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OHIO RIVER BASIN

CALVIN CLARK RUN, MERCER COUNTY

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PENNSYLVANIA



LITTLE SHENANGO DAM

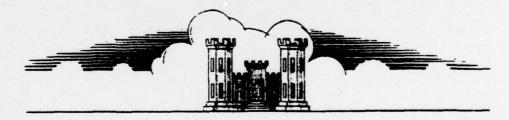
(PA 490)

NDI No. PA 00246 PennDER No. 43-54

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# PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM



prepared for

# **DEPARTMENT OF THE ARMY**

**Baltimore District, Corps of Engineers** 

Baltimore, Maryland 21203

prepared by

MICHAEL BAKER, JR., INC.

Consulting Engineers 4301 Dutch Ridge Road Beaver, Pennsylvania 15009

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#### OHIO RIVER BASIN

LITTLE SHENANGO DAM (PA 490)
MERCER COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI NO. PA 00246
PennDER NO. 43-54

National Dam Inspection Program, Little Shenango Dam (NDI ID Number PA-99246, PennDER Number 43-54), Ohio River Basin, Calvin Clark Run, Mercer County, Pennsylvania, Phase I Inspection Report,

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM

1) Apr 71 ( 15) DACW31-79-C-BAIL/
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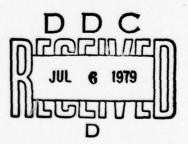
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Date:

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## PREFACE

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

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

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

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

## PHASE I REPORT NATIONAL DAM INSPECTION PROGRAM

Little Shenango Dam (PA 490), Mercer County, Pennsylvania NDI No. PA 00246, PennDER No. 43-54 Calvin Clark Run Inspected 6 December 1978

# ASSESSMENT OF GENERAL CONDITIONS

Little Shenango Dam (PA 490) is a homogeneous earth floodwater retarding dam designed by the U.S. Department of Agriculture, Soil Conservation Service. The dam has a crest length of 430 feet, a maximum height of 45 feet, a storage volume of 472 acre-feet at spillway crest level, and a storage volume of 19 acre-feet at normal pool level.

The dam was found to be in generally poor condition at the time of inspection. The inspection did disclose potential problems with seepage and piping in the dam embankment and abutments. A detailed engineering investigation of seepage, piping, erosion, and structural stability of the dam should be initiated as expeditiously as possible. Items to be included in the investigation include:

- Nature and extent of glacial soil deposits at the dam site.
- 2) Local patterns of natural groundwater flow.
- 3) Locations and extents of silt and fine sand zones in the dam embankment and abutments.
- 4) Locations and extents of piping (internal erosion) conduits in the dam embankments and abutments.
- 5) Seepage patterns in the dam embankment.
- 6) Condition and efficacy of granular drains in the dam foundation and abutments.
- 7) Erosion potential and safety of the silty knoll at the right abutment of the emergency spillway during flood flows.
- 8) Installation of properly bedded riprap at the downstream end of the emergency spillway to prevent erosion from surface runoff.

This investigation should develop recommendations for remedial work as necessary.

Additional items to be performed by the owner include:

- Cleaning of animal guards on outlets of the three dam foundation and abutment drainpipes.
- Removal of debris from the trash rack of the lowlevel orifice inlet in the riser structure and from the pond perimeter.
- Development of emergency operation and evacuation procedures.
- 4) Development of operational and maintenance procedures.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District, Corps of Engineers, for Phase I Inspection Reports, revealed that the spillway will pass the Probable Maximum Flood (PMF) without overtopping the dam. The spillway is therefore considered "adequate."

Submitted by:

MICHAEL BAKER, JR., INC.

C. Y. Chen, Ph.D., P.E. Engineering Manager-Geotechnical

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Date: 5 April 1979

Approved by:

CHUAN YUAN CHEN

No. 14840-E

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

G. K. WITHERS

Colonel, Corps of Engineers

District Engineer

Date: 22 Apr 79



LITTLE SHENANGO DAM

# TABLE OF CONTENTS

Page

Section Section Section Section Section	3 4 5 6	- Project Information - Engineering Data - Visual Inspection - Operational Procedures - Hydraulic/Hydrologic - Structural Stability - Assessment, Recommendations/Remedial Measures
		PLATES
Plate 1	_	Location Plan
		Watershed Map
		Plan of Structural Works
		(Drawing No. PA-490-P, Sheet 3 of 20,
		U.S. Department of Agriculture, Soil
		Conservation Service, "As Built," 1971)
Plate 4	-	Fill Placement
		(Drawing No. PA-490-P, Sheet 4 of 20,
		U.S. Department of Agriculture, Soil
77-4- 5		Conservation Service, "As Built," 1971)
riate 5	-	Principal Spillway
		(Drawing No. PA-490-P, Sheet 5 of 20, U.S. Department of Agriculture, Soil
		Conservation Service, "As Built," 1971)
Plate 6	_	Spillway Excavation
		(Drawing No. PA-490-P, Sheet 6 of 20,
		U.S. Department of Agriculture, Soil
		Conservation Service, "As Built," 1971)
Plate 7	-	Cut-Off Trench Details
		(Drawing No. PA-490-P, Sheet 7 of 20,
		U.S. Department of Agriculture, Soil
n1-+- 0		Conservation Service, "As Built," 1971)
Place 8	-	Drainage Details
		(Drawing No. PA-490-P, Sheet 8 of 20,
		U.S. Department of Agriculture, Soil
		Conservation Service, "As Built," 1971)

# APPENDICES

Appendix	A	-	Check List - Visual Inspection and Field Sketch	
Appendix	В	-	Check List - Engineering Data	
			Photographs	
			Hydrologic and Hydraulic Computation	ns
			Regional Geology	

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM LITTLE SHANANGO DAM (PA 490) NDI NO. PA 00246, PennDER No. 43-54

## SECTION 1 - PROJECT INFORMATION

## 1.1 GENERAL

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

# 1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Little Shenango Dam, a floodwater retarding dam designed by the U.S. Department of Agriculture, Soil Conservation Service (SCS), is also known by its SCS number PA 490. The homogeneous earth embankment has a crest length of 430 feet and a maximum height of 45 feet (Plate 4). The dam crest at El. 1192.6 feet has a width of 16 feet. The upstream slope has an inclination of 3H:lV (horizontal: vertical) and the downstream slope has an inclination of 2H:lV. The upstream slope has a 6-foot wide berm at El. 1162 feet, a 4-foot wide berm at El. 1159 feet, and riprap between these two berms for slope protection at normal pool level (El. 1160 feet).

A foundation cutoff trench was constructed with a base width of 12 feet, 1H:1V side slopes, a length of about 100 feet, and a maximum depth of about 10 feet to glacial till or bedrock (Plates 4, 6, and 7). Cutoff trenches of similar cross-section were also constructed to shallower depths in the abutments (Plate 7).

A 4-foot wide foundation drain trench containing granular material was installed to a maximum depth of about 8 feet beneath the downstream toe of the dam (Plates 4 and 8). Sections of this trench in the valley bottom contain 12-inch diameter perforated corrugated metal collector pipes which discharge from the sides of the reinforced concrete outlet

structure at the downstream toe of the dam (Plate 8). Toe drains of granular material and rockfill were provided along portions of the contacts of the downstream slope with both abutments (Plate 8). The right (west) abutment drain has a 4-inch diameter plastic pipe leading to a 6-inch diameter bituminous coated corrugated metal pipe which discharges in the right (west) side of the outlet channel about 25 feet downstream from the outlet structure. The outlets of the two 12-inch and one 6-inch drainpipes have small animal guards.

The outlet works (principal spillway in SCS terminology) consist of a reinforced concrete riser connected to a 30-inch diameter reinforced concrete pipe which is approximately 208 feet long (Plate 5). This outlet pipe located beneath the embankment in the valley bottom (Plate 3) has a concrete cradle and seven reinforced concrete anti-seep collars (Plates 5 and 6). The downstream end of the outlet pipe with invert El. 1144 feet discharges into a reinforced concrete impact basin (Plates 3, 5, and 6). The 12-foot wide outlet channel is paved with riprap for a distance of about 25 feet downstream from the impact basin. Further downstream, the outlet channel extends through dense, well graded glacial till.

The reinforced concrete riser unit is a two stage drop-inlet structure about 30 feet high. It has an overflow weir with trash rack and anti-vortex device at El. 1177 feet and a low-level inlet consisting of a 1.0- by 3.25-foot orifice at El. 1160 feet (Plate 5). Normal pool level is controlled by this low-level inlet. At normal pool El. 1160 feet, the pond, which was designed to provide storage for 50 years of sediment accumulation, has a surface area of 4.1 acres and a volume of about 19 acre-feet. A pond drain consisting of 34 feet of 21-inch diameter iron or steel pipe extends upstream from the riser unit (Plate 5). According to Mr. James Mondok of the Mercer County Conservation District, this pipe has a steel plate bolted on its inlet end.

The spillway (emergency spillway in SCS terminology) consists of a vegetated earth channel in the left (east) abutment (Plates 3, 6, and 7). This channel has a centerline length of about 320 feet, a base width of 235 feet, and 3H:1V side slopes. The control section of the spillway is at El. 1186 feet (Plates 3 and 6); this is some 6.6 feet below the

embankment crest level. The spillway crest level was selected by routing runoff from a storm with a 100-year recurrence interval and 6 hour duration through the reservoir with maximum conduit outflow of 114 c.f.s. At the spillway crest level, the total volume of floodwater storage is 472 acrefeet. The spillway discharges down the left (east) stream bank about 100 feet downstream from the dam (Plate 3).

The dam is located in an area of complex glacial soil deposits (Appendix E). Boring and test pit information obtained by the SCS, geologic information presented in the references listed in Appendix E, and field observations during dam inspection yield the following simplified description of site geology and soil conditions.

Both abutments consist of kame or kame terrace deposits overlying glacial till and/or bedrock. The valley bottom has recent alluvium and/or glacial outwash overlying glacial till which in turn overlies bedrock. The top of sandstone bedrock is at about El. 1144 feet in the valley bottom beneath the upstream toe of the dam and the top of shale bedrock is at about El. 1134 feet in the valley bottom beneath the dam axis. No bedrock was encountered in a boring extending to El. 1126 feet in the valley bottom about 40 feet downstream from the downstream toe of the dam, but the boring log indicates that bedrock was not far below this elevation. This limited boring information therefore suggests a buried valley segment beneath the downstream portion of the dam.

The spillway was excavated in kame terrace deposits along the left abutment. These deposits consist of partially water sorted silts, sands, and gravels. Subsurface information (Plates 6 and 7) and field observations indicate an abundance of silts and silty sands in this area from which most of the borrow material used in dam construction was obtained. No bedrock was encountered in a boring extending to El. 1179 feet in the spillway or in a boring extending to El. 1153 feet in the left abutment, but sandstone bedrock was encountered at El. 1167+ feet in two borings in the right abutment (Plate 7). These limited boring data, plus topographic information and field observations, indicate a much greater extent of glacial soil deposits on the left abutment than on the right abutment.

Relatively pervious glacial soil deposits on uplands along both sides of Calvin Clark Run function as groundwater recharge areas. This is particularly true for the area of kame and kettle topography east and northeast of the dam site (Plate 1). Calvin Clark Run loops through this area at El. 1180 feet to El. 1250 feet. It is highly probable that groundwater recharge from this reach of the stream is a significant contributor to the extensive spring flow observed on both valley walls at the dam site. Infiltration of surface water, particularly in kettle-type depressions on the hilltop east of the dam (Plate 1), contributes to groundwater discharge on the left (east) side of the valley. Surface water infiltration in the upland west of the dam site contributes to groundwater discharge on the right (west) side of the valley.

The groundwater flow patterns described above, plus the silty nature of the kame-type glacial soil deposits in the dam abutments and dam embankment, give rise to situations favorable for the development of piping, i.e., internal erosion of fine soil particles, irrespective of pool levels behind the dam. Field observations indicated this to be true, as described in later sections of this report.

- b. Location - Little Shenango Dam is located on Calvin Clark Run about 1000 feet upstream (north) from its confluence with the Little Shenango River in Perry Township, Mercer County, Pennsylvania (Plate 1). The dam is about 0.75 mile north of the village of Clarks Mills which is situated on the southwest bank of the Little Shenango River upstream from the confluence of Calvin Clark Run. Normal access to the dam is via an unpaved secondary road extending northerly from Clarks Mills across the Little Shenango River. During periods of high flood flows, access to the dam may be necessary via a route from the north or west of the dam. Clarks Mills is located on Pa. Route 358 about 1.5 miles east of Interstate Route 79.
- c. <u>Size Classification</u> The maximum height of the dam is 45 feet and the reservoir volume to the dam crest is 790 acre-feet. The dam is therefore in the "Intermediate" size category.

