AD-A063 037 WOODWARD-CLYDE CONSULTANTS PLYMOUTH MEETING PA F/G 13/2
NATIONAL DAM SAFETY PROGRAM. PICKERING CREEK DAM (NATIONAL I.D.--ETC(U)
MAY 78 J H FREDERICK, W S GARDNER DACW31-78-C-0048

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John H. /Frederick, Jr.
William S. /Gardner

National Dam Safety Program. Pickering Creek Dam (National I.D. Number ØØ622), Schuylkill River Basin, Pickering Creek, Chester County, Pennsylvania. Phase I Inspection Report

LEVEL II

SCHUYLKILL RIVER BASIN

PICKERING CREEK DAM
CHESTER COUNTY, PENNSYLVANIA
NATIONAL I.D. NO. 00622

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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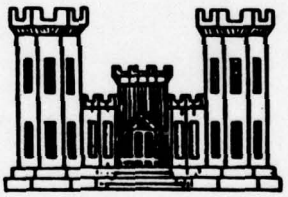

Prepared by:

WOODWARD-CLYDE CONSULTANTS
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Plymouth Meeting, Pennsylvania 19462

S/C 394157

Submitted to:

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

May 1978

ORIGINAL CONTAINS COLOR PLATES: ALL DDC REPRODUCTIONS WILL BE IN BLACK AND WHITE.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Pickering Creek Dam

State Located: Pennsylvania
County Located: Chester County
Stream: Pickering Creek
Coordinates: Latitude 40° 07.4' Longitude 75° 29.6'
Date of Inspection: 11 April 1978

Pickering Creek Dam is a patented concrete structure designed and constructed by the Ambursen Construction Company. It has been stable and serviceable for more than 50 years and is judged to be in fair to good condition. There are sections of deteriorated concrete which the Owner has evaluated and completed plans to initiate repair in the near future to upgrade the structure to good condition. Consistent with these findings, it is recommended that another Phase I type investigation be repeated within the next five years to re-evaluate the integrity of the concrete and/or the repairs.

Available records pertaining to the hydrologic/hydraulic characteristics of the reservoir and structure were reviewed and these data were supplemented with computations using Corps' Guidelines. Based on these findings, it is concluded that the structure will not pass one-half the probable maximum flood (PMF) without overtopping. However, calculations indicate that the structure will safely pass an approximately a 200 year storm (21 percent of PMF). Since the concrete structure is founded entirely on rock, it is not likely the dam will fail during overtopping at approximately one-half PMF. Also, it is likely that the Schuylkill River will back-up, increasing the tailwater significantly which minimizes the effect if failure occurs. Therefore, it is concluded that the spillway is only inadequate and not seriously inadequate. However, it is recommended that a definite plan for around-the-clock surveillance be implemented during periods of unusually heavy rainfall and a formal warning system be developed for use in the event of an emergency.

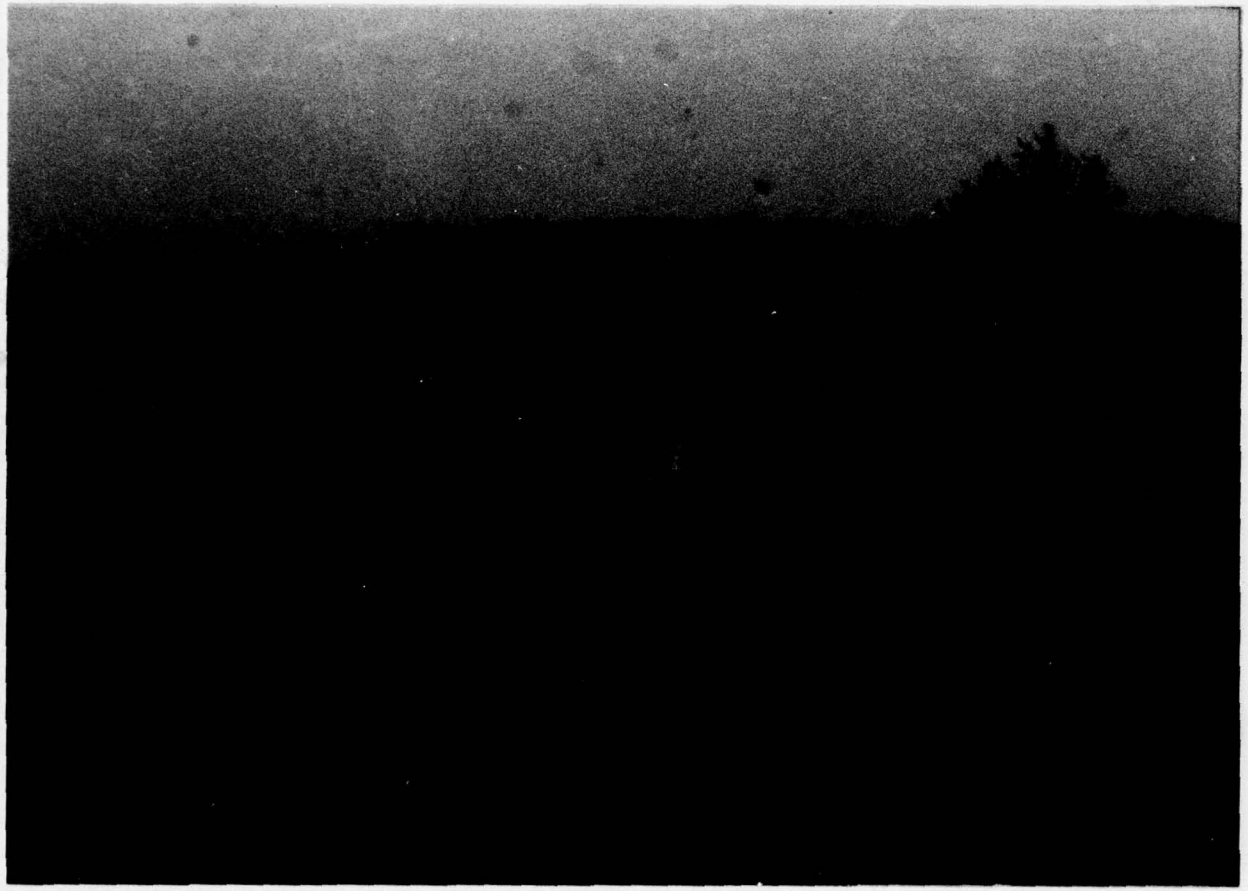
John H. Frederick, Jr., P.E. — 5/31/78
Maryland Registration 7301 — Date

William S. Gardner, P.E. — 5/31/78
Penna. Registration 004302E — Date

APPROVED BY:

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

DATE: 14 June 1978



OVERVIEW

PICKERING CREEK DAM

1.0 AUTHORITY

The Phase I investigation described in this report was made as part of the National Dam Safety Program. This program is being implemented by the Secretary of the Army, through the Corps of Engineers, in response to the National Dam Inspection Act, Public Law 92-367, dated August 8, 1972.

2.0 PURPOSE

The purpose of this inspection is to determine by visual inspection supplemented by a review of available literature, if the dam constitutes a hazard to human life or property.

3.0 GENERAL

This Phase I investigation followed the procedures outlined in the "Recommended Guidelines for Safety Inspection of Dams", issued by the Department of the Army, Office of the Chief of Engineers. It consisted of a review of readily available engineering and operational data pertaining to the project and a visual inspection of the dam and appurtenant structures.

The Phase I investigation seeks to provide a judgement concerning the risk of a dam failure and to suggest remedial measures for mitigation of this risk. The product of this investigation is an assessment of the general condition of the facility and the formulation of an opinion as to the need for any emergency measures or additional studies, investigation and analyses.

The engineering data reviewed was derived from the files of the Pennsylvania State Department of Environmental Resources (DER) in Harrisburg, Pennsylvania; provided by the Owner; or contained in Woodward-Clyde Consultants (WCC) files.

The field inspection was performed on April 11, 1978, by a team of engineers and geologists listed in Appendix B. Local information concerning the operation and maintenance of the facility was provided by Mr. Thomas Kiely, representing the Philadelphia Suburban Water Company.

4.0 DESCRIPTION OF PROJECT

As shown on Plate 1, Pickering Creek Dam is situated on Pickering Creek immediately to the south of Route 23 in Schuylkill Township, Chester County, Pennsylvania. The watershed of the reservoir is contained entirely within Chester County.

Pickering Creek Dam was constructed for the Philadelphia Suburban Water Company between 1926 and 1928 and is primarily a concrete buttress structure containing an overflow spillway section of a type designed and constructed by the Ambursen Construction Company. A plan of the dam showing the location of the buttress sections and adjoining gravity and core wall sections is enclosed as Plate 2. At the location of the dam, Pickering Creek drains a watershed of approximately 38 square miles. At the normal pool elevation the reservoir occupies an area of approximately 105 acres, contained entirely within Chester County.

Water is released from the structure by three methods. The primary purpose of the structure is to supply potable water and this water is withdrawn from the reservoir through an intake structure, containing sluice gates at elevations +80, +90, and +100. The water is conveyed to a treatment and pumping facility downstream from the dam.

As shown on the typical cross-section of the dam, enclosed as Plate 3, the 300-foot long ogee spillway discharges excess overflow down the face of the dam into a bucket (rollway). Emergency drawdown water can be released from the reservoir by means of two 30- inch pipes regulated by gate valves inside the spillway gallery.

Excess and emergency drawdown water discharges into the discharge channel. Over a distance of about 60 feet downstream from the dam, the discharge channel narrows from the spillway width of 300 feet to 160 feet at a bridge carrying Route 23 over Pickering Creek.

4.1 CLASSIFICATION

This dam is classified according to Corps of Engineers' guidelines as an intermediate size dam by virtue of both its maximum storage capacity and its height. Since failure of the dam could potentially result in the loss of life to several residents downstream, it is classified as a High Hazard Potential dam.

4.2 PURPOSE

Pickering Creek Dam is owned and operated by the Philadelphia Suburban Water Company (PSWCo.) primarily as a water supply source for the PSWCo. water purification plant located immediately downstream. There is no boating or swimming allowed on the lake.

4.3 DESIGN AND CONSTRUCTION HISTORY

Pickering Creek Dam was constructed between 1926 and 1928 and is primarily a concrete buttress structure containing an overflow spillway designed, constructed and patented by the Ambursen Construction Company. Concrete gravity sections adjoin the concrete buttress section of the dam as shown on Plate 2.

The buttresses, supporting concrete slabs which form the dam surface, are spaced 15 feet center-to-center. The upstream slab varies in thickness from 1.0 to 2.0 feet and the downstream slab in the spillway section is 1.0 foot thick. The buttress sections at each side of the spillway have a crest elevation of 106.5 and contain a parapet wall extending up to elevation 110. The parapet was reportedly designed as a structural cantilever to retain water in the reservoir. At each end of the buttress sections, there are concrete gravity sections. Concrete cut-off walls are provided at the abutments. As shown on Plate 4, the cut-off walls terminate where the rock surface corresponds to the crest elevation of the dam.

As shown on the typical cross-sections, a concrete cut-off extending into rock is located at the heel of the dam. A grout curtain was also constructed beneath the buttress section of the dam. Details of the cut-off wall and grout curtain are shown on Plate 4. The grout

holes were generally spaced four feet apart and are shown to extend on the order of 10 to 15 feet below the concrete cut-off. As shown by the gaps on Plate 4, occasional grout holes shown on the plan were not drilled. The notations on the drawing at these points indicated that hard rock was encountered.

The spillway bucket, termed rollway, was constructed as a tangential curve off the downstream face of the dam. The bottom of the bucket is at different elevations across the width of the spillway. A series of elevation measurements (1931) of the stream bed downstream from the toe of the dam taken after construction indicated that the spillway discharge was causing erosion. As a result, in 1933, a 15-foot wide concrete apron was constructed downstream from the bucket.

