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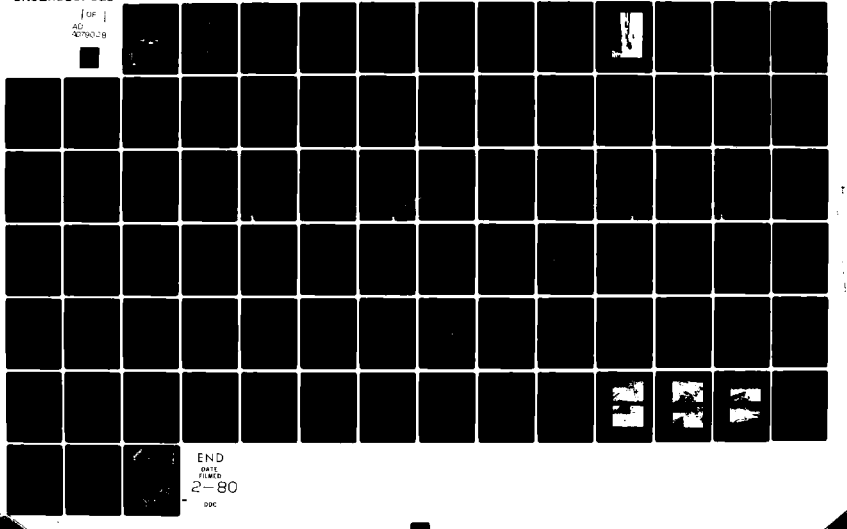

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SUSQUEHANNA RIVER BASIN

TRIBUTARY TO LITTLE ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 3 DAM

NDI ID NO. PA-00376
DER ID NO. 35-23

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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Approved for Public Release
Contract No. DACW31-79-C-0015

Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

For

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

FEBRUARY 1979

(15) DACW31-79-C-0015 (1)

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO LITTLE ROARING BROOK
LACKAWANNA COUNTY
PENNSYLVANIA (10) Albert Charles/Hoskins

(6) National Dam Inspection Program.

DUNMORE [redacted] 3 DAM
(Number)
NDI ID [redacted] PA-00376
DER ID [redacted] 35-23)
(Number)

~~PENNSYLVANIA GAS AND WATER COMPANY~~

Susquehanna River Basin, Tributary to Little Roaring Brook, Lackawanna County, Pennsylvania.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

(12) 85

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
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(11) FEB[redacted]79

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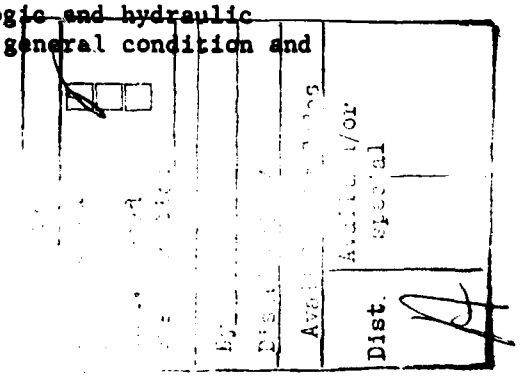
PREFACE

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

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. 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

TRIBUTARY TO LITTLE ROARING BROOK
LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 3 DAM
NDI ID No. PA-00376
DER ID No. 35-23

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

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BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Dunmore No. 3 Dam NDI ID No. PA-00376/DER ID No. 35-23
Owner:	Pennsylvania Gas and Water Company
State Located:	Pennsylvania
County Located:	Lackawanna
Stream:	Tributary to Little Roaring Brook
Date of Inspection:	24 October 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on visual inspection, available records, calculations and past operational performance, Dunmore No. 3 Dam is judged to be in fair condition. The spillway can pass 70 percent of the Probable Maximum Flood (PMF) without overtopping of the dam. The spillway capacity is rated as inadequate. If the low areas on the embankments were raised 0.5 foot to the design elevation, the spillway can pass 100 percent of the PMF with no freeboard remaining. The spillway capacity would then be rated as adequate.

The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform additional studies to determine the zoning of the embankment, the foundation conditions, and relevant engineering properties of the soil. The level of the water surface in the embankment should be determined; this may be obtained with the observation wells recommended below. An analysis of the factors of safety for the embankment should then be made.

(2) Raise the embankments to the design elevation of the top of the dam.

(3) Monitor with any suitable means the depression in the upstream slope of the right embankment. If changes are noted, take immediate remedial measures.

(4) Remove brush and trees that are on or near the embankments. When the brush and trees are removed, the cuttings should be removed from the toes and slopes.

(5) Install six or more observation wells, or other instrumentation, downstream of the axis of the embankments. One well, or other instrumentation, should be located in the vicinity of each of the two wet areas. The others should be at appropriate locations to determine general water levels in the downstream embankments. Data collected from observation wells or other instrumentation should be utilized in evaluating the stability of the structures and assessing piping potential in the future. Continue to observe wet areas and seepage downstream of embankments. If conditions worsen, appropriate action should be taken to control apparent seepage with properly designed drains.

(6) Clear the outlet works outfall of debris.

(7) Ensure that proper plugs are available for upstream closure facilities on the outlet works pipe.

(8) Extend riprap to the top of the dam.

In addition, it is recommended that the Owner modify this operational procedures as follows:

(1) Develop a detailed emergency operation and warning system for Dunmore No. 3 Dam.

(2) Modify snow plowing operations to avoid removing material from the top of the dam.

(3) Provide round-the-clock surveillance of Dunmore No. 3 Dam during periods of unusually heavy rains.

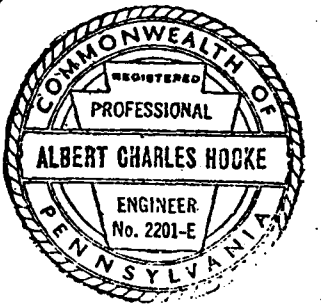
(4) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

Date: 9 March 1979



Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

DATE: 22 Mar 79

DUNMORE NO. 3 DAM

Overview

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO LITTLE ROARING BROOK
LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 3 DAM

NDI ID No. PA-00376
DER ID No. 35-23
PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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. Dunmore No. 3 Dam is two earthfill embankments, each with a timber core-wall, that are separated by high natural ground. The

right embankment is 350 feet long and 14 feet high at its maximum section. The outlet works is located in the middle of the right embankment. The outlet works consists of a 12-inch diameter cast-iron pipe that extends under the embankment to the downstream toe. At the toe, a wye splits the line. One branch extends through a 8-inch valve to the existing streambed, which is directly adjacent to it. The other branch is a water supply line that is abandoned.

The left embankment is 250 feet long and about 10 feet high at its maximum section. The spillway is located at the left abutment. It has a concrete weir with a rounded top and its crest is 2.3 feet below top of dam. The crest length is 48 feet. To the left of the spillway, the exposed bedrock extends up on a mild slope. This exposed bedrock would pass some of the spillway discharge. The various features of Dunmore No. 3 Dam are shown on the Plates at the end of the report and on the Photographs in Appendix D.

b. Location. The dam is located on a tributary to Little Roaring Brook approximately 3.3 miles east of Dunmore, Pennsylvania. Dunmore No. 3 Dam is shown on USGS Quadrangle, Olyphant, Pennsylvania, with coordinates N41°25'10" - W75°32'35" in Lackawanna County, Pennsylvania. The dam is 1.3 miles upstream from Marshwood Dam, which is on Little Roaring Brook. Marshwood Dam releases water into Dunmore No. 1 Reservoir, which is 2.2 miles downstream from it. The location map is shown on Plate 1.

c. Size Classification. Small (14 feet high, 78 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Dunmore No. 3 Dam (Paragraph 5.1c.).

e. Ownership. Pennsylvania Gas and Water Company, Wilkes-Barre, Pennsylvania.

f. Purpose of Dam. Water supply for Dunmore and Dickson City, Pennsylvania and surrounding communities.

g. Design and Construction History. Dunmore No. 3 Dam was built in 1845 by the Pennsylvania Coal Company. No other data concerning the dam's history from 1845 to 1900 was available. The dam was surveyed in 1900 and acquired the next year by the Dunmore Gas and Water Company. In 1919, during one of the periodic inspections by the Commonwealth, the slopes and tops of both embankments were found to be eroded and washed out. The embankments were repaired the same year. The embankment templates may have been changed at this time. Further discussion on this is presented in Section 6.

In 1946, the original spillway at the right abutment of the right embankment was filled in. The present spillway was constructed during this time. This work was performed by the J. Banks Construction Company.

h. Normal Operational Procedure. The reservoir is normally maintained at spillway crest level. The valve on the outlet conduit is normally closed.

1.3 Pertinent Data.

a.	Drainage Area. square miles	0.1
b.	Discharge at Damsite. (cfs.)	
	Maximum known flood at damsite	unknown
	Outlet works at maximum pool elevation	10
	Spillway capacity at maximum pool elevation (low area).	395
	Design spillway capacity	580
c.	Elevation. (Feet above msl.)	
	Top of dam (low area)	2022.8
	Design top of dam	2023.3
	Maximum pool (top of dam low area)	2022.8
	Normal pool (spillway crest)	2021.0
	Upstream invert outlet works	Not available
	Downstream invert outlet works	2008.9
	Streambed at downstream toe of dam	2008.9
d.	Reservoir Length. (Miles.)	
	Normal pool	.17
	Maximum pool	.18

e.	Storage. (Acre-feet.)	
	Normal pool	55
	Maximum pool (design)	78
f.	Reservoir Surface. (Acres.)	
	Normal pool	9.0
	Maximum pool (design)	11.0
g.	Dam.	
	Type - Earthfill.	
	Length - Right Embankment (Feet)	350
	Left Embankment (Feet)	250
	Height - Right Embankment (Feet)	14
	Left Embankment (Feet)	10
	Topwidth (Feet-approximate-both embankments)	10
	Side slopes -	Varies - See Section 6
	Impervious core	Timber Core-wall
	Zoning	None
	Cutoff	Timber Core-wall
	Grout curtain	None
h.	Diversion and Regulating Tunnel.	None
i.	Spillway.	
	Type	Concrete weir with rounded crest.
	Length of Weir (feet)	48.0
	Crest elevation	2021.0
	Upstream channel	Reservoir
	Downstream channel -	Short reach of channel in bedrock extending to a poorly defined channel in overburden
j.	Regulating Outlets -	One 12-inch diameter cast-iron pipe under the embankment which is connected to an 8-inch diameter cast-iron outlet with 8-inch valve.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Very little engineering data were available for review for the original structures. In a study performed in 1914 by the Pennsylvania Water Supply Commission, an account of design concepts, geology, construction materials and methods, and design features was prepared from interviews with the Owner, visual inspection, and other sources. The available information is very limited. The 1914 study also included analyses for hydrology and hydraulics. A summary of the results of the analyses is on file. No information pertinent to the repairs accomplished in 1919 was available. Construction specifications for the 1946 spillway modification are available; however, other details on the modification are limited.

b. Design Features. The dam and appurtenances are described in Paragraph 1.2a. The design features are shown on the Plates at the end of the report and on the Photographs in Appendix D.

The right embankment is shown on Plates 2 and 5, and on Photographs A and B. Plate 2 was drawn from survey information obtained for this inspection. No large scale plan for the right embankment was available in either the files of the Owner or in PennDER records.

The left embankment is shown on Plates 3 and 6 and on Photographs D and E. Plate 3 is dated 1946 and cannot be considered a construction drawing for the embankment. This drawing was prepared for the construction of the present spillway, which was built in 1946. The details of the spillway are shown on Plate 4 and on Photograph F. The outlet works profile is shown on Plate 5. The outfall is shown on Photograph C.

c. Design Considerations. Almost nothing is known about the design. The adequacy of the "double 1-inch sheeting" timber core-wall is addressed in Section 6.

2.2 Construction.

a. Data Available. Construction data available for review for the original structures were limited to information contained in the 1914 report prepared by the Pennsylvania Water Supply Commission. That information was obtained by interviews with the Owner, and it gives very scant details of the construction operations.

b. Construction Considerations. Since the available construction data are limited, the construction methods cannot be assessed.

2.3 Operation. There are no formal records of operation. Based on information from the Owner and the caretaker of the dam, all structures have performed satisfactorily.

2.4 Evaluation.

a. Availability. Engineering data was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania (PennDER), and by the Owner, Pennsylvania Gas and Water Company. The Owner made available a senior construction supervisor for information during the visual inspection. The Owner also researched his files for additional information upon request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data is very 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 was fair, with some deficiencies as noted herein. The locations of some of these deficiencies are shown in Appendix B on Plate B-1. Survey data acquired during this inspection is presented in Appendix B. On the day of the inspection, the pool was 0.2 foot below spillway crest elevation.

b. Embankment. Both embankments appear in fair condition. The downstream slopes of both embankments are covered with a stubble of brush. Remains of a fairly recent brush cut were deposited along the downstream toe of the embankments. On the day of the inspection, newly fallen leaves covered both the cut brush and the stubble, making observation of some areas difficult. On the upstream slopes of both embankments, the riprap extends only up to the normal pool elevation. The tops of both embankments have low areas, as described in the survey information in Appendix B. The lowest area is 0.5 foot below design elevation on the left embankment and 0.3 foot on the right embankment.

Mature trees are growing along the downstream toe of the right embankment. The area where the outlet works pipe intersects the upstream slope of the right embankment was observed. This area was submerged and it was viewed through clear water. The embankment slope was depressed around the pipe. There is a wet area, which is about 5 feet square, to the left of the outlet works at the downstream toe. The area is soft and slick.

Soil was pushed off the top of the left embankment onto the slopes. The Owner reports that this is the result of snowplowing along the top of the embankment. There is a wet area, about 50 feet square, at the downstream toe of the left embankment near the junction of the embankment and the spillway right training wall.

