

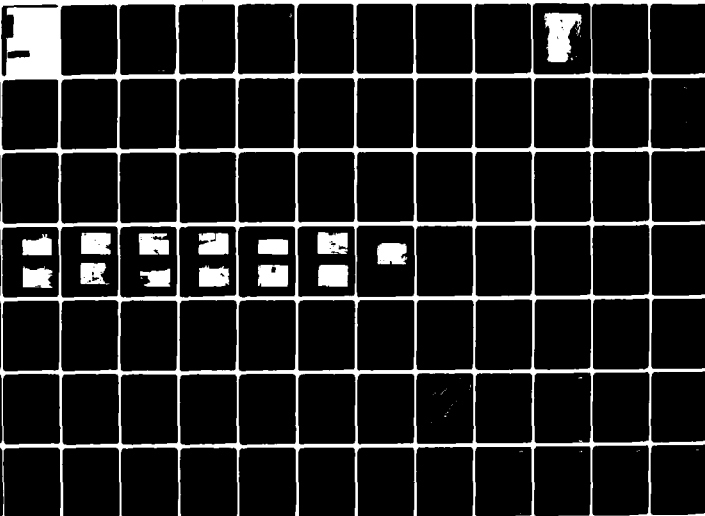
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NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/13  
NATIONAL DAM SAFETY PROGRAM. LAKE WANDA DAM (NJ00510), HUDSON R--ETC(U)  
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PHILADELPHIA, PENNSYLVANIA 19106

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ELECTE  
AUG 6 1980  
D

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

28 JUL 1980

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Wanda Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Wanda Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's three spillways are considered inadequate because a flow equivalent to five percent of the One Hundred Year Flood would cause the dam to be overtopped. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. As the hazard potential classification could change with future development, it is recommended that the classification be reviewed periodically. To ensure the continued functioning of the dam and its impoundment, the following remedial actions could be undertaken by the owner:

a. Retain a professional engineer qualified in the design and construction of dams to accomplish the following:

(1) Evaluate the major seepages, steepness of the downstream slope, and sinkholes on the crest of the dam and design and implement appropriate remedial measures.

(2) Design and implement procedures to rebuild or replace the middle and north spillways with sufficient capacity to prevent overtopping.

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

(4) Design and install erosion protection for the upstream slope.

b. Clear debris from the discharge channels downstream of the three spillways.

NAPEN-N

Honorable Brendan T. Byrne

c. Remove the 30-inch pipes and the fill upstream of the stoplog spillway.

d. Rehabilitate or replace the low-level outlet pipe and operating mechanism.

e. Clear trees and brush from each side of the spillway discharge channels downstream of the three spillways.

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.

This report should prove of value to the dam's owner in that a format for future inspection is provided. Maintenance items, similar to the suggested remedial actions, will periodically develop, requiring attention by the owner.

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

LAKE WANDA DAM (NJ00510)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 7 November 1979 by Anderson-Nichols & Company, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Wanda Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's three spillways are considered inadequate because a flow equivalent to five percent of the One Hundred Year Flood would cause the dam to be overtopped. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. As the hazard potential classification could change with future development, it is recommended that the classification be reviewed periodically. To ensure the continued functioning of the dam and its impoundment, the following remedial actions could be undertaken by the owner:

a. Retain a professional engineer qualified in the design and construction of dams to accomplish the following:

(1) Evaluate the major seepages, steepness of the downstream slope, and sinkholes on the crest of the dam and design and implement appropriate remedial measures.

(2) Design and implement procedures to rebuild or replace the middle and north spillways with sufficient capacity to prevent overtopping.

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

(4) Design and install erosion protection for the upstream slope.

b. Clear debris from the discharge channels downstream of the three spillways.

c. Remove the 30-inch pipes and the fill upstream of the stoplog spillway.

d. Rehabilitate or replace the low-level outlet pipe and operating mechanism.

e. Clear trees and brush from each side of the spillway discharge channels downstream of the three spillways.

APPROVED:

  
JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

DATE:

19 JUN 80

V

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Wanda Dam  
Identification No.: FED ID No. NJ00510  
State Located: New Jersey  
County Located: Sussex  
Stream: Tributary to Wawayanda Creek  
River Basin: Hudson  
Date of Inspection: November 7, 1979

ASSESSMENT OF GENERAL CONDITIONS

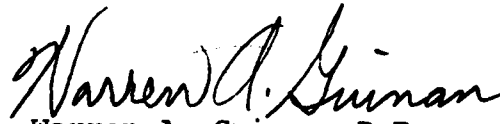
Lake Wanda Dam is an old dam of undetermined age in poor condition. It is small in size and should be downgraded to low hazard from its initial classification of high hazard. The crest of the dam is a grassy footpath with large trees and brush growing on it. There are trees and brush on the upstream and downstream slopes of the dam and in the downstream toe areas. The three spillways are in very poor condition. The concrete at the left and middle spillways is badly cracked and broken. The concrete at the stoplog spillway is surface eroded. There are boulders on the north spillway crest and boulders, logs, and loose soil on the middle spillway crest. Erosion has occurred on the upstream slope at lake level. Large seepages are occurring along the toe of the dam. There is erosion of the soil bank on the north side of the discharge channel immediately downstream of the stoplog spillway. There are logs and debris in the discharge channel of the middle and north spillway. Trees and brush overhang all discharge channels. The three spillways can pass approximately 4 percent of the 100-year storm and are inadequate.

Lake Wanda Dam does not now pose a potential hazard to loss of life and only minimal property damage could occur if it should be breached. However, should the owner wish to maintain the integrity of the embankment he should retain the services of a professional engineer, qualified in the design and construction of dams to accomplish the following as specified. Starting soon: evaluate the major seepages, steepness of the downstream slope, and sinkholes on the crest of the dam and design and implement appropriate remedial measures. Design and implement procedures to rebuild or replace the middle and north spillways. In the near future: specify and oversee procedures for the removal of trees and brush from the embankment and downstream toe of the dam. Design and install erosion protection for the upstream slope. In the future: remove the 36-inch pipes and the fill upstream of the stoplog spillway, Rehabilitate or replace the low-level outlet pipe and operating mechanism.

It is further recommended that the owner accomplish the following tasks as a part of operating and maintenance procedures: starting

in the near future, clear debris from the discharge channels downstream of the three spillways. In the future, clear trees and brush from the sides of each spillway discharge channel downstream of the three spillways.

ANDERSON-NICHOLS & COMPANY, INC.

A handwritten signature in cursive script, reading "Warren A. Guinan".

Warren A. Guinan, P.E.  
Project Manager  
New Jersey No. 16848



7 NOVEMBER 1979

OVERVIEW  
LAKE WANDA DAM

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### PHASE I INSPECTION REPORT NATIONAL DAM SAFETY REPORT

LAKE WANDA DAM N.J. NO. 22-154 FED NO. NJ00510

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## PREFACE

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

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an 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  
LAKE WANDA DAM  
FED ID NO. NJ00510 N.J. NO. 22-154

SECTION 1  
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Lake Wanda Dam was received from the State of New Jersey, Department of Environmental Protection, 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 7 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 Lake Wanda 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. Lake Wanda Dam is a 496 foot long earthfill dam with a hydraulic height of 5.6 feet and a structural height of 6.8 feet. The upstream face of the dam is of earth with a 5H:2V slope except for the far end of the right abutment which is of concrete with vertical slope. The downstream face is of earth with a 6H:7V slope. The crest of the dam is covered by trees and brush with a top width varying between 6.5 feet to 8.0 feet. A 10-foot long concrete free overflow spillway is located on the left (north) end of the dam (north spillway). A 16-foot long concrete free overflow spillway is located in the middle of the dam. Two 3-foot diameter pipes are located on the right (south) side of the dam 6 feet upstream of a 6-foot long stoplog opening. This stoplog section regulates the flow out of the two pipes. A 20-foot long low-level CMP pipe with a diameter of 15 inches is located below the middle spillway. Essential features of the dam are given in Figures 1 and 2.

b. Location. The dam is located in the town of Vernon, Sussex County, New Jersey on a tributary to Wawayanda Creek, approximately 11 miles south of Warwick, New York. It is at north latitude  $41^{\circ} 10.9'$  and west longitude  $74^{\circ} 27.1'$ . A location map is given in Figure 3.

c. Size Classification. Lake Wanda Dam is classified as being small in size on the basis of storage at the dam crest of 186 acre-feet, which is less than 1000 acre-feet but more than 50 acre-feet, and on the basis of its structural height of 6.8 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 showed that failure of Lake Wanda Dam poses no hazard to life and that the possibility of property damage is remote. The lake drains into a swamp with an area equal or greater than the lake area. From the swamp the outlet channel continues through a broad flat area and into Wawayanda Lake, which is approximately 10 times as large as Lake Wanda. Lake Wanda Dam is accordingly classified as Low Hazard.

e. Ownership. According to officials of Vernon Township, Lake Wanda Dam is owned by Mr. Karl Schwarz, Box 13, Montville, New Jersey 07045. Mr. Schwarz's ownership was verified by a conversation with tow of the Lake Wanda residents. A letter was sent to the above address with no response. Mr. Schwarz's phone number is unlisted.

f. Purpose of Dam. The lake is used for recreation.

g. Design and Construction History. No information was revealed regarding the design and construction of the dam.

h. Normal Operational Procedures. No operational procedures were disclosed.

i. Site Geology. No site geologic information (such as borings) was available at the time the dam was inspected. Information derived from a Geologic Map of New Jersey (Lewis & Kummel, 1912) indicates that soils within the immediate site area consist of ground moraine overlying bedrock. Bedrock was observed in sporadic outcrops at the right side of the downstream channel during inspection of this dam. The previously mentioned map indicates that bedrock in this area consists of granitoid gneiss of Precambrian age.

### 1.3 Pertinent Data

#### a. Drainage area

Watershed - 3.48 square miles

Normal water surface - 31 acres

#### b. Discharge at damsite (cfs)

Maximum flood at damsite - unknown

Spillway capacity at top of dam

|                                   |   |           |
|-----------------------------------|---|-----------|
| south spillway (stoplogs removed) | - | 112       |
| south spillway (with stoplogs)    | - | 1         |
| north spillway                    | - | 23        |
| middle spillway                   | - | 4         |
| total spillway capacity           | - | <u>28</u> |

Low-level outlet (if operable) at normal pool elevation - 19

c. Elevation (NGVD)

Top of dam - 1174.8'

Recreation pool - 1174.6'

Spillway crest - north spillway - 1173.9'

middle spillway - 1174.6'

stoplog spillway - top of stoplogs - 1174.7'

-bottom of stoplogs - 1172.7'

d. Reservoir (feet)

Length of maximum pool - 1540

Length of recreational pool - 1530

e. Storage (acre-feet)

Recreational pool - 160

Design surcharge - 298

Top of dam - 184

f. Reservoir Surface (acres)

Top of dam - 33

Recreational pool - 31

g. Dam

Type - earthfill with earthen and concrete upstream face

Length - 496 feet

Height - 5.6 (hydraulics)

6.8 (structural)

Top width - varies, 6.5 to 8 feet

Side slopes - dam: upstream - 5H:2V and vertical  
downstream - 6H:7V and vertical

Zoning - concrete and earthfill upstream and earthfill  
downstream faces

impervious core - unknown

cutoff - unknown

grout curtain - unknown

h. Spillways

North Spillway -

Type - free overflow flat crested concrete capped

Length - 10 feet

Crest elevation - 1173.9' NGVD

Gates - none

Upstream channel - Lake Wanda

Downstream channel - tributary to Wawayanda Creek

Middle Spillway -

Type - free overflow flat crested concrete capped

Length - 16 feet

Crest elevation - 1174.6' NGVD

Gates - 15-inch low-level outlet

Upstream channel - Lake Wanda

Downstream channel - tributary to Wawayanda Creek

Stoplog (south) Spillway -

Type - concrete capped with wooden stoplogs

Length - 6 feet

Crest elevation - 1174.7' NGVD

Gates - stoplogs

Upstream channel - Lake Wanda

Downstream channel - tributary to Wawayanda Creek

i. Regulating Outlets

Type - one 15-inch diameter CMP low-level outlet

Length - 20'

Access - none found

Regulating facilities - not visible

## SECTION 2 ENGINEERING DATA

### 2.1 Design

No plans, hydraulic or hydrologic data for Lake Wanda Dam were revealed.

### 2.2 Construction

No data concerning construction of Lake Wanda Dam were revealed.

### 2.3 Operation

No engineering operational data was unveiled.

### 2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection files revealed no recorded information. Attempts to contact the owner were unsuccessful.

b. Adequacy. Because of lack of available recorded data, evaluation of this dam was based solely on visual inspection.

SECTION 3  
VISUAL INSPECTION

3.1 Findings

a. Dam. Large seepages, estimated to be in the range of 5-100 gallons per minute, are occurring at five locations along the toe of the dam (at 44 feet and 15 feet to the right, and at 60, 160, and 210 feet to the left of the middle spillway). In addition, there is standing water without evidence of flow at one location (120 feet to the left of the middle spillway). Debris has been dumped at the toe of the dam at one location (71 feet to the right of north spillway). The downstream slope of the dam is steep (6H:7V). On the crest of the dam there are three holes (4, 39, and 207 feet to the left of the middle spillway). At one location (21 feet to the right of the north spillway) the downstream edge of the crest is slightly lower than the upstream edge and major seepage is evidenced by the sound of running water heard beneath the crest. Trees and brush are growing on the upstream and downstream slopes of the dam and in the downstream toe area. There appears to be riprap on the upstream slope below the lake level, but there is no riprap at and above lake level. Some erosion has occurred on the upstream slope at lake level.

b. Appurtenant Structures. The level of the middle spillway appears to have been raised by placing logs, boulders, concrete and soil on the upstream side of the spillway crest. The spillway is poorly constructed and in very poor condition. The concrete is badly cracked and broken and there were no visible abutments to the concrete spillway. The concrete at the north spillway is badly cracked and broken. The abutments to this spillway are not defined and the approach channel is filled with rocks. The spillway at the right end of the dam has stoplogs which are backed up with pieces of plywood. The deterioration of the concrete is limited to surface erosion. There are two pipes in the approach channel to this spillway which restrict the flow to the stoplog facility.

c. Reservoir Area. The watershed above the lake is gently to moderately sloping; it is partly built up and partly wooded. There are many homes on the shore of the lake. The reservoir slopes appear to be stable. No evidence of significant sedimentation was observed.

d. Downstream Channel. The entire width of the valley downstream of the dam is low and swampy. At the spillway near the south end of the dam, there is some erosion of the soil bank on the north side of the discharge channel immediately downstream of the spillway, some trees and brush overhang the channel, and there are a few boards and some brush in the channel. At the spillway near the middle of the dam, there are some logs and debris in the discharge channel and trees and brushes overhang the channel. At the spillway at the north end of the dam, there are trees and brush growing in the discharge channel, there is some debris in the channel (lumber, logs, barrels), and trees overhang the channel.

## SECTION 4 OPERATIONAL PROCEDURES

### 4.1 Procedures

No formal operating procedures were revealed.

### 4.2 Maintenance of Dam

No formal maintenance procedures for the dam were revealed.

### 4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were revealed.

### 4.4 Warning System

No description of any warning system was found.

### 4.5 Evaluation of Operational Adequacy

Because of the lack of operational 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. Because no data were revealed an evaluation could not be performed.

b. Experience Data. No experience data were found.

c. Visual Observation. No visual evidence was found of damage to the structure caused by overtopping. At the time of inspection approximately 0.7 foot of water was passing over the north spillway, 1 inch of water over the middle spillway, and 1 inch of water over the stoplog spillway.

d. Overtopping Potential. The hydrologic/hydraulic evaluation for Lake Wanda Dam is based on a selected spillway design flood (SDF) equal to a 100-year flood in accordance with the range of test floods given in the evaluation guidelines for dams classified as low hazard and small in size. The 100-year flood has been determined by application of the SCS dimensionless unit hydrograph procedure to a 12-hour 100-year storm of 6.2 inches. The routed 100-year flood peak discharge for the subject watershed is 949 cfs.

The minimum elevation of the dam allows 0.9 foot of depth in the north spillway, 0.2 foot in the middle spillway and 0.1 foot in the stoplog spillway before overtopping occurs. Under this head the total spillway capacity is 28 cfs, which is less than the selected SDF. Flood routing calculations indicate that Lake Wanda Dam will be overtopped for more than 10 hours to a maximum depth of 1.48 feet under 12 hour, 100-year storm conditions. It is estimated that the spillways can only pass about 4 percent of the 12 hour 100-year flood without allowing overtopping of the dam, thus the spillways are considered inadequate.

e. Drawdown Capability. Assuming that the low-level outlet currently in place can be restored to an operable condition, it is estimated that the lake can be drained in approximately 7.4 days assuming no significant inflow. Because Lake Wanda poses no hazard to life and the possibility of property damage is remote, this time period is considered adequate for draining the reservoir in an emergency condition.

## SECTION 6 STRUCTURAL STABILITY

### 6.1 Visual Observations

Major seepage taking place through the dam could lead to piping and breaching of the dam at any time. The steepness of the downstream slope increases the probability that the seepage could lead to major problems. Holes on the crest of the dam indicate that serious internal erosion of the dam has already occurred. Trees and brush (which may grow to tree-size) on the upstream and downstream slope of the dam and in the downstream toe area can lead to further seepage and erosion problems if a tree blows over and pulls out its roots or if a tree dies or is cut and its roots rot. Erosion on the upstream slope of the dam could lead to breaching of the dam if not controlled. The deteriorated condition of the middle and north spillways and the lack of abutments could lead to breaching of the dam if left uncorrected. 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 of the embankment. It is therefore 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

No record of post-construction changes pertinent to the structural stability of the dam are available.

### 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, 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. Lake Wanda Dam is an old dam of undetermined age and is in poor condition.

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

c. Urgency. Because the dam poses no hazard to life and little hazard to property there is little urgency to implement the recommendations in Sections 7.2 based on safety considerations. Should the owner wish to maintain the dam embankment the recommendations should be implemented as prescribed.

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 failure of the dam. Because the dam is of low hazard no further hydrologic studies are considered necessary.

7.2 Recommendations/Remedial Measures

The owner should retain a professional engineer qualified in the design and construction of dams to accomplish the following in the specified time frame.

Starting soon:

- (1) Evaluate the major seepages, steepness of the downstream slope, and sinkholes on the crest of the dam and design and implement appropriate remedial measures.
- (2) Design and implement procedures to rebuild or replace the middle and north spillways with sufficient capacity to prevent overtopping.

In the near future:

- (1) Specify and oversee procedures for the removal of trees and brush from the embankment and downstream toe of the dam.
- (2) Design and install erosion protection for the upstream slope.

In the future:

- (1) Remove the 30-inch pipes and the fill upstream of the stoplog spillway.
- (2) Rehabilitate or replace the low-level outlet pipe and operating mechanism.

