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NATIONAL DAM INSPECTION PROGRAM. WOLF CREEK DAM (LAKE RENE). ND--ETC(U)
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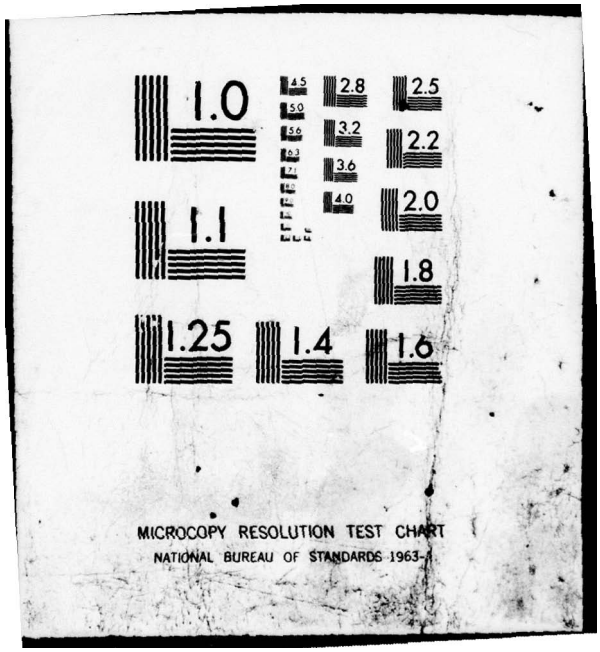
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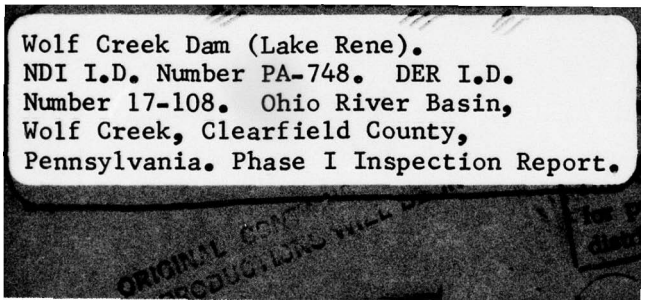

Wolf Creek Dam (Lake Rene).
NDI I.D. Number PA-748. DER I.D.
Number 17-108. Ohio River Basin,
Wolf Creek, Clearfield County,
Pennsylvania. Phase I Inspection Report.

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 investigation and analyses involving topographic mapping, subsurface investigations, material testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the inspection is intended to identify any 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 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 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.

The assessment of the conditions and recommendations was made by the consulting engineer in accordance with generally and currently accepted engineering principles and practices.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Wolf Creek Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Clearfield
STREAM: Wolf Run, a secondary tributary of Sandy Lick Creek
DATE OF INSPECTION: April 4 and May 4, 1979

ASSESSMENT: Based on the evaluation of the existing conditions, the condition of Wolf Creek Dam is considered to be good.

Several wet areas were observed on the downstream slope and along the toe of the embankment. These areas should be periodically observed and remedial work performed if conditions worsen.

Wolf Creek Dam is one of the three dams which impound Lake Rene. The spillways associated with this dam and Galion Bay Dam constitute the flood discharge facilities for Lake Rene. Lake Rene Dam has no spillway structures.

The flood discharge capacity of Lake Rene was evaluated according to the recommended procedure and was found to pass 90 percent probable maximum flood (PMF); therefore, according to the recommended criteria, the flood discharge capacity of Lake Rene was classified to be inadequate.

The following recommendations should be implemented on a continuing basis:

1. The wet areas located along the downstream face and the toe of the embankment should be periodically observed. Necessary remedial work should be performed if the extent of the wet areas increases or seepage and sloughing conditions develop.

2. Around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system should be developed to alert the downstream residents in the event of emergencies.

3. Small trees on the upstream face of the dam should be removed.

4. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.

Lawrence D. Andersen, P.E.
Vice President

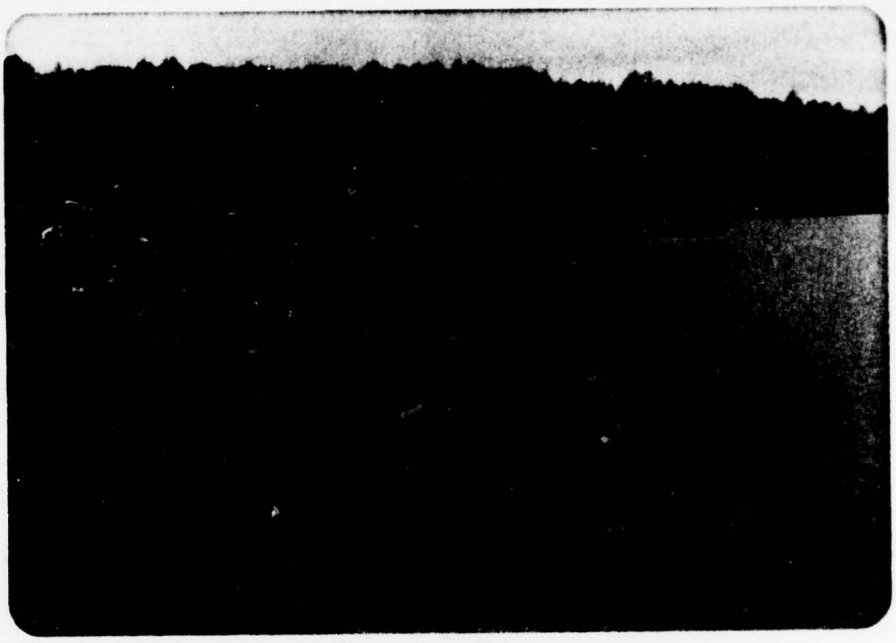
June 25, 1979
Date

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

27 July 1979
Date

WOLF CREEK DAM
NDI I.D. NO. PA-748
APRIL 4, 1979



Upstream Face

Downstream Face

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
WOLF CREEK DAM
NDI I.D. NO. PA-748
DER I.D. NO. 17-108

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct the 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 or property.

ABSTRACT

1.2 Description of Project

a. Dam and Appurtenances. Wolf Creek Dam consists of an earth embankment approximately 1050 feet long with a maximum height of 34 feet from the downstream invert of the outlet works conduit and a crest width of 40 feet. Wolf Creek Dam is one of the three dams which impound Lake Rene. The other two dams are Galion Bay Dam, located at the south side of Lake Rene, and Lake Rene Dam, located on the east side of the reservoir. Lake Rene Dam, which was constructed in 1955, was the original dam at the site. Wolf Creek Dam and Galion Bay Dam were constructed in 1971 in conjunction with the enlargement of Lake Rene.

The flood discharge facilities for Lake Rene consist of primary and emergency spillways associated with Wolf Creek and Galion Bay dams. The Wolf Creek Dam flood discharge facilities are comprised of a drop inlet primary spillway located at the center of the embankment and an emergency spillway on the left abutment (looking downstream). The primary spillway structures consist of a single-stage reinforced concrete riser, a 36-inch-diameter reinforced concrete conduit, and a plunge pool at the downstream end of the outlet pipe. The emergency spillway is an 130-foot-wide trapezoidal earth channel excavated into the left abutment. The reservoir drainpipe for the dam consists of a 15-inch steel pipe extending from the upstream toe of the dam to the drop inlet structure. Flow through the reservoir drainpipe is controlled by a manually operated sluice gate located in the drop inlet structure. The reservoir drainpipe constitutes the emergency drawdown facility for the reservoir.

ABSTRACT

b. Location. The dam is located on Wolf Run, a secondary tributary of Sandy Lick Creek, approximately three miles north of DuBois in Sandy Township, Clearfield County, Pennsylvania (Plate 1).

Downstream from the dam, Wolf Run follows a 1000- to 1500-foot wide valley for approximately 3-1/2 miles where it flows under U.S. Route 219. It then turns south and follows a course parallel to Route 219 for three miles where it joins Sandy Lick Creek approximately 1/2 mile south of Falls Creek, Pennsylvania. The first three-mile reach of Wolf Run downstream from the dam is uninhabited. Two commercial buildings and one police station are located in the area where Wolf Run flows under Route 219. It is estimated that failure of the dam would cause large loss of life and property damage along Route 219 and further downstream in the town of Falls Creek.

c. Size Classification. Intermediate (based on 34-foot height and 6750 acre-feet storage capacity).

d. Hazard Classification. High.

e. Ownership. Treasure Lake of Pennsylvania, Inc. (address: Mr. James R. Farrer, Director of Development, Treasure Lake of Pennsylvania, Inc., P.O. Box 687, DuBois, Pennsylvania 15801).

f. Purpose of Dam. Recreation.

g. Design and Construction History. The dam was designed by R. M. Keddal and Associates, Inc., of Bethel Park, Pennsylvania, and Engineering Mechanics, Inc., of Pittsburgh, Pennsylvania in 1969. The dam was constructed by the Canton Development Company of DuBois, Pennsylvania, with completion in 1971.

h. Normal Operating Procedure. The reservoir is normally maintained at Elevation 1662.5, the uncontrolled primary spillway crest elevation for both Wolf Creek and Galion Bay dams. The inflow occurring when the lake is at or above the primary spillway level is discharged through the primary and emergency spillways of the Wolf Creek and Galion Bay dams.

1.3 Pertinent Data

a. Drainage Area — 4.4 square miles

b. Discharge at Dam Site (cfs)

Maximum known flood at dam site	Unknown
Outlet conduit at maximum pool	20
Gated spillway capacity at maximum pool	N/A

Ungated spillway capacity at maximum pool[1]	3844
Total spillway capacity at maximum pool[1]	3844

c. Elevation (USGS Datum) (feet)

Top of dam	1670 (as designed); 1670.7 (measured low spot)
Maximum pool	1670.7
Normal pool	1662.5
Upstream invert outlet works	1643
Downstream invert outlet works	1637
Streambed at center line of dam	1636±
Maximum tailwater	Unknown

d. Reservoir Length (feet)

Normal pool level	10,000
Maximum pool level	10,000

e. Storage (acre-feet)

Normal pool level	3700
Maximum pool level	6750

f. Reservoir Surface (acres)

Normal pool level	310
Maximum pool level	360

g. Dam

Type	Earth
Crest length	1050 feet
Height	34 feet
Top width	40 feet
Side slopes	3H:1V both upstream and downstream slopes
Zoning	Yes
Impervious core	Yes
Cutoff	Yes
Grout curtain	No

h. Regulating Outlet

Type	15-inch reservoir outlet pipe
Length	50± feet

[1] Wolf Creek Dam spillway only.

	Closure		Sluice gate at drop inlet structure
	Access		Through drop inlet structure
	Retaining facilities		Sluice gate
1.	Spillway	Primary	Emergency
	Type	Drop inlet	Trapezoidal earth channel
	Length	18 feet	130 feet
	Crest elevation	1662.5	1664.5
	Gates	None	None
	Upstream channel	Lake	Trapezoidal earth channel
	Downstream channel	36-inch outlet conduit	Trapezoidal earth channel

SECTION 2
DESIGN DATA

2.1 Design

a. Data Available. The available information was provided by the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER).

(1) Hydrology and Hydraulics. The available information consists of design and freeboard hydrographs and associated flood routings.

(2) Embankment. Available information consists of design drawings, construction specifications, engineer's report and calculations.

(3) Appurtenant Structures. Available information includes design drawings.

b. Design Features

(1) Embankment

a. As designed, the dam (Plate 2) is a zoned embankment (Plate 3) with an impervious core extending through a cutoff trench to the top of rock and an internal drainage system beneath the downstream slope. Two zones were identified. The first zone was identified as an impervious zone and forms the core of the embankment. The second zone was a semi-impervious zone and constitutes the shell sections of the embankment. The impervious core is trapezoidal in cross section and starts at a level five feet below the crest of the dam and extends through the cutoff trench to the top of rock. The internal drainage system consists of a trench drain along the downstream toe of the embankment. The trench drain, as shown in Plate 3, is equipped with a perforated pipe. The trench drainpipe discharges into the outlet works discharge channel.

b. The dam was designed to have a 3H to 1V slope on both the upstream and downstream faces, except for the portion of the upstream slope below the bench at Elevation 1658 which was designed to have a 5H to 1V slope.

c. As shown in Plate 4, the subsurface investigation for the dam consisted of four borings extending into rock and six shallow auger borings. The subsurface profile was described as 6 to 24 feet of medium stiff to very stiff colluvial soils underlain by medium dense to very dense alluvial deposits. The foundation rock was described as sandstone underlain by shale and sandstone layers. While the upper sandstone layer was described as highly weathered, the second sandstone seam was described as moderately broken to massive.

