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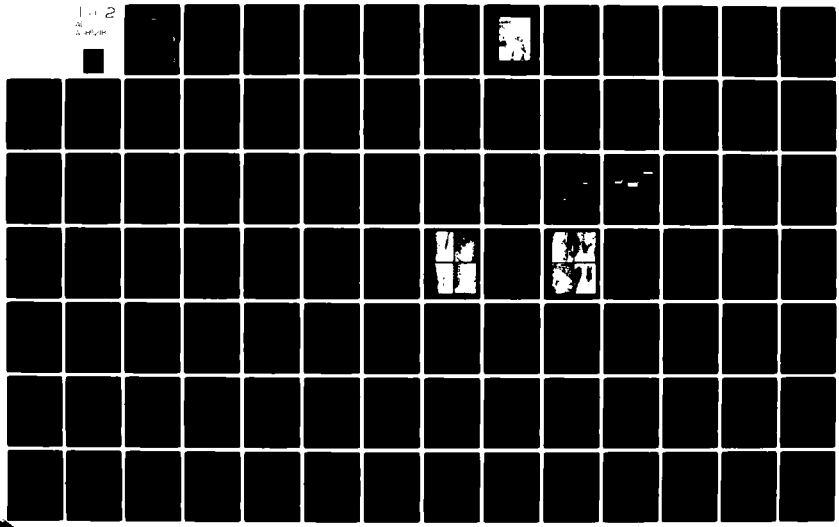

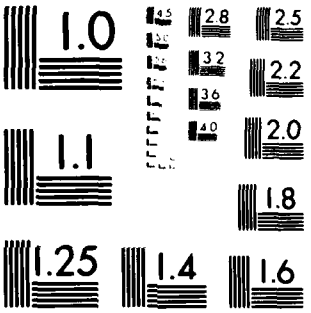

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GITTS RUN, YORK COUNTY,
PENNSYLVANIA.

(6) NATIONAL DAM [redacted] INSPECTION PROGRAM.

UPPER PIGEON HILL DAM,

(NDI I.D. Number PA-00340,
PENNDER I.D. Number 67-5)

LEVEL II

PHASE I INSPECTION REPORT,
~~NATIONAL DAM INSPECTION PROGRAM~~

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PREPARED FOR

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

PREPARED BY

GAI CONSULTANTS, INC.
570 BEATTY ROAD
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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 topograhic 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

Upper Pigeon Hill Dam: NDI I.D. No. PA-00340

Owner:	Hanover Municipal Water Works
State Located:	Pennsylvania (PennDER I.D. No. 67-5)
County Located:	York
Stream:	Gitts Run
Inspection Date:	9 November 1979
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

Based on a visual inspection, operational history, and available engineering data, the dam is considered to be in poor condition.

The size classification of the facility is small and the hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) ranges between the 1/2-PMF (Probable Maximum Flood) and PMF. Since the dam is near the lower end of the small size classification range and because of the lack of extensive downstream development, the SDF for this facility is considered to be the 1/2-PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store only about 20 percent of the PMF prior to dam overtopping. A breach analysis indicates that failure under 1/2-PMF conditions would probably not lead to increased property damage or loss of life at existing residences. Thus, based on the screening criteria contained in the recommended guidelines, the spillway is considered to be inadequate, but not seriously inadequate.

The facility was phased out of operation in 1965 and has since not been subject to a schedule of routine maintenance. As a result, the embankment has become heavily overgrown and the condition of the appurtenances has deteriorated. Specific deficiencies noted by the inspection team include: a severely

deteriorated and partially obstructed spillway; possible seepage through the embankment foundation below the blowoff; and lack of inlet flow control on a blowoff conduit of questionable operability.

Since the facility no longer serves its original purpose (water supply) and in essence, has been abandoned, it is recommended that the owner dismantle the embankment in accordance with PennDER, Division of Dam Safety, regulations.

If it is the owner's intention to maintain and/or reactivate the present facility, it is recommended that the owner immediately:

a. Develop a formal 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. Have the facility studied by a registered professional engineer experienced in hydrology and hydraulics and take remedial measures deemed necessary to make the facility hydraulically adequate.

c. Clear the embankment slopes and crest of all trees and brush.

d. Confirm the present operability of the outlet conduit and provide a means for controlling flow at the inlet.

e. Develop formal manuals of operation and maintenance to ensure future proper care of the facility.

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f. Specifically address in all future inspections the swampy condition at the downstream embankment toe immediately below the blowoff conduit noting any significant changes.

GAI Consultants, Inc.

Bernard M. Mihalcin, P.E.

Date 27 MARCH 1980

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date 3 May 80

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
BERNARD M. MIHALCIN
ENGINEER
20371-E

DLB:BMM/sam

OVERVIEW PHOTOGRAPH

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
UPPER PIGEON HILL DAM
NDI #PA-00340, PENNDER #67-5

SECTION 1
GENERAL INFORMATION

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. Upper Pigeon Hill Dam is a 29-foot high earth embankment approximately 324 feet long, including spillway. The facility is equipped with a trapezoidal-shaped, chute channel spillway located at the right abutment. Flow over the spillway is regulated by a flat crested trapezoidal-shaped weir 17.3 feet long. The design provides for drawdown via a 12-inch diameter cast iron blow-off conduit located near the right abutment to the left of the spillway. Discharge through the conduit is controlled by a 12-inch diameter gate valve located near the outlet end.

b. Location. Upper Pigeon Hill Dam is located on Gitts Run in Penn Township, York County, Pennsylvania. The site is situated just off Pennsylvania Route 194 about 3 miles north of Hanover, Pennsylvania. The dam, reservoir and watershed are contained within the Hanover, Pennsylvania 7.5 minute U.S.G.S. topographic quadrangle (see Figure 1, Appendix E). The coordinates of the dam are N39° 50.9 feet and W76° 57.9 feet.

c. Size Classification. Small (29 feet high, 37 acre-feet storage capacity at top of dam).

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

e. Ownership. Hanover Municipal Water Works
44 Fredrick Street
Hanover, Pennsylvania 17331

f. Purpose. Formerly water supply (abandoned).

g. Historical Data. Information contained in PennDER files indicates that Upper Pigeon Hill Dam was constructed sometime between the years 1873 and 1896. It is the second oldest of 3 similar structures referred to as the Upper, Middle, and Lower Pigeon Hill Dams constructed in series along Gitts Run, just north of Hanover, Pennsylvania. A 1915 state report references the designer of the facility as a Mr. Martin of Baltimore, Maryland. The facility was acquired by Hanover Municipal Water Works in 1933 and served as a water supply impoundment until 1965. Between 1965 and 1972, the reservoir was utilized for recreation, but now serves no useful purpose.

1.3 Pertinent Data.

a. Drainage Area (square miles). 0.4.

b. Discharge at Dam Site.

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

Discharge Capacity of Spillway at maximum Pool ≈ 290 cfs (see Appendix D, Sheet 8).

c. Elevation (feet above mean sea level). The following elevations were obtained from field measurements based on the elevation of normal pool at 838.6 feet (see Appendix D, Sheet 2, Note 2).

Top of Dam	841.2 (field).
Maximum Design Pool	Not known.
Maximum Pool of Record	Not known.
Normal Pool	838.6
Spillway Crest	838.6
Upstream Outlet Invert	Not known.
Downstream Outlet Invert	815 (estimate).
Downstream Embankment Toe	811.8
Maximum Tailwater	Not known.

d. Reservoir Length (feet).

Top of Dam	450
Normal Pool	400

e. Storage (acre-feet).

Top of Dam	37
Normal Pool	31
Design Surcharge	Not known.

f. Reservoir Surface (acres).

Top of Dam	3
Normal Pool	2

g. Dam.

Type	Earth.
Length	300 feet (excluding spillway).
Height	29 feet (field measured; crest to downstream toe).
Top Width	10 feet.
Upstream Slope	2H:1V (varies).
Downstream Slope	2H:1V (varies).
Zoning	Not known.
Impervious Core	Not known.
Cutoff	Not known.
Grout Curtain	Not known.

h. Diversion Canal and Regulating Tunnels — None.

i. Spillway.

Type	Trapezoidal-shaped, chute channel with concrete bottom and rock-lined sidewalls controlled by a flat-crested trapezoidal shaped weir.
Crest Elevation	838.6 feet.

Crest Length	17.3 feet.

j. Outlet Conduit.

Type	12-inch diameter cast iron pipe.
Length	Not known.
Closure and regulating Facilities	Flow through the conduit is controlled by a 12-inch diameter gate valve located near the outlet end.
Access	The valve control is located on the lower downstream embankment slope and is accessible by foot.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No design reports, calculations, or formal design data are available. Limited information pertaining to specific physical features of the embankment is contained in PennDER files in the form of state inspection reports, dated photographs, and miscellaneous correspondence. No design or construction drawings are available.

b. Design Features.

1. Embankment. Based on limited information contained in PennDER files and observations made during the visual inspection, general statements can be made regarding the embankment design. The dam is a 324-foot long earth embankment, including spillway. It has a top width of 10 feet with upstream and downstream slopes set at 2H:1V. Both slopes are covered with hand-placed sandstone. There is no information available that details the internal features of the structure.

2. Spillway. The spillway is an uncontrolled, trapezoidal-shaped, chute channel located at the right abutment. The channel has a concrete bottom and hand-placed rock sidewalls. Flow is regulated by a flat-crested trapezoidal-shaped weir 17.3 feet long.

3. Outlet Conduit. The outlet conduit consists of a 12-inch diameter cast iron pipe controlled by a 12-inch diameter gate valve at its discharge end. The conduit is located near the right abutment and to the left of the spillway.

4. Supply System and By-Pass Line. The original supply line has reportedly been capped and is no longer functional. A line to by-pass spring water inflow during turbid impoundment conditions is still intact near the left abutment, however, its operability is uncertain.

c. Design Data and Procedures. No design data or information relative to design procedures are available.

2.2 Construction Records.

No construction records are available for the facility.

2.3 Operational Records.

The facility has not been in active operation since 1965. No operating records have ever been maintained.

2.4 Other Investigations.

There are no available records concerning formal studies or investigations of Upper Pigeon Hill Dam other than several routine state inspection reports contained in PennDER files dating back to 1915.

2.5 Evaluation.

Information contained in PennDER files indicates Upper Pigeon Hill Dam was constructed sometime between the years 1873 and 1896. The earliest available correspondence is dated 1915. Little engineering data and no drawings are available relative to the design and construction of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests the dam and its appurtenances are in poor condition.

b. Embankment. Observations made during the visual inspection reveal the embankment lacks adequate maintenance and is presently in fair condition. No evidence of seepage through the downstream embankment face, sloughing, erosion, animal burrows, or excess embankment settlement was noted. The embankment faces are covered with hand-placed rock which has apparently undergone some movement over the years making the slopes somewhat irregular. Routine maintenance of the embankment is non-existent and has resulted in the crest and slopes being covered with trees and brush (see Photographs 2, 3 and 4). The area along the downstream embankment toe is wet primarily due to leakage (≈ 1/2 gpm) emanating from the by-pass pipe located near the left abutment. The leakage is drained away from the embankment, from left to right, through a small ditch located along the toe. Immediately below the blowoff outlet, the toe area is swampy. Although this condition is due, in part, to the leakage emanating from the by-pass pipe, it is believed some seepage through the embankment foundation may also be occurring.

c. Appurtenant Structures.

1. Spillway. The spillway is in poor condition. The approach to the spillway channel is partially obstructed by encroaching vegetation (see Photograph 5). The concrete spillway weir is heavily spalled while the concrete channel bottom has been reduced to a number of broken, dislodged slabs (see Photograph 6).

2. Outlet Conduit. The condition of the outlet conduit is suspect. The owner's representative indicated that the control valve located at its downstream end has not been operated for several years. No attempt was made to open the valve in the presence of the inspection team.

d. Reservoir Area. The general area surrounding the reservoir is characterized by steep slopes that are heavily forested. No signs of slope distress were observed.

e. Downstream Channel. Discharge from Upper Pigeon Hill Dam flows directly into the reservoir formed by Middle

Pigeon Hill Dam. Middle Pigeon Hill Dam was overtopped in October, 1975, resulting in the V-shaped breach shown in Photograph 7. Immediately below the middle dam is a small pond formed by Lower Pigeon Hill Dam (see Photograph 8). Discharge from the upper dam presently flows through the breach in the middle dam and directly into the lower pond. Lower Pigeon Hill Dam has no spillway facilities of significance. Excess inflow is discharged through a small breach opposite the access road located along the right abutment hillside. This small breach is apparently the only damage sustained by the lower dam during the 1975 flood. Beyond the lower dam, discharges are directed down a steep, narrow and heavily forested valley. Less than 2,000 feet downstream of Lower Pigeon Hill Dam, the valley opens up into a broad, flat area composed primarily of farmlands. Two farmhouses are located (with 6 to 8 residents estimated) in the floodplain of the stream less than 1-mile downstream of Upper Pigeon Hill Dam. Consequently, the hazard classification is considered to be high.

3.2 Evaluation.

The overall appearance of the facility suggests it to be in poor condition. The facility was phased out of operation in 1965 and has since apparently received little or no maintenance. As a result, the embankment has become heavily overgrown and the condition of the appurtenances has deteriorated. In addition to the overgrowth, specific deficiencies noted by the inspection team include: a severely deteriorated and partially obstructed spillway; possible seepage through the embankment foundation below the blowoff; and lack of inlet flow control on a blowoff conduit of questionable operability.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

Upper Pigeon Hill Dam is essentially a self-regulating facility. Excess inflows are automatically discharged through the uncontrolled spillway. The facility was phased out of operation in 1965. The supply line has reportedly been plugged and is not functional. The blowoff conduit may be functional, but has not been operated for several years. No formal operations manuals are available.

4.2 Maintenance of Dam.

Since the facility ceased operations in 1965, it has been virtually without maintenance. No formal maintenance manuals are 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.

The facility is not maintained on any basis and has been essentially abandoned. The blowoff conduit may be functional, but has not been operated for several years. Formal operations and maintenance manuals need to be developed and a formal warning system put in effect.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No formal design reports, calculations, or miscellaneous design data are available for the facility.

5.2 Experience Data.

Daily records of reservoir levels and/or spillway discharge are not available.

5.3 Visual Observations.

The visual inspection revealed the spillway to be in poor condition. Extensive deterioration of the spillway channel and a partially obstructed approach area will likely reduce its design discharge capacity and could possibly have an adverse effect on the embankment structure during periods of high discharge.

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 the procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Upper Pigeon Hill Dam 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). Since the dam is near the lower end of the small size classification range and because of the lack of extensive downstream development, the SDF for this facility is considered to be the 1/2-PMF.

b. Results of Analysis. Upper Pigeon Hill Dam was evaluated under near normal operating conditions. That is, the reservoir was initially at its normal pool or spillway elevation of approximately 838.6 feet, with the spillway weir discharging freely. The outlet conduit was assumed to be non-functional for the purpose of analysis. In any event, the flow capacity of the outlet conduit is not such that it would significantly increase the total discharge capabilities of the dam and reservoir. The spillway consists of a trapezoidal-shaped chute channel with a concrete bottom and hand-placed rock sidewalls. Discharges are controlled by a flat-crested trapezoidal-shaped weir.

Middle Pigeon Hill Dam is located immediately downstream from Upper Pigeon Hill Dam. The embankment was breached, reportedly during tropical storm Eloise, in October, 1975. No repair work had been made on the embankment as of the date of the field inspection. Since the breach opening is significantly large, it was assumed that the remaining portion of the embankment would have no attenuation effects on discharges from the upstream dam. Thus, discharges from Upper Pigeon Hill Dam were routed directly to Lower Pigeon Hill Reservoir.

Lower Pigeon Hill Dam, located immediately downstream of Middle Pigeon Hill Dam, was also evaluated in this analysis in order to determine its effects, in combination with Upper Pigeon Hill Dam, on the downstream area. It too, was investigated under near normal operating conditions. That is, the reservoir was initially at its normal pool or spillway elevation of approximately 792.3 feet. The spillway consists of an 8-inch diameter cast iron pipe which discharges into the natural channel at the toe of the dam. It was assumed that the spillway pipe, the outlet conduit, and the auxiliary spillway, which consists of three 8-inch diameter cast iron pipes, were non-functional for the purpose of analysis. Thus, all discharge would occur over the embankment crest. In any event, the flow capacities of these outlets are not such that they would significantly increase the total discharge capabilities of this facility.

All pertinent engineering calculations relative to the evaluation of the Pigeon Hill Dams are provided in Appendix D.

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Upper Pigeon Hill Dam can accommodate only about 20 percent of the PMF prior to the overtopping of its embankment. Due to the assumptions noted above, the embankment of Lower Pigeon Hill Dam will be overtopped upon the inflow of any

volume of water which exceeds the storage capacity available between normal pool and the low top of dam elevation, or essentially less than one percent of the PMF (Appendix D, Summary Input/ Output Sheets, Sheets K and L). The low top of embankment of Upper Pigeon Hill Dam was inundated by depths of 1.1 feet under 1/2-PMF conditions and 1.7 feet under PMF conditions. Duration of overtopping was about 4.2 hours for the 1/2-PMF event and 6.5 hours for the PMF event. Under 1/2-PMF conditions, Lower Pigeon Hill Dam was overtopped for about 31 hours with a maximum depth of inundation of about 3.0 feet (Summary Input/Output Sheets, Sheets K and L). Since the SDF for each of the facilities is the 1/2-PMF, each has a high potential for overtopping and thus, for breaching under floods of less than 1/2-PMF magnitude.

Since neither of the dams can safely pass a flood of at least 1/2-PMF magnitude, the possibility of failure of each under floods of 1/2-PMF magnitude was investigated (in accordance with Corps directive ETL-1110-2-234). The dams were evaluated in series in order to ascertain the overall effects of the present system on the downstream population in the event of a severe storm. The major concern of the breaching analysis is with the impact of the breach discharges on increasing downstream water surface elevations above those to be expected if breaching did not occur.

Due to the locations and elevations of the downstream residences, and due to the flat nature of the topography in the downstream region, it was questionable whether nearby structures would be affected by the failure of these dams at all. Therefore, an extreme plan of breaching conditions was first examined, using the Modified HEC-1 Computer Program. Under 1/2-PMF conditions, Upper Pigeon Hill Dam was assumed to begin breaching upon 1.0-foot of overtopping, and Lower Pigeon Hill Dam commenced breaching upon 3.5 feet of overtopping. The geometric breach sections chosen for the dams were considered to be the maximum probable failure sections (Appendix D, Sheet 23). Each dam was assumed to breach rapidly, with a failure time of 0.5 hours (total time for each breach section to reach its final dimensions).

The peak discharges resulting from these extreme breach conditions were found to be 2,240 cfs and 2,690 cfs for Upper Pigeon Hill Dam and Lower Pigeon Hill Dam, respectively. Discharges were routed as far as Section 5 (see Figure 1), located about 4,170 feet downstream of Lower Pigeon Hill Dam. Water surface elevations corresponding to the breach outflows were 1 to 2 feet above those corresponding to the 1/2-PMF non-breach outflows (Appendix D, Sheet 25). At all sections investigated, however, the water surface elevations resulting from the breaches were well below the damage level of

any nearby homes. From this analysis, it is unlikely that the failure of the Pigeon Hill Dams would lead to increased property damage or loss of life in the downstream regions, as they exist at present.

