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NATIONAL DAM SAFETY PROGRAM. HOPE LAKE DAM (NJ 00796) DELAWARE --ETC(U)
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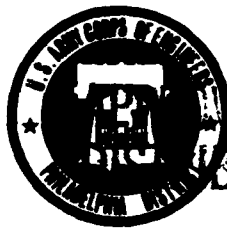
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DELAWARE RIVER BASIN
BEAVER BROOK, WARREN COUNTY
NEW JERSEY

HOPE LAKE DAM

NJ 00796

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



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DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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AUGUST 1981

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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. → pg. 2			



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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

21 AUG 1981

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

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Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Hope Lake Dam in Warren 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, Hope 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 very poor overall condition. The dam's spillways are considered inadequate because a flow equivalent to 5 percent of the Spillway Design Flood (SDF) would cause the dam to be overtopped. 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. In the interim, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within three months from the date of approval of this report the owner should engage a qualified professional consultant to perform the following:

(1) Investigate the cause of the seepage and wet, soft areas at the downstream toe of the dam.

(2) Design procedures for and inspect the removal of the trees and their roots from the entire embankment.

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Honorable Brendan T. Byrne

(3) Design procedures for and inspect the construction of erosion protection on the upstream slope of the dam.

(4) Design procedures for the repair or replacement of the gated and ungated spillways where considerable erosion and seepage are taking place.

(5) Design channels to reroute the flowing water away from the toe of the dam.

(6) Establish procedures and supervise backfilling of the embankment sections on either side of the stoplog spillway.

c. Within one year from the date of approval of this report the owner should engage a qualified professional consultant to design and supervise installation of adequate means to drain the reservoir in case of emergency.

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

(1) Clear debris and trees from the spillway discharge channels and maintain the channels free from debris.

(2) Clear brush and uncontrolled vegetation from slopes of the dam and keep the slopes free from all debris.

(3) Clear trees and brush for some distance downstream from the toe of the dam and from the banks of the discharge channels for some distance downstream from the spillways.

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

f. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

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,



ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:

Mr. Dirk C. Hofman, P.E., Deputy Director
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HOPE LAKE DAM (NJ00796)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 21 April 1981 by Anderson-Nichols and 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.

Hope 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 very poor overall condition. The dam's spillways are considered inadequate because a flow equivalent to 5 percent of the Spillway Design Flood (SDF) would cause the dam to be overtopped. 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. In the interim, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within three months from the date of approval of this report the owner should engage a qualified professional consultant to perform the following:

(1) Investigate the cause of the seepage and wet, soft areas at the downstream toe of the dam.

(2) Design procedures for and inspect the removal of the trees and their roots from the entire embankment.

(3) Design procedures for and inspect the construction of erosion protection on the upstream slope of the dam.

(4) Design procedures for the repair or replacement of the gated and ungated spillways where considerable erosion and seepage are taking place.

(5) Design channels to reroute the flowing water away from the toe of the dam.

(6) Establish procedures and supervise backfilling of the embankment sections on either side of the stoplog spillway.

c. Within one year from the date of approval of this report the owner should engage a qualified professional consultant to design and supervise installation of adequate means to drain the reservoir in case of emergency.

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

(1) Clear debris and trees from the spillway discharge channels and maintain the channels free from debris.

(2) Clear brush and uncontrolled vegetation from slopes of the dam and keep the slopes free from all debris.

(3) Clear trees and brush for some distance downstream from the toe of the dam and from the banks of the discharge channels for some distance downstream from the spillways.

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

f. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

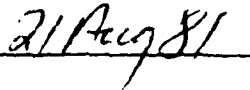
APPROVED:



ROGER L. BALDWIN

Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

DATE:



PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Hope Lake
Identification No.:	Fed ID No. NJ00796
State Located:	New Jersey
County Located:	Warren
Stream:	Beaver Brook
River Basin:	Delaware
Date of Inspection	April 21, 1981

ASSESSMENT OF GENERAL CONDITIONS

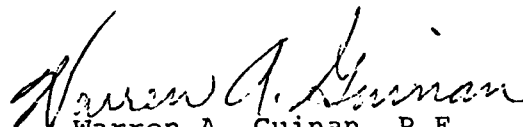
Hope Lake Dam is an earthfill, stone masonry, and concrete dam, about 200 years old, that is in poor overall condition. It is small in size and should be downgraded to significant hazard from its initial classification of high hazard. Trees and brush are growing on both upstream and downstream slopes of the earth embankment portions of the dam. One large tree has blown down causing a large hole in the downstream embankment where the roots were torn out near the left abutment of the principal spillway. Severe erosion of the embankments on either side of the stoplog spillway has undermined the concrete capping and exposed the concrete and stone masonry of the training walls. Much of the downstream stone masonry face under the concrete apron of the emergency spillway has collapsed leaving the slab unsupported. Erosion of the upstream slope at and above the waterline has occurred. Soft, wet areas were noted along the downstream toe of the embankment portions with some clear water discharges. The left abutment of the principal spillway has been patched; yet some leakage was noted below the patch. Leakage around the ends and through the stoplogs was observed. Also, seepage is occurring through the upstream concrete or stone masonry faces at both the stoplog and emergency spillways. The total combined capacities of the principal, emergency, and stoplog spillways (with stoplogs in place) can pass 4 percent of the one-half PMF without overtopping; thus the spillways are considered inadequate.

It is recommended that the owner retain the services of a professional engineer, qualified in the design and inspection of dams, to accomplish the following in the time periods specified. Starting immediately: investigate the cause of the seepage and wet, soft areas at the downstream toe of the dam; very soon: design procedures for and inspect the removal of the trees and their roots from the entire embankment; design procedures for and inspect the construction of erosion

protection on the upstream slope of the dam; design procedures for the repair or replacement of the gated and ungated spillways where considerable erosion and seepage are taking place; design channels to reroute the flowing water away from the toe of the dam; and establish procedures and supervise backfilling of the embankment sections on either side of the stoplog spillway. In the near future: further evaluate the hydrology and hydraulics of the watershed, reservoir, dam, spillways, and design and implement remedial measures; and design and install adequate means to drain the reservoir in case of emergency.

It is also recommended that, as a part of operating and maintenance procedures, the owner should immediately clear debris and trees from the spillway discharge channels and maintain the channels free from debris, check the condition of the dam periodically; clear brush and uncontrolled vegetation from slopes of the dam and keep the slopes free from all debris, and clear trees and brush for some distance downstream from the toe of the dam and from the banks of the discharge channels for some distance downstream from the spillways. In addition, in the future: establish a surveillance program for use during and immediately following periods of heavy rainfall and also a warning program to follow in case of emergency conditions.

ANDERSON-NICHOLS & COMPANY, INC.


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



21 April 1981

OVERVIEW
HOPE LAKE DAM

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 reasonable 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.

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
HOPE LAKE DAM
FED ID NO. #NJ00796

SECTION 1
PROJECT INFORMATION

5.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Hope Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 12 December 1980 under Basic Contract No. FPM-39 and Contract No. A01093 dated 10 October 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.

b. Purpose: The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Hope Lake Dam and appurtenances. Conclusions are based upon available data and visual inspection. The results of this study are used to 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. Hope Lake Dam is a 233-foot long 8.6-foot high earthfill, stone masonry, and concrete structure. The dam crest is approximately 12.5 feet wide with 2.5H:1V slope brush covered earthen embankment on the upstream side. The downstream embankment at Hope Lake Dam is tree covered with a 2H:1V slope. The dam crest is grass covered with small trees growing on it as well. The concrete capped, stone masonry principal spillway is located on the right side of the dam and is 60 feet long and 2 feet wide. A stoplog section is located approximately in the middle of the dam and consists of four 4"x 8" planks placed in a 4'x 4' bay. The concrete capped, stone masonry emergency spillway is located near the left abutment and is 52.4 feet long with a crest width of about 8 inches, it has a concrete slab apron upstream and a 6.5 foot downstream apron. At the end of the left abutment there is a small canal that is about 9 feet wide at the inlet, that formerly used to supply water power for a mill about a quarter mile downstream.

b. Location. Hope Lake Dam is located on Beaver Brook in Hope Township, Warren County, New Jersey. The Dam is at 40° 54.5' north latitude 74° 58.0' west longitude on the Blairstown Quadrangle. A location map has been included as Figure 2. The dam can be reached by taking exit 12 off Rt. 80 west, onto Rt. 521 south. The dam is on the left a mile from the Rt. 521 exit.

c. Size Classification. Hope Lake Dam is classified as being small in size on the basis of storage at the top of dam of 100 acre-feet, which is less than 1000 acre-feet but more than 50 acre-feet, and on the basis of its structural height of 8.8 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 area below Hope Lake Dam indicated that a single house of about 0.1 mile downstream on the left bank could have up to 6 feet of flood water in the garage beneath the house from either overtopping or breaching of the dam. About two feet of overtopping of the road crossings downstream of the house, would likely result in considerable property damage and possible loss of life. For these reasons, the dam is given a significant hazard classification.

e. Ownership. The dam is owned by Mr. & Mrs. Charles Southwick, P.O. Box 282, Milbrook Road, Hope, New Jersey; for information they may be reached at the above address.

f. Purpose. The original purpose of Hope Lake Dam was to generate power for the downstream mill; recreation is its present purpose.

g. Design and Construction History. No information regarding the original plan or design of the dam was available. Mrs. Southwick said that the dam was originally built by Moravians about 1769. The mill race was dug out by hand using adzes.

h. Normal Operational Procedure. No operational procedures exist for the dam.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. Information derived from the Geologic Map of New Jersey (Lewis and Kummel, 1912) and Glacial Drift Map of New Jersey (Kummel and Peet, 1902) indicates that the soils within the immediate site area consist of stratified glacial deposits in the form of sands and gravels, deltas, eskers, kames, and terraces.

