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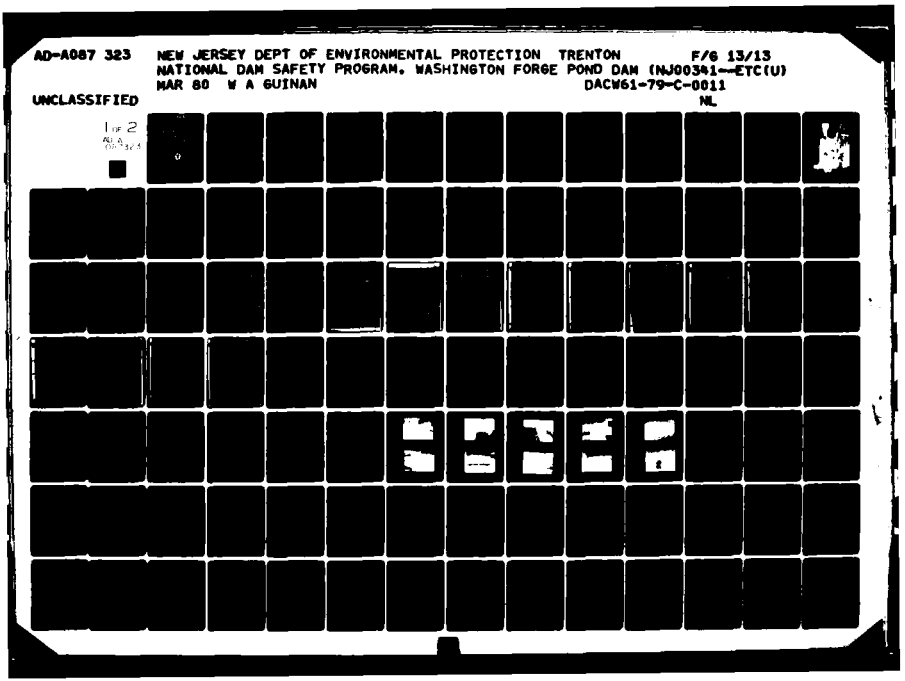

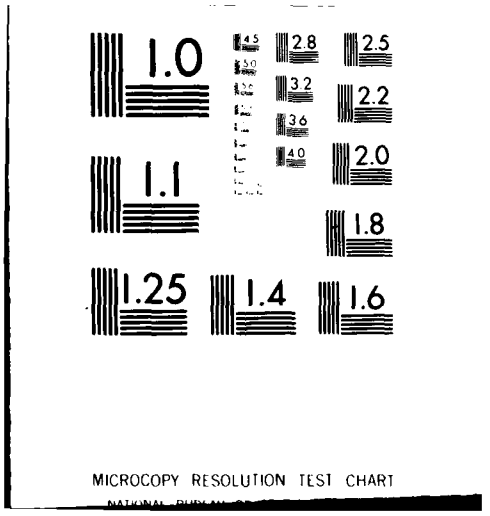
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PASSAIC RIVER BASIN
ROCKAWAY RIVER, MORRIS COUNTY
NEW JERSEY

WASHINGTON FORGE POND DAM
NJ 00341

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

MARCH 1980

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Structural Analysis
Safety
Visual Inspection
National Dam Safety Program
Washington Forge Pond Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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

IN REPLY REFER TO

NAPEN-N

28 JUL 1980

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

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Washington Forge Pond Dam in Morris 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, Washington Forge Pond 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. The dam's spillway is considered inadequate because a flow equivalent to ten 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.) To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

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

b. Clear trees and brush from the banks of the discharge channel between the spillway and the highway bridge immediately downstream within six months from the date of approval of this report.

c. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and oversee the repair of erosion on the upstream slope of the dam and the installation of erosion protection.

(2) Specify and oversee procedures for establishing a cover of grassy vegetation on the crest of the dam.

(3) Specify and oversee procedures for the removal of trees from the embankment and downstream toe.

(4) Design and implement repairs to the concrete training walls and upstream concrete walls.

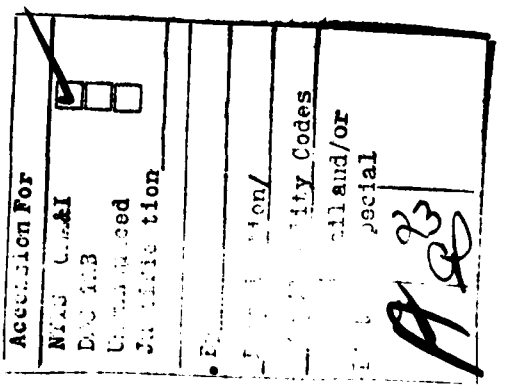
(5) Specify and implement procedures to restore the gate in the spillway section to an operable condition and provide remote control or access to the gate.

d. The owner should develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam within six months from the date of approval of this report.

e. Within one year from the date of approval of this report, 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 Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

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



NAPEN-N
Honorable Brendan T. Byrne

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

WASHINGTON FORGE POND DAM (NJ00341)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 6 November 1979 by Anderson-Nichols and Company Incorporated 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.

Washington Forge Pond 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. The dam's spillway is considered inadequate because a flow equivalent to ten 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.) To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

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

b. Clear trees and brush from the banks of the discharge channel between the spillway and the highway bridge immediately downstream within six months from the date of approval of this report.

c. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and oversee the repair of erosion on the upstream slope of the dam and the installation of erosion protection.

(2) Specify and oversee procedures for establishing a cover of grassy vegetation on the crest of the dam.

(3) Specify and oversee procedures for the removal of trees from the embankment and downstream toe.

(4) Design and implement repairs to the concrete training walls and upstream concrete walls.

(5) Specify and implement procedures to restore the gate in the spillway section to an operable condition and provide remote control or access to the gate.

d. The owner should develop an emergency action plan together with an effective warning system outlining actions to be taken by the operator to minimize downstream effects of an emergency at the dam within six months from the date of approval of this report.

e. Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 1 July 1980

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Washington Forge Pond Dam
Identification No.:	FED ID No. NJ00341
State Located:	New Jersey
County Located:	Morris
Stream:	Rockaway River
River Basin:	Passaic
Date of Inspection:	6 November 1979

ASSESSMENT OF GENERAL CONDITIONS

Washington Forge Pond Dam is about 90 years old and in fair overall condition. It is small in size and is recommended to be downgraded to significant hazard. Extensive wave erosion has occurred on the upstream slope of the embankment and erosion also appears to have occurred as the result of trespassing on the upstream slope. There is a leak at the spalled joint in the concrete training wall at the south end of the spillway. The upstream concrete wall to the left of the spillway has several vertical cracks and several areas of spalling. Both abutment training walls are cracked and spalled. Major areas of undermining occur at the waterline near the dam crest. The stoplogs, steel trashrack, and concrete walls at the penstock intake structure area are also deteriorated. The principal spillway is capable of passing less than 9 percent of the half-PMF and is inadequate.

We recommend that the owner retain the services of a professional engineer, qualified in the design and construction of dams, to accomplish the following in the near future: design and oversee the repair of erosion on the upstream slope of the dam and the installation of erosion protection; specify and oversee procedures for establishing a grassy vegetation on the crest of the dam; specify and oversee procedures for the removal of trees and their root masses from the embankment and downstream toe; design and implement repairs to the concrete training walls and upstream concrete walls; conduct further detailed hydrologic and hydraulic analyses of the watershed, dam and spillway to determine the type and extent of remedial measures necessary; and specify and implement procedures to restore the gate in the spillway section to an operable condition and provide remote control or access to gate.

In the near future, the owner should: clear trees and brush from the banks of the discharge channel between the spillway and the highway bridge immediately downstream; establish a surveillance program for use during and immediately after periods of heavy rainfall, and

also a warning program to follow in case of emergency conditions. Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.

ANDERSON-NICHOLS & COMPANY, INC.

Warren A. Guinan

Warren A. Guinan
Project Manager
New Jersey No. 16848

6 NOVEMBER 1979

OVERVIEW
WASHINGTON FORGE POND DAM

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY REPORT
WASHINGTON FORGE POND DAM N.J. NO. 519 FED ID NO. NJ00341

PREFACE

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

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

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

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
WASHINGTON FORGE POND DAM
FED ID NO. NJ00341 NJ NO. 519

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Washington Forge Pond Dam was received from the State of New Jersey, Department of Environmental Protection (NJDEP), Division of Water Resources by letter dated 26 October 1979 under Contract No. FPM-39 dated 28 June 1978. This authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 6 November 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Washington Forge Pond Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations, and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Washington Forge Pond Dam is a 13-foot high, 755-foot long earthfill and concrete dam. The north side of the dam consists of an earthen embankment with a crest width of approximately 20 feet. The upstream face of the embankment slopes at about 3H:1V and the downstream face of the northern half of the embankment section slopes at about 3H:1V. The remainder of the downstream face of the embankment section consists of a vertical stone masonry retaining wall approximately 5 feet high. Behind the L.E. Carpenter industrial building adjacent to the spillway, the dam has a vertical concrete wall upstream face and a grass covered crest of varying width. A concrete and steel penstock inlet structure is located about 40 feet north of the concrete north abutment of the principal spillway. This concrete spillway is about 60 feet long and 3 feet wide at the crest. The upstream face of the spillway slopes at about 1H:1V and the downstream face is vertical. A manual gate operating mechanism that controls a 3-foot wide by 4-foot high gate opening is located on the crest of the spillway midway between the abutments. The concrete south abutment of the principal spillway forms a 1.5-foot thick reservoir retaining wall that runs southwest for a distance of about 150 feet to

natural ground upstream of the spillway. Essential features of the dam are shown in Figures 1 & 2.

b. Location. Washington Forge Pond Dam is located on the Rockaway River in the Borough of Wharton, Morris County, New Jersey. The dam is shown on U.S.G.S. Quadrangle, Dover, New Jersey, with approximate coordinates of N 40° 54.2', W 74° 34.7'. A location map has been included as Figure 3.

c. Size Classification. Washington Forge Pond Dam is classified as small on the basis of a storage at top of dam of 96 acre-feet, which is less than 1000 acre-feet, but more than 50 acre-feet, and on the basis of a structural height of 13 feet, which is less than 40 feet, in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Visual inspection of the downstream area revealed a large industrial building (L.E. Carpenter) directly across Main Street from the embankment section and several other industrial buildings on the north overbank of the Rockaway River, 100-400 feet downstream of the spillway. The channel routing analysis contained herein indicates that flood stages associated with the half-PMF would reach about 2 feet above the sill of the building located adjacent to the spillway. The other industrial structures located along the north overbank of the river would experience minor flooding. The building on Main Street directly across from the embankment section would be subject to basement and first floor flooding. The roadway on either side of the Main Street bridge just downstream of the spillway would be subject to less than 1 foot of flooding. Excessive property damage would likely result; and loss of a few lives is possible but unlikely. Accordingly, Washington Forge Pond Dam is classified as Significant Hazard.

e. Ownership. The dam is owned by the Borough of Wharton, New Jersey; for information, contact Mr. Guadagnino, Administrative Clerk, 10 Robert Street, Wharton, New Jersey, 07885, phone: 201/361-8444.

f. Purpose of Dam. The dam provides cooling water for the L.E. Carpenter industrial complex.

g. Design and Construction History. No plans or information pertinent to the original design and construction of the dam were obtained. However, design plans of spillway renovations completed in 1958 were obtained from Mr. Henry Jarrett of L.E. Carpenter. These plans were not in a reproducible form. As part of the renovation, the crest of the spillway was lowered two feet and two of the three previously existing gates were closed off; leaving only the gate at the center of the spillway to facilitate drawdown.

h. Normal Operational Procedures. No operational procedures exist for the dam. There is an agreement between the L.E. Carpenter Company and the Borough of Wharton stating that both parties must concur on decisions involving operation of the dam. However, as stated in 1.2 f. above, L.E. Carpenter is entitled to use pond water for industrial cooling purposes. During a flood emergency, the Morris County Civil Defense Director and the Chief of Police of the Borough of Wharton deliberate on possible evacuation of areas downstream of the dam.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. The dam site is located in a river valley which marks the terminus of the last continental glaciation. Information derived from reports entitled "Engineering Geology of the Northeast Corridor, Washington, D.C. to Boston, MA" and the Geologic Map of New Jersey (Lewis and Kummel 1912) indicates that the soils within the immediate site area consist of stratified glacial deposits in the form of sands and gravels and alluvium, typical of valley deposits for this region. Immediately north of the site, soils consist of till grading laterally to sand and gravel. These soils form a nearly continuous band which is believed to be an end moraine for the last continental glaciation.

The depth to bedrock at the dam site is unknown, and outcrops were not observed during the dam inspection. From the reports previously mentioned, bedrock in this area consists of granitoid gneiss with associated migmatite, granulite, amphibolite, and granitic rocks of Precambrian age.

1.3 Pertinent Data

a. Drainage Area

29.1 square miles

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown (See Section 5.1 b. and Appendix 1 for discussion of previous maximum flood dates)

Principal spillway capacity at top of dam - 1207

Low-level outlet - gate opening capacity at top of dam (if operable) - 227

Total spillway capacity at top of dam - 1207

c. Elevation (ft. above NGVD)

Top of dam - 642.3

Spillway crest - 639.0

Design surcharge - (½ PMF) - 645.6

Streambed at centerline of spillway - 630.7 (downstream); estimated at 637.0 (upstream, top of silt)

Maximum tailwater (estimated) - 638.0

d. Reservoir Length (feet)

Maximum pool - 2000 (estimated)

Spillway crest - 1400

e. Storage (acre-feet)

Spillway crest - 53

Design surcharge (½ PMF) - 168

Top of dam - 96

f. Reservoir Surface Area (acres)

Top of dam - 17

Spillway crest - 11

g. Dam

Type - earthfill and concrete

Length - 755 feet

Height - 12 feet (hydraulic)

- 13 feet (structural)

Topwidth - varies from 15 to 20 feet

Side slopes - upstream varies - 3H:1V to vertical;
- downstream varies - 3H:1V to vertical

Zoning - unknown

Impervious core - unknown

Cutoff - unknown

Grout curtain - unknown

h. Principal Spillway

Type - concrete vertical

Length of weir - 60 feet

Crest elevation - 639.0 NGVD

Gates - one, manually operated

Upstream channel - Washington Forge Pond (no approach channel)

Downstream channel - Rockaway River

Regulating Outlets

Type - 3-foot wide by 4-foot high gate opening, invert elevation 632.4 NGVD

Access - crest of principal spillway

Regulating facilities - one steel gate and manual operating mechanism. These facilities are currently not operable.

SECTION 2
ENGINEERING DATA

2.1 Design

No plans, hydraulic or hydrologic data pertinent to the original design of Washington Forge Pond Dam were available. Design plans for the spillway renovation project completed in 1958 were obtained from Mr. Henry Jarrett of L.E. Carpenter. These plans were not of suitable quality for reproduction and inclusion in the report.

2.2 Construction

No data concerning construction of Washington Forge Pond Dam were revealed.

2.3 Operation

No engineering operational data were revealed.

2.4 Evaluation

a. Availability. A search of the NJDEP files, contact with the community officials and contact with L.E. Carpenter Co. revealed only a limited amount of recorded information. All available data was retrieved.

b. Adequacy. The design plans for renovation of the spillway included a plan showing contours of the pond bottom at one foot intervals. This information was used to obtain storage capacity at spillway crest. Because of the limited amount of additional recorded data, evaluation of all other facets of the dam was based solely on visual observations.

c. Validity. Information disclosed by community officials appears to concur with that obtained by the inspection team.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. Dam. There are a footpath and vehicular tracks on the crest of the embankment. There are areas bare of vegetation on the crest near the north and south ends of the embankment. Extensive wave erosion has occurred on the upstream slope of the embankment and erosion also appears to have occurred as the result of trespassing on the upstream slope. Some of these eroded areas are bare of vegetation; on others, the vegetation has been partly or completely re-established. Trees are growing on the upstream edge of the crest and also at the downstream toe of the embankment.

b. Appurtenant Structures. There is a leak at the spalled joint in the concrete training wall at the south end of the spillway. There is one large tree which has blown over into the pond on the south bank immediately upstream of the spillway. Both abutment training walls are cracked and spalled. The major areas of undermining occur at the waterline near the dam crest. The upstream concrete wall to the left of the spillway has several vertical cracks and several areas of spalling. The stoplogs, steel trashrack and concrete walls at the penstock intake structure area are also deteriorated.

c. Reservoir Area. The watershed above the reservoir is flat to moderately sloping and mostly wooded. The reservoir slopes appear to be stable. No evidence of significant sedimentation in the reservoir was observed; sediment has accumulated behind the spillway to an elevation within one or two feet of the crest.

d. Downstream Channel. One large tree and several smaller trees overhang the discharge channel between the spillway and the highway bridge which is immediately downstream.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operational procedures exist for Washington Forge Pond Dam. L.E. Carpenter Company uses water from the pond for cooling water.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were found. From a phone conversation with a Mr. Guadagnino, an employee of the Borough of Wharton, it was learned that the Borough has performed periodic maintenance on the dam in the past.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities exist.

4.4 Warning System

During an intense storm, Morris County Civil Defense monitors river stages throughout the county. The Chief of Police of the Borough of Wharton, along with a County Civil Defense representative, would decide on the necessity of evacuation of endangered areas downstream of the dam, depending on the severity of flooding.

4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures, the remedial measures described in Section 7.2 should be implemented as prescribed.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. The renovation of the spillway in 1958 increased the dams capacity to pass flow appreciably. A "Report on Dam Application" filed May 6, 1958 and included in Appendix 1 shows hydraulic calculations for the proposed renovated spillway with the abutment "wall awash." Using the previous spillway crest elevation of 640.95, say 641.0, the original spillway capacity was about 490 cfs or about 33 percent of the computed capacity for the renovated spillway.

b. Experience Data. Investigation of the files at the NJDEP yielded little data concerning past overtopping or flood heights at Washington Forge Pond Dam. In Appendix 1, a letter dated October 9, 1945 contains several facts concerning dates of occurrence of past floods but includes no specific water surface elevations of the dam. An official at the Wharton town hall stated that the highest water mark he could recall at the dam was at the top of the abutment wall (elevation 642.3).

c. Visual Observations. There was no visual evidence of damage to the structure caused by overtopping.

d. Overtopping Potential. The hydraulic/hydrologic evaluation of Washington Forge Pond Dam is based on a selected Spillway Design Flood (SDF) equal to one-half the Probable Maximum Flood (PMF) in accordance with the range of test floods given in the evaluation guidelines for dams classified as significant hazard and small in size. The PMF was determined by application of the Snyder unit hydrograph procedure to a 24-hour probable maximum storm of 22.7 inches. Hydrologic computations are shown in Appendix 4. The routed half-PMF peak discharge at the dam is 13,730 cfs. Water will rise to a depth of 3.3 feet above the spillway crest before overtopping the abutment walls and embankment section. Under this head, the spillway will pass a total flow of 1207 cfs, which is less than the required SDF. Flood routing calculations indicate that Washington Forge Pond Dam will be overtopped for more than 24 hours to a maximum depth of about 3.3 feet under half-PMF conditions. It is estimated that the spillway can pass less than 9 percent of the half-PMF without overtopping the dam; thus, the spillway is considered inadequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Visual Observations

Erosion of the upstream slope of the embankment, resulting from wave action and trespassing, could lead to breaching of the dam if not controlled.