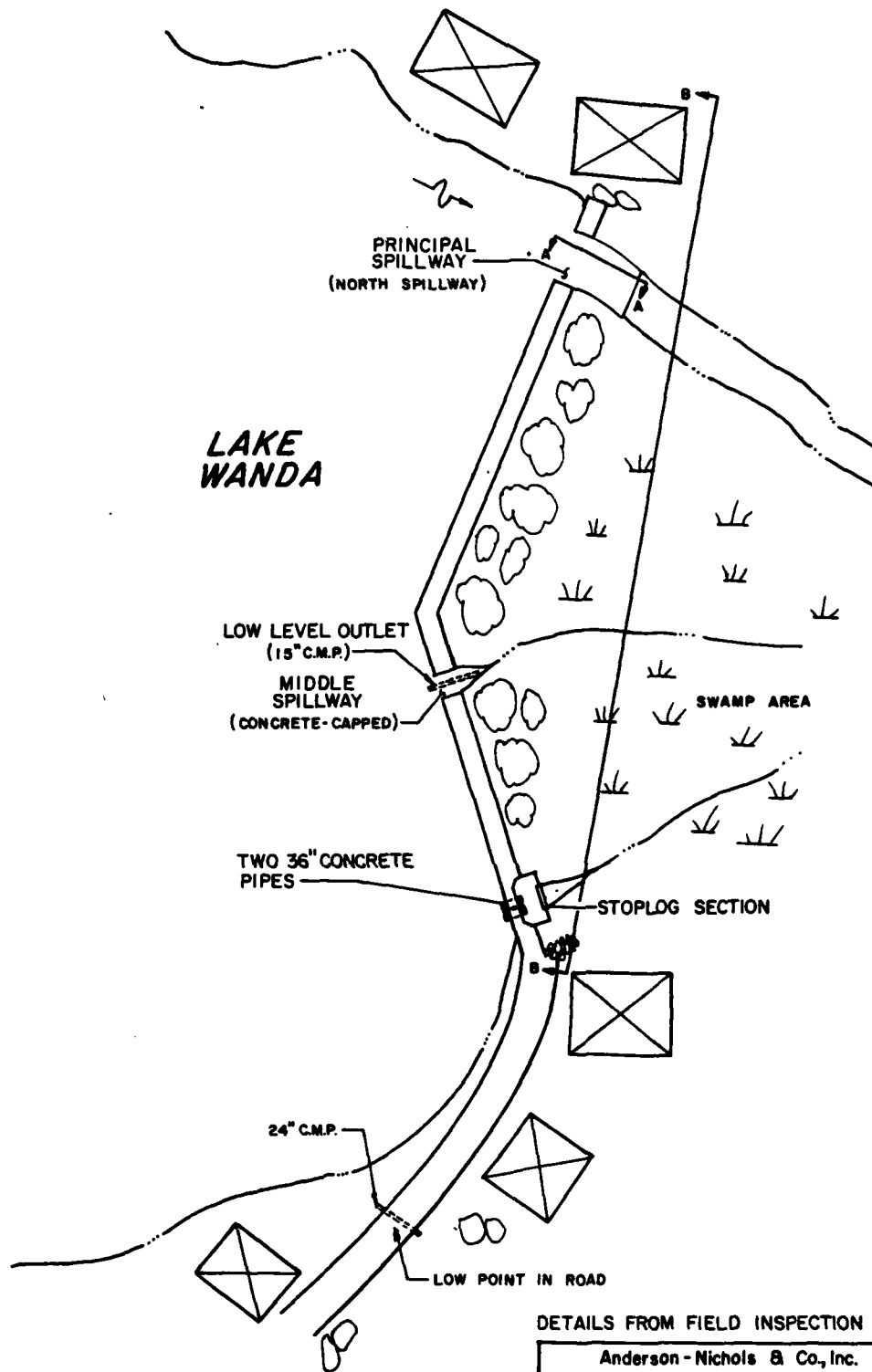
b. Operating and Maintenance Procedures.

The owner should accomplish the following in the near future:

Clear debris from the discharge channels downstream of the three spillways.

The owner should accomplish the following in the future:

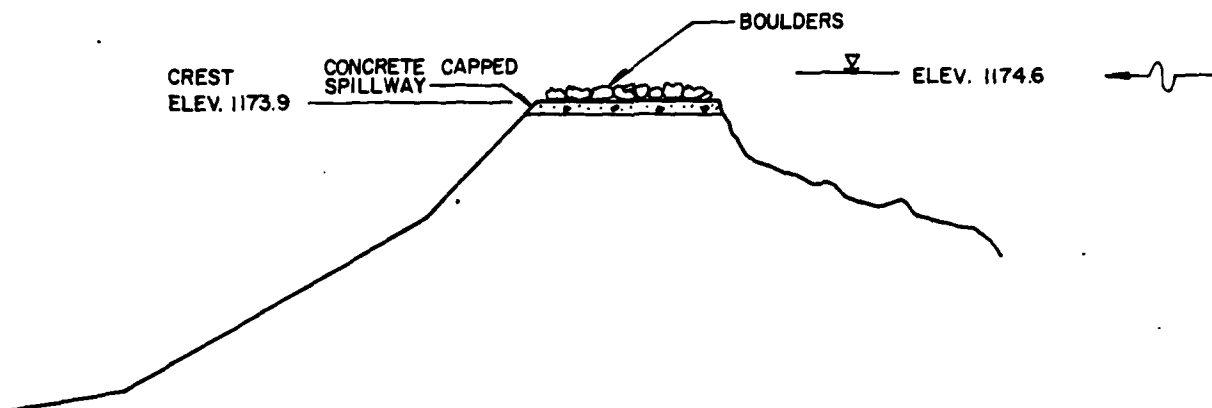
Clear trees and brush from each side of the spillway discharge channels downstream of the three spillways.



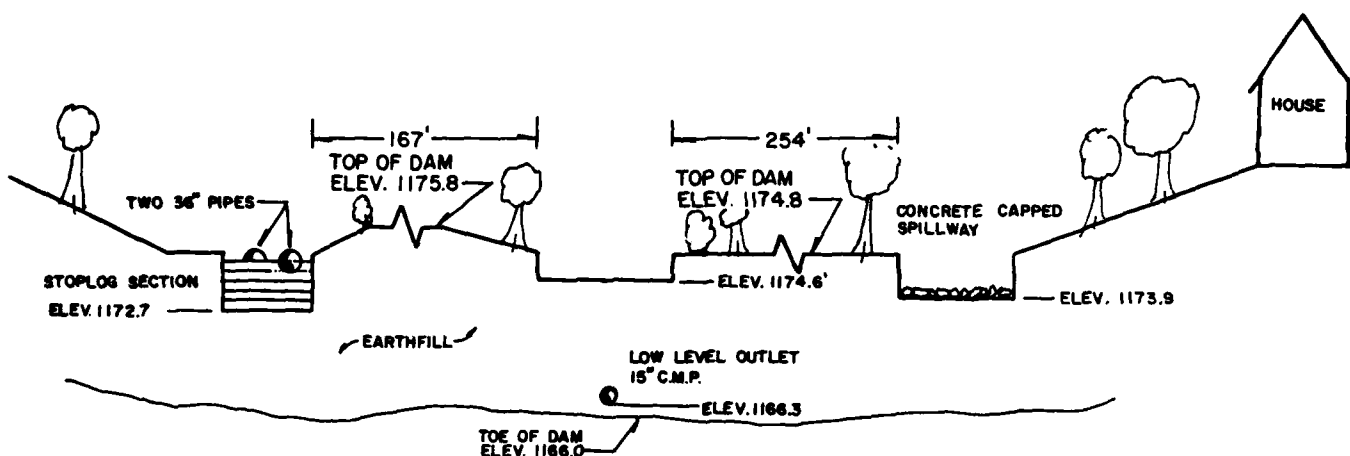
DETAILS FROM FIELD INSPECTION NOV. 7, 1979

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|-------------------------------------------------|--|---------------------------------------|--|
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| NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS |  |                                       |  |
| LAKE WANDA DAM                                  |  |                                       |  |
| TRIB. TO WAWAYANDA CREEK                        |  | NEW JERSEY                            |  |
|                                                 |  | SCALE: NOT TO SCALE                   |  |
|                                                 |  | DATE: FEBRUARY 1980                   |  |

FIGURE 1



## SECTION A-A



## ELEVATION B-B

DETAILS FROM FIELD INSPECTION NOV. 7, 1979

|                                                |  |                                       |  |
|------------------------------------------------|--|---------------------------------------|--|
| Anderson-Nichols & Co., Inc.                   |  | U.S. ARMY ENGINEER DIST. PHILADELPHIA |  |
| CONCORD                                        |  | CORPS OF ENGINEERS                    |  |
| NEW HAMPSHIRE                                  |  | PHILADELPHIA, PA.                     |  |
| NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS |  |                                       |  |
| LAKE WANDA DAM                                 |  |                                       |  |
| TRIB. TO WAWAYANDA CREEK                       |  | NEW JERSEY                            |  |
|                                                |  | SCALE: NOT TO SCALE                   |  |
|                                                |  | DATE: FEBRUARY 1980                   |  |

FIGURE 2



SCALE IN MILES



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

## LAKE WANDA DAM LOCATION MAP

TRIBUTARY TO WAWAYANDA CREEK

NEW JERSEY

SCALE: SEE BAR SCALE

DATE: FEBRUARY 1960

FIGURE -3

Check List  
Visual Inspection  
Phase 1

Name Dam Lake Wanda Dam County Sussex State New Jersey Coordinators NJDEP

Date(s) Inspection Nov. 7, 1979 Weather cool, cloudy Temperature 40° F

Pool Elevation at Time of Inspection 1174.6' NGVD Tailwater at Time of Inspection 1166.5' NGVD

Inspection Personnel:

|                |                          |
|----------------|--------------------------|
| Warren Guinan  | <u>Ronald Hirschfeld</u> |
| Stephen Gilman | <u></u>                  |
| Kenneth Stuart | <u></u>                  |

Gilman/Hirschfeld Recorder

Check List  
Visual Inspection  
Phase 1

Name Dam Lake Warda Dam County Sussex State New Jersey Coordinators NJDEP

Date(s) Inspection Nov. 7, 1979 Weather cool, cloudy Temperature 40° F

Pool Elevation at Time of Inspection 1174.6' NGVD Tailwater at Time of Inspection 1166.5' NGVD

Inspection Personnel:

|                |                          |
|----------------|--------------------------|
| Warren Guinan  | <u>Ronald Hirschfeld</u> |
| Stephen Gilman | <u></u>                  |
| Kenneth Stuart | <u></u>                  |

Gilman/Hirschfeld Recorder

EMBANKMENT

| VISUAL EXAMINATION OF                                       | OBSERVATIONS                                                                                                                                                                                                  | REMARKS OR RECOMMENDATIONS                                   |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| RAILINGS                                                    | None.                                                                                                                                                                                                         |                                                              |
| JUNCTION OF EMBANKMENT<br>AND ABUTMENT, SPILLWAY<br>AND DAM | Sinkhole 6 feet from left side of middle<br>spillway. At other junctions the embank-<br>ment is not in poorer condition than the<br>generally poor condition that it exhibits<br>throughout its total length. | Dam is in need of major rehabilitation<br>or reconstruction. |
| ANY NOTICEABLE SEEPAGE                                      | Major seepages at several locations near<br>toe of dam, up to an estimated 150-200<br>gpm.                                                                                                                    | Dam is in need of major rehabilitation<br>or reconstruction. |
| STAFF GAGE AND RECORDER                                     | None observed.                                                                                                                                                                                                |                                                              |
| DRAINS                                                      | None observed.                                                                                                                                                                                                |                                                              |

EMBANKMENT

| VISUAL EXAMINATION OF                                       | OBSERVATIONS                                                                                                                                                                                                  | REMARKS OR RECOMMENDATIONS                                   |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| RAILINGS                                                    | None.                                                                                                                                                                                                         |                                                              |
| JUNCTION OF EMBANKMENT<br>AND ABUTMENT, SPILLWAY<br>AND DAM | Sinkhole 6 feet from left side of middle<br>spillway. At other junctions the embank-<br>ment is not in poorer condition than the<br>generally poor condition that it exhibits<br>throughout its total length. | Dam is in need of major rehabilitation<br>or reconstruction. |
| ANY NOTICEABLE SEEPAGE                                      | Major seepages at several locations near<br>toe of dam, up to an estimated 150-200<br>gpm.                                                                                                                    | Dam is in need of major rehabilitation<br>or reconstruction. |
| STAFF GAGE AND RECORDER                                     | None observed.                                                                                                                                                                                                |                                                              |
| DRAINS                                                      | None observed.                                                                                                                                                                                                |                                                              |

# OUTLET WORKS AND UNGATED SPILLWAY AT CENTER OF DAM

| VISUAL EXAMINATION OF                                  | OBSERVATIONS                                                                                                                  | REMARKS OR RECOMMENDATIONS                                                                                            |
|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| CRACKING AND SPALLING OF<br>CONCRETE SURFACES OF WEIRS | Concrete is badly cracked and broken.                                                                                         | Spillway is in need of major rehabilitation and reconstruction.                                                       |
| INTAKE STRUCTURE                                       | Visible beneath water is a 2" rusted CMP riser.                                                                               |                                                                                                                       |
| OUTLET PIPE                                            | 15" CMP low-level outlet in downstream channel is badly rusted and deteriorated.                                              | Check functioning of low-level outlet and rehabilitate, or if necessary, replace.                                     |
| OUTLET CHANNEL                                         | Bottom covered with boulders close to spillway structure before channel discharges onto flat, swampy area farther downstream. |                                                                                                                       |
| EMERGENCY GATE                                         | Not visible.                                                                                                                  | Locate and check functioning of low-level outlet gate or valve mechanism. If possible, rehabilitate; if not, replace. |

# OUTLET WORKS AND UNGATED SPILLWAY AT CENTER OF DAM

| VISUAL EXAMINATION OF                                  | OBSERVATIONS                                                                                                                  | REMARKS OR RECOMMENDATIONS                                                                                            |
|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| CRACKING AND SPALLING OF<br>CONCRETE SURFACES OF WEIRS | Concrete is badly cracked and broken.                                                                                         | Spillway is in need of major rehabilitation and reconstruction.                                                       |
| INTAKE STRUCTURE                                       | Visible beneath water is a 2" rusted CMP riser.                                                                               |                                                                                                                       |
| OUTLET PIPE                                            | 15" CMP low-level outlet in downstream channel is badly rusted and deteriorated.                                              | Check functioning of low-level outlet and rehabilitate, or if necessary, replace.                                     |
| OUTLET CHANNEL                                         | Bottom covered with boulders close to spillway structure before channel discharges onto flat, swampy area farther downstream. |                                                                                                                       |
| EMERGENCY GATE                                         | Not visible.                                                                                                                  | Locate and check functioning of low-level outlet gate or valve mechanism. If possible, rehabilitate; if not, replace. |

# RESERVOIR

| VISUAL EXAMINATION OF | OBSERVATIONS                                                                      | REMARKS OR RECOMMENDATIONS |
|-----------------------|-----------------------------------------------------------------------------------|----------------------------|
| SLOPES                | Gently sloping. Mostly occupied by cottages. No evidence of instability observed. |                            |
| SEDIMENTATION         | No evidence of significant sedimentation observed.                                |                            |
|                       |                                                                                   |                            |
|                       |                                                                                   |                            |
|                       |                                                                                   |                            |
|                       |                                                                                   |                            |

# DOWNSTREAM CHANNEL

| VISUAL EXAMINATION OF                         | OBSERVATIONS                                                                                                                | REMARKS OR RECOMMENDATIONS        |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| CONDITION<br>(OBSTRUCTIONS, DEBRIS, ETC.)     | Trees overhang all 3 channels. All are strewn with boulders and have varying amounts of debris such as barrels and timbers. | Clear debris from all 3 channels. |
| SLOPES                                        | Flat and swampy.                                                                                                            |                                   |
| APPROXIMATE NO.<br>OF HOMES AND<br>POPULATION | None.                                                                                                                       | Low hazard.                       |
|                                               |                                                                                                                             |                                   |
|                                               |                                                                                                                             |                                   |

# 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                | None revealed.            |
| REGIONAL VICINITY MAP      | Prepared for this report. |
| CONSTRUCTION HISTORY       | None unveiled.            |
| TYPICAL SECTIONS OF DAM    | None.                     |
| HYDROLOGIC/HYDRAULIC DATA  | None.                     |
| OUTLETS - PLAN             | None.                     |
| - DETAILS                  | None found.               |
| - CONSTRAINTS              | None found.               |
| - DISCHARGE RATINGS        | None found.               |
| RAINFALL/RESERVOIR RECORDS | None found.               |

| ITEM                                                                              | REMARKS        |
|-----------------------------------------------------------------------------------|----------------|
| DESIGN REPORTS                                                                    | None revealed. |
| GEOLOGY REPORTS                                                                   | None revealed. |
| DESIGN COMPUTATIONS<br>HYDROLOGY & HYDRAULICS<br>DAM STABILITY<br>SEEPAGE STUDIES | None found.    |
| MATERIALS INVESTIGATIONS<br>BORING RECORDS<br>LABORATORY<br>FIELD                 | None unveiled. |
| POST-CONSTRUCTION SURVEYS OF DAM                                                  | None revealed. |
| BORROW SOURCES                                                                    | Unknown.       |

| ITEM                                                        | REMARKS |
|-------------------------------------------------------------|---------|
| MONITORING SERVICES                                         | None.   |
| MODIFICATIONS                                               | None.   |
| HIGH POOL RECORDS                                           | None.   |
| POST CONSTRUCTION ENGINEERING<br>STUDIES AND REPORTS        | None.   |
| PRIOR ACCIDENTS OR FAILURE OF DAM<br>DESCRIPTION<br>REPORTS | None.   |
| MAINTENANCE<br>OPERATION<br>RECORDS                         | None.   |

| ITEM | REMARKS |
|------|---------|
|------|---------|

SPILLWAY PLAN

SECTIONS Prepared for this report from field inspection.

DETAILS None.

OPERATING EQUIPMENT

None.

PLANS & DETAILS

None.

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Mountainous, heavy forest, large lake upstream, partly suburban  
ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1174.6' NGVD (160 acre-feet)

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

ELEVATION MAXIMUM DESIGN POOL: 1176.3' NGVD

ELEVATION TOP DAM: 1174.8' NGVD

NORTH SPILLWAY CREST: Free overflow concrete capped spillway

- a. Elevation 1173.9' NGVD
- b. Type concrete weir
- c. Width 2 feet
- d. Length 10 feet
- e. Location Spillover north end of the dam
- f. Number and Type of Gates

MIDDLE SPILLWAY CREST: Free overflow concrete capped spillway

- a. Elevation 1174.6' NGVD
- b. Type concrete weir
- c. Width 3 feet
- d. Length 16 feet
- e. Location Spillover middle of the dam
- f. Number and Type of Gates 15" CMP low-level outlet

STOPLOG SOUTH SPILLWAY CREST: Concrete capped with wooden stoplogs

- a. Elevation 1174.7' (with stoplogs), 1172.7' (without stoplogs)
- b. Type wooden stoplog weir
- c. Width 3 inches
- d. Length 6 feet
- e. Location Spillover south end of the dam
- f. Number and Type of Gates total 2 feet of stoplogs

OUTLET WORKS: One low-level outlet pipe

- a. Type 15" diameter CMP pipe
- b. Location below middle spillway
- c. Entrance Inverts Unknown
- d. Exit Inverts 1166.3' NGVD
- e. Emergency Draindown Facilities (described above)

HYDROMETEOROLOGICAL GAGES: None

- a. Type
- b. Location
- c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 28 cfs

APPENDIX 2

PHOTOGRAPHS

LAKE WANDA DAM



NOVEMBER 7, 1979  
VIEW OF THE CREST OF THE DAM FROM RIGHT  
ABUTMENT LOOKING NORTH.



NOVEMBER 7, 1979  
VIEW OF THE CREST OF THE DAM FROM LEFT  
ABUTMENT LOOKING TOWARD RIGHT ABUTMENT.



NOVEMBER 7, 1979  
FREE OVERFLOW SPILLWAY LOCATED ON THE LEFT  
SIDE OF THE DAM (LEFT SPILLWAY).



NOVEMBER 7, 1979  
MIDDLE SPILLWAY LOOKING FROM LEFT  
ABUTMENT.

