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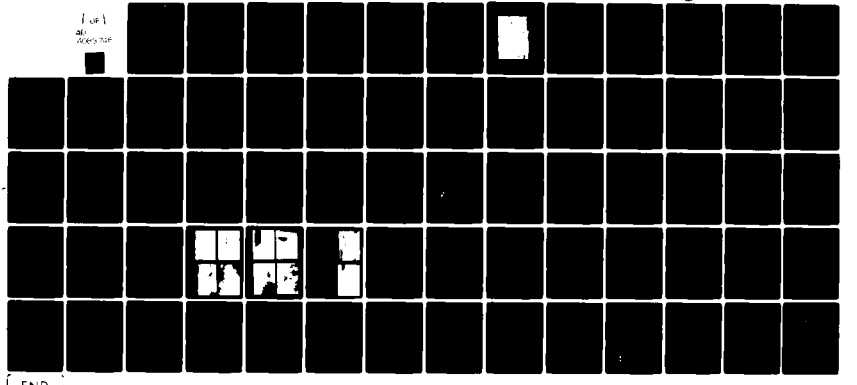

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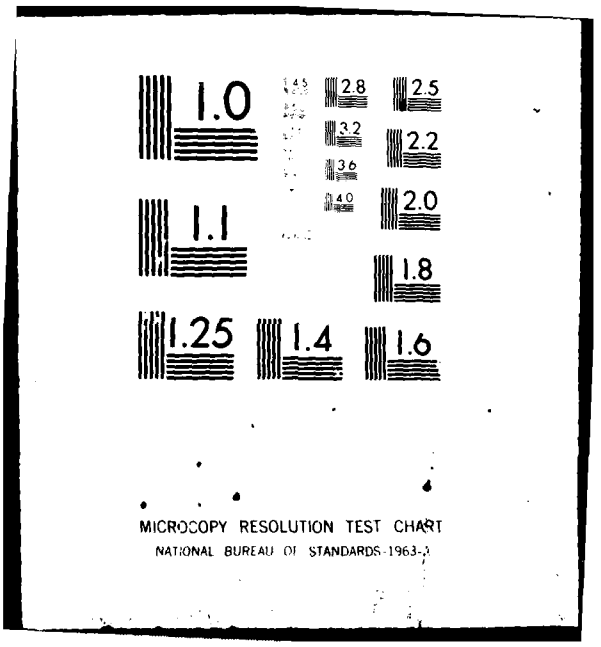
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SUSQUEHANNA RIVER BASIN

LOST CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

RAVEN RUN DAM NO. 2

NDS ID NO. PA-663

DER ID NO. 54-7

SHENANDOAH MUNICIPAL AUTHORITY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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

MARCH, 1980

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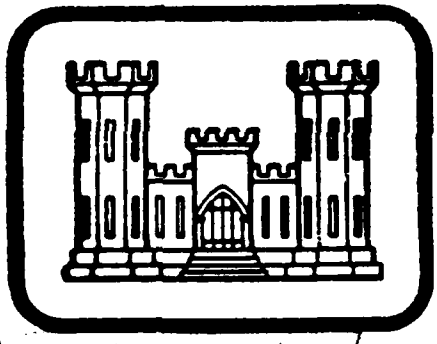

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PREFACE

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 detemining 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 REPORT

NAME OF DAM	Raven Run Dam No. 2
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Schuylkill
STREAM	Lost Creek
DATE OF INSPECTION	November 6 and 16, 1979

ASSESSMENT

The assessment of Raven Run Dam No. 2 is based upon visual observations made at the time of inspection, interviews with the owner and hydraulic and hydrologic analyses.

Raven Run Dam No. 2 is a high hazard-small size dam. The spillway design flood was selected as the PMF (probable maximum flood). The spillway and reservoir are capable of controlling the PMF. Based on criteria established by the Corps of Engineers, the spillway is termed adequate. The seepage exiting below the toe of dam should be monitored at regular intervals. In addition, a subsidence investigation should be conducted to determine the effects of past and present mining beneath the structure.

The following recommendations and remedial measures should be instituted immediately.

1. A professional engineer knowledgeable in earth dams should monitor and evaluate the seepage and slope movement and determine its effects on the stability of the dam.

2. All trees and brush should be cleared from the slopes, crest and from the emergency spillway discharge channel under the direction of a professional engineer knowledgeable in the design and construction of earth dams.

3. Positive drainage should be provided at the toe of dam to drain all ponded areas and flow from those areas should be monitored.

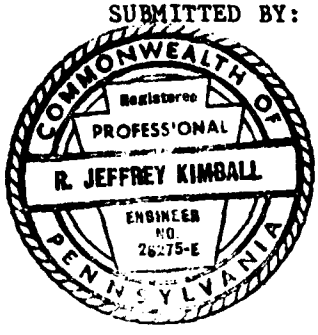
4. Some means of positive closure of the drainline should be developed in case of emergencies.

5. A subsidence investigation should be conducted by the owner or his engineer to determine the possibility of mine subsidence and the affects on the safety of the structure.

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

7. Regular safety inspections should be conducted in accordance with provisions stipulated by the Commonwealth of Pennsylvania regarding the inspection of dams.