The depth to bedrock at the dam site is unknown. From the reports previously mentioned, bedrock in this area consists of massive to thin bedded limestones which are Cambrian to Ordovician in age. However, bedrock exposure in the 16-foot cut for the mill race is a dark, fissile, steeply dipping shale. This exposure is about 200 feet downstream of the dam.

1.3 Pertinent Data

a. Drainage Area

7.7 square miles

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown.

Total ungated spillway capacity at maximum elevation - 337 (with stoplogs in place)

c. Elevation (ft. above NGVD)

Top of dam - 426.0

Maximum pool design surcharge (1/2 PMF) - 430.3

Recreation pool (at time of inspection) - 424.9

Spillway crest - 424.7

Streambed at centerline of principal spillway - 420.4

Maximum tailwater (estimated) - 422.8
(10 ft downstream of dam)

d. Reservoir (feet)

Length of maximum pool - 2600 (estimated)

Spillway crest - 1800

e. Storage (acre-feet)

Spillway crest - 64

Design surcharge (1/2 PMF) - 725

Top of dam - 100

f. Reservoir Surface (acres)

Top of dam - 25 (estimated)

Spillway crest - 12.8

g. Dam

Type - earthfill, stone masonry, and concrete

Length - 233 feet

Height - 8.6 feet (hydraulic)

- 8.8 feet (structural)

Top width - 12.5 feet

Side slopes - upstream 2.5 H:1V, downstream 2H:1V

Zoning - unknown

Impervious core - unknown

Cutoff - unknown

Grout curtain - unknown

h. Principal Spillway

Type - Concrete capped stone masonry

Length of weir - 60

Crest elevation - 424.7 feet NGVD

Low level outlet - none

U/S channel - Hope Lake

D/S channel - Beaver Brook

i. Emergency Spillway

Type - Concrete capping over stone masonry

Length of weir - 52.4

Crest elevation - 425.2

Gates - none

U/S channel - Hope Lake

D/S channel - Beaver Brook

j. Stoplog Spillway

Type - 4"x8" wood planks (4.5 ft long)

Length of weir - 4 feet

Crest elevation - 425.6 (with stoplogs) 421.6 (without stoplogs)

U/S channel - Hope Lake

D/S channel - Beaver Brook

SECTION 2 ENGINEERING DATA

2.1 Design

No original plans, hydraulic or hydrologic data for Hope Lake Dam were available.

2.2 Construction

No data concerning the original construction of Hope Lake Dam were revealed; however, owner indicated that it was built over 200 years ago.

2.3 Operation

No data pertaining to the operation of the dam were found.

2.4 Evaluation

- a. Availability. A search of the New Jersey Department of Environmental Protection Files and contact with representatives of the owner of the dam revealed no pertinent information.
- b. Adequacy. Evaluation was based primarily on visual observations and measurements which were adequate for this study.

SECTION 3 VISUAL INSPECTION

3.1 Findings

a. Dam. The area at the downstream toe of the dam is generally wet and soft and some clear seepage water is discharging. Trees are growing on the upstream slope, crest, on the downstream slope and in the area at the downstream toe of the dam. A large tree has been uprooted from the crest near the spillway at the right abutment and its root ball has been pulled out, leaving a large hole on the crest. Roots of trees were observed extending from the upstream slope near the water line toward the downstream edge of the crest.

The crest of the dam is partially covered with grass with a pedestrian path extending along the entire length. Considerable erosion has taken place on the upstream slope at and above the water line. The downstream slope has undergone considerable erosion and slumping adjacent to each of three spillways. In addition, erosion has occurred along portions of the toe that is due to water passing over the spillways and flowing adjacent to the toe in the discharge channels.

b. Appurtenant Structures.

(1) Ungated emergency spillway - left end. The concrete weir is badly eroded and irregular, and the downstream dry stone masonry wall has collapsed in several areas undermining the concrete apron. The entrance to the spillway is partially clogged with wood and grass vegetation. The left training wall is cracked and has settled approximately 1.5 inches.

(2) Gated spillway - middle of dam. The concrete walls and sill of the stoplog facility are badly eroded and spalled. Considerable undermining has occurred around the abutments of the spillway walls. An attempt to reduce erosion and seepage using gunite, sand bags, concrete, concrete blocks, and bags of cement beneath and adjacent to the spillway has not been successful. The wood stoplog gate is deteriorated and is leaking around the ends and through the joints. The wooden bridge is also badly weathered. The concrete block, cast-in-place concrete and stone masonry walls on top of the dam extending right and left from the gated spillway are cracked, irregular, and show considerable leakage on both sides. The downstream face is badly eroded and undermined on both sides of the spillway.

- (3) Ungated principal spillway - right end. The crest of the spillway is cracked and eroded, and the downstream face is badly spalled causing undermining of the spillway. Seepage was noted near the left end of the spillway where the original crest had been repaired for about 5 feet from the left abutment of the spillway with stones and concrete.

c. Reservoir Area. The watershed above the lake is gently sloping and wooded. Some open fields exist along the west side of the reservoir. Slopes on the shore of the lake appear to be stable. Evidence of significant sedimentation was observed.

d. Downstream Channel. Considerable erosion has occurred on the right and left bank of each channel immediately downstream of the spillways for a distance of approximately 100 to 150 feet. Trees are growing on the banks of the channels and within the confines of the channels.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were revealed.

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 discovered.

4.4 Warning System

No description of any warning system was found.

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 described.

SECTION 5 HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. Because no data were revealed an evaluation of the hydrologic/hydraulic data could not be performed.

b. Experience Data. No experience data were found.

c. Visual Observation. Erosion at left abutment of the principal spillway has been patched with stones (6"-8") and mortar. This area shows some leakage. The crest of the emergency spillway shows considerable spalling. The stone masonry beneath the emergency spillway slab apron has fallen along the downstream face leaving much of the slab without support. Water is leaking through the stone masonry (estimate about 5 to 10 gpm). The stoplog spillway training walls are structurally in poor condition. The stoplog notches are eroded with leakage around the ends and between the logs. The dam has no other low level outlet.

d. Hope Lake Overtopping Potential. The hydraulic/hydrologic evaluation for the 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 a 24-hour probable maximum storm of 23.1 inches to the SCS dimensionless unit hydrograph. Hydrologic computations are given in Appendix 3. The routed one-half PMF peak discharge for the subject drainage area is 8,385 cfs.

The minimum elevation of the dam allows 1.3 foot of depth above the principal spillway, 0.8 foot above the emergency spillway and 0.4 foot above the stoplog spillway (with stoplogs in place) before overtopping occurs. Under this head the total spillway capacity for the 3 spillways is 337 cfs, which is less than the selected SDF (approximately 4 percent).

At discharges above 6900 cfs, the backwater resulting from the narrowing and gradual slope of the channel downstream of the dam begins to cause slightly less flow over the dam than would occur without this backwater effect. Because this effect was found to be negligible for Hope Lake Dam, the discharge coefficient for the spillway weir was not changed. Calculations are shown in Appendix 3.

Flood routing calculations indicate that Hope Lake Dam will be overtopped for 13.2 hours to a maximum depth of 4.3 feet under one-half PMF conditions. It is estimated that the principal spillway can pass 2 percent (240 cfs) of the one-half PMF without overtopping the dam; thus, the spillway is considered inadequate.

