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OHIO RIVER BASIN
TRIBUTARY TO PIGEON CREEK
WASHINGTON COUNTY

PENNSYLVANIA

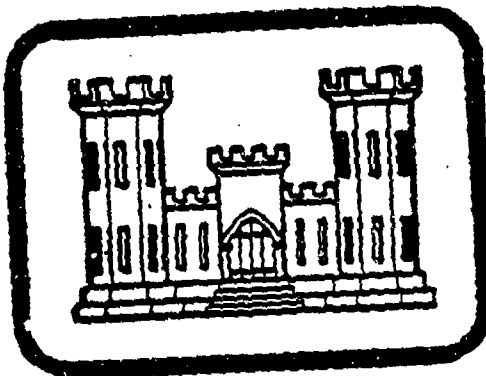
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PENN DER No. 63-94

LEVEL II

MINE No. 51 - POND 3

BETHLEHEM MINES CORPORATION
ELLSWORTH - BUTLER DIVISION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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PREPARED FOR

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

BY

ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.
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JULY 1981

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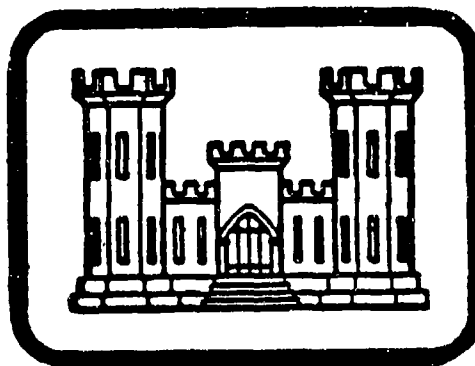
OHIO RIVER BASIN

MINE NO. 51 - POND 3
WASHINGTON COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI NO. PA 00863
PennDER NO. 63-94

BETHLEHEM MINES CORPORATION
ELLSWORTH-BUTLER DIVISION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

Prepared by: ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.
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1000 Banksville Road
Pittsburgh, Pennsylvania 15216

Date: July 1981

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, materials testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the 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 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 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 time 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 investigations 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" (PMF) 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 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS

NAME OF DAM:	Mine No. 51 - Pond 3
STATE LOCATION:	Pennsylvania
COUNTY LOCATION:	Washington
STREAM:	Unnamed tributary to Pigeon Creek.
DATE OF INSPECTION:	26 March 1981
COORDINATES:	Lat. 40°07'04" Long. 80°01'41"

ASSESSMENT

Based on a review of available design information, visual observations of conditions as they existed on the day of the field inspection, and supporting calculations, the general condition of the Mine No. 51 - Pond 3 is considered to be fair.

This assessment is based primarily on visual observations of the embankment and downstream toe area, which revealed potential foundation conditions that require additional investigation.

The structure is classified as an "intermediate" size, "high" hazard dam. Corps of Engineers guidelines recommend the Probable Maximum Flood (PMF) as the Spillway Design Flood for an "intermediate" size, "high" hazard dam. Mine No. 51 - Pond 3's Spillway Design Flood is the Probable Maximum Flood. Spillway capacity is "adequate" because the non-overtopping flood discharge was found, by using the HEC-1 computer program, to be in excess of 100 percent of the PMF.

The visual inspection indicated several deficiencies in addition to those requiring further investigation. The deficiencies can be corrected or improved through implementation of the following recommended monitoring and maintenance efforts.

RECOMMENDATIONS

1. Additional Investigations: It is recommended that the owner immediately retain the services of a registered professional engineer knowledgeable and experienced in the design and construction of earth dams to investigate the extent and stability of the fine coal refuse sediments that may comprise the foundation of part or all of the impounding embankment.

2. Remedial Work: The Phase I Inspection of the Mine No. 51 - Pond 3 impounding embankment also disclosed several other deficiencies which should be corrected. These include:

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Mine No. 51 - Pond 3

(1) Repairing sloughing and erosion of the embankment crest, slopes and groins.

(2) Providing adequate protection against future erosion of the crest, slopes and groins.

(3) Providing protection for the spillway inlet from clogging by trash and debris.

(4) Improving the drainage characteristics of the spillway discharge channel.

3. Emergency Operation and Warning Plan: Concurrent with the additional investigations recommended above, the owner should develop an Emergency Operation and Warning Plan including:

(1) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

(2) Procedures for around-the-clock surveillance during periods of heavy precipitation or runoff.

(3) Procedures for drawdown of the reservoir under emergency conditions.

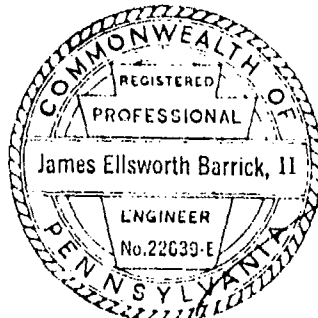
(4) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

4. Maintenance and Inspection Procedures: The owner should develop written maintenance and inspection procedures in the form of checklists and step-by-step instructions.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Mine No. 51 - Pond 3

Samuel G. Mazzella 17 July 1981
Samuel G. Mazzella Date
Project Engineer

James P. Hannan 17 July 1981
James P. Hannan Date
Project Engineer

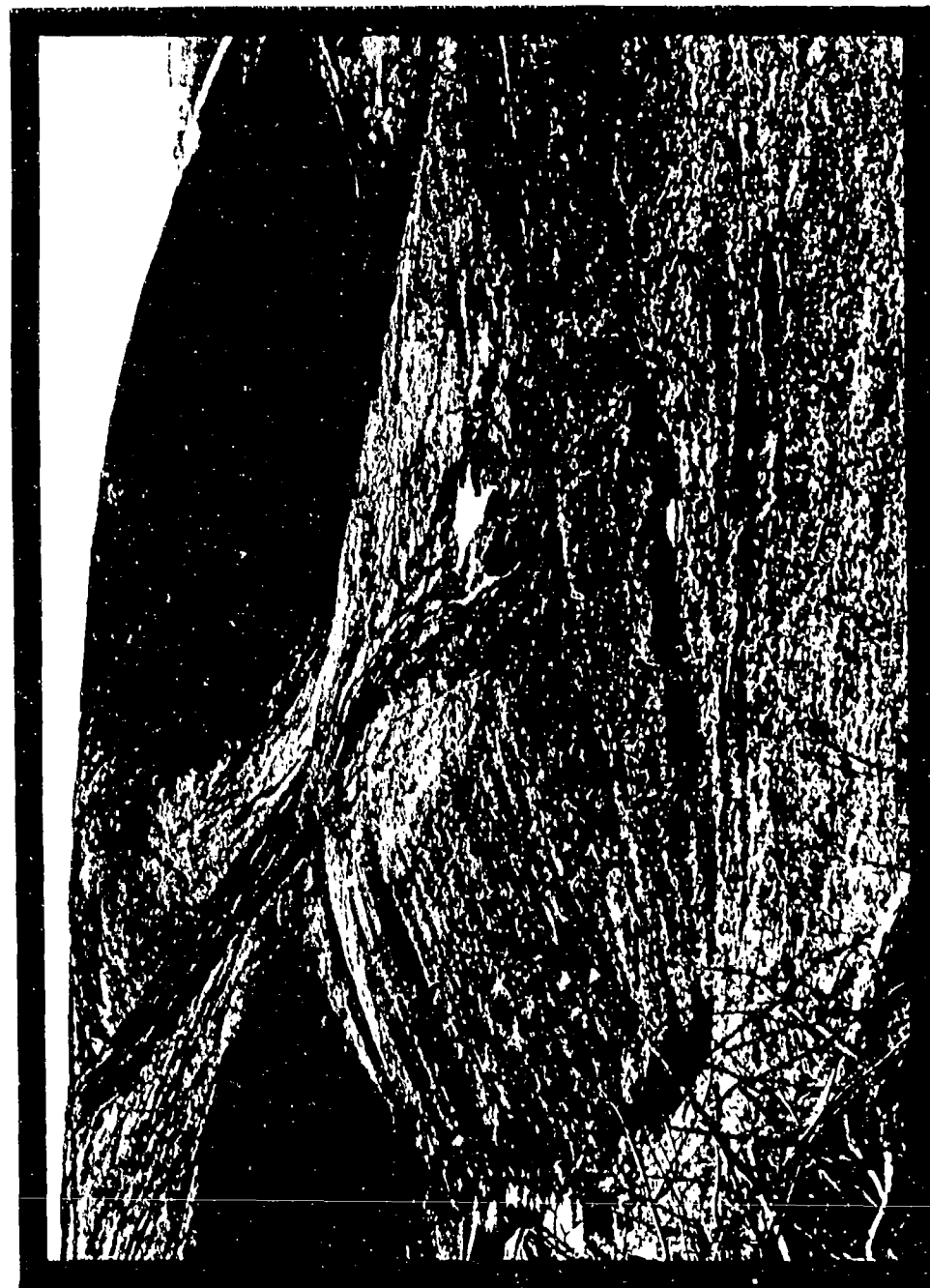


James E. Barrick 17 July 1981
James E. Barrick, P.E. Date
PA Registration No. 022639-E

Approved by:

James W. Peck 11 Aug 81
JAMES W. PECK Date
Colonel, Corps of Engineers
Commander and District Engineer

MINE No. 51 - POND 3



OVERVIEW

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
MINE NO. 51 - POND 3
NATIONAL I. D. NO. PA 00863
PennDER No. 63-94

SECTION 1
PROJECT INFORMATION

1.1 GENERAL

a. Authority: The Phase I investigation was performed pursuant to authority granted by Public Law 92-367 (National Dam Inspection Act) 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 the investigation is to make a determination on whether or not the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances:

(1) Embankment: The Mine No. 51 - Pond 3 impounding embankment is an earthfill structure 200 feet long, with a toe to crest height of 26.9 feet and a crest width of about 48 feet. The embankment's upstream slope was measured to be 2.4H:1V above the waterline; the downstream slope was measured to be 3.8H:1V.

(2) Foundation: The impounding embankment may be founded partly or entirely on fine coal refuse sediments.

(3) Principal (and Emergency) Spillway: The principal (and emergency) spillway for Mine No. 51 - Pond 3 consists of a three foot diameter corrugated metal pipe through the embankment.

(4) Outlet Works: An outlet works, consisting of a submerged pump and pipeline, is located near the upstream end of the impoundment. The partially clarified pond water is returned to the Mine No. 51 Preparation Plant for reuse in the coal cleaning process.

(5) Freeboard Conditions: Freeboard between the low point on the embankment and the spillway invert is 10.4 feet.

(6) Downstream Conditions: The Mine No. 51 - Pond 3 impoundment embankment lies just above a topographic low area that contains ponded water. Spillway discharges are directed to the low area by adverse slopes in the spillway discharge channel.

Below the lower pond, the downstream channel follows the toe of a massive coarse coal refuse disposal area on the left, passes through a rock lined stilling pool and enters a sedimentation pond that has a drop inlet type outlet.

In the first 3,000 feet below the dam, no inhabited dwellings would be imperiled by high flows from the impoundment. However, the Mine No. 51 Coal Preparation Plant could sustain significant damage and loss of more than a few lives could result.

(7) Reservoir: Mine No. 51 - Pond 3 is about 3,700 feet long at the maximum normal (operating) pool elevation and has a surface area of 79 acres. When the pool is at the crest of the dam, the reservoir length increases to 4,000 feet and the surface area would be about 97 acres.

(8) Watershed: The watershed contributing to Mine No. 51 - Pond 3, 177 acres, is mostly grass and brushland.

b. Location: Mine No. 51 - Pond 3 is located at the headwaters of an unnamed tributary to Pigeon Creek in Somerset Township, Washington County, Pennsylvania. The pond is approximately 1/2 mile north of Ellsworth, Pennsylvania.

c. Size Classification: The dam has a maximum storage capacity of 3,496 acre-feet and a toe to crest height of 26.9 feet. Based on the Corps of Engineers guidelines, this dam is classified as an "intermediate" size structure.

d. Hazard Classification: Mine No. 51 - Pond 3 is classified as a "high" hazard dam. In the event of a dam failure, the Mine No. 51 Coal Preparation Plant could be subjected to substantial damage and the loss of more than a few lives could result.

e. Ownership: Mine No. 51 - Pond 3 is owned by the Bethlehem Mines Corporation. Correspondence can be addressed to:

Bethlehem Mines Corporation
Ellsworth-Butler Division
P. O. Box 143
Eighty-Four, Pennsylvania 15330
Attention: Mr. D. F. Patterson, Chief Engineer
(412) 228-5500

f. Purpose of Dam: Mine No. 51 - Pond 3 was constructed to serve as a holding and settling impoundment for fine coal refuse slurry from the Mine No. 51 Coal Preparation Plant.

g. Design and Construction History: The impoundment was designed by Bethlehem Mines Corporation, Ellsworth-Butler Division, and was constructed in stages between 1950 and 1979. The inspected impounding embankment was constructed in 1979.

h. Normal Operating Procedure: Mine No. 51 - Pond 3 was designed to operate as an uncontrolled structure. Under normal operating conditions, the pool level is maintained by the outlet works. A spillway provides for a maximum normal (operating) pool elevation of 1116.

Inflow to Mine No. 51 - Pond 3 includes runoff from the watershed above and fine coal refuse slurry from the Mine No. 51 Preparation Plant.

