosion.

d. The following remedial actions should be initiated within six months from the date of approval of this report.

(1) Clear trees and brush from either side of the downstream channel for a distance of at least 50 feet downstream of the dam or to the nearest property line, whichever is closer to the dam.

(2) Establish a surveillance program for use during and after periods of heavy rainfall and also a warning program to follow in case of emergency conditions.

(3) Expose and clean out valve boxes to the outlet pipes.

(4) Remove the debris at the downstream toe of the spillway.

e. The following remedial actions should be initiated within one year from the date of the report:

(1) The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

(2) The outlet valves should be exercised periodically to ensure proper operation and flush any sediment that has collected in the pipes.

APPROVED: 

JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

DATE: 6 JUN 80

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Foxs Lake Dam  
Identification No.: FED ID No. NJ00342  
State Located: New Jersey  
County Located: Morris  
Stream: Foxs Brook  
River Basin: Passaic  
Date of Inspection: November 9, 1979

ASSESSMENT OF GENERAL CONDITIONS

Foxs Lake Dam (commonly known as Park Lakes Dam) is about 55 years old and in fair overall condition. It is small in size and is classified as Significant Hazard. Erosion of the upstream face of the dam embankment has occurred at the west side of the principal spillway structure, leaving the short training wall there undermined and largely non-functional. Some erosion has occurred along the upstream face of the dam embankment east of the principal spillway. There are a few trees growing on the upstream face of the embankment. The concrete principal spillway structure itself is in good overall condition. Some cracking of the concrete was observed and spalling of concrete is generally limited to portions of the structure close to the normal water line. The crest of the dam has a generally uneven surface and is practically void of vegetation. The twin outlet pipes that protrude from the downstream face of the principal spillway structure are in good condition, exhibiting only minor surface rust. The spillway is capable of passing less than 5% of the half-PMF and is inadequate.

We recommend that the owner retain the services of a professional engineer, qualified in the design and inspection of dams, to accomplish the following in the near future: specify and oversee repairs for the erosion that has occurred on the upstream face and at the west spillway abutment; design or specify and oversee the establishment of grassy vegetation for erosion protection of the crest of the embankment; design or specify and oversee repairs to the eroded, spalled and cracked concrete on the ogee spillway, spillway walls, and downstream concrete retaining walls; specify and oversee procedures for removing trees and their root systems from the upstream slope of the dam; further evaluate the hydrology and hydraulics of the watershed, reservoir, dam, and spillway, and design and implement necessary mitigating measures; and investigate the cause of the unevenness of the crest and design and implement remedial measures if necessary.

We further recommend that as a part of operating and maintenance procedures, the owner check the condition of the dam periodically and control trespassing on the dam to reduce erosion. This should commence immediately. In the near future, the owner should: clear brush and trees from either side of the downstream channel for a distance of at least 50 feet downstream of the dam, or the the nearest property line, whichever is closer to the dam; establish a surveillance program for use during and after periods of heavy rainfall, and also a warning program to follow in case of emergency conditions; exercise the outlet valves periodically to insure proper operation

and flush any sediment that has collected in the pipes; expose and clean out valve boxes to the outlet pipes; remove the debris at the downstream toe of the spillway. Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.

ANDERSON-NICHOLS & CO., INC.

*Warren A. Guinan*

Warren A. Guinan  
Project Manager  
New Jersey No. 16848



9 NOV 1979

OVERVIEW

FOXES LAKE DAM

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PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY REPORT  
FOXES LAKE DAM N.J. NO. 25-49 FED ID NO. NJ00342

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## PREFACE

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

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. 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.

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY INSPECTION PROGRAM  
FOXES LAKE DAM  
U.S. #NJ00342-N.J. #25-49

SECTION 1  
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Foxes Lake Dam (commonly known as Park Lakes Dam) was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 26 October, 1979 under Contract No. FPM-39 dated 28 June 1978. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 9 November 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Foxes Lake Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations, and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Foxes Lake Dam is a 19-foot high, 160-foot long earthfill and concrete dam. A 12-foot wide, concrete, ogee principal spillway is located near the center of the earthen dam embankment and is covered by a concrete deck, the top of which is approximately level with the 30-foot wide dam embankment crest. The spillway section sits between two 1-foot thick concrete walls which are approximately parallel to the flow through the spillway. These walls intersect the 1-foot thick wingwalls that form the downstream face of the spillway structure at 90° angles. Two 16-inch diameter cast iron outlet pipes protrude from this concrete face, each located about 10 feet from the centerline of flow through the principal spillway. The upstream face of the dam embankment section is grass-covered earth, sloping at about 6H:1V, intermittently protected with poorly preserved riprap. The crest of the embankment section is mostly hardpacked sand and gravel with some grass. A 4-foot high chain link fence runs along most of the upstream edge of the crest, while a 6-foot high chain link fence is located on the downstream edge of the crest. Both fences also cross the concrete principal spillway cap. The downstream face of the embankment section is rocky, tree covered natural ground, the slope of which is about 2H:1V. Essential features of the dam are given in Figures 1 & 2.

b. Location. Foxs Lake Dam is located in Morris County, New Jersey, on Foxs Brook, a tributary to the Rockaway River in the Borough of Rockaway. The dam is shown on the U.S.G.S. Quadrangle, Dover, New Jersey, with coordinates of approximately N74° 31.0' W40° 54.3'. A location map has been included as Figure 3.

c. Size Classification. Foxs Lake Dam is classified as "small" on the basis of storage at the dam crest of 97 acre-feet, which is less than 1,000 acre-feet, but more than 50 acre-feet, and on the basis of its structural height of 22 feet, which is less than 40 feet, in accordance with criteria given in Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Foxs Lake Dam is located in a residential area. Visual inspection of the downstream area revealed two inhabited structures located about 7 feet above Foxs Brook. It is unlikely that flood stages resulting from a breach of the dam would reach the first floor sills of these structures. Damage could be appreciable but not excessive. A frequently traveled residential street spans Foxs Brook about 1400 feet downstream of the dam and could be significantly damaged by flooding associated with a breach of the dam. Because the dam is located in a populated area, loss of a few lives could be possible should the dam fail. Accordingly, Foxs Lake Dam is classified as Significant Hazard based on the criteria set forth in the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership. The dam is owned by the Borough of Rockaway, 2 East Main Street, Rockaway, New Jersey, 07866. Phone: (201) 627-2000. Mr. Graner of the Public Works Department was contacted for information.

f. Purpose of Dam. The dam is used to provide recreation.

g. Design and Construction History. No information was disclosed regarding the design and construction of the original dam.

h. Normal Operational Procedures. According to Mr. Graner, the water level of Foxs Lake is drawn down "a couple of feet" each June to allow placement of sand on the beaches. No other formal operational procedures are currently in use.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. Information derived from a report entitled "Engineering Geology of the Northeast Corridor, Washington, DC to Boston, MA" and the Geologic Map of New Jersey (Lewis and Kummel, 1912) indicates that soils within the immediate site area consist of till grading laterally to sand and gravel. These soils form a nearly continuous band which is interpreted to be the end moraine for the last continental glaciation. Although no outcrops were observed during inspection of this dam, the previously mentioned reports indicate that the underlying bedrock consists of granitoid gneiss with associated migmatite, granulite, amphibolite, and granitic rocks of Precambrian age.

### 1.3 Pertinent Data

#### a. Drainage Area

1.2 square miles

#### b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown

Ungated (total) spillway capacity at maximum pool elevation-138

Low-level outlet (if operable) - 37

#### c. Elevation (ft. above NGVD)

Top of dam - 615.7 (low point in crest)

Recreation pool - 613.0

Spillway crest - 613.0

Streambed at centerline of dam - 596.5 (downstream)

- 610.0 (upstream)

Maximum tailwater (estimated) - 601

#### d. Reservoir Length (feet)

Maximum pool - 1370

Recreation pool - 1300

#### e. Storage (acre-feet)

Recreation pool - 63

Design surcharge ( $\frac{1}{2}$  PMF) - 154

Top of dam - 97

#### f. Reservoir Surface Area (acres)

Top of dam - 14

Recreation pool - 11

Spillway crest - 11

#### g. Dam

Type - earthfill and concrete

Length - 160 feet

Height - 19 feet (hydraulic)

- 22 feet (structural)

Top width - 30 feet

Side slopes - upstream 6H:1V

- downstream varies - 2H:1V to vertical

Zoning - unknown

Impervious core - unknown

Cutoff - unknown

Grout curtain - unknown

h. Spillway

Type - concrete ogee

Length of weir - 12 feet

Crest elevation - 613.0 feet above NGVD

Gates - none

Upstream channel - Foxs Lake (no approach channel)

Downstream channel - Foxs Brook

i. Regulating Outlets

Type - two 16-inch diameter cast iron pipes, downstream  
invert elevation - 606.8 NGVD

Length - 50 feet (estimated)

Access - gate valve installation points approximately  
1 foot underground near downstream edge of dam  
crest on either side of spillway.

Regulating facilities - one gate valve each pipe, installed  
temporarily when drawdown is required.

## SECTION 2 ENGINEERING DATA

### 2.1 Design

No plans, hydraulic or hydrologic data pertinent to Foxs Lake Dam were obtained.

### 2.2 Construction

No recorded data concerning construction of Foxs Lake Dam were disclosed.

### 2.3 Operation

No engineering operational data were disclosed.

### 2.4 Evaluation

a. Availability. A search of the NJDEP files and contact with community officials revealed only a limited amount of recorded information.

b. Adequacy. Because of the limited amount of recorded data available, evaluation of this dam was based solely on visual observations.

c. Validity. Parts of the recorded data retrieved were found to be incorrect based on visual observations.

## SECTION 3 VISUAL INSPECTION

### 3.1 Findings

a. Dam. The upstream slope of the dam shows some erosion at the waterline and there are major erosion channels on the upstream slope next to the west side of the concrete spillway structure and about half-way between the spillway and the west abutment. Most of the riprap on the upstream slope is missing between the spillway and the west abutment and the riprap is in poor condition between the spillway and the east abutment. Some trees are growing on the upstream slope close to the east abutment.

The crest of the dam has a generally uneven surface and is practically bare of vegetation.

Severe erosion of the west abutment has occurred at the end of the concrete wall which retains the downstream side of the embankment. This erosion appears to be associated with trespassing on the abutment.

b. Appurtenant Structures. The downstream face of the ogee spillway is surface eroded approximately 3/4 of an inch exposing the coarse aggregate. The concrete walls on either side of the spillway are also eroded and undermined at the water line. The downstream face of the downstream retaining wall on both sides of the spillway is eroded and spalled on the inclined portion exposing the coarse aggregate. Efflorescence is also showing at many cracks in the surface of the downstream retaining walls.

Corners of the concrete deck above the spillway channel have minor spalling.

c. Reservoir Area. The watershed above the reservoir is moderately sloping; it is partly wooded and partly urbanized. Slopes adjacent to the lake appear to be stable. No evidence of significant sedimentation was observed.

d. Downstream Channel. Three trees have fallen over into the channel downstream of the dam and there are several trees hanging over the channel.

## SECTION 4 OPERATIONAL PROCEDURES

### 4.1 Procedures

No formal operating procedures were disclosed. It was learned that gate valves can be temporarily installed in the twin 16-inch diameter cast iron blowoff lines to facilitate reservoir lowering. The installation points on the lines are about 1 foot underground on either side of the spillway section near the downstream edge of the crest. The water level is lowered each June to allow placement of sand on the beaches for summer recreation.

### 4.2 Maintenance of Dam

No formal maintenance procedures for the dam were obtained. From the observed condition of the dam, it is apparent that a regular maintenance program has not been followed.

### 4.3 Maintenance of Operating Facilities

Formal maintenance procedures for the operating facilities do not exist.

### 4.4 Warning System

No warning system exists for Foxs Lake Dam.

### 4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures, the remedial measures described in Section 7.2 should be implemented as prescribed.

SECTION 5  
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. An evaluation could not be performed because no data were disclosed.

b. Experience Data. Investigation of the files at the NJDEP and telephone contact with the Borough of Rockaway yielded no data concerning past overtopping of flood heights at Foxs Lake Dam.

c. Visual Observations. Some erosion of the upstream face of the dam embankment at the west side of the principal spillway structure was observed. This has left the short concrete block training wall at the west side of the spillway virtually non-functional. No evidence of overtopping of the dam crest was noted.

d. Overtopping Potential. The hydraulic/hydrologic evaluation for Foxs Lake Dam is based on a selected Spillway Design Flood (SDF) equal to one-half the probable maximum flood (PMF) in accordance with the range of test floods given in the evaluation guidelines, for dams classified as significant hazard and small in size. The PMF was determined by application of the SCS dimensionless unit hydrograph to a 24-hour probable maximum storm of 22.8 inches. Hydrologic computations are given in Appendix 3. The routed half-PMF peak discharge for the subject drainage area is 3,018 cfs.

Water will rise to a depth of 2.7 feet above the spillway crest before overtopping the low point on the dam embankment crest. Under this head the spillway capacity is 138 cfs, which is less than the selected SDF.

Flood routing calculations indicate that Foxs Lake Dam will be overtopped for more than 7 hours to a maximum depth of 3.4 feet under half-PMF conditions. It is estimated that the spillway can pass less than 5 percent of the half-PMF without overtopping the dam; thus, the spillway is considered inadequate.

e. Drawdown Capacity. Assuming that gate valves can be installed in the twin outlet pipelines, it is estimated that the lake can be drained in less than 2 days, assuming no significant inflow. This time period is considered adequate for draining the reservoir in an emergency situation.

## SECTION 6 STRUCTURAL STABILITY

### 6.1 Visual Inspection

Erosion of the upstream slope of the dam and of the west abutment next to the concrete wall which retains the downstream side of the embankment could lead to breaching of the dam if not controlled. The poor condition of the riprap on the upstream slope has contributed to the erosion problem. The lack of vegetation on the crest of the dam makes the crest susceptible to severe erosion if the dam should be overtopped. The unevenness of the crest may be a sign of internal conditions which could adversely affect the stability of the embankment. If trees that are growing on the upstream slope blow over and pull out their roots or if trees die and their roots rot, serious seepage and erosion problems could result. Spalling, erosion, and cracking of the concrete spillway, channel walls and retaining walls could lead to instability of the structure if the deterioration continues.

### 6.2 Design and Construction Data

No design or construction data pertinent to the structural stability of the dam are available.

### 6.3 Operating Records

No operating records pertinent to the structural stability of the dam are available.

### 6.4 Post-Construction Changes

No records of post-construction changes pertinent to the stability of the dam are available.

### 6.5 Seismic Stability

This dam is in Seismic Zone 1. According to the Recommended Guidelines, dams located in Seismic Zone 1 "may be assumed to present no hazard from earthquake provided static stability conditions are satisfactory and conventional safety margins exist." None of the visual observations made during the inspection are indicative of unstable slopes. However, because no data are available concerning the engineering properties of the embankment and foundation materials for this dam or of the below-ground configuration of the concrete walls in the dam, it is not possible to make an engineering evaluation of the stability of the slopes or the factor of safety under static conditions.

SECTION 7  
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Foxs Lake Dam is about 55 years old and is in fair condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based primarily on the results of the visual inspection.

c. Urgency. The recommendations in 7.2 a. and 7.2 c. should be implemented by the owner as prescribed below.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems which are listed in 7.2 a. These problems require the attention of a professional engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to failure of the structure.

7.2 Recommendations/Remedial Measures

a. Recommendations. The owner should retain a professional engineer qualified in the design and construction of dams to accomplish the following in the near future:

(1) Design or specify and oversee repairs for the erosion that has occurred on the upstream slope and on the west abutment.

(2) Design or specify and oversee the installation of riprap or other erosion protection on the upstream face of the dam.

(3) Design or specify and oversee the establishment of grassy vegetation for erosion protection on the crest of the embankment.

(4) Design or specify and oversee repairs to the eroded, spalled and cracked concrete on the ogee spillway, spillway walls and downstream concrete retaining walls.

(5) Specify and oversee procedures for removing trees and their root systems from the upstream slope of the dam.

(6) Further evaluate the hydrology and hydraulics of the watershed, reservoir, dam and spillway, and design and implement necessary mitigating measures.

(7) Investigate the cause of the unevenness of the crest and design and implement remedial measures if necessary.

b. Operating and Maintenance Procedures: The owner should do the following immediately:

(1) Start a program of periodically checking the condition of the dam.

(2) Control trespassing on the dam to reduce erosion.

The owner should do the following in the near future:

(1) Clear trees and brush from either side of the downstream channel for a distance of at least 50 feet downstream of the dam or to the nearest property line, whichever is closer to the dam.

(2) Establish a surveillance program for use during and after periods of heavy rainfall and also a warning program to follow in case of emergency conditions.