(2) Appurtenant Structures. The appurtenant structures of the dam consist of a drop inlet primary spillway and an emergency spillway. The primary spillway structures include a single-stage reinforced concrete riser and a 36-inch-diameter reinforced concrete conduit through the embankment terminating at a plunge pool at the downstream toe of the dam (Plate 4). A 15-inch steel pipe from the upstream toe of the dam discharging into the drop inlet structure constitutes the reservoir outlet facilities. Flow through the reservoir outlet pipe is controlled by a sluice gate at the drop inlet structure. The spillway conduit is encased in concrete and is equipped with reinforced concrete cutoff collars through the embankment.

The emergency spillway is a trapezoidal earth channel excavated into the left abutment (Plate 2). Plate 5 illustrates the longitudinal profile and cross sections of the emergency spillway channel. The bottom width of the trapezoidal channel is 130 feet with side slopes of 2H to 1V. A 30-foot-wide level section at Elevation 1664.5 in line with the axis of the embankment constitutes the control section of the spillway. Details of the primary spillway drop inlet structure are shown on Plate 6.

c. Design Data

(1) Hydrology and Hydraulics. An undated report entitled, Wolf Creek Dam for Treasure Lake of Pennsylvania, Inc., prepared by R. M. Keddal and Associates, Inc., and Engineering Mechanics, Inc., includes available hydrology and hydraulic analyses for the dam. It appears that although some calculations were performed according to the Soil Conservation Service (SCS) procedures, the emergency spillways of Galion Bay and Wolf Creek dams which constitute the flood discharge facility for Lake Rene were sized according to Pennsylvania design criteria in affect at the time ("C" curve). The combined discharge capacity of Galion Bay and Wolf Creek dams spillways was reported to be 5000 cfs with no freeboard.

(2) Embankment. Available information indicates that apparently the dam was designed based on very limited engineering analyses. The engineer's report indicates that the laboratory testing for the borrow

materials consisted of classification, compaction, and permeability tests. Borrow material for the impervious core was described as brown sandy silt and red silty clay. The permeability of this material was reported to be in the range of 10^{-6} cm/sec. The engineer's report included no reference to laboratory soil strength testing. It appears that the stability calculations were based on assumed soil strength parameters. The assumed effective strength parameters were internal friction angle, 25 degrees; cohesion, 200 pounds per square foot. The computed factors of safety were 2.1 for the downstream slope under steady-state seepage conditions and 1.2 for the upstream slope under rapid drawdown conditions.

(3) Appurtenant Structures. It appears that the design of the appurtenant structures was based on standard SCS designs.

2.2 Construction. Available information consists of various construction progress reports. No as-built drawings were available. One design modification was noted. During foundation excavation for the outlet conduit, top of rock was not encountered at the anticipated elevation of 1640. Additional borings drilled indicated top of rock to be at Elevation 1609. Soils below Elevation 1640 were classified as overconsolidated colluvium. The engineer's recommendation was to found the outlet works at Elevation 1640. The engineer reported that settlement of the oulet works founded on the colluvium would be negligible. Available records indicate that the dam was constructed under the supervision of Engineering Mechanics, Inc.'s field representative.

Available information indicates no post-construction changes.

2.3 Operation. No records of operation have been kept.

2.4 Other Investigations. None reported.

2.5 Evaluation

a. Availability. Available information was obtained from PennDER.

b. Adequacy

(1) Hydrology and Hydraulics. Available information indicates that the spillway was designed in conformance with Pennsylvania spillway design criteria applicable at the time of design. Only the design capacity is reported, therefore, this information is not adequate to assess the conformance of the spillway capacity in accordance with current spillway design criteria.

(2) Embankment. The dam was apparently designed based on limited subsurface investigation and engineering analyses. Laboratory testing consisted of classification, compaction, and permeability tests. No reference to strength testing was found. It appears that the stability of the dam was analyzed based on assumed soil strength parameters.

(3) Appurtenant Structures. Review of the design drawings indicates that as designed no significant design deficiencies existed that should affect the overall performance of the appurtenant structures.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of Wolf Creek Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.

2. Visual examination of the emergency spillway and exposed portions of the primary spillway.

3. Observations of factors affecting the runoff potential of the drainage basin.

4. Evaluation of downstream hazard potential.

The specific observations are illustrated in Plate 7 and in the photographs in Appendix C.

b. Embankment. The general inspection of the embankment consisted of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing general maintenance conditions, vegetative cover, erosion, and other surficial features.

In general, the condition of the dam is considered to be good. However, numerous wet areas were found along the downstream slope and toe areas of the dam. Except for one seepage point located near the right abutment, no measurable seepage was found to be associated with these wet areas. In their present extent and condition, these wet areas are not considered to be a threat to the overall stability of the embankment at this time. However, periodic inspection would be required to insure that the conditions are not changing.

The top of the embankment was surveyed relative to the pool level on the date of inspection, which was estimated to be at Elevation 1662.6, the spillway crest level (Elevation 1664.5), and the crest of the embankment was found to be approximately 0.7 to 1.0 foot above the design elevation of 1670. The dam crest profile is illustrated on Plate 8.

c. Appurtenant Structures. The appurtenant structures were examined for deterioration and other signs of distress and obstructions that would limit flow. In general, the structures were found to be in good condition. No deficiencies were noted at this time.

d. Reservoir Area. A map review indicates that the watershed is predominantly covered with woodlands. A small portion of the watershed has been strip mined. A review of the regional geology (Appendix E) indicates that the reservoir slopes are not likely to be susceptible to massive landslides which would affect the storage volume of the reservoir.

e. Downstream Channel. Below the dam, Wolf Run flows through an uninhabited valley before flowing under U.S. Route 219 approximately 3-1/2 miles downstream from the dam. Further description of the downstream conditions is included in Section 1.2b.

3.2 Evaluation. The condition of the dam is considered to be good. The present extent of the wet areas on the downstream face and along the toe of the dam does not appear to be affecting the stability of the embankment at this time. However, continued inspection of these areas is required to determine if the extent of the wet areas is increasing or seepage and sloughing conditions are developing.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedure. There are no formal operating procedures for the dam. The reservoir is normally maintained at the crest level of the primary spillways for this dam and Galion Bay Dam with excess inflow discharging over the uncontrolled primary or emergency spillway.

4.2 Maintenance of the Dam. The maintenance of the dam is considered to be fair. The downstream face of the dam is covered with partially established grass which appears to be mowed occassionally. Some small trees under 5 feet high were found to be growing on the upstream face.

4.3 Maintenance of Operating Facilities. The only operational feature of the dam is the reservoir outlet pipe sluice gate operated by a hoist located at the drop inlet structure. The reservoir outlet sluice gate was operated and was observed to be functional.

4.4 Warning System. No formal warning system exists for the dam. Telephone communication facilities are available via residences in the vicinity of the dam.

4.5 Evaluation. While the maintenance condition of the dam is considered to be fair, the maintenance condition of the operating facilities is assessed to be good. The embankment should be periodically inspected with emphasis on the wet areas on the downstream face and along the toe of the dam to determine that the conditions are not changing.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Wolf Creek Dam is one of three dams which impound Lake Rene. Lake Rene has a watershed of 4.4 square miles and a lake area of 310 acres at normal pool elevation. The flood discharge facilities for Lake Rene consist of the primary and emergency spillways of Galion Bay and Wolf Creek dams. The combined capacity of the spillways of Galion Bay and Wolf Creek dams was determined to be 5300 cfs with no freeboard.

b. Experience Data. As previously stated, Wolf Creek Dam is classified as an intermediate dam in the high hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass full PMF.

The PMF inflow hydrograph for the reservoir was determined using the Dam Safety Version of the HEC-1 computer program developed by the Hydrologic Engineering Center of the U.S. Army, Corps of Engineers. Data used for the computer analysis are presented in Appendix D. The PMF inflow hydrograph was found to have a peak flow of 10,851 cfs. The computer input and summary of computer output are also included in Appendix D.

c. Visual Observations. On the date of inspection, no conditions were observed that would indicate that the capacity of the spillways of Galion Bay and Wolf Creek dams would be significantly reduced in the event of a flood.

d. Overtopping Potential. Various percentages of PMF inflow hydrograph were routed through the reservoir. It was found that the spillways of Galion Bay and Wolf Creek dams can pass 90 percent PMF without overtopping the embankment. For 100 percent PMF, a low spot on the crest of Galion Bay Dam, which was found to be 0.1 foot above the design elevation of 1670, would be overtopped for a duration of two hours with a maximum depth of 0.2 foot. It is estimated that overtopping of the dam by a maximum of 0.2 foot would not constitute a significant potential for embankment breaching.

e. Spillway Adequacy. Since the flood discharge facilities of Lake Rene cannot pass the recommended spillway design of 100 percent PMF without overtopping the embankment, the spillway capacity is rated to be inadequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. *Visual Observations*

(1) Embankment. As discussed in Section 3, the field observations did not reveal any signs of distress that would significantly affect the stability of the dam at this time. However, in view of the wet areas observed on the downstream slope, concern exists as to the ability of the toe trench drain to lower the phreatic surface through the embankment. Periodic inspection of the wet areas is recommended. Remedial measures should be taken if the extent of the wet areas increases or seepage or sloughing conditions develop.

(2) Appurtenant Structures. The performance of the appurtenant structures is considered to be satisfactory.

b. Design and Construction Data

(1) Embankment. Available information indicates that the stability of the embankment was analyzed for steady-state seepage and rapid drawdown conditions based on assumed soil strength parameters. The factor of safety was reported to be 2.1 under steady-state seepage stability of the downstream slope and 1.2 for the rapid drawdown condition of the upstream slope. Assumed strength parameters for internal friction angle, 25 degrees, and cohesion, 200 psf, appear to be in a reasonable range relative to the indicated classification of embankment material, silty clays with low plasticity.

(2) Appurtenant Structures. Review of the design drawings indicates that there are no apparent structural deficiencies that would significantly affect the performance of the appurtenant structures.

c. Operating Records. There are no operating records kept for the dam.

d. Post-Construction Changes. None reported.

e. Seismic Stability. The dam is located in Seismic Zone 1, and based on visual observations the static stability of the dam is considered to be adequate. Therefore, based on the recommended criteria for evaluation of seismic stability of dams, the structures are presumed to present no hazard from earthquakes.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. The visual observations indicate that Wolf Creek Dam is in good condition. The swampy areas observed on the downstream slope and in the area below the toe of the dam are not considered to be serious relative to the overall performance of the dam at this time. However, these areas should be periodically observed to determine if the conditions are changing.

The flood discharge capacity of Lake Rene via the spillways of Galion Bay and Wolf Creek dams was found to be 90 percent PMF and is therefore classified to be inadequate according to the recommended criteria.

b. Adequacy of Information. Available information in conjunction with visual observations and the previous experience of the inspectors are considered to be sufficient to make a reasonable assessment of the condition of the dam.

c. Urgency. The following recommendations should be implemented as soon as possible or on a continuing basis.

d. Necessity for Additional Data. No additional data are considered required at this time.

7.2 Recommendations/Remedial Measures. It is recommended that:

1. The wet areas located along the downstream face and the toe of the embankment should be periodically observed. Necessary remedial work should be performed if the extent of the wet areas increases or seepage and sloughing conditions develop.

2. Around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system should be developed to alert the downstream residents in the event of emergencies.

3. Small trees on the upstream face of the dam should be removed.

4. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.

