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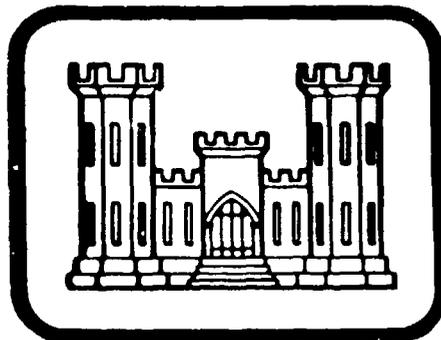
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SUSQUEHANNA RIVER BASIN  
LAKE CONEWAGO DAM  
EASTERN ENTERPRISES, INC

NDI NO PA-00593  
DER NO 38-012

LEBANON COUNTY, PENNSYLVANIA  
PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM



DTIC  
SELECTED  
DEC 29 1981  
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7ACW31-81-C-0013  
PREPARED FOR

DEPARTMENT OF THE ARMY  
Baltimore District, Corps of Engineers  
Baltimore, Maryland 21203

BY  
Berger Associates  
Harrisburg, Pennsylvania 17105

JULY 1981

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PREFACE

This report has been 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. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

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 frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design 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.

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**A**

PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS  
AND RECOMMENDATIONS

Name of Dam: LAKE CONEWAGO DAM  
State & State No.: PENNSYLVANIA, 38-012  
County: LEBANON  
Stream: CONEWAGO  
Date of Inspection: June 15, 1981

Based on the visual inspection, past performance and the available engineering data, the dam and its appurtenant structures appear to be in poor condition.

In accordance with the Corps of Engineers' evaluation guidelines, the size classification of this dam is small, and the hazard classification is significant. These classifications indicate that the Spillway Design Flood (SDF) should be in the range of the 100 year flood to one-half the Probable Maximum Flood (PMF). The recommended SDF for this structure is the 100 year flood. The spillway capacity is insufficient for passing the SDF without overtopping the dam. The spillway, therefore, is considered to be inadequate.

The following recommendations are presented for immediate action by the owner.

1. That provisions be made to provide an adequate spillway capacity.
2. That the upstream and downstream slopes and the crest be cleared of all trees and brush, under the supervision of a professional engineer experienced in the design and construction of dams. The embankment should be provided with an adequate protective vegetative or rock cover and be maintained on a regular basis.
3. That, after clearing the embankment, the downstream slope be inspected by a professional engineer experienced in the design and construction of dams. Recommendations to improve the stability of this slope should be executed.

LAKE CONEWAGO DAM      NDI NO. PA-00593      DER NO. 38-012

EASTERN ENTERPRISES, INC.      LEBANON COUNTY

4. That the valve and outlet of the drawdown pipe be cleared of debris.
5. That provisions be made for closure of the upstream end of the outlet pipe in case of an emergency.
6. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.
7. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

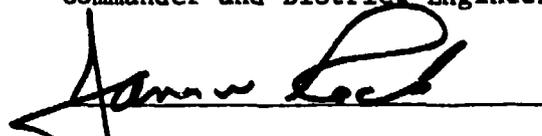
SUBMITTED BY:

BERGER ASSOCIATES, INC.  
HARRISBURG, PENNSYLVANIA

July 31, 1981

APPROVED BY:

James W. Peck  
Colonel, Corps of Engineers  
Commander and District Engineer DATE:



DATE: 7 Aug 81







OVERVIEW - UPSTREAM EMBANKMENT

LAKE CONEWAGO DAM

Photograph No. 1

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PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

LAKE CONEWAGO DAM

NDI NO. PA-00593  
DER NO. 38-012

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

A. Authority

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspections of dams throughout the United States.

B. Purpose

The purpose of this inspection is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

A. Description of Dam and Appurtenances

Note: A drawing outlining repairs to the dam indicates a spillway crest at elevation 102.0. It was estimated from the U.S.G.S. quadrangle that normal pool elevation is at elevation 610.0. This elevation was used in the inspection survey as the spillway crest elevation.

Lake Conewago is a privately owned reservoir used for public recreation. The dam consists of a 270 foot long embankment. The crest of the dam is about 18 feet above the streambed elevation at the downstream toe. A 55 foot wide spillway (North Spillway) is located in the right abutment and discharges through a narrow deep cut in the hillside to the natural stream. A small (12-inch pipe) overflow outlet (South Spillway) is located near the left abutment. The drawdown facility consists of a pipe of unknown size with a downstream control valve.

B. Location: South Londonderry Township, Lebanon County  
U.S.G.S. Quadrangle - Manheim, Pennsylvania  
Latitude 40°-14.6', Longitude 76°-28.7'  
Appendix E, Plates I & II

C. Size Classification: Small: Height - 18 feet  
Storage - 96 acre-feet

- D. Hazard Classification: Significant (Refer to Section 3.1.E.)
- E. Ownership: Eastern Enterprises, Inc.  
Mr. Gene Otto, Jr., Secretary  
Box 14  
Mt. Gretna, Pennsylvania 17064
- F. Purpose: Recreation
- G. Design and Construction History

There are no records of the original design and construction of this dam. The facilities were first inspected by a representative of the predecessor of the Pennsylvania Department of Environmental Resources (PennDER) in 1919. Suggested repairs for the embankment and spillway were prepared by PennDER in 1932. Actual repairs occurred in 1934-1935.

H. Normal Operating Procedures

The reservoir is used for swimming and boating and a normal pool level is desired for these purposes. The beaches and other facilities require maintenance work on an annual basis. The drawdown valve has been operated on a regular schedule since 1936 in order to maintain the beaches.

1.3 PERTINENT DATA

A. Drainage Area (square miles)

From files:	2.0
Computed for this report:	1.61
Use:	1.61

B. Discharge at Dam Site (cubic feet per second)  
See Appendix D for hydraulic calculations

Maximum known flood (estimated from gage records for nearby Beck Creek)	1447
Outlet works at pool Elev. 610	13
Outlet works at low pool Elev. 602	7
North spillway capacity at pool Elev. 611.5 (low point of dam)	384
South spillway capacity at pool Elev. 611.5	5

	Total spillway capacity at pool Elev. 611.5	389
C.	<u>Elevation</u> (feet above mean sea level)	
	Top of dam (low point)	611.5
	Top of dam (design crest in 1932)	612.0
	North spillway crest	610.0
	South spillway crest	609.5
	Upstream outlet invert (estimate)	598±
	Downstream outlet invert	593.3
	Streambed at downstream toe of dam (estimate)	593
D.	<u>Reservoir</u> (miles)	
	Length of normal pool (Elev. 610)	0.3
	Length of maximum pool (Elev. 611.5)	0.4
E.	<u>Storage</u> (acre-feet)	
	Spillway crest (Elev. 610)	76.7
	Top of dam (Elev. 611.5)	96
F.	<u>Reservoir Surface</u> (acres)	
	Spillway crest (Elev. 610)	11.3
	Top of dam (Elev. 611.5)	15.3
G.	<u>Dam</u>	
	Refer to Plate III in Appendix E for plan and section.	
	Type:	Earthfill.
	Length:	270 feet.
	Height:	18 feet.
	Top Width:	Design - 12 feet; Survey - 5 feet.

Side Slopes:		<u>Design</u>	<u>Surveyed</u>
	Upstream	Unknown	Irregular
	Downstream	Unknown	(1.2H to 1V)

Zoning: Unknown. Plate III indicates placing of rock fill on the downstream slope.

Cutoff: Unknown.

Grouting: Unknown.

H. Outlet Facilities

Type: Estimated to be 12-inch diameter pipe with valve on downstream end.

Upstream  
Invert: (Estimated) 598±

Downstream  
Invert: 593.3

Location: Near center of dam.

I. Spillway

North:

Type: Triangular shaped weir.

Length  
of Weir: 55 feet.

Crest  
Elevation: 610

Location: Right abutment.

South:

Type: 12-inch diameter culvert pipe.

Location: Near left abutment.

Crest  
Elevation: 609.5

J. Regulating Outlets

See Section 1.3.H. above.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

Engineering data for the original dam design do not exist. Inspection reports by State (PennDER) representatives in 1919 and subsequent years indicated that the spillway was considered to be too small. They suggested a spillway capacity of 1300 cfs. The facilities were owned by the Pennsylvania State Military Reservation at that time. The commander asked for suggested repairs to the structures, and PennDER provided a drawing (Plate III, Appendix E). Calculations and letters in the file indicate that the spillway capacity was calculated to be 430 cfs. The maximum expected flow of 1300 cfs would overtop the crest by 0.8 foot. A rock fill placed on the downstream slope was intended to prevent damage to the slope in the case of overtopping.

### 2.2 CONSTRUCTION

Construction data for Lake Conewago Dam are limited to some inspection reports prepared by PennDER and photographs. Photographs indicate that in 1921 the spillway was closed off except for two small (4 feet wide) openings. Seven or eight 10-inch diameter trees were located on the crest. The upstream slope and flow line were irregular. Photographs dated 1932 indicate a spillway obstructed by a low footbridge and a 10-inch sewer line. The outlet structure, constructed of heavy masonry, is shown at its present location. The spillway discharge channel appears to be a rock lined ditch 4 feet wide and 3 feet deep. In 1933, the dam was overtopped, and a part of the downstream slope near the left abutment was washed away. In the fall of 1934, work was started on improving the spillway. Photographs taken in March 1935 indicate a straight concrete wall and a concrete abutment wall on the left side. The sewer line is shown crossing the spillway channel. The crest of the dam appears to be built up as shown on Plate III. Heavy brush was reported on the embankment in 1946. A photograph taken in 1959 shows the south spillway headwall.

### 2.3 OPERATION

Records of operation are not maintained by the owner.

### 2.4 EVALUATION

#### A. Availability

The only available information is contained in the PennDER files, Harrisburg, Pennsylvania.

#### B. Adequacy

Because of the lack of engineering and construction data, the assessment of the dam is based on the results of the visual inspection.

C. Operating Records

Operating records have not been maintained.

D. Post Construction Changes

Major repair work to the spillway and the crest of the dam were executed in 1934-1935. The 12-inch pipe for the south spillway was constructed prior to 1959.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

#### A. General

The general appearance of Lake Conewago Dam is poor. The crest and the upstream and downstream slopes are covered with dense brush and large trees. The downstream slope is not uniform and in certain areas is unprotected against erosion. Steep sections show exposed cobbles and loose large stone fragments. The crest of the dam at its low point is only 1.5 feet above normal pool. The spillway discharge channel can be easily obstructed due to the presence of the sewer line.

The visual inspection check list and sketches of the general plan and profile of the dam, as surveyed during the inspection, are presented in Appendix A of this report. Photographs of the facilities taken during the inspection are reproduced in Appendix C.

The site was first visited by the inspectors on April 9, 1981. Mr. Gene Otto, Jr., met the inspectors at the site. Due to heavy rain, the actual inspection was postponed until June 15, 1981.

#### B. Embankment

The centerline of the dam is straight, with the spillway weir angled to this centerline. The upstream slope of the embankment is covered with brush and trees (Photograph No. 1). The flow line is not straight, and the slope is nearly vertical at many locations, with little vegetative protection. The crest of the dam is covered with trees and brush and varies in elevation from 1.5 feet to 2.4 feet above normal pool (Plate A-II, Appendix A). The crest width is irregular.