In 1936, engineering studies were made to examine the possibilities of overtopping the dam. It was concluded that water overtopping the dam would impact the ground surface a few feet downstream from the edge of the dam. As a result, a riprap lined channel was constructed immediately downstream from the east end of the dam, roughly parallel to the dam axis and discharging into Pickering Creek (see Photograph No. 2). Although the west side of the dam is at the same crest elevation, no such emergency discharge channel was constructed on the west side.

4.4 NORMAL OPERATING PROCEDURE

Records documenting the normal operating procedures were not available. However, discussions with plant personnel indicates that water is supplied to the water purification plant through a pipeline by means of sluice gates at the intake structures located at elevations +80, +90, and +100. Excess inflow passes over the spillway and is channeled by Pickering Creek to the Schuylkill River. This spillway serves as both the primary and emergency spillway.

4.5 PERTINENT DATA

A summary of pertinent dam statistics is presented on Table 1. Most of these data were obtained from the Philadelphia Suburban Water Company or from the files of the Pennsylvania State Department of Environmental Resources. Other data was computed from the OCE Guidelines or derived from other pertinent literature.

4.6 GEOLOGIC BACKGROUND

Miscellaneous drawings and literature reviewed indicated that the rock at the dam location was overlain by a maximum of about 13 feet of soil. Regional geologic maps identify the rock as the Stockton Formation of Triassic age. At the location of the dam, the Stockton Formation is reported to be a fine- to medium-grain arkosic sandstone with occasional thin shale beds. Based upon local experience and field reconnaissance, it is believed that the valley bottom soils are primarily alluvial deposits, whereas residual soils, derived from in situ decomposition of the underlying rock, form the soil mantle elsewhere.

Beneath the thin alluvial deposits, or as encountered near the surface, the Stockton Formation is typically identified as decomposed, friable sandstone that increases in quality with increasing depth. The relatively unweathered, intact sandstone could be expected to provide an excellent foundation material for the dam, being relatively incompressible and impervious, except for badly jointed and/or fractured zones. However, any adverse jointing or fracturing would be expected to have an irregular occurrence and to be limited to within a surficial zone of the rock formation.

5.0 SUMMARY OF ENGINEERING DATA AVAILABLE

Data available for review during this investigation included all documents in the files maintained by the Pennsylvania State Department of Environmental Resources as well as data on file at the Philadelphia Suburban Water Company. A summary of selected documents used during this inspection are tabulated below:

(1) Report upon the Application of the Philadelphia Suburban Water Company, dated November 17, 1925.

(2) Miscellaneous "Inspection Reports" and correspondence.

(3) USGS maps of the drainage basin.

(4) Assorted design and construction drawings.

(5) Philadelphia Suburban Water Company, "Pickering Creek Dam, Plan and Profile", Sheet 2 of 3.

(6) Ambursen Construction Company, Inc., "Details of Intake Tower, Ambursen Dam, Philadelphia Suburban Water Company, Phoenixville Development", Sheet No. 3C, 1/18/26.

(7) Philadelphia Suburban Water Company, "Pickering Creek Dam, Cross-Sections", Sheet 1 of 3.

(8) Philadelphia Suburban Water Company, "Pickering Creek Dam", Sheet 3 of 3.

(9) Philadelphia Suburban Water Company, "Investigation of Parapet", Analysis Calculations, 1932.

(10) Philadelphia Suburban Water Company, untitled drawing of grout curtain profile.

(11) Philadelphia Suburban Water Company, "Pickering Creek Dam, Elevations of Rock at Downstream Toe", G-3918, 4/9/31, with subsequent additions.

(12) Philadelphia Suburban Water Company, Analysis and Design Calculations, 1936.

(13) Woodward-Clyde Consultants report to Philadelphia Suburban Water Company, "Remedial Construction, Pickering Creek Dam", 75C611A, dated September 14, 1976.

(14) Woodward-Clyde Consultants report to Philadelphia Suburban Water Company, "Safety Evaluation, Pickering Creek Dam, 71P76, dated September 25, 1975.

6.0 RESULTS OF VISUAL INSPECTION

Inspection of the Pickering Creek Dam was made on April 11, 1978. At the time of this inspection, the reservoir was filled to normal pool elevation and water was flowing over the spillway. Both exterior and interior inspections of the dam were made. Pertinent observations made are described as follows.

6.1 EXTERIOR OBSERVATIONS

The flow of water over the crest and down the face of the spillway was generally observed to contain only minor turbulences or disturbances such as would be indicative of abnormal roughness or erosion of the spillway slab surface.

The retaining wall downstream from the spillway appeared to be in good condition. Clear water observed flowing from the retaining wall weepholes showed no evidence of active subsurface erosion. The exposed concrete of the gravity sections of the dam was found to be free of cracks and surface deterioration and to be in overall good condition. No evidence of movement or distortion of the dam was evidenced by the crest or parapet wall alignment.

6.2 INTERIOR OBSERVATIONS

Inspection of the interior of the spillway section of the dam was made possible by entry via an access walkway located within the dam and entered at the west end of the section. Examination of the condition of the underside of the slabs forming the buttress dam sections was al-

TABLE 1
PICKERING CREEK DAM
SUMMARY OF PERTINENT DATA

1.	Drainage Area	38.4 square miles
2.	Dicharge at Dam Site	
	Maximum known flood at dam site	5,400 cfs
	Total Spillway capacity at maximum pool elevation	12,400 cfs
	Capacity of two emergency drawndown pipes	No rating curve available
3.	Elevation (MSL)	
	Top of Dam	110 ft.
	Maximum Pool	110 ft.
	Maximum Pool of Record, Est.	108 ft.
	Spillway Crest	105 ft.
	Normal Pool Elevation	105 ft.
	Intake Tower Sluice Gates	80, 90 and 100 ft.
	Maximum Tailwater of record	96.6 ft.
	Streambed at end of spillway	74 ± ft.
	Lowest Spillway Bucket Elevation	71± ft.
	Lowest Cutoff Elevation	65± ft.
4.	Reservoir	
	Length of Normal Pool	1.6 miles
	Surface Area at Normal Pool	105 acres
	Storage at Normal Pool	1143 Acre-Feet
	Storage at Maximum Pool	1713 Acre-Feet
5.	Dam	
	Type	Concrete patented Ambursen design. Concrete spillway, concrete gravity and buttress sections founded on rock.
	Length of Entire Dam	800 ft.
	Length of Spillway	300 ft.
	Top Width of Dam	4 ft.
	Grout Curtain	Yes

TABLE 1 (continued)

6	Diversion and Regulating Systems	
	Water Supply	3-sluice gates at El. 80, 90 and 100 supply water via a pipe to the treatment plant downstream.
	Primary Spillway	300 ft. concrete spillway discharges into natural channel.
	Drawdown Facilities	Two 30-inch pipes located at the base of the reservoir discharge into the natural stream channel.

so performed and revealed the slabs to be serviceable but to exhibit leakage and evidence of progressive concrete deterioration, particularly the downstream slab of the spillway section. Evidences of previous concrete repairs and concrete test evaluation core holes in the slabs were also noted.

A pool of water was observed to exist within many of the spillway sections of the dam. Natural soil and rock materials were observed between the buttress footings and beneath the interior water pools. Drains located within the interior of the buttress sections near the toe of the downstream spillway slab were also observed. It is believed that these drains serve to provide equalization of water levels inside of the buttress dam section with the tailwater pool of the dam.

Leakage: Some leakage into the interior of the buttress dam sections was in evidence at the time of this inspection and corresponded with observations made during previous inspections in March 1972 and January 1975. These leaks were primarily located in the downstream slab comprising the spillway ogee. The discharge volume of individual leaks was observed to be small and generally less than 1 gpm. Many of the leaks are intermittent and occur only during spillway overflow.

The source of several leaks was observed to be tie-bolt holes in the downstream spillway slab. Other leaks were observed to be associated with small diameter pipes installed in the upstream slab of the buttressed sections, possibly during a previous remedial construction to grout seal construction joints. Leakage was also observed near the underside of the spillway crest and appeared to issue from the vicinity of a series of plugged pipes or core holes about two inches in diameter.

Evidence of carbonate leaching from the concrete, usually associated with leakage, was also observed. Such leaching was particularly evident beneath the upstream slab of the buttress sections, especially in proximity to horizontal construction joints in the slabs and along the joints where the slabs are supported by the interior buttress walls.

Concrete Condition: A visual examination of the structural concrete was made in bulkhead sections at the east end of the dam and in the buttress spillway sections. Based on this examination, the concrete of the interior buttress columns and beams appeared to be sound with little evidence of deterioration. The condition of the concrete on the underside face of the upstream slab contained surficial zones which were spalled and softened, particularly in the vicinity of the previous patching (see Photograph No. 7). In areas where the patching had fallen away or was easily chipped off, the original concrete was found to be soft and readily abraded with a knife blade. In these areas, the depth of unsound concrete was not readily determined. By comparison, the condition of the underside of the downstream slab appeared to be significantly better. In conjunction with concrete deterioration, reinforcing steel was infrequently observed to be exposed and to have been subject to limited corrosion. These observations were generally associated with the previously patched areas of the upstream slab.

7.0 OPERATION AND MAINTENANCE PROCEDURES

It is understood that no formal operational or maintenance procedures exist. However, in subsequent conversations with site personnel, it was apparent that all operating personnel were aware of the water supply requirements and operation of the water control systems. In summary, municipal water is supplied to the treatment plant via pipes as demand dictates. Excess water is directed over the spillway. In case of an emergency, two valved pipes can be opened inside the spillway chamber and flow released into the downstream channel. Water levels and flows are reportedly recorded daily and maintained at the treatment plant and at PSWCo. office. It is understood that maintenance is performed as conditions requiring immediate repair are observed. Based on this information, it is concluded that formalized written procedures for operation and maintenance of the dam should be prepared.

8.0 WARNING SYSTEM

The inspection revealed that there is no monitoring instrumentation or warning system in effect. Conversations with representatives of the Owner indicated what

course of action individuals might take if emergency conditions developed. However, there was no formal document that delineates a designated response to potentially hazardous conditions. It is understood that the structure is monitored by treatment plant personnel during periods of high flow.

Because of the value that an organized and documented emergency warning system can have on the outcome of an emergency situation, it is concluded that such a plan should be prepared and implemented.

9.0 HYDROLOGIC/HYDRAULIC EVALUATION

9.1 Design Evaluation Data

Readily available hydrological design data was limited to statements in the Application Report, located in the State files. Results of a hydrological evaluation study (Reference 14, listed in Section 5), along with supporting calculations located in PSWCo. files were also available.

The Pickering Dam drainage area characteristics, as determined from USGS maps, disclose that the area is irregularly shaped, fairly long and narrow. The maximum length is approximately 11 miles and the width varies from less than three to more than six miles. The topography is rolling with elevations ranging from 650 feet to approximately 74 feet in the streambed just below the dam, and a dendritic stream pattern exists. The current land use is predominantly open/farm land with wooded areas. The area is approximately one-quarter developed with homes and is a growing area. The structure is located approximately 2,000 feet above the confluence of Pickering Creek with the Schuylkill River.

According to reports located in the State files, the spillway was designed to pass a runoff rate of 210 cubic feet per second per square mile, or 8000 cfs with a freeboard of 1.34 feet.

In 1975, an evaluation of the safety of the dam was completed including a hydrologic evaluation. A synthetic unit hydrograph was developed using Snyder's Method as being the most representative of the watershed when compared to nearby watershed studies (Ridley Creek). A PMF of 54,900 cfs from 25.8 inches of runoff from 48-hour storm was calculated (virtually no runoff) during the first 24 hours. This is greater than the maximum (no freeboard) spillway discharge of 12,400 cfs.

