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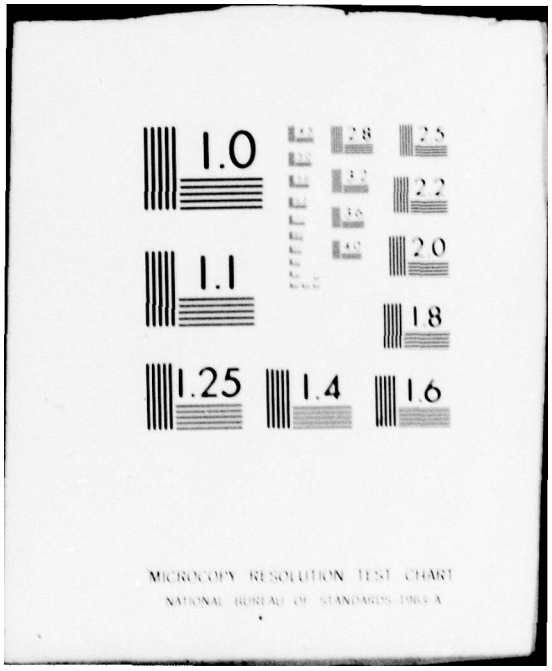
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McGELLAIRDS BROOK, MONMOUTH COUNTY
NEW JERSEY

LEVEL II

LAKE TOPANEMUS DAM
NJ 00219

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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

August, 1979

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REPORT DOCUMENTATION PAGE

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7. AUTHOR(s): (10) Posch, Anthony G. ~~[illegible]~~ / Posch	8. CONTRACT OR GRANT NUMBER(s): (15) DACW61-79-C-0011
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(6) National Dam Safety Program. Lake Topanemus Dam (NJ-00219), Raritan River Basin, McGellairds Brook, Monmouth County, New Jersey. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Lake Topanemus Dam, N.J.
Spillway
Slope
Safety
Structural Analysis
Visual Inspection
National Dam Inspection Act. report

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 - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

12 SEP 1979

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

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Topanemus Dam in Monmouth 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 Topanemus Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 13 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

To insure 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. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operations plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the dam's embankment and foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1980.

c. The ownership of the dam should be established within thirty days from the date of approval of this report.

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

(1) Replace embankment material that has been lost from the downstream face, particularly adjacent to the abutments of the bridge/spillway.

(2) Concrete slope protection should be provided under road drain outfalls, to reduce erosion.

(3) Restore the areas of eroded and spalled concrete and repair cracks to arrest further deterioration.

(4) Fabricate new operating keys for the low-level outlet valves. Clear the key shafts of debris and provide a lockable device for the shaft caps.

e. Remove trees and vegetation from the downstream embankment face and seed with grass within 12 months from the date of approval of this report.

f. The following remedial actions should be completed within one to three years from the date of approval of this report:

(1) A program should be developed to monitor the seepage through and under the dam. Depending on the information provided, the need for corrective measures can be considered and, if necessary, undertaken.

(2) Further plans and drawings of the dam should be made and annotated to form a coherent as-built set.

(3) A program of annual inspection and maintenance should be initiated. This should include lowering the lake and updating the operation and maintenance log.

NAPEN-D
Honorable Brendan T. Byrne

(4) Develop schemes for increasing the low-level outlet capacity.

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 James J. Howard of the Third 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 Safety 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,

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

1 Incl
As stated

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

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
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Trenton, NJ 08625

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LAKE TOPANEMUS DAM (NJ00219)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 30 April, 24 May and 1 June 1979 by Frederic R. Harris, 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 Topanemus Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 13 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

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b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the dam's embankment and foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1980.

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

(1) Replace embankment material that has been lost from the downstream face, particularly adjacent to the abutments of the bridge/spillway.

(2) Concrete slope protection should be provided under road drain outfalls, to reduce erosion.

(3) Restore the areas of eroded and spalled concrete and repair cracks to arrest further deterioration.

(4) Fabricate new operating keys for the low-level outlet valves. Clear the key shafts of debris and provide a lockable device for the shaft caps.

e. Remove trees and vegetation from the downstream embankment face and seed with grass within 12 months from the date of approval of this report.

f. The following remedial actions should be completed within one to three years from the date of approval of this report:

(1) A program should be developed to monitor the seepage through and under the dam. Depending on the information provided, the need for corrective measures can be considered and, if necessary, undertaken.

(2) Further plans and drawings of the dam should be made and annotated to form a coherent as-built set.

(3) A program of annual inspection and maintenance should be initiated. This should include lowering the lake and updating the operation and maintenance log.

(4) Develop schemes for increasing the low-level outlet capacity.

APPROVED: Joel T. Callahan

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

DATE: 11 September 1979

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Topanemus, I.D. NJ00219

State Located: New Jersey

County Located: Monmouth County

Stream: McGellairds Brook

Date of Inspection: April 30, May 24 and June 1, 1979

Assessment of General Condition

Lake Topanemus Dam is an earth-fill road embankment approximately 350 feet long and 20 feet high, with a concrete spillway. The general condition of Lake Topanemus Dam is fair. There is evidence of seepage from the downstream face of the embankment, and this area is heavily overgrown with brush and trees. Small areas of concrete in the spillway have been eroded and spillway wingwalls show signs of settlement. The low-level outlets are not presently operable. The hazard potential is rated as "high."

The safety of Lake Topanemus Dam is considered questionable in view of its lack of spillway capacity to pass one half the PMF without overtopping the dam. The spillway is capable of passing a flood equal to 6% of the PMF, and is assessed as "inadequate."

At present, the engineering data available is not sufficient to make a definitive statement on the stability of the dam.

The following actions, therefore, are recommended along with a timetable for their completion.

1. Establish ownership of the dam immediately.

2. Perform a chemical analysis of the seepage from the left-hand downstream face immediately, to determine its source.

3. Establish a flood warning system for the downstream communities within three months, especially for the lowland area between Taylor Mills and the Borough of Englishtown.

4. Carry out a more precise hydrologic and hydraulic analysis of the dam within six months, to determine the need and type of mitigating measures necessary. If required, conduct a study of the means of

increasing spillway discharge capacity and develop alternative schemes for construction. This should include the installation of headwater and tailwater gages.

5. Install observation wells or piezometers in the downstream embankment, and log the borings to determine engineering properties of the dam fill and foundation material. This program and a stability analysis based on the findings should be completed within six months.

6. Carry out remedial measures to the dam structure within six months, including replacement of eroded material; repair of eroded, cracked and spalled concrete with epoxy cement; provision of slope protection under road-drain outfalls; restoration of low-level outlets to an operable condition.

7. Remove trees and vegetation from the downstream embankment face and seed with grass within 12 months.

Furthermore, while of a less urgent nature, the following additional action is recommended and should be carried out within a reasonable period of time.

1. A program should be developed to monitor the seepage through and under the dam. Depending on the information provided, the need for corrective measures can be considered and, if necessary, undertaken.

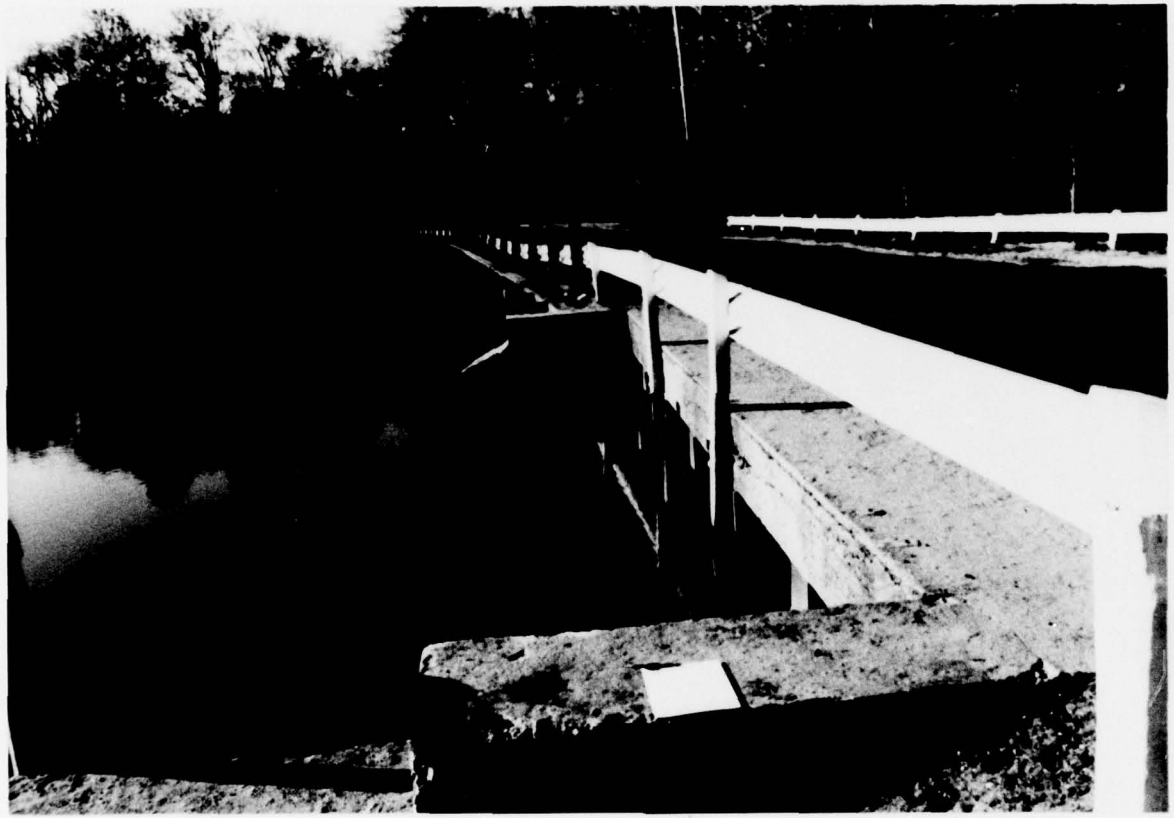
2. Further plans and drawings of the dam should be made and annotated to form a coherent as-built set.

3. A program of annual inspection and maintenance should be initiated. This should include lowering the lake and updating the operation and maintenance log.

4. Develop schemes for increasing the low-level outlet capacity.

Anthony G. Posch, P.E.

AGP/REJ/ak



Lake Topanemus Dam
View of upstream face of the dam.

April 30, 1979

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CHECK LIST - ENGINEERING, CONSTRUCTION, MAINTENANCE DATA

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PREFACE

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

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide 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 PROGRAM

Lake Topanemus Dam, I.D. NJ00219

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act (Public Law 92-367, 1972) provides for the National Inventory and Inspection Program by the U.S. Army Corps of Engineers. This inspection was made in accordance with this authority under Contract C-FPM No. 35 with the State of New Jersey who, in turn is contracted to the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of Lake Topanemus Dam was made on April 30, May 24 and June 1, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the Field Inspection; presents an evaluation of hydrologic and hydraulic conditions at the site; presents an evaluation as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

1.2 Description of Project

a. Description of Dam and Appurtenances

Lake Topanemus Dam is an earth-fill embankment, about 20 feet high and 350 feet long, having an unregulated concrete spillway of the broadcrested weir type towards the right side of the dam. The dam forms part of Pond Road, a two-lane paved road which passes over a reinforced concrete bridge at the spillway; the side and wing-walls of the spillway forming the bridge abutments. The bridge is supported at two intermediate points in its length by continuous concrete piers, which subdivide the spillway into three channels, each approximately 9 feet wide. The weir gains further lateral support

from one intermediate counterfort in each channel. The counterforts project above the weir and tie into the bridge deck, forming six separate openings 4 feet wide. The sides of the counterforts and bridge piers which face the flow over the weir are reinforced against erosion by rolled-steel channel sections. The weir crest is 9 inches thick and its distance below the road surface is 2.8 feet. The spillway apron is of concrete construction and steps down in three horizontal stages to the downstream end. The bridge and spillway structure consists of an original part with an extension added in 1927.

The embankment extends approximately 280 feet to the left and 35 feet to the right of the spillway. The upstream face of the left embankment is retained by a 4 feet high timber bulkhead. The downstream face is sloped at 2H:1V. About 50 cubic yards of sandy fill has recently been placed and graded around a hydrant located at the top of the face. Adjacent to the spillway, the downstream embankment is retained on each side by concrete wingwalls, 10 feet long, on spread footings. A jury-rigged timber extension to the left wingwall retains the embankment for a further 10 feet. The top of the embankment is approximately 35 feet wide and in addition to a 25 feet wide road, the embankment carries for its full length overhead power cables on pylons, underground ducts (presumed telephone conduits), a water main and on the upstream side, a traffic barrier. Two 12" diameter road drains discharge onto the downstream face. No evidence was found to indicate the presence of a clay or concrete core.

On the upstream right-hand side of the spillway, there is a small parking area for the use of the local fire department. The area is retained by concrete walls, and a testing pipe extending into the water has been affixed to one wall. A sluice opening exists on the upstream wall and is not now used. It is reported to be the original spillway from Lake Topanemus.

McGellairds Brook turns to the left after passing through the spillway and runs parallel to the embankment toe for several yards before heading west. The remainder of the embankment toe terminates at a small drainage channel which discharges into the brook. The dam is thought to be founded on Red Bank and Tinton Falls sands which have a high silt content.

There are two low-level outlets to the dam, both of which are cast iron valves located in the central section of the spillway wall on the upstream face. The valves are operated manually from the bridge by means of a long removable valve key. The larger, 18 inch diameter, gate valve is located at the bottom of the vertical weir with its invert approximately 12 feet below the road level. The other is a 12 inch diameter gate valve at 7 feet below the road level. Both valve key shafts project above the water

surface and have bolted caps. The outlets are not presently operable.

b. Location

Lake Topanemus Dam is located in the Township of Freehold, Monmouth County, New Jersey. It is accessible by means of Pond Road which passes across the dam.

c. Size and Hazard Classification

Lake Topanemus Dam has a structural height of 20 feet and a reservoir storage of 141 acre-feet. Since its storage is less than 1,000 acre-feet and its height is less than 40 feet, it is classified in the dam size category as being "small." A hazard potential classification of "high" has been assigned to the dam on the basis that failure would result in excessive damage to the road and services across the dam and to downstream property, including Route 9. Because the road across the dam is heavily traveled, and because Lake Topanemus is used for recreational purposes, the possibility exists of the loss of more than a few lives in the event of dam failure. There are few inhabitable buildings within one mile downstream of the dam. Old Tennent, within 3 miles of the dam has more than 20 residential houses.

d. Ownership

The ownership of Lake Topanemus Dam could not be established after a thorough search. Enquiries were addressed to Engineers and Clerks for the Township of Freehold, the Borough of Freehold, Monmouth County and the NJDEP, none of whom were able to locate the title.

Pond Road, which crosses the dam, is maintained by the Township of Freehold as is the water main.

Township of Freehold

Engineer: Mr. Dickerson (201) 462-7900

Borough of Freehold

Engineer: Mr. Patel (201) 462-4200
51 W. Main Street
Freehold, NJ 07728

e. Purpose of Dam

Lake Topanemus is a Borough Recreational Facility for small non-powered boats and for fishing. The present purpose of the dam is

solely to retain the lake. Originally a commercial ice house operated from the lake.

f. Design and Construction History

No drawings or computations pertaining to the original construction could be found. However, it was reported by a local inhabitant that a one-lane road and the spillway were built before the turn of the century. Prior to that, the only outlet from the lake was a surface-level culvert on the right of the embankment. The date of construction of the original dam is not known.

A plan dated 1920, shows construction details for widening the road and spillway by 13 feet. The Assistant Engineer for Monmouth County reported that Pond Road was not expanded to its present two-lane form until 1927. The stub wingwalls were also built then.

Installation of the cable conduits took place after 1927 as the bridge piers and abutments have been broken out to allow them to pass over the spillway. The watermain was installed by the Township in 1978. The lake was drained down in 1961 following a case of drowning. It was drained through the low-level outlets which have not since been operated. It is not recorded how long the duration of drawdown was.

g. Normal Operating Procedures

The normal discharge from the lake is over the unregulated spillway and it is allowed to balance naturally with inflow to the lake. Two low-level outlets were not operable at the time of inspection. The lake is not lowered on a regular basis.

