

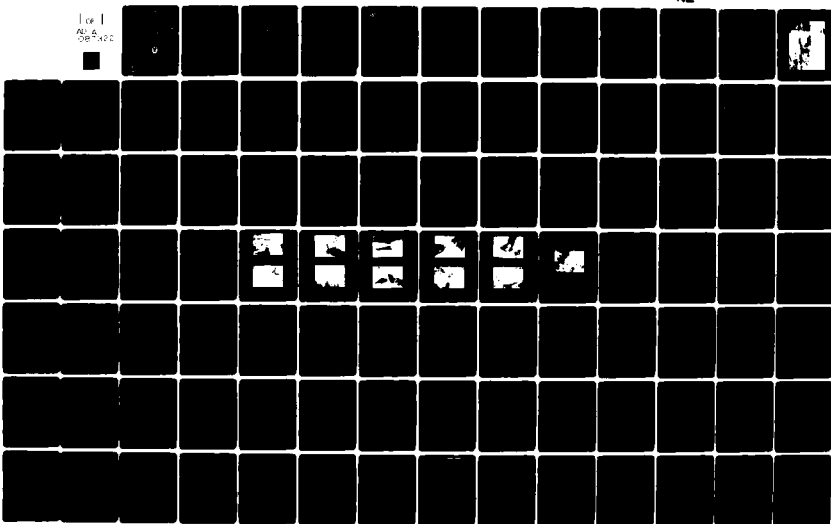
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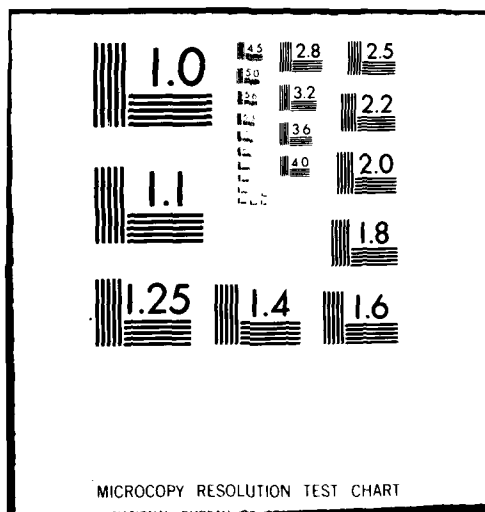
NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/13
NATIONAL DAM SAFETY PROGRAM. JOHNSON LAKE DAM (NJ00499), PASSAIC-ETC(U)
JAN 80 W A GUINAN DACW61-79-C-0011

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1 of 1
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LEVEL

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PASSAIC RIVER BASIN
TRIBUTARY TO LUBBERS RUN BROOK
SUSSEX COUNTY
NEW JERSEY

JOHNSON LAKE DAM

NJ 00499

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) 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.		



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
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PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-N

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

28 JUL 1980

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Johnson Lake Dam in Sussex 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, Johnson 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 seven 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 date of approval of this report, the following engineering studies and analyses should be initiated:

(1) Design and oversee procedures for repair of erosion of the earth berm on the downstream side of the concrete dam and on the banks of the discharge channel immediately downstream of the stoplog spillway.

(2) Design and oversee the repair of the deteriorated portion of the concrete dam on either side of the stoplog facility.

(3) Design and oversee procedures for making the soil abutments resistant to erosion in the event of overtopping.

NAPEN-N

Honorable Brendan T. Byrne

(4) Design and oversee procedures for removing the trees on the right abutment.

(5) Determine the configuration and condition of the concrete and earth sections of the dam and its foundation for the purpose of evaluating the stability of the structure.

(6) Repair eroded and spalled areas of the joint 10 feet to the right of the stoplog section, and monitor lateral movement. If movement progresses, design and implement remedial measures.

c. Within six months from the date of approval of this report, the following actions should be initiated:

(1) Clear brush and trees from the banks of the discharge channel between the dam and the highway culvert immediately downstream of the dam.

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

(3) Restore or replace the gate operating mechanism for the low-level outlet.

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

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.

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Honorable Brendan T. Byrne

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,



JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

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 Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

JOHNSON LAKE DAM (NJ00499)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 5 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.

Johnson 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 seven 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 date of approval of this report, the following engineering studies and analyses should be initiated:

(1) Design and oversee procedures for repair of erosion of the earth berm on the downstream side of the concrete dam and on the banks of the discharge channel immediately downstream of the stoplog spillway.

(2) Design and oversee the repair of the deteriorated portion of the concrete dam on either side of the stoplog facility.

(3) Design and oversee procedures for making the soil abutments resistant to erosion in the event of overtopping.

(4) Design and oversee procedures for removing the trees on the right abutment.

(5) Determine the configuration and condition of the concrete and earth sections of the dam and its foundation for the purpose of evaluating the stability of the structure.

(6) Repair eroded and spalled areas of the joint 10 feet to the right of the stoplog section, and monitor lateral movement. If movement progresses, design and implement remedial measures.

c. Within six months from the date of approval of this report, the following actions should be initiated:

(1) Clear brush and trees from the banks of the discharge channel between the dam and the highway culvert immediately downstream of the dam.

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

(3) Restore or replace the gate operating mechanism for the low-level outlet.

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

APPROVED:



JAMES G. TON

Colonel, Corps of Engineers

District Engineer

DATE:

24 Jan 1980

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Johnson Lake Dam
Identification No.: FED ID No. NJ00499
State Located: New Jersey
County Located: Sussex
Stream: Tributary to Lubbers Run
River Basin: Passaic
Date of Inspection: November 5, 1979

ASSESSMENT OF GENERAL CONDITIONS

Johnson Lake Dam is 36 years old and in fair overall condition. It is small in size and is recommended to be downgraded to Significant Hazard. The crest of the dam is of concrete which was casted irregularly and is very rough. Large trees are located on the right (west) abutment. The joint in the concrete wall on the right side of the stoplogs is eroded and some movement was observed. The joint located 10 feet to the right of the stoplog section is eroded and spalled and there is indication of some lateral movement. Erosion of the earth berm has occurred on the downstream side of the concrete dam. The downstream face of the dam is badly spalled at the base adjacent to the stoplog section and the reinforcing steel is exposed on the right side of the stoplogs. The downstream concrete discharge chute is surface eroded. Brush and a few trees are growing in the downstream channel. The spillway can pass approximately 6 percent of the selected $\frac{1}{2}$ PMF SDF or 3 percent of the PMF and is inadequate.

It is recommended that the owner retain the services of a professional engineer, qualified in the design and construction of dams, to accomplish the following in the future: design and oversee procedures for repair of erosion of the earth berm on the downstream face of the concrete dam and on banks of the discharge channel immediately downstream of the stoplogs; design and oversee the repair of the deteriorated portions of the concrete dam on either side of the stoplog section; repair eroded and spalled areas of the joints located 10' to the right of the stoplog section and monitor lateral movement. If movement progresses, design and implement remedial measures; design and oversee procedures for making the soil abutments resistant to erosion in the event of overtopping; design and oversee procedures for removing the trees and their root systems on the right abutment; and conduct a more detailed hydrologic and hydraulic analysis of the spillway to determine the extent and type of remedial measures necessary.

It is further recommended that the owner accomplish the following tasks as a part of operating and maintenance procedures: in the near future, clear brush and trees from the banks of the discharge channel between the dam and the highway culvert immediately downstream of the dam; establish a surveillance program for use during

and immediately after periods of heavy rainfall, and also a warning program to follow in case of emergency; and restore or replace the gate operating mechanism for the low-level outlet. 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 & COMPANY, INC.

A handwritten signature in cursive script, reading "Warren A. Guinan".

Warren A. Guinan, P.E.
Project Manager
New Jersey No. 16848



5 NOV 1979

OVERVIEW

JOHNSON LAKE DAM

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PHASE I INSPECTION REPORT NATIONAL DAM SAFETY REPORT

JOHNSON LAKE DAM FED ID NO. NJ00499

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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
JOHNSON LAKE DAM
FED ID NO. NJ00499

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Johnson Lake 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 FPM No. 39, dated 28 June 1979. 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 5 November 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to safety of Johnson 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. Johnson Lake Dam is a 42-foot long concrete and earth embankment dam with a concrete core and a hydraulic height (also structural height) of 11.3 feet. The downstream face is of concrete and earth with a 3H:1V slope. A 4-foot long stoplog principal spillway is located on the southeastern (left) part of the dam. The wooden stoplogs are 2 inches thick and total 3.5 feet in height. The stoplogs are held in place by concrete slots. The 10-foot long concrete free overflow spillway is near the center of the dam and has a topwidth of 1 foot. A 2-foot diameter concrete pipe (low-level outlet) approximately 20 feet long is located about 7.2 feet below the principal spillway invert. Essential features of the dam are given in Figure 1.

b. Location. Johnson Lake Dam is located in Sussex County, New Jersey on a tributary to Lubbers Run, approximately 3 miles north of Lockwood. It is at north latitude $40^{\circ} 57.6'$ and west longitude $74^{\circ} 43.6'$. A location map is given in Figure 2.

c. Size Classification. Johnson Lake Dam is classified as being "small" on the basis of storage at the dam crest of 215 acre-feet, which is less than 1000 acre-feet but more than 50 acre-feet,

and on the basis of its height of 11.3 feet, which is less than 40 feet, in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Visual inspection of the downstream area showed that failure of Johnson Lake Dam could possible cause damage to 3 residences; but the breach analysis contained herein indicates that only one of the 3 houses could be severely damaged by about 5.5 feet of water. Accordingly, Johnson Lake Dam is classified as Significant Hazard.

e. Ownership. The dam is owned by Resource Recovery Associates, Totawa, New Jersey 07512. Mr. Arthur Hart was contacted for information, (201) 256-6330.

f. Purpose of Dam. The lake is used for recreation.

g. Design and Construction History. Little information was found regarding the design and construction of the dam.

h. Normal Operational Procedures. No operational procedures were revealed.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. Information derived from a Geologic Map of New Jersey (Lewis and Kummel, 1912) indicates that soils within the immediate site area consist of ground moraine overlying bedrock.

Bedrock was observed in sporadic outcrops at the reservoir perimeter during inspection of this dam. The previously mentioned map indicates that bedrock in this area consists of granitoid gneiss of Precambrian age.

1.3 Pertinent Data

a. Drainage Area

Watershed - 0.6 square mile

Normal water surface - 33 acres

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown

Ungated (total) spillway capacity at maximum pool elevation-28

Low-level outlet (if operable) - 58

c. Elevation (NGVD)

Top of dam - 837.4

Recreation pool - 837

Overflow spillway crest - 837

Principal spillway crest - 836.7 with stoplogs

- 833.2 stoplogs removed

Streambed at centerline of dam - 826.1

Maximum tailwater (estimated) - 927.3

d. Reservoir (feet)

Length of maximum pool - 2765

Length of recreational pool - 2700

e. Storage (acre-feet)

Recreation pool - 198

Design surcharge - ($\frac{1}{2}$ PMF) - 338

Top of dam - 215

f. Reservoir Surface (acres)

Top of dam - 37

Recreation pool - 33

Overflow spillway crest - 33

g. Dam

Type - earthfill and concrete

Length - 42 feet

Height - 11.3 feet

Topwidth - 1 foot

Side slopes - upstream unknown, downstream 3H:1V

Zoning - earthfill downstream face with concrete core

which serves as upstream face

Impervious core - concrete

Cutoff - unknown

Grout curtain - unknown

h. Spillway

Type - concrete overflow spillway

Length of weir - free overflow spillway: 10 feet

- stoplog principal spillway: 4 feet

Crest elevation - free overflow spillway: 837' NGVD

- stoplog principal spillway: 836.7' NGVD

Gates - stoplogs

Upstream channel - Johnson Lake (no approach channel)

Downstream channel - tributary to Lubbers Run

i. Regulating Outlets

Type - one two-foot diameter concrete low-level outlet pipe

Length (estimated) - 20'

Access - not visible

Regulating facilities - none found

SECTION 2 ENGINEERING DATA

2.1 Design

No plans, hydraulic or hydrologic data for Johnson Lake Dam were found.

2.2 Construction

No data concerning construction of Johnson Lake Dam were found.

2.3 Operation

No engineering operational data were found.

2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection files, and contact with the owner revealed no recorded information.

b. Adequacy. Because of lack of available recorded data, evaluation of this dam was based solely on visual inspection.

SECTION 3 VISUAL INSPECTION

3.1 Findings

a. Dam. Some erosion has taken place in the earth berm next to the downstream side of the concrete dam between the spillway and both abutments. Soil is exposed at both abutments and the ground elevation at the abutments is only slightly higher than the crest of the concrete dam. Two pine trees are growing near the right abutment. No leakage under the dam or through the abutments was observed; because water was discharging over the stoplog spillway at the time of the inspection it was not possible to examine for seepage at the spillway location.

b. Appurtenant Structures. The concrete portion of the dam was cast irregularly and the top of the concrete wall is very rough. The steel bars embedded in the top of the wall are rusted. The downstream face of the dam is badly spalled at the base adjacent to the wooden stoplogs. Reinforcing steel is exposed on the right side of the stoplog section. The low-level outlet gate was not visible at the time of the inspection.

The joint in the concrete wall approximately 10 feet to the right of the stoplog section is eroded and spalled, some movement was observed. The downstream concrete discharge chute is surface eroded, exposing the coarse aggregate.

c. Reservoir Area. The watershed above the reservoir is gently to steeply sloping and partly wooded. Slopes adjacent to the reservoir appear to be stable. No structures were observed close to the shore of the reservoir. Sediment has accumulated behind the dam to within one foot of the crest. No evidence of significant sedimentation other than that close to the dam was observed.

d. Downstream Channel. Brush is growing on the left side and there are a few small trees on the right side of the downstream channel between the dam and the highway culvert immediately downstream of the dam. Downstream of the highway culvert, many trees overhang the channel. Macadam has been crudely placed on the right bank of the downstream channel close to the stoplog spillway apparently for the purpose of controlling erosion of the channel bank.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were found.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were found.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were found.

