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SUSQUEHANNA RIVER BASIN ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 7 DAM PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM



Harrisburg, Pennsylvania 17105

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

MAY 1978

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SUSQUEHANNA RIVER BASIN ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 7 DAM

PENNSYLVANIA GAS AND WATER COMPANY (NDS ID No. 363)

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

MAY 1978

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Plan of Dam and Outlet Works.
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- B Checklist Visual Inspection.
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- D Photographs.

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PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	No. 7 Dam (NDS ID No. 363)
Owner:	Pennsylvania Gas and Water Company
State Located:	Pennsylvania
County Located:	Lackawanna
Stream:	Roaring Brook
Date of Inspection:	11 April 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter,

Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on the visual inspection, available records, calculations and past operational performance, No. 7 Dam is judged to be in good condition. However, the spillway will not pass the Probable Maximum Flood (PMF) without overtopping the dam. Therefore, based on criteria established for these studies by the Department of the Army, Office of the Chief of Engineers (OCE), the spillway capacity is rated as inadequate. The spillway will pass one-half the PMF without overtopping the dam. Therefore, based on the OCE criteria established for these studies, the spillway capacity is not rated as seriously inadequate. The existing spillway can accommodate a flood with a peak inflow of 52 percent of the PMF peak flow.

Due to the potential for overtopping of the dam, it is recommended that the Owner develop a detailed emergency operation and warning system for No. 7 Dam as soon as practical.

In order to correct operational, maintenance and repair deficiencies and to more accurately determine the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner: (1) Install two or more observation wells, or other instrumentation, in the vicinity of the wet area in the embankment fill downstream from the dam. Monitor instruments and record data so that any change in condition is detected.

(2) Repair weathered masonry joints and vertical crack on the nonoverflow section located to the left of the spillway.

(3) Remove debris accumulated at spillway crest.

(4) Maintain and operate gated outlets and other operating facilities on a regular basis. In order to increase emergency discharge capacity, consider using the 20-inch blowoffs from the screen chamber as additional emergency conduits.

(5) Determine the amount of sediment against the upstream face of the dam and spillway and evaluate the effect of present and long-term accumulation of sediment with respect to stability of the structures.

(6) Visually monitor condition of timber crib retaining structure.

(7) Repair concrete wall and apron located at the toe of the spillway at the right abutment area.

(8) Remove rubble-fill ramp from outlet channel.

(9) Repair undermined portion of outlet channel left wall.

The following measures are recommended to be undertaken by the Owner when the need arises:

(1) Provide round-the-clock surveillance of No. 7 Dam during periods of unusually heavy rains.

(2) 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.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

A. C. HOOKE Head, Dam Section



NU. / DAM

APPROVED BY:

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JOHN H. KERWORTHY LTC, Corps of Engineers Acting District Engineer

DATE: 6 June 1978 -



SUSQUEHANNA RIVER BASIN

ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 7 DAM

PENNSYLVANIA GAS AND WATER COMPANY (NDS ID NO. 363)

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

SECTION 1

PROJECT INFORMATION

ASSTRACT

1.1 General.

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a. <u>Authority</u>. 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. <u>Purpose</u>. 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. <u>Dam and Appurtenances</u>. No. 7 Dam is a masonry gravity structure with an overall length, including spillway, of 340 feet. It has a height of 45 feet at streambed. The spillway is 192 feet long and is located to the right of the center of the dam. The spillway consists of three parts. Near the right abutment is a 34-foot long masonry gravity section with a free overfall. Adjacent to the left end of that section is a 110-foot long masonry gravity, stepped spillway, and adjacent to the stepped spillway is a 48-foot long masonry gravity section with a free overfall. The spillway is at Elevation 1055.9 and the top of the nonoverflow section is at Elevation 1069.0. Both ends of the dam are keyed into the rock abutments. The outlet works is located to the left of the spillway. The facilities include a screen chamber building, a gatehouse, a meter building, and other facilities. The emergency lines for drawing down the reservoir are a 36-inch diameter line and a 48-inch diameter line, each with an intake located on the upstream face of the dam. Two 20-inch diameter lines that have intakes in the screen chamber and are connected to the reservoir by a 48-inch diameter line could also be used for drawing down the reservoir. Various features of the dam are shown on the plates at the end of the report and on the photographs in Appendix D.

Water for distribution is not withdrawn from No. 7 Dam. However, a system of valves, pipes, and chlorination equipment, which is known as the headworks, is operated by the Owner to regulate flow into the distribution network from Elmhurst Reservoir and from Elmhurst Reservoir to Lake Scranton and Dunmore No. 1 Reservoirs. About 10 million gallons per day (mgd) of water goes into the distribution network. The locations of the reservoirs are shown on Plate 1.

b. <u>Location</u>. The dam is located on Roaring Brook approximately 5 miles upstream from its confluence with the Lackawanna River and 6 miles downstream from Elmhurst Dam, which also is on Roaring Brook. No. 7 Dam is shown on USGS Quadrangle, Olyphant, Pennsylvania, with coordinates N41°22'40" - E75°35'50" in Lackawanna County, Pennsylvania, and is 3 miles east of Scranton, Pennsylvania. The location map is shown on Plate 1.

c. <u>Size Classification</u>. Intermediate (45 feet high, 570 acre-feet).

d. Hazard Classification. High hazard.

e. <u>Ownership</u>. Pennsylvania Gas and Water Company, Wilkes-Barre, Pennsylvania.

f. <u>Purpose of Dam</u>. The original purpose of No. 7 Dam was water supply, but this usage was discontinued due to pollution from adjacent highway construction. Only the operating facilities are used at present to control flow of water from other reservoirs into the distribution system and to storage reservoirs.

g. <u>Design and Construction History</u>. No. 7 Dam was built for Scranton Gas and Water Company in 1872 under the supervision of David Coughlin, City Engineer of Scranton. Another consulting engineer, Mr. Worthen, also participated in the project. No. 7 Dam provided the first gravity water supply to the City of Scranton.

The original water supply line was a 24-inch diameter pipe. In 1896, a 48-inch diameter supply line was added, the screen chamber was constructed, and a 36-inch emergency line for drawing down the reservoir was added. The screen chamber was connected to the dam by a masonry passage, and a gatehouse was constructed for controlling the emergency conduit.

A severe flood in 1902 overtopped the dam and damaged the embankment of the railroad adjacent to the right abutment of the dam. As a result of that flood, the spillway capacity was increased by lowering the dam on both sides of the original spillway and by adding a 4-foot high concrete wall to the remaining nonoverflow sections. In addition, a concrete apron was added along the toe of the spillway and a small concrete wall was constructed at the toe of the spillway at the right abutment to act as a training wall and to prevent erosion of a rock ledge.

After another flood in 1914, additional modifications were made. A 48-inch diameter emergency line was added, and a concrete wall was constructed along the left side of the outlet channel from the spillway to an aerial pipeline crossing located about 250 feet downstream. While the reservoir was drawn down for repairs, about 200,000 cubic yards of silt were excavated and removed from the site.

A third major flood occurred in 1942. No accounts of damages were available for review, but in 1944 additional improvements were made to the dam. The spillway capacity was increased by lowering the crest by 2.7 feet and extending it to a new total length of 192 feet. In addition, the 4-foot high concrete extension to the masonry nonoverfow section was removed and replaced with an 8-foot high by 8-foot wide concrete extension, thus increasing the difference in elevation between spillway crest and top of dam to 13.1 feet. Other work performed at the same time included the following: strengthening the spillway sections by installing 30-foot long, 3-inch diameter pre-stressed steel rods anchored into rock at 5-foot centers located about 2 feet from the upstream face and grouting them into place; increasing the stability of the nonoverflow section to the left of the spillway by adding a compacted earthfill against the downstream face; razing an old gatehouse and constructing a new one adjacent to the left side of the spillway; constructing a spillway training wall adjacent to the left side of the spillway; and filling the area between the free overfall section of the spillway and the training wall with a 15-foot thick concrete apron.

In August 1955, Hurricane Diane resulted in a spillway discharge of 14,500 cfs at Elmhurst Dam. There are no known records of the spillway discharge at No. 7 Dam for Hurricane Diane. However, assuming precipitation from Hurricane Diane was uniform over the Elmhurst and No. 7 watersheds, the spillway discharge at No. 7 Dam is calculated to be about 19,000 cfs. The drainage area of No. 7 watershed is 34 percent greater than that of the Elmhurst watershed.

h. Normal Operating Procedure. The water level at No. 7 Dam is normally maintained at spillway crest level with excess inflow passing over the ungated spillway crest. Emergency lines are used to augment flow in Roaring Brook during periods of low flow but are normally closed. No water is withdrawn from the reservoir for water supply purposes. It was used for water supply until the late 1960's. At that time, a study

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was made of the effects of proposed highway construction in the watershed, and it was predicted that the construction would degrade the water quality to the extent of not being usable for supply purposes. The reservoir was then abandoned for supply purposes, and, in fact, the quality of the water was degraded as anticipated.

The valve and piping system located below the dam are in use. They serve as a control function for distribution of water that comes from Elmhurst Reservoir, Lake Scranton, and Dunmore No. 1 Reservoir. Chlorine is also added to the water at No. 7 Dam.