SUBMITTED BY: L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS



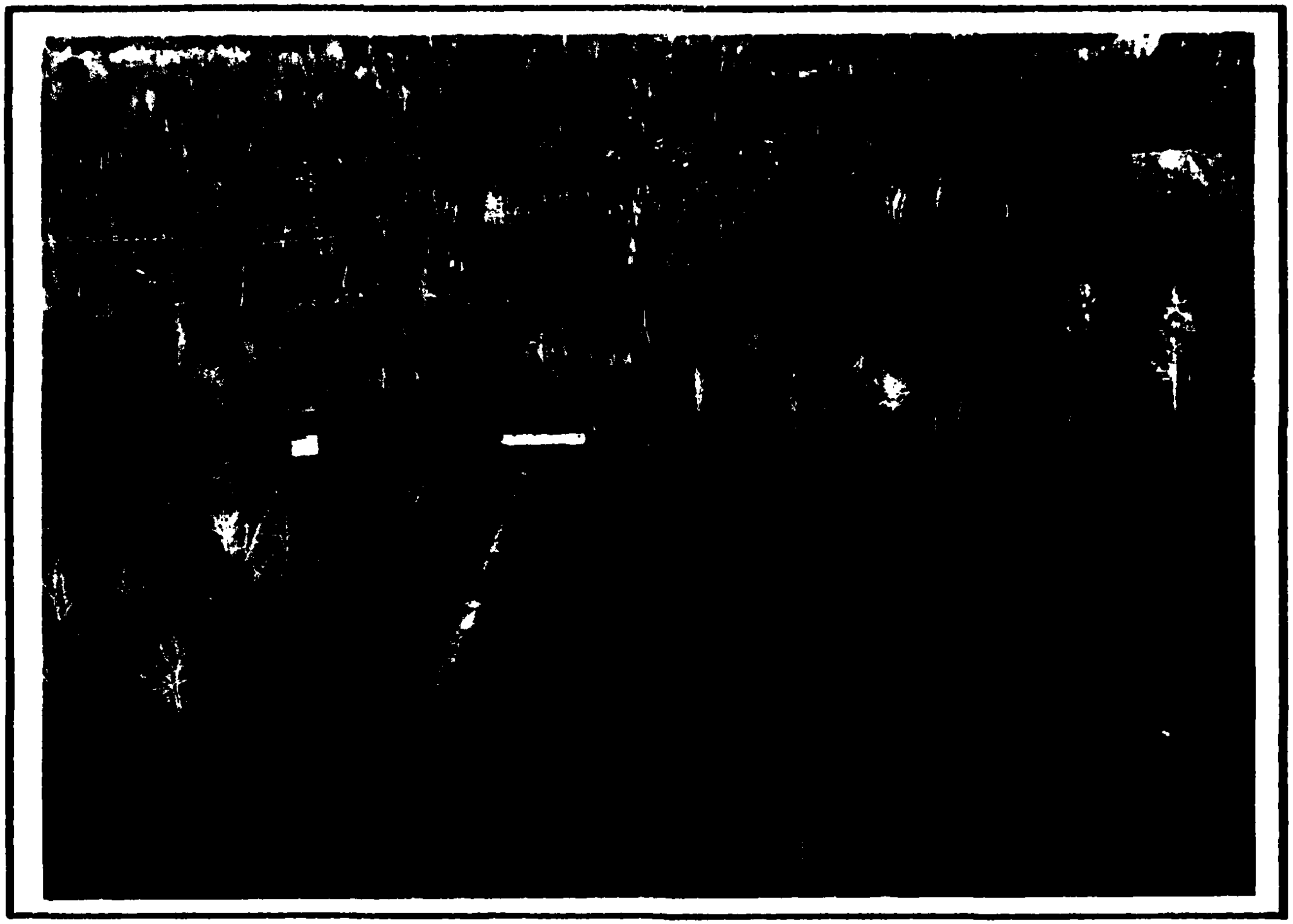
March 18, 1980
Date

R Jeffry Kimball
R. Jeffrey Kimball, P.E.

APPROVED BY:

25 March 1980
Date

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



Overview of upstream slope and spillway of Raven Run Dam No. 2.

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APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
RAVEN RUN DAM NO. 2
NDI. I.D. NO. PA 663
DER I.D. NO. 54-7

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. Raven Run Dam No. 2 is an earth and rockfill dam, 462 feet long and 37 feet high. The crest width of the dam is 8 feet. The upstream slope is 2H:1V and protected with hand placed stone. The downstream slope is 1.5H:1V and is covered with stone rubble.

The spillway is located on the right abutment and consists of a rectangular shaped weir formed by stone masonry walls on both sides. The weir is 60 feet long. The spillway exit channel discharges on the right hillside below the toe of dam.

The outlet conduit consists of a 24" or a 36" cast iron pipe under the earth embankment. A meter box to record flow through the pipe is located 40 feet beyond the toe of dam.

Upstream of Raven Run Dam No. 2 is Raven Run Dam No. 3. All flows from Raven Run Dam No. 3 discharge into Raven Run No. 2 Reservoir.

b. Location. The dam is located on Lost Creek, approximately 2 miles west of Shenandoah, Schuylkill County, Pennsylvania. Raven Run Dam can be located on the Shenandoah, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Rave Run Dam No. 2 is a small size dam (37 feet high, 139 acre-feet).

d. Hazard Classification. Raven Run Dam No. 2 is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail.

Approximately 3,000 feet downstream of the dam is a high railroad embankment with a culvert beneath. Immediately downstream of this culvert are approximately 10 dwellings on Lost Creek.

e. Ownership. Raven Run Dam is owned by the Shenandoah Municipal Authority. Correspondence should be addressed to:

Shenandoah Municipal Authority
26 West Lloyd Street
Shenandoah, PA 17976
Attention: Charles Dallazia, Manager
717-462-1904

f. Purpose of Dam. Raven Run Dam No. 2 is used for water supply.

g. Design and Construction History. No information is available on the design or construction history of the dam. It is believed that the dam was constructed around the time (1884-1885) of Raven Run Dam No. 3.

h. Normal Operating Procedures. The reservoir level is maintained at the spillway crest elevation (1580.5). The outlet pipe remains open and flow is discharged through this pipe on an as-needed basis to the water system. Excess flow is discharged through the spillway.

1.3 Pertinent Data.

a. Drainage Area (total). 0.93 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Unknown
Spillway capacity at top of dam (spillway only)	1601
Discharge at right abutment around spillway	387
Reservoir Drain (24" or 36" CIP)	Unknown

c. Elevation (U.S.G.S. Datum) (feet). - Field survey based on pool elevation of 1580.5' as determined from survey at Raven Run Dam No. 3.

Top of dam - low point	1584.7
Top of dam - design height	Unknown
Maximum pool (PMF)	1584.7
Normal pool	1580.5
Emergency spillway crest	1580.5
Streambed at centerline of dam	1548.0
Toe of dam	1548.2

d. Reservoir (feet).

Length of maximum pool	900
Length of normal pool	900

e. Storage (acre-feet).

Normal pool	98
Top of dam	139

f. Reservoir Surface (acres).

Top of dam	11.4
Normal pool	9
Spillway crest	9

g. Dam.

Type	Earthfill
Length	462'
Height	37'
Top width	8'
Side slopes - upstream	2H:1V
- downstream	1.5H:1V
Zoning	Earth and rock rubble
Impervious core	Unknown
Cutoff	Unknown
Grout curtain	Unknown

h. Reservoir Drain.

Type	24" or 36" CI pipe
Length	Approximately 140 feet
Closure	Valve at toe
Access	None
Regulating facilities	Valve at toe

i. Spillway.

Type	Rectangular
Weir Length	60'
Crest elevation	1580.5'
Upstream channel	Unrestricted (lake)
Downstream channel	Open channel

SECTION 2
ENGINEERING DATA

2.1 Design. Neither the owner nor the Commonwealth of Pennsylvania, Department of Environmental Resources had any information pertaining to construction drawings, inspection reports, permits, photographs or correspondence for this structure. All information regarding this dam was obtained from discussions with the owner and from the visual inspection.

2.2 Construction. No information exists on construction of the dam.

2.3 Operation. No operating records are maintained.

2.4 Evaluation.

a. Availability. No engineering data were provided by PennDER or by the owner. A representative of the owner accompanied the inspection team to answer questions on operation and maintenance of the dam. The owner did not provide any information on past deep mining activities in the area of the dam and reservoir.

b. Adequacy. No design, construction or engineering data are available. The information is not sufficient to conduct a detailed engineering study. The Phase I report was completed based upon data obtained from the visual inspection and hydrologic analysis only.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Raven Run Dam No. 2 was conducted by personnel of L. Robert Kimball and Associates accompanied by a representative of the owner. 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. The dam appears to be in fair condition. From a brief survey conducted during the inspection, it is noted that the crest of the dam contained a low spot at elevation 1584.7. The crest width is 8 feet. The upstream slope above the water level was measured to be 2H:1V and covered with hand placed stone. In addition, the upstream slope is covered with small trees and brush. The downstream slope was measured to be 1.5H:1V and covered with stone rubble. The downstream slope is extensively covered with large trees.

A ponded area was noted at the toe of dam. This ponded area is formed by poor surface drainage. A seepage zone was noted downstream of the dam on the right abutment approximately 12 feet above the toe. This seepage was estimated at 2 gallons per minute. Seepage was also exiting from a meter box which houses the outlet conduit. Only the top portion of the box was visible and some of the seepage may be flowing under the pipe and out of view.

c. Appurtenant Structures. The outlet conduit consists of a 24 to 36 inch cast iron pipe. This pipe was noted in the meter box, which is located 40 feet downstream of the toe of dam. The outlet conduit does not have an upstream shutoff. No other details are known on the outlet works because of the lack of any drawings.

