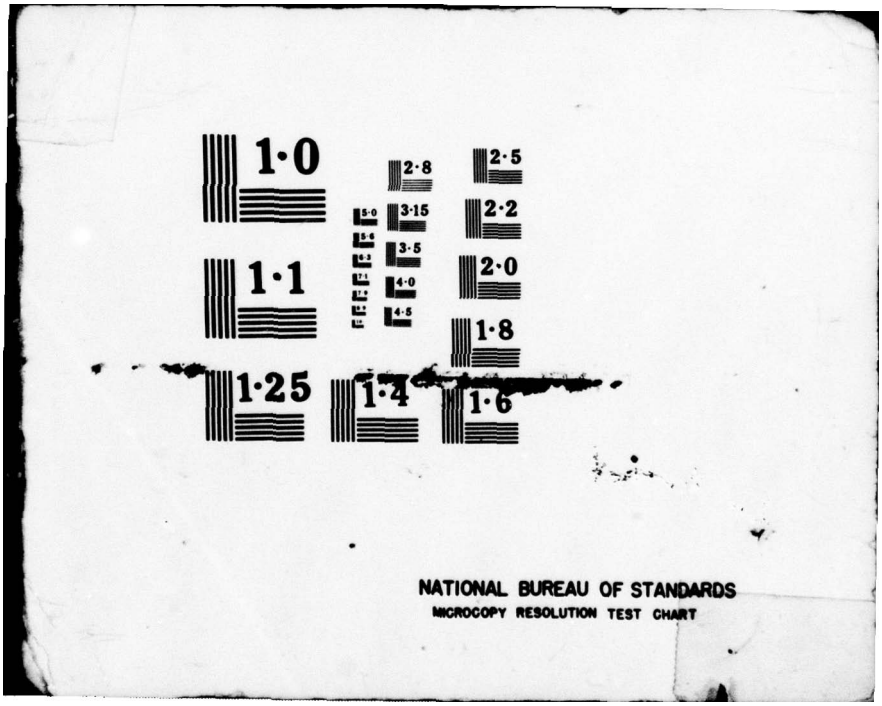
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DELAWARE RIVER BASIN

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NEW JERSEY

LEVEL II

CENTENNIAL LAKE DAM
NJ 00424

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM.

Centennial Lake Dam (NJ 00424). Delaware River Basin, Haynes Creek Tributary, Burlington County, New Jersey. Phase 1 Inspection Report.



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(9) Final rept.,
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Centennial Lake Dam Burlington, County, N.J.		5. TYPE OF REPORT & PERIOD COVERED FINAL 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Richard J. McDermott, P.E.		8. CONTRACT OR GRANT NUMBER(s) DACW61-78-C-0124
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	Safety
Embankments	Visual Inspection
Dam Crest	National Dam Inspection Act Report
Structural Analysis	Centennial Lake Dam, N.J.

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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15 MAY 1979

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

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Centennial Lake Dam in Burlington 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, Centennial Lake Dam, a high hazard potential structure, is judged to be in fair overall condition. However, the spillway is considered seriously inadequate since 19 percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam. 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 three 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 operation 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 analysis should be performed to determine the dam's embankment condition and structural stability. This should include test borings to determine material properties relative to stability. Any remedial measures found necessary should be initiated within calendar year 1980.

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

(1) All trees and brush on the earthfill embankment should be cut off at ground level and removed with minimal disturbance of the embankment surface.

(2) Eroded and bare areas along the upstream and downstream embankment slopes should either be stabilized and treated so as to support the growth of ground cover vegetation or riprapped in the near future. Positive drainage should be provided along the crest road.

(3) The depressed areas along the dam crest should be filled with suitable material to develop a continuous level dam crest or as an alternative the downstream slope in these areas should be paved with asphalt or concrete to protect these areas during periods of overflow.

(4) An improved securing mechanism should be provided for the slide gate wheel.

d. Within one year from the date of approval of this report the submerged portion of the timber box spillway and the discharge culvert should be inspected closely and repaired as necessary.

e. Since the annual lowering of the lake does not completely expose the dam and appurtenances, the lake should be drained at least once every five years for the purpose of removing sediment at the spillway and to permit complete inspection and repair of the dam and appurtenances.

f. The owner of the dam should initiate a formal program of annual inspection and maintenance in the near future. The inspections should be recorded on standardized check-list forms. Inspection check-lists, complete records of maintenance, and design calculations and construction drawings for changes made to the dam and appurtenances should be included in a permanent file. Repairs should be performed as required and the following maintenance should be performed annually: remove brush and trees from the embankment and clear debris from the spillway openings and the downstream channel.

g. A topographic survey of the dam and vicinity should be made.

h. The present informal warning system should be formalized with a written procedure for monitoring and operating the facility with specific responsibilities assigned to personnel involved.

NAPEN-D
Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Edwin B. Forsythe of the Sixth District. Under the provisions 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,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
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P. O. Box CN029
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John O'Dowd, Acting Chief
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Trenton, NJ 08625

CENTENNIAL LAKE DAM (NJ00424)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 19 December 1978 by Storch Engineers 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.

Centennial Lake Dam, a high hazard potential structure, is judged to be in fair overall condition. However, the spillway is considered seriously inadequate since 19 percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam. 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 three 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 operation 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 analysis should be performed to determine the dam's embankment condition and structural stability. This should include test borings to determine material properties relative to stability. Any remedial measures found necessary should be initiated within calendar year 1980.

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

(1) All trees and brush on the earthfill embankment should be cut off at ground level and removed with minimal disturbance of the embankment surface.

(2) Eroded and bare areas along the upstream and downstream embankment slopes should either be stabilized and treated so as to support the growth of ground cover vegetation or riprapped in the near future. Positive drainage should be provided along the crest road.

(3) The depressed areas along the dam crest should be filled with suitable material to develop a continuous level dam crest or as an alternative the downstream slope in these areas should be paved with asphalt or concrete to protect these areas during periods of overflow.

(4) An improved securing mechanism should be provided for the slide gate wheel.

d. Within one year from the date of approval of this report the submerged portion of the timber box spillway and the discharge culvert should be inspected closely and repaired as necessary.

e. Since the annual lowering of the lake does not completely expose the dam and appurtenances, the lake should be drained at least once every five years for the purpose of removing sediment at the spillway and to permit complete inspection and repair of the dam and appurtenances.

f. The owner of the dam should initiate a formal program of annual inspection and maintenance in the near future. The inspections should be recorded on standardized check-list forms. Inspection check-lists, complete records of maintenance, and design calculations and construction drawings for changes made to the dam and appurtenances should be included in a permanent file. Repairs should be performed as required and the following maintenance should be performed annually: remove brush and trees from the embankment and clear debris from the spillway openings and the downstream channel.

g. A topographic survey of the dam and vicinity should be made.

h. The present informal warning system should be formalized with a written procedure for monitoring and operating the facility with specific responsibilities assigned to personnel involved.

APPROVED: *James G. Ton*

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 7 May 79

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

IN REPLY REFER TO
NAPEN-D

30 MAR 1979

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

Dear Governor Byrne:

This is in reference to our ongoing National Program for Inspection of Non-Federal Dams within the State of New Jersey. Centennial Lake Dam (Federal I.D. No. NJ00424), a high hazard potential structure has recently been inspected. The dam is owned by the Centennial Land Development Company and is located on Taunton Lake, a tributary of Haynes Creek in Medford Lakes, Burlington County.

Using Corps of Engineers screening criteria, it has been determined that the dam's spillway is seriously inadequate since approximately 19 percent of the Probable Maximum Flood would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise, or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard potential to loss of life downstream from the dam. As a result of this UNSAFE determination, it is recommended that the dam's owner take the following measures within 30 days of the date of this letter:

a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.

b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, round-the-clock surveillance should be provided during periods of unusually heavy precipitation.

NAPEN-D
Honorable Brendan T. Byrne

A final report on this Phase I Inspection with a detailed analysis of the situation, will be forwarded to you within two months.

Sincerely,

Joel Kollbon LTC

JAMES G. TON
Colonel, Corps of Engineers
for District Engineer

Cy Furn:
Dirk C. Hofman, Actg. Deputy Director
Division of Water Resources
N.J. Dept of Environmental Protection
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UNSAFE DAM
NATIONAL PROGRAM OF INSPECTION OF DAMS

a. NAME: CENTENNIAL LAKE DAM

b. ID NO.: NJ00424

c. LOCATION State: New Jersey County: Burlington
River or Stream: Tributary to Haynes Creek
Nearest D/D City or Town: Taunton Lake

d. HEIGHT: 18 feet

e. MAXIMUM IMPOUNDMENT CAPACITY: 998 ac. ft.

f. TYPE: Earth Fill

g. OWNER: Centennial Land Development Co.

h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 30 Mar 79

i. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT
Preliminary report calculations indicate 19% of PMF would overtop the dam.

j. URGENCY CATEGORY: UNSAFE, Non-Emergency

j. DESCRIPTION OF DANGER INVOLVED: Overtopping and failure of the dam significantly increases hazard potential to loss of life and property downstream of dam.

m. EMERGENCY ACTIONS TAKEN:
Governor notified of this condition by District Engineer's letter of 30 Mar 79

n. REMEDIAL ACTIONS TAKEN:
NJDEP will notify dam's owner upon receipt of our letter.

k. RECOMMENDATIONS GIVEN TO GOVERNOR:
Within 30 days of date of District Engineer letter the owner do the following:
a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.

b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, round-the-clock surveillance should be provided during periods of unusually heavy precipitation.

o. REMARKS: Final Report, to be issued within six weeks, will have WHITE cover.

W.H. Zink 3/30/79

W. H. ZINK, Coordinator
Dam Inspection Program
U.S.A.E.D., Philadelphia

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Centennial Lake Dam, NJ00424
State Located:	New Jersey
County Located:	Burlington
Drainage Basin:	Delaware River
Stream:	Tributary to Haynes Creek
Date of Inspection:	December 19, 1978

Assessment of General Condition of Dam

Information available for this study is adequate for a Phase I assessment. Based on available records, past operational performance, a visual inspection and Phase I engineering analyses, Centennial Lake Dam is in fair overall condition, and outwardly structurally stable, however the hydraulic capacity of the spillway is seriously inadequate. The SDF (Spillway Design Flood) for Centennial Lake Dam is 1/2 PMF. The spillway at the dam is capable of passing 18% of the PMF.

Unsatisfactory conditions observed at the dam consist of trees and brush growing on the embankment, eroded and bare areas along the embankment slopes, one foot deep depressed areas in the paved crest road at each end of the dam and an inadequate securing mechanism for the gate wheel. Reportedly, in the past holes and depressions have developed in the embankment as a result of loss of soil from above the joint between the brick arch and corrugated metal arch.

It is recommended that the following remedial measures be undertaken by the owner in the near future.

1. All trees and brush on the earthfill embankment should be cut off at ground level and removed with minimal disturbance of the embankment surface.

2. Eroded and bare areas along the upstream and downstream embankment slopes should either be stabilized and treated so as to support the growth of ground cover vegetation or riprapped in the near future. Positive drainage should be provided along the crest road.

3. The depressed areas along the dam crest should be filled with suitable material to elevation 66, so as to develop a continuous level dam crest or as an alternative the downstream slope in these areas should be paved with asphalt or concrete to protect these areas during periods of overflow.

4. An improved securing mechanism should be provided for the slide gate wheel.

The owner of the dam should initiate a formal program of annual inspection and maintenance in the near future. The inspections should be performed by a qualified professional engineer and the observations and measurements should be recorded on standardized check-list forms. Inspection check-lists, complete records of maintenance and design calculations and construction drawings for changes made to the dam and appurtenances should be included in a permanent file, available for public inspection.

Repairs should be performed as required and the following maintenance should be performed annually: remove brush and trees from the embankment and clear debris from the spillway openings and the downstream channel.

Since the annual lowering of the lake does not completely expose the dam and appurtenances, the lake should be drained at least once every five years for the purpose of removing sediment at the spillway and to permit complete inspection and repair of the dam and appurtenances.

The present informal warning system should be formalized with a written procedure for monitoring and operating the facility with specific responsibilities assigned to personnel involved.

A qualified professional engineer should be engaged in the near future to perform a comprehensive dam stability analysis with special attention given to the discharge culvert joint. A topographic survey, borings and test probes should be performed as part of the stability analysis. In addition Taunton Lake (downstream of Centennial Lake Dam) should be drawn down so that the downstream toe of Centennial Lake Dam is exposed for inspection as part of the stability analysis. This inspection should be coordinated with the normal annual lowering of the lake if possible.

The submerged portion of the timber box spillway and the discharge culvert should be inspected closely in the future for distress or deterioration.

Richard J. McDermott

Richard J. McDermott, P.E.



OVERVIEW - CENTENNIAL LAKE DAM

19 DEC. 1978

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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. 30214. 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 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 the unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CENTENNIAL LAKE DAM I.D. NJ00424

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The Division of Water Resources of the New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

Centennial Lake Dam was inspected on December 19, 1978 to generally assess the operational adequacy and structural integrity of the dam and appurtenances.

1.2 Description of Project

a. Description of Dam and Appurtenances

The facilities at Centennial Lake Dam consist of an earthfill embankment with a timber box spillway (See Plate 4, Overview Photo and Photos 1 and 2). The spillway discharges into an arch culvert which extends through the embankment and outfalls into Taunton Lake at the downstream toe of the dam (See Photos 3, 4 and 10).

The earthfill embankment is approximately 300 feet long and extends east/west. The embankment crest width is about 37 feet with an asphalt paved roadway at its center, 21 feet wide (See Photo 9). Based on field measurements the upstream slope of the dam is approximately 1:1 and the downstream slope is about 1.5:1 (See Plate 6). Moderate vegetation consisting of low level ground cover, brush and trees, covers most of the upstream and downstream slopes of the embankment. There are depressed areas (one foot deep) in the dam crest at the east and west ends of the dam. There are several bare areas on the upstream and downstream slopes which apparently have been caused by poor crest road drainage. (See Photos 6, 7 and 8). Erosion of the upstream slope is also partly due to wave action.

The spillway consists of a timber box with a timber cover platform (See Plate 5). The lake discharges via overflow through five timber stoplog controlled openings. Three openings are located on the south face of the timber structure. The center opening is connected by a timber chamber to a manual slide gate, which discharges into the

discharge culvert under the embankment. The remaining openings in the south face plus the two openings, one on each of the east and west faces of the spillway, serve as controlled overflow weirs discharging into the arch culvert.

The discharge culvert consists of approximately 25 feet of brick arch (upstream) and 20 feet of corrugated metal pipe arch (downstream). The culvert discharges directly into Taunton Lake at the downstream toe of the embankment.

b. Location

Centennial Lake Dam is located in the Medford Lakes section of the Township of Medford, Burlington County, New Jersey (See Plates 1 and 2). Discharge from Centennial Lake enters Taunton Lake, a tributary of Haynes Creek.

c. Size and Hazard Classification

Lands immediately surrounding Centennial Lake are generally privately owned and contain moderate residential development. There are two lakes downstream from Centennial Lake Dam that are directly effected by Centennial Lake discharge, Taunton Lake and Lake Pine. Both downstream lakes have substantial residential development along their shorelines.

Size and hazard classification criteria presented in "Recommended Guidelines for Safety Inspection of Dams," published by the U. S. Army Corps of Engineers are as follows:

SIZE CLASSIFICATION

	IMPOUNDMENT	
Category	Storage (Ac-Ft)	Height (Ft)
Small	<1000 and ≥ 50	<40 and ≥ 25
Intermediate	≥ 1000 and $<50,000$	≥ 40 and <100
Large	$\geq 50,000$	≥ 100

HAZARD POTENTIAL CLASSIFICATION

Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
Low	None expected (No permanent structures for human habitation	Minimal (Undeveloped to occasional structures or agriculture)
Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than few	Excessive (Extensive community, industry or agriculture)

The characteristics of Centennial Lake Dam are:

Storage = 887 acre-feet (at top of dam)

Height = 18 feet

Potential Loss of Life: Approximately 40 residential dwellings along shore of Taunton Lake (immediate downstream) within the SDF flood plain.

Potential Economic Loss: Flooding of residential and commercial development in the downstream area.

Therefore, Centennial Lake Dam is classified as "small" size with "high" hazard potential.

d. Ownership

Centennial Lake Dam is owned by the Centennial Land Development Company, 30 Springdale Rd., Cherry Hill, N.J. 08003.

e. Purpose of the Dam

Centennial Lake Dam impounds a recreational lake used by land owners adjoining the impoundment. This use is consistent with the "Application for Permit for Construction or Repair of Dam made by the Centennial Land Development Company in 1955.

f. Design and Construction History

No drawings or design calculations are available for the original construction of the dam. Reportedly, the dam was constructed to impound cranberry bogs in 1876.

Reconstruction work was performed on the dam and spillway in 1954. The embankment crest was raised one foot, the spillway was reconstructed and the discharge culvert was extended downstream. The work was inspected on November 30, 1954 by New Jersey Division of Water Policy and Supply (NJDWPS) Engineer W.E. Edens.

g. Normal Operational Procedures

The operation of the spillway facilities at Centennial Lake Dam is coordinated and for the most part performed by the Civil Defense Director of the Township of Medford.

Maintenance at Centennial Lake Dam is usually performed "as-needed" by the Burlington County Road Department or the Township of Medford, in cooperation with the owner. Regular maintenance consists of the following: lowering the water level each spring to permit repair of docks, cleaning of beaches and inspection and repair of the dam and appurtenances. Occasionally fill and sod is placed on the embankment slopes to restore and stabilize eroded areas.

1.3 Pertinent Data

a. Drainage Area = 7.3 square miles

b. Maximum known flood at dam site	Nearly overtopped in 1967
Outlet works at pool elevation	68
Diversion tunnel low pool outlet at pool elevation	N.A.
Diversion tunnel outlet at pool elevation	N.A.
Gated spillway capacity at pool elevation	0 cfs
Gated spillway capacity at top of dam (Elev. 65.0)	324 cfs
Total spillway capacity at top of dam (Elev. 65.0)	324 cfs

c. Elevation (ft. above MSL)

Top of dam	65.0 (depressed areas) 66.0 (remainder of crest)
Maximum pool design surcharge	67.1
Full flood control pool	N.A.
Recreation pool	59.6
Spillway crest	59.6
Upstream portal invert diversion tunnel	N.A.
Stream bed at center line of dam	47.9
Maximum tail water	60.5 (estimated)

d. Reservoir

Length of maximum pool	5700 ft.
Length of recreational pool	5000 ft.
Length of flood control pool	N.A.

e. Storage (Acre-Feet)

Spillway pool	334
Recreation pool	334
Flood control pool	N. A.
Maximum design surcharge	940
Top of dam (65.0,depressed areas)	701

f. Reservoir Surface (acres)

Spillway crest	52.8
Recreation pool	52.8
Maximum design surcharge	102
Top of dam	88

g. Dam

Type	Earthfill
Length	300 feet
Height	18.1 feet
Side slope - Upstream	1 horiz. to 1 vert.
- Downstream	1.5 horiz. to 1 vert.
Impervious core	Unknown
Cut-off	Timber sheeting adjacent to spillway
Grout curtain	Unknown

h. Diversion and Regulating Tunnel — N.A.

i. Spillway

Type	Timber box with 4 weir openings
Length of weir	10.7 ft. (4 openings)
Crest elevation	+59.6
Gates	Stoplogs
Upstream Channel	N.A.
Downstream channel	Discharge culvert(Brick arch and CMPA)

j. Regulating Outlets

A 24" X 24" manual timber slide gate and stoplogs on center opening of spillway as shown in 1954 reconstruction drawing. Reportedly, a 30" X 30" manual stainless steel slide gate and stoplogs on center opening of spillway. The new gate wheel and stainless steel stem were observed during the field inspection, but the size of the gate could not be confirmed.

SECTION 2: ENGINEERING DATA

2.1 Design

Design calculations and construction drawings were not available for the original dam construction. The dam was reconstructed in 1954. One construction drawing is on file with the NJDEP. This drawing indicates reconstruction work consisting of:

1. Installation of new creosoted horizontal timber sheeting and bracing in the spillway,
2. Raising of the embankment crest (1 foot),
3. Timber sheet pile cutoff walls between the outside of the spillway and the discharge culvert on upstream embankment slope.
4. Extension of the arch culvert downstream.

2.2 Construction

There are no records of the original construction of the dam in the in the NJDEP file. Reportedly, the dam was constructed in 1876 to impound cranberry bogs.

The 1954 reconstruction drawing in the NJDEP file contains as-built information for the timber box spillway openings. The dam reconstruction was inspected by NJDWPS Engineer, W. E. Edens on November 30, 1954. The inspection report indicates that the work performed up to the report date consisted of reconstruction of the timber box spillway. Work to be performed subsequent to the inspection consisted of raising the embankment crest, installing the sheet pile cutoff wall and installing the downstream corrugated pipe arch section.