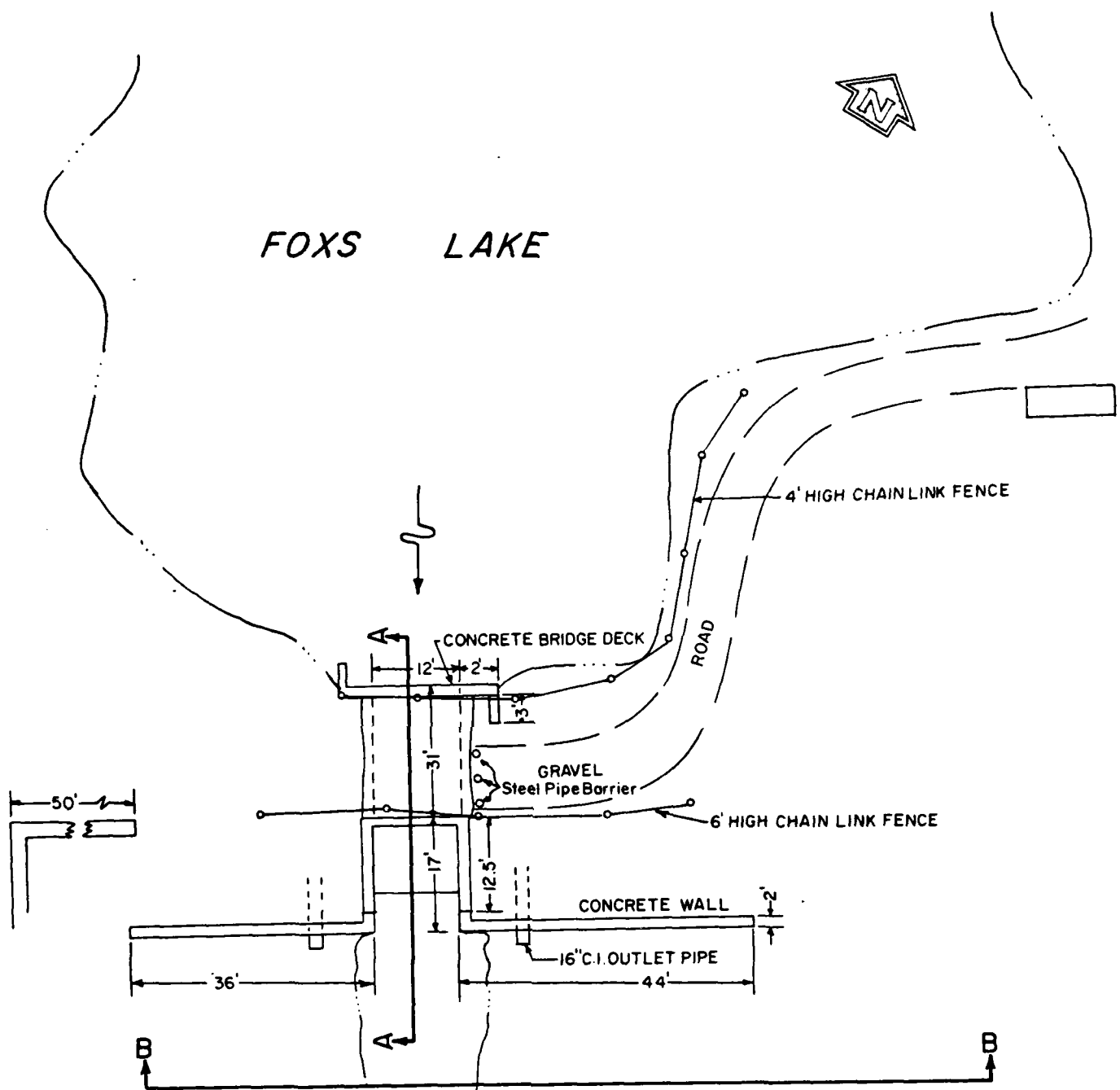
(3) Expose and clean out valve boxes to the outlet pipes.

(4) Remove the debris at the downstream toe of the spillway.

The owner should do the following in the future:

(1) Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.

(2) The outlet valves should be exercised periodically to insure proper operation and flush any sediment that has collected in the pipes.

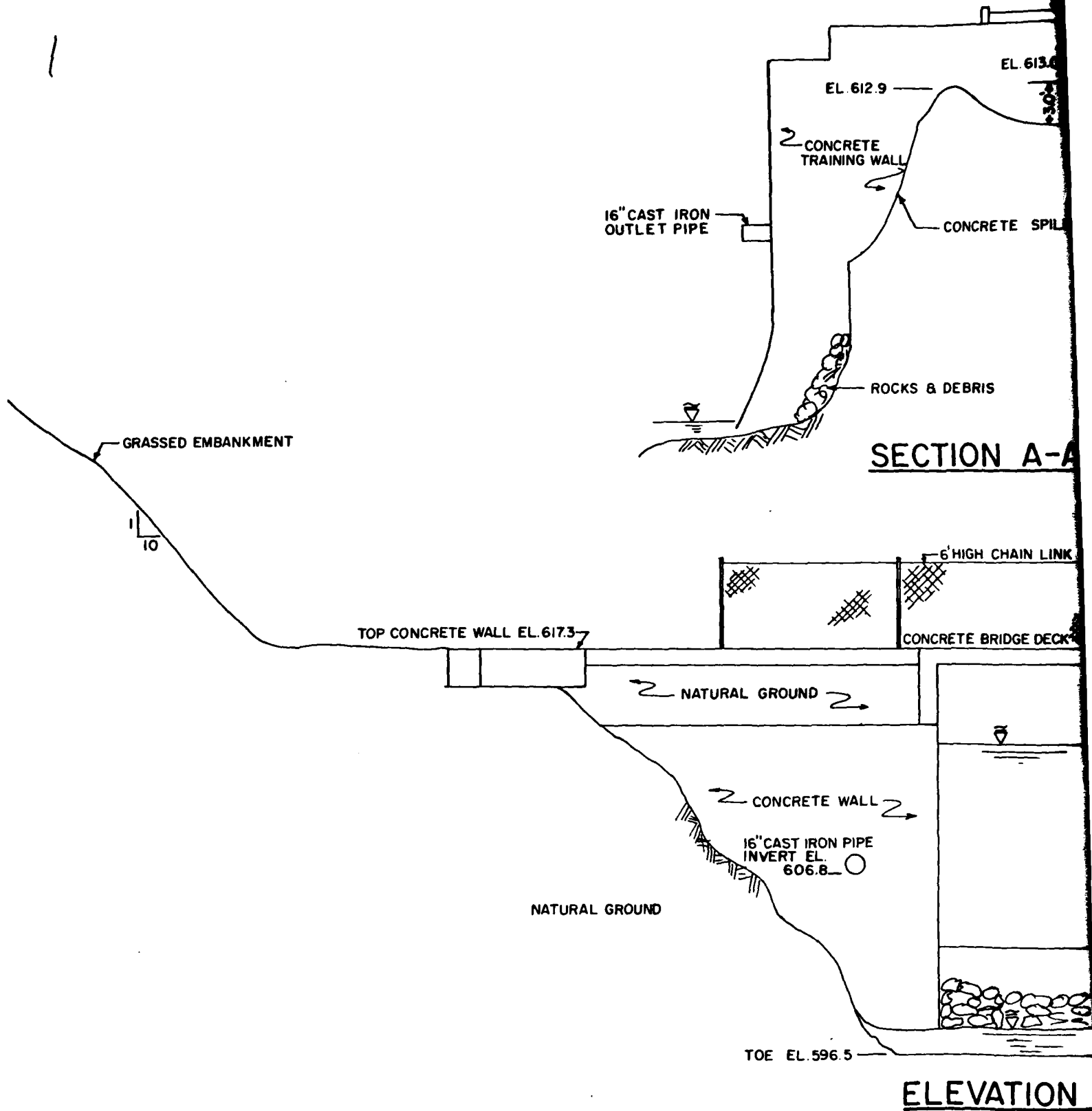


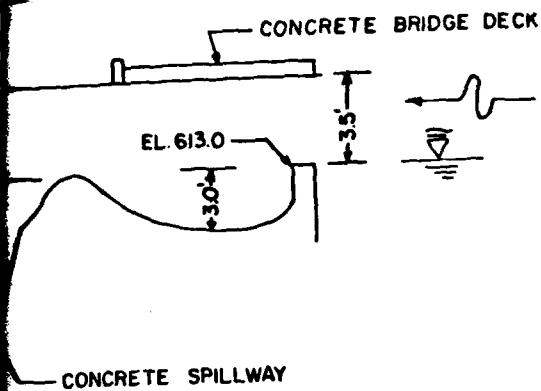
# PLAN

DATA FROM FIELD INSPECTION 11/9/79

|                                                 |  |                                      |  |
|-------------------------------------------------|--|--------------------------------------|--|
| Anderson - Nichols & Co., Inc.                  |  | U.S. ARMY ENGINEER DIST PHILADELPHIA |  |
| CONCORD                                         |  | CORPS OF ENGINEERS                   |  |
| NEW HAMPSHIRE                                   |  | PHILADELPHIA, PA                     |  |
| NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS |  |                                      |  |
| FOXES LAKE DAM                                  |  |                                      |  |
| FOXES BROOK                                     |  | NEW JERSEY                           |  |
|                                                 |  | SCALE: NOT TO SCALE                  |  |
|                                                 |  | DATE: JANUARY 1980                   |  |

FIGURE 1

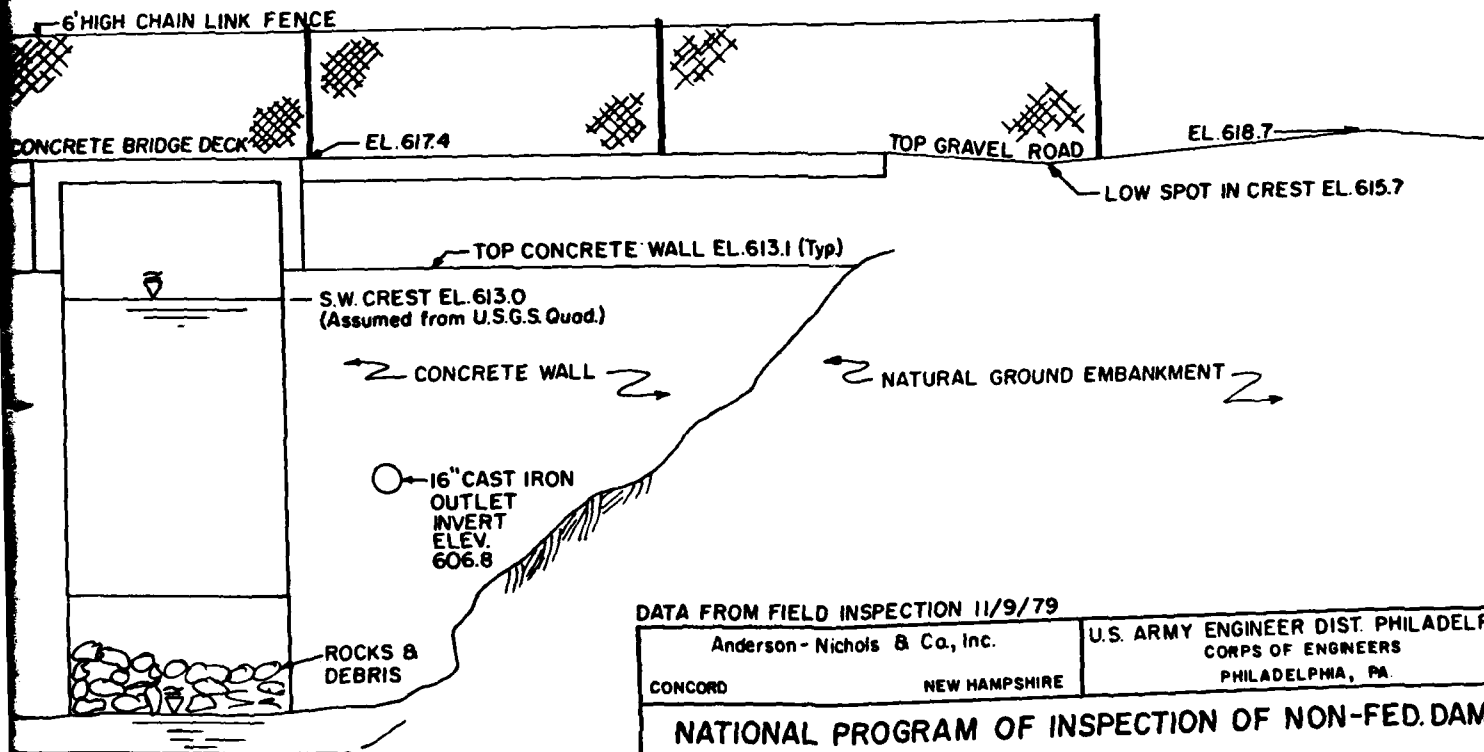




2

ROCKS & DEBRIS

## SECTION A-A

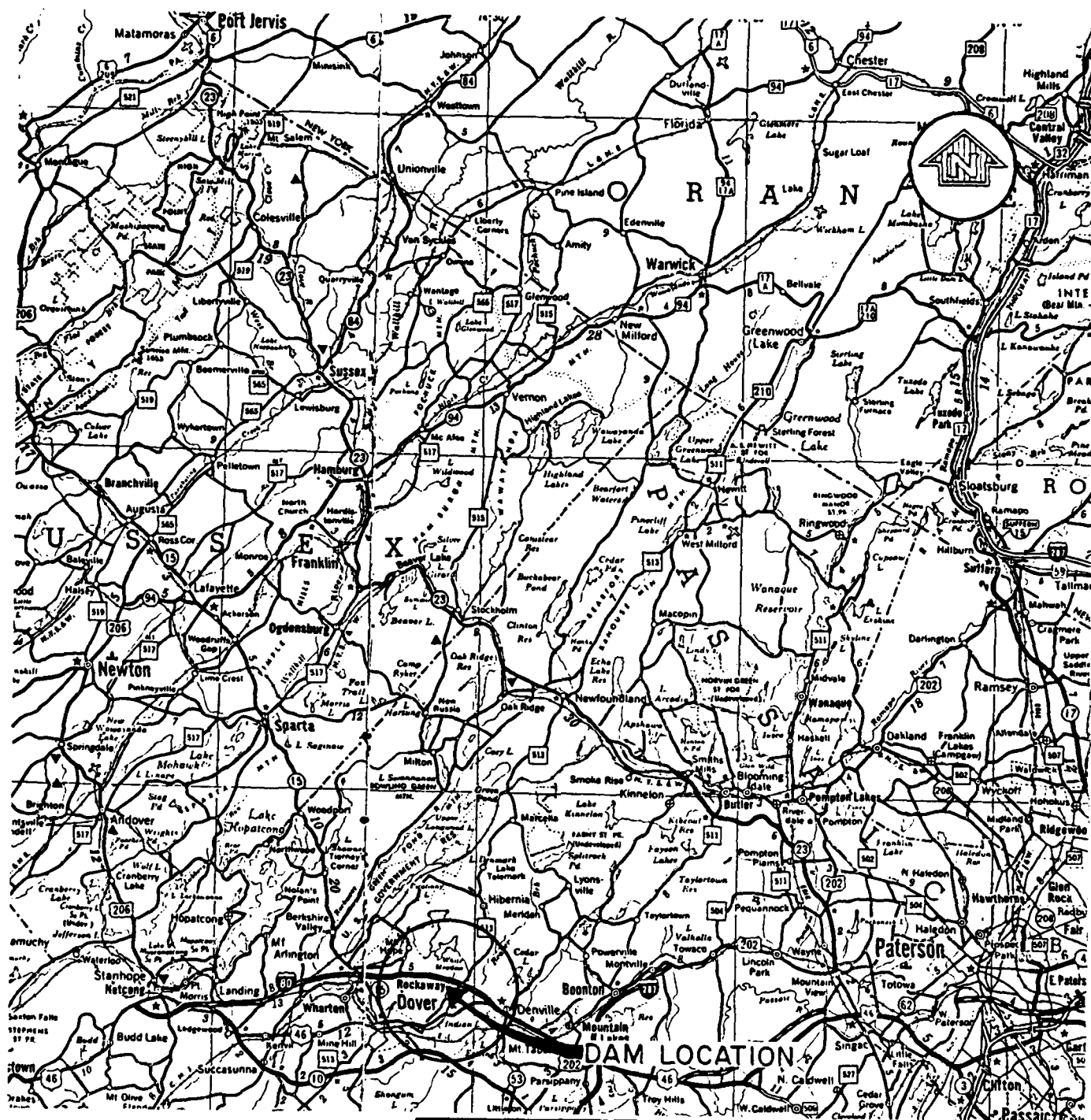


## ELEVATION B-B

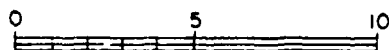
DATA FROM FIELD INSPECTION 11/9/79

|                                                 |  |                                       |  |
|-------------------------------------------------|--|---------------------------------------|--|
| Anderson - Nichols & Co., Inc.                  |  | U.S. ARMY ENGINEER DIST. PHILADELPHIA |  |
| CONCORD                                         |  | CORPS OF ENGINEERS                    |  |
| NEW HAMPSHIRE                                   |  | PHILADELPHIA, PA.                     |  |
| NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS |  |                                       |  |
| FOXES LAKE DAM                                  |  |                                       |  |
| FOXES BROOK                                     |  | NEW JERSEY                            |  |
|                                                 |  | SCALE: NOT TO SCALE                   |  |
|                                                 |  | DATE: JANUARY 1980                    |  |

FIGURE 2



SCALE IN MILES



MAP BASED ON STATE OF NEW JERSEY  
OFFICIAL HIGHWAY MAP AND GUIDE.

|                                                 |  |                                       |  |
|-------------------------------------------------|--|---------------------------------------|--|
| Anderson-Nichols & Co., Inc.                    |  | U.S. ARMY ENGINEER DIST. PHILADELPHIA |  |
| CONCORD                                         |  | CORPS OF ENGINEERS                    |  |
| NEW HAMPSHIRE                                   |  | PHILADELPHIA, PA.                     |  |
| NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS |  |                                       |  |
| FOX'S LAKE DAM                                  |  |                                       |  |
| LOCATION MAP                                    |  |                                       |  |
| FOX'S BROOK                                     |  | NEW JERSEY                            |  |
|                                                 |  | SCALE SEE BAR SCALE                   |  |
|                                                 |  | DATE JANUARY 1980                     |  |

FIGURE 3

APPENDIX 1

ENGINEERING AND EXPERIENCE DATA

FOXS LAKE DAM

# Borough of Rockaway

MUNICIPAL BUILDING • 1 EAST MAIN STREET • ROCKAWAY, NEW JERSEY 07866



CHAS. T. NICHOLS  
Borough Clerk

July  
11th  
1968

RECEIVED

JUL 15 '68

DEPT. OF ENVIRONMENT & PLANNING  
WATER POLICY AND SUPPLY

Mr. Robert L. Hardman, Chief  
Bureau of Water Control  
N. J. Dept. of Conservation & Economic Development  
Division of Water Policy & Supply  
Trenton, N. J. 08625

Dear Mr. Hardman:

re: Rockaway Park Lake  
Dam Application No. 93

With regard to your communications of April 26th and July 3rd, 1968, please be advised that the Borough of Rockaway acquired Rockaway Park Lakes, the subject dam and surrounding shore area by Tax Foreclosure on September 12, 1941.

