

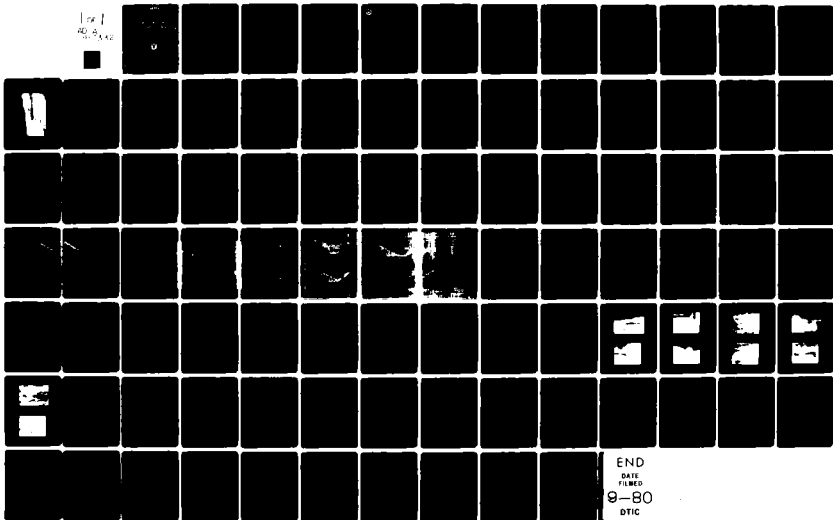
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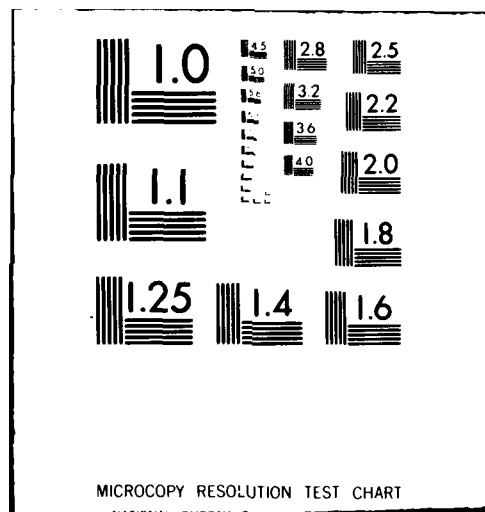
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NEW JERSEY

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LAKE DAM
NJ 00189 S**

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**PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**

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DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

FEBRUARY 1980

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1. REPORT NUMBER NJ00189	2. GOVT ACCESSION NO. AD A087332	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program West Milford Lake Dam (NJ00189). Passaic River Basin, Passaic County, NJ Longhouse Creek, Passaic County, New Jersey. Phase I Inspection Report.		5. TYPE OF REPORT & PERIOD COVERED 9 FINAL report
6. PERFORMING ORGANIZATION NAME AND ADDRESS Frederic R. Harris Inc. 453 Amboy Ave. Woodbridge, NJ 07095		7. AUTHOR John P. Talerico
8. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, PA 19106		9. CONTRACT OR GRANT NUMBER(s) DACW61-79-C-0011 ✓
10. CONTROLLING OFFICE NAME AND ADDRESS NJ Department of Environmental Protection Division of Water Resources P.O. Box CN029 Trenton, NJ 08625		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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19. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		



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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
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PHILADELPHIA, PENNSYLVANIA 19106

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

21 JUL 1980

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Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for West Milford Lake Dam in Passaic 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, West Milford Lake Dam, a high hazard potential structure, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to 27 percent of the Spillway Design Flood--SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To ensure adequacy of the structure, the following remedial actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. The ability of the dam to withstand overtopping should also be studied. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

NAPEN-N

Honorable Brendan T. Byrne

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

(1) The existing dam plans and drawings should be annotated and updated to form a coherent as-built set.

(2) Repair all cracked and spalled concrete especially the cavity in the left abutment wall.

(3) All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection.

(4) Remove all vegetation and shrubs from the spillway and seal the joint between the apron and the left abutment.

(5) Fill in and regrade areas of erosion near the abutment walls.

(6) Fill in the eroded area along the left bank of the downstream channel and provide slope protection to prevent future erosion.

(7) Investigate the embankment for animal burrows and fill in any burrow holes with impervious material.

(8) Replace the steel plate over the low-level outlet controls with a manhole cover that can be removed readily if required. Operate the low-level outlet controls periodically.

c. Within three months from the date of approval of this report, the owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities.

d. Within one year from the date of approval of this report:

(1) The owner should consider providing additional low-level outlet facilities to decrease drawdown time.

(2) The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

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 Roe of the Eighth District. Under the provision

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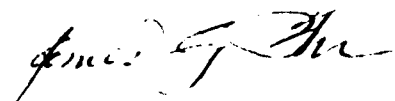
Honorable Brendan T. Byrne

of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

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

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

Sincerely,



JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

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

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

WEST MILFORD LAKE DAM (NJ00189)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 15 November and 5 December 1979 by Harris - ECI Associates, Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

West Milford Lake Dam, a high hazard potential structure, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to 27 percent of the Spillway Design Flood--SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To ensure adequacy of the structure, the following remedial actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. The ability of the dam to withstand overtopping should also be studied. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

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

(1) The existing dam plans and drawings should be annotated and updated to form a coherent as-built set.

(2) Repair all cracked and spalled concrete especially the cavity in the left abutment wall.

(3) All brush and trees should be removed from the downstream and upstream slopes. The embankment face should then be seeded to develop a growth of grass for surface erosion protection.

(4) Remove all vegetation and shrubs from the spillway and seal the joint between the apron and the left abutment.

(5) Fill in and regrade areas of erosion near the abutment walls.

(6) Fill in the eroded area along the left bank of the downstream channel and provide slope protection to prevent future erosion.

(7) Investigate the embankment for animal burrows and fill in any burrow holes with impervious material.

(8) Replace the steel plate over the low-level outlet controls with a manhole cover that can be removed readily if required. Operate the low-level outlet controls periodically.

c. Within three months from the date of approval of this report, the owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities.

d. Within one year from the date of approval of this report:

(1) The owner should consider providing additional low-level outlet facilities to decrease drawdown time.

(2) The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

APPROVED:


JAMES G. FOW

Colonel, Corps of Engineers
District Engineer

DATE:

22 July 1980

PASSAIC RIVER BASIN
LONG HOUSE CREEK, PASSAIC COUNTY
NEW JERSEY

WEST MILFORD LAKE DAM

NJ00189

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA 19106

FEBRUARY 1980

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name: West Milford Lake Dam, I.D. NJ 00189
State Located: New Jersey
County Located: Passaic County
Stream: Long House Creek
River Basin: Passaic River
Date of Inspection: November 15 and December 5, 1979

Assesment of General Conditions

West Milford Lake Dam is an earthfill dam containing a broad crested concrete weir spillway at the left end of the dam. The overall condition of the dam is good. There is no major sign of distress or instability in the embankment. There is a vertical crack and cavity exposing the underlying stone in the left abutment. The downstream channel is well defined but has a severely eroded left bank in the vicinity of the spillway cut-off wall. The operation of the low-level outlet was not demonstrated since the owner's representative was not present during the inspection. The hazard potential is rated as "high".

The adequacy of West Milford Lake Dam is considered questionable in view of its lack of spillway capacity to pass the SDF (1/2 PMF) without overtopping the dam. The spillway is capable of passing a flood equal to 13 percent of the PMF (26 percent of the 1/2 PMF), and is assessed as "inadequate".

At present, the engineering data available is not sufficient to make a definitive statement on the stability of the dam, but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory. The following actions are recommended along with a timetable for their completion. All recommended actions should be conducted under the supervision of an Engineer who is experienced in the design, construction and inspection of dams.

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within twelve months, to determine the need and type of mitigating measures necessary. Based on the results of these studies, remedial measures should be instituted. This should include the installation of a tailwater gage.
2. Repair all cracked and spalled concrete especially the cavity in the left abutment wall within twelve months.

3. Replace the steel plate over the low-level outlet controls with a manhole cover that can be readily removed if required. Operate the low-level outlet controls periodically.
4. All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection. This program should be started within twelve months.
5. Remove all vegetation and shrubs from apron and seal joint between apron and left abutment within twelve months.
6. Fill in and regrade areas of erosions near abutment walls within twelve months.
7. Fill in erosion area along left bank of downstream channel and provide slope protection to prevent future erosion.
8. Investigate embankment for animal burrows and fill in any burrow holes with impervious material.
9. The owner should develop an emergency action plan (if one is not already available) outlining action to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.

Furthermore, while of a less urgent nature, the following additional action is recommended and should be carried out within twenty-four months.

1. Consider providing additional low-level outlet facilities, to decrease the drawdown time.
2. The owner should develop within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.


John P. Talerico, P.E.
HARRIS-ECI ASSOCIATES

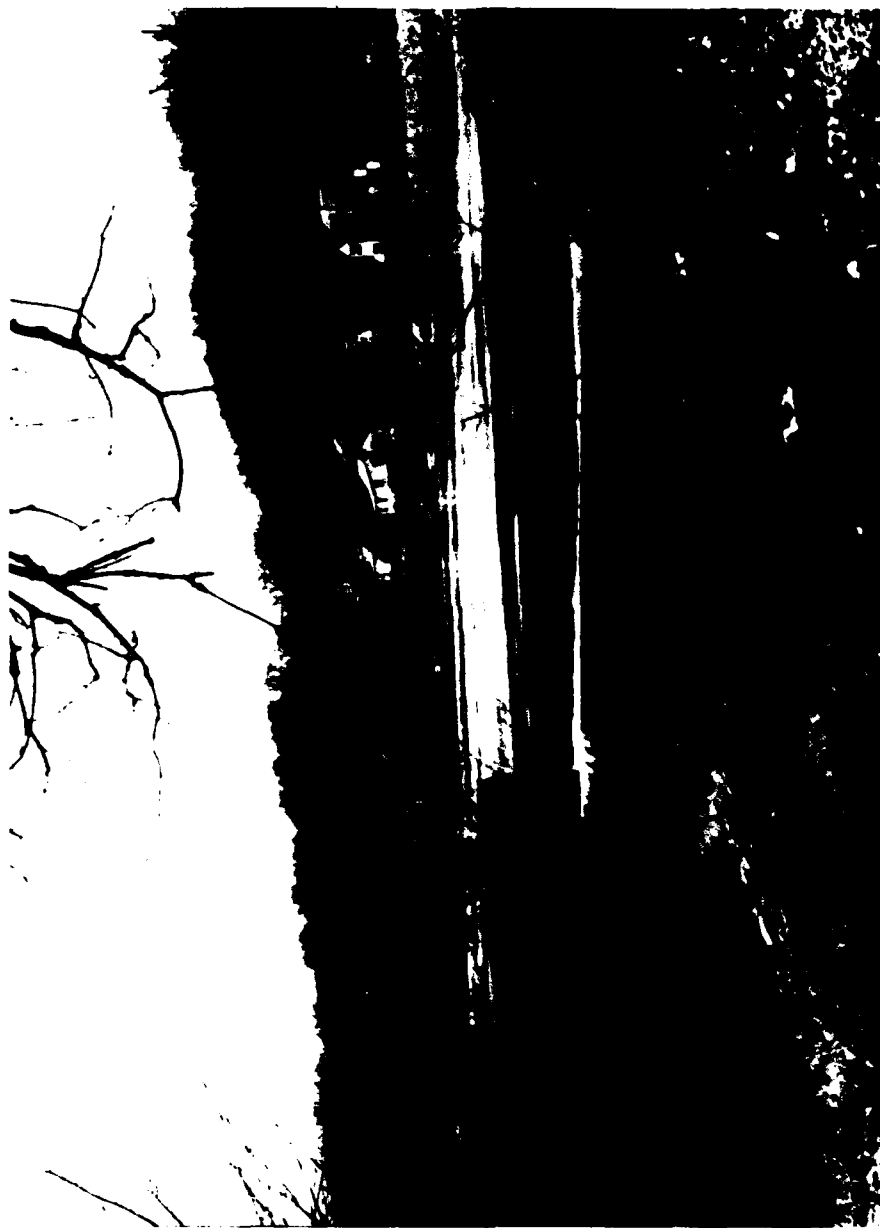


Photo taken November 15, 1979

WEST MILFORD LAKE DAM

Embankment is out of photo on viewer's left.

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 the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation intended to identify any need for such studies.

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

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

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

WEST MILFORD LAKE DAM, I.D. NJ00189

SECTION 1

1. PROJECT INFORMATION

1.1 General

a. Authority

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

b. Purpose of Inspection

The visual inspection of West Milford Lake Dam was made on November 15, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

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

1.2 Description of Project

a. Description of Dam and Appurtenances

West Milford Lake Dam is an earthfill dam approximately 665-feet long, and 16-feet high with a concrete core wall. There is a 25-foot wide broad crested concrete weir spillway at the left end of the embankment with concrete abutments. The crest of the spillway is 3.0 feet below the top of dike.

The embankment has a top width of 8 feet with an upstream slope of 2H:1V and downstream of 1.7H:1V. Riprap protection has been placed on the upstream side of the embankment.

The low-level outlet consists of an 8-inch cast iron pipe through the dike approximately 280 feet right of the spillway. The flow through the pipe is controlled by a manually operated valve located in the center of the dike. The inlet end of the pipe is located at the upstream toe of the slope. The outlet discharges into the spillway channel.

The downstream spillway channel runs parallel to the embankment approximately 100 feet from the top of the dike and discharges into the Long House Creek Channel just before it crosses under Marshall Hill Road.

