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NATIONAL DAM INSPECTION PROGRAM. TROUT RUN DAM NUMBER 4. (NDI N--ETC(U)
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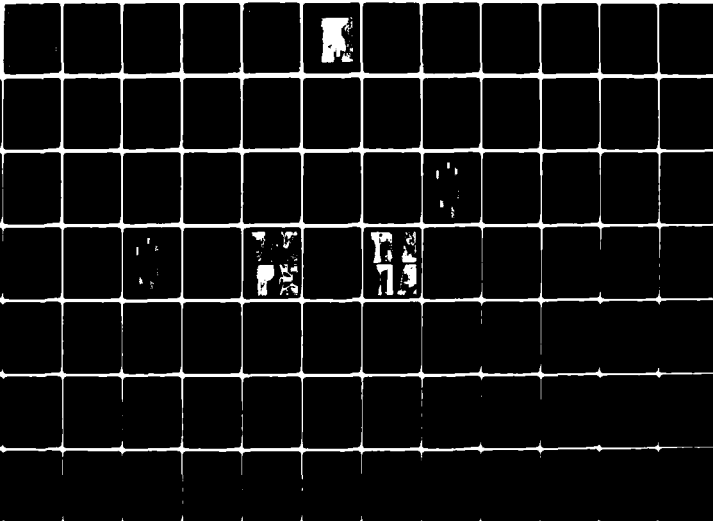
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NUMBER 4. (NDI N--ETC(U)
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SUSQUEHANNA RIVER BASIN
TROUT RUN, NORTHUMBERLAND COUNTY

PENNSYLVANIA

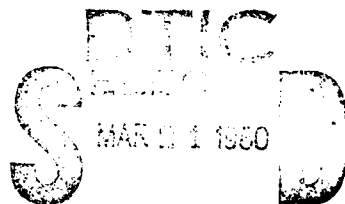
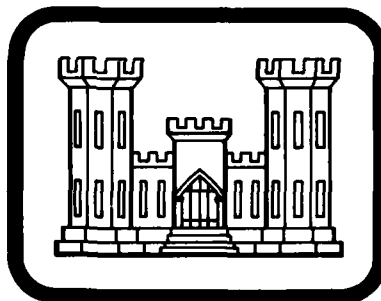
TROUT RUN DAM NO. 4

NDI I.D. No. PA-00512

PENNDER I.D. No. 49-5

DACW-31-80-C -0016 new

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



PREPARED FOR

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

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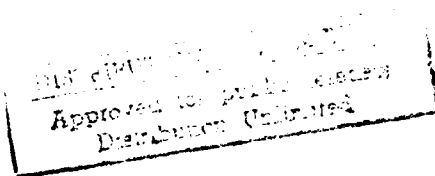
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PREFACE



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.

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

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

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Trout Run Dam No. 4: NDI I.D. No. PA-00512

Owner: Roaring Creek Water Company
State Located: Pennsylvania (PennDER I.D. No. 49-5)
County Located: Northumberland
Stream: Trout Run
Inspection Date: 6 November 1979
Inspection Team: GAI Consultants, Inc.
570 Beatty Road
Monroeville, Pennsylvania 15146

✓
The visual inspection, operational history, and hydrologic/hydraulic analysis indicate that the facility is in good condition.

Deficiencies noted by the inspection team included slumping and bulging of the rock surface on the steep downstream embankment slope, minor seepage along the downstream embankment toe and minor deterioration of the control tower. In addition, the growth of large trees in the immediate area of the downstream toe is a hindrance to expedient visual evaluation of the embankment.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Due to the high potential for damage to downstream structures and possibly loss of life, the SDF is considered to be the PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store only 27 percent of the PMF prior to embankment overtopping. A breach analysis indicates that failure under less than 1/2 PMF conditions could lead to increased downstream damage and potential for loss of life. Thus, based on screening criteria provided in the recommended guidelines, the spillway is considered to be seriously inadequate and the facility unsafe, non-emergency. ↗

It is recommended that the owner immediately:

- a. Develop a formal emergency warning system to notify downstream residents should hazardous conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.
- b. Remove the masonry blocks located atop the spillway crest and adjacent the wingwalls and seal all cracks in the spillway channel floor.
- c. Have the facility evaluated by a registered professional engineer experienced in the hydraulics and hydrology of dams and take remedial measures deemed necessary to make the facility hydraulically adequate.
- d. Develop formal manuals of operation and maintenance to ensure the continued proper care of the facility.
- e. Remove and/or trim the trees located immediately beyond the downstream embankment toe to provide an unobstructed view of the facility.
- f. Specifically address in all future inspections the bluing and slumping of the downstream embankment face and seepage along the downstream embankment toe noting any significant changes.

GAI Consultants, Inc.

Approved by:

Bernard M. Mihalcin
Bernard M. Mihalcin, P.E.

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

Date 12 Feb 1980
DLB:BMM/sam

DATE: 12 March 1980





OVERVIEW PHOTOGRAPH

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[REDACTED]
NATIONAL DAM INSPECTION PROGRAM.

TROUT RUN DAM [REDACTED] Number 4.
(NDI # PA-00512, PENNDER [REDACTED] Number 49-5)

Number

[REDACTED]
Susquehanna River Basin, Trout Run,
Northumberland County, Pennsylvania.
Phase I Inspection Report.

1.0 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.

1.1 Purpose.

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

1.2 Description of Project.

a. Dam and Appurtenances. Trout Run Dam No. 4 is an earth embankment approximately 30 feet high and 505 feet long (including spillway). The facility is provided with a two-stage, uncontrolled, service-emergency spillway located at the right abutment. The combined spillway crest length is approximately 55 feet. A reinforced concrete control tower is located along the upstream embankment toe near the center of the dam. Access to the tower is provided by a steel framed footbridge. The outlet works housed within the tower consists of a 16-inch diameter cast iron supply pipe and a 16-inch diameter cast iron blowoff pipe.

b. Location. Trout Run Dam No. 4 is located on Trout Run in Coal Township, Northumberland County, Pennsylvania, about 2 miles north of Shamokin, Pennsylvania. The dam, reservoir, and watershed are contained within the Shamokin, Pennsylvania, U.S.G.S. 7.5 minute topographic quadrangle (see Figure 1, Appendix E). The coordinates of the dam are N40° 48.7' and W76° 32.9'.

c. Size Classification. Small (30 feet high, 155 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

e. Ownership. Roaring Creek Water Company
204 East Sunbury Street
Shamokin, Pennsylvania 17872

f. Purpose. Water supply.

g. Historical Data. Drawings and records contained in PennDER files indicates that Trout Run Dam No. 4 was originally constructed in 1882 by the Shamokin Water Company. The structure was modified to its present configuration in 1894 by the Roaring Creek Water Company which acquired the facility in 1884.

The watershed in which the dam is located has a long recorded history of heavy flooding. A state report on the facility dated 1915 states "the region receives nearly as heavy an annual rainfall as any portion of Pennsylvania." The same report recommended the spillway capacity be increased in compliance with then applicable state guidelines. The spillway was subsequently modified to its present configuration in 1920.

Deficiencies noted in available state inspection reports between the years 1925 to 1946 include; 1) settlement across the embankment crest (apparently corrected) and subsequent bulging of the downstream face, and 2) seepage between the spillway and blowoff.

A representative of the owner stated that the spillway structure sustained minor damage from the floods of 1972 and 1975 and was renovated in 1978.

1.3 Pertinent Data.

a. Drainage Area (square miles). 1.9

b. Discharge at Dam Site.

Discharge Capacity of Outlet Conduit - Discharge curves are not available.

Discharge Capacity of Spillway at Maximum Pool = 1060 cfs (see Appendix D, Sheet 11).

c. Elevation (feet above mean sea level). The following elevations were obtained from available drawings and through field measurements that were based on the elevation of the service spillway crest at 878.5 feet (see Appendix D, Sheet 1).

Top of Dam	882.0 (design)
	881.9 (field)
Maximum Design Pool	Not known
Maximum Pool of Record	Not known
Normal Pool	878.5
Service Spillway Crest	878.5
Emergency Spillway Crest	878.8
Upstream Inlet Invert	853.5 (estimated)
Downstream Inlet Invert	851.7
Streambed at Dam Centerline	852.0 (estimated)
Maximum Tailwater	Not known
d. <u>Reservoir length (feet).</u>	
Top of Dam	1350
Normal Pool	1300
e. <u>Storage (acre-feet).</u>	
Top of Dam	155
Normal Pool	108
Design Surcharge	Not known.
f. <u>Reservoir Surface (acres).</u>	
Top of Dam	16
Normal Pool	12
Maximum Design Pool	Not known.
g. <u>Dam.</u>	
Type	Earth.
Length	505 feet (including spillway).
Height	30 feet (field measured; crest to downstream blowoff invert).
Top Width	13 feet.
Upstream Slope	2.5H:1V.
Downstream Slope	1.25H:1V to 1.5H:1V (varies).
Zoning	Homogeneous earth (see Figure 5).

Impervious Core	Plank corewall reportedly along embankment centerline.
Cutoff	None indicated.
Grout Curtain	None indicated.
h. <u>Diversion Canal and Regulating Tunnels.</u>	None.
i. <u>Spillway.</u>	
Type	Two-stage, uncontrolled, service-emergency spillway located at right abutment (see Figure 3).
Crest Elevation (service)	878.5 feet.
Crest Elevation (emergency)	878.8 feet.
Crest Length (service)	30.4 feet.
Crest Length (emergency)	24.5 feet.
j. <u>Outlet Works.</u>	
Type	Supply - 16-inch diameter cast iron pipe. Blowoff - 16-inch diameter cast iron pipe.
Length	140 feet (estimated; inlet to blowoff outlet).
Closure and Regulating Facilities	Flow through both conduits are controlled via 16-inch diameter gate valves located

within a concrete control tower (see Figure 5). In addition, the blowoff conduit is equipped with a 16-inch diameter gate valve located near the outlet.

Access

Steel framed footbridge from crest (see Photograph 3).

SECTION 2 ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No formal design reports or calculations are available for any aspects of the facility. Several drawings of the facility are available from both the owner and PennDER files including; 1) drawings of the original facility dated 1894 (see Figures 2 and 5); 2) a drawing showing modifications to the spillway dated 1916 (see Figure 4) and; 3) a drawing of the latest spillway renovation dated 1977 (see Figure 3).

b. Design Features.

1. Embankment. Little information is available relative to the physical characteristics of the embankment. Available drawings indicate the embankment to be composed of homogeneous earth with no distinct zoning (see Figure 5). Reports contained in PennDER files indicate the original embankment was constructed with 1H:1V side slopes and a plank corewall along the centerline. The upstream slope was later flattened to 2.5H:1V and protected by a layer of gravel (large crushed stone) while the downstream face was covered with hand-placed sandstone slope protection.

2. Appurtenant Structures.

a) Spillway. The spillway is an uncontrolled, two-stage, service-emergency spillway located at the right abutment. The service spillway occupies the left portion of the structure and has an ogee-like weir crest that is 30.4 feet long. The emergency spillway occupies the right portion of the structure. It has a flat overflow crest that is 24.5 feet long and is set 0.3 feet above the crest of service spillway (see Figure 3). The entire structure is keyed with concrete beneath the overflow crest and is supported on steel sheet piling at the downstream end (see Photograph 7).

b) Outlet Works. The outlet works consist of two 16-inch diameter cast iron blowoff and supply lines. Both conduits originate at the base of the concrete control tower located on the upstream embankment face and can be regulated at this location by 16-inch diameter gate valves operated from within the tower. The blowoff line is also valved near the outlet.

c. Specific Design Data and Criteria. No formal design reports, calculations or specific design data are available for any aspect of this facility.

2.2 Construction Records.

No records of any phase of the original construction of the facility are available.

2.3 Operational Records.

Formal records of daily rainfall and spillway discharge are available dating back to circa 1880. Rainfall is currently measured by a gauge located atop the roof of the owner's main office in downtown Shamokin. Spillway discharges are estimated from water level datums painted on the exterior wall of the control tower. No standard staff gauge was observed.

2.4 Other Investigations.

No records of any formal investigations other than periodic state inspection reports are available. The inspection reports are contained in PennDER files.

2.5 Evaluation.

The available data are considered sufficient to make a reasonable Phase I assessment of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests that it is in good condition.

b. Embankment. The visual inspection indicates that the embankment is in good condition and adequately maintained. The crest is protected with a layer of crushed stone and is well aligned vertically and horizontally. The gravel slope protection provided on the upstream face appears adequate for this facility. The downstream face is somewhat irregular as minor bulging and slumping of the stone slope protection was observed (see Photograph 2). Some minor seepage was observed across the downstream embankment toe over an area that extends from the blowoff near the left abutment to approximately 120 feet left of the spillway. No measureable flow was observed at any particular location. Large trees occupy the general area along the immediate downstream embankment toe and obstruct the overall view of the facility (see Photograph 1).

c. Appurtenant Structures.

1. Spillway. The overall condition of the spillway is good. Minor seepage through the channel floor of the emergency portion was observed but, was not measurable. Masonry blocks have been placed adjacent the wingwalls and atop the spillway crest to serve as stepping stones into and out of the channel (see Photographs 6 and 7). The blocks are considered an obstruction to free flow and should be removed.

2. Outlet Works. The outlet works are reportedly functional although they were not operated in the presence of the inspection team. The concrete control tower is in fair condition exhibiting minor exterior concrete deterioration (see Photograph 3).

d. Reservoir Area. Trout Run Dam No. 4 is situated in a valley which is confined to the north and south by practically parallel ridges that are heavily forested and have moderate to steep slopes. No evidence of slope distress was observed.

e. Downstream Channel. The spillway discharges into Trout Run which cuts through a narrow, forested valley with

steep confining slopes. The stream, on a steep gradient, converges with Shamokin Creek approximately 1.3 miles downstream of the embankment. The left bank of Shamokin Creek, opposite the inlet of Trout Run, is heavily developed in this area with both industrial and residential structures. Several hundred people reside and/or work in this area. Substantial property damage and loss of life could possibly be incurred in this area as a result of an embankment breach due to the close proximity of the structures to the stream.

3.2 Evaluation.

The overall condition of the facility is considered to be good. Deficiencies noted by the inspection team include slumping and bulging of the downstream embankment face and minor seepage along the downstream embankment toe. Historical accounts contained in PennDER files indicate these conditions to have been initially reported in the mid-1920's and again in the 1930's. Neither condition has changed significantly over the last 50 years and are considered minor at this time. The condition of the control tower is deteriorating; however, it remains functional.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

The facility is essentially self-regulating. Excess inflow discharges through the spillway and is directed downstream. Under normal operating conditions the blowoff line is closed. The supply line is left open and is regulated at a distribution point downstream. All of the valves are reportedly functional, however, none were operated in the presence of the inspection team. No formal operations manual is available.

4.2 Maintenance of Dam.

The facility is maintained on an unscheduled basis as needed. No formal maintenance manual outlining maintenance procedures is available.

4.3 Maintenance of Operating Facilities.

See Section 4.2 above.

4.4 Warning System.

No formal warning system is in effect.

4.5 Evaluation.

No formal operations or maintenance manuals are available, but, are recommended to ensure the continued proper care and maintenance of the facility. In addition, no formal warning system is in effect.

SECTION 5 HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No formal design reports, calculations, or design data are available for any aspect of this facility.

5.2 Experience Data.

Formal records of daily rainfall and spillway discharge are available dating back to circa 1880. The inspection team checked the records for the floods of March 1936 and June 1972 which the owner's representative indicated were the largest floods experienced in the area. The records indicated the June 1972 event to be the largest flood on record when a total of 17.2 inches of rain fell from June 19 through June 25. The embankment was not overtopped in 1972, but, some damage was sustained by the spillway. Repairs to the structure were not initiated until the spillway was further damaged by a lesser flood that occurred in the fall of 1975. According to available records the embankment has never been overtopped.

5.3 Visual Observations.

On the date of inspection, no conditions were observed that would indicate the spillway could not perform satisfactorily during a flood event within the limits of its design capacity. The masonry blocks set atop the spillway crest adjacent the wingwalls should be removed in that they do represent a minor obstruction.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U.S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U.S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix D.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Trout Run Dam No. 4 ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. This classification is based on the relative size of the dam (small), and the potential hazard of dam failure to downstream developments (high). Due to the high potential for loss of life and damage to the downstream residences and structures, the SDF for this facility is considered to be the PMF.

b. Results of Analysis. Trout Run Dam No. 4 was evaluated under near normal operating conditions. That is, the reservoir was initially at its normal pool or spillway elevation of approximately 878.5 feet, with the spillway weir discharging freely (masonry blocks removed) and the outlet conduit assumed to be closed. The spillway is a two-stage channel, consisting of a service spillway and an emergency spillway. Discharges through the service spillway are controlled by an ogee-like weir. Flows through the emergency spillway are controlled by a small flat-crested weir. The necessary downstream channel routing was done under the assumption that the routing stream was dry prior to the inflow of the dam discharge. All pertinent engineering calculations relative to the evaluation of this facility are provided in Appendix D.

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Trout Run Dam No. 4 can accommodate only about 27 percent of the PMF (SDF) prior to the overtopping of the embankment (Appendix D, Summary Input/Output Sheets, Sheet H). The low top of the dam was inundated by maximum depths of water of 0.7 and 1.5 feet under the 1/2 PMF and PMF events for 5.0 and 8.7 hours, respectively (Summary Input/Output Sheets, Sheet H). Since the SDF for Trout Run Dam No. 4 is the PMF, it can be concluded the dam has a high potential for overtopping, and thus, for breaching under floods of less than SDF magnitude.

As Trout Run Dam No. 4 cannot safely accommodate a flood of at least 1/2 PMF magnitude, the possibility of embankment failure under floods of less than 1/2 PMF intensity was investigated (in accordance with Corps directive ETL-1110-2-234). Several possible alternatives were examined, since it is difficult, if not impossible, to determine how or if a specific dam will fail. The major concern of the breaching analysis is the effect of the various breach discharges on downstream water surface elevations in comparison to those to be expected if breaching does not occur.

The Modified HEC-1 Computer Program was used for the breaching analysis, with the assumption that the breaching of an earth dam would begin once the water level of the reservoir reached the low top of dam elevation.

Five breach models were analyzed for Trout Run Dam No. 4. Two sets of breach geometry were evaluated for each of two failure times (Appendix D, Sheet 17). The two sets of breach sections chosen were considered to be the minimum and maximum probable failure sections. The two failure times (total time for the breach section to reach its final dimensions) under which the two breach sections were investigated were assumed to be a rapid time (0.5 hours) and a prolonged time (4.0 hours), so that a range of this most sensitive variable might be examined. In addition, an average set of breach conditions was analyzed with a failure time of 2.0 hours.

Two potential damage centers were investigated in the analysis. The first area is located about 200 feet downstream of the confluence of Trout Run and Shamokin Creek (about 7600 feet downstream from the dam) where several houses are situated on the left bank. The damage level of the houses is approximately elevation 665 feet (MSL). Breach outflows from a 0.29 PMF storm routed to this point for the maximum section-minimum fail time scheme yielded a maximum water surface elevation of 662.5 feet (Summary Input/Output Sheets, Sheet M). The average breach failure scheme yielded a peak water surface elevation of 660.4 feet (MSL). Accordingly, for the conditions analyzed, the breach outflows result in water surface elevations somewhat below the damage level of the houses. However, other factors must be considered here. First of all, the effects of the railroad bridge located at the confluence of Trout Run and Shamokin Creek are uncertain and largely dependent on the structure's ability to withstand the force of the floodwave. Secondly, since Trout Run discharges approximately at a right angle into Shamokin Creek, it is apparent that the breach outflow will not remain completely within the main channel, but will probably inundate the overbank area around the confluence. Since the houses in question are located only about 200 feet downstream of the confluence near the stream, it is quite possible that they would indeed be flooded. In addition, numerous other failure schemes that allow for breaching of the embankment under larger base flood conditions and a more accurate survey of those residences within the reach would likely contribute to more conclusive results. Therefore, damage and loss of life at these residences due to the failure of Trout Run Dam No. 4 cannot be ruled out and a more detailed hydrologic and hydraulic study is required.

The second damage center analyzed was a group of houses located on the right bank of Shamokin Creek, about 9800 feet downstream of the dam, at approximately elevation 640 feet (Section 5). The water surface level here corresponding to the non-breach 0.29 PMF peak discharge was about 640.9 feet (Summary Input/Output Sheets, Sheet H). The maximum water surface level for the average breach conditions was about 642.6 (Summary Input/Output Sheets, Sheet M). The increase in water surface elevation due to dam failure was 1.7 feet, with the breach water surface above the damage level of the homes. (The homes affected by breach outflows would also be flooded by the 0.29 PMF even without embankment failure.)

The consequences of dam failure, however, can be better envisioned if not only the increase in the height of the floodwave is considered, but also the great increase in the momentum of the larger and probably swifter moving volume of water. Therefore, the failure of Trout Run Dam No. 4 would most probably lead to increased property damage and possibly increased loss of life in the downstream regions.