2.3 Operation

No records of operation of the dam have been kept by the owner. Generally, the lake level is lowered a few feet annually in early spring to permit repair of the docks and bulkheads along the shoreline. The lake is permitted to function naturally throughout the rest of the year and is naturally regulated by uncontrolled overflow at the spillway.

The dam was inspected on July 20, 1966 by NJDWPS Engineer, C.D. Gilman. This inspection was made in response to requests by local residents. The inspection report in the NJDEP file indicates that the dam was in good condition. It was also noted in this report that the dam could be altered to accommodate a 50-year flood (South Jersey Curve) by providing an emergency spillway at the east end of the dam.

Based on calculations in Appendix 4, and experience at the dam, the total drawdown of the lake would take approximately 4 days. The slide gate controlling discharge from the center opening of the principal spillway is used to lower the lake level. This gate is generally used to augment overflow discharge during severe storms and stoplogs are removed from the other four openings.

2.4 Evaluation

a. Availability

Limited engineering information was available from the NJDEP file. This file contains one construction drawing, the "Application for Permit for Construction or Repair of Dam" for the 1954 reconstruction, two dam inspection

reports, dated November 30, 1954 and July 20, 1966 and miscellaneous correspondence. This information is on microfiche and is available for inspection at the offices of the Bureau of Flood Plain Management, 1474 Prospect Street, Trenton, N. J.

A representative of the Centennial Land Development Company indicated that there are no formal records for operation and construction at Centennial Lake Dam.

b. Adequacy

Available engineering data pertaining to Centennial Lake Dam and appurtenances is not adequate to be of significant assistance to the performance of a Phase I assessment.

c. Validity

Based on the findings of the field inspection, the information contained in the NJDEP file on Centennial Lake Dam is essentially accurate with respect to the as-built conditions at the site.

SECTION 3: VISUAL

3.1 Findings

a. General

Centennial Lake Dam was inspected on December 19, 1978 and March 8, 1979 by members of the staff of Storch Engineers. A visual inspection check list containing information collected during the field inspections is contained in Appendix 1. The following procedures were employed for the inspection:

1. The embankment, appurtenant structures, and adjacent areas were examined.

2. The embankment and accessible appurtenant structures were measured and key elevations were determined by hand level.

3. The embankment, appurtenant structures and adjacent areas were photographed.

Information presented in the following portions of this Section of the report consists of observations made during the field inspections.

b. Dam

The earthfill embankment and spillway appeared to be in good condition with no localized depressions, wildlife burrows or other signs of distress. Most of the upstream and downstream slopes were covered with extensive vegetation

consisting of low ground cover, brush and trees. Several localized eroded areas were noted on the slopes. These areas were apparently the result of poor crest road drainage on the upstream and downstream slope and wave action during high water levels on the upstream slope. No seepage was observed.

Depressed areas were observed in the embankment crest at the east and west ends. These areas were 1 foot deep (bottom elevation 65) with triangular cross sections and about 50 feet wide at elevation 66. Reportedly, these areas were intended as emergency overflow areas.

An 18 inch diameter storm drain outfall with a concrete headwall was observed on the east side of the downstream channel about 10 feet north of the toe of the dam. (See Plate 4 and Photo 5).

Generally, soils at the dam site are composed of unconsolidated stratified silty sand and narrowly graded sand of marine origin. These deposits, known as Kirkwood Sands, were formed during the Tertiary Period and extend for a considerable depth. The lake basin contains significant surficial organic matter, silt and sand with some clay. Bedrock is more than 100 feet below the surface.

Spillway

The exposed portion of the timber box structure was generally in good condition. The submerged and buried portions were not inspected. The spillway was essentially in accordance with the as-built information on the 1954

reconstruction drawing. It was noted however, that all of the openings except the center opening on the south face of the spillway structure had been reduced in height from the 3 feet indicated on the 1954 reconstruction drawing to 2.4 feet. Apparently, an additional stoplog has been placed in these spillway openings. The center opening on the south face of the structure was still 3-feet high as indicated on the 1954 reconstruction drawing.

Auxiliary Spillways

Two 18 inch diameter corrugated metal pipes located 123 feet east and 46 feet west of the center line of the principal spillway were described in the "Application for Permit for Construction or Repair of Dam" in the 1954 reconstruction and the dam inspection reports prepared by NJDWPS engineers on November 30, 1954 and July 20, 1966. No evidence of these pipes was found during the inspection performed on December 19, 1978, or during the follow-up inspection on March 8, 1979.

Outlet Works

Water passing through the center opening of the principal spillway enters a timber chamber which is controlled by a manual slide gate. The slide gate opening permits discharge from the chamber to the arch culvert. The gate wheel was readily accessible from the timber platform on top of the timber box spillway. The lift mechanism and the stainless steel stem were in good condition. The securing mechanism for the slide gate consisted of a light duty chain extending from a gate wheel to the adjacent timber railing, which is considered to be inadequate. The mechanism was not tested.

At the time of the inspection the slide gate controlling the center opening was closed.

Discharge Culvert

Overall the discharge culvert was in good condition with no noticeable deterioration. The timber post and the joint at the center of the culvert between the two sections were observed but were not accessible and therefore could not be inspected closely.

The upstream section of the culvert consists of a brick arch section 7.3 feet high by 9.1 feet wide. The downstream culvert section consists of a corrugated metal pipe arch 8.5 feet high by 8.5 feet wide.

d. Reservoir Area

Centennial Lake is approximately 5,000 feet long and varies in width from about 300 feet at the dam to about 1200 feet at the widest point. The immediate shore line contains residential development.

Most of the Centennial Lake drainage area is flat and swampy. The area surrounding the lake slopes gradually upward away from the lake to a maximum relief of approximately 120 feet above the normal pool elevation. There are numerous docks and bulkheads in the residentially developed areas along the lake shore. There are also recreational beach areas along the shore.

e. Downstream Channel

The spillway and the outlet works discharge through the arch culvert directly into Taunton Lake. Flow discharging from the culvert was unobstructed.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The water level in Centennial Lake is naturally controlled by overflow through the spillway. The center section of the spillway is used to lower the lake. The lake level is lowered several inches in anticipation of intense storms by Township of Medford officials. Reportedly, the lake level is observed closely during these periods. These activities are coordinated with upstream and downstream lakes so as to accommodate large discharges from one lake to another.

The lake level is generally lowered a few feet in the early spring to repair and maintain docks and beaches.

4.2 Maintenance of the Dam

There is no regular maintenance or inspection procedures for the dam and appurtenances. Maintenance is performed "as-needed" by the Burlington County Road Department and the Township of Medford in cooperation with the owner. Overall conditions at the dam are observed by local officials at least weekly. Reportedly, occasional comprehensive inspections are made during periods when the lake is completely drawn down.

There has been no maintenance documentation for the dam. However, verbal accounts indicate almost annual repairs to the crest road and side slopes consisting of filling of road drainage related erosion, and placing of sod on the side slopes.

Past experience has shown that the joint between the brick arch culvert and corrugated metal pipe arch is an area of potential weakness. Differential movement and loss of soil from above the culvert has been experienced and large holes in the embankment crest and the road have developed. Repair work performed consists of patching the joint with mortar and filling the holes and depressions with available material.

4.3 Maintenance of Operating Facilities

Maintenance documentation for operating facilities at Centennial Lake Dam has been poor. Reportedly, no additional work has been performed on the timber box spillway since the 1954 reconstruction. It has been reported that the slide gate controlling the center section of the principal spillway was replaced in 1976 with a new 30" X 30" slide gate consisting of a stainless steel gate and lifting mechanism. A new gate wheel and stainless steel stem were observed during the field inspection.

4.4 Description of Warning System

The warning system for Centennial Lake Dam consists of frequent observation of the lake level by the Civil Defense Director, as often as hourly during intense storms and close coordination with upstream and downstream dams. This procedure is not written, but has been established through long past experience of municipal officials.

The system was found to be inadequate at one time in the recent past. In 1958 an intense storm caused the dam at Marlton Lakes (upstream) to breach. This dam is not in the

Township of Medford and is not monitored by the above system. The breach outflow from Marlton Lakes caused dams at Packowango, the Girl Scout Camp and Bradocks Mill to breach. The flood flow was stopped at Centennial Lake Dam.

4.5 Evaluation of Operational Adequacy

The dam and appurtenances at Centennial Lake have performed satisfactorily since reconstruction in 1954 with no overtopping or breaching.

There has been poor maintenance documentation for this dam, however maintenance has apparently been adequate to sustain the earthfill embankment and appurtenant structures.

The informal warning system that has been developed over the years has served adequately since 1958. However, it probably would not be adequate, sould a storm of magnitude equal to the SDF occur.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

Size and hazard classification were used in conjunction with "Recommended Guidelines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers to establish the SDF (Spillway Design Flood) for Centennial Lake Dam. The appropriate design range for this facility is 1/2 PMF to PMF (Probable Maximum Flood). Since the characteristics of Centennial Lake Dam fall into the lower end of the prescribed classification range, 1/2 PMF is used as the SDF for Centennial Lake Dam. The peak SDF inflow rate for Centennial Lake is 1478 c.f.s. (See Appendix 4) as calculated by the Clark's Method and a synthetic time-area curve in the HEC-1-DB Flood Hydrograph Computer Program. This flow would result in overtopping and possible breach of the dam.

Drainage area (DA) and general hydrologic characteristics such as Surface Storage Index (S_t), Main Channel Slope (S) and Man-made Impervious Cover Index (I) were computed using USGS quadrangles. These data were used in conjunction with the following equations to determine the Clark's Method Paramenters (R and T_c):

$$R/T_c + R = 0.76$$

$$T_c + R = 21\ (DA/S)^{0.22}\ (S_t)^{0.33}\ \ (1 + 0.3I)^{-0.28}$$

The drainage area contributing to Centennial Lake Dam is 7.3 square miles. The watershed land use is generally undeveloped swamp, cranberry bogs and a golf course with substantial residential development along the lake shoreline. The reservoir storage capacities were estimated using available data and surface areas measured from USGS quadrangles. Storage at normal pool elevation is approximately 334 acre-feet.

Discharge hydraulics for Centennial Lake Dam were established using the standard sharp-crested weir formula and coefficients for the timber box spillway openings for water levels up to the platform. The submerged orifice formula and coefficients were used for water levels above the platform. The discharge culvert was analyzed and it was found that the spillway controls the discharge. (See Appendix 4 for Stage-Discharge Curve).

The SDF hydrograph was routed through the spillway facilities at Centennial Lake Dam using the HEC-1-DB Computer Program, and it was found that the dam would be overtopped. It was assumed that overtopping would develop in the depressed areas at the ends of the dam first and then would overflow the entire dam length. The two modes of overtopping were handled separately in the computer calculation. The computer output in Appendix 4 indicates that the overtopping condition over the entire dam would occur for 39 hours with a maximum flow height of 1.12 feet above the main dam crest (elev. 66) and a maximum non-breach discharge of 1393 c.f.s. It was also calculated that the existing spillway facilities are adequate for a maximum flow of 18 percent of the PMF without overtopping the dam.

The SDF routing referred to above does not include discharge via the slide gate controlled center opening in the spillway. It is clear from the calculations that opening the slide gate during the SDF would not alleviate dam overtopping.

b. Experience Data

Reportedly, Centennial Lake Dam has never been overtopped or breached. However, once in 1967 it appeared that the dam would be overtopped. The gate valve was opened and the crest was sandbagged. The additional discharge through the gate valve relieved the dam stage, but resulted in high water levels in Taunton Lake immediately downstream.

c. Visual Observation

At the time of the field inspection there was no evidence of past overtopping. Eroded areas were noted on the embankment side slopes, which were apparently due to poor crest road drainage on the upstream and downstream slope and wave action during high water levels on the upstream slope.

Based on field measurements, the weir openings with the exception of the center opening are 2.4 feet high. The crest elevation at all, but the center opening is 59.6 feet. The top of all the openings is at 62.0 feet. The embankment crest is at elevation 65.0 in the depressed areas the remainder of the crest is at elevation 66.0.

It was noted that flow passing through the depressed areas would erode the downstream slope of the embankment and on this basis was considered overtopping of the dam.

d. Overtopping Potential

As noted previously the SDF for Centennial Lake Dam would result in overtopping of the dam for about 39 hours with a maximum flow height of 1.12 feet in a non-breach condition. Further calculations indicate that storms greater than 18 percent of the PMF would result in overtopping of the dam.

Considering the type of dam (earthfill), overtopping of the magnitude caused by the SDF would probably cause breaching. It was assumed that one breach area would develop, and that it would start to develop after the entire structure is overtopped (water level above elevation 66). The assumed breach would result in the loss of about 40 percent of the dam crest length and would take approximately one hour to develop.

The breach at Centennial Lake Dam would yield a maximum discharge of about 12,400 c.f.s. Based on the HEC-1-DB analysis performed, Centennial Lake Dam would breach at the same time that Taunton Lake, immediately downstream, would be at its maximum non-breach (elev. 56.8), assuming the dam on Taunton Lake does not breach. As can be seen from the plotting of stage vs. time in Appendix 4, the breach would cause the downstream water level in Taunton Lake to rise 3.4 feet in one hour. This sudden breach induced rise would be superimposed on the already high downstream water level resulting in a maximum downstream stage of elevation 60.5.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

At the time of the field inspection, there were no signs of distress, subsidence or animal burrows in the dam or the spillway. There was no evidence of the two 18 inch diameter corrugated metal pipes referred to in the inspection reports and "Application for Permit for Construction of Repair of Dam" in the NJDEP file. In the event that these pipes are buried, they would constitute a "ready-made" seepage path and could cause localized areas of instability in the upper embankment side slopes.

No seepage was observed in the downstream area of the embankment, however the downstream toe of the embankment was submerged at the time of inspection. Eroded areas were observed along the upstream and downstream embankment slopes which were apparently a result of poor road drainage. Erosion along the upstream slope was also attibuted to wave action during periods of high lake levels.

The timber box spillway was generally in good condition. The submerged and buried portions were not inspected.

The inner section of the discharge culvert was not accessible and consequently was not closely inspected. The timber support at the upstream end of the corrugated metal pipe arch and the joint between the brick arch and corrugated metal arch were observed, but should be checked closely.

Considerable growth in the form of trees and brush exists on both the upstream and downstream embankment side slope. These trees and brush are undesirable and adversely effect the dam.

b. Design and Construction Data

Material on file with NJDEP does not contain design calculations or mathematical analysis of the structural stability of the dam. Accurate information with respect to the typical earthfill section is not available.

The timber sheet pile cutoff wall located between the outside of the spillway and the discharge culvert was installed during the 1954 reconstruction as an anti-seepage measure. There is no record of seepage rings along the arch culvert.

c. Operating Records

No formal records are available. However, verbal accounts indicate that the dam has never showed signs of any sort of structural instability. Eroded areas along the embankment slopes are filled and sodded on an almost annual basis.

Reportedly, the joint between the brick arch and the corrugated metal arch has opened in the past and soil above the joint was lost resulting in depressions and holes in the embankment crest. These areas were repaired by filling with available soil.

d. Post Construction Changes

According to the NJDEP files there have been no major changes in the dam or appurtenances since the 1954 reconstruction. This was verified during the field inspection.

e. Seismic Stability

Centennial Lake Dam is located in Seismic Zone 1 as is defined in "Recommended Guidelines for Safety Inspection of Dams," which is a zone of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions, if stable under static loading conditions. Based on the field inspection findings the dam appeared to be outwardly statically stable, however additional studies must be performed to establish the internal stability of the embankment in the vicinity of the discharge culvert joint, subsequent to this report.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on the hydraulic and hydrologic analyses described in Section 5 and Appendix 4 the spillway is capable of accommodating a maximum flow of 18 percent of the PMF without overtopping the dam. The hazard classification of the dam is high, as established in Section 1. Based on HEC-1-DB computer analyses performed for Centennial Lake Dam and the downstream lake (Taunton Lake), Centennial Lake Dam would most likely breach when Taunton Lake has reached a high stage. Breaching of Centennial Lake Dam would cause an additional rise in the Taunton Lake water level of 3.4 feet in one hour, above the already high stage in the lake. Consequently, failure of Centennial Lake Dam would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. The HEC-1-DB computer analysis also indicates that Centennial Lake Dam would not be capable of passing 1/2 PMF. Therefore, the spillway at Centennial Lake Dam is assessed as seriously inadequate.

The outward structural integrity of the dam appears to be adequate based on the field inspection. However, based on past experience at the dam, the joint between the brick arch and corrugated metal pipe arch is subject to differential movement and loss of soil from above the

joint, undermining the crest road. Future instability of the embankment is likely in this area, therefore additional study of the structural integrity of the embankment is necessary.

b. Adequacy of Information

Information sources for this study include: 1) field investigations, 2) the 1954 reconstruction drawing, "Application for Permit for Construction or Repair of Dam", dam inspection reports and miscellaneous correspondence in the NJDEP file, 3) USGS quadrangles, 4) aerial photographs from Burlington County and 5) consultation with the owner of Centennial Lake Dam and local officials.

Information and data collected for Centennial Lake Dam is sufficient for a Phase I assessment of the hydraulic capacity and structural integrity of the dam and appurtenances.

c. Necessity for Additional Data/Evaluation

Additional information in the form of a comprehensive topographic survey, borings and probes, seepage observations along the downstream toe of the dam, and a thorough investigation of the joint in the discharge culvert should be performed so as to permit an accurate analysis of dam stability, subsequent to the issuance of this report.

7.2 Recommendations

a. Remedial Measures

Based on hydraulic and hydrologic analyses performed for this report using the U.S. Army Corps of Engineers screening criteria, the spillway is "Seriously Inadequate." It is therefore recommended, that a qualified professional engineer be engaged soon to perform a more sophistacated and precise hydraulic and hydrologic analysis and design modifications to the dam and appurtenances as may be required so that the spillway will accommodate the SDF. The design analyses should consider the effects on the upstream and downstream areas and should be coordinated with similar studies to be performed in these areas.

It is further recommended that the following remedial measures be undertaken by the owner in the near future.

1. All trees and brush on the earthfill embankment should be cut off at ground level and removed with minimal disturbance of the embankment surface.

2. Eroded and bare areas along the upstream and downstream embankment slopes should either be stabilized and treated so as to support the growth of ground cover vegetation or riprapped in the near future. Positive drainage should be provided along the crest road.

3. The depressed areas along the dam crest should be filled with suitable material to elevation 66, so as to develop a continuous level dam crest or as an alternative the downstream slope in these areas should be paved with asphalt or concrete to protect these areas during periods of overflow.

4. An improved securing mechanism should be provided for the slide gate wheel.

The implementation of the above measures will require proper detailed design and the obtaining of applicable NJDEP approvals.

b. Maintenance

The owner of the dam should initiate a formal program of annual inspection and maintenance in the near future. The inspections should be performed by a qualified professional engineer and the observations and measurements should be recorded on standardized check-list forms. Inspection check-lists, complete records of maintenance, and design calculations and construction drawings for changes made to the dam and appurtenances should be included in a permanent file, available for public inspection.

Repairs should be performed as required and the following maintenance should be performed annually: remove brush and trees from the embankment and clear debris from the spillway openings and the downstream channel.

Since the annual lowering of the lake does not completely expose the dam and appurtenances, the lake should be drained at least once every five years for the purpose of removing sediment at the spillway and to permit complete inspection and repair of the dam and appurtenances.

The present informal warning system should be formalized with a written procedure for monitoring and operating the facility with specific responsibilities assigned to personnel involved.

c. Additional Studies

A qualified professional engineer should be engaged in the near future to perform a comprehensive dam stability analysis with special attention given to the area along the discharge culvert joint. A topographic survey, borings and test probes should be performed as part of the stability analysis. In addition Taunton Lake (downstream of Centennial Lake Dam)should be drawn down so that the downstream toe of Centennial Lake Dam is exposed for inspection as part of the stability analysis. This inspection should be coordinated with the normal annual lowering of the lake if possible.

The submerged portion of the timber box spillway and the discharge culvert should be inspected closely in the future for distress or deterioration.