The 60 foot wide spillway is located on the right abutment and is formed by stone masonry walls on either side. Flows through the spillway discharge downstream of the dam on the right abutment hillside. Immediately to the right of the spillway is a paved road at an elevation between the spillway crest and the top of dam. During periods of flooding, flow over

this road may act as additional spillway capacity. Grass and brush are growing in the spillway exist channel.

d. Reservoir Area. The watershed is covered mostly with timberland, strip mined land and Raven Run Reservoir No. 3. The reservoir slopes are moderate but are not considered susceptible to massive landslides which would affect the storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. The downstream channel of Lost Creek is narrow and confined. Approximately 3,000 feet downstream of the dam is a high railroad embankment with a culvert through the embankment to control the normal flow of Lost Creek. Immediately downstream of this railroad embankment, 10 dwellings are located on Lost Creek.

3.2 Evaluation. In general, the embankment and appurtenant structures appear to be in fair condition but poorly maintained. No construction drawings are available to compare the field conditions with the design of the structure. The seepage areas at the toe of dam should be monitored on a regular basis.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir water surface is maintained at the spillway crest elevation 1580.5. Water is drawn off the reservoir on an as-needed basis to the water system. Excess inflow discharges over the spillway crest.

4.2 Maintenance of the Dam. No planned maintenance schedule exists. Maintenance of the dam is considered poor and is performed by the Municipal Authority staff.

4.3 Maintenance of Operating Facilities. Maintenance of the operating facilities is considered poor. The owners representative was unaware of the reservoir drain being opened in the recent past.

4.4 Warning System in Effect. At the time of the inspection no system was in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. Maintenance of the dam is considered fair. Maintenance of the operating facilities is considered poor. There is no warning system in effect to warn downstream residents.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No calculations or design data pertaining to hydrology were available.

b. Experience Data. No rainfall, runoff or reservoir level data were available. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The spillway appeared to be in fair condition but poorly maintained. Grass and brush growing in the spillway has been left unattended and debris is collecting in the spillway channel.

A low spot was noted near the middle of the embankment approximately 200 feet from the left abutment.

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 initial water level before the flood is 1580.5.

2. Additional discharge capacity is available at the right abutment. A roadway which passes by the right spillway wall is at such an elevation that flow will occur simultaneously through and around the spillway. Discharge around the spillway was considered in the $L, $V option of the HEC-1 program.

3. The flood was routed through the upstream reservoir (Raven Run Dam No. 3).

Field survey measurements taken during the inspection indicate that the top of dam varies from 1584.7 feet to 1585.7 feet.

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

Peak inflow (PMF)	2002 cfs
Spillway capacity	1601 cfs
Additional capacity (roadway)	380 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for this dam was selected as the PMF. The SDF is based on the hazard and size classification of the dam. Based on the following definition provided by the Corps of Engineers, the spillway is rated as adequate as a result of our hydrologic analysis.

> Adequate - All high hazard dams the spillway can pass the SDF.

The spillway and reservoir are capable of controlling the PMF without overtopping the embankment. A computer printout of the hydrology is included in Appendix D.

5.4 Summary of Dam Breach Analysis. As the subject dam can satisfactorily pass 50% of the PMF without failure (based on our analysis) it was not necessary to perform a breach analysis and downstream routing of flood wave.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. No signs of erosion were noted on the embankment during the inspection. The trees on the downstream slope indicated that slow movement of the downstream rubble rock material was taking place. The downstream slope is very steep (1.5H:1V) and the material forming the embankment is unknown. A ponded area was noted at the toe of dam to the left of the meter box. This ponded area appears to be caused by poor drainage. A seepage area was noted on the right abutment below the toe of dam and was estimated at 2 gallons per minute. The top of the seepage area is approximately 12 feet above the toe of dam. In addition, seepage was exiting from the top of the meter box beyond the toe of dam. Only the top portion of the meter box was visible. These seepage areas should be monitored on a regular basis.

b. Design and Construction Data. No design data are available for this dam. No stability analyses have been performed.

c. Operating Records. No operating records are maintained.

d. Post Construction Changes. Because of the lack of any data corresponding to this dam, it is unknown whether any post construction changes have been made to the dam.

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 appears to be in fair condition. The visual observations and hydrologic and hydraulic calculations indicate that Raven Run Dam No. 2 spillway is adequate. The spillway is capable of controlling the PMF without overtopping the earth embankment. No data are available on the design or construction of the dam. No stability analyses are known to have been performed on the dam. The long term affect of seepage and piping potential on the stability and the possibility of subsidence are of concern.

b. Adeqacy of Information. A detailed analysis of the structure cannot be made because of the lack of any design or construction information, drawings, correspondence or past history. This Phase I Report is based upon the visual inspection, discussions with the owner and hydrolgic and hydraulic analyses.

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. A professional engineer knowledgeable in earth dams should monitor and evaluate the seepage and slope movement and determine its effects on the stability of the dam.

2. All trees and brush should be cleared from the slopes, crest and from the emergency spillway discharge channel under the direction of a professional engineer knowledgeable in the design and construction of earth dams.

3. Positive drainage should be provided at the toe of dam to drain all ponded areas and flow from those areas should be monitored.

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

5. A subsidence investigation should be conducted by the owner or his engineer to determine the possibility of mine subsidence and the affects on the safety of the structure.

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

7. Regular safety inspections should be conducted in accordance with provisions stipulated by the Commonwealth of Pennsylvania regarding the inspection of dams.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Raven Run Dam No. 2 COUNTY Schuylkill STATE Pennsylvania ID# PA663

TYPE OF DAM Earth and rockfill dam HAZARD CATEGORY High

DATE(s) INSPECTION Nov. 6 and 16, 1970 WEATHER Cloudy and warm TEMPERATURE 50°

POOL ELEVATION AT TIME OF INSPECTION 1580.5 M.S.L. TAILWATER AT TIME OF INSPECTION None M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

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.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	No erosion noted. Trees on the downstream slope indicated slow movement.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Low spot in middle of embankment. Horizontal alignment appear all right.	
RIPRAP FAILURES	Riprap in good condition.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	The upstream and crest were covered with small trees and brush. The downstream slope is covered with heavy timber.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appeared to be good, with the exception of seepage exiting along the right abutment.	
ANY NOTICEABLE SEEPAGE	Junction of right abutment and embankment showed signs of seepage which was measured to be approximately 2 gallons per minute. Approximately 1 gallon per minute was exiting from the meter box which is located approximately 40 feet downstream of the toe of dam.	
STAFF GAUGE AND RECORDER	None	
DRAINS	None	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	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	The outlet structure was only observed in the meter box. The outlet works appeared to be a 24 to 36 inch cast iron pipe. Seepage was exiting from this vicinity.	
INTAKE STRUCTURE	Unobserved.	
OUTLET STRUCTURE	None.	
OUTLET CHANNEL	Lost Creek steep, narrow.	
EMERGENCY GATE	Unobserved.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Appeared to be in good condition.	
APPROACH CHANNEL	Lake	
DISCHARGE CHANNEL	Natural hillside on right abutment.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

