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O'BRIEN AND GERE ENGINEERS INC PHILADELPHIA PA JUSTIN--ETC F/G 13/2  
NATIONAL DAM SAFETY PROGRAM. ROBERT G. STRUBLE DAM (NDI-PA 0062--ETC(U)  
JUL 79

DACW31-79-C-0010

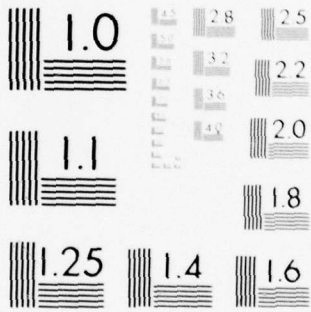
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DELAWARE RIVER BASIN  
EAST BRANCH BRANDYWINE CREEK, CHESTER COUNTY

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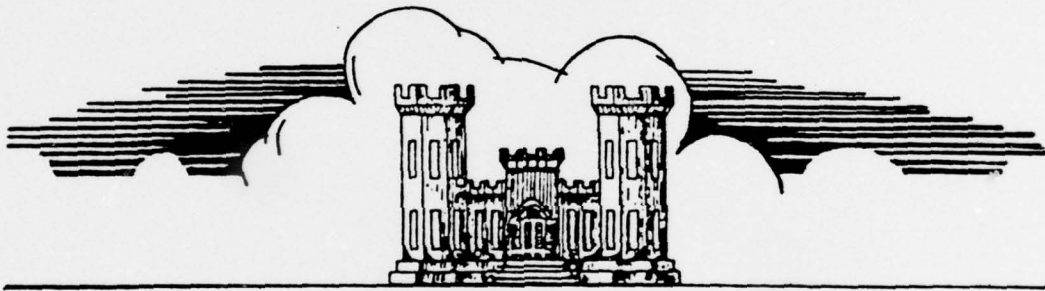
PENNSYLVANIA **LEVEL II**

**R. G. STRUBLE DAM**

NDI - PA 00621  
PA DER 15-298  
SCS PA - 431

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PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM



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Prepared By

**O'BRIEN & GERE**

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DELAWARE RIVER BASIN

Name of Dam: Robert G. Struble Dam

County and State: Chester County, Pennsylvania

Inventory Number: PA 00621

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

6 National Dam Safety Program, Robert G. Struble Dam (NDI-PA 00621, PA DER 15-298, SCS PA-431), Delaware River Basin, East Branch Brandywine Creek, Chester County, Pennsylvania, Phase I Inspection Report.



11 Jul 79

Prepared By:  
O'BRIEN & GERE ENGINEERS, INC.  
JUSTIN & COURTNEY DIVISION

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DACW31-79-C-0010

For:  
DEPARTMENT OF THE ARMY  
Baltimore District, Corps of Engineers  
Baltimore, MD. 21203

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PREFACE

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

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

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

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

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Unannounced	<input type="checkbox"/>
Justification	<i>Per file</i>
By	
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Availability	
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PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Robert G. Struble Dam ID # PA 00621  
State Located: Pennsylvania  
County Located: Chester County  
Stream: East Branch Brandywine Creek  
Coordinates: Latitude 40° 6.7' Longitude 75° 51.9'  
Date of Inspection: May 2, 1979

ASSESSMENT

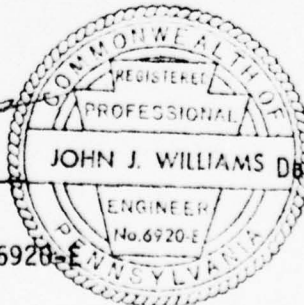
Robert G. Struble Dam is an earth embankment with a drop inlet closed conduit (principal) spillway and a vegetated earth cut (emergency) spillway. The embankment is approximately 1,500 feet long with a maximum height of 31 feet and impounds a reservoir with a normal pool storage capacity of 1,025 acre-feet. The dam is located on the East Brance of Brandywine Creek about 3 miles Northeast of Honeybrook, Pennsylvania.

The Spillway Design Flood (SDF) for this "Intermediate" size, "High" hazard dam is the Probable Maximum Flood (PMF). The combined spillway system is capable of discharging 100 percent of the PMF without overtopping of the earth embankment. Therefore the spillway is considered "Adequate".

Based on the visual observations and review of the information obtained from the Pennsylvania Department of Environmental Resources, Division of Dam Safety, Struble Dam is considered to be in good condition. No further investigations or remedial measures are recommended at the present time.

O'BRIEN & GERE ENGINEERS, INC.  
JUSTIN & COURTNEY DIVISION

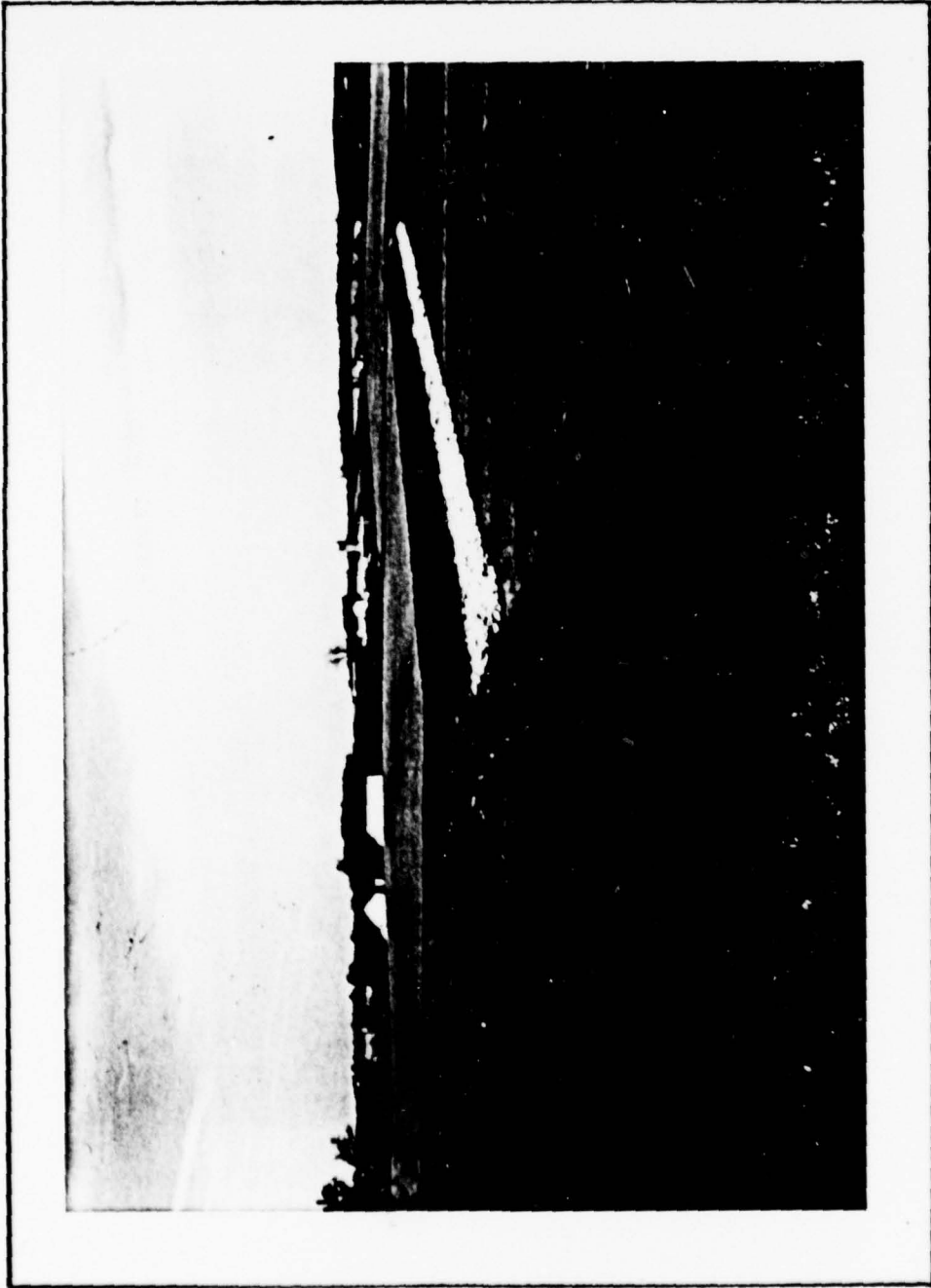
*John J. Williams*  
\_\_\_\_\_  
J. J. Williams, P.E.  
Vice President  
Pennsylvania Registration #PE 006920-E



JOHN J. WILLIAMS Date: 20 July '79

*James W. Lech*  
← \_\_\_\_\_  
Approved By

Date: 1 Aug 79



*OVERVIEW  
R.G. STRUBLE DAM, CHESTER COUNTY, PENNSYLVANIA*

## TABLE OF CONTENTS

	<u>PAGE</u>
SECTION 1 - PROJECT INFORMATION	
1.1 General	1
1.2 Description	1
1.3 Pertinent Data	4
SECTION 2 - ENGINEERING DATA	
2.1 Design	6
2.2 Construction	6
2.3 Operation	6
2.4 Evaluation	6
SECTION 3 - VISUAL INSPECTION	
3.1 Findings	7
SECTION 4 - OPERATIONAL FEATURES	
4.1 Procedures	9
4.2 Maintenance of the Dam	9
4.3 Maintenance of Operating Facilities	9
4.4 Warning System in Effect	9
4.5 Evaluation of Operational Adequacy	9
SECTION 5 - HYDRAULICS AND HYDROLOGY	
5.1 Evaluation of Features	10
SECTION 6 - STRUCTURAL STABILITY	
6.1 Evaluation of Structural Stability	11
SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND PROPOSED REMEDIAL MEASURES	
7.1 Dam Assessment	12
7.2 Recommendations and Proposed Remedial Measures	12

TABLE OF CONTENTS  
(Continued)

APPENDIX A -	CHECKLIST, ENGINEERING DATA, DESIGN CONSTRUCTION, OPERATION, PHASE I
APPENDIX B -	CHECKLIST, VISUAL INSPECTION, PHASE I
APPENDIX C -	HYDROLOGIC & HYDRAULIC DATA
APPENDIX D -	PHOTOGRAPHS
APPENDIX E -	DRAWINGS
APPENDIX F -	SITE GEOLOGY

PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM  
ROBERT G. STRUBLE DAM  
NDI I.D. PA 00621

SECTION I  
PROJECT INFORMATION

1.1 General

- a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.
- b. Purpose. The purpose of this inspection is to determine if Struble Dam constitutes a hazard to human life or property.

