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NATIONAL DAM INSPECTION PROGRAM. RECREATION DAM (NDS ID NUMBER --ETC(U)
MAR 79 DACW31-79-C-0013
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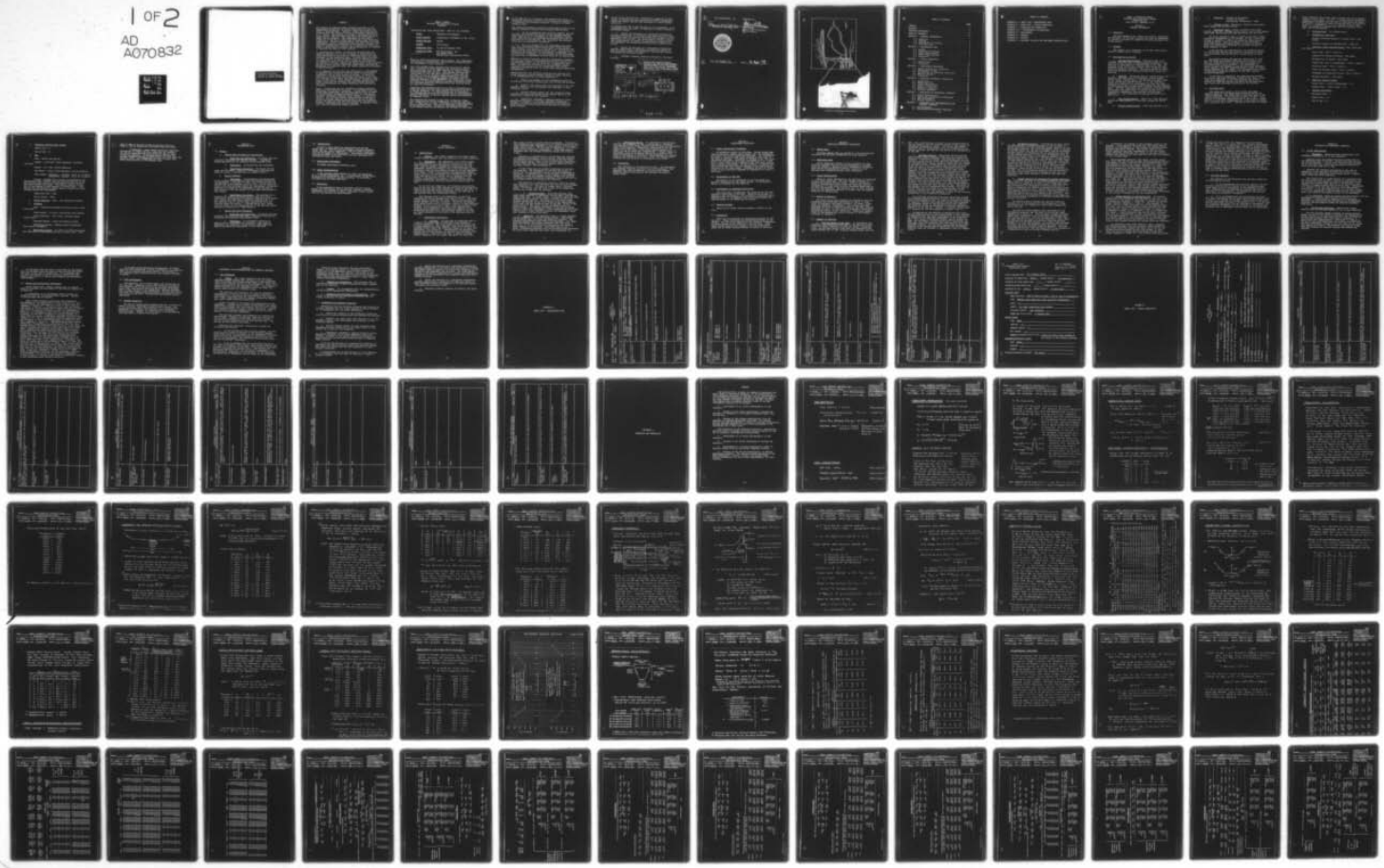


PREFACE

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 expeditiously identify those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered (as was Recreation Dam) or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

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

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

PHASE I REPORT
National Dam Inspection Program
Abstract

Recreation Dam (Cold Stream Dam): NDS I.D. No. PA-00446

Owner:	Borough of Philipsburg
State Located:	Pennsylvania (PennDER I.D. No. 14-26)
County Located:	Centre
Stream:	Cold Stream
Inspection Date:	14 and 22 November 1978
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

[CONT'D FROM P. I]

Based on visual observations, past history, and a hydrologic and hydraulic investigation, the dam and its appurtenances are considered in poor condition.

Data from PennDER files indicate that the original embankment, a portion of which comprises the existing facility, was constructed prior to 1889, possibly of timber cribbing backfilled with rock and soil. The present spillway was constructed in 1937 and 1938, modified in about 1967 and has been in need of frequent repair especially following major floods. A Philipsburg resident indicated that the easterly extension to the embankment was constructed in the mid-1960's of strip-mine spoil to provide a diversion ditch for directing acid-mine drainage around the facility which was used for recreation.

Presently, the downstream face of the dam is vegetated with trees and brush and the crest requires regrading to bring it to design elevation. No riprap protection is provided on the upstream dam face, and the spillway and its appurtenances require replacement of several masonry blocks and repointing of numerous joints.

The reservoir was drained in May 1978, following a flood that caused failure of the flashboards in the left spillway bay. A scour pool at least 3 feet deep was formed downstream of the spillway apron. Borough of Philipsburg personnel noted seepage issuing from beneath the spillway at that time.

As the facility is of historic and recreational value, a consultant has been retained to investigate the feasibility of restoring the structure; however, no report has been issued to date.

The hydrologic/hydraulic evaluation performed as part of the Phase I evaluation yielded the following implications:

1. If the flashboards were entirely removed, the dam facility could handle 54 percent of the Probable Maximum Flood (PMF) prior to overtopping of the embankment occurring, assuming that the upstream Philipsburg Dam would not fail due to its overtopping. The Recreation Dam spillway would then be considered "inadequate."

2. If it is assumed that the Philipsburg Dam would fail upon overtopping (which occurs under floods greater than or equal to 47 percent of the PMF), the Recreation Dam could also be overtopped and possibly fail. The spillway of Recreation Dam would still be considered "inadequate", but not seriously inadequate, as the increase in the downstream tailwater due to embankment failure would not be significant.

Based on a visual evaluation and past performance, however, the spillway system is considered structurally unsafe but of non-emergency status as the reservoir is completely drawn down. In addition, evaluation of the flashboard system indicated that failure of the flashboards under normal operating procedures could in itself cause serious downstream consequences.

Recognizing that the existing structure may function as a flood retarding facility during periods of heavy rainfall, it is recommended that the owner immediately:

a. Remove the remnants of the flashboard system and sluice gate to provide unrestricted flow through the spillway.

b. Backfill the large scour hole adjacent to the left abutment wingwall with well-graded rock available in the discharge channel.

c. Provide lateral support for the wingwalls where required and slope protection to the channel walls in and around the vicinity of the wingwalls.

d. Immediately implement a warning system to notify downstream residents in the event emergency conditions develop. Included in the system should be provisions for around-the-clock surveillance during periods of unusually heavy rainfall.

If use of the facility as a recreational reservoir is abandoned, the entire spillway system and northerly embankment should be removed and the area restored to a near-original condition.

If recreational use of the facility is to be restored, it is recommended that the owner, in addition to Items a through d previously stated:

e. Enlist the services of a registered professional engineer experienced in the design and construction of earth and masonry dams to evaluate the structural integrity of the embankment and spillway. The study should include a subsurface investigation to assess the engineering properties of the embankment and foundation materials and a seepage evaluation.

f. Enlist the services of a registered professional engineer experienced in hydrology and hydraulic design to more accurately assess the adequacy of the spillway system (including the diversion ditch).

g. Implement remedial measures dictated by the above analyses.

GAI Consultants, Inc.

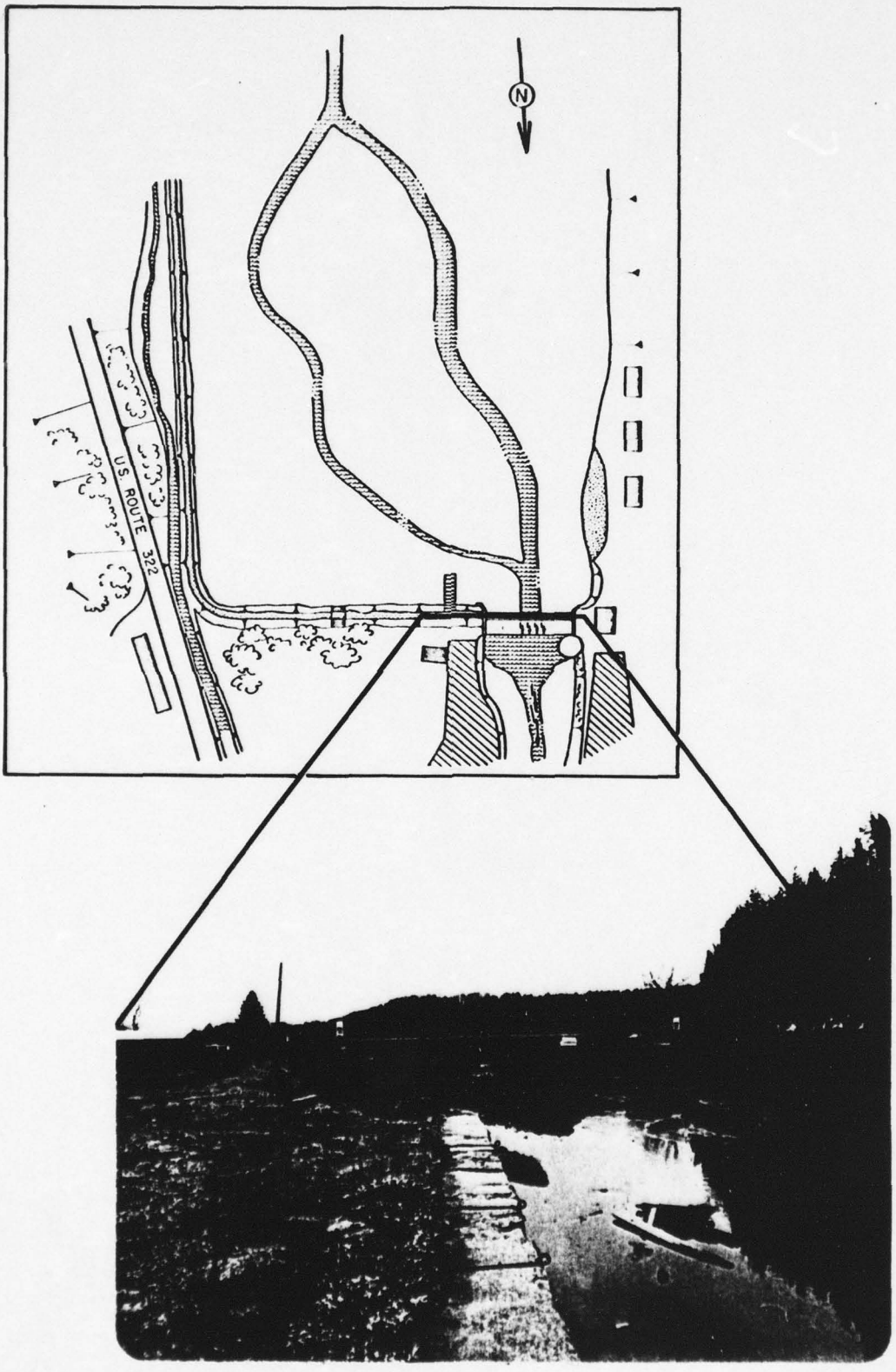
Bernard M. Mihalcin, P.E.

Date 27 MAR 79

Approved by:

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

Date 10 Apr 79



OVERVIEW PHOTOGRAPH AND SKETCH

TABLE OF CONTENTS

	Page
PREFACE	i
ABSTRACT	ii
OVERVIEW PHOTOGRAPH	vi
TABLE OF CONTENTS	vii
SECTION 1 - GENERAL INFORMATION	1
1.0 Authority	1
1.1 Purpose	1
1.2 Description of Project	1
1.3 Pertinent Data	2
SECTION 2 - ENGINEERING DATA	6
2.1 Design.	6
2.2 Construction Records	7
2.3 Operational Records	7
2.4 Other Investigations	7
2.5 Evaluation	7
SECTION 3 - VISUAL INSPECTION	8
3.1 Observations	8
3.2 Evaluation	10
SECTION 4 - OPERATIONAL PROCEDURES	11
4.1 Normal Operational Procedures	11
4.2 Maintenance of Dam	11
4.3 Maintenance of Operating Facilities	11
4.4 Warning Systems	11
4.5 Evaluation	11
SECTION 5 - HYDROLOGIC/HYDRAULIC EVALUATION	12
5.1 Design Data	12
5.2 Experience Data	12
5.3 Visual Observations	12
5.4 Method of Analysis	12
5.5 Summary of Analysis	12
5.6 Spillway Adequacy	16
SECTION 6 - EVALUATION OF STRUCTURAL INTEGRITY	17
6.1 Visual Observations	17
6.2 Design and Construction Techniques	18
6.3 Past Performance	19
6.4 Seismic Stability	19
SECTION 7 - ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES	20
7.1 Dam Assessment.	20
7.2 Recommendations/Remedial Measures	21

TABLE OF CONTENTS

APPENDIX A - CHECK LIST - ENGINEERING DATA
APPENDIX B - CECCK LIST - VISUAL INSPECTION
APPENDIX C - HYDROLOGY AND HYDRAULICS
APPENDIX C-1 - SUPPLEMENTAL CALCULATIONS
APPENDIX D - PHOTOGRAPHS
APPENDIX E - GEOLOGY
APPENDIX F - FIGURES
APPENDIX G - REGIONAL VICINITY AND WATERSHED BOUNDARY MAPS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
RECREATION DAM
NDI# PA-446, PENNDER# 14-26

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. Recreation Dam is an L-shaped earth dam with a measured maximum height of 14.7 feet and a total length of approximately 1,600 feet. The facility is provided with a masonry spillway at the left abutment along its northern section and a diversion canal along its easterly extension. The latter serves to divert acid mine drainage from upstream mined areas around the facility.

[CONT'D ON P. ii]

b. Location. Recreation Dam is located across Cold Stream on the east side of Philipsburg, Rush Township, Centre County, Pennsylvania. The Dam has also been known as the "Lower Cold Stream Dam No. 1" or the "Borough - Owned Cold Stream Dam" to distinguish it from two other upstream facilities (the Philipsburg Reservoir Dam operated by the Keystone Water Company and a defunct smaller impoundment). The dam, watershed, and reservoir are located on the Philipsburg and Sandy Ridge 7.5 minute series U.S.G.S. topographic quadrangles (see Regional Vicinity Map, Appendix G). The coordinates of the dam are N40° 54.0'; W78° 12.5'.

c. Size Classification. Small (14.7 feet measured height and approximately 75 acre-feet storage at top of dam).

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

e. Ownership. Borough of Philipsburg
4 North 3rd Street
Philipsburg, Pennsylvania 16866

f. Purpose of Dam. Recreation (formerly water power, water supply, and ice harvesting).

g. Historical Data. Little is known of the early history of the dam. PennDER files contain a map of Philipsburg, dated 1889, which shows that the dam existed at that time.

The first inspection report, issued by the Water Supply Commission (predecessor of the PennDER) in 1917, states that the dam is possibly a timber crib structure which was later covered by earth. This is supported by old photographs which show planks and timbers within a portion of the dam which was intentionally breached by the owner (Citizen's Water Company) in 1929.

A new spillway was constructed in the breached section in 1932 and the facility was used for recreation for about two years before failing during an intense storm in early 1936.

The present masonry spillway was constructed in 1937 and 1938 while the easterly extension and diversion ditch were not constructed until the mid-1960's, according to a discussion with a local resident. The impoundment is nearly filled with sediment to the spillway crest and water, until recently, has been impounded using a system of flashboards supported by iron pipes. The flashboards have failed (by design) on numerous occasions in the past, causing flooding downstream.

At the time of inspection, the reservoir was drained. This action was taken following a storm in May 1978, during which the flashboards in the left spillway bay failed, seepage was observed issuing from below the spillway apron and a scour pool developed downstream of the spillway.

1.3 Pertinent Data.

The elevations listed in this section have been compiled based on field measurements gathered during the visual inspection. The datum used by the field team is the relative elevation of the spillway wingwall of 109.2. This results in a spillway crest elevation of 101.5 feet. Normal pool is at the top of flashboards set 4 feet above the crest or at elevation 105.5 feet. Information contained in PennDER

files indicates the surface area of normal pool to be approximately 9 to 12 acres. U.S.G.S. 7.5-minute series topographic quadrangle Philipsburg has the pool of Recreation Dam represented with a surface of about 9 acres and sets its elevation at 1444.0. Consequently, U.S.G.S. elevation 1444.0 feet (MSL) is assumed to coincide with relative elevation 105.5 feet (top of flashboards).

a. Drainage Area. 21.0 square miles.

b. Discharge at Dam Site.

Gateway Discharge Capacity at Normal Pool - Not known.

Spillway Capacity at Maximum Pool ≈ 7800 cfs.

c. Elevation (feet-relative datum) [feet above mean sea level].

Top of Dam ≈ 108.7, [1447.2].

Maximum Pool Design Surcharge - Not known.

Maximum Pool of Record - Not known.

Normal Pool (top of flashboards) ≈ 105.5, [1444.0].

Spillway Crest ≈ 101.5, [1440.0].

Invert of Gateway Portal ≈ 96.6, [1435.1].

Streambed at Centerline of Dam ≈ 94.0, [1432.5].

Maximum Tailwater - Not known.

d. Reservoir Length (miles).

Normal Pool ≈ (top of flashboards) ≈ 0.1

Maximum Pool ≈ (top of dam) ≈ 0.4

e. Storage (acre-feet).

Spillway Crest ≈ 3

Normal Pool ≈ 25

Top of Dam ≈ 75

f. Reservoir Surface Area (acres).

Normal Pool ≈ 9

Top of Dam ≈ 22

g. Dam.

Type - Earth (see zoning).

Length ≈ 1,600 feet (field measured, including spillway).

Height ≈ 14.7 feet (field measured).

Top Width ≈ 9 feet (field measured, varies slightly).

Side Slopes - upstream: variable 4H:1V to 1-1/2H:1V
downstream: variable 2H:1V to 1-1/2H:1V

Zoning - PennDER files contain correspondence and photographs which indicate that the northern portion of the dam may have been initially constructed of timber cribbing and later covered with earth. The eastern section of the dam is constructed of what appears to be mine spoil. This section was constructed in recent years to divert acid mine drainage around the impoundment.

Impervious Core - None.

Grout Curtain - None.

h. Outlet Conduits. None. See regulating outlets.

i. Spillway.

Type - Uncontrolled masonry spillway with an ogee-like crest.

Crest Length ≈ 113 feet (subtracting pier widths).

Crest Elevation ≈ 101.5 feet, relative datum [1440.0 MSI].

Upstream Channel - Earth and masonry blocks.

Downstream Channel - Masonry apron discharging into natural streambed.

j. Regulating Outlets. A 4-foot by 5-foot slide gate was installed in the masonry spillway in about 1967. This

gate is used to draw down or empty the reservoir (see Photograph 4) and is raised with a portable winch and chain.

Flashboards - Under normal operating conditions, flashboards 35 inches high are authorized (by PennDER) for use to raise the pool level since the dam is nearly filled with sediment. Field measurements indicate the average flashboard height extended about four feet above the spillway crest. The flashboards are held in place with steel pipes anchored in the masonry crest.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources.

1. Hydrology and Hydraulics. No design data are available concerning the masonry spillway. Flashboard design calculations are contained within PennDER files.

2. Embankment. No design data are available.

3. Appurtenant Structures. No design calculations are available. Details of the masonry spillway are shown on Figure 2 (Revised Plan #1, dated 1/28/37).

b. Design Features.

1. Embankment. Correspondence and photographs within PennDER files indicate that the northern portion of the embankment is possibly a timber crib structure that was covered with earth sometime prior to 1917. In an effort to divert acid mine drainage around the impoundment, an easterly extension was added to the embankment in the mid-1960's. This portion of the dam appears to have been constructed of mine refuse.

2. Appurtenant Structures. The spillway is an uncontrolled masonry structure with an ogee-like crest. Construction photographs and drawings indicate that a cutoff wall (about five feet deep) extends to elevation 89.7 on the upstream side of the spillway, penetrating into the alluvial sands and gravels. A second cutoff wall (about five feet deep) on the downstream end of the spillway apron extends to elevation 91.7 (see Figure 2).

c. Design Data And Procedures.

1. Hydrology and Hydraulics. No design data are available concerning the spillway. Flashboard failure calculations are available from PennDER files.

2. Embankment. No information relative to design data or procedures are available. The original embankment was apparently raised and/or graded when the masonry spillway was constructed in 1937 and 1938.

2.2 Construction.

Little is known about the construction of the dam except what is inferred from photographs, PennDER correspondence, and the visual inspection. The 1937-1938 reconstruction was performed as a WPA project. The easterly embankment section was added in the mid-1960's and was reportedly constructed of strip mine spoil.

2.3 Operational Procedures.

No formal operational procedures exist.

2.4 Other Investigations.

A cost estimate dated October 23, 1978, was submitted by R. E. Wright Associates, Inc., of Harrisburg, Pennsylvania, to perform an evaluation of the structure. To this date, the report has not been submitted.

2.5 Evaluation.

Little engineering data is available relative to the design and construction of the facility; however, sufficient information is available to make a reasonable Phase I evaluation of the dam and its appurtenances.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The visual inspection and recent operational history suggest that the facility is in poor condition.

b. Embankment. The embankment, as it exists today, is a modification of a dam that was built prior to 1889. Modifications of major consequence occurred in 1937 and 1938, when the masonry spillway was constructed and the embankment raised and widened, and in the mid-1960's, when a diversion ditch and the easterly extension of the embankment were added. Parts of the original dam undoubtedly remain intact since a 1917 photograph from PennDER files shows the flood gate which still exists (but is plugged) near the center of the northern portion of the embankment. The original embankment was possibly a timber crib structure, founded on alluvium, that was covered with earth prior to 1917.

At the time of inspection, the reservoir was drained. This action was taken when seepage was reported issuing from beneath the spillway apron following a flood in May 1978. A large scour pool was formed downstream of the left bay of the spillway when the flashboards failed.

The upstream slope of the embankment is partially vegetated and varies between 4H:1V and 1-1/2H:1V. The downstream slope is covered with trees, shrubs, and grasses and varies between 2H:1V and 1-1/2H:1V. The crest has experienced some erosion and/or settlement (about 0.5 feet measured maximum) and is 9 to 10 feet wide. Since the reservoir was drained, it was impossible to detect any seepage zones although some hydrophilic vegetation was observed on the downstream dam slope near the northeast corner of the dam. No riprap protection is provided on the upstream slope of the dam.

c. Appurtenant Structures.

1. Spillway. The spillway at Recreation Dam is a masonry structure with an ogee-like crest founded on alluvial sediments. The total length of the spillway crest is approximately 125 feet; however, piers which support an overhead bridge reduce the effective length to 113 feet (see Photograph 1 and Figure 2). Sedimentation has apparently reduced the storage capacity of the dam over the years (see Photograph 10). Since 1937 and 1938, a system of flashboards, supported by iron pipes, has served to raise the

pool level so that it can be used for swimming. Originally, the flashboards were designed to be 35 inches high and to fail under various heads, depending on the spacing of the support pipes (see Figure 2). At the time of inspection, 2 of the 4 spillway bays contained flashboards. Field measurements indicated that the average flashboard height was actually 4 feet.

According to PennDER files, the spillway has required considerable maintenance over the years, consisting mainly of repointing the masonry joints and replacing the flashboard support pipes. Many of the joints require repointing at this time and there is severe cracking along the left spillway wingwall (see Photograph 8).

A large scour pool is present downstream of the left spillway bay. The flashboard in the left bay failed in early 1978 and considerable erosion occurred downstream of the apron. A representative of the Borough of Philipsburg stated that there was seepage issuing beneath the spillway following the above-mentioned flashboard failure and this is the primary reason for draining the reservoir.

The reservoir is drained by raising a 4-foot by 5-foot gate located in the third spillway bay from the left abutment (see Photograph 4). The gate is raised using a portable winch. It is then tied off with a chain to an I-beam supporting the bridge over the spillway.

2. Diversion Canal. Acid mine drainage from mined areas upstream of Recreation Dam has been a problem at least since 1928. In recent years, a diversion canal has been constructed which serves to divert a portion of the mine effluent around the dam. The canal is of variable cross-section and extends up the Cold Stream valley approximately 8,000 feet from the northerly axis of the dam. Prior to the construction of the canal, the dam extended across the entire valley. The eastern extension to the dam was added when the canal was constructed. Field observations and a discussion with a local resident indicate the embankment extension consists of strip mine spoil.

d. Reservoir. The reservoir area is a broad sediment filled floodplain in the Cold Stream valley. Side slopes and watershed area are steep and primarily forested. Two upstream impoundments occur within the watershed. The uppermost impoundment, Philipsburg Reservoir Dam (see Photograph 11), is an active facility operated by the Keystone Water Company of Philipsburg. The lower facility is a small, dilapidated structure that has virtually been abandoned but which still impounds some water (see Photograph 12).

e. Downstream Channel. As indicated on the Regional Vicinity Map (Appendix G) and in Photograph 9, discharge from Recreation Dam passes through both business and residential areas of Philipsburg. Immediately downstream of the dam (about 500 to 900 feet), Cold Stream passes beneath U.S. Route 322 and PA Route 504, respectively. Several homes and businesses (with an estimated population of twenty) that could be affected by a failure of the embankment are located close to the stream in this area. Thus, the hazard classification for the facility is considered to be "high".

3.2 Evaluation.

The condition of the facility is poor. The embankment and spillway indicate a general lack of maintenance. The reservoir has been drained due to concern over seepage observed issuing from beneath the spillway following a recent flood.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operational Procedure.

No operations manual is available. During normal operating conditions, excess inflow passes over the flashboards and enters the natural downstream drainage. The flashboards are held in place by steel pipes anchored in the crest of the masonry spillway. According to PennDER files, the flashboards are designed to fail when overtopped by 2 to 3 feet and, in fact, have failed frequently over the years causing minor flooding downstream. On one occasion, it appears that the failures may have occurred because of the deteriorated condition of the steel pipes. Flashboard failure is further known to have previously happened as frequently as twice in one month.

4.2 Maintenance of the Dam.

Maintenance is not performed on the dam except for periodic mowing during the summer months. No maintenance manual is available for the facility.

4.3 Maintenance of Operating Facilities.

The slide gate, flashboards, and supports are the only operating facilities at the site. Based on the visual inspection, past performance, and information contained within PennDER files, it is apparent that little maintenance has been performed on the operating facilities.

4.4 Warning Systems.

There are no formal warning systems in effect at the site.

4.5 Evaluation.

There are no operations or maintenance manuals for the facility. Trees and bushes have become established on the slopes. The iron pipes supporting the remaining flashboards are deteriorated as are portions of the spillway. These above-listed deficiencies suggest a lack of maintenance. There are no formal warning systems in effect at the site.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

Available design data is limited to a few calculations regarding the spillway flashboards and pipe supports.

5.2 Experience Data.

Actual discharge records are not available for this facility; however, much of the correspondence in PennDER files is related to spillway and/or flashboards indicating that storms of significant intensity, relative to the spillway and flashboard design, occur frequently.

5.3 Visual Observations.

Based on visual observations, the spillway is considered to be in poor condition. The left abutment wingwall is cracked and missing several stones. Much of the mortar is loose or missing from joints along the ogee-like section. In addition, a large scour hole has developed downstream of the left spillway bay. The reservoir was, in fact, drained prior to the inspection because of concern over the present condition of the spillway.

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 C.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Recreation 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 on downstream developments (high). Due to the high damage potential and the questionable structural stability of the present spillway, the SDF for this facility is considered to be the PMF.

b. Spillway Analysis. Recreation Dam was analyzed under assumed normal operating conditions even though the reservoir is presently drained. The existing state of the reservoir is due to the recent spillway flashboard failures and the ensuing opening of the dam's sluice gate for passage of inflowing water. Normal operating conditions were taken to be that the 4-foot flashboards were in place (as indicated on Figure 2; present top of flashboard elevation = 105.5 ft) and functional for heads of less than 2 feet (Appendix C, Sheet 13) and that the sluice gate was closed. However, since the flashboards would probably fail instantaneously when the spillway discharge reached about 1050 cfs (Appendix C, Sheet 17), and the time between the failure of the flashboards and the inflow of the peak of the PMF is about 2 hours (which should be long enough for the reservoir to again reach equilibrium under a new spillway discharge control), the ogee-like spillway weir crest should regulate the passage of the peak flow through the dam. Therefore, it was assumed that the flashboards were removed, the spillway rating curve could be based on an ogee section, and the initial reservoir pool level was at the spillway crest elevation of 101.5 ft (see Appendix C, Sheet 17 for a further explanation of the flashboard assumption).

An 8,500-foot diversion ditch with significant storage and discharge capacities helps to drain the 21 square mile basin above Recreation Dam. In order to consider its effects on reservoir inflows, the potential storage and corresponding discharge values of the diversion ditch were added to the reservoir values at appropriate elevations (Appendix C, Sheets 19 to 22, and 24). Further, a tailwater rating curve was computed for the dam (Appendix C, Sheets 6 and 7).

In addition to the analysis of Recreation Dam itself, the Philipsburg Reservoir Dam located about 4 miles upstream of Recreation Dam was also investigated so as to ascertain the effects of the upstream impoundment on the downstream dam. The 4 miles of necessary channel routing between the dams and the channel routing downstream of Recreation Dam were done under the assumption that the channels were empty preceding routing. All pertinent engineering calculations relative to the evaluations of Recreation and Philipsburg Reservoir Dams are provided in Appendices C and C-1, respectively.

c. Non-Breach Analysis. Overtopping analysis (using the Modified HEC-1 Computer Program) of the two dams in series indicated that the discharge/storage capacity of the Philipsburg Reservoir Dam could accommodate about 47 percent of the PMF before the dam was overtopped, and the discharge/storage capacity of Recreation Dam in combination with that of the adjacent diversion ditch could accommodate about 54 percent of the PMF prior to overtopping (Appendix C, Summary Input/Output Sheets, Sheet Q). The depths of inundation of the Philipsburg Reservoir Dam would be about 0.4 feet under 1/2 PMF conditions and about 2.3 feet under PMF conditions. Recreation Dam would be topped by approximately 1.9 feet of water under PMF conditions, with the 1/2 PMF peak water surface rising to within about 0.5 feet of overtopping. Therefore, since the SDF of each of the dam facilities is the PMF, both the Philipsburg Reservoir Dam and Recreation Dam have a high potential for overtopping, and thus, for breaching under lower frequency floods of less than SDF magnitude.

d. Breach Analysis of Upstream Philipsburg Reservoir Dam. Since the spillway of Philipsburg Reservoir Dam cannot safely handle a flood of at least 1/2 PMF magnitude, the possibility of embankment failure under 1/2 PMF conditions was investigated (in accordance with ETL-1110-2-234) in order to determine its effects on possible overtopping and breaching of Recreation Dam. Several feasible alternatives were analyzed since it is difficult, if not impossible, to determine exactly how or if a specific dam will fail. The major concern of the breaching evaluations is the impact of the various breach discharges on increasing downstream water surface elevations.

The Modified HEC-1 Program was used for breaching analysis and it was assumed that the breaching of a dam would begin once its reservoir's water level reached the top of the dam.

Two sets of breach geometry were evaluated for the Philipsburg Reservoir Dam for each of two failure times (Appendix C-1, Sheet 11). The two sets of breach sections chosen were considered to be the minimum and maximum probable failure sections. The two failure times (total time for each section to reach its final dimensions) under which the minimum and maximum sections were investigated were assumed to be near instantaneous (15 minutes) and prolonged (4 hours), so that the possible upper and lower limits of this most sensitive variable might be examined. The near instantaneous failure time was chosen due to the presence of a concrete core wall as the dam's seepage barrier.

