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NATIONAL DAM SAFETY PROGRAM. HOLIDAY LAKE DAM (NJ 00061), ATLAN--ETC(U)
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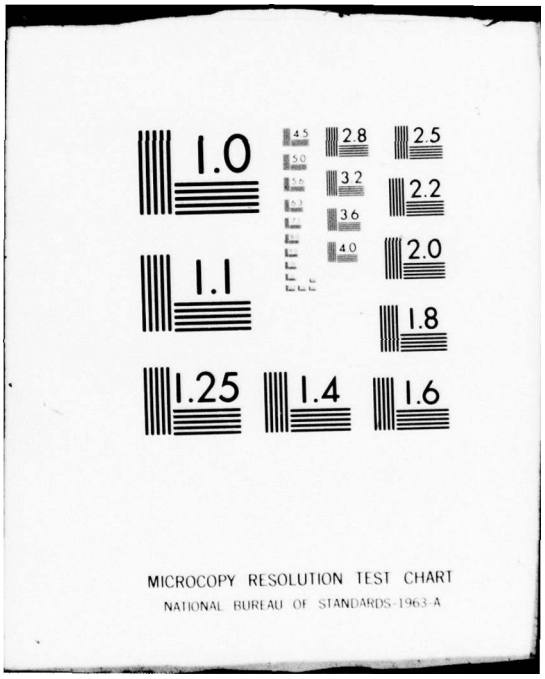
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ATLANTIC COAST BASIN
FOUR MILE BRANCH MILL CREEK
OCEAN COUNTY
NEW JERSEY

HOLIDAY LAKE DAM
NJ 00061

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

May, 1979

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7. AUTHOR(s) (10) Richard J. McDermott, P.E.		8. CONTRACT OR GRANT NUMBER(s) (15) DACW61-78-C-0124
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Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

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

Dams	Visual Inspection
Riprap	Structural Analysis
Embankments	National Dam Inspection Act Report
Spillways	Holiday 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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PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

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

17 MAY 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Holiday Lake Dam in Ocean 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, Holiday Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition and the dam's spillway is considered adequate. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within three months from the date of approval of this report, a qualified professional engineer should be engaged to monitor the three seepage zones on the downstream side of the dam (especially near the spillway discharge culvert) by visual observation and measurements on a monthly basis. Measurements should be made, if necessary, to determine the source and seriousness of the seepage and a complete inspection of the toe drain should be performed. In addition a detailed topographic survey of the dam and area around the dam based on USGS datum should be made. The survey map should be related to existing construction drawings and should become part of the permanent record. Any remedial measures found necessary should be initiated within calendar year 1980.

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

(1) Trees, brush and weeds on the embankment and in the emergency spillway should be removed.

(2) The asphalt coating on the spillway anti-vortex cover should be renewed after rust is removed.

(3) Erosion on the downstream embankment should be filled, compacted and sodded.

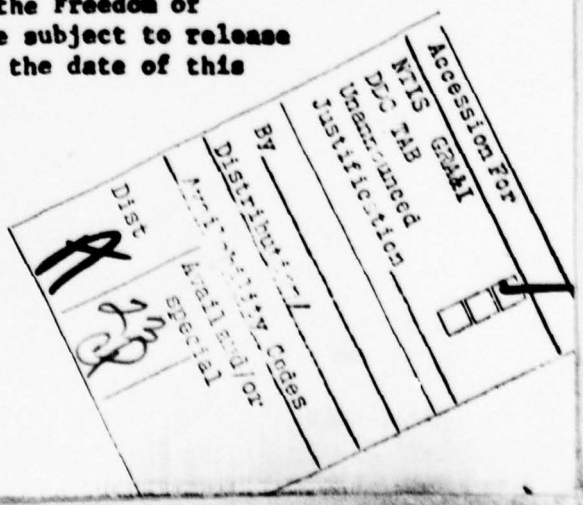
(4) A suitable stand of grass should be established on the bare sections of the embankment.

(5) Access to the dam by motor vehicles should be prevented by constructing barriers at each end of the embankment.

(6) Riprap on the upstream face of embankment should be renovated by the placement of additional stones.

(7) The owner of the dam should initiate a program of periodic inspection and maintenance, the complete records of which to be kept on file. A visual inspection of the dam and appurtenances by a qualified professional engineer should be made annually and reported on a standardized check-list form. Repairs should be made when required and the following maintenance should be performed annually: remove trees and brush from the embankment, fill and sod any eroded surfaces of the embankment and clear the downstream channel. The current practice of periodically lowering the lake for maintenance purposes should be continued and at least once every five years the lake should be lowered completely at which time the lake should be cleaned and submerged portions of the dam and spillway should be inspected and repaired.

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 William J. Hughes of the Second District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.



NAPEN-D
Honorable Brendan T. Byrne

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

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N. J. Dept. of Environmental Protection
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HOLIDAY LAKE DAM (NJ00061)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 20 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.

Holiday Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition and the dam's spillway is considered adequate. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within three months from the date of approval of this report, a qualified professional engineer should be engaged to monitor the three seepage zones on the downstream side of the dam (especially near the spillway discharge culvert) by visual observation and measurements on a monthly basis. Measurements should be made, if necessary, to determine the source and seriousness of the seepage and a complete inspection of the toe drain should be performed. In addition a detailed topographic survey of the dam and area around the dam based on USGS datum should be made. The survey map should be related to existing construction drawings and should become part of the permanent record. Any remedial measures found necessary should be initiated within calendar year 1980.

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

(1) Trees, brush and weeds on the embankment and in the emergency spillway should be removed.

(2) The asphalt coating on the spillway anti-vortex cover should be renewed after rust is removed.

(3) Erosion on the downstream embankment should be filled, compacted and sodded.

(4) A suitable stand of grass should be established on the bare sections of the embankment.

(5) Access to the dam by motor vehicles should be prevented by constructing barriers at each end of the embankment.

(6) Riprap on the upstream face of embankment should be renovated by the placement of additional stones.

(7) The owner of the dam should initiate, a program of periodic inspection and maintenance, the complete records of which to be kept on file. A visual inspection of the dam and appurtenances by a qualified professional engineer should be made annually and reported on a standardized check-list form. Repairs should be made when required and the following maintenance should be performed annually: remove trees and brush from the embankment, fill and sod any eroded surfaces of the embankment and clear the downstream channel. The current practice of periodically lowering the lake for maintenance purposes should be continued and at least once every five years the lake should be lowered completely at which time the lake should be cleaned and submerged portions of the dam and spillway should be inspected and repaired.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 22 May 1979

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Holiday Lake Dam, I.D. NJ00061
State Located:	New Jersey
County Located:	Ocean
Drainage Basin:	Atlantic Coastal
Stream:	Fourmile Branch, Mill Creek
Date of Inspection:	December 20, 1978

Assessment of General Condition of Dam

Based on visual inspection, available records, past operational performance and Phase I engineering analyses, Holiday Lake Dam is assessed as being in fair overall condition.

The spillways are capable of passing the designated spillway design flood when the water level in the lake is equal to the dam crest elevation and, therefore, are assessed as being adequate.

Three zones of seepage are present on the downstream side of the dam. A qualified professional engineer should be engaged soon to monitor the seepage in order to assess its source and effect on the structural stability of the dam.

The following remedial measures should be undertaken by the owner in the near future:

1. Trees, brush and weeds on the embankment and in the emergency spillway should be removed.

2. The asphalt coating on the spillway anti-vortex cover should be renewed after rust is removed.
3. Erosion on the downstream embankment should be filled, compacted and sodded.
4. A suitable stand of grass should be established on the bare sections of the embankment.
5. Access to the dam by motor vehicles should be prevented by constructing barriers at each end of the embankment.
6. Riprap on the upstream face of embankment should be renovated by the placement of additional stones.

The owner should, in the near future, implement a program of periodic inspection and maintenance for the dam which would include a topographic survey to provide a record of existing conditions. Repairs should be made when required and the following maintenance should be performed annually: remove trees and brush from the embankment, fill and sod any eroded surfaces and clear the downstream channel. The current practice of lowering the lake for maintenance purposes should be continued and at least once every five years the lake should be lowered completely at which time the lake should be cleaned and submerged portions of the dam and spillway inspected and repaired.

Richard J. McDermott

Richard J. McDermott P.E.

OVERVIEW - HOLIDAY LAKE DAM

20 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

HOLIDAY LAKE DAM, I.D. NJ00061

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 inititate 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 responsiblity 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

The visual inspection of Holiday Lake Dam was made on December 20, 1978. The purpose of the inspection was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description

Holiday Lake Dam is an earthfill dam with a clay core. Discharge from Holiday Lake which is impounded by the subject dam is provided by a corrugated metal drop inlet spillway and a grass emergency spillway with trapezoidal cross-section. A slide gate located at the bottom of the drop inlet serves as an outlet works. Water which enters the drop inlet spillway discharges into the downstream channel via a corrugated metal discharge culvert which transversely penetrates the dam embankment.

Slope protection is provided on the upstream face of embankment by the placement of riprap. A cut-off trench is located along the center of the dam and a toe drain along the downstream toe of dam.

Having an overall crest length of 600 feet, the dam has a top width of 15 feet and upstream and downstream slopes of 3 horizontal to 1 vertical each. The drop inlet comprising the spillway has a diameter of 6 feet and a total weir length of 18.8 feet. A corrugated metal trash rack and anti-vortex chamber having dimensions 7 feet by 7 feet is located atop the drop inlet. The spillway discharge culvert has a diameter of 48 inches and outlets through a flared end section at the downstream toe of dam. The outlet works intake consists of a 24-inch diameter corrugated metal pipe.

The emergency spillway discharge channel has a bottom width of 75 feet and side slopes of 4:1. The crest is composed of a concrete slab with breadth 25 feet and length 70 feet and is surrounded by riprap.

The spillway crest lies 5 feet below the crest of dam and 10.6 feet above the invert of the spillway discharge culvert flared end section. The emergency spillway crest lies 2.9 feet below the crest of dam and 2.1 feet above the spillway crest.

b. Location

Holiday Lake Dam is located in the Township of Strafford, Ocean County, New Jersey. Constructed across the Fourmile Branch of Mill Creek, it impounds Holiday Lake which is the recreation focus of a residential development known as Ocean Acres. Principal access to the dam is provided by an easement through a residential building lot at the southwest end of the dam.

c. Size and Hazard Classification

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 Holiday Lake Dam are:

Storage = 810 acre-feet

Height = 15.6 feet

Potential Loss of Life: No homes in downstream flood plain as delineated by SDF outflow. Traffic on two Garden State Parkway bridges.

Potential Economic Loss: Two Garden State Parkway bridges within 1000 feet of dam. Failure outflow would overtop roadway but would not wash out bridges.

Therefore, Holiday Lake Dam is classified as "Small" size and "Significant" hazard potential.

d. Ownership

Holiday Lake Dam is owned by Ocean Acres Country Club, Manahawkin, New Jersey 08050

e. Purpose of Dam

The purpose of the dam is the impoundment of a recreational lake facility. The lake is also used for irrigation for Ocean Acres Country Club located along its west shore.

f. Design and Construction History

The dam was constructed in 1965 to impound a lake in connection with a residential development. Construction plans were prepared by Site Engineers Inc. in 1965.

g. Normal Operational Procedures

The dam and appurtenances are maintained by the maintenance staff of Ocean Acres Country Club. Maintenance generally is performed on an "as-needed" basis and regular maintenance reportedly consists of mowing the grass on the embankment.

The outlet works is used to drain the lake to facilitate lake related maintenance and is not used for emergency purposes during storms.

1.3 Pertinent Data

a. Drainage Area - 5.5 square miles

b. Discharge at Damsite

Maximum known flood at damsite	Unknown
Outlet works at pool elevation	26 c.f.s.
Diversion tunnel low pool outlet pool elevation	N. A.
Diversion tunnel outlet at pool elevation	N.A.
Gated spillway capacity at pool elevation	N. A.
Gated spillway capacity at maximum pool elevation	N. A.
Ungated spillway capacity at top of dam	192 c.f.s.
Emergency spillway at top of dam	1000 c.f.s.
Total spillway capacity at top of dam	1192 c.f.s.

c. Elevation (Feet above MSL)

Top of dam	57.0
Maximum pool-design surcharge	57.0
Full flood control pool	N.A.
Recreation pool	52.0
Spillway crest	52.0
Upstream portal invert diversion tunnel	N.A.
Stream bed at centerline of dam	42
Maximum tailwater	46± (Estimated)

d. Reservoir

Length of maximum pool	5,000 feet (Estimated)
Length of recreation pool	3,000 feet (Scaled)
Length of flood control pool	N.A.

e. Storage (Acre-feet)

Recreation pool	338 acre-feet
Flood control pool	N.A.
Design surcharge	810 acre-feet
Top of dam	810 acre-feet

f. Reservoir Surface (Acres)

Top of dam	108 acres (Estimated)
Maximum pool	108 acres (Estimated)
Flood control pool	N.A.
Recreation pool	39 acres
Spillway crest	39 acres

g. Dam

Type	Earthfill
Length	680 feet
Height	15.6 feet
Sideslopes - Upstream	3 horiz. to 1 vert.
- Downstream	3 horiz. to 1 vert.
Zoning	Impervious core flanked by pervious fill
Impervious core	Clay
Cutoff	Trench, 5' deep
Grout curtain	None

h. Diversion and Regulating Tunnel — N.A.

i. Spillway

Type	Drop Inlet
Length of weir	18.8 feet
Crest elevation	52.0
Gates	N.A.
Upstream channel	N.A.
Downstream channel	48" dia. CMP Discharge culvert

j. Emergency Spillway

Type	Grassed waterway, Trapezoidal section
Weir	25'x70' conc. slab surrounded by riprap
Crest elevation	54.1
Discharge channel	
Bottom width	75'
Side slopes	4 horiz. to 1 vert.

k. Regulating Outlet

24-inch gated CMP discharging into drop inlet spillway

SECTION 2: ENGINEERING DATA

2.1 Design

The firm of Site Engineers Inc., Moorestown, New Jersey prepared the original design for Holiday Lake Dam including a soils report, a report on general engineering analysis and contruction drawings. In the soils report, the following analyses were developed:

1. Subsoil investigation including borings and field permeability tests
2. Laboratory investigation
3. Permeability and structural design and design of filter, cutoff trench, spillway, freeboard and slope protection.