Under the OCE Guidelines, the recommended spillway design flood for the size (intermediate) and hazard potential (high) classification of the dam is the probable maximum flood (PMF)

9.2 EXPERIENCE DATA

Major storms, as noted in the State's files and PSWCo. files, have occurred in August, 1933, when three feet of water passed over the spillway (5,400 cfs); July, 1927, when 4.93 inches of rain produced a depth of flow of 16 inches (1500 cfs); November, 1950, when 5.98 inches produced a depth of flow of 2.5 feet (4100 cfs); and June, 1972, when the maximum tailwater elevation was recorded in the filtration and pumping plant area. The 1972 storm (Hurricane Agnes) produced an estimated 6.5 inches over a five-day period, (other rainfalls noted are for 24-hour periods). Pictures taken of the spillway at that time show an estimated 1.5 to 2 feet of water passing over the spillway (1800 to 2900 cfs) and a record high water elevation in the plant area of 96.58 was recorded.

9.3 VISUAL OBSERVATIONS

On the date of the inspection, conditions relating to the reservoir, spillway, downstream channel and downstream hazards were noted and recorded on Sheets 7, 10 and 11 of Appendix B. The filtration and pumping plant is built on the flood plain of Pickering Creek. A flood wall is built around the plant area and may serve as a downstream restriction during flood flows.

9.4 OVERTOPPING POTENTIAL

The 1975 evaluation study determined that the maximum flood that would not overtop the structure to have a peak inflow of 11,600 cfs resulting from a 12-hour storm runoff of 5.20 inches. By implication, any greater flood would result in overtopping. As a check, the triangular approximate flood routing method recommended in the OCE Guidelines was computed and included in Appendix C. The peak inflow rate and inflow volume used were the values determined for the 1975 evaluation. The available storage is insufficient to contain either the PMF, or 0.5 PMF (27,450 cfs) without overtopping. However, overtopping may not necessarily be a catastrophic event as the dam appears to be capable of withstanding overtopping without failure.

9.5 SPILLWAY

The spillway capacity is considered inadequate as it will not pass 0.5 PMF without overtopping the dam.

It is likely that if the PMF occurs, the backwater from the Schuylkill will be at or near the crest of Pickering Dam spillway. If the dam were to fail during the PMF, the downstream stage may be increased by only a few feet and the downstream damage should not be significantly greater than non-failure during PMF.

Failure during a (highly unlikely) localized PMF, i.e., peak inflow into Pickering Dam reservoir occurring before the Schuylkill River rises significantly, could result in more downstream damage then for the non-failure PMF case.

10.0 EVALUATION OF STRUCTURAL STABILITY

In summary, field observations did not delineate any indications of impending structural distress. However, inspection of the buttress members revealed that one of the thrust braces shown as the design drawing in the vicinity of the eastern blow-off valve was not in place.

Independent stability analyses considering the as-built condition of the dam were conducted by Woodward-Clyde Consultants in their report dated September 25, 1975. Analyses were performed on the spillway, bulkhead, and gravity sections of the dam, assuming maximum pool and seismic loading conditions, indicated no evidence of structural instability. Results of these analyses can be found in the PSWCo. files.

An investigation of the structural concrete by Woodward-Clyde Consultants in 1976 was also conducted and plans and specifications for remedial construction were pre-prepared. The results of the 1975 analyses were reviewed and were found to be reasonable and consistent with on-site observations. Review of the 1976 remedial construction plans indicate the proposed concrete repairs to be appropriate. All of these reports are on file at the Philadelphia Suburban Water Company office.

11.0 DAM ASSESSMENT

The review of the available records for Pickering Creek Dam indicates that, in general, the design and construction were adequate to assure the integrity and stability of the structure. Consistent with the long service record of the dam and the findings of the 1975 and 1976 PSWCo's dam evaluations, no deficiencies were noted which would change this opinion. Pending the scheduled concrete repairs, however, the effect of long-term concrete deterioration on the current structural integrity should be periodically evaluated.

Hydraulic analyses performed by Woodward-Clyde Consultants in 1975 at the request of PSWCo. indicate that the dam can contain a storm with a return period of at least 200 years (21 percent of PMF) without overtopping. This storm, representing an inflow of approximately 11,600 cfs does not meet the OCE guidelines for dams with the "intermediate size dam" classification of Pickering Creek Dam.

The PMF, as well as one-half of PMF, determined in accordance with Corps' guidelines, cannot be passed by the Pickering dam spillway and will overtop the dam. Therefore, the spillway is classified as "inadequate".

As the core walls of the concrete dam extend into rock and the rock surface elevations at the dam abutmets are at or above the crest of the parapet wall, it can be concluded that overtopping of the dam for short periods will not lead to catastrophic failure. It is probable that long-term flows over the dam would lead to erosion and ultimate failure. However, this event, coupled with low tailwater of the Schuylkill River is highly unlikely. Therefore, the spillway has not been classified as seriously inadequate.

12.0 REMEDIAL MEASURES

Visual inspections of the structural integrity of the buttress sections, revealed areas of leakage and concrete deterioration; probably as a result of long-term temperature differential and cyclic wetting and drying of the concrete - particularly within the slabs forming the spillway surface. To protect against future progressive deterioration of the structure, remedial measures should be undertaken as are currently proposed by the Owner.

As described in Sections 7 and 9, it is recommended that detailed operational and emergency procedures be developed and followed by the operating personnel. Around-the-clock surveillance should be provided during periods of high precipitation. The Owner should develop a formal warning system and provide an emergency operational procedure to follow in the event of an emergency.

APPENDIX

A

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM *Pickering Creek Dam*

ID # *PA 00622*

ITEM	REMARKS
AS-BUILT DRAWINGS	*Constructed in accordance with design drawings.*
REGIONAL VICINITY MAP	*Data provided and reviewed.*
CONSTRUCTION HISTORY	*Data unavailable for this inspection. Full time inspector hired by the Water and Power Resources Board and paid for by PSW Co. State's files have correspondence which indicates some problems with the concrete mixing and placement. Apparently some concrete required removal and replacement after the forms were removed.*
TYPICAL SECTIONS OF DAM	*Data available for this inspection.*
OUTLETS - PLAN	*All data available for this inspection.*
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	
RAINFALL/RESERVOIR RECORDS	*These are maintained at the Bryn Mawr office of the Philadelphia Suburban Water Company.*

ITEM	REMARKS
DESIGN REPORTS	*Design data was made available from a combination of files contained at the Harrisburg office and the owner's office (Philadelphia Surburban Water Company).*
GEOLOGY REPORTS	*Geologic literature identified bedrock at dam site as Stockton Formation of Triassic Age. It is reported to be a fine to medium grain arkosic sandstone with occasional thin shale beds. Outcrops of arkosic sandstone were observed approximately 750 feet downstream of the dam and 1400 feet south of the dam on east bank of reservoir.*
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	*Original data was not available, but design checks were available from a Safety Evaluation Report, dated September 25, 1975, as prepared by Woodward-Clyde Consultants.* *State of Pennsylvania files had very little information on design computations.*
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	*Investigative data was not in the State files.*
POST-CONSTRUCTION SURVEYS OF DAM	*None available.*
BORROW SOURCES	*This data was not available for this Phase I review.*

ITEM	REMARKS
MONITORING SYSTEMS	*N/A*
MODIFICATIONS	*None.*
HIGH POOL RECORDS	*These are maintained at the Bryn Mawr office of the Philadelphia Suburban Water Company.*
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	*All reports were available for review.* *Copies of State inspection reports were in the State files.*
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	*None.*
MAINTENANCE OPERATION RECORDS	*These records are maintained at the plant.*

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	*This data was available for review and generally agreed with the field observations.*
OPERATING EQUIPMENT PLANS & DETAILS	*Plans were available for review and agreed with the field observations. However, inspection of the buttress members revealed that one of the thrust braces in the vicinity of the eastern blow-off valve was not in place. Operating procedures were not available but should be formulated.*

APPENDIX

B

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam *Pickering Creek Reservoir* County *Chester* State *Pennsylvania* National ID # *PA 00622*

Type of Dam *Concrete Gravity-Buttress (Ambursen Dam)* Hazard Category *I (High)*

Date(s) Inspection *4/11/78* Weather *Cloudy* Temperature *50°F*

Pool Elevation at Time of Inspection *105.2* M.S.L. Tailwater at Time of Inspection *74.5±* M.S.L.

Inspection Personnel:

Vince McKeever (Hydrologist) *David Chou (Structural)* *Jack H. Frederick, Jr. (Geotechnical)*

Mary Beck (Hydrologist) *John Boschuk (Geotechnical)*

Noel Ravneberg (Geologist)

John Boschuk, Jr. Recorder

Remarks:

The dam is a concrete structural dam made up of concrete slabs spanning between concrete buttresses. Cored holes and windsor probe darts left behind from 1975-76 evaluation show no distress, indicating indicating insignificant deterioration since that inspection. A plan of the dam is enclosed as Plate 1.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	*There was no seepage observed through the corewall or gravity bulkhead sections of the dam. Seepage was observed through joints and cracks of the buttressed bulkhead and spillway sections as well as evidence of progressive concrete deterioration. Evidence of previous concrete repair to the slabs was also noticed from inside of the spillway (Buttresses 18 through 38) as shown on Plate 1 attached to this field inspection report.*	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	*The surface areas of all abutment contacts were inspected and no signs of seepage were observed.*	
DRAINS	*The retaining wall drains downstream of the spillway appeared to be in good condition. Clear water observed flowing from the retaining wall weepholes showed no evidence of active subsurface erosion.*	
WATER PASSAGES	*N/A*	
FOUNDATION	*Foundations could not be inspected.*	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES OUTSIDE OF SPILLWAY	*Surface cracks on concrete slabs (upstream face) occur in many bays. Most of these cracks are around construction joints where water seeping through is causing deterioration.*	
STRUCTURAL CRACKING AND DETERIORATION	*Concrete spalling, as well as leaching, is present at several locations and rebars are exposed at a few of these locations as described on page 3A. The concrete deterioration appears to be surficial but should be prevented from progressing to a hazardous state.*	
VERTICAL AND HORIZONTAL ALIGNMENT	*No evidence of vertical or horizontal movement or distortion of the dam was evidenced by the crest of the parapet wall alignment.*	
MONOLITH JOINTS	*N/A*	
CONSTRUCTION JOINTS	*Construction joints at upstream face are leaching and can cause further deterioration of the concrete. These, as well as other spalled areas, should be repaired.*	

STRUCTURAL CRACKING AND DETERIORATION

Between Buttress #14 & Buttress #15	5' circular area spalled one horizontal rebar exposed and rusted
Between Buttress #15 & Buttress #16	5' circular area spalled 3 horizontal rebars exposed and rusted
Between Buttress #16 & Buttress #17	Spalled around construction joint 2 horizontal, 2 vertical bars exposed and rusted
Between Buttress #40 & Buttress #41	Large spalled area - also hollow sounding slab around the spalled area
Between Buttress #41 & Buttress #42	4' area spalled one horizontal rebar exposed and rusted
Between Buttress #42 & Buttress #43	4'x10' area spalled 5 horizontal rebars exposed and rusted
Between Buttress #43 & Buttress #44	4' area spalled
Between Buttress #45 & Buttress #46	Water flowing from 2-2"ϕ pipes embedded in upstream slab.

NOTE: A detailed tabulation of all deteriorated areas is presented in a Woodward-Clyde Consultants' report to the Philadelphia Suburban Water Company entitled, "Remedial Construction, Pickering Creek Dam," 14 September 1976.

