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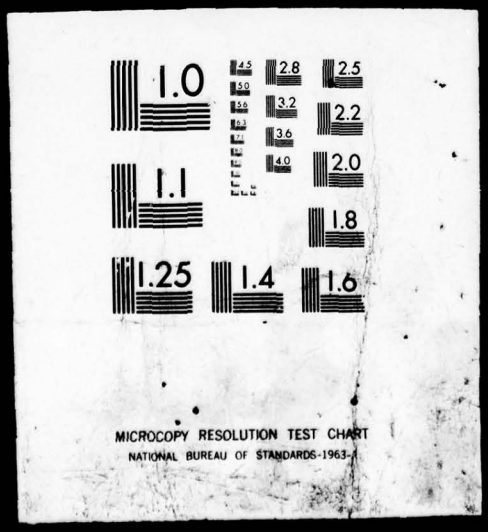

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LEVEL II

DELAWARE RIVER BASIN
LEAVITT BRANCH; BRODHEAD CREEK
MONROE COUNTY
PENNSYLVANIA
NDS ID PA. 00814
DER ID 45-250

SOIL CONSERVATION SERVICE DAM PA-463

(LEAVITT BRANCH DAM)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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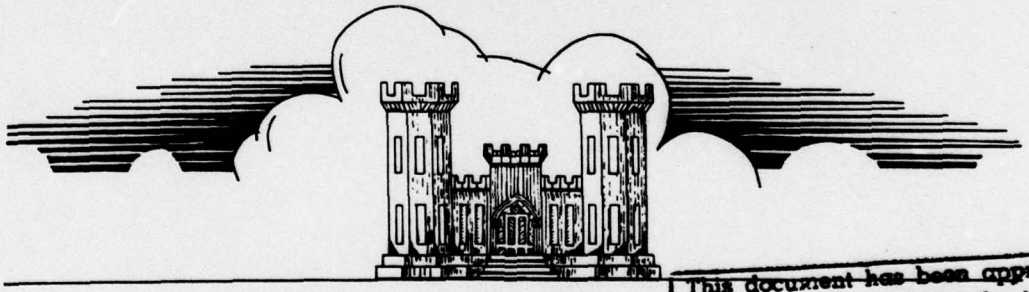

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DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

MARCH 1979

DELAWARE RIVER BASIN

LEAVITT BRANCH; BRODHEAD CREEK
MONROE COUNTY, PENNSYLVANIA

SOIL CONSERVATION SERVICE
DAM PA-463

NDS I.D. NO. PA 00814
DER I.D. NO. 45-250

(6) PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM.
Soil Conservation Service.
DAM PA-463. NDS I.D. Number PA-00814
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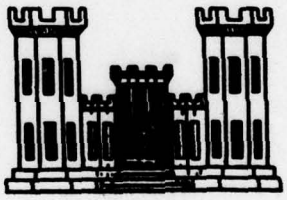
Basin, Leavitt Branch: Brodhead Creek.
Conroe County, Pennsylvania.
Phase I Inspection Report.



(15) DACW31-79-C-0017

Prepared by:

WOODWARD-CLYDE CONSULTANTS
5120 Butler Pike
Plymouth Meeting, Pennsylvania 19462

Submitted to:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 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 the Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I investigation is to expeditiously identify 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, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed 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.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	SCS Dam PA 463
County Located:	Monroe County
State Located:	Pennsylvania
Stream:	Leavitt Branch of Brodhead Creek
Coordinates:	Latitude 41° 12.4' Longitude 75° 15.0'
Date of Inspection:	17 October 1978

SCS Dam PA 463 is owned by the Wayne Commissioners and maintained by the County. The dam and reservoir are used as a flood control structure for the downstream town of Canadensis, Pennsylvania. The impoundment was designed by the United States Department of Agriculture, Soil Conservation Service (SCS), in 1972 and 1973, and the structure was completed in 1976.

With the exception of possible design deficiencies in the filter drainage system, the dam and its appurtenant facilities are considered to be in good condition and well maintained. The dam is classified as an "Intermediate" size structure with a "High" hazard classification consistent with its potential for extensive property damage and probable loss of life in the event of failure. Calculations indicate that the existing spillway systems are capable of passing the Probable Maximum Flood without overtopping. Therefore, the spillway systems are considered to be "Adequate".

The visual inspection noted that fines were deposited in the ends of the internal drainage discharge pipes and also at the base of the pipes, indicative of a potential piping problem. As a result, the redesign data was independently checked (see Appendix G) to determine if the filter criteria was satisfactory to prevent piping. These calculations, using criteria set forth by the SCS and the Corps of Engineers, indicate that all aspects of the criteria in reference to piping were not satisfied. Therefore, the possibility of piping does exist and is evident by the accumulation of fines in and at the base of the drainage pipes. With the exception of this deficiency, the visual inspection and review of the available documentation indicates that all other external features of the dam and its appurtenant structures are in reasonably good condition and the embankment materials were placed in accordance with specification requirements.

Considering the possible deficiency in the filter design, the following recommendation should be implemented immediately.

1. It is recommended that the Owner monitor seepage through the downstream toe drains, especially after a period of retention. This monitoring could last several weeks or until the seepage has decreased. Particular emphasis should be directed towards monitoring for the presence of fines. If fines are observed and conditions indicate that piping is occurring as determined by a Professional Engineer, appropriate action should be taken.

These recommendations should be performed as soon as practical.

1. It is recommended that the trash rack be monitored and kept thoroughly clean to prevent clogging.

2. The log currently wedged at the base of the entrance tower should be removed to improve hydraulic conditions into the principal spillway.

Because of the location of the dam upstream from populated areas, a formalized procedure of observation and warning during periods of high precipitation should be written and implemented. The Owner's current maintenance inspection checklist provided by the SCS is adequate for this structure, provided provisions are incorporated to check for the presence of fines through the drainage systems.

John Boschuk, Jr., P.E.
Pennsylvania Registration 27450E
Woodward-Clyde Consultants

9 March 79
Date

William S. Gardner, P.E.
Pennsylvania Registration 4302E
Woodward-Clyde Consultants

3/9/79
Date

APPROVED BY:

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

4 Apr 79
Date

OVERVIEW
SCS DAM PA 463, MONROE COUNTY, PENNSYLVANIA

TABLE OF CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
SCS DAM PA 463
NATIONAL ID #PA 00814
DER #45-250

SECTION 1
PROJECT INFORMATION

1.1 General.

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

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

ABSTRACT → Soil Conservation Service

1.2 Description of Project.

(Leavitt Branch Dam)

a. Dam and Appurtenances. ~~SCS~~ Dam PA 463 is a homogeneous embankment composed predominantly of materials classified as sandy silts, Zone 1. The dam is approximately 850 feet long, has a crest width of 26 feet, a crest elevation of 1,223.4, and a maximum height at the centerline above the stream bed of 88 feet. The upstream slope is 3.75H:1V with 10-foot and 12-foot wide berms at elevations 1,190 and 1,159 feet, respectively. The slope between the berms is protected with Zone 2 material classified as cobbles and boulders, or other oversize material raked from the Zone 1 fill. The downstream slope is 3.5H:1V, and has two 10 foot wide berms at elevations 1,194 and 1,164 feet.

The dam contains an unusual internal drainage system ~~(see Plates 3 and 5)~~. Drain fill material was placed on the downstream slope of the cutoff trench excavation. In addition, a trench drain was placed about two-thirds of the distance from the centerline to the downstream toe and a blanket drain is under a portion of the dam. Seepage collected in the drains outlets in the impact basin at the downstream toe or through one of the three pipes discharging at the downstream toe.

ABSTRACT

The reservoir area is normally dry, impounding water temporarily during severe storms. Water is normally dis charged through the principal spillway via a drop inlet riser located within the upstream embankment toe at approximately

Station 5 + 50, as shown on Plate 7. Water can enter the ungated reservoir drain at elevation 1,138 and also overflow weirs at elevation 1,158.9, discharging through a 30-inch diameter reinforced concrete pipe. The reservoir drain is about 52 feet long and has 2 anti-seep collars (see Plate 7). The concrete discharge pipe is located at the base of the dam and is founded on natural ground. The pipe is approximately 638 feet long and has 21 anti-seep collars. This pipe discharges into the impact basin at the downstream toe. The pipe outlet invert and the impact basin end sill are at elevation 1,125.0.

During severe storms, excess water can be discharged over the emergency spillway at the right abutment. The grass-lined emergency spillway is 200 feet wide with a 30 foot long level control section at elevation 1,214.9. The cut for the control section of the emergency spillway was made to about elevation 1,214.9 (see Plate 2). To control hillside seepage and prevent slides, the spillway cut slopes are benched with under drains and a rock-lined diversion to intercept rain runoff and seepage above the cut (see Plate 6). The channel discharges through the woods into the downstream valley, meeting the principal spillway discharge channel approximately 500 feet downstream of the impact basin.

b. Location. The dam is located on the Leavitt Branch of Brodhead Creek, approximately 1¼ miles south of Skytop, Pennsylvania, west of Route 390. The dam and drainage basin are located in Barrett Township, Monroe County, Pennsylvania. The dam site and reservoir are shown on USGS Quadrangle entitled "Skytop, Pennsylvania" at coordinates N 41° 12.4' W 75° 15.0'. A regional location plan of SCS PA Dam 463 is enclosed as Plate 1, Appendix E. As shown on Plate 1A, there are five dams upstream of this structure.

c. Size Classification. The dam is classified as an "Intermediate" structure by virtue of its 88-foot height and 1,430 acre-foot maximum storage capacity.

d. Hazard Classification. A "High" hazard classification is assigned consistent with the potential for extensive property damage and probable loss of life in Canadensis, Pennsylvania.

e. Ownership. The dam is owned by the Monroe County Commissioners. However, Monroe County has made an agreement with the Civil Defense Office to inspect and maintain the dam. Therefore, all correspondence should be sent to Mr. Joel Keller, Civil Defense Director, Civil Defense Office, c/o The Court House, Stroudsburg, Pennsylvania 18360.

f. Purpose of Dam. SCS PA 463 is a single purpose flood control dam. It is one of four structures designed for the Brodhead Creek watershed, of which three are built.

g. Design and Construction History. The dam was designed by the United States Department of Agriculture, Soil Conservation Service (SCS), and final construction drawings were prepared in 1972 and 1973. The dam was constructed by the DeVault Contracting Company of Kimberton, Pennsylvania. All work was inspected by SCS representatives, Mssrs. Peter Petras and Walter Hamlyn, Jr.

The original geologic investigation indicated that material excavated from the emergency spillway would be suitable for embankment construction. However, the suitability of the material, mostly a non-plastic silty sand, was subsequently questioned. As the material would be excavated from below the groundwater table, the natural water content could be well above the optimum for compaction. Further, as the embankment material is non-plastic and the abutments are very steep, some potential exists for cracking of the embankment as a result of differential settlement.

As a result of a site visit on 16 April 1974 by SCS personnel from the State and regional offices, the original internal drainage design was questioned and a reevaluation was performed. Concern was expressed by the inspector as to whether fill material would pipe into the drain fill. Therefore, samples of the fill and drain material were taken from the embankment to determine if piping had actually taken place. As a result of this reevaluation, the internal drainage systems were redesigned to the configurations shown on Plates 5 and 5a, Appendix E.

The application to construct the dam was submitted on 15 January 1973. At the request of the Pennsylvania Fish Commission, the reservoir drain gate was eliminated, thus eliminating the normal pool at elevation 1,158.9 feet, the riser weir elevation. The "Report Upon the Application of the Commissioners of Monroe County" was submitted on 26 March 1973 by the State of Pennsylvania and the permit to construct the dam was issued 3 April 1973. Construction began in August 1973 and was essentially completed by 6 July 1976. The official completion date for this project is listed in Department of Environmental Resources files as 13 September 1976.

h. Normal Operating Procedures. Reservoir outflow is controlled by the principal and emergency spillways. Under normal conditions, the reservoir remains dry with all flows passing through the reservoir drain, through a 30-inch

diameter reinforced concrete pipe located at the base of the embankment, and discharging into an impact basin at the downstream toe. During storms, water can be stored and discharged over the intake riser weirs. The outlet invert of the common 30-inch pipe is at elevation 1,125.0. As the reservoir drain is ungated, the minimum discharge for this structure is the natural stream flow.

Excess water is stored up to elevation 1,214.9. Thereafter, water is discharged through the emergency spillway.

1.3 Pertinent Data.

A summary of pertinent data for SCS PA 463 is tabulated below:

a.	Drainage Area (sq miles)	6.68
b.	Discharge at Dam Site (cfs)	
	Maximum Known Flood at Dam	Unknown
	Principal Spillway w/Water at Elev 1,214.9	157
	Design High Water at Elev 1,218.1	2,796
	Freeboard Storm (top of dam)	13,753
c.	Elevation (feet above MSL)	
	Top of Dam (after settlement)	1,223.4
	Normal Pool	None
	Principal Riser	
	Reservoir drain	1,138.0
	Weir	1,158.9
	Emergency Spillway Crest	1,214.9
	Principal Spillway Exit Invert	1,125.0
d.	Reservoir (miles)	
	Length at Normal Pool	N/A
	Length at Design High Water (elev 1,218.1)	0.5
e.	Storage (acre-feet)	
	Riser Crest (elev 1,158.9)	40
	Emergency Spillway Crest (elev 1,214.9)	1,136
	Top of Dam (elev 1,223.4)	1,430
f.	Reservoir Surface (acres)	
	Normal Pool	0 (dry)

g.	Dam Data	
	Type	Homogeneous earth.
	Length	850 ft
	Height Above Stream Bed	88 ft
	Crest Width	26 ft
	Volume	511,000 cu yd
	Side Slopes	
	Upstream	3.75H:1V
	Downstream	3.5H:1V
	Benches	
	Upstream	
	Top (width)	10 ft minimum at elev 1,190.
	Low (width)	12 ft minimum at elev 1,159.
	Downstream	
	Top (width)	10 ft minimum
	Low (width)	10 ft minimum
	Cutoff	12 ft width with 1:1 side slopes.
	Grout Curtain	None
h.	Principal Spillway	
	Type	2½ ft x 7½ ft x 22 ft concrete drop inlet riser, 30-inch conduit and impact basin.
	Elevations (ft)	
	Weir	1,158.9
	Reservoir Drain Invert	1,138.0
	Pipe Outlet Invert (and impact basin end sill)	1,125.0
i.	Emergency Spillway	
	Type	Trapezoidal channel cut through natural soils, grass-lined.
	Size	200 ft wide
	Side Slopes	3H:1V and 2.5H:1V.
	Downstream Channel	The channel flows through a predominantly wooded valley for 1.1 miles before entering Brodhead Creek. The confluence of Brodhead and Leavitt Branch is the first downstream damage center.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Data Available. A summary of engineering data on SCS PA 463 is presented on the checklist attached as Appendix A. Principal documents containing data used for this report are the "Report Upon the Application of the Commissioners of Monroe County" by the Department of Environmental Resources (DER), dated 26 March 1973, and the "Permit" prepared by the Commonwealth of Pennsylvania, DER, dated 3 April 1973. In addition, there was a 36-sheet set of drawings prepared by the U.S. Department of Agriculture, Soil Conservation Service (SCS), Job No. PA-463-P, dated 1972 and 1973, and a complete design folder including geology and soils reports; hydraulic and structural design data located in SCS archives, Mechanicsburg, Pennsylvania. SCS files also contain job diaries, field books, memos and letters. DER files contain miscellaneous letters, correspondence, memos, photographs and construction progress reports.

b. Design Features. The principal design features of PA Dam 463 are illustrated on the plans and profiles enclosed herein in Appendix E as Plates 2 through 9. These plates were reproduced from SCS drawings. A detailed description of the design features of the dam and appurtenant structures is presented in Section 1.2 of this report, paragraph a. As noted, this dam is basically a homogeneous embankment with three drainage systems. The first drainage system is located on the downstream inclined face of the cutoff trench, the second one is located approximately two-thirds of the way downstream from the centerline of the embankment, and a blanket drain, as shown on Plates 3, 4 and 5. All drains discharge through a series of drainage pipes which collect the water and discharge it adjacent to the impact basin or through pipes along the toe of the dam. This unusual drainage system was constructed as a result of the re-evaluation performed during construction. Reservoir discharges are controlled by use of the multi-level principal spillway located at the upstream toe and through the emergency spillway located at the right abutment.

2.2 Construction.

Details of construction are presented in Section 1.2, paragraph g. DER files contain a series of progress

reports which show that 134 in-place density tests were performed. Each of these tests was reported to have densities greater than the 95 percent of the Standard Procter test required by the specifications. The construction reports, dated 1973 through 1976, also indicate that all construction was performed in a satisfactory manner and approved by the resident engineer for SCS.

2.3 Operation Data.

There are no operational records maintained. There are no water level measurements or rainfall records maintained within this watershed. The dam is reportedly monitored during severe storms by local Civil Defense authorities.

2.4 Evaluation.

a. Availability. All engineering data evaluated and reproduced for this report was provided by either the Pennsylvania DER, SCS, or from conversations with local Civil Defense personnel.

b. Adequacy. The data available was sufficiently adequate to evaluate this structure for a Phase I investigation.

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

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix B, and are summarized and evaluated as follows. In general, the appearance of the facility indicates that the dam and its appurtenances were constructed in general accordance with specifications. The structures appear to be well maintained and in good condition. With the exception of the sand deposits observed at the ends of the drainage pipes, all features appear to be functioning properly. A detailed discussion of the filter is presented below and in Section 6.

b. Dam. Careful inspection of the embankment revealed no signs of surface cracks, unusual movements or cracking at or beyond the toe. Some minor erosion and two depressions were observed on the upstream side of the dam just below the first bench. These benches are graded towards the embankment but do not drain laterally. As a result, there is standing water on the benches. No unusual distortions were observed relative to the vertical and horizontal alignment of the crest when checked with survey equipment.

Both the upstream and downstream slopes of the embankment are covered with Crownvetch and other vegetation. There is no evidence of unusual movement, distortions or deterioration observed between the junction of the embankment and the abutment and between the spillway and the dam.

No seepage was observed at the base of the dam, but a flow of approximately 5 to 7 gallons per minute was observed from beneath a 12-inch diameter corrugated metal drainage pipe adjacent to the toe of the right abutment. Two other 12-inch diameter corrugated metal drainage pipes were also noted near the downstream toe. These pipes were observed to be dry. A review of the "as-built" drawings showed that these pipes were part of the redesigned drainage system incorporated in the dam. Deposits of fine sand were noted in and at the ends of two pipes. It appears that this sediment may be related to piping beneath the drainage pipe. However, the sand deposits were observed to not exceed one or two cubic feet per pipe, and there is no evidence of ground loss or erosion. Embankment drains which discharge through both sides of the impact basin were also inspected. There was no noticable flow from either of these two pipes.

It is noted that the water level behind the dam was at elevation 1,138.7± feet. Therefore, the performance of the internal drainage system under high reservoir levels could not be evaluated.

c. Appurtenant Structures.

1. Principal Spillway. Exposed portions of the riser and reservoir drain inlet were inspected and observed to be in good condition with no signs of distress, concrete spalling, or other indications of poor construction or movement of the riser. The reservoir drain inlet was partially clogged with a log, resulting in the backup of approximately 8 inches of water. The impact basin located at the downstream toe was also inspected with no signs of deterioration. In general, the outlet system appears to be in good condition.

2. Emergency Spillway. The emergency spillway was found to be in good condition, being excavated into erosion resistant materials and grass-lined. There are no signs of significant erosion, channel deterioration or other evidence that the spillway would not function as designed. As noted on design drawings, the benches on the right side cut of the emergency spillway channel contain gravel-filled drainage trenches to control sidehill seepage. Additional drains were installed at the junction of the channel bottom and right wall and in the right channel wall (see Photo 4). These systems were carefully inspected and assessed to be operating properly.

d. Reservoir. Reconnaissance of the reservoir disclosed no evidence of significant siltation, slope instability, or other features that would significantly affect the flood storage capacity of the reservoir. It is noted that during the severe winter of 1977-78, many deer died in the reservoir area, and the remains flowed downstream during spring thaws, blocking the reservoir drain inlet. This is an unavoidable condition which should be monitored during the spring of each year.

e. Downstream Channel. As shown on Plate 1, Appendix E, Leavitt Branch joins Brodhead Creek above Canadensis, Pennsylvania. Between SCS PA 463 Dam and Brodhead Creek, the stream passes through a densely wooded valley. The first downstream house is located approximately 5,000 feet below the dam. Canadensis is a heavily populated area containing more

than 100 homes, and many are built on the flood plain. Therefore, the "High" hazard classification is clearly warranted.

3.2 Evaluation.

In summary, the visual survey of the dam disclosed no evidence of apparent past or present movements to indicate instability of the structures. The seepage noted through and beneath the drainage pipes at the downstream toe is not assessed to be critical, but there is concern that piping of fines has occurred. Conclusive evidence to indicate that piping is continuing could not be obtained, but continuing piping should not be discounted until proper monitoring is performed. This monitoring should be performed particularly after a period of high reservoir level.

All other portions of the dam, which include the principal spillway intake systems and discharge outlet, the emergency spillway and the exposed portions of the embankment, were inspected and observed to be in good condition. Overall, it is assessed that the dam is properly maintained and reasonable efforts have been made to keep debris from clogging the intake system.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures.

SCS PA 463 is a "Dry" flood retention structure and its operation does not require a dam tender. Under normal stream flow conditions, all water is discharged through the reservoir drain to the 30-inch ID reinforced concrete pipe, discharging into an impact basin at the downstream toe.