1.3 Pertinent Data.

a. <u>Drainage Area</u>. 50.0 square miles, 37.3 square miles of which flows into Elmhurst Reservoir.

b. Discharge at Damsite. (cfs).

Maximum known flood at damsite - unknown -Hurricane Diane, August 1955, estimated at 19,000 cfs. Outlet works at maximum pool elevation -830 (approximate). Spillway capacity at maximum pool elevation -25,000.

c. Elevation. (Feet above msl.)

Top of dam - 1,069.0. Maximum pool - 1,069.0. Normal pool - 1,055.9. Upstream invert outlet works -36-inch pipe - 1,025.0. 48-inch pipe - 1,025.25. 48-inch pipe - 1,025.0. Downstream invert outlet works -36-inch pipe - 1,024.5. 48-inch pipe - 1,025.0. two 20-inch pipes - 1,028.5. Stream at dam - 1,024.0 (approximate).

d. Reservoir. Length. (Miles).

Normal pool - 0.36. Maximum pool - 0.4.

e. Storage. (Acre-feet.)

Normal pool (spillway crest) - 310. Maximum pool (top of dam) - 570 f. <u>Reservoir Surface</u>. (Acres.)

Normal pool (spillway crest) - 18.8. Maximum pool (top of dam) - 20.8.

g. Dam.

Type - Masonry gravity structure.

Length - 340 feet (including spillways).

Height - 45 feet.

Slopes - Downstream - 1V on 2.5H.

Zoning - Earthfill embankment on downstream face of gravity section for 120 feet from left abutment. Top of earthfill at Elevation 1050.0.

Cutoff - Founded on rock (conglomerate).

Grout curtain - None.

h. Diversion and Regulating Tunnel.

Type - Steel pipe - 36-inch diameter.

Cast-iron pipe - 48-inch diameter. 48-inch diameter to screen chamber. 20-inch diameter from screen chamber to discharge channel.

Length - Steel pipe - 36-inch diameter - 90 feet. Cast-iron pipes - 48-inch diameter - 170 feet. 48-inch diameter screen chamber -60 feet. 20-inch diameter from screen chamber to discharge channel - 100 feet.

<u>Access</u> - None except to 48-inch diameter pipe from dam to screen chamber by closing gate valve on face of dam.

Regulating Facilities - 36-inch diameter pipe.

Two manually operated rising stem, 2 threads per inch (TPI), 36-inch gate valves with exposed 5.86 to 1 gear reducers in gatehouse.

48-inch diameter pipe - two manually operated nonrising stem, enclosed, 48-inch gate valves with exposed 5 to 1 gear reducers and 8-inch diameter bypasses in gatehouse.

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48-inch diameter pipe to screen chamber - manually operated, rising stem sluice gate at upstream face of dam.

i. Spillway.

<u>Type</u>. - Center section - broad-crested weir (width 10 feet, and 1 foot by 2 feet wide block on top) with masonry steps.

Left section - broad-crested weir (width 10 feet, and 1 foot by 2 feet wide block on top) with free overfall.

Right section - broad-crested weir (width 10 feet, and 1 foot by 2 feet wide block on top) with free overfall.

Length of weir - Center section - 110 feet. Left section - 48 feet. Right section - 34 feet. Total - 192 feet.

Crest elevation - 1055.9 (center, left and right sections).

Upstream channel - Reservoir.

<u>Downstream channel</u> - Concrete apron 12 feet long followed by natural channel with stone protection. Abutments for aerial pipeline cross, located 250 feet downstream form constriction. Spillway access ramp also forms constriction.

j. <u>Regulating Outlets</u>. - None other than outlet works.

SECTION 2

ENGINEERING DATA

2.1 Design.

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a. <u>Data Available</u>. Very little engineering data was available for review for the original structures or for the modifications made prior to 1914. In a study performed in 1914 by the Water Supply Commission of Pennsylvania, an account of design concepts, geology, construction materials and methods, and design features was prepared for the structures from interviews with the Owner, visual inspection, and other sources. The 1914 study also included a hydraulic analysis and stability analyses for the spillway and the nonoverflow section of the dam. An account of the performance of the dam during the July 1914 flood is included along with a description of the silt removal operation and repairs to the project that were made after the flood.

A report on proposed improvements to No. 7 Dam dated May 31, 1944, by Thomas H. Wiggin, Consulting Engineer, New York City, is on file. The report summarizes the measures to be taken to increase spillway capacity and to strengthen the structures to withstand the additional loading that would be imposed on them.

In May 1944, the Owner applied for a permit to enlarge the spillway and to reinforce the structures. In July 1944, the Water and Power Resources Board, Division of Dams and Encroachments, Commonwealth of Pennsylvania, prepared a report on the permit application. The report included the summary of results for a stability analysis for the proposed new section of spillway. Pertinent hydraulic data and computations for the spillway capacity are available. Load test results for the prestressed steel rods that were used to reinforce sections of the spillway are also on file.

b. Design Features. No. 7 Dam is a masonry gravity dam with an overall length, including spillway, of 340 feet. The height is about 45 feet measured at streambed, and the project is founded on rock along its whole length. A plan of the dam and a profile along its axis are shown on Plates 2 and 3, respectively. The dam is also shown on Photographs B and C. A discussion on geology is presented in Appendix E. The nonoverflow sections consist of a 20-foot long section at the right abutment (Photograph J) and a 128-foot long section at the left abutment (Photographs A and B). The nonoverflow sections are masonry gravity sections, with an 8-foot high by 8-foot wide concrete extension that has a masonry facing. The top width is 8 feet, and it is at Elevation 1069.0 A nonoverflow section is shown on Plate 6. The spillway is located between the two nonoverflow sections, and it is 192 feet in length and is at Elevation 1055.9.

The spillway is comprised of three sections, all at the same crest elevation (Photograph D). The spillway crest is 10 feet wide, and it has a 1 foot high by 2 foot wide concrete block along its length. The central section, which was the original spillway, is a 110-foot long masonry gravity, stepped spillway (Plate 4 and Photograph E). Adjacent to the right end of the stepped spillway is a 34-foot long masonry gravity, free overfall section (Photograph J). Adjacent to the left end of the stepped spillway is a 48-foot long masonry gravity, free overfall section (Plate 5 and Photograph E). Protection along the toe of the spillway sections includes a small training wall and a concrete apron for the free overfall section near the right abutment, a 12-foot wide concrete apron block for the stepped spillway, and a 15-foot thick, variable width, concrete apron and a high training wall for the free overfall section on the left end of the spillway. The two free overfall sections have 3-inch diameter steel rods at 5-foot centers located 2 feet from the upstream face. The rods were anchored into rock and were prestressed to 70,000 pounds. The stepped spillway is similar, except that the rods were 2 inches in diameter and were prestressed to a lesser load.

The portion of the nonoverflow section between the left end of the spillway and the screen chamber building, which is located about 90 feet from the right abutment, has an embankment fill area against its downstream face with a top elevation of about Elevation 1050 (Plate 6). The fill area is level for a 25-foot distance from the dam, then it slopes downward to Elevation 1035. This embankment fill area is separated from the adjacent chlorinator house and chlorine tank storage platform by a retaining wall about 10 feet high. From that retaining wall to the left abutment of the dam, the level of the ground surface along the downstream face varies from about 9 feet from the top of dam at the retaining wall to 0 feet from the top of the dam at the left abutment.

The outlet works is located to the left of the spillway. The facilities include a screen chamber building and chlorinator house, a gatehouse, a meter building, and other distribution facilities. Water is no longer withdrawn from the reservoir for supply purposes. Consequently, the valves on a 48-inch diameter supply line from the reservoir to the screen chambers are closed, and the screen chambers are dry. Two 20-inch diameter blowoff lines extend from the screen chambers to the outlet channel. There is a slide gate on the upstream end of the unused 48-inch intake line. A plan of the outlet works is shown on Plate 2.

The emergency lines for drawing down the reservoir are a 36-inch diameter line and a 48-inch diameter line. The intakes are located on the upstream face of the free overfall section at the left end of the spillway, and the intakes are covered with steel trashracks. The emergency lines pass through the gatehouse and then outlet into the downstream channel. Each line has two gate valves on it.

A system of values, pipes and chlorination equipment, which is known as the headworks, is operated by the Owner to regulate flow into the distribution network from Elmhurst Reservoir and from Elmhurst

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Reservoir to Lake Scranton and Dunmore No. 1 Reservoirs. There are also other pipes in the area that have been plugged and abandoned. A plan of the headworks is shown on Plate 2.

The downstream channel is unlined, but there is a concrete wall along the left side of the outlet channel (Photographs K and L). This wall acts as a training wall for flow from the spillway and also protects the adjacent pipe network from damage by erosion.

2.2 Construction.

a. <u>Data Available</u>. Almost no construction data for the original structures was available for review. Drawings, correspondence, and photographs are available for the 1914 and 1944 repairs, and they provide some information relevant to construction materials and methods.

b. <u>Construction Considerations</u>. A 1914 inspection report by the Water Supply Commission of Pennsylvania for the installation of the 48-inch emergency line expressed concern for two items. During the modification, it was possible to inspect the original rubble masonry construction of the interior of the dam, and it was observed that the stones had not been properly cleaned before being placed in the mortar and that pockets of clay and sand were present. Concern was also expressed for the procedure used for installing the 48-inch intake, which consisted of installing the line and then filling the annular space around it.