PLATES

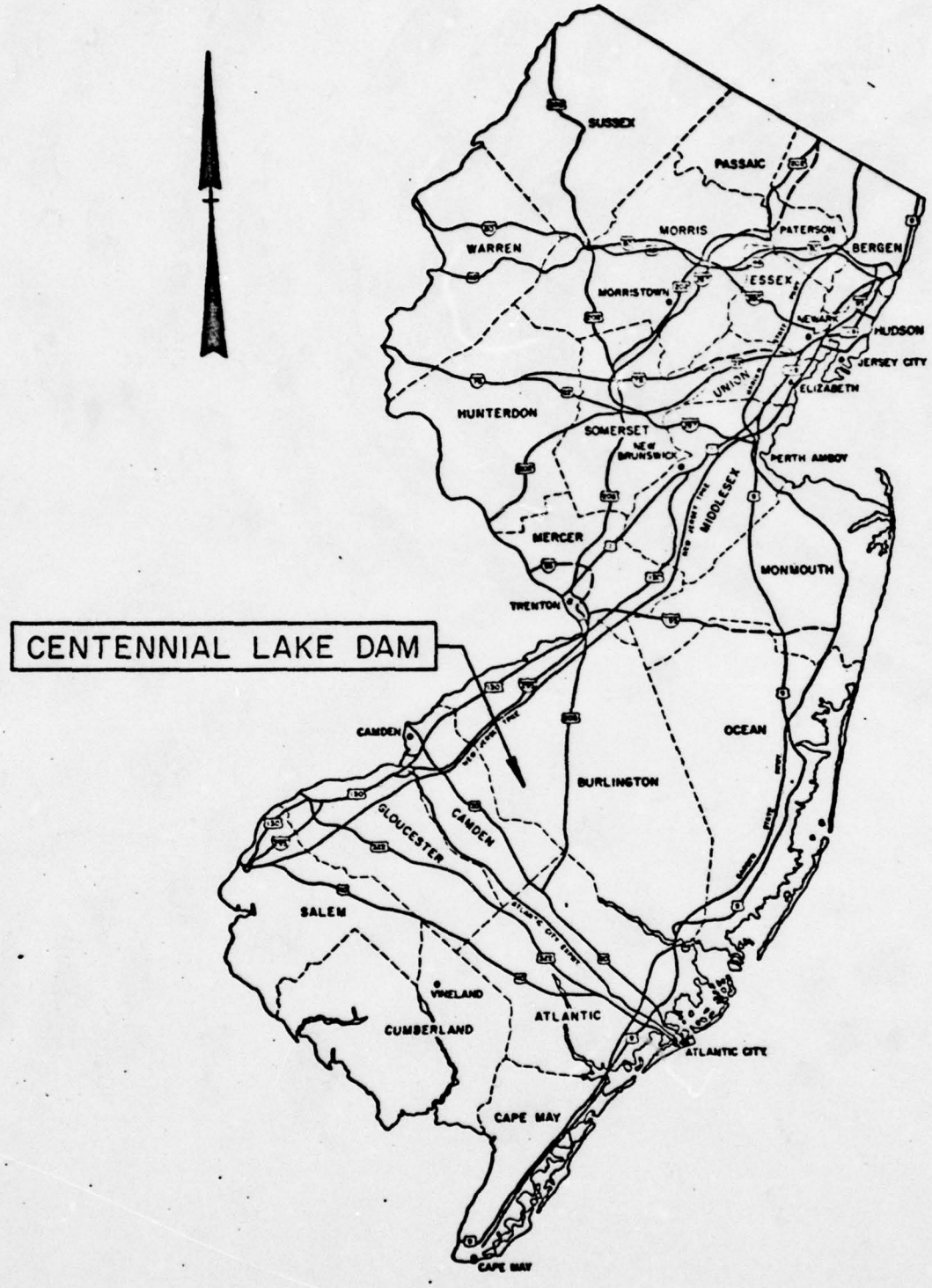


PLATE 1

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

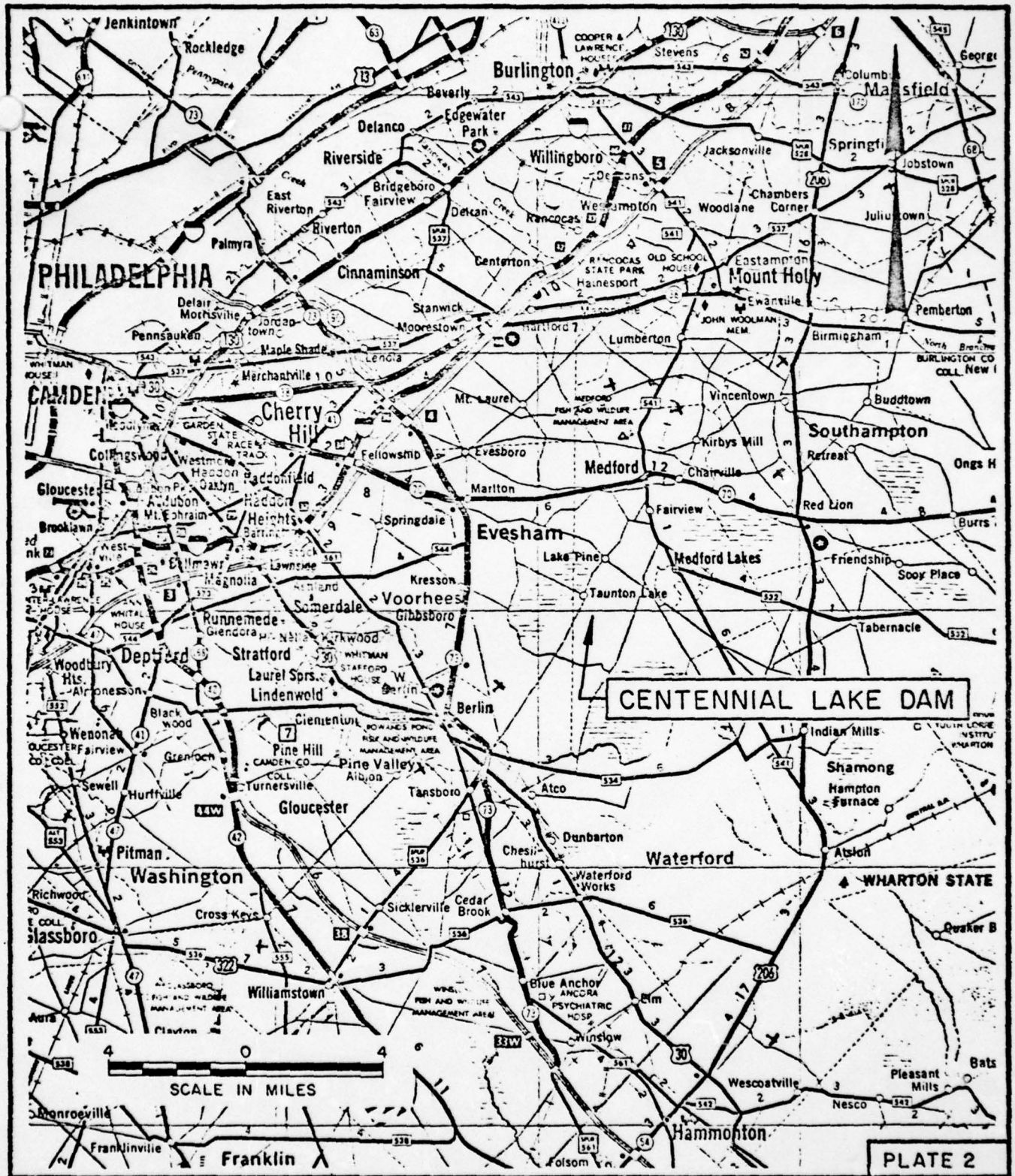
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

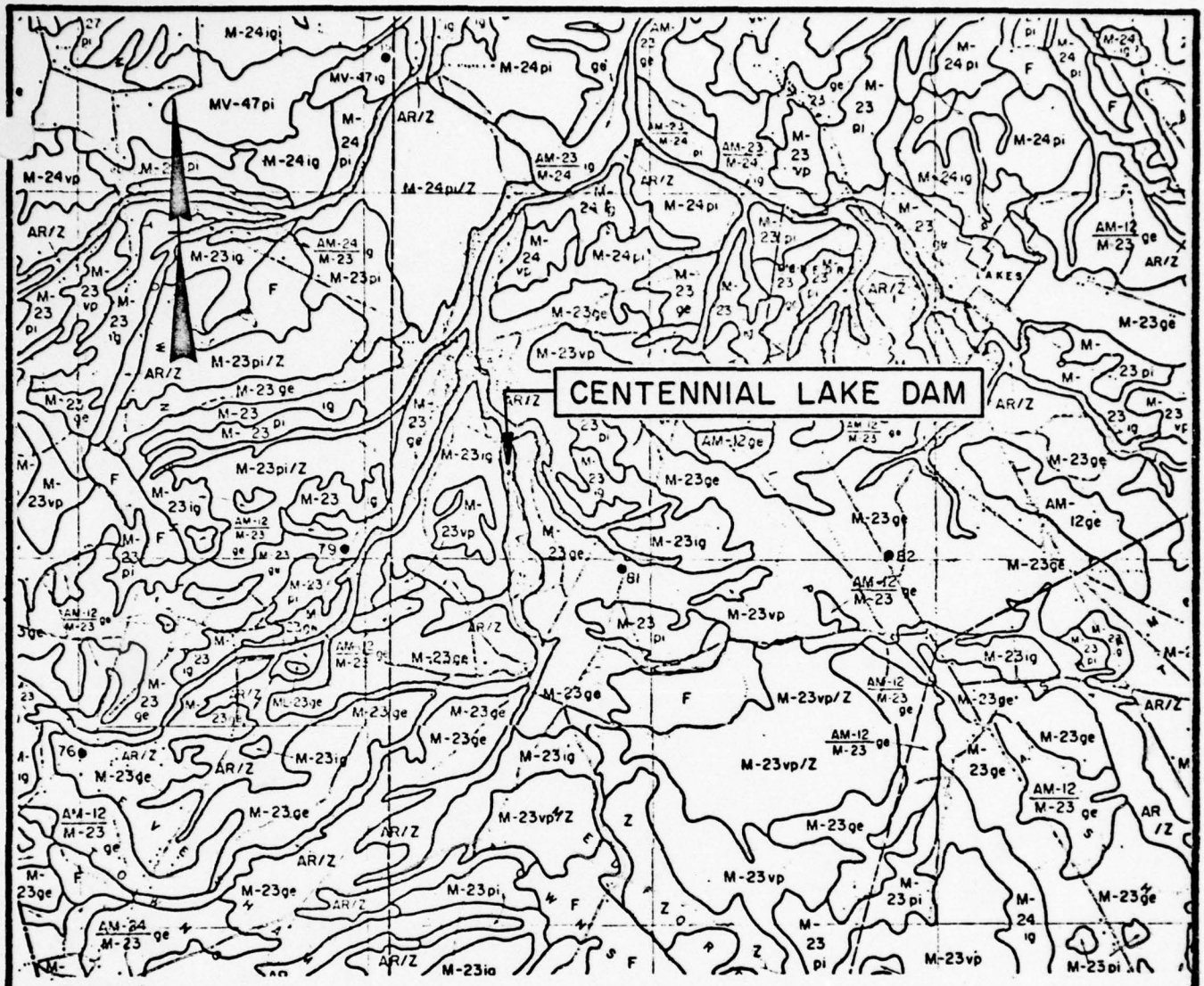
INSPECTION AND EVALUATION OF DAMS

KEY MAP

CENTENNIAL LAKE DAM

I.D. N.J. 00424	SCALE: NONE
	DATE: MARCH, 1979


CENTENNIAL LAKE DAM
PHILADELPHIA
CAMDEN
Burlington
Mount Holly
Evesham
Medford
Voorhees
Cherry Hill
Washington
Gloucester
Waterford
Southampton
Lumberton
Pemberton
Jenkintown
Rockledge
Beverly
Delanco
Riverside
Willingboro
Edgewater Park
Riverton
Palmyra
Cinnaminson
Delran
Centerton
Moorestown
Mt. Laurel
Evesboro
Marlton
Springdale
Fellowship
Maple Shade
Merchantville
Pennsauken
Collingswood
Haddonfield
Haddon Heights
Lindenwold
Stratford
Runnemede
Somerdale
Kresson
Gibbsboro
Lake Pine
Taunton Lake
Medford Lakes
Fairview
Chairville
Vincentown
Kirbys Mill
Retreat
Red Lion
Friendship
Tabernacle
Indian Mills
Shamong
Hampton Furnace
Atco
Tansboro
Berlin
Pine Hill
Pine Valley
Turnersville
Sicklerville
Cedar Brook
Waterford Works
Chesilhurst
Dunbarton
Atsion
Blue Anchor
Elm
Winslow
Williamstown
Cross Keys
Richwood
Sewell
Hurffville
Pitman
Woodbury Hts.
Deptford
Wenonah
Clementon
Barnsboro
Wescoatville
Pleasant Mills
Nesco
Hammonton
Franklin
Franklinville
Monroeville
Aura
Folsom
Buddtown
Southampton
Ongs H
Burrs
Soor Place
Jacksonville
Springfield
Jobstown
Woodlane
Chambers Corner
Eastampton
Ewanville
Birmingham
Stevens
Columbus
Mansfield
Edgewater Park
Bridgeboro
Fairview
East Riverton
Riverton
Delran
Rancocas
Westampton
Haines port
Stanwick
Hartford
Lenola
Merchantville
Maple Shade
Pennsauken
Delair
Morrisville
Jordantown
Gloucester
Audubon
Mt. Ephraim
Brooklawn
Barrington
Oaklyn
Westmont
Magnolia
Lawnside
Ashland
Kirkwood
Whitman Stafford House
Berlin
Blackwood
Clementon
Pine Hill
Camden Co. Coll.
Atco
Shamong
Hampton Furnace
Indian Mills
Tabernacle
Taunton Lake
Lake Pine
Medford Lakes
Friendship
Soor Place
Red Lion
Burrs
Fairview
Chairville
Vincentown
Kirbys Mill
Retreat
Southampton
Buddtown
Ongs H
Pemberton
Birmingham
Lumberton
Ewanville
Eastampton
Mount Holly
Woodlane
Chambers Corner
Jacksonville
Springfield
Jobstown
Julius town
Columbus
Mansfield
Stevens
Cooper & Lawrence House
Old School House
Rancocas State Park
John Woolman Mem.
Medford Fish and Wildlife Management Area
Rowands Pond Fish and Wildlife Management Area
Whitman House
Whitall House
Garden State Race Track
Wharton State
Quaker B
Bats
Pleasant Mills
Nesco
Wescoatville
Hammonton
Folsom
Franklin
Franklinville
Monroeville
Aura
Clayton
Williamstown
Winslow
Blue Anchor
Ancora Psychiatric Hosp.
Elm
Waterford
Waterford Works
Chesilhurst
Dunbarton
Atsion
Sicklerville
Cedar Brook
Cross Keys
Richwood
Sewell
Hurffville
Pitman
Washington
Gloucester
Turnersville
Barnsboro
Pine Valley
Pine Hill
Clementon
Blackwood
Wenonah
Fairview
Glendora
Runnemede
Somerdale
Kresson
Voorhees
Gibbsboro
Deptford
Woodbury Hts.
Laurel Spgs.
Lindenwold
Stratford
Haddonfield
Haddon Heights
Collingswood
Gloucester
Brooklawn
Springdale
Evesham
Marlton
Evesboro
Fellowship
Mt. Laurel
Moorestown
Centerton
Cinnaminson
Delair
Morrisville
Jordantown
Maple Shade
Merchantville
Pennsauken
Riverton
East Riverton
Palmyra
Riverside
Delanco
Bridgeboro
Fairview
Edgewater Park
Beverly
Burlington
Rockledge
Jenkintown
Pennypack
Delran Creek
Rancocas Creek
Assiscunk Creek
Rancocas
Westampton
Haines port
Stanwick
Hartford
Lenola
Vincentown
Buddtown
Southampton
Ongs H
Burrs
Soor Place
Friendship
Tabernacle
Indian Mills
Shamong
Hampton Furnace
Atco
Tansboro
Berlin
Pine Hill
Pine Valley
Turnersville
Sicklerville
Cedar Brook
Waterford Works
Chesilhurst
Dunbarton
Atsion
Blue Anchor
Elm
Winslow
Williamstown
Cross Keys
Richwood
Sewell
Hurffville
Pitman
Washington
Gloucester



Legend

M-23 — Unconsolidated stratified silty sand and narrowly graded sand of marine origin (Kirkwood Sands).

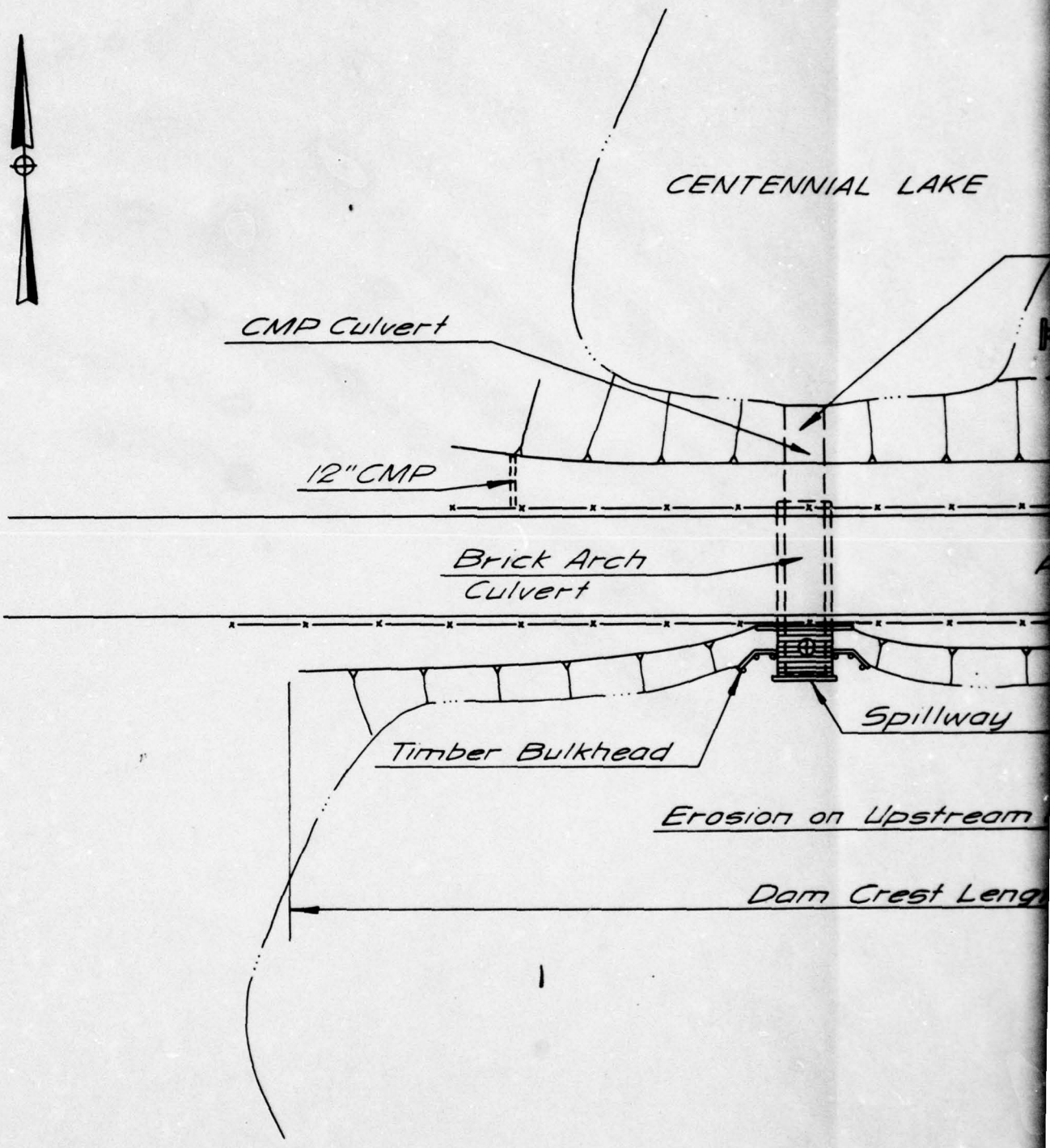
AR/Z — Silt and sand, with some clay and significant organic matter near the surface.

Note

Information taken from Rutgers University Soil Survey of New Jersey, Report No. 20 Burlington County and Geologic Map of New Jersey prepared by Lewis and Kummel.

PLATE 3

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS **SOIL MAP** CENTENNIAL LAKE DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D. N.J. 00424 — SCALE: NONE DATE: MARCH, 1979



NOTE:
Information taken from plans prepared by B. Harold Wills dated Aug. 27, 1954, revised Nov. 5, 1954 and field inspection December 19, 1978.