3. Drawdown Capacity. There are no drawdown pipes for Hope Lake Dam.

SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. The soft, wet areas and seepage at the downstream toe of the dam is indicative of seepage through and under the dam, which, if not properly controlled, could lead to failure of the dam by piping or sloughing of the downstream slope. Trees growing on the crest and on the upstream and downstream slopes may cause seepage and erosion problems if a tree blows over and pulls out its roots, or if a tree dies or is cut and its roots rot. One large tree has already blown over, leaving a hole in the crest where its roots pulled out and this hole weakens the crest. Erosion at the abutments of the spillways and seepage below and adjacent to these structures could lead to breaching of the dam at these locations if not controlled. Erosion caused by overtopping of the upstream concrete walls on either side of the center spillway could lead to breaching.

Erosion of the upstream slope at the water line could eventually lead to breaching of the dam.

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 were available.

6.4 Post-Construction Changes

No record of post-construction changes was available. However, evidence of numerous patchings are clearly visible.

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, 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. Hope Lake is probably over 200 years old and is in very poor condition.
- b. Adequacy of Information. The information available is such that the assessment of the dam must be based entirely on the results of the visual inspection.
- c. Urgency. The recommendations made in 7.2.a and 7.2.b should be implemented by the owner as prescribed.
- 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 dam.

7.2 Recommendation/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 time periods specified:

Immediately:

Investigate the cause of the seepage and wet, soft areas at the downstream toe of the dam.

Very soon:

- (1) Design procedures for and inspect the removal of the trees and their roots from the entire embankment.
- (2) Design procedures for and inspect the construction of erosion protection on the upstream slope of the dam.
- (3) Design procedures for the repair or replacement of the gated and ungated spillways where considerable erosion and seepage are taking place.

- (4) Design channels to reroute the flowing water away from the toe of the dam.
- (5) Establish procedures and supervise backfilling of the embankment sections on either side of the stoplog spillway.

In the near future:

- (1) Further evaluate the hydrology and hydraulics of the watershed, reservoir, dam, and spillways, and design and implement necessary mitigating measures. Items b(2) and b(3) following should be considered in conjunction with this recommendation.
- (2) Design and install adequate means to drain the reservoir in case of emergency.

b. Operating and Maintenance Procedures

The owner should do the following immediately:

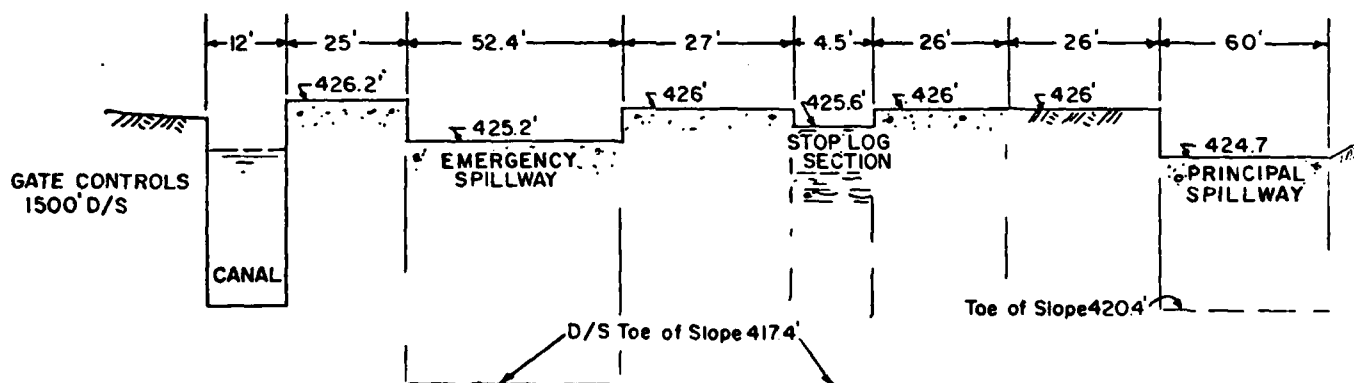
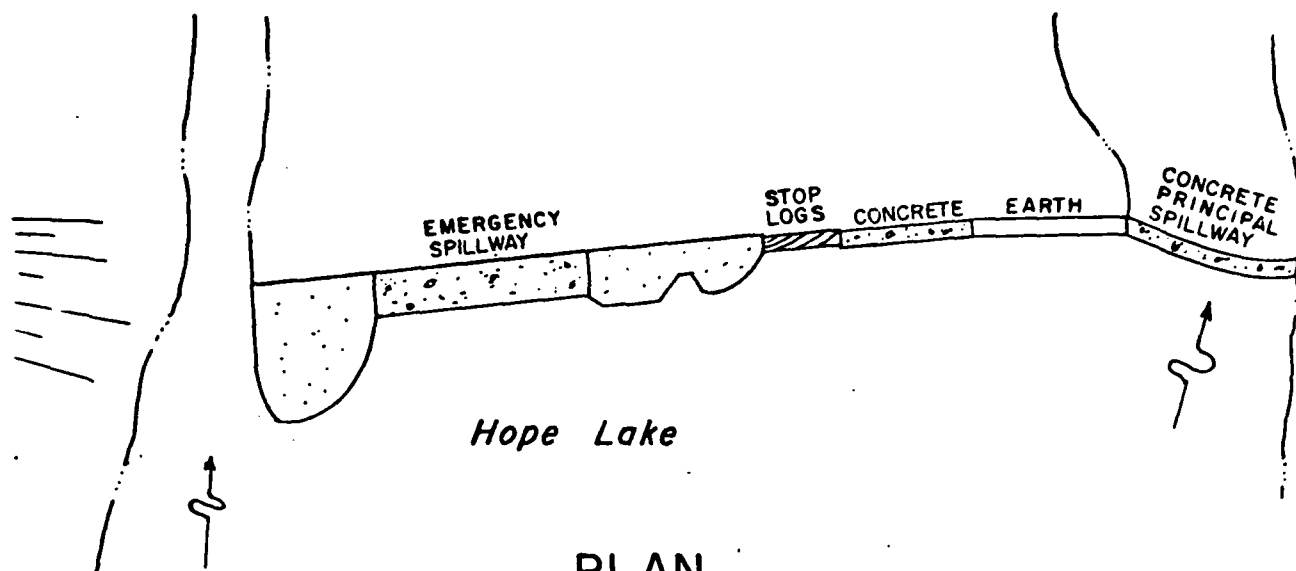
- (1) Clear debris and trees from the spillway discharge channels and maintain the channels free from debris.
- (2) Check the condition of the dam periodically.
- (3) Clear brush and uncontrolled vegetation from slopes of the dam and keep the slopes free from all debris.
- (4) Clear trees and brush for some distance downstream from the toe of the dam and from the banks of the discharge channels for some distance downstream from the spillways.

In the near future:

Develop written operation procedures and a periodic maintenance plan to ensure the safety of the dam.

In the future:

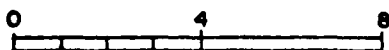
Establish a surveillance program for use during and immediately following periods of heavy rainfall and also a warning program to follow in case of emergency conditions.



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BOSTON		CORPS OF ENGINEERS	
MASSACHUSETTS		PHILADELPHIA, PA	
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS			
HOPE LAKE DAM			
BEAVER BROOK		NEW JERSEY	
		SCALE NOT TO SCALE	
		DATE MAY 1981	
		FIGURE 1	



SCALE IN MILES



MAP BASED ON STATE OF NEW JERSEY
OFFICIAL MAP & GUIDE.

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MASSACHUSETTS

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

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

'HOPE LAKE DAM LOCATION MAP

BEAVER BROOK

NEW JERSEY

SCALE: 1" = 4 Miles Approx.

DATE: MAY 1981

FIGURE 2

APPENDIX 1

CHECK LIST

VISUAL INSPECTION

HOPE LAKE DAM

Check List
Visual Inspection
Phase 1

Name Dam Hope Lake (NJ00796) County Warren State New Jersey Coordinators NJDEP
 Date(s) Inspection 2/16/81 Weather Fair, clear Temperature 36°
4/22/81 Clear, cold 38°
 Pool Elevation at Time of Inspection 424.9 NGVD Tailwater at Time of Inspection 418.2 NGVD

Inspection Personnel:

W. Guinan

S. Gilman

J. Stone

R. Murdock

Guinan/Gilman Recorder

Mrs. Charles Southwick, owner, was present with the inspection party.

UNGATED SPILLWAY

Right End of Dam

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

CONCRETE WEIR

Concrete weir is curved. Top surface is eroded and cracked. Right ends show evidence of movement. Downstream face is badly eroded and spalled undermining face and bottom of wall. Left end has been repaired with mortared cobbles-6-8 in $\pm$. Seepage and leakage noted at both ends of spillway.

Major reconstruction required.

APPROACH CHANNEL

Under water, appears to be shallow, unobstructed.

DISCHARGE CHANNEL

Debris, fallen trees, boulders in bottom channel, joins with discharge channel for gated spillway.