1.2 Description of Project (Supplemented by information obtained from the Pennsylvania Department of Environmental Resources (DER), Division of Dam Safety, Harrisburg, Pennsylvania)

- a. Dam and Appurtenances. <sup>ABSTRACT</sup> Struble Dam is a zoned earth embankment, approximately 1,500 feet in length with a maximum height of 31 feet. The dam, a multiple purpose structure, was constructed as a portion of the Brandywine Creek Watershed Project. The reservoir has a normal pool storage capacity of 1,025 acre-feet for sediment accumulation and fish and wildlife. The normal pool surface area is 146 acres. An additional storage capacity of 596 acre-feet is utilized for floodwater control. The top of dam elevation is 625.5, the crest width is 14 feet, and the side slopes are 3 horizontal to 1 vertical (3H:1V) upstream and 2.5H:1V downstream. A 12-foot wide berm is provided on the upstream face at Elevation 612.8 and the slope is lined with 18-inch thick riprap from the berm to Elevation 618.8. According to the "As-Built" plans, the upstream and central portions of the embankment are composed of Zone I material, which is classified as a clayey silt. The central portion includes a cutoff trench with a 12-foot bottom width. The downstream shell (to Elevation 615.8) of Zone II material is classified as silty sand. The two zones are separated by a four-foot wide chimney drain which terminates in a drain trench at the downstream toe of the Zone I material.

ABSTRACT

According to the "As-Built" plans, the principal spillway consists of a single stage reinforced concrete drop inlet structure, a 30-inch diameter prestressed concrete pipe and a reinforced concrete impact basin at the pipe outlet. The inlet structure, or riser, is situated approximately 40 feet upstream of the embankment axis with its crest (Elevation 615.8) directly above the upstream berm. A pond drain consisting of an inlet structure at the upstream toe of the embankment and 50 feet of 18-inch diameter prestressed concrete pipe outlets into the upstream wall of the riser. Pond drain discharge is controlled by a sluice gate mounted on the inside face of the upstream wall of the riser. Reinforced concrete anti-seep collars are provided for the pond drain and principal spillways pipes. A trapezoidal discharge channel with a 10-foot bottom width leads from the impact basin to a point 300 feet downstream of the dam where the discharge channel blends in with the natural channel. The initial 20-foot section of the outlet channel is riprap lined.

A 150-foot wide vegetated earth emergency spillway with 3H:1V side slopes is located in the left abutment area. A 240-foot long forebay channel is constructed upstream of the spillway crest on a 2% grade and a 300-foot long exit channel is constructed downstream from the crest on a 3.3% grade. The crest is a 30-foot long level section at Elevation 619.5. A vegetated earth dike is located on the right side of the emergency spillway to protect the embankment from any flow through the emergency spillway.

- b. Location. Struble Dam is located on the East Branch of Brandywine Creek, approximately 3 miles northeast of Honey Brook, Pennsylvania. The dam is situated within Honey Brook Township in Chester County. The dam site is shown on the USGS Quadrangle entitled "Wagontown, Pennsylvania" at coordinates N 40° 6.7', W 75° 51.9. A regional location plan of Struble Dam is enclosed as Plate 1, Appendix E.
- c. Size Classification. The dam has a maximum height of 31 feet and a maximum pool storage capacity of 2,880 acre-feet. Therefore, the structure is in the "Intermediate" size category.
- d. Hazard Classification. A dam failure could cause loss of lives and extensive property damage in the town of Cupola which is located about 1.5 miles downstream of the dam. Therefore, the dam is in the "High" hazard category.
- e. Ownership. Struble Dam is owned by the Chester County Water Resources Authority, 406 Farmers & Mechanics Building, West Chester, PA 19380.

- f. Purpose of Dam. The dam provides sediment, fish and wildlife storage at normal pool and floodwater storage at maximum pool (emergency spillway crest).
- g. Design and Construction History. Struble Dam was designed by the engineering staff of the Soil Conservation Service (SCS) of the United States Department of Agriculture and was constructed by Roger E. Gerhart, Inc. Construction began in May of 1971 and was completed in November of the same year. The dam was known as Supplee Dam until October 26, 1971, when it was officially dedicated as the Robert G. Struble Dam. There is no record of any subsequent modifications to the dam.
- h. Normal Operating Procedures. The only operating mechanism is the pond drain sluice gate which controls the pond drain. There is no written record of operation of the sluice gate; however, according to David Yaeck, Executive Director, Chester County Water Resources Authority, the sluice gate is operated at least twice a year by the Pennsylvania Fish Commission, which has jurisdiction over the reservoir.

### 1.3 Pertinent Data

#### a. Drainage Area.

Square Miles 2.94

#### b. Discharge at Dam Site. (cfs)

Max. flood of record (estimated) 60  
Max. principal spillway discharge (water level  
to emergency spillway crest Elev. 619.5) 101.5  
Max. emergency spillway discharge (water level  
to top of dam - Elev. 625.5) 6,050  
Max. non-overtopping discharge 6,165

#### c. Elevation (feet above MSL)

Principal spillway crest (normal pool) 615.8  
Emergency spillway crest 619.5  
Top of dam (design) 625.5  
Upstream berm 612.8  
Pond drain invert 595.25  
Principal spillway conduit invert (inlet) 594.0  
Principal spillway conduit invert (outlet) 592.0  
Streambed at downstream toe 594.5

#### d. Reservoir (miles)

Length of normal pool 0.57  
Length of flood storage pool 0.68  
Length of maximum (non-overtopping) pool 0.76

#### e. Storage (acre-feet)

Sediment, fish, and wildlife (normal pool) 1,025  
Floodwater retardation 596  
Total (emergency spillway crest) 1,621  
Top of dam 2,880

#### f. Reservoir Surface Area (acres)

Normal pool 146  
Flood storage pool 183  
Top of dam 245

#### g. Dam Data

Type Compacted Earth  
Embankment  
Length 1,500 feet  
Height 31 feet (Maximum)  
Crest Width 14 feet  
Side slopes 3H:1V (upstream)  
2.5H:1V (downstream)

Zoning	2 zones separated by a chimney drain (refer to section 1.2.a)
Impervious core	Impervious upstream and central section (refer to section 1.2.a)
Cutoff	Yes (refer to section 1.2.a)
Grout Curtain	None

h. Spillways

Principal

Type	Drop inlet structure with 30-inch conduit and impact basin
Crest Width	15 feet
Crest Elevation	615.8
Gates	None
Upstream Channel	None
Downstream Channel	Impact basin directs flow into a 300 foot long trapezoidal channel that is riprap lined for the initial 20 feet.

Emergency

Type	Trapezoidal vegetated earth cut (3H:1V side slopes)
Crest Width	150 feet
Crest Elevation	619.5
Gates	None
Upstream Channel	240-foot long approach section on a 2% grade
Downstream Channel	300-foot long discharge channel on a 3.3% grade

i. Outlet Works

Type	18-inch reinforced concrete pipe pond drain connected to the upstream face of the riser.
Length	50 feet
Closure	Sluice gate mounted on the inside face of the riser.
Access	Control mechanism is located on top of the riser and is accessible from the upstream face of the dam.
Regulating Facilities	Hand operated gate

SECTION 2  
ENGINEERING DATA

2.1 Design

- a. Data Available. The information available for review of Struble Dam includes the following obtained from DER:
1. "Application", "Report Upon the Application", and "Permit" to construct Robert G. Struble Dam, DER, 1970.
  2. Complete set of "As-Built" plans including soil boring logs
  3. Set of original design drawings
  4. SCS design report
  5. Construction progress reports and photographs
  6. Annual inspection reports (1972 through 1974)
  7. Miscellaneous correspondence and memoranda
- b. Design Features. The design features are described in Section 1.2.a and shown on the Plates in Appendix E.

2.2 Construction

Based on the field investigation and the information available in the construction reports, the dam appears to have been constructed in general conformance with the design drawings.

2.3 Operation

Operational procedures are limited to the control of the sluice gate for the pond drain. The sluice gate is located on the inside face of the upstream endwall of the riser.

2.4 Evaluation

- a. Availability. The information utilized in this report was provided by the DER.
- b. Adequacy. The information concerning design and construction supplied by the DER is adequate for a Phase I investigation.
- c. Validity. There is no reason to question the validity of the data obtained from DER.

## SECTION 3

### VISUAL INSPECTION

#### 3.1 Findings

- a. General. The field inspection of Struble Dam took place on May 2, 1979. At the time of inspection, the water surface was approximately two inches above the principal spillway crest. The observations and comments of the field inspection team are in the check list which is Appendix B of this report. The appearance of the facility indicated that the dam and its appurtenances are well maintained.
- b. Dam. On the date of the inspection, the upstream and downstream faces of the earth embankment appeared to be in good condition and supported a thick grass cover. The upstream berm and riprap lining are composed of large, dumped rock (up to 4-foot in size) with little apparent gradation.

A large, wet area, approximately 200 feet square was observed beginning about 100 feet downstream of the embankment between the emergency spillway and the principal spillway outlet channel. Several smaller marshy areas were noted between the right abutment and the principal spillway outlet channel. These wet areas appear to be natural marshy ground and not the result of seepage through or beneath the embankment. According to Mr. David Yaeck, Executive Director of the Chester County Water Resources Authority, the marshy ground existed prior to the construction of Struble Dam.

- c. Appurtenant Structures. Mr. Yaeck stated that in 1972 an under drain was installed downstream of the embankment between the right abutment and the principal spillway outlet channel. The purpose of the drain is to collect ground water and direct the flow into the spillway outlet channel. The under drain outlet was clogged with debris; however, during the inspection, when debris was removed, clear water discharged freely from the drain.

The principal spillway appears to be in good condition and is apparently functioning properly. During the inspection, a small amount of water was flowing from the toe drain outlets, which are located in the impact basin side walls. The discharge was slightly greater from the left side toe drain.

The emergency spillway has a thick grass cover throughout its length. A vegetated earth dike extends over 100 feet downstream along the right side of the emergency spillway providing adequate protection of the embankment from emergency spillway discharge.

- d. Reservoir Area. A railroad embankment, approximately 500 feet long is constructed across the northwest tip of the reservoir, about 3,000 feet from the dam. A large culvert is built through the railroad embankment. The hydrology of the reservoir does not appear to be affected by the culvert. The slopes along the perimeter of the reservoir are relatively mild and well vegetated.
- e. Downstream Channel. A trapezoidal cut channel with a 10-foot bottom width and 2H:1V side slopes joins the natural streambed about 300 feet downstream of the dam. The stream flows through the town of Cupola 1.5 miles downstream of the dam. There are approximately 5 homes and 25 people in the potential damage area in Cupola. Failure of Struble Dam would cause extensive property damage and probable loss of life.