PLATES

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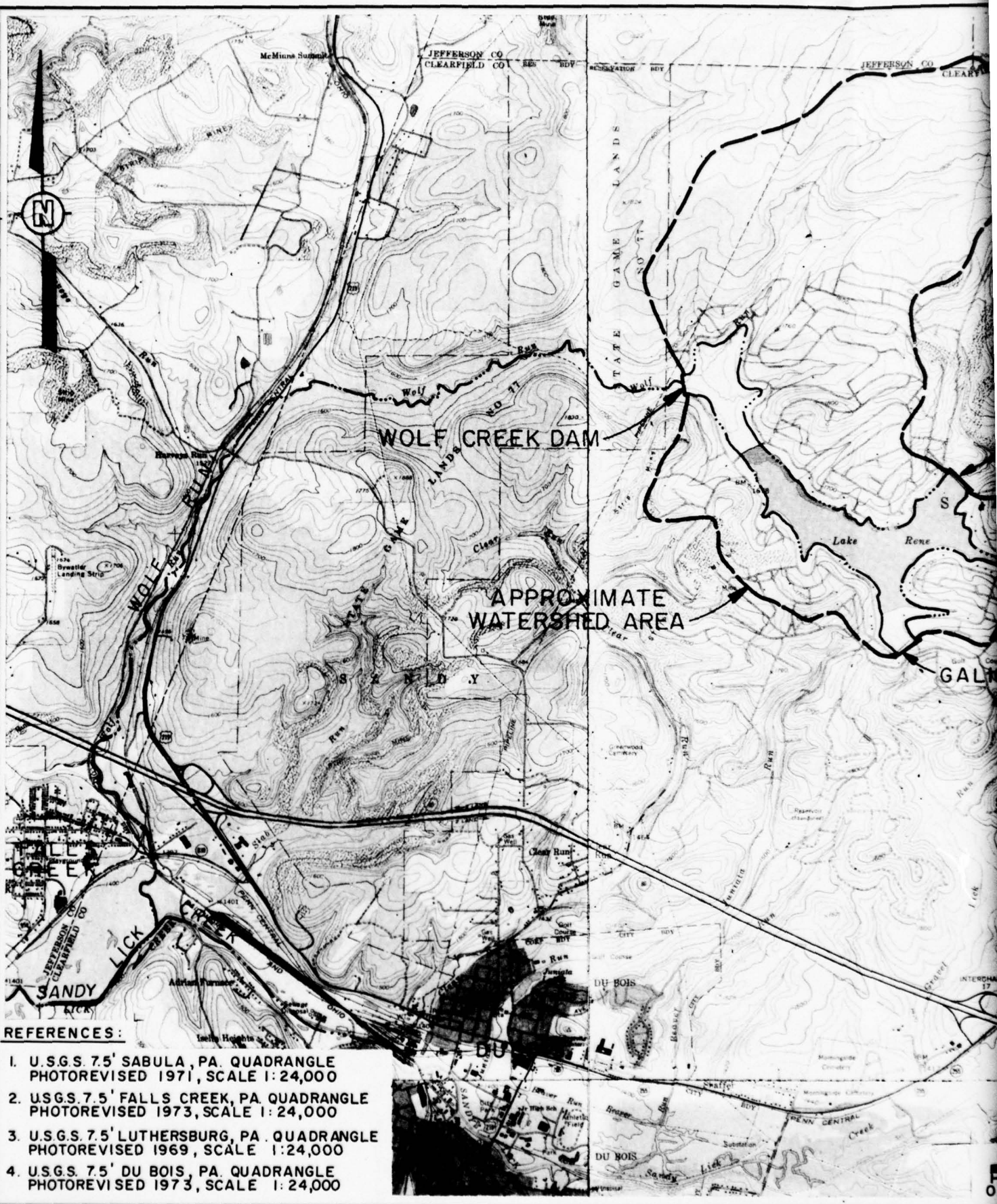

REFERENCES:

1. U.S.G.S. 7.5' SABULA, PA. QUADRANGLE PHOTOREVISED 1971, SCALE 1:24,000
2. U.S.G.S. 7.5' FALLS CREEK, PA. QUADRANGLE PHOTOREVISED 1973, SCALE 1:24,000
3. U.S.G.S. 7.5' LUTHERSBURG, PA. QUADRANGLE PHOTOREVISED 1969, SCALE 1:24,000
4. U.S.G.S. 7.5' DU BOIS, PA. QUADRANGLE PHOTOREVISED 1973, SCALE 1:24,000

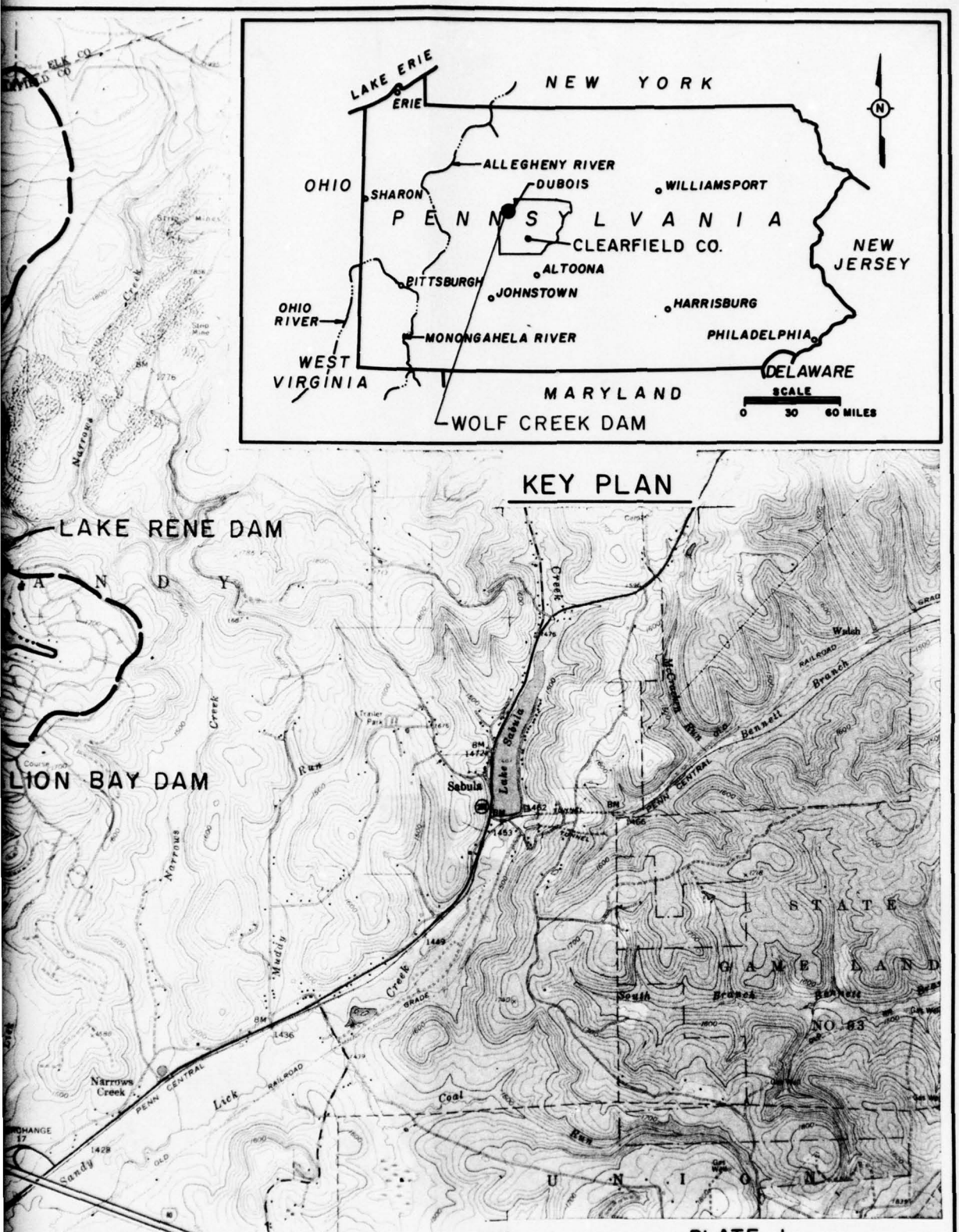

PLATE 1

WOLF CREEK DAM
VICINITY, FLOOD PLAIN & WATERSHED MAP

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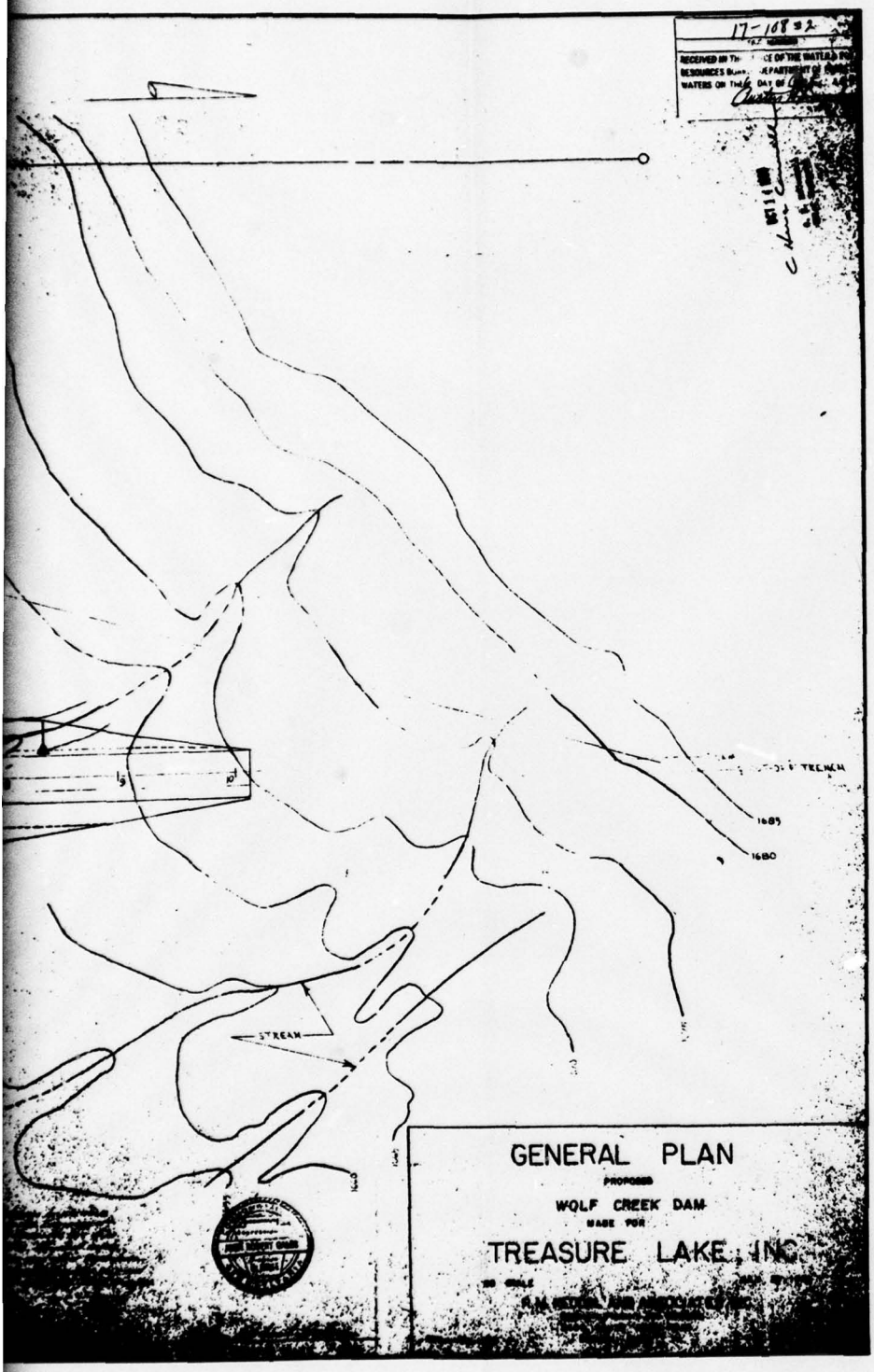

