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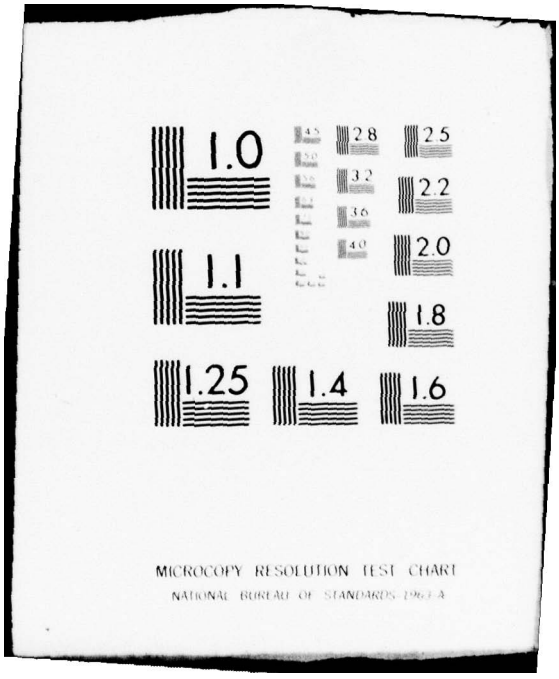
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National Dam Inspection Program. Hutchinson Reservoir Dam Number 1 (NDI-PA-214), Ohio River Basin, Redstone Creek, Fayette County, Pennsylvania. Phase I Inspection Report.

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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 such as the one encountered at Hutchinson Reservoir Dam No. 1 where the reservoir was lower than the spillway crest (normal pool) at the time of inspection, certain conditions may be obscured 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 inspection 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

Hutchinson Reservoir Dam No. 1: NDS I.D. No. PA-00214

Owner:	Western Pennsylvania Water Company
State Located:	Pennsylvania (PennDER I.D. No. 26-13)
County Located:	Fayette County
Stream:	Redstone Creek
Inspection Date(s):	6 October 1978
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

The visual inspection, operational history and hydrologic/hydraulic analysis indicate the facility is in poor condition. Apparent rotation of the outlet riser structure, uneveness of the upstream face and a sinkhole in the crest suggest possible internal piping problems which are possibly active under normal or high pool conditions. Records of past performance show numerous problems related to seepage both under and through the embankment during its 91 year life span.

Based on recommended guidelines, it has been determined that the Spillway Design Flood (SDF) for this facility is the Probable Maximum Flood (PMF). Hydrologic and hydraulic calculations indicate that the reservoir and existing spillway system will pass only 33 percent of the (PMF) before overtopping occurs. Under 1/2 PMF conditions, it has also been determined that the embankment will be overtopped leading to failure and a significant increase in the hazard to loss of life downstream. As the hazard rating is "high" the present spillway condition is assessed as being "seriously inadequate."

The inadequacies of the spillway and evidence of possible internal piping are deficiencies of such a nature that if left uncorrected could result in the failure of the dam with subsequent increase in the potential for loss of life and/or substantial property damage. Thus, the facility is considered unsafe. Failure does not appear imminent, under the

conditions which existed at the time of inspection; however, a detailed emergency operation plan and warning system should be immediately activated which includes around-the-clock surveillance during periods of unusually heavy precipitation by a registered professional engineer experienced in the design and performance evaluation of earth structures.

It is recommended that the owner:

1. Perform a detailed hydrologic and hydraulic evaluation of the facility including an assessment of downstream effects if the facility is breached or removed from the system that includes Hutchinson Reservoir Dams Nos. 1, 2 and 3.

2. Perform a detailed subsurface evaluation to determine the cause of sinkhole development in the crest and the in-situ properties of the embankment materials.

3. Perform a stability and seepage evaluation of the embankment under all possible operating conditions utilizing the results of Item 2 above.

4. Determine the extent of apparent structural distress in the outlet structure.

5. Take appropriate remedial actions based on results of the above analyses.

6. Immediately activate a plan for emergency operation and a warning system for downstream residents. Included in the plan should be provisions for around-the-clock surveillance of the facility by a professional engineer experienced in the design and performance evaluation of earth structures during periods of unusually heavy precipitation.

7. Inspect the facility on a daily basis to determine if the sinkhole development in the crest is an active process requiring immediate remedial action. Particular attention should be given to the seepage at the outlet conduit and the apparent seepage near the toe of the left abutment. This area should also be cleared of all brush and debris to facilitate inspection.

8. Monitor apparent movements of the outlet structure.

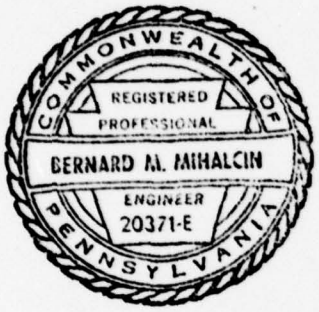
BMM/jh

GAI Consultants, Inc.

Bernard M. Mihalcin, P.E.

Approved by:

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



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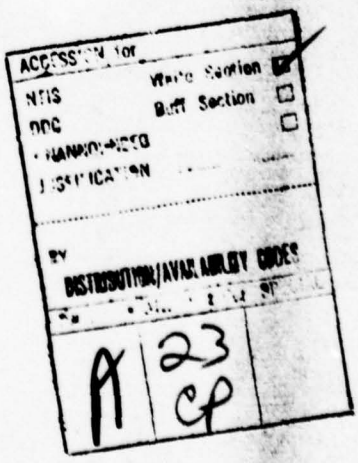

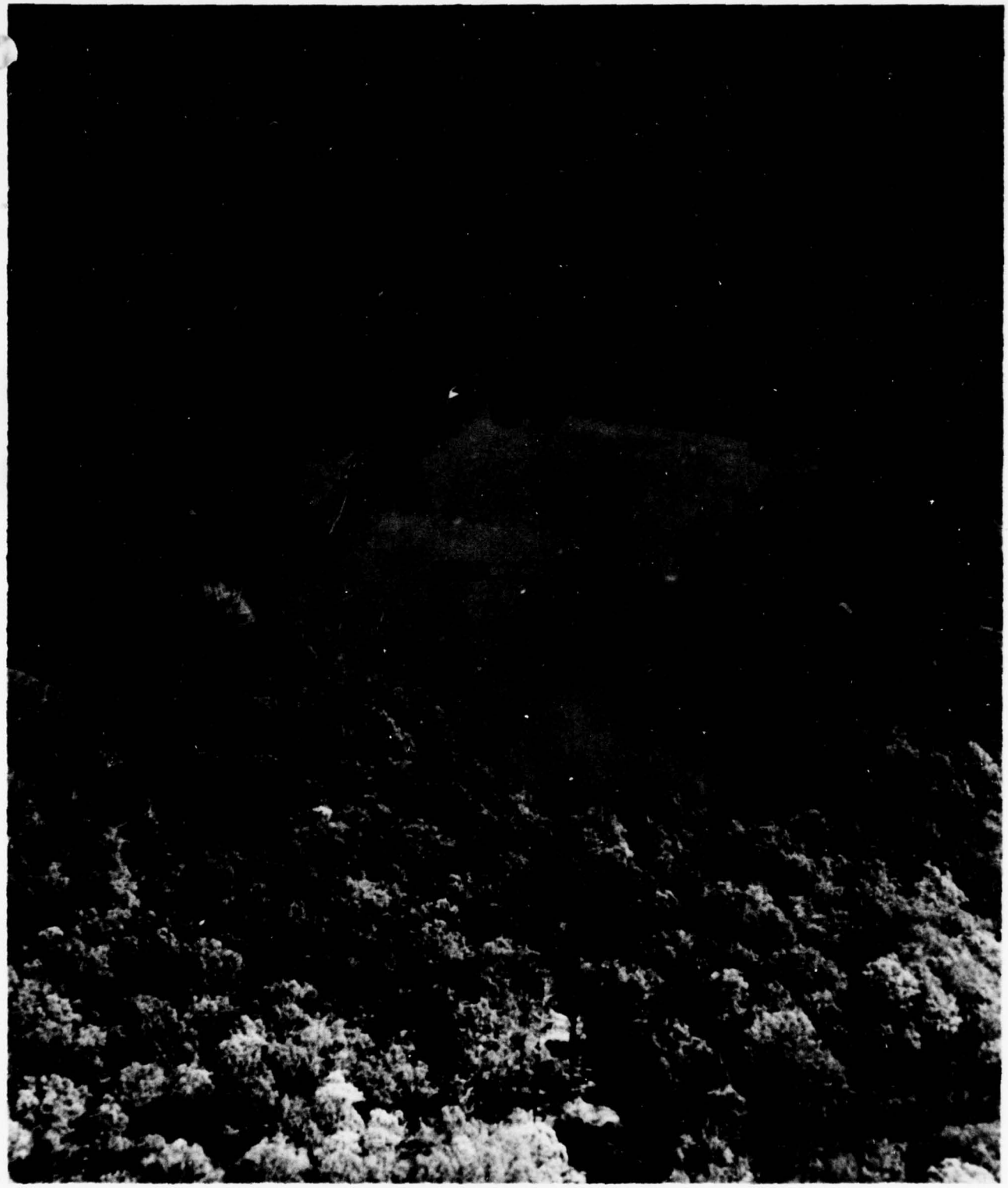

Overview Photograph of Hutchinson Reservoirs Nos. 1, 2, and 3

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
HUTCHINSON RESERVOIR DAM NO. 1
NDI# PA-214, PENNDER# 26-13

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. Hutchinson Reservoir Dam No. 1 is an earth embankment (with an upstream concrete face) approximately 308 feet in length and with a maximum height of 33 feet. The embankment reportedly is provided with a 2-foot thick clay puddle core wall extending 14 feet below the original ground surface.

The facility is served by a rectangular concrete overflow spillway with a multiple vertical drop concrete discharge channel along the right abutment. A 20-inch diameter cast-iron pipe passing through the embankment serves as a supply line. Reservoir drawdown control is provided by a 14-inch diameter cast-iron blowoff conduit which parallels the 20-inch supply line. The blowoff conduit is valved on the upstream side within a concrete intake tower (referred to as a vault by the owner's personnel).

At the upstream end of the reservoir is a sedimentation basin and miscellaneous appurtenances which can direct flow (via flash boards) into Reservoir No. 1 and/or into an earth and masonry raceway which can carry part of the inflow around the reservoir.

b. Location. Hutchinson Reservoir Dam No. 1 is located along Redstone Creek in South Union Township, Fayette County, Pennsylvania. The community of Hopwood, Pennsylvania lies immediately downstream while the city of Uniontown is located to the north approximately three miles downstream of

the site. The dam, reservoir and watershed are contained within the Brownfield, Pennsylvania, U.S.G.S. 7.5 minute topographic quadrangle (see Appendix G). The coordinates of the dam are N39° 51.3' and W79° 42.4'.

c. Size Classification. Small (33 feet high, 56 acre-feet storage capacity at top of dam).

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

e. Ownership. Western Pennsylvania Water Company
Uniontown District
72 Coolspring Street
Uniontown, Pennsylvania 15401

f. Purpose. Domestic water supply.

g. Historical Data. This historical account of Hutchinson Reservoir Dam No. 1 is based on sketchy and incomplete state inspection reports available from PennDER files. The best documentation is from the early period, spanning the years 1914 through 1919. The decade of the 1920's is represented by seven inspection reports. Between 1930 and 1950, there are only five reports. From 1950 to present, there is only one cursory report available which was written in 1961.

Based on the above data, Hutchinson Reservoir Dam No. 1 was constructed in 1887 to serve as a water supply reservoir for the city of Uniontown, Pennsylvania. The first reported inspection of the facility was conducted by the Water Supply Commission of Pennsylvania on September 19, 1914. The initial inspection revealed seepage at the toe of the dam near the left abutment and adjacent to the outlet pipe at the toe of the dam. The spillway was also deemed seriously inadequate. Consequently, the water company was directed to enlarge the spillway from a design capacity of 400 cfs to 1170 cfs and to install a weir or weirs to measure the observed seepage. In 1915, the water company responded by modifying the facility which increased the spillway capacity to 990 cfs, but still less than the commission's request.

Inspection reports from 1919 to 1941 recount numerous occurrences of leakage and remedial work, the most pertinent of which are discussed below.

In 1919, a small leak through the embankment appeared near the spillway. This was repaired by backfilling a portion of the clay puddle core. In 1921, a leak developed through the puddle core wall beneath the spillway. This was repaired by excavating the fill materials from beneath the spillway and replacing the clay puddle core wall with a two-foot thick concrete wall, anchored in rock and extending

from the right abutment to the left side of the spillway. At this time, continued seepage was observed at the toe of the dam on the left abutment and at the outlet pipe. Seepage on the left abutment was investigated around 1921-1922 when two borings were drilled from the top of the dam and extended 50 feet below the crest elevation. Subsequent grouting of these holes failed to reduce the flow.

In the spring of 1928, a leak developed near the top of the embankment. A trench was dug on the crest behind the upstream paving to the top of the timber sheeting, which supports the clay puddle core. An effective repair was made by replacing the timber sheeting to a depth of approximately one foot below spillway crest elevation. About the same time this work was in progress, two test pits were dug downstream from the toe of the dam to determine the location of the rock foundation with the idea that at some future date a cutoff wall might be constructed along the upstream toe of the dam. Rock was located in these pits at a depth of 18 feet below the natural ground surface. The 1929 and 1930 inspection reports reiterate the problems of seepage on the left abutment and from around the outlet pipe.

In the fall of 1930, the clay puddle core wall between the vault (see Figure 2) and the spillway was opened to a depth of 20 feet in an effort to stop seepage through the embankment near the left side of the spillway channel.

As a result of the 1933 inspection, the Water and Power Resources Board instructed the owner to raise the embankment on both sides of the spillway as this area was a foot lower than the normal embankment crest elevation. The Board also requested that cracks in the spillway abutment walls be filled with mortar or gunite to prevent saturation of the embankment. In 1934, the reservoir was drained and "work was in progress drilling and grouting the foundation, and tamping clay into the embankment." The work of raising the embankment in compliance with the Board's request was also performed at this time. The 1935 inspection report indicates that repair work on the structure was satisfactorily completed and that most of the leakage had been stopped, although a "sizeable stream" was observed to flow at the outlet pipe.

In 1941, it was determined that seepage from around the outlet pipe was increasing, however, no additional records regarding the outcome of this matter are available. The most recent cursory report, dated July 19, 1961, indicates that no leakage was observed, the general appearance is good and that no maintenance is required.

In 1973, or thereabouts, modifications of the intake structure were made. Specific details regarding these modifications were not made available for review during the

inspection, however, water company officials did say that the screen and screen cleaning mechanism were added to the inlet side of the vault at this time. Furthermore, water company officials indicated that modifications are continually being made to the water treatment facility in an effort to improve service.

1.3 Pertinent Data.

The elevations listed below are based on a recent datum (spillway crest = 1291.8 feet) provided by the owner.

a. Drainage Area. Local ≈ 0.43 sq. miles (Dam No. 1 only)
Total ≈ 2.42 sq. miles (Dams 1,2, and 3, inclusive)

b. Discharge at Dam Site. Discharge records are not available. The owner's representative could not recall with any certainty the maximum spillway discharge to date.

c. Elevation (feet above mean sea level).

Top of Dam ≈ 1294.3 (low point on embankment).

Maximum Design Pool - Not known.

Maximum Pool of Record - Not known.

Normal Pool ≈ 1291.8.

Emergency Spillway Crest ≈ 1291.8.

Upstream Portal Outlet Invert ≈ 1269 (Rough Estimate).

Downstream Portal Outlet Invert ≈ 1261 (Rough Estimate).

Streambed at Dam Centerline ≈ 1270.

Maximum Tailwater - Not known.

d. Reservoir Length (miles).

Maximum Pool ≈ 0.2 (elevation 1294.3).

Normal Pool ≈ 0.2 (elevation 1291.8).

e. Storage (Acre-feet).

Emergency Spillway ≈ 46 (elevation 1291.8).

Top of Dam ≈ 56 (elevation 1294.3).

Design Surcharge - Not known.

f. Reservoir Surface (Acres).

Normal Pool ≈ 4 (elevation 1291.8).

Top of Dam ≈ 5 (elevation 1294.3).

Maximum Design Pool - Not known.

g. Dam.

Type - Earth embankment with a clay puddle core and upstream concrete facing.

Length ≈ 308 feet.

Height ≈ 33 feet (outlet invert to crest).

Side Slopes - Upstream: 1H:1V (exposed freeboard zone field measured).
Downstream: 1.5 H:1V (crest to toe, field measured).

Zoning - None indicated.

Impervious Core - Drawings indicate that the dam is provided with a 2-foot thick clay puddle core wall confined with one-inch thick oak plank. The puddle extends 14 feet below the original ground surface along the centerline section to the top of the dam (see Figure 2).

Cutoff - The puddle core trench serves as the only embankment cutoff. (A 2-foot thick concrete core wall anchored in rock was installed in 1921 to provide cutoff beneath the spillway section.)

Grout Curtain - None indicated, however, historical records imply some remedial grouting was done.

h. Diversion and Regulating Tunnels. None.

i. Spillway.

Type - Uncontrolled concrete rectangular overflow with a multiple vertical drop concrete discharge channel located on the right abutment.

Crest Elevation - 1291.8.

Crest Length - 42 feet (field measured).

j. Outlet Conduits.

1. Supply Pipe - 20-inch diameter, cast-iron; length ≈ 110 feet (vault to downstream valve).

Closure - Gate valves in upstream vault and near downstream toe adjacent to water treatment building.

2. Blowoff Pipe - 14-inch diameter, cast-iron; length ≈ 110 feet (vault to outlet).

Closure - Gate valve in vault and on upstream extension in small sedimentation basin.

Regulating Facilities - The vault (control tower) is located on the upstream face and contains three gates and/or valves for regulating discharge.

Access - Access to the vault is from the crest of the dam. Other valves are at ground level.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No design reports are available for any aspects of this facility. Design features, presented below, are derived from two drawings (see Page 1 of 5, Appendix A), available state inspection reports, and discussions with the owner's representatives during the inspection.

b. Design Features.

1. Embankment. Available drawings indicate that the embankment is constructed of earth; however, placement and compaction procedures are unknown. A drawing issued in 1914 (see Figure 2) shows the original configuration. A second drawing issued in 1915 presents typical cross sections and an embankment profile for raising the embankment approximately four feet to increase spillway capacity.

The earliest descriptive report pertaining to the facility was made by the Water Supply Commission of Pennsylvania on September 19, 1914. This report was prepared 27 years following construction and contains data relative to the pertinent dimensions of the original facility. The following excerpt is from this report and presumably describes the condition of the embankment in 1914.

"This dam is an earth embankment with a clay puddle core wall. It is 300 feet long and has a maximum height of 25 feet. The top of the embankment has a width of about 30 feet with a slope of 4 feet in it away from the reservoir. The downstream face has a slope of 1 vertical on 2 horizontal. The upstream face has a slope of 1 on 1-1/2 and is lined with concrete. The clay puddle core wall is in the upstream portion of the embankment. It is 2 feet thick and extends into the foundation to a depth of 14 feet below the original surface of the ground. According to the plan of the reservior, this wall, for its full height, has 1 inch oak planks on both sides of it."

2. Appurtentant Structures.

a) Outlet Structure and Conduits. The outlet structure (known as a vault) is a rectangular, masonry unit which houses valve mechanisms and a filtration device for the potable water supply. The unit is located to the right of dam center and on the upstream side of the crest

(see Photographs 9 and 10). Winch and pulley assemblies located atop the structure are parts of the screen cleaning and filtration apparatus. A 20-inch diameter cast-iron supply pipe passes from the vault on the upstream side through the embankment to the water treatment building at the downstream toe of the dam. Flow is indirectly regulated at the upstream inlet by a 20-inch diameter gate valve controlling flow into the vault. Just downstream of the water treatment building a 20-inch diameter gate valve is used to control flow to the supply system. Below the downstream gate valve, the 20-inch diameter cast-iron supply pipe extends down the creek channel several hundred feet to a distribution box.

Modifications of the outlet system were made around 1973. Specific details regarding these modifications were not made available for review; however, water company officials did indicate that the screen and manual screen cleaning device (a wire broom) were installed at the 20-inch pipe discharging into the vault.

b) Blowoff. A 14-inch diameter cast-iron pipe passes beneath the entire length of Hutchinson Reservoir No. 1. The valved inlet to this pipe is located in the sedimentation pond at the extreme upstream edge of the reservoir. The pipe passes beneath the reservoir, adjacent to the vault and through the embankment. This line is connected to the vault via a "T" coupling and valve. Blowoff and drawdown can be regulated by the gate valve in the vault. The outlet of the 14-inch diameter blowoff is located immediately downstream of the embankment, adjacent the water treatment building (see Photograph 11).

c) Emergency Spillway. The emergency spillway at this facility is a rectangular concrete chute which discharges into a 4-tiered concrete spillway channel located on the right abutment. At the control section, the concrete channel is approximately 42 feet in width. The length of the control section is approximately 30 feet whereas the total channel length from the inlet to the plunge pool is about 55 feet. Discharge from the spillway enters a plunge pool protected on the right by a sandstone outcropping and on the left by a sandstone block retaining wall.

c. Design Data and Procedures. No design data are available for any aspect of this facility.

2.2 Construction Records.

No construction records are available.

2.3 Operating Records.

No operational records are available.

2.4 Other Investigations.

It is our understanding that the owner has retained the services of a consulting engineer to make a detailed hydraulic and hydrologic evaluation of all three Hutchinson facilities. The owner refused to provide the inspection team with a copy of the consultant's report.

2.5 Evaluation.

No formal engineering data are available; however, sufficient information in the form of drawings and historical records are available which indicate the facility was constructed around 1887 and is of antiquated design.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. Based on the visual inspection, the structure is considered to be in poor condition. Observations noted during the inspection indicate numerous deficiencies exist at the facility which require immediate maintenance, repair and investigation.

b. Embankment. The general appearance of the embankment suggests that it is in poor condition. Poor horizontal alignment, sinkholes on the crest and on the right abutment, visible movement of the upper portion of the vault and a history of chronic seepage problems raise doubts as to the structural integrity of the embankment. A sinkhole on the crest measuring three feet in depth suggests internal erosion of embankment materials (see Figure 1 and Photograph 4) and movement of the upper portion of the vault (Photograph 10) suggests differential movements within the embankment.

Considerable seepage and ponding was observed in the channel adjacent to the treatment building at the downstream toe of the embankment (see Photograph 11). This area of seepage has been observed for many years.

A sharply defined seepage channel also exists below the dam on the left abutment, however, no free flowing water was observed at the time of the inspection. Seepage observations may not be conclusive as the reservoir was drawn down approximately 3.6 feet below normal pool (spillway crest) at the time of the inspection.

The downstream slope of Hutchinson Reservoir Dam No. 1 is seeded in part by crown vetch. The left half of the slope is partially covered with grass, weeds, and shrubbery. The crest of the embankment is protected with a well established grass cover. The upstream slope of the embankment is lined with concrete. Although numerous horizontal and vertical cracks are apparent, the observed portion of the lining above the water line appears to be intact.

c. Appurtenant Structures.

1. Outlet Structure and Conduits. As indicated in Photograph 10, the outlet structure has apparently rotated and cracked from differential movements in the upstream slope of the embankment. Valve stems and miscellaneous mechanical devices atop the structure are well

maintained and, according to the owner's representative, reportedly are functional. All pipes and valves are submerged and not visible.

2. Spillway. Visual inspection found the spillway to be in fair condition. The flow surface (see Photograph 5) is good throughout, however, the sidewalls are deteriorated, exhibiting many cracks. The sandstone block retaining wall at the bottom left of the spillway channel is in good condition.

d. Reservoir. The slopes surrounding the reservoir are heavily wooded and steep with no apparent signs of slope distress. Sedimentation, observed due to the subnormal pool level, does not appear significant (see Photograph 7).

e. Downstream Channel. Hutchinson Reservoirs Nos. 1, 2 and 3 occur in tandem within the Redstone Creek valley. As shown on the Overview Photograph, Reservoir No. 1 is the lowermost of the three Hutchinson reservoirs (see Regional Vicinity Map, Appendix G). All three of the structures are located just upstream of the communities of Hutchinson and Hopwood, each having many residences and apartment buildings on the Redstone Creek floodplain (see Photograph 13).

The total number of residences which could be affected by a breach of Hutchinson Reservoir Dam No. 1 exceeds 20.

Because of the above mentioned considerations, the facility was given a "high" hazard rating.

3.2 Evaluation.

Observations made during the visual inspection suggest that the overall condition of the facility is poor. This conclusion is based on a variety of deficiencies that include: 1) evidence of movement of the upper portion of the vault; 2) ponding and seepage at the downstream toe of the facility; 3) a sinkhole on the crest of the embankment; and 4) poor horizontal alignment of the crest.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

According to the owner's representatives, there are no formal operating procedures detailed in manual form that pertain to the operation of this facility. Discharge to the supply system can be regulated below the water treatment building by the 20-inch diameter gate valve. Flow into the vault is controlled by a 20-inch diameter gate valve on the inlet side of the vault. The inlet to this pipe is covered with a fine mesh wire screen. On top of the vault, a pulley device manually operates a wire broom which clears debris from the face of the screen. The 20-inch diameter supply line passing through the embankment is also covered with a fine wire mesh screen on the inlet end within the vault. In addition to the screen, a wooden box over the screen is periodically filled with excelsior to provide additional filtration.

Drawdown is controlled by operating the 14-inch diameter gate valve on the 14-inch diameter cast-iron pipe passing beneath the reservoir and embankment. Water entering the vault can be diverted into the 14-inch diameter line for complete reservoir drawdown. The outlet of the blowoff conduit is located adjacent to the water treatment building at the downstream toe of the dam. The valves are operated by the resident dam tender upon orders of water company officials.

4.2 Maintenance of Dam.

There are no formal maintenance procedures at the dam. General maintenance is provided by the resident dam tender on an unscheduled basis.

4.3 Maintenance of Operating Facilities.

Other than occasionally operating the gate valves, no regular maintenance is performed on the operating mechanisms.

4.4 Warning Systems.

There are no formal warning systems in effect at this facility. The water company has authored a publication entitled, "Emergency Plan to Maintain Safe Potable Water Delivery to Consumers of WPWCO." The plan includes a listing

of local radio stations, police and fire, etc. The plan itself makes no provisions for a flood emergency warning system, but could easily be modified to include one. Currently, the resident dam tender is charged with the responsibility of informing the proper authorities in the event of an emergency.

4.5 Evaluation.

The facility is operated by a resident dam tender although no formal operations and maintenance manuals are available. There is no formal warning system in effect to protect downstream residents in the event of an emergency; however, the written emergency plan for safe water supply could be adapted for such use.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No original design data are available. The water company has reportedly retained a consulting engineer to investigate the hydraulic adequacy of the structure. Details of this investigation were not made available to the inspection team.

5.2 Experience Data.

No records of discharge data are available at the facility.

5.3 Visual Observations.

On the date of inspection, no conditions were observed that would indicate that the outlet pipe and spillway would not operate satisfactorily within the limits of their design during a flood event.

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.

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. 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 estimates of the peak discharge, time of the peak discharge, and the maximum stage 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 follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.

d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevation(s) of the failure hydrograph(s) for each location.

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 SDF for this facility ranges between the 1/2 PMF (probable maximum flood) and the PMF based on the relative size (small) and hazard potential (high) of Hutchinson Reservoir Dam No. 1. Due to the extensive downstream hazard potential and the requirements of the upstream reservoirs, the SDF for this facility is considered to be the PMF.

b. Results. Although this report deals specifically with the analysis of Hutchinson Reservoir Dam No. 1, the effects of the upstream Reservoir Dams Nos. 2 and 3 were also considered since they presently control the inflows into Reservoir No. 1. The dams were investigated such that Reservoir No. 3 was initially empty (as has been the case since 1974), and Reservoirs Nos. 1 and 2 were initially at their normal pool or emergency spillway elevations (although at the time of inspection both reservoirs were partially drawn down). The effects of the existing raceways around Reservoirs Nos. 1 and 3 on inflows and outflows were taken into account via the discharge rating curves of the respective

dams (Appendix C, Sheets 10-13 of 17; and Appendix C-1, Sheets 14-15 of 15). Also, the actual estimated storage-elevation relationship of Reservoir No. 2 was modified in order to compensate for the discharge over the left bank of its dam into an adjacent watershed which occurs once the dam is overtopped (Appendix C-1, Sheets 24-29 of 29). All pertinent engineering calculations relative to the analysis of the Hutchinson Dams System are provided in Appendices C and C-1.

Overtopping Analysis (using the Modified HEC-1 Computer Program) of the dams in series indicated that the emergency spillway(s) of each dam could discharge only a small fraction of the PMF prior to overtopping. In particular, Dam No. 3 passed approximately 37 percent of the PMF before overtopping, Dam No. 2 passed about 27 percent of the PMF, and Dam No. 1 passed approximately 33 percent of the PMF (Appendix C, Summary Input/Output Sheets). Analyzed individually, the spillways of Dams Nos. 1 and 2 would be less adequate than stated above, since the effect of an upstream impoundment on a downstream reservoir is to attenuate the potential inflows into, and thus the outflows from the downstream reservoir. Therefore, if Dams Nos. 2 and 3 were ignored in the analysis or removed from the system, the overtopping of Dam No. 1 would occur at a lower percentage of the PMF than reported above. In either case, Dam No. 1, as well as Dams Nos. 2 and 3, has a high potential for overtopping, and thus for breaching, due to its structural condition (see Section 6 for the structural evaluation of Dam No. 1).

Since none of the three dam facilities of the system could safely pass at least a flood of 1/2 PMF magnitude (the SDF on each of the dams is the full PMF), the possibility of failure of each of the dams under 1/2 PMF conditions was investigated (in accordance with ETL-1110-2-234). It must, however, be understood that it is difficult, if not impossible, to determine exactly how or if a specific dam will fail. Therefore, several possible alternatives were investigated. Again, the dams were evaluated in series so as to ascertain the overall effect of the present system on the downstream population in the event of a severe storm.

The Modified HEC-1 Program was used to generate the possible results of dam breaching due to downcutting by the overtopping waters. Breaching due to piping could not be analyzed directly.

It was assumed, for the purpose of analysis, that breaching would begin once the reservoir water level reached the top of dam elevation of each of the dams. This assumption was based on the opinion that any amount of overtopping

can potentially fail an earth dam, since there are so many unknowns that can contribute to the failure process, and in the particular case of the Hutchinson dams, all are of questionable structural integrity. Breaching the dams at their respective top of dam elevations yields minimum downstream consequences due to failure under 1/2 PMF conditions since, the volumes of water behind the dams will be at a minimum when failure begins (if one assumes that a dam would not fail unless overtopped). However, failure of any of the dams could occur prior to overtopping due to the structural conditions of the dams. That is, failure of each of the dams due to piping under higher than normal heads is a possibility. Dams Nos. 2 and 3 have concrete core walls which may be considered to add to the overall stability of the dams when overtopped. Dam No. 2 is, however, visibly misaligned and replete with structural irregularities and a history of seepage problems. All of these deficiencies suggest that the integrity of the present corewall at Dam No. 2 is questionable. Similarly Dam No. 3 is beset by problems the extent of which have prompted the owner to maintain the reservoir drained indefinitely until further studies of its present structural integrity can be completed. An additional overall assumption was that the breach sections would propagate downward to depths equal to the heights of the respective dams (56 feet for Dam No. 3, 47 feet for Dam No. 2, and 33 feet for Dam No. 1), since the impounded streams should tend to seek the previous equilibrium levels which they had attained prior to the construction of the dams (if at all possible).

Two sets of breach section geometry were evaluated for each of two failure times (Appendix C, Sheets 14-15 of 17). The two sets of breach sections chosen were considered to be the minimum and maximum probable failure sections. The minimum section for each dam was triangular in shape with very steep side slopes (1/2H to 1V) and a zero bottom width. The maximum section for each dam was trapezoidal in shape with side slopes representative of the estimated side slopes of the valley walls adjacent to the individual dams, and bottom widths equal to the estimated valley widths along the center lines of the individual dams. The two failure times (total time for each breach 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 lower and upper limits of this most sensitive variable might be evaluated. The near instantaneous failure time was thought to be realistic if the concrete core walls of Dams Nos. 2 and 3 were indeed in poor condition and/or major piping channels developed prior to and during the early stages of downcutting. The near instantaneous time of

failure could also apply if the concrete core walls of Dams Nos. 2 and 3 were truly in good condition, and could support the respective structures while the downstream toes of the dams were eroded away by the overtopping waters. In such cases, failure by instantaneous overturning of the concrete core walls could occur. The prolonged failure time was thought to be on the optimistic side (with respect to the dams), but still possible at least for Dams Nos. 2 and 3 if their concrete core walls were actually only in fair condition (some cracks). In these cases, the downcutting of the dams would probably be controlled by the slow rates at which the concrete core walls could be broken up and removed in chunks.

In addition to the above breach conditions, an average or more probable set of conditions was analyzed. These conditions were such that the breach sections were defined by side slopes of 1H to 1V and bottom widths intermediate to the minimum and maximum breach widths previously stated. The failure times for Dams Nos. 2 and 3 were assumed to be longer (2 hours) than that for Dam No. 1 (1 hour) due to the probable resistance of their concrete core walls to quick downcutting. The clay puddle core of Dam No. 1 should offer no such resistance.

Regardless of the assumed breach geometry or failure times (and under the "top of dam" initial breaching elevation assumption), the dams always breached in the same sequence. That is, Dam No. 1 failed first, and was followed some time later (about 2 hours) by the failure of Dam No. 2, which was followed a short time later (about 5 minutes) by the failure of Dam No. 3 (Appendix C, Sheet 16 of 17). Further, the same ultimate results were obtained for each set of breaching conditions. Simply stated, the failure of one or more of the dams of the system will significantly increase the estimated non-breach downstream water surface elevations, and thus, the probability of additional loss of life and property damage. A supplementary consequence of the system is that the possible failure of an upstream dam prior to overtopping (for reasons mentioned previously) will most probably cause the failure of a downstream dam.