- d. Hazard Classification As discussed in more detail in paragraph 3.1.d., failure of Little Shenango Dam might result in damage to a feed mill and several houses, plus loss of "more than a few" lives. The dam is therefore considered to be in the "High" hazard category.
- e. Ownership The dam is owned by the Mercer County Commissioners, Mercer County Courthouse, Mercer, Pennsylvania 16137.
- f. <u>Purpose of Dam</u> The dam is used for floodwater detention.
- Design and Construction History Little Shenango g. Dam was designed by the SCS under the authority of the Watershed Protection and Flood Prevention Act, Public Law 566, as amended. The dam was constructed by Kirila Contractors, Inc. of Brookfield, Ohio from May 1970 through May 1971. No work except for some spillway excavation was done over the winter from mid-November 1970 through mid-April 1971. According to Mr. James Mondok of the Mercer County Conservation District, three small slides with a total breadth of about 75 feet occurred in the excavated slope on the left (east) side of the spillway soon after the dam was constructed. These slides were repaired and drainage measures were installed in 1973. No other problems have occurred in this area since this remedial work was done.
- Normal Operational Procedures The pond is typically maintained at the low-level inlet of the riser structure, El. 1160 feet. There has reportedly been no major flood since the dam was constructed. According to Mr. Mondok, the maximum pool of record was probably near the top of the straight portion of the riser structure, El. 1170+ feet. Operational information is scanty as the dam is in a somewhat remote location, has no operating equipment, and is only occasionally visited by Mercer County or SCS personnel. Mercer County and SCS personnel inspect the dam each year according to procedures for annual inspections of SCS dams of this type. Copies of all annual inspection reports are available in the Mercer office of the SCS and copies of most annual inspection reports are available in the files of the Pennsylvania Department of Environmental Resources (PennDER). Routine maintenance of the dam and spillway is performed as necessary by Mercer County personnel.

## 1.3 PERTINENT DATA

- a. <u>Drainage Area</u> The drainage area of Little Shenango Dam is 2100 acres or 3.29 square miles.
- b. <u>Discharge at Dam Site</u> The maximum discharge at the dam site is not available.
- c. <u>Elevation [feet above Mean Sea Level (M.S.L.)]</u> -

Design Top of Dam -	1192.6
Maximum Design Pool -	1190.4
Riser Crest -	1177.0
Emergency Spillway Crest -	1186.0
Normal Pool -	1160.0
Streambed at Centerline of Dam -	1147+
Maximum Tailwater -	N.A.

## d. Reservoir (feet) -

Length	of	Maximum Pool -	3700
Length	of	Normal Pool -	1000

# e. Storage (acre-feet) -

Top of Dam (El. 1192.6 ft.) -	790
Maximum Pool (El. 1190.4 ft.) -	680
Spillway Crest (El. 1186.0 ft.) -	472
Normal Pool (El. 1160.0 ft.) -	19

# f. Reservoir Surface (acres) -

Spillway	Crest	(El. 1	186	ft.)	-	37.5
Normal Po			-			4.1

## g. Dam -

Type - Homogeneous earth embankment containing 54,200 c.y. of fill

Length (feet) -	430
Maximum Height (feet) -	45
Crest Width (feet) -	16
Side Slopes - Upstream -	3H:1V
Downstream -	2H:1V

Cutoff - Compacted earth with 12-foot base width in foundation and lower abutments.

Drains - Foundation drain trench with granular material and 12-inch diameter perforated corrugated metal collector pipes in valley bottom; toe drains of granular material and rockfill along portions of downstream slope junctions with both abutments.

- h. <u>Diversion and Regulating Tunnel</u> None
- i. Spillway -

Type - vegetated earth channel in left abutment Length (feet along centerline) -320 Base Width (feet) -235 Side Slopes -3H:1V Crest Elevation (feet M.S.L.) -1186 Gates -None Downstream Channel - Slightly meandering stream channel about 20 feet wide in floodplain about 200 feet wide extends 1000 feet downstream to Little Shenango River.

j. Regulating Outlets - Reinforced concrete riser structure connected to 30-inch diameter reinforced concrete outlet pipe beneath the dam has overflow weir at El. 1177 feet and low-level orifice inlet at El. 1160 feet. The downstream end of the outlet pipe has invert El. 1144 feet.

#### SECTION 2 - ENGINEERING DATA

## 2.1 DESIGN

0

Little Shenango Dam was designed by the SCS according to its standard practice for structures of this type, circa 1960. Design data included in this report were obtained from:

- 1) SCS Drawings No. PA-490-P, "Little Shenango River Watershed, Floodwater Retarding Dam PA 490, Mercer County, Pennsylvania," 20 sheets Designed 1967, "As Built" 1971; 1 Sheet (Bronze Plaque and Monument) Designed and "As Built" 1971. (Copies of Sheets 3-8 are included in this report as Plates 3-8; prints of other sheets are available in PennDER files.)
- "Little Shenango River Watershed Work Plan," report prepared by Mercer County Soil Conservation District, et al., April 1963 (copy in file of Mercer office of SCS).
- 3) Dam Permit Application Report prepared by the Pennsylvania Department of Forests and Waters (predecessor of PennDER) on 5 April 1968.
- "Design Report, Site PA-490, Pennsylvania," U.S. Department of Agriculture, Soil Conservation Service, undated (copy in file of Harrisburg office of SCS).

# 2.2 CONSTRUCTION

Chronological information on construction of Little Shenango Dam was summarized in paragraph 1.2.g. and additional information is given below. This information was obtained from the files of PennDER and the Mercer office of the SCS. The SCS provided essentially fulltime inspection of dam construction. Semi-monthly construction progress reports prepared by SCS personnel are available in PennDER files. A representative of the Pennsylvania Department of Forests and Waters (now PennDER) made periodic visits to the dam during construction. Memoranda, and black and white photographs of construction progress are also available in PennDER files. SCS "as built" drawings for the dam are available in PennDER files as noted in paragraph 2.1 and several of these drawings are included as Plates 3-8 of this report.

Kirila Contractors, Inc. of Brookfield, Ohio began clearing, grubbing, and foundation excavation for the dam in late May 1970. The riser, outlet conduit, and outlet structure were constructed and the embankment was completed to within about 10 feet of finished grade during the Summer and Autumn of 1970. Construction proceeded relatively slowly throughout this period due to rainy weather and resultant wet ground conditions. Much of the embankment borrow material excavated from the left abutment spillway was extremely wet due to rainy weather and, probably also, the groundwater conditions noted in paragraph 1.2.a.

Dam construction ceased for the winter on 13 November 1970, with the embankment fill at a height of about 35 feet. Excavation of waste material (probably wet silt) from the spillway began on 21 January 1971 when frozen ground permitted heavy equipment to operate in the area. This work continued until 17 February 1971 when operations ceased for the remainder of the winter with the spillway excavation 95 percent complete.

A memorandum in the files of the Mercer SCS office indicates that rain and snowmelt from 19-22 February 1971 produced heavy runoff with a flood crest at approximately 5 PM on 20 February 1971. The height of floodwater behind the partially completed dam is not given, but it was noted that the flood storage was 75 acre-feet and the flood pool covered approximately 10 acres. These data suggest that the flood crest was at approximately El. 1167 feet and that the maximum height of water temporarily behind the 35-foot high dam was about 20 feet. It seems unlikely that the dam sustained any damage from this minor flood.

Construction resumed on 14 April 1971 and the dam was essentially completed by 27 May 1971. Some erosion of the dam and spillway slopes occurred during heavy rains in the Summer of 1971. This erosion was repaired prior to seeding the area in late Summer to Autumn of 1971. Impoundment of water commenced in November 1971.

According to Mr. James Mondok of the Mercer County Conservation District, three small slides with a total breadth of about 75 feet occurred in the excavated slope on the left (east) side of the spillway soon after the dam was constructed. These slides were repaired and drainage measures were installed in the Summer of 1973. No other problems have occurred in this area since this remedial work was done.

# 2.3 OPERATION

Readily available information on the operation of Little Shenango Dam was summarized in paragraph 1.2.h. Most of this information was obtained from interviews with Mr. Mondok on 6-8 December 1978.

# 2.4 EVALUATION

The readily available information summarized above is considered adequate for purposes of this Phase I Inspection Report on Little Shenango Dam.

## SECTION 3 - VISUAL INSPECTION

## 3.1 FINDINGS

a. General - The dam was found to be in generally poor condition at the time of inspection. Most of the problems noted during the visual inspection are considered minor. Items requiring immediate attention are seepage and piping features observed in several locations on the upstream and downstream slopes of the dam, and along both abutment contacts with the downstream slope. A more detailed investigation of these features is recommended as discussed in Sections 6 and 7.

Significant observations made during visual inspection of Little Shenango Dam on 6 December 1978 are presented briefly in the following paragraphs. The complete visual inspection check list is included in Appendix A along with a Seepage and Piping Supplement and a field sketch of the dam.

b. Dam - Seepage and evidence of piping (internal erosion of fine soil particles) was observed at several locations in the dam embankment and its abutments. These seepage and piping areas are shown in the field sketch (Appendix A), and they are described briefly below and in detail in the Seepage and Piping Supplement.

A 3-inch diameter piping tunnel was noted at a depth of about 1 foot in silty fill on the right (west) side of the upstream slope of the dam at El. 1174+ feet. This tunnel appeared to extend horizontally some 50 feet left from the right abutment contact before turning into the embankment in an area where the fill is denser and well graded. It seems likely that this tunnel was produced by piping due to flow from springs in the right abutment as normal pool level is El. 1160 feet.

Surface water flow along the downstream right (west) side of the spillway, perhaps in combination with flow from springs in the left (east) abutment area, has produced a line of erosion gullies and piping tunnels with maximum depths of 2 to 3 feet from the downstream right side of the spillway toward the stream (El. 1180-1170+ feet). These features are in silt of glacial ice contact

(i.e., kame) origin. Minor seepage and piping indications were also observed:

- 1) Some 50 to 100 feet right (west) of the above-mentioned area in similar silt deposits lower on the downstream left (east) abutment at El. 1163+ feet.
- 2) Along the contact of the downstream slope with the right (west) abutment at El. 1172+ feet.
- 3) At several locations along the downstream toe of the dam at El. 1155-1160+.

No significant migration of fine soil particles was observed at any of these areas during the inspection but numerous "ratholes" and tunnels from a fraction of an inch to a few inches in diameter were observed.

It appears that piping features in abutment soils resulted mainly from natural groundwater flow as described in paragraph 1.2.a. Groundwater flow from the abutments probably contributed to piping indications observed in the embankment fill. Seepage from the impoundment may also have contributed to piping features observed along the downstream toe of the dam.

The two 12-inch diameter foundation drainpipe outlets and the one 6-inch diameter abutment drainpipe outlet (Plate 8) were all trickling clear water at the time of inspection and appeared to be functioning properly. However, seepage and piping features observed along the contacts of the downstream slope with both abutments (field sketch) generally correlate with the granular drains on the abutment contacts (Plate 8). The possibility of partial plugging or other malfunctioning of the granular drains in the foundation and abutments requires attention in the recommended investigation of seepage and piping features. The small animal guards on the outlets of all three drainpipes were partially plugged with moss, slime, and debris. These animal guards should be cleaned during routine maintenance in 1979.

The seepage and piping situation observed during inspection of Little Shanango Dam was not considered to require emergency action for the following reasons:

- The pool level is low and no indications of active piping were observed during the inspection.
- 2) The volume of impounded water is small-less than 20 acre-feet.
- 3) The floodwater retarding dam seldom impounds much water and the pool is drawn down fairly quickly following flood storage events.

Dr. James V. Hamel of the field inspection team discussed the situation briefly with Mr. James Mondok of the Mercer County Conservation District on 7 December 1978, and again with Mr. Mondok and Mr. Richard Crowley of the Mercer SCS office on 8 December 1978. Michael Baker, Jr., Inc. advised the Baltimore District Corps of Engineers of the situation by telephone shortly thereafter and a preliminary assessment memorandum was submitted for information purposes on 2 January 1979.

c. Appurtenant Structures - Minor to moderate seepage was observed at several locations along the toes of the excavated slopes on both sides of the spillway (field sketch), and piping features were observed in the silt along the downstream right (west) side of the spillway as noted in paragraph 3.1.b. All of these seepage and piping areas are well above normal pool level. They are attributed to natural groundwater flow from the left (east) abutment area and they are not considered detrimental to stability or operation of the spillway.

Some debris was noted on the trash rack of the low-level orifice inlet in the riser structure and other debris was noted around the pond perimeter just above normal pool level. This debris should be removed during routine maintenance in 1979.

d. Reservoir Area - The moderately steep, well vegetated, reservoir slopes consist of glacial soil deposits of ice contact (i.e., kame) origin. Most of these soils are sands and gravels, but there are local pockets and zones of silt. The reservoir slopes are quite stable from geotechnical and hydraulic standpoints.

Minor sedimentation was observed around the edges of the normal pool pond upstream from the dam. This pond acts essentially as a sediment and debris basin. The sedimentation is relatively insignificant due to watershed characteristics. The pond was designed by the SCS with allowance for a 50-year sediment storage.

Downstream Channel - The reach of Calvin Clark Run extending 1000 feet downstream from the dam to the Little Shenango River is uninhabited. An unpaved secondary road extends along the right (west) side of Calvin Clark Run to a small bridge over the Little Shenango River about 200 feet downstream (west) of the confluence of Calvin Clark Run. A feed mill is located on the left (south) bank of the Little Shenango River just east of the bridge. The only house in the immediate vicinity is located on the left (south) bank of the Little Shenango River, about 300 feet southwest of the feed mill. From the bridge near the house and feed mill, the Little Shenango River extends about 4 miles westerly through a fairly wide, uninhabited valley to the village of Hadley which has an estimated population of 500 persons, most of whom reside well above river level. The village of Clarks Mills with an estimated population of 200 persons lies about 0.5 mile southeast of the feed mill and upstream from the confluence of Calvin Clark Run. Most of Clarks Mills lies more than 10 feet above the floodplain of the Little Shenango River. Some six houses are located in the Little Shenango River valley between Calvin Clark Run and Clarks Mills. Some of these houses, plus the feed mill and the house near the feed mill, might be subjected to damage and "more than a few" lives might be lost in the event of failure of Little Shenango Dam.