The lack of vegetation on the crest of the dam in several areas renders the crest susceptible to erosion due to rainfall and, if it should occur, overtopping.

Trees growing on the upstream slope and at the downstream toe of the embankment could result in serious seepage or erosion problems if a tree blows over and pulls out its roots or if a tree dies or is cut and its roots rot.

If the spalling and erosion of the training walls are allowed to continue, the stability of the walls and embankment will be affected.

Leakage from a spalled joint in the training wall at the south end of the spillway is the result of severe deterioration of the concrete which could result in failure of the wall if not controlled.

Based on the visual inspection alone it is not possible to determine the character of the dam foundation or the interior of the cross section. Therefore, it is not possible to evaluate the factor of safety of the dam against slope failure.

6.2 Design and Construction Data

No design or construction data pertinent to the structural stability of the dam are available.

6.3 Operating Records

No operating records pertinent to the structural stability of the dam are available.

6.4 Post-Construction Changes

A plan obtained from Mr. Henry Jarrett of L.E. Carpenter, dated April 8, 1958 by Henry J. Ahlers, Parsippany, New Jersey shows the spillway of the dam to be modified by lowering the crest of of the spillway 2 feet and plugging of two gate openings. The field inspection confirmed that the work outlined on the plan was performed.

6.5 Seismic Stability

This dam is in Seismic Zone 1. According to the Recommended Guidelines, dams located in Seismic Zone 1 "may be assumed to present no hazard from earthquake provided static stability conditions are satisfactory and conventional safety margins

exist". None of the visual observations made during the inspection are indicative of unstable slopes. However, because no data are available concerning the engineering properties of the embankment and foundation materials for this dam or of the below-ground configuration of the concrete walls in the dam, it is not possible to make a numerical evaluation of the factor of safety under static conditions.

SECTION 7
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Washington Forge Pond Dam is about 90 years old and is in fair condition.

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

c. Urgency. The recommendations made in Sections 7.2 should be implemented by the owner as prescribed below.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems which are listed in 7.2 a. below. These problems require the attention of a professional engineer qualified in the design and construction of dams who will have to make additional engineering studies to design or specify remedial measures. If left unattended, the problems could lead to instability of the structure.

7.2 Recommendations/Remedial Measures

a. Recommendations. The owner should retain a professional engineer qualified in the design and construction of dams to accomplish the following things in the near future:

1. Design and oversee the repair of erosion on the upstream slope of the dam and the installation of erosion protection.

2. Specify and oversee procedures for establishing a cover of grassy vegetation on the crest of the dam.

3. Specify and oversee procedures for the removal of trees and their root masses from the embankment and downstream toe.

4. Design and implement repairs to the concrete training walls and upstream concrete walls.

5. Specify and implement procedures to restore the gate in the spillway section to an operable condition and provide remote control or access to gate.

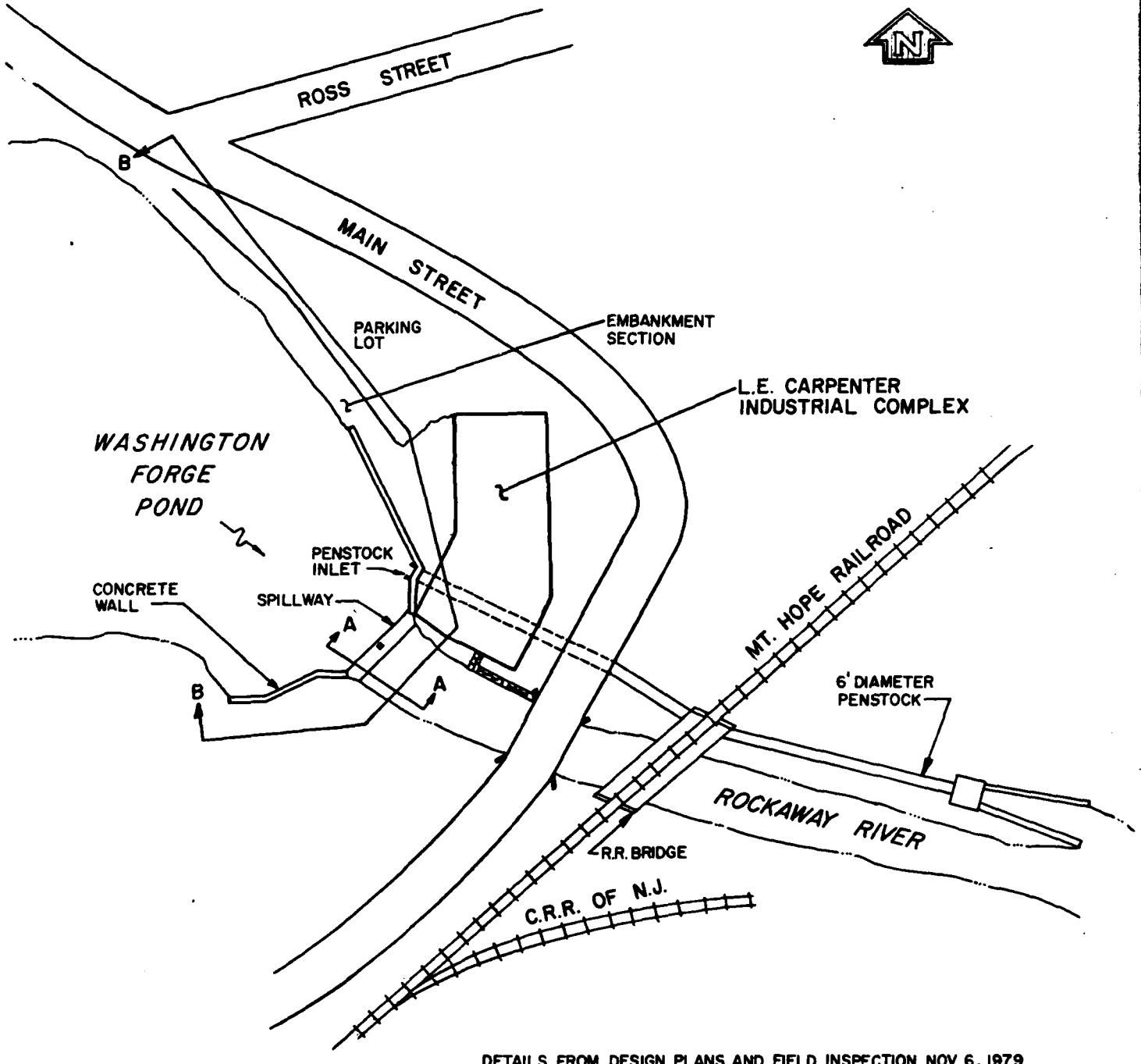
6. Conduct further detailed hydrologic and hydraulic analyses of the watershed, dam and spillway to determine the type and extent of mitigating measures necessary.

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

1. Clear trees and brush from the banks of the discharge channel between the spillway and the highway bridge immediately downstream.

2. Establish a surveillance program for use during and immediately after periods of heavy rainfall, and also a warning program to follow in case of emergency conditions.

Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.



DETAILS FROM DESIGN PLANS AND FIELD INSPECTION NOV. 6, 1979

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIST. PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA.

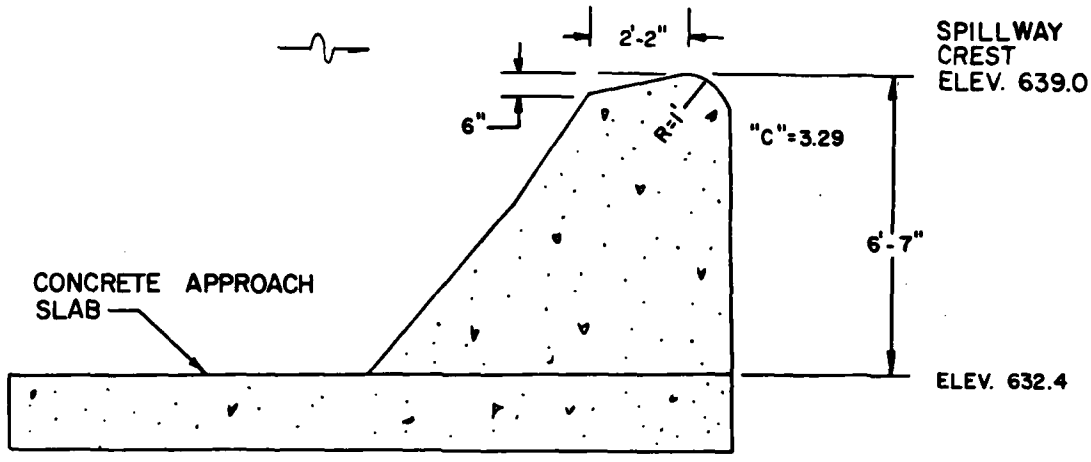
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WASHINGTON FORGE POND DAM

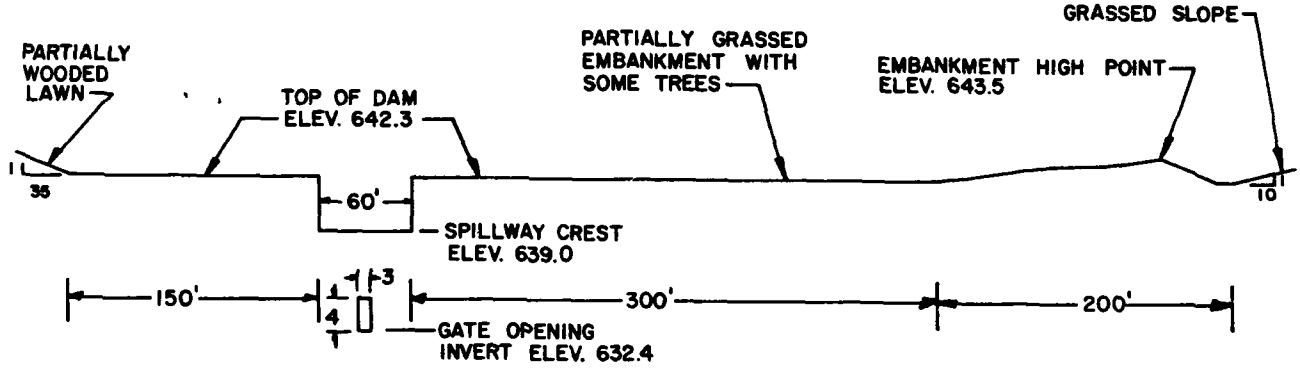
ROCKAWAY RIVER NEW JERSEY

			SCALE: NOT TO SCALE
			DATE: FEBRUARY 1980

FIGURE 1



SECTION A-A



ELEVATION B-B

DETAILS FROM DESIGN PLANS AND FIELD INSPECTION NOV. 6, 1979

Anderson - Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIST. PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA.

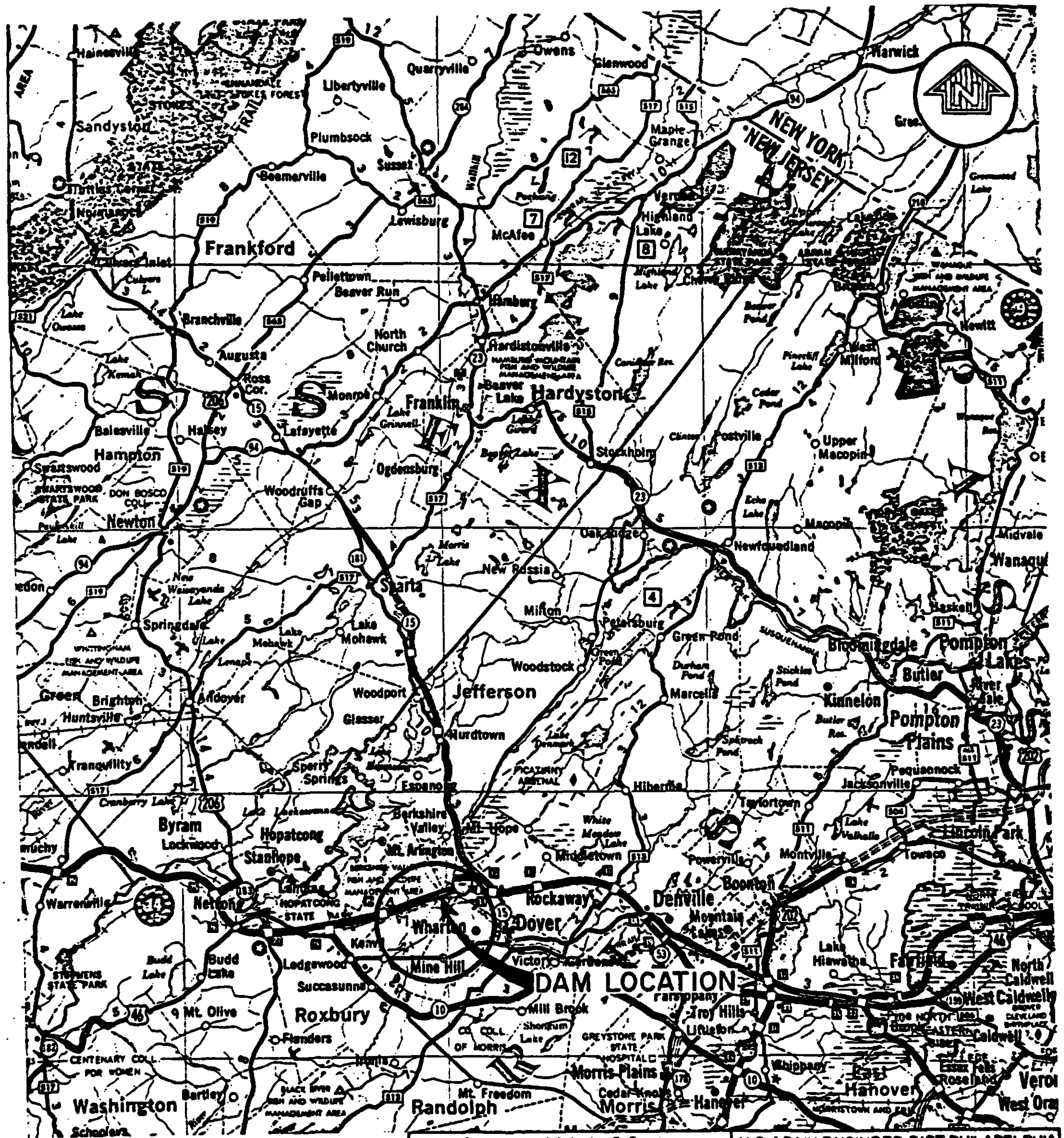
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WASHINGTON FORGE POND DAM

ROCKAWAY RIVER NEW JERSEY

			SCALE: NOT TO SCALE
			DATE: FEBRUARY 1980

FIGURE 2



SCALE IN MILES

0 5 10

MAP BASED ON STATE OF NEW JERSEY OFFICIAL HIGHWAY MAP AND GUIDE.

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIST. PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WASHINGTON FORGE POND DAM LOCATION MAP

ROCKAWAY RIVER NEW JERSEY

SCALE: SEE BAR SCALE

DATE: JANUARY 1980

FIGURE-3

APPENDIX 1

ENGINEERING AND EXPERIENCE DATA

WASHINGTON FORGE POND DAM

Dam Application No. 519
(25-135)

State of New Jersey

State Water Policy Commission

REPORT ON DAM APPLICATION

To the State Water Policy Commission,
State of New Jersey.

Gentlemen:

The application of L. E. Carpenter Co., Inc.

filed May 6, 1958 for approval of plans and for a permit to modify a dam

known as Washington Forge Pond Dam near Wharton on Rockaway River

tributary to Passaic River in Morris County, New Jersey,

has been examined by Daniel Berardinelli Assistant Engr. Hydraulic.

PRINCIPAL FEATURES

Location	25.2.3.8.9	Site inspected	10/13/55 W.E.B. 9/6/57 M.C.M.
Purpose of dam	Reduce flooding	Length of dam	60.5 feet
Drainage area	29.1 sq. mi.	Elevation of flow line	638.95
Area of Lake	11.0 acres	Capacity of lake	11.6 Mill. gals.
Type of dam	Concrete wall	Top width	3.17 feet
Upstream slope	Vertical wall	Downstream slope	Vertical Wall
Foundation material	No information (Ogee)	Max. height	8.1 feet
Type of spillway	Concrete gravity section with wingwalls at gate structure	Length of spillway	59.7 feet
Max. head on spillway	3.84 feet (wingwalls swash)		
Spillway capacity	1470 + (3' x 4' gate) sec. ft.= 45.5	sec. ft. per sq. mi.	
Estimated 50 yr. flood flow	2150 sec.ft. 74	sec. ft. per sq. mi.	(Central Jersey Curve)
Outlets other than spillway	One 3' x 4' opening with iron sluice gate		
Drawings filed by	Henry J. Ahlers	N. J. Lic.	#2131

It has been found that the site for the dam is suitable and the plans adequate to ensure the construction of a structure which will not be a menace to life or property. It is therefore recommended that the plans be approved and that a permit be issued, subject, however, to the following terms and conditions:—

1. That this permit does not give any property rights, either in real estate or material, nor any exclusive privileges; neither does it authorize any injury to private property nor invasion of private rights, nor any infringement of Federal, State or local laws or regulations, nor does it waive the obtaining of Federal assent, when necessary.

Pertinent Information

The applicant proposes to modify the dam in order to help reduce flooding of the adjacent downstream areas of Washington Forge Pond.

The proposed modifications provide for the lowering of the spillway by 2.0 ft.; the removal of all unnecessary piers and projecting buttresses down to spillway crest level; the repair of the center gate, and the elimination of two gates.

Existing top of spillway	El. 640.95
Proposed top of spillway	El. 638.95

Hydrology

The Central Jersey Curve has been established as a 50-year flood along this reach of the Rockaway River and will be used for this examination.

