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KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA

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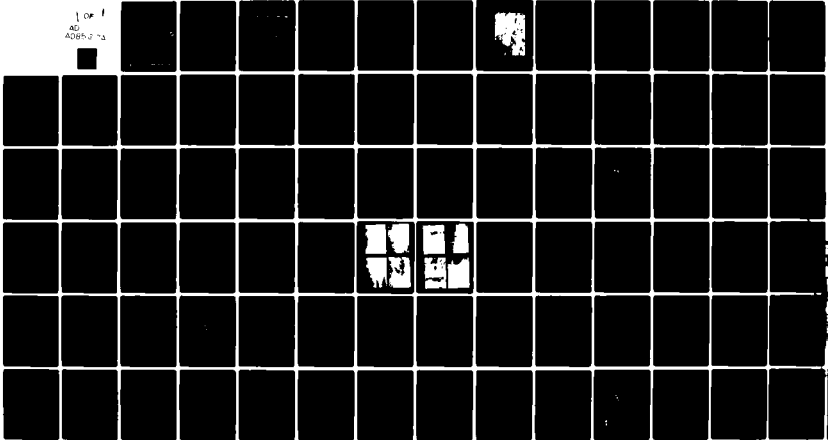
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UNNAMED TRIBUTARY TO SHAMOKIN CREEK, NORTHUMBERLAND COUNTY

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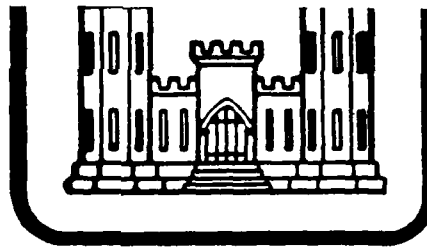
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MT. CARMEL MUNICIPAL WATER AUTHORITY

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

L. ROBERT KIMBALL & ASSOCIATES

DACW31-80-C-0020



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Prepared By  
**L. ROBERT KIMBALL & ASSOCIATES**  
CONSULTING ENGINEERS & ARCHITECTS  
EBENSBURG, PENNSYLVANIA  
15931

FOR  
DEPARTMENT OF THE ARMY  
BALTIMORE DISTRICT CORPS OF ENGINEERS  
BALTIMORE, MARYLAND  
21203

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PENNSYLVANIA

National Dam Inspection Program Number  
**STORAGE RESERVOIRS NO. 1 & NO. 2**

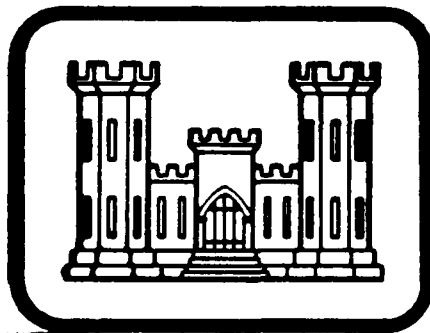
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~~MT. CARMEL MUNICIPAL WATER AUTHORITY~~

PHASE I INSPECTION REPORT,  
NATIONAL DAM INSPECTION PROGRAM



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Prepared By

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FOR

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 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.

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PHASE I REPORT  
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Storage Reservoirs No. 1 and No. 2
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Northumberland
STREAM	Unnamed tributary to Shamokin Creek
DATE OF INSPECTION	November 19, 1979

ASSESSMENT

The assessment of Storage Reservoir No. 1 and Storage Reservoir No. 2 is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance.

Storage Reservoirs No. 1 and No. 2 appeared to be in fair condition. A heavy growth of trees is present on both downstream slopes. A wet area, located between the two embankments near the toe, was noted during the inspection. The reservoir drain valves have not been operated in the recent past. Maintenance of the dam and operating facilities is considered fair.

Storage Reservoirs No. 1 and No. 2 are high hazard-intermediate size dams. The spillway design flood is the PMF (Probable Maximum Flood). The spillway and reservoir for Storage Reservoir No. 1 is capable of controlling approximately 35% of the PMF without overtopping the embankment. Storage Reservoir No. 2's spillway is capable of controlling only 10% of the PMF without overtopping the embankment. Based on criteria established by the Corps of Engineers, both spillways are termed seriously inadequate. If Storage Reservoir No. 1 or Storage Reservoir No. 2 should fail due to overtopping, hazard to loss of life and property downstream from the dam would be significantly increased from that which would exist prior to the overtopping. Storage Reservoirs No. 1 and No. 2 are classified as unsafe non-emergency dams.

The following recommendations and remedial measures should be instituted immediately.

1. Perform additional studies by a registered professional engineer knowledgeable in dam design for modification of the spillway and/or embankment to increase spillway capacity. This study should begin immediately and remedial modifications begun immediately after the study is complete. Increasing the capacity of the spillway exit channels should also be considered in this study.

2. The fence apparatus located in Storage Reservoir No. 2's spillway should be removed or modified.

STORAGE RESERVOIRS NO. 1 AND NO. 2  
PA-653

3. The wet and seepage areas should be monitored on a regular basis and after periods of heavy precipitation and evaluated by a professional engineer knowledgeable in dam design and analysis.

4. Some means of upstream positive closure of the drainlines should be developed in case of emergencies.

5. Exercise and lubricate all valves on a regular basis.

6. A subsidence investigation should be conducted by the owner or his engineer to determine the effects of any past and present mining beneath the reservoir.

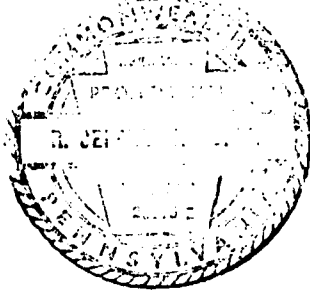
7. The trees and large vegetation on the embankment and slopes should be cleared at the direction of a professional engineer knowledgeable in the design and construction of dams.

8. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

9. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

SUBMITTED BY:

L. ROBERT KIMBALL & ASSOCIATES  
CONSULTING ENGINEERS AND ARCHITECTS



April 11, 1980

Date

*R. Jeffrey Kimball*

R. Jeffrey Kimball, P.E.

APPROVED BY:

*16 May 80*

Date

*James W. Peck*  
JAMES W. PECK  
Colonel, Corps of Engineers  
District Engineer



Overview of Storage Reservoir No. 1 and No. 2.

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PHASE I  
NATIONAL DAM INSPECTION PROGRAM  
STORAGE RESERVOIR NO. 1  
NDI. I.D. NO. PA 653  
DER I.D. NO. 49-29

SECTION 1  
PROJECT INFORMATION

1.1 General.

a. Authority. The National 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.

1.2 Description of Project.

a. Dam and Appurtenances. This report concerns Storage Reservoir No. 1 and the adjacent Storage Reservoir No. 2. Storage Reservoir No. 1 is an earth embankment semi-circular in shape with a top width of 16 feet, a length of approximately 318 feet and a height of 49 feet.

A 6 inch cast iron drainline and a 10 inch cast iron water supply line pass through the embankment to a valve chamber at the toe of dam. A masonry spillway and exit channel are located at the left abutment of the dam. The spillway crest is 6 feet long. The spillway exit channel is 120 feet in length and empties into Storage Reservoir No. 2.

Storage Reservoir No. 2 is an earth embankment with a crest width of 14 feet, a height of 40 feet and a length of approximately 420 feet. The right abutment of the dam ties into the embankment of Storage Reservoir No. 1. The crest of Storage Reservoir No. 1 is approximately 22 feet higher than the crest of Storage Reservoir No. 2.

Storage Reservoir No. 2 also has a 6 inch cast iron drainline and a 10 inch cast iron water supply line, passing beneath the embankment to the same valve chamber at the toe of dam between Storage Reservoirs No. 1 and No. 2. Storage Reservoir No. 2's spillway is located at the left abutment and consists of a 6.4 feet long weir with masonry walls forming the sides of the spillway. The spillway exit channel for Storage Reservoir No. 2 is a hand placed grouted masonry gutter along the left abutment of the dam.

b. Location. The dam is located on the side of a mountain immediately south of the Mt. Carmel Borough line. Drainage from the reservoir enters Shamokin Creek near the Borough of Mt. Carmel, Northumberland County, Pennsylvania. Storage Reservoirs No. 1 and No. 2 can be located on the Mt. Carmel, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Storage Reservoirs No. 1 and No. 2 are intermediate size dams (49 feet, 5 acre-feet; 40 high, 6.5 acre-feet, respectively).

d. Hazard Classification. Storage Reservoirs No. 1 and No. 2 are high hazard dams. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail.

e. Ownership. Storage Reservoirs No. 1 and No. 2 are owned by the Mt. Carmel Municipal Water Authority. Correspondence should be addressed to:

Mr. Robert Teufel, Manager  
Mt. Carmel Municipal Water Authority  
123 North Oak Street  
Mt. Carmel, PA 17851  
(717)339-4350

f. Purpose of Dam. Storage Reservoirs No. 1 and No. 2 are used for water supply.

g. Design and Construction History. The dams were built in 1883. No information is available on the design or construction of the dams. No drawings are available on the dams.

h. Normal Operating Procedures. Water is pumped from the village of Atlas into Storage Reservoir No. 1. Water is maintained in Storage Reservoir No. 1 at the spillway crest elevation. Excess inflow discharges through the spillway into Storage Reservoir No. 2. A chlorination station is present adjacent to the spillway and the water is chlorinated as it passes through the spillway. Water is normally drawn off Storage Reservoir No. 2 into the water system. The water system valves are normally kept open but are operated on a yearly basis. The reservoir drainlines have not been operated for at least 5 years.

### 1.3 Pertinent Data. Storage Reservoir No. 1

a. Drainage Area. 0.14 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Unknown
Drainline capacity at normal pool	Unknown
Spillway capacity at top of dam	148

c. Elevation (U.S.G.S. Datum) (feet). - Field survey based on spillway crest elevation 1270 interpolated from the U.S.G.S. 7.5 minute quadrangle.

