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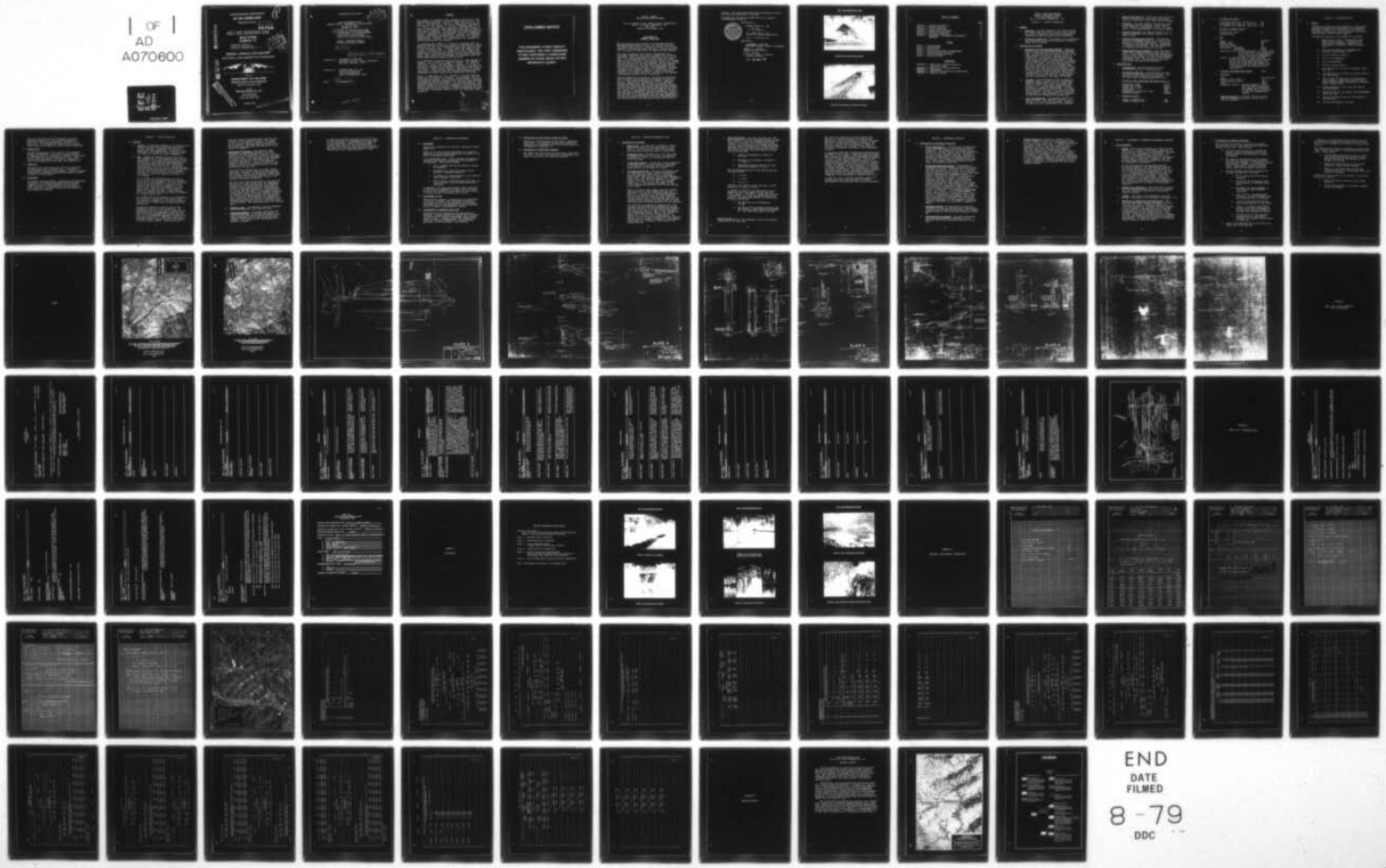

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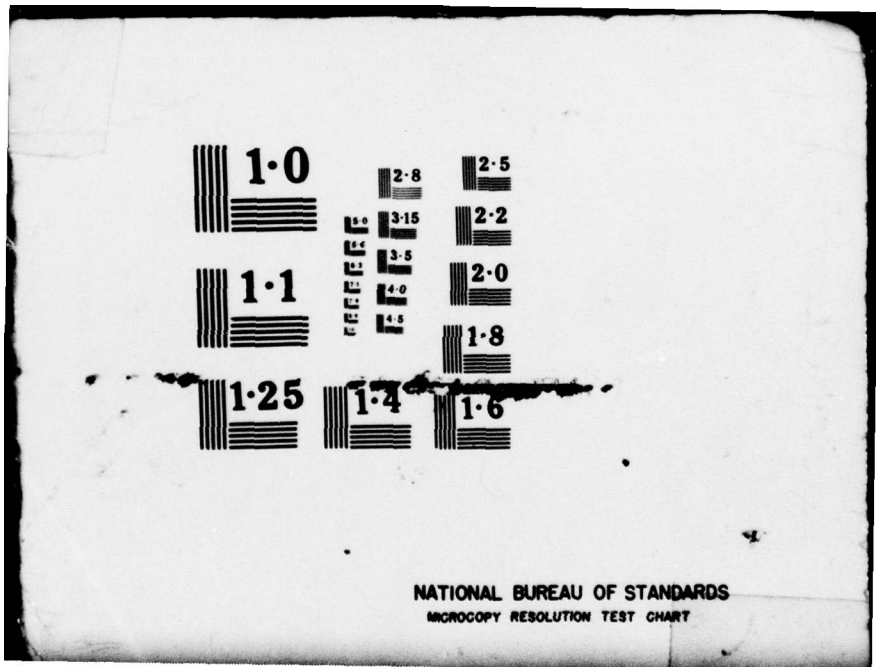
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SUSQUEHANNA RIVER BASIN

SALT RUN, CAMERON COUNTY

PENNSYLVANIA

LEVEL

SALT RUN RESERVOIR DAM

NDI No. PA 00392

PennDER No. 12-4

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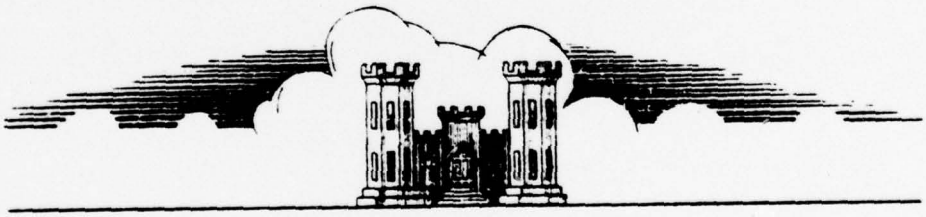
PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM



prepared for

DEPARTMENT OF THE ARMY

Baltimore District, Corps of Engineers

Baltimore, Maryland 21203

prepared by

MICHAEL BAKER, JR., INC.

Consulting Engineers
4301 Dutch Ridge Road
Beaver, Pennsylvania 15009

February 1979

SUSQUEHANNA RIVER BASIN

SALT RUN RESERVOIR DAM
CAMERON COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI NO. PA 00392
PennDER NO. 12-4

(6) National Dam Inspection Program. Salt Run Reservoir Dam (NDI Number PA-00392, PennDER Number 12-4), Susquehanna River Basin, Salt Run, Cameron County, Pennsylvania. Phase I Inspection Report.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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Date: (11) February 1979

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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 SAFETY PROGRAM

Salt Run Reservoir Dam, Cameron County, Pennsylvania
NDI No. PA 00392, PennDER No. 12-4
Salt Run
Inspected 10 November 1978

ASSESSMENT OF GENERAL CONDITIONS

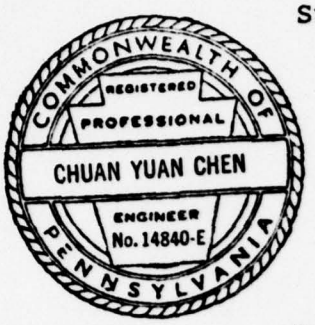
Salt Run Reservoir Dam consists of a diaphragm earthfill embankment approximately 42 feet high and 355 feet long. The uncontrolled overflow spillway is located at the right abutment of the dam and is 65 feet wide. The dam and reservoir are owned and operated by the Emporium Water Company.

The visual inspection and review of engineering data, performed in November 1978 through January 1979, revealed necessasry items of maintenance and rehabilitation for the dam. It is recommended that the owner repair the undermining of the right end of the spillway, monitor all seepage from the dam for quantity and turbidity, monitor and provide erosion protection at the left abutment hillside seepage, provide drainage for the marshy area downstream from the dam, repair the animal burrows in the embankment, implement a rodent control program, repair all eroded areas on the embankment and reseed as necessary, repair the spalled concrete on the intake structure, and develop and implement a maintenance schedule for all facilities.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District of the U.S. Army Corps of Engineers for Phase I Inspection Reports, revealed that the spillway will not pass the Probable Maximum Flood (PMF) without overtopping the dam. The analysis indicated that the spillway will pass approximately 37 percent of the PMF before overtopping will occur. As a result of this analysis and others noted in Section 5, the spillway is considered "seriously inadequate." Based upon the observed condition and the review of the design of the spillway, it is recommended that the owner immediately initiate an engineering study to develop recommendations for the reconstruction of the spillway to meet current design

criteria. The owner should also develop emergency operation and evacuation procedures for the dam.

In summary the dam must be categorized as an "unsafe"-"non-emergency" condition.



Submitted by:

MICHAEL BAKER, JR., INC.

C. Y. Chen

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

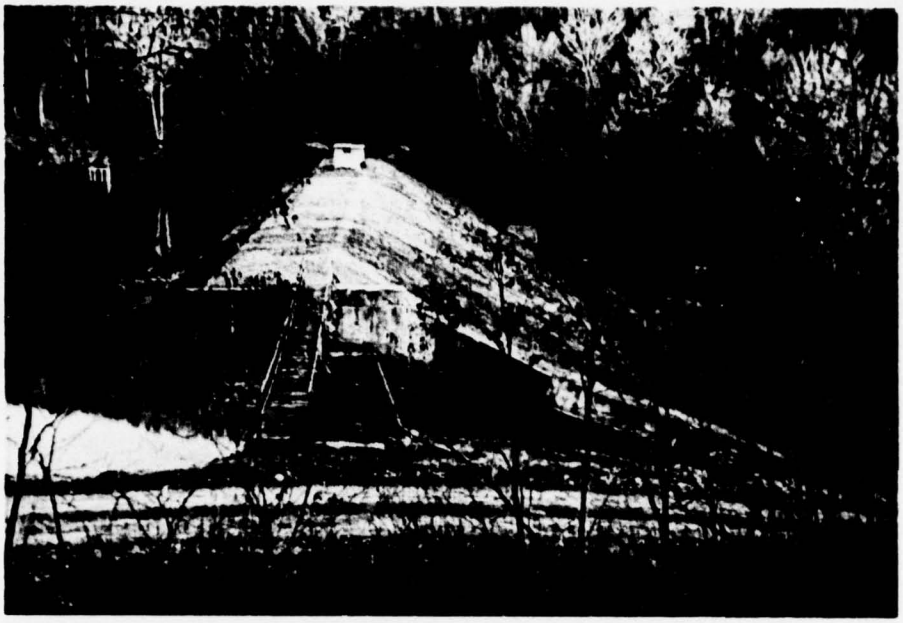
Date: 16 February 1979

Approved by:

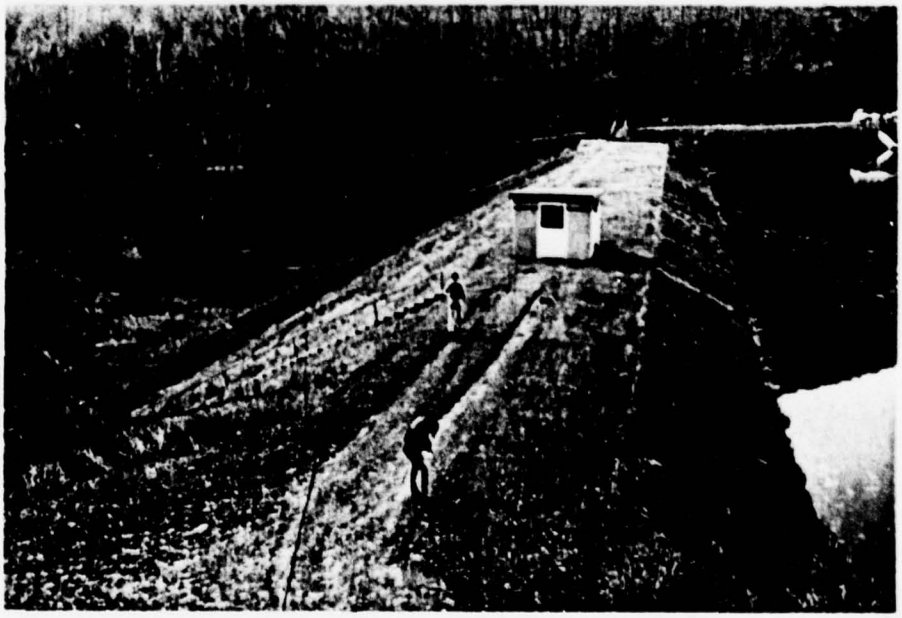
DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

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

Date: 15 Mar 79



Overall View from Spillway (Right) Hillside



Overall View from Hillside (Left) Opposite of Spillway

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NATIONAL DAM SAFETY PROGRAM
SALT RUN RESERVOIR DAM
NDI NO. PA 00392, PennDER No. 12-4

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

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

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

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Salt Run Reservoir Dam is a diaphragm earthfill embankment which is approximately 42 feet high and 355 feet long. The 65-foot wide spillway is located at the right abutment of the dam. Seepage control is provided by a concrete core wall which extends 9 feet below the original ground surface. Additional seepage control is provided by a compacted clay cutoff trench, which was constructed in 1940 and 1941, along the toe of the upstream slope. The outlet works for the dam are located approximately 60 feet right of the left abutment. A 30-inch cast-iron pipe passes through the embankment at this location, running from the intake riser (approximately 100 feet upstream of the center of the dam) to the outlet head wall (approximately 100 feet downstream of the center of the dam).

b. Location - Salt Run Reservoir Dam is located in Portage Township, Cameron County, Pennsylvania. Emporium, Pennsylvania with a 1970 census population of 3074 is the nearest downstream town. PA Route 155 is located approximately 2 miles downstream (southwest) from the dam. A private access road from PA Route 155 is the only access way to the dam. The dam is located on Salt Run approximately 2 miles upstream of the confluence of Salt Run and Sinnemahoning Portage Creek.

c. Size Classification - The maximum height of the dam is 42 feet. The reservoir volume to the average top of dam is 200 acre-feet. Therefore, the dam is in the "Intermediate" size category.

d. Hazard Classification - Many lives would likely be lost in the event of a dam failure; the dam is therefore considered in the "High" hazard category.

e. Ownership - Salt Run Reservoir and Dam are owned by the Emporium Water Company, 22 West Fourth Street, Emporium, Pennsylvania 15834. Mr. John Sepiol is the superintendent of the water company.

f. Purpose of the Dam - The dam and reservoir are used for emergency water supply storage (i.e., to quench fires).

g. Design and Construction History - The existing facility was designed by Mr. H. B. Norton, Civil Engineer, of Ridgway, Pennsylvania. The dam was constructed by N. Applegate and Son, Contractors of Bradford, Pennsylvania. The dam construction was completed in the latter part of 1911.

h. Normal Operational Procedures - The lake level is maintained at approximately the same level year round. The spillway is uncontrolled and personnel from the water company visit the dam infrequently (averaging once a week) to check various routine maintenance items. The outlet pipe valve and sluice gate are operated periodically.

1.3 PERTINENT DATA

a. Drainage Area - The drainage area of Salt Run Reservoir Dam is 5.78 square miles.

b. Discharge at Dam Site - The maximum flow at the dam site through the spillway is unknown. The ungated spillway capacity at maximum pool El. 1249.9 feet is approximately 3650 c.f.s.

c. Elevation [feet above Mean Sea Level (M.S.L.)] -

Design Top of Dam -	1250.0
Minimum Top of Dam -	1249.4
Average Top of Dam -	1249.9
Normal Pool -	1243.0
Streambed at Centerline of Dam -	1207.0
Maximum Tailwater -	Unknown

d. Reservoir (feet) -

Length of Maximum Pool -	2200
Length of Normal Pool -	1500

e. Storage (acre-feet) -

At Spillway Crest (El. 1243.0 ft.) -	132
At Minimum Top of Dam (El. 1249.4 ft.) -	195
At Average Top of Dam (El. 1249.9 ft.) -	200

f. Reservoir Surface (acres) -

Average Top of Dam -	14
Spillway Crest -	7

g. Dam -

Type -	Earthfill
Length (feet) -	420
Height (feet) -	42
Top Width (feet) -	20
Side Slopes - Upstream -	2H:1V
Downstream -	2H:1V

Impervious Core - Concrete core wall, 4.75 feet thick at the base and 1 foot thick at top; top of core wall is approximately 4 feet below crest of embankment.

Cutoff - In 1940 and 1941, a 4-foot wide compacted clay cutoff trench was constructed at the toe of the upstream slope. The base of the cutoff wall was founded in a "tight fire clay" and varied from 5 feet to 10 feet below the elevation of the upstream toe.

h. Diversion and Regulating Tunnel - None

i. Spillway -

Type -	Overflow weir
Length of Weir (feet) -	65
Crest Elevation (feet) -	1243.0
Gates -	None

Downstream Channel - Concrete channel to toe of dam; from the stilling pool, the channel has a moderate 2% gradient and is lined with in situ rock fragments and cobbles.

j. Regulating Outlet - A 30-inch cast-iron outlet pipe is located approximately 60 feet right of the left abutment.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Information reviewed for the preparation of this report included the Pennsylvania Department of Environmental Resources (PennDER) file for the dam and information obtained from the owner (interview with Mr. John Sepiol, Superintendent, Emporium Water Company).

Information contained in the PennDER file included:

1) "Report Upon the No. 3 Storage Dam of the Emporium Water Company," prepared by the Water Supply Commission of Pennsylvania (predecessor of PennDER), dated 15 October 1915.

2) Plan showing addition to embankment and spillway, dated December 1916.

3) Various inspection reports.

4) Various correspondence.

5) Various memorandums.

6) Various progress reports.

7) Plan and section of core wall addition, dated June 1936.

8) 1939 application and permit for making repairs and improvements.

9) "Report Upon the Application of the Emporium Water Company," prepared by the Water and Power Resources Board (predecessor of PennDER), dated 21 August 1939.

10) Design drawings for the circa 1940 repairs and improvements.