Clear trees and brush 25 ft on either side of discharge channel for a distance of 100 ft downstream from the dam or to the property line, whichever is less.

BRIDGE AND PIERS OVER SPILLWAY

None

Stop Log Section and Adjacent Concrete Dam

GATED SPILLWAY at Center of Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Bottom of stop log section is eroded & deteriorated 1 in $\pm$.	Major construction required of entire structure.
APPROACH CHANNEL	Upstream face of stop log section is badly deteriorated with concrete cap showing evidence of forward movement.	
DISCHARGE CHANNEL	Sidewalls are badly cracked and spalled. Some repairs have been made with mortared stone.	Clear trees and brush 25 ft on either side of discharge channel for a distance of 100 ft downstream from the dam.
BRIDGE AND PIERS	2 in wood planks are badly weathered with some deterioration.	See note above Major Construction
GATES AND OPERATION EQUIPMENT	Stop logs are deflected. All planks show evidence of deterioration. Leakage is observed around ends of stop log and thru joints. Stop log slots are badly eroded.	See note above Major Construction
CONCRETE DAM WALLS ADJACENT TO GATED SPILLWAY	Walls are cracked, irregular and show considerable leakage on both sides. D/S face is badly eroded and undermined on both sides.	See note above Major Construction

UNGATED SPILLWAY
Left End of Dam

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The top of the concrete weir is badly eroded and uneven. D/S apron is in fair condition. Left training wall is cracked and has settled 1.5 in. Dry stone masonry wall on d/s face has collapsed in several areas.	Repair concrete weir. Repair dry stone masonry wall.
APPROACH CHANNEL	Under water, appears to be shallow, unobstructed.	
DISCHARGE CHANNEL	Debris, fallen trees, boulders in bottom channel, joins with discharge channel for gated spillway.	Clear trees and brush 25 ft on either side of discharge channel for a distance of 100 ft downstream from the dam or up to the property line, whichever is less.
BRIDGE AND PIERS OVER SPILLWAY	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None apparent.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Pronounced erosion on both upstream and downstream slopes. Trees present on both slopes.	Control trespassing on dam. Repair erosion on dam.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment - fair. Vertical alignment - right undulation of crest.	
RIPRAP FAILURES	Slight amount of riprap evident below water surface. Only a few riprap pieces present on the slope.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	None apparent.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Erosion at both abutments and at junction with spillway structure. See Notes in "Ungated Spillway" regarding concrete walls along embankment.	
ANY NOTICEABLE SEEPAGE	Seepage evident below and adjacent to spillway, emergency spillway and gated spillway.	Investigate seepage and design appropriate remedial measures.
STAFF GAGE AND RECORDER	None apparent.	
DRAINS	None apparent.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None apparent.	
OBSERVATION WELLS	None apparent.	
WEIRS	None apparent.	
PIEZOMETERS	None apparent.	
OTHER	None apparent.	

RESERVOIR

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

SLOPES

Gradual slopes, wooded. Open fields.

SEDIMENTATION

Appears to be significant sedimentation in the reservoir.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Debris, boulders in channel. Banks heavily overgrown with trees and vines.	
SLOPES	Trees and brush covered, gentle slopes on the right bank; tree- and brush-covered steep slopes with a flat flood plain on the left bank.	
APPROXIMATE NO. OF HOMES AND POPULATION	One house about 0.1 mile downstream on left bank with 2 residents. The first floor is about 14 feet above the channel invert. Three empty buildings (corn canning plant) on the right bank are within 100 yards of the dam with a first floor elevation from 8 to 10 ft above channel bottom.	

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 found
- DETAILS	None found
- CONSTRAINTS	None found
- DISCHARGE RATINGS	None found
RAINFALL/RESERVOIR RECORDS	None found

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

ITEM	REMARKS
MONITORING SYSTEMS	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

ITEMS	REMARKS
SPILLWAY PLAN	Prepared for this report from field inspection
SECTIONS	None
DETAILS	None
OPERATING EQUIPMENT PLANS & DETAILS	None

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 7.7 square miles, gentle slope,
woods.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 424.7' NGVD
(64 acre-feet).

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

ELEVATION MAXIMUM HIGH POINT ON DAM: 426.2' NGVD

ELEVATION TOP DAM: 426.0' NGVD

PRINCIPAL SPILLWAY CREST: Uncontrolled concrete capped stone
masonry

a. Elevation 424.7' NGVD

b. Type Concrete

c. Width 2 feet

d. Length 60 feet

e. Location Spillover Right end of dam

f. Number and Type of Gates None

EMERGENCY SPILLWAY CREST: Free overflow concrete spillway

a. Elevation 425.2' NGVD

b. Type Concrete

c. Width 12.5 feet w/aprons up and downstream

d. Length 52.4 feet

e. Location Spillover Left of center of dam

f. Number and Type of Gates None

STOPLOG SECTION: 4" x 8" wood planks

- a. Elevation 426.5" NGVD
- b. Type Wood planks
- c. Width 4 inches
- d. Length 4.5 feet
- e. Location Spillover Center of dam
- f. Number and Type of Gates Four 4" x 8" stoplogs

OUTLET WORKS: None

HYDROMETEOROLOGICAL GAGES: None

MAXIMUM NON-DAMAGING DISCHARGE: 337 cfs (Total spillway
capacity)

APPENDIX 2

PHOTOGRAPHS

HOPE LAKE DAM



21 April 1981

Spillway crest looking toward left (east) side of dam



21 April 1981

Looking eastward across emergency spillway crest and apron



21 April 1981

View of downstream face of emergency spillway



21 April 1981

Looking u/s at stoplog spillway



21 April 1981

View of undermining of concrete cap on stoplog spillway training wall.