1.3 Pertinent Data

a. Drainage Area	1.6 square miles
b. Discharge at Dam Site	
Maximum known flood at dam site:	None over road.
Ungated spillway capacity at elevation of top of dam:	176 cfs (el. 120' assumed)
Total spillway capacity at maximum pool elevation:	245 cfs (el. 122.1 assumed)
c. Elevation (Feet Above MSL)	
Top of dam:	120

Maximum pool design surcharge (SDF stage):	122.1
Recreation pool:	117.3
Spillway crest:	117.2
Streambed at centerline of dam:	100.2
Maximum tailwater:	114.5 (estimate)

d. Reservoir

Length of maximum pool:	3,700 ± feet (estimate)
Length of recreation pool:	2,100 ± feet (estimate)

e. Storage (Acre-feet)

Recreation pool:	66
Top of dam:	141

f. Reservoir Surface (Acres)

Top of dam:	32 (estimate)
Recreation pool:	22
Spillway crest:	22

g. Dam

Type:	Earth fill with concrete spillway.
Length:	327' (effective)
Height:	19.8'
Top width:	35' (average) 28' (minimum)
Side Slopes - Upstream:	Vertical with timber bulkhead.
- Downstream:	2 Horizontal to 1 Vertical
Zoning:	Unknown
Impervious core:	Unknown

Cutoff:	None
Grout curtain:	None

h. Diversion and Regulating Tunnel

N/A

i. Spillway

Type:	Overflow
Length of weir:	23 feet
Crest elevation:	117.2 feet above MSL
Gates:	None
U/S Channel:	Lake Topanemus
D/S Channel:	After the wier, a stepped apron 43 feet-long divided into three channels, before becoming McGellairds Brook.

j. Regulating Outlets

Low level outlet:	18 inch diameter (inoperable at time of inspection)
Controls:	Manually operated gate valves.
Emergency gate:	N/A
Outlet (mid-level):	12 inch diameter (inoperable at time of inspection)

SECTION 2: ENGINEERING DATA

2.1 Design

No drawings or computations pertaining to original construction of the dam could be found. No data from soil borings, soil tests or other geotechnical data is available. One drawing, dated 1920, and showing details for widening the bridge and spillway is included in the appendices. The drawing was obtained from Monmouth County Engineers Department.

2.2 Construction

Construction history has been provided in Section 1.2.f. Construction of the bridge extension follows the drawing, with the exception that the hand rails have been replaced by traffic barriers. Periodic, unrecorded remedial work has been undertaken by the Township of Freehold to provide road drainage and to restore the road shoulders. It could not be ascertained who had carried out the patching of cracks in the wingwalls.

2.3 Operation

No records of operation of the lake are known to exist.

2.4 Evaluation

a. Availability

The one drawing of the bridge widening was freely available from the County. No other data were available.

b. Adequacy

The engineering data was insufficient to perform even an approximate evaluation of the dam's stability. A preliminary assessment of the dam could be carried out with the data obtained in the field in view of the overall fair condition of the dam.

c. Validity

Information contained in the drawing appeared, by visual inspection, to be correct.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection made of Lake Topanemus Dam revealed that the dam and spillway were in serviceable condition, but that a regular program of inspection and repair is required to maintain its serviceability.

b. Dam

The earth embankment appears to be basically sound. The upstream face, retained by a timber bulkhead, shows very minor local misalignment. The condition of the timber and the tie-bolts is good, with rotting and algae growth being minimal. The downstream face is covered with bushes, trees and low vegetation; its slope is approximately 2H:1V. Local erosion has taken place, notably adjacent to the bridge abutments, mainly due to surface runoff. Seepage from the toe is slight, but at one point 10 feet below the dam crest and towards the left side of the dam, a seepage flow in excess of 5 gpm was found. This seepage appeared to be clean, but silt deposits in the stream created by the seepage indicated that fine material had been washed out from the fill. It is possible that a water main leak is the source of this seepage, and a Township foreman who was present at the inspection stated that a chemical analysis would be made of the leaking water.

Minor settlement was noted on parts of the downstream side of the road, and surface cracks in the road were found. It is not felt that these originated from any general movement of the embankment but rather from the affects of freezing and consolidation. No cracking or sloughing was seen on the downstream face. It was not possible to determine visually if the embankment has been built with a corewall. No evidence of burrowing by animals was found.

Additional sandy fill was being placed by the Township of Freehold during the inspection. The fill, concentrated in the area surrounding the fire hydrant, was end-dumped and spread but not compacted.

The dam appears to be founded on and constructed of Red Bank and Tinton Falls sands. The high silt content of these sands has impeded internal drainage.

c. Appurtenant Structures

1. Spillway

The spillway consists of a vertical concrete wall which acts as a broad-crested weir, supported laterally by the piers and abutments of the bridge carrying Pond Road over the stream. The wall is 9 inches thick and presents a flow length of 23 feet. It is in sound condition with no evidence of erosion, cracking or leakage. The spillway apron steps down to the stream in three horizontal stages and is of concrete construction. Alignment is good and no cracking, spalling or significant erosion was found. Undermining of the apron toe is negligable.

2. Low-Level Outlet

Two circular gate-valve openings were just visible in the central section of the weir and no leaks were noted. The valves are located on the upstream face of the weir; the larger (18") outlet having its invert at the base of the wall, and the smaller (12") at 5 feet higher up. Shafts for the valve-operating keys project above the water surface and have bolted caps. At the inspection, one cap was bolted tight and the other was hanging loosely on one bolt and the shaft had been jammed with cans. The operating key has been lost and thus the outlets are inoperable. An assistant Borough Engineer undertook, at the inspection, to have a key made up and to test the valves.

3. Bridge and Piers

Erosion and spalling of the concrete at the base of the bridge piers and abutments is extensive. In places the piers have been eroded right through. Surface spalling of the concrete is up to 6" deep in small local areas. Between the old and the new construction, joints have opened due to foundation settlement, but this condition appears to have stablized. The cracks thus formed are no larger than ¼ inch across. The piers and abutments have been cut out in two places to allow a water main and a bank of cable conduits to pass through.

The lower bridge stringer is in poor condition, with badly spalled concrete exposing the main reinforcement over most of its length. The remainder of the bridge deck is satisfactory. Stub wingwalls have been provided on the downstream side to retain material adjacent to the abutments. These wingwalls have been partially undermined, and the resulting settlement has caused them to crack away from the abutments. Concrete in the old construction is generally in better condition than in the new.

d. Reservoir Area

The rim of the reservoir is moderately sloped with grass banks

and trees. No indication of instability was apparent. A few residential houses exist on the south bank, and a minor road for recreational users runs along the north bank. Access to the lake is unrestricted and there are a few small boat docks on the shore. Sedimentation at the spillway entrance was about 2 feet deep.

e. Downstream Channel

The downstream channel winds through a broad, wooded valley. The stream banks are steep due to undermining. This has caused trees to fall across the stream and has led to local instability of the embankment near the dam.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Lake Topanemus Dam is used to impound water for recreation activities. The policy is to maintain a nearly constant lake level close to the elevation of the spillway crest. The lake level is maintained by unregulated discharge over the broad-crested weir in the spillway of the concrete section.

The lake is not lowered on a regular basis, and the last known occasion on which this was done, was in 1961.

4.2 Maintenance of the Dam

There is no program of regular inspection and maintenance of the dam and appurtenant structures. No authority has been identified as being responsible for operation or maintenance and at present, no records of these functions are kept.

4.3 Maintenance of Operating Facilities

The low level outlet gate valves are designed to be operated manually from the bridge. No known maintenance of the valves has been made to keep them operable. The operating key for the valves has been lost and one of the valve shafts is jammed with cans. They are both inoperable at present.

4.4 Evaluation

The present operational procedures are unsatisfactory. The principal cause for concern is that no authority or party has been identified as being responsible for the operation and maintenance of the dam. The general poor level of these functions at present, reflects the lack of responsible supervision.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The drainage area above Lake Topanemus Dam is approximately 1.6 square miles. A drainage map of the watershed of Lake Topanemus damsite is presented on plate 1, Appendix D.

The topography within the basin is generally flat. Elevations range from approximately 200 feet above MSL at the north end of the watershed to about 118 feet at the Lake Topanemus dam site. Land use patterns within the watershed are mostly forest in the north section and urban in the south.

The evaluation of the hydraulic and hydrologic features of Lake Topanemus was based on criteria set forth in the Corps guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The SDF for Lake Topanemus Dam falls in a range of ½ PMF to PMF. In this case the low end of the range, ½ PMF, is chosen since the factors used to select size and hazard classification are on the low-side of their respective ranges.

The probable maximum flood (PMF) was calculated from the probable maximum precipatation using Hydrometeorological Report No. 33 with standard reduction factors. Due to the small drainage area, the SCS triangular hydrograph transformed to a curvilinear hydrograph was adopted for developing the unit hydrograph, with the aid of the HEC1-DB Flood Hydrograph Computer program.

Initial and infiltration loss rates, using SCS procedures, were applied to the Probable Maximum Precipitation to obtain rainfall excesses. The rainfall excesses were applied to the unit hydrograph to obtain the PMF and various ratios of PMF utilizing program HEC1-DB.

The SDF peak inflow calculated for Lake Topanemus Dam is 3015 cfs. This value is derived from the ½ PMF hydrograph computed by the HEC1-DB program.

The spillway and overtopping discharge rating curves for Lake Topanemus Dam were combined to form one discharge rating curve. The peak outflow discharge for ½ PMF results in overtopping of the dam.

The stage-outflow relation for the spillway was prepared from

field notes and sketches. The reservoir stage capacity was based on the U.S.G.S. quadrangle topographic maps.

The reservoir storage capacity curve can be computed directly by the conic method, utilizing the HEC1-DB program. The conic method assumes that the reservoir capacity resembles a series of vertically stacked cones. The reservoir surface areas at various elevations were measured by planimeters from topographic maps. Reservoir storage capacity included surcharge levels exceeding the top of the dam, and the spillway rating curve was based on the assumption that the dam remains intact during routing. The spillway rating curve is presented in the hydrologic computations

A breach analysis indicates that the hazard potential for loss of life downstream, due to dam failure from overtopping, is not significantly greater than that which exists without failure.

Drawdown calculations indicate that to empty the lake to an elevation of 108' MSL through the two low-level outlets would take 63 hours, assuming a 2 cfs/square mile inflow. Consequently an increased low-level outlet capacity should be considered.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site. However, according to interviews with a member of the staff of the Public Works Department of the Township of Freehold, the dam has never been overtopped.

c. Visual Observation

The valley below the dam is heavily wooded, with much debris, and there are no dwellings immediately downstream of the dam, along McGellairds Brook. The slopes around the lake are moderate and wooded.

d. Overtopping Potential

A storm of magnitude equivalent to the SDF would cause overtopping of the dam to a height of 2.1 feet. Computations indicate that the dam can pass approximately 6% of the PMF without overtopping the dam crest. Since one half the PMF is the minimum Spillway Design Flood (SDF) for this dam, according to the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers, the spillway capacity of the Lake Topanemus Dam is assessed as "inadequate."

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There are no signs of major embankment sloughing, local slides or slumps on the downstream side. The top of the upstream side of the embankment is retained by a timber bulkhead which shows no significant sign of deterioration. The remainder was completely under water and was not accessible for visual inspection. The seepages near the abutments and on the left embankment face, described in Section 3.1-b, have not been monitored and no information was uncovered concerning their age or flow rates.

The spillway exhibits no visible evidence of slide failure. Settlement of the newer portion is evidenced by opening of construction joints, but this condition appears to have stabilized. Undermining of the toe of the left abutment has taken place, and stub wingwalls have settled and cracked away from the abutments.

b. Design and Construction Data

No design computations were uncovered during the report preparation phase. No embankment or foundation soil parameters are available for carrying out a conventional stability analysis on the embankment. No construction data or specifications relating to the degree of embankment compaction are available for use in the stability analysis.

c. Operating Records

No operating records are available relating to the stability of the dam. The dam has served satisfactorily since its raising before the turn of the century.

d. Post-construction Changes

The original embankment cross-section is not known. An outline of the original bridge and spillway structure is shown in the Plans for widening of the Bridge, dated 1920 (Report Plate 3).

Widening of the road and the bridge/spillway structure is reported to have been completed in 1927, and its present condition concurs with the 1920 plan. Cracks between the stub wingwalls and bridge abutments have been repaired more than once;

it is not known when or by whom these repairs were made.

Since the widening of the road, a set of buried cable conduits have been placed on the upstream side and overhead power cables, supported on pylons, have been installed along the downstream crest. In 1978 a water main was laid in the embankment fill and during the inspection, additional material was being dumped to stabilize a part of the crest against lateral creep.

e. Static Stability

A static stability analysis was not performed for Lake Topanemus Dam because the lack of data on which to base assumptions of material properties and embankment cross-sections might produce misleading results.

The widening of the road and bridge/spillway structure increased the resistance of the dam to lateral thrust. Cracking at the stub wingwalls indicates that they are not stable and this could result in a loss of support for the road adjacent to the abutments. The undermining at the toe of the left abutment has not progressed sufficiently to jeopardize its stability.

Based on a visual inspection which revealed no major misalignment or movement, the static stability of the spillway structure and the embankments of Lake Topanemus Dam is considered satisfactory. However, this can only be confirmed by analyses, based on detailed investigation of constituent soil parameters.

f. Seismic Stability

The dam is located in Seismic Zone 1, as defined in Recommended Guidelines for Safety Inspection of Dams, prepared by the Corps of Engineers. In general, projects located in Seismic Zones 0, 1 and 2 may be assumed to present no hazard from earthquake, provided the static stability conditions are satisfactory, and conventional safety margins exist. In this case, the latter conditions are satisfactory, and seismic stability is thus not regarded as a problem.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The dam has been inspected visually and a review has been made of the available engineering data. This assessment is subject to the limitations inherent in the visual inspection procedures stipulated by the Corps of Engineers for a Phase I report.

The safety of Lake Topanemus Dam is in question because the dam does not have adequate spillway capacity to pass the PMF or even one-half of the PMF without overtopping. Overtopping of the dam carries with it the danger of possible progressive failure of the dam or spillway. The dam's present spillway capacity can pass only about 6% of the PMF.

No definitive statement pertaining to the safety of the embankment can be made without acquisition of embankment and foundation material engineering properties and determination of phreatic levels in the downstream part of the embankment. The present embankment, however, has performed adequately since the 1927 modification without failure or evidence of instability. The possibility of minor sloughing may exist, particularly in the event of seismic excitation.

b. Adequacy of Information

The information and data uncovered is not adequate to perform even an approximate evaluation of the dam's stability. The seepage at the toe of the downstream embankment calls for an additional study to determine the actual location of the phreatic surface. Such an investigation will also yield information pertaining to the nature of the material in the embankment. The source of the seepage at the left of the downstream embankment should be determined by chemical analysis.

c. Urgency

Studies to augment the spillway discharge capacity or to determine the hydrologic and hydraulic ability of the dam to withstand overtopping should be undertaken within six months.

Observation wells or piezometers should be installed in the downstream embankment to determine the location of the phreatic surface. The borings should be logged according to the Unified Soil Classification system by qualified personnel and samples

taken to determine the values of pertinent soil parameters. Stability analyses should then be performed in accordance with Chapter 4.4 of the Corps Guidelines. This work should be commenced within 3 months.

A complete topographic survey of the dam area should be made within 3 months, in order to develop a detailed plan and several cross-sections of the dam. The location of utilities on the dam should be shown in the drawings.

The chemical analysis of the seepage from the left of the downstream face should be conducted within one month in order to determine its source. All seepage should be monitored semi-monthly.

7.2 Remedial Measures

a. Alternatives for Increasing Spillway Capacity

Alternatives for increasing spillway capacity are as follows:

1. Increase the dam and bridge height, thus permitting a higher discharge to pass over the spillway and reducing the possibility of overtopping.

2. Lower the weir crest elevation.

3. Widen the weir structure.

4. A combination of any of the above alternatives.

b. Other Remedial Measures

1. The embankment material that has been lost from the downstream face, particularly adjacent to the abutments of the bridge/spillway, should be replaced with quarry-process stone or gravel. Slopes should be reconstructed with keying and compaction of material to improve stability and to support the abutments and wingwalls. This should be undertaken within six months.

2. Concrete slope protection should be provided under road drain outfalls, to reduce erosion, within six months.

3. Restore the areas of eroded and spalled concrete and repair cracks on the spillway and bridge structures with epoxy cement to arrest further deterioration, within six months.

4. Fabricate new operating keys for the low-level outlet valves. Clear the key shafts of debris and provide a lockable device for the shaft caps. This is to be done within six months.

5. All brush and trees should be removed from the downstream slope to avoid problems which may develop from their roots. The embankment should then be seeded to develop a growth of grass for surface erosion protection. This program should be started within 12 months.

c. Recommendations

The following additional action is recommended.

