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JUL 79 DACW31-79-C-0010

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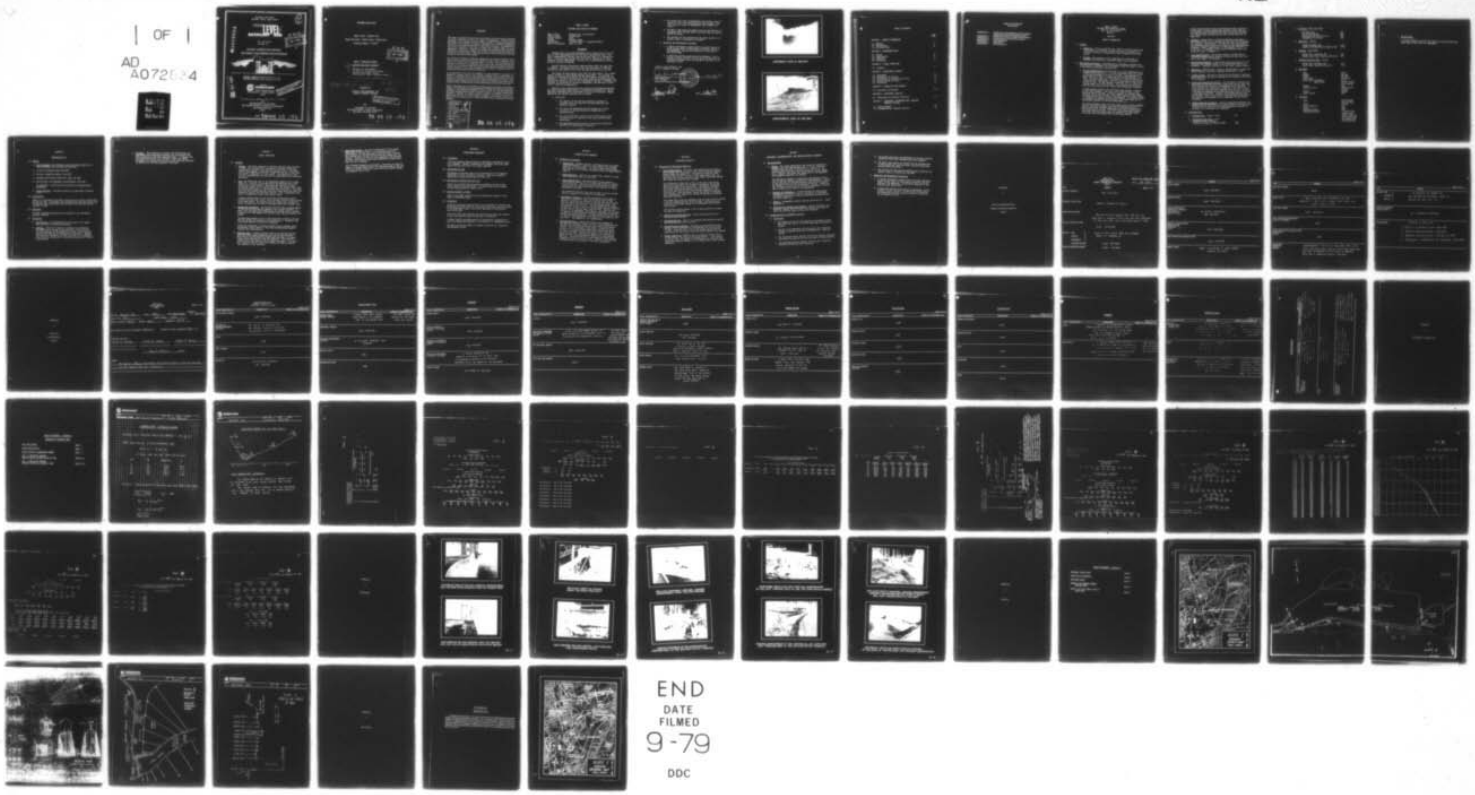

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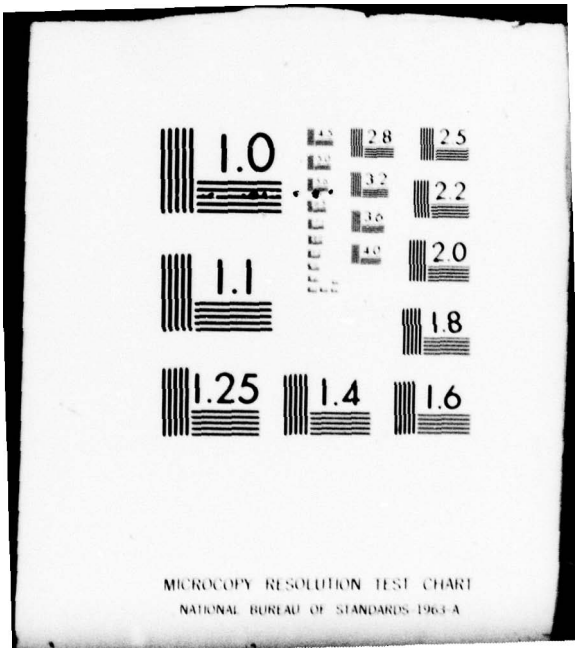
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DELAWARE RIVER BASIN
BERNHART CREEK BERKS COUNTY

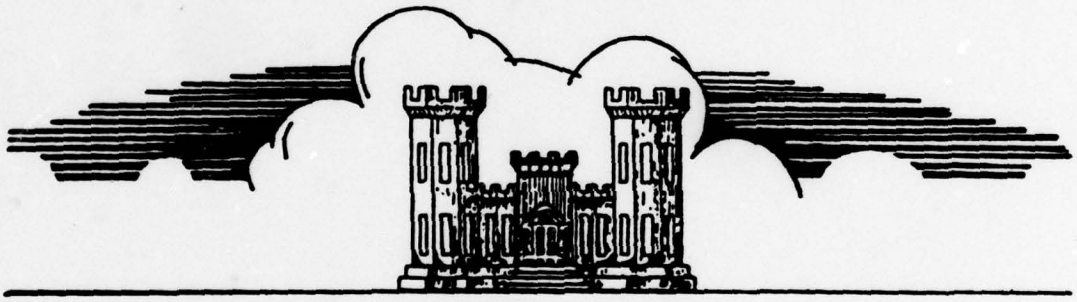
PENNSYLVANIA

LEVEL II

BERNHART DAM

NDI - PA 00717
PA DER 6-1

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



ORIGINAL CONTAINS COLOR PLATES: ALL DDC REPRODUCTIONS WILL BE IN BLACK AND WHITE.

Prepared By
O'BRIEN & GERE
Justin & Courtney Division
PHILADELPHIA, PENNSYLVANIA
19103

Contract # DACW31-79-C-0010
FOR
DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

JULY 1979

DELAWARE RIVER BASIN

Name of Dam: Bernhart Dam

County and State: Berks County, Pennsylvania

Inventory Number: PA 00717

PHASE I INSPECTION REPORT

(6) NATIONAL DAM SAFETY PROGRAM.

Bernhart Dam. NDI-PA-00717.
PA DER-6-1. Delaware River Basin.
Bernhart Creek, Berks County,
Pennsylvania. Phase I Inspection Report.

(15) DACW31-79-C-0010 (11) Jul 79 (12) 74p

Prepared by:

O'BRIEN & GERE ENGINEERS, INC.
JUSTIN & COURTNEY DIVISION

For:

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

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

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

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

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

PHASE I REPORT

NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Bernhart Dam ID # PA 00717
State Located	Pennsylvania
County Located:	Berks
Stream:	Bernhart Creek
Coordinates:	Latitude $42^{o}22.7'$, Longitude $75^{o}54.5'$
Date of Inspection:	April 3, 1979

ASSESSMENT

Bernhart Dam is an earth embankment with a masonry brick core wall and a 5-foot high masonry wall at the top of the upstream face. The dam is approximately 180 feet long and 30 feet high at its maximum section. A 40-foot wide concrete drop spillway is located at the right abutment (looking downstream). The dam site is approximately one mile north of the City of Reading.

Bernhart Dam was constructed sometime before 1865, the exact date is unknown. The masonry brick core wall was constructed in 1896 and the masonry gate house on the top of the dam was built prior to 1913.

The chosen Spillway Design Flood (SDF) for this "Small" size, "High" hazard structure is the Probable Maximum Flood (PMF). The spillway is capable of discharging 24 percent of the PMF without overtopping of the embankment. Failure of the dam would cause excessive property damage and increase the hazard to loss of life downstream of the dam. Therefore, the spillway is classified as "Seriously Inadequate", and the dam is classified as "Unsafe (non-emergency)".

Based on visual observations and review of the information obtained from the Pennsylvania Department of Environmental Resources Division of Dam Safety, Bernhart Dam is considered to be in fair condition. Recommendations and remedial measures are as follows:

a. Facilities

1. The capacity of the spillway should be increased in accordance with the results of further hydrologic and hydraulic studies.

2. The top of the embankment and the masonry wall should be restored to design elevation as determined by a detailed survey.

3. The sluice gate which controls the 16-inch diameter blow-off pipe should be repaired and the pipe should be made operational.

4. The downstream spillway channel training walls should be repaired and replaced where necessary.

5. The eroded path along the embankment and spillway junction should be filled with compacted earth and reseeded. Measures should be taken to accommodate future pedestrian traffic.

6. The small trees should be removed from the upstream face of the masonry wall and the cracks from which they are growing should be sealed.

7. The spillway for the upstream settling basin should be repaired so that it functions as designed.

b. Operation and Maintenance Procedures

1. A regular maintenance program should be established which would include repair of the masonry structures, mowing of the embankment, and periodic operation of the blow-off pipe sluice gate.

2. A downstream warning system should be developed. During periods of heavy rainfall, the dam should be monitored and downstream residents should be alerted in the event of an impending failure.

O'BRIEN & GERE ENGINEERS, INC.
JUSTIN & COURTNEY DIVISION

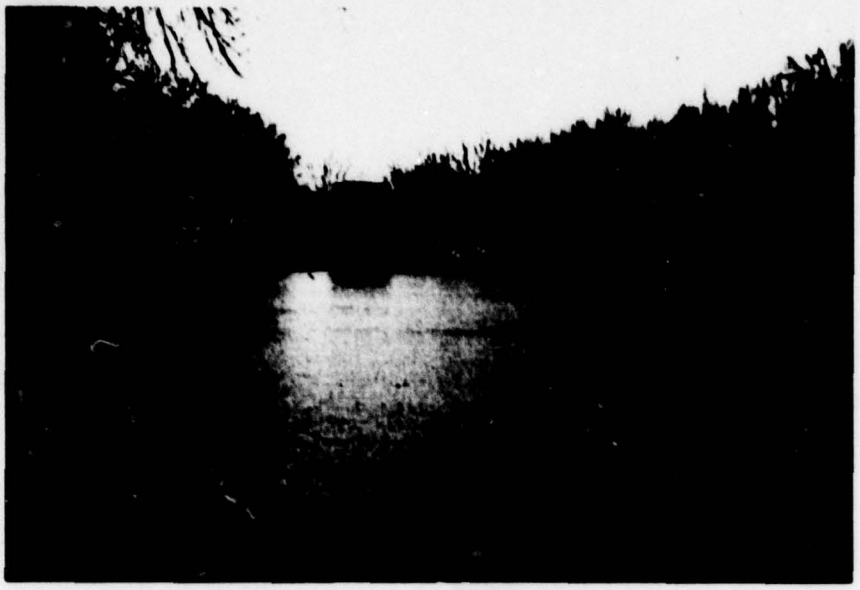
John J. Williams
Vice President
Pennsylvania Registration #PE 005920-E

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
JOHN J. WILLIAMS
ENGINEER
No. 5920-E

Date: 20 July '79

Approved By

Date: 1 Aug 79



UPSTREAM FACE OF THE DAM

DOWNSTREAM FACE OF THE DAM

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
NDI I.D. NO. PA 00717
DER #6-1

SECTION 1

PROJECT INFORMATION

1.1 General

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

b. Purpose. The purpose of this inspection is to determine if Bernhart Dam constitutes a hazard to human life or property.

1.2 Description of Project. (Supplemented by information obtained from the Pennsylvania Department of Environmental Resources (DER), Division of Dam Safety, Harrisburg, Pennsylvania).

a. Dam and Appurtenances. Bernhart Dam is an earth embankment with a masonry brick core wall. A 5-foot high masonry wall is located at the upstream edge of the top of the dam. The embankment is approximately 180 feet in length and has a maximum height of 30 feet. The side slopes are 2 horizontal to 1 vertical (2H:1V) upstream and 3H:1V downstream. The top of dam width varies between 22 and 35 feet. The dam impounds a reservoir with a normal pool storage capacity of 129 acre-feet. The reservoir was originally used for water supply but now serves only recreational purposes.