1.3 PERTINENT DATA

a.	<u>Drainage Area</u>	0.28 sq. mi.
b.	<u>Discharge</u>	
	Maximum flood at Dam Facility	Unknown
	Spillway Capacity at Top of Dam	Assumed Zero
c.	<u>Elevation (feet above MSL)</u>	
	Design Top of Dam	Unknown
	Current Top of Dam (low point)	1126.4
	Spillway Crest*	1116.0
	Operating Pool at Time of Inspection	1110.6
	Toe of Embankment	1099.5
d.	<u>Reservoir Length</u>	
	Maximum Pool	4000 feet
	Maximum Normal (Operating) Pool	3700 feet
e.	<u>Reservoir Storage</u>	
	Design Top of Dam	Unknown
	Current Top of Dam	3496 acre-feet
	Spillway Invert	2618 acre-feet
f.	<u>Reservoir Surface</u>	
	Design Top of Dam	Unknown
	Current Top of Dam	97 acres
	Spillway Crest	79 acres

g. Embankment

Type	Earth
Length	200 feet
Height	26.9 feet
Crest Width	48 feet
Slopes	
Downstream	3.8 H:1V
Upstream	2.4 H:1V
Impervious Core	Unknown
Cutoff Provisions	Unknown
Grout Curtain	Unknown

h. Principal (and Emergency) Spillway

Type	Three foot diameter CMP
Location	Through embankment
Invert Elevation*	1116.0 feet

i. Outlet Works

Type	Pump
Location	Near Upstream End of Impoundment

*Datum for field measurements as per owner's drawing (Plate IV).

SECTION 2 ENGINEERING DATA

2.1 DESIGN

a. Data Available: The files of the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER), were reviewed but no engineering data relating to the original design of the facility were found.

All available design and construction information was obtained from representatives of Bethlehem Mines Corporation.

b. Design History: The dam was designed by Bethlehem Mines Corporation, Ellsworth-Butler Division.

2.2 CONSTRUCTION

The Mine No. 51 - Pond 3 impoundment was constructed in stages by the Bethlehem Mines Corporation, Ellsworth-Butler Division, between 1950 and 1979. The inspected impounding embankment was constructed in 1979.

2.3 OPERATION

The dam is designed to operate without a dam tender. The principal (and emergency) spillway is a three foot diameter CMP through the right portion of the embankment.

The outlet works is an electric pump through which partially clarified water is pumped back to the Mine No. 51 Preparation Plant. Besides the return pump, there are no facilities to draw down the impoundment in case of emergency.

Performance and operation records are not maintained. There is no information available on the operation of the outlet works pump system.

2.4 EVALUATION

a. Availability: There were no engineering data available in the files of PennDER, Bureau of Dams and Waterway Management. The owner provided the topographic maps and Development Plan listed in Appendix B and reproduced in Appendix E.

b. Adequacy: The available engineering information, though greatly limited, was supplemented by a field inspection and supporting engineering analyses and is considered adequate for the purpose of this Phase I Inspection Report.

c. Validity: There appears to be no reason to question the validity of the limited available engineering data.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

a. General: The field inspection of Mine No. 51 - Pond 3 was performed on 26 March 1981, and consisted of:

(1) Visual observations of the embankment crest and slopes, groins and abutments;

(2) Visual observations of the principal (and emergency) spillway, including discharge channel;

(3) Transit stadia field measurements of relative elevations along the embankment crest centerline, spillway, and across the embankment slopes;

(4) Visual observations of the embankment's downstream toe area;

(5) Visual observations of downstream conditions and evaluation of the downstream hazard potential;

(6) Visual observations of the reservoir shoreline and watershed.

The visual observations were made during periods when the reservoir and tailwater were at normal operating levels.

The visual observations checklist, field sketch, profiles, and sections containing the observations and comments of the field inspection team are contained in Appendix A. Specific observations are illustrated on photographs in Appendix C. Detailed findings of the field inspection are presented in the following sections.

b. Embankment:

(1) Crest: The crest of the embankment was generally straight throughout its length. No offsets or indications of misalignment were observed that would indicate anomalous movement of the embankment.

The crest pitched from left to right and contained a small ponded area near the right abutment. To the left, the crest rose sharply as it approached the coarse coal refuse deposit that comprises the left abutment.

The crest was sparsely vegetated and contained numerous vehicle ruts and erosion gullies. The erosion appeared to be the result of surface runoff from the coarse refuse deposit on the left.

(2) Upstream Slope: The upstream slope was sparsely vegetated and contained numerous erosional gullies caused by runoff from the crest of the embankment. There was no indication of slope instability, such as scarps or cracks, but the slope was somewhat non-uniform, being higher on the left than on the right.

(3) Downstream Slope: The downstream slope was sparsely vegetated and contained some erosional gullies, particularly on the left side adjacent to the coarse coal refuse deposit. The slope was particularly steep near the toe on the left side of the embankment. The slope was generally uniform, though locally uneven, and showed no signs of slope instability such as scarps, cracks or anomalous bulges.

c. Groins (junction of embankment and abutment): Both upstream groins contained deep erosional gullies that appeared to be the result of surface runoff. Delta deposits were observed in the reservoir at the end of both upstream groins.

The right downstream groin appeared to be in good condition with no sign of significant erosion or instability.

The left downstream groin was ill-defined as the intersection of the embankment and the coarse coal refuse deposit. Considerable erosion has occurred, and steep slopes were observed in the refuse materials.

No seepage was observed in any of the groins.

d. Abutments: The left abutment of Mine No. 51 - Pond 3 consists of a massive and extensive deposit of coarse coal refuse. In the immediate vicinity of the embankment, the top of the refuse pile is approximately 80 feet above the crest of the embankment. The deposit is L-shaped and approximately 2,500 feet long.

The right abutment consists of original ground, and was observed to be tree-covered and partially vegetated. Some erosion was observed, but there were no indications of significant abutment instability.

The lower right abutment is traversed by the spillway discharge channel that passes around the perimeter of the topographic low area that lies below the embankment.

e. Seepage: No seepage was observed during the field inspection.

f. Downstream Toe Area: The downstream toe area of Pond 3 consists of a topographic low area that contains a fine coal refuse deposit, a small pond, a number of trees, and a cable tower for a coal refuse tram facility.

The fine refuse that lies immediately below the toe of the embankment appears to be depositional rather than colluvial, in that no mud waves or other disturbances indicating post-depositional movement were observed.

g. Principal (and Emergency) Spillway:

(1) Approach Channel: The approach channel to the spillway was clear and free of obstructions.

(2) Structure: The spillway structure consists of a three foot diameter corrugated metal pipe (CMP) located approximately ten feet below the crest of the dam near the right abutment. The inlet to the pipe consists of a commercial sheet metal wingwall attachment. The inlet has no protection from potential clogging by debris.

The pipe appears to have settled following installation but is still capable of discharging inlet flows, although some sediment has been deposited near the downstream end of the pipe.

The pipe discharges to an earth cut open channel in the right abutment.

(3) Discharge Channel: The spillway discharge channel consists of a small, shallow open channel that traverses the right abutment at the perimeter of the topographic low area below the dam. On the date of inspection, the channel contained considerable vegetation and numerous pools of standing water. The channel slopes were not measured but appeared to have sections where adverse grades existed.

h. Outlet Works: Pond 3 is reported to have a pump-type outlet works located near the upper end of the reservoir. The facility is used to provide return water to the preparation plant below the dam. The facility was not observed during the field inspection.

i. Reservoir:

(1) Slopes: The slopes of the reservoir are moderate to steep and consist of natural ground and coal refuse materials.

On the right, the reservoir slopes are formed by natural ground and are wooded or grass-covered. The slopes were generally moderate to moderately steep, and showed no signs of significant slope instability.

On the left, the majority of the reservoir shoreline consists of the extensive deposit of coarse coal refuse. The refuse is banked steeply and has suffered considerable erosion and some slope instability.

(2) Inlet Stream: There is no well defined inlet stream because of the impoundment's location high in the watershed.

(3) Sedimentation: Pond 3 contains a considerable volume of fine coal refuse sediment which has been placed hydraulically by slurry flow from a pipe that discharges to the impoundment from the lower left abutment area.

(4) Watershed: The watershed contributing to Pond 3 is comprised mainly of farmland, with some residential dwellings. Ground cover consists primarily of fields with a small amount of woodland. The watershed appeared to be similar to that indicated on the most recent USGS topographic map. No signs of major construction or mining activities were observed in the watershed.

j. Downstream Conditions:

(1) Channel: The downstream channel below Pond 3 passes along the toe of the coarse coal refuse deposit that comprises the left abutment for approximately 800 feet where it enters a stilling pool area. From the stilling pool, flow is to a small impoundment (West Sedimentation Pond) that has been constructed into the hillside immediately above the Mine No. 51 Preparation Plant complex in Bentleyville, Pennsylvania. Discharge from the impoundment is via a metal pipe decant facility to the preparation plant area below. No open channel spillway was observed in the vicinity of the pond.

(2) Floodplain Conditions: In the first 3,000 feet below Pond 3 there are no inhabited dwellings that would be imperiled by high flows resulting from failure of Pond 3 impounding embankment. However, failure of Pond 3 may ultimately lead to failure of the West Sedimentation Pond above the preparation plant complex, resulting in considerable damage to the industrial facility and the possible loss of more than a few lives.

3.2 EVALUATION

The following evaluations are based on the results of the visual inspection performed on 26 March 1981.

a. Embankment: The condition of Mine No. 51 - Pond 3 was poor. Several deficiencies were observed which included:

(1) Water ponding on the crest and erosion at several locations on the crest, upstream and downstream slopes.

(2) Lack of uniform vegetal covering or other erosion retarding conditions.

(3) Poor surface drainage conditions on both abutments that have lead to significant erosion of the embankment and its groins.

b. Foundation: The fine coal refuse sediments observed at the downstream toe of the impounding embankment may comprise part or all of the embankment's foundation.

c. Principal (and Emergency) Spillway: The spillway was in fair condition. Deficiencies observed included:

(1) Lack of a debris control structure at the inlet.

(2) Settlement of the pipe that has lead to deposition of sediments near the downstream end.

(3) An ineffective discharge channel that contained adverse slopes and considerable vegetation.

d. Outlet Works: The outlet pump and return line were not examined on the date of inspection. However, their functionality must be maintained for proper operation of the Mine No. 51 Preparation Plant.

e. Reservoir Slopes: The reservoir slopes were observed to be moderate to steep and showed signs of instability in the steeper coal refuse deposits on the left. However, the large size of the impoundment zone and lack of surface water would preclude embankment distress due to shoreline slope failures.

f. Hazard Potential: Based on the observed downstream conditions, Mine No. 51 - Pond 3 was assigned a "high" hazard potential rating.

SECTION 4 OPERATIONAL FEATURES

4.1 PROCEDURE

Fine coal refuse slurry is pumped to the facility and is discharged to the pond across the left abutment.

Reservoir pool level is normally maintained by the outlet works and is limited by the invert of the principal (and emergency) spillway.

The outlet works consists of a submerged pump system which draws off the partially clarified pond water and recycles it back to the Mine No. 51 Preparation Plant.

There are no reported pipes through the embankment other than the spillway CMP.

Normal operating procedure does not require a dam tender.

4.2 MAINTENANCE OF DAM

The impounding embankment and appurtenances are maintained by the Bethlehem Mines Corporation. Maintenance reportedly consists of periodically repairing eroded areas and making miscellaneous repairs as necessary.

4.3 INSPECTION OF DAM

The Bethlehem Mines Corporation is required by the State of Pennsylvania to inspect the dam annually and make needed repairs.

The Bethlehem Mines Corporation is required by the Mine Safety and Health Administration (MSHA) to inspect the dam at least once every seven days and to make an annual report and certification of the dam.

4.4 WARNING PROCEDURE

There is no known warning system and no formal emergency procedure to alert or evacuate downstream areas upon threat of a dam failure.

4.5 EVALUATION

The maintenance program should be continued and expanded. There are no written operation, maintenance or inspection procedures; nor is there a warning system or formal emergency procedure for this dam. These procedures should be developed in the form of checklists and step by step instructions and should be implemented as necessary.

SECTION 5
HYDROLOGY AND HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data: Mine No. 51 - Pond 3 has a watershed of 179 acres which is vegetated primarily by grass and brushland. The watershed is about 5,700 feet long and 2,000 feet wide and has a maximum elevation of 1,220 feet (MSL). At maximum normal pool, the dam impounds a reservoir with a surface area of 79 acres and a storage volume of 2,618 acre-feet. Maximum normal pool level is maintained at Elevation 1116.0 by the inlet of the principal (and emergency) spillway conduit.

There were no design calculations available related to spillway capacity. Mine No. 51 - Pond 3's actual spillway capacity was not computed. The spillway conduit was assumed to be blocked for purposes of the routing analysis.

No additional hydrologic calculations were found relating reservoir/spillway performance to the Probable Maximum Flood or fractions thereof.

b. Experience Data: Records are not kept of reservoir level or rainfall amounts. There is no record or report of the embankment ever being overtopped.

c. Visual Observations: On the date of the field inspection, no serious deficiencies were observed that would prevent the principal (and emergency) spillway from functioning. The sediment level at the time of the field inspection was observed to be 5.4 feet below the spillway crest. There was no trash cage observed on the principal (and emergency) spillway inlet.

d. Overtopping Potential: Overtopping potential was investigated through the development of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway. The Corps of Engineers guidelines recommends the Probable Maximum Flood as the SDF for "intermediate" size, "high" hazard dams. Based on the observed size and existing downstream conditions, Mine No. 51 - Pond 3 was assigned a Spillway Design Flood (SDF) of one PMF.