The downstream slope is very uneven, with some steep sections (1.2H to 1V). This slope is also covered with trees and brush and several bare spots were in evidence. One area appears to be a footpath adjacent to the valve box (Photographs No. 4). Two areas have exposed loose steep rock fills (Photographs No. 2 and 3). Voids are in evidence and some sloughs indicate an unstable surface condition.

#### C. Appurtenant Structures

The main spillway is located in the north abutment. The 55 foot long concrete weir is in good condition (Photograph No. 7). The left side of the spillway channel has a concrete wall. The right side is formed by natural ground. Downstream of the dam the spillway discharge channel has been excavated into rock or has eroded its own channel (Photograph No. 9). A sewer line crosses the channel about 20 feet

downstream from the weir, with only about 1.5 feet of clearance above the channel bottom. Clogging of the waterway opening could occur (Photograph No. 8).

Another small outlet (south spillway) is located near the left abutment. It consists of a small concrete headwall with a 1.0 foot x 1.33 foot opening (Photograph No. 5).

A 12-inch pipe daylights at the downstream side and discharges into a concrete flume (Photograph No. 6). The drawdown facility is located near the center of the dam. A heavy masonry structure (Photograph No. 4) with an open top contains the downstream valve. The outlet pipe was buried, and the size could not be determined and was unknown to the owner. The valve is used annually for lowering the pool.

#### D. Reservoir Area

The reservoir and immediate adjacent land is used as a recreational area. Beaches and piers are located on the west side of the reservoir. The east side of the reservoir is wooded and is adjacent to Route 117. The slopes to the reservoir are stable. Most of the drainage area is woodlands.

#### E. Downstream Channel

The immediate downstream channel of the spillway is a narrow channel with rock bottom and sides. A bridge with a waterway opening of 13.0 feet x 7.2 feet is located about 125 feet downstream. The Conewago Creek runs through a wooded area. A lumber company, two homes, a trailer, and a restaurant are located in the floodplain area about 2.5 miles downstream of the dam. A potential hazard to loss of life exists downstream if the dam fails. There is a possibility of the loss of a few lives. The hazard category is, therefore, considered to be "Significant."

### 3.2 EVALUATION

The overall visual evaluation of Lake Conewago Dam is poor. The embankment is irregular in profile and cross section; it is overgrown with trees and brush and has loose fill on the downstream slope. The sewer line in the spillway channel could reduce the efficiency of the spillway.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

Lake Conewago Dam is used only as a recreational facility. The reservoir is lowered on an annual basis to permit maintenance work on beaches, piers, and other recreational facilities. There are no procedures for the embankment maintenance.

### 4.2 MAINTENANCE OF EMBANKMENT

The inspection of the facilities indicates that the embankment has not been maintained. Trees and brush and steep slopes show little maintenance of the embankment structure.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

The only operating facility is the drawdown valve, which is operated on an annual basis. Maintenance of the outlet pipe and the spillway appear to be minimal.

### 4.4 WARNING SYSTEM

There is no formally organized surveillance and downstream warning system in existence at the present time.

### 4.5 EVALUATION

The operational procedures for Lake Conewago Dam are minimal. It is recommended that a program be developed for maintenance of the embankment and the drawdown valve. A formal surveillance plan and downstream warning system should be developed for implementation during periods of heavy or prolonged rainfall.

## SECTION 5 - HYDROLOGY/HYDRAULICS

### 5.1 EVALUATION OF FEATURES

#### A. Design Data

The hydrologic and hydraulic analysis available from PennDER for Lake Conewago Dam was not very extensive. No area-capacity curve, frequency curve, unit hydrograph, design storm, design flood hydrograph, or flood routings were available.

#### B. Experience Data

There are no records of flood levels at Lake Conewago Dam. It was reported that the dam was overtopped in June 1972 (Agnes) when an upstream dam failed. Based on records of the U.S.G.S. stream gage on Beck Creek at nearby Cleona, Pennsylvania, this flood event is estimated to have produced a maximum inflow to Lake Conewago of 1447 cfs.

#### C. Visual Observations

No other conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event.

#### D. Overtopping Potential

Lake Conewago Dam has a total storage capacity of 96 acre-feet and an overall height of 18 feet above streambed. These dimensions indicate a size classification of "Small." The hazard classification is "Significant" (see Section 3.1.E).

The recommended Spillway Design Flood (SDF) for a dam having the above classifications is in the range of the 100 year flood to one-half the Probable Maximum Flood (PMF). Because of the small size of this dam and the distance to the population downstream, the recommended SDF is the 100 year flood. For this dam, the SDF peak inflow is 939 cfs (see Appendix D for HEC-1 inflow computations).

Comparison of the estimated SDF peak inflow of 939 cfs with the estimated spillway discharge capacity of 389 cfs indicates that a potential for overtopping of the Lake Conewago Dam exists.

#### E. Spillway Adequacy

Calculations show that the total spillway discharge capacity, based on the present low point in the dam profile, can not pass the SDF without overtopping (refer to Appendix D). The spillway, therefore, is considered to be inadequate.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

#### A. Visual Observations

##### 1. Embankment

The visual inspection of Lake Conewago Dam did not detect any signs of seepage through the embankment. The downstream slope has several areas with exposed loose rock fills. This condition would cause rapid erosion during overtopping. The height of the embankment above normal pool is only 1.5 feet and overtopping appears quite feasible. The exposed upstream slope is steep.

##### 2. Appurtenant Structures

The outlet of the drawdown pipe is buried in debris and stone. The presence of the sewer pipe across the main spillway could cause an obstruction. The left abutment wall of the spillway appeared to be in good condition.

#### B. Design and Construction Data

Design and construction data for the embankment do not exist.

#### C. Operating Records

Operating records for this dam have not been maintained by the owner.

#### D. Post Construction Changes

Reference is made to Section 2 of this report for discussion of post construction changes. A rock fill was placed on the downstream slope in 1935. This area appears to erode.

#### E. Seismic Stability

This dam is located in Seismic Zone 1, and it is considered that the static stability is sufficient to withstand minor earthquake-induced dynamic forces. No studies or calculations have been made to confirm this assumption.

## SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

### 7.1 DAM ASSESSMENT

#### A. Safety

The visual inspection indicates that Lake Conewago Dam is in poor condition. Engineering design and construction data are not available for review. The visual inspection indicates a possible unstable surface condition of the downstream slope. Overtopping could cause severe erosion. Trees and brush are covering the embankment.

In accordance with the Corps of Engineers' evaluation guidelines, the size classification of this dam is small and the hazard classification is significant. These classifications indicate that the Spillway Design Flood (SDF) should be in the range of the 100 year flood to one-half the Probable Maximum Flood (PMF). The recommended SDF for this structure is the 100 year flood.

The hydrologic and hydraulic computations indicate that the combination of storage capacity and the discharge capacity of the spillway is insufficient to pass the recommended SDF without overtopping the dam. The spillway is therefore considered to be inadequate.

#### B. Adequacy of Information

The visual inspection is considered to be sufficiently adequate for making a reasonable assessment of this dam.

#### C. Urgency

The recommendations presented below should be implemented immediately.

#### D. Additional Studies

An evaluation should be made of the downstream embankment slope, after removal of the trees, and appropriate recommendations should be made.

### 7.2 RECOMMENDATIONS

In order to assure the continued satisfactory operation of this dam, the following recommendations are presented for immediate implementation by the owner:

1. That provisions be made to provide an adequate spillway capacity.

2. That the upstream and downstream slopes and the crest be cleared of all trees and brush under the supervision of a professional engineer experienced in the design and construction of dams. The embankment should be provided with an adequate protective vegetative or rock cover and be maintained on a regular basis.
3. That, after clearing the embankment, the downstream slope be inspected by a professional engineer experienced in the design and construction of dams. Recommendations to improve the stability of this slope should be executed.
4. That the valve and outlet of the drawdown pipe be cleared of debris.
5. That provision be made for upstream closure of the outlet pipe in case of an emergency.
6. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.
7. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

**APPENDIX A**  
**CHECK LIST OF VISUAL INSPECTION REPORT**

**APPENDIX A**

CHECK LIST

PHASE I - VISUAL INSPECTION REPORT

PA DER # <u>38-012</u>	NDI NO. <u>PA-00 593</u>
NAME OF DAM <u>Lake Conewago</u>	HAZARD CATEGORY <u>Significant</u>
TYPE OF DAM <u>Earth Embankment</u>	
LOCATION <u>West Cornwall</u>	TOWNSHIP <u>Lebanon</u> COUNTY, PENNSYLVANIA
INSPECTION DATE <u>6-15-81</u>	WEATHER <u>Cloudy-Showers</u> TEMPERATURE <u>70's</u>
INSPECTORS: <u>R. Houseal (Recorder)</u>	OWNER'S REPRESENTATIVE(s):
<u>H. Jongsma</u>	<u>Mr. Gene Otto, Jr. (4-9-81)</u>
<u>A. Bartlett</u>	_____
<u>R. Shireman</u>	_____
_____	_____
NORMAL POOL ELEVATION: <u>610</u>	AT TIME OF INSPECTION: _____
BREAST ELEVATION: <u>Unknown</u>	POOL ELEVATION: <u>Spillway + 1/2"</u>
SPILLWAY ELEVATION: <u>610 (Est. U.S.G.S.)</u>	TAILWATER ELEVATION: _____
MAXIMUM RECORDED POOL ELEVATION: <u>Unknown</u>	
GENERAL COMMENTS: This dam appears to be in poor condition. The crest and the slopes are covered with dense brush and large trees. The downstream slope is not uniform and exposed cobbles and large rock fragments are loose and have noted voids. The exposed upstream slope is only about 2 feet above water level to the crest and is near vertical at many locations.	

VISUAL INSPECTION  
EMBANKMENT

	OBSERVATIONS AND REMARKS
A. SURFACE CRACKS	None observed - Cover too heavy. Trees up to 36" $\phi$ .
B. UNUSUAL MOVEMENT BEYOND TOE	None detected - Cover too heavy.
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	Rock Fill on downstream slope is loose and displaced in some areas. Voids in rock are evident - Slope uneven appears to have sloughed.
D. ALIGNMENT OF CREST: HORIZONTAL: VERTICAL:	Horizontal - straight  Vertical - Refer to Plate A-II.
E. RIPRAP FAILURES	Could not observe - brush and trees prevent observations.
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Junction on left appears sound. Junction on right with spillway appears sound.
G. SEEPAGE	None detected.
H. DRAINS	None.
J. GAGES & RECORDER	None.
K. COVER (GROWTH)	Downstream. Trees and Brush. Up to 36" dia. Crest same. U/S slope is nearly vertical to water's edge - Large trees growing.