A broad-crested spillway with a 40-foot crest length is located at the right abutment. The crest is at Elevation 395; 5 feet below the top of the dam. A masonry sidewall is provided along the left side of the spillway. The right sidewall of the spillway is formed by the nearly vertical rock abutment. The outlet channel is provided with masonry training walls along both sides for an approximate distance of 300 feet downstream.

Two 30-inch diameter pipes for water supply and a 16-inch diameter pipe for reservoir drawdown lead into the upstream side of a masonry gate house located approximately 85 feet from the spillway on the top of the dam. The three sluice gates which control the inflow from the three pipes are located in the gate house, as are the two sluice gates which control the outflow.

A small settling basin with an approximate storage capacity of 6 acre-feet is located immediately upstream of the reservoir. The settling basin discharges flow into the reservoir by means of a 50-foot long spillway section with a crest elevation of about 399.

b. Location. Bernhart Dam is located on Bernhart Creek about 1 mile north of the City of Reading and just south of the Borough of Laureldale, Pennsylvania. The dam site lies within Muhlenberg Township, Berks County and is shown on the USGS Quadrangle entitled, "Temple, Pennsylvania" at coordinates N 42° 22.7', W 75° 54.5'. A regional vicinity plan of Bernhart Dam is enclosed as Plate 1, Appendix E.

c. Size Classification. The maximum height of 30 feet and an estimated maximum storage capacity of 203 acre-feet place the dam in the "Small" size category.

d. Hazard Classification. A dam failure could cause loss of lives and extensive property damage in the downstream community of Bernharts. Therefore, the dam is in the "High" hazard catagory.

e. Ownership. Bernhart Dam is owned by the Department of Parks and Public Property, City Hall, Reading, Pennsylvania 17120.

f. Purpose of Dam. The dam was originally constructed to impound a water supply for the City of Reading and is presently used solely for recreation.

g. Design and Construction History. The information obtained indicates that the dam was originally constructed earlier than 1865. The structure was originally a homogeneous earth embankment. A brick corewall was constructed in 1896 and a gate house was incorporated into the structure sometime prior to 1913. In 1921, a new dam was proposed and designed which would raise the height of the dam over 20 feet. However, the proposed dam was never constructed. There is no record in the available information of any construction subsequent to the completion of the original structure.

h. Normal Operating Procedures. The only operating mechanisms for Bernhart Dam are the three sluice gates located in the gate house. According to Mr. George Patton, Water Department Engineering Director, all three gates are inoperable.

1.3 Pertinent Data

a.	Drainage Area. (square miles)	2.6
b.	Discharge at Dam Site. (CFS)	
	Maximum spillway discharge (reservoir surface at Elevation 400)	1390

c. Elevation. (feet above MSL)

Spillway Crest	395
Top of Dam (Design)	400
Settling Basin Pool Elevation	399
Streamed at Toe of Dam	370

d. Reservoir. (miles)

Length of Normal Pool	0.25
Length of Maximum Non-overtopping Pool	0.28

e. Storage. (acre-feet)

Normal Pool, Elevation 395	129
Design Top of Dam, Elevation 400 (est.)	203

f. Reservoir Surface Area. (acres)

Normal Pool, Elevation 395	13.3
Top of Dam, Elevation 400 (est.)	17.0

g. Dam Data.

Type	Earth
Length	180 feet
Height	30 feet
Crest Width	22-35 feet
Side Slopes (Upstream)	2H:1V
(Downstream)	Variable slope; 3H:1V average
Zoning	None
Impervious Core	Masonry brick corewall
Cutoff	Unknown
Grout Curtain	None

h. Spillway.

Type	Broad-crested drop spillway
Width	40 feet
Crest Elevation	395
Gates	None
Upstream Channel	None
Downstream Channel	A 16-foot wide channel with masonry training walls extends approximately 300 feet downstream

i. Outlet Works.

A 16-inch diameter blow-off pipe leads into the gate house and downstream to the toe of the embankment.

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. The information made available by DER for review of Bernhart Dam includes the following:

1. A set of 6 drawings dated 1894-1908

2. Periodic inspection reports, 1919-1970

3. Drawdown applications dated 1945, 1953, and 1958

4. Miscellaneous correspondence and memoranda, 1913-1970.

An additional 10 drawings were provided by the Reading Water Department.

b. Design Features. The design features are described in Section 1.2.a.

2.2 Construction

There is no information available concerning the original construction of Bernhart Dam. An undated report (between 1932 and 1939) states that the dam was built before 1865 and that the brick core wall was constructed in 1896.

2.3 Operation

No formal operating procedures were included in the information obtained from DER.

2.4 Evaluation

a. Availability. The engineering data utilized in this report were provided by the Pennsylvania DER.

b. Adequacy. There is no design or construction information available due to the age of the structure. There are also no cross-sections of the embankment included in the drawings obtained from DER and the Reading Water Department. However, the available information (listed in Section 2.1.a) combined with the visual inspection is considered adequate for a Phase I investigation.

c. Validity. The elevations provided on the DER drawings and the Reading Water Department drawings are inconsistent with those indicated on the USGS Quadrangle Sheet. It appears that the obtained elevations were refered to some local datum. Throughout this report the elevations given have been converted to conform with the USGS Quadrangle elevations.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Bernhart Dam took place on April 3, 1979. At the time of the inspection, the water surface was approximately one-half inch above the spillway crest. The observations and comments of the field inspection team are in the check list which is Appendix B of this report. The appearance of the facility indicated that the dam and its appurtenances are marginally maintained.

b. Dam. The downstream face of the embankment appears to be in good condition. The only visible portion of the upstream face is the masonry wall which extends 5 feet above the reservoir surface. The masonry appears to be in good condition, but several small trees are growing from cracks in the upstream face of the wall. The grass cover has been eroded away and a path has formed along the crest and downstream slope at the spillway junction. This is apparently the result of pedestrian traffic and surface runoff.

A survey revealed that the top of dam has settled below design elevation by more than a foot along a 20-foot stretch in the vicinity of the gate house. The elevation of the lowest point surveyed is 398.8, allowing only 3.8 feet of freeboard above the spillway crest.

c. Appurtenant Structures. The spillway vertical drop is approximately 15 feet and the drop section appears to be in good condition. A metal truss and wood deck bridge spans the spillway with a minimum clearance of 5 feet between the spillway crest and the bottom of the bridge.

The gate house appears to be in good structural condition, but the door and windows are boarded up to prevent entry. Therefore, the sluice gate controls could not be inspected.

During the inspection, a 36-inch diameter pipe of unknown origin discharging a small amount of flow into the downstream channel from the left training wall.

d. Reservoir Area. A brick spillway controls the outflow from the settling basin located immediately upstream of the reservoir. Both ends of the spillway have eroded away and water is flowing freely around the ends and into the reservoir. The reservoir slopes on the right side are fairly steep and wooded. The reservoir slopes on the left side are variable, but they are fairly flat adjacent to the reservoir.

e. Downstream Channel. The left training wall of the channel downstream of the spillway is in dilapidated condition. Approximately 150 feet downstream of the spillway, the wall has crumbled and a 30-foot long section has toppled into the channel. Portions of the wall have completely disintegrated and both training walls have been undermined in places where they are still standing.

The residental community of Bernharts, consisting of about 20 homes, is located approximately 300 feet downstream of the dam. Failure of Bernhart Dam would cause excessive property damage and probable loss of life.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

A 16-inch diameter blow-off pipe was originally provided for reservoir drawdown. However, according to Mr. Patton, the sluice gate which controls this pipe is no longer operable.

4.2 Maintenance of Dam

Maintenance of Bernhart Dam is the responsibility of the Reading Department of Parks and Public Property. There is no regular maintenance program established for this site.

4.3 Maintenance of Operating Facilities

There are no established maintenance procedures for the sluice gates located in the gate house. The gate house does not appear to have been entered in several years.

4.4 Warning Systems in Effect

There is no formal system of warning downstream residents in the event of impending danger.

4.5 Evaluation

A regular maintenance program should be established for Bernhart Dam which would include repair of the masonry structures, periodic mowing of the embankment grass, and periodic operation of the blow-off pipe sluice gate.

The sluice gate which operates the blow-off pipe should be repaired so that the reservoir may be drawn down if necessary.

A formal warning procedure should be developed and implemented to alert the downstream residents in the event of an impending failure.

The dam is accessible under all weather conditions for inspection and emergency action.

SECTION 5

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Bernhart Dam has a drainage area of 2.6 square miles and impounds a reservoir with a normal pool storage capacity of 129 acre-feet. The 40-foot wide broad-crested drop spillway has a maximum discharge capacity of approximately 1,400 cfs.

b. Experience Data. There is no evidence that rainfall or water level records are kept for this dam.

c. Visual Observations. The downstream spillway channel is constricted by the section of training wall that has toppled into the channel. The training walls have become so deteriorated along the downstream channel that they are no longer considered functional.

The inoperable blow-off pipe could present a serious problem should a drawdown of the reservoir be required.

d. Overtopping Potential. The Spillway Design Flood (SDF) for this dam is given as a range from ½ PMF to the full PMF. Based on the height and storage of Bernhart Dam and the potential for damage and loss of life at the hazard center, the SDF selected is the full PMF. The PMF hydrograph was routed through the reservior with the starting water surface elevation at the crest of the spillway, Elevation 395. Based on the results of the hydrologic and hydraulic analyses, the spillway is capable of discharging approximately 24 percent of the PMF without overtopping the dam. The peak inflow and outflow rates for the SDF were determined to be 5,628 cfs and 5,582 cfs respectively. (see Appendix C for computations)

e. Spillway Adequacy. A dam break analysis was computed to evaluate the increased "hazard to loss of life downstream from the dam from that which would exist just before overtopping failure" (ETL 1110-2-234, 10 May 1978). According to the analysis, failure of Bernhart Dam would increase the depth of flow at the hazard area from 5.2 feet to 6.7 feet for 30 percent of the PMF. The peak discharge at the hazard area would increase from approximately 1,680 cfs to approximately 3,370 cfs. Failure of the dam is considered to significantly increase the hazard to loss of life. Therefore, the spillway of Bernhart Dam is classified as "Seriously Inadequate".

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The small trees growing out of cracks in the upstream face of the masonry wall create potential seepage paths through the embankment. The point at which the trees protrude from the wall is about 2 feet above normal pool, so during periods of high reservoir level, water could seep through the cracks and along the root systems.

The depression of more than a foot in the top of the dam appears to be the result of differential settlement due to the additional weight of the gate house. The general settlement of several inches which extends along the remainder of the top of the dam could be the result of poor compaction during construction. Such settlement reduces the amount of freeboard and, consequently, reduces the ability of the dam to withstand high pool elevations.

The eroded path along the embankment and spillway junction creates a natural seepage path for surface runoff. Continued erosion could lead to possible damage to the embankment and spillway training wall.

The spillway section appears to be in good condition and shows no signs of instability.

b. Design and Construction Data. There are no design and construction data available.

c. Operating Records. There is no evidence that operating records are maintained for this structure.

d. Post-Construction Changes. According to the available information, a brick core wall was incorporated into the structure in 1896. Sometime prior to 1913, the masonry gate house was constructed and the intake structure in the reservoir was removed.

e. Seismic Stability. Bernhart Dam is located in Seismic Zone 1 of the "Seismic Zone Map of Contiguous States". A dam located in Seismic Zone 1 is generally considered to be safe under any expected earthquake loading if it is stable under static loading conditions.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual observations and review of available information indicate that Bernhart Dam is in fair condition. Problem areas are noted in Sections 5.1.c and 6.1.a. No serious deficiencies were observed during the visual inspection. However, the nature and composition of the embankment and foundation materials are unknown.

The spillway is capable of discharging approximately 24 percent of the PMF without overtopping of the embankment. Failure of the structure by overtopping would significantly increase the hazard to loss of life downstream of the dam. Therefore, the spillway is classified as "Seriously Inadequate", and the dam is classified as "Unsafe (non-emergency)".

b. Adequacy of Information. Although design and construction information is minimal, a Phase I evaluation is considered reasonable based on the revealing conditions observed during the field inspection.

c. Urgency. Recommended remedial measures should be implemented immediately.

d. Necessity for Further Investigation. Further hydrologic and hydraulic studies should be made to determine the extent to which the spillway capacity should be increased.

