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NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON --ETC F/G 13/13
NATIONAL DAM SAFETY PROGRAM, LAKE KALMIA DAM (NJ00166), DELAWARE--ETC(U)
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DELAWARE RIVER BASIN
TRIBUTARY TO PAULINS KILL,
WARREN COUNTY
NEW JERSEY

LAKE KALMIA DAM

NJ 00166

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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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.		



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

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

31 AUG 1981

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Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Kalmia 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, Lake Kalmia Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in poor overall condition. Also, the dam's spillway is considered inadequate since 2 percent of the 100 year flood would overtop the dam. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. To assure continued functioning of the dam and its impoundment, the following actions could be undertaken by the owner:

- a. Repair the depression and cracking of the concrete slab on the dam crest.
- b. Remove trees and their root systems from the crest and downstream slope of the dam.
- c. Take action to correct potential erosion and undermining of the downstream toe of the dam caused by the flow of water from seepage near the right abutment.
- d. Take action to correct seepage and wet, soft areas along the downstream toe of the spillway.



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Honorable Brendan T. Byrne

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

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

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

Sincerely,



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

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

LAKE KALMIA DAM (NJ00166)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 22 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.

Lake Kalmia Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in poor overall condition. Also, the dam's spillway is considered inadequate since 2 percent of the 100 year flood would overtop the dam. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. To assure continued functioning of the dam and its impoundment, the following actions could be undertaken by the owner:

- a. Repair the depression and cracking of the concrete slab on the dam crest.
- b. Remove trees and their root systems from the crest and downstream slope of the dam.
- c. Take action to correct potential erosion and undermining of the downstream toe of the dam caused by the flow of water from seepage near the right abutment.
- d. Take action to correct seepage and wet, soft areas along the downstream toe of the spillway.

APPROVED:



ROGER L. BALDWIN

Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

DATE:

31 Aug 81

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lake Kalmia
Identification No.:	Fed ID No. NJ00166
State Located:	New Jersey
County Located:	Warren
Stream:	Tributary to Paulins Kill
River Basin:	Delaware
Date of Inspection	April 22, 1981

ASSESSMENT OF GENERAL CONDITIONS

Lake Kalmia Dam is 52 years old and in poor condition. It is small in size and should be downgraded to low hazard from its initial classification of high hazard. It is a 346-foot long earthen embankment with a concrete upstream face along most of its length. The dam has a hydraulic height of 6.6 feet. Its spillway is a broadcrested 4.3-foot wide weir passing flow through a flume 0.8-foot deep and 39.5 feet long across the dam crest. The low-level outlet is a valved 8-inch CIP. The soft, wet areas and seepage at the downstream toe of the dam near the right abutment are indicative of seepage through or under the dam. Trees growing on the dam crest and downstream slope and brush which eventually attains tree size may cause seepage and erosion problems. The flow of water along a portion of the toe of the dam from the seep near the right abutment could erode the toe of the embankment which could contribute to stability problems. Erosion and further deterioration of the downstream vertical, concrete-faced masonry wall (probably remnants of the original spillway) could contribute to stability problems, if not controlled. Cracks and spalling of the upstream, vertical concrete wall, if not repaired, could also contribute to stability problems. The depression and cracking of the concrete slab on the dam crest near the upstream face and left of the spillway flume may be indicative of internal erosion and should be corrected. The spillway capacity of 9.2 cfs at top of dam is 1.9 percent of the routed 100-year spillway design flood peak discharge of 487 cfs, and it is considered inadequate.

Lake Kalmia Dam does not now pose a potential hazard to loss of life and only minimal property damage could occur if it should be breached. However, should the owner wish to maintain the integrity of the embankment he should retain the services of a professional engineer, qualified in the design and construction of dams to accomplish the following in the near future: Investigate the cause of the depression and cracking of the concrete slab on the dam crest and design and oversee required corrective measures; design and oversee procedures for the removal of trees and their root systems from the crest and downstream slope of the dam; evaluate the potential for

erosion and undermining of the downstream toe of the dam caused by the flow of water from seepage near the right abutment; investigate the cause of seepage and wet, soft areas along the downstream toe of the spillway and design remedial measures; design or specify repairs for the vertical, concrete-faced masonry wall at the end of the spillway apron and to the right and left of the spillway; design and oversee the repairs to the deteriorated concrete wall on the upstream face; design and oversee repairs to restore the low-level outlet to operable condition; and investigate the adequacy of the spillway capacity and design and oversee remedial measures as needed.

It is further recommended that the owner accomplish the following tasks as a part of operating and maintenance procedures. In the near future: start a program of periodically checking the condition of the dam and monitoring the wet area along the toe of the upstream slope; remove trees and brush for a distance of 100 feet downstream from the toe of the dam; clear trees and brush on either side of the spillway discharge channel for a distance of 100 feet from the spillway crest or to the property line whichever is the lesser; develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

ANDERSON-NICHOLS & COMPANY, INC.



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



LAKE KALMIA DAM
OVERVIEW PHOTO

April 22, 1981

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.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
LAKE KALMIA DAM
FED ID NO. #NJ00166

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Lake Kalmia 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 Lake Kalmia 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 to conclude if additional studies, investigations, and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Lake Kalmia Dam is a 346-foot long earth embankment with a concrete upstream face along most of its length. It has a hydraulic height of 6.6 feet, and a structural height of 7.5 feet. The embankment's width varies from 16 to 80 feet. The principal spillway is a 4.3 foot long broad-crested weir, about 0.8 feet below the low point of the dam. The 244-foot long concrete portion of the upstream slope is vertical. The rest of the upstream face and the downstream face vary in slope. Early plans show an 8-inch outlet pipe. The valve for this pipe is on the dam crest, but the outlet may not be in operating condition. About 400 feet east of the dam's left (east) abutment, a natural saddle would serve to carry some flow at high stages as an emergency spillway.

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b. Location. The dam is located in Blairstown Township, Warren County, New Jersey on a tributary of Paulins Kill. The dam is at 40° 59.6' north latitude and 74° 58.0' west longitude on the Blairstown Quadrangle. The dam can be reached by taking State Route 521 North (Exit 12 off Interstate 80) for about 6 miles, to Mill Brook Road. The dam is approximately one mile down Mill Brook Road on the left hand side. A location map has been included as Figure 3.

c. Size Classification. Lake Kalmia Dam is classified as being small in size on the basis of storage at the dam crest of 92.8 acre-feet, which is less than 1000 acre-feet but more than 50 acre-feet, and on the basis of its structural height of 7.5 feet, which is less than 40 feet, in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. The only structures along the stream downstream of Lake Kalmia Dam are the frame buildings of the old Girl Scout headquarters and seasonal cabins associated with a camp. The structures have been unoccupied for about 5 years and are scheduled to be torn down. Accordingly the hazard classification for this dam is low.

e. Ownership. Lake Kalmia Dam is owned by the Girl Scouts of Essex County, 120 Valley Road, Montclair, New Jersey 07042. The dam's caretaker, Art Hoehny, can be reached at (717) 828-2970.

f. Purpose. Lake Kalmia Dam was built for recreational purposes.

g. Design and Construction History. The dam was originally built in 1929. A plan and elevation of Lake Kalmia Dam entitled "Proposed Dam Reinforcement - Lake Kalmia - Blairstown, N.J., Mr. E. O. Ogur, Consulting Engineer, Newark, N.J." was available in the NJDEP files. The date on this plan is illegible, but believed to be dated October 25, 1935. Rebuilding was accomplished in 1936.

h. Normal Operational Procedure. No operational procedures for the dam were disclosed.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. Information derived from the Geological Map of New Jersey (Kummel and Johnson, 1912) indicates soils consist of till overlying bedrock.

The depth to bedrock at the dam site is unknown and outcrops were not observed during the dam inspection. The previous mentioned map indicates that bedrock in this area consists of massive to thin bedded limestone of Cambrian to Ordovician age. Based on information contained in New Jersey Department of Environmental Protection files, the area downstream contains sink holes (probably in the limestones).

1.3 Pertinent Data

a. Drainage Area

0.50 square miles (NJDEP records indicate 0.6 square miles).

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown; caretaker indicates that dam was overtopped by 4 inches in the spring of 1981.

Total ungated spillway capacity at maximum pool elevation 411.1 (at top of dam) - 9.2.

c. Elevation (ft. above NGVD)

Top of dam - 411.1

Test flood surcharge (100-year storm) - 411.85

Recreational pool (at time of inspection) - 410.0

Spillway crest - 410.3

Streambed at centerline of spillway - 404.5

Maximum tailwater - 405.3 (estimated)

d. Reservoir (feet)

Length of maximum pool - 1200 (estimated)

Spillway crest - 1100 (estimated)

e. Storage (acre-feet)

Spillway crest - 77.0

Test flood surcharge (100-year storm) - 108

Top of dam - 92.8

f. Reservoir Surface (acres)

Top of dam - 20.3 (estimated)

Spillway crest - 19.2 (estimated)

g. Dam

Type - earthfill with concrete upstream face

Length - 346 feet

Height - 6.6 feet (hydraulic)

- 7.5 feet (structural)

Top Width - Varies from 16 to 80 feet

Side slopes - Upstream varies, vertical for much of
its length; downstream varies

Zoning - unknown

Impervious core - unknown

Cutoff - unknown

Grout curtain - unknown

h. Spillway

Type - Broad-crested concrete spillway flume 39.5 feet
in length

Length of weir - 4.3 feet

Crest elevation - 410.3' NGVD

Low level outlet - 8-inch valved CIP - may not be
operable

U/S Channel - Lake Kalmia

D/S Channel - Small unnamed stream (this stream
drains into a sink hole; no culvert is
present under road 0.2 mile downstream
of dam).

SECTION 2 ENGINEERING DATA

2.1 Design

No hydraulic, hydrologic, or other design engineering data were disclosed. The design plans for rebuilding the dam (1935) on file at NJDEP were in basic agreement with field observations.

2.2 Construction

Only correspondence concerning original construction of the Lake Kalmia Dam were disclosed. The rebuilding plan and profile (1935) was recovered from NJDEP files.

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 community officials revealed a limited amount of information. All disclosed information was retrieved and is contained in Appendix 1.

b. Adequacy. The plans, supplemented by visual inspection, are deemed adequate to complete this Phase I inspection.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. Dam. Trees are growing on the crest of the dam, on the downstream slope, and in the area at the downstream toe of the dam. Cracked and spalled concrete was evident at several locations along the upstream vertical concrete wall.

Some seepage is discharging at the toe of the dam near the contact with the right abutment. The seepage is clear with no evidence of suspended fines. This seepage flows along the downstream toe until it reaches a large wet swampy area to the right of the spillway channel. The area at the downstream toe is generally wet and soft for its entire length, and contains extensive wetland vegetation.

A partially deteriorated concrete faced masonry stone wall, approximately 2 to 3 ft. high, was exposed to the right and left of the spillway for a distance of approximately 20 to 40 ft. The concrete faced wall grades into a series of large stones and boulders which have been placed along the toe.