VISUAL INSPECTION  
OUTLET WORKS

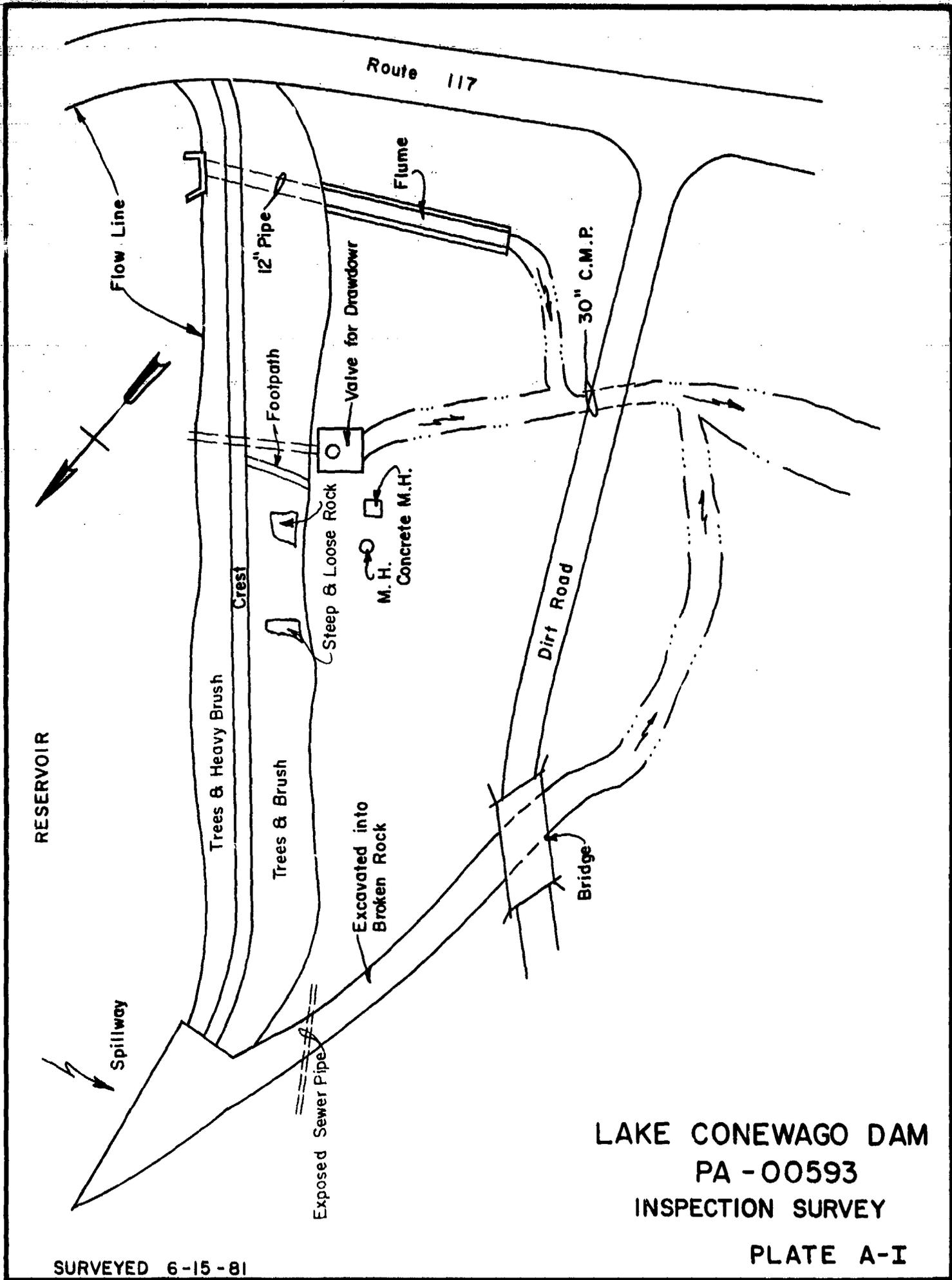
	OBSERVATIONS AND REMARKS
A. INTAKE STRUCTURE	None.
B. OUTLET STRUCTURE	Valve in downstream pit - Not observed.
C. OUTLET CHANNEL	Narrow channel to 30" CMP under roadway.
D. GATES	Valve of unknown size.
E. EMERGENCY GATE	See above.
F. OPERATION & CONTROL	Open valve for off season drawn down for beach repair and maintenance.
G. BRIDGE (ACCESS)	None.

VISUAL INSPECTION  
SPILLWAY

	OBSERVATIONS AND REMARKS
A. APPROACH CHANNEL	Approach is directly from right side of reservoir into major spillway.
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Sharp crested weir. Good condition - Some exposed aggregate in concrete (Right side). 12" x 16" concrete orifice on left side discharging through embankment then into a concrete flume.
C. DISCHARGE CHANNEL: Lining Cracks Stilling Basin	Rock lined and natural rock. 8" dia. pipe 18" above channel at end of stone walls. Obstruction (sewer). Flume concrete and rock lined.
D. BRIDGE & PIERS	Bridge for access road 125 feet downstream of weir.  Opening 13'0" wide by 7.2' high.
E. GATES & OPERATION EQUIPMENT	None.
F. CONTROL & HISTORY	None.

VISUAL INSPECTION

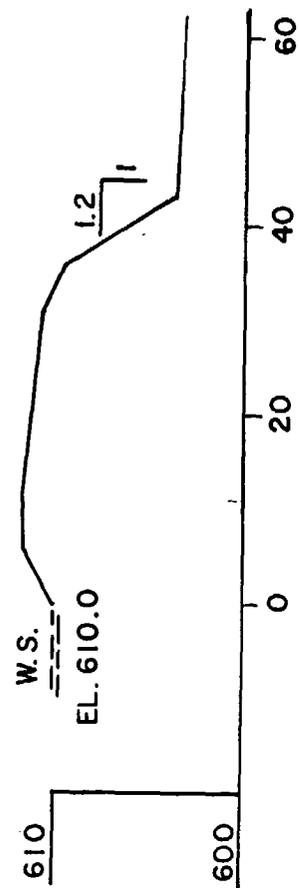
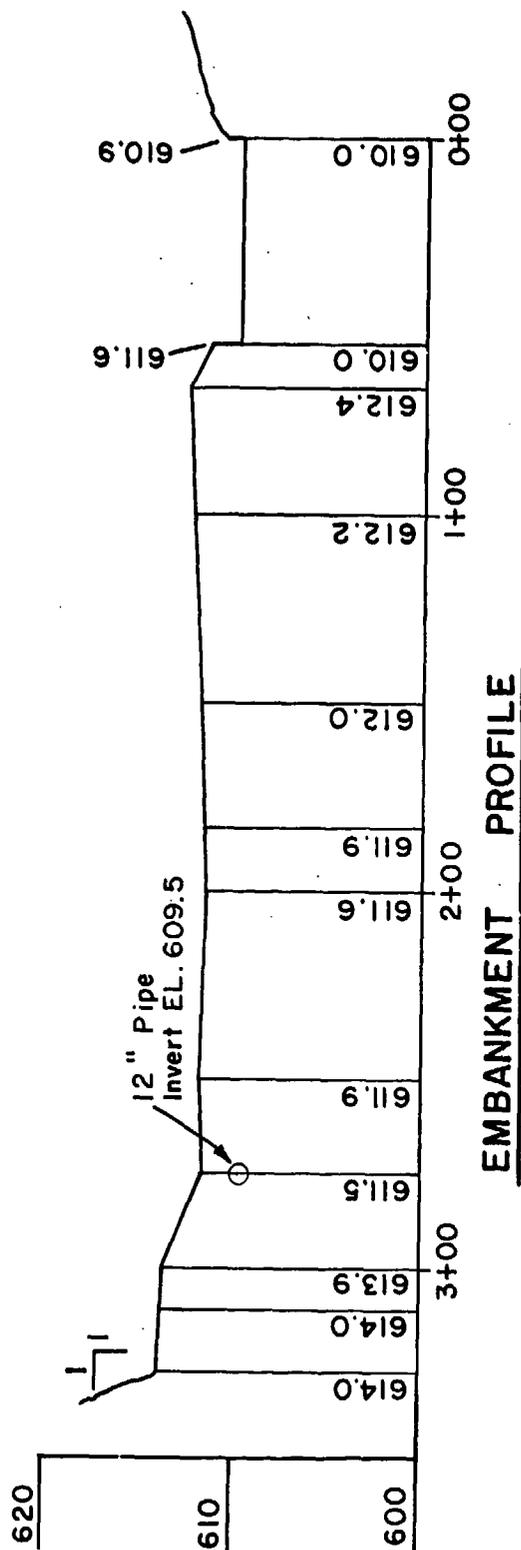
	OBSERVATIONS AND REMARKS
<u>INSTRUMENTATION</u>	
Monumentation	None.
Observation Wells	None.
Weirs	None.
Piezometers	None.
Staff Gauge	None.
Other	None.
<u>RESERVOIR</u>	
Slopes	Woods and beach area.
Sedimentation	None reported.
Watershed Description	Mostly wooded with many summer cabins.
<u>DOWNSTREAM CHANNEL</u>	
Condition	Brush and trees in overbanks.
Slopes	Woodlands.
Approximate Population	15+
No. Homes	Lumber Co. - 2 homes - 1 trailer. 1 Rest. - 1 Service Station 2 1/2 miles d/s



LAKE CONEWAGO DAM  
 PA - 00593  
 INSPECTION SURVEY

PLATE A-I

SURVEYED 6-15-81

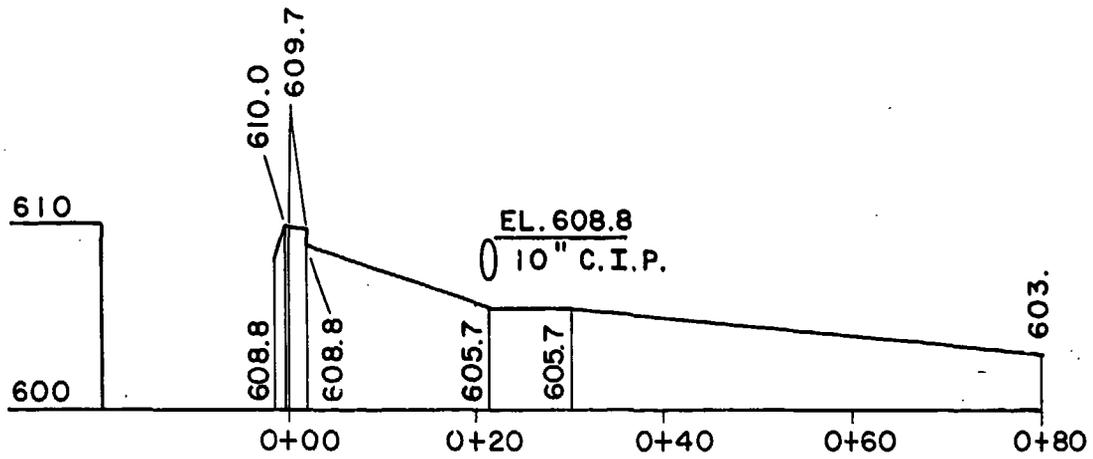


SURVEYED 6-15-81

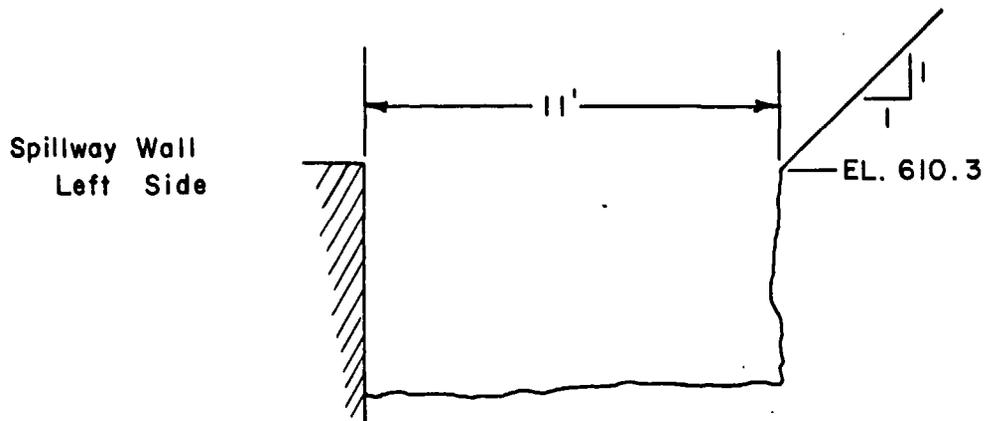
LAKE CONEWAGO DAM  
PA - 00593

INSPECTION SURVEY

PLATE A-II



SPILLWAY PROFILE



CROSS SECTION SPILLWAY CHANNEL

LAKE CONEWAGO DAM  
PA - 00593  
INSPECTION SURVEY

SURVEYED 6-15-81

PLATE A-III

**APPENDIX B**  
**CHECK LIST OF ENGINEERING DATA**

**APPENDIX B**

CHECK LIST  
ENGINEERING DATA

PA DER # 38-012

NDI NO. PA-00 593

NAME OF DAM Lake Conewago Dam

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. Quadrangle - Manheim, Pennsylvania See Plate II, Appendix E
CONSTRUCTION HISTORY	Original construction date unknown. Major repairs in 1934-1935.
GENERAL PLAN OF DAM	Plate III, Appendix E.
TYPICAL SECTIONS OF DAM	Plate III, Appendix E.
OUTLETS: PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	None.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL & RESERVOIR RECORDS	No records.
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS: HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS: BORING RECORDS LABORATORY FIELD	None.
POST CONSTRUCTION SURVEYS OF DAM	Plate III, Appendix E.
BORROW SOURCES	Unknown.