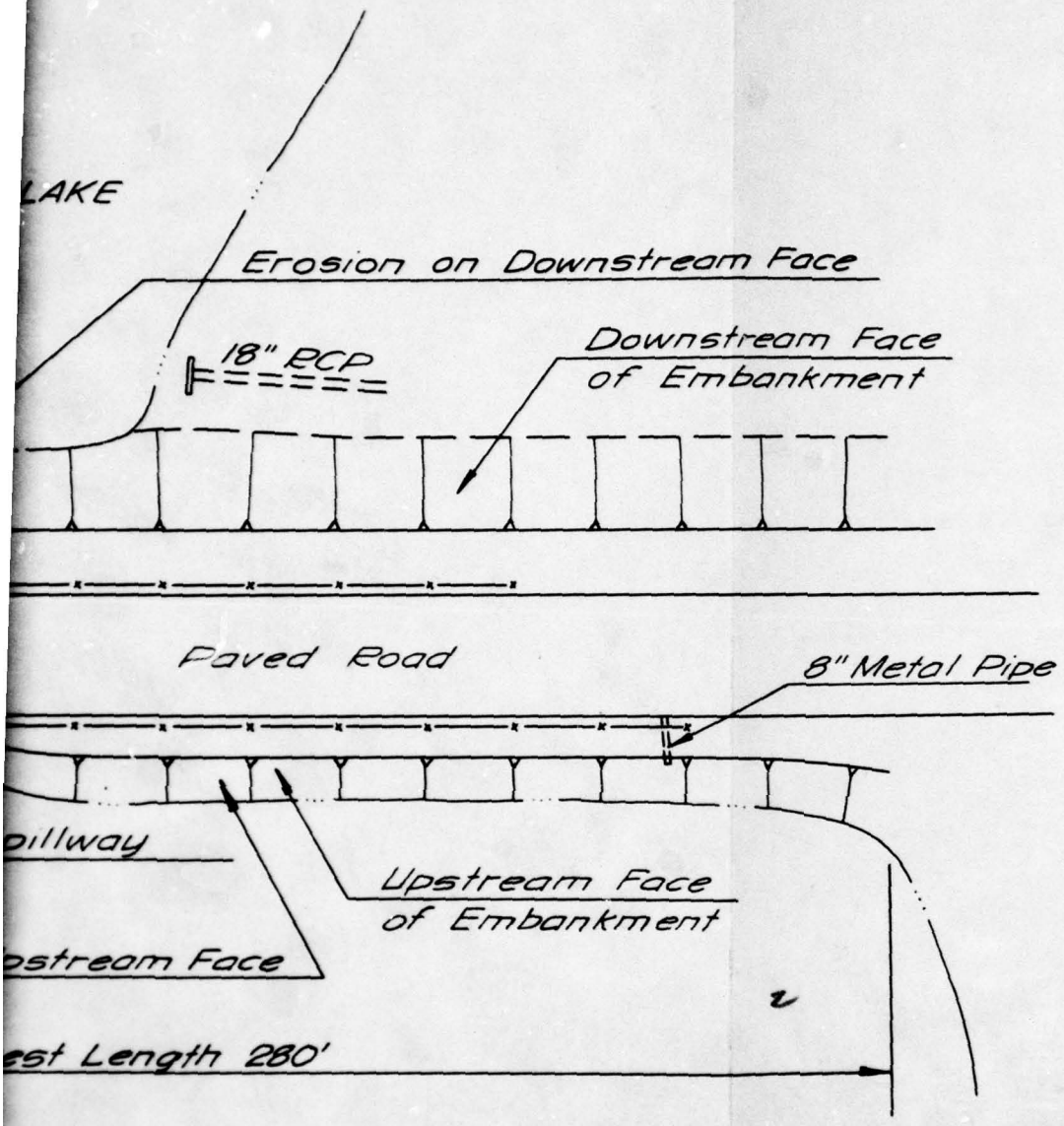


PLATE 4

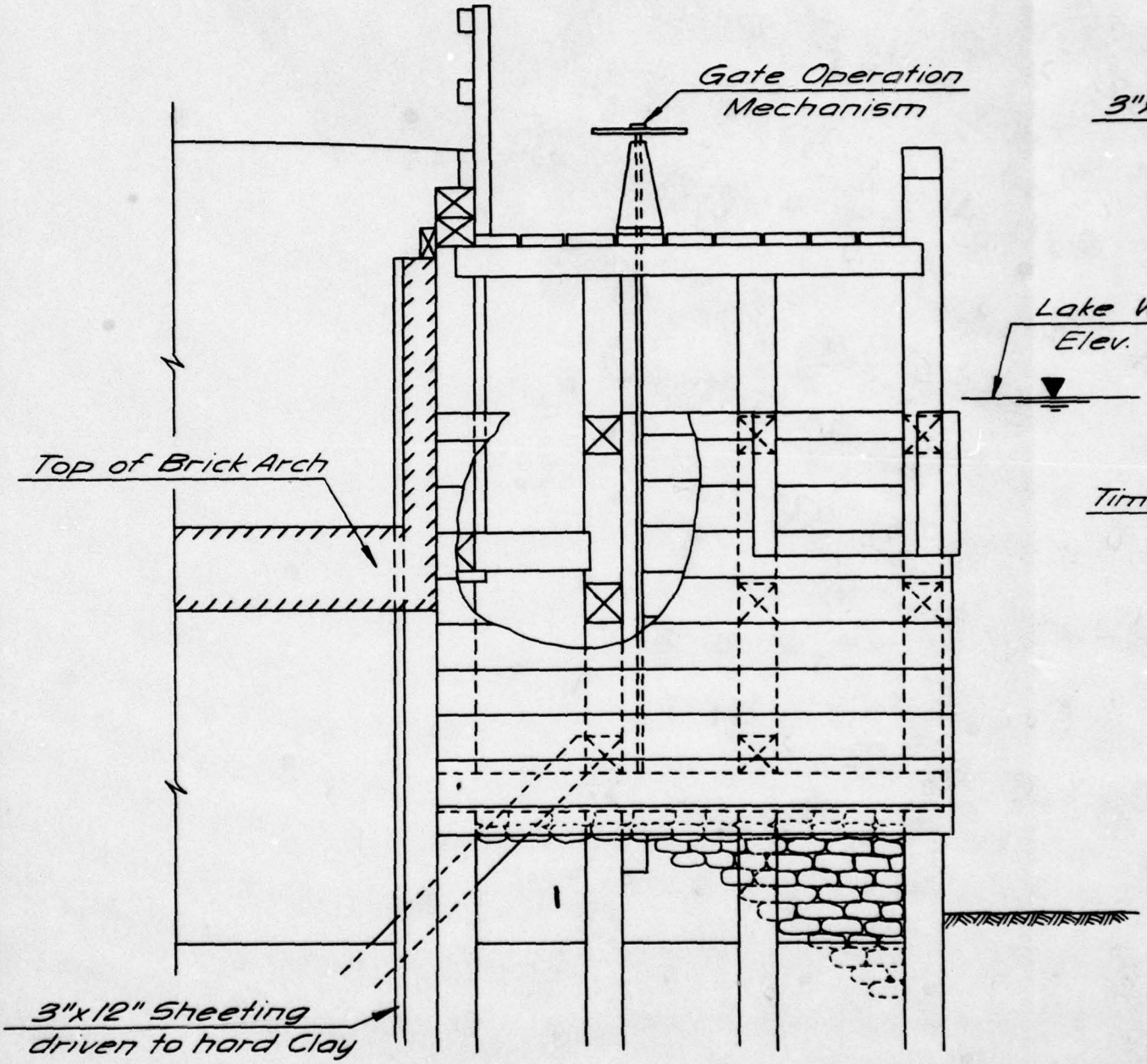
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

GENERAL PLAN

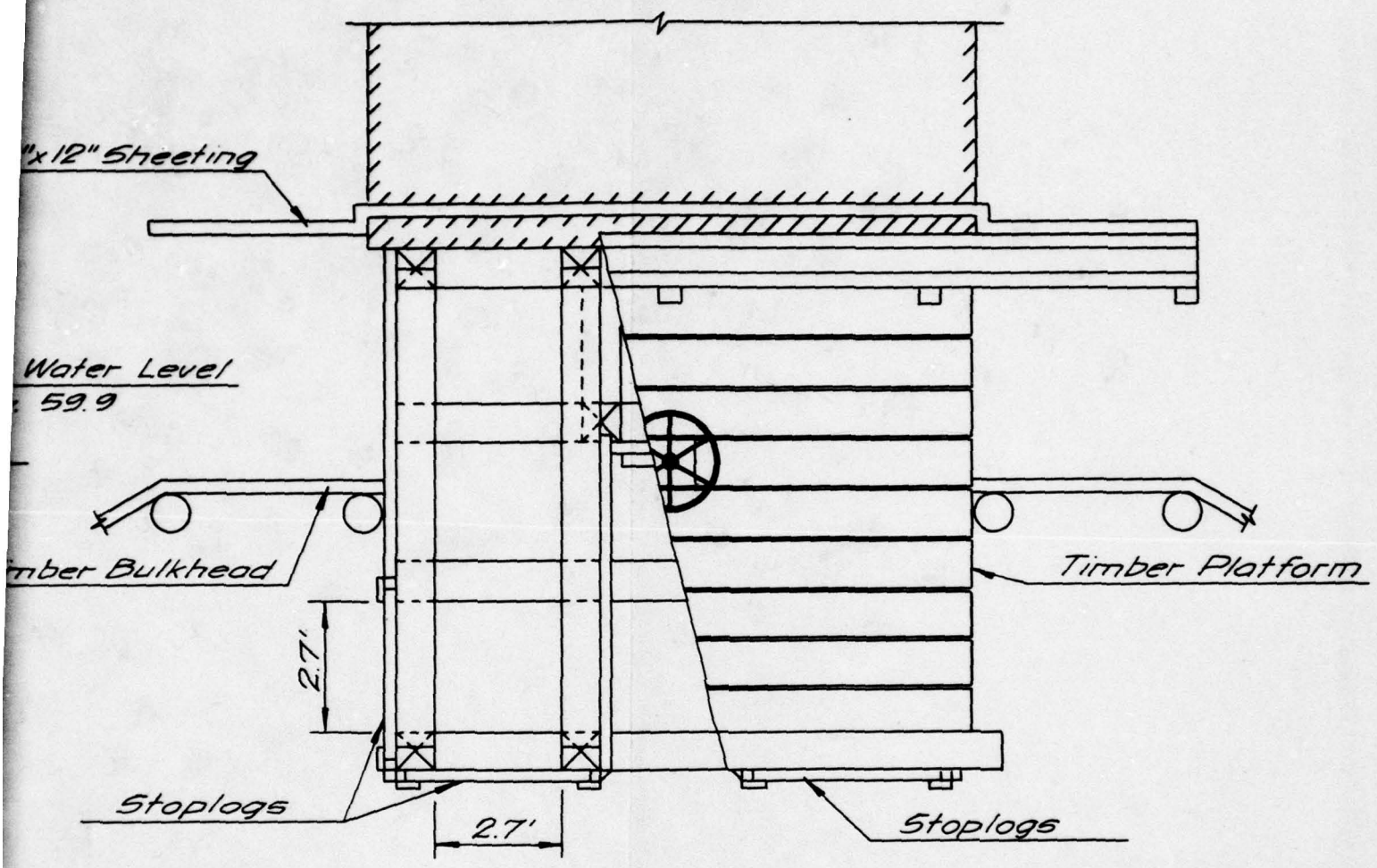
CENTENNIAL LAKE DAM

I.D.N.J. 00424	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979



ELEVATION

NOTE:
Information taken
B Harold Wills dat
Nov. 5, 1965 and field



2 PLAN

taken from plans prepared by
lls dated Aug. 27, 1954, revised
d field Inspection Dec. 19, 1978.

1

PLATE 5

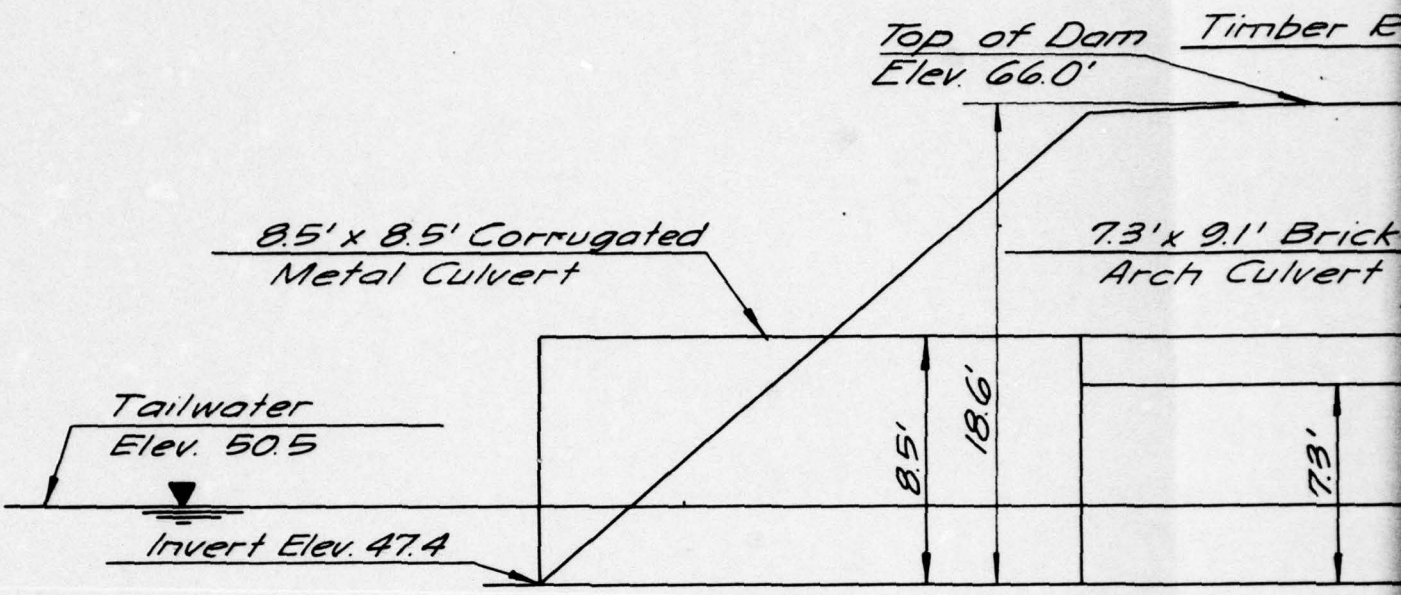
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

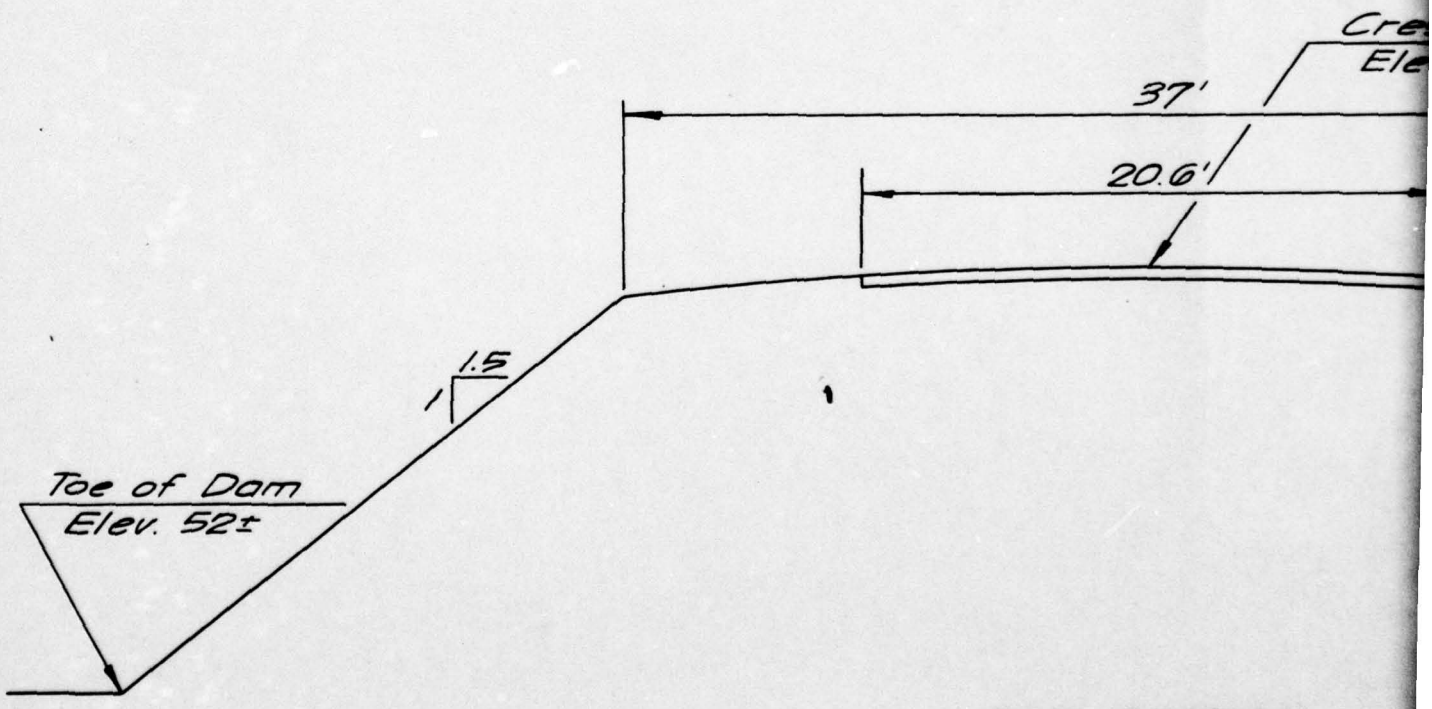
SPILLWAY PLAN & ELEVATION

CENTENNIAL LAKE DAM

I.D.N.J. 00424	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979

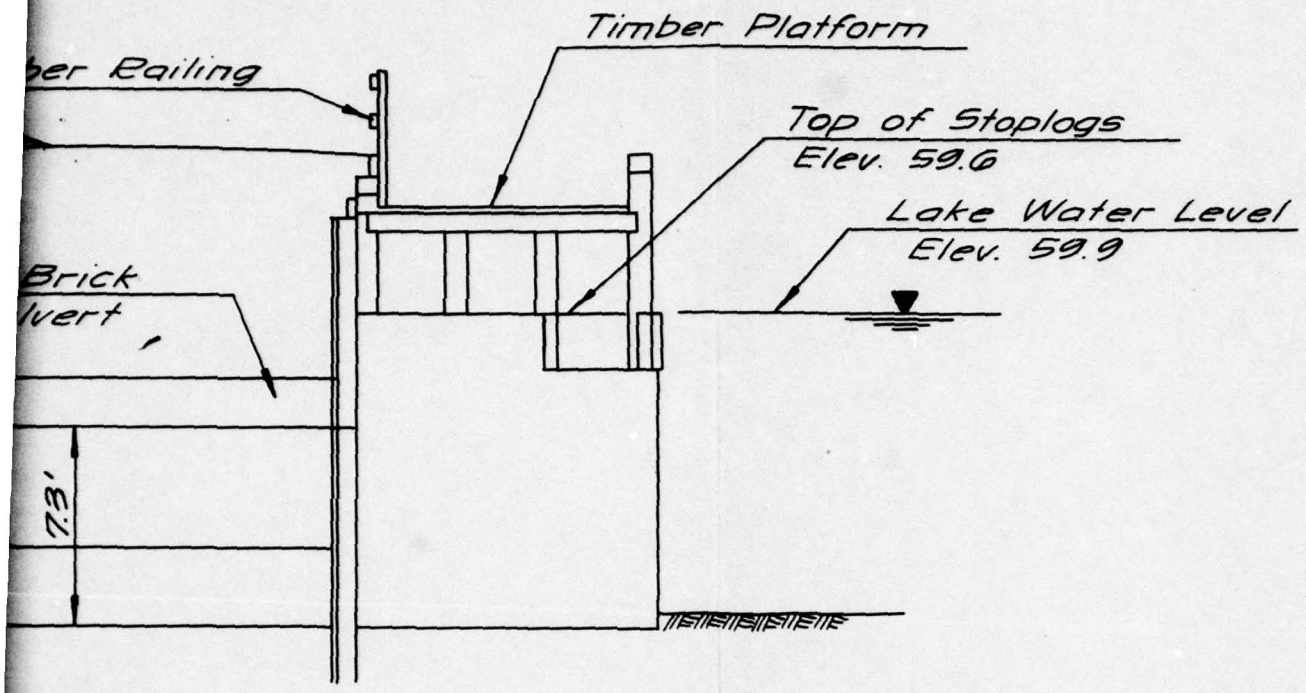


SPILLWAY SECTION



DAM SECTION

NOTE:
Information taken from plans prepared by B. Harold Wills dated Aug. 27, 1954, revised Nov. 5, 1954 and field inspected Dec. 19, 1978.