A depression was observed in the crest of dam near the upstream face adjacent to the left side of the spillway flume. The concrete slab covering the crest is cracked and settled in this area.

b. Appurtenant Structures. Erosion has occurred on the downstream slope of the embankment adjacent to both spillway wingwalls. Extensive erosion has developed at the vertical masonry and concrete wall at the end of the spillway flume which was partially obscured owing to water flowing from the spillway flume during the site visit. The low-level outlet and gate valve were not visible at the time of inspection. (The outlet is reported to be an 8-inch CIP.) A vertical 12-inch CMP pipe stand on the dam crest apparently houses the valve stem.

c. Reservoir Area. The watershed above the lake is gently to moderately sloping and wooded. The reservoir slopes appear to be stable. No evidence of significant sedimentation was observed.

d. Downstream Channel. The channel downstream from the spillway is poorly defined and meanders past the large swampy area downstream from the dam. Some trees are growing on the banks of the channel downstream of the spillway. As no culvert could be found under the road 0.2 miles downstream, channel discharges may as yet be draining into the old sink hole mentioned in Section 1.2.h.

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 original hydrologic/hydraulic design data were revealed, an evaluation of such data could not be performed.

b. Experience Data. No experience data were found. The caretaker, by phone, recently stated that the dam was overtopped by 4 inches in the spring of 1981 (probably subsequent to the site inspection).

c. Visual Inspection. The spillway for Lake Kalmia Dam consists of a 4.3 foot long concrete broad-crested weir discharging into a 39.5 foot long by 0.8 foot deep flume. No visual evidence was found of damage to the structure caused by overtopping. At the time of inspection, approximately 0.1 foot of water was flowing over the spillway crest.

d. Lake Kalmia Dam Overtopping Potential. The hydraulic/hydrologic evaluation for the dam is based on a selected Spillway Design Flood (SDF) equal to the 100-year flood in accordance with the range of test floods given in the evaluation guidelines, for dams classified as low hazard and small in size. The 100-year flood was determined by applying the 100-year 2-hour rainfall hyetograph to the SCS dimensionless unit hydrograph for the drainage area. Hydrologic computation are given in Appendices 4 and 5. The peak 100-year outflow from Lake Kalmia is 487 cfs.

The minimum elevation of the dam allows 0.8 foot of flow over the spillway crest before overtopping occurs. Under this head the spillway capacity is 9.2 cfs, which is about 1.9 percent of the selected SDF. Thus the spillway capacity is inadequate.

Under test flood conditions the natural saddle 400 feet east of the dam, which might serve as an emergency spillway would convey 96 cfs, with 26 cfs going over the spillway and 372 cfs over the dam crest. The elevation of the natural saddle is higher than the dam crest, so it does not increase project capacity at the top of the dam.

e. Drawdown. If the 8-inch cast iron pipe shown on the plans for Lake Kalmia Dam could be operated, it would draw Lake Kalmia down in 15 days assuming no inflow. This is considered marginal for draining the reservoir under emergency conditions; but adequate, considering the small drainage area.

SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

The soft, wet area and seepage at the downstream toe of the dam near the right abutment are indicative of seepage either through or under the dam which, if not properly controlled, could lead to failure of the dam by piping or sloughing of the downstream slope. The flow of water along a portion of the toe of the dam from the seep near the right abutment could erode the toe of the embankment which would contribute to stability problems. Trees growing on the crest and downstream slope and brush which eventually attain tree size may cause seepage and erosion problems. This is especially true if a tree blows over and pulls out its roots, or if a tree dies or is cut and its roots rot. Erosion and further deterioration of the downstream, vertical, concrete-faced masonry wall (probably remnants of the original spillway) could contribute to stability problems in the embankment, if not properly controlled. Cracks and spalling of the upstream, vertical, concrete wall, if not repaired, could also contribute to stability problems.

The depression and cracking of the concrete slab on the dam crest near the upstream face and left side of the spillway flume may be indicative of internal erosion and should be corrected.

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

A plan showing the rebuilding, accomplished in 1936, shows the upstream concrete wall and spillway to be as noted in the inspection (See Appendix 1). State of New Jersey records (see also Appendix 1) reflect that the saddle, 400 feet left of the dam, contained a second concrete spillway that would have been the principal spillway as its invert was one-half foot lower than that of the flume spillway at the dam. No evidence of the concrete work in this area was observed.

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 satisfied and conventional safety margins exist." None of the visual observations made during the inspection are conclusively indicative of unstable slopes. However, because no data are available concerning the engineering properties of the embankment and foundation materials for this dam, or the condition of the base of 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. Lake Kalmia Dam is 52 years old and is in poor condition.

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

c. Urgency. Because the dam poses no hazard to life and little hazard to property there is little urgency to implement the recommendations in Section 7.2 based on safety considerations. Should the owner wish to maintain the dam embankment the recommendations should be implemented 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 Recommendatons/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:

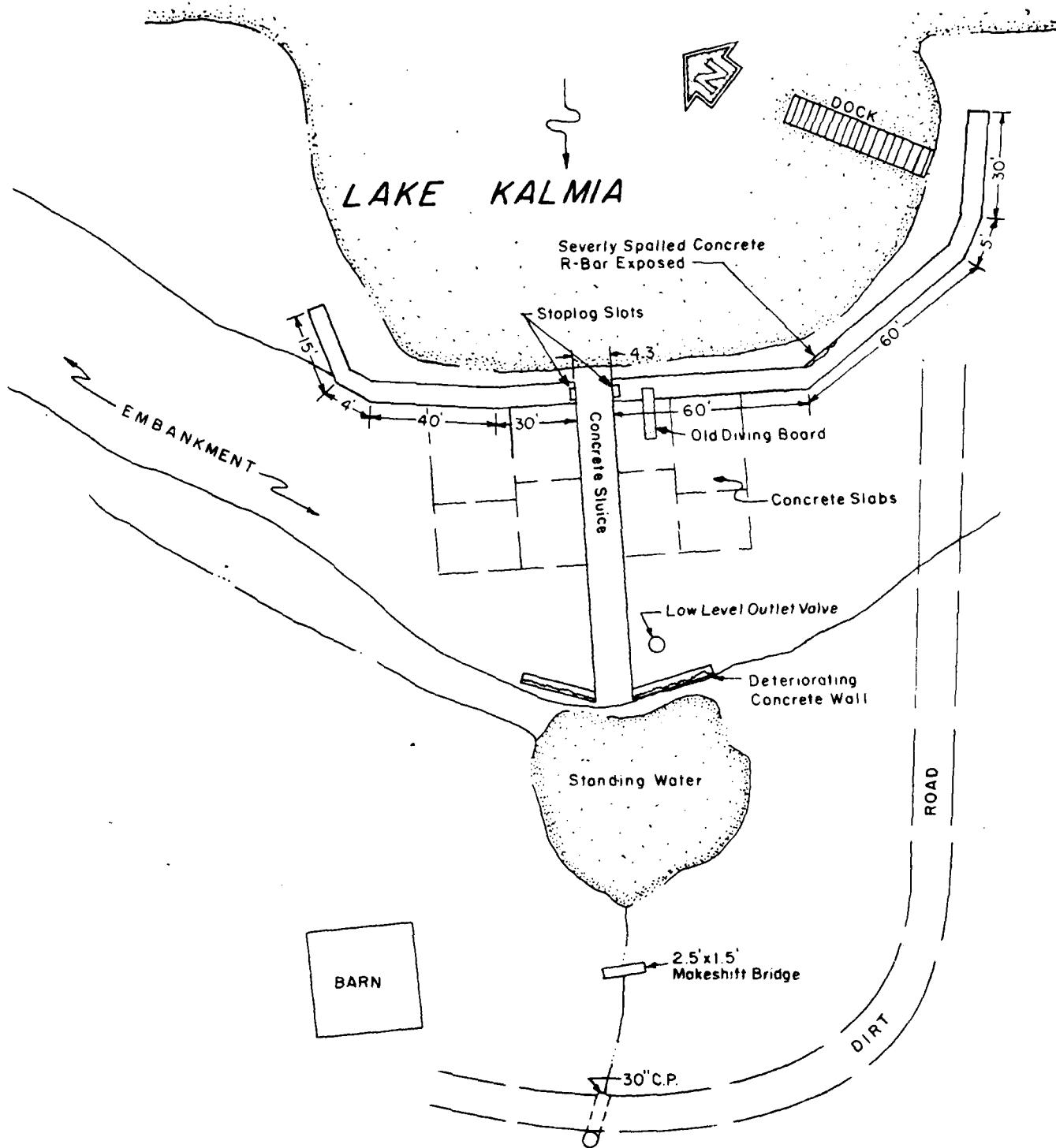
- (1) Investigate the cause of the depression and cracking of the concrete slab on the dam crest and design and oversee required corrective measures.
- (2) Design and oversee procedures for the removal of trees and their root systems from the crest and downstream slope of the dam.
- (3) Evaluate the potential for erosion and undermining of the downstream toe of the dam caused by the flow of water from seepage near the right abutment.
- (4) Investigate the cause of seepage and wet, soft areas along the downstream toe of the spillway and design remedial measures.

- (5) Design or specify repairs for the vertical, concrete-faced masonry wall at the end of the spillway apron and to the right and left of the spillway.
- (6) Design and oversee the repairs to the deteriorated concrete wall on the upstream face.
- (7) Design and oversee repairs to restore the low-level outlet to operable condition.
- (8) Investigate the adequacy of the spillway capacity and design and oversee remedial measures as needed.

b. Alternatives. If the recreational aspects of this dam and reservoir are considered essential, no alternative is recommended; however, if considered non-essential, the dam could be breached and the reservoir returned to the Lake Kalmia original state of a small springfed lake.

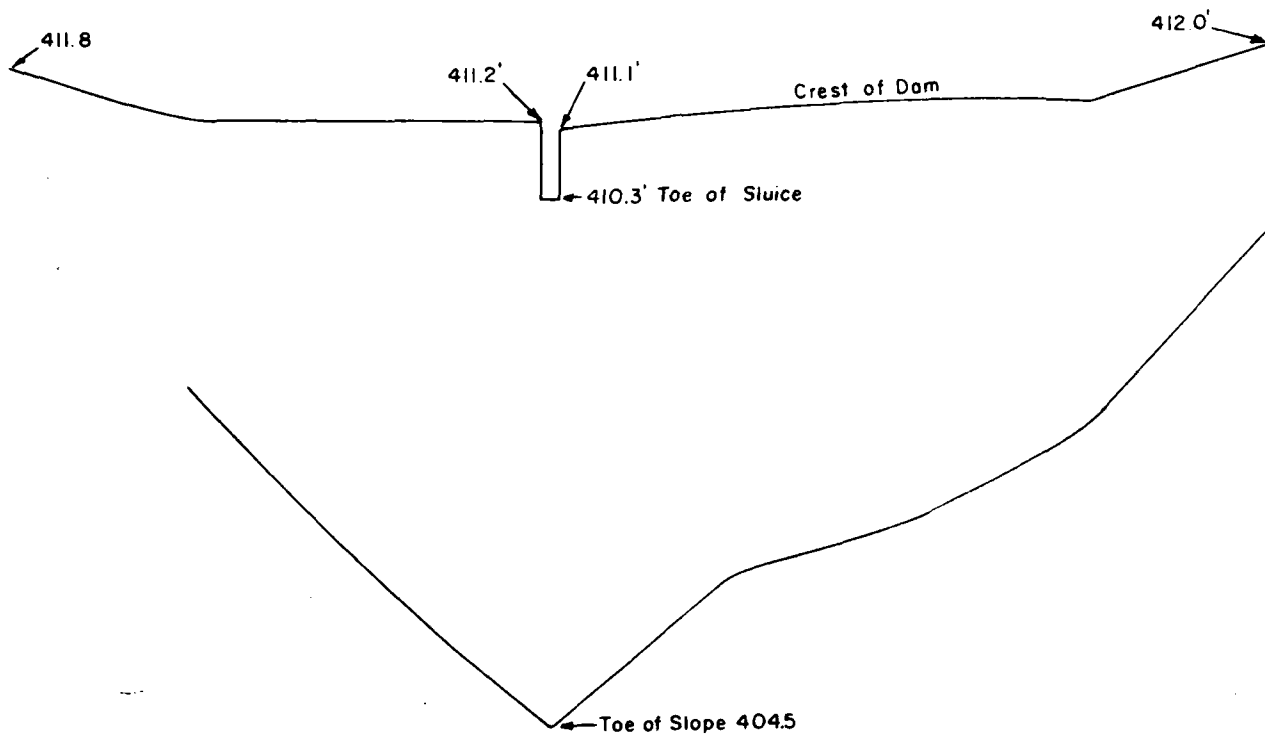
c. Operating and Maintenance Procedures. The owner should accomplish the following items in the near future:

- (1) Start a program of periodically checking the condition of the dam and monitoring the wet area along the toe of the downstream slope.
- (2) Remove trees and brush for a distance of 25 feet downstream from the toe of the dam or to the property line whichever is less.
- (3) Clear trees and brush on either side of the spillway discharge channel for a distance of 100 feet from the spillway crest or to the property line whichever is less.
- (4) Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.