7.2 Recommendations and Remedial Measures

a. Facilities

1. The capacity of the spillway should be increased in accordance with the results of further hydrologic and hydraulic studies.

2. The top of the embankment and the masonry wall should be restored to design elevation as determined by a detailed survey.

3. The sluice gate which controls the 16-inch diameter blow-off pipe should be repaired and the pipe should be made operable.

4. The downstream spillway channel training walls should be repaired and replaced where necessary.

5. The eroded path along the embankment and spillway junction should be filled with compacted earth and reseeded.

6. The small trees should be removed from the upstream face of the masonry wall and the cracks from which they were growing should be sealed.

7. The spillway for the upstream settling basin should be repaired so that it functions as designed.

b. Operation and Maintenance Procedures

1. A regular maintenance program should be established which would include repair of the masonry structures, periodic mowing of the embankment, and periodic operation of the blow-off pipe sluice gate.

2. A downstream warning system should be developed. During periods of heavy rainfall, the dam should be monitored and downstream residents should be alerted in the event of an impending failure.

APPENDIX

A

Check List Engineering Data

Design, Construction, Operation

Phase I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM BERNHART DAM

ID # PA 00717

ITEM	REMARKS
AS-BUILT DRAWINGS	NONE AVAILABLE
REGIONAL VICINITY MAP	REFER TO APPENDIX E, PLATE 1
CONSTRUCTION HISTORY	THE DAM WAS BUILT EARLIER THAN 1865, BUT THE EXACT DATE IS UNKNOWN. A BRICK CORE WALL WAS CONSTRUCTED IN 1896, AND A GATE HOUSE WAS ADDED PRIOR TO 1913.
TYPICAL SECTIONS OF DAM	NONE AVAILABLE
OUTLETS - PLAN	PLANS OF THE OUTLET PIPES ARE AVAILABLE. REFER TO APPENDIX E.
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	NONE AVAILABLE
RAINFALL/RESERVOIR RECORDS	NONE AVAILABLE

ITEM	REMARKS
DESIGN REPORTS	NONE AVAILABLE
GEOLOGY REPORTS	NONE AVAILABLE
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	NO DESIGN COMPUTATIONS ARE AVAILABLE.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	NONE AVAILABLE
POST-CONSTRUCTION SURVEYS OF DAM	NONE AVAILABLE
BORROW SOURCES	THERE IS NO RECORD OF WHERE BORROW MATERIAL CAME FROM

ITEM	REMARKS
MONITORING SYSTEMS	NONE
MODIFICATIONS	A BRICK CORE WALL WAS INCORPORATE INTO THE STRUCTURE IN 1896, AND A MASONRY GATE HOUSE WAS ADDED PRIOR TO 1913.
HIGH POOL RECORDS	NONE AVAILABLE
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE
MAINTENANCE OPERATION RECORDS	CORRESPONDENCE THROUGH THE YEARS (FROM DER FILES) GIVES INFORMATION ABOUT PERIODIC MAINTENANCE WORK THAT WAS DONE AS REQUIRED BY THE INSPECTION REPORTS. THERE ARE NO OPERATING RECORDS AVAILABLE.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	NO SECTIONS OR DETAILS OF THE SPILLWAY ARE AVAILABLE. REFER TO APPENDIX E FOR PLAN VIEW.
OPERATING EQUIPMENT PLANS & DETAILS	NO INFORMATION AVAILABLE
MISCELLANEOUS	MATERIAL IN DER FILES: 1. A SET OF 6 DRAWINGS DATED 1894-1908 2. PERIODIC INSPECTION REPORTS, 1919-1970 3 DRAWDOWN APPLICATIONS DATED 1945, 1953, AND 1958 4. MISCELLANEOUS CORRESPONDENCE AND MEMORANDA, 1913-1970

APPENDIX

B

Check List

Visual Inspection

Phase I

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam BERNHART DAM County BERKS State PENNSYLVANIA National ID # PA 00717

Type of Dam EARTH Hazard Category HIGH

Date(s) Inspection 4/3/79 Weather RAINY Temperature 45° F.

Pool Elevation at Time of Inspection 395.0 ± M.S.L. Tailwater at Time of Inspection 380 ± M.S.L.

Inspection Personnel:

LEROY H. DEHEER STEVEN H. SNIDER ROBERT R. BOWERS

LEROY H. DEHEER Recorder

Remarks:

MR. ROBERT MASLEY ACCOMPANIED THE INSPECTION TEAM TO THE DAM SITE BUT DID NOT REMAIN FOR THE INSPECTION.

CONCRETE/MASONRY DAMS
UPSTREAM MASONRY WALL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	NONE OBSERVED	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	THE TOP OF THE MASONRY WALL WAS GENERALLY SEVERAL INCHES ABOVE THE ADJOINING TOP OF THE EMBANKMENT	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	THE FOUNDATION MATERIALS ARE UNKNOWN	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	SEVERAL TREES WERE GROWING FROM CRACKS IN THE UPSTREAM FACE OF THE MASONRY WALL.	THE TREES SHOULD BE REMOVED AND THE CRACKS SHOULD BE SEALED.
STRUCTURAL CRACKING	NONE OBSERVED	
VERTICAL AND HORIZONTAL ALIGNMENT	NO ALIGNMENT PROBLEMS WERE OBSERVED.	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE OBSERVED	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE OBSERVED	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	NONE OBSERVED	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	A VERTICAL DEPRESSION WAS OBSERVED IN THE VICINITY OF THE GATE HOUSE. THIS DEPRESSION APPEARED TO BE DIFFERENTIAL SETTLEMENT DUE TO THE WEIGHT OF THE GATE HOUSE.	
RIPRAP FAILURES	NO RIPRAP ON STRUCTURE	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DRAINS	NONE OBSERVED	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	A PATH HAS BEEN ERODED ALONG THE TOP OF THE DAM AND THE DOWNSTREAM SLOPE AT THE SPILLWAY AND EMBANKMENT JUNCTION.	THIS PATH SHOULD BE FILLED WITH COMPACTED EARTH AND RESEEDED, AND PROVIDED WITH FLAGSTONES ALONG THE DOWNSTREAM SLOPE.
ANY NOTICEABLE SEEPAGE	NONE OBSERVED	
STAFF GAGE AND RECORDER	NONE	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N/A	
INTAKE STRUCTURE	THE INTAKE STRUCTURE WAS SUBMERGED	
OUTLET STRUCTURE	THE OUTLET END OF THE PIPE IS LOCATED IN THE LEFT TRAINING WALL OF THE DOWNSTREAM CHANNEL, APPROX-IMATELY 250 FEET BELOW THE DAM.	
OUTLET CHANNEL	FLOW WOULD BE DISCHARGED INTO THE SPILLWAY OUTLET CHANNEL.	
EMERGENCY GATE	THE SLUICE GATE IS LOCATED IN THE GATE HOUSE AND IS CURRENTLY INACCESSIBLE DUE TO THE BOARDED UP GATE HOUSE. MR. GEORGE PATTON STATED THAT THE GATE WAS NO LONGER OPERABLE.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	NO PROBLEMS OBSERVED	
APPROACH CHANNEL	NO APPARENT OBSTRUCTIONS	
DISCHARGE CHANNEL	THE TRAINING WALLS OF THE DISCHARGE CHANNEL ARE IN POOR CONDITION.	THE TRAINING WALLS SHOULD BE REPAIRED, RECONSTRUCTED, AND REPLACED WHERE NECESSARY.
BRIDGE AND PIERS	A METAL TRUSS AND WOOD DECK BRIDGE SPANS THE SPILLWAY. THE BRIDGE MAINTAINS 5 FEET OF FREEBOARD ACROSS ITS LENGTH.	

GATED SPILLWAY

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

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE	
OBSERVATION WELLS	NONE	
WEIRS	NONE	
PIEZOMETERS	NONE	
OTHER	NONE	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	THE RIGHT RESERVOIR SLOPE IS FAIRLY STEEP (UP TO 50%) AND WOODED NEAR THE DAM, BUT FLATTENS OUT UPSTREAM (<10%). THE LEFT RESERVOIR SLOPE RANGES FROM ABOUT 20% NEAR THE DAM TO ABOUT 10% UPSTREAM.	
SEDIMENTATION	A SETTLING BASIN JUST UPSTREAM OF THE RESERVOIR LIMITS THE SEDIMENTATION IN THE RESERVOIR. HOWEVER, THE SETTLING BASIN SPILLWAY IS ERODED ON THE ENDS AND IS NOT FUNCTIONING AS DESIGNED.	THE SETTLING BASIN SPILLWAY SECTION SHOULD BE REPAIRED.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	THE DOWNSTREAM CHANNEL TRAINING WALLS ARE IN A STATE OF DISREPAIR. PORTIONS OF THE WALLS HAVE FALLEN INTO THE CHANNEL AND CREATE A GREAT DEAL OF FLOW.	THE CHANNEL TRAINI WALLS SHOULD BE REP RECONSTRUCTED, AND REPLACED WHERE NECESSARY.
SLOPES	THE DOWNSTREAM CHANNEL HAS AN INITIAL SLOPE OF ABOUT 15% AND FLATTENS TO AN APPROXIMATE SLOPE OF 2%.	
APPROXIMATE NO. OF HOMES AND POPULATION	THERE ARE ABOUT 20 HOMES AND APPROXIMATELY 100 PEOPLE IN THE RESIDENTIAL COMMUNITY OF BERNHARTS ABOUT 300 FEET DOWNSTREAM OF THE DAM.	A FORMAL WARNING SYST SHOULD BE DEVELOPED A IMPLEMENTED. PROCEDUR FOR EVACUATING PEOPLE WITHIN THE POTENTIAL FL AREA SHOULD BE IMPLEM

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	THE DOWNSTREAM CHANNEL TRAINING WALLS ARE IN A STATE OF DISREPAIR. PORTIONS OF THE WALLS HAVE FALLEN INTO THE CHANNEL AND CREATE A GREAT DEAL OF EROSION.	THE CHANNEL TRAINING WALLS SHOULD BE REPAIRED, RECONSTRUCTED, AND REPLACED WHERE NECESSARY.
SLOPES	THE DOWNSTREAM CHANNEL HAS AN INITIAL SLOPE OF ABOUT 13% AND FLATTENS TO AN APPROXIMATE SLOPE OF 2%.	
APPROXIMATE NO. OF HOMES AND POPULATION	THERE ARE ABOUT 20 HOMES AND APPROXIMATELY 100 PEOPLE IN THE RESIDENTIAL COMMUNITY OF BERNHARTS ABOUT 300 FEET DOWNSTREAM OF THE DAM.	A FORMAL WARNING SYSTEM SHOULD BE DEVELOPED AND IMPLEMENTED. PROCEDURES FOR EVACUATING PEOPLE WITHIN THE POTENTIAL FLOOD AREA SHOULD BE IMPLEMENTED.

APPENDIX

C

Hydrologic & Hydraulic Data

TABLE OF CONTENTS - APPENDIX C

HYDROLOGIC & HYDRAULIC DATA

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO.
BERNHART DAM, Balt. Corps of Engineers	1	SHS	3/22/79	

HYDROLOGY CALCULATIONS

Drainage Basin (Area planimetered from USGS) = 2.6 sq. mi.

PMP Calculations (HMS REPORT 33)

Area is in Zone 6.

