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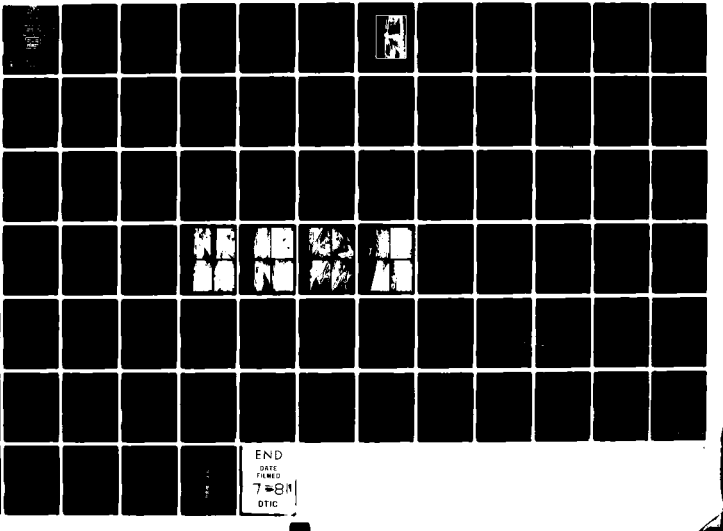

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LEVEL I

OHIO RIVER BASIN,
TRIBUTARY TO CENTER BRANCH - PIGEON CREEK,
WASHINGTON COUNTY,

PENNSYLVANIA.

NDI No. PA 01145

PENN DER No. 63-89

National Dam Inspection Program.

MINE No. 60 - POND 6 (NDI Number PA Ø1145) (PENN DER Number 63-89)

~~PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES~~
~~BUREAU OF WATER QUALITY MANAGEMENT~~
~~DIVISION OF DAM SAFETY~~

JUL 1 0 1981

PHASE I INSPECTION REPORT.

~~NATIONAL DAM INSPECTION PROGRAM~~

DACW 31-81-C-0027

May 81

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PREPARED FOR

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

BY

ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.
CONSULTING ENGINEERS
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MAY 1981

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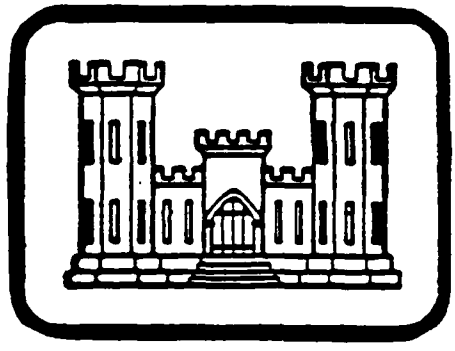
OHIO RIVER BASIN

MINE NO. 60-POND 6
WASHINGTON COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI NO. PA 01145
PennDER NO. 63-89

BETHLEHEM MINES CORPORATION
ELLSWORTH-BUTLER DIVISION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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: May 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. 60-Pond 6
STATE LOCATION:	Pennsylvania
COUNTY LOCATION:	Washington
STREAM:	Unnamed tributary to Center Branch of Pigeon Creek.
DATE OF INSPECTIONS:	18 March and 26 March 1981
COORDINATES:	Lat. 40°08'56" Long. 80°03'30"

ASSESSMENT

Based on a review of available information and visual observations of conditions as they existed on the date of the field inspections, the general condition of the Mine No. 60-Pond 6 is considered to be good.

This assessment is based primarily on visual observations of the embankment and appurtenances and hydrologic/hydraulic analyses of reservoir/spillway capacity.

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. 60-Pond 6'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 Phase I investigation revealed deficiencies which should be corrected or improved through implementation of the following recommended remedial, monitoring and/or improvement efforts.

RECOMMENDATIONS

1. Outlet Works: Install the proposed outlet works as soon as possible, to provide a means for draining the impoundment zone.

2. Emergency Operation and Warning Plan: The owner should develop an Emergency Operation and Warning Plan including:

a. Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

b. Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

c. Procedures for drawdown of the reservoir under emergency conditions.

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

3. Remedial Work: The visual inspection of Mine No. 60-Pond 6 disclosed several minor deficiencies which should be corrected or monitored. These include:

a. Improvements to downstream bench drainage to eliminate wet zones and embankment erosion conditions.

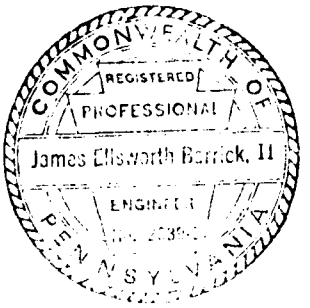
b. Completing the embankment crest to design elevation. The crest should be graded to promote proper drainage and should be surfaced to prevent wheel rutting by vehicles that may traverse the crest.

c. Implementation of a regularly scheduled monitoring program to observe the seepage at the downstream toe of the embankment for changes in water quality and/or quantity.

4. Follow-Up Remedial Work: Following the establishment of a vegetal cover on the embankment, spillway and adjacent slopes, backfill all erosional gullies and repair all surface slough zones and revegetate to achieve uniform, stable slopes.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)

Mine No. 60-Pond 6



Samuel G. Mazzella 8 May 1981
Samuel G. Mazzella Date
Project Engineer

James P. Hannan 8 May 1981
James P. Hannan Date
Project Engineer

James E. Barrick 8 May 81
James E. Barrick, P.E. Date
PA Registration No. 022639-E

Approved by: James W. Peck
James W. Peck
Colonel, Corps of Engineers
District Engineer

22 May 81
Date

MINE No. 60 - POND 6

OVERVIEW

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
MINE NO. 60-POND 6
NATIONAL I. D. NO. PA 01145
PennDER No. 63-89

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. 60-Pond 6 was designed and constructed as a earthfill structure. The embankment is 845 feet long, with a toe to crest height of 68.2 feet and a crest width of about 20 feet. The embankment's upstream slope was observed to be 2H:1V above the waterline; the downstream slope was observed to be 2H:1V above the bench and 2.1H:1V below the bench.

(2) Principal (and Emergency) Spillway: The spillway for the Mine No. 60-Pond 6 consists of a 20 foot wide trapezoidal open channel in the left abutment.

(3) Outlet Works: An outlet works consisting of a submerged pump and pipeline is to be located near the rear of the impoundment. Water is to be returned to the Mine No. 60 Preparation Plant for reuse in the coal cleaning process. The outlet works was not installed at the time of the inspection.

(4) Freeboard Conditions: Freeboard between the the spillway crest and the reservoir pool level was 38.8 feet at the time of inspection.

(5) Downstream Conditions: The unnamed creek below the Mine No. 60-Pond 6 flows through an inhabited valley for about 1.5 miles to a confluence with the Center Branch of Pigeon Creek. Pigeon Creek flows into the Monongahela River near Monongahela, Pennsylvania. In the first 5 miles below the Mine No. 60-Pond 6, at least 5 inhabited dwellings, several major secondary roads, a railyard and a reservoir lie within the limits of the affected floodplain.

(6) Reservoir: The Mine No. 60-Pond 6 is about 1450 feet long at the spillway crest elevation and has a surface area of 21.1 acres. When the pool is at the (design) crest of the dam, the reservoir length increases to 1500 feet and the surface area is about 24.7 acres.

(7) Watershed: The watershed contributing to the Mine No. 60-Pond 6 is woodland and brushland. The watershed, 102 acres, is completely owned by the Bethlehem Mines Corporation.

b. Location: The Mine No. 60-Pond 6 is located at the headwaters of an unnamed tributary to the Center Branch of Pigeon Creek in Somerset Township, Washington County, Pennsylvania, approximately 3 miles north of Ellsworth, Pennsylvania.

c. Size Classification: The dam has a maximum storage capacity of 616 acre-feet and a toe to crest height of 68.2 feet. Based on the Corps of Engineers guidelines, this dam is classified as an "intermediate" size structure.

d. Hazard Classification: The Mine No. 60-Pond 6 is classified as a "high" hazard dam. In the event of a dam failure, at least 5 inhabited dwellings, several roads, a railyard and a reservoir could be subjected to damage, and the loss of more than a few lives could result.

e. Ownership: The Mine No. 60-Pond 6 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: The Mine No. 60-Pond 6 was constructed to serve as a holding and settling impoundment for fine coal refuse slurry from the Mine No. 60 Coal Preparation Plant.

g. Design and Construction History: The dam was designed by Michael Baker, Jr., Inc. of Beaver, Pennsylvania, in 1980 and was constructed by Mack Equipment Corporation of Eighty-Four, Pennsylvania, from September through December 1980.

h. Normal Operating Procedures: The Mine No. 60-Pond 6 was designed to operate as an uncontrolled structure. Under normal operating conditions, the pool level (operating pool level) is maintained by the outlet works. The spillway defines the maximum operating pool elevation of about 1165.4. Inflow to the Mine No. 60-Pond 6 includes runoff from the watershed above and fine coal refuse slurry from the Mine No. 60 Preparation Plant.

