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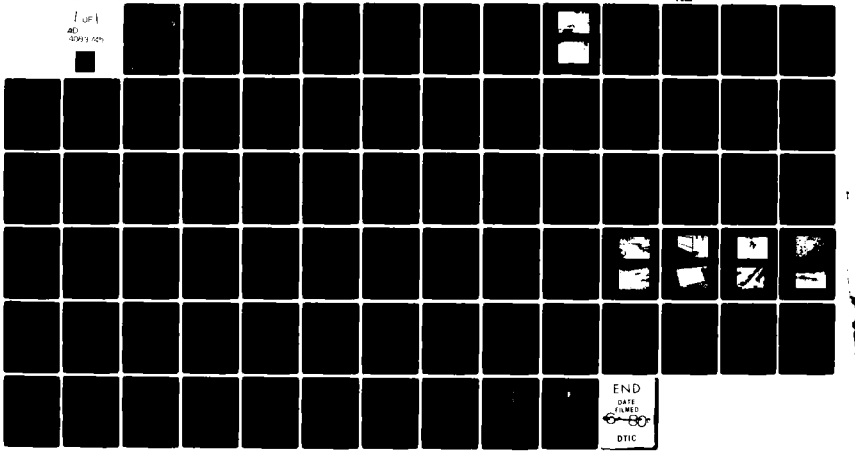

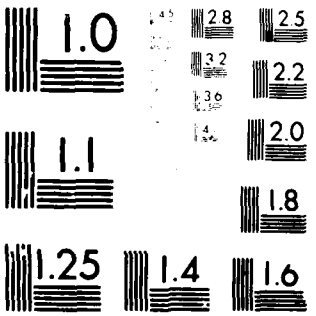

OHIO RIVER BASIN

TRIBUTARY OF CLARK'S RUN, BEAVER COUNTY

PENNSYLVANIA

BIG BEAVER DAM

(PA No Name No. 14)

NDI No. PA 00258

PennDER No. 4-11

LEVEL II

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

prepared for

DEPARTMENT OF THE ARMY

Baltimore District, Corps of Engineers

Baltimore, Maryland 21203

prepared by

MICHAEL BAKER, JR., INC.

Consulting Engineers

4301 Dutch Ridge Road

Beaver, Pennsylvania 15009

February 1980

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OHIO RIVER BASIN

(1)

BIG BEAVER DAM
BEAVER COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI No. PA 00258
PennDER No. 4-11

(6) PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Big Beaver Dam (Pa No Name Number 14, NDI Number PA 00258, PennDer Number 4-11), Ohio River Basin, Tributary of Clark's Run, Beaver County, Pennsylvania. Phase I Inspection Report,

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

(11) Feb 80

(12) 78

Prepared by: MICHAEL BAKER, JR., INC.
Consulting Engineers
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Beaver, Pennsylvania 15009

(15) DACW31-80-C-0025

(10) John A. Dzinbek

410 710

JAB

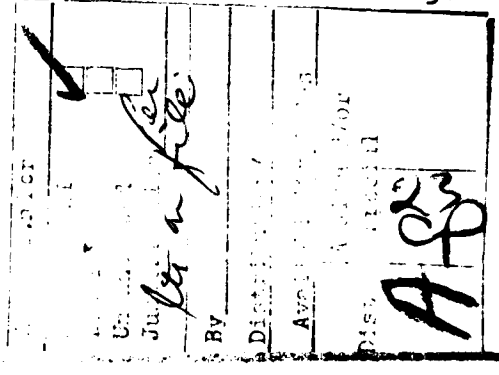
PREFACE

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

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. 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

Big Beaver Dam (PA No Name No. 14)
NDI No. PA 00258, PennDER No. 4-11
Tributary of Clark's Run
Inspected 21 November 1979

ASSESSMENT OF GENERAL CONDITIONS

Big Beaver Dam is classified as a "Small" size - "High" hazard dam. The dam and reservoir, owned by Mr. Al DeSanzo, are used for recreation and fire protection.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District, Corps of Engineers, for Phase I Inspection Reports, revealed that the spillway will pass approximately 37 percent of the Probable Maximum Flood (PMF) before overtopping will occur. Because the duration and depth of overtopping under the 1/2 Probable Maximum Flood (1/2 PMF) are relatively small (3.0 hours and 0.41 foot), the spillway is considered "inadequate." The owner should immediately raise the low spot on the dam to Elevation 989.0 feet or 4.0 feet above the crest of the spillway. Based upon the Phase I analysis, the net result of raising the embankment would be an increase of the spillway capacity such that it would be capable of passing the 1/2 PMF with only a minor amount of overtopping.

The dam was found to be in fair overall condition at the time of inspection. Several items of remedial work should be performed by the owner without delay. These include:

1) The owner should engage the service of a qualified professional engineer experienced in the design of earth dams to develop recommendations for the best method to remove the trees on the embankment that would produce minimal damage to the embankment during and subsequent to removal.

2) The low area on the crest should be raised to Elevation 989.0 feet and the erosion ditch on the downstream face should be repaired.

3) All loose stones in the spillway should be secured and the chute channel walls repaired as necessary.

4) Fill all rodent holes in the embankment.

5) Properly backfill the stone wall along the upstream face.

6) The owner should develop a conscientious repair and maintenance schedule.

7) An upstream closure (i.e. gate valve) for the outlet pipe should be installed to protect the embankment in the event of a pipe rupture and for periodic inspection and maintenance of the pipe.

In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

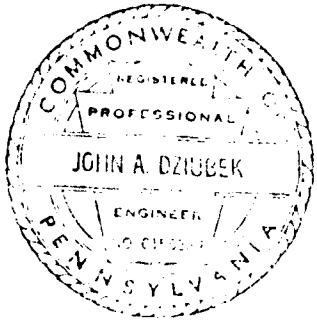
3) When warning of a storm of major proportions is given by the National Weather Service, the owner should activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operation procedures and records be developed and implemented.

BIG BEAVER DAM

Submitted by:

MICHAEL BAKER, JR., INC.



John A. Dziubek, P.E.
Engineering Manager-Geotechnical

Date: 18 February 1980

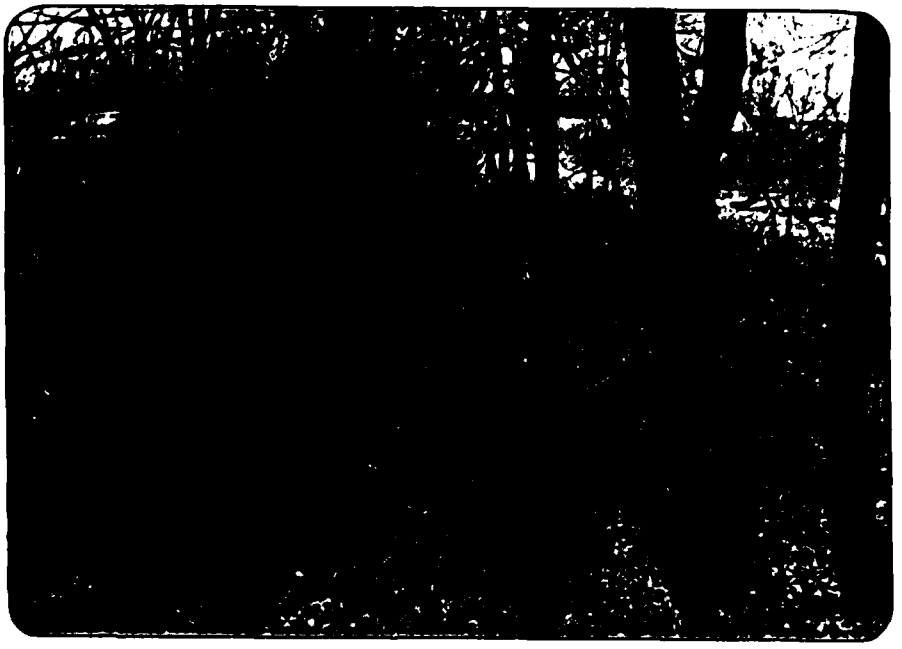
Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 19 MARCH 1980

Overall View of Dam from the Right Abutment



Overall View of the Downstream Portion of the Dam from the Left Abutment

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
BIG BEAVER DAM (PA NO NAME No. 14)
NDI No. PA 00258, PennDER No. 4-11

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

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Big Beaver Dam is an earth embankment with a maximum height of 25 feet and a total length of 320 feet. The embankment has a crest width of 10 feet and side slopes of 2H:1V (Horizontal to Vertical) upstream and 1.5H:1V flattening to 2H:1V at the toe downstream. The top 4 feet of the upstream slope is partially protected from wave and ice formation by a stone wall.

The spillway, located at the right abutment, consists of a cut stone lined broad crested weir and chute. The spillway crest is 9.6 feet long perpendicular to the flow and 12 feet long parallel to the flow. The chute has an overall width of 10 feet and a length of 75 feet; the spillway crest is located 3.5 feet below the low spot of the crest of the dam. The chute width varies from 10 feet wide near the crest to 6 feet wide at the bottom of the chute. The chute is on a 3H:1V slope and curves to the left back towards the center of the dam.

The outlet works for the dam consist of an 8 inch cast-iron pipe with the upstream end submerged approximately 30 feet out from the center line of the dam. The pipe is reportedly (according to the owner) housed in a timber cribbed bin raised off the floor of the lake. Other information indicates there may be the remains of a circular masonry

stone control tower originally located in the reservoir at this same approximate location. An 8 inch gate valve is located on the downstream end of the pipe housed in a timber crib pit. The Borough of Homewood (formerly Racine) has a fire line connected to this outlet works. For this reason the 8 inch gate valve is always left open. It is reported that this valve is exercised at least twice a year to check its movements.

b. Location - Big Beaver Dam is located on a tributary to Clark's Run along Friendship Road. The structure is located in the Borough of Homewood (formerly Racine), Beaver County, Pennsylvania. The co-ordinates of the dam are N 40° 48.8' and W 80° 20.0'. The dam and reservoir can be located on USGS 7.5 minute topographic quadrangle, Beaver Falls, Pennsylvania.

c. Size Classification - The maximum height of the dam is 25 feet and the reservoir volume is 12.87 acre-feet to the top of dam (Elevation 988.5 feet). The dam is therefore in the "Small" size category.

d. Hazard Classification - Loss of life would likely result from a failure of the dam since three residential structures are located less than 1000 feet downstream from the dam. The economic damage would be moderate due to two secondary roads located downstream along with several houses and garages. Because of possible property damage and the loss of life, Big Beaver Dam is classified in the "High" hazard category.

e. Ownership - The dam is owned by Mr. Al DeSanzo, Box 417, Homewood, Pennsylvania 15010.

f. Purpose of Dam - The dam was originally used for an ice and watering station for the Pennsylvania Railroad until 1953. The dam is now used for recreation and water supply for fire protection.

g. Design and Construction History - The dam was designed and built by the Pennsylvania Railroad sometime in the 1800's. There were no construction plans or design information available to review at the time this report was prepared. Minor modifications made to the dam are discussed in detail in Section 2.2.

h. Normal Operational Procedures - The reservoir is typically maintained at the crest elevation of the spillway. There has reportedly been no major flood since the dam was constructed. The dam is visited by the owner every few weeks. The owner also watches the dam during times of heavy rainfall.

1.3 PERTINENT DATA

a. Drainage Area (square miles) -	0.23
b. Discharge at Dam Site (c.f.s.) -	
Spillway Capacity at Maximum Pool (El. 988.5 ft.*) -	176.0 c.f.s.
c. Elevation (feet above M.S.L.) -	
Design Top of Dam -	Unknown
Actual Top of Dam (low spot) -	988.5
Average Top of Dam -	989.5
Maximum Design Pool -	Unknown
Normal Pool -	985.0
Maximum Tailwater -	Unknown
d. Reservoir (feet) -	
Length of Maximum Pool -	450
Length of Normal Pool -	400
e. Storage (acre-feet) -	
Normal Pool (El. 985.0 ft.) -	7.90
Top of Dam (El. 988.5 ft.) -	12.87
f. Reservoir Surface (acres) -	
Top of Dam (El. 988.5 ft.) -	1.63
Normal Pool (El. 985.0 ft.) -	1.22
g. Dam -	
Type -	Earthfill
Length (feet) -	320
Height (feet) -	25
Top Width (feet) -	10
Side Slopes - Upstream -	2H:1V
Downstream -	1.5H:1V at top decreasing to 2H:1V at toe

*Feet above Mean Sea Level (M.S.L.)