SECTION 4  
OPERATIONAL PROCEDURES

4.1 Procedures

According to Mr. Yaeck, the pond drain sluice gate is operated at least twice a year by the Pennsylvania Fish Commission, which has jurisdiction over the reservoir.

4.2 Maintenance of the Dam

Maintenance inspections are performed four times a year by the Chester County Water Resources Authority. General maintenance, such as cutting the grass, is performed once a year.

4.3 Maintenance of Operating Facilities

The Pennsylvania Fish Commission maintains possession of the sluice gate hoist wheel. The hoist is lubricated as required and the gate is operated periodically.

4.4 Warning Systems in Effect

Stream elevations of Brandywine Creek are monitored by gages and the residents of the area are kept informed by emergency broadcasts on local commercial radio stations during periods of heavy rainfall. According to Mr. Yaeck, residents downstream of Struble Dam would be notified by this radio network as soon as The Emergency Spillway went into operation.

4.5 Evaluation of Operational Adequacy

Struble Dam has a well established maintenance program and appears to be carefully monitored. The operational features and procedures are considered adequate.

The Dam is not readily accessible under severe weather conditions for inspection and emergency action.

## SECTION 5

### HYDRAULICS AND HYDROLOGY

#### 5.1 Evaluation of Features

- a. Design Data. The complete SCS hydraulic and hydrologic design is available from DER. A summary of the SCS hydrologic and hydraulic design is enclosed in Appendix C, Sheet 10.

Struble Dam has a drainage area of 2.9 square miles and impounds a reservoir with a normal pool storage capacity of 1,025 acre-feet. Additional storage capacity to the crest of the emergency spillway of 596 acre-feet is available for flood control. The spillway system consists of a principal spillway (drop inlet closed conduit spillway) and an emergency spillway (vegetated earth cut). The combined spillway discharge capacity without overtopping of the embankment is 6,165 cfs.

- b. Experience Data. No rainfall or reservoir level records are kept for this dam. Mr. Yaeck stated that the highest reservoir level occurred in January of 1978 when the reservoir level was about 1.5 feet above the principal spillway crest.
- c. Visual Observations. On the date of the inspection, the principal spillway and the emergency spillway appeared to be unobstructed and functioning as designed. Further observations are given in Appendix B.
- d. Overtopping Potential. The Spillway Design Flood (SDF) for this "Intermediate" size "High" hazard dam is the full PMF. The PMF hydrograph was routed through the reservoir with the starting water surface elevation at the crest of the principal spillway, Elevation 615.8. Based on the hydraulic and hydrologic analysis, the spillway system is capable of discharging 100% of the PMF without overtopping of the embankment. The peak inflow and outflow rates for the PMF are 8,453 cfs and 5,592 cfs respectively (see Appendix C for computations).
- e. Spillway Adequacy. The Struble Dam spillway system is classified as "Adequate".

## SECTION 6

### STRUCTURAL STABILITY

#### 6.1 Evaluation of Structural Stability

- a. Visual Observations. The downstream face of the embankment and the visible portion of the upstream face appear to be in good condition. There are no visible signs of instability of the dam. The survey of the top of dam revealed that little settlement has occurred since construction. The entire length of the top of dam is well above design elevation which is evidence of the overfill built into the top of the dam for possible future settlement of the embankment and to maintain a level appearance.

The structural features of the principal spillway appear to be in good condition. There is no evidence of cracking or spalling of the concrete surfaces. The emergency spillway shows no visible signs of structural instability.

- b. Design and Construction Data. The SCS design report, construction progress reports and photographs were obtained from DER. "As-Built" plans were also included in the DER files.

The earth embankment cross section geometry shown on the drawings was verified during the field inspection. The embankment and foundation design is consistent with SCS, Soil Mechanics Laboratory Report and Recommendations.

SCS inspection personnel were reported to be present on the job site during the entire construction operation.

- c. Operating Records. There are no operating records maintained for this structure.
- d. Post-Construction Changes. The only post-construction change was the installation of the under drain downstream of the right side of the embankment. The drain was added in 1972, one year after construction was completed, to drain ground water from this area.
- e. Seismic Stability. Struble Dam is located in Seismic Zone I on the Seismic Zone Map of Contiguous States. A dam located in Zone I is generally considered to be safe under any expected earthquake loading, if it is stable under static loading conditions.

## SECTION 7

### ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

#### 7.1 Dam Assessment

- a. Safety. The visual observations and review of available information indicate that the Robert G. Struble Dam is in good condition. The embankment and appurtenant structures show no signs of instability or structural deficiency. The dam is inspected regularly and is well maintained.

The combined spillway system is capable of discharging 100% of the PMF without overtopping of the embankment. Therefore, the spillway system is classified as hydraulically "Adequate".

- b. Adequacy of Information. The information received from DER is adequate for a Phase I investigation.
- c. Urgency. Regular inspections of the structure should be continued.
- d. Necessity for Further Investigation. Further investigations are not considered necessary.

#### 7.2 Recommendations and Proposed Remedial Measures

##### a. Facilities

1. The dam and appurtenant structures are considered to be in good condition and no remedial measures are recommended at the present time.

##### b. Operation and Maintenance Procedures

1. Struble Dam is regularly inspected and general maintenance is performed on an annual basis. The sluice gate is operated periodically and maintenance to the gate system is performed as required. Emergency broadcasts on local commercial radio stations inform area residents of high stages in the Brandywine Creek. Residents downstream of Struble Dam would be alerted when the emergency spillway goes into operation.

APPENDIX

A

Check List Engineering Data  
Design, Construction, Operation  
Phase I

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
PHASE I

NAME OF DAM ROBERT G. STRUBLE

ID # PA 00621

Sheet 1 of 4

ITEM

REMARKS

AS-BUILT DRAWINGS

A COMPLETE SET OF AS BUILT PLANS WERE OBTAINED

REGIONAL VICINITY MAP

REFER TO APPENDIX E, PLATE 1

CONSTRUCTION HISTORY

CONSTRUCTION PROGRESS REPORTS AND PHOTOGRAPHS  
ARE AVAILABLE FROM DER.

TYPICAL SECTIONS OF DAM

REFER TO APPENDIX E.

OUTLETS - PLAN

DETAILS

CONSTRAINTS

INCLUDED IN AS BUILT  
PLANS

DISCHARGE RATINGS

CONTAINED IN SCS DESIGN REPORT

RAINFALL/RESERVOIR RECORDS

NONE AVAILABLE

ITEM \_\_\_\_\_ REMARKS \_\_\_\_\_

DESIGN REPORTS

SCS DESIGN REPORT WAS  
OBTAINED FROM DER.

GEOLOGY REPORTS

CONTAINED IN SCS  
DESIGN REPORT

DESIGN COMPUTATIONS  
HYDROLOGY & HYDRAULICS  
DAM STABILITY  
SEEPAGE STUDIES

CONTAINED IN SCS  
DESIGN REPORT

MATERIALS INVESTIGATIONS  
BORING RECORDS }  
LABORATORY }  
FIELD }

BORING LOGS ARE CONTAINED IN  
THE AS BUILT PLANS, SOILS REPORT IS  
PART OF THE DESIGN REPORT.

POST-CONSTRUCTION SURVEYS OF DAM

CONTAINED IN AS BUILT PLANS

BORROW SOURCES

SHOWN IN AS BUILT PLANS



ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	REFER TO APPENDIX E
OPERATING EQUIPMENT PLANS & DETAILS	REFER TO APPENDIX E
MISCELLANEOUS	REFER TO SECTION 2.1.A

APPENDIX

B

Check List  
Visual Inspection  
Phase I

CHECK LIST  
VISUAL INSPECTION  
PHASE I

Sheet 1 of 11

Name Dam ROBERT G. STRUBLE DAM County CHESTER State PENNA. National ID # PA 00621

Type of Dam EARTH Hazard Category \_\_\_\_\_

Date(s) Inspection 5/2/79 Weather FAIR Temperature 65° F.

Pool Elevation at Time of Inspection 616 ± M.S.L. Tailwater at Time of Inspection 593 ± M.S.L.

Inspection Personnel:

LEE H. DECKER LEONARD R. BRICK ROBERT R. BOWERS

LEE H. DECKER Recorder

Remarks:

MR. DAVID YACK AND MR. AL PALMATEER, REPRESENTATIVES FROM THE CHESTER COUNTY WATER RESOURCES AUTHORITY, WERE PRESENT DURING THE INSPECTION. MR. GARY EMMANUEL, FROM THE DEPARTMENT OF ENVIRONMENTAL RESOURCES, WAS ALSO PRESENT.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF OBSERVATIONS REMARKS OR RECOMMENDATIONS

ANY NOTICEABLE SEEPAGE

N/A

STRUCTURE TO  
ABUTMENT/EMBANKMENT  
JUNCTIONS

N/A

DRAINS

N/A

WATER PASSAGES

N/A

FOUNDATION

N/A

CONCRETE/MASONRY DAMS

Sheet 3 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

Sheet 4 of 11

VISUAL EXAMINATION OF                      OBSERVATIONS                      REMARKS OR RECOMMENDATIONS

SURFACE CRACKS

NONE OBSERVED

UNUSUAL MOVEMENT OR  
CRACKING AT OR BEYOND  
THE TOE

NONE OBSERVED

SLOUGHING OR EROSION OF  
EMBANKMENT AND ABUTMENT  
SLOPES

NONE OBSERVED

VERTICAL AND HORIZONTAL  
ALIGNMENT OF THE CREST

THE SURVEY OF THE CREST  
REVEALED THAT LITTLE SETTLEMENT  
HAD OCCURRED AND THE TOP OF DAM  
SHOWED A DEFINITE CAMBER (AS  
CONSTRUCTED).

RIPRAP FAILURES

NONE OBSERVED

EMBANKMENT

Sheet 5 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
DRAINS	THE TWO DRAIN OUTLETS AND THE FRENCH DRAIN OUTLET WERE DISCHARGING CLEAR WATER. THE DRAINS WERE LOCATED BENEATH THE EMBANKMENT OF THE NATURAL GROUND SURFACE.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	NO PROBLEMS NOTED	
ANY NOTICEABLE SEEPAGE	NONE OBSERVED	
STAFF GAGE AND RECORDER	NONE	

OUTLET WORKS  
PRINCIPAL SILEWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	THE OUTLET CONDUIT IS LOCATED BENEATH THE EMBANKMENT.	
INTAKE STRUCTURE	THE INTAKE STRUCTURE (RISER) APPEARED TO BE IN GOOD CONDITION AND WAS UNOBSTRUCTED.	
OUTLET STRUCTURE	THE IMPACT PADDLE ALSO APPEARED TO BE IN GOOD CONDITION AND WAS FUNCTIONING PROPERLY.	
OUTLET CHANNEL	THE INITIAL PORTION OF THE OUTLET CHANNEL IS REPAIR LINED.	
EMERGENCY GATE	THE ONLY GATE IS THE SLUICE GATE WHICH CONTROLS THE POND DRAIN INLET.	