11) Specifications for the repairs and improvements, dated June 1940.

12) Permits and applications for the drawdown of the reservoir.

13) Various photographs of the dam.

The last inspection of Salt Run Reservoir Dam was performed by Charles H. Zinn, Hydraulic Engineer, Division of Dams and Encroachments, PennDER, on 10 March 1965. No problems were reported at that time, and the dam was considered in "good" general appearance.

2.2 CONSTRUCTION

The dam was designed by H. B. Norton, Civil Engineer, Ridgway, Pennsylvania. The dam was constructed by N. Applegate and Son, Contractors, Bradford, Pennsylvania and was completed in the latter part of 1911. The modifications performed on the dam are presented as a part of the engineering data check list, Appendix B.

2.3 OPERATION

The operational characteristics of Salt Run Reservoir Dam were obtained by interviewing Mr. John Sepiol, Superintendent, Emporium Water Company. Other information concerning the operating equipment and details is shown on Plate 5 of this report.

2.4 EVALUATION

The readily available design, construction and operations information, and observations made during the field inspection are considered adequate for this Phase I Inspection Report. No observations made during the field inspection indicated concern for the validity of the information reviewed.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The dam was inspected on 10 November 1978. The dam and appurtenant structures were in poor overall condition. Noteworthy deficiencies observed are described briefly in the following paragraphs. The complete visual inspection check list and field sketch are given in Appendix A.

b. Dam - Seepage was observed flowing from a soil-rock contact zone in the downstream left hillside approximately 5 feet above and 15 feet left of the outlet pipe. The seepage extended approximately 100 feet downstream from the outlet head wall along the soil-rock contact zone. The maximum (approximately 10 g.p.m.) flow of seepage was near the outlet head wall, and the rate of flow decreased with the distance downstream along the seepage outcrop line. Minor erosion is occurring on the left bank of the outlet channel as a result of this seepage.

A wet, marshy area extending from 160 feet to 200 feet left of the right abutment was observed at the toe of the embankment. The area is approximately 40-foot by 50-foot in plan view and is shown on the field sketch in Appendix A. This area may have resulted from ponding of surface water runoff, since the area is not properly graded for adequate drainage. Proper drainage should be provided, and the area should be observed for seepage from the dam.

Two animal burrows were observed in the embankment. The locations of these holes are shown on the field sketch in Appendix A. Both holes should be repaired, and a rodent control program should be implemented.

Erosion was observed in several areas on the embankment during the visual inspection. The eroded areas consist of an erosion channel on the downstream slope, the embankment crest near the junction of the embankment and the left spillway wall, and the downstream embankment along the left spillway training wall. These areas should be restored to their original elevation and reseeded to prevent future erosion. Erosion was also

observed along the upstream riprap near the left wing wall of the approach channel. The riprap at this location should be repaired to prevent future erosion. The approximate locations of all the eroded areas have been included on the field sketch in Appendix A.

c. Appurtenant Structures - The concrete intake structure is located approximately 100 feet upstream from the centerline of the dam. Minor spalling of the concrete has occurred on the edges of the structure. This spalling is not considered to present a problem at the present time, but it should be repaired as a part of routine maintenance in the future. Presently, access to the intake structure is attained by using a row boat available at the dam site.

The concrete in the spillway is in poor overall condition. Previously, some areas were repaired with gunite; however, the gunite has deteriorated and loosened, and should be repaired. Other areas of the concrete have spalled and cracked in the interim, and should be repaired.

The end of the right training wall of the spillway and the lower right channel slab are undermined. According to the design drawings, the downstream channel slab of the spillway was constructed on in situ or embankment materials. The downstream end of the slab was observed to be constructed on a hand-placed, hard shale, rock fragment foundation. No drainage outlets or filters (transition zones) are shown on the design drawings for the spillway slab. Therefore, the potential for undermining and failure of the slab exists as evidenced by the observed undermining of the end of the right side of the spillway. The undermining should be repaired soon.

d. Reservoir Area - No problems or unusual sedimentation were observed in the reservoir area.

e. Downstream Channel - No unusual conditions were observed downstream of the spillway channel. A large stilling pool was formed by erosion immediately downstream from the end of the spillway channel. This erosion is not considered to be a problem at present.

No homes are located along Salt Run from the dam to the confluence with Sinnemahoning Portage Creek 2 miles downstream. Approximately 100 homes are located along the next mile of Sinnemahoning Portage Creek after the confluence with Salt Run. The creek then flows through a portion of Emporium, Pennsylvania (1970 census population of 3074).

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures are generally discussed in paragraph 1.2.h.

There are no formal written procedures for reservoir operation or for emergency downstream evacuation in the event of impending catastrophe.

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

1) How to operate the dam and reservoir during an emergency.

2) Procedures for evaluating inflow during periods of emergency operation.

3) Procedures for rapid drawdown of the reservoir under emergency conditions.

4) Who to notify, including public officials, in case evacuation from the downstream area is necessary.

In addition, the owner should assist public officials in developing an emergency evacuation plan for areas which will be inundated in the event of a dam failure or during periods of extremely heavy runoff.

4.2 MAINTENANCE OF DAM

Emporium Water Company is responsible for maintenance of the dam, reservoir, and appurtenant structures. Maintenance of the concrete surfaces and structures, and eroded areas of the embankment should be improved, as well as general maintenance of the dam.

4.3 MAINTENANCE OF OPERATING FACILITIES

Maintenance of the operating facilities should be improved. Frequent inspection, maintenance and repair of the facilities should be performed, and a record should be kept. A general maintenance schedule and check list should be prepared for the maintenance personnel to avoid oversight of any feature.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in the event of impending catastrophe. An emergency warning system should be installed, and emergency plans should be developed as recommended in paragraph 4.1.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The operational facilities are functional according to the owner. Overall, the inspection, maintenance, and repair of the facilities should be improved.

SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

5.1 EVALUATION OF FEATURES

a. Design Data - No hydrologic or hydraulic design data was available for the preparation of this report. All calculations used in the analysis were generated during the course of this study.

b. Experience Data - According to a U.S. Army Corps of Engineer's report (circa 1942), the spillway discharge was 1900 c.f.s. during the flood of 17-20 July 1942.

c. Visual Observations - On the date of the inspection, 10 November 1978, no conditions were noted that would indicate the spillway would not operate satisfactorily in the event of a flood.

d. Overtopping Potential - The Salt Run Reservoir Dam is classified as a "High" hazard-"Intermediate" size dam requiring evaluation for a spillway design flood (SDF) equal to the Probable Maximum Flood (PMF). The spillway consists of a rectangular-shaped, concrete, overflow channel with a crest width of 67.1 feet. A 2.1-foot wide, walkway bridge pier is located near the center of the crest reducing the effective width of the spillway to 65.0 feet.

There is a small, water supply reservoir located approximately 3500 feet upstream of Salt Run Reservoir. The effects of the upstream reservoir were not considered in the hydrologic/hydraulic analysis for Salt Run Reservoir Dam, since the storage capabilities of the upstream reservoir are negligible when compared with the volume of runoff resulting from the storms considered in the analysis.

The hydrologic and hydraulic capabilities of the reservoir and spillway were evaluated by routing the PMF and ratios of the PMF through the reservoir with the aid of the U.S. Army Corps of Engineers Flood Hydrograph Package, HEC-1. Both the PMF and the 1/2 PMF were found to overtop the dam by depths of 2.6 and 1.0 feet, respectively. The results of this analysis indicate that the reservoir and spillway are capable of passing a flood approximately equal to 37 percent of PMF without overtopping the dam.

e. Spillway Adequacy - The dam, as outlined in the above analysis, would be overtopped by the 1/2 PMF. The criteria for spillway adequacy determination requires an estimate of the likelihood of dam failure, and an estimate of the downstream damage increase during overtopping by 1/2 PMF conditions. Therefore, the following conditions were used as the limiting criteria which are likely to cause failure of this dam.

1) Depth of overtopping in excess of 1.0 foot.

2) Duration of overtopping in excess of 1.5 hours.*

3) Approximate maximum velocity of overtopping in excess of 2 f.p.s.*

The overtopping analysis of this dam yielded the following values.

1) 1.0 foot.

2) 3.3 hours.

3) 4.6 f.p.s.

Therefore, dam failure during the above 1/2 PMF conditions is likely to occur.

To assess the impact of the dam failure on the downstream area, the channel routing and dam breach options of the HEC-1 program were utilized. A flood equal to 1/2 PMF was routed through the reservoir and downstream channel for both of the following conditions:

1) The dam would not be breached by 1/2 PMF.

2) The dam would be breached beginning when the reservoir stage reached an elevation of 1 foot above the crest of the dam.

*These parameters will vary according to cover and material conditions of the dam crest.

The results of these two routings indicate that the water surface elevations in the downstream damage area, shown in Appendix D, would be increased and cause a significant increase in damage in the event of a dam failure by overtopping. Based on the above results, the spillway is classified as "seriously inadequate" according to the recommended criteria.

It should be noted that the hydrologic determinations presented in this Phase I Inspection Report are based upon the use of a Snyder's unit hydrograph developed from coefficients determined by the Baltimore District of the U.S. Army Corps of Engineers. Due to the limited number of gaging stations available in this hydrologic region and the wide variation of watershed slopes, the Snyder's coefficients may yield results of limited accuracy for this watershed. As directed, a further refinement of these coefficients is beyond the scope of this Phase I investigation and, therefore, must be addressed by the dam owner's engineering consultant during the detailed investigation as suggested in the "Assessment of General Conditions."

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

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - No structural inadequacies of the embankment were noted during the visual inspection. The seepage flowing around the left abutment of the dam, however, may cause instability of the left hillside below the dam. Therefore, the left abutment seepage should be periodically measured to determine if the seepage quantity is increasing or the seepage is becoming turbid with time. Additionally, protection against erosion should be provided at this area.

b. Design and Construction Data - Calculations of embankment slope and foundation stability were not available for review. Given the age of the structure (the dam was built in 1911), it is doubtful that any calculations for design were ever performed. General experience with embankment slopes of heights, inclinations, materials (with the inclusion of a concrete core wall), and hydraulic conditions similar to those of the dam slopes indicates that these slopes could be shown to satisfy the stability requirements of the "Recommended Guidelines for Safety Inspection of Dams." This inference is supported by empirical guidelines on stable slope inclinations given by the U.S. Bureau of Reclamation (1973) Design of Small Dams, 2nd ed., pp. 261-267. In view of the modest height and inclinations of the dam slopes, their history of satisfactory performance, and no indications of instability were observed during the field inspection of 10 November 1978; no further stability assessments of the embankment slopes are considered necessary for this Phase I Inspection Report.

c. Operating Records - No operational records are available for Salt Run Reservoir Dam. Operational procedures and information available do not indicate concern related to the structural stability of the dam.

d. Post-Construction Changes - The post-construction modifications presented in Appendix B do not adversely affect the structural stability of the dam.

e. Seismic Stability - The dam is located in Zone 1 on the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." Seismic Zone 1 is considered a zone of very low seismic activity. Experience has shown that dams with adequate stability under static loading conditions will also have adequate stability under seismic loading conditions in such zones of low seismic activity. As indicated in paragraph 6.1.b., Salt Run Reservoir Dam could be shown to meet the stability requirements of the "Recommended Guidelines for Safety Inspection of Dams." Therefore, further consideration of the seismic stability is not warranted for this Phase I Inspection Report.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - There are no findings as a result of this inspection to indicate a detrimental assessment of the structural stability of the embankment, provided the dam is not overtopped by flood waters. The effect of the seepage flowing around the left abutment on the left hillside could not be assessed by this Phase I Inspection. Therefore, the left abutment seepage should be periodically measured as recommended in paragraph 7.2.

The spillway capacity was analyzed using the criteria presented in the "Recommended Guidelines for Safety Inspection of Dams" and according to the procedures presented in paragraphs 5.1.d. and 5.1.e. The analysis determined that the spillway will pass approximately 37 percent of the PMF before the dam will be overtopped. Based upon this observation and others noted in Section 5, the spillway is considered "seriously inadequate." As a result of these analyses and observations, the dam is considered as an "unsafe"-"non-emergency" condition.

b. Adequacy of Information - The information available and the observations made during the field inspection are considered sufficient for this Phase I Inspection Report.

c. Urgency - The owner should immediately initiate further investigation, as discussed in paragraph 7.1.d.

d. Necessity for Additional Data/Evaluation - The hydraulic/hydrologic analysis performed in connection with this Phase I Inspection Report has indicated the need for additional spillway capacity. It is recommended that the owner of the dam immediately initiate an engineering study to develop recommendations for the reconstruction of the spillway to meet current design criteria. Additionally, the quantity and turbidity of the seepage from the left abutment hillside should be monitored and recorded. If conditions indicate the necessity, remedial measures should be taken.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection and review of information revealed certain items of work which should be performed immediately by the owner. These include:

1) The owner should initiate an engineering study to develop recommendations for the reconstruction of the spillway to increase the capacity.

2) The quantity and turbidity of the seepage from the left abutment hillside should be monitored and recorded. If conditions indicate the necessity, remedial action should be taken. Additionally, protection against erosion should be provided in this area.

3) Develop emergency operation procedures for the dam and reservoir, including:

    a) How to operate the dam during an emergency.

    b) Procedures for evaluating inflow during periods of emergency operation.

    c) Procedures for rapid drawdown of the reservoir under emergency conditions.

    d) Who to notify, including public officials, in case evacuation from the downstream area is necessary.

    e) Provide around-the-clock surveillance during periods of high runoff.

    f) Install a reliable flood warning system in all areas downstream of the dam which would be affected in the event of a failure of the dam.

    g) Provide copies of the emergency procedures to all operational personnel and instruct the personnel on their use.

4) Repair the undermined area at the end of the right side of the spillway.

In addition, the owner should assist public officials in developing an emergency evacuation plan for areas which will be inundated in the event of a flood or dam failure.

The inspection and review of information revealed other items of work which should be accomplished soon by the owner. These include:

1) Provide proper drainage for the wet, marshy area downstream from the dam and visually monitor the quantity and turbidity of all seepage from the dam.

2) Repair the animal burrows in the dam and implement a rodent control program.

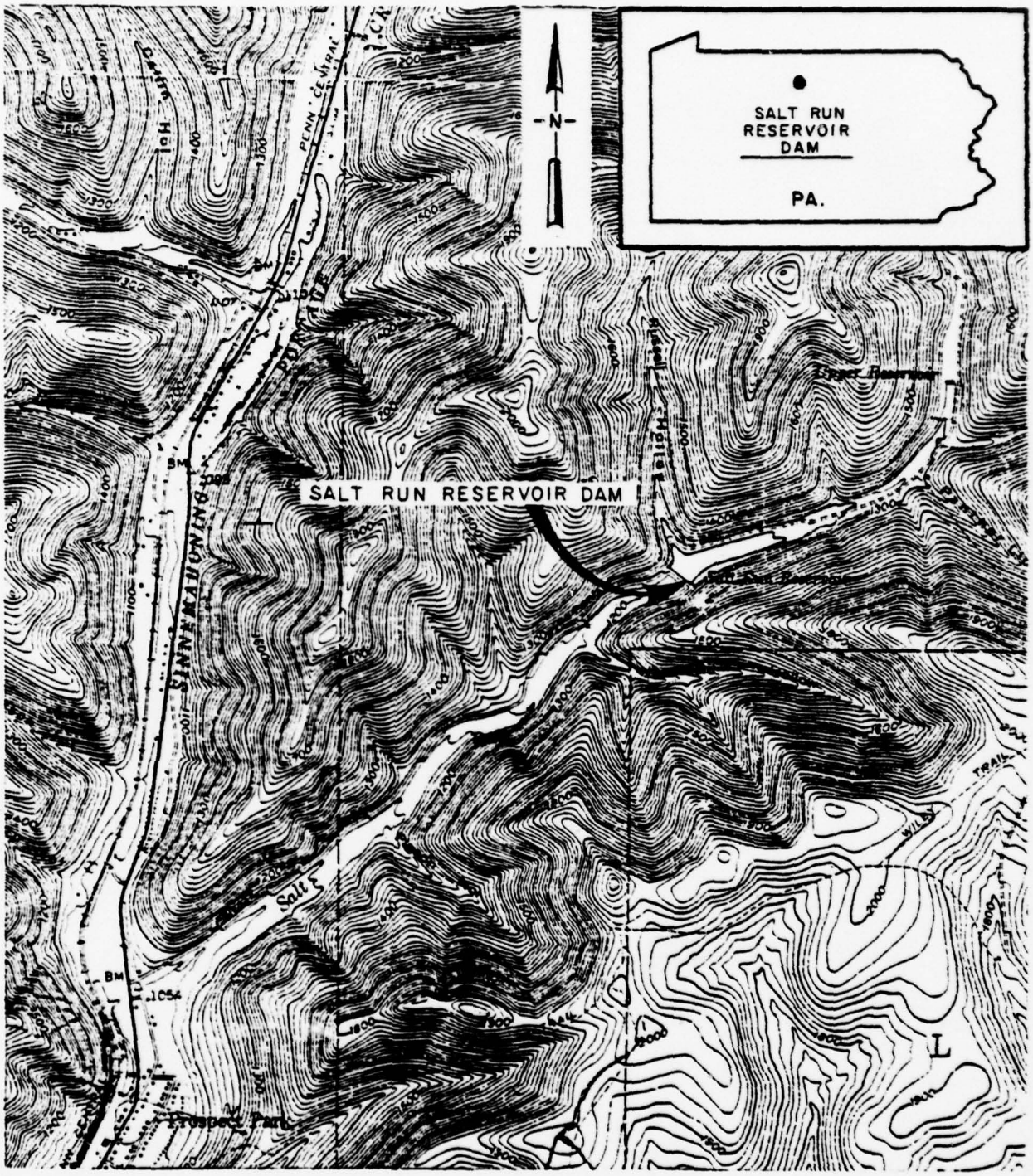
3) Repair all the eroded areas on the dam, including the area on the upstream slope, and reseed as necessary.

Additional items of work to be performed in the future by the owner include:

1) Repair the spalled concrete on the intake structure.

2) Develop and implement a maintenance schedule for all facilities.