The near instantaneous failures produced the largest peak outflows and corresponding downstream water surface increases, while the optimistic (with respect to the dam) prolonged failures resulted in much smaller, although still significantly high, relative peak outflows and downstream water surface increases (Appendix C, Sheets 16-17 of 17).

The average or more probable mode of failure provided peak breach discharges of 6000 cfs, 7700 cfs, and 8100 cfs from Dams Nos. 3, 2, and 1, respectively. Downstream water

surfaces increased by 5.7 feet (above the maximum 1/2 PMF water surface elevation) at a section located 250 feet downstream of Dam No. 1, and by 5.8 feet (above the same datum) at a section located about 1500 feet downstream. Even when the system of dams was analyzed such that breaching would not begin until the dams were overtopped by six inches of water, the same approximate system results were obtained for the more probable type of failure (Appendix C, Sheets 16 and 17 of 17, Plan 6). The only major differences between the two sets of results analyzed, was that for the 6-inch failure criterion analyzed, all of the dams failed within 15 minutes of each other. In any event, as can be seen on the Regional Vicinity Map (Appendix G), the many homes located on the floodplain immediately below the dams would be significantly affected by the dam failures, especially if one considers not only the increase in the height of the breach floodwave, but also the increased momentum that the larger and probably swifter moving volume of water would possess.

Although Reservoir No. 1 is presently only a part of a larger system and was analyzed as such, some approximations can be inferred from the system results as to the downstream effects of the "removal" (by way of estimating and eliminating the increased Dam No. 1 outflows due to upstream breaching) of one or both of the upstream dams. If, perhaps Reservoir No. 3 was "removed" from the present system, the specific result of the combined failures of Dams Nos. 1 and 2 would be to raise the maximum 1/2 PMF water surface elevation at the section located 1500 feet below Dam No. 1 by about 3 feet according to the more probable breach analysis. This increase in water surface was determined via the interpolated water surface elevation corresponding to the estimated maximum Dam No. 2 breach outflow of 3600 cfs. The 3600 cfs flow was approximated as the largest difference between the actual computed breach outflows from Dam No. 2 and the estimated Dam No. 3 contributions to the Dam No. 2 outflows. Since Dam No. 1 fails about 2 hours before Dam No. 2, it will have reached its maximum breach dimensions prior to the inflow of the 3600 cfs and will cause very little attenuation of the flow. If both Dams Nos. 2 and 3 were "removed" from the system, the immediate results of the failure of Dam No. 1 alone would be to increase the base elevation at the most downstream section by about 0.2 feet based on the more probable breach analysis. This increase was determined via the interpolated water surface elevation corresponding to the maximum Dam No. 1 breach outflow of 1750 cfs (which occurs prior to the failures of Dams Nos. 1 and 2). Although this slight increase in the downstream water surface might not seem to be significant, the increases resulting from the two possible near instantaneous failure conditions are significant. In particular, the increase in

the base elevation resulting from a near instantaneous breach of Dam No. 1 with minimum section dimensions would be about 1.7 feet (based on the maximum breach outflow of 2950 cfs), and that with maximum section geometry would be about 3.5 feet (based on the maximum breach outflow of 4640 cfs). These breach outflows were unaffected by the failures of Dams Nos. 2 and 3. Therefore, whether considered alone or, more correctly, as a part of the existing system, the failure of Dam No. 1 is highly possible and will most probably lead to increased loss of life and property damage in the downstream communities.

5.6 Spillway Adequacy.

As presented previously, under existing conditions Hutchinson Reservoir Dam No. 1 can safely pass approximately 33 percent of the PMF prior to overtopping. Should a 1/2 PMF-size event occur, the dam will be overtopped and, in all probability, will subsequently fail, endangering the population of the downstream communities. Therefore, the spillway system of Hutchinson Reservoir Dam No. 1 is deemed seriously inadequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on the visual inspection, the embankment appears to be in poor structural condition. Seepage near the outlet pipe continues despite efforts in the past to control it. The upstream face of the dam is cracked and very irregular. A sinkhole is evident in the crest of the embankment to the left of the gate house.

b. Appurtenant Structures. Based on the visual inspection, the remainder of the facility appeared to be in fair condition. The concrete spillway surface showed no evidence of significant deterioration or damage although the spillway walls exhibited numerous cracks. The upper portion of the valve chamber, as shown in Photograph 10, has rotated, possibly from movements within the embankment. The outlet works could not be observed closely as both conduits were buried or submerged. The outlet of the 14-inch diameter blowoff conduit was submerged in a pool formed by seepage at the downstream toe of the embankment (see Photograph 11). Below the dam, the water treatment building, chemical storage shed, a 20-inch diameter supply line valve pit, and related facilities are in good condition. The inlet control mechanisms and screen clearing device are reportedly in good working order.

6.2 Design and Construction Techniques.

No records are available detailing the methods of design and construction.

6.3 Past Performance.

No formal records of past performance are available from the owner; however, historical accounts and inspection reports available from PennDER files recount a history of seepage (possibly piping) and remedial work. These included grouting, installation of a section of concrete cut-off wall and several attempts to replace sections of the clay puddle core. Field inspection revealed an irregular upstream crest, a sinkhole in the crest, and seepage or evidence of seepage in previously recorded areas, with the pool level below the spillway crest approximately 3.6 feet. In summary, the available information and field inspection indicate a history of poor past performance.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and is thus subject to minor earthquake induced forces. Since no records of construction materials or techniques are available and since the structure has a history of excessive seepage both beneath and through the embankment, it is possible that even minor earthquake induced dynamic forces could be significant at high pool levels. However, no investigations or calculations were performed to confirm this opinion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection, operational history and hydrologic and hydraulic analysis indicate that the structure is in poor condition. Apparent rotation of the outlet structure, uneveness of the upstream face and a sinkhole in the crest suggest possible internal piping problems which are possibly active under normal pool conditions. Records of past performance show numerous problems related to seepage both under and through the embankment during its 91 year life span.

Hydrologic and hydraulic calculations indicate that the existing reservoir and spillway system will pass only 33 percent of the PMF before overtopping occurs. Under 1/2 PMF conditions, it has been determined that the embankment will be overtopped leading to failure and a significant increase in the hazard to loss of life downstream. As the facilities hazard rating is "high", the present spillway condition is assessed as being seriously inadequate.

The inadequacies of the spillway and evidence of possible internal piping are deficiencies of such a nature that if left uncorrected could result in the failure of the dam with subsequent loss of life and/or substantial property damage. Thus, the facility is considered unsafe. Failure does not appear imminent under the conditions which existed at the time of inspection; however, a detailed emergency operation plan and warning system should be immediately activated which includes around-the-clock surveillance during periods of unusually heavy precipitation by a registered professional engineer experienced in the design and performance evaluation of earth structures.

b. Adequacy of Information. The available data are considered sufficient to make an accurate assessment of the facility. A detailed hydrologic and hydraulic evaluation of all three Hutchinson facilities has reportedly been prepared by a consultant retained by the owner. This report was not made available for review and could possibly aid to more accurately evaluate the facilities.

c. Urgency. Detailed evaluation of the facility and implementation of an emergency operation plan, warning system, and around-the-clock surveillance during intense storms should be initiated immediately.

d. Necessity for Additional Investigation. The owner should initiate the following investigations:

1. A subsurface investigation to determine the condition and engineering properties of the embankment materials and an assessment of causes of sinkhole development in the crest.

2. A hydrologic and hydraulic evaluation including effects on downstream developments if the facility is breached or removed from the system which includes Hutchinson Reservoir Dams Nos. 1, 2, and 3.

7.2 Recommendations/Remedial Measures.

a. Facilities. It is recommended that the owner:

1. Perform a detailed hydrologic and hydraulic evaluation of the facility including an assessment of downstream effects from breaching or removing the embankment from the system which includes Hutchinson Reservoir Dams Nos. 1, 2, and 3.

2. Perform a detailed subsurface evaluation to determine the cause of sinkhole development in the crest and the in-situ properties of the embankment materials.

3. Perform a stability and seepage evaluation of the embankment under all possible operating conditions utilizing the results of Item 2 above.

4. Determine the extent of apparent structural distress in the outlet structure.

5. Take appropriate remedial actions based on the results of the above analyses.

b. Maintenance and Operating Procedures. It is recommended that the owner:

1. Immediately activate a plan for emergency operation and a warning system for downstream residents. Included in the plan should be provisions for around-the-clock surveillance of the facility by a professional engineer experienced in the design and performance evaluation of earth structures during periods of unusually heavy precipitation.

2. Inspect the facility on a daily basis to determine if the sinkhole development in the crest is an active process requiring immediate remedial action. Particular attention should be given to the seepage at the outlet

conduit and the apparent seepage near the toe of the left abutment. This area should also be cleared of all brush and debris to facilitate daily inspection.

3. Monitor apparent movement of the outlet structure.

APPENDIX A

CHECK LIST - ENGINEERING DATA

NAME OF DAM: Hutchinson Reservoir Dam No.1

NDI#: PA-214 PENNDER#: 26-13

CHECK LIST
ENGINEERING DATA
PHASE I

ITEM	REMARKS NDI# PA - 214
PERSONS INTERVIEWED AND TITLE	William McAdams (Engineer) - Western Pennsylvania Water Company John Orlando (Superintendent) Western Pennsylvania Water Company
REGIONAL VICINITY MAP	See Appendix G U.S.G.S. 7.5 minute series quadrangle, Brownfield, Pennsylvania, dated 1964 and photorevised in 1973.
CONSTRUCTION HISTORY	Inferred from PennDER correspondence and converstaions with the dam owner's representatives. See Section 1.2.g of this report.
AVAILABLE DRAWINGS	Cross-section and profile drawing dated August 1914, entitled "Uniontown Water Company Hutchinson Reservoir No. 1"(see Figure 2, Appendix F). Also, drawing dated June, 1915, entitled "Alignment and X-section Map of Proposed Improvement at Hutchinson Reservoir No. 1" (see Figure 3, Appendix). Both drawings by W.S. McClay, Uniontown, PA. available from PennDER.
TYPICAL DAM SECTIONS	See Figure 2, Appendix F.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Figure 2, Appendix F

ITEM	REMARKS NDI# PA - 214
SPILLWAY: PLAN SECTION DETAILS	See Figure 2, appendix G.
OPERATING EQUIPMENT PLANS AND DETAILS	None available.
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	None available.
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	None available.

ITEM	REMARKS NDI# PA - 214
BORROW SOURCES	Unknown.
POST CONSTRUCTION DAM SURVEYS	Study prepared by Burgess by Niple, Consulting Engineers, Columbus, Ohio, dated 1973 is reportedly available from the owner. Access to this information was denied the inspection team by the owner.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	See above.
HIGH POOL RECORDS	Elevation of highest pool to date is not known. According to the owner's representatives, none of the Hutchinson Reservoir Dams have ever overtopped.
MONITORING SYSTEMS	None.
MODIFICATIONS	Intake structure modified sometime around 1973. According to the owner's representatives no drawings and/or design data are available pertaining to this modification.

ITEM	REMARKS	NDI# - PA 214
PRIOR ACCIDENTS OR FAILURES	None.	
MAINTENANCE: RECORDS MANUAL	Maintenance records are not kept for this facility. No formal maintenance manual is available.	
OPERATION: RECORDS MANUAL	Pool elevation, daily discharge, or operational records are not kept for this facility. No formal operation manual is available.	
OPERATIONAL PROCEDURES	There are no formal operational procedures associated with this facility. Excess inflow is discharged through the emergency spillway. The outlet works are operated manually by the resident dam tender upon orders from the owner.	
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	There are no formal warning systems or emergency procedures presently in effect. A full-time caretaker resides near the facility just downstream of Hutchinson Reservoir Dam No. 2 and is responsible to take whatever steps are necessary to warn downstream residents in the event of an emergency.	
MISCELLANEOUS		

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-214
PENN DER ID # 26-13

SIZE OF DRAINAGE AREA: Local ≈ .043 sq. mi.; Total ≈ 2.42 sq. mi.

ELEVATION TOP NORMAL POOL: 1291.8 STORAGE CAPACITY: 46 ac-ft.

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -

ELEVATION TOP DAM: 1294.3 STORAGE CAPACITY: 56 ac-ft.

SPILLWAY DATA

CREST ELEVATION: 1291.8.

TYPE: Concrete channel

CREST LENGTH: 42 feet

CHANNEL LENGTH: 30 feet. (Measured from upstream embankment face to the edge of the first vertical drop in the discharge channel)

SPILLOVER LOCATION: Right abutment.

NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

TYPE: 14-inch CIP blowoff.

LOCATION: Left of emergency spillway.

ENTRANCE INVERTS: 1269 (rough estimate)

EXIT INVERTS: 1261 (rough estimate)

EMERGENCY DRAWDOWN FACILITIES: Valved at intake.

HYDROMETEOROLOGICAL GAGES

TYPE: Rain gage

LOCATION: Between Dam Nos. 1 and 2.

RECORDS: Daily records available at owner's Uniontown office.

MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Hutchinson Reservoir Dam No.1 STATE Pennsylvania COUNTY Fayette

NDI# PA - 214 PENNDER# 26-13

TYPE OF DAM Earth SIZE Small HAZARD CATAGORY High

DATE(S) INSPECTION 6 October 1978 WEATHER overcast w/ occasional light drizzle TEMPERATURE 50° @ 1:00 ~~AM~~ PM

POOL ELEVATION AT TIME OF INSPECTION 1288.2 M.S.L.

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

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	OTHERS
B. M. Mihalcin	W. McAdams	
J. P. Nairn	J. Orlando	
S. R. Michalski		
G. R. Thiers		
K. H. Khilji		
D. L. Bonk		

RECORDED BY B. M. Mihalcin

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 214
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Left side of the embankment near the abutment displays irregularities that are possibly attributable to past erosion. Presently, this particular area is poorly maintained and overgrown. Substantial amounts of depris laden fill have been dumped in this area for no readily apparent reason.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical - good; maximum observed settlements do not exceed 1-foot horizontal - irregular; particularly evident along the upstream face. Embankment crest is sloped 10 percent upstream to downstream.
RIPRAP FAILURES	No riprap. Upstream slope is faced with concrete that is extensively cracked and irregular.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	O.K. - No noticeable problems.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 214
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	No damp areas were observed along the downstream embankment face, however, the pool was found to be substantially lower than normal on the day of the inspection. The left side of the embankment and toe area immediately beyond are not maintained to the same degree as the rest of the embankment. The area is generally overgrown and debris laden.
ANY NOTICEABLE SEEPAGE	Possible evidence of past seepage was observed along the downstream toe near the left abutment. Although no seepage was observed during the inspection, the area was found in a damp condition. In addition, a significant amount of fine material was observed below the fallen trees and brush. Perhaps seepage would be evident at higher pools.
STAFF GAGE AND RECORDER	None.
DRAINS	4-inch diameter tile drain observed at toe of spillway.
SINKHOLES	A sinkhole is located along the embankment crest approximately 50 feet to the left of the intake structure. The origin of this sinkhole is not known, however, it may be associated with a piping problem. A second, smaller sinkhole was discovered located along the right shoreline several feet upstream of the embankment between the reservoir and raceway.

OUTLET WORKS

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA -
INTAKE STRUCTURE	Masonry structure in poor condition; top 6 feet has rotated as a unit and is visibly misaligned. Refered to as a vault by the owner's representatives, the intake structure houses valve mechanisms for the blowoff and supply lines and a filtration device for the potable water supply. The unit is located to the right of dam center along the upstream face of the embankment.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	No concrete surfaces of outlet conduit are exposed. The discharge end of the outlet conduit was submerged when encountered by the field team during the inspection. The inundation could be the result of seepage in or around the conduit. Although no discernable seepage was observed, information available from PennDER files show that the problem had been previously reported by state inspectors.
OUTLET STRUCTURE	14-inch diameter cast-iron pipe discharges at the downstream toe to the right of embankment center. The conduit was submerged on the day of the inspection by several inches of water and was not readily observed. A 20-inch diameter cast-iron supply pipe reportedly passes from the vault, through the embankment, to the water treatment building at the downstream toe of the embankment.
OUTLET CHANNEL	Natural streambed.
GATE(S) AND OPERATIONAL EQUIPMENT	The blowoff conduit is valved at the intake structure located along the upstream face of the embankment to the left of the spillway. The owner reports the valves to be functional, however, they were not operated in the presence of the inspection team. The supply line is regulated within the vault by two 20-inch diameter gate valves controlling flow into and out of the structure. There is also a 20-inch diameter gate valve on the line just downstream of the water treatment building.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 214
TYPE AND CONDITION	Concrete channel in fair condition.
APPROACH CHANNEL	N/A
SPILLWAY CHANNEL AND SIDEWALLS	Channel floor is in good condition. Sidewalls are in poor condition with many cracks in evidence.
STILLING BASIN PLUNGE POOL	None.
DISCHARGE CHANNEL	Rectangular channel with floor and sidewalls constructed of concrete. Discharge is passed over four vertical drops before reaching the stream at the downstream embankment toe.
BRIDGE AND PIERS	A 3-foot high wood plank bridge spans the spillway channel a few feet downstream of the crest. The bridge is supported by five angle frames spaced at approximate 8-foot intervals.
EMERGENCY GATES	None.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 214
TYPE AND CONDITION	N/A
APPROACH CHANNEL	N/A
OUTLET STRUCTURE	N/A
DISCHARGE CHANNEL	N/A

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 214
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA -214
SLOPES: RESERVOIR	Steep and heavily forested.
SEDIMENTATION	Significant sedimentation was observed along the upstream reaches of the reservoir.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	175-foot wide valley. Sides slopes are heavily forested while the bottom has been substantially cleared and developed.
SLOPES: CHANNEL VALLEY	Steep and heavily forested.
APPROXIMATE NUMBER OF HOMES AND POPULATION	Portions of the communities of Hutchinson and Hopwood are located along the floodplain just downstream of the reservoir. At least 20 homes could easily be affected by a breach of Hutchinson Reservoir Dam No. 1. Population - 60-80.

APPENDIX C

HYDROLOGY AND HYDRAULICS

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 1

BY DLB DATE 10-24-78 PROJ. NO. 78-617-214

CHKD. BY WJV DATE 1/9/79 SHEET NO. 1 OF 17

gai CONSULTANTS,
Engineers • Geologists • Planners
Environmental Specialists

DAM LOCATION - BROWNFIELD QUADRANGLE, FAYETTE COUNTY, PENNSYLVANIA; U.S.G.S. 7.5 MINUTE SERIES, (TOPOGRAPHIC) PHOTOREVISED 1973

DAM STATISTICS

MAXIMUM HEIGHT - 33 FEET (FIELD MEASURED)

DRAINAGE AREA - 0.43 SQ. MI. (PLANIMETERED OFF U.S.G.S. BROWNFIELD QUADRANGLE)

STORAGE CAPACITY -

@ NORMAL POOL (EL 1291.8) ≃ 45 AC-FT (SEE NOTE BELOW)
@ TOP OF DAM (EL 1294.3) ≃ 56 AC-FT. (SHEET 5)

SIZE CLASSIFICATION

DAM SIZE - SMALL (REF 1; TABLE 1)

HAZARD RATING - HIGH (FIELD OBSERVATION: REF 1: TABLE 2)

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

NOTE: THE VALUE OF STORAGE CAPACITY IS TAKEN FROM AN UNPUBLISHED NOTEBOOK CONTAINING PERTINANT DATA FOR DAMS OPERATED BY THE UNIONTOWN BRANCH OF W.P.W.. THE NOTEBOOK IS AVAILABLE FROM THE FILES LOCATED AT THE UNIONTOWN OFFICE OF W.P.W..

SUBJECT DAM SAFETY INSPECTION.
HUTCHINSON RESERVOIR # 1

KHK DATE 10-11-78 PROJ. NO. 78-617-214

CHKD. BY RFU DATE 10-13-78 SHEET NO. 2 OF 17

gai CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

HUTCHINSON RESERVOIR # 1

DRAINAGE AREA:

LOCAL = 0.43 SQ. MILE

U.S.G.S MAP
BROWNFIELD QUAD.
PENNSYLVANIA.

TOTAL = 1.9 + .09 + .43
= 2.42 SQ. MILES.

SURFACE AREA (NORMAL POOL) = 0.04 SQ. INC. (PLANIMETERED)
= 3.7 ACRES.

SURFACE AREA AT CONTOUR 1300 = 0.063 SQ IN (PLANIMETERED)
= 5.79 ACRES. ≈ 5.8

SURFACE AREA AT CONTOUR 1320 = 0.13 SQ. IN (PLANIMETERED)
= 11.9 ACRES

RATE OF AREA CHANGE PER FOOT OF RISE:

$$\frac{\Delta A}{\Delta Y} = \frac{(11.9 \text{ ACRES}) - (3.7 \text{ ACRES})}{(1320 \text{ FEET}) - (1291.8 \text{ FEET})} = 0.29 \text{ ACRE/FT}$$

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR DAM Nº 1

BY DLB DATE 10-24-78 PROJ. NO. 78-617-214

CHKD. BY WJV DATE 11/28/78 SHEET NO. 3 OF 17

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UNIT HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE (L) ≃ 1.17 MILES

L_{CA} ≃ 0.56 MILES

[VALUES OF L AND L_{CA} ARE FROM U.S.G.S. 7.5 MINUTE QUAD BROWNFIELD, PA.]

NOTE: ALL VARIABLES ARE DEFINED IN REFERENCE 2 IN THE SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH"

$C_t = 1.6$

$C_p = 0.5$

[SUPPLIED BY C of E; ZONE 29, OHIO RIVER BASIN]

t_p = SNYDER'S STANDARD LAG = $1.6\,(L \times L_{CA})^{0.3}$

$t_p = (1.6)[(1.17)(0.56)]^{0.3} = 1.41$ HRS

PMP CALCULATIONS

HUTCHINSON RESERVOIR DAM Nº 1 LOCATION – ZONE 7 (REF 3)

PMP INDEX = 24 INCHES (FIG 1, REF 3)

DURATION % INDEX –

6 HRS = 102

12 HRS = 120

24 HRS = 130

NOTE: A 24-HOUR RATHER THAN A 48-HR TOTAL DURATION WAS USED. THIS WAS NECESSITATED BY THE NEED TO USE A 5-MINUTE TIME STEP IN THE HEC-1-DAM PROGRAM IN ORDER TO MORE ACCURATELY DEFINE THE PEAKS OF THE HYDROGRAPHS. (A MAXIMUM OF ONLY 300 TIME INTERVALS IS ALLOWED IN THE PROGRAM.)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR # 1

BY KHK DATE 10-12-78 PROJ. NO. 78-617-214

CHKD. BY RFV DATE 10-13-78 SHEET NO. 4 OF 17

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APPROXIMATE ELEVATION @ ZERO STORAGE

VOLUME = $\frac{1}{3}$ HA (CONIC METHOD)

VOLUME = 45.4 ACRE-FT (SEE NOTE SHEET 1)

SURFACE AREA = 3.7 ACRES (PLANIMETERED)

$$H = \frac{3 \times 45.4}{3.7} = 36.8 \text{ FT.}$$

ELEVATION AT SPILLWAY CREST = 1291.8 FT (WPW. FILE UNION TOWN OFFICE)

ELEVATION AT ZERO VOLUME = 1291.8 − 36.8

= 1255. FT.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR DAM Nº 1
BY DLB DATE 1/5/79 PROJ. NO. 78-617-214
CHKD. BY WJV DATE 1/9/79 SHEET NO. 5 OF 17

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ACTUAL ESTIMATED ELEVATION - STORAGE RELATIONSHIP

ESTIMATED SURFACE AREA: (LINEAR INTERPOLATION EQUATION)

$$A = A_o + \left(\frac{\Delta A}{\Delta y}\right) y$$

A_o = 3.7 ACRES

$\frac{\Delta A}{\Delta y}$ = 0.29 ACRE/FT

y = (ELEVATION OF CONCERN) - 1291.8'

ESTIMATED INCREMENTAL INCREASE IN STORAGE:

MODIFIED PRISMOIDAL FORMULA: $\Delta V_{1-2} = \frac{Y}{3}\left(A_1 + A_2 + \sqrt{(A_1)(A_2)}\right)$
(REF 14, pg 15)

ELEVATION (FT)	ESTIMATED AREA (ACRE)	CUMULATIVE INCREASE IN STORAGE ABOVE NORMAL POOL VIA MOD. PRIS. EQ. (ACRE-FEET)	AVAILABLE STORAGE BELOW NORMAL POOL (ACRE-FEET)	ACTUAL ESTIMATED STORAGE (ACRE-FEET)
1291.8	3.7	0	45	45*
1292.0	3.8	1	"	46
1293.0	4.0	5	"	50
1294.0	4.3	9	"	54
1294.3	4.4	11	"	56
1295.0	4.6	14	"	59
1216.0	4.9	19	"	64
1297.0	5.2	24	"	69
1298.0	5.5	29	"	74
1299.0	5.8	35	"	80
1300.0	6.1	40	"	85
			"	

* KNOWN VALUE (SEE NOTE SHEET 1)

EL 1291.8 - NORMAL POOL
EL 1294.3 - TOP OF DAM

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR # 1

BY DLB DATE 1-13-79 PROJ. NO. 78-617-214

CHKD. BY WJV DATE 1-13-79 SHEET NO. 6 OF 17

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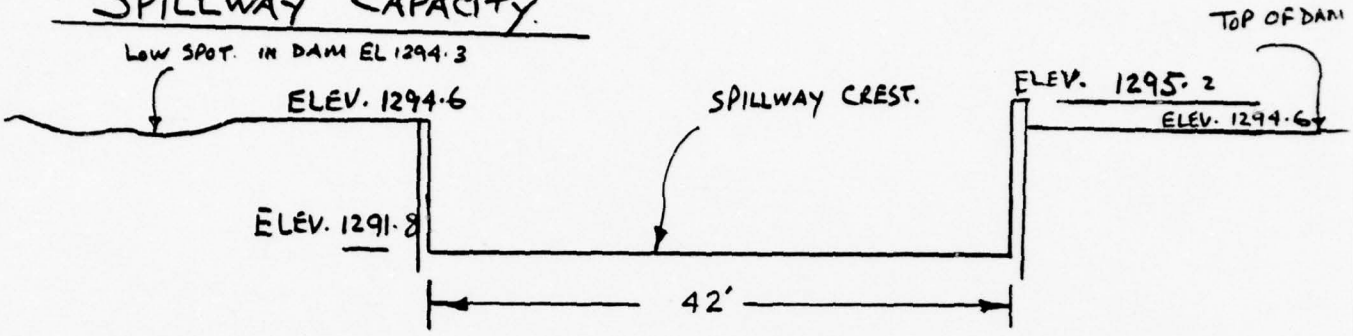
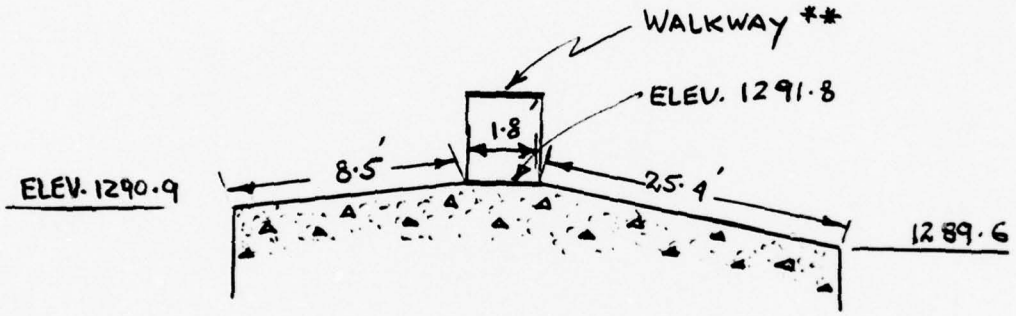
SPILLWAY CAPACITY





MAXIMUM HEAD = 1294.3 - 1291.8 = 2.5 FT.

LENGTH OF WEIR = 42 FT.

$$Q = C L H^{3/2}$$ (REF 5, EQ 5-10)

$$= 3.07^{*} \times 42 \times (2.5)^{3/2}$$

* C VALUE EXTRAPOLATED FROM TABLE 5-3 REF 5

$$= 509.7 \text{ CFS (SAY 510 CFS)}$$

** WALKWAY ALLOWANCE NEGLECTED

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR # 1

BY DLB DATE 1/13/79 PROJ. NO. 78-617-214.

CHKD. BY WJV DATE 1/13/79 SHEET NO. 7 OF 17

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SPILLWAY RATING CURVE

$$Q = C^{*}LH^{3/2}$$

* C VALUE EXTRAPOLATED ** TOP OF DAM

ELEVATION FT.	H FT	$H^{3/2}$	C^{*}	Q CFS
1291.8	0	0	0	0
1292	0.2	.089	2.54	10
1292.5	0.7	.586	2.61	64
1293	1.2	1.31	2.7	149
1293.5	1.7	2.22	2.88	268
1294	2.2	3.26	2.94	403
1294.3**	2.5	3.95	3.07	510
1295	3.2	5.72	3.25	781
1295.5	3.7	7.12	3.32	992
1296	4.2	8.61	3.32	1200
1297	5.2	11.86	3.32	1653
1298	6.2	15.44	3.32	2153
1299	7.2	19.32	3.32	2694

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR DAM Nº 1

BY DLB DATE 10-20-78 PROJ. NO. 78-617-214

CHKD. BY WJV DATE 11/20/78 SHEET NO. 8 OF 17

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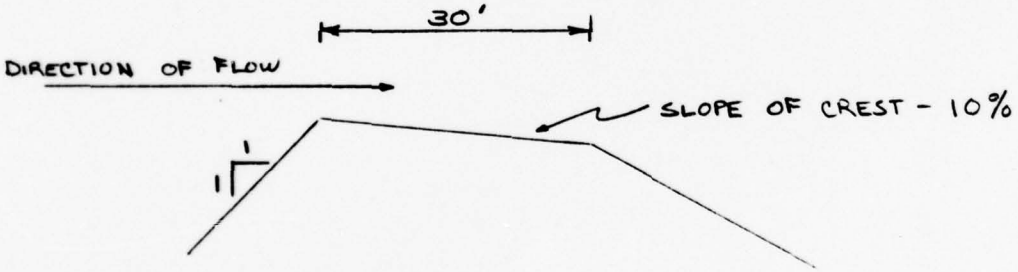
MAIN DAM

THE TOP OF DAM IS AT ELEVATION 1294.3. THIS IS THE POINT WHERE OVERTOPPING OF THE DAM STARTS. THE TOTAL COMBINED LENGTH OF THE DAM, EXCLUDING THE SPILLWAY, IS 278 FT. THE BREADTH OF THE CREST OF THE DAM IS 30 FT AND IS ON A 10% SLOPE AS SHOWN BELOW.



$$Q = CLH^{3/2}$$ (REF 5, EQ 5-10)

BREATH OF CREST = 30 FT
LENGTH OF DAM = 278 FT

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR DAM Nº 1

BY RFV DATE 10-23-78 PROJ. NO. 78-617-214

CHKD. BY KHL DATE 10-24-78 SHEET NO. 9 OF 17

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MAIN DAM RATING CURVE

$$Q = C^* L H^{3/2}$$

ELEVATION	H (FT)	$H^{3/2}$	H/B	C	Q (CFS)
1294.3	0	0	0		0
1295	0.7	0.586	0.023	3.03	493
1295.5	1.2	1.315	0.04	3.04	1111
1296	1.7	2.217	0.057	3.04	1873
1297	2.7	4.437	0.090	3.05	3762
1298	3.7	7.117	0.123	3.05	6035
1299	4.7	10.189	0.157	3.06	8668

* VALUES OF "C" ARE TAKEN FROM REFERENCE 12, FIG. 24, pg 46

THE EFFECT OF THE 10% CREST SLOPE ON THE WEIR COEFFICIENTS IS NEGLIGIBLE IF THE CURVE OF REFERENCE 12 IS USED TO DETERMINE THE "C"'s (REF. 5 and 8).

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #1 DAM
EJM DATE 10-30-78 PROJ. NO. 78-617-214
CHKD. BY DLB DATE 10-31-78 SHEET NO. 10 OF 17

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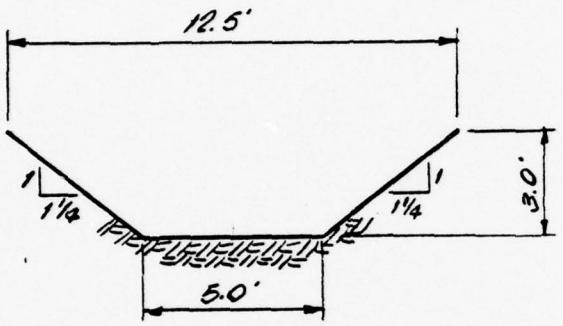
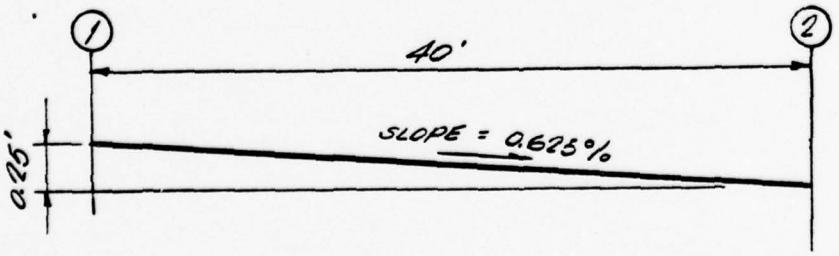
CALCULATION OF FLOW CAPACITY IN RACEWAY



NOTE: CHANNEL IS LINED WITH HIGH VEGETATION, ROCK DEBRIS, AND BRUSH. (FIELD OBSERVATION)

TYPICAL CROSS-SECTION THROUGH RACEWAY *
SCALE: 1" = 5'



PROFILE THROUGH RACEWAY *
SCALE: 1" = 10' H
1" = 1' V

* ALL DIMENSIONS REPRESENT FIELD MEASUREMENTS.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #1 DAM

BY EJM DATE 10-30-78 PROJ. NO. 78-617-214

CHKD. BY DLB DATE 10-31-78 SHEET NO. 11 OF 17

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THE FOLLOWING SIMPLIFYING ASSUMPTIONS APPLY IN APPROMATING THE FLOW CAPACITY OF THE RACEWAY:

1. THE LINING AS DESCRIBED BY THE NOTE ON SHEET 10 IS CONSISTENT OVER THE ENTIRE CHANNEL LENGTH, THEREFORE THE ROUGHNESS COEFFICIENT IS UNIFORM.