5.6 Spillway Adequacy.

As presented previously, under existing conditions, Upper Pigeon Hill Dam can accommodate only about 20 percent of the PMF prior to overtopping. Should a 0.21 PMF or larger event occur, the dam would be overtopped and could possibly fail, possibly resulting in the failure of Lower Pigeon Hill Dam. Since the failure of these dams would probably not lead to increased property damage or loss of life at existing residences, Upper Pigeon Hill Dam is considered inadequate, but not seriously inadequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment is considered to be in fair condition. The heavy overgrowth that covers the crest and both slopes is directly attributable to a lack of routine maintenance and care. Trees which have rooted themselves into the embankment may eventually threaten the stability of the structure. Consequently, all trees should be removed along with their root systems.

b. Appurtent Structures.

1. Spillway. The spillway is considered to be in poor condition. The spillway channel is virtually in ruin and in need of a major rehabilition. The severely broken and dislodged channel bottom has exposed the foundation, subjecting it to potential erosion. Such erosion could eventually undermine the rock-lined spillway sidewalls and adversely affect the structural integrity of the embankment.

2. Outlet Conduit. The condition of the outlet conduit is considered fair. No leakage through or around the conduit was observed. The control valve on the conduit has not been operated for several years and its current operability is suspect.

3. Supply System and By-Pass Line. The supply system has been disconnected and capped while the by-pass line is reportedly functional. Leakage noted at the discharge end of the by-pass line is not considered to be significant at present.

6.2 Design and Construction Techniques.

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

6.3 Past Performance.

PennDER records indicate that, during the years of active operation, the facility was maintained on a regular basis. State inspection reports, dating back to 1915, indicate the embankment to have been in satisfactory to good condition throughout its history, with only minor leakage

noted. No specific documentation is available pertaining to water levels at this facility during the flood of October, 1975 which caused the overtopping and subsequent breaching of Middle Pigeon Hill Dam. Since 1965, however, the facility has been neglected and allowed to steadily deteriorate.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and may be subject to minor earthquake induced dynamic forces. As the facility appears soundly constructed and sufficiently 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 that the facility is in poor condition.

The size classification of the facility is small and the hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) ranges between the 1/2-PMF (Probable Maximum Flood) and the PMF. Since the dam is near the lower end of the small size classification range and because of the lack of extensive downstream development, the SDF for this facility is considered to be the 1/2-PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store only about 20 percent of the PMF prior to dam overtopping. A breach analysis indicates that failure under 1/2-PMF conditions would probably not lead to increased property damage or loss of life at existing residences. Thus, based on the screening criteria contained in the recommended guidelines, the spillway is considered to be inadequate, but not seriously inadequate.

The facility was phased out of operation in 1965 and has since not been subject to a schedule of routine maintenance. As a result, the embankment has become heavily overgrown and the condition of the appurtenances has deteriorated. Specific deficiencies noted by the inspection team include; a severely deteriorated and partially obstructed spillway; possible seepage through the embankment foundation below the blowoff; and lack of inlet flow control on a blowoff conduit of questionable operability.

b. Adequacy of Information. The available data is 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 as discussed below, are required to ensure safe operation of the facility.

7.2 Recommendations/Remedial Measures.

Since the facility no longer serves its original purpose (water supply) and in essence, has been abandoned, it is recommended that the owner dismantle the embankment in accordance with PennDER, Division of Dam Safety, regulations.

If it is the owner's intention to maintain and/or reactivate the present facility, it is recommended that the owner immediately:

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

b. Have the facility studied by a registered professional engineer experienced in hydrology and hydraulics and take remedial measures deemed necessary to make the facility hydraulically adequate.

c. Clear the embankment slopes and crest of all trees and brush.

d. Confirm the present operability of the outlet conduit and provide a means for controlling flow at the inlet.

e. Develop formal manuals of operation and maintenance to ensure future proper care of the facility.

f. Specifically address in all future inspections the swampy condition at the downstream embankment toe immediately below the blowoff conduit noting any significant changes.

APPENDIX A

VISUAL INSPECTION CHECKLIST AND FIELD SKETCHES

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Upper Pigeon Hill Dam STATE Pennsylvania COUNTY York

NDI # PA — 00340 PENNDER # 67-5

TYPE OF DAM Earth SIZE Small HAZARD CATEGORY High

DATE(S) INSPECTION 9 November 1979 WEATHER Partly Cloudy TEMPERATURE 50° @ Noon

POOL ELEVATION AT TIME OF INSPECTION 838.7 M.S.L.

TAILWATER AT TIME OF INSPECTION - M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	*OTHERS*
B.M. Mihalcin	Hanover Municipal Water Works	
D. J. Spaeder	Hugh Topper - Manager	
D. L. Bonk		

RECORDED BY B.M. Mihalcin

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00304
SURFACE CRACKS	None observed. Both the upstream and downstream embankment slopes are overgrown with trees and shrubs.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	No signs of sloughing or erosion observed. Both embankment faces are somewhat irregular, apparently due to minor movements within their respective rock slope protections.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal - good. Vertical - See "Profile of Dam Crest" (Field Sketch, Appendix A).
RIPRAP FAILURES	None observed. Riprap is a well graded, durable, hand-placed sandstone.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00340
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	Swamp-like condition exists in the small area below the blowoff. Probably due to seepage emanating below the blowoff. No seepage observed through the downstream embankment face.
ANY NOTICEABLE SEEPAGE	See above. Some minor leakage (≈ 1/2 gpm) was noted at the discharge end of the by-pass line located near the left abutment.
STAFF GAGE AND RECORDER	None.
DRAINS	None observed. Downstream embankment face is rock covered. A small drainage ditch runs along the downstream embankment toe.
DOWNSTREAM DAMS	Two earth embankments are located immediately downstream of Upper Pigeon Hill Dam. Middle Pigeon Hill Dam is of comparable size, but, was overtopped and breached by a flood in October 1975. Lower Pigeon Hill Dam forms a small pond of minor consequence.

OUTLET WORKS

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00340
INTAKE STRUCTURE	Submerged, not observed.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	12-inch diameter cast iron blowoff conduit located near the right abutment to the left of the spillway.
OUTLET STRUCTURE	The outlet conduit discharges near the base of the downstream embankment toe. It is apparently encased in a vault composed of hand-placed rock.
OUTLET CHANNEL	Natural channel.
GATE(S) AND OPERATIONAL EQUIPMENT	12-inch diameter gate valve located on blowoff line near its discharge end. The by-pass line located near the left abutment is also valved at its discharge end along the downstream slope. Neither valve has been operated for several years, but may be functional.

EMERGENCY SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00304
TYPE AND CONDITION	Trapezoidal-shaped chute channel with concrete bottom and rock-lined sidewalls in poor condition. Concrete bottom is severely broken into large displaced slabs.
APPROACH CHANNEL	Rock-lined channel partially obstructed by overgrowth and debris.
SPILLWAY CHANNEL AND SIDEWALLS	Rock-lined sidewalls intact. Channel bottom dislodged and severely broken.
STILLING BASIN PLUNGE POOL	None.
DISCHARGE CHANNEL	Discharges directly into Middle Pigeon Hill Dam (breached).
BRIDGE AND PIERS EMERGENCY GATES	Deteriorated log bridge spans the spillway several feet downstream of the weir.

SERVICE SPILLWAY

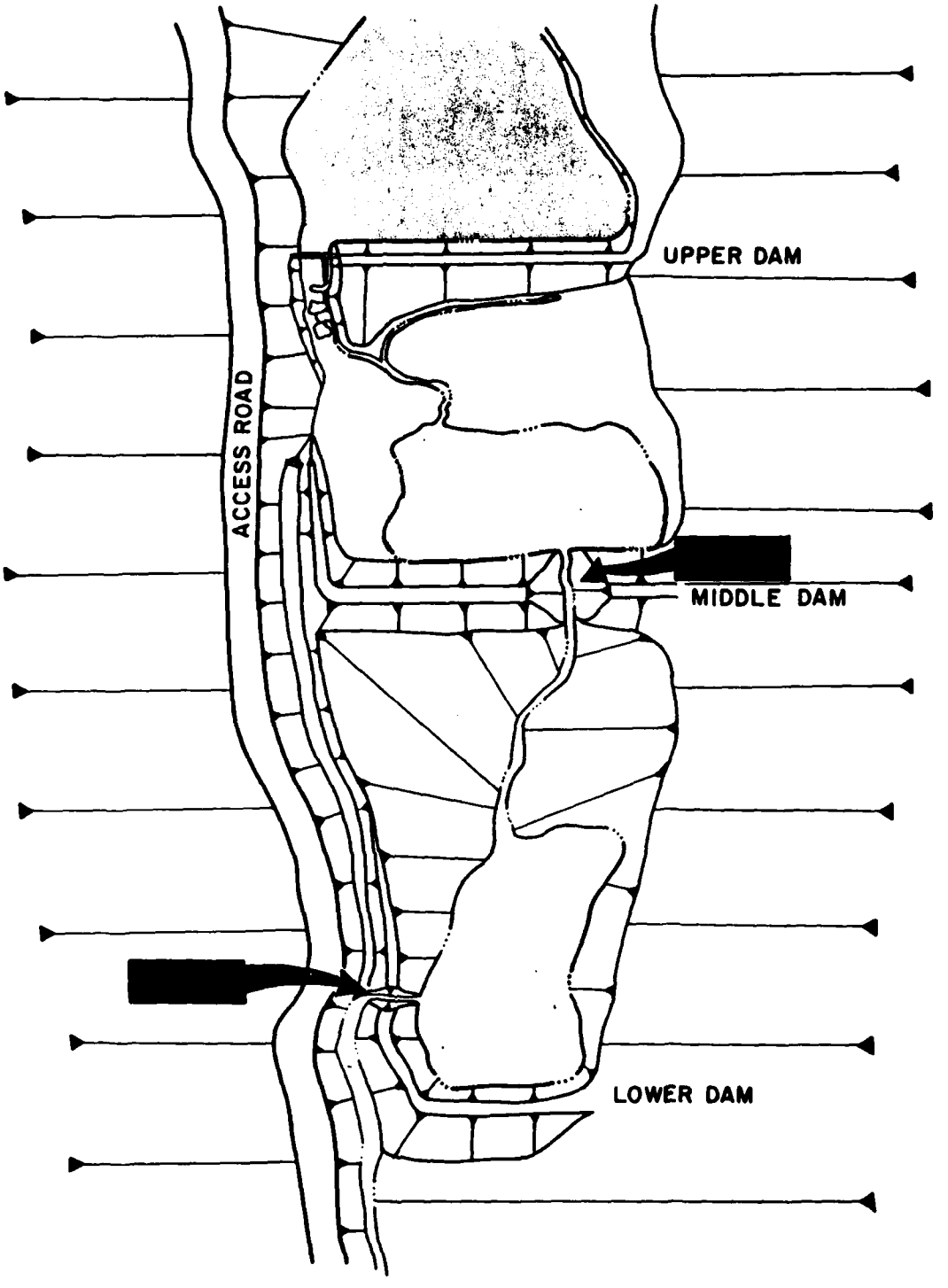
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00340
TYPE AND CONDITION	N/A.
APPROACH CHANNEL	N/A.
OUTLET STRUCTURE	N/A.
DISCHARGE CHANNEL	N/A.

INSTRUMENTATION

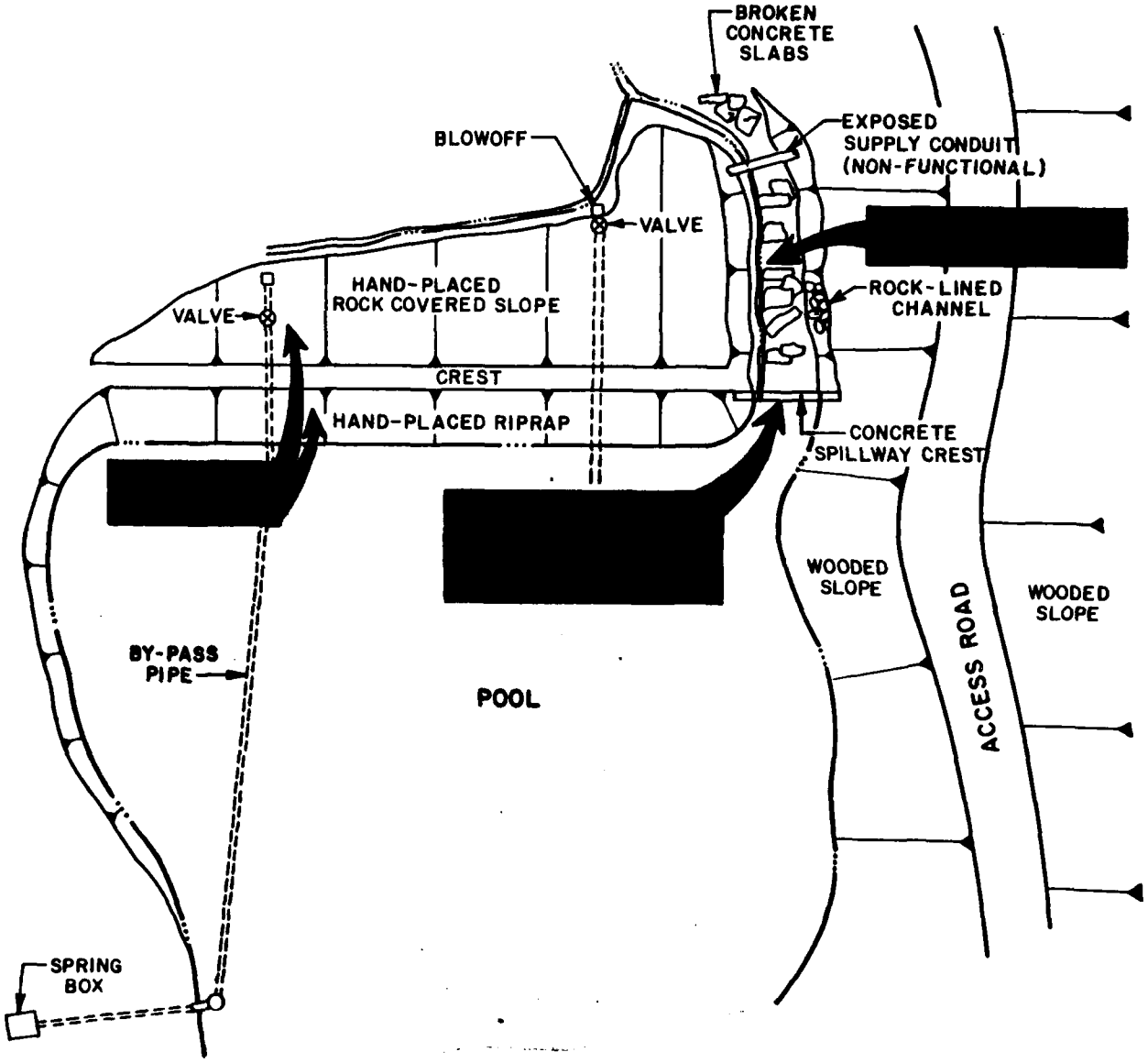
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00340
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

RESERVOIR AREA AND DOWNSTREAM CHANNEL

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00340
SLOPES: RESERVOIR	Steep and heavily forested. No evidence of slope distress observed.
SEDIMENTATION	None observed.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Discharge from Upper Pigeon Hill Dam flows directly into the reservoir formed by Middle Pigeon Hill Dam.
SLOPES: CHANNEL VALLEY	Steep, narrow and heavily forested valley. Less than 2,000 feet downstream of Lower Pigeon Hill Dam, the valley opens up into a broad, flat area composed primarily of local farmlands and pastures.
APPROXIMATE NUMBER OF HOMES AND POPULATION	Two farmhouses are located several hundred feet off the stream less than 1-mile downstream of Upper Pigeon Hill Dam. It is estimated that as many as 6 to 8 persons could be affected by the failure of Upper Pigeon Hill Dam and the subsequent failure of Lower Pigeon Hill Dam.



PIGEON HILL DAMS (UPPER, MIDDLE, AND LOWER)
GENERAL PLAN - FIELD INSPECTION NOTES

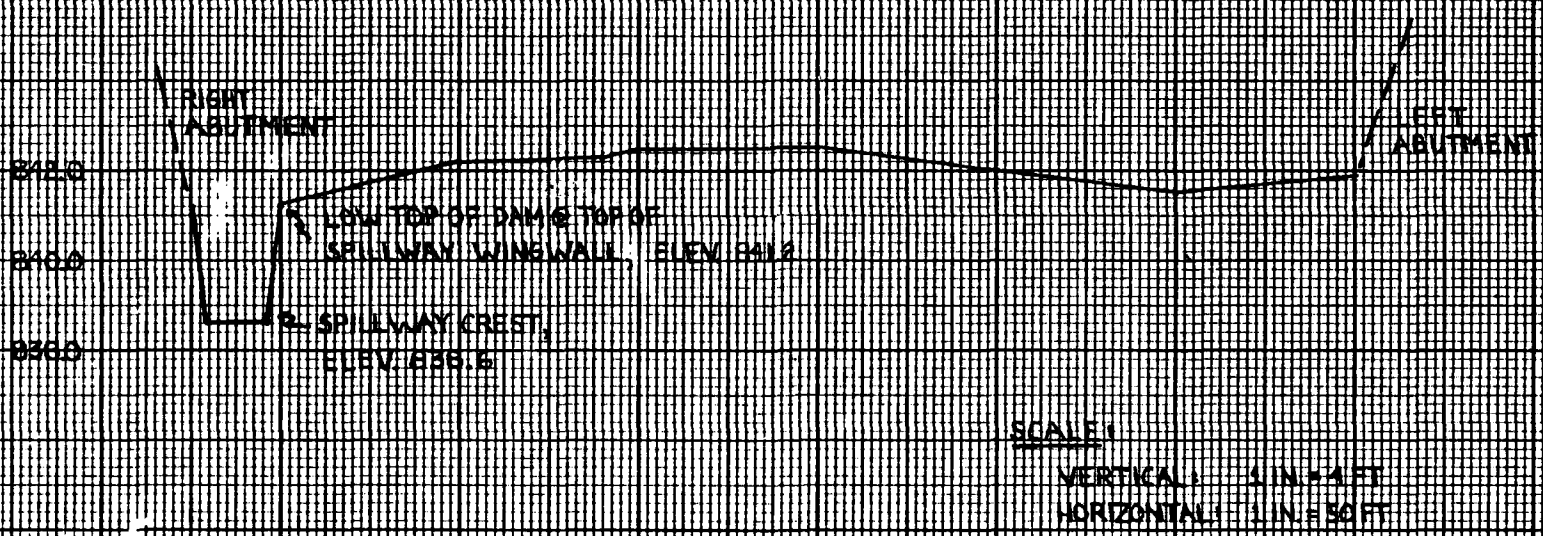


UPPER PIGEON HILL DAM
GENERAL PLAN - FIELD INSPECTION NOTES

UPPER PIGEON HILL DAM

PROFILE OF DAM CREST

FROM FIELD SURVEY



APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
PHASE I

NAME OF DAM Upper Pigeon Hill Dam

ITEM	REMARKS NDI# PA- 00340
PERSONS INTERVIEWED AND TITLE	Hanover Municipal Water Works.. Hugh Topper - Manager.
REGIONAL VICINITY MAP	See Figure 1, Appendix E.
CONSTRUCTION HISTORY	See 1915 Report in PennDER files. Built between 1873 and 1896.
AVAILABLE DRAWINGS	See Figure 2, Appendix E. No other drawings available.
TYPICAL DAM SECTIONS	Not available.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	Not available.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA - 00340
SPILLWAY: PLAN SECTION DETAILS	Not Available.
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. 00340
BORROW SOURCES	Not known.
POST CONSTRUCTION DAM SURVEYS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Several state inspection reports are contained in PennDER files. Corps of Engineers inspected dams subsequent to the flood of 1975 which caused the middle dam to be breached. No formal report available.
HIGH POOL RECORDS	None available.
MONITORING SYSTEMS	None.
MODIFICATIONS	None.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA - 00340
PRIOR ACCIDENTS OR FAILURES	Middle dam overtopped and breached in October, 1975 (Hurricane Eloise). Failure not witnessed. No downstream damage reported. Flood of June, 1972 (Hurricane Agnes) apparently not as severe.
MAINTENANCE: RECORDS MANUAL	No regular maintenance performed. No formal records or manual available.
OPERATION: RECORDS MANUAL	Self-regulating. No formal records or manual available.
OPERATIONAL PROCEDURES	Presently abandoned.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	None. Owner has programs in effect for its larger facilities in operation.
MISCELLANEOUS	

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CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-00340
PENNDER ID # 67-5

SIZE OF DRAINAGE AREA: 0.4 Square Miles.