PLATES



SCALE 1:24000

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

PLATE 1 LOCATION PLAN

SALT RUN RESERVOIR DAM

SCALE 1:24000

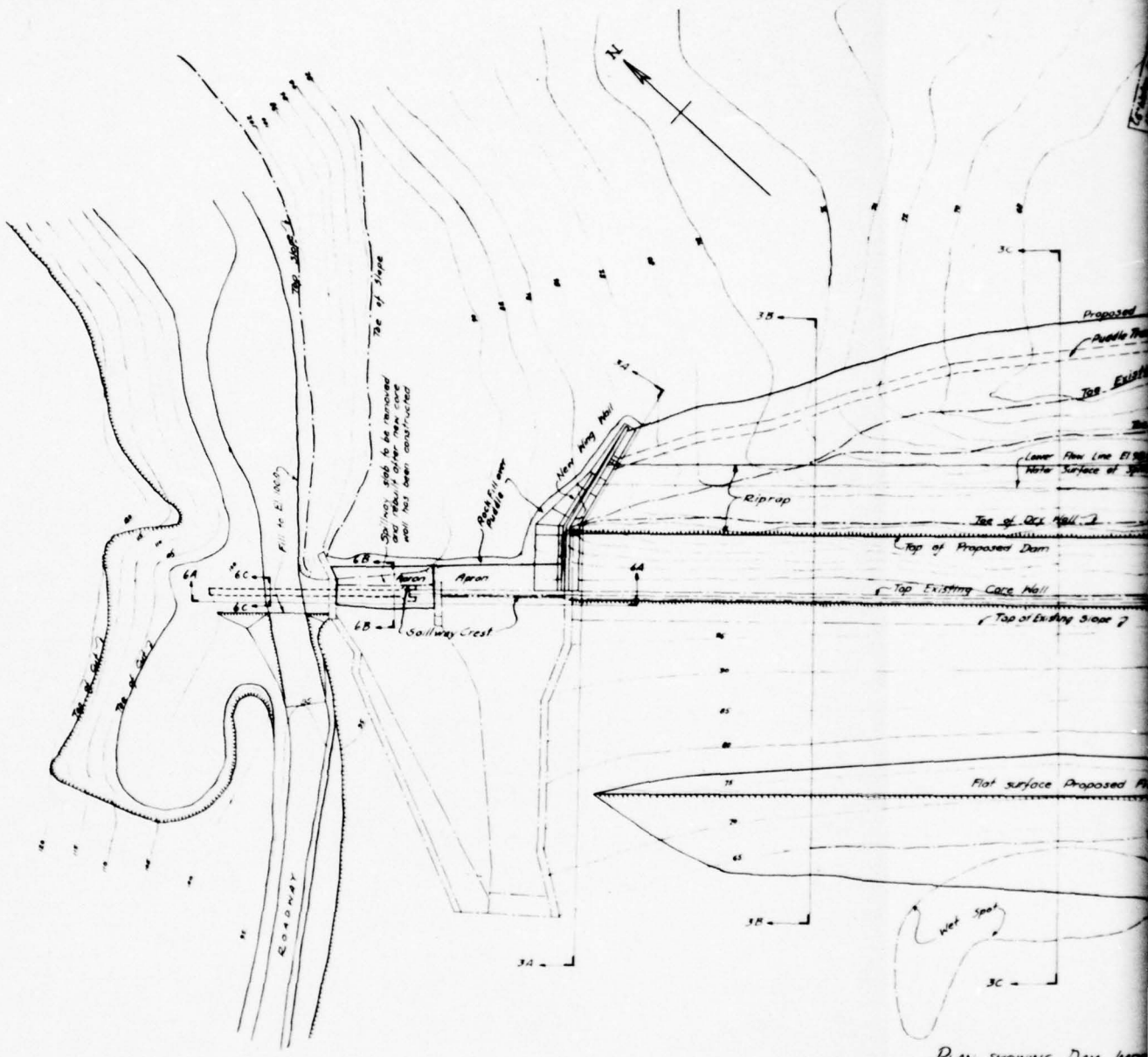
1 0 1/2 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

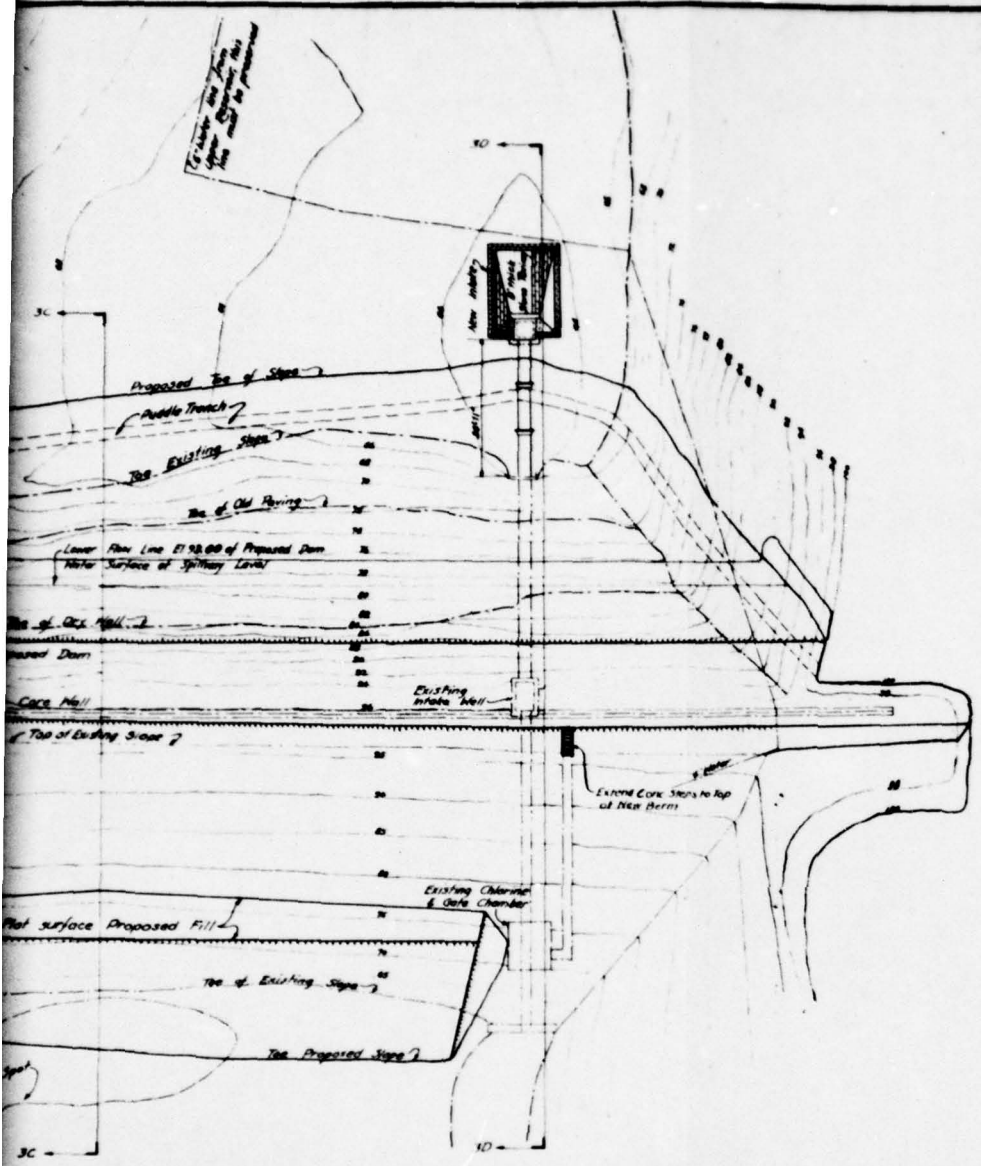
1 0 1 KILOMETER

PLATE 2 WATERSHED MAP

SALT RUN RESERVOIR
DAM



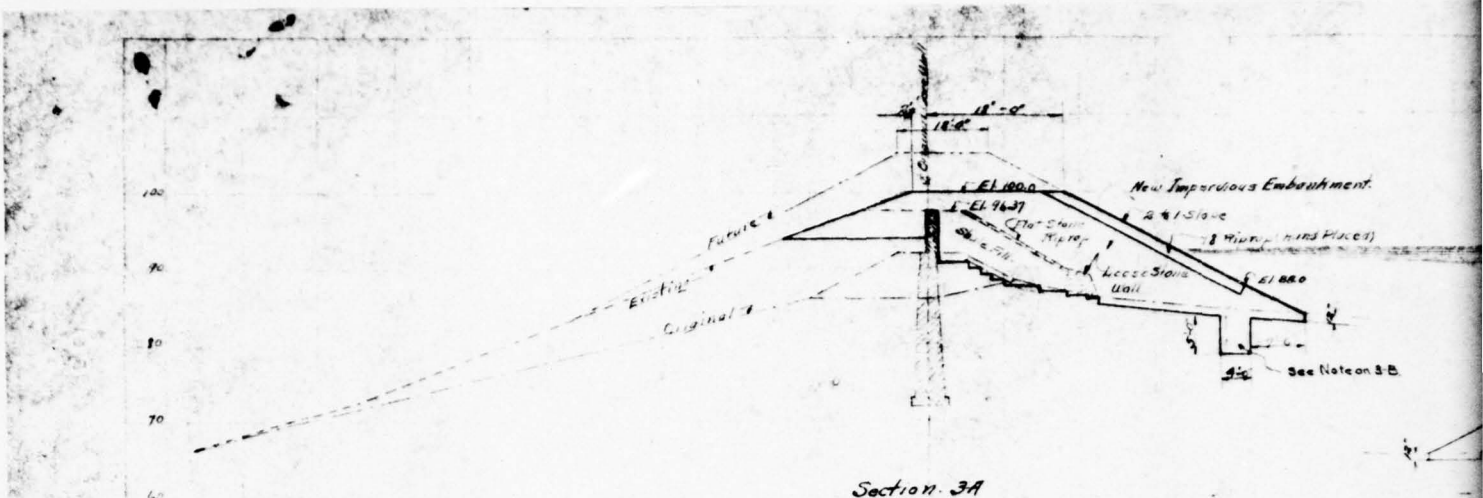
PLAN SHOWING DAM IMPR
Scale 1"=20'



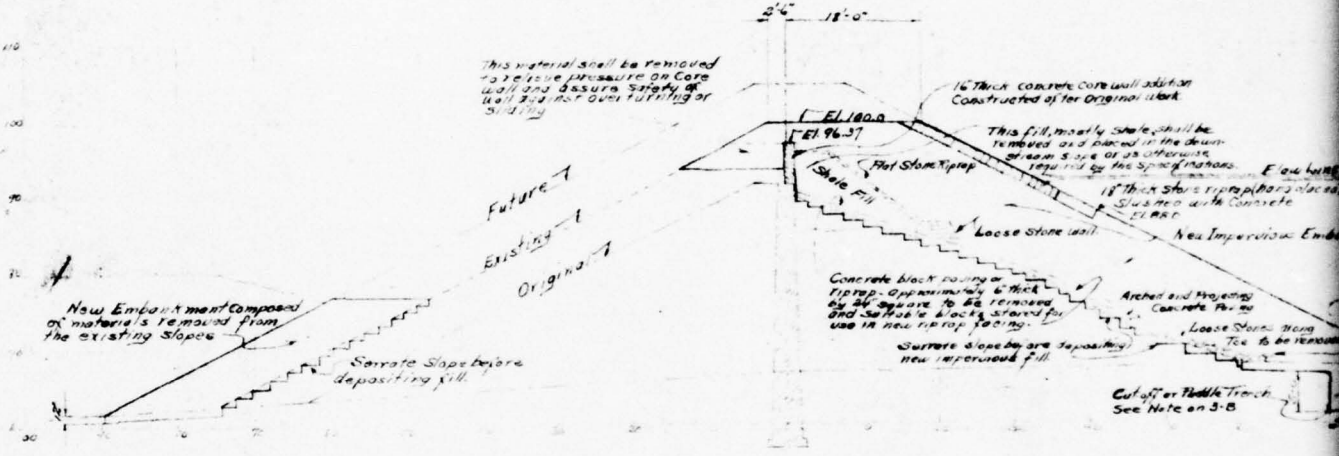
SHOWING DAM IMPROVEMENTS - 2A
Scale: 1" = 20'

PLATE 3

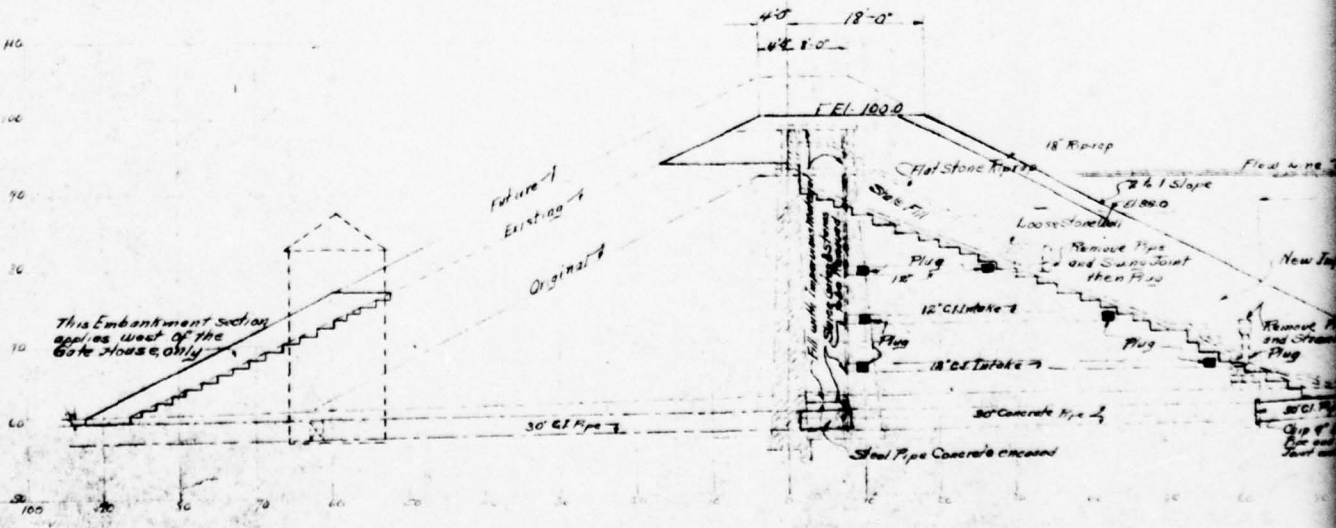
REVISIONS	APPROVAL	EMPORIUM WATER CO. EMPORIUM, PA. DAM Nº 3 SALT RUN PLAN of IMPROVEMENTS
9-4-40	2	Scale: As Shown — July 1940 The Chester Engrs. Pittsburgh — 1352-2A



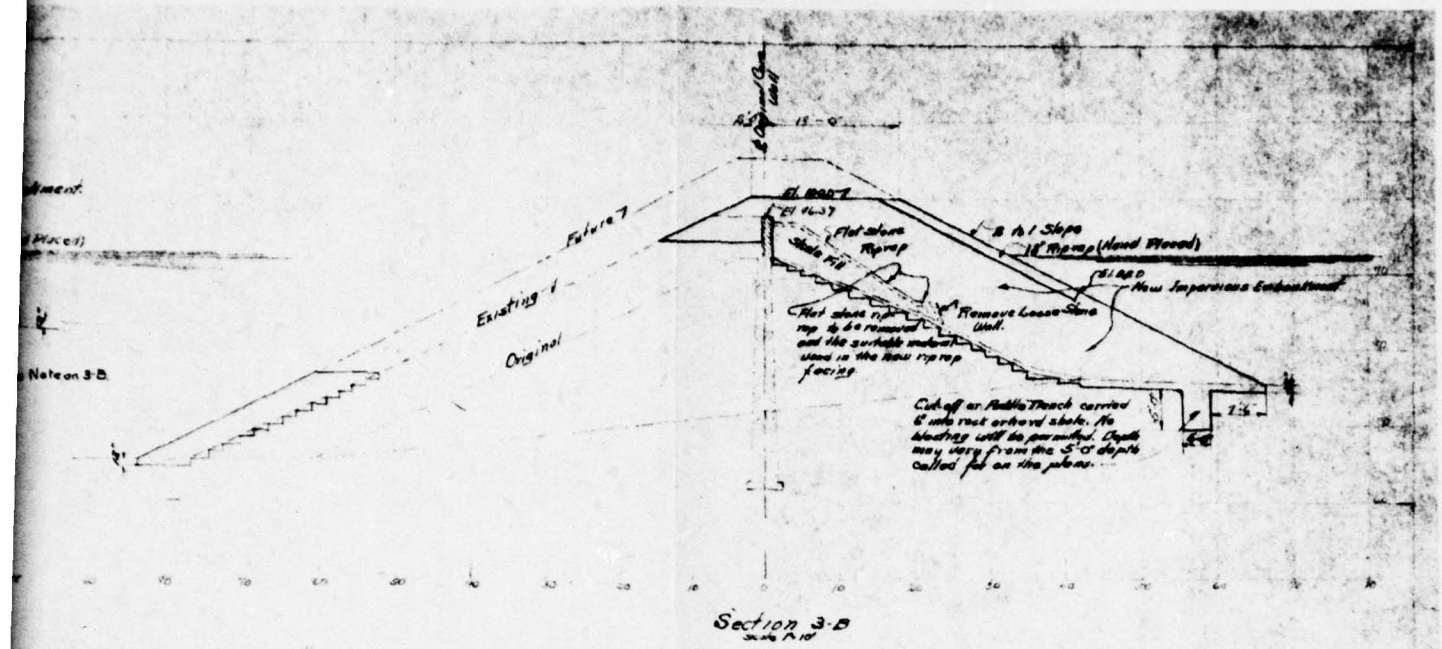
Section 3A
Scale 1"=10'



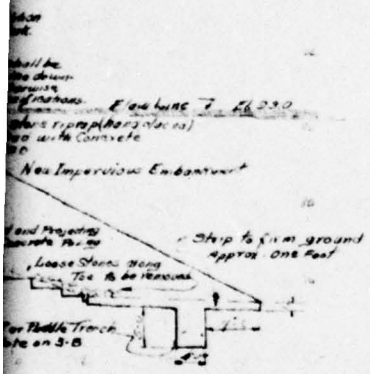
Section -3-C
Scale 1"=10'



Section 3-D
Scale 1"=10'



Section 3-B
Scale 1"=10'