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

DOWNSTREAM CHANNEL

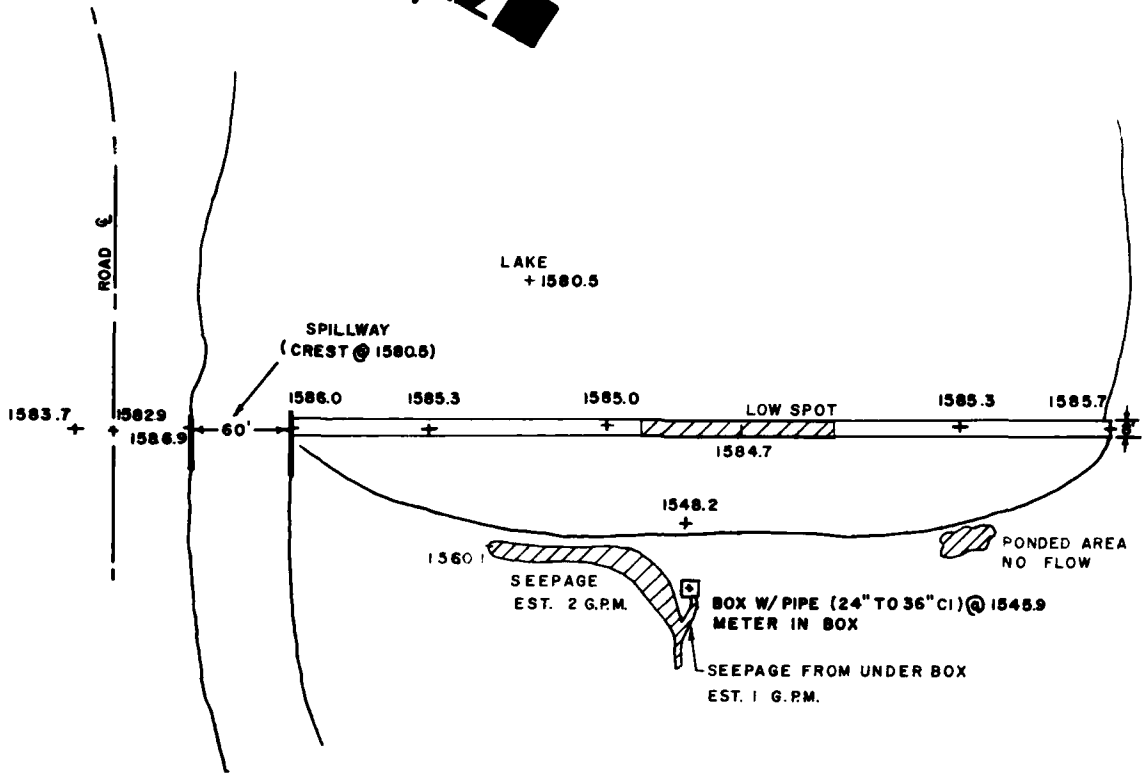
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Steep, narrow and confined. Approximately 3,000 feet downstream is a high railroad embankment with a culvert beneath.	
SLOPES	Steep. Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 10 dwellings, 40 people.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate appear to be stable.	
SEDIMENTATION	Does not appear to be excessive due to upstream reservoir.	

INSTRUMENTATION

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



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RAVEN RUN NO. 2

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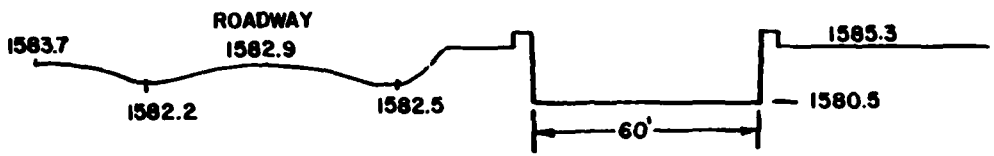
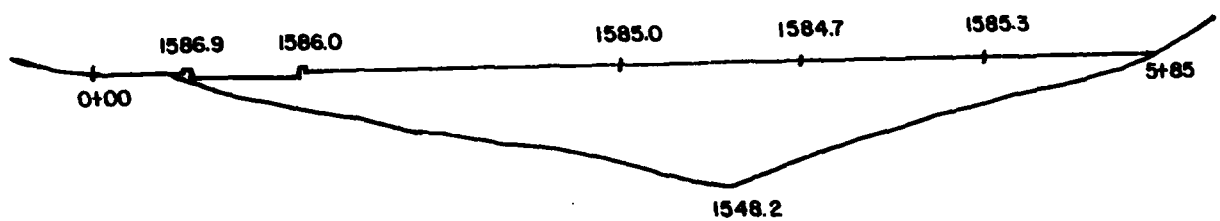


SPILLWAY AND RIGHT ABUTMENT
PROFILE
(Not to Scale)



PROFILE
LOOKING UPSTREAM

RAVEN RUN NO. 2
Scale 1"=100'

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

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Raven Run Dam No. 2

ID# PA 663

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.

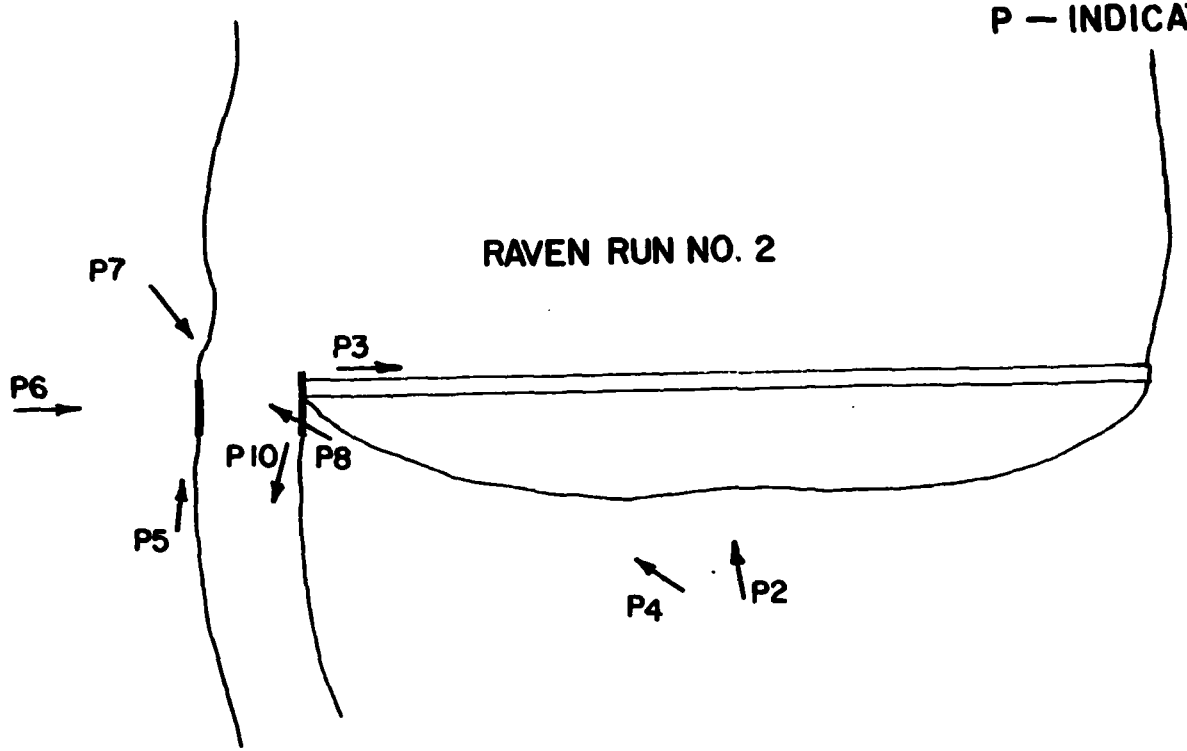
ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Unknown.
POST-CONSTRUCTION SURVEYS OF DAM	Unknown.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Unknown.
HIGH POOL RECORDS	None.
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

P — INDICATES PHOTO LOCATION



C-1

RAVEN RUN NO. 2
PHOTO INDEX

RAVEN RUN DAM NO. 2

Photograph Descriptions.