21 April 1981

Outside and d/s appearance of right training wall of stoplog spillway



18 February 1981

Looking u/s across Hope Lake Reservoir



21 April 1981

Spillway channel looking downstream



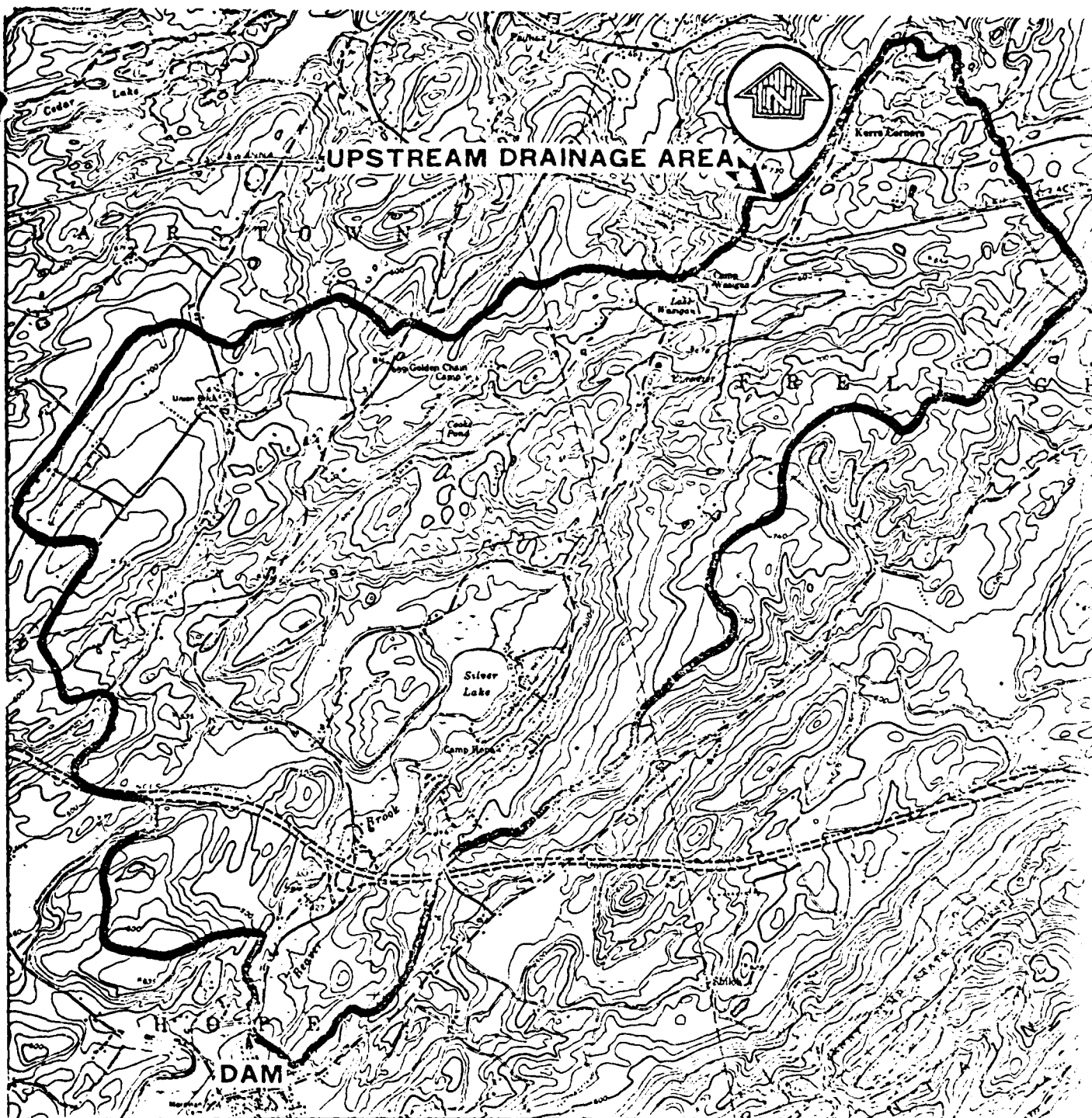
21 April 1981

Mill Race looking d/s near left (east) end of dam

APPENDIX 3

HYDROLOGIC COMPUTATIONS

HOPE LAKE DAM



**NATIONAL PROGRAM OF INSPECTION OF
NON-FED. DAMS**

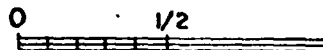
**HOPE LAKE DAM
HOPE TOWNSHIP, NEW JERSEY**

REGIONAL VICINITY MAP

MAY 1981

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

SCALE IN MILES



**MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE
SHEET. BLAIRSTOWN, N.J. 1954, REVISED 1971.**

JOB NO.

 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
 1/4 IN. SCALE

TIME OF CONCENTRATION

① Texas Highway Method

 Overland
 woodlands
 reach = 5000'

$$\text{slope} = \frac{734 - 600}{5000} = 0.027$$

$$\text{ave vel} = 1 \text{ fps} \quad \frac{5000 \text{ ft}}{1 \text{ ft/sec}} = 5000 \text{ sec}$$

$$= 83 \text{ min} = 1.4 \text{ hrs.}$$

Channel

reach = 25,000'

$$\text{slope} = \frac{600 - 435}{25000} = .007$$

$$\text{ave vel} = 2 \text{ fps} \quad \frac{25000'}{2 \text{ ft/sec}} = 12500 \text{ sec}$$

$$= 208 \text{ min} = 3.5 \text{ hrs}$$

$$\text{Total } t_c = 1.4 + 3.5 = 4.9 \text{ hrs}$$

② Soil & Water Conservation

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

$$S = \frac{1000}{60} - 10$$

$$CN = 70 \text{ for } L$$

$$L = 5000 + 25000 = 30,000'$$

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

$$Y = \frac{.027 + .007}{2} = 0.017 = 1.7\%$$

JOB NO.

 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

$$L = \frac{(30,000)^{0.8} (4.3+1)^{1.67}}{9000 (17)^{.5}} = 5.2 \text{ hrs.}$$

$$T_c = \frac{L}{.6} = \frac{5.2}{.6} = \underline{\underline{8.7 \text{ hrs}}}$$

③ SCS TR #55 method
overland

$$l = 5,000 \text{ ' head} = 134'$$

$$\text{slope} = 0.027 \quad \text{Woodland}$$

from plot of % slope vs. velocity, $V = 4 \text{ fps}$

$$\frac{5000 \text{ ft}}{4 \text{ ft/sec}} = 1250 \text{ sec} = 0.35 \text{ hr}$$

channel

$$l = 25,000' \quad \text{slope} = 0.007 \quad n = .03$$

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

(assume 1' x 10' rectangular channel
to calculate R)

$$R = \frac{A}{wp} = \frac{10}{2(1) + 10} = 0.83 \text{ ft}^2$$

$$V = \frac{1.49}{.03} (0.83)^{2/3} (.007)^{1/2} = 3.7 \text{ ft/sec}$$

$$\frac{25000 \text{ ft}}{3.7 \text{ ft/sec}} = 6793 \text{ sec} = 1.9 \text{ hrs}$$

$$\text{Total} = 1.9 + 3.5 = \underline{\underline{5.4 \text{ hrs}}}$$

JOB NO.

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
1/4 IN. SCALE

(4) Kerby method

$$T_c = 0.83 \left(\frac{N \cdot l}{\sqrt{A}} \right)^{0.467}$$

$$l = 5000' \quad A = .027 \quad N = 0.60$$

$$T_c = 0.83 \left[\frac{(0.6)(5000)}{\sqrt{.027}} \right]^{0.467} = \underline{1.4 \text{ hrs}}$$

for channel use

Manning's, as Method 3

$$V = 3.6 \text{ fps} \quad \frac{25000 \text{ ft}}{3.6 \text{ ft/sec}} = 6944 \text{ sec} = \underline{1.9 \text{ hrs}}$$

$$T_c = 1.4 + 1.9 = \underline{3.3 \text{ hrs}}$$

$$\text{ave } T_c = \frac{4.9 + 8.7 + 5.4 + 3.3}{4} = 5.6 \text{ hrs}$$

$$T_{\text{lag}} = 0.6 \times 5.6 = \underline{3.3 \text{ hrs}}$$

JOB NO.

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

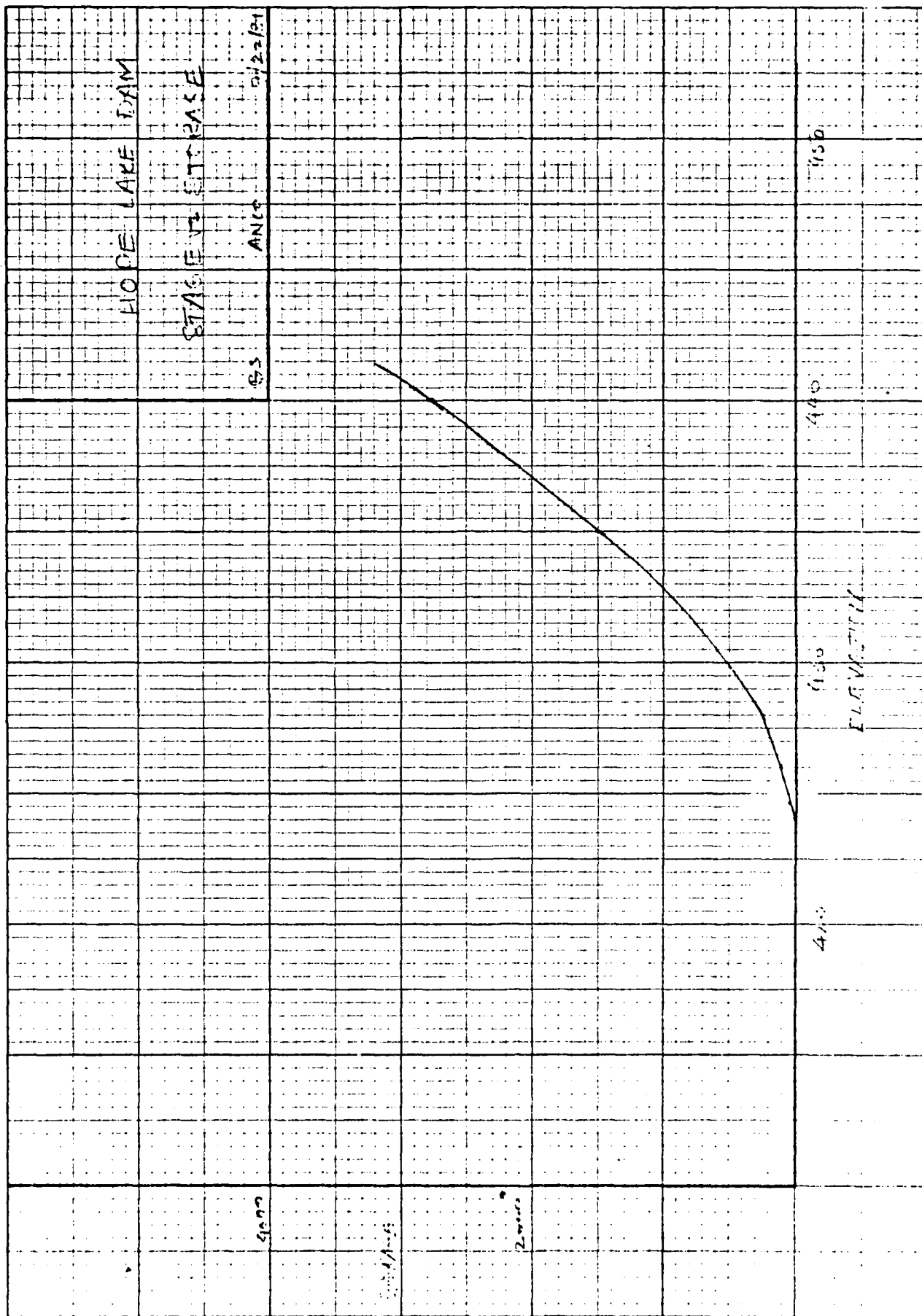
STAGE - STORAGE DETERMINATIONS

ASSUME DEPTH OF LAKE TO BE 5 FEET

ELEVATION	SURFACE AREA ACRES	AVG SA. ACRES	INCREMENTAL Storage AC-Ft	CUMULATIVE Storage AC-Ft
		12.8	64	
424.7	12.8			64
		176	2692.8	
440	345.6			2756.8
		480	9600	
460	614.4			12356.8