Anderson-Nichols & Co., Inc.		U.S. ARMY ENGINEER DIST PHILADELPHIA	
BOSTON		CORPS OF ENGINEERS	
MASSACHUSETTS		PHILADELPHIA, PA.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
LAKE KALMIA DAM			
PLAN			
TRIB. TO PAULINS KILL		NEW JERSEY	
		SCALE: NOT TO SCALE	
		DATE:	

FIGURE -1



Anderson-Nichols & Co., Inc.		U.S. ARMY ENGINEER DIST. PHILADELPHIA	
BOSTON		CORPS OF ENGINEERS	
MASSACHUSETTS		PHILADELPHIA, PA.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS			
LAKE KALMIA DAM			
ELEVATION			
TRIB. TO PAULINS KILL		NEW JERSEY	
		SCALE: NOT TO SCALE	
		DATE:	

FIGURE 5



SCALE IN MILES



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

Anderson-Nichols & Co., Inc.		U.S. ARMY ENGINEER DIST. PHILADELPHIA	
BOSTON		MASSACHUSETTS	
CORPS OF ENGINEERS PHILADELPHIA, PA.			
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
LAKE KALMIA DAM LOCATION MAP			
TRIB. TO PAULINS KILL		NEW JERSEY	
		SCALE: 1" = 4 Miles Approx.	
		DATE:	

APPENDIX 1

ENGINEERING DATA

LAKE KALMIA DAM

PATRICK

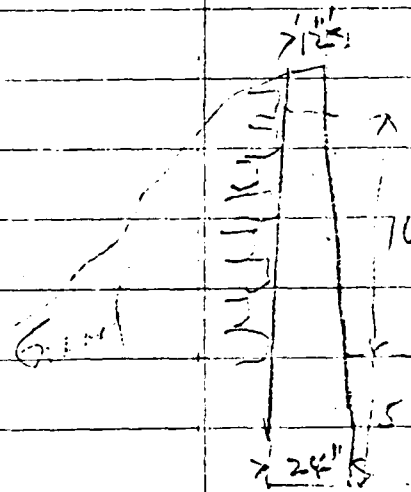
DAMS IN NEW JERSEY—REFERENCE DATA

Name of Owner: Newark City Schools NO. 21-30
 Name of Dam: Lake Katella Address: 901 Broad Street, Newark, N.J.
 COUNTY: Essex Location: 21.53.1.3.8
 CONSTRUCTION: Dam Rebuilt 1935-36 By whom: Longmire, Inc.
 Stream: Small Branch Tributary to: Fall Brook
 DRAINAGE BASIN: Area: 0.35 sq. mi. Description: Rollins 1/2 wooded.
 Description of valley below dam: Meads
 DAMAGE FROM FAILURE: Probable: None
 Previous (date):
 Purpose: Recreation Type: Earth, when built, reinforced concrete
 Foundation:
 Length: 240 ft. Max. height: 10 ft. Max. width of base: 100 ft.
 Upstream slope: Vertical Downstream slope: 1:1 Volume: --- cu yd
 SPILLWAY: Type: Concrete, notched Length: 100 ft.
 Depth below top of dam 2' and 3.5' Capacity: 5000 cu ft. per sq. ft.
 RESERVOIR: Capacity: --- min. gate area: --- max. length: --- ft.
 Outlet: 1 - 12" C.I. Pipe with gate valve in manhole.
 Remarks: Spillway 2' concrete brought on dam fill 1/2 1.5' deep
 --- 3.0' concrete notch in middle 1/2 of spillway
 --- 1.0' freeboard
 Sources of data: Inspection and drawing filed 10/11/35 Date: 11/1/35

10/31/35
HJC
B

ham near Plainstown -
on very small brook - Reported by
~~person~~ person - with captioned
Newark Girl Scout Council

Mrs. Tom Vance 901 Penn St.
Newark



E. Ogur 446 N 9th St
E. Orange

P. E. House of
Leroy - House Line
336 Pleasant Ave
Princeton N.J.

Essex 2-6118

W. H. H. Co.
Newark Girl Scout Dam
Dam # 21-22
Fairfield

October 31, 1935.

Mr. P. G. Hasse,
336 Stuyvesant Avenue,
Irvington, N. J.

Dear Sir:

With regard to the repair of the Newark Girl Scout dam at Lake Kalmir near Blairstown, New Jersey, I wish to advise that after conversation with Mr. John Quigley, game warden residing in Blairstown, we were able to confirm your statement that this lake is spring fed and is not on a stream of any size. Under the circumstances, no formal permit is necessary from this Commission to repair the structure in accordance with the drawings prepared by E. Ogur, Consulting Engineer, Newark, dated October 25, 1935.

We are returning herewith the specification, but are retaining the drawing for our files.

Yours very truly,

H. T. Critchlow
Division Engineer.

Report on Dam Inspection

NEWARK GIRL SCOUT DAM

Dam No. 21 - 30.

Location 21.43.13.8.

At the request of Mr. Edward L. Lanterman, Engineer, inspection of this dam was made on January 14, 1930 in company with Mr. Lanterman.

Since the inspection of October 15, 1929 additional fill has been made on the top and the downstream slope of the dam, erosion of the earth fill has been stopped and a concrete notch spillway has been built in a natural saddle 500 feet to left of dam.

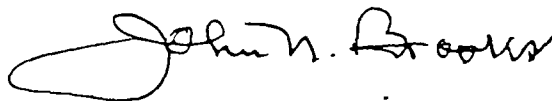
The additional fill on downstream slope of dam should be completed to the left end of embankment reducing the slope from 1 to 1 to about 1-1/2 to 1.

The spillway consists of a concrete wall with its top at the same elevation as the top of the dam and two openings each 2 feet deep and 12 feet long. With 1 foot freeboard the spillway capacity is 400 sec. ft. per sq. mi. and with the top of dam avash 1130 sec. ft. per sq. mi. From the spillway notch a small ditch has been dug around the back of the knoll to a limestone sink hole in the meadow below the dam. This sink hole is reported to have taken the stream flow before the dam was built. The ditch appears too small to carry the maximum spillway discharge but overflow from it will probably be infrequent and no damage is likely to be done by the overflow spreading out on the meadow below. A pile of clay which lies across the upstream side of the spillway should be removed.

Water in the pond stood 2 feet below the spillway crest.

The spillway capacity is sufficient to care for the probable maximum flood flow and the slopes of the earth embankment, though steeper than usually approved by the Commission's engineers are considered sufficient in view of the clay of which the banks are made and the absence of apparent damage should the dam fail by slumping of the embankment.

When the above mentioned work has been done, namely the completion of the additional fill on downstream slope and removal of clay bank in front of spillway, the dam may be considered satisfactory.



John N. Brooks,
Assistant Division Engineer.

Trenton, N. J.,
January 15, 1930.

Copy to Mr Hamilton

COMMISSIONERS

WILLARD I. HAMILTON, CHAIRMAN
NEWARK

F. MORSE ARCHER
CAMDEN

CORNELIUS DOREMUS
RIDGEWOOD

MAX GROSSMAN
ATLANTIC CITY

THURLOW G. NELSON
HIGHLAND PARK

HENRY G. PARKER
NEW BRUNSWICK

OWEN J. PRIOR
TRENTON



MORRIS R. SHERRERD
CHIEF ENGINEER

GEORGE S. BURGESS
SECRETARY
605 BROAD STREET
NEWARK, N. J.

STATE OF NEW JERSEY
STATE WATER POLICY COMMISSION

December 31, 1929. **RECEIVED**

Mr. H. T. Critchlow, Division Engineer,
State Water Policy Commission,
Trenton, N. J.

JAN 2 1930
STATE WATER POLIC
COMMISSION

Dear Mr. Critchlow:

In reply to yours of the 30th, enclosing copy of letter written to Mr. Lanterman, I quite agree with the practice followed, and since I am interested in the Girl Scouts organization, authorized the above to apply for the inspection merely in order to see that proper report of the completion of the work was made.

The precautions taken at my direction when the new dam was built represented a substantially greater margin of safety than required by law. One of Mr. Brooks' inspections was rendered necessary because he failed to get in touch with Mr. Lanterman as had been suggested, and either went alone or, as was rumored, perhaps inaccurately, with a contractor who had failed to secure some work. The net result was that he gained an erroneous impression, which was later corrected.

Yours sincerely,

Willard I. Hamilton
Chairman.

Trenton Office.

December 30, 1929.

Mr. Willard I. Hamilton, Chairman
State Water Policy Commission,
605 Broad Street,
Newark, N. J.

Dear Mr. Hamilton:-

I am enclosing for your information copy of my letter of even date herewith, to Mr. Edward L. Lanterman, in regard to inspection of the Newark Girl Scout dam near Blairstown.

This dam was inspected twice during last summer, and I am satisfied that it is in satisfactory condition for the winter. I doubt if any satisfactory inspection could be made at the present time.

Yours very truly,

H. T. Critchlow,
Division Engineer

JNB:121B

Fish Dam - ~~Swamp~~ Co.
Warren

RECEIVED

NOV 14 1929

STATE WATER POLICY
COMMISSION

Plaistown Nov 13 1929

Mr John Brooks
Dear Mr Brooks

Mr J. M. Crouse Contractor
is now putting the stone on the Dam known as
Newark Hill south of Plaistown nearly finished
I wish you would drop around and look it over
so we can finish it up to your satisfaction

Sincerely

Edward L. Lauterman

P.S. If you have a chance to let me know when
you will be up I will be glad to see you

Edward L. Lauterman
Blauvelt New Jersey

RECEIVED

SEP 28 1929

STATE WATER POLICY
COMMISSION

Mr John W. Brooks,
Hydraulic Engineer,
State Water Policy Commission,
State House Annex,
Trenton N.J.

September 26-1929

Dear Mr Brooks:

The improvements at the Newark Girl
Scouts' Camp at Blairstown, N.J. started in November, 1928.
Since receiving your letter I have made a survey of the
water shed at the lake and find the same to be about
One hundred acres.

There was no intention whatever of with holding an
application for permission to build the Dam at the
Girl Scouts' Camp, if it were necessary.

If you think it necessary, we can file an
Application now and send you the details, maps, etc.
but before doing so, think you should visit me
on the property and make a complete in-
spection with me. You will recall my earlier
invitation to do so when we met at Mountain
Lake at Mr. Folger's proposed dam.