Hydraulics

Spillway Capacity

C = 3.29, H = 3.83 ft., L = 59.7 ft.

$Q = 3.29 \times 59.7 \times (3.83)^{3/2}$

Q = 3.29 X 59.7 X 7.496

Q = 1470 cfs (Wall swash)

Wall:

C = 3.0, H = 0.52 ft., L = 605 ft.

$Q = 3 \times 605 \times (.52)^{3/2}$

Q = 3 X 605 X .375

Q = 680 cfs (Wall swash)

Total Q =	1470	(spillway)
	680	(walls)
	2150 cfs	

Spillway crest El.	638.95	Wall El.	642.86
H =	3.83 ft.	H =	.52 ft.
Lake level El.	642.78	Lake level El.	642.78

The structure, after modification, will not discharge the design flood, therefore, overtopping of the concrete walls adjacent to the spillway and low portions of the dam embankment between the pond and Main St. will occur. The excess flood waters will be confined to the L. E. Carpenter property.

It was recommended that a permit for the proposed modification be subject to the two special conditions. (See letter dated 10/7/57).

Backwater from the Main Street bridge will not affect the discharge over the proposed reconstructed spillway as indicated by the following backwater analysis through the Main Street bridge for Q = 2150 cfs

Invert at inlet El. 629.00

D. [redacted]

Backwater from the Main Street bridge will not affect the discharge over the proposed reconstructed spillway as indicated by the following backwater analysis through the Main Street bridge for Q = 2150 cfs

Invert at inlet	El. 629.00
D_c	3.88 ft.
Corres. h_v	1.94 ft.
Inlet loss = 0.1 (1.94 - 0.00)	0.19 ft.
Water level above inlet	El. 635.01

Stability

Due to the fact that the dam has been in existence for many years, and there has been no apparent signs of possible failure, a stability analysis will not be computed in this review.

2. That the work shall at all times be subject to supervision and inspection by representatives of the State Water Policy Commission and that no changes in plans and specifications as approved shall be made except with written consent of the Commission. The Commission however, reserves the right to require such changes or modifications in the plans and specifications as may be considered necessary, and further reserves the right to suspend or revoke this permit at any time should such action be deemed advisable in the interest of public safety.

3. That all work shall be performed under the direct supervision at all times of a competent professional engineer licensed in the State of New Jersey, or his qualified representative. Acceptance of the dam for permanent operation will be subject to a certification by the engineer that the dam has been constructed in conformance with the drawings and specifications submitted and hereby approved, or with modifications of these drawings subsequently approved.

portion of the foundation has been approved in writing by a repres...

5. That a report, on forms to be submitted by the Commission, on the status of the construction work shall be mailed to the State Water Policy Commission, 28 West State Street, Trenton, New Jersey, on the first day of each month until the work upon the dam has been completed.

6. That no brush or waste timber cleared from the area under this approval shall be burned unless and until the party doing the work shall have obtained a permit from the Firewarden of the district in which the burning is to be done, in accordance with Title 13:9-19 of the Revised Statutes.

7. That no flashboards or other obstruction shall be placed or permitted to remain on the crest of the spillway.

8. That the work shall be started within one year from date of this permit and completed within two years from said date; otherwise, this permit, if not previously revoked or specifically extended, shall cease and be null and void.

9. This permit shall not become operative unless and until the applicant shall file with the Commission within thirty days from date hereof, upon a form furnished by the Commission, its written acceptance of the terms and conditions hereby imposed.

10. The modifications to the structure hereby approved provide spillway capacity adequate for the safe discharge of minor floods only, somewhat in excess of the discharge capacity of the existing spillway and gates. During major floods, the spillway end walls, or the earth embankment between the pond and Main Street, or both, may be overtopped. Such overtopping should not endanger the safety of the dam, nor should any potential hazard to life and property, be increased thereby.

11. The modification hereby approved is therefore subject to the maintenance of the existing low portion of the earth embankment between the pond and Main Street for the overflow of excess flood waters.

12. The drawings hereby approved are three sheets prepared by Henry J. Ahlers entitled,

"Dam at Washington Forge Pond, Borough of Wharton
Morris County, N. J., L. E. Carpenter Co. Property,"
dated April 8, 1950, Sheets 1 & 2 of 3, and

"Proposed Alterations to Dam at Washington
Pond ...

Report to Commissioner Van Pelt:

WASHINGTON FORGE POND DAM
Rockaway River
Wharton, Morris County
Dam 25-135

A conference was held on September 4, 1957 in the office of L. E. Carpenter & Co. at Wharton, New Jersey for the purpose of discussing the future of the dam which impounds Washington Forge Pond. The conference was attended by the following:

FOR L. E. Carpenter & Company:
R. H. Grant, Plant Engineer

FOR the Citizens Committee:
John I. Lynch, Former Mayor of Wharton
William S. McKiernan
Charles A. Williams, Member of Planning Board

FOR the Division:
H. S. Whitmer, Assistant Chief Engineer

The conference was necessitated because of the fear on the part of property owners in vicinity of the pond that the L. E. Carpenter Company is planning to either remove the spillway or lower the water level. The following points were brought out during the discussion:

1. The company has no present intention of abandoning the dam or removing the spillway.
2. The company has been planning to lower the normal water level from 1 " to 24".
3. The company owns the dam and all lands flooded by the pond.
4. Company-owned buildings used for manufacturing purposes have been flooded in the past during excessive floods.
5. Some of the lands near the pond, now occupied by residences, were formerly owned by the company's predecessors.
6. There is no recollection or evidence to indicate that the presence of the pond was offered as an inducement to induce prospective purchasers to purchase.
7. The planning board intends to include the pond in the pending master plan for the borough.
8. The borough realizes that the pond must be purchased if it is intended to become public property.
9. The company is now paying for public liability insurance on the property included by the dam and pond.
10. The company has no further use for the pond, and is presently utilizing it only for fire protection and cooling water purposes, a use which can readily be converted over to the public water supply.
11. The writer outlined the statute relative to dams, with particular reference to par. 4-9 and 4-10.

The conference was continued at the site of the spillway. The water level in the pond had been drawn down considerably below its normal level, and was fixed by a new all steel submerged concrete box in front of an open slide gate. This level is

3'+ below the spillway crest, and 4.1 feet below the top of the concrete wall extending some distance upstream from the left side of the spillway. The wall along the right side of the spillway was at the same top level. The long earth embankment extending along the left side of the pond between the pond and Main Street appeared to be also at the same approximate level. Mr. Grant was requested to furnish a profile in order to determine how much raising of this embankment may be required.

The pond level, as described above, is the level which was objected to by the Citizen's Committee. The writer suggested that, as compromise toward a permanent solution, the pond level be raised approximately 18 inches above its present level and the top of spillway be cut down approximately 18 inches. One of the three 36" x 42" slide gates will be retained and the other two gates eliminated in order that the obstructions by the gate piers can be removed from the spillway.

The spillway structure is presently in a very dilapidated condition, and will require extensive repairs independent to the proposed modifications.

The spillway, when lowered and reconstructed, will have the following dimensions:

1.	Overall crest length	59.5 ft.
2.	Width of gate pier	1.5 ft.
3.	Net length	58.0 ft.
4.	Freeboard, spillway crest to top of end walls.	2.5 ft.

The capacity of the spillway will be as follows for C = 3.33, L = 58 ft.

	H = 1.5'	H = 2.0'	H = 2.5'
Freeboard	1.0'	0.5'	Dam Awash
Q =	355 cfs	544 cfs	756 cfs

This compares with the capacity of the present structure, which was overtopped in 1936, 1945, and 1955, allegedly due to failure to open the gates.

Spillway crest, net length	52 ft.
Max. H, dam awash	1.0 ft.
Q for spillway =	173 cfs
3 - 36" x 42" gates, net head (See Encr. Appl. 1824.)	6.50 ft.
Q for gates = $CA\sqrt{2gh}$	
$= .62 \times 31.5 \times 8\sqrt{6.5}$	= 397 cfs
Total Q, spillway & gates	= 570 cfs

The design flood adopted for the review of the Main Street bridge, 100 ft. d.s. (Encr. Appl. 1824) was 1960 cfs.

Obviously, the structure, after modification, will not discharge our design flood, but its capacity will be increased somewhat over its previous capacity if the gates were opened in advance of a flood.

It is recommended that the attached letter be sent to Mr. Grant.

Trenton, N.J.
September 6, 1957

Norman C. Wittner
Assistant Chief Engineer

September 6, 1957

Mr. H. R. Grant
Plant Engineer
L. E. Carpenter & Company
Wharton, New Jersey

Re: Dam No. 25-135 - Morris County

Dear Mr. Grant:

As a result of the conference of September 4, 1957 between yourself, the writer, and several representatives of the Citizens' Committee relative to the dam owned by your company at Washington Forge Pond across the Rockaway River in Wharton, New Jersey, a study has been made of the conditions which might result if the spillway crest is lowered approximately 18 inches below its present level.

For your information, the Main Street bridge was approved by this Division in 1950 as being adequate to safely discharge a flood of 1060 cubic feet per second. The spillway and gates, if repaired and restored to the former condition of the structure, would have capacity to discharge 570 cubic feet per second with the concrete walls at each end of the spillway swash.

If the spillway is lowered 18 inches as discussed, all but one of the three gates removed, and all unnecessary piers and projecting portions of buttresses cut down to spillway crest level, such a spillway would have then a capacity of 756 cubic feet per second with the concrete walls at each end of the spillway swash.

It is apparent, therefore, that lowering the spillway crest will increase the discharge capacity of the spillway by approximately 30%. However, if such a plan is agreed upon, the use of the remaining gate to lower the water level of the pond in anticipation of a flood would undoubtedly prove beneficial in many instances, and should be encouraged.

If application is filed with this Division, accompanied by satisfactory drawings in duplicate showing the existing structure, the proposed repairs and modifications, and a profile of the earth embankment along the Main Street side of the pond, recommendation can be made for the issuance of a permit subject to the following special condition:

The structure hereby approved is adequate for minor floods only, but, in the opinion of this Division, will have flood discharge capacity somewhat in excess of the flood discharge capacity of the structure which it will replace. During major floods, the spillway and walls, or the earth embankment between the pond and Main Street may be overtopped.

We await your further advice.

Very truly yours,

Norman C. Hitner
Assistant Chief Engineer

NCH:mm
cc: Mr. J. L. Lynch
60 W. Dewey Avenue
Wharton, New Jersey

July 30, 1957

Mr. R. E. Grant
Plant Engineer
L. E. Carpenter & Company
Wharton, New Jersey

Re: Dam No. 25-135 - Morris County

Dear Mr. Grant:

This Division has recently received a petition signed by a large number of property owners in the Borough of Wharton protesting the abandonment of the Washington Forge Pond dam across the Rockaway River at your plant in Wharton, New Jersey.

As explained by you over the telephone, such action is not contemplated by the company, but that the company is considering the permanent lowering of the normal water level of the pond approximately 24 inches below the present spillway crest. It is requested that no action be taken relative to the lowering of all or a portion of the present spillway crest until such action is approved by this Division. The procedure for obtaining such approval, if requested, will be outlined to you at a later date after other phases of this problem have been explored.

As you were advised by telephone, the spokesman for the petitioners is Mr. John L. Lynch of 60 West Dewey Avenue, Wharton. It is suggested that you contact Mr. Lynch and arrange for a meeting in Wharton to be held between representatives of the company, representatives of this Division, and not more than two representatives of the petitioners.

We await your further advice in this matter.

Very truly yours,

George R. Shanklin
Chief Engineer and
Acting Director

MCK:mm

No copy sent to Commission

October 20, 1955

Mr. Robert L. Hood, Counsellor at Law
Raymond Commerce Building
Newark 2, New Jersey

Re: Dam No. 25-135, Morris County

Attention: Mr. Max I. Mints

Gentlemen:

On September 27, 1955 inspection was made in accordance with your request of September 21 of the Washington Forge Dam located across the Rockaway River on the property of L. E. Carpenter and Company, Wharton, Morris County. Unfortunately, Mr. Richard Borton of the L. E. Carpenter and Company to whom you referred in your letter was unable to be present and therefore our engineer was unable to discuss with Mr. Borton, his company's plans for the future of this dam. Mr. George Saupe of the company was present.

The inspection disclosed that no substantial change has been made in the dam since our previous inspection in 1945, which was made at the request of the company to survey the damage created by the flood of July 18, 1945. Copy of our letter of October 9, 1945 submitting recommendations to Mr. George Horack, Chief Engineer, of the company, is enclosed.

The inspection further disclosed that no substantial damage to the dam or adjacent buildings was experienced from the August floods. The Company does have reason to fear substantial damage to their plant should dikes surrounding the pond be overtopped or washed out. In order to assist the company in its studies relative to modifications, the names of several competent engineers were given to Mr. Borton. You will note that the specifications of the Division for modification of the existing spillway are given in our letter of October 9, 1955. In the event that the company should decide to remove this dam, it will be necessary, not only to remove the gates, but to also remove entirely the concrete piers between the two dam abutments.

We are enclosing for your information, copy of our dam booklet which gives the law and rules of the Division relative to dams. Should you have any further questions, we will be glad to discuss them with you or representatives of the company by appointment in this office.

Very truly yours,

H. T. Critchlow
Director and Chief Engineer

By _____
George R. Shanklin
Asst. Director & Asst. Chief Engineer

enc.

Report on Dam Inspection

Washington Forge Dam

Dam No. 25-135

Morris County

On Tuesday, September 27, 1955, in company with Mr. George Saupe representing the owners, the writer made an inspection of the subject dam which is owned by the L. E. Carpenter & Company of Wharton, New Jersey. It is located across the Rockaway River approximately 50 ft. upstream of the Main Street bridge in Wharton.

Mr. Richard Borton with whom the writer had an appointment was unable to be present and Mr. Saupe was not familiar with the company's desires and intentions for the inspection. He explained, however, that during the floods of August, 1955 the waters behind the dam rose to such a point that it was necessary to place sandbags adjacent to the spillway structure in order to protect one of the company's plant buildings. The sandbags were visible in the location Mr. Saupe indicated.

No measurements or estimations of high-water were made and no indications of how high the water came were visible at the time of the inspection. The spillway structure appeared to be unchanged from the condition which existed at the time of the inspections by Mr. Shanklin in 1945.

On Tuesday, October 4, the writer spoke to Mr. Borton on the telephone regarding the dam and the inspection. Mr. Borton said that the company is concerned lest an occurrence of floods greater than those experienced during August would cause flooding of the company's buildings and cause serious damage to the large inventory of material stored in them. He said that the company was considering removing the dam and doing away with the pond upstream. The writer explained to Mr. Borton that the law required, in some instances, that old dams be retained if lands adjacent to their pools had been developed as a result of the presence of the water adjacent to it. It was likewise impressed upon Mr. Borton that the municipality might be concerned with the continued maintenance of the dam and pool.

Upon the question of providing expert engineering advice relative to the removal or alteration of the dam the writer named three engineers in his opinion confident to advise the company. No effort was made on the writer's part to give any information additional to that submitted in the letter written to the company on October 4, 1945.

It is recommended that the advice submitted in 1945 be resubmitted to the company for their information and guidance.

Wm E. Edens

William E. Edens
Senior Hydraulic Engineer

October 13, 1955

October 9, 1945

Mr. George Horack, Chief Engineer
L. E. Carpenter & Company
Wharton, New Jersey

Re: Dam - Morris County

Dear Sir:

In reply to your letter of September 21, 1945 in further reference to your proposed modifications to the spillway and retaining walls at your dam, known as Washington Forge Pond, on the Rockaway River at Wharton, we can advise you that we have completed our examination of this structure and find that your spillway, including the gates, has a very limited capacity for passage of flood waters.

The drainage area tributary to this dam is 29.1 square miles, for which we would normally recommend that spillway capacity be provided to pass 2150 second feet, with a minimum of 1 foot freeboard. This size of flood is based on an analysis of observed flood peaks at the Boonton gaging station on the Rockaway River and is comparable to the size of flood experienced on March 1902. This design flood is only 30% of the maximum flood of record on October 1903 and is 20% greater than the largest flood experienced on the Rockaway River since 1903.

The peak for your recent flood of July 18, 1945 is estimated from your observed high water marks to be only 850 second feet, neglecting the overflow of the dam embankment. Of this total, 280 second feet was passed over the spillway and 570 second feet was discharged through the gates.

The wide spread between the present spillway capacity and the safe size of design flood makes it difficult to recommend any modification of your existing spillway without including an extension of the spillway along the retaining wall at the right end of the dam. The modifications which you discussed with Mr. Shanklin on the inspection of August 29 would only increase the capacity of your spillway and gates to 1140 second feet for a flood height level with the top of the new walls one foot above the present top of walls and no freeboard.

Our stream surveys, copies of which are enclosed, indicate that an additional 60 feet of spillway can be obtained by modifying the retaining wall at the right end of your spillway to provide an overflow spillway with its crest 6 inches above normal pond level. Since we understand that the practicability of this modification will depend upon the location

of your property line, we suggest that you have your engineer, Mr. Sharp, make a detailed survey of the dam, showing this property line, and investigate the foundation conditions below this wall. Upon completion of this survey, we suggest that you and Mr. Sharp arrange for a conference in this office to discuss this problem further. In view of the age of your existing structure we are willing to consider a reduction in the 2150 second foot-flood. The addition of the 60-foot extension to your spillway will add 425 second feet to the 1140 second feet provided by your proposed modification.

Yours very truly,

H. T. Critchlow
Chief Engineer

GRS:LMS

of your property line, we suggest that you have your engineer, Mr. Sharp, make a detailed survey of the dam, showing this property line, and investigate the foundation conditions below this wall. Upon completion of this survey, we suggest that you and Mr. Sharp arrange for a conference in this office to discuss this problem further. In view of the age of your existing structure we are willing to consider a reduction in the 2150 second foot-flood. The addition of the 60-foot extension to your spillway will add 425 second feet to the 1140 second feet provided by your proposed modification.