Review of available information for this study raised one additional concern. The drawings show that a stratum of soft slate probably underlies the concrete apron for the free overfall section of the spillway that is located near the right abutment. The visual inspection of the area showed that the apron is in poor condition and that substantial erosion of this stratum is possible.

c. Few formal records of operation are available. The dam has been inspected at irregular intervals by Commonwealth authorities since 1914 and, in recent years, on an annual basis by the Owner. Most observations made during this inspection are also indicated on previous inspections. The Owner indicated that the problems that were observed in this inspection have existed for several years.

2.4 <u>Other Investigations</u>. In 1915, Frederic P. Stearns, Consulting Engineer, made a study of drainage and reservoir inflows for Roaring Brook. Correspondence indicated that a sedimentation survey was apparently made in 1959, but the results were not available for review.

2.5 Evaluation.

a. <u>Availability</u>. Engineering data was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania and by the Owner, Pennsylvania Gas and Water Company. The Owner made available an engineer, dam operators, and a valve crew for information and operating demonstrations during the visual inspection. The Owner also researched his files for additional information upon request of the inspection team.

b. <u>Adequacy</u>. The type and amount of 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. <u>Validity</u>. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. <u>General</u>. The general appearance of this project indicated that some project features have deteriorated with age and are in need of repair, while other project features have been properly maintained and are in good condition.

b. Dam.

(1) Embankment Fill Area. The slope of the embankment fill area, which is located along the downstream face of the masonry gravity dam between the gatehouse and the screen chamber building, had a 12-foot by 25-foot area adjacent to the screen chamber building that was outlined by cracks. At the top of the affected area, which is at the top of the slope, some sloughing over a 5-foot by 2-foot area was observed (Photograph I). Maximum depth of depression at that area was 18 inches. At the lower end of the affected area, which is at the toe of the slope, the soil was more moist than the adjacent areas, but no actual water was visible. Along the toe of the slope at its right end, which is at the left corner of the gatehouse, clear standing water covered an area about 6 feet in diameter to a maximum depth of 4 inches (Photograph H). The source of the water could not be determined. Investigation of the lower level of the gatehouse showed several small weep holes in the wall near the same corner that were apparently installed to admit the water. The estimated flow into the gatehouse was 4 to 5 gallons per minute. The inflow was collected by a 6-inch diameter cast-iron pipe that discharged into the adjacent downstream channel. A 2-foot diameter depression in the backfill was at the junction of the outlet channel wall and the gatehouse, and several smaller depressions were located along the junction of the embankment slope and the left side of the gatehouse. The Owner said that the wet area and other conditions are seasonal.

(2) <u>Gravity Dam.</u> Exposed masonry joints on the downstream face of the gravity dam were generally sound. However, over a 3-foot by 20-foot area between the gatehouse and the screen chamber building above the normal pool level, the masonry joints were cracked and weathered. A 1/16-inch wide vertical crack was on the downstream face behind the screen chamber building at the chlorine tank storage platform (Photograph G). The crack extended from just above the platform level to the top of dam, and a corresponding crack was nearby on the upstream face. The crack on the downstream face did not follow masonry joints, but went through two of the 12-inch thick facing stones. No differential movement was observed.

c. Appurtenant Structures.

(1) <u>Spillway</u>. Logs and other floating debris were accumulated along the upstream side of the spillway crest (Photograph E). The Owner said that the debris would be removed as soon as the water level receded. Too much water was flowing over the spillway crest to inspect the spillway in detail. However, no blocks of stone were missing.

The inside face of the spillway left wall, (Photograph E) which is concrete, had very severe scaling over 50 percent of the area above the spillway crest level. Fine surface cracking was present over most other locations on the inside face of that wall. Very severe scaling was observed on the inside face of the spillway left training wall near its top, and one joint, located on the most downstream monolith, was spalled.

(2) Outlet Works. Much of the original piping that enters the screen chamber building is no longer being used, and the screen chamber is dry. However, the valves are still in place. The gatehouse adjacent to the spillway has two valves each for both the 48-inch and 36-inch emergency lines. The valves had coatings of rust. The wood flooring was just adequate. Portions of the gatehouse floor had loose boards that made access hazardous. The 48-inch valve was opened 120 turns in 20 minutes by four men (Photograph K). The gate position indicator did not function when the valve was closed. The by-pass for the 48-inch valve was operated by one man. The 36-inch valve was opened 12 inches in ten minutes by one man. The 36-inch valve was well lubricated. A rubble fill ramp was constructed over the outlet of one of the 20-inch blowoffs that extend from the screen chamber to the outlet channel (Photograph L). The other 20-inch blowoff line was not obstructed. The caretaker said that the flood in August 1977, made it impossible to reach the gatehouse and open valves until the day after the flood peak.

d. <u>Reservoir Area</u>. The watershed area is generally wooded and hilly. The left side of the reservoir is bounded by steep, wooded hillsides with many rock outcrops. The right side of the reservoir is bounded by a railroad. No evidence of slope instability was noted. The Owner said that sedimentation is a problem, and that it was aggravated substantially in the late 1960's by construction of Interstate Route 81 through the watershed. As a result of the degradation of water quality caused by the construction, Pennsylvania Gas and Water Company no longer uses the reservoir for water supply.

e. Downstream Channel.

(1) <u>Timber Crib Retaining Structure</u>. On the right abutment adjacent to the downstream face of the dam, a timber crib retaining structure helps stabilize the slope adjacent to the railroad (Photograph F). The bottom members of the timber crib are in poor condition. (2) Area Below Spillway Along Right Abutment. A small concrete wall serves the dual function of a training wall for spillway flow and as a support for a large block of rock on the adjacent hillside (Photograph J). The wall was in very poor condition. The concrete was disintegrated in several areas and was undermined at three locations to depths of 2 to 5 feet. The rock mass above the wall has fractures ranging from 1 inch to 4 inches in width. Although soil covered the top of the rock mass, it appeared from the orientation of the fractures that it would act as an independent block. However, no signs of recent movement were observed. The concrete apron covering rock outcrops between the base of the training wall and the base of the spillway was severely disintegrated and, in some locations, missing.

(3) <u>Outlet Channel</u>. The abutments for an aerial pipeline crossing, located about 250 feet downstream from the dam, form a channel constriction (Photograph L). A pile of derrick stone, soil, and gravel that functioned as an access ramp for recent spillway repairs blocks part of the outlet channel between the spillway and the pipeline crossing (Photograph L).

(4) <u>Outlet Channel Left Wall</u>. A concrete wall extends along the left side of the outlet channel from the gatehouse to the pipeline crossing (Photographs K and L). The following observations were made: (1) downstream from the outlet of the 48-inch diameter blowoff, about 20 linear feet of the foundation was undermined to an average depth of 1 foot; (2) seven drains had outlets on the face of the wall at various elevations, source of pipes unknown; (3) severe scaling and spalling were present along the base; and (4) many medium longitudinal cracks, one wide vertical crack, and one diagonal crack were on the exposed face.

3.2 Evaluation.

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a. Dam.

(1) Embankment Fill Area. The various problems that were observed in the embankment fill area might be related. Apparently, all the problems are caused by one or more undetermined flows of water through the embankment fill. Examination of the surface area that drains to the problem areas indicated that probably not enough direct surface runoff would result to account for the observed deficiencies. Examination of previous inspection reports did not yield any information pertinent to the wet area. The actual damage caused by the water was slight, and it appears that the water is being removed in a manner that does not damage other features. The consequences of a slope failure of the embankment fill area are that the reserve resistance that it provides for the nonoverflow section of the dam against overturning and sliding would be reduced. Therefore, even though the Owner indicated that it is a seasonal condition, the problems are of some concern. (2) The condition of the weathered and cracked masonry joints on the small area on the downstream face of the nonoverflow section is undesirable, and the condition will probably worsen in time.

(3) The vertical crack in the nonoverflow section at the chlorine tank platform would result in leakage at high pool elevations. Any leakage would go onto the concrete chlorine tank storage platform. Because the platform was nearly level, it could not be conclusively established whether or not runoff from the platform would go to the left or right. If it went off the right side of the platform, additional water would be added to the embankment fill area, and it would probably aggravate the existing problems in that area. Because of the nature and location of this crack, it appears that the concrete extension of the top of dam that is under the masonry facing is also cracked.

b. Appurtenant Structures.

(1) The debris that was accumulated along the upstream face of the spillway could result in damage to the spillway if it is washed over.

(2) The deterioration of the concrete on the inside face of the spillway left wall has not yet affected performance of the structure. However, deterioration of the concrete will probably continue.