A generalized description of the soil conditions is contained in Engineering Soil Survey of New Jersey, Report No.3 - Passaic County by Rutgers University. The report describes the dam area as a variable, but usually shallow mantle of glacial ground moraine over gneiss bedrock. Ground moraine is unstratified, heterogeneous material including clay, silt and sand sizes with varying amounts of gravel, cobbles and boulders. The underlying rock is classified as hornblende granite and gneiss by the U.S.G.S. Geologic Overlay Sheet 22. The downstream channel is described as a swampy area with the water-table at the ground most of the year.

b. Location

West Milford Lake Dam is located on Long House Creek in the Township of West Milford, Passaic County, New Jersey. It is accessible by way of Marshall Hill Road.

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams" by the U.S. Department of the Army, Office of the Chief Engineers, the dam is classified in the dam size category as being "small", since its storage volume of 102 acre-feet is less than 1,000 acre-feet and because its height of 16 feet is less than 40 feet.

d. Hazard Classification

A hazard potential classification of "high" has been assigned to the dam on the basis that a hypothetical failure would result in excessive damage to the houses and the road immediately downstream of the dam. Because the road is heavily traveled and there are several habitable buildings within the flood path, the possibility exists of the loss of more than a few lives in the event of dam failure.

e. Ownership

West Milford Lake Dam is owned by:

West Milford Lake
Taxpayers and Community Association
8662 15th Avenue
Brooklyn, NY 11228

Attention: Mr. Sam Filippo
(212) 236-5474

f. Purpose

West Milford Lake Dam is presently used for recreational purposes only.

g. Design and Construction History

West Milford Lake was constructed in 1929; however, no plans, design criteria, computations or inspection reports of the construction could be found. Between 1961 and 1968, the top of the dam was widened and general repairs were made to the spillway. The West Milford Taxpayers and Community Association was ordered by the New Jersey Department of Environmental Protection (NJ-DEP) in 1960 to drain the lake and make these repairs.

No other modifications have taken place since 1968.

h. Normal Operating Procedures

The discharge from the lake is unregulated and is allowed to naturally balance the inflow into the lake. The low-level outlet is used to lower outlet pipe was not possible because at the time of inspection, the owner's representative was not present to operate the valve.

1.3 Pertinent Data

a. Drainage Area

0.7 square miles

b. Discharge at Dam Site

Ungated spillway capacity at
elevation of top of dam:

351 cfs (659.5 NGVD)

Total spillway capacity at
maximum pool elevation (SDF):

1,975 cfs (660.39 NGVD)

c. Elevation (Feet above NGVD)

Top of dam:

659.5

Maximum pool design surcharge (SDF):

660.27

Recreation pool:

656.7

Spillway crest:

656.5

Streambed at centerline of dam:

643 (estimated)

Maximum tailwater:

644 (estimated)

d. Reservoir

Length of maximum pool:

950 ft. (estimated)

Length of recreation pool:

850 ft. (estimated)

e. Storage (acre-feet)

Spillway Crest:

46

Top of dam:

87

Maximum pool (SDF):

102

f. Reservoir Surface (acres)

Top of dam:

16.8 (estimated)

Maximum pool (SDF):

17.2 (estimated)

Spillway Crest:

11.0 (656.5 NGVD)

g. Dam

Type: Earthfill with concrete weir

Length: 665 ft. (effective)

Height: 16 ft.

Top width: 8 ft.

Side slopes. - Upstream: 2H:1V
- Downstream: 1.7H:1V (Measured in field)

Zoning: Unknown

Impervious core: Concrete core, length unknown

Cutoff: None

Grout curtain: None

h. Diversion and Regulating Tunnel

N/A

i. Spillway

Type: Concrete weir

Length of weir: 25 ft.

Crest elevation: 656.5 ft. NGVD

Gates: None

U/S Channel: West Milford Lake

D/S Channel: Trapezoidal shape with a 5 to 7 ft. wide bottom, 3-foot deep and covered with cobblestone and boulders

j. Regulating Outlets

Low level outlet: 8-inch

Controls: The supposed manual valve had not been inspected during field investigation

Emergency Gate: None

Outlet: 643 NGVD

SECTION 2

2. ENGINEERING DATA

2.1 Design

Drawings for the original construction of the West Milford Lake Dam in 1929 are not available to the N.J. Department of Environmental Protection (NJ-DEP). Drawings showing the increase in width to the top of the dam and repairs to the spillway are available at the NJ-DEP. No embankment data from soil borings, soil tests, design computations, or other geotechnical data are available to assess the stability properly. Data concerning the hydraulic capacity of the spillway is also unavailable.

2.2 Construction

Data is not available concerning the as-built original construction of the dam or the rehabilitation. No data exists of construction methods, borrow sources, or other data pertinent to the construction of the dam.

2.3 Operation

Formal operation records are not kept for the dam and reservoir. The lake is allowed to operate naturally without regulation.

2.4 Evaluation

a. Availability

The availability of original engineering data is poor. The stated drawings and some correspondence concerning the widening and spillway repairs are available from the NJ-DEP.

b. Adequacy

The engineering data available, together with that obtained in the field, were adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform a stability analysis, but preliminary evaluation could be made based on visual observations.

c. Validity

Information contained in the 1961 modification drawings and checked by limited field measurements appears to be valid for the dam in general. However, there are two exceptions; the downstream embankment slope is shown as 2H:1V, but is actually 1.7H:1V, and the rock paving of the spillway discharge channel as shown on the plans is not there.

SECTION 3

3. VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection of West Milford Lake Dam revealed the dam and spillway to be in a good condition, but in need of repairs. The lake level was above the spillway's crest at the time of inspection.

b. Dam

The earth embankment appears to be sound. No surface cracking on the embankment or at the toe was noted. No misalignment of the embankment in the horizontal or vertical plane was observed. Minor sloughing was visible on the downstream upper slope just beyond the cut-off wall. Numerous trees, small to large sizes, are growing on both sides of the embankment. The trees, dense vegetation and debris along the embankment toe prevented a proper inspection of the downstream slope for seepage, movement, cracking or burrowing by animals. However, none of these conditions were observed, but there is the possibility that they might exist.

c. Appurtenant Structures

1. Spillway

No seepage or leakage was noticed at the concrete spillway. Severe spalling was visible at the left abutment and wingwall. Minor spalling was noticed at the right abutment and apron. A vertical crack was visible at the left abutment. A cavity, exposing the underlying stone, exists on the left abutment where it meets the spillway. There is erosion behind the entire length of the right abutment. The erosion is evidently caused by this area being used as a footpath. Severe erosion has occurred behind the end portion of the left wingwall. This erosion is a cavity in the fill concrete. Evidently, this fill concrete has been poured behind the wall in an attempt to stop the erosion. The spillway crest appears to have settled near its right abutment. Water is flowing over the spillway for only a distance of 10 feet from the abutment. Vegetation and shrubs are growing in the apron along its interface with the left wingwall.

2. Low-Level Outlet

An 8-inch cast iron pipe exits at the toe of the downstream slope. Its valve was located in a deep concrete pit covered by a heavy steel plate on the embankment's crest. The cover was supported only on two sides by the surrounding earth. The other two sides were unsupported as a result

of severe earth erosion. Unseating the cover for inspection would risk further disturbance to the surrounding earth and possible personal injury as a result of the loose sloping earth adjacent the cover. The owner/representative was not present at inspections. Visual inspection and operation of the valve was not possible under the circumstances.

d. Reservoir Area

The side slopes of the reservoir are approximately 2H:1V. There is no sign of slope instability. The lake appears clean with no indication of surface growth.

e. Downstream Channel

The downstream channel is well defined with shallow and steep slopes. Cobblestones and boulders clutter the stream bed in the vicinity of the cut-off wall. From the end of the wall to approximately 100 feet beyond, the left bank is seriously eroded. Further downstream, the channel has a buildup of fallen trees. Rubble is also present near the low-level outlet pipe.

There are two houses on the left bank. The first house is located approximately 150 feet from the spillway. A wood shelter, used by bus passengers, is located approximately 50 feet from the spillway. The channel flows under Marshall Hill Road about 250 feet from the spillway.

SECTION 4

4. OPERATIONAL PROCEDURES

4.1 Procedures

West Milford Lake Dam is used to impound water for recreational activities. The level of the lake is maintained through the unregulated flow over the spillway. The lake is not lowered on a regular basis.

4.2 Maintenance of the Dam

There is no regular inspection and maintenance program for the dam and appurtenant structures. The West Milford Lake Taxpayers and Community Association is responsible for the maintenance of the dam.

4.3 Maintenance of Operating Facilities

The low-level outlet operating facilities consist of one manually operated 8-inch valve. At the time of inspection, operation of the valve was not demonstrated as mentioned in Section 1.1.h.

4.4 Evaluation

The present operational and maintenance procedures are fair with the dam and spillway being maintained in a serviceable condition.

SECTION 5

5. HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The drainage area above West Milford Lake Dam is approximately 0.7 square miles. A drainage map of the watershed of the dam site is presented on Plate 1, Appendix D.

The topography within the basin has relatively flat slopes. Elevations range from approximately 1,100 feet above NGVD at the south end of the watershed to about 656 feet at the dam site. Land use patterns within the watershed are mostly woodland with concentrated residential development around the lake area.

The evaluation of the hydraulic and hydrologic features of the dam and lake was based on criteria set forth in the Corps Guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The Spillway Design Flood (SDF) for the dam is equal to the 1/2 PMF.

The Probable Maximum Flood(PMF) was calculated from the Probable Maximum Precipitation using Hydrometeorological Report No. 33 with standard reduction factors. Due to the small drainage area, the SCS triangular hydrograph transformed to a curvilinear hydrograph was adopted for developing the unit hydrograph, with the aid of the HEC-1DB Flood Hydrograph Computer Program.

Initial and infiltration loss rates were applied to the Probable Maximum Precipitation to obtain rainfall excesses. The rainfall excesses were applied to the unit hydrograph to obtain the PMF and various ratios of PMF utilizing program HEC-1DB.

The SDF peak outflow calculated for the dam is 1,975 cfs. This value is derived from the 1/2 PMF, and results in overtopping of the dam, assuming that the lake was originally at the spillway crest elevation.

The stage-outflow relation for the spillway was determined from the geometry of the spillway and dam, utilizing HEC-1DB program.

The reservoir stage-storage capacity relationship was computed directly by the conic method, utilizing the HEC-1DB program. The reservoir surface areas at various elevations were measured by planimeter from a U.S.G.S. Quadrangle topographic map. Reservoir storage capacity included surcharge levels exceeding the top of the dam, and the spillway rating curve was based on the assumption that the dam remains intact during routing.

A breach analysis indicates that the stage of the stream where it crosses Marshall Hill Road is 3.6 feet higher due to dam failure from overtopping, at 20 percent PMF than it would be without failure at 20 percent PMF. This is likely to jeopardize the well traveled road and two houses downstream of the road but not significantly more than without failure. The discharge facility is thus rated "inadequate".

Drawdown calculations indicate that to empty the lake to an elevation of 644 NGVD through the one low-level sluice would take 6 days, assuming a 2 cfs/square mile inflow. This is considered to be an excessive draw-down period, and provision of additional outlets should be considered.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site.

c. Visual Observation

The downstream channel is well defined. The slopes of the channel are shallow to steep. Erosion of the left bank has occurred, for an approximate length of 100 feet, beginning at the cut-off wall. A wood shelter is on the left bank. It is provided for bus passengers and is located approximately 50 feet from the spillway. There are also two houses on the left bank, located about 150 feet from the spillway. A roadway bridge crosses over the channel approximately 250 feet from the spillway.

The slopes of the reservoir are moderate and at the time of inspection did not exhibit signs of instability. The drainage area is wooded, moderately flat sloped and developed for residential use around the lake.

d. Overtopping Potential

A storm of magnitude equivalent to the SDF would cause overtopping of the dam to a height of 0.89 feet. Computations indicate that the dam can pass approximately 13 percent of the PMF without overtopping the dam crest. Since the 1/2 PMF is the Spillway Design Flood (SDF) for this dam, according to the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers, the spillway capacity of the dam is assessed as "inadequate".

SECTION 6

6. STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There were no observed distress signs in the embankment of the West Milford Lake Dam; however, trees, dense vegetation, leaves and debris limited the areas of inspection to the embankment's crest and unobstructed portions of its slope and toe. The numerous trees growing on both sides of the embankment could pose a threat to stability. Where the embankment and toe were accessible, no cracks or major movements were noted. The vertical and horizontal alignment of the crest was good. There was minor sloughing of the upper embankment's downstream slope just beyond the cut-off wall. The concrete spillway is in fair condition. It appears to have settled near the right abutment. Spalling was noted at both abutments and a cavity exists in the left abutment at the intersection of the abutment with the spillway.

b. Design and Construction Data

No design computations relating to embankment stability were uncovered during the report preparation phase. No embankment or foundation soil parameters are available for carrying out a conventional stability analysis on the embankment. There are stability calculations for the new wingwalls "L" and "R" as shown on the 1961 Phase I plans.

c. Operating Records

No operating records are available relating to the stability of the dam. The dam and spillway have served satisfactorily since its rehabilitation was completed in 1968.

d. Post-Construction Changes

The dam was widened and the spillway rebuilt during a two-phase rehabilitation plan which began in 1961 and ended in 1968, as described in Section 1.2.g.

e. Static Stability

A static stability analysis was not performed on the West Milford Dam because the lack of data on which to base assumptions of material properties inside embankment zones might produce misleading results, but based on the finding of the visual inspection, the preliminary assessment of static stability is that it is satisfactory.

f. Seismic Stability

The dam is located in Seismic Zone 1, as defined in the Recommended Guidelines for Safety Inspection of Dams, prepared by the Corps of Engineers. In general, project located in Seismic Zones 0, 1 and 2 may be assumed to present no hazard from earthquake, provided the static stability conditions are satisfactory and conventional safety margins exist and based on the findings of the visual inspection, the preliminary assessment of the static and seismic stabilities is that they are satisfactory.