ELEVATION TOP NORMAL POOL: 838.6 STORAGE CAPACITY: 31 acre-feet.

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -

ELEVATION TOP DAM: 841.2 STORAGE CAPACITY: 37 acre-feet.

SPILLWAY DATA

CREST ELEVATION: 838.6 feet.

TYPE: Uncontrolled, trapezoidal chute w/trapezoidal weir.

CREST LENGTH: 17.3 feet.

CHANNEL LENGTH:

SPILLOVER LOCATION: Right abutment.

NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

TYPE: 12-inch diameter cast iron pipe.

LOCATION: Left of spillway.

ENTRANCE INVERTS: Not known.

EXIT INVERTS: Not known.

EMERGENCY DRAWDOWN FACILITIES: 12-inch diameter gate valve at discharge end.

HYDROMETEOROLOGICAL GAGES

TYPE: None.

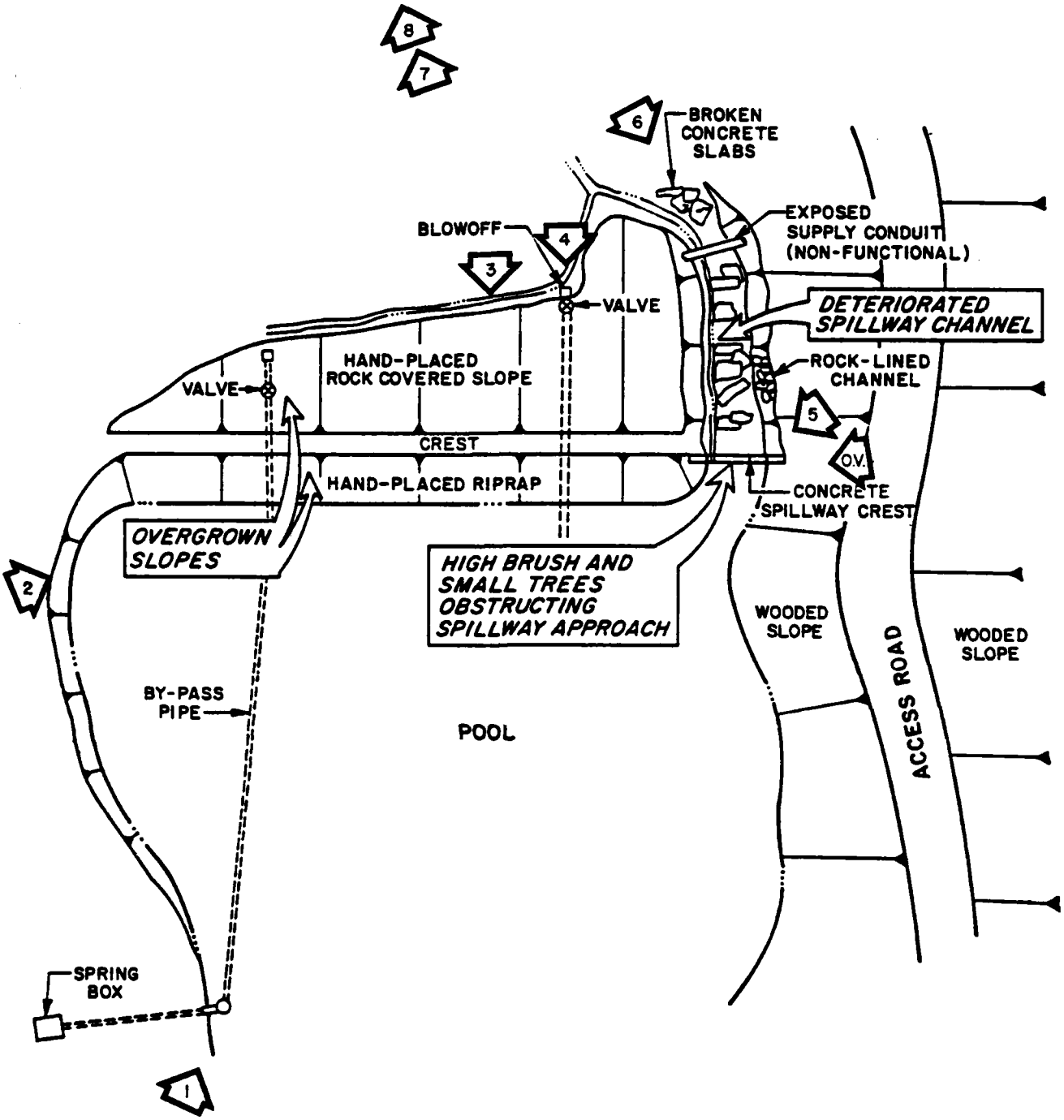
LOCATION: -

RECORDS: -

MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX C

PHOTOGRAPHS



UPPER PIGEON HILL DAM
PHOTOGRAPH KEY MAP

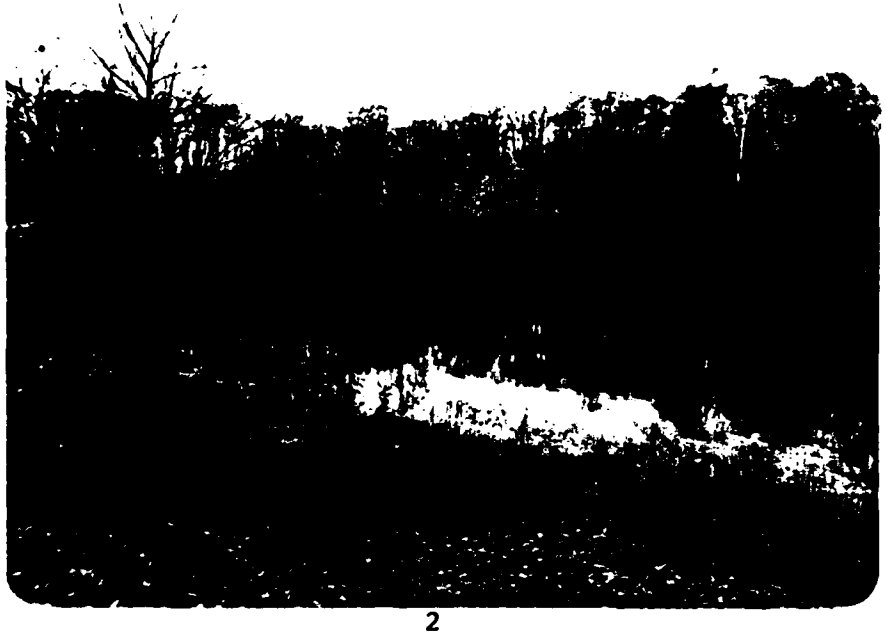
PHOTOGRAPH 1 View, looking downstream, of the reservoir behind Upper Pigeon Hill Dam.

PHOTOGRAPH 2 View of the tree covered upstream embankment face of Upper Pigeon Hill Dam as seen from the left abutment.

PHOTOGRAPH 3 View of the hand-placed rock that covers the downstream embankment face.

PHOTOGRAPH 4 View of the discharge end of the blowoff conduit.

1



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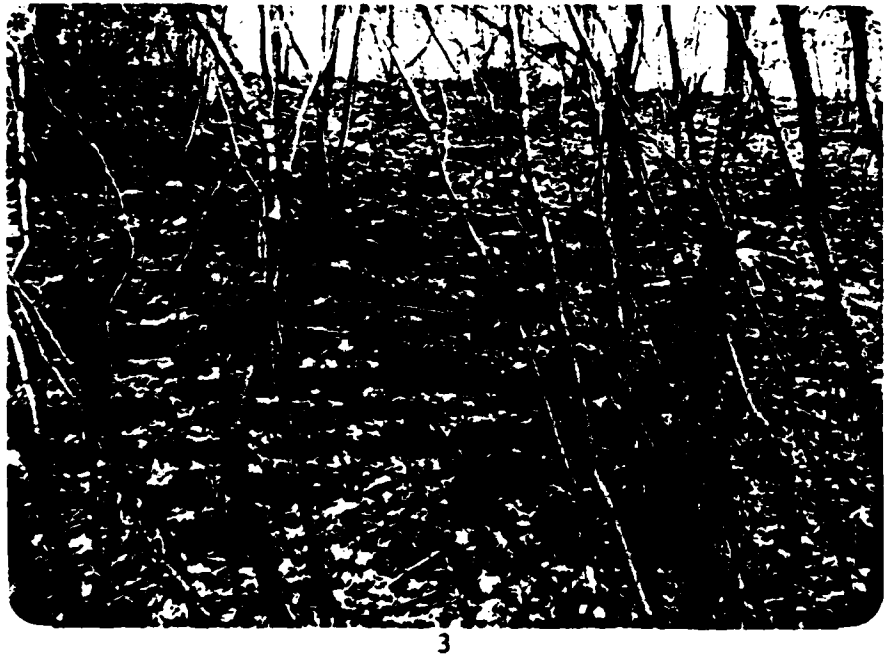


3

4

PHOTOGRAPH 5 View of the overgrown spillway approach as seen from the right abutment.

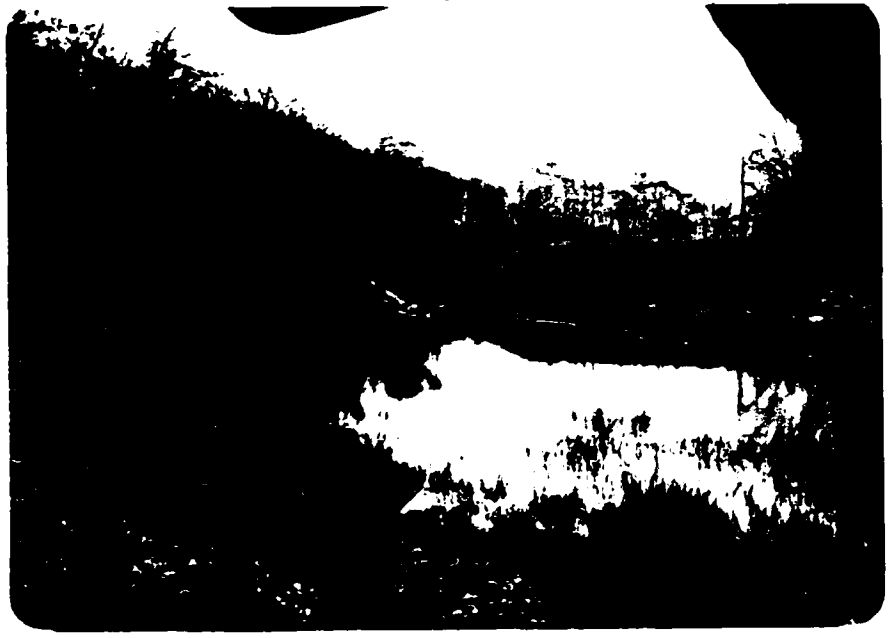
PHOTOGRAPH 6 View, looking upstream, of the deteriorated concrete spillway channel located at the right abutment.

PHOTOGRAPH 7 View, looking downstream, of the breached Middle Pigeon Hill Dam as seen from the downstream toe of Upper Pigeon Hill Dam.

PHOTOGRAPH 8 View of Lower Pigeon Hill Dam as seen from the crest of Middle Pigeon Hill Dam.

5

6



7

8

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: UPPER PIGEON HILL DAM

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.7 INCHES/24 HOURS (1)

STATION	1	2	3
STATION DESCRIPTION	UPPER PIGEON HILL DAM	LOWER PIGEON HILL DAM	
DRAINAGE AREA (SQUARE MILES)	0.40	0.04	
CUMULATIVE DRAINAGE AREA (SQUARE MILES)	-	0.44	
ADJUSTMENT OF PMF FOR DRAINAGE AREA LOCATION (%) (1)			
6 HOURS	113	113	
12 HOURS	123.5	123.5	
24 HOURS	132	132	
48 HOURS	143	143	
72 HOURS	-	-	
SNYDER HYDROGRAPH PARAMETERS			
ZONE (2)	15-A	15-A	
C_p (3)	0.54	0.54	
C_t (3)	1.15	1.15	
L (MILES) (4)	1.0	0.26	
L_{ca} (MILES) (4)	0.5	0.07	
$t_p = C_t\ (L \cdot L_{ca})^{0.3}$ (HOURS)	0.93	0.35	
SPILLWAY DATA			
CREST LENGTH (FEET)	17.3	N/A	
FREEBOARD (FEET)	2.6		

(1) HYDROMETEOROLOGICAL REPORT - 33, U.S. ARMY CORPS OF ENGINEERS, 1956

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

(3) SNYDER COEFFICIENTS

(4) L = LENGTH OF LONGEST WATERCOURSE FROM DAM TO BASIN DIVIDE.
L_{ca} = LENGTH OF LONGEST WATERCOURSE FROM DAM TO POINT OPPOSITE BASIN CENTROID.

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 12-4-79 PROJ. NO. 79-203-340

CHKD. BY WJV DATE 2-7-80 SHEET NO. 1 OF 25

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DAM STATISTICS

- HEIGHT OF DAM ≈ 29 FT (FIELD MEASUREMENT)
- NORMAL POOL STORAGE CAPACITY ≈ 10×10^6 GALLONS (SEE NOTE 1)
  ≈ 31 ACRE-FT
- MAXIMUM POOL STORAGE CAPACITY ≈ 37 ACRE-FT (HEC-1)
  (@ LOW TOP OF DAM)
- DRAINAGE AREA ≈ 0.4 SQUARE MILES [PLANIMETERED ON U.S.G.S. 7.5 MINUTE QUADRANGLE: HANOVER, PA.]
- ELEVATION OF TOP OF DAM (DESIGN) — NOT KNOWN
- ELEVATION OF LOW TOP OF DAM (FIELD) ≈ 841.2
- NORMAL POOL ELEVATION ≈ 838.6 (SEE NOTE 2)
- UPSTREAM INLET INVERT — NOT KNOWN
- DOWNSTREAM OUTLET INVERT ≈ 814.0 (FIELD ESTIMATE)
- DOWNSTREAM EMBANKMENT TOE ≈ 811.8 (FIELD MEASUREMENT)
- STREAMBED AT DAM CENTERLINE — NOT KNOWN

NOTE 1:

- TAKEN FROM "REPORT UPON THE UPPER PIGEON HILL DAM OF HANOVER AND McSHERRYSTOWN WATER CO.," TO THE WATER SUPPLY COMMISSION OF PENNSYLVANIA; JULY 16, 1915.

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 12-4-79 PROJ. NO. 79-303-340

CHKD. BY WJV DATE 2-7-80 SHEET NO. 2 OF 25

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NOTE 2:

- NORMAL POOL ELEVATION ESTIMATED FROM U.S.G.S. TOPOGRAPHIC MAP, HANOVER, PA, 7.5 MINUTE QUADRANGLE, FIELD NOTES, AND "REPORT UPON THE MIDDLE PIGEON HILL DAM OF HANOVER AND McSHERRYSTOWN WATER Co.," JULY, 1915; FOUND IN PENNDER FILES. ELEVATIONS USED IN THIS ANALYSIS ARE CONSIDERED ESTIMATES AND ARE NOT NECESSARILY ACCURATE.

DAM CLASSIFICATION

DAM SIZE : SMALL (REF. 1, TABLE 1)

HAZARD CLASSIFICATION : HIGH (FIELD OBSERVATION)

REQUIRED SDF : ½ PMF to PMF (REF. 1, TABLE 3)

HYDROGRAPH PARAMETERS

- LENGTH OF LONGEST WATERCOURSE : L = 1.0 MILE

- LENGTH OF LONGEST WATERCOURSE FROM DAM TO BASIN CENTROID : L_{CA} = 0.5 MI.
(MEASURED ON USGS TOPO MAP, HANOVER, PA)

C_t = 1.15

C_p = 0.54

(SNYDER PARAMETERS SUPPLIED BY C.O.E.; ZONE 15-A, SUSQUEHANNA RIVER BASIN)

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 12-5-79 PROJ. NO. 79-203-340
CHKD. BY WJV DATE 2-7-80 SHEET NO. 3 OF 25

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t_p = SNYDER'S STANDARD LAG = $C_t (L \times L_{CA})^{0.3}$

$= (1.15)(1.0 \times 0.5)^{0.3} \simeq \underline{0.93}$ HOURS

NOTE: HYDROGRAPH VARIABLES USED HERE ARE DEFINED IN REFERENCE 2, IN SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH.

RESERVOIR SURFACE AREAS

- SURFACE AREA AT NORMAL POOL (ELEV. 838.6) ≈ 2 ACRES (NOTE 1)

- S.A. @ ELEV 860.0 = 8.3 ACRES (PLANIMETERED ON USGS TOPO, HANOVER, PA.)
(THE LOCATION OF THE 840 CONTOUR IS ASSUMED TO BE IN ERROR.)

- ELEVATION OF LOW TOP OF DAM ≈ 841.2 (FIELD NOTES)

- RATE OF SURFACE AREA INCREASE PER FOOT RISE OF RESERVOIR ELEVATION (BETWEEN EL. 838.6 AND 860.0) ≈

$$\frac{\Delta SA}{\Delta H} \simeq \frac{8.3-2}{21.4} \simeq \underline{0.29} \text{ AC/FT}$$

$$\therefore SA \text{ @ LOW TOP OF DAM (ELEV 841.2)} \simeq SA_{838.6} + (841.2 - 838.6)\left(\frac{\Delta SA}{\Delta H}\right)$$

$$\simeq 2 + (2.6)(0.29) \simeq \underline{2.8} \text{ ACRES}$$

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DTS DATE 12-4-79 PROJ. NO. 79-202-340

CHKD. BY WJV DATE 2-7-80 SHEET NO. 4 OF 25

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RESERVOIR ELEVATION AT "ZERO STORAGE" VOLUME

USING CONIC METHOD, VOLUME AT NORMAL POOL =

$$\frac{1}{3} HA = 31 \text{ ACRE-FT}$$

WHERE A = SURFACE AREA = 2 ACRES @ EL. 838.6
H = MAXIMUM DEPTH

$$\therefore H \approx \frac{31 \times 3}{2} = 46.5 \text{ FEET}$$

$\therefore$ ZERO STORAGE ACCORDING TO CONIC METHOD OCCURS AT
838.6 − 46.5 = 792.1

NOTE: ALTHOUGH THE MINIMUM RESERVOIR ELEVATION IS APPARENTLY MUCH HIGHER THAN 792.1 THIS ELEVATION MUST BE USED IN THE HEC-1 PROGRAM IN ORDER TO MAINTAIN A STORAGE OF 31 ACRE-FT AT NORMAL POOL. (THE ERROR IN BREACH OUTFLOWS DUE TO THIS ASSUMPTION WILL NOT BE SIGNIFICANT.)