In addition, an average or more probable condition was analyzed. This condition was such that the breach section geometry was intermediate to the minimum and maximum breach sections previously defined. The failure time for this breach condition was also intermediate to the two failure times previously mentioned, but closer to the near instantaneous time since it was felt that the core wall was probably in fair to good shape.

The Philipsburg Reservoir Dam breach outflows ranged from about 4620 cfs for the minimum section-prolonged failure time scheme to about 19400 cfs for the maximum section-near instantaneous failure time scheme (Appendix C-1, Sheet 13). The outflow for the average breach condition was about 8320 cfs compared to the non-breach 1/2 PMF peak outflow of about 4590 cfs (Summary Input/Output Sheets, Sheet Q). However, the resultant peak contributions to the Recreation Reservoir inflows (following the 4 miles of channel routings) ranged from about 4410 cfs to 5990 cfs with the average breach condition contribution equal to 5990 cfs (Appendix C-1, Sheet 13). The non-breach routed contribution would be about 4360 cfs. Therefore, only the maximum section-near instantaneous and the average breach contributions, in combination with the local 1/2 PMF inflows, caused Recreation Dam to be overtopped (Summary Input/Output Sheets, Sheet U). Since the average or more probable breaching of Philipsburg Reservoir Dam was able to overtop Recreation Dam (under 1/2 PMF conditions), the effects on the downstream residences of the failure of Recreation Dam was investigated.

e. Breach Analysis of Recreation Dam. The maximum breach depth for Recreation Dam was about 4 feet due to the constraint of the height of tailwater on the dam just prior to overtopping (Appendix C, Sheet 28). Minimum and maximum breach sections (Appendix C, Sheet 27) were assumed in a manner similar to that explained for the Philipsburg Reservoir Dam. The two breach sections were evaluated for each of two failure times, a minimum time (about 0.5 hours as recommended on Sheet 28 of Appendix C) and a prolonged time (4.0 hours). Since Recreation Dam did not have a concrete core wall, an instantaneous or near instantaneous failure did not seem probable. An average condition was also assumed in a manner similar to that explained for the upstream dam, with the average failure time taken to be about 2.0 hours (since a more gradual downcutting through earth was expected).

The Recreation Dam breach outflows (again, assuming that breaching began when the reservoir level reached the top of dam elevation) ranged from about 10550 cfs for the minimum section-prolonged failure time scheme, to about 11770 cfs for the maximum section-minimum failure time scheme (Appendix C, Sheet 29). The average condition breach

outflow was about 10660 cfs compared to the non-breach 1/2 PMF peak outflow of about 8790 cfs (Summary Input/Output Sheets, Sheet Q). The additional increase in water surface elevation over that expected under 1/2 PMF non-breach conditions caused by the combined failures of both Recreation Dam and the upstream Philipsburg Reservoir Dam (breached according to their average set of failure conditions) was about 0.3 feet at the U. S. Route 322 bridge (located at about 500 feet downstream from the dam) and about 0.5 feet at the PA Route 504 bridge (located at about 900 feet below the dam; Appendix C, Sheet 30). Since the 1/2 PMF would cause significant flooding downstream regardless of dam breaching (with maximum depths of flow of about 4 feet above each of the previously mentioned bridges), the failure of Recreation Dam does not seem to pose a serious threat to significantly increase the loss of life or property damage downstream above that to be expected from the 1/2 PMF alone.

5.6 Spillway Adequacy.

The adequacy of the Recreation Dam spillway system can be described as follows:

1. If the flashboards were entirely removed, the dam facility could handle 54 percent of the Probable Maximum Flood (PMF) prior to overtopping of the embankment occurring, assuming that the upstream Philipsburg Dam would not fail due to its overtopping. The Recreation Dam spillway would then be considered "inadequate."

2. If it is assumed that the Philipsburg Dam would fail upon overtopping (which occurs under floods greater than or equal to 47 percent of the PMF), the Recreation Dam could also be overtopped and thus could possibly fail. The spillway of Recreation Dam would still be considered "inadequate", but not seriously inadequate, as the increase in the downstream tailwater due to embankment failure would not be significant.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment appeared to be in poor condition.

Numerous trees and bushes have become established on the downstream face of the dam. Riprap protection is minimal to non-existent. A level check indicated that portions of the dam crest were lower than the design elevation of 109.2 by on the order of 0.5 feet.

Although the reservoir was drained at the time of inspection, a few hydrophilic plants were noted on the downstream slope suggesting that seepage may be a problem under normal operating conditions.

The existing dam is a modification of a structure that was constructed prior to 1889. Details of construction are not certain but photographs and early correspondence within PennDER files suggest that portions of the dam may be constructed of timber cribbing with an earth cover. Photographs of a portion of the dam that failed in 1936 substantiate this belief. It is also apparent that fill has been placed in the area downstream of the northern portion of the embankment, thus reducing the apparent height of the embankment.

It is impossible, under the present drained condition of the lake, to adequately evaluate the structural integrity of the embankment. A more detailed investigation is warranted to determine the engineering characteristics of the embankment materials and the stability under all possible operating conditions.

b. Appurtenant Structures. Based on the visual observations, the spillway appeared to be in poor condition.

The left abutment masonry wingwall is missing several stones and many of the joints are cracked (see Photograph 8). Several joints on the ogee-like section of the spillway and the spillway sidewalls will also require repointing. A large scour pool (approximately 3 feet deep) is present at the toe of the apron beyond the left spillway bay and there has been considerable erosion of the left bank of the stream just beyond the endwall. The reservoir was drained in May 1978 when seepage was observed issuing from beneath the spillway.

It was noted that the color of the water in the plunge pool was different than the water flowing through the outlet structure at the time of inspection. It is possible that the color difference is due to turbidity which would then suggest that piping is taking place beneath the spillway or left abutment.

6.2 Design and Construction Techniques.

Actual design data, design computations, or reports were not available for any aspect of the facility except the flashboards.

An assessment of the flashboard design concept was conducted utilizing the modified HEC-1 program. Results of the analyses are as follows:

Under normal operating conditions the flashboards are assumed to fail under about a 2-foot head (at el. 107.5 relative datum) corresponding to a flow of about 1050 cfs (Appendix C, Sheet 17). The total flow at this elevation just prior to failure would then be about 2320 cfs, including the diversion ditch contribution of 1270 cfs (Appendix C, Sheet 31). If perhaps a flood of about 1/5 PMF magnitude occurred, the flashboards would fail instantaneously at a discharge of 2320 cfs, unleashing a failure outflow of at least 7000 cfs (which is the above mentioned diversion ditch outflow of 1270 cfs in combination with the ogee-like spillway discharge of 5730 cfs corresponding to elevation 107.5 feet; Appendix C, Sheet 18). The approximate water surface elevations corresponding to a discharge of 3500 cfs (the maximum flow if the flashboards did not fail) at the Route 322 and 504 bridges would be 1437.2 feet (MSL) and 1435.2 feet (MSL), respectively (Summary Input/Output Sheets B and C). Both elevations are below their particular top of bridge elevations; thus, the peak 1/5 PMF flow will be contained within bank. On the other hand, the approximate water surface elevations at the two bridges corresponding to a discharge of 7000 cfs (minimum failure outflow) would be 1443.1 feet and 1439.2 feet, respectively. Therefore, the Route 322 bridge would be overtopped by about 3.3 feet, and the Route 504 bridge by about 3.1 feet. Even if only two of the four sets of flashboards failed under the 2-foot design head (as has occurred recently), the failure flow would be such that the two downstream bridges would be overtopped by about 2 feet each (Appendix C, Sheets 31 to 33). Under these circumstances, although the dam embankment would not be overtopped, the failure of the spillway flashbaords (either in part or totally) would cause a significant increase in the downstream water surface elevations.

In so much as the Recreation Dam Reservoir is usable only with the flashboards in place (otherwise a very shallow marsh of no practical use would result), the facility in its existing normal operating state (with present spillway) is unsafe.

6.3 Past Performance.

The structure, as it exists today, was constructed in 1937 and 1938. Remnants of the older structure pre-dating 1889 probably make up portions of the northern embankment. Since 1938, the facility has experienced numerous problems most of them related to the flashboards. Borough personnel indicated that seepage developed beneath the spillway following a flood in May 1978. The facility was drained shortly thereafter.

6.4 Seismic Stability.

The dam is located within Seismic Zone No. 1 and may be subject to minor earthquake induced dynamic forces. Due to its relatively small cross-section, it is believed the embankment can withstand the expected minor earthquake induced forces. However, no calculations 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 and available engineering data suggest that the dam is in poor condition. Trees and bushes have become established on the downstream face of the northern portion of the embankment. There is no riprap protection on the upstream dam face. Field measurements indicated that the embankment crest was below the design crest elevation in several areas.

The reservoir was drained at the time of inspection, consequently, little can be said of seepage conditions. Some hydrophilic vegetation was observed near the northeast end of dam, suggesting possible seepage through the embankment under normal operating conditions.

Little is known of the design and construction of the embankment. PennDER files contain correspondence and photographs which suggest that the original facility was a timber crib structure which was later covered with earth. Some of the original structure probably exists beneath the earth portion of the northern embankment.

The spillway wingwalls and sidewalls are cracked and deteriorated. Seepage was observed issuing at the toe of the spillway following a flood (May 1978) which caused failure of the flashboards in the left spillway bay. The dam was drained shortly thereafter.

Hydraulic and hydrologic calculations yielded the following implications:

1. If the flashboards were entirely removed, the dam facility could handle 54 percent of the Probable Maximum Flood (PMF) prior to overtopping of the embankment occurring, assuming that the upstream Philipsburg Dam would not fail due to its overtopping. The Recreation Dam spillway would then be considered "inadequate."

2. If it is assumed that the Philipsburg Dam would fail upon overtopping (which occurs under floods greater than or equal to 47 percent of the PMF), the Recreation Dam could also be overtopped and possibly fail. The spillway of Recreation Dam would still be considered "inadequate", but not seriously inadequate, as the increase in the downstream tailwater due to embankment failure would not be significant.

Based on visual evaluation and past performance, however, the spillway system is considered structurally unsafe but of non-emergency status as the reservoir is completely drawn down. In addition, evaluation of the flashboard system indicated that failure of the flashboards under normal operating procedures could in itself cause serious downstream consequences.

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

c. Urgency. It is suggested that the recommendations listed below be implemented immediately.

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

7.2 Recommendations/Remedial Measures.

Recognizing that the existing structure may function as a flood retarding facility during periods of heavy rainfall, it is recommended that the owner immediately:

a. Remove the remnants of the flashboard system and sluice gate to provide unrestricted flow through the spillway.

b. Backfill the large scour hole adjacent to the left abutment wingwall with well-graded rock available in the discharge channel.

c. Provide lateral support for the wingwalls where required and slope protection to the channel walls in and around the vicinity of the wingwalls.

d. Immediately implement a warning system to notify downstream residents in the event emergency conditions develop. Included in the system should be provisions for around-the-clock surveillance during periods of unusually heavy rainfall.

If use of the facility as a recreational reservoir is abandoned, the entire spillway system and northerly embankment should be removed and the area restored to a near-original condition.

If recreational use of the facility is to be restored it is recommended that the owner in addition to Items a through d above:

e. Enlist the services of a registered professional engineer experienced in the design and construction of earth and masonry dams to evaluate the structural integrity of the Recreation Dam embankment and spillway. The study should include a subsurface investigation to assess the engineering properties of the embankment and foundation materials and a seepage analyses.

f. Enlist the services of a registered professional engineer experienced in hydrology and hydraulic design to more accurately assess the adequacy of the spillway system (including the diversion ditch).

g. Implement remedial measures dictated by the above analyses.

APPENDIX A

CHECK LIST - ENGINEERING DATA

NAME OF DAM: Recreation Dam

NDI#: PA-446 PENN DER#: 14-26

CHECK LIST
ENGINEERING DATA
PHASE I

ITEM	REMARKS NDI# PA - 446
PERSONS INTERVIEWED AND TITLE	1. Mr. Donald Enck - Street Commisssioner 2. Mr. Francis Stover - Chairman of Street Committee and Recreation Committee 3. Mr. Hislop (R.M.) - President of Borough Council (Sec. of Centre Company Planning Commission).
REGIONAL VICINITY MAP	See Appendix G (Regional Vicinity and Watershed Boundary Maps)
CONSTRUCTION HISTORY	See Section 1.2.g "Historical Data"
AVAILABLE DRAWINGS	None available from the owner. Those in Appendix F are available from PennDER files.
TYPICAL DAM SECTIONS	See Figure 2.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	 See Figure 3. See Figure 3. None available

ENGINEERING DATA (CONTINUED)

ITEM	REMARKS	NDI# PA - 446
SPILLWAY: PLAN SECTION DETAILS	 See Figure 2. See Figure 2. See Figure 2.	
OPERATING EQUIPMENT PLANS AND DETAILS	Not available.	
DESIGN REPORTS	None available.	
GEOLOGY REPORTS	None available.	
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	 Flashboard design calculations available in PennDER files. None. None.	
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	 None available. None available. None available.	

ITEM	REMARKS NDI# PA - 446
BORROW SOURCES	Not known.
POST CONSTRUCTION DAM SURVEYS	Survey currently being conducted by a consultant for the Borough of Philipsburg. No information yet available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	October 23, 1978 cost estimate to perform evaluation (proposal) submitted by R. E. Wright Associates, Inc.
HIGH POOL RECORDS	None available.
MONITORING SYSTEMS	None available.
MODIFICATIONS	1. Spillway repairs in mid-1978. 2. Addition to embankment on east side in mid-1960's. 3. Spillway construction and embankment improvements 1937-38. 4. Spillway reconstructed 1932. 5. Dam intentionally breached in 1929.

ITEM	REMARKS NDI# - PA-446
PRIOR ACCIDENTS OR FAILURES	May 1978 - Considerable storm damage - Mr. Enck observed sand boils at the spillway toe and ordered the reservoir drained. The reservoir has not been filled since that date.
MAINTENANCE: RECORDS MANUAL	None available.
OPERATION: RECORDS MANUAL	None available.
OPERATIONAL PROCEDURES	Not known.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	None.
MISCELLANEOUS	

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-446
PENN DER ID # 14-26

SIZE OF DRAINAGE AREA: 21.0 square miles

ELEVATION TOP NORMAL POOL: 1444.0 STORAGE CAPACITY: 25 Acre-feet

ELEVATION TOP FLOOD CONTROL POOL: -- STORAGE CAPACITY: --

ELEVATION MAXIMUM DESIGN POOL: -- STORAGE CAPACITY: --

ELEVATION TOP DAM: 1447.2 STORAGE CAPACITY: 75 Acre-feet

SPILLWAY DATA

CREST ELEVATION: 1440.0 (Top of Crest); 1444.0 (Top of Flashboards)

TYPE: Masonry with ogee-like crest and wood flashboards

WIDTH: --

LENGTH: 113 feet (excluding pier widths)

SPILLOVER LOCATION: Left abutment

NUMBER AND TYPE OF GATES: 4 ungated bays

OUTLET WORKS

TYPE: None

LOCATION: --

ENTRANCE INVERTS: --

EXIT INVERTS: --

EMERGENCY DRAWDOWN FACILITIES: 4-foot by 5-foot gate located in the center of the masonry spillway

HYDROMETEOROLOGICAL GAGES

TYPE: None

LOCATION: --

RECORDS: --

MAXIMUM NON-DAMAGING DISCHARGE: Not known

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Recreation Dam STATE Pennsylvania COUNTY Centre

NDI# PA - 446 PENNDER# 14-26

TYPE OF DAM Earth and rockfill timber crib SIZE small HAZARD CATAGORY high

DATE(S) INSPECTION 14, 22 November 1978 WEATHER rain and cold TEMPERATURE 40° @ 1:00 PM

POOL ELEVATION AT TIME OF INSPECTION N/A M.S.L.

TAILWATER AT TIME OF INSPECTION N/A M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	OTHERS
B. M. Mihalcin	Mr. Donald Enck - Street Commissioner	
E. J. Mannella	Mr. Francis Stover - Chairman of Street and Recreation Committee	
D. L. Bonk	Mr. Hislop - President of Borough Council	
W. J. Veon		
J. P. Nairn		
P. McIndoe		

RECORDED BY J. P. Nairn

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 446
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Misaligned to the vertical (0.5 feet low in a few areas).
RIPRAP FAILURES	Not applicable - The upstream face has no riprap protection.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good except for juncture of spillway and left abutment. Spillway wingwall needs rebuilding and repointing both upstream and downstream.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 446
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	May be some hydrophilic moss on the downstream face near the northeast corner of the dam.
ANY NOTICEABLE SEEPAGE	Not applicable (reservoir is drained).
STAFF GAGE AND RECORDER	None.
DRAINS	None.

OUTLET WORKS

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA -446
INTAKE STRUCTURE	4-foot by 5-foot gate in the second spillway bay from the right.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	Not applicable.
OUTLET STRUCTURE	See intake structure.
OUTLET CHANNEL	Outlet discharges on to spillway apron.
GATE(S) AND OPERATIONAL EQUIPMENT	Slide gate opened with a portable winch and chained to the I-beam supporting the walkway.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 446
TYPE AND CONDITION	Ungated masonry spillway with ogee-like weir crest. Three piers support a bridge over the spillway. Masonry weir requires repointing in several areas.
APPROACH CHANNEL	Masonry and earth.
SPILLWAY CHANNEL AND SIDEWALLS	Masonry sidewall and wingwall and apron - left wingwall missing masonry blocks and is severely cracked. Left sidewall also requires repointing.
STILLING BASIN PLUNGE POOL	None.
DISCHARGE CHANNEL	Uncontrolled discharges pass over the weir and enter the natural downstream drainage. A scour pool has developed downstream of left spillway bay. Water filled hole in eccess of 3 feet deep at this locale.
BRIDGE AND PIERS	Steel bridge with concrete manway. Alignment should be checked.
EMERGENCY GATES	None

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 446
TYPE AND CONDITION	N/A
APPROACH CHANNEL	N/A
OUTLET STRUCTURE	N/A
DISCHARGE CHANNEL	N/A

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 446
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 446
SLOPES: RESERVOIR	Steep and primarily wooded.
SEDIMENTATION	The entire reservoir area has apparently been filled with sediment.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Two bridges located approximately 500 and 900 feet downstream of the dam.
SLOPES: CHANNEL VALLEY	Gentle to steep and primarily residential in first mile.
APPROXIMATE NUMBER OF HOMES AND POPULATION	At least a half dozen homes and businesses are located sufficiently close to the stream banks to be effected by a dam breach - Population ≈ 20.

APPENDIX C

HYDROLOGY AND HYDRAULICS

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 outlined 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 specific 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 elevation(s) of the failure hydrograph(s) for each location.

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY DLB DATE 1-22-79 PROJ. NO. 78-617-446

CHKD. BY WJV DATE 2-25-79 SHEET NO. 1 OF 33

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Engineers • Geologists • Planne
Environmental Specialists

DAM STATISTICS

DAM HEIGHT ≃ 14.7 FT (FIELD MEASURED)

MAXIMUM POOL STORAGE CAPACITY ≃ 75.1 AC-FT (SHEET 5)
(@ TOP OF DAM)

NORMAL POOL STORAGE CAPACITY ≃ 25.3 AC-FT (SHEET 3)

DRAINAGE AREA ≃ 11.6 SQ. MI (LOCAL)
21.0 SQ. MI (TOTAL)

[PLANIMETERED OFF U.S.G.S. 7.5 MINUTE SERIES QUADS PHILLIPSBURG AND SANDY RIDGE, PA.]

DAM CLASSIFICATION

DAM SIZE - SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATIO

REQUIRED SDF - ½ PMF TO PMF (REF 1, TABLE 3)

40

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY DLB DATE 1-23-79 PROJ. NO. 78-617-446

CHKD. BY WJV DATE 2-25-79 SHEET NO. 2 OF 33

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HYDROGRAPH PARAMETERS (FOR LOCAL SUBAREA)

LENGTH OF LONGEST WATERCOURSE (L) ≈ 7.5 MILES

L_{CA} ≈ 4.2 MILES (MEASURED FROM DAM CREST TO CENTROID OF BASIN)

NOTE 2: VALUES OF L AND L_{CA} ARE MEASURED FROM U.S.G.S. 7.5 MINUTE SERIES QUADS SANDY RIDGE & PHILLIPSBURG, PA.

$C_t = 2.10$

$C_p = 0.40$

} [SUPPLIED BY C OF E; ZONE 20, SUSQUEHANNA RIVER BASIN.]

t_p = SNYDER'S STANDARD LAG = $2.10(L \times L_{CA})^{0.3}$

$t_p = (2.10)\left[(7.5)(4.2)\right]^{0.3} = 5.91$ HRS

NORMAL POOL STORAGE CAPACITY

SURFACE AREA @ NORMAL POOL ≈ 9 ACRES
(@ TOP OF FLASHBOARD ELEVATION ≈ 105.5 FT)

[PLANIMETERED OFF THE USGS 7.5 MINUTE PHILIPSBURG QUAD ASSUMING NORMAL POOL TO BE AT ELEVATION 1444 ON QUAD]

SINCE AT THE TIME OF INSPECTION THE RESERVOIR WAS EMPTY, IT WAS OBSERVED THAT THE POOL AREA WAS HEAVILY SILTED IN TO WITHIN 1½ TO 2 FT OF THE ORIGINAL SPILLWAY CREST. THEREFORE, THE REPORTED NORMAL POOL STORAGE CAPACITY OF 20 MILLION GALLONS (OR 60 A-F) AS REPORTED ON PG 51 OF "DAMS, RESERVOIRS, AND NATURAL LAKES" (WATER RESOURCES BULLETIN Nº 5, COMMONWEALTH OF PENNSYLVANIA, DEPARTMENT OF FORESTS AND WATER, HARRISBURGH, PA. 1970) IS FELT

SUBJECT DAM SAFETY INSPECTION/
RECREATION DAM

BY WJV DATE 2-1-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 3 OF 33

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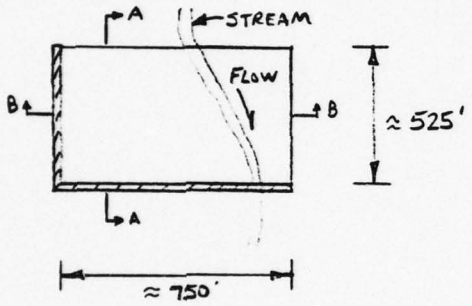
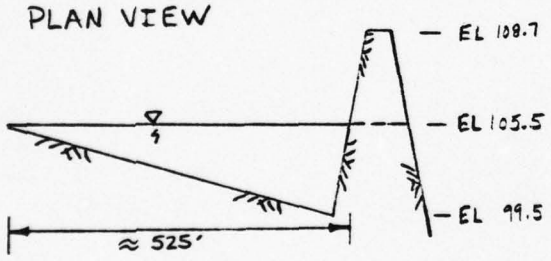
TO BE INACCURATE.

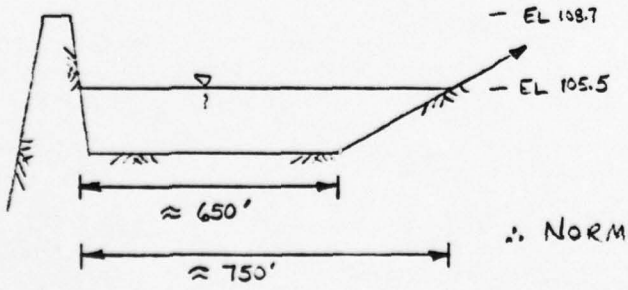
IN ORDER TO ESTIMATE THE PRESENT AVAILABLE STORAGE, ASSUME THAT THE RESERVOIR IS ROUGHLY RECTANGULAR IN SHAPE @ NORMAL POOL WITH THE RESERVOIR BED GRADUALLY SLOPING TOWARD THE DAM (SEE SKETCHES BELOW). THEREFORE, A SECTION FROM THE UPSTREAM PORTION OF THE RESERVOIR THROUGH THE DOWNSTREAM FACE OF THE DAM (SECTION A-A) WOULD SHOW A WEDGE SHAPED AREA OF WATER AT NORMAL POOL. A SECTION FROM THE RIGHT EMBANKMENT TO THE LEFT OF THE RESERVOIR (SECTION B-B) WOULD BE TRAPEZOIDAL IN SHAPE. THUS, THE STORAGE AT NORMAL POOL ELEVATION CAN BE FOUND BY ASSUMING THAT SECTION A-A IS CONSTANT FOR ≈ 650 FT ACROSS THE RESERVOIR (AS SHOWN ON SECTION B-B), AND VARIES FROM ITS MAXIMUM DIMENSIONS TO 0 AREA FOR THE REMAINING 100 FT:



PLAN VIEW



SECTION A-A



SECTION B-B

$V = \left[\frac{1}{2}(105.5 - 99.5) \times 525\,FT\right] \times 650\,FT$
$+ \frac{1}{2}\left[\frac{1}{2}(105.5 - 99.5) \times 525\,FT\right] \times 100\,FT$
$\approx 1102500\,FT^3$

∴ NORMAL POOL STORAGE CAPACITY ≈ 25.3 AC-FT

NOTE: SKETCHES NOT TO SCALE; DIMENSIONS ARE ESTIMATED FROM USGS QUADS AND FIELD INSPECTION NOTES; DAM EMBANKMENT LENGTHS NOT ACTUAL.

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-7-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 4 OF 33

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RESERVOIR SURFACE AREAS

S.A. @ NORMAL POOL (EL. 105.5) ≈ 9 ACRES (SHEET 2)
(≈ USGS ELEVATION 1444.0)

S.A. @ USGS ELEVATION 1460.0 ≈ 75.3 ACRES [PLANIMETERED OFF THE 7.5 MINUTE USGS PITTSBURG QUAD]

$\therefore \Delta SA/\Delta ELEV. \approx (75.3 - 9.0)/(1460.0 - 1444.0)$

≈ 4.14 AC/FT ABOVE ELEV 1444.0 FT (105.5 FT)

TOP OF DAM ELEVATION ≈ 108.7 FT (FIELD MEASURED)

$\therefore$ SA @ 108.7 FT ≈ 9.0 AC + [(108.7 - 105.5) × 4.14 AC/FT]

≈ 22.2 AC

RESERVOIR STORAGE-ELEVATION RELATIONSHIP

ASSUME THAT THE VOLUME RELATIONSHIP ON SHEET 3 IS REPRESENTATIVE OF THE POTENTIAL STORAGE BELOW EL 105.5.

ELEVATION (FT)	DEPTH (FT)	VOLUME (A-F)	
99.5	0	0	
100.5	1	0.7	
101.5	2	2.7	- RESERVOIR ROUTING STARTING POINT
102.5	3	6.3	
103.5	4	11.0	
104.5	5	17.4	
105.5	6	25.3	- NORMAL POOL

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-9-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 5 OF 33

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ASSUME THE MODIFIED PRISMOIDAL FORMULA : $\Delta V_{1-2} = \frac{Y}{3}(A_1 + A_2 + \sqrt{A_1 * A_2})$
IS REPRESENTATIVE OF POTENTIAL STORAGE ABOVE EL. 105.5. (REF 14, PG 15)

	ELEVATION (FT)	Y (FT)	*A (FT²)	ΔV_{1-2} (A-F)	CUM. VOL. (A-F)	ELEVATION (FT)	Y (FT)	*A (FT²)	ΔV_{1-2} (A-F)	CUM. VOL. (A-F)
	105.5	0	9.0	0	25.3	110.5	1	29.7	27.6	121.8
	106.5	1	13.1	11.0	36.3	111.5	1	33.8	31.7	153.5
	107.5	1	17.3	15.2	51.5	112.5	1	38.0	35.9	189.4
TOP OF DAM →	108.7	1.2	22.2	23.6	75.1	113.5	1	42.1	40.0	229.4
	109.5	0.8	25.6	19.1	94.2	114.5	1	46.3	44.2	273.6

* $A = A_0 + \frac{\Delta A}{\Delta Y}(Y) \Rightarrow A = 9.0 + (4.14)Y$ (SEE SHEET 4)

PMP CALCULATIONS

- STANDARD RAINFALL INDEX = 22.2 INCHES (REF 9, FIG 2)
  (CORRESPONDING TO A DURATION OF 24 HR, AND AN AREA OF 200 SQ.MI.)

- GEOGRAPHIC ADJUSTMENT FACTOR = 103% (REF 9, FIG 1)
  (CORRESPONDING TO A LATITUDE OF 40°54' AND A LONGITUDE OF 79°13')
- CORRECTED RAINFALL INDEX = (22.2 IN) x (1.03) ≈ 22.9 IN.
- DRAINAGE AREA ≈ 21.0 SQ.MI.

DURATION (HRS)	% OF INDEX RF (%)
6	109.5
12	119.0
24	128.5

NOTE: A 24 HOUR RATHER THAN A 72-HOUR DURATION WAS USED SO THAT A TIME STEP OF 5 MINUTES COULD BE USED IN HEC-1

- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE, AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALL AREA) ≈ 0.325 (FROM HEC-1 PROGRAM; REF 10, PG B-16)

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-12-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 6 OF 33

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TAILWATER CALCULATIONS

TAILWATER ON THE DAM COULD CAUSE A SIGNIFICANT DECREASE IN THE CAPACITY OF THE SPILLWAY, SINCE THE HEIGHT OF THE SPILLWAY ABOVE THE STREAM CHANNEL IS NOT VERY LARGE, AND THE TAILWATER COULD PARTIALLY DROWN OUT THE WEIR FLOW. THE TAILWATER WILL ALSO AFFECT THE EXTENT OF POSSIBLE BREACHING, SINCE THE EMBANKMENT PROBABLY WON'T ERODE BENEATH THE TAILWATER ELEVATION.

A TAILWATER RATING CURVE WAS COMPUTED VIA THE HEC-2 WATER SURFACE PROFILE COMPUTER PROGRAM*. HEC-2 CALCULATED BACKWATER CURVES BY THE STANDARD STEP METHOD (REF 7, PG 274-280), BASED ON FIELD AND USGS TOPO MAP ESTIMATED CROSS-SECTIONS. A RATING CURVE FOR THE ROUTE 504 BRIDGE SECTION WAS HAND COMPUTED (SHEETS 8 TO 12) AND USED AS THE STARTING POINT FOR THE BACKWATER CALCULATIONS. THE WATER SURFACE PROFILES WERE STARTED AT THE ROUTE 504 BRIDGE SECTION (SHEET 26), PROCEED. 400 FT UPSTREAM AND THROUGH THE 30FT WIDE ROUTE 322 BRIDGE (SHEET 26), THEN PROCEDED 250 FT FURTHER UPSTREAM TO A CONSTRICTED CHANNEL SECTION, AND FINALLY 250 FT MORE UPSTREAM TO THE DAM.

THE RESULTANT TAILWATER RATING CURVE (ELEVATION VS DISCHARGE) IS GIVEN ON THE NEXT PAGE. THE SUMMARY HEC-2 INPUT IS GIVEN ON SHEETS A & B, AND THE SUMMARY OUTPUT ON SHEETS B-D OF THE SUMMARY INPUT/OUTPUT SHEETS.

* HEC-2 WATER SURFACE PROFILES (USERS MANUAL), HYDROLOGIC ENGINEERING CENTER, US ARMY CORPS OF ENGINEERS, DAVIS, CALIF., Nov. 197[illegible].