Yours very truly,

H. T. Critchlow
Chief Engineer

GRS:LMS

APPENDIX 2

CHECK LIST

VISUAL INSPECTION

WASHINGTON FORGE POND DAM

Check List
Visual Inspection
Phase 1

Name Dam Washington Forge Pond Dam County Morris State N.J. Coordinators NJDEP

Date(s) Inspection Nov. 6,1979 Weather cool, cloudy Temperature 48° F

Pool Elevation at Time of Inspection 639.7 NGVD Tailwater at Time of Inspection 632.2 NGVD

Inspection Personnel:

Warren Guinan	Ronald Hirschfeld
Stephen Gilman	
Kenneth Stuart	

Gilman/Hirschfeld Recorder

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	Extensive wave erosion on upstream slope. Some eroded areas bare, some with partially or completely re-established vegetation. Trees growing on upstream edge of crest.	Remove trees and their roots on upstream edge of crest. Repair eroded areas, design erosion protection to resist wave action. Establish grassy vegetation above elevation of erosion protection.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good.	
RIPRAP FAILURES	No riprap.	Provide upstream slope protection.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	No railings.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.	
ANY NOTICEABLE SEEPAGE	None observed.	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Not visible due to water flowing over crest.	
APPROACH CHANNEL	Wide and unobstructed, except for one large sycamore tree that has fallen into channel on right bank. Sediment has accumulated behind overflow section to within one or two feet of the crest.	Remove fallen sycamore tree from right bank of approach channel.
DISCHARGE CHANNEL	Wide and unobstructed. One large sycamore tree is leaning over right bank of channel and appears to be on the verge of falling over. Some smaller trees overhang the channel between dam and highway bridge immediately downstream.	Remove trees for some distance from the right edge of channel between dam and highway bridge to prevent blocking of the bridge opening by windfalls.
BRIDGE AND PIERS OVER SPILLWAY	None.	
RIGHT ABUTMENT	Spalling and erosion of training wall where in contact with water - 6" maximum depth; some movement of joints; construction joint in training wall at crest is badly spalled on backside and water is flowing through cracks; several other joints and cracks are leaking along right training wall; several areas of spalling.	Repair deteriorated concrete.
LEFT ABUTMENT	Spalling and erosion of training wall where in contact with water; training wall is cracked and spalled in many areas on the upstream face.	Repair deteriorated concrete.

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not visible below water surface	
INTAKE STRUCTURE	Not visible below water surface	
OUTLET PIPE	Not applicable	
OUTLET CHANNEL	Not visible below water surface	
EMERGENCY GATE	Not accessible, not lubricated and no indication of recent operation. Previous owner (L.E. Carpenter) indicated that gate stem was broken and the gate hadn't been opened for at least 10 years	Rehabilitate gate and operating mechanism and provide access.

GATED PENSTOCK OUTLET

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE INLET STRUCTURE	Surface of concrete is eroded and spalled in a few areas - 2" maximum depth; trash rack is rusted and plugged with debris; stoplog slots are eroded and spalled; Previous owner reports penstock is permanently plugged except for 6" pipe.	Repair concrete or permanently seal intake structure. Repair or remove.
APPROACH CHANNEL	Wide and unobstructed	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Service bridge has been removed	
GATES AND OPERATION EQUIPMENT	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gently sloping. No signs of instability.	
SEDIMENTATION	No signs of significant sedimentation observed. Sediment has accumulated behind concrete overflow section to within one or two feet of crest.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Good. Main Street bridge located about 100 feet downstream of dam. Some trees felled in channel along north bank.	
SLOPES	North side - vertical stone masonry wall; south side - 15H: IV slope, partially wooded.	
APPROXIMATE NO. OF HOMES AND POPULATION	No residences. Industrial buildings border stream and dam. No permanent population.	Excessive property loss possible.

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed	
OBSERVATION WELLS	None observed	
WEIRS	None observed	
PIEZOMETERS	None observed	
OTHER	None observed	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Plan for 1958 modification of spillway obtained from Mr. Henry Jarrett of L.E. Carpenter; not reproducible.
REGIONAL VICINITY MAP	Prepared for this report
CONSTRUCTION HISTORY	Spillway renovated in 1958
TYPICAL SECTIONS OF DAM	Spillway section included on Figure 2 in this report
HYDROLOGIC/HYDRAULIC DATA	Dates of past major floods included in Appendix 1 of this report.
OUTLETS - PLAN	Included on above non-reproducible plan
- DETAILS	Included on above non-reproducible plan
- CONSTRAINTS	None
- DISCHARGE RATINGS	Rough rating for spillway by NJDEP included in Appendix 1
RAINFALL/RESERVOIR RECORDS	None

ITEM	REMARKS
DESIGN REPORTS	None disclosed
GEOLOGY REPORTS	None
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Spillway renovation computations included in Appendix 1 of this report.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None
POST-CONSTRUCTION SURVEYS OF DAM	Included on non-reproducible plans obtained from L.E. Carpenter Co.
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SERVICES	None
MODIFICATIONS	Spillway renovated in 1958
HIGH POOL RECORDS	Limited information contained in Appendix 1
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	None

ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS	Prepared for this report from field inspection data and non-reproducible plans.
DETAILS	
OPERATING EQUIPMENT	One inoperable manual gate mechanism.
PLANS & DETAILS	None.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 29.1 square miles, partially wooded, hilly

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 639.0 NGVD (63 acre feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not Applicable

ELEVATION MAXIMUM DESIGN POOL: 646.1 NGVD (half-PMF)

ELEVATION TOP DAM: 642.3 NGVD

CREST: Principal spillway - unrestricted flow over concrete

a. Elevation 639.0 NGVD

b. Type Concrete capped vertical

c. Width 3'

d. Length 60'

e. Location Spillover right - center of dam

f. Number and Type of Gates one, manually operated

OUTLET WORKS: one, 3' - wide by 4' - high

a. Type concrete walled opening, steel gate

b. Location center of spillway

c. Entrance Inverts 632.4

d. Exit Inverts 632.4

e. Emergency Draindown Facilities none (gate inoperable)

HYDROMETEORLOGICAL GAGES: none

a. Type

b. Location

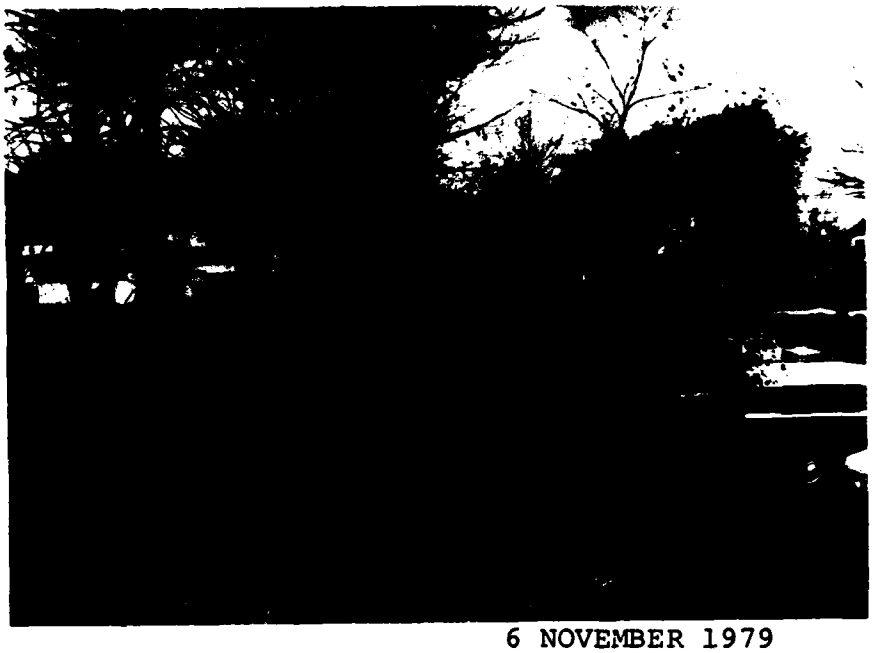
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 1207 cfs (gate closed)

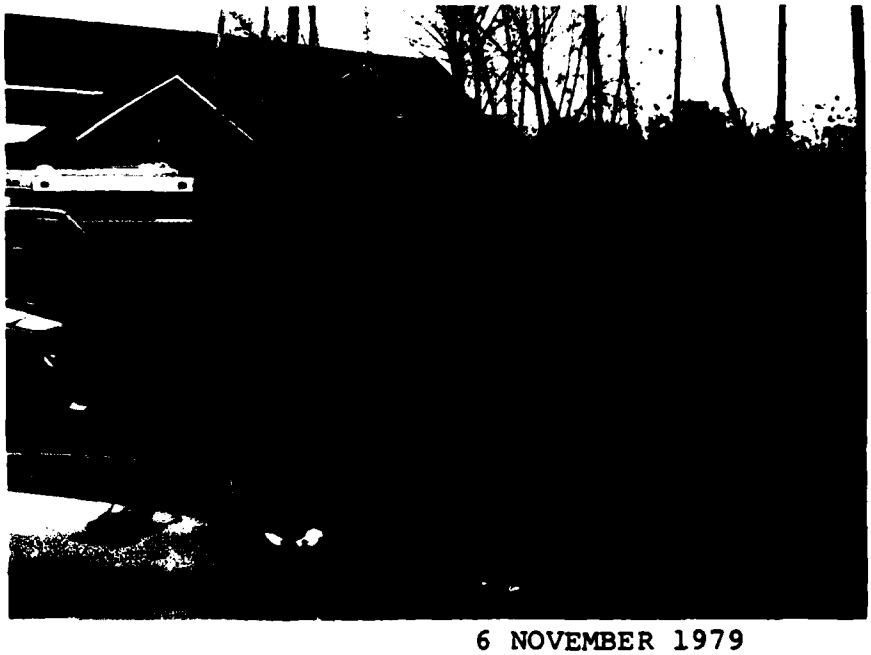
APPENDIX 3

PHOTOGRAPHS

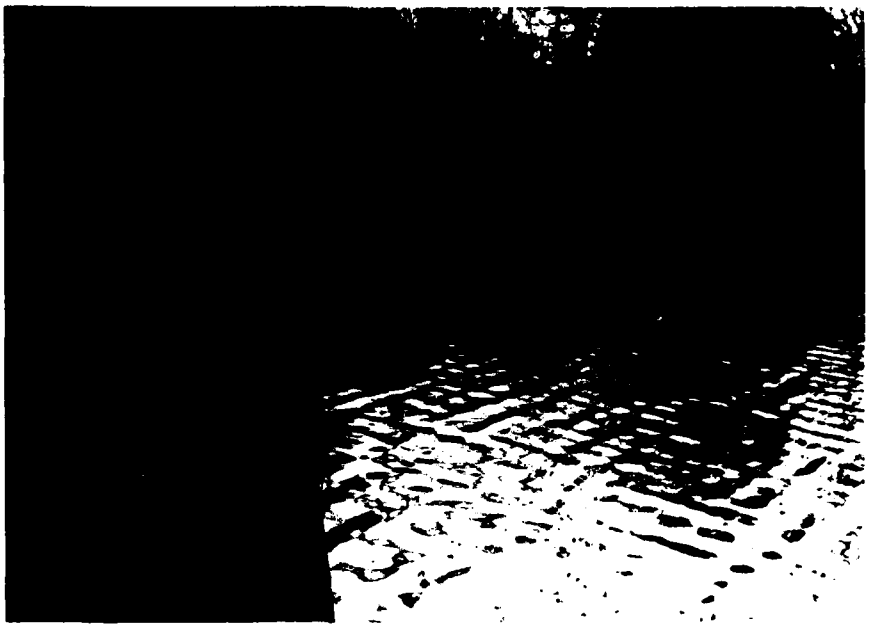
WASHINGTON FORGE POND DAM



6 NOVEMBER 1979
LOOKING NORTH ALONG EMBANKMENT CREST.
NOTE LAKE LEVEL RELATIVE TO PARKING LOT.



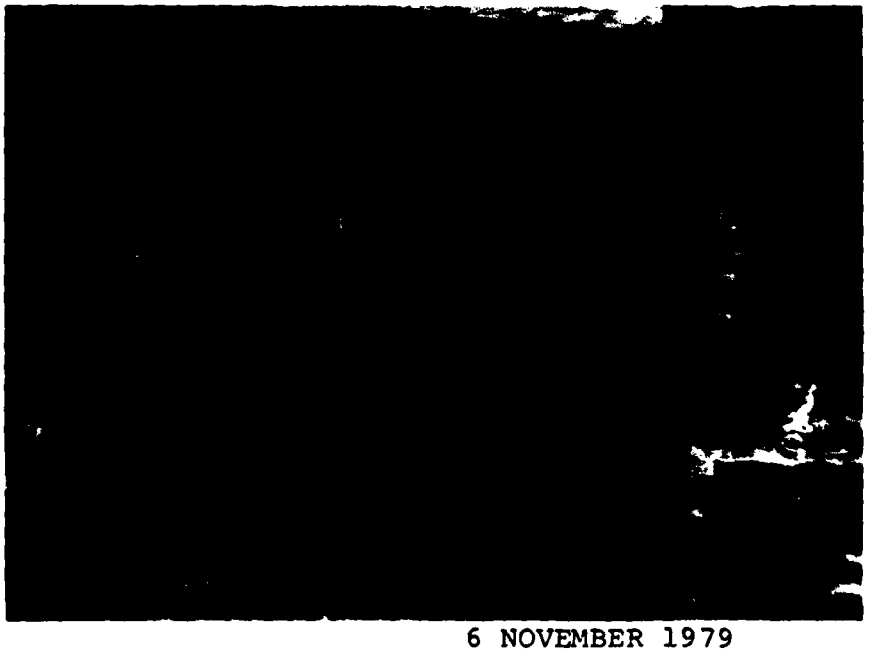
6 NOVEMBER 1979
LOOKING SOUTH ALONG DOWNSTREAM FACE OF
STONE MASONRY EMBANKMENT RETAINING WALL.



6 NOVEMBER 1979
LOOKING SOUTH AT PENSTOCK INTAKE STRUCTURE LOCATED NEAR NORTH ABUTMENT OF PRINCIPAL SPILLWAY.

6 NOVEMBER 1979
LOOKING WEST AT DOWNSTREAM FACE OF PRINCIPAL SPILLWAY.

6 NOVEMBER 1979
LOOKING SOUTH ACROSS PRINCIPAL SPILLWAY CREST. NOTE GATE OPERATING MECHANISM AT CENTER OF CREST.



6 NOVEMBER 1979
LOOKING NORTH AT OUTSIDE FACE OF TRAINING WALL AT SOUTH ABUTMENT OF PRINCIPAL SPILLWAY. NOTE SEEPAGE DISCHARGING FROM HOLE AT CENTER.

6 NOVEMBER 1979
LOOKING NORTH ACROSS PRINCIPAL SPILLWAY CREST. NOTE L.E. CARPENTER INDUSTRIAL COMPLEX ADJACENT TO DAM.

6. NOVEMBER 1979
LOOKING WEST AT UPSTREAM RESERVOIR.

6 NOVEMBER 1979
LOOKING EAST AT UPSTREAM FACE OF NORTH MAIN STREET BRIDGE LOCATED ABOUT 100 FEET DOWNSTREAM OF DAM.

6. NOVEMBER 1979
LOOKING EAST AT UPSTREAM FACE OF RAILROAD BRIDGE LOCATED ABOUT 60 FEET DOWNSTREAM OF NORTH MAIN STREET BRIDGE.

APPENDIX 4

HYDROLOGIC COMPUTATIONS

WASHINGTON FORGE POND DAM

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WASHINGTON FORGE POND DAM

BOROUGH OF WHARTON, NEW JERSEY

REGIONAL VICINITY MAP

JANUARY 1980

DEPARTMENT OF THE ARMY

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

PHILADELPHIA, PENNSYLVANIA

ANDERSON-NICHOLS & CO., INC. CONCORD, N.H.

SCALE IN MILES

0 5 10

MAP BASED ON U.S.G.S. 1:250,000 SERIES TOPOGRAPHIC MAPPING, NK 18-8 SCRANTON, PA., N.J., N.Y. 1944, REVISED 1969. NK 18-11 NEWARK, N.J., PA., N.Y. 1944, REVISED 1969.

Anderson-Nichols & Company, Inc.

Subject WASH. FG. PD. DAM

Sheet No. 1 of 12
Date 23 Jan 80
Computed [illegible]
Checked [illegible]

JOB NO. 3409-02

DETERMINE LAG TIME, T_L

Information given by COE, Philadelphia District

"For Washington Forge Pond (NJ00341) use Snyder coefficients $C_t = 2.0$ and $C_p = 0.62$ to develop the inflow hydrograph."

From Reference 9, (Appendix 5) p. 135

Snyder's Unit Hydrograph Method

Lag time, $T_L = t_1 = C_t (L L_{ca})^{0.3}$

C_t given above

$L^* \doteq 75{,}000$ ft $= 14.20$ mi

$L_{ca}^* \doteq 50{,}000$ ft $= 9.47$ mi

$t_1 = C_t (L L_{ca})^{0.3} = 2.0 [14.20(9.47)]^{0.3} =$ 8.7 hours

* Measured on USGS Quadrangle NJ NK 18-11, Pennsylvania NK 18-8, Scale: 1:250000 feet.

Anderson-Nichols & Company, Inc.

Subject Wash. Fg. Pd. Dam

JOB NO. 2449-02

Sheet No. 2 of 15
Date 23 Jan 80
Computed GRS
Checked DD

SQUARES 1/4 IN. SCALE

DEVELOP RATING CURVE AT DAM

Flow over principal spillway

Use weir equation, $Q = CLH^{3/2}$

where $C = 3.3$ *
$L = 60$ feet
H varies

Flow through gate structure

Use orifice equation, $Q = Ca\sqrt{2gh}$

$$C \overset{\nabla}{=} \left(1 + 0.4r^{0.3} + \frac{0.0045}{r^{1.25}}L\right)^{-1/2}$$

$$r = \frac{A}{WP} = \frac{12}{2(3)+2(4)} = 0.86$$

$$C = \left(1 + 0.4(0.86)^{0.3} + \frac{0.0045(6)}{(0.86)^{1.25}}\right)^{-1/2}$$

$$C = 0.84$$

$a = 12$ ft^2
h measured from water surface to ℄ of gate opening,
= W.S. el. − 634.2

* See Figure 2, cross section A-A.

∇ See Appendix 5, Reference 2, p. 4-24, eq. 4-37.

SQUARES /4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

RATING CURVE DEVELOPMENT (CONT.)