#### SECTION 4 - OPERATIONAL PROCEDURES

# 4.1 PROCEDURES

Operational procedures are summarized in paragraph 1.2.h.

There are no formal emergency procedures in the event of impending catastrophe for the dam. It is understood that the condition of the dam is checked by Mercer County personnel following each occurrence of heavy precipitation. The spillway and outlet works are uncontrolled and the pond drainpipe reportedly has a steel plate bolted on its inlet (paragraph 1.2.a.). Rapid emergency drainage of the pond is therefore impossible. The time required to lower the pond from spillway crest (El. 1186 feet) to riser weir (El. 1177 feet) is estimated to be 1.4 days and the time required to lower the pond from riser weir to normal pool level at the riser orifice (El. 1160 feet) is estimated to be 3.7 days. At normal pool level, the pond storage volume is approximately 19 acre-feet. Additional emergency drawdown capability is never likely to be required. One method of draining the pond completely is pumping the water into the riser orifice.

It is recommended that a formal emergency procedure be prepared and prominently displayed, and furnished to all personnel. This should include:

- Procedures for evaluating inflow during periods of emergency operation.
- Procedures for rapid drawdown of the reservoir under emergency conditions.
- 3) Development of an emergency evacuation plan, including who to notify, for areas which will be affected in the event of a dam failure.

## 4.2 MAINTENANCE OF DAM AND APPURTENANCES

Routine maintenance is performed periodically by Mercer County personnel as noted in paragraph 1.2.h.

### 4.3 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system or procedure in the event of a dam failure. An emergency warning procedure should be developed.

# 4.4 EVALUATION OF OPERATIONAL ADEQUACY

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The nature of Little Shenango Dam and its appurtenances are such that the present operational and maintenance procedures are considered adequate pending results of the seepage, piping, and stability investigation recommended in Sections 3, 6, and 7. Results of that investigation could lead to modification of operational and maintenance procedures.

## 5.1 EVALUATION OF FEATURES

- a. Design Data Hydrologic and hydraulic design calculations for Little Shenango Reservoir were obtained from the SCS "Design Report." According to SCS criteria, the emergency spillway and freeboard hydrographs were developed and routed through the reservoir to establish the elevations of the design high water and top of dam. The emergency spillway hydrograph, with a peak discharge of 5285 c.f.s., was based on a 6-hour rainfall of 9.4 inches. The freeboard hydrograph was developed using a 6-hour rainfall of 18.7 inches, which resulted in a peak discharge of 10,180 c.f.s.
- b. Experience Data Although no detailed reservoir stage or rainfall records are available, there has reportedly been no major flood since the dam was constructed. According to Mr. James Mondok of the Mercer County Conservation District, the maximum reservoir stage has been about 10 feet above the normal pool El. 1160.0 feet.
- C. <u>Visual Observations</u> Except for minor debris located on the trash rack of the low-level inlet, no condition was observed at the time of the inspection to indicate that the spillway and outlet works could not operate satisfactorily in the event of a flood.
- d. Overtopping Potential - The Little Shenango Dam is classified as a "High" hazard-"Intermediate" size dam requiring evaluation for a spillway design flood (SDF) equal to the Probable Maximum Flood (PMF). The outlet works consist of a typical SCS concrete riser and the spillway is a vegetated earth channel. The hydrologic and hydraulic capabilities of the reservoir, outlet works, and spillway were evaluated by routing the PMF through the reservoir with the aid of the U.S. Army Corps of Engineers Flood Hydrograph Package, HEC-1. The PMF hydrograph developed as a part of this analysis had a peak discharge of 3829 c.f.s. based on a peak 6-hour rainfall of 27.1 inches. The results of the flood routing indicate that the reservoir, outlet works, and spillway are capable of passing the PMF with a maximum reservoir level of El. 1187.7 feet, which is about 4.9 feet below the minimum top of dam El. 1192.6 feet.

e. Spillway Adequacy - The dam, as outlined in the above analysis, is capable of passing the PMF without overtopping. Therefore, the spillway is "adequate" according to the recommended criteria.

The hydrologic determinations presented in this Phase I Inspection Report are based on the use of a Snyder's unit hydrograph developed by the U.S. Army Corps of Engineers. Due to the limited number of gaging stations available in this hydrologic region and the wide variation of watershed slope, the Snyder's coefficients may yield results of limited accuracy for this watershed. As directed, however, a further refinement of these coefficients is beyond the scope of this Phase I Investigation.

In addition, the conclusions presented pertain to present conditions, and the effect of future development on the hydrology has not been considered.

## SECTION 6 - STRUCTURAL STABILITY

## 6.1 EVALUATION OF STRUCTURAL STABILITY

a. <u>Visual Observations</u> - Visual observations of seepage and piping features were presented in paragraph 3.1.b. and Appendix A.

It is impossible to assess from the type of visual inspection performed for this Phase I Inspection Report the extent to which observed seepage and piping features affect structural stability of the dam. As recommended in Section 7, the Mercer County Conservation District should seek engineering assistance in performing a more detailed investigation of seepage, piping, and structural stability of the dam.

b. Design and Construction Data - The dam was designed and constructed according to standard SCS procedures for structures of this type. According to the SCS "Design Report," the upstream slope of the dam has a safety factor of approximately 2.1 under rapid drawdown conditions and the downstream slope has a safety factor of approximately 1.6 under steady seepage conditions. These safety factors are of course adequate.

General experience with slopes of heights, inclinations, materials, and overall hydraulic conditions similar to those of the dam indicates that, under ordinary conditions, the dam slopes could be shown to satisfy the stability requirements of the "Recommended Guidelines for Safety Inspection of Dams." This inference is supported by SCS experience and by empirical guidelines given by the U.S. Bureau of Reclamation (1973) Design of Small Dams, 2nd edition, pp. 261-267.

Like all dams, Little Shenango Dam is unique because of site-specific geologic details. At Little Shenango Dam, critical geologic details are those related to the glacial soil deposits and groundwater flow system described in paragraph 1.2.a. These details, plus the standard SCS design and construction procedures used for the dam, have produced the localized seepage and piping features described in paragraph 3.1.b. and Appendix A. As noted in paragraph 6.1.a., a more detailed engineering investigation is necessary to evaluate structural stability of the dam.

- c. Operating Records Nothing in the readily available operating information indicates cause for concern relative to structural stability of the dam.
- d. <u>Post-Construction Changes</u> There have been no post-construction changes which would adversely affect structural stability of the dam.
- e. Seismic Stability The dam is located in Zone l on the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is an area of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions if they have adequate stability under static loading conditions. There will be no need for further consideration of seismic stability once the recommended engineering investigation shows the dam (with remedial measures, if necessary) has adequate static stability.

# 7.1 DAM ASSESSMENT

a. Safety - The dam was found to be in generally poor condition at the time of inspection. Items requiring immediate attention are the seepage and piping features observed in several locations on the upstream and downstream slopes of the dam, and along both abutment contacts with the downstream slope. It is impossible to assess from the visual inspection performed on 6 December 1978 the extent to which these seepage and piping areas may have reduced the structural stability of the dam. A more detailed investigation of seepage, piping, and structural stability is recommended.

The spillway capacity was analyzed using criteria presented in the "Recommended Guidelines for Safety Inspection of Dams" and according to procedures outlined in paragraph 5.1.d. This analysis indicates that the spillway is adequate to pass the PMF without overtopping the dam.

- b. Adequacy of Information The readily available information and the observations made during field inspection of the dam are considered sufficient for purposes of this Phase I Inspection Report.
- c. <u>Urgency</u> No urgent remedial work is required. However, procedures and personnel for the detailed investigation of seepage, piping, and structural stability should be determined as expeditiously as possible. This investigation should begin as soon as weather and field conditions permit in the Spring of 1979.
- d. Necessity for Additional Data/Evaluation As indicated above and discussed in more detail below, an investigation of seepage, piping, erosion, and structural stability should be performed.

# 7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection has revealed the existence of seepage and piping features at several locations in the dam embankment and abutments. It is recommended that the owner retain the services of a registered professional engineer experienced in the design and construction of dams; especially in regards to seepage, piping, and stability aspects of earth dams; to immediately conduct a detailed investigation of the following items.

- Nature and extent of glacial soil deposits at the dam site.
- Local patterns of natural groundwater flow.
- 3) Locations and extents of silt and fine sand zones in the dam embankment and abutments.
- 4) Locations and extents of piping (internal erosion) conduits in the dam embankments and abutments.
- 5) Seepage patterns in the dam embankment.
- 6) Condition and efficacy of granular drains in the dam foundation and abutments.
- 7) The erosion potential and safety of the silty knoll at the right abutment of the emergency spillway.
- 8) The installation of properly bedded riprap at the downstream end of the emergency spillway to prevent erosion from surface runoff.

Some of the above information can probably be determined, or at least inferred, from review of SCS records on dam design and construction. Other information in the above list can probably be developed from detailed field reconnaissance. It is likely, however, that some subsurface exploration involving test pits and perhaps borings will also be required. This investigation should develop recommendations for remedial action as necessary.

It is also recommended that a formal emergency procedure be developed soon including:

- Procedures for evaluating inflow during periods of emergency operation.
- Procedures for rapid drawdown of the reservoir under emergency conditions.
- Development of an emergency evacuation plan, including who to notify, for areas which will be inundated in the event of a flood or dam failure.

The inspection also disclosed items of lower priority which should be completed within the near future. These are:

- Cleaning of animal guards on outlets of all three dam foundation and abutment drainpipes.
- 2) Removal of debris from the trash rack of the low-level orifice inlet in the riser structure and from the pond perimeter.
- Development of operational and maintenance procedures.

