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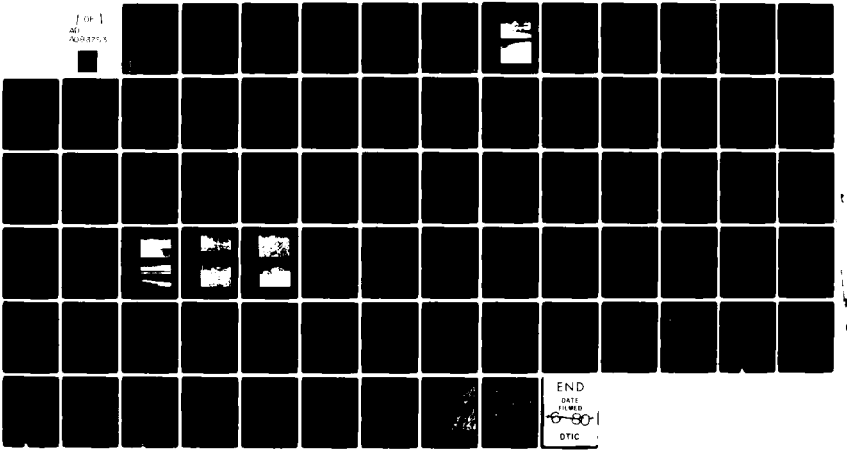

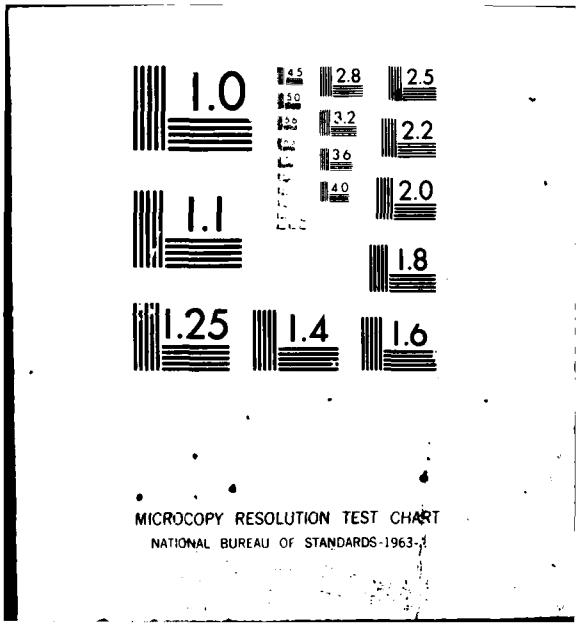
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BEAR ROCK RUN, CAMBRIA COUNTY

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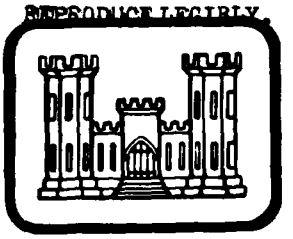
BEAR ROCK NO.1 DAM

NDI I.D. NO: PA-00439
DER I.D. NO: 11-2

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DACW 31-80-C-0022

PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

BY

D'APPOLONIA CONSULTING ENGINEERS
10 DUFF ROAD
PITTSBURGH, PA. 15235

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Department of the Army, 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 visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, material testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the inspection is intended to identify any need for such studies which should be performed by the owner.

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 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 the dam depends on numerous and constantly changing internal and external factors which are 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.

The assessment of the conditions and recommendations was made by the consulting engineer in accordance with generally and currently accepted engineering principles and practices.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Bear Rock No. 1 Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Cambria
STREAM: Bear Rock Run
SIZE CLASSIFICATION: Small
HAZARD CLASSIFICATION: High
OWNER: Highland Sewer and Water Authority
DATE OF INSPECTION: November 13 and December 28, 1979

ASSESSMENT: Based on the evaluation of the existing conditions, the condition of Bear Rock No. 1 Dam is considered to be unsafe/nonemergency due to the seriously inadequate spillway capacity. The condition of the embankment is considered to be fair.

The crest and downstream face of the dam were found to be covered with brush and trees which require clearing. A swampy area and a seepage point were located at the toe level of the dam near the left abutment. An irregularity on the downstream face of the dam near the left abutment was found, but no signs of recent movement or distress appeared to be associated with this irregularity. It is recommended that seepage be monitored to determine if flows are increasing and the irregular slope area be periodically observed to determine if distress is developing.

The operational condition of the blow-off valve was not observed. It is therefore recommended that the operational condition of the blow-off valve be immediately assessed and necessary maintenance performed, if required.

The spillway capacity was evaluated according to the recommended procedure and was found to pass 30 percent of the probable maximum flood (PMF) without overtopping the embankment. This capacity is less than the recommended spillway capacity range of half to full PMF. Relative to the size and hazard classification, a spillway capacity closer to the lower limit of the recommended range is considered applicable to the dam. However, because the spillway capacity is less than 50 percent of the PMF and it was found that failure of the dam due to overtopping would significantly increase the downstream hazard of loss of life compared to that which would exist just before failure, the spillway is considered to be seriously inadequate.

The following recommendations should be implemented immediately or on a continuing basis:

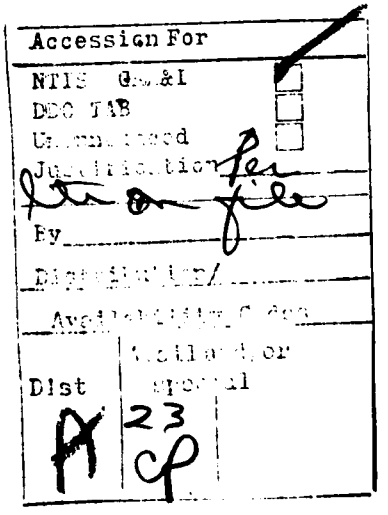
1. The owner should immediately retain a professional engineer to conduct additional studies to more accurately ascertain the spillway capacity and the nature and extent of improvements required to provide adequate spillway capacity.

2. The irregularity on the downstream slope should be periodically observed to determine if distress is developing.

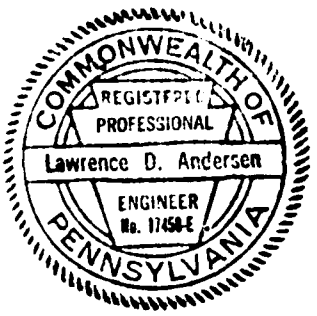
3. The operational condition of the blow-off valve should be evaluated and necessary maintenance performed if required. A means for providing upstream control of the outlet pipes should be developed.

4. Brush and trees on the crest and downstream slope of the dam should be cleared.

5. Around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system developed to alert the downstream residents in the event of emergencies. It is also recommended that the owner take necessary measures to improve the accessibility of the site during high flows.



6. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.



Lawrence D. Andersen, P.E.
Vice President

March 5, 1980
Date

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

31 March 1980
Date

BEAR ROCK NO. 1 DAM
NDI I.D. PA-439
NOVEMBER 13, 1979

Upstream Face

Downstream Face

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(Continued)

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
BEAR ROCK NO. 1 DAM
NDI I.D. PA-439
DER I.D. 11-2

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

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

1.2 Description of Project

a. Dam and Appurtenances. Bear Rock No. 1 Dam consists of an earth embankment approximately 560 feet long with a maximum height of about 26 feet from the downstream toe and a crest width of about 8 feet. The upstream and downstream faces and crest of the dam are covered with riprap. The flood discharge facilities of the dam consist of a concrete overflow spillway located on the left abutment (looking downstream). The overflow spillway is a stone masonry structure with a flow width of 58 feet. The discharge from the spillway flows into an unprotected discharge channel which follows the left side of the valley. A dike is provided along the right side of the spillway discharge channel to prevent flows towards the toe of the dam. The outlet facilities consist of a 16-inch cast-iron blow-off pipe and 10- and 12-inch cast-iron supply pipes. Flows through the 16- and 12-inch pipes are controlled by valves located on the downstream side of the dam. Drawings show an upstream valve on the 10-inch supply line. The 16-inch blow-off pipe constitutes the emergency drawdown facility for the reservoir.

b. Location. The dam is located on Bear Rock Run, a tributary of Little Conemaugh River, about two miles east of Lilly in Washington Township, Cambria County, Pennsylvania. Plate 1 illustrates the location of the dam.

c. Size Classification. Small (based on 26-foot height and 51 acre-feet maximum storage capacity).

d. Hazard Classification. The dam is classified to be in the high hazard category. Bear Rock Run flows through the town of Lilly approximately 2-1/2 miles downstream from the dam. It is estimated that failure of the dam would cause large loss of life and property damage in the town of Lilly.

e. Ownership. Highland Sewer and Water Authority (address: Mr. Charles MacDonald, Manager, 400 Luray Avenue, Johnstown, Pennsylvania 15904).

f. Purpose of Dam. Water supply.

g. Design and Construction History. The dam was designed and constructed by the Pennsylvania Railroad Company in 1904.

h. Normal Operating Procedure. The reservoir is normally maintained at Elevation 2344, the level of uncontrolled spillway. When the lake is at or above the spillway level, inflow is discharged through the uncontrolled spillway.

1.3 Pertinent Data

a. Drainage Area	1.97 square miles
b. Discharge at Dam Site (cfs)	
Maximum known flood at dam site	Unknown
Outlet conduit at maximum pool	20
Gated spillway capacity at maximum pool	Not applicable
Ungated spillway capacity at maximum pool	1438
Total spillway capacity at maximum pool	1438
c. Elevation (USGS Datum) (feet)	
Top of dam	2347.6 (measured low spot) 2348 (as designed)
Maximum pool	2347.6
Normal pool	2344
Upstream invert outlet works	2319±
Downstream invert outlet works	2315±
Maximum tailwater	Unknown
Toe of Dam	2322±
d. Reservoir Length (feet)	
Normal pool level	500
Maximum pool level	550 (estimated)

e. Storage (acre-feet)

Normal pool level	30
Maximum pool level	51

f. Reservoir Surface (acres)

Normal pool level	4.6
Maximum pool level	5±

g. Dam

Type	Earth
Length	560 feet
Height	26 feet
Top width	8 feet
Side slopes	Downstream: 1-3/4H:1V;(1) Upstream: 2H:1V(2)
Zoning	No
Impervious core	Yes
Cutoff	Yes
Grout curtain	No

h. Regulating Outlet

Type	16-inch cast-iron pipe
Length	150± feet
Closure	Gate valves
Access	Downstream valve chamber
Regulating facilities	Gate valve

i. Spillway

Type	Rectangular concrete channel
Length	58 feet
Crest elevation	2344
Upstream channel	Lake
Downstream channel	Earth channel

(1) As surveyed.
(2) As designed.

SECTION 2
DESIGN DATA

2.1 Design

a. Data Available. The available information was provided by the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER). The information includes correspondence, state inspection reports, and design drawings.

(1) Hydrology and Hydraulics. No design information is available. A state report entitled, Report Upon the Application of the Summit Water Supply Company, dated May 10, 1937, gives the design capacity of the spillway as modified in 1937.

(2) Embankment. Available information consists of limited design drawings.

(3) Appurtenant Structures. The available information consists of limited design drawings.

b. Design Features

(1) Embankment. Limited information is available on the design of the dam. One of the available design drawings (Plate 2) shows the plan view of the dam and the reservoir. According to a state report entitled, Report Upon the Bear Rock No. 1 Dam of the Summit Water Supply Company, the embankment consists of compacted clay beneath the upstream and downstream slopes and a central puddle clay core wall. It was reported that the puddle clay core was extended to a depth of 20 to 40 feet below the original ground surface through a cutoff trench. The puddle clay core wall was also extended into the sides of the valley. The dimensions of the puddle clay core wall were reported to be 12 feet at the crest level of the dam, increasing to a width of 16 feet at the original ground surface, and reducing to a 14-foot width at the bottom of the cutoff trench. The report indicates that no record of any subsurface investigation was available for the dam. Subsurface conditions were described as horizontal formations of shale and limestone.

As designed, the embankment slopes were 2 horizontal to 1 vertical on both the upstream and downstream faces. The design provided an 18-inch-thick layer of riprap on both faces and the crest of the dam for erosion protection.

(2) Appurtenant Structures. The appurtenant structures of the dam consist of an uncontrolled overflow spillway located near the left abutment and outlet works at the center of the dam. The

details of the existing spillway structures are illustrated in Plate 3. The spillway is a rectangular open channel comprised of stone masonry side walls and an 8-inch reinforced concrete slab overlain by 6-inch grouted stone pavement.

The outlet facilities as described in a 1914 state report include a 16-inch cast-iron blow-off pipe and 10- and 12-inch supply lines. Below the dam, 10- and 12-inch supply lines combine, discharging into a single 12-inch supply line. It is reported that flow through these pipes is controlled by valves located on the downstream side of the dam. However, a design drawing (Plate 2) shows an upstream valve on the 10-inch supply line. The report indicates that the pipes enter the embankment, passing through a 3-foot-thick masonry wall. It is also reported that in the upstream portion of the dam, the pipes are located through the fill, but enter a cut trench at about midpoint of the embankment, and then emerge from the toe of the dam at a level about 2-1/2 feet below the original ground surface. It is noted that the design provided no cutoff collars, other than the masonry wall located on the upstream end of the pipe, to prevent leakage along the pipes.

c. Design Data

(1) Hydrology and Hydraulics. The 1937 state report indicates that the spillway improvements undertaken at that time were based on a spillway design capacity of 1460 cfs.