1.3 PERTINENT DATA

a. Drainage Area	0.16 sq. mi.
b. Discharge	
Maximum flood at Dam Facility	Unknown
Spillway Capacity at Current Top of Dam	513 cfs
c. Elevation (feet above MSL)	
Design Top of Dam	1172.0*
Current Top of Dam (low point)	1169.5
Principal (and Emergency) Spillway Overflow Crest	1165.4
Operating Pool	Varies
Operating Pool on Date of Inspection	1126.6
Toe of Embankment	1101.3
d. Reservoir Length	
Length of Maximum Pool	1500 feet
Length of Maximum Operating Pool	1450 feet
Length of Operating Pool	Varies
e. Reservoir Storage	
Design Top of Dam	676 acre-feet
Current Top of Dam	616 acre-feet
Spillway Crest	525 acre-feet
f. Reservoir Surface	
Design Top of Dam	24.7 acres
Current Top of Dam	23.3 acres
Spillway Crest	21.1 acres
g. Embankment	
Type	Earth
Length	845 feet
Height	68.2 feet
Crest Width	20 feet
Slopes	
Downstream	2.0H:1V and 2.1 H:1V
Upstream	2.0 H:1V
Impervious Core	No*
Cutoff Provisions	Yes*
Grout Curtain	None reported*

h. Principal (and Emergency) Spillway

Type	Trapezoidal Open Channel
Location	Left Abutment
Overflow Crest Length	20 feet
Crest Elevation	1165.4 feet

i. Outlet Works**

Type	Submerged Pump*
Location	Right Side of Impoundment*

*Taken or derived from available engineering drawings or reports.

**Not installed at the time of the inspection.

SECTION 2
ENGINEERING DATA

2.1 DESIGN

a. Data Available: The data available from the files of the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER), included a set of 17 construction drawings which are listed in Appendix B. Additional information was obtained from representatives of Bethlehem Mines Corporation.

b. Design History: Mine No. 60-Pond 6 was designed in 1980 by Michael Baker, Jr., Inc. of Beaver, Pennsylvania. A portion of the engineering was subcontracted to L. Robert Kimball and Associates of Ebensburg, Pennsylvania.

2.2 CONSTRUCTION

a. Construction: The dam was constructed between September and December 1980 by Mack Equipment Corporation of Eight-Four, Pennsylvania. Completion of the work is anticipated in 1981.

b. Modifications: There were no reported modifications to the dam design during construction.

2.3 OPERATION

The dam was designed to operate without a dam tender. The principal (and emergency) spillway is a 20 foot wide trapezoidal open channel in the left abutment.

The outlet works (to be installed) consists of an electric motor driven pump to return water to the Mine No. 60 Preparation Plant. At the time of the inspection there were no facilities to draw down the impoundment in the case of an emergency.

2.4 EVALUATION

a. Availability: Available design information and drawings were obtained from the Pennsylvania Department of Environmental Resources and were supplemented by conversations with company representatives.

b. Adequacy: The available engineering information was supplemented by field inspections and supporting engineering analyses and is considered adequate for the purpose of this Phase I Inspection Report.

c. Validity: Based on the review of the available information, there appears to be no reason to question the validity of the available engineering data.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

a. General: The field inspection of Mine No. 60-Pond 6 was performed on 18 March 1981 and 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 approach channel, overflow section, and discharge channel;

(3) Visual observations of the embankment's downstream toe area including drainage channels and surficial conditions;

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

(5) Visual observations of the reservoir shoreline and watershed;

(6) Transit stadia surveys of relative elevations along the embankment crest centerline, spillway, and across the embankment slopes.

The visual observations were made during a period when the reservoir pool was well below the normal operating level. The tailwater was at normal operating level during inspection.

The visual observations checklist, field sketch 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 straight throughout its length. No offsets or indications of misalignment were observed that would indicate anomalous movement of the embankment.

The crest was uneven vertically. The center and right portions of the crest appeared to be approximately at design elevation. The left end of the embankment was approximately 1 to 2 feet lower.

The embankment crest was barren earth and contained numerous vehicle ruts and considerable local unevenness.

(2) Upstream Slope: The upstream slope was generally even and uniform from top to bottom and abutment to abutment. Some minor surficial sloughing and erosion were noted as a result of a lack of vegetal cover. The sloughing appeared to be restricted to topsoil and seed bed mulch materials that covered the slope.

(3) Downstream Slope: The downstream slope was generally even and uniform from top to bottom and abutment to abutment. Like the upstream slope, the downstream slope contained a covering of topsoil and seed bed mulch, but had suffered considerably less erosion and sloughing distress.

The downstream slope contains a bench at approximately mid-height which is sloped to drain from the center toward each abutment. Ponded water was observed on the bench at the junctions with both abutments. Some erosion of the embankment slope has occurred below the ponded areas.

The groins (junction of embankment and abutment) contain a riprap erosion protection blanket that extends from the toe up both groins to within approximately 300 feet of the crest. No erosion of riprap or other distress was observed and the stone appeared to be durable material.

c. Drains: Two six inch diameter perforated CMP drain pipes were observed at the downstream toe of the embankment. No water was flowing from either pipe.

d. Abutments: The abutments below the embankment appeared to be in good condition. There were no signs of significant slope instability and only minor sloughing and minor erosion were noted. A small wet spot was observed on the slope along the toe drain channel approximately 200 feet below the dam, but no flowing water was observed.

e. Seepage: A flow of water estimated at 1 to 2 gallons per minute was observed in the toe drain channel. The origin of water appeared to be from below the groin riprap at the toe of the embankment. No sedimentation or movement of fine soil materials was observed.

f. Principal (and Emergency) Spillway:

(1) Approach Channel: The spillway approach channel was clear of obstructions that might reduce the capacity of the spillway.

(2) Overflow Crest: The spillway overflow crest is a level section in the channel at the centerline of the dam. The overflow crest was riprap covered and appeared to be in good condition on the date of inspection.

(3) Discharge Channel: The spillway discharge channel was riprapped for a distance of approximately 700 feet below the overflow crest. Below the riprap, the channel is an earth cut in original ground. The channel contained an erosional gully caused by surface runoff from above and beyond the dam. The depth of erosion ranged from 6 to 12 inches.

(4) Channel Side Slopes: The spillway channel side slopes contained some minor sloughing and considerable minor erosion as a result of surface runoff. The lack of vegetal cover appeared to be the main reason for the surface distress. There was no indication of more significant landslide activity that might reduce the capacity of the spillway channel.

f. Outlet Works: No outlet works was observed.

g. Reservoir:

(1) Slopes: The slopes of the reservoir ranged from mild to moderately steep and were generally barren. Some minor erosion of the unvegetated slopes has occurred. There were no indications of significant instability or erosion problems.

(2) Inlet Stream: Because of the location of the reservoir at the upper end of the watershed, there was no defined inlet stream to Pond 6.

(3) Sedimentation: None observed.

(4) Watershed: The watershed contributing to Pond 6 is entirely undeveloped and consists primarily of woods and brushland. There was no construction activity noted in the watershed on the date of inspection.

h. Downstream Conditions:

(1) Channel: The downstream channel for Pond 6 flows through an undeveloped valley for a distance of approximately 1.4 miles. In this reach, it passes beneath three township roads and a Conrail railyard at Mine No. 60. The channel joins the Center Branch of Pigeon Creek approximately 1.5 miles below the dam.

(2) Floodplain Conditions: In the first five miles below Pond 6 at least five inhabited dwellings lie on the floodplain at elevations low enough to possibly be affected by high flows.

