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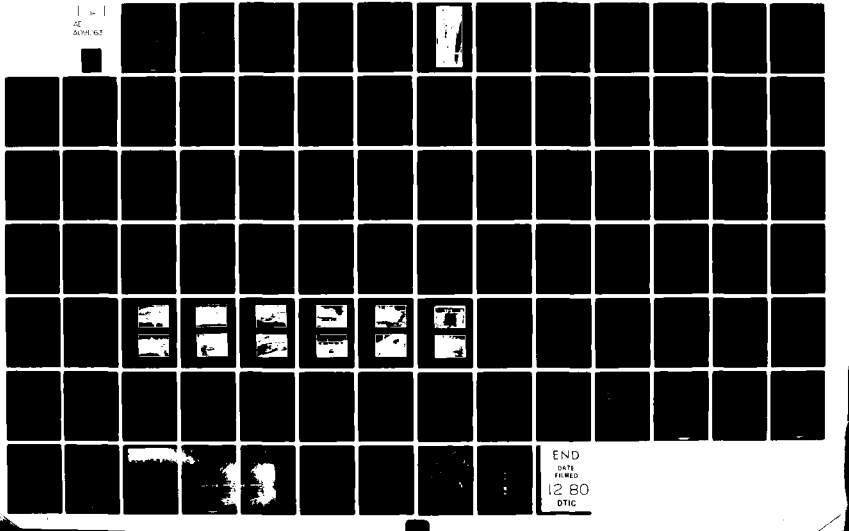

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OHIO RIVER BASIN
HOTTENBAUGH RUN
LAWRENCE COUNTY

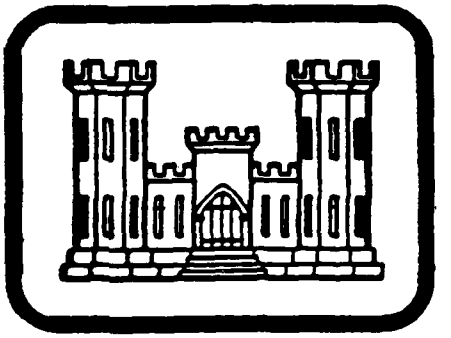
PENNSYLVANIA

NDI No. PA 00909
PENN DER No. 37 - 6

LAKEWOOD DAM

WILLIAM H. STILES

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

BY

DACW31-80-C-0026

ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.
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PITTSBURGH, PENNSYLVANIA 15216

SEPTEMBER 1980

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(6) National Dam Inspection Program
(NDI Number PA-00909, Lakewood Dam
PennDER Number 37-6), (1)
OHIO RIVER BASIN, Hotten Lake
Lawrence

~~LAKEWOOD DAM~~
~~LAWRENCE COUNTY, COMMONWEALTH OF PENNSYLVANIA~~
~~NDI NO. PA 00909~~
~~PennDER NO. 37-6~~

(11) S.1-4
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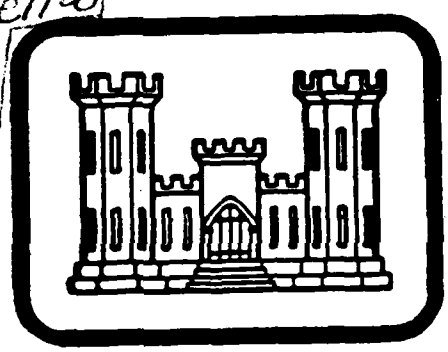
~~WILLIAM H. STILES~~

PHASE I INSPECTION REPORT,
~~NATIONAL DAM INSPECTION PROGRAM~~

(10) Samuel G. Mazzella
James P. Hannan
James E. Banning



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(15) DACW31-80-C-0061

Date: September 1980

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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 Department of the Army, 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 visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, materials testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for such studies which should be performed by the owner.

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 the dam depends on numerous and constantly changing internal and external factors which are 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 time 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 investigations 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" (PMF) 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.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS

NAME OF DAM:	Lakewood Dam
STATE LOCATION:	Pennsylvania
COUNTY LOCATION:	Lawrence
STREAM:	Hottenbaugh Run
DATE OF INSPECTION:	9 May 1980
COORDINATES:	Lat. 41°02'30", Long. 80°18'00"

ASSESSMENT

Based on a review of available design information and visual observations of conditions as they existed on the date of the field inspection and engineering analyses performed, the general condition of Lakewood Dam is considered to be poor.

This assessment is based primarily on visual observations of badly deteriorated spillway structures and an "inadequate" spillway capacity.

The structure is classified as a "small" size, "significant" hazard dam. Corps of Engineers guidelines recommend the 100 Year Flood to one-half the Probable Maximum Flood (PMF) as the Spillway Design Flood for a "small" size, "significant" hazard dam. Lakewood Dam's Spillway Design Flood is one-half the Probable Maximum Flood. Spillway capacity is "inadequate" because the non-overtopping flood discharge was found, by using the HEC-1 computer program, to be in 38 percent of the PMF.

RECOMMENDATIONS

The owner has advised that he does not plan to impound water behind this dam again. However, the possibility exists that during a large storm, the low level outlet could become blocked and water would be impounded behind the dam. The possibility also exists for failure of the gate supports and/or chain which would result in water being impounded behind the dam. It is therefore recommended that the owner remove the principal spillway structure. This would permit the stream to flow unobstructed and the dam would be incapable of impounding water.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Lakewood Dam

Samuel G. Mazzella — Date
Project Engineer

James P. Hannan — Date
Project Engineer

James E. Barrick, P.E. — Date
PA Registration No. 022639-E

Approved by: 24 Sep 80
JAMES W. HECK — Date
Colonel, Corps of Engineers
District Engineer

LAKEWOOD DAM

OVERVIEW

A1

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LAKEWOOD DAM
NATIONAL I. D. NO. PA 00909
PennDER NO. 37-6

SECTION 1
PROJECT INFORMATION

1.1 GENERAL

a. Authority: The Phase I Investigation was performed pursuant to authority granted by Public Law 92-367 (National Dam Inspection Act) to the Secretary of the Army through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose: The purpose of the investigation is to determine whether or not the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances:

(1) Embankment: Lakewood Dam's embankment consists of three earthfill sections that have a total crest length of 295 feet (excluding spillways). The right embankment section, which comprises the major portion of the dam, is 6 feet high, 155 feet long, and has a crest width of eight feet. The upstream slope is 4.4H:1V and the downstream slope is 1H:1V.

The central embankment section is 45 feet long and lies between the principal and emergency spillways. It has a maximum height of 16.4 feet and crest width of about six feet.

The left embankment section is an earthfill dike constructed on the left abutment. The dike is 95 feet long, has a crest width of 8 feet and a maximum height of 16.4 feet.

(2) Outlet Works: An 8.25 foot wide, pulley operated steel sluice gate, at the center bay of the principal spillway, provides outlet facilities for draining the impoundment. There is no record of any other outlet works through the embankment.

(3) Principal Spillway: The principal spillway consists of a 50 foot wide reinforced concrete structure with five 8 foot wide bays. The crest elevation, at 900.5, provides for maintenance of the reservoir pool level and for discharge of normal and flood flows. The spillway has provisions for flashboards to bring the pool elevation to 902.

(4) Emergency Spillway: To the right of the principal spillway is a 105 foot wide open channel emergency spillway. The channel is concrete lined channel and supplements the principal spillway to provide increased discharge capacity. The emergency spillway discharge channel flows into the original stream channel beyond the toe of the principal spillway.

(5) Downstream Conditions: Below Lakewood Dam, Hottenbaugh Run flows under a 2 lane highway bridge about 500 feet from the embankment toe. Approximately 500 feet below that, Hottenbaugh Run flows into Neshannock Creek. Five miles downstream, Neshannock Creek flows into the Shenango River at New Castle, Pennsylvania. In the first 2 miles below the dam, at least six inhabited dwellings lie along the floodplain.

b. Location: Lakewood Dam is located in Hickory Township, Lawrence County, Pennsylvania approximately four miles northeast of New Castle, Pennsylvania.

c. Size Classification: The dam has a maximum storage capacity of 50 acre-feet and a toe to crest height of 16.5 feet. Based on Corps of Engineers guidelines, the dam is classified a "small" size structure.

d. Hazard Classification: Lakewood Dam is classified as a "significant" hazard dam. In the event of a dam failure, at least six inhabited dwellings and two local highways would be subjected to possible damage. Loss of life is possible but not probable.

e. Ownership: Lakewood Dam is owned by Mr. William H. Stiles of New Castle, Pennsylvania. Correspondence can be addressed to:

Mr. William H. Stiles
R. D. #4, Box 109
New Castle, Pennsylvania 16101
(412) 924-9377

f. Purpose: Lakewood Dam was initially constructed as a sawmill dam. In 1919, it was totally reconstructed for recreational purposes. It currently serves no purpose and no water is impounded.

g. Design and Construction History: The dam was originally constructed between 1850 and 1860 for use as a sawmill dam. It was extensively reconstructed in 1919 under the direction of Thomas A. Gilkey, Consulting Engineer of New Castle, Pennsylvania for the Eastbrook Outing Association. Modifications were undertaken in 1919, 1927 and 1934.

h. Normal Operating Procedure: Lakewood Dam was designed to operate as an uncontrolled structure. Under normal operating conditions, the pool level was maintained at elevation 902 by the flashboards of the principal spillway and the crest of the emergency spillway. During its operating life, the impoundment was drained annually for cleaning and maintenance work. According to the owner, the dam has not impounded water for seven years.

1.2 PERTINENT DATA

a. Drainage Area: 12.9 sq. mi.

b. Discharge at Dam Facility

Maximum Flood at Dam Facility	Unknown
Principal Spillway Capacity at Top of Dam	1583 cfs
Emergency Spillway Capacity at Top of Dam	2184 cfs

c. Elevation (feet above MSL)

Design Top of Dam	905.5*
Current Top of Dam (Average)	906
Emergency Spillway Crest (Average)	902
Operating Pool (With Flashboards)	902 *
Principal Spillway Crest	900.5
Normal Pool (Without Flashboards)	900.5
Base of Principal Spillway	889.5
Current Pool Elevation	889.5

d. Reservoir Length

Length of Maximum Pool	1400 feet
Length of Operating Pool	1000 feet

e. Reservoir Storage

Current Top of Dam	50.3 acre-feet
Emergency Spillway Crest	21.5 acre-feet
Operating Pool	21.5 acre-feet
Principal Spillway Crest	14.9 acre-feet*
Normal Pool	14.9 acre-feet*

f. Reservoir Surface

Current Top of Dam	9.3 acres
Emergency Spillway Crest	5.3 acres
Operating Pool	5.3 acres
Principal Spillway Crest	3.5 acres*
Normal Pool	3.5 acres*

g. Embankment

Type	Earth
Length (including spillway)	450 feet
Height	16.5 feet
Crest Width	8.0 to 10.0 feet
Slopes	
Upstream	4.4H:1V
Downstream	1H:1V
Impervious Core	No*
Cutoff Provisions	No*
Grout Curtain	No*

h. Outlet Works (Pond Drain)

Type	Pulley Operated Steel Sluice Gate Square Orifice
Width	8.25 feet
Height	4.0 feet
Location	Center Bay of Principal Spillway
Outlet	Principal Spillway Discharge Channel

i. Principal Spillway

Type	Reinforced Concrete Weir
Location	Left Center of Dam
Overflow Crest Length	5.0 feet
Debris Control	None
Flow Controls	See Outlets Works Above

j. Emergency Spillway

Type	Concrete Slab Overflow
Location	Center of Dam
Crest Length	105 feet
Crest Width	8 feet

*Taken or derived from original specifications and/or drawings.

SECTION 2
ENGINEERING DATA

2.1 DESIGN

The files of the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER) were reviewed for this study.

Design drawings obtained from PennDER files indicate that the original earthen embankment was 240 feet long, 17 feet high and had maximum and minimum widths of 92 and 8 feet, respectively.

The principal spillway was a concrete structure 50 feet long, 3 feet wide and 20 feet high. It was constructed as a vertical drop, reinforced concrete buttressed structure between reinforced concrete abutments. The emergency (auxiliary) spillway was located to the right of the principal spillway and was to be 105 feet long with a crest of one foot higher than the principal spillway crest.

The upstream slope and crest of the emergency spillway were designed to have concrete paving. The downstream slope was designed with a grouted stone pavement. Embankment slopes were designed to be 2H:1V.

The original design capacity was 15 acre-feet.

2.2 CONSTRUCTION

Lakewood Dam was originally constructed as an earthen embankment for a sawmill pond sometime between 1850 and 1860. It was extensively reconstructed in 1919 for recreational purposes, under the direction of Thomas A. Gilkey, Consulting Engineer, of New Castle, Pennsylvania. The reconstruction was for the Eastbrook Outing Association. The construction and reconstruction contractors are not known.

2.3 MODIFICATIONS

Modifications to the dam were undertaken in 1919, 1927, 1934-35, and at various other unknown times.

a. 1919: The extensive reconstruction program cited under Design Drawings and Construction above was performed in 1919. During the course of the work the Water Supply Commission recommended addition of a two foot deep concrete cutoff wall below the crest of the emergency (auxiliary) spillway.

Upon completion of reconstruction, a "stoplog" closure of the principal spillway was made and the impoundment filled (without regulatory agency approval). A storm in the fall of 1919 overtopped and washed out the earthfill at both ends of the principal spillway structure. On the left (embankment) side, three masonry walls were embedded in the replaced fill.

b. 1920-1932: Sometime between 1920 and 1932, 18 inch high flashboards were placed along the principal spillway crest.

c. 1927: The downstream portion of the emergency spillway was paved with concrete, replacing the grouted stone pavement which had been damaged by high flows.

d. 1934-1935: The embankment crest was reportedly raised about two feet to comply with recommendations of the Water and Power Resources Board.

e. Unknown: The original wooden plank sluice gate of the principal spillway was replaced with a metal plate gate.

f. Unknown: A concrete block wall was constructed along the crest of the right end of the embankment.

2.4 OPERATION

The dam was designed to operate without a dam tender. The principal and emergency (auxiliary) spillways are uncontrolled structures and require only periodic maintenance.

The outlet works sluice gate was activated almost annually to drain the pond for maintenance and cleaning operations.

Lakewood Dam reservoir was drained sometime between 1971 and the date of inspection.

2.5 EVALUATION

a. Availability: Engineering data was provided by PennDER, Bureau of Dams and Wasteway Management.

b. Adequacy: The available engineering information was supplemented by field inspections and supporting engineering analyses and is considered adequate for the purpose of the Phase I Inspection Report.

c. Validity: Based on the review of the available information, there appears to be no reason to question the validity of the engineering data.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

a. General: The visual inspection of Lakewood Dam was performed on 9 May 1980, and consisted of:

(1) Visual observations of the embankment crest and slopes, groins and abutments;

(2) Visual observations of the principal and emergency spillways including concrete surfaces, training walls, approach and discharge channels.

(3) Visual observations of the embankment's downstream toe areas including drainage channels and structures.

(4) Visual observations of downstream conditions and evaluation of the downstream hazard potential.

(5) Visual observations of the reservoir bottom and inlet stream channel.

(6) Transit stadia survey of relative elevations along the embankment crest centerline, spillways, and across the embankment slopes.

The visual observations were made during a period when the reservoir was empty and the tailwater was at the original creek level.

The visual observations checklist, field plan, profile and sections containing the observations and comments of the field inspection team are contained in Appendix A. Specific observations are illustrated on photographs in Appendix C. Detailed findings of the field inspection are presented in the following sections.

b. General Configuration: Lakewood Dam consists of an earthen embankment containing two concrete spillways for discharge of normal and flood flows. One spillway, the emergency or auxiliary outlet, near the center of the embankment, consists of an ungated, irregular, open channel surfaced with an unformed, unreinforced concrete slab. The second spillway, the principal outlet, located near the left abutment is a formed, reinforced concrete overfall structure that contains a slide gate outlet works.

On the date of inspection, the slide gate was open and the reservoir was empty. The reservoir appeared to have been empty for many years as numerous trees and considerable brush growth was observed on the reservoir bottom.

c. Embankment:

(1) Crest: Lakewood Dam's embankment consists of three sections. The right embankment lies between the emergency spillway and the right abutment. The crest was observed to be generally level except at the immediate right abutment where an access road to the reservoir has been cut through the crest. As a result, the crest in this area is slightly lower than the remainder of the right embankment. With the exception of the access road, the crest was grassed and in good condition and contained a concrete block wall.

The central embankment lies between the emergency and principal spillways and was found to be slightly higher than the right embankment. The crest of the central embankment contained considerable vegetation including a 12 inch diameter spruce tree.

The crest of the left embankment was observed to be in good condition. It was grass covered and well maintained, as it comprises the backyard area of two of the left shoreline dwellings.

d. Upstream Slope: The upstream slope of the right embankment was generally grassed and in reasonably good condition. The slope was quite flat, measured to be 4.4H:1V, and was covered with dense grass and small brush. No sinkholes or slumping were observed.

The upstream slope of the central embankment was covered with a dense growth of grass, weeds and trees. A pedestrian footpath crossed the slope and some minor erosion was noted.

The upstream slope of the left abutment embankment was observed to be grassed and in well maintained condition.

e. Downstream Slope: The downstream slope of the right embankment was grassed, well maintained and in generally good condition. The toe of the slope and the slope itself were uneroded and gave no indication of structural instability. The crest contains a concrete block wall near the edge of the downstream slope and a concrete staircase traverses the downstream slope to provide access to a building below.

The downstream slope of the central embankment had a varied covering ranging from trees, dense brush and weeds to barren exposed earth. Several large trees are growing on the downstream slope of the central embankment. Its condition was generally poor.

The downstream slope of the left embankment was in very good condition, being grass covered and well maintained. A few pines and decorative bushes were observed on the downstream slope.