4.4 Warning System

No description of any warning system was found.

4.5 Evaluation of Operational Adequacy

Because of the lack of operational 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. Since no data were revealed an evaluation could not be performed.

b. Experience Data. No experience data were found.

c. Visual Observation. The channel immediately downstream of the dam has been paved either because of previous damage due to excessive discharge and very likely overtopping, or as a future protection measure. At the time of inspection, about one inch of water was passing over the free overflow spillway crest.

d. Overtopping Potential. The hydraulic/hydrologic evaluation for Johnson Lake Dam is based on a Spillway Design Flood (SDF) equal to one-half the Probable Maximum Flood (PMF) in accordance with the range of floods given in the evaluation guidelines for dams classified as Significant Hazard and small in size. The PMF has been determined by application of the SCS Dimensionless Unit Hydrograph procedure to a 24-hour Probable Maximum storm of 22 inches. Hydrologic computations are given in Appendix 3. The routed half-PMF peak discharge for the subject watershed is 648 cfs.

The minimum elevation of the dam allows 0.4 feet of depth in the overflow spillway before overtopping occurs. Under this head the spillway capacity is 28 cfs, which is less than the required SDF.

Flood routing calculations indicate that Johnson Lake Dam will be overtopped for more than 14 hours to a maximum depth of 1.8 feet under half-PMF conditions. It is estimated that the spillway can only pass about 3 percent of the PMF without overtopping the dam.

Because the dam was classified as high hazard during the visual inspection the increase in downstream hazard under breach conditions was assessed. The results of this analysis indicated that only one house would be severely damaged under breach or non-breach conditions. Thus, the hazard classification was reduced from high to significant. The spillway can pass less than 50 percent of the PMF and is deemed inadequate.

e. Drawdown Capability. Assuming that the low-level outlet currently in place can be restored to an operable condition, it is estimated that the lake can be drained in approximately 3 days, assuming no significant inflow. This is considered adequate.

SECTION 6 STRUCTURAL STABILITY

6.1 Visual Observations

Erosion of the earth berm against the downstream side of the concrete dam, if not controlled, will reduce the stability of the dam by removal of the earth support. The soil exposed at the abutments is susceptible to erosion if the dam is overtopped, and this erosion, in turn, could result in loss of abutment support and consequent failure of the dam. If one of the trees growing on the right abutment blows over and pulls out its roots, or if one of the trees die and its roots rot, serious seepage and erosion problems may result. Significant spalling of the concrete at the base of the walls adjacent to the stoplogs could cause a release of the stoplog at the bottom of the wall and result in unplanned draining of the lake.

Based on the visual inspection alone it is not possible to determine the geometry of the concrete dam beneath the ground surface or the character of the foundation. Therefore, it is not possible to evaluate the factor of safety of the dam against sliding or overturning.

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 pertinent to post-construction changes 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 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 wall 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. Johnson Lake Dam is of undetermined age and is in fair overall condition.

b. Adequacy of Information. Since there is a lack of recorded information the assessment of the dam is based on the results of the visual inspection.

c. Urgency. The recommendations made 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. below. 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 instability 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 and oversee procedures for repair of erosion of the earth berm on the downstream side of the concrete dam and on the banks of the discharge channel immediately downstream of the stoplog spillway.

(2) Design and oversee the repair of the deteriorated portion of the concrete dam on either side of the stoplog facility.

(3) Design and oversee procedures for making the soil abutments resistant to erosion in the event of overtopping.

(4) Design and oversee procedures for removing the trees and their root systems on the right abutment.

(5) Conduct a more detailed hydrologic and hydraulic analysis of the spillway to determine the extent and type of remedial measures necessary.

(6) Determine the configuration and condition of the concrete and earth sections of the dam, and the foundation conditions, for the purpose of evaluating the stability of the dam.

(7) Repair eroded and spalled areas of the joint 10 feet to the right of the stoplog section, and monitor lateral movement. If movement progresses, design and implement remedial measures.

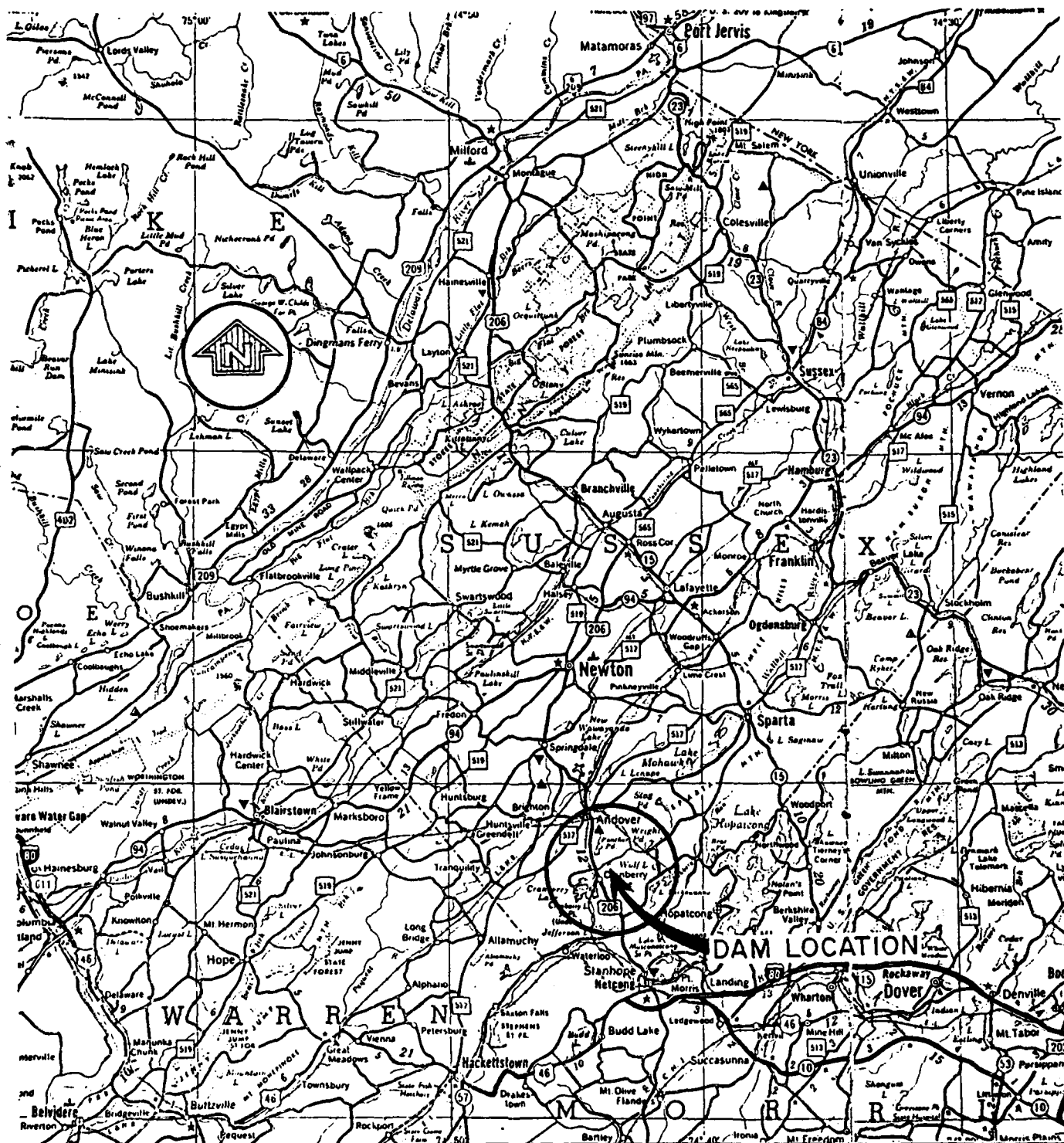
b. Operating and Maintenance Procedures. The owner should do the following in the near future:

(1) Clear brush and trees from the banks of the discharge channel between the dam and the highway culvert immediately downstream of the dam.

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

(3) Restore or replace the gate operating mechanism for the low-level outlet.

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.



SCALE IN MILES



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

Anderson-Nichols & Co., Inc.

CONCORD

NEW HAMPSHIRE

U.S. ARMY ENGINEER DIST. PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

JOHNSON LAKE DAM LOCATION MAP

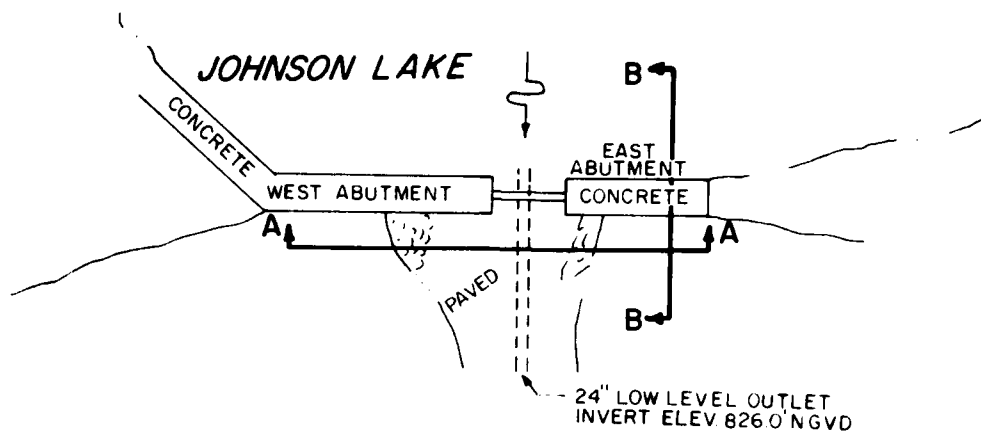
TRIBUTARY TO LUBBERS RUN BROOK

NEW JERSEY

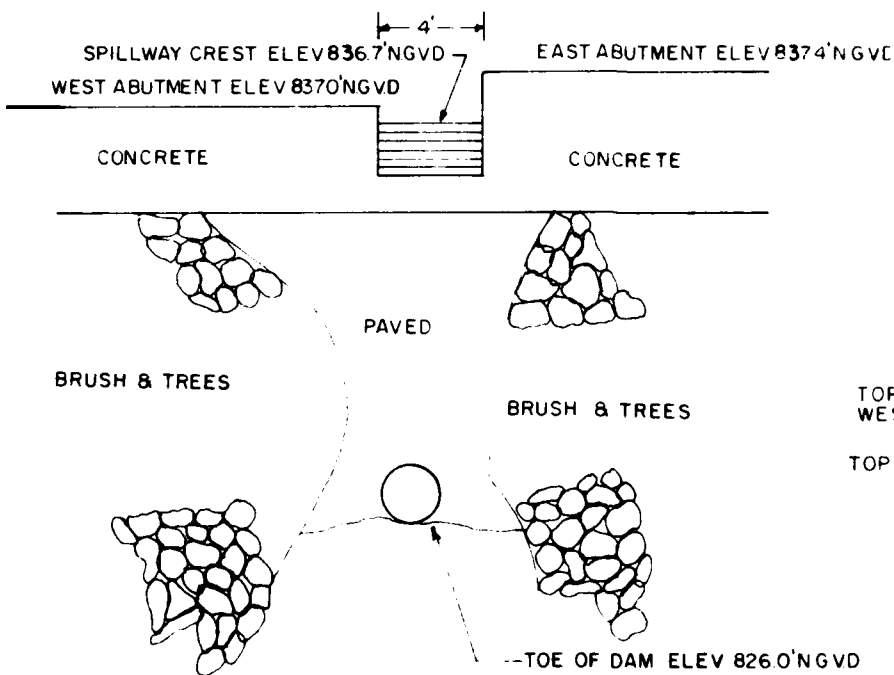
SCALE: SEE BAR SCALE

DATE: JANUARY 1980

FIGURE 2



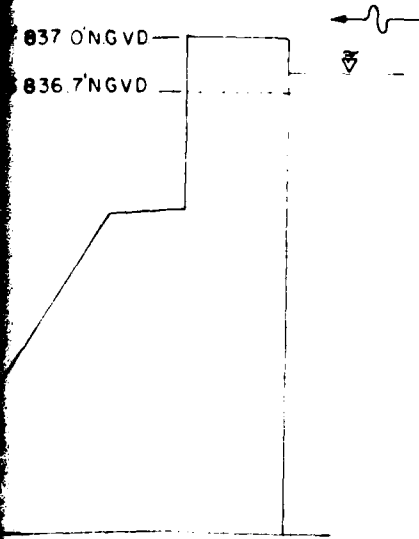
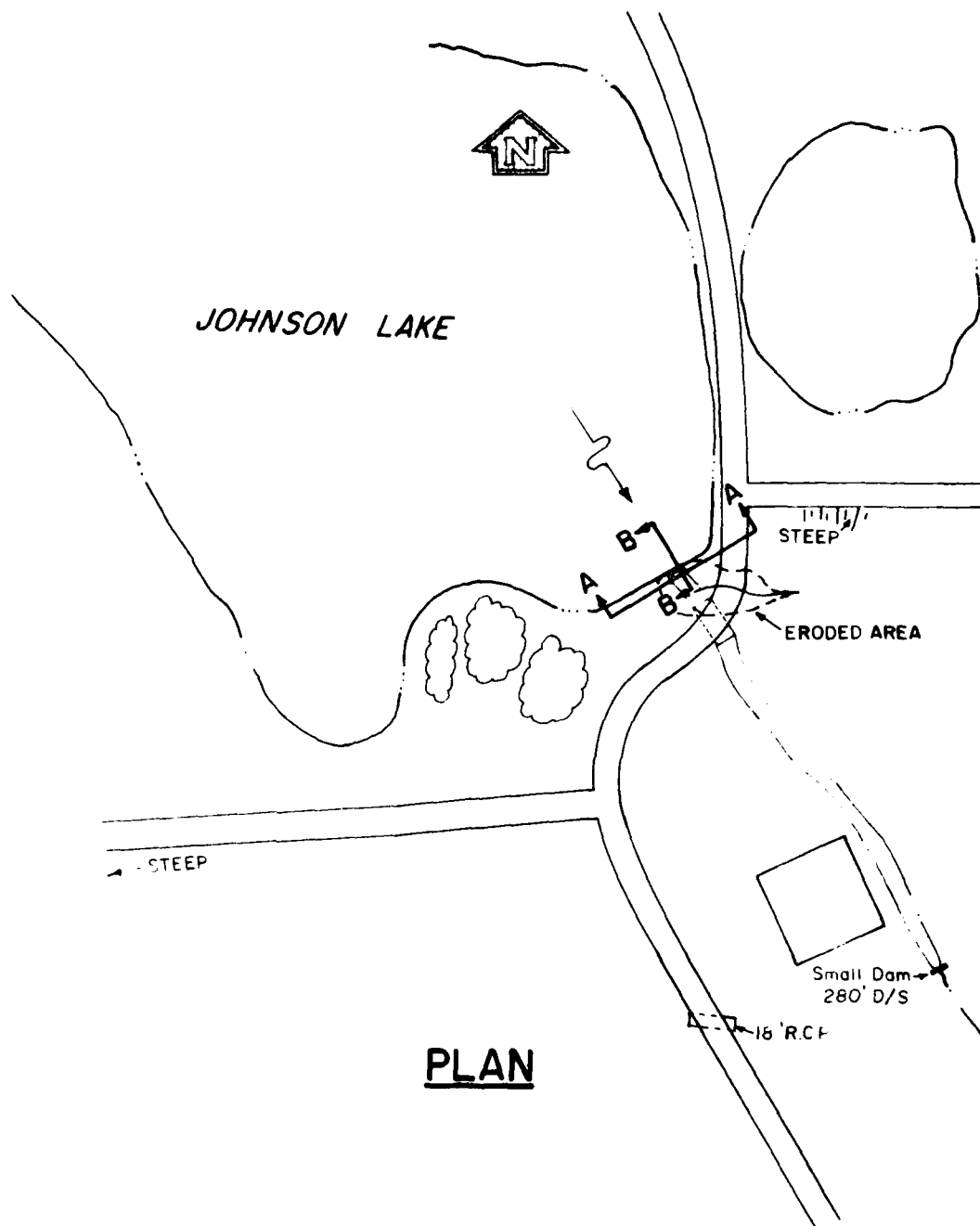
SPILLWAY DETAIL