ELEVATION – STORAGE RELATIONSHIP

AN ELEVATION-STORAGE RELATIONSHIP IS COMPUTED INTERNALLY IN THE HEC-1 PROGRAM, BY USE OF THE CONIC METHOD, BASED ON THE GIVEN RESERVOIR SURFACE AREA AND ELEVATION DATA. (SEE SUMMARY INPUT/OUTPUT SHEETS.)

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 12-5-79 PROJ. NO. 79-203-340

CHKD. BY WJV DATE 2-7-80 SHEET NO. 5 OF 25

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PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 23.7 INCHES (REF 3, FIG 1)

(CORRESPONDING TO A DURATION OF 24 HOURS, AND A DRAINAGE AREA OF 200 SQ. MILES)

- DEPTH-AREA-DURATION ZONE 6 (REF 3, FIG 1)

- LOCAL DRAINAGE AREA = 0.4 SQUARE MILES; HOWEVER, PMP STORM WILL BE CENTERED OVER TOTAL 0.44 SQUARE MILE DRAINAGE AREA (SHEET 13). ASSUME DATA CORRESPONDING TO A 10-SQUARE MILE AREA ARE APPLICABLE TO THE TOTAL AREA:

DURATION (HRS)	PERCENT OF INDEX RAINFALL
6	113
12	123.5
24	132
48	143

(REF 3, FIG. 2)

- HSP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AND FOR THE LESSER LIKELIHOOD OF SEVERE STORM CENTERING OVER SMALL BASIN) FOR DRAINAGE AREA 0.44 SQUARE MILES IS 0.80. (REF 4, p. 48)

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY RJJ DATE 12-5-79 PROJ. NO. 79-203-340

CHKD. BY WJV DATE 2-7-80 SHEET NO. 6 OF 25

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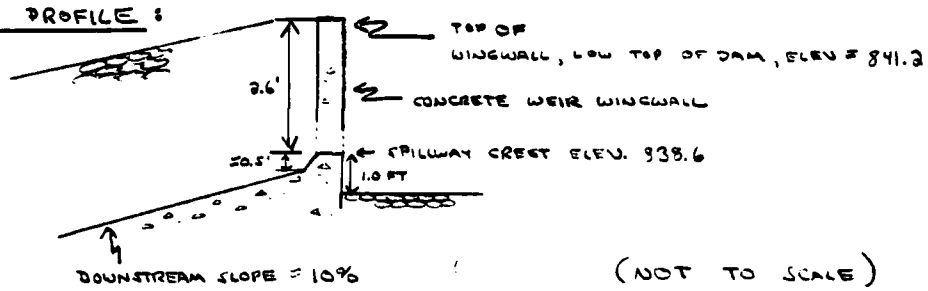
SPILLWAY COMPUTATIONS

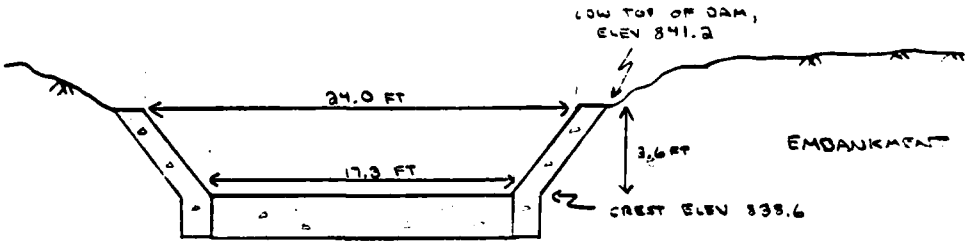
SPILLWAY PROFILE:



(NOT TO SCALE)

SPILLWAY CROSS-SECTION:

LOOKING UPSTREAM:



(NOT TO SCALE)

— FROM FIELD MEASUREMENTS AND COMPUTATIONS

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THE SPILLWAY IS A TRAPEZOIDAL-SHAPED CHUTE CHANNEL WITH CONCRETE BOTTOM AND ROCK-LINED SIDEWALLS, WITH DISCHARGES CONTROLLED BY A FLAT-CRESTED TRAPEZOIDAL WEIR, AS SHOWN ON SHEET 6.

DISCHARGE CAN BE DEFINED BY THE RELATION:

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

WHERE Q = DISCHARGE OVER WEIR, IN CFS,
C = COEFFICIENT OF DISCHARGE,
L = LENGTH OF WEIR, IN FEET,
H = HEAD ON WEIR CREST, IN FEET.

ASSUME THAT THE DESIGN HEAD, H_o, IS 2.6 FEET ABOVE THE WEIR CREST, OR AT THE TOP OF THE WINGWALLS. FOR HEADS IN THIS RANGE, THE DISCHARGE COEFFICIENT WILL BE ON THE ORDER OF 3.32 (REF 5, p. 5-40, TABLE 5-3). WHEN THE RATIO OF HEAD TO WEIR HEIGHT EXCEEDS ABOUT 5.0, THE CONTRACTION OF FLOW DIMINISHES, RESULTING ESSENTIALLY IN REDUCED DISCHARGE COEFFICIENTS (REF 4, p. 373). ALSO AT GREATER HEADS, THERE WILL BE INTERFERENCE DUE TO THE PRESENCE OF THE DOWNSTREAM APRON. IT IS ASSUMED THAT THE NET EFFECT OF THE ABOVE CONDITIONS WILL ESSENTIALLY RESULT IN CRITICAL FLOW AT THE WEIR, OR A DISCHARGE COEFFICIENT OF ABOUT 3.38 (REF 4, PAGES 373-376). THIS VALUE WILL BE USED FOR HEADS OF 5.0 FEET AND GREATER (WEIR HEIGHT = 1.0 FEET). THE EFFECTS OF THE SMALL APPROACH CHANNEL ARE ASSUMED TO BE NEGLIGIBLE HERE.

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– THE FLOW OVER THE SLOPED SIDEWALLS OF THE WEIR IS ASSUMED TO OCCUR AT THE SAME VELOCITY AS THAT DIRECTLY OVER THE WEIR ITSELF. THEREFORE, THE TOTAL FLOW CAN BE REPRESENTED BY THE RELATIONSHIP

$$Q_T = \frac{A_T}{A_W} Q_W$$

WHERE Q_T = TOTAL DISCHARGE, IN CFS
Q_W = DISCHARGE DIRECTLY OVER WEIR, IN CFS
A_T = TOTAL CROSS-SECTIONAL FLOW AREA, IN FT^2
A_W = FLOW AREA DIRECTLY OVER WEIR, IN FT^2

SPILLWAY RATING TABLE

	RESERVOIR ELEVATION (FT)	H (FT)	① C	② A_W (FT^2)	③ A_T (FT^2)	④ Q_W (CFS)	⑤ Q_T (CFS)
	838.6	0	–	–	–	–	0
	839.6	1.0	3.14	17.3	18.6	54	60
	840.6	2.0	3.31	34.6	39.8	162	190
(LOW TOP OF DAM)	841.2	2.6	3.32	45.0	53.7	241	290
	841.6	3.0	3.32	51.9	63.3	398	360
	842.6	4.0	3.32	69.2	87.3	459	580
	843.6	5.0	3.08	86.5	111	596	760
	844.6	6.0	3.08	104	135	783	1030
	845.6	7.0	3.08	121	159	987	1300
	846.6	8.0	3.08	138	183	1206	1600
	847.6	9.0	3.08	156	207	1439	1910
	848.6	10.0	3.08	173	231	1685	2250

① FROM REF 5, TABLE 5-3, ASSUMING BREADTH = 3.75 FT; [illegible] 5.0 FT, USE A [illegible] OF 3.08.

② $A_W = H \times L$, WHERE L = 17.3 FT

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③ – FOR $H \leq 2.6$:

$\rightarrow A_T = (17.3 \times H) + 2(1/2)(H)(1.3H) = \underline{17.3H + 1.3H^2}$; USING A SIDEWALL SLOPE OF $\underline{1.3H:1V}$.

– FOR $H \geq 2.6$:

$\rightarrow A_T = \left(\frac{17.3 + 34.0}{2}\right)(2.6) + (34.0)(H - 2.6)$

$= 33.7 + 34.0(H - 2.6)$

④ $Q_W = CLH^{3/2}$, $L = 17.3$ FT

⑤ $Q_T = (A_T/A_W)Q_W$

EMBANKMENT RATING CURVE

– ASSUME THAT THE EMBANKMENT ACTS ESSENTIALLY AS A BROAD-CRESTED WEIR WHEN OVERTOPPED. THUS, THE DISCHARGE MAY BE DEFINED BY THE RELATIONSHIP

$$Q = CLH^{3/2} \qquad \text{(REF 5, p. 5-23)}$$

WHERE

Q = DISCHARGE, IN CFS, OVER EMBANKMENT

C = COEFFICIENT OF DISCHARGE = $f(H, l$ – SEE l = CREST CREADTH)

L = LENGTH OF EMBANKMENT OVERTOPPED, IN FEET

H = AVERAGE "FLOW-AREA WEIGHTED" HEAD ABOVE LOW TOP OF DAM. ASSUME INCREMENTAL FLOW AREAS OVER LOW TOP OF DAM (FOR SUCCESSIVE RESERVOIR ELEVATIONS) ARE TRAPEZOIDAL IN CROSS-SECTION. THEN THE INCREMENTAL AREA, A_i, IS APPROXIMATELY EQUAL TO $H_i[(L_1 + L_2)/2]$, WHERE H_i = INCREMENTAL HEAD, L_1 = LENGTH OF EMBANKMENT AT HIGHER ELEVATION, L_2 = LENGTH OF EMBANKMENT AT LOWER ELEVATION. THE AVERAGE "FLOW-AREA WEIGHTED" HEAD WILL THEN BE

$H_W = A_T/L_1$, WHERE A_T = TOTAL FLOW AREA.

PROJECT: DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY: DJS DATE: 1-10-80 PROJ. NO. 79-203-340

CHKD. BY: WJV DATE: 2-7-80 SHEET NO. 10 OF 25

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EMBANKMENT RATING TABLE:

RESERVOIR ELEVATION (FT)	① LENGTH OF DAM, L_1 (FT)	L_2 (FT)	INCREMENTAL HEAD, H_i (FT)	INCREMENTAL FLOW AREA, A_i (FT²)	TOTAL FLOW AREA, A_T (FT²)	WEIGHTED HEAD, H_w (FT)	② $\frac{H}{L}$	③ C	④ Q (CFS)
841.2	0	0	0	0	0	0	—	—	0
841.6	45	0	0.4	9	9	0.2	0.02	2.97	10
842.0	145	45	0.4	38	47	0.3	0.03	2.94	70
842.4	275	145	0.4	84	131	0.5	0.05	3.02	390
843.6	400	275	1.2	405	536	1.3	0.13	3.04	1800
844.6	410	400	1.0	405	941	2.3	0.23	3.04	4400
845.6	415	410	1.0	413	1354	3.3	0.33	3.04	7690
846.6	425	415	1.0	420	1774	4.2	0.42	3.04	11,300
847.6	430	425	1.0	428	2202	5.1	0.51	3.04	15,300
848.6	440	430	1.0	435	2637	6.0	0.60	3.04	19,980

① LENGTH OF EMBANKMENT OVERTOPPED ESTIMATED FROM FIELD NOTES AND U.S.G.S. TOPO QUAD, HANOVER, PA; NATURAL VALLEY SIDE-SLOPES: RIGHT = 2.5:1 ; LEFT = 5:1 .

② D = BREADTH OF CREST = 10 FT (FIELD MEASUREMENT)

③ FROM REF 10, FIG. 24

④ $Q = CL_1 H_w^{3/2}$

PROJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY JJS DATE 1-10-80 PROJ. NO. 79-203-340

CHKD. BY WJV DATE 2-7-80 SHEET NO. 11 OF 25

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TOTAL FACILITY RATING CURVE

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

	RESERVOIR ELEVATION (FT)	$Q_{SPILLWAY}$ (CFS)	$Q_{EMBANKMENT}$ (CFS)	Q_{TOTAL} (CFS)
	838.6	0	—	0
	839.6	60	—	60
	840.6	190	—	190
(LOW TOP OF DAM)	841.2	290	0	290
	841.6	360	10	370
	842.0	450 *	70	520
	842.4	540 *	290	830
	842.6	580	440 **	1020
	843.6	760	1800	2560
	844.6	1020	4400	5420
	845.6	1300	7690	8990
	846.6	1600	11,300	12,900
	847.6	1910	15,300	17,210
	848.6	2250	19,980	22,230

* BY LINEAR INTERPOLATION

** BY LOG-LOG INTERPOLATION

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 2-13-80 PROJ. NO. 79-303-340

CHKD. BY DLB DATE 2-14-80 SHEET NO. 12 OF 25

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MIDDLE PIGEON HILL DAM

MIDDLE PIGEON HILL DAM WAS BREACHED, REPORTEDLY DURING TROPICAL STORM ELOISE, IN SEPTEMBER, 1975. THE BREACH OPENING IS 50 FEET WIDE AT THE TOP, 6 FEET WIDE AT THE BOTTOM, AND 14.9 FEET DEEP AT THE UPSTREAM END (FIELD MEASUREMENTS). SINCE THE OPENING IS LARGE, AND SINCE IT IS LIKELY THAT ANY IMMENSE FLOWS (DUE TO THE BREACHING OF UPPER PIGEON HILL DAM) WOULD FURTHER ENLARGE THE BREACH OPENING, IT IS ASSUMED THAT THE REMAINING PORTION OF THE EMBANKMENT HAS NO ATTENUATION EFFECTS ON THE DISCHARGES FROM THE UPSTREAM DAM. IN OTHER WORDS, FLOWS WILL BE ROUTED DIRECTLY FROM THE OUTLET OF UPPER PIGEON HILL DAM TO LOWER PIGEON HILL RESERVOIR. THIS ASSUMPTION, ALTHOUGH NOT NECESSARILY ACCURATE, WILL PROVIDE SOMEWHAT CONSERVATIVE RESULTS CONCERNING DOWNSTREAM ROUTING.

SUBJECT: DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY: DJS DATE: 12-2-79 PROJ. NO. 79-303-340
CHKD. BY: WJV DATE: 2-7-80 SHEET NO. 13 OF 25

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LOWER PIGEON HILL DAM

DAM STATISTICS

- HEIGHT OF DAM ≈ 33 FT (FIELD MEASUREMENT)
- NORMAL POOL STORAGE CAPACITY = 2×10^6 GALLONS
  = 6.1 ACRE-FT (SEE NOTE 1)
- MAXIMUM POOL STORAGE CAPACITY ≈ 9 ACRE-FT (HEC-1)
  (@ LOW TOP OF DAM)
- DRAINAGE AREA:
  LOCAL AREA ≈ 0.04 SQ MI.
  CUMULATIVE AREA ≈ 0.44 SQ MI.
  [PLANIMETERED ON USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE: LANDISVILLE, PA]
- ELEVATION OF LOW TOP OF DAM: 797.8 (FIELD MEASUREMENT)
- NORMAL POOL ELEVATION: 792.3 (SEE NOTE 2)

NOTE 1:
- OBTAINED FROM "DAMS, RESERVOIRS, AND NATURAL LAKES", WATER RESOURCES BULLETIN NO. 5, COMMONWEALTH OF PENNSYLVANIA, DEPT. OF FORESTS AND WATER, HARRISBURG, PA, 1970.

PROJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 12-7-79 PROJ. NO. 79-203-340
CHKD. BY WJV DATE 2-7-80 SHEET NO. 14 OF 25

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LOWER PIGEON HILL DAM

NOTE 2:

- NORMAL POOL ELEVATION ESTIMATED FROM 7.5 MINUTE TOPOGRAPHIC QUADRANGLE, HANOVER, PA.

DAM CLASSIFICATION

DAM SIZE: SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION: HIGH (FIELD OBSERVATION)

REQUIRED SDF: ½ PMF – PMF (REF 1, TABLE 3)

HYDROGRAPH PARAMETERS

- LENGTH OF LONGEST WATERCOURSE: $L \simeq 0.26$ MI. (SEE NOTE 3)
- LENGTH OF LONGEST WATERCOURSE FROM DAM TO BASIN CENTROID: $L_{ca} \simeq 0.07$ MI.
(MEASURED ON U.S.G.S. TOPO QUAD: HANOVER, PA)

$C_t = 1.15$
$C_p = 0.54$
(SNYDER PARAMETERS SUPPLIED BY C.O.E., ZONE 15-A, SUSQUEHANNA RIVER BASIN)

t_p = SNYDER'S STANDARD LAG $= C_t (L \times L_{ca})^{0.3}$
$= (1.15)(0.26 \times 0.07)^{0.3} \simeq 0.35$ HOURS

NOTE 3: - LENGTH OF STREAM MEASURED FROM LOWER DAM TO DRAINAGE DIVIDE OF LOCAL SUB-BASIN.

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LOWER PIGEON HILL DAM

NOTE 4: HYDROGRAPH VARIABLES USED HERE ARE DEFINED IN REFERENCE 2, IN SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH."

RESERVOIR SURFACE AREAS

- SURFACE AREA AT NORMAL POOL (ELEV 792.3) ≈ 0.5 ACRES

  (PLANIMETERED ON USGS TOPO QUAD, HANOVER, PA; THE SURFACE AREA WAS APPROXIMATED AS 1.2 ACRE IN WATER RESOURCES BULLETIN NO. 5 (SEE NOTE 1).)

- S.A. @ ELEV 800 ≈ 1.5 ACRES [PLANIMETERED ON USGS TOPO QUAD: HANOVER, PA]

- ELEVATION OF LOW TOP OF DAM ≈ 797.8 (FIELD)

- RATE OF S.A. INCREASE PER FOOT RISE IN RESERVOIR LEVEL (BETWEEN 792.3 AND 800.0) ≈

$$\frac{\Delta SA}{\Delta H} \approx \frac{1.5-0.5}{7.7} \approx 0.04 \text{ AC/FT}$$

$$\therefore SA @ \text{LOW TOP OF DAM} \approx SA_{792.3} + (797.8 - 792.3)\left(\frac{\Delta SA}{\Delta H}\right)$$

$$\approx 0.5 + (5.5)(0.04) \approx 0.7 \text{ ACRES}$$

RESERVOIR ELEVATION @ ZERO STORAGE VOLUME

USING CONIC METHOD, VOLUME AT NORMAL POOL =

$$\frac{1}{3} HA \approx 6.1 \text{ ACRE FT}$$

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJJ DATE 12-8-79 PROJ. NO. 79-203-340

CHKD. BY WJV DATE 2-7-80 SHEET NO. 16 OF 25

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LOWER PIGEON HILL DAM

H = MAXIMUM DEPTH

A = SURFACE AREA ≃ 0.5 ACRES

$$\therefore H = (6.1 \times 3)/(0.5) \simeq 36.6 \text{ FT}$$

∴ ZERO STORAGE ACCORDING TO CONIC METHOD OCCURS AT

$$792.3 - 36.6 = 755.7$$

NOTE: ALTHOUGH THE MAXIMUM RESERVOIR ELEVATION IS PROBABLY MUCH HIGHER THAN 755.7, THIS ELEVATION MUST BE USED IN THE HEC-1 PROGRAM IN ORDER TO MAINTAIN A NORMAL POOL STORAGE OF 6.1 ACRE-FEET. ANY ERRORS IN BREACH OUTFLOWS CAUSED BY THIS ASSUMPTION WILL BE INSIGNIFICANT.