SECTION 7

7. ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

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

The safety of West Milford Lake is in question because the dam does not have adequate spillway capacity to pass the SDF, one half of the PMF without overtopping. Overtopping of the dam carries with it the danger of possible progressive failure of the dam. The present spillway capacity of the dam is approximately 13 percent of the PMF.

No definitive statement pertaining to the safety of the embankment can be made without acquisition of embankment material engineering properties, but based on the findings of the visual inspection, preliminary assessment of static stability is that it is satisfactory.

b. Adequacy of Information

The information uncovered was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform even an approximate computation of the stability of the dam. A preliminary assessment of the dam could be made by visual observation only.

c. Urgency

The remedial measures and recommended actions along with a timetable for their completion are detailed below. All recommended action should be conducted under the supervision of an engineer who is experienced in the design, construction and inspection of dams.

7.2 Remedial Measures

a. Alternatives for Increasing Spillway Capacity

Alternatives for increasing spillway capacity are as follows:

1. Increase the embankment height of the dam thus permitting a higher discharge to pass over the spillway and reducing the possibility of overtopping.
2. Lower the spillway crest elevation.
3. Increase the effective spillway crest length.
4. A combination of any of the above alternatives.

b. Recommendations

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within twelve months, to determine the need and type of mitigating measures necessary. If required, conduct a study of the means of increasing spillway discharge capacity and develop alternative schemes for construction. This should include the installation of headwater and tailwater gages. The ability of the dam to withstand overtopping should also be studied.
2. The existing dam plans and drawings should be annotated and updated to form a coherent as-built set within twelve months.
3. Repair all cracked and spalled concrete especially the cavity in the left abutment wall within twelve months.
4. All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection. This program should be started within twelve months.
5. Remove all vegetation and shrubs from apron and seal joint between apron and left abutment within twelve months.

6. Fill in and regrade areas of erosions near abutment walls within twelve months.
7. Fill in erosion area along left bank of downstream channel and provide slope protection to prevent future erosion.
8. Investigate embankment for animal burrows and fill in any burrow holes with impervious material.
9. Replace the steel plate over the low-level outlet controls with a manhole cover that can be removed readily if required. Operate the low-level outlet controls periodically.

The following additional actions are recommended:

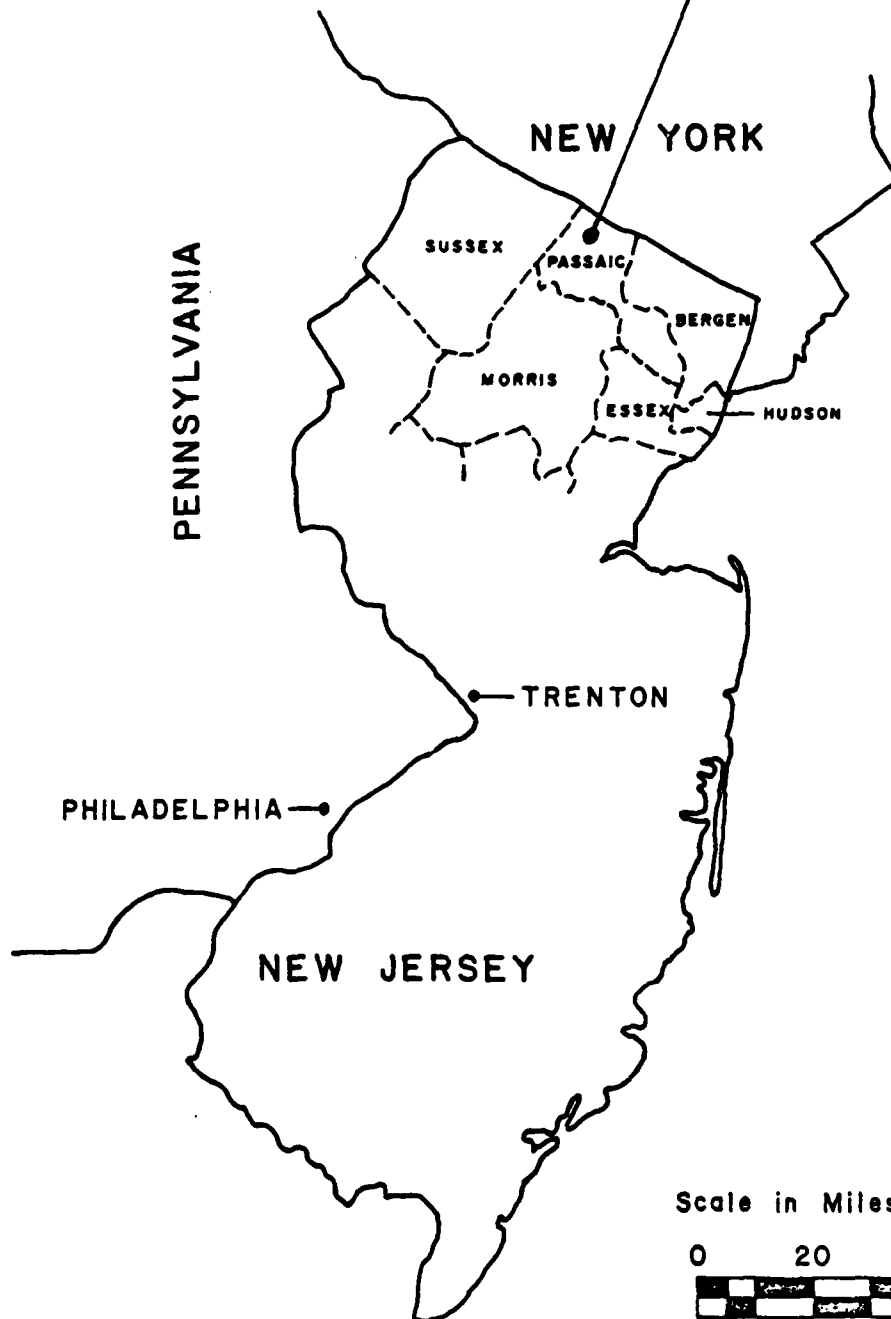
1. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.
2. Consider providing additional low-level outlet facilities to decrease drawdown time.

c. O & M Procedures

The owner should develop, within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.

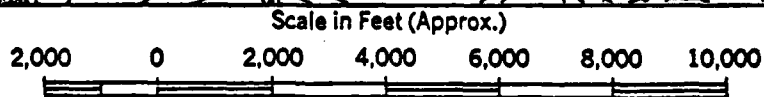
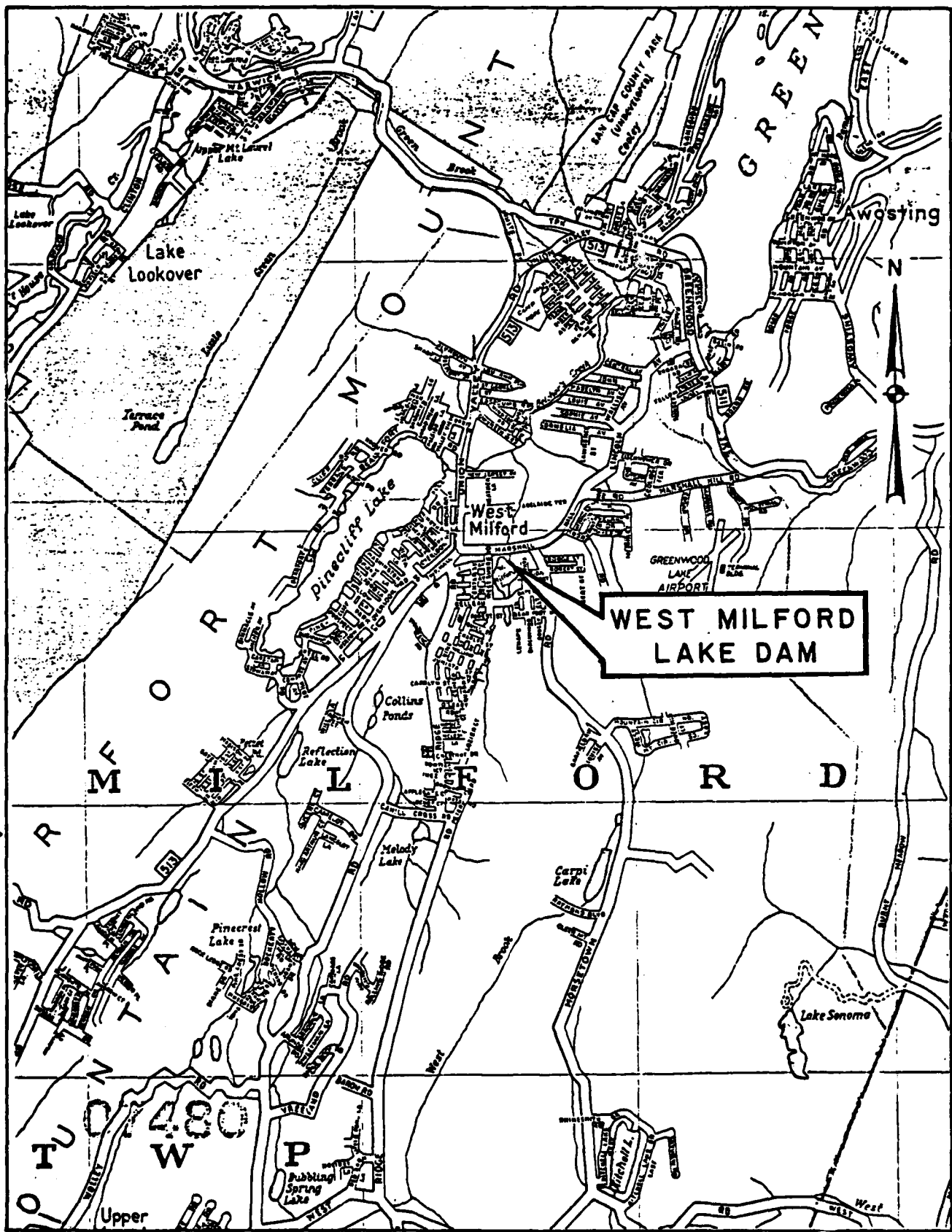
PLATES