Subsoil investigations revealed the following soil strata beneath the dam site:

0' to 40' Gray and brown coarse to fine sand with traces of silt, clay and/or gravel

40' to 50' Dark gray to black silty clay or clayey silt with considerable amount of solid organic material. This material was found to be stiff to very stiff as related to standard penetration test with medium to high plasticity. (The borings did not reach the bottom of this stratum.)

Water table at 2.5' to 5' below ground surface.

Permeablity design was limited to an analysis of seepage loss through and under the dam. Structural design consisted of a "circle stability" analysis of the upstream embankment which indicated a factor of safety of 1.66.

In a subsequent general engineering analysis report, it was disclosed that the dam was designed to pass the design flood by the use of both the spillway and the auxiliary spillway.

Available construction drawings contain the following:

1. Location Plan
2. Profile of Emergency Spillway
3. Plan and Profile of Dam
4. Typical Sections
5 Detail of Drop Inlet Spillway

2.2 Construction

One inspection report made during construction acitivities is contained in the NJDEP file. Two inspection reports made subsequent to the completion of construction are also contained in the NJDEP file. In the first of these reports, written in 1966,the following deficiencies were noted:

1. Soft areas on the downstream face of embankment.
2. Erosion on the downstream face of embankment at the spillway outlet.
3. Riprap not placed to elevation 51.0 at the emergency spillway.

In the second inspection report, written in 1967, it was indicated that the three deficiences had been corrected.

In addition to the inspection reports, construction drawings and specifications are contained in the NJDEP file.

2.3 Operation

No records of operation of the lake or dam are available. Annual inspection reports are available for the years 1969 through 1974. All of these reports indicate that the dam was in very good condition during those years.

2.4 Evaluation

a. Availability

Available engineering information is limited to that which is on file at the NJDEP. The NJDEP file contains copies of plans, calculations, reports, correspondence, photographs, inspection reports and specifications. The file is available for inspection at the offices of the Bureau of Flood Plain Management, 1474 Prospect Street, Trenton, N. J.

b. Adequacy

The available information forms a good description of the subject dam and is of considerable assistance in the performance of a Phase I evaluation. A list of absent data is included in paragraph 7.1.b.

c. Validity

Information that could be verified was found to be valid within a reasonable allowance for error.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspection of Holiday Lake Dam took place on December 20, 1978 by members of the staff of Storch Engineers. A copy of the visual inspection check list is contained in Appendix 1. The following procedures were employed for the inspection:

1. The embankment of the dam, appurtenant structures and adjacent areas were examined.
2. Areas of seepage were noted and located.
3. The embankment and appurtenant structures were measured and key elevations were determined by hand level.
4. The embankment and appurtenant structures and adjacent areas were photographed.

b. Dam

The dam embankment appeared to be uniformly aligned both vertically and horizontally with a good stand of grass covering most surfaces. A path located along the dam crest as well as some sections of the downstream slope lack grass cover. A few small trees were observed on the embankment. No evidence of cracking or settling was noted nor were any animal holes observed.

Riprap was noted along the entire length of the upstream face of embankment and around the concrete slab used as crest for the emergency spillway. The riprap appeared to be insufficient in quantity to provide adequate slope protection.

Severe erosion was observed on the downstream face of embankment at the spillway discharge culvert. The depth of erosion is such that one anti-seep collar is exposed.

Evidence of seepage noted in three locations on the downstream side of the dam. A soft, wet area is located approximately 100 feet northeast of the spillway outlet and two points of seepage discharge are located at the edge of the stilling basin near the spillway outlet. Seepage flow at the stilling basin is characterized as a slight trickle.

The wet area observed at the downstream toe of dam and the erosion at the spillway outlet are considered similar to the description contained in the inspection report written in 1966 subsequent to the completion of construction.

The generalized soils description of the dam site consists of alluvial, stratified materials composed predominately of gravel and sand sizes, with small quantities of silt and clay. These materials overlay an assortment of stratified materials, consisting of gravel, sand, silt and clay in various combinations deposited during the Tertiary Period and known as Cohansey Sand on the Geologic Map of New Jersey prepared by Lewis and Kummel. The lake basin contains significant surficial organic material, silt and sand with some clay. Bedrock is in excess of 100 feet below ground surface.

Reports of borings made at the dam site in 1964 are summarized in paragraph 2.1.

c. Appurtenant Structures

Spillway

Most of the corrugated metal drop inlet spillway was covered, submerged or buried at the time of inspection and, therefore, could not be observed. The corrugated metal trash rack and anti-vortex cover appeared to be in good condition. However, much of the asphalt coating had peeled off of the surface and the metal had become somewhat rusted. The flared end section at the spillway discharge culvert outlet contains some rust but otherwise is in good condition.

Emergency Spillway

The concrete crest of the emergency spillway appeared to be level and in good condition. The discharge channel appeared to be uniformly graded although its bottom contained a thick growth of high grass and weeds.

Outlet Works

The outlet works were submerged and buried except for the upper portion of the manually operated slide gate stem. There was no gate wheel on the stem which was not operated at the time of inspection.

d. Reservoir Area

Holiday Lake is long and narrow, averaging approximately 550 feet in width with an overall length in excess of one-half mile. It is located at the east end of the recently developed residential area of Ocean Acres.

Terrain surrounding the lake has slopes ranging from 1% to 4%. The east shoreline is wooded while the west shoreline contains residential development and Ocean Acres Country Club.

e. Downstream Channel

The spillway discharges into the Fourmile Branch of Mill Creek which is a narrow winding stream with a wide, wooded flood plain. No significant obstructions were observed in the vicinity of the dam.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Holiday Lake is regulated naturally by discharge into the drop inlet spillway and, at times of intense storms, by additional discharge through the emergency spillway.

Periodically, the lake is lowered for maintenance by opening the gate in the outlet works. Reportedly, the most recent drawdown of the lake took place in 1978. At that time, two days were required to lower the lake four to five feet.

The outlet works is not used on an emergency basis to augment the spillway and emergency spillway at times of intense storms.

4.2 Maintenance of Dam

Reportedly, the only regularly scheduled maintenance performed for the dam is the mowing of grass on the embankment surfaces. Other maintenance, such as filling eroded areas, is done on an "as-needed" basis.

4.3 Maintenance of Operating Facilities

Maintenance of operating facilities such as outlet works is performed on an "as-needed" basis. It is not known when such maintenance was last performed.

4.4 Description of Warning System

No warning system is now in effect. The dam is allowed to function uncontrolled during times of high water level.

4.5 Evaluation of Operational Adequacy

The operation of the dam has been adequate to the extent that the dam has not been overtopped since its construction in 1965.

Maintenance documentation, provided by past annual inspection reports, is assessed as fair. No reports are available past 1974 and documentation for specific maintenance procedures is not kept by the owner. Areas of inadequate maintenance are as follows:

1. Small trees and brush on embankment not removed.
2. Erosion on downstream slope not repaired.
3. Bare areas on embankment not restored with grass.
4. Weeds in emergency spillway discharge channel not removed.
5. Anti-vortex assembly not renovated.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The intensity of storm water runoff that the spillway should be able to handle is based on the size and hazard classification of the dam. This runoff intensity, called the spillway design flood (SDF), is described in terms of frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Guidelines for Safety Inspection of Dams," published by the U.S. Army Corps of Engineers, the SDF for Holiday Lake Dam falls in a range of 100-year frequency to 1/2 PMF. In this case, the low end of the range, 100-year frequency is chosen since the factors used to select size and hazard classification are on the low side of their respective ranges.

The SDF peak flow computed for Holiday Lake Dam is 985 c.f.s., as calculated in accordance with analytical procedures contained in Report 38 published by the NJDEP.

Computations used to determine the spillway discharge capacity as well as that of the emergency spillway are contained in Appendix 4. The drop inlet spillway was assumed to have outflow characteristics of a sharp crested weir with circumference equal to weir length. The spillway discharge pipe was analysed as a culvert with outlet control. It was found that for low head above the spillway crest elevation, weir flow controls the spillway discharge capacity while for high head, the discharge pipe controls. The spillway discharge was computed to be 192 c.f.s. with water level equal to dam crest.

It was assumed that the anti-vortex assembly would have negligible effect on the inflow of water into the spillway.

The emergency spillway was assumed to have outflow characteristics of an open channel with Manning's n=0.04. Discharge was computed by determining critical depth at the channel entrance. The emergency spillway discharge was computed to be 1000 c.f.s. with water level equal to the dam crest.

The total discharge passed by the dam with water level at the dam crest was computed to be 1192 c.f.s. Since this value is greater than the computed SDF peak (985 c.f.s.), the spillways are considered to be adequate according to criteria developed by the U.S. Army Corps of Engineers.

b. Experience Data

According to personnel at Ocean Acres Country Club and the annual inspection reports, Holiday Lake Dam has not been overtopped since it was constructed in 1965.

c. Visual Observations

There was no evidence found at the time of inspection of overtopping of the dam.

d. Overtopping Potential

As indicated in paragraph 5.1.a, the dam would not be overtopped during a storm with magnitude equivalent to the designated SDF (100-year flood). This analysis is summarized in the spillway stage-discharge rating contained in Appendix 4.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The embankment appeared, at the time of inspection, to be structurally sound with no evidence of cracks, displacement or differential settlement. However, the visual inspection disclosed three zones of seepage through the dam. One seepage zone was in the form of a wet soft area on the downstream slope of embankment approximately 100 feet northeast of the spillway outlet while the remaining two zones were located at the edge of the stilling basin and characterized as slight trickles.

An accurate determination of the severity of the seepage depends on several factors, one of which is periodic observation. The severity of the seepage noted at Holiday Lake Dam cannot be precisely determined at the present time.

b. Design and Construction Data

Structural stability analysis contained in the design report prepared by Site Engineers Inc. indicates that the dam is structurally sound. No structural analyses for the spillway or discharge pipe are available.

c. Operating Records

No operating records for the dam are available. The water level of Holiday Lake is not monitored.

d. Post Construction Changes

Since Holiday Lake Dam was constructed in 1965, there have been no changes to the dam or the area surrounding it that could have significant effect on its structural integrity.

e. Seismic Stability

Holiday Lake Dam is located in seismic Zone 1 as 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. Holiday Lake Dam appeared, at the time of inspection, to be stable under static loading conditions.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on hydraulic and hydrologic analyses outlined in Section 5 and Appendix 4, the spillways of Holiday Lake Dam are considered to be adequate according to criteria developed by the U.S. Army Corps of Engineers.

The structural integrity of the dam appears to be satisfactory based on field investigations. The seepage is not considered to be an immediate indication of instability. No reported nor written evidence was found that would contradict this assessment.

b. Adequacy of Information

Information sources for this study include: 1) field inspection, 2) design reports, boring logs, drawings and correspondence in the NJDEP file, 3) USGS quadrangles and 4) consultation with personnel of Ocean Acres Country Club. This information is adequate for a Phase I Assessment as outlined in "Recommended Guidelines for Safety Inspection of Dams."

Some of the absent data are as follows:

1. Stream and lake elevation gauging records.
2. Inspection reports subsequent to 1974.
3. Maintenance documentation.

c. Necessity for Additional Data/Evaluation

Additional evaluation is necessary to assess the dam relative to the seriousness and the causes of seepage observed on the downstream side of the embankment. The evaluation should be based on monitoring of the seepage as outlined in paragraph 7.2.c.

7.2 Recommendations

a. Remedial Measures

Based on the visual inspection of Holiday Lake Dam and pertinent data obtained as part of this evaluation, it is recommended that the owner undertake the following remedial measures in the near future:

1. Trees, brush and weeds on the embankment and in the emergency spillway should be removed. All trees brush and weeds should be cut at the ground surface in a way that will cause minimal disturbance to the embankment.

2. The asphalt coating on the anti-vortex assembly should be renewed after rust is removed.

3. Erosion on the downstream embankment slope should be filled, compacted and sodded.

4. A suitable stand of grass should be established on the bare sections of the embankment.

5. Access to the dam by motor vehicles should be prevented by constructing barriers at each end of the embankment.

6. Riprap on the upstream face of the embankment should be renovated by the placement of additional stones.

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

b. Maintenance

The owner of the dam should initiate, in the near future, a program of periodic inspection and maintenance, the complete records of which to be kept on file and made available to the public. A visual inspection of the dam and appurtenances by a qualified professional engineer should be made annually and reported on a standardized check-list form. Repairs should be made when required and the following maintenance should be performed annually: remove trees and brush from the embankment, fill and sod any eroded surfaces of the embankment and clear the downstream channel.