3.2 EVALUATION

The following evaluations are based on the results of the visual inspections performed on 18 March and 26 March 1981.

a. Embankment: The condition of Mine No. 60-Pond 6 was good. Only minor deficiencies were observed which included:

(1) Water ponding and slope erosion near the ends of the bench in the downstream slope.

(2) An uneven profile and considerable wheel rutting and local unevenness of the crest.

(3) Minor erosion and sloughing of both the upstream and downstream slopes.

(4) Seepage at the downstream toe of the embankment.

b. Principal (and Emergency) Spillway: The spillway was in good condition. Only minor deficienies were observed which included:

(1) An erosional gully in the lower discharge channel.

(2) Minor erosion and sloughing of spillway side slopes.

c. Outlet Works: No outlet works was observed. This is considered to be a deficiency.

d. Hazard Potential: Based on the observed downstream floodplain conditions, Mine No. 60-Pond 6 was assigned a "high" hazard potential rating.

SECTION 4
OPERATIONAL FEATURES

4.1 PROCEDURE

Reservoir pool level is not currently maintained except by the overflow crest of the principal (and emergency) spillway.

The outlet works will reportedly consist of a submerged pump which will draw off pond water and return it to the Mine No. 60 Coal Preparation Plant. At the time of the inspection, the outlet works had not been installed.

Fine coal refuse slurry will be pumped to the facility for discharge to the pond across the right abutment near the embankment.

There are no pipelines through the embankment and there is no facility to drain the pond in case of an emergency.

Normal operating procedure does not require a dam tender.

4.2 MAINTENANCE OF DAM

The embankment and appurtenances are maintained by the Bethlehem Mines Corporation. Maintenance reportedly will consist 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 SYSTEM

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

4.5 EVALUATION

Lack of a facility to drain the reservoir in the case of an emergency is considered to be a deficiency.

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. 60-Pond 6 has a watershed of 102 acres which is vegetated primarily by woodland and brushland. The watershed is about 2200 feet long and 1280 feet wide and has a maximum elevation of 1260 feet (MSL). At maximum normal pool, the dam impounds a reservoir with a surface area of 21.1 acres and a storage volume of 525 acre-feet. Maximum normal pool level is maintained at Elevation 1165.4 by the overflow crest of the principal (and emergency) spillway.

There were no calculations available concerning the spillway design capacity requirements at the time of design. Mine No. 60-Pond 6's actual spillway capacity, for the observed cross-section and existing freeboard conditions, was computed to be 513 cfs.

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 water level at the time of the field inspection was observed to be 38.8 feet below the spillway crest.

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 for "intermediate" size, "high" hazard dams. Based on the observed size and existing downstream conditions, Mine No. 60-Pond 6 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 exist 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. 60-Pond 6 was determined by HEC-1 to be 650 cfs for the PMF (and SDF).

An initial pool elevation of 1165.4 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. 60-Pond 6's spillway is "adequate."

SECTION 6
STRUCTURAL STABILITY

6.1 AVAILABLE INFORMATION

a. Design and Construction Data: All available design documentation, calculations and other data received from the Pennsylvania Department of Environmental Resources were reviewed. This data is discussed in Section 2 and a detailed listing is included in Appendix B. PennDER provided the drawings that are presented in Appendix E.

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

c. Visual Observations:

(1) Embankment: Visual observations made during the field inspection did not indicate evidence of a high ground water level in the embankment. There was no pronounced "line of seepage" and no significant surface sloughs were observed.

The upstream slope was generally even and uniform. Some minor surficial sloughing and erosion were noted, apparently as a result of a lack of vegetal over. The sloughing appeared to be restricted to topsoil and seed bed mulch materials that covered the slope.

The downstream slope was generally even and uniform and showed less erosion and sloughing than the upstream slope. Ponded water was observed standing in the bench on the downstream slope.

Some seepage was noted in the toe drain channel at the immediate downstream toe of the embankment. Origin of the water could not be determined. Embankment and foundation drains located immediately behind and 1.5 feet above the seepage area were dry on the dates of the inspection.

The stadia survey revealed a moderate downstream slope at about 2.2H:1V including downstream bench.

(2) Outlet Facilities: The outlet facilities were not installed at the time of the inspection.

(3) Principal (and Emergency) Spillway: The spillway discharge channel contained an erosional gully caused by surface runoff from above and beyond the dam. The channel side slopes contained some minor sloughing and considerable minor erosional distress as a result of surface runoff.

6.2 EVALUATION

a. Design, Construction, and Monitoring Information: The design documentation was, by itself, considered inadequate to evaluate the structure.

Stability analyses by Michael Baker, Jr., Inc., calculated safety factors against sliding for several embankment conditions. The results of these analyses are presented on Plate X in Appendix E.

b. Embankment: On the date of the field inspection, the embankment appeared to have an adequate margin of safety against sliding. This is based on observations of embankment slopes, materials, and seepage conditions.

c. Principal (and Emergency) Spillway: The principal (and emergency) spillway appeared to be functional. There was no indication of significant landslide activity that might imperil the capacity of the spillway channel.

d. Active Outlet Works: The outlet works was not installed at the time of inspection.

f. Seismic Stability: According to the Seismic Risk Map of the United States, Mine No. 60-Pond 6 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. No calculations were developed to verify this assessment, however.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 ASSESSMENT

a. Evaluation:

(1) Embankment: Mine No. 60-Pond 6's embankment is considered to be in good condition. This is based on visual observations that revealed only minor deficiencies.

(2) Principal (and Emergency) Spillway: The spillway is considered to be in good condition. This is based on visual observations that revealed only minor deficiencies and a HEC-1 analysis that indicated an "adequate" capacity rating under current Corps of Engineers guidelines.

The Spillway Design Flood for Mine 60-Pond 6 was the Probable Maximum Flood. The combined reservoir/spillway capacity was determined by HEC-1 to be in excess of 100% of the PMF.

(3) Outlet Works: Lack of an outlet works or facility for draining the pond is considered to be a deficiency.

(4) Seepage: Seepage at the downstream toe of the embankment represents a potential threat to the impoundment. However, on the date of inspection, there was no indication of excessive flow or movement of embankment or foundation soil materials.

(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 7.2a, 7.2b and 7.2c should be implemented immediately.

d. Necessity for Additional Studies: None.

7.2 RECOMMENDATIONS

a. Install Outlet Works: Install the proposed outlet works as soon as possible, to provide a means for draining the impoundment zone.

b. Emergency Operation and Warning Plan: 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.

c. Remedial Work: The visual inspection disclosed several minor deficiencies which should be corrected or monitored. These include:

(1) Improvements to downstream bench drainage to eliminate wet zones and embankment erosion conditions.

(2) Completing the embankment crest to design elevation. The crest should be graded to promote proper drainage and should be surfaced to prevent wheel rutting by vehicles that may traverse the crest.

(3) Implementation of a regularly scheduled monitoring program to observe the seepage at the downstream toe of tne embankment for changes in water quality and/or quantity.

d. Follow-Up Remedial Work: Following the establishment of a vegetal cover on the embankment, spillway and adjacent slopes, backfill all erosional gullies and repair all surface slough zones and revegetate to achieve uniform, stable slopes.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL OBSERVATIONS CHECKLIST I
(NON-MASONRY IMPOUNDING STRUCTURE)

Name of Dam Mine No. 60-Pond 6 County Washington State Pennsylvania National ID # PA 01145

Type of Dam Earth Hazard Category High

Dates of Inspection 18 March 1981 Weather Partly cloudy, cool Temperature 35°F
26 March 1981 Clear, mild 45°F

Pool Elevation at Time of Inspection ± 1126.6 (MSL)
Tailwater at Time of Inspection ± 1101.3 (MSL)

Inspection Personnel:

18 March 1981

J. P. Hannan	Ackenheil & Associates, Geotechnical Engineer
S. G. Mazzella	Ackenheil & Associates, Civil Engineer

26 March 1981

J. E. Barrick, P.E.	Ackenheil & Associates, Project Manager and Hydrologist
J. L. Loveland	Bethlehem Mines Corporation Representative

Recorder J. E. Barrick

A1

GEO Project G80138-G
PennDER I.D. No. 63-89

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Randomly oriented drying cracks observed on downstream bench. No other cracks observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	No significant sloughing or erosion of embankment slopes was observed. Some minor sloughing of seed bed mulch and topsoil was noted. Vegetal cover has not yet been established. Some minor erosion also observed. No significant sloughing or erosion of abutment slopes was observed. As with the embankment, some minor topsoil and mulch sloughing and erosion were noted due to a lack of an established vegetal cover.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The horizontal alignment of the crest appeared to be straight. The vertical alignment of the crest was uneven. The center and right portions of the crest were reasonably level and appeared to be at the required elevation. The left portion of the crest was 1 to 2 feet lower than the center and right. The company representative indicated that completion of the crest to design elevation would take place as soon as the current labor uncertainty was resolved.	