**WEST MILFORD LAKE DAM
WEST MILFORD TWP.
PASSAIC COUNTY, N. J.**

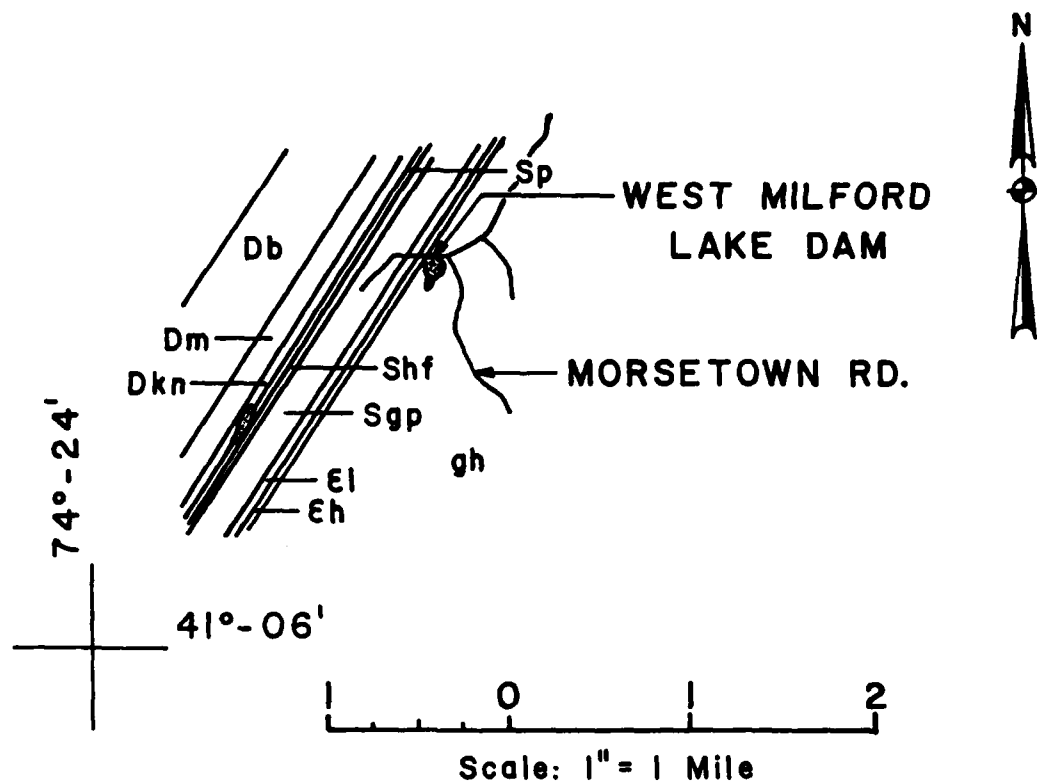


KEY MAP

PLATE I



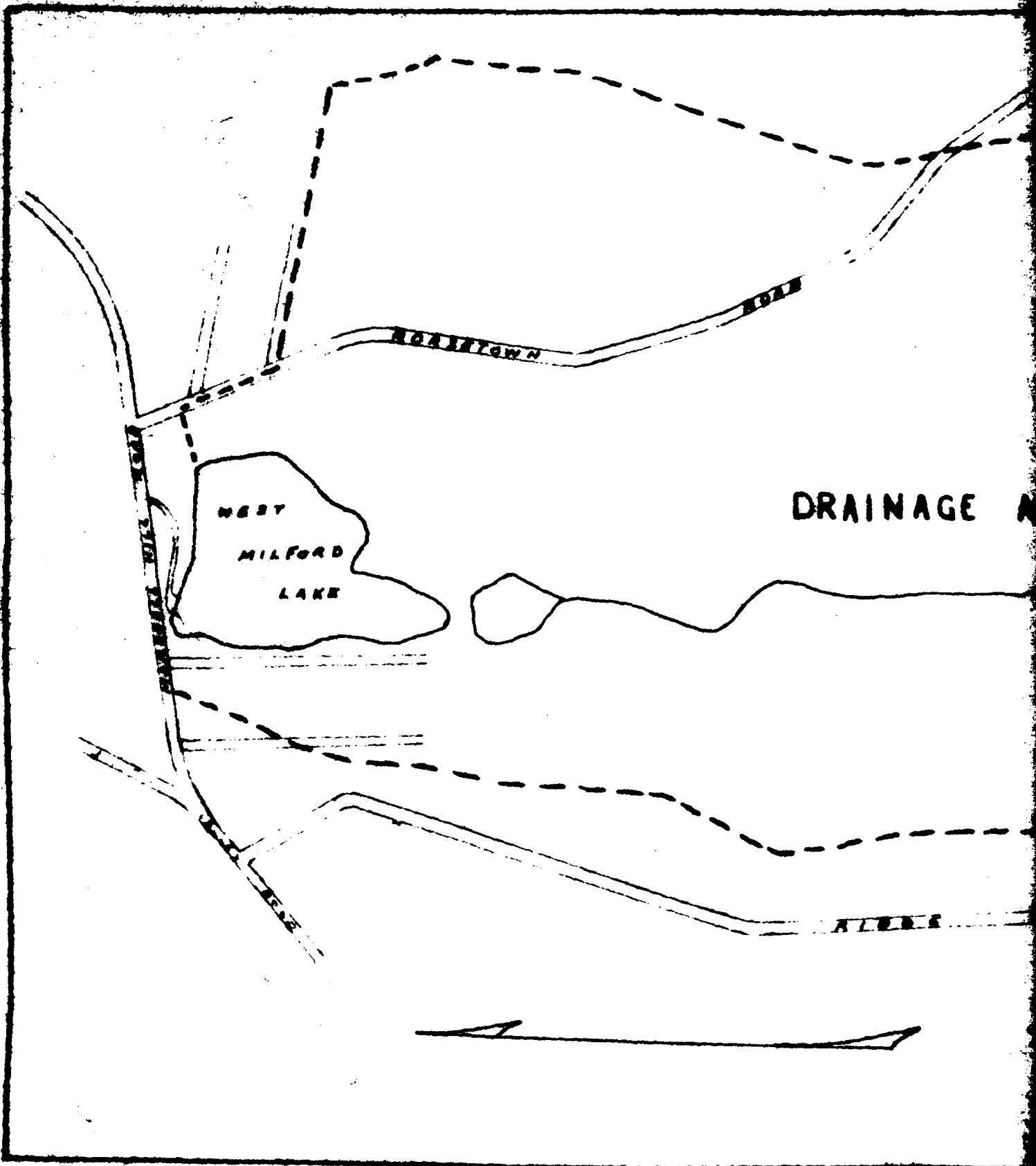
VICINITY MAP



LEGEND:

- DEVONIAN
- Db Bellvale Sandstone
- Dkn Kanouse Sandstone
- Dm Marcellus Shale
- SILURIAN
- Sgp Green Pond Conglomerate
- Shf High Falls Formation
- Sp Poxono Island Formation
- CAMBRIAN
- Eh Hardyston Sandstone
- El Leithsville Formation
- PRECAMBRIAN
- gh Mostly Hornblende Granite and Gneiss

**GEOLOGIC MAP
WEST MILFORD LAKE DAM**



AREA - 0.75 SQ. MI.

ROAD

LOCATION
WEST MILFORD
AT
West Milford
SCALE 1 IN.

Joseph E. Burchard PE
22 JULY 1954

Ref. Maps published by USMT
GREENWOOD LAKE QUADRANGLE

1/4

LOCATION PLAN
WEST MILFORD LAKE

AT
WEST MILFORD, N. H.
SCALE 1 INCH = 500 FEET

Ref. Maps published by UNITED STATES GEOLOGICAL SURVEY
GREENWOOD LAKE QUADRANGLE & WASHINGTON QUADRANGLE

PLATE '3

3

REPLACE STONE RIM
MINIMUM DIMENSION

ENCL 114 55

**PRESENT -
SECTION**

SCALE - 1 inch = 6 feet

30 SPILLWAY 40 ELEVATION 30 111 55 25 12 115 105 102 101

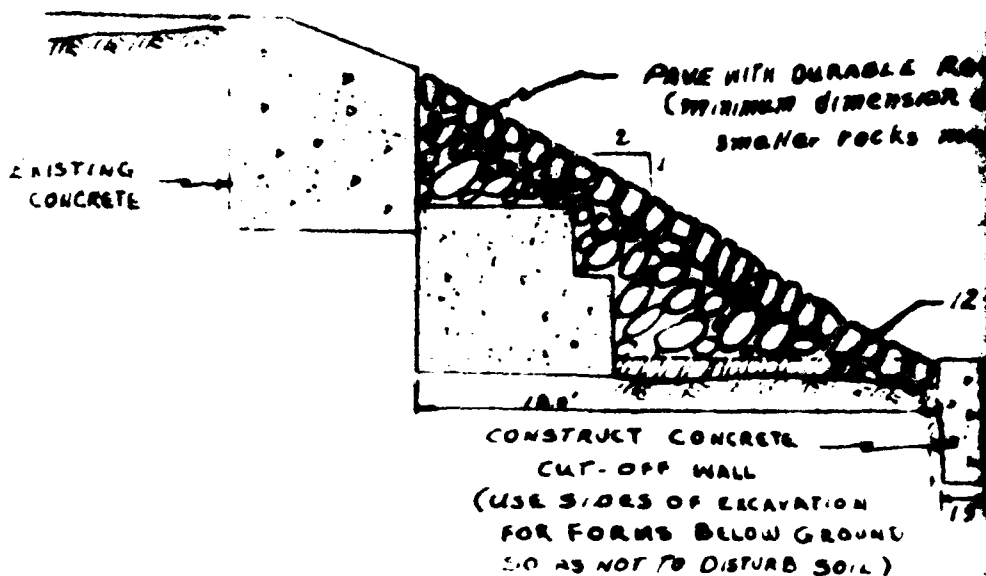
LAKE BOTTOM

EL 106.95 EL 107.20 EL 107.35 EL 108.40 EL 110.45

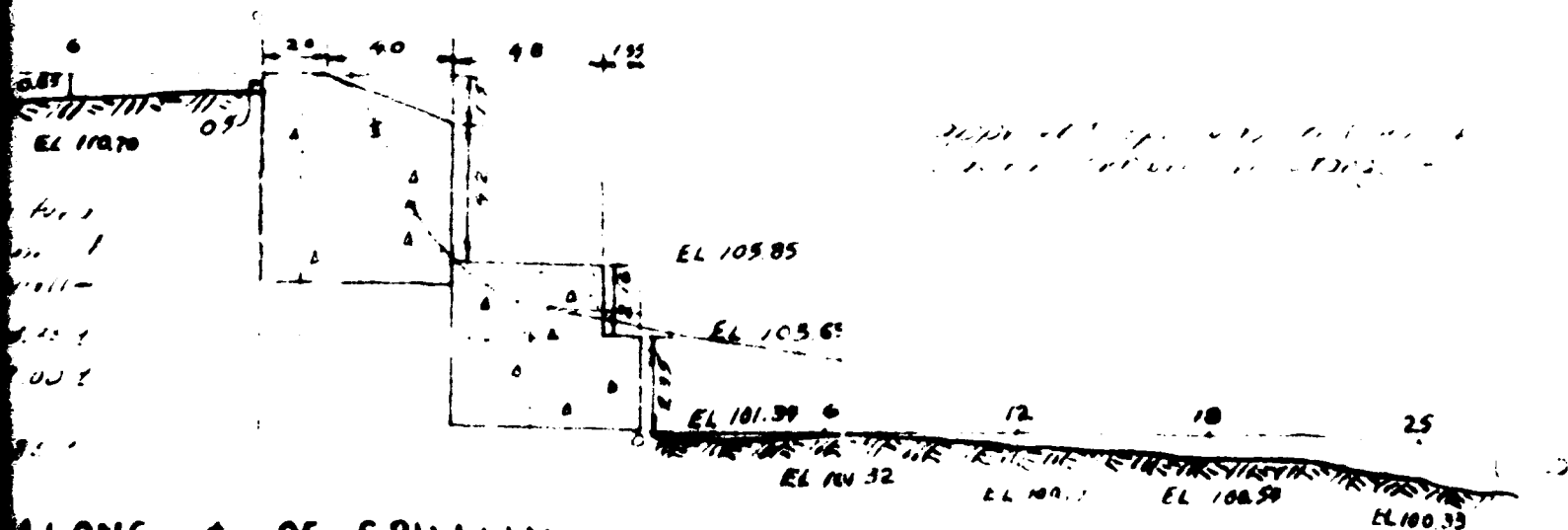
SECTION

SCALE-4

Line Ex 11.55



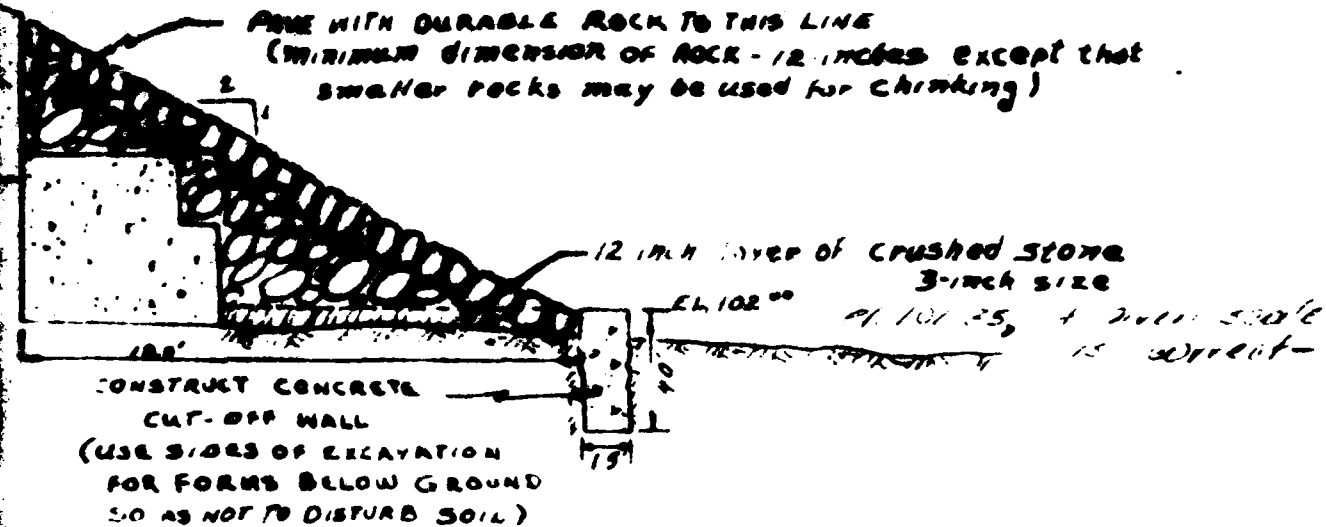
PROPOSED E SECTION OF SPILLWAY
SCALE 1-inch = 5 feet



ALONG E OF SPILLWAY

nach Siegel (Hohl- & Vert.)

2/4



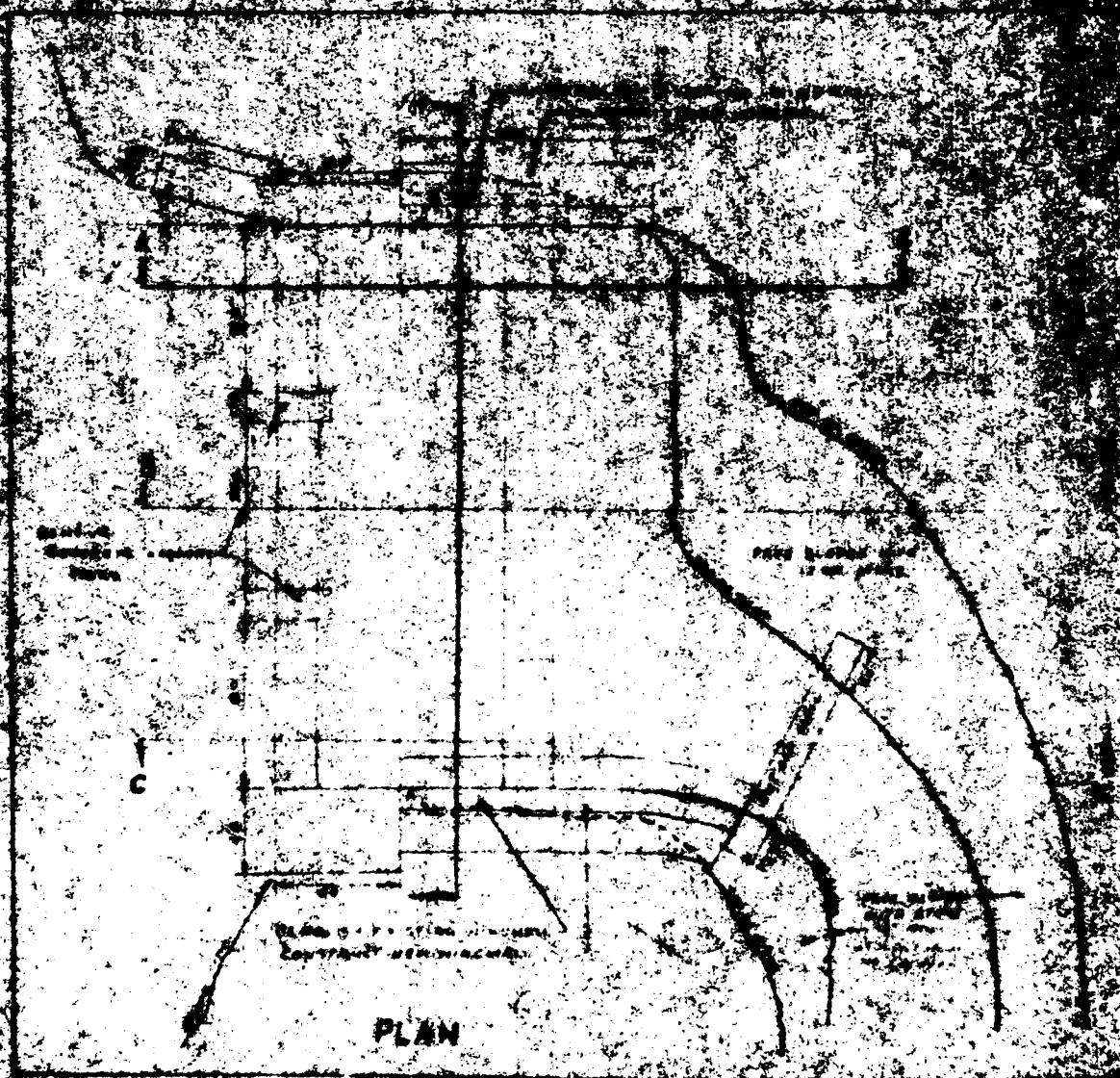
SECTION OF SPILLWAY
SCALE 1-INCH = 5-FOOT