PLATE 2

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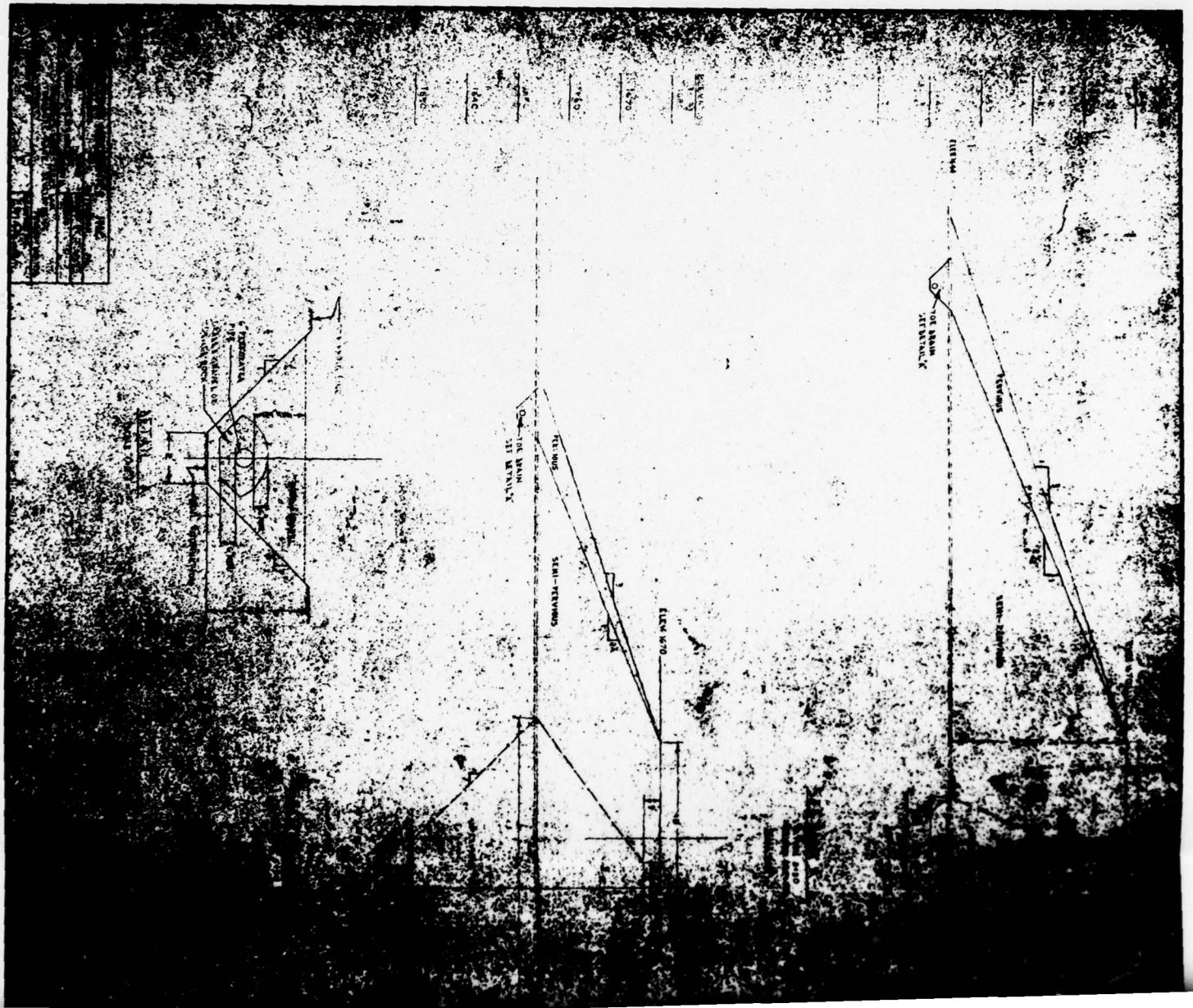

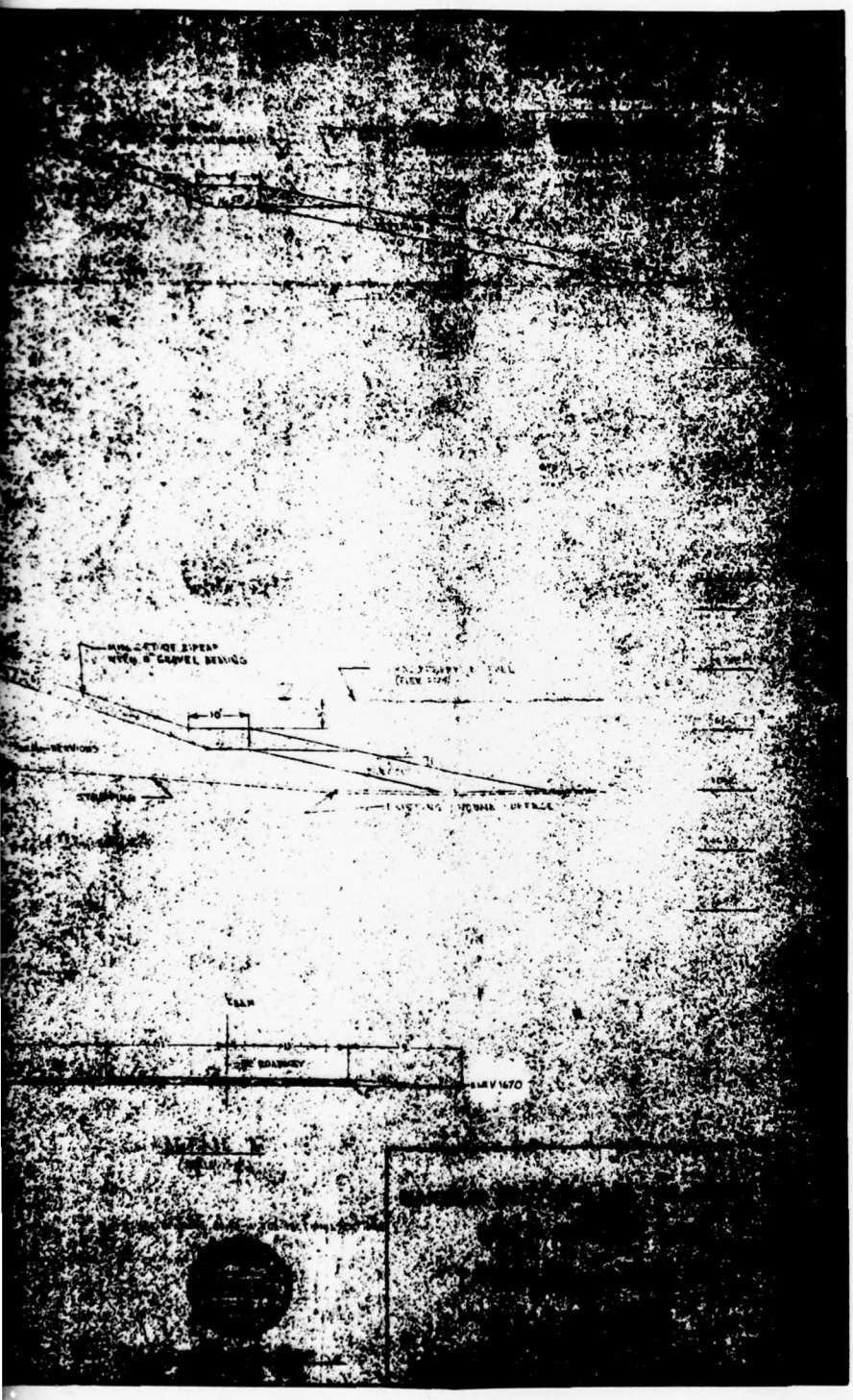

PLATE 3

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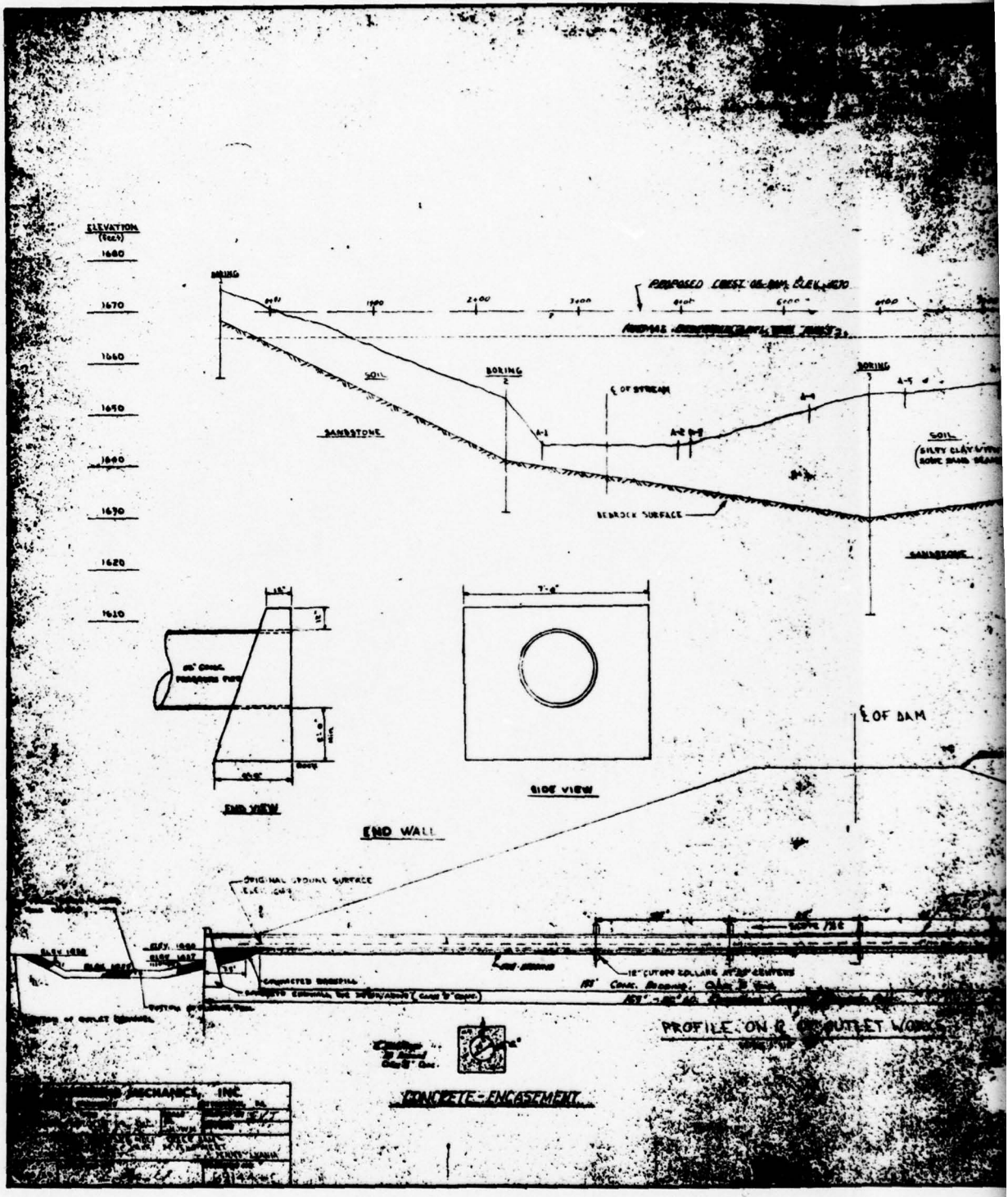
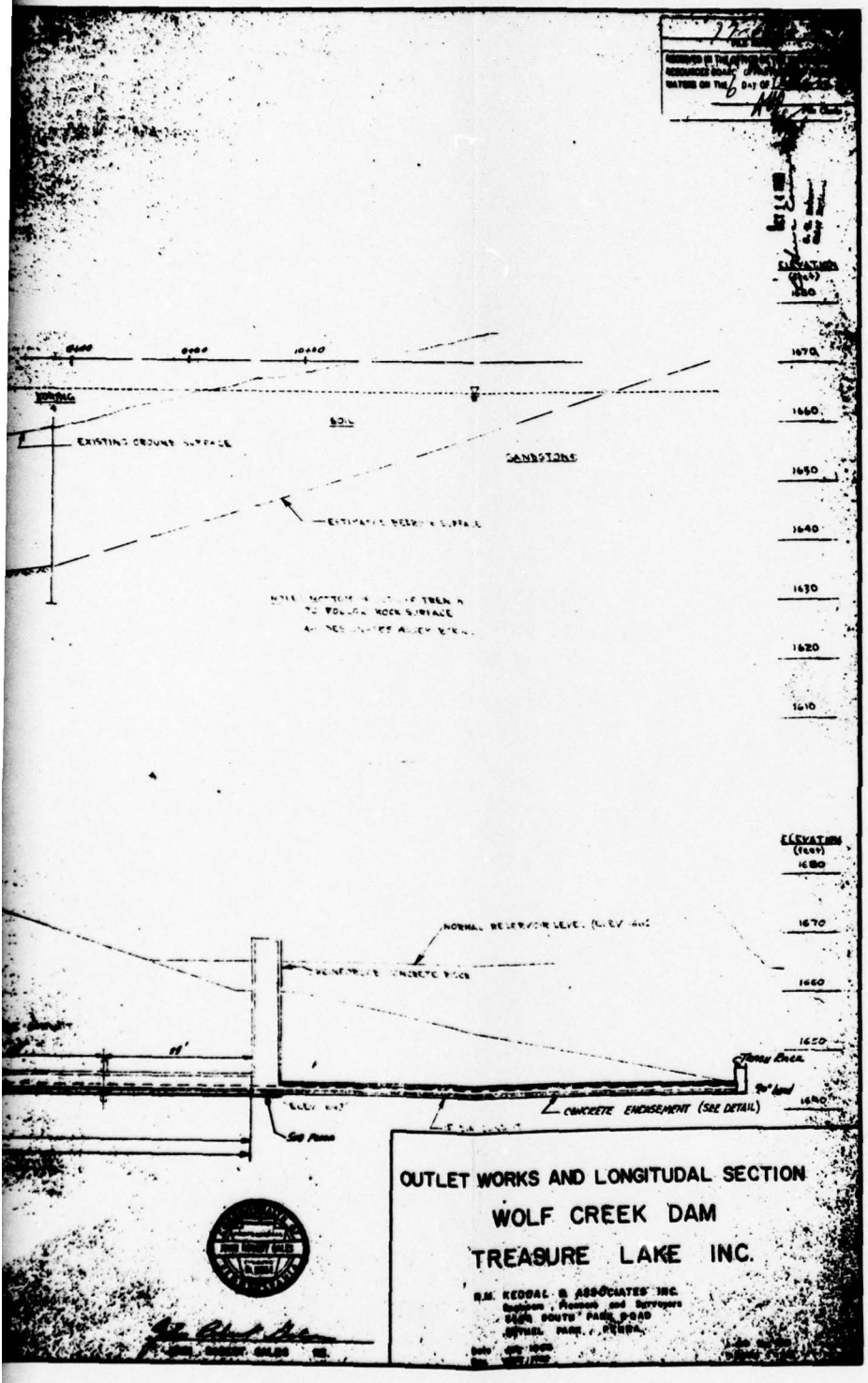