Zoning - No information is available concerning zoning of the embankment. It is conjectured that the dam was constructed of locally available clay and shale.

Impervious Core -	Unknown
Cut-off -	Unknown
Drains -	None observed

h. Diversion and Regulating Tunnel - None

i. Spillway -

Type -	Broad crested weir with chute channel
Length of Crest Perpendicular to Flow (feet) -	9.6
Width of Crest Parallel to Flow (feet) -	12
Crest Elevation (feet M.S.L.) -	985.0
Gates -	None

Upstream Channel - Earth and masonry-lined approach channel which rapidly slopes up to the spillway crest.

Downstream Channel - Masonry-lined stepped channel on the downstream face of the dam.

j. Regulating Outlets - Eight inch cast-iron pipe with control valve in timber cribbed pit downstream from the dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Big Beaver Dam was designed by the Pennsylvania Railroad. The following information was reviewed for the inspection report:

1) The earliest correspondence in the PennDER file was the following report: Water Supply Commission of Pennsylvania, Dam Division, Inspection Report, dated 11 September 1919. A brief summary of the report stated that there was some seepage and that the general impression and maintenance of the dam were considered poor. The report also stated that the crest had been eroded and low in several places.

2) A letter from the Water Supply Commission of Pennsylvania dated 28 October 1919 to the Pennsylvania Railroad stating the reported condition as described in the fore mentioned paragraph and asking the Pennsylvania Railroad to correct these conditions.

3) A letter from the Superintendent of the Pennsylvania Railroad dated 13 November 1919 to the Water Supply Commission of Pennsylvania stating that the railroad had inspected the dam and agreed to the findings of the Water Supply Commission and that the railroad would take corrective measures next year during the next low water season.

4) Inspection report from the Water Supply Commission, Dam Division, dated 1 September 1920, stating that the railroad had not taken any corrective measures.

5) An inspection report from the Department of Forest and Waters, Division of Dams and Encroachments dated 10 November 1961. In this report the dam was covered with brush and trees. There had been an erosion problem developing on the upstream slope, crest, and downstream slope.

6) Letter from the Department of Forest and Waters, Water and Power Resources Board to the Pennsylvania Railroad dated 13 November

1961 stating the condition of the dam as stated in the fore mention paragraph and asking that the railroad take corrective measures.

7) Letter from the Pennsylvania Railroad to the Department of Forest and Waters, Water and Power Resources Board, dated 22 November 1961, stating that they had sold the property to Jesse M. and Dorthy Texter, and several other people, on 10 August 1954.

8) Letter to Mr. and Mrs. Texter from the Department of Forest and Waters, Water and Power Resources Board, dated 4 December 1961, requesting that they take corrective measures on the dam.

9) Letter from Mr. Texter to the Department of Forest and Waters, Water and Power Resources Board, dated 8 December 1961, informing the Board that he had sold the dam to Mr. Al DeSanzo in 1959.

10) A letter from the Department of Forest and Waters, Water and Power Resources Board, dated 13 December 1961, to Mr. Al DeSanzo, requesting that he take corrective measures on the dam.

11) A letter from Mr. Al DeSanzo, dated 26 December 1961, to the Department of Forest and Waters, Water and Power Resources Board, stating that he would work on the corrective measures during the summer of 1962.

2.2 CONSTRUCTION

The Big Beaver Dam was constructed by the Pennsylvania Railroad sometime before the turn of the century. There were no "as built" or design plans, construction reports, or design data available for review.

The only modifications known by the present owner, Mr. Al DeSanzo, are the following items. In 1963, Mr. DeSanzo constructed a concrete deck bridge over the top of the spillway. A stone wall on the upstream slope was started in 1975 and was still not complete at the time this report was written. Additional modifications noticed by reviewing the PennDER file include

the removal of a circular masonry stone tower from the reservoir near the right end of the dam.

2.3 OPERATION

Mr. Al DeSanzo of Homewood is responsible for the maintenance and operation of the dam. Mr. DeSanzo visits the dam once every few weeks and at times of heavy rainfall.

The 8 inch gate valve on the outlet works is exercised twice a year to ensure its operations.

2.4 EVALUATION

a. Availability - There are no drawings, design information, or "as built" drawings available for this dam.

b. Adequacy - The information available, with the observations and measurements of the visual inspection, is thought to be adequate for this dam.

c. Validity - There is no reason to doubt the validity of the information available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The dam and its appurtenant structures were found to be in fair condition at the time of inspection. Noteworthy deficiencies observed are described briefly in the following paragraphs. The complete visual inspection check list, field sketch, top of dam profile, and typical cross-section are given in Appendix A.

b. Dam - The following is a list of obvious deficiencies noted during the visual inspection of the embankment:

1) A small erosion ditch was starting to form on the downstream slope caused from the rainfall run-off of the crest.

2) The dam has several low spots along the crest of the dam.

3) Trees and large bushes are growing on the downstream slope (see Overall View - Bottom Photo).

4) A hole approximately 10 inches in diameter was found at the toe of the downstream slope (see Photo 7).

5) Backfill needs to be placed behind the upstream stone wall.

6) The crest of the dam has minor ruts along it (see Photo 5).

7) The stone wall needs to be completed (see Photo 5). (Note: The stone wall was complete on 24 January 1980 at the time of the field review.)

c. Appurtenant Structures - The spillway channel is constructed of cut stone. Some of the stones appeared to be loose. The approach channel to the spillway has some silt and trash at the entrance of the spillway but is reportedly periodically cleaned by the owner (see Photo No. 1). There is some debris and fallen riprap located in the discharge channel. At times of high flows, minor erosion of the toe of the downstream slope may occur (see Photo 3). (Note: After reviewing the

results of the hydrology and hydraulic analysis, this erosion would probably be minimal.) Several large pieces of pipe and some fallen trees are located in the channel further downstream.

The outlet works consist of an 8 inch cast-iron pipe with a submerged intake housed in a stone or timber crib bin. The control on the outlet is an 8 inch gate valve located in a timber crib pit on the downstream slope (see Photo 4).

d. Reservoir Area - The side slopes of the reservoir are steep but have good vegetation cover. Soundings taken during the inspection indicated that the reservoir has a maximum depth of 12 feet with an average depth of approximately 7 feet. Projecting the valley bottom from upstream and downstream of the reservoir shows that the original depth of the reservoir at the location of the 12 foot sounding was approximately 18 feet. This indicates that approximately 6 feet of sedimentation has occurred at this point.

e. Downstream Channel - The downstream channel is a naturally occurring channel with a growth of trees and low bushes. Approximately 300 feet downstream from the dam there are three residential structures and three garages with an estimated population of 5 to 10 persons.

There are also several secondary roads and several storage buildings along the creek, all within 1500 feet of the dam (see Photo 8 for a view of one of the homes).

SECTION 4 - OPERATION PROCEDURE

4.1 PROCEDURES

There are no formal written instructions for operating the reservoir or excavating the downstream area in case of impending catastrophe.

It is recommended that formal emergency procedures be adopted.

4.2 MAINTENANCE OF DAM

Mr. Al DeSanzo is responsible for the maintenance of the dam. Generally, the maintenance procedures instituted by Mr. Al DeSanzo are considered adequate; however, a more conscientious program should be developed to prevent trees and bushes from growing on the embankment.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only operating facilities at the Big Beaver Dam is the 8 inch gate valve in a valve pit located downstream of the dam. The valve is left open for the fire protection line to the Borough of Homewood. The valve is exercised twice a year to ensure its operations. It is recommended that an upstream control valve (or closure) be installed on the outlet pipe to protect the embankment in the event of a pipe rupture.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system or procedure in the event of an impending catastrophe. Emergency warning procedures should be developed to notify residents downstream.

4.5 EVALUATION OF OPERATING ADEQUACY

The maintenance of the Big Beaver Dam is considered adequate with the exception of those items previously noted. Preventive maintenance should be done in the future to ensure that all facilities are functional.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - No hydrologic or hydraulic design calculations are available for Big Beaver Dam.

b. Experience Data - No information concerning the effects of significant floods on the dam is available.

c. Visual Observation - The crest of the dam slopes towards the center of the embankment. The lowest point on the crest is approximately 75 feet to the left of the spillway. This low spot is only 3.5 feet above the spillway crest. Virtually none of the dam crest is at an elevation high enough to allow for the full utilization of the spillway capacity. As a result, the dam will be overtopped before the ultimate capacity of the spillway is reached.

d. Overtopping Potential - Big Beaver Dam is a "Small" size, "High" hazard dam requiring evaluation for a spillway design flood (SDF) in the range of the 1/2 Probable Maximum Flood (1/2 PMF) to the Probable Maximum Flood (PMF). Due to the small size of the drainage area above the dam, the small size of the impoundment created by the dam and the relatively low numbers of structures located below the dam, the 1/2 PMF flow was selected as the SDF for Big Beaver Dam.

The hydraulic capacity of the dam, reservoir, and spillway was assessed by utilizing the U.S. Army Corps of Engineers Flood Hydrograph Package, HEC-1. The hydrologic characteristics of the drainage basin, specifically, the Snyder Unit hydrograph parameters, were obtained from a regionalized analysis conducted by the Baltimore District of the U.S. Army Corps of Engineers.

Analyses of the dam and spillway show that the dam would be overtopped by a maximum of 0.41 foot for 3.0 hours during the 1/2 PMF event. The dam is capable of passing a flood of only 37 percent of the PMF.

e. Spillway Adequacy - The dam, as outlined in the above analysis, would be overtopped by the SDF (1/2 PMF). The maximum depth and duration of overtopping are 0.41 foot and 3.0 hours,

respectively, which occurs at the low spot on the dam crest. For the remainder of the crest, the depth and duration of overtopping is significantly less.

Further Phase I hydraulic analysis of the dam indicates that if the low spot on the crest were filled in to Elevation 989.0 feet, the dam would pass approximately 50 percent of the PMF. Because overtopping of the dam in its present state is relatively small and minor repair to the alignment of the crest would almost place the spillway in the "adequate" category, the spillway is judged to be "inadequate" and not "seriously inadequate".

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - No distress or seepage was observed for the embankment. The trees located on the downstream slope of the dam indicate a very unsatisfactory condition and may possibly cause leakage and contribute to the failure of the dam. Upon removal of the trees from the dam, however, another problem is created by the dying roots within the embankment which will create a large number of voids. It is therefore recommended that the owner retain a qualified professional engineer experienced in the design of earth dams to evaluate the overall effects and make suggestions to prevent serious damage to the embankment after the trees are removed.

Some of the stone blocks in the spillway structure were loose and require stabilizing. In a few spots along the chute channel walls the stones have fallen into the channel and need to be placed back on the walls. Given the present configuration of the spillway discharge chute channel and the dam, during heavy flows (design flood events) erosion of the toe of the embankment may occur.

b. Design and Construction Data - No design or construction data were available for review. It is estimated that the dam was constructed according to embankment and dam construction experience of the Pennsylvania Railroad engineers in charge. Although it is difficult to assess the structural stability of the embankment without any knowledge of the construction materials and methods, for this particular dam, with its history of satisfactory performance of the slopes and the fact that no indications of instability were observed during the field inspection, further assessments of the stability are not considered necessary for this Phase I Inspection Report. However, should future inspections observe signs of distress which would affect the structural stability of the embankment, additional evaluations and possibly corrective measures may be necessary.

c. Operating Records - No operating records are available. Nothing in the procedures described by

the owner indicate concern relative to the structural stability of the dam.

d. Post-Construction Changes - No changes adversely affecting the structural stability of the dam have been performed.

e. Seismic Stability - The dam is located in Seismic Zone 1 of the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is a zone of minor seismic activity. Therefore, further consideration of the seismic stability is not warranted.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - Big Beaver Dam was found to be in fair overall condition at the time of inspection. Big Beaver Dam is a "High" hazard - "Small" size dam requiring a spillway capacity in the range of 1/2 PMF to PMF. The 1/2 PMF was chosen as the SDF because the dam is on the low side of the "Small" size category and only a small number of structures would be affected in the event of a failure of the dam. As presented in Section 5, the spillway and reservoir were determined to have a capacity of 37 percent of the PMF. During 1/2 PMF, the depth and duration of overtopping are 0.41 foot and 3 hours, respectively. Further, if the low spot on the dam is repaired, the spillway would be capable of passing approximately 50 percent of the PMF. Therefore, the spillway is considered "inadequate".

b. Adequacy of Information - The information available and the observations and measurements made during the field inspection are considered sufficient for this Phase I Inspection Report.

c. Urgency - The owner should initiate the action discussed in paragraph 7.2 without delay.

d. Necessity for Additional Data/Evaluation - The owner should initiate a study concerning the potential problems associated with the removal of the trees and obtain recommendations from a qualified professional engineer experienced in the design of earth dams as to the best method of their removal that would produce the minimal amount of damage to the embankment.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection and review of information revealed certain items of work which should be performed without delay by the owner. These include:

1) The trees and brush should be removed from the downstream slope. Prior to the removal of these trees, however, it would be advantageous for the owner to initiate a study concerning the potential problems

associated with their removal and to obtain recommendations from a qualified professional engineer experienced in the design of earth dams as to the best method of removal that would produce minimal damage to the embankment. It is further recommended that the slope be planted with low cover vegetation, i.e., grass, to reduce erosion on the dam.