Trusting that this is the information that you desire,  
I remain,

Very truly yours,

A handwritten signature in cursive script, reading "Chas. T. Nichols", is written over the typed name.

Chas. T. Nichols  
Borough Clerk

P.O. Box 1390  
Trenton, N.J. 08625

February 23, 1965

Mr. Martin L. Domb  
Rockaway Borough Engineer  
Rockaway, New Jersey

Re: Drainage from Proposed Subdivision in  
Rockaway Township

Dear Mr. Domb:

This is in response to your letter of December 7 and in confirmation of our telephone conversation of January 12 concerning the jurisdiction of this Division over drainage from one municipality into another, and particularly with respect to the drainage from a proposed 523-home subdivision recently approved in Rockaway Township upstream of a branch of the Rockaway River flowing into and through the Borough Lake known as Fox Pond.

As indicated to you, the jurisdiction of this Division is restricted to the control of encroachments on natural streams, and there is no way in which we can intervene in the development of the subdivision referred to, except with respect to plans which involve fill or other construction in the stream bed adjacent to the natural stream channel, within the natural and ordinary high water mark. The criteria applied to the investigation for approval of any such plan is based on the probable runoff under conditions of expected future watershed development, which envisions the sort of subdivision that you are now concerned with, during storms of reasonable magnitude, in this instance using a flood frequency of 15 years.

Since our telephone conversation, I have reviewed the files in the matter and find that the comment made by Alfred H. Linden, Assistant Planning Director for the Morris County Planning Board, in his letter to Chairman Keiffer of the Rockaway Planning Board with respect to the safety of Fox's Pond itself is well taken. While we have no drawings descriptive of the dam construction, we find that inspections were made in 1925 and again in 1926, disclosing that a new spillway had been constructed in 1926 without prior approval by this Division as required by statute, R.S. 58b, which relates to the structural safety and stability of dams for the prevention of the hazard to life and property due to failure and release of impounded waters. Inspection disclosed that the spillway was constructed of concrete

February 23, 1965

with a total length of 12 feet and a maximum freeboard of 4.5 feet with an estimated capacity, at the full head of 4.5 feet (dam awash) of about 400 cubic feet per second.

Our design flood at this point, where the total drainage area is 1.3 square miles, is 740 cfs for the 50-year frequency storm which is used in connection with the analysis of dams for safety and stability. While we have no way of knowing that the proposed subdivision development will itself produce a runoff of this magnitude, it is nevertheless indicated, particularly in consideration of Mr. Linden's statement that the top of the earth dam has eroded to the point that only about 20 inches of water over the spillway would result in overtopping of the dam, that the spillway is woefully inadequate, and that the Borough should immediately undertake the necessary steps to reconstruct both the dam and spillway to eliminate this potential safety hazard.

I am enclosing a copy of our booklet entitled, "Information for Applicants for Construction, Alteration or Repair of Dams", and call your attention to page 13, from which you will note that the Fox Lake dam is a Class I dam, and to page 15, specifying that a freeboard of at least one foot is required for Class I dams with small reservoirs of less than 50 acres in area.

Using these criteria, reconstruction should provide for a discharge of 740 cfs at a maximum head over the spillway crest preferably not exceeding 3 feet, even though 3.5 feet would be acceptable.

Reconstruction design and actual work should be carried out under the supervision of a competent licensed professional engineer, and all plans must be approved by this Division before work is begun. We shall be glad to consult with your engineer, at any stage, with respect to preparation of his plans for reconstruction.

Very truly yours,



Robert L. Hardman, P.E.  
Chief, Bureau of Water Control

RLH:ec  
enc



## MORRIS COUNTY PLANNING BOARD

COURT HOUSE MORRISTOWN NEW JERSEY JEPerson 9-4300

December 2, 1964

Mr. Robert C. Keiffer, Chairman  
Rockaway Planning Board  
Municipal Building  
Rockaway, New Jersey

Dear Mr. Keiffer:

Thank you for your letter dated September 22, 1964 concerning the proposed subdivision known as "FLEETWOOD AT ROCKAWAY" located in Rockaway Township.

By letter dated June 17, 1964 to the Rockaway Township Planning Board, we reviewed the preliminary plat of this subdivision. In that letter we discussed the drainage question relative to Fox Pond, and we quote, "However, we would like to point out that, in our opinion, the County bridges would be only a small part of the total drainage impact of this development on Fox's Brook. Although we have not examined the course of the Brook in detail, we believe that along much of its length down to Fox's Pond it has been confined to a channel of very small cross section, with walls, lawns and gardens on either side. We also believe that several footbridges and pipe culverts have been installed across it that will be completely inadequate to handle the torrents of storm water that development will produce.

(In addition, we wonder about the safety of Fox's Pond itself. A field inspection by our staff some five years ago indicated that a rise in the level of the water in the Pond to a height of only about 20 inches over the bottom of the spillway could mean water could go over the top of the earth dam, with possibly very strong damaging results. With children and weather very gradually wearing down the top of the dam (unless it has been paved since), and the possibility of a log or large plank getting stuck across the estimated 12 foot wide spillway, this does not seem like much of a safety margin for a pond of this size. The added peak flows from this development, if not checked within the tract, will certainly tend to increase any such hazard as may exist in this regard.)"

In reply to the September 3rd resolution passed by your Board, we are sorry we must inform you that the County Planning law gives us no power over municipal interests, nor over private property, except to the extent of protecting County drainage requirements.



OFFICE LOCATED AT NEW HANOVER AVENUE AND SAYRE ROAD, MORRISTOWN

Mr. Kieffer

-2-

December 2, 1964

Under the County Planning law we are enabled to advise municipal Board concerning proposed subdivisions and their effect upon the municipality. However, the municipal Board is not obligated to embrace our advisory comments.

We regret that we cannot be of more definite assistance to your Board in this matter.

Very truly yours,

MORRIS COUNTY PLANNING BOARD

*M.C. Meadowcroft*  
M.C. Meadowcroft  
Principal Planner

*Alfred H. Linden*  
Alfred H. Linden  
Assistant Planning Director

cc: Rockaway Township  
Planning Board

MCN:dbc

Report of DAM INSPECTION

ROCKAWAY PARK LAKES—MORRIS COUNTY

On August 5, 1926 in company with Mr. Dean C. Jenkins, engineer, inspection was made of a dam site on the outlet of Fox Lake, tributary of the Rockaway River. The site is at a culvert beneath the Morris Canal. Location 25.3.2.8.8.

The owner is Mr. J. P. O'Conner, representing the Rockaway Park Lakes Company. Mr. O'Conner desires to place the spillway ~~at~~ the southern ~~part of the~~ outlet <sup>and at</sup> under the old culvert in order to make it visible from the highroad.

One test pit has been sunk to a depth of 4 feet at the site of the proposed spillway. The material disclosed is a fine brown sand carrying a little clay. Mr. Jenkins was advised that it will be necessary to fill the culvert and carry the water across the top of the old canal "fl" by means of a watertight concrete trough. A cantilever wall design was suggested for the spillway with sheet piling cut-off.

C/H

John N. Brooks,

Hydraulic Engineer.

Frederick, New Jersey.

August 10, 1926.

APPENDIX 2

CHECK LIST

VISUAL INSPECTION

FOXS LAKE DAM

Check List  
Visual Inspection  
Phase 1

Name Dam Foxs Lake Dam County Morris State NJ Coordinators NJDEP  
 Date(s) Inspection Nov. 9, 1979 Weather Partly sunny, mild Temperature 70 degrees F.  
 Pool Elevation at Time of Inspection 613.1 NGVD Tailwater at Time of Inspection 598.0 NGVD

Inspection Personnel:

|                         |                          |
|-------------------------|--------------------------|
| <u>Warren Guinan</u>    | <u>Ronald Hirschfeld</u> |
| <u>Stephen Gilman</u>   | <u></u>                  |
| <u>Janusz Czyzowski</u> | <u></u>                  |

S. Gilman/R. Hirschfeld Recorder

EMBANKMENT

| VISUAL EXAMINATION OF                                  | OBSERVATIONS                                                                       | REMARKS OR RECOMMENDATIONS                                                |
|--------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| SURFACE CRACKS                                         | None observed                                                                      |                                                                           |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE      | None observed. Downstream face of embankment is retained by vertical concrete wall |                                                                           |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | Two erosion channels on upstream slope. Minor erosion at waterline                 | Repair eroded areas on upstream slope and re-establish grassy vegetation. |
| VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST         | Vertical alignment is not even.<br>Horizontal alignment is good.                   |                                                                           |
| RIPRAP FAILURES                                        | Riprap on upstream slope is in poor to very poor condition.                        | Provide adequate erosion protection on upstream slope.                    |

EMBANKMENT

| VISUAL EXAMINATION OF                                       | OBSERVATIONS                                                                                                                                                                                                          | REMARKS OR RECOMMENDATIONS                                                          |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| RAILINGS                                                    |                                                                                                                                                                                                                       |                                                                                     |
| JUNCTION OF EMBANKMENT<br>AND ABUTMENT, SPILLWAY<br>AND DAM | Very severe erosion of upstream<br>slope at right edge of spillway<br>structure. Very severe erosion of<br>concrete wall which retains down-<br>stream face of embankment, apparently<br>caused partly by trespassing | Repair eroded areas. Provide<br>adequate erosion protection.<br>Control trespassing |
| ANY NOTICEABLE SEEPAGE                                      | None observed                                                                                                                                                                                                         |                                                                                     |
| STAFF GAGE AND RECORDER                                     |                                                                                                                                                                                                                       |                                                                                     |
|                                                             | None observed                                                                                                                                                                                                         |                                                                                     |
| DRAINS                                                      |                                                                                                                                                                                                                       |                                                                                     |
|                                                             | None observed                                                                                                                                                                                                         |                                                                                     |

# UNGATED SPILLWAY

| VISUAL EXAMINATION OF | OBSERVATIONS                                                                                                                                                                                                                                                                                                                                                                                                              | REMARKS OR RECOMMENDATIONS                                                                                         |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| CONCRETE WEIR         | <p>2 Crests--Both are surface eroded exposing coarse aggregate. Channel walls are eroded and spalled where concrete is in contact with water. D/S toe spalling to a depth of 3". Face of ogee D/S is eroded exposing coarse aggregate.</p> <p>D/S concrete walls-Numerous areas of cracking and spalling. Efflorescence showing at majority of cracks. Worst erosion is at bottom of dam where in contact with water.</p> | <p>Engage an Engineer to design and repair spalled and eroded concrete.</p> <p>Repair spalled and eroded area.</p> |

## APPROACH CHANNEL

Wide and unobstructed

## DISCHARGE CHANNEL

Three trees have fallen over into channel due to erosion of left bank. Other trees overhang channel

Clear trees and brush on either side of channel for some distance downstream from dam.

## BRIDGE AND PIERS OVER SPILLWAY

Corners of concrete deck are spalled U/S ends of wall are surface eroded.

Repair spalled and eroded area

# OUTLET WORKS

| VISUAL EXAMINATION OF                                              | OBSERVATIONS                                               | REMARKS OR RECOMMENDATIONS                                                                              |
|--------------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| CRACKING AND SPALLING OF<br>CONCRETE SURFACES IN OUTLET<br>CONDUIT | Not applicable                                             |                                                                                                         |
| INTAKE STRUCTURE                                                   | Not visible                                                |                                                                                                         |
| OUTLET PIPE - Two 16" cast iron                                    | Pipes are in good<br>condition, only minor<br>surface rust | No action required                                                                                      |
| OUTLET CHANNEL                                                     | see d/s channel of ungated<br>spillway                     |                                                                                                         |
| EMERGENCY GATE - two 16" gate valves                               | Not visible                                                | Expose valve boxes and<br>exercise valves periodically<br>to insure operation and flush<br>out sediment |

# INSTRUMENTATION

| VISUAL EXAMINATION    | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS |
|-----------------------|---------------|----------------------------|
| MONUMENTATION/SURVEYS | None observed |                            |
| OBSERVATION WELLS     | None observed |                            |
| WEIRS                 | None observed |                            |
| PIEZOMETERS           | None observed |                            |
| OTHER                 | None observed |                            |

RESERVOIR

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

SLOPES

Gently sloping. Homes on shoreline

SEDIMENTATION

No evidence of significant sedimentation observed.

# DOWNSTREAM CHANNEL

| VISUAL EXAMINATION OF                         | OBSERVATIONS                                                                                                                                                                   | REMARKS OR RECOMMENDATIONS |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| CONDITION<br>(OBSTRUCTIONS, DEBRIS, ETC.)     | Rocky bottom, few small trees<br>fallen into channel, others<br>overhanging channel. Small<br>breached dam just upstream<br>of first culvert encountered<br>downstream of dam. |                            |
| SLOPES                                        | Narrow channel, low channel banks,<br>moderate to flat sloping overbanks.                                                                                                      |                            |
| APPROXIMATE NO.<br>OF HOMES AND<br>POPULATION | Two homes--sills are both at<br>least 7 feet above streambed;<br>less than 10 total inhabitants.                                                                               |                            |

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

| ITEM                       | REMARKS                  |
|----------------------------|--------------------------|
| PLAN OF DAM                | None disclosed           |
| REGIONAL VICINITY MAP      | Prepared for this report |
| CONSTRUCTION HISTORY       | None                     |
| TYPICAL SECTIONS OF DAM    | None                     |
| HYDROLOGIC/HYDRAULIC DATA  | None                     |
| OUTLETS - PLAN             | None                     |
| - DETAILS                  | None disclosed           |
| - CONSTRAINTS              | None disclosed           |
| - DISCHARGE RATINGS        | None disclosed           |
| RAINFALL/RESERVOIR RECORDS | None disclosed           |

| ITEM                                                                              | REMARKS        |
|-----------------------------------------------------------------------------------|----------------|
| DESIGN REPORTS                                                                    | None disclosed |
| GEOLOGY REPORTS                                                                   | None disclosed |
| DESIGN COMPUTATIONS<br>HYDROLOGY & HYDRAULICS<br>DAM STABILITY<br>SEEPAGE STUDIES | None disclosed |
| MATERIALS INVESTIGATIONS<br>BORING RECORDS<br>LABORATORY<br>FIELD                 | None disclosed |
| POST-CONSTRUCTION SURVEYS OF DAM                                                  | None disclosed |
| BORROW SOURCES                                                                    | Unknown        |

| ITEM                                                        | REMARKS |
|-------------------------------------------------------------|---------|
| MONITORING SERVICES                                         | None    |
| MODIFICATIONS                                               | None    |
| HIGH POOL RECORDS                                           | None    |
| POST CONSTRUCTION ENGINEERING<br>STUDIES AND REPORTS        | None    |
| PRIOR ACCIDENTS OR FAILURE OF DAM<br>DESCRIPTION<br>REPORTS | None    |
| MAINTENANCE<br>OPERATION<br>RECORDS                         | None    |

| ITEM                | REMARKS                                             |
|---------------------|-----------------------------------------------------|
| SPILLWAY PLAN       | Prepared for this report from field inspection data |
| SECTIONS            |                                                     |
| DETAILS             |                                                     |
| None                |                                                     |
| OPERATING EQUIPMENT | Two 16-inch diameter gate valves                    |
| PLANS & DETAILS     |                                                     |
| None                |                                                     |

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 1.2 sq. miles, residential, hilly  
ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 613.0 NGVD (63ac-ft)  
ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): not applicable  
ELEVATION MAXIMUM DESIGN POOL: 619.1 NGVD (half-PMF)  
ELEVATION TOP DAM: low pt. 615.7 NGVD  
CREST: restricted flow over concrete

- a. Elevation 613.0 NGVD
- b. Type concrete ogee
- c. Width 31 +
- d. Length 12'
- e. Location Spillover right center of dam
- f. Number and Type of Gates none

OUTLET WORKS: twin low level outlet pipes

- a. Type 16 inch diameter cast iron  
each 10' from centerline of flow through principal
- b. Location spillway
- c. Entrance Inverts 607 NGVD
- d. Exit Inverts 606.8 NGVD
- e. Emergency Draindown Facilities none

HYDROMETEOROLOGICAL GAGES: none

- a. Type \_\_\_\_\_
- b. Location \_\_\_\_\_
- c. Records \_\_\_\_\_

MAXIMUM NON-DAMAGING DISCHARGE: 138. CFS

APPENDIX 3

PHOTOGRAPHS

FOXS LAKE DAM



9 NOV 1979

Looking southeast at upstream face of dam embankment  
and principal spillway.