Flow over top of dam

Use weir equation, $Q = CLH^{3/2}$

where $C^* = 2.5$

L & H vary

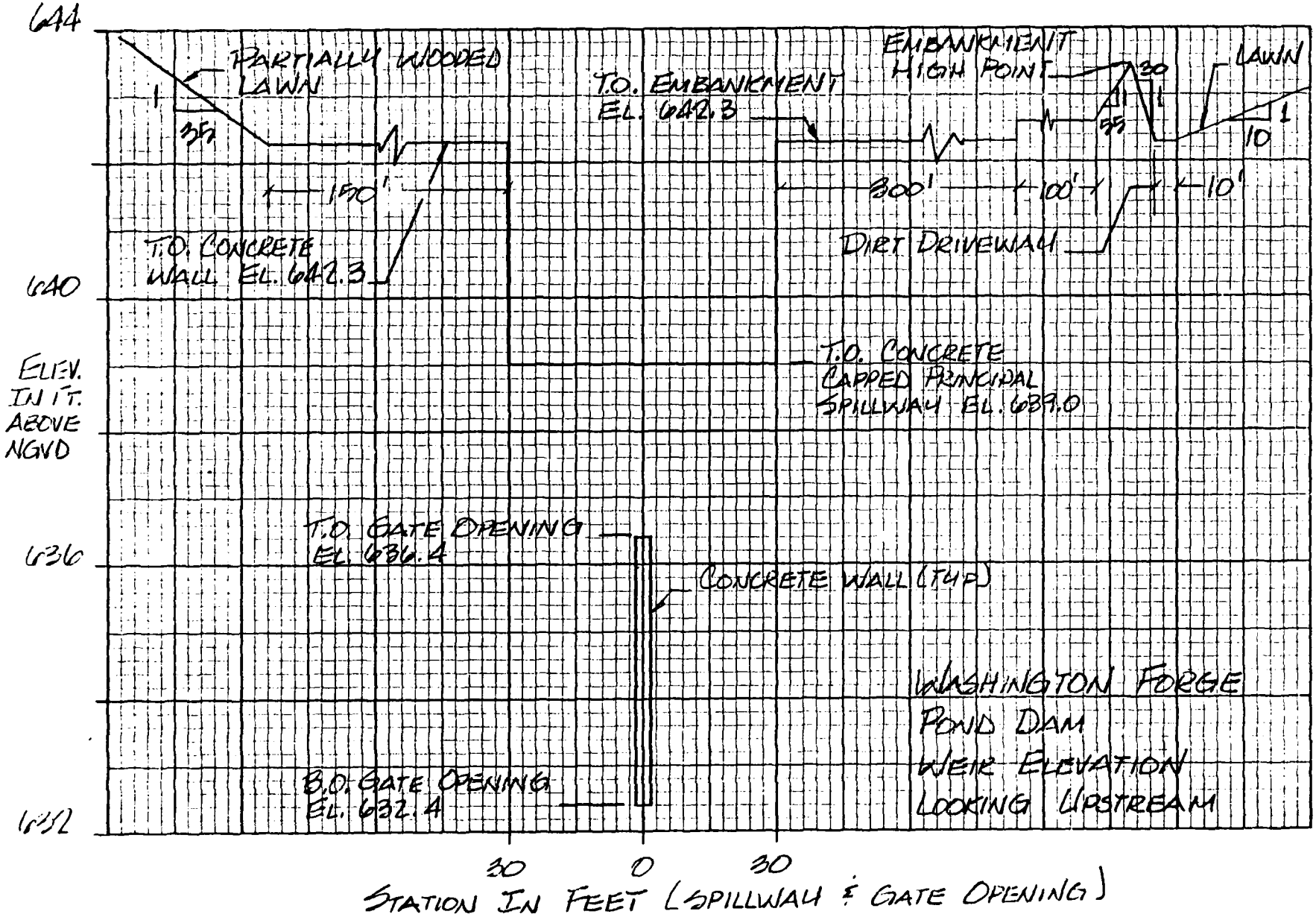
A discharge rating table follows...

The storage-elevation curve shown on p. 7/14 was developed under the following assumptions:

1. Average reservoir overbank slope ≈ 30H : 1V
2. Area of pond surface @ el. 640.0 ≈ 11 acres
3. Perimeter of pond @ el. 640.0 ≈ 4000 feet.

Additional volume resulting from each water surface elevation increase was added to a value of 63 acre-feet, the storage at el. 640.0. This value was obtained through analysis of the plan showing pond bottom contours mentioned in section 2.4.b. This plan was not reproducible and hence has not been included in this report.

* See Appendix D, Reference 2, p. 5-40.



Anderson-Nichols & Company, Inc.

JOB NO. 3409-02

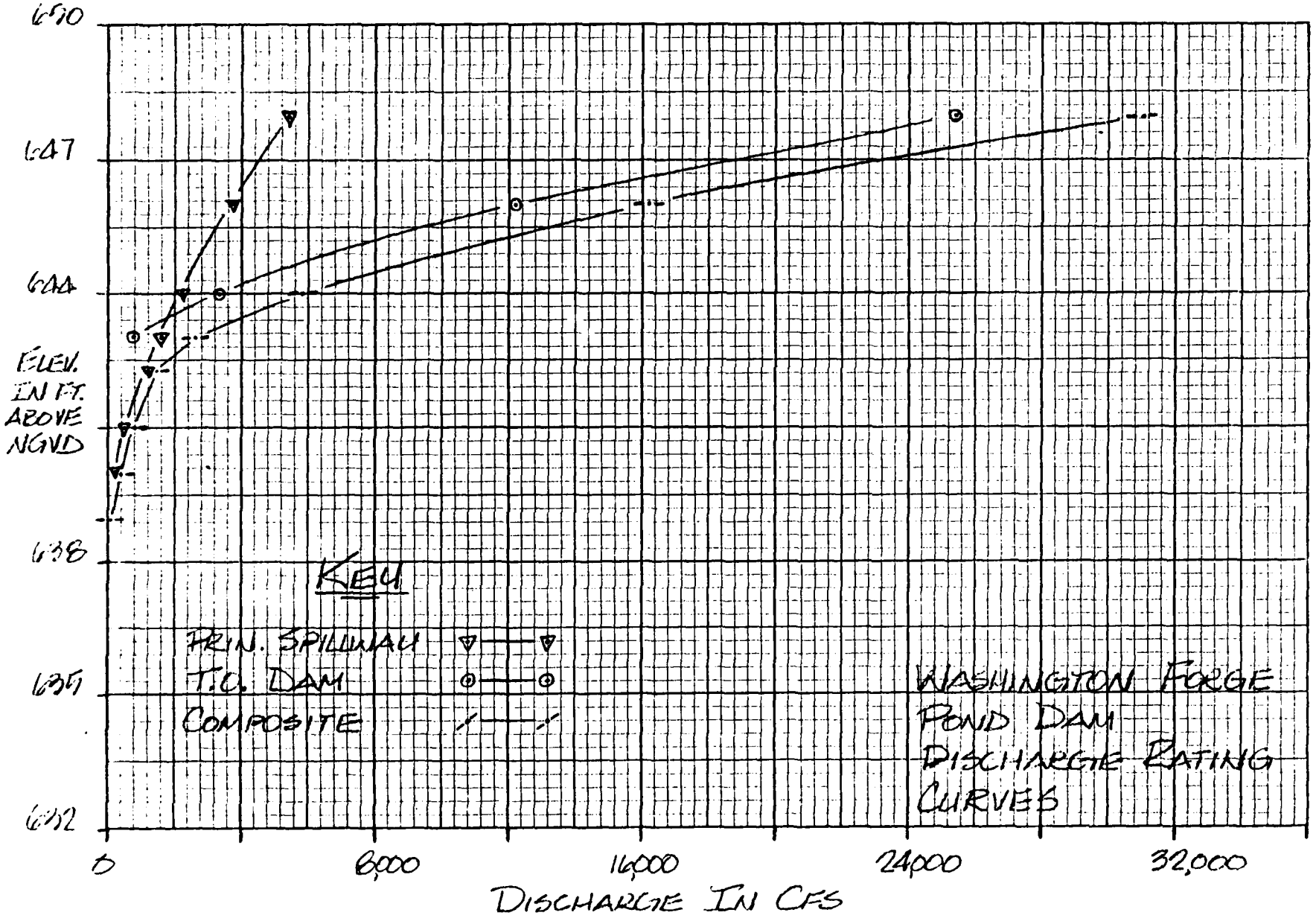
Subject WASH. FG. PD.

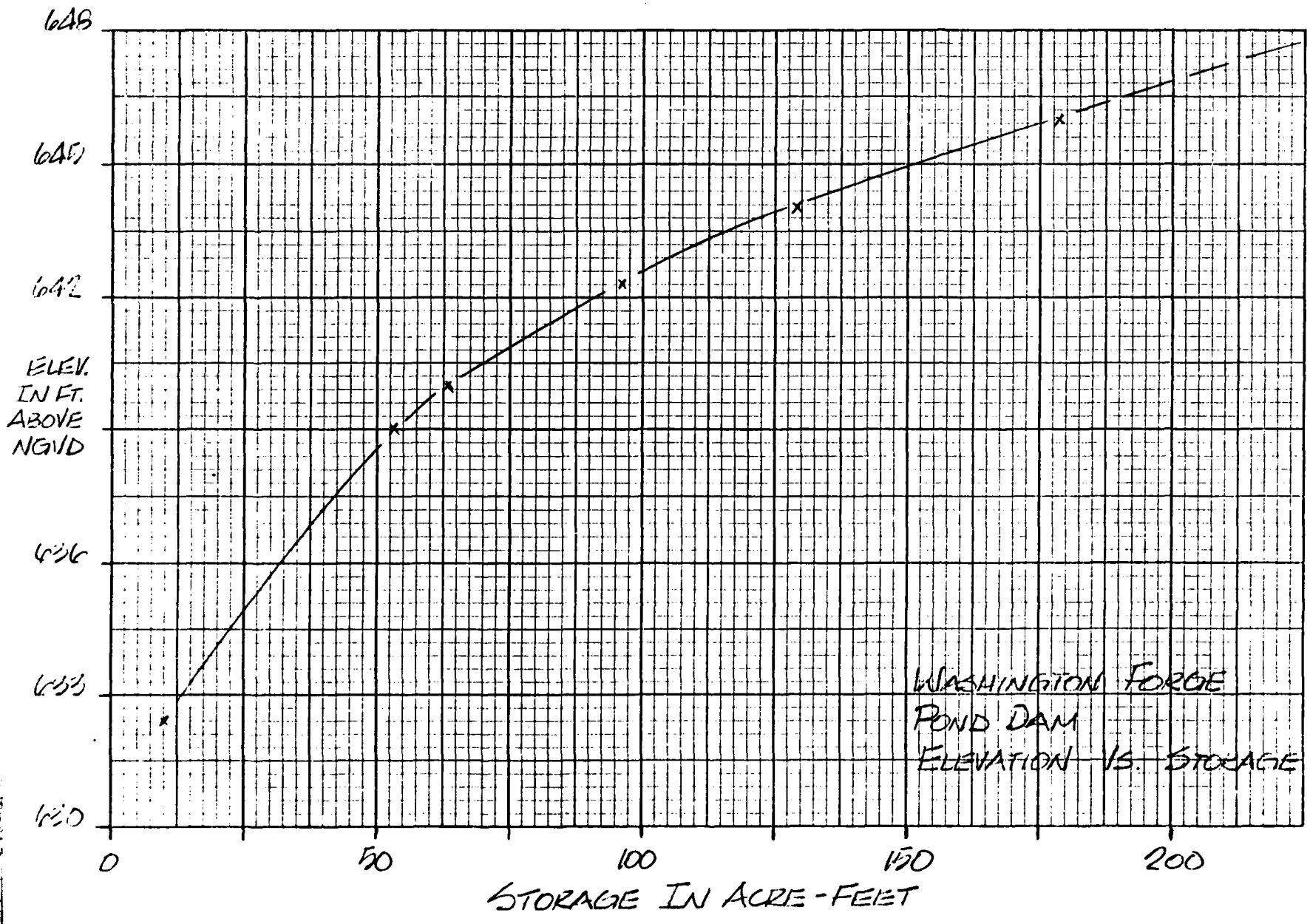
Sheet No. 7 of 15
Date 24 MAY 80
Computed AFS
Checked

ELEVATION (FT. ABOVE NGVD)	SPILLWAY HEAD ▽ (FT.)	SPILLWAY Q (WEIR) (CFS)	TOP OF DAM HEAD * (FT.)	TOP OF DAM LENGTH (FT.)	TOP OF DAM Q (CFS)	Q TOTAL
632.4						0
639.0						0
640.0	1.0	201				201
641.0	2.0	569				569
642.3	3.3	1207				1207
643.0	4.0	1610	0.65	598	783	2393
644.0	5.0	2251	1.69	612	3362	5613
646.0	7.0	3728	3.69	687	12195	15923
648.0	9.0	5435	5.76	732	25315	30750