The current practice of periodically lowering the lake for maintenance purposes should be continued and at least once every five years the lake should be lowered completely at which time the lake should be cleaned and submerged portions of the dam and spillway should be inspected and repaired.

c. Additional Studies

A qualified professional engineer should be engaged soon to monitor the seepage on the downstream side of the dam especially near the spillway discharge culvert by visual observation and measurements on a monthly basis. Measurements should be made if necessary to determine the source and seriousness of the seepage and a complete inspection of the toe drain should be performed.

A detailed topographic survey of the dam and area around the dam based on USGS datum should be undertaken by a qualified licensed land surveyor or professional engineer in the near future. The survey map should be related to existing construction drawings and should become part of the permanent record mentioned in paragraph 7.2.b.

PLATES

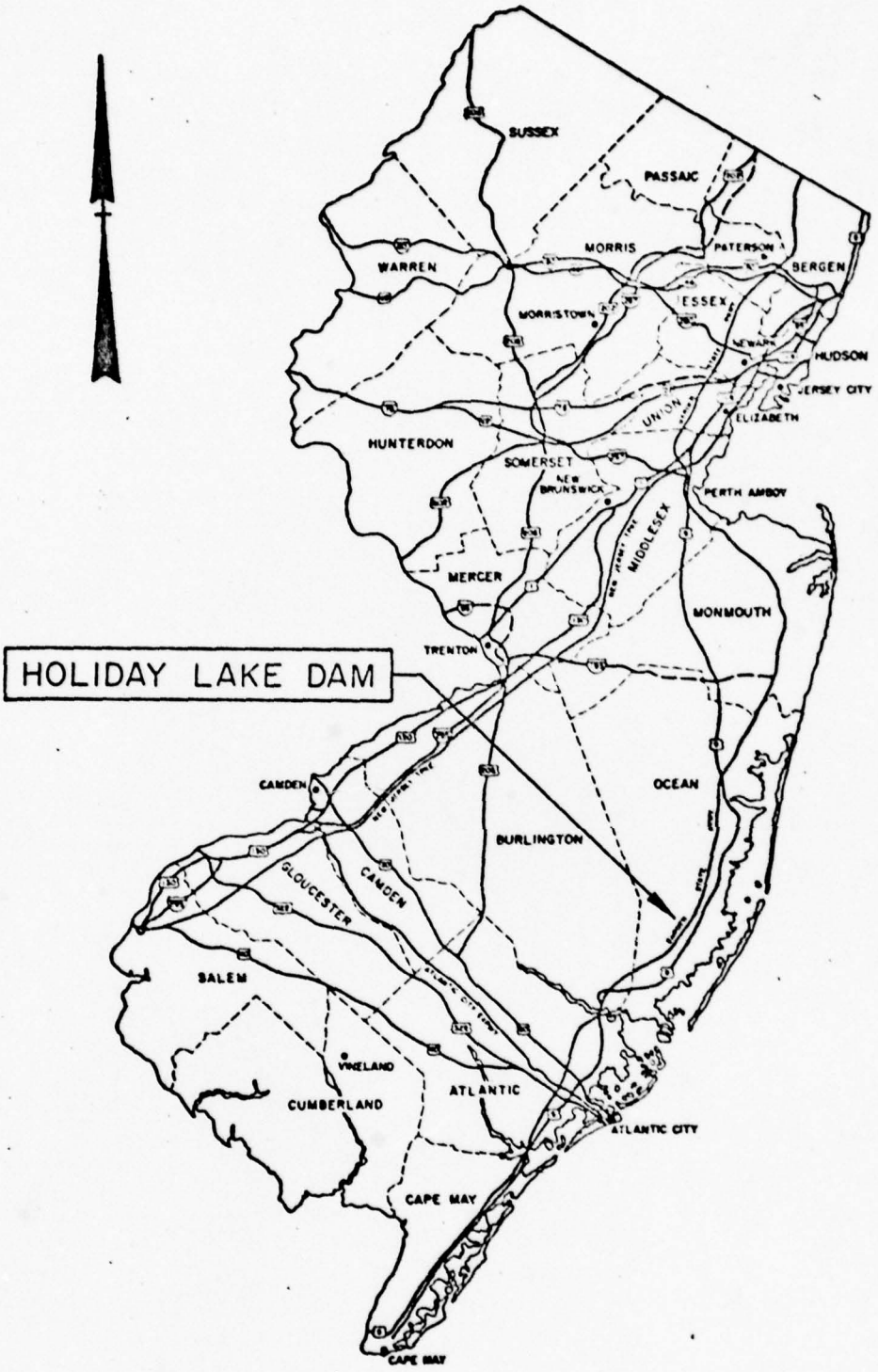


PLATE 1

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS **KEY MAP** HOLIDAY LAKE DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D. N.J. 00061 — SCALE: NONE DATE: FEBRUARY, 1979

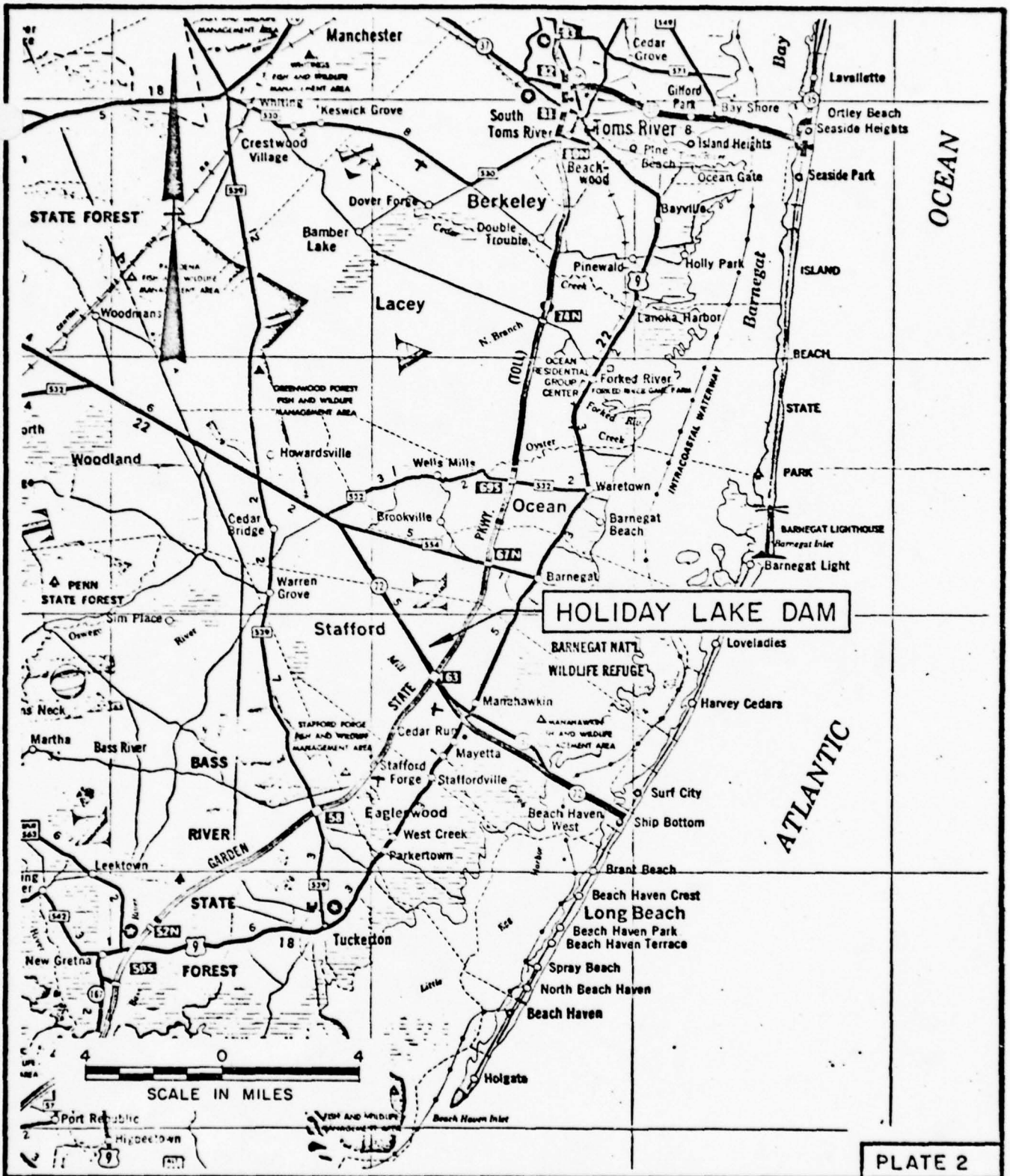


PLATE 2

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

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

INSPECTION AND EVALUATION OF DAMS

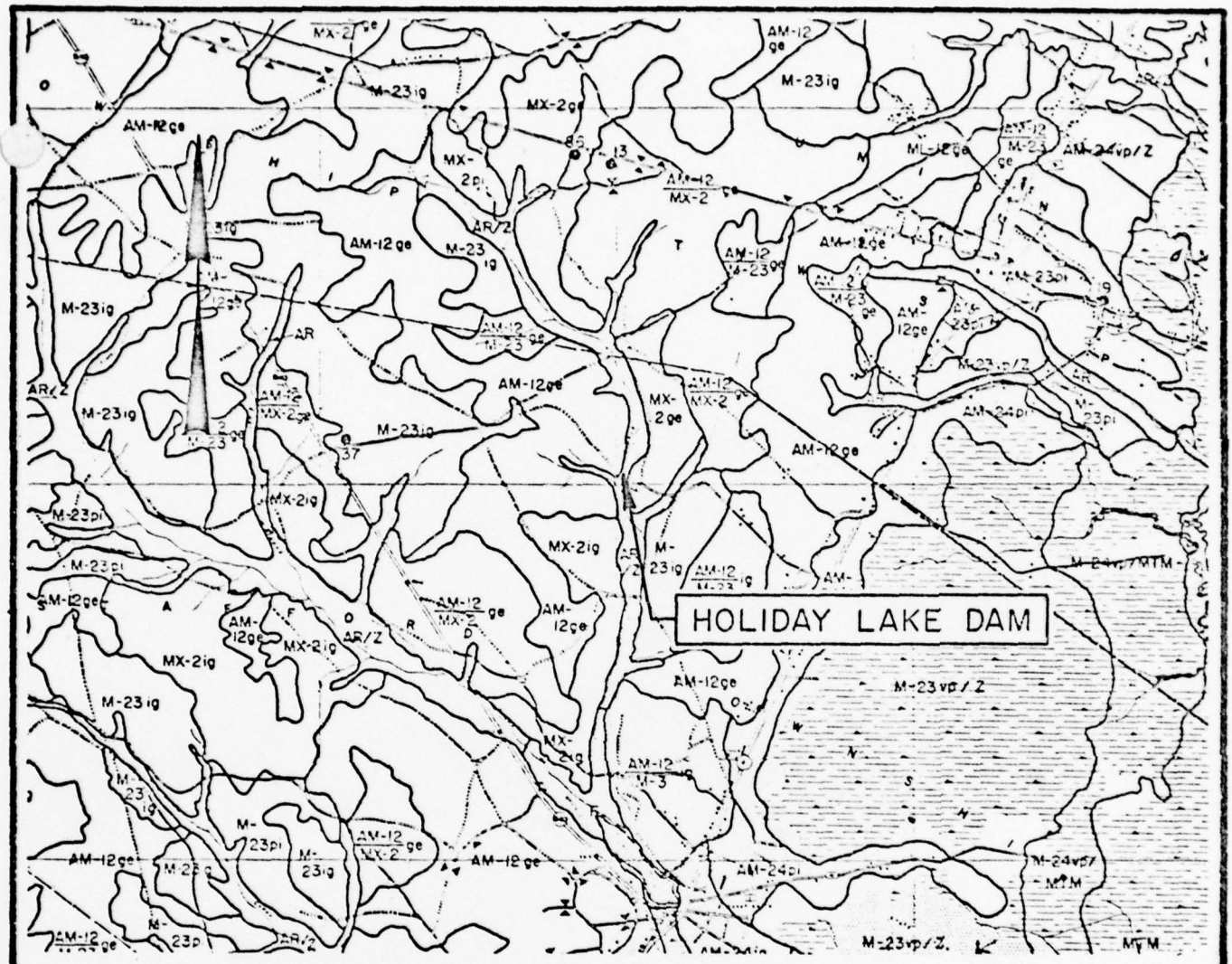
VICINITY MAP

HOLIDAY LAKE DAM

I.D. N.J. 00061

SCALE: AS SHOWN

DATE: FEBRUARY, 1979



Legend

AR/Z	Stratified, swampy alluvium
AM-12	Alluvial, stratified materials composed predominantly of gravel and sand sizes, with small quantities of silt and clay.
MX-2	Assortment of stratified materials, consisting of gravel, sand, silt and clay in various combinations. (Cohansey Sand)

Note — Information taken from Rutgers University Soil Survey of New Jersey, Report No. 8 and Geologic Map of New Jersey prepared by Lewis and Kummel.