5.6 Spillway Adequacy.

As presented previously, under existing conditions Trout Run Dam No. 4 can accommodate only about 27 percent of the PMF (SDF) prior to embankment overtopping. Should a 0.29 PMF or larger event occur, the dam would be overtopped and possibly fail, endangering the residences and increasing the potential for loss of life in the downstream regions. Therefore, the spillway is considered to be seriously inadequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment appears to be in good condition. The facility is well maintained and no evidence of erosion or excess settlements were observed. Minor seepage was observed along the downstream embankment toe between the blowoff and approximately 150 feet left of the spillway. The downstream face was observed to be somewhat irregular exhibiting areas of minor bulging and slumping. Presently, neither condition is considered a threat to the structural stability of the embankment; nevertheless, both conditions should be specifically addressed in future inspections. Large trees along the downstream embankment toe hamper visual observation of both conditions and should be trimmed and/or removed.

b. Appurtenant Structures.

1. Spillway. The spillway appears to be structurally well designed and currently in good condition. The small seep observed through the channel floor of the emergency spillway should be sealed to prevent further concrete deterioration.

2. Outlet Works. The outlet works are reportedly functional. Concrete deterioration associated with the control tower is considered minor at this time.

6.2 Design and Construction Techniques.

No information is available that details the methods of design and/or construction.

6.3 Past Performance.

According to available correspondence and discussions with representatives of the owner, the facility has performed satisfactorily since construction in 1894. Damage to the spillway system was incurred during the floods of 1972 and 1975 and has been corrected.

6.4 Seismic Stability

The dam is located within Seismic Zone No. 1 and, thus

possibly subject to minor earthquake induced dynamic forces. As the embankment appears statically stable it is believed that it can withstand the expected dynamic forces; however, no calculations and/or investigations were performed to confirm this opinion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection suggests the facility is in good condition.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Due to the high potential for damage to downstream structures and possibly loss of life, the SDF is considered to be the PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store only about 27 percent of the PMF prior to embankment overtopping. A breach analysis indicates that failure under less than 1/2 PMF conditions could lead to increased downstream damage and potential for loss of life. Thus, based on the screening criteria contained in the recommended guidelines, the spillway is considered to be seriously inadequate and the facility unsafe, non-emergency.

Deficiencies noted by the inspection team included slumping and bulging of the downstream embankment rock face, minor seepage along the downstream embankment toe, a deteriorating control tower structure and no emergency warning system in effect.

b. Adequacy of Information. The available data are considered sufficient to make a reasonable Phase I assessment of the facility.

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

d. Necessity for Additional Investigations. Additional investigations are considered necessary and are listed in Section 7.2 below.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner immediately:

a. Develop a formal emergency warning system to notify downstream residents should hazardous conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

b. Remove the masonry blocks located atop the spillway and adjacent the wingwall and seal all cracks in the spillway channel floor.

c. Have the facility evaluated by a registered professional engineer experienced in the hydraulics and hydrology of dams and take remedial measures deemed necessary to make the facility hydraulically adequate.

d. Develop formal manuals of operation and maintenance to ensure the continued proper care of the facility.

e. Remove and/or trim the trees in the area immediately beyond the downstream embankment toe to provide an unobstructed view of the facility.

f. Specifically address in all future inspections the bulging and slumping of the downstream embankment face and seepage along the downstream embankment toe noting any significant changes.

APPENDIX A
VISUAL INSPECTION CHECKLIST AND FIELD SKETCHES

CHECK LIST VISUAL INSPECTION PHASE 1

NAME OF DAM Trout Run Dam No. 4 STATE Pennsylvania COUNTY Northumberland
NDI # PA - 00512 PENNDR # 49-5
TYPE OF DAM Earth SIZE Small HAZARD CATEGORY High
DATE(S) INSPECTION 6 November 1979 WEATHER Clear; cool TEMPERATURE 52 @ 3:00 p.m.
POOL ELEVATION AT TIME OF INSPECTION 878.6 M.S.L.
TAILWATER AT TIME OF INSPECTION N/A M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	OTHERS
<u>B. M. Mihalcin</u>	<u>Roaring Creek Water Company</u>	
<u>D. L. Bonk</u>	<u>Harry Sacona (superintendent)</u>	
<u>D. J. Spaeder</u>		

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	ND# PA - 00512
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Downstream slope is very irregular due to apparent movement of the hand-placed rock face. Some local bulging was observed along the toe.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Irregular downstream face is probably due to the steepness of the slope. Does not appear critical.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical - good. Horizontal - good.	
RIPRAP FAILURES	None observed. Original riprap has apparently been covered with topsoil and light vegetation, and small diameter (2- to 3-inch) crushed stone. Functioning adequately with no evidence of erosion observed.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good.	

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDM PA. 00512
DAMP AREAS IRREGULAR VEGETA- TION (LUSH OR DEAD PLANTS)	Area immediately downstream of embankment toe is heavily overgrown with large trees up to about 6 inches in diameter.	
ANY NOTICEABLE SEEPAGE	None through downstream embankment face. Minor seepage is evident across the downstream embankment toe between the spillway and blowoff outlet. Seepage was not measured in that it was not concentrated in any one particular area.	
STAFF GAGE AND RECORDER	Water level marks (relative datum) are painted on control tower.	
DRAINS	None observed.	

OUTLET WORKS

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDI# PA . 00512
INTAKE STRUCTURE	Control tower in fair to good condition with some cracking of masonry and minor concrete deterioration exhibited. Steel and wood plank access bridge is in good condition.	
OUTLET CONDUIT (CRACKING AND SPALLING OF CON- CRETE SURFACES)	16-inch diameter cast iron pipe blowoff.	
OUTLET STRUCTURE	None. The blowoff conduit discharges at the downstream toe to the left of the control tower.	
OUTLET CHANNEL	Conduit discharges at base of downstream embankment toe and combines with natural stream approximately 50 feet below the dam. Rock-lined natural stream channel.	
GATE(S) AND OPERA- TIONAL EQUIPMENT	Two valves in control tower are operated yearly. Accessible by ladder within control tower. Valve on blowoff was not operated in the presence of the inspection team.	

EMERGENCY SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDIN PA . 00512
TYPE AND CONDITION	Two-stage concrete chute channel in good condition located at the right abutment. Minor concrete cracking was observed across the channel floor immediately downstream of the overflow weir. Slight leakage was observed through the cracks.	
APPROACH CHANNEL	Rock- and concrete- lined channel. Unobstructed.	
SPILLWAY CHANNEL AND SIDEWALLS	Spillway sidewalls in good condition. The concrete channel exhibits several cracks through which seepage is emanating. The spillway was renovated in 1977-78. Cracks should be sealed.	
STILLING BASIN PLUNGE POOL	Rock-lined plunge pool in good condition.	
DISCHARGE CHANNEL	Trapezoidal-shaped channel cut into natural ground, partially rock-lined, and in good condition.	
BRIDGE AND PIERS EMERGENCY GATES	None.	

SERVICE SPILLWAY

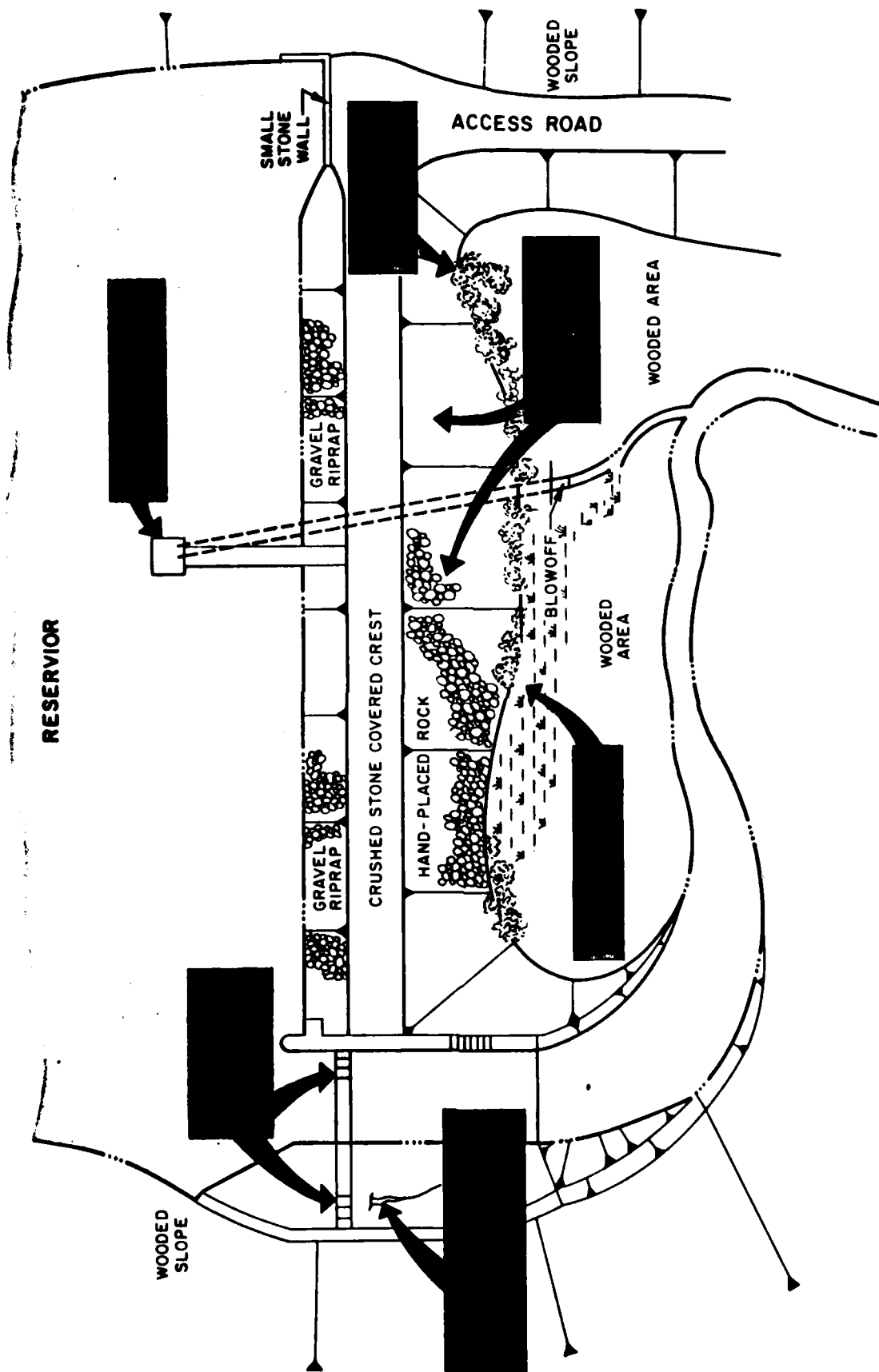
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDI# PA - 00512
TYPE AND CONDITION	See sheet 4 of 8.	
APPROACH CHANNEL	N/A.	
OUTLET STRUCTURE	N/A.	
DISCHARGE CHANNEL	N/A.	

INSTRUMENTATION

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDI# PA - 00512
MONUMENTATION SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHERS	Rain gage located atop roof of owner's office in downtown Shamokin, Pennsylvania.	

RESERVOIR AREA AND DOWNSTREAM CHANNEL

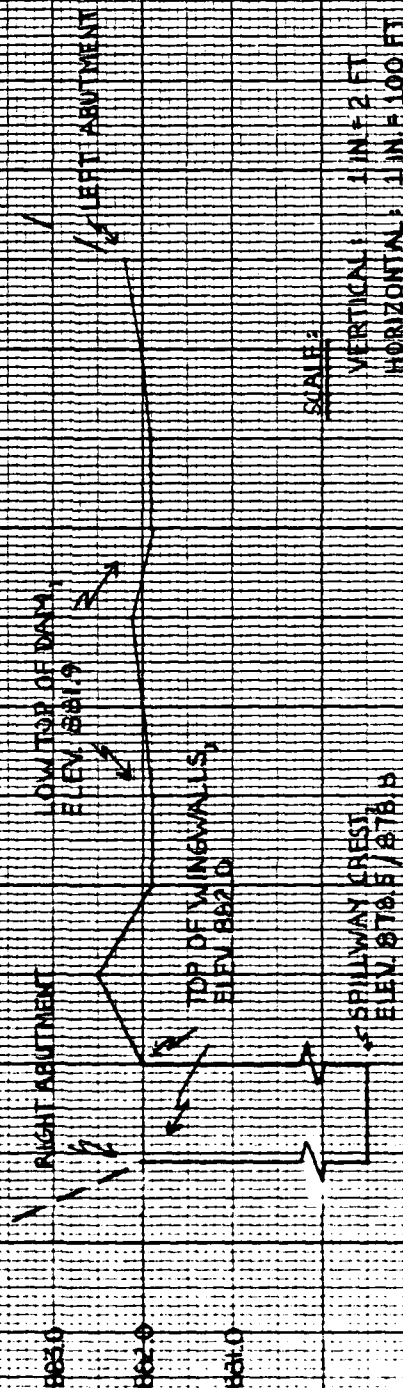
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS	NDI# PA - 00512
SLOPES: RESERVOIR	Moderate to steep wooded slopes.	
SEDIMENTATION	None observed.	
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Trout Run cuts through a steep, narrow, forested valley with steep confining slopes. The stream converges with Shamokin Creek approximately 1.3 miles downstream of the embankment.	
SLOPES: CHANNEL VALLEY	Channel - steep. Valley - steep and heavily forested.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	The left bank of Shamokin Creek, opposite the inlet of Trout Run, is heavily developed with both industrial and residential structures. Several hundred people reside and/or work in this area. Substantial property damage and loss of life possibly could be the result of an embankment breach.	



TROUT RUN DAM NO. 4
GENERAL PLAN - FIELD INSPECTION NOTES

TROUT RUN DAM NO. 4

PROFILE OF DAM CREST
FROM FIELD SURVEY



APPENDIX B
ENGINEERING DATA CHECKLIST

**CHECK LIST
ENGINEERING DATA
PHASE I**

NAME OF DAM Trout Run Dam No. 4

ITEM	REMARKS	NDI# PA - 00512
PERSONS INTERVIEWED AND TITLE	Roaring Creek Water Company Harry Sacona - Superintendent	
REGIONAL VICINITY MAP	See Appendix E, Figure 1, (U.S.G.S. 7.5 minute topographic quadrangle, Shamokin, Pennsylvania).	
CONSTRUCTION HISTORY	Constructed in 1882. Enlarged to present capacity in 1894. No construction records available. Good historical review from 1915 in PennDER files. See Section 1.2.g.	
AVAILABLE DRAWINGS	Several drawings dated 1894 and 1915 available from both the owner and PennDER files. Drawing of last spillway renovation dated 1977 is also available from the owner. See Appendix E, Figures 2, 3, 4, and 5.	
TYPICAL DAM SECTIONS	See Appendix E, Figure 5.	
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Appendix E, Figure 5. Not available. Not available.	

**CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)**

ITEM	REMARKS	NDI# PA -00512
SPILLWAY: PLAN SECTION DETAILS	See Appendix E, Figures 3 and 4.	
OPERATING EQUIP. MENT PLANS AND DETAILS	Not available.	
DESIGN REPORTS	Not available.	
GEOLOGY REPORTS	Not available.	
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	Not available.	
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	Not available.	

**CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)**

ITEM	REMARKS	NDI# PA - 00512
BORROW SOURCES	Not known.	
POST CONSTRUCTION DAM SURVEYS	Sediment survey only (see below).	
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Middle Atlantic States Engineering Company of Fairless Hills, Pennsylvania performed a sediment survey in 1974. Data not available.	
HIGH POOL RECORDS	A cursory review of available records indicates the largest flood to date occurred on June 22 and 23, 1972 when daily rainfall measured 7.73 and 5.54 inches, respectively.	
MONITORING SYSTEMS	Estimate of water level made daily from paint markings on exterior of control tower. Normal pool at 21. feet (relative datum).	
MODIFICATIONS	Original facility built in 1882 and enlarged to present capacity in 1894. Spillway modified in 1920 and renovated in 1978.	

**CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)**

ITEM	REMARKS	NDI# PA - 00512
PRIOR ACCIDENTS OR FAILURES	Spillway walls failed during June 1972 flood. Further damage to spillway resulted from flood in fall of 1975. Dam reportedly has never been overtopped.	
MAINTENANCE: RECORDS MANUAL	No formal records or manual.	
OPERATION: RECORDS MANUAL	No formal records or manual.	
OPERATIONAL PROCEDURES	Self regulating.	
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	Two security guards patrol 6 water company dams during daylight. Gates along access roads are locked at night. No formal warning system in effect.	
MISCELLANEOUS	Downstream dams shown on old topographic maps were breached during 1960's.	

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**CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA**

NDI ID # PA-00512
PENNDER ID # 49-5

SIZE OF DRAINAGE AREA: 1.9 square miles
ELEVATION TOP NORMAL POOL: 878.5 STORAGE CAPACITY: 108 acre-feet
ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -
ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -
ELEVATION TOP DAM: 881.9 STORAGE CAPACITY: 115 acre-feet

SPILLWAY DATA

CREST ELEVATION: 878.5 (service), 878.8 (emergency)
TYPE: Two-staged, uncontrolled, service-emergency spillway
CREST LENGTH: 30.4 feet (service), 24.5 (emergency)
CHANNEL LENGTH: 42 feet
SPILLOVER LOCATION: Right abutment
NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

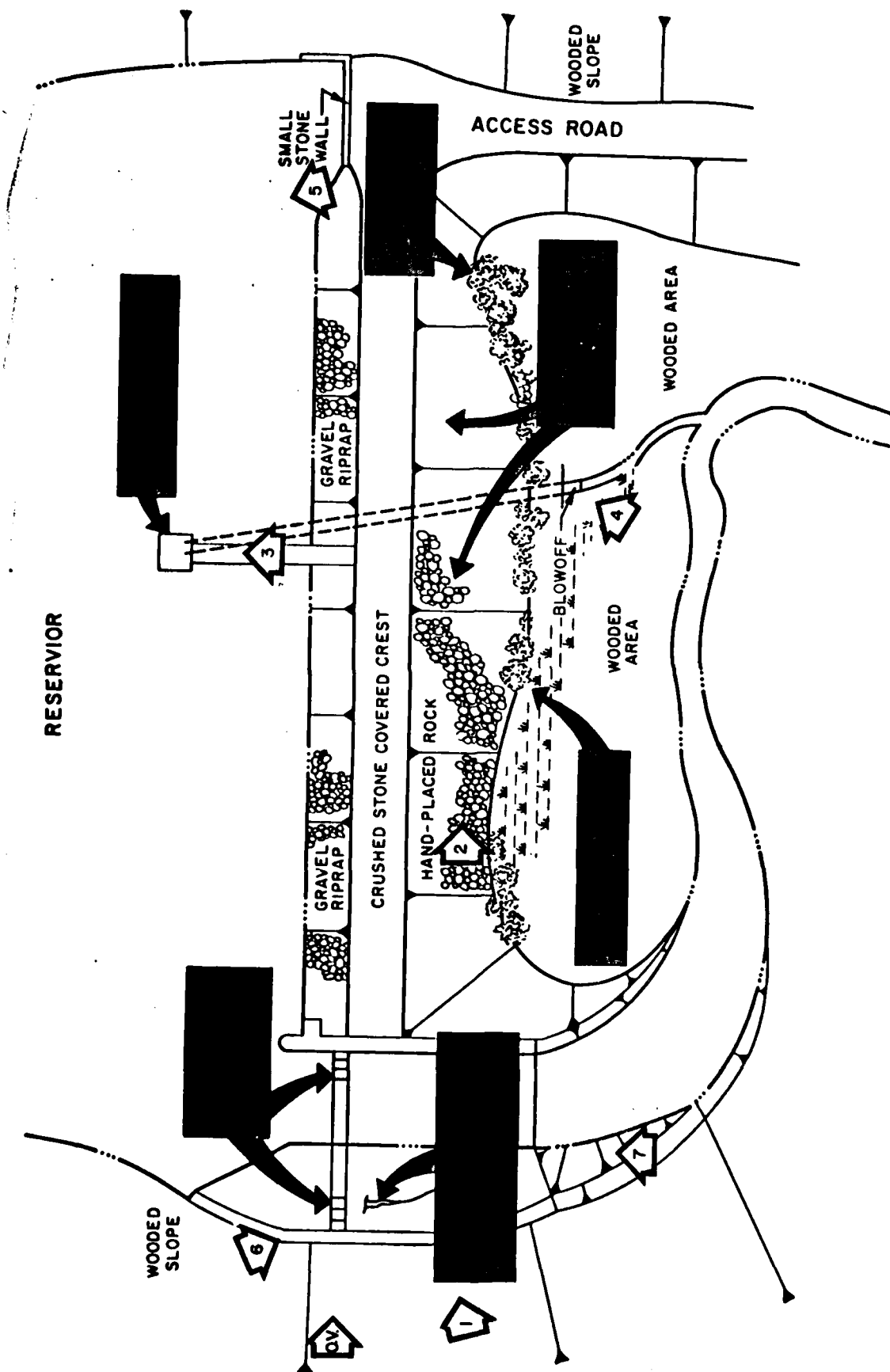
TYPE: 16-inch diameter C.I.P. blowoff and supply lines
LOCATION: Approximate center of embankment
ENTRANCE INVERTS: 853.5 (blowoff; estimated zero storage elevation)
EXIT INVERTS: 851.7 (blowoff)
EMERGENCY DRAWDOWN FACILITIES: 16-inch diameter C.I.P. blowoff

HYDROMETEOROLOGICAL GAGES

TYPE: Rain gage
LOCATION: Atop roof of owner's main office, downtown Shamokin
RECORDS: Date back to circa 1880

MAXIMUM NON-DAMAGING DISCHARGE: June 22 and 23, 1972

APPENDIX C
PHOTOGRAPHS



TROUT RUN DAM NO. 4
PHOTOGRAPH KEY MAP

PHOTOGRAPH 1 View of the discharge end of the spillway and downstream face of the embankment as seen from the right abutment.