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-12-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 7 OF 33

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- TAILWATER RATING CURVE @ THE DAM FROM HEC-2:

* ELEVATION (FT)	DISCHARGE (CFS)
1433.9	340
1435.8	1140
1437.7	2210
1439.8	3510
1440.3	3660
1440.9	3960
1442.2	4790
1443.5	6500
1443.8	9270
1445.0	14000
1446.2	19850
1447.1	26730
1448.1	34610
1449.0	43390

* ELEVATION 1444.0 (MSL) ≅ ELEVATION 105.5 (RELATIVE DATUM)

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-9-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 8 OF 33

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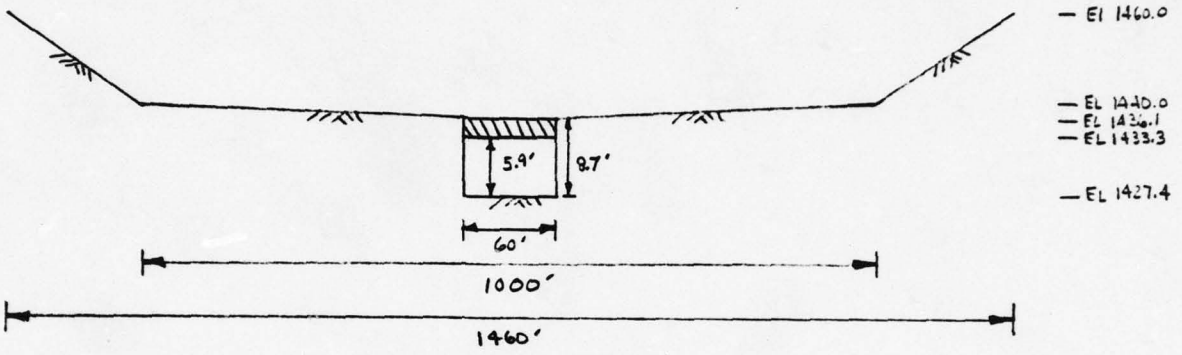
HIGHWAY 504 BRIDGE SECTION: RATING CURVE

- APPROXIMATE SECTION DIMENSIONS (FROM FIELD AND USGS MAPS):



- APPROXIMATE CHANNEL AND CULVERT SLOPE = 0.0055 (FIELD MEASURED)

- CULVERT DISCHARGES ARE CONTROLLED BY EITHER INLET OR OUTLET CONTROL, DEPENDING ON SUCH FACTORS AS CROSS SECTIONAL AREA, LENGTH, ROUGHNESS, SLOPE, AND ENTRANCE CONDITIONS OF THE CULVERT, AS WELL AS HEADWATER AND TAILWATER LEVELS.

- * INLET CONTROL IS INDEPENDENT OF TAILWATER CONDITIONS, AND FOR H/D (HEADWATER DEPTH TO CULVERT DEPTH RATIO) < 1.2, THE DISCHARGE EQUATION IS:

$$Q = \frac{2}{3} C_B B H \sqrt{\frac{2}{3} g H}$$ (CONDITIONED FLOW)

WHERE Q = DISCHARGE IN CFS, C_B = END CONTRACTION COEFFICIENT = 0.9 (SQUARE-EDGED ENTRANCE), B = WIDTH OF CULVERT = 60 FT, H = HEADWATER DEPTH ABOVE INLET INVERT ELEVATION OF 1427.6 FT, AND g = 32.2 FT/SEC^2.

* INFORMATION OBTAINED FROM: OPEN CHANNEL FLOW BY F.M. HENDERSON. MACMILLAN PUBLISHING CO, INC., NEW YORK, NEW YORK. 1966 (PG 263)

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-9-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 9 OF 33

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FOR $H/D > 1.2$

$$Q = C_h B D \sqrt{2g (H - C_h D)}$$ (SLUICE FLOW)

WHERE Q, B, g, AND H ARE AS BEFORE, D = DEPTH OF CULVERT = 5.9 FT, AND C_h = CONTRACTION COEFFICIENT = 0.6 (SQUARE-EDGED ENTRANCE).

- INLET CONTROL FLOWS :

ELEVATION (FT)	H (FT)	H/D (FT/FT)	Q (CFS)
1427.4	0	-	0
1428.0	0.6	0.10	80
1429.0	1.6	0.27	340
1430.0	2.6	0.44	700
1431.0	3.6	0.61	1140
1432.0	4.6	0.78	1650
1433.0	5.6	0.95	2210
1434.0	6.6	1.12	2830
1435.0	7.6	1.29	3480
1436.0	8.6	1.46	3930
1436.1	8.7	1.47	3870
1437.0	9.6	1.63	4200
1438.0	10.6	1.80	4530
1439.0	11.6	1.97	4840
1440.0	12.6	2.14	5130

SUBJECT DAM SAFETY INSPECTION / RECREATION DAM

BY WJV DATE 2-9-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 10 OF 33

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- ** OUTLET CONTROL DISCHARGES ARE ESPECIALLY DEPENDENT ON TAILWATER LEVEL. OUTLET CONTROL CAN OCCUR IF $H > 0.75\,D$, WITH DISCHARGE DEFINED BY ITS RELATIONSHIP TO HW IN THE EQUATION BELOW.

$$HW = \left[1 + k_e + \frac{29 n^2 L}{R^{1.33}}\right] \frac{Q^2}{2gA^2} + TW - L_o S_o$$

WHERE HW = WATER SURFACE ELEVATION @ INLET IN FT; K_e = ENTRANCE LOSS COEFFICIENT ≈ 0.4 (WINGWALLS @ 30° TO 75° TO CULVERT); $n \approx 0.04$; $A = 354\ FT^2$; $R = 354\ FT^2 / 131.9\ FT \approx 2.69\ FT$; L_o = LENGTH OF CULVERT $\approx 35\ FT$ (FIELD MEASURED); Q = CULVERT DISCHARGE IN CFS; TW = TAILWATER ELEVATION = ELEVATION OF OUTLET INVERT (1427.2 FT) + THE AVERAGE OF THE APPROPRIATE CRITICAL DEPTH AND THE DEPTH OF THE CULVERT ($\frac{d_c + D}{2}$), OR THE DEPTH OF THE CULVERT (WHICHEVER IS SMALLER) UP TO HW = 1436.1 AT WHICH POINT A COMBINATION OF WEIR AND OPEN CHANNEL FLOW OCCURS ABOVE THE CULVERT WHICH WILL DROWN OUT THE OUTLET. THEREFORE, @ HW = 1436.1 ± 0.5 FT, THE TW ELEVATION WILL BE ASSUMED TO BE @ EL 1434.8 (½ WAY BETWEEN LOW CHORD AND TOP OF ROAD); ABOVE ABOUT HW = 1439.0, THE TW ELEVATION WILL BE ASSUMED TO BE AT EL 1436.1 (TOP OF ROAD) W/ AN INCREASE OF 1.0 FT PER ADDITIONAL 500 CFS.

** INFORMATION OBTAINED FROM: "HYDRAULIC CHARTS FOR THE SELECTION OF HIGHWAY CULVERTS", HEC Nº 5, BUREAU OF PUBLIC ROADS.

SUBJECT DAM SAFETY INSPECTION/
RECREATION DAM

BY WJV DATE 2-9-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 11 OF 33

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- OUTLET CONTROL FLOWS:

Q (CFS)	d_c *** (FT)	$\frac{d_c+D}{2}$ OR D (FT)	TW (FT)	LS_o (FT)	HW (FT)	
3000	4.3	5.1	1432.3	0.2	1434.1	> OTE + INVER ELEV
3500	4.7	5.3	1432.5	0.2	1435.1	
4000	5.2	5.6	~~1432.8~~	0.2	**** ~~1436.2~~	
4000	—	—	1434.8	0.2	1438.2	
4500	—	—	1436.1	0.2	1440.5	
5000	—	—	1437.1	0.2	1442.6	
5500	—	—	1438.1	0.2	1444.8	
6000	—	—	1439.1	0.2	1447.1	

*** $d_c = \sqrt[3]{q^2/g}$ WHERE $q = Q/60FT$ (REF 13, PG 143; FOR RECTANGULAR SEC

**** SINCE $1435.6 < HW < 1436.6 \Rightarrow TW = 1434.8 \Rightarrow$ RECALCULATE

- ASSUME ALL OPEN CHANNEL FLOW ABOVE EL 1436.1, SINCE THE POSSIBLE WEIR FLOW OVER THE BRIDGE WILL ONLY BE A SMALL CONTRIBUTION TO THE TOTAL SECTION FLOW UNDER HIGHER HEADS. FLOWS ARE DEFINED BY THE MANNING EQUATION:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \qquad \text{(REF 13, PG 132)}$$

WHERE Q = DISCHARGE IN CFS, n = ROUGHNESS COEFFICIENT ≈ 0.08 (FROM EXPERIENCE, SEE NOTE), A = CROSS-SECTIONAL AREA IN FT^2, $R = \frac{\text{WETTED AREA}}{\text{WETTED PERIMETER}}$, S = SLOPE OF THE ENERGY LINE @ THE SECTION $\approx$ CHANNEL SLOPE ≈ 0.0055

NOTE: THE ABOVE n-VALUE IS AN AVERAGE ACROSS THE ENTIRE X-SECT WHICH IS IN A RESIDENTIAL AREA W/ GRASSLAND, TREES, ROADS, AND BUILDINGS

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-10-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 12 OF 33

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- OPEN CHANNEL FLOWS :

ELEVATION (FT)	HEIGHT ABOVE BRIDGE (FT)	A (FT^2)	R (FT)	Q (CFS)
1436.1	0	-	-	0
1437.0	0.9	158	0.54	150
1438.0	1.9	577	1.05	820
1439.0	2.9	1252	1.56	2330
1440.0	3.9	2184	2.06	4380
1441.0	4.9	3254	3.01	9330
1442.0	5.9	4344	3.95	14990
1443.0	6.9	5454	4.87	21640
1444.0	7.9	6584	5.78	29290
1445.0	8.9	7734	6.67	37850

- TOTAL DISCHARGE RATING CURVE FOR THE BRIDGE :
(OUTLET CONTROL FLOWS INTERPOLATED WHERE NECESSARY)

ELEVATION (FT)	Q (CFS)
1427.4	0
1428.0	90
1429.0	340
1430.0	700
1431.0	1140
1432.0	1650
1433.0	2210
1434.0	2830
1435.0	3430
* 1435.2	3510

ELEVATION (FT)	Q (CFS)
1436.0	3650
1436.1	3660
1437.0	3960
1438.0	4790
1439.0	6530
1440.0	9270
1441.0	14000
1442.0	19850
1443.0	26730
1444.0	34610
1445.0	43390

* APPROXIMATE TRANSITION BETWEEN INLET AND OUTLET CONTROL.

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-9-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 13 OF 33

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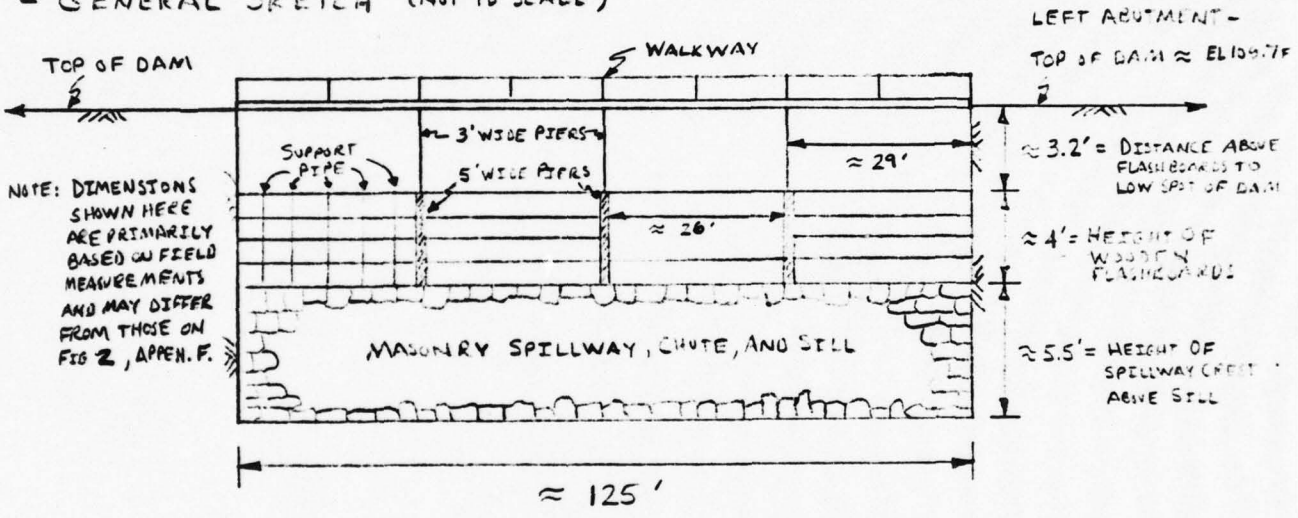
SPILLWAY CAPACITY

- SPILLWAY DIMENSIONS AND ELEVATIONS WERE OBTAINED FROM FIELD MEASUREMENTS AND FIG. 2, APPENDIX F.

- GENERAL SKETCH (NOT TO SCALE)



- NORMAL OPERATION IS TO HAVE THE 4 FT HIGH FLASHBOARDS IN PLACE. HOWEVER, FLASHBOARDS ARE DESIGNED TO FAIL, AND THOSE IN THE FAR LEFT AND FAR RIGHT BAYS HAD FAILED PRIOR TO INSPECTION. ACCORDING TO INFORMATION IN THE PENN DER FILES, THE ORIGINAL DESIGN OF THE FLASHBOARDS CALLED FOR FAILURE HEIGHTS OF BETWEEN 2 AND 3 FT ABOVE THE TOPS OF THE FLASHBOARDS. THEREFORE, ASSUMING THAT THE SUPPORT PIPES ARE RELATIVELY NEW (ALTHOUGH AT THE TIME OF INSPECTION THE REMAINING PIPES APPEARED TO BE IN POOR SHAPE), THE FAILURE HEIGHT FOR EACH SET OF FLASHBOARDS WILL BE TAKEN TO BE 2 FT ABOVE THE TOPS OF THE FLASHBOARDS. THUS, THE FLASHBOARDS WILL HAVE FAILED PRIOR TO OVERTOPPING OF THE DAM, AND THE CAPACITY OF THE SPILLWAY IS DEPENDENT ONLY

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-8-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 14 OF 33

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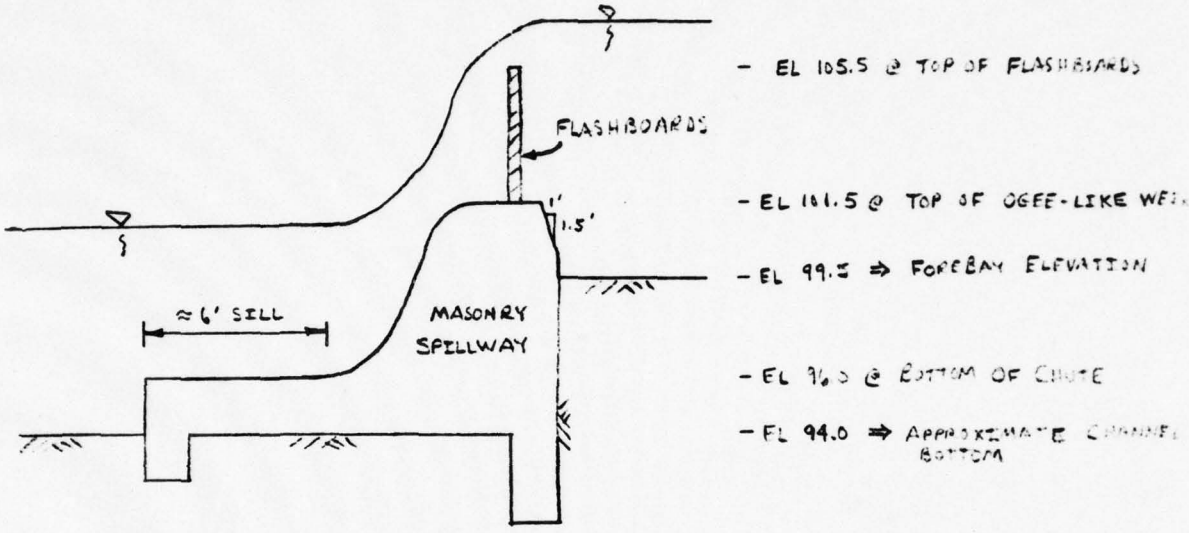
ON FLOW OVER THE ORIGINAL OGEE-LIKE SPILLWAY WEIR AS SHOWN BELOW.



- THE EFFECTIVE SPILLWAY LENGTH IS GIVEN BY:

$$L = L' - 2(NK_p + K_a)H_e \qquad \text{(REF. 4, PG 373)}$$

WHERE L = EFFECTIVE CREST LENGTH IN FT,
L' = NET LENGTH OF CREST IN FT,
N = NUMBER OF PIERS,
K_p = PIER CONTRACTION COEFFICIENT,
K_a = ABUTMENT CONTRACTION COEFFICIENT, AND
H_e = TOTAL HEAD ON CREST IN FT.

AVERAGE PIER WIDTH = $\frac{5+3}{2} = 4'$ (THIS IS AN ASSUMPTION MADE IN ORDER TO SIMPLIFY SPILLWAY CALCULATIONS. THE EFFECT IS TO SLIGHTLY INCREASE THE TOTAL CAPACITY OF THE SPILLWAY.)

∴ SINCE $N = 3 \Rightarrow L' \approx 125' - [3 \times 4\text{ FT}] = 113\text{ FT}$

$K_p \approx 0.02$ (SQUARE NOSE PIERS) ; $K_a \approx 0.10$ (AVERAGE CONDITI

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-8-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 15 OF 33

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H_e = TOP OF DAM EL - SPILLWAY CREST EL.
= 108.7 - 101.5 = 7.2 FT (ASSUMED DESIGN HEAD = H_o)

$\therefore$ $L = 113 - 2[(3 \times 0.02) + 0.10](7.2) \approx 111$ FT

- OGEE-CRESTED WEIR DISCHARGE DEFINED BY :

$$Q = C L H_e^{3/2}$$ (REF 4, PG 378)

WHERE Q = DISCHARGE IN CFS,
L = EFFECTIVE WEIR LENGTH $\approx$ 111 FT,
H_e = EFFECTIVE HEAD ABOVE CREST $\approx$ 7.2 FT, AND
C = COEFFICIENT OF DISCHARGE.

- CALCULATION OF C :

• FOREBAY DEPTH (P) $\approx$ 2FT $\Rightarrow$ $P/H_o = 2/7.2 \approx 0.28$

$\therefore$ $C_o \approx 3.67$ (REF 4, PG 378)

• EFFECT OF HEAD DIFFERING FROM DESIGN HEAD -

$H_e = H_o = 7.2'$ (FOR CAPACITY ESTIMATE)

$\Rightarrow$ $H_e/H_o = 1.0$ $\Rightarrow$ $C_o \approx (1.0)(3.67) = 3.67$ (REF 4, PG 378)

• EFFECT OF INCLINED US FACE -

SLOPE = 1 to 1.5 $\Rightarrow$ $C_c/C_o \approx 1.023$ (REF 4, PG 377)

$\therefore$ $C_c \approx (1.023)(3.67) \approx 3.75$

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-9-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 16 OF 33

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- DOWNSTREAM APRON EFFECTS –

$h_d + d$ = DEPTH OF SPILLWAY SILL BELOW WATER SURFACE ELEVATION @ THE DESIGN HEAD = 7.2 + 5.5 = 12.7 FT

$\therefore \frac{h_d + d}{H_e} = \frac{12.7}{7.2} \approx 1.76 \Rightarrow C_s/C_i = 1.0$ (REF 4, PG 391)

$\Rightarrow$ NO ADVERSE APRON EFFECTS $\Rightarrow$ $C_{s_A} = (1.0)(3.75) = 3.75$

- TAILWATER OR SUBMERGENCE EFFECTS

ESTIMATE OF FLOW PRIOR TO ADJUSTMENT:

$$Q_{INITIAL} = CLH^{3/2} = (3.75)(111)(7.2)^{3/2} \approx 8040 \text{ CFS}$$

$\therefore$ AT $Q_{TOTAL} \approx 8040$ CFS + 1760 CFS (FROM DIVERSION CHANNEL) = 9800 CFS
THE TAILWATER ON THE DAM IS @ EL 1493.9 (OR 105.4) → SHEET 7.

THUS, $h_d/H_e = (108.7 - 105.4)/7.2 \text{ FT} \approx 0.46$

$\Rightarrow C_s/C_i \approx 0.97 \Rightarrow C_s \approx 3.64$ (REF 4, PG 392)

(h_d = THE HEAD DIFFERENCE BETWEEN THE DESIGN HEAD WSEL, AND THE TAILWATER EL.)

- CAPACITY: $Q = (3.64)(111 \text{ FT})(7.2 \text{ FT})^{3/2}$

$$Q \approx 7810 \text{ CFS}$$

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-12-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 17 OF 33

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SPILLWAY RATING CURVE

ALTHOUGH NORMAL OPERATION CALLS FOR THE FLASHBOARDS TO BE IN PLACE, IT MUST BE ASSUMED THAT THEY HAVE ALL FAILED PRIOR TO INFLOW OF THE PMF. PRESENTLY, 2 SETS OF FLASHBOARDS ARE MISSING AND A 5½ FT x 4 FT GATED OPENING PERMITS FLOW THROUGH THE SPILLWAY. THE HEC-1-DAM PROGRAM DOES NOT ALLOW THE USE OF A DISCONTINUOUS RATING CURVE, WHICH WOULD BE NEEDED IN ORDER TO CONSIDER THE FLASHBOARDS. THAT IS, THE FLASHBOARDS WOULD FAIL UNDER A 2 FT HEAD (EL 107.5) OR A FLOW OF ABOUT 1050* CFS, AT WHICH POINT (CONSIDERING AN INSTANTANEOUS FAILURE) THE DISCHARGE CAPACITY WOULD INCREASE TO ABOUT 5730 CFS (SHEET 13) AT THE SAME ELEVATION. SINCE THE OUTFLOW DIRECTLY AFTER FAILURE IS SO MUCH GREATER THAN THE OUTFLOW JUST BEFORE FAILURE (5730 cfs VS 1050 cfs), THE RESERVOIR COULD BE DRAWN DOWN BELOW THE NORMAL POOL ELEVATION (105.5 FT), AT WHICH POINT THERE WOULD BE NO FLOW VALUE CONSIDERING A CONTINUOUS RATING CURVE. FURTHER, THE DISCHARGES CORRESPONDING TO THE RESERVOIR WATER SURFACE ELEVATIONS BETWEEN 105.5 AND 107.5 ARE MUCH LARGER AFTER FAILURE THAN BEFORE FAILURE, AND 2 DIFFERENT DISCHARGES AT THE SAME ELEVATION CAN NOT BE INPUTTED. THEREFORE FOR SIMPLICITY, THE FLASHBOARDS WILL BE ASSUMED TO HAVE FAILED PRIOR TO THE INFLOW OF THE PMF PEAK, WITH THE 5½ FT x 4 FT GATE CLOSED. THE SPILLWAY RATING CURVE WILL THEN BE BASED ON AN OGEE-LIKE WEIR WITH DISCHARGES COMPUTED AS ON SHEETS 13 TO 16 (APPROACH VELOCITY AND LOSSES ARE ASSUMED NEGLIGIBLE).

* FLASHBOARDS ACT LIKE A SHARP-CRESTED WEIR W/ $Q = CLH^{3/2}$: $C \approx 3.3$ (REF. 4, PG 373), $L \approx 112$ (BY EQUATION ON SHEET 14), AND $H = 2$ FT $\Rightarrow$ $Q \approx 1050$ CFS

SUBJECT DAM SAFETY INSPECTION

RECREATION DAM

BY WJV DATE 2-12-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 13 OF 33

- RATING CURVE CALCULATIONS:

** RESERVOIR ELEVATION (FT)	HEAD H_e (FT)	L (FT)	(B) H_e/H_o (FT/FT)	(C) C/C_o	(D) C_L	(E) h_d+d (FT)	$\frac{h_d+d}{H_e}$ (FT/FT)	(F) APPR. EFFECTS C_s/C	(F) APPR. EFFECTS C_{s_A}	(G) INITIAL Q_L (CFS)	(H) TW ELEVATION (FT)	(I) h_d/H_e (FT/FT)	(J) SUBMERGENCE EFFECTS C_s/C	(J) SUBMERGENCE EFFECTS C_s	ACTUAL DISCHARGE Q (CFS)
101.5	0	–	–	–	–	–	0				–	–	–		0
102.5	1	113	0.14	0.835	3.13	6.5	6.5	1.0	3.13	354	1434.3	6.70	1.0	3.13	350
103.5	2	112	0.28	0.875	3.29	7.5	3.8	1.0	3.29	1042	1436.2	2.90	1.0	3.29	1040
104.5	3	112	0.42	0.905	3.40	8.5	2.8	1.0	3.40	1979	1438.3	1.57	1.0	3.40	1980
105.5	4	112	0.56	0.930	3.49	9.5	2.4	1.0	3.49	3127	1441.2	0.70	1.0	3.49	3130
106.5	5	111	0.69	0.955	3.59	10.5	2.1	1.0	3.59	4455	1443.3	0.34	0.95	3.41	4230
107.5	6	111	0.83	0.975	3.66	11.5	1.9	1.0	3.66	5971	1443.6	0.40	0.96	3.51	5730
108.5	7	111	0.97	0.995	3.74	12.5	1.8	1.0	3.74	7689	1443.8	0.46	0.97	3.63	7460
108.7	7.2	111	1.00	1.0	3.75	12.7	1.8	1.0	3.75	8012	1443.9	0.46	0.97	3.64	7810
109.5	8	111	1.11	1.015	3.81	13.5	1.7	1.0	3.81	9569	1444.7	0.41	0.96	3.66	9190
110.5	9	111	1.25	1.030	3.87	14.5	1.6	0.995	3.85	11538	1445.8	0.36	0.95	3.66	10970
(A) 111.5	10	111	1.39	1.050	3.94	15.5	1.6	0.995	3.92	13760	1446.8	0.32	0.94	3.68	12920
112.5	11	111	1.53	1.065	4.00	16.5	1.5	0.980	3.92	15874	1447.7	0.30	0.93	3.65	14780
113.5	12	111	1.67	* 1.077	4.04	17.5	1.5	0.980	3.96	18212	1448.6	0.28	0.93	3.68	16980
114.5	13	111	1.81	* 1.091	4.10	18.5	1.4	0.965	3.96	20603	* 1449.4	0.28	0.93	3.68	19150

** RELATIVE DATUM ELEV 105.5 ≈ USGS ELEV 1444.0 (MSL)

* EXTRAPOLATED

* EXTRAPOLATED

(A) ASSUME WALKWAY ABOVE SPILLWAY WALLS AWAY, PIERS ONLY EXTEND TO EL 109.2, ASSUME L = 111 FT ABOVE EL 109;

(B) H_o = DESIGN HEAD ≈ 7.2 FT; (C) C/C_o = CORRECTION TO $C_o \approx 3.67$ (SHEET 15); (D) $C_L = \frac{C}{C_o} \times C_o \times \frac{C_L}{C}$ WHERE $\frac{C_L}{C} = 1.023$ FOR ALL HEADS (SHEET 15); (E) SEE SHEET 16 FOR EXPLANATION;

(F) C_s/C = CORRECTION FOR APPR. EFFECTS (SHEET 16); (G) $Q_L = C_s L H_e^{3/2}$; (H) TW ELEVATION VALUES OBTAINED FROM INTERPOLATION IN THE TABLE ON SHEET 7 (EL 1444.0 = EL 105.5); TOTAL FLOW MUST BE CONSIDERED ⇒ SPILLWAY (ESTIMATED BY Q_L) + EMBANKMENT (SHEET 23) + DIVERSION CHANNEL (SHEET 24);

(I) h_d = WSEL @ H_e − TW ELEV (J) $C_s = C_s/C \times C_{s_A}$ = CORRECTION FOR TAILWATER ON SPILLWAY (SHEET 16)

SUBJECT DAM SAFETY INSPECTION/
RECREATION DAM

BY WJV DATE 2-12-79 PROJ. NO. 78-617-416

CHKD. BY DLB DATE 2-16-79 SHEET NO. 19 OF 33

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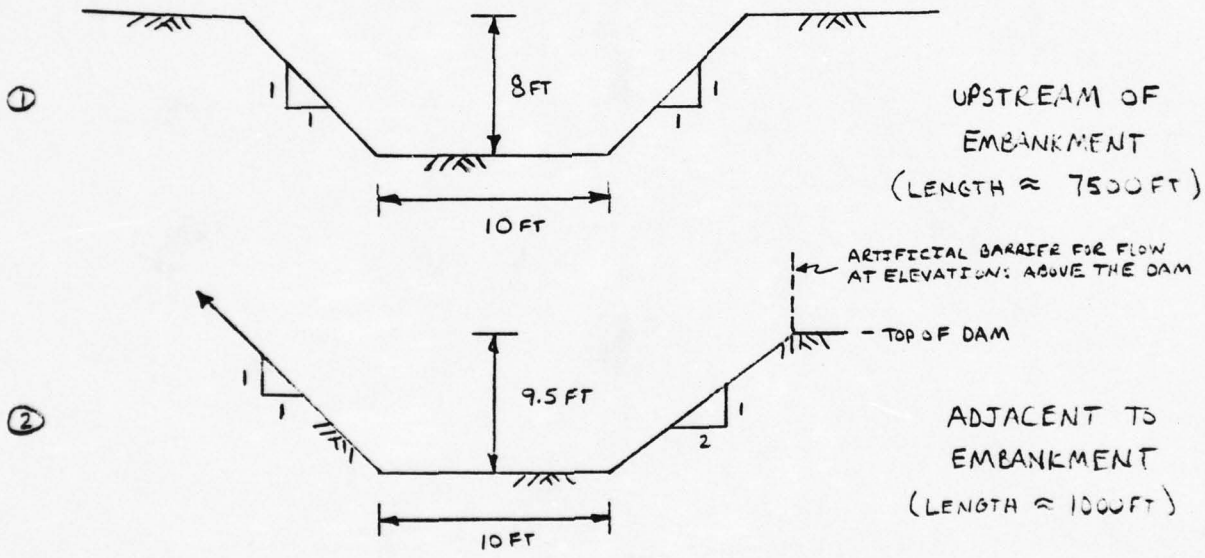
DIVERSION CHANNEL COMPUTATIONS

- AN 8500 FT LONG MAN-MADE CHANNEL DIVERTS A PORTION OF THE RESERVOIR INFLOWS AT A POINT ABOUT 9100 FT UPSTREAM OF THE RESERVOIR (AT NORMAL POOL).

- REPRESENTATIVE SECTIONS: (NOT TO SCALE)



- CHANNEL SLOPE ≈ $(104.5 - 99.1)/(1400 - 500) \approx 0.006 = S_o$
(FIELD MEASURED)

- ASSUME A 50-50 SPLIT OF THE POTENTIAL FLOWS AND CORRESPONDING RUNOFF VOLUMES AT THE CONFLUENCE OF THE NATURAL AND DIVERSION CHANNELS. THEREFORE, THE DECREASE IN AVAILABLE STORAGE WILL BE THE SAME IN BOTH THE RESERVOIR AND DIVERSION CHANNEL FOR EACH INFLOW. KNOWING THIS RELATIONSHIP, THE DIVERSION CHANNEL STORAGE AND CORRESPONDING DISCHARGE VALUES CAN BE ADDED TO THE RESERVOIR VALUES AT THE APPROPRIATE ELEVATIONS.

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-12-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 20 OF 33

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(THE 50-50 SPLIT WAS BASED ON THE FIELD OBSERVATION THAT THE CONVEYANCES OF THE NATURAL AND DIVERSION CHANNELS WERE ABOUT THE SAME AT THE CONFLUENCE, AS WELL AS THE ABSENCE OF FLOW DIVERTING DEVICES.)

- DEPTH VS DISCHARGE RELATIONSHIP: ASSUME MANNINGS EQUATION (SHEET 11) CAN CLOSELY APPROXIMATE THE ACTUAL DISCHARGES W/ $n \approx 0.045$ (FROM EXPERIENCE), $S_f \approx 0.006$ (FROM FIELD NOTES), AND SECTION ② CHANNEL GEOMETRY (SHEET 19).