LAKE WANDA DAM



NOVEMBER 7, 1979  
VIEW OF THE STOPLOG SPILLWAY LOCATED ON  
THE RIGHT SIDE OF THE DAM.



NOVEMBER 7, 1979  
UPSTREAM FACE OF THE DAM FROM RIGHT  
EMBANKMENT.

LAKE WANDA DAM



NOVEMBER 7, 1979  
FIFTEEN INCH CMP LOW-LEVEL OUTLET  
LOCATED BELOW MIDDLE SPILLWAY.



NOVEMBER 7, 1979  
DOWNSTREAM FACE OF THE MIDDLE SPILLWAY.

LAKE WANDA DAM



NOVEMBER 7, 1979  
VIEW OF THE UPSTREAM RESERVOIR FROM  
THE DAM CREST.



NOVEMBER 7, 1979  
SEEPAGE AT THE DOWNSTREAM TOE OF THE  
DAM ABOUT 45 FEET TO THE RIGHT OF THE  
MIDDLE SPILLWAY.

LAKE WANDA DAM



NOVEMBER 7, 1979  
DOWNSTREAM CHANNEL OF LEFT SPILLWAY.



NOVEMBER 7, 1979  
DOWNSTREAM CHANNEL OF MIDDLE SPILLWAY.

LAKE WANDA DAM



NOVEMBER 7, 1979  
DOWNSTREAM CHANNEL OF STOPLOG SPILLWAY.

APPENDIX 3  
HYDROLOGIC COMPUTATIONS

LAKE WANDA DAM

JOB NO. 3409-13SQUARES  
1/4 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

HYDROLOGIC COMPUTATIONS

NAME : LAKE WANDA DAM

LOCATION : SUSSEX COUNTY, N. J.

DRAINAGE AREA : 3.48 mi<sup>2</sup>

SURFACE AREA : 31 acres

EVALUATION CRITERIA: SIZE - SMALL

HAZARD - LOW

SPILLWAY DESIGN FLOOD: BASED ON SIZE  
AND HAZARD CLASSIFICATION, THE SPILLWAY  
DESIGN FLOOD WILL BE THE 12 HOUR 100-YEAR  
STORM, WITH A PEAK INFLOW OF 1430  
CFS.

NOTE: DRAINAGE AREA AND SURFACE AREA OF  
LAKE WANDA WERE PLANIMETERED  
OFF U.S.G.S. QUAD SHEETS.

JOB NO. 3409-13SQUARES  
1/4 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

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
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28  
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30  
31  
32  
33  
34  
35  
36  
37  
38

HIGHLAND LAKE IS LOCATED WITHIN THE LAKE WANDA WATERSHED WITH A DRAINAGE AREA OF  $2.28 \text{ mi}^2$  OF THE  $3.48 \text{ mi}^2$  TOTAL DRAINAGE AREA. 100-YEAR PRECIPITATION DATA WAS USED TO DEVELOPE THE INFLOW HYDROGRAPH INTO HIGHLAND LAKE. THE INFLOW HYDROGRAPH WAS ROUTED THROUGH HIGHLAND LAKE TO DETERMINE THE OUTFLOW HYDROGRAPH. THIS OUTFLOW HYDROGRAPH WAS COMBINED WITH THE INFLOW HYDROGRAPH FROM LAKE WANDA DRAINAGE AREA. THE COMBINED HYDROGRAPH WAS THEN ROUTED TROUGH LAKE WANDA TO DETERMINE THE OUTFLOW.

JOB NO. 3409-13SQUARES  
1/4 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

DURING VISUAL INSPECTION, IT WAS DECIDED THAT LAKE WANDA IS A LOW-HAZARD DAM DUE TO EXISTENCE OF STORAGE AREA D/S (SWAMPS) AND BECAUSE THERE ARE NO STRUCTURES.

100-YEAR FLOOD DISCHARGE WAS CALCULATED USING STANKOWSKI'S REGRESSION EQUATION FOR NEW JERSEY (100-YEAR FLOOD = 200 CFS). THE CAPACITY OF SPILLWAYS AT TOP OF DAM ELEVATION (MAXIMUM SPILLWAY CAPACITY) IS ABOUT 28 CFS.

IT WAS THEREFORE DECIDED TO USE THE 100-YEAR FLOOD AS SPILLWAY DESIGN FLOOD (SDF).

\*100-YEAR PRECIPITATION DATA FOR 5, 15, 30, 60 min, 1, 2, 3, 6, 12 hrs durations WERE USED TO DEVELOPE THE PRECIPITATION HYETOGRAPH.

| 100-YEAR RAINFALL<br>(INCHES) | DURATION |
|-------------------------------|----------|
| 0.755                         | 5 min    |
| 1.6                           | 15 "     |
| 2.3                           | 30 "     |
| 2.9                           | 60 "     |
| 3.7                           | 2 hrs    |
| 4.2                           | 3 "      |
| 5.2                           | 6 "      |
| 6.2                           | 12 "     |

\* 100-YEAR PRECIPITATION DATA WAS TAKEN FROM "NOAA TECHNICAL MEMORANDUM NWS HYDRO-35" AND "WEATHER BUREAU TECHNICAL PAPER NO. 40".

JOB NO. 3409-13SQUARES  
1/4 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

STANKOWSKI'S EQUATION:

$$Q_{100} = 136 A^{0.84} S^{0.26} S_t^{-0.51} I^{0.14}$$

 $Q_{100}$  = PEAK DISCHARGE FOR 100-YEAR INTERVAL, CFS $A$  = DRAINAGE AREA  $mi^2$  $S$  = MAIN CHANNEL SLOPE FT/MILE $S_t$  = SURFACE STORAGE INDEX $I$  = INDEX OF MANMADE IMPERVIOUS COVER IN %

$$I = 0.117 D^{0.792 - 0.039 \log D}$$

$$1\% \leq I \leq 100\%$$

 $D$  = BASIN POPULATION DENSITY  
IN PERSON/ $mi^2$ 

$$A = 3.48 \text{ } mi^2$$

$$S = \frac{1190 - 1175 \text{ FT}}{2.43 \text{ } mi} = 6.2 \text{ FT}/mi$$

$$S_t = \frac{\text{AREA OF LAKES}}{\text{TOTAL DRAINAGE AREA}}$$

$$\text{AREA OF LAKES} = 325 + 15 + 31 = 371 \text{ } ac$$

$$\frac{371 \text{ } ac}{2227 \text{ } ac} = 0.17 = 17\%$$

$$S_t = 18\%$$

JOB NO. 3409-13SQUARES  
1/4 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

$$D = \frac{2800 \text{ PERSONS}}{3.48 \text{ MI}^2} = 805 \frac{\text{PERSONS}}{\text{MI}^2}$$

$$I = 0.117 (805)^{0.792 - 0.039 \log 805}$$

$$I = 11\%$$

$$Q_{100} = 136 (3.48)^{0.84} (6.2)^{0.26} (18)^{-0.51} (11)^{0.14}$$

$$Q_{100} = 200 \text{ CFS}$$

JOB NO. 3409-13SQUARES  
1/4 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

12 HOUR 100-YEAR RAINFALL DISTRIBUTION:NO. OF POINTSINCHES OF RAINFALL

|    |       |
|----|-------|
| 36 | 0.014 |
| 18 | 0.028 |
| 6  | 0.042 |
| 6  | 0.067 |
| 3  | 0.1   |
| 1  | 0.23  |
| 1  | 0.423 |
| 1  | 0.755 |
| 1  | 0.423 |
| 1  | 0.24  |
| 1  | 0.23  |
| 3  | 0.1   |
| 6  | 0.067 |
| 6  | 0.042 |
| 18 | 0.028 |
| 36 | 0.014 |

TOTAL = 6.225  $\approx$  6.2 INCHES

JOB NO. 3409-13

SQUARES  
1/4 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

HIGHLAND LAKE DAM RATING CURVE

THE RATING CURVE DATA FOR HIGHLAND LAKE  
DAM WAS TAKEN FROM PHASE I INSPECTION  
REPORT OF HIGHLAND LAKE DAM BY LOUIS BERGER  
& ASSOCIATES INC. DATED SEP. 25, 1979.

ELEVATION  
(FT NGVD)DISCHARGE  
(CFS)

1190

0

1191

101

1192

425

1192.5

639

1193

917

1194

1404

1195

3113

1196

5837

1197

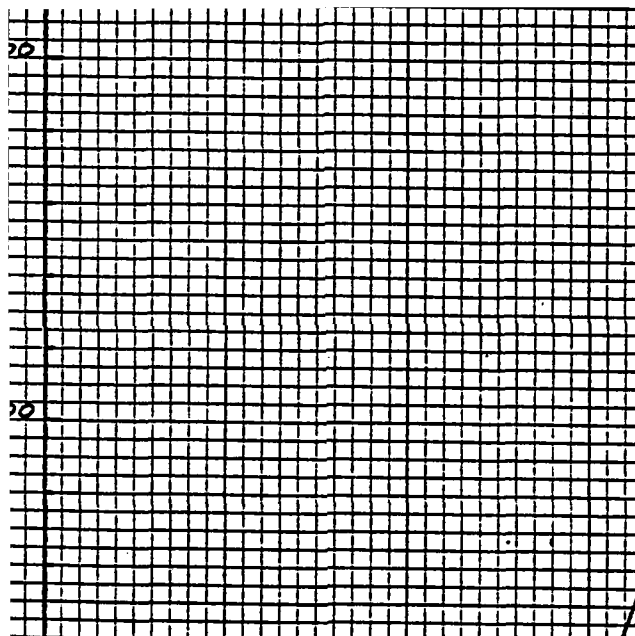
9239

1198

13193

1199

18574



JOB NO. 3409-13SQUARES  
1/4 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

STORAGE-ELEVATION DATA FOR HIGHLAND LAKE

STORAGE-ELEVATION DATA WERE TAKEN FROM  
PHASE I DAM INSPECTION REPORT OF SEP. 1979  
FOR HIGHLAND LAKE DAM, BY LOUIS BERGER &  
ASSOCIATES INC.

| <u>ELEVATION</u><br><u>FT</u><br><u>(NGVD)</u> | <u>STORAGE</u><br><u>AC-FT</u> |
|------------------------------------------------|--------------------------------|
| 1172                                           | 0                              |
| 1190                                           | 1850                           |
| 1191                                           | 2178                           |
| 1192                                           | 2512                           |
| 1192.5                                         | 2675                           |
| 1193                                           | 2852                           |
| 1194                                           | 3199                           |
| 1195                                           | 3551                           |
| 1196                                           | 3910                           |
| 1197                                           | 4274                           |
| 1198                                           | 4645                           |
| 1199                                           | 5022                           |

A7

HIGHLAND LAKE DAM

STAGE STORAGE CURVE

Surcharge storage  
(acre feet)

3,000

2,000

1,000

Height (in feet) above spillway crest

3-10

46 0706

16 X 10 TO THE INCH .7 X 10 INCHES  
KUPPEL & ESSER CO. MADE IN U.S.A.

KSE

JOB NO. 3409-13SQUARES  
1/4 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

TIME OF CONCENTRATION DETERMINATION1- SCS TR # 55 METHODa) OVERLAND FLOW (WOODED)

$$\text{LENGTH} = 2700 \text{ FT}$$

$$\text{HEAD} = 1440 - 1295 = 145 \text{ FT}$$

$$\text{SLOPE} = \frac{145 \text{ FT}}{2700 \text{ FT}} = 0.054 = 5.4\%$$

FROM FIG. 3-1, PAGE 3-2

$$\text{VELOCITY} = 0.59 \text{ FT/SEC}$$

$$T_c = \frac{2700 \text{ FT}}{0.59 \text{ FT/SEC}} = 4576 \text{ SEC} = 76 \text{ MIN}$$

b) CHANNEL FLOW (DEVELOPED)

$$\text{LENGTH} = 4550 \text{ FT}$$

$$\text{HEAD} = 1295 - 1200 = 95 \text{ FT}$$

$$\text{SLOPE} = \frac{95 \text{ FT}}{4550 \text{ FT}} = 0.021 = 2.1\%$$

HYDRAULIC RADIUS = 0.83  
(ASSUME A 10'x1' RECTANGULAR CHANNEL)

USE MANNING'S EQUATION

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

JOB NO. 3409-13SQUARES  
1/4 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

$$\text{WHERE } n^* = 0.04$$

$$V = \frac{1.49}{0.04} (0.83)^{2/3} (0.021)^{1/2} = 4.8 \text{ FT/sec}$$

$$T_c = \frac{4550 \text{ FT}}{4.8 \text{ FT/sec}} = 948 \text{ sec} = 15.8 \text{ Min} \approx 16$$

$$\text{TOTAL } T_c = 76 + 16 = 92 \text{ Min}$$

2 - SOIL & WATER CONSERVATION ENGINEERING.

$$L = 0.6 T_c$$

$$L = \frac{e^{0.8} (S+1)^{1.67}}{9000 Y^{0.5}}$$

$$S = \frac{1000}{CN} - 1.0$$

DETERMINE THE WEIGHTED CN:

| LAND USE  | PERCENT    | CURVE<br>NUMBER | PRODUCT     |
|-----------|------------|-----------------|-------------|
| WOODS     | 70         | 70              | 4900        |
| DEVELOPED | 30         | 90              | 2700        |
|           | <u>100</u> |                 | <u>7600</u> |

$$\text{WEIGHTED CN} = \frac{7600}{100} = 76$$

\* "n" VALUE WAS TAKEN FROM "OPEN CHANNEL HYDRAULICS"  
BY CHOW TABLE 5-6 PAGE 113.

JOB NO. 3409-13SQUARES  
1/4 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

$$S = \frac{1000}{76} - 10 = 3.2$$

$$L = 2700 + 4550 = 7250$$

$$Y = \frac{5.4 + 2.1}{2} = \frac{7.5}{2} = 3.75$$

$$L = \frac{(7250)^{0.8} (3.2 + 1)^{1.67}}{9000 (3.75)^{0.5}} = 0.77 \text{ hrs}$$

$$T_C = \frac{0.77}{0.6} = 1.28 \text{ hrs} = \underline{\underline{77 \text{ min}}}$$

### 3 - TEXAS HIGHWAY VELOCITY DATA (DESIGN OF SMALL DAMS)

#### a) OVERLAND FLOW

$$\text{SLOPE} = 5.4\%$$

$$\text{VELOCITY} = 2 \text{ FT/sec}$$

$$T_C = \frac{2700 \text{ FT}}{2 \text{ FT/sec}} = 1350 \text{ Sec} = 22.5 \text{ Min}$$

#### b) CHANNEL FLOW

$$\text{SLOPE} = 2.1\%$$

$$\text{VELOCITY} = 3 \text{ FT/sec}$$

$$T_C = \frac{4550}{3} = 1517 \text{ Sec} = 25.3 \text{ Sec}$$

$$\text{TOTAL } T_C = 22.5 + 25.3 = 47.8 \approx \underline{\underline{48 \text{ min}}}$$

JOB NO. 3409-13SQUARES  
1/4 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

4 - KERBY METHOD

## a) OVERLAND FLOW

$$T_c = 0.83 \left( \frac{NL}{\sqrt{S}} \right)^{0.467}$$

$$L = 2700 \text{ FT}$$

$$N = 0.6$$

$$S = 0.054$$

$$T_c = 0.83 \left( \frac{(0.6)(2700)}{\sqrt{0.054}} \right)^{0.467} = 52 \text{ Min}$$

## b) CHANNEL FLOW

$$V = \frac{1.49}{0.04} (0.83)^{2/3} (0.021)^{1/2} = 4.8 \text{ FT/sec}$$

$$T_c = \frac{4550}{4.8} = 948 \text{ Sec} = 16 \text{ Min}$$

$$\text{TOTAL } T_c = 52 + 16 = \underline{68 \text{ Min}}$$

$$\text{AVERAGE } T_c = \frac{68 + 92 + 77 + 48}{4} = 71 \text{ Min}$$

$$L = \text{LAG TIME} = 0.6 T_c = 0.6 (71) = 42.6 \text{ Min}$$

$$L = 43 \text{ Min}$$

JOB NO. 3409-13SQUARES  
1/4 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

TIME OF CONCENTRATION DETERMINATION1- SCS TR#55 METHODa) OVERLAND FLOW (WOODS + SWAMPS)

$$\text{LENGTH} = 3800 \text{ FT}$$

$$\text{HEAD} = 1460 - 1178 = 282 \text{ FT}$$

$$\text{SLOPE} = \frac{282 \text{ FT}}{3800 \text{ FT}} = 0.074 = 7.4\%$$

FROM FIG. 3-1, PAGE 3-2

$$\text{VELOCITY} = 0.68 \text{ FT/SEC}$$

$$T_c = \frac{3800 \text{ FT}}{0.68 \text{ FT/SEC}} = 5588 \text{ SEC} = 93 \text{ Min}$$

b) CHANNEL FLOW

$$\text{LENGTH} = 3650 \text{ FT}$$

$$\text{HEAD} = 1178 - 1175 = 4 \text{ FT}$$

$$\text{SLOPE} = \frac{4}{3650} = 0.0011 = 0.11\%$$

$$\text{HYDRAULIC RADIUS} = 0.83$$

(ASSUME A 10'x1' RECTANGULAR CHANNEL)

JOB NO. 3409-13SQUARES  
1/4 IN. SCALE

USE MANNING'S EQUATION

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

$$\text{WHERE } *n = 0.04$$

$$V = \frac{1.49}{0.04} (0.83)^{2/3} (0.0011)^{1/2} = 1.1 \text{ FT/SEC}$$

$$T_c = \frac{3650 \text{ FT}}{1.1 \text{ FT/SEC}} = 3318 \text{ SEC} = 55 \text{ MIN}$$

$$\text{TOTAL } T_c = 93 + 55 = 148 \text{ MIN}$$

2 - SOIL & WATER CONSERVATION ENGINEERING

$$L = 0.6 T_c$$

$$L = \frac{l^{0.8} (S+1)^{1.67}}{9000 y^{0.5}}$$

$$S = \frac{1000}{CN} - 10$$

$$CN = 65$$

\* "n" VALUE WAS TAKEN FROM "OPEN CHANNEL HYDRAULIC" BY CHOW, TABLE 5-6, PAGE 113.