ELEVATION - STORAGE RELATIONSHIP

AN ELEVATION - STORAGE RELATIONSHIP IS COMPUTED INTERNALLY IN THE HEC-1 PROGRAM, BY USE OF THE CONIC METHOD, BASED ON THE GIVEN RESERVOIR SURFACE AREA AND ELEVATION DATA. (SEE SUMMARY INPUT/OUTPUT SHEETS.)

PROJECT	DAM SAFETY INSPECTION UPPER PIGEON HILL DAM		
BY DJS	DATE 12-8-79	PROJ. NO. 79-203-340	
CHKD. BY WJV	DATE 2-7-90	SHEET NO. 17	OF 25

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LOWER PIGEON HILL DAM

PMP CALCULATIONS

- APPROXIMATE RAINFALL AREA = 23.7 INCHES (REF 3, FIG. 1)

(CORRESPONDING TO A DURATION OF 24 HOURS AND A DRAINAGE AREA OF 200 SQUARE MILES)

- DEPTH - AREA - DURATION ZONE 6 (REF 3, FIG. 1)

- LOCAL DRAINAGE AREA = 0.04 SQUARE MILES; HOWEVER, PMP STORM WILL BE CENTERED OVER TOTAL 0.44 SQUARE MILE DRAINAGE AREA (SHEET 12). ASSUME DATA CORRESPONDING TO A 10-SQUARE MILE AREA APPLY HERE:

DURATION (HOURS)	PERCENT OF INDEX RAINFALL
6	113
12	123.5
24	132
48	143

- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AND FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALL BASIN) FOR DRAINAGE AREA 0.44 SQUARE MILES IS 0.80.

ECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 12-10-79 PROJ. NO. 79-203-340
CHKD. BY DLB DATE 2-7-80 SHEET NO. 18 OF 25

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LOWER PIGEON HILL DAM

FACILITY RATING CURVE

- DISCHARGE FACILITIES FOR THIS DAM INCLUDE FOUR 8-INCH PIPES, WHICH CAN BE NEGLECTED FOR THE PURPOSE OF THIS ANALYSIS. THERE IS NO EMERGENCY SPILLWAY, AND THUS, FOR ANY DESIGN FLOODS, ESSENTIALLY ALL OF THE OUTFLOW WILL BE OVER THE EMBANKMENT.

THE EMBANKMENT ITSELF IS CURVED, THE RIGHT-HAND PORTION OF WHICH RUNS PARALLEL TO THE SERVICE ROAD. THE LEFT-HAND PORTION COMPRISES THE MAIN FACE OF THE DAM. ALONG THE RIGHT-HAND PORTION, A SMALL BREACH OPENING CURRENTLY EXISTS, WHICH WOULD DISCHARGE INTO THE DITCH ALONGSIDE THE ROAD UNDER HIGH FLOW. THE DITCH IS ABOUT 5-10 FEET BELOW THE BASE OF THE BREACH OPENING. SINCE THE POTENTIAL SIZE OF THIS BREACH IS SMALL IN COMPARISON TO THE SIZE OF A POTENTIAL BREACH IN THE MAIN FACE OF THE DAM, IT WILL BE NEGLECTED IN THE CALCULATIONS. THUS, ALL DISCHARGE WILL BE ASSUMED TO OCCUR OVER THE EMBANKMENT. THE EFFECTS OF BREACHING THE MAIN PORTION OF THE EMBANKMENT, THEN, WILL BE ANALYZED, IN ORDER TO DETERMINE DOWNSTREAM EFFECTS. FROM FIELD OBSERVATION AND FROM INSPECTION OF THE USGS TOPO QUAD FOR HANOVER, PA, IT IS NOTED THAT THE EFFECTS OF POTENTIAL BREACH OUTFLOWS ON DOWNSTREAM RESIDENCES IS UNCERTAIN. THEREFORE, THIS CONSERVATIVE APPROACH IS TAKEN IN ORDER TO EXAMINE EXTREME POSSIBLE CONDITIONS.

EMBANKMENT RATING CURVE:

- ASSUME THAT THE EMBANKMENT ACTS ESSENTIALLY AS A BROAD-CRESTED WEIR WHEN OVERTOPPED. THUS, THE DISCHARGE CAN BE ESTIMATED AS

$Q = CLH^{3/2}$ (REF 5 p. 5-30)

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 12-10-79 PROJ. NO. 79-203-340
CHKD. BY WJV DATE 2-7-80 SHEET NO. 19 OF 25

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LOWER PIGEON HILL DAM

WHERE Q = DISCHARGE OVER EMBANKMENT, IN CFS
C = COEFFICIENT OF DISCHARGE = $f(H, l)$, WHERE l = CREST LENGTH)
L = LENGTH OF EMBANKMENT OVERTOPPED, IN FEET
H = AVERAGE "FLOW-AREA WEIGHTED" HEAD ABOVE LOW TOP OF DAM. ASSUME INCREMENTAL FLOW AREAS OVER LOW TOP OF DAM (FOR SUCCESSIVE RESERVOIR ELEVATIONS) ARE TRAPEZOIDAL IN CROSS-SECTION. THEN THE INCREMENTAL AREA, $A_i = H_i\left[(L_1+L_2)/2\right]$, WHERE H_i = INCREMENTAL HEAD, L_1 = LENGTH OF EMBANKMENT AT HIGHER ELEVATION, L_2 = LENGTH OF EMBANKMENT AT LOWER ELEVATION. THE AVERAGE "FLOW-AREA WEIGHTED" HEAD WILL THEN BE

$H_w = A_T/L_1$, WHERE A_T = TOTAL FLOW AREA.

EMBANKMENT RATING TABLE:

RESERVOIR ELEVATION (FT)	① LENGTH OF DAM, L_1 (FT)	L_2 (FT)	INCREMENTAL HEAD, H_i (FT)	INCR. FLOW AREA, A_i (FT²)	TOTAL FLOW AREA, A_T (FT²)	WEIGHTED HEAD, H (FT)	② $\frac{H}{l}$	③ C	Q (CFS)
797.8	0	—	0	—	—	—	—	—	0
798.1	5	0	0.3	1	1	0.2	0.03	2.97	0
798.6	15	5	0.5	5	6	0.4	0.05	3.01	10
799.1	30	15	0.5	11	17	0.6	0.09	3.03	40
799.6	70	30	0.5	25	42	0.6	0.08	3.03	100
800.1	160	70	0.5	58	100	0.6	0.08	3.03	230
800.6	200	160	0.5	90	190	1.0	0.13	3.04	610
801.1	205	200	0.5	101	291	1.4	0.18	3.07	1040
802.1	220	205	1.0	213	504	2.3	0.29	3.09	2370
803.1	235	220	1.0	228	732	3.1	0.39	3.09	3960
804.1	255	235	1.0	245	977	3.8	0.48	3.09	5840
805.1	270	255	1.0	263	1240	4.6	0.58	3.09	8230
806.1	290	270	1.0	280	1520	5.2	0.65	3.09	10,630

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY JSS DATE 12-19-79 PROJ. NO. 79-303-340

CHKD. BY WJV DATE 2-7-80 SHEET NO. 20 OF 25

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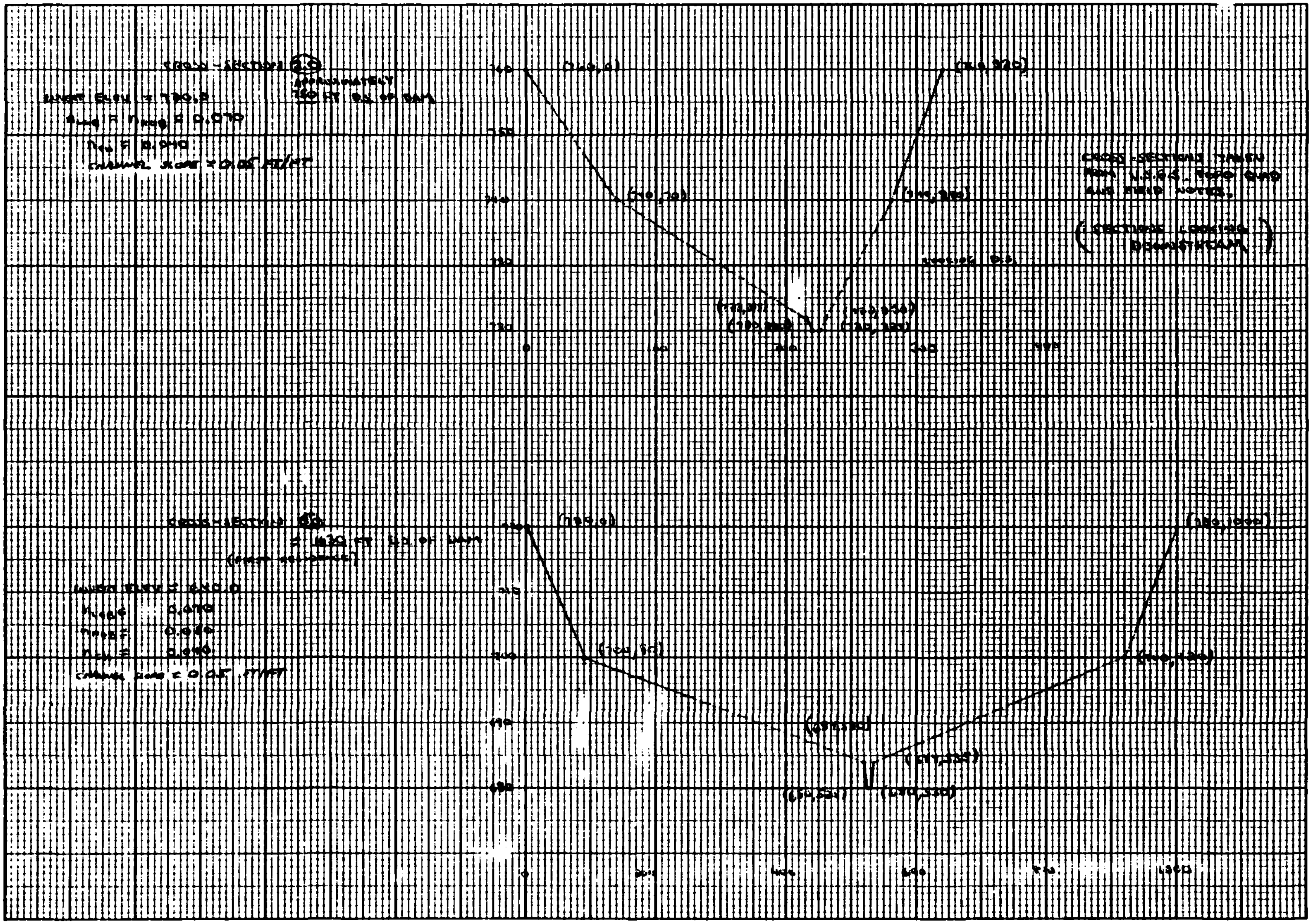
LOWER PIGEON HILL DAM

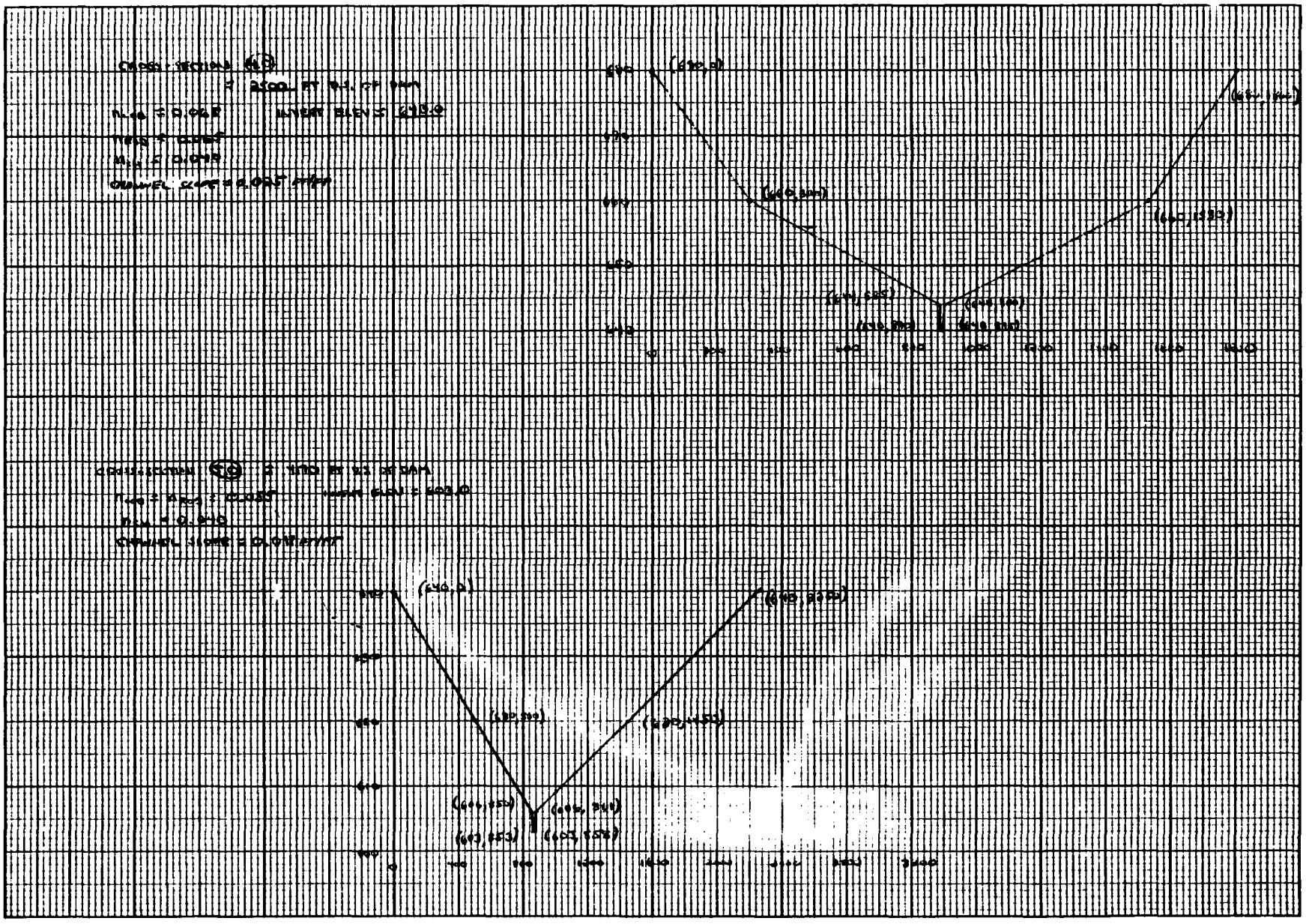
(1) LENGTH OF EMBANKMENT OVERTOPPED ESTIMATED FROM FIELD NOTES AND U.S.G.S. TOPOGRAPHIC QUAD: HANOVER, PA.; NATURAL VALLEY SIDE-SLOPES: RIGHT = 11:1, LEFT = 6:1.

(2) BREADTH OF CREST, 1, MEASURED IN FIELD APPROXIMATELY 8 FEET.

(3) FROM REF 18, FIG. 24.


CROSS SECTIONS TAKEN FROM U.S.G.S. TOPO QUAD AND FIELD NOTES.
(SECTIONS LOOKING DOWNSTREAM)

21/35


CROSS SECTION (6.0)
= 2500 FT D.S. OF DAM
INVERT ELEV = 6150.0
CHANNEL SLOPE = 0.027 FT/FT
(640,0)
(640,1500)
CROSS SECTION (7.0)
= 1700 FT D.S. OF DAM
INVERT ELEV = 6050.0
CHANNEL SLOPE = 0.017 FT/FT
(640,0)
(640,2000)

58/ee

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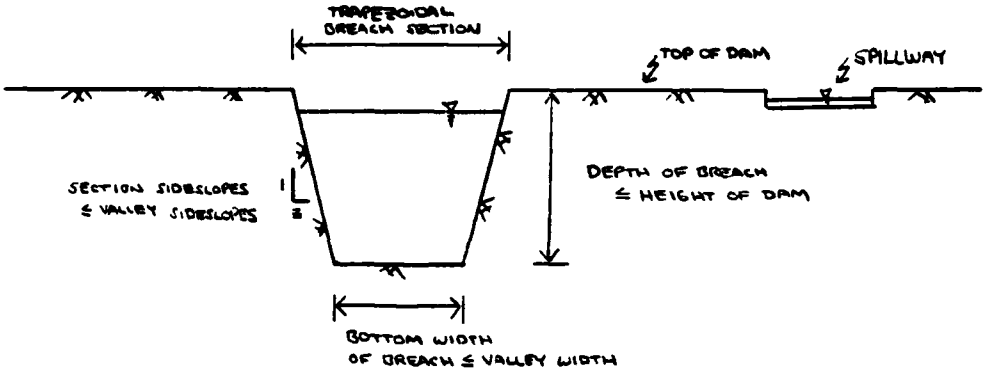
BREACH ASSUMPTIONS

TYPICAL BREACH SECTION:



HEC-1 DAM BREACHING ANALYSIS INPUT: TO ANALYZE EXTREME BREACH CONDITIONS, THE ½ PMF EVENT WILL BE USED, WITH A RAPID FAILURE TIME OF 0.5 HOURS, AND MAXIMUM FAILURE SECTION FOR EACH OF THE DAMS. ALSO, BREACHING WILL BEGIN NOT WHEN THE WATER SURFACE LEVEL REACHES THE LOW TOP OF DAM ELEVATION, BUT RATHER AT SOME ELEVATION ABOVE THIS:

UPPER PIGEON HILL DAM

- MAXIMUM BREACH SECTION: BOTTOM WIDTH = 150 FT, DEPTH = 29 FT, SIDE SLOPES = 2.5:1
- HEAD ON LOW TOP OF DAM AT WHICH BREACHING COMMENCES = 1.0 FT, BASED ON OUTPUT OF OVERTOPPING ANALYSIS (HEC-1): AT 0.50 PMF, MAXIMUM DEPTH OVER DAM = 1.08 FT (SUMMARY INPUT/OUTPUT SHEETS, SHEET K).

LOWER PIGEON HILL DAM (FRONT SECTION ONLY)

- MAXIMUM BREACH SECTION: BOTTOM WIDTH = 40 FT, DEPTH = 34 FT, SIDE SLOPES = 1.5:1
- HEAD ON LOW TOP OF DAM AT WHICH BREACHING COMMENCES = 3.5 FT (IN

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ORDER TO MAXIMIZE FAILURE HEAD), BASED ON OUTPUT OF OVERTOPPING ANALYSIS (HEC-1): AT 0.50PMF, MAXIMUM DEPTH OVER DAM ≈ 3.02 FT (SUMMARY INPUT/OUTPUT SHEETS, SHEET 2).