2. THE SIDE SLOPES OF THE RACEWAY ARE CONSTANT OVER THE CHANNEL LENGTH.

3. THE CHANNEL SLOPE IS CONSTANT AT 0.625%

4. FLOW IS TURBULENT AND THE MANNING EQUATION APPLIES.

MANNING EQUATION:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$ (REF 7, EQ 5-6, pg 99)

WHERE: Q - QUANTITY OF FLOW (CFS)
n - ROUGHNESS COEFFICIENT
A - AREA OF FLOW (FT^2)
R - HYDRAULIC RADIUS (FT) = $\frac{A}{WP}$
S - SLOPE (FT/FT)
WP - WETTED PERIMETER

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR DAM N° 1
BY DLB DATE 10-30-78 PROJ. NO. 78-617-214
CHKD. BY WJV DATE 1/9/79 SHEET NO. 12 OF 17

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- QUANTITY OF FLOW FOR $d = 3.0$

$$A = 2(1/2)(3.75')(3.0') + (5.0')(3.0')$$
$$= 26.25\ FT^2$$

$$WP = 4.8' + 5.0' + 4.8'$$
$$= 14.6\ FT$$

$$R = 26.25\ FT^2 / 14.6\ FT$$
$$= 1.80\ FT$$

$$S = 0.00625 \simeq 0.006$$

$$n = 0.040 \qquad \text{(REF 2, pg 112)}$$

$$Q = \frac{1.49}{0.040}(26.25)(1.80)^{2/3}(0.006)^{1/2}$$

$$Q = 112.1\ CFS$$

- APPROXIMATE STORAGE CAPACITY @ FULL FLOW

RACEWAY LENGTH ≈ 800 FT.

STORAGE = AVERAGE SURFACE AREA × AVERAGE DEPTH
$= [(12.5' \times 800') + (5.0' \times 800')] \times \frac{3'}{2} = 21000\ FT^3 = 0.48\ A\text{-}F$

∴ RACEWAY STORAGE IS INSIGNIFICANT AND WILL BE NEGLECTED

ASSUME RACEWAY FLOWS FULL BY THE TIME THE RESERVOIR WATER LEVEL RAISES 0.7 FT, DUE TO THE COMBINATION OF DIRECT DRAINAGE OF THE SUBAREA'S LONGEST WATERCOURSE AND THE CONTRIBUTIONS OF THE US RESERVOIR

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº1

BY DLB DATE 1/13/79 PROJ. NO. 78-617-214

CHKD. BY WJV DATE 1/13/79 SHEET NO. 13 OF 17

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TOTAL DAM RATING CURVE (SPILLWAY + MAIN DAM + RACEWAY)

ELEVATION	Q SPILLWAY	Q OVERTOPPING OF DAM	Q RACEWAY	Q (CFS) COMBINED
1291.8	0	0	0	0
1292	10	0	0	10
1292.5	64	0	112	176
1293	149	0	112	261
1293.5	268	0	112	380
1294	403	0	112	515
1294.3	510	0	112	622
1295	781	493	112	1386
1295.5	992	1111	112	2215
1296	1200	1873	112	3185
1297	1653	3762	112	5527
1298	2153	6035	112	8300
1299	2694	8668	112	11474

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-2-79 PROJ. NO. 79-617-214

CHKD. BY DLB DATE 2-6-79 SHEET NO. 14 OF 17

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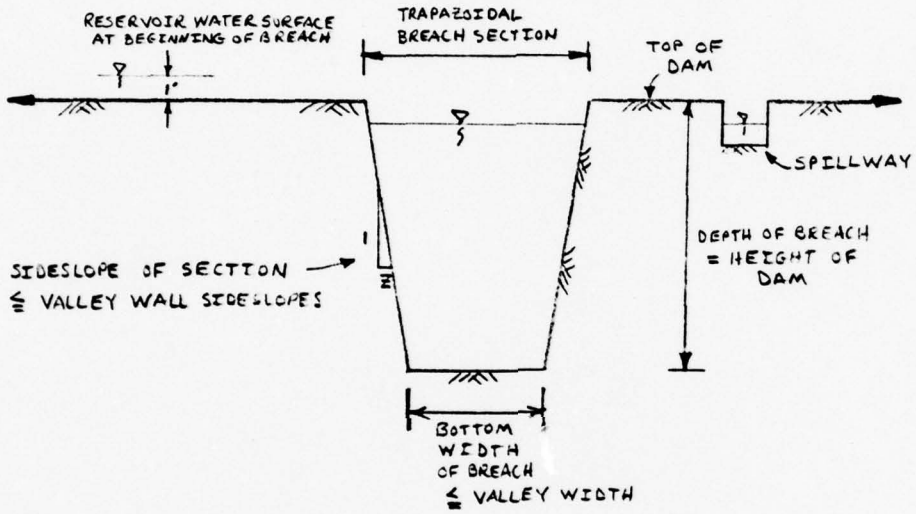
BREACHING ASSUMPTIONS

TYPICAL BREACH SECTION:



HEC-1-DAM BREACHING ANALYSIS INPUTS:

(BREACHING IS INITIATED WHEN THE RESERVOIR WATER SURFACES REACH THE TOPS OF THE DAMS)

PLAN NUMBER AND COMMENTS	RESERVOIR Nº 3				RESERVOIR Nº 2				RESERVOIR Nº 1			
	BREACH BOTTOM WIDTH (FT)	BREACH DEPTH (FT)	SECTION SIDESLOPE	BREACH* TIME (HR)	BREACH BOTTOM WIDTH (FT)	BREACH DEPTH (FT)	SECTION SIDESLOPE	BREACH* TIME (HR)	BREACH BOTTOM WIDTH (FT)	BREACH DEPTH (FT)	SECTION SIDESLOPE	BREACH TIME (HR)
① MINIMUM BREACH SECTIONS, INSTANTANEOUS FAIL TIMES	0	56	0.5 to 1	0.25	0	47	0.5 to 1	0.25	0	33	0.5 to 1	0.25
② MAXIMUM BREACH SECTIONS, INSTANTANEOUS FAIL TIMES	150	56	2 to 1	0.25	100	47	4 to 1	0.25	100	33	2.5 to 1	0.25
③ MINIMUM BREACH SECTIONS, PROLONGED FAIL TIMES	0	56	0.5 to 1	4.0	0	47	0.5 to 1	4.0	0	33	0.5 to 1	4.0
④ MAXIMUM BREACH SECTIONS, PROLONGED FAIL TIMES	150	56	2 to 1	4.0	100	47	4 to 1	4.0	100	33	2.5 to 1	4.0
⑤ AVERAGE POSSIBLE CONDITIONS	100	56	1 to 1	2.0	50	47	1 to 1	2.0	50	33	1 to 1	1.0

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

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 2

BY WJV DATE 1/9/79 PROJ. NO. 78-617-214

CHKD. BY DLB DATE 1/9/79 SHEET NO. 15 OF 17

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

- BREACH BOTTOM WIDTH → $\frac{\text{DAM HEIGHT}}{2} < \text{WIDTH} < 3 \times (\text{DAM HEIGHT})$
- SECTION SIDESLOPE → $0 < Z < 1$
- BREACH TIME → $0.5 < \text{TIME} < 4.0$
- WATER SURFACE HEIGHT ABOVE DAM AT WHICH BREACHING BEGINS → $1 < \text{HEIGHT} < 5$

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

CONSTRAINT	RESERVOIR Nº3	RESERVOIR Nº2	RESERVOIR Nº1
- HEIGHT OF DAM	56'	47'	33'
- LENGTH OF DAM CREST W/O SW	400'	510' (MAIN DAM ONLY)	278'
** - VALLEY BOTTOM WIDTH	150'	100'	100'
** - VALLEY SS: RIGHT WALL	3 to 1	4 to 1	3.5 to 1
LEFT WALL	4.5 to 1	5 to 1	4 to 1
DESCRIPTION	EARTH DAM WITH CONCRETE CORE WALL AND CONCRETE US FACE COVERING	EARTH DAM WITH CONCRETE CORE WALL AND HAND PLACED RIP RAP US AND DS FACE COVERINGS	EARTH DAM WITH CLAY CORE AND CONCRETE US FACE COVERING

* INFORMATION OBTAINED FROM BALTIMORE DISTRICT, CORPS OF ENGINEERS
** ESTIMATED FROM USGS MAP

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR NO 1

BY WJV DATE 2-2-79 PROJ. NO. 79-617-214

CHKD. BY DLB DATE 2-6-79 SHEET NO. 16 OF 17

HEC-1-DAM BREACHING ANALYSIS OUTPUT:

RESERVOIR DATA

OUTPUT FOR RESERVOIR Nº	PLAN * NUMBER	VARIABLE BOTTOM BREACH WIDTH RES.3	RES.2	RES.1	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)
3	①	0	–	–	19572	18.50	19572	18.50	19572	18.50	18.25
	②	150	–	–	29691	18.37	26698	18.33	29691	18.37	18.25
	③	0	–	–	3138	20.42	3138	20.42	3138	20.42	18.25
	④	150	–	–	4330	18.75	4330	18.75	4330	18.75	18.25
	⑤	100	–	–	5997	18.63	5982	18.58	5997	18.63	18.25
	** ⑥	100	–	–	5996	18.83	5996	18.83	5996	18.83	18.50
2	①	0	0	–	12319	18.42	12319	18.42	15532	18.58	18.17
	②	150	100	–	32481	18.37	32303	18.42	32481	18.37	18.17
	③	0	0	–	3762	20.42	3762	20.42	3762	20.42	18.17
	④	150	100	–	5255	18.75	5255	18.75	5255	18.75	18.17
	⑤	100	50	–	7734	18.75	7734	18.75	7734	18.75	18.17
	** ⑥	100	50	–	7597	18.92	7597	18.92	7597	18.92	18.33
1	①	0	0	0	2847	16.14	2771	16.50	15715	18.58	16.25
	②	150	100	100	4636	16.31	3915	16.33	33164	18.42	16.25
	③	0	0	0	–	–	–	–	3927	20.50	16.25
	④	150	100	100	5748	18.75	5748	18.75	5748	18.75	16.25
	⑤	100	50	50	1738	16.48	1628	16.42	8115	18.75	16.25
	** ⑥	100	50	50	8479	18.90	8385	18.92	8479	18.90	18.42

* SEE TABLE ON SHEET 14.

** { AVERAGE POSSIBLE CONDITIONS - [illegible]

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SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR NO 1
BY WJV DATE 2-2-79 PROJ. NO. 79-611-214
CHKD. BY DLB DATE 2-6-79 SHEET NO. 17 OF 17

HEC-1- DAM BREACHING ANALYSIS OUTPUT :

DOWNSTREAM ROUTING DATA

PLAN No. [1.]	VARIABLE BREACH BOTTOM WIDTH RES.3	RES.2	RES.1	OUTPUT @ X-SECT LOCATED 250 FT DS OF DAM NO 1 PEAK FLOW (CFS)	TIME OF FLOW (HR)	CORR WSEL (FT)	WSEL [2.] W/O BREACH (FT)	ΔELEV [3.] (FT)	OUTPUT @ X-SECT LOCATED 1500 FT DS OF DAM NO 1 PEAK FLOW (CFS)	TIME OF FLOW (HR)	CORR WSEL (FT)	WSEL [2.] W/O BREACH (FT)	ΔELEV [3.] (FT)
①	0	0	0	15883	18.58	1266.0	1256.6	9.4	16206	18.58	1220.9	1211.7	9.2
②	150	100	100	34669	18.42	1271.6	1256.6	15.0	34624	18.42	1225.6	1211.7	13.9
③	0	0	0	3936	20.50	1259.4	1256.6	2.8	3930	20.50	1214.7	1211.7	3.0
④	150	100	100	5750	18.83	1260.8	1256.6	4.2	5762	18.83	1216.0	1211.7	4.3
⑤	100	50	50	8112	18.75	1262.3	1256.6	5.7	8040	18.75	1217.5	1211.7	5.8
⑥ [4.]	100	50	50	8415	18.92	1262.5	1256.6	5.9	8325	18.92	1217.7	1211.7	6.0

1. SEE TABLE ON SHEET 14
2. BASE FLOW ELEVATIONS CORRESPONDING TO THE PEAK ½ PMF FLOW. ESTIMATED FROM THE OVERTOPPING ANALYSIS OUTPUT (SEE SUMMARY INPUT/OUTPUT SHEETS)
3. ΔELEV = (CORRESPONDING WSEL) - (WSEL W/O BREACH)
4. BASED ON ASSUMPTION OF ½ FT OF OVERTOPPING PRIOR TO BREACHING (AVERAGE POSSIBLE CONDITIONS)

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR NO. 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY ____ DATE ____ SHEET NO. A OF ____

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HUTCHINSON DAMS #1, #2, AND #3
OVERTOPPING ANALYSIS
(W/ ARTIFICIALLY INCREASED STORAGE FOR RESERVOIR #2)

SUMMARY INPUT/OUTPUT

```
DAM SAFETY INSPECTION PENNSYLVANIA 214 AND 215
HUTCHINSON RESERVOIRS =1 AND =2 ( W/ OS ANALYSIS OF RESERVOIR =3)
5-MINUTE TIME STEP AND 24-HOUR STORM DURATION

                    JOB SPECIFICATION
 NU     NHR     NMIN     IDAY     IHR     IMIN    METRC     IPLT     IPRT    NSTAN
2dB       0        5        0       0        0        0        0        0        0
                         JOPER      NEI   LROPT   TRACE
                             5        0       0       0


                 MULTI-PLAN ANALYSES TO BE PERFORMED
                     NPLAN= 1 NRTIO= 4 LRTIO= 1
          RTIOS=     .20     .30     .40    1.00

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

                    SUB-AREA RUNOFF COMPUTATION

     INFLOW TO RESERVOIR =3

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

                         HYDROGRAPH DATA
          IHDG    IUNG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
             1       1    1.90    0.00    1.90    0.00   0.000       0       1       0

                              PRECIP DATA
                SPFE     PMS      R6      R12     R24     R48     R72     R96
                0.00   24.00  102.00  120.00  130.00    0.00    0.00    0.00
INSPC COMPUTED BY THE PROGRAM IS  .800

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

                         UNIT HYDROGRAPH DATA
                    TP=  2.43    CP= .50    NTA=  0

                         RECESSION DATA
                    STRTQ=   -1.50    QRCSN=    -.05    RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=30.29 AND R=39.29 INTERVALS

     UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG=   2.44 HOURS, CP=  .50  VOL=  .88
    2.      6.     12.     20.     29.     39.     49.     61.     72.     85.
   97.    110.    124.    136.    152.    166.    180.    192.    204.    215.
  224.    233.    241.    247.    253.    257.    261.    263.    263.    262.
  257.    251.    245.    239.    233.    227.    221.    216.    210.    205.
  200.    195.    190.    185.    180.    176.    171.    167.    163.    159.
  155.    151.    147.    143.    140.    136.    133.    130.    126.    123.
  120.    117.    114.    111.    108.    106.    103.    100.     98.     95.
   93.     91.     88.     86.     84.     82.     80.     78.     76.     74.
   72.     70.     69.     67.     65.     64.     62.     60.     59.     57.
   56.     55.     53.     52.     51.     49.     48.     47.     46.     44.
```

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY ____ DATE ____ SHEET NO. B OF ____

JCI CONSULTANTS, I

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MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.96	23.08	1.88	289274.
										(634.)(586.)(48.)(8191.33)			

RESERVOIR Nº 3 INFLOW HYDROGRAPHS

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3677.	2814.	1004.	1004.	289024.
CMS	104.	80.	28.	28.	8184.
INCHES		13.78	19.65	19.65	19.65
MM		349.93	499.20	499.20	499.20
AC-FT		1395.	1991.	1991.	1991.
THOUS CU M		1721.	2455.	2455.	2455.

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1103.	844.	301.	301.	86707.
CMS	31.	24.	9.	9.	2455.
INCHES		4.13	5.90	5.90	5.90
MM		104.98	149.76	149.76	149.76
AC-FT		419.	597.	597.	597.
THOUS CU M		516.	737.	737.	737.

0.4 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1471.	1126.	401.	401.	115610.
CMS	42.	32.	11.	11.	3274.
INCHES		5.51	7.86	7.86	7.86
MM		139.97	199.68	199.68	199.68
AC-FT		558.	796.	796.	796.
THOUS CU M		688.	982.	982.	982.

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HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR =3

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
303	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	0.	-1

STAGE	1375.50	1380.50	1385.50	1390.50	1395.50	1400.50	1405.50	1410.50	1420.50
	1430.50	1431.50	1432.50	1433.50	1434.50	1434.50	1435.50	1436.50	1437.50
FLOW	0.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00	126.00
	126.00	279.00	622.00	883.00	1362.00	3630.00	6771.00	10511.00	14924.00
CAPACITY=	0.	3.	11.	25.	45.	70.	100.	137.	226.	480.
	340.	359.	378.	394.	399.	420.	441.	464.	487.	
ELEVATION=	1376.	1381.	1386.	1391.	1396.	1401.	1406.	1411.	1421.	1426.
	1431.	1432.	1433.	1433.	1434.	1435.	1436.	1437.	1438.	

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1430.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1433.1	0.0	0.0	0.

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY ____ DATE ____ SHEET NO. C OF ____

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RESERVOIR Nº 3 OUTFLOW HYDROGRAPHS

OVERTOPPING OCCURS @ APPROXIMATELY 0.37 PMF

PEAK OUTFLOW IS 3671. AT TIME 18.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3671.	2745.	808.	808.	232634.
CMS	104.	78.	23.	23.	6587.
INCHES		13.44	15.82	15.82	15.82
MM		341.40	401.80	401.80	401.80
AC-FT		1361.	1602.	1602.	1602.
THOUS CU M		1679.	1976.	1976.	1976.

PMF

PEAK OUTFLOW IS 511. AT TIME 21.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	511.	301.	121.	121.	34745.
CMS	14.	9.	3.	3.	984.
INCHES		1.47	2.36	2.36	2.36
MM		37.39	60.01	60.01	60.01
AC-FT		149.	239.	239.	239.
THOUS CU M		184.	295.	295.	295.

0.3 PMF

PEAK OUTFLOW IS 1194. AT TIME [illegible] HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1194.	681.	218.	218.	62899.
CMS	34.	19.	6.	6.	1781.
INCHES		3.34	4.28	4.28	4.28
MM		84.73	108.64	108.64	108.64
AC-FT		338.	433.	433.	433.
THOUS CU M		417.	534.	534.	534.
**********	**********	**********	**********	**********	**********

0.4 PMF

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR =2

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.09	0.00	.09	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	102.00	120.00	130.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

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= .77 CP= .50 NTA= 0

RECESSION DATA

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

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 9.92 AND R=12.57 INTERVALS

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ.NO. 78-617-214

CHKD. BY ____ DATE ____ SHEET NO. D OF ____

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UNIT HYDROGRAPH 72 END-OF-PERIOD ORDINATES, LAG= .77 HOURS, CP= .50 VOL= 1.00

1.	5.	9.	15.	21.	27.	32.	36.	38.	38.
36.	34.	31.	29.	26.	24.	23.	21.	19.	18.
16.	15.	14.	13.	12.	11.	10.	9.	9.	8.
7.	7.	6.	6.	5.	5.	5.	4.	4.	4.
3.	3.	3.	3.	2.	2.	2.	2.	2.	2.
2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	0.	0.	0.	0.	0.	0.
0.	0.								

HO.	DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	HO.	DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
											SUM	24.96	23.08	1.88	15859.
												(634.)(	586.)(	48.)(	449.08)

RESERVOIR Nº 2 — PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	322.	171.	55.	55.	15859.
CMS	9.	5.	2.	2.	449.
INCHES		17.72	22.77	22.77	22.77
MM		450.06	578.28	578.28	578.28
AC-FT		85.	109.	109.	109.
THOUS CU M		105.	135.	135.	135.

LOCAL HYDROGRAPHS — 0.2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	64.	34.	11.	11.	3172.
CMS	2.	1.	0.	0.	90.
INCHES		3.54	4.55	4.55	4.55
MM		90.01	115.66	115.66	115.66
AC-FT		17.	22.	22.	22.
THOUS CU M		21.	27.	27.	27.

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	97.	51.	17.	17.	4756.
CMS	3.	1.	0.	0.	135.
INCHES		5.32	6.83	6.83	6.83
MM		135.02	173.48	173.48	173.48
AC-FT		26.	33.	33.	33.
THOUS CU M		31.	40.	40.	40.

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COMBINE HYDROGRAPHS

COMBINE RES. #3 OUTFLOW W/ AREA #2 RUNOFF FOR INFLOW INTO RESERVOIR #2

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

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY ____ DATE ____ SHEET NO. E OF ____

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RESERVOIR Nº2 INFLOW HYDROGRAPHS

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3846.	2655.	863.	863.	246493.
CMS	109.	81.	24.	24.	7037.
INCHES		13.35	10.13	10.13	10.13
MM		339.04	409.78	409.78	409.78
AC-FT		1410.	1711.	1711.	1711.
THOUS CU M		1747.	2111.	2111.	2111.

0.2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	190.	160.	82.	82.	23630.
CMS	5.	5.	2.	2.	669.
INCHES		.75	1.53	1.53	1.53
MM		19.03	38.97	38.97	38.97
AC-FT		79.	163.	163.	163.
THOUS CU M		98.	201.	201.	201.

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	515.	314.	137.	137.	39503.
CMS	15.	9.	4.	4.	1119.
INCHES		1.47	2.56	2.56	2.56
MM		37.30	65.14	65.14	65.14
AC-FT		156.	272.	272.	272.
THOUS CU M		192.	336.	336.	336.

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HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR =2

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
202	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	121.	-1

STAGE	1345.00	1346.00	1347.00	1347.60	1347.70	1347.80	1348.00	1348.20	1348.40
	1348.60	1349.00	1349.20	1349.30					
FLOW=	0.00	14.00	206.00	378.00	417.00	456.00	533.00	754.00	975.00
	1416.00	1637.00	2182.00	2455.00					
CAPACITY=	0.	121.	123.	131.	136.	137.	138.	140.	142.	145.
	147.	151.	159.	300.	500.				
ELEVATION=	1299.	1346.	1346.	1347.	1348.	1348.	1348.	1348.	1348.	1348.
	1349.	1349.	1349.	1349.	1349.				

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1345.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1347.6	0.0	0.0	0.

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 78-617-214

CHKD. BY ____ DATE ____ SHEET NO. F OF ____

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RESERVOIR Nº 2 OUTFLOW HYDROGRAPHS

OVERTOPPING OCCURS @ 0.27 PMF.

PEAK OUTFLOW IS 2400. AT TIME 20.58 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2400.	2285.	759.	759.	216500.
CMS	66.	65.	21.	21.	6184.
INCHES		10.68	14.19	14.19	14.19
MM		271.26	360.42	360.42	360.42
AC-FT		1133.	1505.	1505.	1505.
THOUS CU M		1397.	1857.	1857.	1857.

PMF

PEAK OUTFLOW IS 181. AT TIME 16.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	181.	159.	79.	79.	22644.
CMS	5.	5.	2.	2.	641.
INCHES		.74	1.47	1.47	1.47
MM		18.92	37.34	37.34	37.34
AC-FT		79.	156.	156.	156.
THOUS CU M		97.	192.	192.	192.

0.2 PMF

PEAK OUTFLOW IS 497. AT TIME 21.92 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	497.	307.	131.	131.	37627.
CMS	14.	9.	4.	4.	1065.
INCHES		1.44	2.44	2.44	2.44
MM		36.45	62.05	62.05	62.05
AC-FT		152.	259.	259.	259.
THOUS CU M		188.	320.	320.	320.

0.3 PMF

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SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR =1

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	.43	0.00	.43	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	102.00	120.00	130.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

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

UNIT HYDROGRAPH DATA

TP= 1.41 CP= .50 NTA= 0

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY ____ DATE ____ SHEET NO. G OF ____

GEI CONSULTANTS, Engineers • Geologists • Planners Environmental Specialists

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

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=17.66 AND R=23.16 INTERVALS

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 1.40 HOURS, CP= .50 VOL= .98

1.	5.	10.	17.	24.	32.	41.	50.	59.	66.
70.	83.	89.	94.	98.	100.	101.	100.	96.	92.
88.	85.	81.	78.	74.	71.	68.	65.	63.	60.
57.	55.	53.	50.	48.	46.	44.	42.	41.	39.
37.	36.	34.	33.	31.	30.	29.	28.	26.	25.
24.	23.	22.	21.	20.	20.	19.	18.	17.	16.
16.	15.	14.	14.	13.	13.	12.	12.	11.	11.
10.	10.	9.	9.	9.	8.	8.	8.	7.	7.
7.	6.	6.	6.	6.	5.	5.	5.	5.	4.
4.	4.	4.	4.	4.	3.	3.	3.	3.	3.

Q SQ.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	SQ.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.96	23.08	1.88	73644.
										(634.)(586.)(48.)(2091.03)			

RESERVOIR Nº 1 LOCAL HYDROGRAPHS

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1119.	745.	256.	256.	73819.
CMS	32.	21.	7.	7.	2090.
INCHES		16.11	22.18	22.18	22.18
MM		409.28	563.36	563.36	563.36
AC-FT		364.	508.	508.	508.
THOUS CU M		450.	627.	627.	627.

0.2 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	424.	149.	51.	51.	14764.
CMS	0.	4.	1.	1.	418.
INCHES		3.22	4.44	4.44	4.44
MM		81.86	112.67	112.67	112.67
AC-FT		74.	102.	102.	102.
THOUS CU M		91.	125.	125.	125.

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	336.	223.	77.	77.	22140.
CMS	10.	6.	2.	2.	627.
INCHES		4.83	6.65	6.65	6.65
MM		122.78	169.01	169.01	169.01
AC-FT		111.	153.	153.	153.
THOUS CU M		137.	188.	188.	188.

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COMBINE HYDROGRAPHS

COMBINE ADJUSTED RES. #2 OUTFLOW W/ AREA #1 RUNOFF FOR INFLOW TO RESERVOIR #1

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

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 78-617-214

CHKD. BY ____ DATE ____ SHEET NO. 4 OF ____

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RESERVOIR Nº 1 INFLOW HYDROGRAPHS

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
	CFS	3068.	2811.	1015.	1015.	292379.	PMF
	CMS	87.	80.	29.	29.	8279.	
	INCHES		10.81	15.61	15.61	15.61	
	MM		274.47	396.48	396.48	396.48	
	AC-FT		1394.	2014.	2014.	2014.	
	THOUS CU M		1719.	2484.	2484.	2484.	
		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
	CFS	404.	308.	130.	130.	37907.	0.2 PMF
	CMS	11.	9.	4.	4.	1059.	
	INCHES		1.18	2.00	2.00	2.00	
	MM		30.09	50.73	50.73	50.73	
	AC-FT		153.	258.	258.	258.	
	THOUS CU M		188.	318.	318.	316.	
		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
	CFS	555.	443.	208.	208.	59773.	0.3 PMF
	CMS	16.	13.	6.	6.	1693.	
	INCHES		1.70	3.19	3.19	3.19	
	MM		43.28	81.06	81.06	81.06	
	AC-FT		220.	412.	412.	412.	
	THOUS CU M		271.	508.	508.	506.	

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HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR #1

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPNT	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	AMSAK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	45.	-1

STAGE	1291.60	1292.00	1292.50	1293.00	1293.50	1294.00	1294.30	1295.00	1295.50
	1297.00	1298.00	1299.00						
FLOW	0.00	10.00	176.00	261.00	380.00	515.00	622.00	1386.00	2215.00
	5527.00	8300.00	11474.00						
CAPACITY=	0.	45.	46.	50.	54.	56.	59.	64.	69.	74.
	80.								
ELEVATION=	1255.	1292.	1292.	1293.	1294.	1294.	1295.	1296.	1297.	1298.
	1299.								

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1291.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1294.3	0.0	0.0	0.

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY DATE SHEET NO. I OF

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RESERVOIR Nº 1 OUTFLOW HYDROGRAPHS

OVERTOPPING OCCURS @ 0.33 PMF

PEAK OUTFLOW IS 3068. AT TIME 18.42 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3068.	2811.	1007.	1007.	290111.
CMS	87.	80.	29.	29.	8215.
INCHES		10.81	15.49	15.49	15.49
MM		274.50	393.41	393.41	393.41
AC-FT		1394.	1998.	1998.	1998.
THOUS CU M		1720.	2465.	2465.	2465.

PMF

PEAK OUTFLOW IS 551. AT TIME 22.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	551.	443.	204.	204.	58849.
CMS	16.	13.	6.	6.	1666.
INCHES		1.70	3.14	3.14	3.14
MM		43.25	79.80	79.80	79.80
AC-FT		220.	405.	405.	405.
THOUS CU M		271.	500.	500.	500.

0.3 PMF

PEAK OUTFLOW IS 1242. AT TIME 19.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1242.	916.	346.	346.	99504.
CMS	35.	26.	10.	10.	2818.
INCHES		3.52	5.31	5.31	5.31
MM		89.42	134.93	134.93	134.93
AC-FT		454.	685.	685.	685.
THOUS CU M		560.	845.	845.	845.

0.4 PMF

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

HYDROGRAPH ROUTING

DOWNSTREAM CHANNEL ROUTING FROM RESERVOIR =1 TO SECTION 7

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
107	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	0.	0

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 1
BY WJV DATE 2-6-79 PROJ. NO. 78-617-214
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NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMAI	ELMAX	MLNTH	SEL
.1250	.0450	.1000	1252.0	1298.0	250.	.05000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1300.00 63.00 1260.00 160.00 1256.00 165.00 1252.00 180.00 1252.00
183.00 1256.00 312.00 1280.00 375.00 1300.00

STORAGE	0.00	.24	.57	1.15	2.06	3.28	4.82	6.68	8.85
	14.14	17.26	20.69	24.35	28.22	32.30	36.60	41.10	45.82
OUTFLOW	0.00	463.36	1667.88	3785.99	6951.84	11341.79	17116.20	24425.50	33412.80
	50962.53	71784.47	89195.85	109307.03	131613.63	156160.56	182995.99	212170.27	243735.16
STAGE	1252.00	1254.42	1256.84	1259.26	1261.68	1264.11	1266.53	1268.95	1271.37
	1276.21	1278.63	1281.05	1283.47	1285.89	1288.32	1290.74	1293.16	1295.58
FLOW	0.00	463.36	1667.88	3785.99	6951.84	11341.79	17116.20	24425.50	33412.80
	50962.53	71784.47	89195.85	109307.03	131613.63	156160.56	182995.99	212170.27	243735.16

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3066.	2611.	1007.	1007.	29[illegible].
CMS	87.	80.	29.	29.	8212.
INCHES		10.81	15.48	15.48	15.48
MM		274.50	393.27	393.27	393.27
AC-FT		1394.	1997.	1997.	1997.
THOUS CU M		1720.	2464.	2464.	2464.

MAXIMUM STORAGE = 1.

MAXIMUM STAGE IS 1258.4

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

HYDROGRAPH ROUTING

DOWNSTREAM CHANNEL ROUTING FROM SECTION 7 TO SECTION 8

ISTAQ	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	0.	0

NORMAL DEPTH CHANNEL ROUTING

SN(1)	SN(2)	SN(3)	ELAVI	ELMAX	RLNTH	SEL
.1000	.0450	.0800	1206.0	1260.0	1250.	.03300

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

0.00 1260.00 87.00 1240.00 360.00 1210.00 363.00 1206.00 378.00 1206.00
390.00 1212.00 590.00 1240.00 772.00 1260.00

STORAGE	0.00	1.35	3.32	6.11	16.69	29.68	46.46	67.25	92.04
	153.64	190.44	231.24	275.44	322.53	372.51	425.37	481.12	539.75
OUTFLOW	0.00	475.58	1552.29	3715.40	7007.73	14022.98	23313.75	36022.02	52595.25
	99001.67	129620.01	165757.17	209683.11	259540.65	315503.46	377754.74	446483.41	521881.73
STAGE	1206.00	1208.84	1211.66	1214.53	1217.37	1220.21	1223.05	1225.89	1228.74
	1234.42	1237.26	1240.11	1242.95	1245.79	1248.63	1251.47	1254.32	1257.16
FLOW	0.00	475.58	1552.29	3715.40	7007.73	14022.98	23313.75	36022.02	52595.25
	99001.67	129620.01	165757.17	209683.11	259540.65	315503.46	377754.74	446483.41	521881.73

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3067.	2611.	1005.	1005.	269392.
CMS	87.	80.	28.	28.	8194.
INCHES		10.81	15.45	15.45	15.45
MM		274.47	392.38	392.38	392.38
AC-FT		1354.	1993.	1993.	1993.
THOUS CU M		1719.	2458.	2458.	2458.

PMF

MAXIMUM STORAGE = 7.

MAXIMUM STAGE IS 1213.7

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR NO. 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY DATE SHEET NO. K OF

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Engineers • Geologists • Planners
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SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 78-617-214

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1375.50	1430.50	1433.10
STORAGE	0.	340.	390.
OUTFLOW	0.	126.	618.

RESERVOIR Nº3

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	1423.40	0.00	257.	126.	0.00	13.50	0.00
.30	1432.18	0.00	372.	511.	0.00	21.50	0.00
.40	1433.42	.32	397.	1194.	2.17	19.67	0.00
1.00	1434.51	1.41	420.	3671.	7.58	18.08	0.00
* 0.50	1433.66	0.56		1748.			

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1345.80	1345.80	1347.60
STORAGE	121.	121.	136.
OUTFLOW	0.	0.	378.

RESERVOIR Nº2

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	1346.87	0.00	130.	181.	0.00	16.75	0.00
.30	1347.91	.31	139.	497.	2.33	21.92	0.00
.40	1348.47	.87	145.	1047.	5.00	20.33	0.00
1.00	1349.28	1.68	460.	2400.	8.00	20.58	0.00
* 0.50	1348.6	1.00		1270.			