During high flow conditions, water passes through the reservoir drain inlet at a controlled rate while excess water is stored behind the embankment. When the water level rises and reaches the upper weir at elevation 1,158.9, the discharge through the principal spillway increases significantly. Thereafter, water is stored until the impoundment level reaches the crest of the emergency spillway at elevation 1,214.9. Flow over the emergency spillway is discharged through the woods to the downstream channel below the toe of the dam.

4.2 Maintenance of the Dam.

The dam is maintained by the County and inspected by the Soil Conservation Service for the first three years. Thereafter, inspections are performed by the Owner. Typical maintenance work includes cutting of grass and the cleaning of the drainage pipes along the downstream toe.

4.3 Maintenance of Operating Facilities.

Since the operating facilities are extremely simple, maintenance work by the County is limited to yearly inspections and the cleaning of these structures. At the time of inspection, all structures were clean and appeared to be well maintained, with the exception of one log at the base of the reservoir drain inlet. This log does not impede flow to any significant extent.

4.4 Warning Systems In Effect.

There are no written warning systems at the time of inspection, or procedures established to be followed during periods of exceedingly heavy rainfall. It is reported that

the structure is monitored by local Civil Defense authorities during storms, and that the Civil Defense Authority would notify the Police and Fire Departments.

4.5 Evaluation.

It is believed that the current operating procedures are reasonably realistic means of operating the relatively simple control facilities at SCS PA 463. Furthermore, it is believed that the maintenance procedure is a reasonable one to maintain this system. The informal warning procedure is considered a reasonable means of monitoring the dam during severe storms and for notifying appropriate authorities. However, this procedure should be formalized in writing and should include telephone numbers and addresses of those persons that are responsible for monitoring the dam and for warning downstream residents of possibly high flows.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. The complete original design folder was reviewed at the Soil Conservation Service (SCS) State office in Harrisburg, Pennsylvania. Portions of the design folder are presented in Appendix C.

The watershed is small, L-shaped, and approximately 3.4 miles long and 4.2 miles wide, having a total area of 6.68 square miles. The longest watercourse is about 8.3 miles. About 88 percent of the watershed is controlled by upstream structures in series. The largest of which, Skytop Dam, National ID #PA 00634, DER #45-71, was also inspected under the National Dam Inspection Program. Results of that inspection and evaluation indicate that Skytop Dam will be overtopped by an 0.5 PMF event, but it is not likely to fail. The dam has withstood overtopping of at least one foot for greater than one day. Failure of any of the other upstream dams, Lake In the Clouds, Lake Jamie or No. 10 Dam, would have a negligible effect on SCS PA 463 because of their limited storage capacities. Watershed elevations range from approximately 2,400 feet in the upper reaches to the pond drain elevation of 1,138 feet. The watershed is more than 95 percent wooded with less than 10 percent residential development. It is likely that residential development will continue within the watershed.

In accordance with the criteria established by the Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard potential classification is the Probable Maximum Flood (PMF).

b. Experience Data. There are no records of reservoir water levels or rainfalls within this watershed. There are no estimates or records of previous high water levels.

c. Visual Observations. On the date of the inspection, there were no conditions observed that would indicate a reduction in spillway capacity during an extreme event. Observations regarding the condition of the downstream channel, spillways and reservoir are located in Appendix B.

d. Overtopping Potential. The dam was designed to pass the PMF without overtopping. The PMF inflow hydrograph and flood routing are presented in Appendix C. This information was reviewed and evaluated.

The watershed area determined for this investigation is greater than the value used in design. Construction of upstream Lake Jamie Dam added about 0.7 square miles to the drainage area. However, the Corps of Engineers criteria includes the Hop Brook factor, which reduces the point rainfall from 25.5 inches to 20.4 inches. The differences are compensating and reduce the total volume of runoff, as indicated by the PMF inflow hydrograph computed by the HEC-1, Rev., Dam Safety Version, computer program. Therefore, the flood routing is judged adequate.

e. Spillway Adequacy. The design PMF peak inflow was computed to be about 13,890 cfs, resulting from a six-hour storm with 25.5 inches of rainfall which produced 21.54 inches of runoff. This storm was routed through the reservoir to produce a peak discharge of 13,750 cfs at maximum water level (elevation 1,223.4 feet) at the top of the dam. The spillway systems for this dam are considered to be "Adequate" since the dam will pass the PMF without overtopping.

f. Downstream Conditions. SCS Dam PA 463 was designed as part of a total flood water control plan for the Brodhead Creek Watershed. The objective of the watershed plan is to protect resorts along the Brodhead and its tributaries, and residences in Canadensis. The flood of August 18, 1955, producing 7.3 inches of rain in eight hours, resulted in direct damage of $1,115,000 and the loss of nine lives within the watershed.

Leavitt Branch enters the Brodhead about 1.1 miles below the dam. Several dozen homes and businesses are built in the flood plain at the confluence of Leavitt Branch with the Brodhead and further downstream along the Brodhead. Damage, including loss of life, would be significantly greater if the dam failed during the PMF than damage resulting from high flows just before failure of the dam during the PMF.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. The visual observations did not indicate any existing embankment stability problems. Some small seepage was observed through and around the dam's drainage system. The seepage observed to be flowing beneath the drainage pipes is considered undesirable and should be monitored, studied and corrective action taken if it is deemed necessary. Furthermore, the fine sands that were noted at the base and inside the discharge pipes are judged to be evidence of limited piping. This is considered a potential long-term failure mechanism and should be corrected. The visual inspection of the principal and emergency spillway systems reveals that all systems are in relatively good condition and well maintained.

b. Design and Construction Data. Available design data is listed in Appendix A and is described in Section 2 of this report. Design computations were reviewed together with the redesign data associated with the drainage system. Construction data consisted of a series of monthly progress reports and job diaries prepared by Soil Conservation Service (SCS) representatives. The data indicates that at least 134 in-place tests were performed for the approximately 511,000 cubic yards of fill. All of the soil test results exceeded the minimum specification requirements of 95 percent of the Standard Proctor test.

Based on the review of the comprehensive set of SCS drawings, available data in Department of Environmental Resources files and conversations with SCS representatives, together with a review of their records, it is believed that the dam was constructed in general accordance with the specifications. There is concern about the loss of fines through and beneath the drainage pipes at the downstream toe. This concern is based on the results of design checks in Appendix G, which show that the filter drain design requirements against piping are not all met. Recommendations pertaining to this concern are presented in Section 7.

c. Operating Records. There are no operational records for this structure.

d. Post-Construction Changes. There are no reports nor is there any evidence that major modifications of the dam or

appurtenant structures were made. Additional drains have been installed at the emergency spillway cut to control hillside seepage.

e. Seismic Stability. This dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. Since the static stability analysis indicates a stable embankment, the seismic stability is also assumed to be satisfactory.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Assessment. The visual inspection, review of available design data, and review of construction data indicate that the dam, embankments, foundation and appurtenant structures of SCS PA 463 are in good condition. With the exception of the filter drain, all other features appear to have been designed properly and constructed in accordance with specification requirements.

The hydrologic and hydraulic routings included in the available design documents, as evaluated in Appendix C, indicate that this structure will pass the Probable Maximum Flood (PMF). Therefore, the discharge systems of this structure are considered "Adequate". In the event of failure during an extreme event, extreme property damage and probable loss of life would most likely occur.

b. Adequacy of Information. It is judged that information available for the purpose of the prescribed inspection was adequate.

c. Urgency. The recommendations presented in Section 7.2 pertaining to the soil piping should be implemented immediately. All other recommendations should be implemented as soon as practical.

d. Necessity of Additional Studies. It is judged that additional investigations pertaining to the possible piping condition of the drains be performed. These recommendations are described in Section 7.2.

7.2 Remedial Measures.

a. Facilities. It is recommended that the following study commence immediately.

It is recommended that the Owner or his representatives monitor the seepage through the downstream toe drains, especially after periods of retention behind the embankment. This monitoring period should last for several weeks or until the seepage has decreased. Particular emphasis should be directed towards monitoring the seepage beneath and through the embankment drainage pipes. Water samples should be taken

to check for the presence of fines. If fines are observed to continue to come from the embankment, the effects should be studied and appropriate measures should be taken.

It is recommended that the following remedial measures be implemented as soon as practical.

1. It is recommended that the trash racks be monitored and kept thoroughly clean to prevent clogging similar to what has happened during the winter of 1977-78.

2. The log currently wedged at the base of the entrance tower should be removed to improve flow through the drain.

b. Operation and Maintenance Procedures. Because of the location of the dam upstream from the populated area of Canadensis, Pennsylvania, a formal procedure of observation and warning during periods of high precipitation should be written and implemented. The Owner's current maintenance inspection checklist provided by the SCS is adequate for this structure, provided provisions are incorporated to check for the presence of fines through the drainage systems.

APPENDIX

A

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM *SCS PA 463*

ID # *PA 00814*

ITEM	REMARKS
AS-BUILT DRAWINGS	*Yes. Located in SCS files.*
REGIONAL VICINITY MAP	*Yes. See Plate 1 of Appendix E.*
CONSTRUCTION HISTORY	*Construction reports submitted to DER and job diaries, field books, letters and memos in SCS files.*
TYPICAL SECTIONS OF DAM	*See Appendix E.*
OUTLETS - PLAN	*See Appendix E.*
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	*See Appendix C.*
RAINFALL/RESERVOIR RECORDS	*None available*

ITEM	REMARKS
DESIGN REPORTS	*Located in SCS files.*
GEOLOGY REPORTS	*Located in SCS files.*
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	*Located in SCS files.*
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	*Located in SCS files and on design drawings prepared by SCS, dated 8/72.*
POST-CONSTRUCTION SURVEYS OF DAM	*None.*
BORROW SOURCES	*Emergency spillway or from flood retention area partly shown on Plate 2, Appendix E.*

ITEM	REMARKS
MONITORING SYSTEMS	*None*
MODIFICATIONS	*None, with the exception of additional drains installed to control seepage into emergency spillway.*
HIGH POOL RECORDS	*None*
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	*None*
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	*None*
MAINTENANCE OPERATION RECORDS	*None available*

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	*See Appendix E.*
OPERATING EQUIPMENT PLANS & DETAILS	*None*
MISCELLANEOUS	1. *"Report Upon the Application of the Commissioners of Monroe County" dated 3 April 1973 by DER.* 2. *The design folder, including geology and soils report, hydrologic and structural design, prepared by SCS.* 3. *Construction history is contained in progress reports submitted to DER, and in job diary, field books, letters and memos located in SCS archives, Mechanicsburg, Pennsylvania.*

APPENDIX

B

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam SCS-PA-463 (Leavitt Branch Dam) County Monroe State Pennsylvania National ID # PA 00814

Type of Dam Earth Hazard Category I (High)

Date(s) Inspection 17 Oct. 1978 Weather Clear & Cool Temperature 40'-50's

Pool Elevation at Time of Inspection N/A M.S.L. Tailwater at Time of Inspection N/A M.S.L.

Inspection Personnel:

Mary Beck (Hydrologist) 23 October 1978
Vincent McKeever (Hydrologist)
John H. Frederick (Geotechnical)
John Boschuk, Jr. (Geotechnical/Civil)
Ray Lambert (Geologist)

John Boschuk, Jr. Recorder

Remarks:

Mr. Cliff Dennis, Edward Hess and Assoc. (County Engineer) and Mr. Lowell Edminster, SCS representative were on site and provided assistance.

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

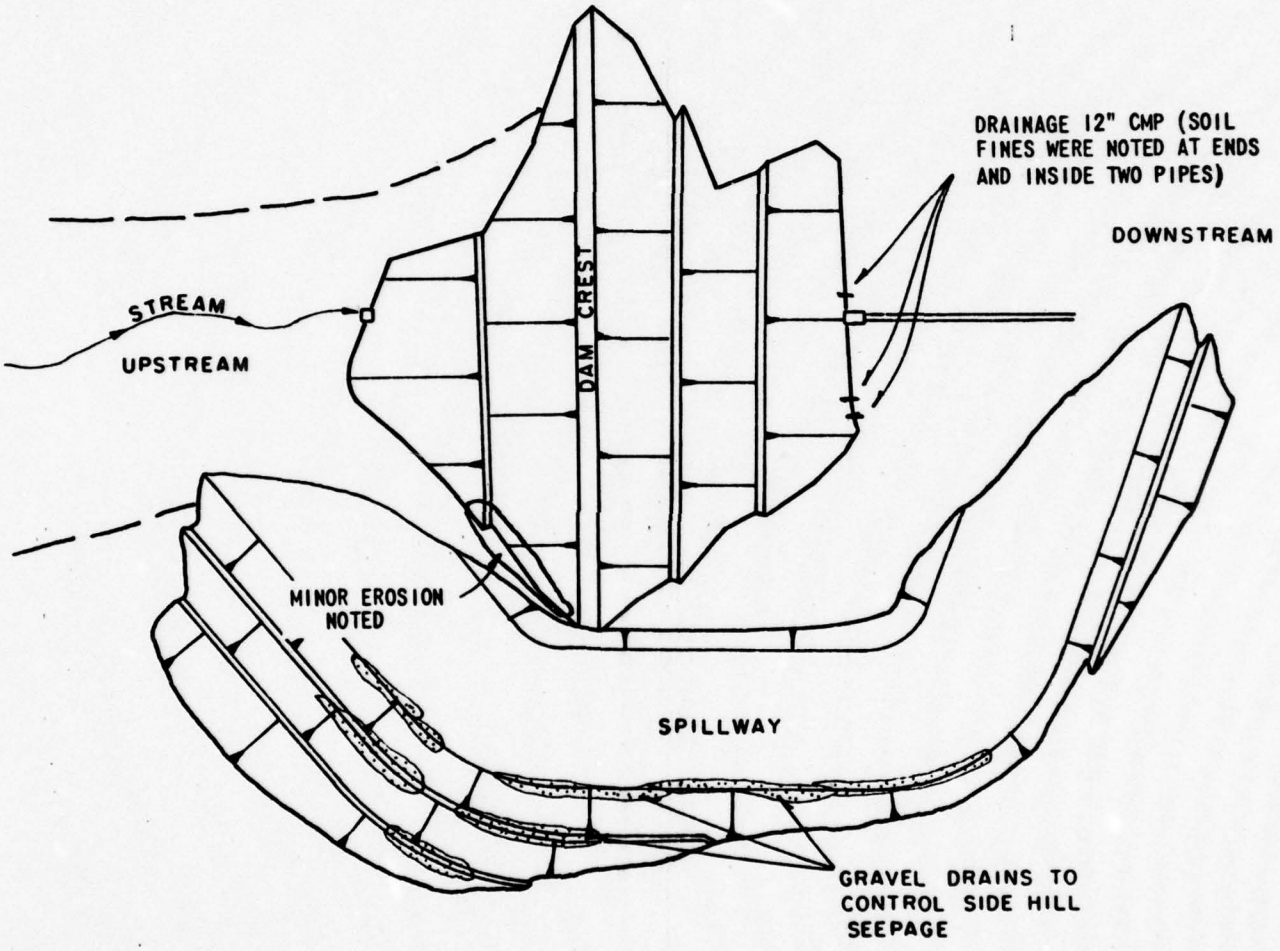
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	*N/A*	
STRUCTURAL CRACKING	*N/A*	
VERTICAL AND HORIZONTAL ALIGNMENT	*N/A*	
MONOLITH JOINTS	*N/A*	
CONSTRUCTION JOINTS	*N/A*	

EMBANKMENT

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	*Some minor erosion and two depressions were observed on the upstream side just below the first bench. The benches are graded towards the embankment but do not drain laterally. As a result, there is standing water on the benches. This water should be drained.*	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	*No unusal distortions observed.*	
RIPRAP FAILURES	*N/A Crownvetch covered slopes.*	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
STAFF GAGE AND RECORDER	*None*	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*No unusual movements, distortions or deterioration observed.*	
ANY NOTICEABLE SEEPAGE	*None observed at base of dam but some (5-7 gpm) observed beneath 12" Dia. CMP at toe adjacent to right abutment. Two other 12" CMP were noted near the downstream toe but they were dry. Deposits of fine sand were noted at the ends of all these pipes. It appears that some minor piping has occurred. It is also possible that this sand is associated with the stabilization of the drainage rock around the pipe. Regardless of the cause, the source of the fine-sand should be investigated.*	
DRAINS	*All drains appeared dry. There was no noticable flow from the 2 CMP on either side of the impact basin.*	



SEEPAGE LOCATION PLAN

SHEET 5A OF 11

OUTLET WORKS
(PRINCIPAL SPILLWAY)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	*None observed.*	
INTAKE STRUCTURE	*The upper and lower intakes were observed to be in good condition. However, the lower intake was partially clogged with a log resulting in the backup of approximately eight inches of water. The SCS representative indicated that the remains of deer clogged the system last year.*	
OUTLET STRUCTURE	*Observed to be in good condition.*	
OUTLET CHANNEL	*Observed to be in good condition.*	
EMERGENCY GATE	*None.*	

UNGATED SPILLWAY

(EMERGENCY SPILLWAY)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	*None. Grass lined channel.*	
APPROACH CHANNEL	*Grass channel observed to be in good condition. At the right edge of the channel along the channel bottom, a drainage trench was excavated and filled with gravel to control side hill seepage. The drainage system appears to be functioning properly.*	
DISCHARGE CHANNEL	*Grass lined channel was observed to be in good condition.*	
BRIDGE AND PIERS	*None.*	

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	*None*	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	*Steep wooded side slopes.*	
SEDIMENTATION	*None.*	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	*The downstream channel is in good condition. The flood plain on each side of the channel is wooded.*	
SLOPES	*The valley gradient is about 0.0125 below the dam.*	
APPROXIMATE NO. OF HOMES AND POPULATION	*The first downstream house is about 5000 feet below the dam. About 1.1 miles below the dam, Leavitt Branch enters the Brodhead River in the community of Canadensis.*	

APPENDIX

C

SCS DAM PA 463

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *95% wooded, five upstream dams, very little residential development.*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *1138.0 (dry).*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *1223.4 (1430 Acre-Feet).*

ELEVATION MAXIMUM DESIGN POOL: *1218.1 feet.*

ELEVATION TOP DAM: *1223.4 feet.*

EMERGENCY SPILLWAY

a. Elevation *1214.9 feet.*

b. Type *Trapezoidal channel cut through natural materials.*

c. Width *200 feet.*

d. Length *About 1750 feet.*

e. Location Spillover *Right abutment.*

f. Number and Type of Gates *None*

OUTLET WORKS:

a. Type *Drop inlet riser, conduit and imapact basin.*

b. Location *Station 5+50.*

c. Entrance inverts *1158.9 feet.*

d. Exit inverts *1125.0 feet.*

e. Emergency draindown facilities *Ungated pond drain, 1138.0*

HYDROMETEOROLOGICAL GAGES:

a. Type *None*

b. Location *N/A*

c. Records *N/A*

MAXIMUM NON-DAMAGING DISCHARGE: ----------

DAM SAFETY ANALYSIS
HYDROLOGIC/HYDRAULIC DATA

Date: 1/24/79
By: MFB
Sheet: 2 of 12

DAM SCS Nat. ID No. PA 00814 DER No. 45-250

ITEM/UNITS	Permit/Design Files (A)	Calc. from Files/Other (B)	Calc. from Observations (C)
1. Min. Crest Elev., ft.	1223.4 ·		
2. Freeboard, ft.			
3. Spillway(1) Crest Elev, ft.	1158.9 ·		
3a. Secondary(2) Crest Elev, ft.	1214.9 ·		
4. Max. Pool Elev., ft.	1218.1		
5. Max. Outflow(3), cfs	13,753 ·		
6. Drainage Area, mi^2	5.3 ·		6.68 ·
7. Max. Inflow(4), cfs	13893		12175 ·
8. Reservoir Surf. Area, Acre			
9. Flood Storage(5), Ac-Ft			

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) Main emergency spillway.

(2) Secondary ungated spillway.

(3) At maximum pool, with freeboard, ungated spillways only.

(4) For columns B, C, use PMF.

(5) Between lowest ungated spillway and maximum pool.

Date: 1/24/79
By: MFB
Sheet: 3 of 12

HYDROLOGIC/HYDRAULIC CALCULATIONS (cont.)

Item (from sheet 2)	Source
1A, 3A, 3aA, 6A	SCS design drawings dated Aug, 1972
4A, 5A, 7A	SCS Freeboard flood routing, see sheet 12
6C	USGS Maps Skytop, PA (1973) Buck Hill Falls, PA (1973) Promised Land, PA (1973) Newfoundland, PA (1973)
7C	See sheet 9

HEC-1, REVISED
FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quandrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are inputed and flows are routed downstream to the damage center and a dam breach analysis is performed.

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out tables.

Classification (Ref. - Recommended Guidelines for Safety Inspection of Dams)

1. The hazard potential is rated as "High" as there would be loss of life if the dam failed.

2. The size classification is "Intermediate" based on its 88-foot height and 1,430 acre-foot total storage capacity.

3. The spillway design flood, based on size and hazard classification, is the Probable Maximum Flood (PMF).

Hydrologic/Hydraulic Analysis

1. Original Design Data.

The complete hydrology/hydraulics design folder was available for review. The PMF inflow hydrograph was determined according to procedures in the SCS National Engineering Handbook, Section 4. Hydrograph calculations and flood routing were performed by the SCS computer program, TR-20. Portions of the original design folder are included in this appendix.