Hydrometeorological Report No. 33 indicates the adjusted 24 hour Probable Maximum Precipitation (PMP) for the subject site is 19.4 inches. No calculations were found that relate the reservoir/spillway system to a PMP type precipitation event. Consequently, an evaluation of the system was performed to determine whether or not the dam's spillway capacity is adequate under current Corps of Engineers' guidelines.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July 1978. The major methodologies and key input data for this program are discussed briefly in Appendix D.

The peak inflow to Mine No. 51 - Pond 3 was determined by HEC-1 to be 870 cfs for the PMF (and SDF).

An initial pool elevation of 1116.0 was assumed prior to commencement of the storm.

e. Spillway Adequacy: The capacity of the combined reservoir and spillway system was determined to be in excess of the PMF by HEC-1. According to Corps of Engineers' guidelines, Mine No. 51 - Pond 3's spillway is "adequate."

SECTION 6
STRUCTURAL STABILITY

6.1 AVAILABLE INFORMATION

a. Design and Construction Data: No design documentation or calculations were available for review. The owner provided the topographic maps and Development Plan that are cited in Appendix B and presented in Appendix E.

b. Operating Records: There are no written operating records or procedures for this dam.

c. Mining Activity: The Pittsburgh Coal Seam lies approximately 350 feet below the dam and impoundment and has reportedly been extensively mined.

d. Visual Observations:

(1) Embankment: The field inspection disclosed no evidence of a high ground water level in the embankment. There was no pronounced "line of seepage"; and no significant bulges, surface sloughs, or cracking were observed. Field measurements indicated a relatively flat downstream slope of 3.8H:1V.

The foundation for the downstream toe of the impounding embankment appeared to be consolidated fine coal refuse sediments having the texture of fine to medium sand. The extent and underlying condition of these materials could not be determined visually.

The embankment crest and slopes were severely eroded at several locations by uncontrolled surface runoff. Locally steep slopes and associated sloughing were observed in the erosional gullies. Vegetal cover was sparse.

(2) Principal (and Emergency) Spillway: The spillway conduit was functional but did not appear to have a uniform slope. It could not be determined if this condition is the result of placement procedures or active or inactive embankment settlement.

(3) Evidence of Mine Subsidence: None.

e. Performance: No information was available on performance of Mine No. 51 - Pond 3 impounding embankment since its construction in 1979.

6.2 EVALUATION

a. Design Documents: No design documentation was available to evaluate the structure.

b. Embankment: Based on the results of the visual observations of embankment slopes, materials and seepage conditions, Mine No. 51 - Pond 3 impounding embankment appears to have an adequate margin of safety against sliding.

The foundation materials observed at the downstream toe, consisting of fine coal refuse sediments, appear to be stable for existing conditions. However, their performance under saturated conditions is subject to question. Such saturated conditions could exist if the water level in the topographic low area below the toe of the dam were to rise by six feet.

c. Principal (and Emergency) Spillway: The principal (and emergency) spillway appeared to be functional. Possible settlement of the pipe does not appear to be a problem.

d. Seismic Stability: According to the Seismic Risk Map of the United States, Mine No. 51 - Pond 3 dam is located in Zone 1 where damage due to earthquakes would most likely be minor.

A dam located in Seismic Zone 1 may be assumed to present no hazard from an earthquake, provided static stability conditions are satisfactory and conventional safety margins exist. However, no calculations were developed to verify this assessment.

The seismic stability of the foundation materials is subject to question for saturated conditions. The observed materials, if extensive enough and saturated, may have liquefaction potential for some conditions of seismic shock. These conditions should be investigated.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 ASSESSMENT

a. Evaluation:

(1) Embankment: Mine No. 51 - Pond 3's embankment is considered to be in fair condition. This is based on visual observations that revealed deficiencies which included significant erosional distress of crest and slopes, resulting from uncontrolled surface run-off and a lack of erosion resisting vegetation.

(2) Foundation: Foundation material observed at the downstream toe of the impounding embankment is considered to be a potential deficiency. The material is fine coal refuse sediments having the visual texture of a uniform fine to medium sand. Although apparently stable for existing conditions, the static and seismic stability of such material may not be sufficient to support the embankment under saturated conditions.

(3) Principal (and Emergency) Spillway: The spillway conduit is considered to be in good condition, although a non-uniform slope was observed and no trash or debris protection exists for the pipe inlet.

The spillway was assumed to be inoperative (blocked or collapsed) for the reservoir routing analysis. Nevertheless, the combined reservoir/spillway capacity was determined by HEC-1 to be in excess of the Spillway Design Flood (SDF), which for a dam of this height and capacity is the Probable Maximum Flood (PMF).

(4) Downstream Channel: The spillway downstream channel is considered to be in poor condition. This is based on observations of adverse channel slopes that would direct spillway flows into the topographic low area below the toe of the impounding embankment.

(5) Emergency Plans: The lack of a documented emergency operation and warning plan is considered to be a deficiency.

b. Adequacy of Information: The information available on design, construction, operation and performance history in combination with visual observations and hydrology and hydraulic calculations was sufficient to evaluate the embankment and appurtenant structures in accordance with the Phase I investigation guidelines.

c. Urgency: The recommendations presented in Section 7 should be implemented immediately.

d. Necessity for Additional Data/Evaluation: Additional engineering information is required to adequately evaluate the stability of the impounding embankment.

7.2 RECOMMENDATIONS

a. Additional Investigations: It is recommended that the owner immediately retain the services of a registered professional engineer knowledgeable and experienced in the design and construction of earth dams to investigate the extent and stability of the fine coal refuse sediments that may comprise the foundation of part or all of the impounding embankment.

b. Remedial Work. The Phase I Inspection of the Mine No. 51 - Pond 3 impounding embankment also disclosed several other deficiencies which should be corrected. These include:

(1) Repairing sloughing and erosion of the embankment crest, slopes and groins.

(2) Providing adequate protection against future erosion of the crest, slopes and groins.

(3) Providing protection for the spillway inlet from clogging by trash and debris.

(4) Improving the drainage characteristics of the spillway discharge channel.

c. Emergency Operation and Warning Plan: Concurrent with the additional investigations recommended above, the owner should develop an Emergency Operation and Warning Plan including:

(1) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

(2) Procedures for around-the-clock surveillance during periods of heavy precipitation or runoff.

(3) Procedures for drawdown of the reservoir under emergency conditions.

(4) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

d. Maintenance and Inspection Procedures: The owner should develop written maintenance and inspection procedures in the form of checklists and step-by-step instructions.

APPENDIX A
VISUAL INSPECTION CHECKLIST

VISUAL OBSERVATIONS CHECKLIST I
(NON-MASONRY IMPOUNDING STRUCTURE)

Name of Dam Mine No. 51 - Pond 3 County Washington State Pennsylvania National ID # 00863

Type of Dam Earth Hazard Category High

Date of Inspection 26 March 1981 Weather Partly cloudy, mild Temperature 55°F

Sediment Elevation at Time of Inspection 1110.6 (MSL)
Tailwater at Time of Inspection 1093.3 (MSL)

Inspection Personnel: J. E. Barrick, P.E. Ackenheil & Associates, Project Manager
and Hydrologist
J. P. Hannan Ackenheil & Associates, Geotechnical Engineer
S. G. Mazzella Ackenheil & Associates, Civil Engineer

Recorder J. E. Barrick

GEO Project G80138-H
PENNDER I.D. No. 63-94

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Only randomly oriented surface drying cracks observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Considerable erosion of both embankment and abutment slopes, both upstream and downstream. Some of the erosional gullies on the embankment are two or more feet deep. No significant signs of slope instability were observed on either the embankment or the abutment slopes.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The horizontal alignment of the crest is approximately straight, and the crest width appears to be uniform from abutment to abutment. Vertically, the embankment crest is pitched from left to right and toward the impoundment zone. The slope steepens sharply near the left, which consists of a massive coarse coal refuse deposit.	
RIPRAP FAILURES	No riprap observed.	
SETTLEMENT	None observed.	

EMBANKMENT (CONTINUED)

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
JUNCTION OF EMBANKMENT AND ABUTMENT	The junctions of the embankment and the abutments on the upstream side of the dam are badly eroded as a result of surface runoff. Sediment deposits exist at the reservoir waterline on both sides of the embankment. The junction of the downstream embankment slope and the right abutment appears to be in good condition. No significant erosion or signs of instability observed. The junction of the downstream embankment slope and the left abutment is ill defined and contains considerable erosional gullies in both earth and coarse coal refuse materials. Gully slopes in this area are quite steep. Considerable deposition of coarse coal refuse material observed at and above the waterline of the pool below the toe of the dam.	
ANY NOTICEABLE SEEPAGE	None observed.	
STAFF GAUGE AND RECORDER	None observed.	
DRAINS	None observed.	

EMBANKMENT (CONTINUED)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFICIAL CONDITIONS	The embankment crest is sparsely vegetated and contains numerous vehicle ruts and erosional channels resulting from runoff from the coarse coal refuse deposit on the left. Near the right end there is a small pond of water. The embankment's upstream slope is partially vegetated and contains numerous erosional gullies. The slope is somewhat higher on the left than on the right, giving a non-uniform appearance. There are no indications of slope instability such as cracks or scarps. The embankment's downstream slope is sparsely vegetated by grass and small weeds. The slope contains numerous erosional gullies but is approximately uniform from right abutment to left. The toe of the downstream slope near the left abutment appears to have been eroded away and is now relatively steep and in an active state of erosion. There are no signs indicating slope instability such as scarps and cracks. The downstream toe area consists of a fine coal refuse deposit immediately below the toe of the dam for approximately 25 feet. Beyond this, there is a small pond that lies in a topographic low below the embankment. The fine refuse appears to have been deposited rather than pushed up by embankment construction. There are no signs of mud waves in the fine refuse.	

PRINCIPAL (AND EMERGENCY) SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
APPROACH CHANNEL	The approach channel to the principal (and emergency) spillway is clear and unobstructed.	
	STRUCTURE	
	The spillway structure consists of a three foot diameter corrugated metal pipe located approximately ten feet below the crest near the right end of the embankment. The inlet end of the pipe has a metal wingwall fitting. There is no trash or debris control structure. The pipe does not appear to have a uniform slope, but deposits of sediment near the downstream end indicate that the pipe is functional.	
DISCHARGE CHANNEL	The spillway discharge channel consists of an open channel ditch constructed into the hillside of the downstream right abutment. The channel extends around the topographic low below the embankment, and proceeds on down-valley adjacent to the toe of the coarse coal refuse deposit on the left of the dam.	
	The discharge channel contains ponded water approximately 100 feet below the dam.	
	The channel is very shallow at places, and is generally brush and weed-clogged. It contains sediment and erosion and, in general, appears to be ineffective for the intended purpose.	