ENGINEERING DATA

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Spillway improved in 1935. Embankment raised in 1935.
HIGH POOL RECORDS	No records.
POST CONSTRUCTION ENGINEERING STUDIES & REPORTS	Inspected by PennDER in 1932.
PRIOR ACCIDENTS OR FAILURE OF DAM  Description:  Reports:	No records of failure. Overtopped in 1933.
MAINTENANCE & OPERATION RECORDS	No records.
SPILLWAY PLAN, SECTIONS AND DETAILS	Plate III, Appendix E.

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT, PLANS & DETAILS	One valve on drawdown line.
CONSTRUCTION RECORDS	No records.
PREVIOUS INSPECTION REPORTS & DEFICIENCIES	Inspection reports by Pennder.
MISCELLANEOUS	

CHECK LIST  
HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: mostly woodland, some urban

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 610      Acre-Feet 76.7

TOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev. 611.5 Acre-Feet 96.6

MAXIMUM DESIGN POOL: Elev. 611.5

TOP DAM: Elev. 611.5

SPILLWAY:	NORTH	SOUTH
a. Elevation	<u>610</u>	<u>609.5</u>
b. Type	<u>triangular weir</u>	<u>12" diameter culvert pipe</u>
c. Width	<u>55'</u>	
d. Length	<u>--</u>	<u>--</u>
e. Location Spillover	<u>right abutment</u>	<u>left abutment</u>
f. Number and Type of Gates	<u>none</u>	<u>none</u>

OUTLET WORKS:

- a. Type (estimated) 12" pipe with valve
- b. Location near center of dam
- c. Entrance inverts 598±
- d. Exit inverts \_\_\_\_\_
- e. Emergency drawdown facilities 12" pipe with valve

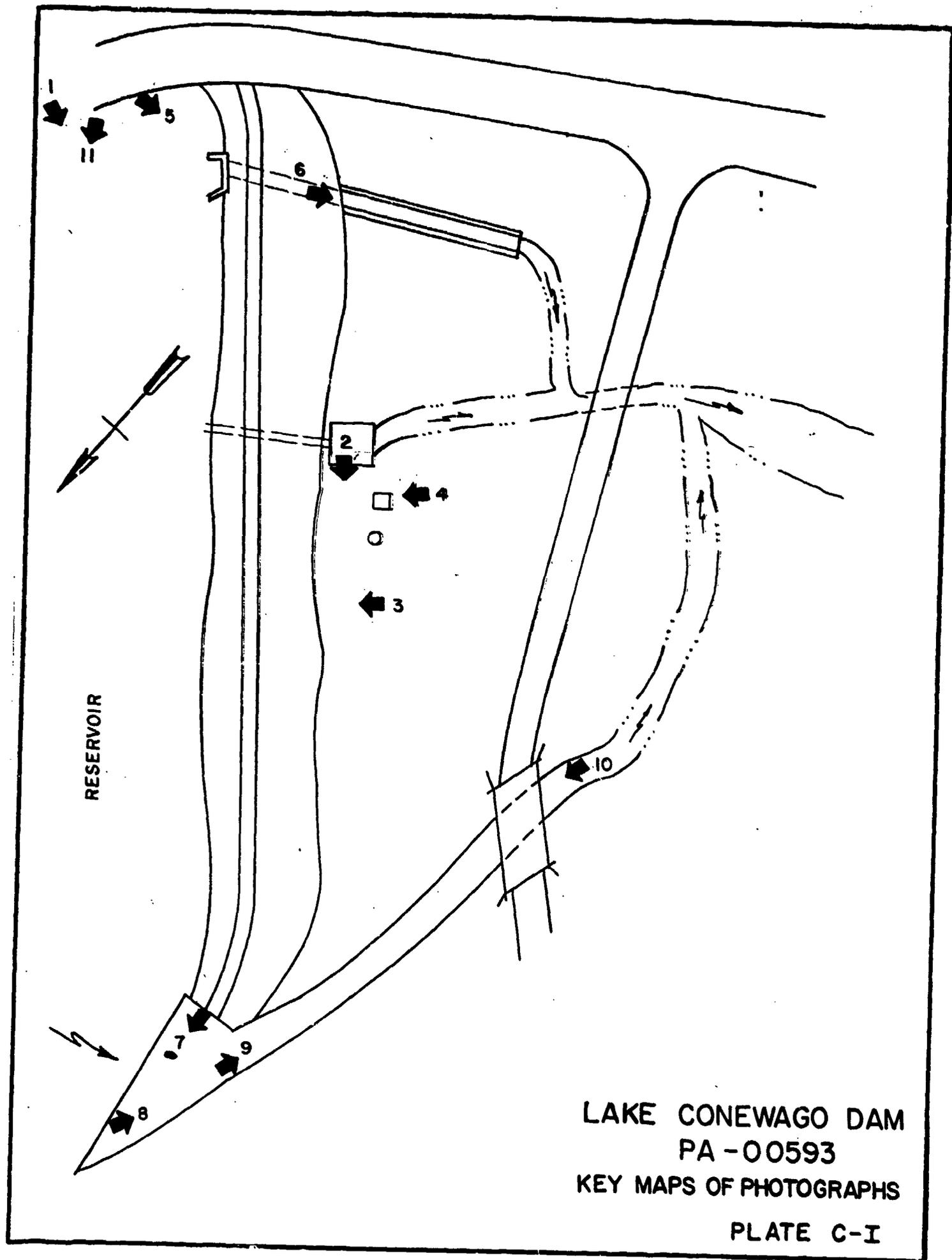
HYDROMETEOROLOGICAL GAGES:

- a. Type none
- b. Location \_\_\_\_\_
- c. Records \_\_\_\_\_

MAXIMUM NON-DAMAGING DISCHARGE: 389 cfs

**APPENDIX C**  
**PHOTOGRAPHS**

**APPENDIX C**



LAKE CONEWAGO DAM  
PA - 00593  
KEY MAPS OF PHOTOGRAPHS  
PLATE C-I

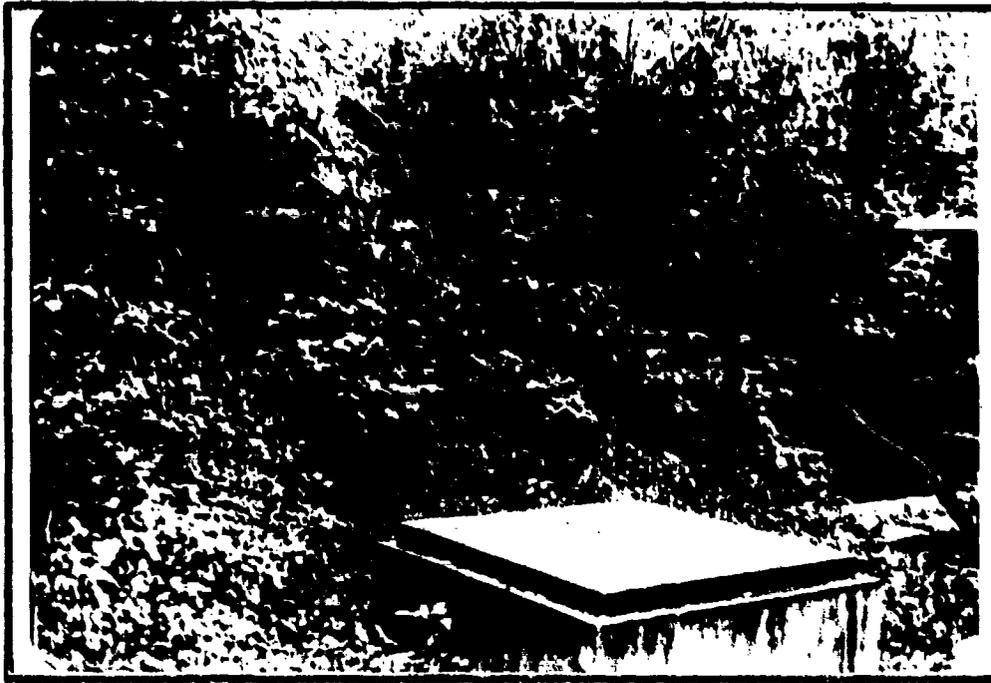


DOWNSTREAM SLOPE AND CREST OF DAM NO. - 2

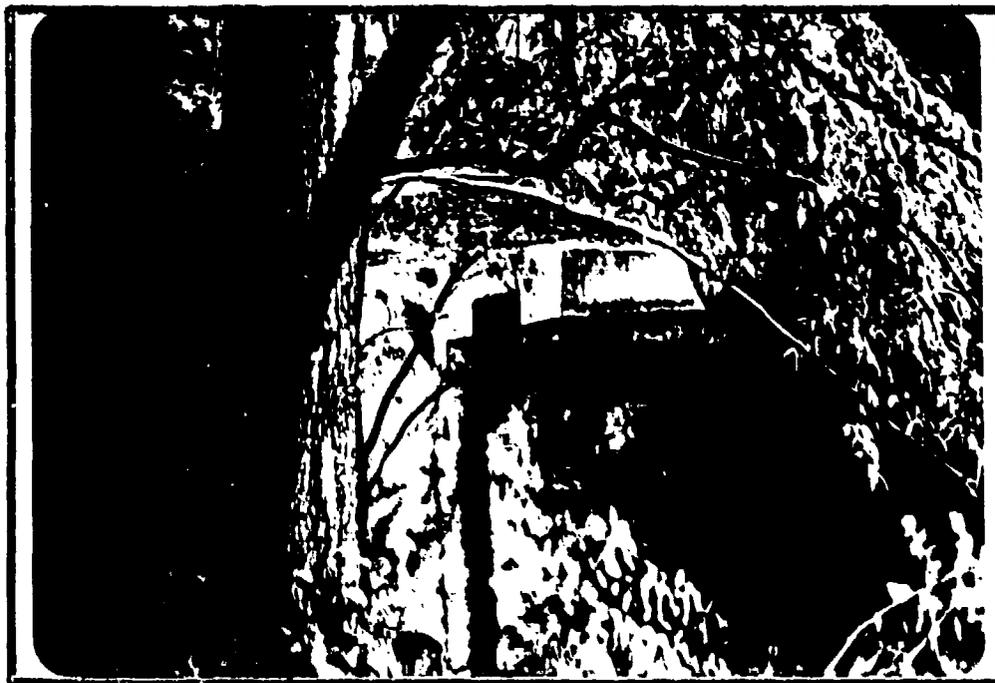


LOOSE ROCK ON DOWNSTREAM SLOPE NO. - 3

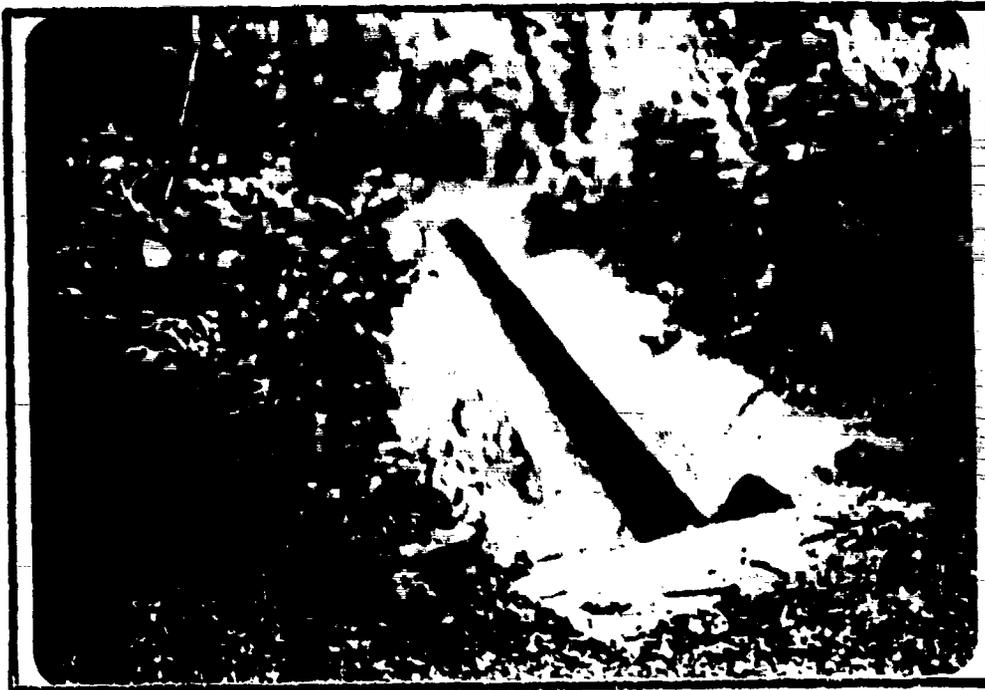
PA-00593  
Plat C-11



DOWNSTREAM SLOPE AND VALVE FIT NO. - 4



OVERFLOW NEAR LEFT ABUTMENT NO. - 5



FLUME OUTLET NO. - 6



SPILLWAY WEIR NO. - 7

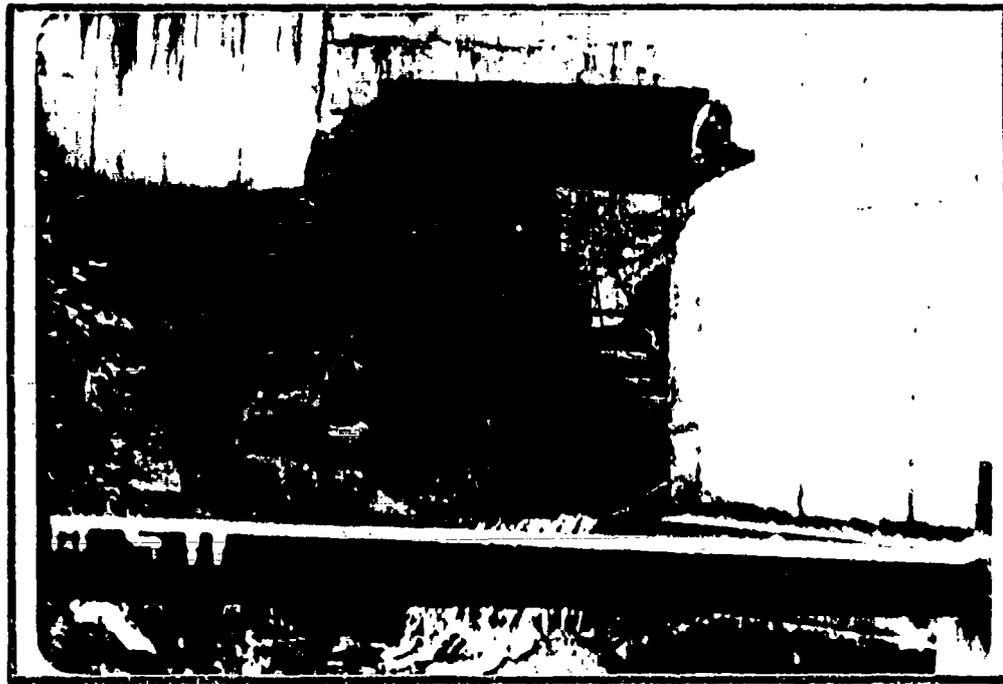
PA-00593  
Plate C-IV



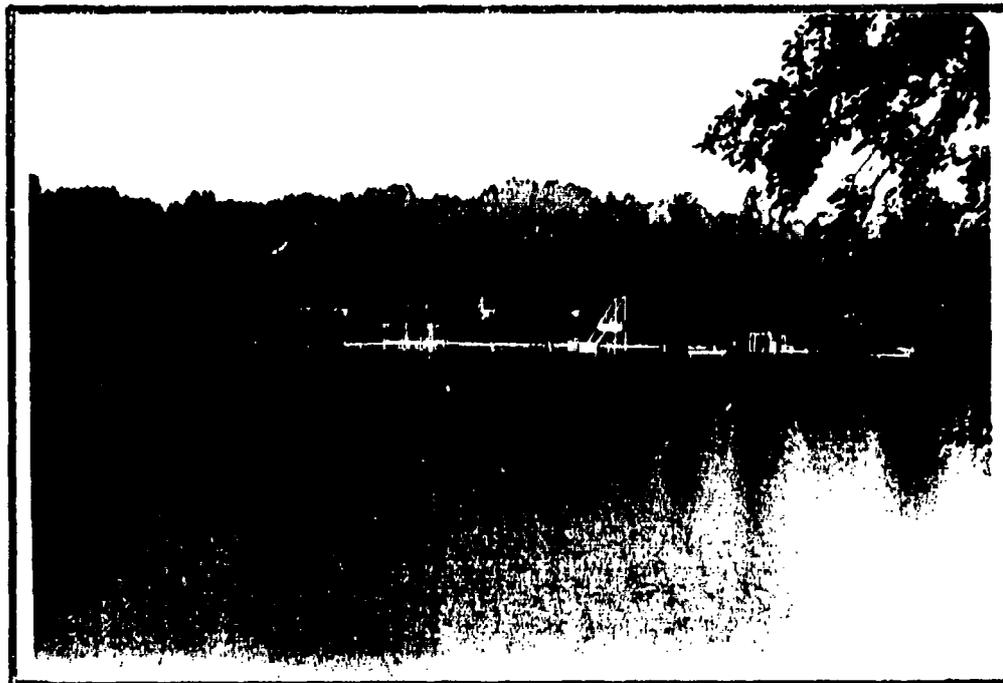
SEWER LINE CROSSING SPILLWAY NO. - 8



SPILLWAY DISCHARGE CHANNEL LOOKING DOWNSTREAM NO. - 9



ROADWAY BRIDGE LOOKING UPSTREAM NO. - 10



OVERVIEW OF RESERVOIR NO. - 11

PA-00593  
Plate C-VI



OVERVIEW OF DAMAGE CENTER DOWNSTREAM LOOKING SOUTH NO. - 12



DAMAGE CENTER LOOKING EAST NO. - 13

PA-00593  
Plate C-VII

**APPENDIX D**  
**HYDROLOGY AND HYDRAULIC CALCULATIONS**

**APPENDIX D**

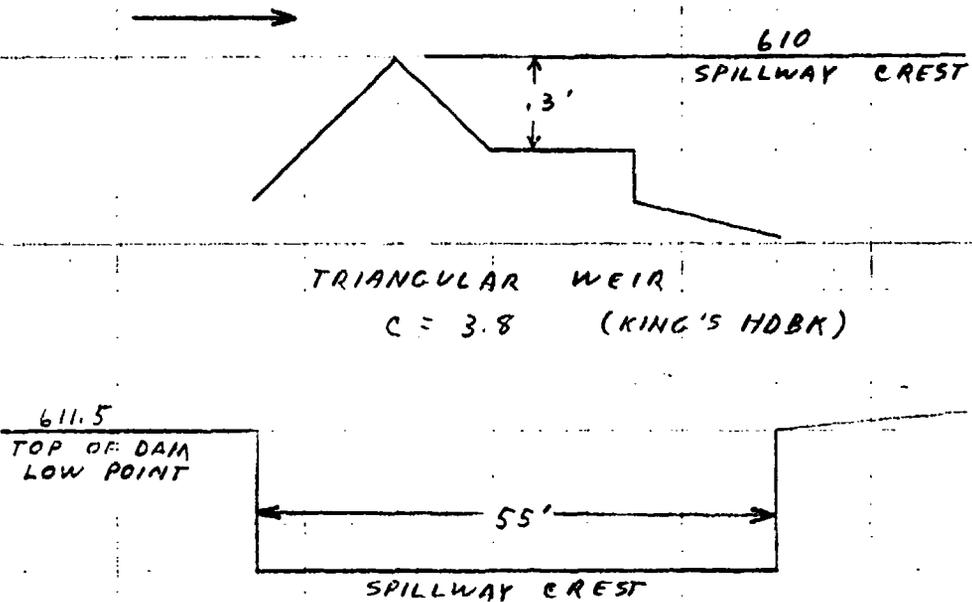
BY RLS DATE 6/30/81  
CHKD. BY DATE  
SUBJECT

BERGER ASSOCIATES

SHEET NO. 1 OF 7  
PROJECT D0590

LAKE CONEWAGO DAM

SPILLWAY RATING (NORTH)



$$Q = C L H^{3/2}$$

$$H = 611.5 - 610 = 1.5'$$

$$Q = 3.8 \times 55 \times (1.5)^{3/2}$$

$$= 384 \text{ CFS}$$

BY RLS DATE 7/1/81  
CHKD. BY DATE  
SUBJECT

BERGER ASSOCIATES

SHEET NO. 2 OF 7  
PROJECT 00590

LAKE CONEWAGO DAM

SPILLWAY RATING (SOUTH)

611.5

TOP OF DAM  
LOW POINT



609.5

12" DIAMETER PIPE

C = 0.6 (KING'S HDGR)

$$Q = C A \sqrt{2gH}$$

$$H = 611.5 - 610 = 1.5'$$

$$Q = 0.6 \times \pi \times \left(\frac{11}{4}\right)^2 \times (2 \times 32.2 \times 1.5)^{0.5}$$
$$= 5 \text{ CFS}$$

STORAGE

76.7 AC-FT AT NORMAL POOL (ELEV 610) (FROM PENNDER FILES)

PLANIMETERED AREAS : ELEV. 610 = 11.3 A  
(QUAD SHEET) ELEV. 620 = 38 A

INTERPOLATED AREA : ELEV. 611.5 = 15.3 A

$$\text{STORAGE} = 76.7 + \left(\frac{1.5}{3} \times (11.3 + 15.3 + (11.3 \times 15.3)^{0.5})\right) = 96 \text{ AC-FT}$$