1. Establish ownership of the dam immediately.

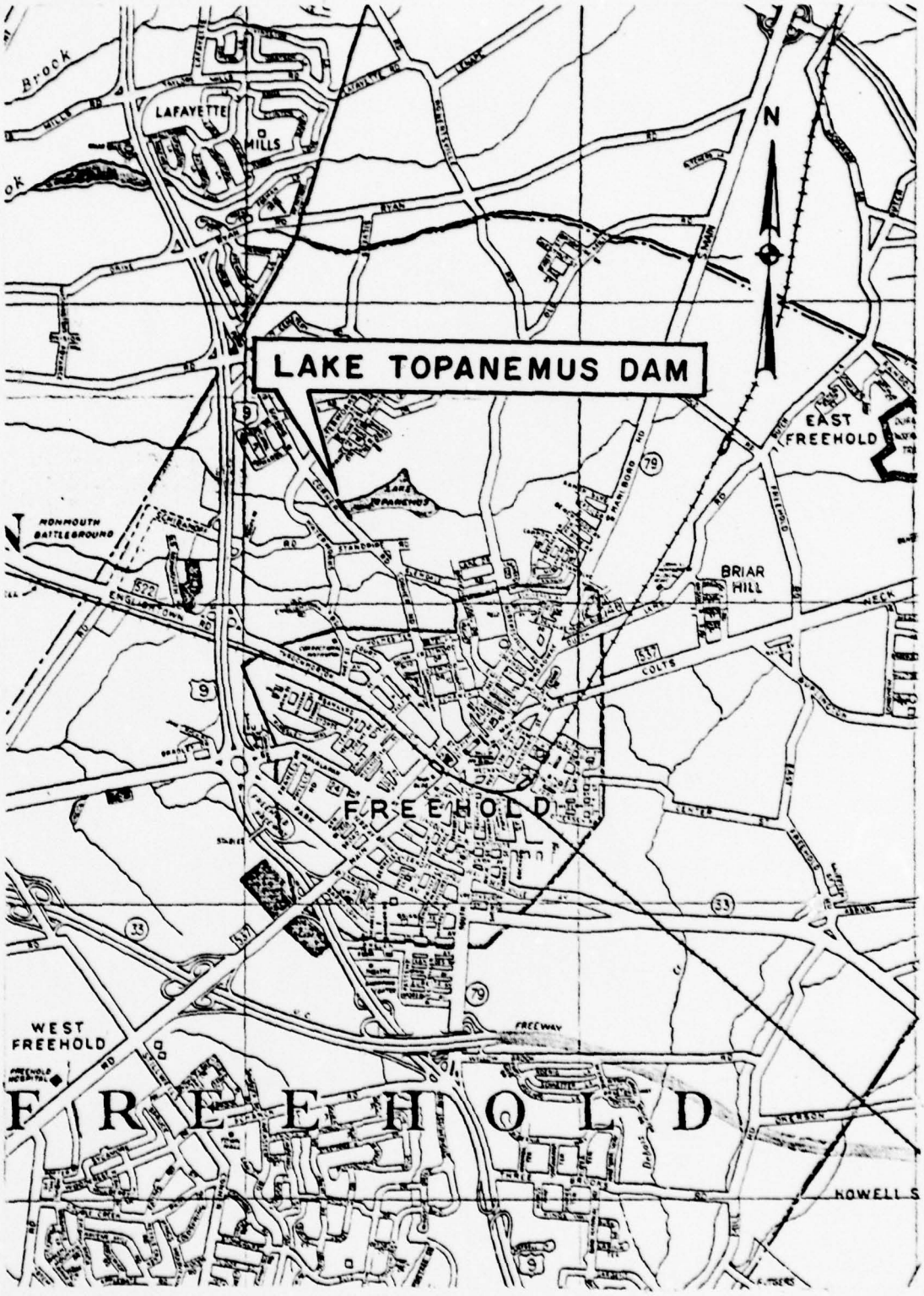
2. Establish a flood warning system for the downstream communities within three months.

3. Develop schemes for increasing low-level outlet discharge capacity.

d. O & M Procedures

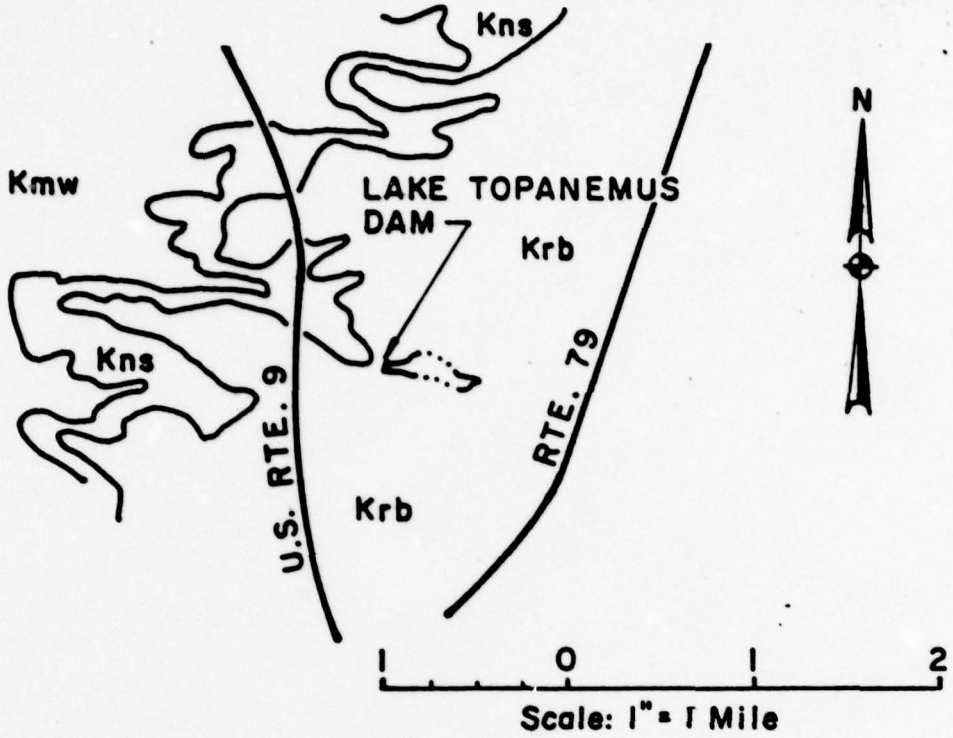
A formalized program of annual inspection of the dam by an experienced party should be initiated, utilizing the standard visual check list in this report. Headwater and tailwater gages should be installed in the dam, and read out during severe rain storms and at routine operating and maintenance visits to the dam. A permanent log should be kept of all maintenance and operating events of the dam, the lake and the outlet passages.

PLATES



VICINITY MAP

PLATE 1



LEGEND

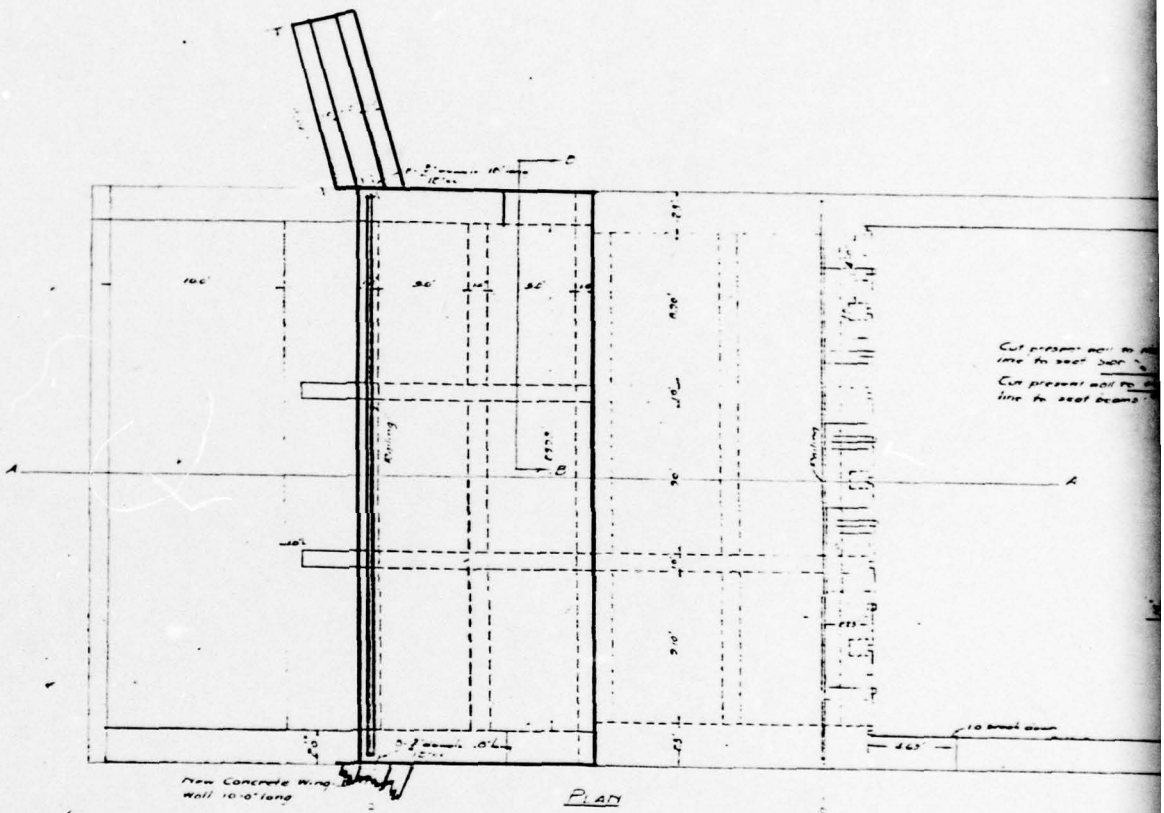
CRETACEOUS

Kns	Navesink Marl Dark Green Glauconitic Marl with Shell Bed at the Base.
Kmw	Mount Laurel and Wenonath Sands Coarse Glauconitic Sand (Mount Laurel) overlying Fine Micaceous Sand (Wenonath).
Krb	Red Bank and Tinton Sands Coarse Rusty Sand, consolidated in place by Iron Oxide.
—	Contact

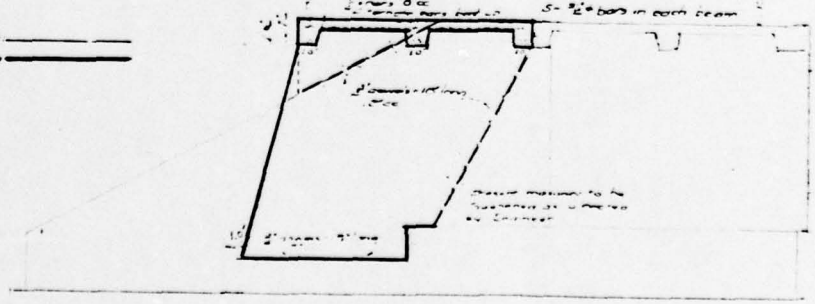
GEOLOGIC MAP
LAKE TOPANEMUS

PLATE 2

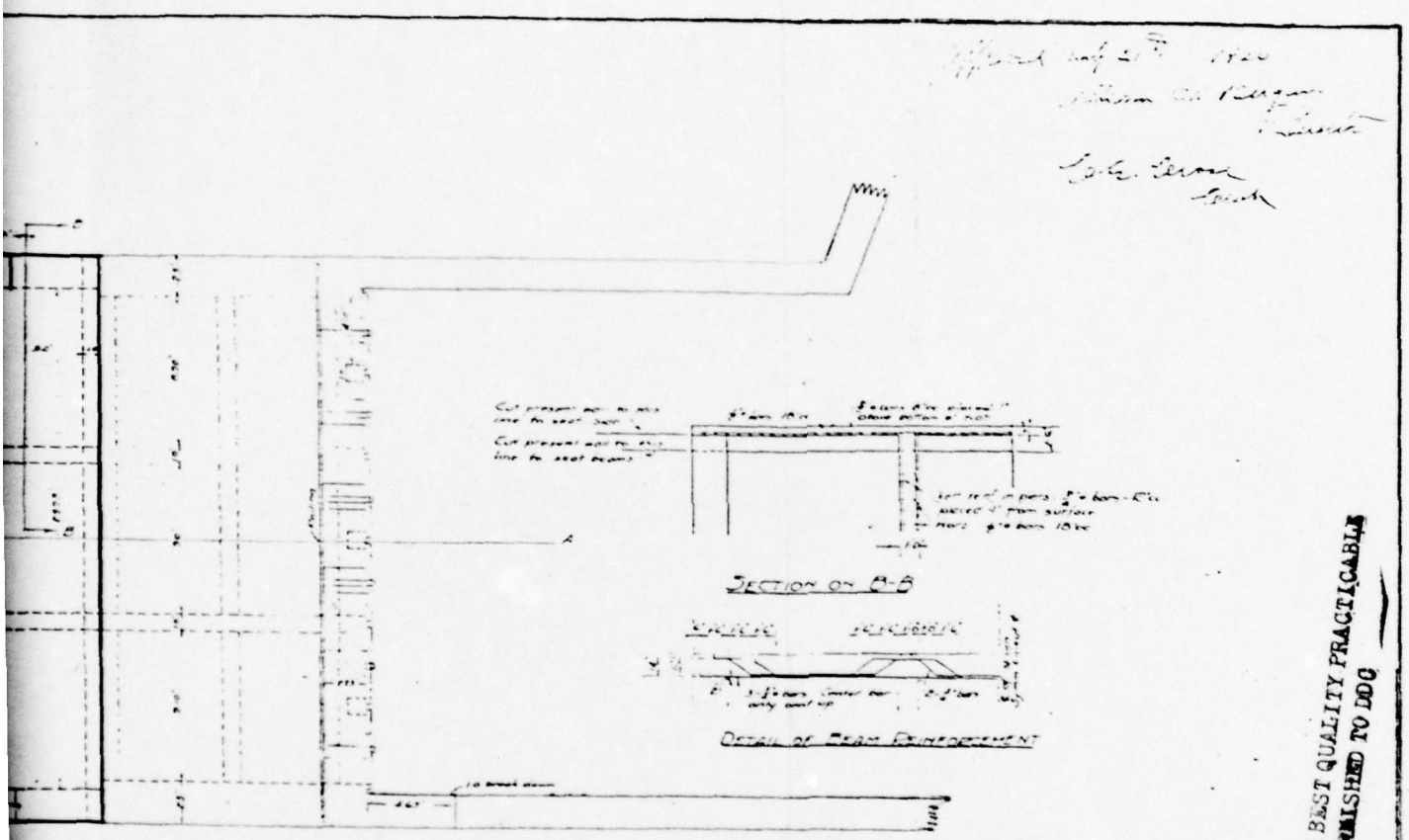
TYPICAL SECTION OF WING - WALL



PLAN



SECTION ON LINE A-A

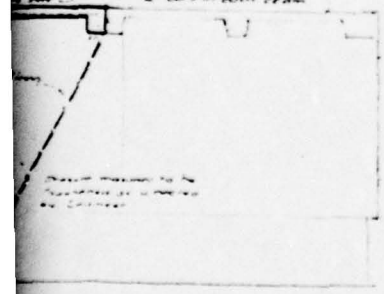


PLAN

SECTION ON B-B

DETAIL OF BEAM REINFORCEMENT

SIDE ELEVATION



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F-55

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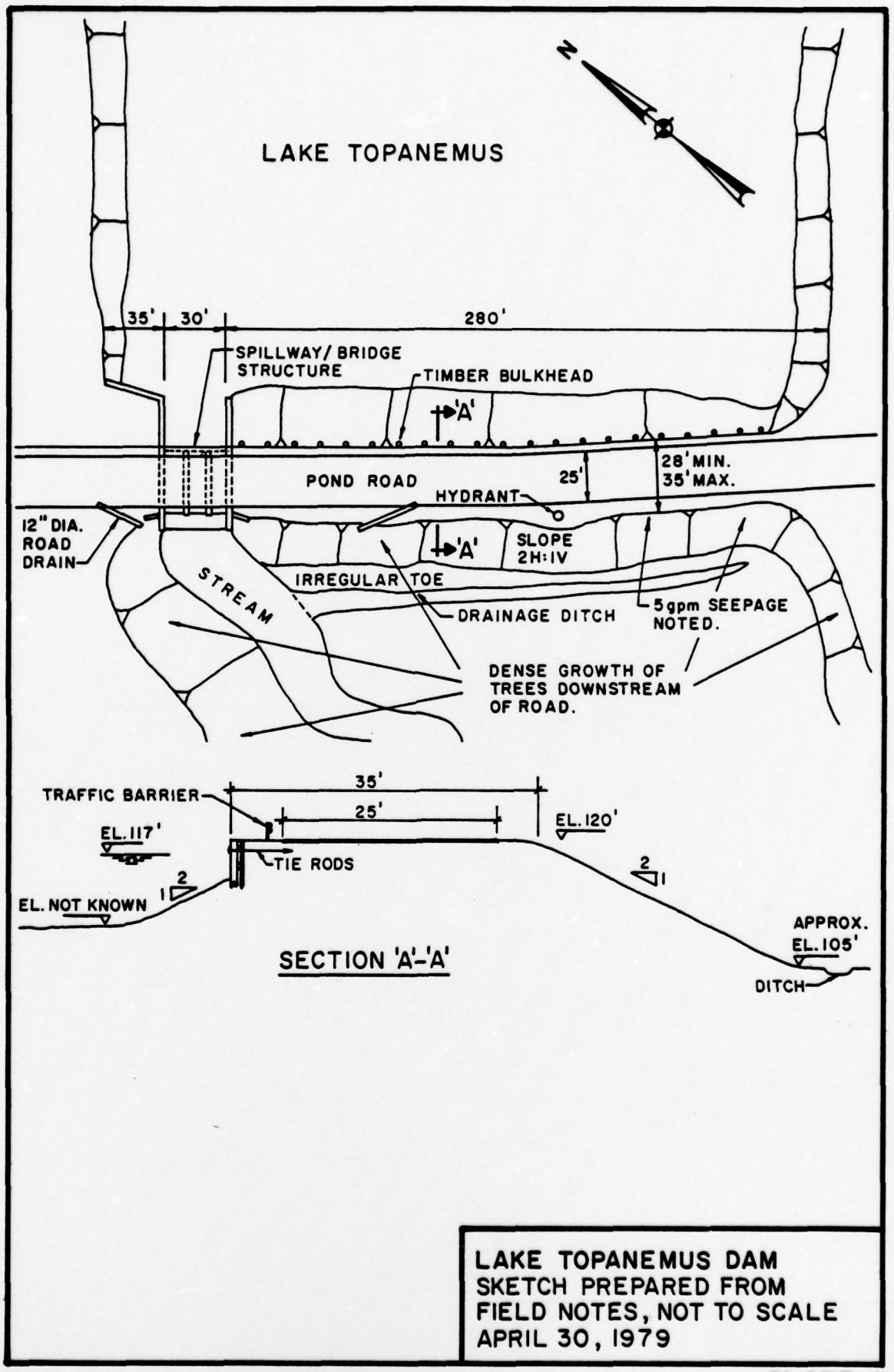
PLATE 3