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

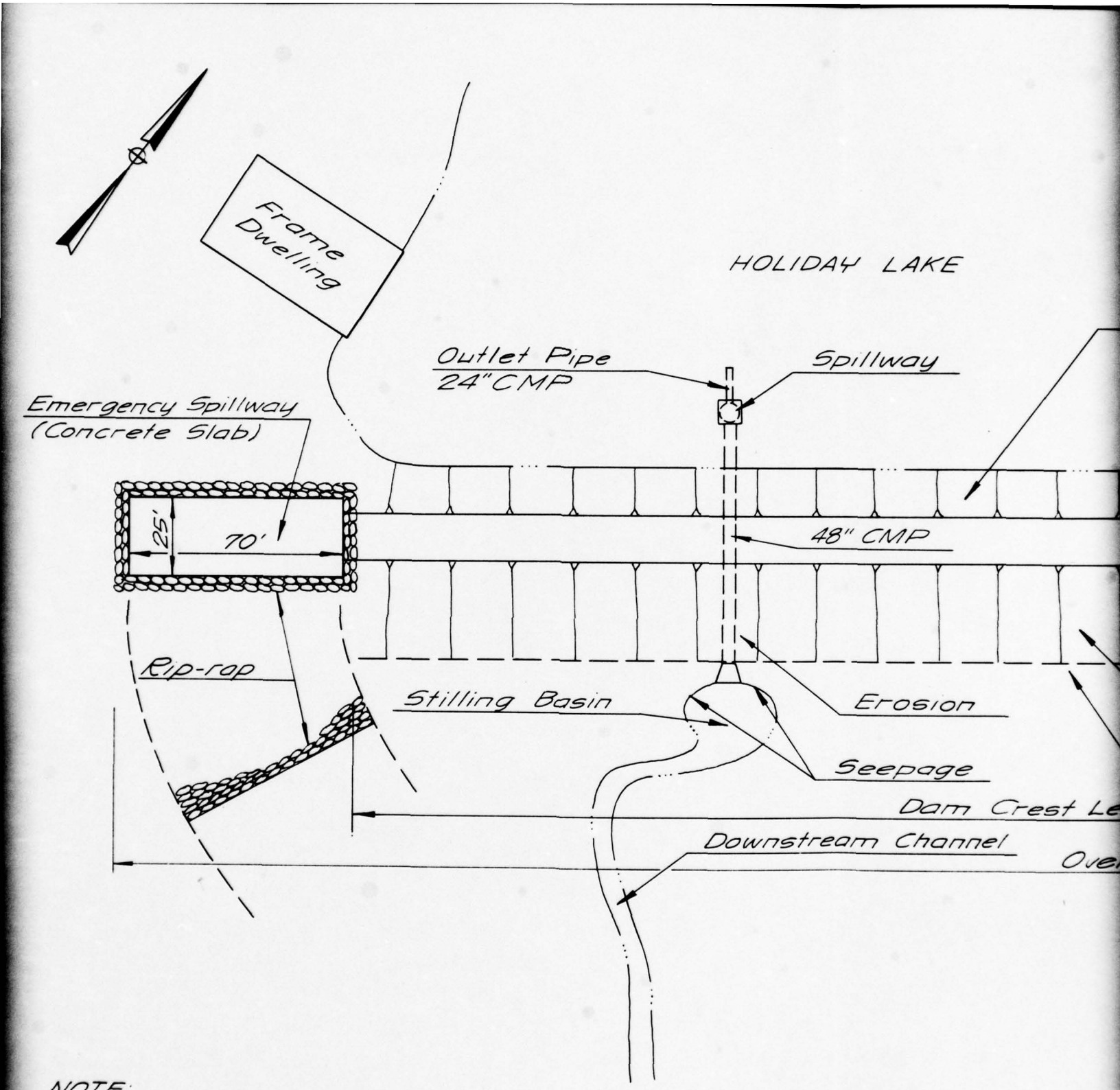
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

SOIL MAP

HOLIDAY LAKE DAM

I.D. N.J. 00061	SCALE: NONE
	DATE: FEBRUARY, 1979



NOTE:
Information taken from plans prepared by Site Engineers Inc. dated Feb. 1, 1965, revised April 2, 1965 and field inspection Dec. 20, 1978.

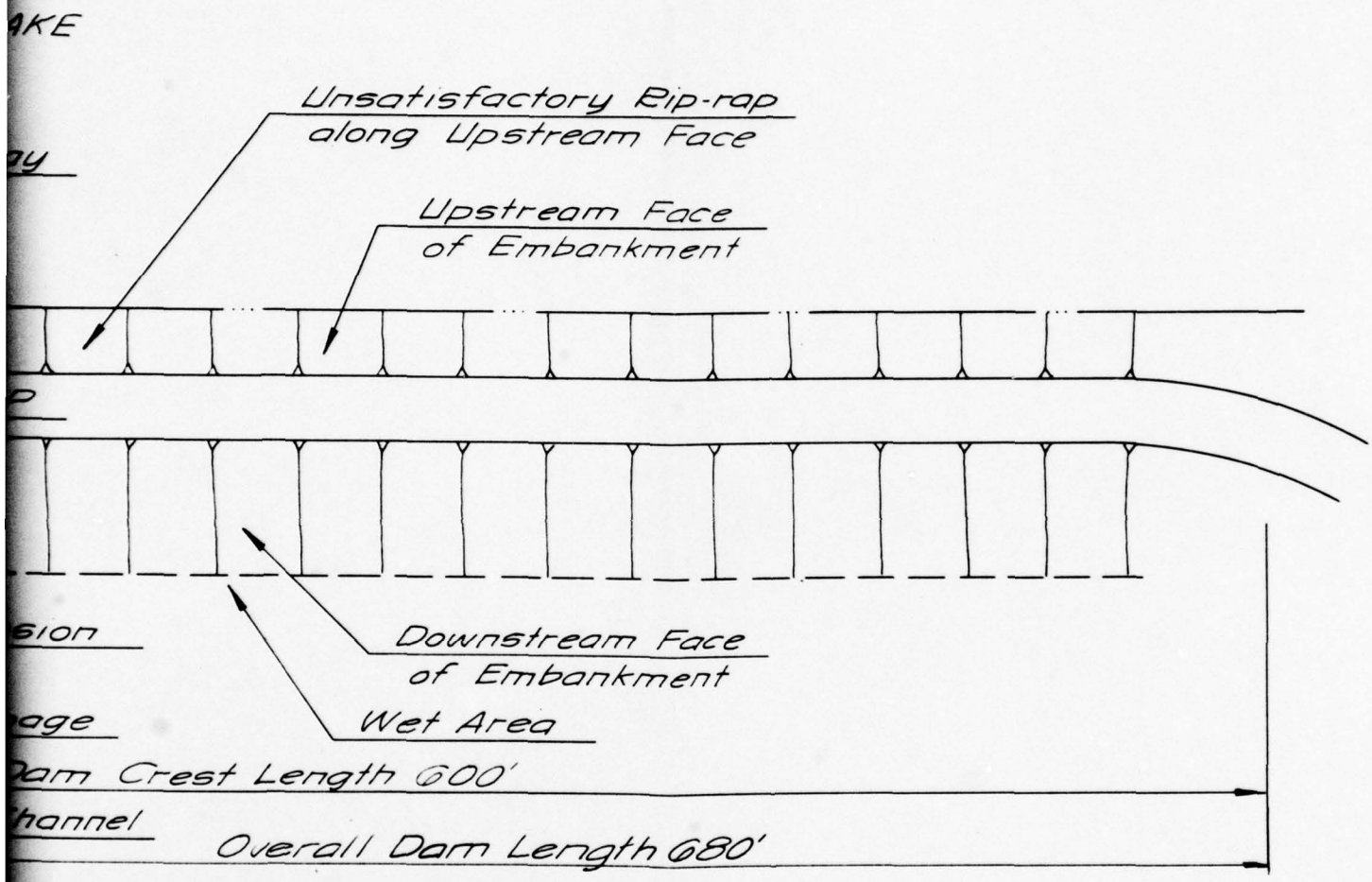


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PLATE 4

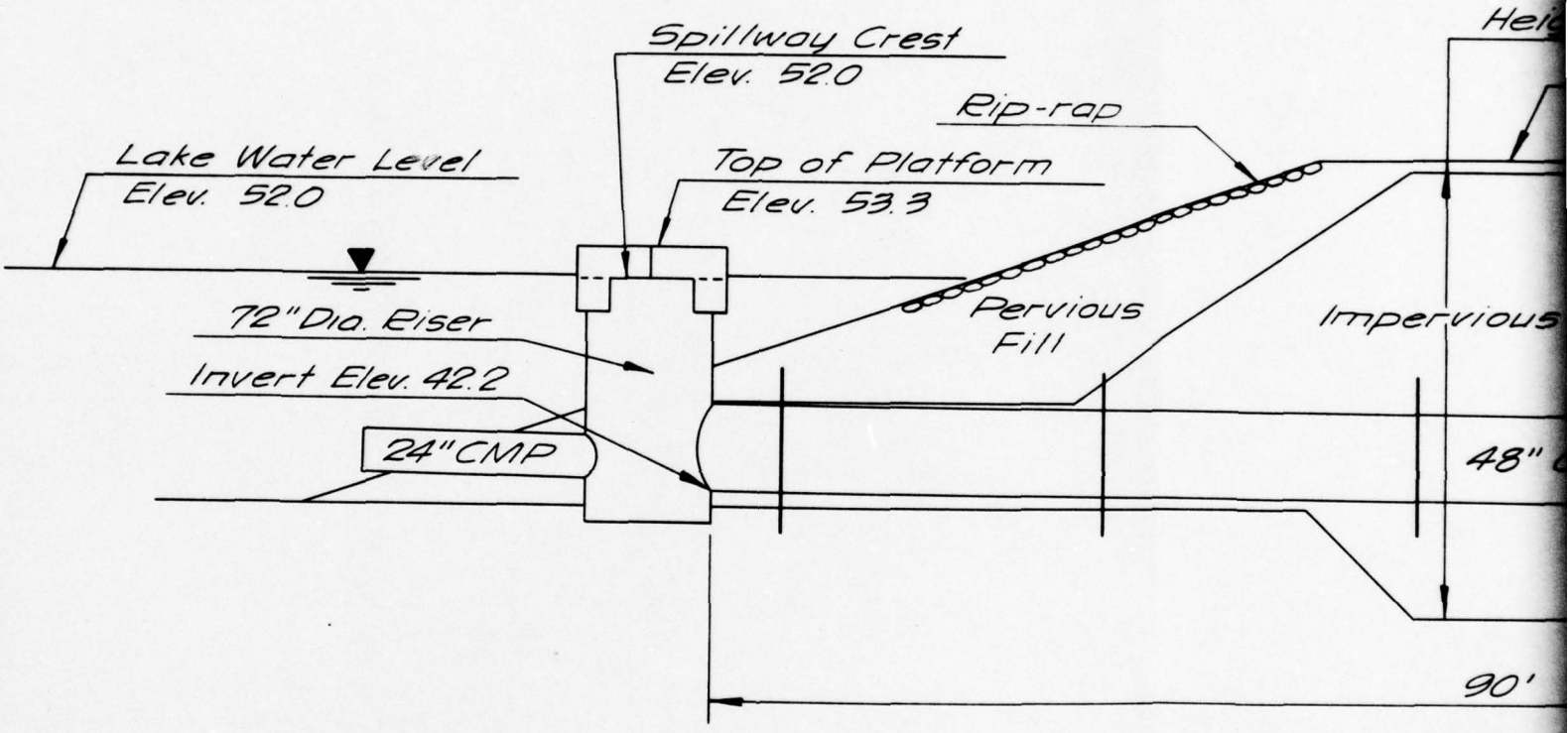
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

GENERAL PLAN

HOLIDAY LAKE DAM

I.D. N.J. 00061	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979



NOTE:
Information taken from plans prepared by Site Engineers Inc. dated Feb. 1, 1965, revised April 2, 1965 and field inspection Dec. 20, 1978.

