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NATIONAL DAM INSPECTION PROGRAM. LAUREL RUN DAM, NDI ID NUMBER --ETC(U)
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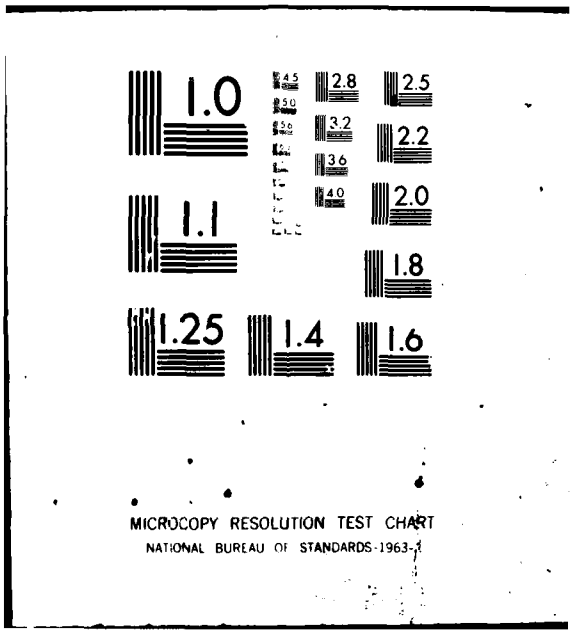
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GANNETT FLEMING CORDDRY AND
CARPENTER, INC.

DACW31-80-C-0017

SUSQUEHANNA RIVER BASIN

LAUREL RUN, LACKAWANNA COUNTY

PENNSYLVANIA

Frederick / Futchko

LAUREL RUN DAM

NDI ID No. PA-00380
DER ID No. 35-6

PENNSYLVANIA GAS AND WATER COMPANY.

12761

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM.

Laurel Run Dam, NDI ID Number PA-00380, DER ID Number 35-6, Susquehanna River Basin, Laurel Run, Lackawanna County, Pennsylvania. Phase I Inspection Report.

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
P.O. Box 1963
Harrisburg, Pennsylvania 17105

DACW31-80-C-0017

For

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

APRIL 1980

JCL

PREFACE

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

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

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

SUSQUEHANNA RIVER BASIN

LAUREL RUN, LACKAWANNA COUNTY

PENNSYLVANIA

LAUREL RUN DAM

NDI ID No. PA-00380
DER ID No. 35-6

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

ARPIL 1980

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APPENDICES

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Laurel Run Dam NDI ID No. PA-00380 DER ID No. 35-6
Size:	Intermediate (44 feet high; 38 acre-ft)
Hazard Classification:	High
Owner:	Pennsylvania Gas and Water Company J. Glenn Gooch, President 39 Public Square Wilkes-Barre, PA 18711
State Located:	Pennsylvania
County Located:	Lackawanna
Stream:	Laurel Run
Date of Inspection:	26 October 1979

Based on visual inspection, available records, calculations, and past operational performance, Laurel Run Dam is judged to be in good condition. The existing spillway will pass the Probable Maximum Flood (PMF) with 0.8 foot of freeboard. The recommended Spillway Design Flood (SDF) for the size and hazard classification of the dam is the PMF. If the low area at the left abutment of the dam were filled to the design elevation, the freeboard would increase to 1.1 feet. The spillway capacity is rated as adequate.

No stability problems were evident for the dam at the time of the visual inspection. The dam has no significant deviations from the OCE recommended guidelines for stability of gravity structures. The ability of the emergency drawdown facilities at the outlet works to function is uncertain. Access to these facilities is poor.

The following studies and remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, without delay:

(1) Either provide adequate access to the valve house or relocate the emergency drawdown facilities to a more suitable location. Repair the valve house and ensure the operational adequacy of the emergency drawdown facilities, which should be operated on a regular basis.

(2) Fill in the low area at the left abutment of the dam.

(3) Monitor the spalling concrete and the eroded mortar. Make repairs when necessary.

In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Laurel Run Dam.

(2) During periods of unusually heavy rains, provide round-the-clock surveillance of Laurel Run Dam.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(4) As presently required by the Commonwealth, submit a formal annual inspection report for Laurel Run Dam to the Commonwealth.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

FREDERICK FUTCHKO
Project Manager, Dam Section

Date: 2 May 1980

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 16 May 1980

LAUREL RUN DAM

Overview

SUSQUEHANNA RIVER BASIN

LAUREL RUN, LACKAWANNA COUNTY

PENNSYLVANIA

LAUREL RUN DAM

NDI ID No. PA-00380
DER ID No. 35-6

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1980

SECTION 1

PROJECT INFORMATION

1.1 General.

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

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Laurel Run Dam is a masonry gravity structure that is 210 feet long and 44 feet high. Most of the structure is a spillway, which is 175 feet long. Its crest is 5.3 feet below the top of

the dam. The right abutment of the dam is bedrock, and the left abutment is the natural hillside overburden. There is earthfill on the upstream side of the masonry gravity structure. The top of the earthfill is about 11 feet below the spillway crest elevation. The outlet works consists of an upstream intake tunnel and screen chamber, two pipes through the masonry gravity structure, and a valve house at the downstream toe of the spillway. One pipe, the water supply pipe, extends downstream. The other pipe, the emergency drawdown pipe, outfalls just downstream from the valve house. The various features of the dam are shown on the Photographs in Appendix C and on the Plates in Appendix E. A description of the geology is included in Appendix F.

b. Location. Laurel Run Dam is located on Laurel Run in Blakely Township, Lackawanna County, Pennsylvania, approximately 0.9 mile southeast of Archbald. Laurel Run Dam is shown on USGS Quadrangle, Olyphant, Pennsylvania, at latitude N 41° 29' 15" and longitude W 75° 31' 25". A location map is shown on Plate E-1.

c. Size Classification. Intermediate (44 feet high, 38 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Laurel Run Dam (Paragraphs 3.1e and 5.1c(5)).

e. Ownership. Pennsylvania Gas and Water Company, J. Glenn Gooch, President, 39 Public Square, Wilkes-Barre, Pennsylvania 18711.

f. Purpose of Dam. Water Supply.

g. Design and Construction History. Laurel Run Dam was constructed in 1894 by Martin Cawley, a contractor from Archbald. The construction was supervised by W. H. Sadler, consulting engineer, who also designed the dam.

The upper part of the upstream face of the dam was covered with shotcrete in 1918. At this time, a concrete cap was added across most of the top of the dam. The dam overtopped during the flood of May 1942. Earthfill on the downstream side of the structure washed out, but the dam did not fail.

Thomas H. Wiggin, consulting engineer of New York City, designed modifications for the dam in 1942. The modifications consisted of lowering the spillway crest to its present elevation and widening the spillway to its present width. At the right abutment, the top of the dam was raised to be level with the concrete cap at the left abutment. The plans were submitted to the Commonwealth. They had no comments and approved the plans in January 1943. Construction was started in March 1943 and completed by July 1943. As they were completed in 1943, the modifications will be referred to as the 1943 modifications in this Report.

h. Normal Operational Procedure. The pool is maintained at the spillway crest level with excess inflow discharging over the spillway. The emergency drawdown facilities are not normally used. Spillway discharge flows downstream to the confluence with the Lackawanna River.

1.3 Pertinent Data.

a. Drainage Area. (square miles)	2.2
b. Discharge at Damsite. (cfs.)	
Maximum known flood at damsite	850
Outlet works at maximum pool elevation	35
Spillway capacity at maximum pool elevation	
Design conditions	7,260
Existing conditions	6,650
c. Elevation. (feet above msl.)	
Top of dam	
Design conditions	1253.5
Existing conditions	1253.2
Maximum pool	
Design conditions	1253.5
Existing conditions	1253.2
Normal Pool (spillway crest)	1248.2
Upstream invert outlet works	1213.0
Downstream invert outlet works	1212.4
Streambed at toe of dam	1209.0

d.	Reservoir Length. (miles)	
	Normal pool	0.14
	Maximum pool	0.15
e.	Storage. (acre-feet)	
	Normal pool	25
	Maximum pool (design)	39
	Maximum pool (existing)	38
f.	Reservoir Surface. (acres)	
	Normal pool	1.8
	Maximum pool (design)	3.7
g.	Dam.	
	Type	Masonry gravity with upstream earthfill.
	Length (feet)	210
	Height (feet)	44
	Topwidth (feet)	
	Concrete cap	2.2
	Masonry	4.9
	Sides Slopes	
	Upstream	16V on 1H
	Downstream	
	Above El. 1239.0	8V on 1H
	Below El. 1239.0	Stepped masonry about 1.67V on 1H
	Zoning	None.
	Cut-off	Masonry founded on rock.
	Grout Curtain	None.

h.	Diversion and Regulating Tunnel.	None.
i.	Spillway. Type	Broad-crested weir with inclined top.
	Length of Weir (feet)	175.0
	Crest Elevation	1248.2
	Upstream Channel	Reservoir.
	Downstream Channel	Bedrock.
j.	Regulating Outlets. Type	One 14-inch dia. CIP.
	Length (feet)	41
	Closure	Valve in valve house.
	Access	Downstream toe of spillway.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Design data available for review included the following: approved design drawings for the 1943 modifications, foundation data based on test pits and photographs, a permit application report for the 1943 modifications, a report prepared in 1914 by the Pennsylvania Water Supply Commission, and computations for spillway and stability analyses.

b. Design Features. The project is described in Paragraph 1.2a. The various features of the dam are shown on the Photographs in Appendix C and on Plates E-2 to E-6 in Appendix E.

c. Design Considerations. The Commonwealth, both in their 1914 report and in their report for the 1943 modifications, raised some questions about the stability of the structure. In both cases they concluded that stability was adequate. This is discussed in Section 6.

2.2 Construction.

a. Data Available. The only data available for the original construction are descriptions of the construction contained in the 1914 report by the Pennsylvania Water Supply Commission. No data are available for the 1918 modifications. The only data for the 1943 modifications are payment estimates for materials used.

b. Construction Considerations. The Pennsylvania Water Supply Commission Report of 1914 indicated that the dam was well-constructed. They also reported that "to provide additional cut-off a trench was carried along the upstream and downstream toes of the dam." This feature is not shown on the Plates in Appendix E. There are insufficient data to assess the 1918 or 1943 modifications.

2.3 Operation. There are no formal records of operation. A record of operation does exist in the form of inspection reports prepared by the Commonwealth between 1919 and 1957 as well as various inspections by the Owner. The findings of the previous inspections note only minor problems.

2.4 Evaluation.

a. Availability. Engineering data were provided by the Bureau of Dams and Waterway Management, Department of Environmental Resources, Commonwealth of Pennsylvania (PennDER). The Owner made available an engineer for information. He also researched his files for information at the request of the inspection team.

b. Adequacy. The type and amount of available design data and other engineering data are limited; and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions, and hydraulic assumptions.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The overall appearance of the dam is good. A few deficiencies were observed as noted below. A sketch of the dam with the locations of deficiencies is presented on Exhibit B-1 in Appendix B. Survey information acquired for this Report is summarized in Appendix B. On the day of the inspection, the pool was at the spillway crest. Another visit to the dam was made about two weeks after the inspection to obtain additional photographs. No observations that differed from the original inspection were noted. Flow conditions on that day varied from the flow conditions on the day of the inspection.

b. Masonry Gravity Structure. Most of this structure acts as the spillway. The masonry is in good condition. Some of the mortar in the joints is eroded. The most severe erosion of the mortar is about 1 inch deep. The concrete cap adjacent to each end of the spillway is slightly spalled (Photograph F). No other deficiencies were observed, although the flow over the section could have obscured minor problems.

c. Appurtenant Structures. The condition of the spillway is described above. The right wall of the valve house has collapsed. The mortar in the remainder of the structure is very deteriorated (Photograph E). The caretaker for the dam did not arrive at the dam; therefore, the operation of the emergency drawdown facilities was not viewed. The Owner subsequently reported that it had not been operated within the last four years.

d. Reservoir Area. Except for a strip-mined area south of the dam, the watershed is entirely wooded and undeveloped. The strip-mined area is shown on Plate E-1. Access could not be gained to the area. The hillsides at the reservoir are steep. There are some rock outcrops in the reservoir area.

e. Downstream Channel. Spillway discharge flows along the downstream toe of the dam by the valve house (Photographs D and E). The discharge collects at the right side of the valley and flows for about 300 feet to the site

where the waterline crosses the stream (Photograph B). The stream then flows for about 0.9 mile through a very steep and deserted valley. The sides of the valley have been strip mined. The last 0.3 mile of this reach has channel improvements that were constructed by the Commonwealth to mitigate acid mine drainage. Work on the improvements was in progress on the day of the inspection. At the end of the channel improvements, the stream flows under a small bridge that supports the Delaware and Hudson railroad tracks. About 300 feet downstream of this bridge is another bridge supporting a local road. The waterway opening at the roadway bridge is 19.5 feet wide by 4 feet high. In the immediate vicinity of this bridge, which is at the south end of Archbald, are seven dwellings adjacent to the stream. About 100 feet downstream of the bridge is the confluence of Laurel Run and the Lackawanna River.