JOB NO. 3409-13SQUARES  
1/4 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

$$S = \frac{1000}{65} - 10 = 5.4$$

$$L = 3800 + 3650 = 7450 \text{ FT}$$

$$Y = \frac{7.4 + 0.11}{2} = 3.75$$

$$L = \frac{(7450)^{0.8} (5.4+1)^{1.67}}{9000 (3.75)^{0.5}} = \frac{27800}{17428} = 1.6 \text{ hrs}$$

$$T_c = \frac{1.6}{0.6} = 2.7 \text{ hrs}$$

$$T_c = 162 \text{ Min}$$

### 3- TEXAS HIGHWAY VELOCITY DATA (DESIGN OF SMALL DAMS)

#### a) OVERLAND FLOW

$$\text{VELOCITY} = 2 \text{ FT/SEC}$$

$$T_c = \frac{3800}{2} = 1900 \text{ SEC} = 32 \text{ Min}$$

#### b) CHANNEL FLOW

$$\text{VELOCITY} = 1 \text{ FT/SEC}$$

$$T_c = \frac{3650}{1} = 3650 \text{ SEC} = 61 \text{ Min}$$

$$\text{TOTAL } T_c = 93 \text{ Min}$$

JOB NO. 3409-13SQUARES  
1/4 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

4- KERBY METHOD

## a) OVERLAND FLOW

$$T_c = 0.83 \left( \frac{NL}{\sqrt{S}} \right)^{0.467}$$

$$L = 3800 \text{ FT.}$$

$$N = 0.6$$

$$S = 0.074$$

$$T_c = 0.83 \left( \frac{(0.6)(3800)}{\sqrt{0.074}} \right)^{0.467}$$

$$T_c = 56 \text{ min}$$

## b) CHANNEL FLOW

$$V = \frac{1.49}{0.04} (0.83)^{2/3} (0.0011)^{1/2} = 1.1 \text{ FT/SEC}$$

$$T_c = \frac{3650}{1.1} = 55 \text{ min}$$

$$\text{TOTAL } T_c = 56 + 55 = 111 \text{ min}$$

$$\text{AVERAGE } T_c = \frac{148 + 162 + 93 + 111}{4}$$

$$\text{AVERAGE } T_c = 128 \text{ min}$$

$$\text{LAG TIME} = L = (128)(0.6) = 77 \text{ min}$$



JOB NO. 3409-13SQUARES  
1/4 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

DEVELOPMENT OF RATING CURVE1 - SPILLWAY CURVE:COMPUTE Q USING WEIR EQUATION  $Q = CLH^{3/2}$   
WHERE $*C = 2.7$  FOR SPILLWAYS2 - TOP OF DAM CURVE:COMPUTE Q USING  $Q = CLH^{3/2}$  WHERE $*C = 2.6$  FOR TOP OF DAM

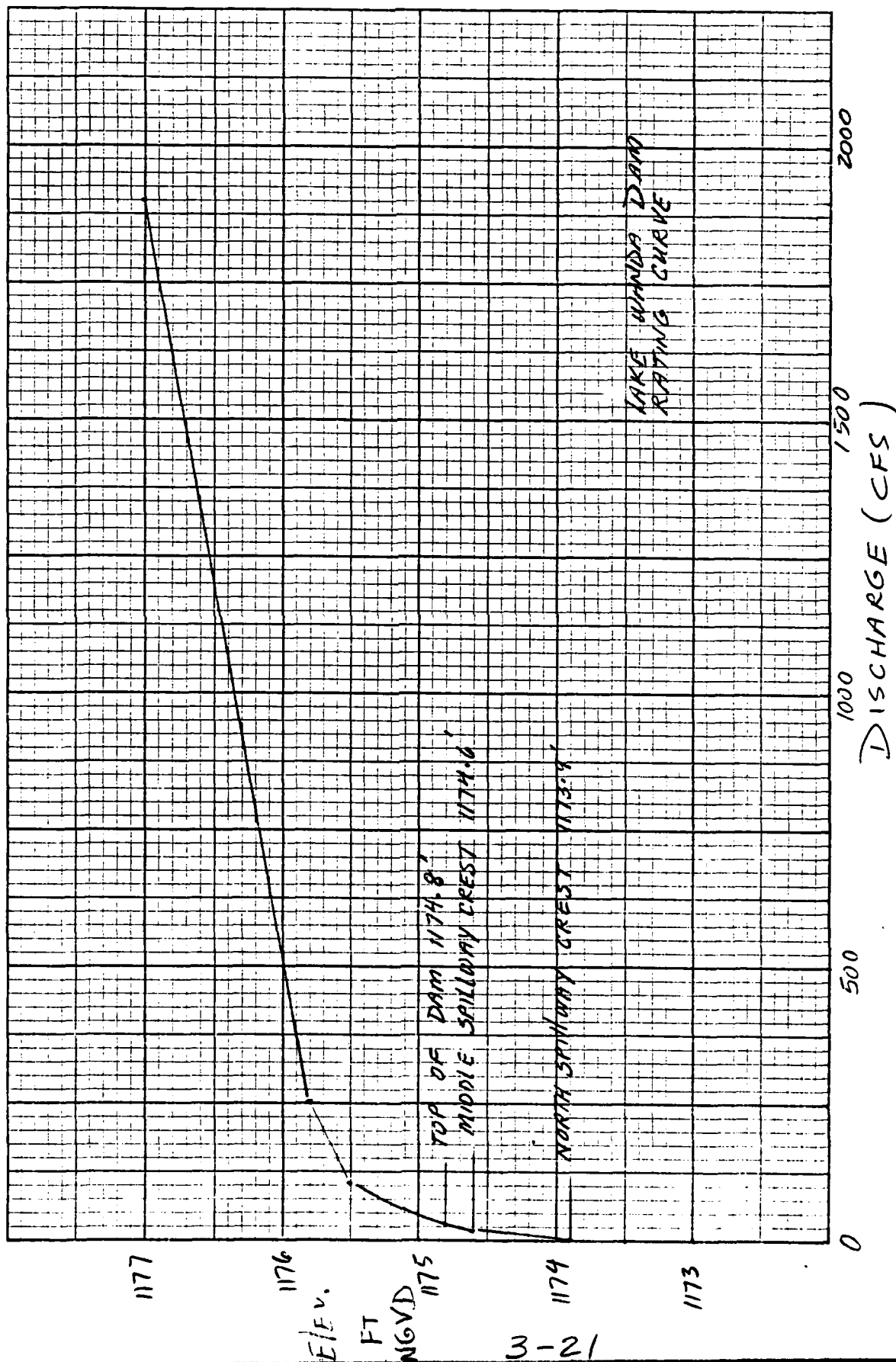
\* "C" VALUES WERE TAKEN FROM BRATER &  
KING "HANDBOOK OF HYDRAULICS".

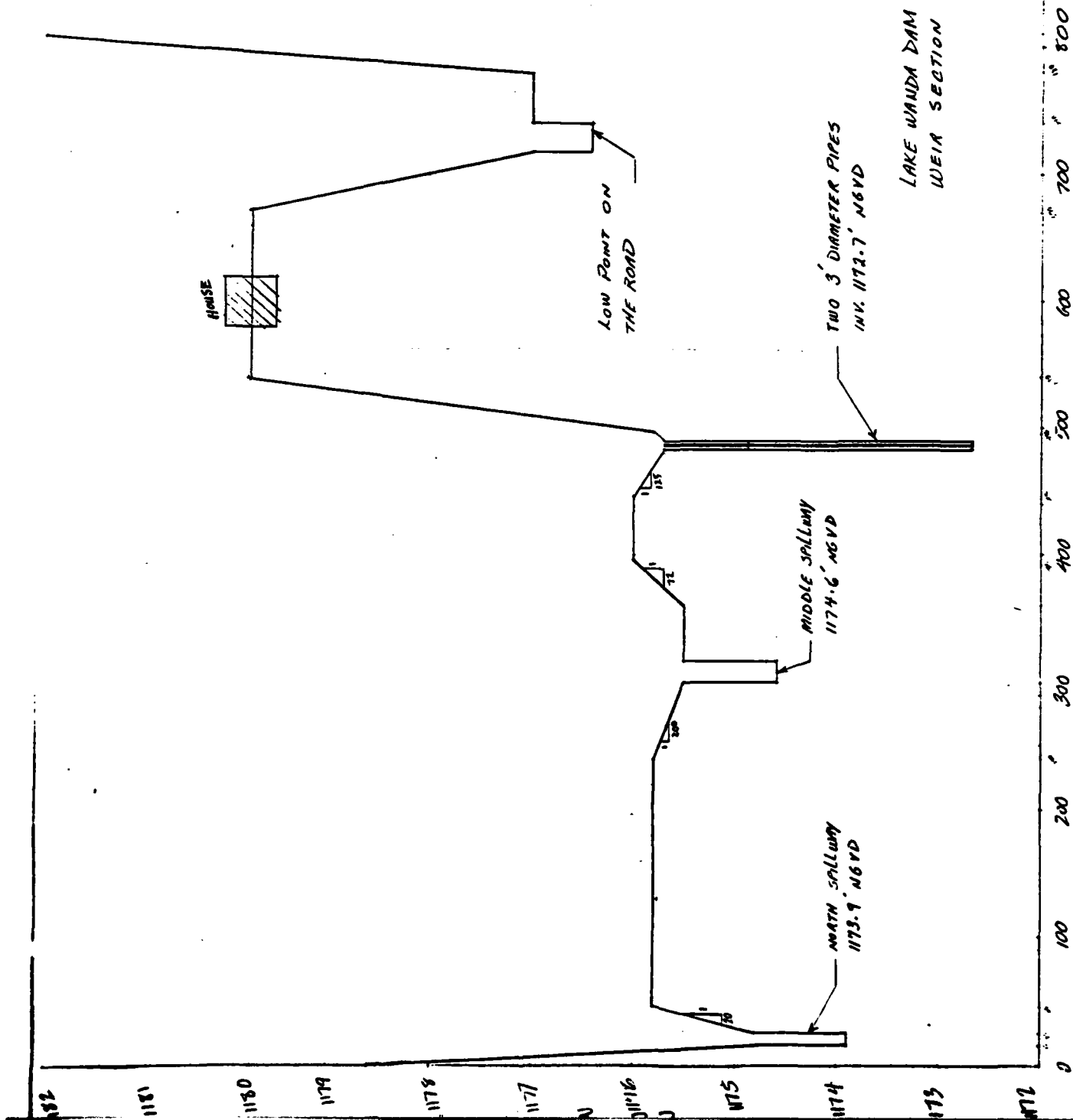
JOB NO. 3409-13SQUARES  
1/4 IN. SCALE

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

1  
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| ELEVATION<br>NGVD | SPILLWAY                |                           | TOTAL<br>SPILLWAY |          | TOP OF DAM |              | COMBINED<br>Q<br>CFS |
|-------------------|-------------------------|---------------------------|-------------------|----------|------------|--------------|----------------------|
|                   | LEFT S.W.<br>HEAD<br>FT | MIDDLE S.W.<br>HEAD<br>FT | Q<br>CFS          | Q<br>CFS | HEAD<br>FT | LENGTH<br>FT |                      |
| 1173.9            | -                       | -                         | -                 | 0        | -          | -            | 0                    |
| 1174.6            | 0.7                     | -                         | 16                | 16       | -          | -            | 16                   |
| 1174.8            | 0.9                     | 0.2                       | 23                | 27       | -          | -            | 27                   |
| 1175.5            | 1.6                     | 0.9                       | 55                | 92       | 0.7        | 14           | 103                  |
| 1175.8            | 1.9                     | 1.4                       | 71                | 143      | 0.41       | 160          | 252                  |
| 1177              | 3.1                     | 2.4                       | 147               | 308      | 1.47       | 407          | 1900                 |





JOB NO. 3409-13SQUARES  
1/4 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

STORAGE - ELEVATION DETERMINATION

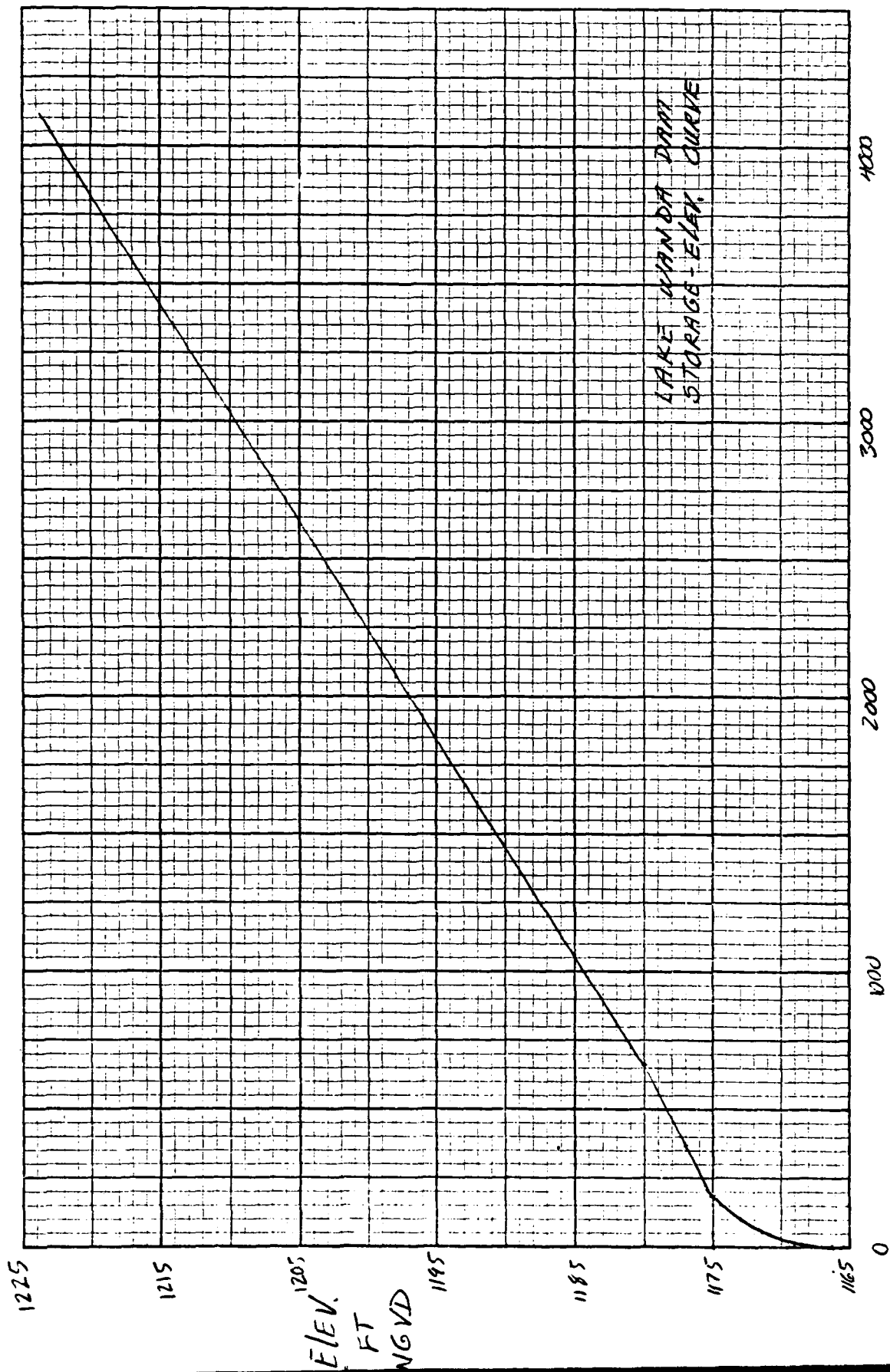
AVERAGE DEPTH OF THE LAKE = 6 FT

MAXIMUM DEPTH OF THE LAKE = 10 FT

| ELEVATION<br>FT | SURFACE<br>AREA<br>AC | AVE. S. A.<br>AC | INCREMENTAL<br>STORAGE<br>AC-FT | CUMULATIVE<br>STORAGE<br>AC-FT |
|-----------------|-----------------------|------------------|---------------------------------|--------------------------------|
| 1175            | 31                    | 31               | 186                             | 186                            |
| 1180            | 158                   | 94.5             | 472.5                           | 658.5                          |
| 1200            | 276                   | 217              | 4340                            | 4998.5                         |

HEC-1 INPUT :

| ELEV.<br>FT<br>NGVD | STORAGE<br>AC-FT |
|---------------------|------------------|
| 1169                | 0                |
| 1173.9              | 150              |
| 1174.6              | 180              |
| 1174.8              | 184              |
| 1175.5              | 225              |
| 1175.8              | 250              |
| 1177                | 370              |



JOB NO. 3409-13

SQUARES  
1/4 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

DETERMINATION OF "C" FOR LOW LEVEL OUTLET

$$D = \text{DIAMETER} = 15" \text{ CMP} = 1.25' \text{ CMP}$$

$$N = 0.015 (\text{SOIL \& WATER CONSERVATION ENG. P. 632})$$

$$A_p = \text{AREA OF PIPE OPENING} = 1.23 \text{ FT}^2$$

$$L_p = \text{LENGTH OF PIPE} = 20'$$

$$K_f = \text{FRICTION LOSS THROUGH PIPE}$$

$$K_e = \text{ENTRANCE LOSS OF PIPE} = 0.8 (\text{IBID P. 639})$$

$$C_p = \text{COEFFICIENT OF DISCHARGE (INCORPORATING } A_p \& 29)$$

$$C = \text{COEFFICIENT OF DISCHARGE}$$

$$K_f = \frac{5087 \text{ m}^2}{D^{4/3}} = \frac{(5087)(0.015)^2}{(15)^{4/3}} = 0.031$$

$$C_p = A_p \sqrt{\frac{2g}{1 + K_e + K_f L_p}} = 1.23 \sqrt{\frac{64.4}{1 + 0.8 + (0.031)(20)}} = 6.3$$

$$C = \frac{6.3/1.23}{\sqrt{64.4}} = 0.64$$

$$Q = C \sqrt{2gh}$$

JOB NO. 3409-13SQUARES  
1/4 IN. SCALE

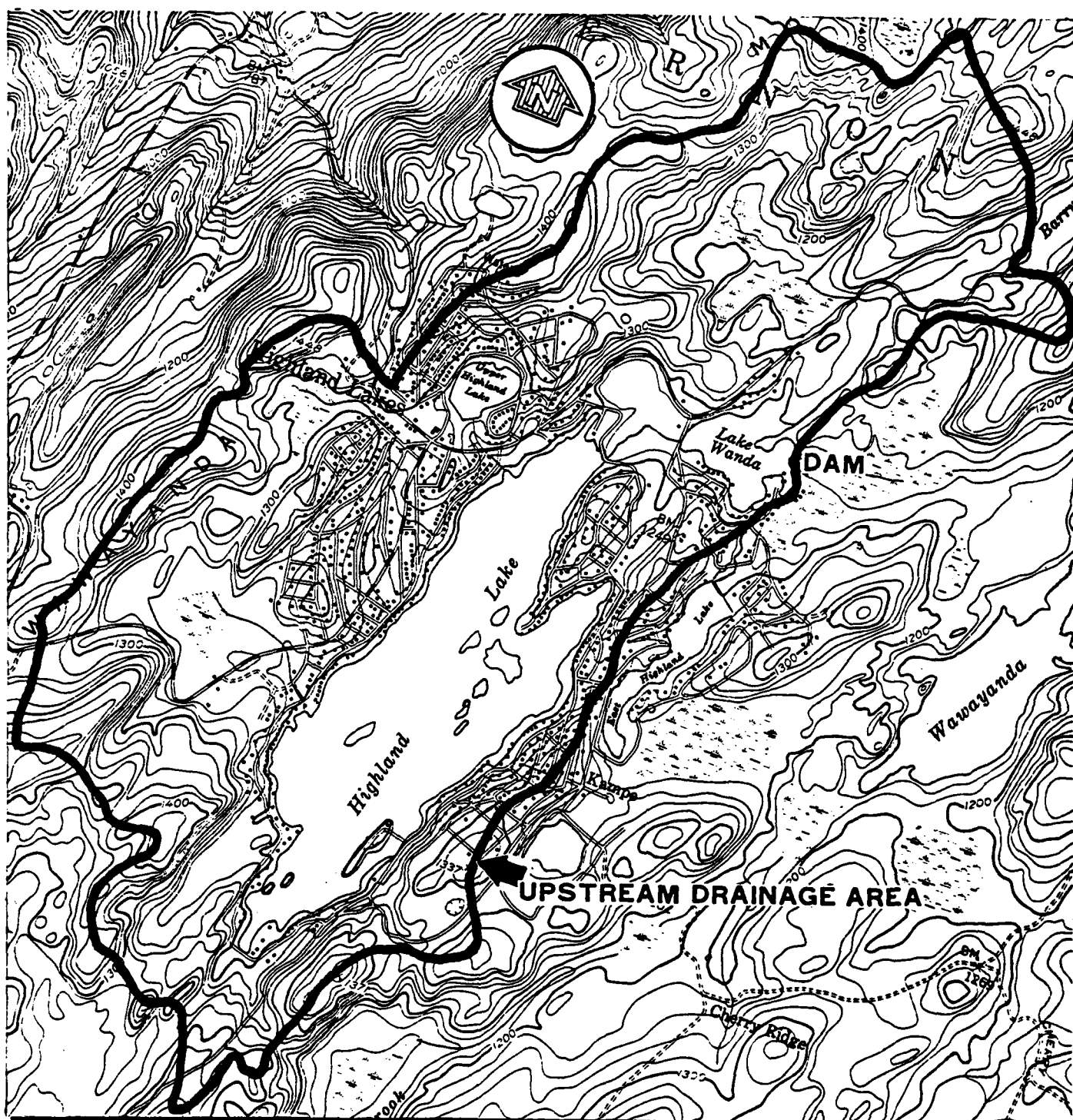
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

DRAWDOWN CALCULATIONS

CALCULATIONS ASSUME:

- 1- NO SIGNIFICANT INFLOW
- 2- LOW-LEVEL OUTLET IS OPERABLE
- 3- INV. U/S IS THE SAME AS INV. D/S AT GATE
- 4-  $Q_p = C_p H^{1/2} = 6.3 H^{1/2}$  (SEE PREVIOUS PAGE)
- 5- AC-FT-DAY = 1.9835 (AVE. Q)
- 6- DAYS =  $\Delta$  STORAGE / AC-FT-DAY

| ELEV.<br>FT | STORAGE<br>AC-FT | $\Delta$ STORAGE<br>AC-FT | H<br>FT | Q<br>CFS | AVE. Q<br>CFS | AC-FT/<br>DAY | DAYS         |
|-------------|------------------|---------------------------|---------|----------|---------------|---------------|--------------|
| 1175        | 186              | 86                        | 8.7     | 18.6     | 17.45         | 34.6          | 2.5          |
| 1173        | 100              | 50                        | 6.7     | 16.3     | 14.95         | 29.6          | 1.7          |
| 1171        | 50               | 30                        | 4.7     | 13.6     | 11.95         | 23.7          | 1.3          |
| 1169        | 20               | 15                        | 2.7     | 10.3     | 7.8           | 15.6          | 0.96         |
| 1167        | 5                | 5                         | 0.7     | 5.3      | 2.65          | 5.2           | 0.96         |
| 1166.3      | 0                |                           | 0       | 0        |               |               |              |
|             |                  |                           |         |          |               |               | 7.42<br>DAYS |



**NATIONAL PROGRAM OF INSPECTION OF  
NON-FED. DAMS**

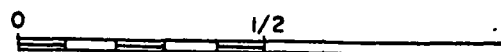
**LAKE WANDA DAM  
VERNON TOWNSHIP, NEW JERSEY  
REGIONAL VICINITY MAP  
FEBRUARY 1980**

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

ANDERSON-NICHOLS & CO., INC.