As described in the survey information presented on Plates 2, 5, and 6, and in Appendix B, the upstream and downstream slopes of both embankments vary. Further discussion is presented in Section 6.

c. Appurtenant Structures. The outfall of the outlet works pipe is covered with soil, twigs, and leaves (Photograph C). It is completely hidden. On the day of the inspection, the operation of the outlet works valve was observed. The valve was operated easily by one man. Flow from the pipe was observed discharging through the materials that covered the end of the pipe.

The spillway is in generally good condition. At the junction of the weir and the right wall, the concrete is slightly spalled. The spillway apron downstream of the weir is a short reach of exposed bedrock. Downstream of the apron, the channel is only 1 foot deep and 3 feet wide. Substantial spillway discharges would mostly travel overland.

d. Reservoir Area. The reservoir has generally gentle slopes. The watershed is uninhabited and undeveloped. It is owned and controlled by Pennsylvania Gas and Water Company.

e. Downstream Channel. The downstream channel extends for 1.3 miles through a steep wooded reach to Marshwood Dam. This reach is undeveloped and uninhabited.

The main access road to Dunmore No. 3 Dam passes through the spillway outlet channel of Dunmore No. 4 Dam. It would be impassable if substantial spillway flow was occurring at Dunmore No. 4 Dam. The Owner stated that an alternate route over an abandoned railroad bed is available. He stated that it was passable by high ground clearance vehicles. This route was not traversed during the course of the inspection.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest, Elevation 2021.0, with excess inflow discharging over the spillway and into the stream which flows into Marshwood Reservoir 1.3 miles downstream. A 12-inch diameter cast-iron pipe discharges water from the reservoir. Flows in the line are regulated by a 8-inch valve, which branches off the 12-inch diameter line. Another branch extends to an abandoned water supply line. Streamflows into Marshwood Dam can be increased by releases from Dunmore No. 3 Dam. Since streamflow is usually augmented only when Marshwood Reservoir is below spillway crest elevation, the valve on the Dunmore No. 3 water discharge line is usually closed.

4.2 Maintenance of Dam. The dam is visited weekly 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 for 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. Brush is cut regularly.

4.3 Maintenance of Operating Facilities. The valve on the outlet works pipe is usually operated annually. In response to the Phase I Dam Inspection Program of the previous year, the Owner is revising his maintenance procedures. Details of the procedures are still being developed.

4.4 Warning Systems in Effect. The Owner furnished the inspection team with a verbal description of the chain of command for Dunmore No. 3 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 Dunmore No. 3 Dam, but are as directed by the Owner's Engineering Department.

4.5 Evaluation of Operational Adequacy. Judging by the amount of brush stubble on the embankment, a more thorough brush cutting method would be warranted. The maintenance precedures for the outlet works valve appear adequate. The procedures used by the Owner for inspecting the dam are adequate, but some needed repairs have not been made. In general, the warning system is adequate, but it would be more effective if it were more detailed.

SECTION 5

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. No design data were available for review. During 1914, a report on the dam was made by the Pennsylvania Water Supply Commission. This study resulted in no recommendations. The spillway was modified to its present configuration in 1946. An analysis of the spillway modification is available in PennDER records. In this analysis by PennDER, the spillway capacity was estimated at 590 cfs with the embankment at design elevation. In a report, dated 1946, Thomas H. Wiggin, consulting engineer of New York City, estimated the discharge capacity of the spillway at 530 cfs. Based on calculations made for this study, a spillway discharge capacity of 395 cfs for existing conditions and 580 cfs for design conditions is used in this report (Appendix C).

b. Experience Data. The Owner has not reported any hydraulic problems with the dam. He does not have any experience data concerning flows during times of flood.

c. Visual Observations.

(1) General. The visual inspection of Dunmore No. 3 Dam, which is described in Section 3, resulted in a number of observations relevant to hydraulics and hydrology. These observations are evaluated herein for the various features.

(2) Embankment. The low areas on the top of the embankments reduce the spillway discharge capacity.

(3) Appurtenant Structures. No deficiencies were observed at the spillway. Although the operation of the outlet works valve was satisfactory, the debris at the outfall could eventually hinder its operation. The outlet works pipe extends under pressure through the embankment. The Owner stated

that an in-house diving capability and various size plugs are available to provide upstream closure for the outlet works. This is deemed adequate, if the proper size plug is readily available.

(4) Reservoir Area. No conditions were observed in the reservoir area or watershed that might present significant hazard to the dam. The assessment of the dam is based on existing conditions, and the effects of future development are not considered.

(5) Downstream Conditions. No conditions were observed immediately downstream of the dam that might present significant hazard to the dam. The downstream conditions indicate that the only hazard presented by the dam is the hazard to Marshwood Dam. A Phase I Inspection Report for the National Dam Inspection Program is being prepared concurrently for Marshwood Dam, which is of small size. Marshwood Dam is classified as high hazard. As the failure of Dunmore No. 3 Dam could cause the overtopping of Marshwood Dam, a high hazard classification is warranted for Dunmore No. 3 Dam. The access to Dunmore No. 3 Dam is deemed adequate.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE) for the size (Small) and hazard potential (High) of Dunmore No. 3 Dam, the spillway design flood (SDF) is between one-half of the probable maximum flood (PMF) and the PMF. Because Marshwood Dam, 1.3 miles downstream, has a SDF equal to the PMF, the PMF is selected as the SDF for Dunmore No. 3 Dam.

(2) Description of Model. The watershed was modeled with the HEC-1DB computer program. The HEC-1DB computer program computes a PMF runoff hydrograph and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure. The PMF inflow to Dumore No. 3 Reservoir was determined and routed through the dam. Identical methods were used for various percentages of the PMF.

(3) Summary of Results. Pertinent results are tabularized at the end of Appendix C. The analysis reveals that Dunmore No. 3 Dam, with its existing top elevation of 2022.8, can pass approximately 70 percent of the PMF without overtopping.

If Dunmore No. 3 Dam were raised to its design elevation of 2023.3, it would be able to pass approximately 100 percent of the PMF, with no freeboard remaining.

(4) Spillway Adequacy. The criteria used to rate the spillway adequacy of a dam are described in Appendix C. Since the spillway can pass the 1/2 PMF but not the PMF without the overtopping of the dam, the spillway capacity is rated as inadequate. If the embankment were raised to its design elevation, the spillway would be rated as adequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Dunmore No. 3 Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for various features.

(2) Embankments. Trees and brush growing on the embankments and at the toes are undesirable. At present, the brush is low. It is only undesirable because it hinders visual inspection. The Owner stated that the soil that was scraped off and pushed onto the embankment slopes was caused by snow plowing operations. This condition has hydraulic significance, and is part of the cause for the lowered top of dam elevation. Settlement of the embankment may also have contributed to the lower elevation. The wet areas, although not excessive, are of some concern because of their potential for piping. The riprap being below top of dam is an erosion hazard during periods when the reservoir is above normal pool elevation.

(3) Appurtenant Structures. The spalling observed at the spillway is of little concern if it does not continue. The depression at the junction of the upstream embankment slope and the outlet works pipe could be cause for concern. The 1914 Pennsylvania Water Supply Commission Report states that the intake was a timber box structure, as shown in profile on Plate 5. No evidence of this structure was observed. The depression may have been the foundation of the structure. It also could be an indication of more serious problems.

b. Design and Construction Data. No record of design data or stability analysis was available for review. Analysis of the embankment stability is

beyond the scope of this study. Also, sufficient data on the engineering properties of the embankment material would have to be acquired before the analysis could be performed. There is no evidence of previous stability problems with the embankment.

The survey information in Appendix B and Plates 2, 5, and 6 indicate that the downstream slope is uniform at any one section but varies between sections. The steepest section has a slope of 1V on 1.5H and the flattest has a slope of 1V on 2.8H. The upstream slope also varies. It is about 1V on 1.3H at the steepest section and 1V on 2.4H at the flattest section.

Plates 3 and 6 indicate that the slopes of the left embankment vary also. The downstream slope is about 1V on 1.4H at the steepest section. The report prepared in 1914 by the Pennsylvania Water Supply Commission indicates that the right embankment had upstream and downstream slopes of 1V on 1H and 1V on 1.25H, respectively. The left embankment was described as of irregular cross section. This variation between the observed slopes and the slopes described in the report is the basis for believing that the embankment was modified in 1919.

The 1914 Pennsylvania Water Supply Commission Report states that there is no core-wall in the embankment, as far as is known. It is not known where the information on Plates 5 and 6 was derived. These plates are undated. The core-wall is described on these plates as "double 1-inch sheeting" with 6-inch by 8-inch stringers. The value of such a timber core-wall is dubious. Such a thin timber section cannot be considered to add significant shear resistance to the embankment. Its ability to act as a watertight structure is also doubtful. Furthermore, considering its age, its condition in the zone of a fluctuating phreatic surface must be questionable. It is not considered that the core-wall can be relied on to act as an effective cutoff.

As such, the slopes of the embankments are much steeper than present standard practice would allow. The structural stability of the embankments must be considered marginal because of the steep slopes, the age of the structure, the unknown interior composition, and the unknown foundation conditions.

For this study, a stability analysis was performed for the concrete weir, assuming a water level at top of dam, full hydrostatic head on the upstream face, tailwater 1.5 feet above the toe, and uplift varying from tailwater at the toe to tailwater plus two-thirds the differential between headwater and tailwater at the heel. For this loading condition, the resultant is within the middle third, about 3.4 feet from the toe, and both the factor of safety against sliding and the toe pressure are within acceptable limits. The structure meets OCE guidelines for stability.

c. Operating Records. There are no formal records of operation. According to the Owner, no stability problems have occurred over the operational history of the dam.

d. Postconstruction Changes. As noted herein, very little information was available for the embankment modifications made in 1919. However, the modifications were made sufficiently long ago that the embankment, as it exists, is the basis for the evaluation.

e. Seismic Stability. Dunmore No. 3 Dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone has adequate factors of safety under static loading conditions, it can be assumed safe for any expected earthquake loading. However, since there are no formal static stability analyses, the theoretical seismic stability of Dunmore No. 3 Dam is not known.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety.

(1) Based on the visual inspection, available records, calculations, and past operational performance, Dunmore No. 3 Dam is judged to be in fair condition. However, the existing spillway will pass 70 percent of the PMF without overtopping of the dam. The spillway is rated as inadequate.

If the embankment were raised to its design elevation, the spillway would be able to pass 100 percent of the PMF with no freeboard remaining. The spillway capacity would be rated as adequate.

(2) There is no formal stability analysis available for Dunmore No. 3 Dam. There is no evidence of problems presently threatening the stability of the embankment. However, because of the steep slopes, apparently inadequate core-wall, age, and unknown composition of the embankment, its stability can only be considered marginal.

(3) The visual inspection resulted in some deficiencies, which are summarized below for the various features.

Feature and Location	Observed Deficiencies
Embankments:	
Slopes	Low brush
Upstream slope	Riprap below top
Top	Below design elevation
Downstream toe	Wet areas, trees
Spillway:	
Weir	Spalling

Feature and Location	Observed Deficiencies
Outlet Works:	
Outlet	Covered with debris.
Closure facilities	Uncertain availability
Intake Area	Depression in embankment

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 immediately.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform additional studies to determine the zoning of the embankment, the foundation conditions, and relevant engineering properties of the soil. The level of the water surface in the embankment should be determined; this may be obtained with the observation wells recommended below. An analysis of the factors of safety for the embankment should then be made.

(2) Raise the embankments to the design elevation of the top of the dam.

(3) Monitor with any suitable means the depression in the upstream slope of the right embankment. If changes are noted, take immediate remedial measures.

(4) Remove brush and trees that are on or near the embankments. When the brush and trees are removed, the cuttings should be removed from the toes and slopes.

(5) Install six or more observation wells, or other instrumentation, downstream of the axis of the embankments. One well, or other instrumentation, should be located in the vicinity of each of the two wet areas. The others should be at appropriate locations to determine general water levels in the downstream embankments. Data collected from observation wells or other instrumentation should be utilized in evaluating the stability of the structures and assessing piping potential in the future. Continue to observe wet areas and seepage downstream of embankments. If conditions worsen, appropriate action should be taken to control apparent seepage with properly designed drains.

(6) Clear the outlet works outfall of debris.

(7) Ensure that proper plugs are available for upstream closure facilities on the outlet works pipe.

(8) Extend riprap to the top of the dam.

b. In addition, it is recommended that the Owner modify his operational procedures as follows:

(1) Develop a detailed emergency operation and warning system for Dunmore No. 3 Dam.

(2) Modify snow plowing operations to avoid removing material from the top of the dam.

(3) Provide round-the-clock surveillance of Dunmore No. 3 Dam during periods of unusually heavy rains.

(4) 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 procedures.