OUTLET WORKS AND LONGITUDAL SECTION

WOLF CREEK DAM

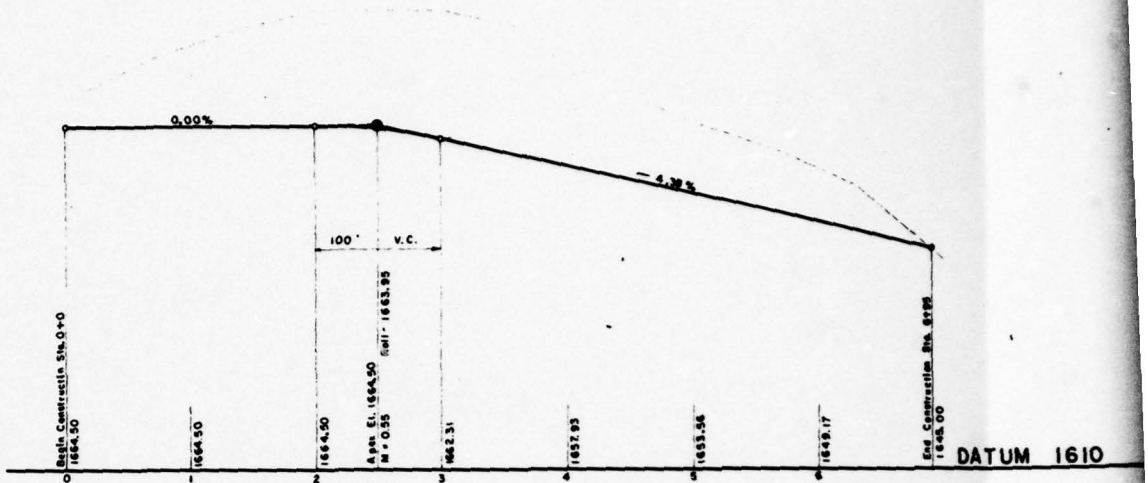
TREASURE LAKE INC.

R.M. KEDDAL & ASSOCIATES INC.

PLATE 4

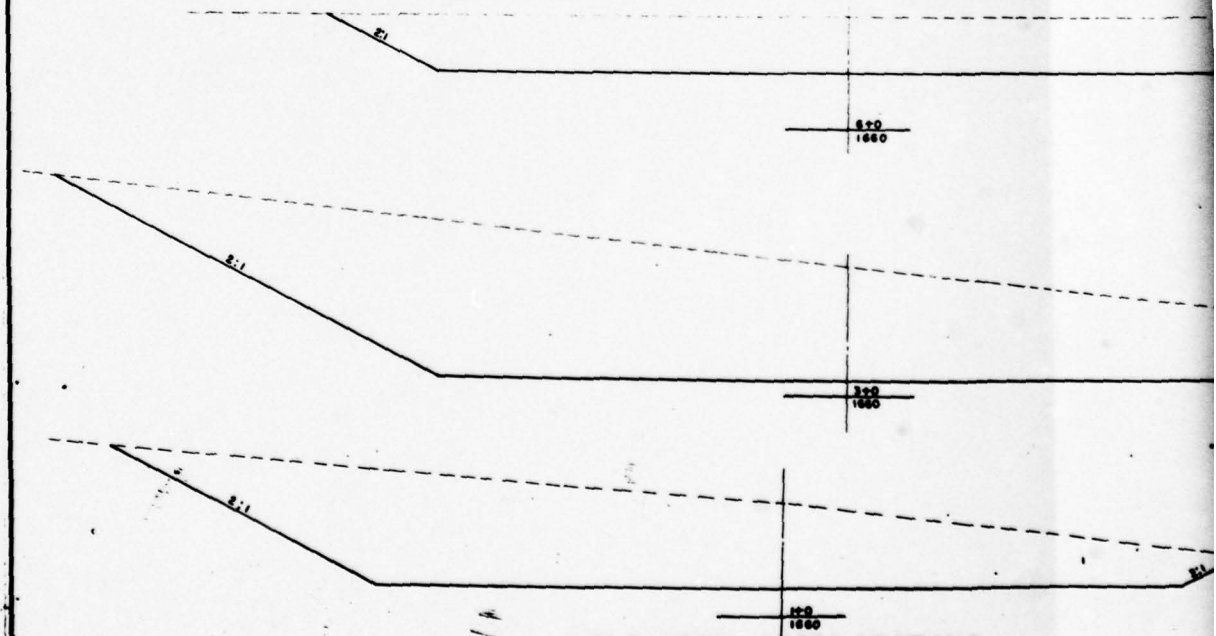
D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	6-4-79 DRAWING
	5-22-79	APPROVED BY	6-4-79 NUMBER 78-367-B141



PROFILE EMERGENCY SPILLWAY-WOLF CREEK DAM

SCALE 1" = 50' Horiz
1" = 10' Vert



WOLF CREEK CROSS SECTIONS

SCALE 1" = 10'

17-108-5

PROFILE & CROSS SECTIONS
PROPOSED
WOLF CREEK DAM
MADE FOR
TREASURE LAKE, INC.

R.M. KEDDAL AND ASSOCIATES INC.
Engineers, Planners and Surveyors
3400 SOUTH PARK ROAD
BETHEL PARK, PA.

DATE AUG.,1969

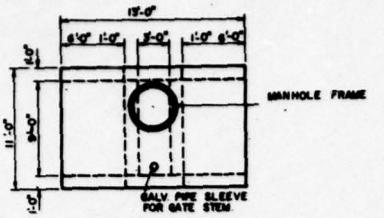
JOB NO. 137
SCALE: AS SHOWN

JOHN ROBERT GALES P.E.

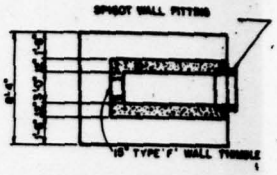
PLATE 5

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	BE	4-4-79	DRAWING NUMBER	78-367-B142
	5-22-79	APPROVED BY	SMP	6-14-79		



TOP PLAN



SECTION A-A

WELD FLANGE TO PIPE

NEOPRENE RUBBER GASKET

1/4" x 6" Steel Plate
Continuous Thru Constr. Joint
Splices Shall Be Either
1. Butt Welded
2. Lapped 3" And Bolted
3. Lapped 3" And Fillet Welded

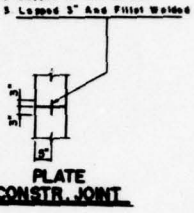
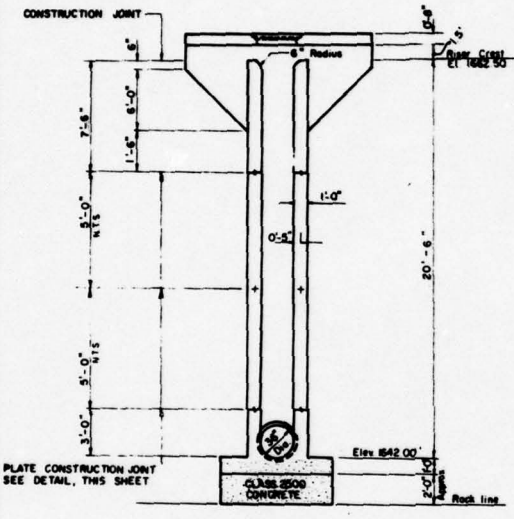
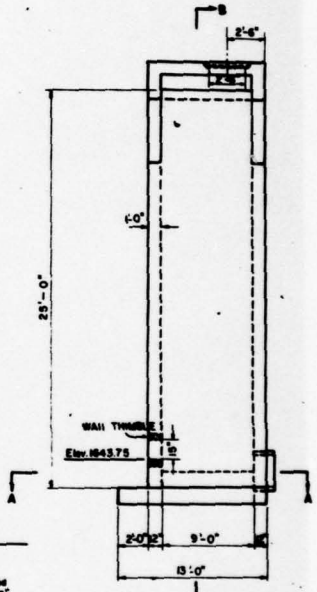


PLATE CONSTR. JOINT

CONSTR. JOINT



SECTION B-B



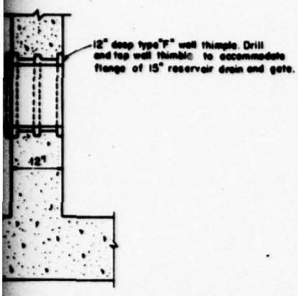
SIDEWALL ELEVATION

CONSTRUCTION DETAILS

Portland cement Type C10-54, C150-56 or C175-56 Air Entraining shall be used
2. All Reinforcing Steel placed in Concrete placed against the ground shall have a minimum of 3" clear cover. All Reinforcing Steel placed in Concrete placed in forms shall have a minimum of 2" clear cover
3. All exposed edges of concrete to have 3/4" chamfer unless otherwise noted.
4. Bar dimensions are out to out of bar.
5. Radius of bends:
3 bar diams for sizes #5 thru #7