Input for Hec-I (from curve)

Stage	Storage
424.0	0
425.7	64
425.8	70
425.6	85
426.0	110
426.2	115
428.	200
430	520
432.	850
435.0	1500
440.0	2757



233'

430

425

420

425

426

425.6

426.2

425.2

426

425.6

426

424.7

gate
21500 cfs
controls

CANAL

EMERGENCY
SPILLWAY

LOG
SECTION

ANCILLARY
SPILLWAY

INVERT

INVERT

120

80

40

0

40

80

120

160

240

ANDERSON-NICHOLS

VERNON

BOSTON

CONCORD

HOPKINS DAM

SPILLWAY & DAM SECTION

DATE 7.27.81

SCALE

JOB NO. 5670-16

SHEET NO. 61F11

JOB NO.

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 SCALE

DEVELOPMENT OF RATING CURVE

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

① Spillway Curve

$$C = 2.7 \quad L = 60 \quad \text{width} = 2.0$$

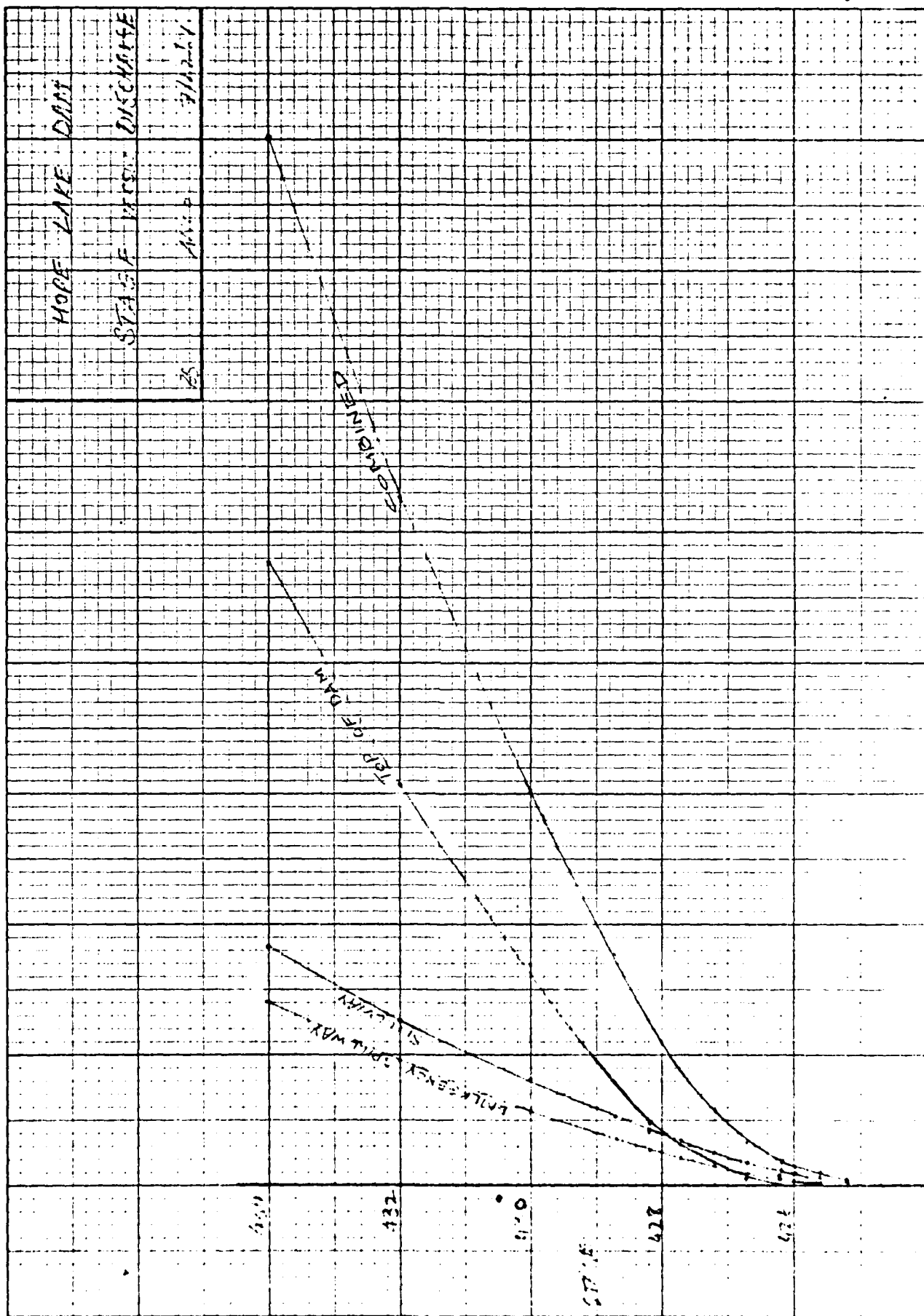
② Top of dam Curve

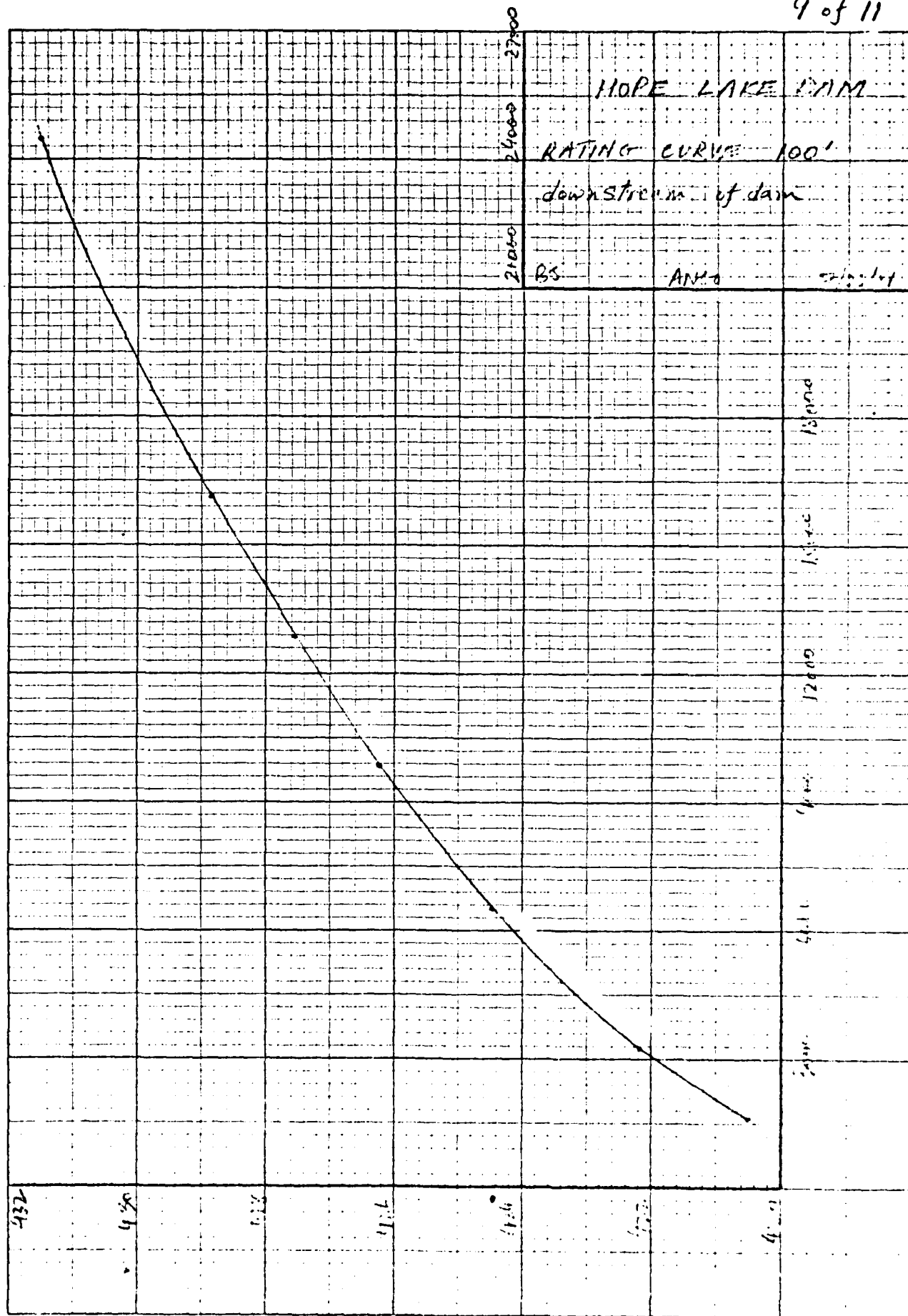
$$C = 2.6 \quad L = 153 \quad \text{width} = 12.5$$