Sheet 1. Front

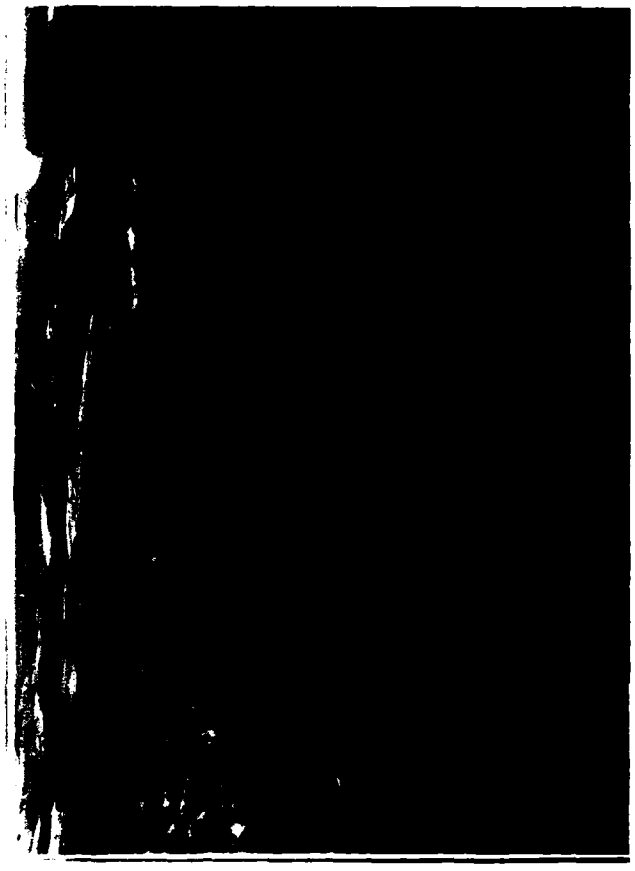
(1) Upper left - Raven Run Dam No. 2 with Raven Run Dam No. 3 upstream.
(2) Upper right - Meter box located beyond toe of dam.
(3) Lower left - Upstream slope and crest.
(4) Lower right - Seepage exiting from embankment (right)/abutment contact.

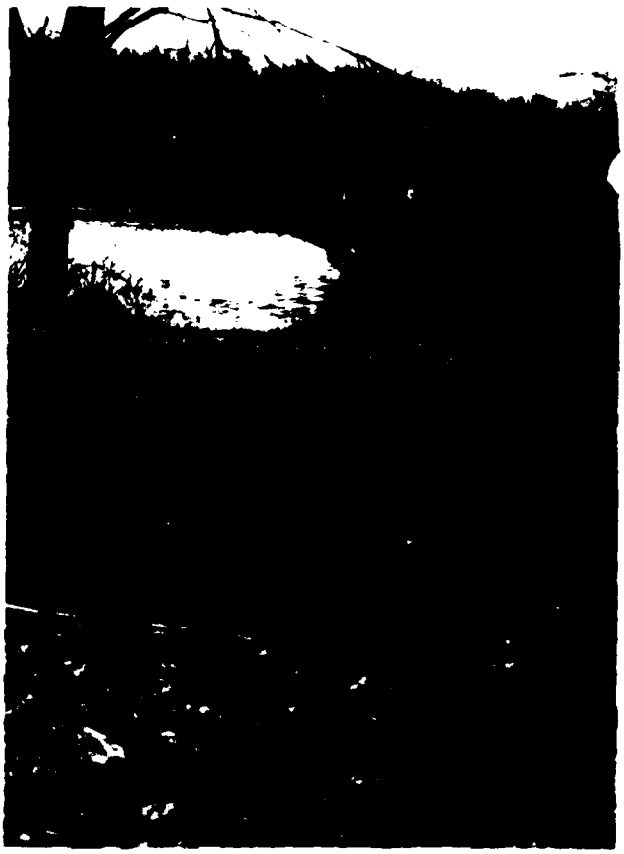
Sheet 1. Back

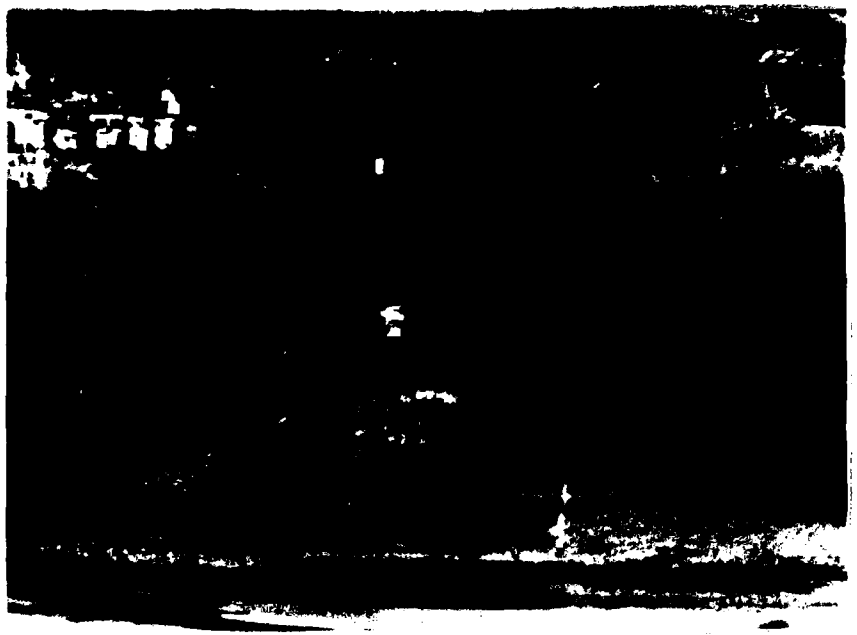
(5) Upper left - Right spillway wall.
(6) Upper right - Upstream slope of dam and spillway approach from right abutment.
(7) Lower left - Spillway weir.
(8) Lower right - Right spillway wall with paved road adjacent.

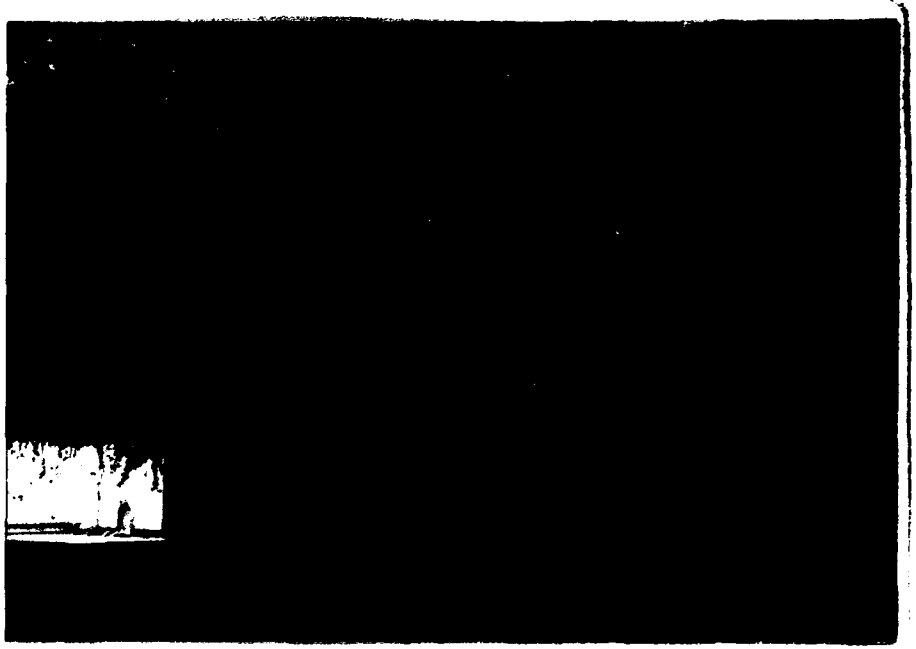
Sheet 2. Front

(9) Upper right - Downstream exposure below Raven Run Dam No. 2.
(10) Lower right - Spillway exit channel.