ELEVATION A-A

826.0' NGVD.

SECTION B-B



SECTION B-B

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			
JOHNSON LAKE DAM			
TRIBUTARY TO LUBBERS RUN BROOK		NEW JERSEY	
		SCALE: NOT TO SCALE	
		DATE: JANUARY 1960	

APPENDIX I
VISUAL INSPECTION
CHECKLIST

JOHNSON LAKE DAM

Check List
Visual Inspection
Phase 1

Name Dam Johnson Lake Dam County Sussex State N.J. Coordinators NJDEP
Date(s) Inspection Nov. 5, 1979 Weather Sunny, cool Temperature 62°
Pool Elevation at Time of Inspection 837.0 NGVD Tailwater at Time of Inspection 827.3 NGVD

Inspection Personnel:

Warren Guinan

Ronald Hirschfeld

Stephen Gilman

Kenneth Stuart

Gilman/Hirschfeld Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	No seepage or leakage.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Some erosion of soil from against downstream side of concrete dam near both abutments.	Eroded areas should be repaired and protected against further erosion.
DRAINS	None observed.	
WATER PASSAGES	None observed.	
FOUNDATION	Unknown. Soil exposed at both abutments. Rock exposed in right bank of reservoir immediately upstream of dam appears to be bedrock.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	- top of concrete eroded to expose coarse aggregate - one large spalled erosion area at downstream face adjacent to stoplog on both sides.	Engage engineer to design and implement repairs.
STRUCTURAL CRACKING	None	
VERTICAL AND HORIZONTAL ALIGNMENT	- Poor - Wall thickness varies	
MONOLITH JOINTS		
CONSTRUCTION JOINTS	Joint 10' . Right of stoplog is eroded and spalled. Some lateral movement observed.	Repair eroded and spalled areas. Monitor lateral movement. If movement progresses design and implement remedial measures.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Some reinforcing steel visible. Concrete spalled at base of wall adjacent to stoplog section. Some vertical movement observed.	Repair deteriorated concrete. Watch for changes in vertical alignment.
APPROACH CHANNEL	See gated spillway.	
DISCHARGE CHANNEL	See gated spillway.	
BRIDGE AND PIERS OVER SPILLWAY	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not applicable	
INTAKE STRUCTURE	Not visible	
OUTLET PIPE	- 24" RCP - only the end of the pipe is visible - fair condition	
OUTLET CHANNEL	Trees overhanging channel. Brush on banks of channel.	Trees and brush should be cleared from banks of channel between dam and highway culvert immediately downstream. Banks should be maintained free of brush.
EMERGENCY GATE	Not applicable	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not visible	
APPROACH CHANNEL	None - body of lake directly upstream	
DISCHARGE CHANNEL	Concrete chute surface eroded to expose coarse aggregate.	Repair eroded concrete surfaces.
BRIDGE AND PIERS	None	
GATES AND OPERATION EQUIPMENT	None	
STOPLOGS	2" weathered wood	Check condition of wood periodically, and replace as necessary.

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 to steeply sloping. No evidence of instability observed.	
SEDIMENTATION	Sediment has accumulated to elevation of bottom of stoplog spillway and to within one foot of crest of dam between stoplog spillway and abutments.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Brush and small trees overhanging	Remove trees and brush which may fall and block channel.
SLOPES	Moderately sloping	
APPROXIMATE NO. OF HOMES AND POPULATION	Three homes, estimated population of ten.	Only one home approximately 250' downstream will be affected by discharges from the dam.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

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

ITEM	REMARKS
DESIGN REPORTS	None found
GEOLOGY REPORTS	None revealed
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None found.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None found
POST-CONSTRUCTION SURVEYS OF DAM	None revealed
BORROW SOURCES	Unknown

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

ITEM	REMARKS
------	---------

SPILLWAY PLAN

SECTIONS

Prepared for this report from field inspection.

DETAILS

None.

OPERATING EQUIPMENT

None.

PLANS & DETAILS

None.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Mountainous, heavy forest

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 837' NGVD (198)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not applicable

ELEVATION MAXIMUM DESIGN POOL: 839.2' NGVD

ELEVATION TOP DAM: 837.4' NGVD

CREST: Free overflow concrete capped spillway.

a. Elevation 837' NGVD

b. Type Concrete weir

c. Width 1 foot

d. Length 10 feet

e. Location Spillover Right side of the dam

f. Number and Type of Gates Unknown

OUTLET WORKS: Low-level outlet pipe

a. Type 24-inch diameter concrete pipe

b. Location Center of the dam

c. Entrance Inverts Unknown

d. Exit Inverts 826.1' NGVD

e. Emergency Draindown Facilities None

HYDROMETEOROLOGICAL GAGES: None

a. Type _____

b. Location _____

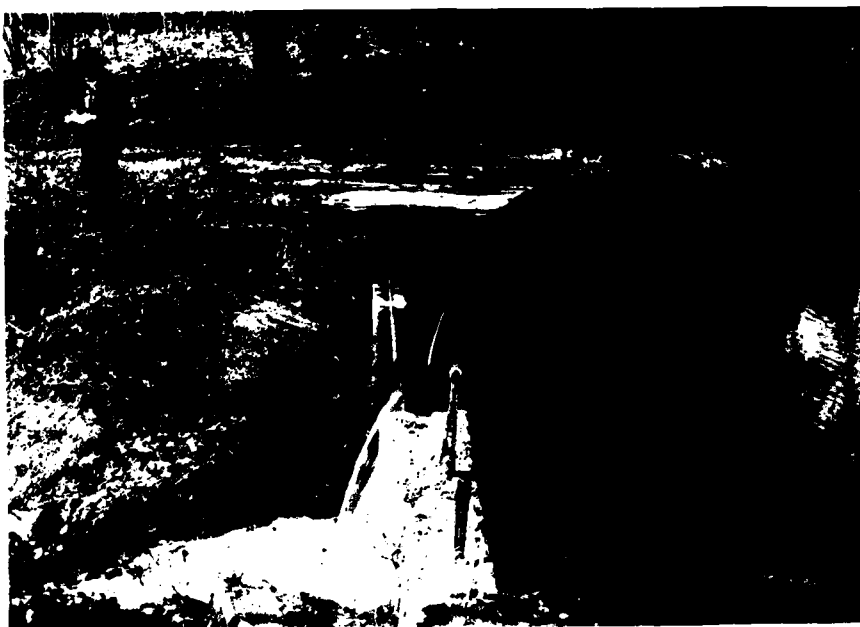
c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE: 28 cfs

APPENDIX 2

PHOTOGRAPHS

JOHNSON LAKE DAM



5 NOV 1979

View of the dam from left abutment looking
northwest.

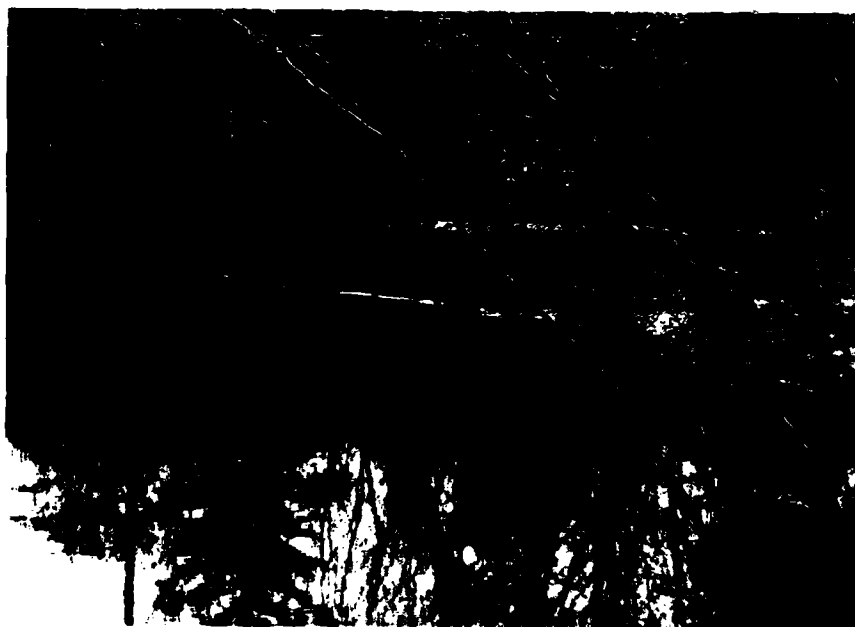


5 NOV 1979

View of the dam from right abutment looking
southeast.



5 NOV 1979
View of the downstream face of the stoplog
principal spillway.



5 NOV 1979
Upstream face of the dam from right abutment.



NOV 1979
View of the upstream reservoir from spillway
crest.



5 NOV 1979
View of the downstream face of the dam
looking toward right abutment.



5 NOV 1979

Erosion of concrete on downstream face of
the dam next to the stoplog principal spillway.



5 NOV 1979

View of the dam from downstream channel
looking upstream.



5 NOV 1979

View of the low-level outlet pipe.



5 NOV 1979

Culvert located 30 feet downstream of the dam.



5 NOV 1979
View of the dam located 280 feet downstream
of the dam.

APPENDIX 3
HYDROLOGIC COMPUTATIONS

JOHNSON LAKE DAM

JOB NO. 3409-14SQUARES 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 COMPUTATIONSNAME: JOHNSON LAKE DAMLOCATION: SUSSEX COUNTY, N.J.DRAINAGE AREA: 0.6 MI.²SURFACE AREA (NORMAL POOL): 33 AC

EVALUATION CRITERIA:

SIZE: SMALLHAZARD: SIGNIFICANT

SPILLWAY DESIGN FLOOD: BASED ON SIZE AND CLASSIFICATION, THE SPILLWAY DESIGN FLOOD WILL BE THE $\frac{1}{2}$ PMF ($\frac{1}{2}$ THE PROBABLE MAXIMUM FLOOD) WITH A PEAK INFLOW OF 1431 CFS.

NOTE: DRAINAGE AREA AND SURFACE AREA OF JOHNSON LAKE WERE PLANIMETERED.