The toe of the slope, in the vicinity of the principal spillway, has been eroded, apparently by surface runoff.

f. Groins:

(1) Right: The right groin consisted of the junction of the embankment and an access road that traverses the right abutment hillside to dwellings above. Minor erosion was observed in and near the roadway, generally as a result of surface runoff.

The toe of the right embankment and the floodplain below was observed to be in very good condition with no erosion and a general uniform grass cover.

The junction of the right abutment and the emergency spillway contains a large tree and considerable brush growth. The condition of the emergency spillways concrete at the groin was deteriorated. On the left, a similar condition exists, although the concrete does not provide as much protection for the central embankment slope.

The junction of the central embankment and the principal spillway is uneroded in the upper reaches of the embankment but has generally been eroded by surface drainage near the toe of the spillway wingwalls. The groin contained trees and considerable vegetal growth including briars and other weeds.

The junction of the right embankment and the principal spillway is similar.

g. Abutments:

(1) Right: The right abutment consists of the valley wall for Hottenbaugh Run which is generally quite steep and covered with large to small trees, considerable brush and ground type vegetal growth. No

significant erosion of the right abutment was observed and in spite of its steepness appeared to be relatively stable.

(2) Left: The left abutment consists of the valley floodplain wall which was observed to be in generally good conditon as it contains several inhabited dwellings. No significant erosion or stability distress was observed on the left abutment.

h. Outlet Works:

(1) General: The outlet works for Lakewood Dam consists of a low level, sluice-gated opening in the principal spillway structure.

The outlet consists of a rectangular opening 8.25 feet wide by 5 feet high that is controlled by a sliding rectangular steel gate.

(2) Inlet: The inlet to the outlet works consists of the original Hottenbaugh Run channel. The outlet works opening was observed to be partially blocked by branches, debris, some growing vegetation.

(3) Gate Control: The outlet works opening is controlled by a 3/4 inch thick rectangular steel plate that slides between 2-1/2 by 2-1/2 inch steel angles embedded in the upstream face of the reinforced concrete spillway wall.

The steel plate is controlled from above by a chain block and tackle that is suspended from a cross beam resting on two steel pipe columns. The columns were originally founded on the principal spillway wall.

The concrete upon which the pipe columns were founded has deteriorated completely, providing little or no support for the columns. The right column has been replaced by a concrete block pier set atop the concrete spillway bridge.

The steel was generally rusted but retained a considerable amount of its original section.

Blockage of the outlet works by debris during large flows is a possiblity. It is conceivable that the outlet works could be rendered useless by such an occurrence resulting in the re-creation of the reservoir.

(4) Discharge Channel: Discharge through the outlet works is directly to the downstream channel between the central concrete buttress walls of the principal spillway.

No obstructions were observed in the immediate downstream channel area that would inhibit discharge through the outlet works.

i. Principal Spillway:

(1) General: The principal spillway has been constructed near the left abutment in the original Hottenbaugh Run channel. The structure consists of a flow control wall across the valley buttressed by reinforced concrete counterfort piers on the downstream side of the wall. The structure rests between two reinforced training walls at each abutment. A reinforced concrete slab walkway crosses the top of the spillway to permit pedestrian access.

(2) Overflow Section: The principal spillway overflow section (weir) was observed to be in very poor condition with considerable spalling and disintegration of concrete surfaces. Reinforcing steel was exposed, rusted and corroded to only a fraction of its original diameter. The upstream face and base of the weir wall were observed to be somewhat spalled and eroded, particularly in the vicinity of the outlet works opening.

(3) Structural Conditions: The formed concrete training walls were observed to be significantly disintegrated, spalled and contained exposed reinforcing bars that have been rusted and corroded to a fraction of their original diameter.

The reinforced concrete counterfort piers were observed to be in a similar state of disintegration. Spalling and disintegration of face and side surfaces is extensive. Considerable reinforcing steel is exposed and generally corroded and rusted away. Particularly significant erosion of the concrete has occurred at and just above the waterline where a significant portion of the counterfort piers have been eroded.

The pedestrian bridge across the top of the structure has suffered considerable spalling and disintegration, particularly of the bottom surface. Several cracks were noted on the top surface at the counterfort piers.

(4) Discharge Conditions: Discharge over the formed concrete spillway is directly to the original Hottenbaugh Run channel.

j. Emergency Spillway:

(1) General: Near the center of the dam, an open channel spillway has been constructed over the crest of the embankment. The spillway surface consists of an unformed, unjointed concrete slab.

(2) Training Walls: The spillway is contained between a concrete block wall on the right and stone wall on the left. Both walls have suffered a significant amount of deterioration and the concrete block wall has collapsed over most of its length. The stone wall was unmortared and was disintegrating.

(3) Structural Conditions: The spillway surface was badly cracked and spalled and contained two very large erosional cavities, one near the right and one near the left. The cavities have eroded into the embankment to a depth of 3 to 4 feet. Two smaller erosional cavities existed near the abutments of the spillway. Considerable vegetation including trees up to 6 inches in diameter are growing through the concrete and have assisted the deterioration of the slab significantly. The overflow crest was generally cracked and deteriorated.

(4) Discharge Channel: The discharge channel was generally clogged with vegetation including trees, downtimber, fallen walls and debris. The condition of the downstream channel was such that it appeared to provide a large resistance to flows.

k. Downstream Conditions:

(1) Downstream Channel: The downstream channel below the principal spillway consists of the original Hottenbaugh Run channel. The channel is approximately 35 to 40 feet wide and is surfaced with alluvial stone and gravel.

The creek's right bank is generally mild sloped and approximately 5 feet high and reaches up to the flood-plain which lies on the right portion of the valley below the dam.

The left slope of Hottenbaugh Run is relatively steep, approximately 10 feet high and contains considerable vegetation including large trees, brush, downtimber and debris. Rock outcrops were observed along the left bank. The rock in the outcrop appeared to be a relatively competant, fine to medium grained sandstone.

The channel is generally clear for a distance of 500 feet below the dam to a point where it approaches a bridge that carries Lakewood Road over the creek. The bridge has a clear span of approximately 45 feet and a height of 8 feet above the creek channel. The bridge is constructed of a reinforced concrete slab on 5 steel beams resting on stone and masonry abutments. Approximately 500 feet below the bridge, Hottenbaugh Run enters Neshannock Creek.

(2) Floodplain Development: In the first 2500 feet below the dam six inhabited dwellings lie on the floodplain. However, the elevations of the dwellings are such that it is questionable if failure of Lakewood Dam would imperil any of the dwellings.

1. Reservoir:

(1) Slopes: The reservoir's right shoreline is generally flat, and in the immediate vicinity of the dam, is grassed and well maintained. In this reach, the reservoir slope comprises the backyards of several inhabited dwellings along the shoreline. Beyond this reach, the slope remains generally mild but contains considerable vegetation and trees.

The slopes above the right shoreline are generally quite steep and tree covered. Several inhabited dwellings lie in and above the slope along the right shoreline in the vicinity near the dam. Observation of the slopes gave no indication of sloughing or instability.

(2) Inlet Stream: The inlet stream to the reservoir follows a generally winding course above the reservoir, entering through a broad, glacial valley. The stream channel is 30 to 40 feet wide, 4 to 5 feet deep and has a gravel lined bottom. Channel sides are generally steep and somewhat eroded from higher flows in the channel. Considerable vegetation grows along the channel banks in the area above the former lake.

(3) Watershed: The watershed was observed to be generally as indicated by the U.S.G.S. topographic map. Limited reconnaissance of the watershed indicated the existence of a recent surface mining operation near the upper end of the watershed. No other new construction or mining was observed in the watershed.

3.2 EVALUATION

a. Embankment: The condition of the Lakewood Dam embankment is considered to be fair. The right embankment downstream slope was generally steep at 1H:1V but appeared to be well maintained. Some erosion was observed on both the upstream and downstream slopes of the central portion of the embankment.

b. Principal Spillway and Outlet Works: The condition of the principal spillway including the outlet works is considered to be very poor. This is based primarily on the observed structural deterioration.

c. Emergency Spillway: The condition of the emergency spillway is considered to be very poor. This is based primarily on the observed deterioration of the concrete slab and training walls.

d. Hazard Potential: Based on the observed height of the dam and downstream floodplain conditions, Lakewood Dam was assigned a "significant" hazard potential rating.

SECTION 4
OPERATIONAL FEATURES

4.1 PROCEDURE

During normal operating conditions, flashboards were placed along the overflow section of the principal spillway. As a result, normal inflows were discharged over the crest of the emergency (auxiliary) spillway.

The reservoir was drained on an annual basis to allow cleaning and repair of facilities.

Normal operating procedure did not require a dam tender.

The dam does not currently impound water.

4.2 MAINTENANCE OF DAM

The embankment and appurtenances are not maintained.

4.3 INSPECTION OF DAM

The owner is required by the State of Pennsylvania to inspect the dam annually and make needed repairs.

4.4 WARNING

There is no known warning system or formal emergency procedure to alert or evacuate downstream residents upon threat of a dam failure.

4.5 EVALUATION

There are no written operation, maintenance or inspection procedures, nor is there a warning system or formal emergency procedure for this dam.

Current operating conditions are unknown, as the reservoir is not now impounding water.

SECTION 5
HYDROLOGY AND HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data. The Lakewood Dam reservoir has a watershed of about 8,250 acres which is vegetated primarily by pasture and includes strip mines and a sand and gravel quarry.

The watershed is about 7 miles long and has a width of about 3 miles. The maximum elevation of the watershed is 1360 feet above Mean Sea Level (MSL). At normal pool, the dam impounded a reservoir with a surface area of about 3.5 acres and a storage volume of 14.9 acre-feet. Normal pool level was maintained at Elev. 900.5 by the overflow crest of the principal spillway. During most of its useful life, the reservoir pool was maintained at Elevation 902 by flashboards across the principal spillway overflow section. Consequently, the reservoir's operating level was maintained at Elevation 902 with a surface area of about 5.3 acres and storage volume of 21.5 acre-feet.

Design spillway capacity and embankment freeboard were made sufficient to accommodate 290 cubic feet per second per square mile which was considered sufficient for this structure at the time of design. The Lakewood Dam spillway capacity for the observed cross section and existing freeboard condition was computed to be 3767 cfs. No additional hydrologic calculations were found relating reservoir/spillway performance to the Probable Maximum Flood or fractions thereof.

b. Experience Data: Continuous records of reservoir level or rainfall amounts are not kept.

Records indicate that the fill placed around the newly installed principal spillway was washed out in 1919.

c. Visual Observations: On the date of the field inspection, the principal spillway was observed to be in very poor condition. Severe spalling and cracking was observed on the crest, retaining walls and buttress walls. The emergency spillway also was in very poor condition. Spalling concrete, sinkholes and tree growth were observed, giving a general indication of no maintenance. There was no water impounded behind the structure at the time of inspection and it appeared that water had not been impounded for many years.

d. Overtopping Potential: Overtopping potential was investigated through the development of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway. The Corps of Engineers guidelines recommend the 100 Year Flood to one-half the PMF for "small" size, "significant" hazard dams. Based on the observed downstream conditions, Lakewood Dam has a Spillway Design Flood (SDF) of one-half PMF.

Hydrometeorological Report No. 33 indicates that the adjusted 24 hour Probable Maximum Precipitation (PMP) for the subject site is 19.0 inches. No calculations are available to indicate whether the reservoir and spillway are sized to pass a flood corresponding to 9.5 inches of rainfall in 24 hours (1/2 PMP). Consequently, an evaluation of the reservoir/spillway system was performed to determine whether the dam's spillway capacity is adequate under current Corps of Engineers guidelines.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California. The major methodologies and key input data for this program are discussed briefly in Appendix D.

The peak inflow to Lakewood Dam for the SDF was determined by HEC-1 to be 5,587 cfs.

e. Spillway Adequacy: The capacity of the combined reservoir and spillway system was determined to be 0.38 PMF using HEC-1. At 0.50 PMF, the dam is overtopped by 0.79 feet of water for 10 hours. An initial pool elevation of 900.5 was assumed prior to commencement of the storm. According to Corps of Engineers' guidelines, Lakewood Dam's spillway is "inadequate."

SECTION 6
STRUCTURAL STABILITY

6.1 AVAILABLE INFORMATION

a. Design and Construction Data: All available design documentation, calculations and other data received from the Pennsylvania Department of Environmental Resources were reviewed.

b. Operating Records: There are no written operating records or procedures for this dam.

c. Modifications: Several modifications have been made to Lakewood Dam including the addition of a foundation cutoff to the emergency spillway slab, adding flashboards and increasing the height of the embankment. The modifications are discussed in Section 2.

d. Visual Observations:

(1) Embankment: The visual observations, although limited by brush, weeds and trees, indicated no strong evidence of potential embankment instability. The downstream slope was generally uniform although somewhat steep at 1H:1V and local undulations and unevenness were noted.

(2) Seepage: No seepage was observed.

(3) Outlet Works: The outlet works was badly deteriorated and appeared to be in peril of collapasing.

(4) Principal Spillway: The concrete wall that maintains the principal spillway overflow crest was eroded and disintegrated along a significant portion of the spillway crest. Severe spalling, cracking and disintegration of the concrete of the buttress and walls were also observed.

(5) Emergency Spillway: The concrete slab of the emergency spillway was observed to be disintegrating and was overgrown with vegetation. Several sinkholes were also noted in the channel.

e. Design Documents: The design documentation was, by itself, considered inadequate to evaluate the structure. There were no structural calculations associated with the stability of the embankment or of the appurtenant structures.

f. Performance: The State inspection reports noted significant embankment and foundation seepage conditions, particularly in the emergency spillway area. Moderate to large sinkholes were observed in this area at the time of the visual inspection.

6.2 EVALUATION

a. Embankment: The margin of safety against piping failure of Lakewood Dam may be less than acceptable. This assessment is based on visual observations of spillway sinkholes and a review of the history of the embankment. Stability of embankment slopes did not appear to be a concern.

b. Principal Spillway: Based on visual observations, the principal spillway appears to have less than adequate structural capability. This is based on the observed general deterioration of the concrete overflow wall and buttress walls and operability of the slide gate.

c. Emergency Spillway: Based on visual observations, the emergency spillway appeared to have less than adequate structural capability. This assessment is based on the observed sinkholes in the spillway channel, and general deterioration of the concrete.

d. Seismic Stability: According to the Seismic Risk Map of the United States, Lakewood Dam is located in Zone 1 where damage due to earthquake would most likely be minor.

A dam located in Seismic Zone 1 may be assumed to present no hazard from an earthquake provided static stability conditions are satisfactory and conventional safety margins exist. Since there is concern regarding the static stability of the principal spillway, the seismic stability is also questionable and should be improved.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 ASSESSMENT

a. Evaluation:

(1) Embankment: Lakewood Dam embankment is considered to be in fair condition. This assessment is based on visual observations of dense vegetation on the crest and slopes, including large trees on the crest, uneven crest conditions, erosion of slopes and a general lack of maintenance of the embankment.

(2) Outlet Works: The condition of the outlet works is considered to be poor. This assessment is based primarily on the questionable structural integrity of the gate support.

(3) Principal Spillway: The condition of the principal spillway is considered to be poor. This assessment is based on visual observations of deteriorated, structural components including the concrete wall overflow section and buttress walls.

(4) Emergency Spillway: The condition of the emergency spillway is considered to be poor. This is based on the visual observation of dense growth of trees and brush on the crest and channel and presence of sinkholes in the channel on the downstream slope.

(5) Flood Discharge Capacity: The principal spillway discharge capacity is assessed to be "inadequate." This is based on hydrologic/hydraulic computations using the HEC-1 Dam Safety Version computer program, that indicated the existing reservoir/spillway system is capable of passing 0.38 PMF. At 0.5 PMF, the embankment is overtopped by a maximum 0.79 feet for 10 hours.

b. Adequacy of Information: The available information and the observations made during the field inspection of the dam are considered sufficient for purposes of the Phase I Inspection Report.

c. Urgency: The recommendation presented in Section 7.2 should be implemented immediately.

d. Necessity for Additional Data/Evaluation: No additional engineering information is required to adequately evaluate the structural stability and hydraulic performance of the facilities.

7.2 RECOMMENDATION

The owner has advised that he does not plan to impound water behind this dam again. However, the possibility exists that during a large storm event, the low level outlet could become blocked and water would be impounded behind the dam. The possibility also exists for failure of the gate supports and/or chain which would result in water being impounded behind the dam. It is therefore recommended that the owner remove the principal spillway structure. This would permit the stream to flow unobstructed and the dam would be incapable of impounding water.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL OBSERVATIONS CHECKLIST I
(NON-MASONRY IMPOUNDING STRUCTURE)

Name Dam Lakewood County Lawrence State Pennsylvania National ID # PA 00909

Type of Dam Earth and Concrete Hazard Category Significant

Date (s) Inspection 9 May 1980 Weather Partly cloudy, mild Temperature 55°F

Pool Elevation at Time of Inspection Reservoir empty (MSL)
Tailwater at Time of Inspection 890 (MSL)

Inspection Personnel:

J. E. Barrick, P.E.	Ackenheil & Associates, Project Manager and Hydrologist
J. P. Hannan	Ackenheil & Associates, Geotechnical Engineer
S. G. Mazzella	Ackenheil & Associates, Civil Engineer

Recorder J. E. Barrick

GEO Project G79153-I
PennDER I.D. No. 37-6

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Some minor drying cracks observed on embankment portion of dam. No tension cracks or other structurally significant cracks observed. Considerable cracking observed on surface of emergency spillway.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No cracking or movement observed below the toe of earth portions of the embankment. No unusual movement observed below spillway portions of dam.	
SLOUGHING OR EROSION OF EMBANKMENT SLOPES	Some minor erosion observed on the downstream slope of central earth portion of the embankment. Erosion appeared to be result of a pedestrian path and lack of vegetation. The left and right portions of the embankment were observed to be generally grassed with a full vegetative cover. No erosion, sloughing, or significant structural distress were observed on either embankment.	
SLOUGHING OR EROSION OF ABUTMENT SLOPES	None observed.	