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO LITTLE ROARING BROOK
LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 3 DAM

NDI ID No. PA-00376
DER ID No. 35-23

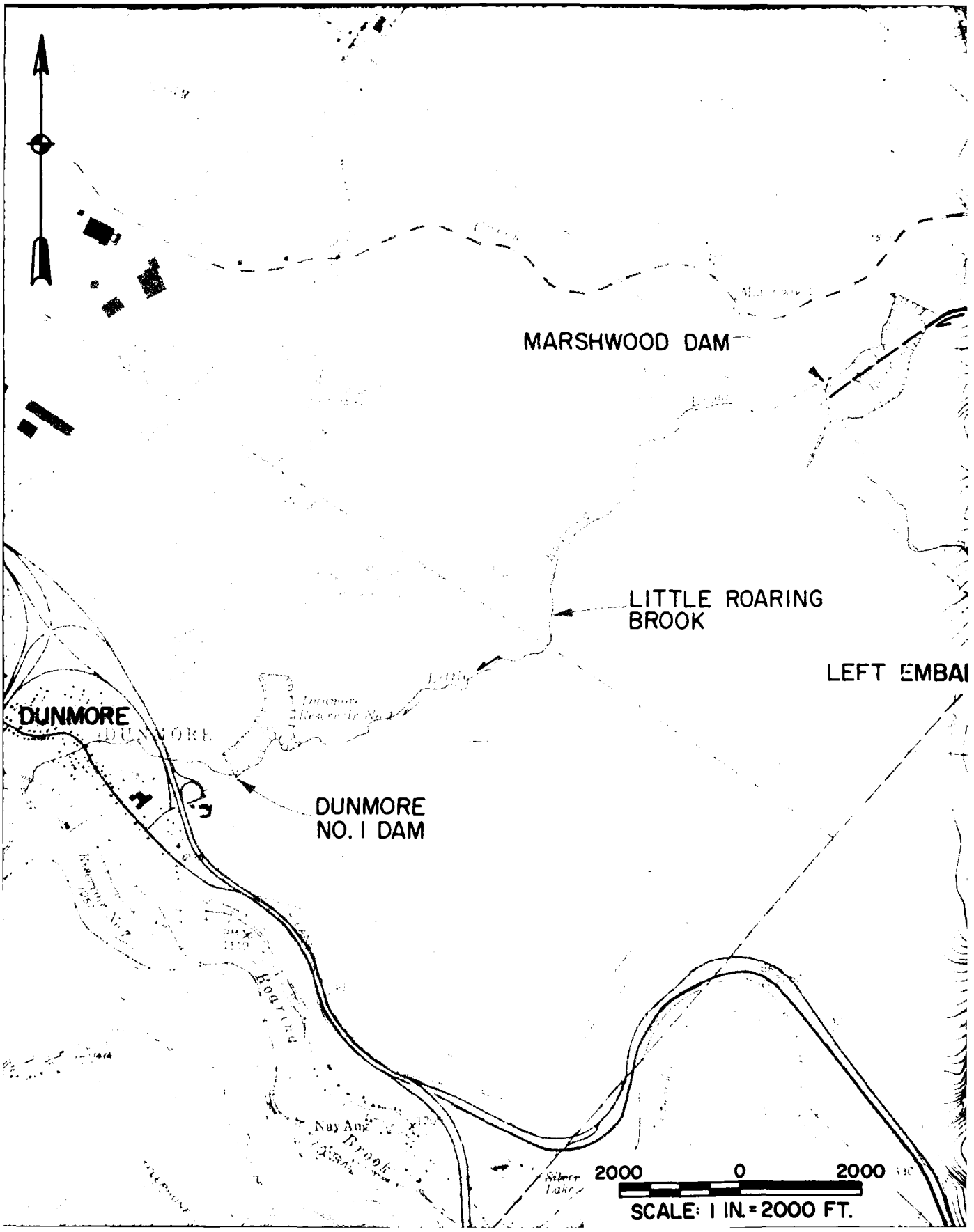
PENNSYLVANIA GAS AND WATER COMPANY

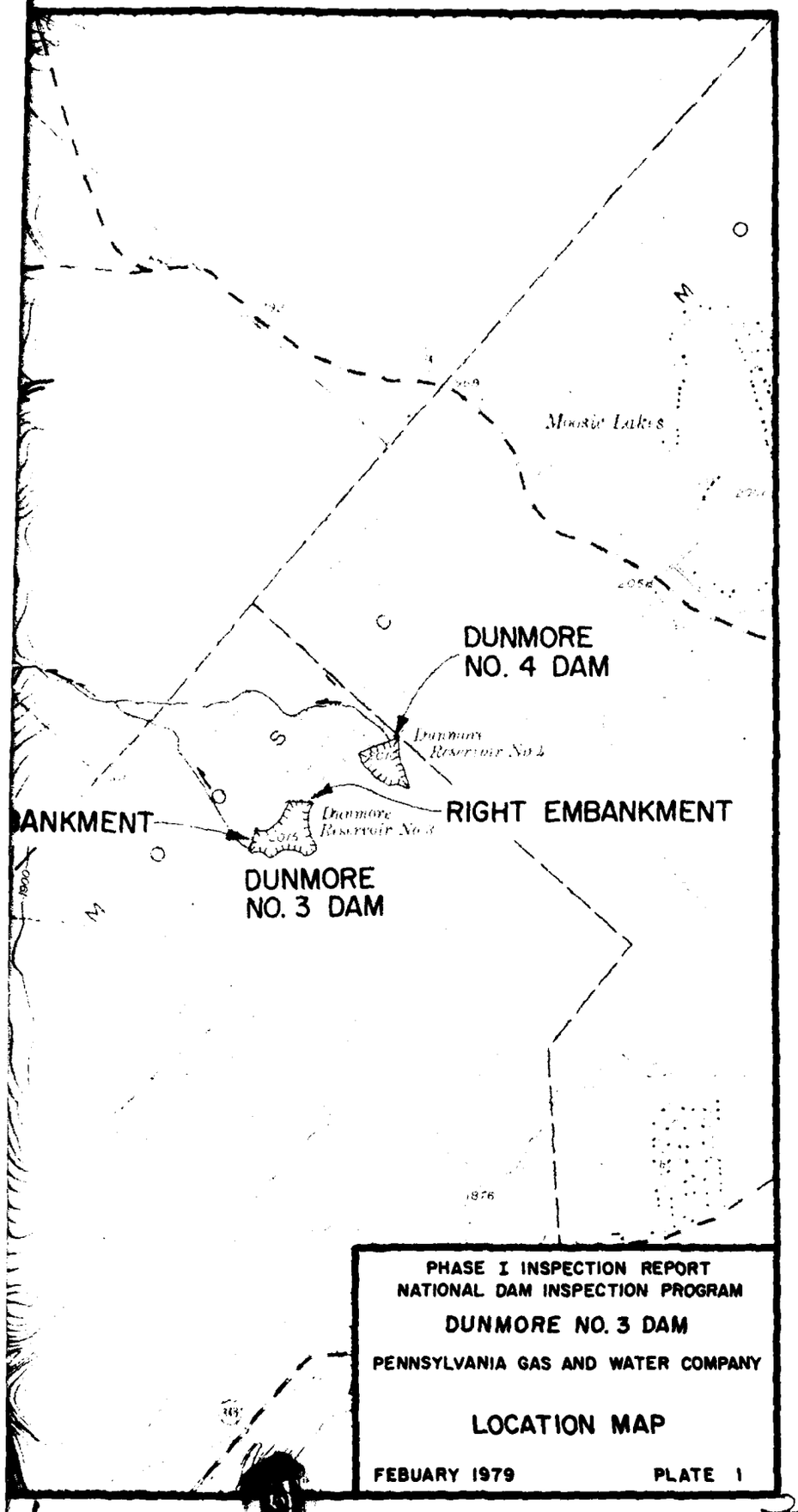
PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

PLATES


MARSHWOOD DAM
LITTLE ROARING BROOK
LEFT EMBAI
DUNMORE
DUNMORE NO. 1 DAM
2000 0 2000
SCALE: 1 IN. = 2000 FT.



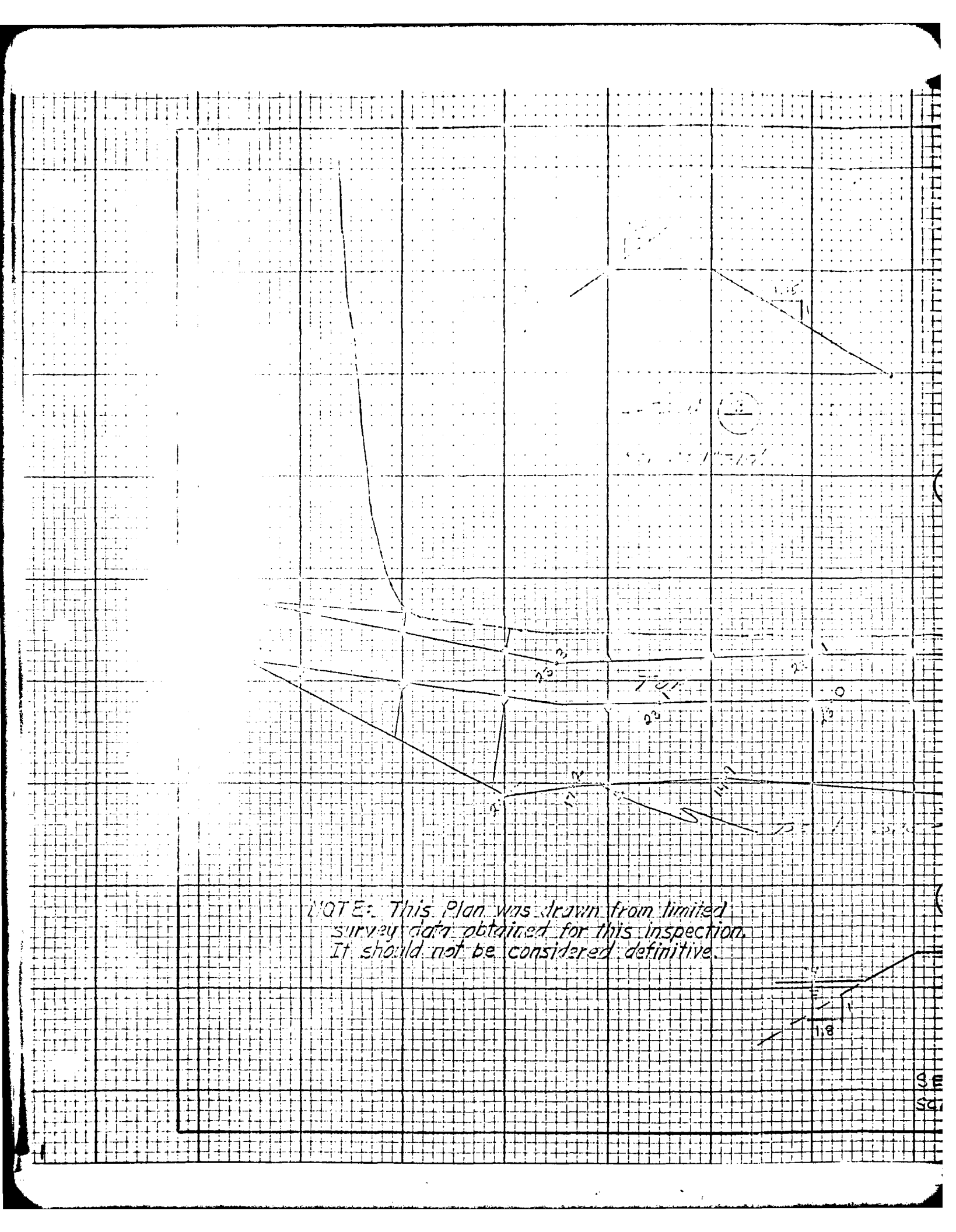
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DUNMORE NO. 3 DAM