(2)

However, I have been informed that you did inspect the site of the new Dam with someone else. Perhaps you were not aware of the provision we are making for an overflow or spillway at another part of the Lake.

You will be interested to know that my instructions from the Trustees of the Camp were to make the Core wall so strong as to be beyond the possibility of criticism. The width of the base and of the Core and the strength of the mixture are evidence of this fact.

The Core is two feet wide at the base and tapers to one foot at the top.

If you still think a formal application is necessary, Please advise me when you can meet me in Blairtown.

Yours very truly,
Edward L. Lantzman

RECEIVED
SEP 10 1929

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS

Blairtown Sept-9-1929

Mr John W. Brooks

Dear Sir:

Your letter of the 6th
received as to the questions you ask
I have forwarded your letter to Mr Willard
Hamilton of Newark to answer same
The Dam is not finished yet,

and any suggestions you may make or
offer in any way will be gladly received
and I will mail them to Mr Hamilton.

Awaiting your reply

Respectfully yours truly

Edward L. Lauterbach

PS Sorry I did not see you while you was
here

Report on Dam Inspection.

NEWARK GIRL SCOUTS

Dam No. ²¹⁻³⁰~~21-30~~

Location 21.43.1.3.8.

This dam was built during the spring of 1929 under the direction of Mr. Edward L. Lanterman of Blairstown, without permit.

The structure is an earth dam with concrete core wall, 250 feet long and with a maximum ~~pipe~~ 11 feet ~~long~~. The top width is 6 feet and the side slope 1:1. height of

The fill has been made of gravel without compacting and has been badly washed at the left end by flood water from a nearby road. The fill shows marked settlement throughout the length of the dam.

There is ¹⁻⁸~~1-8~~ inch cast iron blow-off pipe with gate valve ⁱⁿ~~and~~ manhole.

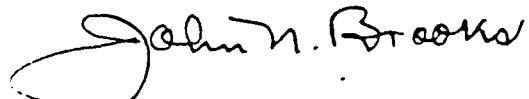
The dam has no spillway.

The water shed measures on the map 0.6 square mile. However, the small stream on which this dam has been placed formerly lost itself in a meadow below the dam site and there is no Culvert beneath the highway 0.2 mile below the dam.

It does not appear probably that the dam will ever be overtopped.

There was no water in the pond.

Trenton, N.J.,
September 6, 1929.


John N. Brooks,
Hydraulic Engineer.

Darius-Nansen Co

Trenton Office.

September 6th, 1929.

Mr. Ed. L. Lanterman,
Blairstown, N. J.

Dear Mr. Lanterman:-

We made an inspection this morning of the dam which you built for the Newark Girl Scouts about 1-1/2 mile northwest of Blairstown.

The drainage area tributary on this dam as measured on the State map is 0.6 square mile and the dam is 11 feet high.

Therefore, under the old law which was in force at the time this dam was built you should have made application to the proper State Authority for approval of your plans.

You will kindly be so good as to inform this office why the dam was built without the approval of plans.

Yours very truly,

STATE WATER POLICY COMMISSION.

John H. Brooks,
Hydraulic Engineer.

JNB:MEB

RECEIVED

AUG 5 1929

STATE WATER POLICE
COMMISSION

Plain town Aug 2^d 1929

Mr John N. Brooke

Dear Sir

Aug 5 1929 JNB
Your letter of July

31 st- received

I have looked over the enclosed
map you sent me the Place where the
Girls Scouts of Newark have built a new
Dam; This Place is simply a Spring run
feeding this place for the Girls & down in
This Spring run emptied into a Sink Hole
Just below the Dam and then disappeared
Any time you come up will show it to
you

As to the Springdale alterations that
Mr N.H. Hart runs there I do not know
what he intends to do as he has never told
me I have asked him several times but no
definite reply I ^{will} stir him up again shortly
then I will write you as soon as I can get

Something Tanagibable to write you
That place would make a fine Lake
if he decides to go ahead with it—

Yours truly
Edward L. Lamm

Did Mr. Folkner write you any thing
in regard to a Spring run he proposes to
dam up to make a fine Pond with dirt
just south of Mountain Lake formerly Queens Pond
I think he better build a concrete one dam
as he has a large water shed behind him
When he writes you, I will leave it all to your
judgement to tell him what to expect

APPENDIX 2

CHECK LIST

VISUAL INSPECTION

LAKE KALMIA DAM

Check List
Visual Inspection
Phase 1

Name Dam Lake Kalmia County Warren State NJ(00166) Coordinators NJDEP
 Date(s) Inspection 2/18/81 4/22/81 Weather' Warm, Sunny Clear Temperature 40° 65°
 Pool Elevation at Time of Inspection 410.3'+ NGVD Tailwater at Time of Inspection 405' NGVD

Inspection Personnel:

<u>K. Stuart</u>	<u>W. Guinan</u>
<u>D. Deane</u>	<u>S. Gilman</u>
<u></u>	<u>R. Murdock</u>

F.D.Deane/S.Gilman/R.Murdock Recorder

Ms. Marjorie Vance, representing the Girl Scouts of Essex County, was present during the April inspection.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	U/s face of dam is badly spalled and cracked. One section near right end is eroded in a "V" form approximately 8" deep - Reinforcing bars are showing. Concrete slabs on top are cracked and disjointed. Stop log slots approximately 1 foot downstream from inlet.	Repair deteriorated, cracked spalled concrete.
APPROACH CHANNEL	Clear and unobstructed;	
DISCHARGE CHANNEL	D/s face is eroded and spalled. D/s concrete masonry walls on either side of spillway channel are badly spalled and cracked. Trash and other debris at toe of spillway, including channel drain. Extensive vegetation, trees & debris, downstream from spillway apron. Drop-off chute spillway severely eroded.	Repair deteriorated concrete. Remove trash and debris. Clear vegetation.

BRIDGE AND PIERS
OVER SPILLWAY

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosion and sloughing on downstream slope. Trees up to 14 inches in diameter on slope.	Under qualified supervision, remove the trees and their roots.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good	
RIPRAP FAILURES	No rip-rap.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	None	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Erosion of both sides of spillway structure.	Repair eroded area.
ANY NOTICEABLE SEEPAGE	Seepage at toe of slope near junction with right abutment. Majority of area at toe of slope is wet and soggy.	Investigate seepage and correct problem.
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Could not observe either end of conduit.	
INTAKE STRUCTURE	Not observable.	
OUTLET PIPE	Not observed - d/s end covered with debris.	Clear debris.
OUTLET CHANNEL	Well-defined flat slope through open area with a few trees (cedar).	
EMERGENCY GATE	CMP access to valve filled with trash. Last operation unknown. Could not determine valve size.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

SLOPES

Gradual to moderately sloped,
wooded and some open fields.

SEDIMENTATION

No noticeable sedimentation
was observed.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Trash and debris at spillway drop-off.	(See description of ungated spillway channel)
SLOPES	Flat	
APPROXIMATE NO. OF HOMES AND POPULATION	Three old former camp cabins to be razed - no occupants.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	None found. Information is available on the Proposed Dam Reinforcement Plan on file at the New Jersey Department of Environmental Protection, Prospect Street, Trenton, New Jersey 08625
REGIONAL VICINITY MAP	Prepared for this report
CONSTRUCTION HISTORY	Some information available in NJDEP files. Legible sheets are included in Appendix 1, ENGINEERING AND EXPERIENCE DATA.
TYPICAL SECTIONS OF DAM	Available from plan mentioned above
HYDROLOGIC/HYDRAULIC DATA	None found
OUTLETS - PLAN	None found
- DETAILS	8" C.I. Pipe with gate valve in manhole
- 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	See PLAN OF DAM on previous page
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	Reinforcement. See PLAN OF DAM
HIGH POOL RECORDS	None found
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Some information available in NJDEP files. Legible sheets are included in Appendix 1, ENGINEERING AND EXPERIENCE DATA.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown
MAINTENANCE OPERATION RECORDS	None found

ITEMS	REMARKS
SPILLWAY PLAN	None found
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	None found

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.50 square miles fields and woods
(50 percent each)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 410.3' NGVD (77 ac-ft)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY: Not applicable

ELEVATION MAXIMUM TEST FLOOD POOL: 411.8' NGVD

ELEVATION TOP DAM: 411.1' NGVD (92.8 acre-feet)

SPILLWAY_CREST: Broad-crested

a. Elevation 410.3' NGVD upstream invert

b. Type Rectangular Flume

c. Width 4.3 feet (flume)

d. Length 39.5 feet (flume)

e. Location Spillover Center of dam

f. Number and Type of Gates None (stop log slots present)

OUTLET WORKS: One 8-inch pipe with valve (may not be operable)

a. Type Presumed to be cast iron pipe

b. Location Just left (east) of spillway

c. Entrance Invert 404' NGVD (estimated)

d. Exit Inverts 404' NGVD (estimated)

HYDROMETEOROLOGICAL GAGES: None

MAXIMUM NON-DAMAGING DISCHARGE: 9.2 cfs

APPENDIX 3

PHOTOGRAPHS

LAKE KALMIA DAM



April 22, 1981

Dam crest, note settlement and cracking of concrete adjacent to iron diving platform.



April 22, 1981

Downstream spillway channel below spillway apron.



April 22, 1981

Downstream end of spillway - note vertical drop of water.



February 18, 1981

Spillway exit - note debris at dropoff. The end is beginning to get undermined.



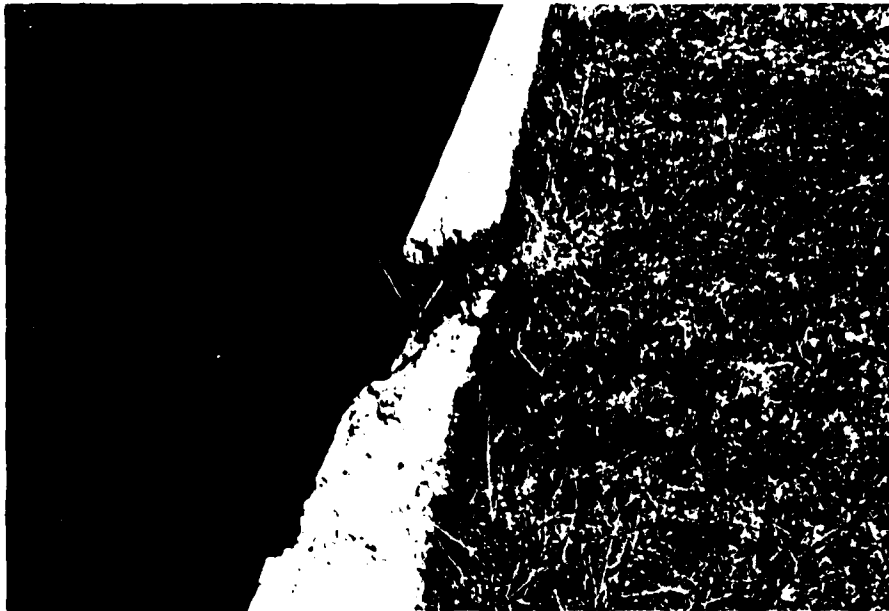
April 21, 1981

Saddle about 400 feet east of dam that probably would serve as emergency spillway. Looking at upstream face from west side of bay.