CONCORD, N.H.

SCALE IN MILES



**MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE  
SHEET. WAWAYANDA, N.J.-N.Y. 1954.**

HEC-1 OUTPUT  
OVERTOPPING ANALYSIS

LAKE WANDA DAM

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*****
1  A1 LAKE WANDA DAM OVERTOPPING AND BREACH ANALYSIS M-NIREMADI ANDERSON-NICHOLS
2  A2 NEW JERSEY NUMBER 22-52
3  A3 12 HOUR 100 YEAR RAINFALL DATA WAS USED
4  B 200 0 5 0 0 0 0 0 0 0 0
5  B1 3
6  K 0 A1
7  K1 LAKE WANDA INFLOW HYDROGRAPH FOR HIGHLAND LAKE DRAINAGE AREA
8  M 0 2 2.28
9  0 144
10 01 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014
11 01 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014
12 01 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014
13 01 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014
14 01 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028
15 01 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028
16 01 0.067 0.067 0.067 0.067 0.067 0.067 0.067 0.067 0.067 0.067
17 01 0.423 0.755 0.423 0.24 0.23 0.1 0.1 0.1 0.1 0.1
18 01 0.067 0.067 0.067 0.067 0.067 0.067 0.067 0.067 0.067 0.067
19 01 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028
20 01 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028 0.028
21 01 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014
22 01 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014
23 01 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014
24 01 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014 0.014
25 T
26 0.72
27 X -3
28 K 1 A2
29 K1 ROUTE INFLOW HYDROGRAPH THROUGH HIGHLAND LAKE RESERVOIR
30 Y 1
31 Y1 1
32 Y4 1190 1191 1192 1192.5 1193 1194 1195 1196 1197 1198
33 Y4 1199
34 Y5 0 101 425 639 917 1404 3113 5837 9239 13193
35 Y5 18574
36 Y5 0 1850 2178 2512 2675 2852 3199 3551 3910 4274
37 Y5 4645 5022
38 Y5 1172 1190 1191 1192 1192.5 1193 1194 1195 1196 1197
39 Y5 1198
40 Y5 1199
41 an 1199

```



| RUN | DATE     | TIME  |
|-----|----------|-------|
| 001 | 01/01/71 | 00.00 |
| 002 | 01/01/71 | 00.00 |

## JOB SPECIFICATION

| IPQ | NHR | NPIN | IDAY  | INR | ININ  | METRC | IPRT | INSTAN |
|-----|-----|------|-------|-----|-------|-------|------|--------|
| 200 | 0   | 5    | 0     | 0   | 7     | 0     | 0    | 0      |
|     |     |      | JOPER | NWT | LROPT | TRACE |      |        |
|     |     |      | X     | 0   | 0     | 0     |      |        |

## SUB-AREA RUNOFF COMPUTATION

# LAKE WANDA INFLOW HYDROGRAPH FOR HIGHLAND LAKE DRAINAGE AREA

| ISTAG | ICOMP | IECON | ITOFF | JPLY | JFRT | INAME | ISTAGE | TAUC |
|-------|-------|-------|-------|------|------|-------|--------|------|
| 61    | 0     | 0     | 0     | 0    | 0    | 1     | 0      | 0    |

| HYDRG | TUNE | HYDROGRAPH DATA |      |       |       |       | RATIO | ISNOV | ISAME | LOCAL |
|-------|------|-----------------|------|-------|-------|-------|-------|-------|-------|-------|
|       |      | TARFA           | SNAP | TRSDA | TRSPC | TRSDP |       |       |       |       |
| 0     | 2    | 2.28            | 0.00 | 2.28  | 0.00  | 0.000 | 0     | 0     | 0     |       |

| PF  | PRECIP DATA | DAK  |
|-----|-------------|------|
| 144 | STORY 0.00  | 0.00 |

[illegible]

LCSS DATA

| TRACOT | STRKBP | FLTIME | RTIME | EDRAIN | STKEXP | RTIME | STIME | RTIME | CASTL | ALSPX | RTIME |
|--------|--------|--------|-------|--------|--------|-------|-------|-------|-------|-------|-------|
| 0      | 0.00   | 0.00   | 1.00  | 0.00   | 0.00   | 1.00  | 1.00  | 1.00  | .10   | 0.00  | 0.00  |

# UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .72

RECESSION DATA  
START= -3.00 ORCSN= 0.00 RTIME= 1.00

UNIT HYDROGRAPH AS END OF PERIOD ORIGINATES. TC= 0.00 FOURS, LAG= .72 VOL= 1.00  
 1. 149. 129. 535. 808. 1984. 1250. 1409. 1403. 1432.  
 1461. 1226. 1055. 750. 614. 512. 362. 305.  
 207. 179. 149. 125. 104. 87. 73. 51.  
 43. 30. 24. 21. 15. 11. 9.  
 7. 4. 3. 1.

| NO. OF | HR. IN | PERIOD | RAIN | EXCS | LOSS | EXP. OF PERIOD FLOW | NO. OF | HR. IN | PERIOD | RAIN | EXCS | LOSS | COMP. R |
|--------|--------|--------|------|------|------|---------------------|--------|--------|--------|------|------|------|---------|
| 1.01   | 0.05   | 1      | .01  | 0.00 | .01  | 7.                  | 1.01   | 0.25   | 101    | .03  | .02  | .01  | 648.    |
| 1.01   | 1.10   | 2      | .01  | 0.00 | .01  | 7.                  | 1.01   | 6.30   | 102    | .03  | .02  | .01  | 600.    |
| 1.01   | 1.15   | 3      | .01  | 0.00 | .01  | 7.                  | 1.01   | 8.35   | 103    | .03  | .02  | .01  | 570.    |
| 1.01   | 1.20   | 4      | .01  | 0.00 | .01  | 7.                  | 1.01   | 8.40   | 104    | .03  | .02  | .01  | 526.    |
| 1.01   | 1.25   | 5      | .01  | 0.00 | .01  | 7.                  | 1.01   | 8.45   | 105    | .03  | .02  | .01  | 497.    |
| 1.01   | 1.30   | 6      | .01  | 0.00 | .01  | 7.                  | 1.01   | 8.50   | 106    | .03  | .02  | .01  | 474.    |
| 1.01   | 1.35   | 7      | .01  | 0.00 | .01  | 7.                  | 1.01   | 8.55   | 107    | .03  | .02  | .01  | 455.    |
| 1.01   | 1.40   | 8      | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.00   | 108    | .03  | .02  | .01  | 430.    |
| 1.01   | 1.45   | 9      | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.05   | 109    | .01  | .01  | .01  | 424.    |
| 1.01   | 1.50   | 10     | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.10   | 110    | .01  | .01  | .01  | 411.    |
| 1.01   | 1.55   | 11     | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.15   | 111    | .01  | .01  | .01  | 396.    |
| 1.01   | 1.60   | 12     | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.20   | 112    | .01  | .01  | .01  | 380.    |
| 1.01   | 1.65   | 13     | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.25   | 113    | .01  | .01  | .01  | 361.    |
| 1.01   | 1.70   | 14     | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.30   | 114    | .01  | .01  | .01  | 339.    |
| 1.01   | 1.75   | 15     | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.35   | 115    | .01  | .01  | .01  | 315.    |
| 1.01   | 1.80   | 16     | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.40   | 116    | .01  | .01  | .01  | 290.    |
| 1.01   | 1.85   | 17     | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.45   | 117    | .01  | .01  | .01  | 264.    |
| 1.01   | 1.90   | 18     | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.50   | 118    | .01  | .01  | .01  | 233.    |
| 1.01   | 1.95   | 19     | .01  | 0.00 | .01  | 7.                  | 1.01   | 9.55   | 119    | .01  | .01  | .01  | 222.    |
| 1.01   | 2.00   | 20     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.00  | 120    | .01  | .01  | .01  | 204.    |
| 1.01   | 2.05   | 21     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.05  | 121    | .01  | .01  | .01  | 187.    |
| 1.01   | 2.10   | 22     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.10  | 122    | .01  | .01  | .01  | 173.    |
| 1.01   | 2.15   | 23     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.15  | 123    | .01  | .01  | .01  | 162.    |
| 1.01   | 2.20   | 24     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.20  | 124    | .01  | .01  | .01  | 153.    |
| 1.01   | 2.25   | 25     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.25  | 125    | .01  | .01  | .01  | 145.    |
| 1.01   | 2.30   | 26     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.30  | 126    | .01  | .01  | .01  | 130.    |
| 1.01   | 2.35   | 27     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.35  | 127    | .01  | .01  | .01  | 124.    |
| 1.01   | 2.40   | 28     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.40  | 128    | .01  | .01  | .01  | 120.    |
| 1.01   | 2.45   | 29     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.45  | 129    | .01  | .01  | .01  | 125.    |
| 1.01   | 2.50   | 30     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.50  | 130    | .01  | .01  | .01  | 122.    |
| 1.01   | 2.55   | 31     | .01  | 0.00 | .01  | 7.                  | 1.01   | 10.55  | 131    | .01  | .01  | .01  | 120.    |
| 1.01   | 2.60   | 32     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.00  | 132    | .01  | .01  | .01  | 117.    |
| 1.01   | 2.65   | 33     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.05  | 133    | .01  | .01  | .01  | 116.    |
| 1.01   | 2.70   | 34     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.10  | 134    | .01  | .01  | .01  | 114.    |
| 1.01   | 2.75   | 35     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.15  | 135    | .01  | .01  | .01  | 113.    |
| 1.01   | 2.80   | 36     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.20  | 136    | .01  | .01  | .01  | 112.    |
| 1.01   | 2.85   | 37     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.25  | 137    | .01  | .01  | .01  | 111.    |
| 1.01   | 2.90   | 38     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.30  | 138    | .01  | .01  | .01  | 110.    |
| 1.01   | 2.95   | 39     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.35  | 139    | .01  | .01  | .01  | 109.    |
| 1.01   | 3.00   | 40     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.40  | 140    | .01  | .01  | .01  | 108.    |
| 1.01   | 3.05   | 41     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.45  | 141    | .01  | .01  | .01  | 107.    |
| 1.01   | 3.10   | 42     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.50  | 142    | .01  | .01  | .01  | 106.    |
| 1.01   | 3.15   | 43     | .01  | 0.00 | .01  | 7.                  | 1.01   | 11.55  | 143    | .01  | .01  | .01  | 105.    |
| 1.01   | 3.20   | 44     | .01  | 0.00 | .01  | 7.                  | 1.01   | 12.00  | 144    | .01  | .01  | .01  | 104.    |

|      |      |     |     |      |     |      |     |       |      |       |     |      |      |      |      |      |
|------|------|-----|-----|------|-----|------|-----|-------|------|-------|-----|------|------|------|------|------|
| 1.01 | 7.45 | 45  | .07 | 0.00 | .07 | 0.00 | .07 | 7.    | 1.01 | 12.01 | 145 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 46  | .07 | 0.00 | .07 | 0.00 | .07 | 7.    | 1.01 | 12.10 | 146 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 47  | .07 | 0.00 | .07 | 0.00 | .07 | 7.    | 1.01 | 12.15 | 147 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 48  | .07 | 0.00 | .07 | 0.00 | .07 | 7.    | 1.01 | 12.20 | 148 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 49  | .07 | 0.00 | .07 | 0.00 | .07 | 7.    | 1.01 | 12.25 | 149 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 50  | .07 | 0.00 | .07 | 0.00 | .07 | 7.    | 1.01 | 12.30 | 150 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 51  | .07 | 0.00 | .07 | 0.00 | .07 | 7.    | 1.01 | 12.35 | 151 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 52  | .07 | 0.00 | .07 | 0.00 | .07 | 7.    | 1.01 | 12.40 | 152 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 53  | .07 | 0.00 | .07 | 0.00 | .07 | 7.    | 1.01 | 12.45 | 153 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 54  | .07 | 0.00 | .07 | 0.00 | .07 | 7.    | 1.01 | 12.50 | 154 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 55  | .07 | 0.00 | .07 | 0.00 | .07 | 10.   | 1.01 | 12.55 | 155 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 56  | .07 | 0.00 | .07 | 0.00 | .07 | 16.   | 1.01 | 13.00 | 156 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 57  | .07 | 0.00 | .07 | 0.00 | .07 | 28.   | 1.01 | 13.05 | 157 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 58  | .07 | 0.00 | .07 | 0.00 | .07 | 40.   | 1.01 | 13.10 | 158 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 59  | .07 | 0.00 | .07 | 0.00 | .07 | 77.   | 1.01 | 13.15 | 159 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 60  | .07 | 0.00 | .07 | 0.00 | .07 | 114.  | 1.01 | 13.20 | 160 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 61  | .07 | 0.00 | .07 | 0.00 | .07 | 211.  | 1.01 | 13.25 | 161 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 62  | .07 | 0.00 | .07 | 0.00 | .07 | 268.  | 1.01 | 13.30 | 162 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 63  | .07 | 0.00 | .07 | 0.00 | .07 | 320.  | 1.01 | 13.35 | 163 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 64  | .07 | 0.00 | .07 | 0.00 | .07 | 394.  | 1.01 | 13.40 | 164 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 65  | .07 | 0.00 | .07 | 0.00 | .07 | 462.  | 1.01 | 13.45 | 165 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 66  | .07 | 0.00 | .07 | 0.00 | .07 | 531.  | 1.01 | 13.50 | 166 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 67  | .07 | 0.00 | .07 | 0.00 | .07 | 603.  | 1.01 | 13.55 | 167 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 68  | .07 | 0.00 | .07 | 0.00 | .07 | 674.  | 1.01 | 14.00 | 168 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 69  | .07 | 0.00 | .07 | 0.00 | .07 | 754.  | 1.01 | 14.05 | 169 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 70  | .07 | 0.00 | .07 | 0.00 | .07 | 863.  | 1.01 | 14.10 | 170 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 71  | .07 | 0.00 | .07 | 0.00 | .07 | 1036. | 1.01 | 14.15 | 171 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 72  | .07 | 0.00 | .07 | 0.00 | .07 | 1248. | 1.01 | 14.20 | 172 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 73  | .07 | 0.00 | .07 | 0.00 | .07 | 1618. | 1.01 | 14.25 | 173 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 74  | .07 | 0.00 | .07 | 0.00 | .07 | 2020. | 1.01 | 14.30 | 174 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 75  | .07 | 0.00 | .07 | 0.00 | .07 | 2498. | 1.01 | 14.35 | 175 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 76  | .07 | 0.00 | .07 | 0.00 | .07 | 2962. | 1.01 | 14.40 | 176 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 77  | .07 | 0.00 | .07 | 0.00 | .07 | 3350. | 1.01 | 14.45 | 177 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 78  | .07 | 0.00 | .07 | 0.00 | .07 | 3626. | 1.01 | 14.50 | 178 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 79  | .07 | 0.00 | .07 | 0.00 | .07 | 3772. | 1.01 | 14.55 | 179 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 80  | .07 | 0.00 | .07 | 0.00 | .07 | 3711. | 1.01 | 15.00 | 180 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 81  | .07 | 0.00 | .07 | 0.00 | .07 | 3543. | 1.01 | 15.05 | 181 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 82  | .07 | 0.00 | .07 | 0.00 | .07 | 3312. | 1.01 | 15.10 | 182 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 83  | .07 | 0.00 | .07 | 0.00 | .07 | 3029. | 1.01 | 15.15 | 183 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 84  | .07 | 0.00 | .07 | 0.00 | .07 | 2731. | 1.01 | 15.20 | 184 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 85  | .07 | 0.00 | .07 | 0.00 | .07 | 2556. | 1.01 | 15.25 | 185 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 86  | .07 | 0.00 | .07 | 0.00 | .07 | 2212. | 1.01 | 15.30 | 186 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 87  | .07 | 0.00 | .07 | 0.00 | .07 | 1997. | 1.01 | 15.35 | 187 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 88  | .07 | 0.00 | .07 | 0.00 | .07 | 1810. | 1.01 | 15.40 | 188 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 89  | .07 | 0.00 | .07 | 0.00 | .07 | 1641. | 1.01 | 15.45 | 189 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 90  | .07 | 0.00 | .07 | 0.00 | .07 | 1488. | 1.01 | 15.50 | 190 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 91  | .07 | 0.00 | .07 | 0.00 | .07 | 1350. | 1.01 | 15.55 | 191 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 92  | .07 | 0.00 | .07 | 0.00 | .07 | 1227. | 1.01 | 16.00 | 192 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 93  | .07 | 0.00 | .07 | 0.00 | .07 | 1115. | 1.01 | 16.05 | 193 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 94  | .07 | 0.00 | .07 | 0.00 | .07 | 1017. | 1.01 | 16.10 | 194 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 95  | .07 | 0.00 | .07 | 0.00 | .07 | 920.  | 1.01 | 16.15 | 195 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 96  | .07 | 0.00 | .07 | 0.00 | .07 | 877.  | 1.01 | 16.20 | 196 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 97  | .07 | 0.00 | .07 | 0.00 | .07 | 765.  | 1.01 | 16.25 | 197 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 98  | .07 | 0.00 | .07 | 0.00 | .07 | 702.  | 1.01 | 16.30 | 198 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 99  | .07 | 0.00 | .07 | 0.00 | .07 |       | 1.01 | 16.35 | 199 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |
| 1.01 | 7.45 | 100 | .07 | 0.00 | .07 | 0.00 | .07 |       | 1.01 | 16.40 | 200 | 0.00 | 0.00 | 0.00 | 0.00 | 107. |

SUM 6.23 4.47 1.75 0.0300  
( 158.3) ( 114.3) ( 45.3) ( 2274.10)

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
 3728. 1067. 401. 401. PC290.  
 108. 30. 11. 2274.  
 INCHES 4.35 4.55 4.55  
 110.60 115.56 115.56  
 529. 553. 553.  
 AC-FT 682. 682.  
 THOUS CU

# HYDROGRAPH ROUTING

## ROUTE INFLOW HYDROGRAPH THROUGH HIGHLAND LAKE RESERVOIR

IESAD IECON IIAFE JPLT JFRT IIAFE IIAFE IAUIC  
 A2 1 0 0 0 0 0 0

### ROUTING DATA

GLOSS CLOSS AVG IRES ISAME IOPT IPMP ISTR  
 0.0 0.000 0.00 1 1 0 0 0

NSTPS NSTCL LAG AMSMK X TSK STORA ISPRAT  
 1 0 0 0.000 0.000 0.000 1850. -1

STAGE 1190.00 1192.00 1192.50 1193.00 1194.00 1195.00 1196.00 1197.00 1198.00  
 1199.00

FLOW 101.00 425.00 639.00 917.00 1404.00 3113.00 5837.00 9239.00 13103.00

CAPACITY 0. 1850. 2178. 2512. 2675. 2852. 3199. 3551. 3910. 4274.

ELEVATION 1172. 1190. 1191. 1192. 1193. 1193. 1194. 1195. 1196. 1197.

CPEL SFVIO CGOW EXFW ELEV ELEV CORL CAREA EXPL  
 1190.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

### DAM DATA

TOPRL CGOW EXPD DAMVLD  
 1194.0 0.0 0.0 0.0

### END-OF-PERIOD HYDROGRAPH COORDINATES

| MO.DA | HR.MN | PERIOD | HOURS | INFLOW | OUTFLOW | STORAGE | STAGE  |
|-------|-------|--------|-------|--------|---------|---------|--------|
| 1.01  | 05    | 1      | 00    | 7.     | 0.      | 1850.   | 1190.0 |
| 1.01  | 10    | 2      | 17    | 7.     | 0.      | 1850.   | 1190.0 |
| 1.01  | 15    | 3      | 25    | 7.     | 0.      | 1850.   | 1190.0 |
| 1.01  | 20    | 4      | 33    | 7.     | 0.      | 1850.   | 1190.0 |
| 1.01  | 25    | 5      | 42    | 7.     | 0.      | 1850.   | 1190.0 |
| 1.01  | 30    | 6      | 51    | 7.     | 0.      | 1850.   | 1190.0 |
| 1.01  | 35    | 7      | 58    | 7.     | 0.      | 1850.   | 1190.0 |
| 1.01  | 40    | 8      | 67    | 7.     | 0.      | 1850.   | 1190.0 |
| 1.01  | 45    | 9      | 75    | 7.     | 0.      | 1850.   | 1190.0 |
| 1.01  | 50    | 10     | 83    | 7.     | 0.      | 1850.   | 1190.0 |
| 1.01  | 55    | 11     | 92    | 7.     | 0.      | 1851.   | 1190.0 |

|      |      |    |      |      |     |       |        |
|------|------|----|------|------|-----|-------|--------|
| 1.01 | 1.00 | 12 | 1.00 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.05 | 13 | 1.00 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.10 | 14 | 1.17 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.15 | 15 | 1.25 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.20 | 16 | 1.33 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.25 | 17 | 1.42 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.30 | 18 | 1.50 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.35 | 19 | 1.58 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.40 | 20 | 1.67 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.45 | 21 | 1.75 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.50 | 22 | 1.83 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 1.55 | 23 | 1.92 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 2.00 | 24 | 2.00 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 2.05 | 25 | 2.08 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 2.10 | 26 | 2.17 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 2.15 | 27 | 2.25 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 2.20 | 28 | 2.33 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 2.25 | 29 | 2.42 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 2.30 | 30 | 2.50 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 2.35 | 31 | 2.58 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 2.40 | 32 | 2.67 | 7.   | 0.  | 1851. | 1190.0 |
| 1.01 | 2.45 | 33 | 2.75 | 7.   | 0.  | 1852. | 1190.0 |
| 1.01 | 2.50 | 34 | 2.83 | 7.   | 0.  | 1852. | 1190.0 |
| 1.01 | 2.55 | 35 | 2.92 | 7.   | 0.  | 1852. | 1190.0 |
| 1.01 | 3.00 | 36 | 3.00 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.05 | 37 | 3.08 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.10 | 38 | 3.17 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.15 | 39 | 3.25 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.20 | 40 | 3.33 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.25 | 41 | 3.42 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.30 | 42 | 3.50 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.35 | 43 | 3.58 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.40 | 44 | 3.67 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.45 | 45 | 3.75 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.50 | 46 | 3.83 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 3.55 | 47 | 3.92 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 4.00 | 48 | 4.00 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 4.05 | 49 | 4.08 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 4.10 | 50 | 4.17 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 4.15 | 51 | 4.25 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 4.20 | 52 | 4.33 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 4.25 | 53 | 4.42 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 4.30 | 54 | 4.50 | 7.   | 1.  | 1852. | 1190.0 |
| 1.01 | 4.35 | 55 | 4.58 | 10.  | 1.  | 1852. | 1190.0 |
| 1.01 | 4.40 | 56 | 4.67 | 16.  | 1.  | 1853. | 1190.0 |
| 1.01 | 4.45 | 57 | 4.75 | 28.  | 1.  | 1853. | 1190.0 |
| 1.01 | 4.50 | 58 | 4.83 | 48.  | 1.  | 1853. | 1190.0 |
| 1.01 | 4.55 | 59 | 4.92 | 77.  | 1.  | 1853. | 1190.0 |
| 1.01 | 5.00 | 60 | 5.00 | 114. | 1.  | 1854. | 1190.0 |
| 1.01 | 5.05 | 61 | 5.08 | 160. | 2.  | 1855. | 1190.0 |
| 1.01 | 5.10 | 62 | 5.17 | 211. | 2.  | 1856. | 1190.0 |
| 1.01 | 5.15 | 63 | 5.25 | 268. | 2.  | 1858. | 1190.0 |
| 1.01 | 5.20 | 64 | 5.33 | 329. | 3.  | 1860. | 1190.0 |
| 1.01 | 5.25 | 65 | 5.42 | 394. | 4.  | 1862. | 1190.0 |
| 1.01 | 5.30 | 66 | 5.50 | 462. | 5.  | 1865. | 1190.0 |
| 1.01 | 5.35 | 67 | 5.58 | 531. | 6.  | 1869. | 1190.1 |
| 1.01 | 5.40 | 68 | 5.67 | 603. | 7.  | 1873. | 1190.1 |
| 1.01 | 5.45 | 69 | 5.75 | 674. | 8.  | 1877. | 1190.1 |
| 1.01 | 5.50 | 70 | 5.83 | 754. | 10. | 1882. | 1190.1 |
| 1.01 | 5.55 | 71 | 5.92 | 833. | 11. | 1887. | 1190.1 |

|      |       |     |       |       |      |       |        |
|------|-------|-----|-------|-------|------|-------|--------|
| 1.01 | 6.00  | 72  | 6.00  | 1436. | 13.  | 1894. | 1190.1 |
| 1.01 | 6.05  | 73  | 6.02  | 1200. | 16.  | 1902. | 1190.2 |
| 1.01 | 6.10  | 74  | 6.17  | 1418. | 19.  | 1911. | 1190.2 |
| 1.01 | 6.15  | 75  | 6.25  | 2020. | 23.  | 1924. | 1190.2 |
| 1.01 | 6.20  | 76  | 6.33  | 2498. | 27.  | 1939. | 1190.3 |
| 1.01 | 6.25  | 77  | 6.42  | 2962. | 33.  | 1958. | 1190.3 |
| 1.01 | 6.30  | 78  | 6.50  | 3350. | 40.  | 1979. | 1190.4 |
| 1.01 | 6.35  | 79  | 6.58  | 3626. | 47.  | 2003. | 1190.5 |
| 1.01 | 6.40  | 80  | 6.67  | 3772. | 55.  | 2028. | 1190.5 |
| 1.01 | 6.45  | 81  | 6.75  | 3798. | 63.  | 2054. | 1190.6 |
| 1.01 | 6.50  | 82  | 6.83  | 3711. | 71.  | 2079. | 1190.7 |
| 1.01 | 6.55  | 83  | 6.92  | 3543. | 78.  | 2104. | 1190.8 |
| 1.01 | 7.00  | 84  | 7.00  | 3312. | 85.  | 2127. | 1190.8 |
| 1.01 | 7.05  | 85  | 7.08  | 3029. | 92.  | 2148. | 1190.9 |
| 1.01 | 7.10  | 86  | 7.17  | 2731. | 98.  | 2167. | 1191.0 |
| 1.01 | 7.15  | 87  | 7.25  | 2456. | 107. | 2184. | 1191.0 |
| 1.01 | 7.20  | 88  | 7.33  | 2212. | 122. | 2200. | 1191.1 |
| 1.01 | 7.25  | 89  | 7.42  | 1997. | 135. | 2213. | 1191.1 |
| 1.01 | 7.30  | 90  | 7.50  | 1810. | 147. | 2225. | 1191.1 |
| 1.01 | 7.35  | 91  | 7.58  | 1641. | 157. | 2236. | 1191.2 |
| 1.01 | 7.40  | 92  | 7.67  | 1468. | 167. | 2246. | 1191.2 |
| 1.01 | 7.45  | 93  | 7.75  | 1350. | 175. | 2254. | 1191.2 |
| 1.01 | 7.50  | 94  | 7.83  | 1227. | 183. | 2262. | 1191.3 |
| 1.01 | 7.55  | 95  | 7.92  | 1115. | 189. | 2269. | 1191.3 |
| 1.01 | 8.00  | 96  | 8.00  | 1013. | 195. | 2275. | 1191.3 |
| 1.01 | 8.05  | 97  | 8.08  | 920.  | 200. | 2280. | 1191.3 |
| 1.01 | 8.10  | 98  | 8.17  | 837.  | 205. | 2285. | 1191.3 |
| 1.01 | 8.15  | 99  | 8.25  | 765.  | 209. | 2289. | 1191.3 |
| 1.01 | 8.20  | 100 | 8.33  | 702.  | 212. | 2293. | 1191.3 |
| 1.01 | 8.25  | 101 | 8.42  | 648.  | 215. | 2296. | 1191.4 |
| 1.01 | 8.30  | 102 | 8.50  | 600.  | 218. | 2298. | 1191.4 |
| 1.01 | 8.35  | 103 | 8.58  | 560.  | 220. | 2301. | 1191.4 |
| 1.01 | 8.40  | 104 | 8.67  | 526.  | 222. | 2303. | 1191.4 |
| 1.01 | 8.45  | 105 | 8.75  | 497.  | 224. | 2305. | 1191.4 |
| 1.01 | 8.50  | 106 | 8.83  | 474.  | 226. | 2307. | 1191.4 |
| 1.01 | 8.55  | 107 | 8.92  | 455.  | 228. | 2309. | 1191.4 |
| 1.01 | 9.00  | 108 | 9.00  | 439.  | 229. | 2310. | 1191.4 |
| 1.01 | 9.05  | 109 | 9.08  | 424.  | 230. | 2311. | 1191.4 |
| 1.01 | 9.10  | 110 | 9.17  | 411.  | 232. | 2313. | 1191.4 |
| 1.01 | 9.15  | 111 | 9.25  | 396.  | 233. | 2314. | 1191.4 |
| 1.01 | 9.20  | 112 | 9.33  | 380.  | 234. | 2315. | 1191.4 |
| 1.01 | 9.25  | 113 | 9.42  | 361.  | 235. | 2316. | 1191.4 |
| 1.01 | 9.30  | 114 | 9.50  | 339.  | 236. | 2317. | 1191.4 |
| 1.01 | 9.35  | 115 | 9.58  | 315.  | 236. | 2317. | 1191.4 |
| 1.01 | 9.40  | 116 | 9.67  | 290.  | 237. | 2318. | 1191.4 |
| 1.01 | 9.45  | 117 | 9.75  | 266.  | 237. | 2318. | 1191.4 |
| 1.01 | 9.50  | 118 | 9.83  | 243.  | 237. | 2318. | 1191.4 |
| 1.01 | 9.55  | 119 | 9.92  | 222.  | 237. | 2318. | 1191.4 |
| 1.01 | 10.00 | 120 | 10.00 | 204.  | 237. | 2318. | 1191.4 |
| 1.01 | 10.05 | 121 | 10.08 | 187.  | 237. | 2318. | 1191.4 |
| 1.01 | 10.10 | 122 | 10.17 | 173.  | 237. | 2317. | 1191.4 |
| 1.01 | 10.15 | 123 | 10.25 | 162.  | 236. | 2317. | 1191.4 |
| 1.01 | 10.20 | 124 | 10.33 | 153.  | 235. | 2316. | 1191.4 |
| 1.01 | 10.25 | 125 | 10.42 | 145.  | 235. | 2316. | 1191.4 |
| 1.01 | 10.30 | 126 | 10.50 | 130.  | 234. | 2315. | 1191.4 |
| 1.01 | 10.35 | 127 | 10.58 | 114.  | 233. | 2314. | 1191.4 |
| 1.01 | 10.40 | 128 | 10.67 | 109.  | 233. | 2314. | 1191.4 |
| 1.01 | 10.45 | 129 | 10.75 | 105.  | 232. | 2313. | 1191.4 |
| 1.01 | 10.50 | 130 | 10.83 | 102.  | 231. | 2312. | 1191.4 |
| 1.01 | 10.55 | 131 | 10.92 | 100.  | 231. | 2312. | 1191.4 |

|      |       |     |       |      |      |       |        |
|------|-------|-----|-------|------|------|-------|--------|
| 1.01 | 11.00 | 132 | 11.00 | 117. | 270. | 2311. | 1191.4 |
| 1.01 | 11.05 | 133 | 11.08 | 116. | 225. | 2310. | 1191.4 |
| 1.01 | 11.10 | 134 | 11.17 | 114. | 228. | 2307. | 1191.4 |
| 1.01 | 11.15 | 135 | 11.25 | 113. | 228. | 2308. | 1191.4 |
| 1.01 | 11.20 | 136 | 11.33 | 112. | 227. | 2307. | 1191.4 |
| 1.01 | 11.25 | 137 | 11.42 | 111. | 226. | 2306. | 1191.4 |
| 1.01 | 11.30 | 138 | 11.50 | 110. | 225. | 2305. | 1191.4 |
| 1.01 | 11.35 | 139 | 11.58 | 110. | 224. | 2304. | 1191.4 |
| 1.01 | 11.40 | 140 | 11.67 | 109. | 224. | 2304. | 1191.4 |
| 1.01 | 11.45 | 141 | 11.75 | 109. | 223. | 2303. | 1191.4 |
| 1.01 | 11.50 | 142 | 11.83 | 108. | 222. | 2302. | 1191.4 |
| 1.01 | 11.55 | 143 | 11.92 | 108. | 221. | 2301. | 1191.4 |
| 1.01 | 12.00 | 144 | 12.00 | 108. | 220. | 2300. | 1191.4 |
| 1.01 | 12.05 | 145 | 12.08 | 107. | 219. | 2299. | 1191.4 |
| 1.01 | 12.10 | 146 | 12.17 | 106. | 218. | 2298. | 1191.4 |
| 1.01 | 12.15 | 147 | 12.25 | 104. | 217. | 2297. | 1191.4 |
| 1.01 | 12.20 | 148 | 12.33 | 101. | 216. | 2296. | 1191.4 |
| 1.01 | 12.25 | 149 | 12.42 | 96.  | 215. | 2295. | 1191.4 |
| 1.01 | 12.30 | 150 | 12.50 | 90.  | 214. | 2294. | 1191.4 |
| 1.01 | 12.35 | 151 | 12.58 | 83.  | 213. | 2293. | 1191.4 |
| 1.01 | 12.40 | 152 | 12.67 | 75.  | 212. | 2292. | 1191.4 |
| 1.01 | 12.45 | 153 | 12.75 | 67.  | 211. | 2291. | 1191.4 |
| 1.01 | 12.50 | 154 | 12.83 | 58.  | 210. | 2290. | 1191.4 |
| 1.01 | 12.55 | 155 | 12.92 | 51.  | 209. | 2289. | 1191.4 |
| 1.01 | 13.00 | 156 | 13.00 | 44.  | 208. | 2288. | 1191.4 |
| 1.01 | 13.05 | 157 | 13.08 | 38.  | 207. | 2287. | 1191.4 |
| 1.01 | 13.10 | 158 | 13.17 | 32.  | 205. | 2286. | 1191.4 |
| 1.01 | 13.15 | 159 | 13.25 | 28.  | 204. | 2285. | 1191.4 |
| 1.01 | 13.20 | 160 | 13.33 | 25.  | 203. | 2284. | 1191.4 |
| 1.01 | 13.25 | 161 | 13.42 | 22.  | 202. | 2283. | 1191.4 |
| 1.01 | 13.30 | 162 | 13.50 | 19.  | 201. | 2282. | 1191.4 |
| 1.01 | 13.35 | 163 | 13.58 | 17.  | 199. | 2281. | 1191.4 |
| 1.01 | 13.40 | 164 | 13.67 | 16.  | 198. | 2279. | 1191.4 |
| 1.01 | 13.45 | 165 | 13.75 | 14.  | 197. | 2278. | 1191.4 |
| 1.01 | 13.50 | 166 | 13.83 | 13.  | 196. | 2277. | 1191.4 |
| 1.01 | 13.55 | 167 | 13.92 | 12.  | 195. | 2276. | 1191.4 |
| 1.01 | 14.00 | 168 | 14.00 | 11.  | 194. | 2275. | 1191.4 |
| 1.01 | 14.05 | 169 | 14.08 | 10.  | 192. | 2274. | 1191.4 |
| 1.01 | 14.10 | 170 | 14.17 | 10.  | 191. | 2273. | 1191.4 |
| 1.01 | 14.15 | 171 | 14.25 | 9.   | 189. | 2272. | 1191.4 |
| 1.01 | 14.20 | 172 | 14.33 | 9.   | 188. | 2270. | 1191.4 |
| 1.01 | 14.25 | 173 | 14.42 | 9.   | 187. | 2269. | 1191.4 |
| 1.01 | 14.30 | 174 | 14.50 | 8.   | 186. | 2268. | 1191.4 |
| 1.01 | 14.35 | 175 | 14.58 | 8.   | 185. | 2267. | 1191.4 |
| 1.01 | 14.40 | 176 | 14.67 | 8.   | 184. | 2266. | 1191.4 |
| 1.01 | 14.45 | 177 | 14.75 | 8.   | 183. | 2265. | 1191.4 |
| 1.01 | 14.50 | 178 | 14.83 | 7.   | 182. | 2264. | 1191.4 |
| 1.01 | 14.55 | 179 | 14.92 | 7.   | 181. | 2263. | 1191.4 |
| 1.01 | 15.00 | 180 | 15.00 | 7.   | 180. | 2262. | 1191.4 |
| 1.01 | 15.05 | 181 | 15.08 | 7.   | 179. | 2261. | 1191.4 |