(3) The gates were operable, but regular maintenance is needed. As indicated by the caretaker, access to the valves would not be possible during peak flow of large floods. Normal access is hazardous because of the condition of the flooring, and during large floods the loose boards would float. The rubble fill ramp makes one of the 20-inch blowoffs ineffective as an additional emergency drawdown line. The other 20-inch blowoff could be used as an emergency conduit if the valve on the abandoned 48-inch supply line could be opened to admit water into the screen chamber.

c. <u>Reservoir Area</u>. The existence of a substantial sediment problem is well known but it is not known how much sediment has been deposited against the upstream face of the dam. Long term accumulation of sediment could cause increased loads on the dam and the spillway.

d. Downstream Channel.

(1) Although the timber crib retaining structure is in poor condition, it is more of a hazard to the railroad embankment than to the dam.

(2) The small concrete wall that acts as both a training wall and a support wall, and the adjacent concrete apron, have deteriorated to the extent that they are not considered fully functional. The longterm ability of the wall to support the rock mass is questionable, and the concrete apron has deteriorated to the extent of providing little protection to the underlying rock. The fractures that define the rock mass appear to be oriented in directions that would favor movement if support from the wall is lost. Failure of the rock mass could result in damage to the spillway.

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(3) Although the abutments for the pipeline crossing constrict the downstream channel, the features of the dam have already withstood uplift from tailwater that might be controlled by this constriction. The access ramp also constricts the channel, but the material would probably be washed away during a large flood. However, washing away of some of the larger stones could result in damage to the outlet channel left wall or to the 48-inch diameter emergency line that is just downstream. In addition, the ramp covers the outlet of a 20-inch diameter blowoff that could be used as an emergency line.

(4) The undermining of the outlet channel wall is the most serious of its deficiencies. Although failure of this wall probably would not directly affect the dam, it might result in damage to the 48-inch emergency line.

SECTION 4

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OPERATIONAL PROCEDURES

4.1 The reservoir is maintained at spillway crest Ele-Procedures. vation 1055.9 with excess reservoir inflow flowing over the spillway. The gate valves for the 36-and 48-inch diameter emergency lines are located in the gatehouse. Each line has two gate valves. The upstream valve on each line is normally open, and the downstream valve on each line is normally closed. When the reservoir pool rises several feet above the spillway crest, water is drawn from the reservoir by opening the downstream valve on each line. The emergency lines are used infrequently because sediment from the reservoir makes the stream turbid. No water is drawn from the reservoir for water supply. A slide gate is located at the upstream face of the dam at the intake of the 48-inch water supply line. This slide gate is normally open, but two downstream gate valves on this line are closed, thereby maintaining a dry screen chamber.

4.2 <u>Maintenance of Dam</u>. The dam is visited daily by two caretakers who check chlorination equipment. The caretakers are also responsible for observing the general condition of the dam an 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 kept on file and used for determining priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons.

4.3 <u>Maintenance of Operating Facilities</u>. There is no known regular maintenance program for the operating facilities. Maintenance is apparently performed when deemed necessary.

4.4 <u>Warning Systems in Effect</u>. The Owner furnished the inspection team with a chain of command diagram for No. 7 Dam and a generalized emergency notification list that is applicable for all 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 No. 7 Dam but are as directed by the Owner's Engineering Department.

4.5 <u>Evaluation</u>. Except for not opening the valves on the emergency lines to the full opening on a regular basis, the operational procedure appears to be satisfactory. Infrequent operation of emergency lines

could affect their functioning satisfactorily during emergency conditions. The procedures used by the Owner for inspecting the dam are adequate, but some repairs have not been timely. As observed in the visual inspection, the maintenance of some of the operating facilities is adequate, but the maintenance of others is not. In general, the warning system is adequate, but is not in sufficient detail for No. 7 Dam when its overall importance is considered. Since No. 7 Dam is classified as a high hazard dam, the warning system deserves special consideration.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data.

(1) No hydrologic and hydraulic analyses for the original No. 7 Dam design were available for review. The spillway capacity has been estimated several times for the various construction modifications that have evolved.

(2) In the recommended guidelines for safety inspection of dams, the Department of the Army, Office of the Chief of Engineers (OCE), established the criteria for rating the capacity of spillways. The recommended spillway design flood for the size (intermediate) and hazard potential (high) classification of No. 7 Dam is the Probable Maximum Flood (PMF). If the dam and spillway are not capable of passing the PMF 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, 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.

(3) The 1944 Permit Application Report to the Water and Power Resources Board, Division of Dams and Encroachments, Commonwealth of Pennsylvania, shows a spillway capacity of 25,000 cfs for the maximum pool elevation. Calculations were performed to check the accuracy of the spillway capacity estimate, and the 25,000 cfs was accepted (Appendix C).

(4) The No. 7 watershed is partially owned by Pennsylvania Gas and Water Company. Some of the watershed is developed. Hydrologic analysis for this study was based on existing conditions and the effects of future development of the watershed were not considered.

b. <u>Experience Data</u>. For this study, a PMF peak previously calculated for hydrologically similar Stillwater Reservoir watershed was

transposed to the No. 7 Reservoir watershed and to Elmhurst Reservoir watershed. Elmhurst Dam is located upstream of No. 7 Dam on Roaring Brook with a drainage area of 37.3 square miles. The PMF peak flow was estimated to be 50,480 cfs at No. 7 and 39,930 cfs at Elmhurst. The Elmhurst component of the No.7 PMF peak flow is 37,660 cfs.

c. <u>Visual Observation</u>. On the date of the inspection, a small amount of debris was observed near the crest of the spillway. However, discharge reduction due to debris accumulation along the spillway is not anticipated to be a significant problem during a flood occurrence.

Overtopping Potential. If a PMF occurs that would produce d. a peak flow of either 37,660 cfs (Elmhurst component of the No. 7 PMF) or 39,930 cfs (Elmhurst PMF), the spillway capacity of 31,000 cfs of Elmhurst Dam is smaller than the inflow. A check of the surcharge storage effect of Elmhurst Reservoir shows that the surcharge storage available is insufficient to contain either PMF without overtopping Elmhurst Dam (Appendix C). In either case, the outflow from Elmhurst Dam just before overtopping would be the spillway capacity of 31,000 cfs. This outflow from Elmhurst, 31,000 cfs is greater than the spillway capacity of No. 7 Dam downstream. A check of the surcharge storage effect of No. 7 Reservoir shows that the surcharge storage available is insufficient to contain an inflow with a peak flow of 31,000 cfs without overtopping No. 7 Dam (Appendix C). Therefore, in the event of a spillway capacity flow at Elmhurst Dam, No. 7 Dam will be overtopped and possibly fail before Elmhurst Dam is overtopped.

e. <u>Downstream Channel</u>. As shown on Plate 1, Erie-Lackawanna Railroad tracks that are along the valley of Roaring Brook would be affected by a failure of No. 7 Dam. Approximately 1 mile below No. 7 Dam, the tracks cross the stream. The communities of Dunmore and Scranton are about 1.3 miles downstream from the dam. These communities would be the first populated areas to be affected by a failure of No. 7 Dam. The downstream conditions indicate that a high hazard classification is warranted for No. 7 Dam.

f. Spillway Adequacy.

(1) The spillway will not pass the PMF without overtopping No. 7 Dam. Therefore, based on OCE criteria as outlined in Paragraph 5.1.a. (2) the spillway capacity of No. 7 Dam is rated as inadequate. One-half of the PMF of the Elmhurst watershed is 19,965 cfs, and one-half of the PMF of the Elmhurst component of the No. 7 watershed is 18,830 cfs. Both are less than the spillway capacity of 31,000 cfs at Elmhurst Dam. Therefore, both peaks pass through Elmhurst Dam without causing overtopping. One-half of the PMF of the No. 7 watershed is 25,240 cfs and is greater than the 25,000 cfs spillway capacity of No. 7 Dam. A check of the combined surcharge storage effect of Curtis, Elmhurst and No. 7 Reservoirs shows that the surcharge storage available is sufficient to contain an inflow with a peak flow of 25,240 cfs without overtopping the dam (Appendix C). Therefore, based on OCE criteria as outlined in Paragraph 5.1.a.(2), the spillway capacity of No. 7 Dam is not rated as seriously inadequate. Considering the effects of the combined surcharge storage of 2,193 acre-feet, the spillway discharge capacity of 25,000 cfs can accommodate a flood with a peak inflow of 26,150 cfs for a storm of the same duration as the PMF. This is 52 percent of the PMF peak inflow.

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(2) The maximum tailwater is estimated to be Elevation 1040.0 at the spillway capacity of 25,000 cfs. At maximum pool elevation, there is a difference of about 30 feet between headwater and tailwater. If No. 7 Dam should fail due to overtopping during the PMF, the hazard to loss of life downstream from the dam will be significantly increased from that which would exist just prior to overtopping.

(3) The effects of Lake Henry and the breached Hollister Dam, both upstream of Elmhurst Dam, were considered to be negligible upon Elmhurst Dam. Consequently, they were also considered to be negligible upon No. 7 Dam. Curtis Dam is located upstream of Elmhurst Dam. The effects of Curtis Dam on Elmhurst Dam were considered in the Phase I Inspection Report for Elmhurst Dam. Since No. 7 Dam will be overtopped and possibly fail before Elmhurst Dam is overtopped, the effect of Curtis Dam on No. 7 Dam need not be considered separately. The conditions at Elmhurst Dam will control the conditions at No. 7 Dam.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) <u>General</u>. The visual inspection of the dam and spillway resulted in some observations that are relevant to structural stability. These observations are listed herein for the various features.