ION

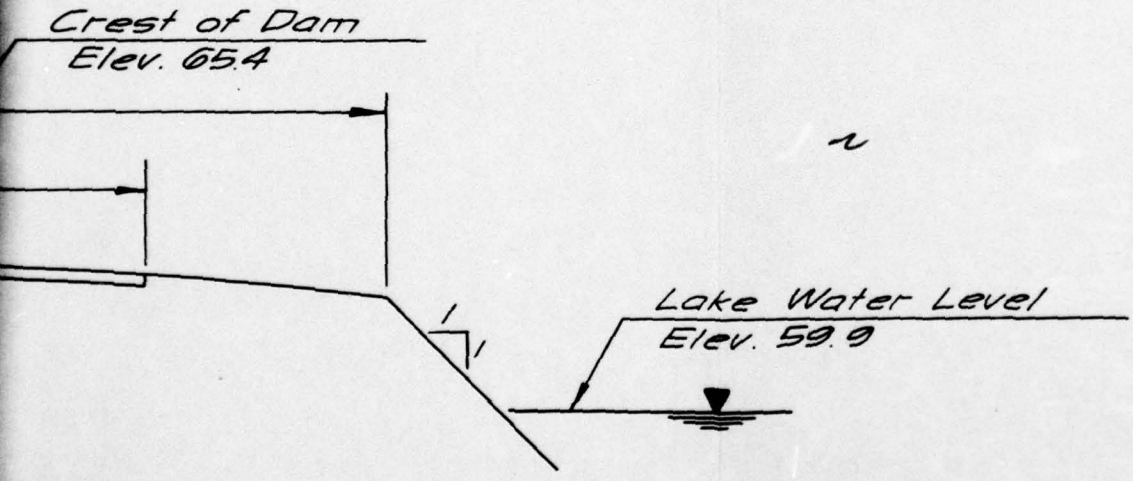


PLATE 6

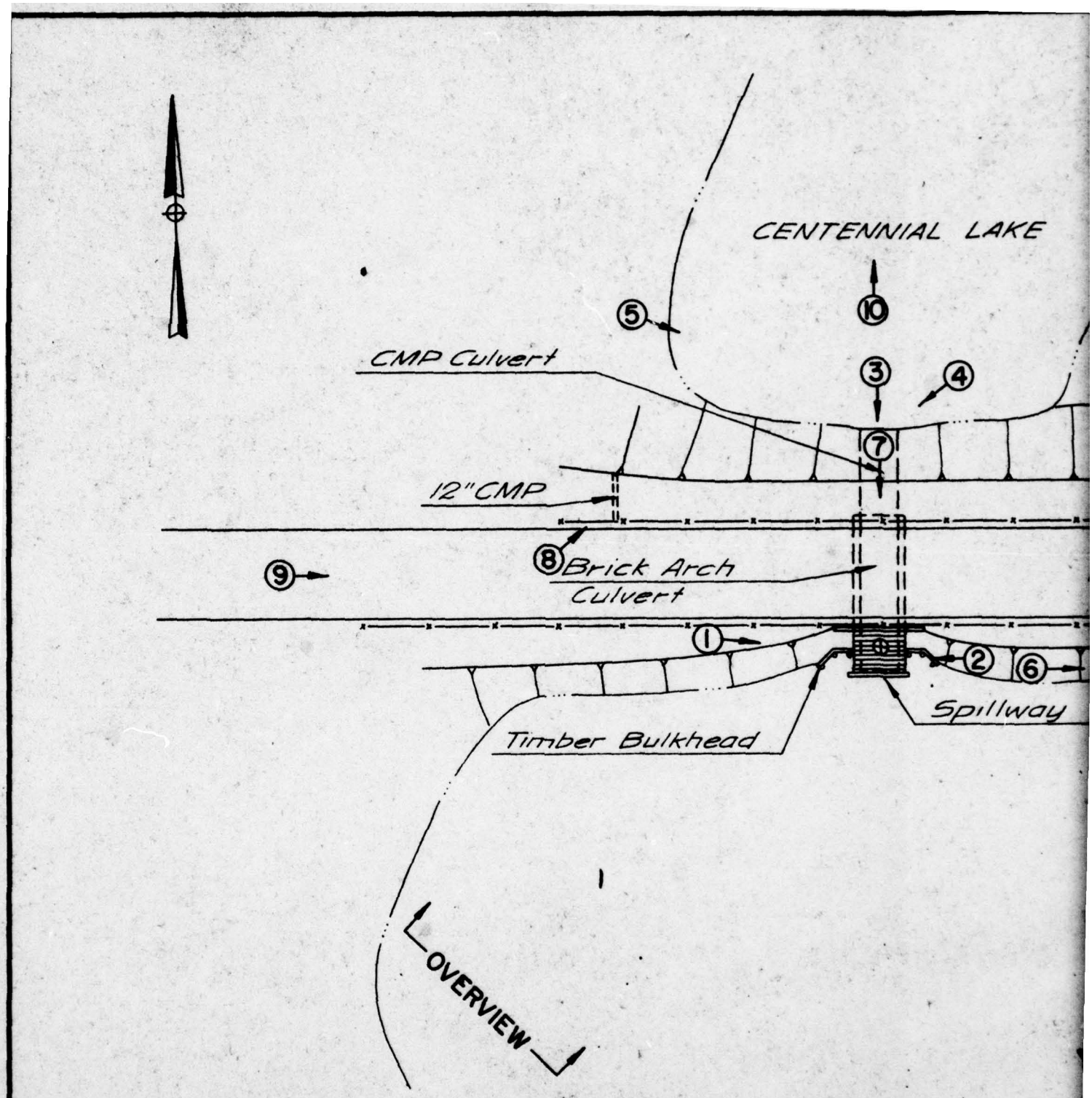
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

SECTIONS

CENTENNIAL LAKE DAM

I.D.N.J. 00424	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979



NOTE:
Information taken from plans prepared by B. Harold Wills dated Aug. 27, 1954, revised Nov. 5, 1954 and field inspection December 19, 1978.

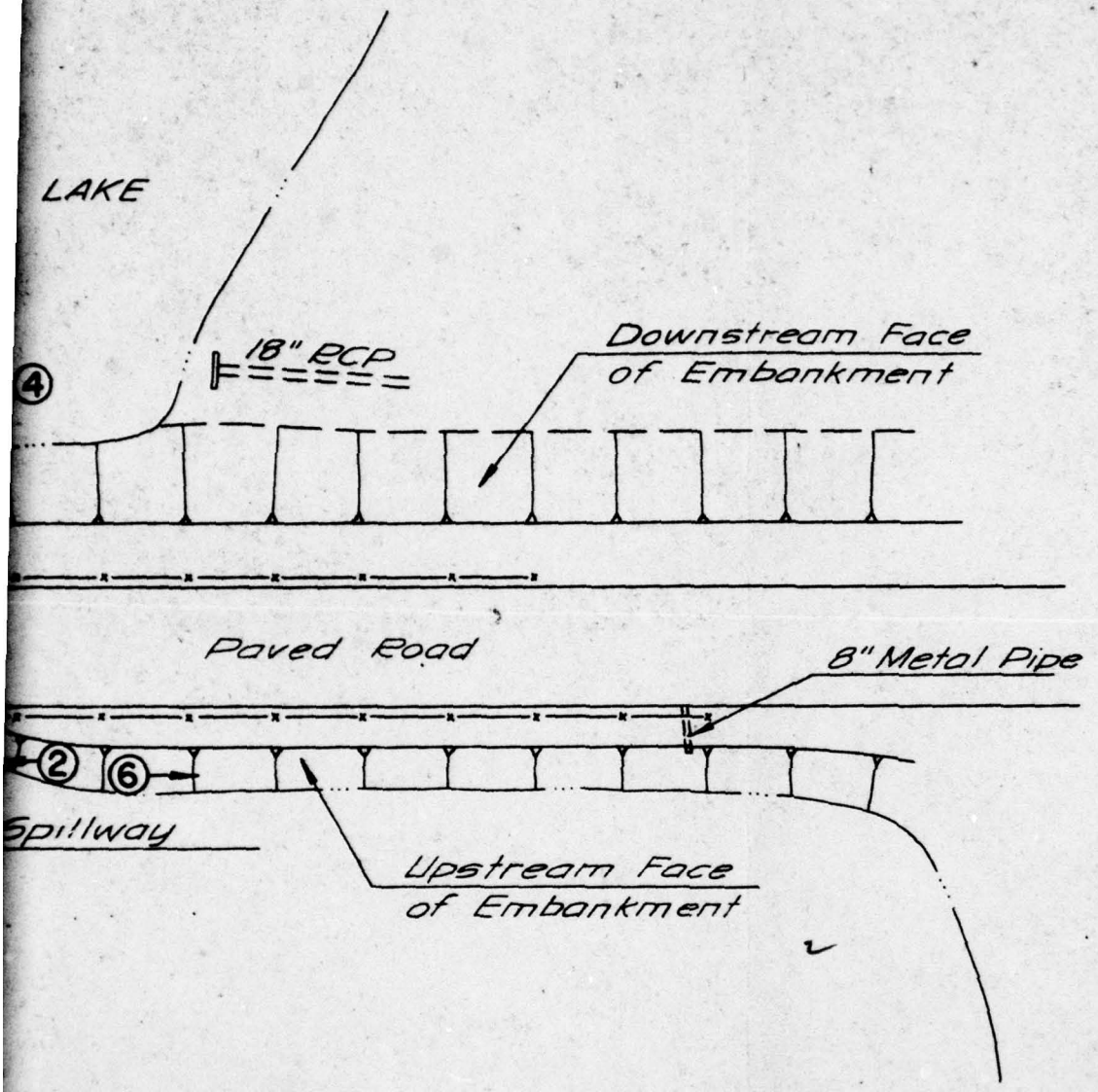


PLATE 7

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

PHOTO LOCATION PLAN

CENTENNIAL LAKE DAM

I.D.N.J. 00424	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979

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APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List
Visual Inspection
Phase 1

Name Dam Centennial Lake County Burlington State N. J. Coordinators N.J.D.E.P.

Date(s) Inspection 12/19/78 Weather Sunny Temperature 42°

Pool Elevation at Time of Inspection 60 M.S.L. Tailwater at Time of Inspection 51.5 M.S.L.

Inspection Personnel:

J. Gribbin R. McDermott

D. Buckelew

A. Miller

J.Gribbin Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE	N.A.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N.A.	
DRAINS	N.A.	
WATER PASSAGES	N.A.	
FOUNDATION	N.A.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N.A.	
STRUCTURAL CRACKING	N.A.	
VERTICAL AND HORIZONTAL ALIGNMENT	N.A.	
MONOLITH JOINTS	N.A.	
CONSTRUCTION JOINTS	N.A.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None Observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None Observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Minor erosion of upstream and downstream faces with significant erosion in vicinity of spillway discharge culvert outlet.	Eroded areas have been repaired with sand in the past.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Vert. alignment: level in center with depressions of approximately 1 foot at both ends. Horiz. alignment: straight	Depressions reportedly were intended to serve as emergency spillways.
RIPRAP FAILURES	N.A.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Embankment is sandy with grass and extensive tree and brush cover. Trees include random desidious and planted pine.	Trees and brush should be removed from embankment and ground surface should be stabilized with ground cover vegetation.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Satisfactory	
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N.A.	
INTAKE STRUCTURE	Chamber in center of spillway structure. Water flows over stop log crest into chamber and through gate at bottom of chamber into arch culvert.	Lake is lowered by removal of stoplogs and opening of outlet gate on center opening.
OUTLET STRUCTURE	Brick arch culvert portion of distance through embankment. Corrugated metal pipe through downstream portion of embankment.	Corrugated Metal Pipe appears to be in satisfactory condition.
OUTLET CHANNEL	Same as outlet channel for spillway	
EMERGENCY GATE	Gate operating wheel in satisfactory condition.	Lock and chain for securing operating wheel unsatisfactory.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	N.A.	
APPROACH CHANNEL	N.A.	
DISCHARGE CHANNEL	N.A.	
BRIDGE AND PIERS	N.A.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N.A.	
APPROACH CHANNEL	N.A.	
DISCHARGE CHANNEL	Generally few obstructions.	Wide shallow body of water consisting of upstream end of Taunton Lake.
BRIDGE AND PIERS	N.A.	
GATES AND OPERATION EQUIPMENT	Timber stoplogs appear to be in satisfactory condition.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Bench mark painted on spillway structure. Elev. = 64.85	Elev. generally in agreement with USGS quadrangle water surface elevation.
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	N.A.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slope of lake banks are relatively steep, ranging from 2% to 12%.	Majority of land around lake consists of residential development.
SEDIMENTATION	Not known	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Generally few obstructions.	Downstream condition consists of lake (Taunton Lake) with residential development along its shores.
SLOPES	Banks of lake are generally moderate.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approx. 40 homes along Taunton Lake.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	1954 Reconstruction Plan, Prepared by Harold Wills, Mount Holly, N. J. August 27, 1954. Available from NJDEP file.
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	Dam Inspection Report by W. E. Edens, Nov. 30, 1954. Available from NJDEP file.
TYPICAL SECTIONS OF DAM	Not Available
HYDROLOGIC/HYDRAULIC DATA	Not Available
OUTLETS - PLAN	1954 Reconstruction Plan. Available from NJDEP file.
- DETAILS	Not Available
-CONSTRAINTS	Not Available
-DISCHARGE RATINGS	Not Available
RAINFALL/RESERVOIR RECORDS	Not Available

ITEM	REMARKS
SPILLWAY PLAN	1954 Reconstruction Plan. Available from NJDEP file.
SECTIONS	1954 Reconstruction Plan. Available from NJDEP file.
DETAILS	1954 Reconstruction Plan. Available from NJDEP file.
OPERATING EQUIPMENT PLANS & DETAILS	Not Available

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	Manual Slide Gate replaced in 1976.
HIGH POOL RECORDS	1967 Dam nearly overtopped. Crest sand bagged and gates opened.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None Available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None Available
MAINTENANCE OPERATION RECORDS	None Available

ITEM	REMARKS
DESIGN REPORTS	None Available
GEOLOGY REPORTS	None Available
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.	Unknown

APPENDIX 2

Photographs



PHOTO 1

SPILLWAY STRUCTURE



PHOTO 2

STOPLOGS IN SPILLWAY

19 DEC. 1978

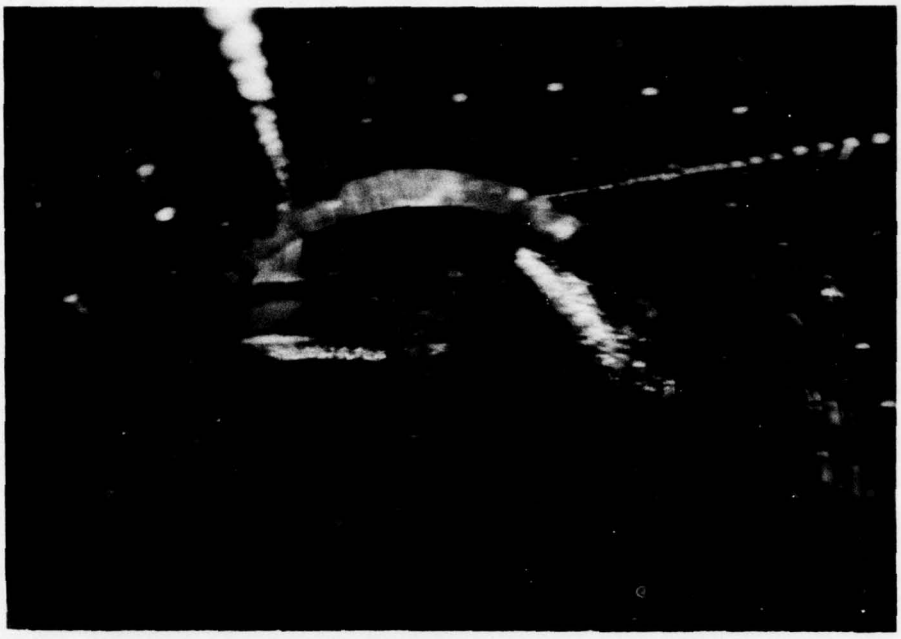


PHOTO 3

SPILLWAY DISCHARGE CULVERT -
BRICK ARCH AND CORRUGATED METAL ARCH



PHOTO 4

SPILLWAY DISCHARGE CULVERT OUTLET

19 DEC. 1978

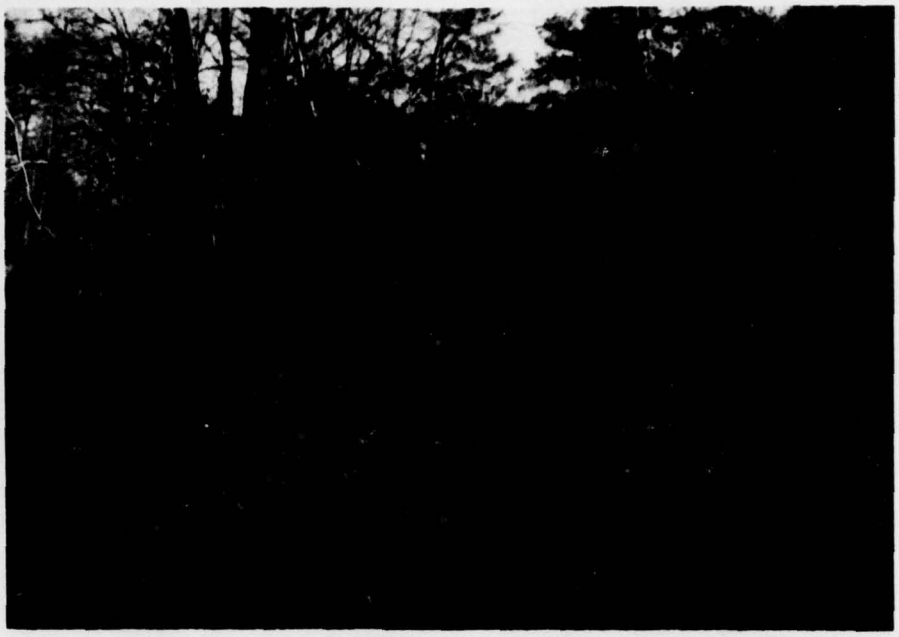


PHOTO 5

DOWNSTREAM FACE OF EMBANKMENT.
HEADWALL FOR STORM DRAINAGE PIPE.



PHOTO 6

EROSION ON UPSTREAM FACE OF EMBANKMENT.

19 DEC. 1978

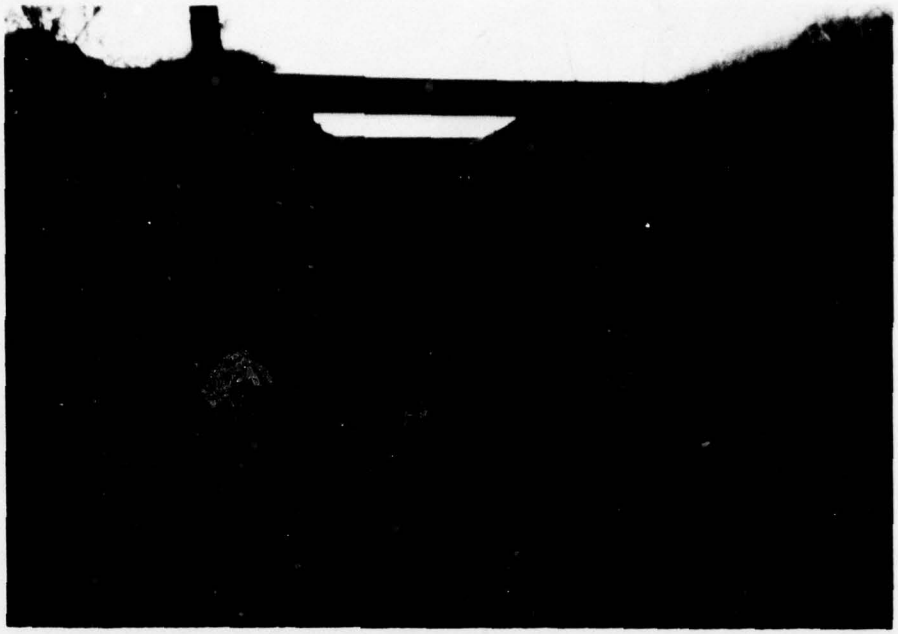


PHOTO 7

EROSION ON DOWNSTREAM FACE OF EMBANKMENT.



PHOTO 8

STORM DRAINAGE PIPE ON UPSTREAM SIDE
OF EMBANKMENT.