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 topgraphic
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: Raven Run Dam No. 2

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

STATION	1	2	3
Station Description	Raven Run No. 3	Raven Run No. 2	
Drainage Area (square miles)	0.70	0.23	
Cumulative Drainage Area (square miles)	0.70	0.93	
Adjustment of PMF for Drainage Area (%)(1)			
6 hours	117	117	
12 hours	127	127	
24 hours	136	136	
48 hours	143	143	
72 hours	145	145	
Snyder Hydrograph Parameters			
Zone (2)	13	13	
Cp (3)	0.50	0.50	
Ct (3)	1.85	1.85	
L (miles) (4)	1.9	0.4	
Lca (miles) (4)	0.95	0.2	
tp = Ct(LxLca) 0.3 hrs.	2.21	0.87	
Spillway Data			
Crest Length (ft)	40	60	
Freeboard (ft)	3.6	4.2	
Discharge Coefficient	3.1	3.1	
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_p and C_t).

(3) Snyder's Coefficients.

(4) L=Length of longest water course from outlet to basin divide. L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: D.A.=0.93 Mi^2 Wooded , large strip area

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 98 ac..ft.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 139 ac.ft.

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1584.7 feet

SPILLWAY CREST:

a. Elevation 1580.5 feet
b. Type Rectangular
c. Width 60 feet
d. Length Unknown
e. Location Spillover Right abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 24" to 36" CIP
b. Location Maximum section
c. Entrance inverts Unknown
d. Exit inverts Approximately 1544 feet
e. Emergency draindown facilities 24" or 36" CIP

HYDROMETEOROLOGICAL GAUGES:

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

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

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CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME RAVEN RUN NO. 2
I.D. NUMBER 54-7
SHEET NO. 1 OF 4
BY OTM DATE 1-25-80

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT.

STRTL = 1 INCH
CNSTL = 0.05 IN/HR
STRTQ = 1.5 cfs/mi^2
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.0

ELEVATION - AREA - CAPACITY RELATIONSHIPS

FROM USGS 7.5-MIN. QUAD., DER FILES AND FIELD INSPECTION DATA.

AT SPILLWAY CREST ELEV. = 1580.5'
INITIAL STORAGE = 97.5 AC.FT
POND SURFACE AREA = 9 AC

AT ELEV. 1600', AREA = 18 AC.

FROM CONIC METHOD FOR RESERVOIR VOLUME. FLOOD HYDROGRAPH PACKAGE (HEC-1), DAM SAFETY VERSION (USERS MANUAL).

$H = 3V/A$
$= 3(97.5)/9$
$= 292.5/9$
$= 32.5'$

ELEVATION WHERE AREA EQUALS ZERO:

$1580.5' - 32.5' = 1548'$

AREA	#A	0	9	18
ELEV.	#E	1548	1580.5	1600

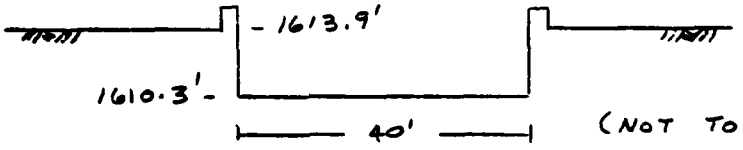
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME RAVEN RUN No. 2
I.D. NUMBER 54-7
SHEET NO. 2 OF 4
BY OTM DATE 2-25-80

DISCHARGE RATING CURVE (RAVEN RUN No. 3)

DETERMINED BY (HEC-1).

SPILLWAY CREST ELEV. = 1610.3'
WEIR LENGTH = 40'
COEFFICIENT OF DISCHARGE (C) = 3.1



(NOT TO SCALE)

OVERTOP PARAMETERS

TOP OF DAM ELEV. (LOW SPOT) = 1613.9'
LENGTH OF DAM (EXCLUDING SPILLWAY) = 1080'
COEFFICIENT OF DISCHARGE (C) = 3.0 (BROAD CREST)
$L_{MAX.}$ = 1080'
$V_{MAX.}$ = 1617'

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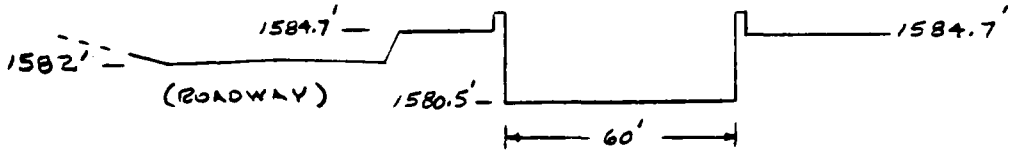
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME RAVEN RUN NO. 2
I.D. NUMBER 54-7
SHEET NO. 3 OF 4
BY OTM DATE 1-25-80

DISCHARGE RATING CURVE (RAVEN RUN NO. 2)

DETERMINED BY (HEC-1).

SPILLWAY CREST ELEV. = 1580.5'
WEIR LENGTH = 60'
COEFFICIENT OF DISCHARGE (C) = 3.1



NOTE:

THE ADJACENT ROADWAY (RIGHT ABUTMENT) WILL AT SOME TIME PROVIDE ADDITIONAL SPILLWAY CAPACITY. THIS ADDITIONAL DISCHARGE WILL BE ACCOUNTED FOR IN THE #L, #V OPTION PROVIDED IN HEC-1 PROGRAM.

THE OUTPUT, "SUMMARY OF DAM SAFETY ANALYSIS", (TOP OF DAM - OUTFLOW) WILL RECORD THE COMBINATION OF SPILLWAY DISCHARGE AND THAT PORTION OF THE #L, #V DISCHARGE PRIOR TO THE POOL ELEV. REACHING THE TOP OF DAM ELEV. 1584.7.