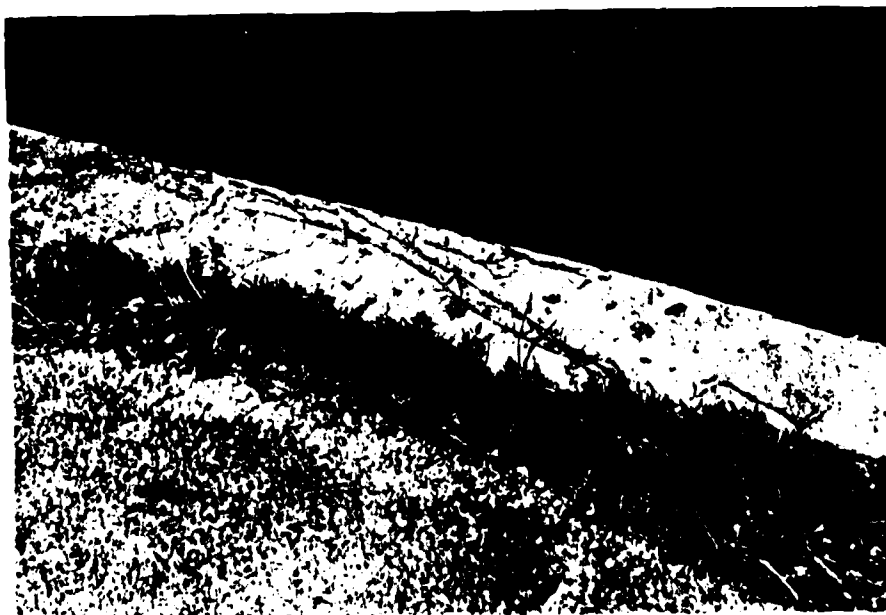
April 22, 1981

Settlement and cracked area under slab at spillway inlet at left training wall near diving board frame. Note training walls notched for stoplog.



April 22, 1981

Spalled concrete upstream wall in first dogleg
to left of spillway.



April 22, 1981

Spalled concrete upstream wall.



April 22, 1981

Erosion and deterioration of masonry wall at downstream face of dam, right (west) of spillway.



April 22, 1981

Erosion adjacent to left spillway wall.



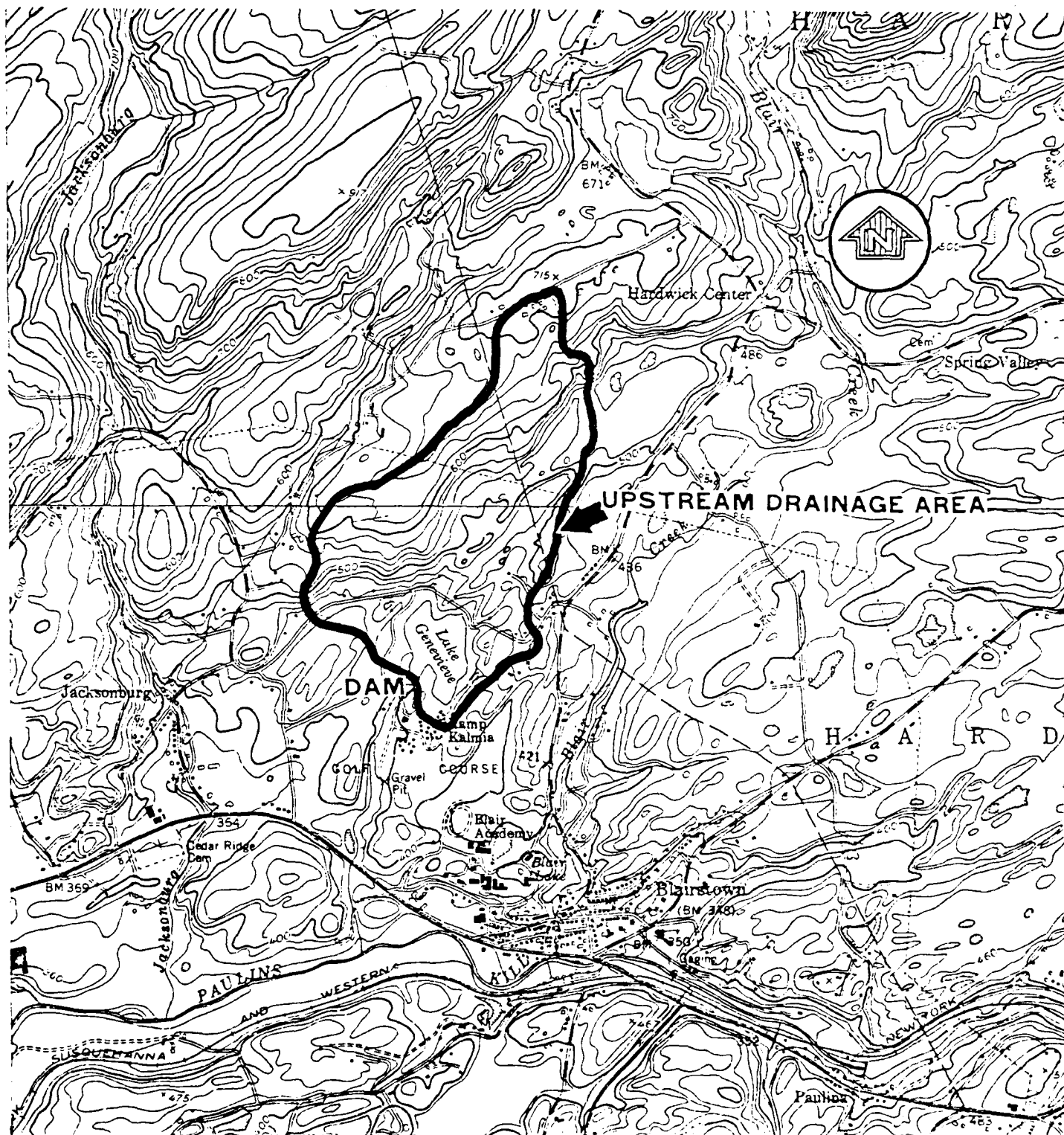
April 12, 1971

Toe of slope, near right abutment. Seepage appears to flow from location directly across from end of upstream vertical concrete face.

APPENDIX 4

HYDROLOGIC COMPUTATIONS

LAKE KALMIA DAM



NATIONAL PROGRAM OF INSPECTION OF
NON-FED. DAMS

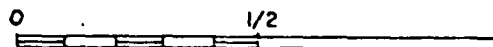
LAKE KALMIA DAM
BLAIRSTOWN TOWNSHIP, NEW JERSEY
REGIONAL VICINITY MAP

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

Anderson-Nichols & Company, Inc.

BOSTON, MA.

SCALE IN MILES



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

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 Concentration① Texas Highway Methodall overland, = 5,300 ft. slope = $\frac{715-410}{5,300} = 0.058 = 5.8\%$ From the Texas Highway method chart in Design of Small Dams, $v = 2.0$ fps for woodlands.

$$\text{Time} = \frac{5,300}{2} = 2,650 \text{ sec} = 0.74 \text{ hours}$$

② Soil and Water Conservation Method

$$L = 0.6 T_c = \frac{L^{0.8} (S+1)^{1.67}}{9,000 y^{0.5}}$$

$$\rightarrow T_c = \frac{L^{0.8} (S+1)^{1.67}}{0.6 (9,000) y^{0.5}}$$

$$L = 5,300 \text{ ft.}$$

$$y = 5.8\%$$

$$S = \frac{1,000}{CN} - 10 \quad \text{CN} = 70 \text{ for woods of soil group C, good condition.}$$

$$S = \frac{1,000}{70} - 10 = 4.29$$

$$T_c = \frac{5,300^{0.8} (5.29)^{1.67}}{0.6 (9,000) (5.8)^{0.5}} = 1.18 \text{ hours}$$

③ Weston, or SCS T.R. #55 Methodall overland. slope = 5.8% $\rightarrow v = 0.6$ fps

$$T_c = \frac{5,300}{0.6} = 8,833 \text{ sec} = 2.45 \text{ hours}$$

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. SCALE④ Kerby Method

all overland.

$$T_c = 0.83 \left(\frac{NL}{\sqrt{S}} \right)^{0.467} \quad N = 0.7; \quad L = 5,300; \quad S = 0.058$$

$$= 0.83 \left(\frac{0.7(5,300)}{\sqrt{0.058}} \right)^{0.467}$$

$$= 74.94 \text{ min} = 1.25 \text{ hours}$$

$$\text{Average} = \frac{0.74 + 1.18 + 2.45 + 1.25}{4} = 1.4 \text{ hours}$$

$$\text{Lag} = 0.6 T_c = 0.84 \text{ hours}$$

$$\text{Drainage Area} = 0.50 \text{ square miles}$$

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. SCALEStage Vs. Discharge

The hydraulic profile of Lake Kalmia is shown on P. 4.
See the profile for sections of dam crest, referred to as ①, ②, etc

Spillway (⑧) $Q = C L H^{3/2}$ $C = 3.0$ for Broad Crested concrete weir
 $Q = 3.0 (4.3) (E-410.3)^{3/2}$

Top of Dam (sections ⑥, ⑦, ⑨, ⑩, ⑪, and ⑫) $C = 2.7$ for all sections

Section ⑥ is a sloping weir 50' long, w/ one end at 411.2' and the other at 411.8' (411.5' avg.). The slope is $\frac{50}{0.6} = 83.3 H:1V$.

Section ⑦ is a level 98' weir at 411.2'.

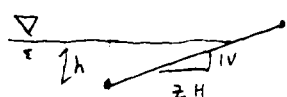
Section ⑨ is a sloping weir 49.7 feet long, with one end at 411.1' and the other at 411.3' (411.2' avg.). The slope is $\frac{49.7}{0.2} = 238.5 H:1V$.

Section ⑩ is a sloping weir 50 feet long, with ends at 411.3' and 411.4' (avg. = 411.35). The slope is $\frac{50}{0.1} = 500 H:1V$.

Section ⑪ is a 50' level weir at 411.4

Section ⑫ is a 50' sloping weir with ends at 411.4 and 412.0 (avg. = 411.7'). The slope is $\frac{50}{0.6} = 83.33 H:1V$

For a sloping weir only partially submerged:



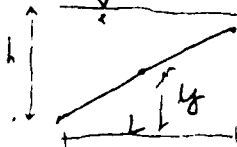
$$Q = C L_{sub} H_{avg}^{3/2}$$

$$H_{avg} = \frac{0 + h}{2} = 0.5 h$$

$$L_{sub} = z h$$

$$Q = C (z)(h) (0.5(h))^{3/2}$$

For a sloping weir fully submerged:



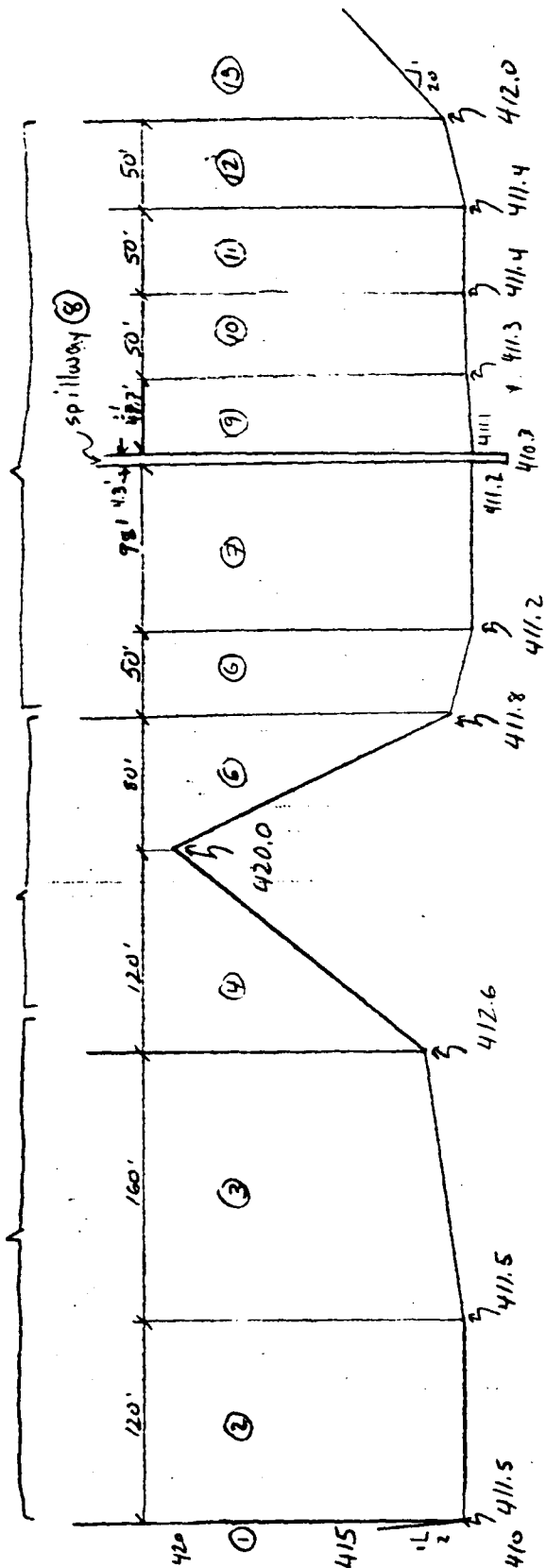
$$Q = C L_{sub} H_{avg}^{3/2}$$

$$= C L (h - z)^{3/2}$$

Natural Saddle Em. s/w

Hill

Dam



Elevation (Ft. above MGLD)

405

400

ANDERSON-NICHOLS

VERNON BOSTON CONCORD

Lake Kalmia Dam
Hydraulic Profile

DATE: 6/25/81 SCALE: 1" = 5' V, 1" = 100' H JOB NO. 3670-08 SHEET NO. P. 4 of 15

JOB NO.

JARES 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

We will compute Q at 410.3, 410.7, 411.1, 411.5, 412.0, 412.5, 413.0, 413.5

at 410.3, 410.7, and 411.1 - no flow

$$\text{at } 411.5: Q_6 = 2.7 (83.3) (E - 411.2) (0.5 (E - 411.2))^{3/2}$$

$$Q_7 = 2.7 (98.) (E - 411.2)^{3/2}$$

$$Q_9 = 2.7 (47.7) (E - 411.2)^{3/2}$$

$$Q_{10} = 2.7 (50) (E - 411.35)^{3/2}$$

$$Q_{11} = 2.7 (50) (E - 411.4)^{3/2}$$

$$Q_{12} = 2.7 (83.3) (E - 411.4) (0.5 (E - 411.4))^{3/2}$$

$$Q = Q_6 + Q_7 + Q_9 + Q_{10} + Q_{11} + Q_{12}$$

at 412.0, 412.5, 413.0, and 413.5

$$Q_6 = 2.7 (50) (E - 411.5)^{3/2}$$

$$Q_{12} = 2.7 (50) (E - 411.7)^{3/2}$$

$$Q_7, Q_9, Q_{10}, Q_{11} \text{ The same as at } 411.5$$

Natural Saddle (sections ①, ②, ③, ④) $C = 2.6$ for all sections

Section ① is a 2H:1V sloping weir with its low end at 411.5'

Section ② is an even crested 120 foot weir at 411.5'

Section ③ is a 145.5 H to 1V weir 160 feet long, with one end at 411.5 and the other at 412.6'

Section ④ is a 16.2 H:1V sloping weir 120 feet long, with one end at 412.6' and the other at 420.0'.

at 410.3, 410.7, 411.1, 411.5 - no flow

$$\text{at } 412.0 \text{ and } 412.5: Q_1 = 2.6 (2) (E - 411.5) (0.5 (E - 411.5))^{3/2}$$

$$Q_2 = 2.6 (120) (E - 411.5)^{3/2}$$

$$Q_3 = 2.6 (145.5) (E - 411.5) (0.5 (E - 411.5))^{3/2}$$

$$Q_4 = \text{no flow}$$

$$Q = Q_1 + Q_2 + Q_3 + Q_4$$

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

$$\text{at } 413.0 \text{ and } 413.5 : Q_3 = 2.6(160)(E-412.05)^{3/2}$$

$$Q_4 = 2.6(16.2)(E-412.6)(0.5(E-412.6))^{3/2}$$

Q_1 and Q_2 the same as before

Side slopes: (sections ⑤ and ③), $C = 2.6$

Section ⑤ is a 9.8 H:1V sloping weir, with one end at 411.8',
The other at 420.0' and 415.9' average.

Section ③ is a 20H:1V sloping weir with its low end at 412.0

at 410.3, 410.7, 411.1, and 411.5: no flow

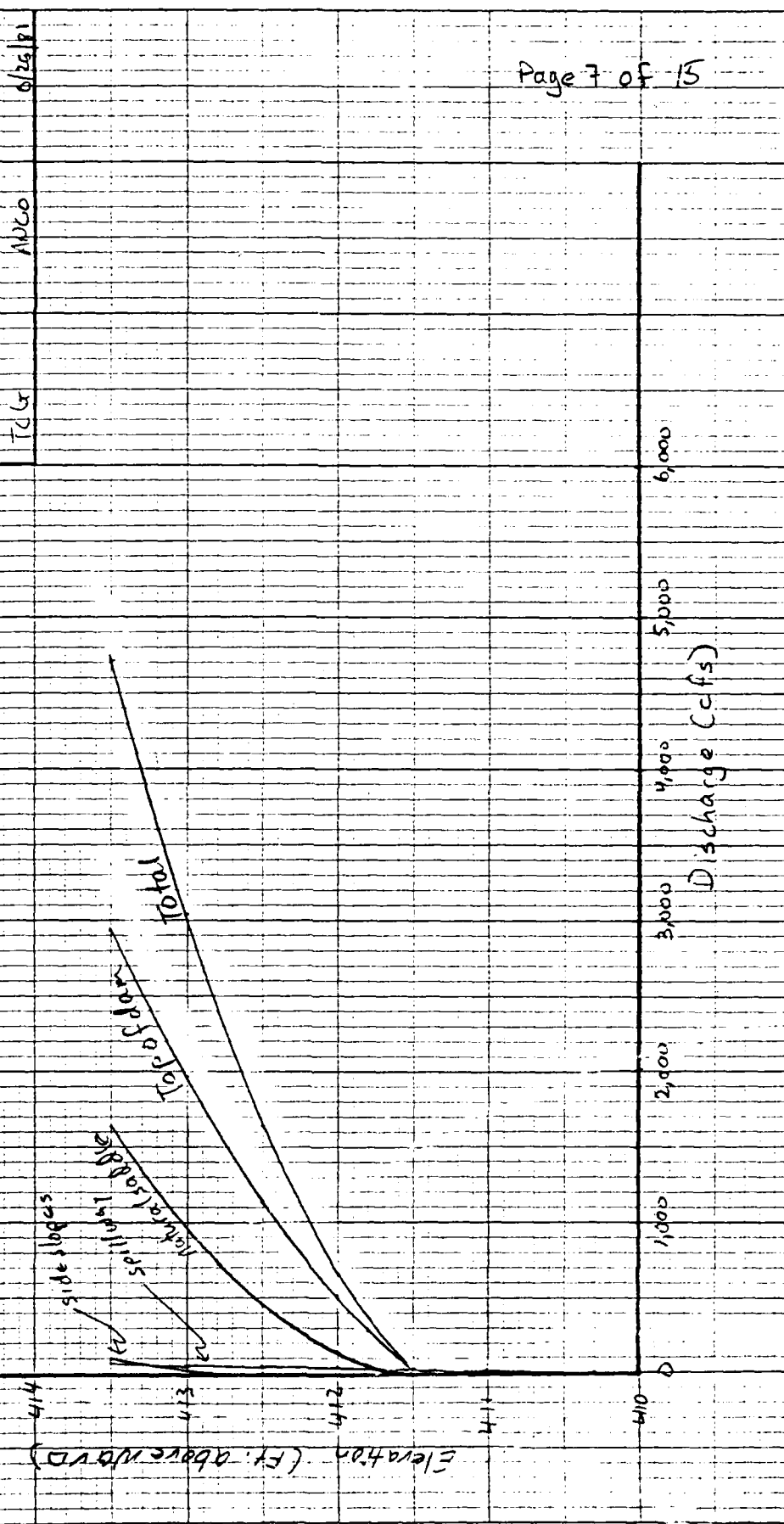
$$\text{at } 412.0, 412.5, 413.0, \text{ and } 413.5 : Q_5 = 2.6(9.8)(E-411.8)(0.5(E-411.8))^{3/2}$$

$$Q_{13} = 2.6(20)(E-412.0)(0.5(E-412.0))^{3/2}$$

Elevation (ft. above Noid)	Q_{spillway} (cfs)	$Q_{\text{Top of Dam}}$ (cfs)	Q_{saddle} (cfs)	$Q_{\text{side slopes}}$ (cfs)	Q_{Total} (cfs)
410.3	0	0	0	0	0
410.7	3.3	0	0	0	3.3
411.1	9.2	0	0	0	9.2
411.5	17.0	81	0	0	98
412.0	29	485	134	0	648
412.5	42	1,137	448	7	1,634
413.0	57	1,957	965	33	3,012
413.5	74	2,917	1,631	85	4,707

Lake Kalma Dam Stage Versus Discharge

Page 7 of 15



JOB NO.