UNGATED SPILLWAY  
EMERGENCY SPILLWAY

Sheet 7 of 11

VISUAL EXAMINATION OF OBSERVATIONS REMARKS OR RECOMMENDATIONS

CONCRETE WEIR

N/A

APPROACH CHANNEL

THE FOREBAY CHANNEL IS WELL  
VEGETATED AND SLOPES UPWARD ON A  
2% GRADE

DISCHARGE CHANNEL

THE DISCHARGE CHANNEL IS WELL VEGETATED  
AND SLOPES DOWNWARD ON A  
3.3% GRADE

BRIDGE AND PIERS

N/A

GATED SPILLWAY

Sheet 8 of 11

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

INSTRUMENTATION

Sheet 9 of 11

VISUAL EXAMINATION      OBSERVATIONS      REMARKS OR RECOMMENDATIONS

MONUMENTATION/SURVEYS

N/A

OBSERVATION WELLS

N/A

WEIRS

N/A

PIEZOMETERS

N/A

OTHER

N/A

RESERVOIR

Sheet 10 of 11

VISUAL EXAMINATION OF      OBSERVATIONS      REMARKS OR RECOMMENDATIONS

SLOPES

THE RESERVOIR SLOPES WERE  
MILD AND GRASS COVERED.

SEDIMENTATION

THE D.C. DESIGN ALLOWS FOR  
50 YEARS OF SEDIMENTATION  
STORAGE IN THE NORMAL POOL  
STORAGE.

DOWNSTREAM CHANNEL

Sheet 11 of 11

VISUAL EXAMINATION OF OBSERVATIONS REMARKS OR RECOMMENDATIONS

CONDITION  
(OBSTRUCTIONS,  
DEBRIS, ETC.)

NO OBSTRUCTIONS OR DEBRIS  
WAS OBSERVED IN THE DOWN-  
STREAM CHANNEL FOR SEVERAL  
HUNDRED FEET DOWNSTREAM.

SLOPES

THE DOWNSTREAM CHANNEL  
SLOPES ABOUT 1:1 TO 1.5:1  
THE DAY AND NE TOWNS OF  
CURSUA.

APPROXIMATE NO.  
OF HOMES AND  
POPULATION

THERE ARE ABOUT 4 HOMES  
AND 20 PEOPLE LOCATED IN THE  
DOWNSTREAM TOWN OF CURSUA.

6

APPENDIX

C

Hydrologic & Hydraulic Data

0

TABLE OF CONTENTS - APPENDIX C

HYDROLOGIC & HYDRAULIC DATA

PMP CALCULATIONS	SHEET 1
SNYDER COEFFICIENTS	SHEET 1
STAGE-STORAGE	SHEET 2
STAGE-DISCHARGE	SHEETS 2-3
HEC-1 DAM SAFETY VERSION COMPUTER OUTPUT	SHEETS 4-9
SCS DESIGN SUMMARY	SHEET 10



O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO.
ROBERT G. STRUBLE DAM	1	RRE	3/30/79	

HYDROLOGY CALCS.

DRAINAGE AREA : 2.94 mi.<sup>2</sup>

PMP CALCULATIONS (HM REPORT 33)

AREA IS IN ZONE 6

24 HR., 200 SQ. MI. RAINFALL = 23.5"

<u>HR.</u>	<u>%</u>	<u>RAINFALL</u>	<u>Δ RF</u>
6	113	26.6"	26.6"
12	123	28.9"	2.3"
24	132	31.0"	2.1"
48	142	33.4"	2.4"

SNYDER COEFFICIENTS

FROM INFO. PROVIDED BY COE, FOR THE DELAWARE RIVER BASIN, ZONE 10 :

$C_p = 0.60$

AND

$C_t = 1.25$

$t_p = C_t (L \cdot L_{ca})^{0.3}$

$L = 2.6 \text{ miles}$

$L_{ca} = 1.0 \text{ miles}$

$t_p = 1.25 (2.6 \cdot 1.0)^{0.3} =$

$1.66 \text{ HRS.}$



O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
STRUBLE DAM	2			

STAGE-STORAGE CURVE VALUES (FROM SCS DESIGN REPORT)

<u>ELEVATION</u>	<u>STORAGE (ACRE-FT.)</u>
601	0 *
615.8	991
619.5	1587
625.5	2846

\* STORAGE VALUES ARE WITHOUT THE 33.8 ACRE-FeET OF SEDIMENT STORAGE.

STAGE-DISCHARGE CURVE VALUES (FROM SCS DESIGN REPORT)

WEIR FLOW  $\rightarrow Q_w = CLH_w^{3/2} = 3.1(15) H_w^{3/2} = 46.5 H_w^{3/2}$   
 $Q_p = 22.95 H_p^{1/2}$

<u>STAGE</u>	<u>H<sub>w</sub></u>	<u>Q<sub>w</sub></u>	<u>H<sub>p</sub></u>	<u>Q<sub>p</sub></u>	<u>H<sub>es</sub></u>	<u>Q<sub>es</sub></u>	<u>Q<sub>TOTAL</sub></u>
615.8	0	0					0
616.2	0.4	11.8					11.8
616.6	0.8	33.3					33.3
617.0	1.2	61.1					61.1
617.43	1.63	95.5	17.43	96			95.5
618.0			18	97.3			97.3
618.5			18.5	98.6			98.6
619.0			19	100			100
619.5			19.5	101.5	0	0	101.5
621.26			21.26	105.8	1.76	754.55	860
622.15			22.15	108.1	2.65	1514.6	1623
622.89			22.89	109.7	3.39	2278.5	2388

(CONT)



O'BRIEN & GERE

SUBJECT	SHEET 3	BY	DATE	JOB NO.
---------	------------	----	------	---------

STAGE - DISCHARGE (CONT.)

<u>STAGE</u>	<u>HP</u>	<u>QP</u>	<u>HES</u>	<u>QPS</u>	<u>QTOTAL</u>
623.54	23.54	111.3	4.04	3047.0	3158
624.64	24.64	113.8	5.14	4591.6	4705
625.64	25.64	116.1	6.14	6148.0	6264
626.5	26.5	118.2	7.0	7715.0	7833

\*\*\*\*\*  
 FLOOD HYDROGRAPH PACKAGE (MCC-1)  
 DAM SAFETY VERSION JULY 1976  
 LAST MODIFICATION 25 SEP 78  
 \*\*\*\*\*

LINE NO.	DESCRIPTION	VALUE	UNIT
1	SI		
2	42		
3	43		
4	9	150	
5	5	1	
6	1	9	
7	2	.3	
8	0	.4	
9	0	.5	
10	1	.6	
11	0	.7	
12	0	.8	
13	1	.9	
14	0	1.0	
15	0	1.0	
16	1	1.0	
17	0	0.05	
18	1		
19	1		
20	1		
21	1		
22	1		
23	1		
24	1		
25	1		
26	1		
27	1		

LINE NO.	DESCRIPTION	VALUE	UNIT
28	30	0	
29	0	0	
30	0	0	
31	0	0	
32	0	0	
33	0	0	
34	0	0	
35	0	0	
36	0	0	
37	0	0	
38	0	0	
39	0	0	
40	0	0	
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300	0	0	

NATIONAL DAM INSPECTION PROGRAM  
 ROBERT G. STROUBLE DAM  
 PWF HYDROGRAPH

RUNOFF TO STROUBLE LAKE

ROUTING THROUGH STROUBLE LAKE



# SHEET 6

SUN 74.82 22.97 1.45 91533.  
( 530.11 583.11 47.11 2551.93)

.....

## HYDROGRAPH ROUTING ROUTING THROUGH STUBBLE LAKE

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO	
OUTFLOW	1	0	0	0	0	1	0	0	
QLOSS	AVG	ROUTING DATA		IPMP		LSTR			
0.0	0.00	1	1	0	0	0	0		
		NSTPS		LAG	4MSK	X	TSK	STORA	ISPRAT
		1	0	0	0.000	0.000	0.000	-616.	-1
STAGE	615.80	616.20	616.60	617.00	617.43	618.00	618.50	619.00	619.50
	622.15	622.89	623.54	624.64	625.64	626.50			
FLOW	0.00	12.00	33.00	61.00	96.00	97.00	99.00	100.00	102.00
	1623.00	2388.00	3158.00	4705.00	6264.00	7833.00			
CAPACITY	0.	991.	1597.	2845.					
ELEVATION	601.	616.	620.	626.					

CREL	SPWID	COO	EXPW	ELEVEL	COOL	CAREA	EXPL
615.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA			
TOPEL	COOD	EXPD	DAMWID
625.5	3.1	1.5	1500.

PEAK OUTFLOW IS	158. AT TIME	23.00 HOURS
PEAK OUTFLOW IS	602. AT TIME	21.00 HOURS
PEAK OUTFLOW IS	1140. AT TIME	20.50 HOURS
PEAK OUTFLOW IS	1825. AT TIME	20.00 HOURS
PEAK OUTFLOW IS	2528. AT TIME	19.50 HOURS
PEAK OUTFLOW IS	3258. AT TIME	19.50 HOURS
PEAK OUTFLOW IS	4058. AT TIME	19.50 HOURS
PEAK OUTFLOW IS	4789. AT TIME	19.00 HOURS

SHEET 7

PEAK OUTFLOW IS 5542. AT TIME 15.00 HOURS

.....  
.....  
.....  
.....  
.....

SHEET 8

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)  
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
HYDROGRAPH AT	INFLOW	2.94		.20	.30	.40	.50	.60	.70	.80	.90	1.00
		( 7.61)	1	1691.	2536.	3381.	4226.	5072.	5917.	6762.	7607.	8453.
ROUTED TO	OUTFLOW	2.94		.20	.30	.40	.50	.60	.70	.80	.90	1.00
		( 7.61)	1	158.	602.	1140.	1825.	2528.	3288.	4058.	4789.	5592.