	DEPTH OF FLOW (FT)	A (FT^2)	R (FT)	Q (CFS)	
	0	—	—	0	
	1	11.5	0.84	30	
	2	26.0	1.50	90	
	3	43.5	2.08	180	
	4	64.0	2.60	310	
	5	87.5	3.10	480	
	6	114.0	3.57	680	
	7	143.5	4.04	930	
	8	176.0	4.49	1230	
	9	211.5	4.94	1570	
FLOW CORRESPONDING TO RESERVOIR LEVEL @	* 9.5	230.4	5.16	1760	← CAPACITY OF DIVERSION CHANNEL PRIOR TO OVERTOPPING OF DAM
1' OVER DAM →	10.5	269.4	5.84	2240	
2' OVER DAM →	11.5	309.4	6.51	2770	
3' OVER DAM →	12.5	350.4	7.16	3340	
4' OVER DAM →	13.5	392.4	7.80	3960	
5' OVER DAM →	14.5	435.4	8.41	4620	
5.8' OVER DAM →	15.3	479.4	9.02	5330	

* DEPTH OF CHANNEL BELOW TOP OF DAM

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-13-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 21 OF 33

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- STORAGE-DEPTH RELATIONSHIP: ASSUME UNIFORM FLOW, AND THAT VOLUME IS DEFINED AS THE CROSS-SECTIONAL AREA TIMES REPRESENTATIVE LENGTH. THE ADDITIONAL MAN-MADE STORAGE IS THE ONLY STORAGE OF CONCERN, SINCE NATURAL VALLEY STORAGE ABOVE THE DAM IS TAKEN INTO CONSIDERATION IN THE UNIT HYDROGRAPH COEFFICIENTS.

DEPTH OF FLOW (FT)	* ADJACENT TO DAM		** UPSTREAM OF DAM		TOTAL CUMULATIVE VOLUME (A-F)
	AREA (FT^2)	VOLUME (A-F)	AREA (FT^2)	VOLUME (A-F)	
0	–	–	–	–	0
1	11.5	0.3	11.0	1.9	2.2
2	26.0	0.6	24.0	4.1	4.7
3	43.5	1.0	39.0	6.7	7.7
4	64.0	1.5	56.0	9.6	11.1
5	87.5	2.0	75.0	12.9	14.9
6	114.0	2.6	96.0	16.5	19.1
7	143.5	3.3	119.0	20.5	23.8
8	176.0	4.0	144.0	24.8	28.8
9	211.5	4.9	–	24.8	29.7
9.5	230.4	5.3	–	24.8	30.1

* REPRESENTATIVE LENGTH ≈ 1000 FT

** REPRESENTATIVE LENGTH ≈ 7500 FT

TOTAL STORAGE-ELEVATION RELATIONSHIP

TOTAL STORAGE = RESERVOIR STORAGE + DIVERSION CHANNEL STORAGE

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJY DATE 2-13-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 22 OF 33

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	RESERVOIR ELEVATION (FT)	* RESERVOIR STORAGE (A-F)	** DIVERSION CHANNEL STORAGE		TOTAL STORAGE (A-F)
			CUMULATIVE STORAGE (A-F)	CORRESPONDING DEPTH (FT)	
	99.5	0	0	-	0
ASSUMED NORMAL DIVERSION DITCH CONDITION	100.5	0.7	0.7	0.32	1.4
	101.5	2.7	2.7	1.20	5.4
	102.5	6.3	6.3	2.53	12.6
	103.5	11.0	11.0	3.97	22.0
	104.5	17.4	17.4	5.60	34.8
USGS ELEV 1444.0 (MSL)=	105.5	25.3	25.3	7.30	50.6
***	105.9	30.1	30.1	9.50	60.2
	106.5	36.3	30.1	9.50	66.4
	107.5	51.5	30.1	9.50	81.6
	108.7	75.1	30.1	9.50	105.2
	109.5	94.2	30.1	9.50	124.3
	110.5	121.8	30.1	9.50	151.9
	111.5	153.5	30.1	9.50	183.6
	112.5	189.4	30.1	9.50	219.5
	113.5	229.4	30.1	9.50	259.5
	114.5	273.6	30.1	9.50	303.7

* OBTAINED FROM SHEETS 4 AND 5

** DUE TO 50-50 SPLIT OF FLOWS ASSUMPTIONS, THE DIVERSION CHANNEL STORAGE FILLS UP AS QUICK AS THE RESERVOIR STORAGE ALTHOUGH THE CHANGES IN WATER SURFACE ELEVATIONS WILL BE DIFFERENT. (DEPTHS CORRESPONDING TO THE STORAGE VALUES NEEDED ARE INTERPOLATED FROM THE TABLE ON SHEET 21.

*** INTERPOLATED FROM TABLE ON SHEET 5 TO CORRESPOND TO THE MAXIMUM DIVERSION CHANNEL STORAGE

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-13-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 23 OF 33

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MAIN EMBANKMENT RATING CURVE

ASSUME THE EMBANKMENT ACTS LIKE A BROAD CRESTED WEIR WHEN OVERTOPPED. ONLY ABOUT 500 FT OF THE TOTAL 1500 FT OF EMBANKMENT WILL CONTRIBUTE TO THE WEIR FLOW, SINCE THE REMAINING 1000 FT ABUTS THE DIVERSION CHANNEL WHICH SHOULD BE FLOWING FULL AND PROBABLY INTO THE RESERVOIR PRIOR TO OVERTOPPING. THE WEIR FLOW IS DEFINED BY:

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

WHERE C VARIES WITH THE RATIO H/L ($L \approx 10$ FT, FIELD MEASURED) AND VALUES ARE OBTAINED FROM REF 12, PG 46; AND $L \approx 500$ FT

* ELEVATION (FT)	H (FT)	H/L (FT/FT)	C	C_s **	Q
108.7	0	–	–	–	0
109.5	0.8	0.08	3.03	1.0	1090
110.5	1.8	0.18	3.07	1.0	3710
111.5	2.8	0.28	3.09	1.0	7240
112.5	3.8	0.38	3.09	1.0	11440
113.5	4.8	0.48	3.09	1.0	16250
114.5	5.8	0.58	3.09	1.0	21590

* USGS ELEV 1444.0 FT (MSL) ≈ ELEV 105.5 FT

** $C_s = C_s/C \times C = C$ CORRECTED FOR POSSIBLE SUBMERGENCE (REF 12, PG 46)

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-13-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 24 OF 33

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TOTAL DAM FACILITY RATING CURVE

TOTAL DAM FACILITY DISCHARGE = SPILLWAY OUTFLOW + EMBANKMENT OVERFLOW + DIVERSION CHANNEL FLOW

	RESERVOIR ELEVATION (FT)	SPILLWAY Q (CFS)	* DIVERSION CHANNEL Q (CFS)	EMBANKMENT Q (CFS)	TOTAL Q (CFS)
OGEE WEIR CREST —	101.5	0	40 ASSUMED NORMAL FLOW	—	40
	102.5	350	140	—	490
	103.5	1040	310	—	1350
	104.5	1980	600	—	2580
USGS ELEV 1444.0 (MSL) =	105.5	3130	1020	—	4150
	105.9	** 3570	*** 1760	—	5330
	106.5	4230	*** 1760	—	5990
	107.5	5730	*** 1760	—	7490
TOP OF DAM —	108.7	7810	*** 1760	0	9570
	109.5	9190	2140	1090	12410
	110.5	10970	2660	3710	17340
	111.5	12920	3230	7240	23390
	112.5	14780	3940	11440	30060
	113.5	16980	5040	16250	38270
	114.5	19150	5230	21590	46060

* INTERPOLATED FROM TABLE ON SHEET 20, BASED ON STORAGE VS DEPTH VS RESERVOIR ELEVATION IN TABLE ON SHEET 22.

** INTERPOLATED FROM TABLE ON SHEET 18.

*** Q = 1760 CFS = CAPACITY OF DIVERSION DITCH PRIOR TO OVERTOPPING OF THE DAM ⇒ ANY FLOW IN EXCESS OF 1760 WILL FLOW OVER EMBANKMENT AND INTO THE DAM UNTIL ENTIRE EMBANKMENT IS OVERTOPPED

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-19-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-19-79 SHEET NO. 25 OF 33

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DOWNSTREAM ROUTING RELATIONSHIPS

STORAGE VS OUTFLOW INFORMATION FOR THE 2 DOWNSTREAM ROUTING SECTIONS WAS OBTAINED FROM THE HEC-2 TAILWATER OUTPUT. (SEE SHEET 6 FOR HEC2 REFERENCE, AND SHEETS A THRU D OF SUMMARY INPUT/OUTPUT SHEETS).

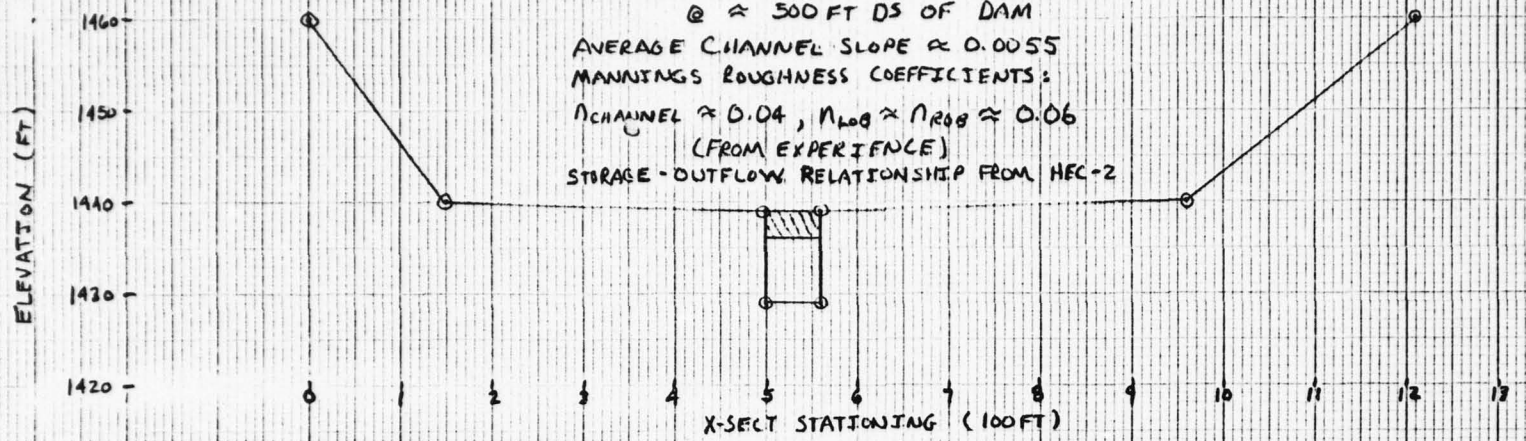
- SECTION 7 ⇒ US ROUTE 322 BRIDGE SECTION @ 500 FT DOWNSTREAM OF THE DAM

STORAGE (A-F)	OUTFLOW (CFS)	STORAGE (A-F)	OUTFLOW (CFS)
0	0	37.6	6500
1.3	340	39.6	9270
3.0	1140	50.2	14000
4.8	2210	61.3	19350
7.1	3510	70.3	26720
8.3	3660	80.1	34610
11.1	3960	90.1	43390
25.4	4790		

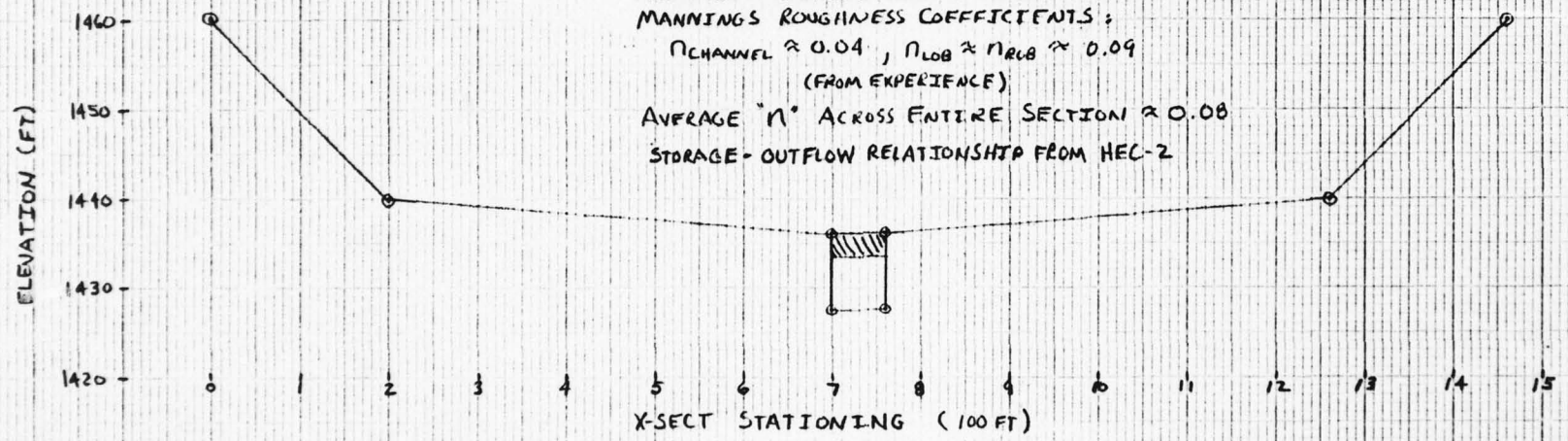
- SECTION 8 ⇒ PA ROUTE 504 BRIDGE SECTION @ 100 FT DS OF DAM

STORAGE (A-F)	OUTFLOW (CFS)	STORAGE (A-F)	OUTFLOW (CFS)
0	0	10.8	6500
0.9	340	21.6	9270
1.9	1140	30.3	14000
2.9	2210	38.1	19350
4.1	3510	47.9	26720
4.5	3660	57.6	34610
5.4	3960	67.4	43390
7.5	4790		

SECTION 7 ⇒ US ROUTE 322 BRIDGE SECTION
@ ≈ 300 FT DS OF DAM
AVERAGE CHANNEL SLOPE ≈ 0.0055
MANNINGS ROUGHNESS COEFFICIENTS:
$n_{CHANNEL} \approx 0.04$, $n_{LOB} \approx n_{ROB} \approx 0.06$
(FROM EXPERIENCE)
STORAGE - OUTFLOW RELATIONSHIP FROM HEC-2



SECTION 8 ⇒ PA ROUTE 504 BRIDGE SECTION
@ ≈ 900 FT DS OF DAM
AVERAGE CHANNEL SLOPE ≈ 0.0055
MANNINGS ROUGHNESS COEFFICIENTS:
$n_{CHANNEL} \approx 0.04$, $n_{LOB} \approx n_{ROB} \approx 0.09$
(FROM EXPERIENCE)
AVERAGE "n" ACROSS ENTIRE SECTION ≈ 0.08
STORAGE - OUTFLOW RELATIONSHIP FROM HEC-2



SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-21-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-22-79 SHEET NO. 27 OF 33

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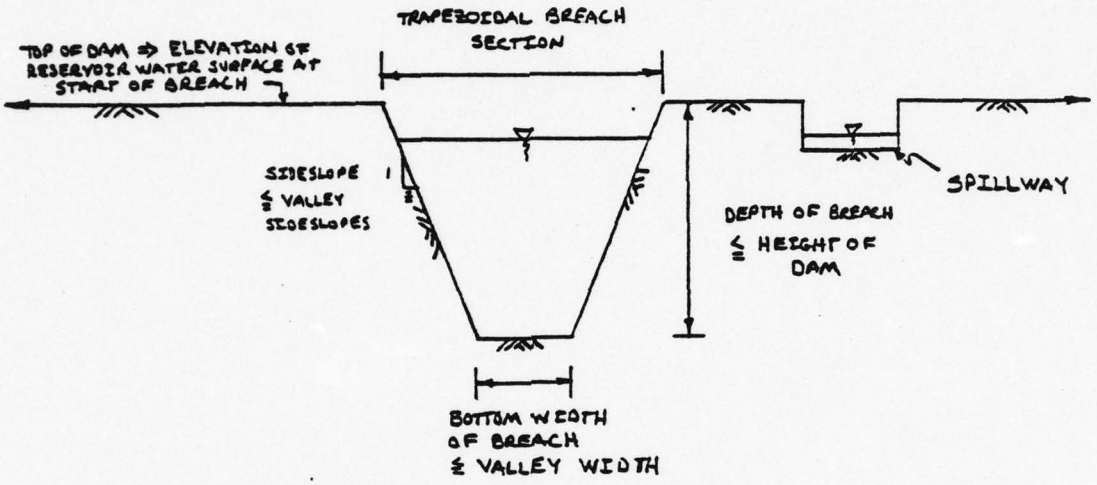
BREACHING ASSUMPTIONS

TYPICAL BREACH SECTION :



- HEC-1-DAM BREACHING ANALYSIS INPUTS:
  (FAILURE BEGINS WHEN RESERVOIR WATER SURFACE REACHES THE TOP OF DAM ELEVATION IN ALL CASES)

PLAN NUMBER AND COMMENT	BREACH BOTTOM WIDTH (FT)	MAX. BREACH DEPTH (FT)	SECTION SIDESLOPES	BREACH * TIME (HR)	** WSEL @ START OF FAILURE (FT)
① MIN. BREACH SECT, MIN FAIL TIME	10	4	1 TO 1	0.5	109.7
② MAX. BREACH SECT, MIN FAIL TIME	490	4	1 TO 1	0.5	109.7
③ MIN BREACH SECT, MAX FAIL TIME	10	4	1 TO 1	4.0	109.7
④ MAX BREACH SECT, MAX FAIL TIME	490	4	1 TO 1	4.0	109.7
⑤ AVERAGE POSSIBLE CONDITIONS	200	4	1 TO 1	2.0	109.7

* BREACH TIME = TOTAL TIME NECESSARY TO REACH FINAL BREACH DIMENSIONS

** RELATIVE ELEVATION 109.7 FT ≈ USGS ELEVATION 1447.2 FT (MSL)

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

WJV DATE 2-21-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-22-79 SHEET NO. 28 OF 33

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- THE PREVIOUS ASSUMPTIONS ARE BASED SOMEWHAT ON THE FOLLOWING SUGGESTED RANGES FOR EARTH DAM BREACHING*:

BREACH BOTTOM WIDTH → $\frac{\text{DAM HEIGHT}}{2}$ < WIDTH < 3 × (DAM HEIGHT)

SECTION SIDESLOPES → $0 < Z < 1$

BREACH TIME → 0.5 HR < TIME < 4.0 HRS

WATER SURFACE HEIGHT ABOVE DAM AT WHICH BREACHING BEGINS → 1 FT < HEIGHT < 5 FT

(HOWEVER FOR THIS ANALYSIS, THE TOP OF DAM ELEVATION WAS CONSIDERED TO BE THE ELEVATION AT WHICH BREACHING WOULD BEGIN ⇒ HEIGHT = 0 ; SEE SECTION 5.5 FOR EXPLANATION)

AND ALSO ON THE PHYSICAL CONSTRAINTS OF THE DAM AND SURROUNDING TERRAIN :

	CONSTRAINT	VALUE
	- HEIGHT OF DAM	13.5 FT
	- HEIGHT OF EMBANKMENT	8 FT
	- EMBANKMENT LENGTH WHICH COULD BE OVERTOPPED (W/O SPILLWAY)	500 FT
	- DEPTH OF TAILWATER ON EMBANKMENT JUST PRIOR TO OVERTOPPING ⇒ TW CORRESPONDING TO Q = 9570 CFS (FROM SHEET 7)	≈ 4.7 FT
**	- VALLEY BOTTOM WIDTH @ ℄ DAM	≈ 500 FT

* INFORMATION OBTAINED FROM BALTIMORE DISTRICT, CORPS OF ENGINEERS

** ESTIMATED FROM USGS TOPO MAP AND FIELD INSPECTION

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY WJV DATE 2-25-79 PROJ. NO. 79-617-446
CHKD. BY DLB DATE 2-26-79 SHEET NO. 21 OF 33

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HEC-1-DAM BREACHING ANALYSIS OUTPUT :

RESERVOIR DATA

UNDER 1/2 PMF CONDITIONS (W/ PHILIPSBURG RESERVOIR DAM FAILING ACCORDING TO ITS AVERAGE BREACH CONDITIONS; APPENDIX C-1, SHEET 13, PLAN (5)) -

PLAN * NUMBER	VARIABLE BREACH BOTTOM WIDTH (FT)	ACTUAL MAX FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HR)	INTERPOLATED OR HEC-1 ROUTED MAX FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HR)	ACTUAL PEAK FLOW THROUGH DAM (CFS)	CORRESPONDING TIME OF PEAK (HR)	TIME OF INITIAL BREACH (HR)
(1)	10	10609	21.27	10608	21.25	10609	21.27	20.83
(2)	490	11769	21.23	11732	21.17	11769	21.23	20.83
(3)	10	10545	21.25	10545	21.25	10545	21.25	20.83
(4)	490	10644	21.25	10644	21.25	10644	21.25	20.83
(5)	200	10659	21.25	10659	21.25	10659	21.25	20.83

* SEE TABLE ON SHEET 27

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY WJY DATE 2-25-79 PROJ. NO. 79-617-446
CHKD. BY DLB DATE 2-26-79 SHEET NO. 30 OF 33

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HEC-1 - DAM BREACHING ANALYSIS OUTPUT :
& DOWNSTREAM ROUTING DATA

UNDER 1/2 PMF CONDITIONS (w/ PHILIPSBURG RESERVOIR DAM FAILING ACCORDING TO ITS AVERAGE BREACH CONDITIONS; APPENDIX C-1, SHEET 13, PLAN (5)) -

PLAN NUMBER [1]	VARIABLE BREACH BOTTOM WIDTH (FT)	OUTPUT @ RT. 322 BRIDGE (500FT DS of DAM) PEAK FLOW (CFS)	*CORRESPONDING [2] WSEL (FT)	*WSEL [3] W/O BREACH (FT)	ΔELEV [4] (FT)	OUTPUT @ RT. 504 BRIDGE (900FT DS OF DAM) PEAK FLOW (CFS)	*CORRESPONDING [2] WSEL (FT)	*WSEL [3] W/O BREACH (FT)	ΔELEV [4] (FT)
(1)	10	10602	1443.4	1443.1	+0.3	10604	1440.3	1439.8	+0.5
(2)	490	11717	1443.7	1443.1	+0.6	11722	1440.5	1439.8	+0.7
(3)	10	10539	1443.4	1443.1	+0.3	10537	1440.3	1439.8	+0.5
(4)	490	10643	1443.4	1443.1	+0.3	10637	1440.3	1439.8	+0.5
(5)	200	10654	1443.4	1443.1	+0.3	10650	1440.3	1439.8	+0.5

* USGS ELEVATIONS (MSL)

1. SEE TABLE ON SHEET 27
2. INTERPOLATED ELEVATIONS ; SHEETS B&C, SUMMARY INPUT/OUTPUT SHEETS
3. BASE FLOW ELEVATION CORRESPONDING TO THE PEAK 1/2 PMF FLOW ESTIMATED FROM THE OVERTOPPING ANALYSIS OUTPUT AND SECTION RATING CURVES ; SHEETS Q, B&C, SUMMARY INPUT/OUTPUT SHEETS
4. ΔELEV = CORRESPONDING WSEL - WSEL W/O BREACH

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 3-3-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 3-5-79 SHEET NO. 31 OF 33

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FLASHBOARD FAILURE

IF THE FLASHBOARDS ARE IN PLACE, THE NORMAL POOL ELEVATION IS AT ABOUT ELEVATION 105.5* FT. UNDER THE ASSUMPTIONS OUTLINED ON SHEETS 19 AND 20, THE DECREASE IN POTENTIAL STORAGE OF THE DIVERSION DITCH IS EQUAL TO THE DECREASE IN POTENTIAL STORAGE OF THE RESERVOIR. PRIOR TO INFLOW OF STORM RUNOFF, THE RESERVOIR IS ASSUMED TO BE AT ITS NORMAL POOL ELEVATION, AND THE DIVERSION DITCH IS ASSUMED TO BE AT ITS NORMAL FLOW DEPTH OF ABOUT 1.2 FT (W/ CORRESPONDING NORMAL STORAGE CAPACITY OF 2.7 A-F, AND NORMAL DISCHARGE OF 40 CFS; SHEETS 22 AND 24). THE INCREMENTAL RESERVOIR STORAGE CAPACITY BETWEEN ELEVATION 105.5 FT AND ELEVATION 107.5 FT (ELEVATION @ WHICH THE FLASHBOARDS ARE ASSUMED TO FAIL) IS ABOUT 26.2 A-F (SEE SHEET 5 FOR RESPECTIVE STORAGE VALUES). THE DISCHARGE FROM THE DIVERSION DITCH CORRESPONDING TO AN INCREASE IN STORAGE OF 26.2 A-F IS, THEN, ABOUT 1270 CFS. (NOTE: 26.2A-F + 2.7A-F = 28.9A-F => CHANNEL DEPTH OF ≈ 3.1 FT FROM SHEET 21 WHICH CORRESPONDS TO A DISCHARGE VALUE OF ABOUT 1270 CFS FROM SHEET 20). THEREFORE, THE DISCHARGE FROM THE DIVERSION DITCH AT THE TIME OF FLASHBOARD FAILURE WILL BE APPROXIMATELY 1270 CFS.

* ELEVATION 105.5 FT ≈ USGS ELEVATION 1444.0 FT (MSL)

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-24-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-26-79 SHEET NO. 32 OF 33

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- ASSUME THAT ONLY 2 OF THE 4 SETS OF FLASHBOARDS WILL FAIL UNDER THE 2FT OF HEAD.

∴ TOTAL DISCHARGE SYSTEM OUTFLOW PRIOR TO FAILURE ≈ 1050 CFS FROM SPILLWAY (SHEET 17) + 1270 CFS FROM DIVERSION DITCH (@ EL. 107.5, SHEET 31) ≅ 2320 CFS

SINCE ONLY TWO SETS OF FLASHBOARDS FAIL, THE FLOW OVER THE REMAINING TWO SETS JUST AFTER FAILURE IS GIVEN BY:

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

WHERE $C \approx 3.2$ (SHEET 17); $L \approx (2 \times 23\text{FT}) - 2[2(0.02) + 0.0] \times 2\text{FT}$ (1 WHOLE PIER + 2 × ½-PIERS; NO ABUTMENTS)
$\approx 56\text{FT}$ (SEE SKETCH AND RELATIONSHIPS ON SHEETS 13 AND 14, ASSUMING THE 2 INTERIOR SETS OF FLASHBOARDS DO NOT FAIL);
AND $H = 2\text{FT}$

$$\therefore Q_{\text{FLASHBOARDS}} \approx 520 \text{ CFS}$$

AND $$Q_{\text{DIVERSION DITCH}} \approx 1270 \text{ CFS}$$

THE HEAD OVER THE OGEE-SHAPED WEIR CREST JUST AFTER FAILURE OF THE FLASHBOARDS OF THE OUTTER TWO BAYS
$\approx 107.5\text{FT} - 101.5\text{FT}$ (ELEVATION OF SPILLWAY CREST) $= 6\text{FT}$

THE DISCHARGE THROUGH THE OUTTER BAYS JUST AFTER FAILURE IS ALSO GIVEN BY:

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-24-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-26-79 SHEET NO. 33 OF 33

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$Q = CLH^{3/2}$

WHERE $H = 6$ FT ; $L \approx (2 \times 23\text{FT}) - 2[1(0.02) + 0.10] \times 6\text{FT} \approx 55$ FT (2× ½ PIERS);
AND $C \approx 3.66$ (SINCE TW @ $Q = 2320 \Rightarrow$ EL 1437.9 FT
$\Rightarrow h_d/H_e \approx 3.1/6.0 \approx 1.4 \Rightarrow$ NO SUBMERGENCE ; SHEETS 7 AND 19)

$\therefore Q_{\text{OUTER BAYS}} \approx 2960$ CFS

THUS THE MINIMUM APPROXIMATE TOTAL DISCHARGE SYSTEM OUTFLOW IF ONLY 2 SETS OF FLASHBOARDS FAIL :

$Q_{\text{TOTAL}} \approx 2960 + 520 + 1270 = 4750$ CFS

THIS FLOW CORRESPONDS TO ELEVATION 1441.6 @ THE ROUTE 322 BRIDGE (ABOUT 1.8 FT ABOVE THE BRIDGE), AND ELEVATION 1439.0 @ THE ROUTE 504 BRIDGE (ABOUT 1.9 FT ABOVE THE BRIDGE).

SUBJECT DAM SAFETY INSPECTION — RECREATION DAM

BY NJV DATE 3-1-79 PROJ. NO. 78-617-44

CHKD. BY DLB DATE 3-4-79 SHEET NO. A OF Y

SUMMARY INPUT / OUTPUT SHEETS

T1 DAM SAFETY INSPECTION - TAILWATER ON RECREATION DAM
T2 STARTING WSEL'S BASED ON HAND COMPUTED RATING CURVE FOR RT.504 BRIDGE SECT.
T3 COLD STREAM, PHILLIPSBURG, PA.