LAKE TOPANEMUS DAM
SKETCH PREPARED FROM FIELD NOTES, NOT TO SCALE
APRIL 30, 1979

PLATE 4

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION, MAINTENANCE DATA

CHECK LIST
VISUAL INSPECTION

PHASE I

Name of Dam Lake Topanemus County Monmouth State New Jersey Coordinators NJDEP

Date(s) Inspection April 30, 1979
May 24, 1979
June 1, 1979
Weather Sunny Temperature 50°F

Pool elevation at Time of Inspection 117.3' M.S.L. Tailwater at time of Inspection 102' M.S.L.

Inspection Personnel:

April 30, 1979	May 24, 1979	June 1, 1979
Eugene Koo	William Flynn	Rhon Ernest-Jones
Henry King		
Chuck Chin		

Owner Representative:

Township Foreman

Art Ackerman
Assistant Borough Engineer
51 W. Main Street
Freehold, NJ 07728

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS	Isolated minor cracks in the paved surface of the road parallel to the center-line, mainly on downstream side. Timber bulkhead in good condition. Heavy ground covering of leaves and vegetation prevents inspection of downstream face for cracks. Recently placed sandy fill shows cracking due to initial settlement.	No treatment required. Probably due to frost action.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	The embankment toe adjacent to the downstream left wingwall has eroded from tailwater vortex action. Some minor cracking is apparent. No cracks or unusual movement noted elsewhere.	Treatment as for erosion.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The downstream face of the embankment is covered with a heavy growth of trees and vegetation. Minor erosion has taken place due to water drainage from the road. Some fine material has been washed out from the embankment material due to minor seepage. No evidence of sloughing.	Continue practice of fill replacement. Clear the downstream face of trees and vegetation. Step or key and compact new fill.
VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST	No major misalignment or settlement is visible. Roadway is at or slightly below the top of the bulkhead.	
RIPRAP FAILURES	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
IMPERVIOUS CORE	No evidence exists of a clay core. The timber bulkhead and the concrete walls retard seepage through the embankment.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	This zone is in poor condition on the downstream face. Loss of material has taken place on both sides from surface water drainage and from seepage. Stub wingwalls have settled as a result, and the main wingwall on the left has been undermined. The slope is reinforced by a well developed root system.	Add quarry process stone or riprap to restore the slope to a stable condition.
ANY NOTICEABLE SEEPAGE	Water was noted seeping at a rate exceeding 5 gpm from a point 10 feet below the dam crest, to the left of the recently placed fill. Other minor seepage was noted over the entire downstream face, and this appeared to have been occuring for many years (evidenced by the accumulation of silt at the toe).	The Township foreman undertook to have the water chemically tested to determine if it was a leak from the water main. This has not been done, and should be pursued further.
STAFF GAGE AND RECORDER	N/A	
DRAINS	Two twelve inch diameter road drains discharge onto the downstream embankment face, and have caused some local erosion.	Restore the eroded material and provide surface protection under drain outfall.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	The concrete weir is in good condition with no leakage evident. It is supported laterally by the two sidewalls, two bridge-piers and three concrete counterforts. No horizontal misalignment or evidence of settlement was observed.	Water flow over weir was light at time of inspection, but visibility of weir was poor.
APPROACH CHANNEL	Channel walls have undergone minor erosion at the water surface.	No treatment.
DISCHARGE CHANNEL	The spillway apron steps down in three horizontal stages to the downstream end. No undue surface erosion, cracking or misalignment was noted. No undermining of toe. Debris on apron.	
BRIDGE AND PIERS	The old bridge and discharge channel were extended in 1927. The old part appears to be in better condition than the new extension. Concrete in the new section has been severly eroded at the junction with the apron, in both the side walls and the intermediate piers. Construction joints have cracked and surface spalling up to 6" deep was noted over small areas. Steel rebar is exposed in bridge stringers.	Spalled and eroded concrete areas should be cleaned out and repaired with epoxy grout. Cracks to be grouted.
FOUNDATIONS	Red Bank and Tinton Falls Sand. The type of foundation is not known. Settlement of the extension has stabilized, except for the stub wingwalls which have been patched more than once.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CRACKING & SPALLING OF CONCRETE SURFACES IN STILLING BASIN	See Discharge Channel and Bridge and Piers Observations.	
INTAKE STRUCTURE	None	
OUTLET STRUCTURE	See Discharge Channel.	
OUTLET FACILITIES	Two circular gate-valve openings just visible in the central section of the concrete weir. Operating key shafts project above water surface and have bolted caps. One shaft was jammed with cans, the top unbolted. The other cap was in place. No leaks noted around valve openings. Valves not operable.	Operating key for gate-valves is missing and whereabouts not traceable. Borough Engineer undertook to have a key made and to test the valves in the near future.
EMERGENCY GATE	None.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
MONUMENTATION/SURVEYS None		Install a nearby benchmark.
OBSERVATION WELLS None		
WEIRS None		Install gages to measure lake and tailwater elevations.
PIEZOMETERS None		
OTHERS None		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES	Banks are grassed. Slopes to lake are very moderate.	
SEDIMENTATION	Little vegetation. Two foot of silt at spillway entrance.	
USE	Recreation and esthetic purposes only.	
SHORELINE BUILDINGS	A few small-boat landing stages.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSERVATIONS, DEBRIS, ETC.)	Fallen trees are visible in the downstream channel. Meandering and undermining of the bank has taken place, leading to instability of banks near the dam. The stream becomes shallow beyond the stilling pool under the apron toe.	
SLOPES	The channel banks are steep.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	None in immediate area of dam, before stream passes under Route 9. Very few inhabitable buildings within one mile downstream of dam.	"High" hazard potential is due to the excessive damage likely to occur to Pond Road and the utilities over the dam, and to the loss of life from Lake and road users.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	None available - to be made up from field observations.
REGIONAL VICINITY MAP	County Map - Monmouth County, U.S.G.S. Quad Sheet-Freehold.
CONSTRUCTION HISTORY	From County and Borough Engineers
TYPICAL SECTIONS OF DAM	From 1920 plan for road widening.
HYDROLOGIC/HYDRAULIC DATA	None available.
OUTLETS - PLAN	None available.
- DETAILS	None available.
- CONSTRAINTS	None available.
- DISCHARGE RATINGS	None available.
RAINFALL/RESERVOIR RECORDS	None available.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	Rutgers University - Eng. Soil Survey for Monmouth County. Quad sheet overlay.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	None available.
SPILLWAY PLAN - SECTIONS - DETAILS	In 1920 Bridge Widening Plans.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	None available.
MONITORING SYSTEMS	None.
MODIFICATIONS	Bridge Widening Plans.
HIGH POOL RECORDS	None recorded.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION - REPORTS	None reported.
MAINTENANCE OPERATION RECORDS	None with Township.

APPENDIX B

PHOTOGRAPHS

(Taken on April 30 and June 1, 1979)

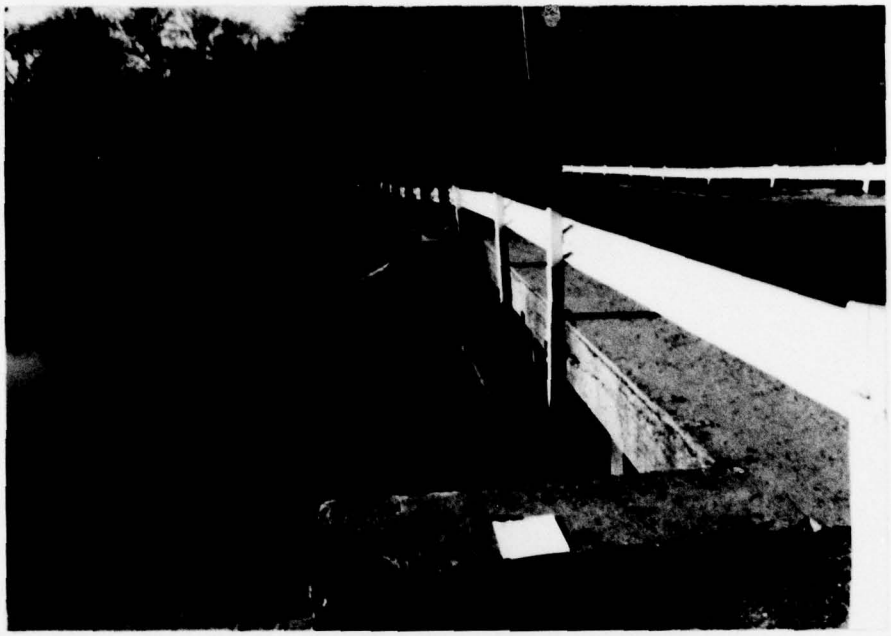


Photo No. 1 - Overall view of dam from upstream. The spillway and bridge structure are in the foreground. Note the key shafts for the low level outlet valves projecting from the water.

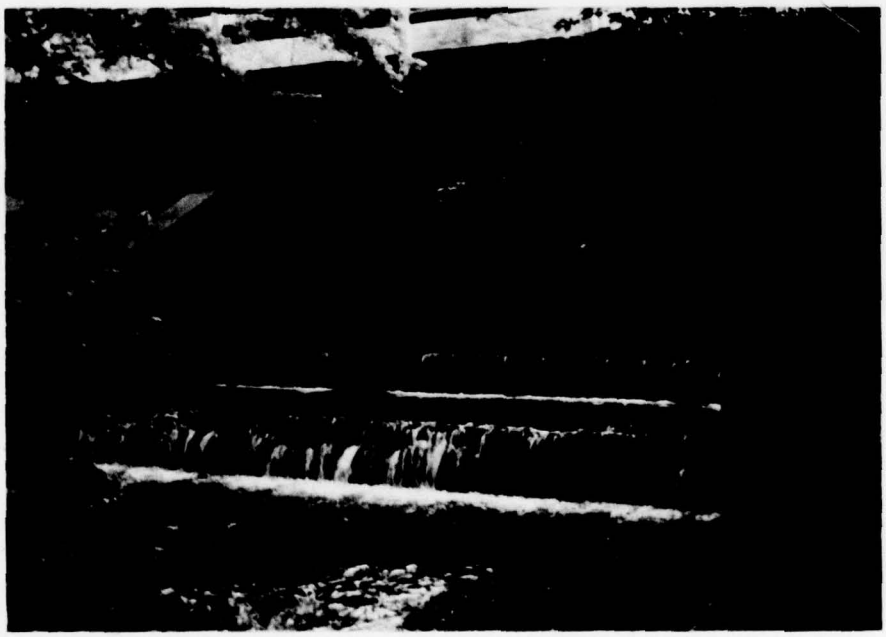


Photo No. 2 - View of spillway apron and bridge from downstream.

Photo No. 3 - View of middle outlet channel and spillway. Note the deteriorated concrete at the foot of the bridge pier.

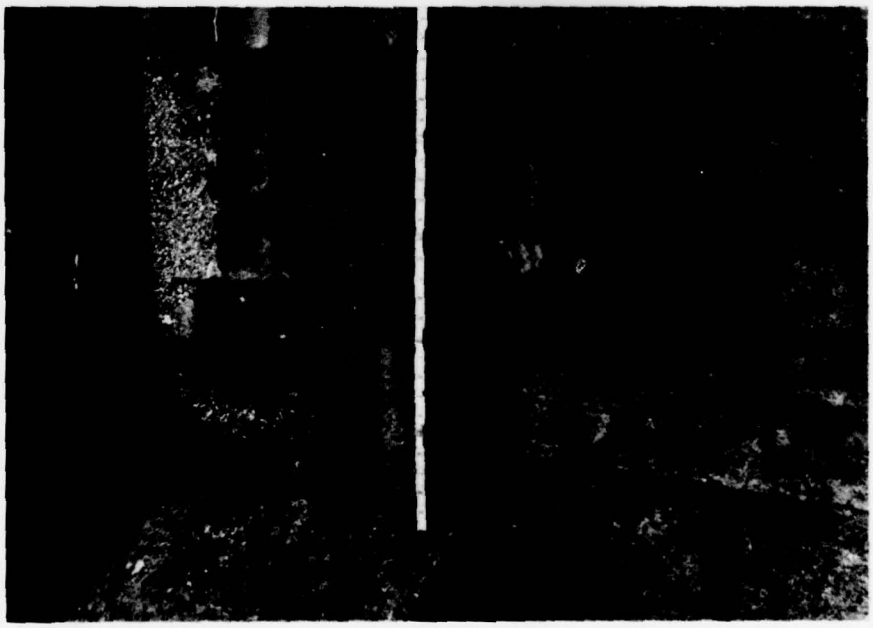


Photo No. 4 - Detail of crack between left bridge abutment and stub wingwall.

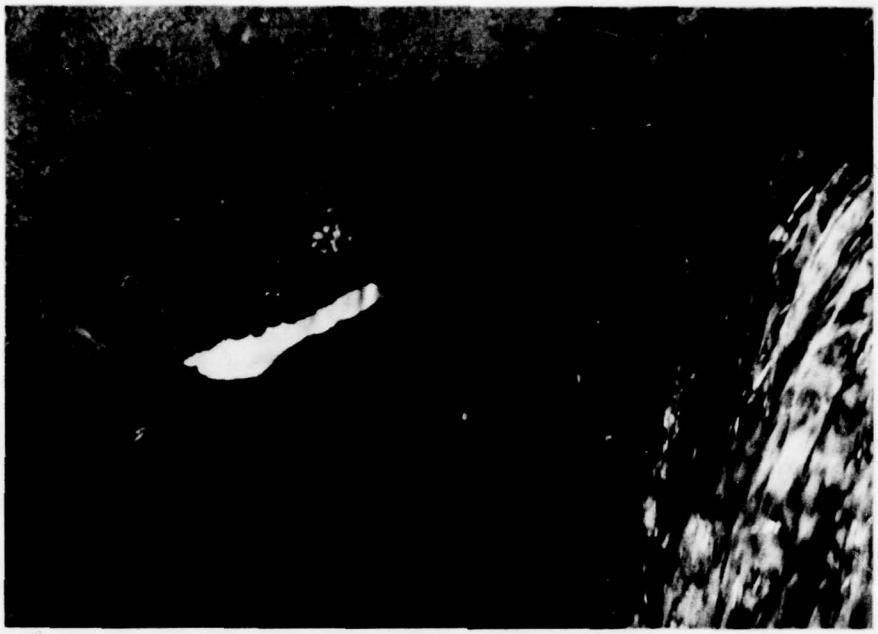


Photo No. 5 - Detail showing the base of bridge pier. Deterioration in this zone is worse in the new section than in the original.

Photo No. 6 - Detail of spailed concrete in the left abutment. Silt-Laden water now seeping through.