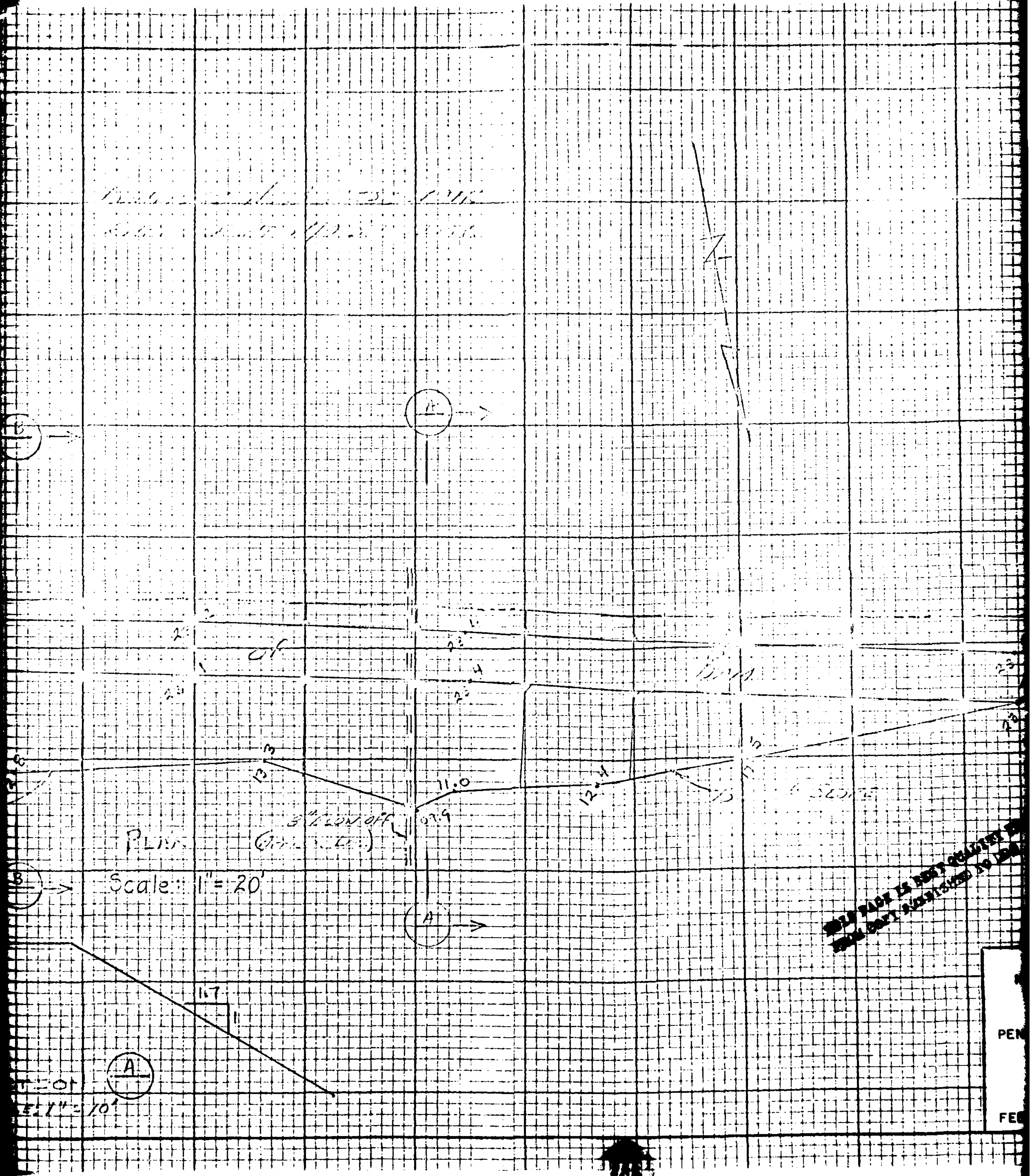
PENNSYLVANIA GAS AND WATER COMPANY

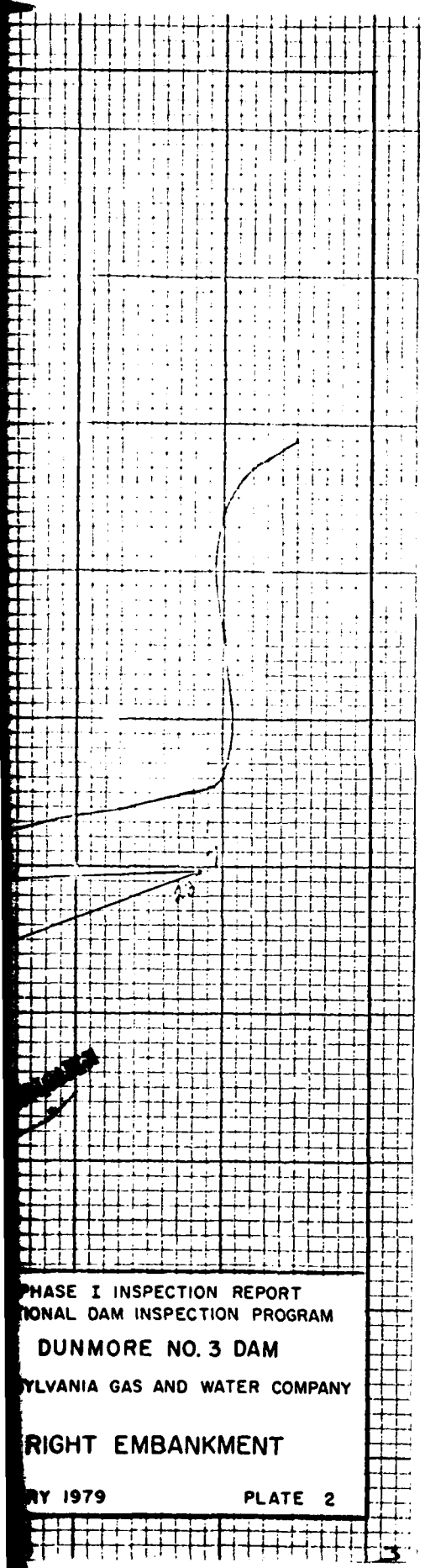
LOCATION MAP

FEBUARY 1979 PLATE 1



NOTE: This Plan was drawn from limited survey data obtained for this inspection. It should not be considered definitive.


PLAN
Scale: 1" = 20'
11.0
1.7
A
B
PEN
FE



PHASE I INSPECTION REPORT
IONAL DAM INSPECTION PROGRAM

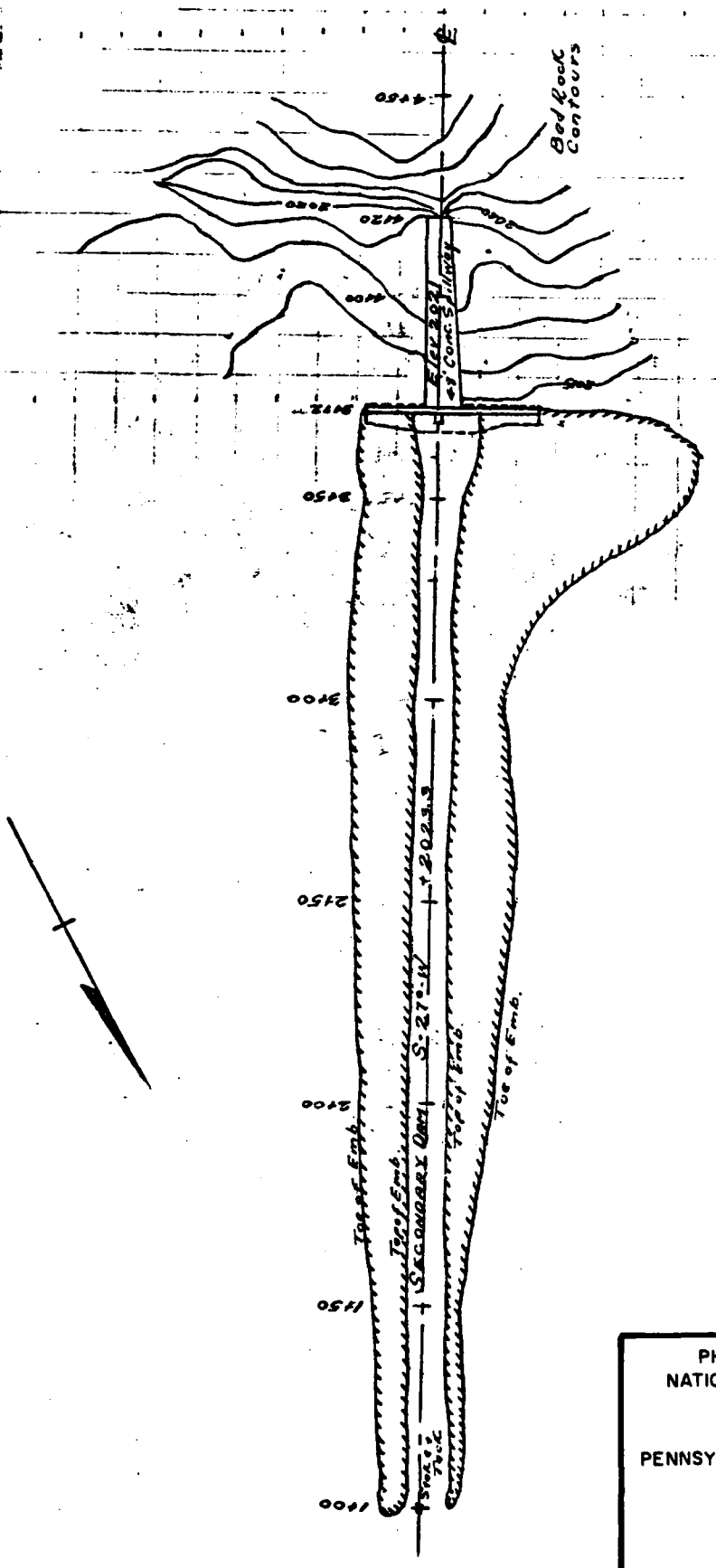
DUNMORE NO. 3 DAM

YLVANIA GAS AND WATER COMPANY

RIGHT EMBANKMENT

Y 1979 PLATE 2

Sheet 148A



DUNMORE NO. 3 DAM
New Spillway @ South End of Secondary Dam
As Constructed in 1946 by J. Banks Const. Co.
Scale: 1 Inch = 40 Feet

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

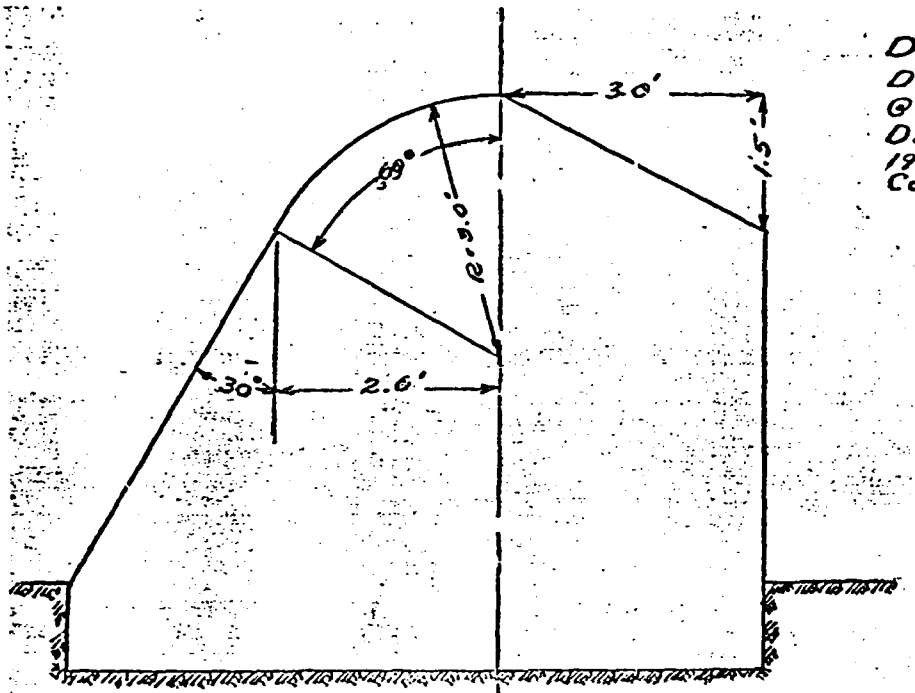
DUNMORE NO. 3 DAM

PENNSYLVANIA GAS AND WATER COMPANY

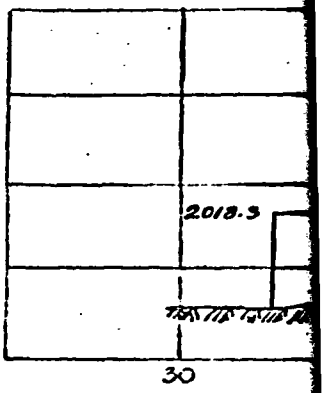
LEFT EMBANKMENT

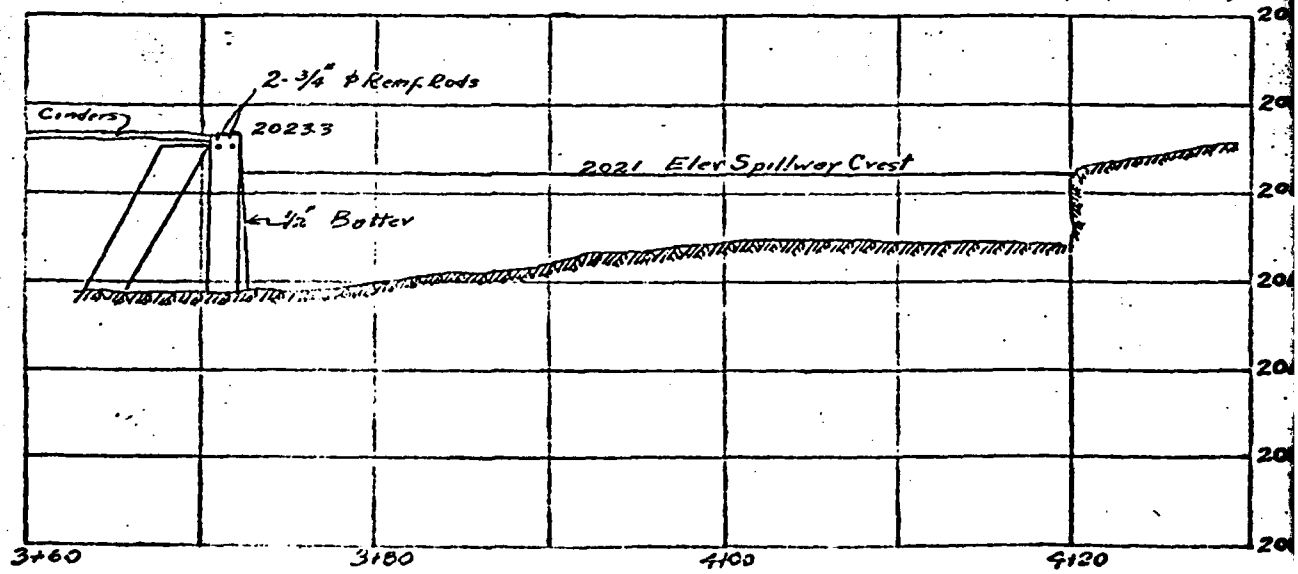
FEBUARY 1979 PLATE 3

DUNMORE No. 3 DAM
Details of New Spillway
@ South End of Secondary
Dam as Constructed in
1946 by Jos. Banks
Const. Co.