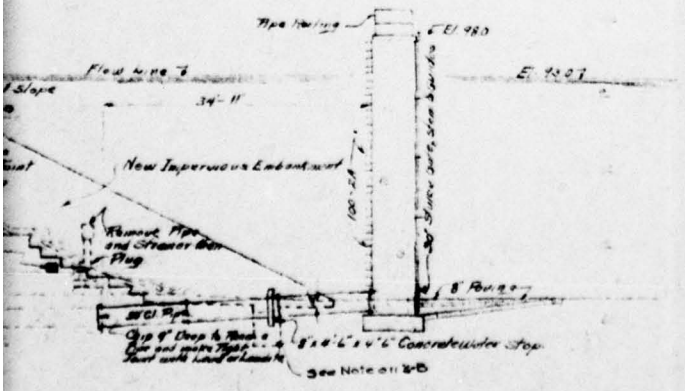
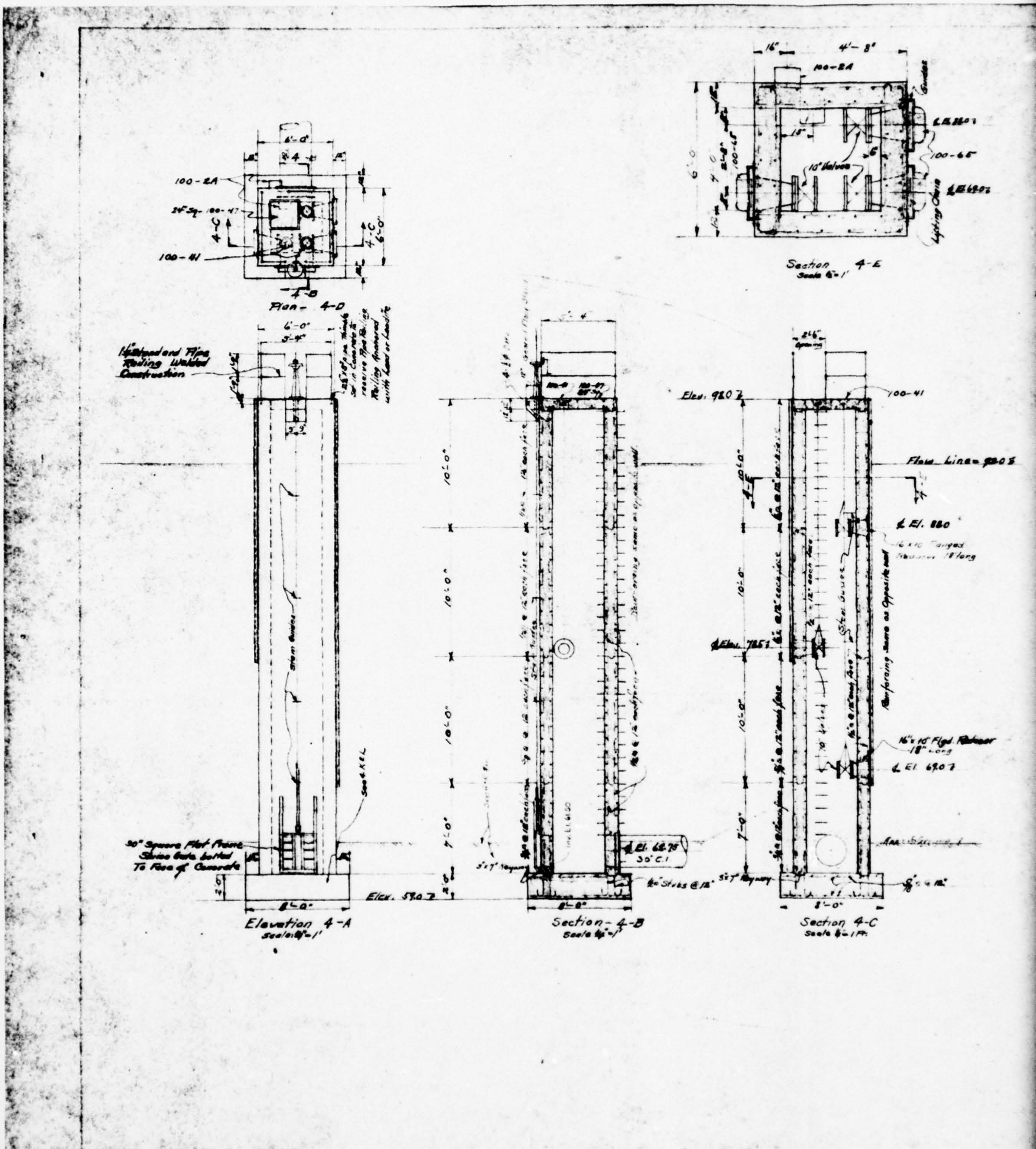
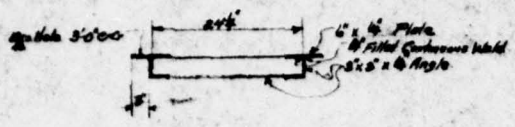


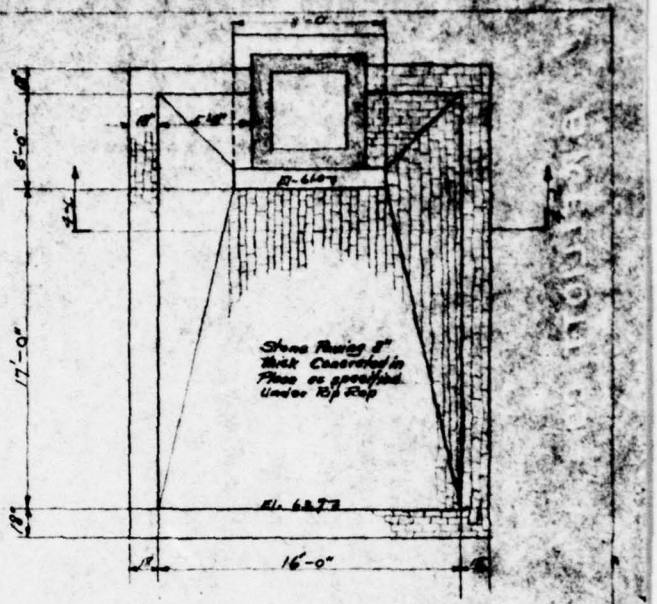
PLATE 4

REVISIONS	APPROVAL	EMPORIUM WATER CO. EMPORIUM, PA. DAM No 3 SALT RUN SECTIONS & DETAILS
5-9-60		
2		Scale 1"=4' June 1960
		The Chester Engrs. Pittsburgh. 1352

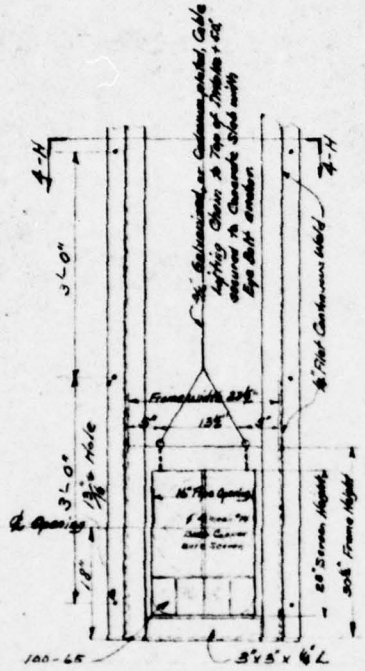

Plan - 4-D
100-2A
100-41
Elevation 4-A
Section - 4-B
Section 4-C
Section 4-E
10" Valves
100-65
Elev. 92.0
Flow Line
Elev. 59.0
30" Square Flat Frame Sluice Gate bolted To Face of Concrete
Stem Guides
8'-0"
6'-0"
4'-8"
30" C.I.
Reinforcing same as Opposite wall



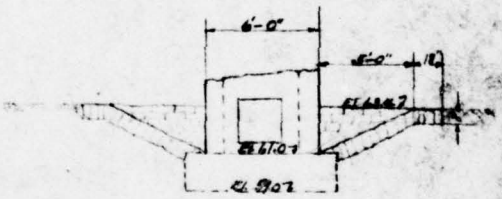
Section of Guides only 4-H
Scale 1"=1'



Paving at Intake 4-K
Scale ⅜"=1'Ft.



Detail of Screen & Guides 4-G
Scale 1"=1'

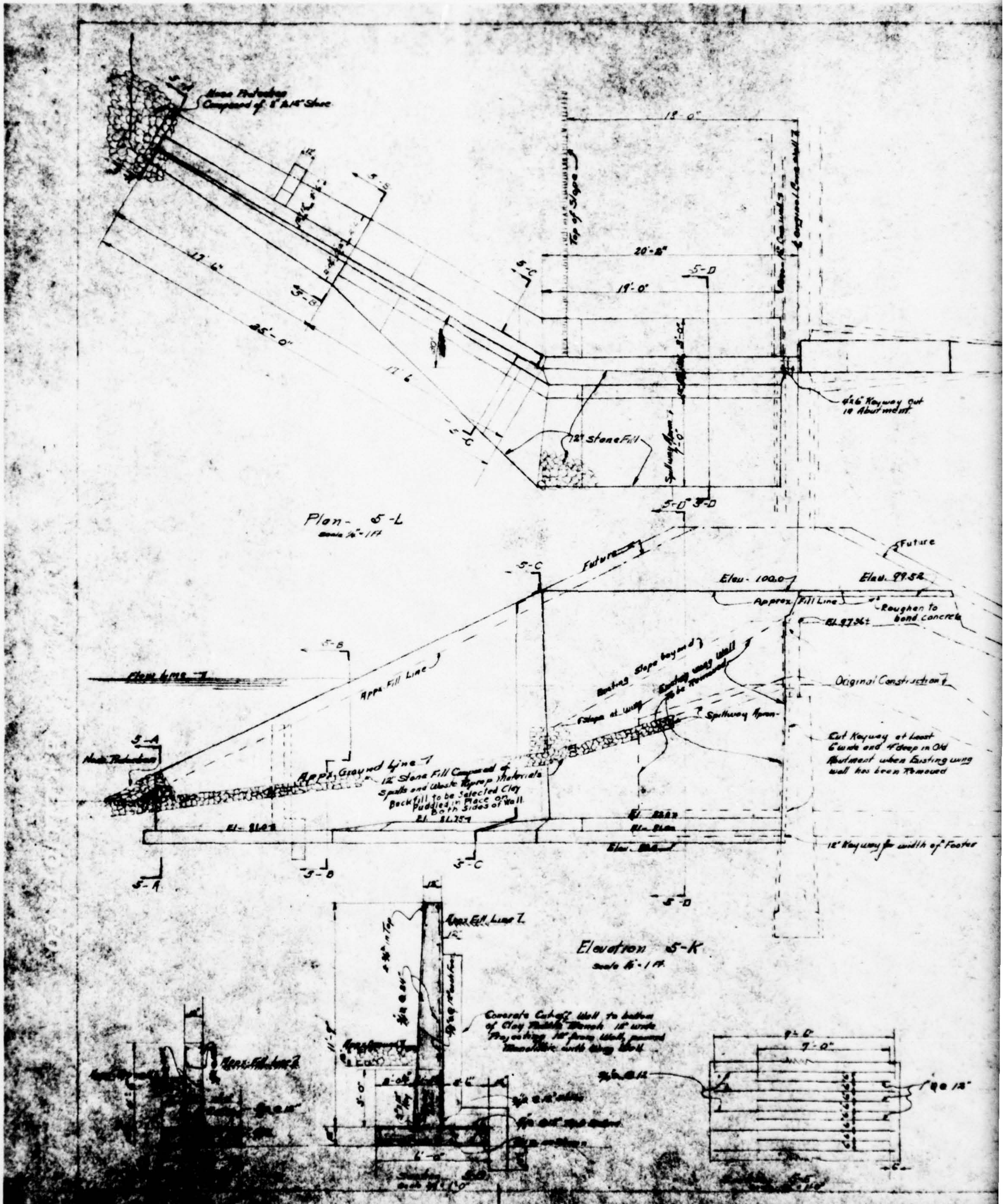


Section 4-L
Scale ¼"=1'Ft.

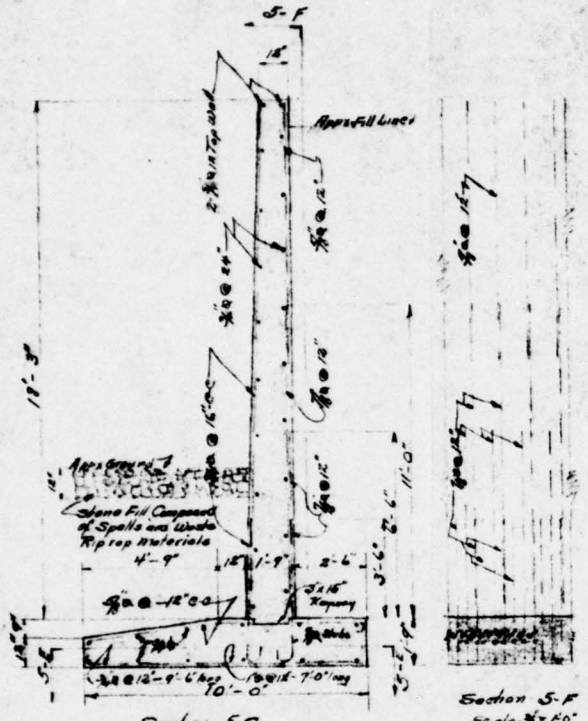
PLATE 5

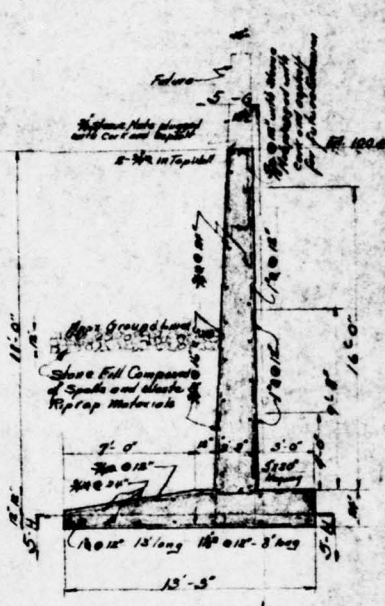
REVISIONS	APPROVAL
	2

EMPORIUM WATER CO.
EMPORIUM, PA.
DAM Nº 3 SALT RUN
INTAKE SECTIONS & DETAILS
June 1960
The Chester Engineers



Compound of 8" to 15" Stone
18'-0"
Top of Slope
20'-8"
19'-0"
17'-6"
25'-0"
5-C
5-D
5-B
12" Stone Fill
4"x6" Keyway cut in Abutment
Plan- 5-L
Future
Elev. 100.0
Elev. 99.52
Approx. Fill Line
Roughen to bond concrete
Original Construction
Appx. Fill Line
Existing Slope beyond
Existing wing Wall to be Removed
Slope at wing
Spillway Apron
Cut Keyway at Least 6" wide and 4" deep in Old Abutment when Existing wing wall has been Removed
5-A
Appx. Ground Line
12" Stone Fill Composed of Spalls and Waste Riprap Materials
Backfill to be Selected Clay Puddled in Place on Both Sides of Wall.
El. 81.75
12" Keyway for width of Footer
Elevation 5-K
Appx. Fill Line
Concrete Cutoff Wall to bottom of Clay Puddle Trench 18" wide Projecting 36" from Wall, poured Monolithic with Wing Wall
9'-0"
7'-0"





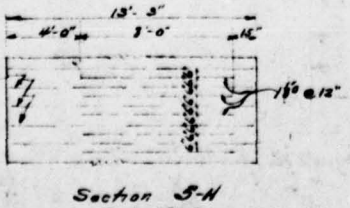
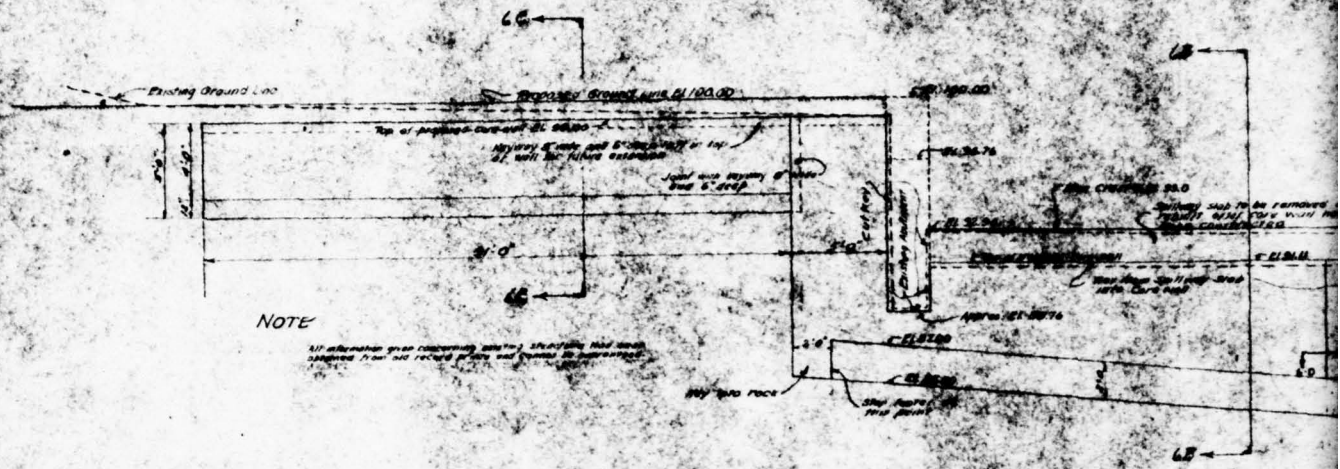


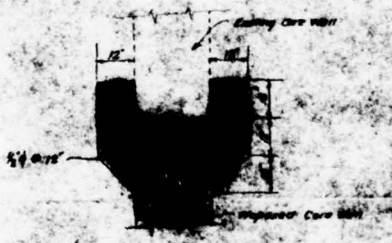
PLATE 6

REVISIONS	APPROVAL
3-4-40	

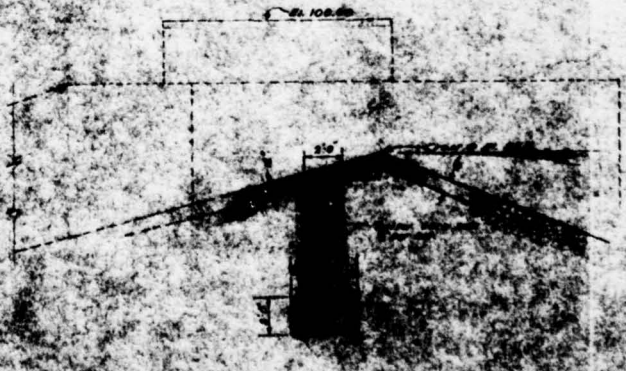
EMPORIUM WATER CO.
EMPORIUM, PA.
DAM NO. 3 SALT RUN
RETAINING WALL & SECTIONS
Scale- As Shown
The Cowley Engineering Co.
Syracuse, N.Y.