INSIDE SPILLWAY

(underside of spillway as viewed from the inspection tunnel)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	*Leaching occurs at construction joints on upstream face, but there was no evidence of cracking or spalling of concrete. However, several pipes embedded in the downstream face with water flowing into the inside of spillway was observed. Rebars are exposed in the downstream slab as viewed from the dam inspection walkway.*	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	*N/A*	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	*N/A*	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	*N/A*	
RIPRAP FAILURES	*N/A*	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*N/A - Dam founded in natural rock*	
ANY NOTICEABLE SEEPAGE	*N/A*	
STAFF GAGE AND RECORDER	*N/A*	
DRAINS	*N/A*	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	*N/A*	
INTAKE STRUCTURE	*The water supply intake structure was functioning, but the hand railing was severely deteriorated at the junction between the upright post and the concrete. In some cases, the post was detached from the anchor plate. Inside the dam, the control valves appeared to be in good condition.*	
OUTLET STRUCTURE	*Underwater -- Could not be inspected.*	
OUTLET CHANNEL	*Underwater but side slope showed no signs of serious erosion.*	
EMERGENCY GATE		

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	*The flow of water over the top of the concrete spillway and down the face of the spillway was generally observed to contain no undue turbulences or disturbances indicative of abnormal roughness or erosion of the spillway slab surface. Collection of debris does not appear to be a problem.*	
APPROACH CHANNEL	*N/A*	
DISCHARGE CHANNEL	*This channel* is approximately 40 feet wide and narrows along several places until it empties into the Schuylkill River. A tailwater problem exists resulting principally from the backing-up of the Schuylkill River during periods of high runoff. A record high level of 96.6 was recorded at the plant on 6/23/72. It is conceivable that large flows could back the river up to elevation 105.* **Pickering Creek*	
BRIDGE AND PIERS *(For structure immediately downstream)*	*The concrete highway bridge with 2 piers spans the channel about 100 feet downstream of the spillway. The span lengths under the bridge are 67', 69' and 69' with 13½ feet between the existing water level and the bottom of the bridge. During the maximum water level recorded on 6/23/72 all but the guard rails of the bridge were under water.* *NOTE: This structure was inspected only because it is located immediately downstream of the spillway and provides a constriction at high flows.*	

GATED SPILLWAY

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

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	*None.*	
OBSERVATION WELLS	*None.*	
WEIRS	*None.*	
PIEZOMETERS	*None.*	
OTHER	*Reservoir water level is measured every day. A standard rain gage is located at the pumping plant, and all records are sent to the National Weather Bureau in Philadelphia.*	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	*The slopes were observed to be moderate, generally wooded and stable.*	
SEDIMENTATION	*Moderate amounts of sedimentation are occuring in the upper ends of the reservoir which have a negligible affect on the flood water storage capacity of the reservoir.*	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	*Downstream obstructions consist of:* 1. *a highway bridge 100 feet from the spillway* 2. *channel flow is constricted at the pumping plant by a flood wall* 3. *there is a railroad bridge downstream from the pumping plant* 4. *a second railroad bridge exists 1-3/4 miles downstream on the Schuylkill River* *The channel does not appear to collect debris which could restrict present flow capacities.*	
SLOPES	*The slopes are moderate, stable and vegetated with trees, grass and brush.*	
APPROXIMATE NO. OF HOMES AND POPULATION	*If an PMF occurred on Pickering Creek, flooding would also occur on the Schuylkill, flooding many businesses and homes. Failure of Pickering Dam would add a few feet to existing stages along Schuylkill River. Sudden failure (not related to PMF) would jeopardize some low-lying homes along Schuylkill River along with bridges and the PSWCo. Pickering Creek pumping plant.*	

APPENDIX

C

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *Predominantely open/farms and woods with approximately ¼ developed with homes.*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *105*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *110 (top of dam wall)*

ELEVATION MAXIMUM DESIGN POOL: *110 (top of dam wall)*

ELEVATION TOP DAM: *110*

CREST:

a. Elevation *105*

b. Type *ogee concrete spillway*

c. Width *ogee top of spillway, 3 foot walk on dam*

d. Length *300 feet - crest length*

e. Location Spillover *center of dam*

f. Number and Type of Gates *N/A*

OUTLET WORKS: *(Water Supply)*

a. Type *a system of pipes connected to the plant*

b. Location *in the intake tower*

c. Entrance inverts *80 ft., 90 ft., and 100 ft.*

d. Exit inverts *water conveyed to downstream via a pipe*

e. Emergency draindown facilities *2 blow valves*

HYDROMETEOROLOGICAL GAGES:

a. Type *standard rain gage*

b. Location *Pumping Plant*

c. Records *PS Water Company office and sent to Weather Service.*

MAXIMUM NON-DAMAGING DISCHARGE: *12400 cfs at the top of dam, non-damaging to structure, plant area will be flooded.*

DAM SAFETY ANALYSIS
HYDROLOGIC/HYDRAULIC DATA

Date: 4/10/78
By: HFB
Sheet: 2 of 7

DAM Pickering Creek Nat. ID No. PA00622 DER No. 15-1

	ITEM/UNITS	Permit/Design Files (A)	Calc. from Files/Other (B)	Calc. from Observations (C)
1.	Min. Crest Elev., ft.		110. ft	
2.	Freeboard, ft.	1.34 ft.		
3.	Spillway[1] Crest Elev, ft.		105 ft	
3a.	Secondary[2] Crest Elev, ft.	—	—	
4.	Max. Pool Elev., ft.			
5.	Max. Outflow[3], cfs		12400 cfs[5]	
6.	Drainage Area, mi²	38.2 mile²	38.4 mile²	38.1 mile²
7.	Max. Inflow	8000 cfs	54,900 cfs	
8.	Reservoir Surf. Area	170 Ac	105 Ac	108 Ac
9.	Flood Storage[4]		970 Ac-Ft.[5]	
10.	PMF Runoff		25.0 inches	

Reference all figures by number or calculation on attached sheets:

Example: 3A - Drawing No. xxx by J. Doe, Engr., in State File No. yyyy.

NOTES:

(1) Emergency spillway.

(2) Secondary ungated spillway (none).

(3) At maximum pool, without freeboard.

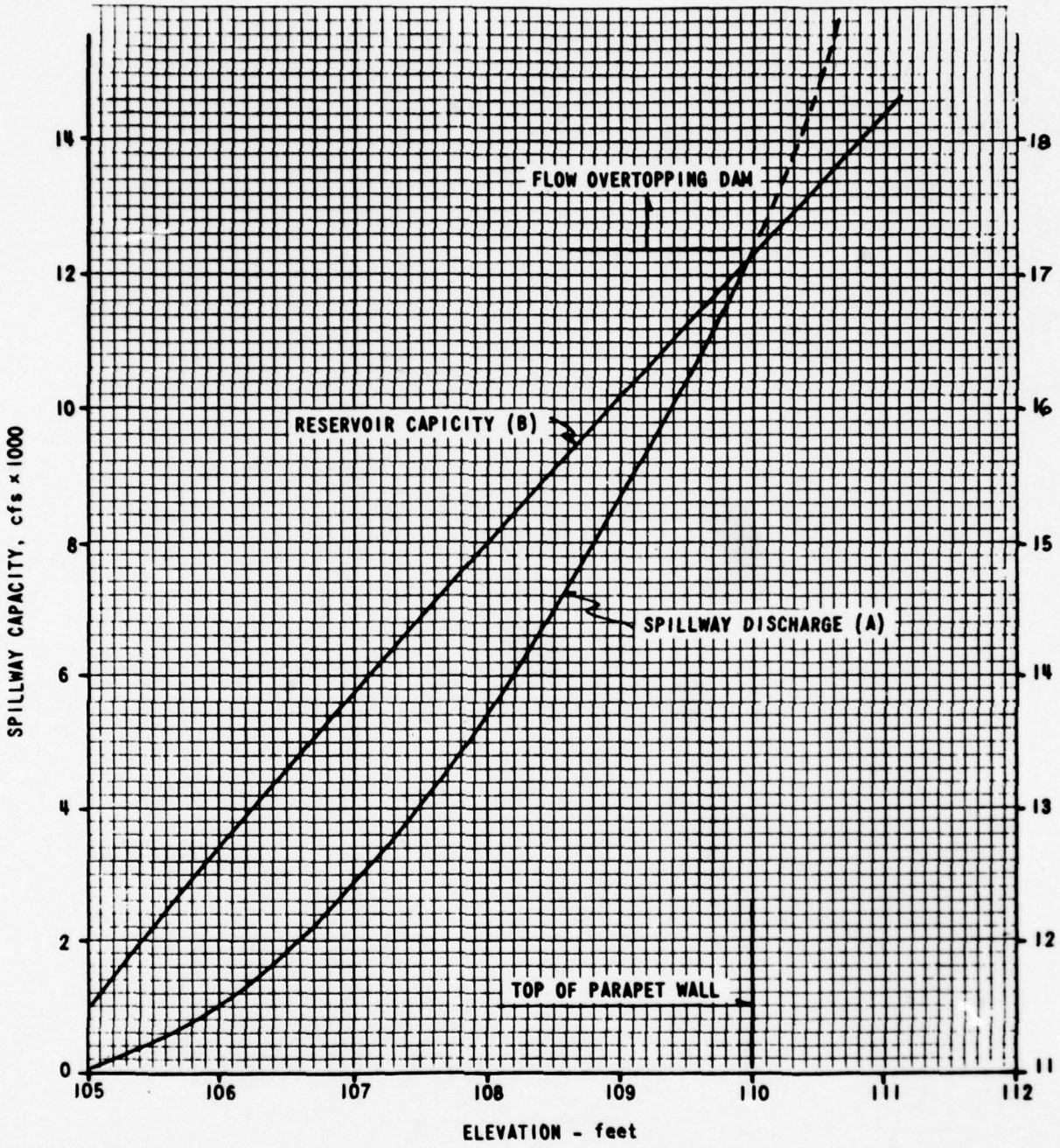
(4) Between spillway and maximum pool.

(5) See Sheet 4.

Date: 4/10/78
By: HFB
Sheet: 3 of 7

HYDROLOGIC/HYDRAULIC CALCULATIONS (cont.)

Item (from page 2)	Source
2A, 6A, 7A, 8A	Application Report, Feb. 6, 1926
6B, 8B	Plan located in Pickering Creek Plant
5B, 9B, 1B, 3B	From PSWCo Plans as noted in WCC Report dated 25 Sept. 1975 Section 5, ref. 14
7B, 10B	WCC Report dated 25 Sept. 1975, Section 5, ref. 14
6C, 8C	USGS Maps Valley Forge (1973) Pottstown (1973) Phoenixville (1973) Malvern (1973) Downingtown (1973)



References

A. P.S.W.Co., "Pickering Creek Spillway Discharge Diagram," Plan No. 8192, 7/30/27

B. P.S.W.Co., "Pickering Creek Reservior", Plan NO. 7966.

SPILLWAY DISCHARGE AND RESERVOIR CAPACITY
PICKERING CREEK DAM
CHESTER COUNTY, PA.

DAM SAFETY ANALYSIS
HYDROLOGIC/HYDRAULIC CALCULATIONS
TRIANGULAR HYDROGRAPH - 5 April 1978 INSTRUCTIONS

Date: 4/11/78
By: VM/MPB
Sheet: 5 of 7

DAM Pickering Creek Nat. ID No. PA0062 DER No. 15-1
Calculations for *Design* ☐, *As-Built* ☐, *Existing* ☑ Conditions

1. Spillway Discharge at Max. Pool, Q_{omac} 12,400 cfs
   Freeboard at Max. Pool 0 ft.

2. Tributary Drainage Area, A 38.4 mi^2

3. From WCC Reports:
   a) Inflow hydrograph peak flow, Q_{Imax} 54,900 (27,450) cfs at 100% (50%) PMF
   b) Inflow hydrograph duration, T N/A hrs.