2. Evaluation.

a. Effect of Upstream Dams. The SCS PMF inflow hydrograph neglects failure of the several upstream dams. The watershed is described in detail in Section 5 of the text and is shown on Plate 1, Appendix E. The largest upstream dam, Upper Skytop Dam, has been inspected under the National Dam Inspection Program and has been judged to withstand some overtopping during extreme events. Failure of any of the other small capacity dams is estimated to have little effect on SCS Dam PA 463. The effect of Upper Skytop Dam was considered in the SCS calculations for time of concentration for the watershed.

b. Original design parameters were checked against current information and/or criteria. The drainage area from current USGS Maps is 6.68 square miles, greater than the 5.3 square miles used in the design. Construction of upstream Lake Jamie Dam added about 0.7 square miles to the drainage area. Because of the difference in drainage area values, the PMF inflow hydrograph was checked using the HEC-1, Rev., computer program. Computer input data is as follows:

Rainfall - Ref. Hydrometeorological Report No. 33. Calculations for the design PMF inflow hydrograph were based on a six-hour rainfall of 25.5 inches. Rainfall criteria established for this investigation by the Corps of Engineers includes the use of the Hop Brook factor, a point rainfall reduction factor. For a watershed of this size, the point rainfall is reduced by 20 percent, or to 20.4 inches.

SCS hydrograph parameters, lag and runoff curve number, CN.
The design CN was judged adequate.
The design time of concentration was increased by two hours, lag = $0.6t_c$, or 3.79 hours.
Results of the evaluation of the PMF inflow hydrograph are shown on Sheet 9.

c. Overtopping Potential. Based on review of the design folder and the above evaluation of design assumptions and data input, the original PMF flood routing is judged adequate (see Sheet 12).

d. Spillway Adequacy. The spillway is rated as "Adequate" as the spillway will discharge the PMF flood without overtopping the dam.

MFB 2/9/79 SCS Dam PA 463 Hydrology/Hydraulics SH. 7 OF 12

```
1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  21 AUG 78
 **********************************

 RUN  DATE* 79/02/09.
      TIME* 13.08.07.
```

SCS DAM PA 463
NAT ID NO. PA 00814 DER NO. 45-250
INFLOW HYDROGRAPH

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	15	0	0	0	0	0	4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 2 LRTIO= 1

RTIOS= .90 1.00

MFB 2/9/79 SCS Dam PA 463 Sh. 8 of 12
Hydrology / Hydraulics

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
IN	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	6.68	0.00	6.68	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.70	111.00	124.00	134.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-73.00	0.00	0.00

CURVE NO = -73.00 WETNESS = -1.00 EFFECT CN = 73.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= 3.79

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.65	20.71	3.94	315468.
										(626.)	(526.)	(100.)	(8933.06)

MFB 2/9/79 SCS Dam PA 463 SH. 9 OF 12
Hydrology / Hydraulics

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 .90	RATIO 2 1.00
HYDROGRAPH AT	IN	6.68	1	10957.	12175.
		(17.30)		(310.28)	(344.75)

WORK PLAN - DESIGN COMPARISON

ITEM	UNIT	WORK PLAN	DESIGN	
DRAINAGE AREA	SQ.MI.	5.3	5.3	
STORAGE CAPACITY				
SEDIMENT (INC. AERATED)	AC.FT.	90	52.1	
BENEFICIAL	AC.FT.	60	—	
RETARDING	AC FT	1050	1048.	
TOTAL	AC.FT	1200	1100	
BETWEEN HIGH & LOW S	AC.FT	—	—	
SURFACE AREA				
NORMAL POOL	ACRE	11.8.	~~2.1~~	3.0
RETARDING POOL	ACRE	35.5	33.3	
DESIGN HIGH WATER	ACRE			
VOLUME OF FILL	CU.YD	215,980		
TOP OF DAM ELEV.	FEET	186.	176.5	
MAX. HEIGHT OF DAM	FEET	86.	88.	
EMERGENCY SPILLWAY				
CREST ELEVATION	FEET	179	168.	
BOTTOM WIDTH	FEET	70'	200	
TYPE	--	Concrete	Earth	
PERCENT CHANCE OF USE	--	1.0	<1	
AVE. CURVE NO. COND. II	--	73	73	
EM. SP HYDROGRAPH				
STORM RAINFALL - 6 HR.	IN.	12.4	10.	
STORM RUNOFF	IN	11.03	~~8.95~~	6.62"
VELOCITY OF FLOW - V	FPS	14.4	8.2	
PEAK DISCHARGE RATE	CFS	6450	2796	
MAX WATER SURFACE EL.	FEET	183.4	171.2	
FREEBOARD HYDROGRAPH				
STORM RAINFALL - 6 HR	IN	24.8	25.5	
STORM RUNOFF	IN	20.8	21.54	
VELOCITY OF FLOW - V	FPS	18.	16.X	Reference- SCS design folder
PEAK DISCHARGE RATE	CFS	13,900	13,753	
MAX. WATER SURFACE EL.	FEET	186.0	176.5	
PRINCIPAL SPILLWAY				
RISER SIZE	FT	—	2½' x 7.5'	
MAX LOW STAGE FLOW	CFS	210	158	
ORFICE SIZE	FT	—	—	
MAX HIGH STAGE FLOW	CFS	—	—	
PIPE SIZE	DIA	—	30"	
CAPACITY EQUIVALENTS				
TOTAL SEDIMENT VOL	IN	0.32	0.184	
RETARDING STORAGE	IN	3.72	3.707	
EM. SPILLWAY STORAGE TO TOP OF DAM	IN	0.97	1.168	
CLASS OF STRUCTURE	--	C	C	

E. S. DESIGN AND FREEBOARD ROUTINGS. 23

BROADHEAD CREEK SITE PA-463 30 IN PIPE APRIL 1969 HLW

CURVE NO. 73. TC 4.31 STORM DURATION 6.00 #

EMER. SPW. RAINFALL 10.00 FREEBOARD RAINFALL 25.50

CASE NO. 2. DRAINAGE AREA 5.30 EMER. SPW. CREST 168.0

~~801 180. L1 300. 802 180. L2 300.~~ 803 200. L3 300.

ELEVATION	STORAGE	CFS	CFS	CFS
112.01	40.	0.	0.	0.
120.00	90.	101.	101.	101.
130.00	196.	115.	115.	115.
140.00	355.	128.	128.	128.
150.00	570.	139.	139.	139.
160.00	849.	149.	149.	149.
168.00	1119.	157.	157.	157.
168.50	1136.	244.	255.	266.
169.00	1153.	448.	484.	520.
170.00	1187.	1107.	1225.	1344.
171.00	1223.	2033.	2266.	2500.
172.00	1260.	3249.	3635.	4021.
174.00	1333.	6307.	7075.	7843.
175.00	1370.	8163.	9164.	10164.
176.00	1410.	10071.	11253.	12485.
178.00	1491.	14375.	16150.	17927.
180.00	1572.	19369.	21769.	24169.
185.00	1800.	34093.	38333.	42573.

Reference-
SCS Design
Folder

Note: Add 1046.9 to relative elevations to obtain M.S.L. elevation

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FREEBOARD ROUTING.

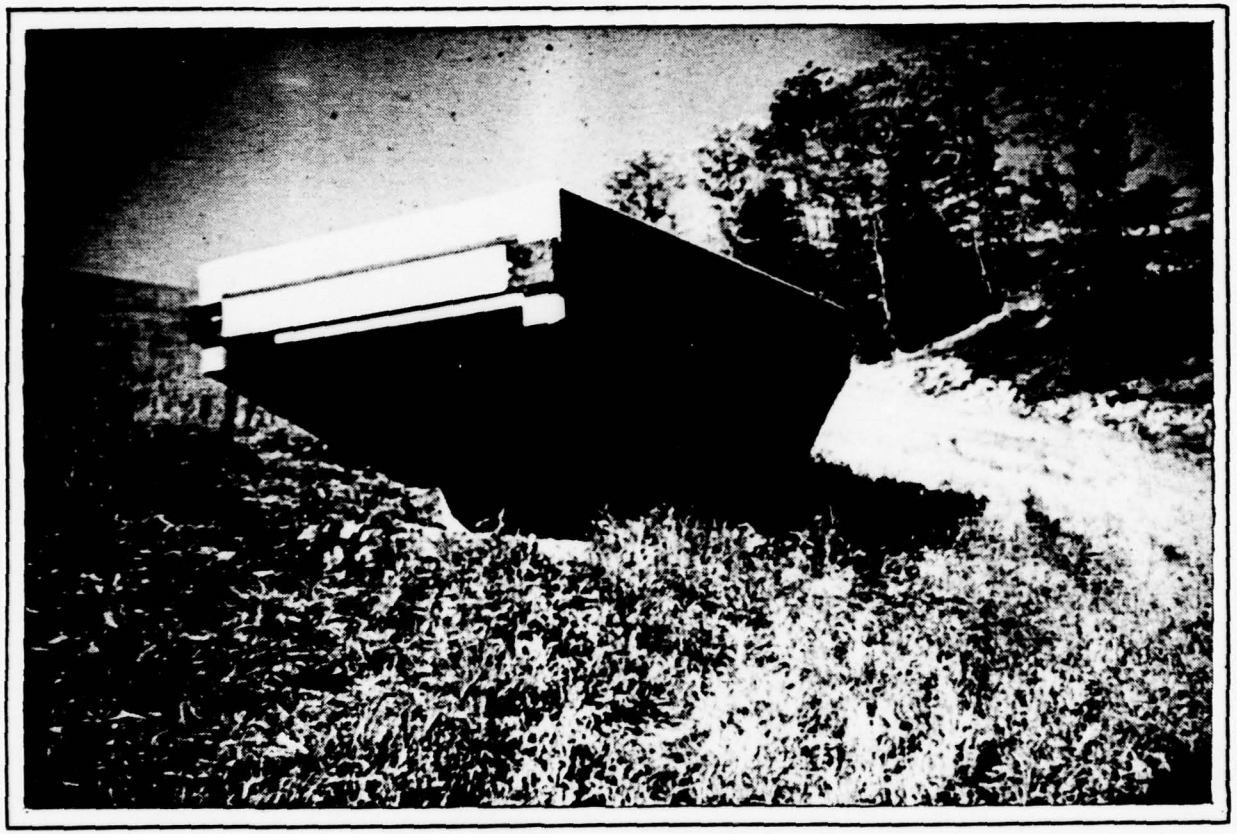
BRODHEAD CREEK SITE PA-463 30 IN PIPE APRIL 1969 HLW

BO = 200. L = 300.

	TIME	INFLOW	AVE IN	OUTFLOW	ELEV.	
	0.25	2.	1.	0.	112.01	
	0.50	5.	4.	0.	112.02	
	0.75	9.	7.	0.	112.05	
	1.00	52.	31.	1.	112.15	
	1.25	95.	73.	4.	112.38	
	1.50	160.	127.	9.	112.78	
	1.75	454.	307.	22.	113.76	
	2.00	748.	601.	46.	115.65	
	2.25	1121.	934.	82.	118.55	
	2.50	2003.	1562.	103.	122.01	
	2.75	2884.	2443.	110.	126.57	
	3.00	3868.	3376.	117.	131.95	
	3.25	5321.	4595.	125.	137.76	
	3.50	6774.	6048.	132.	144.03	
	3.75	8215.	7494.	139.	150.85	
	4.00	9611.	8913.	146.	157.35	
	4.25	11008.	10309.	153.	164.02	
	4.50	12202.	11605.	1875.	170.45	
	4.75	12845.	12524.	8945.	174.47	
	5.00	13488.	13167.	12162.	175.86	
	5.25	13893.	13691.	13384.	176.33	
	5.50	13774.	13834.	13753.	176.46	Top of
PEAK	5.75	13654.	13714.	13721.	176.45	DAM
	6.00	13391.	13522.	13558.	176.39	
	6.25	12867.	13129.	13206.	176.26	
	6.50	12343.	12605.	12713.	176.08	
	6.75	11758.	12050.	12198.	175.87	
	7.00	11079.	11418.	11617.	175.62	
	7.25	10401.	10740.	10964.	175.34	
	7.50	9701.	10051.	10284.	175.05	
	7.75	8974.	9338.	9542.	174.73	
	8.00	8248.	8611.	8805.	174.41	
	8.25	7534.	7891.	8081.	174.10	
	8.50	6833.	7183.	7425.	173.78	
	8.75	6132.	6482.	6764.	173.43	
	9.00	5497.	5814.	6099.	173.08	
	9.25	4919.	5208.	5474.	172.76	
	9.50	4341.	4630.	4883.	172.45	
	9.75	3853.	4097.	4332.	172.16	
	10.00	3429.	3641.	3872.	171.90	
	10.25	3006.	3218.	3479.	171.64	
	10.50	2665.	2836.	3093.	171.38	
	10.75	2374.	2520.	2748.	171.16	
	11.00	2082.	2228.	2447.	170.95	
	11.25	1847.	1965.	2210.	170.74	
	11.50	1640.	1744.	1980.	170.55	
	11.75	1433.	1536.	1762.		
	12.00	1270.	1351.	1560.		Reference- SCS design folder
	12.25	1125.	1198.	1381.		
	12.50	980.	1053.	1242.		
	12.75	870.	925.	1115.		
	13.00	771.	821.	997.	169.57	

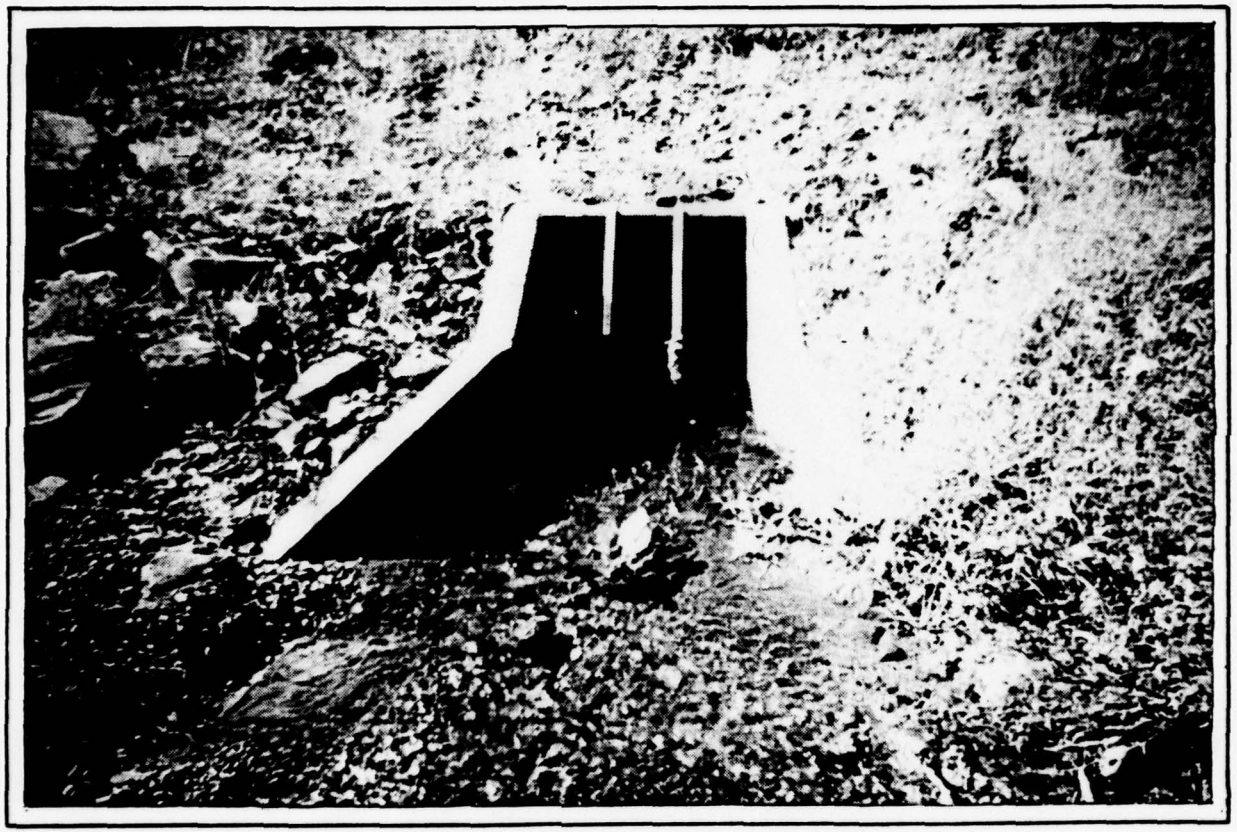
APPENDIX

D



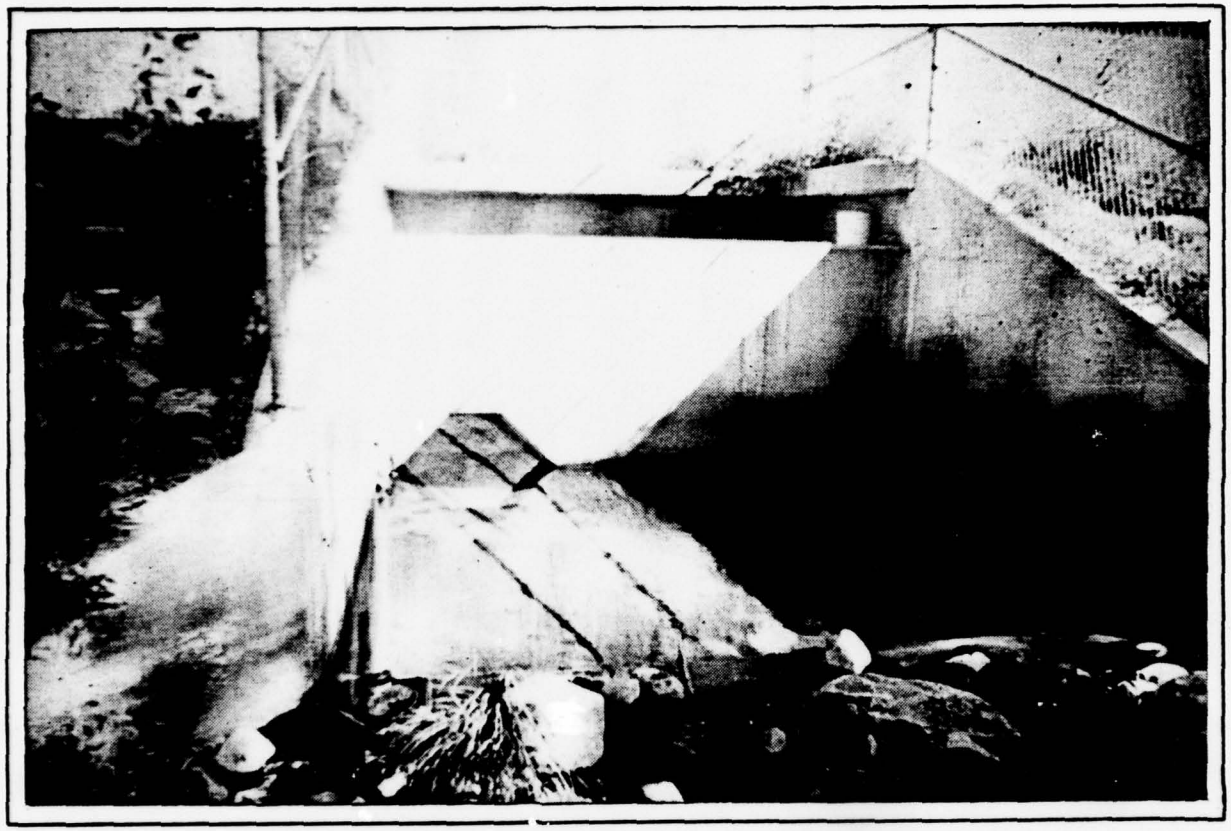
VIEW OF INTAKE RISER ON UPSTREAM SLOPE.

PHOTOGRAPH NO. 1



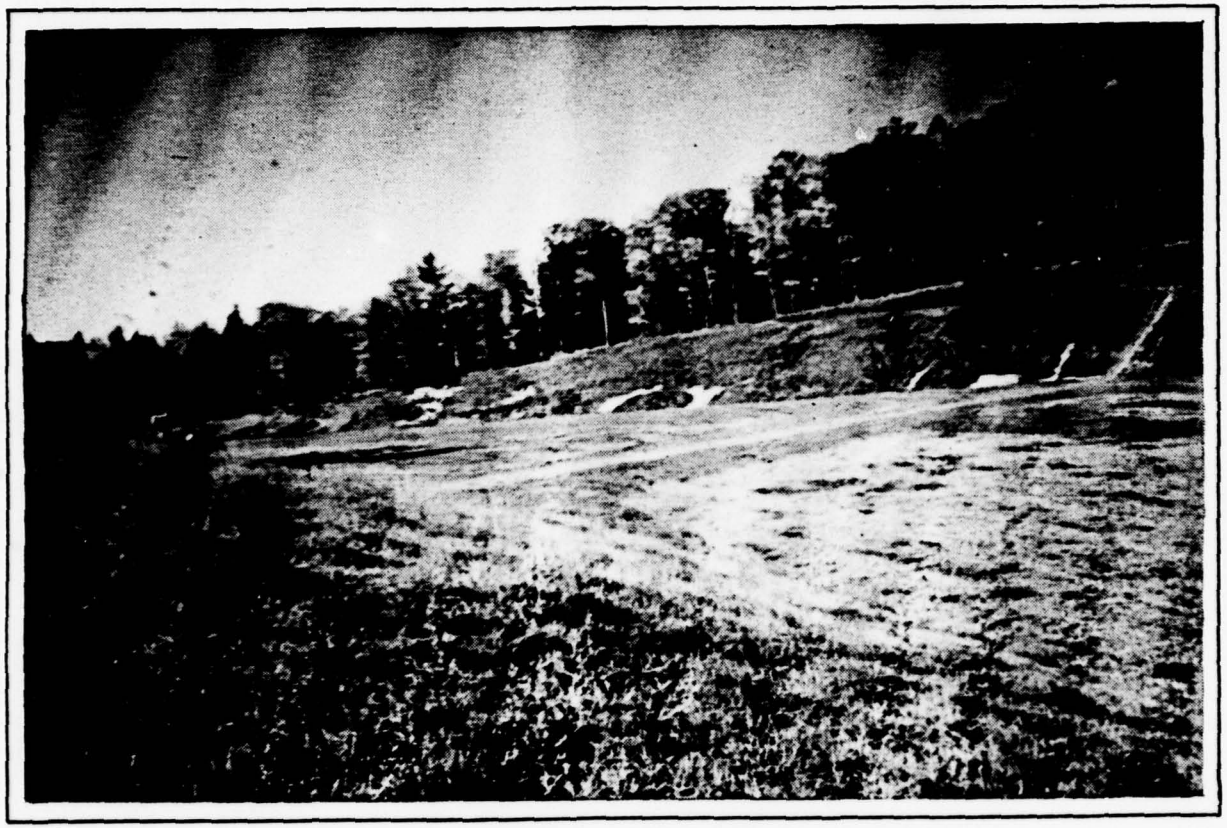
VIEW OF POND DRAIN INTAKE.