2) The crest of the dam should be evenly graded and raised to a minimum Elevation of 989.0 feet to prevent overtopping of the dam during the SDF (1/2 PMF). Also, this should prevent the formation of erosion ditches on the downstream face by decreasing the concentration of rainfall run-off into one low spot. The small eroded ditch on the downstream face should also be repaired.

3) All loose stones in the spillway structure should be secured, possibly by grouting (pointing) the voids. In addition, the walls of the chute channel should be repaired where the stones have falled into the channel.

4) All rodent holes in the dam should be filled.

5) The stone wall for erosion protection along the upstream face should be properly back-filled.

6) The owner should continue to remove the debris at the entrance to the spillway, as necessary, and remove any obstructions and debris in the chute and downstream channel.

7) Upstream closure (i.e. gate valve) for the outlet pipe should be installed to protect the embankment in the event of a pipe rupture and for periodic inspection and maintenance of the pipe.

In order to correct operational, maintenance, and repair deficiencies, the owner should periodically perform the following items:

1) A conscientious preventive maintenance schedule should be developed. This program should continue to include the biannual check of the operation of the gate valve of the outlet works. The owner should in the future

inspect the embankment and appurtenances, and repair as necessary.

2) The owner should keep all brush cut regularly on the dam to prevent the growth of large trees.

3) All rodent holes in the embankment should be filled.

4) Every effort should be made to keep the top of the dam level to at least Elevation 989.0 feet to prevent potential overtopping.

In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, the owner should activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operation procedures and records to developed and implemented.

APPENDIX A

VISUAL INSPECTION CHECK LIST, FIELD SKETCH, TOP OF DAM PROFILE, AND TYPICAL CROSS-SECTION

Check List
Visual Inspection
Phase 1

Name of Dam Big Beaver Dam (PA No Name No. 14) County Beaver State PA Coordinates Lat. N40°48.8'
NDI # PA 00258
PennDER # 4-11
Long. W80°20.0'

Date of Inspection 21 November 1979 Weather Partly cloudy, mild Temperature 45°-50° F.

Pool Elevation at Time of Inspection 985.2 ft.* M.S.L. Tailwater at Time of Inspection 964.2 ft.* M.S.L.

*All elevations are referenced to the spillway crest (El. 985.0 ft.)

Inspection Personnel:

Michael Baker, Jr., Inc.:

James G. Ulinski
Wayne D. Lasch
Jeff S. Maze

Field Review - 24 January 1980

John A. Dziubek
James G. Ulinski

Owner's Representatives:

Mr. Al DeSanzo

James G. Ulinski Recorder

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS		
DRAINS		
WATER PASSAGES		
FOUNDATION		

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING		
VERTICAL AND HORIZONTAL ALIGNMENT		
MONOLITH JOINTS		
CONSTRUCTION JOINTS		

EMBANKMENT

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)

NDI # PA 00258

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	A small erosion ditch is forming at Station 2+55 as a result of run-off from the crest concentrating at the low point of the embankment. (Note: The approximate stationing used during the visual inspection is shown on the field sketch included at the end of Appendix A.)	A proper leveling of the top of dam in profile and crowning in section will alleviate the erosion problem. It is recommended that the top of dam be raised to the top of the spillway walls elevation.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Visual inspection of the horizontal alignment indicated no problems. The Top of Dam Profile (see Appendix D) shows that the vertical alignment at the crest is lower than the top of the walls of the spillway structure from Station 0+50 to Station 2+86. The lowest point on the embankment is Station 2+25, where the embankment is approximately 2 ft. lower than the top of the spillway walls.	
RIPRAP FAILURES	The owner is currently in the process of placing riprap protection at the normal pool level on the upstream slope (see Photo 5). Note: On 24 January 1980, the site visit showed that the riprap protection had been completed.	

EMBANKMENT

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

VISUAL EXAMINGATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RODENT HOLES	One animal burrow was observed at approximate Station 1 + 00 (see Photo 7).	The rodent hole should be filled.
VEGETATION	The downstream slope is covered with large trees (greater than 12 in. in diameter). It was observed that the embankment is extensively rooted (with small roots) at the location where riprap was currently being installed. This is at the left end of the dam and the embankment was opened approximately 2 ft.	The trees should be removed from the dam and within 10 ft. of the toe.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No distress observed	
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The 8 in. C.I.P. outletting from the dam is connected to the fire hydrant system in Homewood. The entire pipe, except for the downstream valve, is buried and could not be examined.	
INTAKE STRUCTURE	The intake structure is submerged.	An upstream closure of the outlet pipe should be installed.
OUTLET STRUCTURE	A timber cribbed pit located downstream from the dam has a left-handed valve. This valve is exercised twice a year to ensure its proper operation.	
OUTLET CHANNEL	Not Applicable	
EMERGENCY GATE	The downstream valve previously mentioned controls the volume of water to the fire hydrant system. If emergency drawdown became necessary, the hydrant near the downstream channel approximately 650 ft. below the dam could be opened to drain into the channel.	

UNGATED SPILLWAY

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The weir and spillway structure consist of sandstone blocks.	
APPROACH CHANNEL	Some silt and trash was present at the entrance to the spillway. This is reportedly cleaned periodically.	Remove the silt and trash at the entrance to the spillway.
DISCHARGE CHANNEL	Some fallen trees and debris are located in the channel. Some of the channel walls (masonry stone) have fallen into the channel and need to be reconstructed. The channel is constructed along the toe of the dam and during heavy flows minor erosion of the toe of the dam may occur. (Note: After reviewing the results of the H/H analysis, it is felt that this erosion would be minimal.)	
BRIDGE AND PIERS	The concrete slab (bridge) over the spillway was installed in 1963 and is in good condition. The ends of the concrete slab rest on the original masonry stone spillway training walls.	

GATED SPILLWAY - Not Applicable

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

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

INSTRUMENTATION - None

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS		
OBSERVATION WELLS		
WEIRS		
PIEZOMETERS		
OTHER		

RESERVOIR

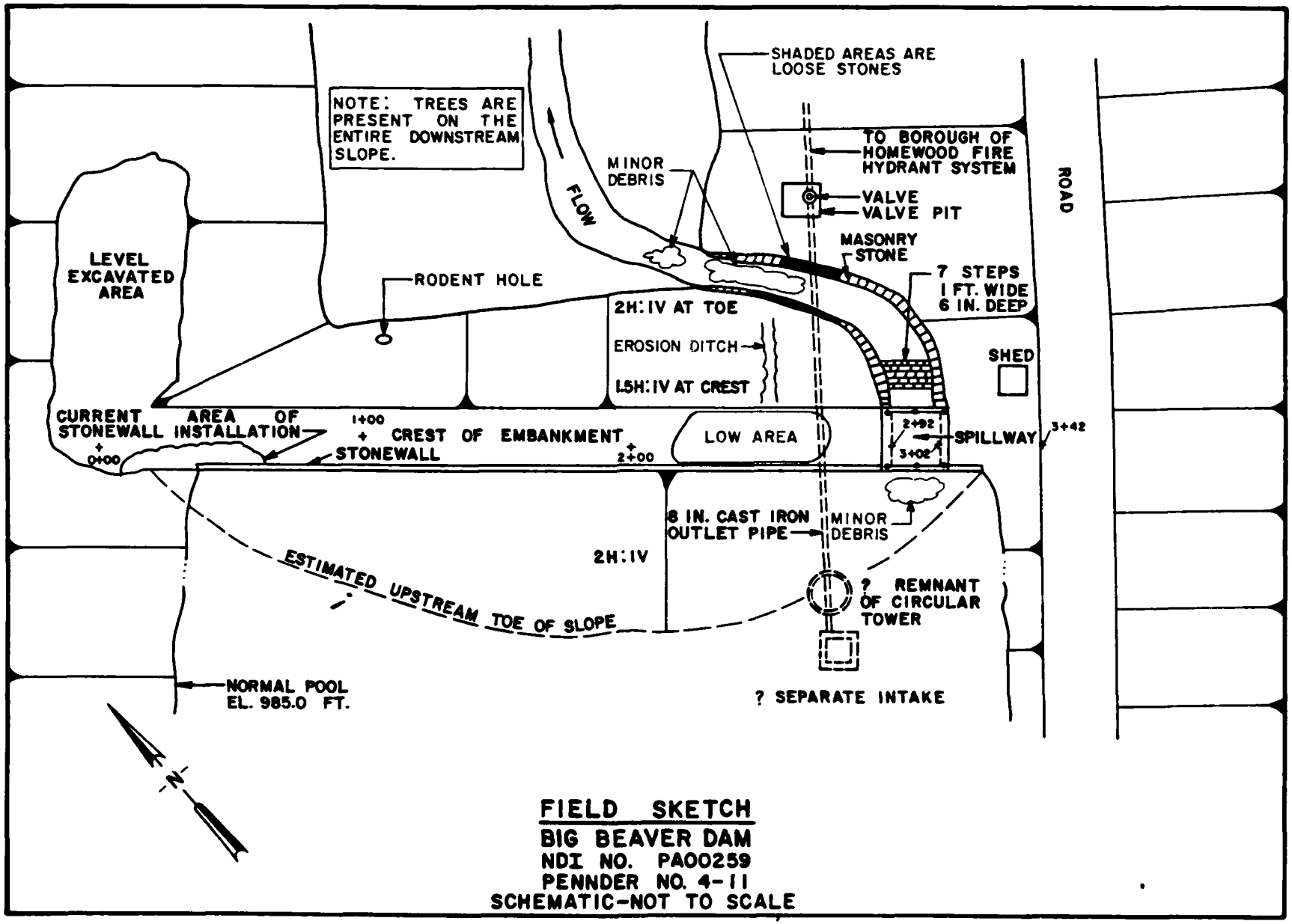
Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	A township road runs along the right side of the reservoir. The left side is moderately steep and forested.	
SEDIMENTATION	Soundings taken during the inspection indicated that the reservoir has a maximum depth of 12 ft. with an average depth of approximately 7 ft. Projecting the valley bottom from upstream and downstream of the reservoir shows that the original depth of reservoir at the location of the 12 ft. sounding (toe of upstream slope) was approximately 18 ft. This indicates that approximately 6 ft. of sedimentation has occurred at this point.	