PLATES

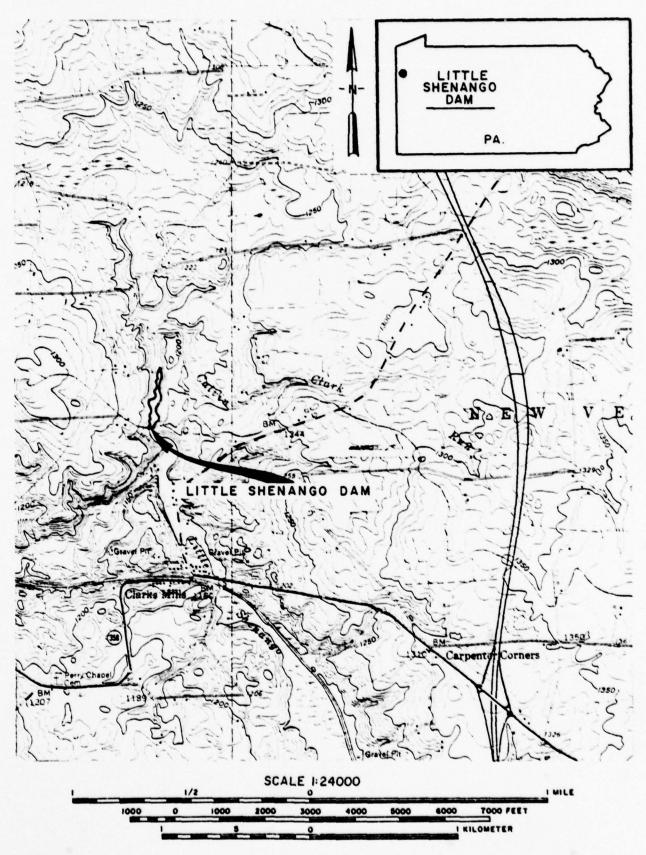


PLATE I LOCATION PLAN LITTLE SHENANGO DAM

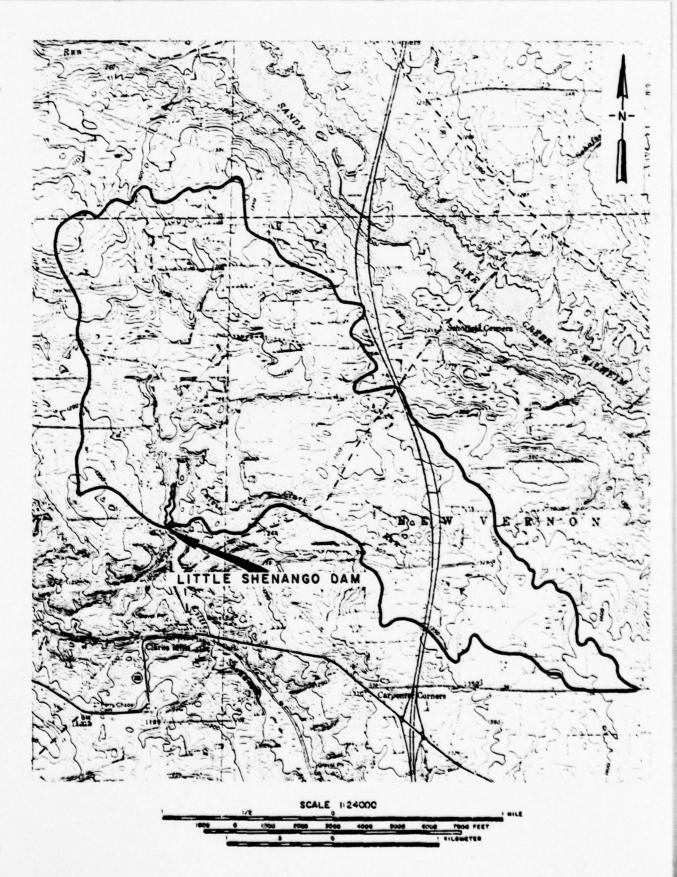
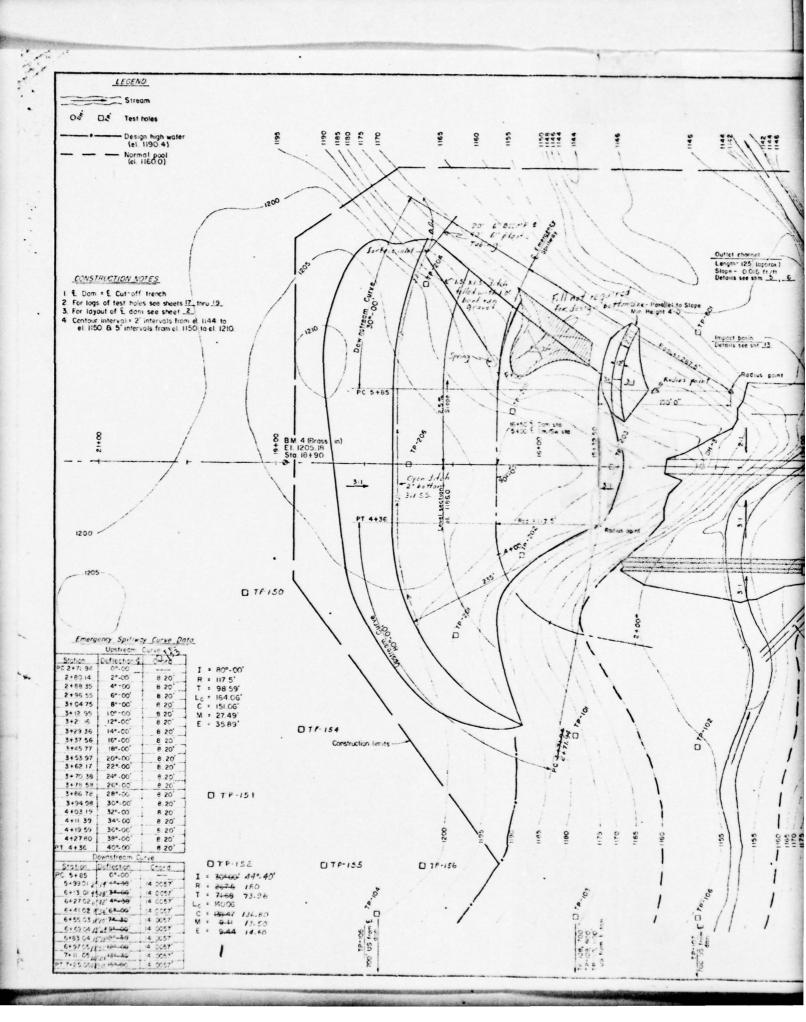
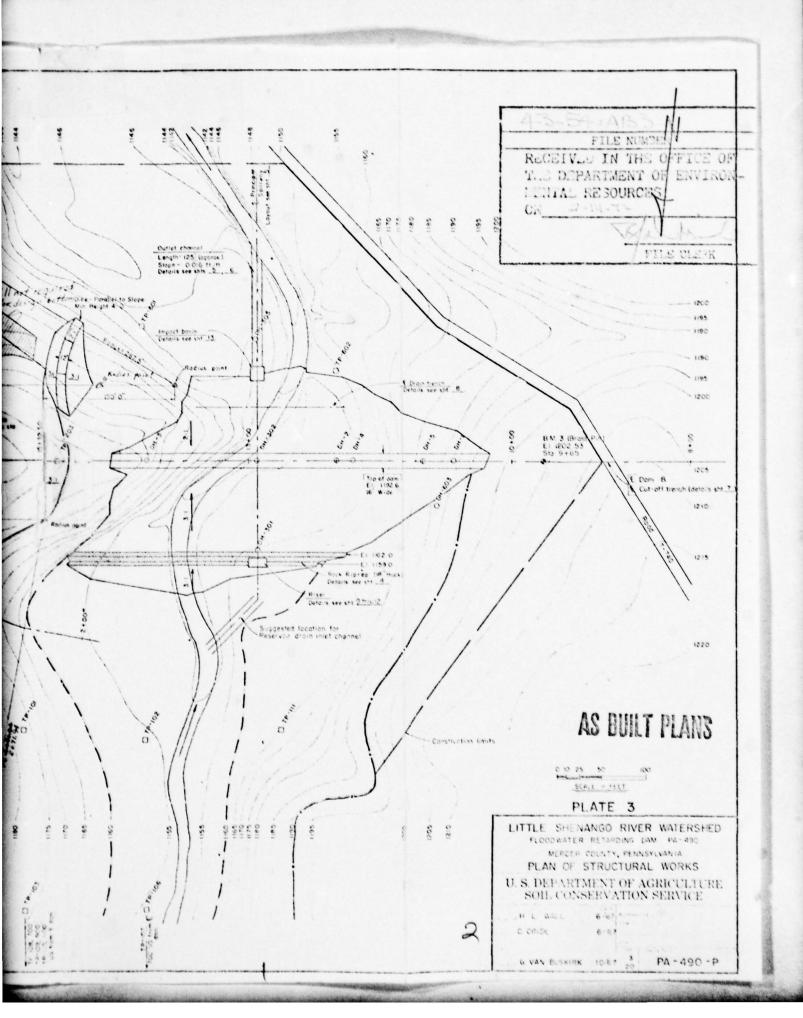
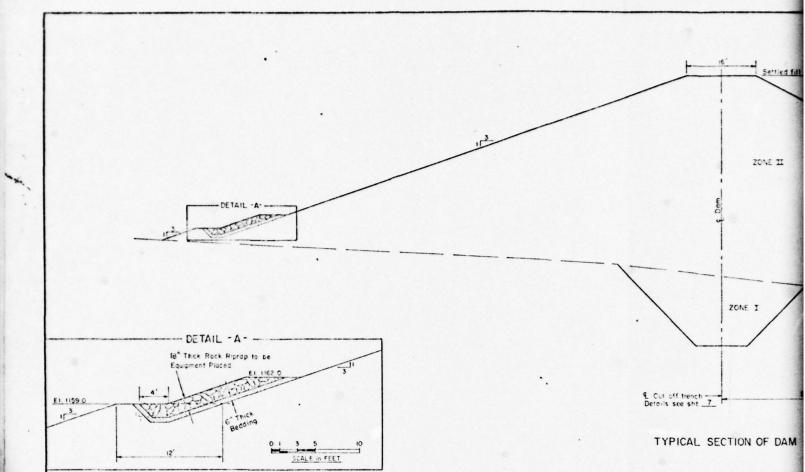


PLATE 2 WATERSHED MAP



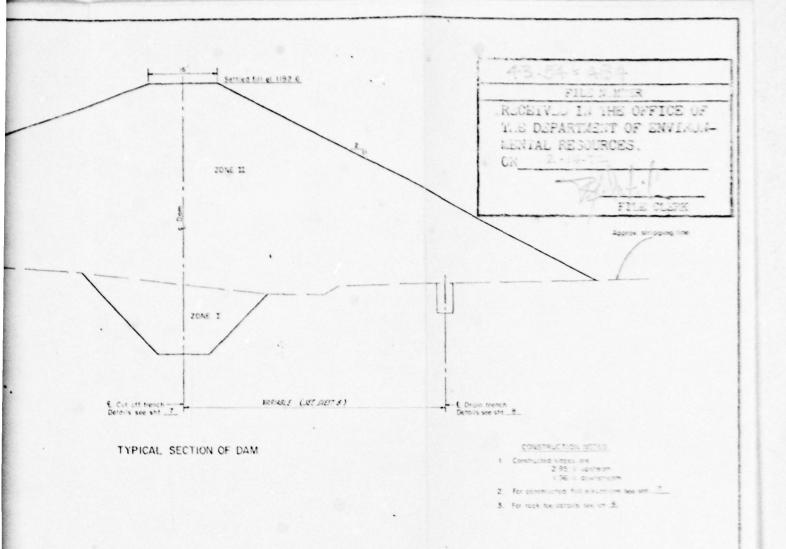




		MAX & REQ'D 2 ROCK MAX WATER			COMPACTION	
ZONE	MATERIAL	SIZE	LIFT	CONTENT	Class	Definition
1	Material as represented by TP-203, depth 10 to 9.0, classified as CL	6"	9"	Cptimum - 2% to + 1%	Α	too % Max density by ASTM D-698 Method "A"
п	Material as represented by TP - 203, depth 10'to 9.0', classified as CL and by TP - 103, Depth 10'to 8.4' classified as ML	6"	9"	00 timem 	А	95 % Max density by ASTM D-698 Method "A"

Maximum permissible lift thickness before compaction.
 Water content of fill matrix at time of compaction.