PHOTOGRAPH NO. 2



DISCHARGE IMPACT BASIN AT DOWNSTREAM TOE.

PHOTOGRAPH NO. 3



EMERGENCY SPILLWAY LOOKING DOWNSTREAM.
NOTE THE SEEPAGE DRAINS IN THE SLOPES
OF THE RIGHT ABUTMENT.

PHOTOGRAPH NO. 4

OVERVIEW OF DOWNSTREAM SLOPE LOOKING
TOWARDS THE RIGHT ABUTMENT.

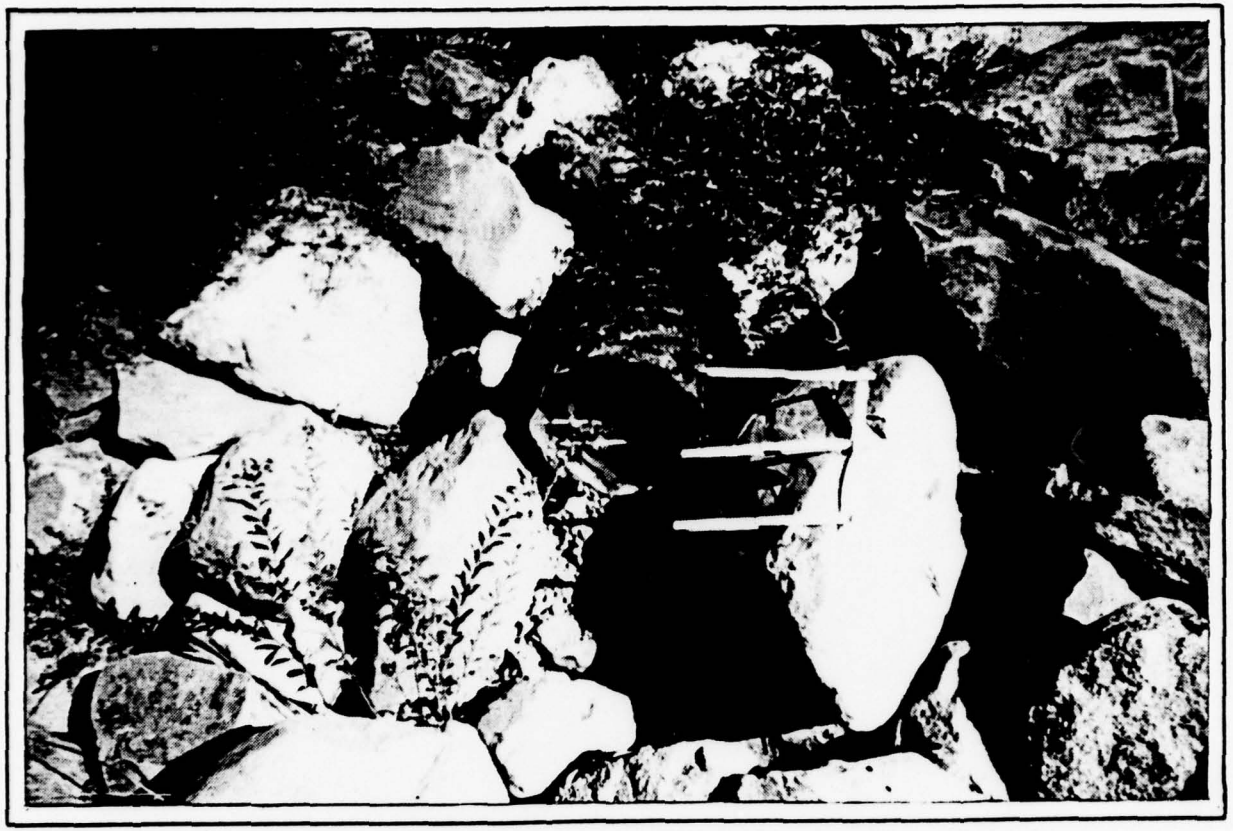
PHOTOGRAPH NO. 5

OVERVIEW OF UPSTREAM SLOPE LOOKING
TOWARDS THE RIGHT ABUTMENT.

PHOTOGRAPH NO. 6

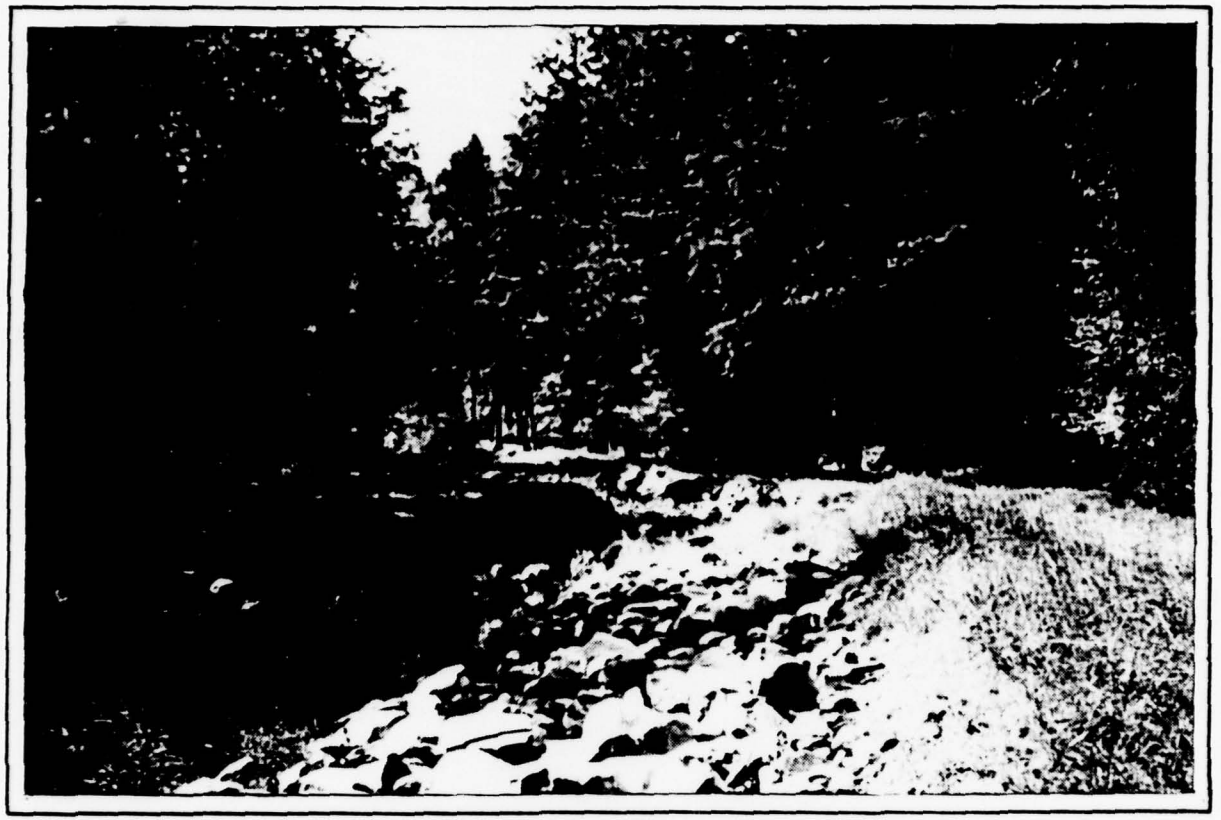
EMBANKMENT DRAIN ADJACENT TO RIGHT ABUTMENT.

PHOTOGRAPH NO. 7



EMBANKMENT DRAIN THROUGH ROCK TOE.

PHOTOGRAPH NO. 8



VIEW OF DISCHARGE CHANNEL BELOW THE
IMPACT BASIN.

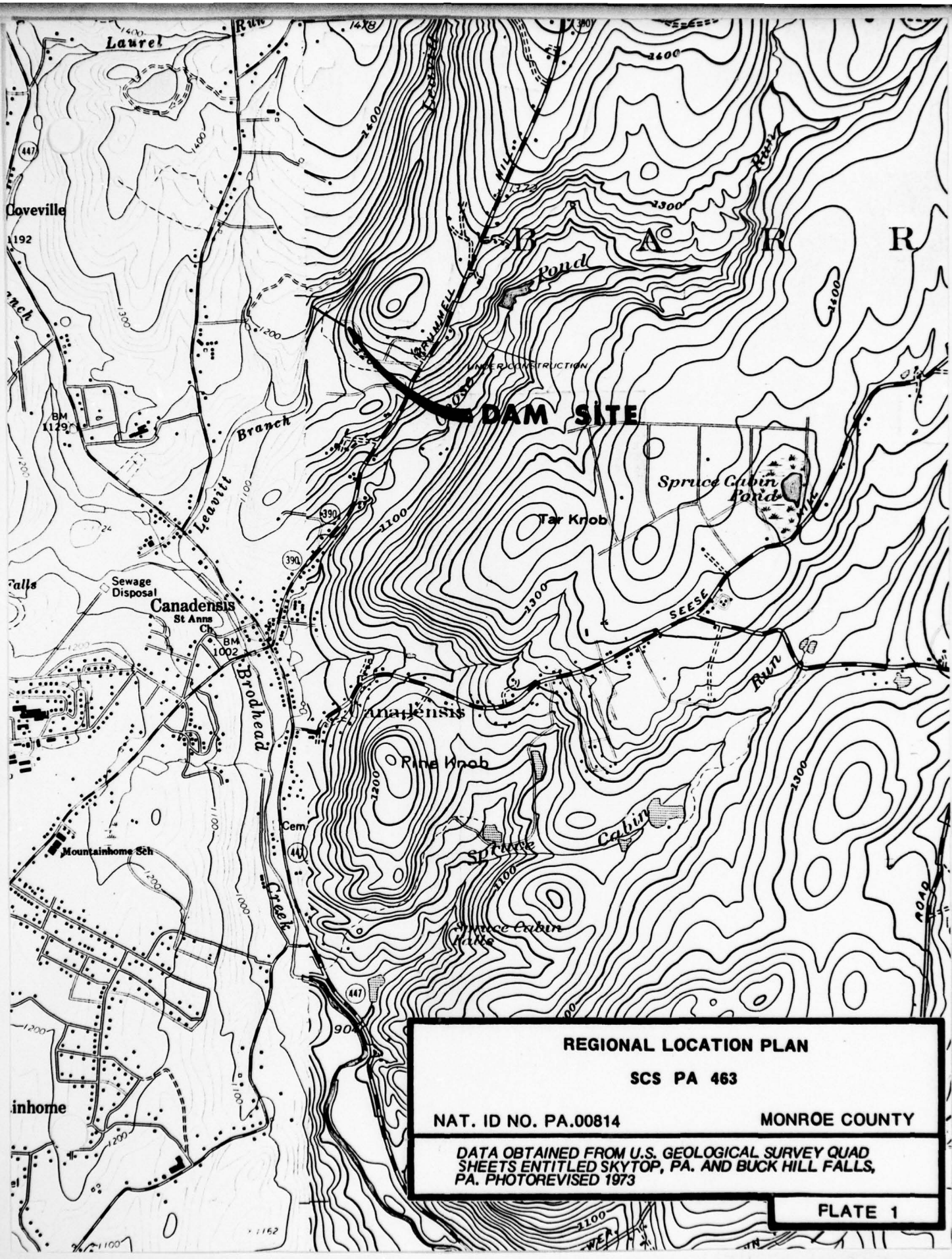
PHOTOGRAPH NO. 9

PONDED WATER ON SLOPE BENCHES.