DOWNSTREAM CHANNEL

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

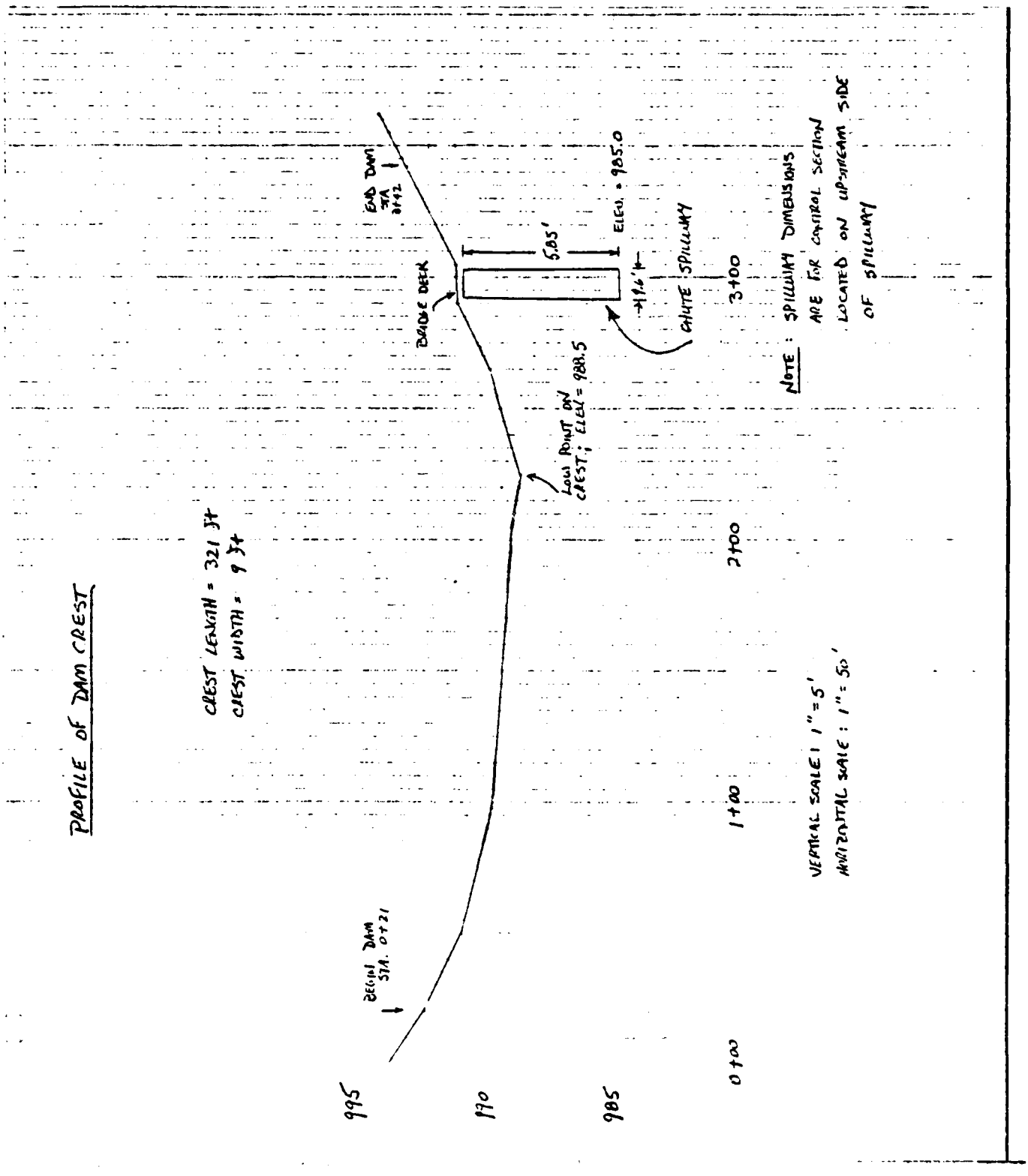
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The channel downstream from the dam is forested for approximately 200 ft. Some fallen trees are in the channel, but they would not obstruct flows. Approximately 200 ft. downstream is a township road and a 24 in. C.M.P. culvert. Beyond the road the channel flows into Clark's Run, approximately 800 ft. downstream from the dam.	
SLOPES	The slope on the right side is moderate. The left hillside slope until the township road is locally steep, but once past the township road it becomes mild (floodplain of Clark's Run). The channel slope is mild to Clark's Run.	
APPROXIMATE NO. OF HOMES AND POPULATION	Downstream from the dam the township road would be overtopped in the event of a dam failure. There are 3 garages and 3 homes (including a trailer) which would be affected in the event of a dam failure. Loss of life in 2 of the garages and the trailer home is probable.	



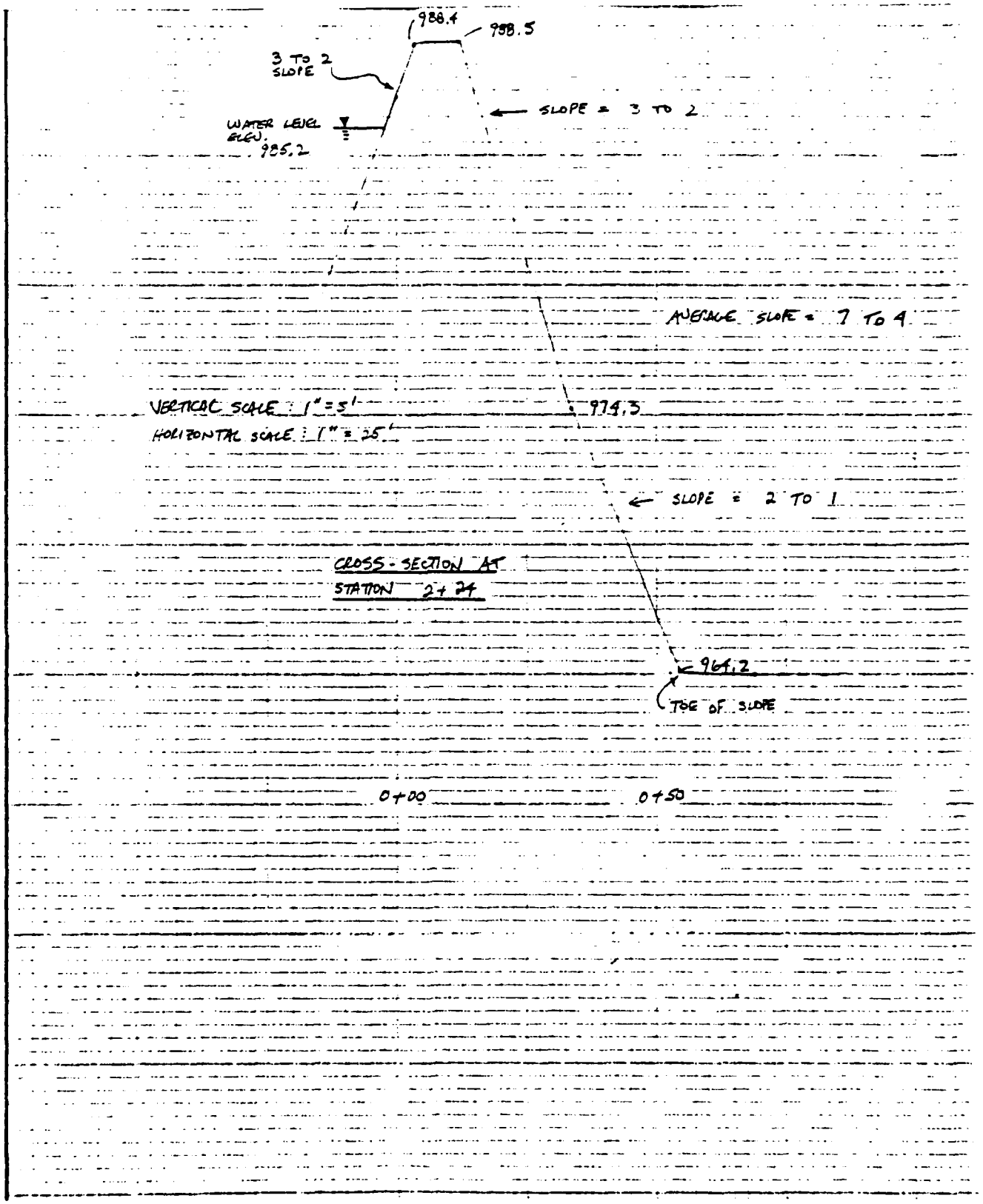
FIELD SKETCH
BIG BEAVER DAM
NDI NO. PA00259
PENNDER NO. 4-11
SCHEMATIC-NOT TO SCALE

BIG BEAVER DAM

TOP OF DAM PROFILE



TYPICAL CROSS-SECTION



APPENDIX B

ENGINEERING DATA CHECK LIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

ITEM	REMARKS
PLAN OF DAM	None available
REGIONAL VICINITY MAP	A USGS 7.5 minute topographic quadrangle, Beaver Falls, Pennsylvania, was used to prepare the vicinity map which is enclosed in this report as the Location Plan (Plate 1).
CONSTRUCTION HISTORY	The original construction history is not known. It is inferred that since it was in use by the Pennsylvania Railroad in 1919 (first record available) that the Pennsylvania Railroad was the constructor. No date of construction is available.
TYPICAL SECTIONS OF DAM	No information available
HYDROLOGIC/HYDRAULIC DATA	No information available
OUTLETS - PLAN, DETAILS, CONSTRAINTS, and DISCHARGE RATINGS	The only information available is an inspection report in 1919 stating that a masonry stone circular tower with a valve was located at the upstream toe of slope and 50 ft. from the right end. This tower is no longer present and a valve located downstream controls the outlet pipe connected to the fire hydrant system.
RAINFALL/RESERVOIR RECORDS	None available

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

ITEM	REMARKS
DESIGN REPORTS	No information available
GEOLOGY REPORTS	No information was available. The regional geology is presented as Appendix F of this report.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	No information available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	No information was available. The material of the dam which could be inspected is primarily shale fragments with some clay.
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	No information available

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	The masonry stone circular tower for the outlet valve was removed (date unknown). A concrete slab (bridge) was placed over the spillway (1963). A stone wall for wave erosion is currently being placed along the upstream face. This wall was started in 1975 and is approximately two-thirds completed.
HIGH POOL RECORDS	No information available
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Inspection Report by Water Supply Commission of Pennsylvania dated 11 September 1919. Inspection Report by Department of Forest and Waters dated 10 November 1961.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported in the information available.
MAINTENANCE OPERATION RECORDS	No formal records are maintained.

Name of Dam: BIG BEAVER DAM (PA No Name No. 14)
NDI # PA 00258

ITEM	REMARKS
SPILLWAY PLAN, SECTIONS, and DETAILS	No information available
OPERATING EQUIPMENT PLANS & DETAILS	No information available

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.23 sq.mi. (primarily low-density residential)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 985.0 ft. (approx. 7.90 ac.-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 988.5 ft. (12.87 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 988.5 ft.

CREST: Spillway

a. Elevation 985.0 ft.
b. Type Open channel
c. Width of Crest Parallel to Flow 12 ft.
d. Length of Crest Perpendicular to Flow 9.6 ft.
e. Location Spillover At right abutment of dam
f. Number and Type of Gates None

OUTLET WORKS:

a. Type One 8 in. dia. C.I.P. with valve
b. Location Approximately 50 ft. from right abutment
c. Entrance inverts Unknown
d. Exit inverts El. 964.9 ft.
e. Emergency drawdown facilities Eight in. cast-iron outlet with valve and draining through fire hydrant system.