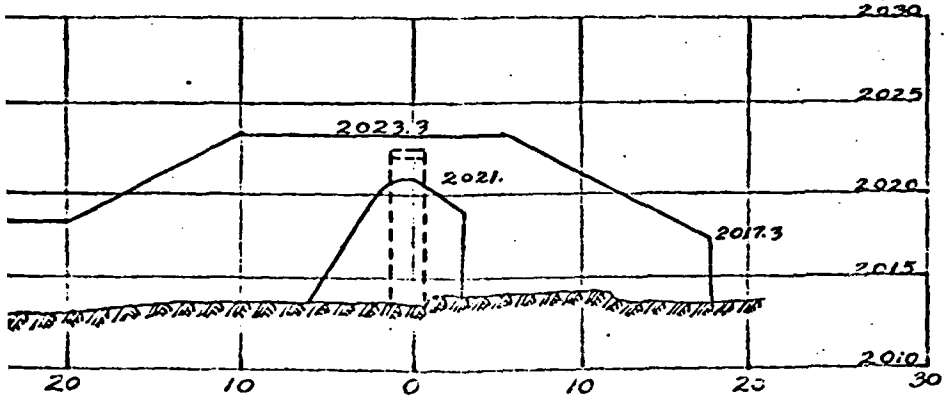


W.F.H TYPE J. SPILLWAY
Scale 1/2 Inch = 1 Foot





LONGITUDINAL SECTION THRU ℄



CROSS SECTION AT 3+72

J.M.L 11/5/52

030
025
020
115
110
105
100

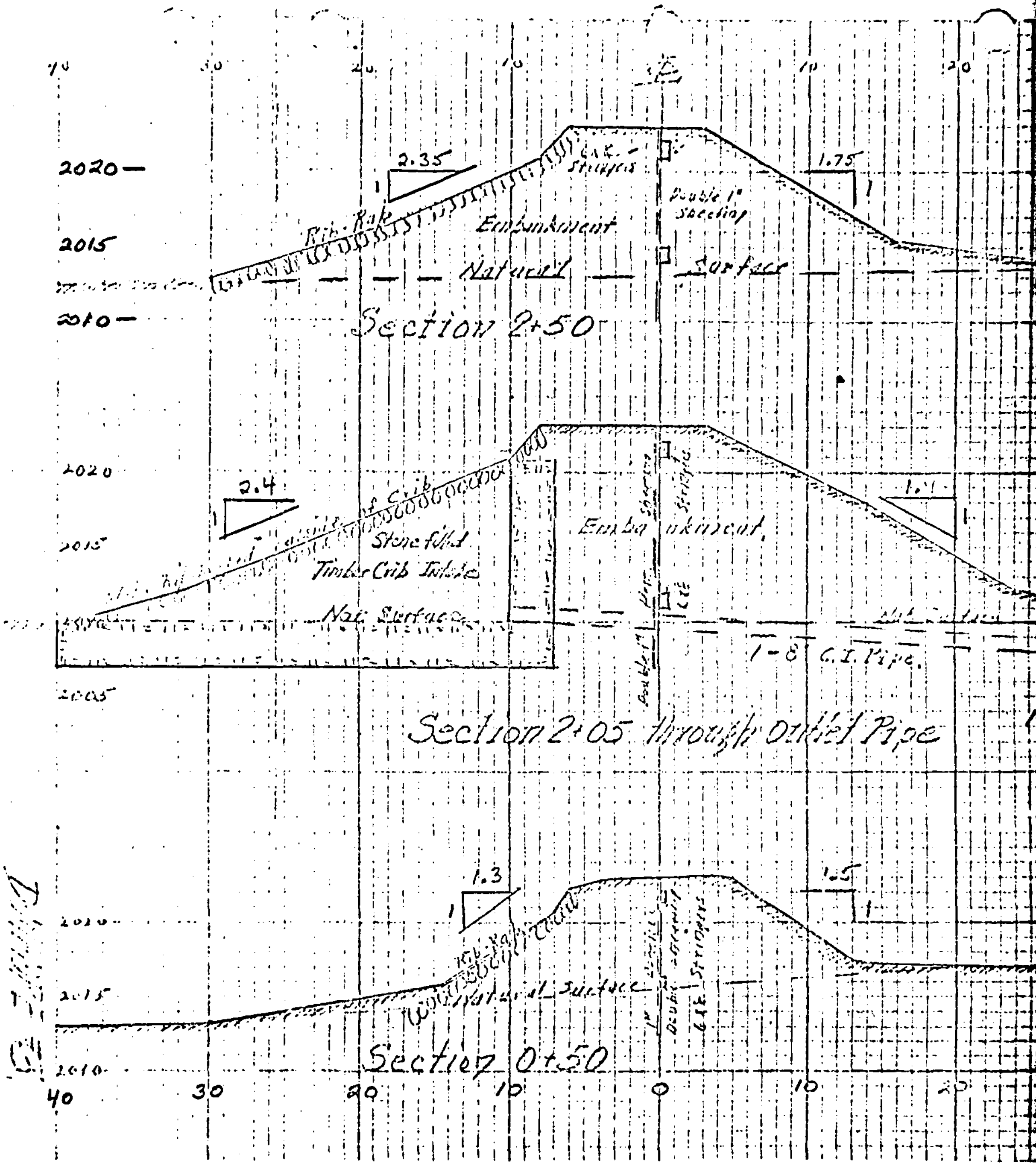
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

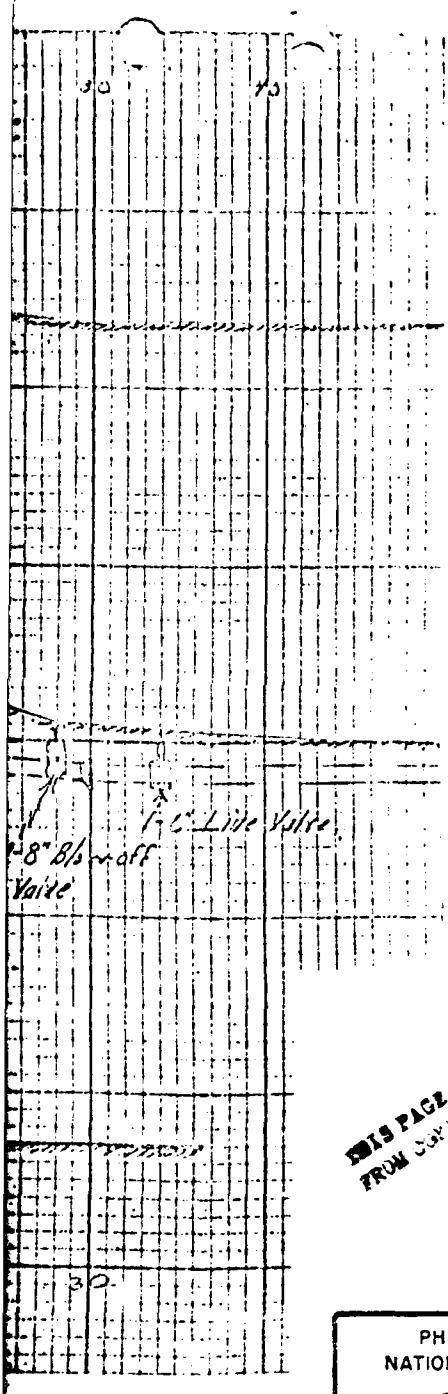
DUNMORE NO. 3 DAM

PENNSYLVANIA GAS AND WATER COMPANY

SPILLWAY DETAILS

FEBUARY 1979 PLATE 4


2.35
1.75
2020
2015
2010
Rip Rap
Embankment
Natural Surface
Double 1" Sheeting
Section 2+50
2.4
Stone filled
Timber Crib Intake
Nat. Surface
Embankment
1-8" C.I. Pipe.
2005
Section 2+05 through Outlet Pipe
1.3
1.5
Natural Surface
Section 0+50
40
30
20
10
0
10
20



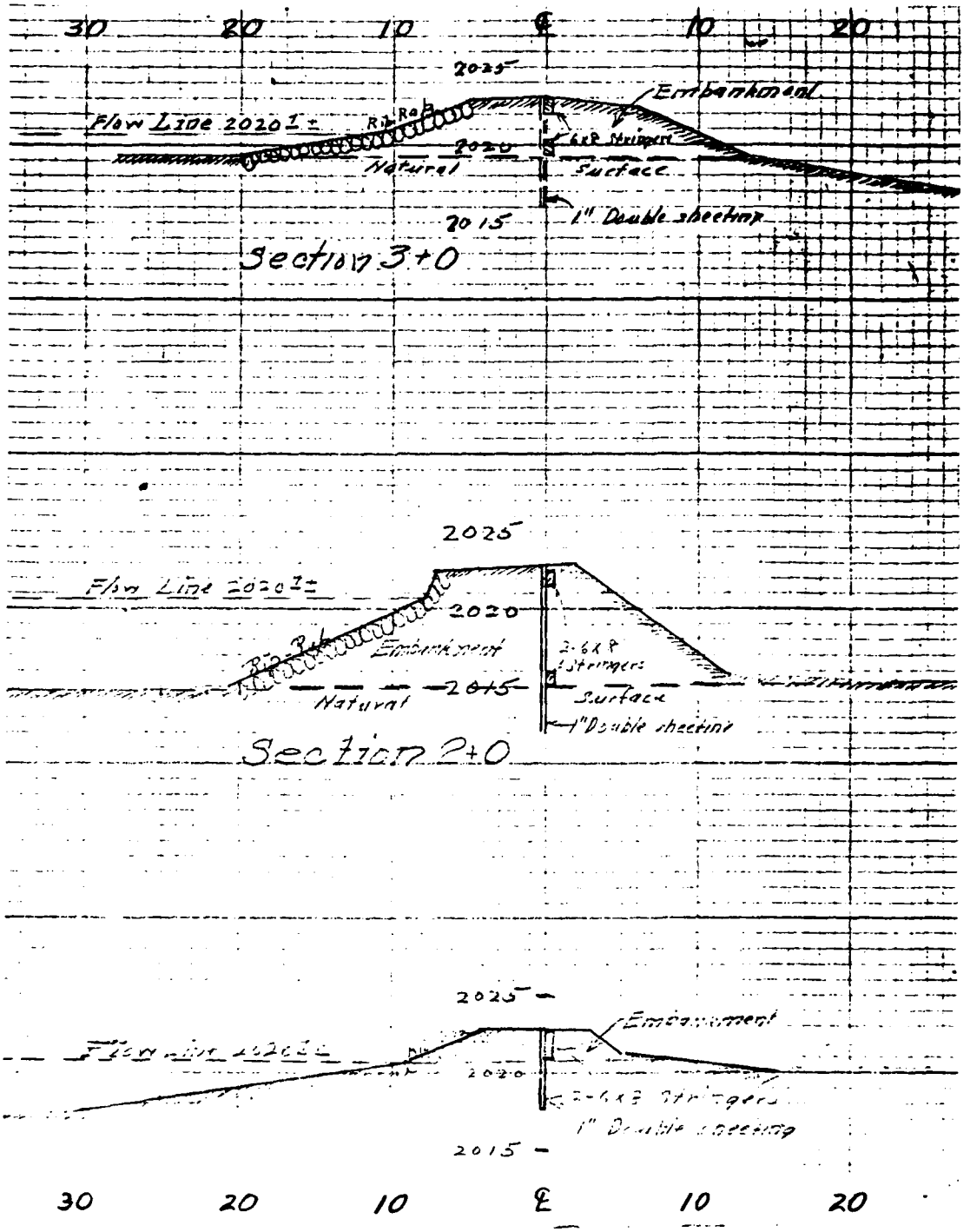
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DUNMORE NO. 3 DAM

PENNSYLVANIA GAS AND WATER COMPANY

RIGHT EMBANKMENT SECTIONS

FEBUARY 1979 PLATE 5



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DUNMORE NO. 3 DAM

PENNSYLVANIA GAS AND WATER COMPANY

LEFT EMBANKMENT SECTIONS

FEBUARY 1979 PLATE 6

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO LITTLE ROARING BROOK
LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 3 DAM

NDI ID No. PA-00376
DER ID No. 35-23

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: DUNMORE NO. 3

NDI ID NO.: PA-00376 DER ID NO.: 35-23

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	NONE - DRAWINGS FROM 1946 PARTIAL SURVEY AVAILABLE
REGIONAL VICINITY MAP	SEE PLATE 1
CONSTRUCTION HISTORY	BUILT 1845 SPILLWAY MODIFIED IN 1946.
TYPICAL SECTIONS OF DAM	NONE
OUTLETS: Plan Details Constraints Discharge Ratings	APPROXIMATE PLAN AVAILABLE. NO OTHER DATA AVAILABLE.

A-1

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NONE
DESIGN REPORTS	NONE
GEOLOGY REPORTS	NONE
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	FOR THE EXISTING SPILLWAY, A REPORT PREPARED by Thomas H. Wiggin, CONSULTING ENGINEER OF NEW YORK. NO OTHER DATA AVAILABLE.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	NONE
POSTCONSTRUCTION SURVEYS OF DAM	SMALL SCALE SURVEY CIRCA 1900

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	NOT AVAILABLE
MONITORING SYSTEMS	NONE
MODIFICATIONS	PRESENT SPILLWAY ADDED IN 1946.
HIGH POOL RECORDS	NONE
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	NONE

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	NONE
SPILLWAY: Plan Sections Details	SEE PLATE 4.
OPERATING EQUIPMENT: Plans Details	NONE
PREVIOUS INSPECTIONS Dates Deficiencies	1919 - Spillway in poor condition. Embankments eroded, and washed out. Repairs ordered. 1921 - Spillway poorly defined. Brush needs cutting 1924 - Spillway poorly defined. Brush at toe needs cutting. 1928 - Downstream face of left embankment has been paved; the downstream face of the right embankment has been seeded. Downstream toe of left embankment swampy; slight seepage
(CONTINUED)	at toe of right embankment. 1932 - Swampy area below right end. Swampy area along toe of left embankment. 1941 - Brush on downstream slope. Left embankment swampy along toe.

A-4

ENGINEERING DATA

ITEM	REMARKS
PREVIOUS INSPECTIONS (CONTINUED)	1941 (CONTINUED) – RIGHT EMBANKMENT IS WET AND SWAMPY AT BOTH ENDS. 1945 – AS 1941. 1953 – BRUSH AND TREES ON SLOPES.
	1957 – DOWNSTREAM FACE NEEDS MAINTENANCE.

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO LITTLE ROARING BROOK
LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 3 DAM

NDI ID No. PA-00376
DER ID No. 35-23

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: DUNMORE NO. 3 County: LACKAWANNA State: PENNSYLVANIA

NDI ID No.: PA-00376 DER ID No.: 35-23

Type of Dam: EARTHFILL Hazard Category: HIGH

Date(s) Inspection: 24 OCTOBER 1978 Weather: CLEAR Temperature: 40°F

SOIL CONDITIONS

Pool Elevation at Time of Inspection: 2020.8 msl/Tailwater at Time of Inspection: NONE msl

Inspection Personnel:

D. WOLF (GFCC)

D. EBERSOLE (GFCC)

J. BORDNAR (PGW)

A. WHITMAN (GFCC) Recorder

B-1

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	LEFT EMBANKMENT: Soil pushed onto slopes. RIGHT EMBANKMENT: See Outlet Works	Owner reports as snowplowing.
CREST ALIGNMENT: Vertical Horizontal	See survey data following inspection forms.	
RIPRAP FAILURES	NONE	Riprap extends to normal pool elevation only.