Minimum moisture content mass 2% optimum



#### AS BUILT PLANS

PLATE 4

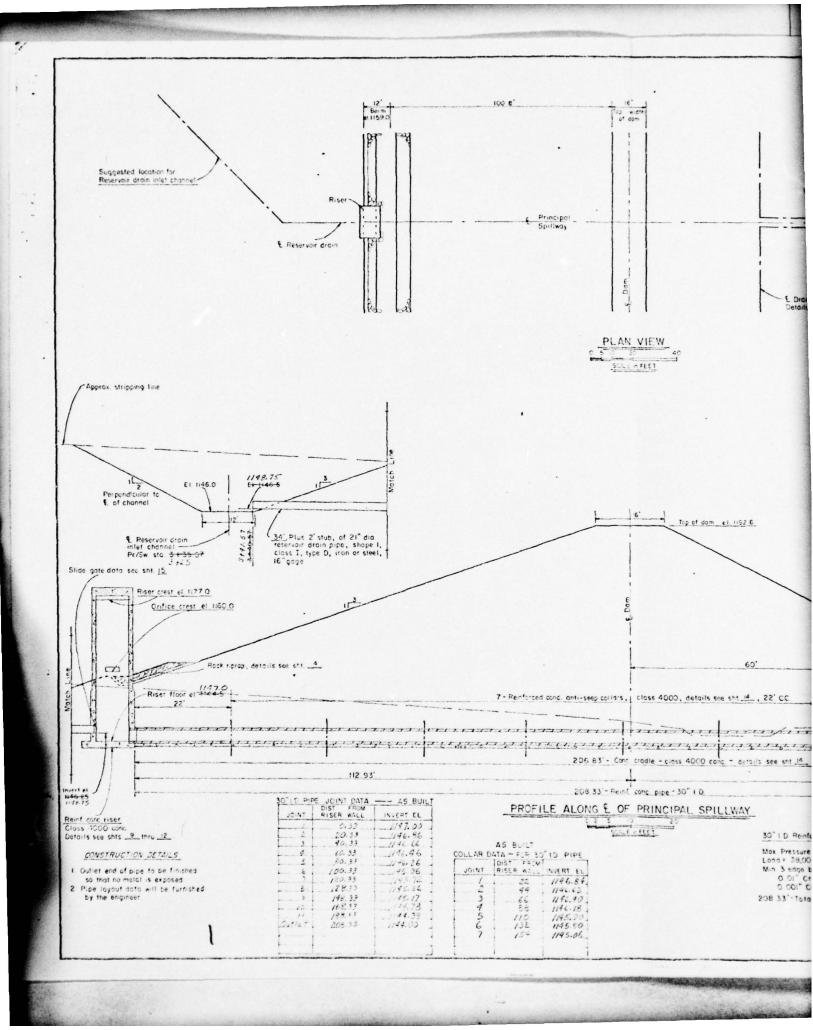
LITTLE SHENANGO RIVER WATERSHED FLOCOMATER RETIRONS DAM PR-490

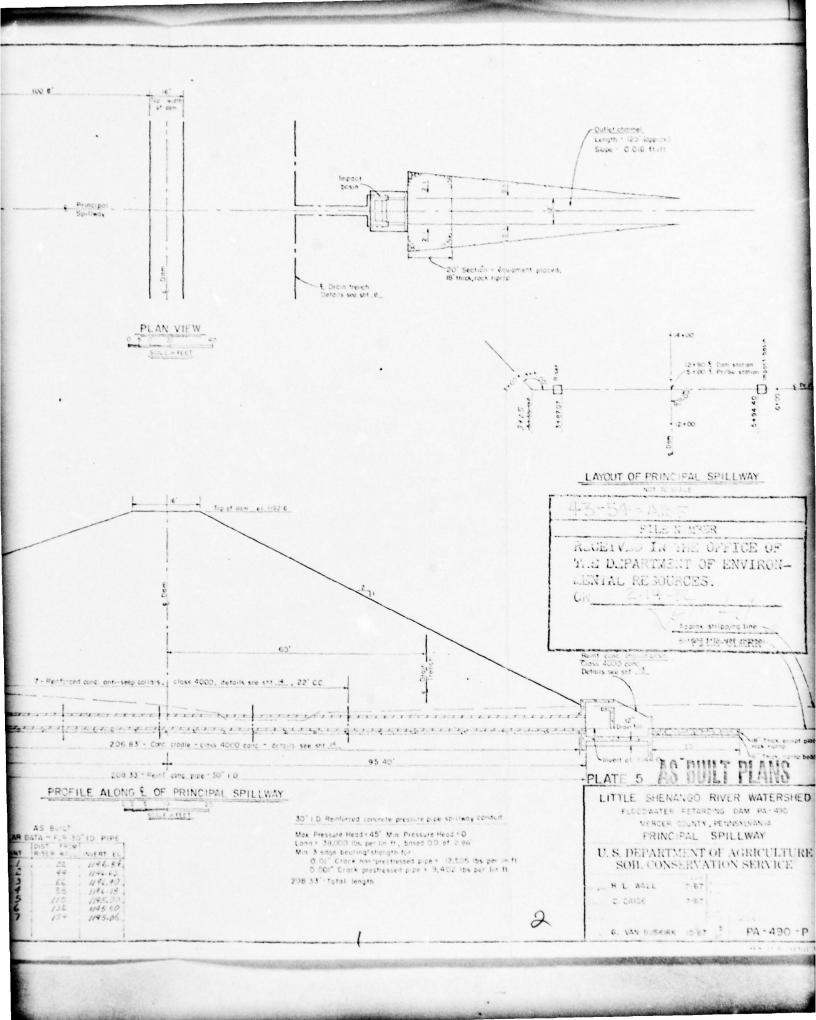
FILL PLACEMENT

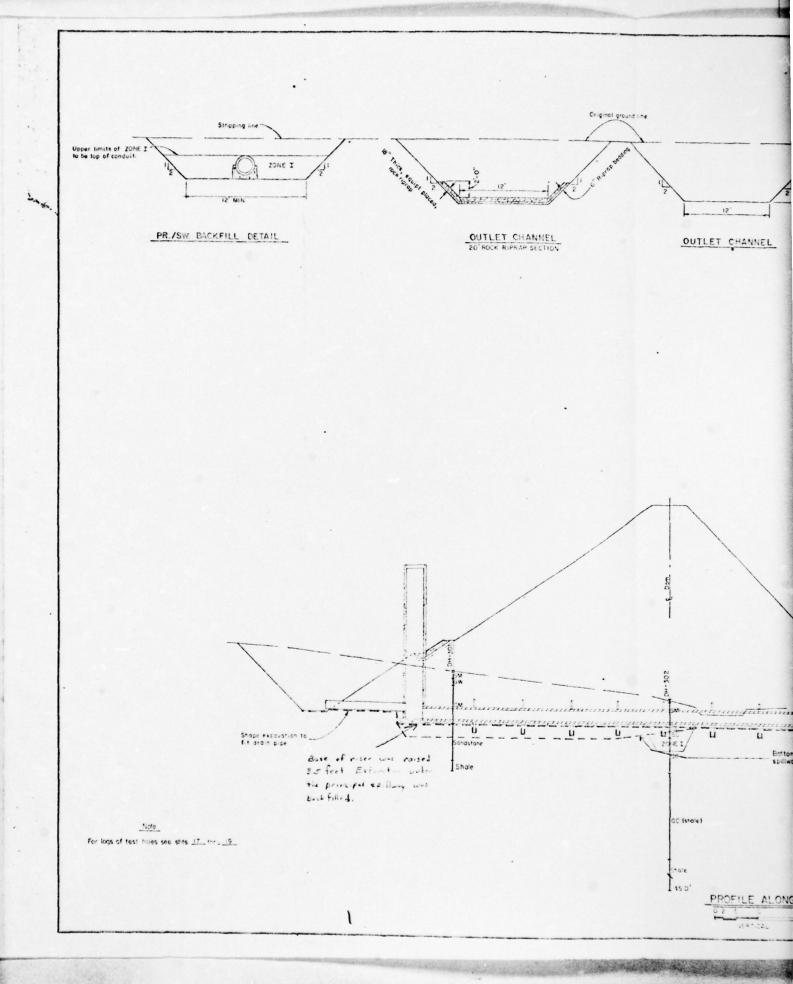
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

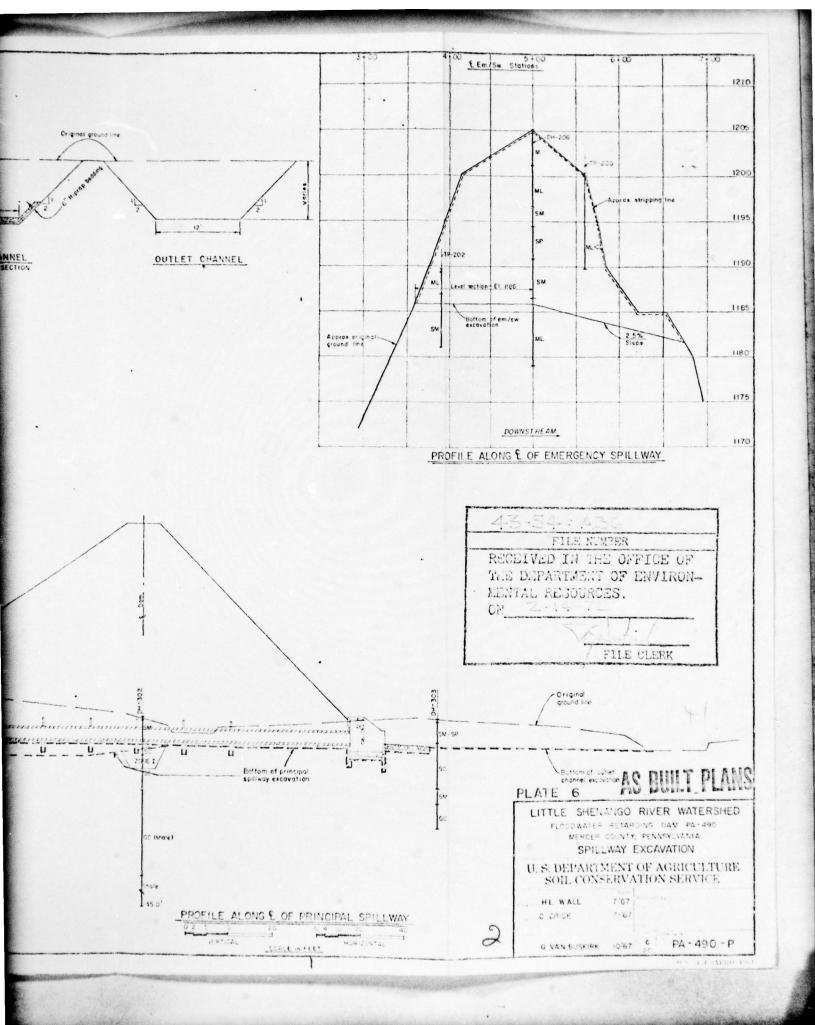
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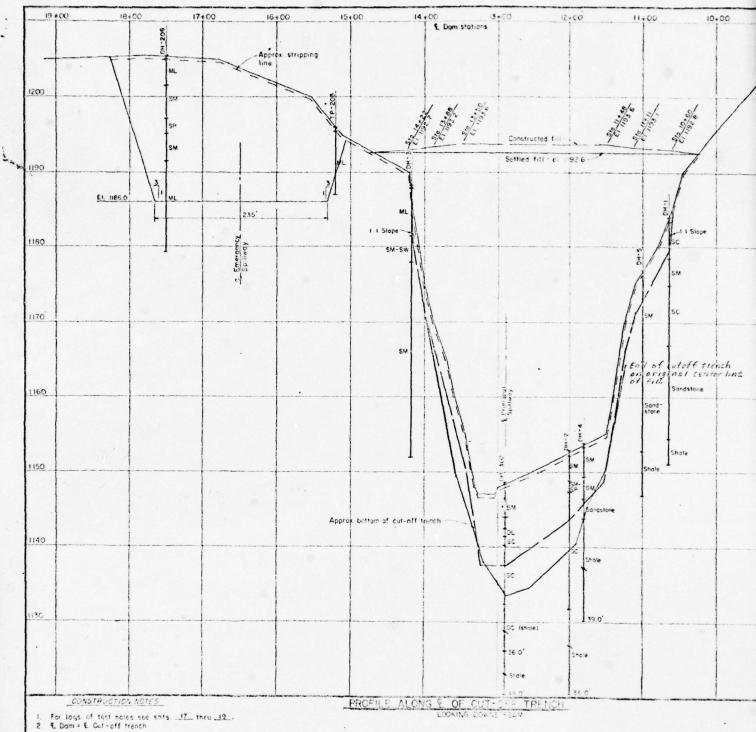
9 VAN SUSKIRK C-5" - PA -490 - P