(2) Embankment. Other than limited design drawings, no engineering data are available on the design of the embankment.

(3) Appurtenant Structures. No design calculations are available for the appurtenant structures.

2.2 Construction. Very limited information is available on the construction of the dam. A 1914 state report indicates that the embankment material was placed in thin layers, wetted, and rolled with a horse roller.

Other than the enlargement of the spillway in 1937, no post-construction changes are reported.

2.3 Operation. No operating records have been kept for the dam.

2.4 Other Investigations. None reported.

2.5 Evaluation

a. Availability. The available information was provided by the Commonwealth of Pennsylvania, Department of Environmental Resources.

b. Adequacy

(1) Hydrology and Hydraulics. The available information consists of the design discharge capacity of the spillway. This information is not considered to be adequate to assess the adequacy of the spillway capacity.

(2) Embankment. The dam was apparently constructed according to the design drawings. In view of the age of the dam, completed in 1904, the design approach and construction techniques are not likely to be in conformance with currently accepted engineering practices. The design lacks such considerations as embankment slope stability, seepage analyses, and other quantitative data to aid in the assessment of the adequacy of the design. However, the design includes such components as embankment zoning, a cutoff wall extending to impervious foundation material, and slope protection.

(3) Appurtenant Structures. Review of the spillway design drawings indicates that no significant design deficiencies exist that would affect the overall performance of these structures. The available information indicates that the design of the outlet works incorporated no special provisions, such as cutoff collars, to control seepage along these pipes, which raises some concern relative to the adequacy of the design to prevent seepage along these pipes. However, no seepage has been reported along these pipes in the past and none was observed at this time, indicating that backfilling around the pipes was adequate to prevent seepage along these pipes.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of Bear Rock No. 1 Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.

2. Visual examination of the spillway structures.

3. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 4.

b. Embankment. The general inspection of the embankment consisted of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing general maintenance conditions, vegetative cover, erosion, and other surficial features.

The two most significant conditions noted at the dam site were the presence of a swampy area and a seepage point located at the toe level of the dam near the left abutment and an irregularity on the downstream slope of the dam, again located near the left abutment. The seepage was found to contain acid mine precipitate and the discharge was estimated to be on the order of 10 to 20 gallons per minute. The irregularity on the downstream slope of the dam, which appears to be an old bulge, was examined, but no apparent signs of distress, such as surface cracks, or indications of movement were noted. A small depression about 2 to 3 feet in diameter was found along the toe of the dam approximately 200 feet from the right abutment. The appearance and the size of the depression suggest that it was caused by surficial movements of the riprap veneer rather than due to deep-seated conditions. The crest and downstream area of the dam were found to be in good condition, but covered with brush and trees up to 8 feet high.

The top of the dam was surveyed relative to the emergency spillway crest and was found to be at or slightly above the design crest elevation. Only a small section adjacent to the spillway wall was found to be about 4 inches below the design level. The crest profile of the dam is illustrated in Plate 5. Several measurements taken along the downstream slope indicated the slope to be 1-3/4 horizontal to 1 vertical, which is steeper than the design value of 2 horizontal to 1 vertical.

c. Appurtenant Structures. The spillway structures were examined for deterioration or other signs of distress and obstructions that would limit flow. The spillway structures were found to be in good condition. For the outlet structures, the only visible portion was the downstream end of the blow-off pipe and the stem of the blow-off valve. The operational condition of the blow-off valve was not observed.

d. Reservoir Area. A map review indicates that the watershed is predominantly covered by woodlands. A review of the regional geology (Appendix F) indicates that the shorelines of the reservoir are not likely to be susceptible to massive landslides, which would affect the storage volume of the reservoir.

e. Downstream Channel. Downstream from the dam, Bear Rock Run flows through an uninhabited valley for about two miles where it enters residential areas of the town of Lilly. It is estimated that in excess of 20 houses are located within the potential flood plain of Bear Rock Run in the event of a dam failure. Further description of the downstream conditions is included in Section 1.2d.

3.2 Evaluation. The condition of the embankment and spillway structures is considered to be fair. The condition of the outlet facilities could not be assessed. The observed conditions are not considered to be a threat to the overall integrity of the embankment. However, it is recommended that seepage quantities be monitored and the irregularity on the downstream face of the dam be periodically observed. Brush and trees on the crest and downstream slope of the dam should be cleared.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedure. There are no formal operating procedures for the dam. The reservoir is normally maintained at the uncontrolled spillway crest level with excess inflow discharging over the spillway.

4.2 Maintenance of the Dam. The maintenance of the dam is considered to be poor.

4.3 Maintenance of Operating Facilities. The only visible portions of the outlet facilities were the downstream end of the 16-inch cast-iron blow-off pipe and a portion of the blow-off valve stem protruding above the ground surface. The operational condition of the blow-off valve was not observed.

4.4 Warning System. No formal warning system exists for the dam. The dam is accessible via a two-mile jeep trail which is in poor condition. Bear Rock Run crosses the jeep trail at two locations. It is estimated that during severe weather conditions, the trail will not be passable. Telephone communication facilities are available via residences located about one mile downstream from the dam.

4.5 Evaluation. The overall maintenance of the dam is considered to be poor. It is recommended that the brush and trees on the downstream face of the dam be cleared and that the operational condition of the blow-off valve be evaluated. It is also recommended that the owner take necessary measures to improve the accessibility of the dam site.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Bear Rock No. 1 Dam has a watershed area of two square miles and impounds a reservoir with a surface area of 4.7 acres at normal pool level. The flood discharge facilities for the dam consist of a 58-foot-wide rectangular channel located on the left abutment. The capacity of the spillway was determined to be 1438 cfs.

b. Experience Data. As previously stated, Bear Rock No. 1 Dam is classified to be a small dam in the high hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass half to full PMF. Based on the size and hazard classification of the dam, a capacity of the spillway closer to the lower limit of the recommended range is considered to be applicable to this dam.

The PMF inflow hydrograph for the reservoir was determined utilizing the Dam Safety Version of the HEC-1 computer program developed by the Hydrologic Engineering Center of the U.S. Army, Corps of Engineers. Data used for the computer analysis are presented in Appendix D. The PMF inflow hydrograph for this dam was determined by initially routing the PMF through the upstream Bear Rock No. 2 Dam. The PMF hydrographs were found to have peak flows of 4001 cfs and 1995 cfs for full and 50 percent of the PMF, respectively. The computer input and a summary of computer output are also included in Appendix D.

c. Visual Observations. On the date of inspection, no conditions were observed that would indicate that the capacity of the spillway would be significantly reduced in the event of a flood.

d. Overtopping Potential. Various percentages of the PMF inflow hydrograph were routed through the reservoir and it was found that the spillway can pass 30 percent of the PMF without overtopping the low spot on the embankment. For 50 percent PMF, the low spot on the crest would be overtopped for a duration of 3.3 hours with a maximum depth of 0.46 foot. For 100 percent PMF, the overtopping duration would be 7.3 hours with a maximum depth of overtopping of 1.2 feet.

e. Spillway Adequacy. Since the spillway cannot pass the recommended spillway design flood without overtopping the embankment, the spillway is classified to be inadequate according to the recommended criteria. A breach analysis was conducted to determine if

the spillway is seriously inadequate; that is, if dam failure resulting from overtopping would significantly increase the potential for loss of life and property damage from that which would exist just before overtopping failure. The results of the dam break analysis and the valley cross sections used for flood routing are included in Appendix D.

Review of the flood stages in the potential damage area before and after failure indicates that flood stages would be raised by about one foot due to a dam failure, which is considered to be a significant increase in damage potential. Therefore, the spillway is classified to be seriously inadequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. As discussed in Section 3, the field observations did not reveal any signs of distress that would significantly affect the performance of the embankment.

(2) Appurtenant Structures. The structural performance of the spillway structures is considered to be satisfactory. Because no portion of the outlet works except the downstream end of the blow-off pipe was visible, no conclusions were reached as to the structural adequacy of the outlet facilities. Flow through the outlet pipes is controlled by valves located on the downstream side, which cause the pipes always to be under pressure through the embankment. In view of this condition and since no design information is available to assess the structural adequacy of the outlet facilities, it is considered advisable that the structural adequacy of the outlet pipe should be evaluated and a means for placing an upstream control on these pipes should be developed.

b. Design and Construction Data

(1) Embankment. The dam was constructed in 1904 when limited understanding of geotechnical behavior of earth structures existed. Consequently, available design and construction information does not provide any quantitative data to aid in the assessment of stability. Since the embankment design lacks a positive internal drainage system, some concern exists as to the location of the phreatic surface through the embankment as it affects the stability of the embankment. However, at this time, no signs were observed that would indicate the phreatic surface is intersecting the downstream slope of the dam. As previously noted, the dam appears to have been constructed adequately and has performed satisfactorily since its construction. Therefore, the static stability of the dam is considered to be adequate.

(2) Appurtenant Structures. Other than limited design drawings, no design and construction data are available for the appurtenant structures.

c. Operating Records. The structural stability of the dam is not considered to be affected by the operational features of the dam.

d. Post-Construction Changes. The only reported post-construction change is the enlargement of the spillway from 29 feet to 58 feet in 1937.

e. Seismic Stability. The dam is located in Seismic Zone 1, and based on visual observations, the static stability of the dam appears to be adequate. Therefore, based on the recommended criteria for evaluation of seismic stability of dams, the structure is presumed to present no hazards from earthquakes.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. The visual observations indicate that the embankment of Bear Rock No. 1 Dam is in fair condition. However, in view of the seriously inadequate spillway capacity, the condition of the dam is assessed to be unsafe/nonemergency.

The spillway capacity was evaluated according to the recommended criteria and was found to pass 30 percent of the PMF without overtopping the embankment. This capacity is less than the recommended spillway capacity according to the size and hazard classification for the dam. Further, because the spillway capacity is less than 50 percent of the PMF and it was found that failure of the dam would significantly increase the downstream damage potential, the spillway is classified to be seriously inadequate.

b. Adequacy of Information. The available information, in conjunction with the visual observations, is considered to be sufficient to make the following recommendations.

c. Urgency. The following recommendations should be implemented immediately or on a continuing basis.

d. Necessity for Additional Data. In view of the seriously inadequate spillway capacity, the owner should immediately initiate additional studies to more accurately ascertain the spillway capacity and the extent of improvements required to provide adequate spillway capacity.

7.2 Recommendations/Remedial Measures.

It is recommended that:

1. The owner should immediately retain a professional engineer to conduct additional studies to more accurately ascertain the spillway capacity and the nature and extent of improvements required to provide adequate spillway capacity.

2. The irregularity on the downstream slope should be periodically observed to determine if distress is developing.

3. The operational condition of the blow-off valve should be evaluated and necessary maintenance performed if required. A means for providing upstream control of the outlet pipes should be developed.

4. Brush and trees on the crest and downstream slope of the dam should be cleared.

5. Around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system developed to alert the downstream residents in the event of emergencies. It is also recommended that the owner take necessary measures to improve the accessibility of the site during high flows.

6. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Bear Rock No. 1 COUNTY Cambria STATE Pennsylvania ID# NDI I.D. PA-439 DER I.D. 11-2

TYPE OF DAM Earth HAZARD CATEGORY High

DATE(S) INSPECTION November 13, 1979 WEATHER Cloudy TEMPERATURE 40s

POOL ELEVATION AT TIME OF INSPECTION 2344 M.S.L. TAILWATER AT TIME OF INSPECTION 2322± M.S.L.

INSPECTION PERSONNEL:	REVIEW INSPECTION PERSONNEL: (December 28, 1979)
Bilgin Erel	E. D'Appolonia
Wah-Tak Chan	L. D. Andersen
	J. H. Poellot
	B. Erel

B. Erel RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	An irregularity was found on the downstream slope of the dam, which appeared to be an old slump. However, at this time, no signs of distress were found to be associated with this irregularity.	This feature of the embankment should be closely observed during regular inspection of the dam.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No perceivable misalignments. See Plate 5 for dam crest profile.	
RIPRAP FAILURES	None	

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No signs of distress.	
ANY NOTICEABLE SEEPAGE	A swampy area and a seepage point exist along the toe level of the dam near the left abutment. The seepage area contains acid mine precipitate.	Seepage quantities should be monitored.
STAFF GAGE AND RECORDER	None	
DRAINS	None	

VISUAL INSPECTION
PHASE I
OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The outlet pipe is a 16-inch cast-iron pipe. Only the downstream end of the pipe is visible.	
INTAKE STRUCTURE	Submerged	
OUTLET STRUCTURE	None	
OUTLET CHANNEL	An earth channel.	
EMERGENCY GATE	Operation of the outlet pipe was not observed.	Operational condition of the outlet pipe valve should be evaluated and necessary maintenance performed.

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	In good condition.	
APPROACH CHANNEL	Submerged. Appears to be free of debris.	
DISCHARGE CHANNEL	Earth channel in good condition.	
BRIDGE AND PIERS	None	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable	
APPROACH CHANNEL	Not applicable	
DISCHARGE CHANNEL	Not applicable	
BRIDGE PIERS	Not applicable	
GATES AND OPERATION EQUIPMENT	Not applicable	

VISUAL INSPECTION
PHASE I
INSTRUMENTATION

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

VISUAL INSPECTION
PHASE I
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle to moderately steep. No significant shoreline erosion was noted.	
SEDIMENTATION	Unknown	
UPSTREAM RESERVOIRS	Bear Rock No. 2 Dam is located immediately upstream from this dam.	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No apparent obstructions immediately downstream from the dam that would affect the discharge capacity of the spillway.	
SLOPES	No features pertinent to the safety of the dam.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	The town of Lilly is located approximately 2-1/2 miles downstream from the dam. More than 20 homes are located in the potential flood plain. Population: approximately 200.	