(2) <u>Embankment Fill Area</u>. A wet area and a cracked zone were observed. The detailed description and evaluation are in Paragraphs 3.1.b.(1) and 3.2.a.(1), respectively.

(3) <u>Reservoir Area</u>. Sedimentation problems exist. The detailed description and evaluation are in Paragraphs 3.1.d. and 3.2.c., respectively.

b. <u>Design and Construction Data</u>. No records of design data or stability computations for the original structures were available for review. However, a stability analysis was performed for the nonoverflow section of the dam in 1914 by the Water Supply Commission of Pennsylvania. The analysis performed by the Commission is of little value in assessing the stability of the present structure because significant modifications to the dam were made in 1944.

A report on proposed improvements to No. 7 Dam dated May 31, 1944, by Thomas H. Wiggin, Consulting Engineer, New York City, is on file. The report summarizes the measures taken to increase spillway capacity and to strengthen the structures to withstand the additional loading that would be imposed on them.

In May 1944, the Owner applied for a permit to enlarge the spillway and reinforce the structure. In July 1944, the Water and Power Resources Board, Division of Dams and Encroachments, prepared a report on the permit application. The report included the summary of results for a stability analysis for the proposed new section of spillway. The report summarizes the loading conditions as follows: water at maximum pool elevation and uplift pressure varying from full at the heel to zero at the toe applied to 30 percent of the base area. The analysis indicated that the resultant would fall 3.5 feet outside the middle third at Elevation 1035. Steel rods, 3-inch diameter at 5-foot centers located 2 feet from the upstream face and anchored in foundation rock were to be pre-stressed to 70,000 pounds, or 11,800 pounds per square inch, and then grouted in the holes over their full length. The proposed improvements were considered satisfactory and the permit was issued. A memorandum, dated June 1945, is also on file and indicates that one of the rods was tested with a repeatedly applied load of 70,000 pounds. The memorandum also indicates that, although they were not required by the Board, the older portions of the spillway were similarly reinforced with 2-inch diameter rods. Review of available drawings confirms the descriptions in the correspondence.

For this study, additional analyses for the various sections were performed. The loading assumptions were as follows: water at maximum pool level, full hydrostatic pressure on upstream face and uplift varying uniformly from full tailwater at the toe to full tailwater at the heel plus 2/3 of the difference between headwater and tailwater also applied at the heel. The pre-stressed steel rods were not included in the analyses nor were any sediment loads used. Tailwater values were assumed depending on the location of the section. The following sections were considered: the stepped spillway at Elevation 1020, the nonoverflow section at Elevation 1020, the right free overfall section of the spillway at Elevation 1035, and the left free overfall section of the spillway at Elevations 1035 and 1020. The analyses indicated that toe pressure and the factor of safety for sliding were within acceptable limits for all sections, and for the most critical section, the resultant was about 2.8 feet outside the middle third. Assuming the steel rods are still effective, all resultants would be within the middle third and, consequently, would meet OCE recommended guidelines for stability.

c. <u>Operating Records</u>. There was no information reviewed that gave any indication that stability problems have occurred for the spillway or nonoverflow sections of the dam during its operational history.

d. <u>Post-Construction Changes</u>. Adequate information is available concerning modifications made to No. 7 Dam after 1914.

e. <u>Seismic Stability</u>. No. 7 Dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7

7.1 Dam_Assessment.

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a. Safety.

(1) Based on the visual inspection, available records, calculations and past operational performance, No. 7 Dam is judged to be in good condition. However, deficiencies of varying degree of importance were noted. A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiencies		
Dam: Embankment fill area	Wet area, cracks, sloughing.		
Nonoverflow section	Deterioration of masonry joints over small area. Vertical crack above spill- way crest level.		
Spillway: Crest	Accumulation of debris.		
Left wall	Concrete deterioration.		
Outlet Works:	Lack of regular maintenance		

Reservoir Area:

Downstream Channel: Timber crib retaining structure

Area below spillway along right abutment

Outlet channel left wall

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Sedimentation.

Bottom members in poor condition.

Concrete wall deteriorated. Concrete apron deteriorated.

Undermined and concrete deteriorated. Access ramp material along wall.

(2) The overtopping potential analysis shows that No. 7 Dam will be overtopped by the PMF but will not be overtopped by one-half the PMF. Based on OCE criteria, as outlined in Paragraph 5.1.a.(2), the spillway capacity is not rated as seriously inadequate. The existing spillway can accommodate a flood with a peak inflow of 52 percent of the PMF peak inflow. (3) Review of previous studies for stability and computations made for this study indicates that the locations of the resultants, the factors of safety for sliding, and the toe pressures are within acceptable limits. However, the Owner should be aware of the potential for increased loads that might result from long-term accumulation of sediment against the upstream faces of the structures.

b. <u>Adequacy of Information</u>. 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. <u>Urgency</u>. The recommendations in Paragraph 7.2 should be implemented as soon as practical or in a timely manner, as noted.

d. <u>Necessity for Further Investigation</u>. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations will be required.

7.2 Recommendations and Remedial Measures.

a. Due to the potential for overtopping of the dam, the following measure is recommended to be undertaken by the Owner as soon as practical:

(1) Develop a detailed emergency operation and warning system for No. 7 Dam.

b. In order to correct operational, maintenance and repair deficiencies, and to more accurately assess the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Install two or more observation wells, or other instrumentation, in the vicinity of the wet area in the embankment fill downstream from the dam. Monitor instruments and record data so that any change in condition is detected.

(2) Repair weathered masonry joints and vertical crack on the nonoverflow section located to the left of the spillway.

(3) Remove debris accumulated at spillway crest.

(4) Maintain and operate gated outlets and other operating facilities on a regular basis. In order to increase emergency discharge capacity, consider using the 20-inch blowoffs from the screen chamber as additional emergency conduits.

(5) Determine the amount of sediment against the upstream face of the dam and spillway and evaluate the effect of present and long-term accumulation of sediment with respect to stability of the structures.

(6) Visually monitor condition of timber crib retaining

(7) Repair concrete wall and apron located at the toe of the spillway at the right abutment area.

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structure.

(8) Remove rubble-fill ramp from outlet channel.

(9) Repair undermined portion of outlet channel left wall.

c. The following measures are recommended to be undertaken by the Owner when the need arises:

(1) Provide round-the-clock surveillance of No. 7 Dam during periods of unusually heavy rains.

(2) 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 ROARING BROOK, LACKAWANNA COUNTY PENNSYLVANIA

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NO. 7 DAM

PENNSYLVANIA GAS AND WATER COMPANY

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MAY 1978

PLATES












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CROSS SECTION THROUGH SPILLWAY A





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PLATE 5



CROSS SECTION THROUGH DAM AND FLOOD WALL ALSO LONGITUDINAL SECTION THROUGH EMBANKM



SUSQUEHANNA RIVER BASIN ROARING BROOK, LACKAWANNA COUNTY PENNSYLVANIA

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NO. 7 DAM

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APPENDIX A

CHECKLIST - ENGINEERING DATA

Sheet 1 of 4 Constructed in 1872 by Scranton Gas and Water Company. First gravity supply for Scranton. Structural modifications made in 1903 and 1944. DER ID NO.: 35-19 Project is shown on Olyphant, Pennsylvania, Quadrangle Sheet N4122.5 - W7530/7.5, 1946, Photo revised 1969. Construction drawings of original structures and sub-NAME OF DAM: No. 7 NDS ID NO.: 363 REMARKS Plans and sections available. No discharge ratings. sequent modifications. Available. 0 DESIGN, CONSTRUCTION, AND OPERATION PHASE I ENGINEERING DATA TYPICAL SECTIONS OF DAM CHECKLIST CONSTRUCTION HISTORY REGIONAL VICINITY MAP ITEM AS-BUILT DRAWINGS **Discharge Ratings** Constraints Detalls OUTLETS: Plan

A-1

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ENGINEERING DATA	
ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	Very few available.
DESIGN REPORTS	Design report for 1944 modification permit.
GEOLOGY REPORTS	General geologic information on original drawings.
DESIGN COMPUTATIONS; Hydrology and Hydraulics Dam Stability Seepage Studies	1914 stability and hydraulic analyses. 1944 stability and hydraulic analyses of spiliway modification.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	None.
POSTCONSTRUCTION SURVEYS OF DAM	Sediment level checked in 1959 - outcome unknown.

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ENGINEERING DATA

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Sheet <u>3</u> of <u>4</u>

ITEM	REMARKS
BORROW SOURCES	Not applicable.
MONITORING SYSTEMS	Dam operators visit dam daily to check equipment.
MODIFICATIONS	 1903: Spillway length increased by lowering 52 L.F. of dam by 2 feet; remainder of dam raised by adding 4 feet of concrete wall. 1896-1914: Various intake modifications. (Cont'd. on 1914: Removed 200,000 C.Y. silt. Page A-5)
HIGH POOL RECORDS	
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	1914 evaluation of hydraulics and stability.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	1902: Dam overtopped; description in 1914 report.