INSTRUMENTATION

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

RESERVOIR

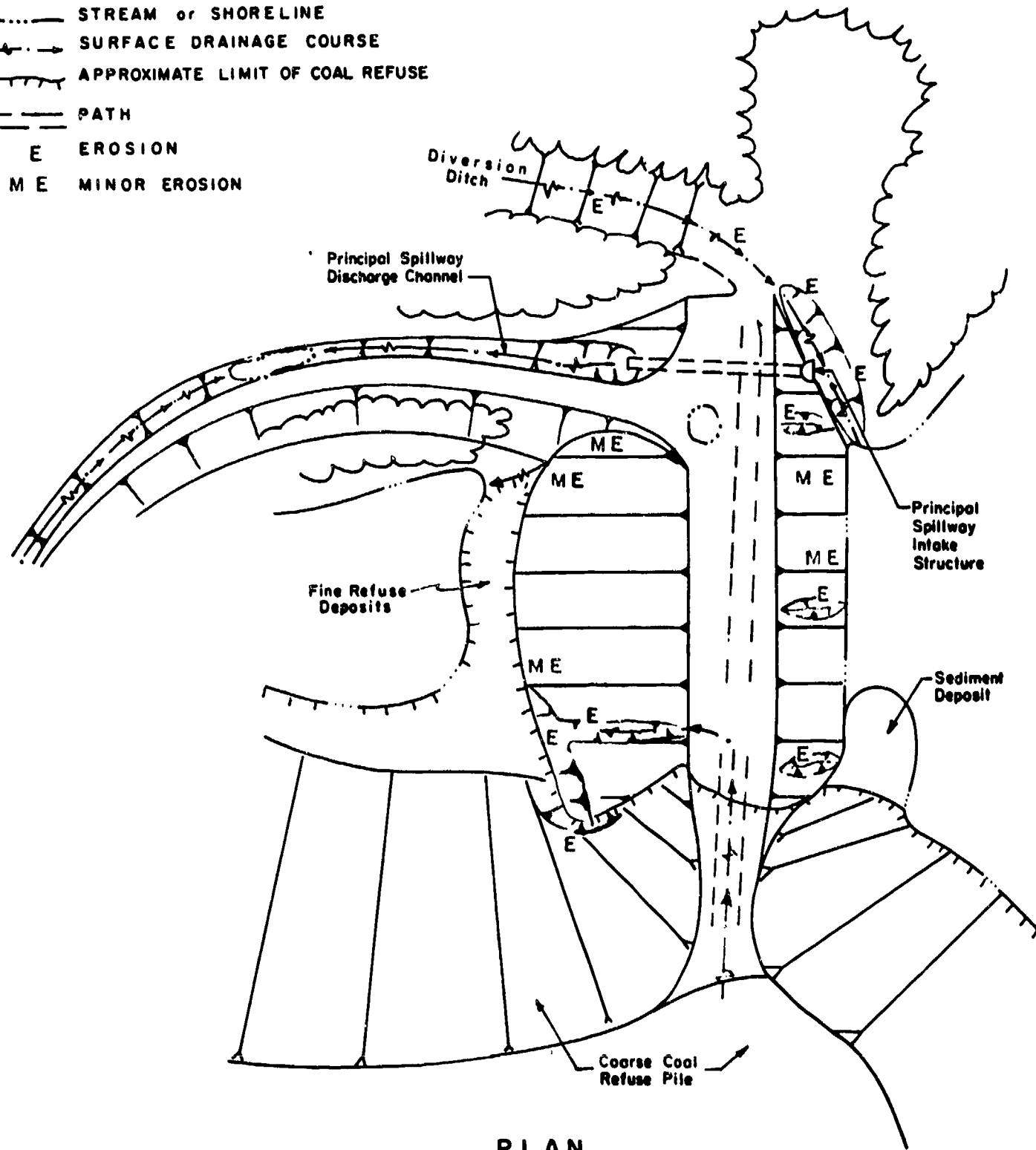
<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
SLOPES	The reservoir slopes range from moderately steep to steep, and consist of both natural and coarse coal refuse materials. On the right and upper left, the reservoir slopes consist of natural ground that is either wooded or brush-covered. There are no signs of slope instability in these materials. The lower left side of the reservoir is comprised of a massive and extensive deposit of coarse coal refuse, whose top elevation is considerably above that of the embankment. In general, the refuse materials have suffered significant erosion, and some indications of sloughing can be seen.	
SEDIMENTATION	Mine No. 51 - Pond 3 contains a significant deposit of fine coal refuse sediments. On the date of inspection, there was very little standing water in the facility, that being located at the far upstream end. The sediment deposits appear to be unconsolidated and capable of liquid flow in the event of an embankment failure.	
INLET STREAM	Because of the impoundment's location high in the watershed, there is no well defined inlet stream.	
WATERSHED	The watershed for Mine No. 51 - Pond 3 is primarily agricultural, containing farms and a few residential dwellings. The watershed appears to be as indicated on the most recent USGS topographic map.	

DOWNSTREAM CONDITIONS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	The spillway discharge channel flows in a shallow, open ditch around the topographic low below the embankment. The channel then passes through a groin between natural ground and the coarse coal refuse deposit on the left, parallels the toe of the deposit for 800 feet, and enters a stilling pond approximately 1,500 feet below the embankment. Flow from the stilling pond is via an open channel to a small impoundment located in the side of the hill above the Ellsworth Mine No. 51 Preparation Plant facility. Discharge from the small impoundment is via a corrugated metal pipe drop inlet. No open channel spillway was observed. The freeboard appears to be approximately 15 feet.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	In the first 3,000 feet below Mine No. 51 - Pond 3, no inhabited dwellings would be imperiled by high flows from the impoundment. However, the Ellsworth Mine No. 51 Preparation plant could sustain significant damage and loss of more than a few lives could result as the result of overtopping and failure of the small impoundment at the lower end of the spillway discharge channel.	

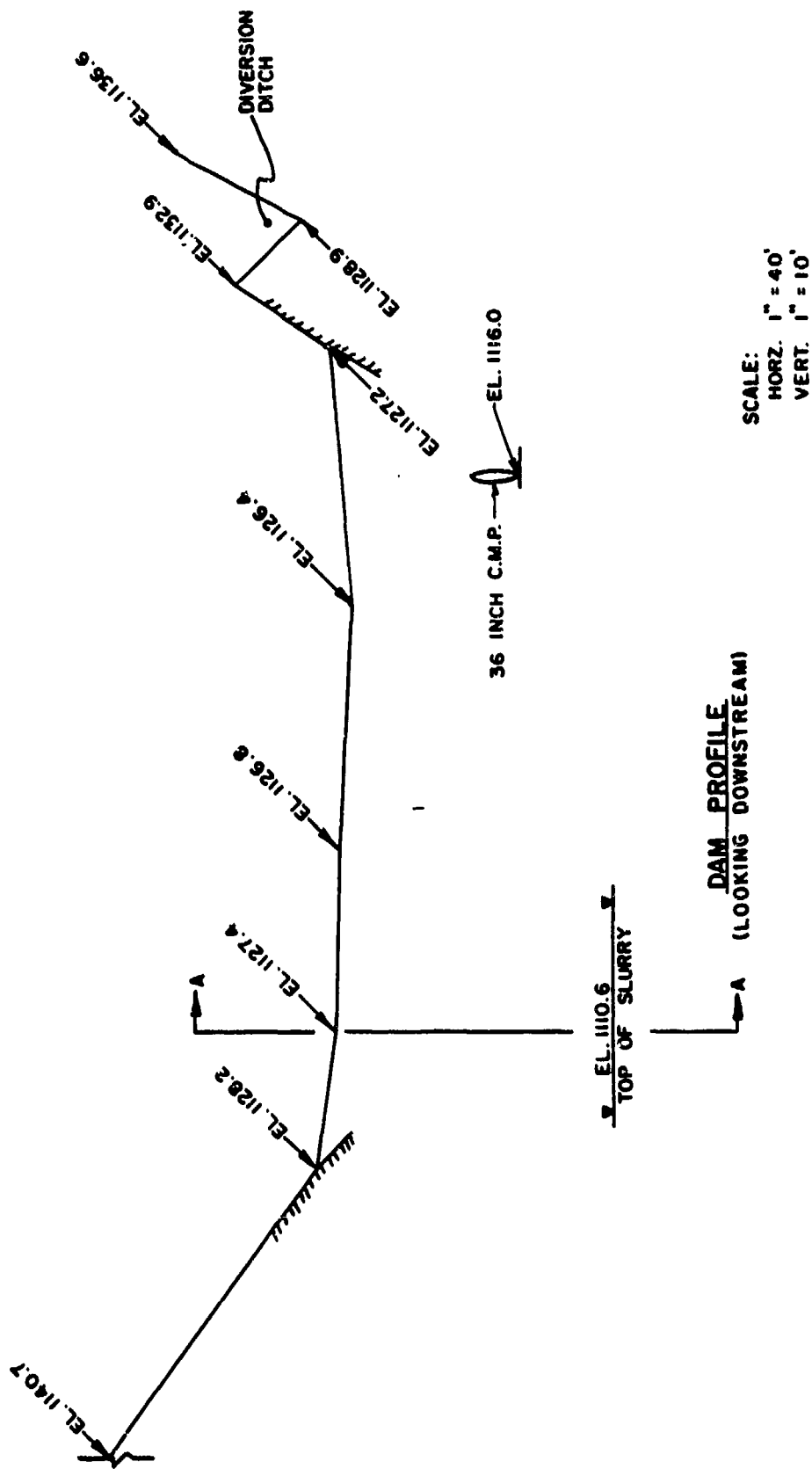
LEGEND

- T IMPOUNDING EMBANKMENT SLOPE
- Y OTHER SLOPES
- STREAM or SHORELINE
- SURFACE DRAINAGE COURSE
- APPROXIMATE LIMIT OF COAL REFUSE
- PATH
- E EROSION
- M E MINOR EROSION

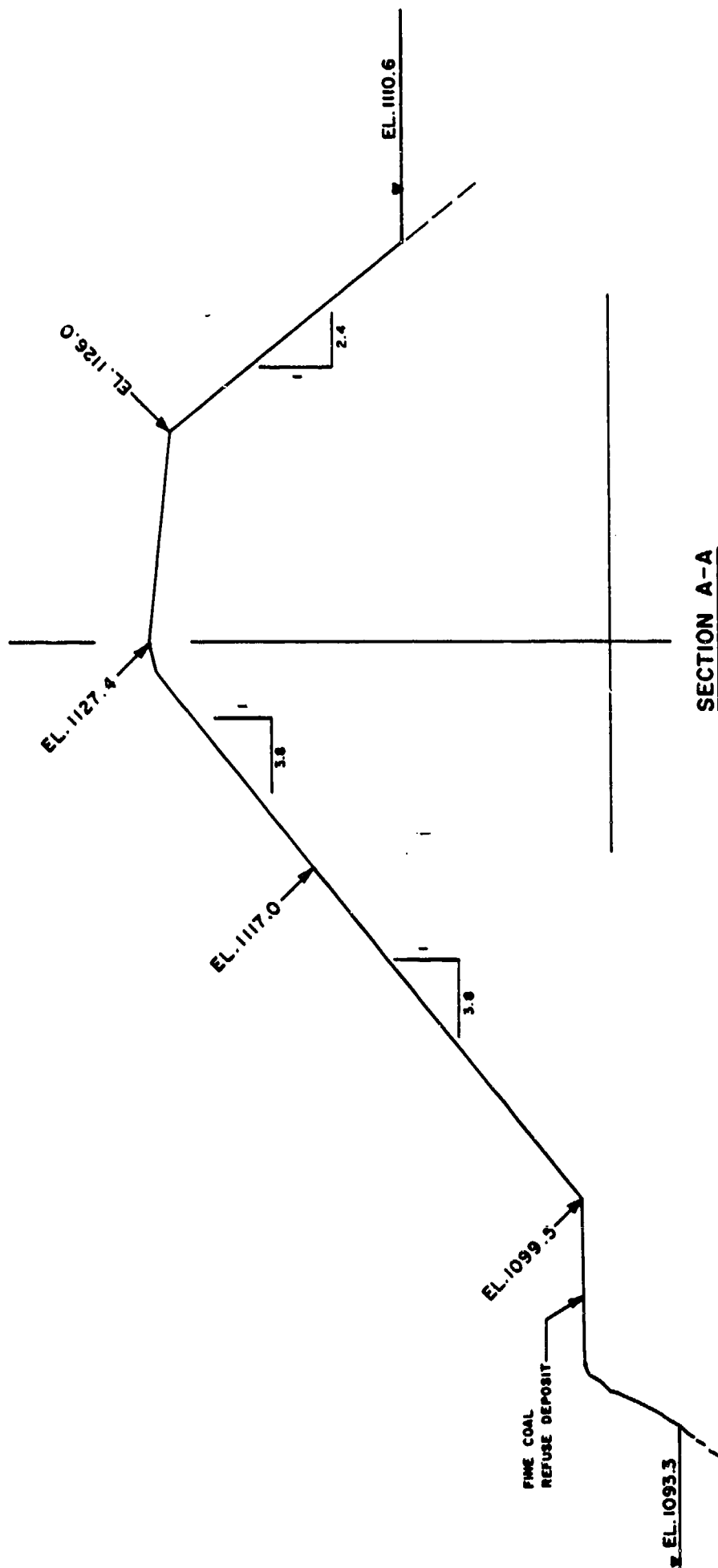


PLAN
No Scale

DATE: JULY 1981	MINE No. 51—POND 3 NATIONAL DAM INSPECTION PROGRAM	FIELD SKETCH
SCALE: NONE		
DR: JF CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH, PA. 15216	
DWG. NO. 80138H-1		



DATE: JULY 1981	MINE No. 51 — POND 3		FIELD PROFILE
SCALE: AS SHOWN	NATIONAL DAM INSPECTION PROGRAM		
DR: JF	CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH, PA. 15216	
DWG. NO. 80138H-2			



SECTION A-A

SCALE: 1" = 30'
 HORIZ. 1" = 10'
 VERT. 1" = 10'

DATE: JULY 1981		MINE No. 51— POND 3		FIELD SECTION
SCALE: AS SHOWN		NATIONAL DAM INSPECTION PROGRAM		
DR: JF	CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS		
DWG. NO. 80138H-3		GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH, PA. 15216		

APPENDIX B
ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Mine No. 51 - Pond 3
NDI No. PA 00863

ITEM	REMARKS
Design Drawings	None available.
As-Built Drawings	None available.
Regional Vicinity Map	USGS 7-1/2 minute Ellsworth and Hackett, Pennsylvania Quadrangle Maps.
*Construction History	Constructed in stages by the Bethlehem Mines Corporation, Ellsworth-Butler Division, between 1950 and 1979.
Typical Sections of Dam	None available.
Outlets-Plan Details Constraints Discharge Ratings	None available.
Rainfall/Reservoir Records	None available.
Design Reports	None available.

ITEM	REMARKS
Geology Reports	None available.
Design Computations	None available.
Hydrology and Hydraulics	None available.
Dam Stability	None available.
Seepage Studies	None available.
Materials Investigations, Boring Records, Laboratory, Field	None available.
*Post-Construction Surveys of Dam	See Topographic Map of Ellsworth Area for Bethlehem Mines Corporation, Ellsworth Division, Sheets 1 and 2 of 3, revised March 1980.**
Borrow Sources	Data not available.
Monitoring Systems	None available.
*Modifications	See Bethlehem Mines Corporation, Mine No. 51, Ellsworth, Pennsylvania, Development Plan Stage I, Drawing No. 75-681-E7 (Plate IV).** Phase II plans for Pond 3 dike implemented January 1977. Dike was constructed in the summer of 1979.