19 DEC. 1978



PHOTO 9

ROADWAY ON CREST OF DAM

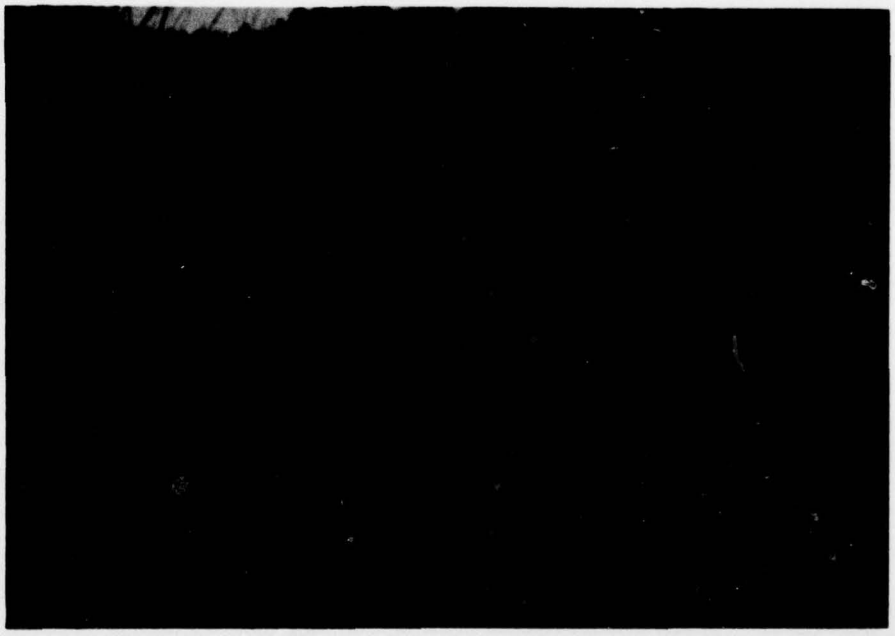


PHOTO 10

DOWNSTREAM CHANNEL (TAUNTON LAKE)

19 DEC. 1978

APPENDIX 3

Engineering Data

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Generally marsh and wooded, small portion residential dwellings.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 59.6 (334 Acre-Feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N.A.

ELEVATION MAXIMUM DESIGN POOL: 65.0

ELEVATION TOP DAM: 65.0 (lowpoint, depressed areas along dam crest)

SPILLWAY CREST: Timber Stoplogs

a. Elevation 59.6

b. Type Controlled overflow

c. Width 2" (Stoplog width)

d. Length 13.7' total (5 openings)

e. Location Spillover Timber chamber downstream from stoplogs.

f. Number and Type of Gates Stoplogs on 5 openings plus manual slide gate on center opening.

OUTLET WORKS: Slide gate controlled center opening to timber chamber to discharge culvert.

a. Type Manual slide gate

b. Location Center opening on spillway

c. Entrance inverts 58.8 Stoplog crest, 47.9 Slide gate

d. Exit inverts 44 Discharge Culvert

e. Emergency draindown facilities: Slide gate on center opening

HYDROMETEOROLOGICAL GAGES: None

a. Type N.A.

b. Location N.A.

c. Records N.A.

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake stage equal to top of dam) 270 cfs (Water surface at elev. 65, depressed areas in dam crest)

APPENDIX 4

Hydrologic Computations

STORCH ENGINEERS Sheet 1 of ____

Project CENTENNIAL LAKE DAM #1132 Made By EAW Date Feb 16, 1979

DAM CLASSIFICATION Chkd By RL Date 4-17-79

SIZE CLASSIFICATION:

Surface area of impoundment as measured from 1"=400' aerial photograph. 55.7 acres

Average depth of lake say, 6 ft.

Approximate storage = 55.7 × 6 334 acre-ft.

Structural height of dam 18.7 ft.

∴ Size classification: "Small"

HAZARD POTENTIAL CLASSIFICATION:

1. Centennial Lake is upstream of Taunton Lake and Lake Pine, both of which have a substantial number of inhabitable structures along their shore lines.

2. In the event of a failure at Centennial Lake Dam the dams downstream may fail as well, resulting in loss of lives and substantial economic loss.

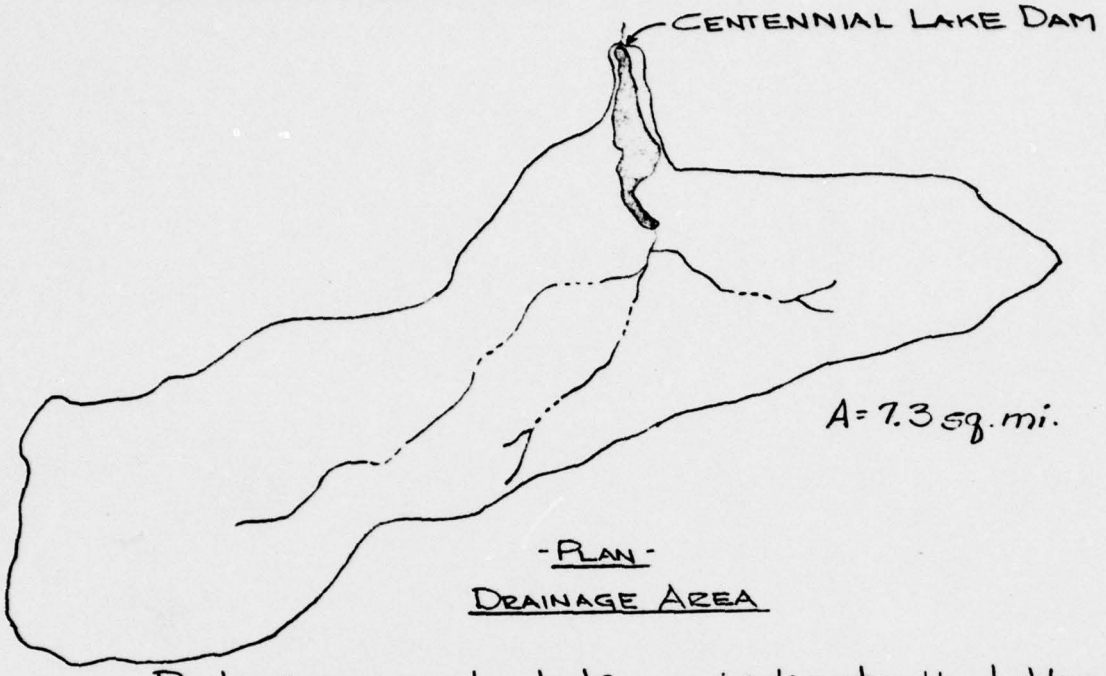
∴ Hazard Potential classification: "High"

SPILLWAY DESIGN FLOOD RANGE:

Based on above PMF to ½ PMF

Since Centennial Lake falls close the lower limits of the classification, use ½ PMF.

HYDROLOGIC ANALYSIS-



-PLAN-
DRAINAGE AREA

Preliminary calculations indicate that the discharge from Centennial Lake drainage area will result in over topping of the dam. Consequently, the HEC-1-DB computer program will be used to route the flood, and the data developed in the following pages will be organized as input for the program. Clark's method with a synthetic time-area curve will be used.

PRECIPITATION-

(Re "Design of Small Dams" USDI, 1973)
From Fig. 15 Zone 6
Probable Maximum Precipitation = 27 inches for 6 hr. duration and 10 sq. mi. area.

Duration (hrs.)	% PMP
6	100
12	109
24	117

SURFACE STORAGE INDEX-(S_t)

Information taken from U.S.G.S. Quadrangles.

Surface Area = 4616 acres
Storage Area = 745 acres
Surface Storage Index = S_t = 16%

MAIN CHANNEL SLOPE -(S)

Information taken from USGS Quadrangles.

Length of Main Channel = 25,000'
10% Length = 2,500' Elev. = 68'
85% Length = 21,250' Elev. = 125'
Slope = S = 16.1 ft/mi

MANMADE IMPERVIOUS COVER INDEX -(I)

Population information taken from U.S.G.S. Quadrangles.

$I = 0.117\ D^{(0.792-0.039 \log D)}$ (Special Report 38)

Population ≅ 770
Surface Area = 7.3 sq. mi.
Population Density = $D = 770/7.3 = 105.5$

$I = 0.117\ (105.5)^{(0.792-0.039 \log 105.5)}$
$= 3.24$

CLARK'S METHOD PARAMETERS-

For Centennial Lake -(from CoE)

$$\frac{R}{T_c + R} = 0.76$$

$$T_c + R = 21 (DA/S)^{0.22} (S_t)^{0.33} (1 + 0.3I)^{-0.28}$$

$$T_c + R = 21\left(\frac{7.3}{16.1}\right)^{0.22}(16)^{0.33}(1+0.3(5.24))^{-0.28}$$
$$= 36.4$$

$R = 27.7$ hrs.
$T_c = 8.7$ hrs.

CENTENNIAL LAKE STORAGE VOLUME:
Information taken from USGS Quadrangles and 400'=1" aerial photos.

Elevation (ft)	47.3*	59	60	70
Surface Area (acres)	0	52.3	61.5	115.7

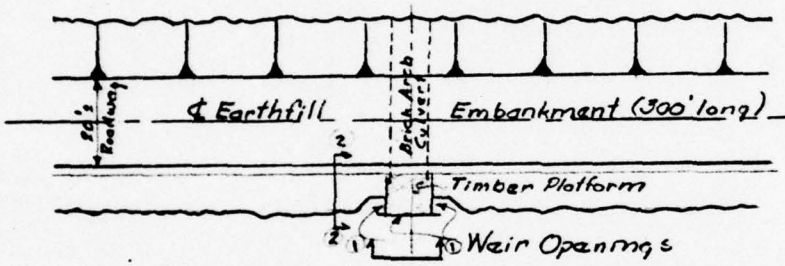
* Bottom of Dam at spillway.

HEC-1-DB program will develop storage capacity from the surface area & el.

-SPILLWAY DISCHARGE-

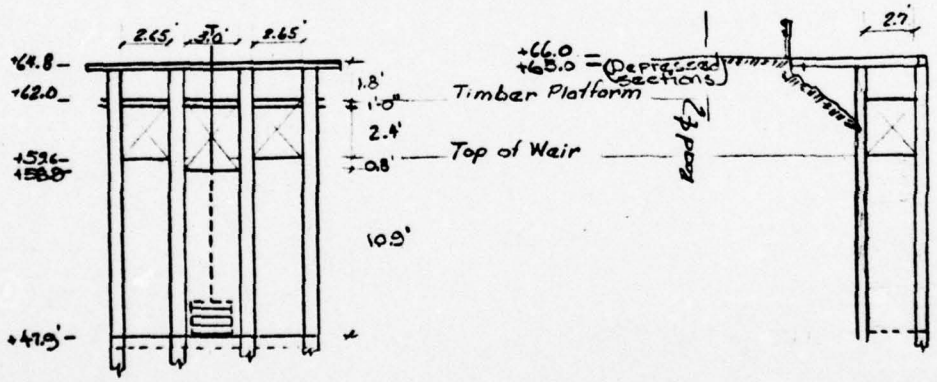
A trial calculation indicated that the weir openings will control the discharge through the brick arch culvert during all periods of discharge.

PRINCIPAL SPILLWAY-
DISCHARGE AS A WEIR-
Sharp Crested Weir



There are 1' deep depressed triangular areas in the dam crest.

-Plan-



-Section 1-1-
(A opening is gated)

-Section 2-2-(Opposite side Symmetry)

$L = 2.65+2.65+2.7+2.7 = 10.7'$ *

USE Rehbock Formula (Pg. 5-8, "Handbook of Hydraulics", King et. al., 1963)

$C = 3.235 + \frac{1}{60H-0.56} + 0.428\,H/P$ $\quad P_{AVG} = 12'$

$Q = CLH^{3/2}$ $\quad L$ = Weir Length

H = Water Surface Height above weir crest.

* Based on operation, the front center opening, "A", operates only when the lake is lowered for repair and maintenance work.

Water Surface Elev. (ft)	H (ft)	C	Q (cfs)
59.6	0	—	—
60.0	0.4	3.29	9
60.5	0.9	3.29	30
61.0	1.4	3.30	58
61.5	1.9	3.31	93
62.0	2.4	3.33	132

DISCHARGE SUBMERGED (Acts as an orifice w/ free outlet)

$Q = CA\sqrt{2gH}$ "C" from Table 4-8 (Re. "Handbook of Hydraulics", H.W. King, et. al., 1963)

Water Surface Elev. (ft)	h_1 (ft)	H (ft)	C	Q (cfs)
62.5	0.5	1.7	0.654	176
63.0	1.0	2.2	0.660	202
63.5	1.5	2.7	0.656	222
64.0	2.0	3.2	0.652	241
64.5	2.5	3.7	0.645	256
65.0	3.0	4.2	0.638	270
65.5	3.5	4.7	0.634	283
66.0	4.0	5.2	0.630	296
67.0	5.0	6.2	0.622	319
68.0	6.0	7.2	0.619	343
69.0	7.0	8.2	0.616	364
70.0	8.0	9.2	0.615	385

$H = h_1 + 1.2'$ (depth to ℄ opening)
$A = 2.4 \times 10.7 = 25.7\ ft^2$
h_1 = water height above top of opening.

DAM OVERTOPPING

Flow over the dam will be similiar to flow over a broad crested weir.

C from Table 5-3 (King)

$Q = CLH^{3/2}$ $C \simeq 2.63$

L = Weir Length

H = Water Surface Height above weir crest.

Water Surface El. (ft)	H (ft)	Q* (cfs)
66.0	—	—
67.0	1.0	789
68.0	2.0	2232
69.0	3.0	4100
70.0	4.0	6312

* No breach

There are two depressed areas incorporated into the top of the embankment at the East & West ends.
These depressions are triangular in cross-section, about 1' deep and 50' wide.

$Q = C_1 \tan \Phi/2 \, H^{5/2}$ (King eq. 5-13)
C_1 from King table 5-3

Water Surface El. -	0.5'	1.0' (max)
Discharge, Q	12 cfs	66 cfs (each spwy.)

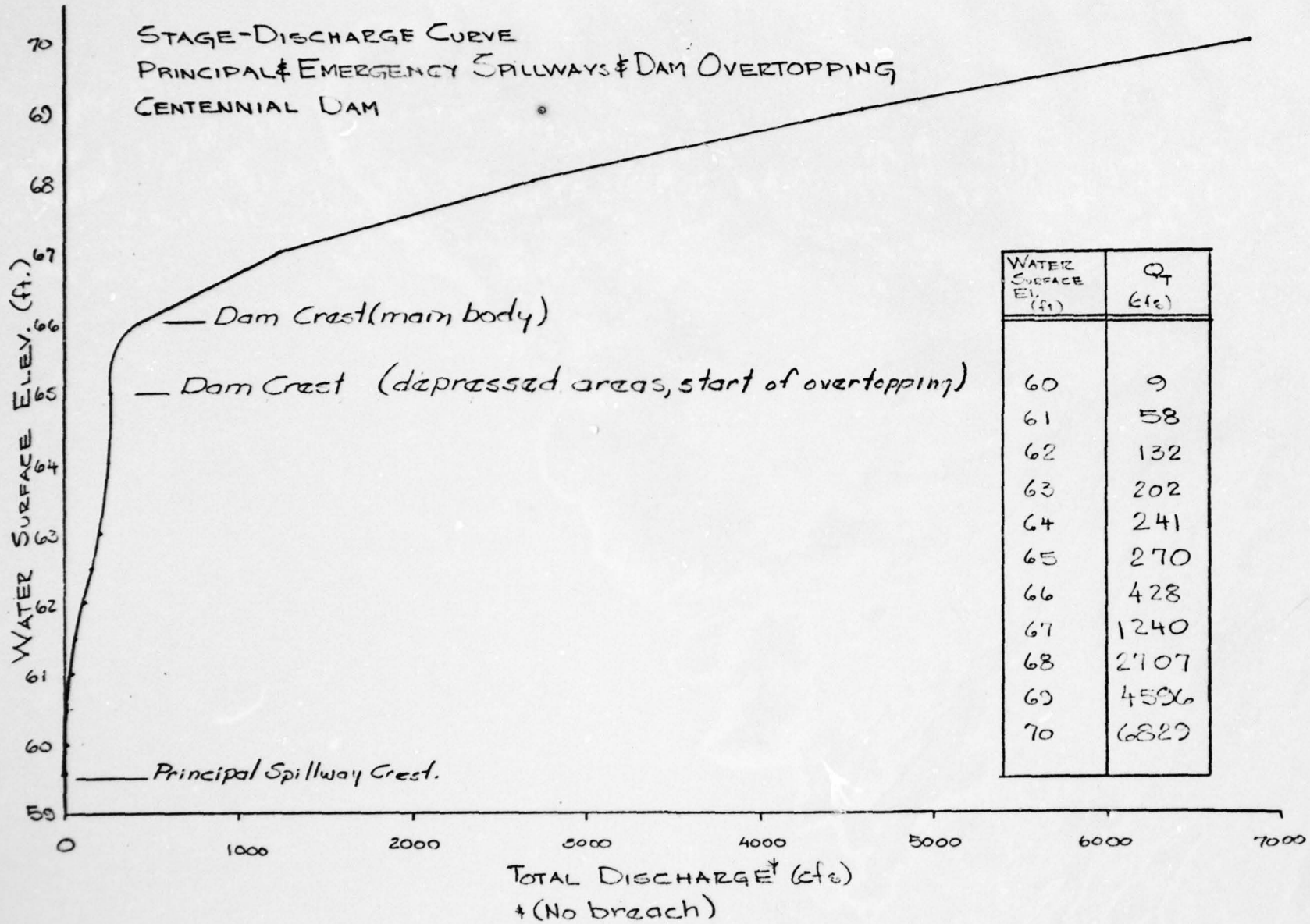
SIORCH ENGINEERS

Project CENTENNIAL LAKE DAM *1132 Made By EAW Date Feb 23, 1979

DISCHARGE HYDRAULICS Chkd By RL Date 4-17-79

Sheet 8 of

STAGE-DISCHARGE CURVE
PRINCIPAL & EMERGENCY SPILLWAYS & DAM OVERTOPPING
CENTENNIAL DAM

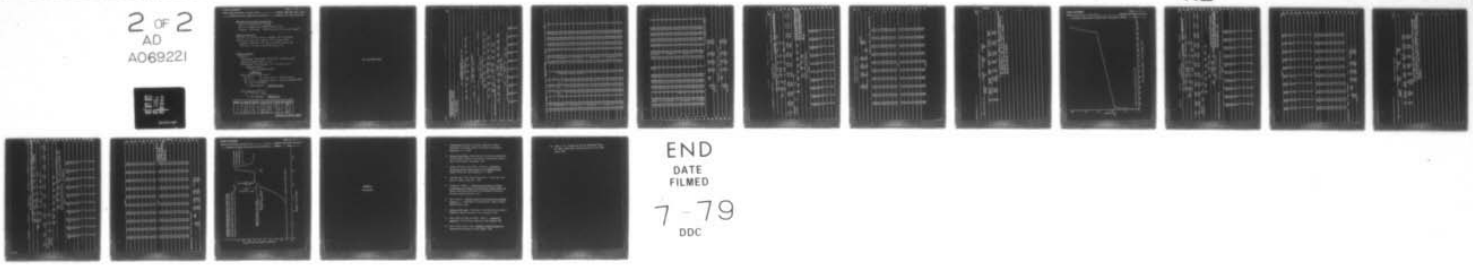


WATER SURFACE El. (ft)	Q_T (cfs)
60	9
61	58
62	132
63	202
64	241
65	270
66	428
67	1240
68	2107
69	4556
70	6820

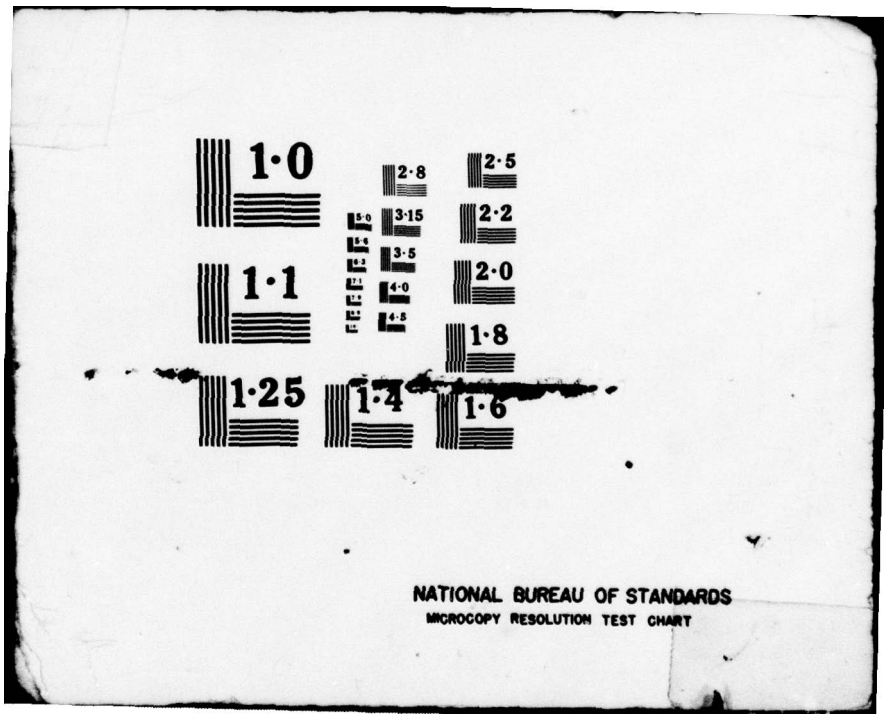
AD-A069 221 NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. CENTENNIAL LAKE DAM (NJ 00424). DE--ETC(U)
APR 79 R J MCDERMOTT DACW61-78-C-0124

UNCLASSIFIED NL

2 OF 2
AD
A069221



END
DATE
FILMED
7-79
DDC


1·0
1·1
1·25
1·4
1·6
1·8
2·0
2·2
2·5
2·8
3·15
3·5
4·0
4·5
5·0
NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

STORCH ENGINEERS Sheet 3 of ____

Project CENTENNIAL LAKE DAM Made By EAW Date Feb 28, 1979

DRAWDOWN CALCULATIONS Chkd By RL Date 4-17-79

RESERVOIR CHARACTERISTICS:

Normal Pool Elev. = 59.5'

Normal Depth at Outlet Works ≅ 12'

Approx. Storage = 334 acre-ft (@ normal pool)

ASSUMPTIONS:

① Use 4 drawdown steps at 3' each.