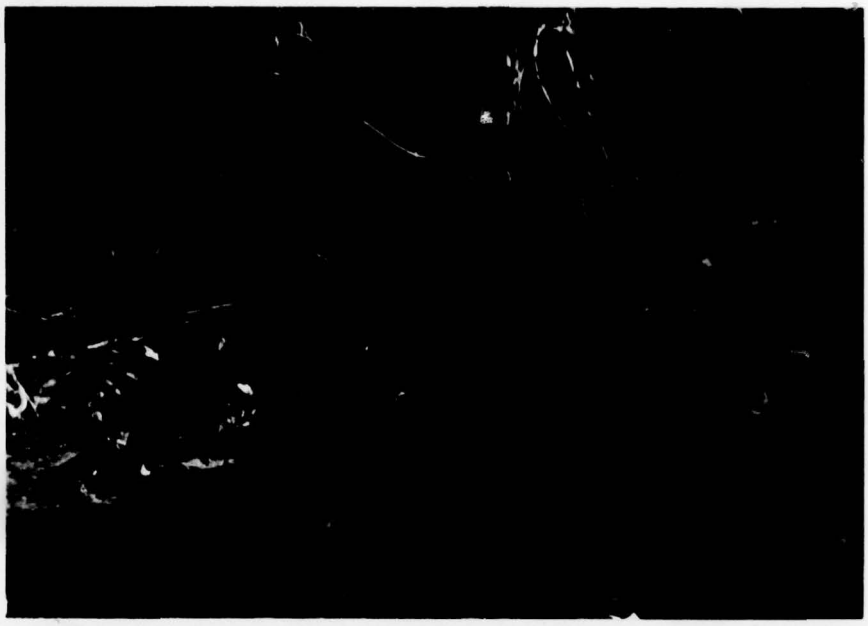


Photo No. 7 - Typical view of undergrowth on downstream embankments. Photo shows the point of issue of the worst seepage from the downstream face.

Photo No. 8 - View of downstream embankment face to the right of the spillway. Note the loss of material due to erosion under the road drain outfall.

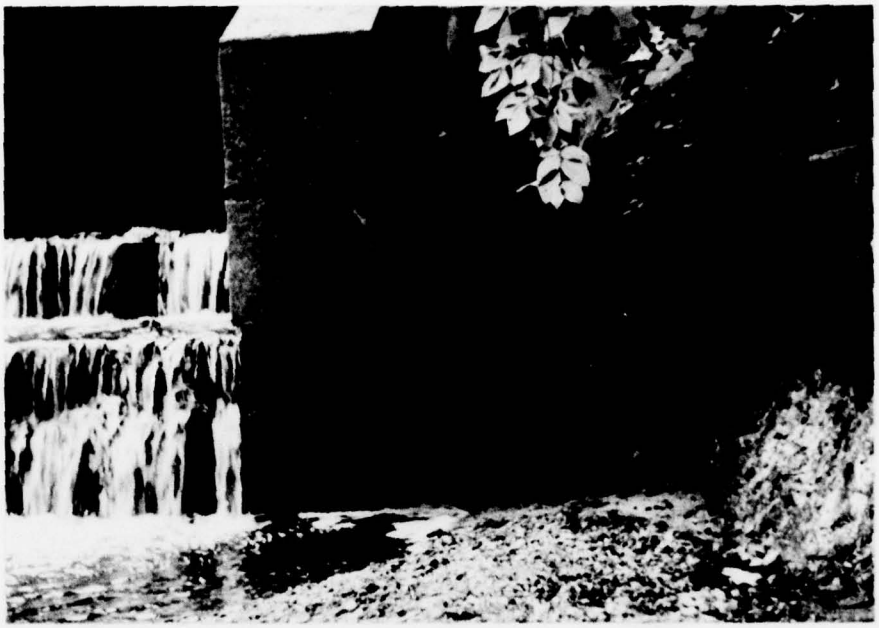


Photo No. 9 - Detail showing loss of material and seepage around the toe of the left abutment.

Photo No. 10 - Overall view roadway looking to the right. Cracking in the surface of the road appears to be due to freezing.

Photo No. 11 - View of Lake Topanemus looking upstream from the right shore. Note moderate slopes.

Photo No. 12 - View of downstream channel - McGellairds Brook. Note undermining of the banks and the fallen trees.

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: Lake Topanemus Dam

Drainage Area Characteristics: 1.6 square miles, generally flat, forest, minor residential.

Elevation Top Normal Pool (Storage Capacity): 117.3' MSL (66 acre-feet)

Elevation Top Flood Control Pool (Storage Capacity): N/A

Elevation Maximum Design Pool: 122.1' MSL (SDF pool: 215 acre-feet)

Elevation Top Dam: 120' MSL (141 acre-feet)

SPILLWAY CREST

a. Elevation 117.2' MSL

b. Type Broad-crested weir, subdivided

c. Width 9 inches

d. Length 23 feet

e. Location Spillover Right side of dam.

f. No. and Type of Gates None.

OUTLET WORK

a. Type Open channels (three)

b. Location D/S of weir.

c. Entrance Inverts 117.2' MSL

d. Exit Inverts 104' MSL

e. Emergency Draindown Facilities Two Gate Valves 18" & 12" dia.

HYDROMETEOROLOGICAL GAGES

a. Type None

b. Location None

c. Records None

MAXIMUM NON-DAMAGING DISCHARGE 176 cfs at elevation 120' MSL.

APPENDIX D

HYDROLOGIC COMPUTATIONS

LAKE TOPANEMUS DAM
DRAINAGE BASIN

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT NJ DAM SAFETY INSPECTION GROUP X
LAKE TOPANEMUS
COMPUTED BY RLC CHECKED BY

SHEET NO. 1 OF
JOB NO. 10-A20-01
DATE 5/15/79

SIZE CLASSIFICATION

SURFACE AREA OF MAIN IMPOUNDMENT	22 ACRE ±
AVERAGE DEPTH OF LAKE	8 FT ±
STRUCTURAL HEIGHT OF DAM	19.8 FT
SIZE CLASSIFICATION	SMALL

HAZARD POTENTIAL CLASSIFICATION

RECREATION LAKE WITH HEAVILY TRAVELED ROADS WHICH IS PART OF IMPOUNDMENT STRUCTURE

HAZARD POTENTIAL CLASSIFICATION	HIGH
RECOMMENDED SDF	½ PMF

HYDROLOGIC ANALYSIS

THE HEC-1 DB WILL BE USED TO ROUTE THE FLOOD USING SCS TRIANGULAR UNIT HYDROGRAPH WITH CURVILINEAR TRANSFORMATION

D.A. = 1.6 Sq mi.

PRECIPITATION

FROM FIG. 15, ZONE 6 (REF. "DESIGN OF SMALL DAM" 1977"

PROBABLE MAX. PRECIPATION = 26 INCHES FOR 6 HR.

DURATION AND 10-SQ MI - AREA

DURATION (HRS)	% OF PMP
6	100
12	109
24	117
48	126

Values are reduced by 20% to account for Misalignment of Basin & Storm Isohyetals

INFILTRATION DATA

DRAINAGE CONSISTS OF MOST OF M-27 ge, M-24 ge, AM-2a/M27 ge MATERIAL

(REF. 'ENGINEERING SOIL SURVEY OF NJ - MONMOUTH COUNTY, RUTGERS UNIVERSITY)

HYDROLOGIC SOIL GROUP	D & SMALL PORTION B
LAND USED 1/3 URBAN 2/3 WOODED LOTS	
USE INITIAL INFILTRATION	1.0 INCH
USE CONSTANT MINIMUM RATE	0.08 INCH/HR

TIME OF CONCENTRATION

1) ESTIMATING Tc FROM VELOCITY ESTIMATE & WATER COURSE LENGTH

	Slope	VEL.	REMARK
OVERLAND FLOW	20/2200	1.0	PASTURE
CHANNEL REACH	80/8000	1.5	NEGLECTING FLOW THRU LAKE

$$T_c = \left(\frac{2200}{1} + \frac{8000}{1.5}\right)\frac{1}{3600} = 2.09 \text{ hr.}$$

(REF. SCS' HYDROLOGY HANDBOOK')

2) ESTIMATING Tc FROM VELOCITY & WATERCOURSE LENGTH
ASSUME SAME VELOCITY FOR OVERLAND & CHANNEL FLOW

$$T_c = \frac{10200}{1.5 \times 3600} = 1.89 \text{ hr}$$

3) FROM NOMOGRAPH " DESIGN OF SMALL DAM"

$\Delta H = 150'$ $L = 10200$ ft

$T_c = 0.95$ Hr.

4) KIRPICH

$$T_c = 0.0078K^{.77} \quad K = \frac{L}{\sqrt{S}} \quad S = \frac{H}{L}$$

$= 1.19$ hr.

TIME OF CONCENTRATION CONTINUED

5) USING THE F.A.A. FORMULA FOR SURFACE FLOW (AIRPORT DRAINAGE)

$$T_c = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{S}}$$

D = 10200'

C = 0.35 (URBAN RESIDENT)

$S = \frac{100}{10200} = 1\%$

$$T_c = \frac{1.8\,(1.1-0.35)\sqrt{10200}}{\sqrt[3]{1}\quad(60)} = 2.29 \text{ hr}$$

6) G.B. WILLIAMS FLOOD COMMITTEE

$$T = 0.908\,L\sqrt[5]{\frac{1}{FD}}$$

T IS THE PERIOD IN HOURS

L IS THE LENGTH OF THE CATCHMENT IN MILES

D IS THE DIAMETER IN MILES OF A CIRCLE HAVING THE SAME AREA

F IS THE CATCHMENT SLOPE EXPRESSED AS IN %

$$T = 0.908\left(\frac{10200}{5280}\right)\sqrt[5]{\frac{1}{1 \times 1.43}} = 1.63 \text{ hr}$$

USE $T_c = 1.89$ hr

LAG = $0.6\,T_c = 1.13$ hr

LAG = 1.13 hr

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT Lake Topanemus
COMPUTED BY E.K. CHECKED BY

SHEET NO. 5 OF
JOB NO. 10-A20-01
DATE 5/15/79

ELEVATION - AREA - CAPACITY RELATIONSHIP

INFORMATION OBTAINED FROM U.S.G.S.

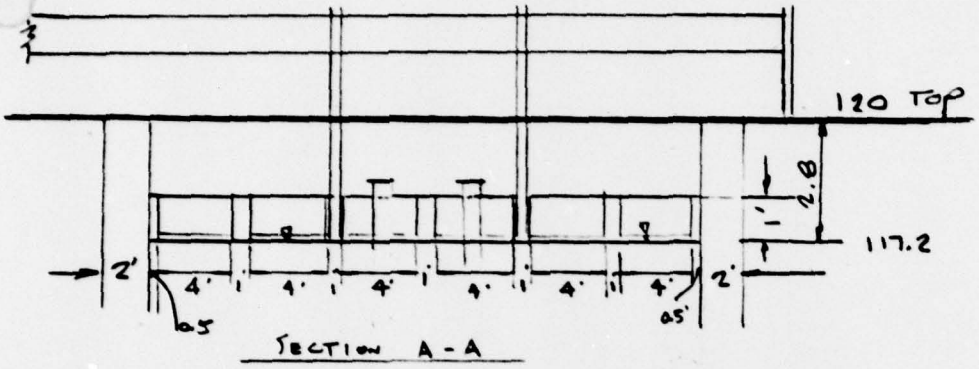
ELE.	108*	117.3	120	140
SURFACE AREA (AC)	0	22	32	1065

* BOTTOM OF LAKE AT SPILLWAY

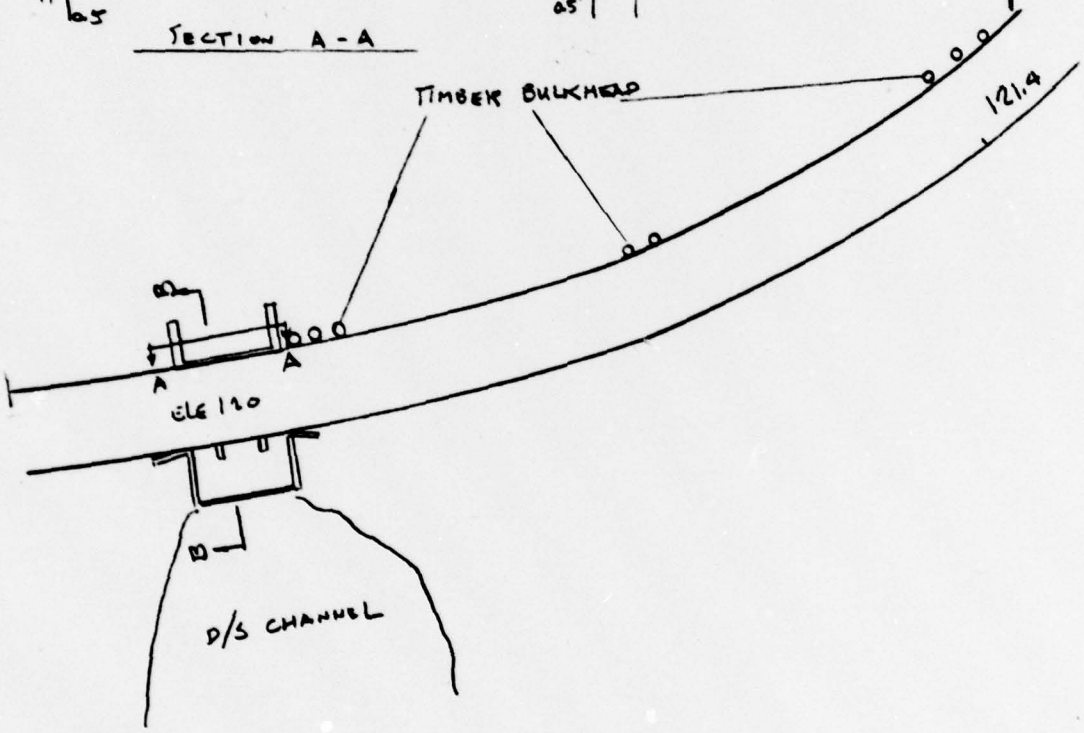
HEC-1 DB PROGRAM WILL DEVELOP STORAGE CAPACITY FROM SURFACE AREA & ELEVATIONS

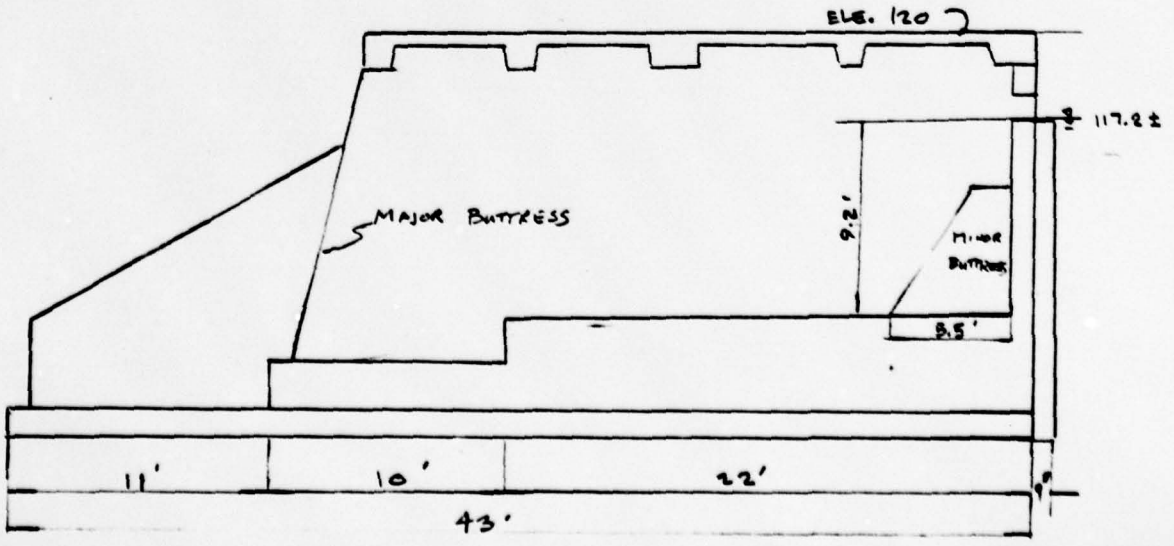
FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT Lake Tobaniens — SHEET NO. 6 OF
JOB NO. 12-A20-01
COMPUTED BY EK — CHECKED BY — DATE 5/16/79