Top of dam - low point	1273.9
Top of dam - design height	Unknown
Normal pool	1270
Spillway crest	1270
Upstream portal - 6" drainline	Unknown
Downstream portal - 6" drainline	Unknown
Streambed at centerline of dam	Unknown
Maximum tailwater	1251.5
Toe of dam	1225.0

d. Reservoir (feet).

Length of maximum pool	150
Length of normal pool	150

e. Storage (acre-feet).

Normal pool	?
Top of dam	4.9

f. Reservoir Surface (acres).

Top of dam	0.50
Normal pool	0.46
Spillway crest	0.46

g. Dam.

Type	Earth embankment
Length	318'
Height	49'
Top width	16'
Side slopes - upstream	1.75H:1V
- downstream	1.25H:1V and 1.5H:1V

Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown
Grout curtain	Unknown

h. Reservoir Drain.

Type	6" CIP
Length	Approximately 140'
Closure	Valve at toe
Access	None
Regulating facilities	Valve at toe

i. Spillway.

Type	Rectangular
Length	6'
Crest elevation	1270

1.3 Pertinent Data. Storage Reservoir No. 2

a. Drainage Area. 0.21 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site (1972)	Approximately 40
Drainline capacity at normal pool	Unknown
Emergency spillway capacity at top of dam	55

c. Elevation (U.S.G.S. Datum) (feet). - Field survey was based on Storage Reservoir No. 1's spillway crest elevation 1270.0 interpolated from U.S.G.S. 7.5 minute quadrangle.

Top of dam - low point	1251.5
Top of dam - design height	Unknown
Normal pool	1249.6
Emergency spillway crest	1249.6
Streambed at centerline of dam	Unknown
Maximum tailwater	None
Toe of dam	1211.1

d. Reservoir (feet).

Length of maximum pool	300
Length of normal pool	300

e. Storage (acre-feet).

Normal pool	5.1
Top of dam	6.4

f. Reservoir Surface (acres).

Top of dam	0.70
Normal pool	0.64
Spillway crest	0.64

g. Dam.

Type	Earth embankment
Length	420'
Height	40'
Top width	14'
Side slopes - upstream	1.75H:1V
- downstream	1.5H:1V
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown
Grout curtain	Unknown

h. Reservoir Drain.

Type	6" CIP
Length	Approximately 120'
Closure	Valve at toe
Access	None
Regulating facilities	Valve at toe

i. Spillway.

Type	Rectangular
Length	6.4'
Crest elevation	1249.6

SECTION 2  
ENGINEERING DATA

2.1 Design. Review of information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources revealed that several inspection reports and one photograph were available for review. No design reports or construction drawings were available. The owner did not furnish any supporting data.

2.2 Construction. No data is available on the construction of the dam.

2.3 Operation. The owner maintains daily reservoir levels.

2.4 Evaluation.

a. Availability. Engineering data were provided by PennDER, Bureau of Dams and Waterways Management. The manager of the Municipal Authority was interviewed to obtain data on operation and maintenance of the structures.

b. Adequacy. Detailed analyses cannot be made because of the lack of detailed design information or drawings. This Phase I report was based on available data, visual inspection and a hydrologic and hydraulic analysis

SECTION 3  
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Storage Reservoirs No. 1 and No. 2 was conducted by personnel of L. Robert Kimball and Associates on November 19, 1979. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. Storage Reservoirs No. 1 and No. 2 both appear to be in fair condition. From a brief survey conducted during the inspection, it was noted that a low spot was present to the left of the spillway on the crest of Storage Reservoir No. 1. The crest width was measured to be 16 feet. The upstream slope was measured at 1.75H:1V and grass covered. The upper portion of the downstream slope was measured at 1.25H:1V. A 16 foot wide berm is located approximately 22 feet (coincides with the crest elevation of Storage Reservoir No. 2) below the crest of Storage Reservoir No. 1. The lower portion of the downstream slope was measured at 1.5H:1V and covered with numerous large trees.

Storage Reservoir No. 2 contained a low spot approximately 120 feet to the right of the spillway. The crest width was measured at 14 feet. The upstream slope is 1.75H:1V and covered with grass. The downstream slope is 1.5H:1V. The lower portion of the downstream slope is covered with trees. No slope movements were noted on either reservoir slopes.

A wet area is located on the downstream slope between elevation 1230 and 1213 between Storage Reservoir No. 1 and Storage Reservoir No. 2 (see page A-12). Flow from this wet area was measured at 4 gallons per minute.

A chain link fence is located around the crest of Storage Reservoir No. 2 and across the bench of Storage Reservoir No. 1.

c. Appurtenant Structures. The spillway for Storage Reservoir No. 1 is located near the left abutment and consists of a masonry spillway with a 6 foot long weir crest. A chlorination station is located adjacent to the spillway and water is chlorinated as it passes through the spillway. The spillway

exit channel consists of a masonry channel, 120 feet long, which discharges into Storage Reservoir No. 2. Both the spillway and exit channel appear to be in fair condition.

The spillway for Storage Reservoir No. 2 is located near the left abutment and consists of a rectangular shaped masonry spillway. The weir length is 6.4 feet at the bottom and 7.3 feet near the top. A fence device is placed in the spillway to keep intruders out. This fence device significantly decreases the capacity of the spillway and allows trash to build up in the spillway.

Both reservoirs contain a 6-inch cast iron drainline and a 10 inch cast iron water supply line which pass through the embankments and meet at one valve chamber at the toe of dam between the two embankments. None of these pipes or valves on the pipes were observed during the inspection. It is reported that the valves on the water system lines are operated once each year, but the valves on the reservoir drains have not been operated for at least five years.

d. Reservoir Area. The watershed is covered mostly with steep woodland. The reservoir slopes do not appear to be susceptible to landslides which would affect the storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. No defined channel exists below the storage reservoirs. Several homes are located immediately below the toe of both reservoirs.

3.2 Evaluation. In general, the embankment and appurtenant structures appear to be in fair condition, and fairly maintained.

SECTION 4  
OPERATIONAL PROCEDURES

4.1 Procedures. Water is pumped into Storage Reservoir No. 1 from outside sources. The water level in Storage Reservoir No. 1 is maintained at the spillway crest elevation 1270.0. Excess inflow discharges over the spillway into Storage Reservoir No. 2. Water is drawn off Storage Reservoir No. 2 on an as needed basis to the water system. The water system valves remain open year around and flow is regulated at the pumping station located at Mt. Carmel.

4.2 Maintenance of the Dam. No planned maintenance schedule exists. Maintenance of the dam is performed by the Municipal Authority's staff on an as needed basis. Maintenance of the dam is considered fair.

4.3 Maintenance of Operating Facilities. Maintenance of the spillway and outlet works is considered fair. The valves on the reservoir drain have not been operated for at least five years.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. Maintenance of the dam and operating facilities is considered fair. There is no system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

SECTION 5  
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No design data or calculations exist pertaining to hydrology or hydraulics.

b. Experience Data. The Municipal Water Authority maintains daily reservoir levels on Storage Reservoir No. 2. In June of 1972, the water level in the reservoir reached 6 inches from the top of the embankment crest.

c. Visual Observations. Storage Reservoirs No. 1 and No. 2 spillway's appear to be in fair condition. Some minor maintenance of the masonry should be conducted. Storage Reservoir No. 2's spillway has a fence apparatus partially blocking and reducing the spillway discharge.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions:

1. The low point on each embankment were considered to be the top of dam.

2. The flood was routed through Storage Reservoir No. 1 and into Storage Reservoir No. 2. Water pumped into the reservoir was neglected.

3. The fence apparatus located in the spillway for Storage Reservoir No. 2 was not considered. This apparatus would significantly reduce the spillway capacity from that indicated in our analyses.

4. For the dam breach analyses it was assumed that dam failure of Storage Reservoir No. 2 occurred first and was only considered. Failure of Reservoir No. 2 would begin when water in the reservoir reached elevation 1251.7 or 0.2 feet over the top of dam.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

	Reservoir No. 1	Reservoir No. 2
Peak inflow (PMF)	449 cfs	688 cfs
Spillway capacity	148 cfs	55 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for these dams are considered the PMF. The SDF is based on the hazard and size classification of the dams. Based on the following definition provided by the Corps of Engineers, the spillways for each of these two reservoirs is considered to be seriously inadequate as a result of our hydrologic analysis.

Seriously inadequate - High hazard classification dams not capable of passing 50% of the SDF and where there is a significant increase in the hazard potential for loss of life due to the overtopping failure.

The spillway and reservoir for Storage Reservoir No. 1 are capable of controlling approximately 35% of the PMF without overtopping the dam. This spillway and reservoir for Storage Reservoir No. 2 are capable of controlling less than 10% of the PMF without overtopping the embankment.

5.4 Summary of Dam Breach Analysis. As the subject dam cannot pass 50% of the PMF (based on our analyses) it was necessary to perform a breach analysis and downstream routing of the flood wave. This analysis determines the degree of increased flooding due to dam failure.

The flood wave was routed downstream with and without embankment failure conditions considered. Detailed printout of the downstream flood wave is included in Appendix D.

Results of the dam breach analysis do not indicate that the downstream potential of the loss of life and property damage is significantly increased by the failure of Storage Reservoir No. 1 and/or Storage Reservoir No. 2. An accurate model of the downstream flood wave could not be developed from information obtained in the Phase I study. Based on the location of the reservoirs and several homes located directly beyond the toe of the reservoirs the potential for loss of life and property damage is significant. Therefore, the spillway is rated as seriously inadequate.

Note: Future development within the watershed, at the dam, or downstream may change the characteristics and assumptions made for this study and different results are likely. Future development downstream may also greatly increase the potential for loss of life due to failure of the structure.