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Sheet 4 of 4

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Sheet 4 of 4	REMARKS	No detailed operation records.	Plans and sections available.	Plans and details available.	 1921: Seepage right end. 1925: Seepage through rock at right side spillway. 1928: Seepage at right end and on downstream face. 1930: Seepage at right end. 1933: Seepage at both abutments. 1941: Seepage at toe at right end. 1941: Seepage at too at right end. 1943: Seepage at both sides spillway; no seepage at toe with high pool. 1953: Logs in spillway approach area. 1957: Spillway crest deterioration. 1965: Spillway crest and abutment deterioration. 	
ENGINEERING DATA	ITEM	MAINTENANCE AND OPERATION RECORDS	SPILLWAY: Plan Sections Details	OPERATING EQUIPMENT: Plans Details	PREVIOUS INSPECTIONS Dates Deficiencies	

A-4

Sheet 4a of 4	REMARKS	1944: Increased spillway length by 34 L.F. and lowered spillway by 2.7 feet; reinforced wall sections used for additional spillway with prestressed steel rods; removed 4-foot high wall built in 1903 and replaced with 8-foot high wall; placed earthfill to Elevation 1050 at downstream face of nonoverflow section; constructed outlet channel right wall.		
ENGINEERING DATA	ITEM	MODIFICATIONS (Cont'd.) (from Sheet 3)		

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A-5

CHECKLIST

ENGINEERING DATA

HYDROLOGY AND HYDRAULICS

NAME OF D	AM: <u>No</u>	. 7 Dam	ID NO.:	<u>363</u> II	DER	35-19
ELEVATION	TOP NORMAL	POOL (STORAGE C	APACITY): E	Elevation	1055.9	
ELEVATION	TOP FLOOD CO	ONTROL POOL (SI	ORAGE CAPA	ACITY): E	levation	1069.0
ELEVATION	MAXIMUM DE	SIGN POOL:E	levation 106	9.0		

ELEVATION TOP DAM: Elevation 1069.0

SPILLWAY CREST:

- a. Elevation 1055.9
- b. Type Broad-crested with 1' high x 2' wide concrete coping.
- c. Width 10'
- d. Length 192'
- e. Location Spillover Right-center of dam
- f. Number and Type of Gates <u>None</u>

OUTLET WORKS:

- a. Type <u>36-inch and 48-inch CIP</u> b. Location <u>Near left abutment</u>
- c. Entrance Inverts 36-inch: 1025.0; 48-inch: 1025.5
- d. Exit Inverts 36-inch: 1024.5; 48-inch: 1025.0
- e. Emergency Draindown Facilities 36-inch blowoff and 48-inch blowoff .

HYDROMETEOROLOGICAL GAGES:

- a. Type None b. Location None
- None c. Records

MAXIMUM NONDAMAGING DISCHARGE: Unknown

SUSQUEHANNA RIVER BASIN ROARING BROOK, LACKAWANNA COUNTY

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PENNSYLVANIA

NO. 7 DAM

PENNSYLVANIA GAS AND WATER COMPANY

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APPENDIX B

CHECKLIST - VISUAL INSPECTION

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CHECKLIST VISUAL INSPECTION PHASE I

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County: Lackawanna State: Pennsylvanla	DER ID No.: 35-19	Hazard Category: H1gh	Weather: Cloudy Temperature:	General soll condition - moist	: 1056.1 msl/Tailwater at Time of Inspection: 1024.0		I. Crouse (GFCC)	D. Kaufman (PG&W)	R. Bonner (PG&W)	D. Wilson (GFCC) Recorder
Name of Dam: ·No. 7 Dam	NDS ID No.: 363	Type of Dam: Masonry Gravity	Date(s) Inspection: 4/11/78		Pool Elevation at Time of Inspection:	Inspection Personnel:	D, Wilson (GFCC)	W. Setp (GFCC)	D. Ebersole (GFCC)	

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EMBANKMENT Sheet <u>1</u> of <u>2</u>

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Cracking of embankment slope adjacent to screen chamber.	Also sloughing as described below.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	Minor sloughing over 12' x 25' area adjacent to screen chamber.	Sloughing at top slope to 1.5' maximum depth. Sloughing is not in critical location.
CREST ALIGNMENT: Vertical Horizontal	No abnormalities .	Noted 1.5' [±] difference between USGS elevation datum and datum used on plans.
RIPRAP FAILURES	No riprap.	

EMBANKMENT Sheet <u>2</u> of <u>2</u>

ATION OF BANKMENT	OBSERVATIONS Sloughing and cracking along screen chamber as described elsewhere.	REMARKS OR RECOMMENDATIONS
E E	Area at toe of slope below sloughed area was more moist than adjacent areas.	No actual seepage or standing water.
DER	None.	
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CONCRETE/MASONRY DAMS Sheet <u>1</u> of <u>2</u>

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	4" of standing water over 6' diam- eter area in front of gatehouse. Water was clear. Owner said it was a seasonal condition.	Water enters lower level of gate- house through drain holes at 4 - 5 gpm and discharged to channel by 6" diameter CIP.
JUNCTION OF STRUCTURE WITH: Abutment Embankment Other Features	2' diameter depression at junction of outlet channel wall and gate- house. Several small holes along left side of gatehouse adjacent to embankment slope.	No hazard to dam.
DRAINS	Outlet channel wall - 7 drains at various elevations.	Drain about 20' downstream from gatehouse had 2 gpm [±] . Others dry or nearly dry.
WATER PASSAGES		
FOUNDATION	Outlet channel wall undermined for 20' just downstream of 48" diam- eter blowoff.	Average depth of undermining is 12".

CONCRETE/MASONRY DAMS Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES: Surface Cracks Spalling	Left outlet channel wall: severe scaling and spalling along base; many medium longitudinal cracks; l vertical crack and l diagonal crack. Inside face left spillway wall: severe scaling and fine cracking.	
STRUCTURAL CRACKING	1/16" wide vertical crack through nonoverflow section of dam at chlorine tank storage area.	Crack goes through 2 facing stones. Does not go to water level. No differential movement.
ALIGNMENT: Vertical Horizontal	No irregularities.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Exposed masonry joints generally sound. Some deterioration on downstream face nonoverflow sec- tion over 3' x 20' area.	
STAFF GAGE OR RECORDER	None.	

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OUTLET WORKS Sheet <u>1</u> of <u>1</u>

AMINATION OF URFACES IN DUIT CTURE 10 CTURE 2	OBSERVATIONS Not applicable. Frashracks on upstream face of dam. 2" of water in gatehouse. Floor- ing loose.	REMARKS OR RECOMMENDATIONS
	None.	
	Gates coated with rust, but operat- Ing mechanisms lubricated. Four men opened 48" valve 12" in 30 minutes. One man opened 36" valve 12" in 10 minutes.	

UNGATED SPILLWAY

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Sheet 1 of 1

REMARKS OR RECOMMENDATIONS	Not inspected - too much overflow no major defects indicated.	t Owner said debris will be removed when amount of overflow decrease:			
OBSERVATIONS	Masonry broad-crested with 1' x 2' concrete coping.	Logs and debris accumulated a spillway crest. No operating constraints.	Too much tallwater to inspect immediate area.	None.	
VISUAL EXAMINATION OF	CONCRETE WEIR	APPROACH CHANNEL	DISCHARGE CHANNEL	BRIDGE AND PIERS	

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INSTRUMENTATION Sheet <u>1</u> of <u>1</u>

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	USGS benchmark on top of dam near right abutment.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR AND WATERSHED

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Sheet 1 of 1

REMARKS OR RECOMMENDATIONS		200,000 C.Y. sediment removed in 1914.		
OBSERVATIONS	Generally steep with rock outcrops No evidence of instability,	History of sediment problems. New highway work in recent years has caused abandonment of water supply function.	Wooded and hilly; bounded on right by railroad and highway.	
VISUAL EXAMINATION OF	SLOPES	SEDIMENTATION	WATERSHED DESCRIPTION	

DOWNSTREAM CHANNEL

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and the second state of th

Sheet 1 of 1

REMARKS OR RECOMMENDATION	ssing Pile of stone and soil was acces arrick ramp for previous repairs and wa tructs not removed.	le is See next sheet for description. bility, am.		
OBSERVATIONS	Constriction at pipeline cros 300' downstream. Pile of de stone, soil, and gravel obst part of channel.	Right side is steep. Left sid mild. No evidence of instab except immediately below da	Dunmore and Scranton about 1.3 miles downstream.	
VISUAL EXAMINATION OF	CONDITION: Obstructions Debris Other	SLOPES	APPROXIMATE NUMBER OF HOMES AND POPULATION	

REMARKS OR RECOMMENDATIONS	Condition unsatisfactory; failure of rock mass might damage the spillway.	Retains part of railroad embankment	Ť,		
OBSERVATIONS	Small wall acts as training wall and support for large block of rock. Undermined to maximum depth of 5 and 1s severely deteriorated. Con- crete apron also badly disinte- grated or missing.	Located Just downstream from right abutment; about 6' high; bottom members deteriorated.		•	
VISUAL EXAMINATION OF	AREA BELOW SPILLWAY NEAR RIGHT ABUTMENT	TIMBER CRIB RETAINING STRUCTURE			