EMBANKMENT (CONTINUED)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RIPRAP FAILURES	None observed.	
SETTLEMENT	None observed.	
JUNCTION OF EMBANKMENT AND ABUTMENT	The left upstream groin (junction of embankment and abutment) contains minor erosion due to channeling of surface runoff. The remaining three groins appeared to be in good condition with no indications of erosion or instability.	
JUNCTION OF EMBANKMENT AND SPILLWAY	No junction observed.	
ANY NOTICEABLE SEEPAGE	The toe drain channel below the embankment contained flowing water estimated at approximately 1 to 2 gallons per minute. Most, if not all, of the flowing water appeared to originate at the riprap groin protection at the downstream toe of the dam. There was no indication of discoloration or deposition of fine soil materials at or below the origin of the seepage. A wet spot was noted on the toe drain channel left slope approximately 30 feet below the toe of the dam. The cause of the wet spot could not be determined.	
STAFF GAUGE AND RECORDER	None observed.	

EMBANKMENT (CONTINUED)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DRAINS	Two six inch diameter perforated CMP drain pipes exit the downstream slope and discharge to the riprap groin protection at the toe of the dam. No flows were observed on the date of inspection.	
SURFICIAL CONDITIONS	The embankment crest was barren earth on the date of inspection. It contained numerous vehicle ruts and was locally irregular and uneven. The upstream slope was generally uniform from top to bottom and abutment to abutment and was uniformly covered with a straw mulch placed to assist development of a vegetal cover. Numerous small mulch and topsoil sloughs were observed and numerous minor shallow erosion channels were noted. These appeared to be the result of a lack of vegetal cover. The downstream slope appeared to be generally uniform and regular from top to bottom and abutment to abutment. As with the upstream slope, the downstream slope was covered with a straw mulch. The downstream slope appeared to have suffered considerably less sloughing and erosion than the upstream slope. The bench on the downstream slope was sloped to drain from the center to each side of the embankment. Ponded water was noted at each end of the bench where the bench intersected the riprap groin protection. In both cases, an erosion drainage channel has been cut from the ponded area over the crest of the bench onto the lower downstream slope.	

PRINCIPAL (AND EMERGENCY) SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
APPROACH CHANNEL	The spillway approach channel was clear of major obstructions that would reduce its capacity during periods of high flow.	
OVERFLOW SECTION	The spillway overflow section occurs at the intersection of the dam centerline and consists of a riprap lined level stretch in the spillway channel. The overflow section was clear of obstructions and appeared to be capable of maintaining design flows.	
DISCHARGE CHANNEL	The spillway discharge channel was unobstructed through its entire length between the overflow section and its confluence with the toe drain channel below the dam. Like the overflow section, the discharge channel was riprap lined for approximately 700 feet beyond the dam centerline. The lower portion of the discharge channel is relatively steep and cut through weathered shales in the upper reach and natural soils in the lower reach. As a result, normal runoff drainage has caused an erosional channel to develop in the spillway bottom. Lack of vegetal cover has promoted the channel bottom erosion.	
SIDE SLOPES	The spillway side slopes from the approach channel through discharge channel have suffered some minor erosion and minor topsoil and mulch sloughing.	

INSTRUMENTATION

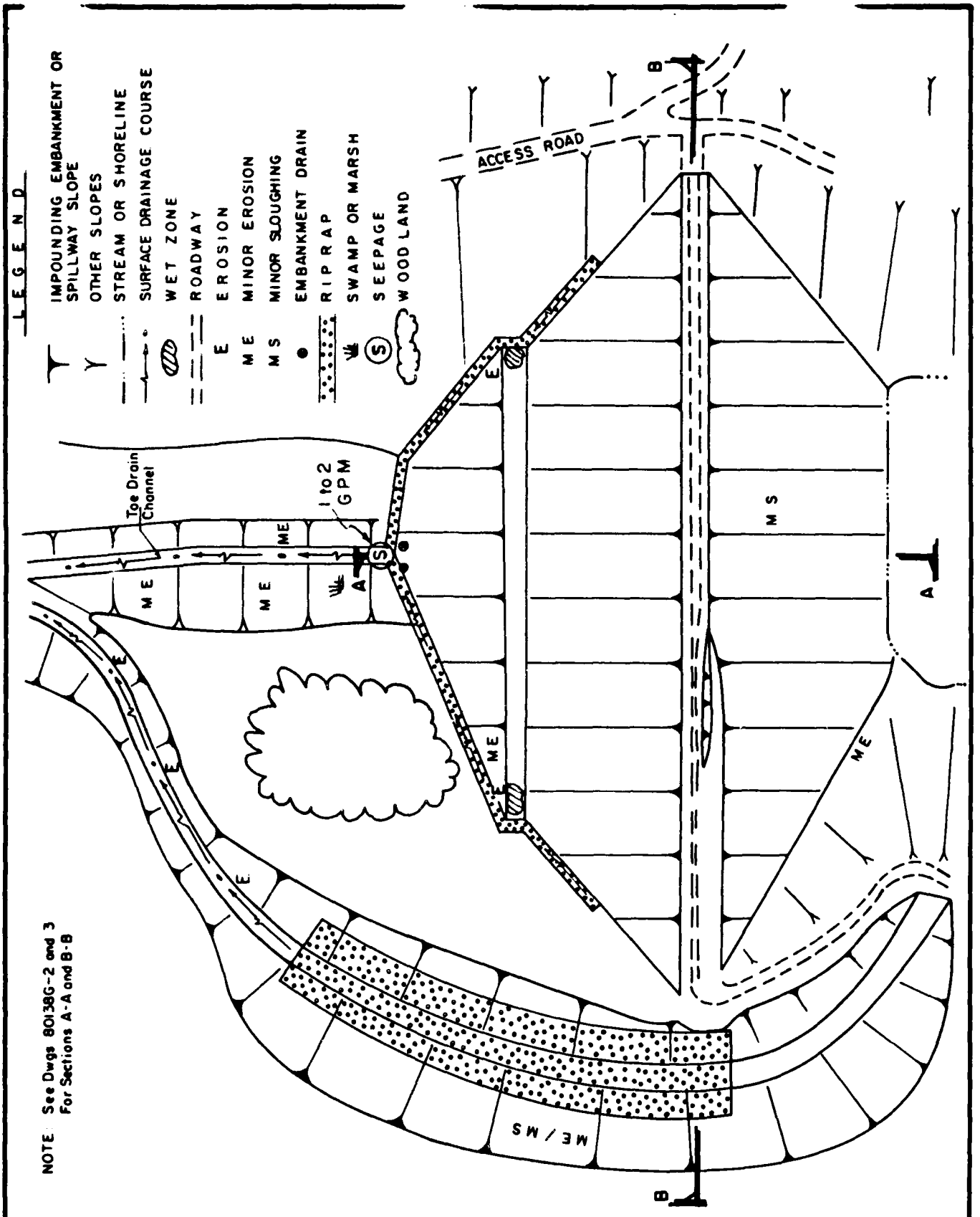
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
WEIRS	None observed.	
PIEZOMETERS	None observed.	
OBSERVATION WELLS	None observed.	