The access road to the dam extends along the right side of the strip-mined valley far above the stream. At the site where the waterline crosses the stream, there is a vehicle turnaround. The access road then crosses the bottom of the stream and extends up to the left abutment of the dam (Photograph B).

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest, with excess inflow discharging over the spillway and into Laurel Run. Water supply lines at the dam are connected directly to the Owner's distribution system. The emergency drawdown facilities are normally not used. Water supply demand at the dam varies greatly. The dam serves as part of the water supply for Archbald and surrounding communities.

4.2 Maintenance of Dam. The dam is visited daily by a caretaker who records the reservoir elevation. Weekly reports are mailed to the Owner's Engineering Department. This information is used by the Owner's Engineering Department for regulating flows in the distribution system. The caretaker is also responsible for observing the general condition of the dam and appurtenant structures and reporting any changes or deficiencies to the Owner's Engineering Department. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and the records are filed and used for determining priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons. In response to the National Dam Inspection Program of the two previous years, the Owner has modified his maintenance and inspection programs. All maintenance, except for minor items, is performed under contract with outside firms. The Owner's operating personnel observe the maintenance performed by outside firms in order to become familiar with required maintenance work. The Owner plans to have all maintenance work performed by his operating personnel within a few years. The emphasis of the maintenance work has been placed on those structures previously inspected under the National Dam Inspection Program. Annual inspection reports for those dams inspected under the National Dam Inspection Program are submitted to the Commonwealth.

4.3 Maintenance of Operating Facilities. The emergency drawdown valve is operated infrequently. It has not been operated for about four years. Maintenance for the water supply outlet is performed on an as-needed basis.

4.4 Warning Systems in Effect. The Owner furnished the inspection team with a verbal description of the chain of command diagram for Laurel Run Dam and of a generalized emergency notification list that is applicable for all of the Pennsylvania Gas and Water Company dams. The Owner said that during periods of heavy rainfall, available personnel are dispatched to the dams to observe conditions. All company vehicles are equipped with radios, and the personnel can communicate with each other and with a central control facility. Evaluation of risk is made by the Owner's Engineering Department. The Owner's Engineering Department is also responsible for notification of emergency conditions to the local authorities. Detailed emergency operational procedures have not been formally established for Laurel Run Dam but are as directed by the Owner's Engineering Department.

4.5 Evaluation of Operational Adequacy. The maintenance of the emergency drawdown facilities is inadequate. The maintenance of the dam is adequate. The inspection program for the dam is good. A detailed emergency operation and warning system is necessary to reduce the risk of dam failure should adverse conditions develop and to prevent loss of life should the dam fail.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. No design data are available for the original design or for the 1918 modifications. In a report by Thomas H. Wiggin in 1942, he recommended a spillway capacity of 4,800 cfs, based on various runoff curves then in use. Mr. Wiggin subsequently designed the 1943 modifications to the dam. The Commonwealth analyzed the design and estimated the spillway capacity at 6,740 cfs. The discharge coefficient of 3.15 used by the Commonwealth is slightly conservative. A discharge coefficient of 3.4 is used in the analysis described in Appendix D.

b. Experience Data. The flood of record occurred in May 1942. By extrapolating runoff rates in adjacent watersheds, Mr. Wiggin estimated the peak flood discharge at 385 csm (or 850 cfs). This is used as the flood of record. Using this flood and the then existing spillway, the Commonwealth subsequently estimated that the dam overtopped by 0.55 foot. The overtopping is equivalent to a pool at Elevation 1254.1.

c. Visual Observations.

(1) General. The visual inspection of Laurel Run Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics. These observations are evaluated herein for the various features.

(2) Masonry Gravity Section. The low area at the left abutment of the dam limits the existing spillway capacity to less than the design capacity. Although the left abutment is natural overburden, it functions as an embankment.

(3) Appurtenant Structures. No deficiencies relevant to hydraulics were observed at the spillway. The operational adequacy of the emergency drawdown facilities is uncertain because they have not been operated for four years.

(4) Reservoir Area. The mapping indicates that the strip-mined area is only 3 percent of the watershed. Its effects on flood runoff should be negligible.

(5) Downstream Conditions. If the dam were to fail, the steep valley would provide very little mitigating effect. The channel improvements recently constructed by the Commonwealth would not have a significant effect on flow from a dam failure. Therefore, if the dam were to fail, the Delaware and Hudson railroad tracks, a local road, and 7 dwellings would be flooded. Because of the small storage at the dam and because of the flat overbanks of Laurel Run adjacent to the Lackawanna River, flooding would probably not be very deep. However, there is the potential for loss of life. The downstream conditions indicate that a high hazard classification is warranted for Laurel Run Dam.

The access road to the dam, between Archbald and the site where the waterline crosses the stream, is adequate. Crossing the stream in a vehicle would be impossible during periods of significant spillway flow. The waterline acts as a footbridge and provides access; however, it too would be flooded during periods of significant spillway discharge. The turnaround area at the waterline crossing is sufficiently close to the dam that the condition of the dam could be monitored from it during periods of significant spillway discharge. Access to the emergency drawdown facilities during periods of significant spillway discharge is not of concern; operating the emergency drawdown facilities would not provide a significant increase in discharge during such periods. However, it is judged that access to the emergency drawdown facilities would be almost impossible and certainly hazardous during periods of freezing weather, when ice would coat the valve house, pipes, and bedrock near the stream.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) for the size (Intermediate) and hazard potential (High) of Laurel Run Dam is the Probable Maximum Flood (PMF). The watershed was modeled with the HEC-1DB computer program. A description of the model is included in Appendix D. The assessment of the hydrology and hydraulics is based on

existing conditions, and the effects of future development are not considered.

(2) Summary of Results. Pertinent results are tabulated at the end of Appendix D. The analysis reveals that Laurel Run Dam can pass the PMF with 0.8 foot of freeboard. The dam is rated at its existing top elevation. At its design top elevation, the freeboard would increase to 1.1 feet.

(3) Spillway Adequacy. The criteria used to rate the spillway adequacy are described in Appendix D. Because the dam can pass the PMF, the spillway capacity is rated as adequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Laurel Run Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Masonry Gravity Section. The spalled concrete and the eroded mortar are both minor problems caused by long term exposure to the weather and to flowing water. These problems are not a hazard at present.

(3) Appurtenant Structures. The collapse of the right wall of the valve house and the deterioration of the remainder of the structure is caused by long-term exposure to flowing water. The valve house is at the downstream toe of the spillway. Collapse of the structure could block access to the valve for the emergency drawdown facilities.

b. Design and Construction Data. The Pennsylvania Water Supply Commission Report of 1914 summarized a conversation with the original designer. The original designer stated that the dam was designed for a 2.0 factor of safety against overturning at the original design normal pool level. Uplift was neglected in the design. The Pennsylvania Water Supply Commission analyzed the structure assuming a pool 1 foot above spillway crest and 67 percent uplift. At the base, they computed the resultant to be 2.40 feet outside the middle third, the toe pressure to be 42 psi, and the "coefficient of sliding" to be 0.83. They judged that these were acceptable results and did not recommend modifications.

No data are available for the 1918 modifications to the dam. Thomas H. Wiggin, who designed the 1943 modifications to the dam, considered these modifications would improve the stability of the dam, which had just been overtopped with no apparent stability problems. The Commonwealth analyzed the stability of the dam with the proposed modifications. With the reservoir at normal pool

level and assuming both 67 percent uplift and no earth pressure, they computed the resultant to be 3 feet outside the middle third and the "coefficient of sliding" to be 0.86. Because the dam had withstood a pool level 3.3 feet higher than the maximum expected pool level that they computed, they considered the stability of the dam to be adequate.

For this Report, another stability analysis was performed. Earth pressure and uplift were considered. The pool was assumed to be at the top of the dam. Only the base section was analyzed. For this condition, the resultant was computed to be outside the middle third, about 3.1 feet inside the toe. The factor of safety against sliding and the toe pressures were adequate. Although OCE guidelines recommend the resultant to be inside the middle third, the toe pressures are adequate. Thus, the resultant being outside the middle third is not judged to be a significant deviation from the OCE guidelines.

c. Operating Records. There are no formal records of operation. According to available data, no stability problems have occurred over the operational history of the dam, which includes an overtopping in 1942.

d. Post-construction Changes. Post-construction changes are described in Paragraph 1.2g. The changes are assessed with the dam.

e. Seismic Stability. Laurel Run Dam is located in Seismic Zone 1. Earthquake loadings are not considered to be significant for intermediate size masonry dams located in Seismic Zone 1 when there are no readily apparent stability problems and its theoretical static stability is deemed to be adequate. As there are neither readily apparent stability problems nor concern for its theoretical static stability, it is assumed that the seismic stability of Laurel Run Dam is adequate.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on available records, visual inspection, calculations, and past operational performance, Laurel Run Dam is judged to be in good condition. Based on existing conditions, the spillway will pass the PMF with 0.8 foot of freeboard. If the low area at the left abutment of the dam was filled to the design elevation, the freeboard would increase to 1.1 foot. The spillway capacity is rated as adequate.

(2) No stability problems were evident for the dam at the time of the visual inspection.

(3) The spillway weir has no significant deviations from OCE guidelines for stability.

(4) The ability of the outlet works to function is uncertain. Access to these facilities is poor.

(5) A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiency
Masonry Gravity Dam and Spillway:	Low area at abutment; minor erosion of mortar; minor spalling of concrete
Outlet Works:	Uncertain operation of emergency drawdown facilities, which are not accessible during freezing weather; valve house near collapse

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented without delay.

d. Necessity for Further Investigations. Accomplishment of the remedial measures outlined in Paragraph 7.2 will not require further investigations by the Owner.

7.2 Recommendations and Remedial Measures.

a. The following studies and remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, without delay:

(1) Either provide adequate access to the valve house or relocate the emergency drawdown facilities to a more suitable location. Repair the valve house and ensure the operational adequacy of the emergency drawdown facilities, which should be operated on a regular basis.

(2) Fill in the low area at the left abutment of the dam.

(3) Monitor the spalling concrete and the eroded mortar. Make repairs when necessary.

b. In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Laurel Run Dam.

(2) During periods of unusually heavy rains, provide round-the-clock surveillance of Laurel Run Dam.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(4) As presently required by the Commonwealth, submit a formal annual inspection report for Laurel Run Dam to the Commonwealth.

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: LAUREL RUN

NDI ID NO.: PA-00380 DER ID NO.: 35-6

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	FOR 1943 MODIFICATIONS SEE PLATES E-2 TO E-6
REGIONAL VICINITY MAP	SEE PLATE E-1
CONSTRUCTION HISTORY	BUILT 1894
TYPICAL SECTIONS OF DAM	SEE PLATES E-4 TO E-6
OUTLETS: Plan Details Constraints Discharge Ratings	SEE PLATE E-2 AND E-6

A-1

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NONE
DESIGN REPORTS	NONE
GEOLOGY REPORTS	NONE
DESIGN COMPUTATIONS: Hydrology and Hydraulics (H&H) Dam Stability Seepage Studies	NONE FOR design H&H FOR 1943 MODIFICATIONS STABILITY (by PWSC) IN 1914 AND FOR 1943 MODIFICATION.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	NONE
POSTCONSTRUCTION SURVEYS OF DAM	SEE As-Built DRAWINGS

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	UNKNOWN FOR MASONRY UPSTREAM EARTHFILL FROM ADJACENT HILLSIDE.
MONITORING SYSTEMS	NONE
MODIFICATIONS	1918 - CONCRETE CAP AND GUNITE ADDED. 1943 - SPILLWAY CREST LOWERED AND LENGTHENED.
HIGH POOL RECORDS	SEE PRIOR ACCIDENTS
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	1943 MODIFICATION
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	OVERTOPPED IN MAY 1942 DOWNSTREAM EARTHFILL WASHED OUT BUT NO FAILURE. SPILLWAY SUBSEQUENTLY MODIFIED.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	NONE
SPILLWAY: Plan Sections Details	SEE PLATES E-2 TO E-6
OPERATING EQUIPMENT: Plans Details	SEE PLATE E-6
PREVIOUS INSPECTIONS Dates Deficiencies	1919 - SLIGHT LEAKAGE THROUGH BASE. NOTES REPAIRS IN 1918 CONSISTING OF: 4" THICK GUNITE COAT OVER UPPER 15' OF UPSTREAM FACE, FASTENED WITH SPIKES. (OTHER COMMENTS NOT FULLY LEGIBLE) 1924 - VERY SLIGHT SEEPAGE. 1928 - SLIGHT SEEPAGE FROM LEFT SIDE, SMALL LEAK 15 TO 20' LEFT OF SPILLWAY. 1932 - SEEPAGE AT NUMEROUS JOINTS IN MASONRY. 1941 - SLIGHT LEAK 18' LEFT OF VALVE HOUSE AND 12' BELOW TOP
CONTINUED	

ENGINEERING DATA

ITEM	REMARKS
PREVIOUS INSPECTIONS (CONTINUED)	1945 - NO DEFICIENCIES - NOTES 1943 MODIFICATIONS 1953 - NO DEFICIENCIES 1957 - SLIGHT LEAKAGE AT TOE.