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1291.80	1291.80	1294.30
STORAGE	45.	45.	56.
OUTFLOW	0.	0.	822.

RESERVOIR Nº 1

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	1293.57	0.00	53.	399.	0.00	17.17	0.00
.30	1294.10	0.00	55.	551.	0.00	22.00	0.00
.40	1294.87	.57	58.	1242.	5.25	19.75	0.00
1.00	1295.94	1.64	63.	3068.	9.50	18.42	0.00
* 0.50	1295.0	0.70		1550.			

* INTERPOLATED VALUES

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 78-617-214

CHKD. BY _____ DATE _____ SHEET NO. M OF _____

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SECTION 7
250 FT DS
OF DAM Nº 1

PLAN 1 STATION 107

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	400.	1254.0	17.17
.30	551.	1254.6	22.00
.40	1241.	1256.0	19.25
1.00	3068.	1258.4	18.42
* 0.50	1550.	1256.6	

SECTION 8
1500 FT DS
OF DAM Nº 1

PLAN 1 STATION 708

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	400.	1208.4	17.17
.30	551.	1209.0	22.00
.40	1240.	1210.9	19.25
1.00	3067.	1213.7	18.50
* 0.50	1550.	1211.7	

* INTERPOLATED VALUES

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 1
BY WJV DATE 2-6-79 PROJ.NO. 79-617-214
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DAM SAFETY INSPECTION PENNSYLVANIA 214 AND 215
HUTCHINSON RESERVOIRS =1 AND =2 (=/ US ANALYSIS OF RESERVOIR =3)
BREACHING ANALYSIS

BREACHING ANALYSIS

(SAME INPUT DATA AS FOR THE OVERTOPPING ANALYSIS W/ THE ADDITION OF THE BREACH CONDITIONS GIVEN HERE)

PLAN

ROUTE THRU RESERVOIR =3

DAM DATA

TOPEL	COOD	EXPD	DAM#ID
1433.1	0.0	0.0	0.

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
0.	.50	1377.10	.25	1375.50	1433.10

(1)

BEGIN DAM FAILURE AT 18.25 HOURS

PEAK OUTFLOW IS 19572. AT TIME 18.50 HOURS

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
150.	2.00	1377.10	.25	1375.50	1433.10

(2)

BEGIN DAM FAILURE AT 18.25 HOURS

PEAK OUTFLOW IS 29691. AT TIME 18.37 HOURS

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
0.	.50	1377.10	4.00	1375.50	1433.10

(3)

BEGIN DAM FAILURE AT 18.25 HOURS

PEAK OUTFLOW IS 3138. AT TIME 20.42 HOURS

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
150.	2.00	1377.10	4.00	1375.50	1433.10

(4)

BEGIN DAM FAILURE AT 18.25 HOURS

PEAK OUTFLOW IS 4330. AT TIME 18.75 HOURS

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
100.	1.00	1377.10	2.00	1375.50	1433.00

(6)

BEGIN DAM FAILURE AT 18.50 HOURS

PEAK OUTFLOW IS 5996. AT TIME 18.63 HOURS

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
100.	1.00	1377.10	2.00	1375.50	1433.10

(5)

BEGIN DAM FAILURE AT 18.25 HOURS

PEAK OUTFLOW IS 5997. AT TIME 18.63 HOURS

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CKD. BY ______ DATE ______ SHEET NO. 0 OF ______

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 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)
18.250	0.000	851.		851.	OUTFLOWS W/O BREACH FROM OVERTOPPING ANALYSIS	0.	0.	0.
18.292	.042	1509.		1380.		129.	129.	0.
18.333	.083	2167.		- 2167.	- 1186 = 981	-0.	129.	0.
18.375	.125	2969.		2982.		-13.	116.	0.
18.417	.167	3771.		- 3771.	- 1554 = 2217	0.	116.	0.
18.458	.208	4409.		4475.		-67.	50.	0.
18.500	.250	5046.		- 5046.	- 1681 = 3365	0.	50.	0.
18.542	.292	5514.		5530.		-16.	33.	0.
18.583	.333	(5982)		- 5982.	- 1732 = 4250	0.	33.	0.
18.625	.375	5962.		(5997)		-35.	-2.	-0.
18.667	.417	5941.		- 5941.	- 1748 = 4193	0.	-2.	-0.
18.708	.458	5906.		5901.		5.	3.	0.
18.750	.500	5871.		- 5871.	- 1746 = 4125	0.	3.	0.
18.792	.542	5748.		5753.		-4.	-1.	-0.
18.833	.583	5626.		- 5626.	- 1736 = 3890	0.	-1.	-0.
18.875	.625	5553.		5540.		13.	12.	0.
18.917	.667	5480.		- 5480.	- 1722 = 3750	0.	12.	0.
18.958	.708	5264.		5269.		-5.	7.	0.
19.000	.750	5048.		- 5048.	- 1705 = 3343	0.	7.	0.
19.042	.792	4935.		4910.		25.	32.	0.
19.083	.833	4822.		- 4822.	- 1686 = 3136	0.	32.	0.
19.125	.875	4773.		4764.	↑	9.	41.	0.
19.167	.917	4724.		4724.	APPROXIMATE	0.	41.	0.
19.208	.958	4698.		4691.	OUTFLOWS	3.	44.	0.
19.250	1.000	4672.		4672.	DUE TO	0.	44.	0.
19.292	1.042	4504.		4513.	BREACH	-9.	36.	0.
19.333	1.083	4336.		4336.		0.	36.	0.
19.375	1.125	4251.		4231.		20.	55.	0.
19.417	1.167	4166.		4166.		0.	55.	0.
19.458	1.208	3968.		3951.		17.	72.	0.
19.500	1.250	3769.		3769.		0.	72.	0.
19.542	1.292	3691.		3670.		21.	93.	0.
19.583	1.333	3613.		3613.		0.	93.	0.
19.625	1.375	3453.		3417.		36.	129.	0.
19.667	1.417	3292.		3292.		0.	129.	0.
19.708	1.458	3241.		3227.		14.	143.	0.
19.750	1.500	3190.		3190.		0.	143.	0.
19.792	1.542	3026.		2973.		52.	195.	1.
19.833	1.583	2862.		2862.		0.	195.	1.
19.875	1.625	2821.		2809.		11.	206.	1.
19.917	1.667	2780.		2780.		0.	206.	1.
19.958	1.708	2570.		2463.		107.	314.	1.
20.000	1.750	2361.		2361.		0.	314.	1.
20.042	1.792	2311.		2323.		-12.	301.	1.
20.083	1.833	2261.		2261.		0.	301.	1.
20.125	1.875	2060.		1883.		177.	479.	2.
20.167	1.917	1859.		1859.		0.	479.	2.
20.208	1.958	1776.		1844.		-68.	411.	1.
20.250	2.000	1693.		1693.		0.	411.	1.

(5)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CKD. BY _____ DATE _____ SHEET NO. P OF _____

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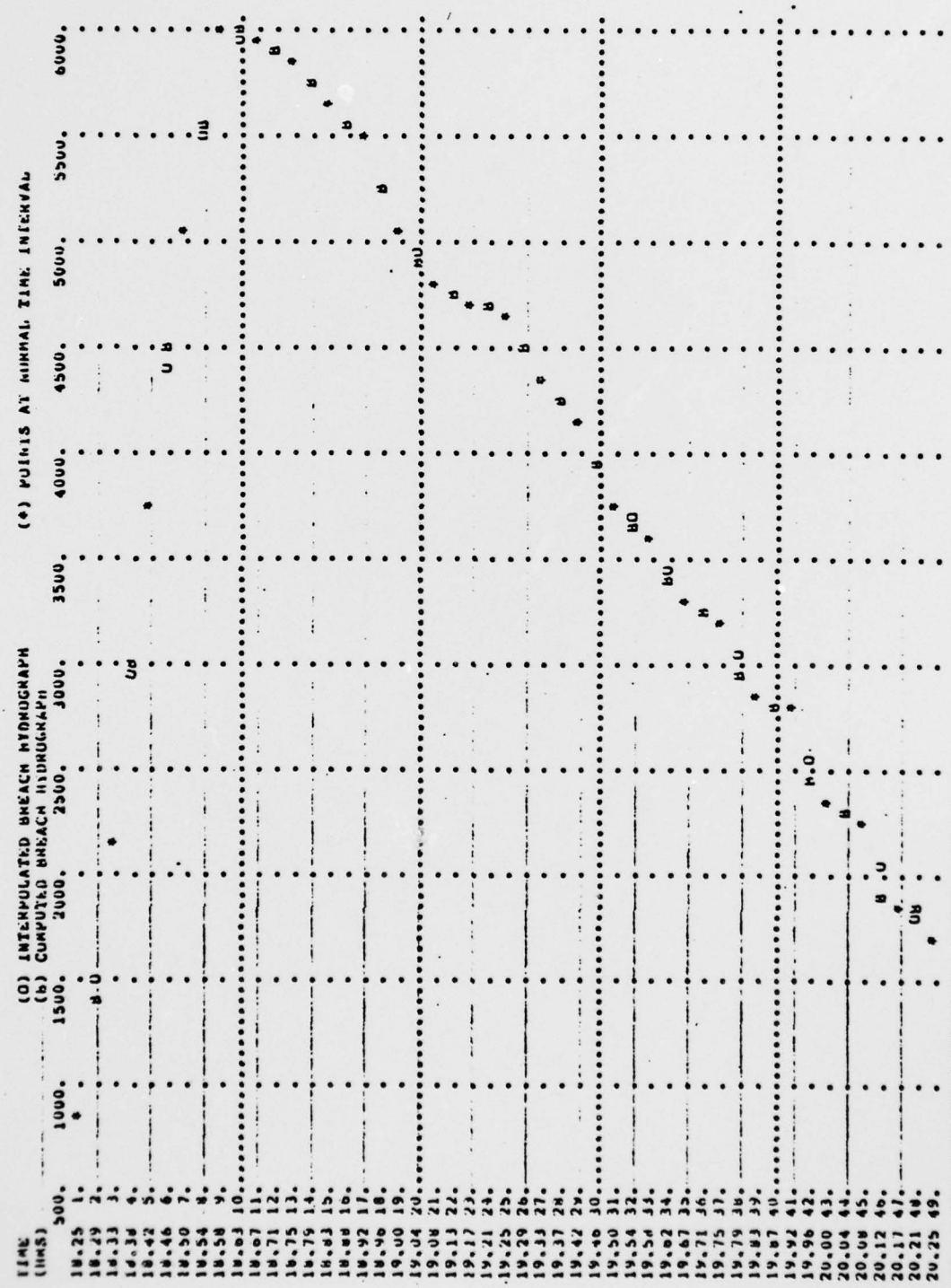

SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY DATE SHEET NO. Q OF

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ROUTE THRU RESERVOIR #2

PLAN

DAM DATA

TOPEL	COOD	EXPD	DAM#ID
1347.6	0.0	0.0	0.

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
0.	.50	1300.60	.25	1345.80	1347.60

(1) BEGIN DAM FAILURE AT 18.17 HOURS

PEAK OUTFLOW IS 15532. AT TIME 18.58 HOURS

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
100.	4.00	1300.60	.25	1345.80	1347.60

(2) BEGIN DAM FAILURE AT 18.17 HOURS

PEAK OUTFLOW IS 32481. AT TIME 18.37 HOURS

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
0.	.50	1300.60	4.00	1345.80	1347.60

(3) BEGIN DAM FAILURE AT 18.17 HOURS

PEAK OUTFLOW IS 3762. AT TIME 20.42 HOURS

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
100.	4.00	1300.60	4.00	1345.80	1347.60

(4) BEGIN DAM FAILURE AT 18.17 HOURS

PEAK OUTFLOW IS 5255. AT TIME 18.75 HOURS

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
50.	1.00	1300.60	2.00	1345.80	1346.10

(6) BEGIN DAM FAILURE AT 18.33 HOURS

PEAK OUTFLOW IS 7597. AT TIME 18.92 HOURS

DAM BREACH DATA

BR#ID	Z	ELBM	TFAIL	#SEL	FAILEL
50.	1.00	1300.60	2.00	1345.80	1347.60

(5) BEGIN DAM FAILURE AT 18.17 HOURS

PEAK OUTFLOW IS 7734. AT TIME 18.75 HOURS

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR № 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214
CHKD. BY ______ DATE ______ SHEET NO. R OF ______

GAI CONSULTANTS, Engineers • Geologists • Planners, Environmental Specialists

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 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.

APPROXIMATE DAM № 1 BREACH OUTFLOWS (SEE SHEET O)

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)
18.167	0.000	461.	461.	0.	0.	0.
18.208	.042	741.	702.	40.	40.	0.
18.250	.083	1022.	1022.	-0.	40.	0.
18.292	.125	1498.	1430.	67.	107.	0.
18.333	.167	1974.	1974. -931=1043	0.	107.	0.
18.375	.208	2745.	2682.	64.	171.	1.
18.417	.250	3517.	3517. -2217=1300	-0.	171.	1.
18.458	.292	4324.	4353.	-29.	142.	0.
18.500	.333	5131.	5131. -3365=1766	-0.	142.	0.
18.542	.375	5650.	5959.	-109.	32.	0.
18.583	.417	6569.	6569. -4250=2319	0.	32.	0.
18.625	.458	7008.	7089.	-81.	-48.	-0.
18.667	.500	7448.	7448. -4113=3335	0.	-48.	-0.
18.708	.542	7591.	7626.	-35.	-83.	-0.
18.750	.583	7734.	7734. -4125=3609	0.	-83.	-0.
18.792	.625	7171.	7133.	38.	-45.	-0.
18.833	.667	6608.	6608. -3890=2718	0.	-45.	-0.
18.875	.708	6469.	6427.	42.	-2.	-0.
18.917	.750	6331.	6331. -3750=2581	0.	-2.	-0.
18.958	.792	6164.	6195.	-32.	-34.	-0.
19.000	.833	5997.	5997. -3343=2654	0.	-34.	-0.
19.042	.875	5847.	5825.	23.	-11.	-0.
19.083	.917	5698.	5698. -3136=2562	0.	-11.	-0.
19.125	.958	5621.	5605.	16.	5.	0.
19.167	1.000	5545.	5545.	0.	5.	0.
19.208	1.042	5507.	5501.	6.	11.	0.
19.250	1.083	5469.	5469.	0.	11.	0.
19.292	1.125	5355.	5388.	-33.	-22.	-0.
19.333	1.167	5241.	5241.	0.	-22.	-0.
19.375	1.208	5127.	5109.	17.	-4.	-0.
19.417	1.250	5012.	5012.	0.	-4.	-0.
19.458	1.292	4857.	4882.	-25.	-29.	-0.
19.500	1.333	4702.	4702.	0.	-29.	-0.
19.542	1.375	4579.	4553.	26.	-4.	-0.
19.583	1.417	4456.	4456.	0.	-4.	-0.
19.625	1.458	4326.	4342.	-17.	-20.	-0.
19.667	1.500	4196.	4195.	0.	-20.	-0.
19.708	1.542	4102.	4079.	23.	3.	0.
19.750	1.583	4007.	4007.	0.	3.	0.
19.792	1.625	3888.	3911.	-23.	-20.	-0.
19.833	1.667	3768.	3768.	0.	-20.	-0.
19.875	1.708	3679.	3654.	25.	5.	0.
19.917	1.750	3589.	3589.	0.	5.	0.
19.958	1.792	3450.	3484.	-34.	-29.	-0.
20.000	1.833	3310.	3310.	0.	-29.	-0.
20.042	1.875	3198.	3167.	31.	1.	0.
20.083	1.917	3085.	3085.	0.	1.	0.
20.125	1.958	2947.	2976.	-28.	-27.	-0.
20.167	2.000	2809.	2809.	0.	-27.	-0.

APPROXIMATE OUTFLOWS DUE TO BREACHING OF DAM № 2 ONLY

(5)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY _____ DATE _____ SHEET NO. 5 OF _____

gai CONSULTANTS,
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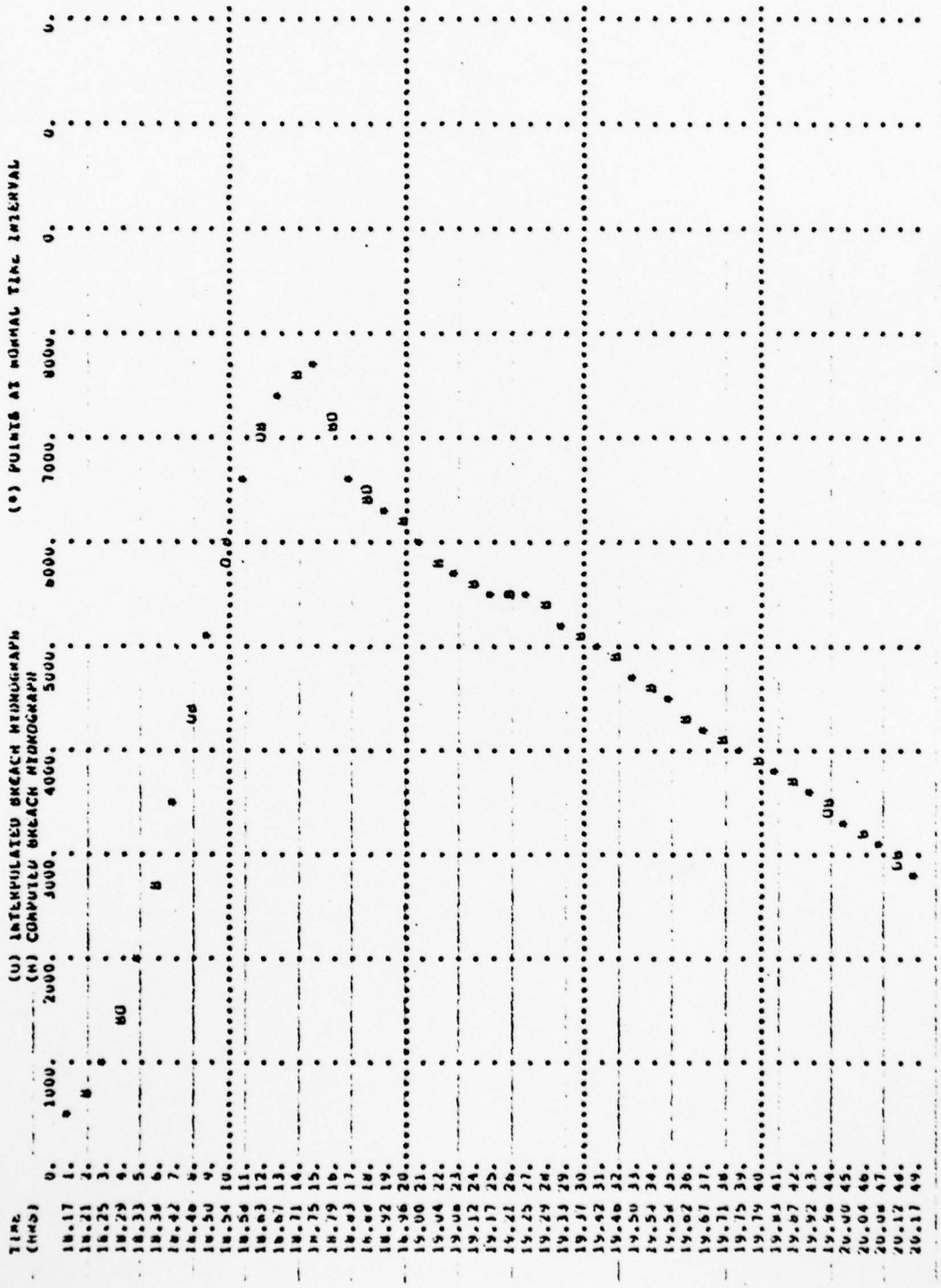
Environmental Specialists



SUBJECT: DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1

BY: WJV DATE: 2-6-79 PROJ. NO. 79-617-214

CKD. BY: DATE: SHEET NO. T OF

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Environmental Specialists

```
ROUTE THRU RESERVOIR #1

                     DAM DATA
        TOPEL     COOD     EXPD    DAMWID
        1294.3     0.0      0.0      0.
```

PLAN

③
```
                          DAM BREACH DATA
        BRWID       Z      ELBM    TFAIL     WSEL   FAILEL
          0.       .50   1261.30    4.00   1291.80  1294.30

BEGIN DAM FAILURE AT 16.25 HOURS

PEAK OUTFLOW IS    3927. AT TIME  20.50 HOURS
```

④
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                          DAM BREACH DATA
        BRWID       Z      ELBM    TFAIL     WSEL   FAILEL
        100.      2.50   1261.30    4.00   1291.80  1294.30

BEGIN DAM FAILURE AT 16.25 HOURS

PEAK OUTFLOW IS    5746. AT TIME  18.75 HOURS
```

⑥
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                          DAM BREACH DATA
        BRWID       Z      ELBM    TFAIL     WSEL   FAILEL
         50.      1.00   1261.30    1.00   1291.80  1294.80

BEGIN DAM FAILURE AT 18.42 HOURS

PEAK OUTFLOW IS    8479. AT TIME  18.90 HOURS
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①
```
                          DAM BREACH DATA
        BRWID       Z      ELBM    TFAIL     WSEL   FAILEL
          0.       .50   1261.30     .25   1291.80  1294.30