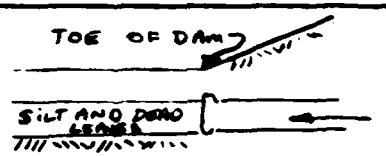
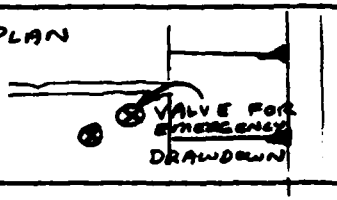
EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	NONE	
ANY NOTICEABLE SEEPAGE	LEFT EMBANKMENT: WET AREA (COVERED WITH DEAD LEAVES) ABOUT 50'x50' AT TOE TO RIGHT OF SPILLWAY.	RIGHT EMBANKMENT: WET AREA AT TOE TO LEFT OF OUTLET WORKS.
STAFF GAGE AND RECORDER	NONE	
DRAINS	NONE	
BRUSH	DOWNSTREAM SLOPES OF BOTH EMBANKMENTS COVERED WITH BRUSH CUTTINGS. TREES AT TOE.	

OUTLET WORKS

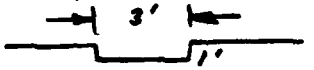
Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	CIP	
INTAKE STRUCTURE	SKETCH: 	
OUTLET STRUCTURE		PIPE NOT OBSERVED; END COVERED WITH DETRIUS.
OUTLET CHANNEL	POORLY DEFINED SWALE	
EMERGENCY GATE	VALVE OPERATED EASILY BY 1 MAN.	PLAN 

B-1

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	AGGREGATE EXPOSED. VERY SMALL SPALL AT JUNCTION OF WEIR AND RIGHT WALL.	
APPROACH CHANNEL	RESERVOIR	
DISCHARGE CHANNEL	VERY POORLY DEFINED 	
BRIDGE AND PIERS	N/A	

INSTRUMENTATION

Sheet 1 of 1

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

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	1V on 3H to 1V on 4H ±	
SEDIMENTATION	No reported or observed problems.	
WATERSHED DESCRIPTION	Uninhabited and wooded.	

DOWNSTREAM CHANNEL

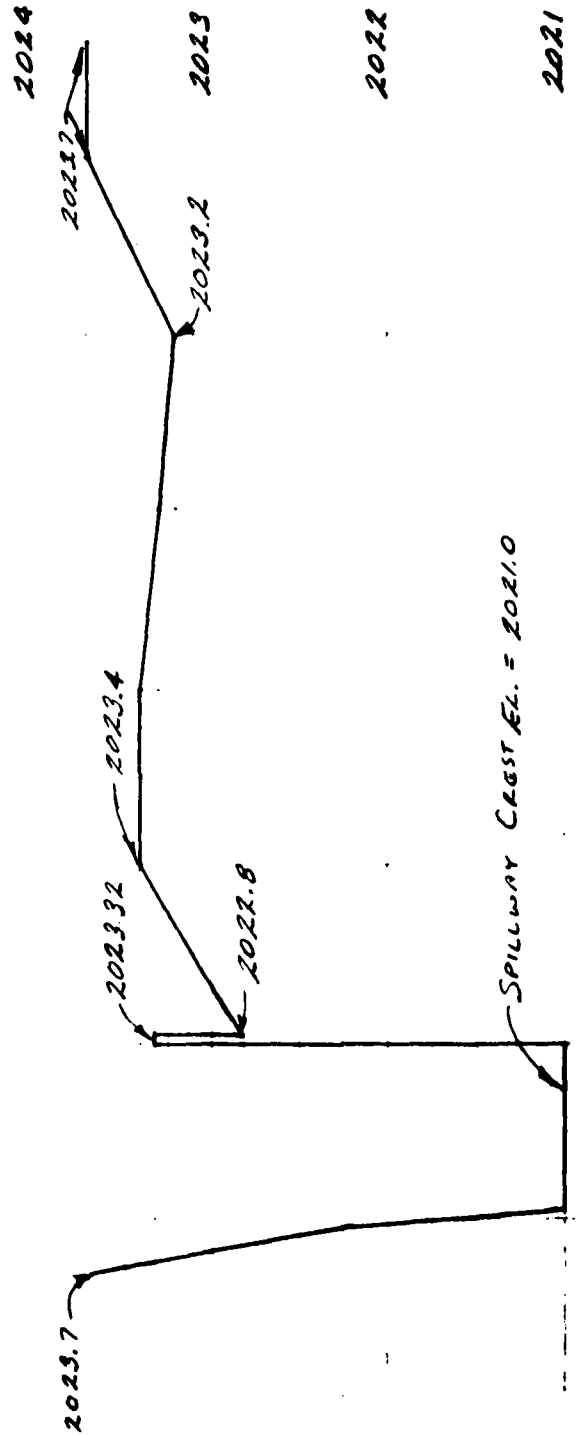
Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	NO OBSTRUCTIONS. OVERBANKS ARE HEAVILY WOODED WITH MATURE TREES.	
SLOPES	STEEP	
APPROXIMATE NUMBER OF HOMES AND POPULATION	NONE	MARSHWOOD DAM DOWNSTREAM

B-8

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

SUBJECT Dunmore No. 3 Dam FILE NO. 7826
Profile - Top of Dam SHEET NO. 1 OF ____ SHEETS
W/ Spillway
COMPUTED BY DKS DATE 11-24-78 CHECKED BY ____ DATE ____

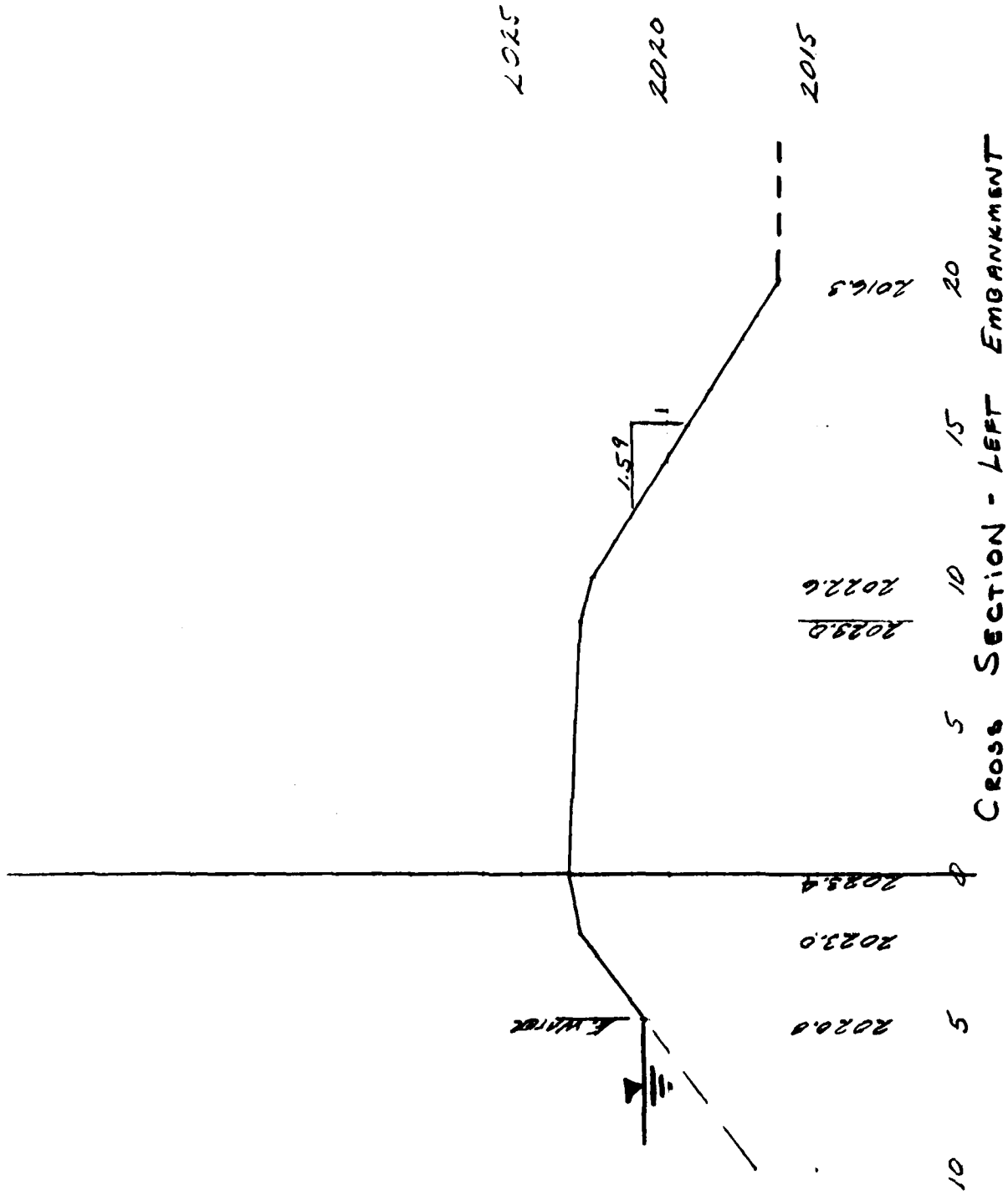


PROFILE - LEFT EMBANKMENT
SURVEY INFORMATION

6813

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

SUBJECT Dunmore No. 3 Dam. FILE NO. 7892
Section - Embankment w/Spillway SHEET NO. ___ OF ___ SHEETS
FOR ___
COMPUTED BY ___ DATE ___ CHECKED BY ___ DATE ___