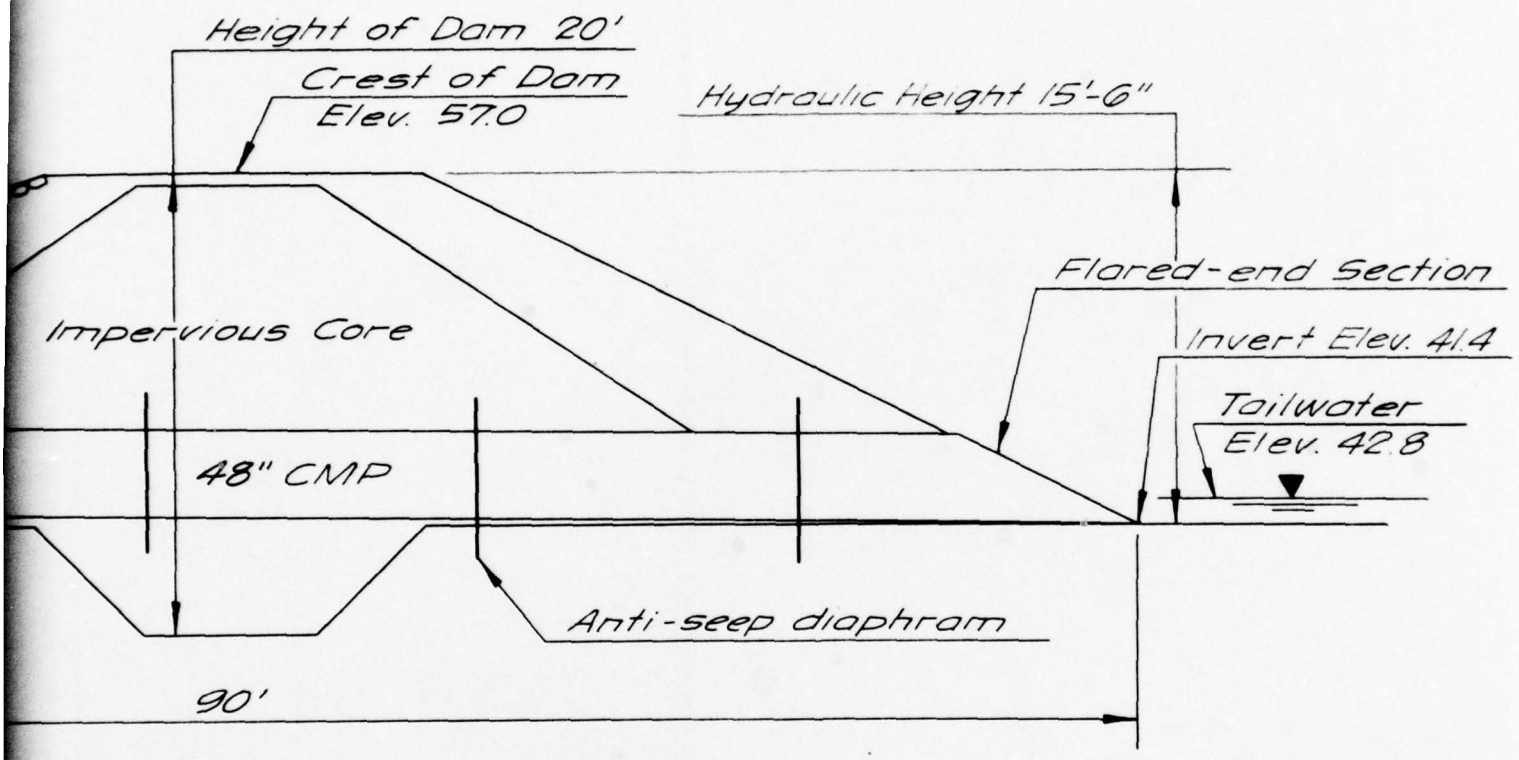


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PLATE 5

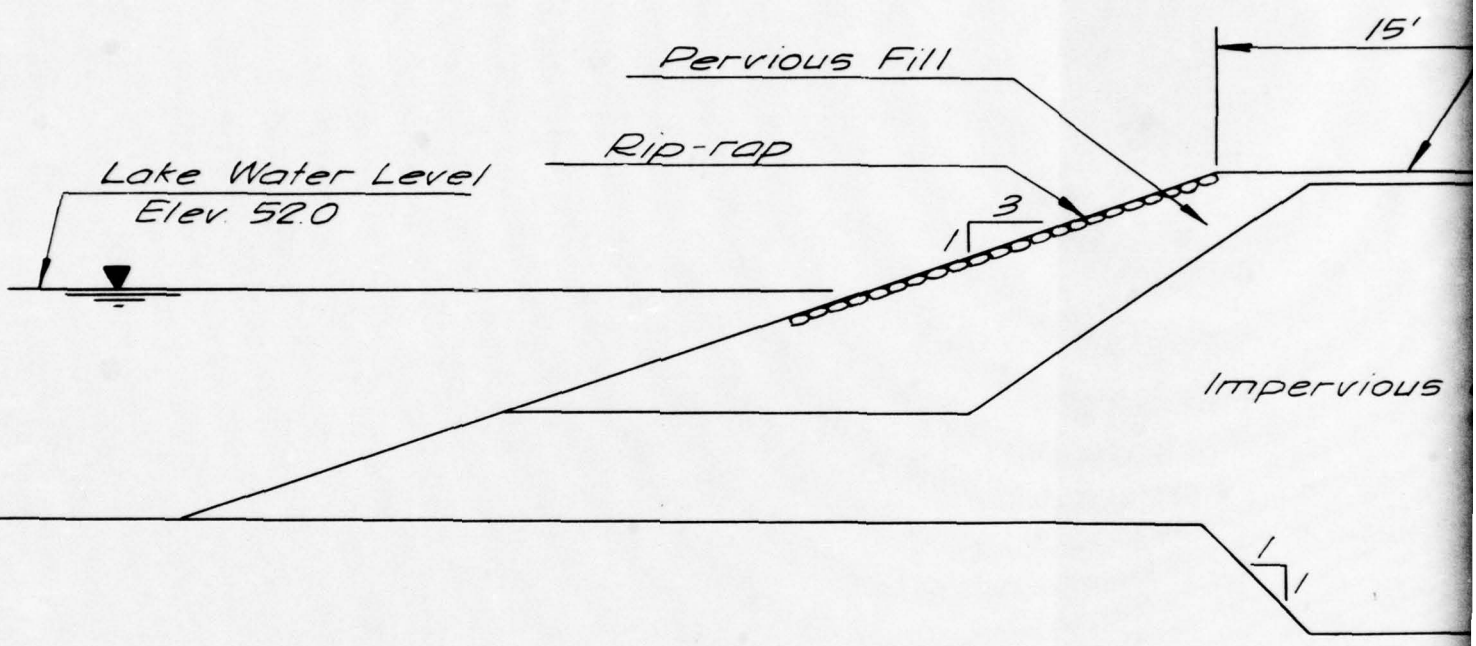
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

SPILLWAY SECTION

HOLIDAY LAKE DAM

I.D.N.J. 00061	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979



NOTE:
Information taken from plans prepared by Site Engineers Inc. dated Feb. 1, 1965, revised April 2, 1965 and field inspection Dec. 20, 1978.

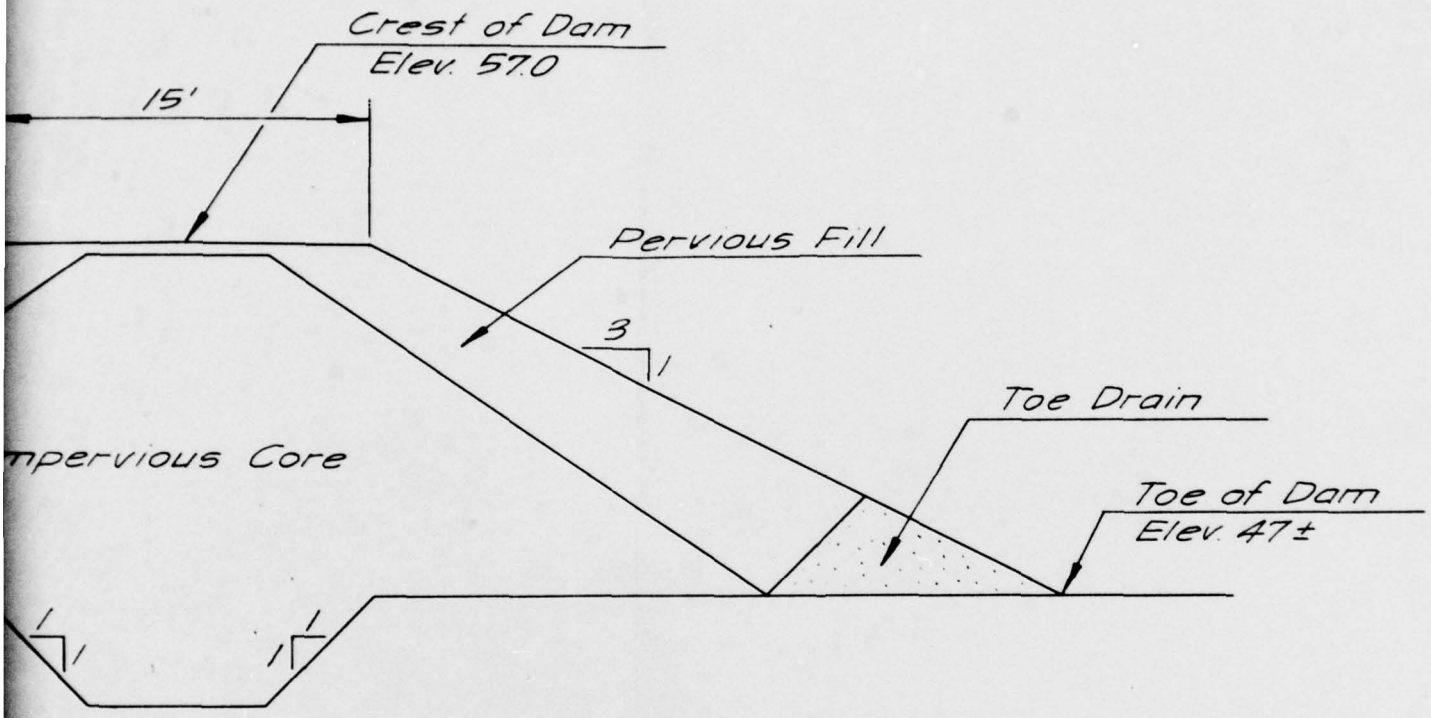


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PLATE 6

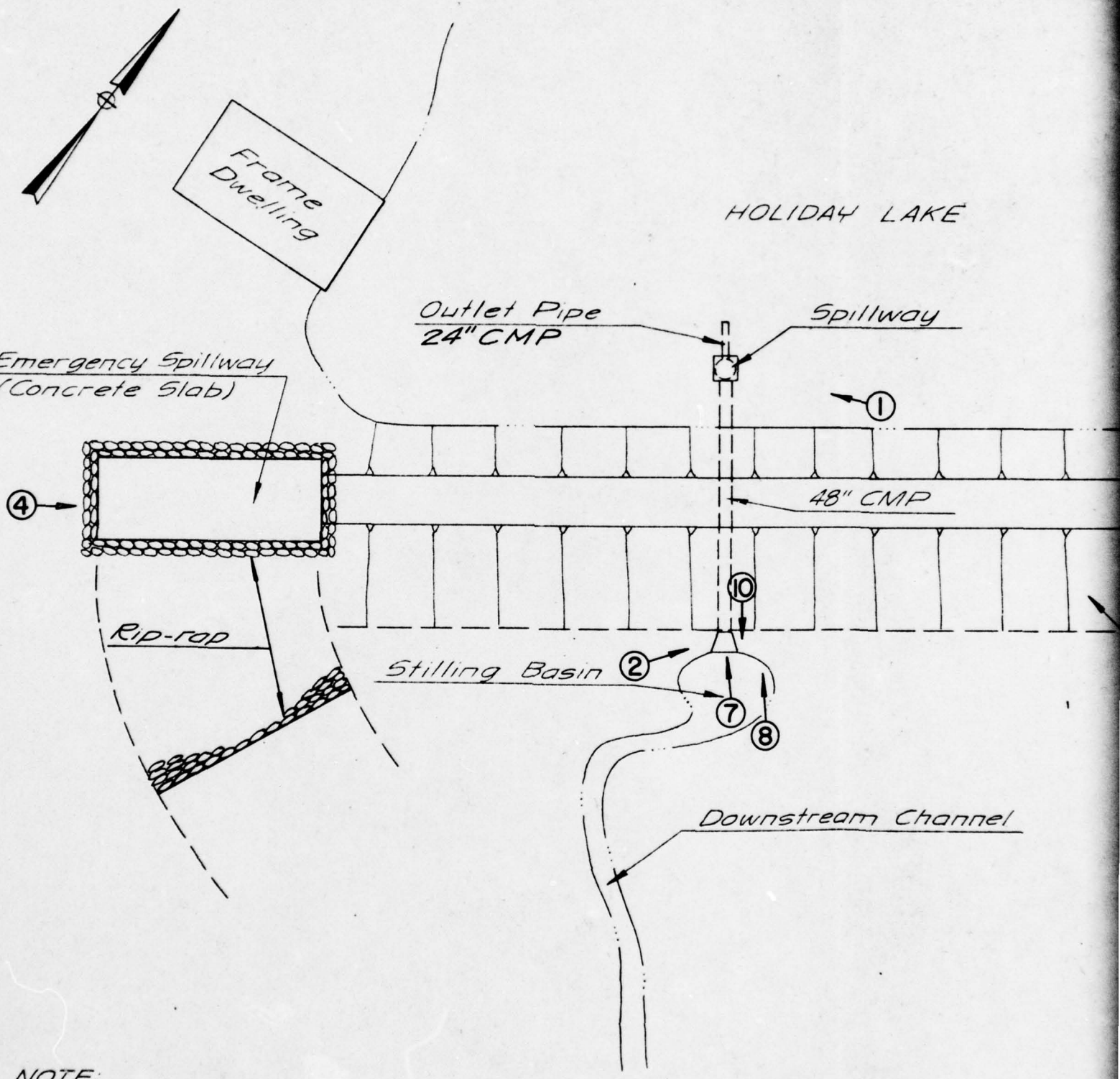
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

DAM SECTION

HOLIDAY LAKE DAM

I.D.N.J. 00061	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979



NOTE:
Information taken from plans prepared by Site Engineers Inc. dated Feb. 1, 1965, revised April 2, 1965 and field inspection Dec. 20, 1978.