BEGIN DAM FAILURE AT 16.25 HOURS

PEAK OUTFLOW IS   15715. AT TIME  18.58 HOURS
```

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

KD. BY ____ DATE ____ SHEET NO. U OF ____

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .005 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)
16.250	0.000	662.		662.		0.	0.	0.
16.255	.005	686.		666.		20.	20.	0.
16.260	.010	710.		671.		40.	60.	0.
16.265	.015	734.		677.		57.	117.	0.
16.270	.020	758.		686.		72.	189.	0.
16.275	.025	782.		697.		85.	274.	0.
16.279	.029	806.		711.		95.	369.	0.
16.284	.034	830.		727.		103.	472.	0.
16.289	.039	854.		746.		108.	580.	0.
16.294	.044	878.		768.		110.	690.	0.
16.299	.049	902.		792.		110.	800.	0.
16.304	.054	926.		818.		108.	908.	0.
16.309	.059	950.		848.		103.	1010.	0.
16.314	.064	974.		879.		95.	1105.	0.
16.319	.069	998.		919.		79.	1185.	0.
16.324	.074	1022.		966.		56.	1241.	1.
16.328	.078	1046.		1016.		30.	1271.	1.
16.333	.083	1070.		1070.		-0.	1271.	1.
16.338	.088	1152.		1126.		25.	1296.	1.
16.343	.093	1234.		1186.		48.	1344.	1.
16.348	.098	1315.		1248.		67.	1411.	1.
16.353	.103	1397.		1313.		84.	1495.	1.
16.358	.108	1479.		1384.		95.	1590.	1.
16.363	.113	1561.		1461.		100.	1689.	1.
16.368	.118	1642.		1540.		102.	1791.	1.
16.373	.123	1724.		1622.		102.	1894.	1.
16.377	.127	1806.		1706.		100.	1994.	1.
16.382	.132	1888.		1792.		96.	2090.	1.
16.387	.137	1970.		1881.		89.	2178.	1.
16.392	.142	2051.		1973.		78.	2257.	1.
16.397	.147	2133.		2067.		67.	2323.	1.
16.402	.152	2215.		2161.		54.	2377.	1.
16.407	.157	2297.		2259.		38.	2415.	1.
16.412	.162	2379.		2359.		19.	2435.	1.
16.417	.167	2460.		2460.		0.	2435.	1.
16.422	.172	2479.		2549.		-70.	2364.	1.
16.426	.176	2497.		2620.		-123.	2241.	1.
16.431	.181	2515.		2691.		-176.	2065.	1.
16.436	.186	2533.		2816.		-283.	1782.	1.
16.441	.191	2552.		2847.		-295.	1487.	1.
16.446	.196	2570.		2835.		-265.	1222.	0.
16.451	.201	2588.		2825.		-237.	985.	0.
16.456	.206	2606.		2816.		-209.	776.	0.
16.461	.211	2625.		2808.		-183.	592.	0.
16.466	.216	2643.		2801.		-158.	434.	0.
16.471	.221	2661.		2795.		-133.	301.	0.
16.475	.225	2680.		2789.		-110.	191.	0.
16.480	.230	2698.		2785.		-87.	105.	0.
16.485	.235	2716.		2780.		-64.	40.	0.
16.490	.240	2734.		2777.		-42.	-2.	-0.
16.495	.245	2753.		2774.		-21.	-23.	-0.
16.500	.250	2771.		2771.		0.	-23.	-0.

DUE TO BREACHING OF DAM No 1 ONLY →

(1)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR NO 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CKD. BY _____ DATE _____ SHEET NO. V OF _____

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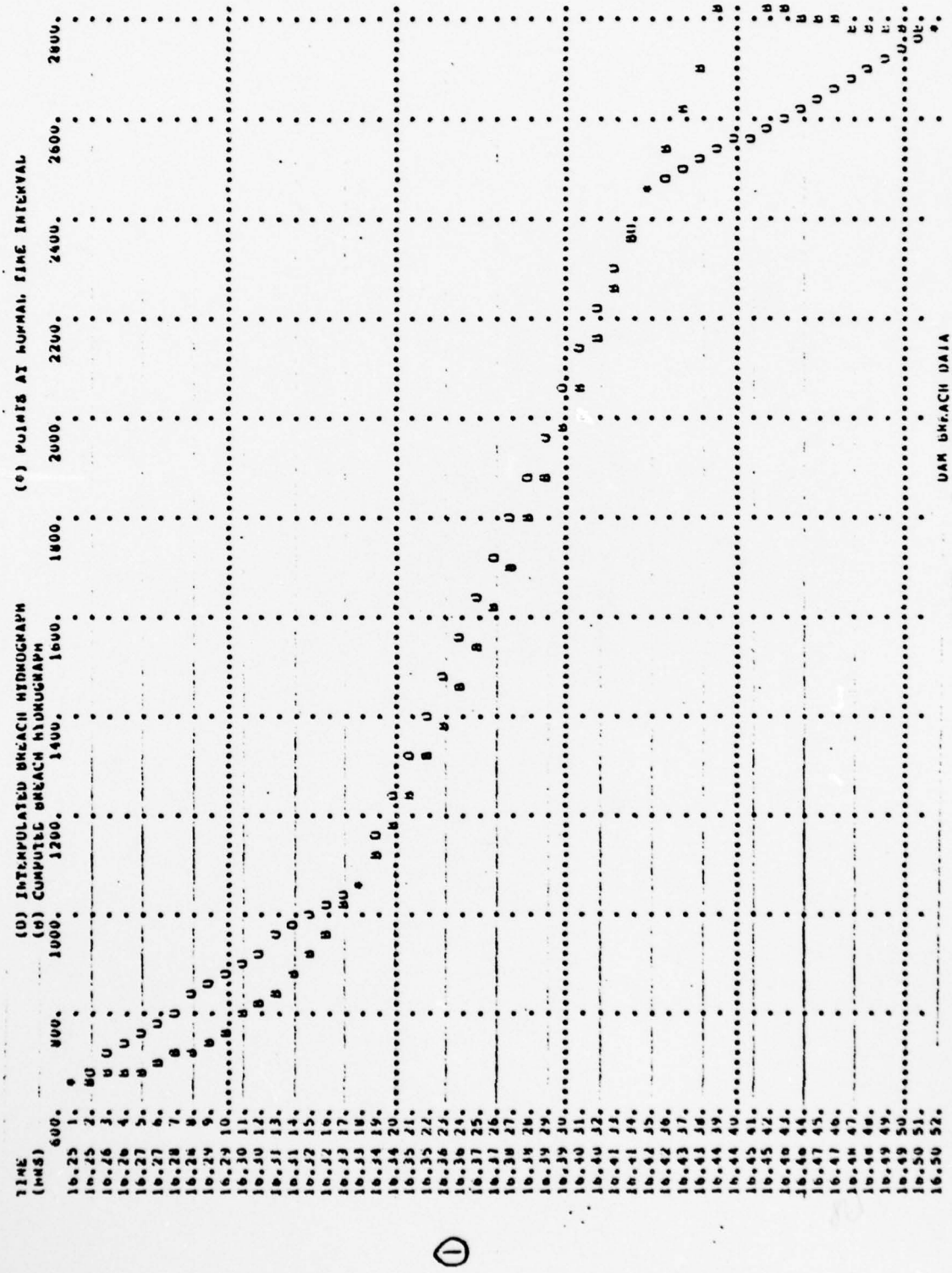

(2)

(1)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

KD. BY ______ DATE ______ SHEET NO. W OF ______

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .005 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)
16.250	0.000	663.		663.		0.	0.	0.
16.255	.005	806.		831.		-25.	-25.	-0.
16.260	.010	949.		1102.		-153.	-178.	-0.
16.265	.015	1092.		1439.		-347.	-524.	-0.
16.270	.020	1235.		1809.		-574.	-1098.	-0.
16.275	.025	1378.		2190.		-811.	-1910.	-1.
16.279	.029	1521.		2585.		-1064.	-2973.	-1.
16.284	.034	1664.		2975.		-1310.	-4284.	-2.
16.289	.039	1808.		3349.		-1542.	-5825.	-2.
16.294	.044	1951.		3707.		-1756.	-7582.	-3.
16.299	.049	2094.		4033.		-1940.	-9521.	-4.
16.304	.054	2237.		4322.		-2085.	-11606.	-5.
16.309	.059	2380.		4527.		-2147.	-13753.	-6.
16.314	.064	2523.		4637.		-2114.	-15867.	-6.
16.319	.069	2666.		3966.		-1300.	-17167.	-7.
16.324	.074	2809.		3547.		-738.	-17905.	-7.
16.328	.078	2952.		3275.		-323.	-18229.	-7.
16.333	.083	3095.		3095.		0.	-18229.	-7.
16.338	.088	3073.		2973.		100.	-18129.	-7.
16.343	.093	3051.		2890.		161.	-17969.	-7.
16.348	.098	3029.		2833.		195.	-17773.	-7.
16.353	.103	3007.		2794.		213.	-17561.	-7.
16.358	.108	2985.		2767.		217.	-17343.	-7.
16.363	.113	2963.		2749.		214.	-17130.	-7.
16.368	.118	2941.		2737.		204.	-16926.	-7.
16.373	.123	2919.		2728.		190.	-16736.	-7.
16.377	.127	2897.		2723.		173.	-16562.	-7.
16.382	.132	2875.		2720.		155.	-16407.	-7.
16.387	.137	2852.		2718.		135.	-16273.	-7.
16.392	.142	2830.		2717.		113.	-16159.	-7.
16.397	.147	2808.		2717.		91.	-16068.	-7.
16.402	.152	2786.		2717.		69.	-15999.	-6.
16.407	.157	2764.		2718.		46.	-15953.	-6.
16.412	.162	2742.		2719.		23.	-15930.	-6.
16.417	.167	2720.		2720.		0.	-15930.	-6.
16.422	.172	2722.		2721.		0.	-15930.	-6.
16.426	.176	2723.		2723.		0.	-15929.	-6.
16.431	.181	2724.		2724.		0.	-15929.	-6.
16.436	.186	2726.		2725.		0.	-15929.	-6.
16.441	.191	2727.		2727.		0.	-15929.	-6.
16.446	.196	2728.		2728.		0.	-15929.	-6.
16.451	.201	2729.		2729.		0.	-15929.	-6.
16.456	.206	2731.		2731.		0.	-15929.	-6.
16.461	.211	2732.		2732.		0.	-15928.	-6.
16.466	.216	2733.		2733.		0.	-15928.	-6.
16.471	.221	2735.		2735.		0.	-15928.	-6.
16.475	.225	2736.		2736.		0.	-15928.	-6.
16.480	.230	2737.		2737.		0.	-15928.	-6.
16.485	.235	2739.		2739.		0.	-15928.	-6.
16.490	.240	2740.		2740.		0.	-15928.	-6.
16.495	.245	2741.		2741.		0.	-15928.	-6.
16.500	.250	2743.		2743.		0.	-15928.	-6.

DUE TO BREACHING OF DAM No 1 ONLY

(2)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1

BY WJV DATE 2-6-79 PROJ. NO. 78-617-214

CHD. BY _____ DATE _____ SHEET NO. X OF _____

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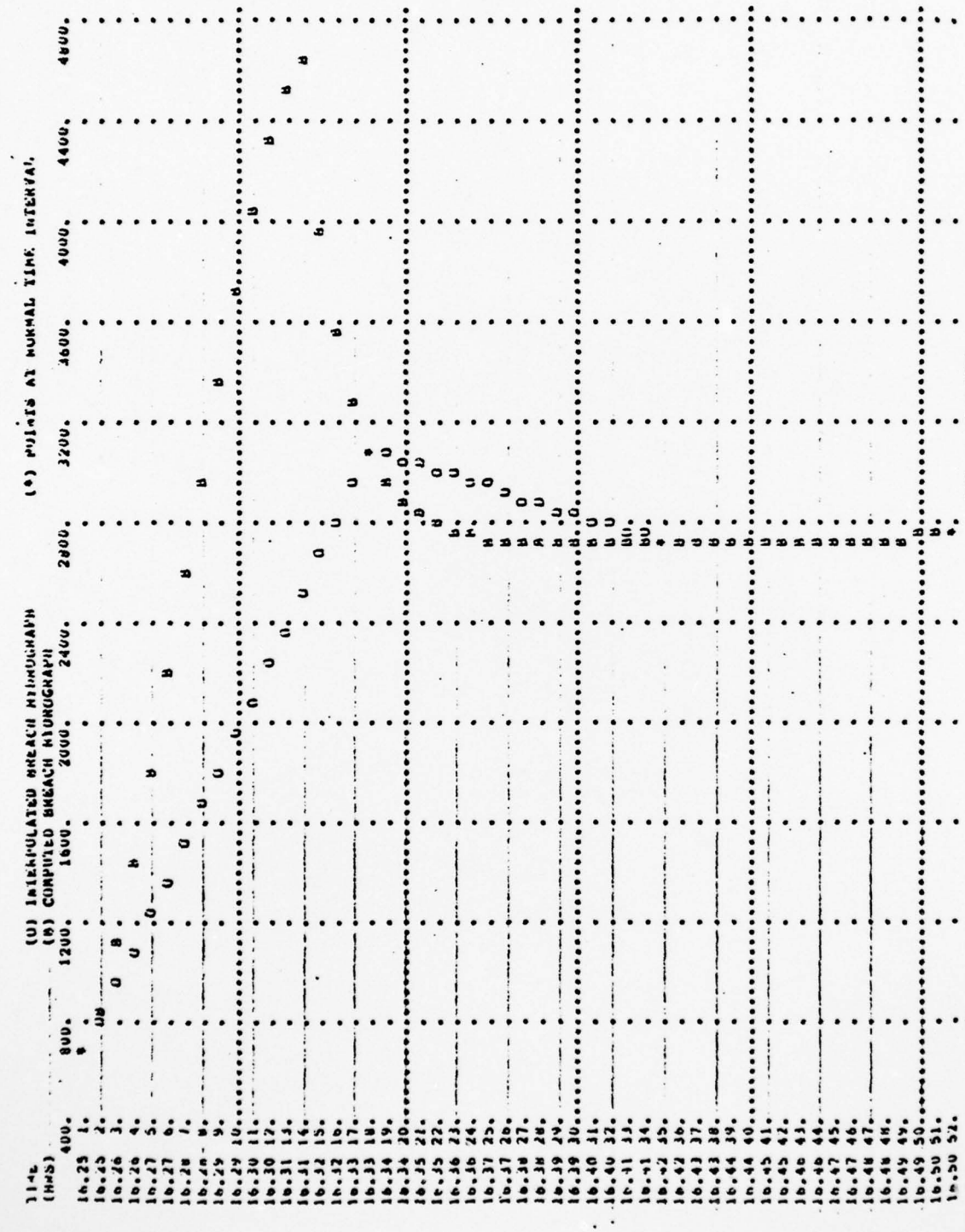

(2)

(5)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR No 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY ______ DATE ______ SHEET NO. Y OF ______

GAI CONSULTANTS, Engineers • Geologists • Planners Environmental Specialists

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)
16.250	0.000	663.		663.		0.	0.	0.
16.271	.021	786.		754.		33.	33.	0.
16.292	.042	910.		873.		37.	70.	0.
16.313	.063	1034.		1020.		13.	83.	0.
16.333	.083	1157.		1157.		-0.	83.	0.
16.354	.104	1275.		1296.		-21.	62.	0.
16.375	.125	1393.		1420.		-28.	35.	0.
16.396	.146	1511.		1532.		-21.	13.	0.
16.417	.167	1628.		1628.		0.	13.	0.
16.438	.188	1590.		1711.		-121.	-107.	-0.
16.458	.208	1552.		1723.		-171.	-278.	-0.
16.479	.229	1514.		1738.		-224.	-502.	-1.
16.500	.250	1475.		1475.		0.	-502.	-1.
16.521	.271	1429.		1366.		64.	-439.	-1.
16.542	.292	1383.		1318.		65.	-373.	-1.
16.563	.313	1337.		1298.		39.	-334.	-1.
16.583	.333	1291.		1291.		0.	-334.	-1.
16.604	.354	1293.		1290.		3.	-332.	-1.
16.625	.375	1294.		1292.		3.	-329.	-1.
16.646	.396	1296.		1294.		2.	-327.	-1.
16.667	.417	1297.		1297.		0.	-327.	-1.
16.688	.437	1300.		1300.		-0.	-328.	-1.
16.708	.458	1302.		1303.		-0.	-328.	-1.
16.729	.479	1305.		1305.		-0.	-328.	-1.
16.750	.500	1308.		1308.		0.	-328.	-1.
16.771	.521	1310.		1310.		-0.	-329.	-1.
16.792	.542	1311.		1312.		-0.	-329.	-1.
16.813	.562	1313.		1314.		-0.	-329.	-1.
16.833	.583	1315.		1315.		0.	-329.	-1.
16.854	.604	1316.		1316.		-0.	-330.	-1.
16.875	.625	1316.		1317.		-0.	-330.	-1.
16.896	.646	1317.		1317.		-0.	-331.	-1.
16.917	.667	1318.		1318.		0.	-331.	-1.
16.938	.687	1317.		1318.		-0.	-331.	-1.
16.958	.708	1317.		1317.		-1.	-332.	-1.
16.979	.729	1316.		1317.		-0.	-332.	-1.
17.000	.750	1316.		1316.		0.	-332.	-1.
17.021	.771	1315.		1315.		-0.	-332.	-1.
17.042	.792	1313.		1314.		-0.	-333.	-1.
17.063	.812	1312.		1312.		-0.	-333.	-1.
17.083	.833	1310.		1310.		0.	-333.	-1.
17.104	.854	1308.		1308.		-0.	-333.	-1.
17.125	.875	1306.		1306.		-0.	-333.	-1.
17.146	.896	1304.		1304.		-0.	-334.	-1.
17.167	.917	1302.		1302.		0.	-334.	-1.
17.188	.937	1300.		1300.		-0.	-334.	-1.
17.208	.958	1297.		1297.		-0.	-334.	-1.
17.229	.979	1295.		1295.		-0.	-334.	-1.
17.250	1.000	1292.		1292.		0.	-334.	-1.

DUE TO BREACHING OF DAM No 1 ONLY

(5)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY _____ DATE _____ SHEET NO. 2 OF _____

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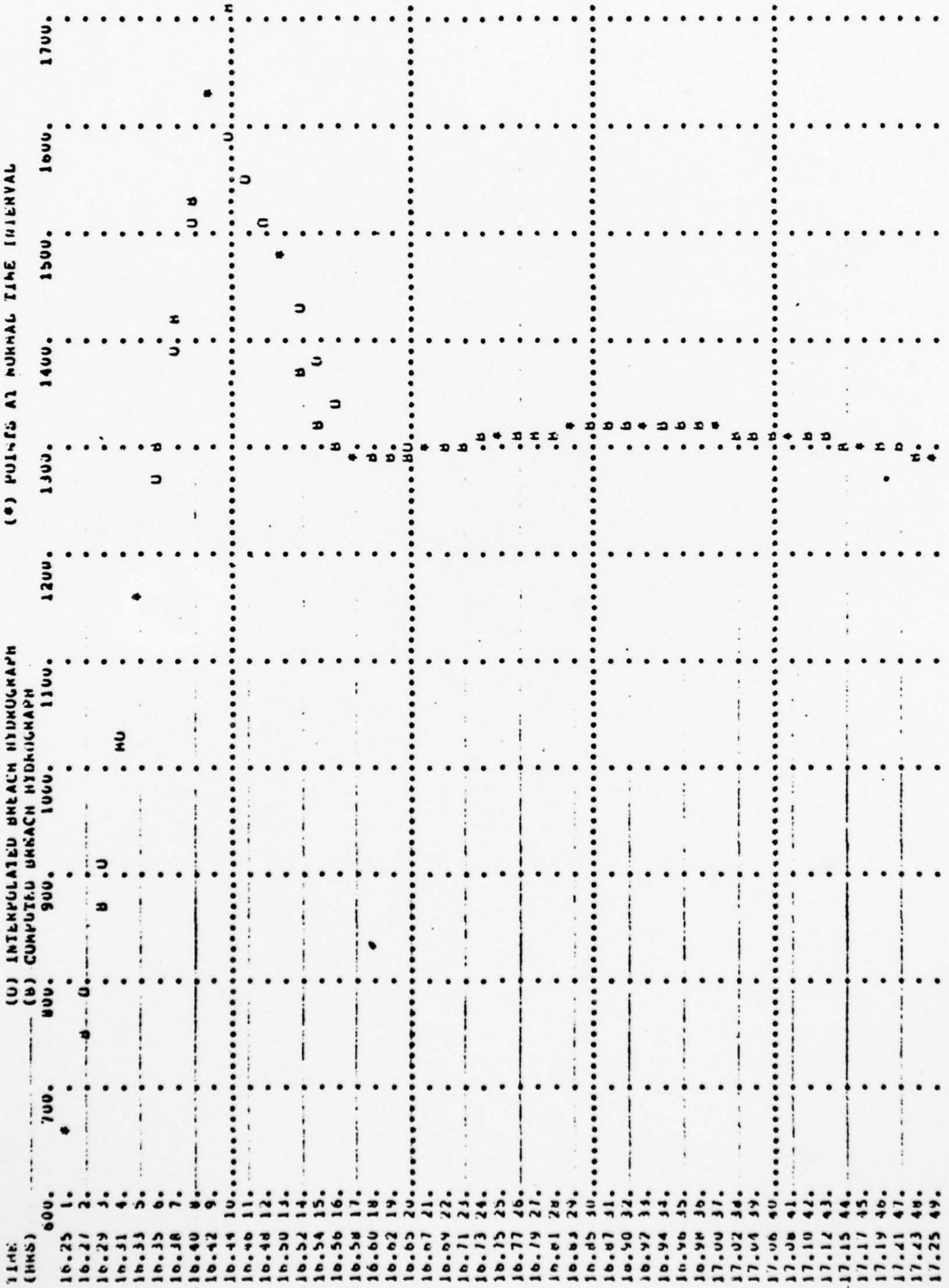

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SUBJECT DAM SAFETY INSPECTION

HUTCHINSON RESERVOIR Nº 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

CHKD. BY DATE SHEET NO. AA OF

GAI CONSULTANTS, Engineers • Geologists • Planner Environmental Specialists

RESERVOIR Nº 3

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1375.50	1430.50	1433.10
STORAGE	0.	340.	390.
OUTFLOW	0.	120.	816.

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	1433.34	.24	395.	19572.	.19	18.50	18.25
2	.50	1433.19	.09	392.	29691.	.10	18.37	18.25
3	.50	1433.64	.54	401.	3136.	1.17	20.42	18.25
4	.50	1433.35	.25	395.	4330.	.25	18.75	18.25
5	.50	1433.31	.21	395.	5997.	.21	18.63	18.25
6	.50	1433.63	.53	401.	5996.	.46	18.83	18.50

RESERVOIR Nº 2

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1345.80	1345.80	1347.80
STORAGE	121.	121.	130.
OUTFLOW	0.	0.	378.

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	1347.89	.29	139.	15532.	.19	18.58	18.17
2	.50	1347.79	.19	138.	32481.	.10	18.37	18.17
3	.50	1348.59	.99	147.	3762.	2.00	20.42	18.17
4	.50	1348.03	.43	140.	5255.	.50	18.75	18.17
5	.50	1348.25	.65	143.	7734.	.54	18.75	18.17
6	.50	1348.30	.70	143.	7597.	.56	18.92	18.33

RESERVOIR Nº 1

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1291.80	1291.80	1294.30
STORAGE	45.	45.	56.
OUTFLOW	0.	0.	622.

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	1297.26	2.96	70.	15715.	.48	18.58	18.25
2	.50	1294.34	.04	56.	33969.	.09	18.42	18.25
3	.50	1294.44	.14	56.	3927.	1.00	20.50	18.25
4	.50	1294.34	.04	56.	5748.	.17	18.75	18.25
5	.50	1294.34	.04	56.	8115.	.10	18.75	18.25
6	.50	1295.27	.97	60.	8479.	2.52	18.90	18.42

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR № 1

BY WJV DATE 2-6-79 PROJ. NO. 79-617-214

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DOWNSTREAM CHANNEL ROUTING FROM RESERVOIR #1 TO SECTION 7

SUMMARY

STATION 7

PLAN	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.50	15883.	1266.0	18.58
2	.50	34669.	1271.6	16.42
3	.50	3936.	1259.4	20.50
4	.50	5750.	1260.8	18.83
5	.50	8112.	1262.3	18.75
6	.50	8415.	1262.5	18.92

DOWNSTREAM CHANNEL ROUTING FROM SECTION 7 TO SECTION 8

SUMMARY

STATION 8

PLAN	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.50	16206.	1220.9	18.58
2	.50	34624.	1225.6	16.42
3	.50	3930.	1214.7	20.50
4	.50	5762.	1216.0	18.83
5	.50	8040.	1217.5	18.75
6	.50	8325.	1217.7	18.92

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NATIONAL DAM INSPECTION PROGRAM. HUTCHINSON RESERVOIR DAM NUMBE--ETC(U)
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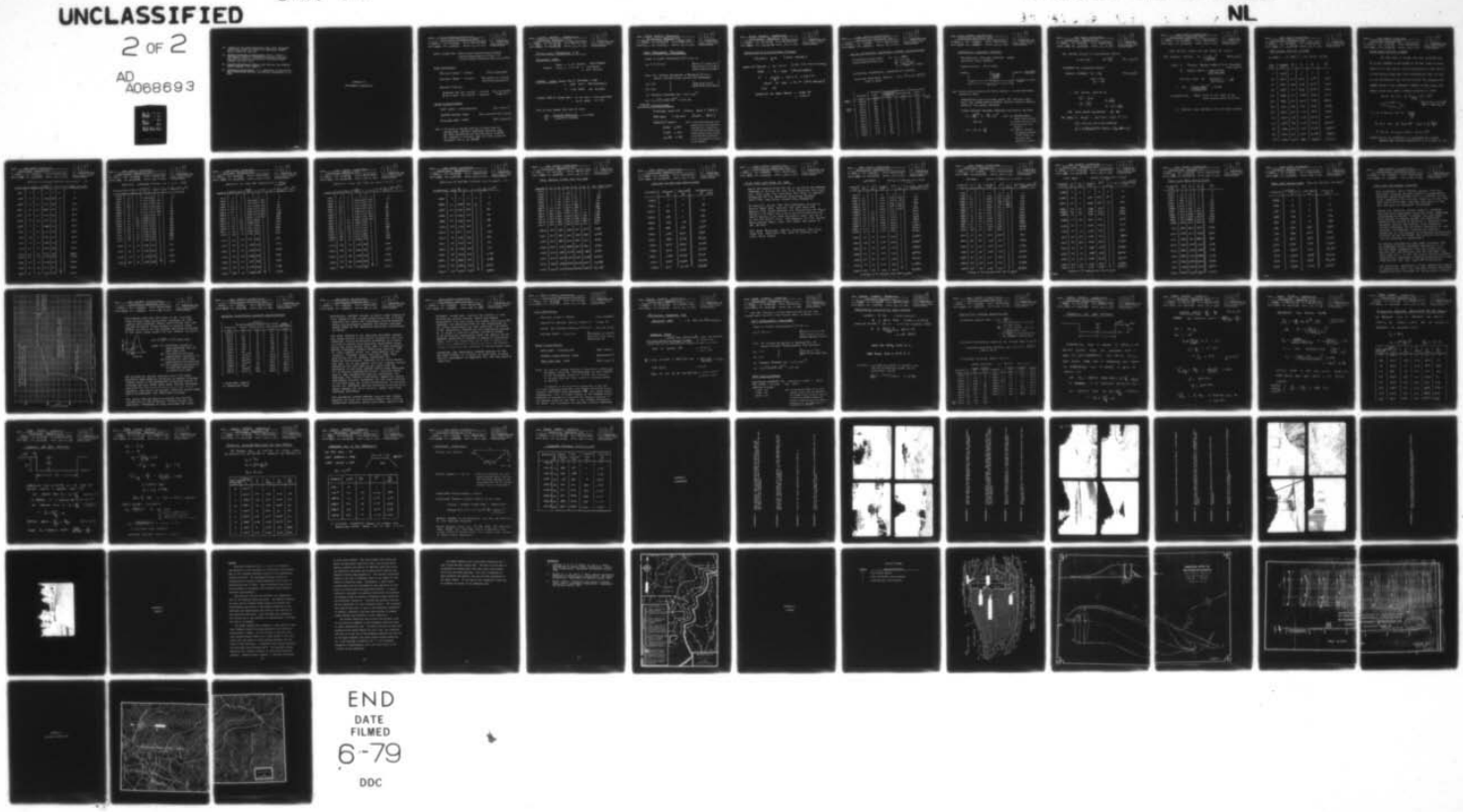

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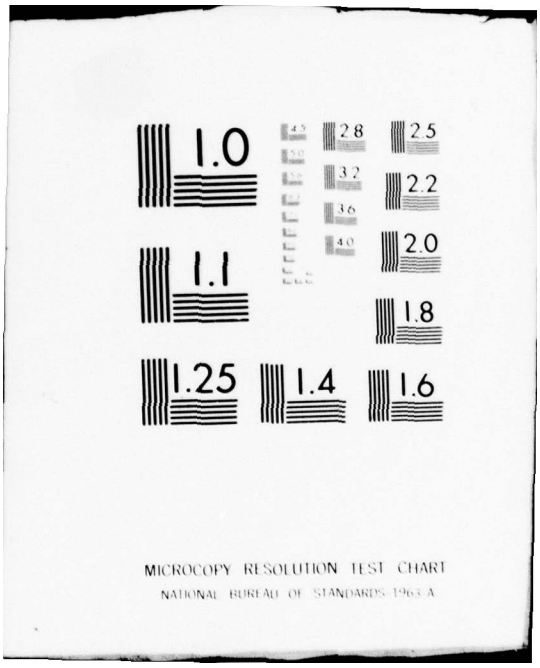
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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APPENDIX C-1

SUPPLEMENTAL CALCULATIONS

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº2

BY DLB DATE 10-27-78 PROJ. NO. 78-617-215

CHKD. BY WJV DATE 1/9/79 SHEET NO. 1 OF 29

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DAM LOCATION - BROWNFIELD QUADRANGLE, FAYETTE COUNTY, PENNSYLVANIA; U.S.G.S. 7.5 MINUTE SERIES, (TOPOGRAPHIC) PHOTOREVISED 1973

DAM STATISTICS

MAXIMUM HEIGHT - 47 FEET (FIELD MEASURED)

DRAINAGE AREA - 2.0 sp.mi. (PLANIMETERED OFF U.S.G.S. BROWNFIELD QUADRANGLE)

STORAGE CAPACITY -

@ NORMAL POOL (EL 1345.8) - 121 AC-FT (SEE NOTE BELOW)
@ TOP OF DAM (EL 1347.6) - 136 AC-FT (SHEET 5)

SIZE CLASSIFICATION

DAM SIZE - INTERMEDIATE (REF 1; TABLE 1)

HAZARD RATING - HIGH (FIELD OBSERVATION: REF 1; TABLE 2

REQUIRED SDF - PMF (REF 1; TABLE 3)

NOTE: THE VALUE OF STORAGE CAPACITY IS TAKEN FROM AN UNPUBLISHED NOTEBOOK CONTAINING PERTINANT DATA FOR DAMS OPERATED BY THE UNIONTOWN BRANCH OF W.P.W.. THE NOTEBOOK IS AVAILABLE FROM THE FILES LOCATED AT UNIONTOWN OFFICE OF W.P.W.

SUBJECT DAM SAFETY INSPECTION.
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HUTCHINSON RESERVOIR # 2.

DRAINAGE AREA:

LOCAL = 0.09 SQ. MILE (PLANIMETERED).

OVERALL TOTAL = 1.9 + .09 = 1.99 SQ. MILES
≈ 2.0 SQ. MILES.

SURFACE AREA (NORMAL POOL) ELEV 1345.8 ≈ 1346

= .087 SQ. IN. (PLANIMETERED).

= 7.99 ACRES USE 8 ACRES.

SURFACE AREA AT CONTOUR 1360 = 0.143 SQ. IN. (PLANIMETERED)
= 13.13 ACRES. USE 13.1

RATE OF AREA CHANGE PER FOOT OF RISE:

$$\frac{\Delta A}{\Delta y} = \frac{(13.1 \text{ ACRES}) - (8.0 \text{ ACRES})}{(1360 \text{ FEET}) - (1346 \text{ FEET})} = 0.36 \text{ ACRE/FT}$$

SUBJECT DAM SAFETY INSPECTION
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UNIT HYDROGRAPH PARAMETERS.

LENGTH OF LONGEST WATERCOURSE (L) ≃ 0.51 MILES

L_{CA} ≃ 0.17 MILES

[VALUES OF L AND L_{CA} ARE FROM U.S.G.S. 7.5 MINUTE SERIES QUAD BROWNFIELD, PA.]

NOTE: ALL VARIABLES ARE DEFINED IN REFERENCE 2 IN THE SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH".

$C_t = 1.6$

$C_p = 0.5$

[SUPPLIED BY C OF E; ZONE 29, OHIO RIVER BASIN]

t_p = SNYDER'S STANDARD LAG = $1.6(L \times L_{CA})^{0.3}$

$t_p = (1.6)[(0.51)(0.17)]^{0.3} = 0.77$ HRS

PMP CALCULATIONS

HUTCHINSON DAM # 2 LOCATION ZONE 7 (REF 3)

PMP INDEX = 24 INCHES (FIGURE 1, REF 3)

DURATION % INDEX -

6 HRS = 102

12 HRS = 120

24 HRS = 130

NOTE: A 24-HOUR DURATION RATHER THAN A 48-HOUR DURATION WAS USED. THIS WAS NECESSITATED BY THE NEED TO USE A 5-MINUTE TIME STEP IN THE HEC-1-DAM PROGRAM IN ORDER TO MORE ACCURATELY DEFINE THE PEAKS OF THE HYDROGRAPHS. (A MAXIMUM OF ONLY 300 TIME INTERVALS IS ALLOWED IN THE PROGRAM.)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR # 2.
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APPROXIMATE ELEVATION @ ZERO STORAGE

VOLUME = $\frac{1}{3}$ HA (CONIC METHOD)

NORMAL POOL VOLUME = 121 AC-FT (WPW. FILES UNION TOWN OFFICE)

AREA = 8.0 ACRES (PLANIMETERED).

$H = \frac{3 \times 121}{8} = 45.4$ FT ≈ 45.4 FT.

HEIGHT OF DAM = 47 FT. (FIELD MEASURED)

USE 47.

ELEVATION OF ZERO VOLUME = 1346 - 47
= 1299 FT.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR NO 2
BY WJV DATE 1/4/79 PROJ. NO. 79-617-215
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ACTUAL ESTIMATED ELEVATION - STORAGE RELATIONSHIP

ESTIMATED SURFACE AREA : $A = A_0 + \left(\frac{\Delta A}{\Delta Y}\right) Y$
(LINEAR INTERPOLATION EQUATION)

$A_0 = 8.0$ ACRES
$\frac{\Delta A}{\Delta Y} = 0.36$ ACRES/FOOT
$Y = ($ELEVATION OF CONCERN$) - 1345.9'$

ESTIMATED INCREMENTAL INCREASE IN STORAGE :

MODIFIED PRISMOIDAL FORMULA : $\Delta V_{1-2} = \frac{Y}{3}\left(A_1 + A_2 + \sqrt{A_1 \cdot A_2}\right)$
(REF 14, PG 15)

	ELEVATION (FT)	ESTIMATED AREA (ACRE)	CUMULATIVE INCREASE IN STORAGE ABOVE NORMAL POOL VIA MOD. PRIS. EQ (A-F)	AVAILABLE STOR. BELOW NORMAL POOL (A-F)	ACTUAL ESTIMATED STORAGE (A-F)	
NORMAL POOL —	1345.9	8.0	0	121	121	KNOWN VALUE
	1346.0	8.1	2	"	123	
	1347.0	8.4	10	"	131	
TOP OF DAM —	1347.6	8.6	15	"	136	
	1348.0	8.8	19	"	140	
	1349.0	9.2	28	"	149	
	1350.0	9.5	37	"	153	
	1351.0	9.9	47	"	168	
	1352.0	10.2	57	"	178	
	1353.0	10.6	67	"	188	
	1354.0	11.0	78	"	199	
	1355.0	11.3	89	"	210	
	1356.0	11.7	100	"	221	
				"		

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 2
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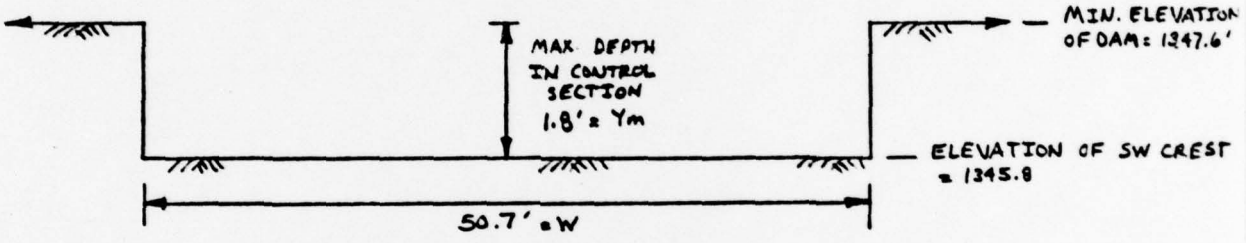
EMERGENCY SPILLWAY CAPACITY

RECTANGULAR SPILLWAY SECTION WITH CRITICAL FLOW CONTROL

CONTROL SECTION : (NOT TO SCALE)