2

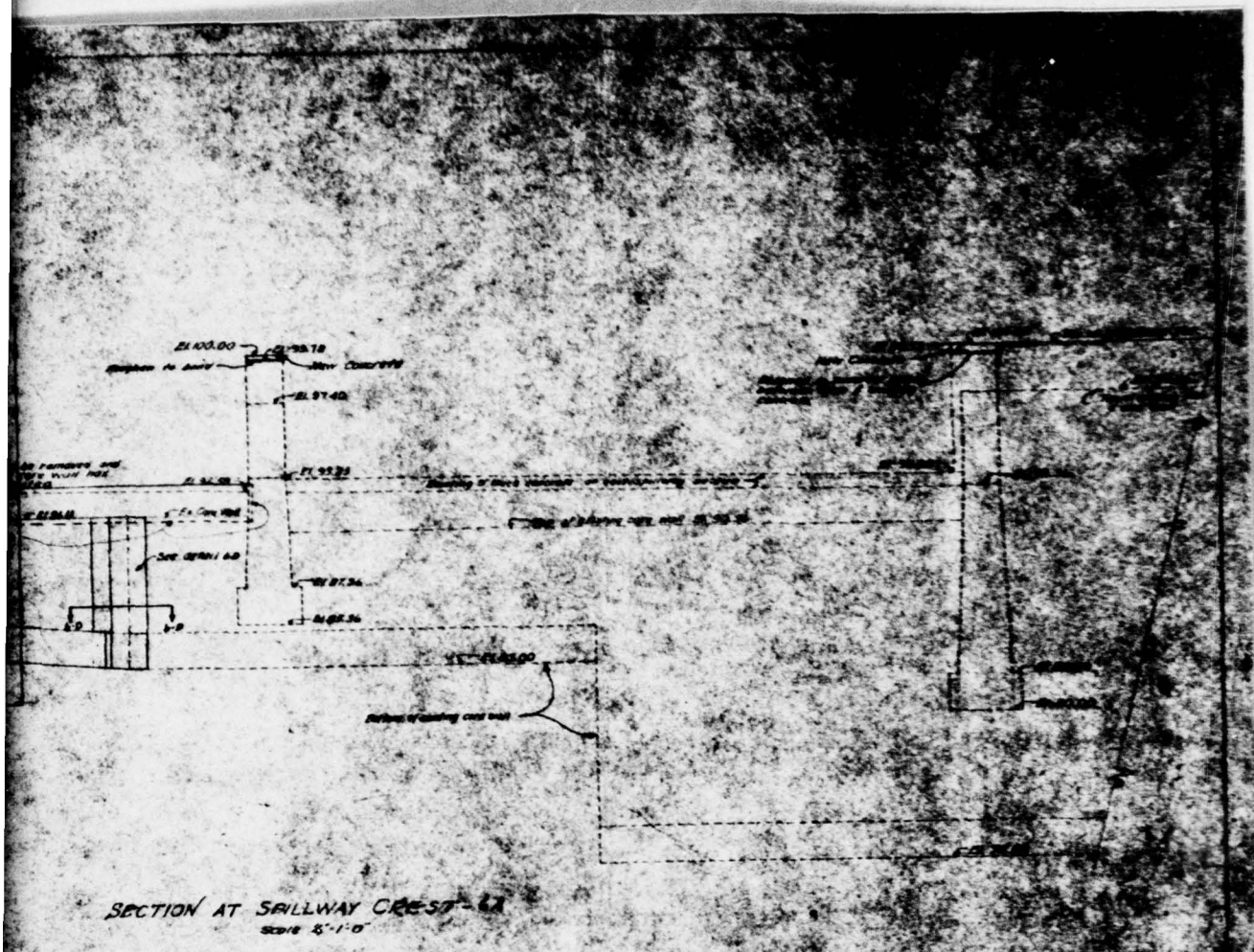




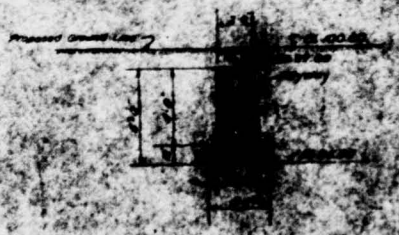
DETAIL OF CORE WALL CONNECTION
Scale 1" = 1'-0"



SECTION
Scale 1" = 1'-0"



SECTION AT SPILLWAY CREST - A



SECTION B-C

PLATE 7

APPENDIX A

CHECK LIST - VISUAL INSPECTION AND FIELD SKETCH

Check List
Visual Inspection
Phase 1

Name of Dam Salt Run Reservoir County Cameron State PA Coordinates Lat. N 41°32.4'

NDI # PA 00392
PennDER # 12-4

Long. W 78°11.2'

Date Inspection 10 Nov. 1978 Weather Sunny, Calm Temperature 50°F.

Pool Elevation at Time of Inspection 1243.0 ft.* M.S.L. Tailwater at Time of Inspection 1211.9 ft.*M.S.L.

*Based on N.G.S. datum (all elevations were referenced to the pool elevation of 1243.0 ft. as indicated on the U.S.G.S. 7.5 minute topographic quadrangle sheet, Emporium, PA).

Inspection Personnel:

Michael Baker, Jr., Inc.:

James G. Ulinski
Thomas W. Smith
Rodney E. Holderbaum

Owner's Representatives:

John Sepiol, Superintendent
Emporium Water Company

Rodney E. Holderbaum Recorder

CONCRETE/MASONRY DAMS (N/A)

Name of Dam: SALT RUN RESERVOIR

NDI # PA 00392

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS		
DRAINS		
WATER PASSAGES		
FOUNDATION		

CONCRETE/MASONRY DAMS (N/A)

Name of Dam: SALT RUN RESERVOIR
NDI # PA 00392

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

EMBANKMENT

Name of Dam: SALT RUN RESERVOIR

NDI # PA 00392

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	No surface cracks were observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No unusual movement was observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	No sloughing of the embankment or abutment slopes was observed. An erosion channel 1.5 ft. wide by 0.25 ft. deep was observed approximately 250 ft. from the right abutment on the downstream slope.	This erosion channel should be repaired as a part of routine maintenance of the dam.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No problems noted in the horizontal alignment. The embankment crest is approximately 1.5 ft. low at the junction of the embankment and left spillway wall.	The embankment crest should be restored to the proper elevation and reseeded.
RIPRAP FAILURES	Minor erosion is occurring at the junction of the upstream riprap and the left approach channel wing wall.	The riprap at this location should be repaired.

EMBANKMENT

Name of Dam: SALT RUN RESERVOIR

NDI # PA 00392

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANIMAL BURROWS	Two animal burrows were observed in the embankment. One is located approximately 165 ft. from the right abutment and 15 ft. below the crest of the embankment on the downstream slope. The other is located approximately 270 ft. from the right abutment at the toe of the downstream slope.	These holes should be repaired and a rodent control program should be implemented.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The embankment along the downstream spillway training wall should be raised approximately 6 in. and reseeded.	
ANY NOTICEABLE SEEPAGE	Yes, seepage is flowing around the left end of the dam. The seepage/groundwater flow is outletting at a soil-rock contact zone in the downstream left hillside approximately 5 ft. above and 15 ft. left of the outlet pipe. This seepage line extends approximately 100 ft. downstream from the outlet head wall in the left hillside. The volume of flow is greatest (approximately 10 g.p.m.) near the outlet head wall and the flow diminishes with distance along the seepage outcrop line. A marshy area is located from 160 ft. to 200 ft. left of the right abutment extending from the toe of a berm at the downstream toe to approximately 50 ft. downstream.	The left abutment area was grouted in 1939 to decrease the volume of flow. Minor erosion is occurring along the outlet channel at this seepage line; observe erosion and seepage as a part of future inspections. The marshy area near the center of the dam is not properly graded to allow drainage of surface water; provide proper drainage and observe in the future.
STAFF GAGE AND RECORDER	None	
DRAINS	No drains were observed.	

OUTLET WORKS

Name of Dam: SALT RUN RESERVOIR

NDI # PA 00392

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION OF CONCRETE SURFACES IN OUTLET CONDUIT	30-in. cast-iron outlet pipe exits near left abutment of dam; no excessive deterioration of the pipe (at the exit) was observed.	
INTAKE STRUCTURE	Concrete intake structure is located approximately 100 ft. upstream from centerline of dam. Minor spalling has occurred on the edges of the structure; no other deterioration was observed.	Spalling of concrete does not represent a problem at this time.
OUTLET STRUCTURE	Stone head wall, at outlet, is in fair condition; head wall is covered with vegetation.	Vegetation at outlet structure does not restrict flow from outlet pipe.
OUTLET CHANNEL	No debris or vegetation is constricting the outlet channel. Some siltation has occurred in the channel near the outlet structure. The channel joins the main stream channel a short distance downstream. Minor erosion on left hillside along channel.	Silt should be removed periodically.
EMERGENCY GATE	30-in. outlet is operated manually from intake tower.	Owner indicated that the emergency gate is operated periodically; it should be operated annually as part of an annual inspection program.

UNGATED SPILLWAY

Name of Dam: SALT RUN RESERVOIR
NDI # PA 00392

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The 65-ft. long concrete weir is in poor condition. It has been patched with gunite which is now cracked and spalled in numerous locations.	The concrete should be repaired and inspected periodically.
APPROACH CHANNEL	Channel is earth-lined. No debris, restrictive vegetation or erosion was noted.	
DISCHARGE CHANNEL	Consists of a 106-ft. long concrete channel exiting into a natural stilling basin. The concrete in the channel and retaining walls is in poor condition; cracking and spalling has taken place at several locations.	The channel and retaining walls were repaired with gunite; however, the sections repaired have deteriorated and should be repaired.
BRIDGE AND PIERS	A wooden, foot bridge is located above the spillway crest. One 2.1-ft. wide concrete pier is located near the center of the bridge. The clearance between the spillway crest and bridge deck is about 7.0 ft.	The bridge is not a serious restriction to high flows passing through the spillway.
SPILLWAY FOUNDATION	The spillway crest is constructed on a concrete core wall. The spillway channel slab rests on in situ or embankment materials. The downstream end of the spillway channel slab rests on a constructed shale foundation. The end of the right spillway training wall and channel slab is undermined.	Proper drainage outlets and filters have not been provided. With the present design, potential for undermining and failure of the slab exists. The undermining at the right end should be repaired.

GATED SPILLWAY (N/A)

Name of Dam: SALT RUN RESERVOIR
NDI # PA 00392

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		
GATES AND OPERATION EQUIPMENT		

INSTRUMENTATION (N/A)

Name of Dam: SALT RUN RESERVOIR

NDI # PA 00392

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None observed	
WEIRS	None observed	
PIEZOMETERS	None observed	
OTHER	N/A	

RESERVOIR

Name of Dam: SALT RUN RESERVOIR

NDI # PA 00392

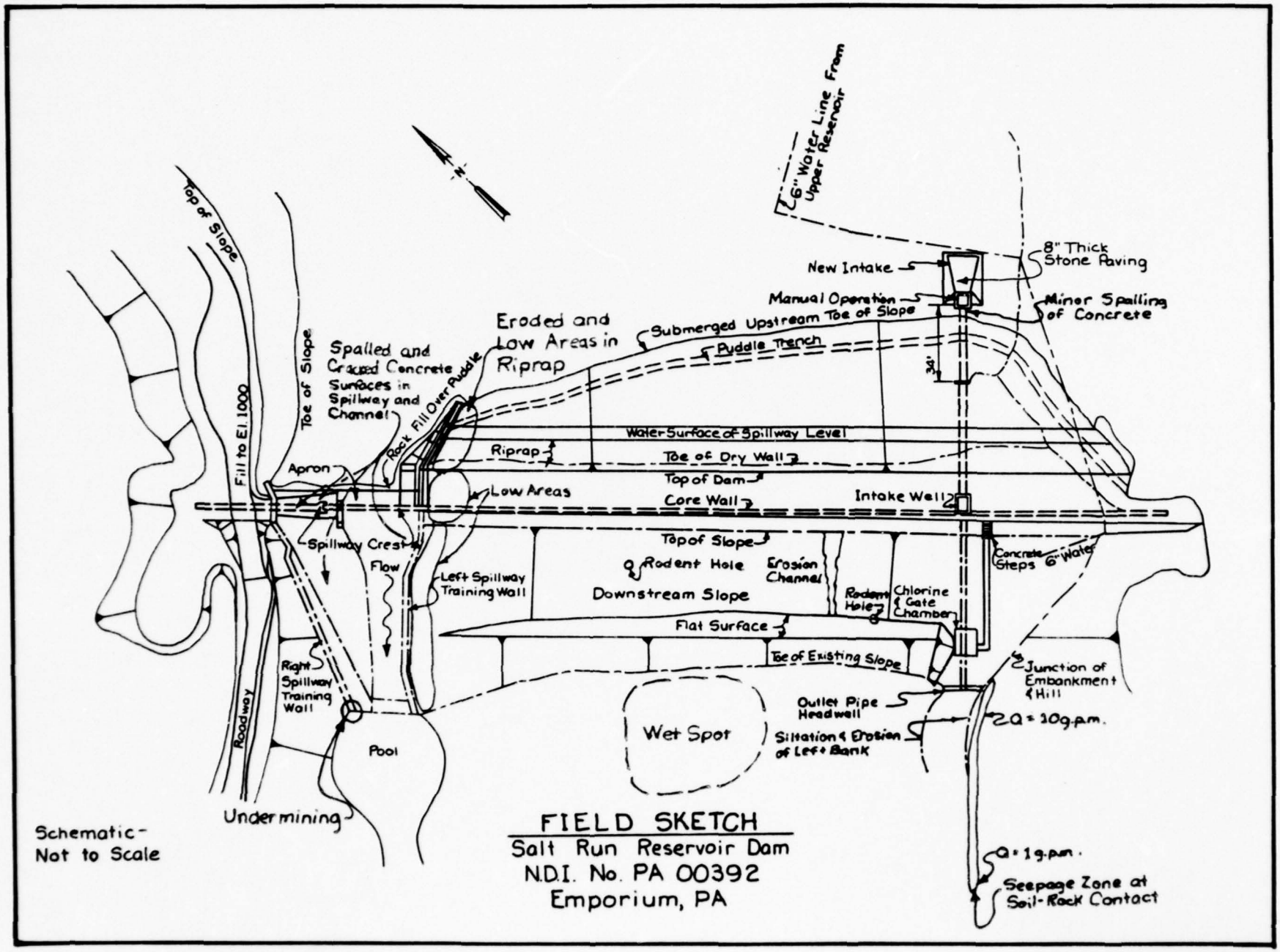
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Reservoir slopes are steep and heavily wooded; no slides or slide scarps were observed on the existing slopes.	
SEDIMENTATION	No unusual sedimentation was observed.	Reservior has been drawn down periodically to remove sediment.

DOWNSTREAM CHANNEL

Name of Dam: SALT RUN RESERVOIR

NDI # PA 00392

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel is relatively free of debris, vegetation or other obstructions.	
SLOPES	The gradient of the downstream channel is moderate to steep averaging about 2%. The side slopes are heavily forested and stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Salt Run empties into Sinnemahoning Portage Creek about 2 mi. below the dam; no homes are located along this reach of the stream. From this point to the Emporium corporate limit (approx. 1 mi. downstream) the floodplain is heavily populated (100 homes ±); the population of the Borough of Emporium is 3074 (1970 census).	



FIELD SKETCH

Salt Run Reservoir Dam
N.D.I. No. PA 00392
Emporium, PA

APPENDIX B

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: SALT RUN RESERVOIR
NDI # PA 00392

ITEM	REMARKS
PLAN OF DAM	See Plate 3 of this report.
REGIONAL VICINITY MAP	See Plate 1 of this report.
CONSTRUCTION HISTORY	The dam was designed by Mr. H. B. Norton, Civil Engineer, of Ridgeway, PA; constructed by N. Applegate and Son, Contractors of Bradford; and was completed in the latter part of 1911.
TYPICAL SECTIONS OF DAM	See Plate 4 of this report.
HYDROLOGIC/HYDRAULIC DATA	No information available.
OUTLETS - PLAN,	
DETAILS and CONSTRAINTS	See Plates 4 and 5 of this report.
- DISCHARGE RATINGS	No information was available.
RAINFALL/RESERVOIR RECORDS	No information was available.

Name of Dam: SALT RUN RESERVOIR

NDI # PA 00392

ITEM	REMARKS
DESIGN REPORTS	None
GEOLOGY REPORTS	None
DESIGN COMPUTATIONS, HYDROLOGY & HYDRAULICS AND DAM STABILITY	No information was available.
SEEPAGE STUDIES	A seepage weir, located near the left end of the dam, was monitored from 1916 to spring 1917 and then occasionally from 1919 until 1939. In 1939, the left abutment area, which was seeping, was grouted to reduce the seepage. The weir was abandoned subsequent to grouting.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	No information was available.

Name of Dam: SALT RUN RESERVOIR

NDI # PA 00392

ITEM	REMARKS
MONITORING SYSTEMS	None, previous seepage weir was destroyed.
HIGH POOL RECORDS	None was available.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	A "Report Upon the No. 3 Storage Dam of the Emporium Water Company" dated 15 October 1915 and prepared by the Water Supply Commission of Pennsylvania is available in the PennDER file for this dam. Subsequent to the 1915 report, 16 inspection reports are available in the PennDER file for this dam.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	In 1913, two years after construction, a portion of the downstream embankment overlying a 6-in. water supply pipe failed. The 6-in. line was rerouted around the dam and the failure repaired.
MAINTENANCE OPERATION RECORDS	None was available

Name of Dam: SALT RUN RESERVOIR
NDI # PA 00392

ITEM	REMARKS
SPILLWAY PLAN	See Plates 6 and 7 of this report.
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	See Plate 5 of this report.
MODIFICATIONS	1917 - Downstream slope of the embankment changed from 1.5H:1V to 2H:1V, and the crest width was increased from 4 ft. to 12 ft. A core wall was constructed under the spillway prior to the widening and repaving of the spillway. The height of the embankment was increased to 4 ft. above the spillway crest.
	1934 and 1935 - Additional 18 in. of material placed on the crest and upstream portion of the embankment.
	1936 The core wall was raised 4 ft. to the top of the dam.
	1939 - Raised the spillway walls approximately 2 ft. Rebuilt the right spillway training wall. The left abutment area was grouted to reduce seepage.
	1940 and 1941 - 4-ft. wide cut off trench extending into the left abutment constructed all along the upstream toe of the embankment. Intake tower constructed approximately 100 ft. upstream from the center of the dam. Additional fill placed on the upstream slope to change it to a 2H:1V slope. The upstream face was lined with riprap.
	1948 - Additional material placed on the embankment crest to restore proper elevation.
	1959 - The reservoir was drawn down, and the silt deposition removed.
	1973 - The reservoir was drawn down, and the silt deposition removed.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.78 sq.mi. (primarily wooded)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1243.0 ft. (132 ac.-ft.)