| 1.01 | 15.10 | 182 | 15.17 | 7.   | 178. | 2260. | 1191.4 |
| 1.01 | 15.15 | 183 | 15.25 | 7.   | 177. | 2259. | 1191.4 |
| 1.01 | 15.20 | 184 | 15.33 | 7.   | 176. | 2258. | 1191.4 |
| 1.01 | 15.25 | 185 | 15.42 | 7.   | 175. | 2257. | 1191.4 |
| 1.01 | 15.30 | 186 | 15.50 | 7.   | 174. | 2256. | 1191.4 |
| 1.01 | 15.35 | 187 | 15.58 | 7.   | 173. | 2255. | 1191.4 |
| 1.01 | 15.40 | 188 | 15.67 | 7.   | 172. | 2254. | 1191.4 |
| 1.01 | 15.45 | 189 | 15.75 | 7.   | 171. | 2253. | 1191.4 |
| 1.01 | 15.50 | 190 | 15.83 | 7.   | 170. | 2252. | 1191.4 |
| 1.01 | 15.55 | 191 | 15.92 | 7.   | 169. | 2251. | 1191.4 |
| 1.01 | 15.60 | 192 | 16.00 | 7.   | 168. | 2250. | 1191.4 |

PEAK OUTFLOW IS 237. AT TIME 9.83 HOURS

|            | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL  |
|------------|------|--------|---------|---------|--------|
| CFS        | 237. | 221.   | 120.    | 120.    | 23926. |
| CFS        | 7.   | 6.     |         | 3.      | 679.   |
| INCHES     |      | .90    | 1.76    | 1.36    | 1.36   |
| "          |      | 22.94  | 34.44   | 34.44   | 34.44  |
| AC-FT      |      | 110.   | 165.    | 165.    | 165.   |
| THOUS CU Y |      | 135.   | 207.    | 203.    | 203.   |

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*****  
***** SUB-AREA RUNOFF COMPUTATION *****  
*****
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DEVELOP INFLOW HYDROGRAPH FOR LAKE WANDA DRAINAGE AREA

| ISTAQ | JCOMP | IECON | ITAPF | JPLT | JPRY | INAME | ISTAGE | IAUTN |
|-------|-------|-------|-------|------|------|-------|--------|-------|
| 13    | 0     | 0     | 0     | 0    | 0    | 1     | 0      | 0     |

HYDROGRAPH DATA

|        |   |       |      |       |       |       |       |       |       |
|--------|---|-------|------|-------|-------|-------|-------|-------|-------|
| ISMYNG |   | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNCW | ISAPE | LOCAL |
| 0      | ? | 1.20  | 0.00 | 1.20  | 0.00  | 0.000 | 0     | 0     | 0     |

**PRECIP DATA**

| P/P | STORM | DAJ  | PAK  |
|-----|-------|------|------|
| 144 | 0.00  | 0.00 | 0.00 |

[illegible][illegible]



|      |      |    |     |      |     |       |      |       |     |      |      |      |     |
|------|------|----|-----|------|-----|-------|------|-------|-----|------|------|------|-----|
| 1.01 | 3.20 | 40 | .02 | 0.00 | .03 | 4.    | 1.01 | 11.40 | 140 | .01  | .01  | .01  | 84. |
| 1.01 | 3.25 | 41 | .02 | 0.00 | .03 | 4.    | 1.01 | 11.45 | 141 | .01  | .01  | .01  | 82. |
| 1.01 | 3.30 | 42 | .03 | .00  | .03 | 4.    | 1.01 | 11.50 | 142 | .01  | .01  | .01  | 79. |
| 1.01 | 3.35 | 43 | .03 | 0.00 | .03 | 4.    | 1.01 | 11.55 | 143 | .01  | .01  | .01  | 77. |
| 1.01 | 3.40 | 44 | .03 | 0.00 | .03 | 4.    | 1.01 | 12.00 | 144 | .01  | .01  | .01  | 75. |
| 1.01 | 3.45 | 45 | .03 | 0.00 | .02 | 4.    | 1.01 | 12.05 | 145 | 0.00 | 0.00 | 0.00 | 72. |
| 1.01 | 3.50 | 46 | .02 | 0.00 | .03 | 4.    | 1.01 | 12.10 | 146 | 0.00 | 0.00 | 0.00 | 71. |
| 1.01 | 3.55 | 47 | .03 | 0.00 | .03 | 4.    | 1.01 | 12.15 | 147 | 0.00 | 0.00 | 0.00 | 69. |
| 1.01 | 4.00 | 48 | .03 | 0.00 | .03 | 4.    | 1.01 | 12.20 | 148 | 0.00 | 0.00 | 0.00 | 67. |
| 1.01 | 4.05 | 49 | .03 | 0.00 | .03 | 4.    | 1.01 | 12.25 | 149 | 0.00 | 0.00 | 0.00 | 65. |
| 1.01 | 4.10 | 50 | .03 | 0.00 | .03 | 4.    | 1.01 | 12.30 | 150 | 0.00 | 0.00 | 0.00 | 63. |
| 1.01 | 4.15 | 51 | .03 | 0.00 | .03 | 4.    | 1.01 | 12.35 | 151 | 0.00 | 0.00 | 0.00 | 61. |
| 1.01 | 4.20 | 52 | .03 | 0.00 | .03 | 4.    | 1.01 | 12.40 | 152 | 0.00 | 0.00 | 0.00 | 59. |
| 1.01 | 4.25 | 53 | .03 | 0.00 | .03 | 4.    | 1.01 | 12.45 | 153 | 0.00 | 0.00 | 0.00 | 56. |
| 1.01 | 4.30 | 54 | .03 | .01  | .02 | 4.    | 1.01 | 12.50 | 154 | 0.00 | 0.00 | 0.00 | 54. |
| 1.01 | 4.35 | 55 | .04 | .03  | .01 | 4.    | 1.01 | 12.55 | 155 | 0.00 | 0.00 | 0.00 | 51. |
| 1.01 | 4.40 | 56 | .04 | .03  | .01 | 5.    | 1.01 | 13.00 | 156 | 0.00 | 0.00 | 0.00 | 49. |
| 1.01 | 4.45 | 57 | .04 | .03  | .01 | 6.    | 1.01 | 13.05 | 157 | 0.00 | 0.00 | 0.00 | 46. |
| 1.01 | 4.50 | 58 | .04 | .03  | .01 | 8.    | 1.01 | 13.10 | 158 | 0.00 | 0.00 | 0.00 | 43. |
| 1.01 | 4.55 | 59 | .04 | .03  | .01 | 12.   | 1.01 | 13.15 | 159 | 0.00 | 0.00 | 0.00 | 41. |
| 1.01 | 5.00 | 60 | .04 | .03  | .01 | 16.   | 1.01 | 13.20 | 160 | 0.00 | 0.00 | 0.00 | 39. |
| 1.01 | 5.05 | 61 | .07 | .06  | .01 | 22.   | 1.01 | 13.25 | 161 | 0.00 | 0.00 | 0.00 | 35. |
| 1.01 | 5.10 | 62 | .07 | .06  | .01 | 29.   | 1.01 | 13.30 | 162 | 0.00 | 0.00 | 0.00 | 33. |
| 1.01 | 5.15 | 63 | .07 | .06  | .01 | 39.   | 1.01 | 13.35 | 163 | 0.00 | 0.00 | 0.00 | 30. |
| 1.01 | 5.20 | 64 | .07 | .06  | .01 | 51.   | 1.01 | 13.40 | 164 | 0.00 | 0.00 | 0.00 | 28. |
| 1.01 | 5.25 | 65 | .07 | .06  | .01 | 65.   | 1.01 | 13.45 | 165 | 0.00 | 0.00 | 0.00 | 25. |
| 1.01 | 5.30 | 66 | .07 | .06  | .01 | 80.   | 1.01 | 13.50 | 166 | 0.00 | 0.00 | 0.00 | 23. |
| 1.01 | 5.35 | 67 | .10 | .09  | .01 | 98.   | 1.01 | 13.55 | 167 | 0.00 | 0.00 | 0.00 | 21. |
| 1.01 | 5.40 | 68 | .10 | .09  | .01 | 118.  | 1.01 | 14.00 | 168 | 0.00 | 0.00 | 0.00 | 19. |
| 1.01 | 5.45 | 69 | .10 | .09  | .01 | 140.  | 1.01 | 14.05 | 169 | 0.00 | 0.00 | 0.00 | 18. |
| 1.01 | 5.50 | 70 | .10 | .09  | .01 | 164.  | 1.01 | 14.10 | 170 | 0.00 | 0.00 | 0.00 | 16. |
| 1.01 | 5.55 | 71 | .42 | .41  | .01 | 193.  | 1.01 | 14.15 | 171 | 0.00 | 0.00 | 0.00 | 15. |
| 1.01 | 6.00 | 72 | .76 | .75  | .01 | 229.  | 1.01 | 14.20 | 172 | 0.00 | 0.00 | 0.00 | 14. |
| 1.01 | 6.05 | 73 | .42 | .41  | .01 | 275.  | 1.01 | 14.25 | 173 | 0.00 | 0.00 | 0.00 | 13. |
| 1.01 | 6.10 | 74 | .24 | .23  | .01 | 330.  | 1.01 | 14.30 | 174 | 0.00 | 0.00 | 0.00 | 12. |
| 1.01 | 6.15 | 75 | .23 | .22  | .01 | 393.  | 1.01 | 14.35 | 175 | 0.00 | 0.00 | 0.00 | 11. |
| 1.01 | 6.20 | 76 | .10 | .09  | .01 | 464.  | 1.01 | 14.40 | 176 | 0.00 | 0.00 | 0.00 | 11. |
| 1.01 | 6.25 | 77 | .10 | .09  | .01 | 545.  | 1.01 | 14.45 | 177 | 0.00 | 0.00 | 0.00 | 10. |
| 1.01 | 6.30 | 78 | .10 | .09  | .01 | 633.  | 1.01 | 14.50 | 178 | 0.00 | 0.00 | 0.00 | 9.  |
| 1.01 | 6.35 | 79 | .07 | .06  | .01 | 730.  | 1.01 | 14.55 | 179 | 0.00 | 0.00 | 0.00 | 9.  |
| 1.01 | 6.40 | 80 | .07 | .06  | .01 | 833.  | 1.01 | 15.00 | 180 | 0.00 | 0.00 | 0.00 | 8.  |
| 1.01 | 6.45 | 81 | .07 | .06  | .01 | 934.  | 1.01 | 15.05 | 181 | 0.00 | 0.00 | 0.00 | 8.  |
| 1.01 | 6.50 | 82 | .07 | .06  | .01 | 1024. | 1.01 | 15.10 | 182 | 0.00 | 0.00 | 0.00 | 7.  |
| 1.01 | 6.55 | 83 | .07 | .06  | .01 | 1111. | 1.01 | 15.15 | 183 | 0.00 | 0.00 | 0.00 | 7.  |
| 1.01 | 7.00 | 84 | .07 | .06  | .01 | 1180. | 1.01 | 15.20 | 184 | 0.00 | 0.00 | 0.00 | 7.  |
| 1.01 | 7.05 | 85 | .04 | .03  | .01 | 1232. | 1.01 | 15.25 | 185 | 0.00 | 0.00 | 0.00 | 6.  |
| 1.01 | 7.10 | 86 | .04 | .03  | .01 | 1268. | 1.01 | 15.30 | 186 | 0.00 | 0.00 | 0.00 | 6.  |
| 1.01 | 7.15 | 87 | .04 | .03  | .01 | 1290. | 1.01 | 15.35 | 187 | 0.00 | 0.00 | 0.00 | 6.  |
| 1.01 | 7.20 | 88 | .04 | .03  | .01 | 1299. | 1.01 | 15.40 | 188 | 0.00 | 0.00 | 0.00 | 6.  |
| 1.01 | 7.25 | 89 | .04 | .03  | .01 | 1295. | 1.01 | 15.45 | 189 | 0.00 | 0.00 | 0.00 | 5.  |
| 1.01 | 7.30 | 90 | .04 | .03  | .01 | 1277. | 1.01 | 15.50 | 190 | 0.00 | 0.00 | 0.00 | 5.  |
| 1.01 | 7.35 | 91 | .03 | .02  | .01 | 1251. | 1.01 | 15.55 | 191 | 0.00 | 0.00 | 0.00 | 5.  |
| 1.01 | 7.40 | 92 | .03 | .02  | .01 | 1216. | 1.01 | 16.00 | 192 | 0.00 | 0.00 | 0.00 | 5.  |
| 1.01 | 7.45 | 93 | .03 | .02  | .01 | 1175. | 1.01 | 16.05 | 193 | 0.00 | 0.00 | 0.00 | 5.  |
| 1.01 | 7.50 | 94 | .03 | .02  | .01 | 1126. | 1.01 | 16.10 | 194 | 0.00 | 0.00 | 0.00 | 5.  |
| 1.01 | 7.55 | 95 | .03 | .02  | .01 | 1071. | 1.01 | 16.15 | 195 | 0.00 | 0.00 | 0.00 | 5.  |
| 1.01 | 8.00 | 96 | .03 | .02  | .01 | 1000. | 1.01 | 16.20 | 196 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 8.05 | 97 | .03 | .02  | .01 | 945.  | 1.01 | 16.25 | 197 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 8.10 | 98 | .03 | .02  | .01 | 894.  | 1.01 | 16.30 | 198 | 0.00 | 0.00 | 0.00 | 4.  |
| 1.01 | 8.15 | 99 | .03 | .02  | .01 | 827.  | 1.01 | 16.35 | 199 | 0.00 | 0.00 | 0.00 | 4.  |



PM 1.12  
 EXP. 8

ROUTE COMBINED INFLOW HYDROGRAPH THROUGH WANDA LAKE

| ISTAB        | ICOMP | IECON | ITAPE | JFLT  | JFRT  | INAME | ISTADE | IAUTO |
|--------------|-------|-------|-------|-------|-------|-------|--------|-------|
| A3           | 1     | 0     | 0     | 0     | 0     | 1     | 0      | 0     |
| ROUTING DATA |       |       |       |       |       |       |        |       |
| GLOSS        | 0.000 | AVG   | IRCS  | ISAME | IOPT  | IFHP  | LSIR   |       |
| 0.0          | 0.000 | 0.00  | 1     | 1     | 0     | 0     | 0      |       |
| NSIPS        | NSIDL | LAG   | ANSKK | X     | ISK   | STURA | ISPRAT |       |
| 1            | 0     | 0     | 0.000 | 0.000 | 0.000 | 160.  | -1     |       |

|            |         |         |         |         |         |         |
|------------|---------|---------|---------|---------|---------|---------|
| STAGE      | 1173.90 | 1174.60 | 1174.80 | 1175.50 | 1175.80 | 1177.00 |
| FLOW       | 0.00    | 16.00   | 28.00   | 118.00  | 276.00  | 1973.00 |
| CAPACITY=  | 0.      | 150.    | 180.    | 184.    | 225.    | 370.    |
| ELEVATION= | 1169.   | 1174.   | 1175.   | 1175.   | 1176.   | 1177.   |

|        |       |      |      |      |      |       |      |
|--------|-------|------|------|------|------|-------|------|
| CREL   | SFWID | CORW | EXPW | ELEV | CORL | CAREA | EXPL |
| 1173.9 | 0.0   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0   | 0.0  |

|          |      |      |        |
|----------|------|------|--------|
| DAM DATA |      |      |        |
| TOPEL    | CORW | EXPW | DAMWID |
| 1174.8   | 0.0  | 0.0  | 0.     |

| MO.DA |      | HR.MN        | END-OF-PERIOD HYDROGRAPH ORDINATES |         | STORAGE |      | STAGE  |
|-------|------|--------------|------------------------------------|---------|---------|------|--------|
|       |      | PERIOD HOURS | INFLOW                             | OUTFLOW |         |      |        |
| 1.01  | .05  | 1            | .08                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | .10  | 2            | .17                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | .15  | 3            | .25                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | .20  | 4            | .33                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | .25  | 5            | .42                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | .30  | 6            | .50                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | .35  | 7            | .58                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | .40  | 8            | .67                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | .45  | 9            | .75                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | .50  | 10           | .83                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | .55  | 11           | .92                                | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.00 | 12           | 1.00                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.05 | 13           | 1.08                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.10 | 14           | 1.17                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.15 | 15           | 1.25                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.20 | 16           | 1.33                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.25 | 17           | 1.42                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.30 | 18           | 1.50                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.35 | 19           | 1.58                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.40 | 20           | 1.67                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.45 | 21           | 1.75                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.50 | 22           | 1.83                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 1.55 | 23           | 1.92                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 2.00 | 24           | 2.00                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 2.05 | 25           | 2.08                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 2.10 | 26           | 2.17                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 2.15 | 27           | 2.25                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 2.20 | 28           | 2.33                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 2.25 | 29           | 2.42                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 2.30 | 30           | 2.50                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 2.35 | 31           | 2.58                               | 4.      | 5.      | 160. | 1174.1 |
| 1.01  | 2.40 | 32           | 2.67                               | 4.      | 5.      | 160. | 1174.1 |

|      |      |    |      |       |      |      |        |
|------|------|----|------|-------|------|------|--------|
| 1.01 | 2.45 | 33 | 2.   | 4     | 5.   | 160. | 1174.1 |
| 1.01 | 2.50 | 34 | 2.83 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 2.55 | 35 | 2.92 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.00 | 36 | 3.00 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.05 | 37 | 3.08 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.10 | 38 | 3.17 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.15 | 39 | 3.25 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.20 | 40 | 3.33 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.25 | 41 | 3.42 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.30 | 42 | 3.50 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.35 | 43 | 3.58 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.40 | 44 | 3.67 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.45 | 45 | 3.75 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.50 | 46 | 3.83 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 3.55 | 47 | 3.92 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.00 | 48 | 4.00 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.05 | 49 | 4.08 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.10 | 50 | 4.17 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.15 | 51 | 4.25 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.20 | 52 | 4.33 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.25 | 53 | 4.42 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.30 | 54 | 4.50 | 4.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.35 | 55 | 4.58 | 5.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.40 | 56 | 4.67 | 6.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.45 | 57 | 4.75 | 7.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.50 | 58 | 4.83 | 9.    | 5.   | 160. | 1174.1 |