THE ADDITIONAL DISCHARGE CAPACITY CAN BE COMPUTED BY THE FOLLOWING EQUATION.

$$Q_1 = Q_T - Q_2$$
$$= Q_T - [(C)(L)(h)^{3/2}]$$
$$= Q_T - [(C)(L)(\text{MAX. RES. W.S. ELEV} - \text{SPILLWAY CREST})^{3/2}]$$

WHERE Q_1 = DISCHARGE CAPACITY (ROADWAY)
Q_T = TOP OF DAM (OUTFLOW)
Q_2 = SPILLWAY DISCHARGE

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME RAVEN RUN No. 2
I.D. NUMBER 54-7
SHEET NO. 4 OF 4
BY OTM DATE 1-25-80

"FROM HEC-1 OUTPUT"

Q_T = 1988 cfs
MAXIMUM RESERVOIR W.S. ELEV. = 1584.71' (PMF)

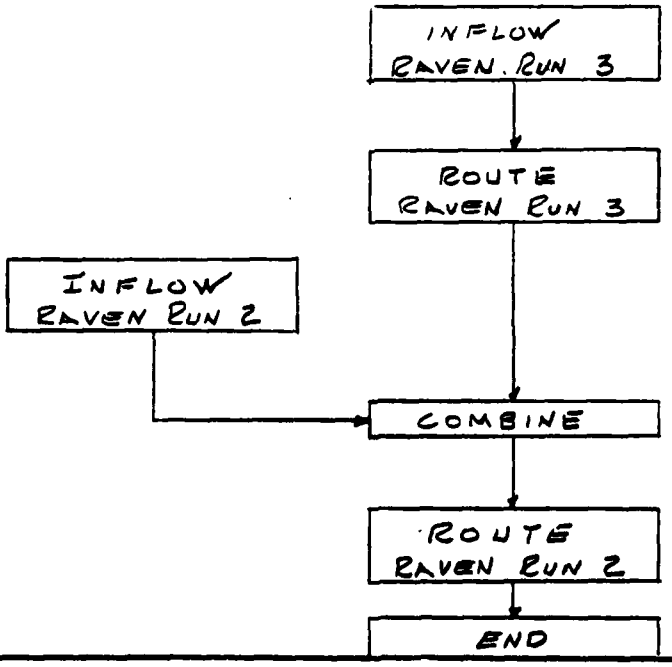
$$Q_2 = 1988 - [(3.1)(60)(1584.71 - 1580.5)^{3/2}$$

$$= 1988 - 1606.7$$
$$= 381.3 \text{ cfs}$$

OVERTOP PARAMETERS

TOP OF DAM ELEV. (LOW SPOT) = 1584.7'
LENGTH OF DAM (EXCLUDING SPILLWAY) = 462'
COEFFICIENT OF DISCHARGE (C) = 3.0 (BROAD CREST)
#L_{MAX} = 800'
#Y_{MAX} = 1600'

PROGRAM SCHEDULE



```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1  A1    ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2  A2    HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF RAVEN RUN NO. 2
    3  A3    RATIOS OF PMF ROUTED THROUGH THE RESERVOIR  PA. 54-7
    4  B     288       0      15       0       0       0       0       0       0       0
    5  B1    5
    6  J     5         5      1
    7  J1    .1        .2     .3       .4      .5      1
    8  K     0         1                                       1
    9  K1      INFLOW TO RESERVOIR NO. 3
   10  M     1         1      0.7                                                      1
   11  P               22.3   117      127     136     143     145
   12  T                                                       1.0     0.05
   13  W     2.21      0.50
   14  X     -1.5      -.05   2.0
   15  K     1         2                                       1
   16  K1      ROUTE THRU RESERVOIR NO. 3
   17  Y                                       1       1
   18  Y1    1                                                 -1610.3
   19  SA    0         14     37
   20  SE1564.2        1610.3 1620
   21  SS1610.3        40     3.1     1.5
   22  SD1613.9        3.0    1.5     1080
   23  SL    10        200    350     660     1080
   24  SV1613.9        1614   1615    1616    1617
   25  K     0         3                                       1
   26  K1      INFLOW TO RESERVOIR NO. 2
   27  M     1         1      0.23                                                     1
   28  P               22.3   117      127     136     143     145
   29  T                                                       1.0     0.05
   30  W     0.87      0.50
   31  X     -1.5      -.05   2.0
   32  K     2         4                                       1
   33  K1      COMBINE
   34  K     1         5                                       1
   35  K1      ROUTE THRU RESERVOIR NO. 2
   36  Y                                       1       1
   37  Y1    1                                                 -1580.5
   38  SA    0         9      18
   39  SE    1548      1580.5 1600
   40  SS1580.5        60     3.1     1.5
   41  SD1584.7        3.0    1.5     462
   42  SL    2         27     37      137     560     585     800
   43  SV    1582      1583   1584    1584.7  1585    1586    1600
   44  K     99
```

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

RUN  DATE= 80/01/15.
     TIME= 07.35.48.

     ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
     HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF RAVEN RUN NO. 2
     RATIOS OF PMF ROUTED THROUGH THE RESERVOIR  PA. 54-7

                              JOB SPECIFICATION
      NQ     NRK    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
     288      0      15       0       0      0       0       0       0       0
                            JOPER     NWT   LROPT   TRACE
                               5       0       0       0

                  MULTI-PLAN ANALYSES TO BE PERFORMED
                  NPLAN= 1  NRTIO= 6  LRTIO= 1
          RTIOS=   .10    .20    .30    .40    .50   1.00

                          SUB-AREA RUNOFF COMPUTATION

     INFLOW TO RESERVOIR NO. 3

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

                              HYDROGRAPH DATA
          IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO  ISNOW  ISAME  LOCAL
              1       1     .70    0.00     .70    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  145.00    0.00

     TRSPC COMPUTED BY THE PROGRAM IS  .800

                              LOSS DATA
          LROPT  STRKR  DLTKR  RTIOL  ERAIN  STRKS  RTIOK  STRTL  CNSTL  ALSMX  RTIMP
              0   0.00   0.00   1.00    .00   0.00   1.00   1.00    .05   0.00   0.00

                          UNIT HYDROGRAPH DATA
                TP=  2.21    CP= .50    NTA=  0

                          RECESSION DATA
                STRTQ= -1.50    QRCSN=  -.05    RTIOR= 2.00
     APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 9.45 AND R=12.07 INTERVALS