EMBANKMENT (CONT'D)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The vertical alignment of the crest was observed to be somewhat irregular. To the left, an earthen embankment curves upstream until it reaches a local residential backyard. To the right, an earthen portion of embankment has approximately the same elevation and alignment as the spillway structure. This portion of the embankment, referred to as the central portion, is approximately 45 feet long and terminates at the left edge of the emergency (auxiliary) spillway. The emergency spillway crest was approximately level and curved toward the downstream through the central portion of the dam. The right portion of the embankment begins at the right end of the emergency spillway, proceeds for about 155 feet in a curved, upstream direction. The crest of this portion of the embankment is defined by a concrete block wall. The wall appears to be somewhat lower in elevation than the central portion of the embankment on the other side of the emergency spillway. At the far right abutment, an access road has been cut through the embankment into the impoundment area. This portion of the embankment is lower than the remainder of the right embankment. The access road is generally barren but appears to be suffering no severe erosional distress. A few minor tire ruts were noted and the downstream portion was surfaced with gravel material.	

EMBANKMENT (CONT'D)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RIPRAP FAILURES	No riprap observed.	
SETTLEMENT	None observed.	
JUNCTION OF EMBANKMENT AND ABUTMENT	The junction of the right portion of the embankment and the abutment occurs at a paved residential road that provides access to several inhabited dwellings on the hillside of the right abutment. This area has suffered minor erosion due to surface runoff but appears to be generally stable. The junction of the right embankment and the downstream toe area was observed to be in good condition, having a full cover of vegetation in the form of grass. No erosional distress was observed and no indications of past seepage were noted.	
JUNCTION OF EMBANKMENT AND SPILLWAY	The junction of the right embankment and the emergency spillway was observed to have suffered some minor erosion but was generally protected by an unformed concrete slab that comprises the emergency spillway erosion protection. The junction of the emergency spillway and the central embankment appeared to be unprotected near the lake but contained a collapsed stone wall in the lower portion of the spillway. No indication of erosion was observed but satisfactory performance of this groin during spillway flows is questionable.	

EMBANKMENT (CONT'D)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND SPILLWAY (continued)	The junction of the central and right embankments and the principal spillway structure was observed to be adequate but in relatively poor condition. Considerable vegetal growth including trees and heavy brush, as well as minor erosion, were observed adjacent to the spillway walls, both upstream and downstream at each end of the structure.	
ANY NOTICEABLE SEEPAGE	None - Reservoir empty.	
DRAINS	None observed.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	The principal spillway contains five concrete overflow sections that could be utilized as weirs, if required. However, severely deteriorated concrete conditions preclude this possibility.	
PIEZOMETERS	None observed.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONFIGURATION	The outlet works for the impoundment consists of a rectangular opening at the base of the central bay of the principal spillway. The opening is 8.25 feet wide by 5 feet high and is controlled by a 3/4 inch thick steel plate that rides in two 2-1/2 by 2-1/2 steel channels. The slide gate is controlled by a chain winch supported from cross bar resting atop two steel columns that were formerly founded on the spillway wall. The steel is generally corroded and the foundation for the two steel columns has completely disintegrated to the extent that the cross bar is being held at one end by seven concrete blocks that are founded on the walkway slab at the top of principal spillway.	
INTAKE STRUCTURE	The inlet to the outlet works is the original stream channel which flows to the base of the principal spillway and through the opening of the outlet works. Some debris was observed clogging the lower portion of the entrance to the outlet works. The debris included logs, brush and some green, growing vegetation.	
OUTLET STRUCTURE	The outlet channel for the outlet works consists of the original stream channel at the base of the principal spillway. No downstream obstructions were observed that would impair discharge through the outlet works.	

OUTLET WORKS (CONT'D)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
OUTLET CHANNEL	The outlet channel is the discharge channel for the principal spillway and consists of the original stream channel below the dam.	
EMERGENCY GATE	None.	

PRINCIPAL SPILLWAY
(CONCRETE OVERFLOW STRUCTURE)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The concrete weir (overflow section) of the principal spillway was observed to be significantly deteriorated. Considerable spalling and disintegration of concrete has exposed reinforcing steel which has subsequently rusted to a small fraction of its original diameter. In general, the concrete weir is badly disintegrated.	
APPROACH CHANNEL	The approach channel to the principal spillway is the original Hottenbaugh Run. The lower portion of the approach channel has steep sides which are partially vegetated but show some bare earth and considerable amounts of debris in the vicinity of the structure. If the reservoir were at normal pool, the approach channel would be generally clear and unobstructed and provide an unobstructed discharge over the overflow section.	
DISCHARGE CHANNEL	The discharge channel is the original Hottenbaugh Run stream channel below the principal spillway. The bridge over the principal spillway is formed of reinforced concrete and was observed to be cracked, particularly at the locations of the concrete piers. The underside of the slab was observed to be generally deteriorated and exposed reinforcing bars have corroded to a fraction of their original diameter. The bridge, however, is passable, and could carry pedestrian traffic. No handrail was observed.	

PRINCIPAL SPILLWAY (CONT'D)
(CONCRETE OVERFLOW STRUCTURE)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE PIERS	The concrete piers and abutment training walls that provide support for the overflow section were observed to be in an advanced state of disintegration. Considerable spalling, cracking and erosion of the concrete was observed. Steel reinforcing rods exposed to the weather have corroded to a fraction of their original diameter. Concrete at the waterline has been badly eroded and is generally disintegrated. Training walls at either end of the structure show considerable spalling and erosion of top and side surfaces. In general, the condition of the principal spillway is poor.	

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Near the center of the dam there is an emergency spillway which consists of unreinforced, unjointed, concrete slab over the crest of the embankment.	
CONCRETE WEIR	The concrete overflow section of the emergency spillway was observed to be generally deteriorated, including significant spalling and cracking of the concrete.	
APPROACH CHANNEL	The approach channel is the reservoir, and was observed to be blocked by trees.	
DISCHARGE CHANNEL	The discharge channel below the emergency spillway is contained between a concrete block wall on the right and a stone wall on the left. Both walls are in a serious and advanced state of collapse. The channel bottom is original ground and was observed to contain several trees, considerable brush and undergrowth, considerable downtimber and a collapsed right training wall. A swampy area was observed in the channel below the spillway. In general, the discharge channel has only limited flow capacity.	
CONCRETE OVERFLOW SECTION	The condition of the concrete overflow section was observed to be very poor. Two major erosional holes were observed in the section; one on the far right and the other on the far left. At these places, the slab has been eroded away as well as the founding material to depths of up to four feet.	

EMERGENCY SPILLWAY (CONT'D)

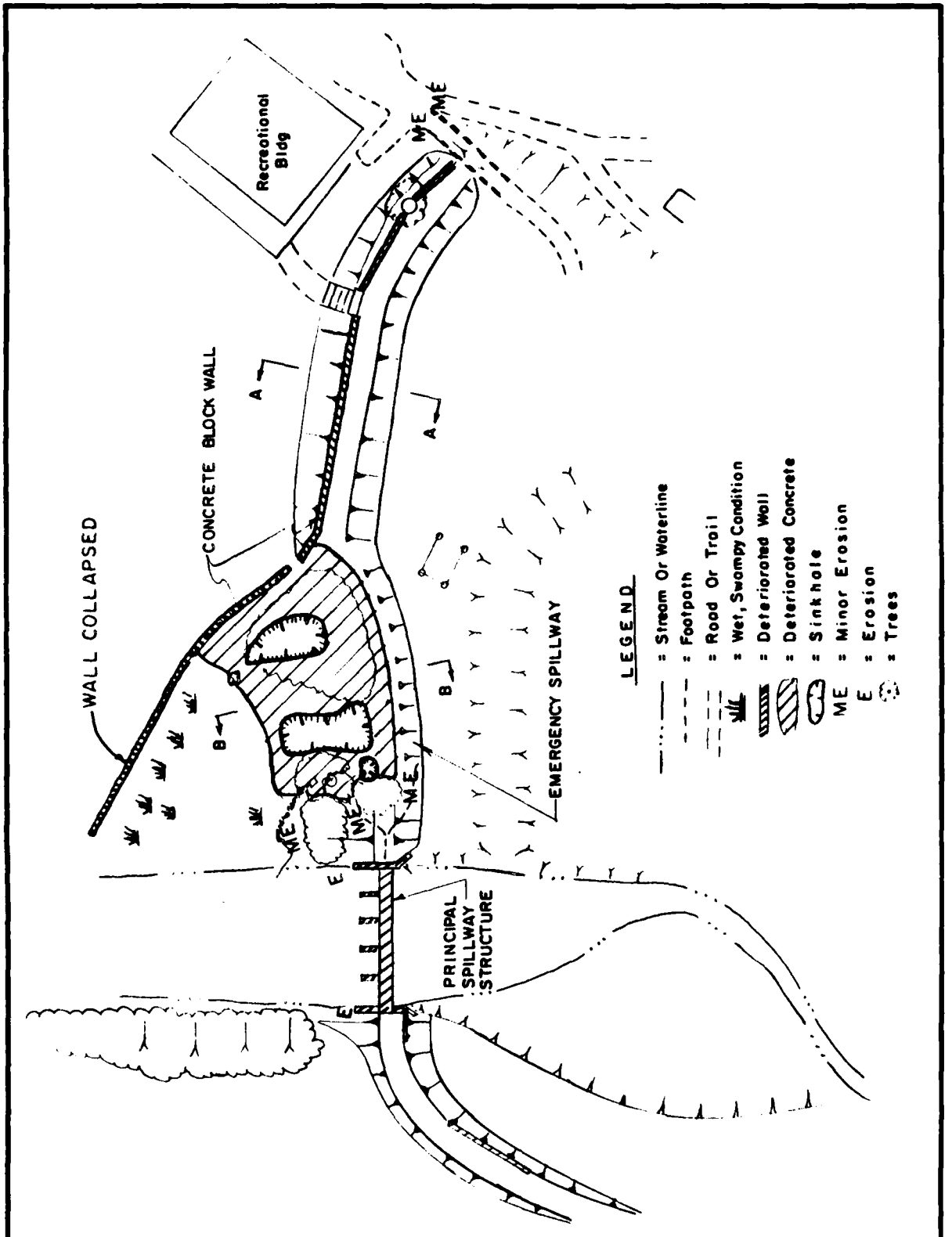
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE OVERFLOW SECTION (continued)	Advanced spalling and cracking of the concrete surface was observed at numerous locations on the structure. The downstream toe consisted of a two foot drop to the discharge channel below. Observation of the spillway foundation at the drop showed disintegration near the right end and serious distress throughout the remainder of the length of the overflow section.	
BRIDGE AND PIERS	None observed.	

RESERVOIR

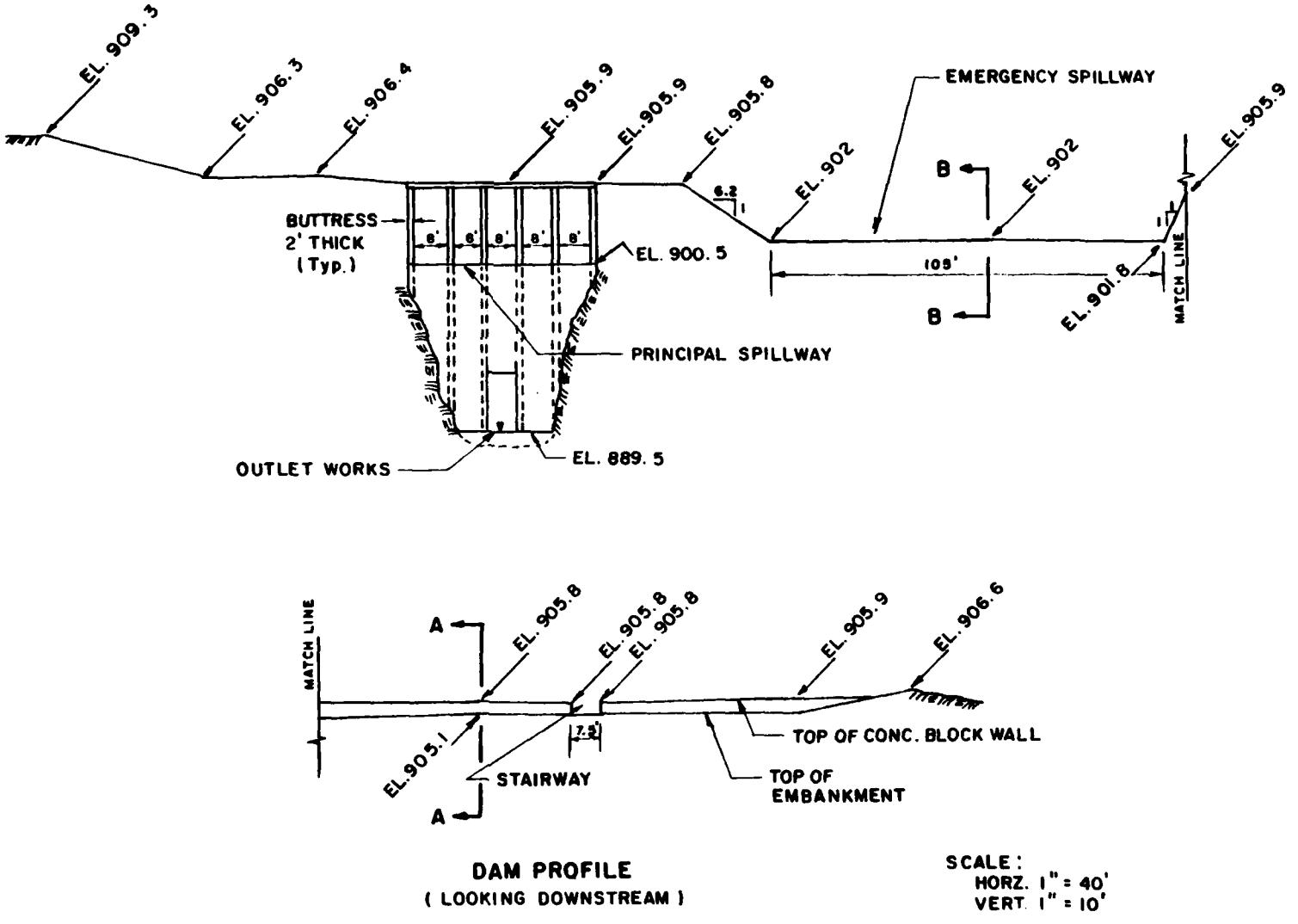
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The slopes above the right shoreline of the reservoir were observed to be relatively steep and generally wooded. In the vicinity of the dam, they contain several inhabited dwellings. The reservoir's left shoreline was observed to be generally flat and in the immediate vicinity of the dam, was grassed. Just beyond the shoreline, are five inhabited dwellings. Beyond this, the shoreline remains relatively flat, wooded and brush covered.	
SEDIMENTATION	Extent unknown.	
INLET STREAM	The inlet stream to the reservoir follows a generally winding course above the reservoir entering through a broad, glacial valley. The stream channel is 30 to 40 feet wide, 4 to 5 feet deep and has a gravel lined bottom. Channel sides are generally steep and somewhat eroded from water flows in the channel. Considerable vegetation grows along the channel banks in the area above the former lake.	
WATERSHED	The watershed was observed to be generally as indicated by the U.S.G.S. topographic map. Limited reconnaissance of the watershed indicated the existence of a recent surface mining operation near the very upper end of the watershed. No other new construction or mining was observed in the watershed.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel below the principal spillway is the original Hottenbaugh stream channel. It is approximately 40 feet wide and gravel lined with alluvial gravel materials. Immediately below the dam, the left bank is relatively steep and approximately 10 feet high. The bank contains considerable vegetation, including trees, some of which are tilted, brush and considerable downtimber and debris. The right bank is somewhat flatter, approximately five feet high and rises to the floodplain below the dam. Approximately 500 feet below the dam, the highway bridge carries Lakewood Road across Hottenbaugh Run. The bridge is a single span structure with an opening approximately 45 feet wide and a height of 8 feet above the stream bed. The bridge has a reinforced concrete deck, supported by 5 deep steel beams, resting on stone masonry abutments. Below the bridge, the channel remains unchanged for an additional 500 feet above the confluence with Neshannock Creek.	
APPROXIMATE NO. OF HOMES AND POPULATION	Below the dam. three structures lie on the floodplain of Hottenbaugh Run as well as the bridge for Lakewood Road. It is questionable whether the failure of Lakewood Dam would imperil any of these structures.	