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
AND HYDROLOGIC AND HYDRAULIC
PHASE I

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Bear Rock No. 1

ID# NDI I.D. PA-439
DER I.D. 11-2

ITEM	REMARKS
AS-BUILT DRAWINGS	Limited design drawings are available in the state files.
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	The dam was designed and constructed by Pennsylvania Railroad Company in 1904.
TYPICAL SECTIONS OF DAM	Not available
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	Not available

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	Not available
DESIGN REPORTS	Not available
GEOLOGY REPORTS	Not available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Not available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Not available

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	None reported
BORROW SOURCES	Unknown
MONITORING SYSTEMS	None
MODIFICATIONS	The spillway was enlarged in 1937.
HIGH POOL RECORDS	Not recorded

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None reported
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported
MAINTENANCE OPERATION RECORDS	Not maintained
SPILLWAY PLAN SECTIONS DETAILS	See Plate 3.
OPERATING EQUIPMENT PLANS AND DETAILS	Not available

CHECKLIST
ENGINEERING DATA
HYDROLOGIC AND HYDRAULIC

DRAINAGE AREA CHARACTERISTICS: 2 square miles

ELEVATION, TOP OF NORMAL POOL AND STORAGE CAPACITY: 2344 (30 acre-feet)

ELEVATION, TOP OF FLOOD CONTROL POOL AND STORAGE CAPACITY: 2348 (951 acre-feet)

ELEVATION, MAXIMUM DESIGN POOL: 2348 (design dam crest level)

ELEVATION, TOP OF DAM: 2348

SPILLWAY:

a. Elevation 2344

b. Type Concrete overflow

c. Width 59 feet

d. Length Not applicable

e. Location Spillover Adjacent to spillway

f. Number and Type of Gates None

OUTLET WORKS:

a. Type 16-inch cast-iron pipe

b. Location Center of embankment

c. Entrance Inverts 2319±

d. Exit Inverts 2315±

e. Emergency Drawdown Facilities 16-inch pipe

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location None

c. Records None

MAXIMUM NONDAMAGING DISCHARGE: 1460 cfs (spillway capacity)

APPENDIX C

PHOTOGRAPHS

LIST OF PHOTOGRAPHS
BEAR ROCK NO. 1 DAM
NDI I.D. PA-439
NOVEMBER 13, 1979

PHOTOGRAPH NO.	DESCRIPTION
1	Crest (looking east).
2	Spillway crest.
3	Spillway discharge channel.
4	Blow-off pipe (16-inch diameter).
5	Blow-off pipe valve stem.
6	Bear Rock Run at Lilly (Mile 2.5).

Photograph No. 1

Crest (looking east).

Photograph No. 2

Spillway crest.

Photograph No. 3

Spillway discharge channel.

Photograph No. 4

Blow-off pipe (16-inch diameter).

Photograph No. 5

Blow-off pipe valve stem.

Photograph No. 6

Bear Rock Run at Lilly (Mile 2.5).

APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Bear Rock No. 1 Dam (NDI I.D. PA-439)

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

STATION	1	2	3	4	5
Station Description	Bear Rock No. 2 Reservoir	Bear Rock No. 2 Dam	Bear Rock No. 1 Reservoir	Bear Rock No. 1 Dam	Downstream Routing[6]
Drainage Area (square miles)	1.42	-	0.55	-	-
Cumulative Drainage Area (square miles)	1.42	1.42	1.97	1.97	-
Adjustment of PMF for Drainage Area (%)[2]	Zone 7				
6 Hours	102	-	102	-	-
12 Hours	120	-	120	-	-
24 Hours	130	-	130	-	-
48 Hours	140	-	140	-	-
72 Hours	-	-	-	-	-
Snyder Hydrograph Parameters					
Zone[3]	24	-	24	-	-
C_p/C_t[4]	0.45/1.60	-	0.45/1.60	-	-
L (miles)[5]	2.3	-	1.4	-	-
L_{ca} (miles)[5]	0.9	-	0.8	-	-
$t_p = C_t(L \cdot L_{ca})^{0.3}$ (hours)	2.0	-	1.66	-	-
Spillway Data					
Crest Length (ft)	-	33.2	-	58.0	-
Freeboard (ft)	-	4.4	-	4.0	-
Discharge Coefficient	-	2.8	-	3.1	-
Exponent	-	1.5	-	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.
[6] See Pages D8 through D18.

STORAGE VS. ELEVATION

ELEVATION	ΔH, FEET	AREA (ACRES)[1]	ΔVOLUME (ACRE-FEET)[2]	STORAGE (ACRE-FEET)
2360.0	12.0	10.1	95.5	146.4
2348.0		6.0[4]		50.9
	4.0		21.1	
2344.0		4.6		29.8
	22.0		29.8[3]	
Reservoir Bottom		-		0

[1] Planimetered from USGS maps.
[2] $\Delta Volume = \Delta H/3 \ (A_1 + A_2 + \sqrt{A_1 A_2})$.
[3] From PennDER files.
[4] Linearly interpolated.

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  17 JAN 81
**********
    1                 A1       SNYDER UNIT HYDROGRAPH,FLOOD ROUTING AND DAM OVERTOPPING ANALYSES
    2                 A2       BEAR ROCK NO.1 DAM,CAMBRIA COUNTY,NDI-I.D.PA.439     PROJECT NO.79-543-07
    3                 A3       FOR 20%,30%,40%,50%,60%,70%,80%,90%,AND 100% PMF
    4                 H     300        0       10        0        0        0        0        0       -4        0
    5                 H1      5
    6                 J       1        9        1
    7                 J1   0.20     0.30     0.40     0.50     0.60     0.70     0.80     0.90     1.00
    8                 K       0        1                                                  1
    9                 K1       CALCULATION OF SNYDER INFLOW HYDROGRAPH TO BEAR ROCK #2 RESERVOIR(UPPER)
   10                 M       1        1     1.42             1.42                                    1
   11                 P                23.7      102      120      130      140
   12                 T                                                           1.0      .05             0.0081
   13                 W    2.00     0.45
   14                 X    -1.0    -0.05      2.0
   15                 K       1        2                                          1
   16                 K1       ROUTING FLOW THROUGH BEAR ROCK NO.2 DAM (NDI-I.D.PA.441)(UPPER)
   17                 Y                                 1        1
   18                 Y1      1                                                -2400.0
   19                 $S    0.0     92.1    130.5    338.3
   20                 $E2362.5   2400.0   2404.5   2420.0
   21                 $$2400.0     3.2      2.80     1.5
   22                 $D2404.4     3.08     1.50   760.0
   23                 $L   50.0   150.0    250.0    450.0    550.0    680.0    760.0
   24                 $V2404.4   2404.5   2404.6   2404.7   2404.8   2404.9   2405.0
   25                 K       0        2                                          1
   26                 K1       CALCULATION OF SNYDER INFLOW HYDROGRAPH TO BEAR ROCK #1 RESERVOIR(LOWER)
   27                 M       1        1     0.55             1.97                                    1
   28                 P                23.7      102      120      130      140
   29                 T                                                           1.0      .05             0.0130
   30                 W    1.66     0.45
   31                 X    -1.0    -0.05      2.0
   32                 K       2        2                                          1
   33                 K1       COMBINED INFLOW HYDROGRAPH AT BEAR ROCK NO.1 RESERVOIR (LOWER)
   34                 K       1        3                                          1
   35                 K1       ROUTING FLOW THROUGH BEAR ROCK NO.1 DAM (LOWER)(NDI-I.D.PA.439)
   36                 Y                                 1        1
   37                 Y1      1                                                -2344.0
   38                 $S    0.0     29.8     50.9    146.5
   39                 $E2320.0   2344.0   2348.0   2360.0
   40                 $$2344.0     5R.0      3.1      1.5
   41                 $D2348.0     3.09     1.5    560.0
   42                 $L   30.0   210.0    410.0    460.0    560.0
   43                 $V2348.0   2348.1   2348.2   2348.3   2348.4
   44                 K       1        4                                          1
   45                 K1       CHANNEL ROUTING USING MODIFIED PLUS: REACH 1-2(MILE 0.04 TO 0.28)
   46                 Y                                 1        1
   47                 Y1      1
   48                 Y6 0.045    0.028    0.045   2220.0   2239.0   1267.00.078914
   49                 Y7    0.0   2239.0     63.0   2230.0    125.0   2221.0    127.0   2220.0    143.0   2220.0
   50                 Y7  145.0   2221.0   220.0    2230.0    295.0   2239.0
```

COMPUTER INPUT: OVERTOPPING ANALYSIS AND DOWNSTREAM ROUTING