ELEVATION MINIMUM TOP OF DAM (STORAGE CAPACITY): 1249.4 ft. (195 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1249.4 ft. (minimum elevation), 1249.9 ft. (average elevation)

CREST: Principal Spillway

a. Elevation 1243.0 ft.
b. Type Overflow spillway
c. Width 65 ft.
d. Length 106 ft.
e. Location Spillover At right abutment
f. Number and Type of Gates N/A

OUTLET WORKS: 30-in. cast-iron pipe

a. Type 30 in. cast-iron pipe
b. Location Travels through embankment approx. 60-ft. from left abutment
c. Entrance inverts 1181.5 ft.
d. Exit inverts 1208.1 ft.
e. Emergency draindown facilities 30-in. hand-operated sluice gate and 30-in. blow-off pipe

HYDROMETEOROLOGICAL GAGES: Not Applicable

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE Unknown

APPENDIX C

PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam
Top - View from Right Hillside Toward Dam and Spillway
Bottom - View from Left Hillside Toward Dam

Photo 1 - Upstream View of Spillway

Photo 2 - Downstream View of Spillway

Photo 3 - View of Upstream Slope
(Intake Riser at Left-Center of Photo)

Photo 4 - Close-Up View of Intake Riser

Photo 5 - View of Outlet Pipe and Head Wall
(Ruler in center of photo shows the location of the seepage line along the left hillside)

Photo 6 - View of Right End of Spillway Showing Undermining

Note: Photographs were taken on 10 November 1978.

SALT RUN RESERVOIR DAM

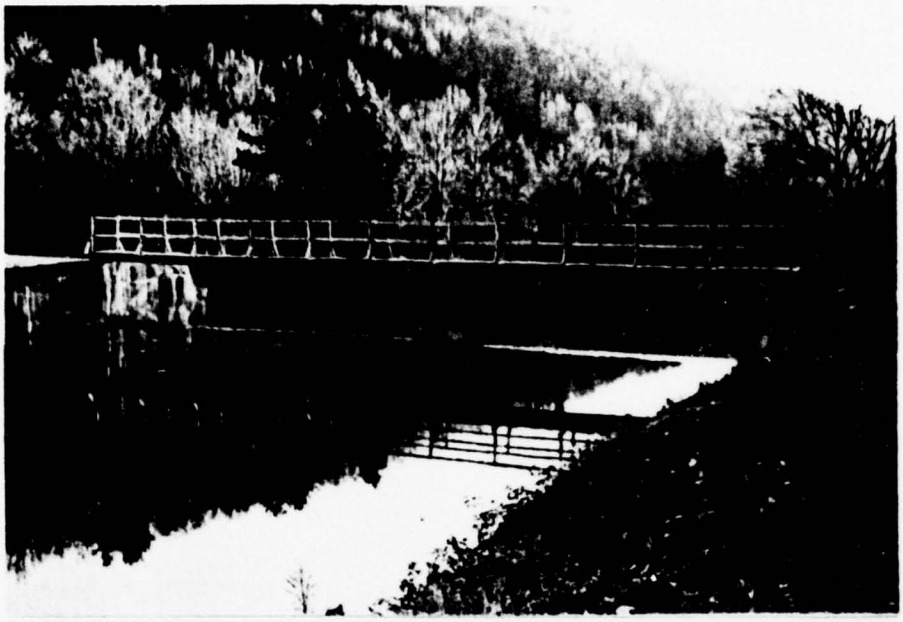


PHOTO 1. Upstream View of Spillway

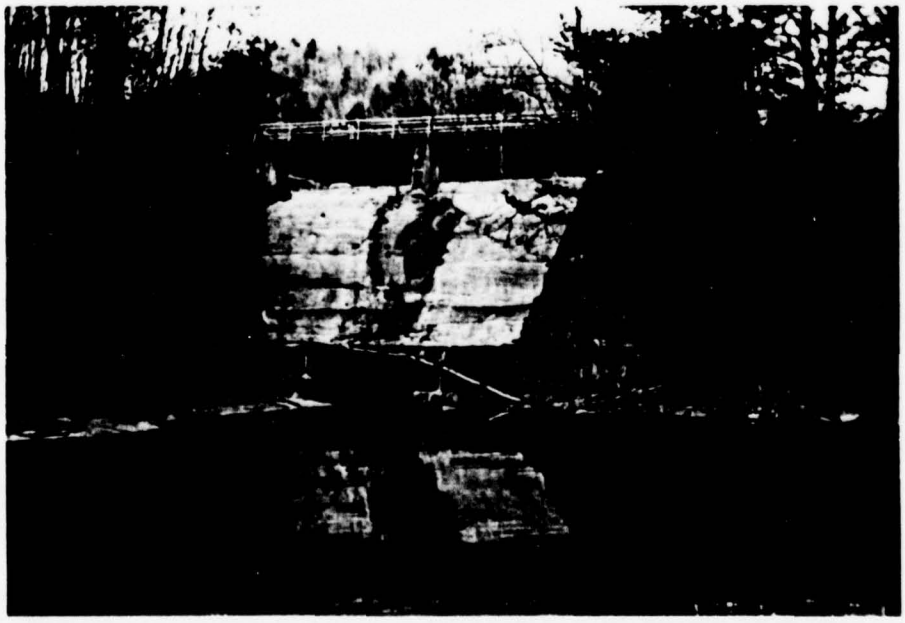


PHOTO 2. Downstream View of Spillway

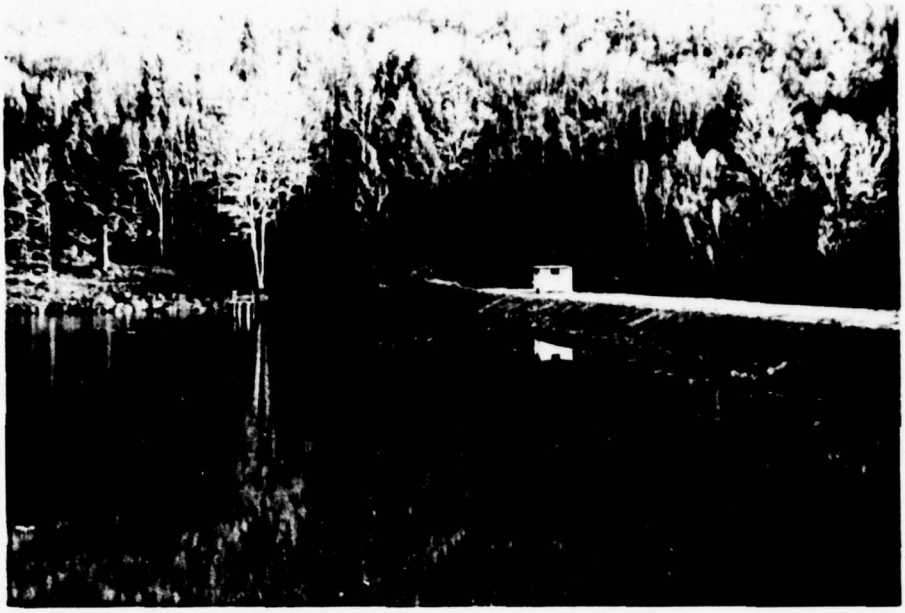


PHOTO 3. View of Upstream Slope (Intake Riser at Left-Center of Photo)

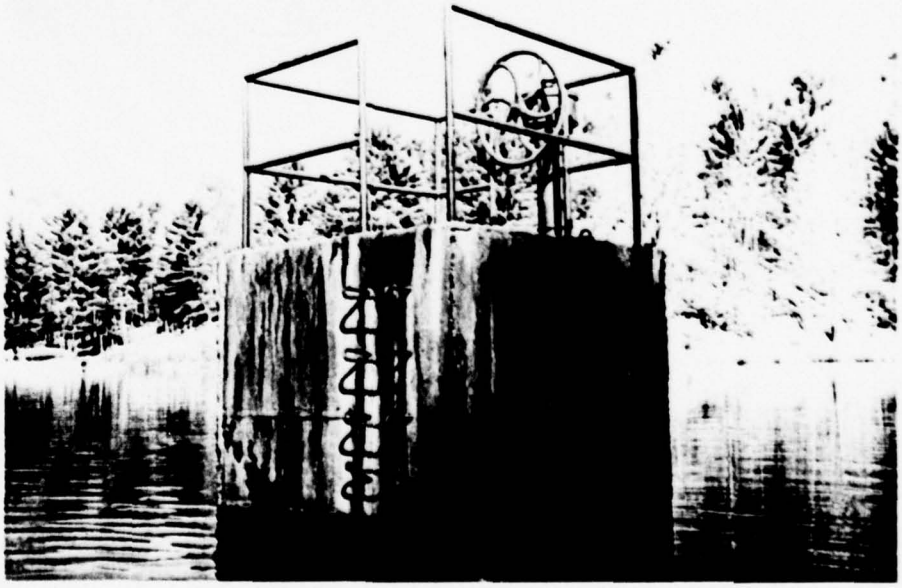


PHOTO 4. Close-Up View of Intake Riser

PHOTO 5. View of Outlet Pipe and Head Wall

PHOTO 6. View of Right End of Spillway Showing Undermining

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject Salt Run Dam S.O. No.

Sheet No. of

Drawing No.

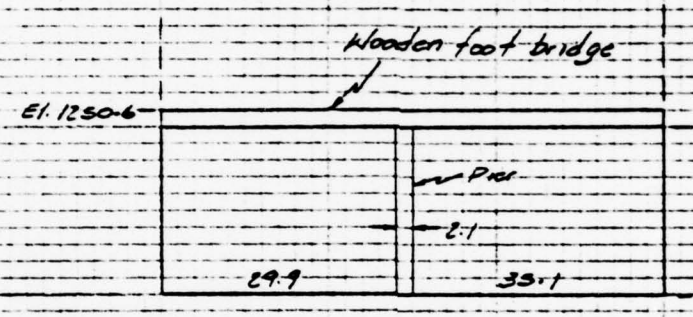
Computed by Checked by Date

Table of Contents

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject PA Dam Inspections S.O. No.
Salt Run Sheet No. 1 of 24
Spillway Rating Drawing No.
Computed by REH Checked by Date 12-13-78



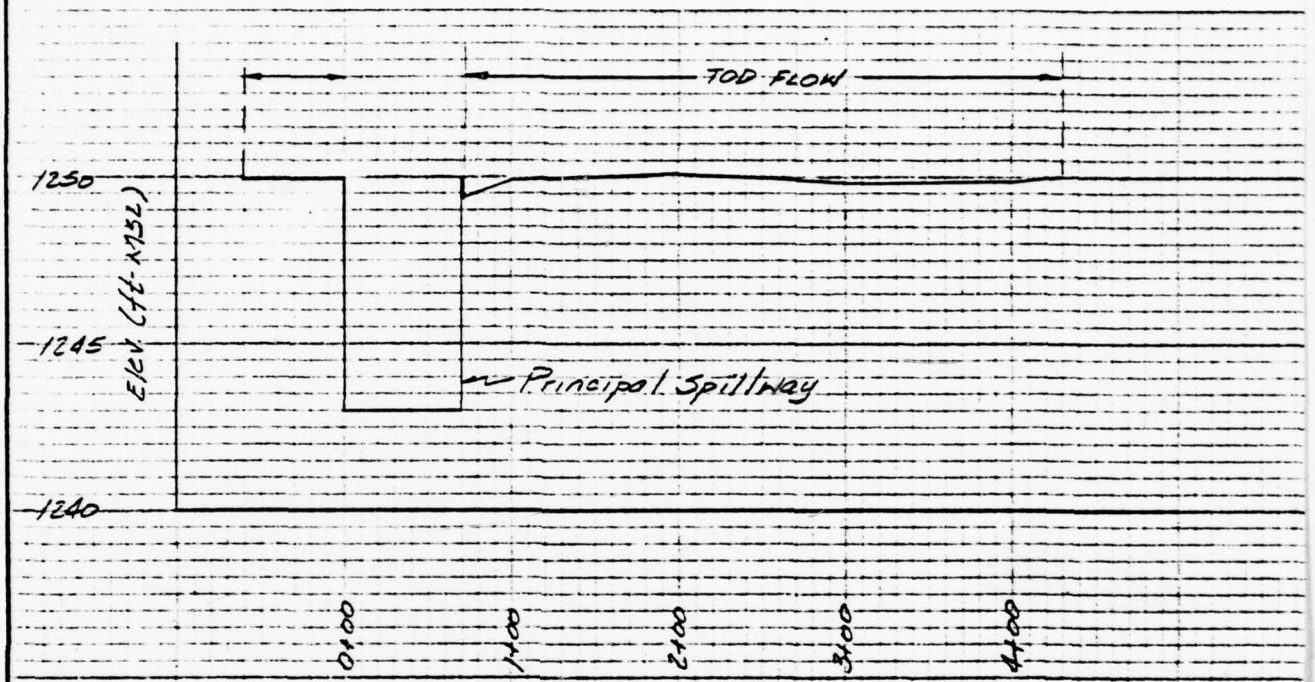
The above elevations were taken from design plans, converted to USGS datum, and verified by field measurements.

Q (cfs)	q (cfs/ft)	dc (ft)	A (ft²)	V (ft/s)	V²/2g	EG.	WSEL
0							1243.0
100	1.54	0.42	27.23	3.67	0.21	0.63	23.63
400	6.15	1.06	68.61	5.83	0.53	1.59	44.59
800	12.31	1.67	108.86	7.35	0.84	2.51	45.51
1200	18.46	2.20	142.70	8.41	1.10	3.30	46.30
1600	24.62	2.66	172.87	9.26	1.33	3.99	46.99
2000	30.77	3.09	200.62	9.97	1.54	4.63	47.63
2500	38.46	3.58	232.79	10.74	1.79	5.37	48.37
3000	46.15	4.04	262.85	11.41	2.02	6.06	49.06
3500	53.85	4.48	291.29	12.02	2.24	6.72	49.72
4000	61.54	4.90	318.41	12.56	2.45	7.35	50.35
5000	76.92	5.68	369.48	13.53	2.64	8.52	51.52

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject PA Dam Inspections — S.O. No.
Salt Run Reservoir — Sheet No. 2 of 24
Top of Dam Profile — Drawing No.
Computed by REH — Checked by — Date 12-13-78



Average TOD Elev. = 1249.9 Ft.

Minimum TOD Elev. = 1249.4 Ft.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS
Box 280
Beaver, Pa. 15009

Subject Salt Run Dam — S.O. No.
Unit Hydrograph Comps — Sheet No. 3 of 24
Snyders Method — Drawing No.
Computed by D.J.G. — Checked by — Date 1/3/79

1. Drainage Area = 5.78 mi.^{2}
2. L = 25,300 ft. = 4.79 mi.
3. L_{CA} = 12,050 ft. = 2.28 mi.
4. Area .19 (from Map of Snyders Coeff.)
5. Cp = 0.45
6. Plate H with $L L_{CA}$ = 10.94 mi.^{2}
7. $t_p = 1.84 (L L_{CA})^{.3}$ = 5.11 hours
8. $t_{pR} = 3.11 + 0.25 (19/60 - 3.77/65)$ = 3.64 hours
   (for 10 min U.H.)
9. $q_p = \frac{640 (0.45)(5.78)}{3.64}$ = 457 cfs.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject: Non Federal Dam Inspections — S.O. No.
Salt Run - Storage & — Sheet No. 4 of 24
Overtopping Data — Drawing No.
Computed by D.J.G. — Checked by — Date 1/12/79

STORAGE

El. P.D.	El. USGS	Area - Ac.
64	1214	0.05
93	1243	1.4
110	1260	23.0
62.5	1212.5	0

USING CONIC METHOD

Elev. @ Zero Area

$DE = \frac{3S}{\text{Area (2)}} = \frac{30(23)}{1.4} = 33.51$

Release = 1243 − 33.51 = 1189.49

OVERTOPPING RATING DATA

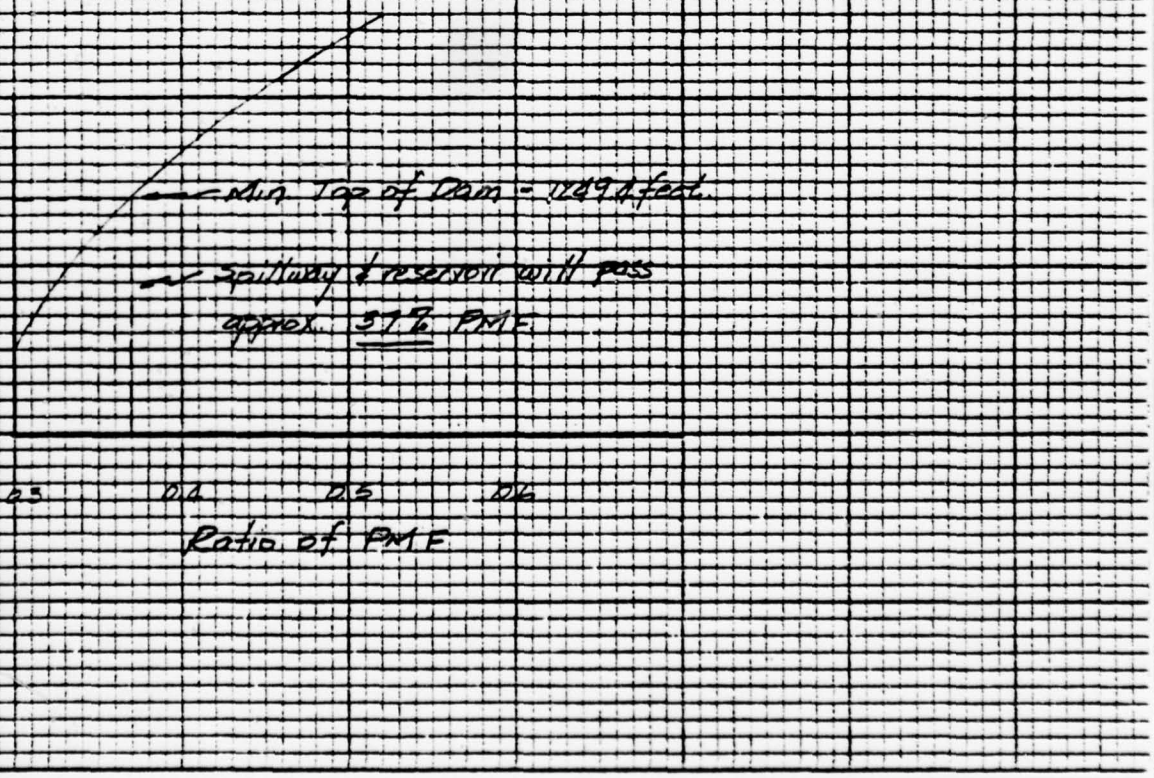
$Q = CLH^{3/2}$

L = 415 feet length of dam

l = 20 feet Crest Width

Assume Depth of Overtopping = 1 foot

$H/l = 1/20 = 0.05 \Rightarrow C = 2.63$ TABLE 5-3 King & Brater Handbook of Hyde



MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject Salt Run Reservoir — S.O. No.
Dam Breach Data — Sheet No. 5 of 24
Drawing No.
Computed by REH — Checked by — Date 2-13-79

Breach Parameters

Earth dam $\Rightarrow \frac{HD}{2} < BRWID < 3HD$

$HD = 42$ ft

$\therefore 21' < BRWID < 126'$

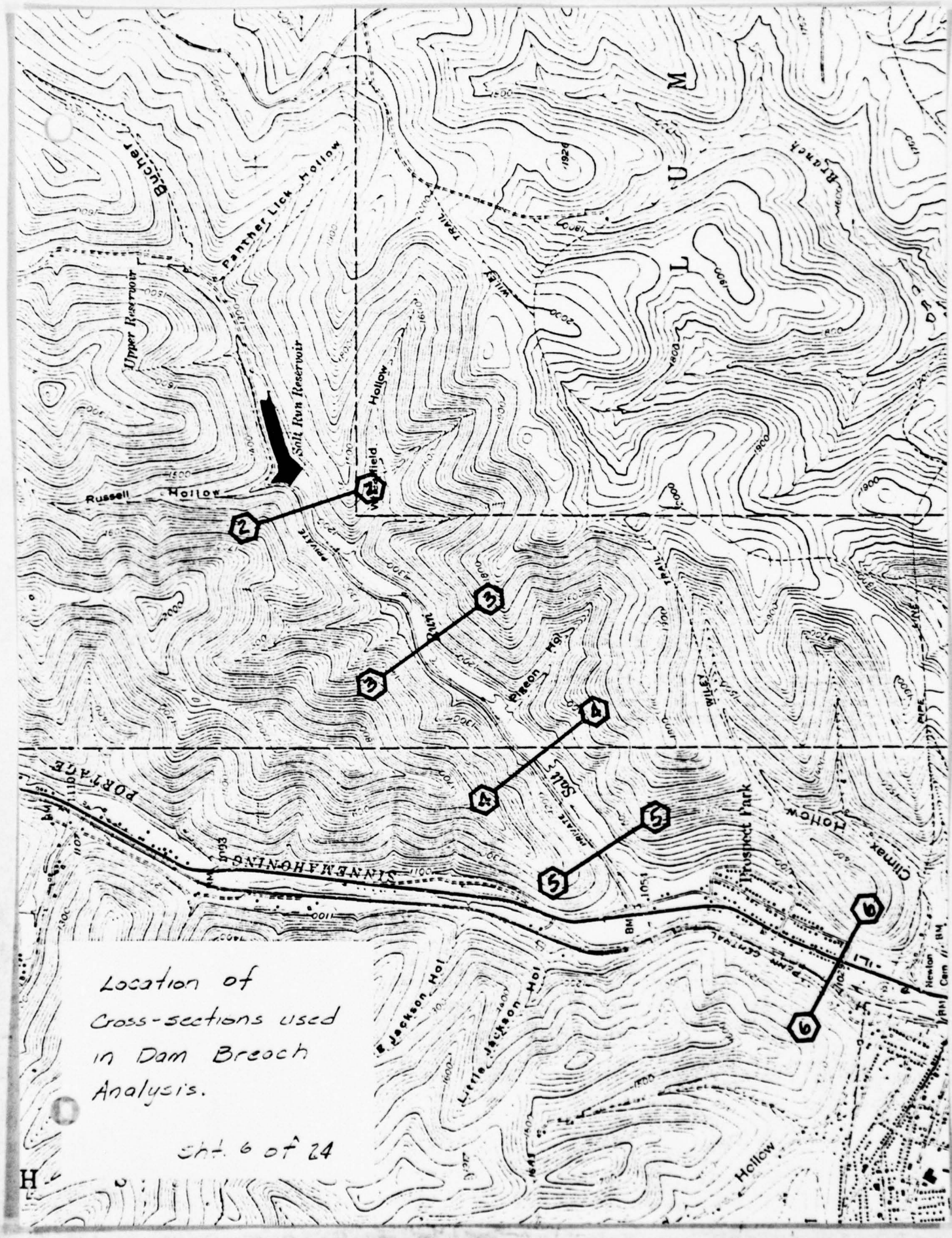
Use $BRWID = 100$ feet

Assume Trapezoidal breach with $z = 0.5$

Assume failure time = 1.0 hours (very erosive material)

Begin failure when water level reaches approx 1.0 foot above minimum top of dam = velocities at this point will be sufficient to cause erosion of the dam crest.

Cross-sections for downstream channel routing are shown on following page.


Location of
Cross-sections used
in Dam Breach
Analysis.
Sht. 6 of 24

FINAL
SUMMARY

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 SEP 78
**********
     1              A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
     2              A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF SALT RUN RES. MBJ  24
     3              A3       PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD
     4              B    300       0      10       0       0       0       0       0      -4       0
     5              B1     5
     6              J      1       4       1
     7              J1   1.0     0.5     0.4     0.3
     8              K        SNYDER'S
     9              M      1       1    5.78                                                      1
    10              P             23.0     117     127     141     151
    11              T                                                     1.0     .05
    12              W   3.64     0.45
    13              X   -1.5    -0.05     2.0
    14              K      1     DAM                                              1
    15              K1       THIS IS A ROUTING AT THE SALT RUN DAM
    16              Y                                       1       1
    17              Y1     1                                                  -1243      -1
    18              Y4  1243 1243.63 1244.59 1245.51 1246.30 1246.99 1247.63 1248.37 1249.06 1249.72
    19              Y41250.4 1251.52
    20              Y5              100     400     800    1200    1600    2000    2500    3000    3500
    21              Y5  4000     5000
    22              $A              7.4    23.0
    23              $F1189.5     1243    1260
    24              $$  1243
    25              $D1249.9     2.63     1.5     415
    26              K     99
```

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 25 SEP 78
****

RUN DATE 02/07/79
TIME 09.37

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSIS OF SALT RUN RES. MBJ 24
PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	10	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= 1.00 0.50 0.40 0.30

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
VDER*S	0	0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	5.78	0.0	5.78	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.00	117.00	127.00	141.00	151.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 3.64 CP=0.45 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 3.66 HOURS, CP= 0.45 VOL= 0.92

4.	16.	33.	54.	78.	104.	132.	162.	193.	226.
260.	294.	327.	357.	383.	407.	428.	446.	460.	471.
478.	480.	474.	462.	449.	436.	424.	411.	400.	388.
377.	366.	356.	345.	336.	326.	317.	307.	299.	290.
282.	274.	266.	258.	251.	244.	237.	230.	223.	217.
211.	204.	199.	193.	187.	182.	177.	172.	167.	162.
157.	153.	148.	144.	140.	136.	132.	128.	125.	121.
118.	114.	111.	108.	105.	102.	99.	96.	93.	90.

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88. 85. 83. 80. 78. 76. 74. 72. 70. 68.
66. 64. 62. 60. 58. 57. 55. 54. 52. 51.

END-OF-PERIOD FLOW

0 MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SLM	27.78	25.35	2.43	44203.
										(706.1)	(644.)	(62.)	(12534.7)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

THIS IS A ROUTING AT THE SALT RUN DAM

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

ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-1243.	-1

STAGE	1243.00	1243.63	1244.59	1245.51	1246.30	1246.99	1247.63	1248.37	1249.06	1249.72
	1250.40	1251.52								
FLOW	0.0	100.00	400.00	800.00	1200.00	1600.00	2000.00	2500.00	3000.00	3500.00
	4000.00	5000.00								
SURFACE AREA=	0.	7.	23.							
CAPACITY=	0.	132.	378.							
ELEVATION=	1190.	1243.	1260.							

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1243.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1249.9	2.6	1.5	415.

PEAK OUTFLOW IS 8698. AT TIME 43.33 HOURS

PEAK OUTFLOW IS 4347. AT TIME 43.33 HOURS

PEAK OUTFLOW IS 3466. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 2600. AT TIME 43.50 HOURS

********** ********** ********** ********** **********

9 of 24

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 1.00	RATIO 2 0.50	RATIO 3 0.40	RATIO 4 0.30
HYDROGRAPH AT	YDER*S	5.78	1	8696.	4348.	3478.	2609.
		(14.97)		(246.25)(	123.12)(	98.50)(	73.87)(
ROUTED TO	DAM	5.78	1	8698.	4347.	3466.	2600.
		(14.97)		(246.31)(	123.09)(	98.16)(	73.63)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	AVERAGE TOP OF DAM	MINIMUM TOP OF DAM
ELEVATION	1243.00	1243.00	1249.90	1249.40
STORAGE	132.	132.	200.	
OUTFLOW	0.	0.	3632.	

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	AVERAGE MAXIMUM DEPTH OVER DAM	MAXIMUM DEPTH	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1251.99	2.05	2.59	229.	8898.	9.67	43.33	0.0
0.50	1250.38	0.48	0.98	207.	4347.	3.33	43.33	0.0
0.40	1249.68	0.0	0.28	198.	3466.	0.0	43.50	0.0
0.30	1248.51	0.0	0.00	184.	2600.	0.0	43.50	0.0

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FINAL DAM BREACH SUMMARY

```
*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
  LAST MODIFICATION  25 SEP 78
*************************************
      1              A1        NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
      2              A2        HYDROLOGIC AND HYDRAULIC ANALYSIS OF SALT RUN RES. MRJ  24
      3              A3    .5  PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD
      4              B    300       0      10       0       0       0       0       0      -4       0
      5              B1     5
      6              J      2       1       1
      7              J1   0.5
      8              K         SNYDER'S
      9              M      1       1    5.78                                                1
     10              P           23.0     117     127     141     151
     11              T                                                    1.0     .05
     12              W   3.64    0.45
     13              X   -1.5   -0.05     2.0
     14              K      1     DAM                                       1
     15              K1        THIS IS A ROUTING AT THE SALT RUN DAM
     16              Y                             1       1
     17              Y1     1                                          -1243      -1
     18              Y4  1243 1243.63 1244.59 1245.51 1246.30 1246.99 1247.63 1248.37 1249.06 1249.72
     19              Y41250.4 1251.52
     20              Y5           100     400     800    1200    1600    2000    2500    3000    3500
     21              Y5  4000    5000
     22              $A           7.4    23.0
     23              $F1189.5    1243    1260
     24              $$  1243
     25              $D1249.9    2.63     1.5     415
     26              $B   100     0.5    1205     1.0    1243  1250.3
     27              $B   100     0.5    1205     1.0    1243    1260
     28              K      1       2                                       1
     29              K1        CHANNEL ROUTING-MOD PULS REACH 1
     30              Y                             1       1
     31              Y1     1
     32              Y6  0.08    0.04    0.08    1200    1216     530   0.048
     33              Y7     0    1300     150    1220     280    1204     280    1200     300    1200
     34              Y7   300    1204     500    1240     620    1300
     35              K      1       3                                       1
     36              K1        CHANNEL ROUTING-MOD PULS REACH 2
     37              Y                             1       1
     38              Y1     1
     39              Y6  0.08    0.04    0.08    1140    1157    3430   0.017
     40              Y7     0    1260     200    1160     300    1144     300    1140     320    1140
     41              Y7   320    1144     520    1160     750    1260
     42              K      1       4                                       1
     43              K1        CHANNEL ROUTING-MOD PULS REACH 3
     44              Y                             1       1
     45              Y1     1
     46              Y6  0.08    0.04    0.08    1100    1117    2830   0.016
     47              Y7   130    1200     400    1120     700    1097     700    1093     720    1093
     48              Y7   720    1097     800    1120     870    1200
     49              K      1       5                                       1
     50              K1        CHANNEL ROUTING-MOD PULS REACH 4
```