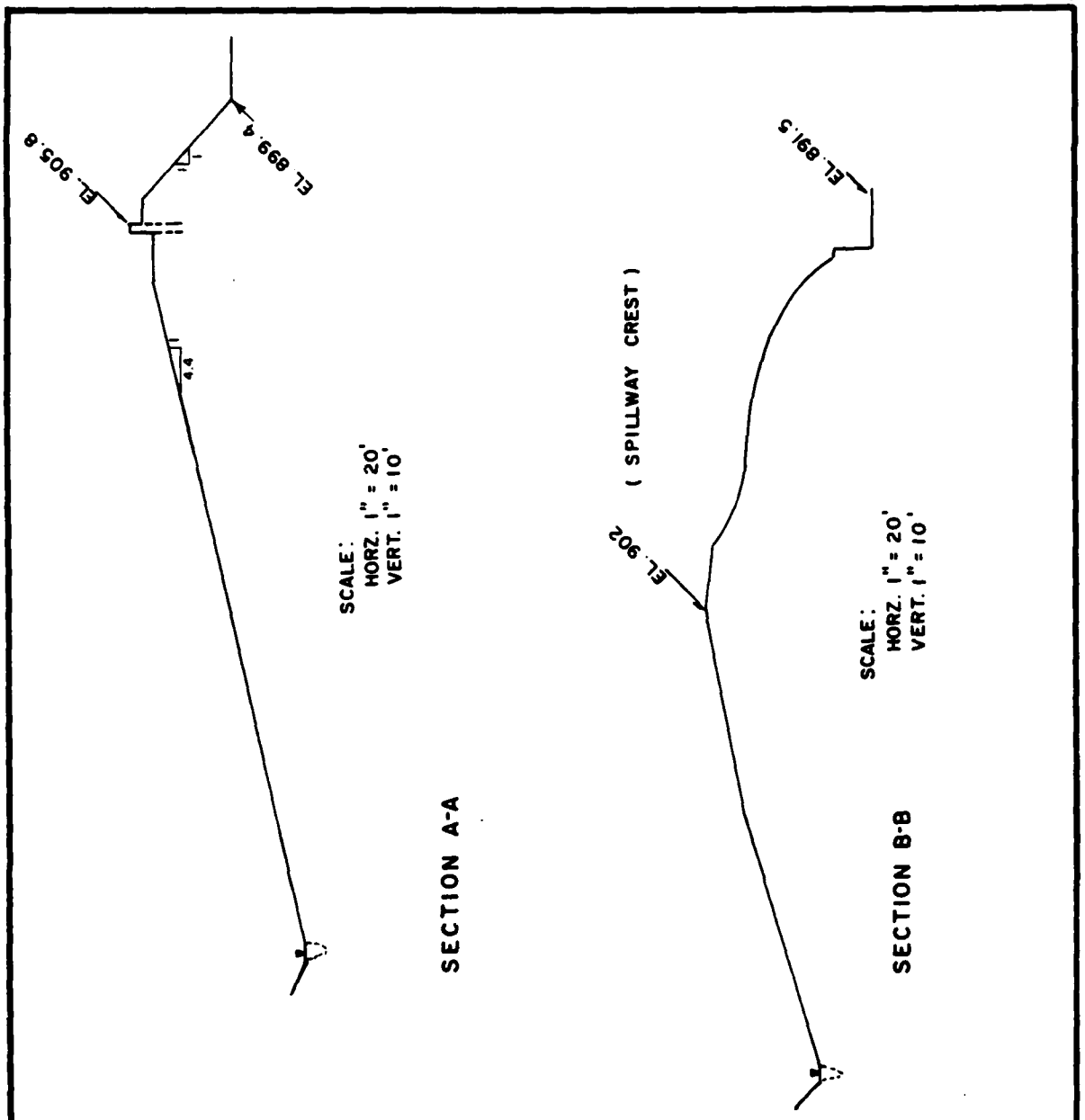
DATE: SEPT. 1980		LAKEWOOD DAM NATIONAL DAM INSPECTION PROGRAM	FIELD PLAN
SCALE: NONE			
DR: AP	CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH, PA. 15216	



DAM PROFILE
(LOOKING DOWNSTREAM)

SCALE:
HORZ. 1" = 40'
VERT. 1" = 10'

DATE: SEPT. 1980	LAKEWOOD DAM
SCALE: As Shown	NATIONAL DAM INSPECTION PROGRAM
DR: AP CK:	
ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH PA 15216	FIELD PROFILE



DATE: SEPT. 1980		LAKEWOOD DAM NATIONAL DAM INSPECTION PROGRAM	FIELD SECTIONS
SCALE: As Shown			
DR: AP	CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD/PITTSBURGH PA 15216	

APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Lakewood Dam
I.D. No. PA 00909

ITEM	REMARKS
*Design Drawings	"Reconstruction of Dam on Hottenbaugh Run near Eastbrook, Lawrence County, Pennsylvania, Topographic Map and Location Plan" dated May 1919, Sheet 1 of 2. Sheets by Thomas A. Gilkey, C.E., New Castle, Pennsylvania. Also, same sheet marked Revised May 30, 1919.** "Reconstruction of Dam on Hettenbaugh Run near Eastbrook, Lawrence County, Pennsylvania, Arrangement and Details of Sluiceway" dated May 1919, Sheet 2 of 2. Sheets by Thomas A. Gilkey, C.E., New Castle, Pennsylvania. Also, same sheet marked Revised May 30, 1919.** "Elevation View of Spillway of Dam at Lakewood Beach" dated 29 May 1933.** "Plan and Profile Showing Proposed Improvement at Lakewood Beach, Hickory Township, Lawrence County, Pennsylvania" dated 19 June 1933. Three copies showing differing embankment upstream slope configurations. Latest copy.**
*Design Report	See "Report Upon the Application of the Eastbrook Outing Association" dated 26 June 1919 and "Progress Report Upon the Dam of the Eastbrook Outing Association" dated 9 September 1919.
As-Built Drawings	None available.

B1

ITEM	REMARKS
Regional Vicinity Map	U.S.G.S. New Castle North 7-1/2 Minute Quadrangle Map.**
*Construction History	Originally built between 1850 and 1860 as a sawmill dam. Extensively reconstructed in 1919, contractor unknown. Design prepared by Thomas A. Gilkey, Consulting Engineer, New Castle, Pennsylvania.
*Typical Sections of Dam	See Design Drawings above.
Outlets - Plan Details Constraints Discharge Ratings	None.
*Rainfall/Reservoir Records	Storm and flood in fall of 1919 washed out newly placed fill at each end of concrete section. Severe storm in 1927 damaged downstream toe of emergency (auxiliary) spillway.
Geology Reports	None available.
*Dam Stability	See undated calculations contained in PennDER files.
Seepage Studies	None available.
Materials Investigations Boring Records, Laboratory, Field	None available.

ITEM	REMARKS
*Post-Construction Surveys of Dam	See Design Drawings above.
Borrow Sources	None reported.
Monitoring Systems	None reported.
*Modifications	See Design Drawings above. Upon completion of re-construction in the fall of 1919, the impoundment was filled (without regulatory approval). Almost immediately, a large storm resulted in overtopping and erosion of the new earthfill on both sides of the principal spillway. As part of repairs, three masonry walls were built on the left (embankment) side of the spillway, one on the centerline of the dam and one each on upstream and downstream sides of the embankment. The spaces between were filled with compacted earthfill. A concrete apron was placed on and downstream of the emergency (auxiliary) spillway to repair and improve erosion resistance following damage resulting from a large storm in 1927. Pool level raised at sometime between 1921 and 1932 by placing 18 inch high flashboards across the principal spillway crest. The embankment was raised about two feet to comply with Water and Power Resources Board recommendations. The work was performed between 1934 and 1935. The pond was drained and cleaned annually and miscellaneous repairs made as required.

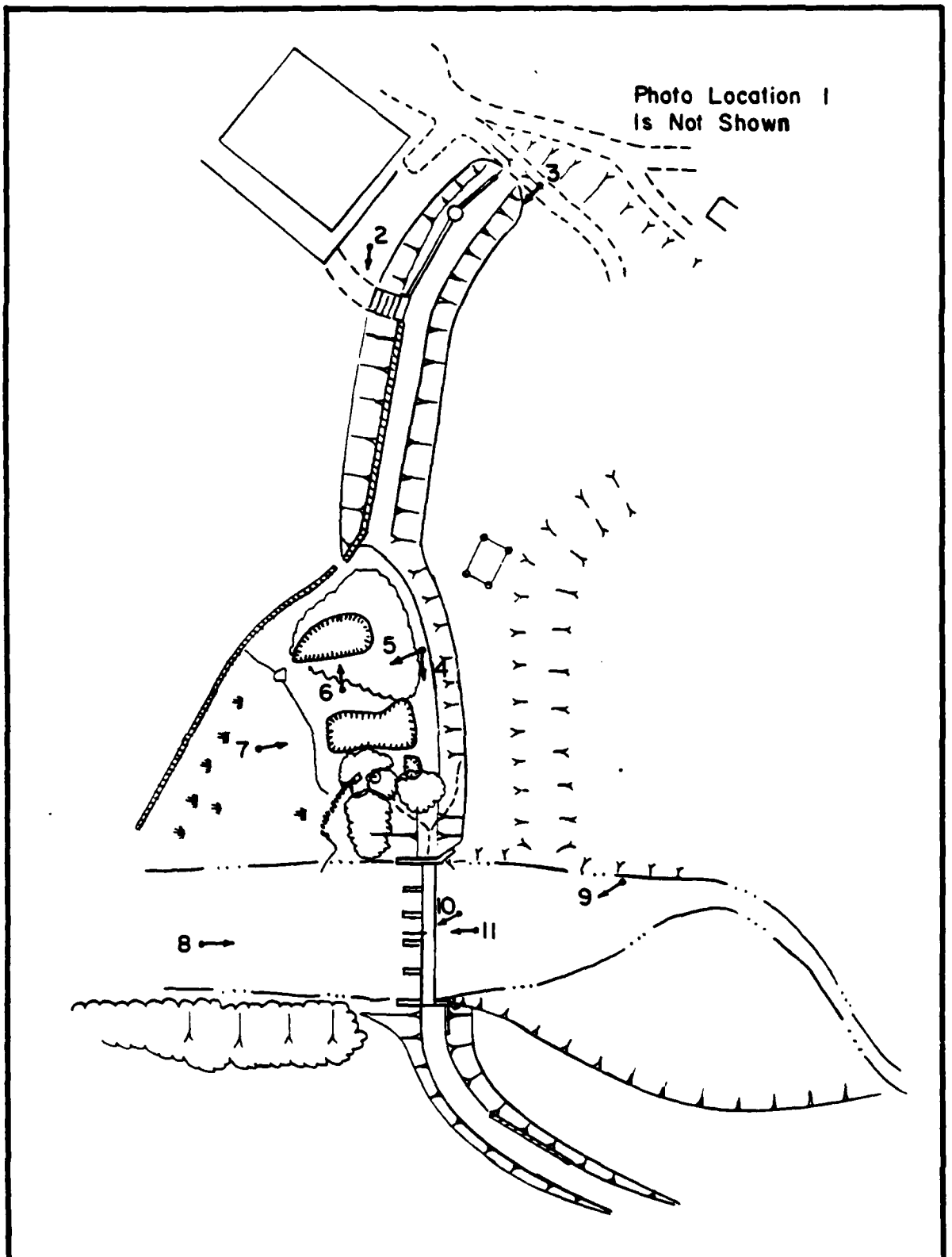
ITEM	REMARKS
*High Pool Records	See Rainfall/Reservoir Records above.
*Post Construction Engineering Studies and Reports	See miscellaneous correspondence in PennDER files regarding addition of flashboards, concrete apron, and raising height of embankment dated between 1932 and 1936.
*Maintenance Operation, Records	See records of annual drawdown for purpose of cleaning, dated between 1933 and 1971.
*Spillway Plan Sections Details	See Design Drawings above.
*Operating Equipment Plans and Details	See Design Drawings above.
*Specifications	See "Specifications for Sluiceway on Hettenbaugh Run" dated 1919.
Miscellaneous	
*Prior Accidents or Failure of Dam Description Reports	See Rainfall/Reservoir Records above. See "Inspection Report on the Dam of the Eastbrook Outing Association" dated 27 April 1920.
*Inspection Reports	By Water Supply Commission of Pennsylvania or Water and Power Resources Board.

ITEM	REMARKS
*Inspection Reports (continued)	8 September 1919, 27 April 1920. 21 March 1921, 20 July 1932 (Inspection Date), 17 August 1932, 20 September, 1932, 17 November 1932, 12 June 1933, 9 May 1934, 8 June 1934, 3 July 1934, 13 December 1961
*Applications and Permits,	Application by Eastbrook Outing Association to construct a "Sluiceway for old earth dam," dated 9 May 1919. Permit issued by Water supply Commission to Eastbrook Outing Association for reconstruction . . ., dated 8 July 1919. Application to the Water and Power Resources Board, "to change the water level of the Hottenbaugh Run by the addition of a one foot board in the headgates or control works of a dam, . . ." dated 11 August 1932. 31 "Applications for Permit to Draw Dam of Other Body of Water" in accordance with either Act of May 2, 1925 or December 15, 1959. Also letters of approval of applications.

*Information and data may be obtained from the PennDER, Harrisburg, Pennsylvania.
**Reduced size reproductions contained in Appendix E.

APPENDIX C

PHOTOGRAPHS



DATE: SEPT. 1980		LAKEWOOD DAM NATIONAL DAM INSPECTION PROGRAM	PHOTO KEY MAP
SCALE: NONE			
DR: AP	CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD/PITTSBURGH PA 15216	
DWG. NO.			

Photo 1 Overview of dam showing principal and emergency spillways and dewatered impoundment area.

Photo 2 Embankment at right end of dam as observed from below.

Photo 3 Embankment upstream slope near right end of dam.

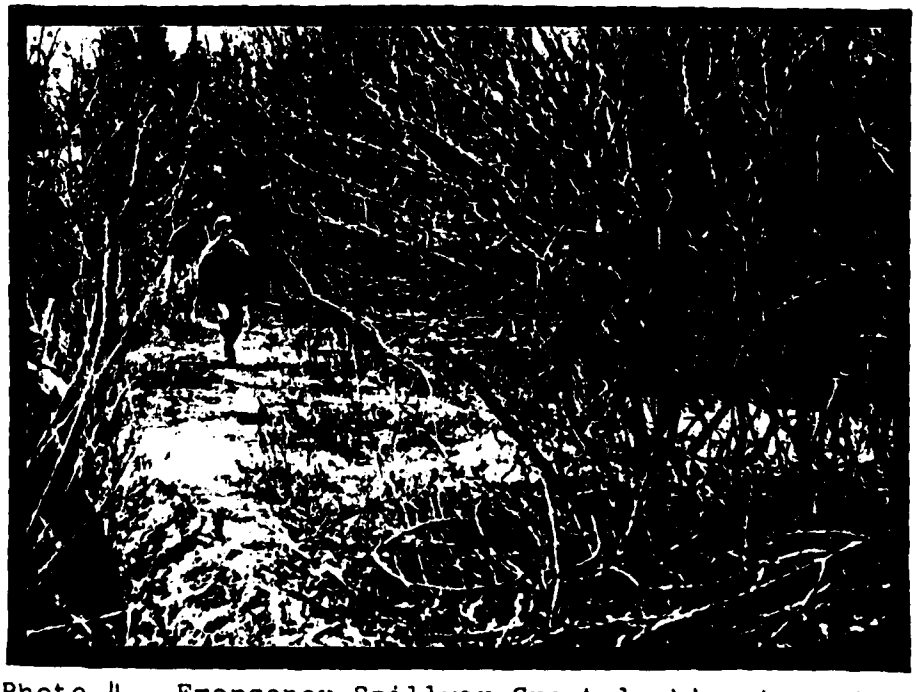


Photo 4 Emergency Spillway Crest looking toward the left.

Photo 5 Emergency Spillway Discharge Channel looking downstream. Note collapsed training wall and swampy conditions.

Photo 6 Sinkhole in emergency spillway discharge channel.

Photo 7 Emergency Spillway crest and discharge channel as seen from below.

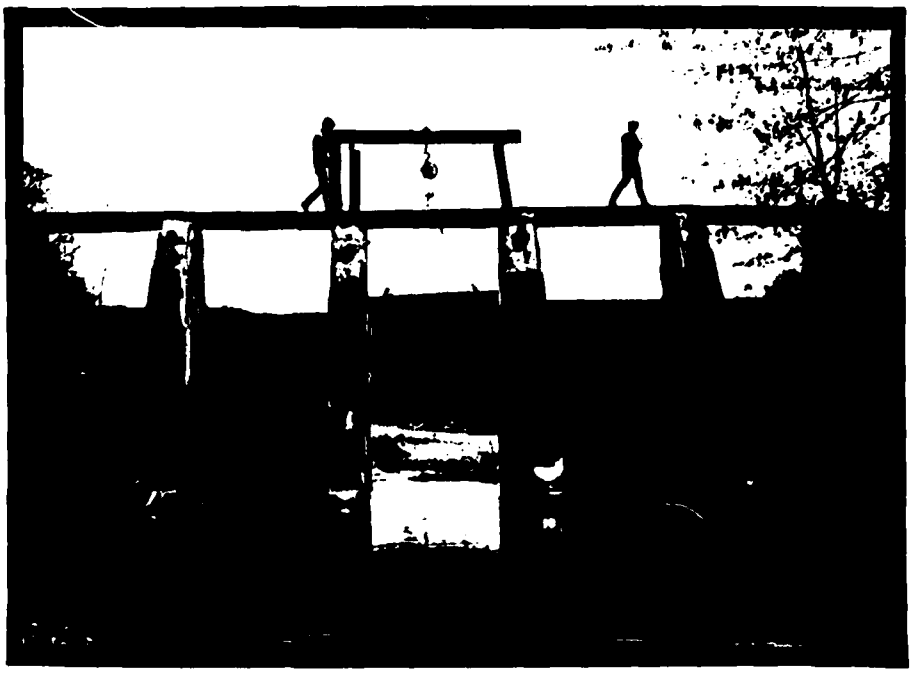


Photo 8 Principal Spillway structure showing low level outlet works as seen from downstream.

Photo 9 Principal Spillway structure showing outlet works as seen from upstream.

Photo 10 Outlet Works Gate Frame. Note deteriorated support conditions.

Photo 11 Outlet Works. Note concrete deterioration.

Photo 12 Downstream Hazards. Note highway bridge below.

APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology: The dam overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation: The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph: The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters, their definition and how they were obtained for these analyses.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel	From U.S.G.S. 7.5 minute topographic map
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic map

Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic map

3. Routing: Reservoir routing is accomplished by using Modified Puls routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation-discharge relationship.

Storage in the pool area is defined by an area-elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping: Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominately farmland. Some surface mining/quarrying activities.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 900.5 (14.9 acre-feet.)

ELEVATION TOP OPERATING POOL (STORAGE CAPACITY): 902 (21.5 acre-feet.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 906 (50.3 acre-feet.)