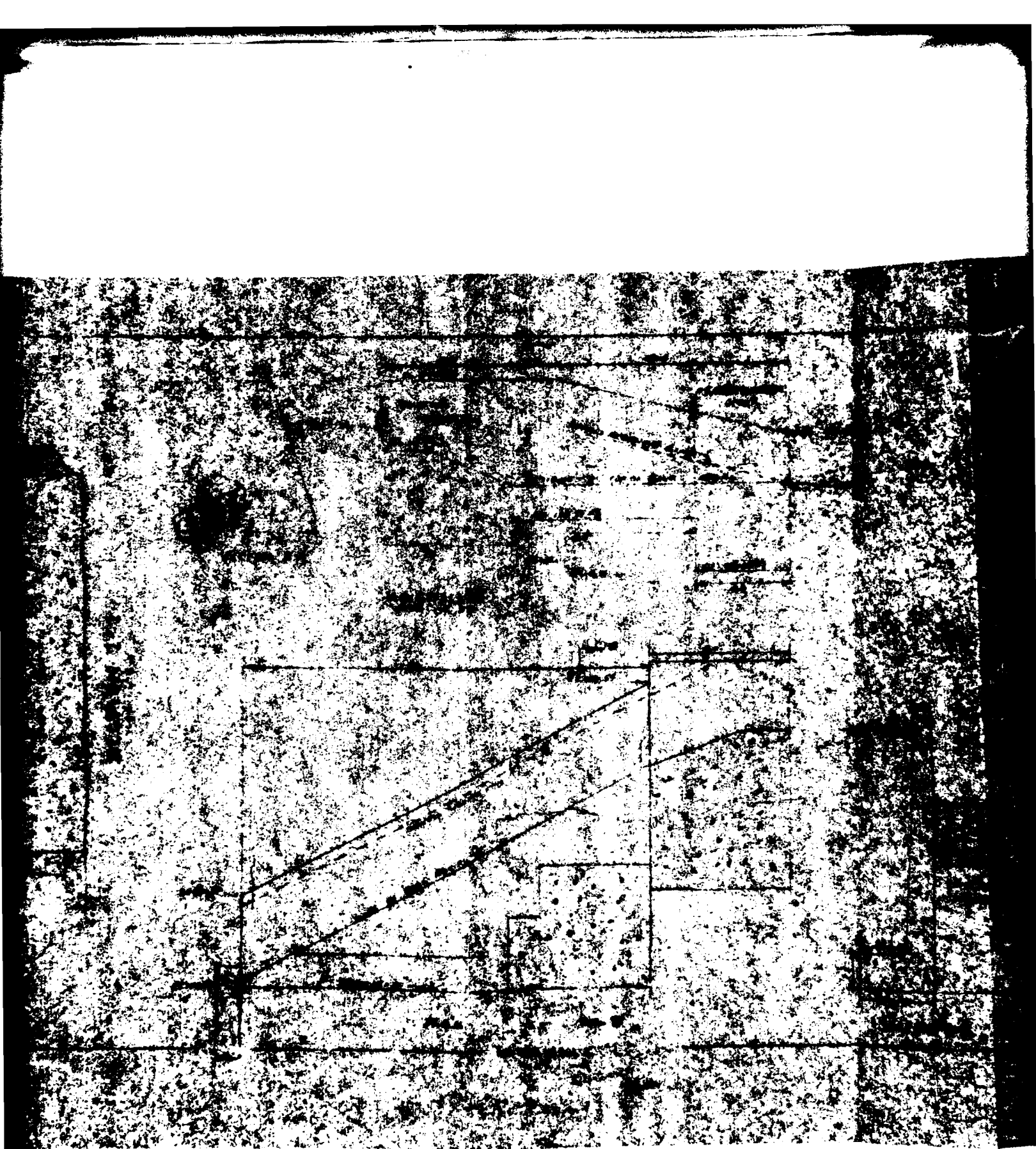
10 25
EL 100.59 EL 100.33

WEST MILFORD LAKE
DAM & SPILLWAY REPAIRS
SCALE AS NOTED

Joseph B. Bruchman P.E.
27/ June 1960

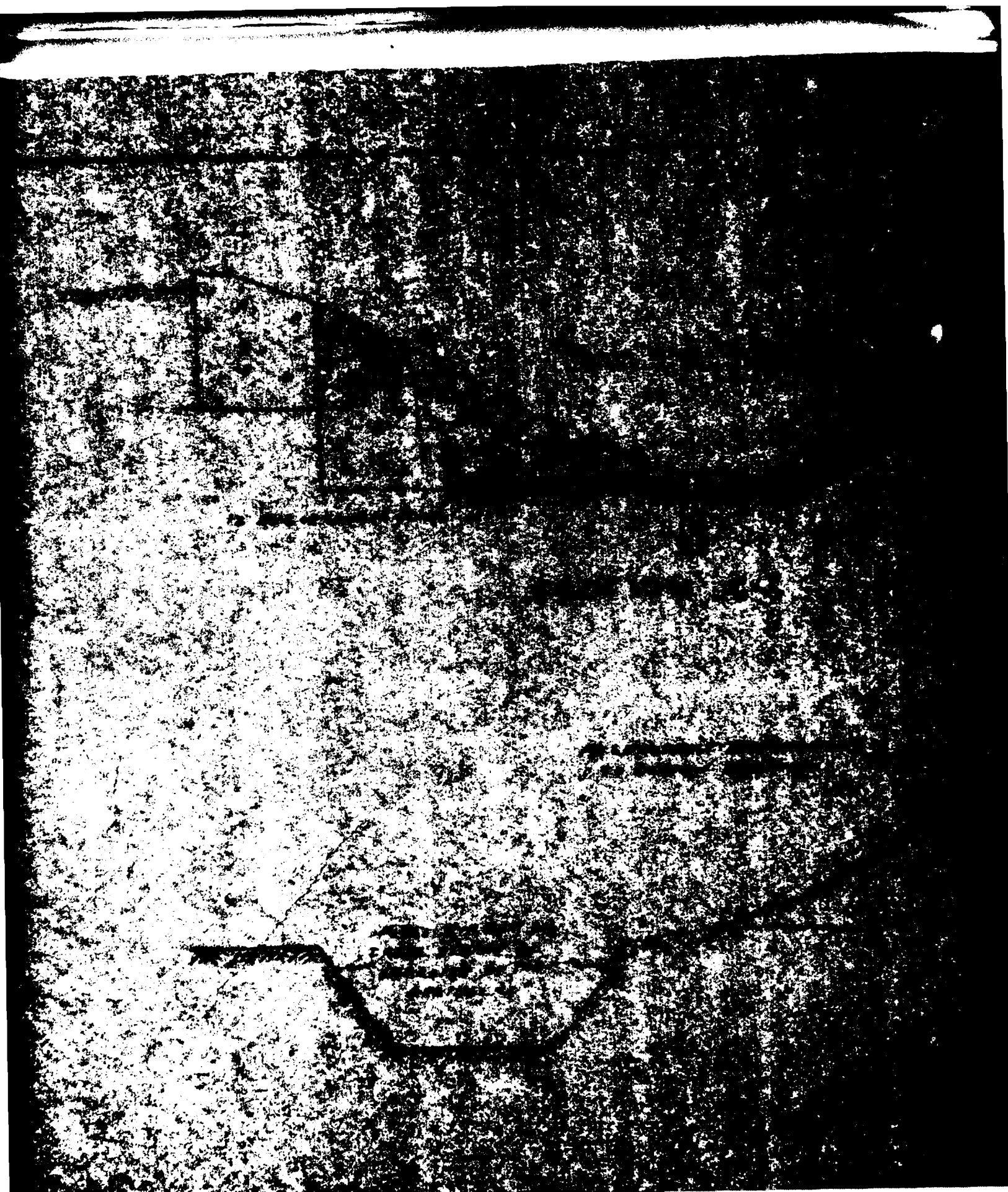
PLATE 4







From the top of the stone
found in the ground





APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION
MAINTENANCE DATA

CHECK LIST
VISUAL INSPECTION
PHASE 1

Name Dam WEST MILFORD LAKE DAM County Passaic State New Jersey Coordinators NJ-DEP

Date(s) Inspection November 15, 1979 Weather Clear Temperature 36°F
December 5, 1979

Pool Elevation at Time of Inspection 659.5 NGVD Tailwater at Time of Inspection 644 NGVD

Inspection Personnel:

November 15, 1979:

Chuck Chin
Henry King (Recorder)
Thomas Lakovich

December 5, 1979:

Chuck Chin
James McCormick

Owner/Representative - None attended

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SEEPAGE OR LEAKAGE N/A		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS N/A		
DRAINS N/A		
WATER PASSAGES N/A		
FOUNDATIONS N/A		

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND 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 AND RECOMMENDATIONS
SURFACE CRACKS None noticed.		
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No visible movement or cracking at or beyond the toe was noticed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	There is minor sloughing of upper embankment, downstream side, immediately beyond the cut-off wall.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
EARTH EMBANKMENT Numerous trees, small to large-sized, and shrubs are growing on both sides of the embankment.		Remove trees and shrubs.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM Good condition. Slight erosion behind the right abutment. The erosion is probably the result of this area being used as a footpath.		
ANY NOTICEABLE SEEPAGE None noticed. However, numerous trees, dense vegetation, debris and leaves prevented a proper inspection.		Remove trees, vegetation, debris and leaves. Upon removal, inspect for seepage.
STAFF GAGE AND RECORDER None.		
DRAINS None.		

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACE IN STILLING BASIN	Surface of stilling basin of low-level outlet could not be seen because it was under water.	
INTAKE STRUCTURE	Low level drain under water in lake. Not visible.	
OUTLET STRUCTURE	An 8-inch cast iron pipe, without headwall, is the low level outlet drain. It is in good condition. Operation of valve could not be performed because the owner/representative was not present.	Replace plate with manhole cover and check operation of valve.
OUTLET FACILITIES	None.	
EMERGENCY GATE	None.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	No seepage of leakage noted. Concrete spillway appears to have settled from the right abutment to a point approximately 10 feet along the spillway. Severe spalling was noticed at left abutment and minor spalling at the right. A cavity exists in the fill concrete that has been poured behind the left abutment to control erosion.	Repair cracks, spalling and cavities.
APPROACH CHANNEL	Reservoir	
DISCHARGE CHANNEL	Vegetation and shrubs are growing along and near the left wingwall.	Remove vegetation and shrubs.
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND 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 OF MONUMENTATION/SURVEYS	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
None.		
OBSERVATION WELLS None.		
WEIRS None.		
PIEZOMETERS None.		
OTHER None.		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES 2 horizontal to 1 vertical. No indication of slope instability.		
SEDIMENTATION None visible.		

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Cobblestones and boulders in channel near cut-off wall. Scattered fallen trees and other debris in channel. Erosion of the left bank has occurred for an approximate length of 100 feet. The erosion begins at the cut-off wall.	Relocate cobblestones and boulders to side slopes. Remove fallen trees and debris. Place riprap along the 100 feet eroded left bank.
SLOPES	Shallow to steep.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Two homes on the left bank with the first home being approximately 150 feet from the spillway. Approximately 50 feet from the spillway is a wood shelter used by bus passengers. The channel flows under Marshall Hill Road about 250 feet from the spillway.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available on microfilm at N.J. Department of Environmental Protection (NJ-DEP), 1474 Prospect Street, P. O. Box CN-029, Trenton, NJ 08625.
REGIONAL VICINITY MAP	Available-Passaic County Map and USGS Quadrangle Sheet for Greenwood Lake, New York-New Jersey.
CONSTRUCTION HISTORY	History after 1961 can be deduced from microfilm at NJ-DEP.
TYPICAL SECTIONS OF DAM	Available on microfilm at NJ-DEP.
HYDROLOGIC/HYDRAULIC DATA	Hydrologic data and hydraulic data for a 50-year storm available on microfilm at NJ-DEP.
OUTLETS - PLAN	Available on microfilm (NJ-DEP).
- DETAILS	Available on microfilm (NJ-DEP).
- CONSTRAINTS	None.
- DISCHARGE RATINGS	Not available.
RAINFALL / RESERVOIR RECORDS	Not available.