PHOTOGRAPH NO. 10

APPENDIX

E



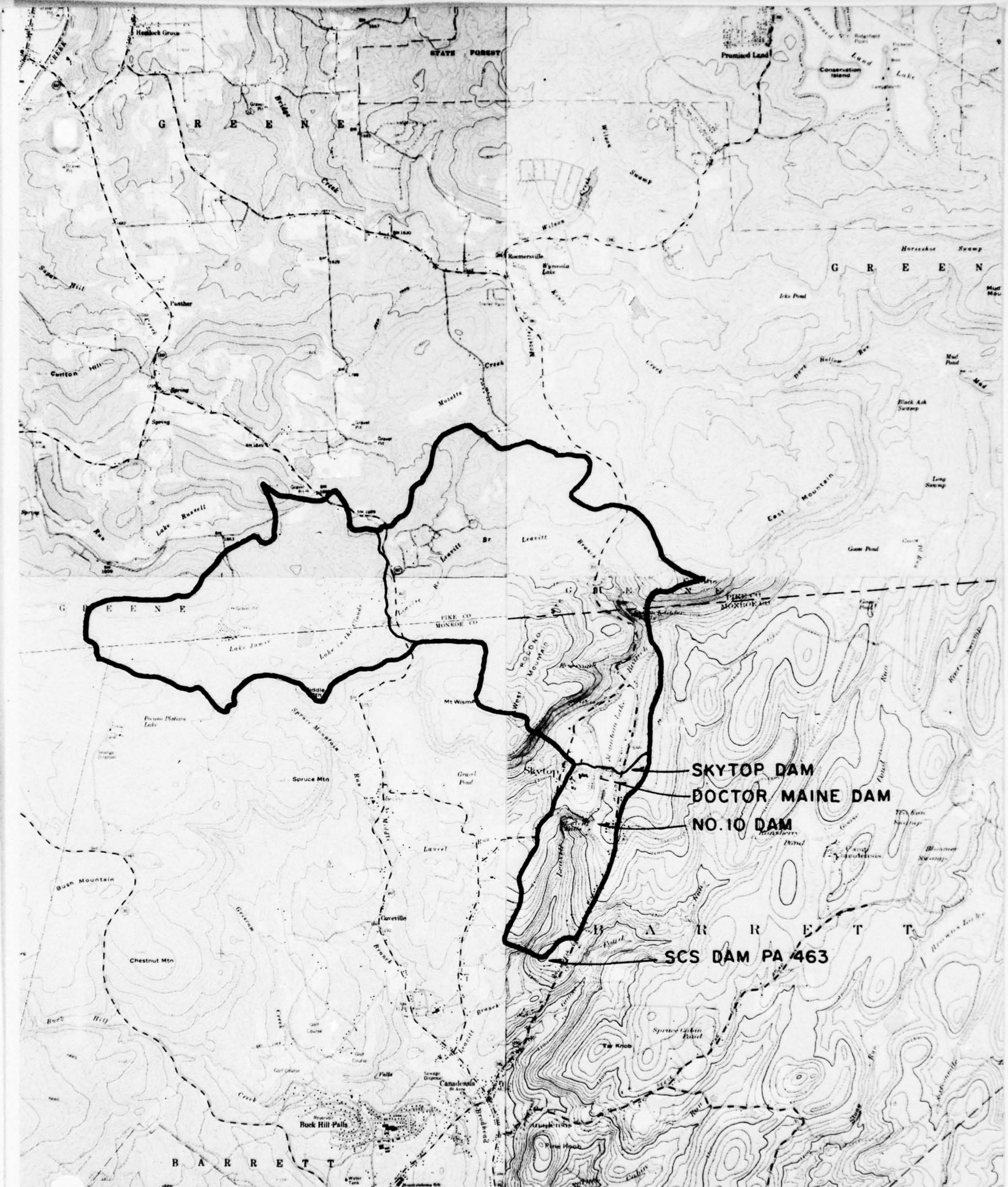
REGIONAL LOCATION PLAN

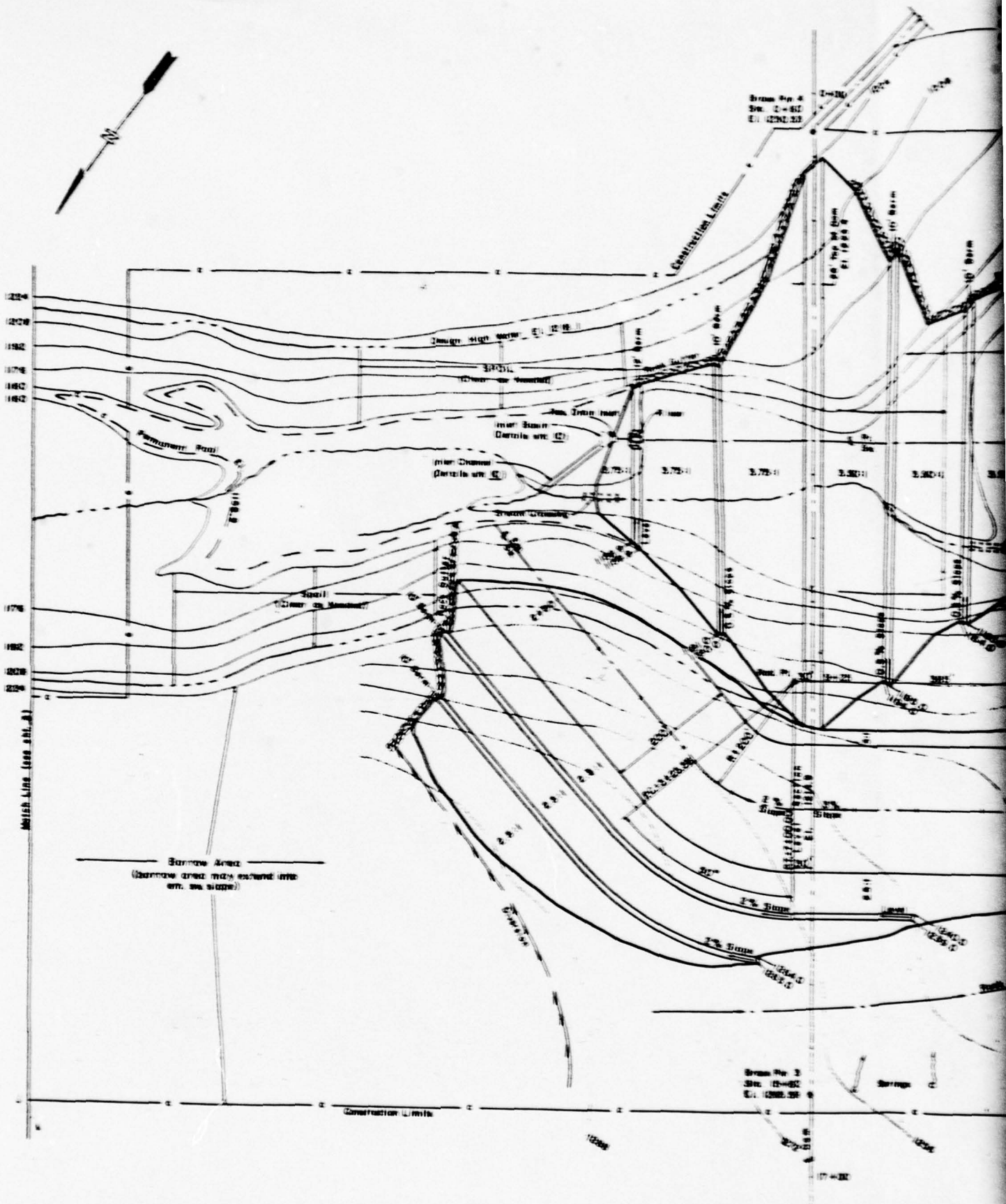
SCS PA 463

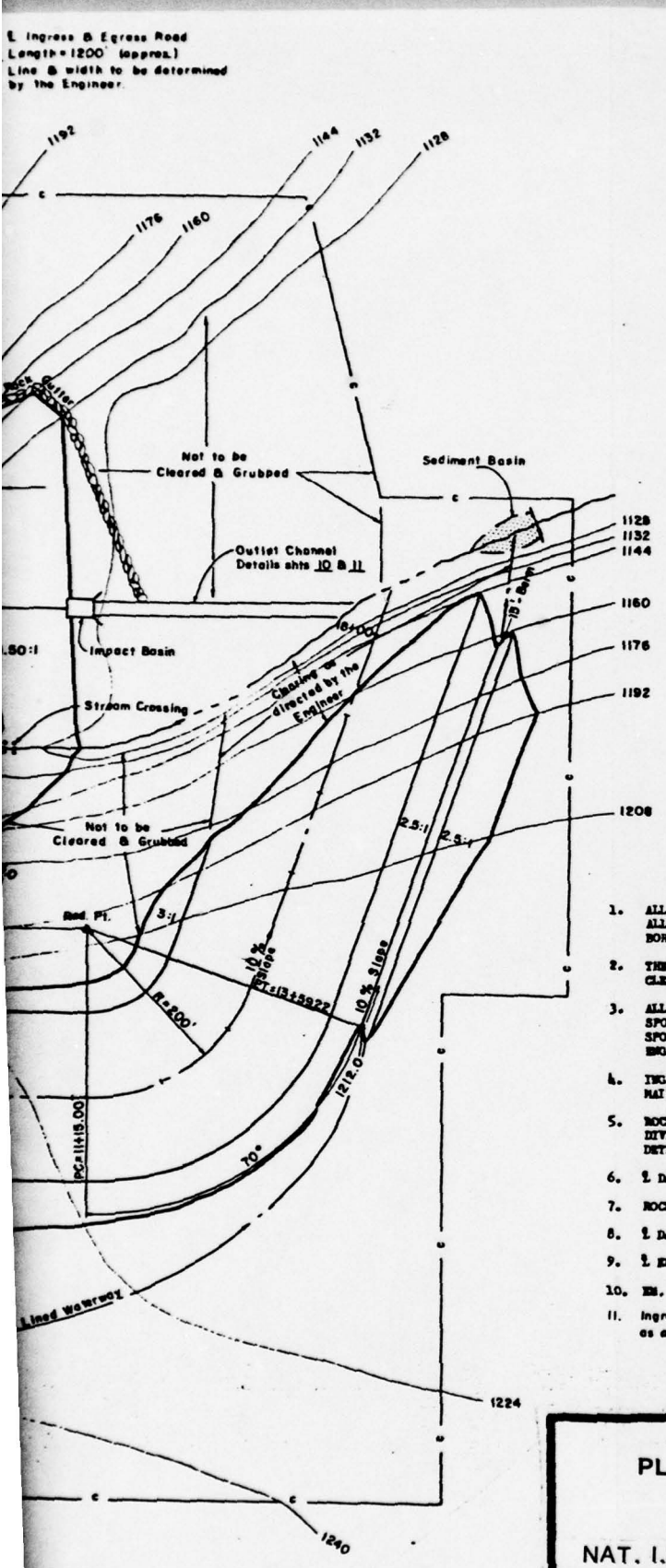
NAT. ID NO. PA.00814 **MONROE COUNTY**

DATA OBTAINED FROM U.S. GEOLOGICAL SURVEY QUAD SHEETS ENTITLED SKYTOP, PA. AND BUCK HILL FALLS, PA. PHOTOREVISED 1973

PLATE 1


SKYTOP DAM
DOCTOR MAINE DAM
NO. 10 DAM
SCS DAM PA 463
HYDROLOGIC MAP
PLATE I-A


Construction Limits
Construction Limits



EM SW

UPSTREAM CURVE DATA

I = 50°-00'
R = 200'
E = 20.68'
M = 18.74'
C = 169.05'
L = 174.44'
T = 93.26'
P.C. = 5+25.56
P.T. = 7+00.00

DOWNSTREAM CURVE DATA

I = 70°-00'
R = 200'
E = 44.16'
M = 36.17'
C = 229.43'
L = 244.22'
T = 140.04'
P.C. = 11+15.00
P.T. = 13+59.22

CONSTRUCTION NOTES

1. ALL STRUCTURE AREAS TO BE CLEARED AND GRUBBED & ALL BORROW AREAS TO BE CLEARED AND GRUBBED AS BORROW IS NEEDED; AS DIRECTED BY THE ENGINEER.
2. THE AREA BELOW PERM. POOL ELEVATION SHALL BE CLEARED.
3. ALL SPOIL AREAS TO BE CLEARED (CLASS B) BEFORE SPOILING. AFTER SPOIL MATERIAL IS PLACED, SPOIL AREA WILL BE GRADED AS DIRECTED BY THE ENGINEER.
4. INGRESS & EGRESS ROAD TO BE CONSTRUCTED AND MAINTAINED BY THE CONTRACTOR.
5. ROCK FILL SEDIMENT BASIN, STREAM CROSSINGS AND DIVERSION SHOWN ARE APPROX. AND SHALL BE DETERMINED BY THE ENGINEER.
6. ℄ DAM = ℄ CUTOFF TRENCH
7. ROCK GUTTER DETAILS SHT. 26 .
8. ℄ DAM LAYOUT SHT. 3 .
9. ℄ EM. SW. PROFILE SHT. 28 .
10. EM. SW. BERM AND DRAINAGE DETAILS SHT. 9 .
11. Ingress & Egress Road shall be cleared, Class A, as approved by the Engineer.

100 50 20 0 100
SCALE in FEET

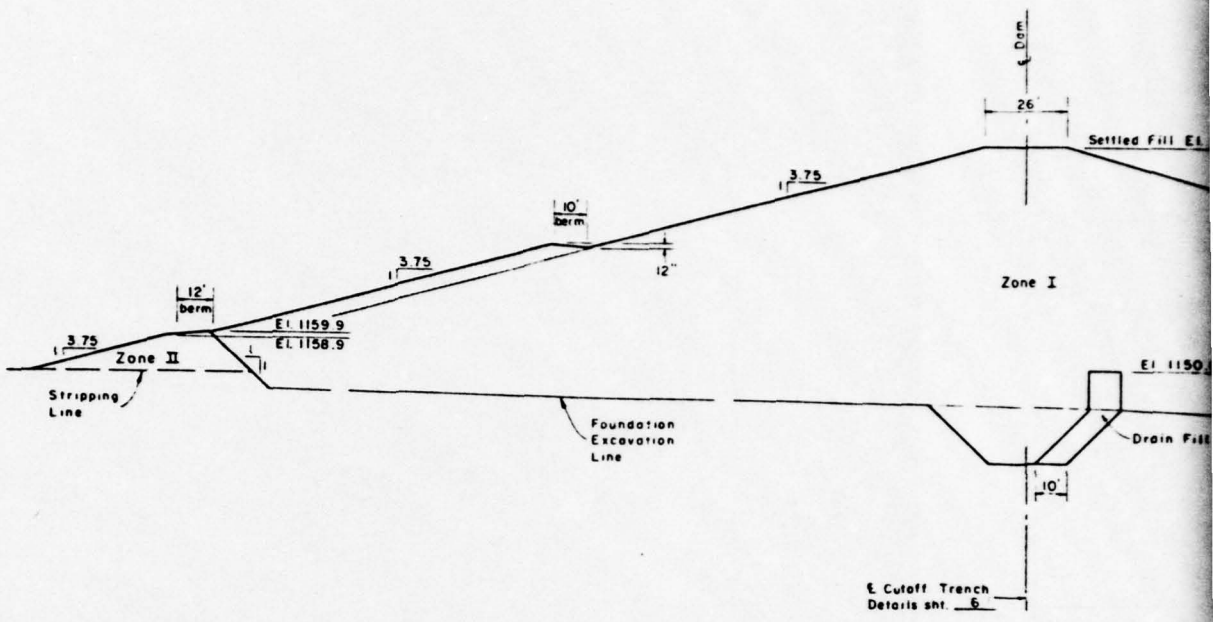
PLAN OF DAM AND APPURTENANT STRUCTURES

SCS PA 463

NAT. I.D.NO. PA.00814 MONROE COUNTY

DATA OBTAINED FROM U.S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, DRAWING NO. PA-463-P, SHEET NO. 2 OF 35, DATED 2/73

PLATE 2



TYPICAL SECTION OF DAM

30 15 5 0 30

SCALE in FEET

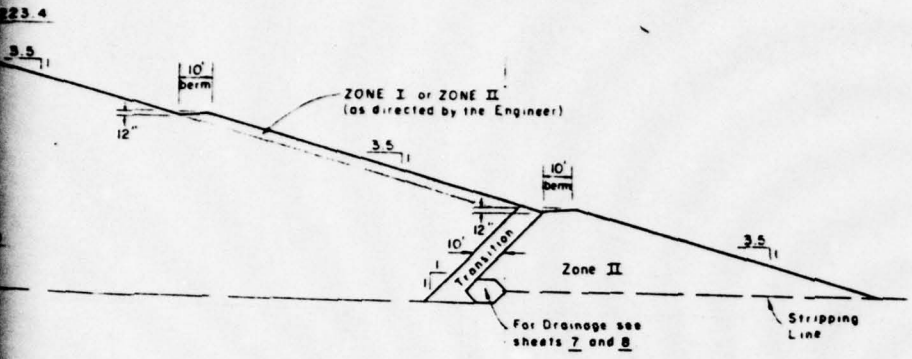
SELECTIVE PLACEMENT	MATERIAL	MAX ROCK SIZE	MAX. LIFT [1]	REQ'D WATER CONTENT [2]	COMPACTION [3]	
					CLASS	DEFINITION
Zone I [4]	Material as represented by Test Pits, 106, depth 7'-9"; 101, depth 3'-4.5"; 102, depth 3'-6.5"; Classified as SM	6"	9"	Optimum +	A	95% Max density, by ASTM D-698, Method "A"
Zone II [4]	Cobbles & boulders from borrow, em. sw and found exc areas and oversized material raked from Zone I	18"	24"	none	C	Compact with min. 6 passes of 450 psi tamping roller per lift.

[1] Maximum permissible lift thickness before compaction.

[2] Water content of fill matrix at time of compaction. Variation from water content shown may be approved by the Engineer.

[3] For typical compaction curves see sht 35

[4] Selective placement of material within zones will be required



CONSTRUCTION NOTES

1. Constructed Slopes are ;
   3.71 :1 Upstream
   3.46 :1 Downstream
2. For constructed fill elevations see sht 6
3. For berm elevations and slopes see sht 2

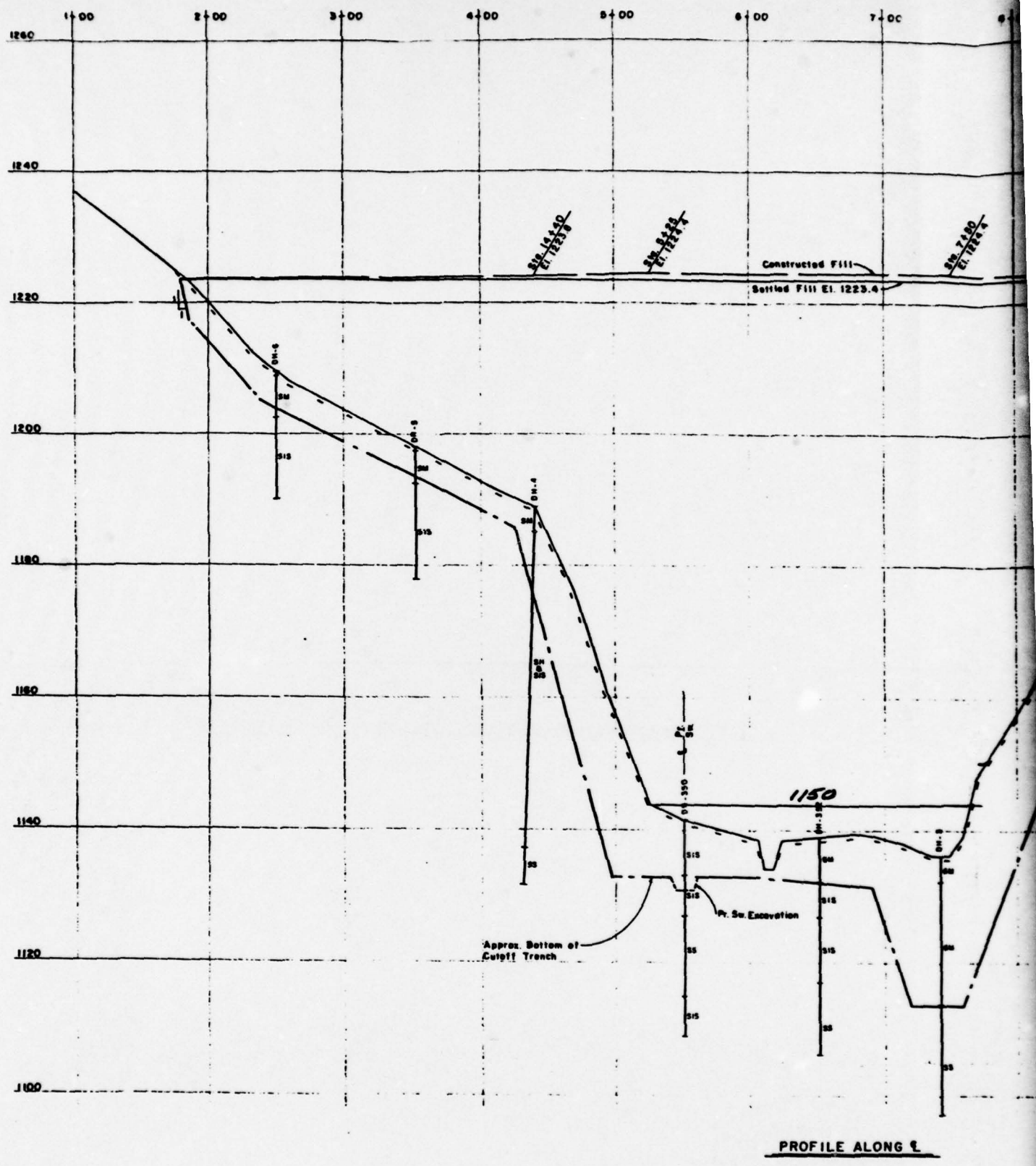
TYPICAL EMBANKMENT SECTION

SCS PA 463

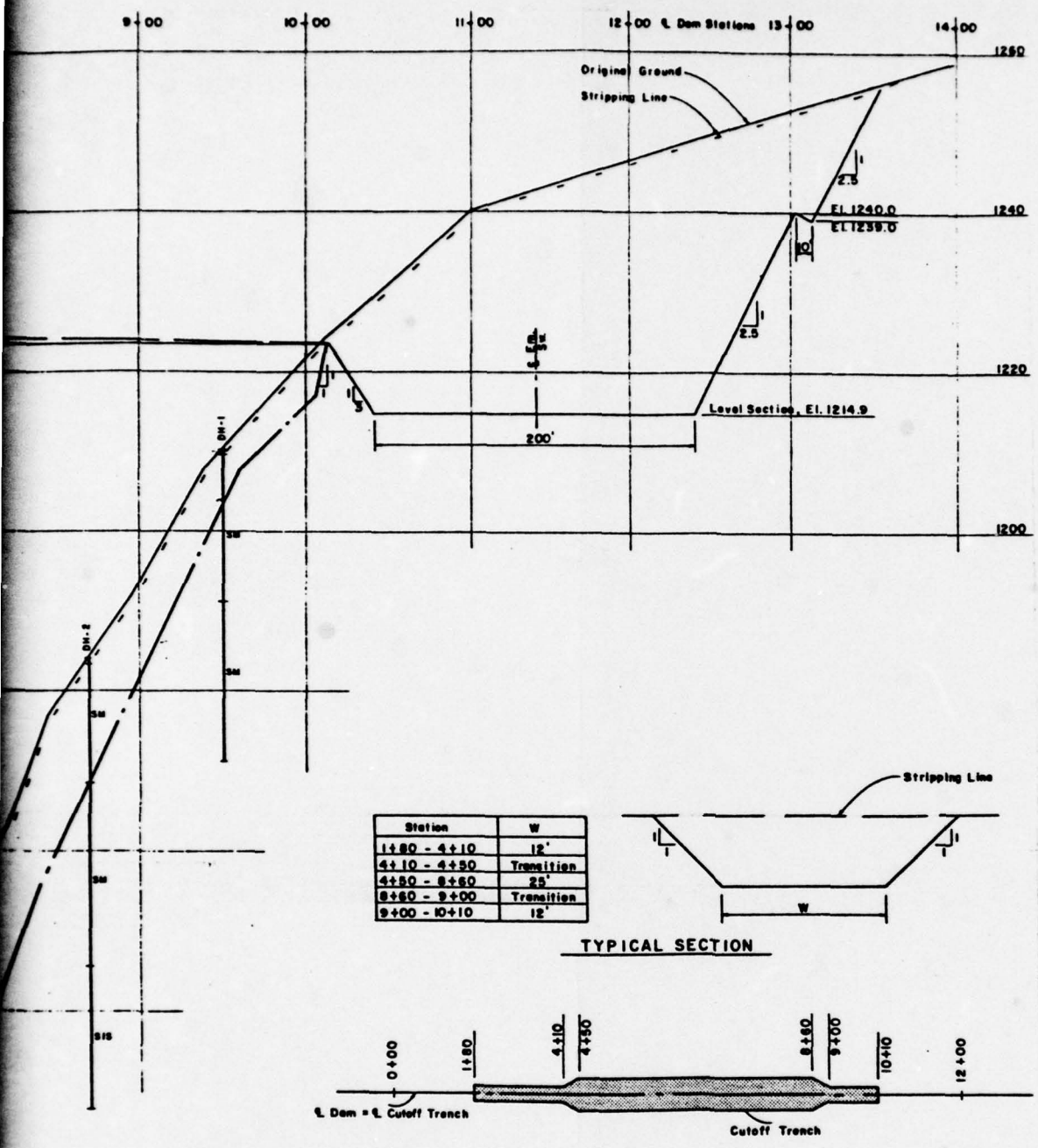
NAT. I.D. NO. PA.00814 MONROE COUNTY

DATA OBTAINED FROM U.S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, DRAWING NO. PA - 463 - P, SHEET NO. 4 OF 35, DATED 2/73

PLATE 3



PROFILE ALONG ℄



Station	W
1+80 - 4+10	12'
4+10 - 4+50	Transition
4+50 - 8+60	25'
8+60 - 9+00	Transition
9+00 - 10+10	12'

TYPICAL SECTION

PLAN VIEW
NOT TO SCALE

NOTE

For logs of test holes see shts. 29 thru 34

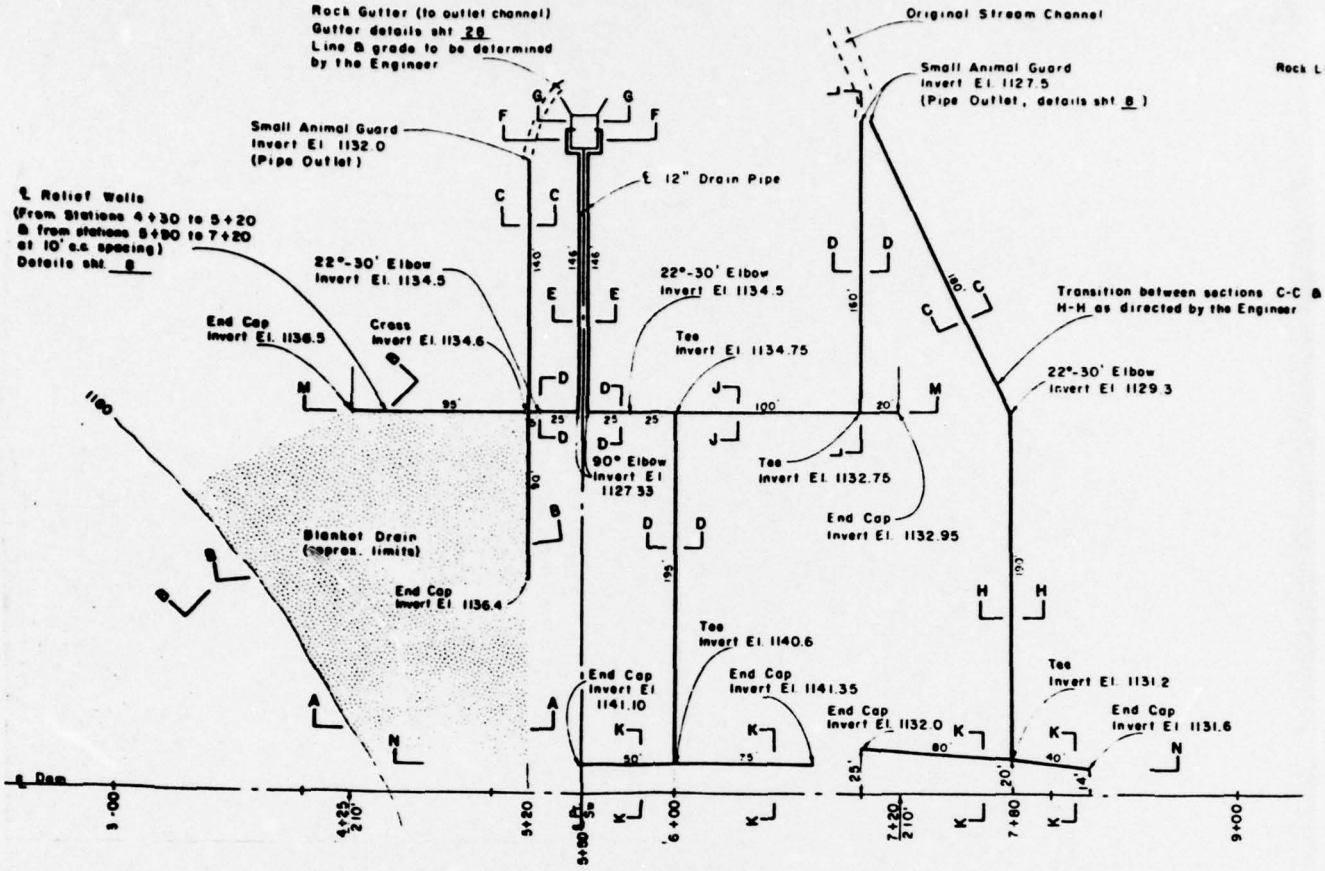
CUTOFF TRENCH DETAILS

SCS PA 463

NAT. I.D. NO. PA.00814 MONROE COUNTY

DATA OBTAINED FROM U.S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, DRAWING NO. PA-463-P, SHEET NO. 6 OF 35, DATED 2/73