ELEVATION MAXIMUM DESIGN POOL: 905.5

ELEVATION TOP DAM: 1,906 (Effective)

OVERFLOW SECTION

		Principal	Emergency
a.	Elevation	900.5	902
b.	Type	Sharp Weir	Broad Weir
c.	Width	10 inches	30+ feet
d.	Length	40 feet	105 feet
e.	Location Spillover	Left abutment	Center of Dam
f.	Number and Type of Gates	None	None

OUTLET WORKS

a. Type Steel sluice gate
b. Location Center Bay - Principal Spillway
c. Entrance Inverts 889.5
d. Exit Inverts 889.5
e. Emergency Drawdown Facilities Same

HYDROMETEOROLOGICAL GAGES

a. Type None
b. Location N/A
c. Records None

MAXIMUM REPORTED NON-DAMAGING DISCHARGE None reported.

HEC-1 DAM SAFETY VERSION
HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Lakewood Dam NDI ID NO. PA 00909

Probable Maximum Precipitation (PMP)	23.7*
Drainage Area	12.9 sq. mi.
Reduction of PMP Rainfall for Data Fit	0.8
Reduce by 20%, therefore PMP rainfall =	=19.0 in.

Adjustments of PMF for Drainage Area (Zone 2)

6 hrs.	114%
12 hrs.	124%
24 hrs.	138%
48 hrs.	148%

Snyder Unit Hydrograph Parameters

Zone	27**
C_p	0.4
C_t	2.7
L	7.1 mile
L_{ca}	2.8 mile
$t_p = C_t (L \cdot L_{ca})^{0.3}$ =	6.62 hours

Loss Rates

Initial Loss	1.0 inch
Constant Loss Rate	0.05 inch/hour

Base Flow Generation Parameters

Flow at Start of Storm	1.5 cfs/sq.mi=19.4 cfs
Base Flow Cutoff	0.05 x Q peak
Recession Ratio	2.0

Overflow Section Data (Principal Spillway)

Crest Length (Effective)	37.2 to 40.0 feet
Freeboard	5.5 feet
Discharge Coefficient	2.6-3.3
Exponent	1.5
Discharge Capacity	1583 cfs

Overflow Section Data (Emergency Spillway)

Crest Length	105 feet
Freeboard	4.0 feet
Discharge Coefficient	2.6
Exponent	1.5
Discharge Capacity	2184 cfs

---

*Hydrometerological Report 33
**Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

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Job LAKEWOOD DAM Job No. 79153E
Subject HYDROLOGIC/HYDRAULIC ANALYSIS
Made By JEB Date 8/4/80 Checked SGM Date 8/10/80

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS OF ENGINEERS - BALTIMORE DISTRICT

STRTL = 1 INCH
CNSTL = 0.05 INCH/HOUR
STRTQ = 1.5 CFS/MI^2
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.0

ELEVATION-AREA-CAPACITY RELATIONSHIPS

FROM USGS NEW CASTLE NORTH QUADRANGLE, PENNDER FILES AND FIELD INSPECTION DATA.

BY 1958 USGS QUAD - LAKEWOOD POOL EL. = 902 (MSL)

ASSUME THIS TO BE PRINCIPAL SPILLWAY CREST ELEVATION WITH FLASHBOARDS.

FROM FIELD PROFILE - SPILLWAY CREST EL = 901.8 TO 902.0 USE 902.0

EMBANKMENT CREST VARIES 905.8 TO 909.3 BUT IS MOSTLY LEVEL THROUGHOUT - USE EL. AVG. = 906.0

FROM USGS A_{902} = 15.3 ACRES
A_{910} = 14.4 ACRES
A_{920} = 42.5 ACRES

FROM PENNDER V_o = 650,000 CF AT EL 900.5
= 14.9 ACRE-FEET
A_o = 3.5 ACRES

BY CONIC METHOD OF RESERVOIR VOLUME FLOOD HYDROGRAPH PACKAGE (HEC-1), DAM SAFETY VERSION

$$H = \frac{3V_o}{A_o} = \frac{3(14.9)}{3.5} = 12.8$$

V = 0 AT 887.8

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Subject

Made By JEB Date 8/9/00 Checked SGM Date 8/10/00

AREA	$A	0.0	3.5	5.3	14.4	42.5
ELEVATION	$E	887.8	900.5	902.0	910.0	920.0

DAM OVERTOP PARAMETERS

TOP OF DAM ELEVATION (EFFECTIVE)	906.0
LENGTH, EXCLUDING SPILLWAYS	295 FEET
COEFFICIENT OF DISCHARGE	3.09

SPILLWAY STAGE-DISCHARGE RELATIONSHIP

PRINCIPAL SPILLWAY:

CREST WIDTH	10 INCHES	USE 1 FOOT
CREST LENGTH	40 FEET	USE END CONTRACTION CORRECTION
H_o	5 FEET	NEGLECT ORIFICE EFFECT ABOVE H = 5 FEET
WEIR COEFFICIENT		KING AND BRATER TABLE 5-3
END CONTRACTIONS	$L = L' - 2[NK_p + K_A]H_o$	

$K_p = 0.02$
$K_A = 0.20$
$N = 4$
$L' = 5 \times 8 = 40$ FEET

$L_{MIN} = 37.2$

$\Delta L/\Delta H = 0.56$ FT/FT.

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Job LAKEWOOD DAM Job No. 79153I

Subject

Made by JEB Date 8/6/80 Checked SPM Date

PRINCIPAL SPILLWAY: $Q = CLH^{1.5}$

H	C	L	Q	POOL ELEVAT.
0	2.6	40	0	900.5
1.5	3.2	39.2	230	902.0
3.5	3.3	38.0	821	904.0
5.5	3.3	37.2*	1583	906.0
9.5	3.3	37.2*	3595	910.0

* MINIMUM

EMERGENCY SPILLWAY: $Q = C L H^{1.5}$

H	C	L	Q	POOL ELEVAT.
–	–	–	0	900.5
0	2.6	105	0	902.0
2	2.6	105	772	904.0
4	2.6	105	2184	906.0
8	2.6	105	6177	910.0

COMBINED SPILLWAY CAPACITY

PRINCIPAL	EMERGENCY	VS: Q	YA: POOL ELEV.
0	0	0	900.5
230	0	230	902
821	772	1593	904
1583	2184	3767	906
3595	6177	9772	910

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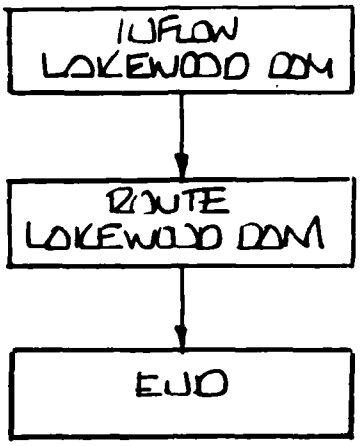
Job LAKEWOOD DAM Job No. 791531

Subject

Made By JJB Date 8/9/84 Checked SGM Date 8/10/84

PROGRAM SCHEDULE



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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
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    1              A1       NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS
    2              A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF LAKEWOOD DAM
    3              A3       PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD
    4              B   300       0      30       0       0       0       0       0      -4       0
    5              B1    5
    6              J     1       4       1
    7              J1  1.0     0.5    0.25    0.10
    8              K     0       1                                               1
    9              K1       INFLOW HYDROGRAPH FOR LAKEWOOD DAM
   10              M     1       1    12.9               12.9                                    1
   11              P            23.7     114     124     138     148
   12              T                                                       1.0     .05
   13              W  6.62     0.4
   14              X  -1.5   -0.05     2.0
   15              K     1       2                                               1
   16              K1       ROUTING AT LAKEWOOD DAM
   17              Y                                       1       1
   18              Y1    1                                                 -900.5      -1
   19              Y4 900.5   902.0   904.0   906.0   910.0
   20              Y5    0.   230.0  1593.0  3767.0  9772.0
   21              $A    0.     3.5     5.3    14.4    42.5
   22              $E 887.8   900.5   902.0   910.0   920.0
   23              $$ 900.5
   24              $D 906.0    3.09     1.5    295.
   25              K    99
   26              A
   27              A
   28              A
   29              A
   30              A
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
END OF NETWORK	

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

RUN DATE: 8 SEP 80
RUN TIME: 8.27.52

NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSIS OF LAKEWOOD DAM
PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	30	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= 1.00 0.50 0.25 0.10

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

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR LAKEWOOD DAM

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	12.90	0.0	12.90	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.70	114.00	124.00	138.00	148.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.809

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 6.62 CP=0.40 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 6.68 HOURS, CP= 0.40 VOL= 0.98

9.	35.	72.	117.	168.	223.	282.	341.	393.	437.
473.	499.	515.	515.	500.	480.	461.	442.	425.	408.
392.	376.	361.	347.	333.	320.	307.	295.	283.	272.
261.	251.	241.	231.	222.	213.	205.	196.	189.	181.
174.	167.	160.	154.	148.	142.	136.	131.	126.	121.
116.	111.	107.	103.	99.	95.	91.	87.	84.	80.
77.	74.	71.	68.	66.	63.	61.	58.	56.	54.
51.	49.	47.	46.	44.	42.	40.	39.	37.	36.
34.	33.	32.	30.	29.	28.	27.	26.	25.	24.
23.	22.	21.	20.	19.	19.	18.	17.	17.	16.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	28.37	25.93	2.44	425686.
										(721.)	(659.)	(62.)	(12054.10)

HYDROGRAPH ROUTING

ROUTING AT LAKEWOOD DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-901.	-1

STAGE	900.50	902.00	904.00	906.00	910.00
FLOW	0.0	230.00	1593.00	3767.00	9772.00
SURFACE AREA=	0.	4.	5.	14.	43.
CAPACITY=	0.	15.	21.	97.	369.
ELEVATION=	888.	901.	902.	910.	920.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
900.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
906.0	3.1	1.5	295.

PEAK OUTFLOW IS 11178. AT TIME 46.50 HOURS

PEAK OUTFLOW IS 5591. AT TIME 46.50 HOURS

PEAK OUTFLOW IS 2795. AT TIME 46.50 HOURS

PEAK OUTFLOW IS 1118. AT TIME 46.50 HOURS

****

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 0.50	RATIO 3 0.25	RATIO 4 0.10
HYDROGRAPH AT	1	12.90	1	11175.	5587.	2794.	1117.
	(	33.41)	(	316.44)(	158.22)(	79.11)(	31.64)(
ROUTED TO	2	12.90	1	11178.	5591.	2795.	1118.
	(	33.41)	(	316.52)(	158.32)(	79.16)(	31.67)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	900.50	900.50	906.00
STORAGE	15.	15.	50.
OUTFLOW	0.	0.	3767.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	908.51	2.51	77.	11178.	20.50	46.50	0.0
0.50	906.79	0.79	58.	5591.	10.00	46.50	0.0
0.25	905.11	0.0	42.	2795.	0.0	46.50	0.0
0.10	903.30	0.0	29.	1118.	0.0	46.50	0.0

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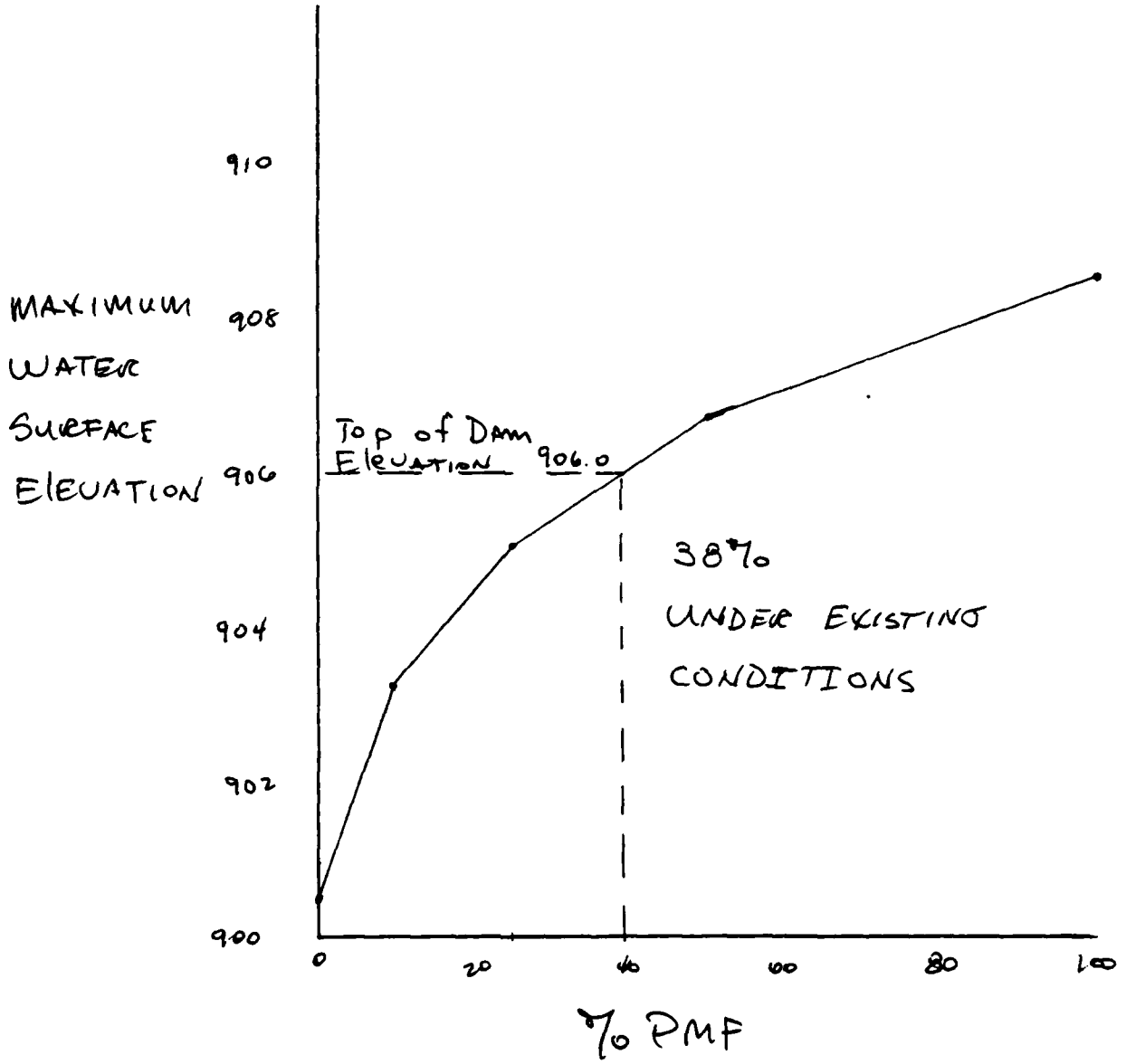
Sheet _____ of _____