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

ITEM	REMARKS
DESIGN REPORTS	Design memorandum available on microfilm at NJ-DEP.
GEOLOGY REPORTS	Available USGS Geologic overlay sheet for Passaic County and Engineering Soils Survey of New Jersey, Report No. 3--Passaic County, by Rutgers University (New Brunswick, N.J.).
DESIGN COMPUTATIONS	Structural calculations available on microfilm at NJ-DEP.
HYDROLOGY & HYDRAULICS	Available.
DAM STABILITY	}----- None available
SEEPAGE STUDIES	}
MATERIALS INVESTIGATIONS	}
BORING RECORDS	}
LABORATORY	}
FIELD	} None available.
POST-CONSTRUCTION SURVEYS OF DAM	Available on microfilm at NJ-DEP.
BORROW SOURCES	Unknown.
SPILLWAY PLAN - SECTIONS	} Available on microfilm at NJ-DEP.
- DETAILS	} - DETAILS }

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

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	None available.
MONITORING SYSTEMS	None available.
MODIFICATIONS	Existing spillway and embankment altered beginning in 1961. Available on microfilm at NJ-DEP.
HIGH POOL RECORDS	Not kept.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Post construction studies beginning in 1961, ending 1968. Available on microfilm at NJ-DEP.
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION - REPORTS	None known to exist.
MAINTENANCE OPERATION RECORDS	None known to exist.

APPENDIX B

PHOTOGRAPHS

(Taken on November 15, 1979)

WEST MILFORD LAKE DAM



Photo 1 - Looking upstream. Note apparent settlement of spillway at right abutment.



Photo 2 - Looking upstream. Note cavity in waste concrete behind wingwall and vegetation and shrubs growing in apron.

WEST MILFORD LAKE DAM

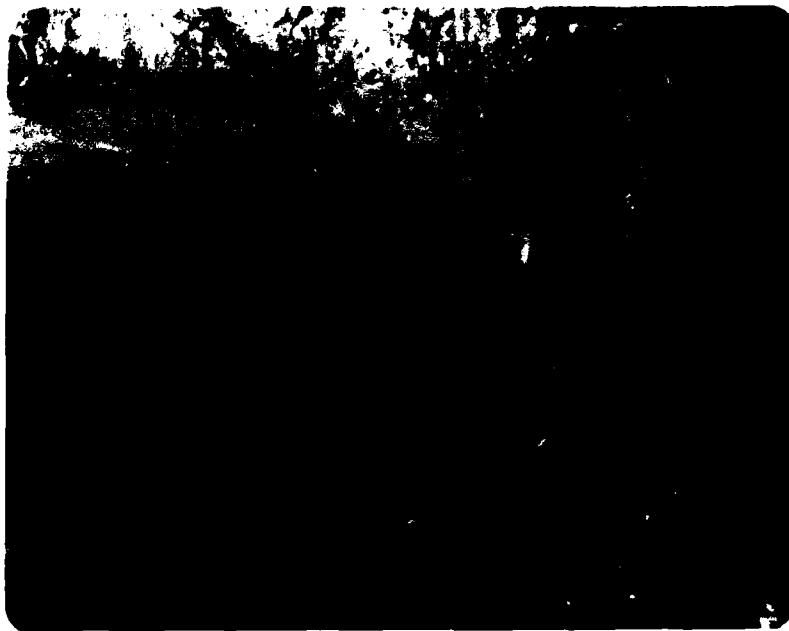


Photo 3 - Looking upstream showing cavity in the left abutment where it meets the spillway.



Photo 4 - Looking upstream showing erosion behind and minor spalling of the right abutment.

WEST MILFORD LAKE DAM



Photo 5 - Looking downstream from left abutment. Note erosion along bank. Back of wood shelter, for use by bus passengers, is at far left.



Photo 6 - Looking downstream from right abutment showing erosion, mentioned above, on left bank. House shown above is out of photo at top.

WEST MILFORD LAKE DAM



Photo 7 - Showing spalling of right abutment and portion of embankment beyond abutment.



Photo 8 - Showing vertical crack (survey rod within) and spalling of left abutment.

WEST MILFORD LAKE DAM



Photo 9 - Showing earth embankment and steel plate cover for the low-level outlet. Lake is visible at left.

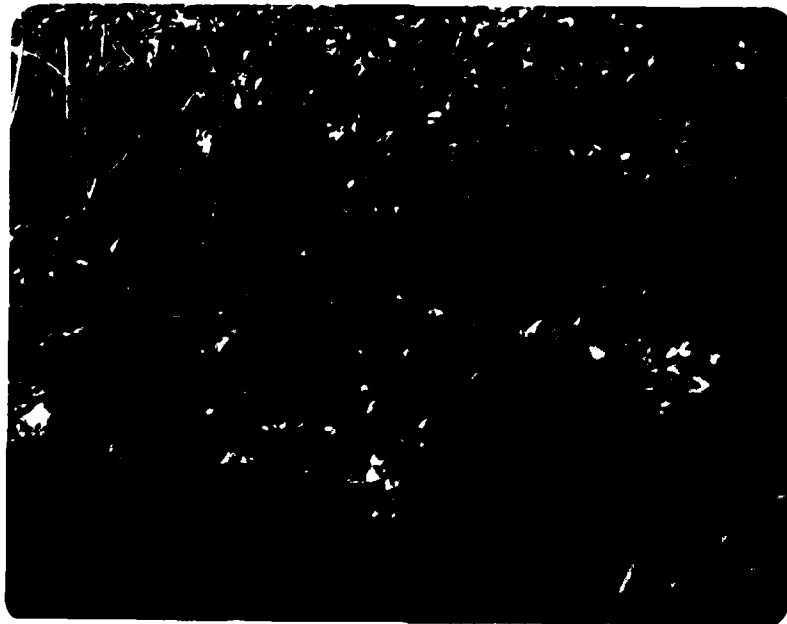


Photo 10 - Showing 8-inch cast iron pipe, low-level outlet, at downstream side of embankment.

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: WEST MILFORD LAKE DAM

Drainage Area Characteristics: 0.7 square miles

Elevation Top Normal Pool (Storage Capacity): 656.5 NGVD (46 acre-feet)

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

Elevation Maximum Design Pool: 660.39 NGVD (SDF pool: 102 acre-feet)

Elevation Top Dam: 659.5 NGVD (87 acre-feet)

SPILLWAY CREST:

a. Elevation 656.5 NGVD

b. Type Broad crested concrete weir

c. Width 4 feet

d. Length 25 feet

e. Location Spillover Right side of spillway

f. No. and Type of Gates None

OUTLET WORKS:

a. Type 8-inch C.I.P.

b. Location 280 feet right of spillway

c. Entrance Inverts Unknown

d. Exit Inverts 643 NGVD

e. Emergency Draindown Facilities Gate valve 8-inch dia. C.I.P.

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location None

c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: 351 cfs at elevation 659.5 NGVD

APPENDIX D

HYDROLOGIC COMPUTATIONS



2,000 0 2,000 4,000

Scale: 1" = 2,000 FT.

WEST MILFORD LAKE DAM
DRAINAGE BASIN

PRC Harris, Inc.
CONSULTING ENGINEERS

GROUP XVII
SUBJECT NEW JERSEY STATE
DAM SAFETY INSPECTION
COMPUTED BY C.L.C. CHECKED BY PK

SHEET No. 1 OF 9
JOB No. 10-AB3-01
DATE 11/3/80

WEST MILFORD LAKE DAM

SIZE CLASSIFICATION:

Main Impoundment Surface Area	11 Acres
Average Depth of Lake	11 ft ±
Structural Height of Dam	16 ft
Size Classification	Small

HAZARD POTENTIAL CLASSIFICATION:

Heavily Travelled Road and Houses D/S of Dam

Hazard Potential High

Recommend SDF $\frac{1}{2}$ PMF

HYDROLOGIC ANALYSIS:

Flood Routing will be computed by HEC-1 DB

Using SCS Triangular Unit Hydrograph with
Curvilinear Transformation.

D.A. = 0.7 sq. mi.

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.J. DAM SAFETY INSPECTION
WEST MILFORD LAKE DAM
COMPUTED BY C.L.S. CHECKED BY R.K.

SHEET NO. 2 OF 9
JOB NO. 10-AB3-01
DATE 1/3/80

PRECIPITATION :

From Fig. 15 the Drainage area located at ZONE 1 & ZONE 6
(Ref.: 'Design of Small Dam', p. 48) Probable Max. Precipitation
= 25 inches For 6 hrs. duration & 10 sq. mi.

Duration (HRS.)	% of PMF		AVG.	} Note: Values are reduced by 20% to account for misalignment of Basin & storm isohyets.
	ZONE 1	ZONE 6		
6	99	100	99.5	
12	111	109	110	
24	119	117	118	
48	127	126	126.5	

INFILTRATION DATA

DRAINAGE Area Consists of most GMX24R & some I
NM19

Hydrologic Soil Group

C

use initial infiltration

1.0 inch

use constant infiltration

0.1 in/hr.

Ref.: 'Engineering Soil Survey of N.J. Report 3, Passaic County.'
by Rutgers University

TIME OF CONCENTRATION

- 1) T_c estimated from velocity and water course lengths.

	Slope (%)	Vel. (fps)
Overland Flow	$\frac{1060 - 860}{2200} = 9.1$	3.0
Channel Flow	$\frac{860 - 660}{5000} = 4$	3.5

$$T_c = (2200/3 + 5000/3.5) / 3600 = 0.60 \text{ HR.}$$

- 2) From Nomograph "Design of small Dam", p. 71

$$\Delta H = 1060 - 660 = 400' \quad L = 7200'$$

$$S = 400/7200 = 5.6\%$$

$$t = 0.35 \text{ HR.}$$

- 3) Using FAA Formula for surface Flow (Airport Drainage)

$$T_c = 1.8(1.1 - C) \sqrt{D} / S^{1/2} = 1.8(1.1 - 0.3) \sqrt{7200} / (5.6)^{1/2} = 1.15 \text{ HRS.}$$

- 4) From channel velocity & water course length:

$$T_c = 7200 / 3.5(3600) = 0.57 \text{ HR.}$$

$$\text{Use } T_c = 0.67 \text{ HR.}$$

$$\text{LAG} = 0.6 T_c = 0.40 \text{ HR.}$$

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.J. DAM SAFETY INSPECTION
WEST MILFORD LAKE DAM
COMPUTED BY C.L.C. CHECKED BY PK

SHEET NO. 4 OF 9
JOB NO. 10-F-93-21
DATE 1/3/90

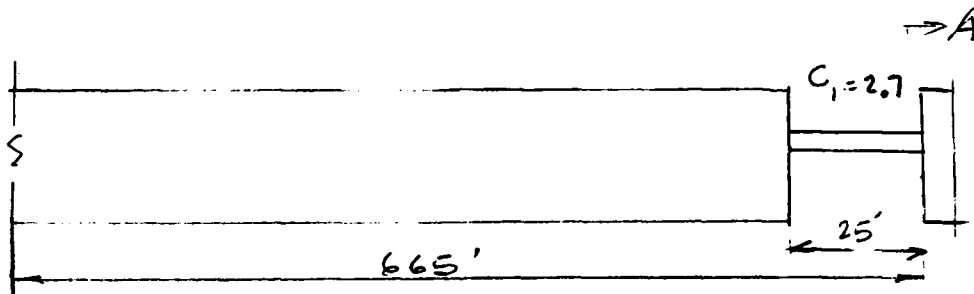
ELEVATION-AREA-CAPACITY RELATIONSHIP :

Data Estimated From U.S.G.S. MAP

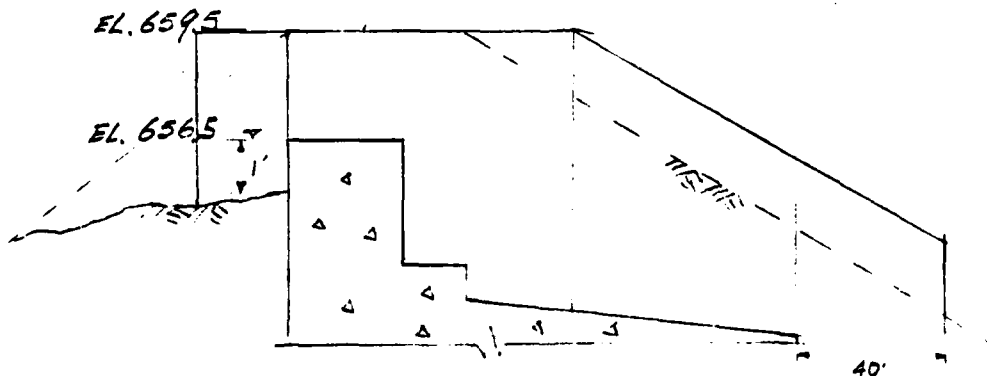
ELEVATION (FT.)	644*	656.5	660	680
SURFACE AREA (AC.)	0	11.0	17.45	36.73

* Estimated bottom Elevation of Lake at spillway

HEC-1 DB Program will develop storage capacity
From surface area and Elevations



$C_1 = 2.70$ spillway
 $C_2 = 2.70$ DAM
 $C_2 = 2.70$
Assume 3rd crest weir (Knot from HEC 2 User Manual)