NOTE: SPILLWAY ELEVATION OBTAINED FROM FIGURE 3, APPENDIX F. ALL OTHER MEASUREMENTS OBTAINED IN FIELD

SUPERCRITICAL FLOW IS ASSUMED BELOW THE SPILLWAY CREST WITH THE WATER SURFACE PROFILE PASSING THROUGH CRITICAL DEPTH AT THE CONTROL SECTION.

ENERGY BALANCE BETWEEN RESERVOIR AND CONTROL SECTION:

$$Y_m + \frac{v_R^2}{2g}^{\to 0} = Y_c + \frac{v_c^2}{2g} + H_L^{\to 0}$$

(REF 13)

$$\therefore Y_m = 1.8' = Y_c + \frac{v_c^2}{2g}$$

WHERE: v_R = RESERVOIR APPROACH VELOCITY (ASSUMED NEGLIGIBLE)
Y_c = CRITICAL CONTROL SECT. DEPTH
v_c = CRITICAL CONTROL SECT. VELOCITY
H_L = HEAD LOSS BETWEEN THE RESERVOIR ENTRANCE TO THE SPILLWAY AND THE CONTROL SECT. (ASSUMED NEGLIGIBLE)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

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THE CRITICAL VELOCITY IN A RECTANGULAR SECTION IS GIVEN BY: $V_c = \sqrt{g y_c}$ (REF 13, PG 141)

FURTHERMORE FOR A RECTANGULAR CHANNEL:

SPECIFIC ENERGY = $Y_m = 1.5 y_c$ (REF 13, PG 143)

$1.8 \text{ FT} = 1.5 y_c$

$y_c = 1.2 \text{ FT}$

∴ THE CRITICAL VELOCITY IS:

$V_c^2 = y_c(g)$

$V_c = \sqrt{y_c g}$

$V_c = \sqrt{(1.2)g}$

$V_c = 6.22 \text{ ft/sec}$

THE FLOW CAN BE CALCULATED: $Q_c = V_c A_c$

THE AREA IS: $W(y_c) = 50.7'(1.2) = 60.84 \text{ FT}^2 = A_c$

Q_c = MAXIMUM SPILLWAY CAPACITY

$Q_c = (6.22)(60.84) \simeq 378 \text{ CFS}$ (SAY 380 CFS)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

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THE CRITICAL SLOPE CAN BE FOUND BY USE OF

THE MANNING FORMULA: $S_c = \left(\frac{n Q}{1.49 A_c R_c^{2/3}}\right)^2$ (REF 13, pg 143)

where n = MANNINGS Roughness coefficient (0.014 FOR CONCRETE) (REF 13, pg 133)

R_c: HYDRAULIC RADIUS = $\frac{\text{AREA OF FLOW}}{\text{WETTED PERIMETER}}$

FOR THIS CASE $R_c = \frac{(50.7)(1.2)}{50.7 + 2(1.2)} = \underline{1.15}$

$\therefore S_c = \left(\frac{0.014(378)}{1.49(60.84)(1.15)^{2/3}}\right)^2 = 0.0028$

$0.0028 < 0.03$ where 0.03 is THE SLOPE OF THE CHUTE CHANNEL BELOW THE SPILLWAY

$\therefore$ CRITICAL FLOW CONTROLS THE SPILLWAY DISCHARGE

SUBJECT DAM SAFETY INSPECTION
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SPILLWAY RATING CURVE

y_c = HEAD/1.5 ; $V_c = (g)(y_c)^{1/2}$; $A_c = 50.7\, y_c$; $Q = A_c V_c$

HEAD (FT)	ELEVATION (FT)	y_c	V_c	A_c	Q
0	1345.8	0	0	0	0
0.2	1346.0	0.13	2.05	6.59	13.5
1.2	1347.0	0.80	5.08	40.56	206.0
1.8	1347.6	1.20	6.22	60.84	378.4
2.2	1348.0	1.47	6.88	74.53	512.8
3.2	1349.0	2.13	8.28	107.99	894.2
4.2	1350.0	2.80	9.50	141.96	1,348.6
5.2	1351.0	3.47	10.57	175.93	1,859.6
6.2	1352.0	4.13	11.53	209.39	2,414.3
7.2	1353.0	4.80	12.43	243.36	3,025.0
8.2	1354.0	5.47	13.27	277.33	3,680.2
9.2	1355.0	6.13	14.05	310.79	4,366.6
10.2	1356.0	6.80	14.80	344.76	5,102.4

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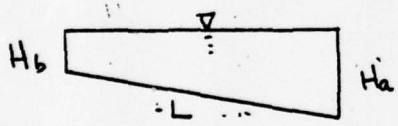
MAIN DAM RATING CURVE

THE MAIN DAM IS DIVIDED INTO FIVE SEGMENTS DUE TO SLIGHT CHANGES IN THE HEIGHT OF THE DAM ALONG ITS LENGTH SECTION 1 IS FROM STATION 0+00 TO 0+60; SECTION 2 FROM STA 1+10 TO 1+60; SECTION 3 FROM STA 1+60 TO 4+60; SECTION 4 FROM STA 4+60 TO 5+10; AND SECTION 5 FROM STA 5+10 TO 5+66. FOR OVERTOPPING, TAKE AVERAGE HEIGHT ON THE OVERTOPPED PORTION OF EACH SECTION. OVERTOPPING OCCURS WHEN WATER SURFACE ELEVATION IS 1347.6

FOR ALL SECTIONS $Q_i = \frac{2}{5} \frac{C_i L_i}{H_a - H_b} (H_a^{5/2} - H_b^{5/2})$

(Derived form of $Q = C_L H^{3/2}$, REF. 14 - Chapter A-5 p. 3)



C_i can be determined from $H_i = \frac{\frac{H_a + H_b}{2}}{\ell}$

IF $H_b = 0$ then $Q_i = \frac{2}{5} C L H_a^{3/2}$ where $C = f\left(\frac{H_a}{2\ell}\right)$

IF $H_a = H_b$ use original formula $Q_i = C_i L_i H_i^{3/2}$

NOTE: ASSUME THE EMBANKMENT WILL DISCHARGE AS A BROAD CRESTED WEIR DURING OVERTOPPING WITH A BREADTH OF 12 FT.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

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SECTION 1 of MAIN DAM (STATIONS 0+00 to 0+60) L=60'

ELEVATION	H_A (FT)	H_B (FT)	$\frac{H_a+H_B}{2}$	C	L (FT)	$Q_1 = \frac{2}{3} C L \frac{H_a^{5/2} - H_b^{5/2}}{H_a - H_b}$
1348.7	0	0	0	0	0	0
1348.8	0.1	0	0.004	2.90	60	5.5
1349.0	0.3	0.2	0.021	2.99		22.5
1349.2	0.5	0.4	0.038	3.01		54.6
1349.4	0.7	0.6	0.054	3.02		95.0
1349.6	0.9	0.8	0.071	3.03		142.5
1349.8	1.1	1.0	0.088	3.03		195.7
1350.0	1.3	1.2	0.104	3.04		255.0
1350.5	1.8	1.7	0.146	3.05		423.7
1351.0	2.3	2.2	0.188	3.07		621.7
1351.5	2.8	2.7	0.229	3.08		842.8
1352.0	3.3	3.2	0.271	3.09		1086.3
1353.0	4.3	4.2	0.354	3.09		1624.4
1354.0	5.3	5.2	0.438	3.09		2230.3
1355.0	6.3	6.2	0.521	3.09		2896.9
1356.0	7.3	7.2	0.604	3.09		3619.3

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

BY RFV DATE 10-18-78 PROJ. NO. 78-617-215

CHKD. BY KWH DATE 10-24-78 SHEET NO. 12 OF 29

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SECTION 2 of MAIN DAM (STATIONS 1+10 to 1+60) L=50'

ELEVATION	H_A (FT)	H_B (FT)	$\frac{H_A+H_B}{2}$	C	L (FT)	$Q_2 = \frac{2}{5} \frac{CL}{H_a-H_b}\left(H_a^{5/2} - H_b^{5/2}\right)$
1347.6	0	0	0	0	0	0
1347.8	0.2	0	0.008	2.94	7.1	0.7
1348.0	0.4	0	0.017	2.96	14.3	4
1348.2	0.6	0	0.025	2.98	21.4	12
1348.4	0.8	0	0.033	3.00	28.6	25
1348.6	1.0	0	0.042	3.01	35.7	43
1348.8	1.2	0	0.050	3.02	42.9	68
1349.0	1.4	0	0.058	3.02	50	100
1349.2	1.6	0.2	0.075	3.03	↓	139
1349.4	1.8	0.4	0.092	3.04		184
1349.6	2.0	0.6	0.108	3.04		234
1349.8	2.2	0.8	0.125	3.04		287
1350.0	2.4	1.0	0.142	3.05		345
1350.5	2.9	1.5	0.183	3.08		509
1351.0	3.4	2.0	0.225	3.08		689
1351.5	3.9	2.5	0.267	3.09		890
1352.0	4.4	3.0	0.308	3.09		1105
1353.0	5.4	4.0	0.392	3.09		1579
1354.0	6.4	5.0	0.475	3.09		2107
1355.0	7.4	6.0	0.558	3.09		2683
1356.0	8.4	7.0	0.642	3.09		3305

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

BY RFV DATE 10-18-78 PROJ. NO. 78-617-215

CHKD. BY KMM DATE 10-24-78 SHEET NO. 13 OF 29

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SECTION 3 OF MAIN DAM (STATIONS 1+60 to 4+60)
L = 300 FT

ELEVATION	H_A(FT)	H_B(FT)	$\frac{H_A+H_B}{2}$	C	L(FT)	$Q_3 = \frac{2}{5}\frac{CL}{H_a-H_b}\left(H_a^{5/2} - H_b^{5/2}\right)$
1347.7	0	0	0	0	0	0
1347.8	0.1	0	0.004	2.90	23.1	1
1348.0	0.3	0	0.013	2.94	69.2	13.
1348.2	0.5	0	0.021	2.96	115.4	48.
1348.4	0.7	0	0.029	2.99	161.5	113.
1348.6	0.9	0	0.038	3.01	207.7	214
1348.8	1.1	0	0.046	3.02	253.8	354
1349.0	1.3	0	0.054	3.02	300.0	537.
1349.2	1.5	0.2	0.071	3.03		766
1349.4	1.7	0.4	0.088	3.03		1026
1349.6	1.9	0.6	0.104	3.04		1318.
1349.8	2.1	0.8	0.121	3.04		1633
1350.0	2.3	1.0	0.138	3.04		1971
1350.5	2.8	1.5	0.179	3.06		2927.
1351.0	3.3	2.0	0.221	3.08		4016.
1351.5	3.8	2.5	0.263	3.09		5210
1352.0	4.3	3.0	0.304	3.09		6490
1353.0	5.3	4.0	0.388	3.09		9318
1354.0	6.3	5.0	0.471	3.09		12,470.
1355.0	7.3	6.0	0.554	3.09		15,916
1356.0	8.3	7.0	0.638	3.09	↓	19,632.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

BY RFV DATE 10-18-78 PROJ. NO. 78-617-215

CHKD. BY KWH DATE 10-24-78 SHEET NO. 19 OF 29

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SECTION 4 OF MAIN DAM (STATIONS 4+60 TO 5+10) L = 50'

ELEVATION	H_A (FT)	H_B (FT)	$\frac{H_A+H_B}{2}$	C	L (FT)	$Q_4 = \frac{2}{5}\frac{CL}{H_a-H_b}\left(H_a^{5/2} - H_b^{5/2}\right)$
1347.7	0	0	0	0	0	0
1347.8	0.1	0	0.004	2.90	3.6	.0
1348.0	0.3	0	0.013	2.94	10.7	2.
1348.2	0.5	0	0.021	2.96	17.9	8
1348.4	0.7	0	0.029	2.99	25.0	18
1348.6	0.9	0	0.038	3.01	32.1	33.
1348.8	1.1	0	0.046	3.02	39.3	55
1349.0	1.3	0	0.054	3.02	46.4	83.
1349.2	1.5	0.1	0.067	3.03	50.0	119.
1349.4	1.7	0.3	0.083	3.03	↓	161.
1349.6	1.9	0.5	0.100	3.04		208.
1349.8	2.1	0.7	0.117	3.04		260
1350.0	2.3	0.9	0.133	3.04		315.
1350.5	2.8	1.4	0.175	3.06		472.
1351.0	3.3	1.9	0.217	3.08		652
1351.5	3.8	2.4	0.258	3.09		849
1352.0	4.3	2.9	0.300	3.09		1,060.
1353.0	5.3	3.9	0.383	3.09		1,529
1354.0	6.3	4.9	0.467	3.09		2,051.
1355.0	7.3	5.9	0.550	3.09		2,623
1356.0	8.3	6.9	0.633	3.09		3,241

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

BY RFV DATE 10-18-78 PROJ. NO. 78-617-215

CHKD. BY KWW DATE 10-24-78 SHEET NO. 15 OF 29

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SECTIONS OF MAIN DAM (STATIONS 5+10 to 5+60) L=50'

ELEVATION	H (ft)	H/L	C	L (ft)	$Q_s = C L H^{3/2}$
1349.1	0	0	0	0	0
1349.2	0.1	0.008	2.94	50	5
1349.4	0.3	0.025	2.98		25
1349.6	0.5	0.042	3.01		53.
1349.8	0.7	0.058	3.02		88.
1350.0	0.9	0.075	3.03		129
1350.5	1.4	0.117	3.04		252
1351.0	1.9	0.158	3.05		399.
1351.5	2.4	0.200	3.07		571
1352.0	2.9	0.242	3.08		761
1353.0	3.9	0.325	3.09		1,190
1354.0	4.9	0.408	3.09		1,676
1355.0	5.9	0.492	3.09		2,214.
1356.0	6.9	0.575	3.09		2,800.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

BY RFV DATE 10-18-78 PROJ. NO. 78-617-215

CHKD. BY KJW DATE 10-24-78 SHEET NO. 16 OF 29

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TOTAL RATING CURVE FOR MAIN DAM

ELEVATION	Q_1	Q_2	Q_3	Q_4	Q_5	$Q_T = \sum_{i=1}^{5} Q_i$ (CFS)
1347.6	0	0	0	0	0	0
1347.8	0	0.7	0.8	0.1	0	2
1348.0	0	4.3	13.4	2.1	0	20
1348.2	0	11.9	48.3	7.5	0	68.
1348.4	0	24.6	113.1	17.5	0	155.
1348.6	0	43.0	213.5	33.0	0	290
1348.8	5.5	68.1	353.7	54.8	0	482.
1349.0	22.5	100.1	537.2	83.1	0	743.
1349.2	54.6	139.4	765.7	119.1	4.6	1,083
1349.4	95.0	184.4	1,025.6	161.0	24.5	1,491.
1349.6	142.5	233.6	1,318.1	208.4	53.2	1,956
1349.8	195.7	286.9	1,632.7	259.7	88.4	2,463.
1350.0	253.0	345.2	1,970.7	315.0	129.4	3,015.
1350.5	423.7	508.9	2,927.2	472.1	251.8	4,584
1351.0	621.7	689.0	4,016.1	651.5	399.4	6,378
1351.5	842.8	889.7	5,210.2	848.7	570.7	8,362.
1352.0	1,086.3	1,104.5	6,489.9	1,060.3	760.5	10,502
1353.0	1,624.4	1,578.5	9,317.9	1,528.7	1,189.9	15,239.
1354.0	2,230.3	2,106.5	12,470.1	2,051.4	1,675.8	20,534.
1355.0	2,896.9	2683.1	15,915.9	2,623.3	2,214.1	26,333.
1356.0	3,619.3	3,304.6	19,632.0	3,240.5	2,800.3	32,597

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2
BY REV DATE 10-18-78 PROJ. NO. 78-617-215
CHKD. BY KWH DATE 10-24-78 SHEET NO. 17 OF 29

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SPILLWAY AND MAIN DAM RATING CURVE

ELEVATION	SPILLWAY Q_S	MAIN DAM Q_M	COMBINED FLOW Q_T (CFS)
1345.8	0	0	0
1346.0	14	0	14
1347.0	206	0	206.
1347.6	378	0	378.
1348.0	513	20	533
1349.0	894	743	1,637
1350.0	1,349	3,015	4,364
1351.0	1860	6,378	8,238
1352.0	2,414	10,502	12,916
1353.0	3,025	15,239	18,264
1354.0	3680	20,534	24,214.
1355.0	4,367	26,333	30,700
1356.0	5,102	32,597	37,699.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 2

BY RFV DATE 10/20/79 PROJ. NO. 79-617-215

CHKD. BY WJV DATE 1/2/79 SHEET NO. 18 OF 29

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FLOW OVER LEFT BANK OF DAM

DUE TO THE LOCATION OF DAM #2 AND A LOW SPOT IN THE SURROUNDING TERRAIN, A PORTION OF THE TOTAL RESERVOIR DISCHARGE WILL FLOW OVER THE LEFT BANK AND INTO AN ADJACENT WATERSHED IF THE RESERVOIR ELEVATION EXCEEDS 1347.7 FEET (SEE REGIONAL VACINITY MAP, APPENDIX G)

IN ORDER TO ACCOUNT FOR THIS ADDITIONAL OUTLET, A RATING TABLE WAS COMPUTED. THE LEFT BANK WAS DIVIDED INTO THREE SECTIONS FOR CALCULATION OF FLOWS. SECTION 1 IS FROM STA 0+00 to STA 2+10 (SEE SKECTCH MAP, APPEN. F). SECTION 2 IS FROM STA 2+10 TO 2+60. SECTION 3 IS FROM STA 2+60 TO 3+60. THE BREADTH OF THE ASSUMED BROAD CRESTED WEIR-LIKE LEFT BANK WAS TAKEN TO BE 50 FEET.

THE SAME PROCEDURE USED IN COMPUTING THE FLOWS OVER THE MAIN DAM WAS USED TO COMPUTE THE LEFT BANK FLOWS.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

BY RFV DATE 10-18-78 PROJ. NO. 78-617-215

CHKD. BY KHH DATE 10-24-78 SHEET NO. 19 OF 29

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LEFT BANK : SECTION 1 (STATION 0+00 TO 2+10)
L = 210'

ELEVATION (FT)	H_A (FT)	H_B (FT)	$\frac{H_A+H_B}{2L}$	C*	L (FT)	$Q_1 = \frac{2}{5}\frac{CL}{H_A-H_B}\left(H_A^{5/2} - H_B^{5/2}\right)$
1347.7	0	0	0	0	0	0
1347.8	0.1	0	0.001	2.90	23.3	0.9
1348.0	0.3	0	0.003	2.94	70.0	13.5
1348.2	0.5	0	0.005	2.96	116.7	48.9
1348.4	0.7	0	0.007	2.99	163.3	115.1
1348.6	0.9	0	0.009	3.01	210.0	215.9
1348.8	1.1	0.2	0.013	3.02		352.7
1349.0	1.3	0.4	0.017	3.03		516.3
1349.2	1.5	0.6	0.021	3.03		700.4
1349.4	1.7	0.8	0.025	3.04		906.7
1349.6	1.9	1.0	0.029	3.04		1,128.1
1349.8	2.1	1.2	0.033	3.04		1,365.7
1350.0	2.3	1.4	0.037	3.04		1,618.3
1350.5	2.8	1.9	0.047	3.05		2,318.0
1351.0	3.3	2.4	0.057	3.05		3,089.2
1351.5	3.8	2.9	0.067	3.05		3,886.7
1352.0	4.3	3.4	0.077	3.05		4,846.7
1353.0	5.3	4.4	0.097	3.05		6,843.6
1354.0	6.3	5.4	0.117	3.05		9069.3
1355.0	7.3	6.4	0.137	3.05		11,489.2
1356.0	8.3	7.4	0.157	3.05		14,093.0

* VALUES OF "C" OBTAINED FROM REF. 12, P 46

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

BY REV DATE 10-18-78 PROJ. NO. 78-617-215

CHKD. BY KWW DATE 10-24-78 SHEET NO. 20 OF 29

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LEFT BANK : SECTION 2 (STATION 2+10 to 2+60) L=50'

ELEVATION (FT)	H_A (FT)	H_B (FT)	$\frac{H_A+H_B}{2l}$	C^*	L (FT)	$Q_2 = \frac{2}{3}\frac{CL}{H_A H_B}\left(H_A^{5/2} - H_B^{5/2}\right)$
1347.7	0	0	0	0	0	0
1347.8	0.1	0	0.001	2.90	5.6	0.2
1348.0	0.3	0	0.003	2.94	16.7	3.2
1348.2	0.5	0	0.005	2.96	27.8	11.6
1348.4	0.7	0	0.007	2.99	38.9	27.4
1348.6	0.9	0	0.009	3.01	50.0	51.4
1348.8	1.1	0.2	0.013	3.02		84.0
1349.0	1.3	0.4	0.017	3.03		122.9
1349.2	1.5	0.6	0.021	3.03		166.8
1349.4	1.7	0.8	0.025	3.04		215.9
1349.6	1.9	1.0	0.029	3.04		268.6
1349.8	2.1	1.2	0.033	3.04		325.2
1350.0	2.3	1.4	0.037	3.04		385.3
1350.5	2.8	1.9	0.047	3.05		551.9
1351.0	3.3	2.4	0.057	3.05		736.1
1351.5	3.8	2.9	0.067	3.05		937.2
1352.0	4.3	3.4	0.077	3.05		1,154.0
1353.0	5.3	4.4	0.097	3.05		1,630.6
1354.0	6.3	5.4	0.117	3.05		2,159.4
1355.0	7.3	6.4	0.137	3.05		2,735.5
1356.0	8.3	7.4	0.157	3.05		3,355.5

* VALUES OF "C" OBTAINED FROM REF 12, pg 46

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

BY RFV DATE 10-18-78 PROJ. NO. 78-617-215

CHKD. BY KWW DATE 10-24-78 SHEET NO. 21 OF 29

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LEFT BANK : SECTION 3 (STATION 2+60 to 3+60)
L = 100'

ELEVATION (FT)	H_A (FT)	H_B (FT)	$\frac{H_A+H_B}{2}$	C*	L (FT)	$Q_3 = \frac{2}{5} \frac{CL}{H_A-H_B} \left(H_A^{5/2} - H_B^{5/2}\right)$
1348.6	0	0	0	0	0	0
1348.8	0.2	0	0.002	2.94	50	5.3
1349.0	0.4	0	0.004	2.96	100	30.0
1349.2	0.6	0.2	0.008	3.00		78.3
1349.4	0.8	0.4	0.012	3.02		142.3
1349.6	1.0	0.6	0.016	3.03		218.5
1349.8	1.2	0.8	0.020	3.03		304.5
1350.0	1.4	1.0	0.024	3.04		401.0
1350.5	1.9	1.5	0.034	3.04		675.0
1351.0	2.4	2.0	0.044	3.05		996.3
1351.5	2.9	2.5	0.054	3.05		1,354.1
1352.0	3.4	3.0	0.064	3.05		1,746.8
1353.0	4.4	4.0	0.084	3.05		2,626.1
1354.0	5.4	5.0	0.104	3.05		3,617.3
1355.0	6.4	6.0	0.124	3.05		4,709.1
1356.0	7.4	7.0	0.144	3.05		5,893.0

* VALUES OF "C" OBTAINED FROM REF 12, pg 46

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR #2

BY RFV DATE 10-18-78 PROJ. NO. 78-617-215

CHKD. BY KJK DATE 10-24-78 SHEET NO. 22 OF 29

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TOTAL LEFT BANK RATING CURVE

ELEVATION (FT)	Q_1	Q_2	Q_3	Q_T
1347.7	0	0	0	0
1347.8	0.9	0.2	0	1
1348.0	13.5	3.2	0	17
1348.2	48.9	11.6	0	61
1348.4	115.1	27.4	0	143
1348.6	215.9	51.4	0	267
1348.8	352.7	84.0	5.3	442
1349.0	516.3	122.9	30.0	669
1349.2	700.4	166.8	78.3	946
1349.4	906.7	215.9	142.3	1265
1349.6	1,128.1	268.6	218.5	1615
1349.8	1,365.7	325.2	304.5	1995
1350.0	1618.3	385.3	401.0	2405
1350.5	2,318.0	551.9	675.0	3545
1351.0	3,089.2	736.1	996.3	4822
1351.5	3,886.7	937.2	1,354.1	6178
1352.0	4,846.7	1,154.0	1,746.8	7748
1353.0	6,843.6	1,630.6	2,626.1	11,100