PHOTOGRAPH 2 View of the hand-placed, sandstone slope protection covering the irregular downstream embankment face.

PHOTOGRAPH 3 View of the concrete control tower that houses the gate valves for the outlet works.

PHOTOGRAPH 4 View of the discharge end of the 16-inch diameter blowoff conduit.



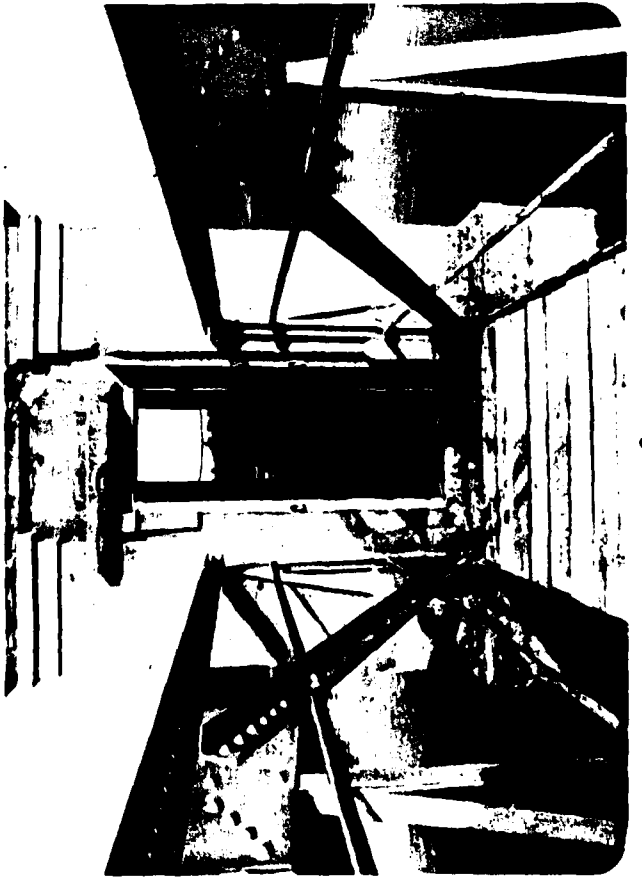
2



4



1



3

PHOTOGRAPH 5 View of the reservoir impounded by Trout Run Dam No. 4 as seen from the embankment crest.

PHOTOGRAPH 6 View, looking downstream, of the spillway structure. Note the masonry blocks placed at the corners of the overflow weir adjacent the wingwalls.

PHOTOGRAPH 7 View, looking upstream, of the two-stage spillway structure.

PHOTOGRAPH 8 View of Trout Run near its confluence with Shamokin Creek approximately 1.3 miles downstream of the embankment.



6



8



5



7

APPENDIX D
HYDROLOGY AND HYDRAULICS ANALYSES

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

- a. Development of an inflow hydrograph(s) to the reservoir.
- b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

- c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

- a. Development of an inflow hydrograph(s) to the reservoir.
- b. Routing of the inflow hydrograph(s) through the reservoir.
- c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.
- d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevations of failure hydrographs for each location.

HYDROLOGY AND HYDRAULIC ANALYSIS DATA BASE

NAME OF DAM: TROUT RUN DAM NO. 4

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 INCHES/24 HOURS (1)

STATION	1	2	3
STATION DESCRIPTION	TROUT RUN DAM NO. 4		
DRAINAGE AREA (SQUARE MILES)	1.9		
CUMULATIVE DRAINAGE AREA (SQUARE MILES)	-		
ADJUSTMENT OF PMP FOR DRAINAGE AREA & LOCATION (2)			
6 HOURS	119		
12 HOURS	128		
24 HOURS	137		
48 HOURS	144		
72 HOURS	146		
SNYLER HYDROGRAPH PARAMETERS			
ZONE (2)	1		
C_p (3)	1.00		
C_t (3)	1.85		
L (MILES) (4)	1.0		
$L_{0.1}$ (MILES) (4)	1.0		
$T_0 = C_t (L - L_{0.1})^{0.3}$ (HOURS)	0.24		
SPILLWAY DATA			
CREST LENGTH (FEET)	50.0		
FREEBOARD (FEET)	3.4		

(1) HYDROMETEOROLOGICAL REPORT 40, U.S. WEATHER BUREAU, 1969.

(2) HYDROLOGIC ZONE DEFINED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT, FOR DETERMINATION OF SNYLER COEFFICIENTS (C_p AND C_t).

(3) SNYLER COEFFICIENTS

(4) L = LENGTH OF LONGEST WATERCOURSE FROM DAM TO BASIN DIVIDE.

$L_{0.1}$ = LENGTH OF LONGEST WATERCOURSE FROM DAM TO POINT OPPOSITE BASIN CENTROID.

(5) T_0 = TIME OF TRAVEL OF TWO-STAGE SERVICE-EMERGENCY SPILLWAY.

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM #4
BY DJS DATE 11-15-79 PROJ. NO. 79-303-512
CHKD. BY DLB DATE 12-18-79 SHEET NO. 1 OF 20



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DAM STATISTICS

- HEIGHT OF DAM $\approx$ 30 FEET (FIELD MEASURED)
- NORMAL POOL STORAGE CAPACITY $\approx$ 35.3×10^6 GALLONS
 $\approx$ 108 ACRE-FT (SEE NOTE 1)
- MAXIMUM POOL STORAGE CAPACITY $\approx$ 155 AC-FT (SHEET 4)
(AT LOW TOP OF DAM)
- DRAINAGE AREA $\approx$ 1.9 SQUARE MILES (PLANIMETERED ON U.S. TOPO
MAP, SHAMOKIN, PA)
- ELEVATION OF TOP OF DAM (DESIGN) $\approx$ 882
- ELEVATION OF TOP OF DAM (FIELD) $\approx$ 881.9 (FIELD NOTES)
- NORMAL POOL ELEVATION $\approx$ 878.5 (SHEET 3)
- UPSTREAM INLET INVERT $\approx$ 853.5 (ESTIMATED ELEVATION
BASED ON ZERO STORAGE
POOL; SEE SHEET 3)
- DOWNSTREAM OUTLET INVERT (FIELD) $\approx$ 851.7 (SEE NOTE 1)
- STREAMBED @ DAM CENTERLINE $\approx$ 852 (ESTIMATED FROM AVAILABLE DATA)

NOTE 1: TAKEN FROM "REPORT UPON THE NO. 4 DAM OF THE RAINES
CREEK WATER COMPANY, IN TROUT RUN, COAL TOWNSHIP,
NORTHAMPTON COUNTY, PA"; DATED MARCH 31, 1955;
CONTAINED IN PENNSYLVANIA...

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM #4
 BY DJS DATE 11-15-79 PROJ. NO. 79-203-512
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 2 OF 20



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DAM CLASSIFICATION

DAM SIZE : SMALL

(REF. 1, TABLE 1)

HABARD CLASSIFICATION: HIGH

(FIELD OBSERVATION)

REQUIRED SDF : 1/2 DMF to PMF

(REFERENCE 1, TABLE 3)

HYDROGRAPH PARAMETERS

- LENGTH OF LONGEST WATERCOURSE : $L = 1.9$ MILES

{ MEASURED ON
USGS TOPOS
CHAMBERLIN QUAD

- LENGTH OF LONGEST WATERCOURSE FROM DAM

TO A POINT OPPOSITE BASIN CENTROID : $L_{CA} = 1.0$ MILE

$$C_t = 1.85$$

(SUPPLIED BY CDE, ZONE 13,
SUSQUEHANNA RIVER BASIN)

$$C_p = 0.50$$

$$\begin{aligned} t_p &= \text{SNYDER'S STANDARD LAG} = C_t (L \times L_{CA})^{0.3} \\ &= 1.85 (1.9 \times 1.0)^{0.3} \\ &\approx \underline{2.24 \text{ HOURS}} \end{aligned}$$

(NOTE: HYDROGRAPH PARAMETERS USED HERE ARE
DEFINED IN REFERENCE 2, IN THE SECTION
ENTITLED "SNYDER'S METHOD")

RESERVOIR SURFACE AREAS

- SURFACE AREA (SA) AT NORMAL POOL ELEVATION (875.5) ≈ 12 ACRES

(SEE NOTE 1)

- SA @ ELEV 900.0 ≈ 35 ACRES

- SA @ ELEV 920.0 ≈ 62 ACRES

{ PLANNED ON USGS
TOPOG MAP, CHAMBERLIN

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DJS DATE 11-20-79 PROJ. NO. 79-203-S12
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 3 OF 20



RESERVOIR VOLUMES BELOW NORMAL POOL :

- THE RESERVOIR CAPACITIES AT ELEVATIONS LESS THAN THAT OF NORMAL POOL ARE GIVEN ON FIGURE 2. (ON THE DRAWING, THE "100-FOOT" CONTOUR CORRESPONDS TO NORMAL POOL ELEVATION, 878.5.)

RESERVOIR ELEVATION (FT)	CAPACITY	
	MILLION GALLONS	ACRE-FT
863.5	1.48	4.5
868.5	6.44	19.7
873.5	17.90	54.8
878.5 (NORMAL POOL)	35.29	108.0

— RESERVOIR ELEVATION AT ZERO STORAGE :

- FROM FIGURE 2, THE ZERO STORAGE ELEVATION IS APPROXIMATELY 25 FEET BELOW THE NORMAL POOL ELEVATION, OR AT 853.5.

RESERVOIR VOLUMES ABOVE NORMAL POOL :

- BETWEEN NORMAL POOL ELEVATION AND ELEVATION 900.0, IT IS ASSUMED THAT THE MODIFIED PRISMATICAL RELATIONSHIP ADEQUATELY MODELS THE RELATIONSHIP BETWEEN SURFACE AREA AND STORAGE: (SEE 4.10.15)

$$LV_{1-2} = \frac{1}{3} (A_1 + A_2 + \sqrt{A_1 A_2}) h$$

WHERE LV_{1-2} = INCREMENTAL VOLUME BETWEEN ELEVATIONS 1 + 2, IN ACRE-FT
 h = ELEVATION₂ - ELEVATION₁, IN FEET
 A_1 = SURFACE AREA (SA) AT ELEVATION₁, IN ACRES
 A_2 = SA AT ELEVATION₂, IN ACRES

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DJS DATE 11-20-79 PROJ. NO. 74-150-512
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 4 OF 20



$$\text{ALSO, } A_i = A_0 + \left(\frac{\Delta SA}{\Delta H} \times H \right)$$

WHERE A_i = SA AT ELEVATION i , IN FEET

A_0 = SA AT ELEV₀ (NORMAL POOL, = 873.5)

$\frac{\Delta SA}{\Delta H}$ = RATE OF RESERVOIR AREA INCREASE PER FOOT RISE IN ELEVATION

- BETWEEN NORMAL POOL AND ELEVATION 883.5,

$$\frac{\Delta SA}{\Delta H} = \frac{(35 - 12)}{(900 - 873.5)} = 1.07 \text{ AC-FT/FT}$$

$$H = \text{ELEV}_i - \text{ELEV}_0 = \text{ELEV}_i - 873.5$$

ELEVATION - STORAGE RELATIONSHIP:

ELEVATION (FT)	A _i (AC)	ΔV_{i-1} (AC-FT)	TOTAL VOLUME (AC-FT)	ELEVATION (FT)	A _i (AC)	ΔV_{i-1} (AC-FT)	TOTAL VOLUME (AC-FT)
853.5	—	—	0 *	884.0	17.9	17.3	120
863.5	—	—	5 *	885.0	19.0	18.4	208
868.5	—	—	20 *	886.0	22.0	19.5	228
873.5	—	—	55 *	887.0	21.1	22.5	248
(873.5) 878.5	12.0	—	138 *	888.0	22.2	21.6	270
879.0	12.5	6.1	114	889.0	23.2	22.7	293
880.0	13.6	13.0	127	890.0	24.3	23.7	316
881.0	14.7	14.1	141	895.0	29.7	134.8	451
(881.0) 881.9	15.6	13.6	155	900.0	35.0	161.6	613
882.0	15.7	1.6	156				
883.0	16.8	16.2	173				

* APPROXIMATE STORAGE CAPACITIES BELOW NORMAL POOL ARE TAKEN FROM SHEET 3.

PROJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DJS DATE 11-29-79 PROJ. NO. 79-303-S13
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 5 OF 20



PMP CALCULATIONS

- FROM REFERENCE 9, FIGURE 2, OBTAIN PMP VALUE FOR A BASIN OF DRAINAGE AREA 220 SQUARE MILES, FOR A DURATION OF 24 HOURS:

PRECIP = 22.2 INCHES

- FROM REFERENCE 9, FIGURE 1, THE GEOGRAPHIC ADJUSTMENT FACTOR = 1.01
- AREA CORRECTION FACTOR (REF. 9):

DURATION (HRS) :	6	12	24	48	72
FACTOR (%) :	117.5	127.0	136.0	142.5	145.0

- TOTAL CORRECTION FACTOR, $\approx 1.01 \times$ AREA CORRECTION FACTOR :

DURATION (HRS) :	6	12	24	48	72
FACTOR (%) :	119	128	137	144	146

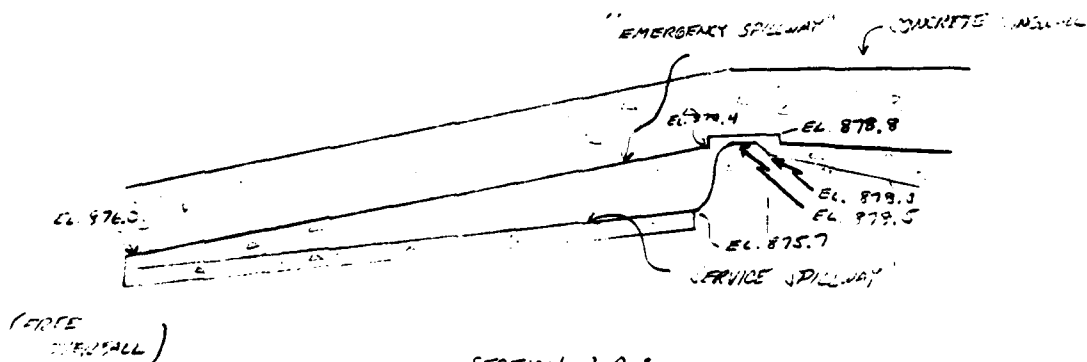
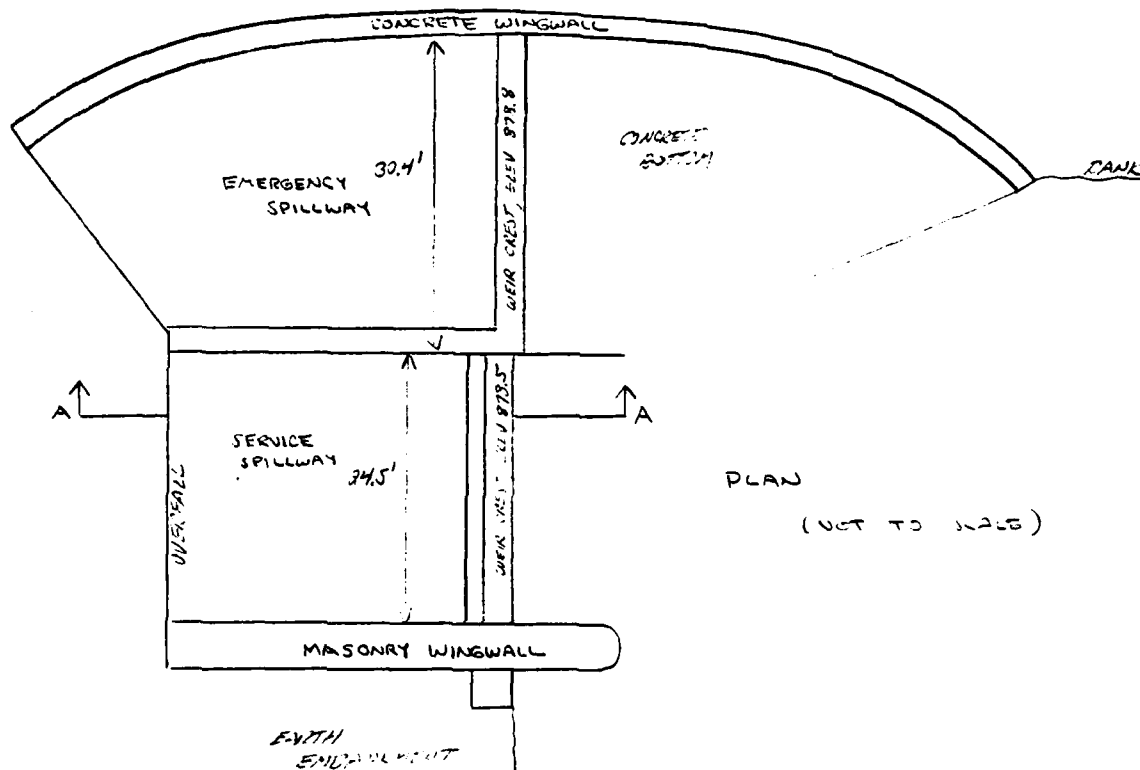
- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AND FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALL BASIN) FOR A DRAINAGE AREA 1.9 SQUARE MILES IS 0.80 (REF 4, p. 48)

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY ATS DATE 11-15-79 PROJ. NO. 79-223-512
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 6 OF 20

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SPILLWAY CAPACITY



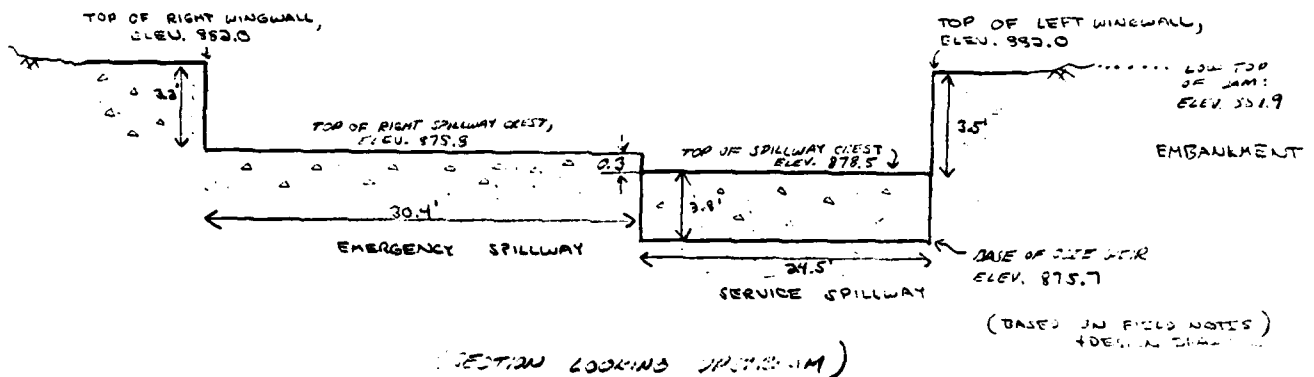
SECTION A-A:
 SPILLWAY PROFILE (NOT TO SCALE)
 (BASED ON FIELD MEASUREMENTS & DESIGN DRAWINGS)

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DJS DATE 11-19-79 PROJ. NO. 79-107-SR
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 7 OF 20

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SPILLWAY CROSS-SECTION:



- THE SPILLWAY IS A TWO-STAGE SERVICE-EMERGENCY TYPE CONSISTING OF A SERVICE SECTION WITH AN OGEE-LIKE OVERFLOW CREST AND AN EMERGENCY SECTION WITH A FLAT OVERFLOW CREST, AS SHOWN ABOVE.