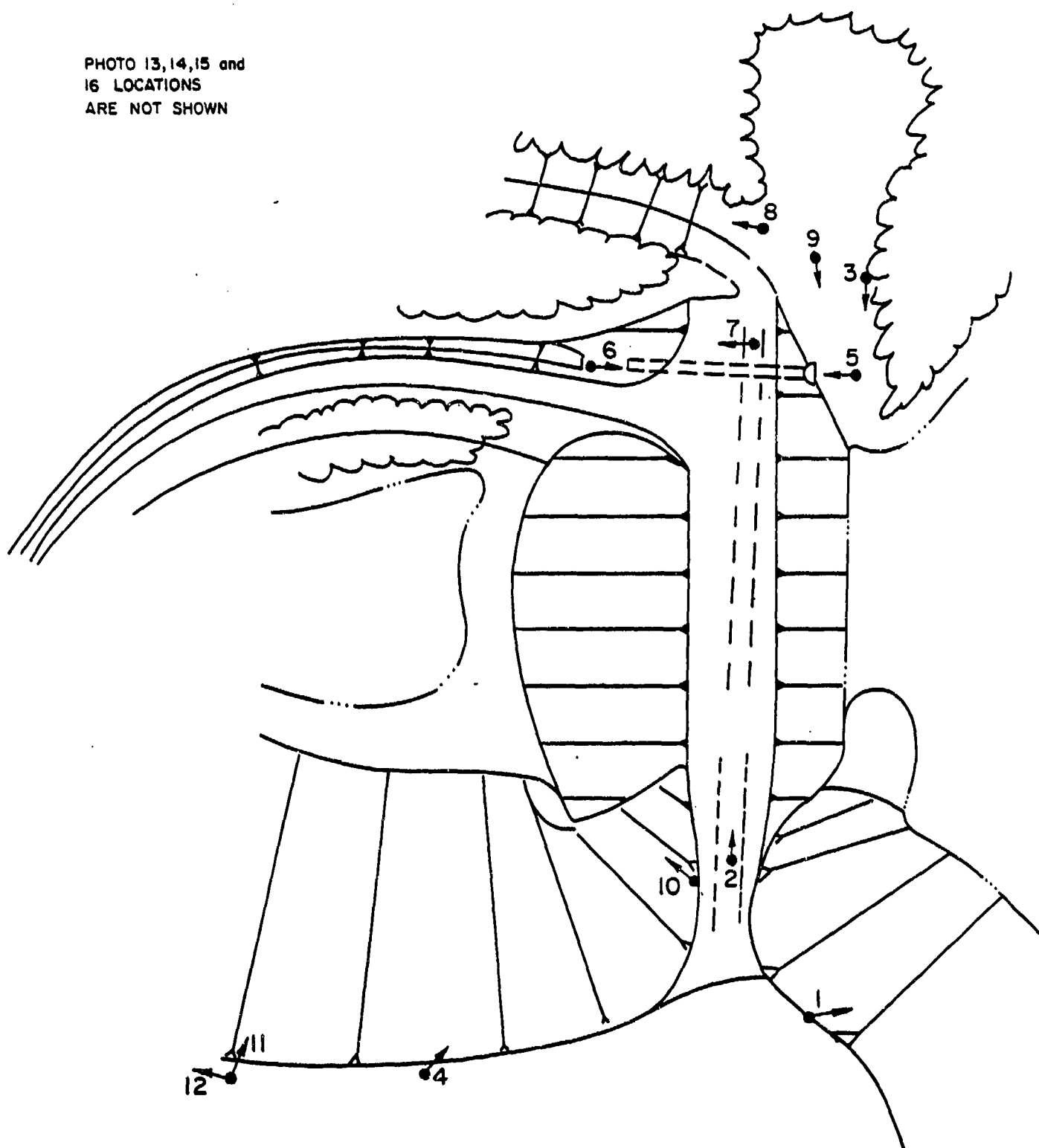
ITEM	REMARKS
High Pool Records	None reported.
Post-Construction Engineering Studies and Reports	None available.
Maintenance/Operation Records	None available.
Spillway - Plan Sections Details	None available.
Operating Equipment Plans and Details	None available.
Specifications	None available.
Miscellaneous	No additional information available.
Prior Accidents or Failure of Dam, Description Reports	None reported.

*Drawings and information obtained from Bethlehem Mines Corporation, Ellsworth-Butler Division.

**Reduced size reproduction contained in Appendix E.

APPENDIX C
PHOTOGRAPHS

PHOTO 13, 14, 15 and
16 LOCATIONS
ARE NOT SHOWN



DATE: JULY 1981

SCALE: NONE

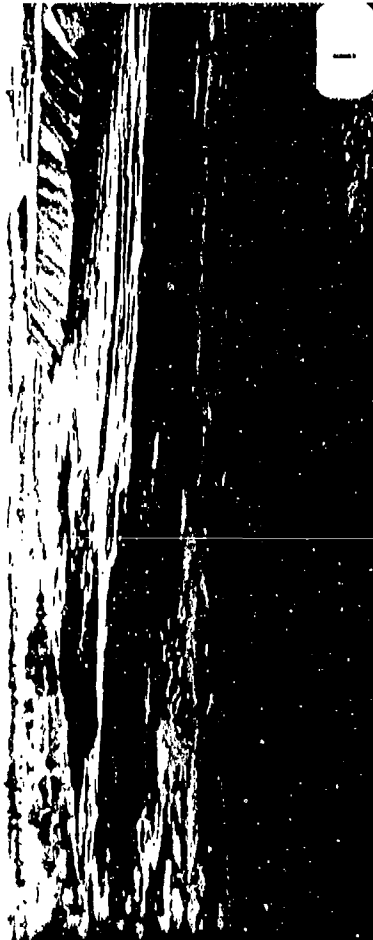
DR: JF CK:

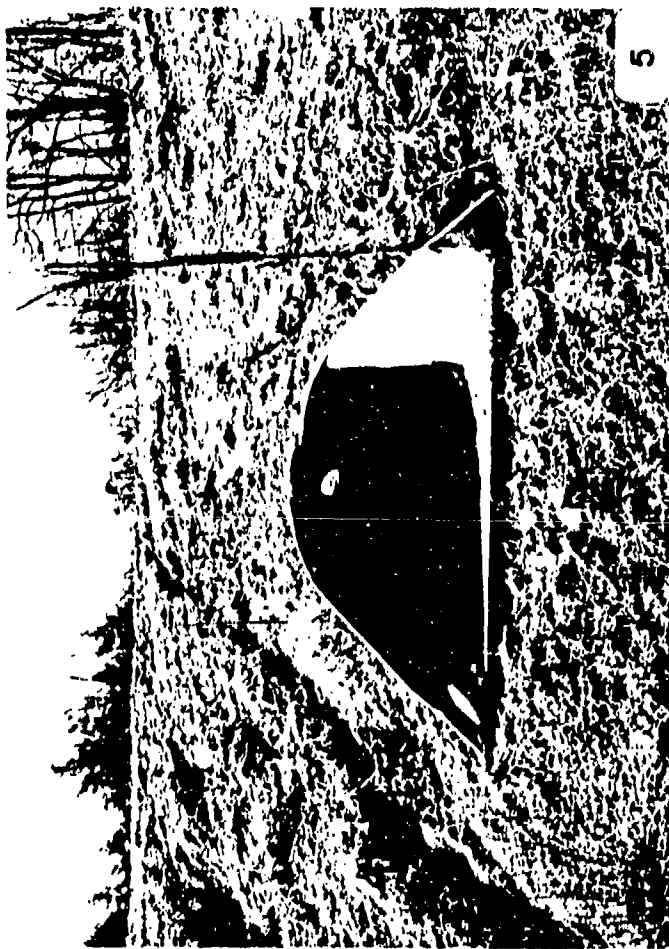
DWG. NO. 80138H

MINE No. 51—POND 3
NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES CONSULTING
GEO SYSTEMS, INC. ENGINEERS
1000 BANKSVILLE RD./PITTSBURGH, PA. 15215

PHOTO KEY MAP







10



12



9



11

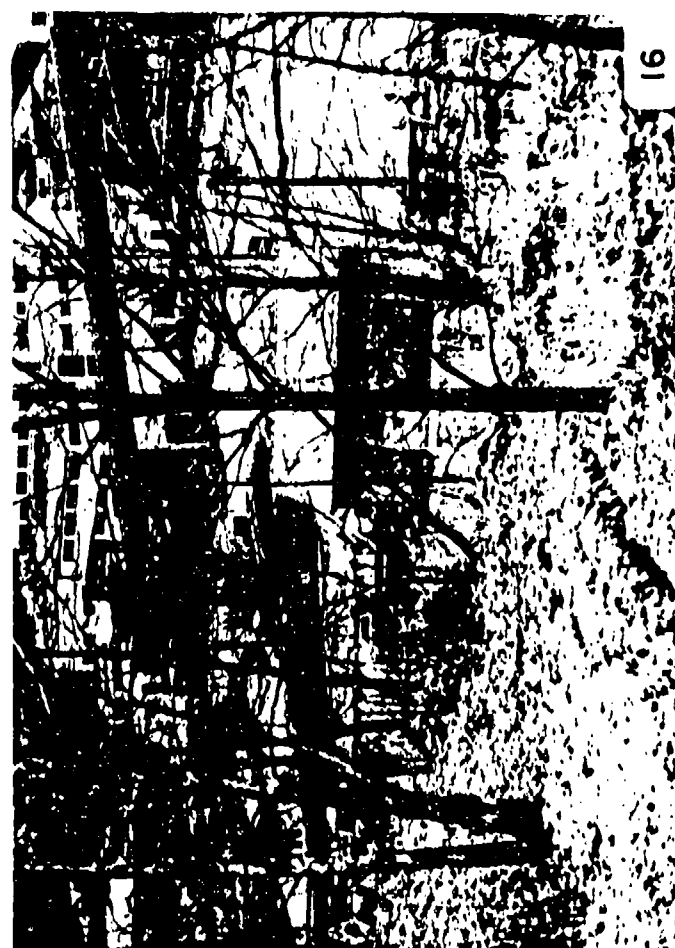


PHOTO DESCRIPTIONS

- Photo 1 Pond Overview taken from top of coarse coal refuse deposit.
- Photo 2 Embankment Crest taken from coarse coal refuse deposit.
- Photo 3 Upstream Slope.
- Photo 4 Downstream Slope showing fine coal refuse deposit at toe.
- Photo 5 Principal (and Emergency) Spillway Entrance.
- Photo 6 Principal (and Emergency) Spillway Exit.
- Photo 7 Spillway Discharge Channel.
- Photo 8 Diversion Ditch.
- Photo 9 Erosion Channel, Right Upstream Groin.
- Photo 10 Erosion Channel, Left Downstream Groin.
- Photo 11 Pond at toe of embankment.
- Photo 12 Downstream Overview, from top of coarse coal refuse deposit.
- Photo 13 Downstream Channel above West Sedimentation Pond.
- Photo 14 Downstream Hazard, Conrail railroad bridge below Mine No. 51 Preparation Plant.
- Photo 15 Downstream Hazard, West Sedimentation Pond above Mine No. 51 Preparation Plant.
- Photo 16 Downstream Hazard, Mine No. 51 Preparation Plant.

APPENDIX D
HYDROLOGY AND HYDRAULICS
ANALYSES

APPENDIX D
HYDROLOGY AND HYDRAULICS
ANALYSES

Methodology: The dam overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation: The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph: The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters, their definition and how they were obtained for these analyses.

<u>Parameter</u>	<u>Definition</u>	<u>Where Obtained</u>
Ct	Coefficient representing variations of watershed	From Corps of Engineers
L'	Length from centroid of watershed to spillway	From USGS 7.5 minute topographic map
Cp	Peaking coefficient	From Corps of Engineers
A	Watershed size	From USGS 7.5 minute topographic map

3. Routing: Reservoir routing is accomplished by using Modified Puls routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the spillway and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of an outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation-discharge relationship.

Storage in the pool area is defined by an area-elevation relationship from which the computer calculates storage. Surface areas are either planimeted from available mapping or USGS 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping: Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominately farmland.