SECTION 6  
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. No signs of movement or erosion were noted on the embankment slopes despite the excessively steep embankments. A wide wet area and seepage area was noted near the toe of the embankments between the two embankments. This seepage was measured at 4 gallons per minute at the time of the inspection.

Immediately downstream of the reservoir is an abandoned mine shaft. It is unknown whether mining has occurred beneath the Storage Reservoirs which at some time may cause subsidence of the embankment.

b. Design and Construction Data. No stability analyses are on record for this dam. No data on the design or construction is available.

c. Operating Records. The only operating records that are maintained are daily reservoir levels on Storage Reservoir No. 2.

d. Post Construction Changes. No post construction changes are known.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7  
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam embankments appear to be in fair condition. No movements or erosion were noted on the embankments during the inspection. An extensive wet area and seepage area was noted near the downstream toe between the two reservoirs. Seepage was estimated at 4 gallons per minute exiting from this area. No stability analyses have been conducted for these structures despite the excessively steep downstream embankment slopes. The visual observations, review of available information, hydrologic and hydraulic calculations and past operations and performance indicate that both spillways for Storage Reservoirs No. 1 and No. 2 are seriously inadequate. The spillways for Storage Reservoirs No. 1 and No. 2 are capable of controlling 35% and 10%, respectively, of the PMF without overtopping the earth embankment. Storage Reservoirs No. 1 and No. 2 are classified as unsafe non-emergency.

b. Adequacy of Information. Detailed analyses of the structure cannot be made because of the lack of any design and construction data. This Phase I report is based upon visual observations, review of available data, hydrologic and hydraulic calculations and past operations and performances.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required.

7.2 Recommendations/Remedial Measures.

1. Perform additional studies by a registered professional engineer knowledgeable in dam design for modification of the spillway and/or embankment to increase spillway capacity. This study should begin immediately and remedial modifications begun immediately after the study is complete. Increasing the capacity of the spillway exit channels should also be considered in this study.

2. The fence apparatus located in Storage Reservoir No. 2's spillway should be removed or modified.

3. The wet and seepage areas should be monitored on a regular basis and after periods of heavy precipitation and evaluated by a professional engineer knowledgeable in dam design and analysis.

4. Some means of upstream positive closure of the drain-lines should be developed in the case of emergencies.

5. Exercise and lubricate all valves on a regular basis.

6. A subsidence investigation should be conducted by the owner or his engineer to determine the effects of any past and present mining beneath the reservoir.

7. The trees and large vegetation on the embankment and slopes should be cleared at the direction of a professional engineer knowledgeable in the design and construction of dams.

8. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

9. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

APPENDIX A  
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST  
VISUAL INSPECTION  
PHASE I

Storage Reservoirs  
NAME OF DAM No. 1 & No. 2 COUNTY Northumberland STATE Pennsylvania ID# PA 653  
TYPE OF DAM Earthfill HAZARD CATEGORY High  
DATE(s) INSPECTION November 19, 1979 WEATHER Clear, warm TEMPERATURE 50°  
Reservoir 1 Reservoir 2  
POOL ELEVATION AT TIME OF INSPECTION 1259.7; 1244.7 M.S.L. TAILWATER AT TIME OF INSPECTION 1244.7; None.

INSPECTION PERSONNEL:

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

James T. Hockensmith  
RECORDER

**EMBANKMENT**

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Both dam crests are semi-circular in shape. Storage Reservoir No. 1 has a low spot located to the left of the spillway. Storage Reservoir No. 2 has a low spot 120 feet to the right of its spillway.	
RIPRAP FAILURES	No riprap.	

**EMBANKMENT**

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Large trees and vegetation on the downstream slopes.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Both appear to be good.	
ANY NOTICEABLE SEEPAGE	Wet area and seepage area located near the toe of dam between the two embankments. Flow out of this seepage area was estimated at 4 gallons per minute.	
STAFF GAUGE AND RECORDER	On Storage Reservoir No. 2	
DRAINS	None.	

**CONCRETE/MASONRY DAMS**

<b>VISUAL EXAMINATION OF</b>	<b>OBSERVATIONS</b>	<b>REMARKS OR RECOMMENDATIONS</b>
<b>ANY NOTICEABLE SEEPAGE</b>	Not applicable.	
<b>STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS</b>	Not applicable.	
<b>DRAINS</b>	Not applicable.	
<b>WATER PASSAGES</b>	Not applicable.	
<b>FOUNDATION</b>	Not applicable.	

**CONCRETE/MASONRY DAMS**

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

**OUTLET WORKS**

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet works unobserved during the inspection.	
INTAKE STRUCTURE	Unobserved.	
OUTLET STRUCTURE	Valve chamber located at toe of dam. Inside of valve chamber unobserved during inspection.	
OUTLET CHANNEL	No defined outlet channel.	
EMERGENCY GATE	Located on 6 inch reservoir drain. Unobserved during the inspection.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Both weirs on spillways appear to be in fair condition.	
APPROACH CHANNEL	Lake.	
DISCHARGE CHANNEL	Storage Reservoir No. 1 has a masonry shaped discharge channel into Storage Reservoir No. 2. This discharge channel appears to be in fair condition. Storage Reservoir No. 2's discharge channel is a hand placed grouted masonry gutter which appears to be undersized. High flows through the spillway could cause erosion of the embankment.	
BRIDGE AND PIERS	None.	

**GATED SPILLWAY**

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
<b>CONCRETE SILL</b>	Not applicable.	
<b>APPROACH CHANNEL</b>	Not applicable.	
<b>DISCHARGE CHANNEL</b>	Not applicable.	
<b>BRIDGE AND PIERS</b>	Not applicable.	
<b>GATES AND OPERATION EQUIPMENT</b>	Not applicable.	

**DOWNSTREAM CHANNEL**

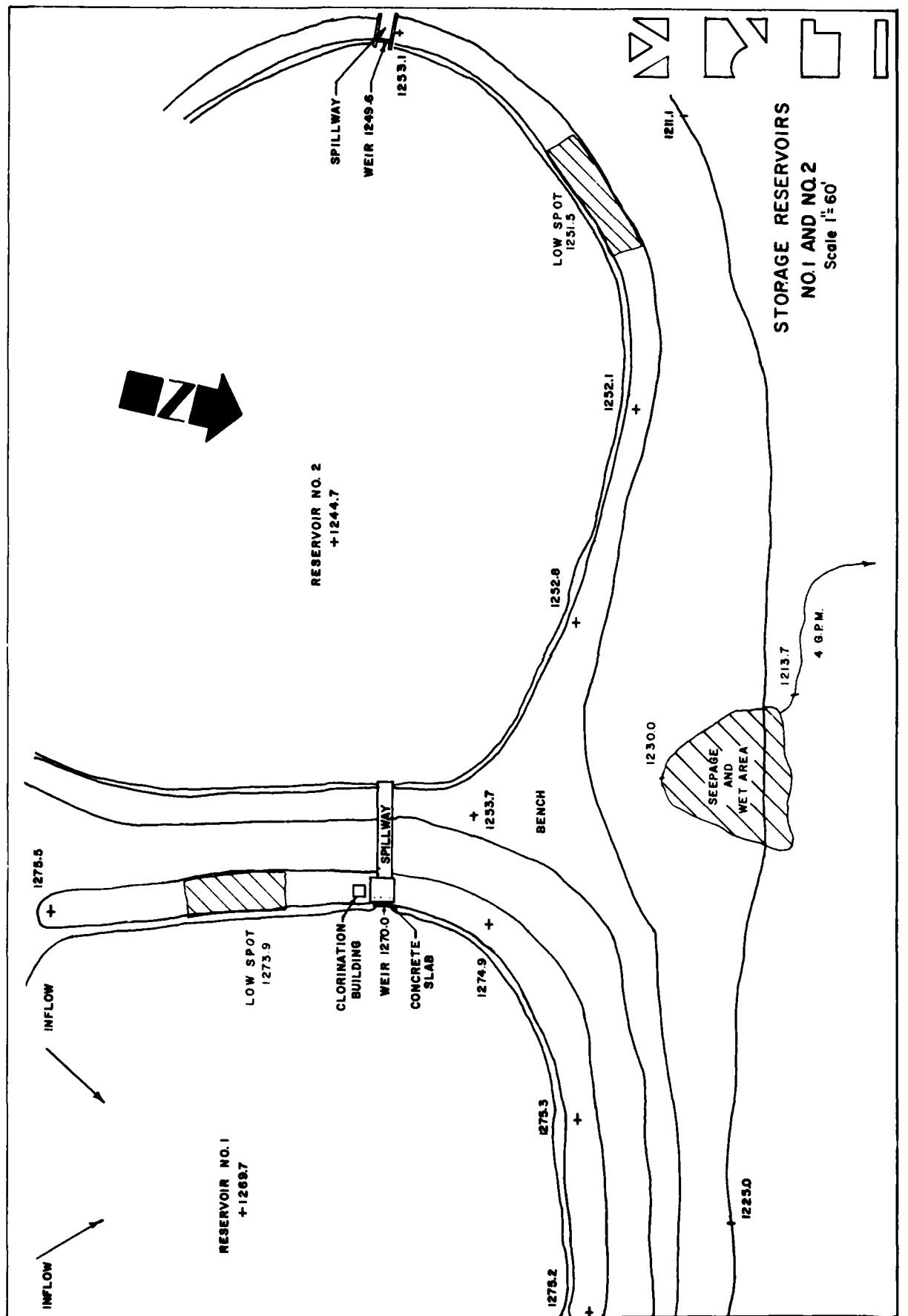
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No defined downstream channel.	
SLOPES	Steep.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 200 homes - 1,000 people.	