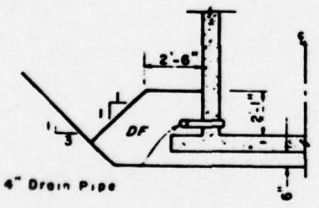
PLATE 4



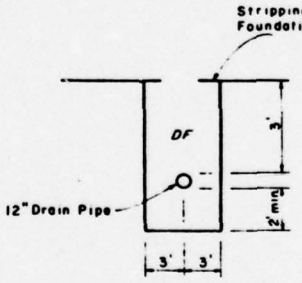
PLAN VIEW

0 10 25 50

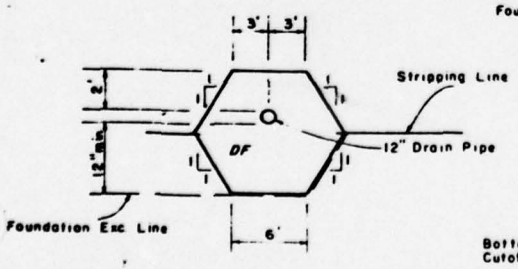
SCALE in FEET



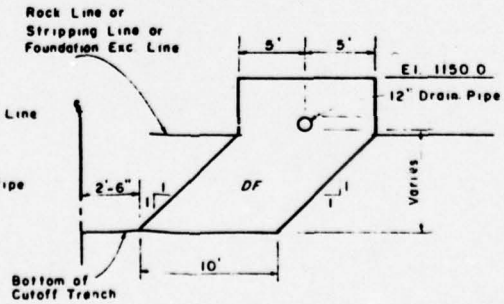
SECTION G-G



SECTION H-H



SECTION J-J



SECTION K-K

PIPE QUANTITY SUM

1767'-2" - 12" Dia. Perforated

60'-0" - 12" Dia. Non-Perfora

which includes:

8 - 90° Elbows

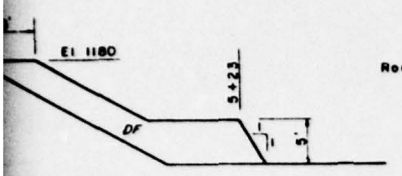
3 - 22°-30' Elbows

4 - Tees

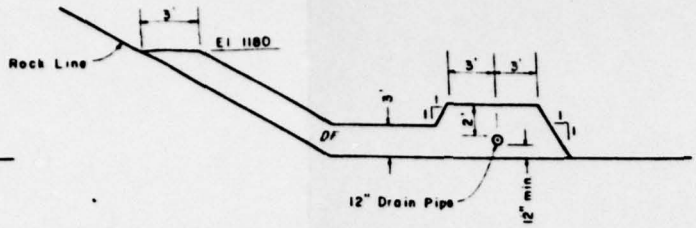
1 - Cross

5 - Small Animal Guar
Details sht 28

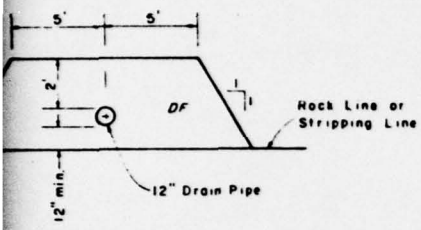
7 - End Caps



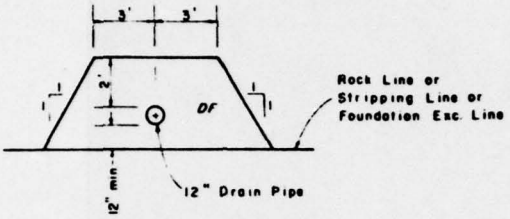
SECTION A-A



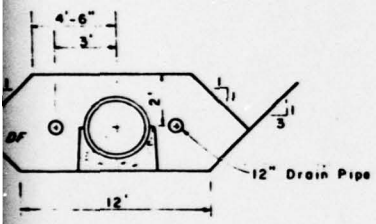
SECTION B-B



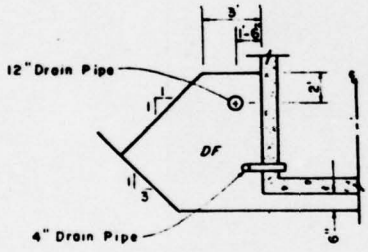
SECTION C-C



SECTION D-D



SECTION E-E



SECTION F-F

DF = Drain Fill

NOTES

1. See sheet 8 for pipe outlet details and sections L-L, M-M & N-N.
2. All 12" dia. drain pipe shall be Class I or II, Shape 1, Coating A, 16 gage, Spec 551, Perforated. (one- 20' non-perforated section at each outlet, 3-required)

MMARY

Drain Pipe
ated Drain Pipe

GRADATION LIMITS - DRAIN FILL

SIEVE NO	% PASSING (BASED ON DRY WEIGHT)
1/2"	100
3/8"	75 - 100
no. 4	10 - 30
no 8	0 - 10

rd

NOT TO SCALE

DRAINAGE PLAN AND PROFILE

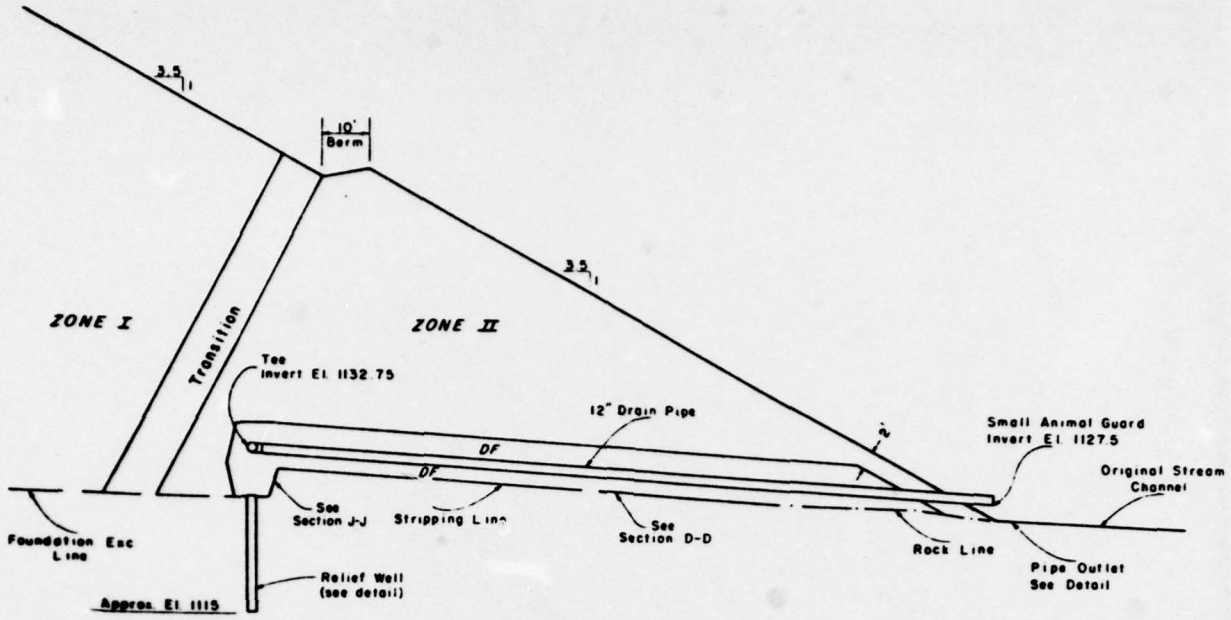
SCS PA 463

NAT. I.D. NO. PA.00814 **MONROE COUNTY**

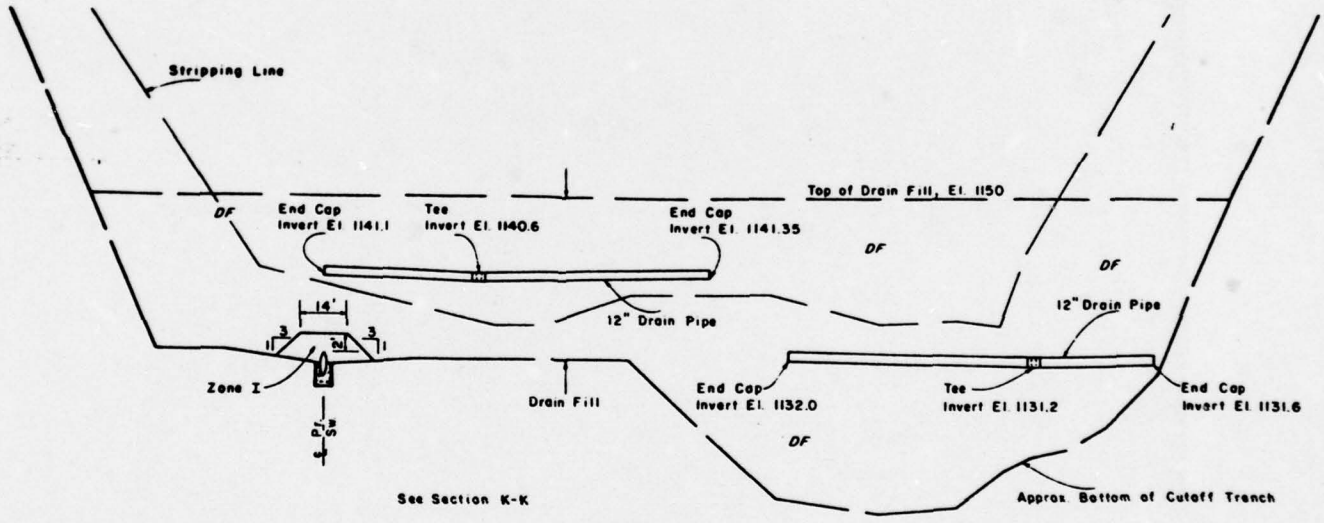
DATA OBTAINED FROM U.S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, DRAWING NO. PA - 463 - P, SHEET NO. 7 OF 35, DATED 2/73

2

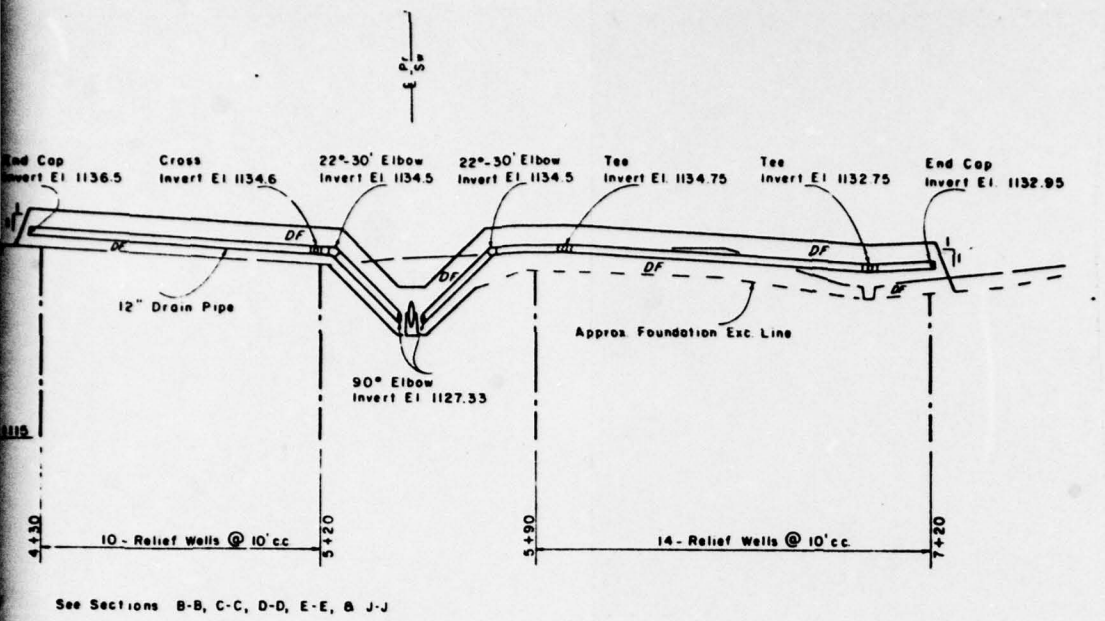
PLATE 5



SECTION L-L

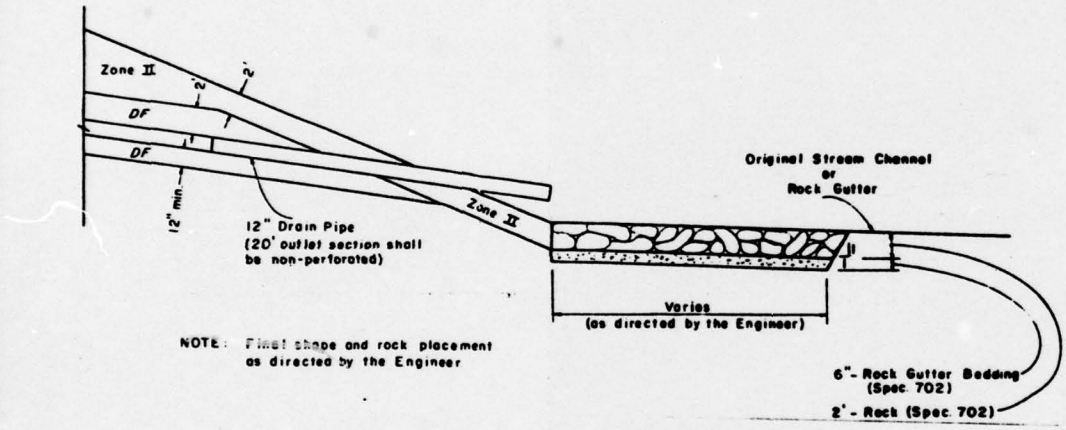


SECTION N-N



See Sections B-B, C-C, D-D, E-E, & J-J

SECTION M-M

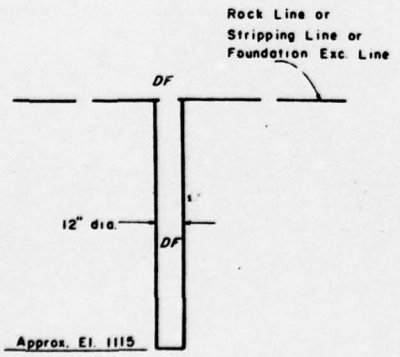


NOTE: Final shape and rock placement as directed by the Engineer

PIPE OUTLET DETAIL

DF = Drain Fill

NOT TO SCALE



RELIEF WELL DETAIL

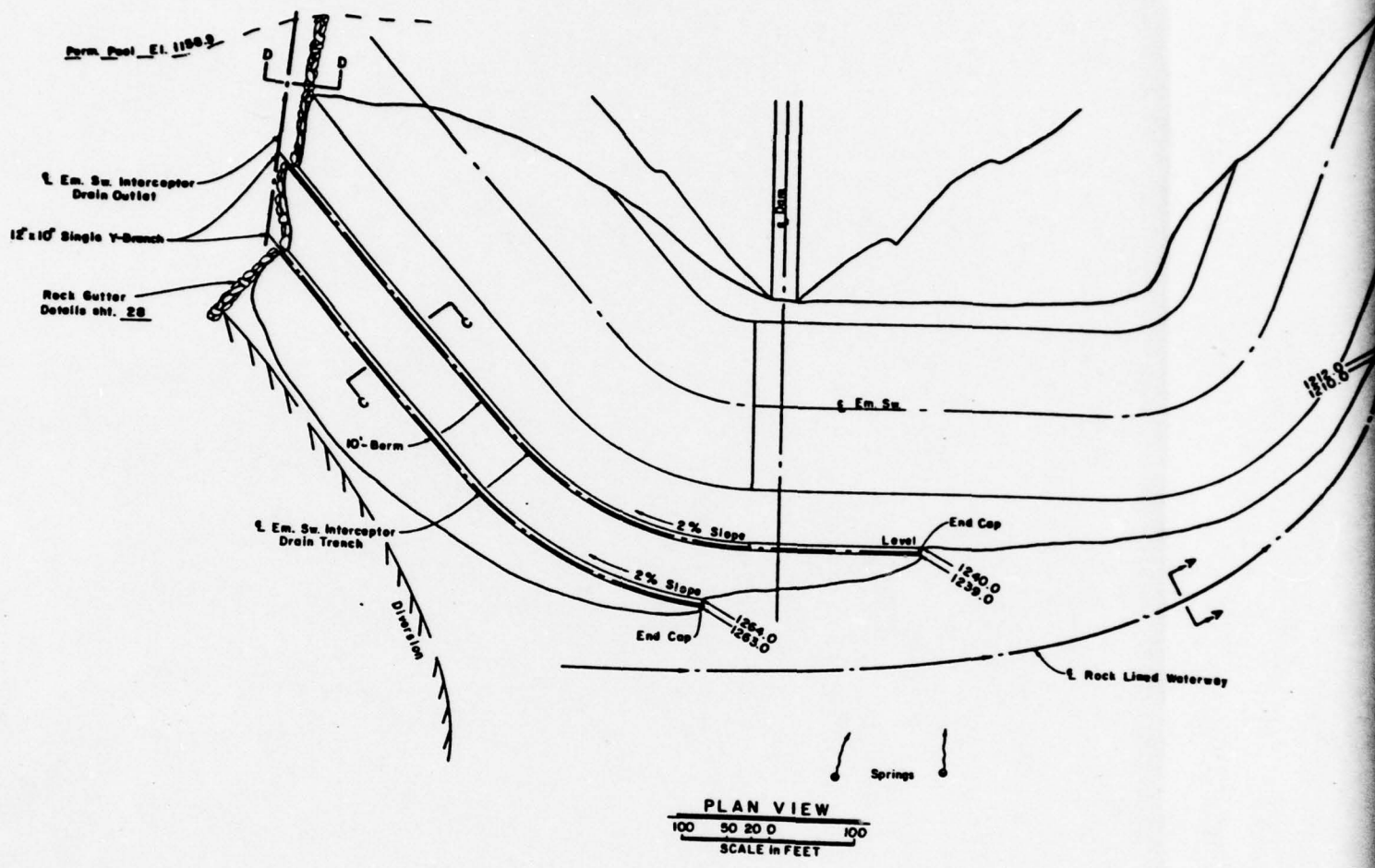
DRAINAGE PLANS

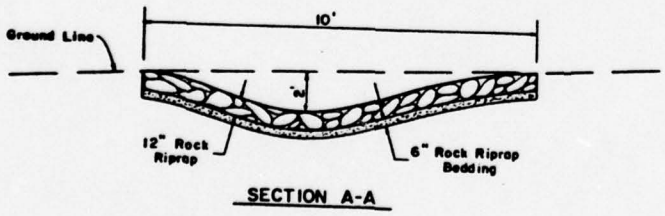
SCS PA 463

NAT. I.D. NO.PA.00814 MONROE COUNTY

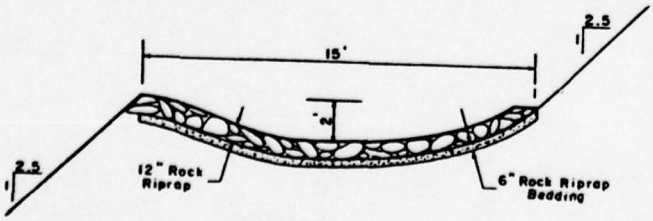
DATA OBTAINED FROM U.S. DEPT, OF AGRICULTURE, SOIL CONSERVATION SERVICE, DRAWING NO. PA - 463 - P, SHEET NO. 8 OF 35, DATED 5/74