IF Q_{omax} exceeds Q_{Imax}, check here and stop ☐

4. Calculate $p = Q_{omax}/Q_{Imax}$ = $\frac{12,400/54,900}{(12,400/27,450)}$ = $\frac{0.2259}{(0.4517)}$.

5. Calculate Volume of inflow hydrograph, V_I

   V_I = ~~1800 Q_{Imax} T = 1800 *~~ ___ x ___ = $\frac{52840}{(26420)}$ ~~ft³~~ Ac-Ft

6. Calculate volume of storage between normal and maximum pool, V_s

   Crest Elevation = 110 ft.
   Freeboard = 0 ft.
   El. Max. Pool = 110 ft.
   El. Normal Pool = 105 ft.
   Storage Height = 5 ft.

   Area of reservoir from USGS quad sheet, — ft^2

   V_s = ~~Storage Height x Area~~ = 570 ft^3

IF V_s exceeds V_I, check here and stop ☐.

HYDROLOGIC/HYDRAULIC CALCULATIONS (cont.)
DAM Pickering Creek
Design ☐, *As-Built* ☐, *Existing* ☑

Date: 4/11/78
By: VM / MFB
Sheet: 6 of 7

7. Calculate storage required to pass flood, V_R

$$V_R = (1-p)\, V_I = \frac{(1 - .2259)}{(1 - .4517)} \times \frac{52840}{(26420)} = \frac{40,905}{(14,485)} \text{ Ac-Ft}$$

IF V_S exceeds V_R, check here and stop ☐ .

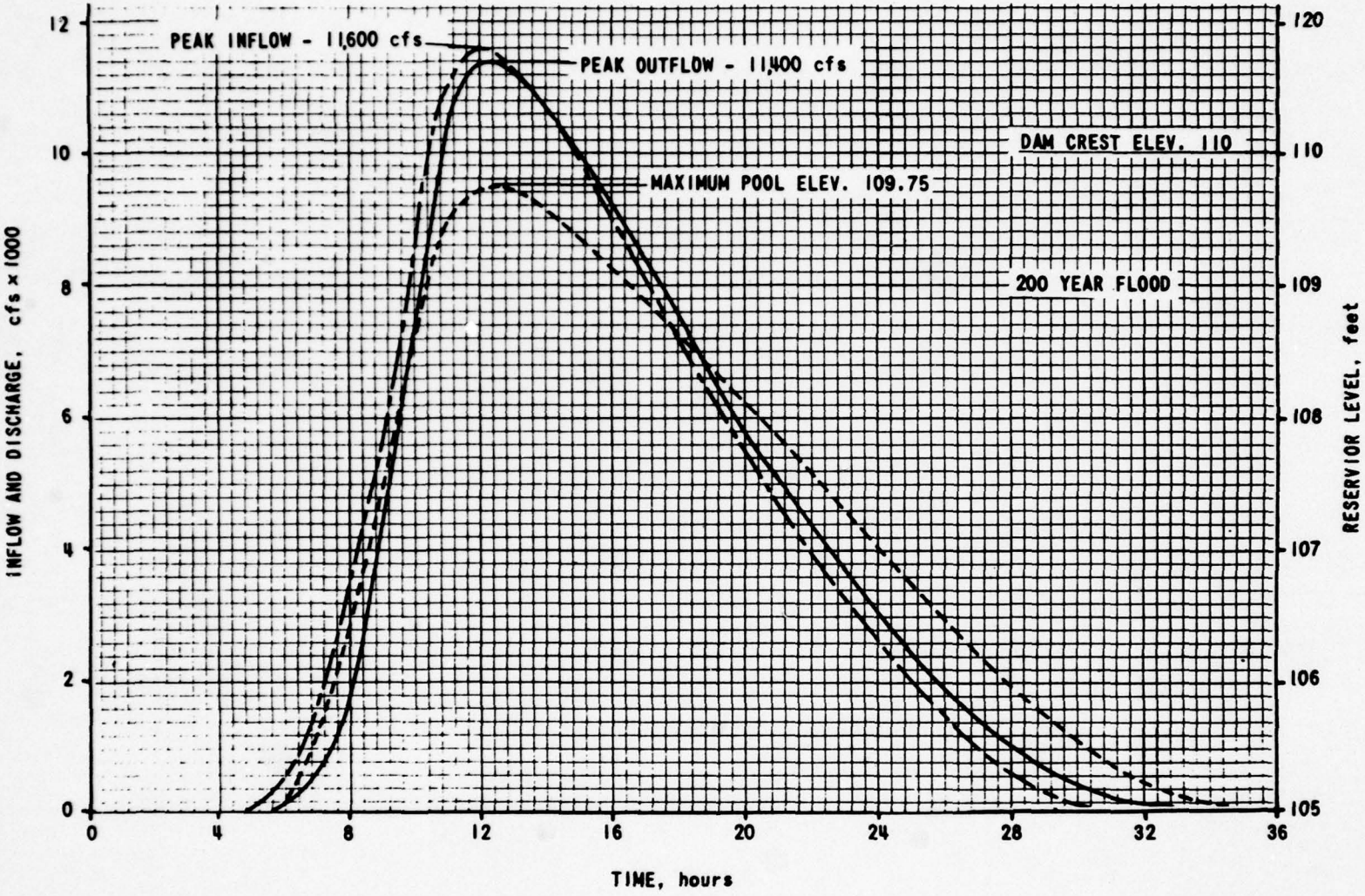
8. Calculate freeboard storage, V_F

V_F = Freeboard x Area = _____ x _____ = 0 ft^3

Does V_R exceed $V_S + V_F$? yes . If yes, repeat for 1/2 PMF, if this calculation is for 1/2 PMF, and answer is still yes, dam may be unsafe.

SUMMARY

Dam passes
- PMF with _____ ft. freeboard . . . ☐
- PMF with no freeboard . . . . . ☐
- 1/2 PMF with _____ ft. freeboard . ☐
- 1/2 PMF with no freeboard . . . . . ☐
- None of the above . . . . . ☑



NOTE: Peak flows without overtopping (zero freeboard)

FLOOD ROUTING
PICKERING CREEK DAM
CHESTER COUNTY, PA.

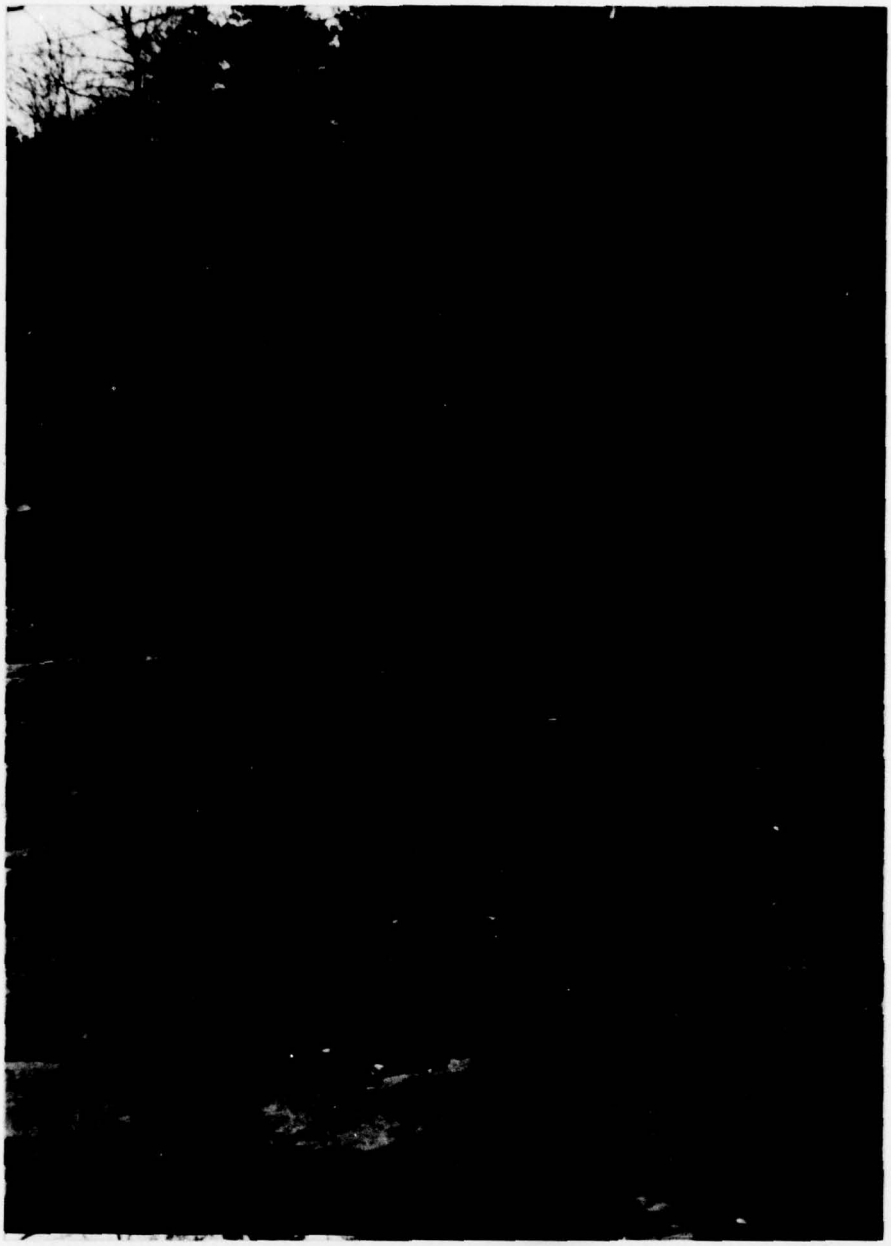
SHEET 7 OF 7

APPENDIX

D

VIEW FROM THE SPILLWAY LOOKING TOWARDS THE RIGHT ABUTMENT.
THE RESERVOIR IS AT NORMAL POOL.
NOTE THE FREEBOARD DEVELOPED BY THE PARAPET WALL.

PHOTO NO. 1



VIEW SHOWING THE DOWNSTREAM SIDE OF THE BUTTRESS PORTION OF THE DAM, AND THE RIPRAP PROTECTION. PHOTO NO. 1 SHOWS THE UPSTREAM SIDE OF THIS FEATURE. EACH BUTTRESS CHAMBER WALL WAS NUMBERED AND EVALUATED DURING PREVIOUS INSPECTIONS