TAILWATER ON RECREATION DAM VIA HEC-2: INPUT AND OUTPUT

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ	
	0.	2.	0.	0.	0.0	0.0	0.0	0.	1429.000	0.0	
J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE	
	1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
J3	VARIABLE CODES FOR SUMMARY PRINTOUT										
	38.000	39.000	40.000	41.000	42.000	43.000	1.000	2.000	3.000	7.000	
J5	LPRAT	NUMSEC	********REQUESTED SECTION NUMBERS********								
	-10.000	-10.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
NC	0.080	0.080	0.040	0.200	0.400	0.0	0.0	0.0	0.0	0.0	0.0
QT	14.000	340.000	1140.000	2210.000	3510.000	3660.000	3960.000	4790.000	6500.000	9270.000	
QT	14000.000	19850.000	26730.000	34610.000	43390.000	0.0	0.0	0.0	0.0	0.0	
X1	2.000	8.000	700.000	760.000	0.0	0.0	0.0	0.0	0.0	0.0	
GR	1460.000	0.0	1440.000	200.000	1436.100	700.000	1427.400	700.000	1427.400	760.000	
GR	1436.100	760.000	1440.000	1260.000	1460.000	1460.000	0.0	0.0	0.0	0.0	
X1	2.100	8.000	500.000	559.000	400.000	400.000	400.000	0.0	0.0	0.0	
GR	1460.000	0.0	1440.000	150.000	1439.800	500.000	1429.800	500.000	1429.800	559.000	
GR	1439.800	559.000	1440.000	960.000	1460.000	1210.000	0.0	0.0	0.0	0.0	
FC	0.0	0.0	0.0	0.400	0.600	0.0	0.0	0.0	0.0	0.0	
X1	2.110	0.0	0.0	0.0	1.000	1.000	1.000	0.0	0.0	0.0	
X2	0.0	0.0	0.0	1436.800	1439.800	0.0	0.0	0.0	0.0	0.0	
NC	0.0	0.0	0.0	0.100	0.300	0.0	0.0	0.0	0.0	0.0	
X1	1.200	0.0	0.0	0.0	30.000	30.000	30.000	0.0	0.0	0.0	
X2	0.0	0.0	0.0	1436.800	1439.800	0.0	0.0	0.0	0.0	0.0	
NC	0.0	0.0	0.0	0.400	0.600	0.0	0.0	0.0	0.0	0.0	
X1	1.210	0.0	0.0	0.0	1.000	1.000	1.000	0.0	0.0	0.0	
NC	0.080	0.080	0.040	0.200	0.400	0.0	0.0	0.0	0.0	0.0	

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SUBJECT DAM SAFETY INSPECTION

RECREATION DAM

BY WJV DATE 3-1-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 3-4-79 SHEET NO. B OF Y

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1.000	10.000	350.000	418.000	250.000	250.000	250.000	0.0	0.0	0.0	0.0							
1460.000	0.0	1460.000	75.000	1440.000	200.000	1439.000	350.000	1431.200	358.000								
1431.200	418.000	1439.000	418.000	1440.000	800.000	1460.000	1100.000	1480.000	1250.000								
0.0	0.0	0.0	0.300	0.500	0.0	0.0	0.0	0.0	0.0								
4.000	0.080	300.000	0.040	444.000	0.500	800.000	0.060	1150.000	1150.000								
0.0	10.000	300.000	444.000	250.000	250.000	250.000	0.0	0.0	0.0								
1460.000	0.0	1460.000	100.000	1440.000	200.000	1440.000	300.000	1432.500	312.000								
1432.500	437.000	1439.000	444.000	1440.000	800.000	1460.000	1050.000	1480.000	1150.000								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0								

SUMMARY PRINTOUT

RATING CURVE

						DISCHARGE	ELEVATION			CUMULATIVE STORAGE VOLUME	
STCND	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CHWS	EG	VOL		
2.000	0.0	0.0	0.0	1427.40	340.00	1429.00	0.0	1429.19	0.0	US OF PA RT. 504 BRIDGE	
2.000	0.0	0.0	0.0	1427.40	1140.00	1431.00	0.0	1431.43	0.0		
2.000	0.0	0.0	0.0	1427.40	2210.00	1433.00	0.0	1433.67	0.0		
2.000	0.0	0.0	0.0	1427.40	3510.00	1435.20	0.0	1436.07	0.0		
2.000	0.0	0.0	0.0	1427.40	3660.00	1436.10	0.0	1436.86	0.0		
2.000	0.0	0.0	0.0	1427.40	3960.00	1437.00	0.0	1437.70	0.0		
2.000	0.0	0.0	0.0	1427.40	4790.00	1438.00	0.0	1438.69	0.0		
2.000	0.0	0.0	0.0	1427.40	6500.00	1439.00	0.0	1439.73	0.0		
2.000	0.0	0.0	0.0	1427.40	9270.00	1440.00	0.0	1440.79	0.0		
2.000	0.0	0.0	0.0	1427.40	14000.00	1441.00	0.0	1441.85	0.0		
2.000	0.0	0.0	0.0	1427.40	19850.00	1442.00	0.0	1442.89	0.0		
2.000	0.0	0.0	0.0	1427.40	26730.00	1443.00	0.0	1443.93	0.0		
2.000	0.0	0.0	0.0	1427.40	34610.00	1444.00	0.0	1444.98	0.0		
2.000	0.0	0.0	0.0	1427.40	43390.00	1445.00	0.0	1446.03	0.0		
2.100	400.00	0.0	0.0	1429.80	340.00	1431.31	0.0	1431.54	0.85	DS OF US RT 322 BRIDGE	
2.100	400.00	0.0	0.0	1429.80	1140.00	1432.99	0.0	1433.56	1.86		
2.100	400.00	0.0	0.0	1429.80	2210.00	1434.79	0.0	1435.67	2.89		
2.100	400.00	0.0	0.0	1429.80	3510.00	1436.77	0.0	1437.90	4.04		
2.100	400.00	0.0	0.0	1429.80	3660.00	1437.33	0.0	1438.38	4.44		
2.100	400.00	0.0	0.0	1429.80	3960.00	1438.00	0.0	1439.04	5.34		
2.100	400.00	0.0	0.0	1429.80	4790.00	1438.84	0.0	1440.09	7.49		
2.100	400.00	0.0	0.0	1429.80	6500.00	1439.68	0.0	1441.61	10.82		
2.100	400.00	0.0	0.0	1429.80	9270.00	1441.58	1441.58	1442.83	21.50		
2.100	400.00	0.0	0.0	1429.80	14000.00	1442.54	1442.54	1443.96	30.18		
2.100	400.00	0.0	0.0	1429.80	19850.00	1443.25	0.0	1445.04	38.04		
2.100	400.00	0.0	0.0	1429.80	26730.00	1444.39	0.0	1446.08	47.78		
2.100	400.00	0.0	0.0	1429.80	34610.00	1445.48	0.0	1447.17	57.45		
2.100	400.00	0.0	0.0	1429.80	43390.00	1446.53	0.0	1448.25	67.23		

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY NJV DATE 3-1-79 PROJ. NO. 78-617-446

CHKD. BY DCB DATE 3-4-79 SHEET NO. C OF Y

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US RT 322 BRIDGE

US OF US RT 322 BRIDGE

SECND	ALCH	ELMND	ELLC	ELMIN	DISCHARGE Q	ELEVATION CWSEL	CRIWS	EG	STORAGE VOLUME VOL
2.110	1.00	1439.80	1436.80	1429.80	340.00	1431.32	0.0	1431.54	0.85
2.110	1.00	1439.80	1436.80	1429.80	1140.00	1433.00	0.0	1433.57	1.86
2.110	1.00	1439.80	1436.80	1429.80	2210.00	1434.80	0.0	1435.67	2.90
2.110	1.00	1439.80	1436.80	1429.80	3510.00	1436.77	0.0	1437.90	4.05
2.110	1.00	1439.80	1436.80	1429.80	3660.00	1437.27	0.0	1438.49	4.45
2.110	1.00	1439.80	1436.80	1429.80	3960.00	1437.85	0.0	1439.28	5.35
2.110	1.00	1439.80	1436.80	1429.80	4790.00	1438.51	0.0	1440.60	7.50
2.110	1.00	1439.80	1436.80	1429.80	6500.00	1438.93	1436.80	1442.77	10.83
2.110	1.00	1439.80	1436.80	1429.80	9270.00	1439.07	1441.50	1443.26	21.56
2.110	1.00	1439.80	1436.80	1429.80	14000.00	1444.23	0.0	1444.45	30.26
2.110	1.00	1439.80	1436.80	1429.80	19850.00	1445.40	0.0	1445.66	38.14
2.110	1.00	1439.80	1436.80	1429.80	26730.00	1446.29	0.0	1446.63	47.90
2.110	1.00	1439.80	1436.80	1429.80	34610.00	1447.27	0.0	1447.68	57.59
2.110	1.00	1439.80	1436.80	1429.80	43390.00	1448.25	0.0	1448.74	67.40
1.200	30.00	1439.80	1436.80	1429.80	340.00	1431.53	0.0	1431.70	0.92
1.200	30.00	1439.80	1436.80	1429.80	1140.00	1433.26	0.0	1433.75	2.00
1.200	30.00	1439.80	1436.80	1429.80	2210.00	1435.05	0.0	1435.84	3.11
1.200	30.00	1439.80	1436.80	1429.80	3510.00	1437.01	0.0	1438.13	4.33
1.200	30.00	1439.80	1436.80	1429.80	3660.00	1437.65	0.0	1438.86	4.73
1.200	30.00	1439.80	1436.80	1429.80	3960.00	1438.30	0.0	1439.72	5.64
1.200	30.00	1439.80	1436.80	1429.80	4790.00	1439.18	0.0	1441.27	7.79
1.200	30.00	1439.80	1436.80	1429.80	6500.00	1443.21	0.0	1443.30	12.08
1.200	30.00	1439.80	1436.80	1429.80	9270.00	1443.20	0.0	1443.38	23.72
1.200	30.00	1439.80	1436.80	1429.80	14000.00	1444.36	0.0	1444.56	33.13
1.200	30.00	1439.80	1436.80	1429.80	19850.00	1445.53	0.0	1445.77	41.74
1.200	30.00	1439.80	1436.80	1429.80	26730.00	1446.44	0.0	1446.76	52.00
1.200	30.00	1439.80	1436.80	1429.80	34610.00	1447.43	0.0	1447.82	62.41
1.200	30.00	1439.80	1436.80	1429.80	43390.00	1448.42	0.0	1448.90	72.87
1.210	1.00	0.0	0.0	1429.80	340.00	1431.54	0.0	1431.71	0.92
1.210	1.00	0.0	0.0	1429.80	1140.00	1433.27	0.0	1433.75	2.00
1.210	1.00	0.0	0.0	1429.80	2210.00	1435.06	0.0	1435.85	3.12
1.210	1.00	0.0	0.0	1429.80	3510.00	1437.17	0.0	1438.18	4.34
1.210	1.00	0.0	0.0	1429.80	3660.00	1438.16	0.0	1439.02	4.74
1.210	1.00	0.0	0.0	1429.80	3960.00	1439.19	0.0	1439.98	5.65
1.210	1.00	0.0	0.0	1429.80	4790.00	1441.67	0.0	1441.98	7.82
1.210	1.00	0.0	0.0	1429.80	6500.00	1443.16	0.0	1443.37	12.16
1.210	1.00	0.0	0.0	1429.80	9270.00	1443.11	0.0	1443.53	23.80
1.210	1.00	0.0	0.0	1429.80	14000.00	1444.24	0.0	1444.74	33.22
1.210	1.00	0.0	0.0	1429.80	19850.00	1445.40	0.0	1445.97	41.86
1.210	1.00	0.0	0.0	1429.80	26730.00	1446.29	0.0	1447.00	52.22
1.210	1.00	0.0	0.0	1429.80	34610.00	1447.26	0.0	1448.09	62.57
1.210	1.00	0.0	0.0	1429.80	43390.00	1448.23	0.0	1449.19	73.05

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 3-1-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 3-4-79 SHEET NO. D OF Y

CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

250 FT DS OF RECREATION DAM

SECTN	XLOC	ELTRD	ELLC	ELMIN	Q	CWSEL	CRWS	EG	VOL
1.000	250.00	0.0	0.0	1431.20	340.00	1432.79	0.0	1434.04	1.46
1.000	250.00	0.0	0.0	1431.20	1140.00	1434.58	0.0	1435.16	3.13
1.000	250.00	0.0	0.0	1431.20	2210.00	1436.34	0.0	1437.21	4.85
1.000	250.00	0.0	0.0	1431.20	3510.00	1438.28	0.0	1439.37	6.79
1.000	250.00	0.0	0.0	1431.20	3660.00	1438.99	0.0	1439.94	7.50
1.000	250.00	0.0	0.0	1431.20	3960.00	1439.89	1436.64	1440.67	9.36
1.000	250.00	0.0	0.0	1431.20	4790.00	1442.00	0.0	1442.23	19.59
1.000	250.00	0.0	0.0	1431.20	6500.00	1443.36	0.0	1443.54	30.18
1.000	250.00	0.0	0.0	1431.20	9270.00	1443.56	0.0	1443.89	42.06
1.000	250.00	0.0	0.0	1431.20	14000.00	1444.75	0.0	1445.17	56.71
1.000	250.00	0.0	0.0	1431.20	19850.00	1445.94	0.0	1446.46	70.79
1.000	250.00	0.0	0.0	1431.20	26730.00	1446.92	0.0	1447.60	85.60
1.000	250.00	0.0	0.0	1431.20	34610.00	1447.95	0.0	1448.77	100.81
1.000	250.00	0.0	0.0	1431.20	43390.00	1448.97	0.0	1449.95	116.29

TOE OF RECREATION DAM

SECTN	XLOC	ELTRD	ELLC	ELMIN	Q	CWSEL	CRWS	EG	VOL
0.0	250.00	0.0	0.0	1432.50	340.00	1433.85	0.0	1433.92	2.19
0.0	250.00	0.0	0.0	1432.50	1140.00	1435.75	0.0	1435.86	4.87
0.0	250.00	0.0	0.0	1432.50	2210.00	1437.73	0.0	1437.89	7.68
0.0	250.00	0.0	0.0	1432.50	3510.00	1439.82	0.0	1440.01	11.17
0.0	250.00	0.0	0.0	1432.50	3660.00	1440.30	0.0	1440.49	12.78
0.0	250.00	0.0	0.0	1432.50	3960.00	1440.94	0.0	1441.11	16.53
0.0	250.00	0.0	0.0	1432.50	4790.00	1442.23	0.0	1442.40	32.86
0.0	250.00	0.0	0.0	1432.50	6500.00	1443.49	0.0	1443.70	48.35
0.0	250.00	0.0	0.0	1432.50	9270.00	1443.79	0.0	1444.18	61.19
0.0	250.00	0.0	0.0	1432.50	14000.00	1444.99	0.0	1445.63	80.51
0.0	250.00	0.0	0.0	1432.50	19850.00	1446.15	0.0	1447.13	99.36
0.0	250.00	0.0	0.0	1432.50	26730.00	1447.12	0.0	1448.54	118.23
0.0	250.00	0.0	0.0	1432.50	34610.00	1448.08	0.0	1450.01	137.70
0.0	250.00	0.0	0.0	1432.50	43390.00	1449.00	0.0	1451.52	157.46

DAM SAFETY INSPECTION
RECREATION DAM (W/ US PHILIPSBURG RESERVOIR DAM)*****OVERTOPPING ANALYSIS*****
5-MINUTE TIME STEP AND 24-HOUR STORM DURATION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	0	0

JOPER	NWT	LKOPT	TRACE
5	0	0	0

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

RTIOS= .60 .70

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

SUB-AREA RUNOFF COMPUTATION

INFLOW TO US PHILIPSBURG RESERVOIR

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	9.40	0.00	21.00	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.90	109.50	119.00	128.50	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .825

INITIAL AND CONSTANT RAINFALL LOSSES AS PER COE

LOSS DATA

LKOPT	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= 4.95 CP= .40 NTA= 0

BASE FLOW PARAMETERS AS PER COE

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

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=59.45 AND R=***** INTERVALS

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 4.96 HOURS, CP= .40 VOL= .47

1.	4.	8.	13.	19.	26.	33.	41.	49.	57.
66.	76.	86.	96.	106.	117.	128.	140.	151.	163.
175.	187.	200.	213.	225.	239.	252.	265.	279.	293.
307.	320.	333.	345.	358.	369.	381.	392.	402.	412.
422.	431.	440.	448.	456.	463.	470.	477.	483.	488.
493.	498.	501.	505.	507.	509.	510.	510.	509.	506.
502.	497.	493.	488.	484.	480.	475.	471.	467.	463.
459.	454.	450.	446.	442.	438.	434.	430.	427.	423.
419.	415.	411.	406.	404.	400.	397.	393.	390.	386.
383	379	376	373.	369.	366.	363.	359.	356.	353.

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY NJV DATE 3-1-79 PROJ. NO. 78-617-442
CHKD. BY DLB DATE 3-4-79 SHEET NO. E OF Y

CJC CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY WJV DATE 3-1-79 PROJ. NO. 78-617-442
CHKD. BY DLB DATE 3-4-79 SHEET NO. F OF Y

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MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q
					SUM	24.27 22.41 1.85 710129.
						(616.)(569.)(47.)(20108.61)

PHILIPSBURG RESERVOIR INFLOW HYDROGRAPHS

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9247.	7626.	2461.	2461.	708679.
CMS	262.	216.	70.	70.	20068.
INCHES		7.55	9.74	9.74	9.74
MM		191.69	247.41	247.41	247.41
AC-FT		3782.	4881.	4881.	4881.
THOUS CU M		4664.	6020.	6020.	6020.

0.4 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3699.	3050.	984.	984.	283472.
CMS	105.	86.	28.	28.	8027.
INCHES		3.02	3.90	3.90	3.90
MM		76.68	98.96	98.96	98.96
AC-FT		1513.	1952.	1952.	1952.
THOUS CU M		1866.	2408.	2408.	2408.

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4623.	3813.	1230.	1230.	354340.
CMS	131.	108.	35.	35.	10034.
INCHES		3.77	4.87	4.87	4.87
MM		95.85	123.70	123.70	123.70
AC-FT		1891.	2440.	2440.	2440.
THOUS CU M		2332.	3010.	3010.	3010.

HYDROGRAPH ROUTING

ROUTE THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
101	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	-1621.	1

SURFACE AREA=	0.	10.	27.	48.
CAPACITY=	0.	80.	241.	621.
ELEVATION=	1597.	1621.	1630.	1640.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1621.0	54.5	0.0	0.0	0.0	0.0	0.0	0.0

IABCOA	ISPITW	ISPCTW
10	0	0

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 3-1-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 3-4-79 SHEET NO. G OF Y

GAI CONSULTANTS, INC
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			SS	NGATES	DESHD	APEL	APWID	APLOSS	PDPTH
			0.00	1	8.5	0.0	0.0	0.0	0.0
1597.00	0.	0.0	0.	0.	0.0	0.	0.	0.	
1621.00	80.	0.0	0.	0.	0.0	0.	0.	0.	
1629.50	231.	5.7	4042.	0.	0.0	0.	4042.	4042.	
1640.00	621.	12.7	12970.	0.	0.0	0.	12970.	12970.	

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1629.5	3.1	1.5	310.

PHILIPSBURG RESERVOIR OUTFLOW HYDROGRAPHS; OVERTOPPING OCCURS @ ≈ 0.47 PMF

PEAK OUTFLOW IS 9220. AT TIME 20.42 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9220.	7612.	2386.	68.	687047.
CMS	261.	216.	68.	68.	19455.
INCHES		7.53	9.44	9.44	9.44
MM		191.34	239.86	239.86	239.86
AC-FT		3775.	4732.	4732.	4732.
THOUS CU M		4656.	5836.	5836.	5836.

} PMF

PEAK OUTFLOW IS 3588. AT TIME 20.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3588.	3026.	958.	958.	276022.
CMS	102.	86.	27.	27.	7816.
INCHES		2.99	3.79	3.79	3.79
MM		76.07	96.36	96.36	96.36
AC-FT		1501.	1901.	1901.	1901.
THOUS CU M		1851.	2345.	2345.	2345.

} 0.4 PMF

PEAK OUTFLOW IS 4592. AT TIME 20.42 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4592.	3775.	1194.	1194.	343982.
CMS	130.	107.	34.	34.	9740.
INCHES		3.74	4.73	4.73	4.73
MM		94.89	120.09	120.09	120.09
AC-FT		1872.	2369.	2369.	2369.
THOUS CU M		2309.	2922.	2922.	2922.

} 0.5 PMF

SUBJECT DAM SAFETY INSPECTION — RECREATION DAM

BY WJV DATE 3-1-79 PROJ. NO. 78-617-446

CHKD. BY DLS DATE 3-4-79 SHEET NO. H OF Y

CJ CONSULTANTS, INC
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HYDROGRAPH ROUTING

ROUTE FROM RESERVOIR TO SECTION 2 + 4300 FT DOWNSTREAM OF DAM

ISTAO	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	NSTOL	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)	ELMVI	ELMAX	RLNTH	SEL
.1250	.0400	.1250	1562.0	1600.0	4300.	.01000

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

0.00 1600.00 50.00 1580.00 350.00 1566.00 355.00 1562.00 365.00 1562.00
370.00 1566.00 500.00 1580.00 550.00 1600.00

STORAGE	0.00	2.47	5.92	15.94	38.08	72.34	118.74	177.26	247.91
	420.52	512.33	606.11	701.86	799.59	899.29	1000.96	1104.61	1210.24
OUTFLOW	0.00	123.33	425.93	1071.01	2212.55	4026.44	6660.84	10249.54	14916.65
	20921.09	38246.47	48702.65	60250.85	72861.68	86512.46	101185.47	116866.87	133545.82
STAGE	1562.00	1564.00	1566.00	1568.00	1570.00	1572.00	1574.00	1576.00	1578.00
	1582.00	1584.00	1586.00	1588.00	1590.00	1592.00	1594.00	1596.00	1598.00
FLOW	0.00	123.33	425.93	1071.01	2212.55	4026.44	6660.84	10249.54	14916.65
	20921.09	38246.47	48702.65	60250.85	72861.68	86512.46	101185.47	116866.87	133545.82

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9177.	7594.	2344.	2344.	674985.
CMS	260.	215.	66.	66.	19113.
INCHES		7.51	9.28	9.28	9.28
MM		190.88	235.65	235.65	235.65
AC-FT		3765.	4649.	4649.	4649.
THOUS CU M		4645.	5734.	5734.	5734.

PMF

MAXIMUM STORAGE = 160.

SUBJECT DAM SAFETY INSPECTION

RECREATION DAM

BY WJV DATE 3-1-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 3-4-79 SHEET NO. I OF Y

HYDROGRAPH ROUTING

ROUTE FROM SECTION 2 TO SECTION 3 * 2800 FT DOWNSTREAM OF SECTION 2

ISTAO	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)	ELMVT	ELMAX	RLNTH	SEL
.1250	.0400	.1250	1543.0	1580.0	2800.	.00700

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

0.00 1580.00 200.00 1560.00 350.00 1547.00 355.00 1543.00 365.00 1543.00
370.00 1547.00 750.00 1560.00 800.00 1580.00

STORAGE	0.00	1.56	3.72	10.67	27.54	54.36	91.11	137.79	194.42
	331.92	406.16	483.45	563.79	647.17	733.60	823.07	915.59	1011.16
OUTFLOW	0.00	98.51	339.25	856.67	1836.79	3465.88	5901.57	9285.35	13747.98
	27359.46	36295.53	46421.25	57726.44	70207.28	83864.37	98701.56	114725.12	131943.19
STAGE	1543.00	1544.95	1546.89	1548.84	1550.79	1552.74	1554.68	1556.63	1558.58
	1562.47	1564.42	1566.37	1568.32	1570.26	1572.21	1574.16	1576.11	1578.05
FLOW	0.00	98.51	339.25	856.67	1836.79	3465.88	5901.57	9285.35	13747.98
	27359.46	36295.53	46421.25	57726.44	70207.28	83864.37	98701.56	114725.12	131943.19

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9149.	7581.	2304.	2304.	663608.
CMS	259.	215.	65.	65.	18791.
INCHES		7.50	9.12	9.12	9.12
MM		190.55	231.67	231.67	231.67
AC-FT		3759.	4570.	4570.	4570.
THOUS CU M		4637.	5637.	5637.	5637.

PMF

MAXIMUM STORAGE = 136.

MAXIMUM STAGE IS 1556.6

CONSULTANTS, INC

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SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY NJV DATE 3-1-79 PROJ. NO. 78-617-446
CHKD. BY DLB DATE 3-4-79 SHEET NO. J OF Y

CONSULTANTS, INC
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HYDROGRAPH ROUTING

ROUTE FROM SECTION 3 TO SECTION 4 * 6000 FT DOWNSTREAM OF SECTION 3

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
.1100	.0400	.1200	1490.0	1520.0	6000.	.00800

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1520.00 300.00 1500.00 400.00 1494.00 405.00 1490.00 415.00 1490.00
420.00 1494.00 750.00 1500.00 800.00 1520.00

STORAGE	0.00	2.60	6.07	12.97	41.11	93.86	171.22	269.06	373.94
	601.73	724.64	853.55	988.48	1129.42	1276.36	1429.32	1588.28	1753.26
OUTFLOW	0.00	73.32	247.48	560.70	1228.69	2485.71	4531.49	7787.91	12137.50
	23604.86	30704.57	38716.34	47646.81	57505.42	68303.54	80053.98	92770.60	106468.05
STAGE	1490.00	1491.58	1493.16	1494.74	1496.32	1497.89	1499.47	1501.05	1502.63
	1505.79	1507.37	1508.95	1510.53	1512.11	1513.68	1515.26	1516.84	1518.42
FLOW	0.00	73.32	247.48	560.70	1228.69	2485.71	4531.49	7787.91	12137.50
	23604.86	30704.57	38716.34	47646.81	57505.42	68303.54	80053.98	92770.60	106468.05

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9075.	7476.	2201.	2201.	633777.
CMS	257.	212.	62.	62.	17947.
INCHES		7.40	8.71	8.71	8.71
MM		187.92	221.26	221.26	221.26
AC-FT		3707.	4365.	4365.	4365.
THOUS CU M		4573.	5384.	5384.	5384.

PMF

MAXIMUM STORAGE = 300.

MAXIMUM STAGE IS 1501.5

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY NJV DATE 3-1-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 3-4-79 SHEET NO. K OF Y

CONSULTANTS, INC
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HYDROGRAPH ROUTING

ROUTE FROM SECTION 4 TO SECTION 5 @ 5800 FT DOWNSTREAM OF SECTION 4

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVI	ELMAX	RLNTH	SEL
.1250	.0400	.1250	1450.0	1480.0	5800.	.00600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1480.00 100.00 1460.00 150.00 1454.00 155.00 1450.00 165.00 1450.00
170.00 1454.00 450.00 1460.00 1150.00 1480.00

STORAGE	0.00	2.52	5.86	11.94	33.79	73.90	132.27	207.79	296.86
	514.85	643.75	785.94	941.41	1110.15	1292.17	1487.47	1696.04	1917.90
OUTFLOW	0.00	63.49	214.33	482.84	1006.07	1920.64	3349.32	5450.51	8242.50
	16014.17	21099.35	27053.08	33925.76	41766.68	50624.06	60545.12	71576.10	83762.39
STAGE	1450.00	1451.58	1453.16	1454.74	1456.32	1457.89	1459.47	1461.05	1462.63
	1465.79	1467.37	1468.95	1470.53	1472.11	1473.68	1475.26	1476.84	1478.42
FLOW	0.00	63.49	214.33	482.84	1006.07	1920.64	3349.32	5450.51	8242.50
	16014.17	21099.35	27053.08	33925.76	41766.68	50624.06	60545.12	71576.10	83762.39

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8977.	7258.	2083.	2083.	599900.
CMS	254.	206.	59.	59.	16987.
INCHES		7.18	8.25	8.25	8.25
MM		182.45	209.43	209.43	209.43
AC-FT		3599.	4132.	4132.	4132.
THOUS CU M		4440.	5096.	5096.	5096.

MAXIMUM STORAGE = 318.

MAXIMUM STAGE IS 1463.0

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY NJV DATE 3-1-79 PROJ. NO. 78-617-446
CHKD. BY DLB DATE 3-4-79 SHEET NO. L OF Y

CJC CONSULTANTS, INC
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SUB-AREA RUNOFF COMPUTATION

LOCAL INFLOW TO RECREATION DAM RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	11.60	0.00	21.00	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.90	109.50	119.00	128.50	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .825

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRIL	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= 5.91 CP= .40 NTA= 0

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

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=71.07 AND R=***** INTERVALS

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 5.93 HOURS, CP= .40 VOL= .38

1.	3.	6.	10.	15.	20.	26.	32.	39.	46.
53.	61.	68.	77.	85.	94.	102.	112.	121.	130.
140.	150.	160.	171.	181.	192.	202.	213.	224.	236.
247.	259.	270.	282.	294.	306.	318.	329.	341.	352.
362.	373.	383.	393.	402.	411.	420.	429.	437.	445.
453.	460.	467.	474.	480.	486.	492.	497.	502.	507.
511.	514.	518.	521.	523.	525.	527.	527.	528.	527.
525.	522.	518.	514.	511.	507.	503.	499.	495.	492.
488.	484.	481.	477.	473.	470.	466.	463.	459.	456.
452.	449.	445.	442.	439.	435.	432.	429.	426.	422.

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	24.27	22.41	1.85	711728.
										(616.)	(569.)	(47.)	(20153.89)

RECREATION DAM LOCAL INFLOW HYDROGRAPH

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9378.	7822.	2466.	2466.	710067.
CMS	266.	221.	70.	70.	20107.
INCHES		6.27	7.91	7.91	7.91
MM		159.33	200.88	200.88	200.88
AC-FT		3879.	4890.	4890.	4890.
THOUS CU M		4784.	6032.	6032.	6032.

PMF

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY WJV DATE 3-1-79 PROJ.NO. 78-617-446
CHKD. BY DLB DATE 3-4-79 SHEET NO. M OF Y

RECREATION DAM LOCAL INFLOW HYDROGRAPHS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4689.	3911.	1233.	1233.	355033.
CMS	133.	111.	35.	35.	10053.
INCHES		3.14	3.95	3.95	3.95
MM		79.66	100.44	100.44	100.44
AC-FT		1939.	2445.	2445.	2445.
THOUS CU M		2392.	3016.	3016.	3016.

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5627.	4693.	1479.	1479.	426040.
CMS	159.	133.	42.	42.	12064.
INCHES		3.76	4.75	4.75	4.75
MM		95.60	120.53	120.53	120.53
AC-FT		2327.	2934.	2934.	2934.
THOUS CU M		2871.	3619.	3619.	3619.

0.6 PMF

COMBINE HYDROGRAPHS

COMBINE LOCAL INFLOW W/ US ROUTED FLOWS FOR TOTAL INFLOW TO RECREATION DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	2	0	0	0	0	1	0	0

RECREATION DAM TOTAL INFLOW HYDROGRAPHS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	18137.	15021.	4548.	4548.	1309967.
CMS	514.	425.	129.	129.	37094.
INCHES		6.65	8.06	8.06	8.06
MM		169.01	204.71	204.71	204.71
AC-FT		7449.	9022.	9022.	9022.
THOUS CU M		9188.	11128.	11128.	11128.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8801.	7370.	2249.	2249.	647699.
CMS	249.	209.	64.	64.	18341.
INCHES		3.26	3.98	3.98	3.98
MM		82.93	101.22	101.22	101.22
AC-FT		3655.	4461.	4461.	4461.
THOUS CU M		4508.	5502.	5502.	5502.

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10723.	8869.	2701.	2701.	777911.
CMS	304.	251.	76.	76.	22028.
INCHES		3.93	4.79	4.79	4.79
MM		99.79	121.56	121.56	121.56
AC-FT		4398.	5358.	5358.	5358.
THOUS CU M		5425.	6608.	6608.	6608.

0.6 PMF

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SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY WJV DATE 3-1-79 PROJ. NO. 78-617-442
CHKD. BY DLR DATE 3-4-79 SHEET NO. N OF Y

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HYDROGRAPH ROUTING

ROUTE THROUGH RECREATION DAM RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
606	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	-102.	-1

STAGE*	101.50	102.50	103.50	104.50	105.50	105.90	106.50	107.50	108.70
	110.50	111.50	112.50	113.50	114.50				
FLOW	40.00	490.00	1350.00	2580.00	4150.00	5330.00	5990.00	7490.00	9570.00
	17340.00	23390.00	30060.00	38270.00	46060.00				
CAPACITY=	0.	1.	5.	13.	22.	35.	51.	60.	66.	82.
	105.	124.	152.	184.	220.	260.	304.			
ELEVATION=	100.	101.	102.	103.	104.	105.	106.	106.	107.	108.
	109.	110.	111.	112.	113.	114.	115.			

CREL	SPWID	COOW	EXPW	ELEVL	COQL	CAREA	EXPL
101.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

* RELATIVE ELEVATIONS WERE USED IN THE RESERVOIR ANALYSIS, HOWEVER, EL 105.5 ≈ USGS EL. 1444.0 (MSL)

DAM DATA

TOPEL	COOD	EXPD	DAMWID
108.7	0.0	0.0	0.

RECREATION DAM OUTFLOW HYDROGRAPHS: OVERTOPPING OCCURS @ ≈0.54 PMF

PEAK OUTFLOW IS 18133. AT TIME 21.08 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	18133.	14990.	4500.	4500.	1296117.
CMS	513.	424.	127.	127.	36702.
INCHES		6.64	7.97	7.97	7.97
MM		168.66	202.54	202.54	202.54
AC-FT		7433.	8926.	8926.	8926.
THOUS CU M		9169.	11011.	11011.	11011.

PMF

PEAK OUTFLOW IS 8787. AT TIME 21.42 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8787.	7349.	2225.	2225.	640781.
CMS	249.	208.	63.	63.	18145.
INCHES		3.26	3.94	3.94	3.94
MM		82.68	100.13	100.13	100.13
AC-FT		3644.	4413.	4413.	4413.
THOUS CU M		4495.	5443.	5443.	5443.

0.5 PMF

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY VJV DATE 3-1-79 PROJ. NO. 78-617-442
CHKD. BY DLB DATE 3-4-79 SHEET NO. 0 OF Y

PEAK OUTFLOW IS 10718. AT TIME 21.25 HOURS

RECREATION DAM OUTFLOW HYDROGRAPH

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10718.	8842.	2672.	2672.	769526.
CMS	303.	250.	76.	76.	21791.
INCHES		3.92	4.73	4.73	4.73
MM		99.46	120.25	120.25	120.25
AC-FT		4384.	5300.	5300.	5300.
THOUS CU M		5408.	6537.	6537.	6537.

0.6 PMF

HYDROGRAPH ROUTING

ROUTE FROM RESERVOIR TO SECTION 6 (US ROUTE 322 BRDG SECT.) * 500FT DS OF DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
607	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

STORAGE	0.00	1.30	3.00	4.80	7.10	8.30	11.10	25.40	37.60
	50.20	61.30	70.30	80.10	90.10				
OUTFLOW	0.00	340.00	1140.00	2210.00	3510.00	3660.00	3960.00	4790.00	6500.00
	14000.00	19850.00	26730.00	34610.00	43390.00				

SECTION @ U.S. ROUTE 322 BRIDGE

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10132.	14984.	4479.	4479.	1290005.
CMS	513.	424.	127.	127.	36529.
INCHES		6.64	7.94	7.94	7.94
MM		168.59	201.59	201.59	201.59
AC-FT		7430.	8884.	8884.	8884.
THOUS CU M		9165.	10959.	10959.	10959.

MAXIMUM STORAGE = 58.

PMF CORRESPONDING TO ≈ ELEV 1445.1 FT (SEE SHEET C)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8786.	7307.	2208.	2208.	635883.
CMS	249.	207.	63.	63.	18006.
INCHES		3.24	3.91	3.91	3.91
MM		82.22	99.37	99.37	99.37
AC-FT		3623.	4379.	4379.	4379.
THOUS CU M		4470.	5402.	5402.	5402.