JOB NO. 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

TIME OF CONCENTRATION

OVERLAND FLOW:

LENGTH OF FLOW = 4300 FT

HEAD = 1200 - 837 = 363 FT

SLOPE = $\frac{363}{4300} = 0.084$

1- SCS TR #55 METHOD

FROM FIG. 3-1, PAGE 3-2

VELOCITY = 0.72 FT/SEC

$$T_c = \frac{4300 \text{ FT}}{0.72 \frac{\text{FT}}{\text{SEC}}} = 5972 \text{ SEC} = \underline{\underline{100 \text{ MIN}}}$$

2- SOIL & WATER CONSERVATION ENGINEERING METHOD

$$L = 0.6 T_c$$

$$L = \frac{l^{0.8} (S+1)^{1.67}}{9000 y^{0.5}}$$

$$S = \frac{1000}{CN} - 10$$

TAKE CN = 70 FOR WOODS

$$S = \frac{1000}{70} - 10 = 4.3$$

$$l = 4300 \text{ FT}$$

$$y = 8.4 \%$$

JOB NO. 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

$$L = \frac{(4300)^{0.8} (4.3+1)^{1.67}}{9000 (8.4)^{.5}} = 0.5 \text{ hrs}$$

$$T_c = \frac{0.5}{0.6} = 0.83 \text{ hrs} = \underline{50 \text{ Min}}$$

3 - KERBY METHOD

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

$$L = 4300 \text{ FT}$$

$$N = \text{RETARDANCE ROUGHNESS COEFF.} = 0.6$$

$$S = 0.084$$

$$T_c = 0.83 \left[\frac{(0.6)(4300)}{\sqrt{0.084}} \right]^{0.467}$$

$$T_c = \underline{58 \text{ Min}}$$

4 - TEXAS HIGHWAY VELOCITY DATA METHOD

$$\text{SLOPE} = 8.4 \%$$

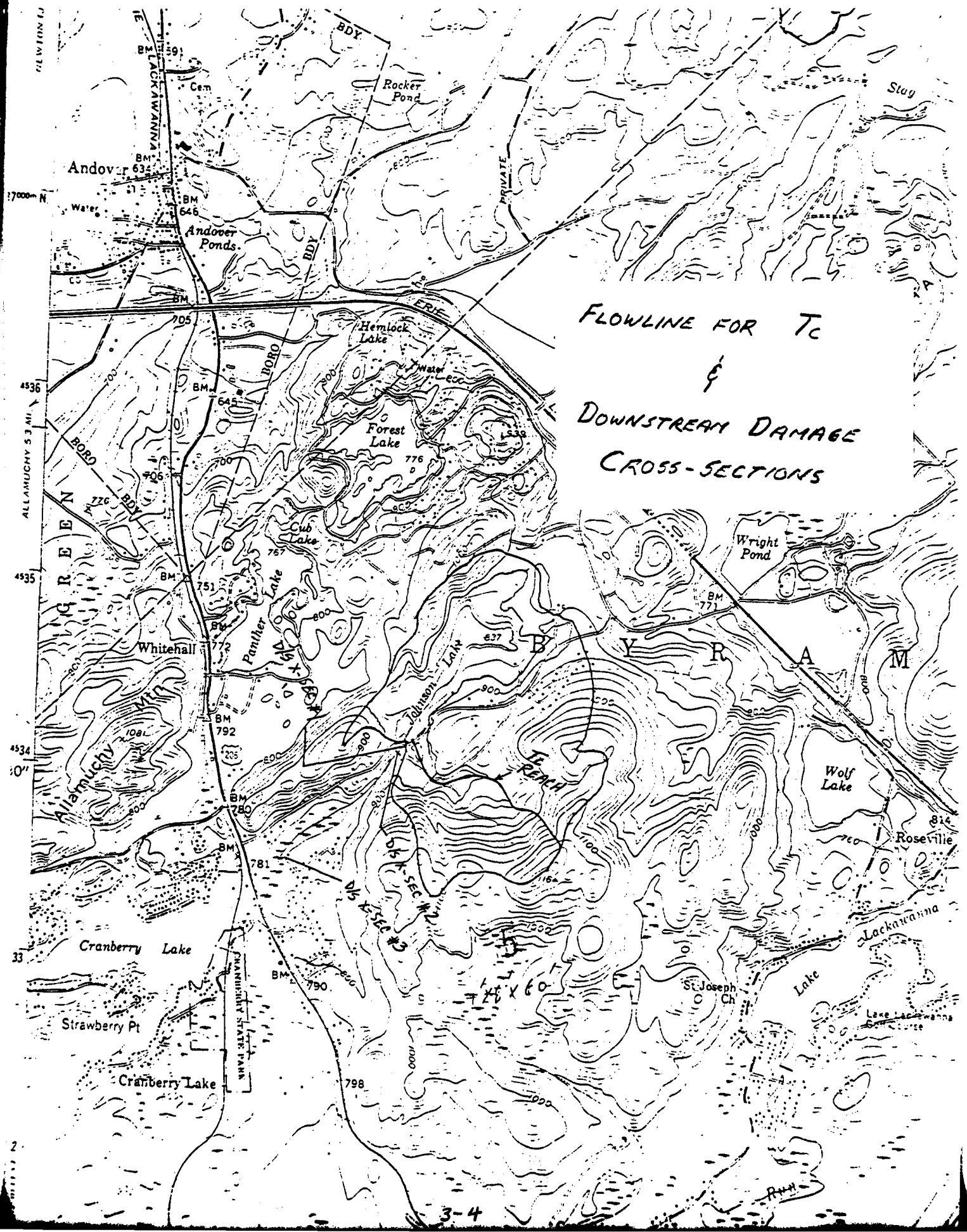
$$\text{ESTIMATED VELOCITY} = 3 \text{ FT/SEC}$$

$$T_c = \frac{4300 \text{ FT}}{3 \text{ FT/SEC}} = 1433 \text{ SEC} = 24 \text{ Min}$$

$$\text{Average } T_c = \frac{100 + 50 + 58 + 24}{4}$$

$$\text{Average } T_c = 58 \text{ Min}$$

$$\text{LAG TIME} = 0.6(58) = 35 \text{ Min} = \underline{0.58 \text{ hrs}}$$



FLOWLINE FOR T_c
DOWNSTREAM DAMAGE
CROSS-SECTIONS

JOB NO. 3409-14

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. SCALEDEVELOPMENT OF RATING CURVE

USE WEIR EQUATION $Q = C L H^{3/2}$ TO DETERMINE
THE RATING CURVE, WHERE

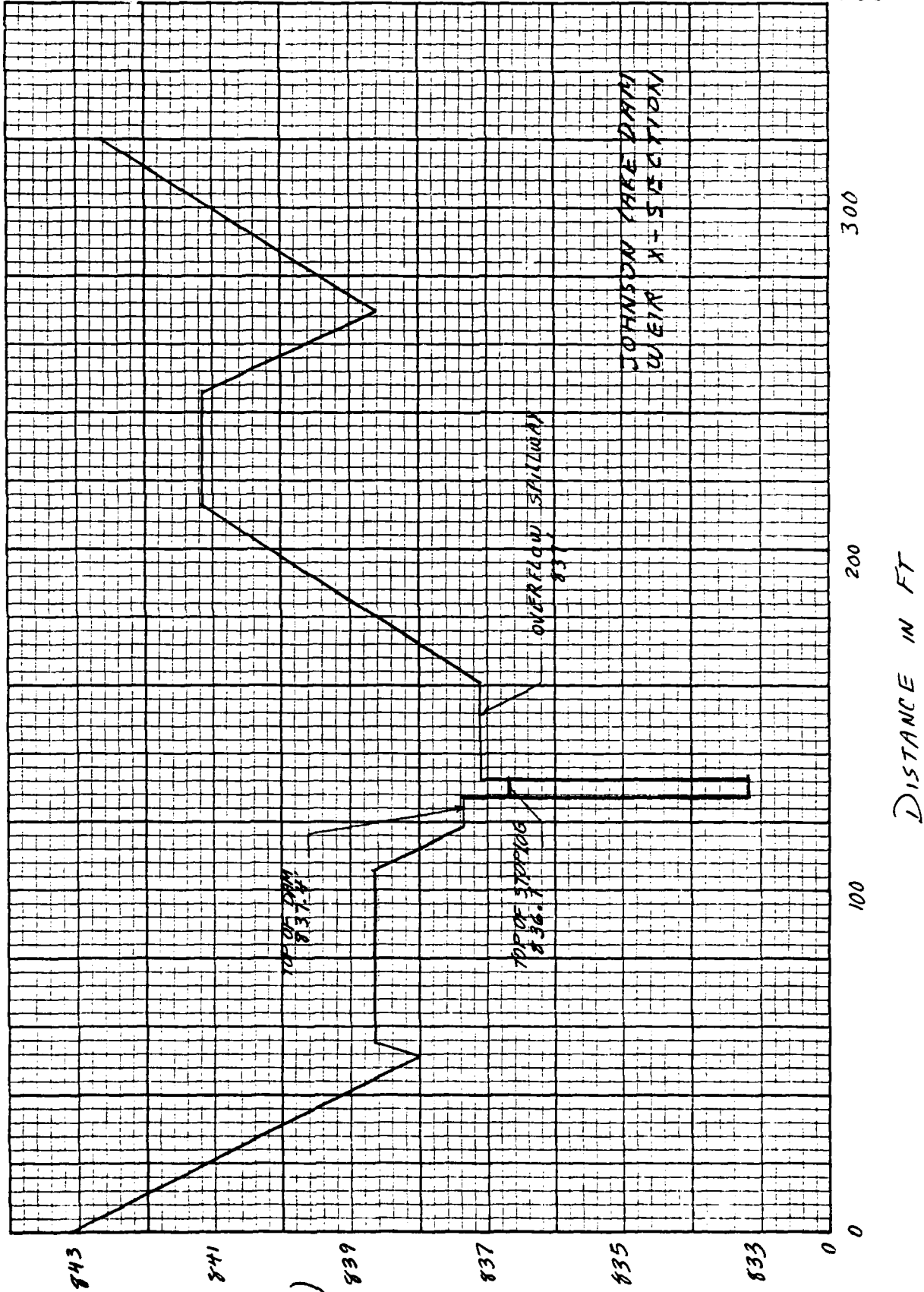
* $C = 3.5$ FOR 2" THICK STOPLOGS

$C = 2.6$ FOR WOODED EMBANKMENT

$C = 2.9$ FOR CONCRETE SECTION

* "C" VALUES ARE TAKEN FROM BRATER & KING "HANDBOOK
OF HYDRAULICS" PAGE 5-40, TABLE 5-3.

COMPUTED: HMMY
CHKD: FDD



ELEV.
(NVGD)

JOB NO. _____

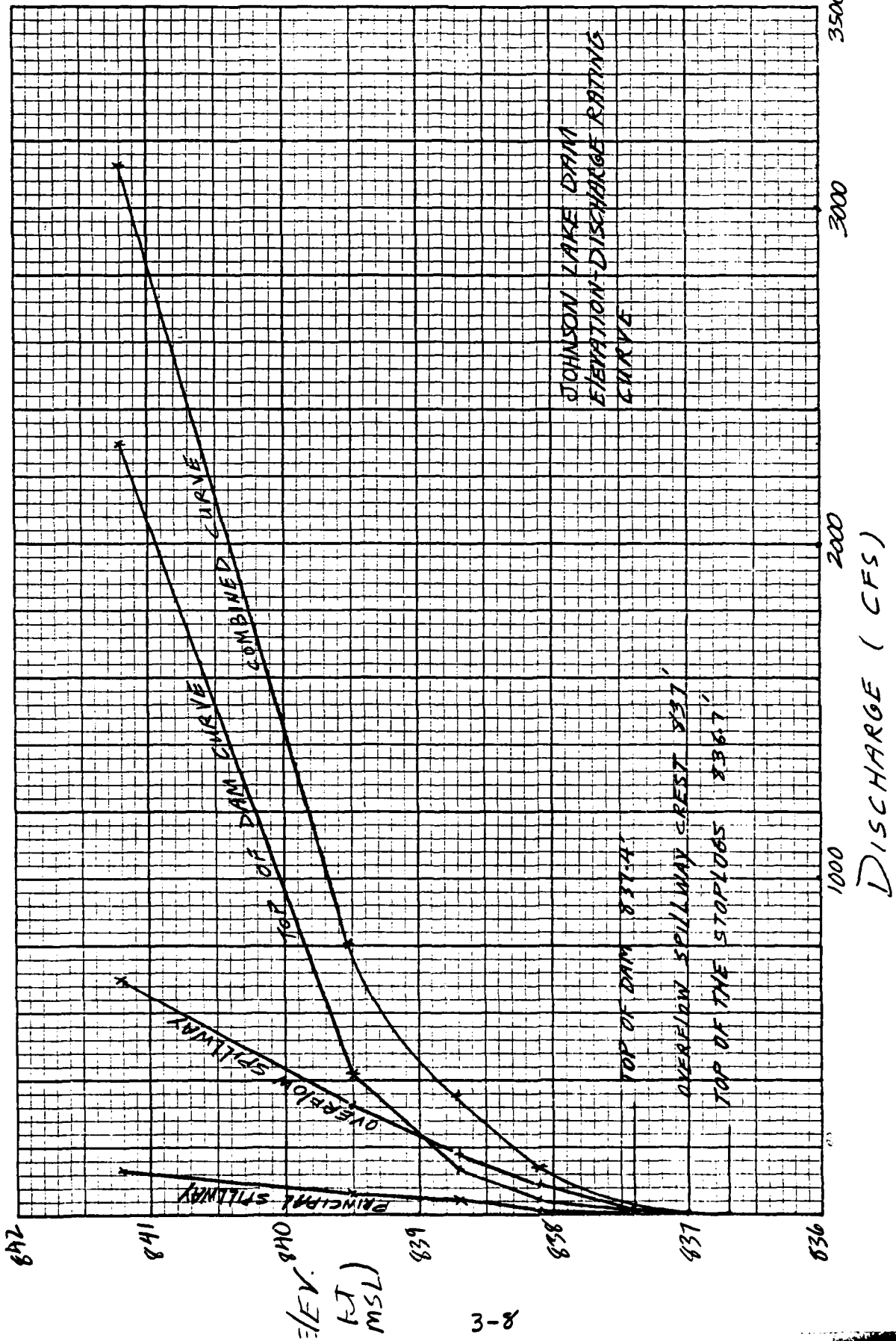
 SQUARES
 1/4 IN. SCALE

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

 1
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4
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38

ELEVATION FT.	PRINCIPAL (WITH SPILOWAY (STOPLOSS)		OVERFLOW SPILOWAY SECTION		TOP OF DAM		COMBINED Q CFS
	HEAD FT	Q CFS	HEAD FT	Q CFS	HEAD FT	LENGTH FT	
836.7	0	0					0
837	0.3	2.3	0	0			2.30
837.4	0.7	8.0	0.4	20	0	10	28
838.1	1.4	10	1.1	94	0.84	21	146
838.7	2.0	40	1.7	180	1.2	40	357
839.5	2.8	66	2.5	321	1.7	73	808
841.2	4.5	134	4.2	700	3.0	170	3131