∴ 24-hour, 200 sq. mile PMP = 23.5 inches

HR.	%	RAINFALL	Δ
6	113	26.6	26.6
12	123	28.9	2.3
24	132	31.0	1.1
48	142	33.4	2.4

SNYDER COEFFICIENTS (information supplied by Balt. COE, Area 6

$C_p = 0.40$ $C_t = 1.35$

$t_p = C_t (LL_{ca})^{0.3}$

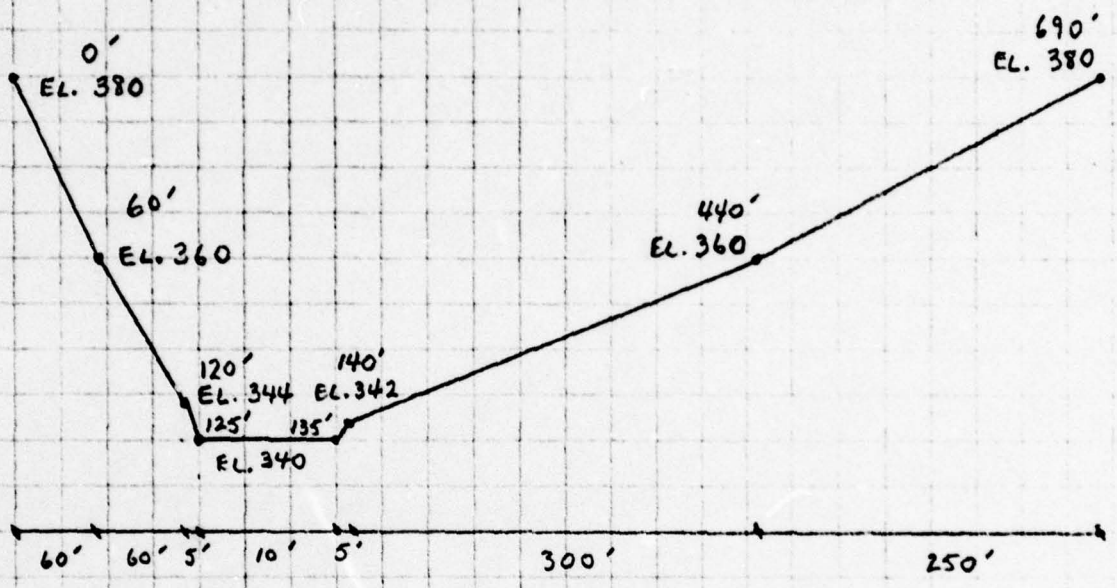
$t_p = 1.35 [2.3(0.9)]^{0.3}$

$t_p = 1.7$

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO.
BERNHART DAM	2	RRC	4/26/79	

DOWNSTREAM CHANNEL FOR DAM BREAK ANALYSIS



STAGE - SURFACE AREA INFORMATION

THE SURFACE AREA OF THE RESERVOIR AT ELEVATION 369.7 WAS CALCULATED BY THE CONIC METHOD ASSUMING ZERO STORAGE AT THIS POINT.

THE SURFACE AREA AT ELEVATION 412 WAS PLANIMETERED FROM A MAP OBTAINED FROM THE CITY OF READING (ELEVATION WAS CORRECTED TO USGS DATUM).

SHEET 3

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 SEP 78
**********************************
    1                 A1                                NATIONAL DAM INSPECTION PROGRAM
    2                 A2                                      BERNHART DAM
    3                 A3                                    PMF HYDROGRAPH
    4                 N     150       0      30       0       0       0       0       0      -4       0
    5                 M1      5
    6                 J       1       9       1
    7                 J1   .05     .10     .15     .20     .25     .30     .40     .50    1.0
    8                 K       0  INFLOW                                        1
    9                 K1                          RUNOFF TO BERNHART RESERVOIR
   10                 M       1       1     2.6                                                1
   11                 P       0    23.5     113     123     132     142
   12                 T                                                   1.0    0.05
   13                 B     1.7     0.4
   14                 A    -1.5   -0.05       2
   15                 K       1 OUTFLOW                                     1
   16                 K1                        ROUTING THROUGH BERNHART RESERVOIR
   17                 V                                 1       1
   18                 V1      1                                          -395.1
   19                 $A   0.23    13.3    24.8
   20                 $E  369.7     395     412
   21                 $$    395      40     3.1     1.5
   22                 $D  399.7     3.1     1.5     150
   23                 K      99
```

SHEET 4

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

RUN  DATE= 04/25/79.
     TIME= 08.25.10.
```

NATIONAL DAM INSPECTION PROGRAM
BERNHART DAM
PMF HYDROGRAPH

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	30	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS=	.05	.10	.15	.20	.25	.30	.40	.50	1.00

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO BERNHART RESERVOIR

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.60	0.00	2.60	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LRUPT	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= 1.70 CP= .40 NTA= 0

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

UNIT HYDROGRAPH 36 END-OF-PERIOD ORDINATES, LAG= 1.70 HOURS, CP= .40 VOL= 1.00

55.	199.	345.	387.	345.	295.	252.	215.	184.	157.
134.	115.	98.	84.	72.	61.	52.	45.	38.	33.
28.	24.	20.	17.	15.	13.	11.	9.	8.	7.
6.	5.	4.	4	3.	3				

SHEET 5

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.70	24.30	2.40	83614.
										(676.)	(617.)	(61.)	(2367.68)

HYDROGRAPH ROUTING

ROUTING THROUGH BENNHAM RESERVOIR

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

ROUTING DATA

GLOSS	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	-395.	0

SURFACE AREA=	0.	13.	25.
CAPACITY=	0.	129.	448.
ELEVATION=	370.	395.	412.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
395.0	40.0	3.1	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
399.7	3.1	1.5	150.

PEAK OUTFLOW IS 262. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 534. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 806. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 1078. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 1379. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 1675. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 2233. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 2791. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 5582. AT TIME 41.50 HOURS

....

SHEET 1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .05	RATIO 2 .10	RATIO 3 .15	RATIO 4 .20	RATIO 5 .25	RATIO 6 .30	RATIO 7 .40	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	INFLOW	2.60	1	281.	563.	844.	1126.	1407.	1688.	2251.	2814.	5628.
	(	6.73)	(	7.97)(	15.94)(	23.91)(	31.87)(	39.84)(	47.81)(	63.75)(	79.68)(	159.37)
ROUTED TO	OUTFLOW	2.60	1	262.	534.	806.	1078.	1379.	1675.	2233.	2791.	5582.
	(	6.73)	(	7.43)(	15.13)(	22.83)(	30.53)(	39.06)(	47.44)(	63.24)(	79.02)(	158.06)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

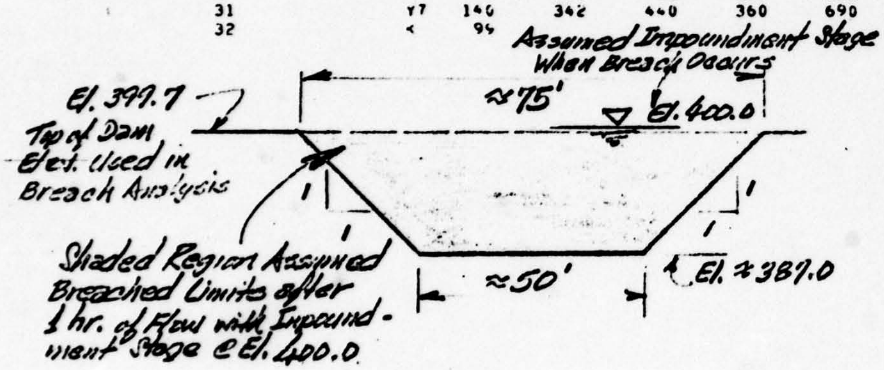
	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	395.10	395.00	399.70
STORAGE	130.	129.	198.
OUTFLOW	4.	0.	1263.

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
.05	396.65	0.00	152.	262.	0.00	42.50	0.00
.10	397.65	0.00	166.	534.	0.00	42.50	0.00
.15	398.48	0.00	179.	806.	0.00	42.50	0.00
.20	399.23	0.00	190.	1078.	0.00	42.00	0.00
.25	399.89	.19	201.	1379.	2.00	42.00	0.00
.30	400.24	.54	207.	1675.	3.00	42.00	0.00
.40	400.77	1.07	216.	2233.	4.50	42.00	0.00
.50	401.22	1.52	223.	2791.	6.00	42.00	0.00
1.00	402.99	3.29	254.	5582.	10.00	41.50	0.00

SHEET 9

0.3 PMF WITH BREACH OF DAM

```
*****************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
 LAST MODIFICATION   25 SEP 78
*****************************************
A1                              NATIONAL DAM INSPECTION PROGRAM
A2                                     BERNHART DAM
A3                                    PMF HYDROGRAPH
B    150       0      30       0       0       0       0       0      -4       0
B1     5
J      2       1       1
J1   0.3
K      0  INFLOW                                       1
K1                           RUNOFF TO BERNHART RESERVOIR
M      1       1     2.6                                               1
P      0    23.5     113     123     132     142
T                                                    1.0    0.05
W    1.7     0.4
X   -1.5   -0.05       2
K      1  OUTFLO                                       1
K1                       ROUTING THROUGH BERNHART RESERVOIR
Y                                  1       1
Y1     1                                           -395.1
$A  0.23    13.3    24.6
$E 399.7     395     412
$S   395      40     3.1     1.5
$C 399.7     3.1     1.5     150
$B    59       1     387       1   395.1     412
$B    50       1     387       1   395.1     400
K      1  HAZARD                                       1
K1                     ROUTING DOWNSTREAM OF BERNHART RESERVOIR
Y                                  1       1
Y1     1                                              -1
Y6  0.06    0.05    0.07     340     340     600    .033
Y7     0     380      60     360     120     344     125     340     135     340
Y7   140     342     440     360     690     380
K     99
```



The portion of the dam assumed to be breached is based on the geometry of the site. The depth of flow over the top of the dam at which failure is initiated and the elapsed time to complete failure are based on the general appearance and age of the structure. Consideration was given to the parameters used in the C.O.E. publication "Basic Concepts of Dam Breaks and Development of Dam Break Hydrographs."

0.3 PMF WITH BREACH OF DAM

[illegible]

DATE 84/06/14.
TIME 11:41:04.

NATIONAL DAM INSPECTION PROGRAM
BERNHART DAM
PMF HYDROGRAPH

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	30	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

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

RTIOS= .30

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO BERNHART RESERVOIR

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

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.60	0.00	2.60	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .600

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= 1.70 CP= .40 NTA= 0

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

UNIT HYDROGRAPH 36 END-OF-PERIOD ORDINATES, LAG= 1.70 HOURS, CP= .40 VOL= 1.00

55.	199.	345.	387.	345.	295.	252.	215.	184.	157.
134.	115.	98.	84.	72.	61.	52.	45.	38.	33.
28.	24.	20.	17.	15.	13.	11.	9.	8.	7.
6.	5.	4.	4.	3.	3.				

SHEET 11

0.3 PMF WITH BREACH OF DAM

	END-OF-PERIOD FLOW									
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.70	24.30	2.40	83614.
										(678.)	(617.)	(61.)	(2367.68)

HYDROGRAPH ROUTING

ROUTING THROUGH BERNHART RESERVOIR

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

ALL PLANS HAVE SAME ROUTING DATA

WLOSS	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	-395.	0

SURFACE AREA=	0.	13.	25.
CAPACITY=	0.	129.	448.
ELEVATION=	370.	395.	412.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
395.0	40.0	3.1	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
399.7	3.1	1.5	150.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
50.	1.00	387.00	1.00	395.10	412.00

PEAK OUTFLOW IS 1675. AT TIME 42.00 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
50.	1.00	387.00	1.00	395.10	400.00