RESERVOIR

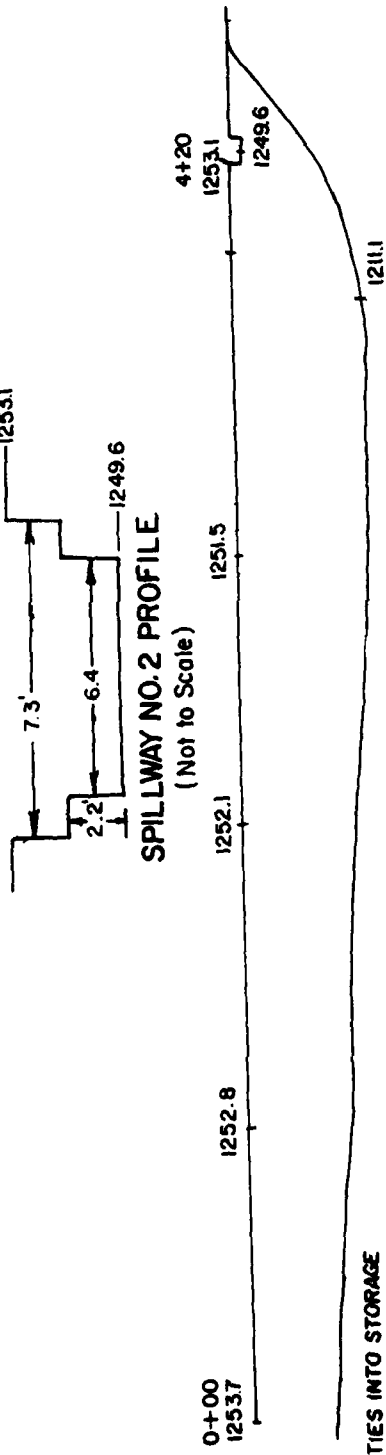
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Steep but appears to be stable.	
SEDIMENTATION	Does not appear to be excessive.	

**INSTRUMENTATION**

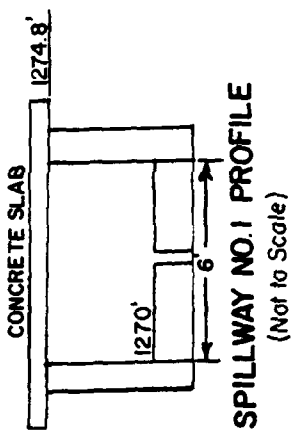
<b>VISUAL EXAMINATION OF</b>	<b>OBSERVATIONS</b>	<b>REMARKS OR RECOMMENDATIONS</b>
<b>MONUMENTATION/SURVEYS</b>	None.	
<b>OBSERVATION WELLS</b>	None.	
<b>WEIRS</b>	None.	
<b>PIEZOMETERS</b>	None.	
<b>OTHER</b>	None.	



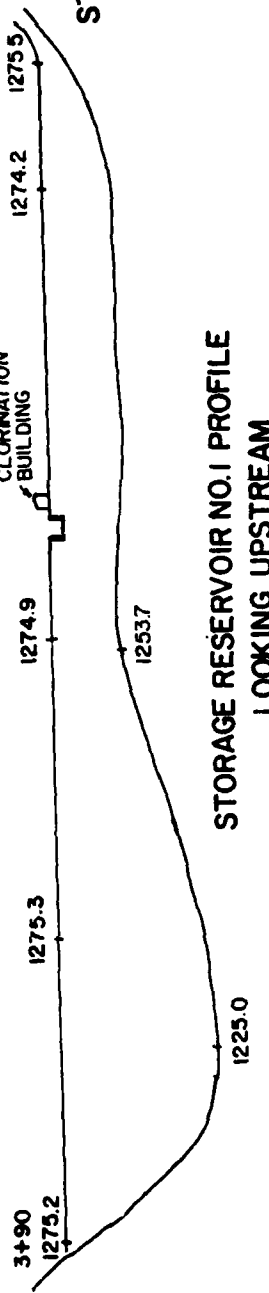
STORAGE RESERVOIRS  
NO. 1 AND NO. 2  
Scale 1"=60'



STORAGE RESERVOIR NO. 2 PROFILE  
LOOKING UPSTREAM

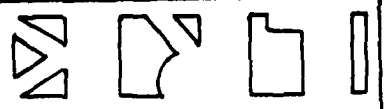


SPILLWAY NO. 1 PROFILE  
(Not to Scale)



STORAGE RESERVOIR NO. 1 PROFILE  
LOOKING UPSTREAM

STORAGE RESERVOIRS  
NO. 1 AND NO. 2  
Scale 1" = 60'



TIES INTO STORAGE  
RESERVOIR NO. 1

APPENDIX B  
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION,  
PHASE I

Storage Reservoirs  
 No. 1 and No. 2

CHECK LIST  
 ENGINEERING DATA  
 DESIGN, CONSTRUCTION, OPERATION  
 PHASE I

NAME OF DAM

ID# PA 653

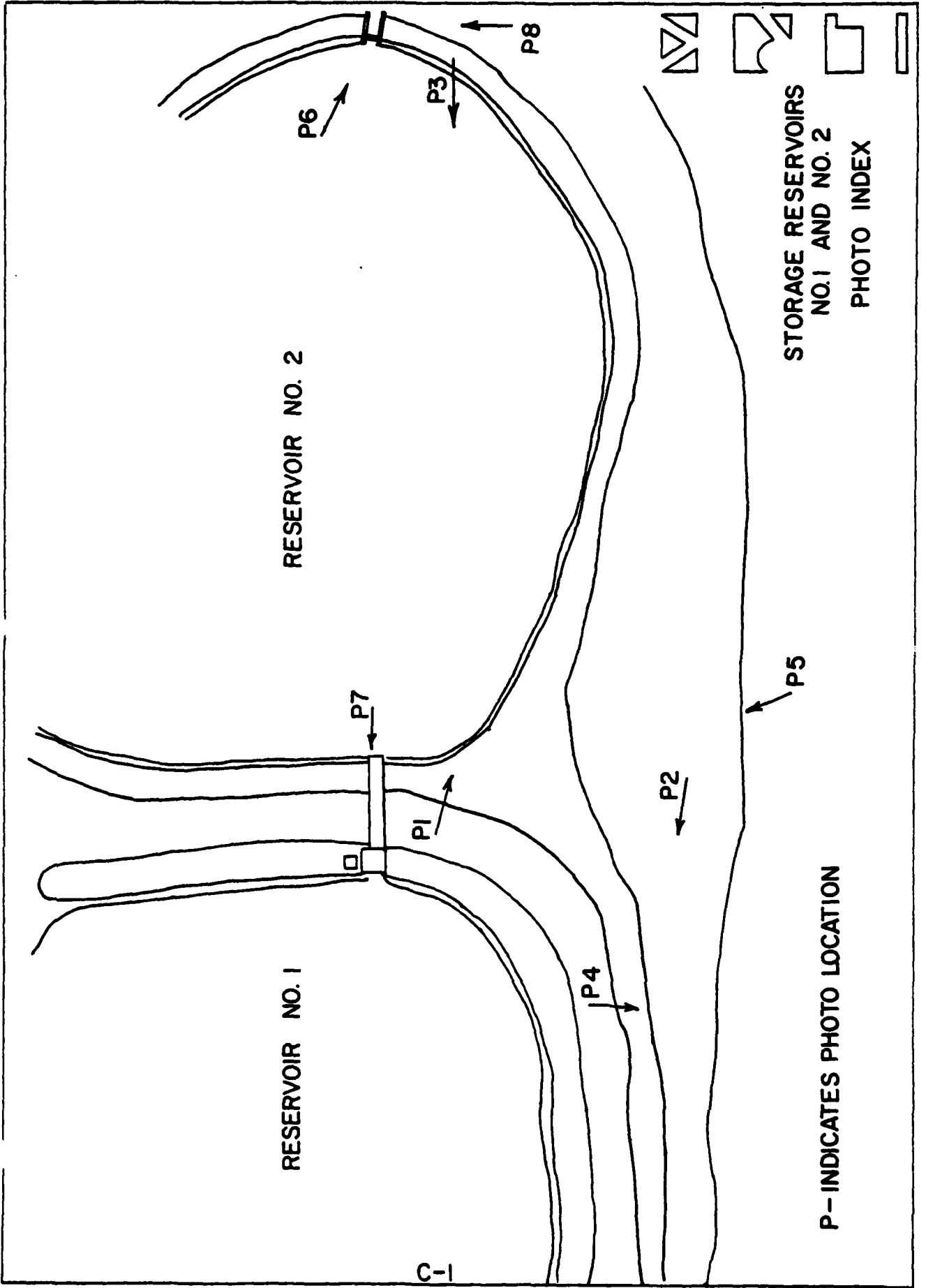
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	None.
TYPICAL SECTIONS OF DAM	None.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	None. None. None. None. None.

ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Unknown.
POST-CONSTRUCTION SURVEYS OF DAM	Unknown.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Unknown.
HIGH POOL RECORDS	Contained in the Municipal Water Authority's files.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C  
PHOTOGRAPHS



RESERVOIR NO. 2

RESERVOIR NO. 1

C-1

STORAGE RESERVOIRS  
NO.1 AND NO.2  
PHOTO INDEX

P- INDICATES PHOTO LOCATION

## STORAGE RESERVOIR NO. 1 AND NO. 2

### Photograph Descriptions

#### Sheet 1. Front

- (1) Upper left - Crest of Storage Reservoir No. 2 looking from crest of Storage Reservoir No. 1
- (2) Upper right - Downstream slope of Storage Reservoir No. 1.
- (3) Lower left - Downstream slope of Storage Reservoir No. 1 with Storage Reservoir No. 2 in foreground.
- (4) Lower right - Downstream slope of Storage Reservoir No. 1.