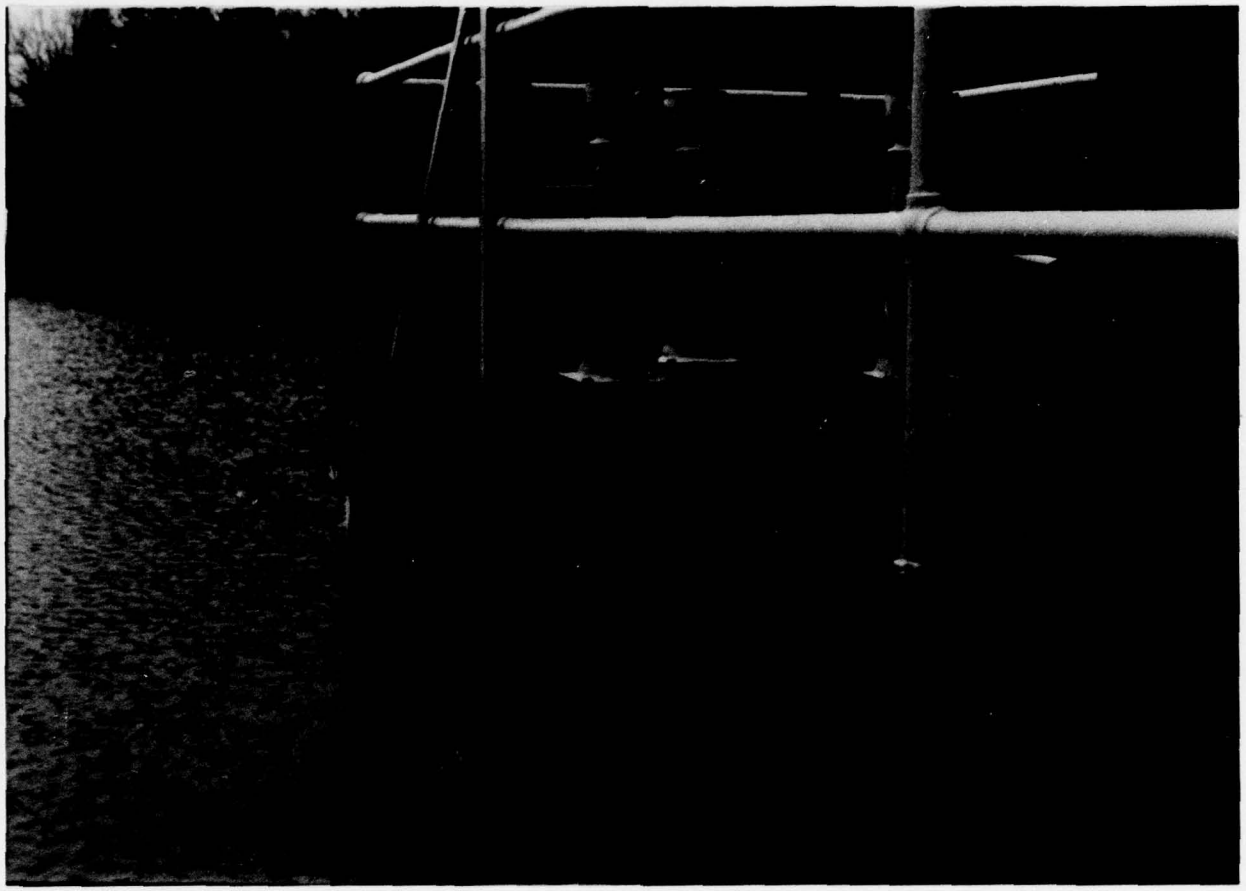
PHOTO NO. 2

VIEW IMMEDIATELY DOWNSTREAM OF THE SPILLWAY. THE SPILLWAY CAN BE SEEN IN THE LOWER LEFT CORNER. WITH THE EXCEPTION OF THE DOWNSTREAM GUARD RAIL, THE ENTIRE BRIDGE WAS INUNDATED DURING THE STORM OF JUNE 1972.

PHOTO NO. 3

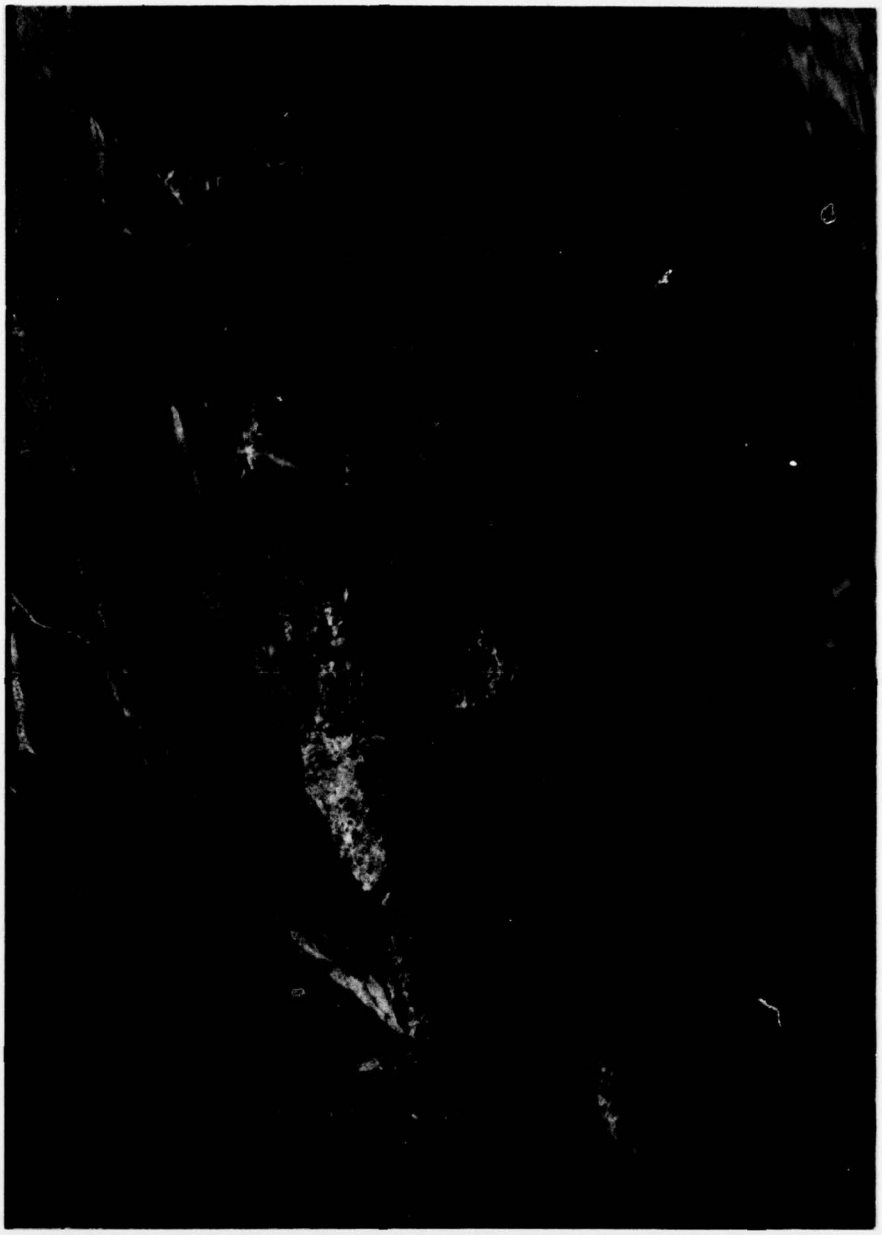
VIEW OF TYPICAL DOWNSTREAM CHANNEL SECTION. RAILROAD BRIDGE IS APPROXIMATELY 400 FEET UPSTREAM FROM THE SCHUYLKILL RIVER.

PHOTO NO. 4



VIEW OF CONTROL TOWER. NOTE MINOR DETERIORATION OF CONCRETE AND HANDRAIL.

PHOTO NO. 5

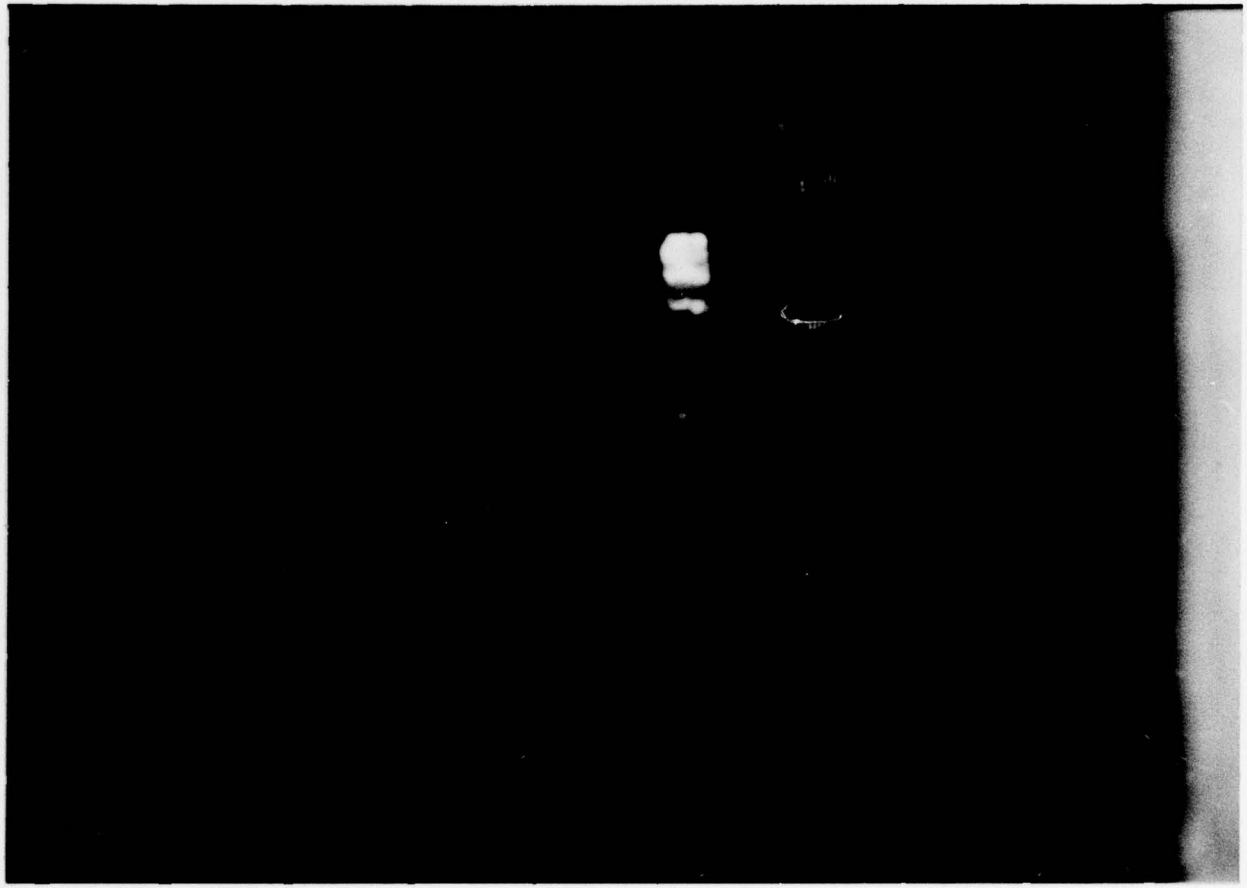


VIEW OF SPALLING CONCRETE AT THE RIGHT ABUTMENT OF THE SPILLWAY. PHOTO SHOWS HANDRAIL IMBEDDED INTO RETAINING WALL WITH WATER FLOWING OVER THE SPILLWAY IN THE BACKGROUND.

PHOTO NO. 6

VIEW OF SPALLED CONCRETE BENEATH ONE OF THE BUTTRESS BAYS RIGHT OF THE SPILLWAY. THE GREEN PAINT SHOWN REPRESENTS AREAS EVALUATED IN 1976 BY WOODWARD-CLYDE CONSULTANTS IN ACCORDANCE WITH A CONTRACT WITH THE PHILADELPHIA SUBURBAN WATER COMPANY.