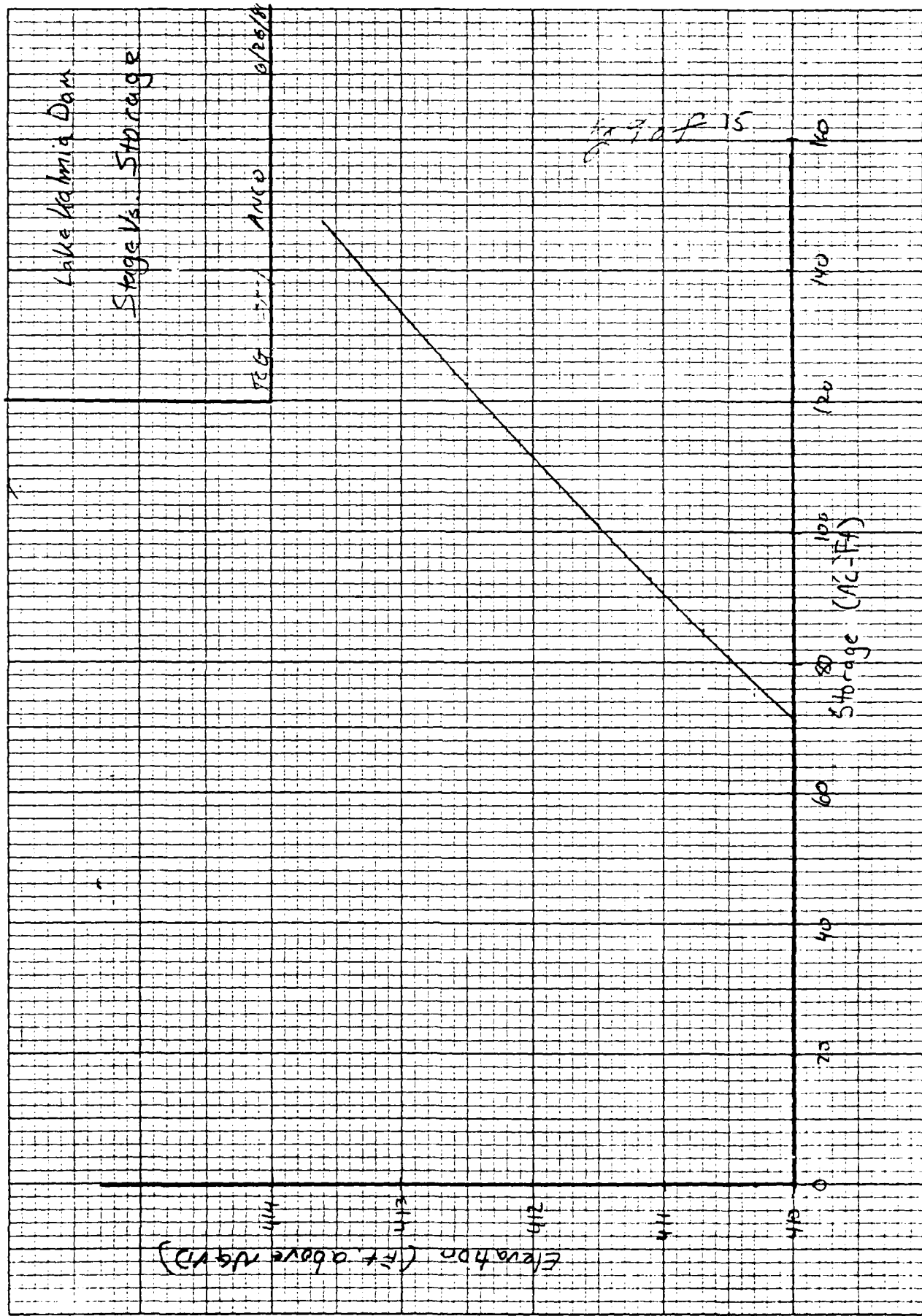
SQUARES
1/4 IN. SCALE

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

Stage versus Storage

At the spillway crest, elevation 410.3, the pond has an area of 19.2 acres. At elevation 420, the surface area would be about 33 acres. Assume a linear increase in surface area with stage. Storage at the spillway crest = 77 ac-ft (avg depth = 4 ft.). Storage = 0 at 404.

Elevation (ft. above NGVD)	ΔH	Surface Area (Acres)	Avg. S. A. (Acres)	Incremental Storage (Ac-Feet)	Cumulative Storage (Ac-Feet)
404.	-	-	-	-	0.0
410.3	-	19.2	-	-	77.0
410.7	0.4	19.8	19.5	7.8	84.8
411.1	0.4	20.3	20.05	8.0	92.8
411.5	0.4	20.9	20.6	8.2	101.0
412.0	0.5	21.6	21.25	10.6	111.6
412.5	0.5	22.3	21.95	11.0	122.6
413.0	0.5	23.0	22.65	11.3	133.9
413.5	0.5	23.8	23.4	11.7	145.6



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 3
1/4 IN. SCALERainfall - 100 year flood

The 100-year flood is the test flood for this dam. For a T_c of 1.4 hours, we will use a 2-hour storm. (5 minute time steps). Use the "synthetic storm from depth-duration data", Hydro-35 NWS

Duration100-year rainfall

5 minutes

0.78" 1.

10 "

 $0.59 D_{15} + 0.41 D_5 = 1.31" 3.$

15 "

1.68" 1.

30 "

 $0.49 D_{60} + 0.51 D_{15} = 2.38" 3.$

60 "

3.10" 1.

120 "

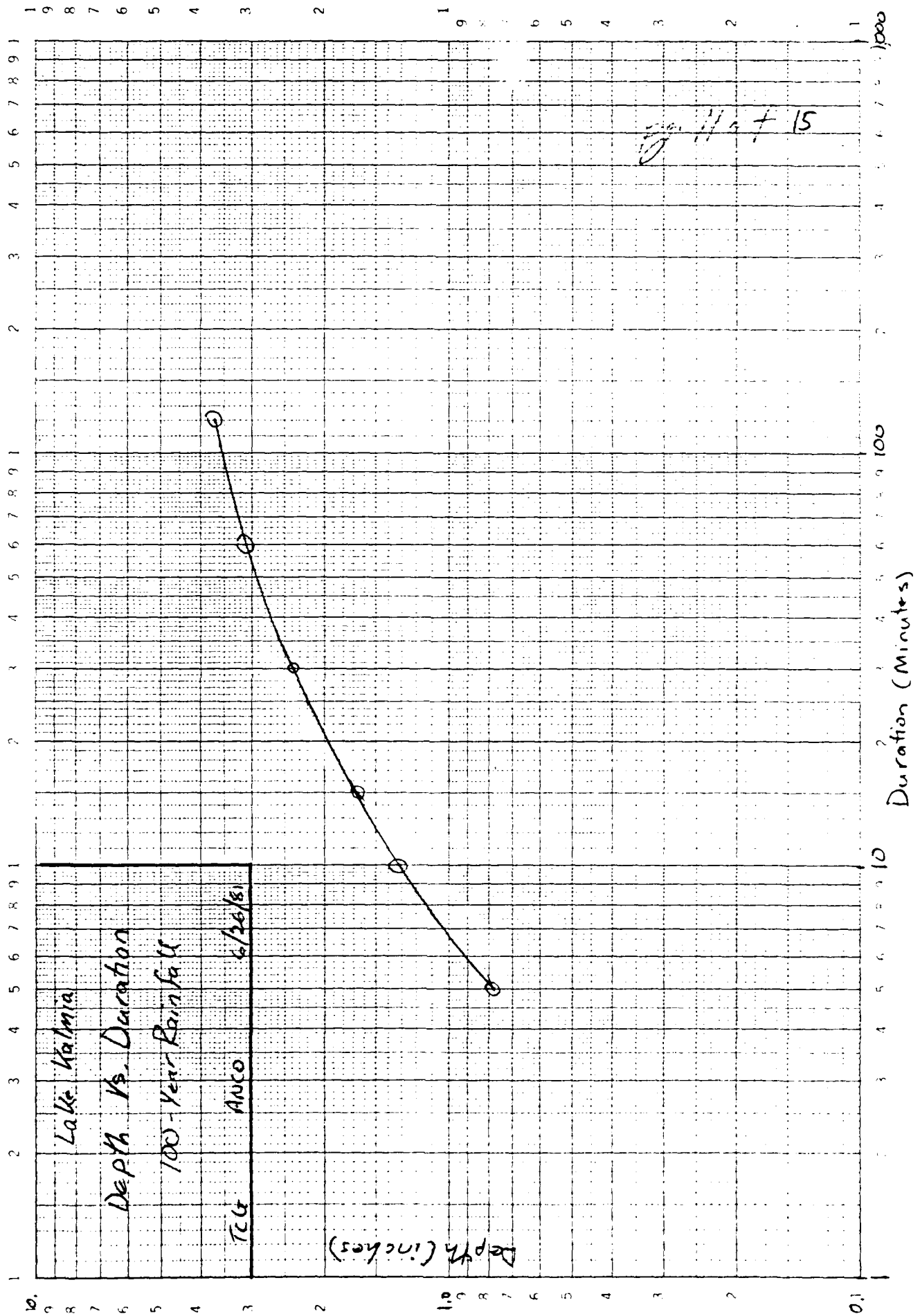
3.70" 2.

P.11 shows a mass curve for the peak 100 year depth versus duration for Lake Kalmia on Log-Log paper. The increments of rain are given on page 12. The storm will have the largest in the 13th time interval, 2nd largest in the 12th, 3rd largest in 14th, etc.

1. NWS Hydro-35

2. NWS TP-40

3. Interpolation from NWS Hydro 35.



Lake Kalmia
Depth vs. Duration
100-Year Rainfall
TCL ANCO 6/24/81

Depth (inches)

Duration (Minutes)

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

	<u>Duration (min.)</u>	<u>Depth (in.)</u>	<u>ΔT (min.)</u>	<u>Δ Rain (in.)</u>	<u>Ranking</u>	<u>Time int.</u>
1						
2						
3	0	0	5	0.78	1	13
4	5	0.78	5	0.53	2	12
5	10	1.31	5	0.37	3	14
6	15	1.68	5	0.29	4	11
7	20	1.97	5	0.22	5	15
8	25	2.19	5	0.19	6	10
9	30	2.38	5	0.18	7	16
10	35	2.56	5	0.14	8	9
11	40	2.70	5	0.10	9	17
12	45	2.80	5	0.10	10	8
13	50	2.90	5	0.10	11	18
14	55	3.00	5	0.10	12	7
15	60	3.10	5	0.07	13	19
16	65	3.17	5	0.06	14	6
17	70	3.23	5	0.06	15	20
18	75	3.29	5	0.05	16	5
19	80	3.34	5	0.05	17	21
20	85	3.39	5	0.05	18	4
21	90	3.44	5	0.05	19	22
22	95	3.49	5	0.05	20	3
23	100	3.54	5	0.04	21	23
24	105	3.58	5	0.04	22	2
25	110	3.62	5	0.04	23	24
26	115	3.66	5	0.04	24	1
27	120	3.70				
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So input incremental rainfall for 5 minute increments is 0.04, 0.04, 0.05, 0.05,
0.06, 0.06, 0.10, 0.10, 0.14, 0.19, 0.29, 0.53, 0.78, 0.37, 0.22, 0.18, 0.19, 0.10, 0.07,
0.06, 0.05, 0.05, 0.04, 0.04

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. SCALEOvertopping Analysis

For this small, low-hazard dam the 100 year storm was used to generate a test flood. The storm gives a peak outflow of 494 cfs, which is 54 times as large as the spillway capacity. The peak 100-year stage would be 41.86 feet, 0.86 feet over the dam crest.