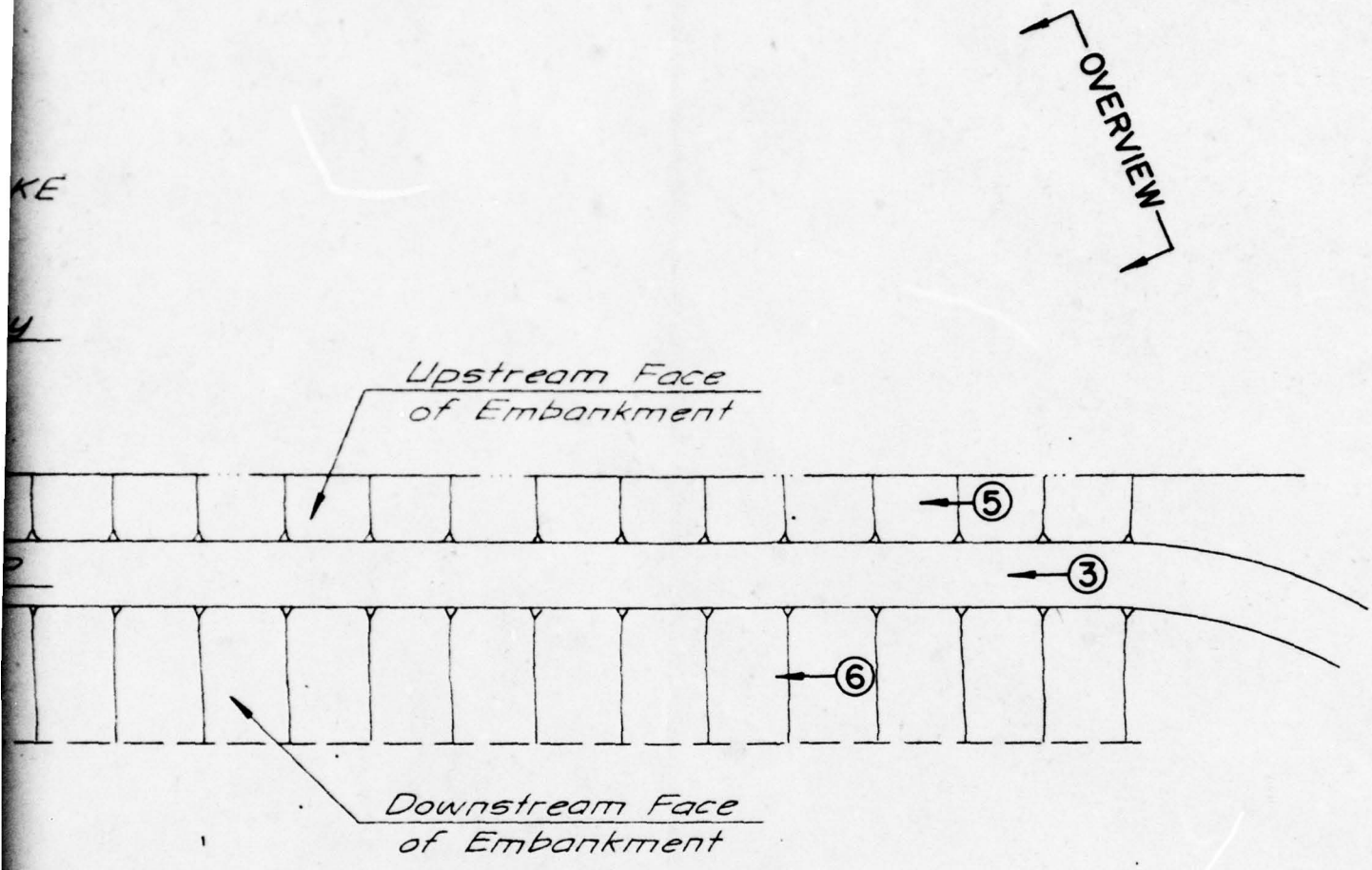


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PLATE 7

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

HOLIDAY LAKE DAM

I.D. N.J. 00061	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List
Visual Inspection
Phase 1

Name Dam Holiday Lake County Ocean State N.J. Coordinators NJDEP

Date(s) Inspection 12/20/78 Weather Cloudy Temperature 30°F

Pool Elevation at Time of Inspection 52.0 M.S.L. Tailwater at Time of Inspection 42.8 M.S.L.

Inspection Personnel:

J. Gribbin R. McDermott

D. Buckelew

A. Miller

J. Gribbin Recorder

Consulted with Mr. Theissen, Ocean Acres Inc., at his office.

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	Severe erosion on downstream face at spillway discharge pipe. One anti-seep collar exposed.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Satisfactory	
RIPRAP FAILURES	Riprap observed along entire upstream face. Condition unsatisfactory.	Riprap should be replaced. Addit stones are required.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Embankment is covered with good stand of grass with narrow path located along center. Some bare sections noted on down-stream slope.	The crest appears to be used as a motor bike trail.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	N.A.	
ANY NOTICEABLE SEEPAGE	Seepage observed at edge of stilling basin near outlet of spillway discharge pipe. Seepage flow characterized as a trickle. Wet area observed at toe of embankment approx. 100' east of spillway.	
STAFF GAGE AND RECORDER	None	
DRAINS	None observed	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N.A.	
INTAKE STRUCTURE	24" CMP with manually operated gate for outletting into spillway discharge pipe.	
OUTLET STRUCTURE	48" CMP (spillway discharge pipe)	
OUTLET CHANNEL	Natural stream with stilling basin at outlet of 48" CMP.	
EMERGENCY GATE	Manually operated gate at intake end of 24" CMP. Only the stem was visible - wheel not in place.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	N.A.	6-foot diameter corrugated metal pipe vertical riser. Weir length approxima 18.8 feet.
APPROACH CHANNEL	N.A.	
DISCHARGE CHANNEL	48" CMP conveys water from spillway through embankment into stilling basin and natural stream. Some rust at water line.	
BRIDGE AND PIERS	N.A.	
EMERGENCY SPILLWAY	Emergency spillway crest consists of concrete slab with riprap along each edge of west end of dam. Condition is satisfactory.	Elev. of slab is 2.9 feet below elev. dam crest.

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N.A.	
APPROACH CHANNEL	N.A.	
DISCHARGE CHANNEL	N.A.	
BRIDGE AND PIERS	N.A.	
GATES AND OPERATION EQUIPMENT	N.A.	

INSTRUMENTATION

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

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slopes range from 1% to 4%.	Surrounding land: east shore - wooded west shore - golf course & residential development.
SEDIMENTATION	Not known	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Narrow winding stream Free of significant obstructions.	
SLOPES	Wide flood plain, wooded.	
APPROXIMATE NO. OF HOMES AND POPULATION	None	Two Garden State Parkway bridges within 1000 feet.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Plan titled "Earth Fill Dam, Manahawkin, N. J." (3 sheets) prepared by Site Engineers Inc., dated April 2, 1965.
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	Available (NJDEP File)
TYPICAL SECTIONS OF DAM	Available - Site Engineers plan
HYDROLOGIC/HYDRAULIC DATA	Available (NJDEP File)
OUTLETS - PLAN - DETAILS -CONSTRAINTS -DISCHARGE RATINGS	Available (NJDEP File)
RAINFALL/RESERVOIR RECORDS	Not Available

ITEM	REMARKS
DESIGN REPORTS	Available (Site Engineers)
GEOLOGY REPORTS	Not Available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Available (Site Engineers)
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Available (Site Engineers)
POST-CONSTRUCTION SURVEYS OF DAM	Not Available
BORROW SOURCES	Not Available

ITEM	REMARKS
MONITORING SYSTEMS	Not Available
MODIFICATIONS	Not Available
HIGH POOL RECORDS	Not Available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Annual inspection reports available. (1969 through 1974)
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	Not Available

ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS	Available - Site Engineers plan
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	Not Available

APPENDIX 2

Photographs

PHOTO 1

SPILLWAY STRUCTURE

PHOTO 2

SPILLWAY DISCHARGE PIPE OUTLET

20 DEC. 1978

PHOTO 3

CREST OF DAM.

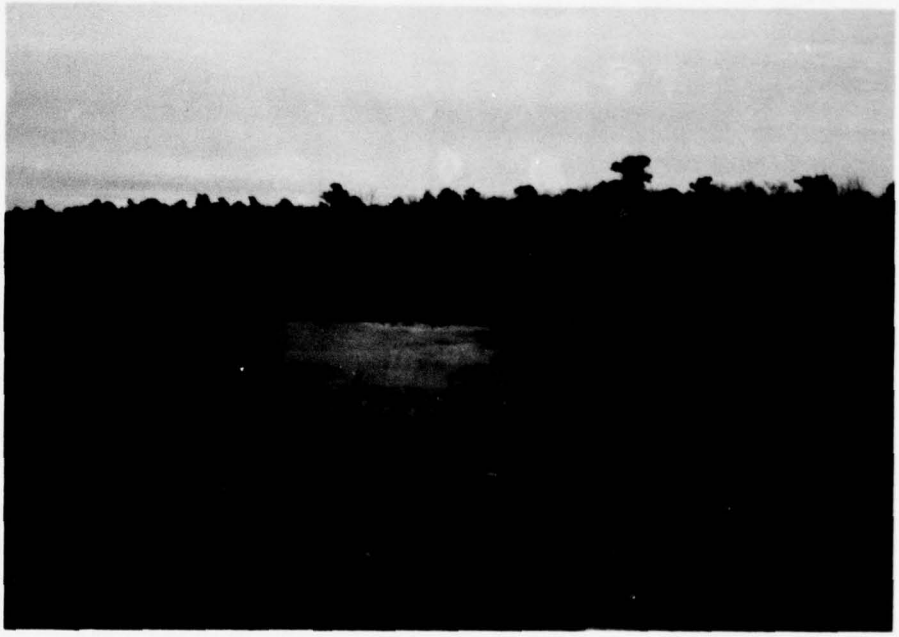


PHOTO 4

CREST OF EMERGENCY SPILLWAY

20 DEC. 1978

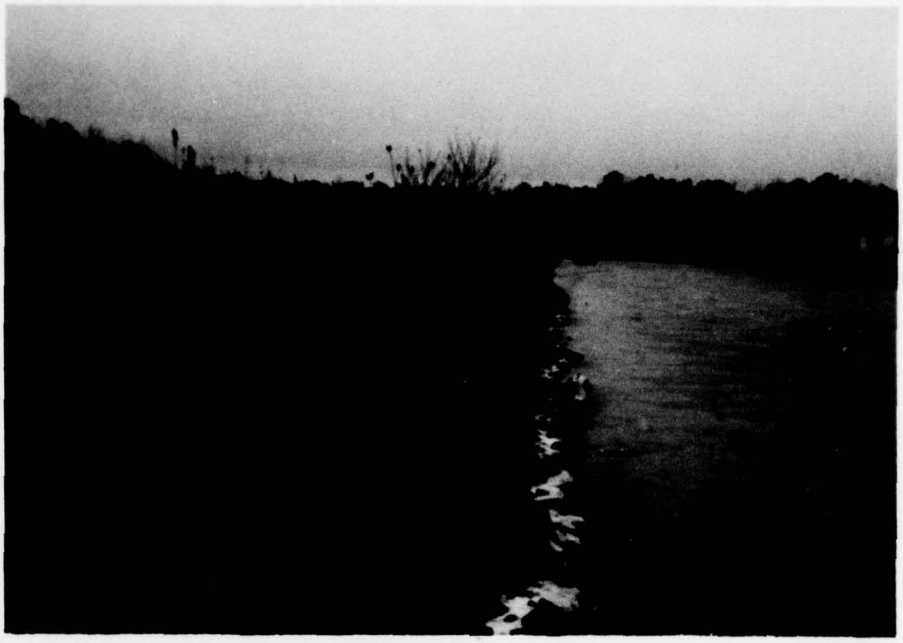


PHOTO 5

UPSTREAM FACE OF EMBANKMENT

PHOTO 6

DOWNSTREAM FACE OF EMBANKMENT

20 DEC. 1978

PHOTO 7

EROSION ON DOWNSTREAM FACE OF EMBANKMENT.

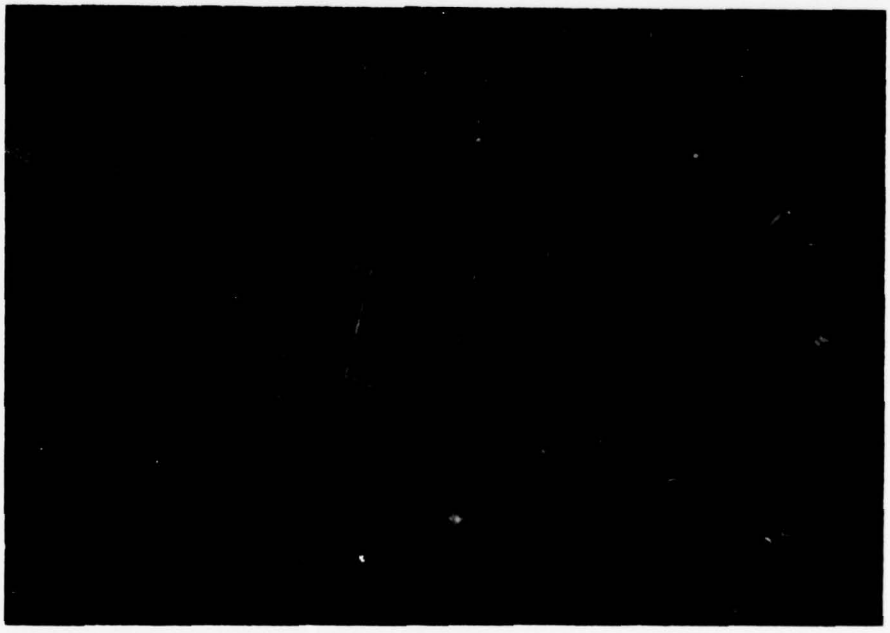


PHOTO 8

SEEPAGE AT EDGE OF STILLING BASIN.