SECTION A-A

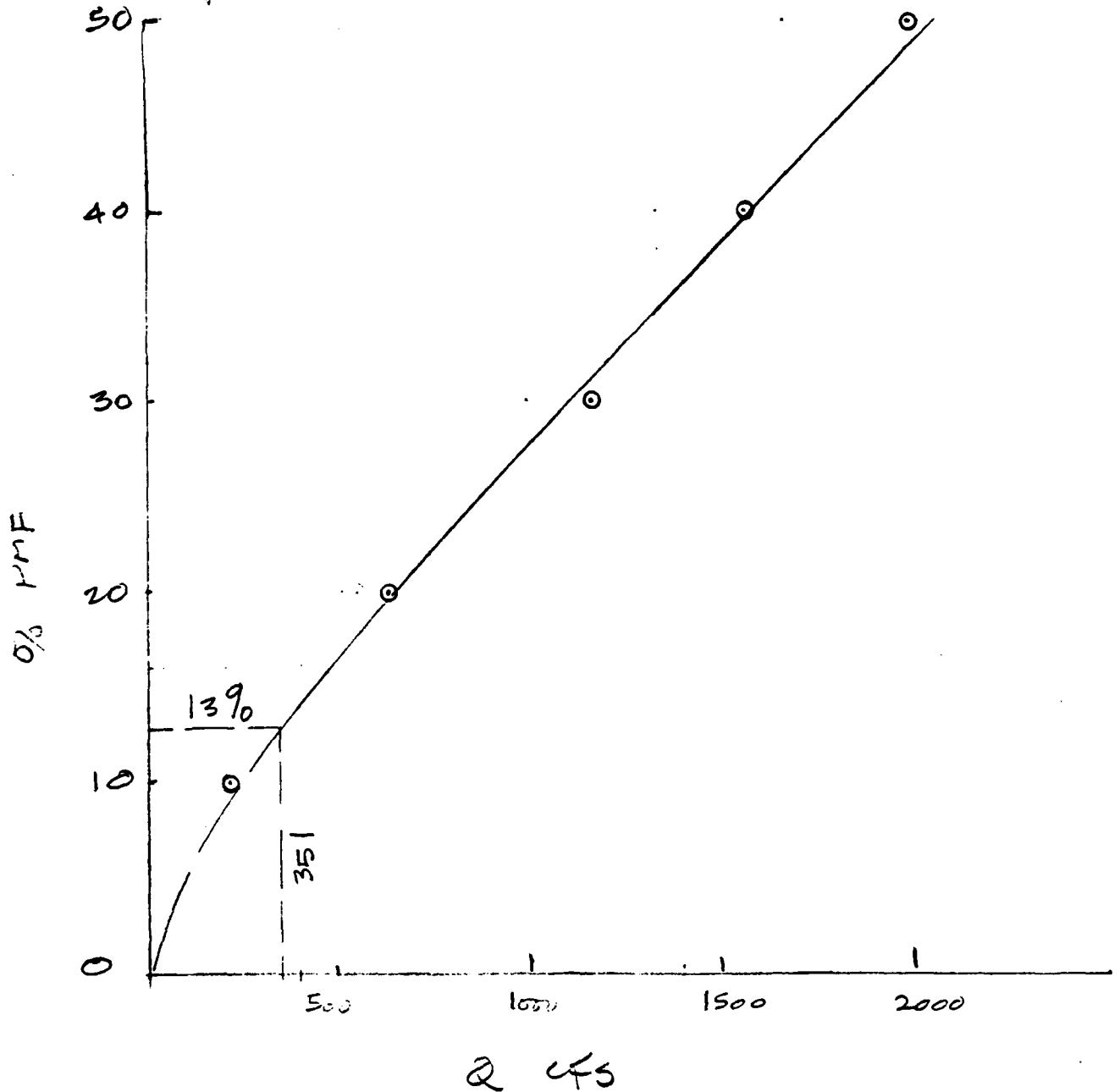
PRC Harris, Inc.

CONSULTING ENGINEERS

SUBJECT N.J. DAM SAFETY INSP.
West Miford Lake
 COMPUTED BY EKAO CHECKED BY C.L.C.

SHEET NO. 5 OF 9
 JOB NO. D-AP3-01
 DATE 1/18/80

Overtopping Potential



Overtopping of Dam occur at Ele. 689.5 with $Q=351$ cfs
 (~ 13% PMF)

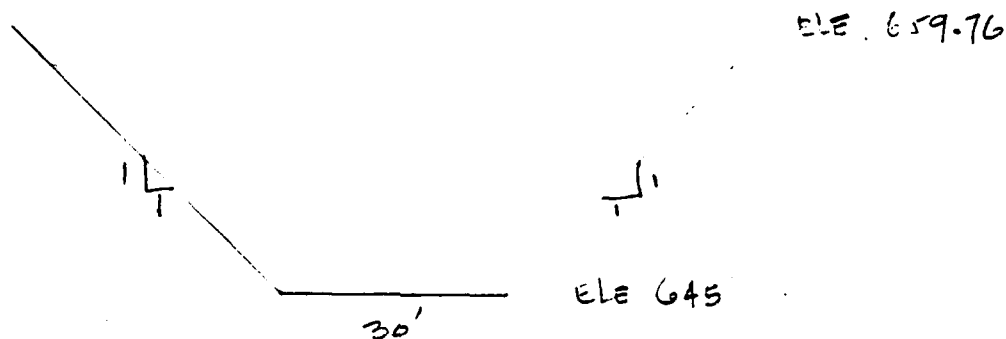
PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.J. DAM SAFETY INSP.
West Milford Lake
COMPUTED BY AK CHECKED BY C.L.C.

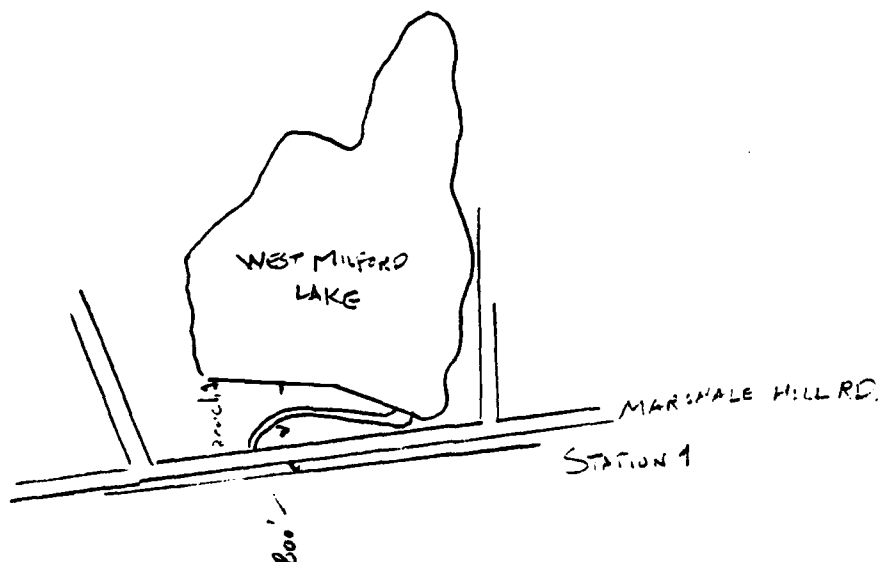
SHEET NO. 6 OF 9
JOB NO. 10-112-21
DATE VE/EO

Breach Analysis

The breach begins to develop when Lake stage reaches Elev. 659.76 @ 20% PMF with failure time = 0.5 hr.



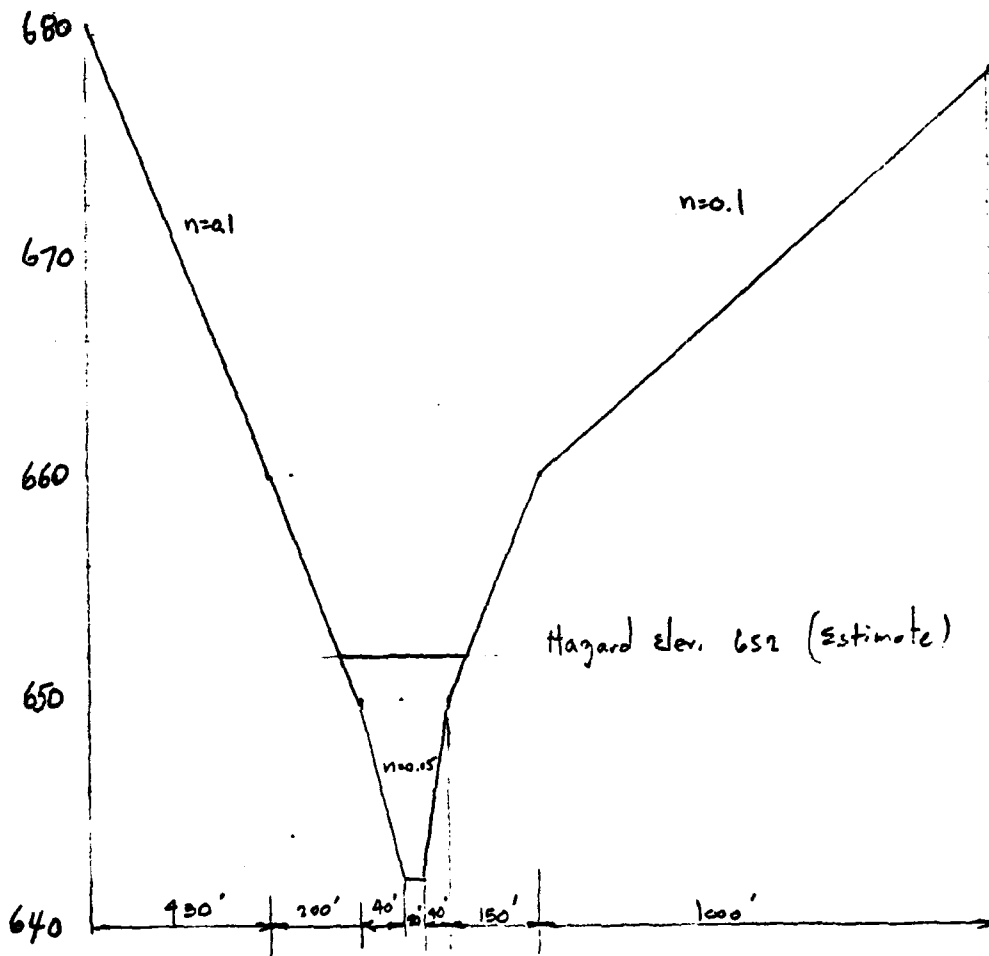
Assume bridge across the stream fails instantly upon impact of Flood wave. The resulting energy loss is negligible.



PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.J. DAM SAFETY INSP.
WEST MILFORD LAKE
COMPUTED BY E.K. CHECKED BY C.L.G.

SHEET No. 7 of 9
JOB No. 10-A23-01
DATE 1/8/80



Cross-section

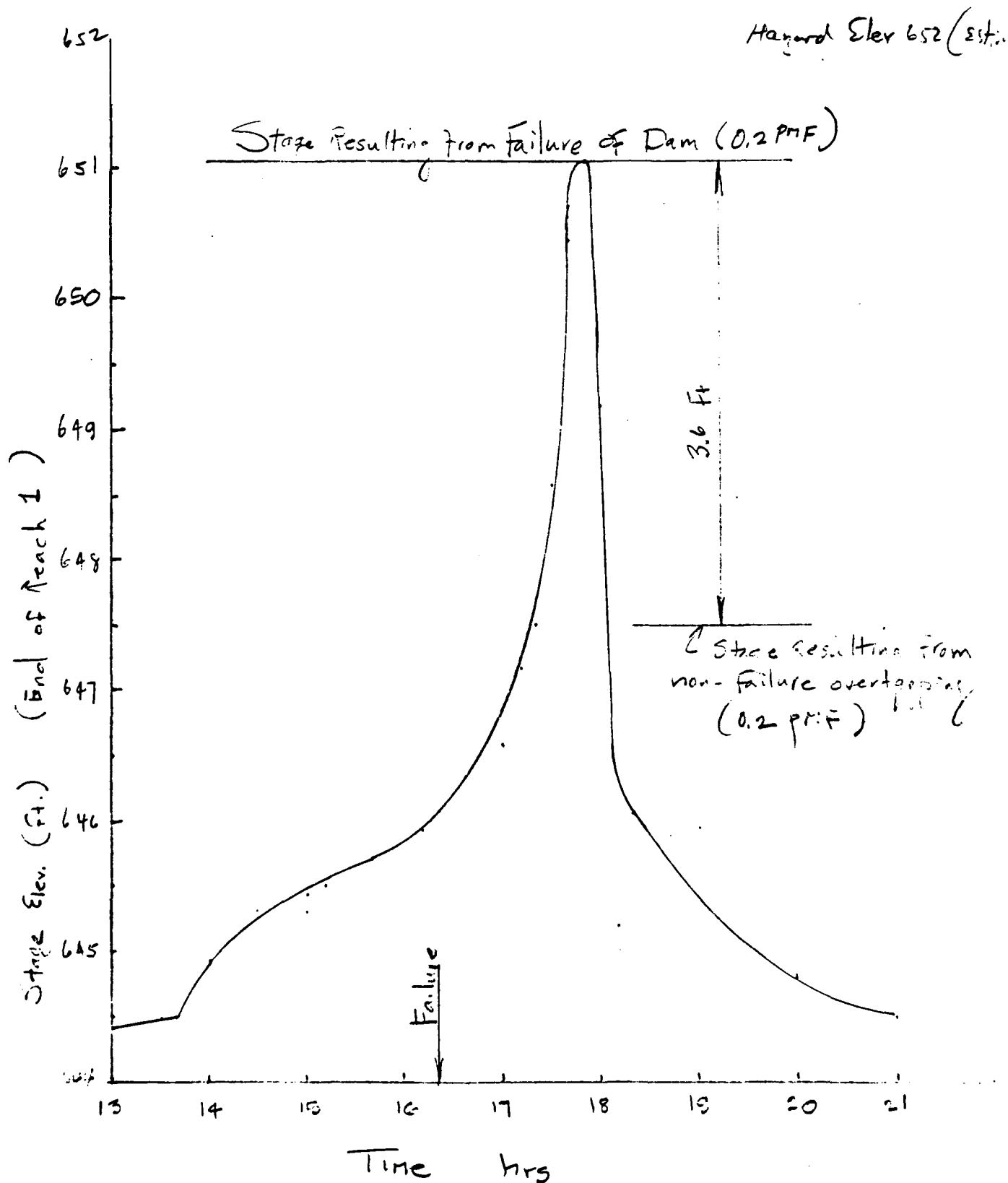
Env of Reach 1 (Station 1)

$$S = 0.0066$$

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT VI Dam Safety Pro. Group VII
West Milford Dam
COMPUTED BY EK CHECKED BY C.L.C.