```
51          K      1       5                                                1
52          K1       CHANNEL ROUTING USING MODIFIED PLUS: REACH 2-3(MILE 0.28 TO 0.70)
53          Y                                      1       1
54          Y1     1
55          Y6 0.045    0.028    0.045  2120.0  2139.0  2218.00.045C94
56          Y7   C.0  2139.0     63.0  2130.0   125.0  2121.0    127.0  2120.0    143.0  2120.0
57          Y7 145.0  2121.0    220.0  2130.0   295.0  2139.0
58          K      1       6                                                1
59          K1       CHANNEL ROUTING USING MODIFIED PLUS: REACH 3-4(MILE 0.70 TO 1.24)
60          Y                                      1       1
61          Y1     1
62          Y6 0.035    0.028    0.045  2020.0  2039.0  2851.00.020584
63          Y7   0.0  2039.0    410.0  2030.0   425.0  2021.0    427.0  2020.0    443.0  2020.0
64          Y7 445.0  2021.0    495.0  2030.0   545.0  2039.0
65          K      1       7                                                1
66          K1       CHANNEL ROUTING USING MODIFIED PLUS: REACH 4-5(MILE 1.24 TO 1.73)
67          Y                                      1       1
68          Y1     1
69          Y6 0.026    0.028    0.045  1940.0  1959.0  2587.00.038652
70          Y7   0.0  1959.0    100.0  1952.0   150.0  1952.0    300.0  1941.0    302.0  1940.0
71          Y7 318.0  1940.0    320.0  1941.0   420.0  1959.0
72          K      1       8                                                1
73          K1       CHANNEL ROUTING USING MODIFIED PLUS: REACH 5-6(MILE 1.73 TO 2.80)
74          Y                                      1       1
75          Y1     1
76          Y6 0.026    0.028    0.026  1860.0  1879.0  5650.00.014160
77          Y7   0.0  1879.0    100.0  1861.0   102.0  1860.0    123.0  1860.0    125.0  1861.0
78          Y7 425.0  1872.0    475.0  1872.0   625.0  1879.0
79          K     99
```

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 .20	RATIO 2 .30	RATIO 3 .40	RATIO 4 .50	RATIO 5 .60	RATIO 6 .70	RATIO 7 .80	RATIO 8 .90	RATIO 9 1.00
HYDROGRAPH AT	1	1.42	1	564.	847.	1129.	1411.	1693.	1975.	2258.	2540.	2822.
	(	3.68)	(	15.98)(	23.97)(	31.96)(	39.96)(	47.95)(	55.94)(	63.93)(	71.92)(	79.91)
ROUTED TO	2	1.42	1	548.	827.	1124.	1407.	1691.	1974.	2256.	2539.	2821.
	(	3.68)	(	15.53)(	23.42)(	31.81)(	39.85)(	47.89)(	55.89)(	63.89)(	71.89)(	79.88)
HYDROGRAPH AT	2	.55	1	242.	363.	483.	604.	725.	846.	967.	1088.	1209.
	(	1.42)	(	6.85)(	10.27)(	13.69)(	17.11)(	20.54)(	23.96)(	27.38)(	30.80)(	34.23)
2 COMBINED	2	1.97	1	774.	1169.	1590.	1997.	2398.	2799.	3199.	3599.	4000.
	(	5.10)	(	21.93)(	33.09)(	45.03)(	56.54)(	67.91)(	79.25)(	90.59)(	101.92)(	113.26)
ROUTED TO	3	1.97	1	773.	1166.	1587.	1995.	2398.	2799.	3200.	3601.	4001.
	(	5.10)	(	21.88)(	33.01)(	44.95)(	56.50)(	67.91)(	79.26)(	90.61)(	101.96)(	113.30)
ROUTED TO	4	1.97	1	773.	1166.	1588.	1993.	2398.	2799.	3200.	3600.	4001.
	(	5.10)	(	21.88)(	33.01)(	44.96)(	56.45)(	67.91)(	79.26)(	90.62)(	101.95)(	113.29)
ROUTED TO	5	1.97	1	773.	1166.	1588.	1993.	2397.	2800.	3200.	3601.	4001.
	(	5.10)	(	21.88)(	33.02)(	44.97)(	56.45)(	67.88)(	79.27)(	90.62)(	101.96)(	113.31)
ROUTED TO	6	1.97	1	772.	1166.	1586.	1994.	2395.	2795.	3196.	3597.	3997.
	(	5.10)	(	21.86)(	33.01)(	44.91)(	56.46)(	67.83)(	79.14)(	90.49)(	101.85)(	113.20)
ROUTED TO	7	1.97	1	772.	1165.	1587.	1994.	2396.	2797.	3196.	3596.	3996.
	(	5.10)	(	21.86)(	33.00)(	44.95)(	56.47)(	67.85)(	79.19)(	90.51)(	101.83)(	113.15)
ROUTED TO	8	1.97	1	770.	1162.	1582.	1989.	2389.	2790.	3190.	3590.	3990.
	(	5.10)	(	21.80)(	32.90)(	44.79)(	56.32)(	67.65)(	79.00)(	90.34)(	101.66)(	112.98)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	2400.00	2400.00	2404.40
STORAGE	92.	92.	130.
OUTFLOW	0.	0.	858.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	2403.27	0.00	120.	548.	0.00	42.17	0.00
.3[illegible]	2404.29	0.00	129.	827.	0.00	42.17	0.00
.4[illegible]	2404.77	.37	134.	1124.	3.00	41.83	0.00
.50	2404.95	.55	136.	1407.	4.33	41.67	0.00
.60	2405.07	.67	138.	1691.	5.33	41.67	0.00
.70	2405.18	.78	140.	1974.	6.33	41.67	0.00
.8[illegible]	2405.28	.88	141.	2256.	7.17	41.67	0.00
.90	2405.37	.97	142.	2539.	7.83	41.67	0.00
1.00	2405.45	1.05	143.	2821.	8.67	41.67	0.00

OVERTOPPING ANALYSIS SUMMARY
(BEAR ROCK NO. 2 DAM)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	2344.00	2344.00	2348.00
STORAGE	30.	30.	51.
OUTFLOW	0.	0.	1438.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	2346.64	0.00	44.	773.	0.00	42.17	0.00
.30	2347.48	0.00	48.	1166.	0.00	42.00	0.00
.40	2348.19	.19	52.	1587.	1.67	41.83	0.00
.50	2348.46	.46	55.	1995.	3.33	41.67	0.00
.60	2348.64	.64	56.	2398.	4.33	41.67	0.00
.70	2348.80	.80	57.	2799.	5.17	41.67	0.00
.80	2348.94	.94	58.	3200.	6.00	41.67	0.00
.90	2349.08	1.08	59.	3601.	6.67	41.67	0.00
1.00	2349.20	1.20	60.	4001.	7.33	41.67	0.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	773.	2221.8	42.17
.30	1166.	2222.2	42.00
.40	1588.	2222.6	41.83
.50	1993.	2223.0	41.67
.60	2398.	2223.2	41.67
.70	2799.	2223.5	41.67
.80	3200.	2223.7	41.67
.90	3600.	2224.0	41.67
1.00	4001.	2224.1	41.67

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	773.	2122.1	42.17
.30	1166.	2122.6	42.17
.40	1588.	2123.1	41.83
.50	1993.	2123.4	41.67
.60	2397.	2123.7	41.67
.70	2800.	2124.0	41.67
.80	3200.	2124.2	41.67
.90	3601.	2124.5	41.67
1.00	4001.	2124.7	41.67

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	772.	2022.4	42.33
.30	1166.	2022.9	42.17
.40	1586.	2023.3	42.00
.50	1994.	2023.6	41.83
.60	2395.	2023.9	41.83
.70	2795.	2024.2	41.83
.80	3196.	2024.4	41.67
.90	3597.	2024.6	41.67
1.00	3997.	2024.8	41.67

PLAN 1 STATION 7

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	772.	1942.3	42.33
.30	1165.	1942.8	42.17
.40	1587.	1943.2	42.00
.50	1994.	1943.5	41.83
.60	2396.	1943.8	41.83
.70	2797.	1944.1	41.83
.80	3196.	1944.3	41.83
.90	3596.	1944.5	41.83
1.00	3996.	1944.7	41.83

PLAN 1 STATION 8

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	770.	1862.4	42.50
.30	1162.	1863.0	42.33
.40	1582.	1863.3	42.17
.50	1989.	1863.6	42.00
.60	2389.	1863.9	42.00
.70	2790.	1864.2	41.83
.80	3190.	1864.4	41.83
.90	3590.	1864.6	41.83
1.00	3990.	1864.8	41.83

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
  SAFETY VERSION      JULY 1978
  LAST MODIFICATION  17 JAN 80
**********
     1              A1       SNYDER UNIT HYDROGRAPH,FLOOD ROUTING AND DAM OVERTOPPING ANALYSES
     2              A2       BEAR ROCK NO.1 DAM,CAMBRIA COUNTY,NDI-I.D.PA.439    PROJECT NO.79-543-07
     3              A3       FOR 20%,30%,40%,50%,60%,70%,80%,90%,AND 100% PMF
     4              B     300        0       10        0        0        0        0        0       -4        0
     5              B1      5
     6              J       1        9        1
     7              J1   0.20     0.30     0.40     0.50     0.60     0.70     0.80     0.90     1.00
     8              K       0        1                                                    1
     9              K1       CALCULATION OF SNYDER INFLOW HYDROGRAPH TO BEAR ROCK #2 RESERVOIR(UPPER)
    10              M       1        1     1.42              1.42                                    1
    11              P              23.7      102      120      130      140
    12              T                                                          1.0      .05             0.0081
    13              W    2.00     0.45
    14              X   -1.0     -0.05      2.0
    15              K       1        2                                                    1
    16              K1       ROUTING FLOW THROUGH BEAR ROCK NO.2 DAM (NDI-I.D.PA.441)(UPPER)
    17              Y                                         1        1
    18              Y1      1                                                  -2400.0
    19              SS    0.0     92.1    130.5    338.3
    20              SE2362.5   2400.0   2404.5   2420.0
    21              SS2400.0     33.2     2.80      1.5
    22              SD2414.4     3.08     1.50    760.0
    23              SL    50.0    150.0    250.0    450.0    550.0    680.0    760.0
    24              SV2404.4   2404.5   2404.6   2404.7   2404.8   2404.9   2405.0
    25              SR 100.0      1.0   2362.5      0.5   2400.0   2404.5
    26              K       0        2                                                    1
    27              K1       CALCULATION OF SNYDER INFLOW HYDROGRAPH TO BEAR ROCK #1 RESERVOIR(LOWER)
    28              M       1        1     0.55              1.97                                    1
    29              P              23.7      102      120      130      140
    30              T                                                          1.0      .05             0.0130
    31              W    1.66     0.45
    32              X   -1.0     -0.05      2.0
    33              K       2        2                                                    1
    34              K1       COMBINED INFLOW HYDROGRAPH AT BEAR ROCK NO.1 RESERVOIR (LOWER)
    35              K       1        3                                                    1
    36              K1       ROUTING FLOW THROUGH BEAR ROCK NO.1 DAM (LOWER)(NDI-I.D.PA.439)
    37              Y                                         1        1
    38              Y1      1                                                  -2344.0
    39              SS    0.0     29.8     50.9    146.5
    40              SE2320.0   2344.0   2348.0   2360.0
    41              SS2344.0     58.0      3.1      1.5
    42              SD2348.0     3.08     1.5     560.0
    43              SL   30.0    210.0    410.0    460.0    560.0
    44              SV2348.0   2348.1   2348.2   2348.3   2348.4
    45              SR 100.0     3.33   2320.0      0.5   2344.0   2348.1
    46              K       1        4                                                    1
    47              K1       CHANNEL ROUTING USING MODIFIED PLUS: REACH 1-2(MILE 0.04 TO 0.28)
    48              Y                                         1        1
    49              Y1      1
    50              Y6 0.045    0.028    0.045   2220.0   2239.0   1267.00.078914
```

COMPUTER INPUT: DAM BREACH ANALYSIS AND DOWNSTREAM ROUTING
(BEAR ROCK NO. 1 BREACHED)

```
Y7   0.0  2239.0    63.0  2230.0   125.0  2221.0   127.0  2220.0   143.0  2220.0
Y7 145.0  2221.0   220.0  2230.0   295.0  2239.0
K      1       5                                                1
K1       CHANNEL ROUTING USING MODIFIED PLUS: REACH 2-3(MILE 0.28 TO 0.70)
Y                                      1       1
Y1     1
Y6 0.045   0.028   0.045  2120.0  2139.0  2218.00.045C94
Y7   0.0  2139.0    63.0  2130.0   125.0  2121.0   127.0  2120.0   143.0  2120.0
Y7 145.0  2121.0   220.0  2130.0   295.0  2139.0
K      1       6                                                1
K1       CHANNEL ROUTING USING MODIFIED PLUS: REACH 3-4(MILE 0.70 TO 1.24)
Y                                      1       1
Y1     1
Y6 0.035   0.028   0.045  2020.0  2039.0  2851.00.020584
Y7   0.0  2039.0   210.0  2030.0   425.0  2021.0   427.0  2020.0   443.0  2020.0
Y7 445.0  2021.0   495.0  2030.0   545.0  2039.0
K      1       7                                                1
K1       CHANNEL ROUTING USING MODIFIED PLUS: REACH 4-5(MILE 1.24 TO 1.73)
Y                                      1       1
Y1     1
Y6 0.026   0.028   0.045  1940.0  1959.0  2587.00.038652
Y7   0.0  1959.0   100.0  1952.0   150.0  1952.0   300.0  1941.0   302.0  1940.0
Y7 319.0  1941.0   320.0  1941.0   420.0  1959.0
K      1       8                                                1
K1       CHANNEL ROUTING USING MODIFIED PLUS: REACH 5-6(MILE 1.73 TO 2.80)
Y                                      1       1
Y1     1
Y6 0.026   0.028   0.026  1860.0  1879.0  5650.00.014160
Y7   0.0  1879.0   100.0  1861.0   102.0  1860.0   123.0  1860.0   125.0  1861.0
Y7 425.0  1872.0   475.0  1872.0   625.0  1879.0
K     99
```

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 .20	RATIO 2 .30	RATIO 3 .40	RATIO 4 .50	RATIO 5 .60	RATIO 6 .70	RATIO 7 .80	RATIO 8 .90	RATIO 9 1.00
HYDROGRAPH AT	1	1.42	1	564.	847.	1129.	1411.	1693.	1975.	2258.	2540.	2822.
	(	3.68)	(	15.98)(	23.97)(	31.96)(	39.96)(	47.95)(	55.94)(	63.93)(	71.92)(	79.91)
ROUTED TO	2	1.42	1	548.	827.	5606.	5662.	5708.	5692.	5564.	5576.	5670.
	(	3.68)	(	15.53)(	23.42)(	158.75)(	160.33)(	161.63)(	161.18)(	157.54)(	157.91)(	160.55)
HYDROGRAPH AT	2	.55	1	242.	363.	483.	604.	725.	846.	967.	1088.	1209.
	(	1.42)	(	6.85)(	10.27)(	13.69)(	17.11)(	20.54)(	23.96)(	27.38)(	30.80)(	34.23)
2 COMBINED	2	1.97	1	774.	1169.	6088.	6200.	6260.	6224.	6034.	6055.	6175.
	(	5.10)	(	21.93)(	33.09)(	172.39)(	175.55)(	177.26)(	176.24)(	170.87)(	171.46)(	174.85)
ROUTED TO	3	1.97	1	773.	1166.	6912.	7044.	7107.	7084.	6923.	6926.	6997.
	(	5.10)	(	21.88)(	33.01)(	195.72)(	199.46)(	201.25)(	200.59)(	196.03)(	196.13)(	198.13)
ROUTED TO	4	1.97	1	773.	1166.	6931.	7090.	7159.	7131.	6947.	6954.	7046.
	(	5.10)	(	21.88)(	33.01)(	196.25)(	200.76)(	202.73)(	201.93)(	196.70)(	196.91)(	199.51)
ROUTED TO	5	1.97	1	773.	1166.	6631.	6822.	6900.	6864.	6650.	6662.	6784.
	(	5.10)	(	21.88)(	33.02)(	187.76)(	193.19)(	195.38)(	194.38)(	188.29)(	188.65)(	192.10)
ROUTED TO	6	1.97	1	772.	1166.	6474.	6667.	6764.	6749.	6547.	6529.	6606.
	(	5.10)	(	21.86)(	33.01)(	183.32)(	188.79)(	191.54)(	191.12)(	185.39)(	184.87)(	187.07)
ROUTED TO	7	1.97	1	772.	1165.	6600.	6797.	6890.	6870.	6661.	6651.	6742.
	(	5.10)	(	21.86)(	33.00)(	186.90)(	192.47)(	195.10)(	194.53)(	188.63)(	188.34)(	190.91)
ROUTED TO	8	1.97	1	770.	1162.	5480.	5688.	5798.	5791.	5581.	5553.	5634.
	(	5.10)	(	21.80)(	32.90)(	155.17)(	161.06)(	164.18)(	163.98)(	158.05)(	157.25)(	159.55)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	2400.00	2400.00	2404.40
STORAGE	92.	92.	130.
OUTFLOW	0.	0.	858.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	2403.27	0.00	125.	548.	0.00	42.17	0.00
.3[illegible]	2404.29	0.00	127.	827.	0.00	42.17	0.00
.4[illegible]	2404.55	.15	131.	7424.	.25	41.21	41.00
.5	2404.54	.16	131.	7496.	.25	40.71	40.50
.6	2404.61	.20	132.	7535.	.25	40.37	40.17
.7[illegible]	2404.61	.20	132.	7517.	.41	40.04	39.83
.8	2404.52	.12	131.	7489.	.24	39.54	39.33
.9[illegible]	2404.52	.12	131.	7402.	.24	39.21	39.00
1.0[illegible]	2404.61	.20	132.	7486.	.41	39.04	38.83