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE No records available

APPENDIX C

PHOTOGRAPH LOCATION PLAN AND PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTION

Overall View of Dam

Top Photo - (OV-T) Overall View of Dam from the Right Abutment

Bottom Photo - (OV-B) Overall View of the Downstream Portion of the Dam from the Left Abutment

Photograph Location Plan

Photo 1 - View of Entrance to Spillway

Photo 2 - View of Exist from Spillway

Photo 3 - View of Discharge Channel from End of the Spillway Structure

Photo 4 - View of Valve for Outlet Pipe Located in Timber Crib Pit Downstream from Dam

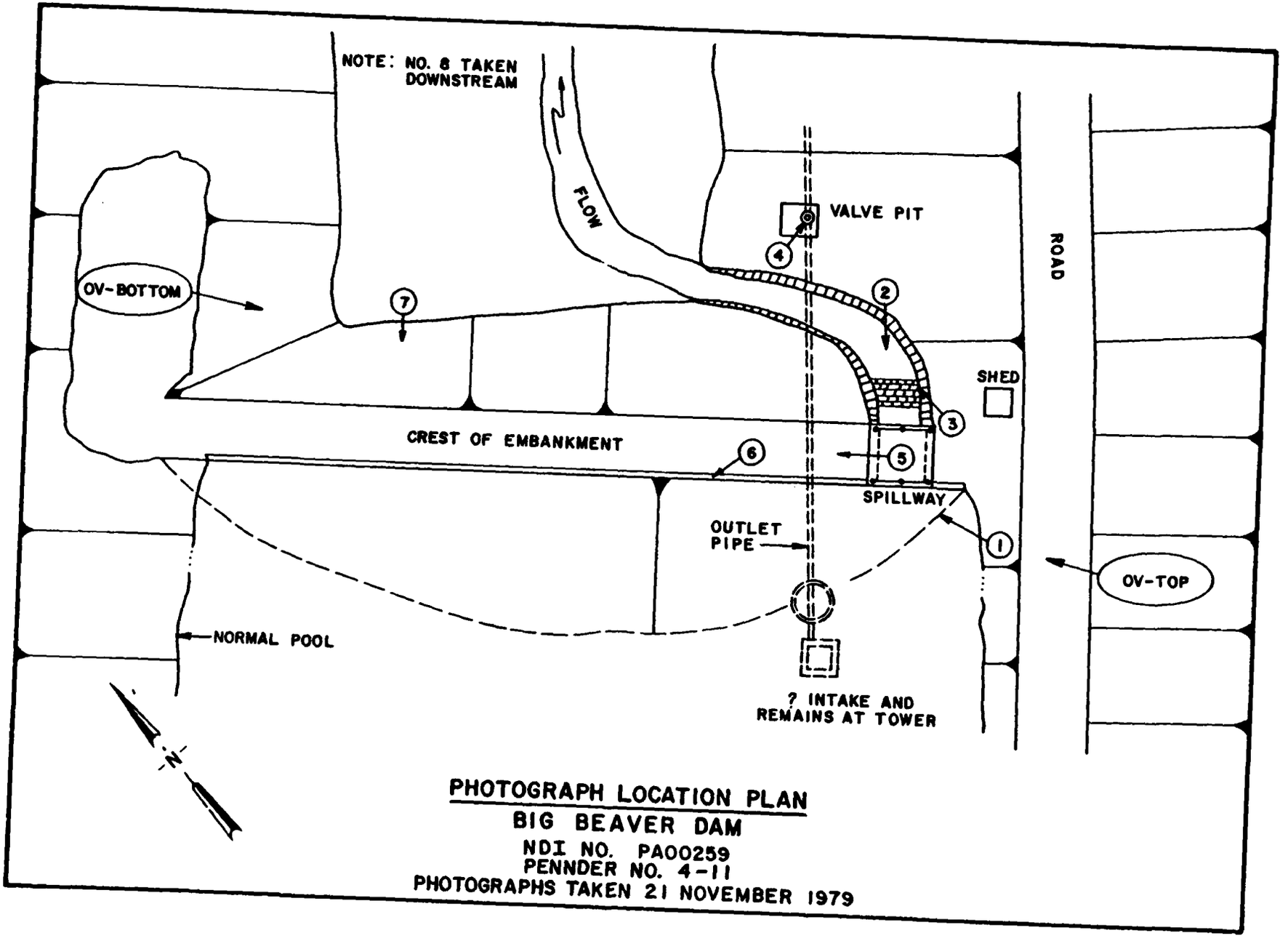
Photo 5 - View of the Crest of the Dam

Photo 6 - Close-up View of Slope Protection on Upstream Face (at the normal pool level)

Photo 7 - Close-up View of Rodent Hole at Toe of Slope, Approximate Station 1+00

Photo 8 - View of Trailer Located Next to Stream, Approximately 500 feet Downstream from the Dam

Note: All photographs were taken on 21 November 1979.



PHOTOGRAPH LOCATION PLAN
BIG BEAVER DAM
NDI NO. PA00259
PENNDER NO. 4-11
PHOTOGRAPHS TAKEN 21 NOVEMBER 1979

BIG BEAVER DAM

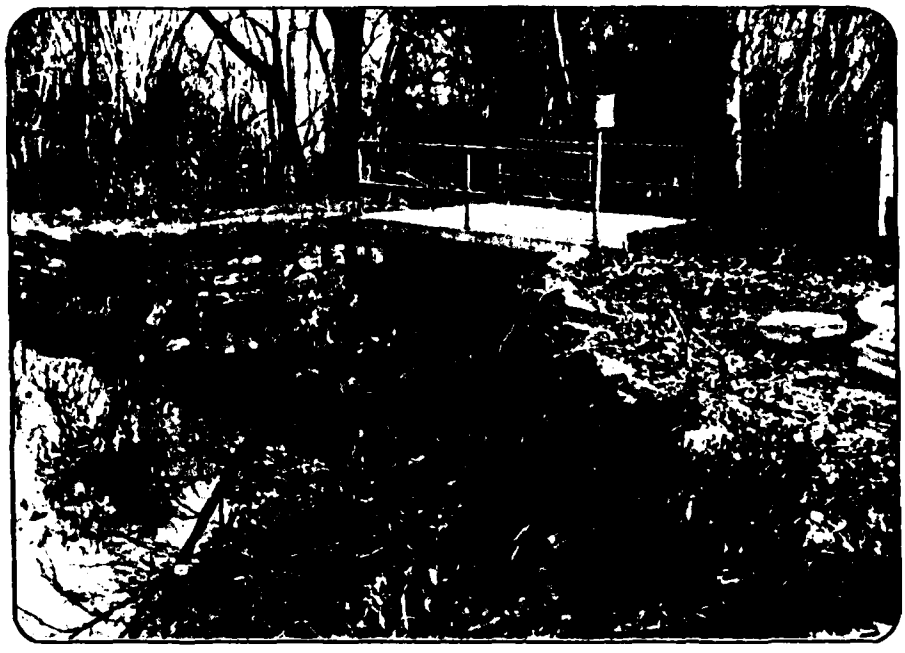


PHOTO 1. View of Entrance to Spillway

PHOTO 2. View of Exit from Spillway

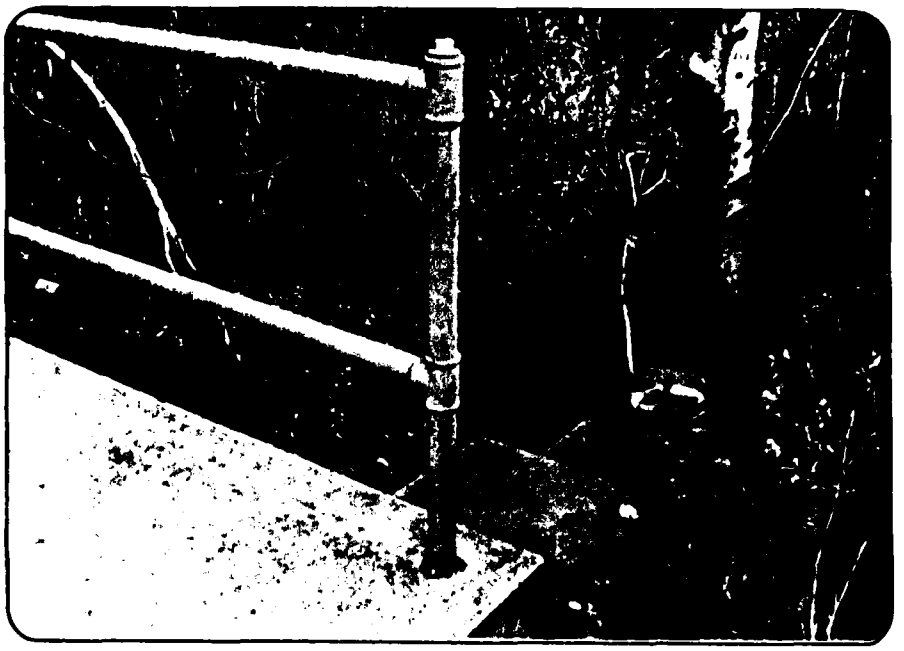


PHOTO 3. View of Discharge Channel from End of the Spillway Structure

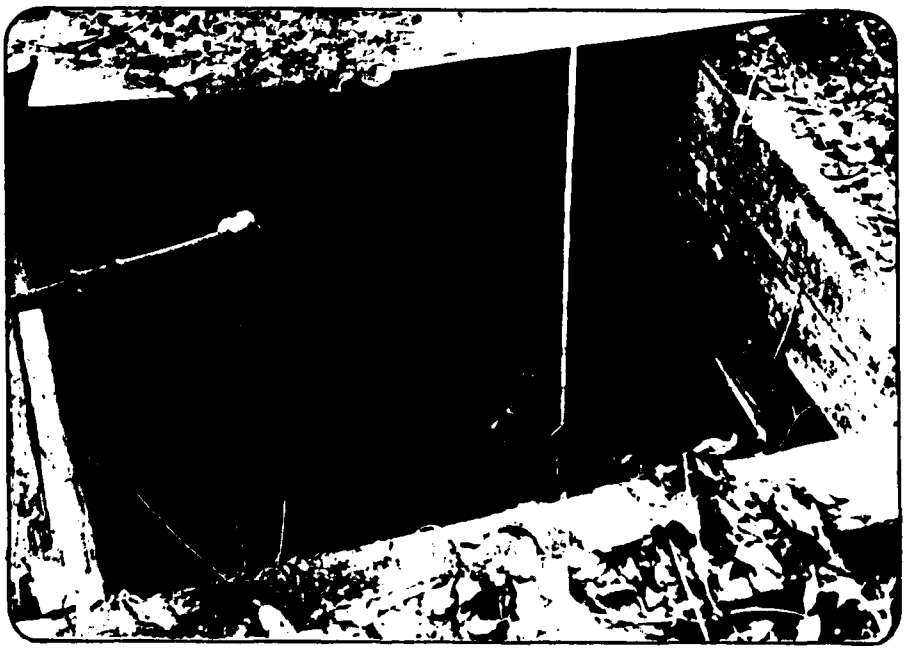


PHOTO 4. View of Valve for Outlet Pipe Located in Timber Crib Pit Downstream from Dam

BIG BEAVER DAM

PHOTO 5. View of the Crest of the Dam

PHOTO 6. Close-up View of Slope Protection on Upstream Face (at the normal pool level)

PHOTO 7. Close-up View of Rodent Hole at Toe of Slope, Approximate Station 1 + 00

PHOTO 8. View of Trailer Located Next to Stream, Approximately 500 feet Downstream from the Dam

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject BIG BEAVER DAM S.O. No.
APPENDIX D - HYDROLOGIC AND Sheet No. of
HYDRAULIC ANALYSES Drawing No.
Computed by Checked by Date

TABLE OF CONTENTS

PREFACE

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The hydrologic determinations presented in this Phase I Inspection Report are based on the use of a Snyder's unit hydrograph developed by the U.S. Army Corps of Engineers. Due to the limited number of gaging stations available in this hydrologic region and the wide variations of watershed slopes, the Snyder's coefficients may yield results of limited accuracy for this watershed. As directed however, a further refinement of these coefficients is beyond the scope of this Phase I Investigation.

In addition, the conclusions presented pertain to present conditions, and the effect of future development on the hydrology has not been considered.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: BIG BEAVER DAM (PA 00258)

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.6 INCHES/24 HOURS[1]

STATION	1	2	3	4	5
Station Description	BIG BEAVER DAM				
Drainage Area (square miles)	0.23				
Cumulative Drainage Area (square miles)	0.23				
Adjustment of PMF for Drainage Area (%)[2]					
6 Hours	109.5	(Adjustment factors			
12 Hours	123.5	are average of			
24 Hours	135.5	Zones 2 and 7, see			
48 Hours	145.5	Sheet 4 of 13)			
72 Hours	-				
Snyder Hydrograph Parameters					
Zone [3]	27				
C_p/C_t [4]	0.40/2.70				
L (miles) [5]	0.89				
L_{ca} (miles) [5]	0.40				
$t_p = C_t (L \cdot L_{ca})^{0.3}$ (hours)	1.98				
Spillway Data					
Crest Length (ft)	9.6				
Freeboard (ft)	5.85				
Discharge Coefficient	2.80				
Exponent	1.5				

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

(2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

(3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

(4) Snyder's Coefficients.

(5) L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject BIG BEAVER DAM (PA ID NAME NO. 14) S.O. No. _____ Sheet No. 2 of 13 Drawing No. _____

Computed by WLS Checked by WBC Date _____

HYDROLOGIC AND HYDRAULIC DATA :

DRAINAGE AREA ABOVE DAM = 1.60 in^2 (MEASURED ON BEAVER FALLS, PA. QUAD)
= 0.23 mi^2

L_{ca} = 2,100 ft = 0.40 mi.

L = 4,680 ft = 0.89 mi.