9 NOV 1979

Looking south at upstream face of dam embankment  
(west end).

FOXS LAKE DAM



9 NOV 1979

Looking east across upstream face at entrance to principal spillway. Note undermined training wall and embankment erosion.



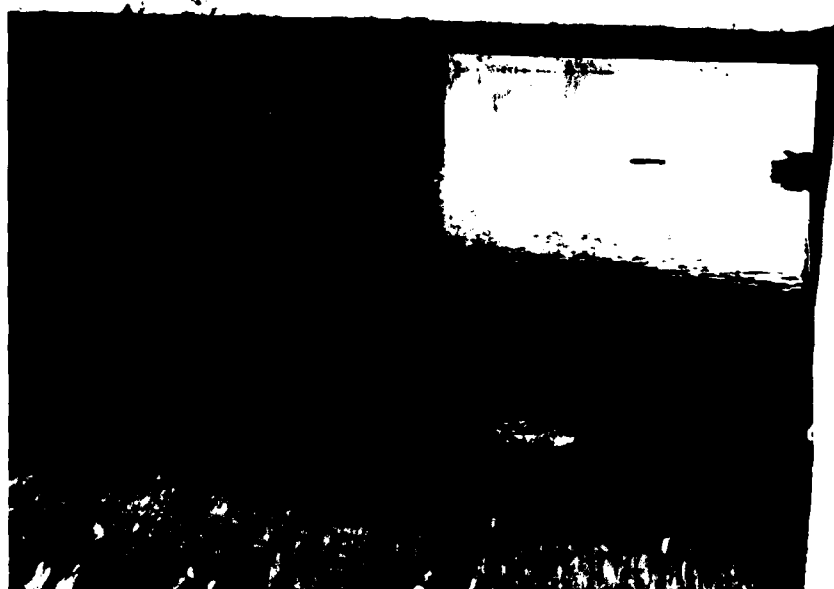
9 NOV 1979

Looking southwest across dam crest.



9 NOV 1979

Looking north at downstream face of principal spillway structure. Note twin blowoff pipes set in concrete at either side of ogee spillway.



9 NOV 1979

Looking northwest through principal spillway opening at upstream reservoir.

FOXS LAKE DAM



9 NOV 1979

Looking north at upstream reservoir from dam crest.



9 NOV 1979

Looking upstream at spalled face of concrete wall  
adjacent to principal spillway toe.

FOXS LAKE DAM



9 NOV 1979  
Looking downstream at Foxs Brook just below Foxs  
Lake Dam.



9 NOV 1979  
Looking downstream at entrance to first culvert  
encountered downstream of Foxs Lake Dam.

FOXS LAKE DAM



9 NOV 1979  
Looking downstream at channel just below first culvert.

FOXS LAKE DAM

• • • • •

APPENDIX 4

HYDROLOGIC COMPUTATIONS

FOXS LAKE DAM

• • • • •

JOB NO. 3409-01SQUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30  
1/4 IN SCALEHYDROLOGIC COMPUTATIONSDrainage area =  $1.2 \text{ mi}^2$ 

Lake surface area (normal pool) = 11 acres

Evaluation criteria

size: small  
hazard: significant

Spillway design flood

Based on size and hazard classification,  
the selected spillway design flood will be one  
half the probable maximum flood (1/2 P.M.F.).

JOB NO. 3409-01SQUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30  
1/4 IN SCALEDETERMINE TIME OF CONCENTRATION,  $T_C$ Method 1 \*

Estimate velocity

overland flow

reach length = 4600 ft.

$$\text{slope} = \frac{790 - 650}{4600} = 0.03$$

from table, mostly residential ("pastures")  
average velocity = 1.5 fps.

channel flow

reach length = 1800 ft (including lake)

$$\text{slope} = \frac{650 - 613}{1800} = 0.02$$

from table,  $V_{avg.} = 3 \text{ fps}$ 

$$T_C = \frac{4600}{1.5} + \frac{1800}{3} = 3667 \text{ sec} \div 61.1 \text{ min.}$$

Method 2 ▽

from group C, runoff curve No. = 77

from nomograph,  $T_L = 0.39 \text{ hrs.}$ 

$$T_C = 1.67 T_L = 1.67(0.39) = 0.65 \text{ hrs} = \underline{39 \text{ min.}}$$

\* from "Design of Small Dams", Bureau of Reclamation.

▽ Soil and Water Conservation Engineering, SCS.

JOB NO. 3409-01SQUARES  
1/4 IN SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Method 3\*

Overland flow

slope = 0.03 (see Method 1.)

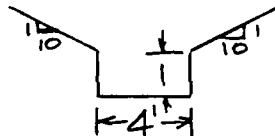
overland flow occurs mostly over a residential area (lawns);

from plot of % of slope vs. velocity,

$$V = 1.3 \text{ fps}$$

Channel flow

estimate channel shape



assume depth of water in channel = 1 ft.

$$A = 4(1) = 4 \text{ ft}^2$$

$$R = \frac{A}{WP} = \frac{4}{2(1) + 4} = 0.67$$

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

$$S = 0.02, R = 0.67, n = 0.045$$

from Manning's nomograph,  $V = 3.4 \text{ fps}$ 

$$T_c = \frac{4600}{1.3} + \frac{1800}{3.4} = 4068 \text{ sec} = \underline{\underline{67.8 \text{ min.}}}$$

\* Weston Method (SCS)

JOB NO. 3409-01SQUARES  
1/4 IN SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Method 4 \*

$$T_c = 0.83 \left( \frac{NL}{\sqrt{S}} \right)^{0.467}$$

overland flow

$$N = 0.20, S = 0.03, L = 4600 \text{ ft}$$

$$T_{c_{ov}} = 0.83 \left( \frac{0.20(4600)}{\sqrt{0.03}} \right)^{0.467} = 45.6 \text{ min.}$$

channel flow

from Manning's nomograph,  $V = 3.4 \text{ fps}$   
(see Method 3)

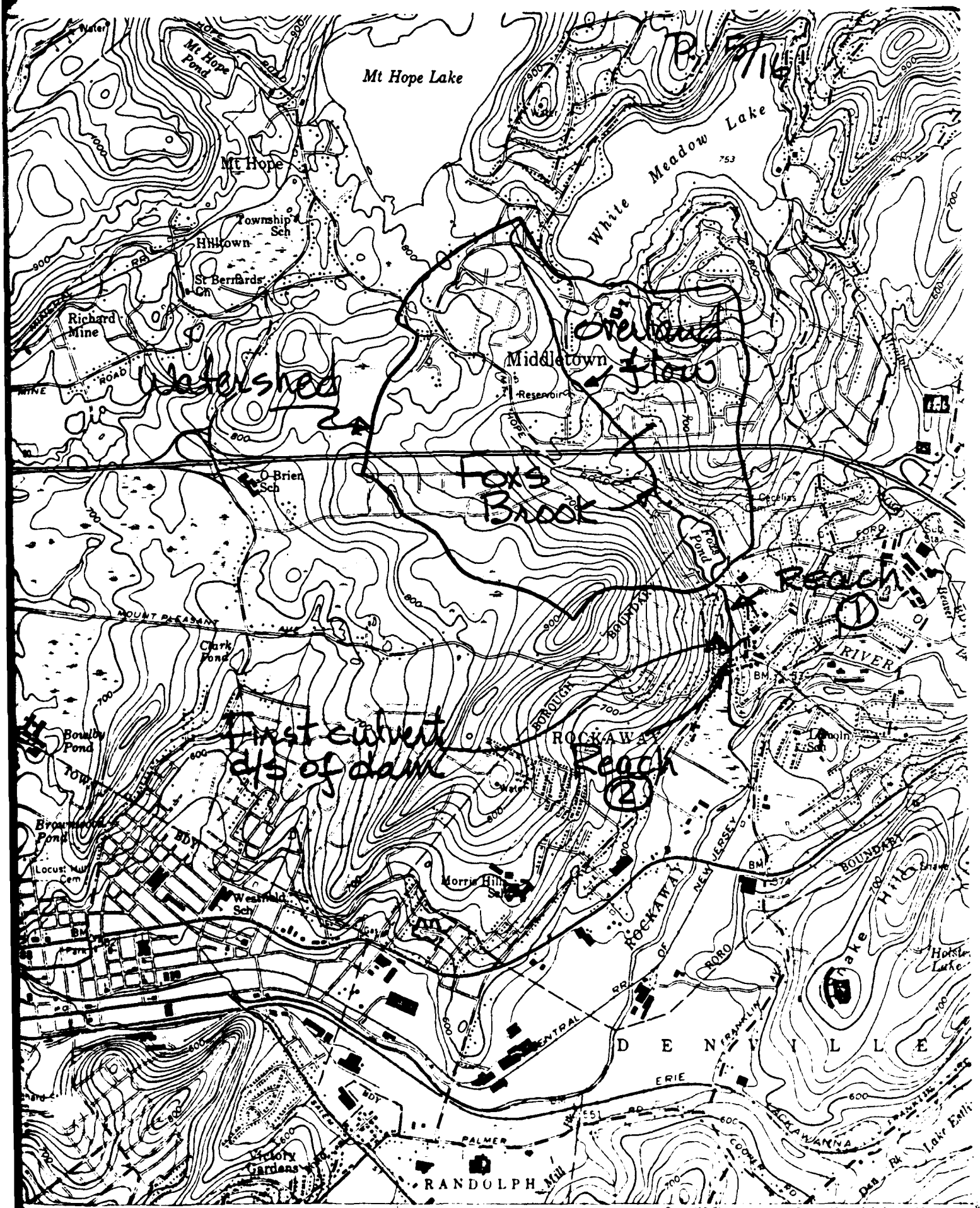
$$T_{c_{ch}} = \frac{1800}{3.4} = 529 \text{ sec} = 8.8 \text{ min.}$$

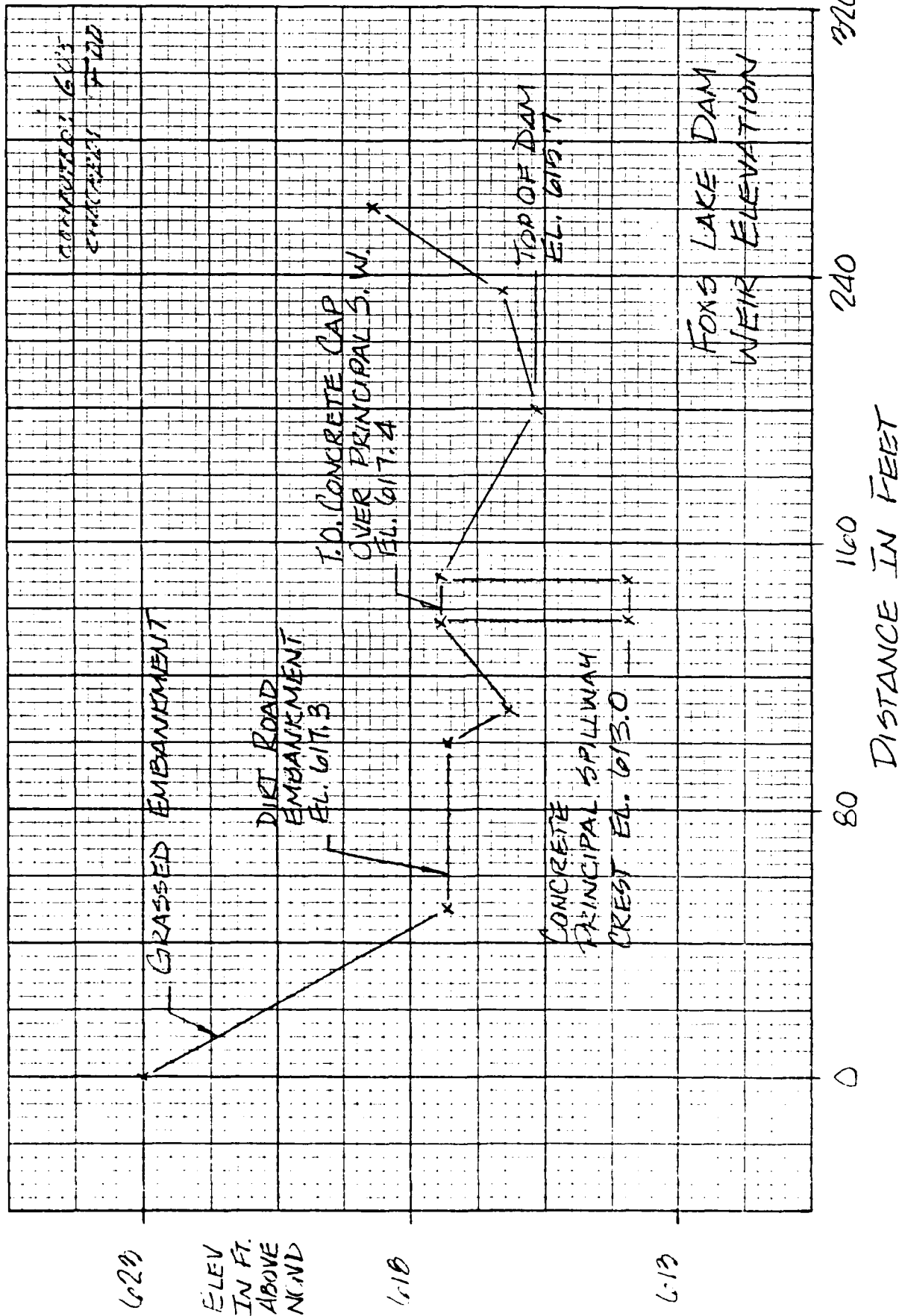
$$T_c = 45.6 + 8.8 = \underline{54.4 \text{ min.}}$$

$$T_{c_{avg}} = \frac{61 + 39 + 68 + 54}{4} = 55.5 \text{ min} = \underline{0.93 \text{ hr.}}$$

$$T_{LAG} = 0.6 T_c = 0.6(0.93) = 0.56 \text{ hr.}$$

\* Kenby Method





JOB NO. 3409-C1

SQUARES  
1/4 IN. SCALE

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DEVELOP RATING CURVE AT DAM

Flow over spillway

Use weir equation,  $Q = CLH^{3/2}$ , for flow over spillway while a free surface is maintained... $C = 2.6^*$ ,  $H$  variesUse orifice equation,  $Q = Ca \sqrt{2gh}$ , for pressure flow...

$$C = \left( 1 + 0.4 \lambda^{0.3} + \frac{0.0045 L}{\lambda^{1.25}} \right)^{-1/2}$$

$$\lambda = \frac{3.5(12)}{2(3.5) + 2(12)} = 1.35$$

$$C = \left( 1 + 0.4(1.35)^{0.3} + \frac{0.0045(30)}{(1.35)^{1.25}} \right)^{-1/2}$$

$$C = 0.81$$

$$a = 12(3.5) = 42 \text{ ft}^2$$

$$h = \text{water surface} - \text{opening} = \text{W.S.} - 614.8$$

Flow over dam crest

Use weir equation,  $Q = CLH^{3/2}$   
where  $C = 2.4$  and  $H$  varies

\* from table 5-3, p. 5-40, Eichel &amp; King, Handbook of Hydraulics.

† Equation 4-37, p. 4-24, B &amp; K, Handbook of Hydraulics.

Anderson-Nichols &amp; Company, Inc.