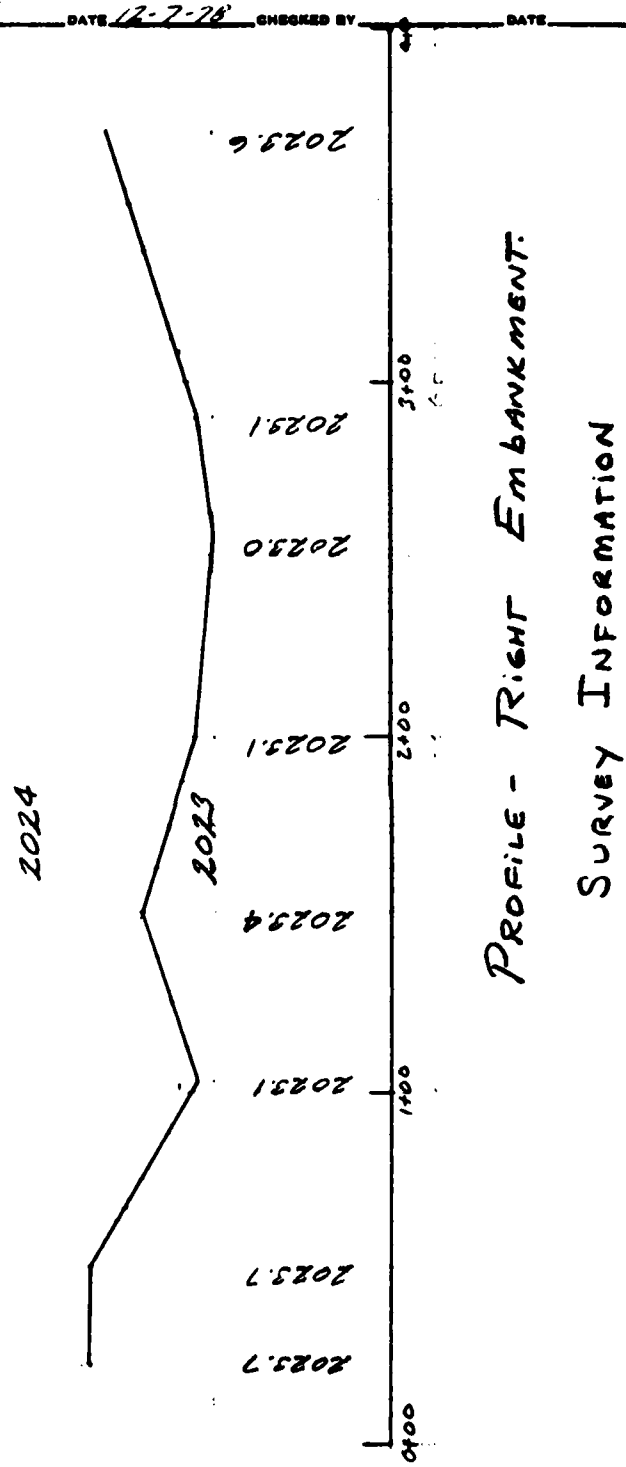


Cross Section - Left Embankment
Survey Information

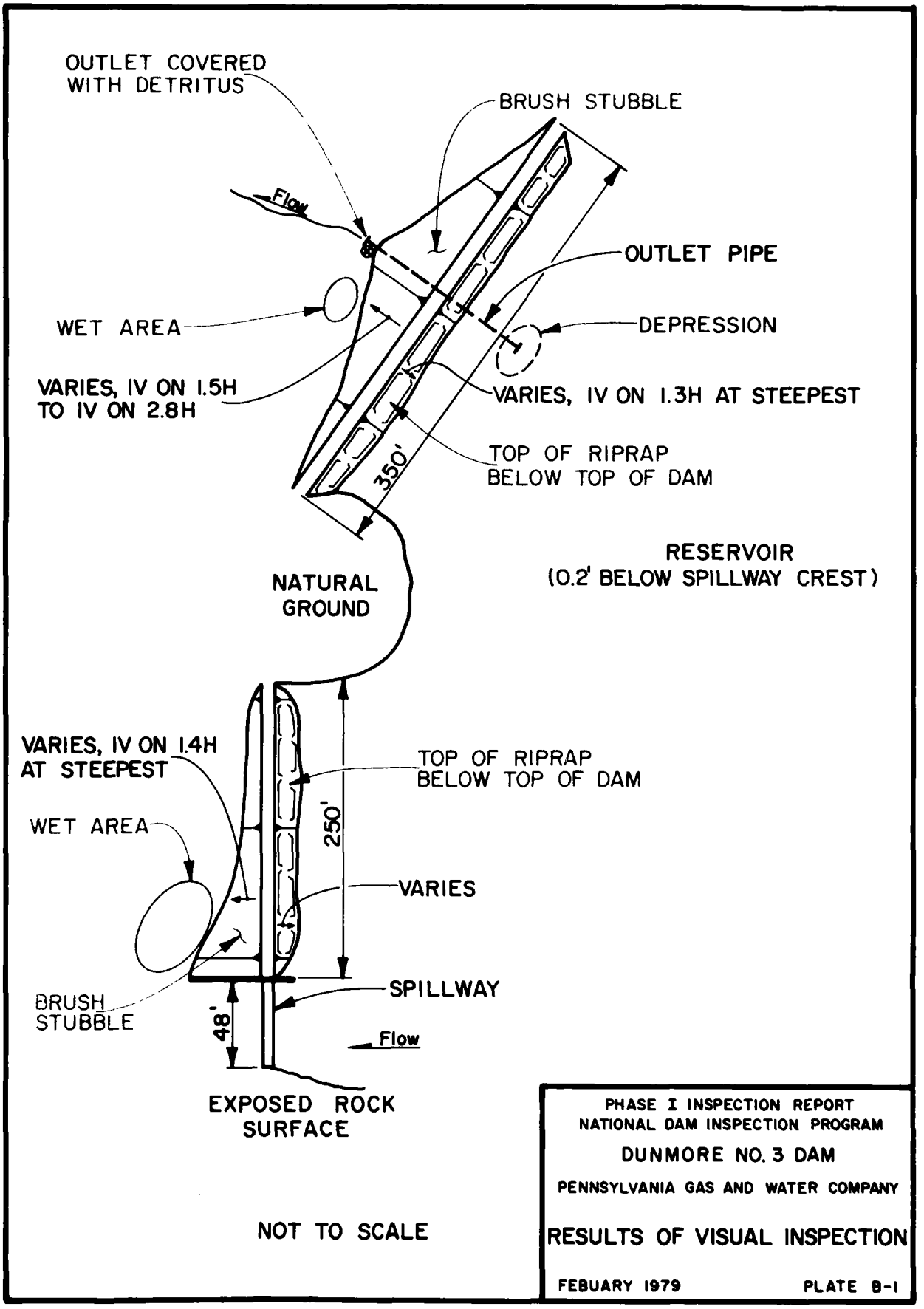
B-10

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

SUBJECT Dunlow's No 3 Reservoir FILE NO. 7832
Profile - Top of Dam SHEET NO. ___ OF ___ SHEETS
FOR W/O Spillway
COMPUTED BY DRE DATE 12-7-78 CHECKED BY ___ DATE ___



B-11



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DUNMORE NO. 3 DAM

PENNSYLVANIA GAS AND WATER COMPANY

RESULTS OF VISUAL INSPECTION

FEBUARY 1979 PLATE B-1

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO LITTLE ROARING BROOK
LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 3 DAM

NDI ID No. PA-00376
DER ID No. 35-23

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

APPENDIX C

HYDROLOGY AND HYDRAULICS

APPENDIX C

HYDROLOGY AND HYDRAULICS

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.

APPENDIX C

SUSQUEHANNA River Basin

Name of Stream: TRIBUTARY TO LITTLE ROARING BROOK

Name of Dam: DUNMORE NO. 3

NDS ID No.: PA-00376

DER ID No.: 35-23

Latitude: N 41° 25' 10" Longitude: W 75° 32' 35"

Top of Dam (~~low spot~~) Elevation: 2023.3

Streambed Elevation: 1408.9 Height of Dam: 14 ft

Reservoir Storage at Top of Dam Elevation: 78 acre-ft

Size Category: SMALL

Hazard Category: HIGH (see Section 5)

Spillway Design Flood: VARIES ½ PMF TO PMF
PMF USED BECAUSE MARSHWOOD DAM DOWNSTREAM HAS SDF = PMF

UPSTREAM DAMS

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

DOWNSTREAM DAMS

MARSHWOOD	1.3	14	286	HIGH HAZARD
DUNMORE NO 1	3.5	47	603	HIGH HAZARD

SUSQUEHANNA River Basin

Name of Stream: TRIBUTARY TO LITTLE ROARING BROOK

Name of Dam: DUNMORE NO. 3

NDS ID No.: PA-00376

DER ID No.: 35-23

Latitude: N 41° 25' 10" Longitude: W 75° 32' 35"

DETERMINATION OF PMF RAINFALL

For Area A

which consists of Subareas A1 of 0.14 sq. mile

Total Drainage Area 0.14 sq. mile

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

	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone	N/A	
Geographic Adjustment Factor	97%	1.0
Revised Index Rainfall	21.5	

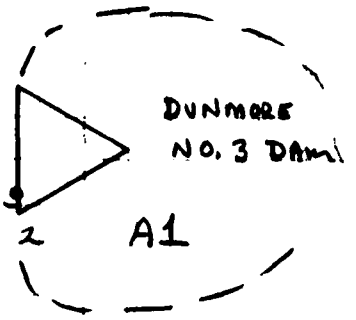
RAINFALL DISTRIBUTION (percent)

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

NOTE: POINTS 1, ... NOT USED

MARSHWOOD DAM. --
AND
DUNMORE NO. 1 DAM
DOWNSTREAM.

NOT INCLUDED IN
ANALYSIS



SKETCH
OF
SYSTEM

Data for Dam at Outlet of Subarea A1
(see Sketch on Sheet C-4)

Name of Dam: DUNMORE NO. 3 Sheet 1 of ___

Height: 14 FEET (existing)

Spillway Data:	Existing Conditions	Design Conditions
Top of Dam Elevation	2022.8	2023.3
Spillway Crest Elevation	2021.0	2021.0
Spillway Head Available (ft)	1.8	2.3
Type Spillway	OGEE TYPE TOP	
"C" Value - Spillway	3.17 *	3.17 *
Crest Length - Spillway (ft)	48.0	48.0
Spillway Peak Discharge (cfs)	395	581 *
Auxiliary Spillway Crest Elevation	NONE	NONE
Auxiliary Spillway Head Available (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spillway		
Crest Length - Auxiliary Spillway (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)	≈	

Spillway Rating Curve: * 530 CFS IN A REPORT 3/22/46 THOS. H. WIGGIN CONSULTING ENGINEER

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
	SEE NEXT SHEET		

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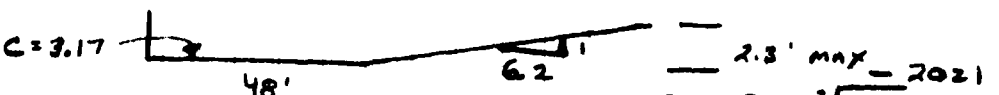
DUNMORE NO. 3
SPILLWAY RATING CURVE



ADJUSTED CRITICAL DEPTH → $Q = \frac{3.17}{3.1}\sqrt[2]{\frac{A^3}{T}}$

depth	Area	Topwidth	Q	V	hv	EGL
0	–	–	0	–	–	2021.00
0.5	24.78	51.1	100	4.04	.25	2021.75
1.0	51.1	54.2	288	5.63	.49	2022.49
1.5	78.98	57.3	538	6.81	.72	2023.22
2.0	108.4	60.4	842	7.77	.94	2023.94
2.3	126.80	62.26	1050	8.28	1.06	2024.36
3.0	171.9	66.6	1602	9.32	1.35	2025.35

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DUNMORE NO. 3

TAILWATER

FROM PREVIOUS SHEET

EGL	Q	EGL - 2015.5	SEQUENT depth AT ENERGY ON APRON	CRITICAL DEPTH
2021.0	0	5.5		
2021.15	100	6.25		
2022.49	288	6.99		
2023.22	538	7.72	NOT COMPUTED	
2023.94	842	8.44		
2024.36	1050	8.86		
2025.35	1602	9.85	9.78 - 1.31	3.05

APRON EL

APRON HAS SAME GEOMETRY AS SPILLWAY EXCEPT BOTTOM IS AT 2015.5

DOWNSTREAM CONDITIONS MAKE THE SUBCRITICAL SEQUENT DEPTH IMPOSSIBLE TO BE ATTAINED. SINCE THE SUPERCRITICAL AND SUBCRITICAL DEPTHS ARE BELOW THE WEIR ELEVATION, NO TAILWATER EFFECTS WILL OCCUR.

8313

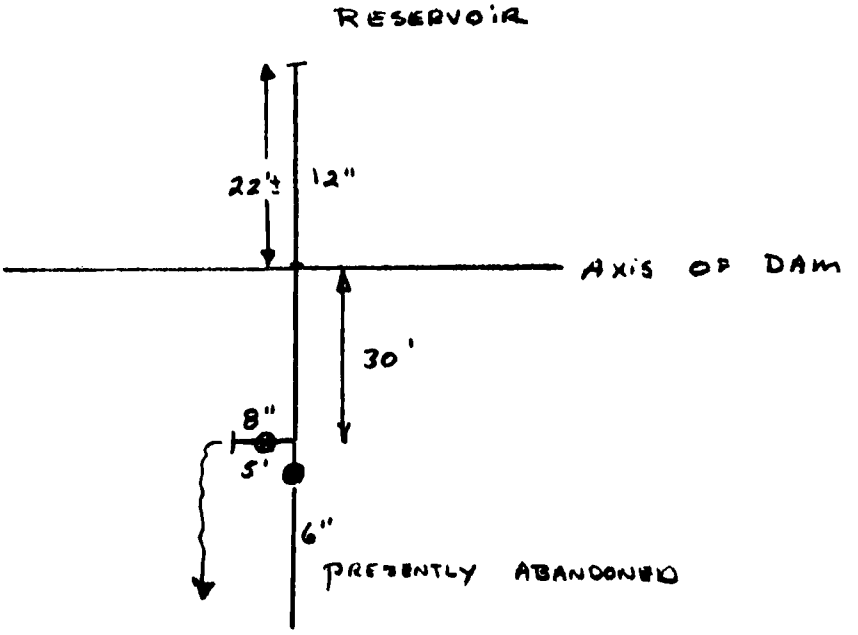
Data for Dam at Outlet of Subarea A2

Name of Dam: DUNMORE NO.3 Sheet 2 of ___

Outlet Works Rating:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	NOT AVAILABLE		
Invert of Inlet			
Type	CIP		
Diameter (ft) = D	SEE NEXT SHEET		
Length (ft) = L	SEE NEXT SHEET		
Area (sq. ft) = A	SEE NEXT SHEET		
N	"		
K Entrance	"		
K Exit	"		
K Friction* $= 29.1 n^2 L/R^{4/3}$	"		
Sum of K	1.14		
$(1/K)^{0.5} = C$	0.937		
Maximum Head (ft) = HM	13		
$Q = C A \sqrt{2g(HM)}$ (cfs)	≈10		
Q Combined (cfs)	≈10		

SEE NEXT SHEET

* R = Hydraulic Radius = (Area/Wetted Perimeter) = D/4 for Circular Conduits.



REFERENCE 12" pipe $A = .785$

$K_e = 0.5$

$K_f = \frac{29.1 n^2 L}{R^{4/3}}$ $n = .014$ $K_f = 1.88$

$\Sigma K_{A=.785} = 2.38$

$K' = \Sigma K \left(\frac{A_{8"}}{A_{12"}}\right)^2 = .047$

$A_{8"} = .349$

TRANSITION LOSS $= 0.3 \left(\frac{A_2}{A_1} - 1\right)^2$

$= .09$

$K_{EXIT} = 1.0$ $\Sigma K = 1.0 + .09 + .047$

$= 1.14$

Data for Dam at Outlet of Subarea A1

Name of Dam: DUNMORE NO. 3 Sheet 3 of __

Storage Data:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
2002.6 = ELEVO*	0	0	0	
2021 = ELEV1	9 = A1	18	55.2 = S1	
2040**	26.8			
**				

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Top of Dam is 10 percent of watershed.

Remarks: _____

SUSQUEHANNA River Basin

Name of Stream: TRIBUTARY TO LITTLE ROARING BROOK

Name of Dam: DUNMORE NO. 3

NDS ID No.: PA - 00376

DER ID No.: 35 - 23

Latitude: N 41° 25' 10" Longitude: W 75° 32' 35"

Drainage Area: 0.14 sq. mile

Data for Subarea: A1 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: DUNMORE NO. 3

Drainage Area of Subarea: 0.14 sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 0.568 mile

L_{CA} = Length of Main Watercourse to the centroid = 0.292 mile

From NAB Data: AREA 11, PLATE E

Cp = 0.62

C_T = 1.5

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 0.58 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 0.2 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

APPENDIX C

SUMMARY

SEE SHEET C-4

	A1 Subarea	Subarea	Subarea	Subarea	Total
Drainage Area (sq. mile)	0.14				
PMF:					
Peak Outflow (cfs)	600				
Total Runoff (inches)					
Dam at Outlet?	YES				
Is Dam Overtopped?	YES				
Depth of Overtopping (ft)	0.45				
One-Half PMF:					
Peak Outflow (cfs)	273				
Total Runoff (inches)					
Dam at Outlet?	YES				
Is Dam Overtopped?	NO				
Depth of Overtopping (ft)	-				
Does Dam Fail?	NO				
Peak Failure Outflow (cfs)	-				
At time (hrs)	-				
Spillway (percent of PMF)	70				

DOWNSTREAM SUMMARY

	Peak Water Surface Elevation Before Failure	After Failure	Remarks
Cross Section _____	NOT USED		
Cross Section _____			
Cross Section _____			
Cross Section _____			
Cross Section _____			

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SUBJECT _____ FILE NO. _____

_____ SHEET NO. ____ OF ____ SHEETS

FOR _____

COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

SELECTED COMPUTER OUTPUT

```
*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  11 JAN 79
*************************************
A1                    DUNMORE DAMS AND MARSHWOOD DAM-PFCC
A2                        LITTE ROARING BROOK AND ITS TRIBUTARY
A3                          DUNMORE NO. 3 DAM
B      300       0      15       0       0       0       0       0      -4       0
B1       5
J        1       4       1
J1       1      .8      .6      .5
K        0       2                                       1
K1         DUNMORE 3 RUNOFF
M        1       1     .14            0.14
P             21.5     115     127     136     142     145
T                                                        1     .05              .1
W      .58     .62
X     -1.5    -.05     2.0
K        1       2                                       1
K1         DUNMORE 3 ROUTING
Y                                1
Y1       1                                           -2021      -1
Y4    2021  2021.8  2022.5  2023.2  2023.9  2024.4  2025.4
Y5       0     100     288     538     842    1050    1602
$A       0       9    26.8
$E2002.6      2021    2040
$S    2021      48    3.17     1.5
$D2022.8       2.7     1.5     700
$L       1      12     110     183     483     680     680
$V2022.8  2023.0  2023.1  2023.2  2023.4  2023.7  2025.0
```

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	RATIO 1 1.00	RATIO 2 .80	RATIO APPLIED TO FLOWS RATIO 3 .60	RATIO 4 .50
HYDROGRAPH AT	2	.14	1	556.	533.	400.	333.
	(	.36)	(	15.87)(	15.09)(	11.32)(	9.43)(
ROUTED TO	2	.14	1	600.	457.	336.	273.
	(	.36)	(	17.00)(	12.93)(	9.51)(	7.73)(

C-19

SUMMARY OF DAM SAFETY ANALYSIS

DUNMORE NO.3 DAM

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	2021.00	2021.00	2022.80
STORAGE	55.	55.	73.
OUTFLOW	0.	0.	395.