#### Sheet 1. Back

- (5) Upper left - Seepage area between Storage Reservoir No. 1 and Storage Reservoir No. 2.
- (6) Upper right - Spillway of Storage Reservoir No. 2.
- (7) Lower left - Spillway of Storage Reservoir No. 1.
- (8) Lower right - Spillway discharge channel - Storage Reservoir No. 2.

TOP OF PAGE

1	2
3	4





APPENDIX D  
HYDROLOGY AND HYDRAULICS

APPENDIX D  
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topographic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

\*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS  
DATA BASE

NAME OF DAM: Storage Reservoir No. 1 and No. 2

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 (1.005) = 22.3 inches

STATION	1	2	3
Station Description	Reservoir No. 1	Reservoir No. 2	
Drainage Area (square miles)	0.14	0.07	
Cumulative Drainage Area (square miles)	0.14	0.21	
Adjustment of PMF for Drainage Area (%) <sup>(1)</sup>			
6 hours	117	117	
12 hours	127	127	
24 hours	136	136	
48 hours	143	143	
72 hours			
Snyder Hydrograph Parameters			
Zone <sup>(2)</sup>	13	13	
C <sub>p</sub> <sup>(3)</sup>	0.50	0.50	
C <sub>t</sub> <sup>(3)</sup>	1.85	1.85	
L (miles) <sup>(4)</sup>	0.56	0.47	
L <sub>ca</sub> (miles) <sup>(4)</sup>	0.28	0.19	
t <sub>p</sub> = C <sub>t</sub> (LxL <sub>ca</sub> ) 0.3 hrs.	1.06	0.90	
Spillway Data			
Crest Length (ft)	6'	6.4'	
Freeboard (ft)	3.9'	1.9'	
Discharge Coefficient	3.2	3.2	
Exponent	1.5	1.5	

(1) Hydrometeorological Report 40 (Figure 1), U.S. Army Corps of Engineers, 1965.

(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C<sub>p</sub> and C<sub>t</sub>).

(3) Snyder's Coefficients.

(4) L=Length of longest water course from outlet to basin divide.

L<sub>ca</sub>=Length of water course from outlet to point opposite the centroid of drainage area.

STORAGE RESERVOIR No.1  
CHECK LIST  
HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: DA-0.14 mi<sup>2</sup> wooded with steep slopes

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 3 ac-ft

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 5 ac-ft

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1273.9

SPILLWAY CREST:

- a. Elevation 1249.6'
- b. Type Rectangular
- c. Width 6'
- d. Length Unknown
- e. Location Spillover Left abutment
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type 6" CIP
- b. Location Maximum section
- c. Entrance inverts Unknown
- d. Exit inverts Unknown
- e. Emergency draindown facilities 6" CIP

HYDROMETEOROLOGICAL GAUGES:

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

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

STORAGE RESERVOIR No. 2  
CHECK LIST  
HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: DA-0.21 mi<sup>2</sup> wooded with steep slopes

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 5 ac-ft

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 6 ac-ft

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1251.5

SPILLWAY CREST:

- a. Elevation 1249.6
- b. Type Rectangular
- c. Width 6.4'
- d. Length Unknown
- e. Location Spillover Left abutment
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type 6" CIP
- b. Location Maximum section
- c. Entrance inverts Unknown
- d. Exit inverts Unknown
- e. Emergency draindown facilities 6" CIP

HYDROMETEOROLOGICAL GAUGES:

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

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

\*\*\*\*\*  
 FLOOD HYDROGRAPH PACKAGE (HEC-1)  
 DAM SAFETY VERSION JULY 1978  
 LAST MODIFICATION 26 FEB 79  
 \*\*\*\*\*

AL ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF  
 A2 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF STORAGE RESERVOIRS NO.1 (NO.2)  
 A3 RATIOS OF PMF ROUTED THROUGH THE RESERVOIRS (PA. 49-21)

1	B	288	0	10	0	0	0	0	0
2	B1	5							
3	J	1	5	1					
4	J1	0	85	85					
5	K	1							
6	K1	0							
7	M	1	0.14						
8	P	1	22.3	117	127	136	143	1.0	0.05
9	T	1	1906	1050					
10	X	-1.5	4.08	4.0					
11	K	1	1.2	1.2					
12	K1	1	1.2	1.2					
13	Y	1							
14	V1	1							-1270
15	SE	1256	1270	1273.9					
16	SE	1270	1270	1273.9					
17	SE	1273.9	3.0	1.5	390				
18	K	0							
19	K1	1							
20	M	1	0.07						
21	P	1	22.3	117	127	136	143	1.0	0.05
22	T	1	0.9	0.50					
23	X	-1.5	-0.05	2.0					
24	K	2							
25	K1	1							
26	M	1	0.07						
27	P	1	22.3	117	127	136	143	1.0	0.05
28	T	1	0.9	0.50					
29	X	-1.5	-0.05	2.0					
30	K	2							
31	K1	1							
32	M	1	0.07						
33	P	1	22.3	117	127	136	143	1.0	0.05
34	T	1	0.9	0.50					
35	X	-1.5	-0.05	2.0					
36	K	2							
37	K1	1							
38	M	1	0.07						
39	P	1	22.3	117	127	136	143	1.0	0.05
40	T	1	0.9	0.50					
41	X	-1.5	-0.05	2.0					
42	K	2							

\*\*\*\*\*  
 ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF  
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF STORAGE RESERVOIRS NO.1 (NO.2)  
 RATIOS OF PMF ROUTED THROUGH THE RESERVOIRS (PA. 49-21)  
 \*\*\*\*\*

\*\*\*\*\*  
FLOOD HYDROGRAPH PACKAGE (HEC-1)  
DAM SAFETY VERSION JULY 1978  
LAST MODIFICATION 26 FEB 79  
\*\*\*\*\*

RUN DATE: 00/03/061  
TIME: 15100.53

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMP  
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF STORAGE RESERVOIRS (NO. 1 6NO.2  
RATIOS OF PMP ROUTED THROUGH THE RESERVOIRS (PA. 49-217)

NO NHR NMIN IDAY IMR IMIN METRC IPLT IPRT NSTAN  
JOB SPECIFICATION

MULTI-PLAN ANALYSES TO BE PERFORMED

RTIOS= .10 .50 .70 1.00  
MPCARR 1.00 1.00 1.00 1.00

\*\*\*\*\*  
SUB-AREA RUNOFF COMPUTATION  
\*\*\*\*\*

INFLOW

ISTAQ ICOMP IECON ITAPE JPLT JPRI INAME ISTAGE IAUTO  
1 0 0 0 0 0 1 0 0  
HYDROGRAPH DATA  
THYDG TURG TAREA SNAP TRSDA TRSPC RATIO TSNOW TSAME LOCAL  
1 1 .14 0.00 .14 0.00 0.000 0 0 0

PRECIP DATA

SPFE PMS R6 R12 R24 R48 R72 R96  
0.00 22.30 117.00 127.00 136.00 143.00 0.00 0.00  
TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

PROPT STRKR DLYKR RTDOL ERATN STRKS RTYOK STRTL CNSTC ALSHX RTIMP  
0 0.00 0.00 1.00 0.00 0.00 1.00 1.00 .05 0.00 0.00

UNIT HYDROGRAPH DATA  
 TP= 1.00 CP= .50 RTA= 1.0

RECESSION DATA  
 STRIP= -1.50 QRCSN= -.05 RTIOR= 2.00  
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN STRIP CP AND TP ARE TESTED AND R= 8.69 INTERVALS  
 UNIT HYDROGRAPH TO END-OF-PERIOD ORDINATES, LAG= 1.07 HOURS, CP= .50, VOLT= 1.00

7.	8.	17.	27.	25.	41.	43.	40.	36.	32.
28.	25.	23.	20.	18.	16.	14.	13.	11.	10.
1.	1.	1.	1.	1.	0.	0.	0.	0.	0.

PERIOD HYDROGRAPH DATA  
 PERIOD= 1.00 HOURS  
 INCHES  
 MM  
 AC-FT

17.94	22.70	22.83	22.83
456.73	576.62	579.82	579.82
134.	169.	170.	170.

HYDROGRAPH ROUTING

ROUTE THRU NO. 1

ESTAG	I	COMP	SECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	1	1	0	0	0	0	0	0	0

ROUTING DATA

CLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS NSTDL LAG ANSKK X TSK STORA ISPRAT

1	0	0	0.000	0.000	0.000	-1270.	0
---	---	---	-------	-------	-------	--------	---

CAPACITY= 0. 3. 5.

ELEVATION= 12566 12706 1274.

CREL	SPWID	COOM	ESPW	ELEVL	COOL	CAREA	EXPL
1270.0	6.0	3.2	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	ERPD	DAMWID
1273.9	3.0	1.5	390.



\*\*\*\*\*

COMBINE HYDROGRAPHS

COMBINE

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	IStage	IAUTO
1	2	0	0	0	0	1	0	0

\*\*\*\*\*

HYDROGRAPH ROUTING

ROUTE THRU NO. 1

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	IStage	IAUTO
5	1	0	0	0	0	1	0	0

LOSS	CLOSS	AVG	INES	ISAME	TOPT	IPHP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1250.	-1

STAGE	1249.60	1250.00	1250.50	1251.00	1251.80	1252.00	1252.50	1253.00	1255.00
FLOW	0.00	5.00	18.00	34.00	67.00	69.00	81.00	98.00	201.00

CAPACITY= 0. 5. 6.  
ELEVATION= 1232. 1250. 1252.