COMPUTED: HNT
CHKD: FOD



JOB NO. 3409-14SQUARES 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. SCALESTORAGE - ELEVATION DETERMINATION

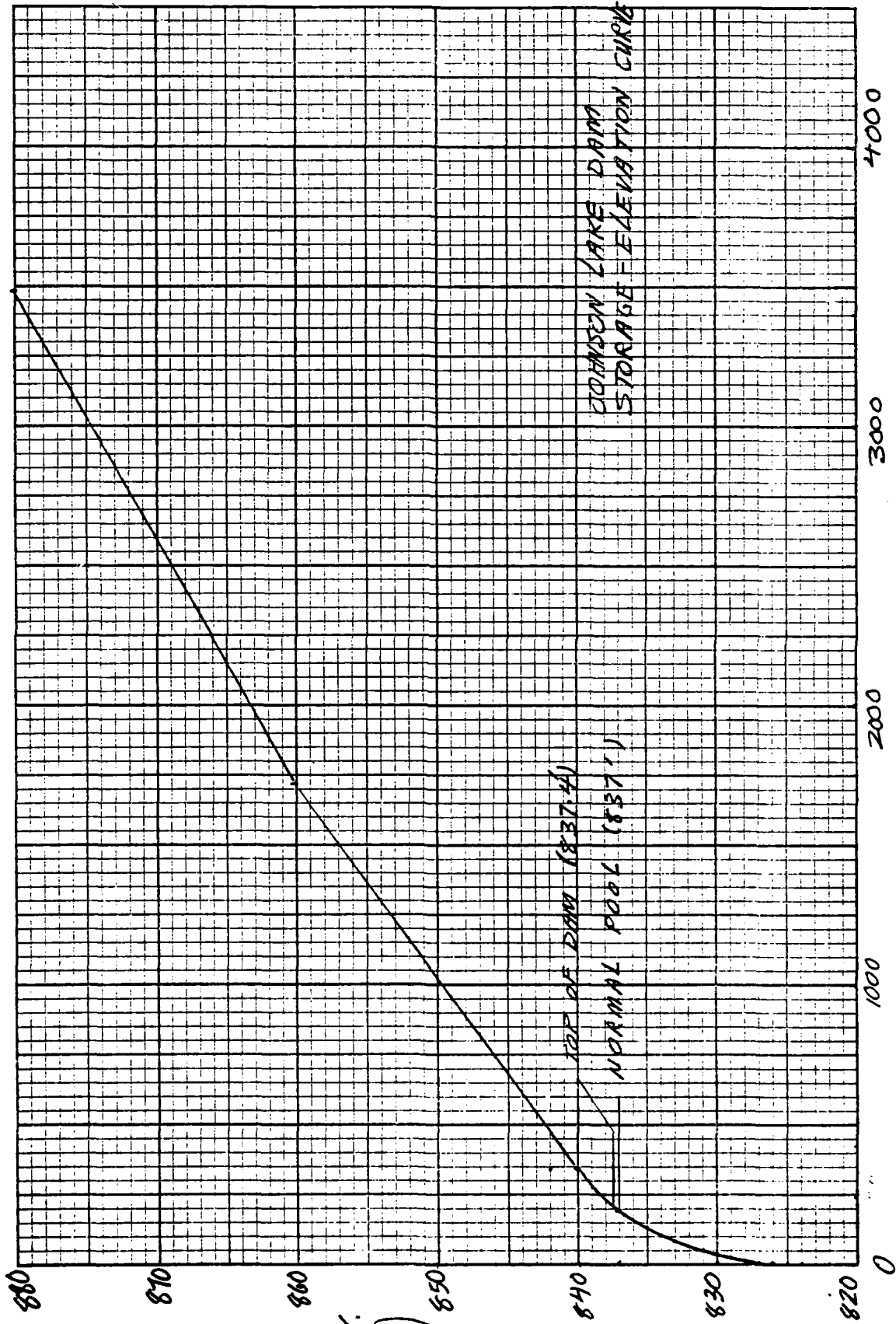
ASSUME AN AVERAGE DEPTH OF 6'
 ASSUME A MAXIMUM DEPTH OF 11'

ELEVATION FT	SURFACE AREA ACRES	AVE. S.A. ACRES	INCREMENTAL STORAGE AC-FT	CUMULATIVE STORAGE AC-FT
837	33	33	198	198
840	63	48	144	342
860	76	69.5	1390	1732
880	99	87.5	1750	3482

INPUT FOR HEC-1 (FROM CURVE)

ELEVATION FT.	STORAGE AC-FT
825.7	0
836.7	170
837	198
837.4	215
838.1	240
838.7	270
839.5	375
841.2	425

COMPUTED: HMM
CHKD: TDD

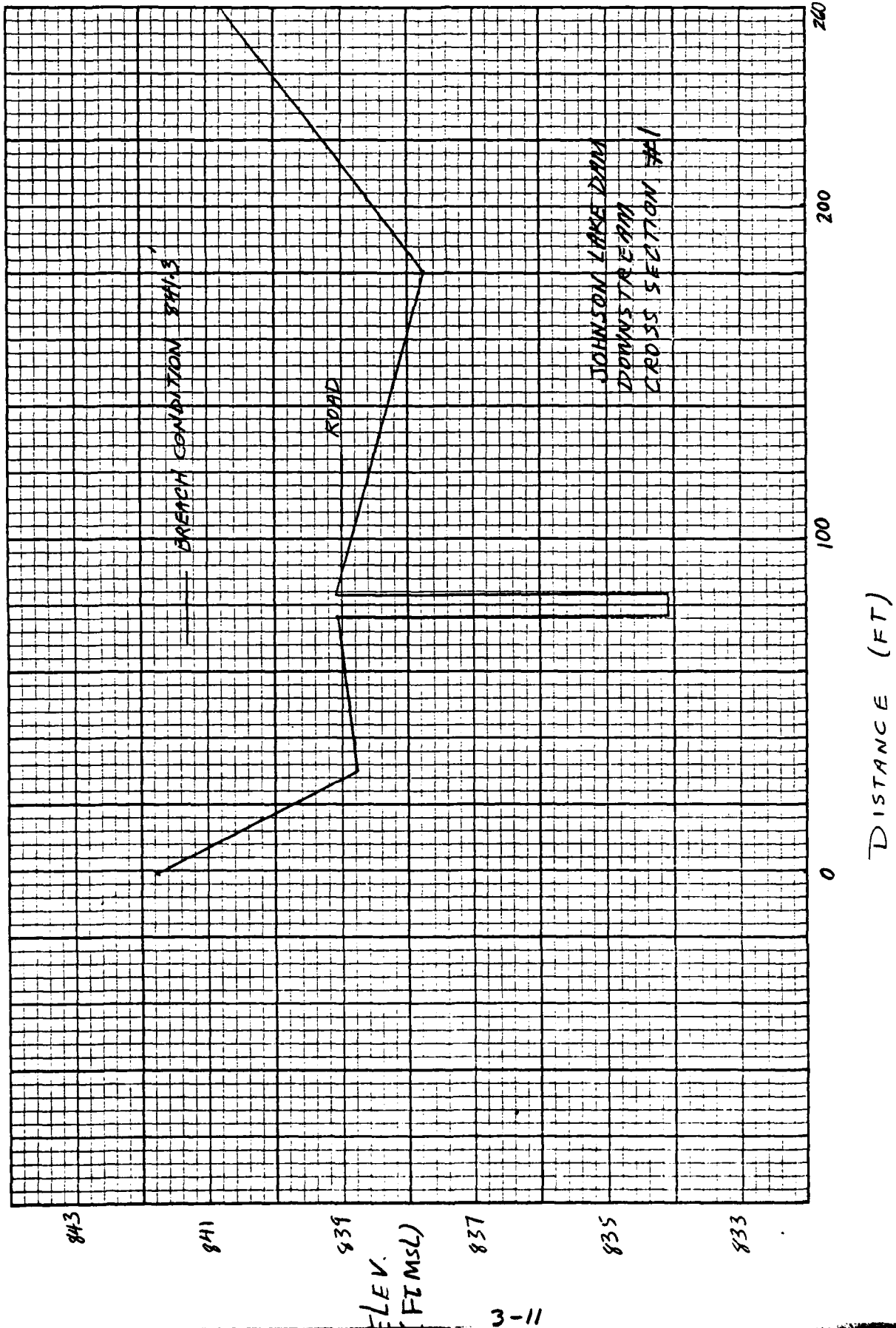


ELEV.
(FT.)
MSL

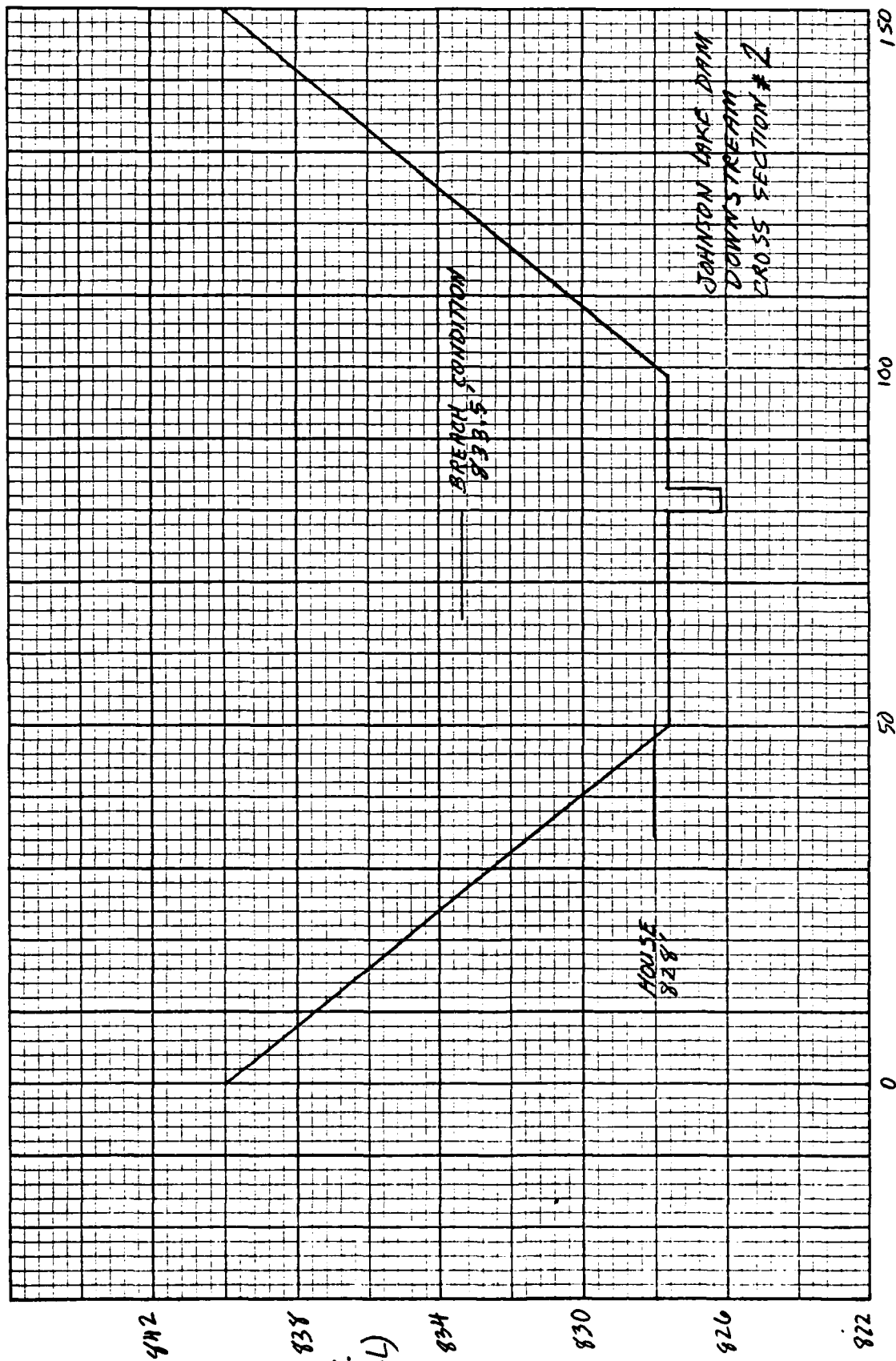
3-10

STORAGE (AC-FT)

COMPUTED: FIFTY
CHRS: FDD



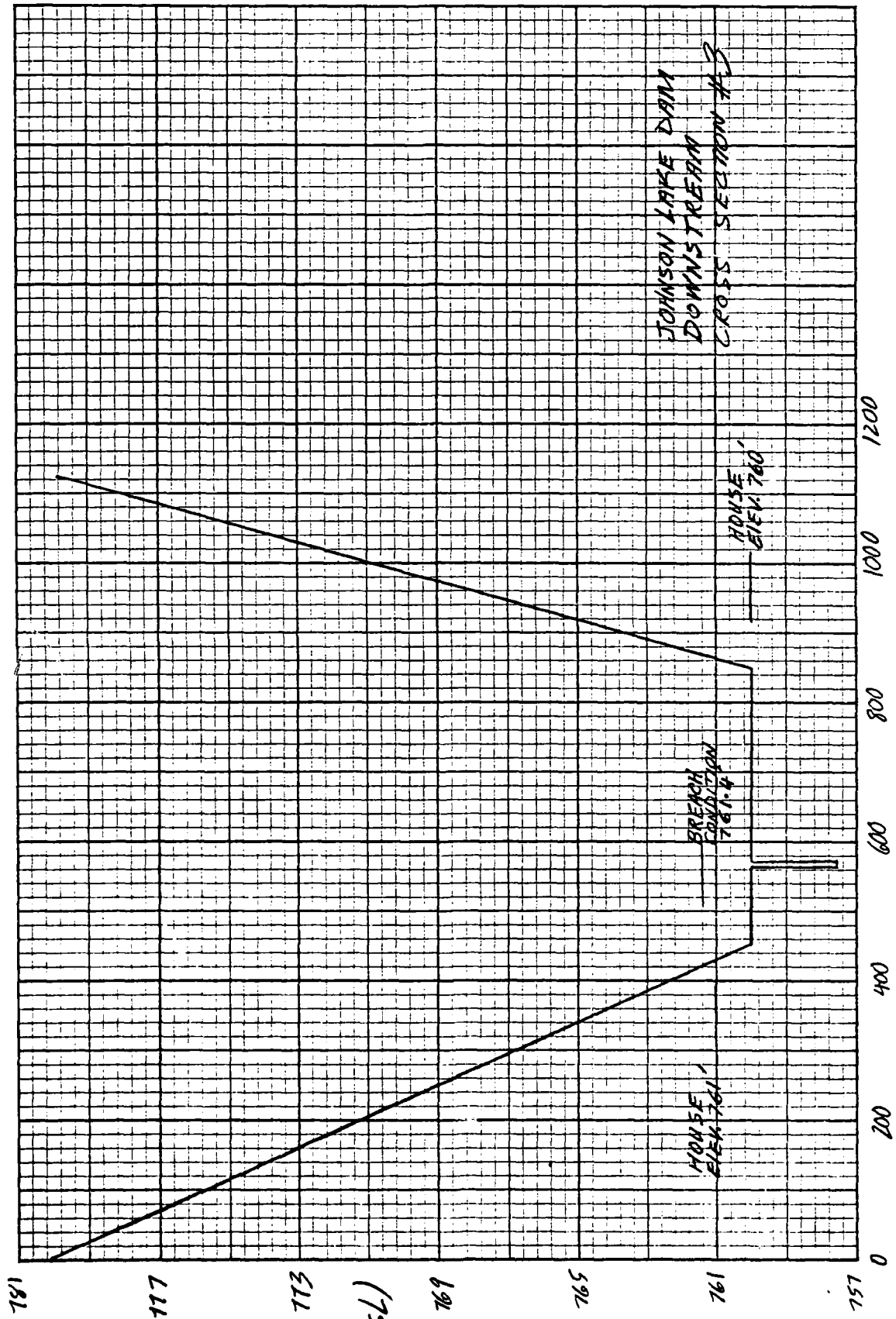
COMPUTED: HMM
 CNA: FOD



DISTANCE (FT)