RESERVOIR

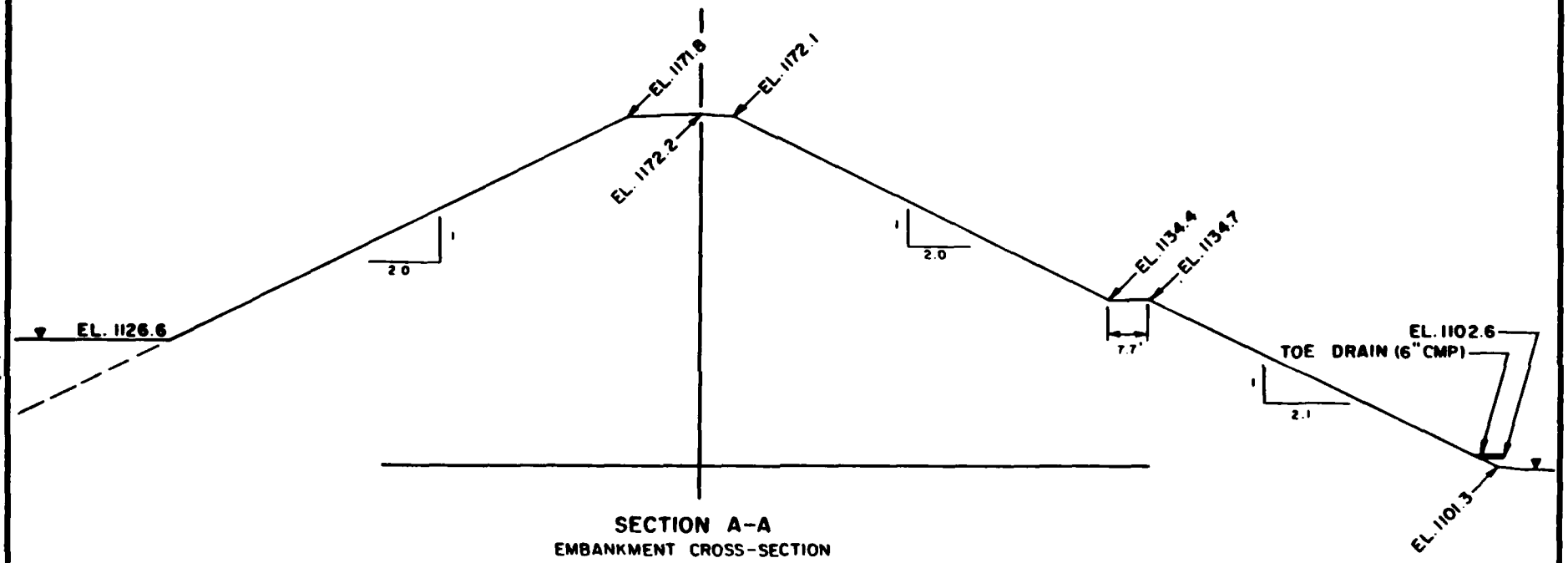
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The slopes of the reservoir ranged from gentle to moderately steep and generally consisted of barren earth. Some minor erosion was noted in all areas without vegetation. There were no indications of reservoir slope instability.	
SEDIMENTATION	None observed.	
INLET STREAM	Pond 6 is located near the top of the watershed and has no defined inlet stream.	
WATERSHED	The watershed above Pond 6 is undeveloped and generally tree and brush covered. On the date of inspection there were no signs of construction activity in the contributing watershed.	

DOWNSTREAM CONDITIONS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	The spillway discharge channel joins the toe drain channel approximately 700 feet below the dam in an area that was formerly the impoundment zone of Lake Calydon. Lake Calydon was removed prior to construction of Pond 6. Lake Calydon Dam was located approximately 400 feet below the toe of the Pond 6 embankment. Below this, the downstream channel passes through an uninhabited brush and tree-lined valley for approximately 1.3 miles where it joins the Center Branch of Pigeon Creek. In this reach, the Creek passes beneath three township roads and a Conrail railyard below the Mine No. 60 complex. Approximately three miles below the dam, Center Branch joins Pigeon Creek. At 3.6 miles, Pigeon Creek enters a reservoir above the Ellsworth Mine No. 51 complex on the outskirts of Ellsworth, Pennsylvania.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	In the first five miles below Pond 6 there are at least five inhabited dwellings that lie on the flood plain at elevations low enough to possibly be affected by high flows.	



DATE: MAY 1981	MINE No. 60 – POND 6 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. 80138G-1			

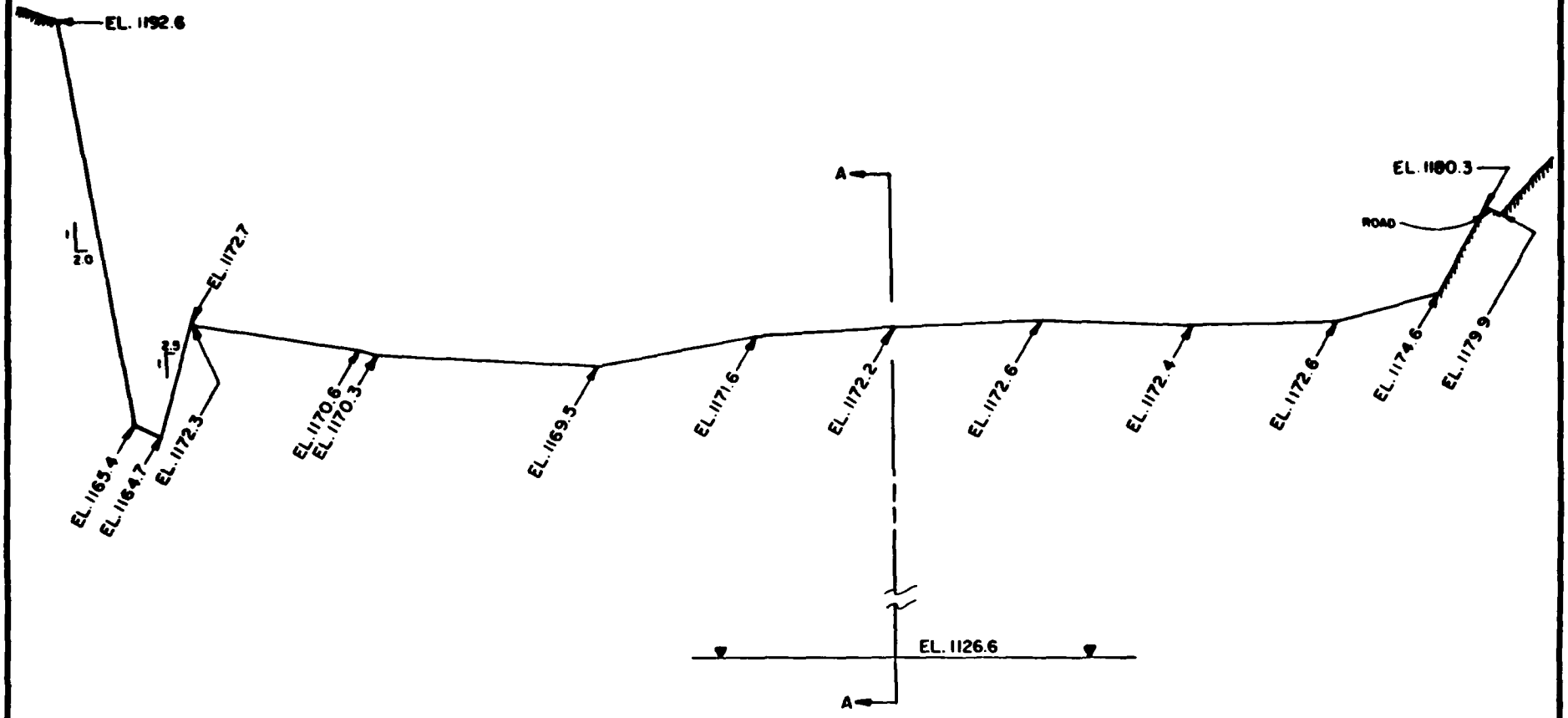


SECTION A-A

EMBANKMENT CROSS-SECTION

SCALE: 1"=30'

DATE: MAY 1981		MINE No. 60 - POND 6 NATIONAL DAM INSPECTION PROGRAM	FIELD SECTION A-A
SCALE: AS SHOWN			
DR: JF	CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH PA 15216	
DWG. NO. 80138G-2			



SECTION B-B

DAM PROFILE

(LOOKING DOWNSTREAM)

SCALE:

HORZ. 1" = 100'

VERT. 1" = 10'

DATE: MAY 1981		MINE No. 60 - POND 6	FIELD SECTION B-B
SCALE: AS SHOWN		NATIONAL DAM INSPECTION PROGRAM	
DR: JF	CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS	
DWG. NO. 80138G-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. 60-Pond 6
NDI No. PA 01145

ITEM	REMARKS
Design Drawings*	Set of drawings entitled "Construction Drawings for Slurry Impoundment for Mine 60" prepared by Michael Baker, Jr. Inc. of Beaver, Pennsylvania, dated 1980, including: 1 of 17 General Plan. ** 2 of 17 General Plan, Test Pit and Test Boring Locations. ** 3 of 17 General Plan, Test Pit and Test Boring Locations. ** 4 of 17 Profile of Dam Base Line "D". ** 5 of 17 Emergency Spillway. ** 6 of 17 Exit Channel and Details. 7 of 17 Existing Dam and Details. 8 of 17 Geologic Sections. ** 9 of 17 Cutoff Trench and Toe Drain Profile. **10 of 17 Drainage Details. **11 of 17 Test Pit and Boring Records. **12 of 17 Stability Analyses and Triaxial Shear Results. 13 of 17 Laboratory Soil Test and Filter Gradations. **14 of 17 Construction Specifications. 15 of 17 Cross Sections Base Line "A". 16 of 17 Cross Sections Base Line "A". 17 of 17 Cross Sections Base Line "A".
As-Built Drawings	None available.