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: LAUREL RUN County: LACKAWANNA State: PENNSYLVANIA

NDI ID No.: PA-00380 DER ID No.: 35-6

Type of Dam: MASONRY GRAVITY Hazard Category: HIGH

Date(s) Inspection: 26 OCTOBER 1979 Weather: LIGHT SNOW Temperature: 35-40°F

Pool Elevation at Time of Inspection: 1248.2 msl/Tailwater at Time of Inspection: 1209± msl

Inspection Personnel:

D. WILSON (GFCC)

D. EBERSOLE (GFCC)

A. WHITMAN (GFCC) Recorder

B-1

CONCRETE/MASONRY DAMS

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	NONE	
JUNCTION OF STRUCTURE WITH: Abutment Embankment Other Features	SEE SURVEY DATA FOLLOWING INSPECTION FORMS	EXCEPT FOR SLIGHT LOW AREA - NO DEFICIENCIES.
DRAINS	NONE	
WATER PASSAGES	NONE	
FOUNDATION	BEDROCK	

CONCRETE/MASONRY DAMS

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES: Surface Cracks Spalling	AT ABUTMENTS - SLIGHT SPALLING OF CONCRETE	
STRUCTURAL CRACKING	NONE	
ALIGNMENT: Vertical Horizontal	VERTICAL - SEE SURVEY DATA FOLLOWING INSPECTION FORMS	
MONOLITH JOINTS	MASONRY JOINTS - SLIGHTLY OBSCURED by FLOW. MORTAR ERODED AT ARMS.	EROSION OF MORTAR IS MINOR.
CONSTRUCTION JOINTS	SEE ABOVE	
STAFF GAGE OR RECORDER	NONE	

B-3

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	CIP	
INTAKE STRUCTURE	SUBMERGED	
OUTLET STRUCTURE	PIPE HAS FREE OUTFALL.	
OUTLET CHANNEL	CLEAR OF DEBRIS	
EMERGENCY GATE	NO OPERATING PERSONNEL AT SITE	OPERATION NOT VIEWED.

UNGATED SPILLWAY (PART OF MASONRY DAM)

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	GOOD CONDITION	
APPROACH CHANNEL	RESERVOIR	
DISCHARGE CHANNEL	MINOR BRUSH	
BRIDGE AND PIERS	NONE	

B-5

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE AT SITE	
OBSERVATION WELLS		
WEIRS		
PIEZOMETERS		
OTHER	NONE AT SITE	

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	ACCESS ROAD GOES THROUGH STREAM.	
SLOPES	STEEP	
APPROXIMATE NUMBER OF HOMES AND POPULATION	AT CONFLUENCE WITH LACKAWANNA RIVER - 7 DWELLINGS.	

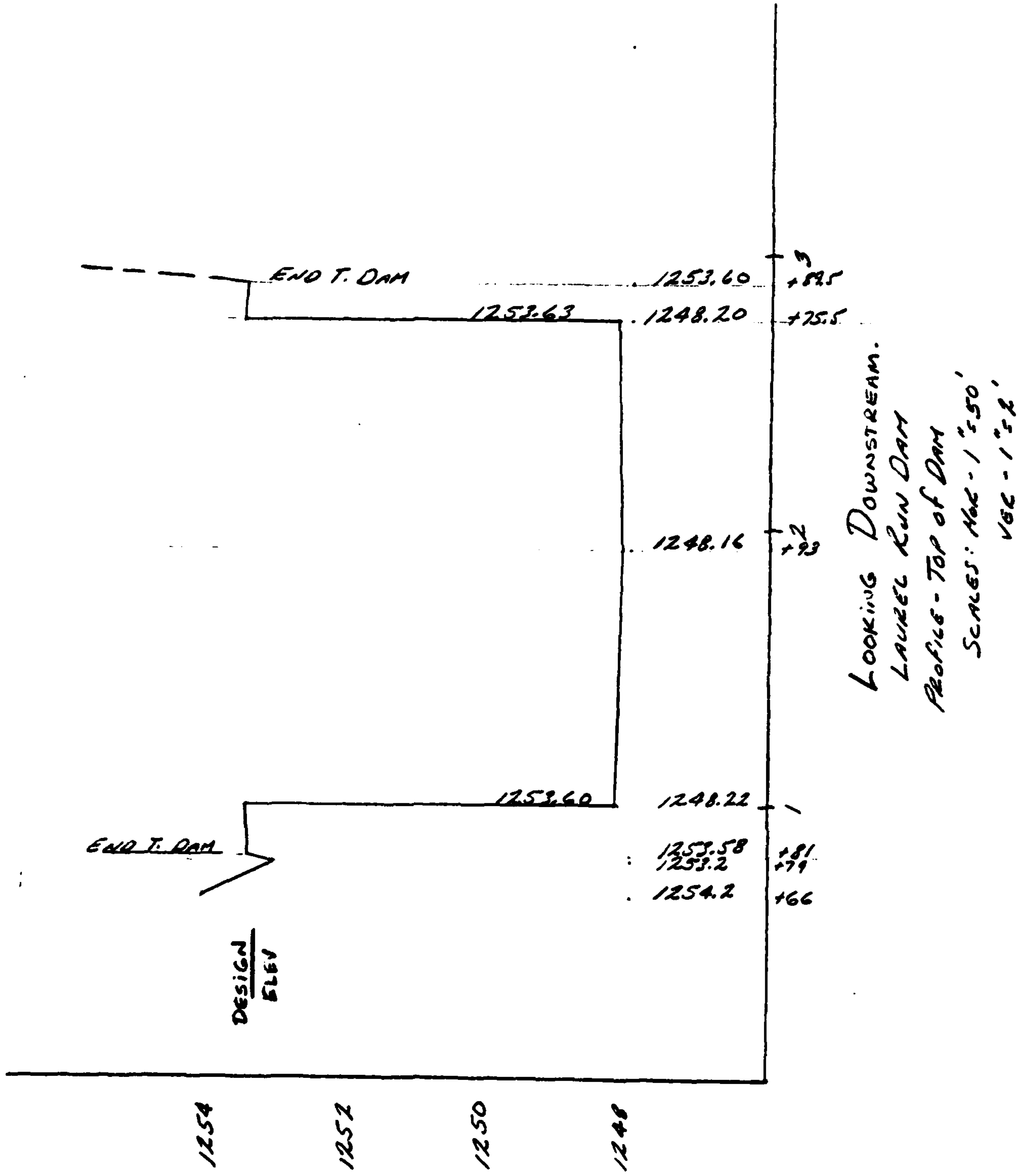
RESERVOIR AND WATERSHED

Sheet 1 of 1

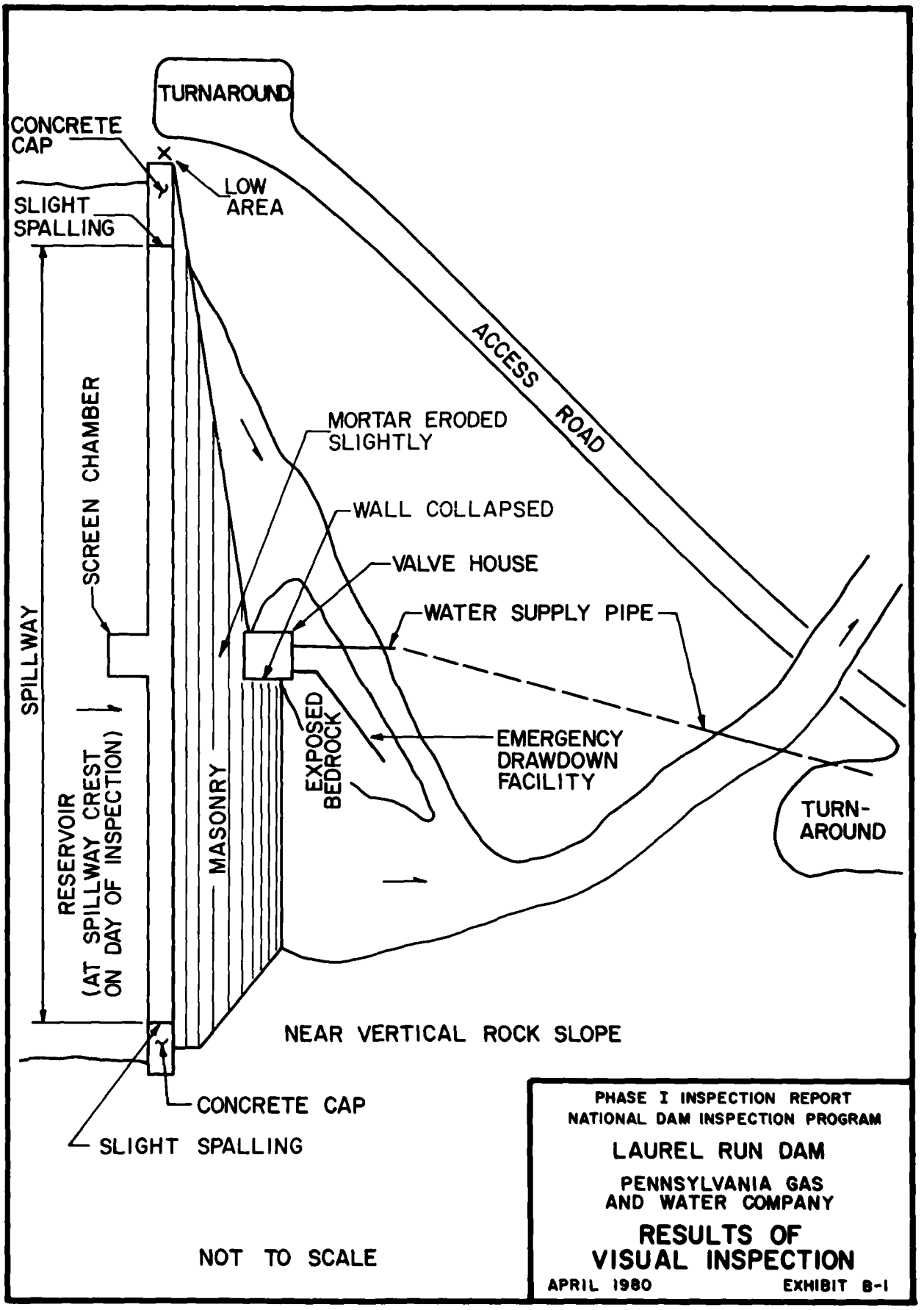
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	STEEP	
SEDIMENTATION	No Reported or observed problems	
WATERSHED DESCRIPTION	Wooded except for strip mine south of dam.	