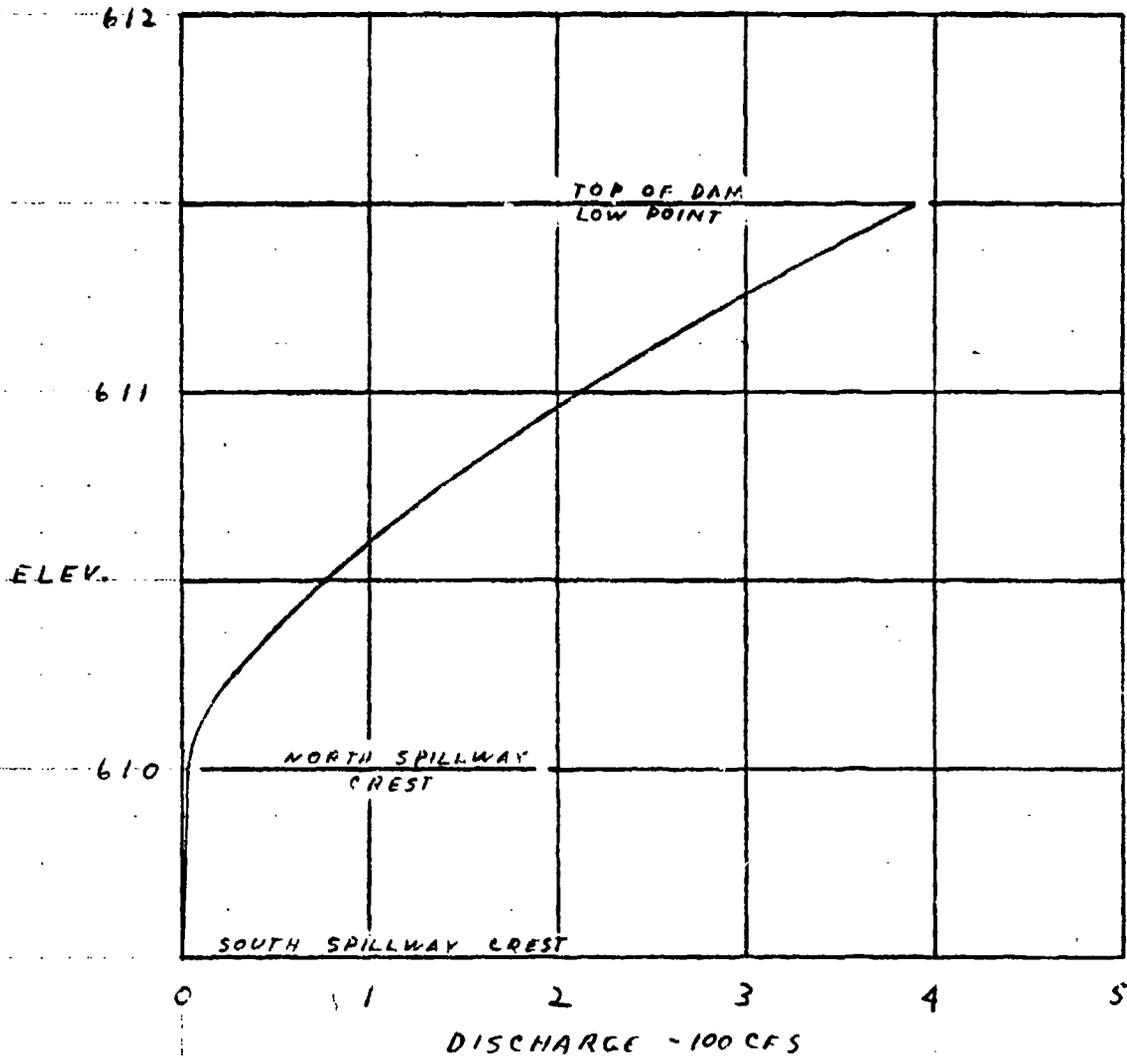
BY RLS DATE 7/1/81  
CHKD. BY DATE  
SUBJECT

BERGER ASSOCIATES

SHEET NO. 3 OF 7  
PROJECT D0590

LAKE CONEWAGO DAM

DISCHARGE CAPACITY CURVE



BY R.L.S. DATE 7/1/51  
CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
SUBJECT \_\_\_\_\_

BERGER ASSOCIATES

SHEET NO. 4 OF 7  
PROJECT D0590

LAKE CONEWAGO DAM

DISCHARGE THROUGH OUTLET WORKS

12" PIPE WITH VALVE ON DOWNSTREAM END

INLET INVERT ELEV. = 598 ±

C = 0.6 (KINGS HOOK)

$$Q = CA \sqrt{2gH}$$

AT POOL ELEV 610

$$H = 610 - 598.5 = 11.5'$$

$$Q = 0.6 \times \pi \times \left(\frac{11}{4}\right)^2 \times (2 \times 32.2 \times 11.5)^{0.5}$$
$$= 13 \text{ CFS}$$

AT LOW POOL ELEV. 602

$$H = 602 - 598.5 = 3.5'$$

$$Q = 0.6 \times \pi \times \left(\frac{11}{4}\right)^2 \times (2 \times 32.2 \times 3.5)^{0.5}$$
$$= 7 \text{ CFS}$$

MAXIMUM KNOWN FLOOD AT DAM SITE

THERE ARE NO RECORDS OF FLOOD LEVELS AT THIS DAM. IT WAS REPORTED THAT LAKE CONEWAGO DAM WAS OVERTOPPED BY SEVERAL INCHES DURING A FLOOD EVENT IN 1972 WHEN AN UPSTREAM DAM FAILED. BASED ON GAGE RECORDS FOR BECK CREEK AT NEARBY CLEONA, PA. (D.A. = 7.87 SQ. MI.) THIS FLOOD EVENT PRODUCED A DISCHARGE OF 5150 CFS. THE MAXIMUM INFLOW TO LAKE CONEWAGO IS ESTIMATED TO BE:

$$\left(\frac{1.61}{7.87}\right)^{0.8} \times 5150 = 1447 \text{ CFS}$$

DESIGN FLOOD

SIZE CLASSIFICATION

MAXIMUM HEIGHT = 18 FEET

MAXIMUM STORAGE = 9 ACRE-Feet

SIZE CLASSIFICATION IS "SMALL"

HAZARD CLASSIFICATION

VILLAGE OF COLEBROOK LOCATED ABOUT TWO AND ONE-HALF MILES DOWNSTREAM.

USE "SIGNIFICANT"

RECOMMENDED SPILLWAY DESIGN FLOOD

THE ABOVE CLASSIFICATIONS INDICATE USE OF AN SDF EQUAL TO THE 100 YEAR FLOOD TO ONE-HALF THE PROBABLE MAXIMUM FLOOD.

BY RLS  
CHKD. BY  
SUBJECT

DATE 7/1/81  
DATE

BERGER ASSOCIATES

SHEET NO. 6 OF 7  
PROJECT R0590

LAKE CONEWAGO DAM

100 YEAR FLOOD

REF: "HYDROLOGIC STUDY, TROPICAL STORM AGNES"  
NORTH ATLANTIC DIVISION, U.S. ARMY, CORPS OF ENGINEERS.

DRAINAGE AREA = 1.61 SQ. MI.

(FIG. 21)  $C_m = 2.01$

$$\begin{aligned} \text{LOG}(Q_m) &= C_m + .75 \text{LOG}(DA) \\ &= 2.01 + .75 \text{LOG}(1.61) = 2.165 \end{aligned}$$

(FIG. 22)  $C_s = .39$

$$\begin{aligned} S &= C_s - 0.05 \text{LOG}(DA) \\ &= .39 - 0.05 \text{LOG}(1.61) = .38 \end{aligned}$$

(FIG. 23) SKEW( $g$ ) = .41

STANDARD DEVIATE =  $K(P, g) = 2.6224$

$$\text{LOG}(Q(P)) = \text{LOG}(Q_m) + K(P, g) S$$

$$\begin{aligned} \text{LOG}(Q_1) &= 2.165 + (2.6224 \times .38) \\ &= 3.162 \end{aligned}$$

$Q_1 = 1450 \text{ CFS}$

BY RLS DATE 7/1/81  
CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
SUBJECT \_\_\_\_\_

BERGER ASSOCIATES

SHEET NO. 7 OF 7  
PROJECT D0590

LAKE CONEWAGO DAM

100 YR FLOOD

(CONT.)

REF: WATER RESOURCES BULLETIN NO. 13, "FLOODS IN PENNSYLVANIA"  
PA. DEPT. OF ENVIRONMENTAL RESOURCES AND U.S. GEOLOGICAL SURVEY.

DRAINAGE AREA = 1.61 SQ. MI.