OVERTOPPING ANALYSIS SUMMARY (BEAR ROCK NO. 2 DAM)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	2344.00	2344.00	2348.00
STORAGE	30.	30.	51.
OUTFLOW	0.	0.	1438.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	2346.64	1.00	44.	773.	0.00	42.17	0.00
.30	2347.48	0.00	48.	1166.	0.00	42.00	0.00
.40	2349.61	1.61	64.	8036.	.33	41.42	41.17
.50	2349.62	1.62	64.	8241.	.34	40.92	40.67
.60	2349.64	1.64	64.	8341.	.34	40.59	40.33
.70	2349.63	1.63	64.	8321.	.34	40.25	40.00
.80	2349.58	1.58	63.	8100.	.33	39.75	39.50
.90	2349.58	1.58	64.	8086.	.33	39.42	39.17
1.00	2349.62	1.62	64.	8174.	.34	39.25	39.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	773.	2221.8	42.17
.30	1166.	2222.2	42.00
.40	6931.	2225.3	41.33
.50	7190.	2225.4	40.83
.60	7159.	2225.4	40.50
.70	7131.	2225.4	40.17
.80	6947.	2225.3	39.67
.90	6954.	2225.3	39.33
1.00	7046.	2225.4	39.17

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	773.	2122.1	42.17
.30	1166.	2122.6	42.17
.40	6631.	2126.0	41.33
.50	6822.	2126.0	40.83
.60	6900.	2126.1	40.50
.70	6864.	2126.0	40.17
.80	6650.	2126.0	39.67
.90	6662.	2126.0	39.33
1.00	6784.	2126.0	39.17

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	772.	2022.4	42.33
.30	1166.	2022.9	42.17
.40	6474.	2025.9	41.50
.50	6667.	2025.9	41.00
.60	6764.	2026.1	40.67
.70	6749.	2026.0	40.33
.80	6547.	2025.9	39.83
.90	6529.	2025.9	39.50
1.00	6616.	2025.9	39.33

PLAN 1 STATION 7

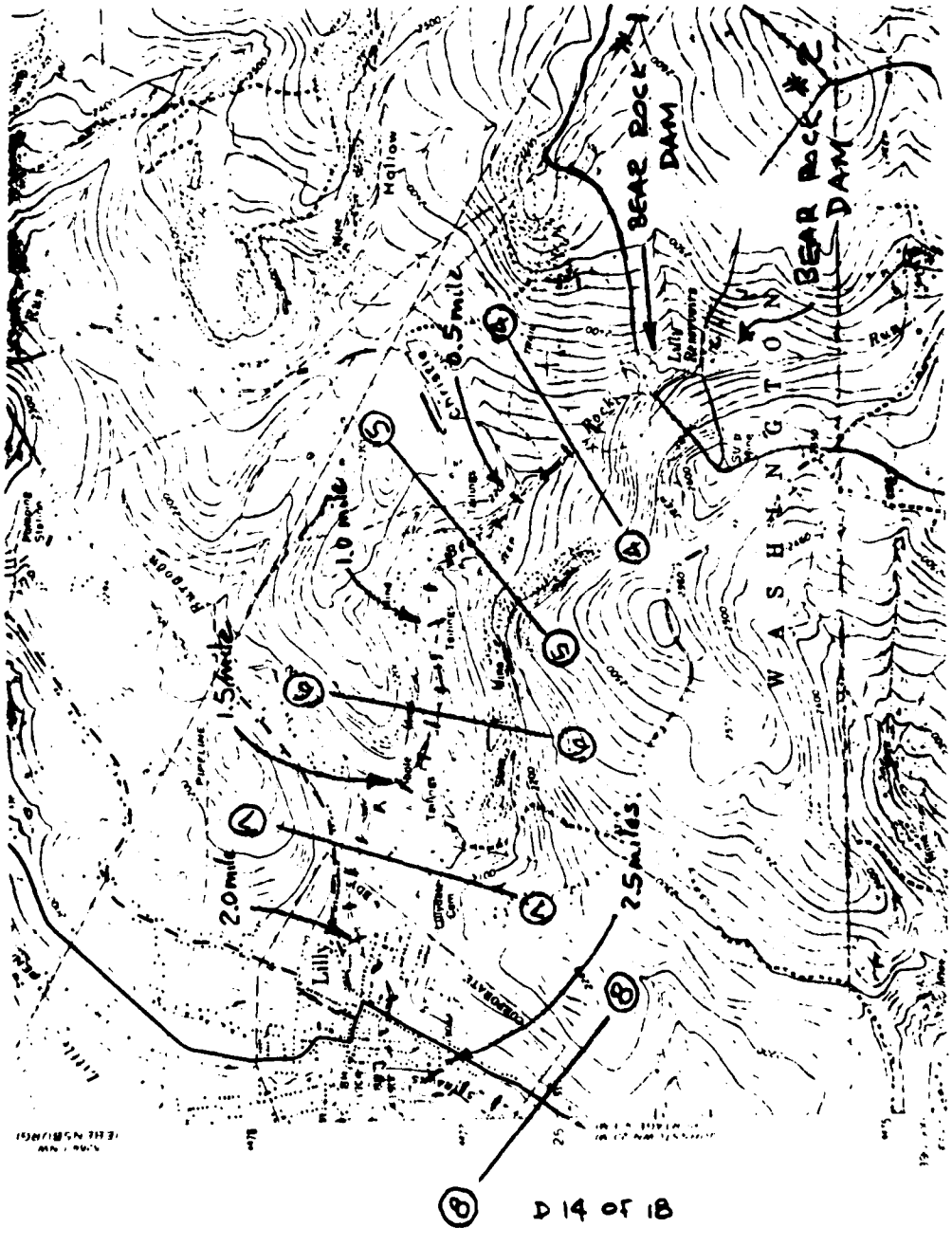
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	772.	1942.3	42.33
.30	1165.	1942.8	42.17
.40	6600.	1945.7	41.50
.50	6797.	1945.8	41.00
.60	6890.	1945.8	40.67
.70	6870.	1945.8	40.33
.80	6661.	1945.8	39.83
.90	6651.	1945.8	39.50
1.00	6742.	1945.8	39.33

PLAN 1 STATION 8

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	770.	1862.4	42.50
.30	1162.	1863.0	42.33
.40	5480.	1865.3	41.67
.50	5688.	1865.4	41.17
.60	5798.	1865.5	40.83
.70	5791.	1865.5	40.50
.80	5581.	1865.4	40.00
.90	5553.	1865.4	39.67
1.00	5634.	1865.4	39.33

DAMPRODANLA
CONSULTING ENGINEERS INC

By MC Date 2/7/80 Subject BEAR ROCK #1 DAM Sheet No 1 of 1
Chkd By BE Date 2/18/80 STATION LOCATIONS Proj No 79-542-03



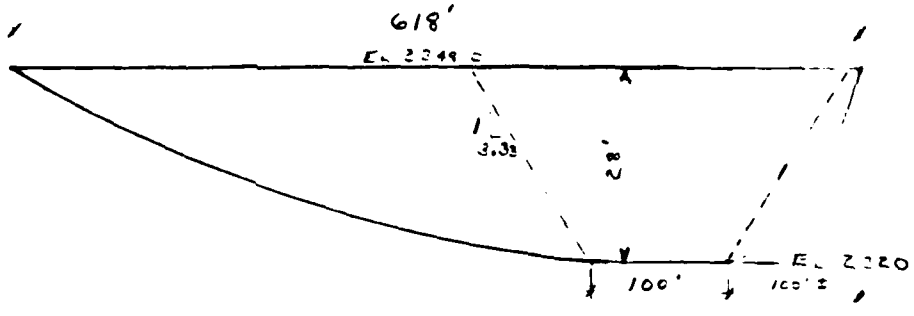
DAMTECHNICA
CONSULTING ENGINEERS INC

By MB Date 2/6/80 Subject DAM BREACH, BEAR ROCK Sheet No 1 of 1
Chkd By ___ Date ___ #1 DAM AND DOWNSTREAM ROUTING Proj No 79-543-09

DAM CREST ELEV. = 2348.0
LENGTH, INCLUDING SPILLWAY = 618'

ASSUME TIME FOR BREACH, 0.5 HOURS

FROM DER FILE DRAWINGS, THE FOLLOWING DAM
PROFILE AND BREACH ARE ASSUMED

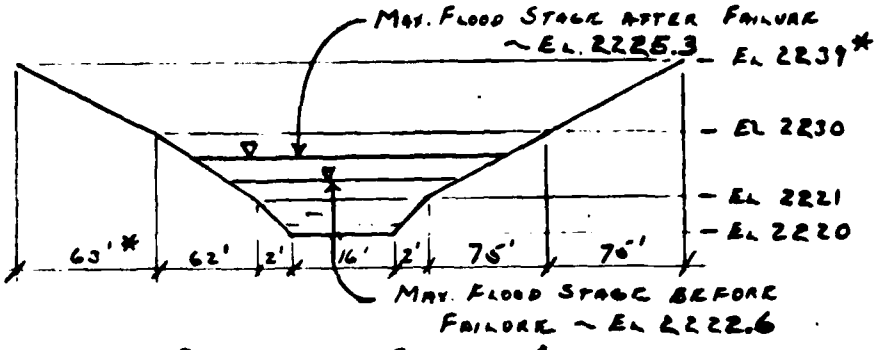


ASSUMED BREACH
BEAR ROCK # 1 DAM

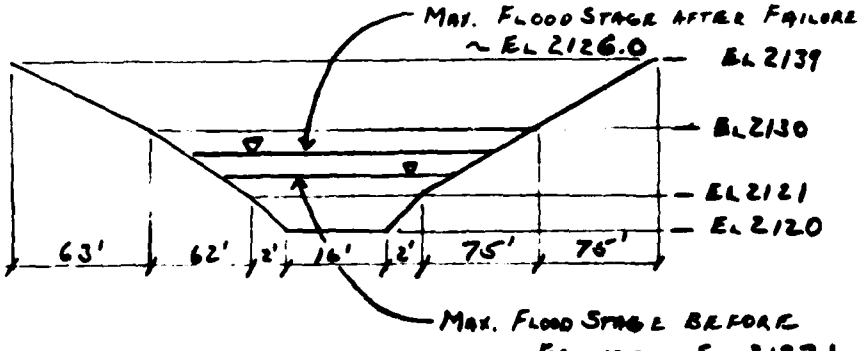
D'APPOLONIA
CONSULTING ENGINEERS, INC

By MB Date 2/7/80 Subject SECTIONS USED FOR Sheet No. 1 of 3
Chkd. By BE Date 2/18/80 DOWNSTREAM ROUTING Proj. No. 79-593-0

BREACH OF BEAR ROCK #1 DAM



SECTION AT STATION 4
(NO SCALE)

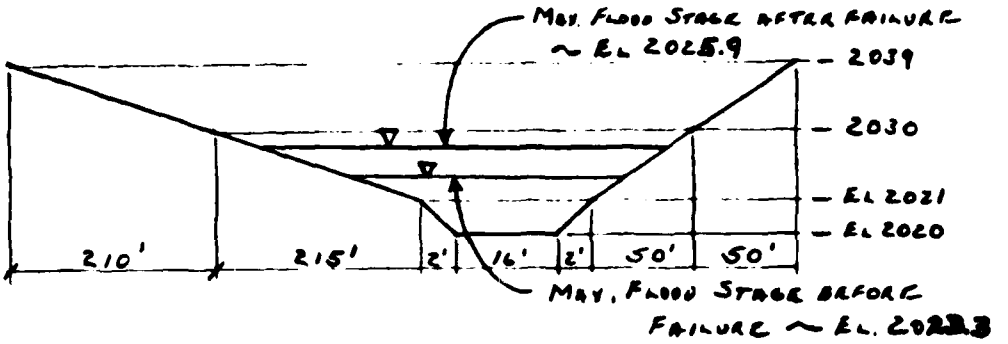


SECTION AT STATION 5
(NO SCALE)

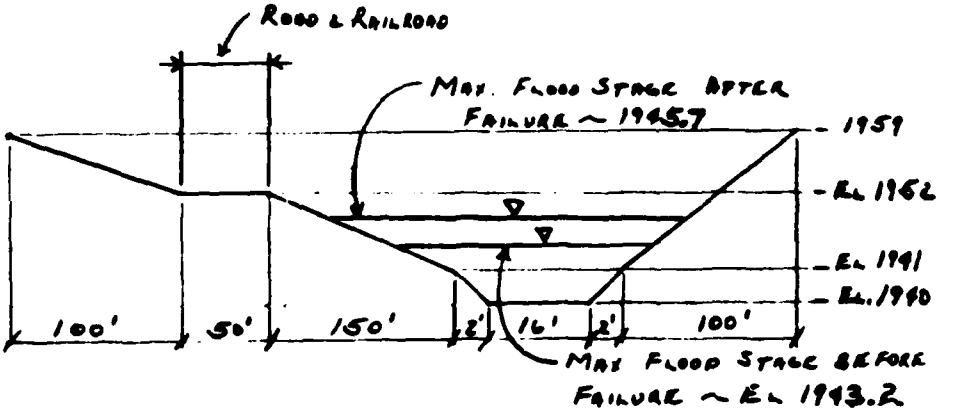
* ALL ELEVATIONS & DISTANCES ARE APPROXIMATE