Job LAKEWOOD DAM Job No. 79153I

Subject HYDROLOGIC PERFORMANCE PLOT

Made By JDH Date 9/8/80 Checked _____ Date _____

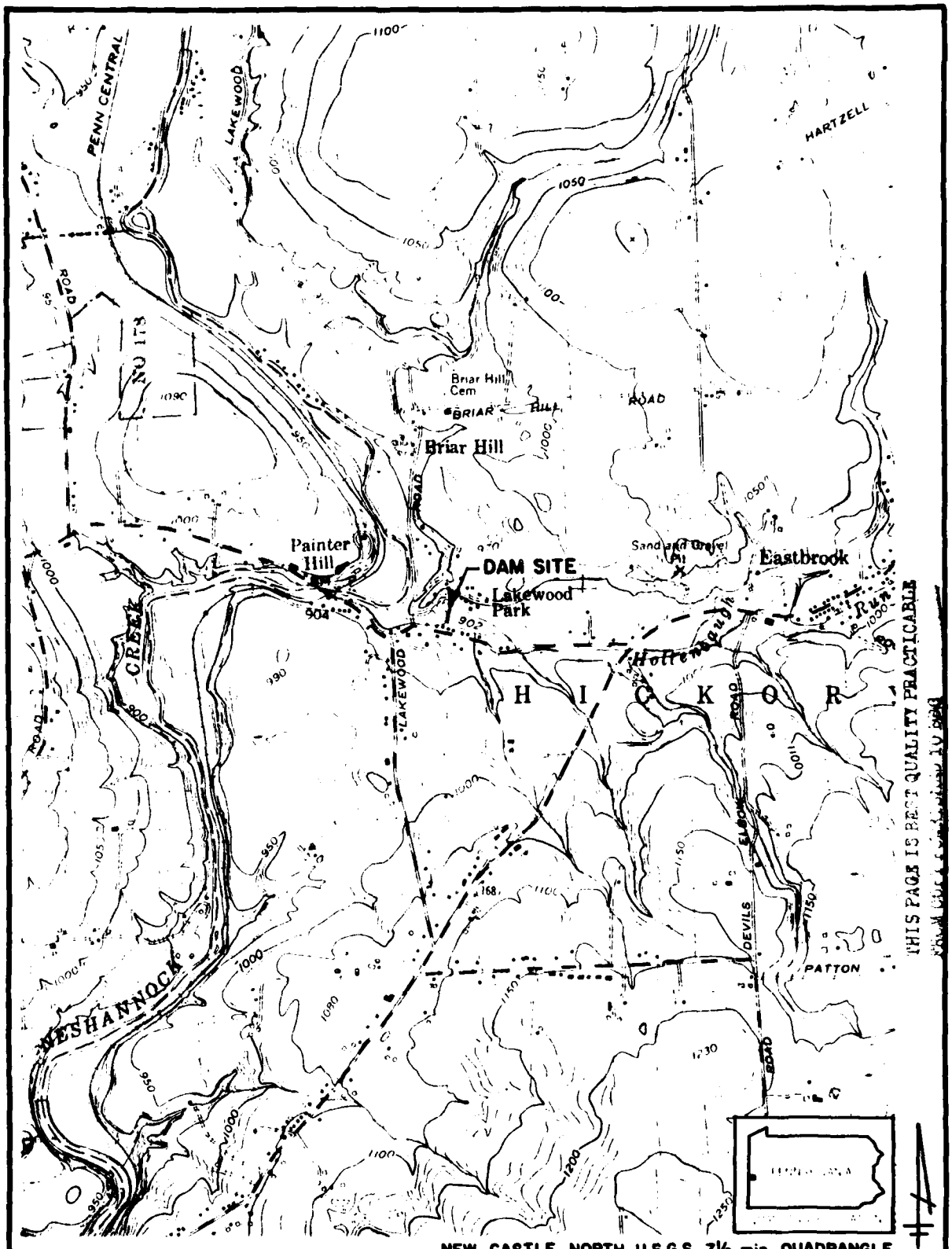


APPENDIX E

PLATES

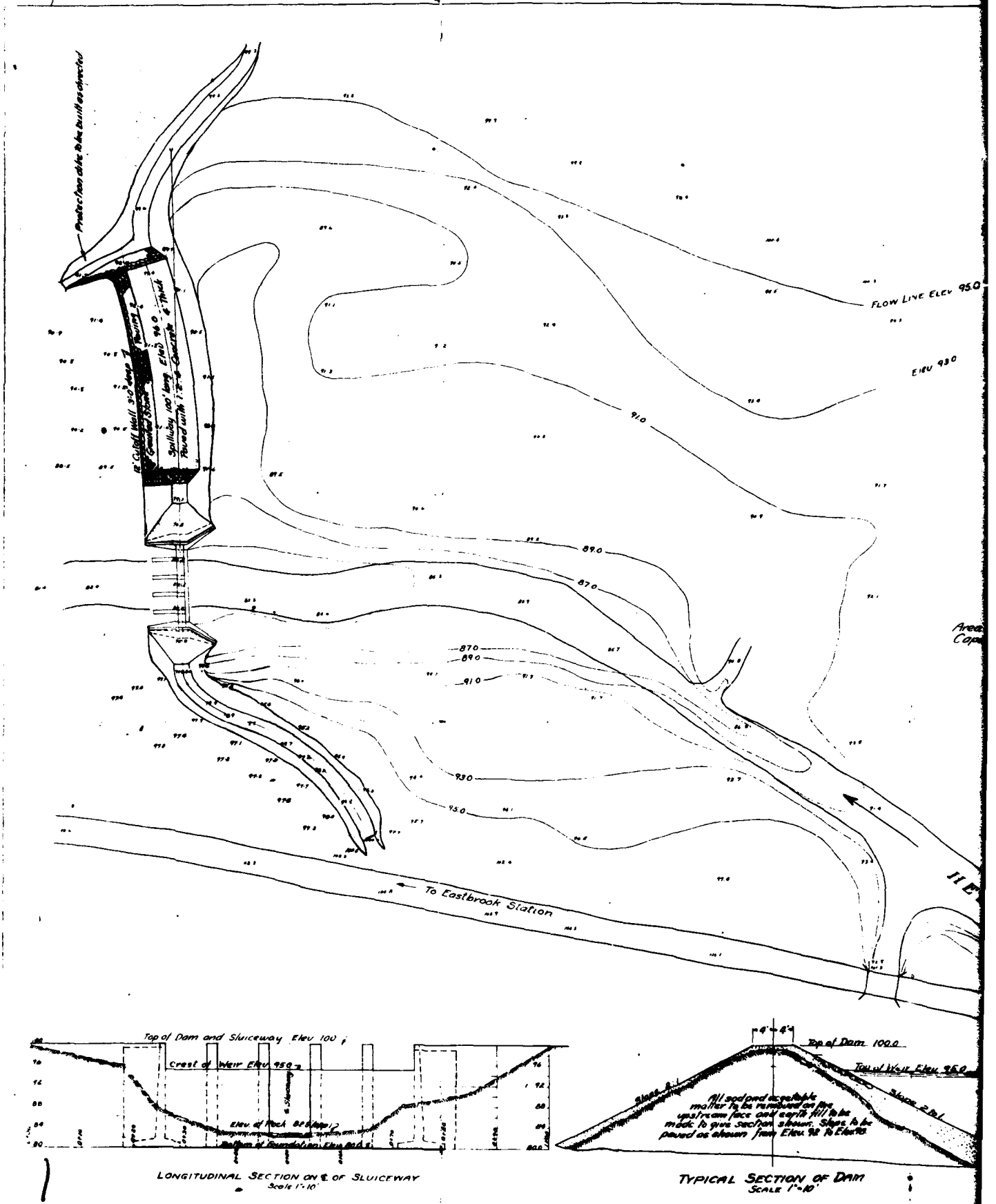
LIST OF PLATES

Plate I	Regional Vicinity Map.
Plate II	"Reconstruction of Dam on Hettenbaugh Run near Eastbrook, Lawrence County, Pennsylvania for the Eastbrook Outing Association - Topographic Map and Location Plan", Sheet 1 of 2, Revised May 30, 1919.
Plate III	"Reconstruction of Dam on Hettenbaugh Run near Eastbrook, Lawrence County, Pennsylvania for the Eastbrook Outing Association - Arrangement and Details of Sluiceway", Sheet 2 of 2, Revised May 30, 1919.
Plate IV	"Elevation View of Spillway of Dam at Lakewood Beach," dated 29 May 1933.
Plate V	"Plan and Profile Showing Proposed Improvement at 'Lakewood Beach'. Hickory Township - Lawrence County, Pennsylvania," dated 19 June 1933.



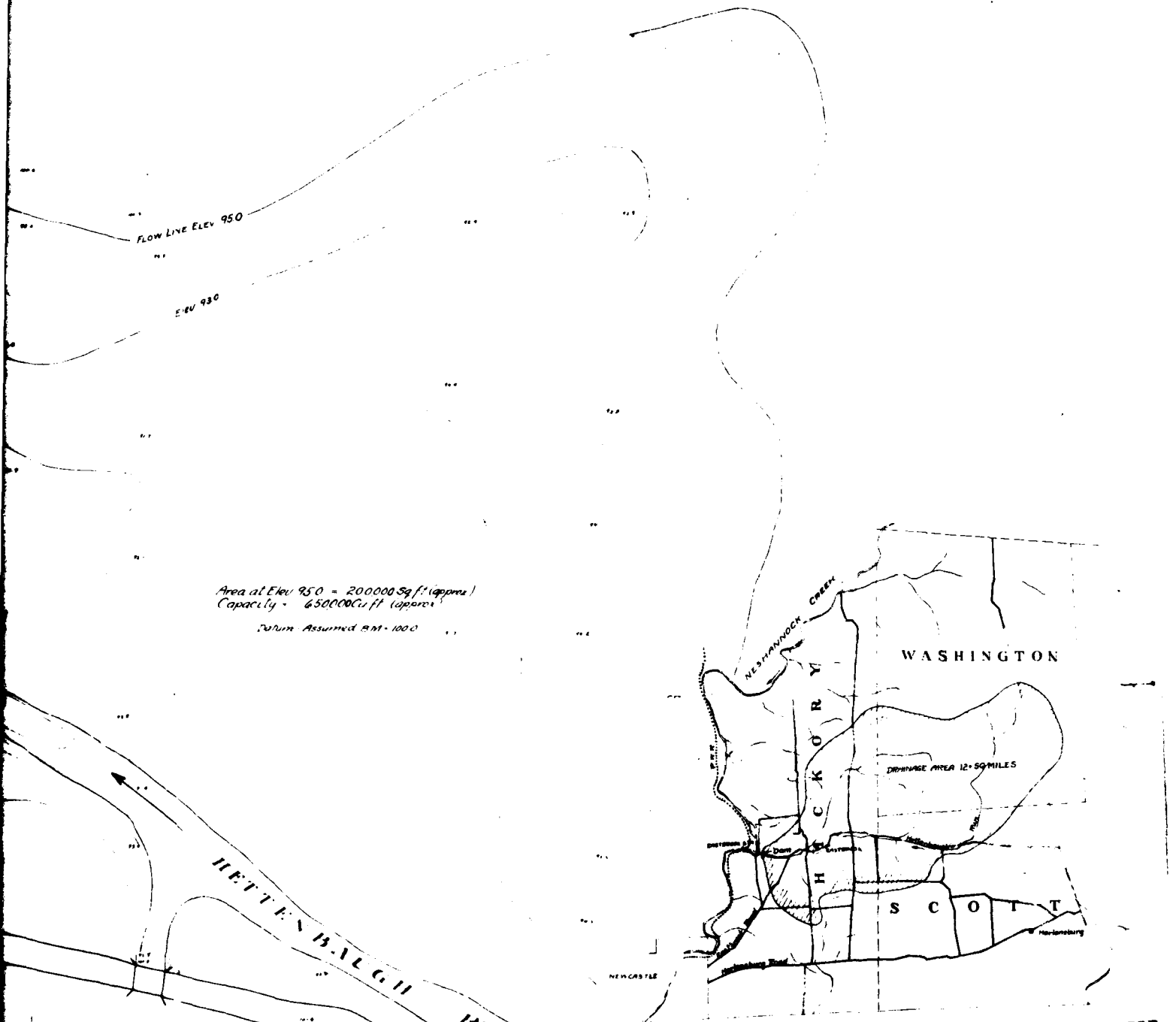
NEW CASTLE NORTH U.S.G.S. 7½ min. QUADRANGLE

DATE: SEPT. 1980	LAKEWOOD DAM NATIONAL DAM INSPECTION PROGRAM	REGIONAL VICINITY MAP
SCALE: 1" = 2000'		
DR: JF CK:	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH, PA 15216	
DWG. NO. PLATE I		



LONGITUDINAL SECTION ON ℄ OF SLUICEWAY
Scale 1"=10'

TYPICAL SECTION OF DAM
SCALE 1"=10'



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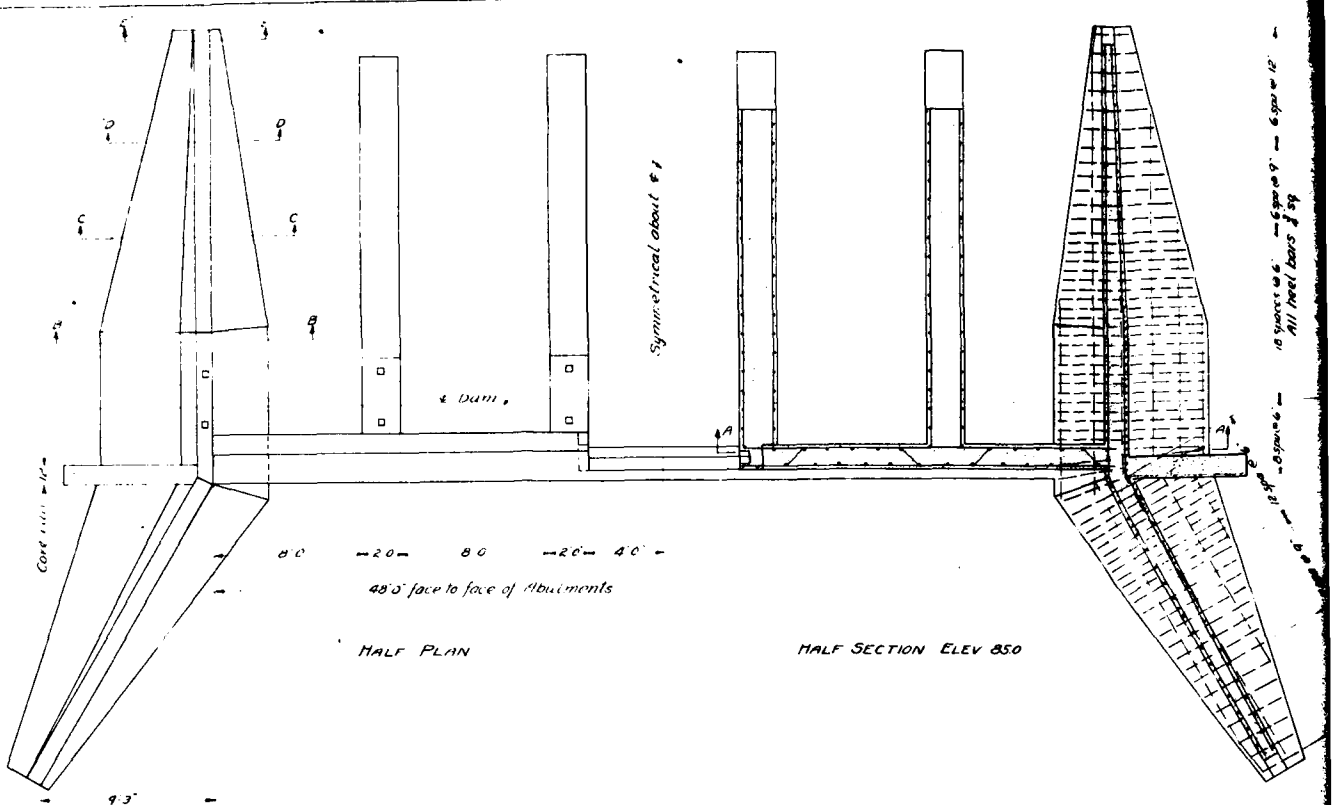
RECONSTRUCTION OF DAM
ON HETTENBAUGH RUN NEAR EASTBROOK
LAWRENCE COUNTY, PA. FOR THE
EASTBROOK OUTING ASSOCIATION
TOPOGRAPHIC MAP AND LOCATION PLAN
Scale 1" = 50 Feet
May 1979
Thos. J. Gilkey C.E.
Consulting Engineer
New Castle Pa

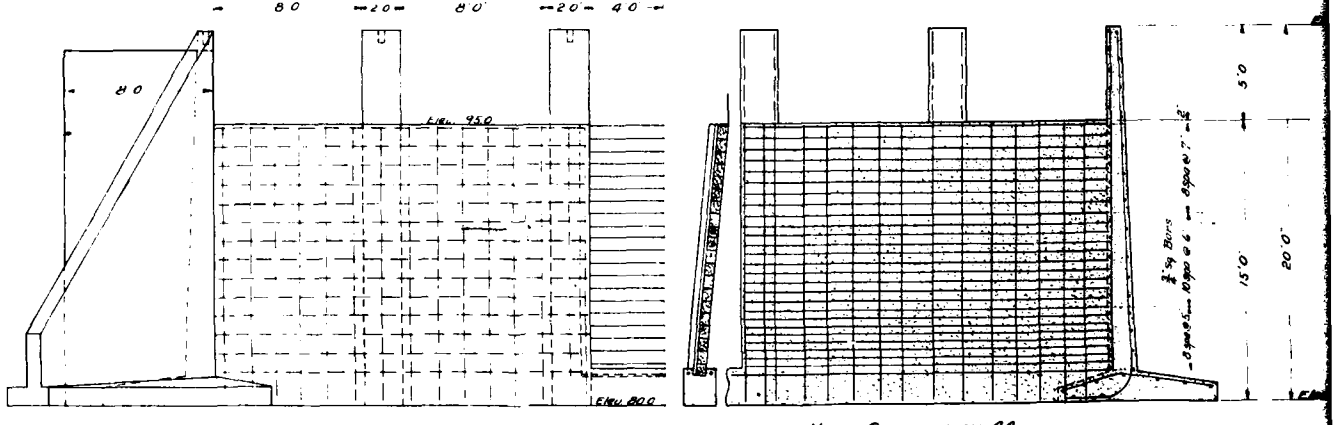
PLATE II

Revised May 30, 1979 Sheet 1 of



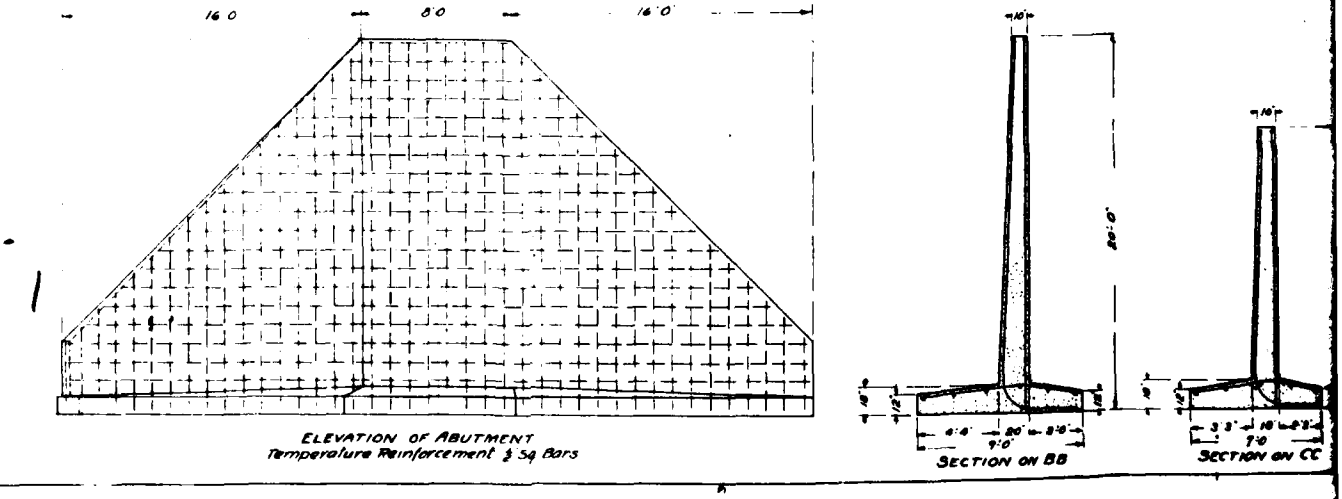
HALF PLAN

HALF SECTION ELEV 850



HALF ELEVATION
Showing Temperature Reinforcement
½ Sq Bars Horiz and Vert

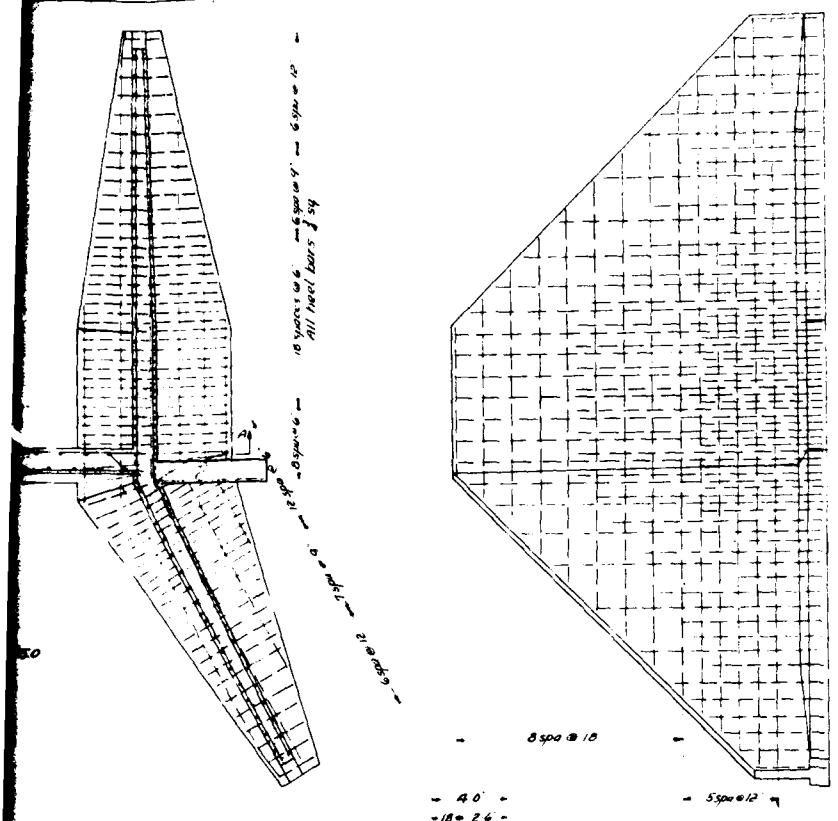
HALF SECTION ON AA
Showing stress bars in back of Weir
½ Sq Bars Vert ⅝ Sq Bars Horiz