③ Emergency Spillway

$$C = 2.6 \quad L = 52 \quad \text{width} = 6.5$$

	Elevation	Principal Spillway		Emergency Spillway		Top of Dam		Combined
		head	Q	head	Q	head	length	Q
Spillway	424.7	0						
Emergency	425.2	0.5	57.2	0				57
Spillway	425.6	1.0	162	0.5	118			210
TOP DAM	426.0	1.3	240	0.8	97			337
	426.2	1.5	298	1.0	135		153	433
	426.7	2.0	458	1.5	248	0.5	153	246
	427.2	2.5	640	2.0	532	1.0	170	1442
	427.7	3.0	842	2.5	534	1.5	170	2193
	428.2	3.5	1061	3.0	701	2.0	190	2117
	428.7	4.0	1296	3.5	834	2.5	190	4133
	430.0	5.3	1777	4.3	1420	3.8	210	7442
	432.0	7.3	3195	6.8	2514	5.9	210	13216
	434.0	9.3	4595	8.2	3524	7.9	210	20013





JOB NO.

Weir Submergence Calculations

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

Data for Rating Curve @ 100' downstream
from HEC-1

1	FLOW	1646.	3223.	6477.	9782.	12868.	16137.	24513.	33009.
7	TIME	19.67	19.83	19.75	19.75	19.83	19.83	19.75	19.67
8	** PEAK STAGES IN FEET **								
9	1	STAGE	420.52	422.16	424.45	426.22	427.57	428.82	431.46
		TIME	19.67	19.83	19.75	19.75	19.83	19.75	19.67

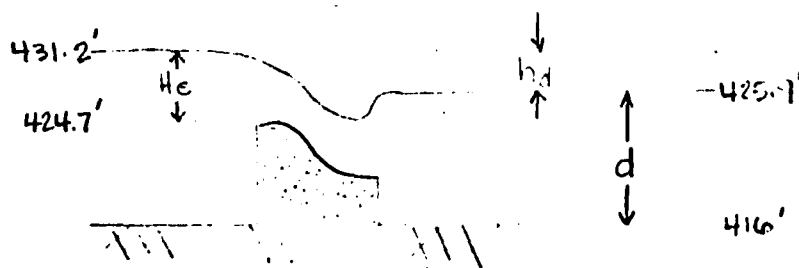
FROM HEC 1 CALCULATION -

$$\frac{1}{2} \text{ PMF } Q = 8114 \text{ CFS}$$

$$\frac{1}{2} \text{ PMF ELEV @ d/s Xsect.} = 425.9'$$

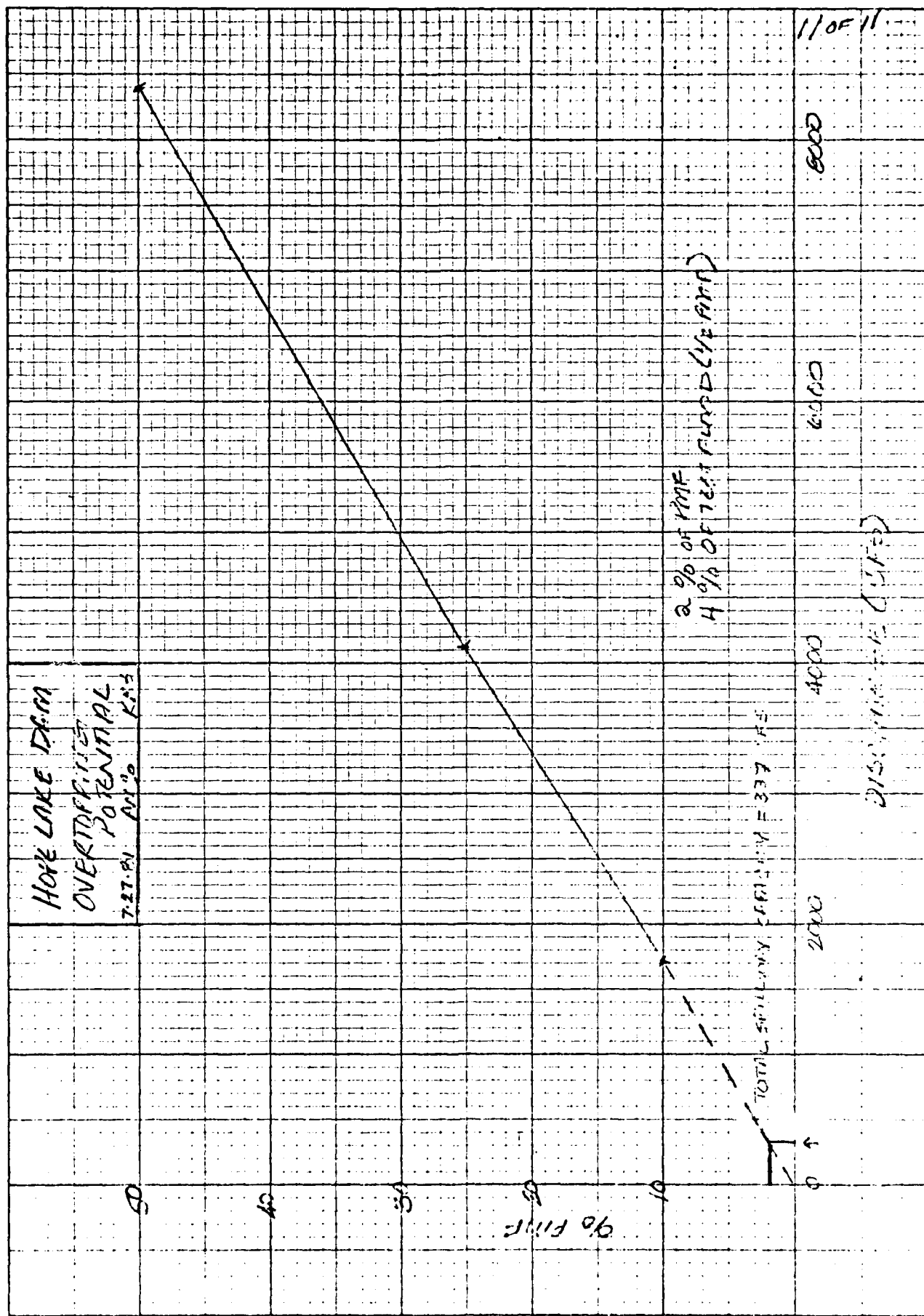
$$\frac{1}{2} \text{ PMF ELEV @ dam} = 431.2'$$

Calculations of decrease in discharge coefficient
for submerged orifice flow (using Chow's
Chow's Open Channel Hydraulics, 1957).



Q	ELEV @ XSCT	ELEV @ DAM	% WEIR	hd	He	d	h _d /H _e	h _d /d
8114	425.9	431.2	1.2	5.3	6.5	9.7	0.6	0.6

0.23% reduction in C value for weir (using Chow) - negligible



APPENDIX 4

HEC-1 OUTPUT

HOPE LAKE DAM

NEWARK, N.J. (AP) — The New York City Police Department on Tuesday said it had arrested a man suspected of being involved in the 1993 World Trade Center bombing.