(PLATE 1) MODEL = 6 B

$$Q_T = CA^x$$

$$C = 259$$

$$x = 1.050$$

$$Q_{100} = 259 \times (1.61)^{1.05}$$

$$Q_{100} = 427 \text{ CFS}$$

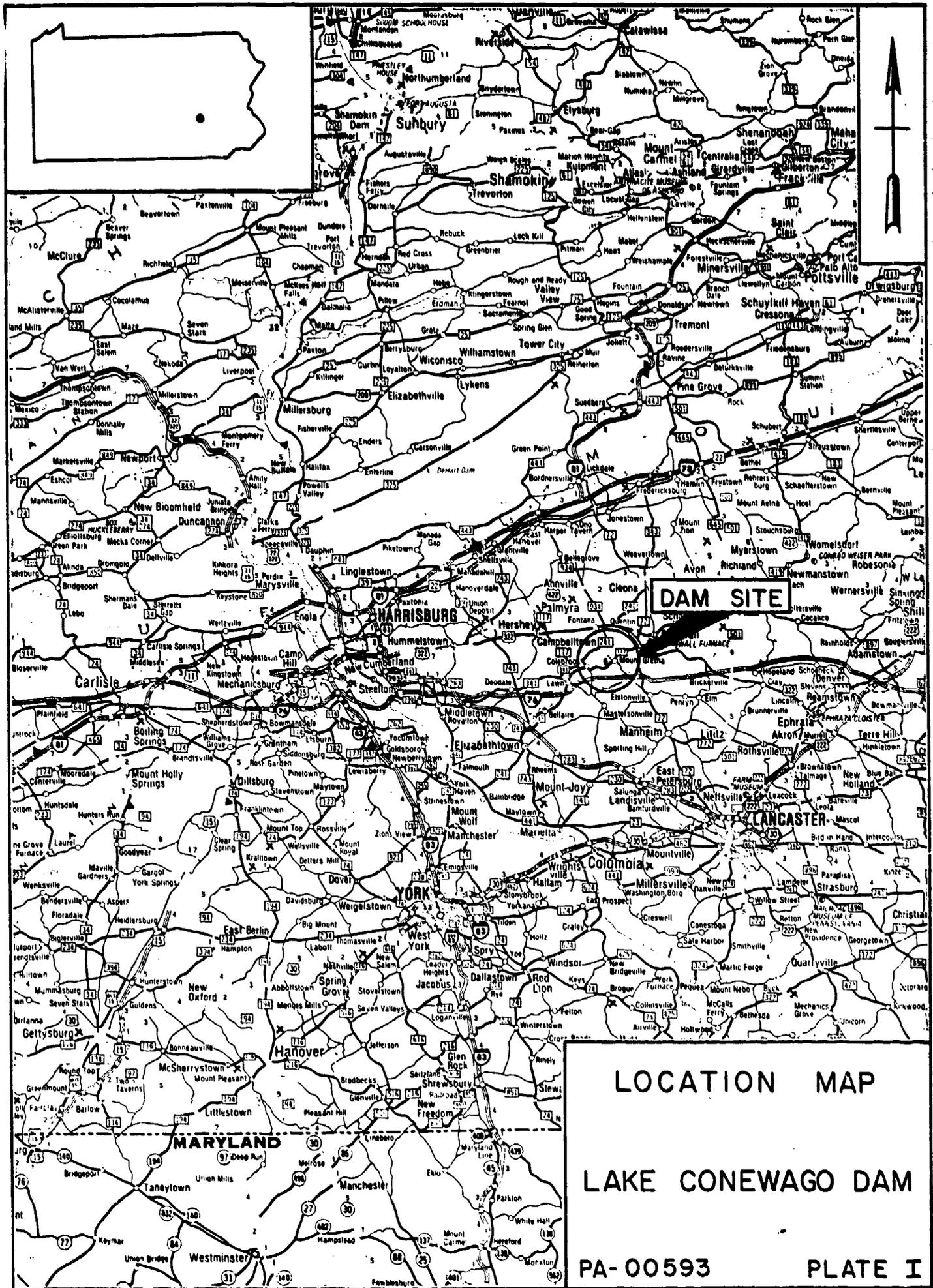
APPROXIMATE 100 YEAR DISCHARGE

$$(1450 + 427) / 2 = 939 \text{ CFS}$$

**APPENDIX E**

**PLATES**

**APPENDIX E**



**DAM SITE**

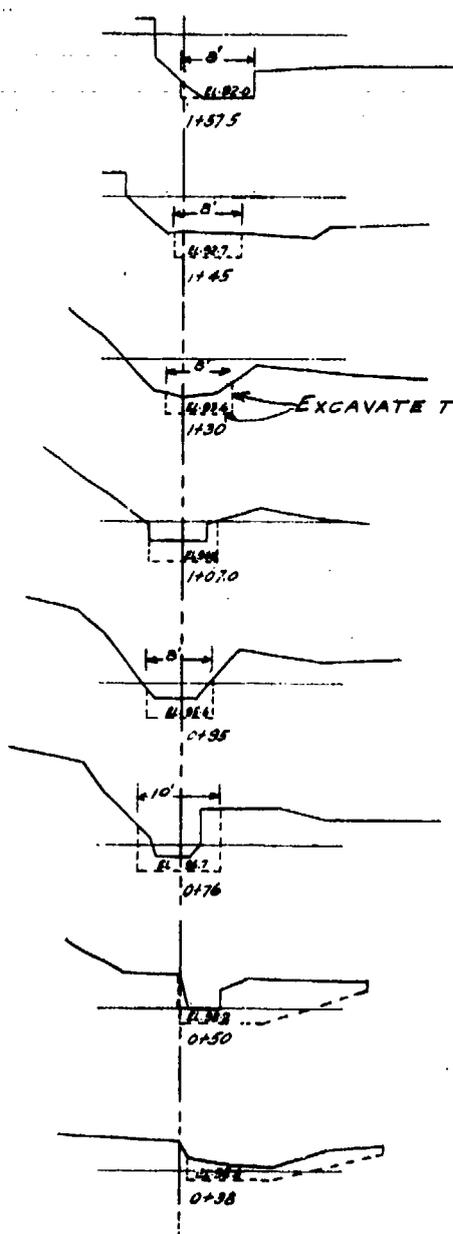
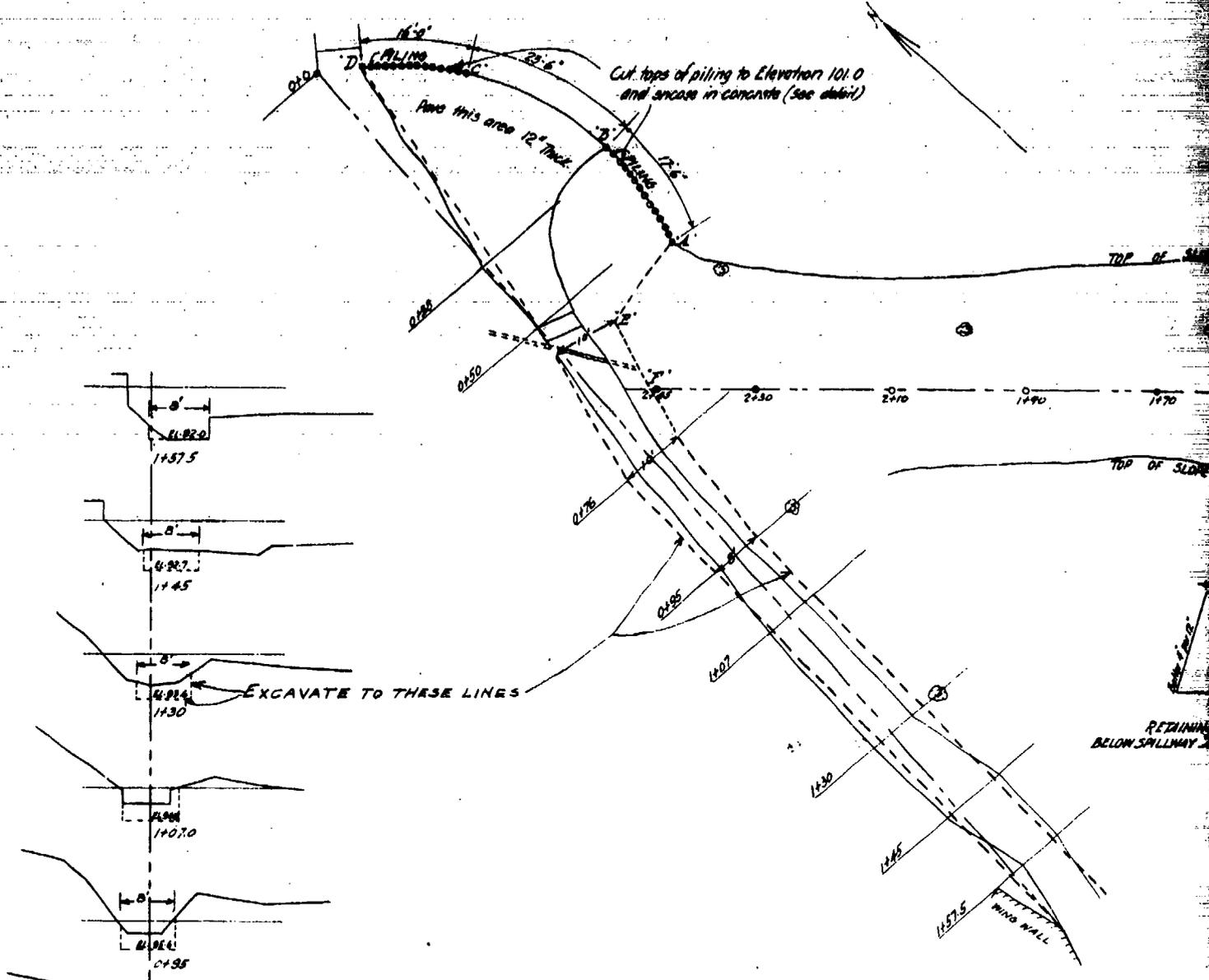
**LOCATION MAP**

**LAKE CONEWAGO DAM**

**PA-00593**

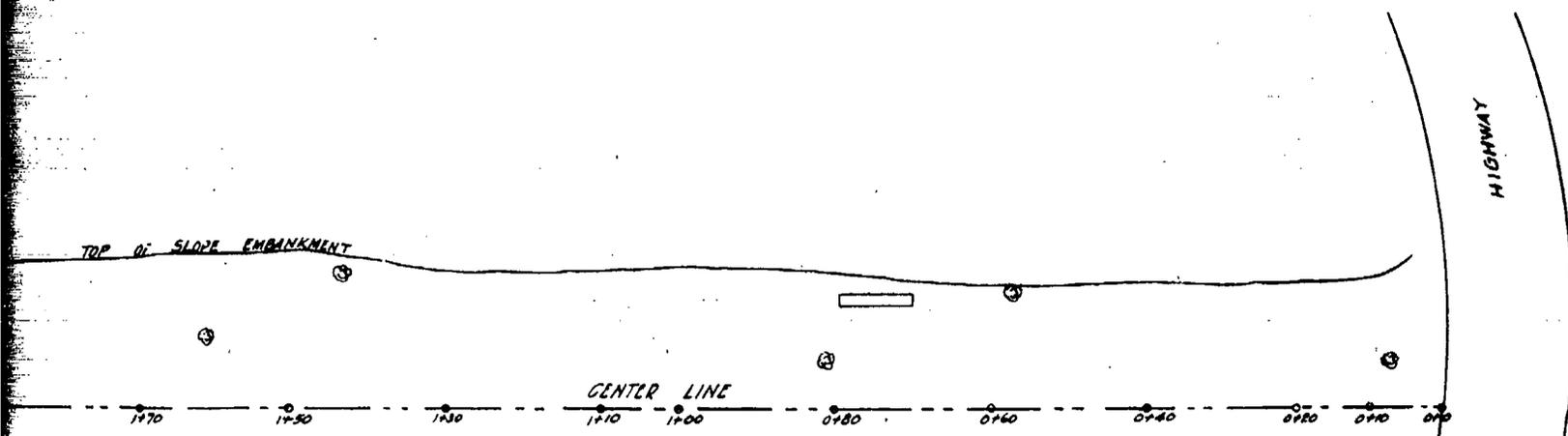
**PLATE I**



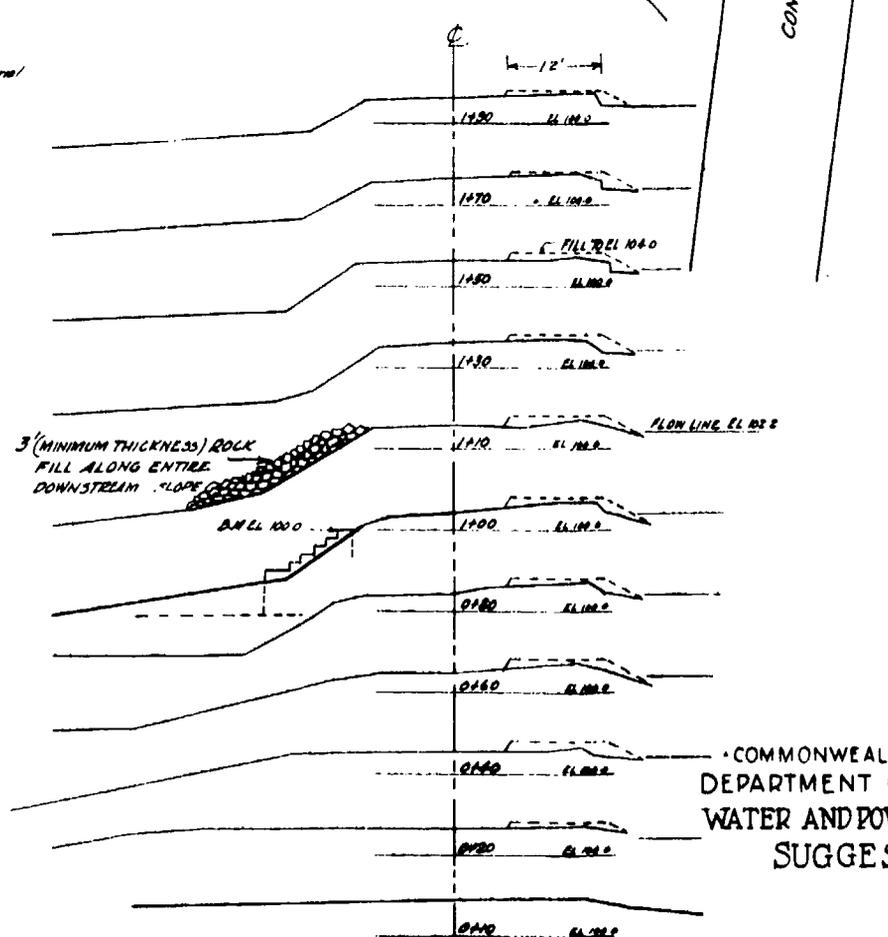
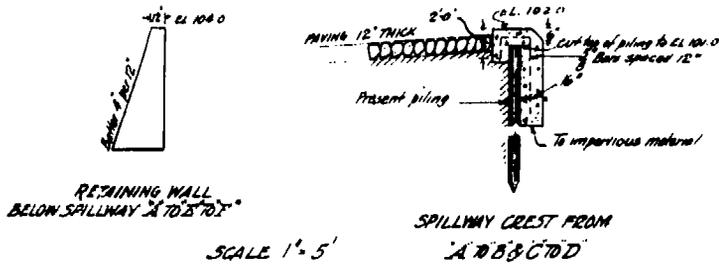