1354.0	9,069.3	2,159.4	3,617.3	14,846
1355.0	11,489.2	2,735.5	4,709.1	18,934
1356.0	14,093.0	3,355.5	5,893.0	23,342

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR # 2

BY RFV DATE 10-24-78 PROJ. NO. 78-617-215

CHKD. BY KMH DATE 10-24-78 SHEET NO. 23 OF 29

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TOTAL DAM RATING CURVE (SPILLWAY + MAIN DAM + LEFT BANK)

ELEVATION	MAIN DAM + SPILLWAY Q	LEFT BANK Q	TOTAL Q CFS
1345.8	0	0	0
1346	14	0	14
1347	206	0	206
1347.6	378	0	378
1348	533	17	550
1349	1,637	669	2,306
1350	4,364	2,405	6,769
1351	8,237	4,822	13,059
1352	12,916	7,748	20,664
1353	18,264	11,100	29,364
1354	24,214	14,846	39,060
1355	30,700	18,934	49,634
1356	37,699	23,342	61,041

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 2
BY WJV DATE 1/2/79 PROJ. NO. 79-617-215
CHKD. BY DLB DATE 1/9/79 SHEET NO. 24 OF 29

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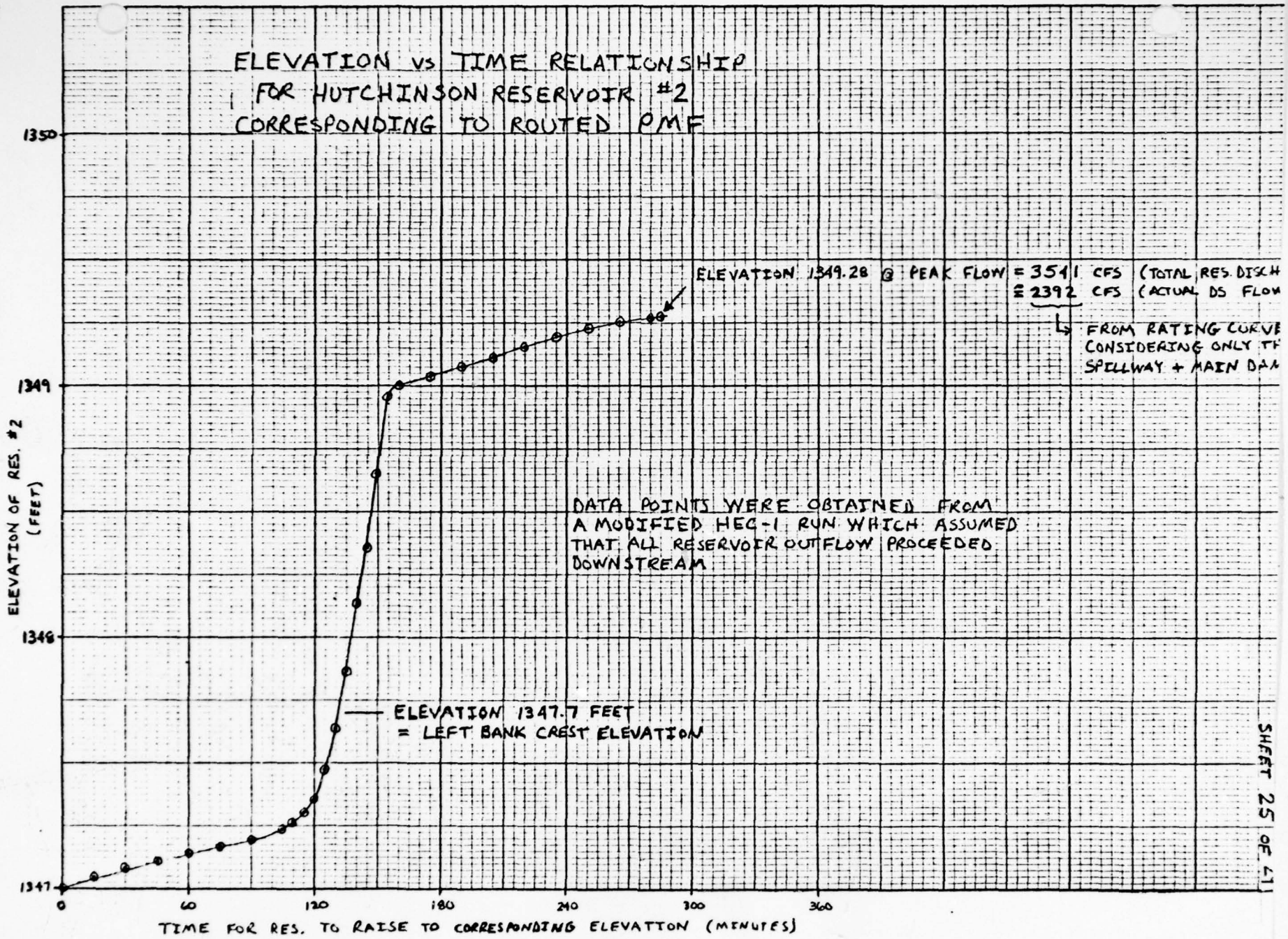
LEFT BANK DISCHARGE PROBLEM

THE MODIFIED HEC-I PROGRAM ASSUMES THAT ALL RESERVOIR OUTFLOW PROCEEDS DIRECTLY DOWNSTREAM. HOWEVER, ABOVE ELEVATION 1347.7 A PORTION OF THE TOTAL RESERVOIR #2 OUTFLOW (ABOUT 1/3 OF THE PEAK PMF FLOW) DISCHARGES OVER THE LEFT BANK OF THE DAM AND INTO AN ADJACENT WATERSHED.

SINCE THE PROGRAM CANNOT DIRECTLY SEPERATE THE LEFT BANK DISCHARGES FROM THE TOTAL RESERVOIR DISCHARGES, A SCHEME TO CONVERT THE LEFT BANK FLOW VALUES TO STORAGE VALUES WAS DEVELOPED. (MODIFIED PULS ROUTING IS BASICALLY A PROCEDURE WHICH BALANCES INFLOWS AND OUTFLOWS WITH AVAILABLE STORAGE. THEREFORE, IF THE INFLOW HYDROGRAPH IS HELD CONSTANT, THE RESERVOIR OUTFLOWS ARE DIRECTLY CONTROLLED BY THE STORAGE ⇒ TO DECREASE OR ELIMINATE A PORTION OF THE DISCHARGE, THE CORRESPONDING STORAGE MUST BE INCREASED TO COMPENSATE.)

AN INITIAL COMPUTER RUN WAS MADE ASSUMING THAT ALL RESERVOIR OUTFLOW PROCEEDED DOWNSTREAM (ie, A RATING TABLE CONSIDERING TOTAL DISCHARGE FROM THE SPILLWAY, THE MAIN DAM, AND THE LEFT BANK WAS USED; SHEET 23), SO THAT THE ACTUAL RESERVOIR SURFACE FLUCTUATIONS (ELEVATION vs TIME RELATIONSHIP) RESULTING FROM ROUTING THE PMF COULD BE ESTABLISHED.

THE RESERVOIR ELEVATION vs TIME INFORMATION (SHEET 25) IN CONJUNCTION WITH THE LEFT BANK RATING TABLE (SHEET 22 ENABLED INITIAL ESTIMATES OF THE VOLUMES OF WATER


ELEVATION vs TIME RELATIONSHIP
FOR HUTCHINSON RESERVOIR #2
CORRESPONDING TO ROUTED PMF
1350
1349
1348
1347
ELEVATION OF RES. #2 (FEET)
ELEVATION 1349.28 @ PEAK FLOW = 3511 CFS (TOTAL RES. DISCH
≅ 2392 CFS (ACTUAL DS FLOW
↳ FROM RATING CURVE
CONSIDERING ONLY TH
SPILLWAY + MAIN DAM
DATA POINTS WERE OBTAINED FROM
A MODIFIED HEC-1 RUN WHICH ASSUMED
THAT ALL RESERVOIR OUTFLOW PROCEEDED
DOWNSTREAM.
ELEVATION 1347.7 FEET
= LEFT BANK CREST ELEVATION
0
60
120
180
240
300
360
TIME FOR RES. TO RAISE TO CORRESPONDING ELEVATION (MINUTES)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 2

BY WJV DATE 1/3/79 PROJ. NO. 78-617-215

CHKD. BY DLB DATE 1/9/79 SHEET NO. 26 OF 29

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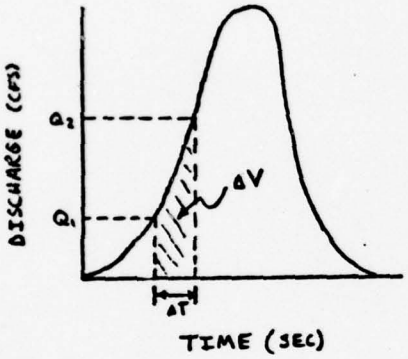
DISCHARGING OVER THE LEFT BANK TO BE COMPUTED. THESE VOLUMES WERE CALCULATED ACCORDING TO THE LOGICAL RELATIONSHIP BELOW, WHICH STATES THAT THE VOLUME OF WATER PASSED DURING A CERTAIN TIME PERIOD IS EQUAL TO THE AVERAGE DISCHARGE MULTIPLIED BY THE TOTAL TIME LENGTH OF THAT PERIOD (SEE SKETCH):



$$\Delta V = \left[\left(\frac{Q_1 + Q_2}{2}\right) \times \Delta T\right] / 43560 \text{ FT}^2/\text{ACRE}$$

WHERE ΔV = INCREMENTAL VOLUME OF WATER DISCHARGED OVER THE LEFT BANK (A-F),

Q_1 = FLOW OVER THE LEFT BANK CORRESPONDING TO ELEVATION 1 (CFS

Q_2 = FLOW OVER THE LEFT BANK CORRESPONDING TO ELEVATION 2 (CFS

ΔT = TIME NECESSARY FOR RESERVOIR TO RAISE FROM ELEVATION 1 TO ELEVATION 2 (SEC).

THE VOLUMES OF WATER COMPUTED WITH THE ABOVE EQUATION WERE ADDED TO THE ACTUAL ESTIMATED AVAILABLE STORAGE VALUES AT THE APPROPRIATE ELEVATIONS (SHEET 27). A COMPUTER RUN WAS MADE USING THESE INITIAL ARTIFICIAL STORAGE VALUES (ACTUAL + INITIAL ON SHEET 27) TO REPLACE THE LEFT BANK DISCHARGE POTENTIAL, AND USING THE SPILLWAY + MAIN DAM RATING TABLE (SHEET 17) TO DETERMINE THE RESERVOIR OUTFLOWS.

THE OUTPUT FROM THE ABOVE RUN SHOWED THAT FURTHER CALIBRATION OF THE ARTIFICIAL STORAGE VALUES WAS NECESSARY. THEREFORE, BY TRIAL AND ERROR THE FINAL

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 2

BY WJV DATE 1/4/79 PROJ. NO. 78-617-215

CHKD. BY DLB DATE 2-6-79 SHEET NO. 27 OF 29

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REVISED ELEVATION - STORAGE RELATIONSHIP

ELEVATION (FT)	ACTUAL ESTIMATED STORAGE * (A-F)	CUMULATIVE INITIAL ARTIFICIAL STORAGE VALUES (A-F)	ACTUAL + INITIAL STORAGE VALUES (A-F)	FINAL ARTIFICIAL STORAGE VALUES (A-F)
1299.0	0	0	0	0
1345.8	121	0	121	121
1346.0	123	0	123	123
1347.0	131	0	131	131
1347.6	136	0	136	136
1347.7	137	0	137	137
1347.8	138	0	138	138
1348.0	140	0.1	140.1	140.1
1348.2	141.8 **	0.4	142.2	142.2
1348.4	143.6 **	0.9	144.5	144.5
1348.6	145.4 **	1.9	147.3	147.3
1348.8	147.2 **	3.7	150.9	150.9
1349.0	149	9.9	158.9	158.9
1349.2	150.8 **	98.8	249.6	300.0
1349.3	151.7 **	183.6	335.3	500.0

* VALUES FROM SHEET 5

** INTERPOLATED VALUE

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 2

BY WJV DATE 1/3/79 PROJ. NO. 78-617-215

CHKD. BY DLB DATE 1/9/79 SHEET NO. 28 OF 29

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ARTIFICIAL STORAGE VALUES ON SHEET 27 WERE ARRIVED AT. (THE PURPOSE OF THE FURTHER CALIBRATION WAS TO BETTER REPRODUCE THE KNOWN PMF DOWNSTREAM OUTFLOW HYDROGRAPH WHICH WAS OBTAINED BY APPLYING THE SPILLWAY + MAIN DAM RATING TABLE TO THE RESERVOIR ELEVATION INFORMATION ON SHEET 25).

THE ABOVE APPROACH TO THE LEFT BANK DISCHARGE PROBLEM WAS CHOSEN INSTEAD OF JUST SIMPLY MULTIPLYING THE TOTAL RESERVOIR OUTFLOW HYDROGRAPH ORDINATES BY A RATIO (ie, 0.67) TO OBTAIN MORE REALISTIC DOWNSTREAM FLOWS, SINCE THE RATIO METHOD WOULD LEAD TO MORE ERRONEOUS RESULTS, ESPECIALLY DURING BREACHING ANALYSIS. THAT IS, ONCE A BREACH OCCURS, THE WATER BEHIND THE DAM QUICKLY RECEDES BELOW THE LEFT BANK CREST ELEVATION, AND ALL OUTFLOW THEREAFTER IS DIRECTED DOWNSTREAM. HOWEVER, IF THE RATIO METHOD WAS USED ALL OF THE BREACH OUTFLOWS, WHETHER ACTUALLY AFFECTED BY THE LEFT BANK OR NOT, WOULD FIRST BE MULTIPLIED BY THE RATIO BEFORE INFLOW INTO RESERVOIR Nº 1 OR FURTHUR DOWNSTREAM TRAVEL. THIS THEN WOULD LEAD TO VERY CONSERVATIVE RESULTS DOWNSTREAM. IN ADDITION, THE OUTFLOW HYDROGRAPHS GENERATED DURING OVERTOPPING ANALYSIS (ESPECIALLY FOR THE LOWER FRACTIONS OF THE PMF) WOULD BE QUITE CONSERVATIVE VOLUME-WISE, BECAUSE ALL ORDINATES WOULD BE MULTIPLIED BY THE ONE RATIO VALUE, WHEREAS THE RATIO ACTUALLY VARIES WITH THE RESERVOIR ELEVATION.

THE ARTIFICIAL STORAGE APPROACH ALSO HAS SOME MINOR DRAWBACKS IN THAT THE RECESSION LIMBS OF THE OUTFLOW HYDROGRAPHS GENERATED DURING OVERTOPPING ANALYSIS ARE

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 2

BY WJV DATE 1/3/79 PROJ. NO. 79-617-215

CHKD. BY DLB DATE 1/9/79 SHEET NO. 29 OF 29

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INCORRECT SINCE THEY CONTAIN THE EFFECTS OF THE ARTIFICIAL STORAGE VOLUMES BEING DISCHARGED DOWNSTREAM (THE FLOW VALUES ARE LARGER THAN SHOULD BE). HOWEVER, THE RECESSION LIMB OF THE HYDROGRAPH IS OF LITTLE IMPORTANCE IN THIS ANALYSIS. THE EFFECT OF THE ARTIFICIAL STORAGE ON THE BREACHING ANALYSIS IS TO CAUSE A SLIGHTLY LARGER VOLUME OF WATER TO BE DISCHARGED DOWNSTREAM ONCE THE BREACH OCCURS. HOWEVER, BREACHING IS ASSUMED TO BEGIN AT ELEVATION 1347.6 (TOP OF DAM ELEVATION), OR AT MOST AT ELEVATION 1348.1 (½ FT ABOVE DAM) AT WHICH ELEVATIONS THE INCREASED STORAGE VOLUMES WHICH WILL BE ROUTED DS ARE NEGLIGIBLE (SHEET 27

THEREFORE, THE ARTIFICIAL STORAGE APPROACH TO THE LEFT BANK PROBLEM IS THOUGHT TO GIVE MORE ACCURATE RESULTS DOWNSTREAM OF RESERVOIR Nº 2 FOR THIS PHASE I ANALYSIS

SUBJECT DEM SAFETY INSPECTION
HUTCHINSON RESERVOIR DAM N° 3

BY DLB DATE 8-28-78 PROJ. NO. 78-617-216

CHKD. BY EJM DATE 9-13-78 SHEET NO. 1 OF 15

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DAM STATISTICS

MAXIMUM HEIGHT ≃ 56 FEET (FIELD MEASURED)

MAXIMUM POOL STORAGE CAPACITY ≃ 390 AC-FT (SHEET 5)

NORMAL POOL STORAGE CAPACITY ≃ 340 AC-FT (SEE NOTE BELOW)

DRAINAGE AREA ≃ 1.9 SQ. MILES [PLANIMETERED OFF U.S.G.S. 7.5 MINUTE SERIES QUAD BROWNFIELD, PA.]

SIZE CLASSIFICATION

DAM SIZE - INTERMEDIATE (REF 1, TABLE 1)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF - PMF (REF 1, TABLE 3)

NOTE: THE VALUE OF STORAGE CAPACITY IS TAKEN FROM AN UNPUBLISHED NOTEBOOK CONTAINING PERTINANT DATA FOR DAMS OPERATED BY THE UNIONTOWN BRANCH OF W.P.W.. THE NOTEBOOK IS AVAILABLE FROM THE FILES LOCATED AT UNIONTOWN OFFICE OF W.P.W.

A COMPARISON OF THE CALCULATIONS PRESENTED IN THIS TEXT WITH THOSE PREVIOUSLY SUBMITTED IN THE REPORT ENTITLED "HUTCHINSON RESERVOIR NO.3 DAM", DATED SEPTEMBER 1978 WILL REVEAL SEVERAL DISCREPANCIES. THIS IS A DIRECT RESULT OF THE INCREASED ACCURACY REQUIRED TO SUCCESSFULLY COMPLETE THIS ANALYSIS ACCORDING TO THE REVISED GUIDELINES SET FORTH IN THIS CONTRACT. NEVERTHELESS, THE BOTTOM LINE END RESULT HAS REMAINED VIRTUALLY UNCHANGED.

SUBJECT DAM SAFETY INSPECTION.
HUTCHINSON RESERVOIR Nº 3

BY KHK DATE 10-13-78 PROJ. NO. 78-617-216

CHKD. BY RFJ DATE 10-18-78 SHEET NO. 2 OF 15

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HUTCHINSON RESERVOIR # 3

DRAINAGE AREA. = 1.9 SQ. MILES (PLANIMETERED)

SURFACE AREA

NORMAL POOL (ELEV. 1430.5)* = 0.20 SQ. INC (PLANIMETER)
= 18.36 ACRES

(THIS EXCEEDS SURFACE AREA OF 14.5 ACRES GIVEN in 3/14/74 LETTER FROM W.S. McCLAY to UNIONTOWN WATER CO., BUT CALCS. AND POOL LEVEL for 3/14/74 VALUE ARE NOT GIVEN. THEREFORE 18.36 ACRES WILL BE USED)

AREA AT CONTOUR 1440 = .28 SQ INC
= 25.71 ACRES

$\frac{\Delta A}{\Delta Y}$ = RATE OF CHANGE IN AREA / FOOT RISE = $\frac{25.71 - 18.36}{1440 - 1430.5}$ = 0.77 AC/FT

FREE BOARD = 2.8 FT

AREA AT THE TOP OF DAM ELEV. 1433.1 = 18.36 + 2.6 x .77
= 20.4 ACRE-

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 3

BY KHK DATE 10-20-78 PROJ. NO. 79-617-216

CHKD. BY RFU DATE 10-20-78 SHEET NO. 3 OF 15

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* RIGHT ABUT. SPILLWAY IS 0.2' BELOW CREST OF LEFT ABUT. SPILLWAY. FROM UNIONTOWN WATER CO DWG 93-127. LT. ABUT. SPILLWAY CREST IS AT ELEVATION 1430.7'.

UNIT HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE (L) ≃ 2.95 MILES

L_{CA} ≃ 1.37 MILES

[VALUES OF L AND L_{CA} ARE FROM U.S.G.S. 7.5 MINUTE SERIES QUAD BROWNFIELD, PA.]

NOTE: ALL VARIABLES ARE DEFINED IN REFERENCE 2 IN THE SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH".

$C_t = 1.6$

$C_p = 0.5$

[SUPPLIED BY C OF E; ZONE 29, OHIO RIVER BASIN]

t_p = SNYDER'S STANDARD LAG = $1.6\,(L \times L_{CA})^{0.3}$

$t_p = (1.6)\,[(2.95)(1.37)]^{0.3} = 2.43$ HRS

PMP CALCULATIONS

HUTCHINSON RESERVOIR #3 LOCATION ⇒ ZONE 7 (REF. 3)
PMP INDEX = 24 INCHES (FIG. 1, REF. 3)
DURATION % INDEX:
6 HRS = 102
12 HRS = 120
24 HRS = 130

NOTE: A 24-HOUR DURATION RATHER THAN A 48-HOUR DURATION WAS USED. THIS WAS NECESSITATED BY THE NEED TO USE A 5-MINUTE TIME STEP IN THE HEC-1-DAM PROGRAM IN ORDER TO MORE ACCURATELY DEFINE THE PEAKS OF THE HYDROGRAPH. (A MAXIMUM OF ONLY 300 TIME INTERVALS IS ALLOWED IN THE PROGRAM.)

SUBJECT DAM SAFETY INSPECTION.
HUTCHINSON RESERVOIR Nº 3
BY KHK DATE 10-25-78 PROJ. NO. 78-617-216.
CHKD. BY WJV DATE 1/2/79 SHEET NO. 4 OF 15

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APPROXIMATE ELEVATION @ ZERO STORAGE

VOLUME = $\frac{1}{3}$ HA (CONIC METHOD)

A = 18.4 ACRES (SHEET 2 OF CALCS).

NORMAL POOL VOLUME = 340 A-F (WPW FILES UNIONTOWN OFFICE)

$$H = \frac{340 \times 3}{18.4} = 55.43 \text{ FT.}$$

= USE 55 FT

NORMAL POOL ELEV = 1430.5 FT.

ZERO VOLUME ELEV = 1375.5 FT

FURTHER, THE RATE OF CHANGE OF SURFACE AREA PER FOOT OF RESERVOIR RISE BELOW ELEVATION 1430.5:

$$\left(\frac{\Delta A}{\Delta Y}\right)' = 18.4 \text{ ACRES} / 55 \text{ FT} = 0.335 \frac{\text{ACRES}}{\text{FT}}$$

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 3

BY WJV DATE 1/2/79 PROJ. NO. 78-617-216

CHKD. BY DLB DATE 1/9/79 SHEET NO. 5 OF 15

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ELEVATION - STORAGE RELATIONSHIP

- ESTIMATED SURFACE AREA: $A = A_o + \left(\frac{\Delta A}{\Delta Y}\right) Y$

A_o = 18.4 ACRES ABOVE EL. 1430.5, AND 0.0 ACRES BELOW;

$\frac{\Delta A}{\Delta Y}$ = 0.77 AC/FT ABOVE EL. 1430.5, AND 0.335 AC/FT BELOW; AND

Y = [(ELEVATION OF CONCERN) − 1430.5 FT] ABOVE 1430.5 FT AND [(ELEVATION OF CONCERN) − 1375.5 FT] BELOW

- ESTIMATED INCREMENTAL INCREASE IN STORAGE ABOVE EL. 1430.5 FT

MODIFIED PRISMOIDAL FORMULA: $\Delta V_{1-2} = \frac{Y}{3}\left(A_1 + A_2 + \sqrt{A_1 * A_2}\right)$
(REF. 14, PG 15)

- ESTIMATED STORAGE BELOW 1430.5 FT:

CONIC FORMULA: $V = \frac{1}{3} H A$ (where $H = Y$)

ELEVATION (FT)	H (FT)	ESTIMATED AREA (ACRE)	ESTIMATED STORAGE (A-F)	ELEVATION (FT)	Y (FT)	ESTIMATED AREA (ACRE)	INCREMENTAL STORAGE (A-F)	CUMULATIVE STORAGE (A-F)
1375.5	0	0	0	1431.5	1	19.2	18.8	358.8
1380.5	5	1.67	3	1432.5	2	19.9	19.5	378.3
1385.5	10	3.35	11	1433.3	2.8	20.6	16.1	394.4
1390.5	15	5.00	25	1433.5	3	20.7	4.1	398.5
1395.5	20	6.70	45	1434.5	4	21.5	21.1	419.6
1400.5	25	8.36	70	1435.5	5	22.3	21.8	441.4
1405.5	30	10.0	100	1436.5	6	23.0	22.6	464.0
1410.5	35	11.7	137	1437.5	7	23.8	23.4	487.4
1420.5	45	15.0	226					
1425.5	50	16.7	290					
NORMAL POOL - 1430.5	55	18.4	340					

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 3

BY KHK DATE 10-17-78 PROJ. NO. 78-617-216

CHKD. BY RFV DATE 10-19-78 SHEET NO. 6 OF 15

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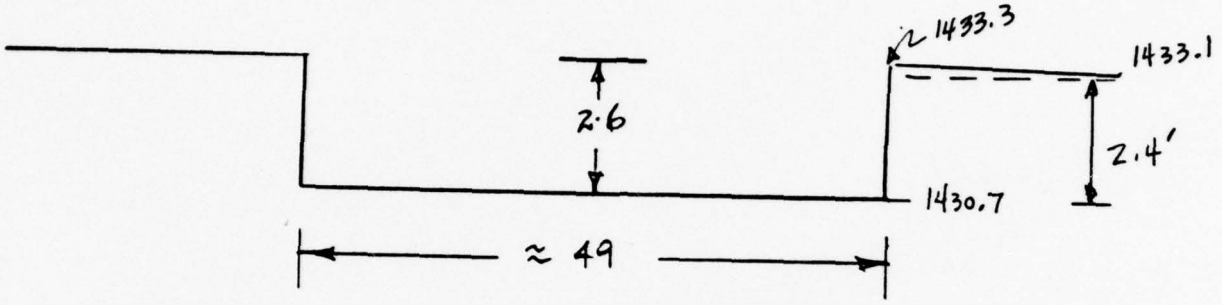
CAPACITY OF LEFT SPILLWAY



SUPERCRITICAL FLOW IS ASSUMED TO OCCUR IN THE SPILLWAY CHANNEL SINCE THE DOWNSTREAM SLOPE IS ABOUT 3% (FIELD MEASUREMENTS). THE CRITICAL SECTION, THAT SECTION WHERE FLOW IS TRANSFORMED FROM SUBCRITICAL TO SUPERCRITICAL FLOW IS ASSUMED TO BE AT THE SPILLWAY INLET.

LET H_s = SPECIFIC ENERGY HEAD = $y + \frac{V^2}{2g}$ (REF. 13, PG 139)

IN RESERVOIR, V IS NEGLIGIBLE $\Rightarrow H_s = H = 2.4$ ft

AT SPILLWAY INLET $H_s = y_c + \frac{V_c^2}{2g}$ (CRITICAL CONDITIONS)

$$\therefore y_c + \frac{V_c^2}{2g} = H$$

SUBJECT DAM SAFETY INSPECTION.
HUTHINSON RESERVOIR NO 3

BY KHK DATE 10-17-78 PROJ. NO. 78-617-216

CHKD. BY RFV DATE 10-19-78 SHEET NO. 7 OF 15

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CRITICAL DEPTH IN RECTANGULAR CHANNEL $\frac{V_c^2}{2g} = \frac{D_c}{2}$ (REF 13, PG. 143)

WHERE D_c = HYDRAULIC DEPTH = $\frac{\text{AREA}}{\text{TOP WIDTH}} = \frac{A_c}{W_c}$

$A_c = 49\, y_c$.

$W_c = 49'$

$$y_c + \frac{49\, y_c}{2 \times 49} = H = 2.4'$$

$$y_c + \frac{y_c}{2} = H = 2.4'$$

$$1.5\, y_c = 2.4' \qquad y_c = 1.60'$$

$$V_c^2/2g = \frac{D_c}{2} = \frac{49 \times 1.60}{2(49)} = 0.800$$

$$V_c^2 = 64.4 \times 0.800$$

$$V_c = 7.18 \text{ FPS.}$$

$$Q_c = V_c \times A_c = 7.18 \times 49 \times 1.60 =$$

$$= 563 \text{ CFS}$$

SUBJECT DAM SAFETY INSPECTION.
HUTCHINSON RESERVOIR Nº 3

BY KHK DATE 10-17-78 PROJ. NO. 78-617-216