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT: LAUREL RUN DAM 35-6 FILE NO. ______
PROFILE - TOP of DAM SHEET NO. ____ OF ____ SHEETS
FOR ______
COMPUTED BY ______ DATE ______ CHECKED BY ______ DATE ______



8319



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAUREL RUN DAM

PENNSYLVANIA GAS AND WATER COMPANY

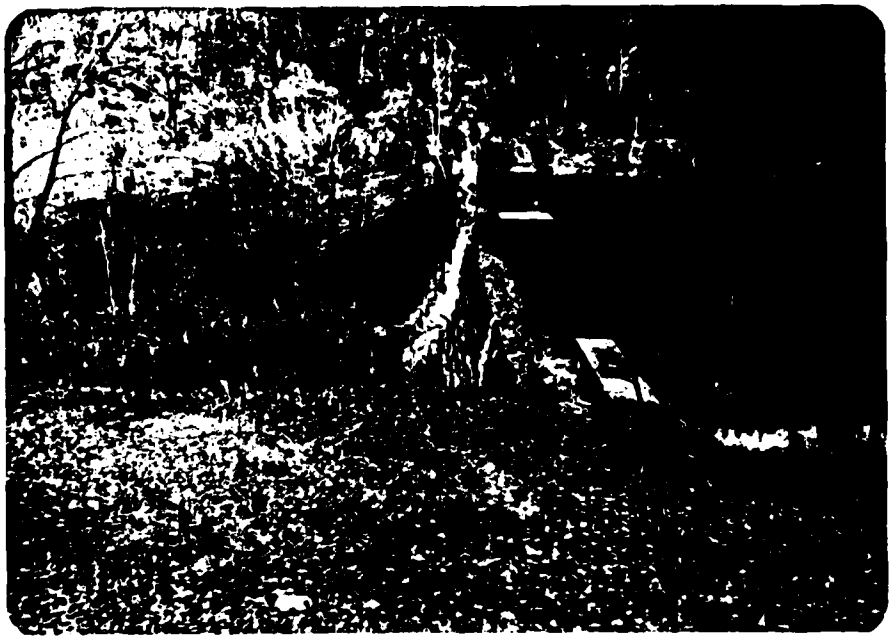
RESULTS OF VISUAL INSPECTION

APRIL 1980 EXHIBIT B-1

APPENDIX C

PHOTOGRAPHS

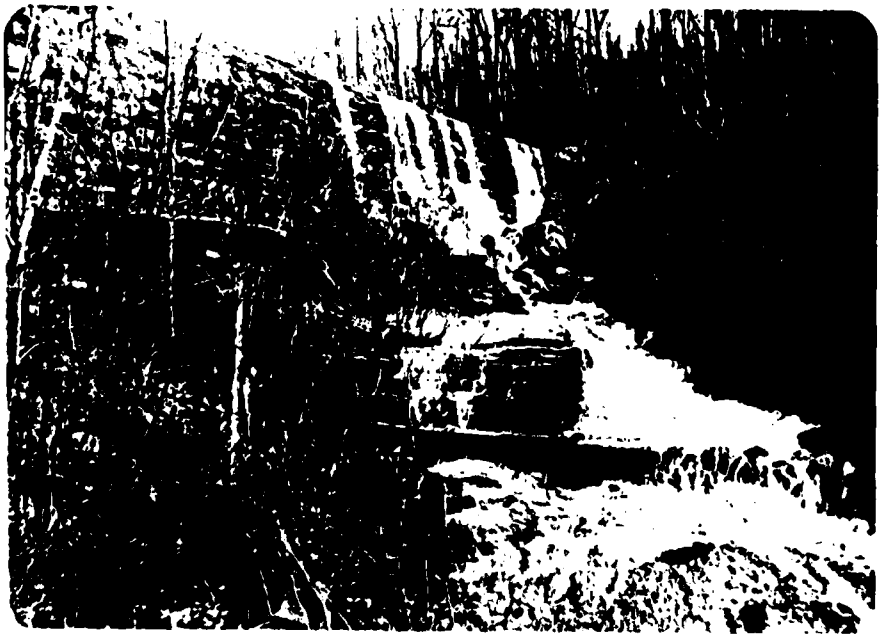
LAUREL RUN DAM



A. View From Left Abutment

B. View Looking Upstream

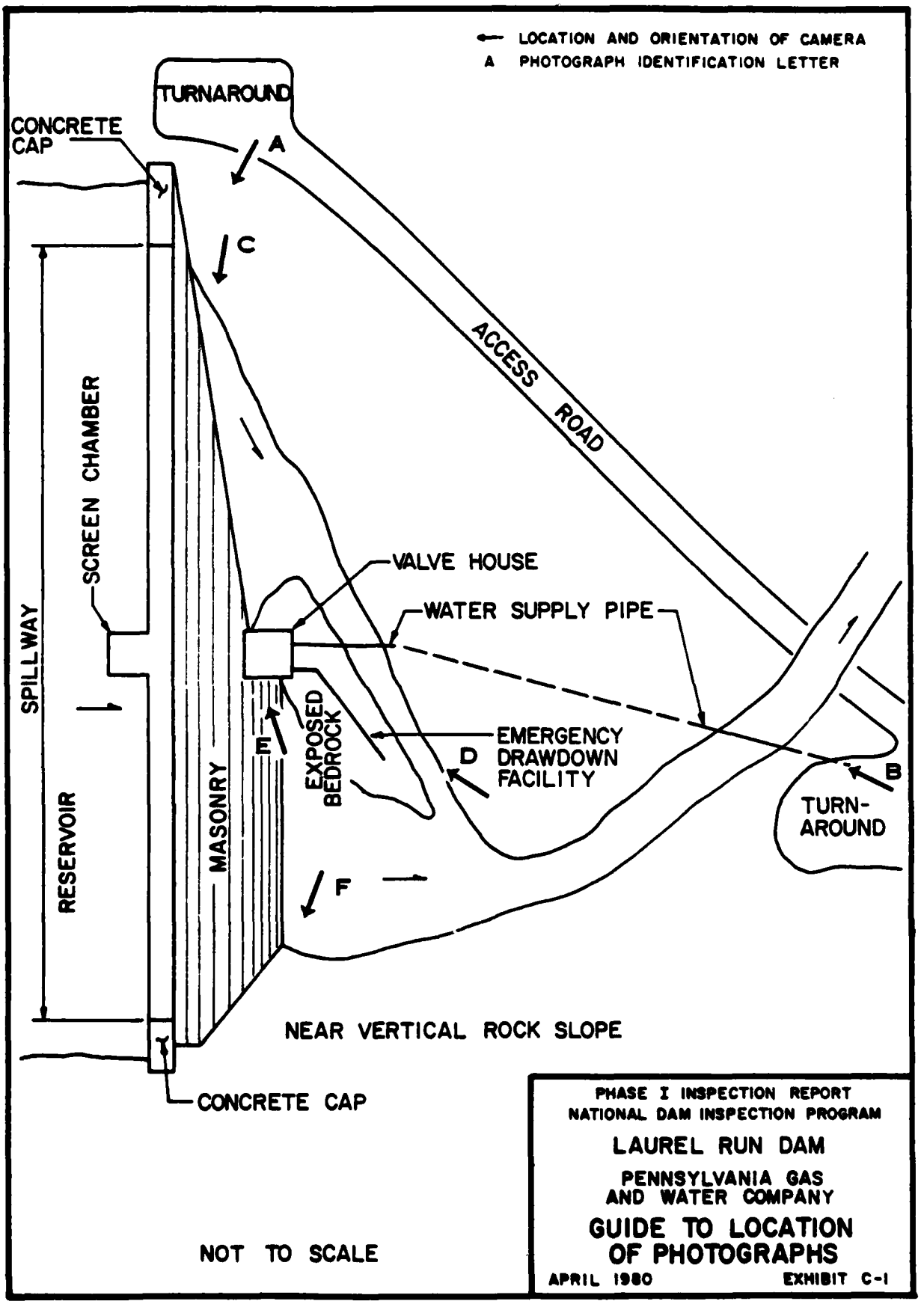
C. Downstream Face



D. Emergency Drawdown Facility

E. Valve House

F. Right Abutment



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAUREL RUN DAM

PENNSYLVANIA GAS AND WATER COMPANY

GUIDE TO LOCATION OF PHOTOGRAPHS

APRIL 1980 EXHIBIT C-1

APPENDIX D

HYDROLOGY AND HYDRAULICS

APPENDIX D

HYDROLOGY AND HYDRAULICS

Spillway Capacity Rating:

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

Description of Model:

If the Owner has not developed a PMF for the dam, the watershed is modeled with the HEC-1DB computer program, which was developed by the U.S. Army Corps of Engineers. The HEC-1DB computer program calculates a PMF runoff hydrograph (and percentages thereof) and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure. By modifying the rainfall criteria, it is also possible to model the 100-year flood with the program.

APPENDIX D

SUSQUEHANNA River Basin
Name of Stream: LAUREL RUN
Name of Dam: LAUREL RUN
NDI ID No.: PA-00380
DER ID No.: 35-6
Latitude: N 41° 29' 15" Longitude: W 75° 31' 25"
Top of Dam Elevation: 1253.5 (design
Streambed Elevation: 1209.0 Height of Dam: 44 ft
Reservoir Storage at Top of Dam Elevation: 39 acre-ft
Size Category: INTERMEDIATE
Hazard Category: HIGH (see Section 5)
Spillway Design Flood: PMF

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
NONE				

DOWNSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
NONE				

SUSQUEHANNA River Basin

Name of Stream: LAUREL RUN

Name of Dam: LAUREL RUN

DETERMINATION OF PMF RAINFALL & UNIT HYDROGRAPH

UNIT HYDROGRAPH DATA:

Sub-area	Drainage Area (square miles)	Cp (1)	Ct (2)	L miles (3)	L_{ca} miles (4)	L' miles (5)	Tp hours (6)	Map Area (7)	Plate (8)
A-1	2.20	0.62	1.50	2.95	1.50	N/A	2.34	11	E
Total	2.20								

(See Sketch on Sheet D-4)

(1) & (2): Snyder Unit Hydrograph coefficients supplied by Baltimore District, Corps of Engineers on maps and plates referenced in (7) & (8)

The following are measured from the outlet of the subarea:

(3): Length of main watercourse extended to divide

(4): Length of main watercourse to the centroid

The following is measured from the upstream end of the reservoir at normal pool:

(5): Length of main watercourse extended to divide

(6): $Tp=C_t \times (L \times L_{ca})^{0.3}$, except where the centroid of the subarea is located in the reservoir. Then $Tp=C_t \times (L')^{0.6}$

Initial flow is assumed at 1.5 cfs/sq. mile

Computer Data: QRCSN = -0.05 (5% of peak flow)
RTIOR = 2.0

RAINFALL DATA:

PMF Rainfall Index= 22.15 in., 24 hr., 200 sq. mile

	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone:	N/A	N/A
Geographic Adjustment Factor:	96%	1.0
Revised Index Rainfall:	21.2	N/A

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	118
12 hours	127
24 hours	136
48 hours	142
72 hours	145
96 hours	

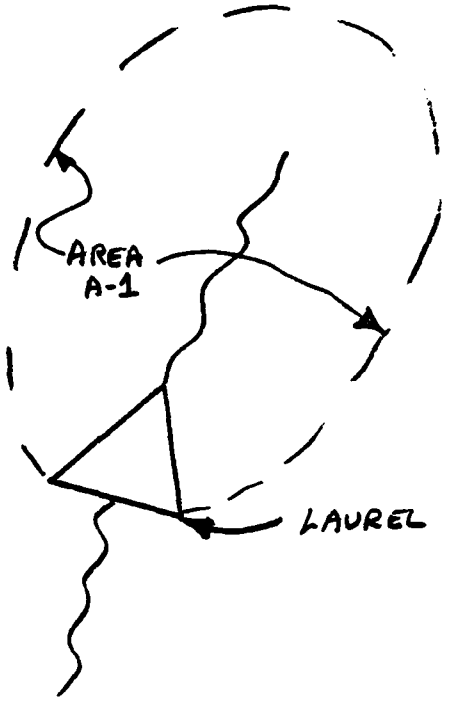
GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____

_____ SHEET NO. ____ OF ____ SHEETS

FOR _____

COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



SKETCH
OF
SYSTEM

Data for Dam at Outlet of Subarea A-1 (See sketch on Sheet D-4)

Name of Dam: LAUREL RUN

STORAGE DATA:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1206.5 =ELEVO*	0	0	0	
1248.2 =ELEV1	1.768 =A1	8	24.6 =S1	OWNER DATA
1253.2	3.56		38	
1253.5	3.68		39	
1260	7			

* ELEVO = ELEV1 - $(3S_1/A_1)$
** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Normal Pool is NEGL percent of subarea watershed.