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	2023.25	.45	77.	600.	1.50	40.50	0.00
.80	2022.97	.17	74.	457.	.75	40.50	0.00
.60	2022.63	0.00	71.	336.	0.00	40.50	0.00
.50	2022.44	0.00	69.	273.	0.00	40.50	0.00

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SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

SUMMARY OF RESULTS
(DAM WITH EXISTING CONDITIONS)

TOTAL PMF RAINFALL = 24.9"

	PMF	½ PMF
RUNOFF (INCHES)	22.6	11.3
DUNMORE NO. 3 DAM:		
PEAK INFLOW (CFS)	666	333
PEAK OUTFLOW (CFS)	600	273
DEPTH OF OVERTOPPING (FT)	0.45	—

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO LITTLE ROARING BROOK
LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 3 DAM

NDI ID No. PA-00376
DER ID No. 35-23

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

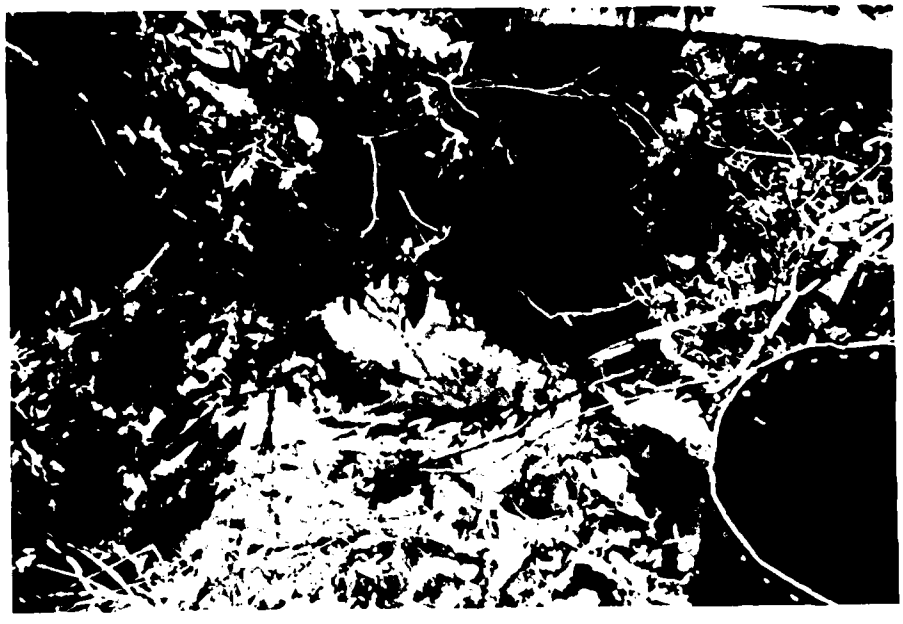
APPENDIX D

PHOTOGRAPHS

DUNMORE NO. 3 DAM

A. Right Embankment
Downstream Slope

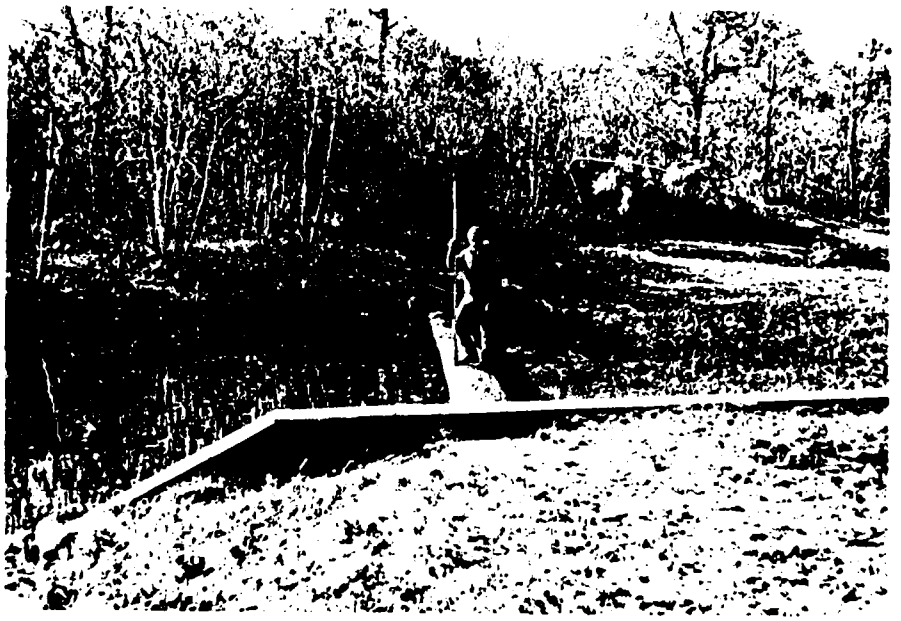
B. Right Embankment
Upstream Slope



C. Valve Operating Facilities
at Toe of Right Embankment

D. Left Embankment
View from Right Abutment

E. Left Embankment
View from Spillway at Left Abutment



F. Spillway at Left Abutment
of Left Embankment

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO LITTLE ROARING BROOK
LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 3 DAM

NDI ID No. PA-00376
DER ID No. 35-23

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

APPENDIX E

GEOLOGY

DUNMORE NO. 3 DAM

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Lackawanna County. Lackawanna County was completely covered with ice during the last continental glaciation of Pleistocene time. The general direction of ice movement was S 35° - 40° W. Glacial drift covers the entire County, except where subsequent erosion has removed it. Thick deposits of glacial outwash occur in many places along the Lackawanna River, and are 50 to 100 feet thick near Dickson, Scranton, and Moosic.

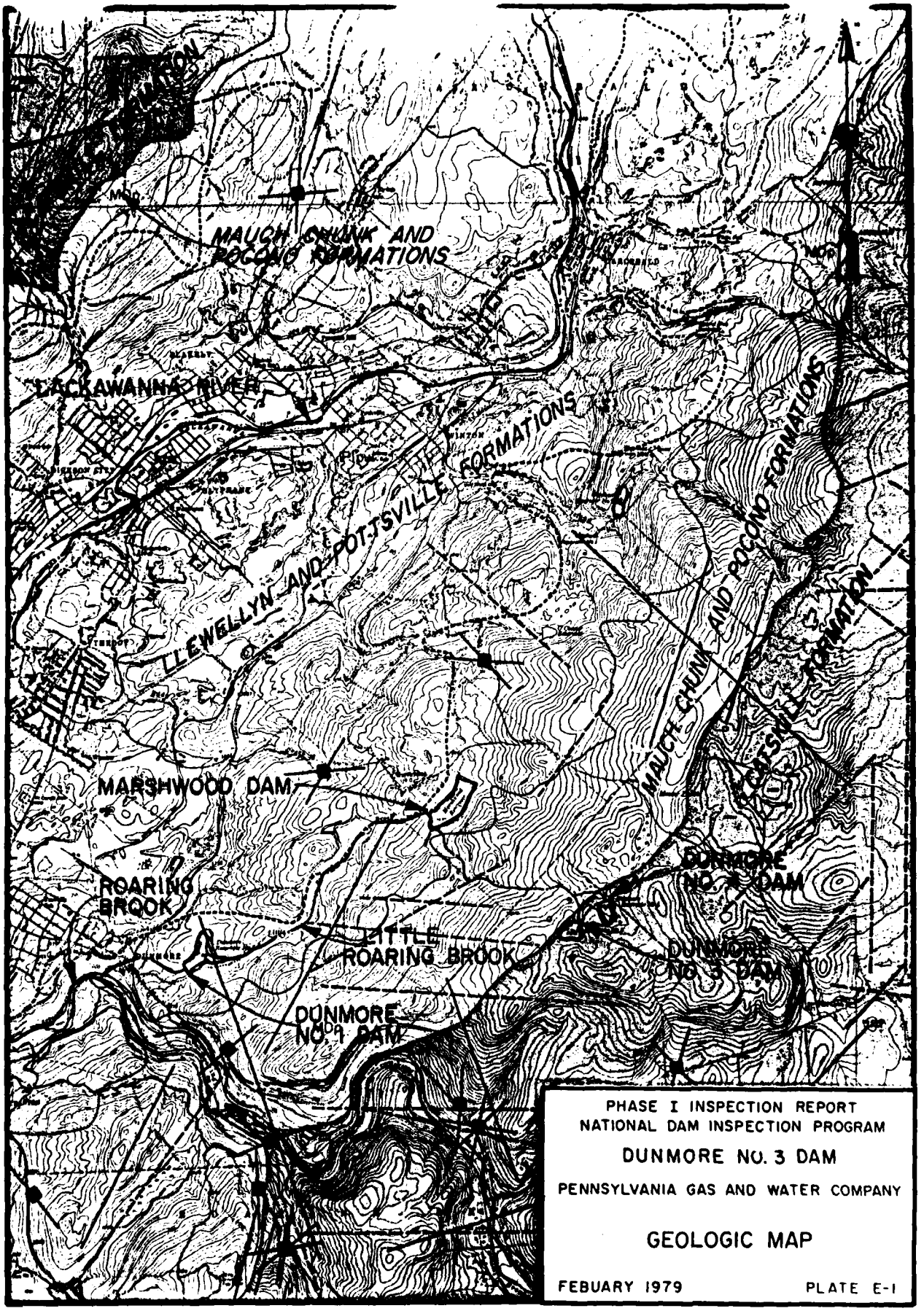
The only important structural feature in Lackawanna County is the Lackawanna Syncline, which traverses the County in a southwesterly direction. The syncline enters the County at the northeast corner as a narrow shallow trough, gradually deepens and broadens toward the southwest, and reaches its maximum development in Luzerne County. The rock formations exposed range from the post-Pottsville formations (youngest) through the Pottsville, Mauch Chunk shale, Pocono sandstone to the Damascus formation of the Catskill group (oldest). The rim rocks, the Pottsville formation and Pocono sandstone, have dips that rarely exceed 10° to 20° and form a rather simple syncline. The core rocks, the post-Pottsville formations, are folded into a series of minor anticlines and synclines which trend about N 70° E. The rocks in the northwestern and southeastern parts of the County, outside of the limits of the Lackawanna Syncline, are generally horizontally stratified.

The Lackawanna River, in general, follows the axis of the Lackawanna Syncline. Southeast of the Lackawanna River, the rise in terrain is quite gradual and the crests of the high mountains are several miles from the Lackawanna River. Streams, such as Roaring Brook, Stafford Meadow Brook, and Spring Brook, have cut deep canyons through the mountains and follow a torturous course to their confluence with the Lackawanna River near Scranton, Pennsylvania. Northwest of

Lackawanna River, the mountains rise abruptly to a sharp ridge which in most places is somewhat higher than the country to the northwest. Consequently, most of the drainage in this part of the County flows westward by way of Tunkhannock Creek. A few small tributary streams, however, such as Leggetts Creek, flow eastward from this area into Lackawanna River. In the area of interest, the Lackawanna River streambed is founded in post-Pottsville formations. Proceeding uphill from the river, the older Pottsville formation, Mauch Chunk shale, Pocono sandstone, and Catskill continental group are encountered in turn. The tributary streams, in flowing down the mountains, have generally cut through or around the hard sandstone and conglomerate members, and have eroded their streambed into the softer shales and glacial till. The Catskill continental group of rocks underlies the greater part of Lackawanna County.

2. Site Geology. Dunmore No. 3 Dam is underlain by the catskill formation of late Devonian Age and is very close to the Devonian/Mississippian contact to the northwest. The Catskill formation is composed of red to reddish brown shale, claystone, and siltstone; grayish-red fine to medium grained sandstone and light green, medium to coarse grained conglomerates. Crossbedding, channeling and cut-and-fill features are common to the sandstone and conglomerate units. The rocks in this area are joined with the preferred orientation of N 20° E. The bedding is usually well developed, with thicknesses ranging from fractions of an inch in the shales to 10 to 16 feet in the coarser more competent beds.

The available records did not yield information pertinent to the foundation conditions at the damsite.



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NATIONAL DAM INSPECTION PROGRAM

DUNMORE NO. 3 DAM

PENNSYLVANIA GAS AND WATER COMPANY

GEOLOGIC MAP

FEBUARY 1979 PLATE E-1