ELEVATION-TOP OF MAXIMUM NORMAL POOL
(STORAGE CAPACITY): 1116.0 (2618 acre-feet)

ELEVATION-TOP FLOOD CONTROL POOL
(STORAGE CAPACITY): 1126.4 (3496 acre-feet)

ELEVATION-MAXIMUM DESIGN POOL: Unknown

ELEVATION-TOP DAM: 1126.4 (minimum)

OVERFLOW SECTION (Principal and Emergency Spillway)

- a. Elevation 1116.0
- b. Type Three foot diameter CMP
- c. Width N/A
- d. Length N/A
- e. Location Spillover Through Embankment
- f. Number and Type of Gates None

OUTLET WORKS AND DRAWDOWN FACILITY

- a. Type Submerged pump
- b. Location Near upstream end of pond
- c. Entrance Invert Unknown
- d. Exit Inverts Unknown

HYDROMETEOROLOGICAL GAGES

- a. Type None
- b. Location N/A
- c. Records None

MAXIMUM REPORTED NON-DAMAGING
DISCHARGE None reported

HEC-1 DAM SAFETY VERSION
HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Mine No. 51 - Pond 3	NDI NO. PA 00863
Probable Maximum Precipitation (PMP)	24.2*
Drainage Area	0.28 sq. mi.
Reduction of PMP Rainfall for Data Fit	0.8 (24.2)
Reduce by 20%, therefore PMP rainfall	=19.4 inches
Adjustments of PMF for Drainage Area (Zone 7)	
6 hrs.	102%
12 hrs.	120%
24 hrs.	130%
48 hrs.	140%
Snyder Unit Hydrograph Parameters	
Zone	29**
C_p	0.5
C_t	1.6
L	0.47 mile
$t_p = C_t (L')^{0.6}$	1.02 hours
Loss Rates	
Initial Loss	1.0 inch
Constant Loss Rate	0.05 inch/hour
Base Flow Generation Parameters	
Flow at Start of Storm	1.5 cfs/sq.mi=0.42 cfs
Base Flow Cutoff	0.05 x Q peak
Recession Ratio	2.0
Spillway Data	
Diameter	3 feet
Freeboard (minimum)	10.4 feet
Flow Control	Inlet
Discharge Capacity	Not calculated***

* Hydrometeorological Report 33

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

*** PMF Reservoir routing performed assuming pool level is at principal spillway invert and that pipe is blocked.

ACKENHEIL & ASSOCIATES
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Job MINE NO. 51 POND 3 Job No. 80138H
Subject DATA Input
Made By JPH Date 4/22/81 Checked LEB Date 6/15/81

LOSS RATE AND BASE FLOW Parameters

As Recommended BY Corp of Engineers, BALTIMORE District

STATL = 1 INCH
CNSTL = 0.05"/hr.
STATQ = 1.5 cfs/mi²
QRCN = 0.05 (5% of Peak Flow)
RTIOR = 2.0

Elevation - Storage Relationships

There is no information available concerning the storage capacity of this facility. Therefore a stage-storage relationship was developed using a 1954 Elkworth 7.5 minute quadrangle.

Elevation	AREA (Acres)	D Storage (Acres-Ft.)	Total Storage (Acres-Ft.)
1020	0		0
1040	9.2	61.3	61.3
1060	13.8	228.5	289.8
1080	32.1	446.3	736.1
1100	48.7	802.3	1538.4
1120	88.2	1349.6	2888.0
1130	101.9	949.7	3837.7

STORAGE	\$S	0	61	290	736	1538	2888	3838
Elevation	\$E	1020	1040	1060	1080	1100	1120	1130

ACKENHEIL & ASSOCIATES
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Job MINE No 51 Pond 3 Job No. 80/384
Subject DATA Input
Made By JPA Date 4/22/81 Checked JEB Date 6/15/81

Overtop Parameters

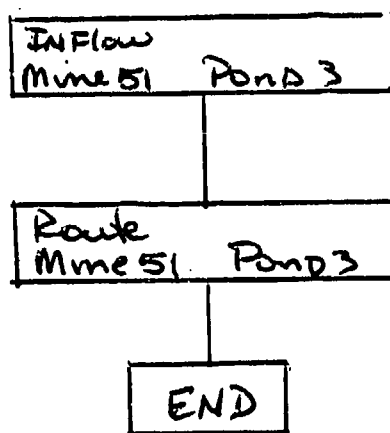
Top of Dam Elevation (minimum)	1126.4
Length of Dam	200 FEET
Coefficient of Discharge	3.09

Spillway Parameters

Invert Elevation	1116.0
------------------	--------

SPILLWAY ASSUMED BLOCKED FOR HEC-1 RATING

Program Schedule



 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

1	A1	NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS										
2	A2	HYDROLOGIC AND HYDRAULIC ANALYSIS OF MINE 51, POND 3										
3	A3	PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD										
4	B	300	0	10	0	0	0	0	0	0	-4	0
5	B1	5										
6	J	1	2	1								
7	J1	1.	.5									
8	K	0	1					1				
9	K1	INFLOW HYDROGRAPH FOR MINE 51, POND 3										
10	M	1	1	0.28		0.28					1	
11	P		24.2	102	120	130	140					
12	T							1.0	.05			
13	W	1.02	0.5									
14	X	-1.5	-0.05	2.0								
15	K	1	2					1				
16	K1	ROUTING AT MINE 51, POND 3										
17	Y			1	1							
18	Y1	1								-1116.		
19	\$S	0.	61.	290.	736.	1538.	2888.	3838.				
20	\$E	1020.	1040.	1060.	1080.	1100.	1120.	1130.				
21	\$S	1116.	.0001	3.09	1.5							
22	\$D	1126.4	3.09	1.5	200.							
23	K	99										
24	A											
25	A											
26	A											
27	A											
28	A											

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
END OF NETWORK	

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE: 16 JUN 81
 RUN TIME: 8.54.39

NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS
 HYDROLOGIC AND HYDRAULIC ANALYSIS OF MINE 51, POND 3
 PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD

JOB SPECIFICATION									
NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	10	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

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

RTIOS= 1.00 0.50

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR MINE 51, POND 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	LAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA									
IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	0.28	0.0	0.28	0.0	0.0	0	1	0

PRECIP DATA								
SPFE	PMS	R6	R12	R24	R48	R72	R96	
0.0	24.20	102.00	120.00	130.00	140.00	0.0	0.0	

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA										
LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	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= 1.02 CP=0.50 NTA= 0

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

UNIT HYDROGRAPH 48 END-OF-PERIOD ORDINATES, LAG= 1.02 HOURS, CP= 0.50 VOL= 1.00									
5.	19.	38.	58.	76.	87.	89.	82.	72.	64.
57.	50.	44.	39.	35.	31.	27.	24.	21.	19.
17.	15.	13.	12.	10.	9.	8.	7.	6.	6.
5.	4.	4.	3.	3.	3.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	1.		

END-OF-PERIOD FLOW													
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
						SUM	27.10 24.68 2.42 26604. (688.)(627.)(61.)(753.34)						

HYDROGRAPH ROUTING

ROUTING AT MINE 51, POND 3

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

ROUTING DATA								
GLOSS	GLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR	
0.0	0.0	0.0	1	1	0	0	0	

NSTPS	NSTD	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-1116.	0

CAPACITY=	0.	61.	290.	736.	1538.	2088.	3838.
ELEVATION=	1020.	1040.	1060.	1080.	1100.	1120.	1130.

CREL	SPWID	COQW	EXPW	ELEV	COQL	CAREA	EXPL
1116.0	0.0	3.1	1.5	0.0	0.0	0.0	0.0

DAM DATA			
TOPEL	COQD	EXPD	DAMWID
1126.4	3.1	1.5	200.

PEAK OUTFLOW IS 0. AT TIME 50.00 HOURS
 PEAK OUTFLOW IS 0. AT TIME 50.00 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)

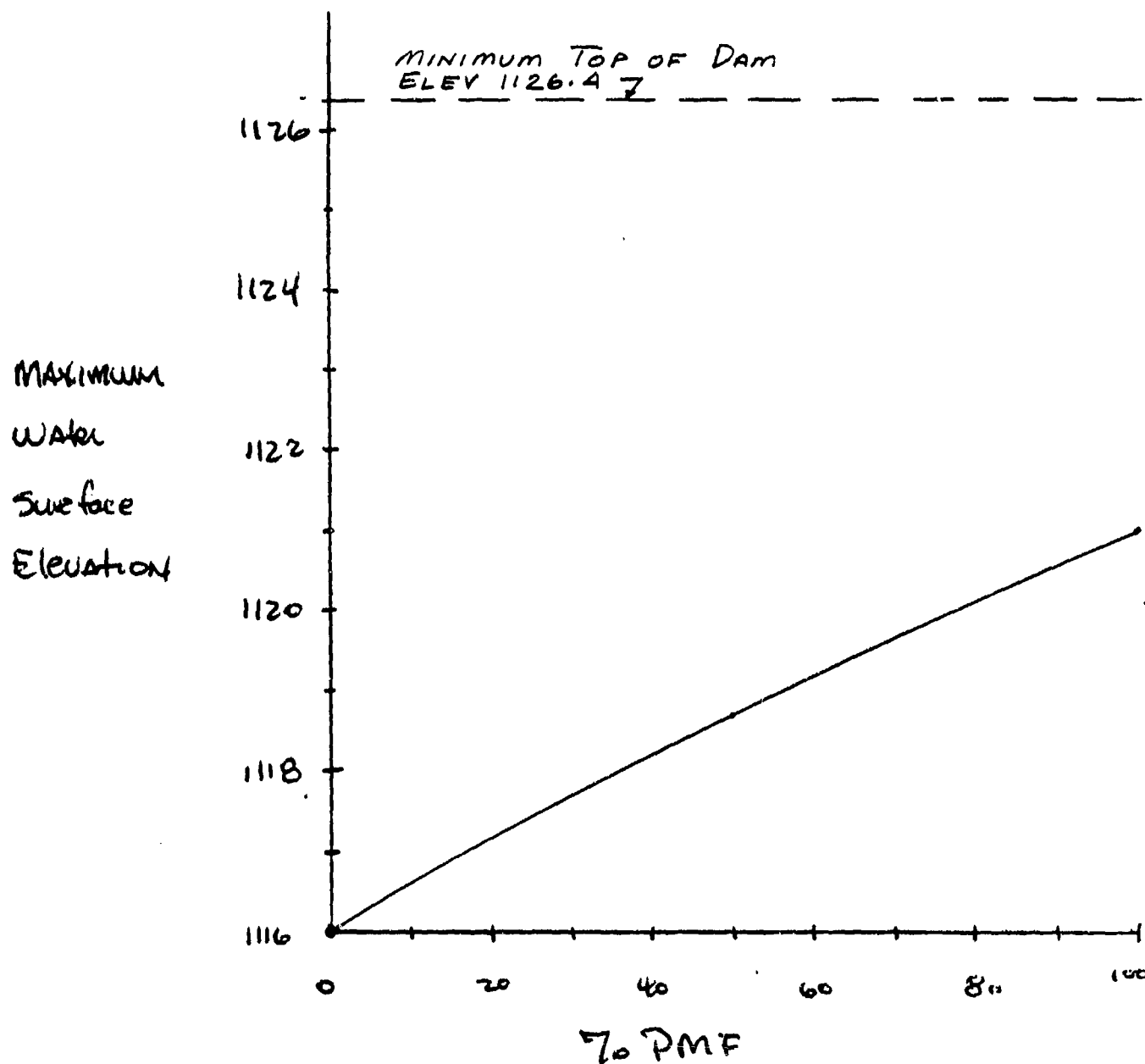
OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS	
				RATIO 1 1.00	RATIO 2 0.50
HYDROGRAPH AT	1	0.28	1	869.	435.
	(	0.73)	(	24.61)(	12.31)(
ROUTED TO	2	0.28	1	0.	0.
	(	0.73)	(	0.00)(	0.00)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1			INITIAL VALUE	SPILLWAY CREST	TOP OF DAM			
	ELEVATION		1116.00	1116.00	1126.40			
	STORAGE		2618.	2618.	3496.			
	OUTFLOW		0.	0.	0.			
	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	1120.99	0.0	2982.	0.	0.0	50.00	0.0
	0.50	1118.69	0.0	2800.	0.	0.0	50.00	0.0

ACKENHEIL & ASSOCIATES
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Job Mine No 51 Pond 3 Job No. 80138H
Subject Hydrologic Performance Plot
Made By JPH Date 4/23/81 Checked JEB Date 6/15/81



APPENDIX E

PLATES

LIST OF PLATES

- Plate I Regional Vicinity Map.
- Plate II Topographic Map of Ellsworth Area for
Bethlehem Mines Corporation, Ellsworth Division,
dated May 1974, Sheet 1 of 3, revised March 1980.
- Plate III Topographic Map of Ellsworth Area for
Bethlehem Mines Corporation, Ellsworth Division,
dated May 1974, Sheet 2 of 3, revised March 1980.
- Plate IV Development Plan, Stage I, Proposed Coal Refuse
Disposal Facility, Mine No. 51, Ellsworth,
Pennsylvania, Drawing No. 75-681-E7, Figure No. 4.