U. S. DEPARTMENT OF AGRICULTURE - SOIL CONSERVATION SERVICE

Element of Structure	Determining Factor	Elevation	Surface Area Acres		Storage		Inflow		Peak Outflow c.f.s.
			Acres	Acres	Acres-foot	Inches*	Volume Inches**	Rate c.f.s.	
	50 year sediment accumulation	601.0	15.0	29	0.185				
Crest of riser	Sediment, Fish & Wildlife Storage	615.8	146	1025 1054	6.54				
Crest of emergency spillway	100 year frequency storm, moisture condition II	619.5	182	576	3.8	5.12		102	
Design high water	1 X value from ES-1020 Sh. A moisture condition II	621.1 1.6'	195	905	5.77	6.77	42.73	650	
Top of dam	1 X value from ES-1020 Sh. F moisture condition II	625.5 4.4' 6.0'	245	1025	11.95	21.48	12880	6050	

\* Volume expressed in inches of runoff from controlled watershed area of 1882 acres.  
 \*\* Refer to hydrologic criteria in National Engineering Memorandum SCS-27  
 Time required to empty flood storage is 2.5 DAYS

HYDROLOGIC & HYDRAULIC DESIGN SUMMARY

APPENDIX

D

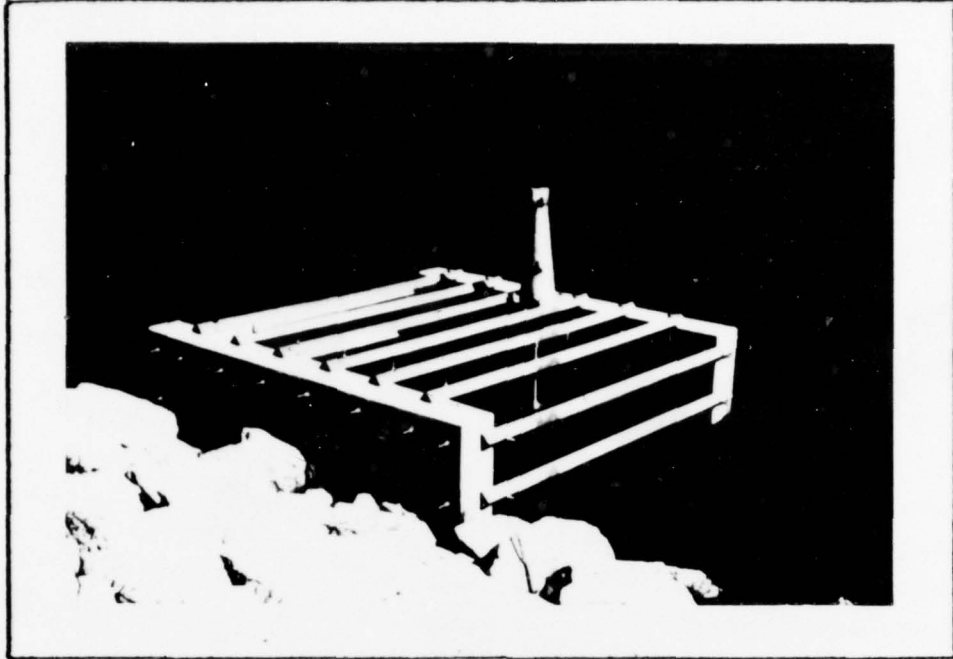
Photographs



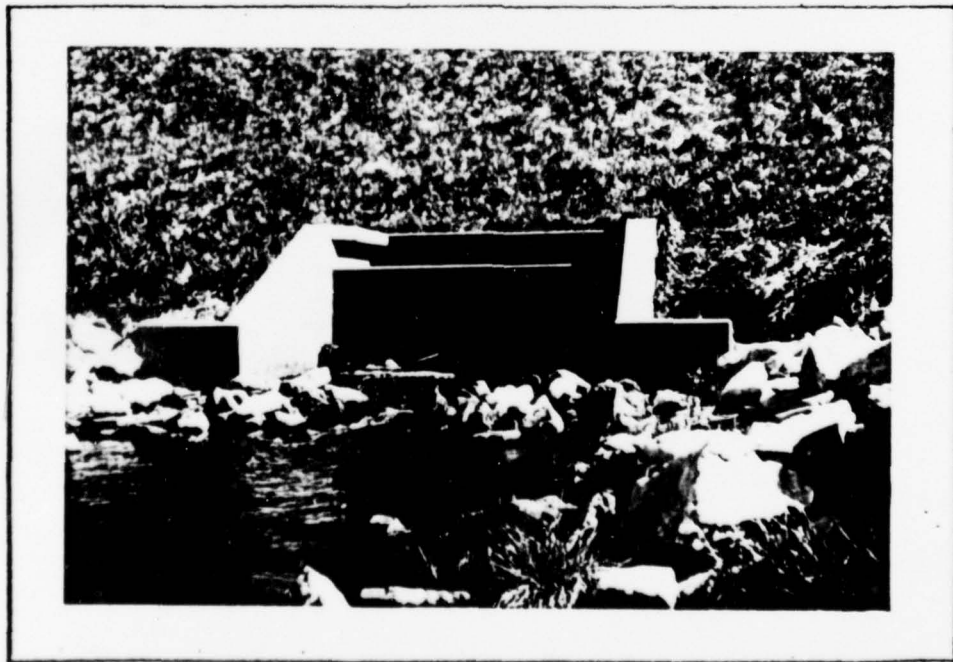
*UPSTREAM FACE OF THE DAM  
LOOKING TOWARDS THE LEFT ABUTMENT*



*DOWNSTREAM FACE OF THE DAM  
LOOKING TOWARDS THE LEFT ABUTMENT*



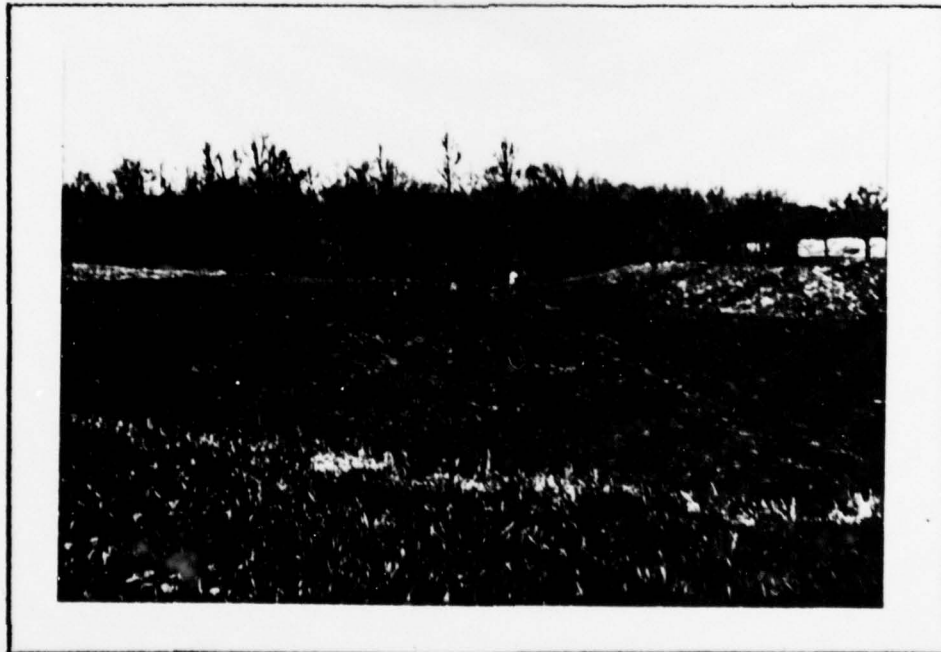
*PRINCIPAL SPILLWAY RISER INLET STRUCTURE  
ADJACENT TO THE ROCK BERM ON THE  
UPSTREAM FACE OF THE DAM*



*PRINCIPAL SPILLWAY IMPACT BASIN OUTLET  
STRUCTURE AT THE DOWNSTREAM TOE OF THE DAM*



*OUTLET OF THE INTERNAL DRAINAGE SYSTEM  
OF THE DAM ON THE LEFT SIDE OF THE  
IMPACT BASIN*



*EMERGENCY SPILLWAY CHANNEL LOOKING DOWNSTREAM*

$$t_p = 1.25 (2.6 - 1.0)^{0.3} = \boxed{1.66 \text{ HRS.}}$$

APPENDIX

E

Drawings

TABLE OF CONTENTS - APPENDIX E

REGIONAL VICINITY MAP	PLATE 1
CROSS SECTION	PLATE 2
PRINCIPAL SPILLWAY	PLATE 3
GENERAL PLAN DRAWING	PLATE 4
PROFILE OF TOP OF DAM @ TIME OF INSPECTION	PLATE 5