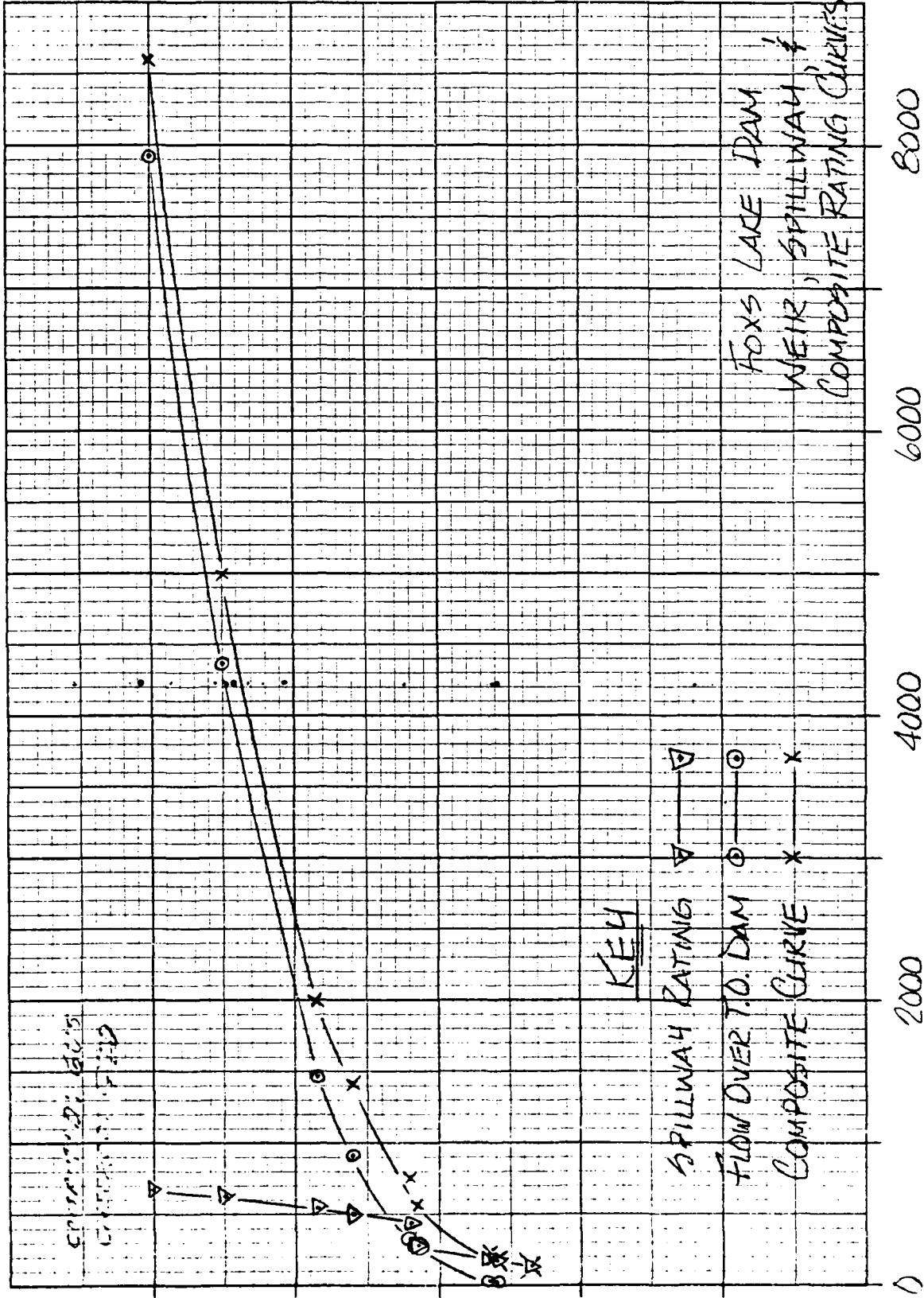
Subject FOXES LAKE
 Sheet No. 8 of 16  
 Date 5 DEC 74  
 Computed ELS  
 Checked F.D.D.
JOB NO. 3409-01
 SQUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30  
 1/4 IN SCALE

| ELEVATION<br>(FT. ABOVE<br>MSL) | SPILLWAY     |                            |                             | TOP OF DAM    |                |            | Q<br>TOTAL |
|---------------------------------|--------------|----------------------------|-----------------------------|---------------|----------------|------------|------------|
|                                 | HEAD<br>(ft) | Q <sub>weir</sub><br>(cfs) | Q <sub>orif.</sub><br>(cfs) | HEAD*<br>(ft) | LENGTH<br>(ft) | Q<br>(cfs) |            |
| 613.0                           |              |                            |                             |               |                |            | 0          |
| 615.7                           | 2.7          | 138                        |                             |               |                |            | 138        |
| 616.2                           | 3.2          | 179                        |                             | 0.5           | 23             | 19         | 198        |
| 616.3                           | 3.3          | 187                        |                             | 0.6           | 29             | 30         | 217        |
| 617.3                           | 4.3          | 278                        |                             | 1.2           | 100            | 280        | 558        |
| 617.4                           |              |                            | 440                         | 0.8           | 190            | 323        | 763        |
| 618.2                           | .....        |                            | 503                         | 1.5           | 258            | 905        | 1408       |
| 618.7                           |              |                            | 539                         | 1.4           | 373            | 1458       | 1997       |
| 620.0                           |              |                            | 623                         | 1.9           | 684            | 4364       | 4987       |
| 621.0                           |              |                            | 680                         | 2.7           | 739            | 7923       | 8603       |

\* Average value



10/16



621

ELEV.  
IN FT.  
ABOVE  
NGVD

617

KEY

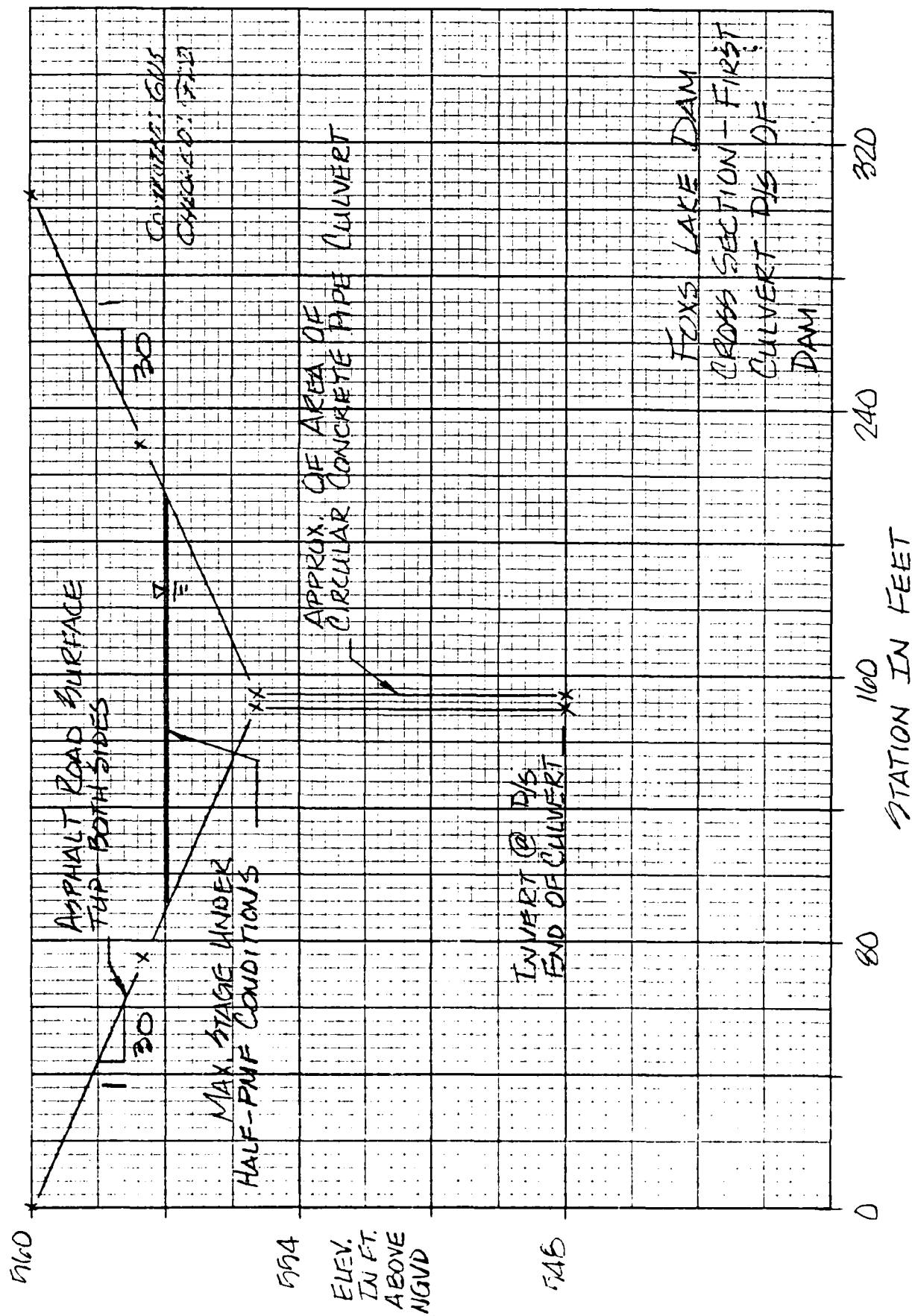
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11/16

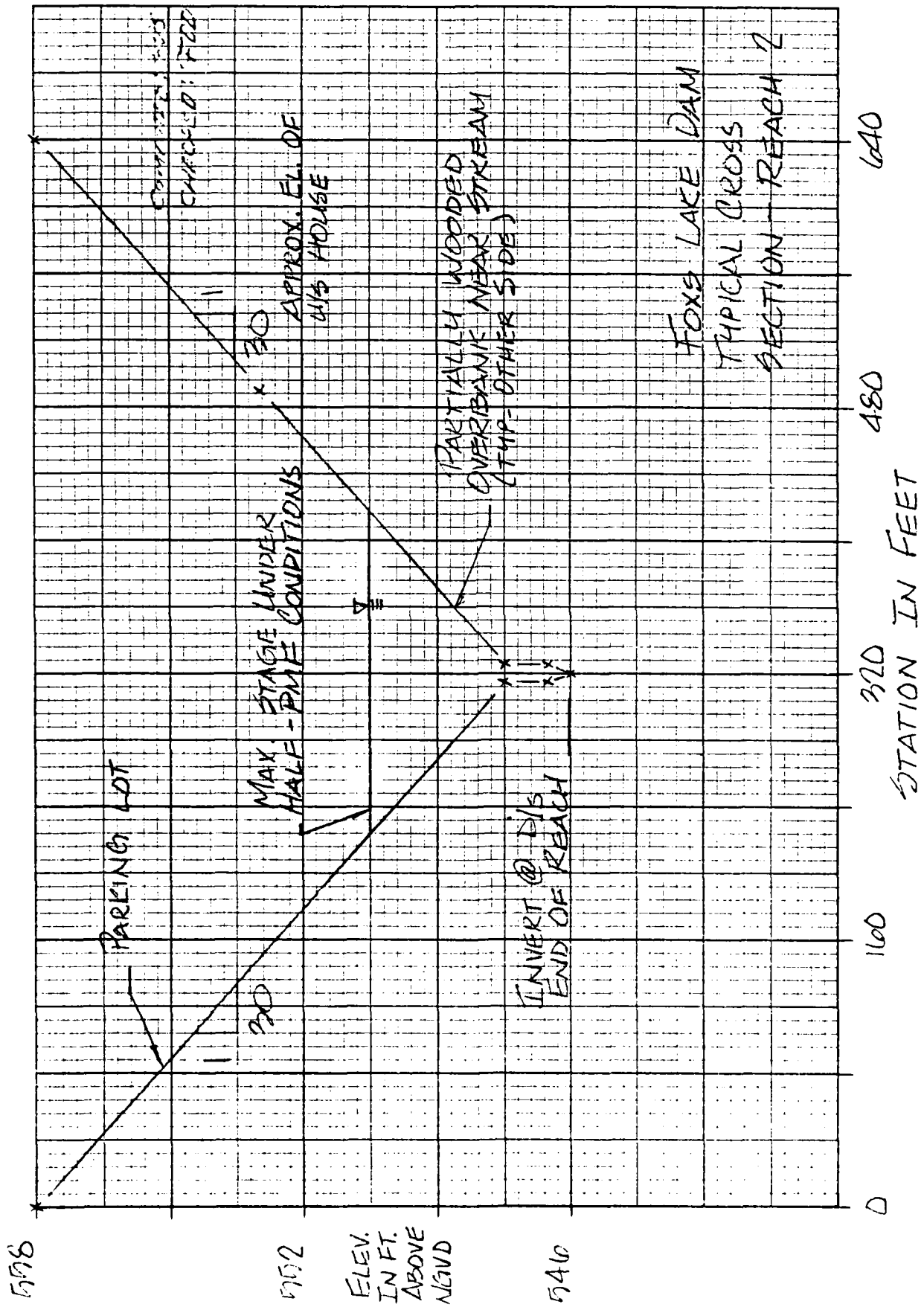


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①



13/16



Anderson-Nichols & Company, Inc.

Subject FOXES LAKE

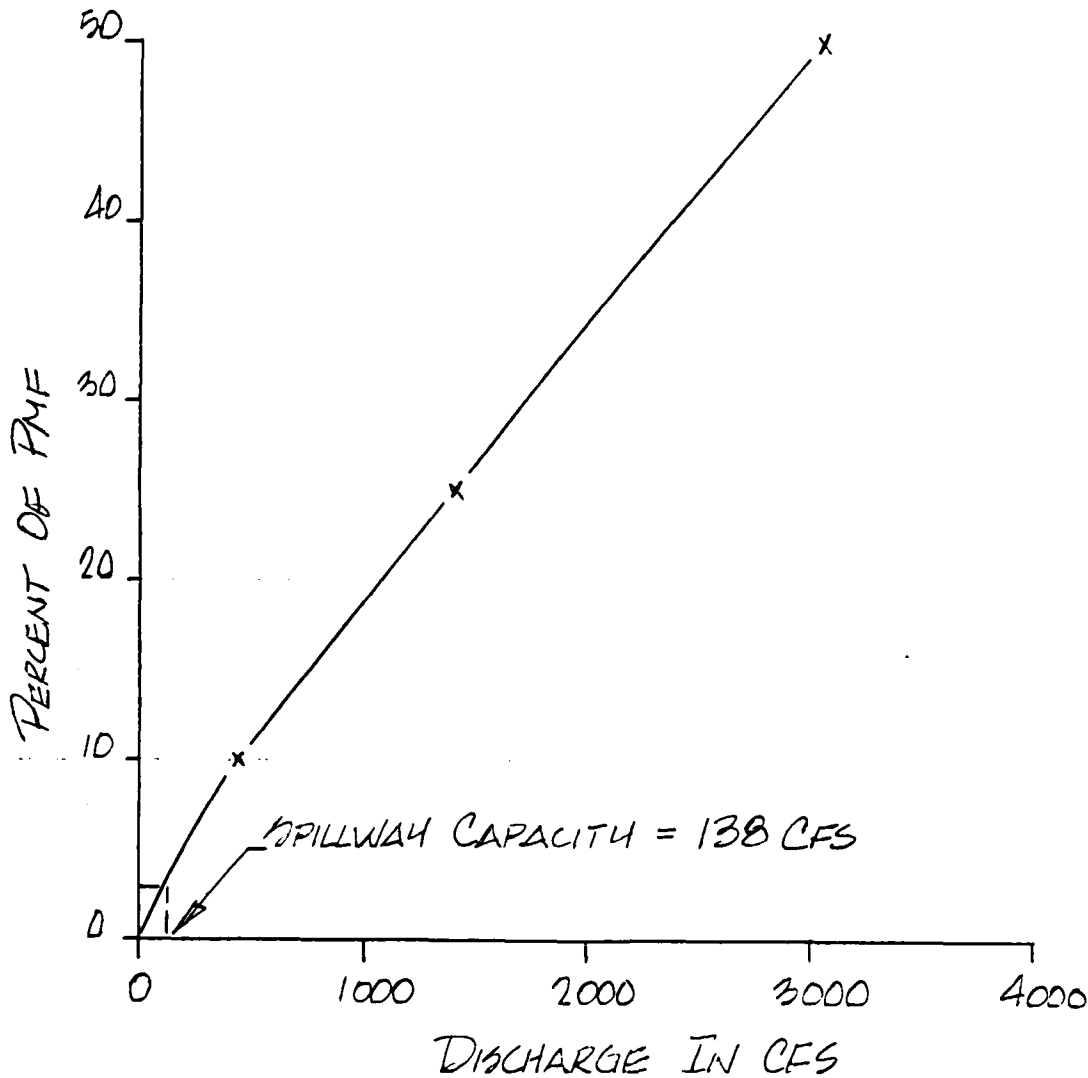
Sheet No. 14 of 16  
Date 26 DEC 79  
Computed GUS  
Checked \_\_\_\_\_

JOB NO. 3409-01

SQUARES  
1/4 IN SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

# OVERTOPPING POTENTIAL



JOB NO. 3409-01SQUARES  
1/4 IN SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

DETERMINE "C" FOR LOW LEVEL OUTLET PIPES

Each Pipe:

 $D = \text{diameter} = 16 \text{ in.}$  $n = 0.013$  (from Soil and Water Conservation Engineering\*, p. 632) $A_p = \text{area of pipe opening} = 1.4 \text{ ft}^2$  $L_p = \text{length of pipe} = 50 \text{ ft.}$  $K_f = \text{friction loss through pipe}$  $K_L = \text{entrance loss to pipe} = 0.8 \text{ (p. 639*)}$  $C_p = \text{coefficient of discharge (incorporating } A_p \text{ \& 29)}$  $C = \text{coefficient of discharge}$ 

$$K_f = \frac{5087 n^2}{D^{4/3}} = \frac{5087 (0.013)^2}{(16)^{4/3}} = 0.021$$

$$C_p = A_p \sqrt{\frac{2g}{1 + K_L + K_f L_p}} = 1.4 \sqrt{\frac{64.4}{1 + 0.8 + 0.021(50)}} = 6.66$$

$$C = \frac{C_p}{A / \sqrt{2g}} = \frac{6.66}{1.4 / \sqrt{2g}} = 0.59$$

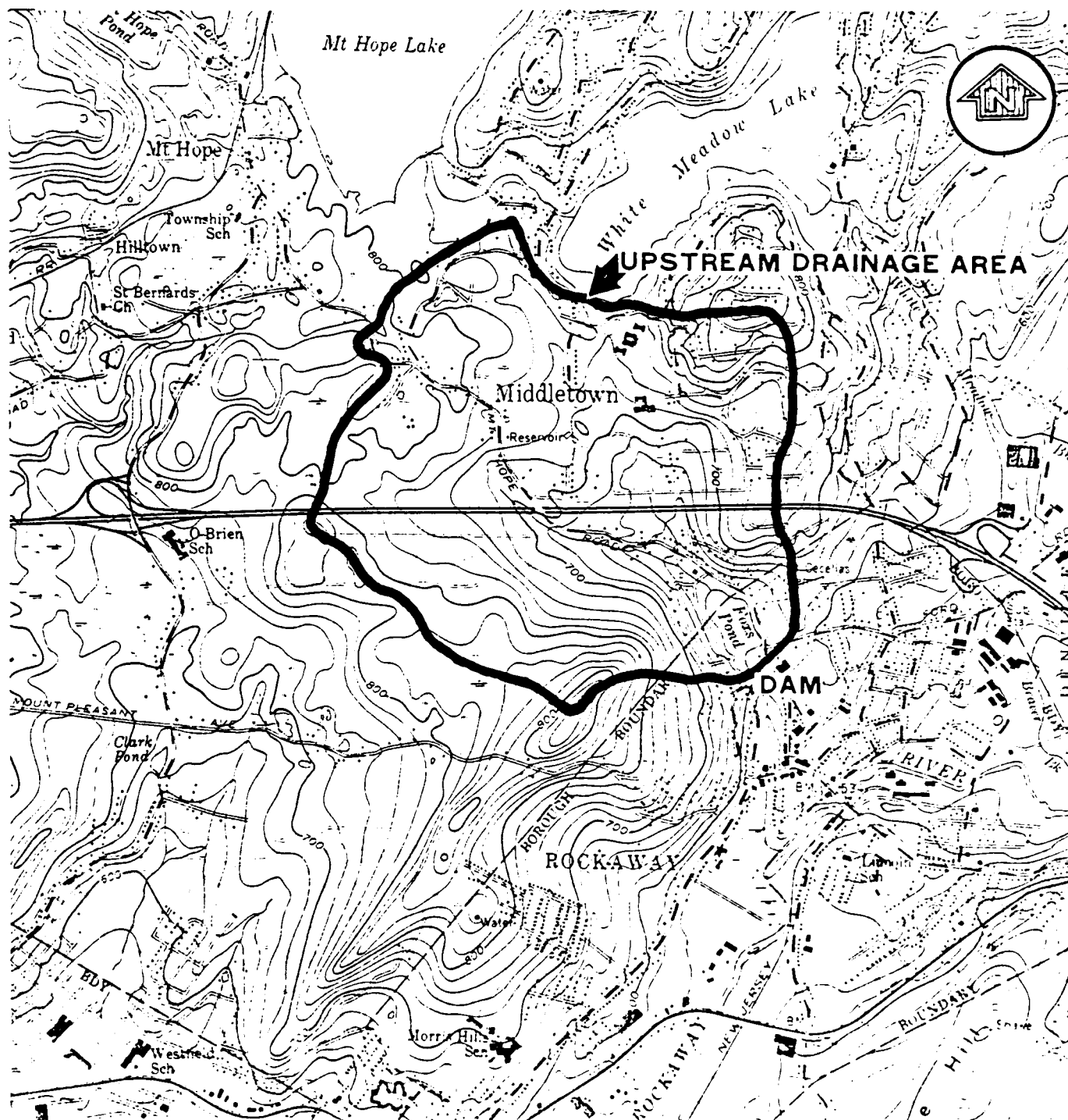
JOB NO. 3409-01SQUARES 0 1 2 3 4 5 6 7 8 9 '10' 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30  
1/4 IN. SCALEDRAWDOWN CALCULATIONS

- Assume:
- ① No significant inflow
  - ② Two 16"  $\phi$  outlet pipes are operational
  - ③  $Q_p = C_p H^{1/2} = 6.66 H^{1/2}$
  - ④  $\Delta c - ft/day = 1.9835 \cdot Q_{avg}$
  - ⑤  $Days = \Delta Storage / \Delta c - ft/day$

| ELEV. - FT.<br>ABOVE NGVD | STORAGE<br>AC-FT | $\Delta S$<br>AC-FT | H<br>FT. | $Q^p$<br>CFS | $Q_{avg}$<br>CFS | AC-FT<br>PER DAY | DAYS |
|---------------------------|------------------|---------------------|----------|--------------|------------------|------------------|------|
| 613.0                     | 63               |                     | 5.5      | 32           |                  |                  |      |
|                           |                  | 11                  |          |              | 30               | 59.5             | 0.18 |
| 612.0                     | 52               |                     | 4.5      | 28           |                  |                  |      |
|                           |                  | 10                  |          |              | 26               | 51.6             | 0.19 |
| 611.0                     | 42               |                     | 3.5      | 24           |                  |                  |      |
|                           |                  | 9                   |          |              | 22               | 43.6             | 0.21 |
| 610.0                     | 33               |                     | 2.5      | 20           |                  |                  |      |
|                           |                  | 8                   |          |              | 18               | 35.7             | 0.22 |
| 609.0                     | 25               |                     | 1.5      | 16           |                  |                  |      |
|                           |                  | 6                   |          |              | 13               | 25.8             | 0.23 |
| 608.0                     | 19               |                     | 0.5      | 10           |                  |                  |      |
|                           |                  | 5                   |          |              | 5                | 9.9              | 0.51 |
| 607.5                     | 14               |                     | 0        | 0            |                  |                  |      |

$$\Sigma = \underline{\underline{1.54 \text{ DAYS}}}$$

▽ Total Q for two pipes



NATIONAL PROGRAM OF INSPECTION OF  
NON-FED. DAMS

FOX'S LAKE DAM

ROCKAWAY TOWNSHIP, NEW JERSEY  
REGIONAL VICINITY MAP

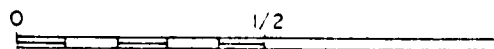
JANUARY 1980

DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
PHILADELPHIA, PENNSYLVANIA

ANDERSON-NICHOLS & CO., INC.

CONCORD, N.H.

SCALE IN MILES



MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE  
SHEET. DOVER, N.J., 1954. REVISED, 1970.

HEC-1 OUTPUT

OVERTOPPING ANALYSIS

FOXS LAKE DAM

**LATEST NOTIFICATION**

165

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|   | 0.1 | 0.25 | 0.5 |
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# K1 DEVELOP INFLOW HYDROGRAPH

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[illegible]

# K1 ROUTE INFLOW HYDROGRAPH THROUGH RESERVOIR

VI 1 63 -1

| Year | 1995 | 1998 | 2007 | 2010 | 2017 | 2020 |
|------|------|------|------|------|------|------|
| 1995 | 138  | 198  | 217  | 558  | 763  | 1402 |
| 1998 | 138  | 198  | 217  | 558  | 763  | 1402 |
| 2007 | 138  | 198  | 217  | 558  | 763  | 1402 |
| 2010 | 138  | 198  | 217  | 558  | 763  | 1402 |
| 2017 | 138  | 198  | 217  | 558  | 763  | 1402 |
| 2020 | 138  | 198  | 217  | 558  | 763  | 1402 |

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| 7 | 19R | 7.6 | 1 | 606.9 | 1 | 613.0 | 615.7 |
|---|-----|-----|---|-------|---|-------|-------|
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9 K I A3 I I I I

1. The first part of the document is a list of names and their corresponding dates. The names are: John Doe, Jane Smith, and Bob Johnson. The dates are: 1990, 1991, and 1992.

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|   | Y6 | 0.016 | 0.014 | 0.016 | 548.0 | 560.0 | 35.0 | 0.033 |
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| 3 | 154. | 555. | 229. | 557.5 | 304. | 560. |

| Y | RI CHAMPAGNE FROOTING AND TOLS REACH 2 |
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|   | Y6 | 0.035 | 0.05 | 0.04 | 546.0 | 558.0 | 300.0 | 0.033 |
|---|----|-------|------|------|-------|-------|-------|-------|
| 7 |    |       |      |      |       |       |       |       |

|   | Y7 | 325. | 547.5 | 490. | 553. | 640. | 558. |
|---|----|------|-------|------|------|------|------|
| 2 |    |      |       |      |      |      |      |

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PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

|                      | A1 |
|----------------------|----|
| RUNOFF HYDROGRAPH AT |    |
| ROUTE HYDROGRAPH TO  | A2 |
| ROUTE HYDROGRAPH TO  | A3 |
| ROUTE HYDROGRAPH TO  | A4 |
| ROUTE HYDROGRAPH TO  | A5 |
| END OF NETWORK       |    |

\*\*\*\*\*  
 FLOOD HYDROGRAPH PACKAGE (FPEC-1)  
 DAM SAFETY VERSION JULY 1978  
 LAST MODIFICATION 26 FEB 79  
 \*\*\*\*\*

RUN DATE: 79/12/07.  
 TIME: 05.57.17.

PARK LAKES DAM OVERTOPPING ANALYSIS ### GUS SHARRY ANDERSON-NICHOLS ###  
 NEW JERSEY DAM NUMBER 25-49 BOROUGH OF ROCKAWAY MORRIS COUNTY  
 0.5 MULTIPLE OF PMF FROM 24-HOUR PMF

JOB SPECIFICATION  
 NO NHR NMIN IDAY IHR IMIN METRC IPLT IPRT NSTAN  
 165 0 10 0 0 0 0 0 0  
 JOPER 5 MUT LRPT TRACE  
 0 0 0

MULTI-PLAN ANALYSES TO BE PERFORMED  
 MPLAN= 2 MPTIO= 3 LRIO= 1  
 RTIO= .10 .25 .50

\*\*\*\*\*

# SUB-AREA RUNOFF COMPUTATION

## DEVELOP INFLOW HYDROGRAPH

| INSTAG | ICOMP | IECON | ITAPE | JPLT | JPRY | INAME | ISTAGE | IAUTO |
|--------|-------|-------|-------|------|------|-------|--------|-------|
| 1      | 0     | 0     | 0     | 0    | 0    | 1     | 0      | 0     |

## HYDROGRAPH DATA

| INHYG | IUNG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |
|-------|------|-------|------|-------|-------|-------|-------|-------|-------|
| 1     | 2    | 1.20  | 0.00 | 1.20  | .80   | 0.000 | 0     | 1     | 0     |

## PRECIP DATA

| SPFE | PMS   | RA     | R12    | R24    | RAH  | R72  | R96  |
|------|-------|--------|--------|--------|------|------|------|
| 0.00 | 22.80 | 113.00 | 123.00 | 132.00 | 0.00 | 0.00 | 0.00 |

## LOSS DATA

| LRPT | STARR | DLTKR | RTIOL | ERAIN | STKRS | RTIOK | STRTL | CNSTL | ALSMY | RTIMP |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0    | 0.00  | 0.00  | 1.00  | 0.00  | 0.00  | 1.00  | 1.00  | .10   | 0.00  | 0.00  |

## UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .50

## RECESSION DATA

STRIO= -3.00 GRCSM= 0.00 RTICR= 1.00

UNIT HYDROGRAPH 19 END OF PERIOD ORIGINATES, TC= 0.00 PCURS, LAG= .56 VOL= 1.00 9A.  
 1.0. 45. 81. 898. 778. 554. 344. 229. 151. 9A.  
 2A. 82. 1P. 12. 6. 3. 1.

END-OF-PERIOD FLOW

| MO-DA | HR-MN | PERIOD | RAIN | EXCS | LOSS | COMP Q | MO-DA | HR-MN | PERIOD | RAIN | EXCS | LCSS | COMP Q |
|-------|-------|--------|------|------|------|--------|-------|-------|--------|------|------|------|--------|
| 1.01  | 1.10  | 1      | .02  | 0.00 | .02  | 4.     | 1.01  | 13.50 | 83     | .41  | .40  | .02  | 1699.  |
| 1.01  | 1.20  | 2      | .02  | 0.00 | .02  | 4.     | 1.01  | 14.00 | 84     | .41  | .40  | .02  | 1749.  |
| 1.01  | 1.30  | 3      | .02  | 0.00 | .02  | 4.     | 1.01  | 14.10 | 85     | .52  | .50  | .02  | 1795.  |
| 1.01  | 1.40  | 4      | .02  | 0.00 | .02  | 4.     | 1.01  | 14.20 | 86     | .52  | .50  | .02  | 1863.  |
| 1.01  | 1.50  | 5      | .02  | 0.00 | .02  | 4.     | 1.01  | 14.30 | 87     | .52  | .50  | .02  | 1961.  |
| 1.01  | 1.00  | 6      | .02  | 0.00 | .02  | 4.     | 1.01  | 14.40 | 88     | .52  | .50  | .02  | 2063.  |
| 1.01  | 1.10  | 7      | .02  | 0.00 | .02  | 4.     | 1.01  | 14.50 | 89     | .52  | .50  | .02  | 2142.  |
| 1.01  | 1.20  | 8      | .02  | 0.00 | .02  | 4.     | 1.01  | 15.00 | 90     | .52  | .50  | .02  | 2210.  |
| 1.01  | 1.30  | 9      | .02  | 0.00 | .02  | 4.     | 1.01  | 15.10 | 91     | .47  | .45  | .02  | 2242.  |
| 1.01  | 1.40  | 10     | .02  | 0.00 | .02  | 4.     | 1.01  | 15.20 | 92     | .78  | .77  | .02  | 2289.  |
| 1.01  | 1.50  | 11     | .02  | 0.00 | .02  | 4.     | 1.01  | 15.30 | 93     | 1.41 | 1.39 | .02  | 2397.  |
| 1.01  | 2.00  | 12     | .02  | 0.00 | .02  | 4.     | 1.01  | 15.40 | 94     | 3.52 | 3.51 | .02  | 3300.  |
| 1.01  | 2.10  | 13     | .02  | 0.00 | .02  | 4.     | 1.01  | 15.50 | 95     | 1.02 | 1.00 | .02  | 4680.  |
| 1.01  | 2.20  | 14     | .02  | 0.00 | .02  | 4.     | 1.01  | 16.00 | 96     | .63  | .61  | .02  | 5998.  |
| 1.01  | 2.30  | 15     | .02  | 0.00 | .02  | 4.     | 1.01  | 16.10 | 97     | .48  | .46  | .02  | 6303.  |
| 1.01  | 2.40  | 16     | .02  | 0.00 | .02  | 4.     | 1.01  | 16.20 | 98     | .48  | .46  | .02  | 5758.  |
| 1.01  | 2.50  | 17     | .02  | 0.00 | .02  | 4.     | 1.01  | 16.30 | 99     | .48  | .46  | .02  | 4791.  |
| 1.01  | 3.00  | 18     | .02  | 0.00 | .02  | 4.     | 1.01  | 16.40 | 100    | .48  | .46  | .02  | 3881.  |
| 1.01  | 3.10  | 19     | .02  | 0.00 | .02  | 4.     | 1.01  | 16.50 | 101    | .48  | .46  | .02  | 3294.  |
| 1.01  | 3.20  | 20     | .02  | 0.00 | .02  | 4.     | 1.01  | 17.00 | 102    | .48  | .46  | .02  | 2905.  |
| 1.01  | 3.30  | 21     | .02  | 0.00 | .02  | 4.     | 1.01  | 17.10 | 103    | .38  | .36  | .02  | 2633.  |
| 1.01  | 3.40  | 22     | .02  | 0.00 | .02  | 4.     | 1.01  | 17.20 | 104    | .38  | .36  | .02  | 2418.  |
| 1.01  | 3.50  | 23     | .02  | 0.00 | .02  | 4.     | 1.01  | 17.30 | 105    | .38  | .36  | .02  | 2224.  |
| 1.01  | 4.00  | 24     | .02  | 0.00 | .02  | 4.     | 1.01  | 17.40 | 106    | .38  | .36  | .02  | 2059.  |
| 1.01  | 4.10  | 25     | .02  | 0.00 | .02  | 4.     | 1.01  | 17.50 | 107    | .38  | .36  | .02  | 1932.  |
| 1.01  | 4.20  | 26     | .02  | 0.00 | .02  | 4.     | 1.01  | 18.00 | 108    | .38  | .36  | .02  | 1844.  |
| 1.01  | 4.30  | 27     | .02  | 0.00 | .02  | 4.     | 1.01  | 18.10 | 109    | .03  | .01  | .02  | 1741.  |
| 1.01  | 4.40  | 28     | .02  | 0.00 | .02  | 4.     | 1.01  | 18.20 | 110    | .03  | .01  | .02  | 1544.  |
| 1.01  | 4.50  | 29     | .02  | 0.00 | .02  | 4.     | 1.01  | 18.30 | 111    | .03  | .01  | .02  | 1230.  |
| 1.01  | 5.00  | 30     | .02  | 0.00 | .02  | 4.     | 1.01  | 18.40 | 112    | .03  | .01  | .02  | 896.   |
| 1.01  | 5.10  | 31     | .02  | 0.00 | .02  | 4.     | 1.01  | 18.50 | 113    | .03  | .01  | .02  | 613.   |
| 1.01  | 5.20  | 32     | .02  | 0.00 | .02  | 4.     | 1.01  | 19.00 | 114    | .03  | .01  | .02  | 413.   |
| 1.01  | 5.30  | 33     | .02  | 0.00 | .02  | 4.     | 1.01  | 19.10 | 115    | .03  | .01  | .02  | 290.   |
| 1.01  | 5.40  | 34     | .02  | 0.00 | .02  | 4.     | 1.01  | 19.20 | 116    | .03  | .01  | .02  | 208.   |
| 1.01  | 5.50  | 35     | .02  | 0.00 | .02  | 4.     | 1.01  | 19.30 | 117    | .03  | .01  | .02  | 153.   |
| 1.01  | 6.00  | 36     | .02  | 0.00 | .02  | 4.     | 1.01  | 19.40 | 118    | .03  | .01  | .02  | 118.   |
| 1.01  | 6.10  | 37     | .05  | 0.00 | .05  | 4.     | 1.01  | 19.50 | 119    | .03  | .01  | .02  | 95.    |
| 1.01  | 6.20  | 38     | .05  | 0.00 | .05  | 4.     | 1.01  | 20.00 | 120    | .03  | .01  | .02  | 80.    |
| 1.01  | 6.30  | 39     | .05  | 0.00 | .05  | 4.     | 1.01  | 20.10 | 121    | .03  | .01  | .02  | 70.    |
| 1.01  | 6.40  | 40     | .05  | 0.00 | .05  | 4.     | 1.01  | 20.20 | 122    | .03  | .01  | .02  | 64.    |
| 1.01  | 6.50  | 41     | .05  | 0.00 | .05  | 4.     | 1.01  | 20.30 | 123    | .03  | .01  | .02  | 59.    |
| 1.01  | 7.00  | 42     | .05  | 0.00 | .05  | 4.     | 1.01  | 20.40 | 124    | .03  | .01  | .02  | 57.    |
| 1.01  | 7.10  | 43     | .05  | .01  | .04  | 5.     | 1.01  | 20.50 | 125    | .03  | .01  | .02  | 55.    |
| 1.01  | 7.20  | 44     | .05  | .03  | .02  | 12.    | 1.01  | 21.00 | 126    | .03  | .01  | .02  | 54.    |
| 1.01  | 7.30  | 45     | .05  | .03  | .02  | 30.    | 1.01  | 21.10 | 127    | .03  | .01  | .02  | 53.    |
| 1.01  | 7.40  | 46     | .05  | .03  | .02  | 58.    | 1.01  | 21.20 | 128    | .03  | .01  | .02  | 53.    |
| 1.01  | 7.50  | 47     | .05  | .03  | .02  | 88.    | 1.01  | 21.30 | 129    | .03  | .01  | .02  | 53.    |
| 1.01  | 8.00  | 48     | .05  | .03  | .02  | 113.   | 1.01  | 21.40 | 130    | .03  | .01  | .02  | 53.    |
| 1.01  | 8.10  | 49     | .05  | .03  | .02  | 130.   | 1.01  | 21.50 | 131    | .03  | .01  | .02  | 53.    |
| 1.01  | 8.20  | 50     | .05  | .03  | .02  | 141.   | 1.01  | 22.00 | 132    | .03  | .01  | .02  | 53.    |
| 1.01  | 8.30  | 51     | .05  | .03  | .02  | 148.   | 1.01  | 22.10 | 133    | .03  | .01  | .02  | 53.    |
| 1.01  | 8.40  | 52     | .05  | .03  | .02  | 153.   | 1.01  | 22.20 | 134    | .03  | .01  | .02  | 53.    |
| 1.01  | 8.50  | 53     | .05  | .03  | .02  | 156.   | 1.01  | 22.30 | 135    | .03  | .01  | .02  | 53.    |
| 1.01  | 9.00  | 54     | .05  | .03  | .02  | 156.   | 1.01  | 22.40 | 136    | .03  | .01  | .02  | 53.    |
| 1.01  | 9.10  | 55     | .05  | .03  | .02  | 159.   | 1.01  | 22.50 | 137    | .03  | .01  | .02  | 53.    |
| 1.01  | 9.20  | 56     | .05  | .03  | .02  | 160.   | 1.01  | 23.00 | 138    | .03  | .01  | .02  | 53.    |
| 1.01  | 9.30  | 57     | .05  | .03  | .02  | 161.   | 1.01  | 23.10 | 139    | .03  | .01  | .02  | 53.    |
| 1.01  | 9.40  | 58     | .05  | .03  | .02  | 161.   | 1.01  | 23.20 | 140    | .03  | .01  | .02  | 53.    |