SECTION A-A





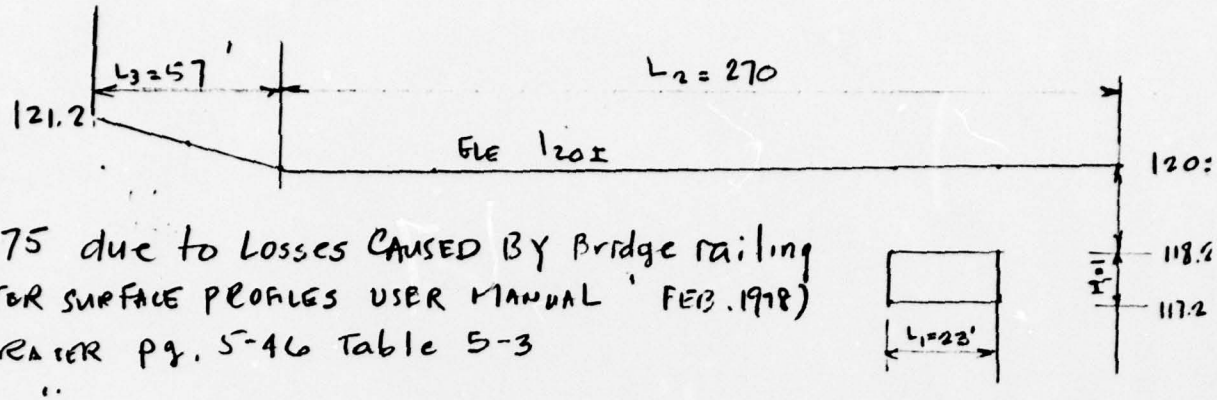
SECTION B B

FREDERIC R. HARRIS, INC. CONSULTING ENGINEERS

SUBJECT Lake Tennessus SHEET NO. 1 OF

COMPUTED BY E.K. CHECKED BY JOB NO. 10-A20-01

DATE 5/16/79



ASSUME C_2 & C_3 = 2.75 due to Losses CAUSED BY Bridge railing
(REF. HEC-2 WATER SURFACE PROFILES USER MANUAL FEB. 1978)

C_1 = 2.7 KING & BRATER pg. 5-46 Table 5-3

C_1 = 0.63 " "

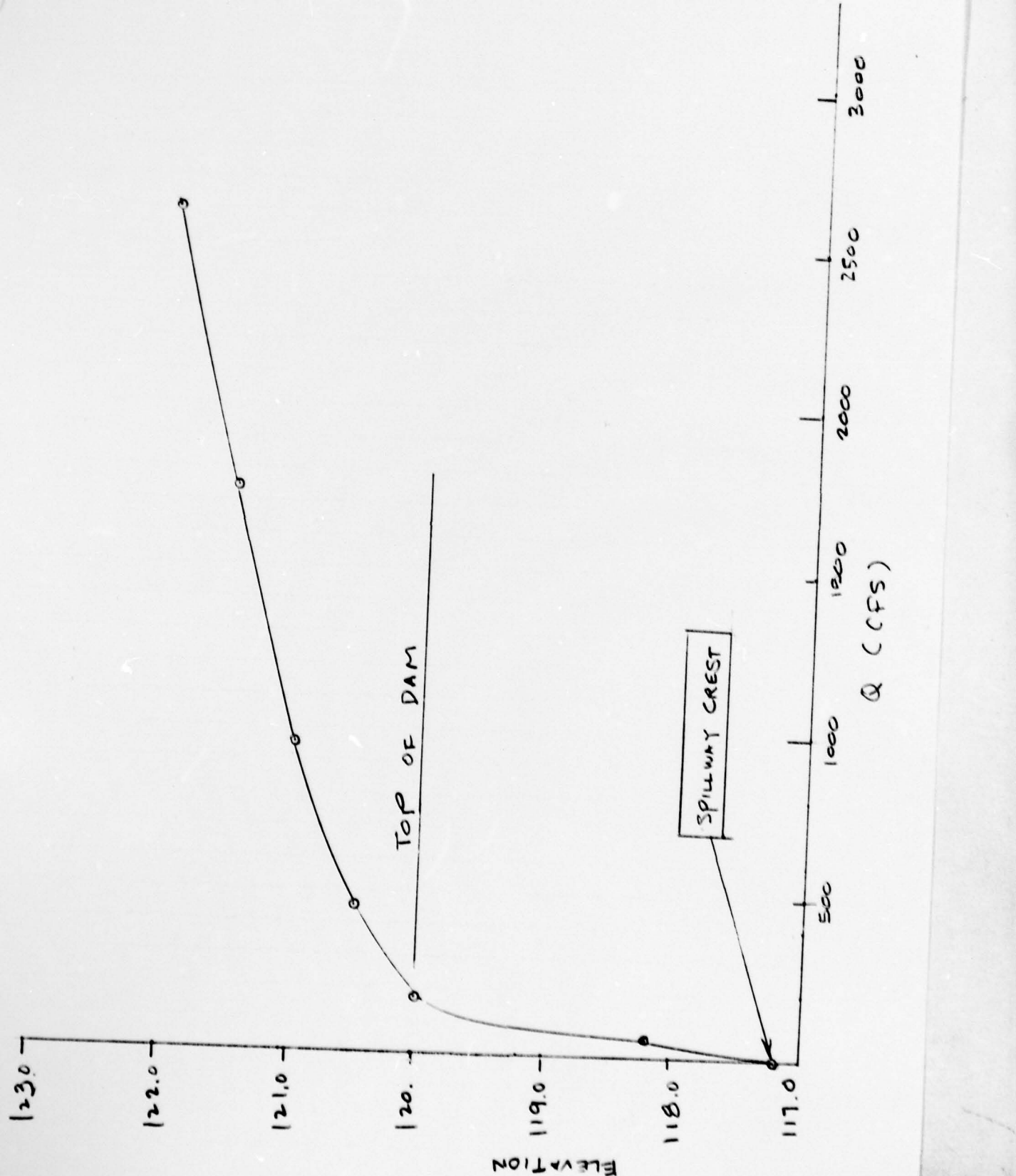
ELE.	H_1	H_1'	H_2	H_3	L_1	L_2	L_3	C_1	C_2	C_3	$Q = C_1L_1H_1^{1.5} + C_2L_2H_2^{1.5} + C_3L_3H_3^{1.5}$ $C_1L_1H^{1.5}$ UP TO H_1=1'. FOR H_1>1' USE ORIFICE EQ FOR SECTION 1 $Q = \frac{2}{3}\sqrt{2g}C_1'L(H_1^{1.5} - H_1'^{1.5}) + C_2L_2H_2^{1.5} + C_3L_3H_3^{1.5}$	
117.2												
118.2	1				23	0	0	2.7			62 + 0 + 0	=62 cfs
	H_1	H_1'						C_1				
120	2.8	1.8			23	0	0	0.63			176 + 0 + 0	=176
120.5	3.3	2.3	0.5		23	270	0	0.63	2.75		194 + 263 + 0	=457
121.0	3.8	2.8	1.0	0.4	23	270	57	0.63	2.75	2.75	211 + 743 + 40	=954
121.5	4.3	3.3	1.5	0.9	23	270	57	0.63	2.75	2.75	227 + 1364 + 134	=1731
122.0	4.8	3.8	2.0	1.4	23	270	57	0.63	2.75	2.75	241 + 2160 + 260	=2601
124	6.9	5.8	4.0	3.4	23	270	57	0.63	2.75	2.75	292 + 5940 + 983	=7215
126	8.8	7.8	6.0	5.4	23	270	57	0.63	2.75	2.75	335 + 10912 + 1967	=13214
128	10.8	9.8	8.0	7.4	23	270	57	0.63	2.75	2.75	373 + 16801 + 3155	=20329

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

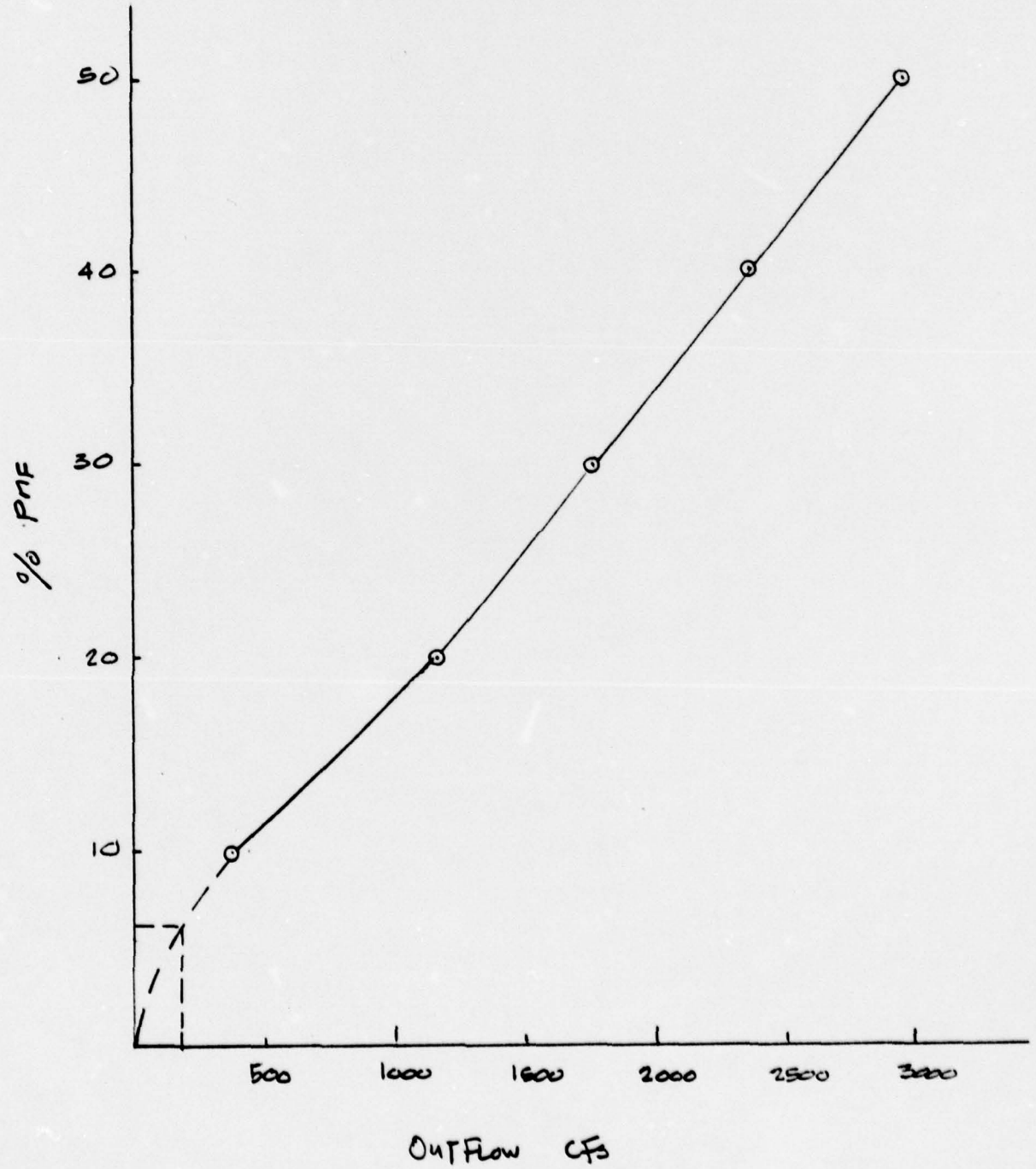
SUBJECT NJ DAM INSPECTION GROUP X
LAKE TOPANEMUS

COMPUTED BY EK CHECKED BY

SHEET NO. 8 OF
JOB NO. 10-A20-01
DATE



OVERTOPPING POTENTIAL

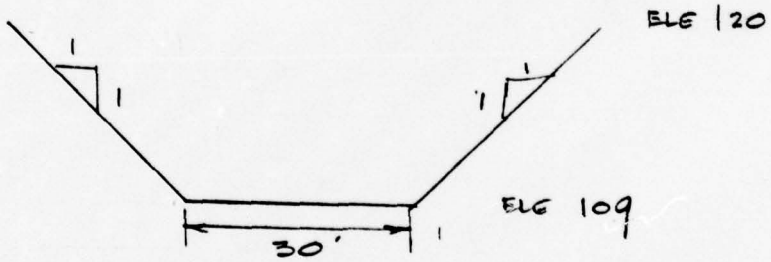


OVERTOPPING OF DAM OCCURS AT ELE. 120 WITH

$Q = 176$ CFS ($\sim 6\%$ PMF)

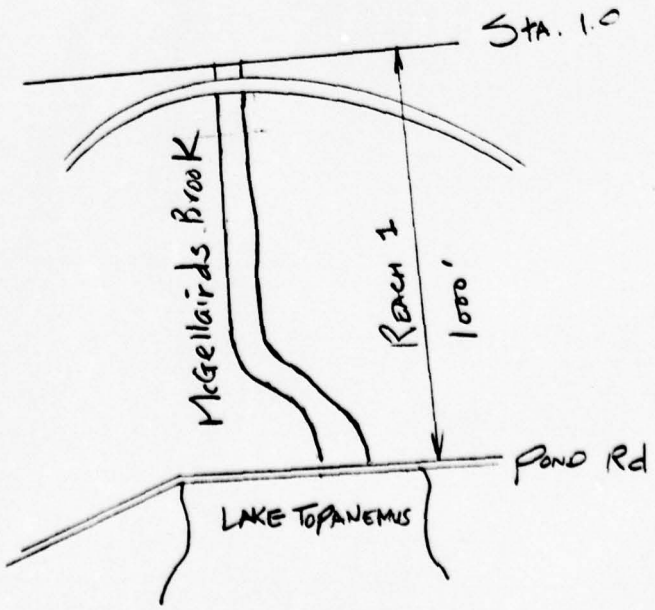
BREACH ANALYSIS

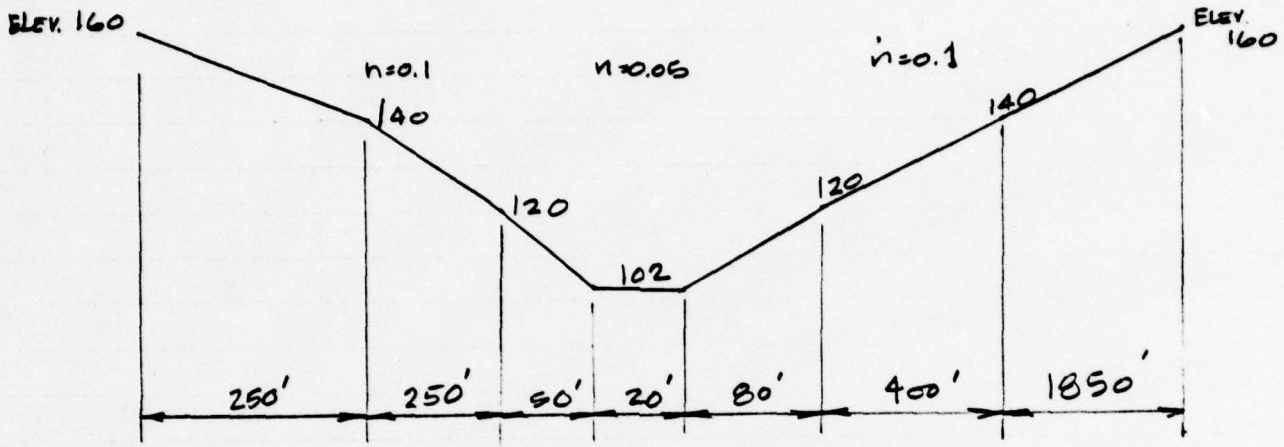
ASSUME BREACH BEGINS TO DEVELOP WHEN RESERVOIR STAGE REACHES ELE. 121.4 (1.4 FT HIGHER THAN THE TOP OF DAM)



FULLY DEVELOPED BREACH

ASSUME Bridge across the stream fails instantly upon Impact of the flood wave.