BEGIN DAM FAILURE AT 41.50 HOURS

PEAK OUTFLOW IS 3343. AT TIME 42.50 HOURS

SHEET 12

0.3 PMF WITH BREACH OF DAM

THE DAM BREACH WAS COMPUTED USING A TIME INTERVAL OF .020 HOURS DURING BREACH FORMATION.
DOWNSTREAM ROUTINGS WILL USE A TIME INTERVAL OF .500 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)
41.500	0.000	1638.		1638.		0.	0.	0.
41.520	.020	1687.		1726.		-39.	-39.	-0.
41.540	.040	1735.		1775.		-40.	-79.	-0.
41.560	.060	1783.		1825.		-42.	-121.	-0.
41.580	.080	1832.		1876.		-44.	-165.	-0.
41.600	.100	1880.		1927.		-47.	-211.	-0.
41.620	.120	1929.		1977.		-48.	-260.	-0.
41.640	.140	1977.		2026.		-49.	-309.	-1.
41.660	.160	2026.		2075.		-49.	-358.	-1.
41.680	.180	2074.		2122.		-48.	-406.	-1.
41.700	.200	2122.		2169.		-47.	-453.	-1.
41.720	.220	2171.		2215.		-45.	-498.	-1.
41.740	.240	2219.		2262.		-43.	-540.	-1.
41.760	.260	2266.		2309.		-42.	-582.	-1.
41.780	.280	2316.		2360.		-44.	-626.	-1.
41.800	.300	2364.		2418.		-53.	-679.	-1.
41.820	.320	2413.		2473.		-60.	-739.	-1.
41.840	.340	2461.		2525.		-63.	-802.	-1.
41.860	.360	2510.		2574.		-64.	-867.	-1.
41.880	.380	2558.		2621.		-63.	-930.	-2.
41.900	.400	2607.		2665.		-58.	-988.	-2.
41.920	.420	2655.		2706.		-51.	-1039.	-2.
41.940	.440	2703.		2745.		-42.	-1081.	-2.
41.960	.460	2752.		2782.		-30.	-1111.	-2.
41.980	.480	2800.		2816.		-16.	-1128.	-2.
42.000	.500	2849.		2849.		0.	-1128.	-2.
42.020	.520	2868.		2879.		-10.	-1138.	-2.
42.040	.540	2888.		2907.		-19.	-1157.	-2.
42.060	.560	2908.		2933.		-25.	-1182.	-2.
42.080	.580	2928.		2957.		-30.	-1211.	-2.
42.100	.600	2948.		2980.		-33.	-1244.	-2.
42.120	.620	2967.		3001.		-34.	-1278.	-2.
42.140	.640	2987.		3021.		-34.	-1312.	-2.
42.160	.660	3007.		3040.		-33.	-1345.	-2.
42.180	.680	3027.		3057.		-30.	-1375.	-2.
42.200	.700	3046.		3074.		-27.	-1402.	-2.
42.220	.720	3066.		3089.		-23.	-1425.	-2.
42.240	.740	3086.		3104.		-18.	-1443.	-2.
42.260	.760	3106.		3118.		-13.	-1456.	-2.
42.280	.780	3126.		3132.		-7.	-1463.	-2.
42.300	.800	3145.		3146.		-1.	-1463.	-2.
42.320	.820	3165.		3160.		5.	-1458.	-2.
42.340	.840	3185.		3174.		11.	-1446.	-2.
42.360	.860	3205.		3188.		17.	-1430.	-2.
42.380	.880	3224.		3204.		21.	-1409.	-2.
42.400	.900	3244.		3221.		23.	-1385.	-2.
42.420	.920	3264.		3242.		22.	-1363.	-2.
42.440	.940	3284.		3271.		13.	-1350.	-2.
42.460	.960	3304.		3300.		3.	-1347.	-2.
42.480	.980	3323.		3324.		-1.	-1348.	-2.
42.500	1.000	3343.		3343.		0.	-1348.	-2.

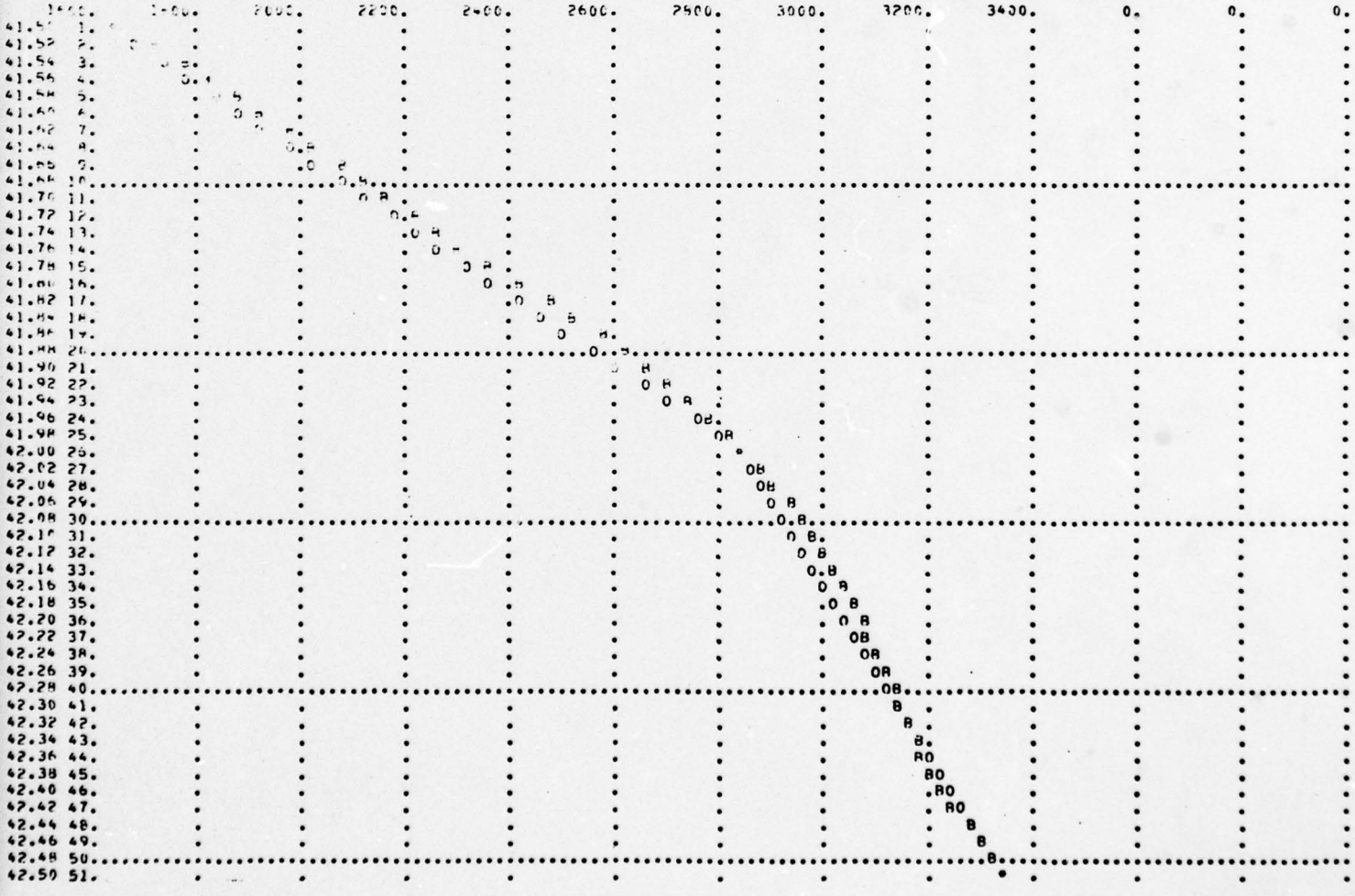
SHEET 13

0.3 PMF WITH BREACH OF DAM

STATION OUTFLO

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

1400. 1800. 2000. 2200. 2400. 2600. 2800. 3000. 3200. 3400. 0. 0. 0.



SHEET 14

0.3 PMF WITH BREACH OF DAM

HYDROGRAPH ROUTING

ROUTING DOWNSTREAM OF BERNHART RESERVOIR

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

ALL PLANS HAVE SAME ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	PLNTH	SFL
.0400	.0500	.0700	340.0	360.0	600.	.03300

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

0.00 360.00 60.00 360.00 120.00 344.00 125.00 340.00 135.00 340.00
140.00 342.00 440.00 360.00 690.00 380.00

STORAGE	0.00	.17	.41	.82	1.52	2.51	3.81	5.42	7.35	9.59
	12.14	15.00	18.17	21.66	25.45	29.56	33.98	38.71	43.75	49.10
OUTFLOW	0.00	62.09	214.20	498.67	977.79	1742.65	2825.23	4276.86	6144.66	8472.85
	11303.47	14676.72	18631.32	23204.70	28433.13	34351.90	40995.40	48397.20	56590.13	65606.35
STAGE	340.00	341.05	342.11	343.16	344.21	345.26	346.32	347.37	348.42	349.47
	350.53	351.58	352.63	353.68	354.74	355.79	356.84	357.89	358.95	360.00
FLOW	0.00	62.09	214.20	498.67	977.79	1742.65	2825.23	4276.86	6144.66	8472.85
	11303.47	14676.72	18631.32	23204.70	28433.13	34351.90	40995.40	48397.20	56590.13	65606.35

MAXIMUM STAGE IS 345.2

MAXIMUM STAGE IS 346.7

SHEET 15

0.3 PMF WITH BREACH OF DAM

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .30
HYDROGRAPH AT	INFLOW	2.60 (6.73)	1	1588. (47.61)(
			2	1588. (47.61)(
ROUTED TO	OUTFLO	2.60 (6.73)	1	1575. (47.44)(
			2	3343. (94.67)(
ROUTED TO	HAZARD	2.60 (6.73)	1	1683. (47.65)(
			2	3369. (95.39)(

RATIOS APPLIED TO FLOWS

SHEET 16

0.3 PMF WITH BREACH OF DAM

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	395.10	395.00	399.70
STORAGE	130.	129.	198.
OUTFLOW	4.	0.	1263.

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
.30	400.24	.54	207.	1675.	3.00	42.00	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	395.10	395.00	399.70
STORAGE	130.	129.	198.
OUTFLOW	4.	0.	1263.

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
.30	400.19	.49	206.	3343.	1.28	42.50	41.50