| 1.01 | 4.55 | 59 | 4.92 | 13.   | 5.   | 160. | 1174.1 |
| 1.01 | 5.00 | 60 | 5.00 | 17.   | 5.   | 160. | 1174.1 |
| 1.01 | 5.05 | 61 | 5.08 | 23.   | 5.   | 160. | 1174.1 |
| 1.01 | 5.10 | 62 | 5.17 | 31.   | 5.   | 160. | 1174.1 |
| 1.01 | 5.15 | 63 | 5.25 | 41.   | 5.   | 160. | 1174.1 |
| 1.01 | 5.20 | 64 | 5.33 | 54.   | 6.   | 160. | 1174.1 |
| 1.01 | 5.25 | 65 | 5.42 | 68.   | 6.   | 161. | 1174.2 |
| 1.01 | 5.30 | 66 | 5.50 | 85.   | 6.   | 161. | 1174.2 |
| 1.01 | 5.35 | 67 | 5.58 | 104.  | 6.   | 162. | 1174.2 |
| 1.01 | 5.40 | 68 | 5.67 | 125.  | 7.   | 163. | 1174.2 |
| 1.01 | 5.45 | 69 | 5.75 | 140.  | 7.   | 164. | 1174.2 |
| 1.01 | 5.50 | 70 | 5.83 | 174.  | 8.   | 165. | 1174.2 |
| 1.01 | 5.55 | 71 | 5.92 | 204.  | 8.   | 166. | 1174.3 |
| 1.01 | 6.00 | 72 | 6.00 | 243.  | 9.   | 167. | 1174.3 |
| 1.01 | 6.05 | 73 | 6.08 | 291.  | 10.  | 169. | 1174.3 |
| 1.01 | 6.10 | 74 | 6.17 | 349.  | 11.  | 171. | 1174.4 |
| 1.01 | 6.15 | 75 | 6.25 | 416.  | 13.  | 174. | 1174.5 |
| 1.01 | 6.20 | 76 | 6.33 | 492.  | 14.  | 177. | 1174.5 |
| 1.01 | 6.25 | 77 | 6.42 | 578.  | 17.  | 180. | 1174.6 |
| 1.01 | 6.30 | 78 | 6.50 | 673.  | 29.  | 185. | 1174.8 |
| 1.01 | 6.35 | 79 | 6.58 | 777.  | 40.  | 189. | 1174.9 |
| 1.01 | 6.40 | 80 | 6.67 | 887.  | 52.  | 195. | 1175.0 |
| 1.01 | 6.45 | 81 | 6.75 | 997.  | 65.  | 201. | 1175.1 |
| 1.01 | 6.50 | 82 | 6.83 | 1099. | 80.  | 208. | 1175.2 |
| 1.01 | 6.55 | 83 | 6.92 | 1189. | 96.  | 215. | 1175.3 |
| 1.01 | 7.00 | 84 | 7.00 | 1265. | 113. | 223. | 1175.5 |
| 1.01 | 7.05 | 85 | 7.08 | 1324. | 153. | 231. | 1175.6 |
| 1.01 | 7.10 | 86 | 7.17 | 1366. | 204. | 239. | 1175.7 |
| 1.01 | 7.15 | 87 | 7.25 | 1397. | 254. | 247. | 1175.8 |
| 1.01 | 7.20 | 88 | 7.33 | 1421. | 335. | 254. | 1175.8 |
| 1.01 | 7.25 | 89 | 7.42 | 1430. | 437. | 261. | 1175.9 |
| 1.01 | 7.30 | 90 | 7.50 | 1424. | 539. | 268. | 1176.0 |
| 1.01 | 7.35 | 91 | 7.58 | 1408. | 611. | 274. | 1176.0 |
| 1.01 | 7.40 | 92 | 7.67 | 1383. | 684. | 279. | 1176.1 |
| 1.01 | 7.45 | 93 | 7.75 | 1350. | 747. | 283. | 1176.1 |
| 1.01 | 7.50 | 94 | 7.83 | 1309. | 801. | 287. | 1176.2 |
| 1.01 | 7.55 | 95 | 7.92 | 1260. | 846. | 290. | 1176.2 |
| 1.01 | 8.00 | 96 | 8.00 | 1204. | 882. | 293. | 1176.2 |
| 1.01 | 8.05 | 97 | 8.08 | 1146. | 909. | 295. | 1176.2 |
| 1.01 | 8.10 | 98 | 8.17 | 1089. | 962. | 298. | 1176.3 |

|      |       |     |       |       |      |      |        |
|------|-------|-----|-------|-------|------|------|--------|
| 1.01 | 8.15  | 99  | 8.25  | 1035. | 941. | 297. | 1176.3 |
| 1.01 | 8.20  | 100 | 8.33  | 986.  | 947. | 297. | 1176.3 |
| 1.01 | 8.25  | 101 | 8.42  | 940.  | 949. | 298. | 1176.3 |
| 1.01 | 8.30  | 102 | 8.50  | 897.  | 946. | 297. | 1176.3 |
| 1.01 | 8.35  | 103 | 8.58  | 857.  | 940. | 297. | 1176.3 |
| 1.01 | 8.40  | 104 | 8.67  | 821.  | 930. | 296. | 1176.3 |
| 1.01 | 8.45  | 105 | 8.75  | 788.  | 919. | 295. | 1176.3 |
| 1.01 | 8.50  | 106 | 8.83  | 754.  | 905. | 294. | 1176.2 |
| 1.01 | 8.55  | 107 | 8.92  | 727.  | 890. | 293. | 1176.2 |
| 1.01 | 9.00  | 108 | 9.00  | 699.  | 873. | 292. | 1176.2 |
| 1.01 | 9.05  | 109 | 9.08  | 673.  | 856. | 291. | 1176.2 |
| 1.01 | 9.10  | 110 | 9.17  | 649.  | 838. | 290. | 1176.2 |
| 1.01 | 9.15  | 111 | 9.25  | 628.  | 819. | 288. | 1176.2 |
| 1.01 | 9.20  | 112 | 9.33  | 608.  | 801. | 287. | 1176.2 |
| 1.01 | 9.25  | 113 | 9.42  | 589.  | 782. | 286. | 1176.2 |
| 1.01 | 9.30  | 114 | 9.50  | 572.  | 763. | 284. | 1176.1 |
| 1.01 | 9.35  | 115 | 9.58  | 555.  | 745. | 283. | 1176.1 |
| 1.01 | 9.40  | 116 | 9.67  | 539.  | 726. | 282. | 1176.1 |
| 1.01 | 9.45  | 117 | 9.75  | 524.  | 708. | 281. | 1176.1 |
| 1.01 | 9.50  | 118 | 9.83  | 509.  | 691. | 279. | 1176.1 |
| 1.01 | 9.55  | 119 | 9.92  | 494.  | 673. | 278. | 1176.1 |
| 1.01 | 10.00 | 120 | 10.00 | 480.  | 656. | 277. | 1176.1 |
| 1.01 | 10.05 | 121 | 10.08 | 466.  | 639. | 276. | 1176.1 |
| 1.01 | 10.10 | 122 | 10.17 | 452.  | 622. | 274. | 1176.0 |
| 1.01 | 10.15 | 123 | 10.25 | 439.  | 606. | 273. | 1176.0 |
| 1.01 | 10.20 | 124 | 10.33 | 427.  | 590. | 272. | 1176.0 |
| 1.01 | 10.25 | 125 | 10.42 | 415.  | 574. | 271. | 1176.0 |
| 1.01 | 10.30 | 126 | 10.50 | 403.  | 559. | 270. | 1176.0 |
| 1.01 | 10.35 | 127 | 10.58 | 393.  | 544. | 269. | 1176.0 |
| 1.01 | 10.40 | 128 | 10.67 | 383.  | 529. | 268. | 1176.0 |
| 1.01 | 10.45 | 129 | 10.75 | 373.  | 515. | 267. | 1176.0 |
| 1.01 | 10.50 | 130 | 10.83 | 364.  | 502. | 266. | 1176.0 |
| 1.01 | 10.55 | 131 | 10.92 | 354.  | 488. | 265. | 1176.0 |
| 1.01 | 11.00 | 132 | 11.00 | 348.  | 476. | 264. | 1175.9 |
| 1.01 | 11.05 | 133 | 11.08 | 341.  | 464. | 263. | 1175.9 |
| 1.01 | 11.10 | 134 | 11.17 | 335.  | 452. | 262. | 1175.9 |
| 1.01 | 11.15 | 135 | 11.25 | 330.  | 441. | 262. | 1175.9 |
| 1.01 | 11.20 | 136 | 11.33 | 325.  | 430. | 261. | 1175.9 |
| 1.01 | 11.25 | 137 | 11.42 | 320.  | 420. | 260. | 1175.9 |
| 1.01 | 11.30 | 138 | 11.50 | 316.  | 411. | 260. | 1175.9 |
| 1.01 | 11.35 | 139 | 11.58 | 312.  | 402. | 259. | 1175.9 |
| 1.01 | 11.40 | 140 | 11.67 | 308.  | 393. | 258. | 1175.9 |
| 1.01 | 11.45 | 141 | 11.75 | 304.  | 385. | 258. | 1175.9 |
| 1.01 | 11.50 | 142 | 11.83 | 301.  | 377. | 257. | 1175.9 |
| 1.01 | 11.55 | 143 | 11.92 | 298.  | 370. | 257. | 1175.9 |
| 1.01 | 12.00 | 144 | 12.00 | 295.  | 363. | 256. | 1175.9 |
| 1.01 | 12.05 | 145 | 12.08 | 292.  | 357. | 256. | 1175.9 |
| 1.01 | 12.10 | 146 | 12.17 | 290.  | 351. | 255. | 1175.9 |
| 1.01 | 12.15 | 147 | 12.25 | 287.  | 345. | 255. | 1175.8 |
| 1.01 | 12.20 | 148 | 12.33 | 284.  | 340. | 254. | 1175.8 |
| 1.01 | 12.25 | 149 | 12.42 | 282.  | 334. | 254. | 1175.8 |
| 1.01 | 12.30 | 150 | 12.50 | 279.  | 329. | 254. | 1175.8 |
| 1.01 | 12.35 | 151 | 12.58 | 276.  | 324. | 253. | 1175.8 |
| 1.01 | 12.40 | 152 | 12.67 | 273.  | 320. | 253. | 1175.8 |
| 1.01 | 12.45 | 153 | 12.75 | 270.  | 315. | 253. | 1175.8 |
| 1.01 | 12.50 | 154 | 12.83 | 266.  | 311. | 252. | 1175.8 |
| 1.01 | 12.55 | 155 | 12.92 | 263.  | 307. | 252. | 1175.8 |
| 1.01 | 13.00 | 156 | 13.00 | 259.  | 302. | 252. | 1175.8 |
| 1.01 | 13.05 | 157 | 13.08 | 255.  | 298. | 252. | 1175.8 |
| 1.01 | 13.10 | 158 | 13.17 | 251.  | 294. | 251. | 1175.8 |
| 1.01 | 13.15 | 159 | 13.25 | 247.  | 290. | 251. | 1175.8 |
| 1.01 | 13.20 | 160 | 13.33 | 243.  | 286. | 251. | 1175.8 |
| 1.01 | 13.25 | 161 | 13.42 | 239.  | 282. | 250. | 1175.8 |
| 1.01 | 13.30 | 162 | 13.50 | 236.  | 277. | 250. | 1175.8 |
| 1.01 | 13.35 | 163 | 13.58 | 232.  | 275. | 250. | 1175.8 |
| 1.01 | 13.40 | 164 | 13.67 | 228.  | 271. | 250. | 1175.8 |

|      |       |     |       |      |      |      |        |
|------|-------|-----|-------|------|------|------|--------|
| 1.01 | 13.45 | 165 | 13.75 | 225. | 271. | 249. | 1175.8 |
| 1.01 | 13.50 | 166 | 13.83 | 221. | 269. | 249. | 1175.8 |
| 1.01 | 13.55 | 167 | 13.92 | 218. | 267. | 249. | 1175.8 |
| 1.01 | 14.00 | 160 | 14.00 | 215. | 265. | 248. | 1175.8 |
| 1.01 | 14.05 | 169 | 14.08 | 212. | 263. | 248. | 1175.8 |
| 1.01 | 14.10 | 170 | 14.17 | 210. | 261. | 248. | 1175.8 |
| 1.01 | 14.15 | 171 | 14.25 | 207. | 259. | 247. | 1175.8 |
| 1.01 | 14.20 | 172 | 14.33 | 205. | 256. | 247. | 1175.8 |
| 1.01 | 14.25 | 173 | 14.42 | 203. | 254. | 247. | 1175.8 |
| 1.01 | 14.30 | 174 | 14.50 | 200. | 252. | 246. | 1175.8 |
| 1.01 | 14.35 | 175 | 14.58 | 198. | 250. | 246. | 1175.8 |
| 1.01 | 14.40 | 176 | 14.67 | 196. | 248. | 246. | 1175.7 |
| 1.01 | 14.45 | 177 | 14.75 | 195. | 246. | 245. | 1175.7 |
| 1.01 | 14.50 | 178 | 14.83 | 193. | 243. | 245. | 1175.7 |
| 1.01 | 14.55 | 179 | 14.92 | 191. | 241. | 245. | 1175.7 |
| 1.01 | 15.00 | 180 | 15.00 | 189. | 239. | 244. | 1175.7 |
| 1.01 | 15.05 | 181 | 15.08 | 188. | 237. | 244. | 1175.7 |
| 1.01 | 15.10 | 182 | 15.17 | 186. | 235. | 244. | 1175.7 |
| 1.01 | 15.15 | 183 | 15.25 | 185. | 233. | 243. | 1175.7 |
| 1.01 | 15.20 | 184 | 15.33 | 183. | 231. | 243. | 1175.7 |
| 1.01 | 15.25 | 185 | 15.42 | 182. | 229. | 243. | 1175.7 |
| 1.01 | 15.30 | 186 | 15.50 | 180. | 227. | 242. | 1175.7 |
| 1.01 | 15.35 | 187 | 15.58 | 179. | 225. | 242. | 1175.7 |
| 1.01 | 15.40 | 188 | 15.67 | 178. | 223. | 242. | 1175.7 |
| 1.01 | 15.45 | 189 | 15.75 | 176. | 221. | 241. | 1175.7 |
| 1.01 | 15.50 | 190 | 15.83 | 175. | 219. | 241. | 1175.7 |
| 1.01 | 15.55 | 191 | 15.92 | 174. | 217. | 241. | 1175.7 |
| 1.01 | 16.00 | 192 | 16.00 | 173. | 216. | 240. | 1175.7 |
| 1.01 | 16.05 | 193 | 16.08 | 171. | 214. | 240. | 1175.7 |
| 1.01 | 16.10 | 194 | 16.17 | 170. | 212. | 240. | 1175.7 |
| 1.01 | 16.15 | 195 | 16.25 | 169. | 210. | 240. | 1175.7 |
| 1.01 | 16.20 | 196 | 16.33 | 168. | 209. | 239. | 1175.7 |
| 1.01 | 16.25 | 197 | 16.42 | 167. | 207. | 239. | 1175.7 |
| 1.01 | 16.30 | 198 | 16.50 | 166. | 205. | 239. | 1175.7 |
| 1.01 | 16.35 | 199 | 16.58 | 165. | 204. | 239. | 1175.7 |
| 1.01 | 16.40 | 200 | 16.67 | 164. | 202. | 238. | 1175.7 |

PEAK OUTFLOW IS 949. AT TIME 8.42 HOURS

|            |      |      |        |         |         |              |
|------------|------|------|--------|---------|---------|--------------|
| CFS        | 949. | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
| CHS        | 27.  |      | 508.   | 268.    | 268.    | 53665.       |
| INCHES     |      |      | 17.    | 8.      | 8.      | 1520.        |
| MM         |      |      | 1.57   | 1.99    | 1.99    |              |
| AC-FT      |      |      | 39.94  | 50.61   | 50.61   |              |
| THOUS CU H |      |      | 292.   | 370.    | 370.    |              |
|            |      |      | 360.   | 456.    | 456.    |              |

\*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)  
AREA IN SQUARE MILES(SQUARE KILOMETERS)

| HYDROGRAPH AT | PEAK    | 6-HOUR  | 24-HOUR | 72-HOUR | AREA  |
|---------------|---------|---------|---------|---------|-------|
| A1            | 3798.   | 1067.   | 401.    | 401.    | 2.28  |
| ( 107.54)(    | 30.22)( | 11.37)( | 11.37)( | 11.37)( | 5.91) |
| A2            | 237.    | 221.    | 120.    | 120.    | 2.28  |
| ( 6.71)(      | 6.27)(  | 3.39)(  | 3.39)(  | 3.39)(  | 5.91) |

AD-A087 543

NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/6 13/13  
NATIONAL DAM SAFETY PROGRAM. LAKE WANDA DAM (NJ00510), HUDSON R--ETC(U)  
MAR 80 W A GUINAN DACW61-79-C-0011

NL

UNCLASSIFIED

2 OF 2  
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10-10-84



END  
DATE  
FILMED  
9-80  
DTIC

HYDROGRAPH AT  
 2-COMBINED  
 ROUTED TO

|  | A3        | 1399.     | 537.     | 205.     | 205.     | 1.20 |
|--|-----------|-----------|----------|----------|----------|------|
|  | ( 36.78 ) | ( 15.20 ) | ( 5.81 ) | ( 5.81 ) | ( 3.11 ) |      |
|  | A4        | 1430.     | 715.     | 325.     | 325.     | 3.48 |
|  | ( 40.49 ) | ( 20.24 ) | ( 9.20 ) | ( 9.20 ) | ( 9.01 ) |      |
|  | A5        | 949.      | 588.     | 248.     | 248.     | 3.48 |
|  | ( 26.87 ) | ( 16.66 ) | ( 7.60 ) | ( 7.60 ) | ( 9.01 ) |      |

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

|                    | ELEVATION<br>STORAGE<br>OUTFLOW  | INITIAL VALUE<br>1190.00<br>1850.<br>0. | SPILLWAY CREST<br>1190.00<br>1850.<br>0. | TOP OF DAM<br>1194.00<br>3199.<br>1404. |
|--------------------|----------------------------------|-----------------------------------------|------------------------------------------|-----------------------------------------|
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM            | MAXIMUM<br>STORAGE<br>AC-FT              | MAXIMUM<br>OUTFLOW<br>CFS               |
| 0.00               | 1191.42                          | 0.00                                    | 2318.                                    | 237.                                    |

.....

|      | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |
|------|-----------------------------|---------------------------|-------------------------------|---------------------------------|-----------------------------|
| 0.00 | 2318.                       | 237.                      | 0.00                          | 9.83                            | 0.00                        |

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

|                    | ELEVATION<br>STORAGE<br>OUTFLOW  | INITIAL VALUE<br>1174.13<br>160.<br>5. | SPILLWAY CREST<br>1173.90<br>150.<br>0. | TOP OF DAM<br>1174.80<br>184.<br>28. |
|--------------------|----------------------------------|----------------------------------------|-----------------------------------------|--------------------------------------|
| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S.ELEV | MAXIMUM<br>DEPTH<br>OVER DAM           | MAXIMUM<br>STORAGE<br>AC-FT             | MAXIMUM<br>OUTFLOW<br>CFS            |
| 0.00               | 1176.28                          | 1.48                                   | 298.                                    | 949.                                 |

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|      | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |
|------|-----------------------------|---------------------------|-------------------------------|---------------------------------|-----------------------------|
| 0.00 | 298.                        | 949.                      | 10.25                         | 8.42                            | 0.00                        |

## APPENDIX 4

### REFERENCES

#### LAKE WANDA DAM

1. Chow, Ven Te, Open Channel Hydraulics, McGraw Hill Book Company, New York, 1959.
2. King, H.W. and E.F. Brater, Handbook of Hydraulics, McGraw-Hill Book Company, New York, Fifth Edition 1963.
3. Lewis, J.V. and H.B. Kummel (1910-1912) Geologic Map of New Jersey, revised by H.B. Kummel, 1931, and by M.E. Johnson, 1950. New Jersey Department of Conservation and Economic Development Atlas, Sheet 10.
4. Louis Berger & Associates, Inc., Phase I Report, National Dam Inspection Program, September 1979.
5. Schway, G.O., R.K. Frevert, T.W. Edmister, and K.K. Barnes, Soil and Water Conservation Engineering, The Ferguson Foundation Agricultural Engineering Series, John Wiley and Sons, Inc., New York, 1966, 683 pp.
6. U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1) for Dam Safety Inspections Users Manual, Davis, California, September 1978.
7. United States Department of Interior, Bureau of Reclamation, Design of Small Dams, U.S. Government Printing Office, Washington, 1977, 816 pp.
8. U.S. Department of Interior, Geological Survey, 7.5-Minute Series (topographic) maps, scale 1:24000, Contour Interval 20 feet: Dover, New Jersey, (1954), Boonton, New Jersey, (1954).
9. U.S. Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release No. 55, Washington, 1975.
10. U.S. Department of Commerce, Weather Bureau, "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24, and 48 Hours", Hydrometeorological Report No. 33, Washington, 1977, 816 pp.