② Discharge will occur through the center section on the south face of the principal spillway only.

DRAWDOWN:

Step 1:

Average Head: H_{AVG} = 9.5' (ctr. of opening)

Gate Area (24'x24') = 4sf

Average Discharge: (C = 0.600 avg.)

$Q_{AVG} = CA\sqrt{2gh}$

$= 0.6(4)\sqrt{2(32.2)9.5}$

$= 59$ cfs

Drawdown Volume:

El. 59.6' Surface Area = 52.3 acres

El. 56.6' ~Surface Area = 39.2 acres $(52.3 - \frac{52.3}{4})$

$V = 3\left(\frac{52.3+39.2}{2}\right)$

$= 137$ acre-ft = 5980,244 cf.

Drawdown Time:

$T = 5,980,244 / 59$

$= 101,360$ sec $=$ 28.2 hrs

Step	H_{avg} (ft)	Q_{avg} (cf)	Volume (cf)	Time (hrs)	Cumulative Time (hrs)
1	9.5	59	6,549,791	28.2	28.2
2	6.5	49	4,271,603	24.2	52.4
3	3.5	36	2,562,962	19.8	72.2
4	0.5	14	854,320	17.0	89.2

Approx. 4 days total.

HEC-1-DB COMPUTATIONS

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 11 JAN 79
****

RUN DATE= 79/03/28.
TIME= 13.10.18.

CENTENNIAL LAKE DAM
PMF CLARK'S METHOD SYNTHETIC TIME-AREA CURVE
TRAPEZOIDAL BREACH SECTION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
250	1	30	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 .18 .10

****

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO CENTENNIAL LAKE

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	0	7.30	0.00	7.30	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	27.00	100.00	109.00	117.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .803

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	1.50	.15	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 8.70 R= 27.70 NTA= 0

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

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 8.95 HOURS, CP= .27 VOL= .99

8.	32.	63.	100.	128.	142.	140.	133.	126.	119.
113.	107.	101.	96.	91.	86.	82.	77.	73.	69.
66.	62.	59.	56.	53.	50.	48.	45.	43.	40.
38.	36.	34.	33.	31.	29.	28.	26.	25.	24.
22.	21.	20.	19.	18.	17.	16.	15.	14.	14.
13.	12.	12.	11.	10.	10.	9.	9.	8.	8.
8.	7.	7.	6.	6.	6.	5.	5.	5.	5.
4.	4.	4.	4.	4.	3.	3.	3.	3.	3.
3.	2.	2.	2.	2.	2.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

Q

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	1.30	1	.17	0.00	.17	7.	1.08	21.00	126	0.00	0.00	0.00	6.
1.01	3.00	2	.17	0.00	.17	6.	1.08	22.30	127	0.00	0.00	0.00	5.
1.01	4.30	3	.17	0.00	.17	5.	1.09	0.00	128	0.00	0.00	0.00	5.
1.01	6.00	4	.17	0.00	.17	6.	1.09	1.30	129	0.00	0.00	0.00	5.
1.01	7.30	5	.49	0.00	.49	5.	1.09	3.00	130	0.00	0.00	0.00	4.
1.01	9.00	6	.49	.09	.40	6.	1.09	4.30	131	0.00	0.00	0.00	4.
1.01	10.30	7	.49	.26	.23	9.	1.09	6.00	132	0.00	0.00	0.00	4.
1.01	12.00	8	.49	.26	.23	20.	1.09	7.30	133	0.00	0.00	0.00	4.
1.01	13.30	9	5.62	5.39	.23	83.	1.09	9.00	134	0.00	0.00	0.00	3.
1.01	15.00	10	11.45	11.22	.23	323.	1.09	10.30	135	0.00	0.00	0.00	3.
1.01	16.30	11	4.54	4.31	.23	818.	1.09	12.00	136	0.00	0.00	0.00	3.
1.01	18.00	12	******	0.00	******	1494.	1.09	13.30	137	0.00	0.00	0.00	3.
1.01	19.30	13	.26	.03	.23	2189.	1.09	15.00	138	0.00	0.00	0.00	3.
1.01	21.00	14	.26	.03	.23	2726.	1.09	16.30	139	0.00	0.00	0.00	2.
1.01	22.30	15	.26	.03	.23	2987.	1.09	18.00	140	0.00	0.00	0.00	2.
1.02	0.00	16	.26	.03	.23	2988.	1.09	19.30	141	0.00	0.00	0.00	2.
1.02	1.30	17	0.00	0.00	0.00	2861.	1.09	21.00	142	0.00	0.00	0.00	2.
1.02	3.00	18	0.00	0.00	0.00	2714.	1.09	22.30	143	0.00	0.00	0.00	2.
1.02	4.30	19	0.00	0.00	0.00	2574.	1.10	0.00	144	0.00	0.00	0.00	2.
1.02	6.00	20	0.00	0.00	0.00	2441.	1.10	1.30	145	0.00	0.00	0.00	2.
1.02	7.30	21	0.00	0.00	0.00	2313.	1.10	3.00	146	0.00	0.00	0.00	1.
1.02	9.00	22	0.00	0.00	0.00	2191.	1.10	4.30	147	0.00	0.00	0.00	1.
1.02	10.30	23	0.00	0.00	0.00	2076.	1.10	6.00	148	0.00	0.00	0.00	1.
1.02	12.00	24	0.00	0.00	0.00	1966.	1.10	7.30	149	0.00	0.00	0.00	1.
1.02	13.30	25	0.00	0.00	0.00	1862.	1.10	9.00	150	0.00	0.00	0.00	1.
1.02	15.00	26	0.00	0.00	0.00	1764.	1.10	10.30	151	0.00	0.00	0.00	1.
1.02	16.30	27	0.00	0.00	0.00	1671.	1.10	12.00	152	0.00	0.00	0.00	1.
1.02	18.00	28	0.00	0.00	0.00	1583.	1.10	13.30	153	0.00	0.00	0.00	1.
1.02	19.30	29	0.00	0.00	0.00	1500.	1.10	15.00	154	0.00	0.00	0.00	1.
1.02	21.00	30	0.00	0.00	0.00	1421.	1.10	16.30	155	0.00	0.00	0.00	1.
1.02	22.30	31	0.00	0.00	0.00	1346.	1.10	18.00	156	0.00	0.00	0.00	1.
1.03	0.00	32	0.00	0.00	0.00	1275.	1.10	19.30	157	0.00	0.00	0.00	1.
1.03	1.30	33	0.00	0.00	0.00	1207.	1.10	21.00	158	0.00	0.00	0.00	1.
1.03	3.00	34	0.00	0.00	0.00	1144.	1.10	22.30	159	0.00	0.00	0.00	1.
1.03	4.30	35	0.00	0.00	0.00	1083.	1.11	0.00	160	0.00	0.00	0.00	1.
1.03	6.00	36	0.00	0.00	0.00	1026.	1.11	1.30	161	0.00	0.00	0.00	1.
1.03	7.30	37	0.00	0.00	0.00	972.	1.11	3.00	162	0.00	0.00	0.00	0.
1.03	9.00	38	0.00	0.00	0.00	921.	1.11	4.30	163	0.00	0.00	0.00	0.
1.03	10.30	39	0.00	0.00	0.00	872.	1.11	6.00	164	0.00	0.00	0.00	0.
1.03	12.00	40	0.00	0.00	0.00	826.	1.11	7.30	165	0.00	0.00	0.00	0.
1.03	13.30	41	0.00	0.00	0.00	783.	1.11	9.00	166	0.00	0.00	0.00	0.
1.03	15.00	42	0.00	0.00	0.00	742.	1.11	10.30	167	0.00	0.00	0.00	0.
1.03	16.30	43	0.00	0.00	0.00	702.	1.11	12.00	168	0.00	0.00	0.00	0.
1.03	18.00	44	0.00	0.00	0.00	665.	1.11	13.30	169	0.00	0.00	0.00	0.
1.03	19.30	45	0.00	0.00	0.00	630.	1.11	15.00	170	0.00	0.00	0.00	0.
1.03	21.00	46	0.00	0.00	0.00	597.	1.11	16.30	171	0.00	0.00	0.00	0.
1.03	22.30	47	0.00	0.00	0.00	566.	1.11	18.00	172	0.00	0.00	0.00	0.
1.04	0.00	48	0.00	0.00	0.00	536.	1.11	19.30	173	0.00	0.00	0.00	0.
1.04	1.30	49	0.00	0.00	0.00	507.	1.11	21.00	174	0.00	0.00	0.00	0.
1.04	3.00	50	0.00	0.00	0.00	481.	1.11	22.30	175	0.00	0.00	0.00	0.
1.04	4.30	51	0.00	0.00	0.00	455.	1.12	0.00	176	0.00	0.00	0.00	0.
1.04	6.00	52	0.00	0.00	0.00	431.	1.12	1.30	177	0.00	0.00	0.00	0.
1.04	7.30	53	0.00	0.00	0.00	409.	1.12	3.00	178	0.00	0.00	0.00	0.
1.04	9.00	54	0.00	0.00	0.00	387.	1.12	4.30	179	0.00	0.00	0.00	0.
1.04	10.30	55	0.00	0.00	0.00	367.	1.12	6.00	180	0.00	0.00	0.00	0.
1.04	12.00	56	0.00	0.00	0.00	347.	1.12	7.30	181	0.00	0.00	0.00	0.
1.04	13.30	57	0.00	0.00	0.00	329.	1.12	9.00	182	0.00	0.00	0.00	0.
1.04	15.00	58	0.00	0.00	0.00	312.	1.12	10.30	183	0.00	0.00	0.00	0.
1.04	16.30	59	0.00	0.00	0.00	295.	1.12	12.00	184	0.00	0.00	0.00	0.
1.04	18.00	60	0.00	0.00	0.00	280.	1.12	13.30	185	0.00	0.00	0.00	0.
1.04	19.30	61	0.00	0.00	0.00	265.	1.12	15.00	186	0.00	0.00	0.00	0.
1.04	21.00	62	0.00	0.00	0.00	251.	1.12	16.30	187	0.00	0.00	0.00	0.
1.04	22.30	63	0.00	0.00	0.00	238.	1.12	18.00	188	0.00	0.00	0.00	0.
1.05	0.00	64	0.00	0.00	0.00	225.	1.12	19.30	189	0.00	0.00	0.00	0.
1.05	1.30	65	0.00	0.00	0.00	213.	1.12	21.00	190	0.00	0.00	0.00	0.
1.05	3.00	66	0.00	0.00	0.00	202.	1.12	22.30	191	0.00	0.00	0.00	0.
1.05	4.30	67	0.00	0.00	0.00	191.	1.13	0.00	192	0.00	0.00	0.00	0.
1.05	6.00	68	0.00	0.00	0.00	181.	1.13	1.30	193	0.00	0.00	0.00	0.
1.05	7.30	69	0.00	0.00	0.00	172.	1.13	3.00	194	0.00	0.00	0.00	0.
1.05	9.00	70	0.00	0.00	0.00	163.	1.13	4.30	195	0.00	0.00	0.00	0.
1.05	10.30	71	0.00	0.00	0.00	154.	1.13	6.00	196	0.00	0.00	0.00	0.
1.05	12.00	72	0.00	0.00	0.00	146.	1.13	7.30	197	0.00	0.00	0.00	0.
1.05	13.30	73	0.00	0.00	0.00	138.	1.13	9.00	198	0.00	0.00	0.00	0.

1.05	16.30	75	0.00	0.00	0.00	124.	1.13	12.00	200	0.00	0.00	0.00	0.
1.05	18.00	76	0.00	0.00	0.00	118.	1.13	13.30	201	0.00	0.00	0.00	0.
1.05	19.30	77	0.00	0.00	0.00	111.	1.13	15.00	202	0.00	0.00	0.00	0.
1.05	21.00	78	0.00	0.00	0.00	105.	1.13	16.30	203	0.00	0.00	0.00	0.
1.05	22.30	79	0.00	0.00	0.00	100.	1.13	18.00	204	0.00	0.00	0.00	0.
1.06	0.00	80	0.00	0.00	0.00	95.	1.13	19.30	205	0.00	0.00	0.00	0.
1.06	1.30	81	0.00	0.00	0.00	90.	1.13	21.00	206	0.00	0.00	0.00	0.
1.06	3.00	82	0.00	0.00	0.00	85.	1.13	22.30	207	0.00	0.00	0.00	0.
1.06	4.30	83	0.00	0.00	0.00	80.	1.14	0.00	208	0.00	0.00	0.00	0.
1.06	6.00	84	0.00	0.00	0.00	76.	1.14	1.30	209	0.00	0.00	0.00	0.
1.06	7.30	85	0.00	0.00	0.00	72.	1.14	3.00	210	0.00	0.00	0.00	0.
1.06	9.00	86	0.00	0.00	0.00	68.	1.14	4.30	211	0.00	0.00	0.00	0.
1.06	10.30	87	0.00	0.00	0.00	65.	1.14	6.00	212	0.00	0.00	0.00	0.
1.06	12.00	88	0.00	0.00	0.00	61.	1.14	7.30	213	0.00	0.00	0.00	0.
1.06	13.30	89	0.00	0.00	0.00	58.	1.14	9.00	214	0.00	0.00	0.00	0.
1.06	15.00	90	0.00	0.00	0.00	55.	1.14	10.30	215	0.00	0.00	0.00	0.
1.06	16.30	91	0.00	0.00	0.00	52.	1.14	12.00	216	0.00	0.00	0.00	0.
1.06	18.00	92	0.00	0.00	0.00	49.	1.14	13.30	217	0.00	0.00	0.00	0.
1.06	19.30	93	0.00	0.00	0.00	47.	1.14	15.00	218	0.00	0.00	0.00	0.
1.06	21.00	94	0.00	0.00	0.00	44.	1.14	16.30	219	0.00	0.00	0.00	0.
1.06	22.30	95	0.00	0.00	0.00	42.	1.14	18.00	220	0.00	0.00	0.00	0.
1.07	0.00	96	0.00	0.00	0.00	40.	1.14	19.30	221	0.00	0.00	0.00	0.
1.07	1.30	97	0.00	0.00	0.00	38.	1.14	21.00	222	0.00	0.00	0.00	0.
1.07	3.00	98	0.00	0.00	0.00	36.	1.14	22.30	223	0.00	0.00	0.00	0.
1.07	4.30	99	0.00	0.00	0.00	34.	1.15	0.00	224	0.00	0.00	0.00	0.
1.07	6.00	100	0.00	0.00	0.00	32.	1.15	1.30	225	0.00	0.00	0.00	0.
1.07	7.30	101	0.00	0.00	0.00	30.	1.15	3.00	226	0.00	0.00	0.00	0.
1.07	9.00	102	0.00	0.00	0.00	29.	1.15	4.30	227	0.00	0.00	0.00	0.
1.07	10.30	103	0.00	0.00	0.00	27.	1.15	6.00	228	0.00	0.00	0.00	0.
1.07	12.00	104	0.00	0.00	0.00	26.	1.15	7.30	229	0.00	0.00	0.00	0.
1.07	13.30	105	0.00	0.00	0.00	24.	1.15	9.00	230	0.00	0.00	0.00	0.
1.07	15.00	106	0.00	0.00	0.00	23.	1.15	10.30	231	0.00	0.00	0.00	0.
1.07	16.30	107	0.00	0.00	0.00	22.	1.15	12.00	232	0.00	0.00	0.00	0.
1.07	18.00	108	0.00	0.00	0.00	20.	1.15	13.30	233	0.00	0.00	0.00	0.
1.07	19.30	109	0.00	0.00	0.00	19.	1.15	15.00	234	0.00	0.00	0.00	0.
1.07	21.00	110	0.00	0.00	0.00	18.	1.15	16.30	235	0.00	0.00	0.00	0.
1.07	22.30	111	0.00	0.00	0.00	16.	1.15	18.00	236	0.00	0.00	0.00	0.
1.08	0.00	112	0.00	0.00	0.00	15.	1.15	19.30	237	0.00	0.00	0.00	0.
1.08	1.30	113	0.00	0.00	0.00	14.	1.15	21.00	238	0.00	0.00	0.00	0.
1.08	3.00	114	0.00	0.00	0.00	13.	1.15	22.30	239	0.00	0.00	0.00	0.
1.08	4.30	115	0.00	0.00	0.00	12.	1.16	0.00	240	0.00	0.00	0.00	0.
1.08	6.00	116	0.00	0.00	0.00	12.	1.16	1.30	241	0.00	0.00	0.00	0.
1.08	7.30	117	0.00	0.00	0.00	11.	1.16	3.00	242	0.00	0.00	0.00	0.
1.08	9.00	118	0.00	0.00	0.00	10.	1.16	4.30	243	0.00	0.00	0.00	0.
1.08	10.30	119	0.00	0.00	0.00	9.	1.16	6.00	244	0.00	0.00	0.00	0.
1.08	12.00	120	0.00	0.00	0.00	9.	1.16	7.30	245	0.00	0.00	0.00	0.
1.08	13.30	121	0.00	0.00	0.00	8.	1.16	9.00	246	0.00	0.00	0.00	0.
1.08	15.00	122	0.00	0.00	0.00	8.	1.16	10.30	247	0.00	0.00	0.00	0.
1.08	16.30	123	0.00	0.00	0.00	7.	1.16	12.00	248	0.00	0.00	0.00	0.
1.08	18.00	124	0.00	0.00	0.00	7.	1.16	13.30	249	0.00	0.00	0.00	0.
1.08	19.30	125	0.00	0.00	0.00	6.	1.16	15.00	250	0.00	0.00	0.00	0.

SUM..... 21.67..... 68027.
(.....)(550.)(.....)(1926.31)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2988.	2889.	2304.	1293.	66033.
CMS	85.	82.	65.	37.	1926.
INCHES		3.68	11.74	19.77	21.67
MM		93.51	298.23	502.21	550.51
AC-FT		1433.	4570.	7694.	8434.
THOUS CU M		1767.	5637.	9490.	10403.

HYDROGRAPH AT STA LAKE FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1494.	1445.	1152.	646.	34017.
CMS	42.	41.	33.	18.	963.
INCHES		1.84	5.87	9.89	10.84
MM		46.75	149.14	251.10	275.25
AC-FT		716.	2285.	3847.	4217.
THOUS CU M		884.	2818.	4745.	5202.

(24)

HYDROGRAPH ROUTING

ROUTED DISCHARGE THROUGH CENTENNIAL LAKE DAM (0.5 PMF DAM OVERTOPPING)

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	-60.	-1

STAGE	59.60	60.00	60.50	61.00	61.50	62.00	62.50	63.00	63.50	64.00
	64.50	65.00	65.50	66.00	67.00	68.00	69.00	70.00		
FLOW	0.00	9.00	30.00	59.00	93.00	132.00	176.00	202.00	222.00	241.00
	256.00	270.00	307.00	428.00	451.00	475.00	496.00	517.00		

CAPACITY=	0.	334.	358.	1244.						
ELEVATION=	48.	60.	60.	70.						

Actual overtopping begins at elevation 65 in the the depressed areas at the ends of the dam.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
59.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
66.0	2.6	1.5	300.