CREL	SPVID	COOM	EXPW	ELEV	COOL	CAREA	EXPL
124926	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA  
TOPREL COOD EXPD DAMRD

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)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
HYDROGRAPH AT	1	.14	1	.45	.19	.22	.51	.44
		.36		1.27	3.83	6.35	8.89	12.70
ROUTED TO	2	.14	1	.44	.13	.22	.31	.47
		.36		1.27	3.79	6.40	8.92	12.86
HYDROGRAPH AT	3	.07	1	.24	.12	.12	.17	.25
		.18		.69	2.08	3.47	5.25	8.93
2 COMBINED	4	.21	1	.67	.20	.34	.40	.68
		.54		1.90	5.71	9.87	13.89	19.90
ROUTED TO	5	.21	1	.67	.20	.34	.40	.68
		.54		1.89	5.78	9.83	13.87	19.85

SUMMARY OF DAM SAFETY ANALYSIS  
STORAGE DAM NO. 1

PLAN 1 ..... ELEVATION 1270.00 SPILLWAY CREST 1270.00 TOP OF DAM 1273.90  
 STORAGE 38 38  
 OUTFLOW 0. 0. 148.

RATIO OF PRF	MAXIMUM RESERVOIR W.S. (FEET)	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE (AC-FT)	MAXIMUM OUTFLOW (CFS)	DURATION OVER TOP (HOURS)	TIME OF MAX OUTFLOW (HOURS)	TIME OF FAILURE (HOURS)
.10	1271.74	0.00	4.	44.	0.00	40.83	0.00
.30	1273.63	0.00	5.	133.	0.00	40.83	0.00
.50	1274.05	.15	5.	226.	2.33	40.50	0.00
.70	1274.16	.26	5.	315.	3.67	40.67	0.00
1.00	1274.28	.38	5.	370.	5.17	40.87	0.00

8/80

SUMMARY OF DAM SAFETY ANALYSIS  
STORAGE DAM NO. 2

PLAN 1 .....  
 ELEVATION STORAGE 1249.60 5. INITIAL VALUE 1249.60 5. SPILLWAY CREST 1251.50 6. TOP OF DAM 1251.50 6.  
 OUTFLOW 0. 0. 0. 55.

RATIO OF PHF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1251.54	.04	6.	67.	1.50	40.83	0.00
.30	1251.73	.23	7.	204.	6.00	40.67	0.00
.50	1251.87	.37	7.	347.	7.33	40.50	0.00
.70	1251.98	.48	7.	482.	8.38	40.67	0.00
1.00	1252.02	.52	7.	609.	9.00	40.67	0.00





\*\*\*\*\*  
 FLOOD HYDROGRAPH PACKAGE (HEC-1)  
 SAM SAFETY VERSION JULY 1978  
 LAST MODIFICATION 26 FEB 79  
 \*\*\*\*\*

RUN DATE\* 80/03/11.  
 TIME\* 06.03.39.

RAYON OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM  
 DOWNSTREAM CONDITIONS DUE TO OVERTOP (STORAGE RES. NO.1 & NO.2)  
 PLANS 1+2 63 ASSUME BREACH PLAN 4 ASSUMES NO BREACH.

NO NHR NMIN IDAY IMR IMIN METRC IPLT IPRT NSTAN  
 288 0 10 0 0 0 0 0 0 0 0 0 0

JOPEH NWF LROPT TRACE  
 0 0 0 0

MULTI-PLAN ANALYSES TO BE PERFORMED

RTIOS= 0.30

\*\*\*\*\*

SUB-AREA RUNOFF COMPUTATION

INFLOW

ISTAU ICUMP IELCON ITAPE JPLT JPRT INAME ISIAGI IAUO  
 1 0 0 0 0 0 1 0 0

HYDROGRAPH DATA  
 TRSDG TORG TAREA SWAP TRSUA TRSPC RATIO ISMOX ISAMP LOCAL  
 1 1 .14 0.00 .14 0.00 0.000 0 1 0

PRECIP DATA

SPFE PMS R6 R12 R24 R48 R72 R96  
 0.00 22.30 117.00 127.00 136.00 143.00 0.00 0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.00

LOSS DATA

LROPT STRKR DLTKH RTIDL ERAIN STNKS RTDIF STRTL CNSTL ALSMX RTIMP  
 0 0.00 0.00 1.00 0.00 0.00 1.00 1.00 0.05 0.00 0.00

UNIT HYDROGRAPH DATA

IP= 1.06 CP= .50 NIA= 0

RECESSION DATA  
SIRIO= -1.50 URCSN= -.05 RTIOR= 2.00  
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND IP ARE C= 6.97 AND R= 8.63 INTERVALS

UNIT HYDROGRAPH 50 END-OF-PERIOD ORDINATES, LAG= 1.07 HOURS, CP= .50 VOL= 1.00

2.	8.	17.	27.	41.	43.	40.	36.	32.
48.	25.	23.	20.	18.	16.	14.	13.	10.
9.	8.	7.	6.	5.	4.	4.	4.	3.
3.	2.	1.	1.	0.	0.	0.	0.	0.

PEAK 6 HOUR 24 HOUR 72 HOUR TOTAL VOLUME  
 CFS 349. 270. 85. 431. 12368.  
 FMS 133. 21. 1. 1. 350.  
 INCHES 22.70 22.83 22.83 579.82 579.82  
 MM 455.73 576.62 579.82 170. 170.  
 AC-FI 134. 169. 170. 210.

HYDROGRAPH ROUTING

ROUTE THRU NO. 1  
 1STAG 1STAG 1STAG 1STAG 1STAG 1STAG 1STAG 1STAG 1STAG 1STAG  
 1STAG 1STAG 1STAG 1STAG 1STAG 1STAG 1STAG 1STAG 1STAG 1STAG

ALL PLANS HAVE SAME

ROUTING DATA  
 LSTR 0  
 IPMP 0  
 ISPRAT 0  
 STOKA -1270.  
 AMSKK X 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000  
 LAG U 0 0 0 0 0 0 0 0 0 0  
 NSTPS 1 0 0 0 0 0 0 0 0 0  
 NSTD 0 5.  
 CLOSE 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000  
 AVG 1 1 1 1 1 1 1 1 1 1  
 IRES ISAME 1 1 1 1 1 1 1 1 1 1

CAPACITY 0.

ELEVATION 1256. 1270. 1276.

CREL 1270.0  
 SPWTD 6.0  
 COBW 3.2  
 EXPW 1.5  
 ELEV 0.0  
 CODE 0.0  
 CAREA 0.0  
 EXPL 0.0

DAM DATA

TOPEL 1273.9  
 COOD 3.0  
 EXPD 1.5  
 DAMWID 390.

5/2

SUB-AREA RUNOFF COMPUTATION

INFLOW

ISTAG ICOMP IECON IITAPE IJPLT JPRT INAME ISTAGE IADTU

IHYDG IUNG TAKLA SNAP TRSDA TRSPC RATIO ISNOW ISAME LOCAL

PRECIP DATA: R6 R12 R24 R48 R72 R96

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA: STRKR DLTKR RTIOL ERAIN STKRS RTIOL STRTL KNSLT ALSMX RTIMP

UNIT HYDROGRAPH DATA

TP= .50 CP= .50 NTA= 0

RECESSION DATA

STR1Q= -1.50 ORCSM= -.705 RTIOL= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.50 AND R= 7.50 INTERVALS

UNIT HYDROGRAPH 47 END-OF-PERIOD ORDINATES, TIME= .90 HOURS, CP= .50 VOL= 1.00

2.	6.	13.	19.	24.	25.	7.	6.	5.	18.
13.	12.	10.	9.	8.	7.	2.	2.	1.	4.
3.	3.	3.	2.	2.	2.	1.	1.	1.	1.
1.	1.	1.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

END-OF-PERIOD FLOW

PEAK	5-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
245.	138.	43.	22.	6206.
7.	4.	1.	1.	176.
CFS	18.39	5.7278	22.91	22.91
INCHES	467.23	578.68	581.92	581.92
MM	69.	85.	85.	85.
AC-FT	85.	105.	105.	105.
THOUS CU M	85.	105.	105.	105.

COMBINE HYDROGRAPHS

COMBINE

ISTAG 4 ICOMP 2 TECON 0 ITAPP 0 JPRT 0 INAME 1 IAU0 0

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
 20% 12% 3% 1% 157.0  
 122.0 38.0 1.0 6.84 6.84

CMS INCHES  
 5.41 1.0 6.84 6.84  
 137.94 172.76 173.70 173.70

AC-FT THOUS CU M  
 61.0 76.0 77.0  
 75.0 94.0 94.0

HYDROGRAPH ROUTING

ROUTE THRU NO. 2

ISTAG 5 ICOMP 2 TECON 0 ITAPP 0 JPRT 0 INAME 1 IAU0 0

ALL PLANS HAVE SAME ROUTING DATA

LOSS CLOSS AVG IRES ISAME IOPT IPMP LSTR  
 0.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

MSR MSR2 MSR3 LAG ANSKA 1 SK STORA 1 SPRAY  
 0.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

STAGE 1249.60 1250.00 1250.50 1251.00 1251.80 1252.00 1252.50 1253.00 1255.00

FLOW 0.00 0.00 18.00 34.00 187.00 69.00 81.00 98.00 201.00

1344.00

CAPACITY= 0. 5. 6.

ELEVATION= 1222. 1250. 1292.

CREL 1249.6 SP/ID 0.0 COOM 0.0 EXPW 0.0 ELEV 0.0 COOL 0.0 CAREA 0.0 EXPL 0.0

DAM DATA

FORM L

NO

AMM

42

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PEAK FLOW AND STORAGE TEND 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)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN RATIO	1	2	3	4
			.30				
HYDROGRAPH AT	1	.14		135.			
		.36		3.81			
	2			135.			
	3			3.81			
ROUTED TO	1			135.			
	2			3.81			
	3			135.			
	4			3.81			
ROUTED TO	1			135.			
	2			3.81			
	3			135.			
	4			3.81			
HYDROGRAPH AT	3	.07		73.			
		.18		2.08			
	2			73.			
	3			2.08			
2 COMBINED	4	.21		204.			
		.54		5.77			
	2			204.			
	3			5.77			
	4			204.			
				5.77			
	4			204.			
				5.77			

1 7.0911  
2 231.  
3 6.5511  
4 219.  
5 6.2011  
6 204.  
7 5.7711

ROUTED TO 6 .21 1 252.