ITEM	REMARKS
Regional Vicinity Map	U.S.G.S. 7-1/2 minute Hacket, Pennsylvania Quadrangle Map.
Construction History***	Built September through December 1980; to be completed 1981. Construction by Mack Equipment Corporation, Eighty-Four, Pennsylvania.
Typical Sections of Dam*	See Design Drawings above.
Outlets-Plan Details Constraints Discharge Ratings	None available.
Rainfall/Reservoir Records	None available.
Design Reports	None available.
Geology Reports*	See Design Drawings above.
Design Computations	None available.
Hydrology and Hydraulics	None available.
Dam Stability*	See Design Drawings above.

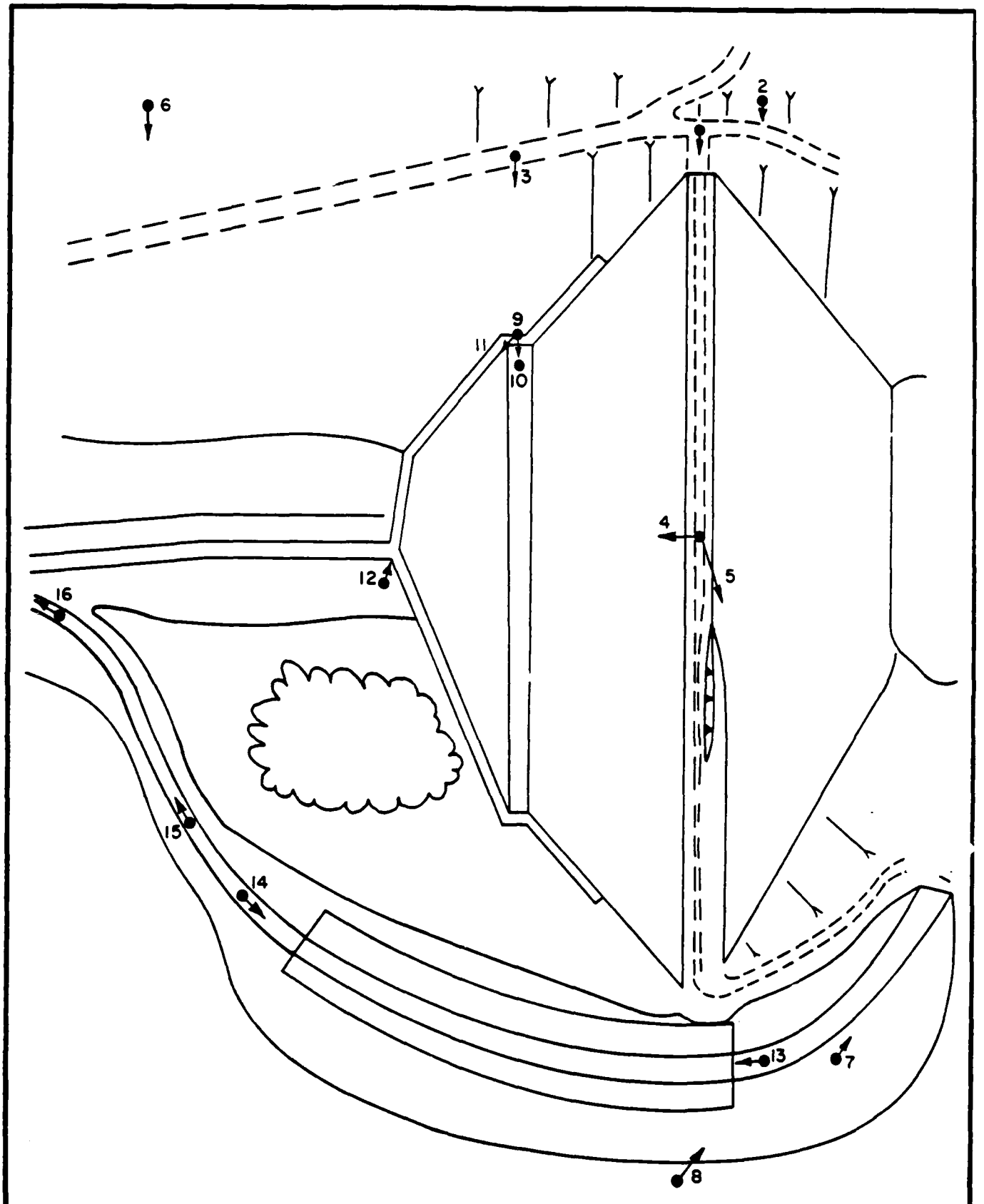
ITEM	REMARKS
Seepage Studies	None available.
Materials Investigations,* Boring Records, Laboratory, Field	See Design Drawings above.
Post-Construction Surveys of Dam	None available.
Borrow Sources***	On site.
Monitoring Systems	None available.
Modifications	None reported.
High Pool Records	None reported.
Post-Construction Engineering Studies and Reports	None available.
Maintenance, Operation, Records	None available.
Spillway - Plan* Sections Details	See Design Drawings above.

ITEM	REMARKS
Operating Equipment Plans and Details	None available.
Specifications*	See Design Drawings above.
Miscellaneous	No additional information available.
Prior Accidents or Failure of Dam, Description Reports	None reported.

*Drawings obtained from the Pennsylvania Deparment of Environmental Resources.
**Reduced size reproductions contained in Appendix E.
***Information obtained from Bethlehem Mines Corporation, Ellsworth-Butler Division.

APPENDIX C

PHOTOGRAPHS



DATE: MAY 1981	MINE No. 60 – POND 6 NATIONAL DAM INSPECTION PROGRAM	PHOTO KEY MAP
SCALE: NONE		
DR: JF CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH PA 15216	
DWG. NO. 80138G		

MINE NO 60 - POND 6

MINE NO 60- POND 6

MINE NO. 60 - POND 6

MINE NO 60 - POND 6

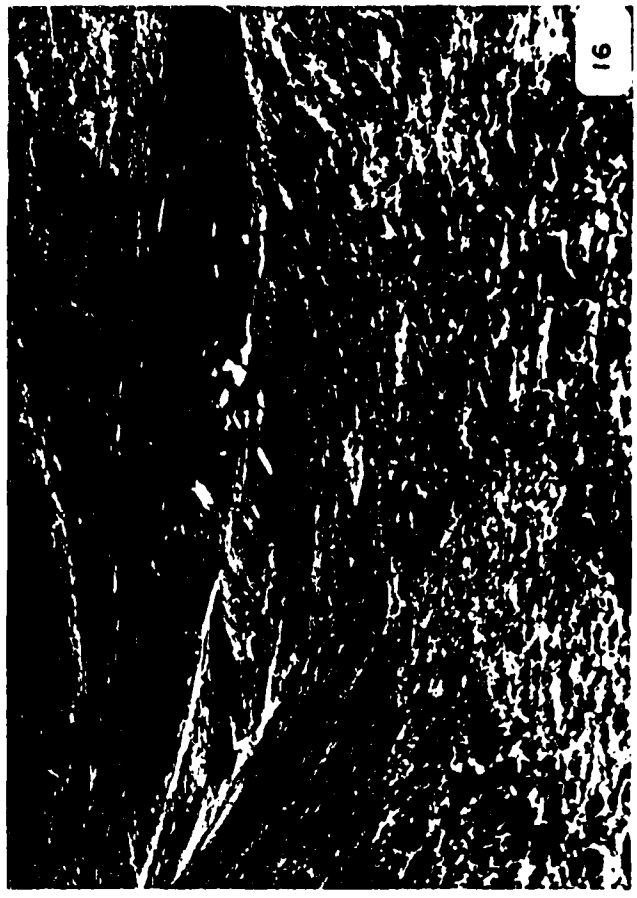


PHOTO DESCRIPTIONS

Photo 1 Embankment Crest Overview.