STATION DAM, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	1.	1.	1.	1.	1.	2.	7.
22.	62.	150.	228.	292.	815.	1393.	1393.	1327.	1260.
1195.	1134.	1075.	1019.	967.	917.	870.	825.	783.	743.
704.	668.	634.	602.	572.	544.	517.	493.	470.	450.
433.	420.	403.	385.	368.	350.	333.	316.	305.	299.
293.	286.	278.	270.	267.	264.	260.	256.	252.	247.
243.	237.	231.	225.	219.	213.	207.	200.	192.	185.
177.	166.	153.	145.	136.	127.	120.	113.	107.	101.
95.	90.	85.	81.	77.	73.	70.	66.	63.	59.
57.	54.	52.	50.	48.	46.	44.	42.	40.	38.
36.	35.	33.	32.	30.	29.	28.	27.	26.	25.
24.	23.	22.	22.	21.	20.	19.	18.	17.	17.
16.	15.	15.	14.	13.	13.	12.	12.	11.	11.
10.	10.	9.	9.	9.	8.	8.	8.	7.	7.
7.	7.	6.	6.	6.	6.	6.	5.	5.	5.
5.	5.	4.	4.	4.	4.	4.	4.	4.	3.
3.	3.	3.	3.	3.	3.	3.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STORAGE

334.	335.	335.	335.	336.	336.	336.	337.	340.	352.
386.	452.	553.	682.	827.	945.	938.	989.	984.	980.
975.	970.	966.	961.	957.	953.	948.	944.	940.	936.
932.	929.	925.	921.	917.	913.	910.	906.	902.	897.
892.	887.	882.	874.	867.	861.	855.	849.	842.	836.
828.	820.	811.	801.	791.	781.	769.	757.	744.	731.
718.	704.	690.	676.	662.	648.	634.	621.	607.	594.
582.	570.	559.	548.	539.	530.	522.	514.	507.	500.
495.	487.	482.	476.	471.	466.	461.	457.	452.	448.
445.	441.	437.	434.	430.	427.	424.	421.	418.	415.
413.	410.	407.	405.	403.	401.	398.	396.	394.	392.
390.	388.	386.	384.	383.	381.	379.	377.	376.	374.
373.	371.	370.	369.	367.	366.	365.	364.	363.	361.
360.	359.	359.	358.	357.	356.	355.	355.	354.	353.
353.	352.	351.	351.	350.	349.	349.	348.	348.	347.
347.	345.	345.	345.	345.	345.	344.	344.	343.	343.
343.	342.	342.	342.	341.	341.	341.	341.	340.	340.
340.	340.	339.	339.	339.	339.	339.	338.	338.	338.
338.	338.	338.	337.	337.	337.	337.	337.	337.	337.
337.	336.	336.	336.	336.	336.	336.	336.	336.	336.
336.	336.	336.	336.	336.	336.	336.	336.	336.	336.
336.	335.	335.	335.	335.	335.	335.	335.	335.	335.
335.	335.	335.	335.	335.	335.	335.	335.	334.	334.
334.	334.	334.	334.	334.	334.	334.	334.	334.	334.
334.	334.	334.	334.	334.	334.	334.	334.	334.	334.

STAGE

59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.7	59.9
60.3	61.1	62.2	63.7	65.3	66.6	67.1	67.1	67.1	67.0
67.0	66.9	66.9	66.8	66.8	66.7	65.7	66.6	66.6	66.5
66.5	66.4	66.4	66.4	66.3	66.3	65.2	66.2	66.1	66.1
66.0	66.0	65.9	65.8	65.8	65.7	65.6	65.5	65.5	65.4
65.3	65.2	65.1	65.0	64.9	64.8	64.6	64.5	64.4	64.2
64.1	63.9	63.7	63.6	63.4	63.3	63.1	63.0	62.8	62.7
62.5	62.4	62.3	62.1	62.0	61.9	61.8	61.8	61.7	61.6
61.5	61.5	61.4	61.3	61.3	61.2	61.2	61.1	61.1	61.0
61.0	60.9	60.9	60.9	60.8	60.8	60.7	60.7	60.7	60.6
60.6	60.6	60.6	60.5	60.5	60.5	60.5	60.4	60.4	60.4
60.4	60.3	60.3	60.3	60.3	60.3	60.2	60.2	60.2	60.2
60.2	60.2	60.1	60.1	60.1	60.1	60.1	60.1	60.1	60.0
60.0	60.0	60.0	60.0	60.0	60.0	60.0	59.9	59.9	59.9
59.9	59.9	59.9	59.9	59.9	59.9	59.8	59.8	59.8	59.8
59.8	59.8	59.8	59.8	59.8	59.8	59.8	59.8	59.8	59.8
59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7	59.7
59.7	59.7	59.7	59.7	59.7	59.7	59.6	59.6	59.6	59.6
59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
59.6	59.6	59.6	59.6	59.5	59.5	59.6	59.6	59.6	59.6

PEAK OUTFLOW IS 1393. AT TIME 27.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1393.	1317.	1021.	592.	34043.
CMS	39.	37.	29.	17.	964.
INCHES		1.69	5.20	9.05	10.85
MM		42.63	132.18	229.89	275.47
AC-FT		653.	2025.	3522.	4220.
THOUS CU M		806.	2498.	4344.	5206.

STATION DAM, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

(3)6

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	59.60	59.60	66.00
STORAGE	334.	334.	890.
OUTFLOW	0.	0.	428.

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	67.12	1.12	989.	1393.	39.00	27.00	0.00
.40	66.84	.84	954.	1053.	31.50	29.50	0.00
.30	66.47	.47	932.	697.	21.00	31.50	0.00
.18	65.01	0.00	802.	271.	0.00	43.50	0.00
.10	62.49	0.00	578.	175.	0.00	39.00	0.00

overtopping above the maindam crest at elevation 66. Overtopping actually begins at elevation 65 in the depressed areas.

03832

STORCH ENGINEERS

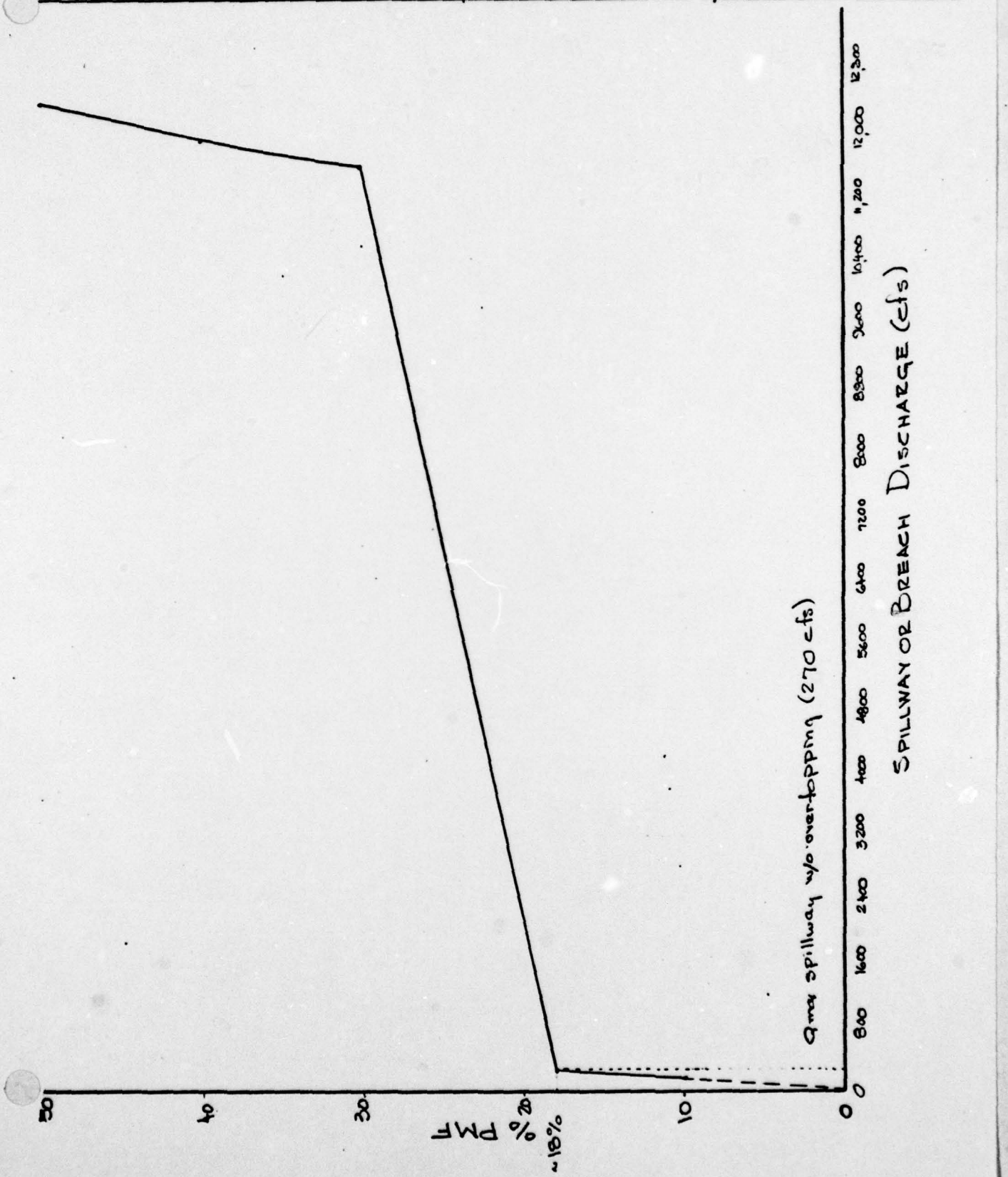
Sheet 1 of ____

Project CENTENNIAL LAKE DAM

Made By EAW Date APR. 3, 1979

% PMF PASSED THROUGH SPILLWAY

Chkd By ____ Date ____



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

HYDROGRAPH ROUTING

ROUTED DISCHARGE THROUGH CENTENNIAL LAKE DAM (0.5 PMF DAM BREACH)

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
TAUN	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	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-60.	-1

STAGE	59.50	60.00	60.50	61.00	61.50	62.00	62.50	63.00	63.50	64.00
	64.50	65.00	65.50	66.00	67.00	68.00	69.00	70.00		
FLOW	0.00	9.00	30.00	58.00	93.00	132.00	176.00	202.00	222.00	241.00
	256.00	270.00	307.00	429.00	451.00	475.00	496.00	517.00		
CAPACITY=	0.	334.	358.	1244.						
ELEVATION=	48.	60.	60.	70.						

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
59.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
66.0	2.6	1.5	300.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
50.	2.00	47.90	1.00	59.60	66.00

(Assumed that breach will not develop until the entire dam is overtopped at elevation 66.

STATION TAUN, PLAN 1, RATIO 1

BEGIN DAM FAILURE AT 25.00 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	1.	1.	2.	4.	8.	18.	34.	66.	118.
185.	227.	262.	371.	850.	12421.	2531.	1407.	1329.	1280.
1255.	1192.	1150.	1110.	1071.	1033.	997.	962.	928.	896.
864.	834.	805.	776.	749.	723.	697.	673.	649.	627.
605.	584.	563.	543.	524.	506.	488.	471.	455.	439.
423.	409.	394.	380.	367.	354.	342.	330.	318.	307.
297.	286.	275.	267.	257.	248.	240.	231.	223.	215.
208.	201.	194.	187.	180.	174.	168.	162.	157.	151.
145.	141.	135.	131.	127.	122.	119.	114.	110.	106.
102.	99.	95.	92.	89.	86.	83.	80.	77.	74.
71.	69.	66.	62.	59.	55.	52.	48.	45.	43.
40.	37.	35.	33.	31.	29.	27.	25.	24.	22.
21.	20.	18.	17.	16.	15.	14.	13.	12.	12.
11.	10.	10.	9.	9.	8.	8.	7.	7.	6.
6.	6.	5.	5.	5.	4.	4.	4.	4.	3.
3.	3.	3.	3.	3.	2.	2.	2.	2.	2.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STORAGE

334.	335.	335.	335.	335.	335.	335.	336.	336.	336.
336.	337.	338.	340.	346.	356.	376.	409.	457.	520.
595.	681.	775.	869.	940.	562.	165.	115.	111.	109.
106.	104.	102.	99.	97.	95.	93.	91.	89.	87.
85.	83.	81.	79.	78.	76.	74.	72.	71.	69.
68.	66.	65.	63.	62.	60.	59.	58.	56.	55.
54.	53.	51.	50.	49.	48.	47.	46.	45.	44.
43.	42.	41.	40.	39.	38.	37.	36.	36.	35.
34.	33.	32.	32.	31.	30.	30.	29.	28.	28.
27.	26.	25.	25.	25.	24.	23.	23.	22.	22.
21.	21.	20.	20.	20.	19.	19.	18.	18.	17.
17.	16.	15.	15.	15.	14.	14.	13.	13.	12.
12.	11.	11.	10.	10.	9.	9.	9.	8.	8.
7.	7.	7.	7.	5.	5.	6.	6.	5.	5.
5.	5.	5.	4.	4.	4.	4.	4.	4.	3.
3.	3.	3.	3.	3.	3.	3.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6
59.6	59.6	59.7	59.7	59.8	60.0	60.2	60.6	61.1	61.8
62.7	63.6	64.7	65.8	66.6	62.3	53.7	51.9	51.8	51.7
51.6	51.5	51.5	51.4	51.3	51.2	51.2	51.1	51.0	50.9
50.9	50.8	50.7	50.7	50.6	50.6	50.5	50.4	50.4	50.3
50.3	50.2	50.2	50.1	50.1	50.0	50.0	49.9	49.9	49.8
49.8	49.7	49.7	49.7	49.6	49.6	49.5	49.5	49.5	49.4
49.4	49.4	49.3	49.3	49.3	49.2	49.2	49.2	49.1	49.1
49.1	49.1	49.0	49.0	49.0	49.0	48.9	48.9	48.9	48.9
48.8	48.8	48.8	48.8	48.8	48.7	48.7	48.7	48.7	48.7
48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.5	48.5	48.5
48.5	48.5	48.5	48.4	48.4	48.4	48.4	48.4	48.3	48.3
48.3	48.3	48.3	48.3	48.2	48.2	48.2	48.2	48.2	48.2
48.2	48.2	48.1	48.1	48.1	48.1	48.1	48.1	48.1	48.1
48.1	48.1	48.1	48.1	48.0	48.0	48.0	48.0	48.0	48.0
48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0
48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0
48.0	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9
47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9	47.9

PEAK OUTFLOW IS 12421. AT TIME 26.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12421.	3335.	1517.	725.	55566.
CMS	352.	94.	43.	21.	1573.
INCHES		4.25	7.73	11.09	11.80
MM		107.95	196.42	281.78	299.75
AC-FT		1654.	3009.	4317.	4592.
THOUS CU M		2040.	3712.	5325.	5664.

Computer Forms Inc. Form 1485J

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	59.60	59.60	65.00
STORAGE	334.	334.	890.
OUTFLOW	0.	0.	428.

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	66.60	.60	943.	12421.	1.46	25.00	25.00
.40	66.18	.18	905.	11927.	1.32	27.00	26.00
.30	66.24	.24	911.	11646.	1.30	31.00	30.00
.18	64.93	0.00	795.	258.	0.00	49.00	0.00
.10	62.46	0.00	576.	173.	0.00	40.00	0.00

overtopping above the main dam crest at elevation 66. Overtopping actually begins at elevation 65 in the depressed areas

HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH BREAKNECK DAM (0.5 PMF ROUTING THROUGH TAUNTON LAKE)

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
BKNK	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	-51.	-1

STAGE	51.00	51.50	52.00	52.50	53.00	53.50	54.00	54.50	55.00	55.80
FLOW	0.00	65.00	170.00	315.00	500.00	715.00	995.00	1215.00	1360.00	1464.00
SURFACE AREA=	0.	39.	78.							
CAPACITY=	0.	122.	639.							
ELEVATION=	42.	51.	60.							

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
51.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
55.8	2.6	1.5	255.

(Assumed that dam on Taunton Lake does not breach)

STATION BKNK, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	1.	2.	2.	2.	2.	2.	2.	2.	3.
5.	10.	20.	43.	105.	260.	572.	1046.	1372.	1599.
2136.	2280.	2231.	2171.	2303.	8320.	9015.	3128.	2685.	2516.
2384.	2262.	2149.	2042.	1942.	1847.	1759.	1677.	1601.	1532.
1474.	1447.	1418.	1383.	1327.	1246.	1158.	1078.	1015.	954.
902.	857.	817.	780.	744.	711.	685.	657.	629.	602.
576.	551.	527.	505.	485.	467.	448.	430.	412.	395.
379.	364.	349.	335.	321.	310.	299.	288.	277.	266.
256.	246.	237.	227.	218.	210.	202.	194.	187.	179.
173.	167.	162.	157.	151.	145.	140.	135.	130.	126.
121.	116.	112.	108.	104.	100.	96.	93.	89.	86.
83.	80.	75.	73.	70.	66.	63.	61.	58.	55.
53.	50.	47.	44.	42.	39.	37.	35.	33.	31.
29.	27.	25.	24.	22.	21.	19.	18.	17.	16.
15.	14.	13.	12.	12.	11.	10.	10.	9.	8.
8.	7.	7.	7.	6.	6.	5.	5.	5.	5.
4.	4.	4.	4.	3.	3.	3.	3.	3.	2.
2.	2.	2.	2.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STORAGE

122.	123.	123.	123.	123.	123.	123.	123.	123.	123.
124.	125.	128.	135.	150.	176.	215.	262.	314.	370.
407.	415.	412.	409.	416.	658.	682.	457.	436.	428.
421.	414.	408.	401.	395.	389.	383.	377.	370.	364.
356.	346.	334.	319.	302.	287.	275.	266.	258.	252.
248.	244.	240.	237.	234.	231.	228.	225.	222.	219.
216.	213.	211.	208.	206.	203.	201.	199.	197.	195.
193.	191.	189.	187.	186.	184.	182.	181.	179.	177.
176.	174.	173.	172.	170.	169.	168.	167.	165.	164.
163.	162.	161.	160.	159.	158.	157.	156.	155.	154.
153.	152.	151.	151.	150.	149.	148.	148.	147.	146.
146.	145.	144.	144.	143.	142.	142.	141.	140.	139.
138.	137.	137.	136.	135.	134.	133.	133.	132.	131.
131.	130.	130.	129.	129.	128.	128.	128.	127.	127.
127.	126.	125.	126.	126.	125.	125.	125.	125.	125.
125.	124.	124.	124.	124.	124.	124.	124.	124.	124.
123.	123.	123.	123.	123.	123.	123.	123.	123.	123.
123.	123.	123.	123.	123.	123.	123.	123.	123.	123.
123.	123.	123.	123.	123.	122.	122.	122.	122.	122.
122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
122.	122.	122.	122.	122.	122.	122.	122.	122.	122.

STAGE

51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.1	51.2	51.3	51.7	52.3	53.2	54.1	55.1	56.1
56.7	56.8	56.8	56.7	56.8	60.2	60.5	57.5	57.1	57.0
56.9	56.8	56.7	56.5	56.5	55.4	56.3	56.2	56.1	56.0
55.8	55.7	55.4	55.2	54.9	54.5	54.4	54.2	54.0	53.9
53.8	53.8	53.7	53.6	53.6	53.5	53.4	53.4	53.3	53.2
53.2	53.1	53.1	53.0	53.0	52.9	52.9	52.8	52.8	52.7
52.7	52.6	52.6	52.6	52.5	52.5	52.4	52.4	52.4	52.3
52.3	52.3	52.2	52.2	52.2	52.1	52.1	52.1	52.1	52.0
52.0	52.0	52.0	51.9	51.9	51.9	51.9	51.9	51.8	51.8
51.8	51.7	51.7	51.7	51.7	51.7	51.6	51.6	51.6	51.6
51.6	51.6	51.6	51.5	51.5	51.5	51.5	51.5	51.4	51.4
51.4	51.4	51.4	51.3	51.3	51.3	51.3	51.3	51.3	51.2
51.2	51.2	51.2	51.2	51.2	51.2	51.1	51.1	51.1	51.1
51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1
51.1	51.1	51.1	51.1	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0

Stage in Taunton Lake. See "Water Surface Elev. Vs Storm Time" plotting.

PEAK OUTFLOW IS 9015. AT TIME 27.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9015.	4668.	2573.	1254.	95132.
CMS	255.	132.	73.	35.	2694.
INCHES		3.34	7.38	10.76	11.35
MM		84.84	187.49	273.42	288.17
AC-FT		2315.	5115.	7459.	7862.
THOUS CU M		2855.	6310.	9201.	9698.

STORCH ENGINEERS

Sheet 2 of _____

Project CENTENNIAL LAKE DAM #1132 Made By EAW Date MAR 28, 1979

BREACH/STAGE ANALYSIS (DOWNSTREAM) Chkd By _____ Date _____

APPENDIX 5

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