- CAPACITY OF 'SERVICE SPILLWAY':

- DISCHARGE OVER THE OGEE-LIKE WEIR OF THE SERVICE SPILLWAY CAN BE ESTIMATED BY THE EQUATION

$$Q_w = CLH^{3/2} \quad (\text{REF. 4, p. 272})$$

WHERE

- Q_w = DISCHARGE OVER THE WEIR (CFS)
- L = LENGTH OF WEIR CREST = 24.5 FT
- H = HEIGHT OF WATER ABOVE CREST (FEET)
- C = DISCHARGE COEFFICIENT

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DJS DATE 11-12-79 PROJ. NO. 79-203-S13
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 8 OF 20



- THE DESIGN HEAD (H_0) IS ASSUMED TO BE AT THE TOP OF THE WEIR, OR 3.5 FEET ABOVE THE SPILLWAY CREST. THE FLOOD DEPTH (P) IS APPROXIMATELY 2.5 FEET. CALCULATE THE DESIGN DISCHARGE COEFFICIENT:

- FOR A VERTICAL-FACED OGEE CREST, WITH $\frac{P}{H_0} = \frac{2.5}{3.5} \approx 0.71$,
 $C = 3.47$

(REF 4, p. 378, FIG. 342)

- FOR AN OGEE-FACED CREST WITH SLOPING UPSTREAM FACE (WITH $\frac{P}{H_0} \approx 0.71$, AND ASSUMING A 45° SLOPING UPSTREAM FACE),

$\frac{C_{\text{SLOPING}}}{C_{\text{VERTICAL}}} = 1.04$ (REF 4, p. 379, FIG. 351)

$\therefore C_0 \approx (1.04)(3.47) \approx 3.61$

- DOWNSTREAM MOUND EFFECTS AND TAILWATER EFFECTS ARE ASSUMED TO BE NEGLIGIBLE HERE. ALSO, IT IS ASSUMED THAT THERE ARE NO FLOOD LOGS HERE.
- AS THE HEAD ABOVE THE WEIR BECOMES SMALL, DISCHARGE IS REDUCED DISPROPORTIONATELY, DUE TO THE ROUGHNESS AND THE CONTACT PRESSURE BETWEEN THE WATER AND THE WEIR. THIS, THE DISCHARGE COEFFICIENT (C) TAKES ON A LOWER VALUE THAN THAT OF DESIGN HEAD. CONVERSELY, AT HEADS HIGHER THAN THAT OF DESIGN, THE DISCHARGE COEFFICIENTS WILL BE HIGHER THAN THAT OF DESIGN. THEREFORE, THE DESIGN DISCHARGE COEFFICIENT IS MODIFIED APPROPRIATELY, ACCORDING TO FIGURE 250, REFERENCE 4.

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM 112.4
 BY DJS DATE 11-20-79 PROJ. NO. 79-203-S12
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 9 OF 20



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SERVICE SPILLWAY RATING TABLE:

RESERVOIR ELEVATION (FT)	H (FT)	H/H ₀	① %C ₀	② C	③ Q = CLH ^{3/2} (CFS)
878.5	0	—	—	—	0
879.0	0.5	0.14	1.83	3.10	30
880.0	1.5	0.43	1.91	3.24	150
881.0	2.5	0.71	0.96	3.47	340
(LOW TOP OF DAM) 881.9	3.4	0.97	0.99	3.57	550
(TOP OF WINGWALL) 882.0	3.5	1.00	1.00	3.61	580
883.0	4.5	1.29	1.04	3.75	830
884.0	5.5	1.57	1.07	3.86	1220
885.0	6.5	1.86	1.07	3.86	1570
886.0	7.5	2.14	1.07	3.86	1940
887.0	8.5	2.43	1.07	3.86	2340
888.0	9.5	2.71	1.07	3.86	2770
889.0	10.5	3.00	1.07	3.86	3220
890.0	11.5	3.29	1.07	3.86	3690

① FROM FIGURE 250, p. 378, REF. 4.

② $C = C_0$ (%C₀)

③ $L = 34.5$

CAPACITY OF EMERGENCY SPILLWAY:

THE EMERGENCY SPILLWAY CONSISTS OF A PROPOSED CHANNEL ON A STEEP SLOPE, WITH A SMALL RECTANGULAR-SHAPED FLAT-CRESTED WEIR. DISCHARGE WILL BE DESCRIBED BY THE WEIR EQUATION

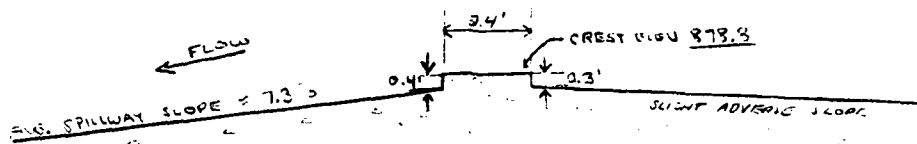
$$Q = CLH^{3/2}$$

(Q, C, L, H, AS DEFINED ON SHEET 7)

(REF 5, p. 5-37)

SUBJECT DAM WEIR IMPROVEMENT
TRIBUTARY DAM NO. 4
 BY DJS DATE 11-21-79 PROJ. NO. 74-001-012
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 10 OF 20

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- FOR LOW FLOWS, THE DIMENSIONS OF THE SMALL WEIR INDICATE THAT IT WILL BEHAVE AS A BROAD-CRESTED WEIR WITH A DISCHARGE COEFFICIENT RANGING FROM ABOUT 0.5 TO 0.7. AT HIGHER HEADS, THE WEIR WILL ACT AS THE CHANNEL CONTROL POINT WHERE CRITICAL FLOW OCCURS, DUE TO THE DOWNSTREAM STEEP SLOPE. IN THESE CASES, THE LIMITING VALUE ON THE DISCHARGE COEFFICIENT WILL BE 3.087. APPROACH LOSSES WILL BE NEGLECTED HERE.

(REF 5, P. 7-21, 3-4)

ENERGETIC WEIR RATING TABLE:

RESERVOIR ELEVATION (FT)	H (FT)	C	Q (CFS)
873.5	0	—	—
877.3	1.2	2.49	10
880.0	1.3	2.66	110
881.3	2.3	2.84	980
(LOW FLOW) 881.9	3.1	3.09	510
(DESIGN) 882.2	3.3	3.09	540
882.0	4.2	3.09	810
884.0	5.3	3.09	1110
885.0	6.3	3.09	1450
886.0	7.2	3.09	1810
887.0	8.2	3.09	2210
888.0	9.2	3.09	2690
889.0	10.2	3.09	3060
890.0	11.2	3.09	3590

① AT HEADS OF 3.0 FEET AND ABOVE, DISCHARGE COEFFICIENTS TAKEN FROM TABLE

SUBJECT DAM SAFETY INSPECTION

TRONT RUN DAM NO. 4

BY DJS DATE 11-21-79 PROJ. NO. 79-302-S12

CHKD. BY DLB DATE 12-18-79 SHEET NO. 11 OF 30



REFERENCE 5, p. 5-40. AT HEADS GREATER THAN THIS, TABLE 5-3 GIVES C-VALUES WHICH ARE HIGHER THAN WOULD BE EXPECTED FOR THE EXISTING WEIR (SINCE THE HEIGHT OF THIS WEIR IS LOW). SO IT IS ASSUMED THAT CRITICAL FLOW OCCURS AT THAT POINT, RESULTING IN A C-VALUE OF $3.087 \approx 3.09$ (CRITICAL FLOW, RECTANGULAR CHANNEL).

② $Q = CLH^{3/2}$, $L = 30.4$ FT.

TOTAL SPILLWAY RATINGS TABLE: $Q_{SPILLWAY TOTAL} = Q_{SERVICE} - Q_{SEVERITY}$

RESERVOIR ELEV (FT)	Q _{SERVICE} (CFS)	Q _{SEVERITY} (CFS)	Q _{TOTAL} (CFS)
878.5	0	0	0
879.0	30	10	40
880.0	150	110	360
881.0	340	280	630
(LOW TOP OF DAM) 881.1	550	510	1060
(TOP OF WEIR/WALL) 882.0	550	540	1120
883.0	890	810	1690
884.0	1320	1110	2330
885.0	1570	1450	3030
886.0	1940	1810	3750
887.0	2340	2210	4550
888.0	2770	2620	5390
889.0	3230	3060	6290
890.0	3690	3520	7310

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DJS DATE 11-23-79 PROJ. NO. 79-222-S12
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 12 OF 20



EMBANKMENT RATING CURVE

- ASSUME THAT THE EMBANKMENT ACTS ESSENTIALLY AS A ERECT-CRESTED WEIR WHEN OVERTOPPED. THUS, THE DISCHARGE WILL BE DEFINED BY THE RELATIONSHIP:

$$Q = CLH^{3/2} \quad (\text{REF. 5, p. 5-20})$$

WHERE

Q = DISCHARGE (CFS)
 L = LENGTH OF EMBANKMENT OVERTOPPED (FT)
 H = HEAD ON THE WEIR; HERE IT IS THE AVERAGE "FLOW-AREA" WEIGHTED HEAD ABOVE THE CREST, USING THE LOW TOP OF DAM AS A DATUM, (FEET)
 C = COEFFICIENT OF DISCHARGE, DEPENDENT ON THE HEAD AND THE WEIR BROADTH.

- FIND THE LENGTH OF EMBANKMENT SUBMERGED FOR VARIOUS RESERVOIR ELEVATIONS:

RESERVOIR ELEV. (FT)	APPROXIMATE LENGTH OF EMBANKMENT (FT)
(LOW TOP OF DAM) 881.9	100
882.0	200
882.2	400
883.5	460
887.0	470
885.0	530
890.0	630

(FROM FIELD NOTES + JUL. 79)

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM AB. 4
 BY DJS DATE 11-20-79 PROJ. NO. 79-000-512
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 13 OF 20



- ASSUME INCREMENTAL DISCHARGES OVER THE EMBANKMENT ARE APPROXIMATELY TRAPEZOIDAL IN CROSS-SECTION. THEN ANY INCREMENTAL AREA OF FLOW $\approx H_i [(L_1 + L_2)/2]$, WHERE L_1 = LENGTH AT LOWER ELEVATION, L_2 = LENGTH AT HIGHER ELEVATION, H_i = DIFFERENCE IN ELEVATIONS. THUS, THE TOTAL AVERAGE "FLOW-AREA WEIGHTED" HEAD, H_{w-T} , $\approx$ TOTAL FLOW AREA / L_2 .

RESERVOIR ELEVATION (FT)	L_1 (FT)	L_2 (FT)	INCREMENTAL HEAD, H_i (FT)	① INCREMENTAL FLOW AREA, A_i (FT ²)	TOTAL FLOW AREA, A_T (FT ²)	③ WEIGHTED HEAD, H_{w-T} (FT)	② $\frac{H_{w-T}}{L_2}$	④ C	⑤ Q (CFS)
881.9	100	—	0	—	—	—	—	—	—
882.0	100	230	0.1	16.5	16.5	0.07	0.01	2.90	10
882.3	230	400	0.2	63	80	0.2	0.02	2.97	110
882.5	400	460	0.3	129	209	0.45	0.03	3.01	420
883.0	460	470	0.5	233	442	0.94	0.07	3.03	1300
885.0	470	530	2.0	990	1432	2.75	0.31	3.38	7000
890.0	530	630	5.0	2875	4307	6.34	0.53	3.39	34,300

① $A_i = L_1 \left(\frac{L_1 + L_2}{2} \right)$

② $H_{w-T} = A_T / L_2$

③ L = LENGTH OF CREST = 13' —

④ $C = f(H, L)$; VALUES TAKEN FROM REF. 2, $f = 3.34$

⑤ $Q = CL_2 H_{w-T}^{3/2}$

SUBJECT TRIBUTARY DRAINAGE
TRIBUTARY RUN DEM. NO. 4
 BY DJS DATE 11-21-79 PROJ. NO. 79-302-512
 CHKD. BY DLB DATE 12-18-79 SHEET NO. 14 OF 20



TOTAL FACILITY RATING TABLE

$$Q_{TOTAL} = Q_{TOTAL SPILLWAY} + Q_{EMBANKMENT}$$

	RESERVOIR ELEVATION (FT)	Q _{SPILLWAY TOTAL} (CFS)	Q _{EMBANKMENT} (CFS)	Q _{TOTAL} (CFS)
(NORMAL POOL)	878.5	0	-	0
	879.0	40	-	40
	880.0	360	-	360
	881.0	620	-	620
(LOW TOP OF DAM)	881.9	1060	0	1060
	882.0	1130	10	1130
	882.2	1330 *	110	1340
	882.5	1410 *	420	1830
	883.0	1690	1300	2990
	884.0	2330	2430 **	5730
	885.0	3020	7300	10320
	886.0	3750	11,300 **	14,950
	887.0	4550	16,000 **	20,550
	888.0	5390	21,200 **	26,590
	889.0	6380	27,570 **	33,740
	890.0	7310	34,830	41,920

* LINEAR INTERPOLATION

** LOG-LOG INTERPOLATION

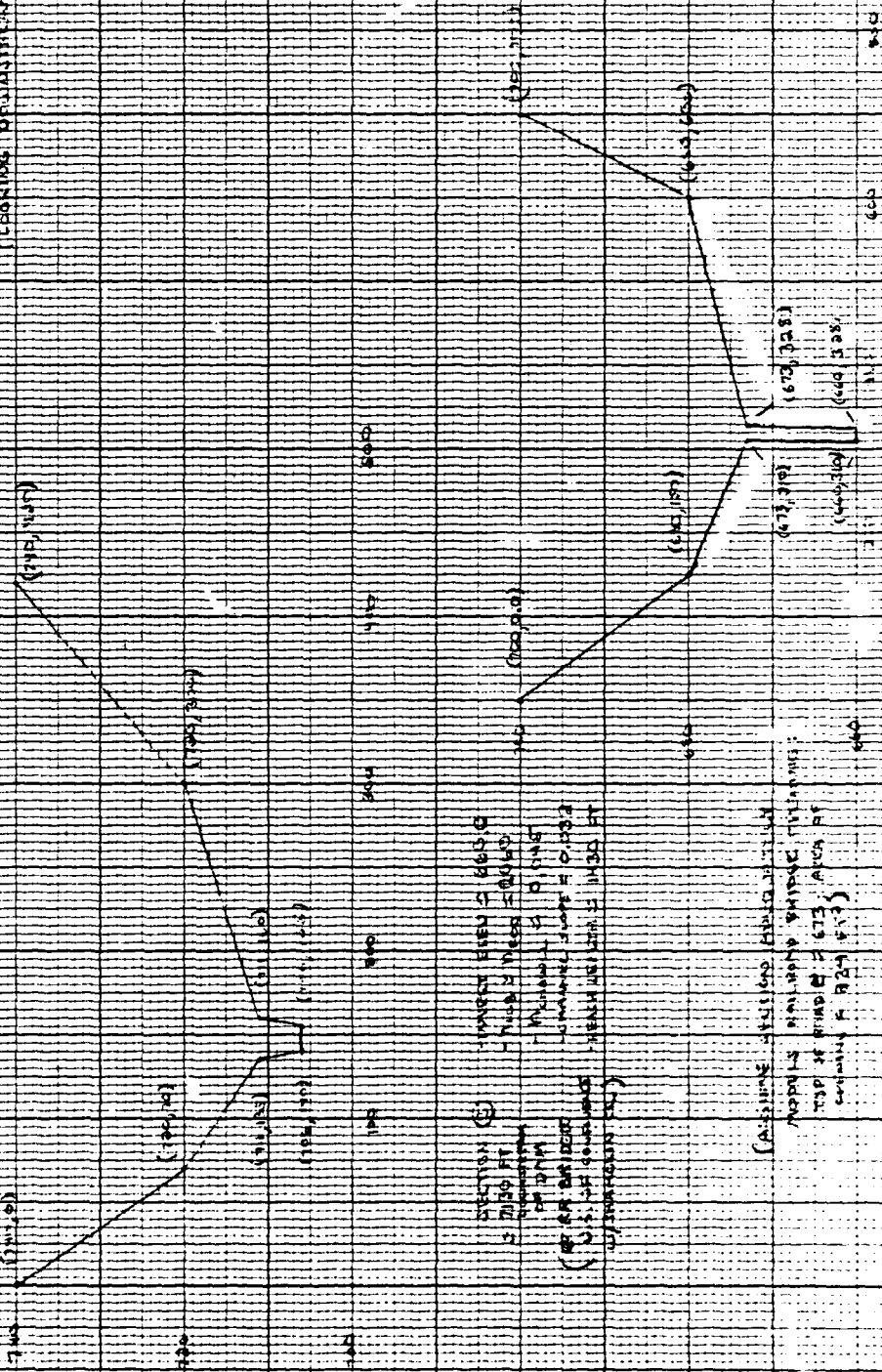
SUBJECT	TRUST RUN DAM #4		
BY	2018	DATE	12/15/22
CHKD BY	2018	DATE	12/15/22
PROJECT NO	10-2018-012		

SECTIONS BOUNDARY FIELD
MEASUREMENTS, AND COORDINATES
+ 0.00 S. POINT
(LOOKING DOWNSTREAM)

SECTION ②
- INVERT ELEV. = 704.4
- HIGH FLOOD ELEV. = 704.9
- FLOOD ELEV. = 704.5
- SPILLWAY ELEV. = 704.0
- DAM ELEV. = 700.0 FT

SECTION ③
- INVERT ELEV. = 665.0
- HIGH FLOOD ELEV. = 665.5
- FLOOD ELEV. = 665.0
- SPILLWAY ELEV. = 664.5
- DAM ELEV. = 660.0 FT

(A) - INVERT ELEV. = 665.0
- HIGH FLOOD ELEV. = 665.5
- FLOOD ELEV. = 665.0
- SPILLWAY ELEV. = 664.5
- DAM ELEV. = 660.0 FT



SUBJECT: TROUT RUN DAM # 4
 BY: JTS DATE: 12/15/79 SHEET NO. 16 OF 20
 CHKD BY: B DATE: 12-16-79 PROJECT NO. 74-200-513

SECTION 1 WATER ELEV = 751.0

15' RIGHT OF
 DAM SUBSTATION
 45' LEFT

MAX. SLOPE = 0.035
 MAX. A = 0.045
 MAX. B = 0.055
 DAM WIDTH = 155.0'

CHANNEL SLOPE = 0.027
 (650, 710)
 (640, 700)
 (630, 690)
 (620, 680)
 (610, 670)
 (600, 660)

SECTION 2 WATER ELEV = 679

15' RIGHT OF
 DAM SUBSTATION
 45' LEFT

MAX. SLOPE = 0.035
 MAX. A = 0.045
 MAX. B = 0.055
 DAM WIDTH = 155.0'

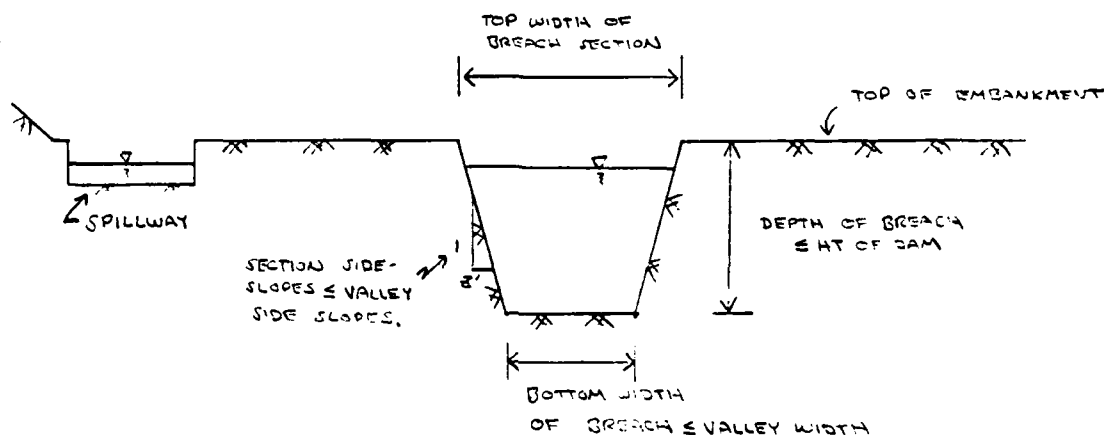
CHANNEL SLOPE = 0.027
 (650, 710)
 (640, 700)
 (630, 690)
 (620, 680)
 (610, 670)
 (600, 660)

SUBJECT DAM SAFETY IMPROVEMENT
TRIST RUN DAM NO. 4
 BY DJS DATE 12-12-79 PROJ. NO. 79-202-512
 CHKD. BY DLB DATE 12-26-79 SHEET NO. 17 OF 20

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BREACH ASSUMPTIONS

TYPICAL BREACH SECTION:



HEC-1 BREACHING ANALYSIS INPUT:

(BREACHING BEGINS WHEN RESERVOIR LEVEL REACHES LOW TOP OF
 DAM ELEVATION: 381.9)

<u>PLAN</u>	<u>BREACH BOTTOM WIDTH (FT)</u>	<u>MAX BREACH DEPTH (FT)</u>	<u>SECTION SIDE SLOPES</u>	<u>BREACH TIME (H)</u>	<u>WHEEL OF STAY OF PAVEMENT</u>
① MINIMUM BREACH SECTION, MINIMUM FAIL TIME.	0	28	1/2 H: 1 V	2.5	381.9
② MAXIMUM BREACH SECTION, MINIMUM FAIL TIME.	250	28	3 H: 1 V	2.5	381.9
③ MINIMUM BREACH SECTION, MAXIMUM FAIL TIME.	0	23	1/2 H: 1 V	4.0	381.9
④ MAXIMUM BREACH SECTION, MAXIMUM FAIL TIME.	250	23	3 H: 1 V	4.0	381.9
⑤ AVERAGE POSSIBLE CONDITIONS.	70	25	1 H: 1 V	2.3	381.9

SUBJECT DAM SAFETY INSPECTION
TRANT RIVER DAM NO. 4
BY DJS DATE 12-12-79 PROJ. NO. 79-200-512
CHKD. BY DLE DATE 12-26-79 SHEET NO. 18 OF 20