THE BREACH ASSUMPTIONS GIVEN ON SHEET 23 ARE BASED SOMEWHAT ON INFORMATION CONCERNING EARTH DAM BREACHING PROVIDED BY THE C.O.E., BALTIMORE DISTRICT, AND ON THE PHYSICAL CONSTRAINTS OF THE DAM AND SURROUNDING TERRAIN:

UPPER PIGEON HILL DAM

- HEIGHT OF DAM ≈ 29 FEET
- LENGTH OF BREACHABLE EMBANKMENT ≈ 300 FT (FIELD NOTES)
- VALLEY BOTTOM WIDTH ≈ 150 FT (FIELD OBSERVATION)
- VALLEY SIDESLOPES ADJACENT TO DAM:
  - LEFT: ≈ 5H:1V
  - RIGHT: ≈ 2.5H:1V (USGS TOPO)

LOWER PIGEON HILL DAM:

- HEIGHT OF DAM ≈ 34 FEET (FRONT SECTION)
- LENGTH OF EMBANKMENT: FRONT SECTION ≈ 125 FT
  - SIDE SECTION ≈ 75 FT (FIELD NOTES)
- VALLEY BOTTOM WIDTH ≈ 40 FT (FRONT SECTION) (FIELD OBSERVATION)
- VALLEY SIDESLOPES ADJACENT TO DAM:
  - LEFT: ≈ 2.5H:1V
  - RIGHT: ≈ 2.5H:1V (USGS TOPO)

HEC-1 DAM BREACHING ANALYSIS OUTPUT: 0.50 PMF EVENT

RESERVOIR DATA*:

RESERVOIR	BREACH BOTTOM WIDTH (FT) UPPER PIGEON HILL	BREACH BOTTOM WIDTH (FT) LOWER PIGEON HILL	ACTUAL MAXIMUM FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HRS)	INTERPOLATED OR HEC-1 ROUTED MAX. FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HRS)	ACTUAL PEAK FLOW THROUGH DAM (CFS)	CORRESPONDING TIME OF PEAK (HRS)	TIME OF INITIAL BREACH (HRS)
UPPER PIGEON HILL	150	—	2238	40.40	1939	40.50	2238	40.40	40.33
LOWER PIGEON HILL	150	40	2686	40.51	1926	40.67	2686	40.51	40.50

DOWNSTREAM ROUTING DATA*:

DOWNSTREAM ROUTING SECTION	PEAK FLOW (CFS)	TIME OF FLOW (HRS)	CORRESPONDING WSEL. (FT)	W.S.EL. W/O BREACH (FT)	Δ ELEV (FT)
SECTION 2, 750 FT D.S. OF LOWER DAM	2030	40.67	725.2	723.4	+1.8
SECTION 3, 1630 FT D.S. OF LOWER DAM	2028	40.67	685.9	684.4	+1.5
SECTION 4, 2500 FT D.S. OF LOWER DAM	2014	40.67	646.3	644.7	+1.6
SECTION 5, 4170 FT D.S. OF LOWER DAM	1824	40.83	608.8	607.4	+1.4

* – DATA BASED ON ASSUMPTION OF 1.0 FT OVERTOPPING PRIOR TO BREACHING OF UPPER PIGEON HILL DAM, AND 3.5 FT OVERTOPPING PRIOR TO BREACHING OF LOWER PIGEON HILL DAM.

LEA CONSULTANTS, INC.
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SUBJECT Dam Safety Inspection
Upper Pigeon Hill Dam

BY DJS DATE 2-19-80 PROJ. NO. 79-303-340

CHKD. BY WJV DATE 2-19-80 SHEET NO. A OF S

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Summary Input/Output Sheets

OVERTOPPING ANALYSIS

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DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM W/D.S. LOWER PIGEON HILL DAM
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION

                    JOB SPECIFICATION
  NQ    NHR   NMIN   IDAY   IHR   IMIN  METRC   IPLT   IPRT  NSTAN
 288     0     10      0     0      0     0      0      0     0
                     JOPER   NWT  LROPT  TRACE
                       5      0     0     0

                 MULTI-PLAN ANALYSES TO BE PERFORMED
                     NPLAN= 1 NRTIO= 5 LRTIO= 1
   RTIOS=    .10    .20    .30    .50   1.00

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

                 SUB-AREA RUNOFF COMPUTATION

  RESERVOIR INFLOW- UPPER PIGEON HILL DAM

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

                    HYDROGRAPH DATA
  IHYDG   IUHG   TAREA   SNAP   TRSDA  TRSPC  RATIO  ISNOW  ISAME  LOCAL
     1      1     .40    0.00    .44   0.00  0.000    0      1      0

                    PRECIP DATA
            SPFE    PMS     R6    R12    R24    R48    R72    R96
           0.00   23.70  113.00 123.50 132.00 143.00   0.00   0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800
                                          INITIAL AND CONSTANT RAINFALL
                                          LOSSES AS PER C.O.E.
                    LOSS DATA
 LROPT  STRKR  DLTKR  RTIOL  ERAIN  STRKS  RTIOK  STRTL  CNSTL  ALSMX  RTIMP
   0    0.00   0.00   1.00   0.00   0.00   1.00   1.00    .05   0.00   0.00

                 UNIT HYDROGRAPH DATA
            TP=   .93    CP= .54    NTA=  0
                                          BASE FLOW PARAMETERS
                                          AS PER C.O.E.
                    RECESSION DATA
            STRTQ=   -1.50    QRCSN=   -.05    RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.08 AND R= 6.77 INTERVALS

      UNIT HYDROGRAPH 40 END-OF-PERIOD ORDINATES, LAG=    .93 HOURS, CP=  .54  VOL= 1.00
     10.     37.     74.    112.    139.    150.    141.    122.    105.     90.
     70.     67.     56.     50.     43.     37.     32.     28.     24.     21.
     18.     15.     13.     11.     10.      8.      7.      6.      5.      5.
      4.      3.      3.      3.      2.      2.      2.      1.      1.      1.

 0                    END-OF-PERIOD FLOW
MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q     MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q

                                                      SUM   27.11  24.70   2.41  37880.
                                                          ( 689.)( 627.)(  61.)( 1072.64)
```

SUBJECT Dam Safety Inspection

Upper Pigeon Hill Dam

BY DJS DATE 2-19-80 PROJ. NO. 79-203-340

CHKD. BY WJV DATE 2-14-80 SHEET NO. B OF 5

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Upper Pigeon Hill Reservoir Inflows

0.1 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	140.	82.	25.	13.	3707.
CMS	4.	2.	1.	0.	107.
INCHES		1.91	2.36	2.45	2.45
MM		48.47	59.89	62.13	62.13
AC-FT		41.	50.	52.	52.
THOUS CU M		50.	62.	64.	64.

0.2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	295.	164.	51.	26.	7574.
CMS	8.	5.	1.	1.	214.
INCHES		3.82	4.72	4.89	4.89
MM		96.95	119.77	124.27	124.27
AC-FT		81.	101.	104.	104.
THOUS CU M		100.	124.	129.	129.

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	443.	246.	76.	39.	11360.
CMS	13.	7.	2.	1.	322.
INCHES		5.73	7.07	7.34	7.34
MM		145.42	179.66	186.40	186.40
AC-FT		122.	151.	156.	156.
THOUS CU M		151.	186.	193.	193.

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	738.	410.	127.	66.	18934.
CMS	21.	12.	4.	2.	536.
INCHES		9.54	11.79	12.23	12.23
MM		242.37	299.43	310.67	310.67
AC-FT		203.	251.	261.	261.
THOUS CU M		251.	310.	322.	322.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1476.	821.	253.	131.	37868.
CMS	42.	23.	7.	4.	1072.
INCHES		19.08	23.58	24.46	24.46
MM		484.74	598.87	621.35	621.35
AC-FT		407.	503.	522.	522.
THOUS CU M		502.	620.	643.	643.

SUBJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 8-19-80 PROJ. NO. 79-092-340
CHKD. BY WJV DATE 2-14-90 SHEET NO. 6 OF 5

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

                                HYDROGRAPH ROUTING

          ROUTE THROUGH RESERVOIR

                    IS1AQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                    DAM 1       1       0       0       0       0       1       0       0
                                          ROUTING DATA
              QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                0.0   0.000    0.00       1       1       0       0               0

                    NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                        1       0       0   0.000   0.000   0.000  -839.      -1

STAGE      838.60    839.60    840.60    841.20    841.60    842.00    842.40    842.60    843.60   844.60
           845.60    846.60    847.60    848.60

FLOW         0.00     60.00    190.00    290.00    370.00    520.00    830.00   1020.00   2560.00  5420.00
        8990.00  12900.00  17210.00  22230.00

SURFACE AREA=      0.      2.      3.      8.

CAPACITY=          0.     31.     37.    137.

ELEVATION=       792.    839.    841.    860.


                CREL   SPWID    COQW    EXPW   ELEVL    COQL   CAREA    EXPL
               838.6     0.0     0.0     0.0     0.0     0.0     0.0     0.0

                                          DAM DATA
                          TOPEL    COWD    EXPD  DAMWID
                          841.2     0.0     0.0      0.

          PEAK OUTFLOW IS      141. AT TIME  40.67 HOURS
```

UPPER PIGEON HILL DAM OUTFLOW HYDROGRAPHS

0.1 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	141.	81.	25.	13.	3779.
CMS	4.	2.	1.	0.	107.
INCHES		1.89	2.35	2.44	2.44
MM		48.01	59.77	62.01	62.01
AC-FT		40.	50.	52.	52.
THOUS CU M		50.	62.	64.	64.

```
          PEAK OUTFLOW IS      284. AT TIME  40.67 HOURS
```

0.2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	284.	163.	51.	26.	7557.
CMS	8.	5.	1.	1.	214.
INCHES		3.80	4.71	4.88	4.88
MM		96.51	119.51	124.00	124.00
AC-FT		81.	100.	104.	104.
THOUS CU M		100.	124.	128.	128.

SUBJECT: DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY: DJC DATE: 2-19-80 PROJ. NO. 79-203-749
CHKD. BY: WJV DATE: 2-19-80 SHEET NO. D OF 5

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UPPER PIGEON HILL DAM OUTFLOW HYDROGRAPHS

PEAK OUTFLOW IS 436. AT TIME 40.67 HOURS

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	436.	245.	76.	39.	11335.
CMS	12.	7.	2.	1.	321.
INCHES		5.71	7.06	7.32	7.32
MM		144.93	179.25	185.98	185.98
AC-FT		122.	150.	156.	156.
THOUS CU M		150.	186.	193.	193.

PEAK OUTFLOW IS 735. AT TIME 40.50 HOURS

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	735.	409.	126.	66.	18893.
CMS	21.	12.	4.	2.	535.
INCHES		9.52	11.76	12.20	12.20
MM		241.68	298.77	310.00	310.00
AC-FT		203.	251.	260.	260.
THOUS CU M		250.	309.	321.	321.

PEAK OUTFLOW IS 1475. AT TIME 40.50 HOURS

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1475.	820.	253.	131.	37783.
CMS	42.	23.	7.	4.	1070.
INCHES		19.06	23.52	24.41	24.41
MM		484.17	597.51	619.95	619.95
AC-FT		406.	502.	520.	520.
THOUS CU M		501.	619.	642.	642.

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

SUB-AREA RUNOFF COMPUTATION

RESERVOIR INFLOW- LOWER PIGEON HILL DAM

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.04	0.00	.44	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.70	113.00	123.50	132.00	143.00	0.00	0.00

TWSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

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

UNIT HYDROGRAPH DATA

TP= .35 CP= .54 NTA= 0

SUBJECT Dam Safety Inspection

Upper Pigeon Hill Dam

BY DJS DATE 3-19-80 PROJ. NO. 79-203-340

CHKD. BY WJV DATE 2-19-80 SHEET NO. E OF 5

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LOWER PIGEON HILL RESERVOIR INFLOWS.

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00
**** ERROR CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 2.38 AND R= 2.36 INTERVALS

UNIT HYDROGRAPH 14 END-OF-PERIOD ORDINATES, LAG= .35 HOURS, CP= .54 VOL= 1.00

10.	31.	37.	27.	17.	11.	7.	5.	3.	2.
1.	1.	1.	0.						

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	27.11	24.70	2.41	3841.
										(689.)(	627.)(	61.)(	108.77)

0.1 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24.	9.	3.	1.	366.
CMS	1.	0.	0.	0.	11.
INCHES		2.05	2.40	2.50	2.50
MM		51.97	61.01	63.38	63.38
AC-FT		4.	5.	5.	5.
THOUS CU M		5.	6.	7.	7.

0.2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	49.	18.	5.	3.	773.
CMS	1.	0.	0.	0.	22.
INCHES		4.09	4.80	4.99	4.99
MM		103.94	122.03	126.76	126.76
AC-FT		9.	10.	11.	11.
THOUS CU M		11.	13.	13.	13.

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	73.	26.	8.	4.	1159.
CMS	2.	1.	0.	0.	33.
INCHES		6.14	7.21	7.49	7.49
MM		155.90	183.04	190.14	190.14
AC-FT		13.	15.	16.	16.
THOUS CU M		16.	19.	20.	20.

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	122.	44.	13.	7.	1931.
CMS	3.	1.	0.	0.	55.
INCHES		10.23	12.01	12.48	12.48
MM		259.84	305.07	316.90	316.90
AC-FT		22.	26.	27.	27.
THOUS CU M		27.	32.	33.	33.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	244.	88.	26.	13.	3863.
CMS	7.	2.	1.	0.	109.
INCHES		20.46	24.02	24.95	24.95
MM		519.68	610.14	633.80	633.80
AC-FT		44.	51.	53.	53.
THOUS CU M		54.	63.	66.	66.

SUBJECT DAM SAFETY INSPECTION

UPPER PIGEON HILL DAM

BY DJS DATE 9-19-80 PROJ. NO. 79-222-340

CHKD. BY WJV DATE 2-19-80 SHEET NO. F OF S

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SUM OF OUTFLOW HYDROGRAPH FROM UPPER PIGEON HILL DAM AND INFLOW HYDROGRAPH FOR LOWER PIGEON HILL RESERVOIR.

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

COMBINE HYDROGRAPHS

COMBINE LOWER DAM INFLOW HYDROGRAPH WITH UPPER DAM OUTFLOW HYDROGRAPH

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

0.1 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	152.	89.	28.	14.	4165.
CMS	4.	3.	1.	0.	118.
INCHES		1.89	2.36	2.45	2.45
MM		47.89	59.88	62.13	62.13
AC-FT		44.	55.	57.	57.
THOUS CU M		55.	68.	71.	71.

0.2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	307.	179.	56.	29.	8329.
CMS	9.	5.	2.	1.	236.
INCHES		3.79	4.71	4.89	4.89
MM		96.36	119.74	124.25	124.25
AC-FT		89.	111.	115.	115.
THOUS CU M		110.	136.	142.	142.

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	474.	270.	86.	43.	12493.
CMS	13.	8.	2.	1.	354.
INCHES		5.70	7.07	7.34	7.34
MM		144.83	179.60	186.36	186.36
AC-FT		134.	166.	172.	172.
THOUS CU M		165.	205.	212.	212.

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	802.	450.	139.	72.	20824.
CMS	23.	13.	4.	2.	590.
INCHES		9.51	11.79	12.23	12.23
MM		241.54	299.35	310.63	310.63
AC-FT		223.	276.	287.	287.
THOUS CU M		275.	341.	354.	354.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1609.	901.	279.	145.	41645.
CMS	46.	26.	8.	4.	1179.
INCHES		19.05	23.57	24.46	24.46
MM		483.96	598.66	621.21	621.21
AC-FT		447.	553.	574.	574.
THOUS CU M		551.	682.	708.	708.

SUBJECT: DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 8-19-80 PROJ. NO. 79-203-340
CHKD. BY WJV DATE 2-19-80 SHEET NO. G OF S

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                              HYDROGRAPH ROUTING

          ROUTE TOTAL HYDROGRAPH THROUGH LOWER RESERVOIR

                        ISTAQ   ICOMP   IECON   ITAPE   JPLT    JPRT   INAME  ISTAGE   IAUTO
                        DAM 2       1       3       0       0       0       1       0       0
                                              ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.000    0.00       1       1       0       0               0

                        NSTPS   NSTDL     LAG   AMSKK       X     TSK   SIONA  ISPRAT
                            1       0       0   0.000   0.000   0.000    -792.      -1

STAGE      797.80    798.10    798.60    799.10    799.60    800.10    800.60    801.10    802.10  803.1
           804.10    805.10    806.10

FLOW         0.00      0.00     10.00     40.00    100.00    230.00    610.00   1040.00   2370.00  3960.00
          5840.00   8230.00  10630.00

SURFACE AREA=      0.      1.      1.      2.

CAPACITY=          0.      6.      9.     33.

ELEVATION=       756.    792.    798.    820.

                CREL   SPWID    COQW    EXPW    ELEVL    COOL   CAREA    EXPL
               797.8     0.0     0.0     0.0     0.0     0.0     0.0     0.0

                                     DAM DATA
                          TOPEL    COQD    EXPD  DAMWID
                          797.8     0.0     0.0      0.

          PEAK OUTFLOW IS      151. AT TIME  40.83 HOURS
```

LOWER PIGEON HILL DAM OUTFLOW HYDROGRAPHS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	151.	89.	27.	14.	3899.
CMS	4.	3.	1.	0.	110.
INCHES		1.88	2.29	2.29	2.29
MM		47.85	58.16	58.16	58.16
AC-FT		44.	54.	54.	54.
THOUS CU M		54.	66.	66.	66.

0.1 PMF