CHKD. BY RFV DATE 10-19-78 SHEET NO. 8 OF 15

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DETERMINE THE CRITICAL SLOPE.

$$Q_c = \frac{1.49}{n} A_c R_c^{2/3} \sqrt{S_c}$$ (MANNING EQ, REF 13, PG 143)

OR $$S_c = \left(\frac{Q_c n}{1.49 A_c R_c^{2/3}} \right)^2$$

$$R_c = \frac{\text{AREA}}{\text{WETTED PERIMETER}} = \frac{49 \times 1.60}{49 + 2 \times 1.60} = 1.50'$$

$n = .014$ CONCRETE LINED (REF 7 PAGE 116)

$$S_c = \left(\frac{563 \times .014}{1.49 \times 78.40 \times (1.50)^{2/3}} \right)^2 = 0.00265$$

$$= 0.265\% < 3\%$$

CRITICAL SLOPE IS LESS THAN ACTUAL SLOPE; THUS SUPER CRITICAL FLOW DOES OCCUR IN THE SPILLWAY CHANNEL.

MAXIMUM SPILLWAY CAPACITY $Q = Q_c = 563$ CFS.

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 3

BY KHK DATE 10-17-78. PROJ. NO. 78-617-216

CHKD. BY RFV DATE 10-19-78 SHEET NO. 9 OF 15

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ELEVATION DISCHARGE RELATIONSHIP FOR LEFT SPILLWAY

THE PROCEDURE USED TO CALCULATE THE SPILLWAY CAPACITY ON SHEETS 6 AND 7 WILL BE FOLLOWED TO DETERMINE THE DISCHARGE VALUES:

$$y_c = H/1.5$$

$$V_c = \left(64.4 \frac{y_c}{2}\right)^{1/2} \qquad Q_c = V_c \times A_c.$$

H HEIGHT ABOVE SPILLWAY CREST (FT)	ELEVATION ABOVE M.S.L (FT)	y_c (FT)	V_c FT/SEC	A_c SQ. FT	Q_c CFS.
0	1430.7	0	0	0	0
0.8	1431.5	0.53	4.13	25.97	107
1.8	1432.5	1.2	6.22	58.8	366
2.4	1433.1	1.60	7.18	78.40	563
2.8	1433.5	1.87	7.76	91.63	711
3.8	1434.5	2.53	9.03	123.97	1119
4.8	1435.5	3.2	10.15	156.8	1592
5.8	1436.5	3.87	11.16	189.63	2116
6.8	1437.5	4.53	12.07	221.97	2679

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 3

BY KHK DATE 10-17-78 PROJ. NO. 78-617-216

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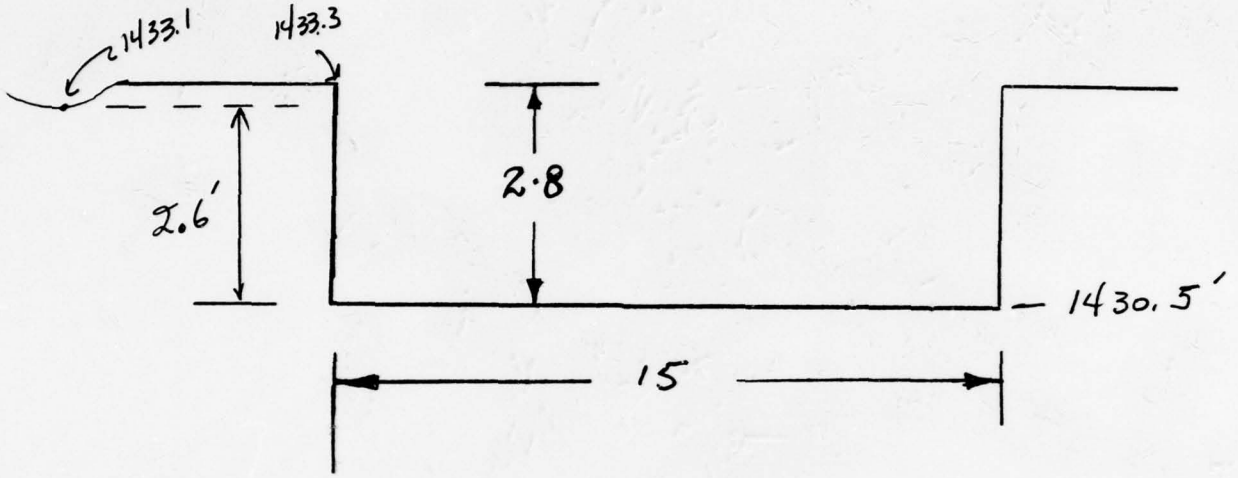
CAPACITY OF RIGHT SPILLWAY.



SUPERCRITICAL FLOW IS ASSUMED AS THE SLOPE OF SPILLWAY CHANNEL IS GREATER THAN 5%

LET SPECIFIC HEAD $H_s = y + \frac{V^2}{2g}$ (REF 13, PG 139)

IN RESERVOIR, V, IS NEGLIGIBLE $\Rightarrow H_s = H = 2.6$ FT.

AT SPILLWAY INLET $H_s = y_c + \frac{V_c^2}{2g}$ (CRITICAL CONDITIONS)

$$\therefore \; y_c + \frac{V_c^2}{2g} = H$$

CRITICAL DEPTH $= \frac{V_c^2}{2g} = \frac{D_c}{2}$ (REF 13, PG. 143)

WHERE D_c = HYDRAULIC DEPTH $= \frac{\text{AREA}}{\text{TOP WIDTH}} = \frac{A_c}{W_c}$

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 3

BY KHK DATE 10-17-78 PROJ. NO. 78-617-216

CHKD. BY RFV DATE 10-19-78 SHEET NO. 11 OF 15

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$A_c = 15\, y_c$

$w_c = 15$

$$y_c + \frac{15\, y_c}{2 \times 15} = 2.6$$

$$1.5\, y_c = 2.6 \qquad y_c = 1.73$$

$$V_c^2/2g = \frac{D_c}{2} = \frac{15 \times 1.73}{2 \times 15} = 0.865$$

$$V_c^2 = 64.4 \times .865$$

$$V = 7.46 \text{ FT/SEC.}$$

$$Q = V_c \times A_c = 7.46 \times 15 \times 1.73 = 194 \text{ CFS.}$$

CHECK SLOPE: (SEE SHEET 8)

$$S_c = \left(\frac{Q_c\, n}{1.49\, A_c R_c^{2/3}}\right)^2 \Rightarrow$$

$Q_c = 194$ CFS
$n = 0.014$ (REF 7, PG. 116)
$A_c = (15')(1.73') = 26.0 \text{ FT}^2$
$R_c = 26.0 \text{ FT}^2 / (15' + 1.73' + 1.73') = 1.41 \text{ FT}$

$$\therefore S_c = \left[\frac{(194)(0.014)}{1.49(26.0)(1.41)^{2/3}}\right]^2 = 0.31\% < 5\%$$

⇒ CRITICAL FLOW CONTROLS

MAXIMUM SPILLWAY CAPACITY = 194 CFS

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 3

BY KHK DATE 10-16-78 PROJ. NO. 78-617-216

CHKD. BY RFV DATE 10-19-78 SHEET NO. 12 OF 15

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ELEVATION DISCHARGE RELATIONSHIP FOR RIGHT SPILLWAY

THE PROCEDURE USED TO CALCULATE THE SPILLWAY CAPACITY ON SHEETS 10 AND 11 WILL BE FOLLOWED TO DETERMINE THE DISCHARGE VALUES:

$$y_c = H/1.5$$

$$V_c = \left(64.4 \frac{y_c}{2}\right)^{1/2}$$

$$Q_c = V_c \times A_c$$

H HEIGHT ABOVE SPILLWAY CREST FT.	ELEVATION ABOVE M.S.L FT.	y_c FT	V_c FT/SEC	A_c SQ. FT.	Q_c CFS.
0	1430.5	-	-	-	-
1	1431.5	0.67	4.6	10.05	46
2	1432.5	1.33	6.5	19.95	130
2.6	1433.1	1.73	7.46	25.95	194
3	1433.5	2	8.02	30	241
4	1434.5	2.67	9.27	40.05	371
5	1435.5	3.33	10.35	49.95	517
6	1436.5	4	11.34	60	680
7	1437.5	4.67	12.26	70.05	859

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 3

BY KHH DATE 10-18-78 PROJ. NO. 78-617-216

CHKD. BY RFV DATE 10-19-78 SHEET NO. 13 OF 15

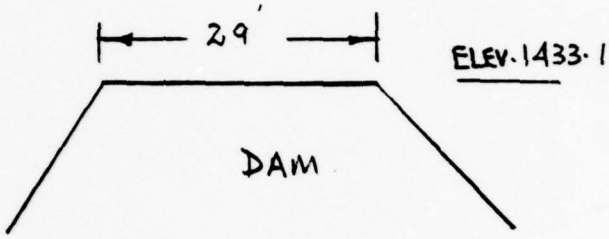
gai CONSULTANTS, I
Engineers • Geologists • Planners
Environmental Specialists

DISCHARGE DUE TO DAM OVERTOPPING

AVE CREST WIDTH = 29'

CREST ELEVATION = 1433.1

CREST LENGTH = 400



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

ELEVATION	H (FT)	H/L	C*	Q CFS
1433.1	0	–	–	–
1433.5	0.4	.014	3.00	304
1434.5	1.4	.05	3.04	2,014
1435.5	2.4	.08	3.05	4,536
1436.5	3.4	.12	3.05	7,649
1437.5	4.4	.15	3.05	11,260

* DISCHARGE COEFFICIENT BASED ON CRITERIA FOR EMBANKMENT SHAPED WEIRS - FIG 24 REF 12 (1970)

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 3

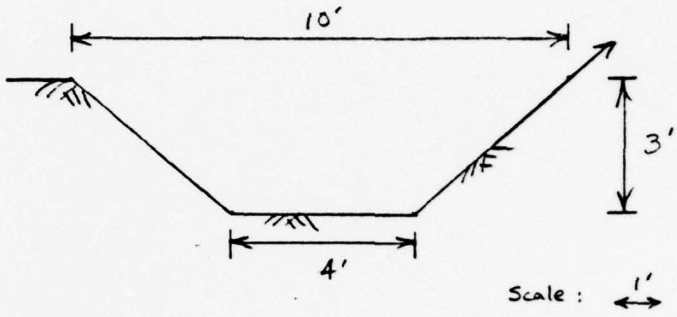
WJV DATE 11/29/78 PROJ. NO. 78-617-216

CHKD. BY DLB DATE 11/30/78 SHEET NO. 14 OF 15

gai CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

RACEWAY ANALYSIS

TYPICAL CROSS SECTION :



RACEWAY CAPACITY = 126 CFS ("HUTCHINSON RESERVOIR Nº3 DAM" PHASE I INSPECTION REPORT, NATIONAL DAM INSPECTION PROGRAM, BY GAI CONSULTANTS, INC FOR THE BALTIMOR DISTRICT CORPS OF ENGINEERS)

APPROXIMATE RACEWAY LENGTH = 1600 FT

APPROXIMATE RACEWAY STORAGE CAPACITY @ FULL FLOW :

STORAGE = AVERAGE SURFACE AREA × AVERAGE DEPTH

$$\text{STORAGE} = \left[(10' \times 1600') + (4' \times 1600')\right] \times \frac{3'}{2} = 33600 \text{ FT}^3$$
$$= 0.77 \text{ AC-FT}$$

RACEWAY STORAGE IS INSIGNIFICANT AND WILL BE NEGLECTED IN THE SPILLWAY ANALYSIS

ASSUME RACEWAY FLOWS FULL BY THE TIME THE RESERVOIR LEVEL RAISES 5 FT (FROM ELEV 1375.5 @ "0" RESERVOIR STORAGE TO ELEV 1380.5) ⇒ RACEWAY FLOWS FULL SHORTLY AFTER BEGINNIN OF DIRECT RUNOFF GENERATION

SUBJECT DAM SAFETY INSPECTION
HUTCHINSON RESERVOIR Nº 3

BY KHK DATE 10-18-78 PROJ. NO. 28-617-216

CHKD. BY REJ DATE 10-19-78 SHEET NO. 15 OF 15

gai CONSULTANTS, II
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Environmental Specialists

COMBINED DISCHARGE RATING CURVE

ELEVATION	RAGENAY	RIGHT SPILLWAY CFS	LEFT SPILLWAY CFS	OVERTOPPING DAM CFS	COMBINED Q CFS.
1430.5	0	0	–	–	–
1431.5	126	46	107	–	279
1432.5	126	130	366	–	622
1433.1	126	194	563	0	883
1433.5	126	241	711	304	1382
1434.5	126	371	1119	2,014	3630
1435.5	126	517	1592	4,536	6771
1436.5	126	680	2116	7,649	10571
1437.5	126	859	2679	11,260	14924

APPENDIX D

PHOTOGRAPHS

PHOTOGRAPH 1 View along the crest of Hutchinson Reservoir Dam No. 1 from the right abutment. The spillway is visible in the foreground and the gate control platform is shown on the upstream side of the dam near the center of the embankment.

PHOTOGRAPH 2 View of the downstream face of Dam No. 1 from approximately 300 feet downstream. The spillway is shown on the left and the chlorination hut in the center of the photograph.

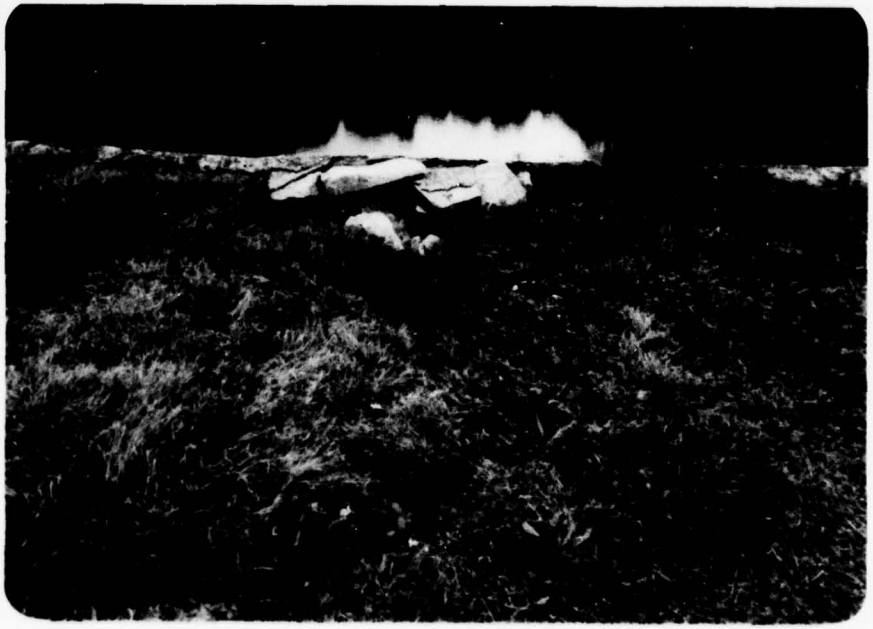
PHOTOGRAPH 3 View of the valley immediately downstream of Dam No. 1.

PHOTOGRAPH 4 Close-up view of a depression (sinkhole) on the upstream side of the crest near the embankment center.

1

2

3



4

PHOTOGRAPH 5 Close-up view of the stepped spillway located on the right abutment. Note the cracking in the sidewalls near the field team members.

PHOTOGRAPH 6 View of the Dam No. 1 spillway. The steel pipe on the left side of the photograph conveys water from Hutchinson Reservoir No. 2 Dam. The pipe can be uncoupled (at the black section) and used as a blowoff line if necessary.

PHOTOGRAPH 7 View of Hutchinson Reservoir No. 1 Dam from the upstream reach of the reservoir. Minor sedimentation is indicated in the foreground.

PHOTOGRAPH 8 View of the diversion ditch that conveys runoff around the right side of Reservoir No. 1.

5

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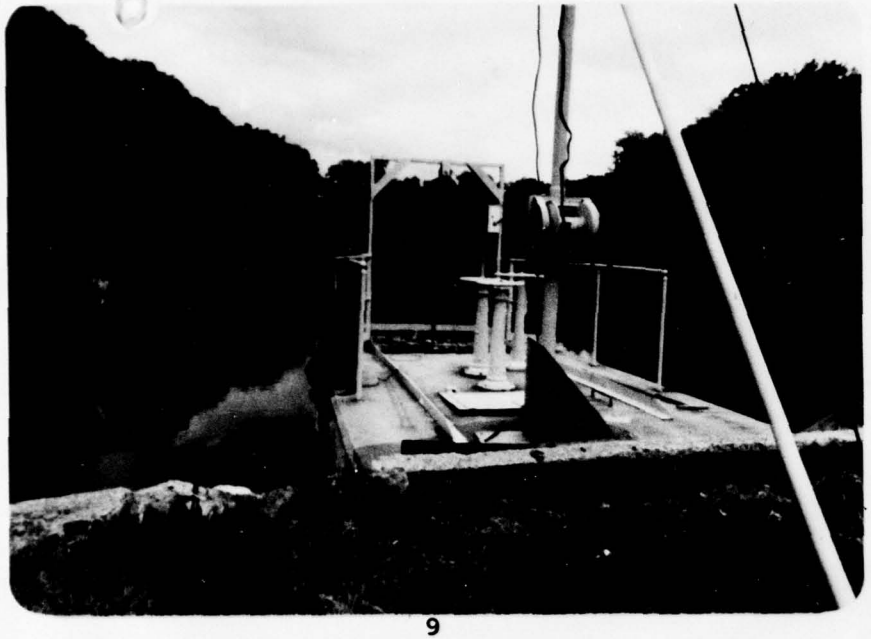
PHOTOGRAPH 9 Close-up view of the valve controls on the Dam No. 1 outlet system.

PHOTOGRAPH 10 View of the cracked upstream face of the Dam No. 1 embankment. Note the cracking and rotation of the riser portion of the gate chamber. (vault)

PHOTOGRAPH 11 View of the discharge end of the 14-inch diameter blowoff pipe (inundated).

PHOTOGRAPH 12 Close-up view of a sediment laden area near the toe of the embankment adjacent to the left abutment.



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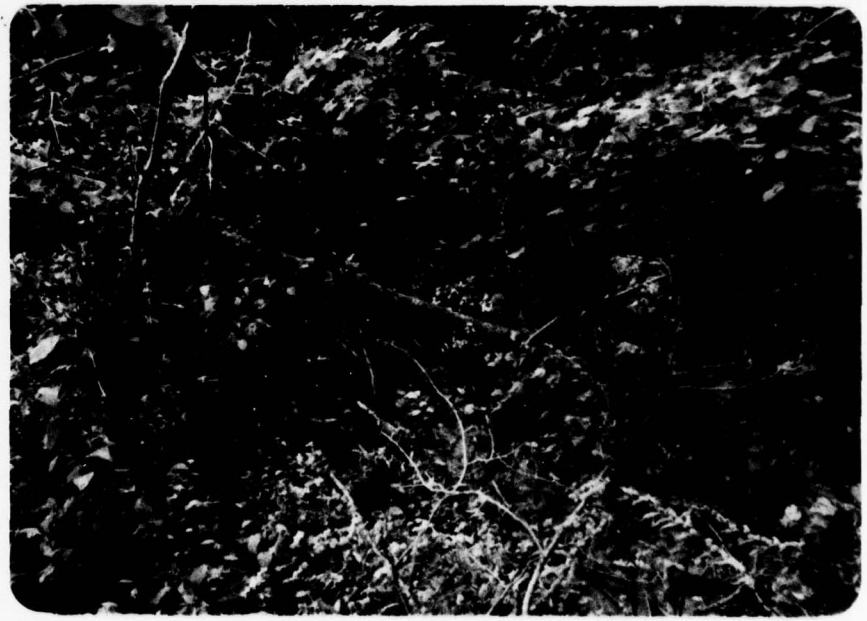
10

11



12

PHOTOGRAPH 13 View of some multiple family dwellings located adjacent to Redstone Creek approximately one mile downstream of Dam No. 1.

APPENDIX E

GEOLOGY

GEOLOGY

Hutchinson Reservoir Nos. 1, 2, and 3 are located approximately 3 miles southeast of Uniontown on the western edge of the Allegheny Mountains section of the Appalachian Plateaus Province. The Allegheny Mountain section is characterized by gently folded sedimentary rock strata of Pennsylvanian age or older. Major structural axes strike from southwest to northeast with flanking strata dipping northwest and southeast.

Structurally, the dam and reservoir lie immediately west of the Chestnut Ridge anticline. The bedrock flanking the west side of Chestnut Ridge consist of Devonian and Mississippian age strata in the higher elevations of the watershed and Pennsylvanian age strata in the vicinity of the reservoirs and below. Near both dams the sedimentary rock strata dip to the northwest at approximately 1,800 feet per mile or 19 degrees.

Two widely spaced joint systems at right angles to each other commonly control drainage patterns on the flanks of Pennsylvania's ridges. In the vicinity of the site, the joint system striking N60°W is at right angles to the anticlinal axis and tends to align drainage patterns off the ridge in this direction. A secondary joint system parallels the anticlinal axis striking N30°E. The secondary system generally has a lesser influence on controlling drainage patterns. Redstone Creek, however, is strongly controlled

by both joint systems. The creek channel both above and below the Hutchinson reservoirs follow the primary N60°W bearing, whereas the section of Redstone Creek containing the reservoirs following the secondary N30°E bearing (see Regional Vicinity Map Appendix G). This abrupt directional change in the flow of Redstone Creek is not common in this section of Chestnut Ridge. Furthermore, a small fault, located about one mile northeast of the reservoirs is also known to strike along this same N30°E bearing. A strong structural influence is evidently controlling the direction of drainage along the section of Redstone Creek containing the Hutchinson reservoirs. Jointing and possibly faulting may be responsible for this drainage control. The influence this feature may have, if any, on the Hutchinson reservoirs is unknown, although it may have some bearing on seepage losses through the foundation of the reservoirs.

The strata underlying the alluvial and residual soils of the valley are members of the Allegheny Formation which is lower Pennsylvanian age. The group consists of shale and sandstone with lesser amounts of coal, clay, and limestone. The base is at the top of the Homewood sandstone and the top at the Upper Freeport coal which passes between Reservoir No. 2 and upstream of Reservoir No. 3. The Allegheny Formation is approximately 150 to 160 feet thick in the vicinity of the reservoirs.

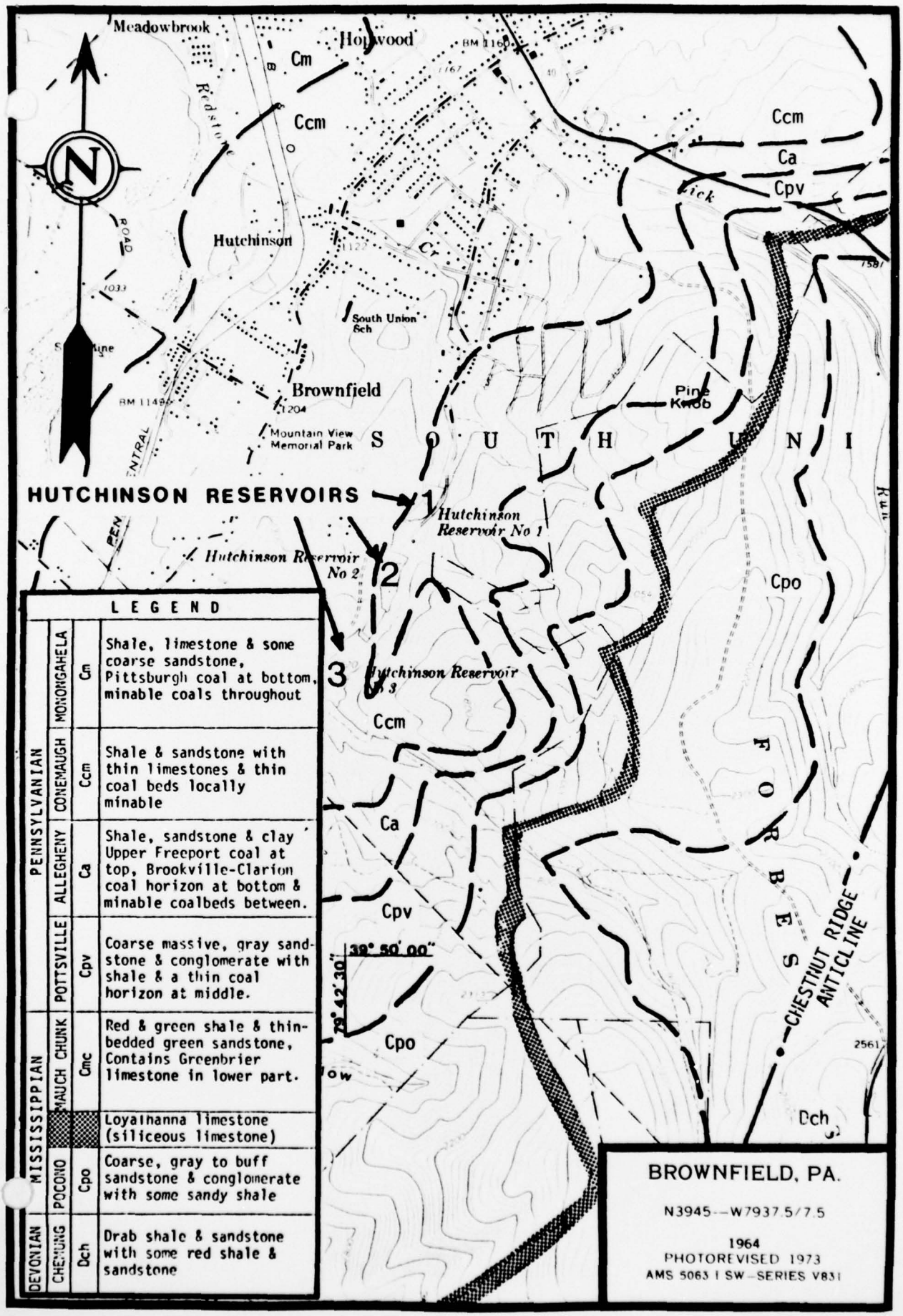
The Upper Freeport coal occurs above Reservoirs No. 1 and 2 along the west valley wall. The coal in this area is considered to average about four feet thick with several thick clay and shale partings. The coal is generally of good thickness and quality, but has not been prospected to any great extent. At the time of the inspection, there was no evidence of mining in the immediate area.

REFERENCES

1. Cathcart, S. H., W. O. Hickok, IV, and F. T. Moyer, Geologic Map of Fayette County, Pennsylvania: Harrisburg, Pennsylvania: Topographic and Geologic Survey, 1938.

2. Hickok, W. O., IV, and F. T. Moyer, Geology and Mineral Resources of Fayette County, Pennsylvania: Harrisburg, Pennsylvania: Topographic and Geologic Survey, 1940.

3. Sisler, James D., Bituminous Coal Fields of Pennsylvania, Part II, Harrisburg, Pennsylvania: Topographic and Geologic Survey, 1961.


Meadowbrook
Holywood
BM 1160
Cm
Ccm
Ca
Cpv
Redstone
Hutchinson
South Union Sch
Brownfield
BM 1149
1204
Mountain View Memorial Park
Pine Knob
S O U T H U N I
HUTCHINSON RESERVOIRS
1
Hutchinson Reservoir No 1
2
Hutchinson Reservoir No 2
3
Hutchinson Reservoir No 3
Cpo
Ccm
Ca
Cpv
39° 50' 00"
79° 42' 30"
Cpo
F O R B E S
CHESTNUT RIDGE ANTICLINE
2561
Dch
LEGEND
PENNSYLVANIAN
MONONGAHELA
Cm
Shale, limestone & some coarse sandstone, Pittsburgh coal at bottom, minable coals throughout
CONEMAUGH
Ccm
Shale & sandstone with thin limestones & thin coal beds locally minable
ALLEGHENY
Ca
Shale, sandstone & clay Upper Freeport coal at top, Brookville-Clarion coal horizon at bottom & minable coalbeds between.
POTTSVILLE
Cpv
Coarse massive, gray sandstone & conglomerate with shale & a thin coal horizon at middle.
MISSISSIPPIAN
MAUCH CHUNK
Cmc
Red & green shale & thin-bedded green sandstone, Contains Greenbrier limestone in lower part.
Loyalhanna limestone (siliceous limestone)
POCONO
Cpo
Coarse, gray to buff sandstone & conglomerate with some sandy shale
DEVONIAN
CHEMUNG
Dch
Drab shale & sandstone with some red shale & sandstone
BROWNFIELD, PA.
N3945--W7937.5/7.5
1964
PHOTOREVISED 1973
AMS 5063 I SW-SERIES V831

APPENDIX F

FIGURES

LIST OF FIGURES

Figure	Description/Title
1	Plan (Field Sketch)
2	Plan and Profile (1914 Drawing)
3	Cross-section (1915 Drawing)

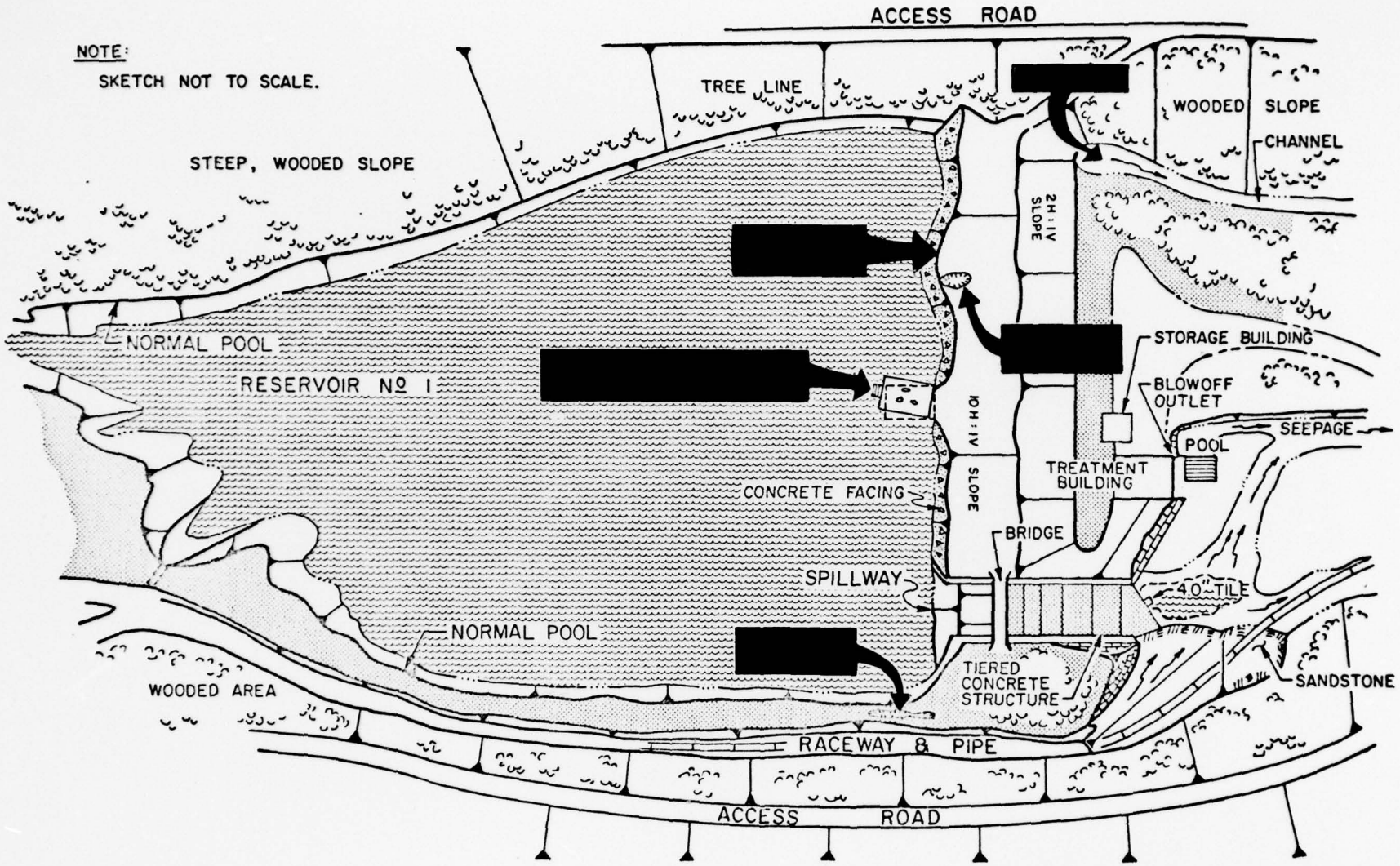
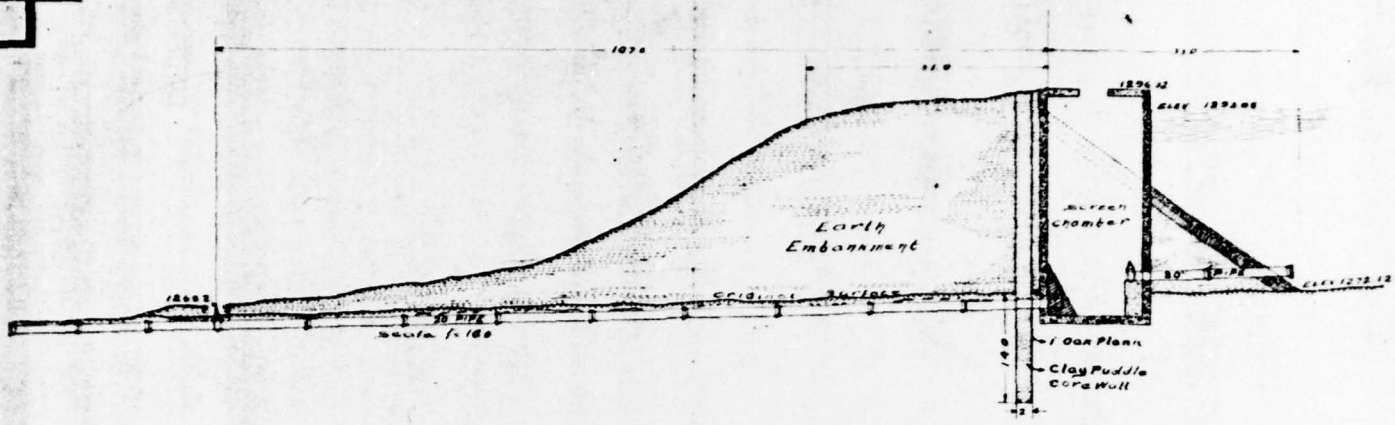
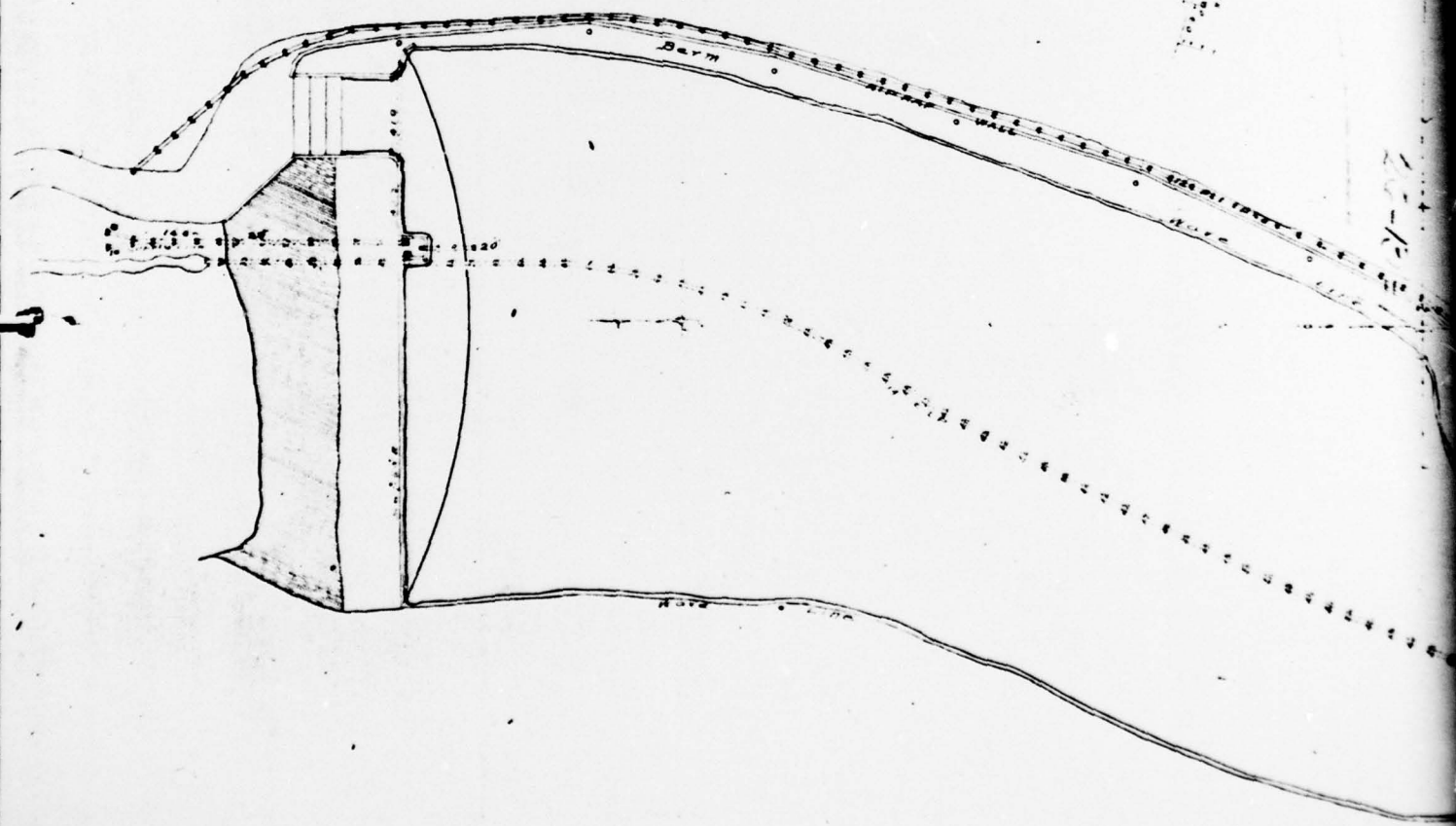


FIGURE 1 - HUTCHINSON RESERVOIR DAM Nº 1
GENERAL PLAN • FIELD INSPECTION NOTES


Earth
Embankment
Screen
Chamber
Clay Puddle
Core Wall


Berm
Rip Rap
Wall

UNIONTOWN WATER CO.

HUTCHISON RESERVOIR. N° 1.

SOUTH UNION TOWNSHIP,

FAYETTE COUNTY, PA.

Scale 1:400 Oct 1914

W.B. McCLAY ENGINEER, UNIONTOWN, PA.

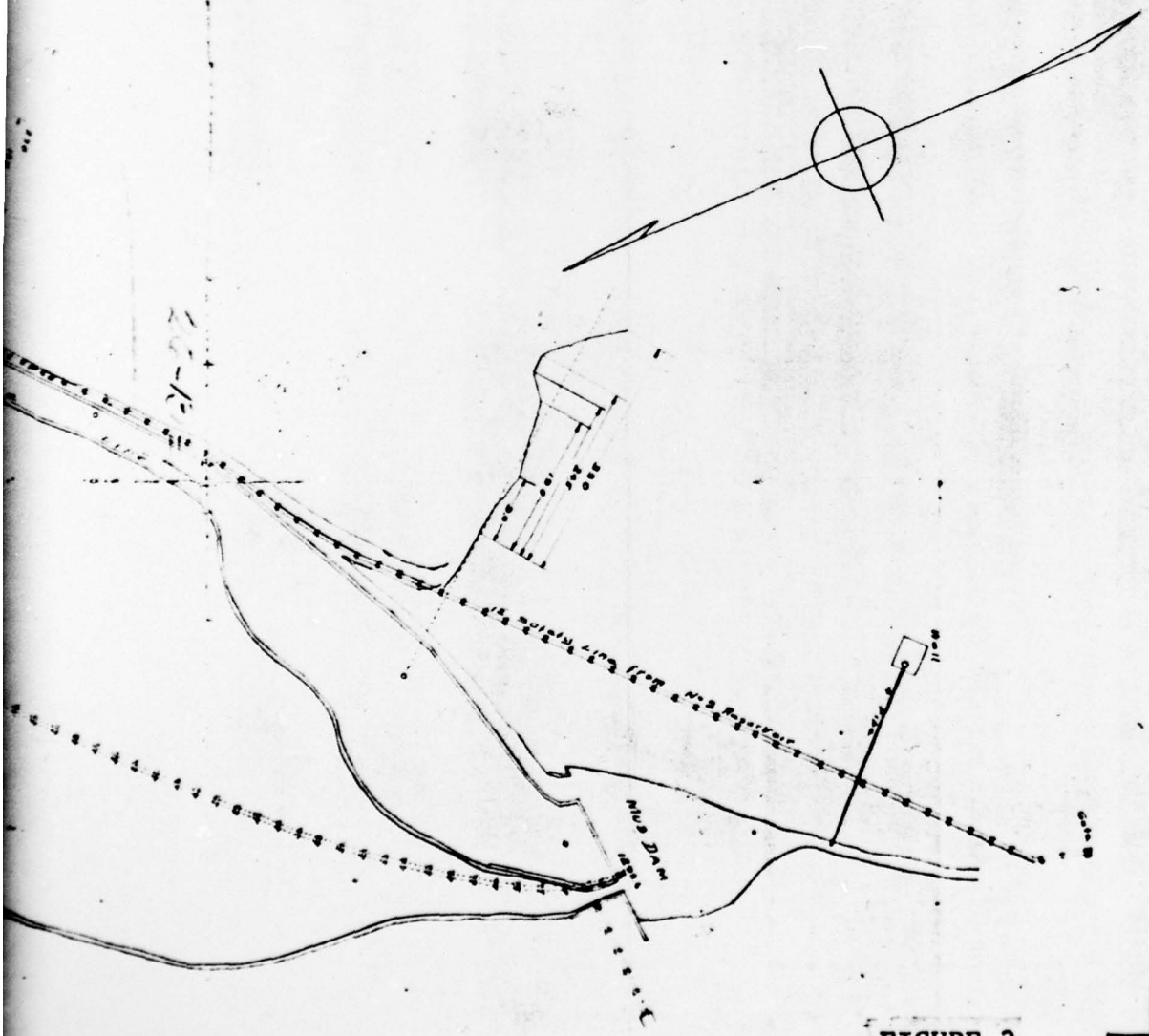
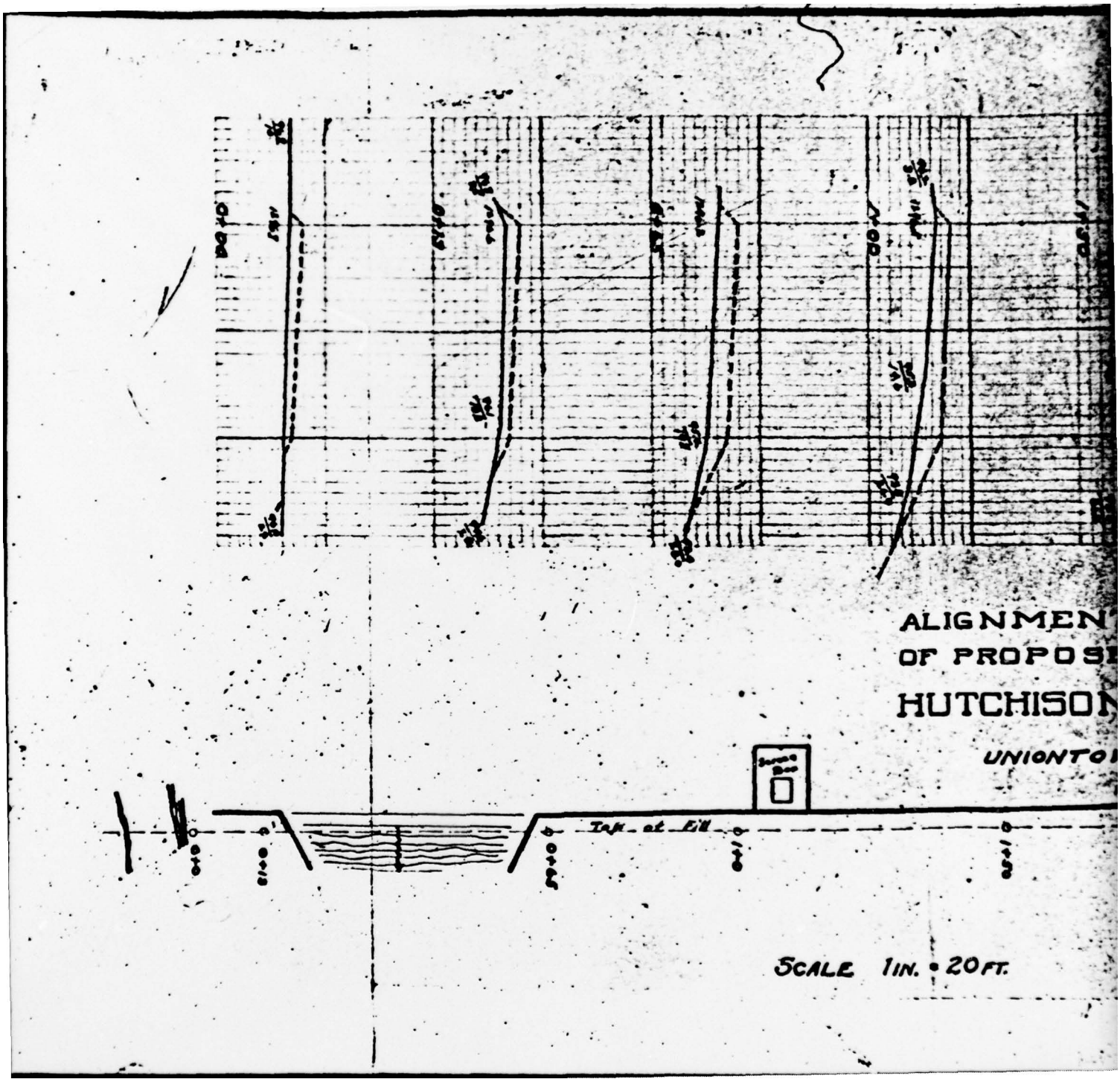
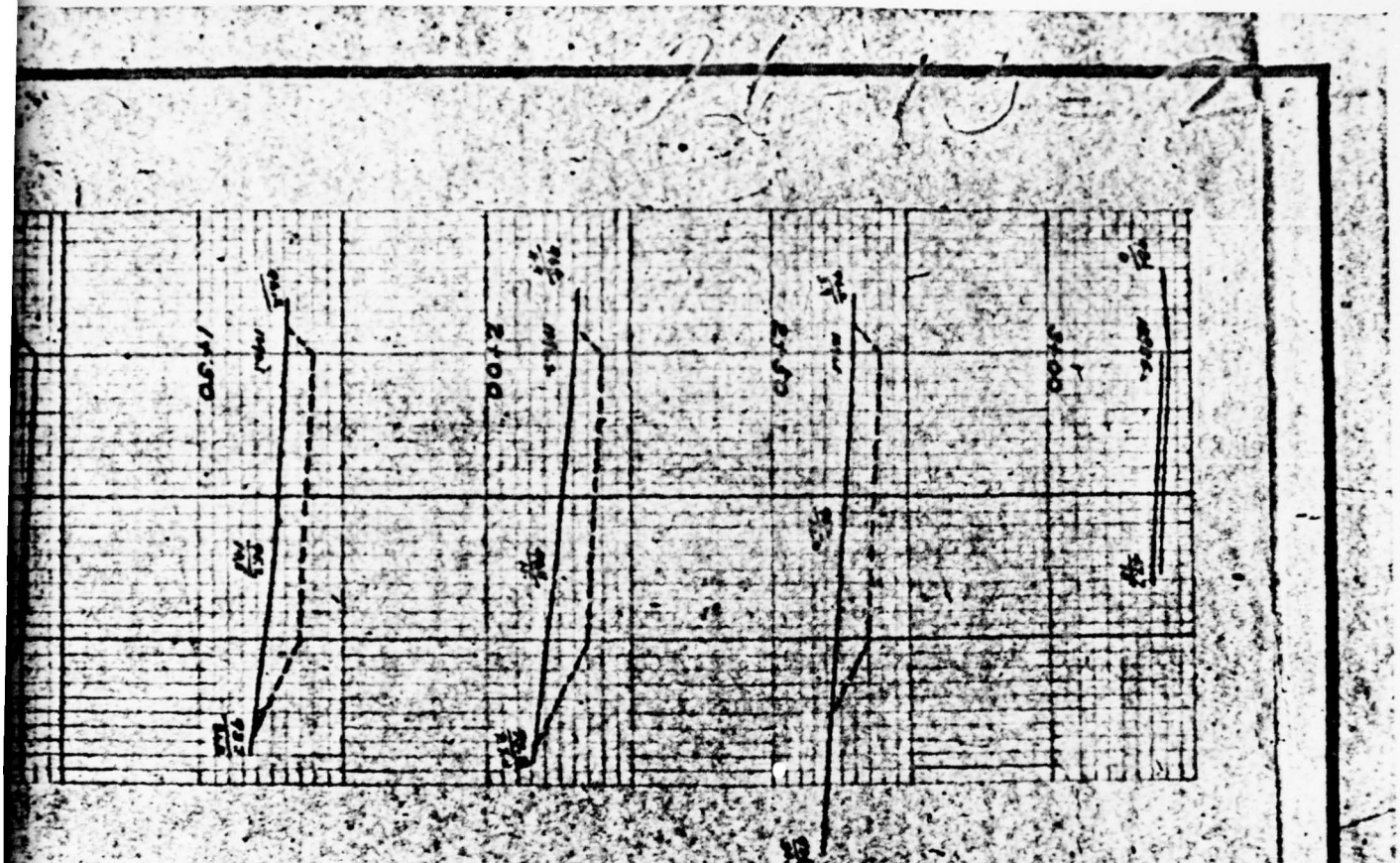


FIGURE 2


ALIGNMEN
OF PROPOS
HUTCHISON
UNIONTO
Top of Fill
SCALE 1 IN. = 20 FT.



IGNMENT and X-SECTION MAP
PROPOSED IMPROVEMENT
AT
UTCHISON RESERVOIR No. 1
OF
UNIONTOWN WATER CO.
Uniontown Fayette Co. Pa.

WATER SUPPLY COMMISSION
APPROVED
DATE
ENGINEER
APPL. No.
OF PENNSYLVANIA

Top of Fill

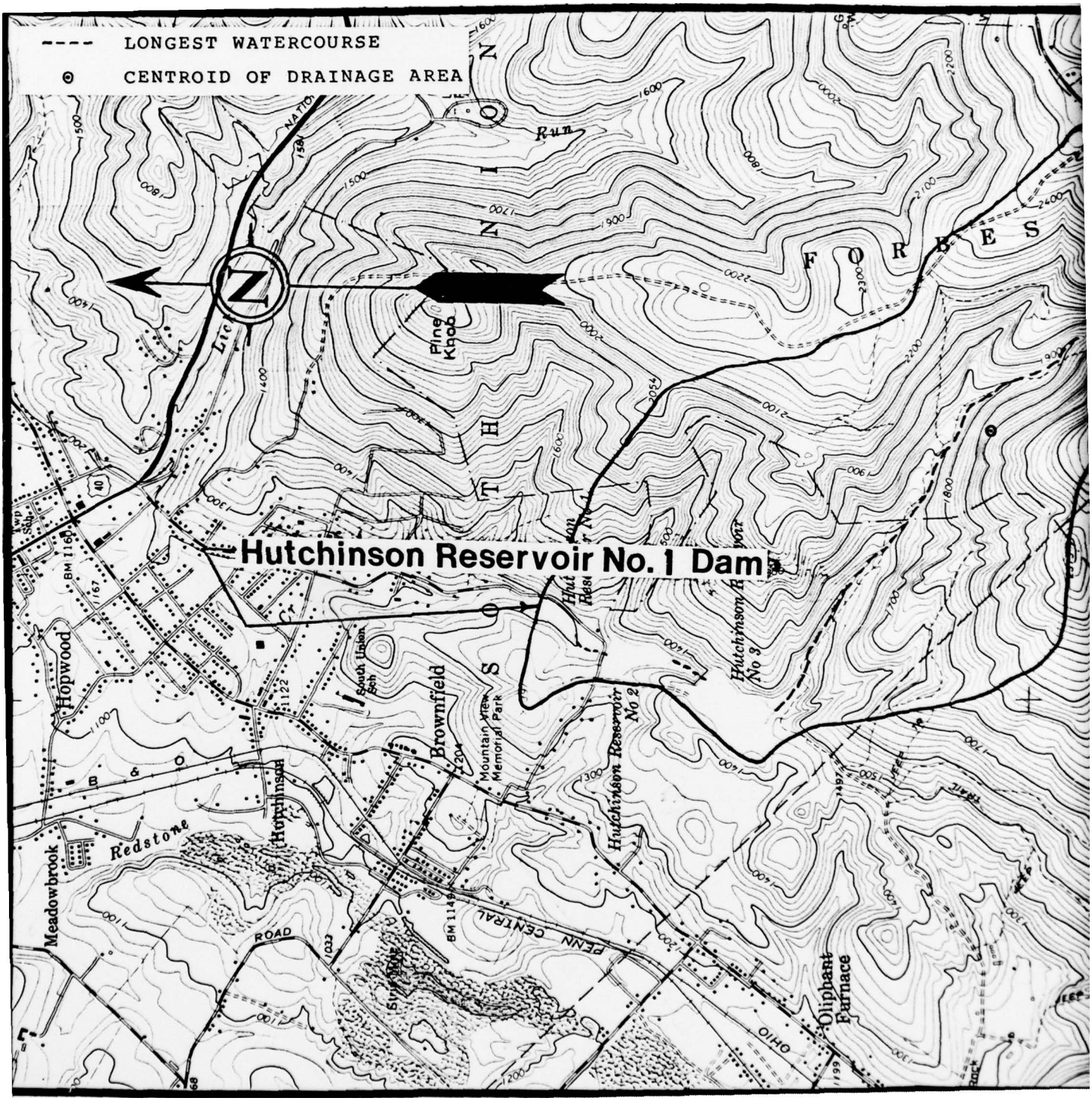
20 FT.

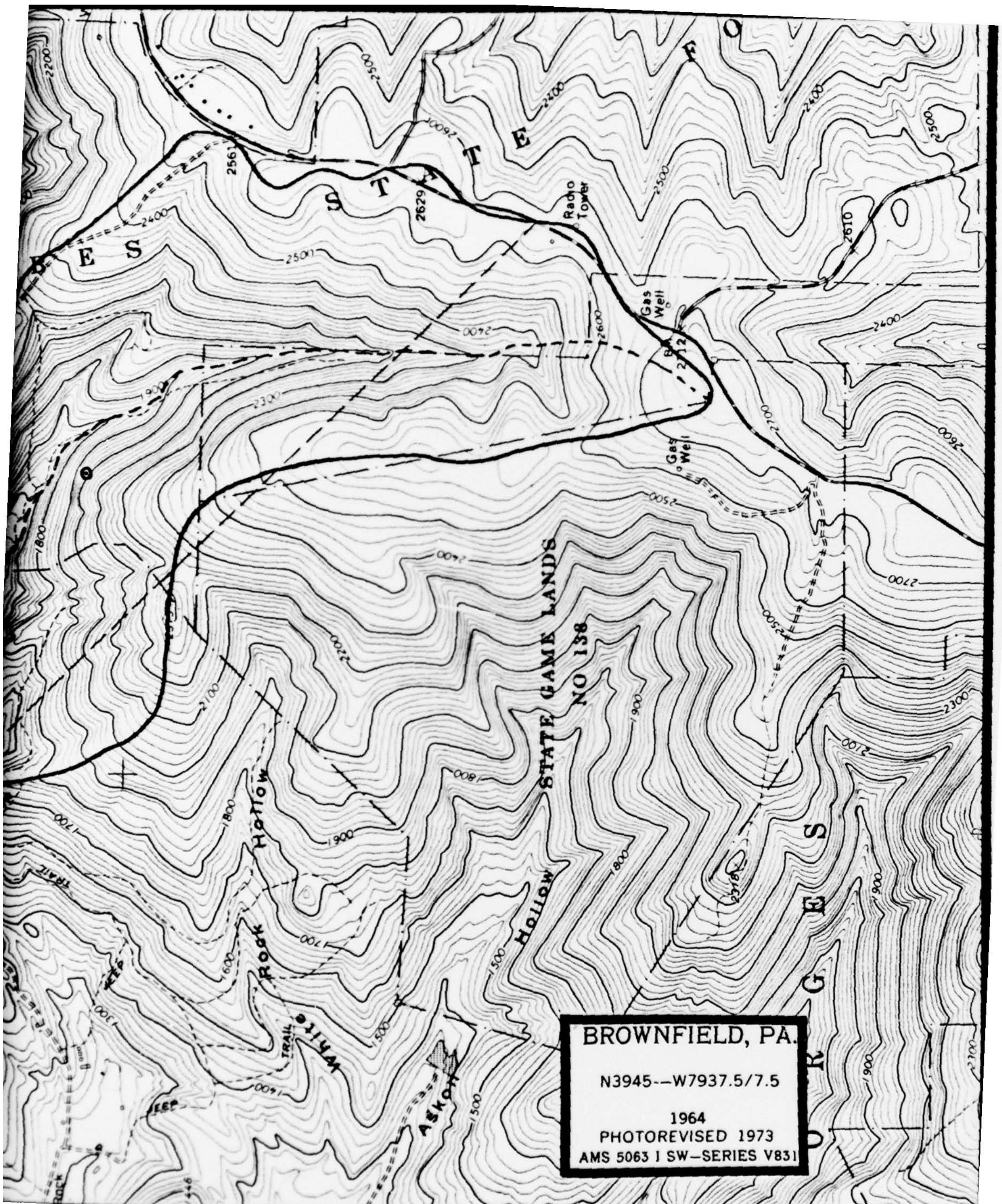
W.S. McCLAY, Engineer
Uniontown Pa.
June 1916

FIGURE 3

APPENDIX G

REGIONAL VICINITY MAP


---- LONGEST WATERCOURSE
⊙ CENTROID OF DRAINAGE AREA
Hutchinson Reservoir No. 1 Dam
Run
Ping Knob
Hopwood
Brownfield
Mountain View Memorial Park
Hutchinson Reservoir No 2
Redstone
Meadowbrook
ROAD
PENN CENTRAL
Oliphant Furnace
OHIO
B & O
FOREST


BROWNFIELD, PA.
N3945--W7937.5/7.5
1964
PHOTOREVISED 1973
AMS 5063 I SW—SERIES V831
STATE GAME LANDS
NO 138
Radio Tower
Gas Well
Gas Well
Hollow
Hollow
White Rock
Askon
TRAIL