SUSQUEHANNA RIVER BASIN ROARING BROOK, LACKAWANNA COUNTY PENNSYLVANIA

NO. 7 DAM

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

MAY 1978

APPENDIX C

HYDROLOGY AND HYDRAULICS

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GANNETT FLEMING CORDDRY AND CARPENTER, INC. HARRISBURG, PA. HO 7 RESERVOIR (35-13) HYDRIUSY AND HYDRAULUS ANALYSIS FOR USCE - BALTIMIRE DISTRICT COMPUTED BY JAC DATE 5/3/73 CHECKED BY FAW DATE 5/10
CLASSIFIC STION
HIGH HEARD, SINCE POPULATION DOWNTREAM IS 18,300
INTERAEDUATE SIZE, SINCE HEIGHT = 45 FET AND CAPACITY = 101,370,000 GALLANS = 311 AC-FT AT SPILLING CREDT CAPACITY = 570 K-FT AT 59 # DAM REFERENCE : "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS," p. D-3
SPILLINAM DESIGN FLOOD (SDF) THE SDF SHOULD BE THE PARF (FROM P. D-12 OF "REL. GUIDELLINES ")
HYDRIDITY AND HYDRIDICS ANALYSS Reference : Phase I procedure package II & 2. PMF INFLOW HYDRIGRAPH NOT ANALAGIE
a FROM CONVERSION OF MIKE KANDWITZ WITH KIG PROBATE FAF AT NO 7 NI = 50 7
SQ. MI, WITH PAR PEAK OF 39,500 CFS AT STILLWATER, D.A. = 36.8 SQ. MI.
GENERALIZED FORM OF TRAVISPOSITION (REFERENCE: ENTIMALE CONTACT - MARE KNINNITE) $\frac{Q_1}{Q_2} = \left(\frac{D, A_{,1}}{D, A_{,2}}\right)^{Q,3}$
$OE_{1} = Q_{2} (D.A{1} / D.A{2})^{0.3}$
$Q_1 = 39,500 (50,0/36,3)^{0,8}$ $Q_1 = 50,480$ (F5
: x = 59,780 CFS = PMF PEAK FIL STONA OVER ENTIRE NO.7 WINTERHED
EFFECT OF VATILEAM RESELVOIRS
NEWER EFFERS OF LAR HEART AND THE DESCRIPTION PALLSTER RESERVE
ASSUME THAT EFFECT OF CURTIS RESERVOIR IS REFLECTED IN THE EFFECT OF ELINIVEST RESERVOIR
PROPORTION OF NO. 7 PAR PENK AT ELAHORST REJERVOIR
ELAHORST COMPANIENT OF PAR PEAK = TOTAL FMF FELK AT NO 7
SP 11860A ELMHURIT DRUYNE AREA TOTAL D.A. AT NO.7

CANNET FLENDER CORDERY MITT RELEVITIR (35-19) - 7613 18
AND CARPENTER INC HYDRALIST AND HYDRALLOS ANALYSIS SHEET NO. 2 OF 6 SHEET
HARRISBURG, PA. FOR USCE - BATHORE DISTRICT
COMPUTED BY AC DATE 3/2 CHECKED BY DATE 3/2
$= 50, \pm 30 \text{ Cis}$
37.3 Sa. MI. 52.0 Sa. MI.
" Y = 37,660 CFS = ELANNIT COMPONENT OF NO.7 PMF PEAK
PMF PEAK INFON FOR STICK OVER EARLY WATESPED ILONE
FROM THE OWNE I INSPECTION REPART FOR ELANDERT DAW, THE PARE PEAK INFLOW
for the elaward waterway alone is 33,930 CFS
LOCALCH AN O CLOSE LUB COME CONTINUE LOCALCH AND
APPROACH BY Z LADES AND CHECK SPILL MAY ALESTACY FOR:
CASE - STAR STER ENTIRE MO, 7 WATER TED
ROUSE ELARVELT COMPONENT TELEVISIK AND
ALD CONDUCTION FRAM LEST OF NO. 7 WATERSTED.
CASE 2 - STOUR OVER ELABORATE WATER THE TOTAL
STAR ELANDER PART TALING ELANDA, LENDAR T
SAUTH FUL OVE TO DUELINPUTO, ESTIMATE EFFECT ON NORTH
Pose Indian Al No. 7 And Creck the mektining of in
1 Deix.
(KE) - STOCK AVER ENDLE NO 7 WISE (1127)
CASE I STORM VIEW ENTINE THE THE PARTIE THE
= LOWGED ONE PEAK AT NO
= 50130 - 37000 = 17970 cer tai 91=
100 - 17 870 / 2 - 540 /
INFOR TO NO TO FEEDIR FIAM FINDET LECEVILR
a) INFINI TO FINIVELT OFFENDING = 37.660 (FS FIL PAT FSIK
= 18 ATO (F) FILL FILL
WITTER FRAM FLANKET OFTERVAIR & INFININ TO UN TO ESTERVOIR
TT & ARILITI OF ELANIKIT SPILINKY TO SALT FLANING TO IMPONENT OF NO 7 PAR VENK
I CAPACITY OF ELMINING STILLING = 31,000 (FS (AMEL TENT)
3 THE ELANDRUT COMPONENT OF THE 112 7 PMF FEAR FLOW IN TREATER THAN THE FILLING CONTENT
(37,660 7 31,000)
b ROMAG IS NOT NUMBER
(1) The church and prof 71 000/27 (60) = 0 627' + 0 - DO - H

(1.) The shughty where $C_1(31,000/37,660) = 0.823^{\circ} - p = B2.376^{\circ}$ of the LECK (2) INCLUME 3 METERS TO ESTIMATE STANGE EFFECT OF NETERSOR

C-2

SP 1186CA
GANNETT FLEMING CORDDRY SUBJECT NO. 7 10 TELEVIDIE (35-10) FILE NO. 7613. 18 SHEET VECE-EASTIMILE DUTING FOR_ HARRISBURG, PA. COMPUTED BY_____NC DATE SISTE CHECKED BY DAW DATE SIS (9) TRIMINE SHAPE FOR PAR GYLISIANA (b) RAE THE COMPORTION - MINIMUM TIME = EINHALT TIME T TOK EYAYAKIT DATA = +1.6 UPURJ $1-p = 1.0 - 0.323 = 0.177 = \frac{1.15}{5.415}$ AAB = = bh = = (+1,6 HET) (37,660 (= 783,300 (FJ-185 △ AOC = (1-p) △ AOB = (0, 171)(783, 300) = 138, 650 CFS-VAS 138,550 CFS- W UF STICKE (EATIND 138,650 CFS-NES × (3,500 K-SEC / +3,500 FT-NE) = 11,460 KC-FT 11, 460 AC-FT (MINI) OF STORAGE IS REATIRED C) INCREMENTAL STARKE ANALLABLE EETHEEL NUMBER POIL ELEMANN AND MANANA PIOL ELEVITION - SEE THE PANE I MIPECTION REPORT FOR EAVING DAY -15 1,645 AC-FT STORIE REATING = 11,460 &C-FT >7 STORIE NILURE = 1,5+5 &C-FT . ELANKIT DAA LO OFFICIPAD BY ELANVILIT COMPINENT OF THE NO.7 PAP PEAK 0 CALENA LINEACT RESCAR INTO 10,7 REECOC REFERENCE: PUNCE I INSTECTION REPORT FOR LANE WILLIAMS SY EAST. DIT., CONE, FEERING 1978. MAXIMUM SPILLWAY DUCHAIE OF NO. 7 = 25, 707 CFJ (1044 PELATT APPLICATION RENET TO WATER & PINER RESIRCE ENLED, DIVISION OF BANS & ENCLINEDEDTS) PAF INFLOW (NOT THE PENK) = SPILINAR CHONOTI OF ELACINCT DAM = 31,000 (FS P = MAY. SPILLARY DISCURLIE OF 110.7 = 25,000 = 0.306 FMF INFLOW TO 110.7 = 31,000 = 0.306 - 1-p = REAVIRED RESERVINE STILLIE = 0.194 VOLVAE OF MELOW HYCLOSCAPH (V) ASSYME TRIANSTLIR SHAPE TOTAL TUNE (T) = SPILIMAT CAPACITY OF ELANVRUT DAM (TUNE FOR ELANVRUT DAM) $T = \frac{31,000}{39,330} (+1.5 \text{ mms}) = 32.3 \text{ Hours}$ V= 之 b h = 之 (32.3 HILC) (31,000 CFS) = 500,650 CFC - HRS SP 11840. C-3