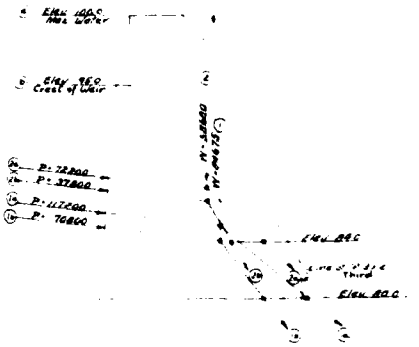
ELEVATION OF ABUTMENT
Temperature Reinforcement ½ Sq Bars

SECTION ON BB

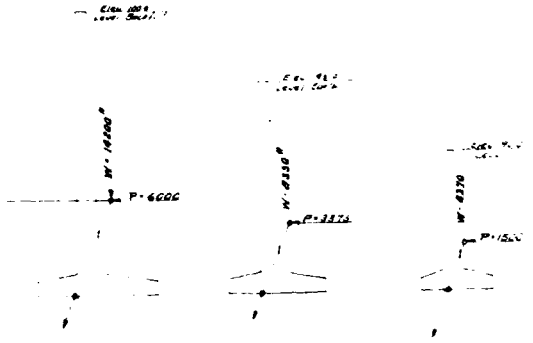
SECTION ON CC

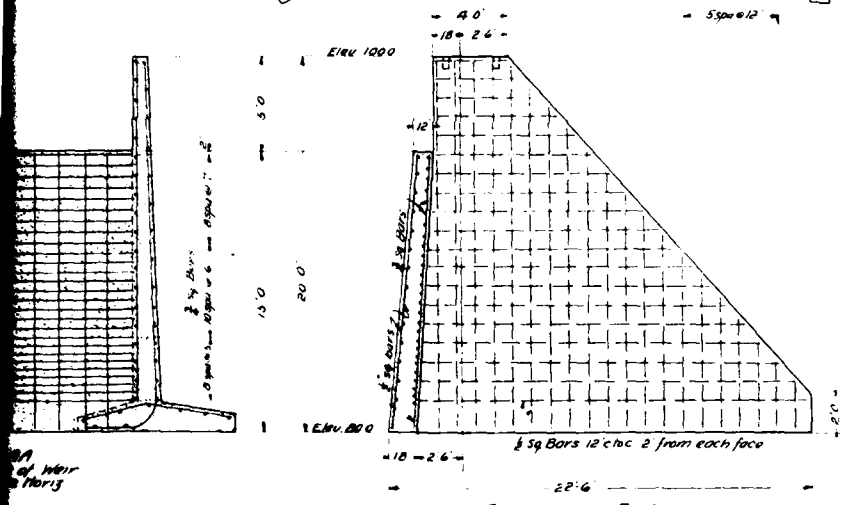


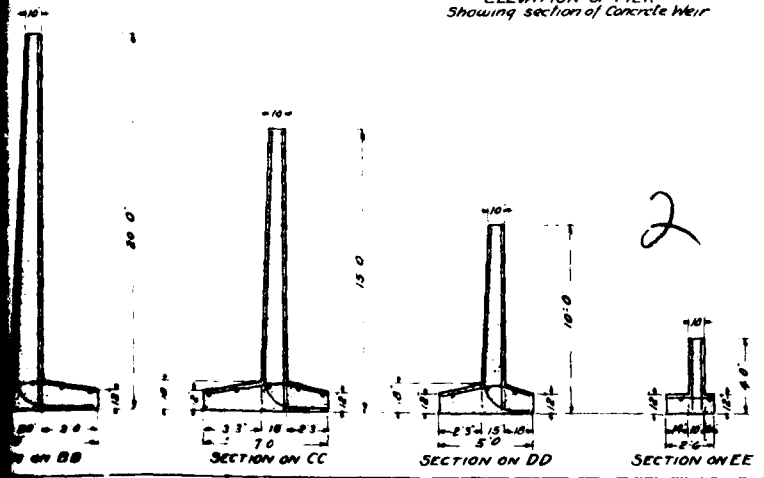
REAR ELEVATION OF ABUTMENT
Showing Cantilever Reinforcement
Vertical Bars # Sq Horiz Bars # Sq



Water level 100.0 Condition
95.0
Section at base
Elev 84.0





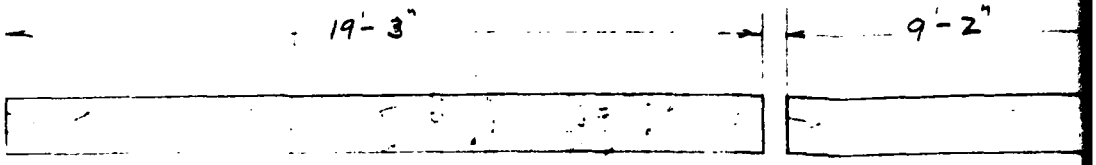


RECONSTRUCTION OF DAM
ON HETTENBAUGH RUN NEAR EASTBROOK
LAWRENCE COUNTY, PA, FOR THE
EASTBROOK OUTING ASSOCIATION
ARRANGEMENT AND DETAILS OF SLUICEWAY
scale 1"=10
May 1944
New Castle, Pa
Thos A Gilkey CE
Consulting Engineer

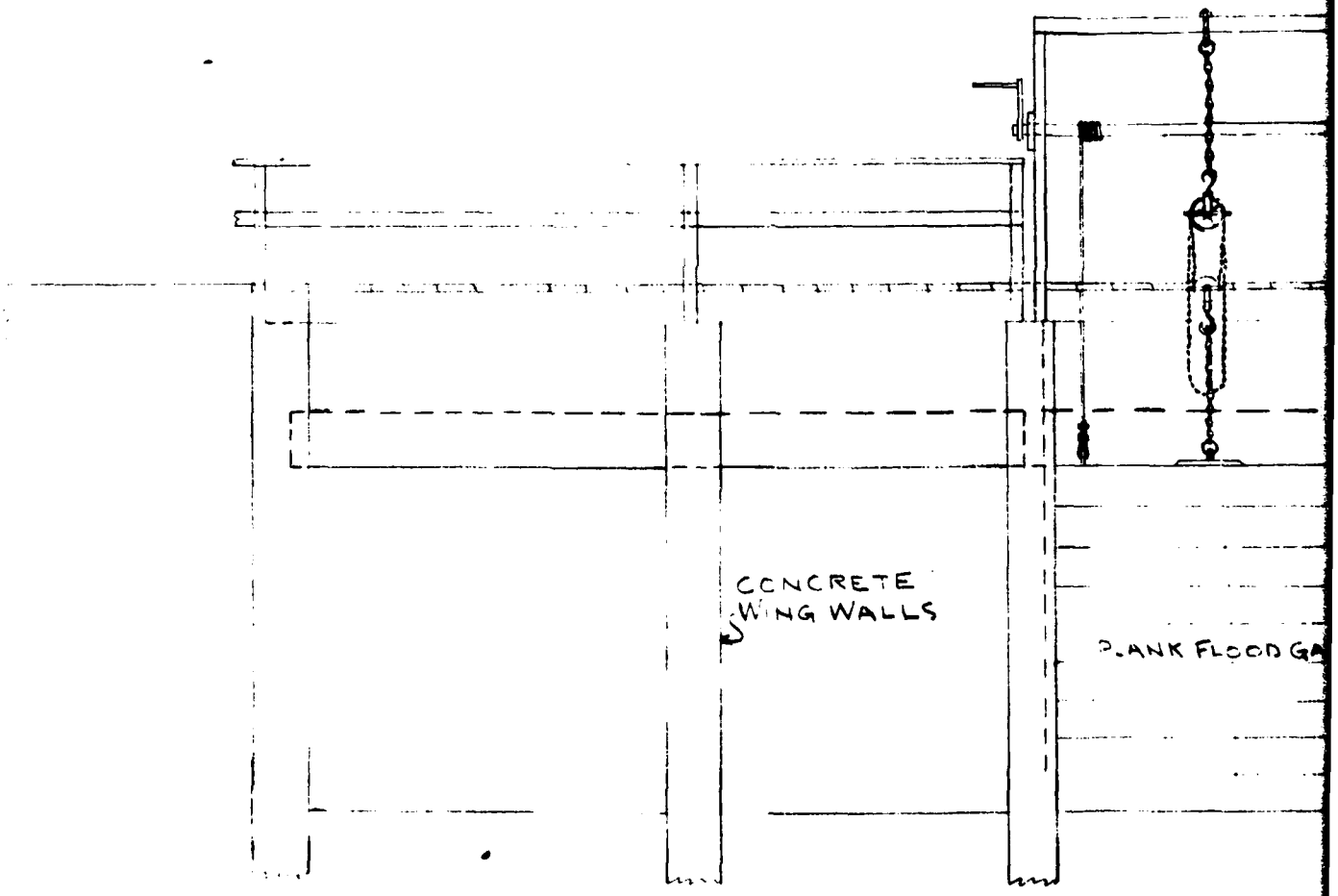
PLATE III

227

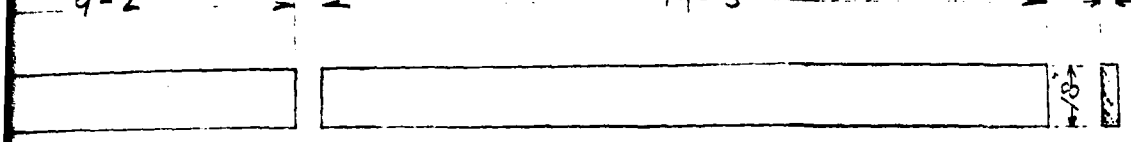
Revised May 1944 Sheet 2 of 2 Sheets



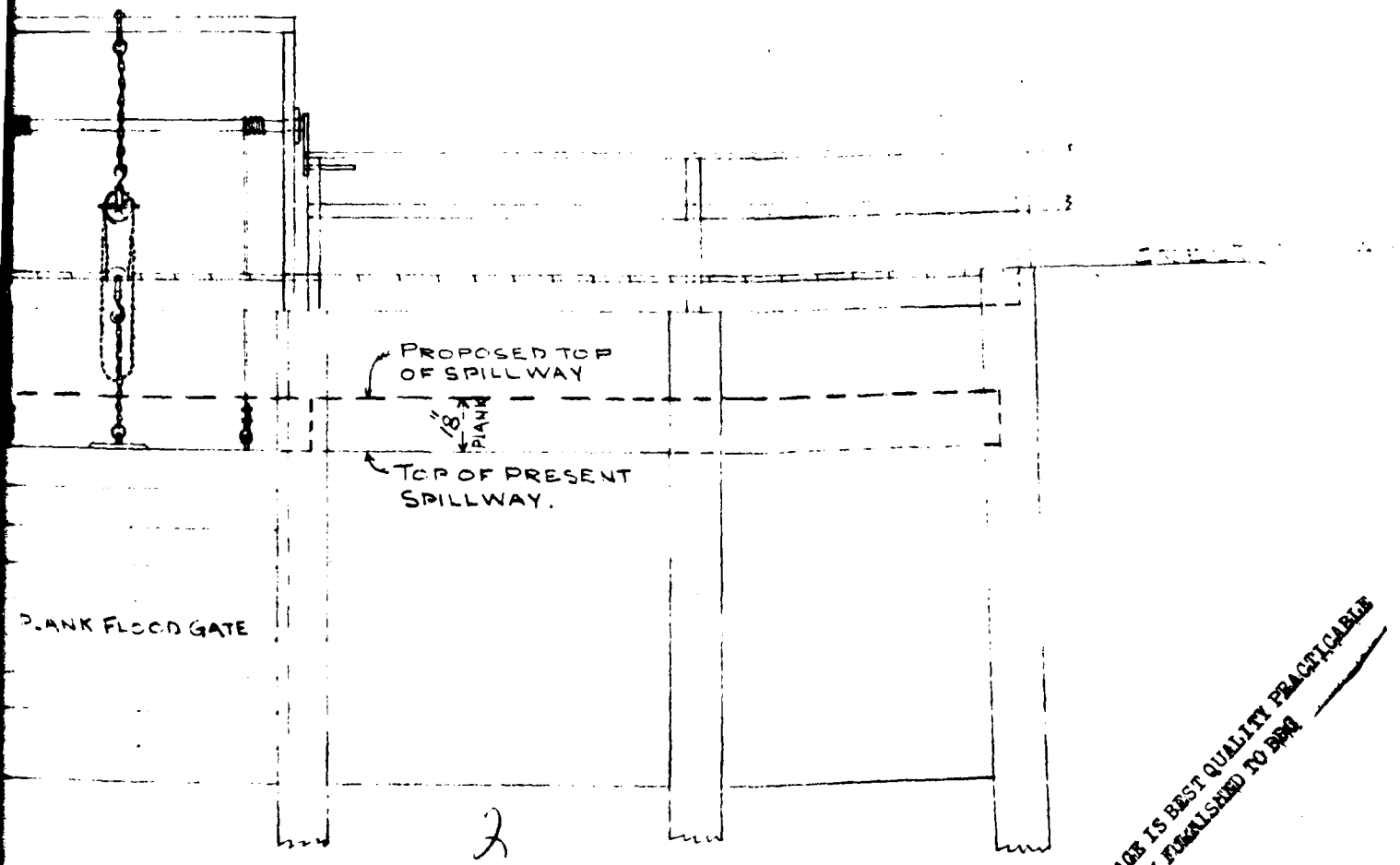
DETAILS OF PLA
RAISING HEIGH



ELEVATION VIEW
DAM AT LAKE WOOD



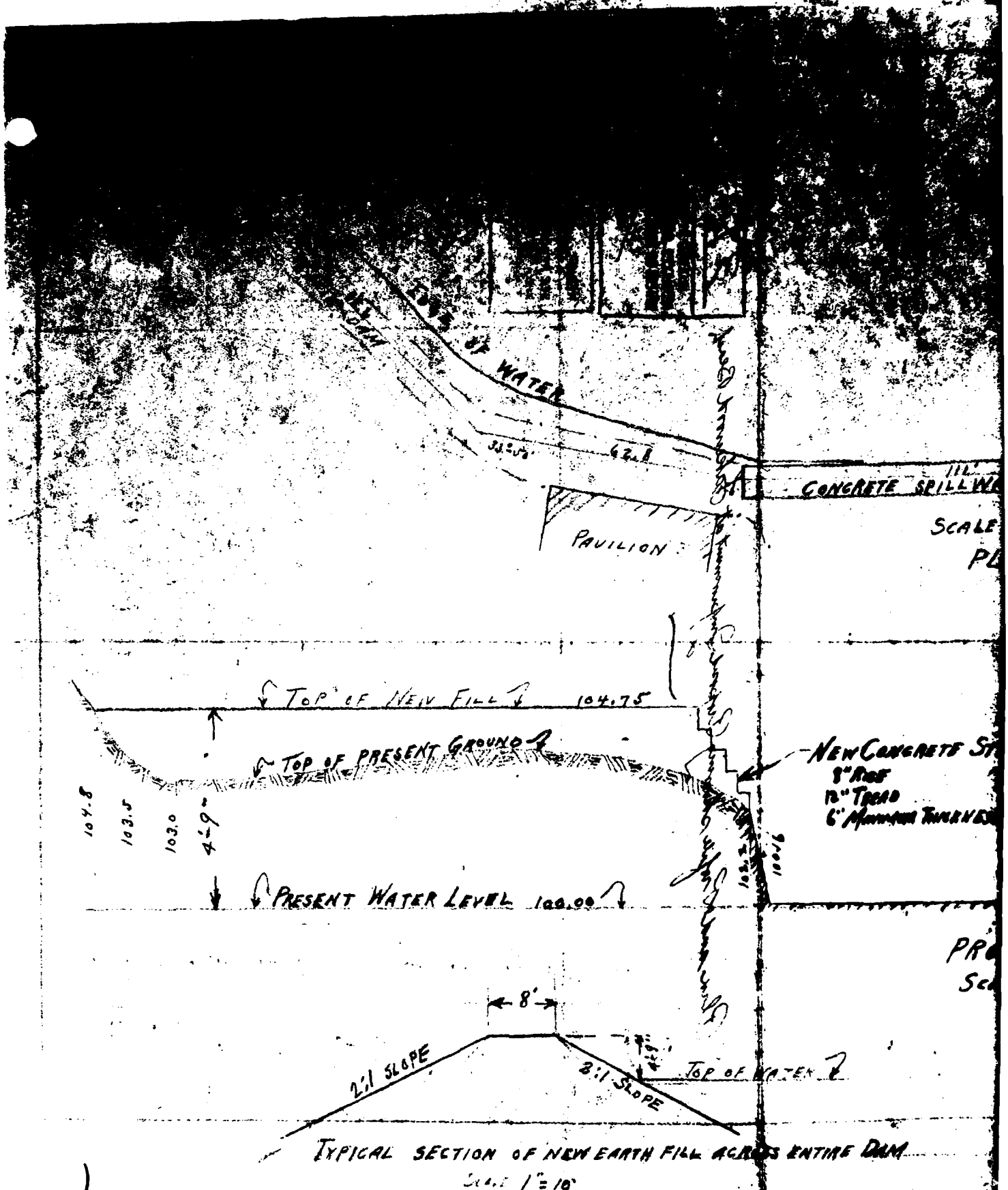
TAILS OF PLANK FOR
ISING HEIGHT OF SPILLWAY.