At this stage, the flow is as follows

over spillway	= 26 cfs
over dam	= 372 cfs
Over natural saddle	= 96 cfs
overside slopes	= 0.0 cfs

494 cfs

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
Drawdown Time

The 8" pipe shown on the plans as a low-level outlet for Lake Kalmia may not be in operating condition. If it is, its invert is at about 404.0. Assume:

① no inflow

 ② inlet control on pipe. $Q = C A \sqrt{2g} \sqrt{H}$. $C = 0.61$, $A = \pi (\frac{1}{3})^2 = 0.349 \text{ ft}^2$
 $Q = 0.61 (0.349) (\sqrt{2g}) (E - 404.33)^{1/2} = 1.71 (E - 404.33)^{1/2}$

 ③ storage follows via form $S = C h^N$. $h = E - 402$. given $S = 77$ at $h = 6.3$ and $S = 145.6$ at $h = 9.5$ (page 8):

$$77 = C 6.3^N$$

$$\ln 77 = \ln C + N \ln 6.3$$

$$\rightarrow \ln C = 4.344 - 1.841N$$

$$\text{and } 145.6 = C 9.5^N$$

$$\ln 145.6 = \ln C + N \ln 9.5$$

substitute for $\ln C$

$$\ln 145.6 = 4.344 - 1.841N + N \ln 9.5$$

$$4.981 - 4.344 = -1.841N + 2.251N$$

$$N = 1.554$$

$$\rightarrow \ln C = 4.344 - 2.116N = 1.483 \rightarrow C = 4407$$

$$\text{so } S = 4407 (E - 404)^{1.554}$$

④ $Ac - \text{ft/day} = Q_{\text{avg}} \times 1.9835$

⑤ $\text{Days} = \frac{\Delta S}{Ac - \text{ft/day}}$

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

Elevation (ft. above MVD)	Storage (acre-ft)	ΔS (acre-ft)	Q (cfs)	Qave (cfs)	Ac-ft/day	DAYS
410.3	77	-	4.2			
		23.2		3.4	7.74	3.0
409	53.8		3.7			
		15.8		3.5	6.44	2.3
408	38.0		3.3			
		13.7		3.1	6.15	2.2
407	24.3		2.8			
		11.4		2.5	4.96	2.3
406	12.4		2.2			
		8.5		1.8	3.57	2.4
405	4.4		1.4			
		4.4		0.7	1.39	3.2
404	0		0			

15.4 days

APPENDIX 5

HEC1 OUTPUT

LAKE KALMIA DAM

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10.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
11 LAKE KALMIA DAM INVERTING ANALYSIS TIM BENCH ANCO
12 VFA JERSEY DAM NO. 100 - WARREN COUNTY - BLAIRSTOWN TOWNSHIP
13 100-YEAR STORM (2-HOUR STORM)
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 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 FEBRUARY 1971
 KUH GATE08/11/61 TIME16.33.13

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

LAKE KALMIA DAM OVERTOPPING ANALYSIS TOM COUCH ANCO
 NEW JERSEY DAM NO. 166 - WARREN COUNTY - BLAIRSTOWN TOWNSHIP
 100-YEAR STORM (2-HOUR STORM)

5 IO OUTPUT CONTROL VARIABLES PRINT CONTROL
 IPRINT 1 PLOT CONTROL
 IPLUT 1 HYDROGRAPH PLOT SCALE
 USCAL 01 PRINT DIAGNOSTIC MESSAGES
 YES

17 HYDROGRAPH TIME DATA 5 MINUTES IN COMPUTATION INTERVAL
 DATE 1 0000 STARTING DATE
 TIME 200 STARTING TIME
 NO DATE 1 1635 NUMBER OF HYDROGRAPH ORDINATES
 NOTIME 0 ENDING DATE
 0 ENDING TIME

COMPUTATION INTERVAL 0.06 HOURS
 TOTAL TIME BASE 16.56 HOURS

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

*** ** ** ** **

6 KK

 AI

LAKE KALMIA INFLOW HYDROGRAPH

INFLW FRM SCS UNIT GRAPH COMPUTATIONS

10 IN TIME DATA FOR INPUT TIME SERIES
 JDATE 1 0000 TIME INTERVAL IN MINUTES
 JATIME 1 0000 STARTING DATE
 0 STARTING TIME

SUBBASIN RUNOFF DATA

6 EA SUBBASIN CHARACTERISTICS
 TAREA 0.50 SUBBASIN AREA

9 EF BASF FLOW CHARACTERISTICS
 TCRG 1.00 INITIAL FLOW
 TCRG 1.00 BEGINNING FLOW RECESSON
 RTCR 1.0000 RECESSON CONSTANT

PRECIPITATION DATA

17 FT TOTAL STORM STATIONS INFLOW
 16 PW WEIGTHS 1.00

15 PR RECORDING STATIONS INFLOW
 16 PW WEIGTHS 1.00

19 LU UNIFORM LOSS RATE 1.00 INITIAL LOSS RATE
 STATION 0.10 UNIFORM LOSS RATE
 CASE 0.0 PERCENT IMPERVIOUS AREA
 20 UD SCS DIMENSIONLESS UNITGRAPH
 FLAG 0.04 LAG

PRECIPITATION STATION DATA

STATION INFLU TOTAL AVG. ANNUAL WEIGHT
 INFLU 3.73 0.0 1.00

TEMPORAL DISTRIBUTIONS

STATION INFLU WEIGHT = 1.00
 0.04 0.05 0.05 0.06 0.10 0.14 0.19
 0.23 0.76 0.37 0.18 0.10 0.10 0.06
 0.03 0.04 0.04

UNIT HYDROGRAPH ORDINATES

52 END-OF-PERIOD ORDINATES
 273. 78. 263. 273.
 79. 231. 108. 92.
 17. 59. 12. 20.
 4. 13. 5. 1.
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HYDROGRAPH AT STATION A1

EQ	MO	HR	MIN	TRC	RAIN	LOSS	EXCESS	COMP	0	RA	MON	HR	MIN	TRC	RAIN	LOSS	EXCESS	COMP	0
1	1	0000		1	0.04	0.04	0.00	2.	1	1	0000		1	0.04	0.04	0.00	2.	1	1
1	1	0005		2	0.04	0.04	0.00	2.	1	1	0005		2	0.04	0.04	0.00	2.	1	1
1	1	0010		3	0.04	0.04	0.00	2.	1	1	0010		3	0.04	0.04	0.00	2.	1	1
1	1	0015		4	0.04	0.04	0.00	2.	1	1	0015		4	0.04	0.04	0.00	2.	1	1
1	1	0020		5	0.04	0.04	0.00	2.	1	1	0020		5	0.04	0.04	0.00	2.	1	1
1	1	0025		6	0.04	0.04	0.00	2.	1	1	0025		6	0.04	0.04	0.00	2.	1	1
1	1	0030		7	0.04	0.04	0.00	2.	1	1	0030		7	0.04	0.04	0.00	2.	1	1
1	1	0035		8	0.04	0.04	0.00	2.	1	1	0035		8	0.04	0.04	0.00	2.	1	1
1	1	0040		9	0.04	0.04	0.00	2.	1	1	0040		9	0.04	0.04	0.00	2.	1	1
1	1	0045		10	0.04	0.04	0.00	2.	1	1	0045		10	0.04	0.04	0.00	2.	1	1
1	1	0050		11	0.04	0.04	0.00	2.	1	1	0050		11	0.04	0.04	0.00	2.	1	1
1	1	0055		12	0.04	0.04	0.00	2.	1	1	0055		12	0.04	0.04	0.00	2.	1	1
1	1	0100		13	0.04	0.04	0.00	2.	1	1	0100		13	0.04	0.04	0.00	2.	1	1
1	1	0105		14	0.04	0.04	0.00	2.	1	1	0105		14	0.04	0.04	0.00	2.	1	1
1	1	0110		15	0.04	0.04	0.00	2.	1	1	0110		15	0.04	0.04	0.00	2.	1	1
1	1	0115		16	0.04	0.04	0.00	2.	1	1	0115		16	0.04	0.04	0.00	2.	1	1
1	1	0120		17	0.04	0.04	0.00	2.	1	1	0120		17	0.04	0.04	0.00	2.	1	1
1	1	0125		18	0.04	0.04	0.00	2.	1	1	0125		18	0.04	0.04	0.00	2.	1	1
1	1	0130		19	0.04	0.04	0.00	2.	1	1	0130		19	0.04	0.04	0.00	2.	1	1
1	1	0135		20	0.04	0.04	0.00	2.	1	1	0135		20	0.04	0.04	0.00	2.	1	1
1	1	0140		21	0.04	0.04	0.00	2.	1	1	0140		21	0.04	0.04	0.00	2.	1	1
1	1	0145		22	0.04	0.04	0.00	2.	1	1	0145		22	0.04	0.04	0.00	2.	1	1
1	1	0150		23	0.04	0.04	0.00	2.	1	1	0150		23	0.04	0.04	0.00	2.	1	1
1	1	0155		24	0.04	0.04	0.00	2.	1	1	0155		24	0.04	0.04	0.00	2.	1	1
1	1	0200		25	0.04	0.04	0.00	2.	1	1	0200		25	0.04	0.04	0.00	2.	1	1
1	1	0205		26	0.04	0.04	0.00	2.	1	1	0205		26	0.04	0.04	0.00	2.	1	1
1	1	0210		27	0.04	0.04	0.00	2.	1	1	0210		27	0.04	0.04	0.00	2.	1	1
1	1	0215		28	0.04	0.04	0.00	2.	1	1	0215		28	0.04	0.04	0.00	2.	1	1
1	1	0220		29	0.04	0.04	0.00	2.	1	1	0220		29	0.04	0.04	0.00	2.	1	1
1	1	0225		30	0.04	0.04	0.00	2.	1	1	0225		30	0.04	0.04	0.00	2.	1	1

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21 KK
 TIME (HR) 2.00
 (CFS) 6-HR
 (MGHS) 142
 (AC-FT) 2.645
 71
 MAXIMUM AVERAGE FLOW 16.58-HR
 24-HR 52
 72-HR 2.656
 72
 CUMULATIVE AREA = 0.50 SQ MI

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ROUTE INFLOW HYDROGRAPH THROUGH LAKE KALMIA

HYDROGRAPH ROUTING DATA

22 KS	STORAGE ROUTING	1	NUMBER OF SUBREACHES
	TYPE	SDA	TYPE OF INITIAL CONDITION
	HYD	72.00	INITIAL CONDITION
	HYD	0.0	WORKING R AND D COEFFICIENT
23 SV	STORAGE	0.0	77.0
24 SE	ELEVATION	402.00	410.30
25 SD	DISCHARGE	0.	0.
26 SE	ELEVATION	402.00	410.30
27 SS	SPILLWAY	410.30	SPILLWAY CREST ELEVATION
	CRSL	4.30	SPILLWAY WIDTH
	SDCH	3.00	WEIR COEFFICIENT
	EXPW	1.50	EXPONENT OF HEAD
28 ST	TOP OF DAM	411.10	ELEVATION AT TOP OF DAM
	DEPMU	395.70	DAM WIDTH
	COCD	0.0	WEIR COEFFICIENT
	EXPD	1.50	EXPONENT OF HEAD

STORAGE	0.0	77.00	84.80	92.80	101.00	111.60	122.60	133.90	145.60
OUTFLOW	0.0	0.0	1.30	9.20	98.00	648.00	1634.00	3012.00	4707.00

A2

[illegible]

 PEAK OUTFLOW IS 487. AT TIME 2.42 HOURS *****

PEAK FLOW (CFS) 487.	TIME (HR) 2.42	6-HR 111. 2.371	MAXIMUM AVERAGE FLOW 24-HR 44. 2.272	15.58-HR 44. 2.272
		(INCHES) (AC-FT) 55.	61. 61.	61.
PEAK STORAGE (AC-FT) 108.	TIME (HR) 2.42	5-HR 98.	MAXIMUM AVERAGE STORAGE 24-HR 92.	15.58-HR 92.
PEAK STAGE (FEET) 411.85	TIME (HR) 2.42	5-HR 411.34	MAXIMUM AVERAGE STAGE 24-HR 411.03	16.58-HR 411.03

CUMULATIVE AREA = 0.50 SQ MI

TIME IN HOURS. AREA IN SQUARE MILES
FILL IN CUBIC FEET PER SECOND
RUNOFF SUMMARY

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW 6-HOUR	FLOW FOR MAXIMUM PERIOD 24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	A1	632.	2.00	142.	52.	52.	0.50		
ROUTED TO	A2	437.	2.42	111.	44.	44.	0.50	411.85	2.42

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION A2

PLAN 1

ELEVATION STORAGE OUTFLOW	INITIAL VALUE 410.30 77. 0.	SPILLWAY CREST 410.30 77. 0.	TOP OF DAM 411.10 93. 9.	
MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS
411.85	108.	487.	5.08	2.42
	0.75			
				0.0

*** NORMAL END OF JOB ***

APPENDIX 6

REFERENCES

LAKE KALMIA DAM

APPENDIX 6
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LAKE KALMIA DAM

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