Photo 2 Upstream Slope showing erosion in foreground.

Photo 3 Downstream Slope showing bench and toe area.

Photo 4 Overview of Downstream Channel.

Photo 5 Overview of Principal (and Emergency) Spillway Approach Channel on opposite shore.

Photo 6 Overview of Principal (and Emergency) Spillway Channel.

Photo 7 Principal (and Emergency) Spillway Entrance looking upstream.

Photo 8 Spillway Channel Erosion Protection Blanket.

Photo 9 Overview of Bench on Downstream Slope showing wet zones.

Photo 10 Close Up of Bench.

Photo 11 Riprapped Left Groin.

Photo 12 Foundation Drain Outlets at Toe of Embankment.

Photo 13 Principal (and Emergency) Spillway Channel, beginning of riprap blanket.

Photo 14 Principal (and Emergency) Spillway Channel, end of riprap blanket.

Photo 15 Spillway Discharge Channel.

Photo 16 Intersection of Spillway Discharge Channel and Toe Drain Channel.

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.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L'	Length from centroid of watershed to spillway	From U.S.G.S. 7.5 minute topographic map
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 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 outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the 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 planimetered from available mapping or U.S.G.S. 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.

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

HYDROLOGIC AND HYDRAULIC ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominatly woods and brushland. No major development noted.

ELEVATION-TOP NORMAL POOL (STORAGE CAPACITY): Varies (varies) Maximum 1165.4 (525 acre-feet)

ELEVATION-TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1165.4 (525 acre-feet)

ELEVATION-MAXIMUM DESIGN POOL: 1172.0

ELEVATION-TOP DAM: 1169.5 (on inspection date)

OVERFLOW SECTION

a. Elevation Varies from 1164.7 to 1165.4
b. Type Broad crested weir in trapezoidal open channel
c. Width 30 feet
d. Length 20 feet
e. Location Spillover Left Abutment
f. Number and Type of Gates None

OUTLET WORKS AND DRAWDOWN FACILITY

a. Type Not installed at time of inspection
b. Location Right reservoir slope
c. Entrance Invert N/A
d. Exit Inverts N/A
e. Emergency Drawdown Facilities None

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. 60-Pond 6	NDI NO. PA 01145
Probable Maximum Precipitation (PMP)	24.2*
Drainage Area	0.16 sq. mi.
Reduction of PMP Rainfall for Data Fit Reduce by 20%, therefore PMP rainfall	0.8 (24.2) =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 (Pond Full Condition)	
Zone	29**
C_p	0.5
C_t	1.6
L'	0.19 mile
$t_p = C_t (L')^{0.6}$ =	0.59 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=0.24 cfs
Base Flow Cutoff	0.05 x Q peak
Recession Ratio	2.0
Overflow Section Data	
Crest Length	20 feet
Crest Elevation	1165.4
Freeboard (Pond Full Condition, Current Embankment Crest Elevation)	4.1 feet
Discharge Coefficient	3.09
Exponent	1.5
Discharge Capacity	513 cfs

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* Hydrometerological Report 33

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

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

Job MINEGO POND 6 Job No 80135
Subject DATA INPUT
Mode By JPH Date 4/1/81 Checked JEB Date 4/21/81

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS of Engineers, BALTIMORE DISTRICT

STRTL = 1 INCH
CNSTL = 0.05 IN/hr
STRTQ = 1.5 cfs/mi^2
QRCSN = 0.05 (5% of PEAK FLOW)
RTIOR = 2.0

ELEVATION - AREA - CAPACITY RELATIONSHIPS

FROM USGS 7.5 minute QUAD, OWNERS INFORMATION, AND FIELD INSPECTION DATA

AT ELEVATION 1165.4 AREA = 21.1 ACRES
STORAGE = 525 ACRE-FT.

AT ELEVATION 1180 AREA = 29.4 ACRES.

From the CONIC METHOD of RESERVOIR VOLUME
FLOOD HYDROGRAPH PACKAGE (HEC-1)
Dam Safety Version (Users manual)

$$H = 3V/A = \frac{3(525)}{21.1} = 74.6 \text{ feet}$$

ELEVATION where AREA EQUALS ZERO

1165.4 - 74.6 = 1090.8

AREA	$A	0.	21.1	29.4
ELEVATION	$E	1090.8	1165.4	1180.0

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

Job MINEGO POND 6 Job No 80138G
Subject DATA INPUT
Made By JPA Date 4/1/81 Checked JBB Date 4/20/81

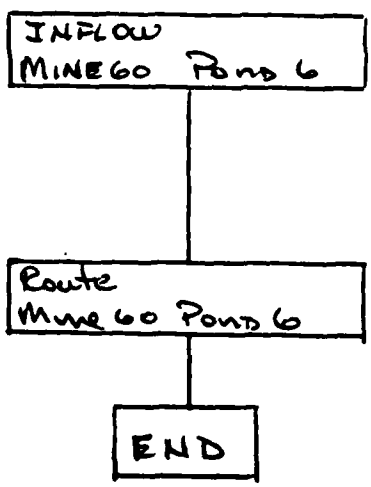
OVERTOP PARAMETERS

Top of Dam Elevation (minimum)	1169.5
Length of Dam	845. feet
Coefficient of Discharge	3.09

SPILLWAY PARAMETERS

CREST ELEVATION	1165.4
CREST Length	20.0 feet
Coefficient of Discharge	3.09
SIDE SLOPES	Assumed Rectangular

Program Schedule



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JOB 7936
**********
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 SLURRY IMPOUNDMENT #6
    3              A3       PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD
    4              B    300       0      10       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 SLURRY IMPOUNDMENT #6, MINE 60
   10              M      1       1    0.16            0.16                                       1
   11              P             24.2     102     120     130     140
   12              T                                                     1.0     .05
   13              W   0.59     0.5
   14              X   -1.5   -0.05     2.0
   15              K      1       2                                       1
   16              K1       ROUTING AT SLURRY IMPOUNDMENT #6, MINE 60
   17              Y                                       1       1
   18              Y1     1                                             525.
   19              $A    0.    21.1    29.4
   20              $E1090.8  1165.4  1180.
   21              $$1165.4    20.0    3.09     1.5
   22              $D1169.5    3.09     1.5    845.
   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: 27 MAR 81
RUN  TIME: 14.43.22


                        NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS
                        HYDROLOGIC AND HYDRAULIC ANALYSIS OF SLURRY IMPOUNDMENT #6
                        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 SLURRY IMPOUNDMENT #6, MINE 60

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	0.16	0.0	0.16	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= 0.59 CP=0.50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 28 END-OF-PERIOD ORDINATES, LAG= 0.59 HOURS, CP= 0.50 VOL= 1.00

11.	41.	72.	85.	76.	62.	50.	41.	33.	27.
22.	18.	15.	12.	10.	8.	7.	5.	4.	4.
3.	2.	2.	2.	1.	1.	1.	1.		

0

END-OF-PERIOD FLOW

MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP Q MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP Q

	RAIN	EXCS	LOSS	COMP Q
SUM	27.10	24.68	2.42	15282.
	(688.)	(627.)	(61.)	(432.74

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

HYDROGRAPH ROUTING

ROUTING AT SLURRY IMPOUNDMENT #6, MINE 60

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

ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	525.	0

SURFACE AREA=	0.	21.	29.
CAPACITY=	0.	525.	892.
ELEVATION=	1091.	1165.	1180.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1165.4	20.0	3.1	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1169.5	3.1	1.5	845.