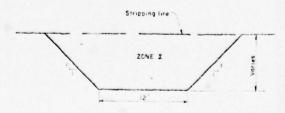




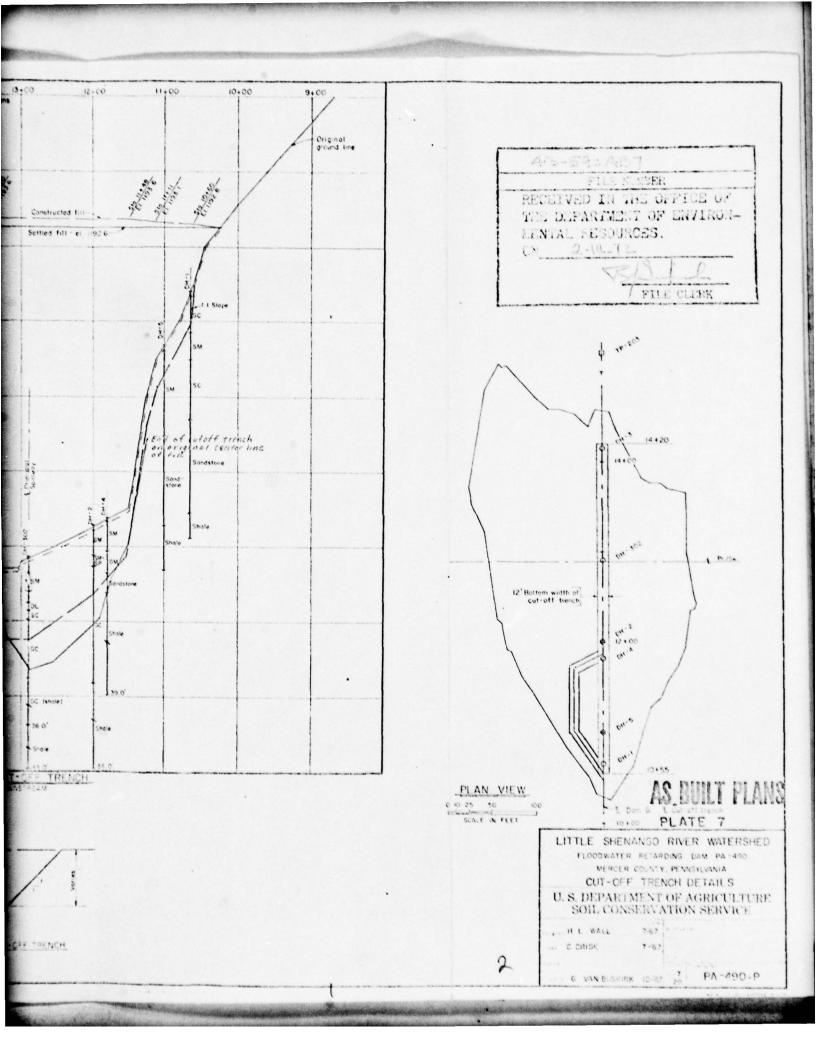


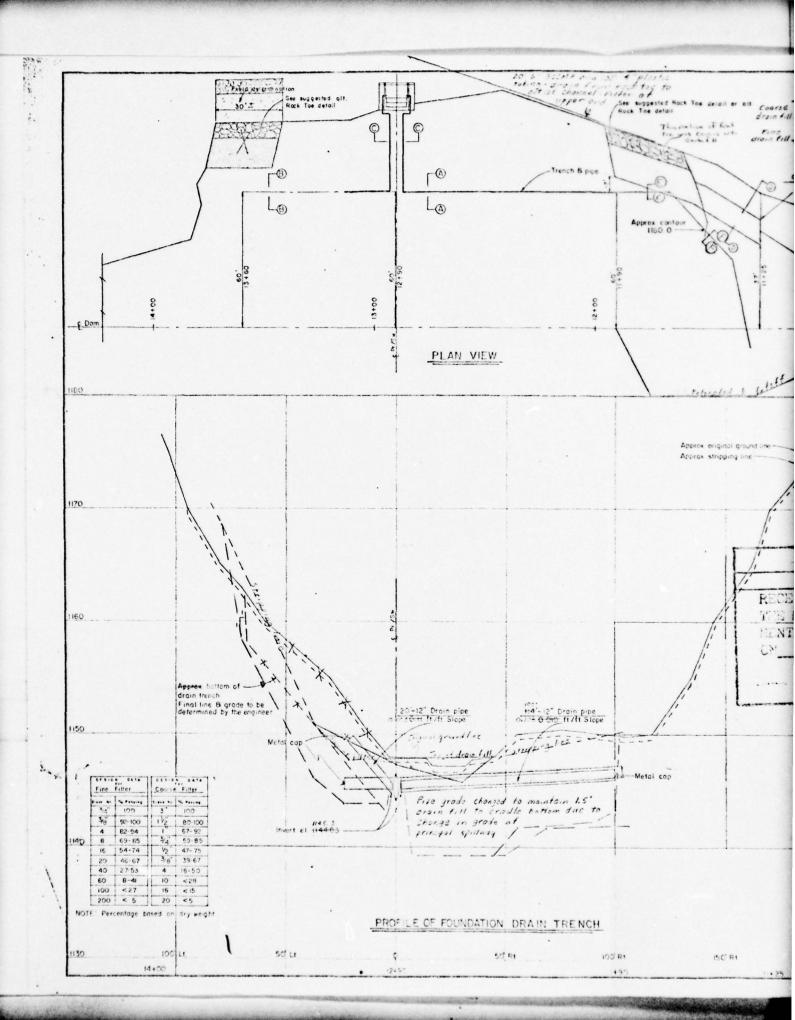


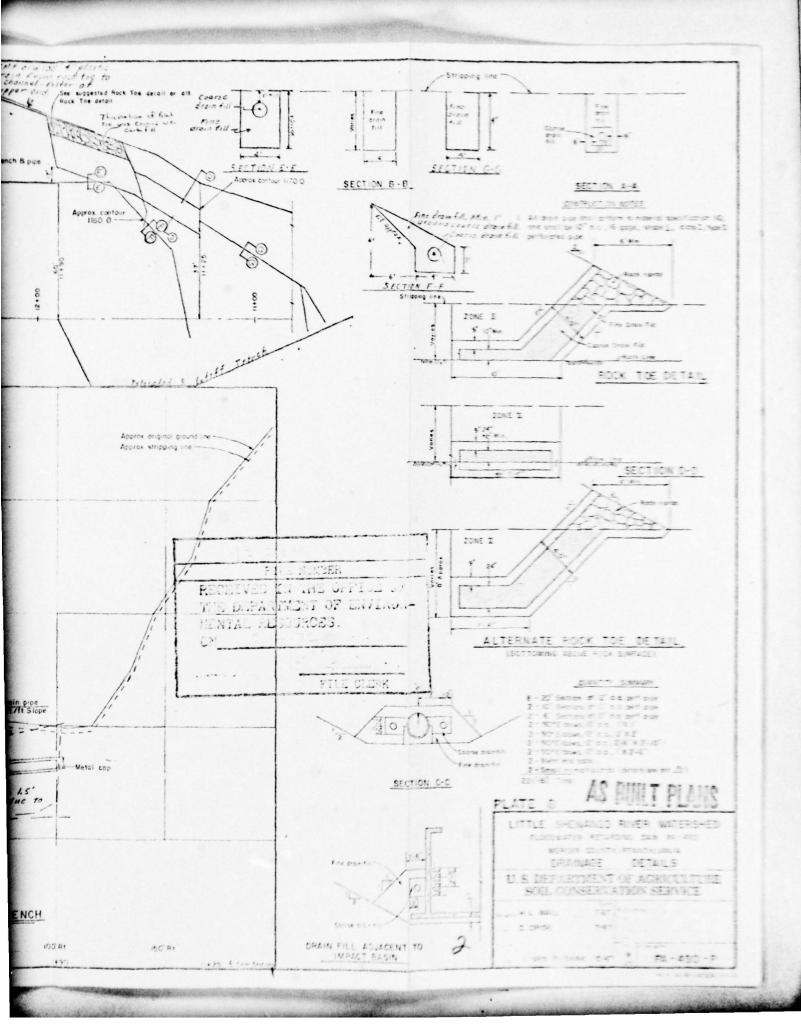




TYPICAL SECTION OF CUT-CEF THENCH







#### APPENDIX A

CHECK LIST - VISUAL INSPECTION, SEEPAGE AND PIPING SUPPLEMENT, AND FIELD SKETCH Check List Visual Inspection Phase 1

Long. W 80°11.0' Coordinates Lat. N 41°24.3' Sunny to
Date Inspection 6 Dec. 1978 Weather Partly Cloudy Temperature 30-40°F. Z State County Mercer Name of Dam LITTLE SHENANGO NDI # PA 00246 PennDER # 43-54

Pool Blevation at Time of Inspection 1160.7 ft. M.S.L. Tailwater at Time of Inspection 1144.4 ft. M.S.L.

Inspection Personnel:

Michael Baker, Jr., Inc.:
James G. Ulinski
Rodney E. Holderbaum
James V. Hamel

Owner's Representative Mercer County Conservation District:

James Mondok (part-time)

James V. Hamel

Recorder

# CONCRETE/MASONRY DAMS - Not Applicable

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	Name		-

OBSERVATIONS VISUAL EXAMINATION OF

REMARKS OR RECOMMENDATIONS

LEAKAGE

STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS

DRAINS

WATER PASSAGES

**POUNDATION** 

## CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: LITTLE SHENANGO NDI PA 00246

SURFACE CRACKS
CONCRETE SURFACES

REMARKS OR RECOMMENDATIONS OBSERVATIONS VISUAL EXAMINATION OF

STRUCTURAL CRACKING

VERTICAL AND HORIZONTAL ALIGNMENT

MONOLITH JOINTS

CONSTRUCTION JOINTS

## EMBANKMENT

Name of Dam: LITTLE SHENANGO NDI # PA 00246

VISUAL EXAMINATION OF OBSERVATIONS

SURFACE CRACKS None

None were observed.

The embankment is well vegetated with grasses and crown vetch.

REMARKS OR RECOMMENDATIONS

UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE

None were observed.

SLOUGHING OR EROSION OF NE EMBANKMENT AND ABUTMENT E SLOPES

No sloughing or surficial erosion was observed.

Trevidence of piping (internal erosion) was observed at several locations; see field sketch and attached Seepage and Piping Supplement.

Sloughing or sliding may eventually develop in seepage and piping areas along junction of downstream slope with left abutment below El. 1163± ft. (field sketch).

See attached Seepage and Piping Supplement.

VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST

No problems were observed.

RIPRAP PAILURES

None were observed.

The state of the s

The upstream slope only has riprap from El. 1159 ft. to El. 1162 ft. for wave protection at normal pool level, El. 1160 ft.

Name of Dam: LITTLE SHENANGO

NDI # PA 00246

VISUAL EXAMINATION OF

OBSERVATIONS

EMBANKMENT

REMARKS OR RECOMMENDATIONS

See attached Seepage and Piping Supplement. See attached Seepage and Piping Supplement. There is no staff gage or recorder. STAFF GAGE AND RECORDER ANY NOTICEABLE SEEPAGE JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY

DRAINS

Two 12-in. diameter toe drainpipes, with small animal guards, discharge from the outlet structure on either side of the outlet pipe. A 6-in. diameter drainpipe, with small animal guards, discharges in right (west) side of outlet channel 25 ft. downstream from outlet structure; this pipe drains the wet area along the downstream right abutment junction. All three drainpipes, which were trickling clear water at the time of inspection, appeared to be functioning properly. Some moss, slime, and debris was observed in the small animal guard on each pipe.

Moss, slime, and debris in the small animal guards at the drain outlets should be removed during routine maintenance in 1979.

Drain performance should be further evaluated in the seepage and piping investigation.

## OUTLET WORKS

LITTLE SHENANGO Name of Dam:

NDI # PA 00246

OBSERVATIONS VISUAL EXAMINATION OF

REMARKS OR RECOMMENDATIONS

CRACKING AND SPALLING OF CONCRETE SURPACES IN OUTLET CONDUIT

No problems were observed.

There was some debris on the trash rack of the low-level orifice inlet (and also around the pond perimeter just above normal pool level). INTAKE STRUCTURE

trash rack and pond perimeter during Debris should be removed from the routine maintenance in 1979.

OUTLET STRUCTURE

No problems were observed.

CHANNEL OUTLET

to El. 1150± ft. (top of outlet structure) for a distance of 25 ft. straight downstream from the outlet structure to the pre-existing channel of Calvin Clark Run. The outlet channel is riprap-lined downstream from the outlet structure. The channel was excavated with 2H:1V side slopes and a 1.6% downstream slope in dense, well An outlet channel about 100 ft. long and 12 ft. wide extends

graded glacial till with silt to cobble size particles.

The outlet channel is considered stable from geotechnical and hydraulic standpoints.

EMERGENCY GATE

The pond drain line (21-in. diameter metal pipe extending 34 ft. upstream from riser structure) reportedly has a steel plate bolted on its inlet end.

below the low-level orifice inlet in The pond cannot readfly be drained the riser structure (normal pool, El. 1160 ft.).

## UNGATED SPILLWAY

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		3	
	•	•	
•	+	5	
	į	2	

		ated		
SN	According to James Mondok, three small slides with a total breadth of 75 ft. occurred in the excavated slope on the left side of the spill-way soon after the dam was constructed. These slides were repaired and drainage measures were installed in 1973. No problems have developed since this remedial work.	Seepage along the toes of the excavated spillway slopes results from natural groundwater flow and is not considered detrimental to stability or operation of the spillway.	ping	
REMARKS OR RECOMMENDATIONS	According to James Mondok, three small slides with a total breadth of 75 ft. occurred in the excaval slope on the left side of the spiway soon after the dam was constitues slides were repaired and diage measures were installed in linemedial work.	Seepage along the toes of the spillway slopes results from natural groundwater flow and considered detrimental to state or operation of the spillway.	See attached Seepage and Piping Supplement.	
RECOMM	James with a curred e left s ter the were r were i have de	ng the topes resundwater	1 Seepag	
RKS OR	According to J small slides w of 75 ft. occu slope on the l way soon after These slides w age measures w No problems ha	age alor Iway sloral ral grou idered o	See attache Supplement.	
REMA		Seep spil natu cons or o	See Supp	
	There is no concrete weir. The spillway is a well vegetated earth channel which was excavated in glacial soils (of probable ice contact origin) in the left abutment.	Minor	and Ilway,	
	well we soils (d ment.	e 3H:1V 11way. 1V exca	n ditch the spi	
	ay is a   acia   ft abut	e of th the spi the 3H: way.	erosto	ırs.
OBSERVATIONS	e spillw ted in g n the le	g the to side of toe of he spill	duced ar stream s e.	s or pie
OBSER	There is no concrete weir. The spillway is a well veg earth channel which was excavated in glacial soils (of probable ice contact origin) in the left abutment.	Minor seepage was observed all along the toe of the 3H:1V excavated slope on the left (east) side of the spillway. Minor seepage was also observed along the toe of the 3H:1V excavated slope or the right (west) side of the spillway.	Seepage and surface runoff have produced an erosion ditch and piping tunnels along the right downstream side of the spillway, adjacent to the spillway outlet dike.	no bridges or piers.
	crete we hich was ntact or	served a he left erved al	runoff b the rig lway out	There are no
	no con lannel w	Minor seepage was observe excavated slope on the le seepage was also observed slope or the right (west)	Seepage and surface runot piping tunnels along the adjacent to the spillway	Ther
NO NO	There is sarth ch probable	seepage ited slo ge was a or the	e and successions to the tent to t	
NDI # PA 00246 VISUAL EXAMINATION OF	RIB	Minor excave seepage slope	Seepag piping adjace	BRIDGE AND PIERS
NDI # PA 00246 VISUAL EXAMINA	CONCRETE WEIR	APPROACH	DISCHARGE CHANNEL	DGE ANI
VISU	CONC	APP	DISC	BRI

Name of Dam: LITTLE SHENANGO	GATED SPILLWAY - Not Applicable	
NDI # PA 00246		
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		

APPROACH CHANNEL	
DISCHARGE CHANNEL	

No press	
BRIDGE AND PIERS	

GATES AND OPERATION
EQUIPMENT

INSTRUMENTATION - There is no instrumentation.

REMARKS OR RECOMMENDATIONS OBSERVATIONS Name of Dam: LITTLE SHENANGO
NDI # PA 00246 VISUAL EXAMINATION

OBSERVATION WELLS

MONUMENTATION/SURVEYS

WEIRS

PIEZOMETERS

OTHER

### RESERVOIR

Name of Dam: LITTLE SHENANGO

8

NDI # PA 00246

The moderately steep, well vegetated reservoir slopes consist of glacial soil deposits of ice contact (i.e., kame) origin. Most of these soils are sands and gravels, but there are local pockets and zones of silt. OBSERVATIONS VISUAL EXAMINATION OF

The reservoir slopes are quite stable from geotechnical and hydraulic standpoints.

REMARKS OR RECOMMENDATIONS

Minor sedimentation was observed around the edges of the 4 acre pond upstream from the dam. This pond acts essentially as a sediment and debris basin. SEDIMENTATION

Sedimentation is relatively insignificant due to watershed characteristics. The pond was designed by the SCS with allowance for a 50-year sediment storage.

## DOWNSTREAM CHANNEL

LITTLE SHANANGO PA 00246 Name of Dam:

OBSERVATIONS

#### VISUAL EXAMINATION OF (OBSTRUCTIONS, DEBRIS, ETC.) CONDITION

Shenango River. The slightly meandering channel has a width on the order of 20 ft. in a floodplain with a Calvin Clark Run extends from the dam approximately 1000 ft. downstream to its confluence with the Little glacial outwash, meltwater, and runoff discharged through this valley.

The reach of Calvin Clark Run from the dam to the Little Shanango River is uninhabited and essentially free of obstructions and debris.

REMARKS OR RECOMMENDATIONS

# SLOPES

The stream channel is eroded in dense, well graded glacial till. The longitudinal slope is quite flat. Channel side slopes are moderately steep. The well vegetated valley walls are steep slopes on ice contact (kame-type) soil deposits.

from geotechnical and hydraulic stand-

points.