PHOTO NO. 7

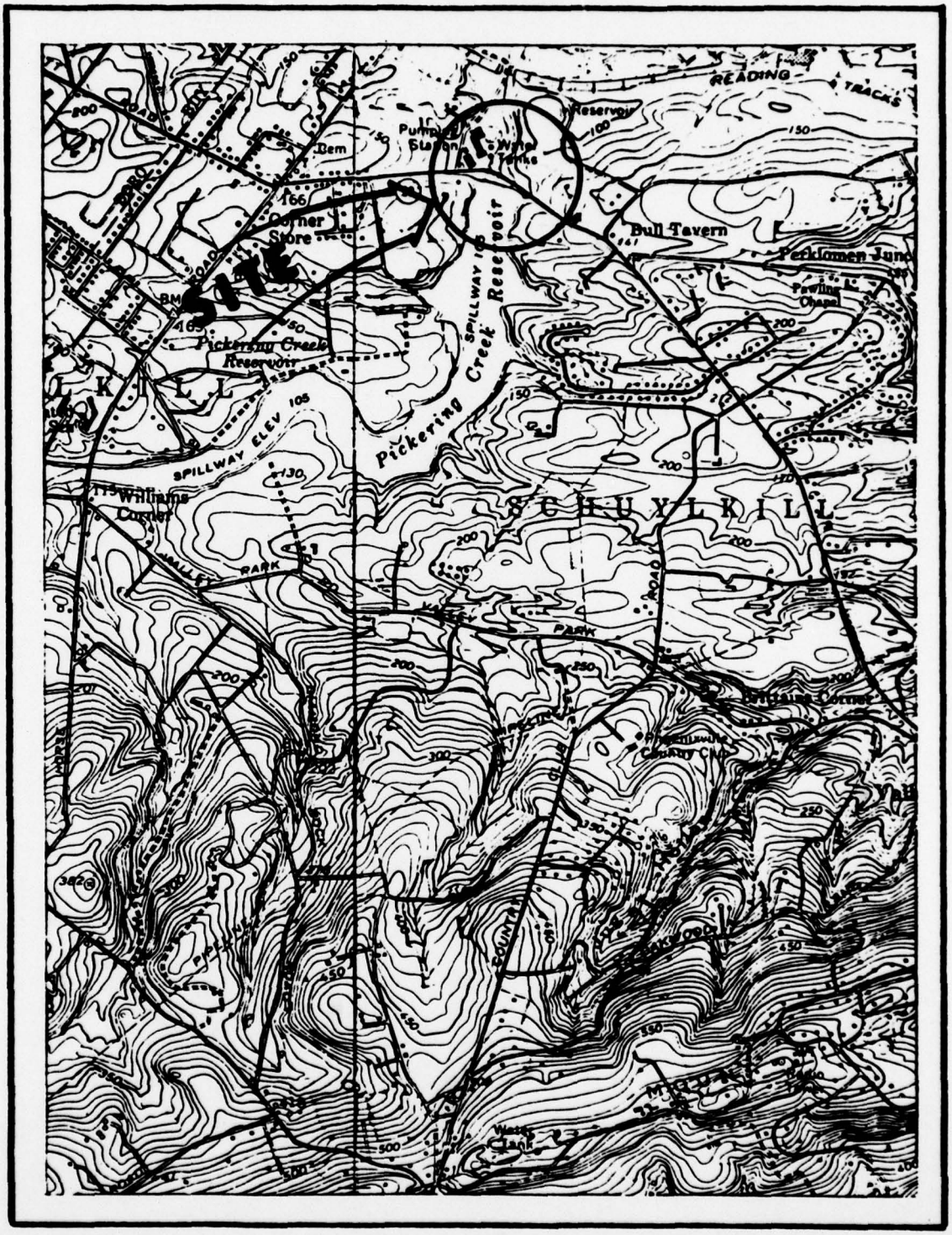


VIEW OF INSPECTION GALLERY UNDER THE SPILLWAY LOOKING TOWARDS
THE RIGHT ABUTMENT AT BAY NO. 26.

PHOTO NO. 8

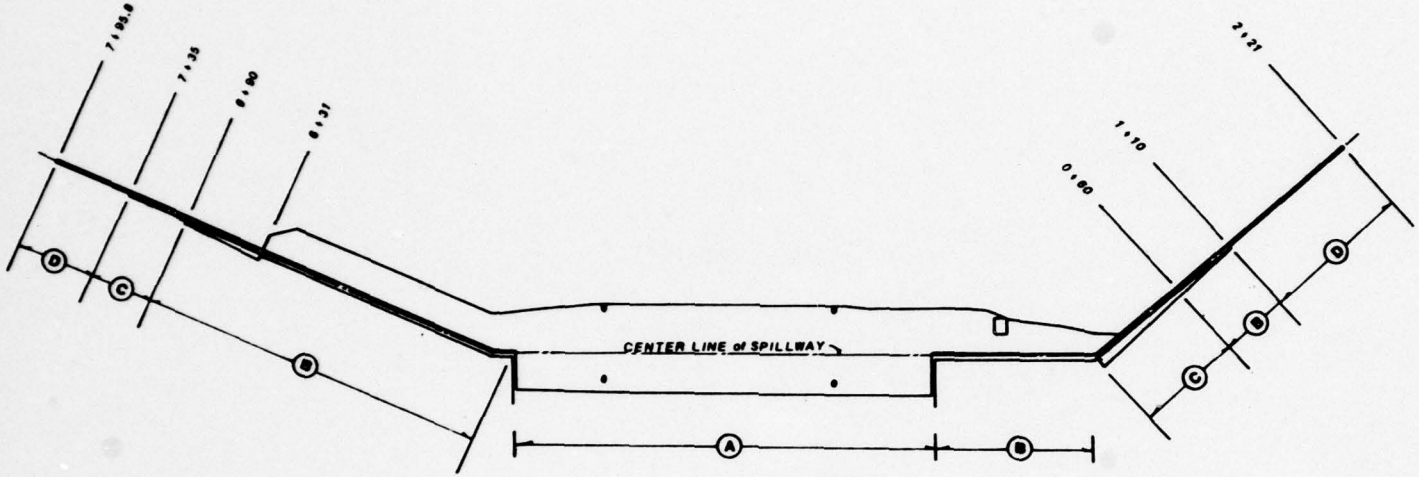
APPENDIX

E



REGIONAL LOCATION PLAN
PICKERING CREEK DAM
U.S.G.S. QUAD SHEET 'VALLEY FORGE'

PLATE 1



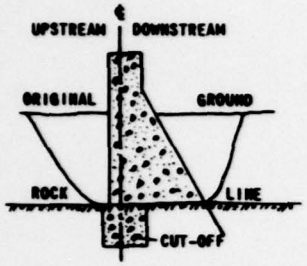
Ⓐ BUTTRESSED SPILLWAY SECTION
Ⓑ BUTTRESSED BULKHEAD SECTION
Ⓒ GRAVITY BULKHEAD SECTION
Ⓓ COREWALL SECTION

PLAN VIEW
PICKERING CREEK DAM

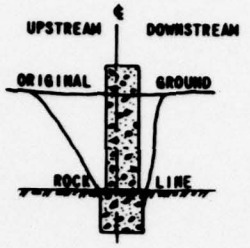
CHESTER COUNTY PENNSYLVANIA

DATA EXTRACTED FROM DESIGN BLUE PRINTS
DATED 1926

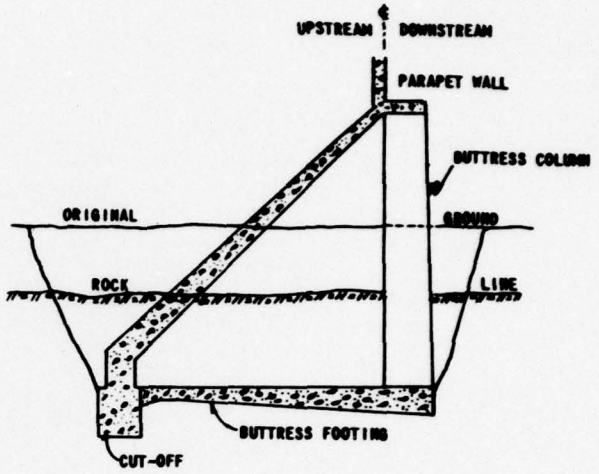
PLATE 2



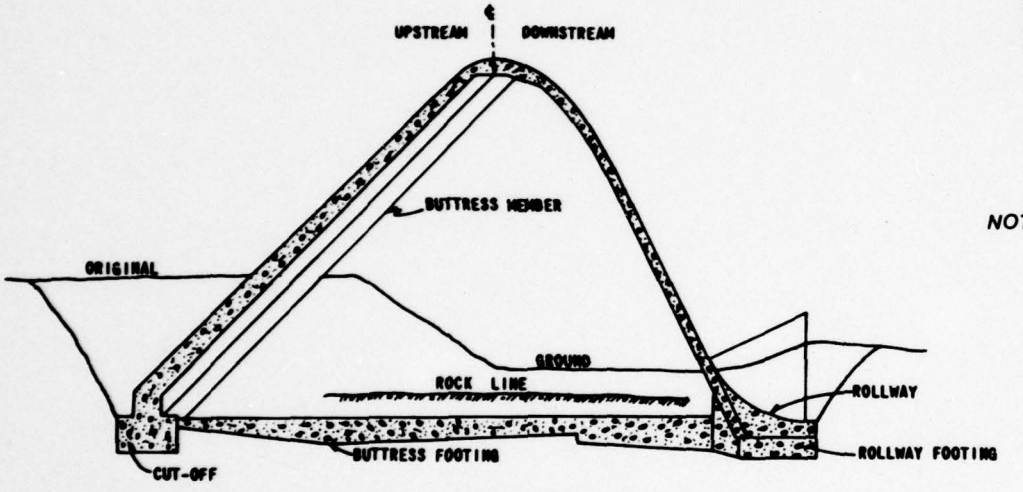
Ⓒ GRAVITY SECTION



Ⓓ COREWALL SECTION



Ⓑ BULKHEAD SECTION



Ⓐ SPILLWAY SECTION

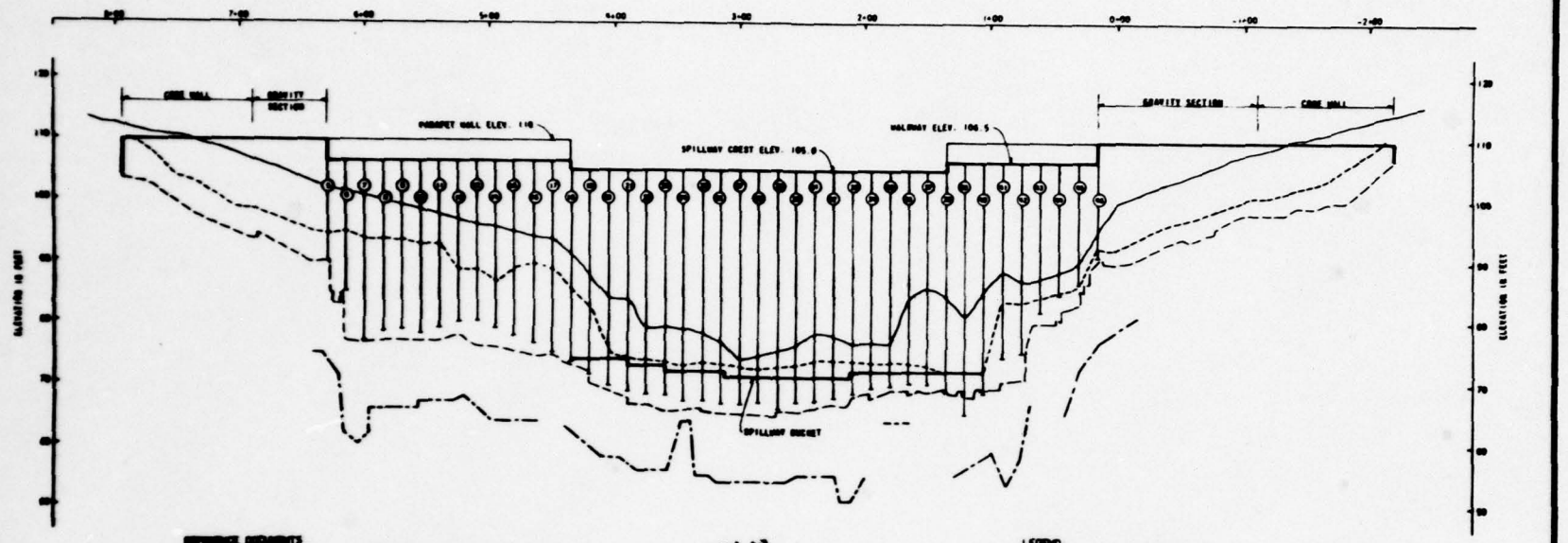
NOTE: See Plate 2 for location of Structures Ⓐ thru Ⓓ