|      |       |    |     |     |     |       |      |       |     |      |      |      |     |
|------|-------|----|-----|-----|-----|-------|------|-------|-----|------|------|------|-----|
| 1.01 | 9.00  | 60 | .05 | .03 | .02 | 161.  | 1.01 | 23.30 | 141 | .03  | .01  | .02  | 53. |
| 1.01 | 10.00 | 60 | .05 | .03 | .02 | 161.  | 1.01 | 23.40 | 142 | .03  | .01  | .02  | 53. |
| 1.01 | 10.10 | 61 | .05 | .03 | .02 | 161.  | 1.01 | 23.50 | 143 | .03  | .01  | .02  | 53. |
| 1.01 | 10.20 | 62 | .05 | .03 | .02 | 161.  | 1.02 | 0.00  | 144 | .03  | .01  | .02  | 53. |
| 1.01 | 10.30 | 63 | .05 | .03 | .02 | 161.  | 1.02 | .10   | 145 | 0.00 | 0.00 | 0.00 | 52. |
| 1.01 | 10.40 | 64 | .05 | .03 | .02 | 161.  | 1.02 | .20   | 146 | 0.00 | 0.00 | 0.00 | 47. |
| 1.01 | 10.50 | 65 | .05 | .03 | .02 | 161.  | 1.02 | .30   | 147 | 0.00 | 0.00 | 0.00 | 30. |
| 1.01 | 11.00 | 66 | .05 | .03 | .02 | 161.  | 1.02 | .40   | 148 | 0.00 | 0.00 | 0.00 | 29. |
| 1.01 | 11.10 | 67 | .05 | .03 | .02 | 161.  | 1.02 | .50   | 149 | 0.00 | 0.00 | 0.00 | 20. |
| 1.01 | 11.20 | 68 | .05 | .03 | .02 | 161.  | 1.02 | 1.00  | 150 | 0.00 | 0.00 | 0.00 | 14. |
| 1.01 | 11.30 | 69 | .05 | .03 | .02 | 161.  | 1.02 | 1.10  | 151 | 0.00 | 0.00 | 0.00 | 11. |
| 1.01 | 11.40 | 70 | .05 | .03 | .02 | 161.  | 1.02 | 1.20  | 152 | 0.00 | 0.00 | 0.00 | 7.  |
| 1.01 | 11.50 | 71 | .05 | .03 | .02 | 161.  | 1.02 | 1.30  | 153 | 0.00 | 0.00 | 0.00 | 6.  |
| 1.01 | 12.00 | 72 | .05 | .03 | .02 | 161.  | 1.02 | 1.40  | 154 | 0.00 | 0.00 | 0.00 | 5.  |
| 1.01 | 12.10 | 73 | .34 | .33 | .02 | 202.  | 1.02 | 1.50  | 155 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 12.20 | 74 | .34 | .33 | .02 | 335.  | 1.02 | 2.00  | 156 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 12.30 | 75 | .34 | .33 | .02 | 574.  | 1.02 | 2.10  | 157 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 12.40 | 76 | .34 | .33 | .02 | 837.  | 1.02 | 2.20  | 158 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 12.50 | 77 | .34 | .33 | .02 | 1065. | 1.02 | 2.30  | 159 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 13.00 | 78 | .34 | .33 | .02 | 1227. | 1.02 | 2.40  | 160 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 13.10 | 79 | .41 | .40 | .02 | 1338. | 1.02 | 2.50  | 161 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 13.20 | 80 | .41 | .40 | .02 | 1436. | 1.02 | 3.00  | 162 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 13.30 | 81 | .41 | .40 | .02 | 1536. | 1.02 | 3.10  | 163 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 13.40 | 82 | .41 | .40 | .02 | 1627. | 1.02 | 3.20  | 164 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 13.50 | 82 | .41 | .40 | .02 | 1627. | 1.02 | 3.30  | 165 | 0.00 | 0.00 | 0.00 | 4.  |

SUP 24.0R 21.39 2.69 99940.  
( 612311 543.31 68.31 2829.99)

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
6303. 2504. 693. 606. 99924.

CFS 71. 20. 17. 2830.  
INCHES 19.41 21.50 21.52 21.52  
MM 493.06 546.13 546.53 546.53  
AC-FT 1242 1375 1376 1376  
1THOUS CU M 1332 1697 1698 1698

HYDROGRAPH AT STA A1 FOR PLAN 1, RTIC 3

|       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    |
| 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    |
| 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    |
| 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    |
| 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    |
| 74.   | 76.   | 78.   | 79.   | 80.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   |
| 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   |
| 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   | 81.   |
| 748.  | 748.  | 748.  | 748.  | 748.  | 748.  | 748.  | 748.  | 748.  | 748.  | 748.  | 748.  | 748.  | 748.  |
| 1121. | 1121. | 1121. | 1121. | 1121. | 1121. | 1121. | 1121. | 1121. | 1121. | 1121. | 1121. | 1121. | 1121. |
| 1647. | 1647. | 1647. | 1647. | 1647. | 1647. | 1647. | 1647. | 1647. | 1647. | 1647. | 1647. | 1647. | 1647. |
| 615.  | 615.  | 615.  | 615.  | 615.  | 615.  | 615.  | 615.  | 615.  | 615.  | 615.  | 615.  | 615.  | 615.  |
| 35.   | 35.   | 35.   | 35.   | 35.   | 35.   | 35.   | 35.   | 35.   | 35.   | 35.   | 35.   | 35.   | 35.   |
| 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   |
| 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   | 27.   |
| 5.    | 5.    | 5.    | 5.    | 5.    | 5.    | 5.    | 5.    | 5.    | 5.    | 5.    | 5.    | 5.    | 5.    |
| 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    | 2.    |

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
3151. 1252. 397. 303. 49962.  
CFS 49. 35. 10. 10. 1415.  
INCHES 9.71 10.75 10.76 10.76 10.76

PM  
AC-FT  
THOUS CU H

246.53 273.07 273.26 273.26  
621. 688. 688. 688.  
766. 849. 849. 849.

# PLAN 2 SAME AS PLAN 1

## HYDROGRAPH ROUTING

### ROUTE INFLOW HYDROGRAPH THROUGH RESERVOIR

| ISTAG | ICOMP | TECON | ITAPE | JPLT | UPRT | INAME | ISTAGE | IAUTO |
|-------|-------|-------|-------|------|------|-------|--------|-------|
| A2    | 1     | 0     | 0     | 0    | 0    | 1     | 0      | 0     |

ALL PLANS HAVE SAME

#### ROUTING DATA

| QLOSS | CLOSS | AVG  | IRCS | ISAME | IOPT | IPMP | LSTR |
|-------|-------|------|------|-------|------|------|------|
| 0.0   | 0.000 | 0.00 | 1    | 1     | 0    | 0    | 0    |

| WSTPS | WSTDL | LAG | AMSK  | X     | ISK   | STORA | ISPRAT |
|-------|-------|-----|-------|-------|-------|-------|--------|
| 1     | 0     | 0   | 0.000 | 0.000 | 0.000 | 63.   | -1     |

| STAGE      | 613.00 | 615.70 | 616.20 | 616.30 | 617.30 | 617.40 | 618.20  | 618.70  | 620.00  | 621.00  |
|------------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|
| FLOW       | 0.00   | 138.00 | 198.00 | 217.00 | 558.00 | 763.00 | 1408.00 | 1997.00 | 4987.00 | 8403.00 |
| CAPACITIVE | 0.     | 63.    | 97.    | 104.   | 106.   | 121.   | 123.    | 137.    | 145.    | 170.    |

| ELEVATION= | 607.00 | 613.00 | 616.00 | 616.00 | 617.00 | 617.00 | 618.00 | 619.00 | 620.00 |
|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|            | 621.   |        |        |        |        |        |        |        |        |

| CREL  | SPVID | COOV | EXPV | FLEVL | COOL | CAREA | EXPL |
|-------|-------|------|------|-------|------|-------|------|
| 613.0 | 0.0   | 0.0  | 0.0  | 0.0   | 0.0  | 0.0   | 0.0  |

| DAM DATA |      |      |        |
|----------|------|------|--------|
| TOPEL    | COOD | EXPD | DAMUID |
| 615.07   | 0.0  | 0.0  | 0.     |

# END-OF-PERIOD HYDROGRAPH ORCINATES

[illegible]



ROUTING DATA

| QLOSS | CLCSS | AVG  | IRIS | ISAME | ISPT | ITMP | LSTR |
|-------|-------|------|------|-------|------|------|------|
| 0.0   | 0.000 | 0.00 | 1    | 1     | 0    | 0    | 0    |

| MSIPS | MSIDL | LAG | AMSKK | X     | ISK   | STORA | ISPRAT |
|-------|-------|-----|-------|-------|-------|-------|--------|
| 1     | 0     | 0   | 0.000 | 0.000 | 0.000 | -1.   | 0      |

NORMAL DEPTH CHANNEL ROUTING

| QNI(1) | QNI(2) | QNI(3) | FLNVT | ELMAX | RLNTH | SEL     |
|--------|--------|--------|-------|-------|-------|---------|
| 0.00   | 0.000  | 0.0500 | 550.0 | 562.0 | 1400. | 0.03300 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

|        |        |        |        |        |        |       |        |        |        |
|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|
| 0.00   | 562.00 | 32.00  | 558.00 | 64.00  | 559.00 | 96.00 | 550.00 | 111.00 | 550.00 |
| 151.00 | 554.00 | 191.00 | 558.00 | 231.00 | 562.00 |       |        |        |        |

| STORAGE | 0.00 | 14.58 | 17.31 | 1.07 | 20.27 | 1.95  | 3.06  | 4.41  | 5.98  | 7.79  | 9.82  | 12.09 |
|---------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|
|         |      |       |       |      |       | 23.46 | 26.88 | 30.53 | 34.41 | 38.52 | 42.86 | 47.44 |

| OUTFLOW | 0.00    | 55.25   | 9975.00  | 206.87   | 472.14   | 871.11   | 1423.00  | 2146.02  | 3200.49  | 4539.80  | 6107.69 |
|---------|---------|---------|----------|----------|----------|----------|----------|----------|----------|----------|---------|
|         | 7916.24 | 9975.00 | 12294.35 | 14884.18 | 17754.24 | 20914.13 | 24373.33 | 28141.19 | 32226.97 | 36639.80 |         |

| STAGE | 550.00 | 550.63 | 556.32 | 551.26 | 557.58 | 551.89 | 552.53 | 553.16 | 553.79 | 554.42 | 555.05 | 555.68 |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|       | 556.32 | 556.95 | 557.58 | 558.21 | 558.84 | 559.47 | 560.11 | 560.74 | 561.37 | 562.00 |        |        |

| FLOW | 0.00    | 55.25   | 9975.00  | 206.87   | 472.14   | 871.11   | 1423.00  | 2146.02  | 3200.49  | 4539.80  | 6107.69 |
|------|---------|---------|----------|----------|----------|----------|----------|----------|----------|----------|---------|
|      | 7916.24 | 9975.00 | 12294.35 | 14884.18 | 17754.24 | 20914.13 | 24373.33 | 28141.19 | 32226.97 | 36639.80 |         |

## STATION A3, PLAN 2, RTIO 3

[illegible]



.....

# HYDROGRAPH ROUTING

## CHANNEL ROUTING MOD PULS FIRST CULVERT

| ISTAQ | ICOMP | IECON | ITAPE | JUFLT | JPRF | INAME | ISTAGE | IAUTO |
|-------|-------|-------|-------|-------|------|-------|--------|-------|
| AA    | 1     | 0     | 0     | 0     | 1    | 1     | 0      | 0     |

ALL PLANS HAVE SAME

| ROUTING DATA |       |      |      |
|--------------|-------|------|------|
| QLOSS        | CLOSS | AVG  | LSTR |
| 0.0          | 0.000 | 0.00 | 0    |

| ROUTING DATA |       |        |        |
|--------------|-------|--------|--------|
| IPMP         | ISAME | ISPRAT | ISPRAT |
| 0            | 1     | 0      | 0      |

| ROUTING DATA |       |       |       |
|--------------|-------|-------|-------|
| MSIPS        | NSIDL | LAG   | AMSKK |
| 1            | 0     | 0.000 | 0.000 |

## NORMAL DEPTH CHANNEL ROUTING

| QNI(1) | QNI(2) | QNI(3) | FLNVT | ELMAX | RLNTH | SEL   |
|--------|--------|--------|-------|-------|-------|-------|
| 0.0160 | 0.0140 | 0.0160 | 548.0 | 560.0 | 35.   | 03300 |

## CROSS SECTION COORDINATES--STAGELEV, STAGELEV--ETC

|         | 0.00   | 75.00  | 557.50 | 150.00 | 555.00 | 150.00 | 558.00   | 548.00    |
|---------|--------|--------|--------|--------|--------|--------|----------|-----------|
| STORAGE | 0.00   | 0.00   | 0.00   | 0.01   | 0.01   | 0.01   | 0.01     | 0.02      |
| OUTFLOW | 0.00   | 29.94  | 82.36  | 210.24 | 279.52 | 350.70 | 423.19   | 496.62    |
| STAGE   | 544.00 | 544.63 | 549.26 | 550.53 | 551.16 | 551.79 | 552.42   | 553.05    |
| FLOW    | 645.41 | 720.50 | 823.36 | 904.10 | 957.67 | 989.43 | 10229.34 | 107928.60 |

[illegible][illegible]

MAXIMUM STORAGE = 0.