PLATE 5A

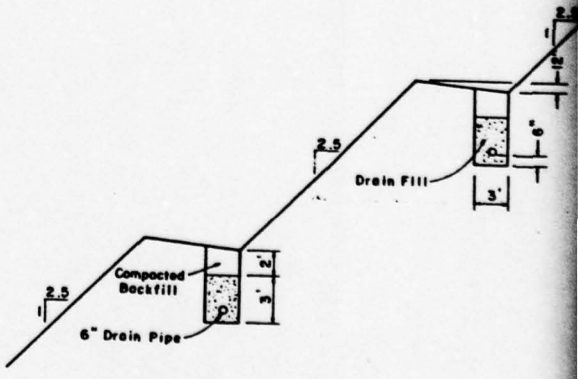




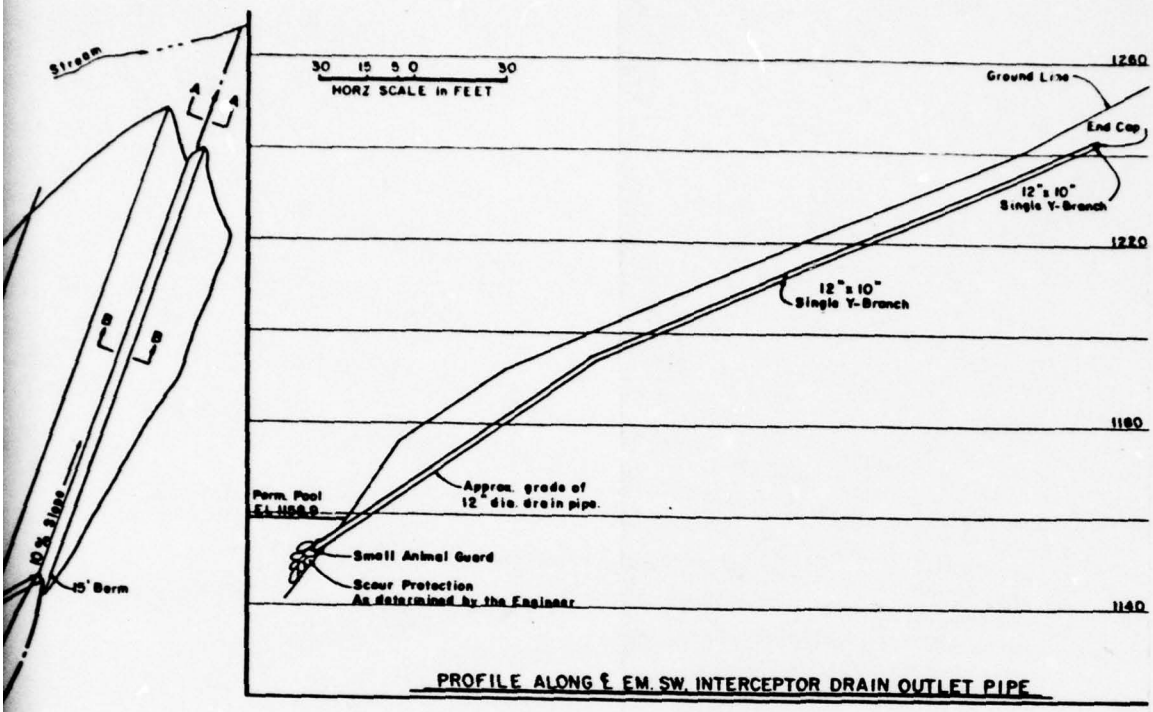
SECTION A-A



SECTION B-B



SECTION C-C



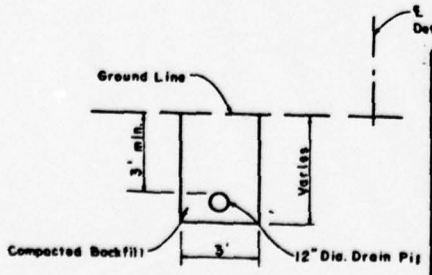
PROFILE ALONG ℄ EM. SW. INTERCEPTOR DRAIN OUTLET PIPE

QUANTITY SUMMARY

1650' - 6" Drain Pipe
290 - 12" Drain Pipe
2 - 12"x 10" Single Y-Branch
2 - 6" End Caps
1 - 12" End Cap
1 - Small Animal Guard (details sht. 28)

CONSTRUCTION NOTES

1. Final line and grade to be determined by the Engineer.
2. All em. sw. interceptor drain outlet pipe shall be 12" dia., Class I or II, Shape I, Type A, iron or steel, 16 gage.
3. All em. sw. interceptor drain pipe shall conform to Spec. 701 , 6" dia., plastic pipe, corrugated, perforated.
4. Insert 6" pipe into 10" branch of Y. Pack with oakum & seal with bituminous compound, as directed by the Engineer.
5. For riprap bedding gradation see sht. 10



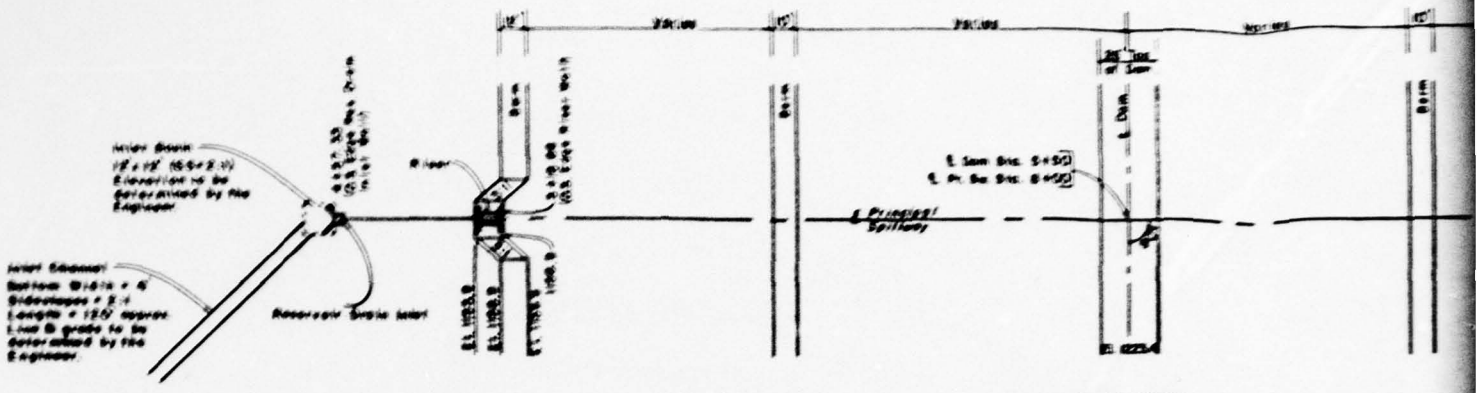
SECTION D-D

EMERGENCY SPILLWAY AND DRAINAGE PLAN
SCS PA 463

NAT. I.D. NO. PA.00814 MONROE COUNTY

DATA OBTAINED FROM U.S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, DRAWING NO. PA - 463 - P, SHEET NO. 9 OF 35, DATED 2/73

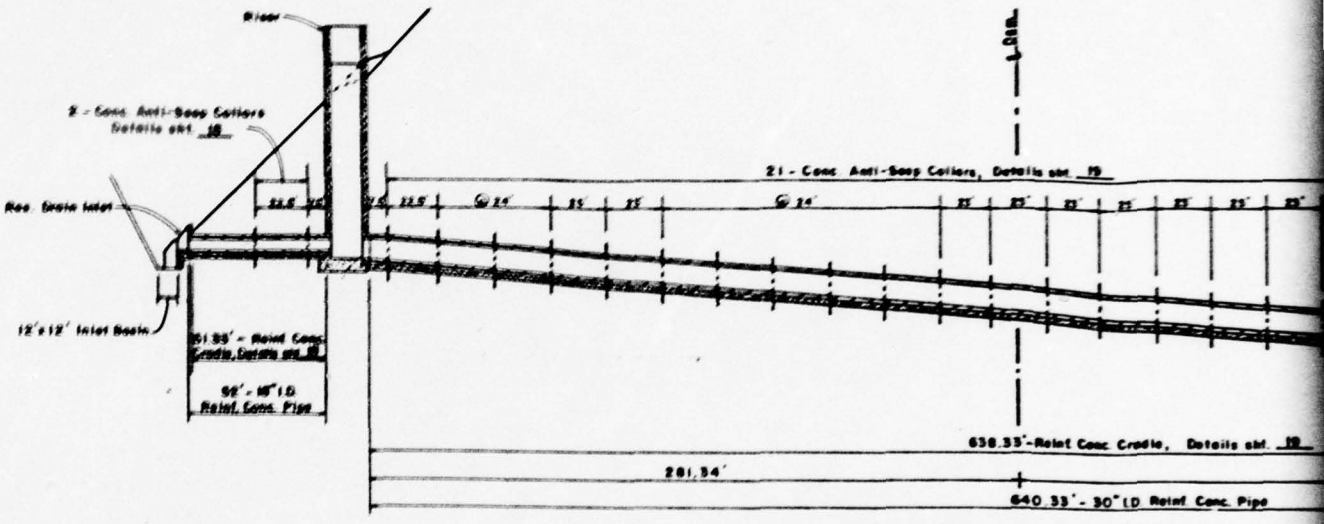
PLATE 6



PLAN VIEW

40 20 0 40

SCALE in FEET

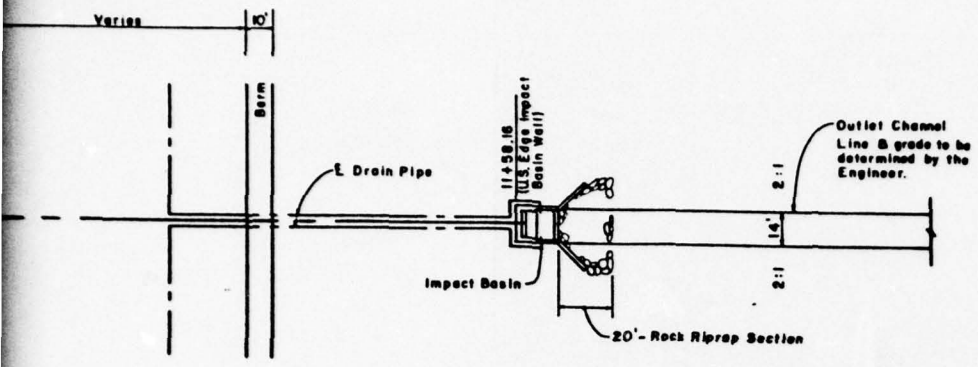


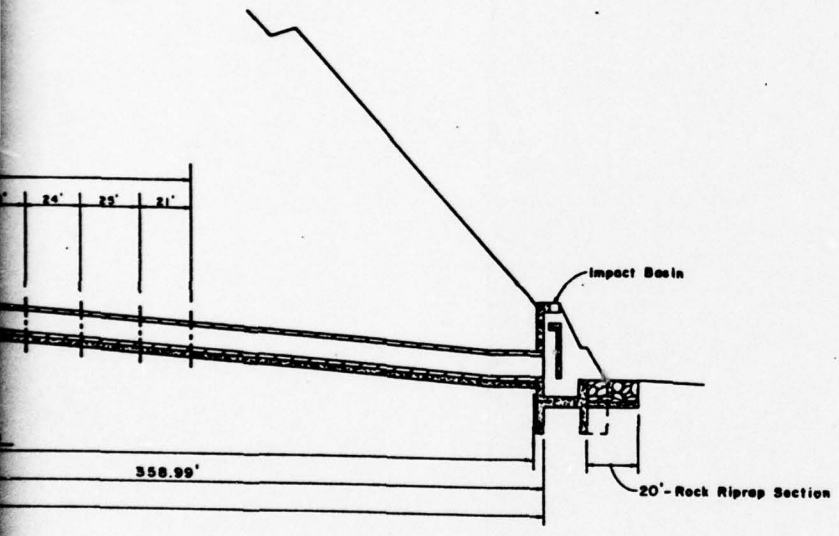
PROFILE ALONG ℄ PR. SW

40 20 10 10 5 2 0

Horizontal Vertical

SCALE in FEET





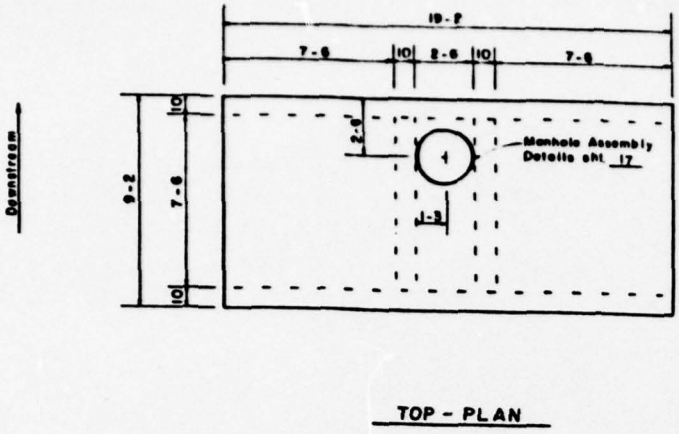
PRINCIPAL SPILLWAY

SCS PA 463

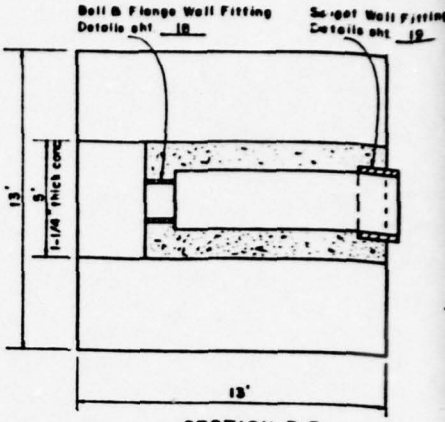
NAT. I.D. NO. PA.00814 MONROE COUNTY

DATA OBTAINED FROM U.S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, DRAWING NO. PA - 463 - P, SHEET NO. 10 OF 35, DATED 2/73

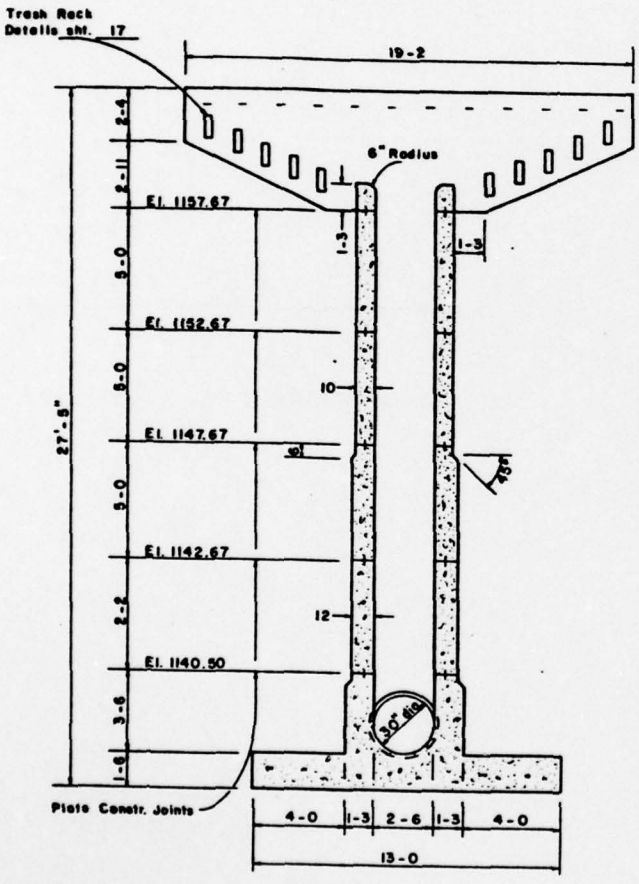
PLATE 7



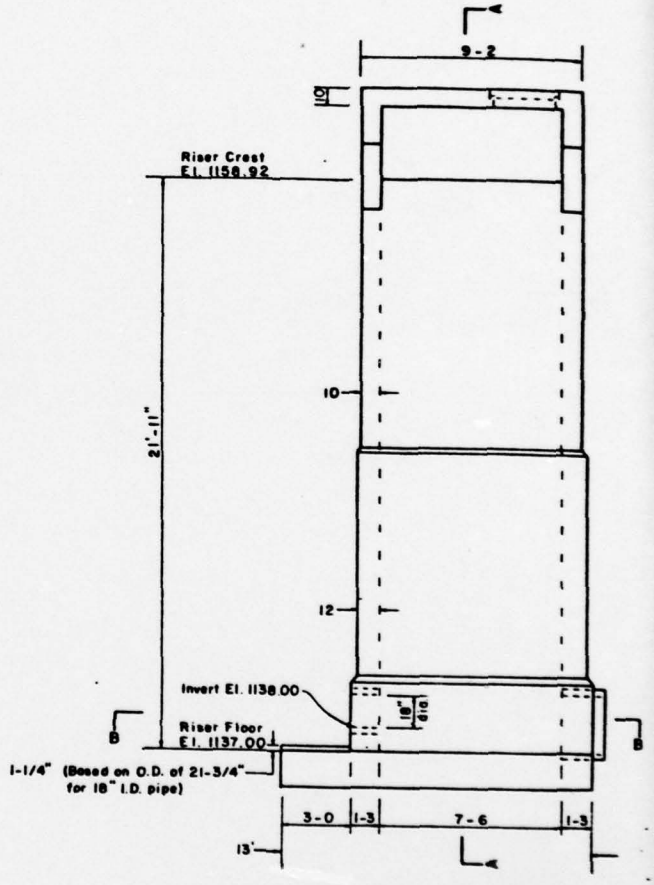
TOP - PLAN



SECTION B-B



SECTION A-A



SIDE ELEVATION

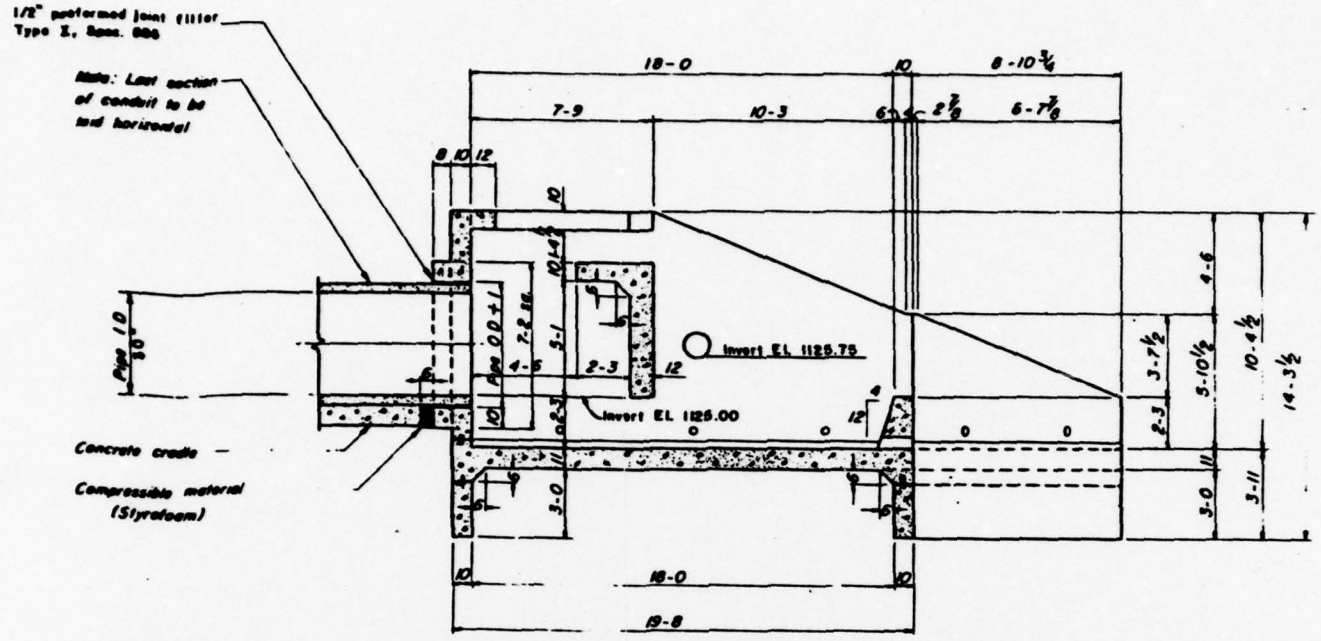
RISER DETAILS

SCS PA 463

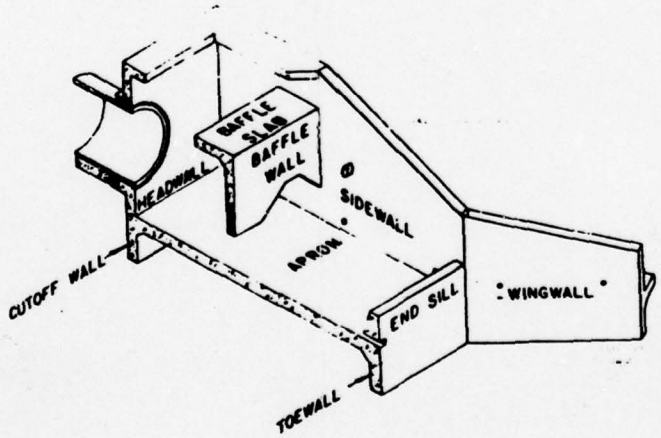
NAT. I.D. NO. PA.00814 MONROE COUNTY

DATA OBTAINED FROM U.S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, DRAWING NO. PA -463 - P, SHEET NO. 13 OF 35, DATED 2/73

PLATE 8



SECTION ON CENTERLINE



ISOMETRIC VIEW

NAT. I.