Downstream channel slopes are stable

damage and "more than a few" lives might feet above the floodplain of the Little Most of Clarks Mills lies more than 10 plus the feed mill and the house near the feed mill, might be subjected to Shenango River. Some six houses are located in the Little Shenango River Clarks Mills. Some of these houses, valley between Clavin Clark Run and be lost in the event of failure of Little Shenango Dam.

APPROXIMATE NO. OF HOMES AND POPULATION

downstream from the confluence of Calvin Clark Run. A miles westerly through a fairly wide, uninhabited valley to the village of Hadley which has an estimated population of 500 persons, most of whom reside well The reach of Calvin Clark Run extending 1000 ft. down-(south bank of the Little Shanango River about 100 ft. above river level. The village of Clarks Mills with an estimated population of 200 persons lies about 0.5 mile southeast of the feed mill and upstream from the small bridge carries an unpaved secondary road across the river about 100 ft. downstream from the mill. Th Calvin Clark Run. From the bridge near the house and feed mill, the Little Shenango River extends about 4 stream from the dam to the Little Shanango River is uninhabited. A feed mill is located on the left 500 ft. length of road north of the bridge might be road extends along the right (west) wall of Calvin subject to inundation during heavy flood flows in Clark Run valley from the dam to the bridge. The confluence of Calvin Clark Run.

#### NDI NO. PA 00246, PennDER No. 43-54

#### SEEPAGE AND PIPING SUPPLEMENT'

During the field inspection on 6 December 1978, seepage and evidence of piping (internal erosion of fine soil particles) was observed at several locations in the dam embankment and its abutments. These seepage and piping areas are shown on the attached field sketch and they are described briefly below.

A 3-inch diameter piping tunnel was noted at a depth of about 1 foot in silty fill on the right (west) side of the upstream slope of the dam at El. 1174+ feet. This tunnel appeared to extend horizontally some 50 feet left from the right abutment contact before turning into the embankment in an area where the fill is denser and well graded. It seems likely that this tunnel was produced by piping due to flow from springs in the right abutment as normal pool level is El. 1160 feet.

Surface water flow along the downstream right (west) side of the spillway, perhaps in combination with flow from springs in the left (east) abutment area, has produced a line of erosion gullies and piping tunnels with maximum depths of 2 to 3 feet from the downstream right side of the spillway toward the stream (El. 1180-1170+ feet). These features are in silt of glacial ice contact (i.e., kame) origin. Minor seepage and piping indications were also observed (1) some 50 to 100 feet right (west) of the abovementioned area in similar silt deposits lower on the downstream left (east) abutment at El. 1163+ feet, (2) along the contact of the downstream slope with the right (west) abutment at El. 1172+ feet, and (3) at several locations along the downstream toe of the dam at El. 1155-1160+ feet. No significant migration of fine soil particles was observed at any of these areas during the inspection but numerous "ratholes" and tunnels from a fraction of an inch to a few inches in diameter were observed.

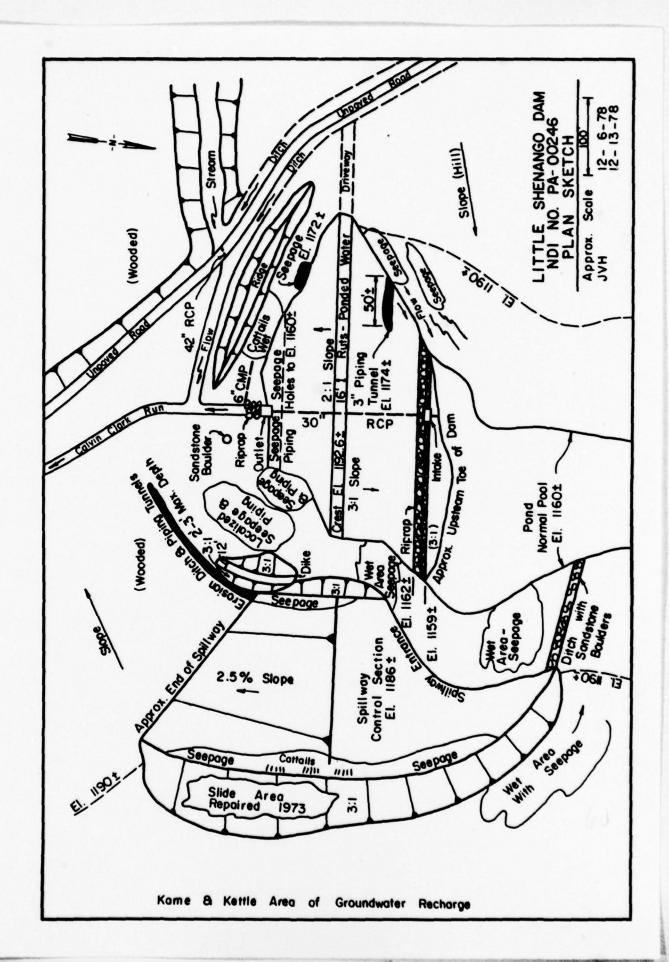
It appears that piping features in abutment soils resulted mainly from natural groundwater flow. Groundwater flow from the abutments probably contributed to piping indications observed in the embankment fill. Seepage from the impoundment may also have contributed to piping features observed along the downstream toe of the dam. The situation was not considered to require emergency action for the following reasons:

- The pool level is low and no indications of active piping were observed during the inspection.
- 2) The volume of impounded water is small--less than 20 acre-feet.
- 3) This floodwater retarding dam seldom impounds much water and the pool is drawn down fairly quickly following flood storage events.

It is recommended that a more detailed investigation of abutment, embankment, and foundation seepage and piping conditions be made as expeditiously as possible. In this investigation, particular attention should be directed to determination of (1) nature and extent of glacial soil deposits at the dam site, (2) local patterns of natural groundwater flow, (3) locations and extents of silt and find sand zones in the dam embankment and abutments, (4) locations and extents of piping (internal erosion) conduits in the dam embankment and abutments, (5) seepage patterns in the dam embankment, and (6) condition and efficacy of granular drains in the dam foundation and abutments.

12 December 1978

James V. Hamel



#### APPENDIX B

CHECK LIST - ENGINEERING DATA

## DESIGN, CONSTRUCTION, OPERATION ENGINEERING DATA

Reference Drawings: "Little Shenango River Watershed, Floodwater Retarding Dam PA-490, Mercer County, Pennsylvania," U.S. Department of Agriculture, Soil Conservation Service (SCS), "As Built" Plans, 21 sheets, 1971. (prints available in files of PennDER); Plan of Dam - Sheets 2, 3, 7, and 8. (Sheets 3, 7, and 8 included in this report as Plates 3, 7, and 8). REMARKS PLAN ITEM DAM

Reference Drawings - Sheet 1; Section of U.S.G.S. Hadley, Pennsylvania, 7.5 minute quadrangle in this report as Plate 1.

work except some spillway excavation was done over the winter from mid-November 1970 through mid-Information in the files of PennDER and in files of Mercer office of SCS indicates the dam was constructed by Kirila Contractors, Inc. of Brookfield, Ohio from May 1970 through May 1971. N CONSTRUCTION

TYPICAL SECTIONS Reference Drawings - Sheets 4-8 (included in this report as Plates 4-8).

Some hydrologic/hydraulic data are included in the "Little Shenango River Watershed Work Plan" report prepared by the Mercer County Soil Conservation District, et. al., April 1963. Other information is included in the Dam Permit Application Report prepared by the Pennsylvania Department of Forests and Waters on 5 April 1968. This report is in PennDER files. Additional data are included in the undated SCS "Design Report Site PA-490, Pennsylvania" available in files of the Harrisburg SCS office. HYDROLOGIC/ HYDRAULIC

Reference Drawings - Sheets 3 and 5 (included in this report as Plates 3 and 5). - PLAN

- DETAILS Reference Drawings Sheets 5, 6, and 9-15 (Sheets 5 and 6 included in this report as Plates 5 and 6.
- No information is readily available. CONSTRAINTS
- PennDER's Dam Permit Application Report indicates a maximum conduit outflow of 114 c.f.s. Additional information is available in the SCS "Design Report." DISCHARGE RATINGS

None were readily available. RAINFALL/RESERVOIR RECORDS

Name of Dam: LITTLE SHENANGO

ITEH

## REMARKS

The undated SCS "Design Report, State PA-490, Pennsylvania," is available in the files of the Harrisburg SCS office. Some design information is included in the "Little Shenango River Watershed Work Plan" and in PennDER's Dam Permit Application Report. DESIGN REPORTS

Geology information is included in the SCS "Design Report." Some geology information is also included in the "Little Shenango River Watershed Work Plan" and in PennDER's Dam Permit Application Report. GEOLOGY REPORTS

Design computations are included in the SCS "Design Report." HYDROLOGY & HYDRAULICS DESIGN COMPUTATIONS SEEPAGE STUDIES DAM STABILITY

Boring and test pit locations and logs are shown on Sheets 3, 6, 7, and 17-19 of the Reference Drawings. Curves from two laboratory (Standard Proctor) compaction tests on samples of borrow material are shown on Sheet 20 of the Reference Drawings. Results of several field permeability tests are given on Sheet 18 of the Reference Drawings. All available information is included in the SCS "Design Report." MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY

Annual inspections have been made from 1972 to 1978 by representatives of the Mercer County Commissioners and the SCS. Copies of all inspection reports are available in the Mercer office of the SCS and copies of most inspection reports are available in PennDER files. POST-CONSTRUCTION SURVEYS OF DAM

Kame terrace glacial soil deposits in the spillway area; Plan - Reference Brawings - Sheet 3 (included in this report as Plate 3). Boring and Test Pit Logs - Reference Brawing - Sheets 6, 7, BORROW SOURCES

Name of Dam: LITTLE SHENANGO

MONITORING SYSTEMS There are no monitoring systems

According to Mr. James Mondok of the Mercer County Conservation District, three small slides with a total breadth of 75 ft. occurred in the excavated slope on the left (east) side of the spillway soon after the dam was constructed. These slides were repaired and drainage measures were installed in 1973. No problems have developed there since this remedial work. MODIFICATIONS

No information is readily available. According to Mr. Mondok, the maximun pool of record was probably near the top of the straight portion of the riser structure, El. 1170 $\pm$  ft. HIGH POOL RECORDS

POST-CONSTRUCTION ENGINEERING Annual inspections have been made from 1972 to 1978 as noted under "POST-CONSTRUCTION STUDIES AND REPORTS STUDIES AND REPORTS

There have been no accidents or failures. PRIOR ACCIDENTS OR PAILURE OF DAM DESCRIPTION REPORTS

No maintenance or operations records are readily available. MAINTENANCE OPERATION RECORDS

Name of Dam; LITTLE SHENANGO NOI # PA 00246

Reference Drawings - Sheet 3 (included in this report as Plate 3). REMARKS SPILLMAY PLAN

ITEM

SECTIONS Reference Drawings - Sheets 6 and 7 (included in this report as Plates 6 and 7).

Reference Drawings - Sheet 3 (included in this report as Plate 3). DETAILS

OPERATING EQUIPMENT There is no operating equipment.

#### CHECK LIST HYDROLOGIC AND HYDRAULIC DATA ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 3.29 sq. mi. of well vegetated, moderately
rolling terrain covered with glacial soil
deposits
ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1160 ft. (19 acft.)
ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 186 ft. (472 acft.)
ELEVATION MAXIMUM DESIGN POOL: 1190.4 ft. (680 acft.)
ELEVATION TOP DAM: 1192.6 ft. (790 acft.)
SPILLWAY:
a. Elevation 1186 ft. (control section, emergency spillway)
b. Type Vegetated earth channel, curved in plan c. Width 235 ft.
d. Length 320 ft. (on centerline)
e. Location spillover Left abutment
f. Number and Type of Gates There are no gates.
OUTLET WORKS:
a. Type Reinforced concrete riser and 30-in. diameter reinforced
concrete outlet pipe b. Location Base of embankment near center of valley
c. Entrance inverts El. 1160 ft. (low level),
El. 1177 ft. (high level)
d. Exit inverts El. 1144 ft.
e. Emergency drawdown facilities Pump water into low-level inlet.
(Steel plate bolted on end of pond
drainpipe, entrance invert
E1. 1149 ft.)
HYDROMETEOROLOGICAL GAGES: None
a. Type
a. Type b. Location
c. Records
MAXIMUM NON-DAMAGING DISCHARGE Not available

APPENDIX C

PHOTOGRAPHS

#### DETAILED PHOTOGRAPH DESCRIPTIONS

- Overall View View East Over Dam from Right (West) Abutment (Pond and intake structure at left edge of photo; spillway across top-center of photo; outlet channel at right edge of photo.)
- Photo 1 View East across Upstream Slope of Dam from Right (West) Abutment (Pond and intake structure at left side of photo; spillway inlet above intake structure.)
- Photo 2 View West over Downstream End of Spillway and Downstream Slope of Dam from Top of Excavated Slope on Left (East) Side of Spillway (Pond behind dam in right-center of photo; outlet channel at left edge of photo.)
- Photo 3 View Northwest at Downstream Slope of Dam
  (Outlet structure at bottom-center of photo; outlet channel in bottom left corner of photo.)
- Photo 4 View Upstream at Outlet Structure
- Photo 5 View Upstream over Intake Structure and Pond from Center of Dam Crest
- Photo 6 View Downstream over Outlet Channel from Right (West)
  Side of Dam Crest
  (Outlet structure in bottom left corner of photo;
  sandstone boulder with dam name plaque in left-center
  of photo; unpaved road in top right corner of photo.)
- Photo 7 View West Across Upstream Slope
  [Intake structure and pond at bottom left corner of photo; piping tunnels (close-up in Photo 8) extend approximately 50 feet along right (west) side of upstream slope between two men in center of photo.]
- Photo 8 Close-up of Piping Tunnels in Right (West) Side of Upstream Slope (Center of Photo 7) (One-inch diameter tunnel above 3-inch diameter water-filled tunnel in silt at approximately El. 1174 feet.)