MAXIMUM STAGE IS 556.9

\*\*\*\*\*

# HYDROGRAPH ROUTING

CHANNEL ROUTING MOD PULS REACH 2

|       |       |       |       |      |      |       |        |       |
|-------|-------|-------|-------|------|------|-------|--------|-------|
| 1STAG | ICOMP | IECON | ITAPE | JPLT | JPRI | INAME | ISTAGE | IAUTO |
| AS    | 1     | 0     | 0     | 0    | 1    | J     | 0      | 0     |

ALL PLANS HAVE SAME

| ROUTING DATA |       | LSTR |      |
|--------------|-------|------|------|
| BLOSS        | CLOSS | AVG  | IPHP |
| 0.0          | 0.00  | 1    | 0    |

|       |       |     |       |       |       |       |        |
|-------|-------|-----|-------|-------|-------|-------|--------|
| NSTPS | NSTOL | LAG | AMSK  | X     | TSK   | STORA | ISPRAT |
| 1     | 0     | 0   | 0.000 | 0.000 | 0.000 | -1.   | 0      |

## NORMAL DEPTH CHANNEL ROUTING

|       |        |        |       |       |       |       |
|-------|--------|--------|-------|-------|-------|-------|
| 04(1) | 04(2)  | 04(3)  | ELNVT | ELNIX | RENTH | SEL   |
| 0.050 | 0.0500 | 0.0400 | 546.0 | 558.0 | 300.  | 03300 |

CROSS SECTION COORDINATES--STA, ELEV, STA, ELEV--ETC

|        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0.00   | 558.00 | 315.00 | 547.50 | 315.00 | 546.50 | 320.00 | 546.00 | 325.00 | 546.50 |
| 325.00 | 547.50 | 490.00 | 553.00 | 640.00 | 558.00 |        |        |        |        |

|         |      |      |      |      |       |       |       |       |       |       |
|---------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| STORAGE | 0.00 | 0.03 | 0.07 | 0.15 | 0.37  | 0.77  | 1.33  | 2.05  | 2.94  | 3.59  |
|         | 5.21 | 6.59 | 8.14 | 9.85 | 11.73 | 13.77 | 15.98 | 18.35 | 20.89 | 23.59 |

|         |          |          |          |          |          |          |          |          |          |          |
|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| OUTFLOW | 0.00     | 10.65    | 50.18    | 121.04   | 335.10   | 810.57   | 1640.13  | 2904.82  | 4678.45  | 7029.67  |
|         | 10023.21 | 13720.63 | 18180.87 | 23460.67 | 29614.84 | 36696.53 | 44757.38 | 53847.70 | 64016.60 | 75312.10 |

|       |        |        |        |        |        |        |        |        |        |        |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| STAGE | 546.00 | 546.63 | 547.26 | 547.89 | 548.53 | 549.16 | 549.79 | 550.42 | 551.05 | 551.68 |
|       | 552.32 | 552.95 | 553.58 | 554.21 | 554.84 | 555.47 | 556.11 | 556.74 | 557.37 | 558.00 |

|      |          |          |          |          |          |          |          |          |          |          |
|------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| FLOW | 0.00     | 10.65    | 50.18    | 121.04   | 335.10   | 810.57   | 1640.13  | 2904.82  | 4678.45  | 7029.67  |
|      | 10023.21 | 13720.63 | 18180.87 | 23460.67 | 29614.84 | 36696.53 | 44757.38 | 53847.70 | 64016.60 | 75312.10 |

**A5, PLAN 2, RTIO 3**

**OUTLINE**

STOR

## STAGE

547.2 547.2 547.1 547.1 547.1 547.0 547.0 547.0 546.9

| PEAK       | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------------|--------|---------|---------|--------------|
| CFS        | 3048.  | 1210.   | 344.    | 49553.       |
| CMS        | 86.    | 34.     | 10.     | 1403.        |
| INCHES     |        | 9.38    | 10.67   | 10.67        |
| MM         |        | 238.32  | 270.95  | 271.03       |
| AC-FT      |        | 600.    | 682.    | 683.         |
| THOUS CU M |        | 740.    | 842.    | 842.         |

MAXIMUM STORAGE = 2.

MAXIMUM STAGE IS 550.5

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

RATIOS APPLIED TO FLOWS

OPERATION STATION AREA PLAN. RATIO 1 RATIO 2 RATIO 3  
 .10 .25 .50

HYDROGRAPH AT A1 1.20 1 630. 1576. 3151.  
 ( 3.11) ( 17.85)( 44.62)( 89.24)(

2 630. 1576. 3151.  
 ( 17.85)( 44.62)( 89.24)(

ROUTED TC A2 1.20 1 1103. 1242. 2874.  
 ( 3.11) ( 31.25)( 35.18)( 41.38)(

2 418. 1403. 3018.  
 11.82( 39.73)( 85.46)(

ROUTED TC A3 1.20 1 1084. 1242. 2885.  
 ( 3.11) ( 30.68)( 35.18)( 41.71)(

2 418. 1396. 3035.  
 ( 11.84)( 39.54)( 85.93)(

ROUTED TC A4 1.20 1 1083. 1243. 2886.  
 ( 3.11) ( 30.67)( 35.19)( 41.72)(

2 418. 1396. 3035.  
 ( 11.84)( 39.53)( 85.95)(

ROUTED TC A5 1.20 1 1073. 1242. 2884.  
 ( 3.11) ( 30.45)( 35.18)( 41.67)(

2 417. 1394. 3048.  
 ( 11.82)( 39.46)( 86.31)(

\* NOTE: ONLY PLAN 2 APPLIES.

# SUMMARY OF DAM SAFETY ANALYSIS

| PLAN 1 .....       |                                  |                              |                             |                           |                               |                                 |                             |  |  |
|--------------------|----------------------------------|------------------------------|-----------------------------|---------------------------|-------------------------------|---------------------------------|-----------------------------|--|--|
| ELEVATION          |                                  | INITIAL VALUE                |                             | SPILLWAY CREST            |                               | TOP OF DAM                      |                             |  |  |
| STORAGE            |                                  | 613.00                       |                             | 613.00                    |                               | 615.70                          |                             |  |  |
| OUTFLOW            |                                  | 63.                          |                             | 63.                       |                               | 97.                             |                             |  |  |
|                    |                                  | 0.                           |                             | 0.                        |                               | 138.                            |                             |  |  |
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |  |  |
|                    |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| .10                | 616.41                           | .71                          | 108.                        | 1103.                     | 1.00                          | 16.83                           | 15.83                       |  |  |
| .25                | 616.15                           | .85                          | 103.                        | 1242.                     | .96                           | 16.50                           | 13.83                       |  |  |
| .50                | 617.79                           | 2.09                         | 130.                        | 2874.                     | 3.10                          | 16.33                           | 13.17                       |  |  |
| PLAN 2 .....       |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| ELEVATION          |                                  | INITIAL VALUE                |                             | SPILLWAY CREST            |                               | TOP OF DAM                      |                             |  |  |
| STORAGE            |                                  | 613.00                       |                             | 613.00                    |                               | 615.70                          |                             |  |  |
| OUTFLOW            |                                  | 63.                          |                             | 63.                       |                               | 97.                             |                             |  |  |
|                    |                                  | 0.                           |                             | 0.                        |                               | 138.                            |                             |  |  |
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |  |  |
|                    |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| .10                | 616.89                           | 1.19                         | 115.                        | 418.                      | 3.50                          | 16.67                           | 0.00                        |  |  |
| .25                | 618.19                           | 2.58                         | 137.                        | 1403.                     | 16.17                         | 16.33                           | 0.00                        |  |  |
| .50                | 619.14                           | 3.44                         | 156.                        | 3018.                     | 7.33                          | 16.17                           | 0.00                        |  |  |
| PLAN 3 .....       |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| ELEVATION          |                                  | INITIAL VALUE                |                             | SPILLWAY CREST            |                               | TOP OF DAM                      |                             |  |  |
| STORAGE            |                                  | 613.00                       |                             | 613.00                    |                               | 615.70                          |                             |  |  |
| OUTFLOW            |                                  | 63.                          |                             | 63.                       |                               | 97.                             |                             |  |  |
|                    |                                  | 0.                           |                             | 0.                        |                               | 138.                            |                             |  |  |
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |  |  |
|                    |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| .10                | 616.89                           | 1.19                         | 115.                        | 418.                      | 3.50                          | 16.67                           | 0.00                        |  |  |
| .25                | 618.19                           | 2.58                         | 137.                        | 1403.                     | 16.17                         | 16.33                           | 0.00                        |  |  |
| .50                | 619.14                           | 3.44                         | 156.                        | 3018.                     | 7.33                          | 16.17                           | 0.00                        |  |  |
| PLAN 4 .....       |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| ELEVATION          |                                  | INITIAL VALUE                |                             | SPILLWAY CREST            |                               | TOP OF DAM                      |                             |  |  |
| STORAGE            |                                  | 613.00                       |                             | 613.00                    |                               | 615.70                          |                             |  |  |
| OUTFLOW            |                                  | 63.                          |                             | 63.                       |                               | 97.                             |                             |  |  |
|                    |                                  | 0.                           |                             | 0.                        |                               | 138.                            |                             |  |  |
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |  |  |
|                    |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| .10                | 616.89                           | 1.19                         | 115.                        | 418.                      | 3.50                          | 16.67                           | 0.00                        |  |  |
| .25                | 618.19                           | 2.58                         | 137.                        | 1403.                     | 16.17                         | 16.33                           | 0.00                        |  |  |
| .50                | 619.14                           | 3.44                         | 156.                        | 3018.                     | 7.33                          | 16.17                           | 0.00                        |  |  |
| PLAN 5 .....       |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| ELEVATION          |                                  | INITIAL VALUE                |                             | SPILLWAY CREST            |                               | TOP OF DAM                      |                             |  |  |
| STORAGE            |                                  | 613.00                       |                             | 613.00                    |                               | 615.70                          |                             |  |  |
| OUTFLOW            |                                  | 63.                          |                             | 63.                       |                               | 97.                             |                             |  |  |
|                    |                                  | 0.                           |                             | 0.                        |                               | 138.                            |                             |  |  |
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |  |  |
|                    |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| .10                | 616.89                           | 1.19                         | 115.                        | 418.                      | 3.50                          | 16.67                           | 0.00                        |  |  |
| .25                | 618.19                           | 2.58                         | 137.                        | 1403.                     | 16.17                         | 16.33                           | 0.00                        |  |  |
| .50                | 619.14                           | 3.44                         | 156.                        | 3018.                     | 7.33                          | 16.17                           | 0.00                        |  |  |
| PLAN 6 .....       |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| ELEVATION          |                                  | INITIAL VALUE                |                             | SPILLWAY CREST            |                               | TOP OF DAM                      |                             |  |  |
| STORAGE            |                                  | 613.00                       |                             | 613.00                    |                               | 615.70                          |                             |  |  |
| OUTFLOW            |                                  | 63.                          |                             | 63.                       |                               | 97.                             |                             |  |  |
|                    |                                  | 0.                           |                             | 0.                        |                               | 138.                            |                             |  |  |
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |  |  |
|                    |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| .10                | 616.89                           | 1.19                         | 115.                        | 418.                      | 3.50                          | 16.67                           | 0.00                        |  |  |
| .25                | 618.19                           | 2.58                         | 137.                        | 1403.                     | 16.17                         | 16.33                           | 0.00                        |  |  |
| .50                | 619.14                           | 3.44                         | 156.                        | 3018.                     | 7.33                          | 16.17                           | 0.00                        |  |  |
| PLAN 7 .....       |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| ELEVATION          |                                  | INITIAL VALUE                |                             | SPILLWAY CREST            |                               | TOP OF DAM                      |                             |  |  |
| STORAGE            |                                  | 613.00                       |                             | 613.00                    |                               | 615.70                          |                             |  |  |
| OUTFLOW            |                                  | 63.                          |                             | 63.                       |                               | 97.                             |                             |  |  |
|                    |                                  | 0.                           |                             | 0.                        |                               | 138.                            |                             |  |  |
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |  |  |
|                    |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| .10                | 616.89                           | 1.19                         | 115.                        | 418.                      | 3.50                          | 16.67                           | 0.00                        |  |  |
| .25                | 618.19                           | 2.58                         | 137.                        | 1403.                     | 16.17                         | 16.33                           | 0.00                        |  |  |
| .50                | 619.14                           | 3.44                         | 156.                        | 3018.                     | 7.33                          | 16.17                           | 0.00                        |  |  |
| PLAN 8 .....       |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| ELEVATION          |                                  | INITIAL VALUE                |                             | SPILLWAY CREST            |                               | TOP OF DAM                      |                             |  |  |
| STORAGE            |                                  | 613.00                       |                             | 613.00                    |                               | 615.70                          |                             |  |  |
| OUTFLOW            |                                  | 63.                          |                             | 63.                       |                               | 97.                             |                             |  |  |
|                    |                                  | 0.                           |                             | 0.                        |                               | 138.                            |                             |  |  |
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |  |  |
|                    |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| .10                | 616.89                           | 1.19                         | 115.                        | 418.                      | 3.50                          | 16.67                           | 0.00                        |  |  |
| .25                | 618.19                           | 2.58                         | 137.                        | 1403.                     | 16.17                         | 16.33                           | 0.00                        |  |  |
| .50                | 619.14                           | 3.44                         | 156.                        | 3018.                     | 7.33                          | 16.17                           | 0.00                        |  |  |
| PLAN 9 .....       |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| ELEVATION          |                                  | INITIAL VALUE                |                             | SPILLWAY CREST            |                               | TOP OF DAM                      |                             |  |  |
| STORAGE            |                                  | 613.00                       |                             | 613.00                    |                               | 615.70                          |                             |  |  |
| OUTFLOW            |                                  | 63.                          |                             | 63.                       |                               | 97.                             |                             |  |  |
|                    |                                  | 0.                           |                             | 0.                        |                               | 138.                            |                             |  |  |
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |  |  |
|                    |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| .10                | 616.89                           | 1.19                         | 115.                        | 418.                      | 3.50                          | 16.67                           | 0.00                        |  |  |
| .25                | 618.19                           | 2.58                         | 137.                        | 1403.                     | 16.17                         | 16.33                           | 0.00                        |  |  |
| .50                | 619.14                           | 3.44                         | 156.                        | 3018.                     | 7.33                          | 16.17                           | 0.00                        |  |  |
| PLAN 10 .....      |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| ELEVATION          |                                  | INITIAL VALUE                |                             | SPILLWAY CREST            |                               | TOP OF DAM                      |                             |  |  |
| STORAGE            |                                  | 613.00                       |                             | 613.00                    |                               | 615.70                          |                             |  |  |
| OUTFLOW            |                                  | 63.                          |                             | 63.                       |                               | 97.                             |                             |  |  |
|                    |                                  | 0.                           |                             | 0.                        |                               | 138.                            |                             |  |  |
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |  |  |
|                    |                                  |                              |                             |                           |                               |                                 |                             |  |  |
| .10                | 616.89                           | 1.19                         | 115.                        | 418.                      | 3.50                          | 16.67                           | 0.00                        |  |  |
| .25                | 618.19                           | 2.58                         | 137.                        | 1403.                     | 16.17                         | 16.33                           | 0.00                        |  |  |
| .50                | 619.14                           | 3.44                         | 156.                        | 3018.                     | 7.33                          | 16.17                           | 0.00                        |  |  |

NOTE: ONLY PLAN 2 APPLIES.

.50 2 PPK. 556.9 16.33

PLAN 2 STATION A4

| RATIO | MAXIMUM FLOW, CFS | MAXIMUM STAGE, FT | TIME HOURS |
|-------|-------------------|-------------------|------------|
| .10   | 418.              | 552.4             | 16.67      |
| .25   | 1396.             | 556.1             | 16.33      |
| .50   | 3035.             | 556.9             | 16.33      |

PLAN 1

STATION A5

| RATIO | MAXIMUM FLOW, CFS | MAXIMUM STAGE, FT | TIME HOURS |
|-------|-------------------|-------------------|------------|
| .10   | 1075.             | 549.4             | 16.83      |
| .25   | 1242.             | 549.5             | 16.50      |
| .50   | 2884.             | 550.4             | 16.33      |

PLAN 2

STATION A5

| RATIO | MAXIMUM FLOW, CFS | MAXIMUM STAGE, FT | TIME HOURS |
|-------|-------------------|-------------------|------------|
| .10   | 417.              | 548.6             | 16.67      |
| .25   | 1394.             | 549.6             | 16.33      |
| .50   | 3048.             | 550.5             | 16.33      |

\*NOTE: ONLY PLAN 2 APPLIES.

APPENDIX 5

REFERENCES

FOXS LAKE DAM

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AD-A087 540

NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/13  
NATIONAL DAM SAFETY PROGRAM. FOXS LAKE DAM (NJ00342), PASSAIC R--ETC(U)  
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## APPENDIX 5

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