MAXIMUM STORAGE = 39.

0.5 PMF CORRESPONDING TO ≈ ELEV 1443.1 FT (SEE SHEET C)

AD-A070 832 GAI CONSULTANTS INC MONROEVILLE PA F/G 13/2
NATIONAL DAM INSPECTION PROGRAM. RECREATION DAM (NDS ID NUMBER --ETC(U)
MAR 79 DACW31-79-C-0013
UNCLASSIFIED NL

2 OF 2
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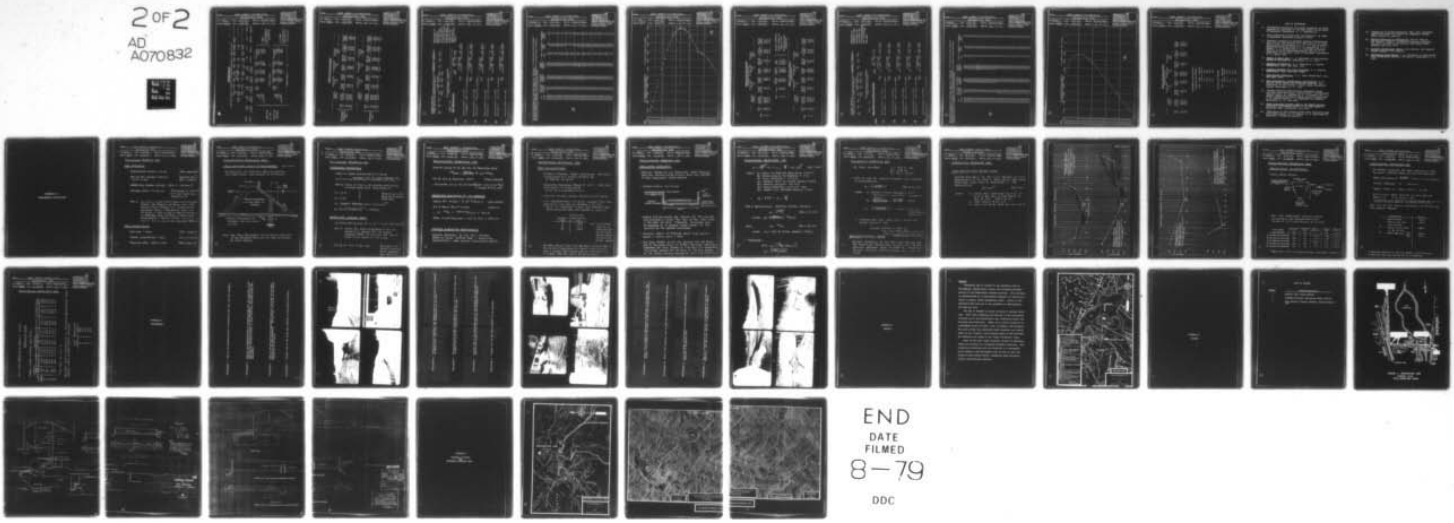

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8-79
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SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY WJV DATE 3-1-79 PROJ. NO. 78-617-446
CHKD. BY DLB DATE 3-4-79 SHEET NO. P OF Y

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HYDROGRAPH ROUTING

ROUTE FROM SECTION 6 TO SECTION 7 (PA ROUTE 504 BRDG SECT.) @ 900FT DS OF DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
708	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

STORAGE	0.00	.90	1.90	2.90	4.10	4.50	5.40	7.50	10.80
	30.30	38.10	47.90	57.60	67.40				
OUTFLOW	0.00	340.00	1140.00	2210.00	3510.00	3660.00	3960.00	4790.00	6500.00
	14000.00	19850.00	26730.00	34610.00	43390.00				

SECTION @ PA ROUTE 504 BRIDGE

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	18130.	14972.	4467.	4467.	1286511.
CMS	513.	424.	126.	126.	36430.
INCHES		6.63	7.92	7.92	7.92
MM		168.45	201.04	201.04	201.04
AC-FT		7424.	8860.	8860.	8860.
THOUS CU M		9157.	10929.	10929.	10929.

MAXIMUM STORAGE = 36.

PMF CORRESPONDING TO ≈ELEV 1439.8 FT (SEE SHEET B)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8784.	7299.	2203.	2203.	634450.
CMS	249.	207.	62.	62.	17966.
INCHES		3.23	3.90	3.90	3.90
MM		82.12	99.15	99.15	99.15
AC-FT		3619.	4369.	4369.	4369.
THOUS CU M		4464.	5390.	5390.	5390.

MAXIMUM STORAGE = 20.

0.5 PMF CORRESPONDING TO ≈ ELEV 1441.7 FT (SEE SHEET B)

SUBJECT DAM SAFETY INSPECTION

RECREATION DAM

BY NJV DATE 3-1-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 3-4-79 SHEET NO. Q OF Y

GAI CONSULTANTS, INC

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SUMMARY OF DAM SAFETY ANALYSIS

PHILIPSBURG RESERVOIR DAM

.....		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1621.00	1621.00	1629.50
	STORAGE	80.	80.	231.
	OUTFLOW	0.	0.	4042.

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
.20	1624.82	0.00	130.	1818.	0.00	20.58	0.00
.30	1626.70	0.00	165.	2710.	0.00	20.67	0.00
.40	1628.55	0.00	207.	3588.	0.00	20.67	0.00
.50	1629.88	.38	242.	4592.	2.17	20.42	0.00
1.00	1631.76	2.26	297.	9220.	6.67	20.42	0.00

RECREATION DAM

.....		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	101.50	101.50	108.70
	STORAGE	5.	5.	105.
	OUTFLOW	40.	40.	9570.

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
.20	105.08	0.00	44.	3491.	0.00	21.42	0.00
.30	105.87	0.00	59.	5229.	0.00	21.33	0.00
.40	107.14	0.00	76.	6952.	0.00	21.42	0.00
.50	108.25	0.00	96.	8787.	0.00	21.42	0.00
1.00	110.63	1.93	156.	18133.	5.75	21.08	0.00
.60	109.02	.32	113.	10718.	2.42	21.25	0.00

SUBJECT DAM SAFETY INSPECTION / RECREATION DAM

BY JV DATE 3-1-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 3-4-79 SHEET NO. R OF Y

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BREACHING OF PHILIPSBURG RESERVOIR DAM ONLY, AND EFFECTS ON RECREATION DAM (SAME INPUT DATA AS FOR THE OVERTOPPING ANALYSIS W/ THE ADDITION OF THE BREACH DATA GIVEN HERE)

DAM SAFETY INSPECTION
RECREATION DAM (W/ US PHILIPSBURG RESERVOIR DAM)*****BREACHING ANALYSIS*****
5-MINUTE TIME STEP AND 24-HOUR STORM DURATION

JOB SPECIFICATION

NJ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 5 NRTIO= 1 LRTIO= 1

RTIOS= .50

ROUTE THROUGH RESERVOIR

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1629.5	3.1	1.5	310.

PLAN

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
0.	.50	1607.50	.25	1621.00	1629.50

① BEGIN DAM FAILURE AT 19.67 HOURS

PEAK OUTFLOW IS 6621. AT TIME 19.92 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
200.	2.00	1607.50	.25	1621.00	1629.50

② BEGIN DAM FAILURE AT 19.67 HOURS

PEAK OUTFLOW IS 19399. AT TIME 19.82 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
0.	.50	1607.50	4.00	1621.00	1629.50

③ BEGIN DAM FAILURE AT 19.67 HOURS

PEAK OUTFLOW IS 4615. AT TIME 20.50 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
200.	2.00	1607.50	4.00	1621.00	1629.50

④ BEGIN DAM FAILURE AT 19.67 HOURS

PEAK OUTFLOW IS 5791. AT TIME 20.42 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
100.	1.00	1607.50	1.00	1621.00	1629.50

⑤ BEGIN DAM FAILURE AT 19.67 HOURS

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 3-1-79 PROJ. NO. 73-617-446

CHKD. BY DLB DATE 3-4-79 SHEET NO. 5 OF Y

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .083 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)
19.667	0.000	4130.		4130.		0.	0.	0.
19.688	.021	4333.		4272.		62.	62.	0.
19.708	.042	4537.		4472.		64.	126.	0.
19.729	.063	4740.		4701.		39.	165.	0.
19.750	.083	4943.		4943.		0.	165.	0.
19.771	.104	5215.		5193.		21.	186.	0.
19.792	.125	5486.		5458.		28.	215.	0.
19.813	.146	5757.		5745.		12.	227.	0.
19.833	.167	6028.		6028.		0.	227.	0.
19.854	.188	6286.		6304.		-18.	208.	0.
19.875	.208	6544.		6570.		-26.	182.	0.
19.896	.229	6801.		6822.		-21.	161.	0.
19.917	.250	7059.		7059.		0.	161.	0.
19.938	.271	7249.		7279.		-29.	132.	0.
19.958	.292	7439.		7479.		-40.	92.	0.
19.979	.313	7629.		7660.		-30.	61.	0.
20.000	.333	7819.		7819.		0.	61.	0.
20.021	.354	7924.		7957.		-33.	28.	0.
20.042	.375	8029.		8073.		-44.	-16.	-0.
20.063	.396	8134.		8167.		-33.	-49.	-0.
20.083	.417	8239.		8239.		-0.	-49.	-0.
20.104	.437	8256.		8288.		-32.	-81.	-0.
20.125	.458	8274.		8316.		-42.	-123.	-0.
20.146	.479	8292.		8323.		-31.	-154.	-0.
20.167	.500	8310.		8310.		0.	-154.	-0.
20.188	.521	8251.		8277.		-26.	-181.	-0.
20.208	.542	8192.		8226.		-34.	-215.	-0.
20.229	.562	8132.		8158.		-25.	-240.	-0.
20.250	.583	8073.		8073.		0.	-240.	-0.
20.271	.604	7956.		7974.		-18.	-258.	-0.
20.292	.625	7840.		7862.		-23.	-281.	-0.
20.313	.646	7723.		7739.		-16.	-297.	-1.
20.333	.667	7606.		7606.		0.	-297.	-1.
20.354	.687	7478.		7465.		14.	-283.	-0.
20.375	.708	7350.		7315.		35.	-248.	-0.
20.396	.729	7223.		7161.		62.	-186.	-0.
20.417	.750	7095.		7095.		0.	-186.	-0.
20.438	.771	7072.		7109.		-37.	-223.	-0.
20.458	.792	7049.		7096.		-47.	-270.	-0.
20.479	.812	7026.		7060.		-33.	-304.	-1.
20.500	.833	7004.		7004.		0.	-304.	-1.
20.521	.854	6915.		6932.		-17.	-320.	-1.
20.542	.875	6826.		6847.		-20.	-341.	-1.
20.563	.896	6737.		6751.		-14.	-355.	-1.
20.583	.917	6649.		6649.		0.	-355.	-1.
20.604	.937	6537.		6540.		-4.	-359.	-1.
20.625	.958	6425.		6429.		-4.	-362.	-1.
20.646	.979	6313.		6315.		-2.	-364.	-1.

(5)

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY VJV DATE 3-1-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 3-4-79 SHEET NO. T OF Y

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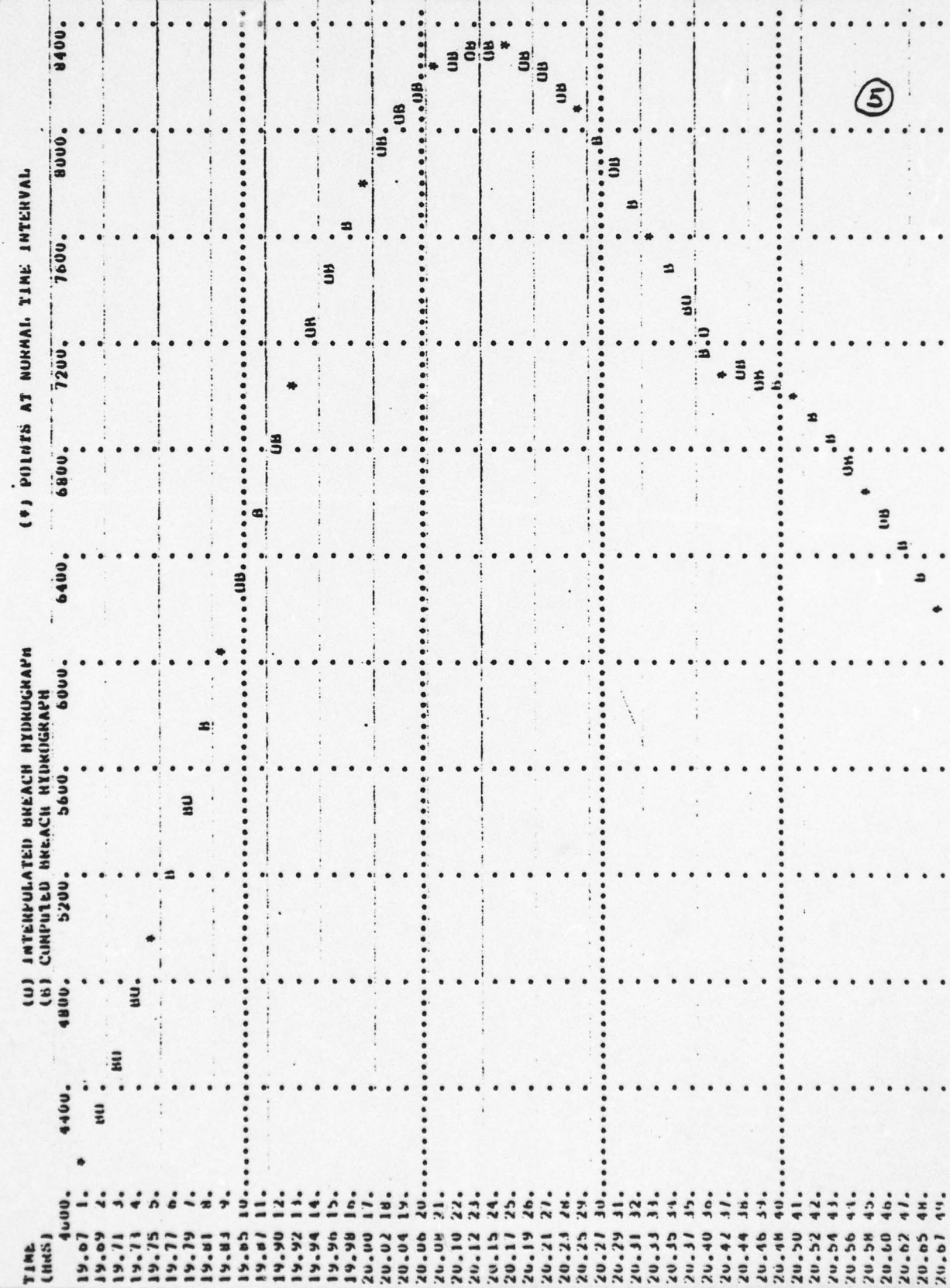
(5)



SUBJECT DAM SAFETY INSPECTION

RECREATION DAM

BY WJV DATE 3-1-79 PROJ. NO. 78-617-44a

CHKD. BY DLB DATE 3-4-79 SHEET NO. U OF Y

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SUMMARY OF DAM SAFETY ANALYSIS

PHILIPSBURG RESERVOIR DAM

.....	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1621.00	1621.00	1629.50
STORAGE	80.	80.	231.
OUTFLOW	0.	0.	4042.

PLAN	RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1	.50	1629.64	.14	235.	6621.	.28	19.92	19.67
2	.50	1629.58	.08	233.	19399.	.11	19.82	19.67
3	.50	1629.86	.36	241.	4615.	1.75	20.50	19.67
4	.50	1629.62	.12	235.	5791.	.33	20.42	19.67
5	.50	1629.60	.10	234.	8323.	.19	20.15	19.67

PLAN	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.50	4850.	1460.6	21.33
2	.50	5912.	1461.3	20.75
3	.50	4413.	1460.3	22.00
4	.50	5225.	1460.9	21.75
5	.50	5993.	1461.4	21.17

ROUTED BREACH FLOWS PRIOR TO INFLOW INTO RECREATION DAM RESERVOIR

SUMMARY OF DAM SAFETY ANALYSIS

RECREATION DAM

.....	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	101.50	101.50	108.70
STORAGE	5.	5.	105.
OUTFLOW	40.	40.	9570.

PLAN	RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1	.50	108.58	0.00	103.	9364.	0.00	21.33	0.00
2	.50	108.97	.27	112.	10545.	1.17	20.83	0.00
3	.50	108.26	0.00	96.	8802.	0.00	21.42	0.00
4	.50	108.71	.01	105.	9593.	.25	21.58	0.00
5	.50	108.97	.27	112.	10541.	1.08	21.25	0.00

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY WJV DATE 3-1-79 PROJ. NO. 78-617-446
CHKD. BY DLB DATE 3-4-79 SHEET NO. V OF Y

BREACHING OF RECREATION DAM FOLLOWING THE FAILURE OF THE PHILIPSBURG RESERVOIR DAM VIA PLAN (5) (SEE SHEETS

DAM SAFETY INSPECTION
RECREATION DAM (w/ US PHILIPSBURG RESERVOIR DAM)*****BREACHING ANALYSIS*****
5-MINUTE TIME STEP AND 24-HOUR STORM DURATION

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	-4	0
			JOPER	NRT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 5 NRTIO= 1 LRTIO= 1

RTIOS= .50

ROUTE THROUGH RECREATION DAM RESERVOIR

DAM DATA

	TOPEL	COND	EXPD	DAMWID
	108.7	0.0	0.0	0.

PLAN ①

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
10.	1.00	104.70	.50	101.50	108.70

BEGIN DAM FAILURE AT 20.83 HOURS

PEAK OUTFLOW IS 10609. AT TIME 21.27 HOURS

PLAN ②

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
490.	1.00	104.70	.50	101.50	108.70

BEGIN DAM FAILURE AT 20.83 HOURS

PEAK OUTFLOW IS 11769. AT TIME 21.23 HOURS

PLAN ③

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
10.	1.00	104.70	4.00	101.50	108.70

BEGIN DAM FAILURE AT 20.83 HOURS

PEAK OUTFLOW IS 10545. AT TIME 21.25 HOURS

PLAN ④

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
490.	1.00	104.70	4.00	101.50	108.70

BEGIN DAM FAILURE AT 20.83 HOURS

PEAK OUTFLOW IS 10644. AT TIME 21.29 HOURS

PLAN ⑤

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
200.	1.00	104.70	2.00	101.50	108.70

BEGIN DAM FAILURE AT 20.83 HOURS

[illegible] AT [illegible] HOURS

SUBJECT DAM SAFETY INSPECTION

RECREATION DAM

BY CWJV DATE 3-1-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 3-4-79 SHEET NO. W OF Y

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS ALSO USE A TIME INTERVAL OF .083 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)
20.833	0.000	9804.		9804.		0.	0.	0.
20.875	.042	9973.		9984.		-12.	-12.	-0.
20.917	.083	10141.		10141.		0.	-12.	-0.
20.958	.125	10262.		10273.		-11.	-23.	-0.
21.000	.167	10383.		10383.		0.	-23.	-0.
21.042	.208	10463.		10473.		-10.	-32.	-0.
21.083	.250	10543.		10543.		0.	-32.	-0.
21.125	.292	10588.		10596.		-8.	-41.	-0.
21.167	.333	10632.		10632.		0.	-41.	-0.
21.208	.375	10645.		10652.		-7.	-48.	-0.
21.250	.417	10659.		10659.		0.	-48.	-0.
21.292	.458	10646.		10652.		-6.	-54.	-0.
21.333	.500	10633.		10633.		0.	-54.	-0.
21.375	.542	10596.		10602.		-6.	-60.	-0.
21.417	.583	10559.		10559.		0.	-60.	-0.
21.458	.625	10514.		10508.		6.	-54.	-0.
21.500	.667	10468.		10468.		0.	-54.	-0.
21.542	.708	10419.		10426.		-7.	-61.	-0.
21.583	.750	10370.		10370.		0.	-61.	-0.
21.625	.792	10299.		10303.		-4.	-64.	-0.
21.667	.833	10229.		10229.		0.	-64.	-0.
21.708	.875	10149.		10150.		-2.	-66.	-0.
21.750	.917	10068.		10068.		0.	-66.	-0.
21.792	.958	9985.		9985.		-0.	-66.	-0.
21.833	1.000	9902.		9902.		0.	-66.	-0.
21.875	1.042	9818.		9818.		-0.	-66.	-0.
21.917	1.083	9734.		9734.		0.	-66.	-0.
21.958	1.125	9650.		9650.		0.	-66.	-0.
22.000	1.167	9566.		9566.		0.	-66.	-0.
22.042	1.208	9484.		9484.		-0.	-66.	-0.
22.083	1.250	9401.		9401.		0.	-66.	-0.
22.125	1.292	9319.		9319.		0.	-66.	-0.
22.167	1.333	9238.		9238.		0.	-66.	-0.
22.208	1.375	9158.		9157.		1.	-65.	-0.
22.250	1.417	9078.		9078.		0.	-65.	-0.
22.292	1.458	8998.		9001.		-3.	-68.	-0.
22.333	1.500	8918.		8918.		0.	-68.	-0.
22.375	1.542	8822.		8817.		5.	-63.	-0.
22.417	1.583	8727.		8727.		0.	-63.	-0.
22.458	1.625	8644.		8642.		2.	-61.	-0.
22.500	1.667	8561.		8561.		0.	-61.	-0.
22.542	1.708	8483.		8482.		1.	-60.	-0.
22.583	1.750	8404.		8404.		0.	-60.	-0.
22.625	1.792	8328.		8328.		0.	-60.	-0.
22.667	1.833	8253.		8253.		0.	-60.	-0.
22.708	1.875	8178.		8178.		0.	-60.	-0.
22.750	1.917	8104.		8104.		0.	-60.	-0.
22.792	1.958	8031.		8031.		-0.	-60.	-0.

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 3-1-79 PROJ. NO. 78-617-44b

CHKD. BY DLB DATE 3-4-79 SHEET NO. X OF Y

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(5)

(*) POINTS AT NORMAL TIME INTERVAL.
(a) ATTENUATED BREACH HYDROGRAPH
(b) COMPUTED BREACH HYDROGRAPH

TIME (HRS)	8000.	8400.	8800.	9200.	9600.	10000.	10400.	10800.	0.	0.	0.
20.83	1.										
20.88	2.										
20.92	3.										
20.96	4.										
21.00	5.										
21.04	6.										
21.08	7.										
21.13	8.										
21.17	9.										
21.21	10.										
21.25	11.										
21.29	12.										
21.33	13.										
21.38	14.										
21.42	15.										
21.46	16.										
21.50	17.										
21.54	18.										
21.58	19.										
21.62	20.										
21.67	21.										
21.71	22.										
21.75	23.										
21.79	24.										
21.83	25.										
21.87	26.										
21.92	27.										
21.96	28.										
22.00	29.										
22.04	30.										
22.08	31.										
22.12	32.										
22.17	33.										
22.21	34.										
22.25	35.										
22.29	36.										
22.33	37.										
22.37	38.										
24.92	39.										
24.96	40.										
22.50	41.										
22.54	42.										
22.58	43.										
22.62	44.										
22.67	45.										
22.71	46.										
22.75	47.										
24.79	48.										
22.83	49.										

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY WJV DATE 3-1-79 PROJ. NO. 78-617-446
CHKD. BY DLB DATE 3-4-79 SHEET NO. Y OF Y

SUMMARY OF DAM SAFETY ANALYSIS

RECREATION DAM

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	101.50	101.50	108.70
STORAGE	5.	5.	105.
OUTFLOW	40.	40.	9570.

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	108.93	.23	111.	10609.	.92	21.27	20.83
.50	108.78	.08	107.	11769.	.20	21.23	20.83
.50	108.97	.27	112.	10545.	1.08	21.25	20.83
.50	108.66	.16	109.	10644.	.75	21.25	20.83
.50	108.68	.18	109.	10659.	.71	21.25	20.83

DOWNSTREAM ROUTING RESULTS

US ROUTE 322 BRIDGE

PLAN	FLOW	ELEVATION *
1	10602. cfs	1443.4 FT
2	11717.	1443.7
3	10539.	1443.4
4	10643.	1443.4
5	10654.	1443.4

PA ROUTE 504 BRIDGE

PLAN	FLOW	ELEVATION *
1	10604. cfs	1440.3 FT
2	11772.	1440.5
3	10537.	1440.3
4	10637.	1440.3
5	10650.	1440.3

* SEE SHEETS B AND C

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APPENDIX C-1

SUPPLEMENTAL CALCULATIONS

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY DLB DATE 1-24-79 PROJ. NO. 78-617-446

CHKD. BY WJV DATE 2-13-79 SHEET NO. 1 OF 13

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PHILLIPSBURG RESERVOIR DAM

DAM STATISTICS

EMBANKMENT HEIGHT ≃ 22 FEET (FIELD MEASURED)

MAXIMUM POOL STORAGE CAPACITY ≃ @ TOP OF DAM [OBTAINED FROM HEC-1 OUTPUT]

NORMAL POOL STORAGE CAPACITY ≃ 80 AC-FT (SEE NOTE 1)

DRAINAGE AREA ≃ 9.4 SQ. MILES [PLANIMETERED OFF U.S.G.S. 7.5 MINUTE SERIES QUAD SANDY RIDGE, PA.]

NOTE 1: THE VALUE FOR STORAGE CAPACITY IS TAKEN FROM THE PUBLICATION ENTITLED "DAMS, RESERVOIRS AND NATURAL LAKES"; WATER RESOURCES PLANNING INVENTORY NO. 1" PREPARED BY THE PENNSYLVANIA BUREAU OF ENGINEERING, DATED 1970. THE FACILITY IS LISTED ON PAGE 59 WHERE IT IS REFERED TO AS UPPER DAM ACROSS COLD STREAM IN CENTRE COUNTY, PENNSYLVANIA (PERMIT NUMBER 14-25). THE STORAGE IS GIVEN AS 27 MILLION GALLONS WHICH ROUGHLY EQUALS 80 ACRE-FEET

DAM CLASSIFICATION

DAM SIZE - SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF - ½PMF TO PMF (REF 1, TABLE 3)

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 3-3-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 3-5-79 SHEET NO. 1-A OF 13

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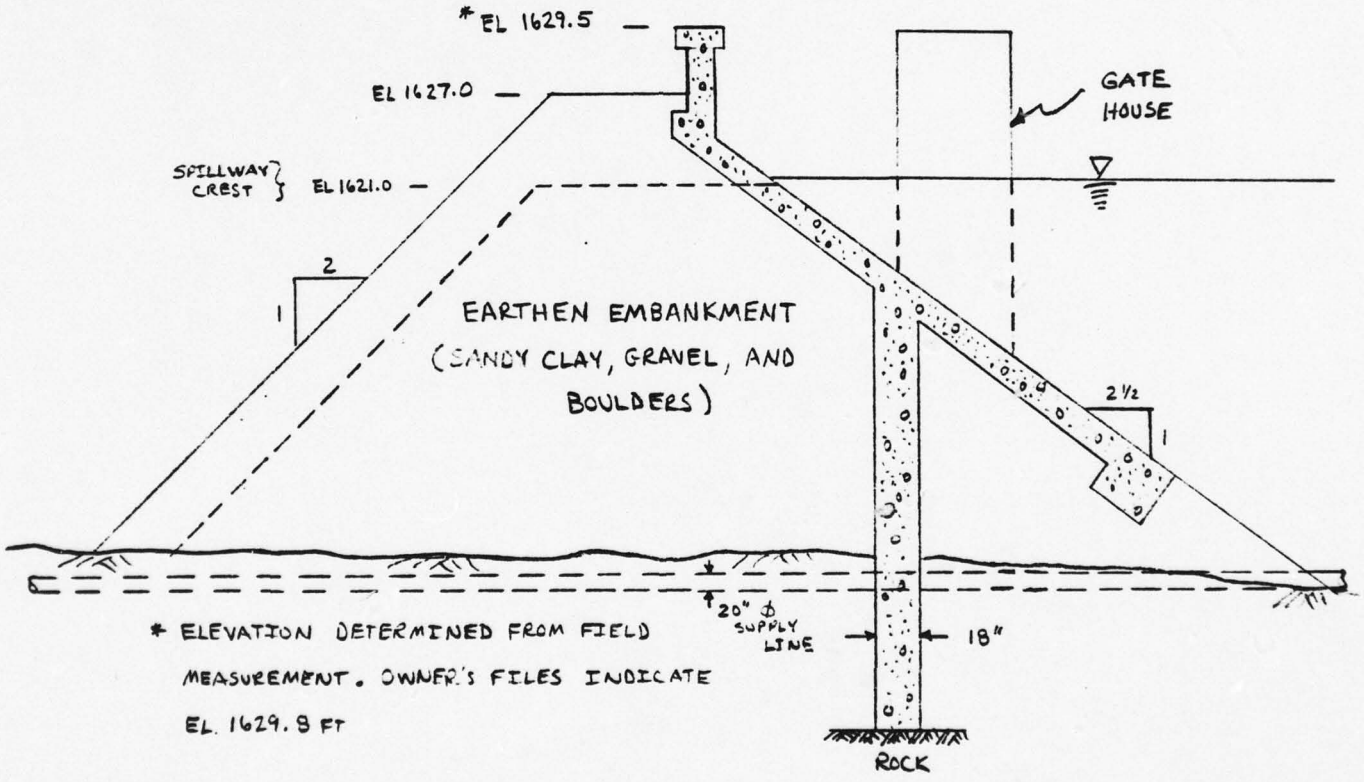
CROSS-SECTIONAL SKETCH OF EMBANKMENT (NOT TO SCALE)

ALL ELEVATIONS AND DIMENSIONS WERE OBTAINED FROM THE OWNER'S RECORDS AND DRAWINGS OF THE FACILITY



NOTE: THE SMALL IMPOUNDMENT LOCATED DIRECTLY DOWNSTREAM OF THE PHILIPSBURG RESERVOIR DAM WILL BE IGNORED IN THESE ANALYSES

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY DLB DATE 1-24-79 PROJ. NO. 78-617-446

CHKD. BY WJV DATE 2-13-79 SHEET NO. 2 OF 13

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HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE (L) ≅ 5.8 MILES

L_{CA} ≅ 3.0 MILES [MEASURED ALONG THE LONGEST WATERCOURSE FROM THE DAM CREST TO THE CENTROID OF THE BASIN]

NOTE 2: VALUES OF L AND L_{CA} ARE MEASURED FROM U.S.G.S. 7.5 MINUTE SERIES QUAD SANDY RIDGE, PA.

$C_t = 2.10$

$C_p = 0.40$

} [SUPPLIED BY C OF E ZONE 20, SUSQUEHANNA RIVER BASIN]

t_p = SNYDER'S STANDARD LAG = $2.10(L \times L_{CA})^{0.3}$

$t_p = (2.10)\,[(5.8)(3.0)]^{0.3} = 4.95$ HRS

RESERVOIR SURFACE AREAS

S.A. (SURFACE AREA) @ NORMAL POOL EL 1621 ≅ 10 ACRES (SEE NOTE 3)

NOTE 3: NORMAL POOL ELEVATION (@ CREST OF SPILLWAY CHANNEL) WAS OBTAINED FROM THE OWNER'S (KEYSTONE WATER COMPANY) FILES. SEE NOTE 1 (SHEET 1) FOR SOURCE OF S.A. VALUE.

S.A. @ EL 1640 ≅ 48.2 ACRE [PLANIMETED OFF U.S.G.S. 7.5 MINUTE SERIES TOPOGRAPHIC QUAD, SANDY RIDGE]

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 1-25-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 3 OF 13

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PHILIPSBURG RESERVOIR DAM

RATE OF CHANGE OF SA PER FOOT OF RESERVOIR RISE:

$$\Delta SA/\Delta ELEV = \frac{48.2-10}{1640.0-1621.0} \cong 2.0 \text{ ACRES/FT}$$

TOP OF DAM @ ELEVATION 1629.5 (FIELD MEASURED)

∴ ESTIMATED S.A. @ TOP OF DAM $\cong [(1629.5 - 1621.0) \times 2.0 \text{ AC/FT}]$
$+ 10 \text{ ACRES} \cong 27.0 \text{ ACRES}$

RESERVOIR ELEVATION AT "0" STORAGE

NORMAL POOL VOLUME = $\frac{1}{3}$ HA $\cong$ 80 AC-FT (CONIC METHOD)

S.A. @ NORMAL POOL $\cong$ 10 ACRES (SHEET 2)

∴ $H = 3V/A = 3(80 \text{ AC-FT})/(10 \text{ AC}) = 24.0 \text{ FT}$

ZERO VOLUME ELEVATION = 1621.0 − 24.0 = 1597.0 FT

STORAGE - ELEVATION RELATIONSHIP

COMPUTED INTERNALLY BY THE HEC-1 PROGRAM BASED ON GIVEN SURFACE AREA VS ELEVATION INFORMATION. (SEE SUMMARY INPUT/OUTPUT SHEETS).