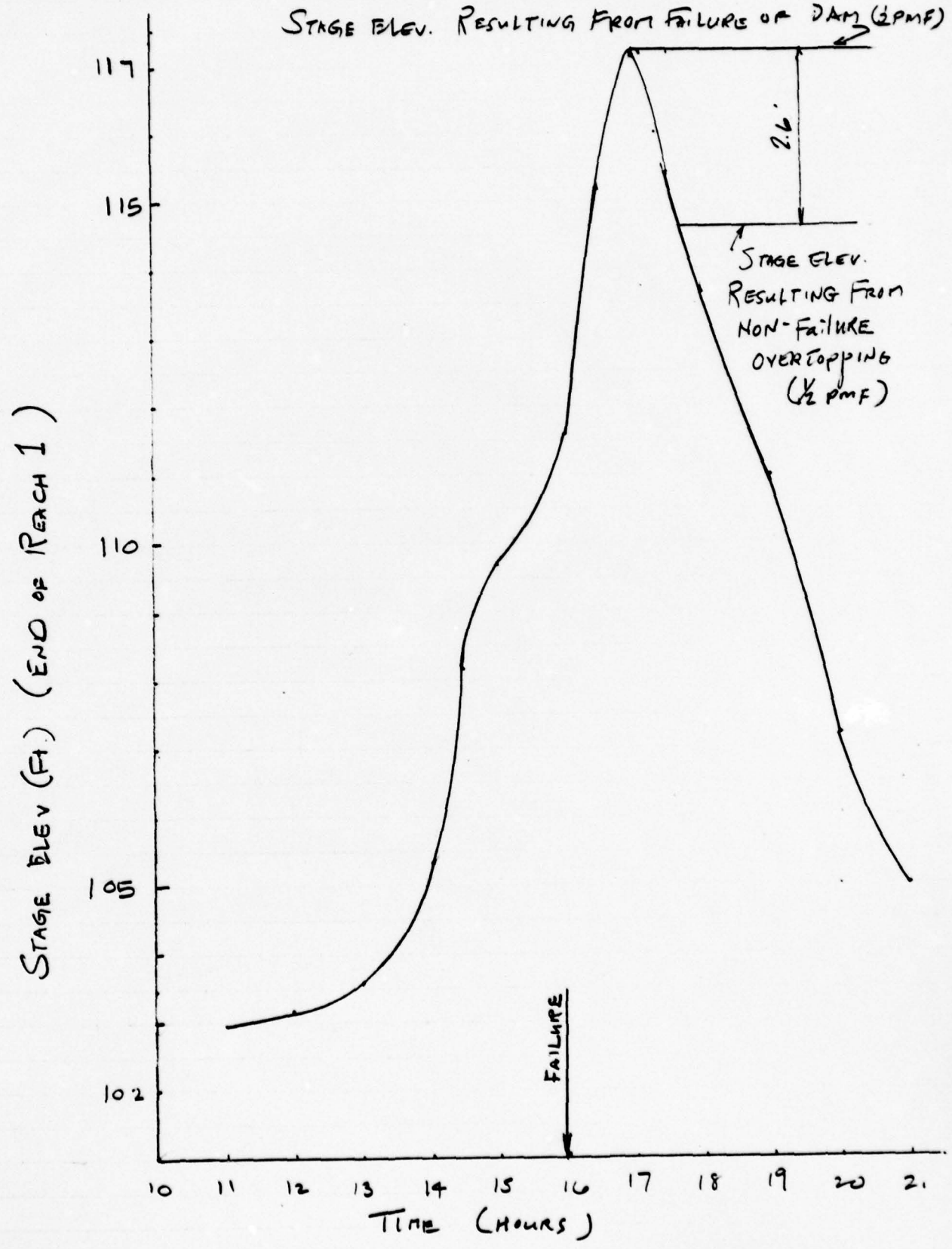




CROSS - SECTION

END OF REACH 1 (STA. 1.0)

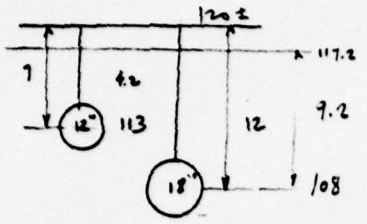
S = 0.001


STAGE ELEV. RESULTING FROM FAILURE OF DAM (½PMF)
2.6'
STAGE ELEV. RESULTING FROM NON-FAILURE OVERTOPPING (½ PMF)
FAILURE
STAGE ELEV (FT) (END OF REACH 1)
117
115
110
105
102
10
11
12
13
14
15
16
17
18
19
20
21
TIME (HOURS)

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT Lake Tomahawk
COMPUTED BY PK CHECKED BY
SHEET NO. 13 OF
JOB NO. 10-A20-0
DATE 8/8/73

DRAWDOWN TIME COMPUTATION



NORMAL ELE TO START 117.2
DRAINAGE AREA = 1.6 mi²
TW ELE EL. 103.0
Inflow = @ 2 cfs/s.m. = 3.2 cfs

Res Ele	Area Acres	Ave Area Acres	Volume Ac Ft	Ave Res EL.	Q Ave outlet Discharge cfs	t, hrs Time to drawdown Vol x 24 / 1.98x8	Cum time hrs	time to drawdown 2.0 CSM 3.2 x t, Q.	Cum time hrs
117.2	22								
		20.6	24.7	116.6	35.3	8.48	8.48	0.76	9.2
116	19.1								
		17.9	17.9	115.5	32.2	6.74	15.22	0.67	16.7
115	16.7								
		15.6	15.6	114.5	28.5	6.63	21.85	0.75	24.0
114	14.4								
		13.2	13.2	113.5	24.10	6.64	28.49	0.8	31.55
113	12								
		10.8	10.8	112.5	18.8	6.96	35.45	1.12	39.6
112	9.6								
		8.4	8.4	111.5	16.5	6.17	42.01	1.20	47.8
111	7.2								
		6.0	6.0	110.5	13.8	5.27	47.68	1.22	54.3
110	4.8								
		3.6	3.6	109.5	10.7	4.08	51.76	1.22	59.6
109	2.4								
		1.2	1.2	108.5	~6.2	2.35	54.11	1.21	63.1
108	0								

A) TIME OF COMPLETE DRAWDOWN WITH NO INFLOW = 54.1 hrs

B) TIME OF COMPLETE DRAWDOWN WITH 2 Cfsm or 3.2 cfs = 63.1 hr

(ASSUME that the surface area of Reservoir varies Linearly from 22 Acres @ ELE 117.2 to 0 acres @ ELE 108)

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HEC1-DB

COMPUTER PRINT-OUT

```
A1                  N J DAM SAFETY INSPECTIONS PROGRAM---GROUP X
A2                  N J 00219 LAKE TO PANEMUS, MONMOUTH COUNTY, NJ
A3                  MUILT RATIO PMF ROUTING, F. R. HARRIS INC,WOODBRIDGE,NJ
B    150       0      10                                        0       0       3
B1     5
J      1       5       1
J1   0.5     0.4     0.3     0.2     0.1
K      0    LAKE                          0       0       1
K1                  INFLOW HYDROGRAPH THROUGH LAKE TOPANEMUS
M      1       2     1.6                   1.6     0.8                       1
P      0      26     100     109     117
T                                                    1.0    0.08
W2           1.13
X     -1   -0.05       2
K      1     DAM                           0       0       1
K1                  ROUTING DISCJARGE THROUGH LAKE TOPANEMUS
Y                                   1       1
Y1     1                                                -117.2      -1
Y4 117.2   118.2     120   120.5     121   121.5     122     124     126     128
Y5     0      62     176     457     954    1731    2601    7215   13214   20329
$A     0      22      32   106.5
$E   108   117.3     120     140
$$ 117.2
$D   120
K     99
A
A
A
A
A
A
$
```

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

RUN  DATE= 79/08/02.
     TIME= 22.57.07.


                    N J DAM SAFETY INSPECTIONS PROGRAM---GROUP X
                    N J 00219 LAKE TO PANEMUS, MONMOUTH COUNTY, NJ
                    MULTI-RATIO-PMF ROUTING, F. R. HARRIS INC, WOODBRIDGE, NJ

                                    JOB SPECIFICATION
      NO     NHR    NMIN    IDAY    IHR    IMIN   METRC   IPLT   IPRT  NSTAN
    .150       0      10       0      0       0       0      0      3      0
                                JOPER     NWT   LROPT   TRACE
                                    5       0       0       0

                          MULTI-PLAN ANALYSES TO BE PERFORMED
                                NPLAN= 1 NRTIO= 5 LRTIO= 1
                RTIOS=     .50     .40     .30     .20     .10

**********      **********      **********      **********      **********

                                SUB-AREA RUNOFF COMPUTATION

                          INFLOW HYDROGRAPH THROUGH LAKE TOPANEMUS

                          ISTAQ   ICOMP   IECON   ITAPE   JPLT   JPRT  INAME  ISTAGE  IAUTO
                          LAKE        0       0       0      0      0      1       0      0

                                    HYDROGRAPH DATA
          IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO  ISNOW  ISAME  LOCAL
              1       2    1.60    0.00    1.60     .80   0.000      0      1      0

                                    PRECIP DATA
                    SPFE     PMS      R6     R12     R24     R48     R72     R96
                    0.00   26.00  100.00  109.00  117.00    0.00    0.00    0.00

                                    LOSS DATA
    LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
        0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .08    0.00    0.00