N 8 000

N 7 000

N 6 000

N 5 000

N 4 000

N 3 000

N 2 000

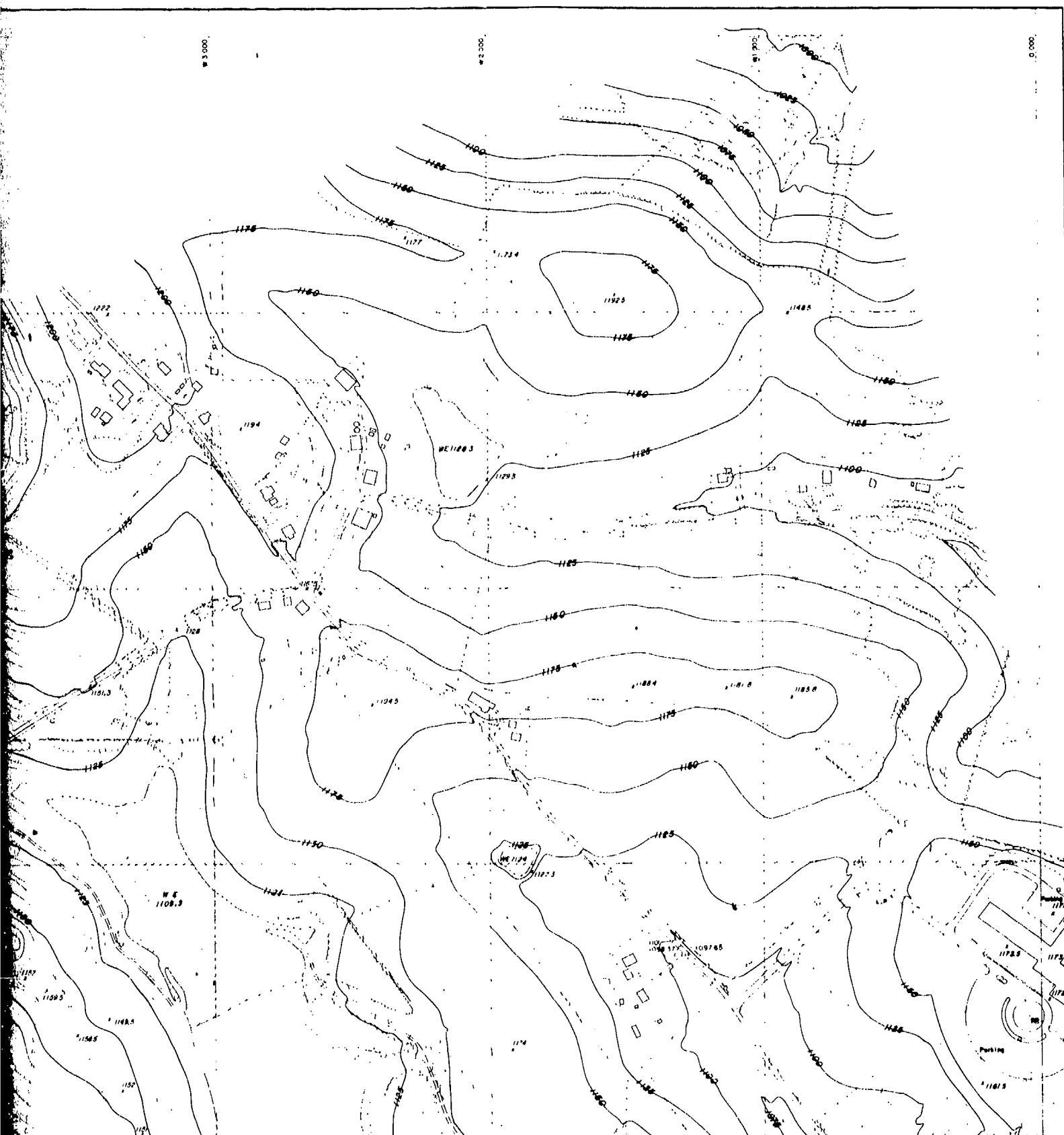
N 1 000

THIS MAP PREPARED BY PHOTOGRAMMETRIC METHODS
FROM AERIAL PHOTOGRAPHY DATED NOVEMBER 20, 1973
BY L. ROBERT KIMBALL, CONSULTING ENGINEERS,
EBENSBURG, PENNSYLVANIA

THIS MAP IN PART REVISED FROM NEW AERIAL
PHOTOGRAPHY DATED FEBRUARY 27, 1976, MARCH 27, 1980

MATCH SHEET 2





MATCH SHEET 2



TOPOGRAPHIC MAP
OF
ELLSWORTH AREA
FOR
BETHLEHEM MINES CORPORATION
ELLSWORTH DIVISION
SCALE 1"=200' MAY 1974
CONTOUR INTERVAL = 5'

SHEET 1 OF 3

PLATE II

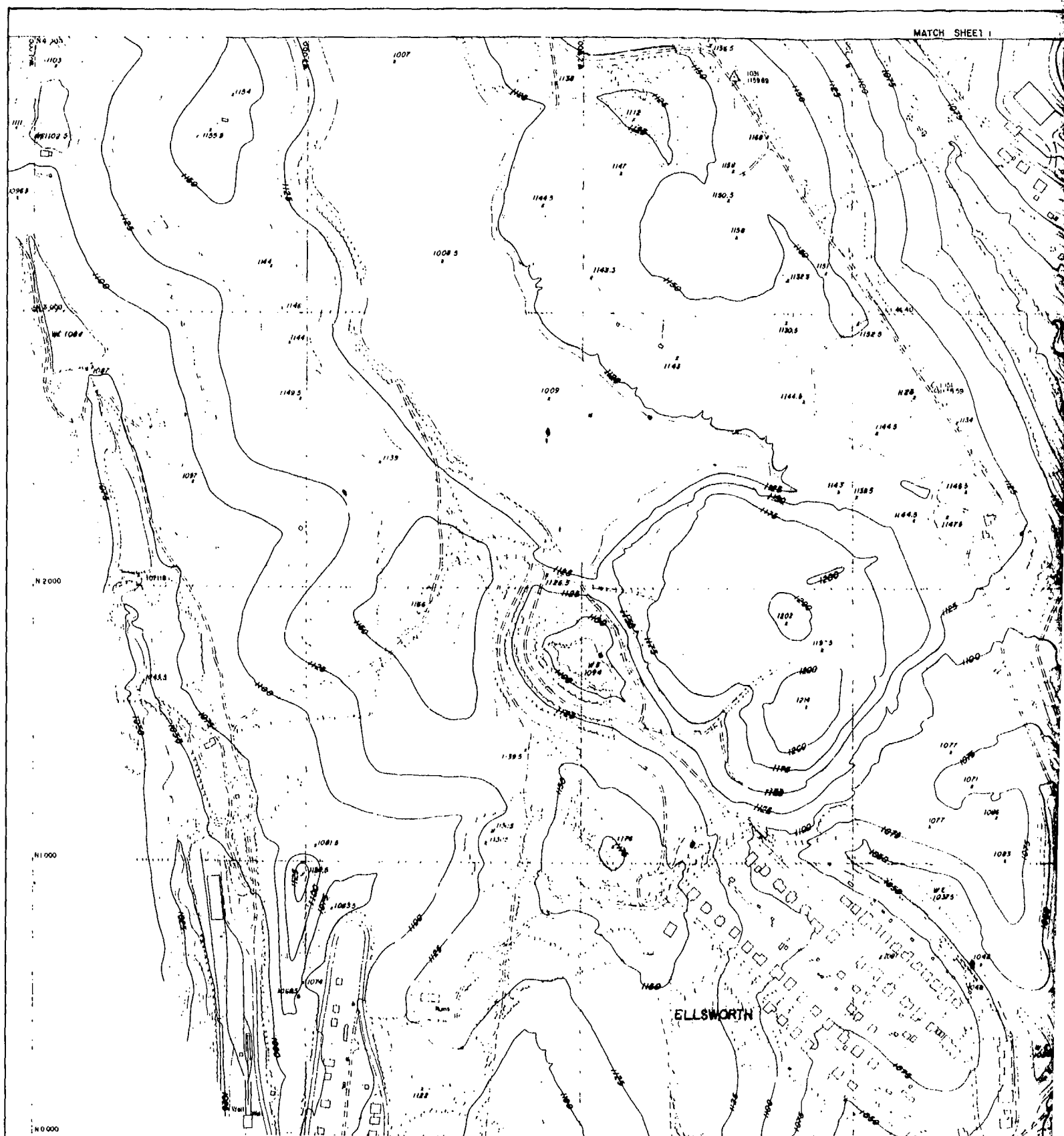
12

MATCH SHEET 1

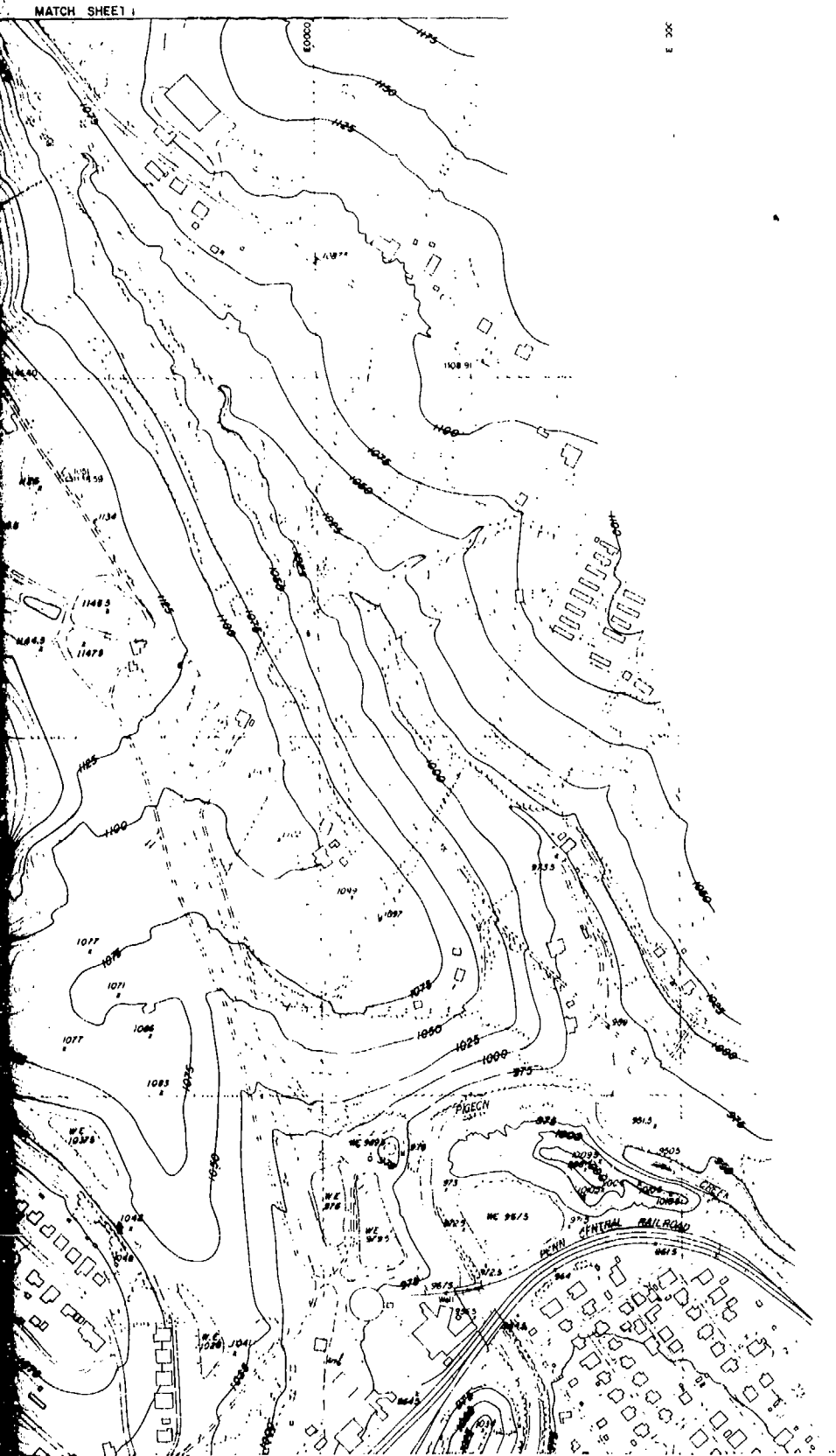
MATCH SHEET 5

THIS MAP PREPARED BY PHOTOGRAMMETRIC METHODS
FROM AERIAL PHOTOGRAPHY DATED NOVEMBER 20, 1973
BY L. ROBERT KIMBALL, CONSULTING ENGINEERS,
EBENSBURG, PENNSYLVANIA.