STORAGE COMPUTATIONS :

SURFACE AREA VS. ELEVATION MEASUREMENTS (TAKEN FROM QUAD) :

ELEVATION (ft)	AREA (ACRES)
985.0	1.22
1000.0	3.95
1020.0	9.18

NOTE: NORMAL POOL ASSUMED TO BE ELEV. 985.0 ft (ESTIMATED FROM QUAD)

CALCULATE STORAGE AT NORMAL POOL (ELEV. 985.0 ft) :

$$V = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 A_2}\right)$$

A_1 = SURFACE AREA OF NORMAL POOL = 1.22 ACRES

A_2 = SURFACE AREA OF BOTTOM OF RESERVOIR = 1.04 ACRES (ESTIMATED FROM OBSERVATIONS OF RESERVOIR SIDE SLOPES AND DEPTH)

h = AVERAGE RESERVOIR DEPTH ; SOUNDINGS TAKEN DURING INSPECTION GAVE AN AVERAGE DEPTH OF 7 ft.

$$V = \frac{7}{3}\left(1.22 + 1.04 + \sqrt{(1.22)(1.04)}\right) = 7.90 \text{ ACRE - ft}$$

CALCULATE ADDITIONAL STORAGE BETWEEN TOP OF DAM (ELEV. 988.5 ft) AND NORMAL POOL LEVEL :

$$V = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 A_2}\right)$$

(CONTINUED)

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject BIG BEAVER DAM (PA NO NAME NO. 14) S.O. No.

Sheet No. 3 of 13

Drawing No.

Computed by WDL Checked by WLS Date

A_1 = NORMAL POOL AREA = 1.22 ACRES

A_2 = SURFACE AREA AT TOP OF DAM ELEVATION = 1.63 ACRES
(INTERPOLATED FROM MEASURED SURFACE AREAS)

h = 3.5 FT

$$V = \frac{3.5}{3}\left(1.22 + 1.63 + \sqrt{(1.22)(1.63)}\right)$$

V = 4.97 ACRE-FT

TOTAL STORAGE AT TOP OF DAM = 4.97 + 7.90 = 12.87 AC-FT.

NOTES:

1. IN THE HEC-1 ANALYSIS, STORAGE VALUES FOR THE SPILLWAY CREST (ELEV. 985.0) AND TOP OF DAM (988.5) ARE CALCULATED AS BEING 5 AND 10 ACRE-FT, RESPECTIVELY. THE DIFFERENCE BETWEEN THESE VALUES AND THOSE CALCULATED IN THE ABOVE ANALYSIS RESULTS FROM THE ROUGH APPROXIMATION OF STORAGE AT NORMAL POOL USED IN HEC-1. THIS DOES NOT AFFECT THE ACCURACY OF THE HEC-1 RESULTS SINCE IT IS THE STORAGE BETWEEN NORMAL POOL LEVEL AND THE TOP OF THE DAM WHICH IS IMPORTANT IN THE ROUTING COMPUTATIONS. IN THE HEC-1 ANALYSIS, THIS STORAGE IS 5 ACRE-FT WHICH IS IDENTICAL TO THE STORAGE CALCULATED IN THE ABOVE ANALYSIS.

2. WHILE THE CREST OF THE DAM WAS MEASURED TO BE 321 FT LONG, THE LENGTH OF DAM CREST WHICH IS ASSUMED TO BE ACTIVELY OVERTOPPED IN THE HEC-1 ANALYSIS WAS LIMITED TO 312 FT. BECAUSE OF THE CONFIGURATION OF THE DAM CREST.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS
Box 280
Beaver, Pa. 15009

Subject BIG BEAR DAM — S.O. No.
HYDROGRAPH AND RAINFALL DATA — Sheet No. 4 of 13
Drawing No.
Computed by WDL — Checked by MED — Date 12/31/79

HYDROGRAPH DATA: (FROM BALTIMORE DIST., U.S. ARMY CORPS OF ENGINEERS)

DAM AND DRAINAGE AREA LOCATED IN ZONE 27

$C_p = 0.40$

C_T = PLATE O

$t_p = 2.7 (LL_{ca})^{0.3}$

$t_p = 2.7 [(0.89)(0.40)]^{0.3}$

$t_p = 1.98$ HRS

RAINFALL DATA: (FROM HMR-33)

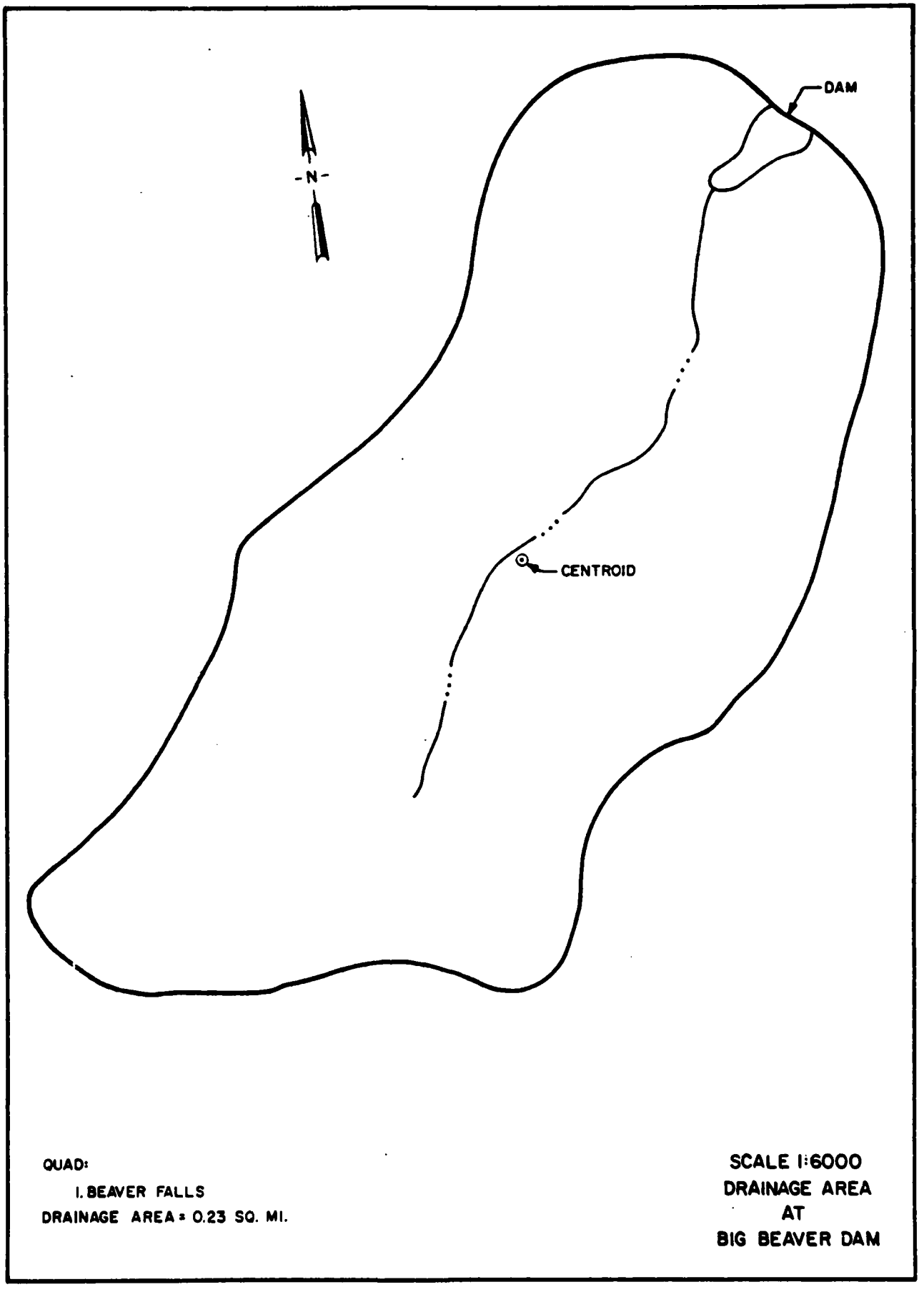
DAM AND DRAINAGE AREA LOCATED IN ZONE 2, IN CLOSE PROXIMITY TO THE BOUNDARY BETWEEN ZONES 2 AND 7

PMP (24 HR)$_{200\ mi^2}$ = 23.6 IN

DRAINAGE AREA = 0.23 mi^2

	ZONE 2	ZONE 7	AVERAGE
PMP (6 HR) =	117% PMP (24 HR)$_{200\ mi^2}$	102%	109.5%
PMP (12 HR) =	127% PMP (24 HR)$_{200\ mi^2}$	120%	123.5%
PMP (24 HR) =	141% PMP (24 HR)$_{200\ mi^2}$	130%	135.5%
PMP (48 HR) =	151% PMP (24 HR)$_{200\ mi^2}$	140%	145.5%

100 YR - 24 HR RAINFALL (FROM TP-40) = 4.9 IN



QUAD:

1. BEAVER FALLS

DRAINAGE AREA = 0.23 SQ. MI.

SCALE 1:6000

DRAINAGE AREA

AT

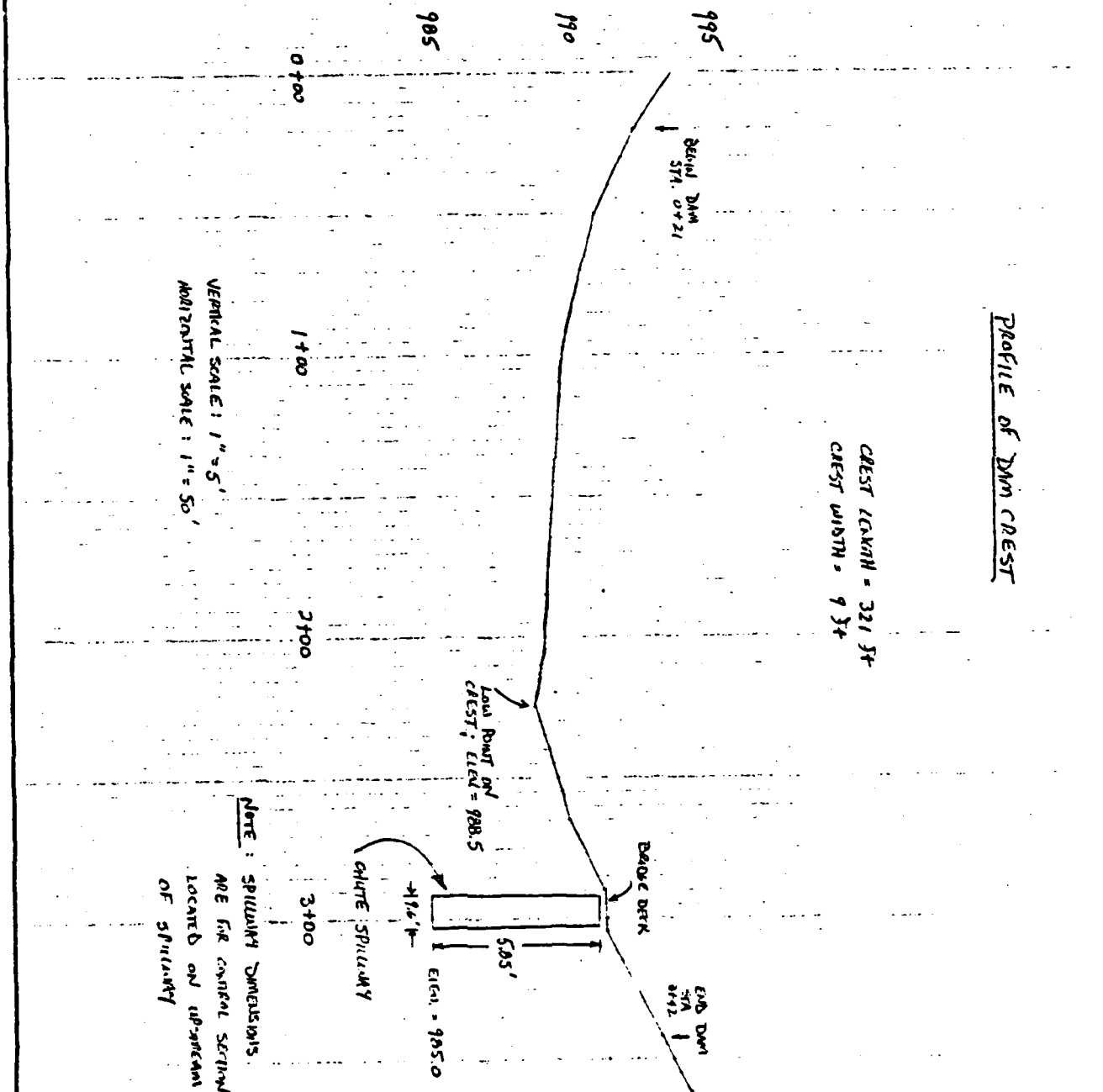
BIG BEAVER DAM

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject PA NO NAME NO. 14 (BIG BEAVER DAM) S.O. No.
Sheet No. 6 of 13
Drawing No.
Computed by WDL Checked by MED Date 12/17/79