SLUICE GATE NOTES

1. Armco model SS-10C flange back sluice gate with necessary stem guides.
2. HD-24 Hand wheel lift.

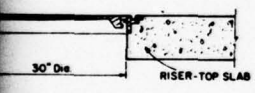


DRAIN WALL THIMBLE

ALE ASSEMBLY

shall be Gray Iron Casting

ting shall consist of a 1" Dia
2" from the outside
a hd.
ting shall consist of a hook
the lid underside and a
a hex bolt at the



STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
B1	6	17	7-8	1	—	—	133-02
B2	6	9	11-1	1	—	—	100-0
B3	6	28	8-9	21	2-7	9-2	252-6
B4	6	8	12-6	1	—	—	100-0
B5	6	12	7-10	1	—	—	94-0
B6	6	1	8-0	1	—	—	6-0
B7	6	4	8-1	21	1-0	8-1	34-4
B8	6	2	19-1	21	1-0	8-1	12-2
B9	6	10	8-1	21	1-0	8-1	97-4
B10	6	2	6-1	21	1-0	8-1	12-2
B11	6	8	4-8	1	—	—	77-4
B12	6	4	3-2	1	—	—	12-8
B13	6	14	7-6	21	3-0	7-6	147-0
B14	6	4	7-11	21	0-5	7-6	31-8
B15	6	4	7-9	21	0-5	7-6	31-0
B16	6	2	8-7	21	1-1	7-6	17-2
B17	6	3	2-3	1	—	—	6-9
B18	6	3	2-3	1	—	—	6-9
B19	6	6	2-0	1	—	—	12-0
R1	6	18	11-7	1	—	—	208-6
R2	6	4	11-7	1	—	—	46-4
R3	6	20	11-7	1	—	—	231-8
R4	6	6	11-7	1	—	—	69-6
R5	6	12	6-8	1	—	—	80-0
R6	6	8	2-8	1	—	—	21-4
R7	6	28	10-4	21	2-6	7-6	288-4
R8	6	8	9-8				77-6
R9	6	8	3-8				29-4
R10	6	24	10-0	21	2-6	7-6	240-0

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
T1	5	10	6-6	1	—	—	65-0
T2	5	6	8-3	1	—	—	49-6
T3	5	10	6-9	1	—	—	67-6
T4	5	6	8-3	1	—	—	49-6
T5	5	12	6-8	1	—	—	80-0
T6	6	4	2-6	1	—	—	10-0
T7	5	2	3-8	1	-	-	7-4
T8	5	2	6-2	1	-	-	12-4
T9	5	2	8-8	1	-	-	17-4
T10	5	2	11-2	1	-	-	22-4
T11	5	24	7-0	21	2-6	4-0	168-0
T12	5	4	4-8	1	-	-	18-8
T13	5	4	3-5	1	-	-	13-8
T14	5	4	2-2	1	-	-	8-8
T15	5	4	7-3	19	1-8	5-7	29-0
T16	5	2	3-8	1	-	-	7-4
T17	5	2	6-2	1	-	-	12-4
T18	5	2	8-8	1	-	-	17-4
T19	5	2	11-2	1	-	-	22-4
T20	5	4	4-8	1	-	-	18-8
T21	5	4	3-5	1	-	-	13-8
T22	5	4	2-2	1	-	-	8-8
T23	5	4	7-3	19	1-8	5-7	29-0
T24	5	2	11-2	1	-	-	22-4
T25	4	12	6-8	1	-	-	80-0
T26	4	2	3-2	1	-	-	6-4
T27	4	6	11-2	1	-	-	67-0
T28	4	4	4-3	1	-	-	17-0
T29	5	20	5-11	21	1-5	4-6	118-4
T30	5	2	4-10	21	1-5	3-5	9-8
T31	5	2	2-3	21	1-5	0-10	4-6
T32	5	2	11-2	1	-	-	22-4
T33	4	6	11-2	1	-	-	67-0
T34	4	4	4-3	1	-	-	17-0

NOTE Prior to Construction Contractor Must Submit Shop Drawings for Approval by the Engineer.

17-1081-E4

RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD "AUTHORITY TO PROCEED" WATER RESOURCES BOARD

RISER DETAILS

FOR

GALION BAY DAM & WOLF CREEK DAM

MADE FOR

TREASURE LAKE, INC.

NO SCALE — JULY 29, 1969

R.M. KEDDAL AND ASSOCIATES, INC.
Engineers, Planners and Surveyors
3400 SOUTH PARK ROAD
BETHEL PARK, PA.

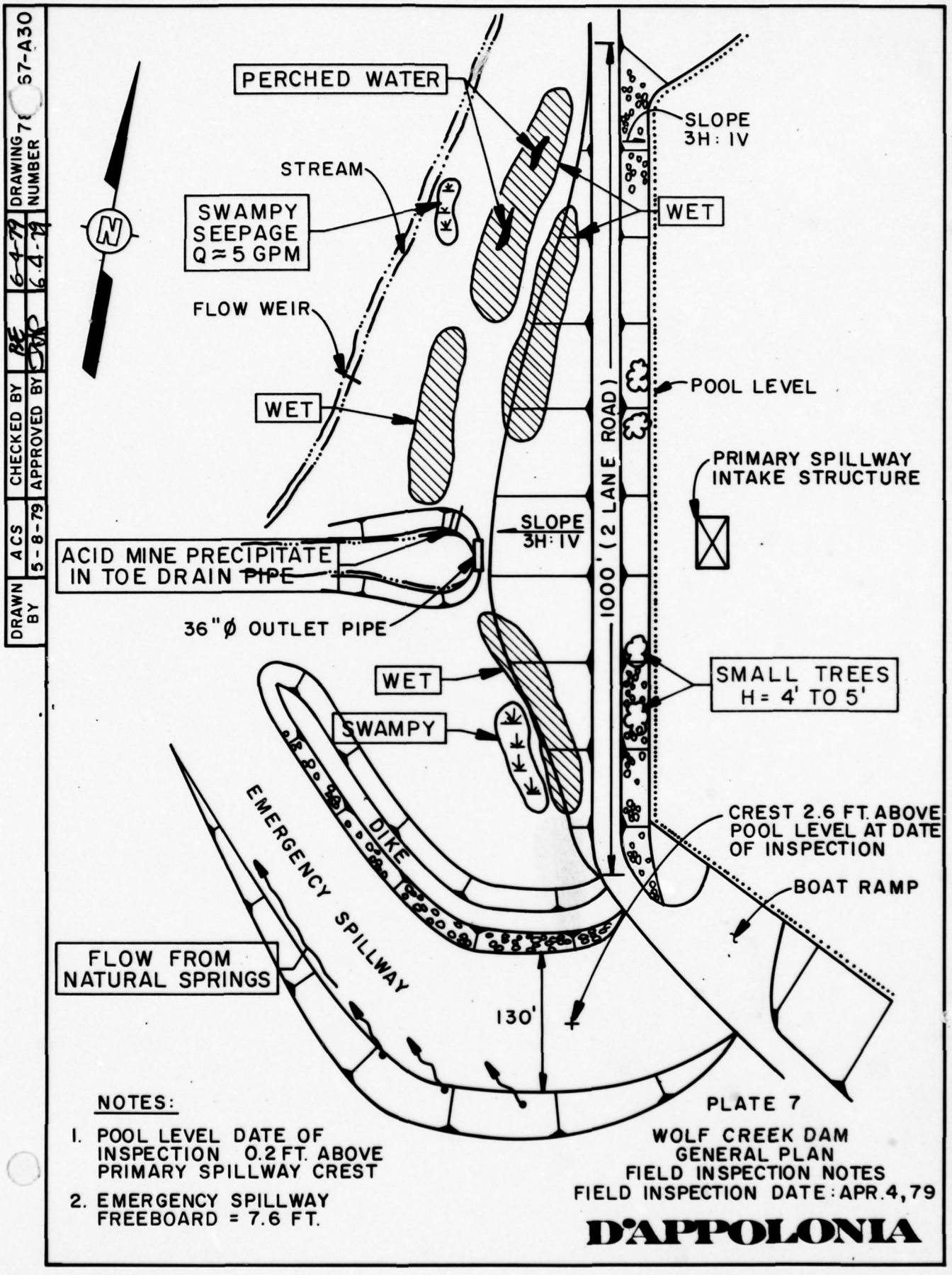
REV AUG 1969
REV OCT 1969

JOB NO. 107

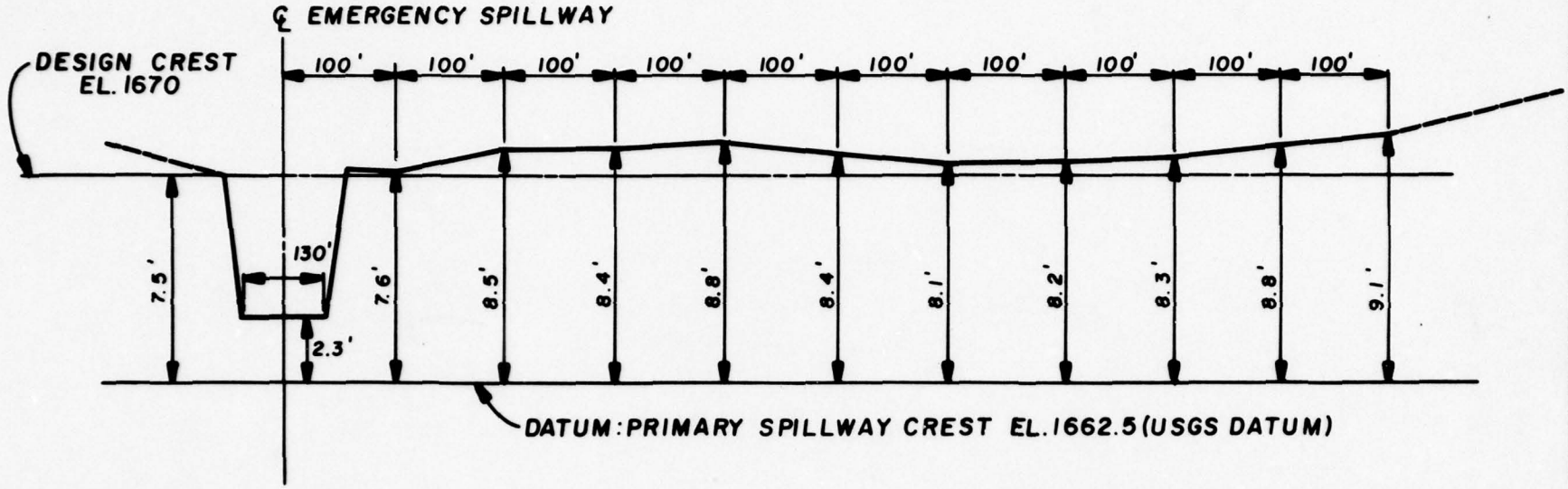
JOHN ROBERT GALES PE

PLATE 6

D'APPOLONIA


DRAWING NUMBER 7(57-A30
6-4-79
6.4-79
CHECKED BY
APPROVED BY
ACS
5-8-79
DRAWN BY
N
PERCHED WATER
STREAM
SWAMPY SEEPAGE Q ≈ 5 GPM
FLOW WEIR
WET
ACID MINE PRECIPITATE IN TOE DRAIN PIPE
36"Ø OUTLET PIPE
SLOPE 3H: IV
1000' (2 LANE ROAD)
SLOPE 3H: IV
WET
POOL LEVEL
PRIMARY SPILLWAY INTAKE STRUCTURE
SMALL TREES H = 4' TO 5'
WET
SWAMPY
EMERGENCY SPILLWAY
DIKE
CREST 2.6 FT. ABOVE POOL LEVEL AT DATE OF INSPECTION
BOAT RAMP
FLOW FROM NATURAL SPRINGS
130'
NOTES:
1. POOL LEVEL DATE OF INSPECTION 0.2 FT. ABOVE PRIMARY SPILLWAY CREST
2. EMERGENCY SPILLWAY FREEBOARD = 7.6 FT.
PLATE 7
WOLF CREEK DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: APR. 4, 79
D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	BE	6/26/79	DRAWING NUMBER	367-A43
	6-28-79	APPROVED BY	[illegible]	7-3-79		



DAM CREST PROFILE

(LOOKING DOWNSTREAM)

NOTE:

DAM CREST IS SURVEYED RELATIVE TO PRIMARY SPILLWAY CREST LEVEL.