TYPICAL CROSS SECTIONS
PICKERING CREEK DAM

CHESTER COUNTY PENNSYLVANIA

DATA EXTRACTED FROM DESIGN BLUE PRINTS DATED 1926

PLATE 3



REFERENCE DOCUMENTS

(A) P.S.W.Co., "PICKERING CREEK DAM, CROSS SECTIONS" SHEET 1 OF 3

(B) P.S.W.Co., "PICKERING CREEK DAM", SHEET 3 OF 3

(C) P.S.W.Co., UNTITLED DRAWING OF GROUT CURTAIN PROFILE

LEGEND

ORIGINAL GROUND SURFACE (A)

ROCK SURFACE (A)

BOTTOM OF CONCRETE CUTOFF (B)

BUTTRESS NUMBER
BUTTRESS LOCATION (B)
BUTTRESS FOUNDATION

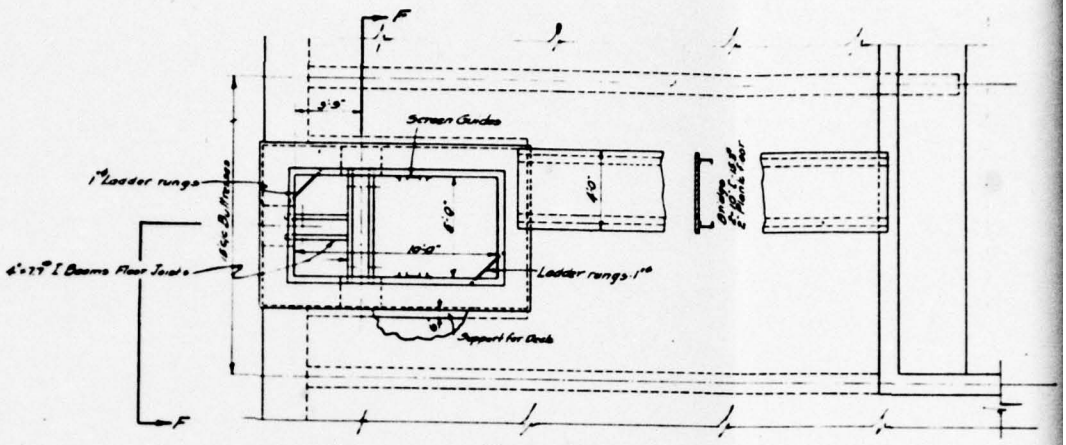
LIMIT OF GROUT CURTAIN (C)

PROFILE ALONG DAM AXIS
PICKERING CREEK DAM

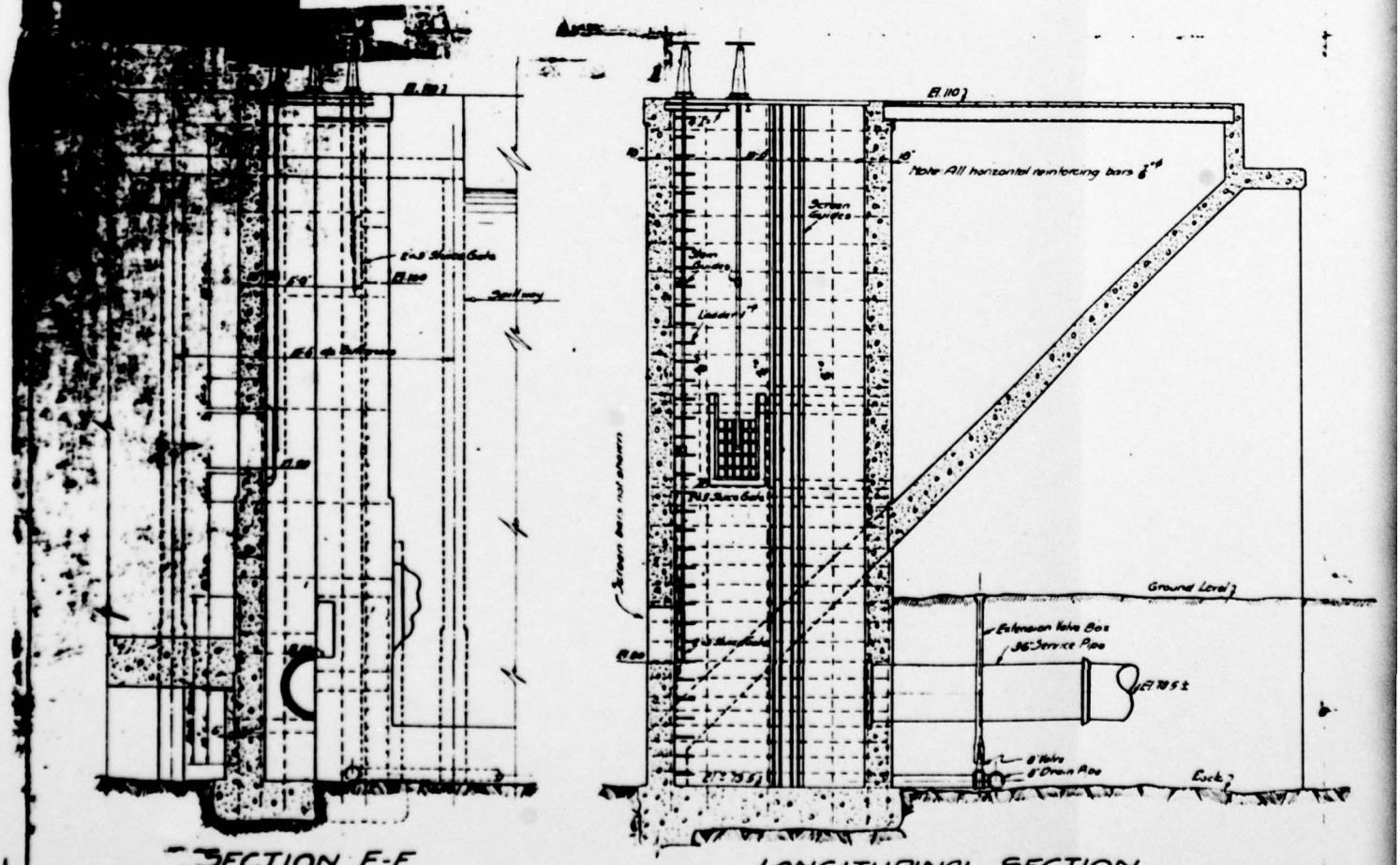
CHESTER COUNTY PENNSYLVANIA

DATA EXTRACTED FROM PHILADELPHIA SUBURBAN WATER COMPANY FILE

PLATE 4

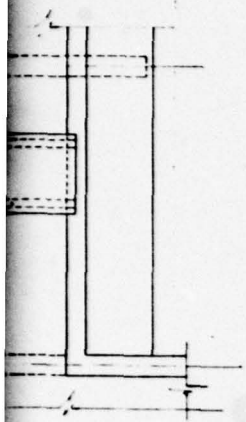


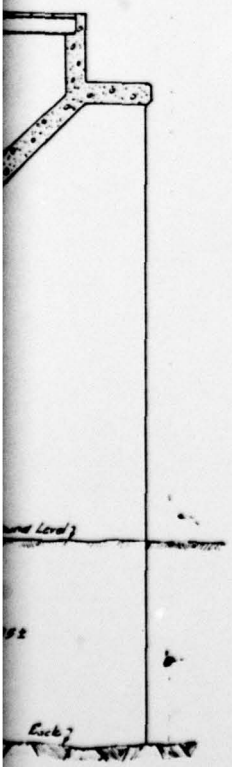
PLAN VIEW



SECTION F-F

LONGITUDINAL SECTION.



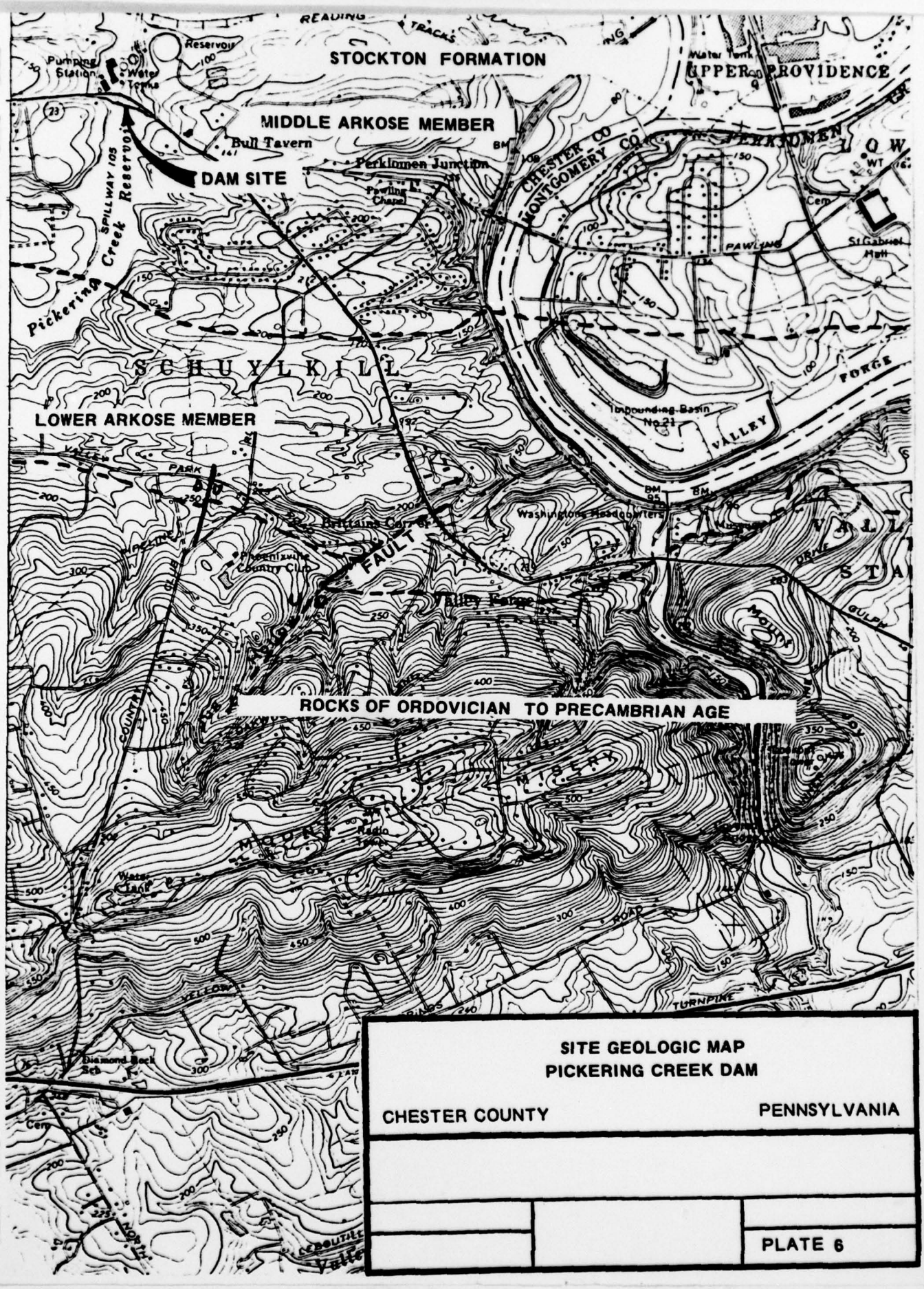


DETAILS OF INTAKE TOWER
PICKERING CREEK DAM

CHESTER COUNTY PENNSYLVANIA

DATA OBTAINED FROM AMBURSEN CONSTRUCTION COMPANY INC. DESIGN DRAWING NO. 3C DATED 1/18/26

PLATE 5



SITE GEOLOGIC MAP
PICKERING CREEK DAM

CHESTER COUNTY **PENNSYLVANIA**

PLATE 6