PROFILE of DAM CREST



MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

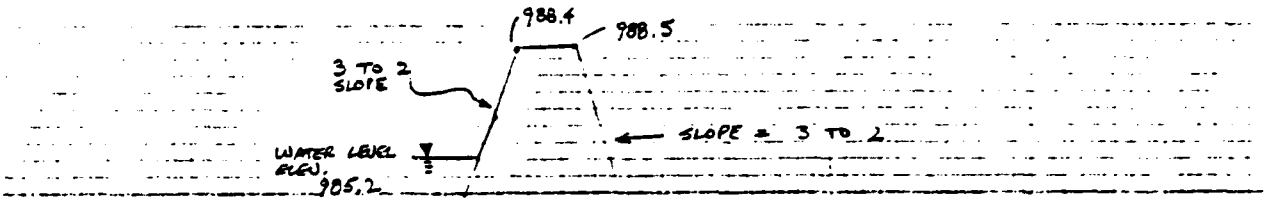
Box 280
Beaver, Pa. 15009

Subject PA NONAME LAKE NO 6 (316 BAKER DAM) S.O. No.

Sheet No. 7 of 13

Drawing No.

Computed by WDL Checked by M.E.D. Date 1/9/80



AVERAGE SLOPE = 7 TO 4

VERTICAL SCALE 1" = 5'

HORIZONTAL SCALE 1" = 25'

974.3

SLOPE = 2 TO 1

CROSS-SECTION AT STATION 2+24

964.2

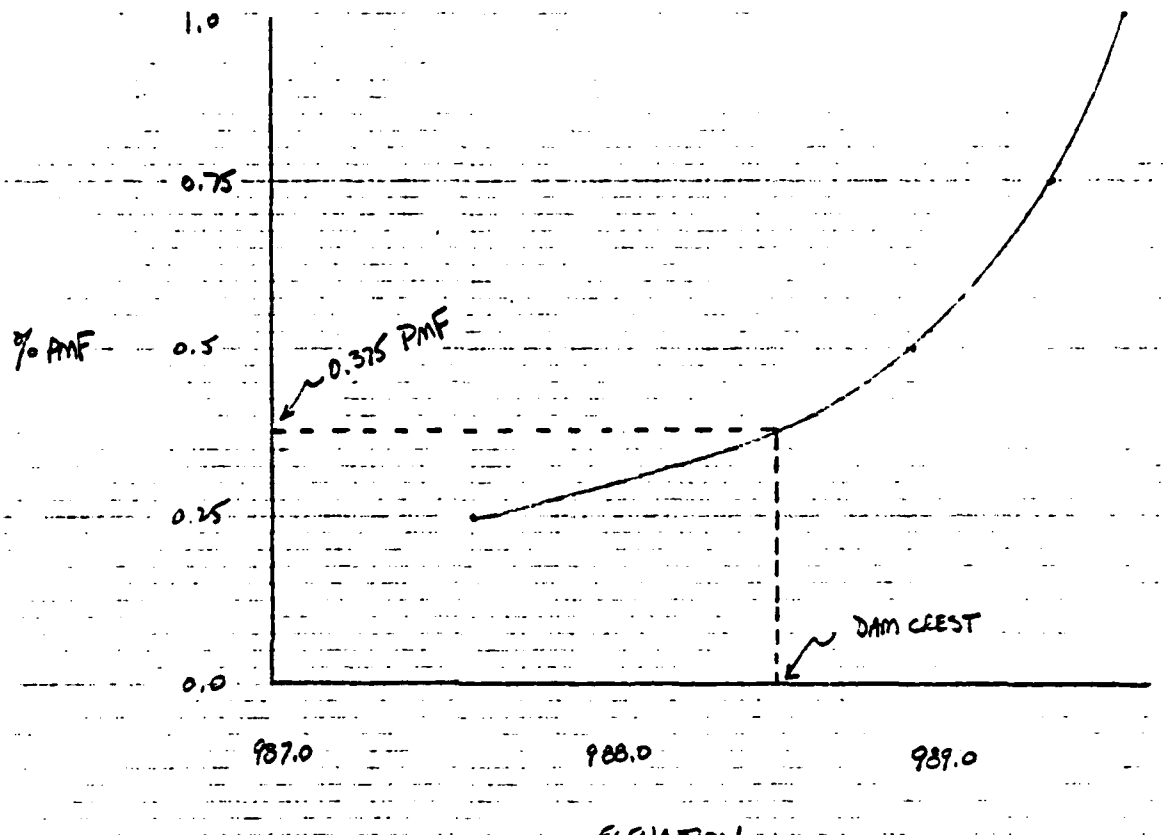
TOE OF SLOPE

0+00 0+50

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject: BIG BEAVER DAM — S.O. No.:
SPILLWAY CAPACITY — Sheet No. 8 of 13
Drawing No.:
Computed by: WDL — Checked by: MED — Date: 1/11/80



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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
  MBJ UPDATE         04 JUN 79
**********
    1              A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
    2              A2       HYDROLOGIC AND HYDRAULIC ANALYSES OF BIG BEAVER DAM
    3              A3       UNIT GRAPH BY SNYDERS METHOD
    4              B    300       0       10        0        0        0        0        0       -4        0
    5              B1     5
    6              J      1       4        1
    7              J1   1.0    0.75     0.50     0.25
    8              K      0       1                                                 1
    9              K1       RUNOFF HYDROGRAPH TO DAM
   10              M      1       1     0.23
   11              P             23.6    109.5    123.5    135.5    142.5
   12              T                                                        1.0     0.05
   13              W   1.98     0.40
   14              X   -1.5    -0.05      2.0
   15              K      1       2                                                 1
   16              K1       ROUTING FOR BIG BEAVER DAM
   17              Y                                 1        1
   18              Y1     1                                                    -985
   19              $A     0      1.2      4.0      9.2
   20              $E   973      985     1000     1020
   21              $S   985      9.6     2.80      1.5
   22              $D 988.5     3.08      1.5      312
   23              $L     0       62      159      191      222      260      281      302      320      355
   24              $V 988.5    989.0    989.5    990.0    990.5    991.0    991.5    992.0    992.5    993.5
   25              K     99
```

Sheet 9 of 13

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
  MBJ UPDATE         04 JUN 79
**********************************

RUN  DATE 31/10/80
     TIME    12.27
```

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSES OF BIG BEAVER DAM
UNIT GRAPH BY SNYDERS METHOD

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	10	0	0	0	0	0	-4	0
			JOPER	NMF	LKOPT	TRACE			
			5	0	0	0	0		

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1

RTIOS= 1.00 0.75 0.50 0.25

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

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO DAM

ISTAQ	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	0.23	0.0	0.23	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.60	109.50	123.50	135.50	145.50	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LRUPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 1.98 CP=0.40 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 1.99 HOURS, CP= 0.40 VOL= 0.99

1.	2.	5.	8.	12.	16.	20.	23.	26.	28.
30.	31.	30.	29.	28.	26.	25.	24.	23.	22.
21.	20.	19.	18.	18.	17.	16.	15.	15.	14.
11.	11.	11.	11.	11.	11.	11.	11.	11.	

9.	8.	8.	8.	7.	7.	7.	6.	6.	6.
5.	5.	5.	5.	5.	4.	4.	4.	4.	4.
3.	3.	3.	3.	3.	3.	3.	3.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

END-OF-PERIOD FLOW

0 MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	27.47	25.04	2.43	20241.
										(698.3)	(636.3)	(62.1)	(580.8)

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

HYDROGRAPH ROUTING

ROUTING FOR BIG BEAVER DAM

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

ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	=985.	0

SURFACE AREA=	0.	1.	4.	9.
CAPACITY=	0.	5.	42.	170.
ELEVATION=	973.	985.	1000.	1020.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
985.0	9.0	2.8	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
988.5	3.1	1.5	312.

CREST LENGTH AT OR BELOW ELEVATION	0.	62.	159.	191.	222.	260.	281.	302.	320.	322.
	988.5	989.0	989.5	990.0	990.5	991.0	991.5	992.0	992.5	993.5

PEAK OUTFLOW IS 447. AT TIME 41.67 HOURS

PEAK OUTFLOW IS 335. AT TIME 41.83 HOURS

PEAK OUTFLOW IS 223. AT TIME 41.83 HOURS

PEAK OUTFLOW IS 110. AT TIME 42.17 HOURS

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

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 1.00	RATIO 2 0.75	RATIO 3 0.50	RATIO 4 0.25
HYDROGRAPH AT	1	0.23	1	448.	336.	224.	112.
	(	0.60)	(	12.68)(	9.51)(	6.34)(	3.17)(
ROUTED TO	2	0.23	1	447.	335.	223.	110.
	(	0.60)	(	12.67)(	9.49)(	6.31)(	3.13)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	985.00	989.00	998.50
STORAGE	5.	5.	10.
OUTFLOW	0.	0.	170.

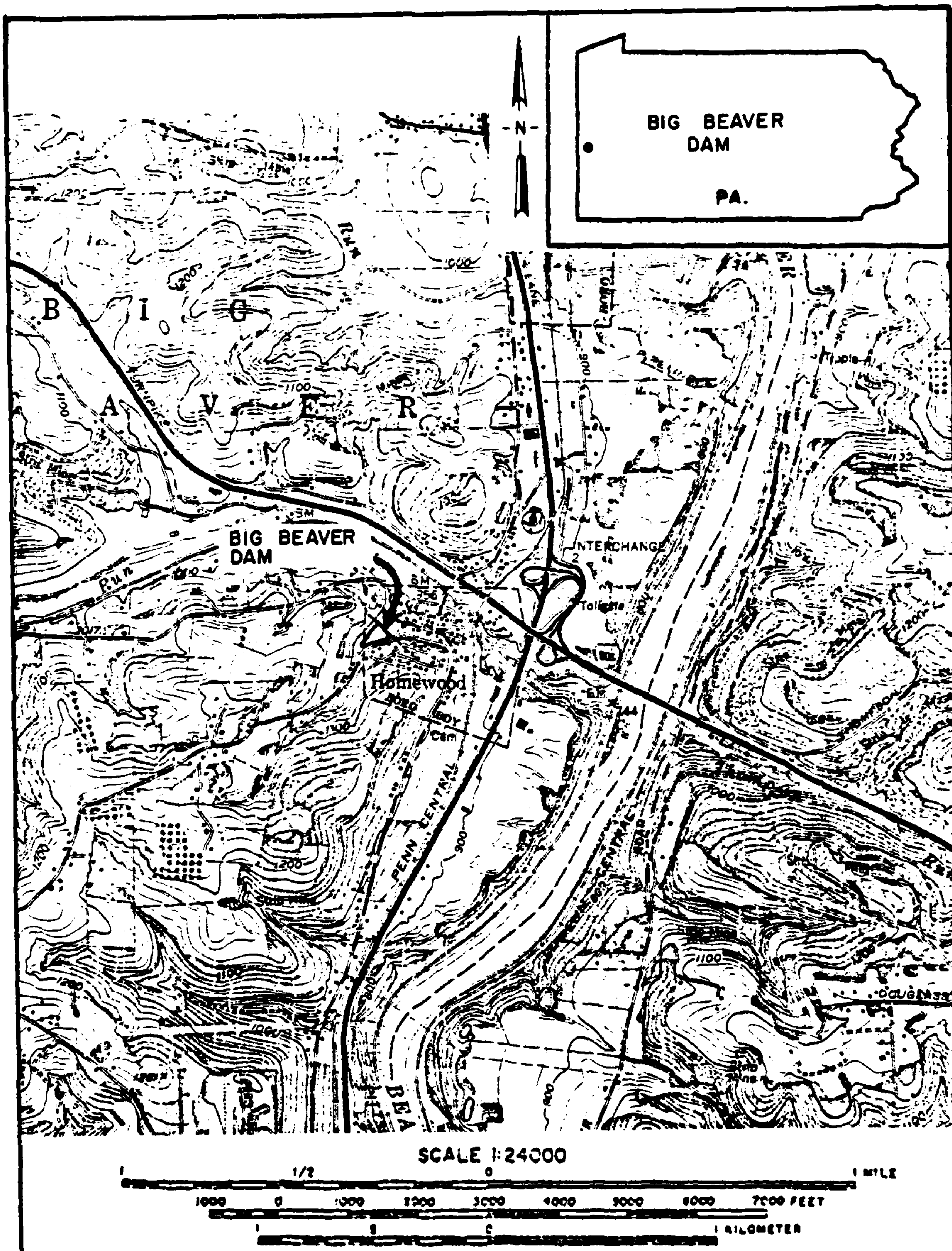
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	989.55	1.05	12.	447.	7.50	41.67	0.0
0.75	989.32	0.82	11.	343.	5.50	41.83	0.0
0.50	988.91	0.41	11.	223.	3.00	41.83	0.0
0.25	987.56	0.0	8.	110.	0.0	42.17	0.0