PLATE 8

WOLF CREEK DAM
DAM CREST SURVEY
FIELD INSPECTION DATE: APR. 4, 79

D'APPOLONIA

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Wolf Creek Dam COUNTY Clearfield STATE Pennsylvania ID# NDI I.D. PA-748 DER I.D. 17-108

TYPE OF DAM Earth HAZARD CATEGORY High

DATE(S) INSPECTION April 4, 1979 WEATHER Partly Cloudy TEMPERATURE 40s

POOL ELEVATION AT TIME OF INSPECTION 1662.5 M.S.L. TAILWATER AT TIME OF INSPECTION 1636± M.S.L.

INSPECTION PERSONNEL:

Bilgin Erel

Wah-Tak Chan

REVIEW INSPECTION PERSONNEL:
(May 4, 1979)

E. D'Appolonia

L. D. Andersen

J. H. Poellot

Bilgin Erel

Bilgin Erel RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None significant.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Crest of the dam is about 0.7 to 1.0 foot above the design crest level of Elevation 1670.	
RIPRAP FAILURES	None.	

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No signs of distress.	
ANY NOTICEABLE SEEPAGE	Numerous wet areas on the downstream face and an area below the toe of the dam. See Plate 7 for locations.	
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	

VISUAL INSPECTION
PHASE I
OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The outlet conduit was not accessible for inspection. Only the downstream end was visible. No distress was observed.	
INTAKE STRUCTURE	Visible portions are in good condition.	
OUTLET STRUCTURE	Riprapped plunge pool. In good condition.	
OUTLET CHANNEL	No obstructions in the outlet channel that would significantly affect the discharge capacity of the outlet works.	
EMERGENCY GATE	Lake drawdown sluice gate was operated by maintenance personnel and was observed to be functional.	

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The emergency spillway has no concrete overflow structure.	
APPROACH CHANNEL	Trapezoidal earth channel. In good condition.	
DISCHARGE CHANNEL	Trapezoidal earth channel. In good condition.	
BRIDGE AND PIERS	None.	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A.	
APPROACH CHANNEL	N/A.	
DISCHARGE CHANNEL	N/A.	
BRIDGE PIERS	N/A.	
GATES AND OPERATION EQUIPMENT	N/A.	

VISUAL INSPECTION
PHASE I
INSTRUMENTATION

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

VISUAL INSPECTION
PHASE I
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle to moderately steep. No significant shoreline erosion.	
SEDIMENTATION	Unknown.	
UPSTREAM RESERVOIRS	None.	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	There are no obstructions that would affect the discharge capacity of the outlet conduit.	
SLOPES	No apparent instability (immediately downstream from the dam).	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Two commercial buildings and one police station are located 3-1/2 miles downstream from the dam. The town of Falls Creek is located six miles downstream from the dam.	

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
AND HYDROLOGIC AND HYDRAULIC
PHASE I

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Wolf Creek Dam
ID# NDI I.D. PA-748
DER I.D. 17-108

ITEM	REMARKS
AS-BUILT DRAWINGS	The drawings are available in the state files.
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	The dam was designed by R. M. Keddal and Associates, Inc., and Engineering Mechanics, Inc., of Pittsburgh, Pennsylvania in 1969. The dam was constructed by Canton Development Company with completion in July 1971.
TYPICAL SECTIONS OF DAM	See Plate 3.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	See Plates 4 and 6.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	Not available.
DESIGN REPORTS	Wolf Creek Dam for Treasure Lake, Inc., prepared by R. M. Keddal and Associates, Inc., Engineers and Surveyors, and Engineering Mechanics, Inc., Consulting Engineers (the report is undated).
GEOLOGY REPORTS	None prepared.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Hydrology and hydraulic calculations and some preliminary stability analyses for the embankment are included in the above-referenced design report. No reference to any detailed stability analysis was found.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Boring logs and the results of laboratory tests are included in the engineer's report.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	None reported.
BORROW SOURCES	Unknown.
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	Not recorded.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None reported.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported.
MAINTENANCE OPERATION RECORDS	Not recorded.
SPILLWAY PLAN SECTIONS DETAILS	See Plates 2 and 5.
OPERATING EQUIPMENT PLANS AND DETAILS	See Plates 4 and 6.

CHECKLIST
ENGINEERING DATA
HYDROLOGIC AND HYDRAULIC

DRAINAGE AREA CHARACTERISTICS: 4.4 square miles (woodlands)

ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 1662.5 (3700 acre-feet)

ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: 1670 (6700 acre-feet)

ELEVATION; MAXIMUM DESIGN POOL: 1670

ELEVATION; TOP DAM: 1670 (as designed); 1670.6 (low spot on crest)

SPILLWAY: (Emergency Spillway)

a. Elevation 1664.5

b. Type Trapezoidal open channel

c. Width 130 feet (as measured perpendicular to flow direction)

d. Length Not applicable

e. Location Spillover Adjacent to emergency spillway

f. Number and Type of Gates None

OUTLET WORKS:

a. Type 15-inch reservoir drainpipe, 36-inch reinforced concrete conduit

b. Location About 250 feet from left abutment

c. Entrance Inverts Elevation 1643

d. Exit Inverts Elevation 1637±

e. Emergency Draindown Facilities 15-inch pipe

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location None

c. Records None

MAXIMUM NONDAMAGING DISCHARGE: Emergency spillway discharge capacity

APPENDIX C

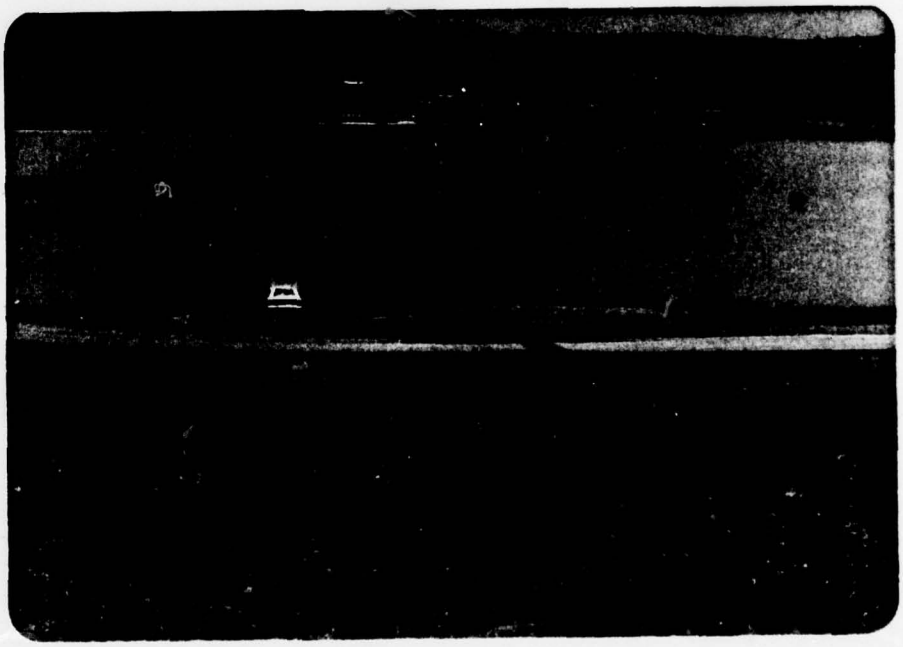
PHOTOGRAPHS

LIST OF PHOTOGRAPHS
WOLF CREEK DAM
NDI I.D. NO. PA-748
APRIL 4, 1979

PHOTOGRAPH NO.	DESCRIPTION
1	Crest (looking north). Emergency spillway in foreground.
2	Emergency spillway approach channel.
3	Emergency spillway discharge channel.
4	Primary spillway intake structure and outlet pipe sluice gate control.
5	Primary spillway discharge pipe.
6	Wolf Run, approximately two miles downstream (stream behind pine trees).

Photograph No. 1

Crest (looking north). Emergency spillway in foreground.



Photograph No. 2

Emergency spillway approach channel.

Photograph No. 3

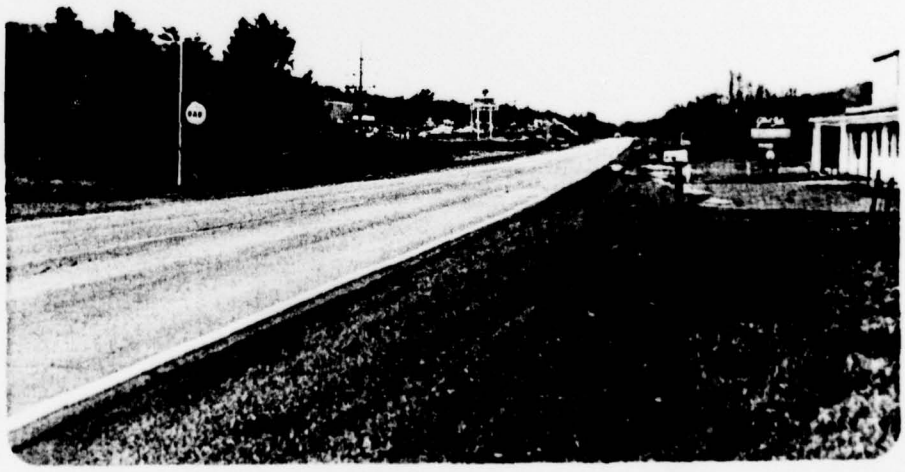
Emergency spillway discharge channel.

Photograph No. 4

Primary spillway intake structure and outlet pipe sluice gate control.

Photograph No. 5

Primary spillway discharge pipe.



Photograph No. 6

Wolf Run, approximately two miles downstream (stream behind pine trees).

APPENDIX D
CALCULATIONS

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Wolf Creek Dam (NDI I.D. PA-425)

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.3 INCHES/24 HOURS[1]

STATION	1	2	3	4	5
Station Description	Treasure Lake	Wolf Creek Dam			
Drainage Area (square miles)	4.36	0			
Cumulative Drainage Area (square miles)	4.36	4.36			
Adjustment of PMF for Drainage Area (%)[2]					
6 Hours	117	-			
12 Hours	127	-			
24 Hours	141	-			
48 Hours	151	-			
72 Hours	-	-			
Snyder Hydrograph Parameters					
Zone[3]	24 | 24A	-			
C_p/C_t[4]	0.45/1.6 | 0.45/4.2	-			
L (miles)[5]	2.1	-			
L_{ca} (miles)[5]	0.5	-			
$t_p = C_t(L \cdot L_{ca})^{0.3}$ (hours)	1.62 | 4.26	-			
Spillway Data[6]		Primary / Emergency			
Crest Length (ft)	-	18 / 130			
Freeboard (ft)	-	8.2 / 5.5			
Discharge Coefficient	-	-			
Exponent	-	-			

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

(2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

(3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t). Zone 24A was recommended by the COE. However, conservative Zone 24 was used.

(4) Snyder's Coefficients.

(5) L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

(6) Flood discharge capacity was based on the combined capacity of the primary and emergency spillways of Wolf Creek Dam and Galion Bay Dam.