BREACH DATA: Not Used

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: _____

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) _____ fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = _____ ft., C = ____ Top of Dam El.= ____

HMAX + Top of Dam El. = _____ = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = _____ ft (width of bottom of breach)
Z = _____ (side slopes of breach)
ELBM = _____ (bottom of breach elevation, minimum of zero storage elevation)
WSEL = _____ (normal pool elevation)
T FAIL = _____ mins = _____ hrs (time for breach to develop)

Data for Dam at Outlet of Subarea A-1

Name of Dam: LAUREL RUN

SPILLWAY DATA:	Existing Conditions	Design Conditions
Top of Dam Elevation	1253.2	1253.5
Spillway Crest Elevation	1248.2	1248.2
Spillway Head Available (ft)	5.0	5.3
Type Spillway	BROAD CRESTED	WEIR / INCLINED TOP
"C" Value - Spillway	3.4 *	3.4 *
Crest Length - Spillway (ft)	175	175
Spillway Peak Discharge (cfs)	6652	7260
Auxiliary Spillway Crest Elev.	N/A	N/A
Auxiliary Spill. Head Avail. (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spill. (ft)		
Crest Length - Auxil. Spill. (ft)		
Auxiliary Spillway Peak Discharge (cfs)	N/A	N/A
Combined Spillway Discharge (cfs)	≈ 6,650	7,260

Spillway Rating Curve: $Q = CLH^{3/2}$ * KING - HANDBOOK OF HYDRAULICS FIG's 5-68 & 5-69

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

OUTLET WORKS RATING:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	1212.4		
Invert of Inlet	1213.0		
Type	CIP		
Diameter (ft) = D	1.167		
Length (ft) = L	41		
Area (sq. ft) = A	1.07		
N	.013		
K Entrance	0.5		
K Exit	1.0		
K Friction=$29.1N^2L/R^{4/3}$	1.04		
Sum of K	2.54		
$(1/K)^{0.5} = C$	0.627		
Maximum Head (ft) = HM	40		
$Q = CA\sqrt{2g(HM)}$ (cfs)	34		
Q Combined (cfs)	≈ 35		