Sheet 13 of 13

APPENDIX E

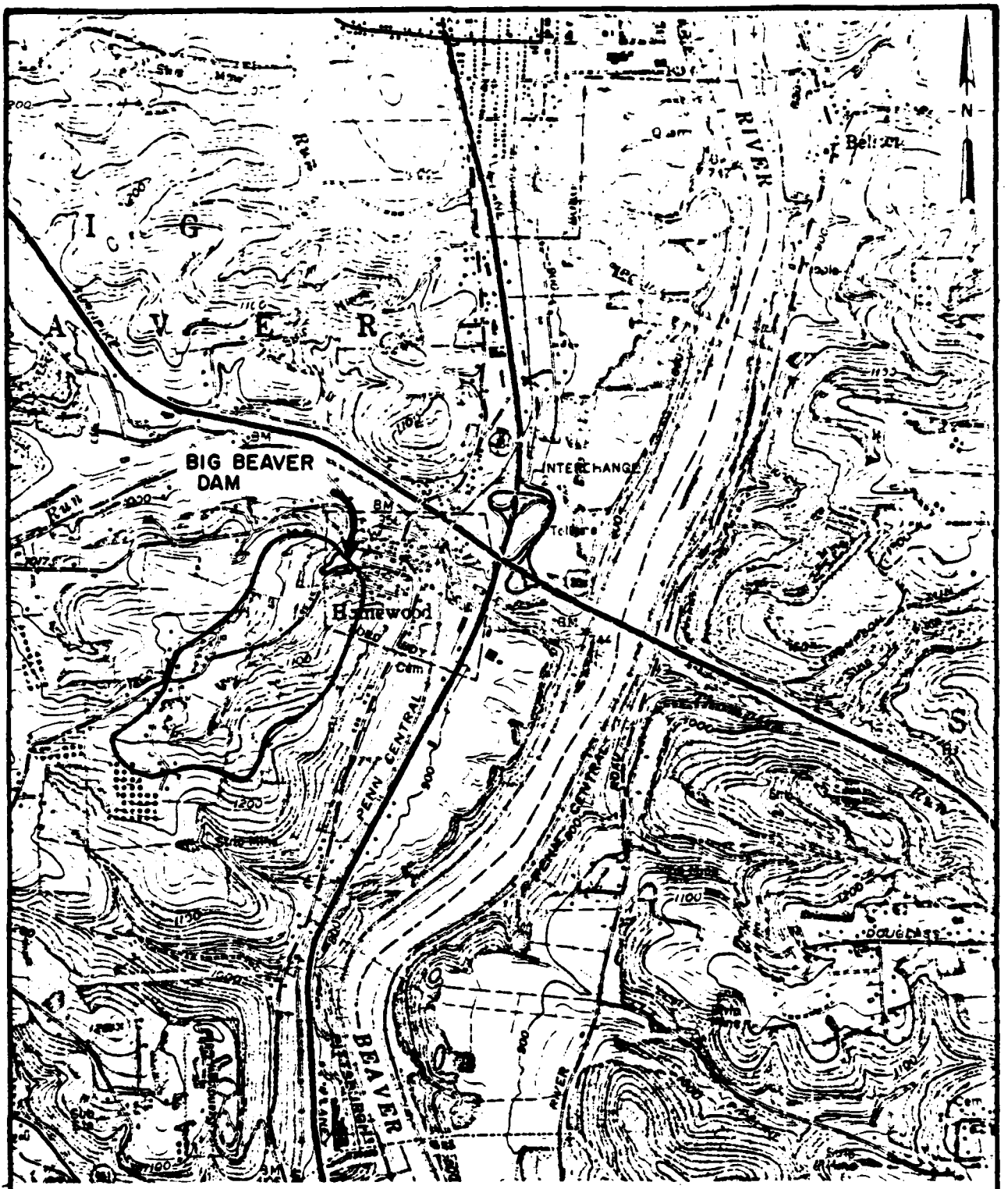
PLATES

CONTENTS



BIG BEAVER DAM

PLATE I LOCATION MAP



SCALE 1:24000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 KILOMETER

BIG BEAVER DAM
PLATE 2 WATERSHED MAP

APPENDIX F

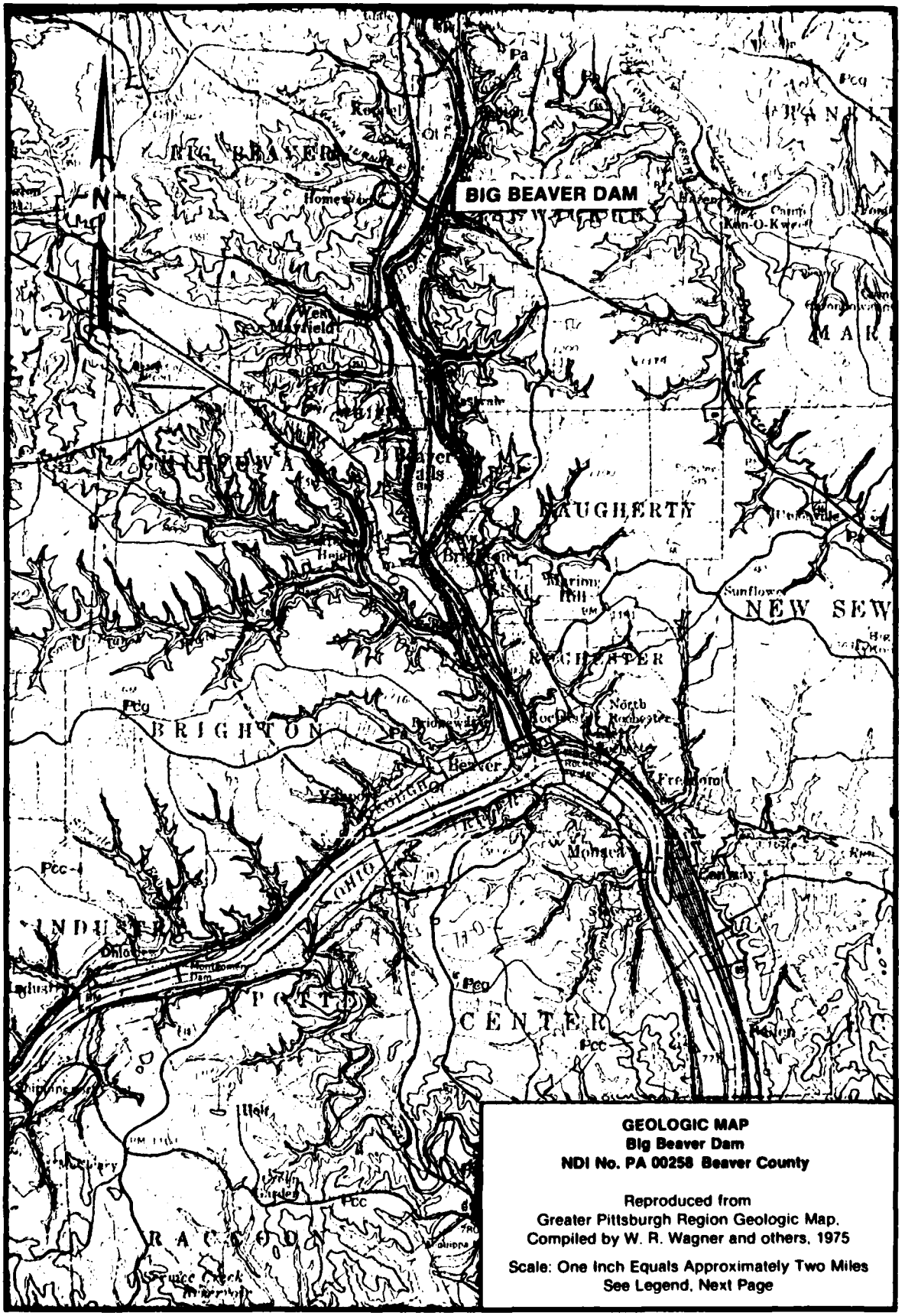
REGIONAL GEOLOGY

BIG BEAVER DAM
(PA NO NAME No. 14)
NDI No. PA 00258, PennDER No. 4-11

REGIONAL GEOLOGY

Big Beaver Dam is located in the Appalachian Plateaus Physiographic Province. Although the dam site has not been glaciated, the dam is located approximately one mile to the east of the border of the Illinoian drift. Outwash terraces are present along the Beaver River to the east (less than one mile) of the dam, but are not present at the dam site. Bedrock units below the dam are of the Allegheny Group, Pennsylvanian System. These members consist of cyclic sequences of shale, sandstone, limestone, and coal. It is estimated that the dam foundation was placed on the unnamed shale overlying the Kittanning Sandstone which is above the Vanport Limestone. Bedrock dips locally approximately 175 feet per mile to the Southwest toward the axis of a local syncline.

Coal reserves possibly located beneath the dam include the Clarion, Brookville, and Mercer coals. These coals have not been extensively mined in the area and not much information is available concerning their thickness. The Vanport Limestone is located approximately 30 feet (El. 950 feet) below the dam. This limestone has been commercially mined to the north of the dam at Wampum, Pennsylvania.



GEOLOGIC MAP
Big Beaver Dam
NDI No. PA 00258 Beaver County

Reproduced from
Greater Pittsburgh Region Geologic Map,
Compiled by W. R. Wagner and others, 1975

Scale: One Inch Equals Approximately Two Miles
See Legend, Next Page

GEOLOGY MAP LEGEND

GROUP	FORMATION		DESCRIPTION
	Alluvium	Qt	Sand, gravel, clay.
	Terrace deposits		Sand, clay, gravel on terraces above present rivers; includes Carmichaels Formation.
DUNKARD	Greene		Cyclic sequences of sandstone, shale, red beds, thin limestones and coals.
DUNKARD	Washington	Pw	Cyclic sequences of sandstone, shale, limestone, and coal; contains Washington coal bed at base.
DUNKARD	Waynesburg		Cyclic sequences of sandstone, shale, limestone and coal; contains Waynesburg coal bed at base.
MONONGAHELA		Pm	Cyclic sequences of shale, limestone, sandstone and coal; contains Pittsburgh coal bed at base.
CONEMAUGH	Casselman	Pcc	Cyclic sequence of sandstone, shale, red beds and thin limestone and coal.
CONEMAUGH	Ames		
CONEMAUGH	Glenshaw	Pcg	Cyclic sequences of sandstone, shale, red beds and thin limestone and coal; several fossiliferous limestone; Ames limestone bed at top.
ALLEGHENY	Vanport	Pa	Cyclic sequences of shale, sandstone, limestone, and coal; contains Brookville coal at base and Upper Freeport coal at top; within group are the commercial Vanport limestone and Kittanning and Clarion coals.
ALLEGHENY	Vanport	Pa	
POTTSVILLE			Sandstone and shale; contains some conglomerate and locally mineable coal.
Mauch Chunk			Red and green shale with some sandstone; contains Wymps Gap and Loyalhanna limestones.
Pocono			Sandstone and shale with Burgoon sandstone at top.