DATA
CONS
NO. 2

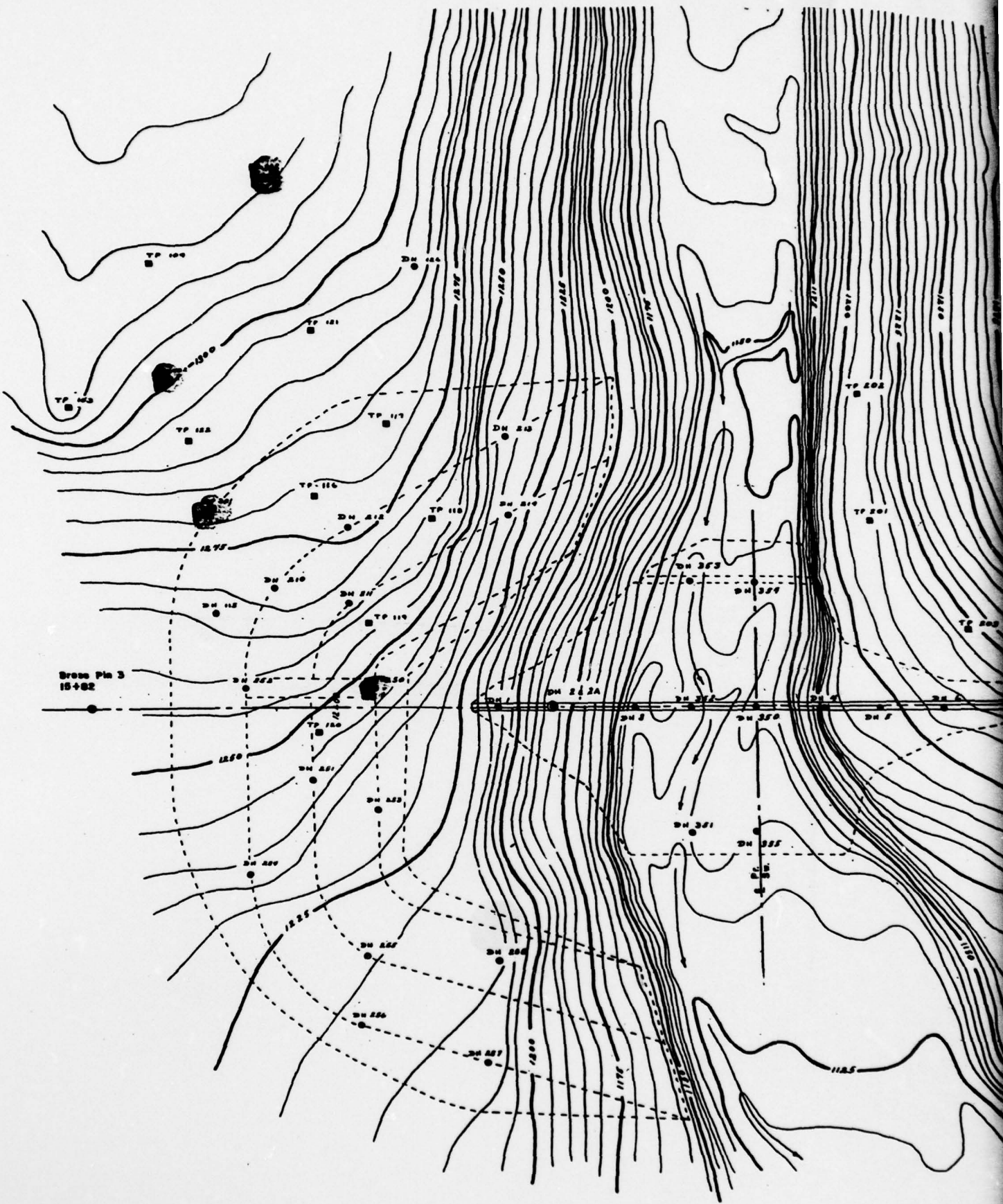
IMPACT BASIN DETAILS

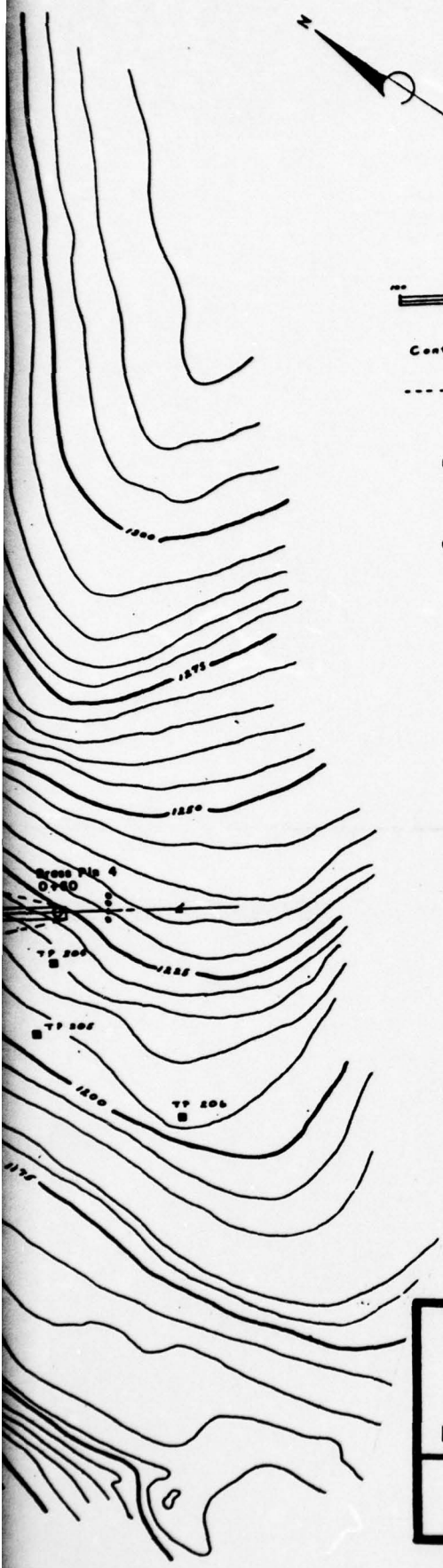
SCS PA 463

NO. PA.00814 MONROE COUNTY

OBTAINED FROM U.S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, DRAWING NO. PA -463 - P, SHEET 2 OF 35, DATED 2/73

PLATE 9


Brass Pin 3
15+82



NOTE: LIMITS OF DAM & EM. SW. SHOWN WAS FOR INVESTIGATION ONLY. FINAL DESIGN SEE SHT. 2.

BORING LOCATION PLAN

SCS PA 463

NAT. I.D. NO. PA.00814 MONROE COUNTY

DATA OBTAINED FROM U.S. DEPT. OF AGRICULTURE, SOIL CONSERVATION SERVICE, DRAWING NO. PA - 463 - P, SHEET NO. 35A OF 35, DATED 2/73

PLATE 10

APPENDIX

F

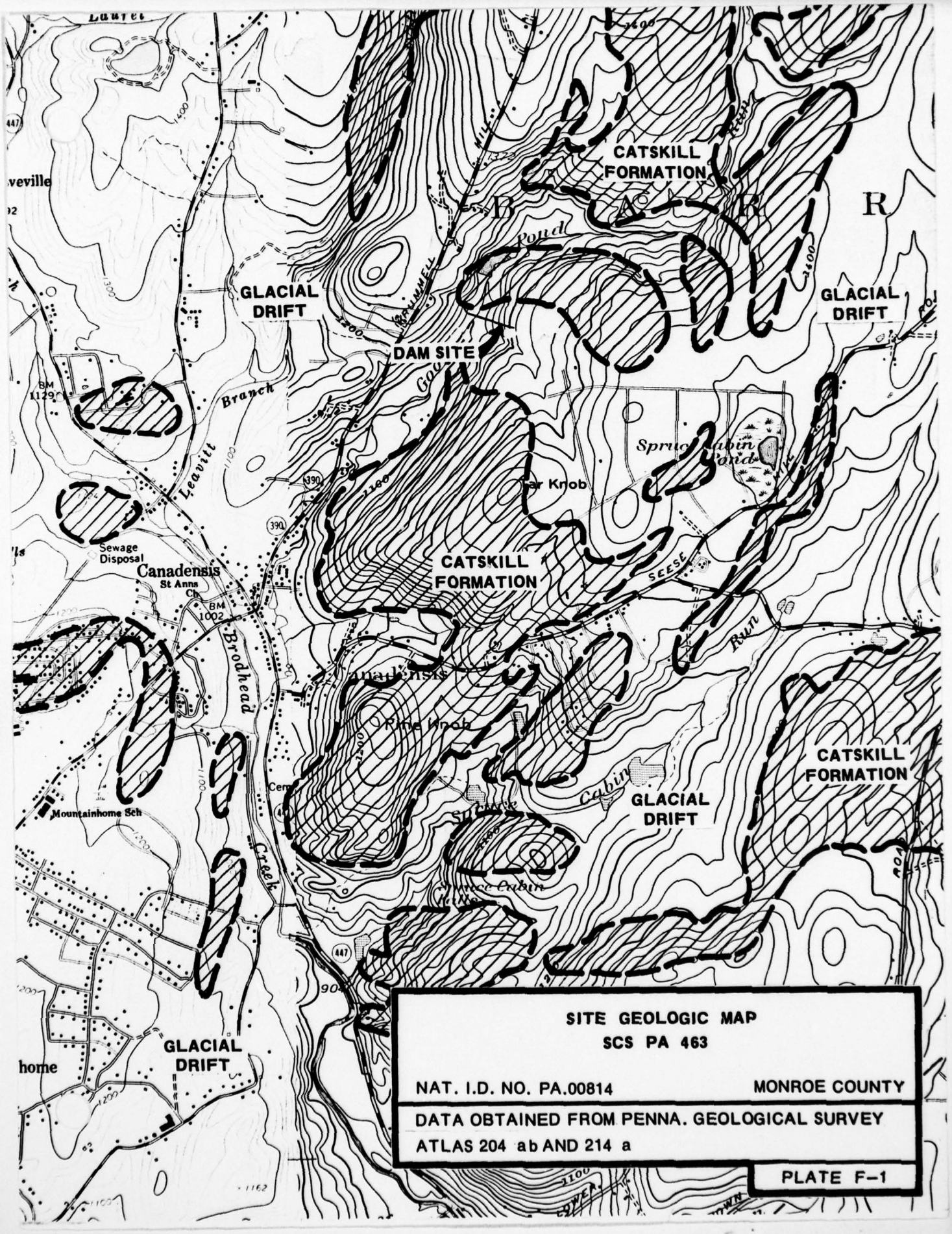
SITE GEOLOGY
SCS PA 463

SCS PA 463 Dam is located in the Glaciated Low Plateaus Section of the Appalachian Plateaus Physiographic Province adjacent to the Pocono Plateau Section. As shown in Plate F-1, the dam site and surrounding region, as is much of northeastern Pennsylvania, is underlain by the Upper Devonian age Catskill Formation. Often, sections of the Catskill Formation are overlain by a mantle of Wisconsin age glacial drift.

Bedrock exposures were observed in the dam site area. A massive siltstone and mudstone outcrop was observed at the left abutment striking N 80° E and dipping 7° N (upstream). This rock readily crumbles and deteriorates, forming a characteristic talus slope. As reported in DER files, the bedrock consists of sandstone, siltstone and shale being faulted and folded, and encountered at depths from less than one to greater than 40 feet. The major bedrock structure in the dam area is a plunging anticline (fold). The dam is located on the north limb of this feature resulting in upstream dipping bedding as previously mentioned. Faulting, as indicated by correlation of sandstone layers, occurs in the dam area. High angle northwest and northeast striking joints were also observed during the field inspection.

Subsurface conditions are variable as indicated by DER files. The left abutment area is underlain by bedrock as previously described, the right abutment and emergency spillway are underlain by glacial deposits from 10 to greater than 40 feet thick and the principal spillway is underlain in part

by a buried Pleistocene age river channel. As is typical for glacial deposits, seepage potential would be an inherent characteristic. Existing conditions favorable for seepage include the glacial drift-bedrock interface and the buried Pleistocene channel in the right abutment area.



SITE GEOLOGIC MAP
SCS PA 463

NAT. I.D. NO. PA.00814 MONROE COUNTY

DATA OBTAINED FROM PENNA. GEOLOGICAL SURVEY
ATLAS 204 ab AND 214 a

PLATE F-1

APPENDIX

G

BY MFB DATE 2/13/79 SUBJECT SCS Dam PA 463 SHEET 1 OF 6

CHKD. BY [illegible] DATE 19 Feb 79 Filter Drain JOB No.

As a result of a visit to the site during construction by several SCS personnel on April 16, 1974, the piping potential of core trench material was re-evaluated by SCS. A core trench and two filter material samples were taken. The resulting gradation curves and results of the revaluation were made available by SCS. Selected portions of the SCS material are inclosed. For purposed of comparison, information from more than one sheet have been combined.

References used in this evaluation are:

1. "Soil Mechanics Note No. 1", May 1, 1968, Soil Conservation Service
2. Lambe & Whitman, Soil Mechanics, 1969, p. 293 (Col E criteria)
3. Sherard, Woodward, Gizienski & Clevenger, Earth & Earth-Rock Dams, 1963, p. 84

References 1 & 3 indicate the use of 1-inch material as D_{100} while reference 2 does not

	"ORIGINAL" Design Sample (Sheet 41)	"ORIGINAL" Design Sample 1-in. = D_{100}	In Place Sample (Sheet 41)	In Place Sample 1-in. = D_{100}	Filter PA 18
D_{85}	33	9.5	19	4.7	8 to 11
D_{50}	0.27	0.16	0.32	0.17	5.6 to 7.2
D_{15}	0.012	≈0.009	0.017	0.014	2.8 to 5
-#200	29%	35%	30%	32%	—
C_u	—	—	—	—	2.6 to 1.7

Using reference 1.

Section III. A.1 Base (PI ≤ 7) w/ high piping potential requirements met:

a. description of base - SM
b. D_5 filter ≥ 0.074 mm
c. D_{15} filter ≤ 4 · D_{85} base
   2.8 to 5 ≤ 4 · 4.7 = 18.8
   4 · 9.5 = 38
e. D_{100} filter ≤ 3-in.
f. C_u filter < 20

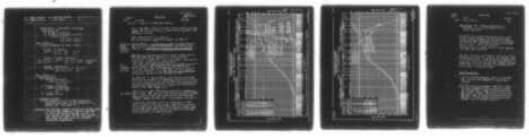
requirement not met

d D_{50} filter ≤ 25 D_{50} base
   5.6 to 7.2 ≤ 25 · 0.17 = 4.25
   25 · 0.16 = 4

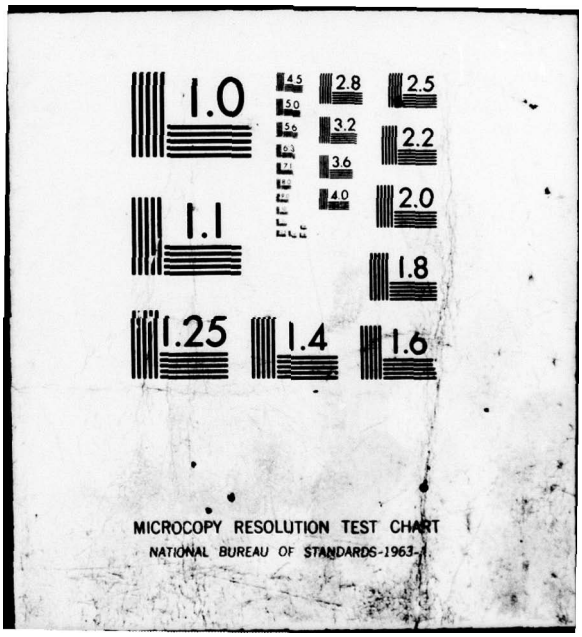
AD-A072 900 WOODWARD-CLYDE CONSULTANTS PLYMOUTH MEETING PA F/G 13/2
NATIONAL DAM INSPECTION PROGRAM. SOIL CONSERVATION SERVICE. DAM--ETC(U)
MAR 79 DACW31-79-C-0017

UNCLASSIFIED NL

2 OF 2
AD A072900



END
DATE FILMED
9-79
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

BY MFB DATE 2/13/79 SUBJECT SCS Dam PA 463 SHEET 2 OF 6

CHKD. BY [illegible] DATE 19 Feb 79 Filter Drain JOB No.

Section III. B. 1 Permeability requirements ✓

requirements met

a. D_{15} filter $\geq$ 0.074 mm

b. D_{15} filter $\geq 5 \cdot D_{15}$ base $\geq$ 0.10 mm ✓

2.8 to 5 $\geq$ 0.10

$\geq 5 \cdot 0.014 = 0.07$ ✓

$\geq 5 \cdot 0.009 = 0.045$ ✓

Using reference 2.

(curve not adjusted to 1-inch = D_{100})

D_{15} filter < 5 D_{85} soil

2.8 to 5 $< 5 \cdot 19 = 95$ OK ✓

$< 5 \cdot 33 = 165$ OK ✓

$4 \cdot D_{15}$ soil $< D_{15}$ filter < 20 D_{15} soil

0.048 $= 4 \cdot 0.012$ ✓ $<$ 2.8 to 5 $< 20 \cdot 0.012 = 0.24$ No good ✓

0.068 $= 4 \cdot 0.017$ $<$ $< 20 \cdot 0.017 = 0.34$ No good ✓

D_{50} filter $< 25 \cdot D_{50}$ soil

5.4 to 7.2 $< 25 \cdot 0.27 = 6.75$ OK ± ✓

$< 25 \cdot 0.32 = 8$ OK ✓

Using reference 3

requirements met

1. D_{15} filter $\geq 5 \cdot D_{15}$ soil

2.8 to 5 $\geq 5 \cdot 0.014 = 0.07$

$\geq 5 \cdot 0.009$

2. D_{15} filter $< 5 \cdot D_{85}$ soil

2.8 to 5 $< 5 \cdot 4.7 = 23.5$

$< 5 \cdot 9.5 = 47.5$

3. 1-inch = D_{100}

5. D_{15} filter > 0.074

requirement not met

3. "The gradation curve of the filter should have roughly the same shape as the gradation of the protected soil." See sheet 4. ✓

Conclusion - the filter drain material does not meet all requirements of any of the references. Sheet 6 notes that no piping had occured at the time samples of in-place materials were taken. But this also would have been before much water would have percolated through the embankment. ✓

JMJ 19Feb79

PENNA BRODHEAD

DIF 4-23-74 PA-463

E & F - Review of DRAINAGE DESIGN 1

From SM2 Report dated 2-11-72, Sample 250.1 represents closely the materials used in cutoff trench backfill in the Pleistocene channel.

Plot of gradations is on Page 2.
Plot of gradations using #4 as 100% is on Page 3

No references located indicating #4 mat'l as D_{100} size

Plotting DH-205.1 using #4 passing 100% and plotting Penn Dot ✓ Type 1B coarse aggregate (drain fill) as specified on plans, indicates to SM material should pipe into the drain fill ✓

Assuming the SM gradation is typical of the material from the E/B, then on sheet 4, is a recommended gradation of drain fill to be used. (Base on DH-205.1) and using 100% passing the #4 Sieve.

This indicates a graded filter req'd

This plot shows that a fine filter is needed to prevent ✓ piping between the SM (Base) and the 1B (Filter). It also shows that the 1B (FILTER) will work very well with the fine filter as will Penn Dot #2A Coarse Aggregate. A decision should be made by others on this.

On Page 84 on Sherard's Book entitled "Earth & Earth Rock Dams", he states that "where the protected Soil Contains a large percentage of gravels, the filter should be designed on the basis of the gradation curve of the portion of the material which is finer than the 1" Sieve ✓

See sheet 2

Sheet 5 is a plot of the SM material based on 100% passing the 1" Sieve. This plot shows that Penn Dot Type 1B will satisfy piping potential but other materials also will (Penn Dot #2B or #2A) and they have a much higher K value. ✓

A decision, therefore, must be made given all the above considerations. An in place sample of Core material is presently being obtained. The gradation of this sample will be the basis for a decision on what is to be done with the filter and filter material.

Form SCS- 353a

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GRAIN SIZE DISTRIBUTION GRAPH

Project Broomhead Site PA-163 Location Core Trench *-in place

FINES | SAND | GRAVEL

DESIGN DATA for SM-Core Trench

Sieve No.	% Passing	
35 mm	100	
25 mm	88	100
3/4"	85	96
15 mm	82	93
8.5 mm	80	91
#4	75	85
#10	70	80
0.85 mm	65	74
#40	60	68
#60	48	54
0.17 mm	44	50
0.13 mm	37	42
#200	30	34
0.06 mm	25	28
0.045 mm	23	26
0.032 mm	20	23
0.022 mm	17	19
0.017 mm	15	17
0.009 mm	10	11
0.006 mm	8	9
0.0045 mm	6	7

U.S. Standard Sieve Sizes

IN-PLACE CORE TRENCH MATERIAL (SM) Sample #3

GRADATION OF SAMPLE USED IN ORIGINAL FILTER DESIGN
LL = 16
PI = 2

GRADATION LIMITS OF SPECIFIED FILTER MATERIAL

Filter Material in middle of Core Trench drain Sample #①

Filter Mat'l @ contact face with Core Trench (SM) Sample #②

Percent Finer by Dry Weight

Grain Size in Millimeters

* SM material used to backfill Core Trench @ STA 7+10 - depth of Sample Taken Same as Sample #1

SM #1 of 6

Sheet No. 41 of ___

Form SCS- 343a

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GRAIN SIZE DISTRIBUTION GRAPH

Project BROOKEND CREEK Location SITE PA-163

FINES | SAND | GRAVEL

DESIGN DATA for 250.1 1"

Sieve No.	% Passing
1"	100
3/4"	94
1/2"	89
3/8"	85
#4	80
#10	77
#20	74
#40	70
#60	60
#140	40
#200	35
0.05	28
0.02	22
0.005	11
0.002	7

U.S. Standard Sieve Size

DH 205.1
100% Passing
1" Sieve

IN-PLACE CORE
TRENCH MATERIAL
100% PASSING 1-INCH
SIEVE

Percent Finer by Dry Weight

Grain Size in Millimeters

Sheet No. 5 of

GPO 921843

Sht. 5 of 6

PENNA DOT — BROOKHEAD

5-2-74 — PA-463

E & F - DRAIN DESIGN — 42

CONCLUSIONS from LABORATY GRADATIONS ON IN-PLACE Core Trench backfill and Core Trench Drainfill.

Gradations of in-place SM Sample Taken in Core Trench closely resembles the SM Samples shown in the Lab Report (SM Lab) - the local lab classified the material as a yellow brown, silty Sand with Some gravel - SM - , LL-0, PI-nonplastic.
The material, as installed, showed no signs of piping into the filter material.

The filter material, both Samples, falls nicely within the gradation limits as shown on the drawings - There is so little variance in the 2 returned, that, for all purposes, it can be assumed that no piping has taken place - this is not to say that at some future date it won't occur at some later date.

RECOMMENDATIONS

1. Install remainder of drainage system with the Penn-Dot Type 1B Coarse Aggregate as specified on drawings.

2. In the interest of obtaining a higher Kvalue drain material, any additional drains installed could be of a Penn Dot #2A or #2B material which would give a 25,000± Kvalue - This material would allow the drain sizes to be proportioned smaller and thereby a savings of some unknown amount of dollars spent on the drain system.