PLAN 1 STATION HAZARD

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	1683.	345.2	42.00

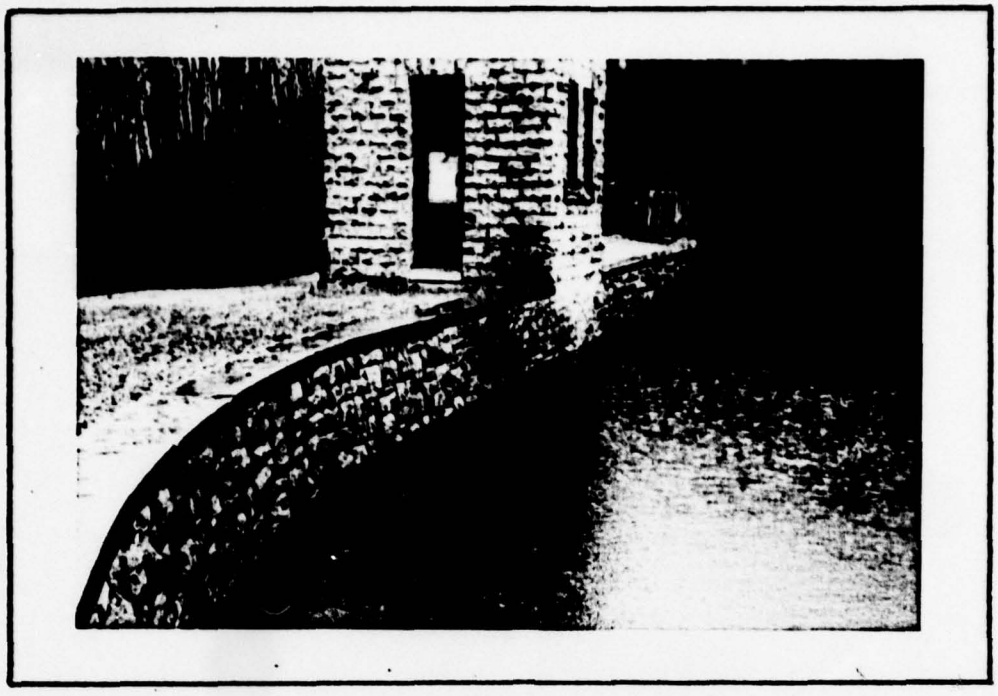
PLAN 2 STATION HAZARD

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	3364.	346.7	42.50

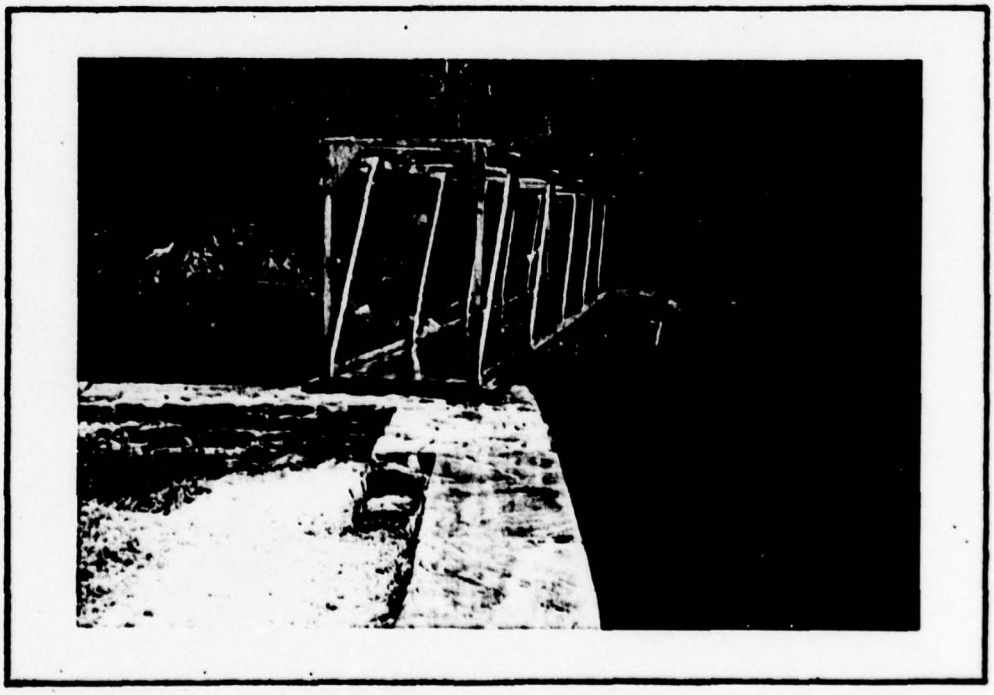
APPENDIX

D

Photographs

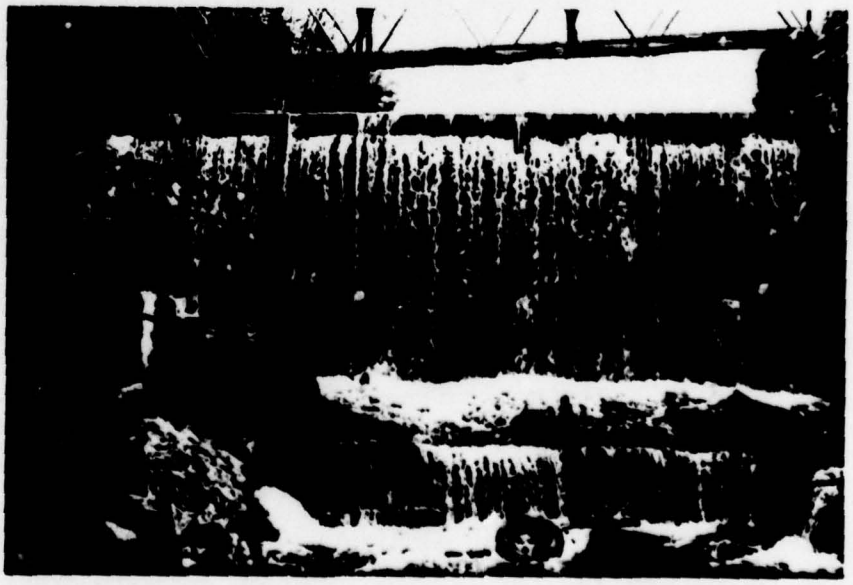


UPSTREAM FACE OF THE DAM SHOWING THE GATE HOUSE AND THE VEGETATION GROWING FROM THE MASONRY WALL



VIEW SHOWING THE FOOT BRIDGE OVER THE SPILLWAY AND THE LACK OF VEGETATION ON PORTIONS OF THE DAM

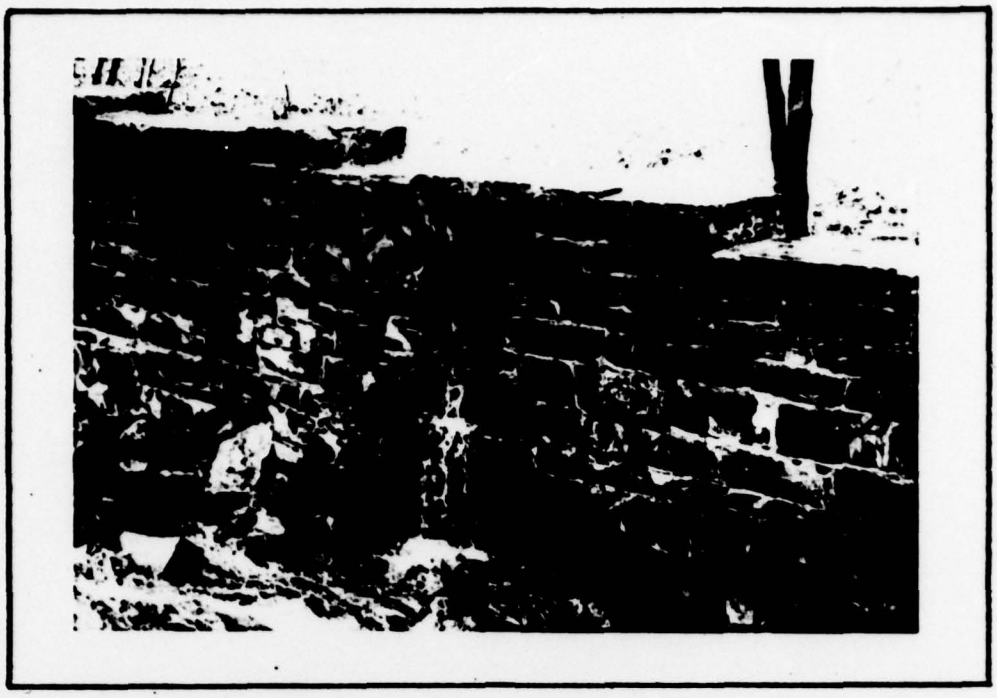
SPILLWAY CREST AS VIEWED
FROM THE RIGHT ABUTMENT



VIEW SHOWING THE FOOT BRIDGE, DROP SPILLWAY,
AND DOWNSTREAM APRON

SPILLWAY DISCHARGE CHANNEL LOOKING DOWNSTREAM FROM THE FOOT BRIDGE

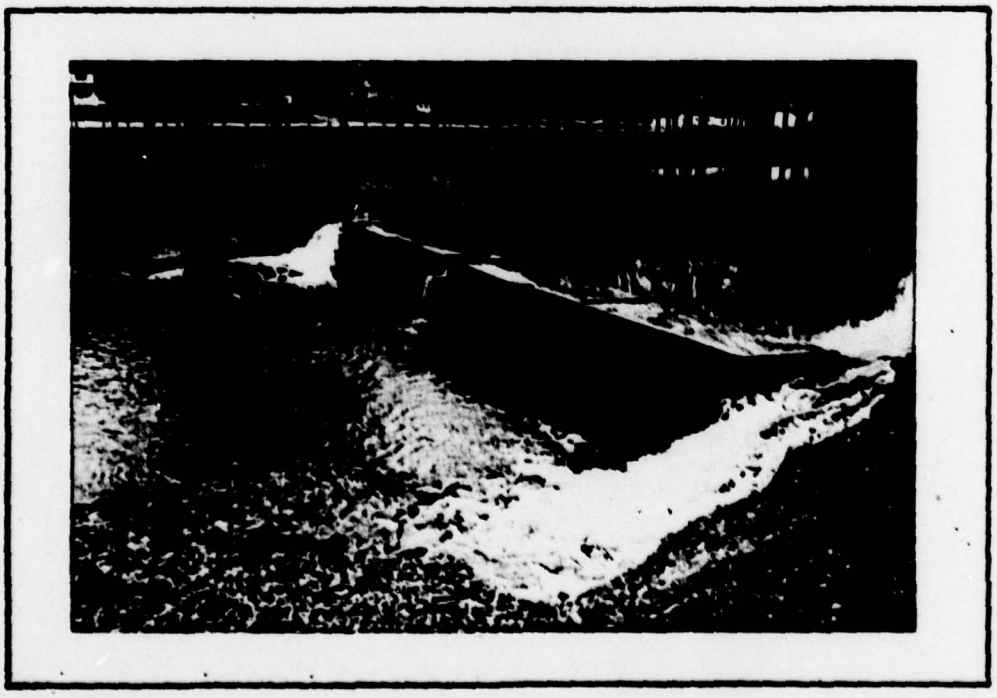
LOOKING UPSTREAM AT THE DETERIORATED TRAINING WALL IN THE SPILLWAY OUTLET CHANNEL



DISCHARGE FROM A 40-INCH PIPE AND UNDERMINING OF THE LEFT TRAINING WALL IN THE SPILLWAY OUTLET CHANNEL

LOOKING DOWNSTREAM AT THE CRUMBLED AND DISPLACED LEFT TRAINING WALL IN THE SPILLWAY OUTLET CHANNEL

SPILLWAY OUTLET CHANNEL LOOKING DOWNSTREAM TOWARDS THE BRIDGE SECTION WHICH IS ABOUT 400 FEET DOWNSTREAM OF THE DAM



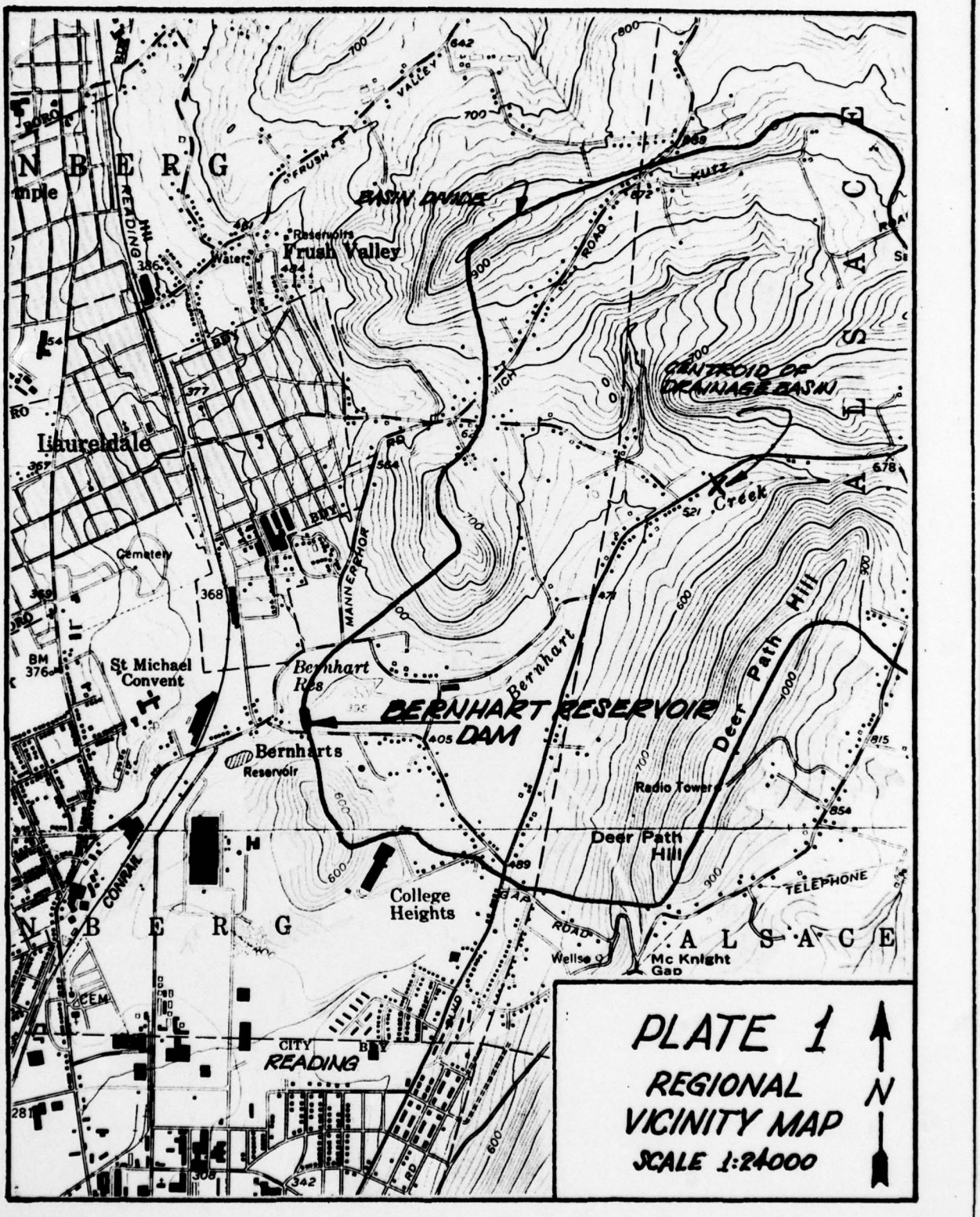
UPSTREAM SETTLING BASIN SHOWING EROSION AT THE ENDS OF THE SPILLWAY AND SEDIMENT ACCUMULATION