- THE BREACH ASSUMPTIONS LISTED IN THE PREVIOUS SHEET WERE BASED ON THE SUGGESTED RANGES PROVIDED BY THE COE (BALTIMORE DISTRICT) AND ON THE PHYSICAL CONSTRAINTS OF THE DAM AND THE SURROUNDING TERRAIN:

- DEPTH OF BREACH OPENING $\approx$ 38 FT (ELEV DIFFERENCE BETWEEN TOP OF DAM AND LOW POINT OF RESERVOIR)
- EMBANKMENT CREST LENGTH $\approx$ 450 FT (BREACHABLE EMBANKMENT, FIELD MEASUREMENT)
- VALLEY BOTTOM WIDTH: $\approx$ 250 FT (FIELD MEASUREMENT)
- VALLEY SIDE SLOPES ADJACENT TO DAM:
 - RIGHT SIDE: 8.0 H : 1.3 V
 - LEFT SIDE: 3.0 : 1.0 V
(1.25 : 1.0 V : HAND-DRAWN)

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DJS DATE 12-18-77 PROJ. NO. 79-273-12
 CHKD. BY DLB DATE 12-26-79 SHEET NO. 19 OF 20



HEC-1 DAM BREACHING ANALYSIS OUTPUT:

RESERVOIR DATA:

(UNDER 0.29 PMF BASE FLOW CONDITIONS)

PLAN NUMBER *	UPSTREAM BREACH HEIGHT (FT)	ACTUAL MAX FLOW DURING FAIL TIME (CFS)	COMPLETING TIME OF FLOW (HR)	INTERPOLATED OR HEC-1 ADJUSTED MAX FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HR)	ACTUAL PEAK FLOW THROUGH DAM (CFS)	CORRESPONDING TIME OF FLOW (HR)	TIME OF INITIAL BREACH (HR)
①	0	4158	42.17	4158	42.17	4158	42.17	41.67
②	250	8449	41.89	8385	41.83	8449	41.89	41.67
③	0	1492	45.35	1491	45.17	1492	45.35	41.67
④	250	3153	42.35	3151	42.33	3153	42.35	41.67
⑤	40	3965	42.50	3965	42.50	3965	42.50	41.67

* - 11 JAN 1978

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DJS DATE 12-18-79 PROJ. NO. 79-202-02
 CHKD. BY DLB DATE 12-26-79 SHEET NO. 20 OF 20



DOWNSTREAM ROUTING DATA:

(UNDER 0.29 PMF BASE FLOW CONDITIONS)

(1) PLAN NUMBER	(2) VARIABLE LENGTH DOWN TO FEET (FT)	OUTPUT @ SECTION 4, ± 7580 FT DS. OF DAM				OUTPUT @ SECTION 5, ± 9780 FT DS. OF DAM			
		PEAK FLOW (CFS)	CORRESPONDING WSEL (A) (FT)	WSEL W/O BREACH (FT)	ELEV DIFF (B) (FT)	PEAK FLOW (CFS)	CORRESPONDING WSEL (A) (FT)	WSEL W/O BREACH (FT)	ELEV DIFF (B) (FT)
①	0	3549	661.0	657.8	+3.2	3282	643.8	640.9	+1.9
②	350	5623	662.5	657.8	+4.7	4977	643.8	640.9	+2.9
③	0	1484	658.4	657.8	+0.6	1480	641.2	640.9	+0.3
④	250	2137	659.5	657.8	+1.7	2134	641.9	640.9	+1.0
⑤	10	2926	660.4	657.8	+2.6	2890	642.6	640.9	+1.7

- (1) SEE SHEET 17.
 (2) WATER SURFACE ELEVATIONS CORRESPONDING TO PEAK FLOW.
 (3) SUMMER DRAIN/OUTPUT SURFACE ELEVATION (M.).
 (4) PEAK FLOW OCCURRING AT THE VERGE 0.29 PMF AS
 INTERPOLATED FROM SHEET H, SUMMER DRAIN/OUTPUT SURFACE ELEVATIONS.
 (5) PEAK FLOW - (CORRESPONDING WSEL) - (WSEL W/O BREACH).

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM No. 4
 BY ST DATE 12-21-79 PROJ. NO. 79-303-512
 CHKD. BY DLB DATE 12-22-79 SHEET NO. A OF M



OVERTOPPING ANALYSIS

DAM SAFETY INSPECTION
 TROUT RUN DAM = 4 *****
 10-MINUTE TIME STEP AND 48 HOUR STORM DURATION

JOB SPECIFICATION
 NO. 288 MHR 0 NMIN 10 IDAY 0 INR 0 IMIN 0 MEIRC 0
 JUPER 5 NWT 0 LKOPT TRACE 0
 NSTAR 0

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NR110= 5 LR110= 1
 K110= .20 .30 .40 .50 1.00

SUB-AREA RUNOFF COMPUTATION

INFLOW INTO RESERVOIR

ISTAD	ICUNP	IECON	IIAPE	IPRT	ISAME	ISAGE	IAUTO
1	0	0	0	0	1	0	0

HYDROGRAPH DATA

INTDG	LONG	TAHEA	SWAP	TRSDA	IRSPC	RATIO	ISROW	ISAME	ISCAL
1	1	1.90	0.00	1.90	0.00	0.000	0	1	0

PRECIP DATA

SIFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.20	119.00	128.00	137.00	144.00	0.00	0.00

INSPC COMPUTED BY THE PROGRAM IS .800

INITIAL + CONSTANT
 CANAL LOSS

STRIL	CHSTL	ALSMX	R1IMP
1.00	.05	0.00	0.00

LOSS DATA

GROUP	SIRK4	OLIR4	RIIOL	ERAIN	SIRK5	RIIUR
0	0.00	0.00	1.00	0.00	1.00	1.00

UNIT HYDROGRAPH DATA

EP= 2.24 LP= .50 MIA= 0

BASEFLOW PARAMETERS

(C.O.E.)

RECESSION DATA

SIRI02	RII02	RII04	RII08	RII16	RII32
-1.50	0.00	0.00	0.00	0.00	0.00

APPROXIMATE CREEK COEFFICIENTS FROM GIVEN SNIKER (P AND IP ARE 10E14.35 AND 10E18.28 INTERVALS)

JECT

DAM SAFETY INSPECTION

TROUT RUN DAM NO. 4

BY DJS

DATE

12-21-79

PROJ. NO.

74-203-512

CHKD. BY DLA

DATE

12-22-79

SHEET NO.

6 OF M



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UNIT HYDROGRAPH END-OF-PERIOD ORIGINATES, LAG = 2.26 HOURS, CFS = 0.80, VOLUME = 0.99

UNIT	HYDROGRAPH	END-OF-PERIOD ORIGINATES	LAG = 2.26 HOURS	CFS = 0.80	VOLUME = 0.99
19.	40.	91.	151.	182.	235.
35.	278.	213.	120.	211.	209.
198.	177.	159.	246.	220.	121.
114.	102.	92.	142.	135.	70.
60.	59.	33.	82.	74.	40.
34.	36.	31.	28.	25.	23.
22.	20.	18.	16.	14.	14.
13.	11.	10.	9.	8.	8.
7.	6.	6.	5.	5.	5.
4.	4.	3.	3.	3.	3.

NO. DA	ORIGIN	PERIOD	HAUL	EACH	LOSS	END-OF-PERIOD	PERIOD	HAUL	EACH	LOSS	CUMUL
NO. DA	ORIGIN	PERIOD	HAUL	EACH	LOSS	END-OF-PERIOD	PERIOD	HAUL	EACH	LOSS	CUMUL
NO. DA	ORIGIN	PERIOD	HAUL	EACH	LOSS	END-OF-PERIOD	PERIOD	HAUL	EACH	LOSS	CUMUL

SUM 25.57 23.25 2.32 154100.

(650.) (591.) (59.) (4365.49)

6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
3092.	1062.	534.	153720.
88.	30.	15.	4353.
15.14	20.80	20.91	20.91
384.51	528.34	531.01	531.01
1533.	2107.	2117.	2117.
1891.	2599.	2612.	2612.

PMF

6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
618.	212.	107.	30744.
18.	6.	3.	871.
3.03	4.16	4.16	4.16
76.90	105.67	106.20	106.20
307.	421.	423.	423.
378.	520.	522.	522.

0.3 PMF

6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
978.	319.	160.	4616.
26.	9.	5.	1306.
4.54	6.24	6.27	6.27
115.35	158.50	159.30	159.30
460.	632.	635.	635.
567.	780.	784.	784.

0.3 PMF

6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
1237.	425.	213.	61408.
35.	12.	6.	1741.
6.06	8.32	8.36	8.36
153.80	211.33	212.40	212.40
613.	843.	847.	847.
756.	1039.	1045.	1045.

0.1 PMF

RESERVOIR
INFLOW
HYDROGRAPHS

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM No. 4
 BY WTS DATE 12-21-79 PROJ. NO. 79-203-512
 CHKD. BY DLB DATE 12-22-79 SHEET NO. C OF M



RESERVOIR
 INFLOW
 HYDROGRAPH

0.5 PMF

TIME	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
PEAK	1546.	531.	267.	20600.
CFS	44.	15.	8.	2176.
INCHES	7.57	10.40	10.45	10.45
MM	197.25	263.17	265.50	265.50
AC-FT	767.	1053.	1054.	1054.
THOUS CU M	946.	1299.	1300.	1300.

HYDROGRAPH ROUTING

ROUT THROUGH RESERVOIR

TIME	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
PEAK	1546.	531.	267.	20600.
CFS	44.	15.	8.	2176.
INCHES	7.57	10.40	10.45	10.45
MM	197.25	263.17	265.50	265.50
AC-FT	767.	1053.	1054.	1054.
THOUS CU M	946.	1299.	1300.	1300.

TIME	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
PEAK	1546.	531.	267.	20600.
CFS	44.	15.	8.	2176.
INCHES	7.57	10.40	10.45	10.45
MM	197.25	263.17	265.50	265.50
AC-FT	767.	1053.	1054.	1054.
THOUS CU M	946.	1299.	1300.	1300.

PEAK INFLOW IS 4098. AT TIME 42.00 HOURS

RESERVOIR
 OUTFLOW
 HYDROGRAPH

PMF

TIME	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
PEAK	3091.	1081.	523.	150502.
CFS	88.	29.	15.	4262.
INCHES	15.13	20.38	20.47	20.47
MM	384.35	517.72	519.89	519.89
AC-FT	1533.	2073.	2073.	2073.
THOUS CU M	1890.	2546.	2557.	2557.



GRI
CONSULTANTS, INC.

IN addition to out. AP time. 42.33 HOURS

ITEM	WEEK	24-HOUR	72-HOUR	TOTAL
WATER	613.	204.	103.	29546.
GAS	23.	6.	3.	137.
INCHES	3.00	4.00	4.02	4.02
ACFT	16.19	101.64	102.07	102.07
THROUS	304.	405.	407.	407.
40 M	175.	500.	502.	502.

EA OFFICE IS 1220. AT TIME 42.17 HOURS

	PEAK	0-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUMF
C ₂ S	1220.	971.	308.	155.		44601.
C ₃ S	35.	26.	9.	4.		1263.
INCEN		4.51	6.04	6.07		6.07
M4		114.49	152.42	154.07		154.07
AT-FI		457.	617.	614.		614.
THUS LU H		563.	755.	758.		758.

at collection is 16 to. At 112. 42.00 mms

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CF ₃	1636.	1730.	413.	207.	5966.	
CH ₃	46.	35.	1.	6.	1690.	
CHCl ₃			8.08	8.12	8.12	
NH		152.94	205.31	206.18	206.18	
AL-F1		610.	819.	822.	822.	
H ₂ O		752.	1010.	1014.	1014.	

DATE RECEIVED IS 2049. AT 11:42. 42.00 HOURS

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CF ₃	15.36	517.	760.	14773.
CF ₂	50.	44.	7.	2117.
CF	7.53	10.13	10.17	10.17
CH ₂	191.41	457.21	258.29	258.29
CH	76.4	1026.	1030.	1030.
ACET	941.	1267.	1270.	1270.

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HYOKU, ARI KUTING,

QUARTER FROM DAWN TO SECTION 2. 5/00 F I D.S. 117 DAM

[illegible]

SUBJECT DAM SAFETY INSPECTION

TROUT RUN DAM NO. 4

BY DS DATE 12-21-79 PROJ. NO. 79-203-512

CHKD. BY DLB DATE 12-21-79 SHEET NO. E OF M



Engineers • Geologists • Planners
Environmental Specialists

ANNUAL DEPT. CHANNEL, KULIN,

[illegible]

CONTRACT HOLDING

[illegible]

—continued on inside back cover—

DATE	DESCRIPTION	DEBIT	CREDIT	BALANCE
1900	TO BALANCE			100.00
1901	BY SALES		100.00	200.00
1902	TO PURCHASES	100.00		100.00
1903	BY SALES		100.00	200.00
1904	TO PURCHASES	100.00		100.00
1905	BY SALES		100.00	200.00
1906	TO PURCHASES	100.00		100.00
1907	BY SALES		100.00	200.00
1908	TO PURCHASES	100.00		100.00
1909	BY SALES		100.00	200.00
1910	TO PURCHASES	100.00		100.00
1911	BY SALES		100.00	200.00
1912	TO PURCHASES	100.00		100.00
1913	BY SALES		100.00	200.00
1914	TO PURCHASES	100.00		100.00
1915	BY SALES		100.00	200.00
1916	TO PURCHASES	100.00		100.00
1917	BY SALES		100.00	200.00
1918	TO PURCHASES	100.00		100.00
1919	BY SALES		100.00	200.00
1920	TO PURCHASES	100.00		100.00
1921	BY SALES		100.00	200.00
1922	TO PURCHASES	100.00		100.00
1923	BY SALES		100.00	200.00
1924	TO PURCHASES	100.00		100.00
1925	BY SALES		100.00	200.00
1926	TO PURCHASES	100.00		100.00
1927	BY SALES		100.00	200.00
1928	TO PURCHASES	100.00		100.00
1929	BY SALES		100.00	200.00
1930	TO PURCHASES	100.00		100.00
1931	BY SALES		100.00	200.00
1932	TO PURCHASES	100.00		100.00
1933	BY SALES		100.00	200.00
1934	TO PURCHASES	100.00		100.00
1935	BY SALES		100.00	200.00
1936	TO PURCHASES	100.00		100.00
1937	BY SALES		100.00	200.00
1938	TO PURCHASES	100.00		100.00
1939	BY SALES		100.00	200.00
1940	TO PURCHASES	100.00		100.00
1941	BY SALES		100.00	200.00
1942	TO PURCHASES	100.00		100.00
1943	BY SALES		100.00	200.00
1944	TO PURCHASES	100.00		100.00
1945	BY SALES		100.00	200.00
1946	TO PURCHASES	100.00		100.00
1947	BY SALES		100.00	200.00
1948	TO PURCHASES	100.00		100.00
1949	BY SALES		100.00	200.00
1950	TO PURCHASES	100.00		100.00
1951	BY SALES		100.00	200.00
1952	TO PURCHASES	100.00		100.00
1953	BY SALES		100.00	200.00
1954	TO PURCHASES	100.00		100.00
1955	BY SALES		100.00	200.00
1956	TO PURCHASES	100.00		100.00
1957	BY SALES		100.00	200.00
1958	TO PURCHASES	100.00		100.00
1959	BY SALES		100.00	200.00
1960	TO PURCHASES	100.00		100.00
1961	BY SALES		100.00	200.00
1962	TO PURCHASES	100.00		100.00
1963	BY SALES		100.00	200.00
1964	TO PURCHASES	100.00		100.00
1965	BY SALES		100.00	200.00
1966	TO PURCHASES	100.00		100.00
1967	BY SALES		100.00	200.00
1968	TO PURCHASES	100.00		100.00
1969	BY SALES		100.00	200.00
1970	TO PURCHASES	100.00		100.00
1971	BY SALES		100.00	200.00
1972	TO PURCHASES	100.00		100.00

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DTG DATE 12-21-79 PROJ. NO. 79-203-513
 CHKD. BY DLB DATE 12-22-79 SHEET NO. F OF M