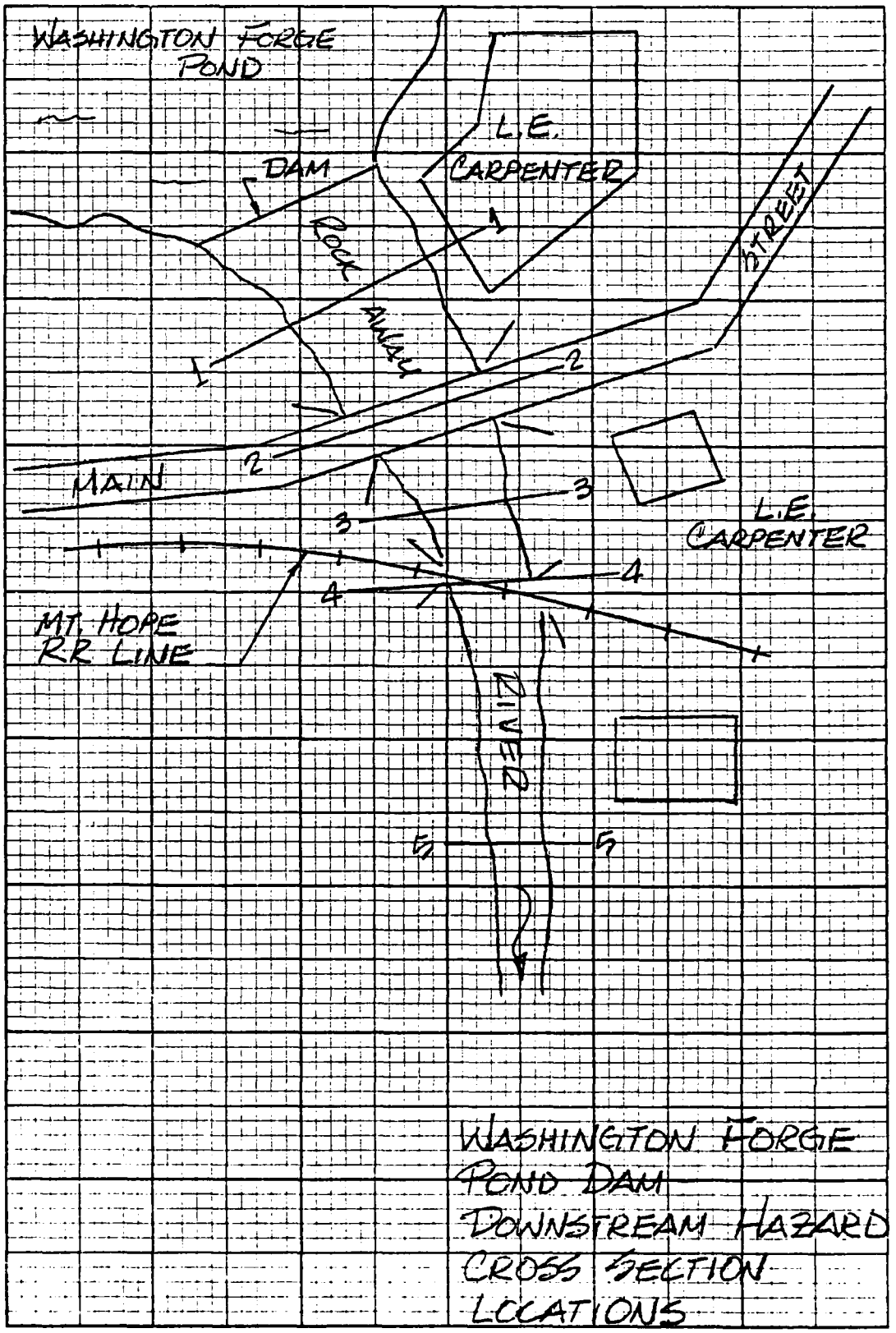
▽ Head over spillway crest

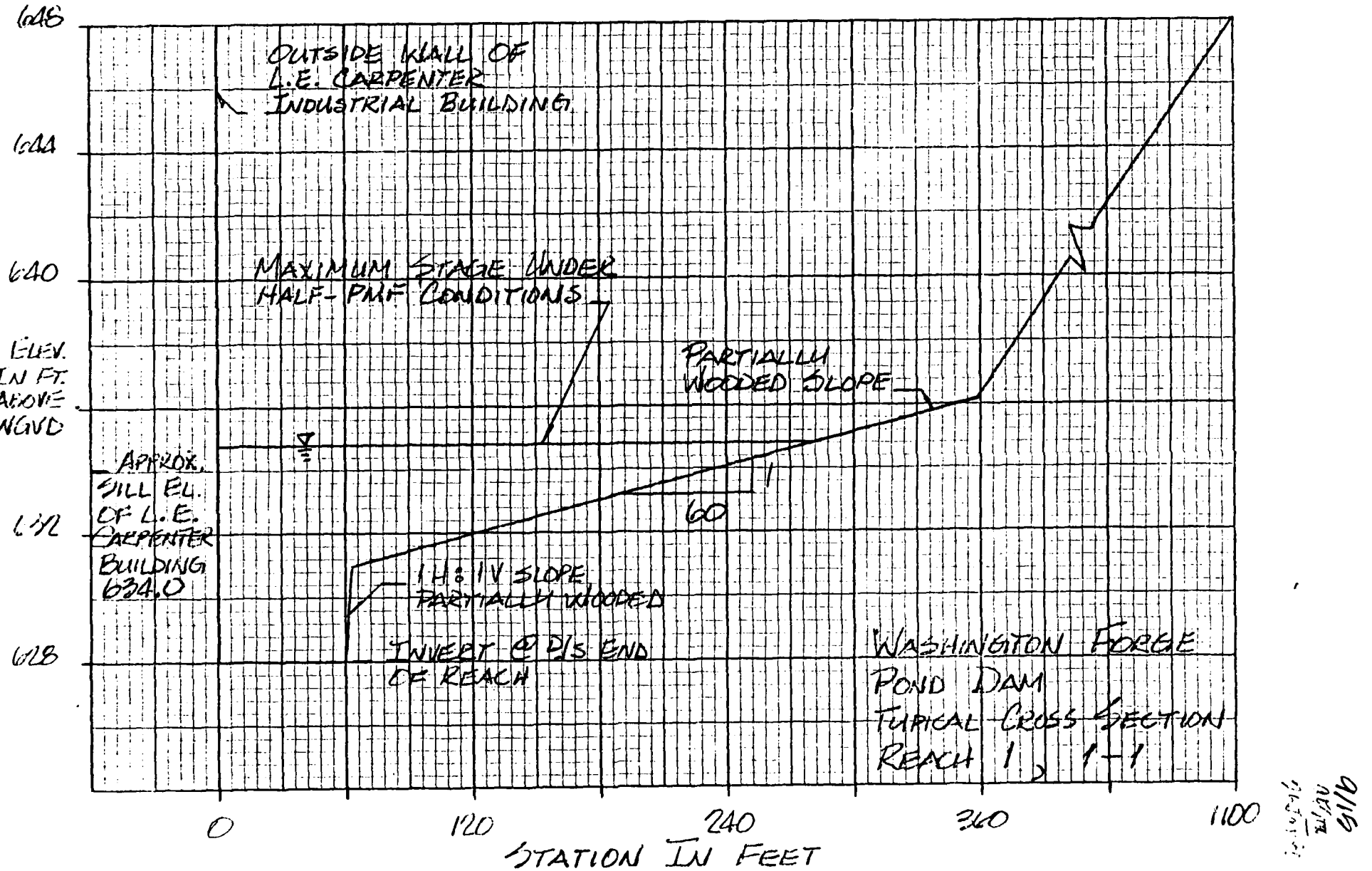
* Average value

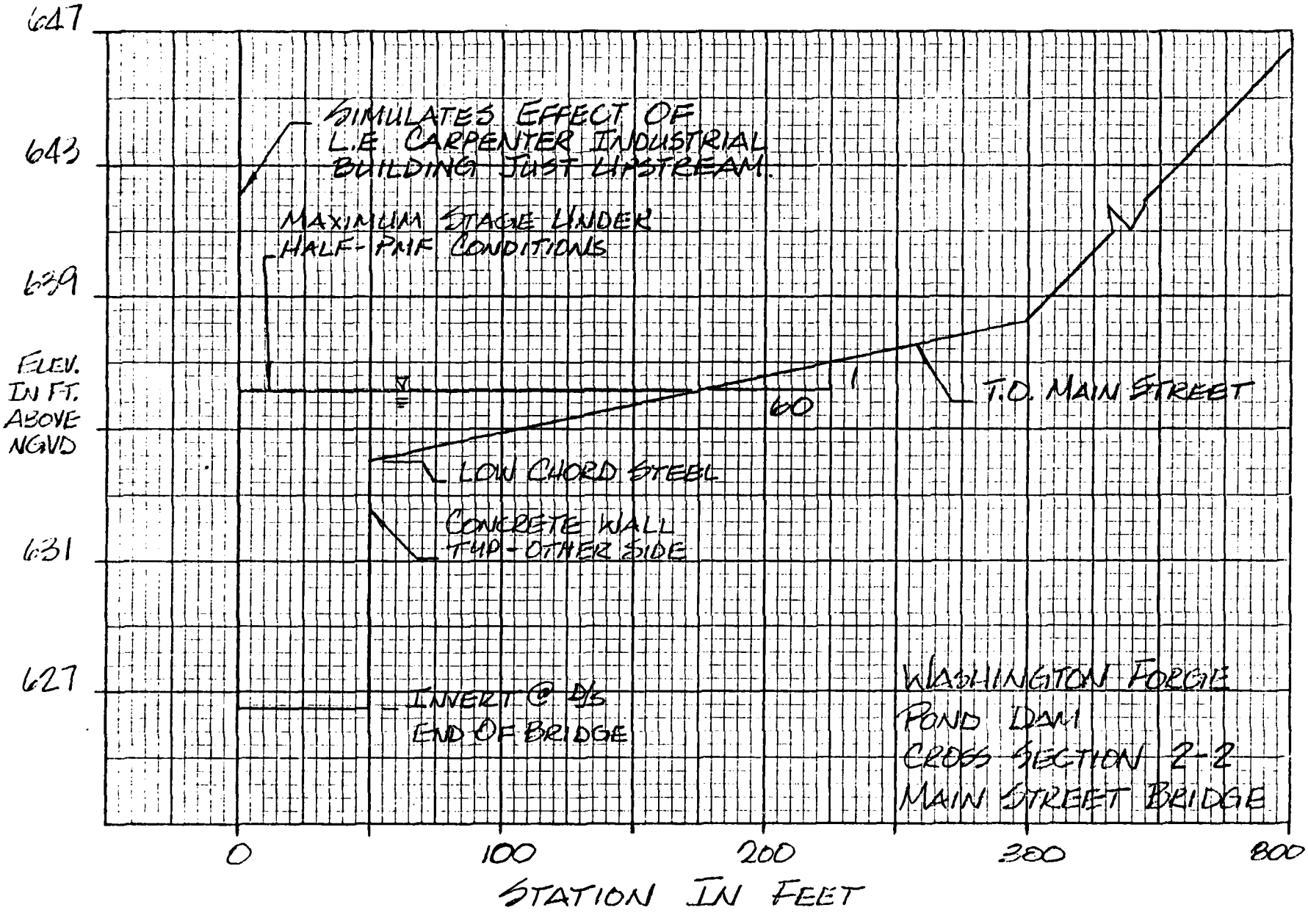


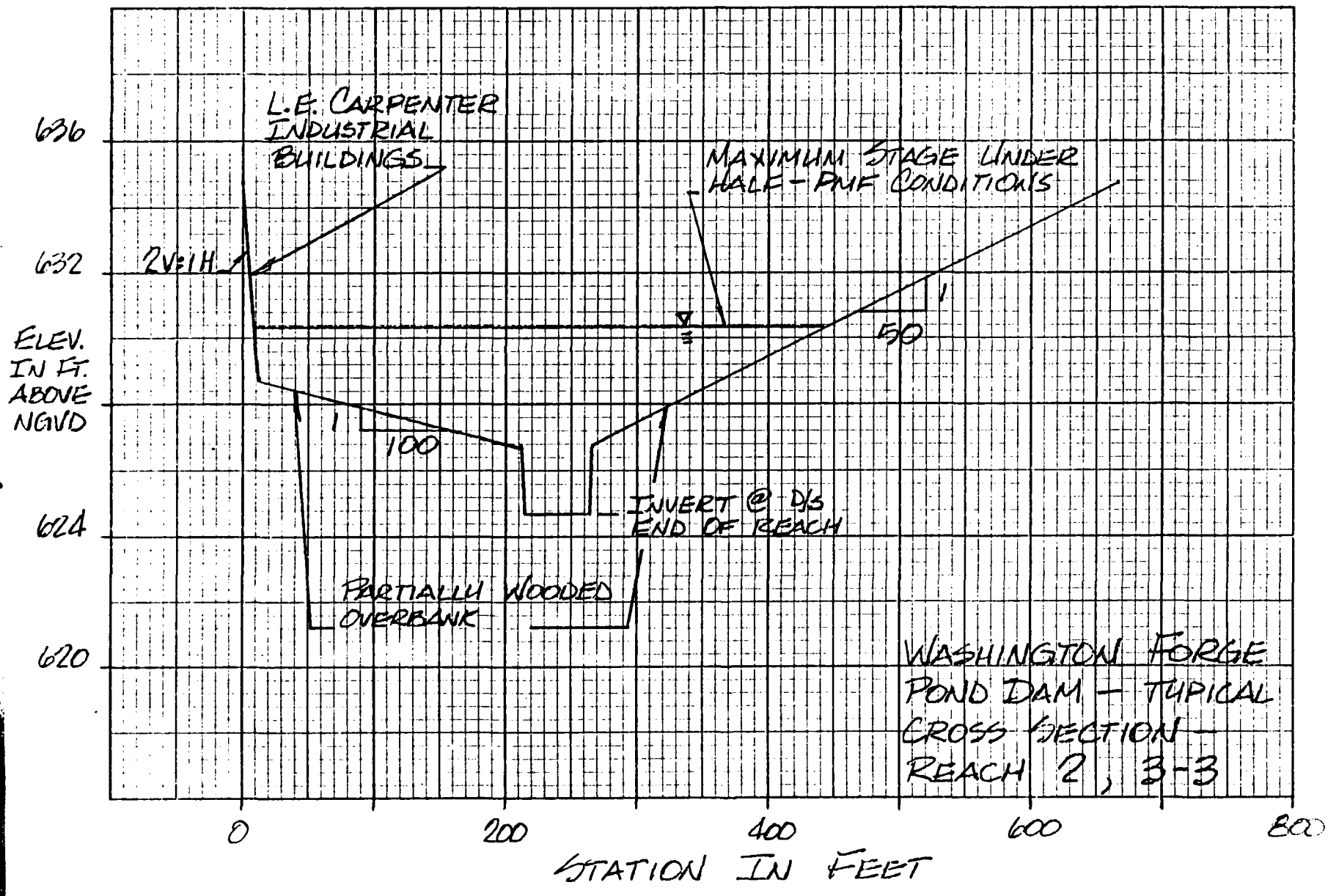


8/15
AFF III
27 Mar 80



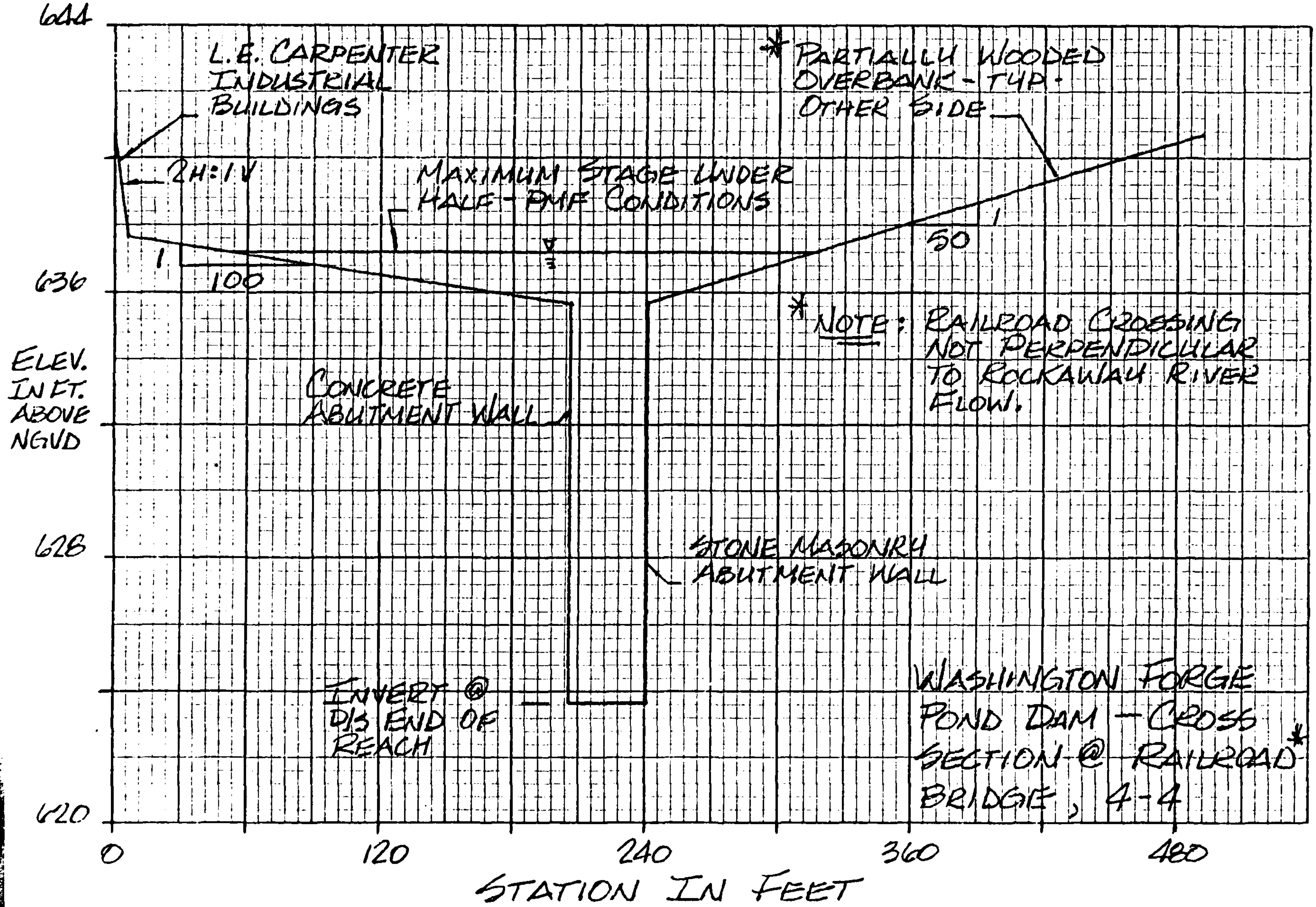


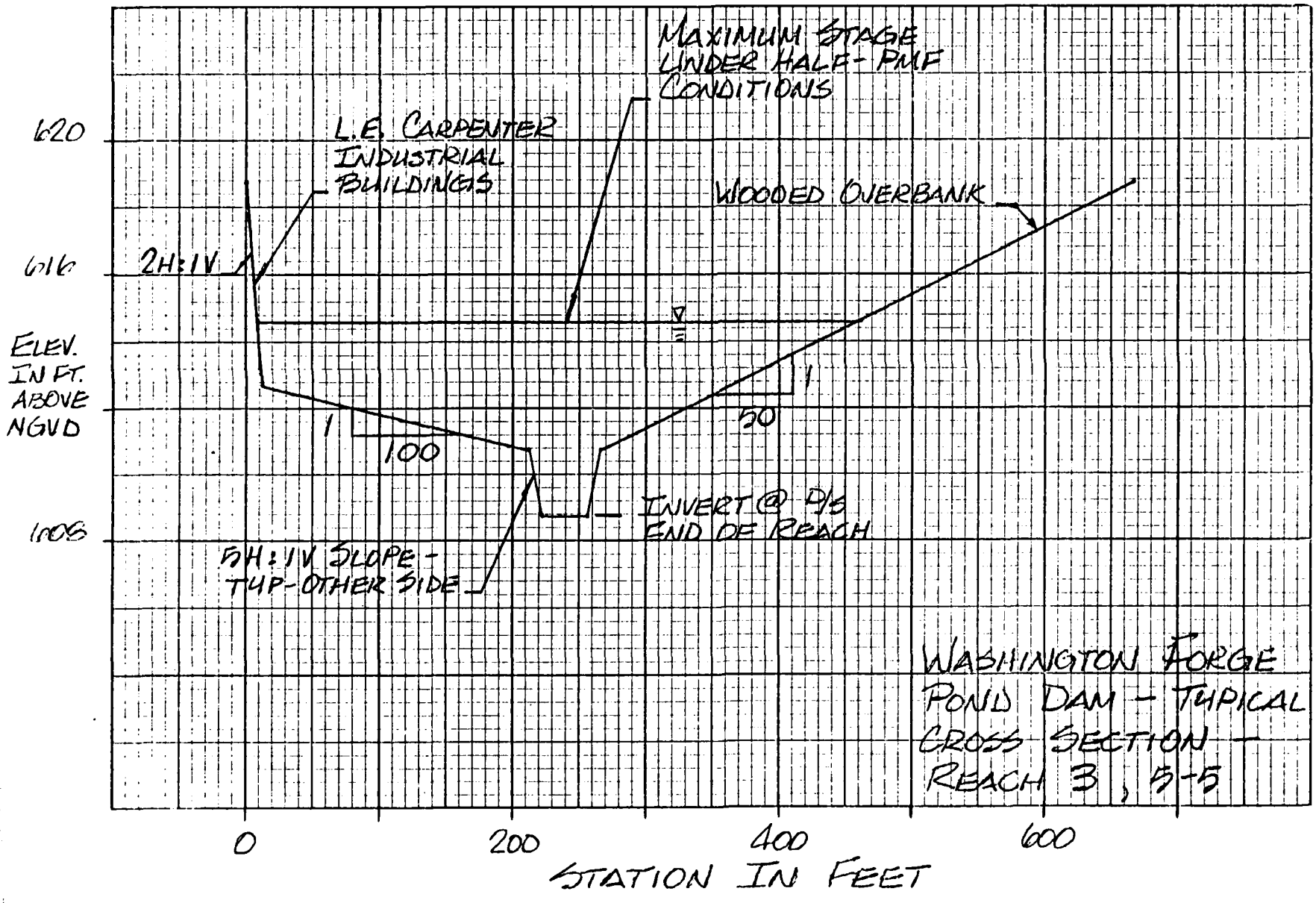




WASHINGTON FORGE POND DAM – TYPICAL CROSS SECTION – REACH 2, B-3

11115 AFS III 23MAR80



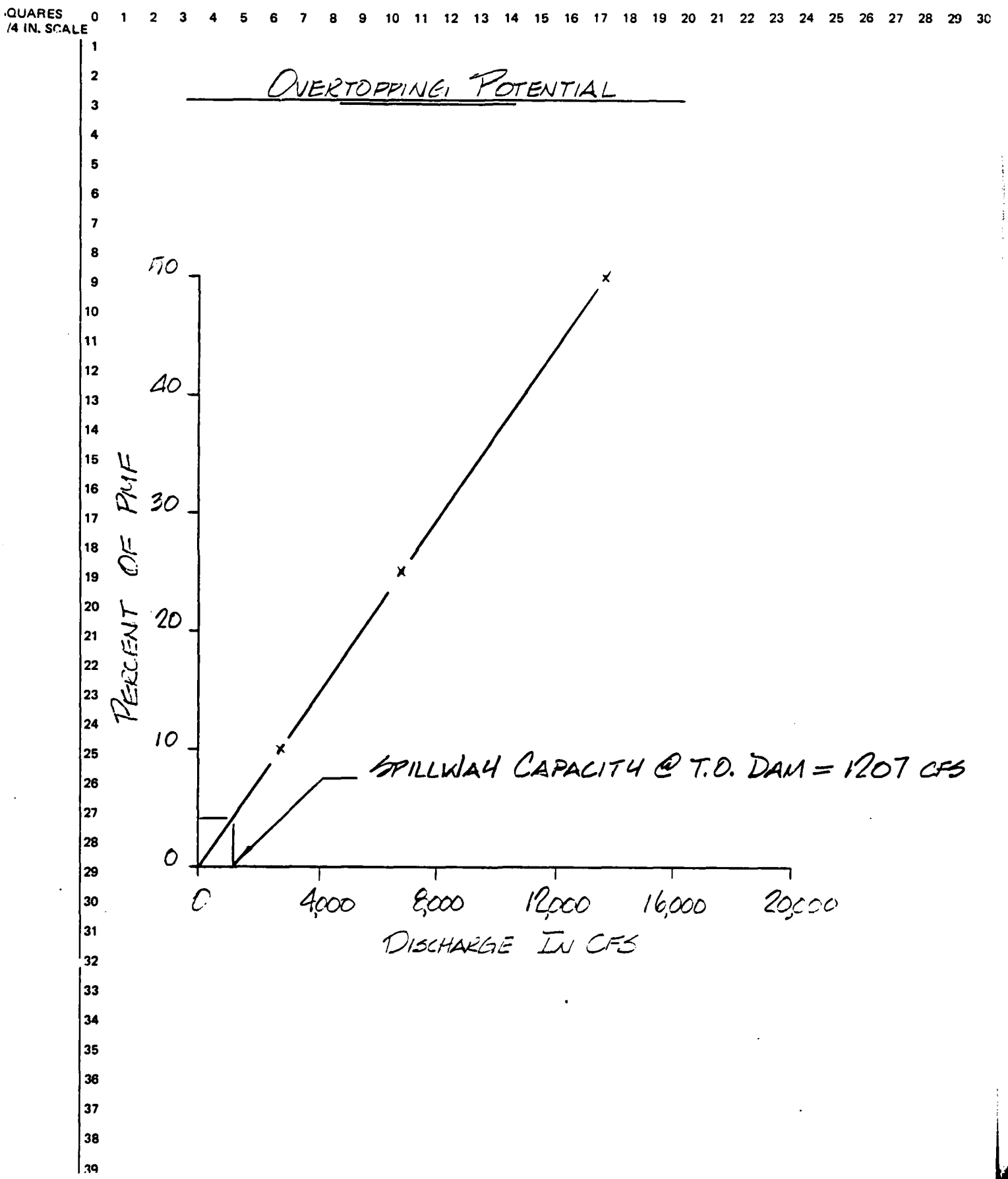


Anderson-Nichols & Company, Inc.