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1                A1       SNYDER UNIT HYDROGRAPH,FLOOD ROUTING AND DAM OVERTOPPING ANALYSES
    2                A2       TREASURE LAKE(LAKE RENE DAM)CLEARFIELD CO.NDI-ID.PA426.PROJ.NO.78-367-21
    3                A3       FOR 20%,30%,40%,50%,60%,70%,80%,90%,AND 100% PMF
    4                B    300         0       10        0        0        0        0        0       -4        0
    5                B1     5
    6                J      1         9        1
    7                J1  0.20     0.30     0.40     0.50     0.60     0.70     0.80     0.90     1.00
    8                K      0         1                                                  1
    9                K1       CALCULATION OF SNYDER INFLOW HYDROGRAPH TO TREASURE LAKE(LAKE RENE DAM)
   10                R      1         1     4.36                4.36                                1
   11                P              23.3      117      127      141      151
   12                T                                                          1.0      .05             0.112
   13                W    1.62     0.45
   14                X    -1.0    -0.05      2.0
   15                K      1         2                                                  1
   16                K1       ROUTING FLOW THROUGH DAMS AND SPILLWAYS OF TREASURE LAKE(LAKE RENE DAM)
   17                Y                                          1        1
   18                Y1     1                                                   1000.0       -1
   19                Y41662.5  1663.0   1663.5   1664.6   1665.0   1665.2   1666.0   1668.0   1670.0   1675.0
   20                Y5   0.0     40.0    112.0    248.0    295.0    312.0    686.0   2535.0   5297.0  15302.0
   21                $S1000.0  4052.0   6087.0
   22                $E1662.5  1670.0   1675.0
   23                $$1662.5
   24                $D1670.1     3.1      1.5   2130.0
   25                $L 215.0   365.0    430.0    530.0    630.0    730.0    980.0   1180.0   1230.0   2130.0
   26                $V1670.1  1670.2   1670.4   1670.7   1670.8   1670.9   1671.0   1671.4   1671.7   1674.0
   27                K     99
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COMPUTER INPUT OVERTOPPING ANALYSIS

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 .20	RATIO 2 .30	RATIO 3 .40	RATIO 4 .50	RATIO 5 .60	RATIO 6 .70	RATIO 7 .80	RATIO 8 .90	RATIO 9 1.00
HYDROGRAPH AT	1	4.36	1	2170.	3255.	4340.	5425.	6510.	7596.	8681.	9766.	10851.
	(	11.29)	(	61.45)(	92.18)(	122.90)(	153.63)(	184.36)(	215.08)(	245.81)(	276.53)(	307.26)
ROUTED TO	2	4.36	1	279.	628.	1273.	1917.	2553.	3387.	4180.	4954.	5913.
	(	11.29)	(	7.91)(	17.77)(	36.06)(	54.29)(	72.28)(	95.91)(	118.36)(	140.28)(	167.43)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1662.50	1662.50	1670.10
STORAGE	1000.	1000.	4093.
OUTFLOW	0.	0.	5497.

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
.20	1664.87	0.00	1963.	279.	0.00	48.83	0.00
.30	1665.88	0.00	2373.	628.	0.00	47.33	0.00
.40	1666.64	0.00	2683.	1273.	0.00	46.00	0.00
.50	1667.33	0.00	2966.	1917.	0.00	45.33	0.00
.60	1668.01	0.00	3243.	2553.	0.00	45.17	0.00
.70	1668.62	0.00	3489.	3387.	0.00	44.67	0.00
.80	1669.19	0.00	3723.	4180.	0.00	44.50	0.00
.90	1669.75	0.00	3951.	4954.	0.00	44.33	0.00
1.00	1670.27	.17	4163.	5913.	2.00	44.17	0.00

OVERTOPPING ANALYSIS SUMMARY

D'APPOLONIA
CONSULTING ENGINEERS, INC.

By WTC Date 4-18-79 Subject LAKE RENE Sheet No. 1 of 1
Chkd. By BE Date 4-19-79 SPILLWAY RATING Proj. No. 78-367-21

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SPILLWAY RATING

TWO PRIMARY — 3'ϕ PIPE W/ SCS RISER @ ELEV 1662.5 (1)

TWO EMERGENCY ROCK CUT SPILLWAYS { WOLF CREEK 130' @ 1665.2 (2); GALION BAY 26' @ 1664.6 (3)

ELEVATION (RESERVOIR)	WOLF CREEK COMBINED SPILLWAY CAPACITY, cfs	GALION BAY COMBINED SPILLWAY CAPACITY, cfs	TOTAL CAPACITY FOR TREASURG LAKE cfs
1662.5	0	0	0
1663	20	20	40
1663.5	56	56	112
1664.6	124	124	248
1665	138	157	295
1665.2	139	173	312
1666	392	294	686
1668	1792 TOP OF DAM	743	2535
1670	3844 ←	1453 ←	5297 ←
1675	10933	4369	15302

NOTE: FIGURES ROUNDED UP TO NEAREST . CFS.

(1) PRIMARY SPILLWAYS

$Q = 3.1(2L)H^{3/2}$ $L=9'$ $\therefore Q = 55.8\,H^{3/2}$ for $0 < H < 1.5'$

$Q = C_b a_b \sqrt{2gH}$ $L_b = 20.7'$ $C_b \doteq 0.5$

$= 28.5\,H^{1/2}$ for $H \geq 1$

(2) WOLF CR. EMER. SPILLWAY $Q = 2.7(130)H^{1.5}$

(3) GALION BY EMER. SPILLWAY $Q = 2.7(26)H^{1.5}$

APPENDIX E
REGIONAL GEOLOGY

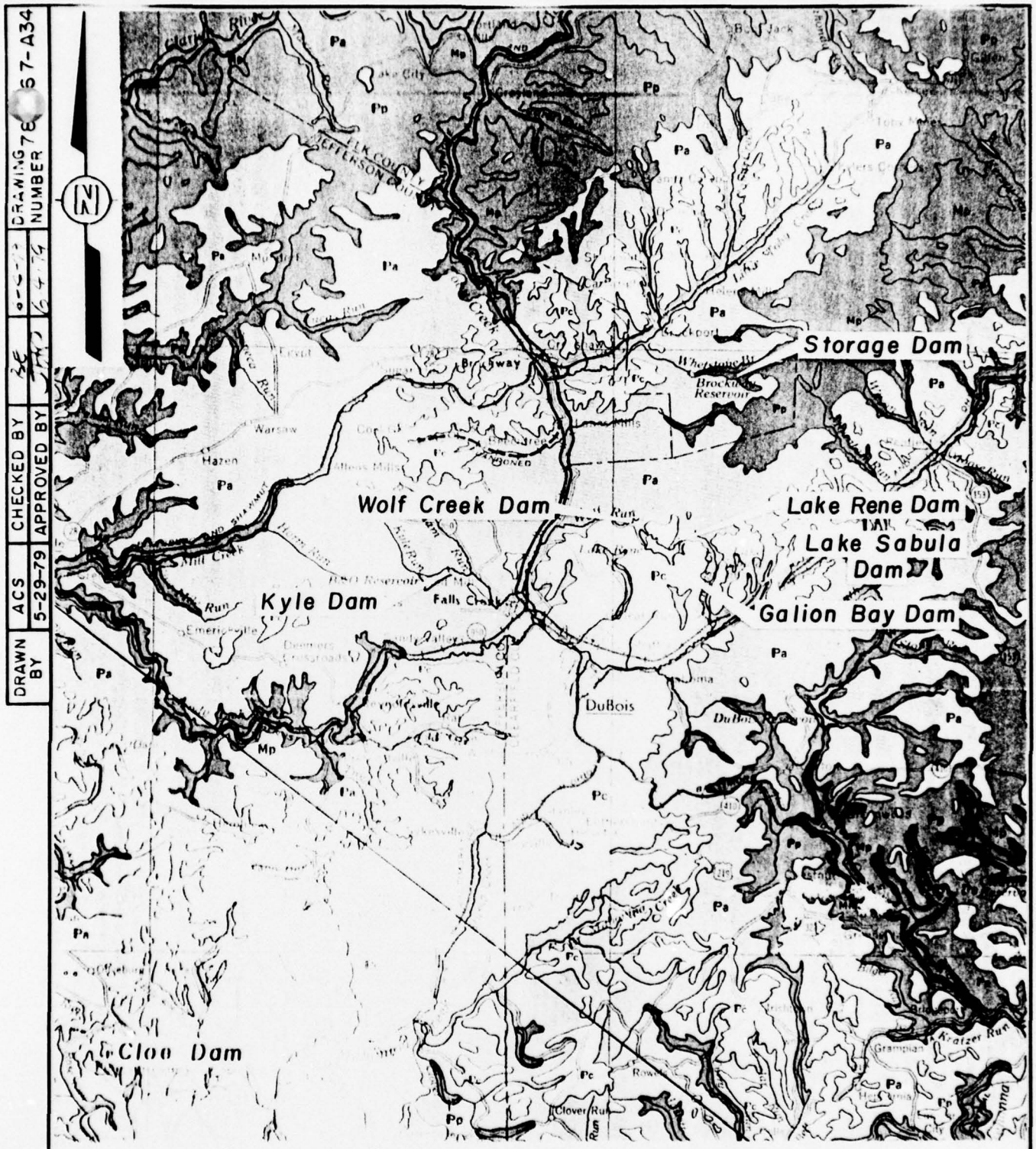
APPENDIX E
REGIONAL GEOLGOY

Wolf Creek Dam is located on strata of the Allegheny Formation (Pennsylvanian Age). The site lies along the northwest flank of the Punxsutawney-Caledonia Syncline. Strata in the area dip gently to the southeast at about 100 feet per mile.

The Allegheny Formation consists primarily of thick-bedded to massive, coarse-grained sandstones and conglomerates. Thin coal seams and shales also exist.

The major coal seam in the area is the Upper Freeport which is the contact between the Allegheny Formation and the overlying Conemaugh Formation. This seam has been strip mined northwest and south of the dam. The Lower Freeport and Kittanning coals also exist in the area below the site. These coals are potential coking coals but have not been widely mined in the area.

One major fault exists in the area and is located approximately two miles northeast of the site. This fault is known as the Mountain Run Fault and trends to the northeast along the southeastern flank of the Boone Mountain Anticline. Maximum displacement along the fault is estimated to be 400 feet.



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	5-29-79	APPROVED BY		

SCALE

0 2 4 6 8 10 miles

REFERENCE

GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA., DEPT. OF INTERNAL AFFAIRS, DATED 1960, SCALE 1" = 4 MILES

STORAGE, WOLF CREEK, KYLE, LAKE RENE, LAKE SABULA, GALION BAY AND CLOE DAM

GEOLOGY MAP

DAPPOLONIA

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PENNSYLVANIAN

APPALACHIAN PLATEAU

Pm — **Monongahela Formation**
Cyclic sequences of sandstone, shale, limestone and coal; limestone prominent in northern outcrop areas; shale and sandstone increase southward; commercial coals present; base at the bottom of the Pittsburgh Coal.

Pc — **Conemaugh Formation**
Cyclic sequences of red and gray shales and siltstones with thin limestones and coals; massive Mahoning Sandstone commonly present at base; Ames Limestone present in middle of sections; Brush Creek Limestone in lower part of section.

Pa — **Allegheny Group**
Cyclic sequences of sandstone, shale, limestone and coal, numerous commercial coals; limestones thicken westward; Vanport Limestone in lower part of section; includes Freeport, Kittanning, and Clarion Formations.

Pp — **Pottsville Group**
Predominantly sandstones and conglomerates with thin shales and coals; some coals mineable locally.

ANTHRACITE REGION

Ppp — **Post-Pottsville Formations**
Brown or gray sandstones and shales with some conglomerate and numerous mineable coals.

Pp — **Pottsville Group**
Light gray to white, coarse grained sandstones and conglomerates with some mineable coal; includes Sharp Mountain, Schuylkill, and Tumbling Run Formations.

MISSISSIPPIAN

Mmc — **Mauch Chunk Formation**
Red shales with brown to greenish gray flaggy sandstones; includes Greenbrier Limestone in Fayette, Westmoreland, and Somerset counties; Loyalhanna Limestone at the base in southwestern Pennsylvania.

Mp — **Pocono Group**
Predominantly gray, hard, massive, crossbedded conglomerate and sandstone with some shale, includes in the Appalachian Plateau Burgoon, Shenango, Cuyahoga, Cussewago, Corry, and Knapp Formations; includes part of "Oswayo" of M. L. Fuller in Potter and Tioga counties.

GEOLOGY MAP LEGEND

REFERENCE:
GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA, DEPT. OF INTERNAL AFFAIRS, DATED 1960, SCALE 1" = 4 MILES

DAPPOLONIA