Selected Computer Output

8819

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  17 JAN 80
**********
    1                 A1                              NATIONAL DAM INSPECTION PROGRAM
    2                 A2                                    LAUREL RUN  (NEAR ARCHBALD)
    3                 A3                                  LAUREL RUN DAM
    4                 B     300        0       15        0        0        0        0        0       -4        0
    5                 B1      5
    6                 J       1        4        1
    7                 J1      1       .9       .8       .5
    8                 K       0        1                                              1
    9                 K1        RUNOFF INTO RESERVOIR
   10                 M       1        1      2.2                2.2                                      1
   11                 P                21.2      118      127      136      142      145
   12                 T                                                                1      .05
   13                 W    2.34      .62
   14                 X    -1.5     -.05      2.0
   15                 K       1        1                                              1
   16                 K1        ROUTE THROUGH LAUREL RUN DAM
   17                 Y                                        1
   18                 Y1      1                                                -1248.2
   19                 SA      0    1.768        7
   20                 SE 1206.5   1248.2     1260
   21                 SS 1248.2      175      3.4      1.5
   22                 SD 1253.2
   23                 SL      1        7       40       60
   24                 SV 1253.2   1253.6   1253.7     1255
   25                 K      99
```

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	RATIO 2	RATIO 3	RATIO 4
				1.00	.90	.80	.50
HYDROGRAPH AT	1	2.20	1	5174.	4656.	4139.	2587.
	(	5.70)	(	146.50)(	131.85)(	117.20)(	73.25)(
ROUTED TO	1	2.20	1	5173.	4656.	4139.	2587.
	(	5.70)	(	146.49)(	131.84)(	117.20)(	73.25)(

D-9

SUMMARY OF DAM SAFETY ANALYSIS

LAUREL RUN DAM

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	1248.20	1248.20	1253.20
STORAGE	25.	25.	38.
OUTFLOW	0.	0.	6652.

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	1252.43	0.00	35.	5173.	0.00	42.00	0.00
.90	1252.14	0.00	34.	4656.	0.00	42.00	0.00
.80	1251.84	0.00	33.	4139.	0.00	42.00	0.00
.50	1250.86	0.00	30.	2587.	0.00	42.00	0.00

D-10

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____

_____ SHEET NO. ____ OF ____ SHEETS

FOR _____

COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

Summary of Pertinent Data

PMF Rainfall = 24.59"

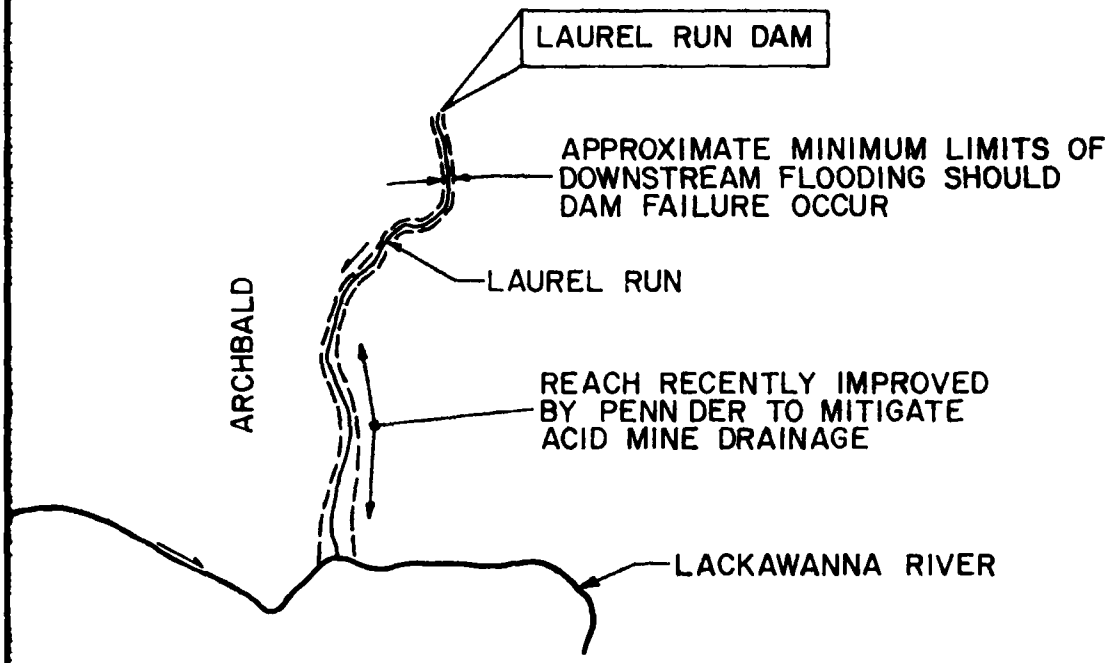
Existing Conditions

	PMF	½ PMF
Runoff (inches)	22.01	11.0
Peak Inflow (cfs)	5,174	2,587
Peak Outflow (cfs)	5,173	2,587