D'APPOLONIA
CONSULTING ENGINEERS, INC

By MB Date 2/7/80 Subject SECTIONS USED FOR Sheet No. 2 of 3
Chkd. By BE Date 2/18/80 DOWNSTREAM ROUTING Proj. No. 79-593-08



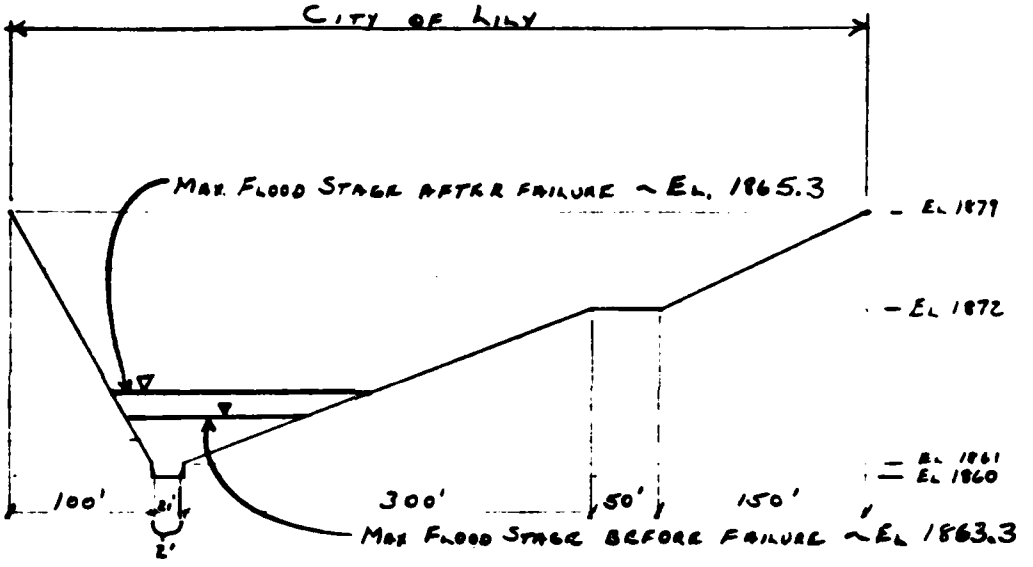
SECTION AT STATION 6
(NO SCALE)



SECTION AT STATION 7
(NO SCALE)

D'APPOLONIA
CONSULTING ENGINEERS, INC

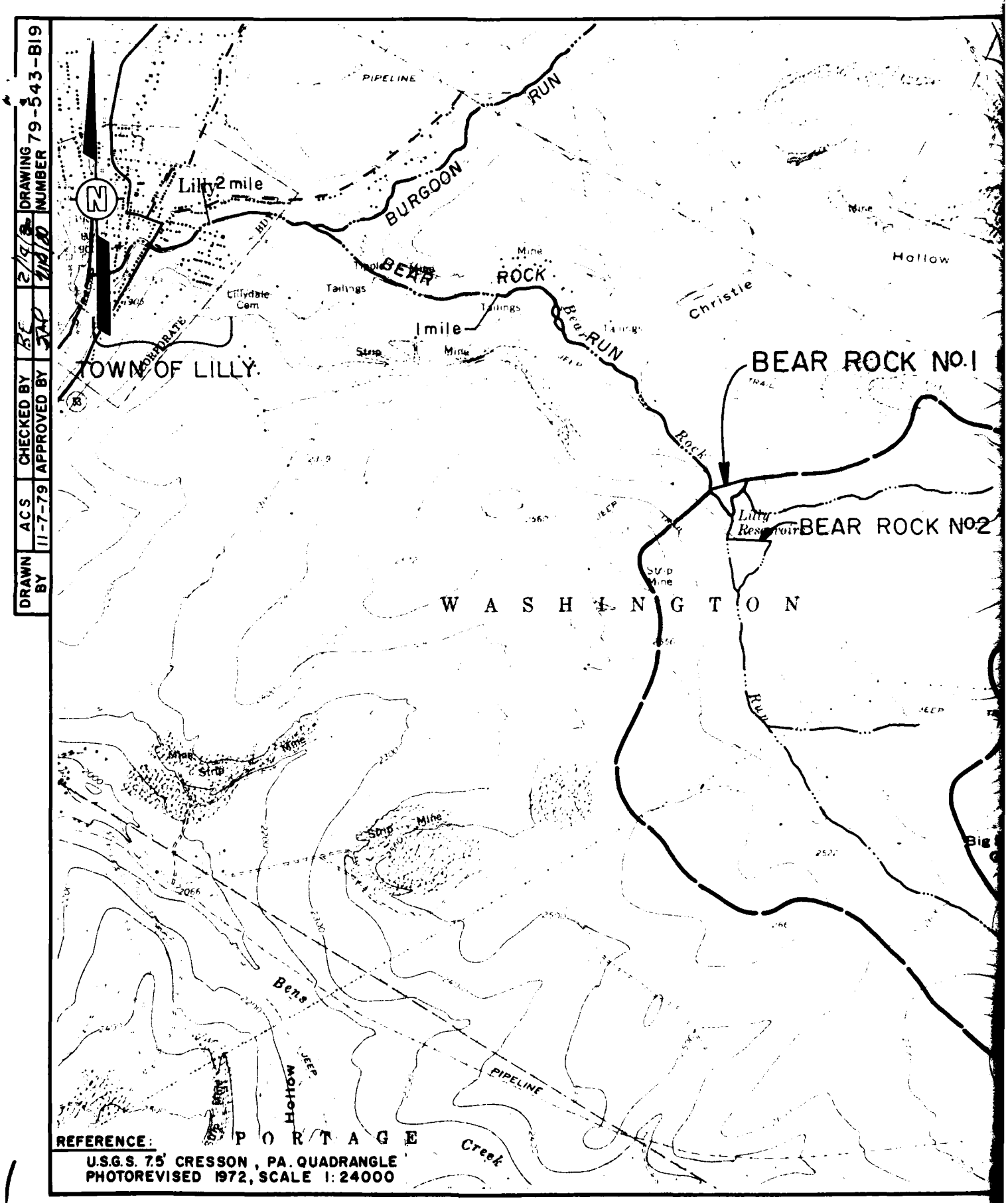
By MB Date 2/7/80 Subject SECTIONS USED FOR Sheet No. 3 of 3
Chkd. By PK Date 2/18/80 DOWNSTREAM ROUTING Proj. No. 79-543-08

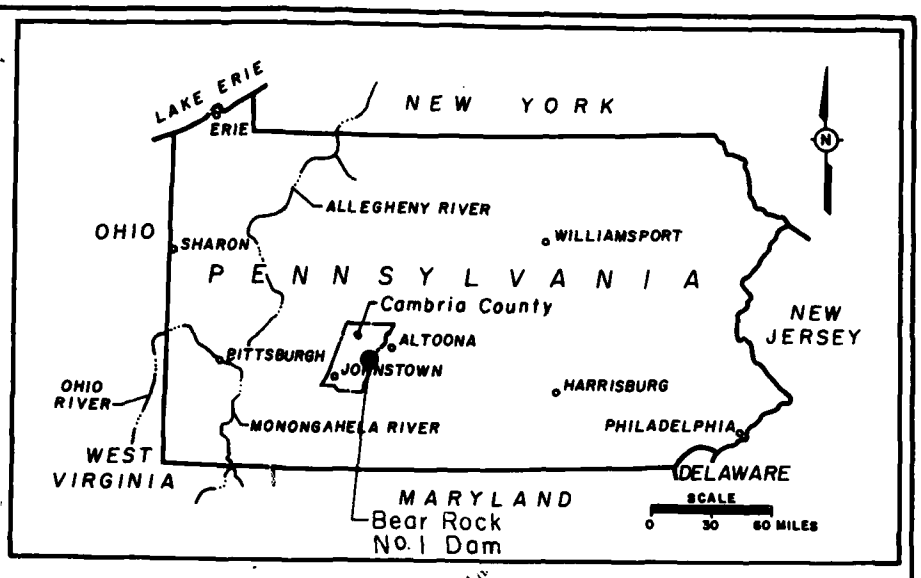


SECTION AT STATION 8
SCALE : VERTICAL : 1" = 10'
HORIZONTAL : 1" = 100'

APPENDIX E

PLATES


DRAWING NUMBER 79-543-B19
DRAWN BY ACS 11-7-79
CHECKED BY
APPROVED BY
N
Lilly 2 mile
PIPELINE
RUN
BURGOON
BEAR ROCK
Mine
Hollow
Christie
Tailings
Cliffydale Cem
1 mile
Bear RUN
TOWN OF LILLY
BEAR ROCK No.1
Rock
Lilly Reservoir
BEAR ROCK No.2
Strip Mine
WASHINGTON
Run
Big
Bens
JEEP
MOHOH
PIPELINE
PORTAGE
Creek
REFERENCE:
U.S.G.S. 7.5' CRESSON, PA. QUADRANGLE
PHOTOREVISED 1972, SCALE 1:24000