```
          PEAK OUTFLOW IS      306. AT TIME  40.67 HOURS
```

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	306.	179.	56.	28.	8054.
CMS	9.	5.	2.	1.	228.
INCHES		3.79	4.70	4.73	4.73
MM		96.34	119.42	120.13	120.13
AC-FT		89.	110.	111.	111.
THOUS CU M		110.	136.	137.	137.

0.2 PMF

SUBJECT: DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY: DTS DATE: 2-19-80 PROJ. NO. 79-203-340
CHKD. BY: WJV DATE: 2-19-80 SHEET NO. H OF S

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LOWER PIGEON HILL DAM OUTFLOW HYDROGRAPHS.

PEAK OUTFLOW IS 472. AT TIME 40.67 HOURS

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	472.	270.	83.	42.	12214.
CMS	13.	8.	2.	1.	346.
INCHES		5.70	7.06	7.17	7.17
MM		144.84	179.22	182.18	182.18
AC-FT		134.	165.	168.	168.
THOUS CU M		165.	204.	208.	208.

PEAK OUTFLOW IS 798. AT TIME 40.50 HOURS

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	798.	450.	139.	71.	20532.
CMS	23.	13.	4.	2.	581.
INCHES		9.51	11.76	12.06	12.06
MM		241.51	298.79	306.26	306.26
AC-FT		223.	276.	283.	283.
THOUS CU M		275.	340.	349.	349.

PEAK OUTFLOW IS 1607. AT TIME 40.50 HOURS

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1607.	901.	278.	144.	41336.
CMS	46.	26.	8.	4.	1171.
INCHES		19.05	23.54	24.28	24.28
MM		483.93	597.91	616.60	616.60
AC-FT		447.	552.	569.	569.
THOUS CU M		551.	681.	702.	702.

DOWNSTREAM ROUTING:

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

HYDROGRAPH ROUTING

ROUTE FROM LOWER DAM TO SECTION 2: 750 FT D.S. OF DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
102	1	0	0	0	0	1	0	0

ROUTING DATA

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

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

SUBJECT: DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY: DJS DATE: 2-10-80 PROJ. NO. 79-203-340
CHKD. BY: WJV DATE: 2-19-80 SHEET NO. I OF 5

GAI CONSULTANTS, INC.
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NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNV1	ELMAX	RLNTH	SEL
.0700	.0400	.0700	720.0	760.0	750.	.05000

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

0.00	760.00	70.00	740.00	215.00	722.00	220.00	720.00	225.00	720.00
230.00	722.00	280.00	740.00	320.00	760.00				

STORAGE	0.00	.37	1.37	3.20	5.85	9.33	13.63	18.76	24.72
	39.07	47.10	55.55	64.42	73.71	83.42	93.55	104.10	115.07
OUTFLOW	0.00	221.57	1128.19	2955.90	5951.94	10337.04	16315.18	24077.90	33806.89
	60487.29	78204.26	98159.66	120373.93	144875.58	171698.73	200881.44	232464.55	266490.97
STAGE	720.00	722.11	724.21	726.32	728.42	730.53	732.63	734.74	736.84
	741.05	743.16	745.26	747.37	749.47	751.58	753.68	755.79	757.89
FLOW	0.00	221.57	1128.19	2955.90	5951.94	10337.04	16315.18	24077.90	33806.89
	60487.29	78204.26	98159.66	120373.93	144875.58	171698.73	200881.44	232464.55	266490.97

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HYDROGRAPH ROUTING

ROUTE FROM SECTION 2 TO SECTION 3; 1630 FT D.S. OF DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
203	1	0	0	0	0	1	0	0

ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNV1	ELMAX	RLNTH	SEL
.0700	.0400	.0500	680.0	720.0	880.	.05000

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

0.00	720.00	90.00	700.00	520.00	684.00	525.00	680.00	530.00	680.00
535.00	684.00	920.00	700.00	1000.00	720.00				

STORAGE	0.00	.32	.89	4.27	12.20	24.70	41.76	63.38	89.55
	155.12	191.18	228.00	265.59	303.93	343.04	382.90	423.53	464.92
OUTFLOW	0.00	164.95	650.05	2471.62	7692.34	17994.17	34789.08	59342.36	92820.55
	196138.72	272143.59	358434.11	454634.17	560461.76	675701.46	800187.00	933789.69	1076410.22
STAGE	680.00	682.11	684.21	686.32	688.42	690.53	692.63	694.74	696.84
	701.05	703.16	705.26	707.37	709.47	711.58	713.68	715.79	717.89
FLOW	0.00	164.95	650.05	2471.62	7692.34	17994.17	34789.08	59342.36	92820.55
	196138.72	272143.59	358434.11	454634.17	560461.76	675701.46	800187.00	933789.69	1076410.22

SUBJECT: DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY: DJS DATE: 2-19-80 PROJ. NO. 79-202-340

CHKD. BY: WJV DATE: 2-19-80 SHEET NO. 5 OF 5

GAI CONSULTANTS, INC.
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********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE FROM SECTION 3 TO SECTION 4; 2500 FT D.S. OF DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
304	1	0	0	0	0	1	0	0

ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0650	.0400	.0650	640.0	680.0	870.	.02500

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 680.00 300.00 660.00 885.00 644.00 890.00 640.00 895.00 640.00
900.00 644.00 1530.00 660.00 1800.00 680.00

STORAGE	0.00	.32	.90	5.56	16.95	35.05	59.88	91.44	129.71
	225.90	280.14	336.90	396.19	458.00	522.33	589.19	658.57	730.47
OUTFLOW	0.00	116.64	460.01	1958.96	6624.19	16071.32	31654.89	54587.77	85987.50
	182070.37	251395.33	330837.41	420362.10	519996.77	629811.17	749905.12	880400.26	1021434.47
STAGE	640.00	642.11	644.21	646.32	648.42	650.53	652.63	654.74	656.84
	661.05	663.16	665.26	667.37	669.47	671.58	673.68	675.79	677.89
FLOW	0.00	116.64	460.01	1958.96	6624.19	16071.32	31654.89	54587.77	85987.50
	182070.37	251395.33	330837.41	420362.10	519996.77	629811.17	749905.12	880400.26	1021434.47

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HYDROGRAPH ROUTING

ROUTE FROM SECTION 4 TO SECTION 5; 4170 FT D.S. OF DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
405	1	0	0	0	0	1	0	0

ROUTING DATA

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

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

SUBJECT DAM SAFETY INSPECTION

Upper Pigeon Hill Dam

BY DTS DATE 2-19-90 PROJ. NO. 79-383-240

CHKD. BY WJV DATE 2-19-90 SHEET NO. K OF S

GAI CONSULTANTS, INC.
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NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNV1	ELMAX	RLNTH	SEL
.0550	.0400	.0550	603.0	640.0	1670.	.01700

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 640.00 500.00 620.00 850.00 606.00 853.00 603.00 858.00 603.00
861.00 606.00 1450.00 620.00 2250.00 640.00

STORAGE	0.00	.52	2.33	12.50	32.43	62.11	101.54	150.73	209.66
	356.54	444.19	541.30	647.85	763.86	889.31	1024.22	1168.57	1322.38
OUTFLOW	0.00	77.77	358.99	1896.37	6048.75	13865.65	26255.36	44041.01	67986.09
	137446.10	184139.77	239553.49	304267.70	378845.54	463834.69	559768.91	667169.35	786545.63
STAGE	603.00	604.95	606.89	608.84	610.79	612.74	614.68	616.63	618.58
	622.47	624.42	626.37	628.32	630.26	632.21	634.16	636.11	638.05
FLOW	0.00	77.77	358.99	1896.37	6048.75	13865.65	26255.36	44041.01	67986.09
	137446.10	184139.77	239553.49	304267.70	378845.54	463834.69	559768.91	667169.35	786545.63

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	838.60	838.60	841.20
STORAGE	31.	31.	37.
OUTFLOW	0.	0.	290.

UPPER PIGEON HILL DAM; OVERTOPPING OCCURS AT APPROXIMATELY 0.20 PMF.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	840.22	0.00	35.	141.	0.00	40.67	0.00
.20	841.17	0.00	37.	284.	0.00	40.67	0.00
.30	841.78	.58	39.	436.	2.00	40.67	0.00
.50	842.28	1.08	40.	735.	4.17	40.50	0.00
1.00	842.90	1.70	42.	1475.	6.50	40.50	0.00

PROJECT DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY DJS DATE 2-19-80 PROJ. NO. [illegible]
CHKD. BY WJV DATE 2-14-80 SHEET NO. L OF S

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	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	792.30	797.80	797.80
STORAGE	6.	9.	9.
OUTFLOW	0.	0.	0.

LOWER PIGEON HILL DAM; OVERTOPPING OCCURS AT LESS THAN 0.01 PMF.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	799.80	2.00	11.	151.	15.83	40.83	0.00
.20	800.20	2.40	11.	306.	29.00	40.67	0.00
.30	800.42	2.62	11.	472.	30.17	40.67	0.00
.50	800.82	3.02	12.	798.	30.83	40.50	0.00
1.00	801.53	3.73	12.	1607.	31.50	40.50	0.00

PLAN 1 STATION 102

SECTION 2, APPROXIMATELY 750 FT D.S. OF LOWER PIGEON HILL DAM.

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	151.	721.4	40.83
.20	307.	722.3	40.67
.30	474.	722.7	40.67
.50	796.	723.4	40.50
1.00	1607.	724.8	40.50

PLAN 1 STATION 203

SECTION 3, APPROXIMATELY 1630 FT D.S. OF DAM.

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	151.	681.9	40.83
.20	307.	682.7	40.67
.30	475.	683.4	40.67
.50	796.	684.4	40.50
1.00	1607.	685.3	40.50

PLAN 1 STATION 304

SECTION 4, APPROXIMATELY 2500 FT D.S. OF DAM.

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	151.	642.3	40.83
.20	307.	643.3	40.67
.30	474.	644.2	40.67
.50	795.	644.7	40.50
1.00	1600.	645.8	40.50

PLAN 1 STATION 405

SECTION 5, APPROXIMATELY 4170 FT D.S. OF DAM.

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	151.	605.5	40.83
.20	306.	606.5	40.83
.30	469.	607.0	40.67
.50	795.	607.4	40.67
1.00	1596.	608.5	40.67

SUBJECT Dam Safety Inspection
Upper Pigeon Hill Dam

BY DJS DATE 8-19-80 PROJ. NO. 79-203-349

CHKD. BY WJV DATE 2-19-80 SHEET NO. M OF S

GAI CONSULTANTS, INC.
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BREACHING ANALYSIS (SAME INPUT AS FOR OVERTOPPING ANALYSIS WITH THE ADDITION OF BREACHING CRITERIA)

UPPER PIGEON HILL DAM.

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DAM SAFETY INSPECTION
 PIGEON HILL DAMS **** BREACHING ANALYSIS ****
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION
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DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
150.	2.50	812.20	.50	838.60	842.20

PEAK OUTFLOW IS 2238. AT TIME 40.40 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1939.	457.	137.	71.	20356.
CMS	55.	13.	4.	2.	576.
INCHES		10.63	12.71	13.15	13.15
MM		270.08	322.78	334.01	334.01
AC-FT		227.	271.	280.	280.
THOUS CU M		280.	334.	346.	346.

PROJECT Dam Safety Inspection
Upper Pigeon Hill Dam

BY DJS DATE 3-19-88 PROJ. NO. 79-203-340

CHKD. BY WJV DATE 2-19-90 SHEET NO. N OF S

GAI CONSULTANTS, INC.
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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .010 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	-	COMPUTED BREACH HYDROGRAPH (CFS)	=	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
40.333	0.000	700.		700.		0.	0.	0.
40.343	.010	773.		1482.		-710.	-710.	-1.
40.353	.020	846.		1656.		-811.	-1520.	-1.
40.363	.029	918.		1837.		-919.	-2439.	-2.
40.373	.039	991.		2013.		-1021.	-3461.	-3.
40.382	.049	1064.		2138.		-1074.	-4535.	-4.
40.392	.059	1137.		2210.		-1073.	-5608.	-5.
40.402	.069	1210.		2238.		-1028.	-6637.	-5.
40.412	.078	1283.		2232.		-949.	-7585.	-6.
40.422	.088	1356.		2206.		-850.	-8435.	-7.
40.431	.098	1429.		2166.		-738.	-9172.	-7.
40.441	.108	1502.		2137.		-636.	-9808.	-8.
40.451	.118	1575.		2106.		-531.	-10339.	-8.
40.461	.127	1647.		2073.		-426.	-10765.	-9.
40.471	.137	1720.		2040.		-319.	-11084.	-9.
40.480	.147	1793.		2006.		-213.	-11297.	-9.
40.490	.157	1866.		1972.		-106.	-11403.	-9.
40.500	.167	1939.		1939.		0.	-11403.	-9.
40.510	.176	1908.		1906.		2.	-11401.	-9.
40.520	.186	1876.		1872.		5.	-11396.	-9.
40.529	.196	1845.		1838.		8.	-11389.	-9.
40.539	.206	1814.		1804.		10.	-11379.	-9.
40.549	.216	1782.		1770.		12.	-11366.	-9.
40.559	.225	1751.		1737.		14.	-11352.	-9.
40.569	.235	1720.		1704.		15.	-11337.	-9.
40.578	.245	1688.		1672.		16.	-11321.	-9.