Freeboard (ft)	0.77	2.34

6813

NOTES:

1. LIMITS OF DOWNSTREAM FLOODING ARE ESTIMATES BASED ON VISUAL OBSERVATIONS.
2. CIRCLED NUMBERS INDICATE STATIONS USED IN COMPUTER ANALYSIS.
3. THIS MAP SHOULD NOT BE USED IN CONNECTION WITH THE EMERGENCY OPERATION AND WARNING PLAN.



2000 0 2000

SCALE: 1 IN. = 2000 FT.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAUREL RUN DAM

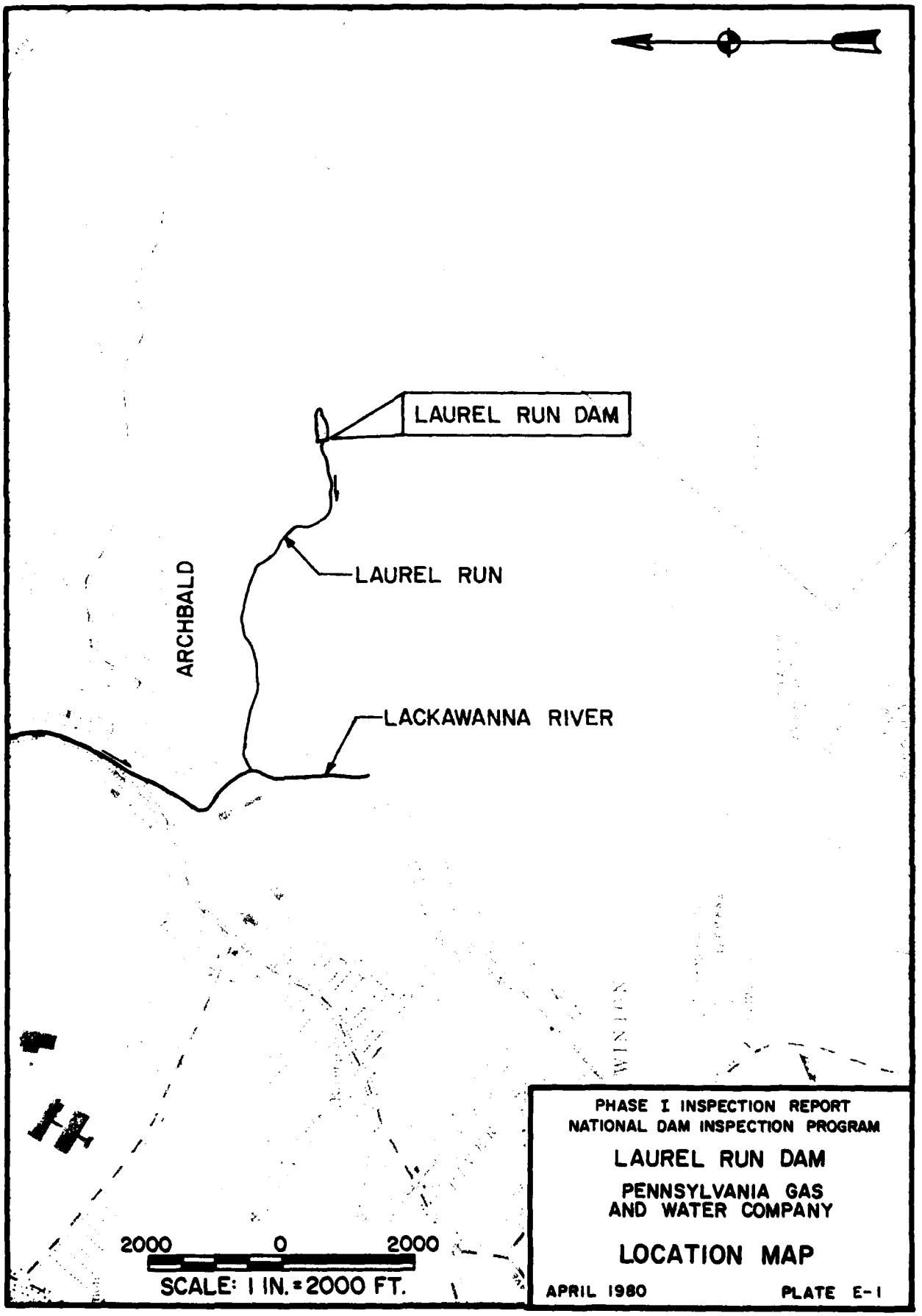
PENNSYLVANIA GAS AND WATER COMPANY

DOWNSTREAM DEVELOPMENT MAP

APRIL 1980 EXHIBIT D-1

APPENDIX E

PLATES



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

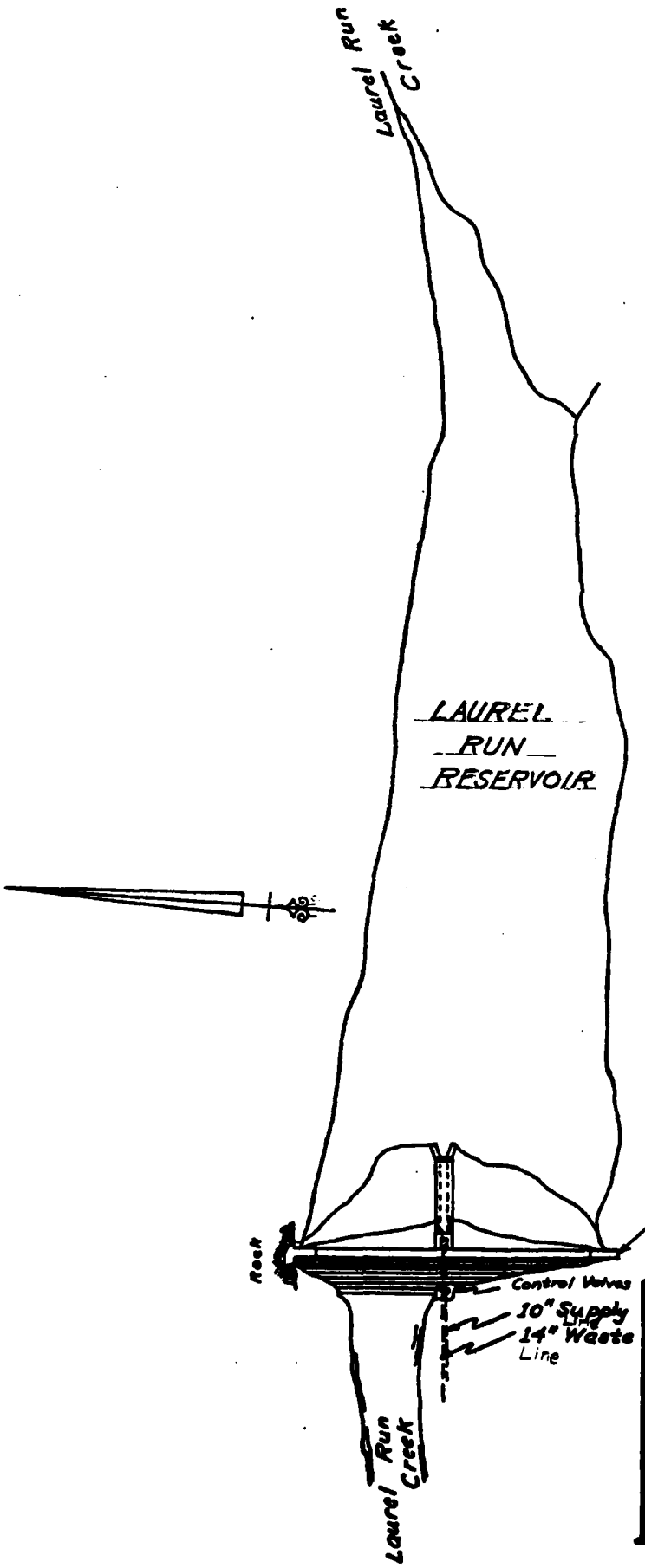
LAUREL RUN DAM

PENNSYLVANIA GAS
AND WATER COMPANY

LOCATION MAP

APRIL 1980 PLATE E-1

O. W. Co.
Archbald Division
(5) Distributing Reservoir
Sheet No. 14



Area of Shed 2.21 Sq. Mi.
Flow Line Elev. 1248.2
Area of Res. Flowed 1.768 Acres
Capacity of Reservoir 8,000,000 Gal.

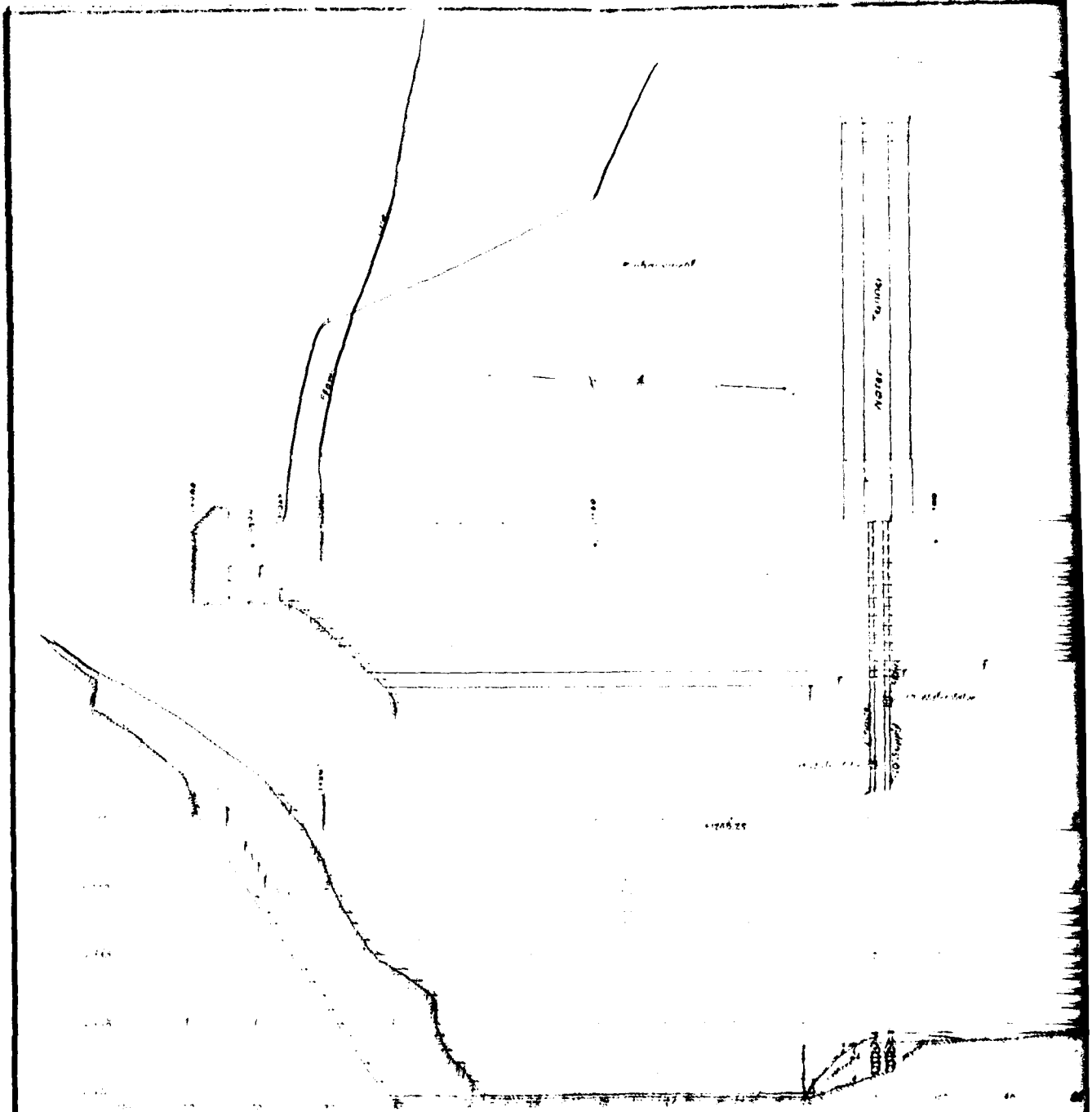
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAUREL RUN DAM

PENNSYLVANIA GAS
AND WATER COMPANY

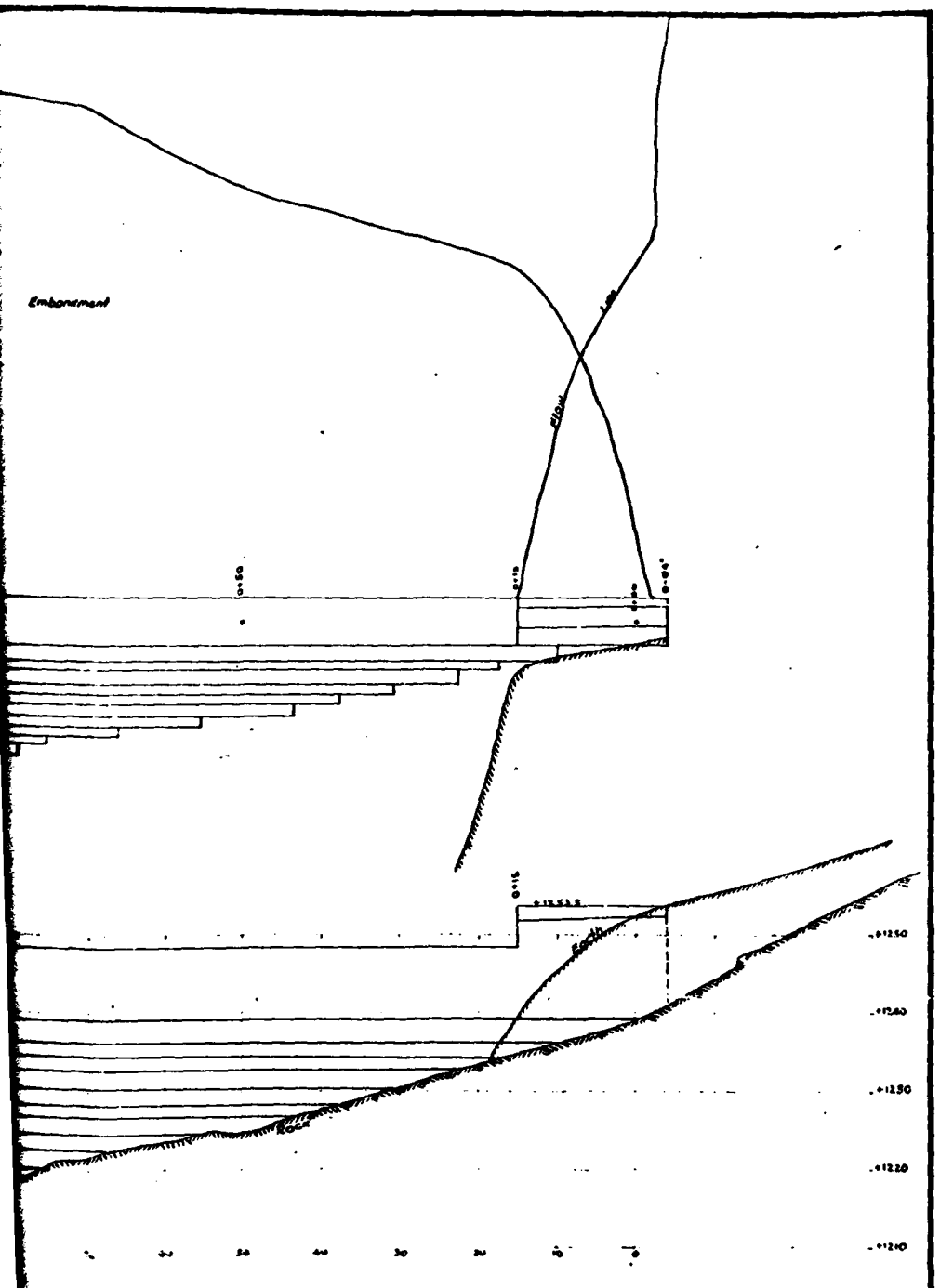
RESERVOIR AREA

APRIL 1980 PLATE E-2



PLAN AND LONGITUDINAL SECTION
OF
PROPOSED SPILLWAY
LAUREL RUN RESERVOIR
ARCHBALD BOROUGH, PA.
FOR THE SCRANTON SUBURBAN WATER SERVICE CO.
SCRANTON, PA.

H. A. Wicker
CHIEF ENGINEER



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

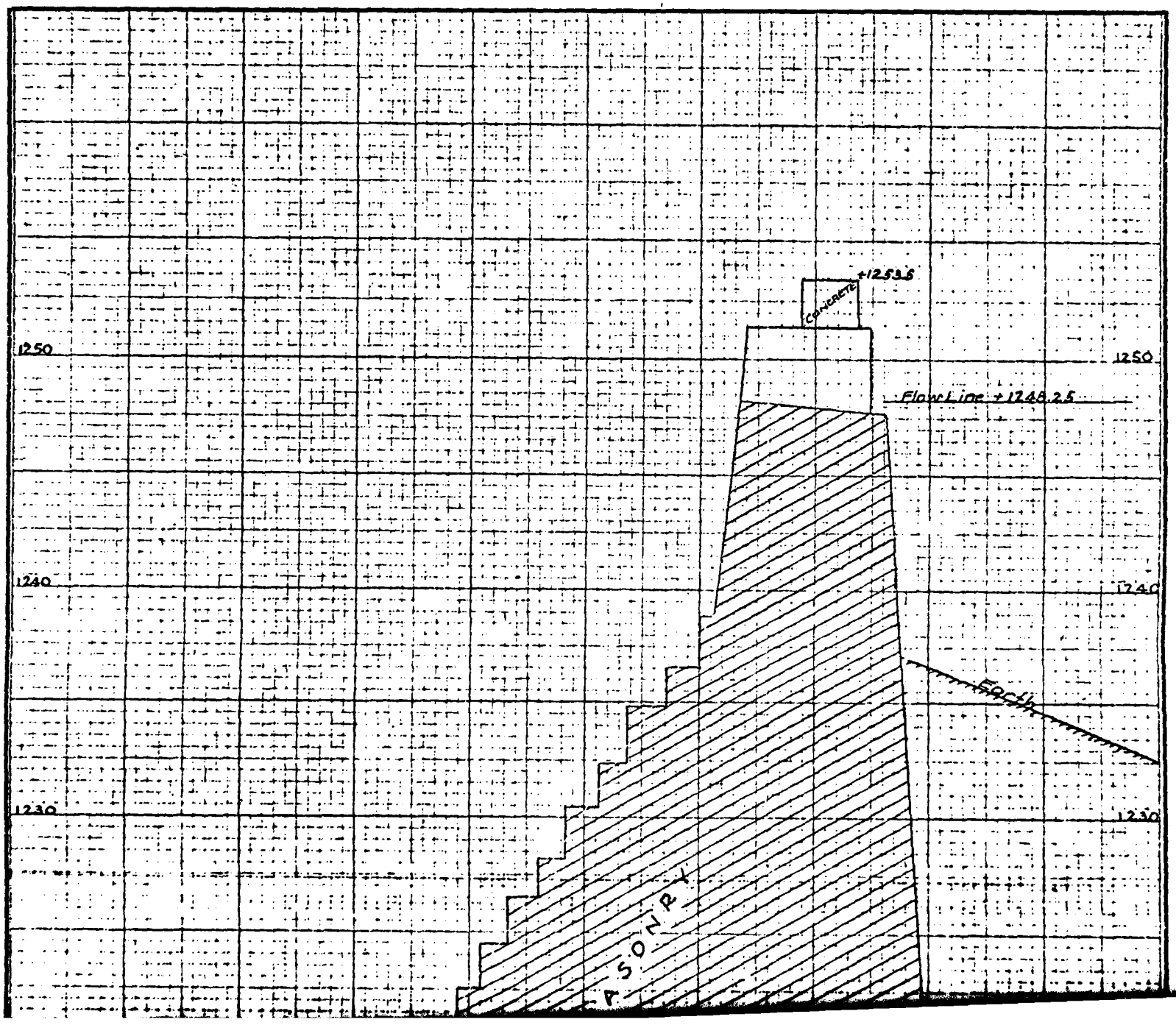
LAUREL RUN DAM

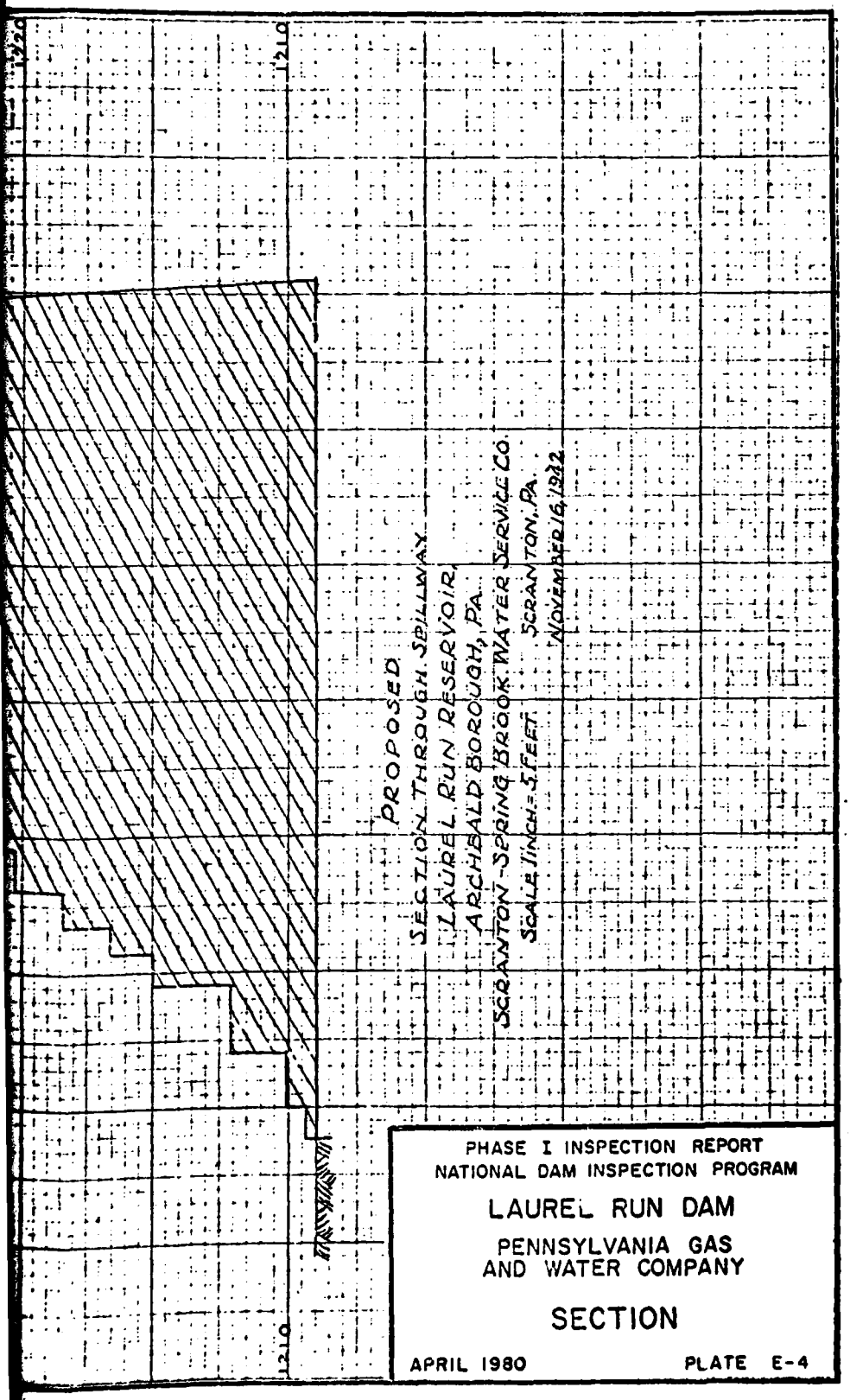
PENNSYLVANIA GAS
AND WATER COMPANY

PLAN AND PROFILE

APRIL 1980 PLATE E-3

2


+1253.5
CONCRETE
1250
1250
Flow Line +1248.25
1240
1240
Earth
1230
1230
MASONRY



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

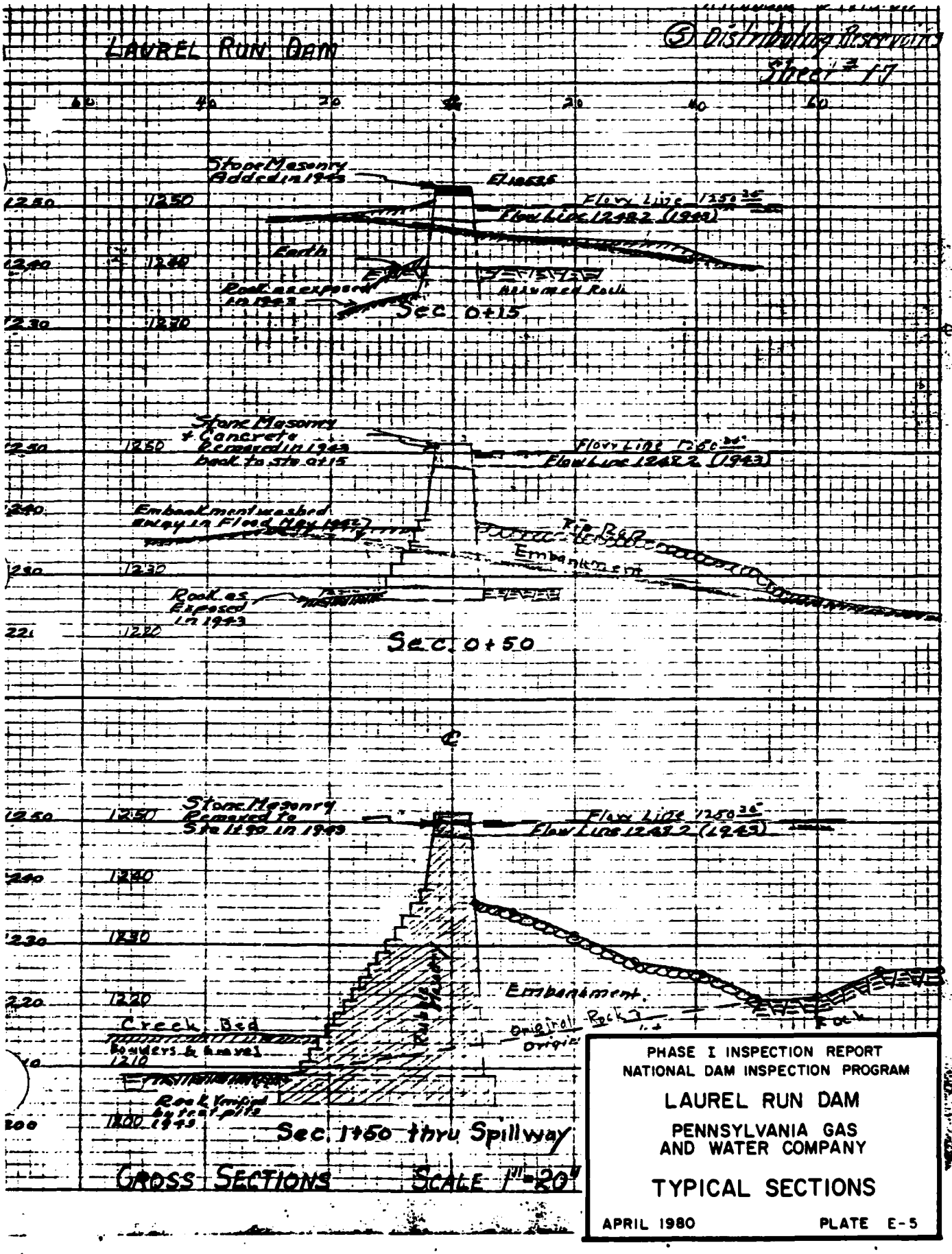
LAUREL RUN DAM

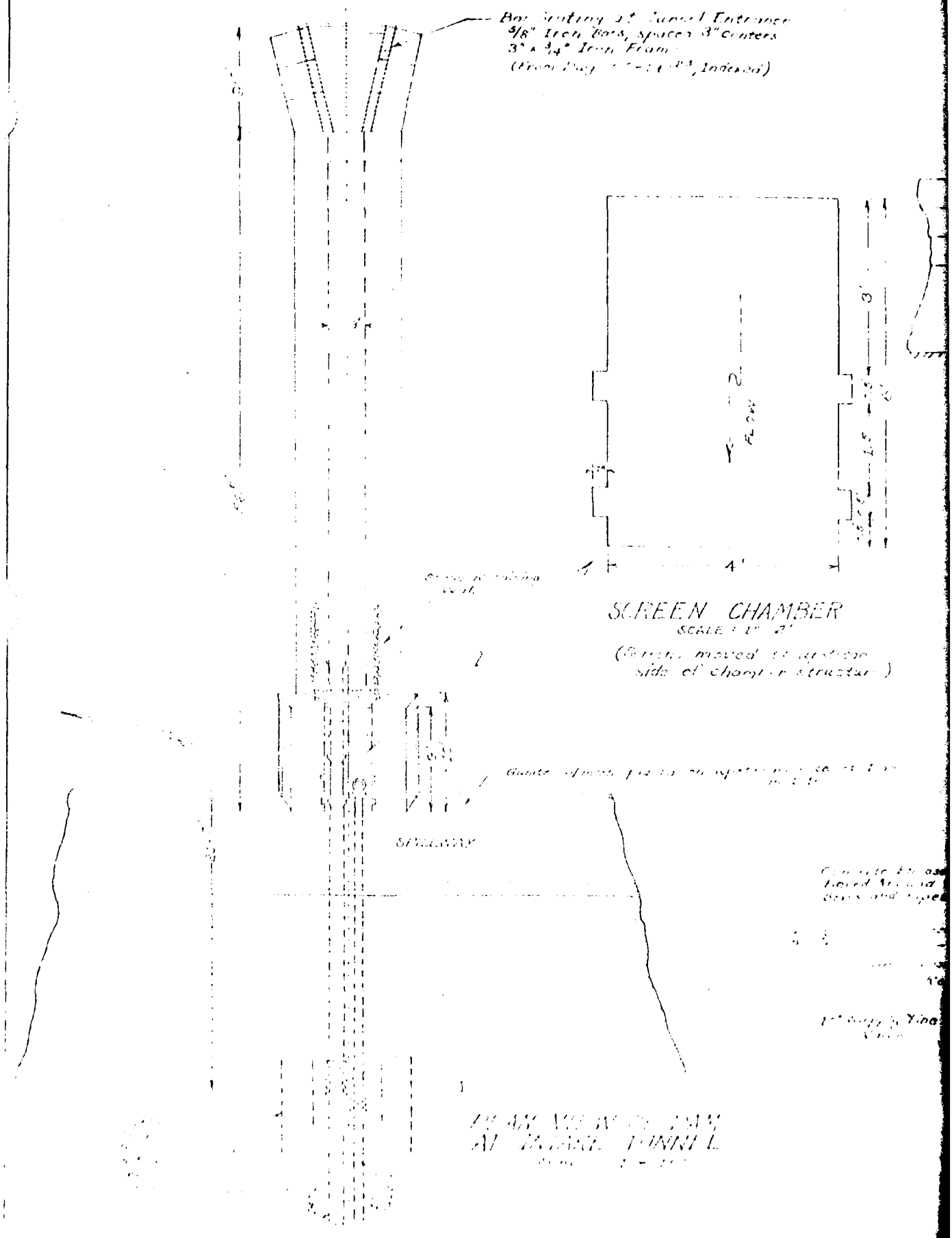
PENNSYLVANIA GAS
AND WATER COMPANY

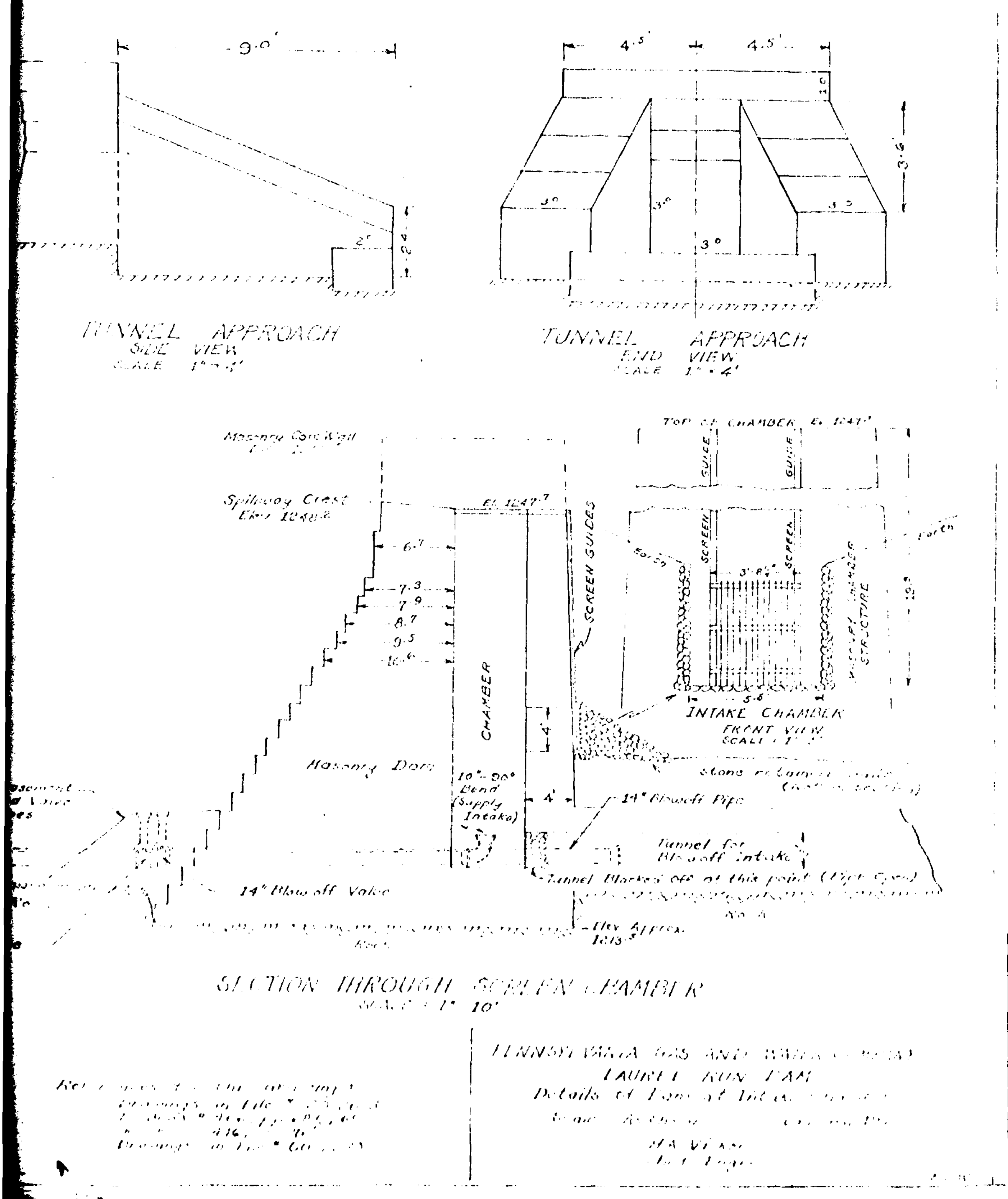
SECTION

APRIL 1980 PLATE E-4

2


LAUREL RUN DAM
Distributing Reservoir
Sheet 17
Stone Masonry Added in 1943
El. 1263.5
Flow Line 1250.36
Flow Line 1248.2 (1943)
Earth Fill
Rock as exposed in 1943
Sec. 0+15
Stone Masonry & Concrete Excavated in 1943 back to Sta 0+15
Flow Line 1250.36
Flow Line 1248.2 (1943)
Embankment washed away in Flood May 1942
Fill
Embankment
Rock as Exposed in 1943
Sec. 0+50
Stone Masonry Removed to Sta 1+50 in 1943
Flow Line 1250.36
Flow Line 1248.2 (1943)
Embankment
Original Rock
Creek Bed
Boulders & Gravel
Rock Varied by test pits
Sec. 1+50 thru Spillway
GROSS SECTIONS
SCALE 1"=20'
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LAUREL RUN DAM
PENNSYLVANIA GAS AND WATER COMPANY
TYPICAL SECTIONS
APRIL 1980
PLATE E-5


Bar footing 2' Tunnel Entrance
5/8" Iron bars, spaced 3" centers
3" x 3/4" Iron Frame
4'
3'
SCREEN CHAMBER
SCALE 1" = 2'
(Screen moved to upstream side of chamber structure)
SPILLWAY
PLAN VIEW OF DAM AT TUNNEL