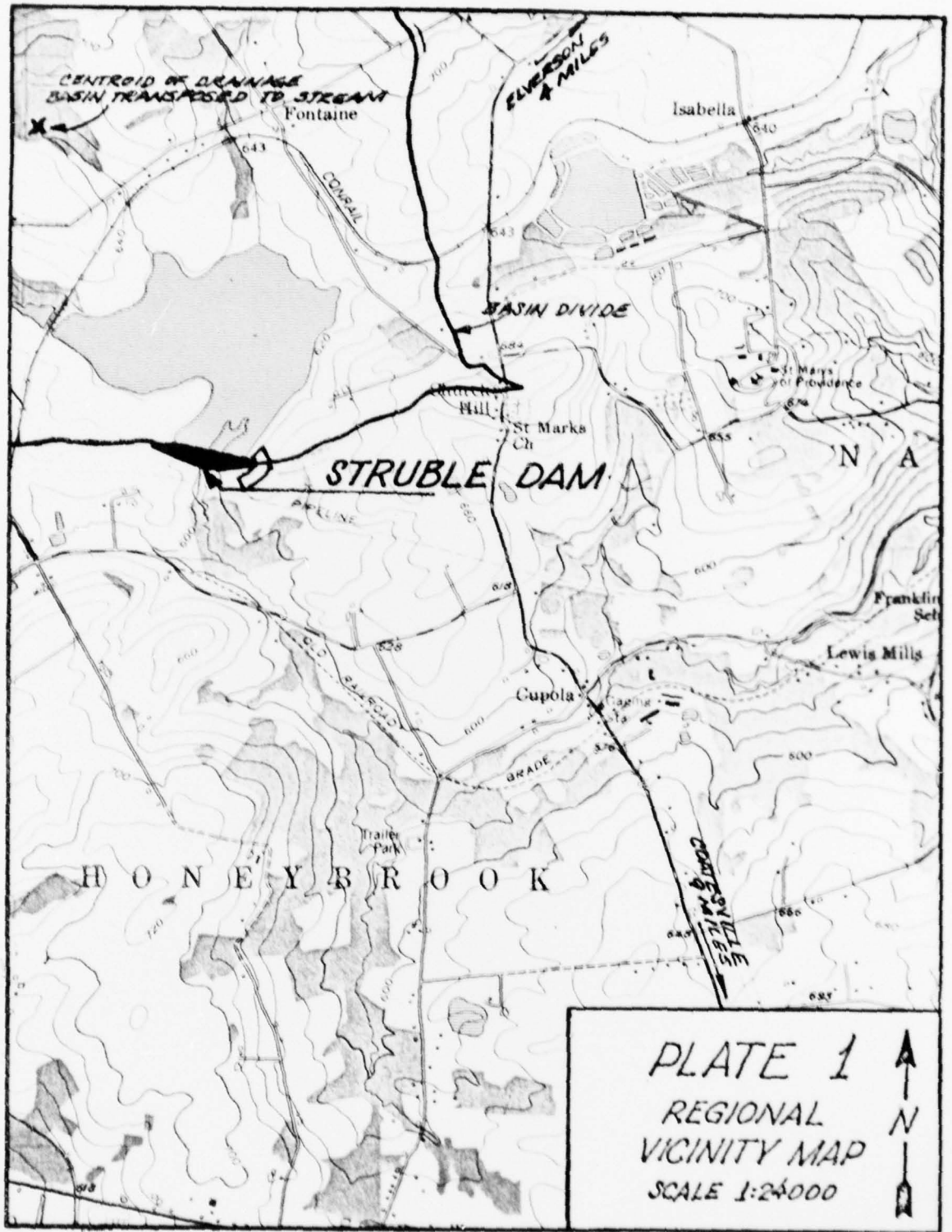
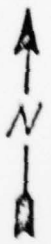
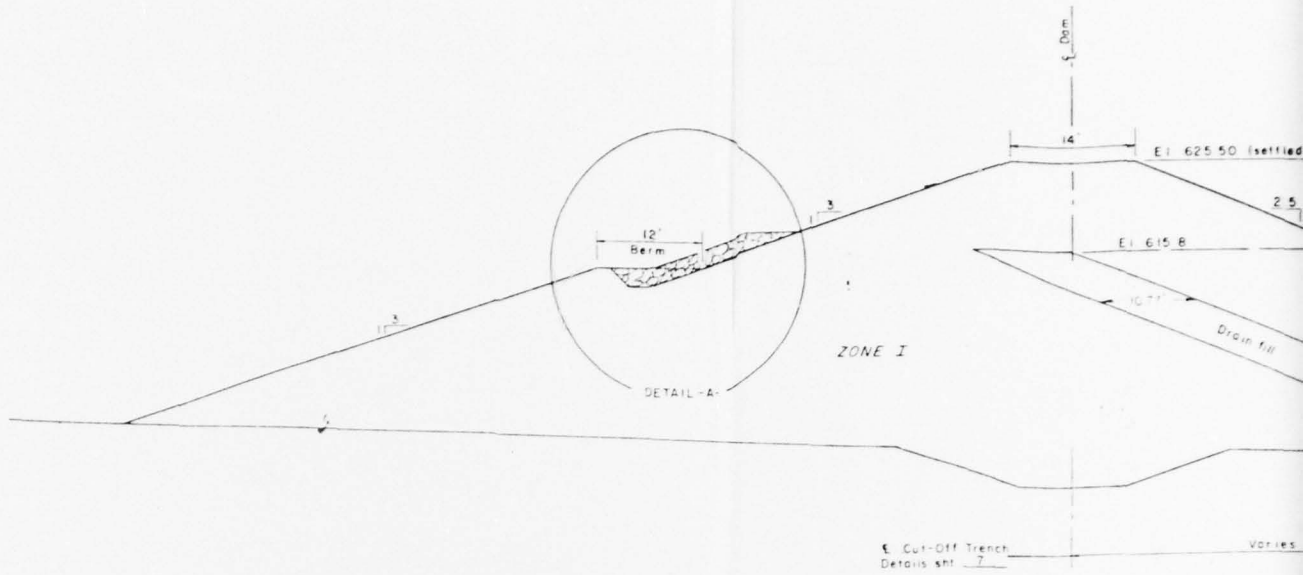
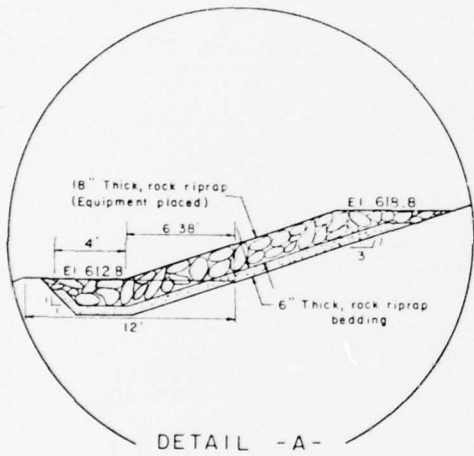
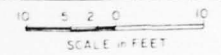


PLATE 1  
REGIONAL  
VICINITY MAP  
SCALE 1:24000





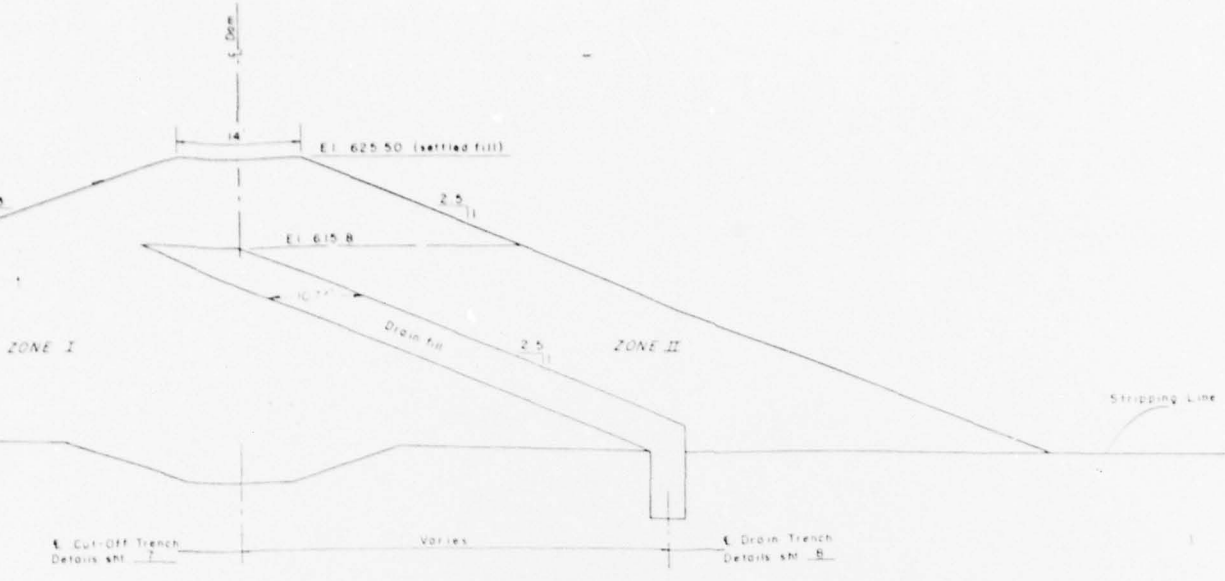
TYPICAL SECTION OF DAM



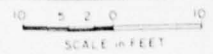
DETAIL - A -

SELECTIVE PLACEMENT	MATERIAL	MAX <sup>1</sup> ROCK SIZE	MAX <sup>2</sup> LIFT	REQ'D <sup>3</sup> WATER CONTENT	COMPACTION <sup>4</sup>	
					CLASS	DEFINITION
Upstream and Cut-Off  <i>ZONE I</i>	Material as represented by TP-1041 depth 1'-3", Classified as ML; by TP-122.1, depth 2'-5", Classified as ML; by TP-202.1, depth 2'-5", Classified as ML	6"	9"	Optimum + 2%	A	95% Max density by ASTM D-698, Method "A"
Downstream  <i>ZONE II</i>	Material as represented by TP-1042 depth 4'-7", Classified as SM, by TP-202.2, depth 5'-10", Classified as SM	6"	9"	Optimum + 2% - 2%	A	95% Max density by ASTM D-698, Method "A"

- <sup>1</sup> For fill adjacent to structures, max rock size 3"
- <sup>2</sup> Maximum permissible lift thickness before compaction
- <sup>3</sup> Water content of fill matrix at time of compaction
- <sup>4</sup> For typical compaction curves see sht. 27



TYPICAL SECTION OF DAM



CONSTRUCTION NOTES

- Constructed slopes are
  - 2.91:1 Upstream
  - 2.43:1 Downstream
- For constructed fill elevations see sht. 7.

IMPACTION	14
DEFINITION	
5% Max density by ASTM - 698, Method "A"	
9% Max density by ASTM - 698, Method "A"	

2

AS BUILT PLANS

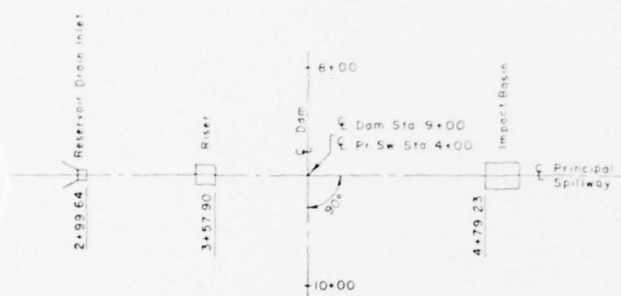
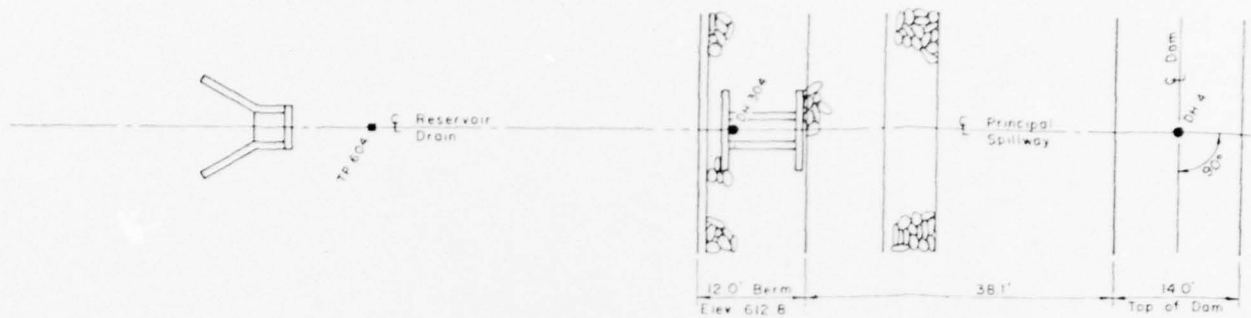
REVISIONS		
DATE	ITEM	APPROVED
4/1/69	Berm Riprap	(Signature)