Subject WASH. FED. PD. DAM.

Sheet No. 14 of 15
Date 28 Jan 80
Computed GES JR.
Checked FDD

JOB NO. F-429-02



DRAWDOWN CALCULATIONS

Given: 3'-wide x 4'-high outlet gate, invert el. 632.4

Assume: 3'x4' gate operational
Reservoir inflow = 87 cfs = Q_{IN}
$Q_{NET} = Q_{OUT} - Q_{IN}$
$Q_{gate} = Q_{orifice} = Ca\sqrt{2gh}$, C = 0.84 (see p. 2/14)
Acre-ft/day = 1.9835 · Q_{AVG}
Days = Δ Storage / Acre-ft/day
*$Q = CLH^{3/2}$, C = 2.7 (see ref. 2, p. 5-40)

ELEV.-FT. ABOVE NGVD	STORAGE AC-FT	ΔS AC-FT	h FT	Q_{OUT} CFS	Q_{NET} CFS	Q_{AVG} CFS	AC-FT PER DAY	DAYS
639.0	53		4.6	173	86			
		11				71	141	0.08
637.5	42		3.1	142	55			
		7				41	81	0.09
636.4	35		2.0	114	27			
		12				14	28	0.43
634.4	23		0	*23	▽0			

Σ = 0.60 DAYS

▽Note: $Q_{NET} = 0$; therefore, reservoir is not draining at or below this elevation.

HEC-1 OUTPUT

OVERTOPPING ANALYSIS

WASHINGTON FORGE POND DAM

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1               A1 WASHINGTON FORGE POND DAM OVERTOPPING ANALYSIS ## GUS SHARRY A-N & CO. INC ##
    2               A2 NEW JERSEY DAM NO. 519   MORRIS COUNTY   BOROUGH OF WHARTON
    3               A3 0.1,0.25,0.5 MULTIPLES OF PMF FROM 24-HOUR PMP  -  BREACH ANALYSIS
    4               B     60       1       0       0       0       0       0       0       0       0
    5               B1     5
    6               J      2       3       1
    7               J1   0.1    0.25     0.5
    8               K      0      A1                                      1       1
    9               K1 DEVELOP WASHINGTON FORGE POND INFLOW HYDROGRAPH
   10               P      1       1    29.1                       0.82                            1
   11               P             22.7     113     123     132
   12               T                                                       1     0.1
   13               W    8.7    0.62
   14               Y     -3
   15               K      1      A2                                      1       1
   16               K1 ROUTE INFLOW HYDROGRAPH THROUGH WASHINGTON FORGE POND
   17               Y                                      1       1
   18               Y1     1                                               59      -1
   19               Y4 632.4   639.0   640.0   641.0   642.3   643.0   644.0   646.0   648.0
   20               Y5     0       0     281     569    1207    2393    5613   15923   30750
   21               $S    10      53      63      96     129     179     230
   22               $E 632.4   639.0   640.0   642.3   644.0   646.0   648.0
   23               $$ 639.0
   24               $D 642.3
   25               $P    20       0  636.8       1   639.0   642.3
   26               $B    20       0  636.8       1   639.0   660.0
   27               K      1      A3                                      1       1
   28               K1 CHANNEL ROUTING -MOD PULS- REACH 1
   29               Y                                      1       1
   30               Y1     1                                               -1
   31               Y6  0.01    0.04    0.04     628     648     100    0.03
   32               Y7     0     648       0     638       0     628      30     628      60     628
   33               Y7    63     631     603     640    1083     648
   34               K      1      A4                                      1       1
   35               K1 CHANNEL ROUTING -MOD PULS- MAIN STREET BRIDGE
   36               Y                                      1       1
   37               Y1     1                                               -1
   38               Y6 0.015    0.04   0.015   626.5   646.5      50    0.03
   39               Y7     0   646.5       0   636.5       0   626.5      25   626.5      50   626.5
   40               Y7    50     634     410     640     800   646.5
   41               K      1      A5                                      1       1
   42               K1 CHANNEL ROUTING -MOD PULS- REACH 2
   43               Y                                      1       1
   44               Y1     1                                               -1
   45               Y6  0.05    0.04    0.05   624.7   634.7      60    0.03
   46               Y7     0   634.7      12   628.7     212   626.7     214   624.7     264   624.7
   47               Y7   266   628.7     466   630.7     666   634.7
   48               K      1      A6                                      1       1
   49               K1 CHANNEL ROUTING -MOD PULS- RAILROAD BRIDGE
   50               Y                                      1       1
```

```
51          Y1     1                                                    -1
52          Y6  0.03     0.04     0.03    623.7    640.7       30   0.03
53          Y7     0    640.7        6    637.7      206    635.7    206    623.7      241    623.7
54          Y7   241    635.7      341    637.7      491    640.7
55          K      1       A7                                    1      1
56          K1 CHANNEL ROUTING -MOD PULS- REACH 3
57          Y                                          1      1
58          Y1     1                                                    -1
59          Y6  0.06     0.04     0.06    608.7    618.7       500   0.03
60          Y7     0    618.7       12    612.7      212    610.7    222    608.7      257    608.7
61          Y7   267    610.7      467    614.7      667    618.7
62          K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	A1
ROUTE HYDROGRAPH TO	A2
ROUTE HYDROGRAPH TO	A3
ROUTE HYDROGRAPH TO	A4
ROUTE HYDROGRAPH TO	A5
ROUTE HYDROGRAPH TO	A6
ROUTE HYDROGRAPH TO	A7
END OF NETWORK	