SHEET NO. 8 OF 9
JOB NO. 10-A83-1
DATE 3/6/80

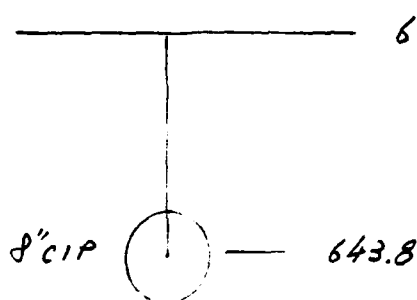


FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT N.J. DAM SAFETY INSPECTION
WEST MILFORD LAKE DAM
COMPUTED BY E.L.C. CHECKED BY B.K.

SHEET No. 9 OF 9
JOB No. 10-A93-01
DATE 3/5/80

DRAWDOWN TIME COMPUTATION



Normal elevation to start draining

@ 656.5 D.A. = 0.7 mi²

$$\text{INFLOW} = (2 \text{ cfs/mi}^2)(0.7 \text{ mi}^2) = 1.4 \text{ cfs}$$

$$Q = C A \sqrt{2 g h} \quad C = 0.63 \quad \therefore Q = 1.76 \text{ NR}$$

Assume T.W. @ El. 644.0

Res. Ele.	Area Ac.	AVG. Area	Vol. Ac.Ft.	AVG. Res. Ele.	$Q = 1.76 \sqrt{h}$ AVG. O/L	Drawdown Time = $\frac{\text{Vol} \times 2.4}{1.48 Q}$ (HRS)	Cul. time w/ inflow HRS.	Drawdown time w/ inflow $\frac{1.4 \text{ cfs}}{Q}$ HRS.	Cul. time HRS.
656.5	11.0								
		9.02	22.6	655.3	5.92	46.3	46.3	10.9	57.2
654	7.04								
		5.76	11.6	653	5.28	26.6	72.9	7.0	79.5
652	4.51								
		3.52	7.04	651	4.66	18.3	91.2	3.5	114.5
650	2.53								
		1.83	3.66	649	3.94	11.3	102.5	4.0	129.9
648	1.13								
		0.71	1.42	647	3.05	5.64	108.1	2.6	138.1
646	0.28								
		0.14	0.3	645	1.76	2.07	110.2	16	141.8
644	0								

A) Time of complete drawdown without inflow = 110.2 HRS. = 4.6 days

B) Time of complete drawdown with inflow (1.4 cfs) = 141.8 HRS. = 6 days

$$A_1 = \frac{A_2}{\left(\frac{h}{H_T} + 1\right)^2}$$

$$A_2 = 11.0 \text{ Ac. } h + H_T = 656.5 - 644 = 12.5$$

NO	NHR	NMIN	JOB SPECIFICATION					IFLT	IFRT	NSTAN
			1DAY	1HR	1MIN	METRC	1KOPT			
200	0	10	0	0	0	0	0	0	4	0
			JOB=	NWT	1 KOPT	TRACE				
			5	0	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
 NP10N= 1 NR110= 5 LR110= 1

SUB--AREA RUNOFF COMPUTATION

INLOW HYDROGRAPH THROUGH WEST MILFORD LAKE												
TIME	INLOW	TAKEA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	ISTAGE	IAUTO		
1	0	0	0	0	0	0	0	1	0	0		
2	0	0	0	0	0	0	0	1	0	0		

RECEIVED DATA

	PMS	K6	R12	K24	R48	R72	R96
SPFL	0.00						
	25.00	99.50	110.00	118.00	0.00	0.00	0.00

0191 5501

RTIME	ALSMX	CNSIL	STKIT	KTIION	STKRS	FKAJIN	KTIIDL	DIJIKR	STIRNK	RTKOPT
0.00	0.00	1.10	1.00	1.00	0.00	0.00	1.00	0.00	0.00	0

UNIT 1 HYDROGRAPH DATA

TC= 0.00 LAG= .40

```
RFCESSION DATA
$IK10= -1.00 QRCSN= -.05 RTIOR= 2.00
```


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

OPERATION STATION AREA PLAN RATIO 1 RATIO 2 RATIO 3 RATIO 4 RATIO 5
50 40 30 20 10

HYDROGRAPH AT LAKE (1.81) 1 2087. 1669. 1252. 835. 417.
ROUTED TO DAM (1.81) 1 1975. 1560. 1165. 631. 214.
(1.81) (55.92) (44.17) (33.00) (17.86) (6.05)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1
ELEVATION STORAGE OUTFLOW
INITIAL VALUE
656.50
46.
0.
SPILLWAY CREST
656.50
46.
0.
TOP OF DAM
659.50
87.
351.
RATIO OF PMF
50
40
30
20
10
MAXIMUM RESERVOIR W.S. ELEV.
660.39
660.23
660.05
659.76
658.66
MAXIMUM STORAGE AC-FT
102.
99.
96.
91.
74.
MAXIMUM OUTFLOW CFS
1975.
1560.
1165.
631.
214.
DURATION OVER TOP HOURS
4.50
3.67
2.17
1.00
0.00
TIME OF MAX OUTFLOW HOURS
16.00
16.00
16.17
16.33
16.50
TIME OF FAILURE HOURS
0.00
0.00
0.00
0.00
0.00

N J DAM SAFETY INSPECTION PROGRAM---GROUP XVII 10A8301
 N J 00189 WEST MILFORD LAKE, PASSAIC COUNTY, NJ
 MULT RATIO ROUTING, PKC-HARRIS INC., WOODBRIDGE, N J

0 10 0 0 0 1

LAKE INFLOW HYDROGRAPH THROUGH WEST MILFORD LAKE

0 0 0 1
 2 70 0.8
 25 99.5 110 118 1.0 0.10

0.40
 -0.05 2
 DAM

ROUTING DISCHARGE THROUGH DAM

0 0 0 1
 1 1 -656.5 0

11 17.5 36.7

656.5 660 680

25 2.7 1.5

2 70 1.5 640

1 645 0.5 656.5 659.76

1 645 0.5 656.5 700.00

REACH

CHANNEL ROUTING

1 1

05 1 644 660 800 0.0066

480 1550 660 1750 650 1790

650 2000 660 3000 680 644

1850 650 2000 660 3000 680 644

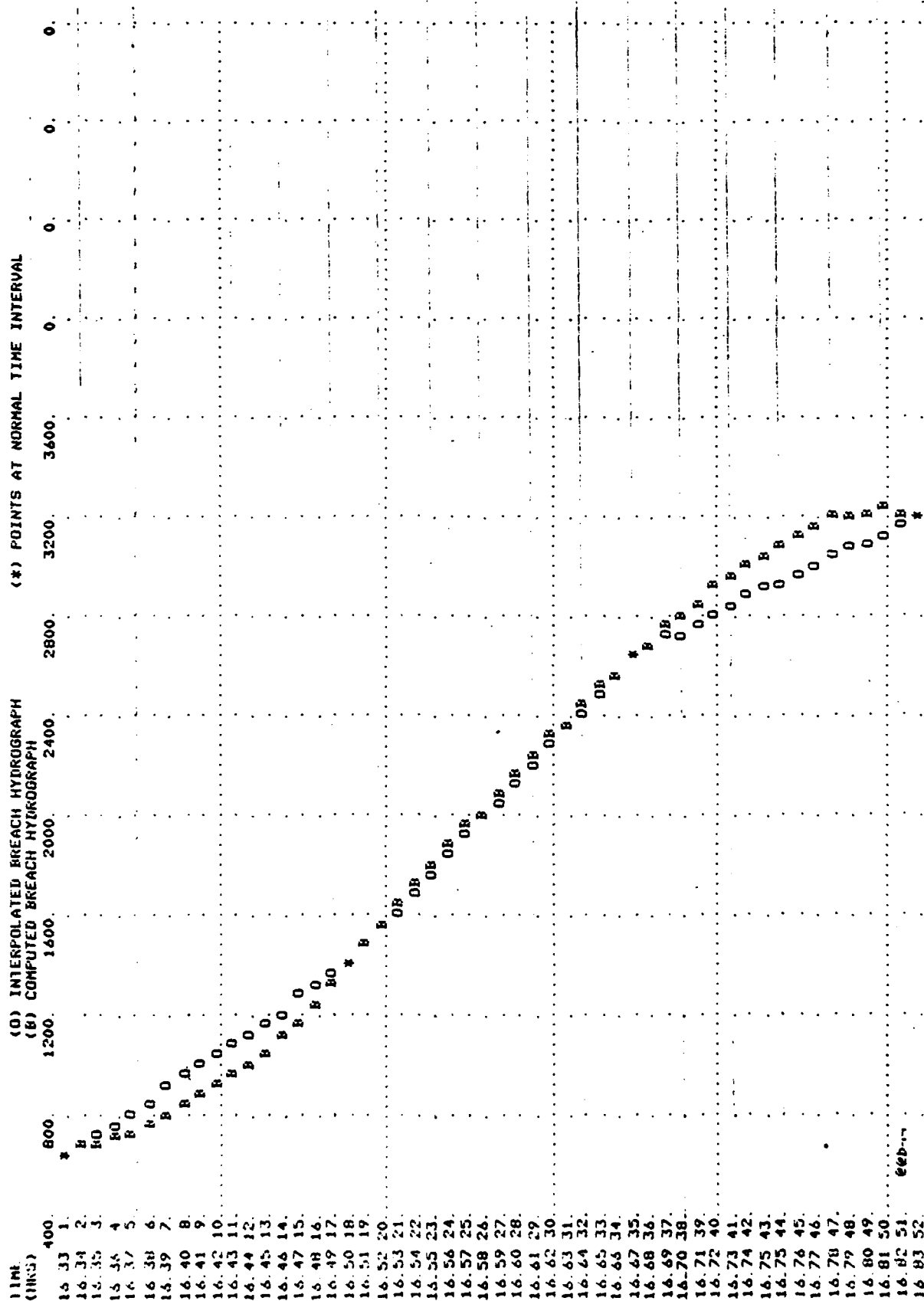
99

A1
 A2
 A3
 R
 R1
 J
 J1
 N
 A1
 M
 P
 F
 U2
 X
 N
 A1
 Y
 Y1
 Y1
 Y1
 Y6
 Y7
 Y7
 Y7
 K
 A
 A
 A
 A
 A

STATION DAM

(O) INTERPOLATED BREACH HYDROGRAPH
(B) COMPUTED BREACH HYDROGRAPH

(*) POINTS AT NORMAL TIME INTERVAL



HYDROGRAPH ROUTING

CHANNEL ROUTING

IN(1)	IN(2)	IN(3)	ELNVI	ELMAX	ELNTH	SEL
1000	0500	1000	644.0	660.0	800	00660
1850	00	2000	00	660.00	3000.00	600.00
1000	00	680.00	150.00	660.00	1750.00	650.00
1850	00	650.00	2000.00	660.00	3000.00	600.00

NORMAL DEPTH CHANNEL ROUTING

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

STORAGE	IN(1)	IN(2)	IN(3)	ELNVI	ELMAX	ELNTH	SEL
0.00	40	15.03	19.57	1.71	2.63	3.72	8.14
12.94	15.03	19.57	23.56	28.02	32.93	38.29	50.38
0.00	40	69	146.29	323.68	583.20	935.16	1389.54
4936.69	6277.33	7810.13	9546.60	11497.77	13674.25	16086.35	21657.30
544.00	644.00	644.00	644.00	644.00	644.00	644.00	644.00
654.42	654.42	654.42	654.42	654.42	654.42	654.42	654.42
0.00	40	69	146.29	323.68	583.20	935.16	1389.54
4936.69	6277.33	7810.13	9546.60	11497.77	13674.25	16086.35	21657.30

FLOW

STORAGE	IN(1)	IN(2)	IN(3)	ELNVI	ELMAX	ELNTH	SEL
0.00	40	15.03	19.57	1.71	2.63	3.72	8.14
12.94	15.03	19.57	23.56	28.02	32.93	38.29	50.38
0.00	40	69	146.29	323.68	583.20	935.16	1389.54
4936.69	6277.33	7810.13	9546.60	11497.77	13674.25	16086.35	21657.30

11/21/79 1057-70

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

RATIO OF PMF	ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	TIME OF FAILURE HOURS
.20	659.76	656.50 46. 0.	656.50 46. 0.	659.50 87. 351.	16.33
		MAXIMUM DEPTH OVER DAM	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	
		.26	3221.	64	

PLAN 2

RATIO OF PMF	ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	TIME OF FAILURE HOURS
.20	659.76	656.50 46. 0.	656.50 46. 0.	659.50 87. 351.	16.33
		MAXIMUM DEPTH OVER DAM	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	
		.26	631.	1.00	0.00

PLAN 1 STATION REACH

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.20	3174.	651.1	16.83

PLAN 2 STATION REACH

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.20	659.	647.5	16.33

END

DATE
FILME

9-8

DTIC