PHASE I IN
NATIONAL DAM

LAUREL

PENNSY
AND WAT

OUTLE

APRIL 1980

2

SPECTION REPORT
INSPECTION PROGRAM

L RUN DAM

LVANIA GAS
ER COMPANY

T WORKS

PLATE E-6

A

3

APPENDIX F

GEOLOGY

LAUREL RUN DAM

APPENDIX F

GEOLOGY

Laurel Run Dam is located in Lackawanna County and lies within the Valley and Ridge Province. The Lackawanna Syncline is the most important structural feature in this section of northeastern Pennsylvania. It is a broad canoe-shaped downwarp that trends northeast and soutwest from Orson to Orangeville. The rim rocks are of the Pottsville and Pocono Formations; they have dips that are usually 20° or less and form a simple syncline. The core rock is of the Llewellyn Formation; it is folded into a series of minor anticlines and synclines that trend N 70° E. Rock to both the northwest and southeast of the Lackawanna Syncline is of the Appalachian Plateau Province and is usually horizontally-bedded.

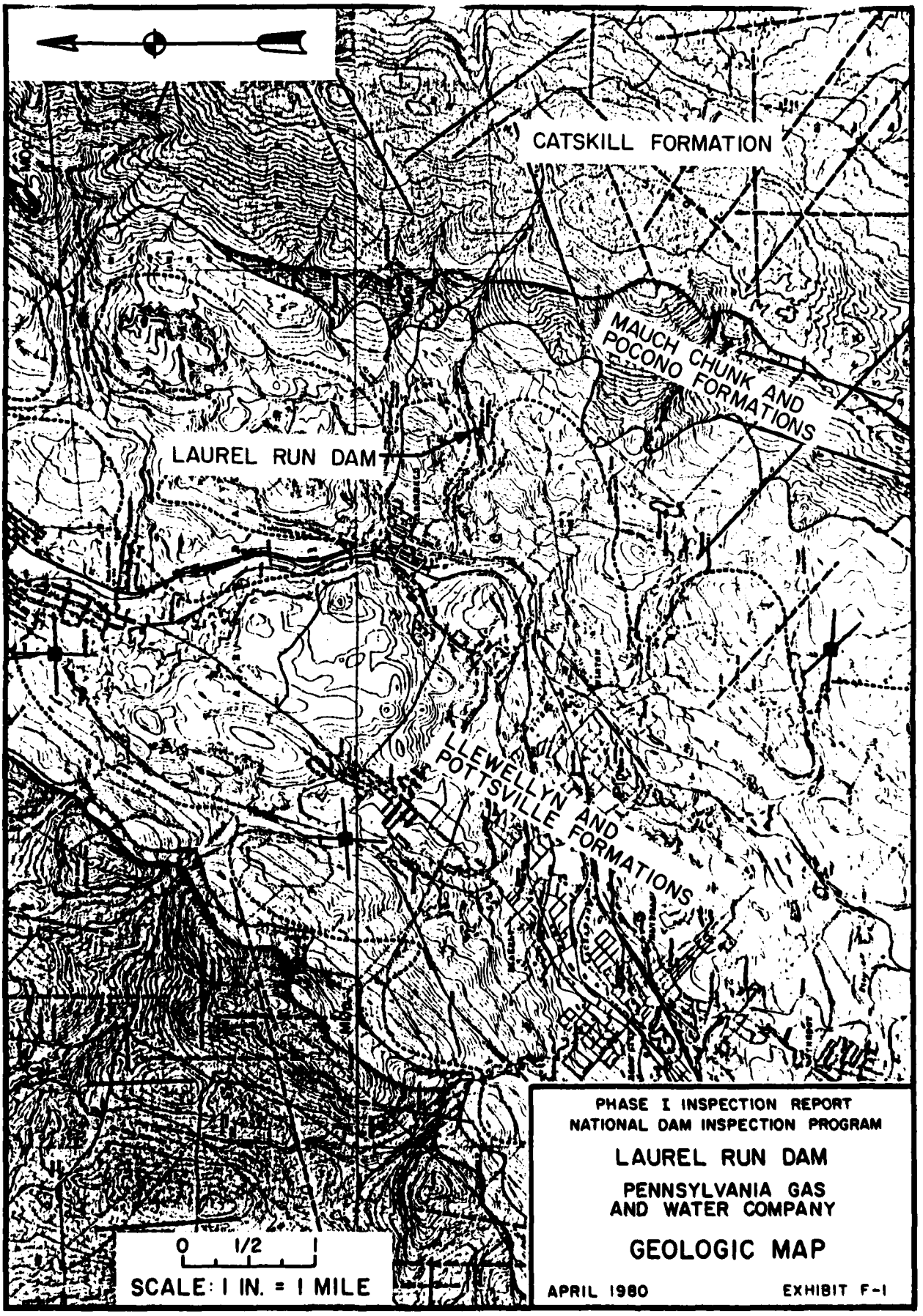
Bedrock units of the Lackawanna Syncline are the lithified sediments of deltaic, fluvial, and swamp environments. The sediments are of the Mississippian and the Pennsylvanian periods. The bedrock units include sandstones, conglomerates, and shales of the Pocono Formation; red shales of the Mauch Chunk Formation; and sandstones, conglomerates, shales, and coals of the Pottsville and Llewellyn Formations.

Laurel Run Dam is underlain by rocks of the Pottsville Formation. This formation primarily consists of a hard sandstone and conglomerate with some shales and a few thin coal beds. Sandstones in this unit are generally very micaceous and range from fine-to coarse-grained. The conglomerates are white and contain rounded to subangular quartz pebbles set in a medium-to coarse-grained, quartz-sand matrix. Shales occur primarily as nonfissile to subfissile thin beds.

Bedding of the rock is generally well-developed and ranges from fractions of an inch in shales to several feet in the sandstones and conglomerates. Crossbedding is common in the sandstones. The sandstones and conglomerates associated with the Pottsville Formation are reported to maintain moderate cut slopes, while weathering of underlying shales may cause rockfalls and slumping. Foundation stability for heavy structures is good except where clays are present. The clays will deform under load

when wet. Joints and minor faulting are common to the Pottsville Formation. Joints are usually widely spaced and are open and vertical.

Bedrock is evident at the toe of the dam. It also outcrops at the right abutment.


CATSKILL FORMATION
MAUCH CHUNK AND POCONO FORMATIONS
LAUREL RUN DAM
LLEWELLYN AND POTTSVILLE FORMATIONS
0 1/2 1
SCALE: 1 IN. = 1 MILE
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LAUREL RUN DAM
PENNSYLVANIA GAS AND WATER COMPANY
GEOLOGIC MAP
APRIL 1980
EXHIBIT F-1