1 231.  
2 6.5511  
3 219.  
4 6.2011  
5 204.  
6 5.7711

10/12

SUMMARY OF DAM SAFETY ANALYSTS

Storage Dam No. 1

PLAN 1 .....  
 INITIAL VALUE SPILLWAY CREST TOP OF DAM  
 ELEVATION 1270.00 1270.00 1273.90  
 STORAGE 3. 3. 5.  
 OUTFLOW 0. 0. 148.

RATIO OF PMF .30  
 MAXIMUM RESERVOIR W.S. ELEV OVER DAM 0.00  
 MAXIMUM STORAGE AC-FT 5.  
 MAXIMUM OUTFLOW CFS 133.  
 DURATION OVER TOP HOURS 0.00  
 TIME OF FAILURE HOURS 40.83  
 TOP OF DAM 1273.90

PLAN 2 .....  
 INITIAL VALUE SPILLWAY CREST TOP OF DAM  
 ELEVATION 1270.00 1270.00 1273.90  
 STORAGE 3. 3. 5.  
 OUTFLOW 0. 0. 148.

RATIO OF PMF .30  
 MAXIMUM RESERVOIR W.S. ELEV OVER DAM 0.00  
 MAXIMUM STORAGE AC-FT 5.  
 MAXIMUM OUTFLOW CFS 133.  
 DURATION OVER TOP HOURS 0.00  
 TIME OF FAILURE HOURS 40.83  
 TOP OF DAM 1273.90

PLAN 3 .....  
 INITIAL VALUE SPILLWAY CREST TOP OF DAM  
 ELEVATION 1270.00 1270.00 1273.90  
 STORAGE 3. 3. 5.  
 OUTFLOW 0. 0. 148.

RATIO OF PMF .30  
 MAXIMUM RESERVOIR W.S. ELEV OVER DAM 0.00  
 MAXIMUM STORAGE AC-FT 5.  
 MAXIMUM OUTFLOW CFS 133.  
 DURATION OVER TOP HOURS 0.00  
 TIME OF FAILURE HOURS 40.83  
 TOP OF DAM 1273.90

PLAN 4 .....  
 INITIAL VALUE SPILLWAY CREST TOP OF DAM  
 ELEVATION 1270.00 1270.00 1273.90  
 STORAGE 3. 3. 5.  
 OUTFLOW 0. 0. 148.

RATIO OF PMF .30  
 MAXIMUM RESERVOIR W.S. ELEV OVER DAM 0.00  
 MAXIMUM STORAGE AC-FT 5.  
 MAXIMUM OUTFLOW CFS 133.  
 DURATION OVER TOP HOURS 0.00  
 TIME OF FAILURE HOURS 40.83  
 TOP OF DAM 1273.90

11/12

SUMMARY OF DAM SAFETY ANALYSIS  
STORAGE DAM NO. 2

PLAN 1	ELEVATION	1249.60	SPILLWAY CREST	1249.60	TOP OF DAM	1251.50
	STORAGE	3.		3.		4.
	OUTFLOW	0.		0.		55.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP	TIME OF FAILURE
.30	1251.71	.21	4.	250.	2.58	40.83
						40.33

PLAN 2	ELEVATION	1249.60	SPILLWAY CREST	1249.60	TOP OF DAM	1251.50
	STORAGE	3.		3.		4.
	OUTFLOW	0.		0.		55.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP	TIME OF FAILURE
.30	1251.71	.21	4.	231.	2.67	40.83
						40.33

PLAN 3	ELEVATION	1249.60	SPILLWAY CREST	1249.60	TOP OF DAM	1251.50
	STORAGE	3.		3.		4.
	OUTFLOW	0.		0.		55.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP	TIME OF FAILURE
.30	1251.71	.21	4.	221.	2.75	40.92
						40.33

PLAN 4	ELEVATION	1249.60	SPILLWAY CREST	1249.60	TOP OF DAM	1251.50
	STORAGE	3.		3.		4.
	OUTFLOW	0.		0.		55.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP	TIME OF FAILURE
.30	1251.71	.21	4.	221.	2.75	40.92
						40.33

12/1

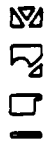
PMF	W.S.ELEV	OVER DAM	AC-FT	CFS	HOURS	HOURS	HOURS
.30	1251.73	.23	4.	204.	6.00	40.67	0.00

PLAN 1		STATION		6	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	MAXIMUM STAGE,FT	TIME HOURS	TIME HOURS
.30	252.	1120.3	1120.3	40.83	40.83

PLAN 2		STATION		6	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	MAXIMUM STAGE,FT	TIME HOURS	TIME HOURS
.30	231.	1120.2	1120.2	41.00	41.00

PLAN 3		STATION		6	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	MAXIMUM STAGE,FT	TIME HOURS	TIME HOURS
.30	217.	1120.2	1120.2	41.00	41.00

PLAN 4		STATION		6	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	MAXIMUM STAGE,FT	TIME HOURS	TIME HOURS
.30	203.	1120.2	1120.2	40.67	40.67



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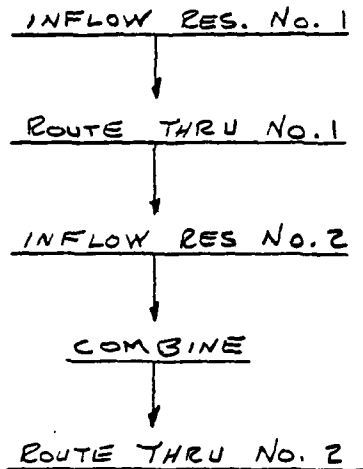
DAM NAME STORAGE RES. No. 1 & No. 2  
 I.D. NUMBER PA. 49-21  
 SHEET NO. 1 OF 3  
 BY OTM DATE 3-14-80

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY THE BALTIMORE DISTRICT  
 CORPS OF ENGINEERS.

STRTL = 1 INCH  
 CNSTL = 0.05 IN/HR  
 STRTQ = 1.5 cfs/Mi<sup>2</sup>  
 QRCSN = 0.05 (5% OF PEAK FLOW)  
 RTIOR = 2.0

PROGRAM SCHEDULE



RESERVOIR No. 1

FROM U.S.G.S. 7.5-MIN. QUAD., DER. FILES AND  
 FIELD INSPECTION DATA.

AT SPILLWAY CREST ELEVATION = 1270'  
 INITIAL STORAGE = 3 AC.FT  
 POND SURFACE AREA = 0.46 AC.

STORAGE (AC.FT)	0	3	4.9
ELEV. (FT)	1256	1270	1273.9



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EBENSBURG PENNSYLVANIA

DAM NAME STORAGE RES. No. 1 & No. 2

I.D. NUMBER PA. 49-21

SHEET NO. 2 OF 3

BY OTM DATE 3-14-80

DISCHARGE RATING CURVE

DETERMINED BY (HEC-1).

SPILLWAY CREST ELEVATION = 1270'

WEIR LENGTH = 6'

COEFFICIENT OF DISCHARGE (C) = 3.2

OVERTOP PARAMETERS

TOP OF DAM ELEVATION (LOW SPOT) = 1273.9'

LENGTH OF DAM (EXCLUDING SPILLWAY) = 390'

COEFFICIENT OF DISCHARGE (C) = 3.0

RESERVOIR No. 2

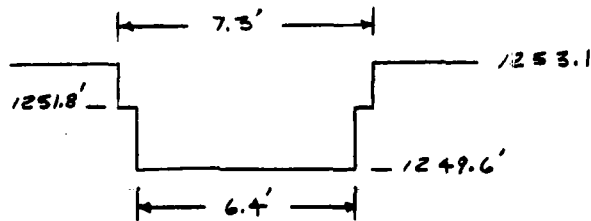
AT SPILLWAY CREST ELEVATION = 1249.6'

INITIAL STORAGE = 5.1 AC.FT

POND SURFACE AREA = 0.64 AC.

STORAGE (AC.FT)	0	5.1	6.4
ELEV. (FT.)	1232	1249.6	1251.5

DISCHARGE RATING CURVE



NOT TO SCALE.