THIS MAP IN PART REVISED FROM NEW AERIAL
PHOTOGRAPHY DATED FEBRUARY 27, 1976, MARCH 27, 1980



MATCH SHEET 1



MATCH SHEET 3



TOPOGRAPHIC MAP
OF
ELLSWORTH AREA
FOR
BETHLEHEM MINES CORPORATION
ELLSWORTH DIVISION
SCALE 1"=200' MAY 1974
CONTOUR INTERVAL = 5'

SHEET 2 OF 3

PLATE III

12

N

STAGE I SLURRY @ EL. 1103.3

DECANT PIPE REMOVED AT
START OF STAGE IV
(SEE DWG. 75-681-E11)

CONVEYANCE CHANNEL FROM
DECANT PIPE (SEE TEMPORARY
DIVERSION DITCH DETAILS ON
DWG. 75-681-E12)

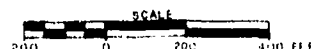
SPRING COLLECTION DRAINS AT
EXISTING SEEPS (SEE DWG. 75-681-E12)

REGRADED BENCHES
IN EXISTING SLOPE
FOR EROSION CONTROL
(SEE DWG. 75-681-E12)

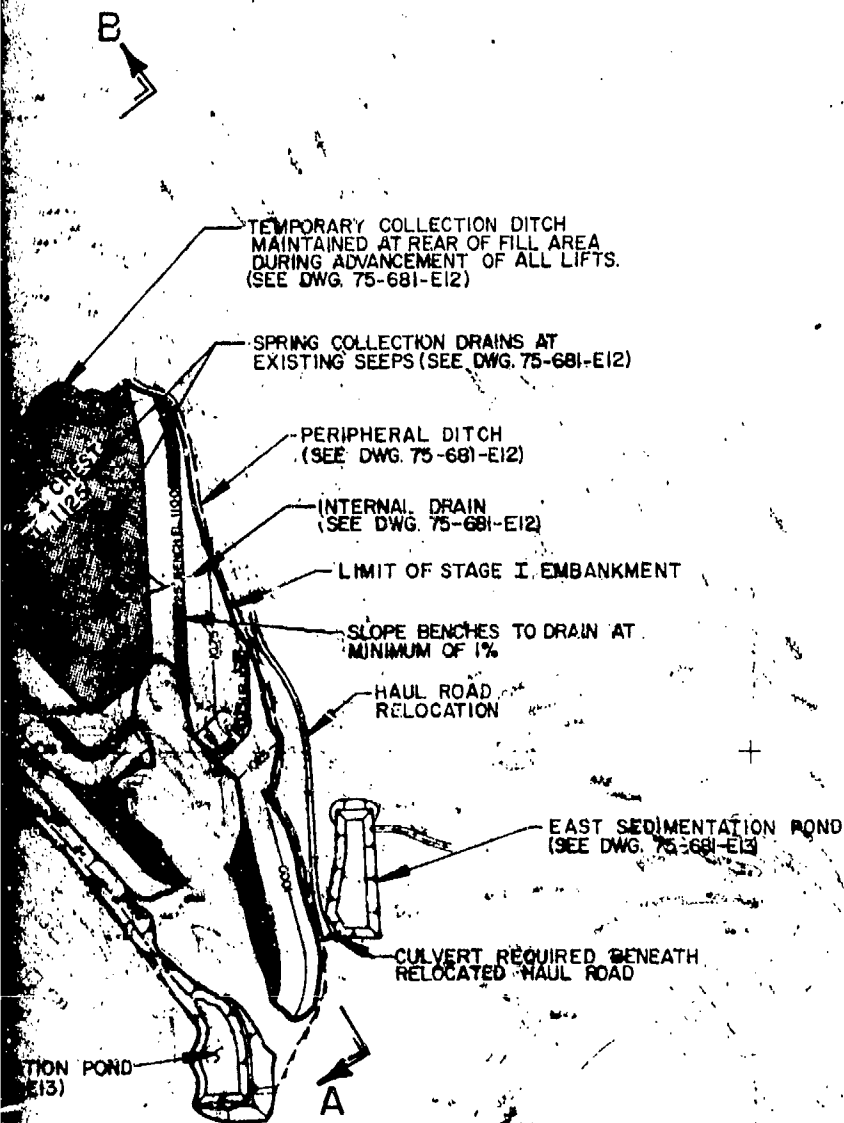
SPILLWAY CHANNEL AND
RIPRAP STILLING POOL
CONSTRUCTED AT START
OF STAGE I (SEE DWG. 75-681-E11)
(ELLSWORTH)

WEST SEDIMENTATION POND
(SEE DWG. 75-681-E13)

PLAN



REFERENCE
THIS MAP PREPARED BY PHOTOGRAMMETRIC METHODS
FROM AERIAL PHOTOGRAPHY DATED NOV. 20, 1973
BY L. ROBERT KIMBALL CONSULTING ENGINEERING,
EBENSBURG, PENNSYLVANIA
REVISED IN PART FROM NEW AERIAL PHOTOGRAPHY
DATED FEBRUARY 27, 1976



STAGE I = 1.9 YEARS

NOTES:

- 1 FOR SECTION A-A, B-B, AND C-C, SEE DWG. 75-681-E10.
- 2 COARSE REFUSE PRODUCTION = 429,000 ton/yr.
COARSE REFUSE DRY DENSITY = 100 pcf
FINE REFUSE PRODUCTION = 66,000 ton/yr.
FINE REFUSE DRY DENSITY = 40 pcf
- 3 SLURRY LEVELS DURING STAGES REPRESENT AVERAGE POND ELEVATION.
- 4 YEAR 0 = 1976

EXHIBIT H-1

BETHLEHEM MINES CORPORATION MINE NO 51 ELLSWORTH, PENNSYLVANIA			
PITTSBURGH • CHESTERTON • WILKINGTON • PLYMOUTH • BUNNELL			
DEVELOPMENT PLAN STAGE I			
PROPOSED COAL REFUSE DISPOSAL FACILITY MINE NO 51 ELLSWORTH, PENNSYLVANIA			
DRAWN BY	DAM	11-3-76	75-681-E7 SHEET NO. 4
CHECKED BY	TAD	11-23-76	
APPROVED BY	MST	11-23-76	

PLATE IV

12

APPENDIX F

GEOLOGY

GEOLOGY

Geomorphology

Mine No. 51 - Pond 3 is located within the Pittsburgh Plateau section of the Appalachian Plateau Physiographic Province. This area is characterized by gently folded sedimentary rocks which have been incised by streams to form steep sided valleys. The site is located near the head of an unnamed tributary to Pigeon Creek. The valley bottom of the unnamed tributary is about 200 feet below the adjacent hilltops. These rounded hilltops are at Elevation 1200 to 1300 feet, and in a regional sense are part of a broad, undulating plateau.

Structure

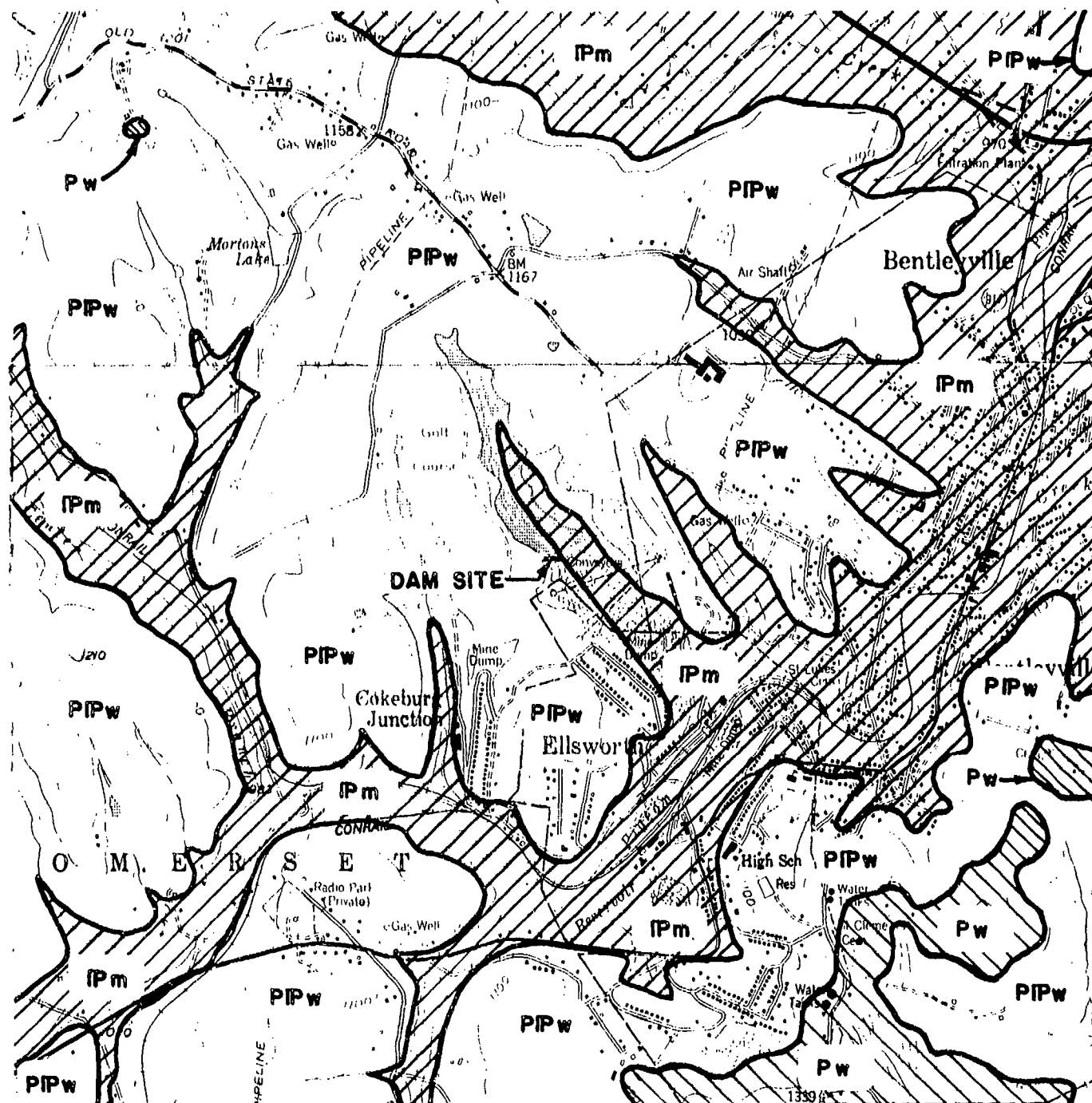
The site lies on the western flank of the Waynesburg Syncline, the axis of which plunges to the southwest. Strata in the immediate vicinity of the dam, however, are practically flat lying. Faulting has not been documented in the area of the dam and no observations were made that would indicate faulting in the rocks outcropping around the dam.

Stratigraphy

Rocks outcropping in the immediate vicinity of the site belong to the Pennsylvanian Age Monongahela Formation and the Permian Age, Waynesburg and Washington Formations. The major rock types in all these formations are cyclic sequences of shale, limestone, sandstone, and coal.

Mining Activity

The Pittsburgh Coal Seam, the lowermost unit of the Monongahela Formation, lies about 350 feet below the crest of the dam and has been deep mined beneath the dam and impoundment. The Waynesburg Coal Seam, which is the lowermost unit of the Waynesburg Formation, lies beneath the dam at an elevation of about 1060 but has not been surface or deep mined to date.



ELLSWORTH and HACKETT QUADRANGLES, ALLEGHENY COUNTY, PENNSYLVANIA

SCALE: 0 1/2 MILE 1:24000
 CONTOUR INTERVAL 20 FT. DATUM IS MEAN SEA LEVEL
 ——— FORMATION CONTACT

DATA OBTAINED FROM PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY GREATER PITTSBURGH REGION
 GEOLOGIC MAP AND CROSS SECTIONS, 1973 and GREATER PITTSBURGH REGION STRUCTURE CONTOUR MAP, 1973

DATE: JULY 1981		MINE No. 51 - POND 3 NATIONAL DAM INSPECTION PROGRAM		GEOLOGIC MAP
SCALE: 1" = 2000'				
DR: JF	CK:	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.		

AGE	SCORING	2-1237	COLUMNAR SECTION	PROMINENT BEDS
QUATERNARY		61		PLEISTOCENE GLACIAL OUTWASH, RIVER TERRACE DEPOSITS AND ALLUVIUM
PERMIAN	DUNKARD (P4)	WASHINGTON GREENE (P6)		UPPER WASHINGTON LIMESTONE
		WASHINGTON (P4)		WASHINGTON COAL
		WAYNESBURG (P4)		WAYNESBURG SANDSTONE
		WAYNESBURG (P4)		WAYNESBURG COAL
PENNSYLVANIAN	MONONGAHELA (P4)	UNIONTOWN (P4)		UNIONTOWN SANDSTONE
		UNIONTOWN (P4)		UNIONTOWN COAL
		SEWICKLEY (P4)		SEWICKLEY LIMESTONE
		SEWICKLEY (P4)		SEWICKLEY COAL
	CONEMAUGH (P4)	PITTSBURGH (P4)		PITTSBURGH SANDSTONE
		PITTSBURGH (P4)		PITTSBURGH COAL
		CONNELLSVILLE (P4)		CONNELLSVILLE SANDSTONE
		MORGANTOWN (P4)		MORGANTOWN SANDSTONE
	GLACIUS (P4)	AMES (P4)		AMES LIMESTONE
		PITTSBURGH (P4)		PITTSBURGH REDBEDS
		SALTSBURGH (P4)		SALTSBURGH SANDSTONE
		MAHONING (P4)		MAHONING SANDSTONE
MISSISSIPPIAN	ALLEGANY (P4)	UPPER FREEPORT (P4)		UPPER FREEPORT COAL
		UPPER KITTANNING (P4)		UPPER KITTANNING COAL
		WORTHINGTON (P4)		WORTHINGTON SANDSTONE
		LOWER KITTANNING (P4)		LOWER KITTANNING COAL
	POTTSVILLE (P4)	HOMEWOOD (P4)		HOMEWOOD SANDSTONE
		MERCER (P4)		MERCER SANDSTONE, SHALE & COAL
		CONNOQUENESSING (P4)		CONNOQUENESSING SANDSTONE
		POCONO (P4)		POCONO SANDSTONE
DEVONIAN	POCONO (P4)	CUYAHOGA (P4)		CUYAHOGA SHALE
		BEREA (P4)		BEREA SANDSTONE

DATE: JULY 1981

SCALE: 1"=360'

DR: JF CK: JEB

MINE No. 51—POND 3

NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS

GEO SYSTEMS, INC.
1000 BANKSVILLE RD./PITTSBURGH, PA. 15216

GEOLOGIC
COLUMN