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 FEBRUARY 1981
 RUN DATE 07/23/81 TIME 17.25.10

 U.S. ARMY CORPS OF ENGINEERS
 THE HYDROLOGIC ENGINEERING CENTER
 609 SECOND STREET
 DAVIS, CALIFORNIA 95616
 (916) 440-3285 (R (FIS) 448-3285

HOPE LAKE DAM NO. 796 WARREN COUNTY TOWNSHIP OF HOPE
 0.160.25-0.5 MULTIPLES OF PMF FROM 24-HOUR PMF

5 10 OUTPUT CONTROL VARIABLES 2 PRINT CONTROL
 IFPMY 2 PLOT CONTROL
 USCAL 0 HYDROGRAPH PLOT SCALE
 CMSC YES PRINT DIAGNOSTIC MESSAGES

IT HYDROGRAPH TIME DATA 5 MINUTES IN COMPUTATION INTERVAL
 APIN 1 0000 STARTING DATE
 IDATE 300 NUMBER OF HYDROGRAPH ORIGINATES
 NO 2 0055 ENDING DATE
 NDATE 0055 ENDING TIME
 NDTIME
 COMPUTATION INTERVAL 0.08 HOURS
 TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS
 DRAINAGE AREA SQUARE MILES
 PRECIPITATION DEPTH INCHES
 LENGTH, ELEVATION FEET
 FLOW CUBIC FEET PER SECOND
 STORAGE VOLUME ACRES-FEET
 SURFACE AREA ACRES
 TEMPERATURE DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION 1 NUMBER OF PLANS
 MPLAN
 JR MULTI-RATIO OPTION 0.50
 RATIOS OF RUNOFF 0.10

7 KK *****
 A1 * HOPE LAKE DAM

 SCS UNIT GRAPH COMPUTATION

9 BA SUBBASIN RUNOFF DATA
 SUBBASIN CHARACTERISTICS
 AREA 7.70 SUBBASIN AREA
 BASE FLOW CHARACTERISTICS
 C OF CRYPTO 23.10 INITIAL FLOW
 ORIGIN 24.10 BEGIN BASE FLOW RECESSON
 FLOW 1.00000 RECESSON CONSTANT

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10.92
TIME

1456.
F56.
F56.

7.70 50 MI

CUMULATIVE AREA =

HYDROGRAPH AT STATION A1 PLAN 1. RATIO = 0.50

DA	MON	HR	MIN	SEC	ORD	FLOW
1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6
7	7	7	7	7	7	7
8	8	8	8	8	8	8
9	9	9	9	9	9	9
10	10	10	10	10	10	10
11	11	11	11	11	11	11
12	12	12	12	12	12	12
13	13	13	13	13	13	13
14	14	14	14	14	14	14
15	15	15	15	15	15	15
16	16	16	16	16	16	16
17	17	17	17	17	17	17
18	18	18	18	18	18	18
19	19	19	19	19	19	19
20	20	20	20	20	20	20
21	21	21	21	21	21	21
22	22	22	22	22	22	22
23	23	23	23	23	23	23
24	24	24	24	24	24	24
25	25	25	25	25	25	25
26	26	26	26	26	26	26
27	27	27	27	27	27	27
28	28	28	28	28	28	28
29	29	29	29	29	29	29
30	30	30	30	30	30	30
31	31	31	31	31	31	31
32	32	32	32	32	32	32
33	33	33	33	33	33	33
34	34	34	34	34	34	34
35	35	35	35	35	35	35
36	36	36	36	36	36	36
37	37	37	37	37	37	37
38	38	38	38	38	38	38
39	39	39	39	39	39	39
40	40	40	40	40	40	40
41	41	41	41	41	41	41
42	42	42	42	42	42	42
43	43	43	43	43	43	43
44	44	44	44	44	44	44
45	45	45	45	45	45	45
46	46	46	46	46	46	46
47	47	47	47	47	47	47
48	48	48	48	48	48	48
49	49	49	49	49	49	49
50	50	50	50	50	50	50
51	51	51	51	51	51	51
52	52	52	52	52	52	52
53	53	53	53	53	53	53
54	54	54	54	54	54	54
55	55	55	55	55	55	55
56	56	56	56	56	56	56
57	57	57	57	57	57	57
58	58	58	58	58	58	58
59	59	59	59	59	59	59
60	60	60	60	60	60	60
61	61	61	61	61	61	61
62	62	62	62	62	62	62
63	63	63	63	63	63	63
64	64	64	64	64	64	64
65	65	65	65	65	65	65
66	66	66	66	66	66	66
67	67	67	67	67	67	67
68	68	68	68	68	68	68
69	69	69	69	69	69	69
70	70	70	70	70	70	70
71	71	71	71	71	71	71
72	72	72	72	72	72	72
73	73	73	73	73	73	73
74	74	74	74	74	74	74
75	75	75	75	75	75	75
76	76	76	76	76	76	76
77	77	77	77	77	77	77
78	78	78	78	78	78	78
79	79	79	79	79	79	79
80	80	80	80	80	80	80
81	81	81	81	81	81	81
82	82	82	82	82	82	82
83	83	83	83	83	83	83
84	84	84	84	84	84	84
85	85	85	85	85	85	85
86	86	86	86	86	86	86
87	87	87	87	87	87	87
88	88	88	88	88	88	88
89	89	89	89	89	89	89
90	90	90	90	90	90	90
91	91	91	91	91	91	91
92	92	92	92	92	92	92
93	93	93	93	93	93	93
94	94	94	94	94	94	94
95	95	95	95	95	95	95
96	96	96	96	96	96	96
97	97	97	97	97	97	97
98	98	98	98	98	98	98
99	99	99	99	99	99	99
100	100	100	100	100	100	100

10 *** 11 *** 12 *** 13 *** 14 *** 15 *** 16 *** 17 *** 18 *** 19 *** 20 *** 21 *** 22 *** 23 *** 24 *** 25 *** 26 *** 27 *** 28 *** 29 *** 30 *** 31 *** 32 *** 33 *** 34 *** 35 *** 36 *** 37 *** 38 *** 39 *** 40 *** 41 *** 42 *** 43 *** 44 *** 45 *** 46 *** 47 *** 48 *** 49 *** 50 *** 51 *** 52 *** 53 *** 54 *** 55 *** 56 *** 57 *** 58 *** 59 *** 60 *** 61 *** 62 *** 63 *** 64 *** 65 *** 66 *** 67 *** 68 *** 69 *** 70 *** 71 *** 72 *** 73 *** 74 *** 75 *** 76 *** 77 *** 78 *** 79 *** 80 *** 81 *** 82 *** 83 *** 84 *** 85 *** 86 *** 87 *** 88 *** 89 *** 90 *** 91 *** 92 *** 93 *** 94 *** 95 *** 96 *** 97 *** 98 *** 99 *** 100 ***

14 KK *****
 L2

ROUTE INFLOW HYDROGRAPH THROUGH HOPE LAKE

HYDROGRAPH ROUTING DATA

	STORAGE ROUTING MSTPS ITYP RSVRIC	NUMBER OF SUBREACHES				STOR TYPE OF INITIAL CONDITION				INITIAL CONDITION				WORKING R AND D COEFFICIENT			
		STOR	TYPE	INITIAL	CONDITION	STOR	TYPE	INITIAL	CONDITION	STOR	TYPE	INITIAL	CONDITION	STOR	TYPE	INITIAL	CONDITION
15 RS		0.0	64.0	70.0	100.0	150.0	180.0	210.0	350.0	520.0	850.0						
16 SV		417.40	424.70	425.20	426.00	426.70	427.20	427.70	428.70	430.00	432.00						
17 SE		0.	0.	57.	337.	846.	1464.	2168.	4133.	7442.	13216.						
18 SO		417.40	424.70	425.20	426.00	426.70	427.20	427.70	428.70	430.00	432.00						
19 SE																	
20 SS																	
21 ST																	

STORAGE	0.0	64.00	70.00	100.00	150.00	210.00	350.00	520.00	850.00
OUTFLOW	0.0	0.0	57.00	337.00	846.00	1464.00	2168.00	4133.00	7442.00

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HYDROGRAPH AT STATION
PLAN 1. RAILROAD -[illegible]

PEAK FLOW AND STAGE (UNDUF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS		
				RATIO 1	RATIO 2	RATIO 3
HYDROGRAPH AT ROUTED TO	A1	7.70	1	0.10	0.25	0.50
	A2	7.70	1	17.92	18.92	87.28
				18.92	19.07	83.82
			** PEAK STAGES IN FEET **			
			1	17.38	18.89	19.33
				19.38	19.89	19.50

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION 42

PLAN 1	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 424.70 0.	SPILLWAY CREST 424.70 0.	TOP OF DAM 426.00 100. 337.	DURATION OVER TOP HOURS	MAXIMUM OUTFLOW CFS	MAXIMUM STORAGE AC-FT	MAXIMUM DEPTH OVER DAM	RATIO FHE	TIME OF MAX. OUTFLOW HOURS	TIME OF FAILURE HOURS
	MAXIMUM RESERVOIR W.S. ELEV										
	427.36				9.42	1696.	190.	1.36	0.10	19.43	0.0
	428.63				11.08	4107.	398.	2.63	0.25	19.67	0.0
	430.33				13.25	8385.	574.	4.33	0.50	19.50	0.0

*** NORMAL END OF JOB ***

APPENDIX 5
REFERENCES

HOPE LAKE DAM

APPENDIX 5
REFERENCES

HOPE LAKE DAM

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