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EBENSBURG PENNSYLVANIA

DAM NAME STORAGE Res. No. 1 & No. 2

I.D. NUMBER PA. 49-21

SHEET NO. 3 OF 3

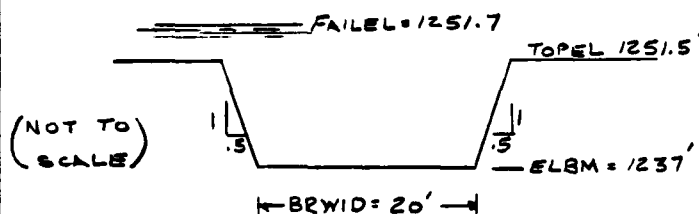
BY OTM DATE 3-14-80

ELEV. (FT.)	C=3.2 L=6.4		C=3.2 L=7.3		DISCHARGE Q (cfs)
	h <sub>1</sub> (FT)	Q <sub>1</sub> (cfs)	h <sub>2</sub> (FT)	Q <sub>2</sub> (cfs)	
1249.6	0	0			0
1250.0	0.4	5			5
1250.5	0.9	18			18
1251.0	1.4	34			34
1251.8	2.2	67	0	0	67
1252.0			0.2	2	69
1252.5			0.7	14	81
1253.0			1.2	31	98
1255.0			3.2	134	201
1257.0			5.2	277	344

### OVERTOP PARAMETERS

TOP OF DAM ELEVATION (LOW SPOT) = 1251.5'  
LENGTH OF DAM (EXCLUDING SPILLWAY) = 420'  
COEFFICIENT OF DISCHARGE (C) = 3.0

### DAM BREACH PARAMETERS



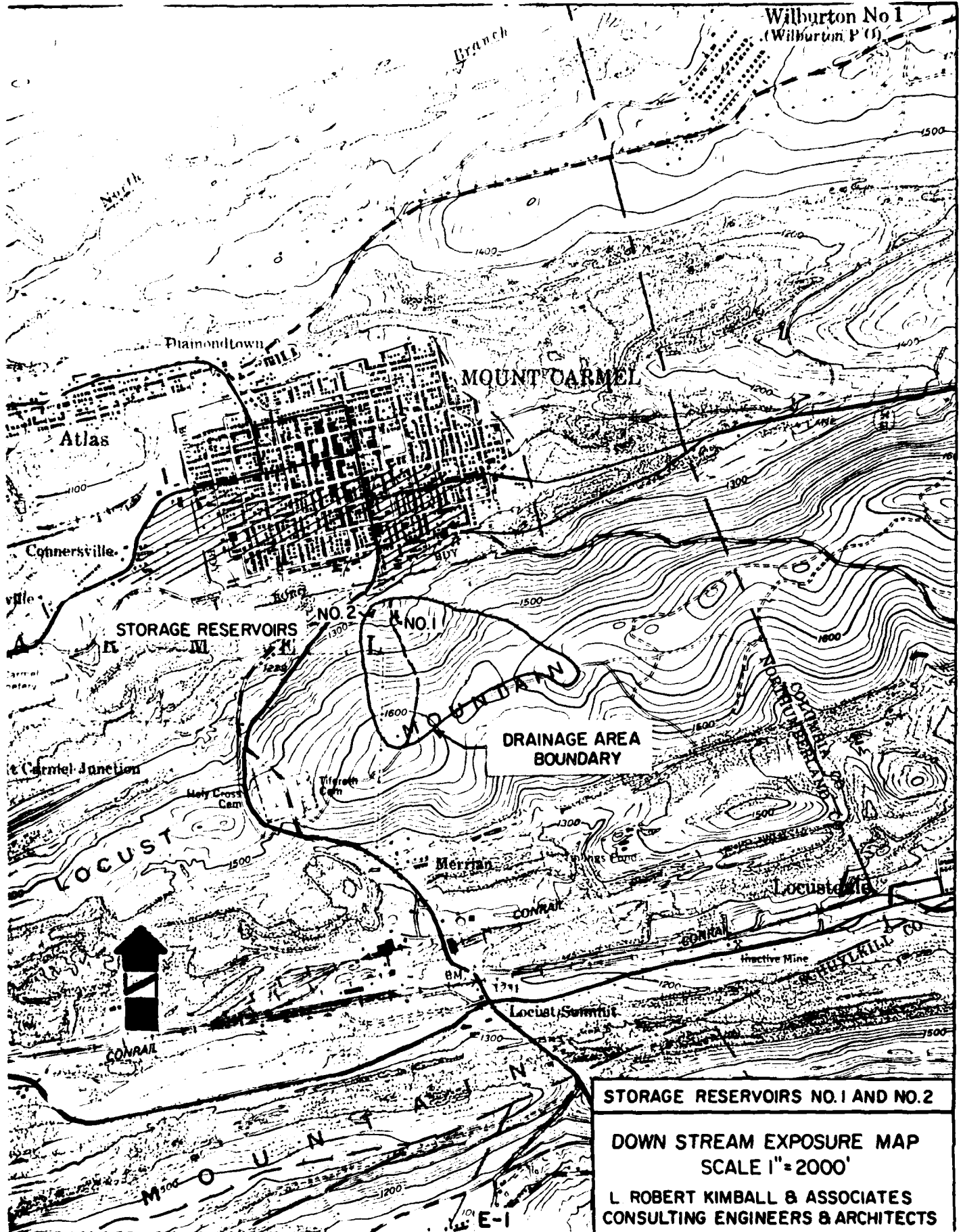
RATIO OF PMF = 0.3  
SIDE SLOPE (Z) = 0.5  
TRAIL = 2, 3 & 4 HRS.  
INITIAL WATER  
SURFACE ELEV. = 1249.6'

### CHANNEL ROUTING

CHANNEL CROSS SECTION OBTAINED FROM U.S.G.S.  
7.5-MIN. QUAD.

QN (1) = 0.06      QN (2) = 0.05

APPENDIX E  
DRAWINGS



Wilburton No 1  
(Wilburton P (S))

Branch

North

Diamondtown

Atlas

MOUNT CARMEL

Connersville

STORAGE RESERVOIRS

NO. 2 NO. 1

DRAINAGE AREA  
BOUNDARY

LOCUST



CONRAIL

MOUNTAIN

NORTH CANTON

Carmel Junction

Holy Cross Cam

Merrian

Locustville

CONRAIL

CONRAIL

Inactive Mine

Locust Summit

SCHUYLKILL CO

MOUNTAIN

STORAGE RESERVOIRS NO. 1 AND NO. 2

DOWN STREAM EXPOSURE MAP  
SCALE 1" = 2000'

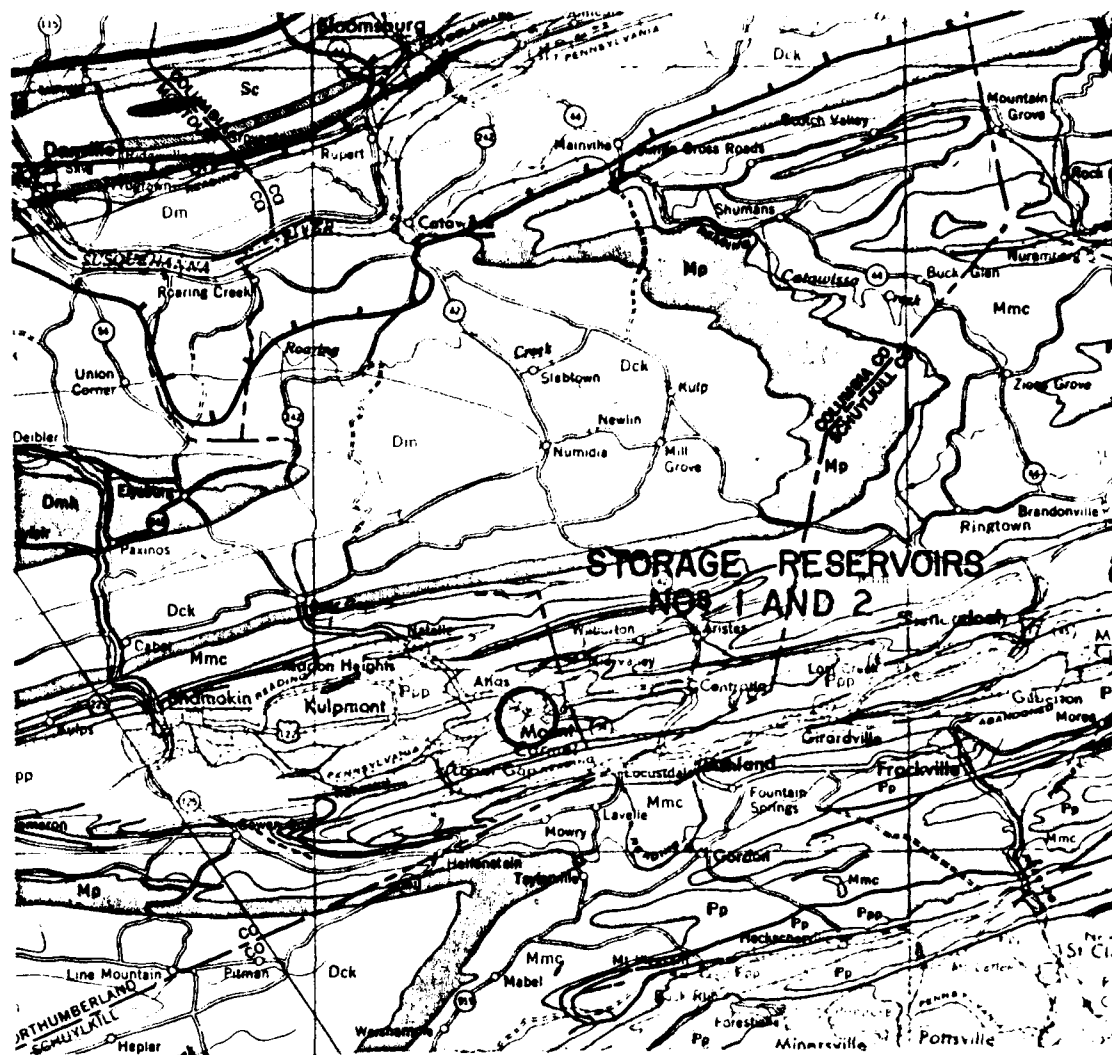
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E-1

APPENDIX F  
GEOLOGY

## General Geology

Storage Reservoirs No. 1 and No. 2 are located in the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. This area is characterized by tightly folded synclines and anticlines. The bedrock underlying the dam and reservoir is the Mississippian aged Mauch Chunk Formation. This formation contains primarily red shales and dark, fine-grained sandstones. The bedding is usually poorly developed. The irregularly spaced joints form a blocky or platy pattern, are fairly abundant and dip steeply. The formation is highly resistant to weathering and forms a good foundation for heavy structures. Some faulting is evidenced approximately three miles east of the reservoir and about four miles south of the reservoir.



GEOLOGIC MAP OF THE AREA AROUND  
STORAGE RESERVOIRS NOS 1 & 2

ANTHRACITE REGION

- Pp Post Pottsville Formations  
*Includes the following formations:*
- Pp Pottsville Group  
*Includes the following formations:*

Scale 1:250,000