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 1-25-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 4 OF 13

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PHILIPSBURG RESERVOIR DAM

PMP CALCULATIONS

- STANDARD RAINFALL INDEX = 22.2 INCHES (REF 9, FIG 2)
  (CORRESPONDING TO A DURATION OF 24 HRS AND AN AREA OF 200 SQ. MI.)

- GEOGRAPHIC ADJUSTMENT FACTOR ≅ 103 % (REF 9, FIG 1)
  (CORRESPONDING TO A LONGITUDE OF 78° 12.5', AND A LATITUDE OF 40° 51')

- CORRECTED RAINFALL INDEX = (22.2 IN.) × (1.03) ≅ 22.9 IN.

- LOCAL DRAINAGE AREA = 9.4 SQ.MI. ; HOWEVER TOTAL AREA OVER WHICH STORM WILL BE CENTERED = 21.0 SQ.MI.
  (DUE TO THE ADDITIONAL 11.6 SQ.MI. LOCAL DRAINAGE AREA ABOVE RECREATION DAM; SEE APPENDIX C , SHEET 1).

DURATION (HRS)	PERCENT OF INDEX RAINFALL (%)
6	109.5
12	119.0
24	128.5

NOTE: A 24 HOUR RATHER THAN A 72-HOUR DURATION WAS USED SO THAT A TIME STEP OF 5 MINUTES COULD BE USED IN THE HEC-1 PROGRAM.

- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE, AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALLER AREA) CORRESPONDING TO A D.A. = 21.0 SQ MI ≅ 0.825 (FROM HEC-1 OUTPUT ; SEE REF 10, PG B-16)

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 1-29-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 5 OF 13

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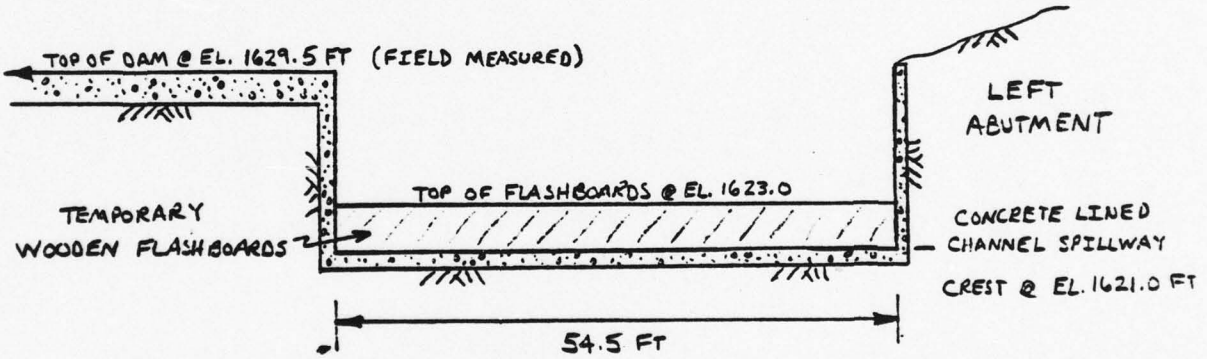
PHILIPSBURG RESERVOIR DAM

SPILLWAY CAPACITY

- SPILLWAY DIMENSIONS AND ELEVATIONS WERE OBTAINED FROM THE KEYSTONE WATER COMPANY FILES AND MODIFIED BY FIELD MEASUREMENTS WHERE NECESSARY

- GENERAL SKETCH : (NOT TO SCALE)



- ASSUME THE FLASHBOARDS ARE REMOVED FOR THIS ANALYSIS (FOR SIMPLICITY), SINCE THEY WILL, IN FACT, FAIL UNDER A FEW FEET OF HEAD. THEREFORE, DISCHARGES WILL BE GOVERNED BY A CRITICAL CONTROL SECTION AT THE LOCATION OF THE REMOVED FLASHBOARDS.

- MAXIMUM HEIGHT OF RESERVOIR ABOVE CONTROL SECTION CREST = 1629.5 - 1621.0 = 8.5 FT

- THE TOTAL ENERGY @ ANY TWO SECTIONS MUST BE EQUAL DUE TO THE CONSERVATION OF ENERGY PRINCIPLE (REF 13, PG 24). THEREFORE, THE TOTAL ENERGY @ A SECTION JUST UPSTREAM FROM THE CONTROL SECTION MUST BE EQUAL TO THE TOTAL ENERGY @ THE CONTROL SECTION (ASSUMING EL. 1621.0 TO BE THE DATUM)

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-1-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 6 OF 13

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PHILIPSBURG RESERVOIR DAM

$$Y_R + \cancel{\frac{v_R^2}{2g}}^{0} + Z_1 = Y_c + \frac{v_c^2}{2g} + Z_c + \cancel{H_L}^{0} \qquad \text{(REF 7, PG 40)}$$

WHERE: Y_R = HEIGHT OF RESERVOIR ABOVE DATUM = 8.5 FT,
v_R = APPROACH VELOCITY OF RESERVOIR ≈ 0 FPS,
Z_1 = DATUM ELEVATION = 1621.0 FT,
Y_c = CRITICAL DEPTH IN CONTROL SECTION (IN FT),
v_c = CRITICAL VELOCITY (IN FPS),
Z_c = DATUM ELEVATION = 1621.0 FT, AND
H_L = ENERGY LOSS BETWEEN SECTIONS ≈ 0 FT.

$$\therefore \quad Y_R = 8.5\,\text{FT} = Y_c + \frac{v_c^2}{2g}$$

- FOR A RECTANGULAR CRITICAL CONTROL SECTION:

$$Y_c = \sqrt[3]{q^2/g} \qquad \text{(REF. 13, PG. 143)}$$

WHERE: $q = \frac{\text{FLOW}}{\text{CHANNEL WIDTH}} = Q/54.5\,\text{FT}$

ALSO, $v_c = Q/A_c$ (REF 13, PG. 22)

WHERE: A_c = AREA OF CONTROL SECTION = $54.5\,Y_c$

- THEREFORE:

$$8.5 = Y_c + \left[Q^2/2g\,(54.5\,Y_c)^2 \right]$$

$$Y_c = \sqrt[3]{Q^2/g\,(54.5)^2}$$

SUBJECT DAM SAFETY INSPECTION/ RECREATION DAM

BY WJV DATE 2-1-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 7 OF 13

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PHILIPSBURG RESERVOIR DAM

- BY TRIAL AND ERROR : Y_c = 5.67 FT AND
  Q_c = 4170 CFS
  $v_c = Q/A_c$ = 13.5 FPS

- CHECK TO SEE IF SPILLWAY CHANNEL SLOPE ACTUALLY IS SUPERCRITICAL :

$$S_c = \left(\frac{n\, v_c}{1.49\, R_h^{2/3}}\right)^2$$ (REF 13, PG 143)

WHERE : n = SPILLWAY CHANNEL ROUGHNESS ≈ 0.017 (REF 7, PG 111 ; CONCRETE FINISHED W/ GRAVEL ON BOTTOM)

$$R_h = \frac{\text{WETTED AREA}}{\text{WETTED PERIMETER}} = \frac{(54.5 \times 5.67)}{54.5 + 2(5.67)} = 4.7 \text{ FT}$$

$$\therefore S_c = \left[\frac{(0.017)(13.5)}{1.49\,(4.7)^{2/3}}\right]^2 = 0.003 < \text{THE ACTUAL FIELD ESTIMATED SLOPE} \approx 0.10$$

∴ SUPERCRITICAL FLOW WILL OCCUR DS OF THE CONTROL SECTION, AND

SPILLWAY CAPACITY ≈ 4170 CFS

(HEC-1-DAM PROGRAM COMPUTED ≈ 4050 CFS FOR CAPACITY W/ Y_c ≈ 5.7 FT ; DISCREPENCY DUE TO COMPUTER'S ITERATIVE PROCESS OF CALCULATI.

SPILLWAY RATING CURVE

COMPUTED INTERNALLY BY THE HEC-1-DAM PROGRAM VIA THE TRAPEZOIDAL RATING CURVE ROUTINE, BASED ON THE SPILLWAY GEOMETRY GIVEN ON SHEET 5 . THE TRAPEZOIDAL ROUTINE CALCULATES CRITICAL CONTROL DISCHARGES AS ABOVE.

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-1-79 PROJ. NO. 78-617-446

CHKD. BY DLB DATE 2-16-79 SHEET NO. 8 OF 13

gai CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

PHILIPSBURG RESERVOIR DAM

DAM EMBANKMENT RATING CURVE

COMPUTED INTERNALLY BY HEC-1-DAM PROGRAM ASSUMING EMBANKMENT TO ACT LIKE A BROAD CRESTED WEIR WHEN OVERTOPPED. WEIR FLOW IS DETERMINED BY THE RELATIONSHIP:

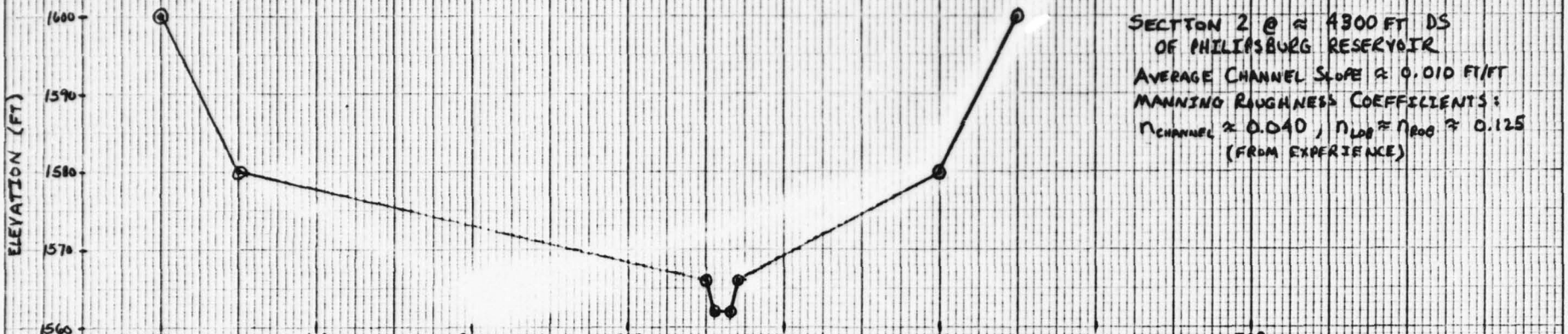
$$Q = CLH^{3/2}$$ (REF 10, PG 10)

WHERE: C = AVERAGE WEIR COEFFICIENT FOR VALUES OF H UP TO 5FT WITH A CREST BREADTH OF 8FT ⇒ 3.08 (REF 12, PG 46),

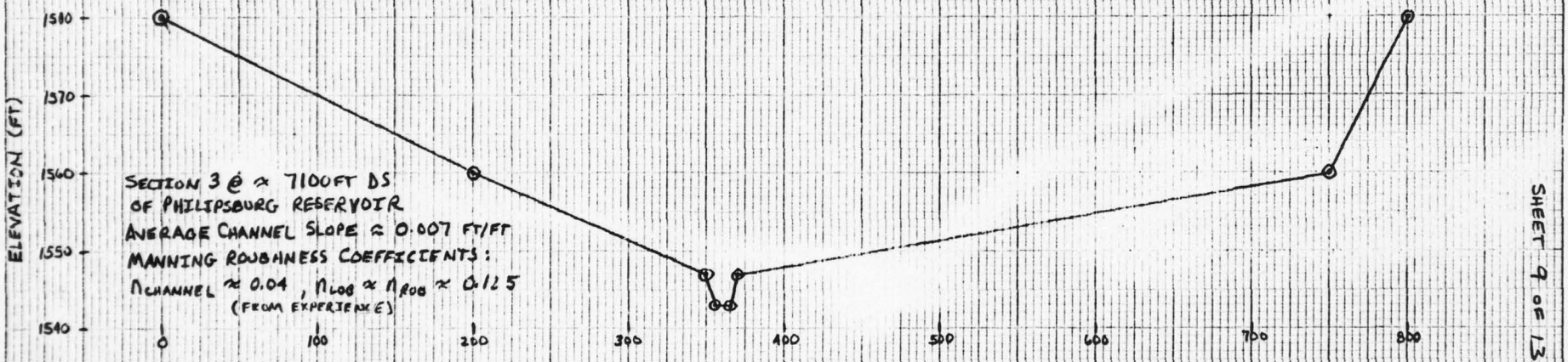
L = CREST LENGTH ≈ 310.0 FT

H = HEIGHT OF WATER ABOVE DAM CREST IN FT.

DOWNSTREAM ROUTING SECTIONS

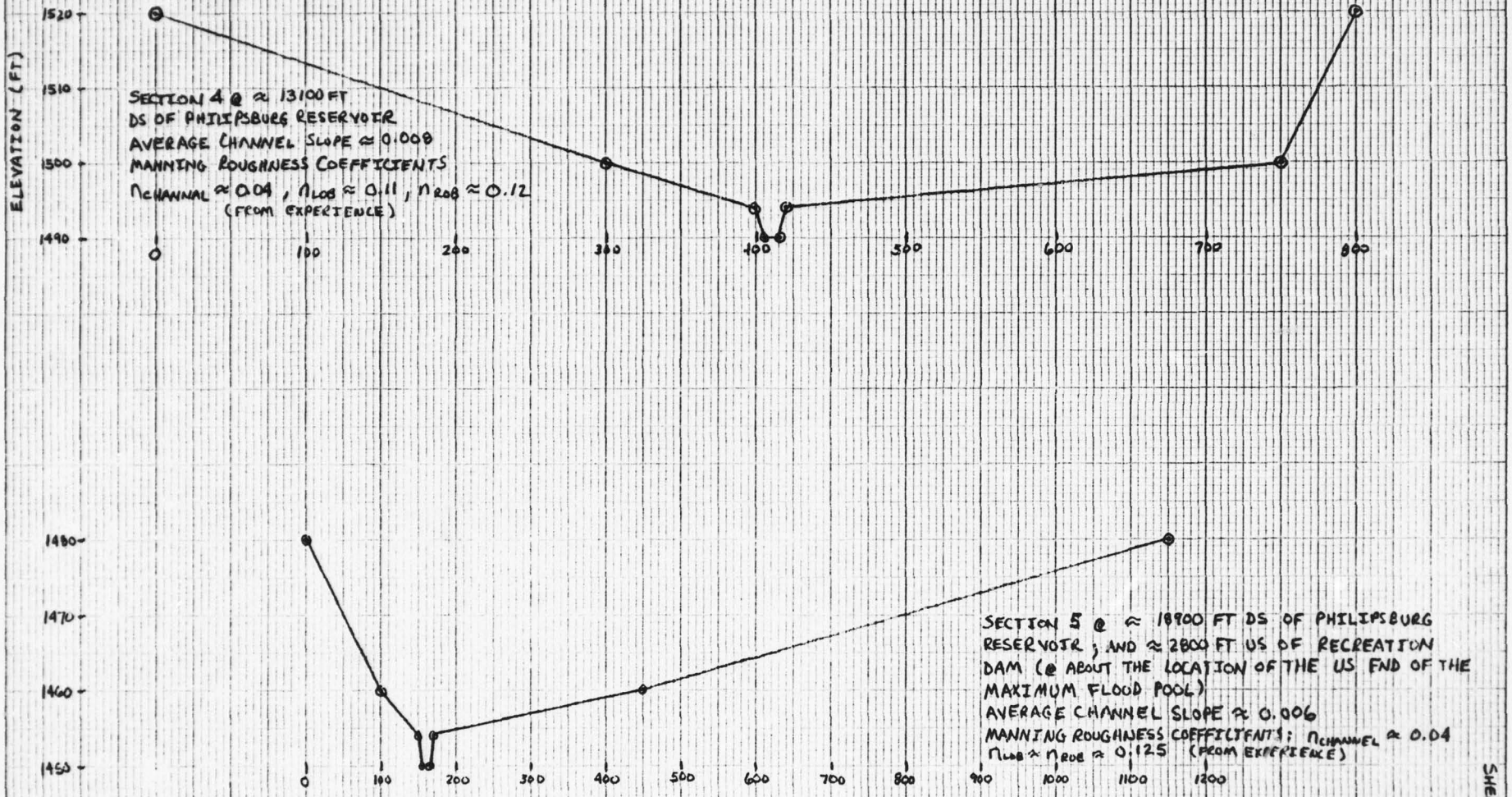


SECTION 2 @ ≈ 4300 FT DS
OF PHILIPSBURG RESERVOIR
AVERAGE CHANNEL SLOPE ≈ 0.010 FT/FT
MANNING ROUGHNESS COEFFICIENTS:
$n_{CHANNEL} \approx 0.040$, $n_{LOB} \approx n_{ROB} \approx 0.125$
(FROM EXPERIENCE)



SECTION 3 @ ≈ 7100FT DS
OF PHILIPSBURG RESERVOIR
AVERAGE CHANNEL SLOPE ≈ 0.007 FT/FT
MANNING ROUGHNESS COEFFICIENTS:
$n_{CHANNEL} \approx 0.04$, $n_{LOB} \approx n_{ROB} \approx 0.125$
(FROM EXPERIENCE)

DOWNSTREAM ROUTING SECTIONS



SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-21-79 PROJ. NO. 79-617-446

CHKD. BY DLB DATE 2-22-79 SHEET NO. 11 OF 13

gai CONSULTANTS, I
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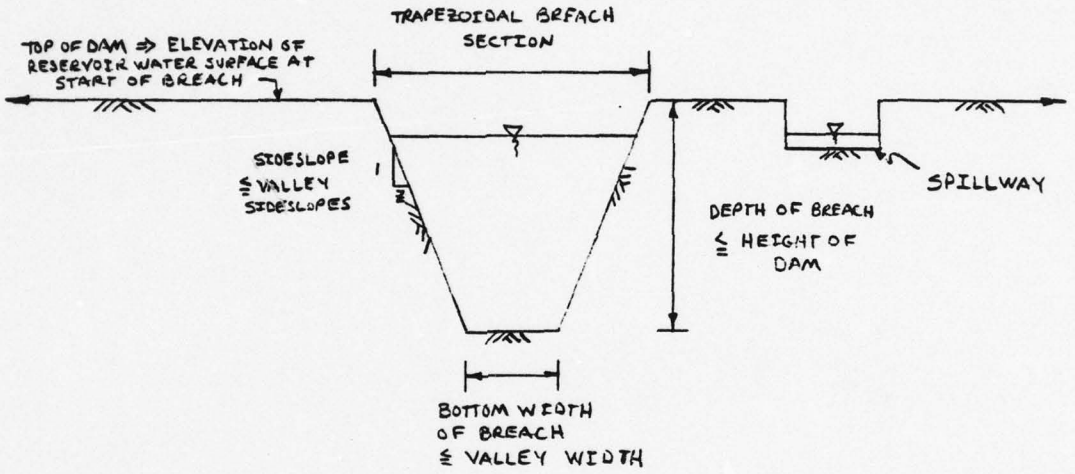
Environmental Specialists

PHILIPSBURG RESERVOIR DAM

BREACHING ASSUMPTIONS

TYPICAL BREACH SECTION :



- HEC-1-DAM BREACHING ANALYSIS INPUTS:
(FAILURE BEGINS WHEN RESERVOIR WATER SURFACE REACHES THE TOP OF DAM ELEVATION IN ALL CASES)

PLAN NUMBER AND COMMENT	BREACH BOTTOM WIDTH (FT)	MAX. BREACH DEPTH (FT)	SECTION SIDESLOPES	BREACH * TIME (HR)	WSEL @ START OF FAILURE (FT)
① MIN. BREACH SECT, MIN FAIL TIME	0	22	0.5 TO 1	0.25	1629.5
② MAX. BREACH SECT, MIN FAIL TIME	200	22	2 TO 1	0.25	1629.5
③ MIN BREACH SECT, MAX FAIL TIME	0	22	0.5 TO 1	4.0	1629.5
④ MAX BREACH SECT, MAX FAIL TIME	200	22	2 TO 1	4.0	1629.5
⑤ AVERAGE POSSIBLE CONDITIONS	100	22	1 TO 1	1.0	1629.5

* BREACH TIME = TOTAL TIME NECESSARY TO REACH FINAL BREACH DIMENSIONS

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM

BY WJV DATE 2-21-79 PROJ. NO. 73-617-446

CHKD. BY DLB DATE 2-22-79 SHEET NO. 12 OF 13

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Environmental Specialists

PHILIPSBURG RESERVOIR DAM

- THE PREVIOUS ASSUMPTIONS ARE BASED SOMEWHAT ON THE FOLLOWING SUGGESTED RANGES FOR EARTH DAM BREACHING*:

BREACH BOTTOM WIDTH → $\frac{\text{DAM HEIGHT}}{2}$ < WIDTH < 3 × (DAM HEIGHT)

SECTION SIDESLOPES → $0 < Z < 1$

BREACH TIME → 0.5 HR < TIME < 4.0 HRS

WATER SURFACE HEIGHT ABOVE DAM AT WHICH BREACHING BEGINS → 1 FT < HEIGHT < 5 FT

(HOWEVER FOR THIS ANALYSIS, BREACHING BEGINS WHEN THE RESERVOIR LEVEL REACHES THE TOP OF DAM ELEVATION ⇒ HEIGHT = 0 FT ; SEE SECTION 5.5 FOR EXPLANATION.)

AND ALSO ON THE PHYSICAL CONSTRAINTS OF THE DAM AND SURROUNDING TERRAIN :

	CONSTRAINT	VALUE
	- HEIGHT OF DAM	22 FT
	- LENGTH OF DAM CREST W/O SPILLWAY	310 FT
**	- VALLEY BOTTOM WIDTH @ ℄ OF DAM	≈ 250 FT
**	- VALLEY SIDE SLOPES: RIGHT WALL	3.75 to 1
	LEFT WALL	3.50 to 1

* INFORMATION OBTAINED FROM BALTIMORE DISTRICT, CORPS OF ENGINEERS

** ESTIMATED FROM USGS TOPO MAP AND FIELD INSPECTION

SUBJECT DAM SAFETY INSPECTION
RECREATION DAM
BY WJV DATE 2-22-79 PROJ. NO. 78-617-446
CHKD. BY DLB DATE 2-22-79 SHEET NO. 13 OF 13
PHILIPSBURG RESERVOIR DAM

HEC-1-DAM BREACHING ANALYSIS OUTPUT:

RESERVOIR DATA

UNDER 1/2 PMF FLOODING CONDITIONS -

PLAN * NUMBER	VARIABLE BREACH BOTTOM WIDTH (FT)	ACTUAL MAX. FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HR)	INTERPOLATED OR HEC-1 ROUTED MAX FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HR)	ACTUAL PEAK FLOW THROUGH DAM (CFS)	CORRESPONDING TIME OF PEAK (HR)	TIME OF INITIAL BREACH (HR)
①	0	6621	19.92	6621	19.92	6621	19.92	19.67
②	200	19399	19.82	19308	19.83	19399	19.82	19.67
③	0	4615	20.50	4615	20.50	4615	20.50	19.67
④	200	5791	20.42	5791	20.42	5791	20.42	19.67
⑤	100	8323	20.15	8310	20.17	8323	20.15	19.67

* SEE TABLE ON SHEET 11.

RESULTANT ROUTED CONTRIBUTIONS TO RECREATION DAM RESERVOIR TOTAL INFLOWS (BASED ON ABOVE BREACH OUTFLOWS)

PLAN * NUMBER	PEAK BREACH INFLOW (CFS)
①	4850
②	5912
③	4413
④	5225
⑤	5993

APPENDIX D

PHOTOGRAPHS

Photograph 1 View of the downstream face of Recreation Dam near the left abutment.

Photograph 2 View of the downstream face of Recreation Dam near the junction of the northern and eastern portions of the embankment. The channel on the left side of the photo serves to divert acid mine drainage around the impoundment.

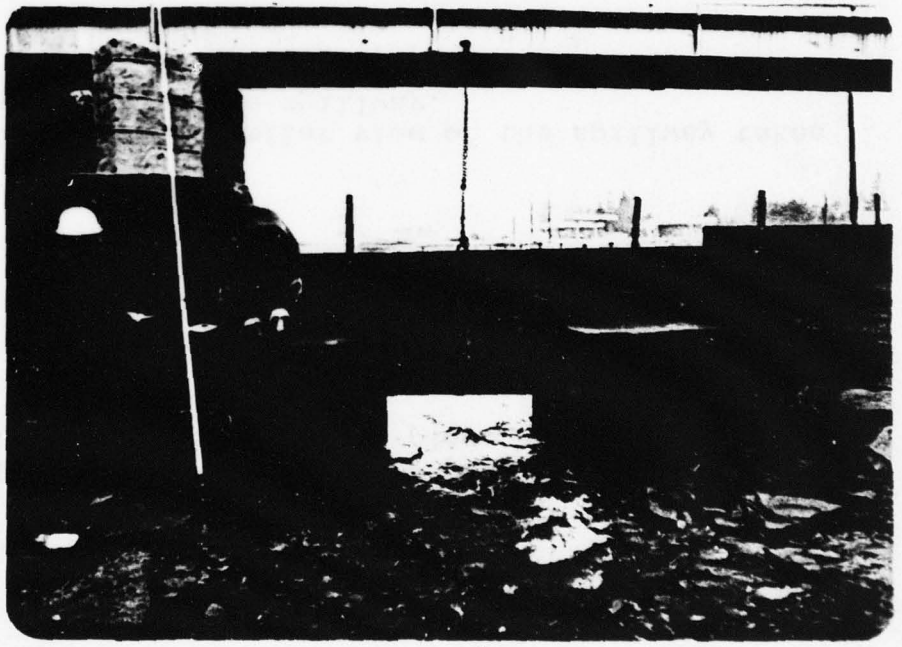
Photograph 3 View of the Recreation Dam impoundment area as seen from the southern portion of the east embankment. The spillway is visible in the center background of the photo.

Photograph 4 Closeup view of the slide gate opening in the masonry spillway.

1

2

3



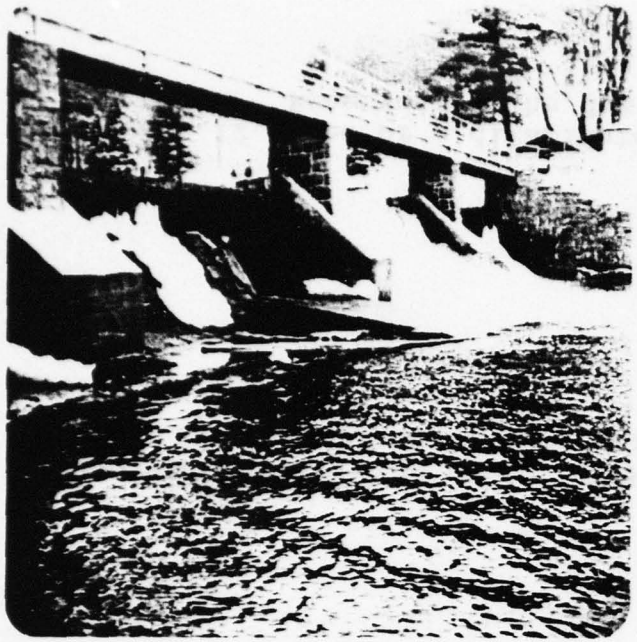
4

Photograph 5 Photograph from PennDER files showing view of the spillway as it appeared in March 1978. Note that the flashboards are in place.

Photograph 6 Photograph from PennDER files showing similar view of the spillway taken in March 1978 from just downstream of the spillway.

Photograph 7 Closeup view of the downstream face of the masonry spillway showing the deteriorated condition of the spillway and flashboard supports.

Photograph 8 Closeup view of the left wingwall of the spillway.



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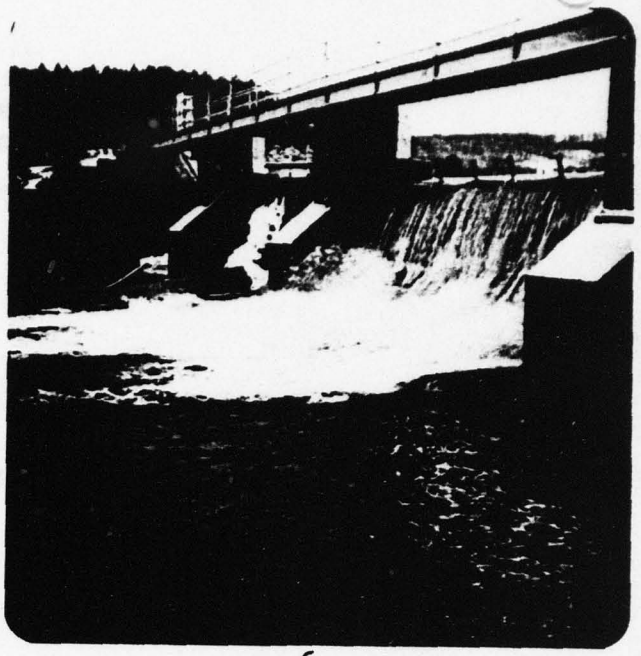

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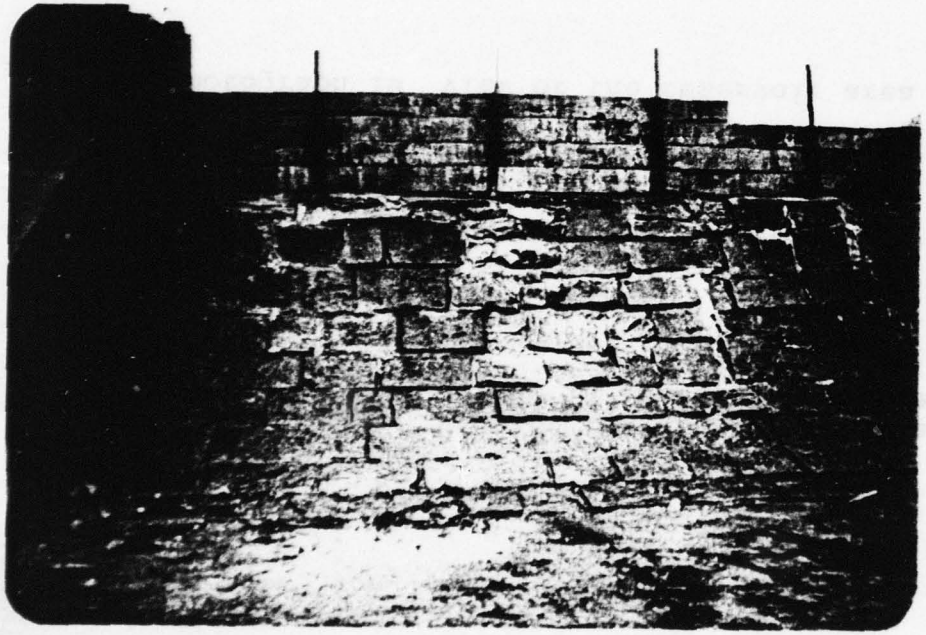

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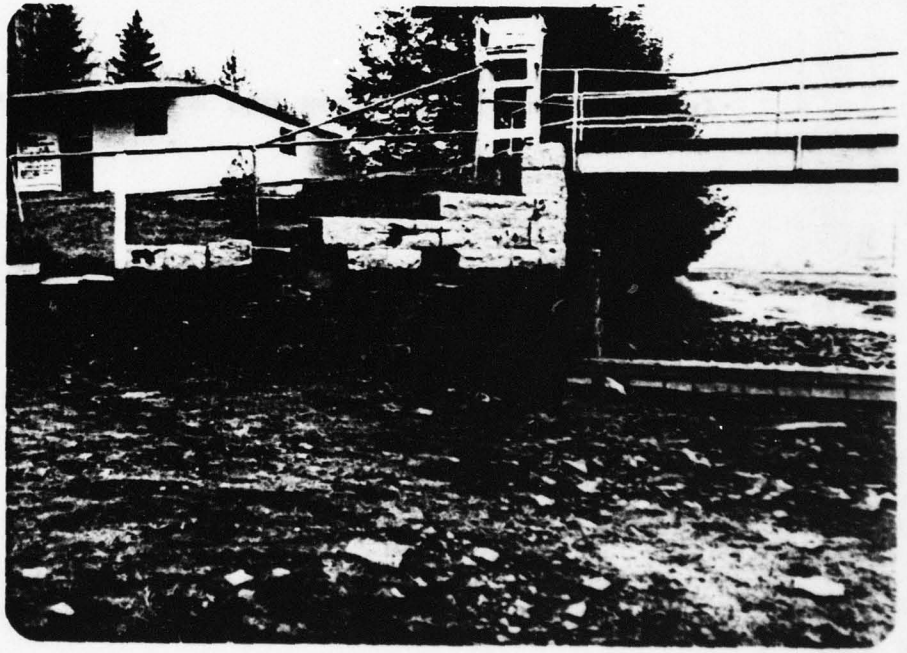


8

Photograph 9 View of the floodplain immediately downstream of the spillway. The bridge in the center of the photo is the first downstream obstruction.