                                UNIT HYDROGRAPH DATA
                            TC=  0.00    LAG=  1.13

                                RECESSION DATA
                            STRTQ=   -1.00    QRCSN=    -.05    RTIOR= 2.00

                UNIT HYDROGRAPH 36 END-OF-PERIOD ORDINATES, TC=   0.00 HOURS, LAG=   1.13  VOL= 1.00
      36.     106.     210.     359.     508.     601.     634.     630.     576.     510.
     424.     326.     255.     203.     164.     132.     106.      84.      67.      54.
      43.      34.      27.      22.      18.      14.      11.       9.       7.       6.
       5.       4.       3.       2.       1.       0.
```

FFIF INFLOW HYDROGRAPH

MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PI COMP Q
1.01	.10	1	.02	0.00	.02	1.
1.01	.20	2	.02	0.00	.02	1.
1.01	.30	3	.02	0.00	.02	1.
1.01	.40	4	.02	0.00	.02	1.
1.01	.50	5	.02	0.00	.02	1.
1.01	1.00	6	.02	0.00	.02	1.
1.01	1.10	7	.02	0.00	.02	1.
1.01	1.20	8	.02	0.00	.02	1.
1.01	1.30	9	.02	0.00	.02	1.
1.01	1.40	10	.02	0.00	.02	1.
1.01	1.50	11	.02	0.00	.02	1.
1.01	2.00	12	.02	0.00	.02	1.
1.01	2.10	13	.02	0.00	.02	1.
1.01	2.20	14	.02	0.00	.02	1.
1.01	2.30	15	.02	0.00	.02	1.
1.01	2.40	16	.02	0.00	.02	1.
1.01	2.50	17	.02	0.00	.02	0.
1.01	3.00	18	.02	0.00	.02	0.
1.01	3.10	19	.02	0.00	.02	0.
1.01	3.20	20	.02	0.00	.02	0.
1.01	3.30	21	.02	0.00	.02	0.
1.01	3.40	22	.02	0.00	.02	0.
1.01	3.50	23	.02	0.00	.02	0.
1.01	4.00	24	.02	0.00	.02	0.
1.01	4.10	25	.02	0.00	.02	0.
1.01	4.20	26	.02	0.00	.02	0.
1.01	4.30	27	.02	0.00	.02	0.
1.01	4.40	28	.02	0.00	.02	0.
1.01	4.50	29	.02	0.00	.02	0.
1.01	5.00	30	.02	0.00	.02	0.
1.01	5.10	31	.02	0.00	.02	0.
1.01	5.20	32	.02	0.00	.02	0.
1.01	5.30	33	.02	0.00	.02	0.
1.01	5.40	34	.02	0.00	.02	0.
1.01	5.50	35	.02	0.00	.02	0.
1.01	6.00	36	.02	0.00	.02	0.
1.01	6.10	37	.05	0.00	.05	0.
1.01	6.20	38	.05	0.00	.05	0.
1.01	6.30	39	.05	0.00	.05	0.
1.01	6.40	40	.05	0.00	.05	0.
1.01	6.50	41	.05	0.00	.05	0.
1.01	7.00	42	.05	0.00	.05	0.
1.01	7.10	43	.05	.02	.03	1.
1.01	7.20	44	.05	.04	.01	4.
1.01	7.30	45	.05	.04	.01	10.
1.01	7.40	46	.05	.04	.01	22.
1.01	7.50	47	.05	.04	.01	39.
1.01	8.00	48	.05	.04	.01	60.
1.01	8.10	49	.05	.04	.01	84.
1.01	8.20	50	.05	.04	.01	109.
1.01	8.30	51	.05	.04	.01	132.
1.01	8.40	52	.05	.04	.01	153.
1.01	8.50	53	.05	.04	.01	171.
1.01	9.00	54	.05	.04	.01	185.
1.01	9.10	55	.05	.04	.01	196.
1.01	9.20	56	.05	.04	.01	205.
1.01	9.30	57	.05	.04	.01	212.
1.01	9.40	58	.05	.04	.01	217.
1.01	9.50	59	.05	.04	.01	222.
1.01	10.00	60	.05	.04	.01	225.
1.01	10.10	61	.05	.04	.01	228.
1.01	10.20	62	.05	.04	.01	231.
1.01	10.30	63	.05	.04	.01	232.
1.01	10.40	64	.05	.04	.01	234.
1.01	10.50	65	.05	.04	.01	235.
1.01	11.00	66	.05	.04	.01	236.
1.01	11.10	67	.05	.04	.01	237.
1.01	11.20	68	.05	.04	.01	237.
1.01	11.30	69	.05	.04	.01	238.
1.01	11.40	70	.05	.04	.01	238.
1.01	11.50	71	.05	.04	.01	238.
1.01	12.00	72	.05	.04	.01	239.
1.01	12.10	73	.35	.33	.01	249.
1.01	12.20	74	.35	.33	.01	281.
1.01	12.30	75	.35	.33	.01	343.

PMF INFLOW HYDROGRAPH

ERIOD FLOW

MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	12.40	76	.35	.33	.01	449.
1.01	12.50	77	.35	.33	.01	599.
1.01	13.00	78	.35	.33	.01	776.
1.01	13.10	79	.42	.40	.01	965.
1.01	13.20	80	.42	.40	.01	1158.
1.01	13.30	81	.42	.40	.01	1342.
1.01	13.40	82	.42	.40	.01	1517.
1.01	13.50	83	.42	.40	.01	1678.
1.01	14.00	84	.42	.40	.01	1815.
1.01	14.10	85	.52	.51	.01	1938.
1.01	14.20	86	.52	.51	.01	2052.
1.01	14.30	87	.52	.51	.01	2162.
1.01	14.40	88	.52	.51	.01	2274.
1.01	14.50	89	.52	.51	.01	2388.
1.01	15.00	90	.52	.51	.01	2498.
1.01	15.10	91	.47	.46	.01	2599.
1.01	15.20	92	.79	.78	.01	2701.
1.01	15.30	93	1.42	1.41	.01	2832.
1.01	15.40	94	3.56	3.54	.01	3097.
1.01	15.50	95	1.03	1.01	.01	3516.
1.01	16.00	96	.63	.62	.01	4087.
1.01	16.10	97	.49	.47	.01	4794.
1.01	16.20	98	.49	.47	.01	5454.
1.01	16.30	99	.49	.47	.01	5875.
1.01	16.40	100	.49	.47	.01	6030.
1.01	16.50	101	.49	.47	.01	5979.
1.01	17.00	102	.49	.47	.01	5729.
1.01	17.10	103	.38	.37	.01	5384.
1.01	17.20	104	.38	.37	.01	4954.
1.01	17.30	105	.38	.37	.01	4492.
1.01	17.40	106	.38	.37	.01	4110.
1.01	17.50	107	.38	.37	.01	3799.
1.01	18.00	108	.38	.37	.01	3542.
1.01	18.10	109	.03	.01	.01	3306.
1.01	18.20	110	.03	.01	.01	3073.
1.01	18.30	111	.03	.01	.01	2834.
1.01	18.40	112	.03	.01	.01	2570.
1.01	18.50	113	.03	.01	.01	2280.
1.01	19.00	114	.03	.01	.01	1980.
1.01	19.10	115	.03	.01	.01	1686.
1.01	19.20	116	.03	.01	.01	1409.
1.01	19.30	117	.03	.01	.01	1161.
1.01	19.40	118	.03	.01	.01	946.
1.01	19.50	119	.03	.01	.01	767.
1.01	20.00	120	.03	.01	.01	629.
1.01	20.10	121	.03	.01	.01	521.
1.01	20.20	122	.03	.01	.01	435.
1.01	20.30	123	.03	.01	.01	366.
1.01	20.40	124	.03	.01	.01	311.
1.01	20.50	125	.03	.01	.01	285.
1.01	21.00	126	.03	.01	.01	266.
1.01	21.10	127	.03	.01	.01	248.
1.01	21.20	128	.03	.01	.01	232.
1.01	21.30	129	.03	.01	.01	216.
1.01	21.40	130	.03	.01	.01	202.
1.01	21.50	131	.03	.01	.01	188.
1.01	22.00	132	.03	.01	.01	176.
1.01	22.10	133	.03	.01	.01	164.
1.01	22.20	134	.03	.01	.01	153.
1.01	22.30	135	.03	.01	.01	143.
1.01	22.40	136	.03	.01	.01	133.
1.01	22.50	137	.03	.01	.01	124.
1.01	23.00	138	.03	.01	.01	116.
1.01	23.10	139	.03	.01	.01	108.
1.01	23.20	140	.03	.01	.01	101.
1.01	23.30	141	.03	.01	.01	94.
1.01	23.40	142	.03	.01	.01	90.
1.01	23.50	143	.03	.01	.01	89.
1.02	0.00	144	.03	.01	.01	89.
1.02	.10	145	0.00	0.00	0.00	89.
1.02	.20	146	0.00	0.00	0.00	87.
1.02	.30	147	0.00	0.00	0.00	84.
1.02	.40	148	0.00	0.00	0.00	79.
1.02	.50	149	0.00	0.00	0.00	74.
1.02	1.00	150	0.00	0.00	0.00	69.
		SUM	24.34	21.98	2.35	136517.
			(618.)	(558.)	(60.)	(3865.73)

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HYDROGRAPH ROUTING

ROUTING DISCJARGE THROUGH LAKE TOPANEMUS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-117.	-1

STAGE	117.20	118.20	120.00	120.50	121.00	121.50	122.00	124.00	126.00	128.00
FLOW	0.00	62.00	176.00	457.00	954.00	1731.00	2601.00	7215.00	13214.00	20329.00
SURFACE AREA=	0.	22.	32.	107.						
CAPACITY=	0.	68.	141.	1453.						
ELEVATION=	108.	117.	120.	140.						

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
117.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
120.0	0.0	0.0	0.

STATION DAM, PLAN 1, RATIO 1 (1/2 PMF)

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	2.	3.	5.
7.	10.	12.	15.	18.	21.	24.	27.	30.	33.
36.	39.	41.	44.	46.	49.	51.	54.	56.	58.
60.	62.	64.	66.	69.	74.	80.	88.	99.	113.
128.	145.	164.	231.	381.	543.	715.	846.	952.	1078.
1169.	1242.	1308.	1388.	1510.	1690.	1950.	2251.	2535.	2782.
2912.	2921.	2837.	2687.	2513.	2336.	2160.	2000.	1857.	1727.
1612.	1492.	1363.	1224.	1080.	941.	842.	737.	634.	537.
454.	409.	365.	324.	287.	255.	228.	205.	185.	175.
173.	171.	169.	166.	164.	161.	158.	156.	153.	150.
147.	144.	141.	139.	136.	133.	131.	128.	125.	123.

STORAGE

66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	67.	67.	68.
69.	69.	70.	71.	72.	74.	75.	76.	77.	78.
79.	80.	81.	82.	83.	84.	85.	86.	87.	88.
89.	89.	90.	91.	92.	94.	97.	100.	105.	111.
118.	126.	135.	144.	153.	160.	166.	170.	174.	177.
179.	180.	182.	184.	187.	191.	196.	203.	209.	213.
215.	215.	214.	212.	208.	204.	201.	197.	194.	192.
189.	186.	183.	180.	177.	174.	170.	167.	163.	160.
157.	154.	152.	149.	147.	145.	144.	142.	141.	140.
139.	138.	137.	136.	134.	133.	132.	131.	129.	128.
127.	125.	124.	123.	121.	120.	119.	118.	116.	115.

STAGE

117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2
117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2
117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2
117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2
117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.3	117.3
117.3	117.4	117.4	117.4	117.5	117.5	117.6	117.6	117.7	117.7
117.8	117.8	117.9	117.9	117.9	118.0	118.0	118.1	118.1	118.1
118.2	118.2	118.2	118.3	118.3	118.4	118.5	118.6	118.8	119.0
119.2	119.5	119.8	120.1	120.4	120.6	120.8	120.9	121.0	121.1
121.1	121.2	121.2	121.3	121.4	121.5	121.6	121.8	122.0	122.1
122.1	122.1	122.1	122.0	121.9	121.8	121.7	121.7	121.6	121.5
121.4	121.3	121.3	121.2	121.1	121.0	120.9	120.8	120.7	120.6
120.5	120.4	120.3	120.3	120.2	120.1	120.1	120.1	120.0	120.0
120.0	119.9	119.9	119.8	119.8	119.8	119.7	119.7	119.6	119.6
119.5	119.5	119.5	119.4	119.4	119.3	119.3	119.2	119.2	119.2

PEAK OUTFLOW IS 2921. AT TIME 17.00 HOURS

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1

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 .40	RATIO 3 .30	RATIO 4 .20	RATIO 5 .10
HYDROGRAPH AT	LAKE	1.60	1	3015.	2412.	1809.	1206.	603.
		(4.14)		(85.37)(	68.30)(	51.22)(	34.15)(	17.07)(
ROUTED TO	DAM	1.60	1	2921.	2319.	1728.	1121.	389.
		(4.14)		(82.71)(	65.66)(	48.95)(	31.75)(	11.03)(

1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	117.20	117.20	120.00
STORAGE	66.	66.	141.
OUTFLOW	0.	0.	176.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	122.14	2.14	215.	2921.	7.67	17.00	0.00
.40	121.84	1.84	204.	2319.	7.00	17.00	0.00
.30	121.50	1.50	192.	1728.	6.17	17.00	0.00
.20	121.11	1.11	178.	1121.	5.00	17.00	0.00
.10	120.38	.38	153.	389.	2.83	17.83	0.00

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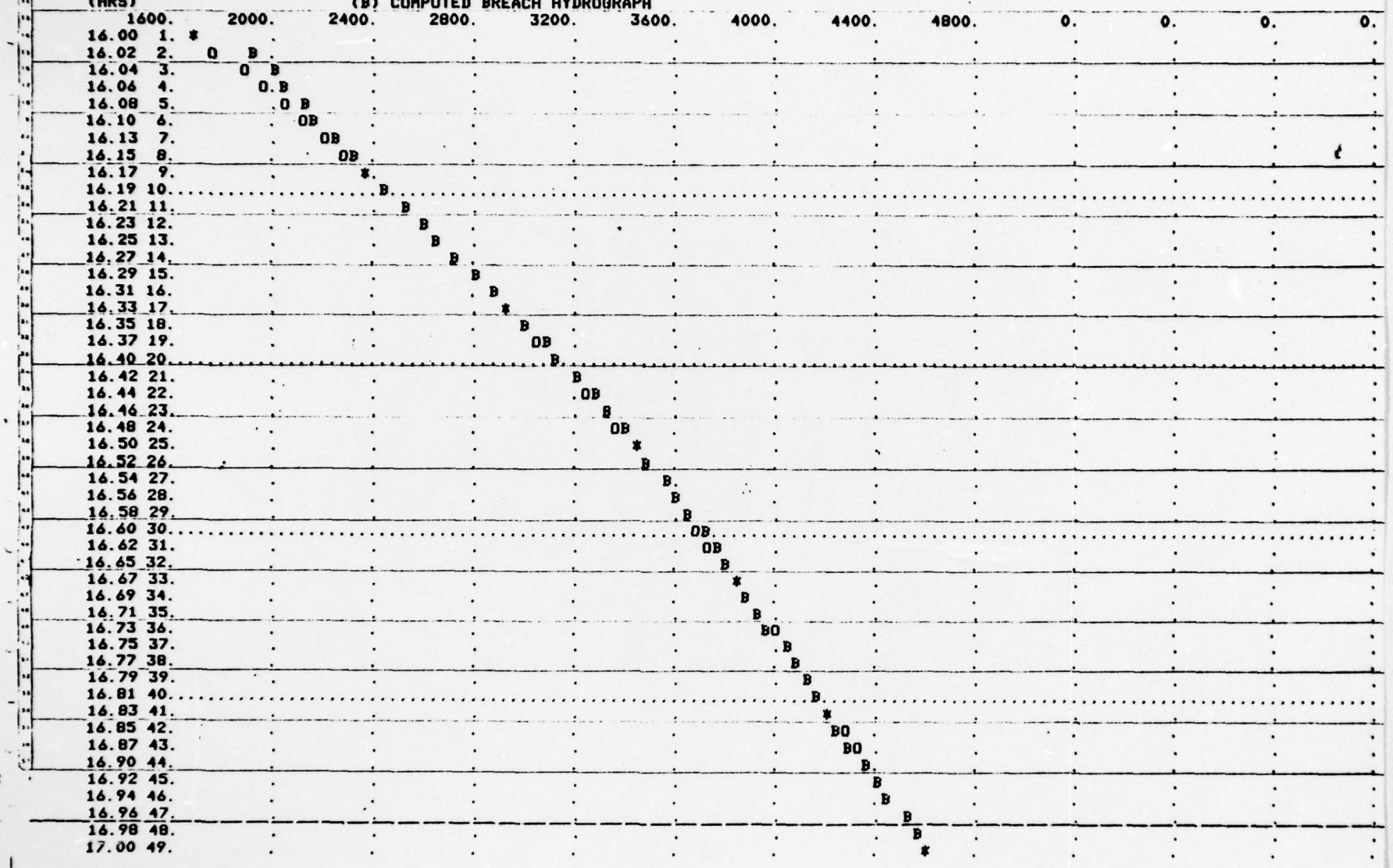
A1                    N J DAM SAFETY INSPECTIONS PROGRAM---GROUP X
A2                    N J 00219 LAKE TO PANEMUS, MONMOUTH COUNTY, NJ
A3                    MUILT RATIO PMF ROUTING, F. R. HARRIS INC, WOODBRIDGE, NJ
B    150      0       10       0       0       0       0       0       5
B1     5
J      2      1        1
J1   0.5
K      0   LAKE                          0       0       1
K1                    INFLOW HYDROGRAPH THROUGH LAKE TOPANEMUS
M      1      2      1.6              1.6     0.8                             1
P      0     26      100     109      117
T                                                          1.0    0.08
W2          1.13
X     -1   -0.05       2
K      1    DAM                         0       0       1
K1                    ROUTING DISCJARGE THROUGH LAKE TOPANEMUS
Y                                      1       1
Y1     1                                                  -117.2    -1
Y4 117.2   118.2     120     120.5     121     121.5     122     124     126     128
Y5     0      62     176      457     954      1731     2601    7215   13214   20329
$A     0      22      32    106.5
$E   108   117.3     120     140
$$ 117.2
$D   120
$B    30       1     109       1   117.2  121.40
$B    30       1     109     1.0   117.2  200.00
K      1     1.0                                         1
K1   D/S LOC 10+00
Y                                      1       1
Y1     1                                                  -1
Y6   0.1    0.05     0.1     102     160    1000   0.001
Y7   200     160     450     140     700     120     750     102     770     102
Y7   850     120    1250     140    3100     160
K      1     4.2                                         1
K1   D/S LOC 42+00
Y                                      1       1
Y1     1                                                  -1
Y6   0.1    0.05     0.1     100     140    3200 0.00063
Y7   500     160     800     140    1000     120    1220     100    1320     100
Y7  1600     120    2200     140    2300     140
K      1     8.0                                         1
K1   D/S LOC 80+00
Y                                      1       1
Y1     1                                                  -1
Y6   0.1    0.05     0.1      93     120    3800  0.0018
Y7  2000     140    2200     120    2550     100    2770      93    2900      93
Y7  2950     100    3650     120    4300     120
K      1    11.6                                         1
K1   D/S LOC 116+00
Y                                      1       1
Y1     1                                                  -1
Y6   0.1    0.05     0.1      86     100    3600  0.0019
Y7  1400     105    2000     100    3100     100    3800      86    4000      86
Y7  4350      95    7100     100    7500     100
K      1    15.9                                         1
K1   D/S LOC 159+00 NR OLD TENNENT CHURCH
Y                                      1       1
Y1     1                                                  -1
Y6   0.1    0.05     0.1      79     120    4300  0.0016
Y7   700     125    1000     120    1200     100    1850      79    2050      79
Y7  2750      80    4050     100    4550     120
K      1     190                                         1
K1   D/S LOC 190+00 AT TAYLOR MILLS
Y                                      1       1
Y1     1                                                  -1
Y6  0.15    0.05     0.1      72      85    3100  0.0023
Y7  1500      85    2600      80    3700      80    3850      72    3950      72
Y7  4050      80    5200      80    7000     100
K     99
A
A
A
A
A
```

1*QVF*

STATION DAM

TIME (HRS)

(O) INTERPOLATED BREACH HYDROGRAPH
(B) COMPUTED BREACH HYDROGRAPH
(*) POINTS AT NORMAL TIME INTERVAL



N J DAM SAFETY INSPECTIONS PROGRAM---GROUP X
N J 00219 LAKE TO PANEMUS, MONMOUTH COUNTY, NJ
MUILT RATIO PMF ROUTING, F. R. HARRIS INC, WOODBRIDGE, NJ

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	10	0	0	0	0	0	5	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

SURFACE AREA=	0.	22.	32.	107.
CAPACITY=	0.	68.	141.	1453.
ELEVATION=	108.	117.	120.	140.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
117.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
120.0	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
30.	1.00	109.00	1.00	117.20	121.40

BEGIN DAM FAILURE AT 16.00 HOURS

PEAK OUTFLOW IS 4597. AT TIME 17.00 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
30.	1.00	109.00	1.00	117.20	200.00

PEAK OUTFLOW IS 2921. AT TIME 17.00 HOURS

NORMAL DEPTH CHANNEL ROUTING

STA 1.0 REACH 1

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0500	.1000	102.0	160.0	1000.	.00100

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

200.00 160.00 450.00 140.00 700.00 120.00 750.00 102.00 770.00 102.00
850.00 120.00 1250.00 140.00 3100.00 160.00

NORMAL DEPTH CHANNEL ROUTING

STA. 4.2

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0500	.1000	100.0	140.0	3200.	.00063

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

500.00 160.00 800.00 140.00 1000.00 120.00 1220.00 100.00 1320.00 100.00
1600.00 120.00 2200.00 140.00 2300.00 140.00

NORMAL DEPTH CHANNEL ROUTING

STA 8.0

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0500	.1000	93.0	120.0	3800.	.00180

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

2000.00 140.00 2200.00 120.00 2550.00 100.00 2770.00 93.00 2900.00 93.00
2950.00 100.00 3650.00 120.00 4300.00 120.00

NORMAL DEPTH CHANNEL ROUTING

STA. 11.6

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0500	.1000	86.0	100.0	3600.	.00190

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
1400.00 105.00 2000.00 100.00 3100.00 100.00 3800.00 86.00 4000.00 86.00
4350.00 95.00 7100.00 100.00 7500.00 100.00

NORMAL DEPTH CHANNEL ROUTING

STA. 15.9

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0500	.1000	79.0	120.0	4300.	.00160

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
700.00 125.00 1000.00 120.00 1200.00 100.00 1850.00 79.00 2050.00 79.00
2750.00 80.00 4050.00 100.00 4550.00 120.00

NORMAL DEPTH CHANNEL ROUTING

STA. 190

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1500	.0500	.1000	72.0	85.0	3100.	.00230

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
1500.00 85.00 2600.00 80.00 3700.00 80.00 3850.00 72.00 3950.00 72.00
4050.00 80.00 5200.00 80.00 7000.00 100.00

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

OPERATION	STATION	AREA	PLAN	RATIO 1 .50
HYDROGRAPH AT	LAKE	1.60	1	3015.
		(4.14)		(85.37)(
			2	3015.
				(85.37)(
ROUTED TO	DAM	1.60	1	4597.
		(4.14)		(130.18)(
			2	2921.
				(82.71)(
ROUTED TO	1.0	1.60	1	4471.
		(4.14)		(126.60)(
			2	2924.
				(82.81)(
ROUTED TO	4.2	1.60	1	4026.
		(4.14)		(114.01)(
			2	2773.
				(78.52)(
ROUTED TO	8.0	1.60	1	3816.
		(4.14)		(108.05)(
			2	2667.
				(75.53)(
ROUTED TO	11.0	1.60	1	3595.
		(4.14)		(101.80)(
			2	2557.
				(72.40)(
ROUTED TO	15.9	1.60	1	3103.
		(4.14)		(87.88)(
			2	2267.
				(64.18)(
ROUTED TO	190	1.60	1	3052.
		(4.14)		(86.41)(
			2	2247.
				(63.62)(

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	117.20	117.20	120.00
STORAGE	66.	66.	141.
OUTFLOW	0.	0.	176.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	121.52	1.52	192.	4597.	3.17	17.00	16.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	117.20	117.20	120.00
STORAGE	66.	66.	141.
OUTFLOW	0.	0.	176.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	122.14	2.14	215.	2921.	7.67	17.00	0.00

PLAN 1 STATION 1.0 REACH 1

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	4471.	117.2	17.00

PLAN 2 STATION 1.0

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	2924.	114.6	17.00

PLAN 1 STATION 4.2

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	4026.	108.4	17.33

PLAN 2 STATION 4.2

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	2773.	106.9	17.33

PLAN 1 STATION 8.0

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	3816.	98.3	17.50

PLAN 2 STATION 8.0

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	2667.	97.5	17.67

PLAN 1 STATION 11.6

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	3595.	99.9	17.83

PLAN 2 STATION 11.6

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	2557.	89.2	18.00

PLAN 1 STATION 15.9

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	3103.	81.2	18.50

PLAN 2 STATION 15.9

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	2267.	80.7	18.67

PLAN 1 STATION 190

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	3052.	77.1	18.67

PLAN 2 STATION 190

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.50	2247.	76.4	18.83