ELEV.
 (T. MSL)

COMPUTED: MNN
CARG: FDD



DISTANCE (FT)

781
777
773
769
765
761
751

±EV.
FT. MSL)

JOB NO. 3409-14SQUARES 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. SCALEDETERMINATION OF "C" FOR LOW LEVEL OUTLET

$$D = \text{DIAMETER} = 24" = 2 \text{ FT}$$

$$m = 0.014 \text{ (OPEN CHANNEL HYDRAULICS, CHOW P. 110)}$$

$$A_p = \text{AREA OF PIPE OPENING} = 3.14 \text{ FT}^2$$

$$L_p = \text{LENGTH OF PIPE} = 20 \text{ FT}$$

$$K_f = \text{FRICTION LOSS THROUGH PIPE}$$

$$* K_e = \text{ENTRANCE LOSS OF PIPE} = 0.78$$

$$C_p = \text{COEFFICIENT OF DISCHARGE (INCORPORATING } A_p \text{ \& } 2g)$$

$$C = \text{COEFFICIENT OF DISCHARGE}$$

$$K_f = \frac{5087 m^2}{D^{4/3}}$$

$$C_p = A_p \sqrt{\frac{2g}{1 + K_e + K_f L_p}}$$

$$C = \frac{C_p / A_p}{\sqrt{2g}}$$

$$K_f = \frac{5087 (0.014)^2}{(2.4)^{4/3}} = \frac{0.997}{68.5} = 0.014$$

$$C_p = 3.14 \sqrt{\frac{64.4}{1 + 0.78 + (0.014)(20)}} = 17.5$$

$$C = \frac{17.5 / 3.14}{\sqrt{64.4}} = 0.69$$

JOB NO. 3409-14SQUARES 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

CALCULATIONS ASSUME:

1- NO SIGNIFICANT INFLOW

2- LOW LEVEL OUTLET TO BE OPERATING

3- INVERT W/S SAME AS INVERT AT LOW LEVEL OUTLET = 826

4- $Q_p = C_p H^{1/2} = 17.5 H^{1/2}$ (SEE PREVIOUS PAGE)

5- AC-FT-DAY = 1.9835 (AVG. Q)

6- DAYS = Δ STORAGE / AC-FT-DAY

ELEV. FT	STORAGE AC-FT	Δ STORAGE AC-FT	H FT	Q CFS	AVG. Q CFS	AC-FT PER DAY	DAYS
837	198		11	58			
		68			55	109	0.62
835	130		9	52.5			
		50			49.4	98	0.51
833	80		7	46.3			
		30			42.6	84.5	0.35
831	50		5	39			
		25			34.6	69	0.36
829	25		3	30.3			
		15			24	48	0.31
827	10		1	17.5			
		10			8.7	17	0.59
826	0		0	0			

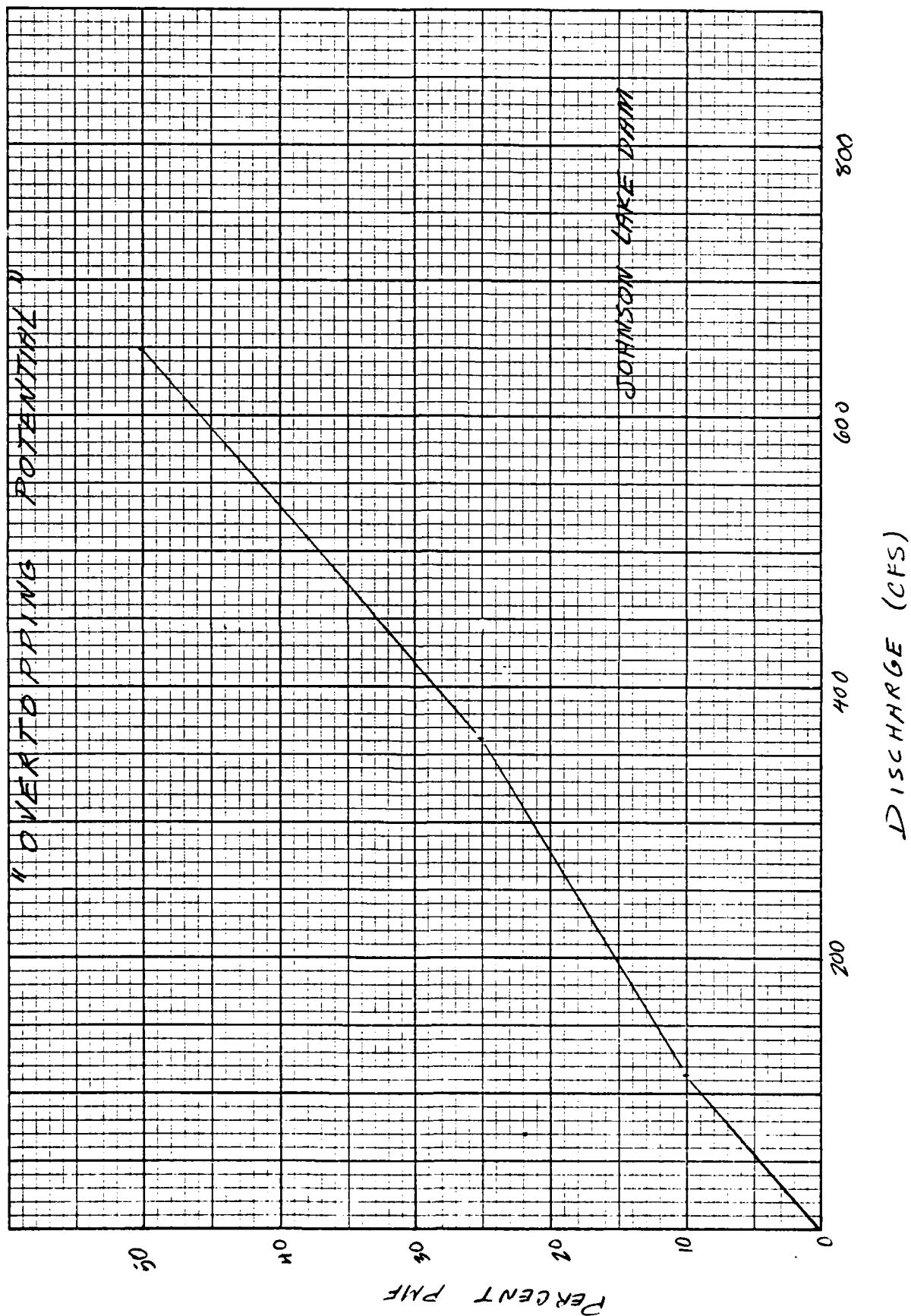
2.74 DAYS

COMPUTED: 1971
CHNO: EDD

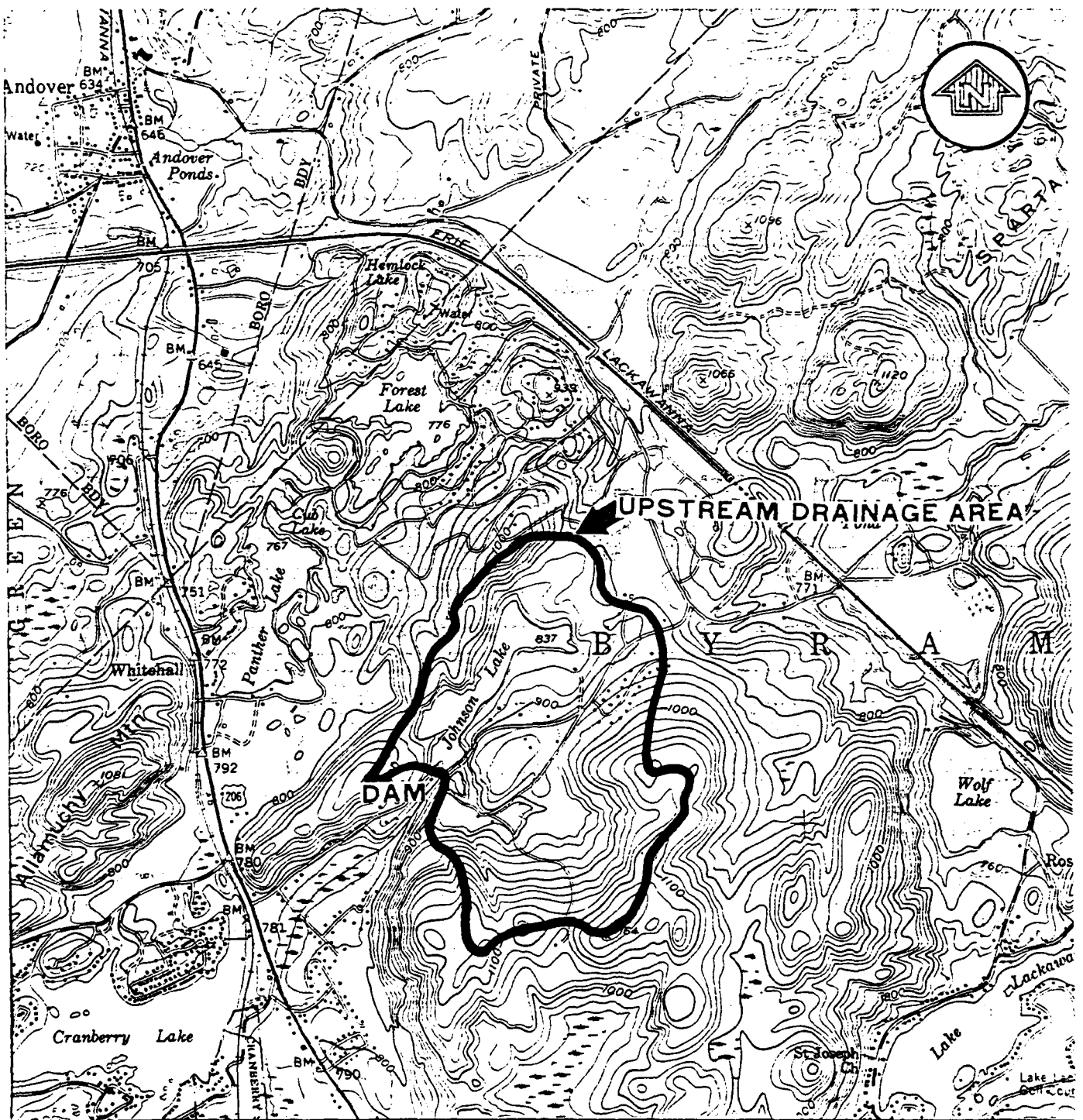
NO. 31.282. 10 DIVISIONS PER INCH BOTH WAYS. 50 BY 50 DIVISIONS.

GRAPH PAPER

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PRINTED IN U.S.A.



91-3



NATIONAL PROGRAM OF INSPECTION OF
NON-FED. DAMS

JOHNSON LAKE DAM

LOCKWOOD, NEW JERSEY

REGIONAL VICINITY MAP

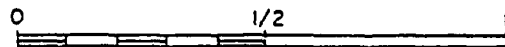
JANUARY 1980

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. STANHOPE, N.J. 1954. REVISED 1970.

HEC-1 OUTPUT
OVERTOPPING AND BREACH ANALYSIS

JOHNSON LAKE DAM

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

A1 JOHNSON LAKE DAM OVERTIPPING ANALYSIS P. MIREHADI ANDERSON-NICHOLS

A2 DAM NUMBER US 00499

A30.1 0.25 0.50 MULTIPLES OF 24-HOUR PMP

P 170 0 10 0 0 0 0 0 0

R1 5 3 1 1 1 1 1 1 1

J1 0.1 0.25 0.5 0.5 0.5 0.5 0.5 0.5 0.5

K 0 0 A1 1 1 1 1 1 1

K DEVELOP INFLOW HYDROGRAPH

P 1 2 0.6 0.8 0.8 0.8 0.8 0.8 0.8

F 1 22 111 123 133 133 133 133 133

T 2 22 111 123 133 133 133 133 133

V2 0.58 0.58 0.58 0.58 0.58 0.58 0.58 0.58 0.58

V -3 -3 -3 -3 -3 -3 -3 -3 -3

K 1 A2 1 1 1 1 1 1 1

KIRROUTE INFLOW HYDROGRAPH THROUGH RESERVOIR

Y 1 1 1 1 1 1 1 1 1

Y1 1 837 837.4 838.1 838.7 839.5 841.2 841.2 841.2

Y4 836.7 837 837.4 838.1 838.7 839.5 841.2 841.2 841.2

Y5 0 2.3 2.8 146 357 808 3131 3131 3131

Y6 0 170 198 215 240 270 375 375 375

Y7 825.7 836.7 837 837.4 838.1 838.7 839.5 841.2 841.2

Y8 837 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y9 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y10 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y11 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y12 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y13 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y14 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y15 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y16 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y17 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y18 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y19 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y20 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y21 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y22 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y23 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y24 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y25 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y26 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y27 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y28 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y29 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y30 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y31 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y32 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y33 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y34 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y35 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y36 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y37 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y38 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y39 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y40 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y41 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y42 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y43 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y44 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y45 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y46 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y47 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

Y48 837.4 837.4 838.1 838.7 839.5 841.2 841.2 841.2 841.2

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT A1
 ROUTE HYDROGRAPH TO A2
 ROUTE HYDROGRAPH TO A2
 ROUTE HYDROGRAPH TO A2
 ROUTE HYDROGRAPH TO A2
 END OF NETWORK

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 NEW SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 75

RUN DATE: 79/11/21.
 TIME: 09.02.17.