```
Y                                                  1       1
Y1      1
Y6  0.08    0.04    0.08    1060    1078    2020    0.016
Y7   300    1140     580    1080     700    1064     700    1060     720     1060
Y7   720    1064     840    1100     920    1140
K      1       6                                           1
K1      CHANNEL ROUTING-MOD PULS REACH 5
Y                                                  1       1
Y1      1
Y6  0.08    0.04    0.08    1022    1040    5080    0.007
Y7   160    1160     380    1040    1080    1028    1080    1022     1150    1022
Y7  1150    1028    1430    1100    1700    1160
K     99
```

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 25 SEP 78
****

RUN DATE 02/07/79
TIME 08.42

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSIS OF SALT RUN RES. MAJ 24
.5 PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	10	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

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

RTIOS= 0.50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
YDER'S	0	0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	5.78	0.0	5.78	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.00	117.00	127.00	141.00	151.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 3.64 CP=0.45 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 3.66 HOURS, CP= 0.45 VOL= 0.92

4.	16.	33.	54.	78.	104.	132.	162.	193.	226.
260.	294.	327.	357.	383.	407.	428.	446.	460.	471.
478.	480.	474.	462.	449.	436.	424.	411.	400.	388.
377.	366.	356.	345.	336.	326.	317.	307.	299.	290.
282.	274.	266.	258.	251.	244.	237.	230.	223.	217.
211.	204.	199.	193.	187.	182.	177.	172.	167.	162.
157.	153.	148.	144.	140.	136.	132.	128.	125.	121.
118.	114.	111.	108.	105.	102.	99.	96.	93.	90.

14 of 24

88. 85. 83. 80. 78. 76. 74. 72. 70. 68.
66. 64. 62. 60. 58. 57. 55. 54. 52. 51.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	27.78	25.35	2.43	442658.
										(706.)(	644.)(	62.)(12534.70)	

********** *********** ********** ********* **********

HYDROGRAPH ROUTING

THIS IS A ROUTING AT THE SALT RUN DAM

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

ALL PLANS HAVE SAME ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-1243.	-1

STAGE	1243.00	1243.63	1244.59	1245.51	1246.30	1246.99	1247.63	1248.37	1249.06	1249.72
	1250.40	1251.52								
FLOW	0.0	100.00	400.00	800.00	1200.00	1600.00	2000.00	2500.00	3000.00	3500.00
	4000.00	5000.00								
SURFACE AREA=	0.	7.	23.							
CAPACITY=	0.	132.	378.							
ELEVATION=	1190.	1243.	1260.							

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1243.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1249.9	2.6	1.5	415.

DAM BREACH DATA

BRWID	Z	ELBM	TRAIL	WSEL	FAILEL
100.	0.50	1205.00	1.00	1243.00	1250.30

BEGIN DAM FAILURE AT 42.83 HOURS

PEAK OUTFLOW IS 8103. AT TIME 43.23 HOURS

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF 0.021 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF 0.167 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

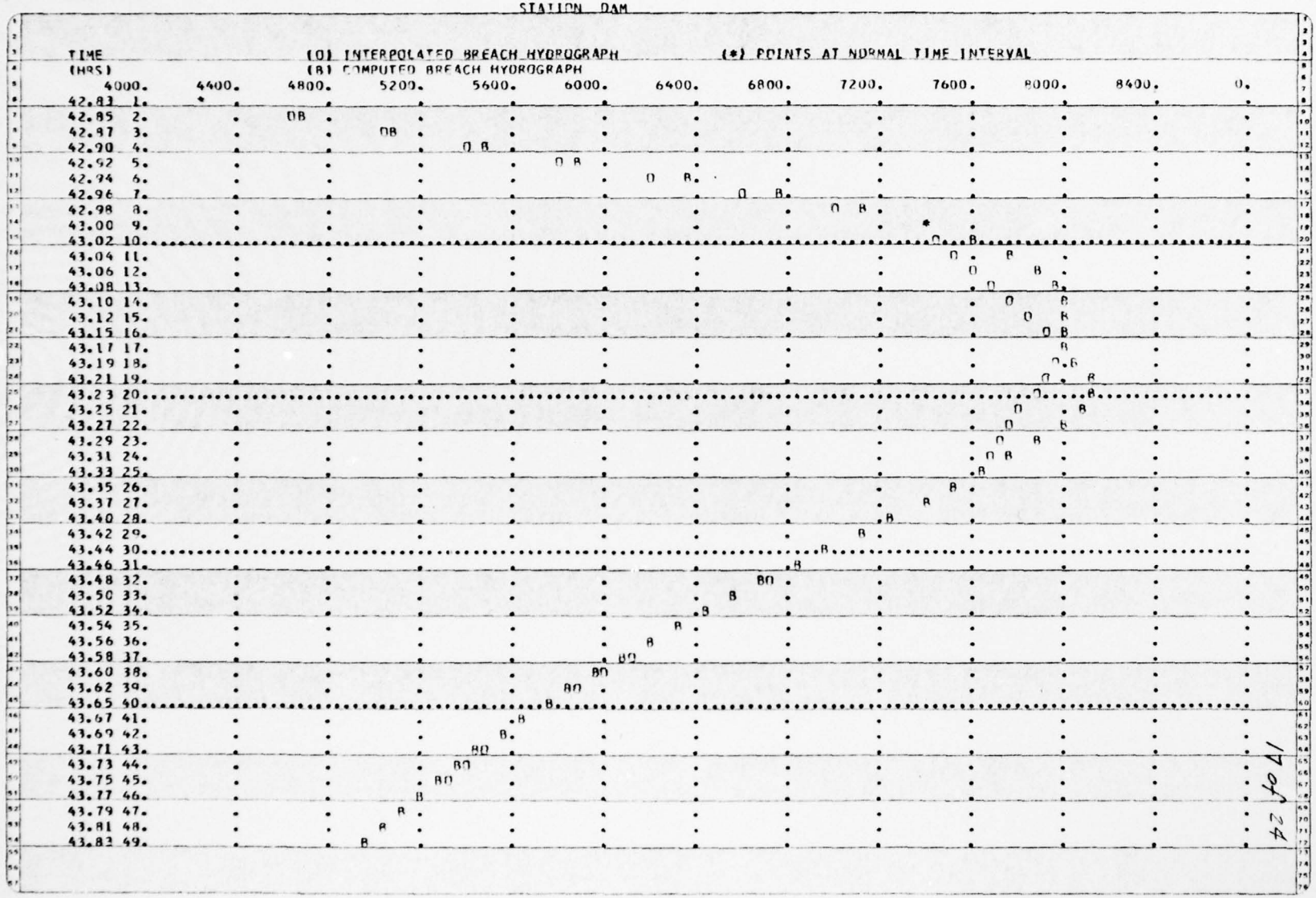
TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	-	COMPUTED BREACH HYDROGRAPH (CFS)	=	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
42.833	0.0	4237.		4237.		0.	0.	0.
42.854	0.021	4630.		4670.		-40.	-40.	-0.
42.875	0.042	5023.		5067.		-44.	-84.	-0.
42.896	0.062	5416.		5472.		-56.	-140.	-0.
42.917	0.083	5809.		5894.		-85.	-225.	-0.
42.937	0.104	6202.		6365.		-163.	-388.	-1.
42.958	0.125	6595.		6769.		-174.	-562.	-1.
42.979	0.146	6988.		7106.		-119.	-681.	-1.
43.000	0.167	7381.		7381.		0.	-681.	-1.
43.021	0.187	7457.		7598.		-141.	-822.	-1.
43.042	0.208	7532.		7757.		-225.	-1047.	-2.
43.062	0.229	7608.		7871.		-263.	-1310.	-2.
43.083	0.250	7684.		7940.		-257.	-1566.	-3.
43.104	0.271	7760.		7986.		-226.	-1792.	-3.
43.125	0.292	7835.		8000.		-165.	-1957.	-3.
43.146	0.312	7911.		7996.		-84.	-2042.	-4.
43.167	0.333	7987.		7987.		0.	-2042.	-4.
43.187	0.354	7945.		8042.		-96.	-2138.	-4.
43.208	0.375	7903.		8100.		-197.	-2335.	-4.
43.229	0.396	7861.		8103.		-241.	-2576.	-4.
43.250	0.417	7820.		8062.		-242.	-2818.	-5.
43.271	0.437	7778.		7988.		-210.	-3029.	-5.
43.292	0.458	7736.		7891.		-155.	-3184.	-5.
43.312	0.479	7694.		7777.		-83.	-3267.	-6.
43.333	0.500	7652.		7652.		0.	-3267.	-6.
43.354	0.521	7516.		7520.		-3.	-3270.	-6.
43.375	0.542	7380.		7382.		-2.	-3273.	-6.
43.396	0.562	7244.		7243.		1.	-3271.	-6.
43.417	0.583	7108.		7103.		5.	-3266.	-6.
43.437	0.604	6972.		6965.		7.	-3259.	-6.
43.458	0.625	6836.		6828.		8.	-3251.	-6.
43.479	0.646	6700.		6695.		5.	-3245.	-6.
43.500	0.667	6564.		6564.		0.	-3245.	-6.
43.521	0.687	6449.		6437.		12.	-3233.	-6.
43.542	0.708	6334.		6313.		22.	-3211.	-6.
43.562	0.729	6220.		6192.		27.	-3184.	-5.
43.583	0.750	6105.		6075.		29.	-3155.	-5.
43.604	0.771	5990.		5962.		28.	-3126.	-5.
43.625	0.792	5875.		5853.		23.	-3104.	-5.
43.646	0.812	5760.		5747.		13.	-3091.	-5.
43.667	0.833	5646.		5646.		0.	-3091.	-5.
43.687	0.854	5559.		5547.		12.	-3079.	-5.
43.708	0.875	5473.		5452.		21.	-3058.	-5.
43.729	0.896	5387.		5361.		27.	-3031.	-5.
43.750	0.917	5301.		5273.		28.	-3003.	-5.
43.771	0.937	5215.		5188.		27.	-2976.	-5.
43.792	0.958	5129.		5107.		21.	-2955.	-5.
43.812	0.979	5042.		5030.		12.	-2943.	-5.
43.833	1.000	4956.		4956.		0.	-2943.	-5.

OVF

STATION DAM

TIME (HRS)

(O) INTERPOLATED BREACH HYDROGRAPH
(B) COMPUTED BREACH HYDROGRAPH
(*) POINTS AT NORMAL TIME INTERVAL



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DVN

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
100.	0.50	1205.00	1.00	1243.00	1260.00

PEAK OUTFLOW IS 4347. AT TIME 43.33 HOURS

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HYDROGRAPH ROUTING

CHANNEL ROUTING-MOD PULS REACH 1

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

ALL PLANS HAVE SAME ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	PLNTH	SEL
0.0800	0.0400	0.0800	1200.0	1216.0	530.	0.04800

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.0 1300.00 150.00 1220.00 280.00 1204.00 280.00 1200.00 300.00 1200.00
300.00 1204.00 500.00 1240.00 620.00 1300.00

STORAGE	0.0	0.20	0.41	0.61	0.82	1.03	1.32	1.73	2.26	2.91
	3.68	4.56	5.56	6.68	7.92	9.27	10.75	12.34	14.05	15.88
OUTFLOW	0.0	116.12	350.74	658.15	1017.93	1432.01	1960.13	2604.37	3389.43	4336.36
	5464.17	6790.57	8332.26	10105.15	12124.54	14405.17	16961.32	19806.91	22955.43	26420.11
STAGE	1200.00	1200.84	1201.68	1202.53	1203.37	1204.21	1205.05	1205.83	1206.74	1207.58
	1208.42	1209.26	1210.10	1210.95	1211.79	1212.63	1213.47	1214.31	1215.16	1216.00
FLOW	0.0	116.12	350.74	658.15	1017.93	1432.01	1960.13	2604.37	3389.43	4336.36
	5464.17	6790.57	8332.26	10105.15	12124.54	14405.17	16961.32	19806.91	22955.43	26420.11

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MAXIMUM STAGE IS 1210.0

MAXIMUM STAGE IS 1207.6

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HYDROGRAPH ROUTING

CHANNEL ROUTING-MOD PULS REACH 2

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

ALL PLANS HAVE SAME ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0800	0.0400	0.0800	1140.0	1157.0	3430.	0.01700

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.0 1260.00 200.00 1160.00 300.00 1144.00 300.00 1140.00 320.00 1140.00
320.00 1144.00 520.00 1160.00 750.00 1260.00

STORAGE	0.0	1.41	2.82	4.23	5.63	7.21	9.83	13.64	18.62	24.79
	32.14	40.67	50.38	61.28	73.35	86.61	101.05	116.67	133.47	151.45
OUTFLOW	0.0	76.19	229.49	429.62	663.10	944.34	1309.93	1777.02	2368.83	3105.59
	4005.75	5086.51	6364.11	7854.07	9571.27	11530.08	13744.41	16227.77	18993.31	22053.86
STAGE	1140.00	1140.89	1141.79	1142.68	1143.58	1144.47	1145.37	1146.26	1147.16	1148.05
	1148.95	1149.84	1150.73	1151.63	1152.52	1153.42	1154.31	1155.21	1156.10	1157.00
FLOW	0.0	76.19	229.49	429.62	663.10	944.34	1309.93	1777.02	2368.83	3105.59
	4005.75	5086.51	6364.11	7854.07	9571.27	11530.08	13744.41	16227.77	18993.31	22053.86

MAXIMUM STAGE IS 1151.6

MAXIMUM STAGE IS 1149.2

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HYDROGRAPH ROUTING

CHANNEL ROUTING-MOD PULS REACH 3

ISTAQ	ICOMP	ICON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0800	0.0400	0.0800	1100.0	1117.0	2830.	0.01600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

130.00 1200.00 400.00 1120.00 700.00 1097.00 700.00 1093.00 720.00 1093.00
720.00 1097.00 800.00 1120.00 870.00 1200.00

STORAGE	0.0	18.40	23.73	29.92	36.97	44.88	53.64	63.27	73.75	85.10
	97.30	110.36	124.28	139.06	154.70	171.20	188.55	206.77	225.84	245.77
OUTFLOW	0.0	2813.96	3611.89	4565.20	5687.76	6992.76	8492.89	10200.38	12127.06	14284.45
	16683.72	19335.80	22251.38	25440.93	28914.70	32682.72	36754.87	41140.93	45850.40	50892.78
STAGE	1100.00	1100.89	1101.79	1102.68	1103.58	1104.47	1105.37	1106.26	1107.16	1108.05
	1108.95	1109.84	1110.73	1111.63	1112.52	1113.42	1114.31	1115.21	1116.10	1117.00
FLOW	0.0	2813.96	3611.89	4565.20	5687.76	6992.76	8492.89	10200.38	12127.06	14284.45
	16683.72	19335.80	22251.38	25440.93	28914.70	32682.72	36754.87	41140.93	45850.40	50892.78

MAXIMUM STAGE IS 1104.9

MAXIMUM STAGE IS 1102.5

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HYDROGRAPH ROUTING

CHANNEL ROUTING-MOD PULS REACH 4

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

ALL PLANS HAVE SAME ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	0.	0

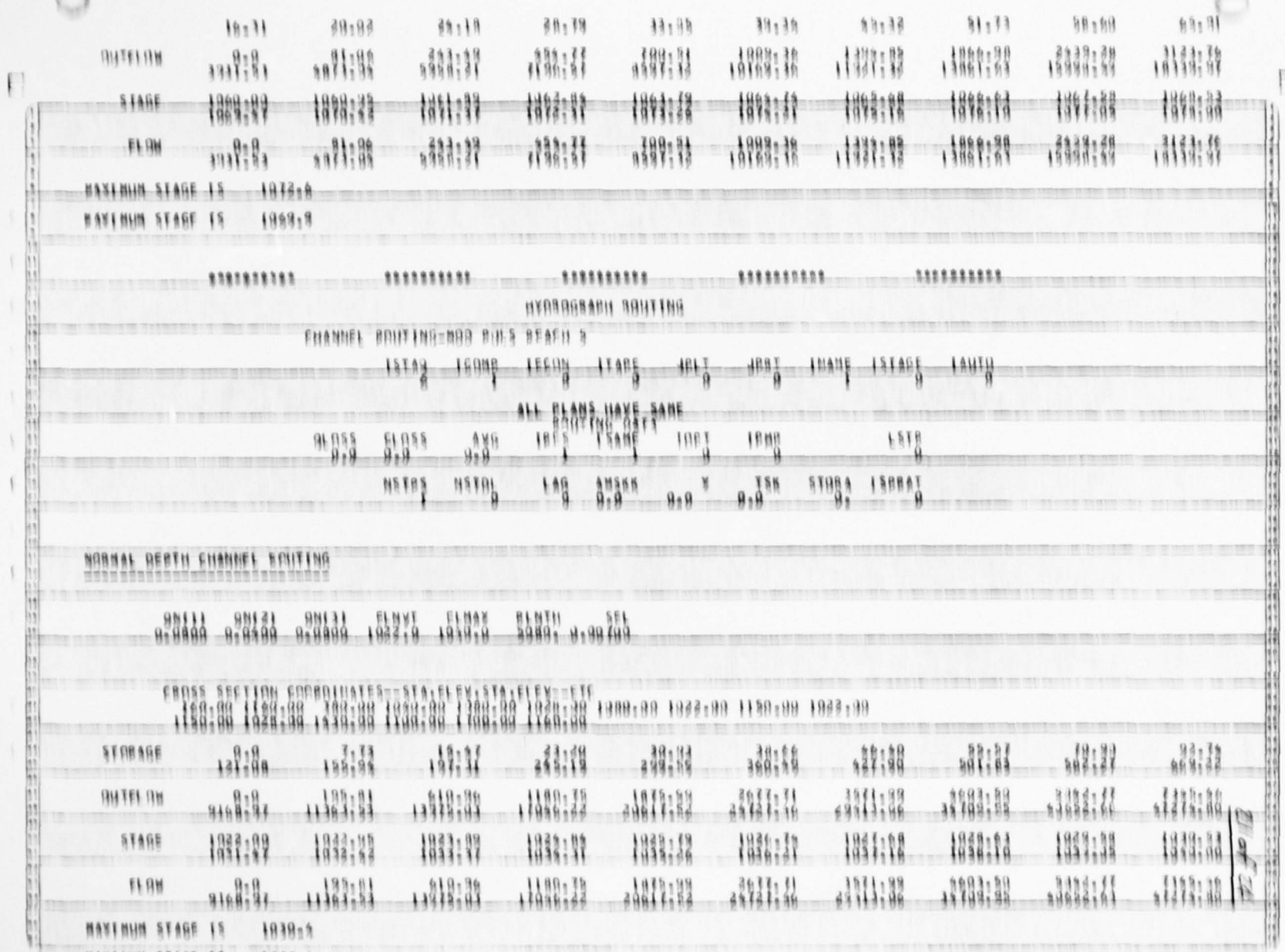
NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0800	0.0400	0.0800	1060.0	1078.0	2020.	0.01600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

300.00 1140.00 580.00 1080.00 700.00 1064.00 700.00 1060.00 720.00 1060.00
720.00 1064.00 840.00 1100.00 920.00 1140.00

STORAGE	0.0	0.88	1.76	2.64	3.51	4.53	5.98	7.89	10.24	13.05



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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 0.50
HYDROGRAPH AT	YDER'S	5.78 (14.97)	1	4348. (123.12)(
			2	4348. (123.12)(
ROUTED TO	DAM	5.78 (14.97)	1	7987. (226.17)(
			2	4347. (123.09)(
ROUTED TO	2	5.78 (14.97)	1	8163. (231.16)(
			2	4347. (123.08)(
ROUTED TO	3	5.78 (14.97)	1	7840. (222.02)(
			2	4342. (122.95)(
ROUTED TO	4	5.78 (14.97)	1	7778. (220.25)(
			2	4340. (122.89)(
ROUTED TO	5	5.78 (14.97)	1	7653. (216.71)(
			2	4337. (122.81)(
ROUTED TO	6	5.78 (14.97)	1	7216. (204.33)(
			2	4335. (122.74)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	AVERAGE TOP OF DAM	MINIMUM TOP OF DAM
ELEVATION	1243.00	1243.00	1249.90	1249.40
STORAGE	132.	132.	200.	
OUTFLOW	0.	0.	3632.	

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	AVERAGE ~~MAXIMUM~~ DEPTH OVER DAM	MAXIMUM DEPTH	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	1250.32	0.42	0.97	206.	8103.	0.30	43.23	42.83

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1243.00	1243.00	1249.90
STORAGE	132.	132.	200.
OUTFLOW	0.	0.	3632.

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
0.50	1250.38	0.48	207.	4347.	3.33	43.33	0.0

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	8163.	1210.0	43.17

PLAN 2 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	4347.	1207.6	43.33

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	7840.	1151.6	43.33

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	4242.	1149.2	43.50

PLAN 1 STATION 4

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RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	7778.	1104.9	43.33

PLAN 2 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	4340.	1102.5	43.50

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	7653.	1072.6	43.50

PLAN 2 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	4337.	1069.9	43.67

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	7216.	1030.4	43.67

PLAN 2 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	4335.	1028.4	43.67

APPENDIX E

REGIONAL GEOLOGY

SALT RUN RESERVOIR DAM
NDI NO. PA 00392, PennDER NO. 12-4

REGIONAL GEOLOGY

Salt Run Reservoir is located in the unglaciated section of the Appalachian Plateaus physiographic province. The bedrock units in the lower portion of the valley of Salt Run are members of the Upper Devonian Catskill formation. The units are characteristically red and brown sandstones and shales, which can be seen as outcrops at scattered locations on the steep slopes in the dam and reservoir area.

Structurally, it can be assumed that the bedrock dips only slightly since the reservoir is located on or near the axis of the Sabinsville Anticline. Although there appears to be no major deformation or faulting in the immediate area of the reservoir, information from the Pennsylvania Geologic Survey shows a strike fault about 6 miles northwest of the reservoir, near the McKean County line. Since the strike of the fault parallels the strike of the Sabinsville Anticline, it can be safety assumed that this fault does not extend into the reservoir area.

The steep slopes surrounding the reservoir are blanketed with a thin cover of residual Allegheny-Dekalb soils. However, observations made by engineers during dam improvements indicate the alluvial soils in the base of the dam are "loose rock, sand, gravel and a small amount of clay and appeared to be very porous materials." This material is apparently 5 to 10 feet thick and underlain by "impervious clay and shale."

GEOLOGIC MAP
Salt Run Reservoir Dam
NDI No. PA 00392 Cameron County

Reproduced from Geologic Map of Pennsylvania, Pennsylvania *Geological Survey, 4th Series*

Scale: One Inch Equals Approximately Four Miles
See Legend, Next page

LEGEND

DEVONIAN

UPPER

WESTERN PENNSYLVANIA

Oswayo Formation (Dos, Dr)
Greenish gray to gray shales, siltstones and sandstones becoming increasingly shaly westward; considered equivalent to type Oswayo. Riceville Formation (Dr in Erie and Crawford Counties; probably not distinguishable north of Corry.

Cattaraugus Formation (Dcr)
Red, gray and brown shale and sandstone with the proportion of red decreasing westward; includes Venango sands of drillers and Salamanca sandstone and conglomerate; some limestone in Crawford and Erie counties.

Conneaut Group
Alternating gray, brown, greenish and purplish shales and siltstones; includes "pink rock" of drillers and "Chemung" and "Girard" Formations of northwestern Pennsylvania.

Canadaway Formation (Dca)
Alternating brown shales and sandstones; includes "Portage" Formation of northwestern Pennsylvania.

CENTRAL AND EASTERN PENNSYLVANIA

Oswayo Formation (Dos)
Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous lenses; includes red shales which become more numerous eastward. Relation to type Oswayo not proved.

Catskill Formation (Dck)
Chiefly red to brownish shales and sandstones; includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.

Marine beds (Dm)
Gray to olive brown shales, graywackes, and sandstones; contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock; Tully Limestone at base.

MIDDLE AND LOWER

Hamilton Group (Dh)

Mahantango Formation
Brown to olive shale with interbedded sandstones which are dominant in places (Montebello); highly fossiliferous in upper part; contains "Centerfield coral bed" in eastern Pennsylvania.

Marcellus Formation
Black, fissile, carbonaceous shale with thick, brown sandstone (Turkey Ridge) in parts of central Pennsylvania.

Onondaga Formation
Greenish blue, thin bedded shale and dark blue to black, medium bedded limestone with shale predominant in most places; includes Selinsgrove Limestone and Needmore Shale in central Pennsylvania and Buttermilk Falls Limestone and Esopus Shale in easternmost Pennsylvania; in Lehigh Gap area includes Palmerton Sandstone and Bowmanstown Chert.

(Dmo)

Oriskany Formation (Do)
White to brown, fine to coarse grained, partly calcareous, locally conglomeratic, fossiliferous sandstone (Ridgeley) at the top; dark gray, cherty limestone with some interbedded shales and sandstones below (Shriver).

Helderberg Formation (Dhb)
Dark gray, calcareous, thin bedded shale (Mandata) at the top, equivalent to Port Ewen Shale and Becraft Limestone in the east; dark gray, cherty, thin bedded, fossiliferous limestone (New Scotland) with some local sandstones in the middle; and, at the base, dark gray, medium to thick bedded, crystalline limestone (Coeymans), sandy and shaly in places with some chert nodules.