Engineers • Geologists • Planners
 Environmental Specialists

STORAGE 0.00 1.24 2.49 3.73 4.98 6.22 7.46 8.70 9.94 11.18 12.42 13.66 14.90 16.14 17.38 18.62 19.86 21.10 22.34 23.58 24.82 26.06 27.30 28.54 29.78 31.02 32.26 33.50 34.74 35.98 37.22 38.46 39.70 40.94 42.18 43.42 44.66 45.90 47.14 48.38 49.62 50.86 52.10 53.34 54.58 55.82 57.06 58.30 59.54 60.78 62.02 63.26 64.50 65.74 66.98 68.22 69.46 70.70 71.94 73.18 74.42 75.66 76.90 78.14 79.38 80.62 81.86 83.10 84.34 85.58 86.82 88.06 89.30 90.54 91.78 93.02 94.26 95.50 96.74 97.98 99.22 100.46 101.70 102.94 104.18 105.42 106.66 107.90 109.14 110.38 111.62 112.86 114.10 115.34 116.58 117.82 119.06 120.30 121.54 122.78 124.02 125.26 126.50 127.74 128.98 130.22 131.46 132.70 133.94 135.18 136.42 137.66 138.90 140.14 141.38 142.62 143.86 145.10 146.34 147.58 148.82 150.06 151.30 152.54 153.78 155.02 156.26 157.50 158.74 159.98 161.22 162.46 163.70 164.94 166.18 167.42 168.66 169.90 171.14 172.38 173.62 174.86 176.10 177.34 178.58 179.82 181.06 182.30 183.54 184.78 186.02 187.26 188.50 189.74 190.98 192.22 193.46 194.70 195.94 197.18 198.42 199.66 200.90 202.14 203.38 204.62 205.86 207.10 208.34 209.58 210.82 212.06 213.30 214.54 215.78 217.02 218.26 219.50 220.74 221.98 223.22 224.46 225.70 226.94 228.18 229.42 230.66 231.90 233.14 234.38 235.62 236.86 238.10 239.34 240.58 241.82 243.06 244.30 245.54 246.78 248.02 249.26 250.50 251.74 252.98 254.22 255.46 256.70 257.94 259.18 260.42 261.66 262.90 264.14 265.38 266.62 267.86 269.10 270.34 271.58 272.82 274.06 275.30 276.54 277.78 279.02 280.26 281.50 282.74 283.98 285.22 286.46 287.70 288.94 290.18 291.42 292.66 293.90 295.14 296.38 297.62 298.86 300.10 301.34 302.58 303.82 305.06 306.30 307.54 308.78 310.02 311.26 312.50 313.74 314.98 316.22 317.46 318.70 319.94 321.18 322.42 323.66 324.90 326.14 327.38 328.62 329.86 331.10 332.34 333.58 334.82 336.06 337.30 338.54 339.78 341.02 342.26 343.50 344.74 345.98 347.22 348.46 349.70 350.94 352.18 353.42 354.66 355.90 357.14 358.38 359.62 360.86 362.10 363.34 364.58 365.82 367.06 368.30 369.54 370.78 372.02 373.26 374.50 375.74 376.98 378.22 379.46 380.70 381.94 383.18 384.42 385.66 386.90 388.14 389.38 390.62 391.86 393.10 394.34 395.58 396.82 398.06 399.30 400.54 401.78 403.02 404.26 405.50 406.74 407.98 409.22 410.46 411.70 412.94 414.18 415.42 416.66 417.90 419.14 420.38 421.62 422.86 424.10 425.34 426.58 427.82 429.06 430.30 431.54 432.78 434.02 435.26 436.50 437.74 438.98 440.22 441.46 442.70 443.94 445.18 446.42 447.66 448.90 450.14 451.38 452.62 453.86 455.10 456.34 457.58 458.82 460.06 461.30 462.54 463.78 465.02 466.26 467.50 468.74 469.98 471.22 472.46 473.70 474.94 476.18 477.42 478.66 479.90 481.14 482.38 483.62 484.86 486.10 487.34 488.58 489.82 491.06 492.30 493.54 494.78 496.02 497.26 498.50 499.74 500.98 502.22 503.46 504.70 505.94 507.18 508.42 509.66 510.90 512.14 513.38 514.62 515.86 517.10 518.34 519.58 520.82 522.06 523.30 524.54 525.78 527.02 528.26 529.50 530.74 531.98 533.22 534.46 535.70 536.94 538.18 539.42 540.66 541.90 543.14 544.38 545.62 546.86 548.10 549.34 550.58 551.82 553.06 554.30 555.54 556.78 558.02 559.26 560.50 561.74 562.98 564.22 565.46 566.70 567.94 569.18 570.42 571.66 572.90 574.14 575.38 576.62 577.86 579.10 580.34 581.58 582.82 584.06 585.30 586.54 587.78 589.02 590.26 591.50 592.74 593.98 595.22 596.46 597.70 598.94 600.18 601.42 602.66 603.90 605.14 606.38 607.62 608.86 610.10 611.34 612.58 613.82 615.06 616.30 617.54 618.78 620.02 621.26 622.50 623.74 624.98 626.22 627.46 628.70 629.94 631.18 632.42 633.66 634.90 636.14 637.38 638.62 639.86 641.10 642.34 643.58 644.82 646.06 647.30 648.54 649.78 651.02 652.26 653.50 654.74 655.98 657.22 658.46 659.70 660.94 662.18 663.42 664.66 665.90 667.14 668.38 669.62 670.86 672.10 673.34 674.58 675.82 677.06 678.30 679.54 680.78 682.02 683.26 684.50 685.74 686.98 688.22 689.46 690.70 691.94 693.18 694.42 695.66 696.90 698.14 699.38 700.62 701.86 703.10 704.34 705.58 706.82 708.06 709.30 710.54 711.78 713.02 714.26 715.50 716.74 717.98 719.22 720.46 721.70 722.94 724.18 725.42 726.66 727.90 729.14 730.38 731.62 732.86 734.10 735.34 736.58 737.82 739.06 740.30 741.54 742.78 744.02 745.26 746.50 747.74 748.98 750.22 751.46 752.70 753.94 755.18 756.42 757.66 758.90 760.14 761.38 762.62 763.86 765.10 766.34 767.58 768.82 770.06 771.30 772.54 773.78 775.02 776.26 777.50 778.74 779.98 781.22 782.46 783.70 784.94 786.18 787.42 788.66 789.90 791.14 792.38 793.62 794.86 796.10 797.34 798.58 799.82 801.06 802.30 803.54 804.78 806.02 807.26 808.50 809.74 810.98 812.22 813.46 814.70 815.94 817.18 818.42 819.66 820.90 822.14 823.38 824.62 825.86 827.10 828.34 829.58 830.82 832.06 833.30 834.54 835.78 837.02 838.26 839.50 840.74 841.98 843.22 844.46 845.70 846.94 848.18 849.42 850.66 851.90 853.14 854.38 855.62 856.86 858.10 859.34 860.58 861.82 863.06 864.30 865.54 866.78 868.02 869.26 870.50 871.74 872.98 874.22 875.46 876.70 877.94 879.18 880.42 881.66 882.90 884.14 885.38 886.62 887.86 889.10 890.34 891.58 892.82 894.06 895.30 896.54 897.78 899.02 900.26 901.50 902.74 903.98 905.22 906.46 907.70 908.94 910.18 911.42 912.66 913.90 915.14 916.38 917.62 918.86 920.10 921.34 922.58 923.82 925.06 926.30 927.54 928.78 930.02 931.26 932.50 933.74 934.98 936.22 937.46 938.70 939.94 941.18 942.42 943.66 944.90 946.14 947.38 948.62 949.86 951.10 952.34 953.58 954.82 956.06 957.30 958.54 959.78 961.02 962.26 963.50 964.74 965.98 967.22 968.46 969.70 970.94 972.18 973.42 974.66 975.90 977.14 978.38 979.62 980.86 982.10 983.34 984.58 985.82 987.06 988.30 989.54 990.78 992.02 993.26 994.50 995.74 996.98 998.22 999.46 1000.70 1001.94 1003.18 1004.42 1005.66 1006.90 1008.14 1009.38 1010.62 1011.86 1013.10 1014.34 1015.58 1016.82 1018.06 1019.30 1020.54 1021.78 1023.02 1024.26 1025.50 1026.74 1027.98 1029.22 1030.46 1031.70 1032.94 1034.18 1035.42 1036.66 1037.90 1039.14 1040.38 1041.62 1042.86 1044.10 1045.34 1046.58 1047.82 1049.06 1050.30 1051.54 1052.78 1054.02 1055.26 1056.50 1057.74 1058.98 1060.22 1061.46 1062.70 1063.94 1065.18 1066.42 1067.66 1068.90 1070.14 1071.38 1072.62 1073.86 1075.10 1076.34 1077.58 1078.82 1080.06 1081.30 1082.54 1083.78 1085.02 1086.26 1087.50 1088.74 1089.98 1091.22 1092.46 1093.70 1094.94 1096.18 1097.42 1098.66 1099.90 1101.14 1102.38 1103.62 1104.86 1106.10 1107.34 1108.58 1109.82 1111.06 1112.30 1113.54 1114.78 1116.02 1117.26 1118.50 1119.74 1120.98 1122.22 1123.46 1124.70 1125.94 1127.18 1128.42 1129.66 1130.90 1132.14 1133.38 1134.62 1135.86 1137.10 1138.34 1139.58 1140.82 1142.06 1143.30 1144.54 1145.78 1147.02 1148.26 1149.50 1150.74 1151.98 1153.22 1154.46 1155.70 1156.94 1158.18 1159.42 1160.66 1161.90 1163.14 1164.38 1165.62 1166.86 1168.10 1169.34 1170.58 1171.82 1173.06 1174.30 1175.54 1176.78 1178.02 1179.26 1180.50 1181.74 1182.98 1184.22 1185.46 1186.70 1187.94 1189.18 1190.42 1191.66 1192.90 1194.14 1195.38 1196.62 1197.86 1199.10 1200.34 1201.58 1202.82 1204.06 1205.30 1206.54 1207.78 1209.02 1210.26 1211.50 1212.74 1213.98 1215.22 1216.46 1217.70 1218.94 1220.18 1221.42 1222.66 1223.90 1225.14 1226.38 1227.62 1228.86 1230.10 1231.34 1232.58 1233.82 1235.06 1236.30 1237.54 1238.78 1240.02 1241.26 1242.50 1243.74 1244.98 1246.22 1247.46 1248.70 1249.94 1251.18 1252.42 1253.66 1254.90 1256.14 1257.38 1258.62 1259.86 1261.10 1262.34 1263.58 1264.82 1266.06 1267.30 1268.54 1269.78 1271.02 1272.26 1273.50 1274.74 1275.98 1277.22 1278.46 1279.70 1280.94 1282.18 1283.42 1284.66 1285.90 1287.14 1288.38 1289.62 1290.86 1292.10 1293.34 1294.58 1295.82 1297.06 1298.30 1299.54 1300.78 1302.02 1303.26 1304.50 1305.74 1306.98 1308.22 1309.46 1310.70 1311.94 1313.18 1314.42 1315.66 1316.90 1318.14 1319.38 1320.62 1321.86 1323.10 1324.34 1325.58 1326.82 1328.06 1329.30 1330.54 1331.78 1333.02 1334.26 1335.50 1336.74 1337.98 1339.22 1340.46 1341.70 1342.94 1344.18 1345.42 1346.66 1347.90 1349.14 1350.38 1351.62 1352.86 1354.10 1355.34 1356.58 1357.82 1359.06 1360.30 1361.54 1362.78 1364.02 1365.26 1366.50 1367.74 1368.98 1370.22 1371.46 1372.70 1373.94 1375.18 1376.42 1377.66 1378.90 1380.14 1381.38 1382.62 1383.86 1385.10 1386.34 1387.58 1388.82 1390.06 1391.30 1392.54 1393.78 1395.02 1396.26 1397.50 1398.74 1399.98 1401.22 1402.46 1403.70 1404.94 1406.18 1407.42 1408.66 1409.90 1411.14 1412.38 1413.62 1414.86 1416.10 1417.34 1418.58 1419.82 1421.06 1422.30 1423.54 1424.78 1426.02 1427.26 1428.50 1429.74 1430.98 1432.22 1433.46 1434.70 1435.94 1437.18 1438.42 1439.66 1440.90 1442.14 1443.38 1444.62 1445.86 1447.10 1448.34 1449.58 1450.82 1452.06 1453.30 1454.54 1455.78 1457.02 1458.26 1459.50 1460.74 1461.98 1463.22 1464.46 1465.70 1466.94 1468.18 1469.42 1470.66 1471.90 1473.14 1474.38 1475.62 1476.86 1478.10 1479.34 1480.58 1481.82 1483.06 1484.30 1485.54 1486.78 1488.02 1489.26 1490.50 1491.74 1492.98 1494.22 1495.46 1496.70 1497.94 1499.18 1500.42 1501.66 1502.90 1504.14 1505.38 1506.62 1507.86 1509.10 1510.34 1511.58 1512.82 1514.06 1515.30 1516.54 1517.78 1519.02 1520.26 1521.50 1522.74 1523.98 1525.22 1526.46 1527.70 1528.94 1530.18 1531.42 1532.66 1533.90 1535.14 1536.38 1537.62 1538.86 1540.10 1541.34 1542.58 1543.82 1545.06 1546.30 1547.54 1548.78 1550.02 1551.26 1552.50 1553.74 1554.98 1556.22 1557.46 1558.70 1559.94 1561.18 1562.42 1563.66 1564.90 1566.14 1567.38 1568.62 1569.86 1571.10 1572.34 1573.58 1574.82 1576.06 1577.30 1578.54 1579.78 1581.02 1582.26 1583.50 1584.74 1585.98 1587.22 1588.46 1589.70 1590.94 1592.18 1593.42 1594.66 1595.90 1597.14 1598.38 1599.62 1600.86 1602.10 1603.34 1604.58 1605.82 1607.06 1608.30 1609.54 1610.78 1612.02 1613.26 1614.50 1615.74 1616.98 1618.22 1619.46 1620.70 1621.94 1623.18 1624.42 1625.66 1626.90 1628.14 1629.38 1630.62 1631.86 1633.10 1634.34 1635.58 1636.82 1638.06 1639.30 1640.54 1641.78 1643.02 1644.26 1645.50 1646.74 1647.98 1649.22 1650.46 1651.70 1652.94 1654.18 1655.42 1656.66 1657.90 1659.14 1660.38 1661.62 1662.86 1664.10 1665.34 1666.58 1667.82 1669.06 1670.30 1671.54 1672.78 1674.02 1675.26 1676.50 1677.74 1678.98 1680.22 1681.46 1682.70 1683.94 1685.18 1686.42 1687.66 1688.90 1690.14 1691.38 1692.62 1693.86 1695.10 1696.34 1697.58 1698.82 1699.06 1700.30 1701.54 1702.78 1704.02 1705.26 1706.50 1707.74 1708.98 1710.22 1711.46 1712.70 1713.94 1715.18 1716.42 1717.66 1718.90 1720.14 1721.38 1722.62 1723.86 1725.10 1726.34 1727.58 1728.82 1730.06 1731.30 1732.54 1733.78 1735.02 1736.26 1737.50 1738.74 1739.98 1741.22 1742.46 1743.70 1744.94 1746.18 1747.42 1748.66 1749.90 1751.14 1752.38 1753.62 1754.86 1756.10 1757.34 1758.58 1759.82 1761.06 1762.30 1763.54 1764.78 1766.02 1767.26 1768.50 1769.74 1770.98 1772.22 1773.46 1774.70 1775.94 1777.18 1778.42 1779.66 1780.90 1782.14 1783.38 1784.62 1785.86 1787.10 1788.34 1789.58 1790.82 1792.06 1793.30 1794.54 1795.78 1797.02 1798.26 1799.50 1800.74 1801.98 1803.22 1804.46 1805.70 1806.94 1808.18 1809.42 1810.66 1811.90 1813.14 1814.38 1815.62 1816.86 1818.10 1819.34 1820.58 1821.82 1823.06 1824.30 1825.54 1826.78 1828.02 1829.26 1830.50 1831.74 1832.98 1834.22 1835.46 1836.70 1837.94 1839.18 1840.42 1841.66 1842.90 1844.14 1845.38 1846.62 1847.86 1849.10 1850.34 1851.58 1852.82 1854.06 1855.30 1856.54 1857.78 1859.02 1860.26 1861.50 1862.74 1863.98 1865.22 1866.46 1867.70 1868.94 1870.18 1871.42 1872.66 1873.90 1875.14 1876.38 1877.62 1878.86 1880.10 1881.34 1882.58 1883.82 1885.06 1886.30 1887.54 1888.78 1890.02 1891.26 1892.50 1893.74 1894.98 1896.22 1897.46 1898.70 1899.94 1901.18 1902.42 1903.66 1904.90 1906.14 1907.38 1908.62 1909.86 1911.10 1912.34 1913.58 1914.82 1916.06 1917.30 1918.54 1919.78 1921.02 1922.26 1923.50 1924.74 1925.98 1927.22 1928.46 1929.70 1930.94 1932.18 1933.42 1934.66 1935.90 1937.14 1938.38 1939.62 1940.86 1942.10 1943.34 1944.58 1945.82 1947.06 1948.30 1949.54 1950.78 1952.02 1953.26 1954.50 1955.74 1956.98 1958.22 1959.46 1960.70 1961.94 1963.18 1964.42 1965.66 1966.90 1968.14 1969.38 1970.62 1971.86 1973.10 1974.34 1975.58 1976.82 1978.06 1979.30 1980.54 1981.78 1983.02 1984.26 1985.50 1986.74 1987.98 1989.22 1990.46 1991.70 1992.94 1994.18 1995.42 1996.66 1997.90 1999.14 2000.38 2001.62 2002.86 2004.

SUBJECT DAM SAFETY INSPECTION

TROUT RUN DAM NO. 4

BY DJS DATE 12-21-79 PROJ. NO. 79-203-512

CHKD. BY DLB DATE 12-22-79 SHEET NO. 6 OF M



Engineers • Geologists • Planners
Environmental Specialists

HYDROGRAPH ROUTING

ROUTE FROM SECTION 4 TO SECTION 5: 9700 FT D.S. OF DAM

ISAD	ICUMP	IFCUM	ITAPE	IPRT	IPRT	INAME	ISTAGE	IAUTO
405	1	0	0	0	0	1	0	0
GLUSS	AVG	INES	ISAP	LOPI	IPMP		LSER	
0.0	0.000	0.00	1	0	0		0	
MSIPS	MSIDL	LAG	AMSK	A	FSK	SIUNA	ISPRAT	
1	0	0	0.000	0.000	0.000	-1.	0	

WATER DEPTH CHANNEL ROUTING

GL(1)	GL(2)	GL(3)	FL(1)	FL(2)	FL(3)	GL
0.000	0.000	0.000	0.000	0.000	0.000	0.000

CROSS SECTION COORDINATES--ELEVATION--FEET--P.C.

	0.00	50.00	600.00	300.00	640.00	330.00	630.00	370.00	630.00
STORAGE	0.00	0.94	19.91	39.87	66.22	99.55	134.66	166.57	240.26
100 FT LOW	0.00	419.08	511.51	585.30	650.45	716.96	814.83	894.05	974.63
STAGE	0.00	608.94	2632.69	6278.25	11842.95	19606.40	29033.14	42716.00	58675.90
FLOW	0.00	129756.95	167396.04	198235.17	237109.18	279191.34	324188.84	372119.61	427010.21
	0.00	640.21	642.42	644.63	646.84	649.05	651.26	653.47	655.68
	0.00	602.32	604.53	606.74	608.95	611.16	613.37	615.58	617.79
	0.00	608.94	2632.69	6278.25	11842.95	19606.40	29033.14	42716.00	58675.90
	100428.47	129756.95	167396.04	198235.17	237109.18	279191.34	324188.84	372119.61	427010.21



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SUMMARY OF DAM SAFETY ANALYSIS

RAILROAD UP PMT	MAXIMUM RESERVOIR ELEVATION 878.50 100. 0.	INITIAL VALUE 878.50 100. 0.	SPILLWAY CREST 878.50 100. 0.	TOP OF DAM 881.90 155. 1000.	TIME UP MAX DURATION HOURS	DURATION OVER TOP HOURS	MAXIMUM OUTFLOW CFS	MAXIMUM STORAGE AC-FT	MAXIMUM AT-B-I CFS	MAXIMUM DEFIN OVER DAM HOURS	TIME UP MAX DURATION HOURS	TIME UP FAILURE HOURS
.20	881.37	0.00	147.	155	1060	0.00	—	42.50	42.50	42.50	42.50	0.00
.27	881.90	—	157.	155	1060	0.00	—	42.50	42.50	42.50	42.50	0.00
.30	882.09	.19	157.	155	1060	0.00	—	42.50	42.50	42.50	42.50	0.00
.40	882.38	.48	162.	162.	1636.	3.83	42.17	710.7	710.7	42.17	42.17	0.00
.50	882.59	.69	166.	166.	2049.	5.00	42.17	711.5	711.5	42.17	42.17	0.00
.50	883.40	1.50	180.	180.	4098.	8.67	42.17	712.0	712.0	42.17	42.17	0.00
1.00								714.0	714.0	42.17	42.17	0.00

* INTERPOLATED VALUES; OVERTOPPING OCCURS AT APPROXIMATELY 0.27 PMF.

PLAN 1 STATION 102

SECTION @ 5700 FT
D.S. FROM DAM

PLAN 1 STATION 203

SECTION @ 7130 FT
D.S. FROM DAM

PLAN 1 STATION 304

SECTION @ 7580 FT
D.S. FROM DAM

PLAN 1 STATION 405

SECTION @ 9780 FT
D.S. FROM DAM

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DJS DATE 12-21-79 PROJ. NO. 79-223-S12
 CHKD. BY DLB DATE 12-22-79 SHEET NO. I OF M



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BREACHING ANALYSIS

(INPUT DATA IS SAME AS THAT FOR OVERTOPPING ANALYSIS
 WITH THE ADDITION OF THE BREACH DATA GIVEN HERE.)

DAM SAFETY INSPECTION
 TROUT RUN DAM # 4 ***** BREACHING ANALYSIS *****
 10-MINUTE TIME STEP AND 48 HOUR STORM DURATION

JOB SPECIFICATION									
NO	CHK	WHIN	UDAY	1HR	1MIN	WEINC	1PRT	NSIAN	
248	0	10	0	0	0	0	0	0	
			JUPER	5	0	0	0	0	
					0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
 PLAN# 5 NRIIDE 1 LRIIDE 1

ROUTE THROUGH RESERVOIR

HYDROGRAPH ROUTING

PLAN 1

DAM DATA			
LOPEL	CUMD	EXPD	DAMWID
881.9	0.0	0.0	0.

DAM BREACH DATA			
HRWID	Z	FLOW	IFAIL
0.	.50	853.50	.50
		878.50	881.90

STATION 101, PLAN 1, RATIO 1

PEAK DAM FAILURE AT 41.67 HOURS
 PEAK OUTFLOW IS 4158. AT TIME 42.17 HOURS

PLAN 2

DAM BREACH DATA			
HRWID	Z	FLOW	IFAIL
250.	3.00	853.50	.50
		878.50	881.90

STATION 101, PLAN 2, RATIO 1

PEAK DAM FAILURE AT 41.07 HOURS
 PEAK OUTFLOW IS 8997. AT TIME 41.89 HOURS

SUBJECT DAM SAFETY INSPECTION
TROUT RUN DAM NO. 4
 BY DJS DATE 12-21-79 PROJ. NO. 79-303-S12
 CHKD. BY DLB DATE 12-22-79 SHEET NO. J OF M



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DAM BREACH DATA
 Z ELEM IPAIL WSEL FAILED
 0. 50 853.50 4.00 878.50 881.90
 STATION 101. PLAN 3, RATIO 1

UPON DAM FAILURE AT 41.67 HOURS

PEAK OUTFLOW IS 1492. AT TIME 45.25 HOURS

PLAN ③

DAM BREACH DATA
 Z ELEM IPAIL WSEL FAILED
 250. 3.00 853.50 4.00 878.50 881.90
 STATION 101. PLAN 4, RATIO 1

UPON DAM FAILURE AT 41.67 HOURS

PEAK OUTFLOW IS 2153. AT TIME 42.25 HOURS

PLAN ④

DAM BREACH DATA
 Z ELEM IPAIL WSEL FAILED
 90. 1.00 853.50 2.00 878.50 881.90
 STATION 101. PLAN 5, RATIO 1

UPON DAM FAILURE AT 41.67 HOURS

PEAK OUTFLOW IS 2965. AT TIME 42.50 HOURS

PLAN ⑤

SUBJECT DAM SAFETY INSPECTION

TROUT RUN DAM NO. 4

BY DJS DATE 12-21-79 PROJ. NO. 79-303-512

CHKD. BY DLB DATE 12-22-79 SHEET NO. K OF M



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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .002 HOURS DURING BREACH FORMATION.
DOWNSPEAK CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSPEAK 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)
41.007	0.000	1114.	1114.	0.	0.	0.
41.708	.042	1302.	1257.	45.	45.	0.
41.750	.083	1489.	1434.	55.	101.	0.
41.792	.125	1677.	1620.	57.	158.	0.
41.833	.167	1865.	1865.	0.	158.	0.
41.875	.208	2053.	2050.	-3.	91.	0.
41.917	.250	2181.	2231.	-50.	41.	0.
41.958	.292	2339.	2376.	-37.	4.	0.
42.000	.333	2497.	2497.	0.	4.	0.
42.042	.375	2575.	2594.	-19.	-15.	-0.
42.083	.417	2653.	2673.	-20.	-35.	-0.
42.125	.458	2731.	2748.	-17.	-51.	-0.
42.167	.500	2810.	2810.	0.	-51.	-0.
42.208	.542	2884.	2865.	19.	-73.	-0.
42.250	.583	2912.	2912.	0.	-106.	-0.
42.292	.625	2947.	2932.	15.	-126.	-0.
42.333	.667	2956.	2947.	9.	-126.	-0.
42.375	.708	2956.	2956.	0.	-131.	-0.
42.417	.750	2956.	2961.	-5.	-136.	-0.
42.458	.792	2960.	2964.	-4.	-140.	-0.
42.500	.833	2965.	2965.	0.	-140.	-0.
42.542	.875	2874.	2964.	-90.	-230.	-1.
42.583	.917	2763.	2962.	-179.	-409.	-1.
42.625	.958	2692.	2764.	-72.	-481.	-2.
42.667	1.000	2601.	2601.	0.	-481.	-2.
42.708	1.042	2540.	2498.	42.	-440.	-2.
42.750	1.083	2479.	2431.	47.	-392.	-1.
42.792	1.125	2418.	2387.	31.	-362.	-1.
42.833	1.167	2357.	2357.	0.	-362.	-1.
42.875	1.208	2181.	2335.	-154.	-515.	-2.
42.917	1.250	2005.	2069.	-64.	-579.	-2.
42.958	1.292	1830.	1764.	65.	-513.	-2.
43.000	1.333	1654.	1654.	0.	-513.	-2.
43.042	1.375	1632.	1609.	23.	-490.	-2.
43.083	1.417	1609.	1587.	22.	-468.	-2.
43.125	1.458	1586.	1574.	12.	-455.	-2.
43.167	1.500	1564.	1564.	0.	-455.	-2.
43.208	1.542	1445.	1350.	95.	-160.	-1.
43.250	1.583	1327.	1096.	231.	71.	0.
43.292	1.625	1209.	1106.	103.	174.	1.
43.333	1.667	1090.	1090.	0.	174.	1.
43.375	1.708	1042.	1044.	-2.	174.	1.
43.417	1.750	1014.	1014.	0.	170.	1.
43.458	1.792	1065.	1065.	0.	170.	1.
43.500	1.833	1056.	1056.	0.	170.	1.
43.542	1.875	1047.	1047.	0.	164.	1.
43.583	1.917	1031.	1031.	0.	164.	1.
43.625	1.958	1028.	1028.	0.	164.	1.
43.667	2.000	1018.	1018.	0.	164.	1.