20 DEC. 1978

PHOTO 9

STILLING BASIN

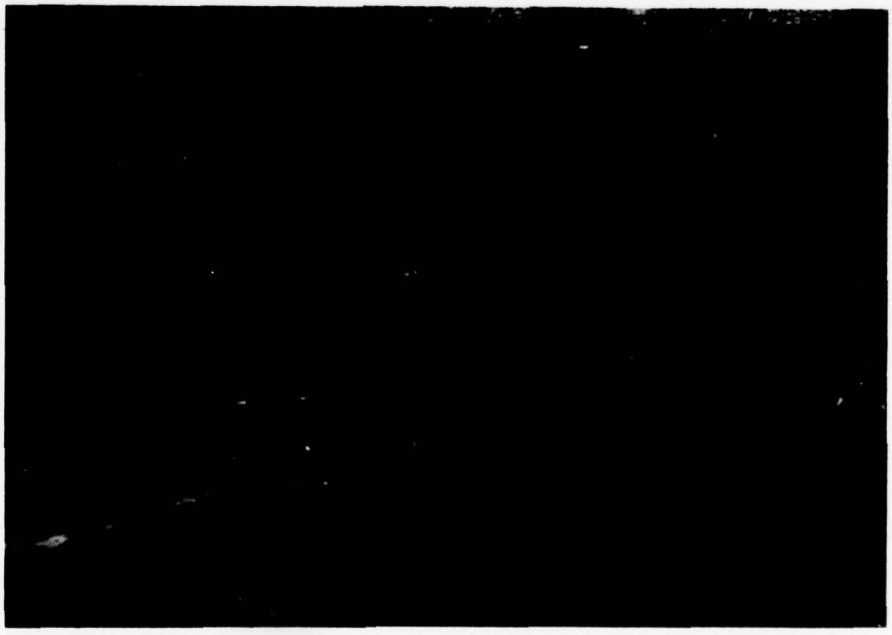


PHOTO 10

DOWNSTREAM CHANNEL

20 DEC. 1978

APPENDIX 3

Engineering Data

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Residential and wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 52.0 (338 acre-feet)

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

ELEVATION MAXIMUM DESIGN POOL: 57.0

ELEVATION TOP DAM: 57.0

PRINCIPAL SPILLWAY CREST: Circular Sharp Crested Weir

a. Elevation 52.0

b. Type 72" diameter corrugated metal drop inlet

c. Width N.A.

d. Length 18.8 feet

e. Location Spillover Into 72" diameter drop inlet

f. Number and Type of Gates None

AUXILIARY SPILLWAY CREST: Concrete Slab Surrounded by Riprap

a. Elevation 54.1

b. Type Broad crested weir-trapezoidal section

c. Width 25 feet

d. Length 75 feet

e. Location Spillover Southwest end of dam

f. Number and Type of Gates N.A.

OUTLET WORKS: Gated pipe discharging into drop inlet

a. Type 24" diameter corrugated metal pipe

b. Location Upstream side of drop inlet

c. Entrance invert 42.2

d. Exit invert 42.2

e. Emergency draindown facilities: Slide gate

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) 1192 c.f.s.

APPENDIX 4

Hydrologic Computations

HOLIDAY LAKE DAM

CLASSIFICATION

SIZE CLASSIFICATION

Storage capacity when lake stage equals elev. of dam crest = 810 acre-ft.

Maximum height of dam = 20 Ft.

Therefore, size classification catagory SMALL

HAZARD POTENTIAL CLASSIFICATION

1. Hazard to Garden State Parkway; the south bound lane is only 400 ft from the dam; the north bound lane is approximately 900 ft from the dam.

2 Possible hazard potential to Manahawkin Lake Dam.

Therefore, hazard potential classification

SIGNIFICANT

STORCH ENGINEERS

Sheet 2 of 15

Project S E H 1132

Made By DMP Date 3/23/79

HOLIDAY LAKE DAM

Chkd By RL Date 3/27/79

SPILLWAY DESIGN FLOOD

For size : Small

and hazard : Significant

Spillway Design Flood (SDF) is :-

100 yr to ½ PMF

HYDRAULICS

Principal Spillway Crest Elevation = 52.0

Auxiliary Spillway crest elevation = 54.5

Crest of embankment elevation = 57.0

PRINCIPAL SPILLWAY :-

Drop inlet Pipe.

Riser : 72" Diam. CM Smooth Flow Pipe.

Culvert : 48" Diam C.M Smooth Flow Pipe

The discharge into the riser pipe will be calculated using the following formula

$$Q = C(2\pi R) H_d^{3/2}$$

where Q = Discharge CFS
C = Discharge coefficient
R = Radius of sharp crest ft.
H_d = Head on spillway crest ft.

The coefficient of discharge will be calculated using Fig 283, 'Design of Small Dams'.

Approach depth to sharp crest P = 52 - 41.4 = 10.6

$$\therefore \frac{P}{R} = \frac{10.6}{3} = 3.53$$

Use the curve for $\frac{P}{R} = 2.0$

STORCH ENGINEERS

Sheet 4 of 15

Project S E # 1132

Made By DMP Date 3/23/79

HOLIDAY LAKE DAM

Chkd By RL Date 3/27/79

Elevation	H_d	$\frac{H_d}{R}$	C	$H_d^{3/2}$	Q_1 CFS
52	0	0			
53	1	0.33	3.70	1	70
54	2	0.66	2.90	2.83	155
55	3	CONTROL BY 48" DIA. CM. HORIZONTAL PIPE SEE SHEETS 5 & 6			175
56	4				184
57	5				192
58	6				201
59	7				208
60	8				216

From BPR

PROJECT: HOLIDAY LAKE DAM.
48" Dia. C.M. HORIZONTAL PIPE

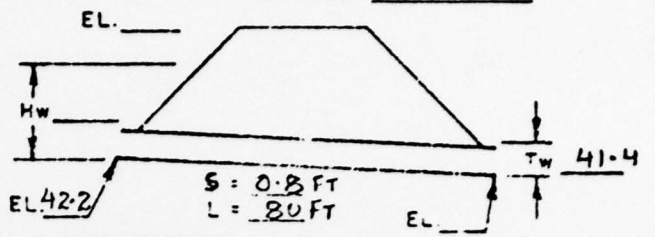
DESIGNER: DMP
DATE: 3/23/79

HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = _____ TAILWATER ELEVATION = ____
Q_2 = _____ TAILWATER ELEVATION = ____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH
STATION: _____



MEAN STREAM VELOCITY = ____
MAX. STREAM VELOCITY = ____
$\frac{L}{100s}$ = ____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q CFS	SIZE	HEADWATER COMPUTATION												CONTROL (INLET OR OUTLET)	OUTLET VELOCITY	COST Elev	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW = H + h_o - L_s$								CHART					
			$\frac{Hw}{D}$	Hw	K_e	H	d_c	$\frac{d_c+D}{2}$	Tw	h_o	L_s	Hw	No.	Hw				
Headwall	200	48" Dia	3.15	12.6	0.5	12.5	4.0	4.0		4.0	0.8	15.7		15.7			57.9	Outlet Control.
	150	"	2.10	8.4	0.5	7.0	3.6	3.8		3.8	0.8	10.0		10.0			52.2	"
	250	"			0.5	19.5	4.0	4.0		4.0	0.8	22.7		22.7			64.9	"

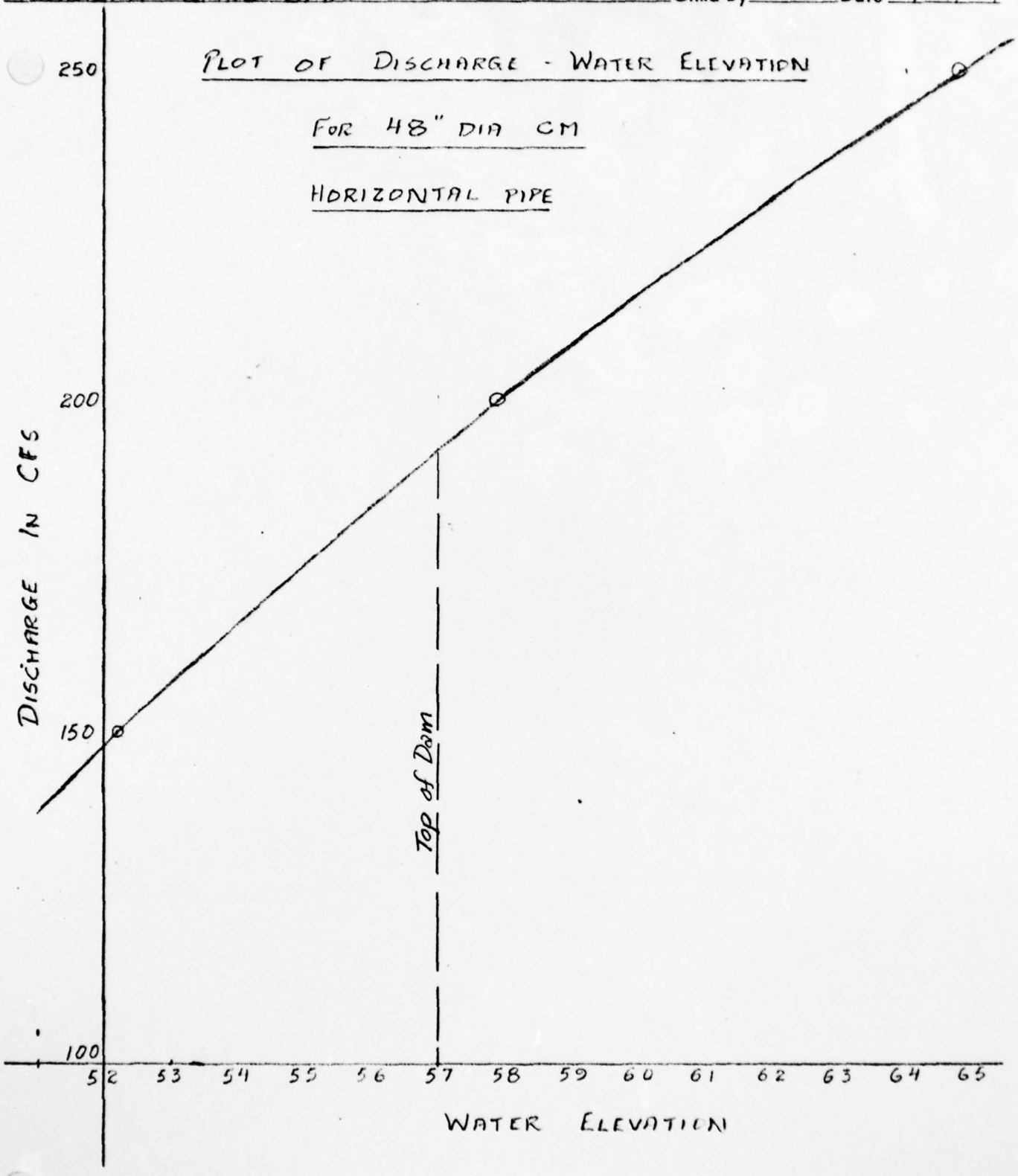
SUMMARY & RECOMENDATIONS:

FIGURE 4-4. DESIGN COMPUTATION FORM FOR CULVERTS

11-15-68

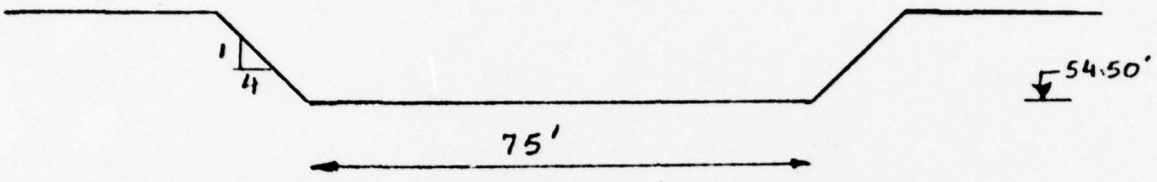
Project SE # 1132 Made By DMP Date 3/23/79

HOLIDAY LAKE DAM Chkd By RL Date 3/27/79

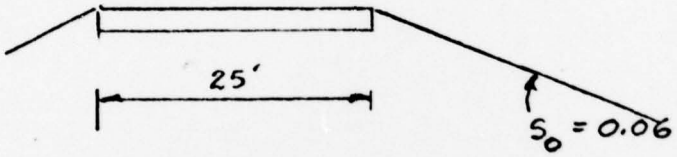


SP 1006AA

AUXILIARY SPILLWAY



TYPICAL SECTION



PROFILE

Ref: Handbook of Hydraulics Kring & Brater

From page 8-16

$$S_c = \frac{14.56\, n^2}{D_m^{4/3}}$$

The auxiliary spillway is overgrown with weeds

$\therefore n = 0.04$

Since the channel is relatively wide as compared to its depth.