KEY PLAN

Gap

Laurel Gap

0.1 DAM

No.2 DAM

STATE GAME LANDS NO 198

APPROXIMATE WATERSHED AREA

Big Spring Gap

CAMBRIA CO
BLAIR CO

SCALE
0 1000 2000 3000 4000 5000 FEET

PLATE 1

BEAR ROCK No.1 DAM
VICINITY, FLOOD PLAIN & WATERSHED MAP

D'APPOLONIA

2

DRAWN BY	ACS	CHECKED BY			DRAWING NUMBER 79-543-B20
	11-8-79	APPROVED BY	JHJ	2/14/80	

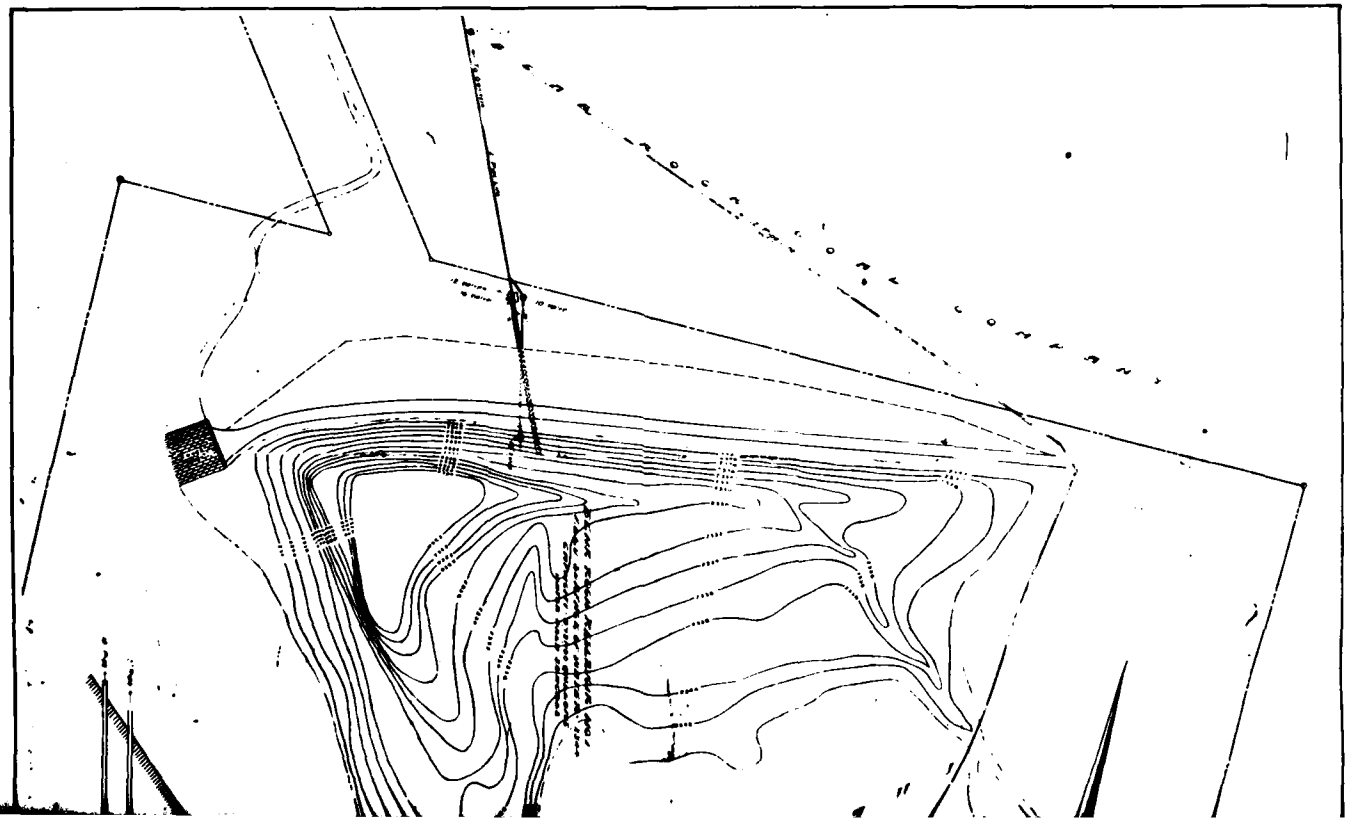
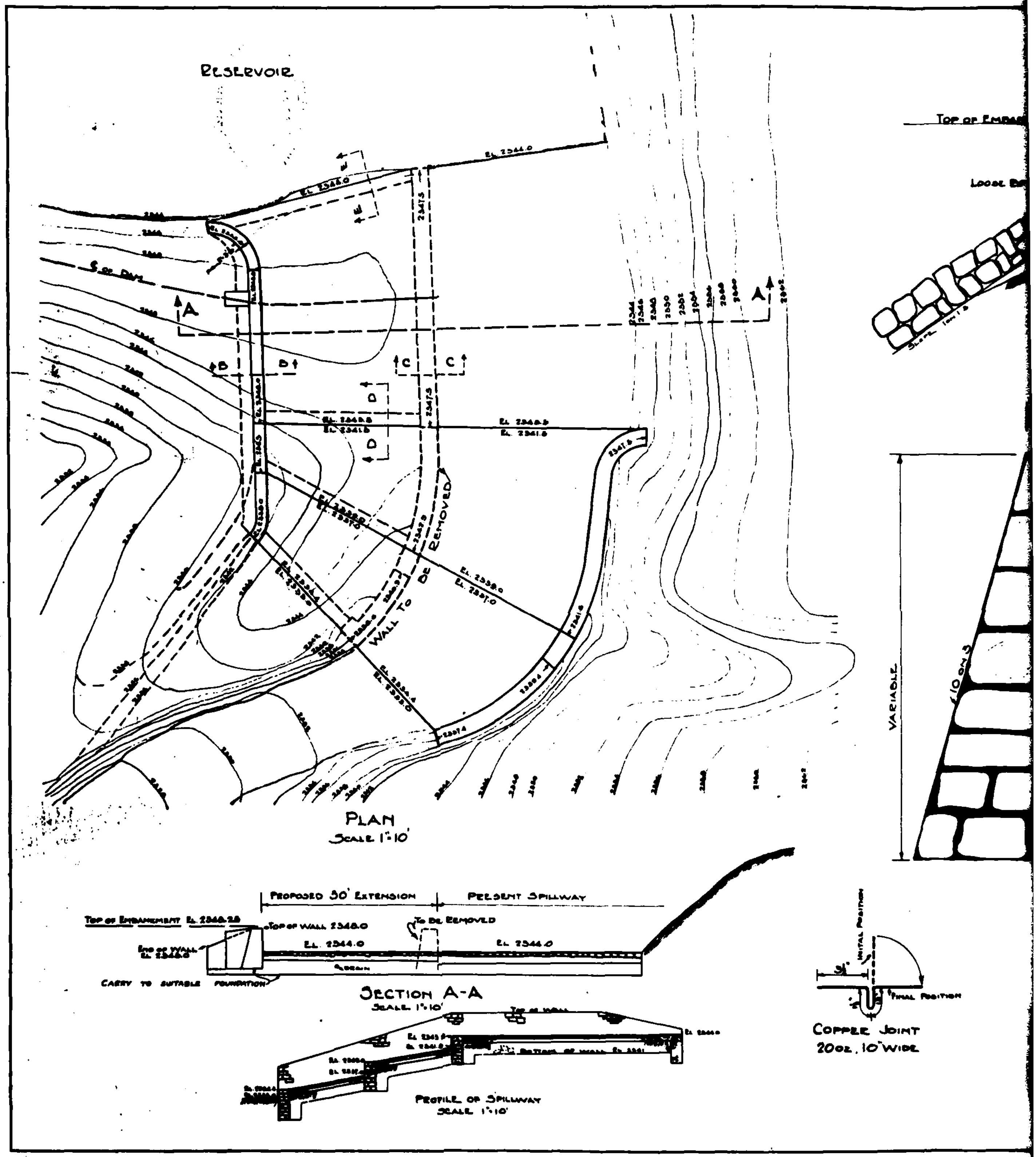
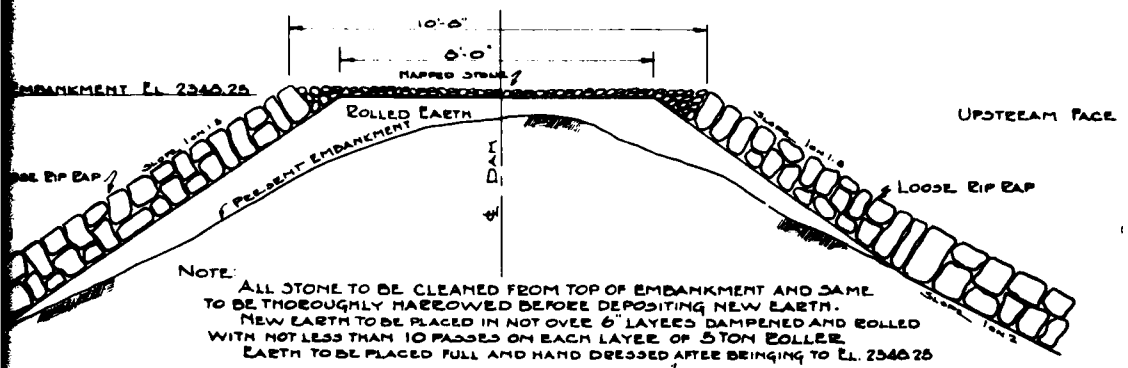


PLATE 2

D'APPOLONIA

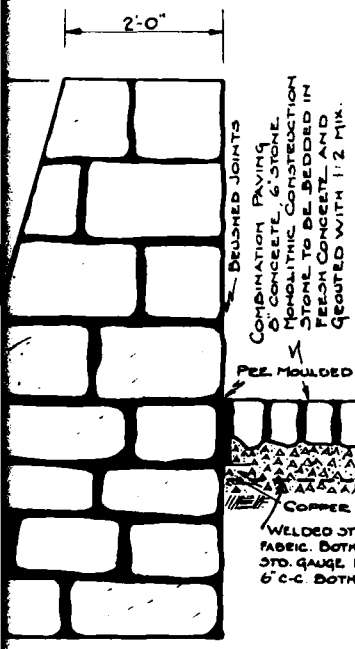
DRAWN BY	ACS	11-8-79
CHECKED BY		
APPROVED BY		2/14/...
DRAWING NUMBER	79-543-B21	



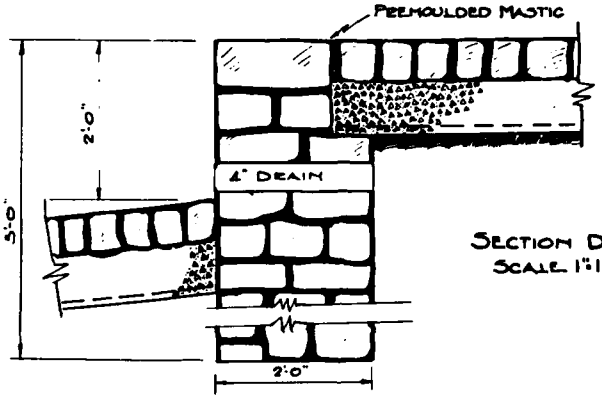


Note
All stone to be cleaned from top of embankment and same to be thoroughly harrowed before depositing new earth.
New earth to be placed in not over 6" layers dampened and rolled with not less than 10 passes on each layer of 5 ton roller.
Earth to be placed full and hand dressed after bringing to El. 2340.25

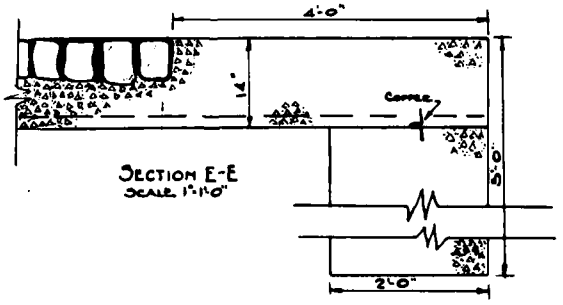
Repairs to Embankment
Scale 1"=2'-0"



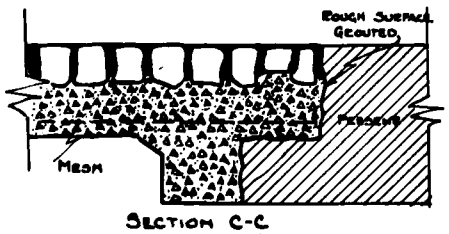
Section B-B
Scale 1"=1'-0"



Section D-D
Scale 1"=1'-0"



Section E-E
Scale 1"=1'-0"



Section C-C
Scale 1"=1'-0"

Summit Water Supply Company
Bear Rock Dam No 1.
Proposed Improvements
Scales-As shown E.E.W. Jr. April 22, 1937
Office of Manager.

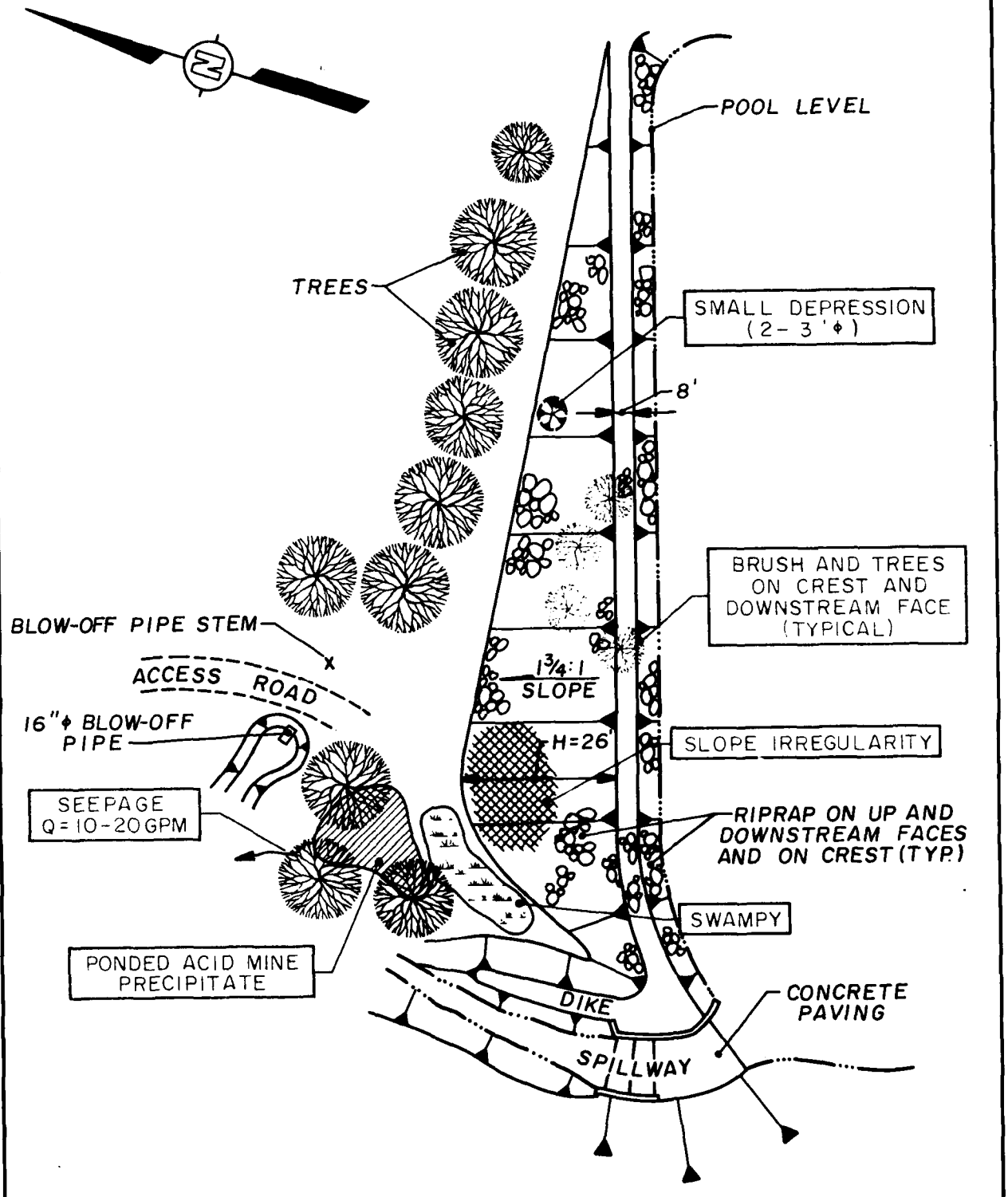
11/142

PLATE 3

D'APPOLONIA

2

DRAWN BY	ACS	CHECKED BY	JJC	DRAWING NUMBER	79-043-A19
	11-30-79	APPROVED BY	JJC		2/14/80



NOTES:

1. POOL LEVEL DATE OF INSPECTION: AT SPILLWAY CREST.

PLATE 4

BEAR ROCK NO.1 DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: NOV.13,1979

D'APPOLONIA

NOT TO SCALE:

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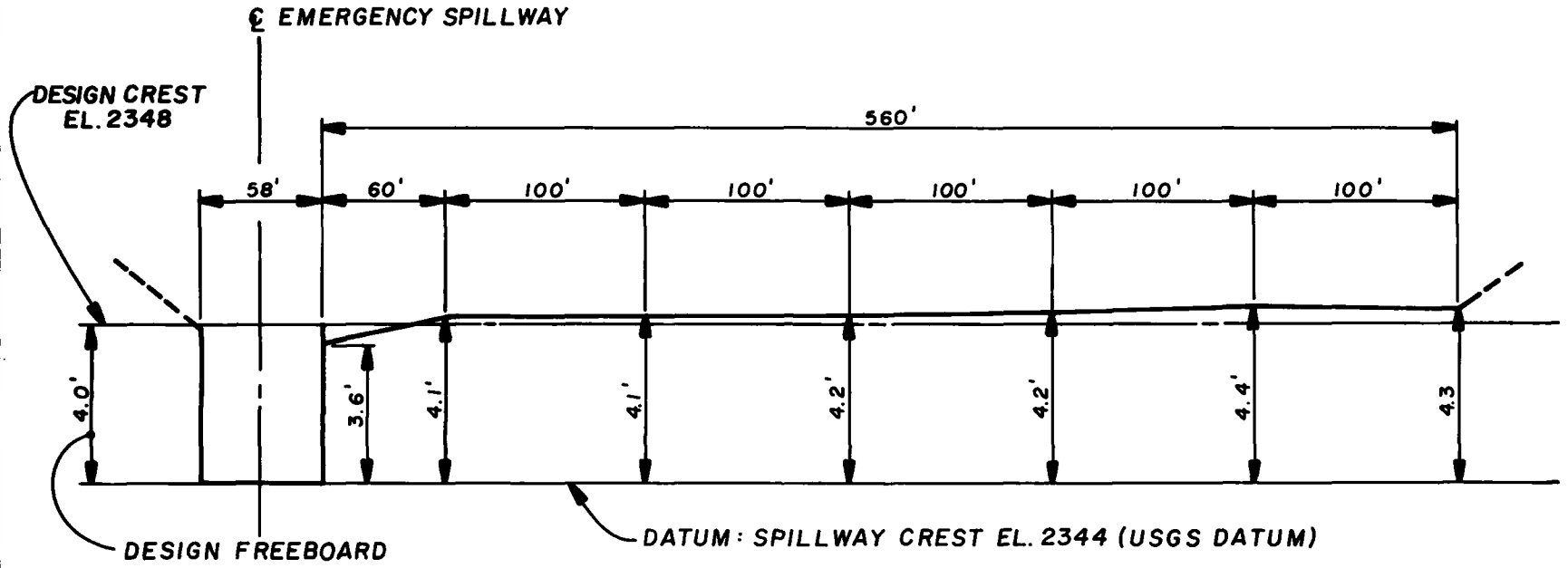
	11-30-79	APPROVED BY	JHC	2/14/80	



DAM CREST PROFILE

(LOOKING DOWNSTREAM)

NOTES:

1. DAM CREST IS SURVEYED RELATIVE TO SPILLWAY CREST LEVEL
2. DATUM ELEVATION PER DESIGN DRAWINGS

PLATE 5

BEAR ROCK No. 1 DAM
DAM CREST SURVEY
FIELD INSPECTION DATE: NOV. 13 & 20, 79

DAMPLONA

APPENDIX F

REGIONAL GEOLOGY

APPENDIX F

REGIONAL GEOLOGY

Bear Rock Nos. 1 and 2 dams are located in the eastern portion of Cambria County. The dams are located in the Allegheny Mountains section of the Appalachian Plateau Physiographic Province, an area characterized by parallel ridge and valley sequences controlled by the relatively gentle folding of the strata. The fold axis trends north-northeast and the strata dip in the area of the dams approximately 500 feet per mile to the northwest. Approximately one mile east of the reservoirs is the Allegheny Front, which separates the more gentle geologic folding to the west from the tight folding and faulting east of the front. In general, the discontinuities trend north-northeast and northwest.

The strata underlying the dams and reservoir consist of the Upper Pottsville Group and the Allegheny Group (Pennsylvanian Age). The Pottsville Group consists of two massive sandstone beds, shales, and one thin coal seam (the Mercer bed). The higher portion of the Pottsville Group consists of the Upper Conoquenessing Sandstone, a thick-bedded micaceous sandstone which is generally resistant to weathering. The thickness ranges from 15 to 25 feet. Below the sandstone is approximately 15 to 40 feet of thin-bedded shale with interbedded sandstone. These strata weather easily. Below the shale is the Lower Conoquenessing Sandstone, which is approximately 50 feet thick and is similar to the upper sandstone.

The strata overlying the Pottsville Group are the Allegheny Group, consisting of sandstone, shale, and at least seven coal seams. The group is approximately 250 feet thick. The strata from the base up consist of the Brookville coal seam, the Clarion Sandstone, the Clarion coal, and a thick sandstone below the Lower Kittanning coal bed, which is approximately 75 feet above the Brookville coal bed. The middle portion of the Allegheny Group consists of the Lower, Middle, and Upper Kittanning coal seams, and the Lower and Upper Worthington sandstones. One limestone bed is present below the Upper Kittanning coal seam. The upper portion of the group consists of the Lower and Upper Freeport coal seams and the Freeport and Rutlen sandstone beds. The overlying Conemaugh Group consist predominantly of shale and claystone with thin sandstone, limestone, and coal seams.

There is no minable coal beneath the dams and reservoirs. The strip mines on the slopes west and northeast of the reservoirs are probably the Lower Kittanning coal beds. The slopes above the reservoirs are relatively gentle, in general greater than 5 to 1, and probably consist predominantly of sandstone. Therefore, there should be no danger of large slides.

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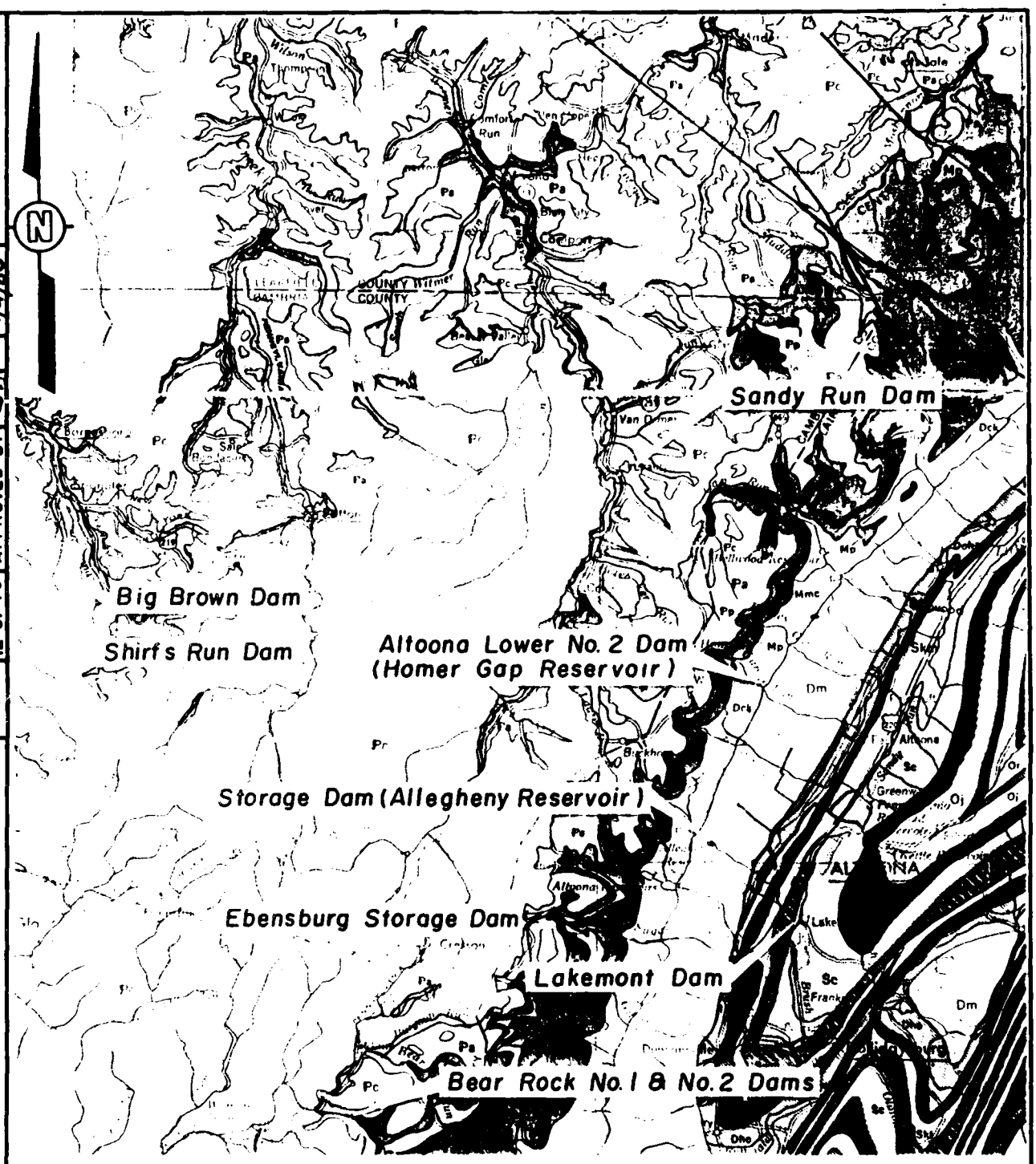
	12-31-79	APPROVED BY	[illegible]	1/14/80

DRAWING NUMBER 79-543-A13



SCALE

0 2 4 6 8 10miles

REFERENCE:

GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA., DEPT. OF INTERNAL AFFAIRS, DATED 1960, SCALE 1" = 4 MILES

SANDY RUN, BIG BROWN, SHIRFS RUN EBENSBURG STORAGE, LAKEMONT, BEAR ROCK NO. 1 AND NO. 2 DAMS, (ALLEGHENY RESERVOIR) STORAGE DAM AND ALTOONA LOWER NO. 2 (HOMER GAP RESERVOIR)

GEOLOGY MAP

DAMPOLONIA

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	12-31-79	APPROVED BY	1/14/80	

LEGEND:

Pc

Conemaugh Formation

Cyclic sequences of red and gray shales and siltstones with thin limestones and coals, massive Mahoning Sandstone commonly present at base; Ames Limestone present in middle of sections, Brush Creek Limestone in lower part of section.

Pottsville Group

Light gray to white, coarse grained sandstones and conglomerates with some minewable coal. Includes Sharp Mountain, Schuylkill, and Tumbling Run Formations.

Pa

Allegheny Group

Cyclic sequences of sandstone, shale, limestone and coal, numerous commercial coals, limestones thicken westward; Vanport Limestone in lower part of section includes Freeport, Kittanning, and Clarion Formations.

Sd

Clinton Group

Predominantly Rose Hill Formation - Reddish purple to greenish gray, thin to medium bedded, fossiliferous shale with interlonguing "iron sandstones" and local gray, fossiliferous limestone, above the Rose Hill is brown to white quartzitic sandstone (Keefer) interbedded upward with dark gray shale (Rochester)

Dm

Marine beds

Gray to olive brown shales, graywackes, and sandstones, contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock. Tully Limestone at base

Pocono Group

Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with some beds exclusive to the Appalachian Plateau Province. Shenango, Cuyahoga, Loyalhanna, Corry, and Knapp Formations includes part of "Oswayo" of M.I. Pottsville Potter and Tioga counties.

Oriskany Formation

White to brown, fine to coarse grained, partly calcareous, locally conglomeratic, fossiliferous sandstone (Ridgeley) at the top, dark gray, cherty limestone with some interbedded shales and sandstones below (Shriver)

Tuscarora Formation

White to gray, medium to thick bedded, fine grained, quartzitic sandstone, conglomeratic in part

Marcellus Formation

Black, fissile, carbonaceous shale with thick, brown sandstone (Turkey Ridge) in parts of central Pennsylvania

Onondaga Formation

Greenish blue, thin bedded shale and dark blue to black, medium bedded limestone with shale predominant in most places, includes Selinsgrove Limestone and Needmore Shale in central Pennsylvania and Buttermilk Falls Limestone and Esopus Shale in easternmost Pennsylvania, in Lehigh Gap area includes Palmerton Sandstone and Bowmanstown Chert

Dmo

Wills Creek Formation

Greenish gray, thin bedded, fissile shale with local limestone and sandstone zones, contains red shale and siltstone in the lower part.

Bloomsburg Formation

Red, thin and thick bedded shale and siltstone with local units of sandstone and thin impure limestone, some green shale in places.

McKenzie Formation

Greenish gray, thin bedded shale interbedded with gray, thin bedded, fossiliferous limestone, shale predominant at the base, intraformational breccia in the lower part. Absent in Harrisburg quadrangle and to the east

Keyser Formation

Dark gray, highly fossiliferous, thick bedded, crystalline to nodular limestone, passes into Manlius, Rondout, and Decker Formations to the east

Skt

Tonoloway Formation

Gray, highly laminated, thin bedded, argillaceous limestone, passes into Rosendale and Poxono Island beds in the east

Dck

Catskill Formation

Chiefly red to brownish shales and sandstones, includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east

REFERENCE:

GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA. DEPT. OF INTERNAL AFFAIRS, DATED 1960, SCALE 1" = 4 MILES

GEOLOGY MAP LEGEND

D'APPOLONIA


6F