PLAN
⑤

PROJECT DAM SAFETY INSPECTION

TROUT RUN DAM A/C 4

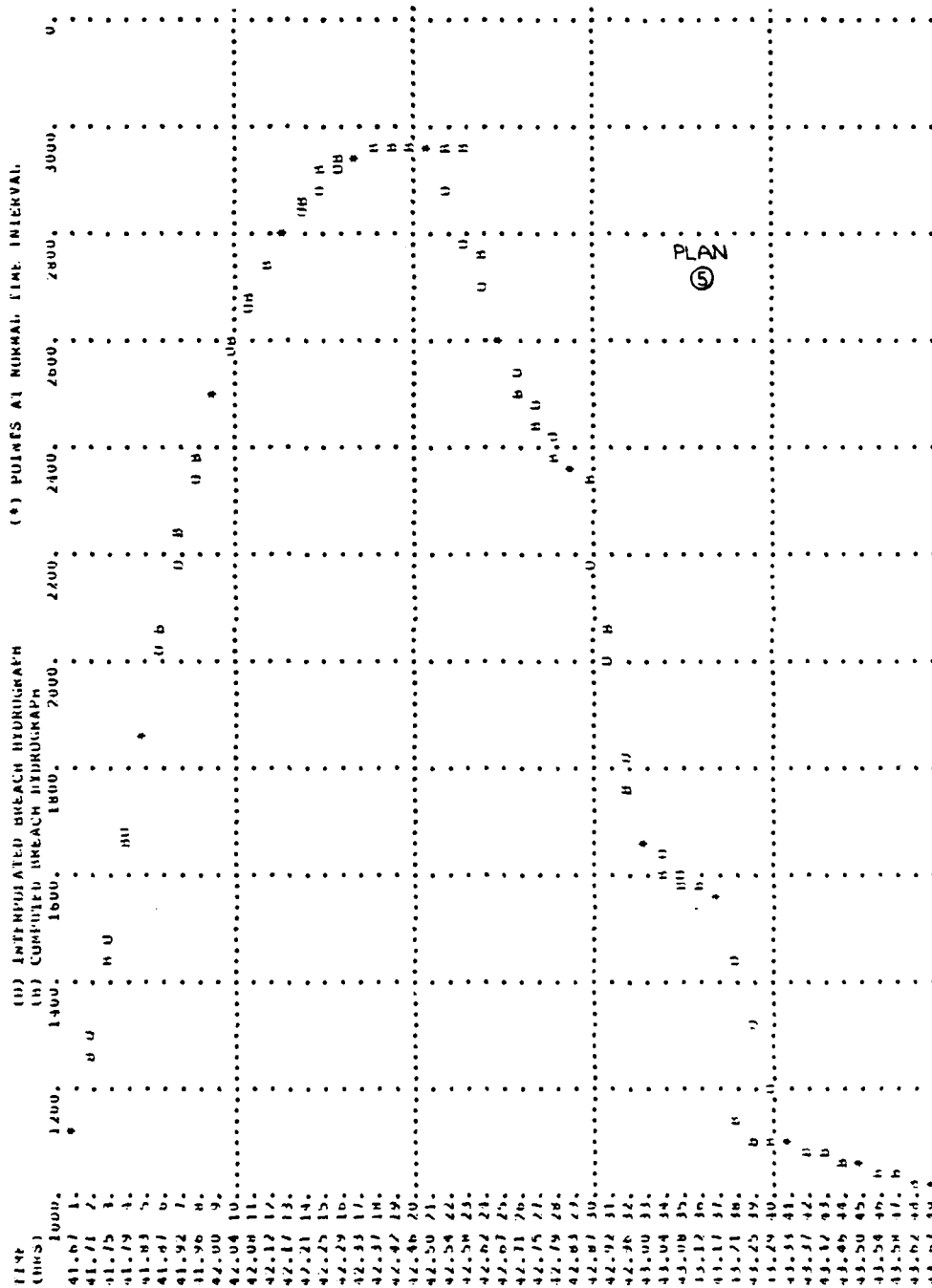
BY DJS DATE 12-31-79 PROJ. NO. 79-203-512

CHKD. BY DLB DATE 12-22-79 SHEET NO. L OF M



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Environmental Specialists

STATION 101



SUBJECT DAM SAFETY INSPECTION

TROUT RUN DAM NO. 4

BY DJS DATE 12-21-77 PROJ. NO. 79-303-S12

CHKD. BY DLB DATE 12-22-79 SHEET NO. M OF M



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Environmental Specialists

SUMMARY OF DAM SAFETY ANALYSIS

		ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
		STORAGE	878.50	878.50	881.90
		OUTFLOW	108.	108.	155.
			0.	0.	1060.

PLAN	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
①	.29	881.99	.09	156.	4158.	.34	42.17	41.67
②	.29	881.97	.07	156.	9449.	.19	41.89	41.67
③	.29	882.04	.14	157.	1492.	1.08	45.25	41.67
④	.29	881.97	.07	156.	2153.	.25	42.25	41.67
⑤	.29	881.97	.07	156.	2965.	.25	42.50	41.67

STATION 304

PLAN	RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
①	.29	3549.	661.0	42.33
②	.29	5623.	662.5	42.00
③	.29	1484.	658.4	45.17
④	.29	2137.	659.5	42.33
⑤	.29	2928.	660.4	42.50

SECTION 4 @ 7580 FT
D.S. FROM DAM
(@ 1ST GROUP OF HOMES)

STATION 405

	RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
①	.29	3282	642.8	42.33
②	.29	4977.	643.8	42.17
③	.29	1480.	641.2	45.33
④	.29	2134.	641.9	42.50
⑤	.29	2890.	642.6	42.50

SECTION 5 @ 9780 FT
D.S. FROM DAM
(@ 2ND GROUP OF HOMES)

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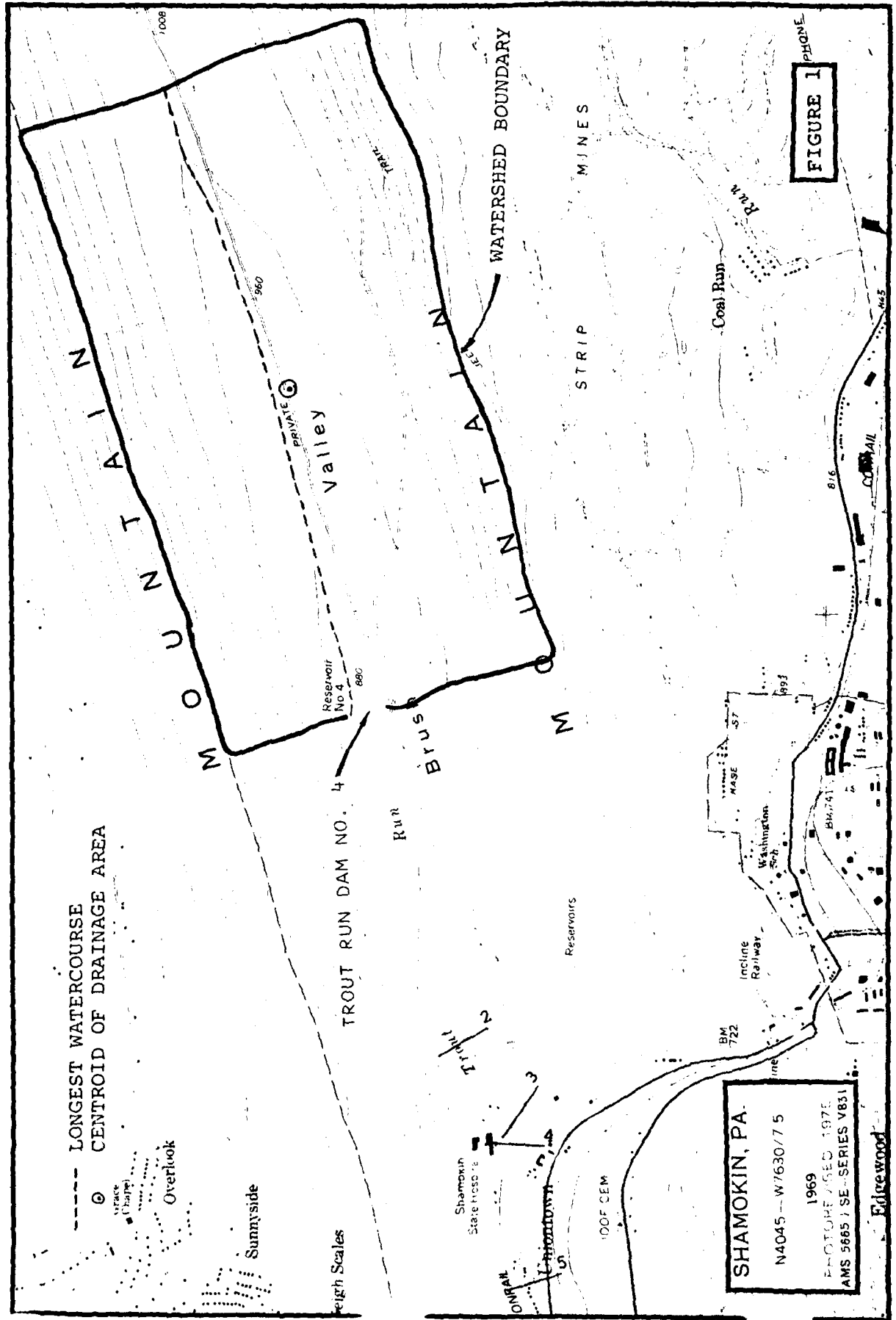
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13. Applied Hydraulics in Engineering, Morris, Henry M. and Wiggert, James N., Virginia Polytechnic Institute and State University, 2nd Edition, The Ronald Press Company, New York, 1972.
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15. Engineering Field Manual, U. S. Department of Agriculture, Soil Conservation Service, 2nd Edition, Washington, D. C. 1969.

APPENDIX E

FIGURES

LIST OF FIGURES

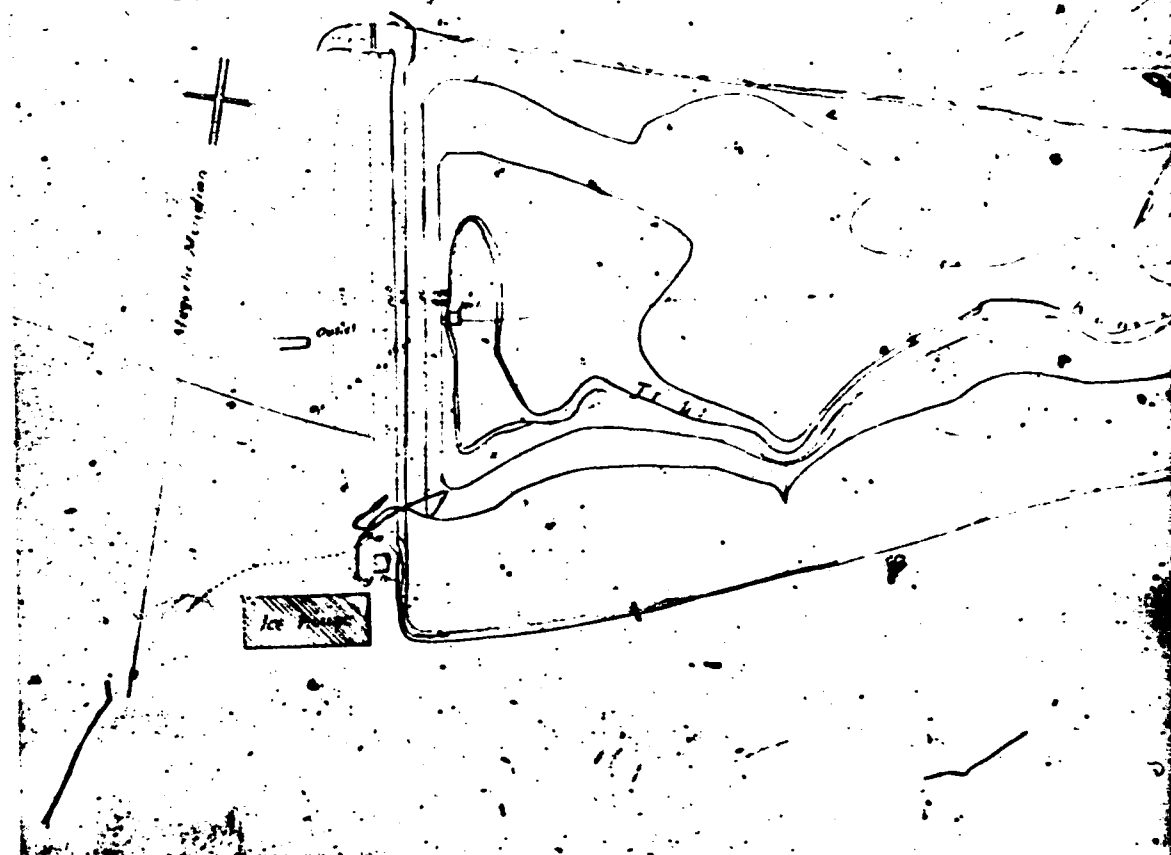
<u>Figure</u>	<u>Description/Title</u>
1	Regional Vicinity and Watershed Boundary Map
2	Plan of Reservoir
3	Spillway Plan, Sections, and Details (1977)
4	Spillway Plan (1916)
5	Plan of Dam and Cross Sections