D_m = Mean Depth = $\frac{\text{Area}}{\text{Top width}}$ = ≈ Hydraulic Radius

= D_{flow}

D_{flow}	$D_{flow}^{V_3}$	$S_c = \frac{14.5 \text{ ft}^2}{D_{flow}^{V_2}}$
0.5	0.794	0.0293
1.0	1.000	0.0233
1.5	1.145	0.0203
2.0	1.260	0.0185
2.5	1.357	0.0172
3.0	1.442	0.0162

Actual downstream slope $S_o = 0.06$

The actual downstream slope is greater than the critical slope.

The discharge is equal to Q_{max}, and it will be at critical depth.

Equation 8-59 $y = \frac{D_c}{b}$

$\therefore y = \frac{D_c}{75}$

$Z = \frac{e}{D} = \frac{4}{1} = 4$

Equation 8-61 $$Q = K_c D_c^{5/2}$$

$$K_c = \frac{(1/y + z)^{3/2}}{(1/y + 2z)^{1/2}} g^{1/2}.$$

Equation 8-86 $$D_r = D_e + \frac{Q^2}{2ga^2}$$

D_c Ft	$y = \frac{D_c}{75}$	K_c	Q CFS	$\frac{Q^2}{2g\,a^2}$	$D_r = D_c + \frac{Q^2}{2ga^2}$	Elevation
0.5	0.0067	858	152	0.242	0.74	55.24
1.0	0.0133	438	438	0.477	1.48	55.98
1.5	0.0200	295	813	0.695	2.20	56.70
2.0	0.0267	225	1.273	0.913	2.91	57.41
2.5	0.0333	183	1,808	1.124	3.62	58.12
3.0	0.0400	154	2401	1.314	4.31	58.81

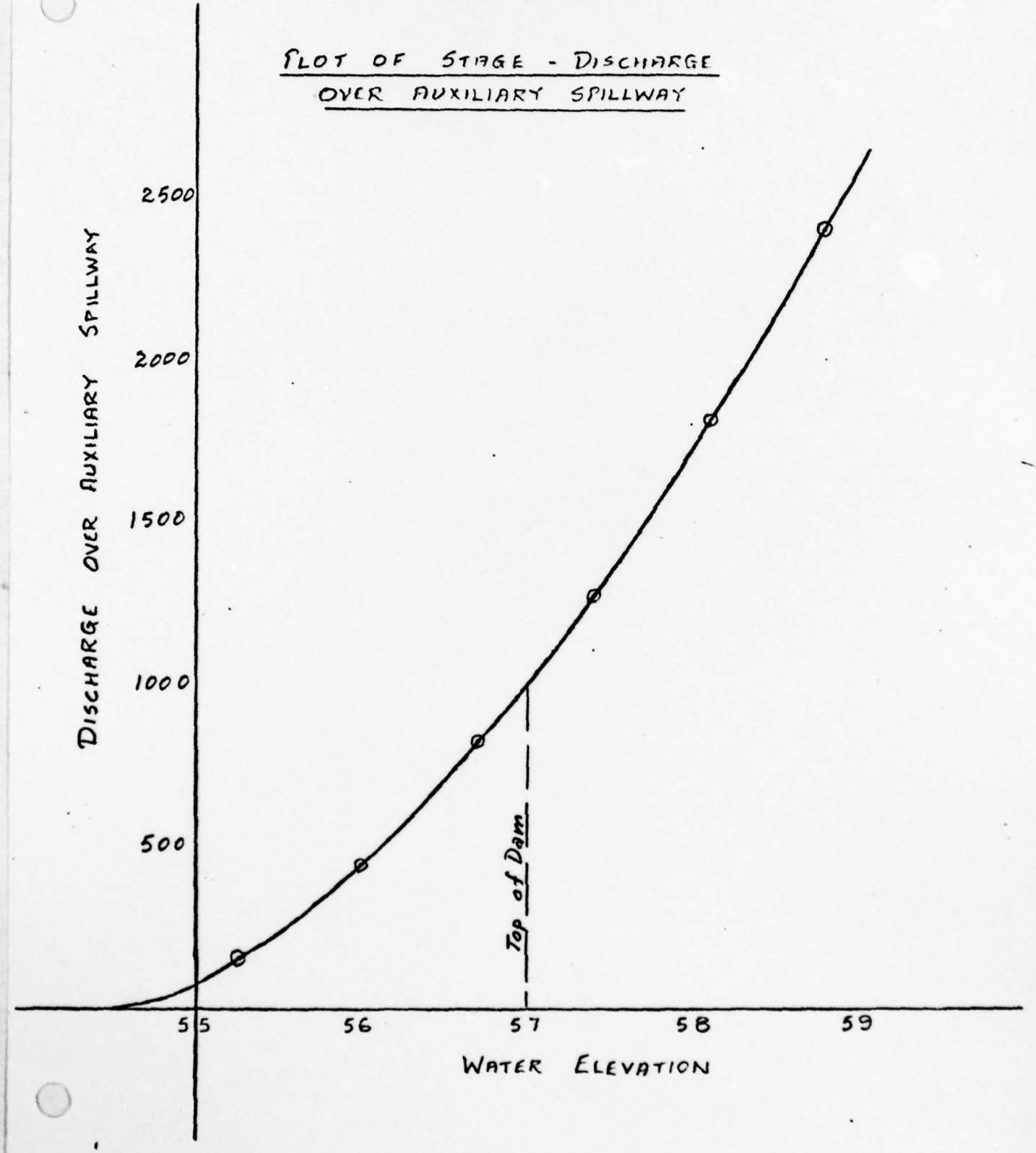
STORCH ENGINEERS

Sheet 10 of 15

Project S E # 1132 Made By DMP Date 3/26/79

HOLIDAY LAKE DAM - HYDRAULICS Chkd By RL Date 3/27/79

PLOT OF STAGE - DISCHARGE
OVER AUXILIARY SPILLWAY



Elevation	Q_1	Q_2	Total Discharge
52	0		0
53	70		70
54	155		155
54.5	165	0	165
55.0	175	90	265
56.0	184	440	624
57.0	192	1000	1,192
58.0	201	1710	1,911
59.0	208	2590	2,798

Crest of Embankment

STORCH ENGINEERS

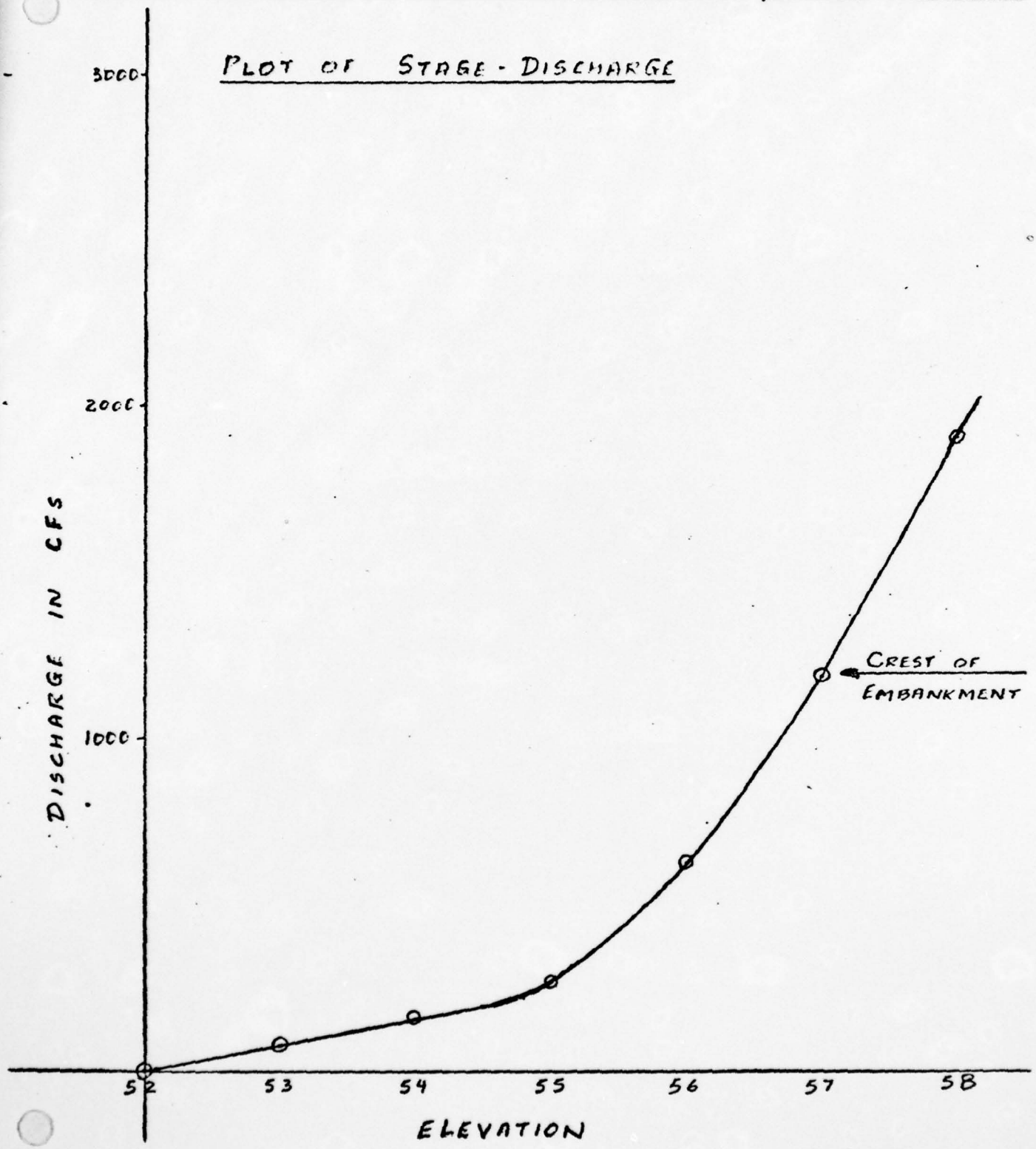
Sheet 12 of 15

Project S E # 1132

Made By DMC Date [illegible]

HOLIDAY LAKE DAM - HYDRAULICS

Chkd By RL Date 3/27/79



Project SE # 1132 Made By DMP Date 3/26/79

Holiday Lake Dam Chkd By RL Date 3/27/79

DRAWDOWN CALCULATION

Outlet Pipe = 24" Dia CMP

Entrance Type — Projecting.

Capacity of lake at Elev 52.0 = 110 Million Gallons

Length of pipe : 6 Ft

Capacity will be calculated on Inlet control basis

Elevation	Storage Million Gallons	Increm. storage Million Gallons	H Ft	Q CFS	Average Q CFS	Average Q Mill. Gal Per Day	Days
52	110.0		9.8	26			
		39.6			25	16.16	2.45
50	70.4		7.8	24			
		31.0			22.5	14.54	2.13
48	39.4		5.8	21			
		22.5			19	12.28	1.83
46	16.9		3.8	17			
		13.0			13	8.40	1.55
44	3.9		1.8	9			
		3.9			4.5	2.91	1.34
42.2	0		0	0			

9.3 DAYS

10 DAYS

HYDROLOGY

100 YEAR FLOOD FLOW

The 100 year flood flow will be calculated by using the following formula :- (Ref. - Special Report 38)

$$Q_{100} = 136\, A^{0.64}\, S^{0.26}\, S_t^{-0.51}\, I^{0.14}$$

1 Area of contributing drainage area } = 5.5 Sq. Mi.

2 Main Channel Slope (S):

Length from the selected site to the basin divide } = 3.6 Miles

85% of the stream length = 3.06 Miles

Elevation at 85% of stream length = 100

10% of the stream length = 0.36 Miles

Elevation at 10% of stream length = 50

Main channel slope $= \frac{100 - 50}{3.06 - 0.36} = \frac{50}{2.7} = 18.52$ Ft/Mile

3 Surface Storage Index :-

Area of lake as measured from 100-scale map } = 0.06 Sq Mi.

$\therefore S_t = \frac{0.01}{5.5} \times 100 + 1 = 2.1\%$

4 Man made impervious cover index :-

No. of homes in the drainage area as counted on 1976 aero sheets } = 120 approximately

∴ Population in the drainage area as at 1976 } = 480

Increase since 1976 say 120

Total 600

$$\therefore \quad D = \frac{600}{5.5} = 109 \text{ per sq mi}$$

$$\therefore \quad I = 0.117\,[D]^{0.792 - 0.039 \log_{10}(D)}$$

$$= 0.117\,[109]^{0.792 - 0.039 \log 109}$$

$$= 3.312$$

5 $$\therefore \quad Q_{100} = 136\,(5.5)^{0.84}\,(18.52)^{0.26}\,(2.1)^{-0.51}\,(3.31)^{0.14}$$

$$= 136\,(4.187)(2.136)\,(0.685)\,(1.182)$$

$$= \underline{\underline{985 \text{ CFS}}}$$

APPENDIX 5

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