GANNETT FLE/ AND CAR MARRISE	MING CORDDRY PENTER, INC. BURG, PA. 1 = 500, 650 CFJ- LEQVIRED RELEXITIE	SUBJECT NO. 7 RESERVOIR (35-19) FILE NO. 7613. 18 HYMAUCIY AND HYMAUCS ANALYSIS SHEET NO. 4 OF 6 SHEET FOR 15CE- BALTIMANE DISTRICT COMPUTED BY JMC DATE \$15/73 CHECKED BY DAW DATE \$700 HIRS X (3,500 AC-SEC/ 43,560 M2-HR) = 41,380 AC-FT ST JAAGE = (1-p) V = (0, 154) 41,330 AC-FT = 8.027 AC-FT
· · · · · ·	NCRENESITIAL STURASE NOOMAL POOL ELE MAXIMIA POOL ELE AREA OF RESERIO AREA OF RESERIO ALSUME RESERIO WITH CH ON 11	ATAILABLE BETWEEN MORIAL POOL ELEVATION AND MAXIMUM POOL ELEVATION HATION = SPILLINGY CREST ELEVATION = 1055.9' ENATION = TOP IF DAM ELEVATION = 1069.0' IL WITH M.S. & SPILLINAY CREST = 18.8 ACRES (FROM 1044 WAT. SUPER IL WITH M.S. & TOP OF DAM = ? K SIDE DOPED OF 2.4 ON (V AND ASSUME CIRCIUM SHAPE V SLIVE AND DY = 13.1', DH = 2(13.1') = 25.2'
0	INCREMENTAL STON	$A = \pi r^{2}, \text{ where } r = \text{Eguitaleyt RADIVS OF ALSWHED CARCHAR SIAPE 3.3 MIES x (+3,50) = \pi r^{2}260,670 = r^{2}r_{1} = 510,6 \text{ Fest}r_{2} = r_{1} + 26,2' = 5125 + 26.2 = 536.3'A_{2} = \pi r^{2} = 905,100 \text{ Ft}^{2}A_{3} = 20.8 \text{ Kress}Have = (A1 the/2) x H = (13.3 + 23.3/2) x 13.1= 250 \text{ KC-FT}$
	Storage R	EQUILE) = 8,027 AC-FT >7 STORAGE ANALUBLE = 533 AC-FT
	SINCE THE ANALLABU	E STORAGE AT NO. 7 RESERVOIR IS INSUFFICIENT TO CONTRIN THE

SPILLINAY CHRATTY PENK OF ELINVIKIT DAM (AND THE NISICIPED VOLUME), NO. 7 RELEXANCE WILL NOT CONTIN THE PARF.

CASE 2 - STUGM ONEL ELMAURIT WATERVED ANDRE

AS SHOW IN THE PLAIS I REPAIT FOR ELMARKOT DAM, THE EMBINIST PARE PEDOKES OTEDRANG AT ELMARCT DAM. FOLLOWING THE LOSIC OF THE PREHIMPED DEREBED CASE 1, & DUCURSE OF 31,000 (FS (SPILLWAY CAPACITY) AT ELARACT IS SUFRICIENT TO PRIDIKE OVERTOPPUS AT NO. 7 DAM.

* NO, 7 RELEVIDA WILL NOT CONTAIN THE FOR

SP 11840A

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GANNETT FLEMING CORDDRY AND CARPENTER, INC.	SUBJECT NO. 7 RESERVING (35-19) FILE NO. 7613. 18 HTEODOT AND HIDRARICO ANALYSIS SHEET NO. 5 OF 6 SHEET FOR USCE - CATURINE DISTRICT		
·····	COMPUTED BY JAC DATE 5/3/73 CHECKED BY PAW DATE 5/14		
I. E. ASILITY OF ELMUNAT I. SPILINA CAPACITY = 2. THE PEAK FLIM IS L 6. ELMANAST CAM CA OTECNOME II. B. ABILITY OF ELMUNAST SP SINCS LAGES (FS 15)	SPILLIVAY TO PASS $\frac{1}{2}$ EUNIVIENT (WARWEINT OF NO, 7 PARF PEAK = 18,830 31,000 CFS ES THAN THE SPILLIVAY (ARKITY IN BE ASSUMED TO BE ABLE TO PUS $\frac{1}{2}$ EUNIVIENT OF NO, 7 WHENT INCLINENT TO PASS $\frac{1}{2}$ ELANDERT PARF PEAK = 30,930/2 = 10,365 CFS		
TI PASS & SUMBARY PAT YEAR WITHING OVERTHANKST CLAN GE ASUMED TO BE ABLE			
I. B. LEVITY OF NO. 7 FUER ASSUME ELMINIKIT RESER THEN, OUTFLUW = (ELMINIET COMPUTENT + 1. SPILIMAY CARMOTY = 2. THE PEAK FLUM IS LESS 6. NO. 7 GAM CAN BE ASSU PMMT FEAK IS LESS THAN T II C. 2. C. TAILINATER AT IN	IR TO PAUS $\frac{1}{2}$ NJ. 7 FINF PEAK = $(39490/c)$ = $25,240$ = NOIR ATTENUATES FLOOD PEAK TO PRIDIXE AN OUTFLOW OF 3370 OF THE INFLOW ().3) 18830 = 13,453 CFS DIRECT DAMINAGE COMPONENT = 18,453 + 6,410 = 24,863 CFS Z5,000 CFS TEAN THE SPILLINAY CLEAKITY MED TO RE ABLE TO PUSS $\frac{1}{2}$ NO. 7 PMF FEAK WITHOUT OVERTOFPING, SULE $\frac{1}{2}$ OF THE NO ME SPILLINA CREATY OF NO. 7 DNH, AND THE UPSTEENA REJEVOIR, EMULUIT, IS NOT OVER- STAMT BEFORE DIERTORING UCCURS		
SPILINA CJ TAILWATE D TOP OF DA HEIGUT OF	PRITY DISCURSE = 25,000 (FJ; FLM HEC-2 COMPUTER KIN, BTH Q Q = 25,000 (FJ IS 16.0 FET A ELEVATION = 1060.0' DAM = 45 '		
BOTTIN OF TAILWATER TAILWATER I TOP OF CAM	DAM ESTATION = 1024.0' DEPTH = 16.0' SEPATION = 1040.0' ELET - TAILINETER ELEVATION = 1053.0' - 1040.0' = 23.0'		

in mage

GANNETT FLEMING CORDORY SUBJECT NO. 7 RESERVOIR (35-13) FILE NO. 7613. 13 AND CARPENTER, INC. HILLILII AND HIDANULICS ANALISIS SHEET NO. 6 OF 6 AND CARPENTER, INC. SHEET FOR USCE - BATIMONE DUTRICT HARRISBURG, PA. COMPUTED BY JAC DATE SI31/78 CHECKED BY DAW DATE 6/55 0 PERCENT OF PMF THAT SPILMAY CAN PASS GENERAL FORMULA 7. OF PMF THAT SPILLINAY CAN PASS = QT × 10070, WHERE QT = QSPILINAY + 25 S = E Si FOR VPUTREAM RESERVOR CASES, AND T = TOTAL TIME OF PAF HYDRIFFAPH FRUM CURVE FOR SLUAVEHANNA RIVER ENDN $7. \text{ OF PMF} = \frac{25,000 + \left(\frac{2 \times (253 + 1,646 + 288) \text{ AC-FT}}{46.0 \text{ HURS}} \times \frac{+3,550 \text{ FT}^2 - \text{HS}}{3,600 \text{ IC-SECS}}\right)}{50,480} \times 100\%$ $= \frac{25,000 + 1,154}{50,480} \times 100\%$ \cap = 5270

SUSQUEHANNA RIVER BASIN ROARING BROOK, LACKAWANNA COUNTY PENNSYLVANIA

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NO. 7 DAM

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM

MAY 1978

APPENDIX D PHOTOGRAPHS



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A. Downstream Face of Dam Left of Spillway



B. Dam and Spillway Approach Area Looking Downstream









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I. Slough in Embankment Adjacent to Gatehouse



J. Rock Mass and Wall Downstream from Spillway at Right Abutment



NO.7 DAM

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K. Flow from 48-Inch Blowoff During Valve Operation



L. Debris in Downstream Channel and Aerial Pipe Crossing SUSQUEHANNA RIVER BASIN

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ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 7 DAM

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM

MAY 1978

<u>APPENDIX E</u> <u>GEOLOGY</u>

NO. 7 DAM

APPENDIX E

GEOLOGY

1. <u>General Geology</u>. The damsite and reservoir are located in the northeastern portion of Lackawanna County. Lackawanna County was completely covered with ice during the last continental glaciation of Pleistocene time. The general direction of ice movement was $35^{\circ}-40^{\circ}$ 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 and Stafford Meadow Brook, have cut deep canyons through the mountains and follow a tortuous course to their confluence with the Lackawanna River near Scranton, Pennsylvania. 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. <u>Site Geology</u>. No. 7 Dam is founded on Pottsville sandstones or conglomerates for its entire length. The exposed rock is primarily a gray, massive, coarse-grained conglomerate with a slight dip downstream and in the direction of the left abutment. The stream in this area is turning out of Mauch Chunk shale formations and is now cutting through the Pottsville formation toward a confluence with the Lackawanna River. A view of the exposed rock in the left abutment reveals a sandstone stratum at the base followed by shallow layers of soft shale and hard slate. Next, there is a 3-foot thick coal seam, indicative of the Pottsville formation, followed by 20 feet of conglomerate to bottom of overburden. The right abutment is similar, except that the soft shale layer is not visible. It has either been phased out or it has dipped below the level of exposure. The masonry abutments of the dam are keyed well into the rock sidewalls.

U