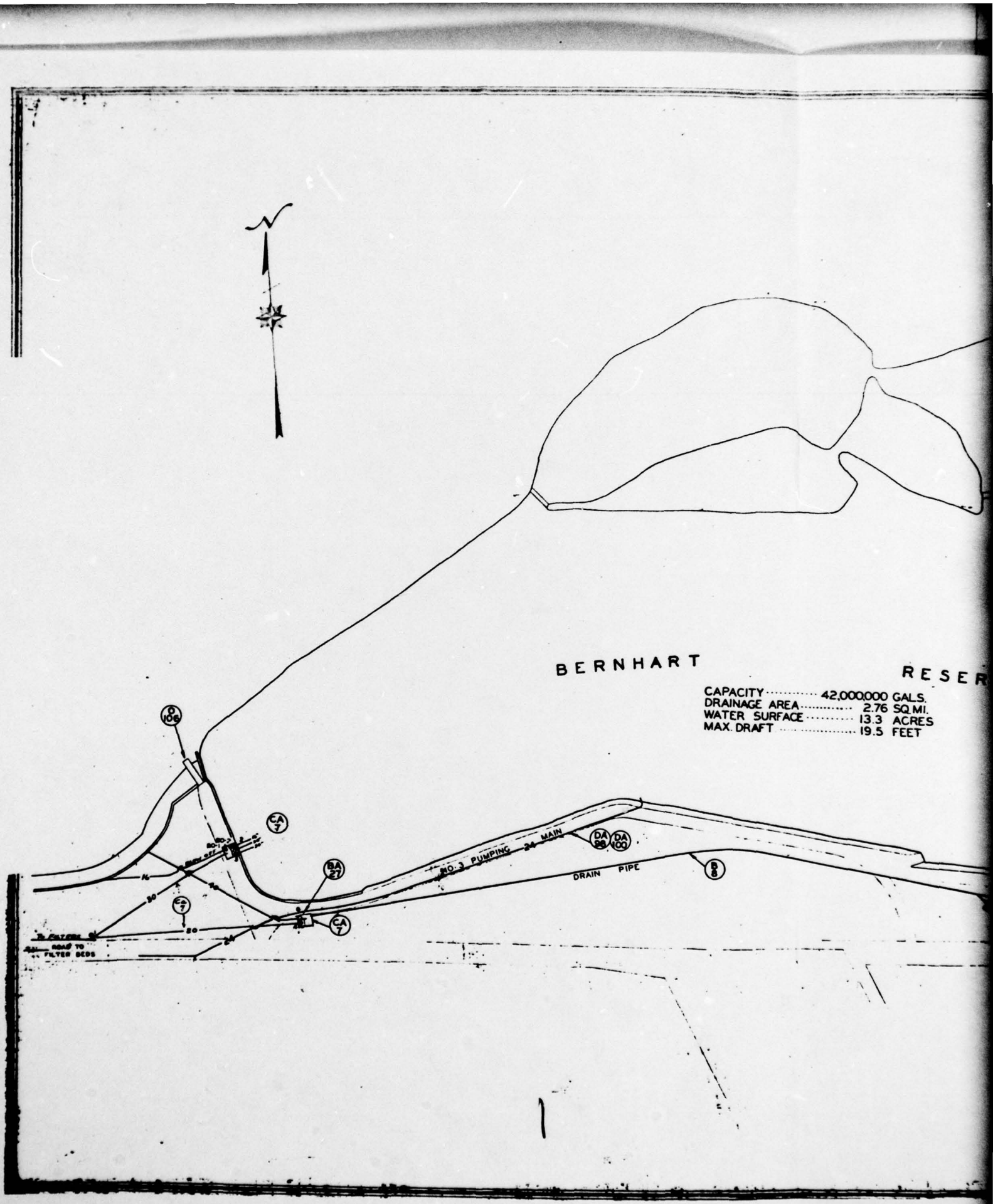
APPENDIX

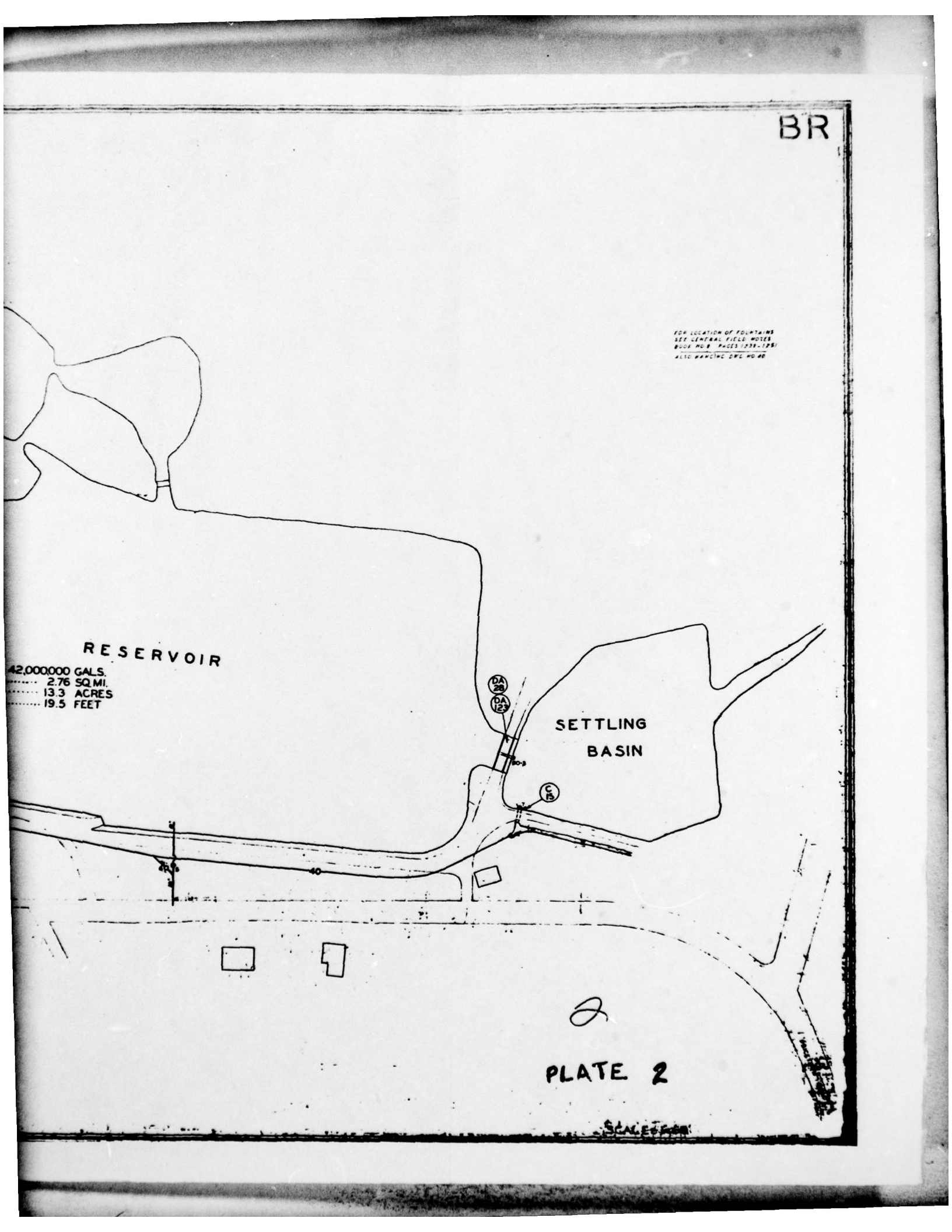
E

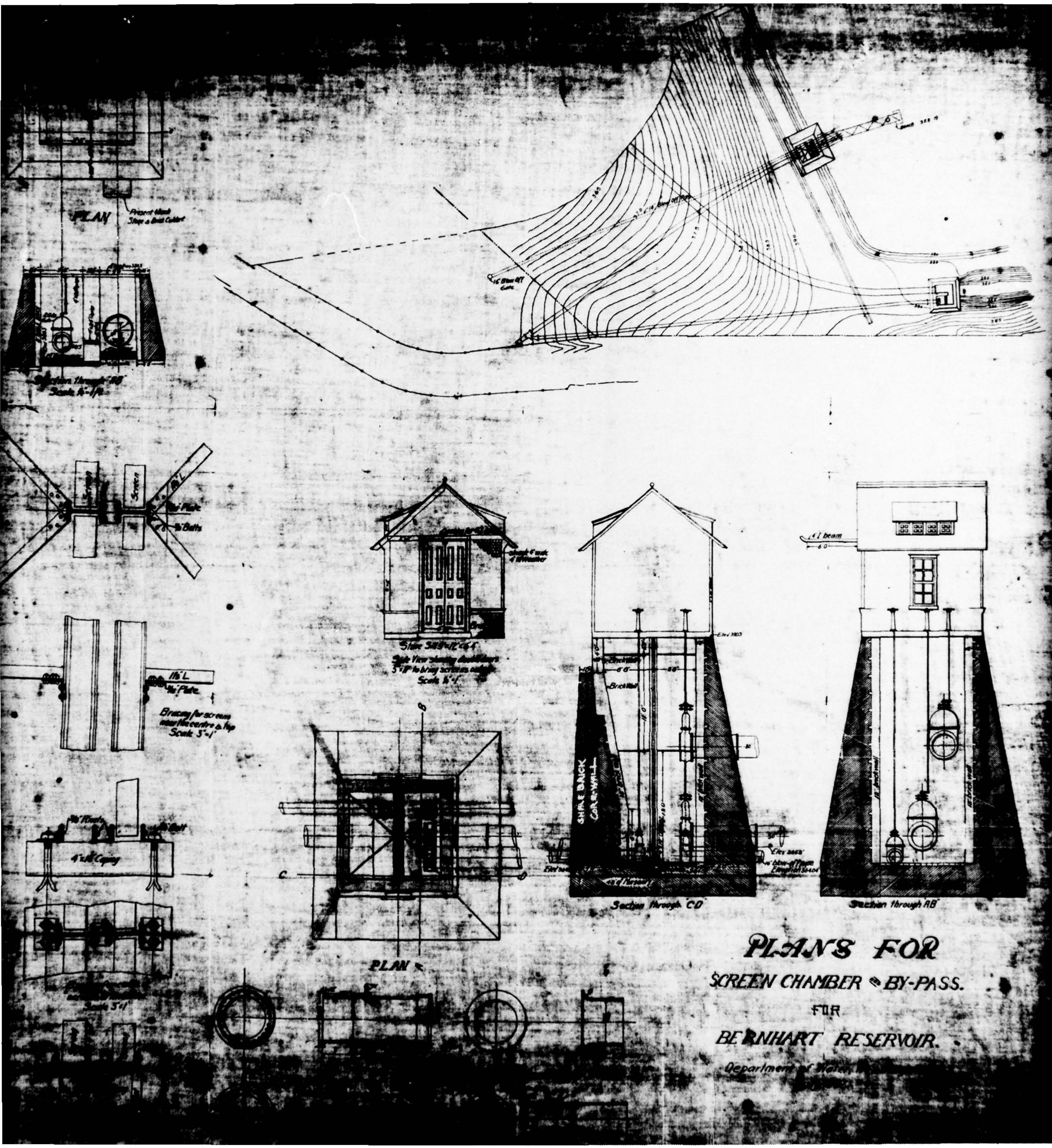
Drawings

TABLE OF CONTENTS - APPENDIX E


N B E R G
Laureldale
Reservoirs
Water
Frush Valley
FRUSH VALLEY
BASIN DIVIDE
KUTZ ROAD
CENTROID OF DRAINAGE BASIN
Creek
Cemetery
St Michael Convent
Bernhart Res
BERNHART RESERVOIR DAM
Bernhart
Bernharts Reservoir
Deer Path Hill
Radio Towers
College Heights
TELEPHONE
ROAD
Wellso
Mc Knight Gap
A L S A C E
CITY
READING
CONRAIL
MANNERHOR
PLATE 1
REGIONAL
VICINITY MAP
SCALE 1:24000
N


BERNHART
RESER
CAPACITY ..... 42,000,000 GALS.
DRAINAGE AREA ..... 2.76 SQ. MI.
WATER SURFACE ..... 13.3 ACRES
MAX. DRAFT ..... 19.5 FEET
D 106
CA 7
BA 27
NO. 3 PUMPING
24" MAIN
DA 99
DA 100
DRAIN PIPE
B 8
CA 7
CA 7
20
24
ROAD TO FILTER BEDS


BR
FOR LOCATION OF FOUNTAINS
SEE GENERAL FIELD NOTES
BOOK NO. 8 PAGES 1239-1251
ALSO MARGINAL DWG. NO. 40
RESERVOIR
42,000,000 GALS.
2.76 SQ. MI.
13.3 ACRES
19.5 FEET
DA 28
DA 123
SETTLING
BASIN
C.P. 15
40
PLATE 2


PLAN
Section through "AB"
Brick Wall
SHALE BRICK
COFR-WALL
Section through "CD"
Section through "AB"
PLAN
PLANS FOR
SCREEN CHAMBER & BY-PASS.
FOR
BERNHART RESERVOIR.