BRANDYWINE CREEK WATERSHED  
 MULTIPLE PURPOSE DAM PA-431  
 CHESTER COUNTY, PENNSYLVANIA  
 FILL PLACEMENT  
 U. S. DEPARTMENT OF AGRICULTURE  
 SOIL CONSERVATION SERVICE

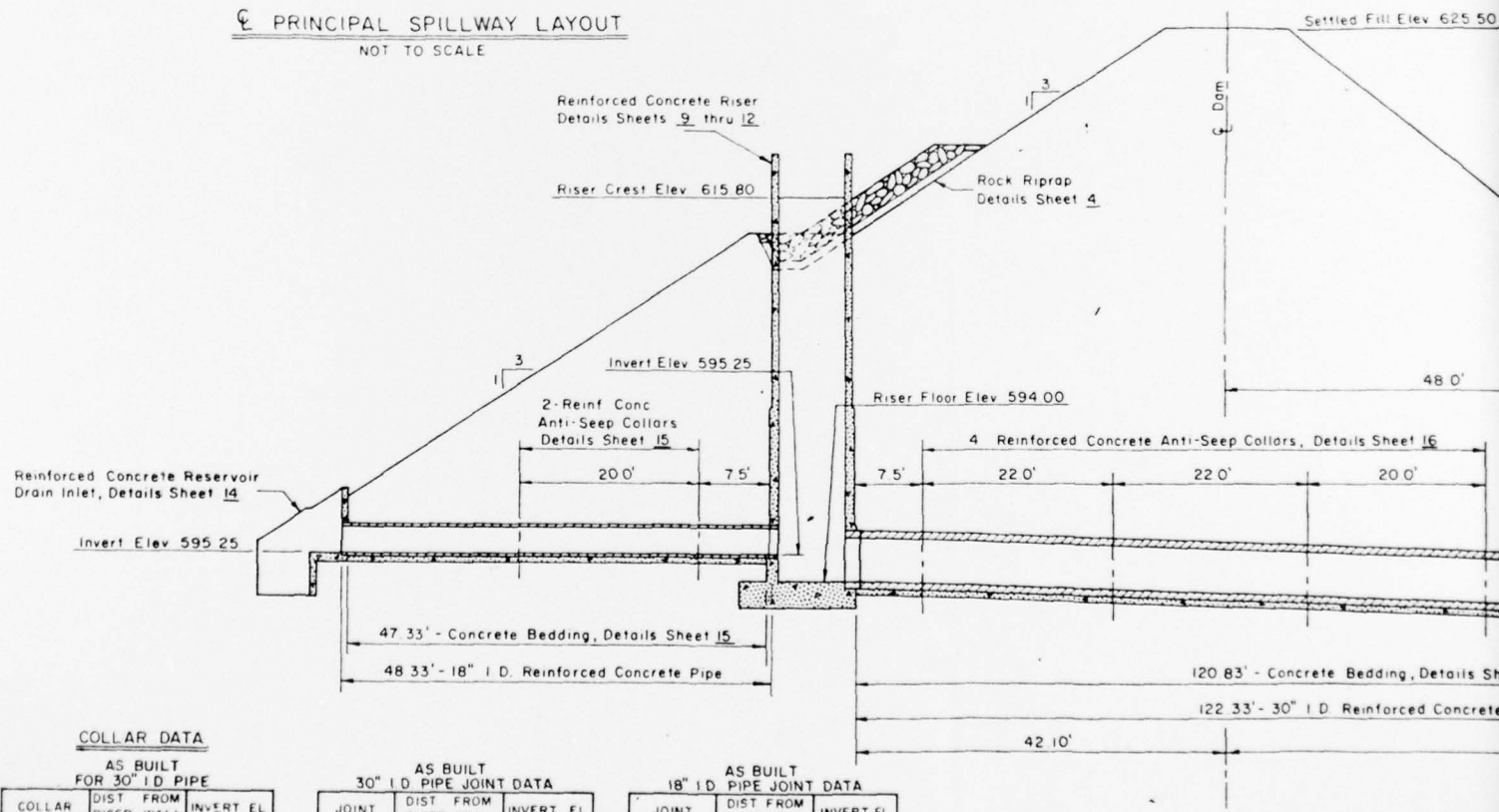
*R. R. Hall* 11/68  
 C. CRISE 11-69

*(Signature)* 4/27  
 PA-431-P

PLATE 2



PRINCIPAL SPILLWAY LAYOUT  
NOT TO SCALE



COLLAR DATA

AS BUILT FOR 30" I.D. PIPE

COLLAR	DIST FROM RISER WALL	INVERT EL
1	7.5	593.97
2	29.5	593.87
3	51.5	592.67
4	71.5	592.25

AS BUILT FOR 18" I.D. PIPE

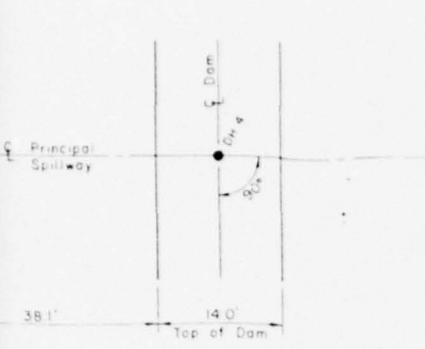
COLLAR	DIST FROM RISER WALL	INVERT EL
1	7.5	592.25
2	27.5	592.25

AS BUILT 30" I.D. PIPE JOINT DATA

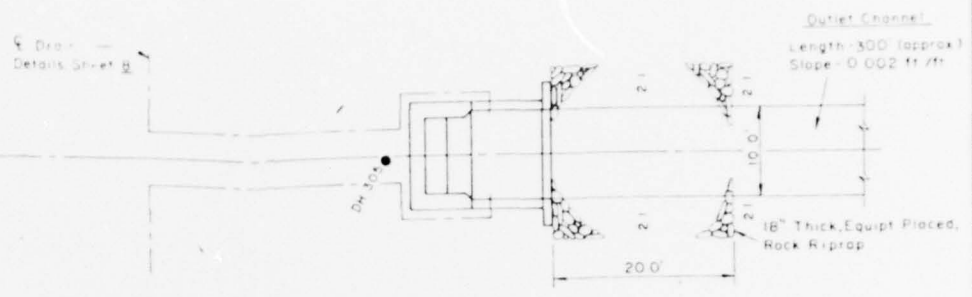
JOINT	DIST FROM RISER WALL	INVERT EL
J-1	0.33	594.0
J-2	16.33	593.93
J-3	32.33	593.64
J-4	48.33	593.71
J-5	64.33	593.46
J-6	80.33	593.18
J-7	96.33	592.80
J-8	112.33	592.34
J-9	128.33	592.00

AS BUILT 18" I.D. PIPE JOINT DATA

JOINT	DIST FROM RISER WALL	INVERT EL
J-1	0.33	595.25
J-2	16.33	595.25
J-3	32.33	595.25
J-4	48.33	595.25



PLAN VIEW OF PRINCIPAL SPILLWAY  
 SCALE: 0 5 10 20 Feet



18" I.D. Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Spec 541 (AWWA C-300 or C-301)

48' - Straight sections  
 1 - Bell and flange wall fitting (for 15" wall)  
 Pressure head = 30'  
 Load = 8,991 lbs per lin ft  
 Min 3 edge bearing strength for:  
 0.01" Crack non-prestressed pipe = 4,067 lbs per lin ft  
 0.001" Crack prestressed pipe = 3,058 lbs per lin ft

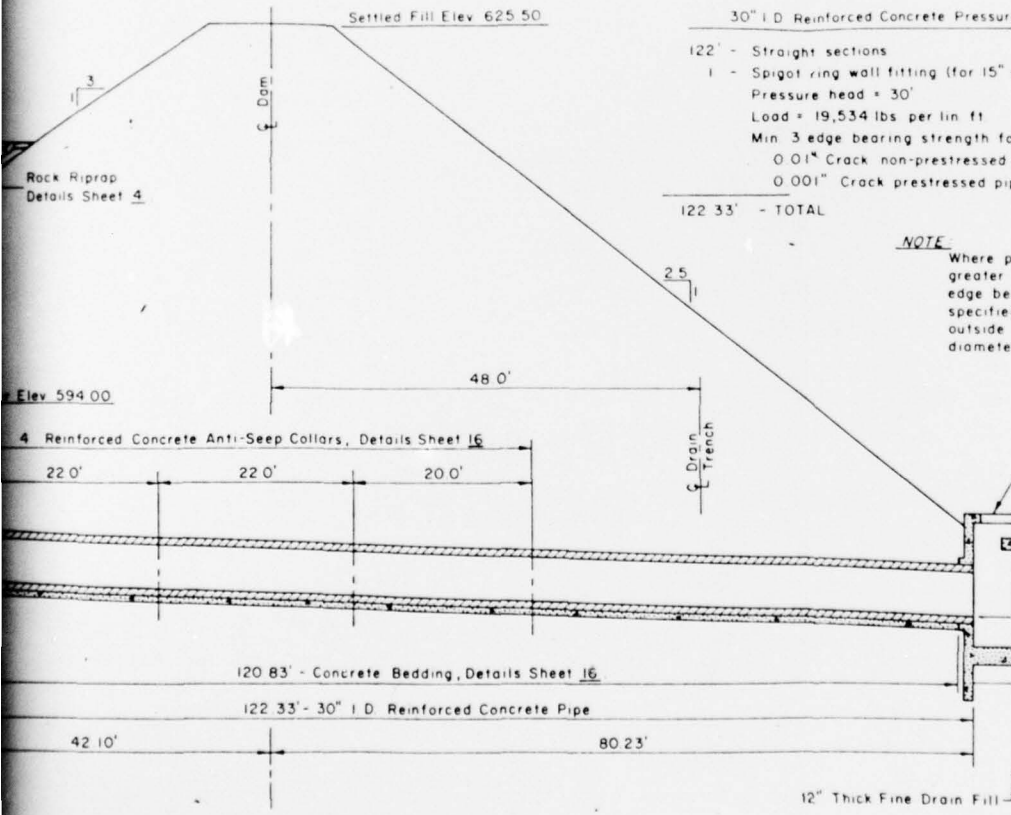
48 33' - TOTAL

30" I.D. Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Spec 541 (AWWA C-300 or C-301)

122' - Straight sections  
 1 - Spigot ring wall fitting (for 15" wall)  
 Pressure head = 30'  
 Load = 19,534 lbs per lin ft  
 Min 3 edge bearing strength for:  
 0.01" Crack non-prestressed pipe = 8,837 lbs per lin ft  
 0.001" Crack prestressed pipe = 6,644 lbs per lin ft

122 33' - TOTAL

**NOTE:**  
 Where pipe furnished has an outside diameter greater than that called for on the plans, the 3 edge bearing strength must equal or exceed the specified strength multiplied by the ratio of the outside diameter furnished to the outside diameter specified.