ION VIEW OF SPILLWAY OF
LAKE WOOD BEACH.

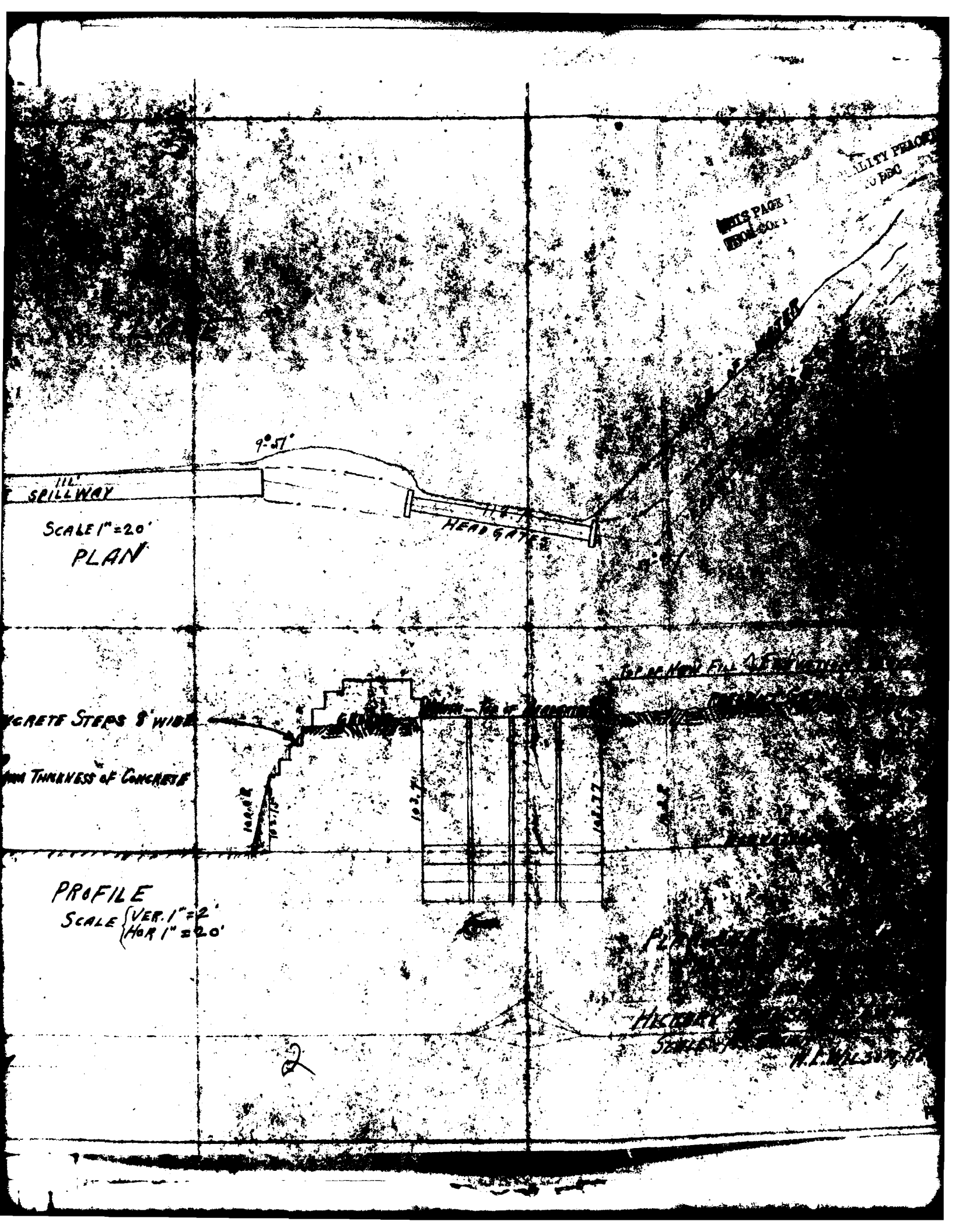
MAY 29, 1933.

PLATE IV



TYPICAL SECTION OF NEW EARTH FILL ACROSS ENTIRE DAM

SCALE 1" = 10'


9°-57'
SPILLWAY
HEADGATES
SCALE 1"=20'
PLAN
CRETE STEPS 8' WIDE
PROFILE
SCALE {VER. 1"=2'
HOR 1"=20'

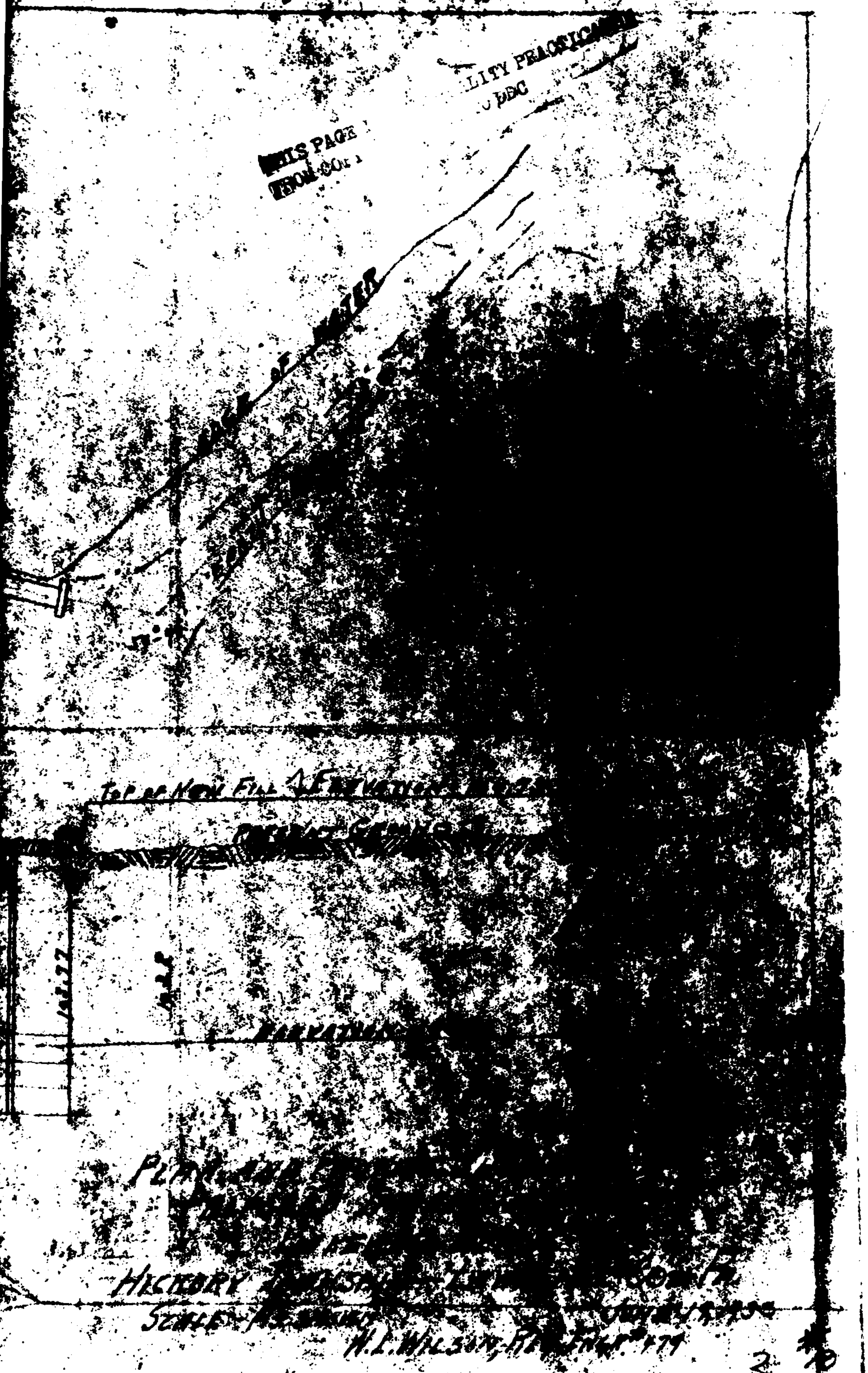


PLATE V

APPENDIX F

GEOLOGY

GEOLOGY

Geomorphology

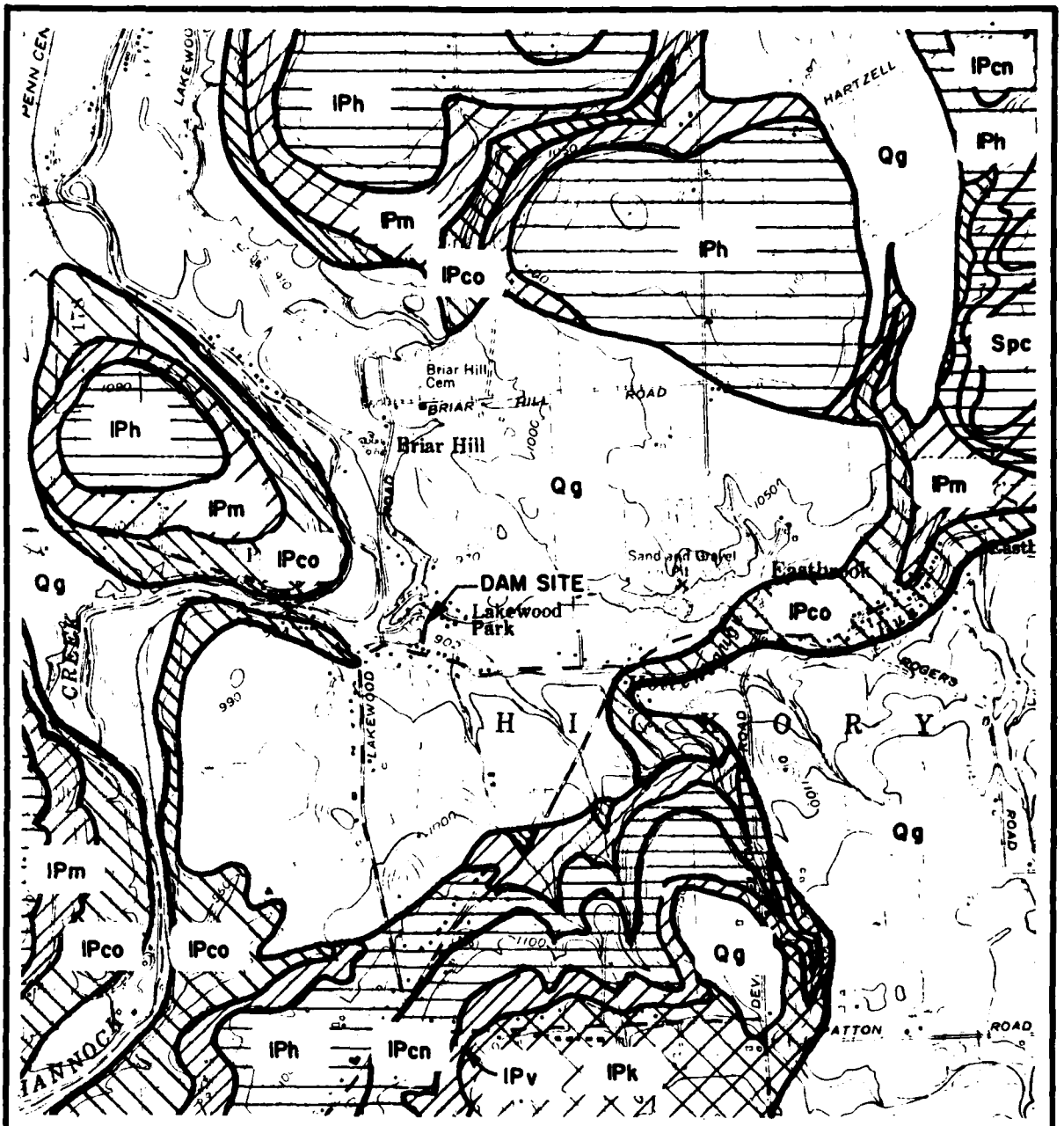
Lakewood Dam is located within the glaciated section of the Appalachian Plateau Physiographic Province. This area is characterized by broad, flat floodplains composed of glacial outwash on which the streams meander. In places, the valley sides rise rather abruptly from the edges of the flood plains. Lakewood Dam lies along Hottenbaugh Run, a tributary to Neshannoch Creek. Hottenbaugh Run is a flood plain that has been cut 100 to 200 feet into glacial outwash.

Structure

The regional dip of the bedrock near the dam site is about 15 feet per mile to the southest.

Stratigraphy

The bedrock in the area of the dam is of Pennsylvanian Age and includes those formations in the Pottsville Group and the lower part of the Allegheny Group. The dam immediately overlies recent glacial outwash deposits which cover the valley floor.



NEW CASTLE NORTH QUADRANGLE, LAWRENCE COUNTY, PENNSYLVANIA

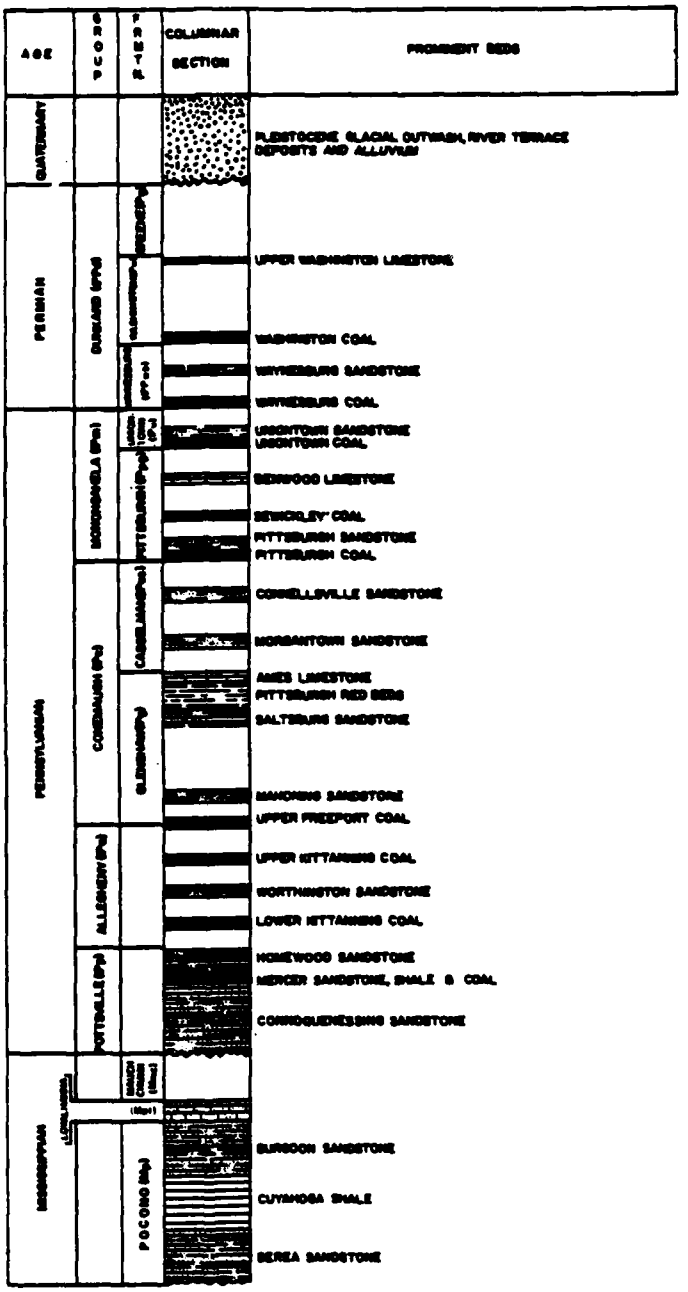
SCALE: 0 1/2 MILE 1:24000

CONTOUR INTERVAL 20FT. DATUM IS MEAN SEA LEVEL

FORMATION CONTACT

DATA OBTAINED FROM PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY, GEOLOGY AND HYDROLOGY OF THE NESHANNOCK QUADRANGLE GROUNDWATER REPORT W15, 1963

DATE: SEPT. 1980		LAKEWOOD DAM NATIONAL DAM INSPECTION PROGRAM	GEOLOGIC MAP
SCALE: 1" = 2000'			
DR: JF	CK:	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH, PA 15216	



DATE: SEPT. 1980	LAKEWOOD DAM NATIONAL DAM INSPECTION PROGRAM	GEOLOGIC COLUMN
SCALE: None		
DR: AP CK:	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH, PA 15216	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2