JOHNSON LAKE DAP OVERTOPPING ANALYSIS P. FIREWADI ANDERSON-NICKCLS
 DAP NUMBER US 00499
 0.1 0.25 0.50 MULTIPLES OF 24-HOUR FMP

JOR SPECIFICATION									
NO	MHR	MMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
170	0	10	0	0	0	0	0	0	0
			JCFR	NVT	LRCFT	TPACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 2 NRATIO= 3 LRTIO= 1

RTIOS= .10 .25 .50

SUB-AREA RUNOFF COMPUTATION

DEVELOP INFLOW HYDROGRAPH

ISTAO	ICOMP	TECON	ITAPF	JPLT	JPRT	INAME	ISTAGE	TAUTO
A1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

1HYDG	IUNG	TAREA	SNAP	TRSDA	TPSPC	RATIO	ISNCH	ISAME	LOCAL
1	2	.60	0.00	.60	.80	0.000	0	1	0

PRECIP DATA

SFFE	PMS	R4	R12	P24	R48	R72	R96
0.00	22.00	111.00	123.00	133.00	0.00	0.00	0.00

LOSS DATA

LROPT	STKR	DLTKR	RTIOL	ERAIN	STKS	RTIOK	STRTL	CNSIL	ALSMX	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= .5P

RECESSION DATA

STRIO= -3.00 GRCSH= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 19 END OF PERIOD COORDINATES. TC= 0.00 10URS. LAGE .5P VOL= 1.00 54.
 64. 20P. 38P. 47. 30P. 20P. 1P2. 121. P3. 1.
 35. 24. 11. 7. 5. 3. 2. 1.

END-OF-PERIOD FLOW

PC-DA	HR-FN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO-DA	HR-PA	PERIOD	RAIN	EXCS	LCSS	COMP R
1.01	.10	1	.02	0.00	.02	2.	1.01	14.20	86	.49	.47	.02	.876.
1.01	.20	2	.02	0.00	.02	2.	1.01	14.30	87	.49	.47	.02	.921.
1.01	.30	3	.02	0.00	.02	2.	1.01	14.40	88	.49	.47	.02	.969.
1.01	.40	4	.02	0.00	.02	2.	1.01	14.50	89	.49	.47	.02	1010.
1.01	.50	5	.02	0.00	.02	2.	1.01	15.00	90	.49	.47	.02	1041.
1.01	1.00	6	.02	0.00	.02	2.	1.01	15.10	91	.45	.43	.02	1057.
1.01	1.10	7	.02	0.00	.02	2.	1.01	15.20	92	.74	.73	.02	1080.
1.01	1.20	8	.02	0.00	.02	2.	1.01	15.30	93	1.34	1.32	.02	1171.
1.01	1.30	9	.02	0.00	.02	2.	1.01	15.40	94	3.34	3.32	.02	1524.
1.01	1.40	10	.02	0.00	.02	2.	1.01	15.50	95	.97	.95	.02	2134.
1.01	1.50	11	.02	0.00	.02	2.	1.01	16.00	96	.59	.58	.02	2753.
1.01	2.00	12	.02	0.00	.02	2.	1.01	16.10	97	.46	.44	.02	2942.
1.01	2.10	13	.02	0.00	.02	2.	1.01	16.20	98	.46	.44	.02	2737.
1.01	2.20	14	.02	0.00	.02	2.	1.01	16.30	99	.46	.44	.02	2326.
1.01	2.30	15	.02	0.00	.02	2.	1.01	16.40	100	.46	.44	.02	1486.
1.01	2.40	16	.02	0.00	.02	2.	1.01	16.50	101	.46	.44	.02	1594.
1.01	2.50	17	.02	0.00	.02	2.	1.01	17.00	102	.46	.44	.02	1406.
1.01	3.00	18	.02	0.00	.02	2.	1.01	17.10	103	.36	.34	.02	1270.
1.01	3.10	19	.02	0.00	.02	2.	1.01	17.20	104	.36	.34	.02	1164.
1.01	3.20	20	.02	0.00	.02	2.	1.01	17.30	105	.36	.34	.02	1069.
1.01	3.30	21	.02	0.00	.02	2.	1.01	17.40	106	.36	.34	.02	.989.
1.01	3.40	22	.02	0.00	.02	2.	1.01	17.50	107	.36	.34	.02	.926.
1.01	3.50	23	.02	0.00	.02	2.	1.01	18.00	108	.36	.34	.02	.881.
1.01	4.00	24	.02	0.00	.02	2.	1.01	18.10	109	.03	.01	.02	.831.
1.01	4.10	25	.02	0.00	.02	2.	1.01	18.20	110	.03	.01	.02	.744.
1.01	4.20	26	.02	0.00	.02	2.	1.01	18.30	111	.03	.01	.02	.604.
1.01	4.30	27	.02	0.00	.02	2.	1.01	18.40	112	.03	.01	.02	.450.
1.01	4.40	28	.02	0.00	.02	2.	1.01	18.50	113	.03	.01	.02	.315.
1.01	4.50	29	.02	0.00	.02	2.	1.01	19.00	114	.03	.01	.02	.215.
1.01	5.00	30	.02	0.00	.02	2.	1.01	19.10	115	.03	.01	.02	.153.
1.01	5.10	31	.02	0.00	.02	2.	1.01	19.20	116	.03	.01	.02	.112.
1.01	5.20	32	.02	0.00	.02	2.	1.01	19.30	117	.03	.01	.02	.85.
1.01	5.30	33	.02	0.00	.02	2.	1.01	19.40	118	.03	.01	.02	.66.
1.01	5.40	34	.02	0.00	.02	2.	1.01	19.50	119	.03	.01	.02	.54.
1.01	5.50	35	.02	0.00	.02	2.	1.01	20.00	120	.03	.01	.02	.46.
1.01	6.00	36	.02	0.00	.02	2.	1.01	20.10	121	.03	.01	.02	.41.
1.01	6.10	37	.06	0.00	.06	2.	1.01	20.20	122	.03	.01	.02	.37.
1.01	6.20	38	.06	0.00	.06	2.	1.01	20.30	123	.03	.01	.02	.35.
1.01	6.30	39	.06	0.00	.06	2.	1.01	20.40	124	.03	.01	.02	.33.
1.01	6.40	40	.06	0.00	.06	2.	1.01	20.50	125	.03	.01	.02	.32.
1.01	6.50	41	.06	0.00	.06	2.	1.01	21.00	126	.03	.01	.02	.32.
1.01	7.00	42	.06	.04	.02	4.	1.01	21.10	127	.03	.01	.02	.31.
1.01	7.10	43	.06	.04	.02	13.	1.01	21.20	128	.03	.01	.02	.31.
1.01	7.20	44	.06	.04	.02	29.	1.01	21.30	129	.03	.01	.02	.31.
1.01	7.30	45	.06	.04	.02	47.	1.01	21.40	130	.03	.01	.02	.31.
1.01	7.40	46	.06	.04	.02	63.	1.01	21.50	131	.03	.01	.02	.31.
1.01	7.50	47	.06	.04	.02	76.	1.01	22.00	132	.03	.01	.02	.31.
1.01	8.00	48	.06	.04	.02	84.	1.01	22.10	133	.03	.01	.02	.31.
1.01	8.10	49	.06	.04	.02	89.	1.01	22.20	134	.03	.01	.02	.31.
1.01	8.20	50	.06	.04	.02	92.	1.01	22.30	135	.03	.01	.02	.31.
1.01	8.30	51	.06	.04	.02	95.	1.01	22.40	136	.03	.01	.02	.31.
1.01	8.40	52	.06	.04	.02	96.	1.01	22.50	137	.03	.01	.02	.31.
1.01	8.50	53	.06	.04	.02	97.	1.01	23.00	138	.03	.01	.02	.31.
1.01	9.00	54	.06	.04	.02	98.	1.01	23.10	139	.03	.01	.02	.31.
1.01	9.10	55	.06	.04	.02	99.	1.01	23.20	140	.03	.01	.02	.31.
1.01	9.20	56	.06	.04	.02	99.	1.01	23.30	141	.03	.01	.02	.31.
1.01	9.30	57	.06	.04	.02	99.	1.01	23.40	142	.03	.01	.02	.31.
1.01	9.40	58	.06	.04	.02	99.	1.01	23.50	143	.03	.01	.02	.31.

CFS 42. 17. 5. 4. 685.
 INCHES 9.10 10.40 10.41 10.41
 KW 233.22 264.21 264.45 264.45
 AC-FT 294. 332. 333. 333.
 THOUS CU M 362. 410. 411. 411.

PLAN 2 SAME AS PLAN 1

HYDROGRAPH ROUTING

ROUTE INFLOW HYDROGRAPH THROUGH RESERVOIR

ISTAO	ICOMP	JECOM	ITAF	JPLT	JFRT	INAVE	ISTAGE	IAUTC
A2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

LOSS	CLCSS	AVG	IRCS	ISAF	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

STAGE	836.70	837.00	838.10	838.70	839.50	841.20
FLOW	0.00	28.00	146.00	357.00	802.00	3131.00
CAPACITY	0.	170.	215.	240.	270.	375.
ELEVATION	826.	837.	837.	838.	839.	840.

CRIL	SPVID	COQU	EXPV	ELEV	COCL	CAREA	EXPL
837.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPFL	CCRD	EXPD	DAMPVID
837.4	0.0	0.0	0.

DAM BREACH DATA

PRVID	Z	ELPP	TFAIL	NSEL	FAIEL
11.	1.00	826.00	1.00	837.00	837.40

REGIN DAY FAILURE AT 12.47 HOURS

STATION

AC, PLAN. 1, RATIO 3

(BREACH)

END-OF-PERIOD HYDROGRAPH COORDINATES

[illegible]

STÖRAGE

[illegible]

STAGE

[illegible]

827.8 827.7 827.2 827.6 827.5 827.4 827.4 827.3
 827.3 827.3 827.2 827.2 827.2 827.1 827.1 827.0
 827.0 826.9 826.9 826.9 826.9 826.8 826.8 826.8
 826.8 826.7 826.7 826.7 826.7 826.6 826.6 826.6

PEAK OUTFLOW IS 2118. AT TIME 13.67 PCURS

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
2118.	889.	261.	221.	37626.	
60.	25.	7.	6.	1065.	
	13.65	16.10	16.20	16.20	
	346.72	410.95	411.58	411.58	
	437.	517.	518.	518.	
	539.	638.	639.	639.	

CFS
 CMS
 INCHES
 "M
 AC-FY
 THOUS CU M

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
 DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
 THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
 INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	COMPUTED BREACH HYDROGRAPH (CFS)	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED EPRCR (AC-FT)
12.667	0.000	29.	29.	0.	0.	0.
12.688	.021	44.	35.	9.	9.	0.
12.708	.042	58.	44.	14.	23.	0.
12.729	.063	73.	56.	17.	39.	0.
12.750	.083	87.	70.	17.	56.	0.
12.771	.104	102.	86.	15.	72.	0.
12.792	.125	116.	104.	12.	84.	0.
12.813	.146	131.	124.	7.	91.	0.
12.833	.167	145.	145.	0.	91.	0.
12.854	.188	173.	148.	5.	96.	0.
12.875	.208	201.	193.	9.	104.	0.
12.896	.229	229.	219.	11.	115.	0.
12.917	.250	257.	246.	11.	126.	0.
12.938	.271	285.	275.	11.	137.	0.
12.958	.292	313.	305.	8.	145.	0.
12.979	.313	342.	337.	5.	150.	0.
13.000	.333	370.	370.	0.	150.	0.
13.021	.354	408.	404.	4.	154.	0.
13.042	.375	446.	439.	7.	161.	0.
13.063	.396	484.	476.	9.	170.	0.
13.083	.417	523.	513.	9.	179.	0.
13.104	.438	561.	552.	9.	188.	0.
13.125	.458	599.	592.	8.	196.	0.
13.146	.479	637.	632.	5.	201.	0.
13.167	.500	676.	676.	0.	201.	0.
13.188	.521	724.	721.	4.	205.	0.
13.208	.542	773.	767.	6.	211.	0.
13.229	.563	822.	814.	8.	219.	0.
13.250	.583	871.	863.	8.	227.	0.
13.271	.604	919.	912.	7.	234.	0.
13.292	.625	968.	962.	6.	240.	0.
13.313	.646	1017.	1013.	3.	243.	0.
13.333	.667	1066.	1066.	0.	243.	0.
13.354	.688	1124.	1119.	5.	248.	0.
13.375	.708	1181.	1172.	9.	257.	0.
13.396	.729	1239.	1227.	12.	270.	0.
13.417	.750	1297.	1292.	5.	285.	0.
13.438	.771	1355.	1338.	17.	302.	1.
13.458	.792	1413.	1395.	18.	320.	1.
13.479	.812	1471.	1461.	10.	331.	1.
13.500	.833	1529.	1529.	0.	331.	1.
13.521	.854	1603.	1598.	4.	335.	1.
13.542	.875	1676.	1665.	7.	342.	1.
13.562	.896	1750.	1741.	9.	351.	1.
13.583	.917	1823.	1814.	9.	360.	1.
13.604	.937	1897.	1888.	9.	369.	1.
13.625	.958	1971.	1964.	7.	376.	1.
13.646	.979	2044.	2040.	4.	380.	1.
13.667	1.000	2118.	2118.	0.	380.	1.