BOTTOM PRESENT WASTEWAY CHANNEL  
 BOTTOM PROPOSED WASTEWAY CHANNEL SLAP 0.037

WASTEWAY CHANNEL SECTIONS  
 SCALE 1" = 10'



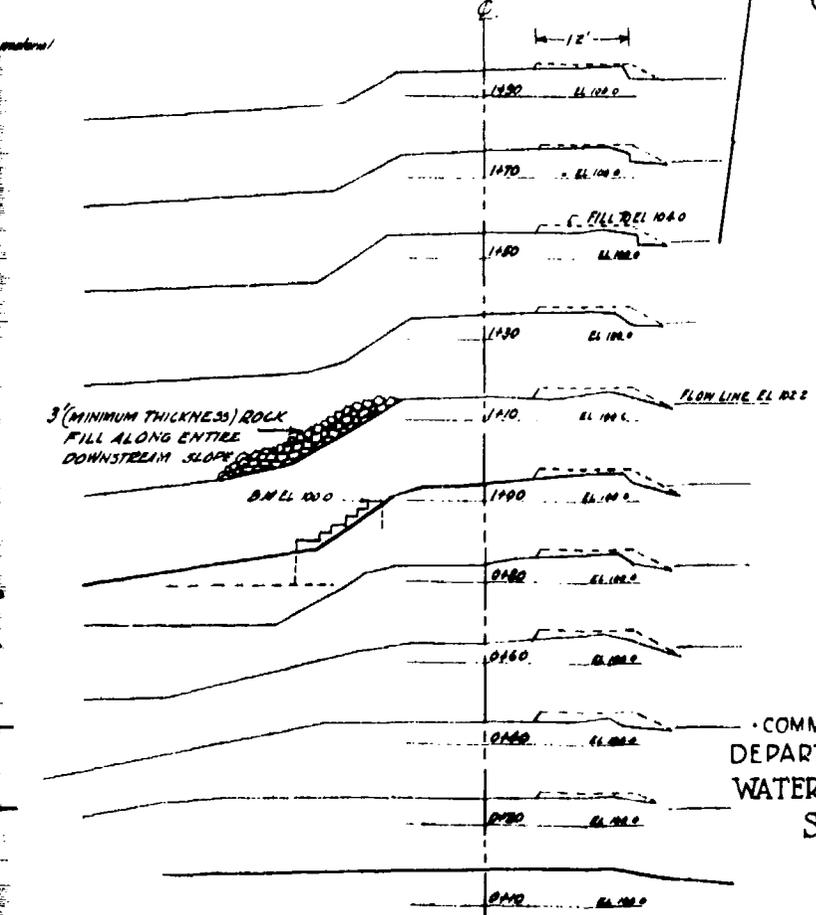
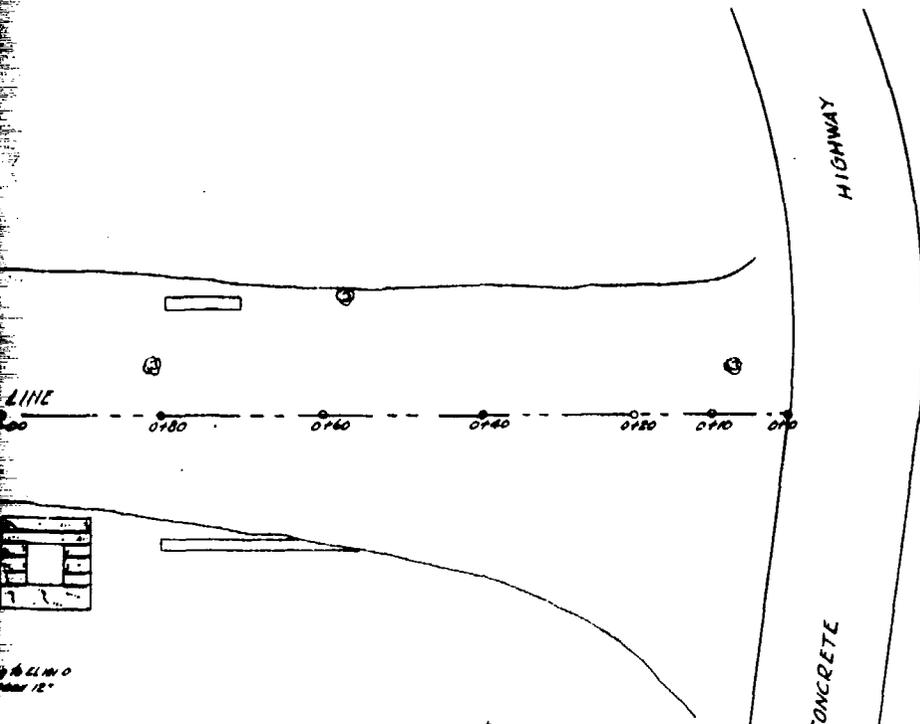
PLAN  
SCALE 1" = 10'



COMMONWEALTH  
DEPARTMENT OF  
WATER AND POWER  
SUGGESTS

DAM ON MT. GRETNA M

HARRISBURG MAR 30 1932



COMMONWEALTH OF PENNSYLVANIA  
 DEPARTMENT OF FORESTS AND WATERS  
 WATER AND POWER RESOURCES BOARD  
 SUGGESTED REPAIRS

• TO •

DAM ON MT. GREYNA MILITARY RESERVATION

HARRISBURG MAR 30 1932

SCALES AS SHOWN

PLATE III  
 PA-00593

2

3

**APPENDIX F**  
**GEOLOGIC REPORT**

**APPENDIX F**

## GEOLOGIC REPORT

### BEDROCK - DAM AND RESERVOIR

It appears that this area overlies the Gettysburg Formation which consists of very fine-grained, reddish-brown shale, mudstone and siltstone with interbeds of red argillite.

### STRUCTURE

Joints are moderately developed in a blocky pattern, dipping between 45-85° and are sometimes filled with quartz and calcite.

### OVERBURDEN

The overburden in this area is most probably a residual soil originating from the parent bedrock.

### AQUIFER CHARACTERISTICS

The Gettysburg Formation has a secondary porosity of medium magnitude and subsurface seepage should be of little concern.

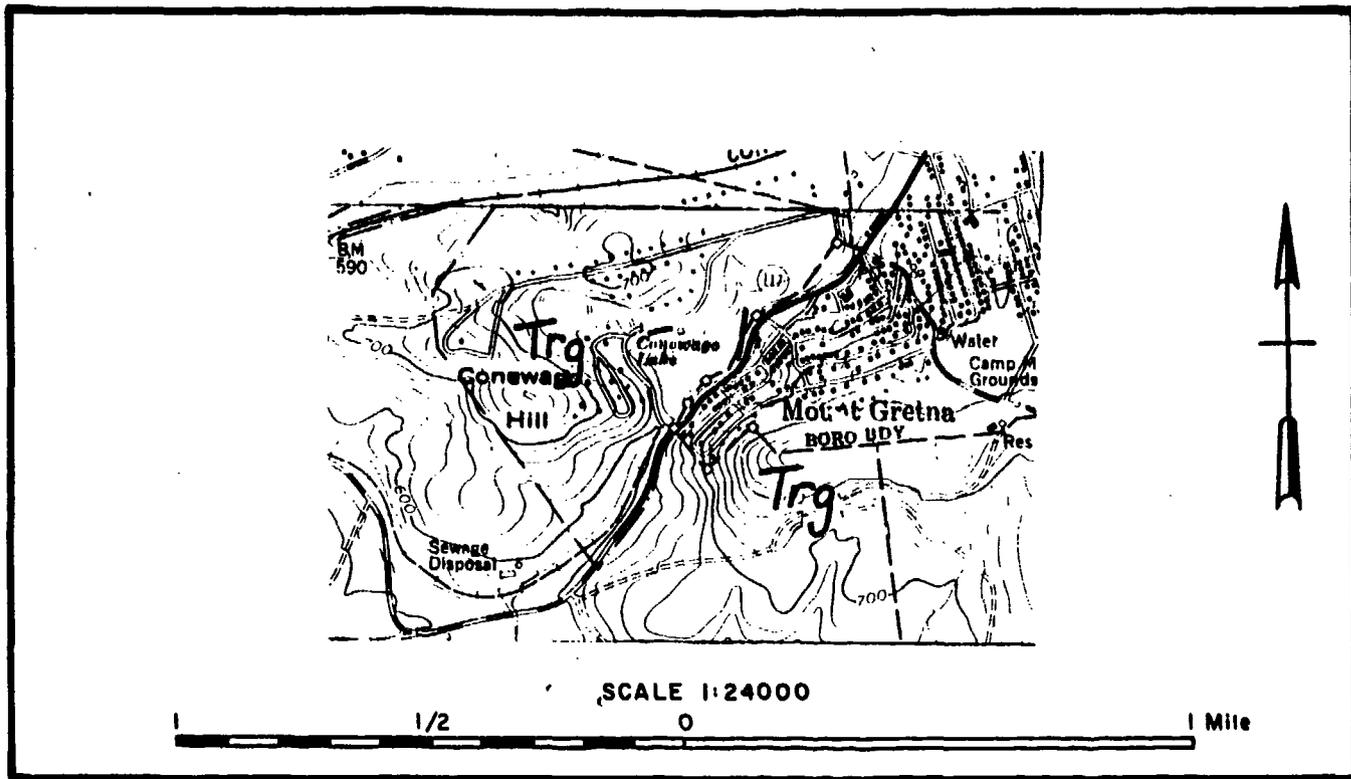
### DISCUSSION

According to available construction plans, the dam appears to be resting on bedrock. If this is the case, the Gettysburg Formation provides a good foundation for heavy structures.

### SOURCES OF INFORMATION

1. McGlade, W.G., et. al., 1972. Engineering Characteristics of the Rocks of Pennsylvania: Pennsylvania Geological Survey EG-1.
2. Geologic Map of Pennsylvania, 1960. Pennsylvania Geological Survey Map 1.

GEOLOGICAL MAP - LAKE CONEWAGO DAM



LEGEND



Gettysburg Foundation