Note: Photographs were taken on 6 December 1978.

- Photo 9 View East across Downstream Slope
  [R. E. Holderbaum on outlet structure in bottomcenter of photo; J. G. Ulinski on seepage and
  piping area (close-up in Photo 10) near center of
  photo above outlet structure.]
- Photo 10 Close-Up of Seepage and Piping Area near Center of Photo 9
  [Seepage occurs in silt along contact of downstream slope with left (east) abutment at approximately El. 1163 feet.]

Note: Photographs were taken on 6 December 1978.

#### LITTLE SHENANGO DAM



PHOTO 1. View East across Upstream Slope



PHOTO 2. View West across Downstream Slope



PHOTO 3. View Northwest at Downstream Slope and Outlet Structure

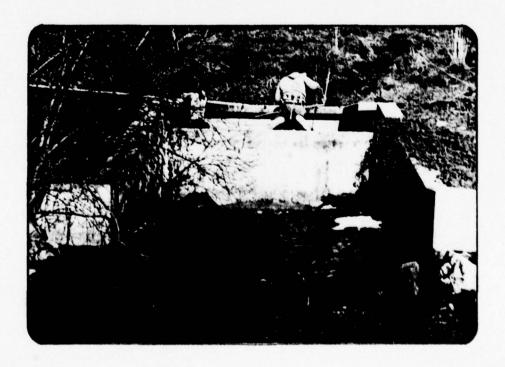


PHOTO 4. View Upstream at Outlet Structure



PHOTO 5. View Upstream from Dam Crest



PHOTO 6. View Downstream from Dam Crest



PHOTO 7. View West across Upstream Slope



PHOTO 8. Close-up of Piping Tunnels in Upstream Slope

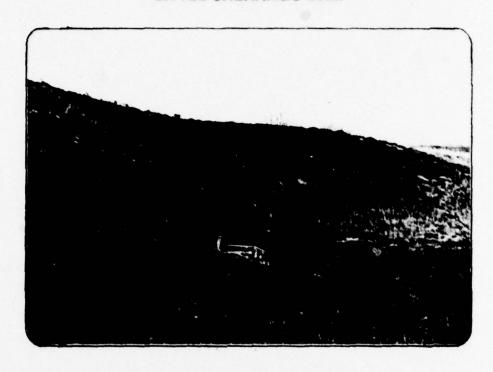


PHOTO 9. View East across Downstream Slope



PHOTO 10. Close-up of Seepage and Piping Area in Downstream Slope

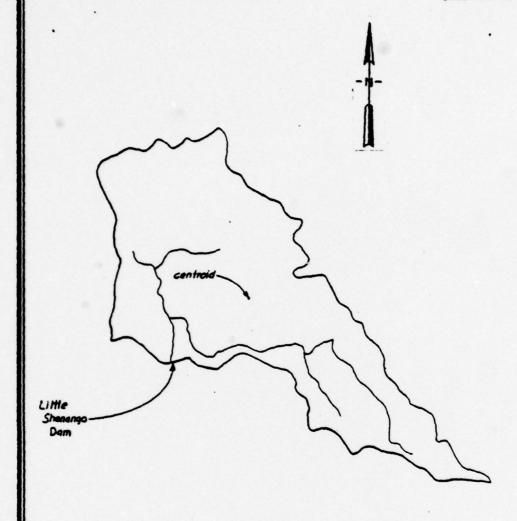
# APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Subject Little Shenango Dam MICHAEL BAKER, JR., INC. 5.0. No.\_ THE BAKER ENGINEERS Drawing No. \_\_\_ Box 280 Beaver, Pa. 15009 Computed by \_\_\_\_ Checked by \_\_\_ Subject Rainfull & Hydrograph Doite Watershed Map Pencipal Spilling Reling Stage us Stange Top of Dan Date Map at Cake Champs strong Dearge Fren Spood Routing

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sheet 2 of 11



- Quad: Hadley Drainage Area: 3.29 mi.<sup>2</sup> L: 4.49mi. Lca: 1.36 mi.

DATE: 3.28.79 ....

Calvin Clark Run Watershed

at

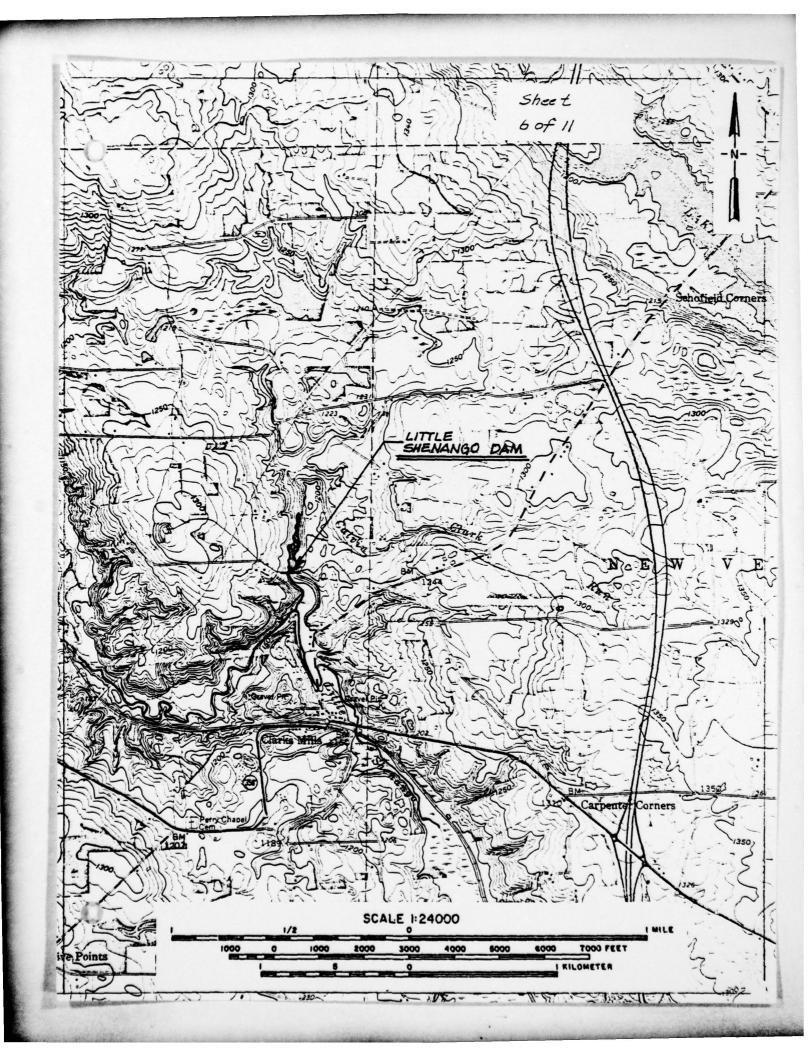
Little Shenango Dam

MICHAEL BAKER JR. INC.
Gonsulting Engineers & Surveyors

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APPENDIX E

REGIONAL GEOLOGY

# LITTLE SHENANGO DAM NDI NO. PA 00246, PennDER No. 43-54

#### REGIONAL GEOLOGY

Little Shenango Dam is located in the northwestern glaciated portion of the Appalachian Plateaus physiographic province. Bedrock consists of flat-lying shales and sandstones of the Mississippian age Pocono Formation (Mercer County Soil Conservation District, et al, 1963; Ellam, 1968). These rock strata are overlain by glacial soil deposits of various types and thicknesses (Shepps, et al., 1959; White, et al., 1969). Topographically, the area has broad, gently sloping uplands and steep sided valleys. The dam is located in a steep sided reach of Calvin Clark Run about 1000 feet upstream from its confluence with the Little Shenango River.

Glacial soil deposits of this area are among the most complex in North America. Continental ice sheets advanced into northwestern Pennsylvania from the Lake Erie basin at least seven times during the Pleistocene Epoch (Shepps, et al., 1959). For long intervals of time, more or less stationary ice masses produced extensive kame-type ice contact soil deposits as well as various tills, moraines, lake bed, and outwash deposits (Shepps, et al., 1959; White, et al., 1969). Little Shenango Dam is located in an area of kames and kame terraces surrounding by glacial tills of the Kent ground moraine and Kent end moraine (Shepps, et al., 1959).

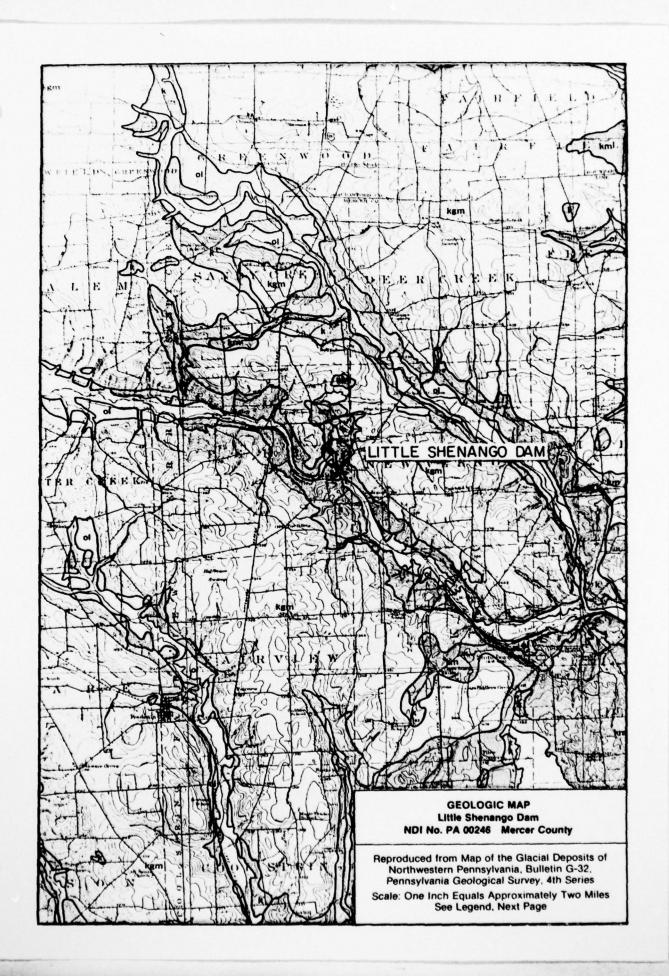
Field observations during dam inspection on 6 December 1978 confirmed the above description of glacial soil deposits in the area. Both abutments of the dam consist of silty kame or kame terrace deposits. The vegetated earth channel spillway in the left (east) abutment was apparently excavated in silty kame materials and most of the excavated soils were incorporated in the dam embankment. A small ridge of kame or moraine material lies on the right abutment downstream from the dam. The channel of Calvin Clark Run downstream from the dam is eroded in dense, well graded glacial till.

Relatively pervious glacial soil deposits on uplands along both sides of Calvin Clark Run function as groundwater recharge areas. This is particularly true for the area of kame and kettle topography east and northeast of the dam (Plate 1). Calvin Clark Run loops through this area at El. 1180 feet to El. 1250 feet. Groundwater recharge from this reach of stream is probably a significant contributor to the extensive spring flow observed on both valley walls at the dam site. Infiltration of surface water, particularly

in kettle-type depressions on the hilltop east of the dam (Plate 1), contributes to groundwater discharge on the east side of the valley. Surface water infiltration in the upland west of the dam contributes to groundwater discharge on the west side of the valley.

#### REFERENCES

- 1. Ellam, J. J. (1968). "Dam Permit Application Report."
- Mercer County Soil Conservation District, et al., (1963). "Little Shenango River Watershed Work Plan," 47 pp.
- 3. Shepps, V. C. et al., (1959). "Glacial Geology of Northwestern Pennsylvania," Bulletin G-32, Pennsylvania Geological Survey, 59 pp. + map.
- White, G. W., et al., (1969). "Pleistocene Stratigraphy of Northwestern Pennsylvania," General Geology Report G-55, Pennsylvania Geological Survey, 88 pp.



			LEGEN	ND	
	ISIN			(Inn)	Kent end moraine Till (sandy loam)
N E	WISCONSIN	CARY	Kent Till		Findley Lake recessional moraine Till (loam)
TOCE			Acid III	haye.	Clymer recessional moraine Till (loam)
PLEIS				kgm	ground moraine Till (loam becoming sandy loam toward the east and southeast)
	DIAN		Inner phase		ground (?) moraine Thin, discontinuous, weathered till blanket
	ILLINOIAN		Outer phase	Africa to	ground moraine (?) Rare patches of thin weathered till over bedrock; scattered erratics
	N OR WISCONSIN		Undifferentiated members of units above		kames, kame terraces, kame moraines, and eskers Sand and gravel
	ILLINOIAN OR		Undifferentiated members of units above	ol	outwash (valley trains), river terraces, lake deposits including beaches of former high levels of Lake Erie
RECENT OR PRE-			Undifferentiated		Bedded sand, silt, and clay; sand and gravel stream alluvium and bedrock