O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
BERNHART DAM		RRB		

PLATE 4

GENERAL PLAN DRAWING

SHOWING PROBLEM AREAS

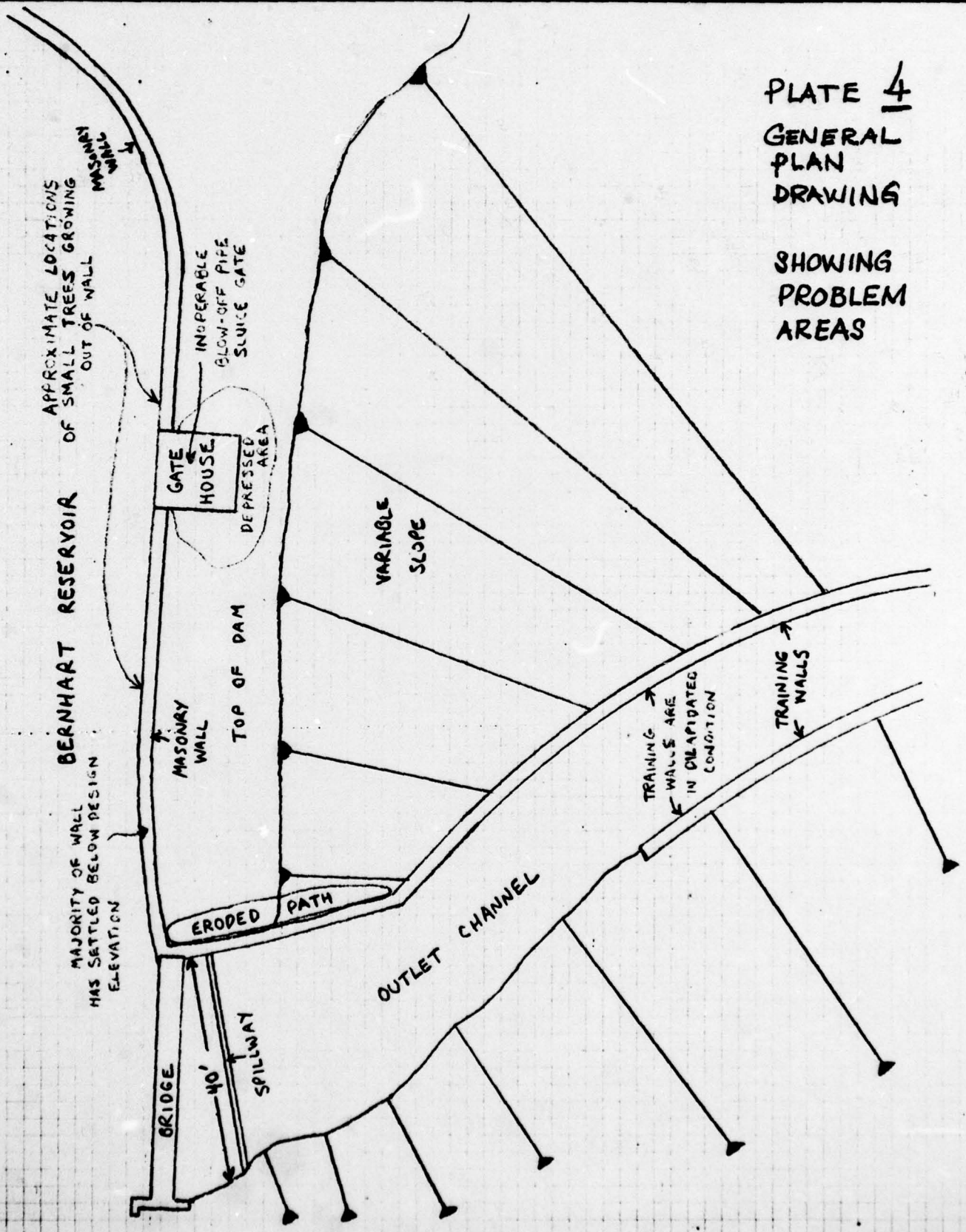
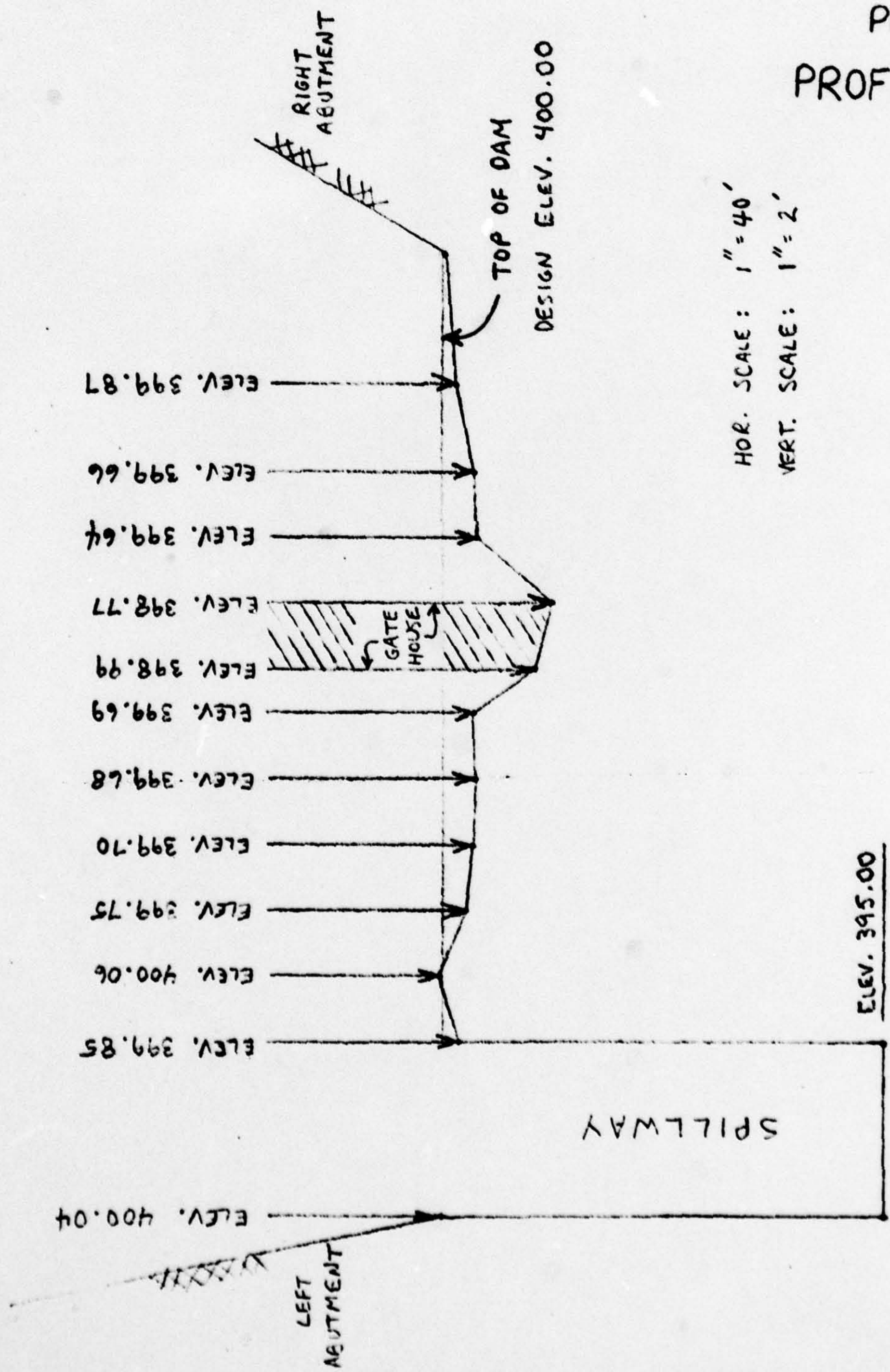


PLATE 5

PROFILE OF CREST OF DAM



APPENDIX

F

Site Geology

SITE GEOLOGY

BERNHART DAM

Bernhart Dam is located in the western section of the Reading Prong of the New England Uplands physiographic province. The crystalline rocks in this province are folded and highly faulted complex Precambrian metamorphics. Bedrock at the dam site has a gneissic structure as indicated by inspection of the outcrop forming the right abutment and by geologic mapping performed by other investigators. No major faulting or structural defects were noted in the field in the immediate vicinity of the dam or reservoir.

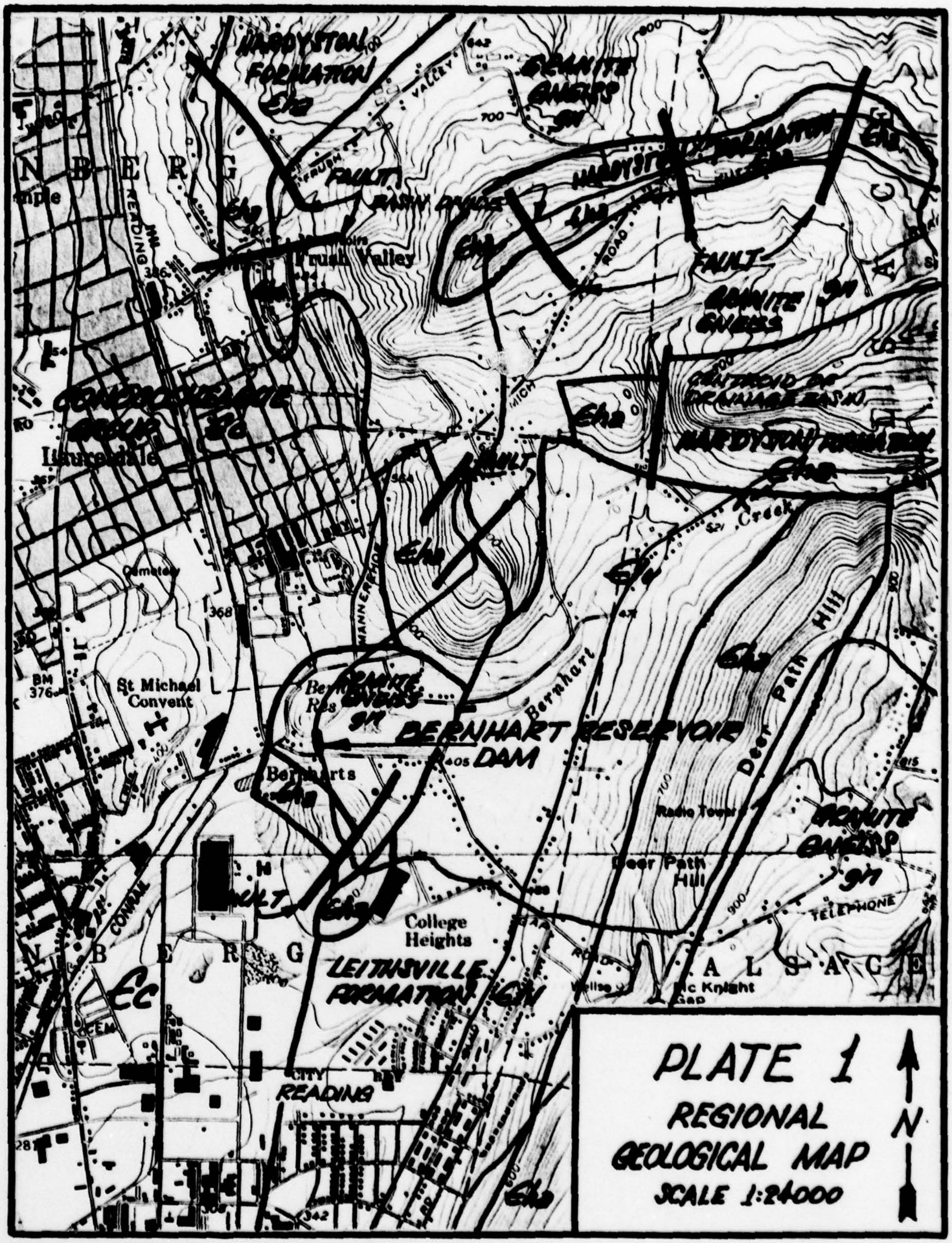


PLATE 1
REGIONAL
GEOLOGICAL MAP
SCALE 1:24000
N