STATION A2

(•) POINTS AT NORMAL TIME INTERVAL

[illegible]

OUTLOOK

[illegible]

198.	198.	198.	198.	198.	198.	198.	198.	198.	198.
198.	198.	198.	198.	198.	198.	198.	198.	198.	198.
198.	198.	198.	198.	198.	198.	198.	198.	198.	198.
201.	202.	202.	203.	203.	203.	203.	203.	203.	203.
206.	207.	207.	208.	208.	208.	208.	208.	208.	208.
211.	211.	211.	212.	212.	212.	212.	212.	212.	212.
231.	235.	235.	236.	236.	236.	236.	236.	236.	236.
264.	267.	267.	270.	270.	270.	270.	270.	270.	270.
336.	338.	338.	339.	339.	339.	339.	339.	339.	339.
321.	321.	321.	322.	322.	322.	322.	322.	322.	322.
269.	269.	269.	271.	271.	271.	271.	271.	271.	271.
240.	240.	240.	241.	241.	241.	241.	241.	241.	241.
227.	227.	227.	228.	228.	228.	228.	228.	228.	228.
220.	219.	219.	218.	218.	218.	218.	218.	218.	218.
215.	214.	214.	214.	214.	214.	214.	214.	214.	214.

837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.1	837.1	837.1	837.1	837.1	837.1	837.1	837.1	837.1	837.1
837.2	837.2	837.2	837.2	837.2	837.2	837.2	837.2	837.2	837.2
837.3	837.3	837.3	837.3	837.3	837.3	837.3	837.3	837.3	837.3
837.8	837.8	837.8	837.8	837.8	837.8	837.8	837.8	837.8	837.8
838.6	838.6	838.6	838.6	838.6	838.6	838.6	838.6	838.6	838.6
839.2	839.2	839.2	839.2	839.2	839.2	839.2	839.2	839.2	839.2
839.1	839.1	839.1	839.1	839.1	839.1	839.1	839.1	839.1	839.1
838.7	838.7	838.7	838.7	838.7	838.7	838.7	838.7	838.7	838.7
838.1	838.1	838.1	838.1	838.1	838.1	838.1	838.1	838.1	838.1
837.7	837.7	837.7	837.7	837.7	837.7	837.7	837.7	837.7	837.7
837.5	837.5	837.5	837.5	837.5	837.5	837.5	837.5	837.5	837.5
837.4	837.4	837.4	837.4	837.4	837.4	837.4	837.4	837.4	837.4

PEAK OUTFLOW IS 648. AT TIME 17.00 HOURS

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
648.	483.	161.	137.	23229.
18.	14.	5.	4.	658.
	7.50	9.98	10.00	10.00
	190.39	251.47	254.10	254.10
	240.	319.	320.	320.
	296.	394.	395.	395.

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HYDROGRAPH ROUTING

ROUTE OUTFLOW HYDROGRAPH THROUGH REACH ONE

ISTAG	ICOMP	ICCON	ITATF	JPLT	JPRY	INAME	ISTAGE	IAUTO
	1	0	0	0	0	0	0	0

ALL PLANS HAVE SAPE

[illegible]

ROUTE OUTFLOW HYDROGRAPH THROUGH REACH TWO

ISTAQ	JCOMP	IECON	ITAPF	JPLT	JFRT	INAME	ISTAGE	TAUTC
	1	0	0	0	0	0	0	0

ALL PLANS HAVE SAME

ROUTING DATA

CLASS	CLASS	AVG
9.0	0.000	0.00

INSTPS	NSIDL	LAG	APSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL, FIFTH CHANNEL ROUTING

QW(1)	QW(2)	QW(3)	FLNVT	ELMAX	RLNTH	SEL
.1000	.0400	.1000	226.1	840.0	325.	.01300

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

0.00	440.00	50.00	827.60	80.00	026.10	826.10
83.00	827.60	98.00	827.60	150.00	040.00	

	0.00	.02	.03	.30	.61	.95	1.32	1.73	2.17	2.65
	3.15	3.69	4.27	4.87	5.51	6.10	6.00	7.62	8.39	9.19
STORAGE	0.00	.02	.03	.30	.61	.95	1.32	1.73	2.17	2.65
	3.15	3.69	4.27	4.87	5.51	6.10	6.00	7.62	8.39	9.19
OUTFLOW	0.00	5.81	15.26	72.29	192.79	366.33	591.03	866.93	1194.93	1576.35
	2012.74	2595.79	3057.28	3669.00	4342.80	5000.53	5884.04	6755.17	7695.76	8707.65
STAGE	826.10	826.83	827.56	828.29	829.03	829.76	830.49	831.22	831.95	832.68
	833.42	834.15	834.88	835.61	836.34	837.07	837.81	838.54	839.27	840.00
FLOW	0.00	5.81	15.26	72.29	192.79	366.33	591.03	866.93	1194.93	1576.35
	2012.74	2595.79	3057.28	3669.00	4342.80	5000.53	5884.04	6755.17	7695.76	8707.65

15

833.4

STATION 2, PLAN 1, RTIC 3 (BREACH)

PLAN 1, RTIO 3

2

STATION

continued on next page

OUTFLOW

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[illegible]

STOR

10

3945

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	2043.	880.	261.	221.	37623.	37623.
CMS	58.	25.	7.	6.	1065.	1065.
INCHES		13.64	16.18	16.20	16.20	16.20
PM		346.51	410.92	411.55	411.55	411.55
AC-FT		436.	517.	518.	518.	518.
CU		518.	639.	639.	639.	639.

MAXIMUM STORAGE =

MAXIMUM STAGE IS 33.5

PLAN 2. P110 3
(OVERTOPPING)

[illegible]

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
21.	22.	23.	24.	25.	26.	27.	28.	29.	30.
100.	117.	134.	153.	176.	199.	222.	244.	267.	289.
311.	331.	352.	372.	399.	431.	464.	498.	536.	574.
582.	647.	688.	746.	811.	884.	964.	1051.	1146.	1249.
358.	562.	519.	275.	251.	239.	209.	175.	138.	100.
147.	138.	131.	123.	116.	110.	104.	99.	93.	88.
84.	80.	76.	72.	69.	66.	63.	60.	57.	53.
50.	48.	45.	42.	40.	37.	35.	33.	31.	29.
28.	27.	26.	25.	24.	23.	22.	21.	20.	19.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4
R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4
R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4
R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4	R26.4
R26.9	R27.0	R27.1	R27.6	R27.6	R27.6	R27.6	R27.6	R27.6	R27.6
R27.5	R27.6	R27.6	R27.6	R27.6	R27.6	R27.6	R27.6	R27.6	R27.6
R27.6	R27.6	R27.7	R27.7	R27.7	R27.7	R27.7	R27.7	R27.7	R27.7
R28.5	R29.6	R29.7	R29.8	R29.9	R30.0	R30.2	R30.5	R30.5	R30.5
R30.6	R30.6	R30.6	R30.6	R30.6	R30.6	R30.6	R30.6	R30.6	R30.6
R30.5	R30.4	R30.3	R30.3	R30.2	R30.1	R30.0	R29.9	R29.9	R29.9
R29.7	R29.6	R28.5	R28.6	R28.6	R28.5	R28.5	R28.5	R28.5	R28.5
R28.4	R28.3	R28.3	R28.3	R28.3	R28.2	R28.2	R28.2	R28.2	R28.2
R28.0	R27.9	R27.9	R27.9	R27.9	R27.8	R27.8	R27.8	R27.8	R27.8
R27.7	R27.7	R27.7	R27.7	R27.7	R27.7	R27.7	R27.7	R27.7	R27.7

CFS	64R.	6-HOUR	24-HOUR	72-HOUR	TOTAL
INCHES	1R.	4R3.	141.	137.	23224.
AC-FT		14.	5.	4.	65P.
THOUS CU F		190.39	253.41	254.04	320.
		240.	319.	320.	395.
		296.	394.	395.	

MAXIMUM STORAGE = 1.

MAXIMUM STAGE IS 830.6

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HYDROGRAPH ROUTING

ROUTE OUTFLOW HYDROGRAPH THROUGH REACH THREE

ISTAO	ICOMP	IECON	ITAPE	JFLY	JPRI	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	0	0	0

ALL PLANS HAVE SAME

ROUTING DATA				ROUTING DATA			
QLOSS	CLCSS	AVG	IRIS	ISAME	IOPY	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKX	X	STOR	ISPRAT
1	0	0	0.000	0.000	-1.	0

KORPAL DEPTH CHANNEL ROUTING

QNI(1)	QNI(2)	QNI(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0400	.1000	757.5	780.0	2800.	.02300

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

0.00	780.00	450.00	760.00	550.00	757.50	757.50
552.50	760.00	822.50	760.00	1120.00	780.00	

STORAGE	0.00	.17	.38	59.97	96.37	136.15	177.29	225.80	275.68
	328.93	385.54	445.53	575.61	645.70	719.17	796.00	876.20	959.77
OUTFLOW	0.00	12.00	29.26	84.34	7101.53	11932.57	17922.64	25087.36	33452.74
	43050.63	53916.37	66087.44	94501.50	110824.11	120610.68	147901.52	168736.86	191156.81
STAFF	757.50	758.68	771.71	762.24	763.42	764.61	765.79	766.97	768.16
	769.34	770.53	771.71	774.08	775.26	776.45	777.63	778.82	780.00
FLOW	0.00	12.00	29.26	84.34	7101.53	11932.57	17922.64	25087.36	33452.74
	43050.63	53916.37	66087.44	94501.50	110824.11	120610.68	147901.52	168736.86	191156.81

[illegible]

(OVERTOPPING)

STATION 3, PLAN 2, PTIO 3

[illegible]

STOR

[illegible]

STAGE

[illegible]

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)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS		
				RATIO 1	RATIO 2	RATIO 3
				.10	.25	.50
HYDROGRAPH AT	A1	.60	1	294.	735.	1471.
	(	1.55)	(	8.33)(	20.82)(	41.65)(
	A2	.60	2	294.	735.	1471.
	(	1.55)	(	8.33)(	20.82)(	41.65)(
ROUTED TC	1	.60	1	2045.	2075.	2118.
	(	1.55)	(	57.90)(	58.75)(	59.97)(
	2	.60	2	114.	362.	648.
	(	1.55)	(	3.21)(	10.25)(	18.34)(
ROUTED TC	1	.60	1	2027.	2052.	2093.
	(	1.55)	(	57.41)(	58.11)(	59.26)(
	2	.60	2	114.	362.	648.
	(	1.55)	(	3.22)(	10.25)(	18.35)(
ROUTED TC	1	.60	1	1984.	2007.	2043.
	(	1.55)	(	56.18)(	56.84)(	57.86)(
	2	.60	2	113.	362.	648.
	(	1.55)	(	3.21)(	10.25)(	18.35)(
ROUTED TC	1	.60	1	1646.	1672.	1730.
	(	1.55)	(	46.61)(	47.34)(	48.99)(
	2	.60	2	112.	353.	637.
	(	1.55)	(	3.17)(	10.00)(	18.04)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
STORAGE		837.00		837.00		837.40	
OUTFLOW		198.		198.		215.	
		2.		2.		28.	
RATIO	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM	DURATION	TIME OF	TIME CF
OF	RESERVOIR	STORAGE	OUTFLOW	OUTFLOW	OVER TOP	MAX OUTFLOW	FAILURE
PMF	V.S.ELEV	AC-FT	CFS	CFS	HOURS	HOURS	HOURS
.10	837.42	216.	2045.	2045.	.44	16.33	15.33
.25	837.50	219.	2075.	2075.	.60	14.67	13.67
.50	837.48	218.	2118.	2118.	.65	13.67	12.67

PLAN 2

ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
STORAGE		837.00		837.00		837.40	
OUTFLOW		198.		198.		215.	
		2.		2.		28.	
RATIO	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM	DURATION	TIME OF	TIME CF
OF	RESERVOIR	STORAGE	OUTFLOW	OUTFLOW	OVER TOP	MAX OUTFLOW	FAILURE
PMF	V.S.ELEV	AC-FT	CFS	CFS	HOURS	HOURS	HOURS
.10	837.91	233.	114.	114.	7.17	17.33	0.00
.25	838.71	271.	362.	362.	11.33	17.00	0.00
.50	839.22	338.	(648)	(648)	(14.17)	17.00	0.00

PLAN 1 STATION 1 (BREACH)

RATIO	MAXIMUM	MAXIMUM	TIME
OF	FLOW, CFS	STAGE, FT	PCURS
PMF			
.10	2027.	841.2	16.33
.25	2052.	841.2	14.67
.50	2093.	841.3	13.67

(OVERTOPPING)

PLAN 2 STATION 1

RATIO	MAXIMUM	MAXIMUM	TIME
OF	FLOW, CFS	STAGE, FT	HOURS
PMF			
.10	114.	836.4	17.33
.25	362.	839.1	17.00
.50	648.	839.7	17.17

PLAN 1 STATION 2 (BREACH)

RATIO	MAXIMUM	MAXIMUM	TIME
OF	FLOW, CFS	STAGE, FT	HOURS
PMF			
.10	1984.	833.4	16.33
.25	2007.	833.4	14.67

.50 2043. 833.5 13.67

(OVERTOPPING)

PLAN 2 STATION 7

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.10	113.	828.5	17.33
.25	362.	829.7	17.00
.50	649.	830.6	17.17

(BREACH)

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.10	1646.	761.4	16.50
.25	1672.	761.4	14.83
.50	1730.	761.4	13.83

(OVERTOPPING)

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.10	112.	760.0	17.83
.25	353.	760.3	17.50
.50	637.	760.6	17.67

APPENDIX 4

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