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

RUN  DATE= 80/03/25.
     TIME= 04.51.16.
```

WASHINGTON FORGE POND DAM OVERTOPPING ANALYSIS ## GUS SHARRY A-N & CO, INC ##
NEW JERSEY DAM NO. 519   MORRIS COUNTY   BOROUGH OF WHARTON
0.1,0.25,0.5 MULTIPLES OF PMF FROM 24-HOUR PMP - BREACH ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
60	1	0	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 3 LRTIO= 1

RTIOS= .10 .25 .50

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

SUB-AREA RUNOFF COMPUTATION

DEVELOP WASHINGTON FORGE POND INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A1	0	0	0	0	1	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	29.10	0.00	29.10	.82	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.70	113.00	123.00	132.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 8.70 CP= .62 NTA= 0

RECESSION DATA
STRTQ= -3.00 QRCSN= 0.00 RTIOR= 1.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 9.76 AND R= 8.16 INTERVALS

UNIT HYDROGRAPH 49 END-OF-PERIOD ORDINATES, LAG= 8.70 HOURS, CP= .62 VOL= 1.00

50.	187.	376.	592.	824.	1044.	1215.	1324.	1360.	1328.
1208.	1069.	945.	836.	740.	654.	579.	512.	453.	400.
354.	313.	277.	245.	217.	192.	170.	150.	133.	117.

	104.	92.	81.	72.	64.	56.	50.	44.	39.	34.			
	30.	27.	24.	21.	19.	16.	15.	13.	11.				

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	1.00	1	.11	0.00	.11	87.	1.02	7.00	31	0.00	0.00	0.00	13240.
1.01	2.00	2	.11	0.00	.11	87.	1.02	8.00	32	0.00	0.00	0.00	12364.
1.01	3.00	3	.11	0.00	.11	87.	1.02	9.00	33	0.00	0.00	0.00	10956.
1.01	4.00	4	.11	0.00	.11	87.	1.02	10.00	34	0.00	0.00	0.00	9703.
1.01	5.00	5	.11	0.00	.11	87.	1.02	11.00	35	0.00	0.00	0.00	8593.
1.01	6.00	6	.11	0.00	.11	87.	1.02	12.00	36	0.00	0.00	0.00	7611.
1.01	7.00	7	.31	0.00	.31	87.	1.02	13.00	37	0.00	0.00	0.00	6742.
1.01	8.00	8	.31	.20	.11	97.	1.02	14.00	38	0.00	0.00	0.00	5973.
1.01	9.00	9	.31	.21	.10	135.	1.02	15.00	39	0.00	0.00	0.00	5294.
1.01	10.00	10	.31	.21	.10	211.	1.02	16.00	40	0.00	0.00	0.00	4692.
1.01	11.00	11	.31	.21	.10	333.	1.02	17.00	41	0.00	0.00	0.00	4161.
1.01	12.00	12	.31	.21	.10	503.	1.02	18.00	42	0.00	0.00	0.00	3690.
1.01	13.00	13	2.10	2.00	.10	809.	1.02	19.00	43	0.00	0.00	0.00	3274.
1.01	14.00	14	2.52	2.42	.10	1418.	1.02	20.00	44	0.00	0.00	0.00	2906.
1.01	15.00	15	3.16	3.06	.10	2479.	1.02	21.00	45	0.00	0.00	0.00	2581.
1.01	16.00	16	7.99	7.89	.10	4348.	1.02	22.00	46	0.00	0.00	0.00	2293.
1.01	17.00	17	2.94	2.84	.10	7239.	1.02	23.00	47	0.00	0.00	0.00	2038.
1.01	18.00	18	2.31	2.21	.10	10931.	1.03	0.00	48	0.00	0.00	0.00	1813.
1.01	19.00	19	.17	.07	.10	15038.	1.03	1.00	49	0.00	0.00	0.00	1613.
1.01	20.00	20	.17	.07	.10	19142.	1.03	2.00	50	0.00	0.00	0.00	1437.
1.01	21.00	21	.17	.07	.10	22806.	1.03	3.00	51	0.00	0.00	0.00	1281.
1.01	22.00	22	.17	.07	.10	25572.	1.03	4.00	52	0.00	0.00	0.00	1143.
1.01	23.00	23	.17	.07	.10	27143.	1.03	5.00	53	0.00	0.00	0.00	1021.
1.02	0.00	24	.17	.07	.10	27457.	1.03	6.00	54	0.00	0.00	0.00	914.
1.02	1.00	25	0.00	0.00	0.00	26544.	1.03	7.00	55	0.00	0.00	0.00	818.
1.02	2.00	26	0.00	0.00	0.00	24635.	1.03	8.00	56	0.00	0.00	0.00	734.
1.02	3.00	27	0.00	0.00	0.00	22265.	1.03	9.00	57	0.00	0.00	0.00	657.
1.02	4.00	28	0.00	0.00	0.00	19878.	1.03	10.00	58	0.00	0.00	0.00	589.
1.02	5.00	29	0.00	0.00	0.00	17674.	1.03	11.00	59	0.00	0.00	0.00	529.
1.02	6.00	30	0.00	0.00	0.00	15703.	1.03	12.00	60	0.00	0.00	0.00	476.
									SUM	24.57	21.88	2.69	412803.
										(624.)	(556.)	(68.)	(11689.28)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	27457.	25648.	15322.	6875.	412524.
CMS	777.	726.	434.	195.	11681.
INCHES		8.20	19.59	21.98	21.98
MM		208.25	497.62	558.25	558.25
AC-FT		127186.	303904.	34093.	34093.
THOUS CU M		15687.	37486.	42053.	42053.

HYDROGRAPH AT STA A1 FOR PLAN 1, RTIO 1

9.	9.	9.	9.	9.	9.	9.	10.	13.	21.
33.	50.	81.	142.	248.	435.	724.	1093.	1504.	1914.
2281.	2557.	2714.	2746.	2654.	2464.	2227.	1988.	1767.	1570.
1394.	1236.	1096.	970.	859.	761.	674.	597.	529.	469.
416.	369.	327.	291.	258.	229.	204.	181.	161.	144.
128.	114.	102.	91.	82.	73.	66.	59.	53.	48.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2746.	2565.	1532.	688.	41252.

CMS	78.	73.	43.	19.	116R.
INCHES		.82	1.96	2.20	2.20
MM		20.82	49.76	55.83	55.83
AC-FT		1272.	3039.	3409.	3409.
THOUS CU M		1569.	3749.	4205.	4205.

HYDROGRAPH AT STA A1 FOR PLAN 1, RTIO 2

22.	22.	22.	22.	22.	22.	22.	24.	34.	53.
83.	126.	202.	355.	620.	1087.	1810.	2733.	3759.	4786.
5702.	6393.	6786.	6864.	6636.	6159.	5566.	4969.	4418.	3926.
3485.	3091.	2739.	2426.	2148.	1903.	1685.	1493.	1323.	1173.
1040.	923.	819.	727.	645.	573.	509.	453.	403.	359.
320.	286.	255.	228.	205.	183.	164.	147.	132.	119.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6864.	6412.	3830.	1719.	103131.
CMS	194.	182.	108.	49.	2920.
INCHES		2.05	4.90	5.49	5.49
MM		52.06	124.41	139.56	139.56
AC-FT		3179.	7598.	8523.	8523.
THOUS CU M		3922.	9371.	10513.	10513.

HYDROGRAPH AT STA A1 FOR PLAN 1, RTIO 3

44.	44.	44.	44.	44.	44.	44.	49.	67.	106.
166.	251.	405.	709.	1239.	2173.	3619.	5466.	7519.	9571.
11403.	12786.	13571.	13729.	13272.	12318.	11133.	9939.	8837.	7851.
6970.	6182.	5478.	4852.	4296.	3805.	3371.	2987.	2647.	2346.
2080.	1845.	1637.	1453.	1290.	1146.	1019.	906.	807.	719.
641.	572.	511.	457.	409.	367.	329.	295.	265.	238.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13729.	12824.	7661.	3438.	206262.
CMS	389.	363.	217.	97.	5841.
INCHES		4.10	9.80	10.99	10.99
MM		104.12	248.81	279.13	279.13
AC-FT		6359.	15195.	17046.	17046.
THOUS CU M		7844.	18743.	21026.	21026.

*
PLAN 2 SAME AS PLAN 1

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HYDROGRAPH ROUTING

ROUTE INFLOW HYDROGRAPH THROUGH WASHINGTON FORGE POND

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A2	1	0	0	0	1	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	59.	-1

STAGE	632.40	639.00	640.00	641.00	642.30	643.00	644.00	646.00	648.00
FLOW	0.00	0.00	201.00	569.00	1207.00	2393.00	5613.00	15923.00	30750.00
CAPACITY=	10.	53.	63.	96.	129.	179.	230.		
ELEVATION=	632.	639.	640.	642.	644.	646.	648.		

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
639.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
642.3	0.0	0.0	0.

STATION A2, PLAN 2, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

40.	43.	44.	44.	44.	44.	44.	46.	57.	84.
131.	202.	332.	563.	1044.	2026.	3503.	5318.	7413.	9439.
11315.	12711.	13548.	13730.	13319.	12381.	11207.	10006.	8900.	7905.
7020.	6225.	5520.	4900.	4331.	3842.	3399.	3015.	2669.	2370.
2124.	1871.	1667.	1476.	1313.	1175.	1067.	945.	841.	749.
668.	596.	536.	482.	431.	387.	347.	311.	279.	251.

STORAGE

55.	55.	55.	55.	55.	55.	55.	55.	56.	57.
60.	63.	68.	77.	91.	105.	116.	127.	138.	148.
157.	163.	167.	168.	166.	162.	156.	150.	145.	140.
136.	132.	128.	125.	121.	118.	116.	113.	111.	109.
107.	104.	101.	99.	97.	95.	92.	88.	85.	83.
80.	78.	76.	74.	72.	70.	69.	67.	66.	65.

STAGE

639.2	639.2	639.2	639.2	639.2	639.2	639.2	639.2	639.3	639.4
639.7	640.0	640.4	641.0	642.0	642.8	643.3	643.9	644.3	644.7
645.1	645.4	645.5	645.6	645.5	645.3	645.1	644.9	644.6	644.4
644.3	644.1	644.0	643.8	643.6	643.4	643.3	643.2	643.1	643.0
642.8	642.7	642.6	642.5	642.4	642.2	642.0	641.8	641.6	641.4
641.2	641.1	640.9	640.8	640.6	640.5	640.4	640.3	640.2	640.1

PEAK OUTFLOW IS 13730. AT TIME 24.00 HOURS

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME

CFS	13730.	12825.	7659.	3436.	206141.
CMS	389.	363.	217.	97.	5837.
INCHES		4.10	9.79	10.98	10.98
MM		104.13	248.75	278.96	278.96
AC-FT		6359.	15191.	17036.	17036.
THOUS CU M		7844.	18738.	21014.	21014.

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HYDROGRAPH ROUTING

CHANNEL ROUTING -MOD PULS- REACH 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A3	1	0	0	0	1	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVT	ELMAX	ALNTH	SEL
.0100	.0400	.0400	628.0	648.0	100.	.03000

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

0.00	648.00	0.00	638.00	0.00	628.00	30.00	628.00	60.00	628.00
63.00	631.00	803.00	640.00	1083.00	648.00				

STORAGE	0.00	.15	.30	.45	.70	1.10	1.66	2.37	3.23	4.25
	5.41	6.73	8.21	9.83	11.61	13.54	15.62	17.86	20.25	22.79
OUTFLOW	0.00	416.18	1305.35	2543.31	4306.56	7002.42	10961.26	16462.36	23757.51	33080.10
	44735.45	58973.60	75925.96	95788.73	118751.46	144997.90	174706.63	208051.66	245202.83	286326.20
STAGE	628.00	629.05	630.11	631.16	632.21	633.26	634.32	635.37	636.42	637.47
	638.53	639.58	640.63	641.68	642.74	643.79	644.84	645.89	646.95	648.00
FLOW	0.00	416.18	1305.35	2543.31	4306.56	7002.42	10961.26	16462.36	23757.51	33080.10
	44735.45	58973.60	75925.96	95788.73	118751.46	144997.90	174706.63	208051.66	245202.83	286326.20

STATION A3, PLAN 2, RTIO 3

OUTFLOW

40.	43.	44.	44.	44.	44.	44.	46.	57.	83.
131.	201.	331.	563.	1043.	2024.	3500.	5314.	7409.	9437.
11311.	12710.	13547.	13731.	13319.	12384.	11208.	10009.	8901.	7908.
7021.	6228.	5520.	4902.	4331.	3844.	3399.	3016.	2669.	2372.
2124.	1873.	1667.	1477.	1312.	1177.	1066.	946.	840.	751.
667.	597.	535.	483.	430.	388.	346.	312.	278.	252.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
2.	2.	2.	2.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

628.1	628.1	628.1	628.1	628.1	628.1	628.1	628.1	628.1	628.2
628.3	628.5	628.8	629.2	629.8	630.7	631.7	632.6	633.4	633.9
634.4	634.7	634.8	634.8	634.8	634.6	634.4	634.1	633.8	633.5
633.3	633.0	632.7	632.4	632.2	631.9	631.7	631.4	631.2	631.0
630.8	630.6	630.4	630.3	630.1	630.0	629.8	629.7	629.6	629.4
629.3	629.3	629.2	629.1	629.1	629.0	628.9	628.8	628.7	628.6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13731.	12825.	7659.	3436.	206140.
CMS	389.	363.	217.	97.	5837.
INCHES		4.10	9.79	10.98	10.98
MM		104.13	248.75	278.96	278.96
AC-FT		6359.	15191.	17036.	17036.
THOUS CU M		7844.	18738.	21014.	21014.

MAXIMUM STORAGE = 2.

MAXIMUM STAGE IS 634.8

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HYDROGRAPH ROUTING

CHANNEL ROUTING -MOD PULS- MAIN STREET BRIDGE

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A4	1	0	0	0	1	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0150	.0400	.0150	626.5	646.5	50.	.03000

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

0.00 646.50 0.00 636.50 0.00 626.50 25.00 626.50 50.00 626.50
50.00 634.00 410.00 640.00 800.00 646.50

STORAGE	0.00	.06	.12	.18	.24	.30	.36	.42	.51	.68
	.92	1.24	1.63	2.10	2.65	3.27	3.97	4.75	5.60	6.53
OUTFLOW	0.00	341.86	1057.04	2025.57	3192.65	4522.91	5990.84	7576.93	9612.96	13253.48
	19582.47	29460.78	43565.22	62569.03	87100.30	117752.23	155089.82	199654.66	251968.35	312535.25
STAGE	626.50	627.55	628.61	629.66	630.71	631.76	632.82	633.87	634.92	635.97
	637.03	638.08	639.13	640.18	641.24	642.29	643.34	644.39	645.45	646.50
FLOW	0.00	341.86	1057.04	2025.57	3192.65	4522.91	5990.84	7576.93	9612.96	13253.48
	19582.47	29460.78	43565.22	62569.03	87100.30	117752.23	155089.82	199654.66	251968.35	312535.25

STATION A4, PLAN 2, RTIO 3

OUTFLOW

40.	43.	44.	44.	44.	44.	44.	46.	57.	83.
131.	201.	331.	563.	1042.	2024.	3499.	5313.	7407.	9436.
11310.	12709.	13546.	13732.	13319.	12385.	11208.	10010.	8901.	7909.
7021.	6228.	5520.	4903.	4331.	3844.	3399.	3017.	2669.	2372.
2124.	1873.	1666.	1478.	1312.	1177.	1066.	947.	840.	751.
666.	597.	535.	484.	430.	388.	345.	312.	278.	252.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

626.6	626.6	626.6	626.6	626.6	626.6	626.6	626.6	626.7	626.8
626.9	627.1	627.5	627.9	628.6	629.7	631.0	632.3	633.8	634.8
635.4	635.8	636.0	636.1	636.0	635.7	635.4	635.0	634.6	634.0
633.5	633.0	632.5	632.0	631.6	631.2	630.9	630.6	630.2	630.0
629.7	629.5	629.3	629.1	628.9	628.7	628.6	628.4	628.3	628.2
628.0	627.9	627.8	627.8	627.7	627.6	627.6	627.5	627.4	627.3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13732.	12825.	7659.	3436.	206140.
CMS	389.	363.	217.	97.	5837.
INCHES		4.10	9.79	10.98	10.98
MM		104.13	248.75	278.96	278.96
AC-FT		6359.	15191.	17036.	17036.
THOUS CU M		7844.	18738.	21014.	21014.

MAXIMUM STORAGE = 1.

MAXIMUM STAGE IS 636.1

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HYDROGRAPH ROUTING

CHANNEL ROUTING -MOD PULS- REACH 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A5	1	0	0	0	1	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0500	.0400	.0500	624.7	634.7	60.	.03000

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

0.00 634.70 12.00 628.70 212.00 626.70 214.00 624.70 264.00 624.70
266.00 626.70 466.00 630.70 666.00 634.70

STORAGE	0.00	.04	.07	.11	.15	.23	.37	.56	.81	1.08
	1.38	1.69	2.03	2.38	2.75	3.15	3.56	3.99	4.45	4.92
OUTFLOW	0.00	110.45	350.04	687.07	1112.97	1704.75	2591.40	3880.07	5731.01	8217.93
	11227.71	14760.45	18821.41	23418.72	28562.21	34262.85	40532.31	47382.76	54826.72	62876.90
STAGE	624.70	625.23	625.75	626.28	626.81	627.33	627.86	628.38	628.91	629.44
	629.96	630.49	631.02	631.54	632.07	632.59	633.12	633.65	634.17	634.70
FLOW	0.00	110.45	350.04	687.07	1112.97	1704.75	2591.40	3880.07	5731.01	8217.93
	11227.71	14760.45	18821.41	23418.72	28562.21	34262.85	40532.31	47382.76	54826.72	62876.90

11308.	12708.	13545.	13732.	13319.	12386.	11209.	10012.	8902.	7910.
7021.	6230.	5521.	4904.	4331.	3846.	3399.	3018.	2669.	2373.
2124.	1874.	1666.	1478.	1312.	1178.	1065.	947.	840.	751.
666.	598.	535.	484.	430.	389.	345.	313.	277.	252.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	2.	2.	2.	2.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

624.9	624.9	624.9	624.9	624.9	624.9	624.9	624.9	625.0	625.1
625.3	625.4	625.7	626.1	626.7	627.5	628.2	628.8	629.3	629.6
630.0	630.2	630.3	630.3	630.3	630.1	630.0	629.8	629.6	629.4
629.2	629.0	628.9	628.7	628.5	628.4	628.2	628.0	627.9	627.7
627.6	627.4	627.3	627.1	627.0	626.9	626.7	626.6	626.5	626.4
626.2	626.1	626.0	626.0	625.9	625.8	625.7	625.7	625.6	625.5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13732.	12825.	7659.	3436.	206139.
CMS	389.	363.	217.	97.	5837.
INCHES		4.10	9.79	10.98	10.98
MM		104.13	248.75	278.96	278.96
AC-FT		8359.	15191.	17036.	17036.
THOUS CU M		7844.	18738.	21014.	21014.

MAXIMUM STORAGE = 2.

MAXIMUM STAGE IS 630.3

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

HYDROGRAPH ROUTING

CHANNEL ROUTING -MOD PULS- RAILROAD BRIDGE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A6	1	0	0	0	1	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

AD-A087 323 NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/13
NATIONAL DAM SAFETY PROGRAM. WASHINGTON FORGE POND DAM (NJ00341—ETC(U)
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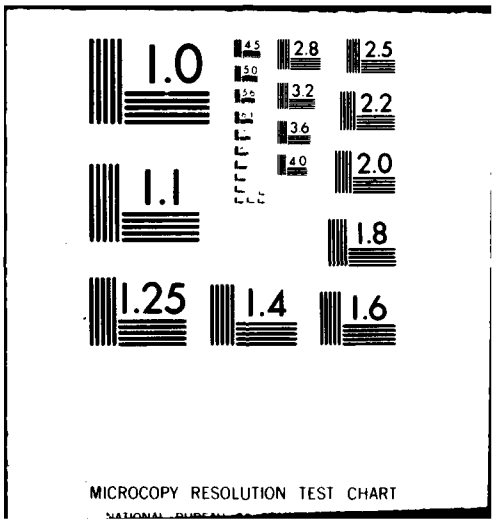
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
MICROCOPY RESOLUTION TEST CHART

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0300	.0400	.0300	623.7	640.7	30.	.03000

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

0.00 640.70 6.00 637.70 206.00 635.70 206.00 623.70 241.00 623.70
241.00 635.70 341.00 637.70 491.00 640.70

STORAGE	0.00	.02	.04	.06	.09	.11	.13	.15	.17	.19
	.22	.24	.26	.28	.32	.43	.62	.85	1.11	1.40
OUTFLOW	0.00	181.47	558.18	1064.47	1670.35	2356.61	3109.57	3918.92	4776.60	5676.14
	6612.27	7580.64	8577.56	9599.95	10644.77	13121.34	17441.43	24357.06	33557.81	45104.48
STAGE	623.70	624.59	625.49	626.38	627.28	628.17	629.07	629.96	630.86	631.75
	632.65	633.54	634.44	635.33	636.23	637.12	638.02	638.91	639.81	640.70
FLOW	0.00	181.47	558.18	1064.47	1670.35	2356.61	3109.57	3918.92	4776.60	5676.14
	6612.27	7580.64	8577.56	9599.95	10644.77	13121.34	17441.43	24357.06	33557.81	45104.48

STATION A6, PLAN 2, RTIO 3

OUTFLOW

40. 43. 44. 44. 44. 44. 44. 46. 57. 83.

131.	281.	330.	562.	1041.	2021.	3495.	5310.	7404.	9433.
11307.	12708.	13545.	13732.	13320.	12387.	11210.	10012.	8902.	7911.
7021.	6230.	5521.	4904.	4332.	3846.	3399.	3018.	2669.	2373.
2124.	1874.	1667.	1478.	1312.	1178.	1065.	947.	840.	751.
666.	598.	535.	484.	430.	389.	345.	313.	277.	252.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

623.9	623.9	623.9	623.9	623.9	623.9	623.9	623.9	624.0	624.1
624.3	624.6	624.9	625.5	626.3	627.7	629.5	631.4	633.4	635.2
636.4	637.0	637.2	637.2	637.2	636.8	636.4	635.6	634.7	633.8
633.0	632.3	631.6	631.0	630.4	629.9	629.4	629.0	628.5	628.2
627.9	627.5	627.3	627.0	626.7	626.6	626.4	626.2	626.0	625.8
625.7	625.6	625.4	625.3	625.2	625.1	625.0	624.9	624.8	624.8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13732.	12825.	7659.	3436.	206139.
CMS	389.	363.	217.	97.	5837.
INCHES		4.10	9.79	10.98	10.98
MM		104.13	248.75	278.96	278.96
AC-FT		6360.	15191.	17036.	17036.
THOUS CU M		7844.	18738.	21014.	21014.

MAXIMUM STORAGE = 0.

MAXIMUM STAGE IS 637.2

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HYDROGRAPH ROUTING

CHANNEL ROUTING -MOD PULS- REACH 3

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A7	1	0	0	0	1	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0400	.0600	608.7	618.7	500.	.03000

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

0.00 618.70 12.00 612.70 212.00 610.70 222.00 608.70 257.00 608.70
267.00 610.70 467.00 614.70 667.00 618.70

STORAGE	0.00	.23	.49	.78	1.11	1.78	2.92	4.54	6.61	8.90
	11.36	13.99	16.78	19.73	22.85	26.14	29.59	33.20	36.99	40.93
OUTFLOW	0.00	79.49	259.91	527.25	890.86	1442.25	2258.13	3426.07	5078.36	7275.46
	9922.34	13018.44	16567.60	20576.13	25051.84	30003.48	35440.48	41372.69	47810.26	54763.58
STAGE	608.70	609.23	609.75	610.28	610.81	611.33	611.86	612.38	612.91	613.44
	613.96	614.48	615.02	615.54	616.07	616.59	617.12	617.65	618.17	618.70
FLOW	0.00	79.49	259.91	527.25	890.86	1442.25	2258.13	3426.07	5078.36	7275.46
	9922.34	13018.44	16567.60	20576.13	25051.84	30003.48	35440.48	41372.69	47810.26	54763.58

STATION A7, PLAN 2, RTIO 3

OUTFLOW

40.	43.	44.	43.	44.	43.	44.	46.	56.	82.
130.	199.	328.	558.	1033.	1998.	3469.	5282.	7379.	9412.
11288.	12697.	13539.	13735.	13325.	12400.	11221.	10025.	8913.	7922.
7031.	6248.	5529.	4913.	4340.	3852.	3407.	3023.	2675.	2377.
2128.	1878.	1670.	1482.	1314.	1180.	1067.	949.	841.	753.
667.	599.	535.	485.	431.	389.	346.	313.	278.	252.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	1.	1.	1.	3.	5.	7.	9.	11.
13.	14.	14.	15.	14.	13.	12.	11.	10.	10.
9.	8.	7.	6.	6.	5.	5.	4.	3.	3.
3.	2.	2.	2.	2.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	0.

STAGE

609.0	609.0	609.0	609.0	609.0	609.0	609.0	609.0	609.1	609.2
609.4	609.6	609.9	610.3	610.7	611.7	612.4	613.0	613.5	613.9
614.2	614.4	614.6	614.6	614.5	614.4	614.2	614.0	613.8	613.6
613.4	613.2	613.0	612.9	612.7	612.5	612.4	612.2	612.0	611.9
611.8	611.6	611.5	611.4	611.2	611.1	611.0	610.9	610.7	610.6
610.5	610.4	610.3	610.2	610.1	610.0	609.9	609.9	609.8	609.7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13735.	12825.	7659.	3436.	206135.
CMS	389.	363.	217.	97.	5837.
INCHES		4.10	9.79	10.98	10.98
MM		104.13	248.74	278.95	278.95
AC-FT		6360.	15191.	17036.	17036.
THOUS CU M		7844.	18737.	21014.	21014.

MAXIMUM STORAGE = 15.

MAXIMUM STAGE IS 614.6

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .25	RATIO 3 .50
HYDROGRAPH AT	A1	29.10	1	2746.	6864.	13729.
		(75.37)		(77.75)(	194.37)(	388.75)(
			2	2746.	6864.	13729.
				(77.75)(	194.37)(	388.75)(
ROUTED TO	A2	29.10	1	2748.	6869.	13739.
		(75.37)		(77.82)(	194.51)(	389.06)(
			2	2751.	6873.	13730.
				(77.90)(	194.63)(	388.80)(
ROUTED TO	A3	29.10	1	2747.	6869.	13740.
		(75.37)		(77.80)(	194.51)(	389.08)(
			2	2751.	6874.	13731.
				(77.89)(	194.65)(	388.83)(
ROUTED TO	A4	29.10	1	2747.	6869.	13741.
		(75.37)		(77.77)(	194.50)(	389.09)(
			2	2750.	6874.	13732.
				(77.87)(	194.65)(	388.84)(
ROUTED TO	A5	29.10	1	2745.	6868.	13741.
		(75.37)		(77.74)(	194.48)(	389.10)(
			2	2750.	6874.	13732.
				(77.86)(	194.65)(	388.85)(
ROUTED TO	A6	29.10	1	2745.	6868.	13741.
		(75.37)		(77.74)(	194.48)(	389.10)(
			2	2750.	6874.	13732.
				(77.86)(	194.65)(	388.85)(
ROUTED TO	A7	29.10	1	2738.	6864.	13743.
		(75.37)		(77.53)(	194.37)(	389.15)(
			2	2746.	6874.	13735.
				(77.77)(	194.66)(	388.92)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	639.00	639.00	642.30
STORAGE	53.	53.	96.
OUTFLOW	0.	0.	1207.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	642.69	.39	104.	2748.	9.62	24.00	19.00
.25	644.01	1.71	129.	6869.	19.00	24.00	17.00
.50	645.26	2.98	161.	13739.	26.00	24.00	16.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	639.00	639.00	642.30
STORAGE	53.	53.	96.
OUTFLOW	0.	0.	1207.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	643.11	1.81	112.	2751.	14.00	24.00	0.00
.25	644.24	1.94	135.	6873.	23.00	24.00	0.00
.50	645.67	3.27	168.	13730.	30.00	24.00	0.00

PLAN 1 STATION A3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2747.	631.3	24.00
.25	6869.	633.2	24.00
.50	13740.	634.8	24.00

PLAN 2 STATION A3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2751.	631.3	24.00
.25	6874.	633.2	24.00
.50	13731.	634.8	24.00

PLAN 1 STATION A4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2747.	630.3	24.00
.25	6869.	633.4	24.00

.50	13741.	636.1	24.00

PLAN 2 STATION A4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2750.	630.3	24.00
.25	6874.	633.4	24.00
.50	13732.	636.1	24.00

PLAN 1 STATION A5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2745.	627.9	24.00
.25	6868.	629.2	24.00
.50	13741.	630.3	24.00

PLAN 2 STATION A5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2750.	627.9	24.00
.25	6874.	629.2	24.00
.50	13732.	630.3	24.00

PLAN 1 STATION A6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2745.	628.6	24.00
.25	6868.	632.9	24.00
.50	13741.	637.2	24.00

PLAN 2 STATION A6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2750.	628.6	24.00
.25	6874.	632.9	24.00
.50	13732.	637.2	24.00

PLAN 1 STATION A7

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2738.	612.1	24.00
.25	6864.	613.3	24.00

.50	13743.	614.6	24.00

PLAN 2 STATION A7

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2746.	612.1	24.00
.25	6874.	613.3	24.00
.50	13735.	614.6	24.00

APPENDIX 5

REFERENCES

WASHINGTON FORGE POND DAM

APPENDIX 5

REFERENCES

WASHINGTON FORGE POND DAM

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