          UNIT HYDROGRAPH 69 END-OF-PERIOD ORDINATES, LAG=  2.23 HOURS, CP=  .50  VOL= 1.00
            3.    13.    27.    43.    60.    77.    90.    99.   104.   102.
           98.    87.    80.    74.    68.    62.    57.    53.    49.    45.
```

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1610.	0

SURFACE AREA=	0.	14.	37.	
CAPACITY=	0.	219.	454.	
ELEVATION=	1564.	1610.	1620.	

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1610.3	40.0	3.1	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1613.9	3.0	1.5	1080.

CREST LENGTH AT OR BELOW ELEVATION	10. 1613.9	200. 1614.0	350. 1615.0	660. 1616.0	1080. 1617.0

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR NO. 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.23	0.00	.23	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	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= .87 CP= .50 NTA= 0

RECESSION DATA

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

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.67 AND R= 4.76 INTERVALS

UNIT HYDROGRAPH 28 END-OF-PERIOD ORDINATES, LAG= .87 HOURS, CP= .50 VOL= 1.00

11.	41.	72.	83.	73.	59.	48.	39.	32.	26.
21.	17.	14.	11.	9.	7.	6.	5.	4.	3.
3.	2.	2.	1.	1.	1.	1.	1.		

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR NO. 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0.

ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1581.	0

SURFACE AREA=	0.	9.	18.
CAPACITY=	0.	98.	356.
ELEVATION=	1548.	1581.	1600.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
1580.5	60.0	3.1	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1584.7	3.0	1.5	462.

CREST LENGTH AT OR BELOW ELEVATION	2. 1582.0	27. 1583.0	37. 1584.0	137. 1584.7	560. 1585.0	585. 1586.0	800. 1600.0

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50	RATIO 6 1.00
HYDROGRAPH AT	1	.70	1	150.	300.	451.	601.	751.	1502.
		(1.81)		(4.25)(	8.51)(	12.76)(	17.01)(	21.27)(	42.53)(
ROUTED TO	2	.70	1	134.	275.	417.	559.	701.	1489.
		(1.81)		(3.79)(	7.78)(	11.80)(	15.84)(	19.86)(	42.17)(
HYDROGRAPH AT	3	.23	1	81.	162.	243.	324.	405.	810.
		(.60)		(2.29)(	4.59)(	6.88)(	9.17)(	11.47)(	22.93)(
1 2 COMBINED	4	.93	1	173.	359.	546.	733.	921.	2002.
		(2.41)		(4.90)(	10.16)(	15.46)(	20.77)(	26.09)(	56.70)(
ROUTED TO	5	.93	1	170.	354.	541.	728.	915.	1999.
		(2.41)		(4.81)(	10.03)(	15.32)(	20.62)(	25.92)(	56.59)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	1610.30	1610.30	1613.90
STORAGE	215.	215.	278.
OUTFLOW	0.	0.	847.

RATIO OF PMF	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	1611.35	0.00	231.	134.	0.00	43.00	0.00
.20	1612.00	0.00	242.	275.	0.00	43.00	0.00
.30	1612.54	0.00	251.	417.	0.00	42.75	0.00
.40	1613.03	0.00	260.	559.	0.00	42.75	0.00
.50	1613.47	0.00	269.	701.	0.00	42.75	0.00
1.00	1614.61	.71	294.	1489.	4.50	42.25	0.00

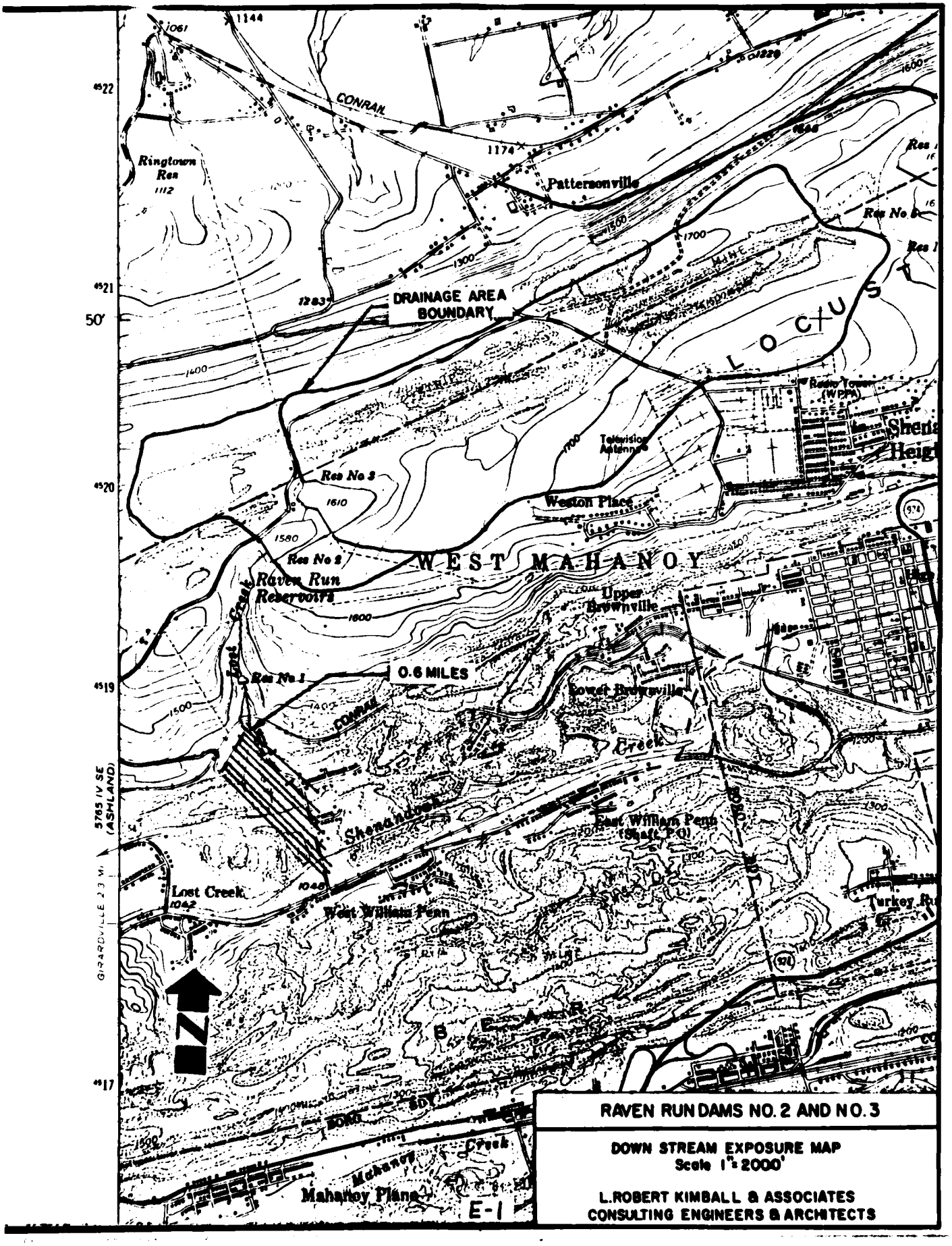
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	1580.50	1580.50	1584.70
STORAGE	98.	98.	139.
OUTFLOW	0.	0.	1988.

RATIO OF PMF	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	1581.44	0.00	105.	170.	0.00	42.75	0.00
.20	1582.04	0.00	112.	354.	0.00	42.50	0.00
.30	1582.52	0.00	116.	541.	0.00	42.50	0.00
.40	1582.92	0.00	120.	728.	0.00	42.50	0.00
.50	1583.26	0.00	124.	915.	0.00	42.50	0.00
1.00	1584.71	.01	139.	1999.	.25	42.00	0.00

APPENDIX E
DRAWINGS



RAVEN RUN DAMS NO. 2 AND NO. 3

DOWN STREAM EXPOSURE MAP
Scale 1" = 2000'

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

APPENDIX F
GEOLOGY

Raven Run Dam No. 2 - General Geology

Raven Run Dam No. 2 is located in the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. This province is typified by numerous synclinal and anticlinal features. Some minor faulting is indicated less than a mile to the south of the dam. The bedrock underlying the reservoir consists of the Pennsylvania aged Pottsville Group and Post-Pottsville formation.

The Pottsville Group consists of light to dark gray, fine grained to conglomeratic sandstone, with lesser amounts of shale, siltstone, coal and underclay. The bedding is generally well-developed with sandstones and siltstones often cross-bedded. Joints are usually regular and moderately well formed. The Post-Pottsville formation consists of light gray to brown, medium to coarse-grained interbedded sandstone and conglomerate. The bedding is moderately well developed while the joints are regular and moderately developed.

Both deep mining and surface mining of anthracite coal has taken place in the vicinity of this dam. The extent of any deep mining is unknown without extensive research.

GEOLOGIC MAP OF THE AREA SURROUNDING RAVEN RUN DAMS NO. 2 AND 3, KEHLY RUN DAMS NO. 3 AND 5, BRANDONVILLE PUMPING STATION RESERVOIR

Pp — **Pottsville Group**
Predominantly sandstones and conglomerates with thin shales and coals; some coals mineable locally

ANTHRACITE REGION

Ppp — **Post-Pottsville Formations**

Pp — **Pottsville Group**

MISSISSIPPIAN

Mmc — **Mauch Chunk Formation**

SCALE 1:250,000