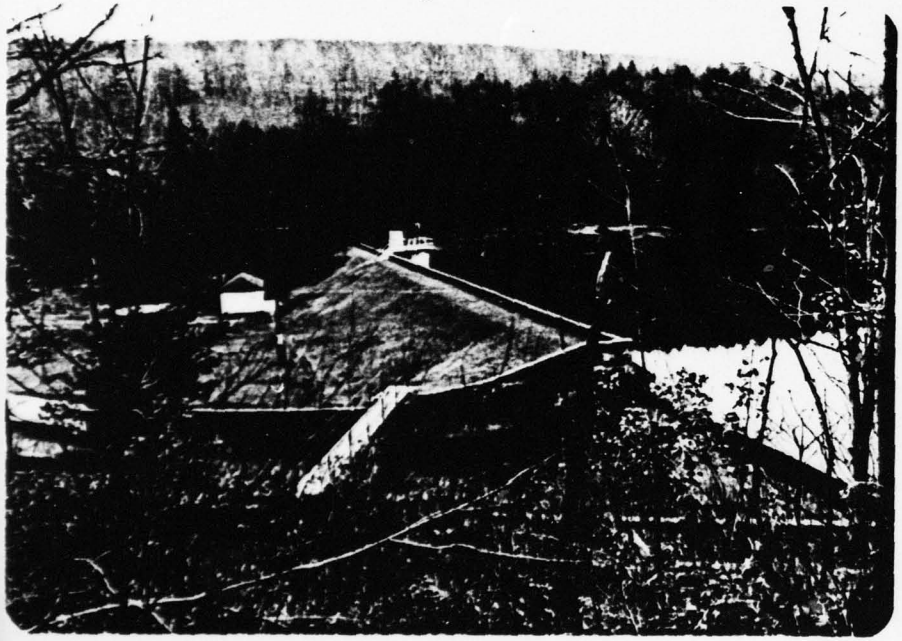
Photograph 10 View of the reservoir area as seen from the Recreation Dam spillway.

Photograph 11 Overview photo of Philipsburg Reservoir located approximately 4 miles upstream of Recreation Dam.

Photograph 12 View of a dilapidated dam located just downstream of the Philipsburg Reservoir. The dam still impounds a small amount of water.

9

10



11

12

APPENDIX E

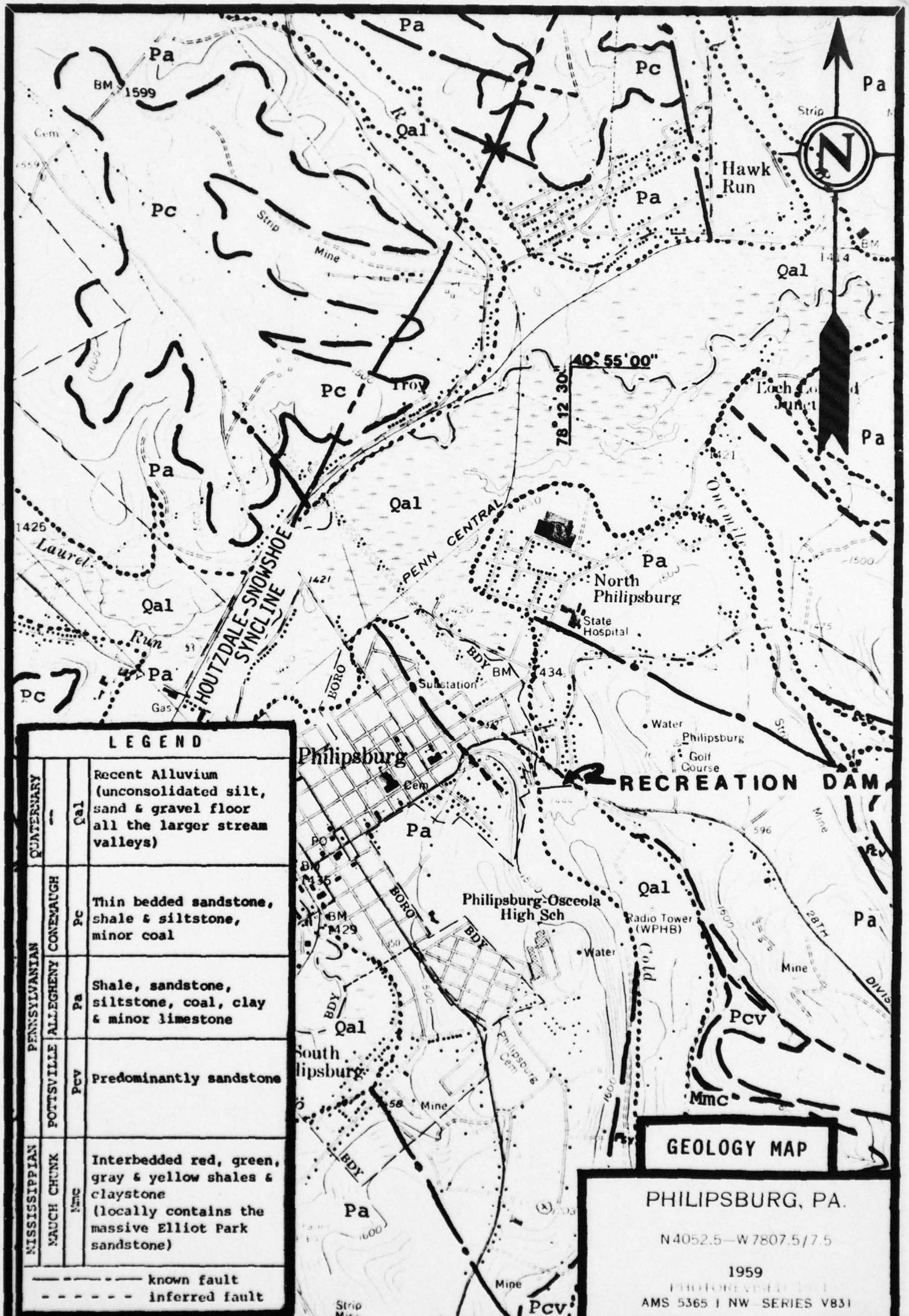
GEOLOGY

GEOLOGY

Recreation Dam is located on the southeast side of Philipsburg, Pennsylvania, within the Pittsburgh Plateaus section of the Appalachian Plateaus Province. This province is characterized as a high plateau underlain by nearly horizontal to gently folded sedimentary rocks. Strata in the Recreation Dam area dip to the northwest at approximately 220 feet per mile.

The dam is founded on recent alluvium of unknown thickness. Rock units underlying the dam and in the surrounding hilltops are of the Pennsylvania age, Clearfield Creek, and Millstone Run Formations. These units consist primarily of interbedded strata of shale, coal, siltstone, and sandstone. The coals within the Clearfield Creek Formation are locally known as the "Clarion" coals whereas those of the Millstone Run Formation are known as the "Lower Kittanning" coals.

Many of the first order tirbutary valleys of Moshannon Creek are oriented in a northwest-southeast direction. This orientation coincides with the direction of a systematic joint system in the Philipsburg area as well as with the strike of many wrench faults, suggesting some structural control from drainage patterns.


GEOLOGY MAP
PHILIPSBURG, PA.
N4052.5—W7807.5/7.5
1959
PHOTOREVISED
AMS 5365 I NW SERIES V831
LEGEND
QUATERNARY — Qal — Recent Alluvium (unconsolidated silt, sand & gravel floor all the larger stream valleys)
PENNSYLVANIAN CONEMAUGH — Pc — Thin bedded sandstone, shale & siltstone, minor coal
PENNSYLVANIAN ALLEGHENY — Pa — Shale, sandstone, siltstone, coal, clay & minor limestone
PENNSYLVANIAN POTTSVILLE — Pcv — Predominantly sandstone
MISSISSIPPIAN MAUCH CHUNK — Mmc — Interbedded red, green, gray & yellow shales & claystone (locally contains the massive Elliot Park sandstone)
known fault
inferred fault
HOUTZDALE-SNOWSHOE SYNCLINE
RECREATION DAM
PENN CENTRAL
40°55'00"
78°12'30"
N
Hawk Run
North Philipsburg
State Hospital
Philipsburg
South Philipsburg
Philipsburg-Osceola High Sch
Radio Tower (WPHB)
Philipsburg Golf Course
Substation
Troy
Laurel Run
Cold
Pa
Pc
Qal
Pcv
Mmc
BM 1599
Strip Mine
BORO BDY

APPENDIX F

FIGURES

LIST OF FIGURES

Figure	Description/Title
1	General Plan (Field Sketch)
2	Proposed Spillway (Revisions dated 1/28/37)
3	Plan Showing Proposed Gateway, dated October 7, 1961

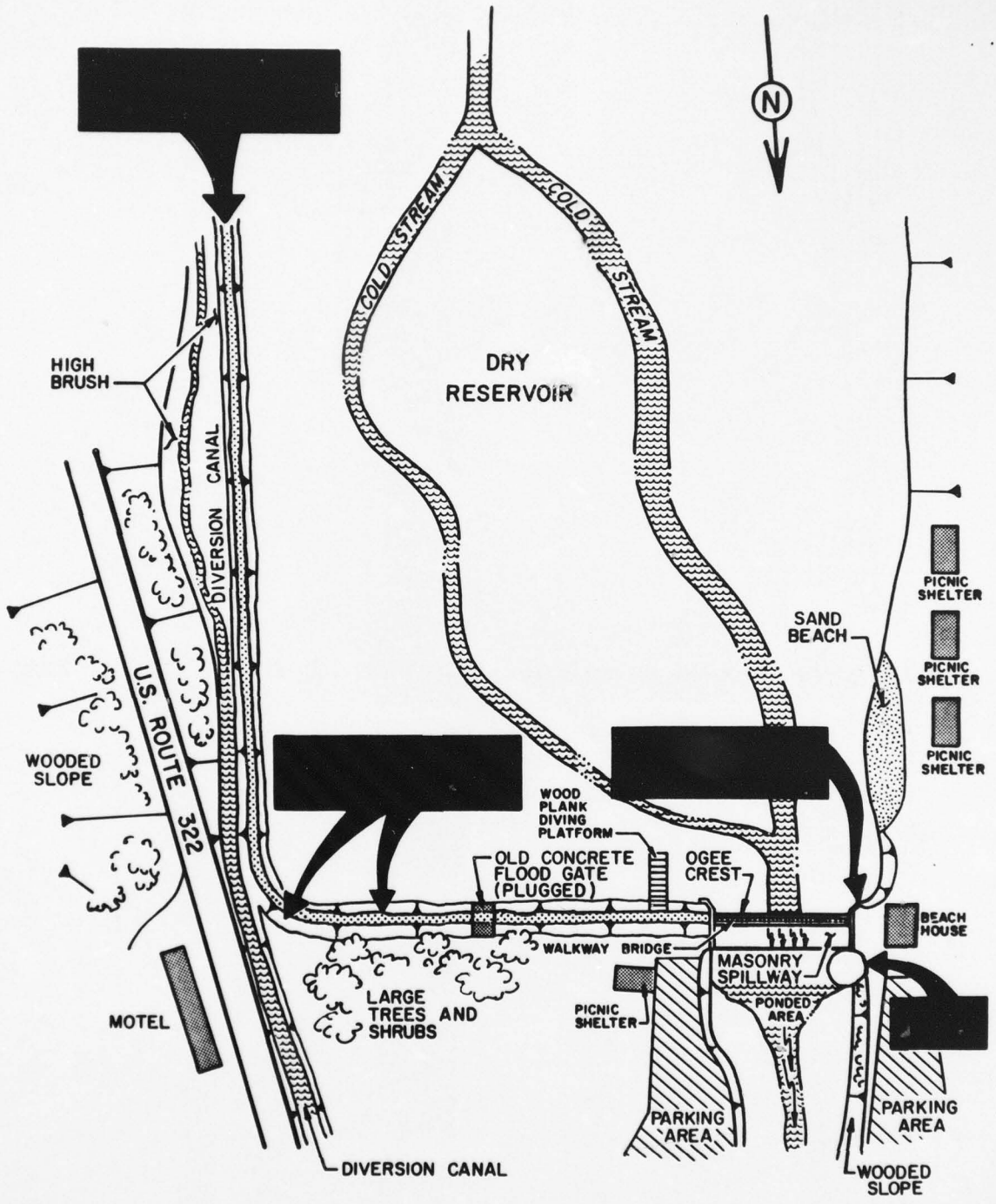
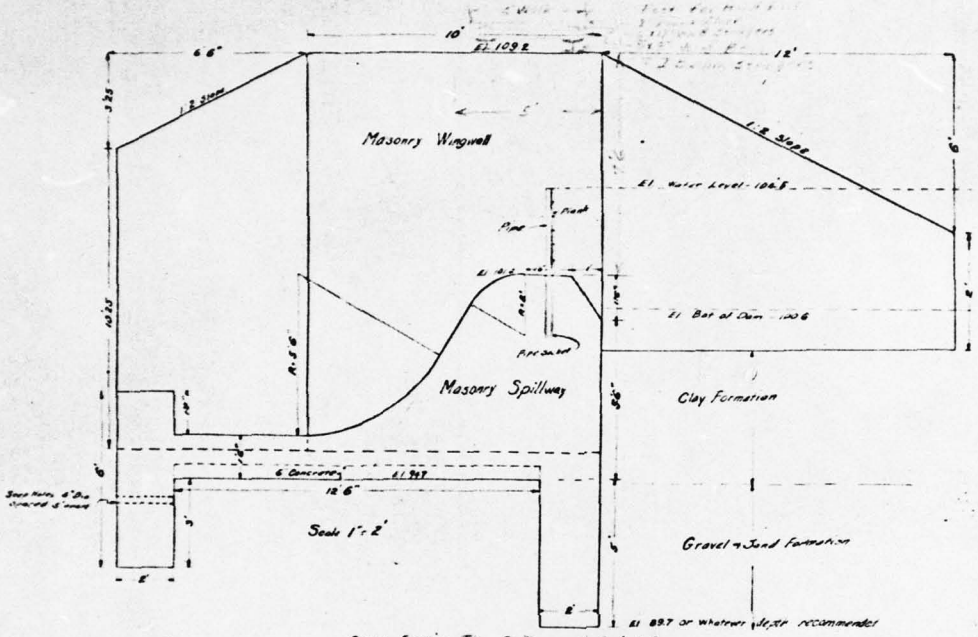
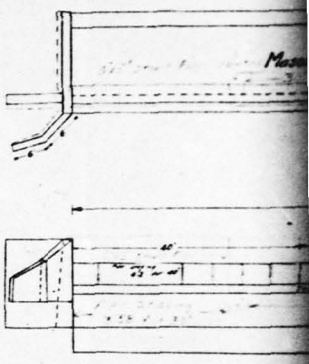
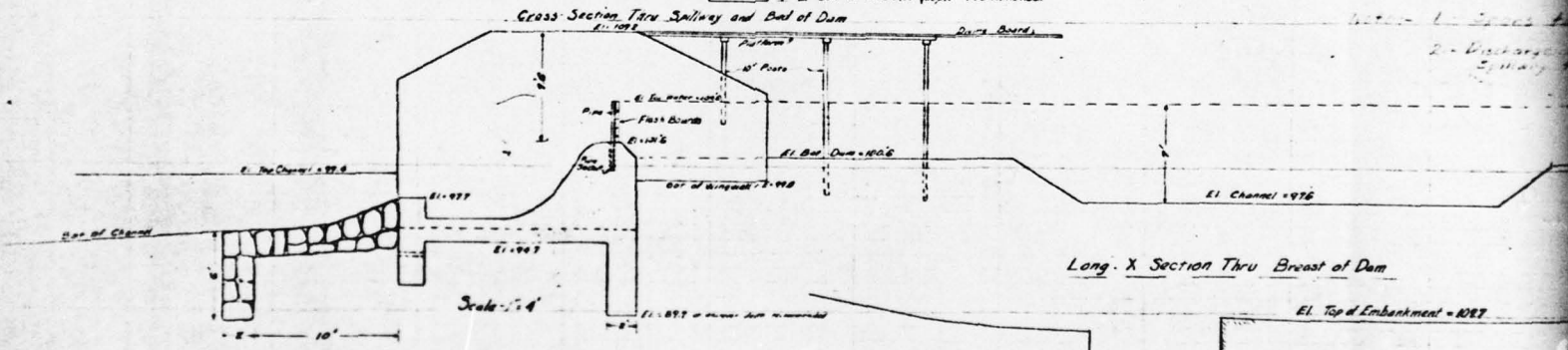


FIGURE 1 - RECREATION DAM
GENERAL PLAN
FIELD INSPECTION NOTES

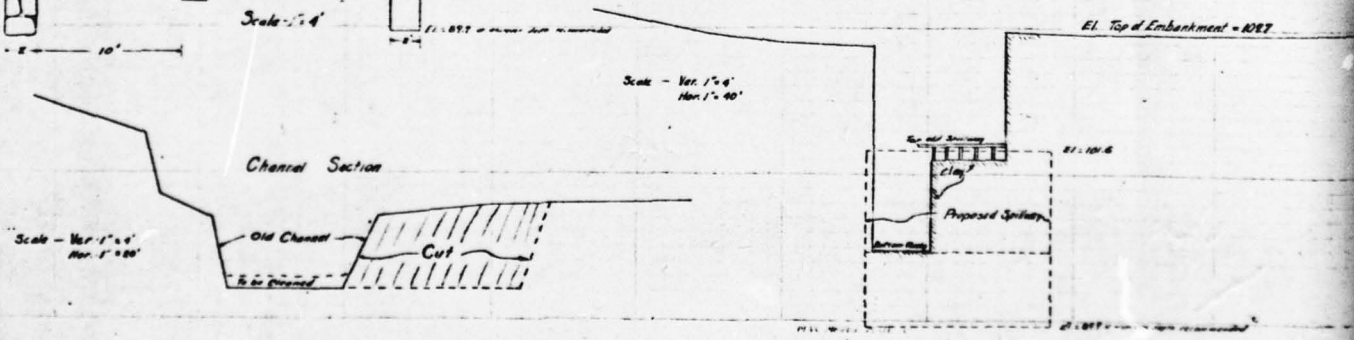




Cross Section Thru Spillway and Bed of Dam

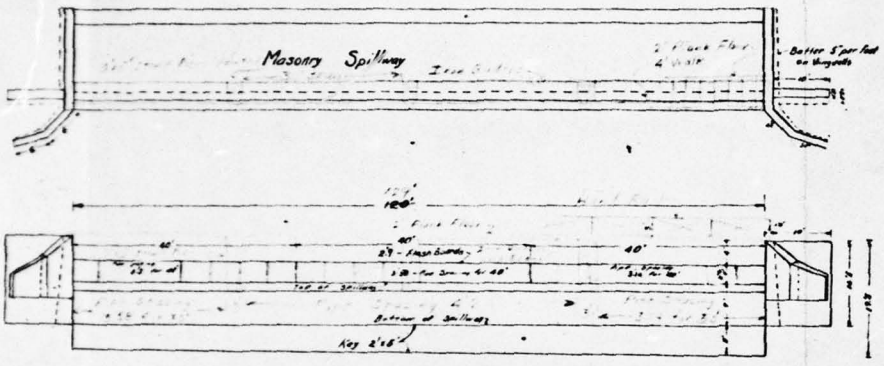


Long. X Section Thru Breast of Dam

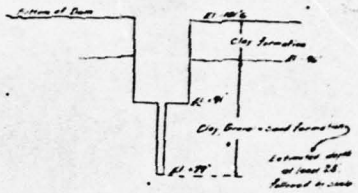


Revised Plan #1 Submitted 1/28/37.

West Wall to be constructed over Spillway.
Portion shown in Yellow to be added to plans.



Sketch Added



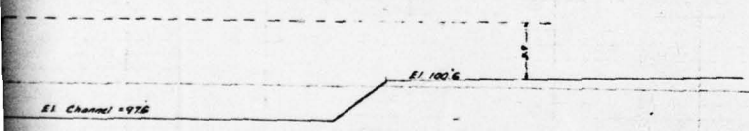
"COPY."

This print is a copy of plan filed on Nov 27, 1935 with Supervisor of Allegheny Borough for permit to construct a new spillway on dam across Cold Stream in Pond Township, Centre County and is the plan referred to on condition #2 of permit #14-26 issued May 29, 1936.

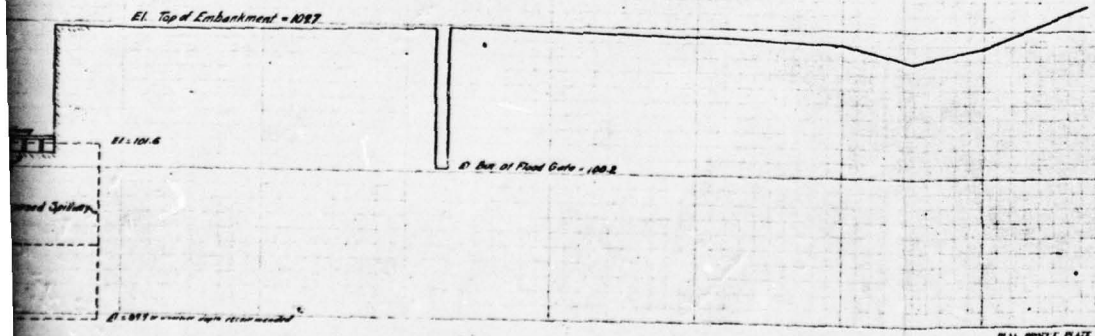
W E Hackenberg
Acting Secretary

Notch 1' Square to be 3' between Crest Piers

2 - Discharge down to be 7' from top of Crest Spillway to bottom of Iron Girders.



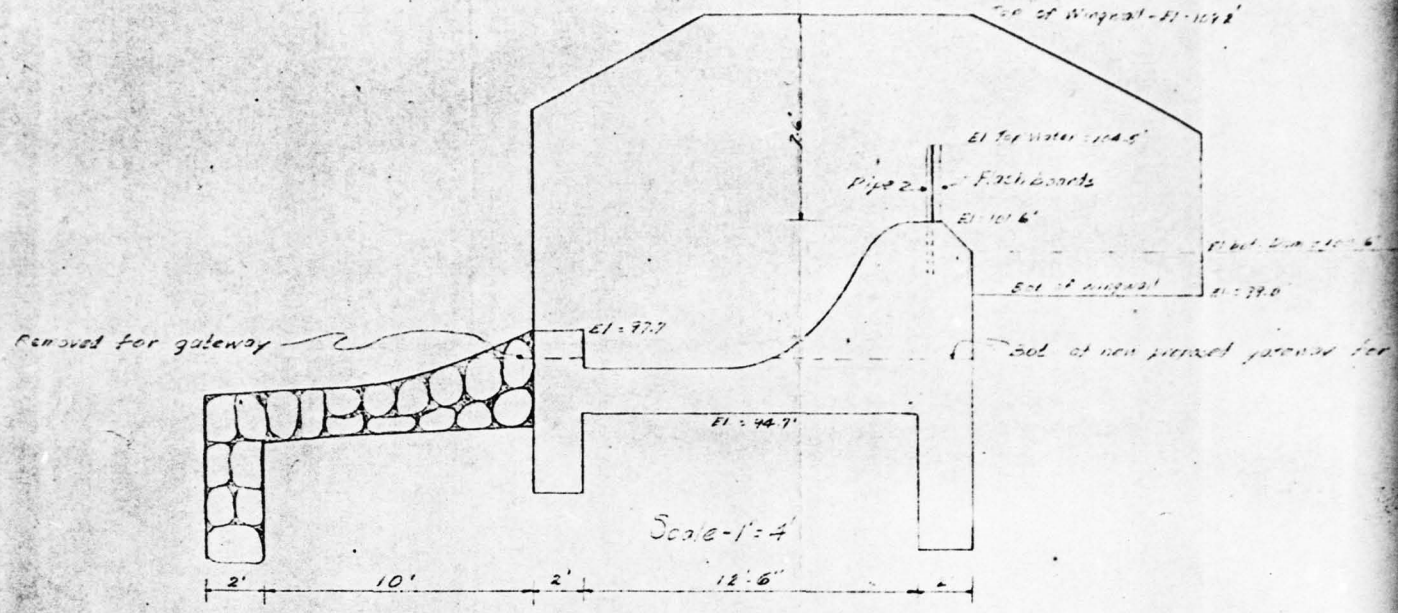
Section Thru Breast of Dam



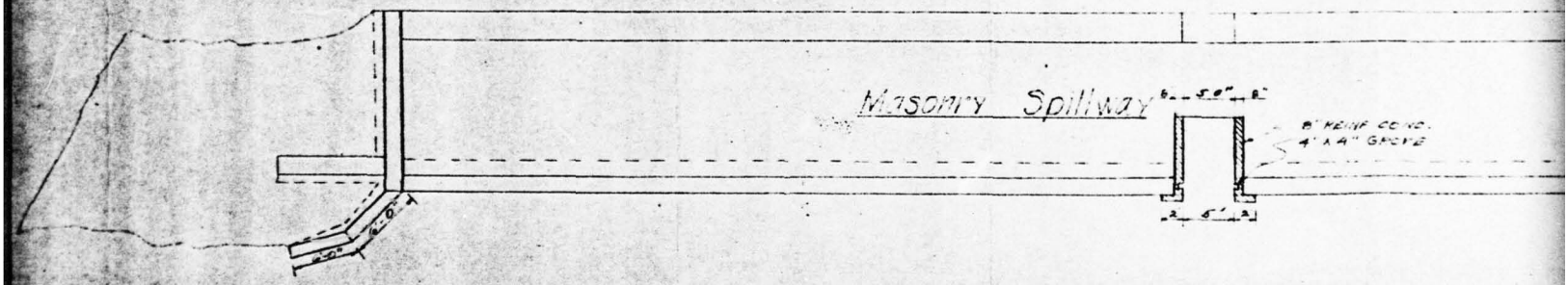
PROPOSED SPILLWAY
AT
COLD STREAM DAM
PHILIPSBURG, PA. ENG. DWG.

FIGURE 2

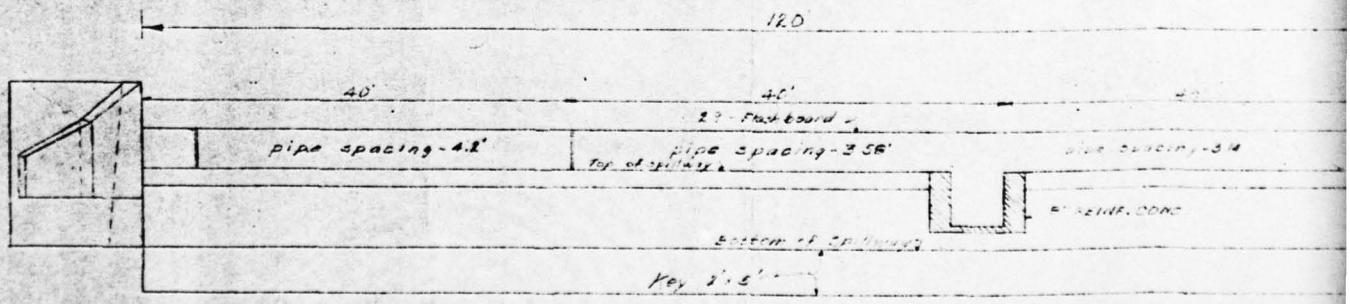
2.



END VIEW

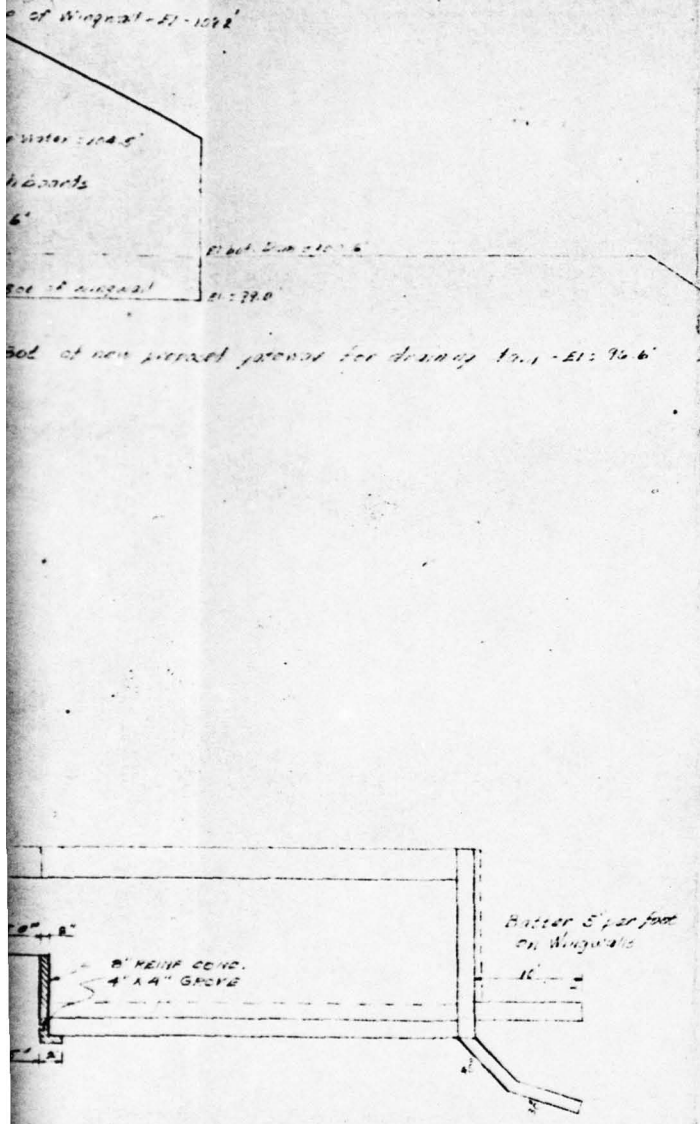


HORIZONTAL VIEW SHOWING PROPOSED GATEWAY



Scale 1" 10'

FRONT VIEW OF SPILLWAY SHOWING PROPOSED GATEWAY



DUPLICATE

14-26-9
FILE NUMBER

RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD OF THE DEPARTMENT OF FORESTS & WATERS ON THIS 1st DAY OF Dec. A.D. 1961
File Clerk

REC'D _____ FOR _____
SEE REPORT NO. _____
Div. Dams

PLANS SHOWING
PROPOSED GATEWAY
COLD STREAM DAM
PHILIPSBURG, PENNA.
Scale 1"=10' - October 9, 1961
John M. Williams, PE. 4566

FIGURE 3

2

APPENDIX G

REGIONAL VICINITY
AND
WATERSHED BOUNDARY MAPS

REGIONAL VICINITY MAP

PHILIPSBURG, PA.

N4052.5—W7807.5/7.5

1959

PHOTOREVISED 1971

AMS 5365 I NW SERIES V831

WATERSHED BOUNDARY MAP

ATERSHED BOUNDARY MAP

2.

135