SHAMOKIN

No. 1

August 10th 1894



SHAMOKIN WATER CO'S

No. 1 RESERVOIR

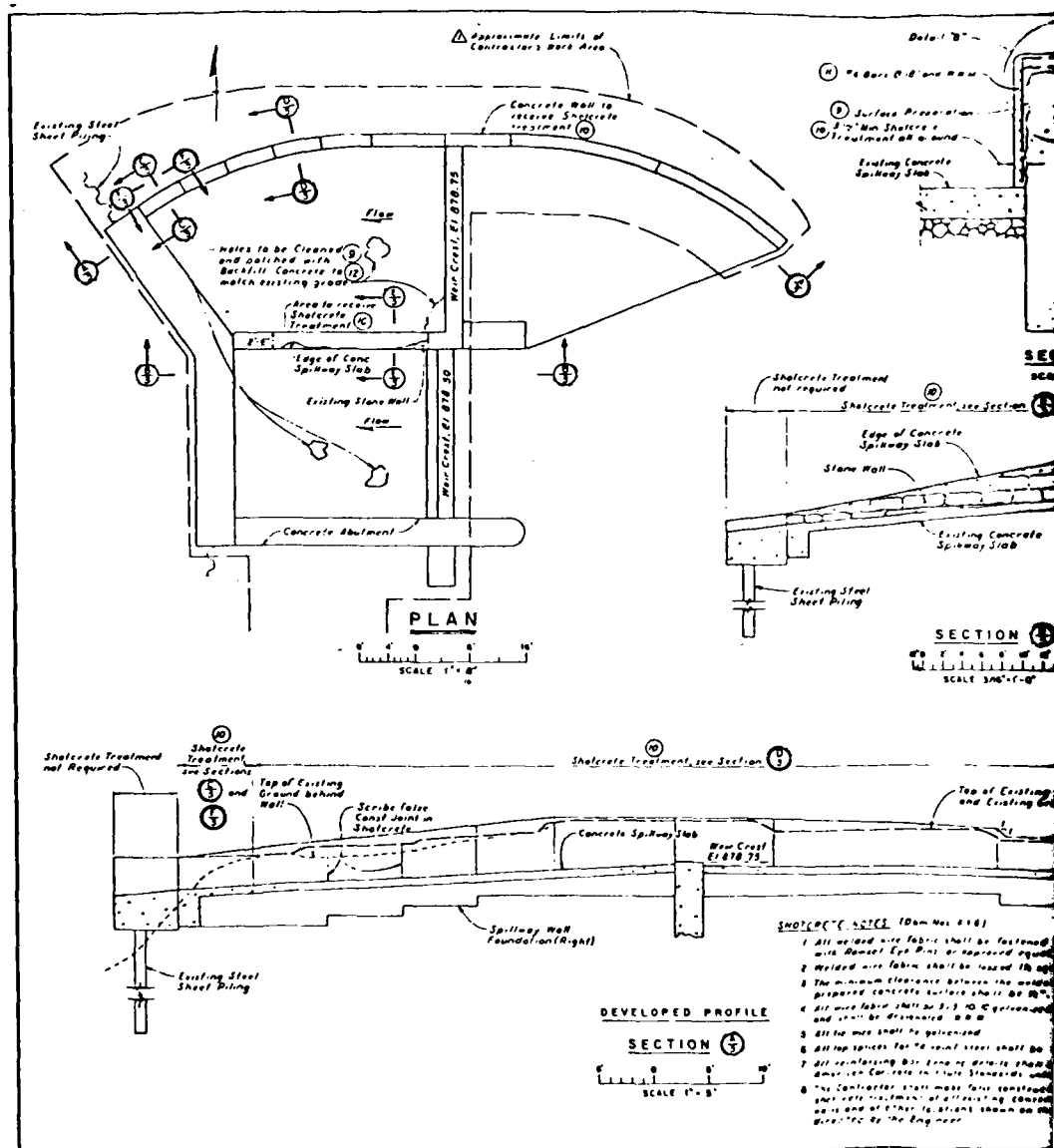
June 10, 1904

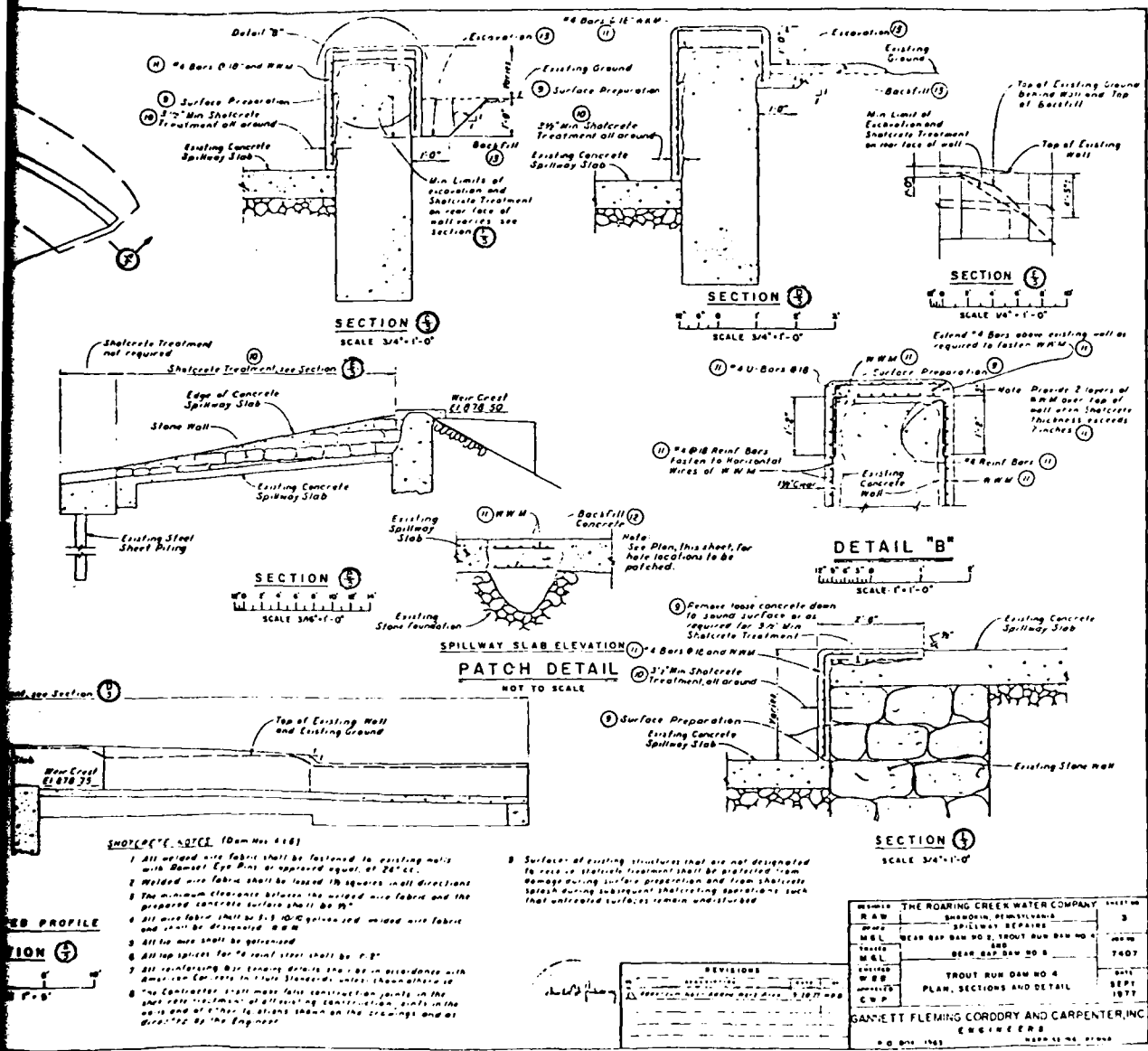
Scale 100 feet to the inch

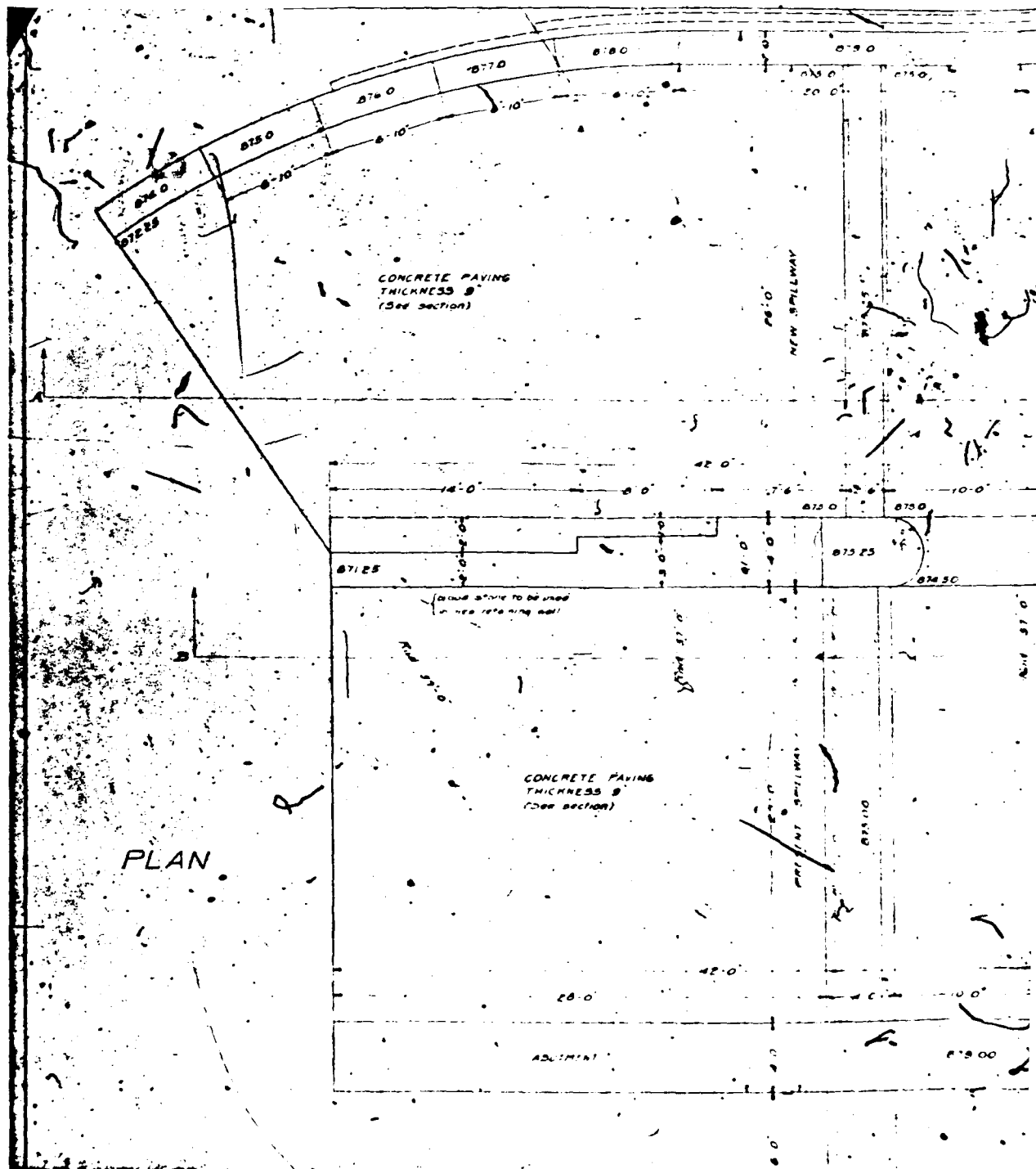


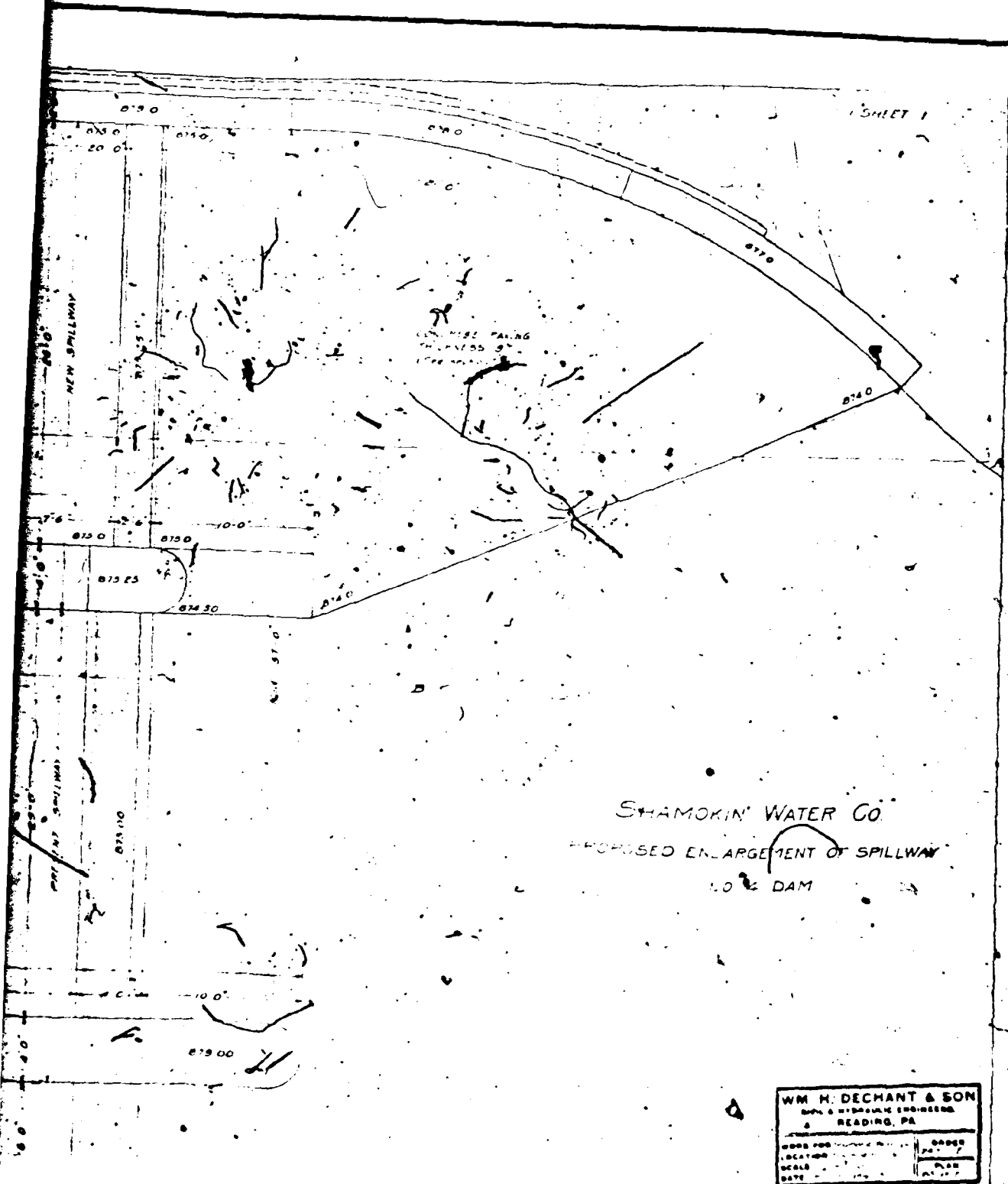
Capacity of Reservoir

45 ft. to top	1475267 Gallons of Water
50 ft. "	6437316 " "
55 ft. "	15596232 " "
60 ft. "	32289600 " "









SHAMOKIN' WATER CO.
 PROPOSED ENLARGEMENT OF SPILLWAY
 NO. 2 DAM

WM. H. DECHANT & SON	
CIVIL & HYDRAULIC ENGINEERS	
READING, PA.	
WORK FOR	DRAWN
LOCATION	DATE
SCALE	PLANS
DATE	

AD-A082 109

GAI CONSULTANTS INC MONROEVILLE PA

NATIONAL DAM INSPECTION PROGRAM. TROUT RUN DAM

JAN 80

NUMBER 4. (NDI N--ETC(U)

DACW31-80-C-0016

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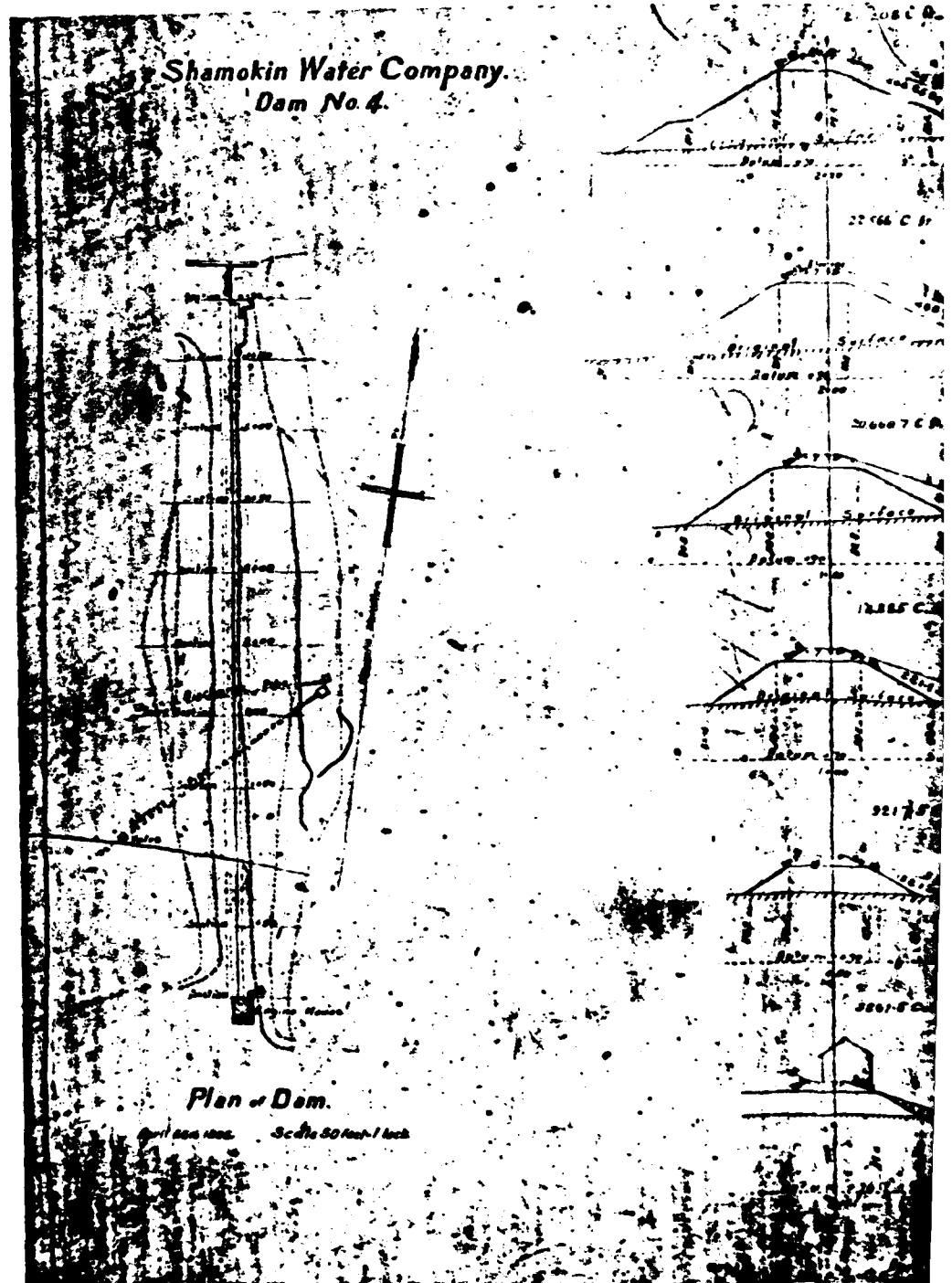
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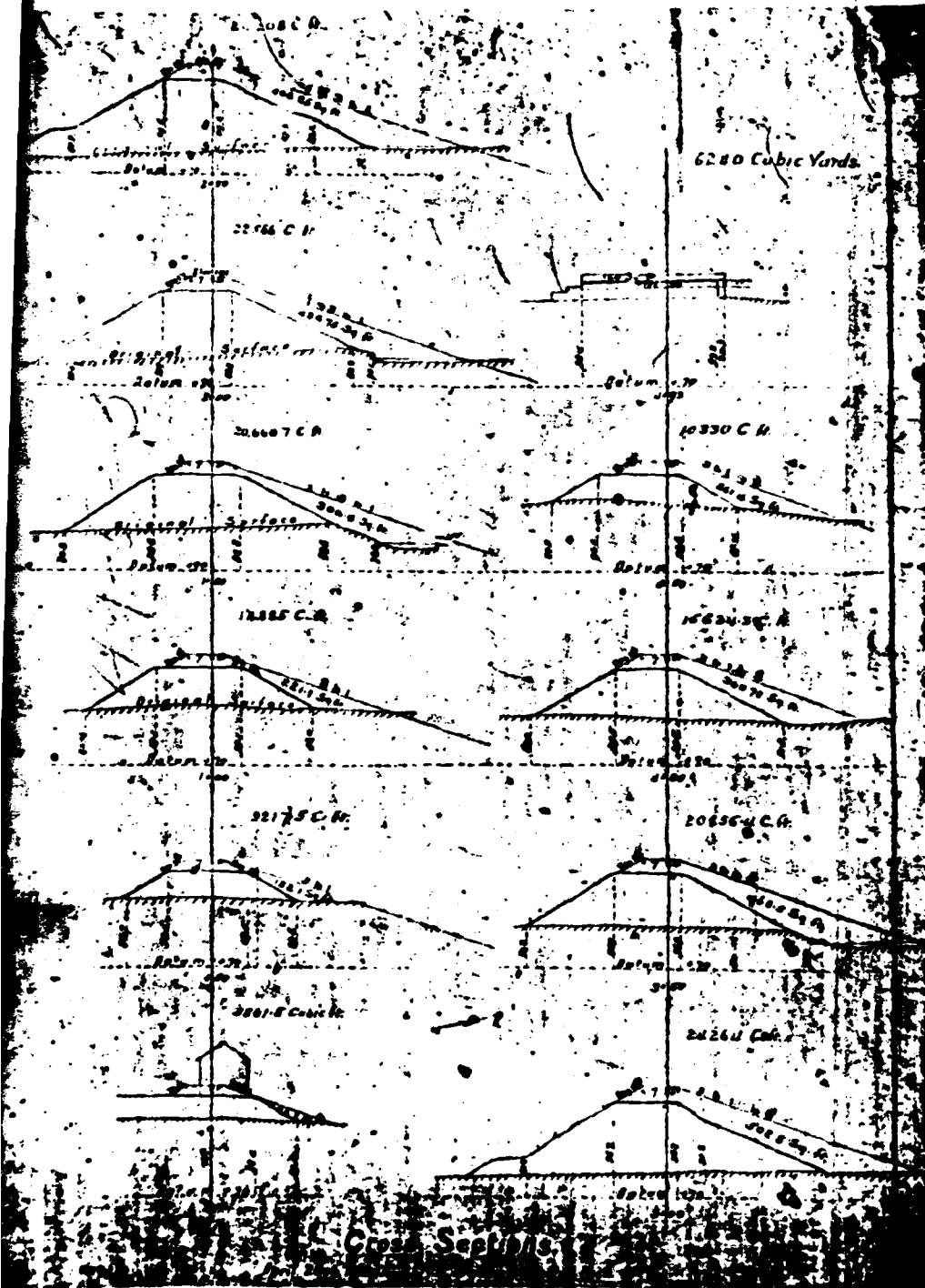
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DTIC

Shamokin Water Company.
Dam No. 4.





APPENDIX F

GEOLOGY

Geology

Trout Run Dam No. 4 is located in the Appalachian Mountain section of the Valley and Ridge Physiographic Province of Pennsylvania.

The dam is located on Trout Run in Brush Valley which is flanked on the north by Little Mountain and on the south by Big Mountain. The north flanking ridge rises 540 to 620 feet above the dam and reservoir, whereas the south flanking mountain rises 720 feet above the dam and reservoir.

Structurally, the site lies on the southeast flank of the Selinsgrove Anticlinorium, a broad structural feature trending in a southwest-northeast direction. Immediately south of the site over Big Mountain is the Western Middle Synclinorium containing the Pennsylvania age strata of the Western Middle Anthracite Coal Field. Intense tectonic forces from the southeast produced the many minor folds, flexures and faults typical of the region.

In the vicinity of the dam, the bedrock dips from the right abutment (north) to the left abutment (south) at approximately 35 to 40 degrees. A small, strike-slip fault has been noted on the crest of Little Mountain about 2,000 feet north of the reservoir. The bedrock immediately underlying the dam and reservoir consists of Mississippian age sandstone, siltstone, mudstone and shale, generally thin to medium bedded, very fine to medium grained with grayish-red

and reddish brown sandstone interbedded with similarly colored siltstone, mudstone and shale. Bedrock in Brush Valley is generally concealed by a thick soil mantle and vegetative growth.

Arndt, Harold, et. al., "Geologic Map of the South Half of the Shamokin Quadrangle, Northumberland and Columbia Counties, Pennsylvania," United States Geological Survey, Miscellaneous Geologic Investigations, Map 1-734, 1973.



PENNSYLVANIAN

Pop

*Brown or gray sandstones and shales with some conglomerate and numerous min-
eral congl.*

Pe

light gray to white, coarse grained sandstones and conglomerates with some minor coal; includes Sharp Mountain, Schuylkill, and Tumbling Run Formations.

Minc

Red shales with brown to greenish gray
sluggish sandstones, includes Treachier
Limestone in Fayette, Westmoreland, and
Somerset counties, Loganham Limestone
at the base in southwestern Pennsylvania.

159

predominantly gray, hard, massive, cross-bedded conglomerate and sandstone, with some shale, includes in the Appalachian Plateau Barren, Shinarump, "Cynops", Canebrake, Curry, and Kanab Formations, includes part of "Chugwa" of M. L. Potter in Potter and Trego counties.

UPPER

Dec

Chiefly red to brownish shales and sandstones, includes gray and greenish sandstone tongues named Elk Mountain, Howendale, Shokida, and Delaware River in the east.

Dm

Gray to olive brown shales, graywackes, and sandstones, contains "Chemung" beds and "Pottsville" beds including Hasket, Stralio, Harrell, and Trimmers Rock. Fully laminated at base.

Draw

Plumage to olive white with interbedded
minutemen which are dominant in places
(Montebello). Highly translucent in upper
part, contains "Centerfield coral bed" in
eastern Transylvania

A horizontal scale bar with markings at 0, 2, 4, 6, 8, and 10. The text "10 MILES" is at the right end.

CONSUL

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REFERENCE:

GEOLIC MAP OF PENNSYLVANIA PREPARED
 BY COMMONWEALTH OF PENNA. DEPT. OF INTERNAL
 AFFAIRS, DATED 1960, SCALE 1" = 4 MILES