40.588	.255	1657.		1641.		16.	-11305.	-9.
40.598	.265	1626.		1610.		16.	-11289.	-9.
40.608	.275	1594.		1579.		15.	-11273.	-9.
40.618	.284	1563.		1549.		14.	-11259.	-9.
40.627	.294	1532.		1519.		12.	-11241.	-9.
40.637	.304	1500.		1490.		10.	-11237.	-9.
40.647	.314	1469.		1462.		7.	-11230.	-9.
40.657	.324	1438.		1434.		4.	-11226.	-9.
40.667	.333	1406.		1406.		0.	-11226.	-9.
40.676	.343	1382.		1379.		3.	-11223.	-9.
40.686	.353	1358.		1351.		7.	-11216.	-9.
40.696	.363	1334.		1324.		10.	-11207.	-9.
40.706	.373	1310.		1298.		12.	-11194.	-9.
40.716	.382	1286.		1271.		14.	-11180.	-9.
40.725	.392	1262.		1246.		16.	-11164.	-9.
40.735	.402	1237.		1220.		17.	-11147.	-9.
40.745	.412	1213.		1196.		18.	-11130.	-9.
40.755	.422	1189.		1172.		18.	-11112.	-9.
40.765	.431	1165.		1148.		17.	-11095.	-9.
40.775	.441	1141.		1125.		16.	-11079.	-9.
40.784	.451	1117.		1102.		15.	-11064.	-9.
40.794	.461	1093.		1080.		13.	-11051.	-9.
40.804	.471	1069.		1058.		10.	-11041.	-9.
40.814	.480	1044.		1037.		7.	-11033.	-9.
40.824	.490	1020.		1016.		4.	-11029.	-9.
40.833	.500	996.		996.		0.	-11029.	-9.

SUBJECT: DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY: DJS DATE: 2-19-80 PROJ. NO. 79-303-340

CHKD. BY: WJV. DATE: 2-19-80 SHEET NO. 0 OF 5

GAI CONSULTANTS, INC.
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STATION DAM 1

(U) INTERPOLATED BREACH HYDROGRAPH
(B) COMPUTED BREACH HYDROGRAPH

(*) POINTS AT NORMAL TIME INTERVAL

TIME (HRS)	600.	800.	1000.	1200.	1400.	1600.	1800.	2000.	2200.	2400.	0.	0.
40.33	1.	*										
40.34	2.	U										
40.35	3.	U	O									
40.36	4.		O									
40.37	5.		U	U								
40.38	6.			O								
40.39	7.			O	O							
40.40	8.				U							
40.41	9.				U	U						
40.42	10.					O						
40.43	11.					U						
40.44	12.					U						
40.45	13.					U	U					
40.46	14.						U					
40.47	15.						U					
40.48	16.						O					
40.49	17.						U	U				
40.50	18.							U				
40.51	19.							*				
40.52	20.							B				
40.53	21.							B				
40.54	22.							BU				
40.55	23.							B				
40.56	24.							BU				
40.57	25.							BU				
40.58	26.							B				
40.59	27.							BU				
40.60	28.							BU				
40.61	29.							BU				
40.62	30.							BU				
40.63	31.							BU				
40.64	32.							B				
40.65	33.							B				
40.66	34.							B				
40.67	35.							*				
40.68	36.							*				
40.69	37.							B				
40.70	38.							BO				
40.71	39.							B				
40.72	40.							BU				
40.73	41.							BU				
40.74	42.							BU				
40.75	43.							BU				
40.76	44.							*				
40.77	45.							BO				
40.78	46.							BU				
40.79	47.							BU				
40.80	48.							BU				
40.81	49.							BU				
40.82	50.							B				
40.83	51.							*				
40.83	52.							*				

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LOWER PIGEON HILL DAM:

DAM BREACH DATA

BRWID	Z	ELBR	TFAIL	WSEL	FAILEL
40.	1.50	765.00	.50	792.30	801.30

PEAK OUTFLOW IS 2686. AT TIME 40.51 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1926.	513.	153.	78.	22468.
CMS	55.	15.	4.	2.	636.
INCHES		10.85	12.90	13.19	13.19
MM		275.47	327.67	335.14	335.14
AC-FT		254.	303.	309.	309.
THOUS CU M		314.	373.	382.	382.

SUBJECT: DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY: DJS DATE: 2-19-90 PROJ. NO. 19-303-340

CHKD. BY: WJV DATE: 2-19-90 SHEET NO. 2 OF 5

GAI CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .010 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	-	COMPUTED BREACH HYDROGRAPH (CFS)	=	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
40.500	0.000	1898.		1898.		0.	0.	0.
40.510	.010	1900.		2686.		-786.	-786.	-1.
40.520	.020	1901.		2192.		-291.	-1077.	-1.
40.529	.029	1903.		2160.		-257.	-1334.	-1.
40.539	.039	1905.		2144.		-239.	-1573.	-1.
40.549	.049	1906.		2123.		-217.	-1790.	-1.
40.559	.059	1908.		2188.		-281.	-2070.	-2.
40.569	.069	1909.		2228.		-318.	-2389.	-2.
40.578	.078	1911.		2254.		-343.	-2732.	-2.
40.588	.088	1913.		2266.		-353.	-3085.	-2.
40.598	.098	1914.		2261.		-347.	-3432.	-3.
40.608	.108	1916.		2233.		-317.	-3749.	-3.
40.618	.118	1918.		2191.		-274.	-4023.	-3.
40.627	.127	1919.		2142.		-223.	-4245.	-3.
40.637	.137	1921.		2089.		-168.	-4413.	-4.
40.647	.147	1922.		2035.		-112.	-4526.	-4.
40.657	.157	1924.		1980.		-56.	-4582.	-4.
40.667	.167	1926.		1926.		0.	-4582.	-4.
40.676	.176	1886.		1875.		11.	-4570.	-4.
40.686	.186	1846.		1830.		16.	-4554.	-4.
40.696	.196	1806.		1787.		19.	-4535.	-4.
40.706	.206	1766.		1746.		20.	-4515.	-4.
40.716	.216	1726.		1705.		21.	-4494.	-4.
40.725	.225	1686.		1665.		21.	-4473.	-4.
40.735	.235	1646.		1625.		21.	-4453.	-4.
40.745	.245	1606.		1586.		20.	-4432.	-4.
40.755	.255	1566.		1547.		19.	-4413.	-4.
40.765	.265	1526.		1508.		18.	-4395.	-4.
40.775	.275	1486.		1470.		17.	-4378.	-4.
40.784	.284	1446.		1432.		15.	-4364.	-4.
40.794	.294	1406.		1394.		12.	-4351.	-4.
40.804	.304	1366.		1357.		10.	-4342.	-4.
40.814	.314	1326.		1320.		7.	-4335.	-4.
40.824	.324	1286.		1283.		4.	-4331.	-4.
40.833	.333	1246.		1246.		0.	-4331.	-4.
40.843	.343	1200.		1204.		-4.	-4335.	-4.
40.853	.353	1154.		1156.		-2.	-4337.	-4.
40.863	.363	1108.		1107.		1.	-4337.	-4.
40.873	.373	1062.		1059.		3.	-4334.	-4.
40.882	.382	1016.		1011.		5.	-4329.	-4.
40.892	.392	970.		963.		7.	-4322.	-4.
40.902	.402	923.		916.		8.	-4314.	-3.
40.912	.412	877.		869.		9.	-4306.	-3.
40.922	.422	831.		822.		9.	-4297.	-3.
40.931	.431	785.		776.		9.	-4288.	-3.
40.941	.441	739.		730.		9.	-4279.	-3.
40.951	.451	693.		684.		8.	-4270.	-3.
40.961	.461	647.		639.		7.	-4263.	-3.
40.971	.471	600.		594.		6.	-4256.	-3.
40.980	.480	554.		550.		4.	-4252.	-3.
40.990	.490	508.		506.		2.	-4250.	-3.
41.000	.500	462.		462.		0.	-4250.	-3.

PROJECT: DAM SAFETY INSPECTION
UPPER PIGEON HILL DAM

BY: DJS DATE: 2-19-80 PROJ. NO. 79-203-340

CHKD. BY: WJV DATE: 2-19-80 SHEET NO. R OF S

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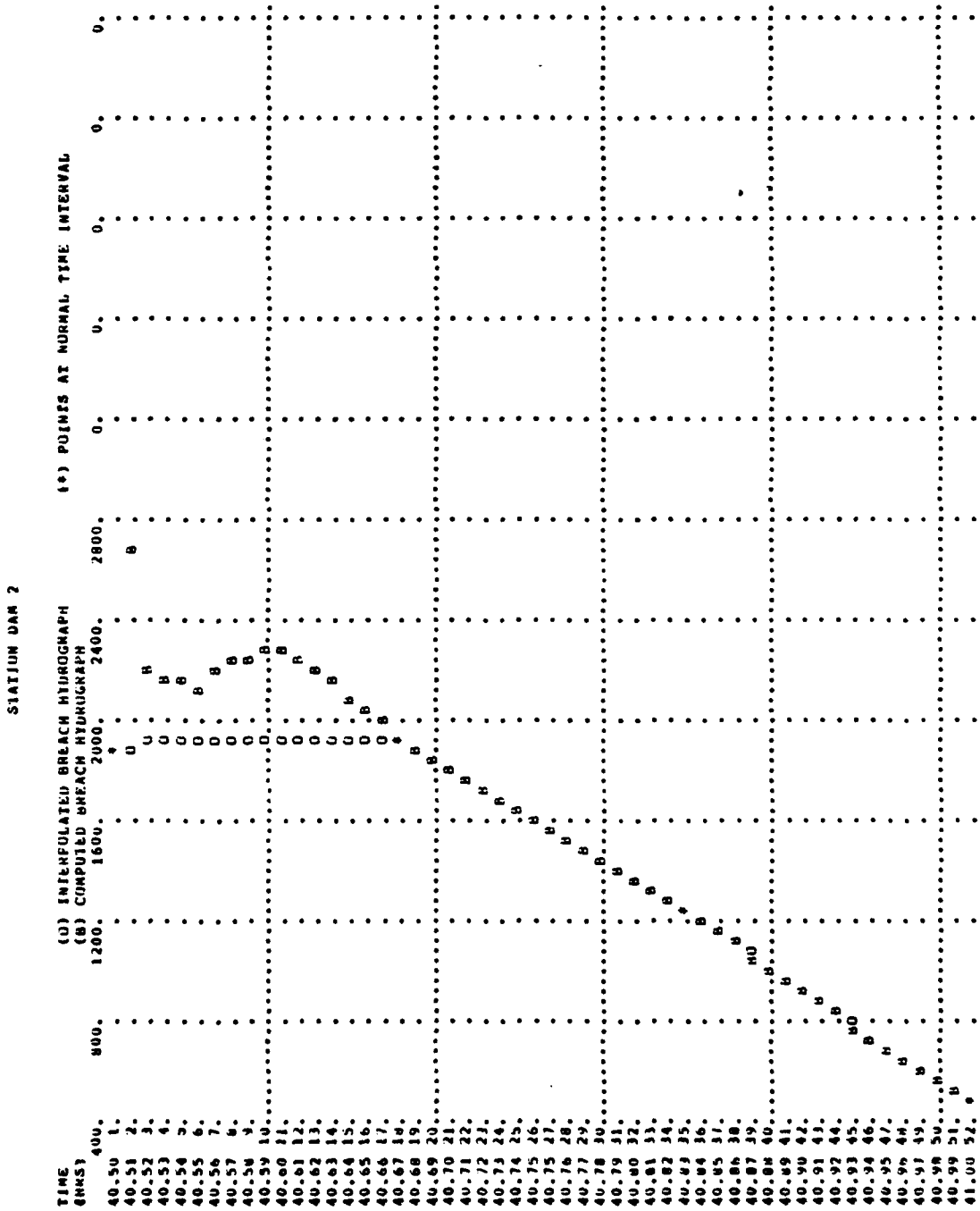

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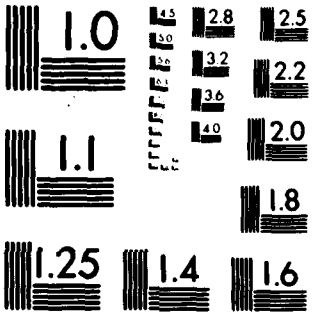

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

SUBJECT Dam Safety Inspection
Upper Pigeon Hill Dam

BY DJS DATE 3-19-80 PROJ. NO. [illegible]
CHKD. BY WJV DATE 2-19-80 SHEET NO. 5 OF 5

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Environmental Specialists

SUMMARY OF DAM SAFETY ANALYSIS
(BREACH ANALYSIS)

UPPER PIGEON HILL DAM.

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	838.60	838.60	841.20
STORAGE	31.	31.	37.
OUTFLOW	0.	0.	290.

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
.50	842.23	1.03	40.	2238.	1.54	40.40	40.33

LOWER PIGEON HILL DAM.

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	792.30	797.80	797.80
STORAGE	6.	9.	9.
OUTFLOW	0.	0.	0.

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
.50	801.72	3.92	12.	2686.	23.42	40.51	40.50

PLAN 1 STATION 102

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	2030.	725.2	40.67

SECTION 2

PLAN 1 STATION 203

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	2088.	685.9	40.67

SECTION 3

PLAN 1 STATION 304

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	2014.	646.3	40.67

SECTION 4

PLAN 1 STATION 405

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1824.	608.8	40.83

SECTION 5

LIST OF REFERENCES

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APPENDIX E

FIGURES

LIST OF FIGURES

Figure	Description/Title
1	Regional Vicinity and Watershed Boundary Map
2	Site Survey Plan

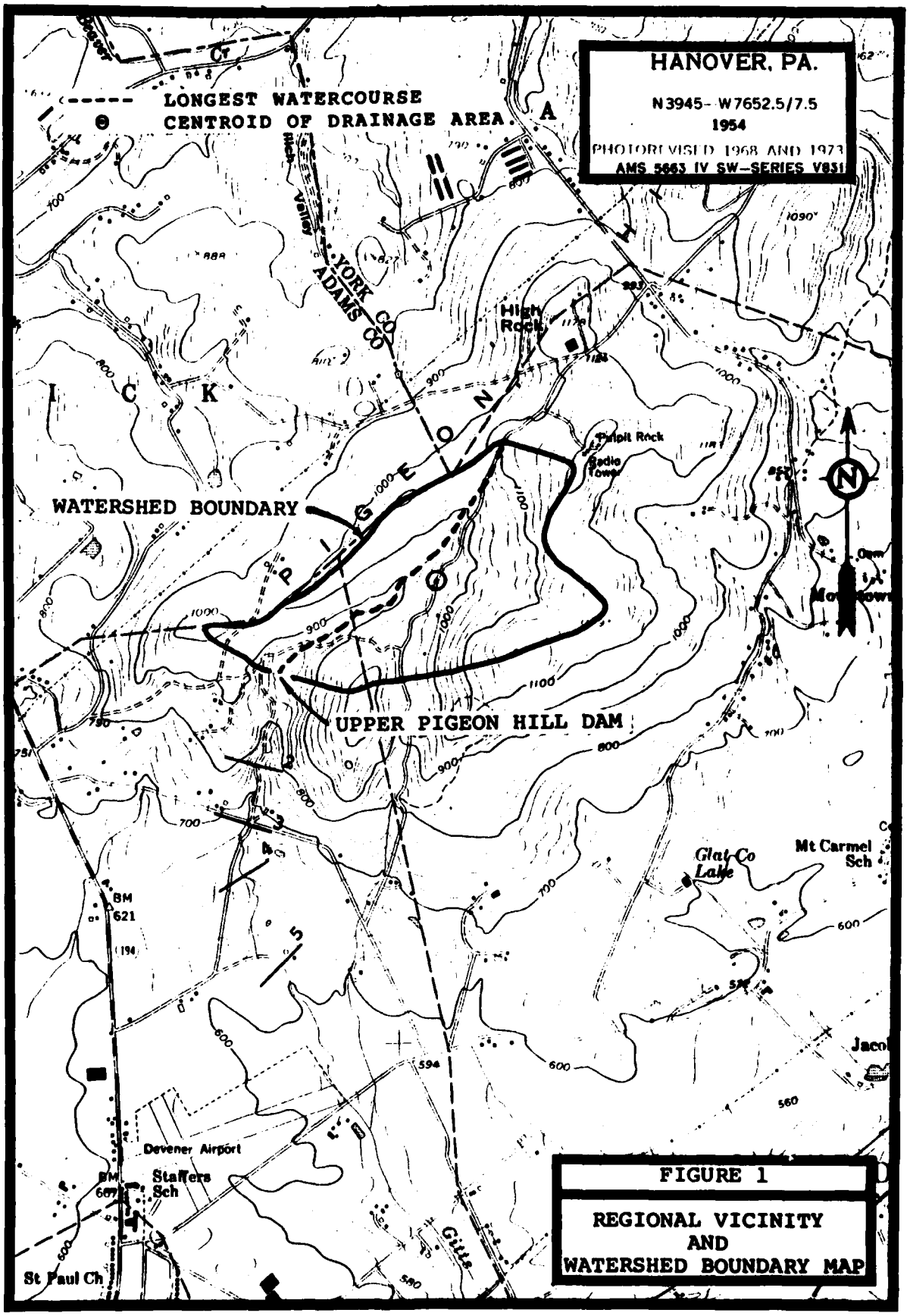
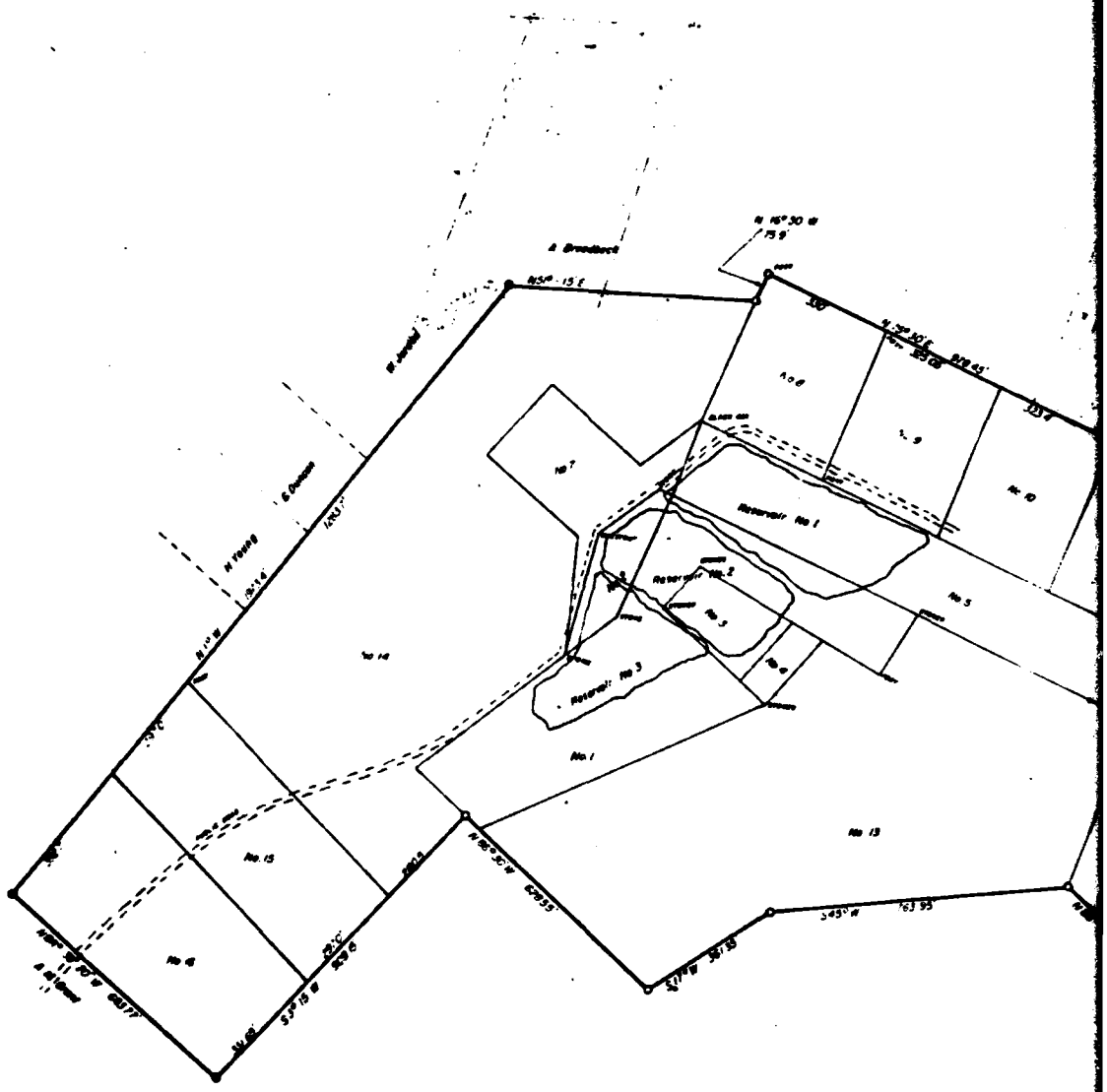


FIGURE 1

REGIONAL VICINITY AND WATERSHED BOUNDARY MAP


Reservoir No. 1
Reservoir No. 2
Reservoir No. 3
No. 1
No. 5
No. 7
No. 9
No. 10
No. 13
No. 14
No. 15
No. 16
N 16°30' W
75.9'
N 85°-15' E
N 65°-30' W
62.55'
S 49° W
163.95'
S 37° W
56.35'
S 53°15' W
529.6'
N 11° W
1603.7'
N 10° W
N 11° W
N 11°10' W
1607.7'

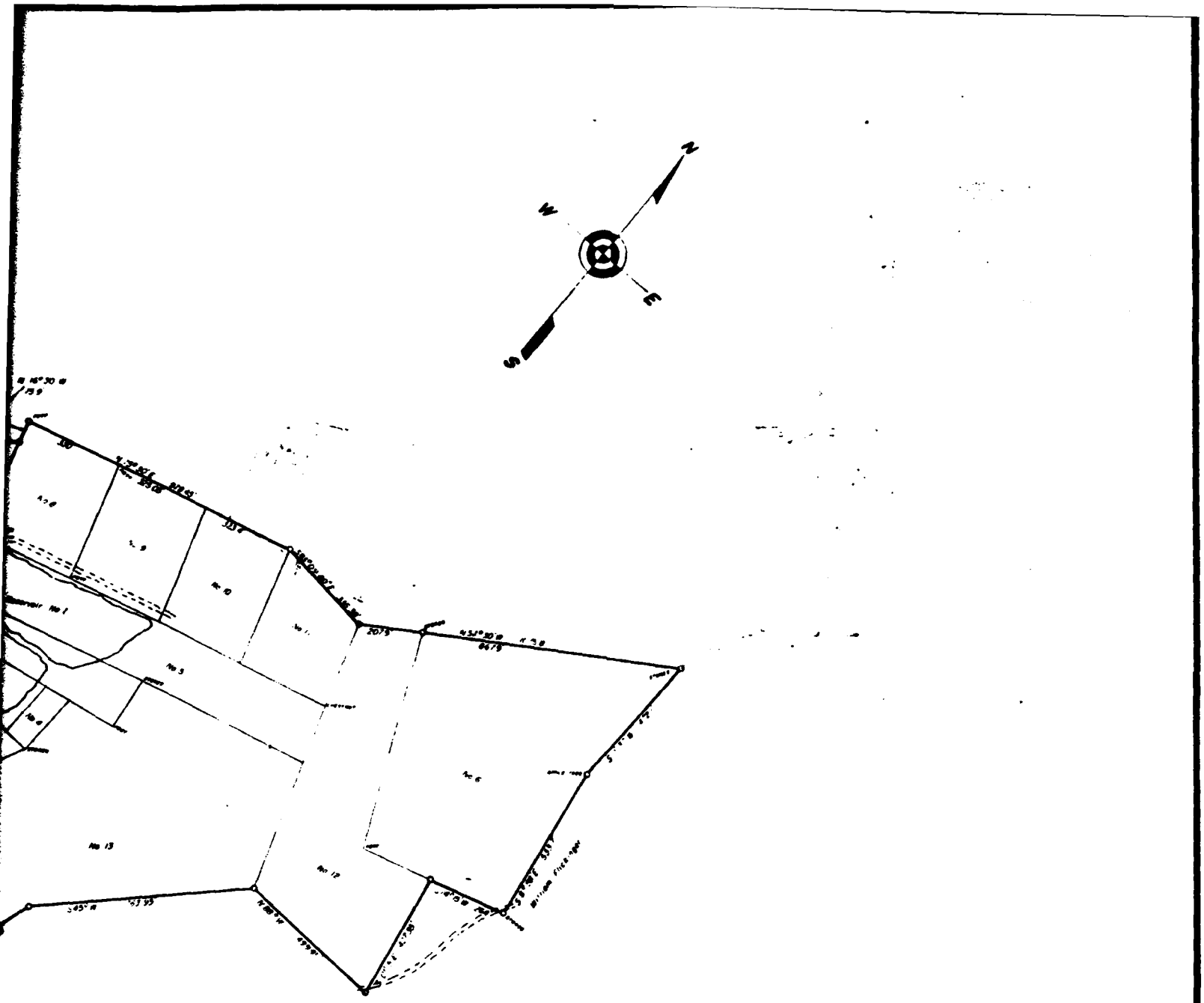


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FIGURE 2

2

APPENDIX F

GEOLOGY

Geology.

The Upper Pigeon Hill Dam is located in the Conestoga Valley section of the Piedmont physiographic province of southeastern Pennsylvania. The dam and reservoir are located in the Pigeon Hills, an elevated upland composed predominantly of Pre-Cambrian and Cambrian age bedrock.

The stratigraphic and structural geology of this region is extremely complex. The Pre-Cambrian rocks of the Pigeon Hills are metamorphosed volcanic rocks, blue slates containing flattened green amygdules occur in some places in the metabasalts. The Chickies Formation, generally a quartzite with its basal Hellam conglomerate member of Cambrian age, surrounds the core of Pre-Cambrian metabasalts in the Pigeon Hills. The volcanic rocks of the Pigeon Hills in the Hanover quadrangle are designated Pre-Cambrian because they are overlain unconformably by basal lower Cambrian sedimentary rocks.

The Gnatstown overthrust lies to the north while the Stoner and Martic overthrust lie to the south. "The main overthrusting probably began early in the period of compression and mountain making that took place at the close of the Paleozoic Era, when the rocks of the Hanover-York district and the entire Appalachian region were closely folded and raised above sea level."

According to the "Report upon the Upper Pigeon Hill Dam of Hanover and McSheerystown Water Company," Report No. 67-5-1, July 16, 1915, the "geological formation at the dam site is sandstone." The "sandstone" mentioned in the above referenced report is most likely the Hellam Member of the Chickies Formation. In the immediate vicinity of the dam, this formation dips to the south at approximately 35 degrees.

Stose, Anna J., and Stose, George W., "Geology of the Hanover-York District Pennsylvania," Professional Paper 204, United States Department of the Interior, 1944.

LEGEND

ORDOVICIAN

CONESTOGA FORMATION - Limestone, argillaceous in places, thin- and thick-bedded with thin partings of graphitic shale.

CAMBRIAN

Cl — LEDGER FORMATION - Massive granular gray dolomite; chert horizon occurs near top of formation.

Ckm, Ckl, Cks — KINZERS FORMATION - Upper member-earthy limestone containing dark argillaceous layers; Middle member-limestone of variable composition; Lower member-dark shale with earthy limestone.

Cv — VINTAGE FORMATION - Pure fine-grained blue limestone at top. Lower part is chiefly a blue knotty dolomite.

ANTIETAM FORMATION - Fine to medium grained phyllitic quartzite.

Chp — HARPERS FORMATION - Dark gray quartzose phyllites contains beds of dense green ferruginous quartzite and magnetite - bearing gray quartzite.

Cc, Ch — CHICKIES FORMATION - Massive, prominently bedded, white vitreous quartzite. Contains a basal quartzose conglomerate interbedded with black slate.

PRECAMBRIAN

METABASALT - Grayish-green to bluish-gray hornblende schist, blotched with green epidote.

Scale

1/2 0 1 2 MILES

GEOLOGY MAP

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REFERENCE:
GEOLOGIC AND HYDROLOGIC MAP OF CENTRAL AND SOUTHERN YORK COUNTY AND SOUTHEASTERN ADAMS COUNTY, PENNSYLVANIA, PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY, WATER RESOURCES REPORT 42, 1977.