PROFILE ALONG C PRINCIPAL SPILLWAY  
 HORIZ SCALE: 0 5 10 20 Feet  
 VERT SCALE: 0 1 2 3 4 5 10 Feet

- CONSTRUCTION NOTES**
- Outlet end of 30" pipe (spigot end) and inlet end of 18" pipe (bell end) to be finished so that no metal is exposed
  - Pipe layout data will be furnished by the Engineer
  - Riprap bedding shall meet fine drain fill gradation limits (Sheet B)
  - For logs of test holes see sheets 19 thru 26

PLATE 3  
**AS BUILT PLANS**

REVISIONS		
DATE	ITEM	APPROVED
2/2/67	Berm Riprap	[Signature]

BRANDYWINE CREEK WATERSHED  
 MULTIPLE PURPOSE DAM PA-431  
 CHESTER COUNTY, PENNSYLVANIA  
 PRINCIPAL SPILLWAY

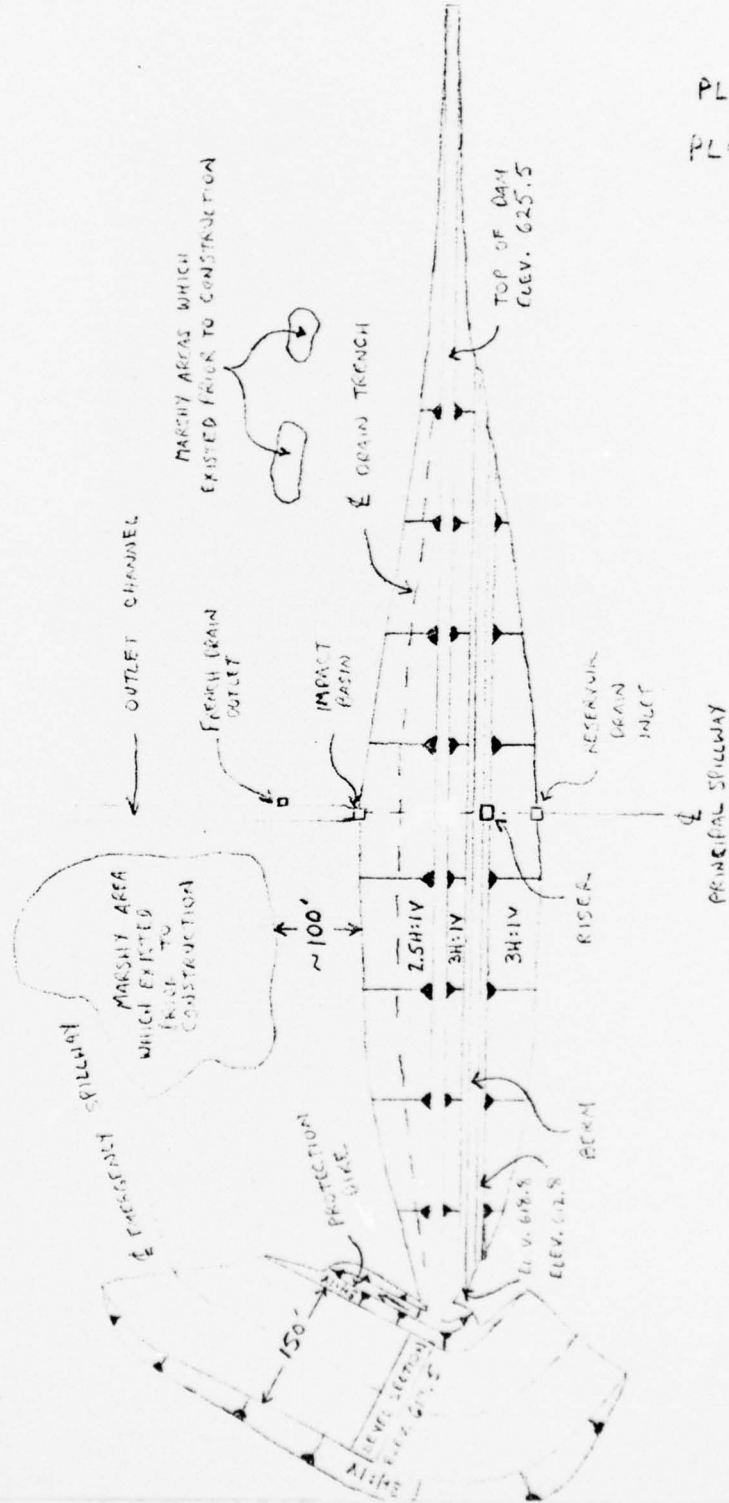
U. S. DEPARTMENT OF AGRICULTURE  
 SOIL CONSERVATION SERVICE

H. Lewis Hall 11/67  
 R. A. STALTER 11-69

PA-431-P

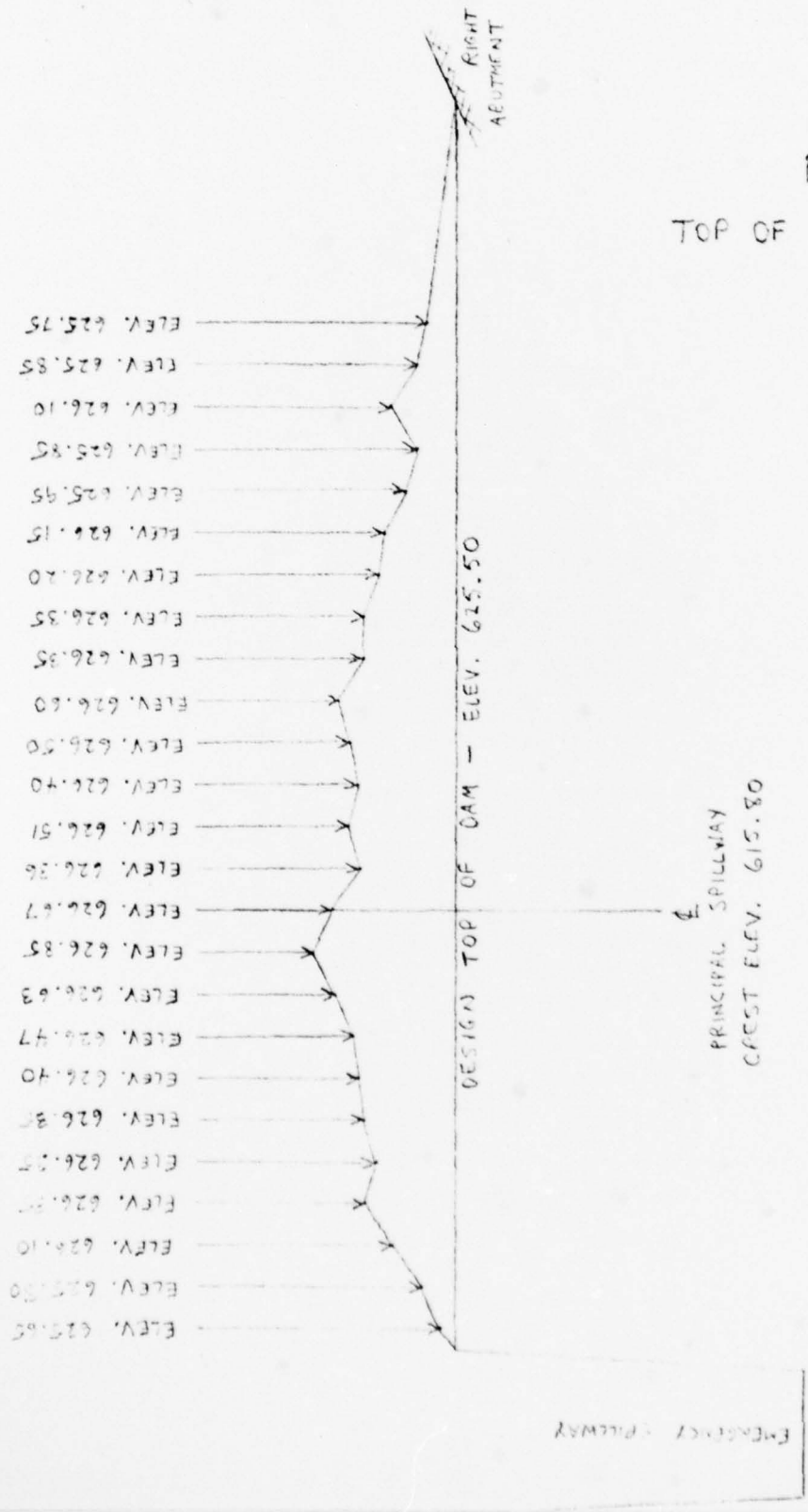
SUBJECT ROBERT G. STRUBLE DAM	SHEET	BY RRC	DATE	JOB NO.
----------------------------------	-------	-----------	------	---------

PLATE 4  
PLAN VIEW



SUBJECT	ROBERT G. STROBLE DAM	SHEET	BY	DATE	JOB NO
			RRB		

PLATE 5  
TOP OF DAM PROFILE



HOR. SCALE : 1" = 200'  
VERT. SCALE : 1" = 1.6'

APPENDIX

F

Site Geology

SITE GEOLOGY

ROBERT G. STRUBLE DAM

Robert G. Struble Dam is located in the Uplands section of the Piedmont physiographic province. Bedrock at the site is a Precambrian quartz monzonite of igneous origin. This rock unit has differentially weathered in-situ such that its character varies throughout the site from a soil-like material exhibiting cohesion and/or granulation to a broken and fractured hard rock mass. The results of exploratory boreholes at the site indicate that the thickness of the weathered material (which exhibits remnant rock structure) varies from 2 to 31 feet. No faults or major structural defects are noted in the vicinity of the dam or reservoir.