PEAK OUTFLOW IS 376. AT TIME 41.33 HOURS

PEAK OUTFLOW IS 170. AT TIME 41.50 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	0.16	1	652.	326.
	(	0.41)	(	18.47)(	9.24)(
ROUTED TO	2	0.16	1	376.	170.
	(	0.41)	(	10.63)(	4.81)(

SUMMARY OF DAM SAFETY ANALYSIS

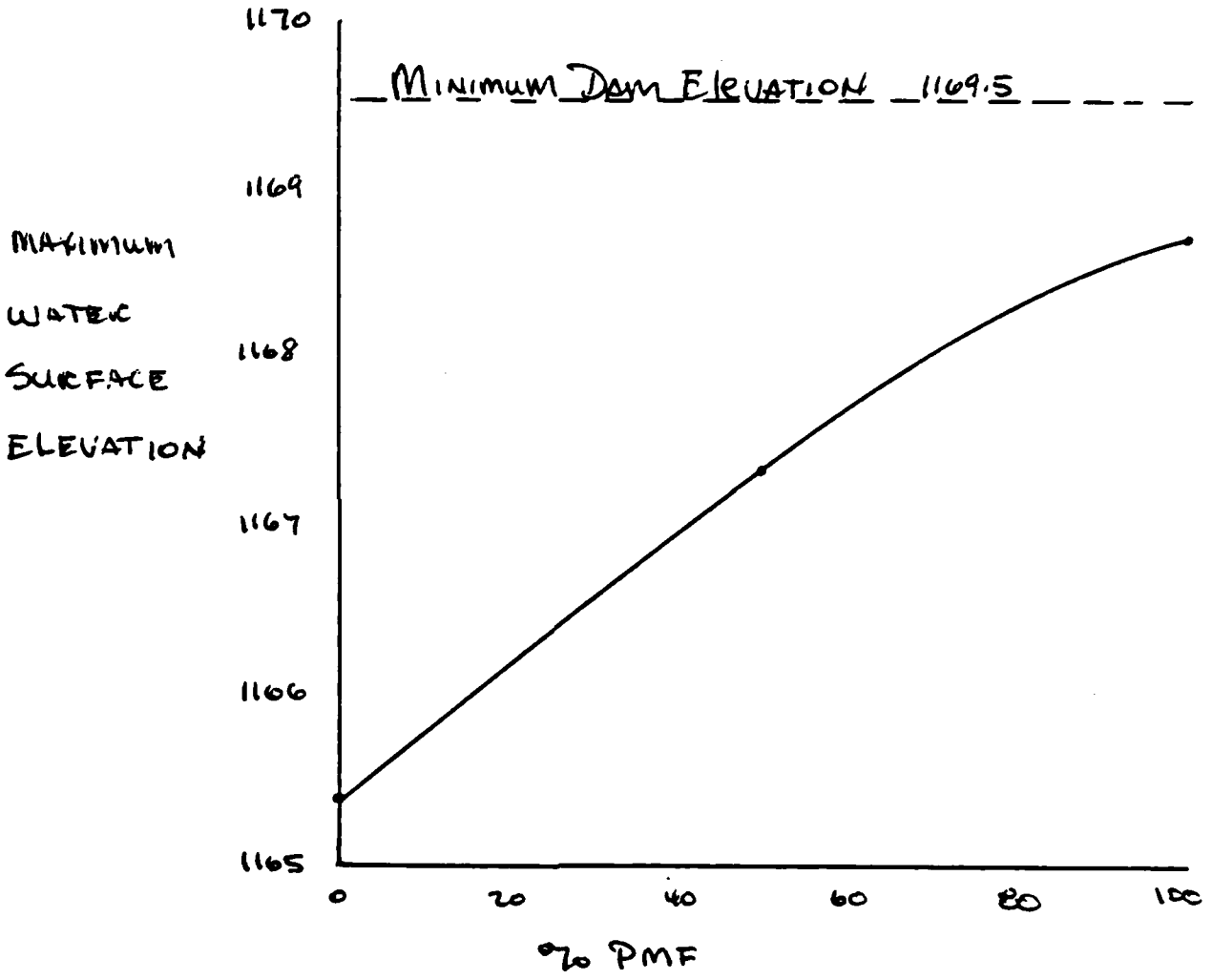
PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1165.41	1165.40	1169.50
STORAGE	525.	525.	616.
OUTFLOW	0.	0.	513.

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	1168.73	0.0	598.	376.	0.0	41.33	0.0
0.50	1167.36	0.0	567.	170.	0.0	41.50	0.0

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

Job MINE 60 POND 6 Job No 501350
Subject HYDROLOGIC PERFORMANCE PLOT
Made By JDH Date 4/1/81 Checked JEB Date 4/2/81

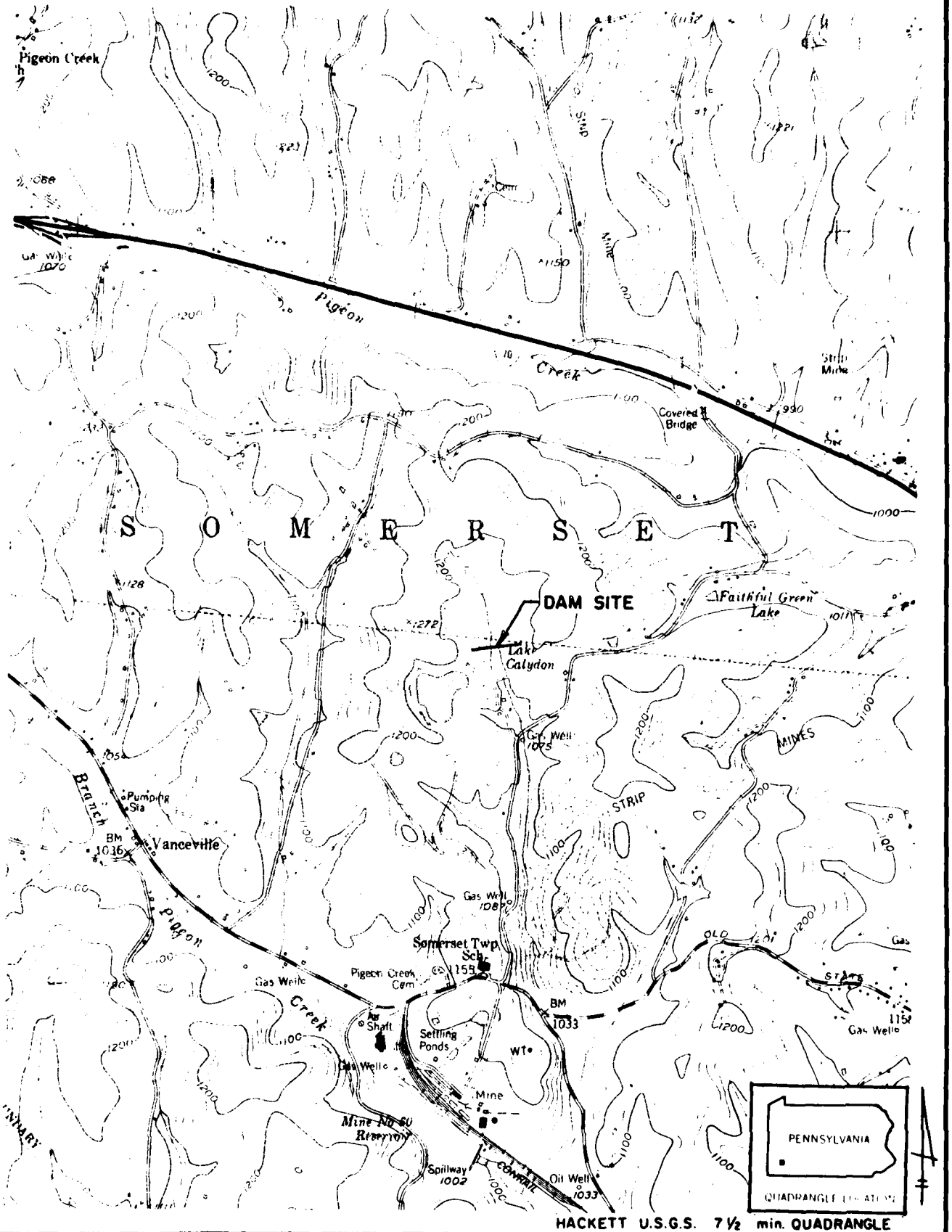


APPENDIX E

PLATES

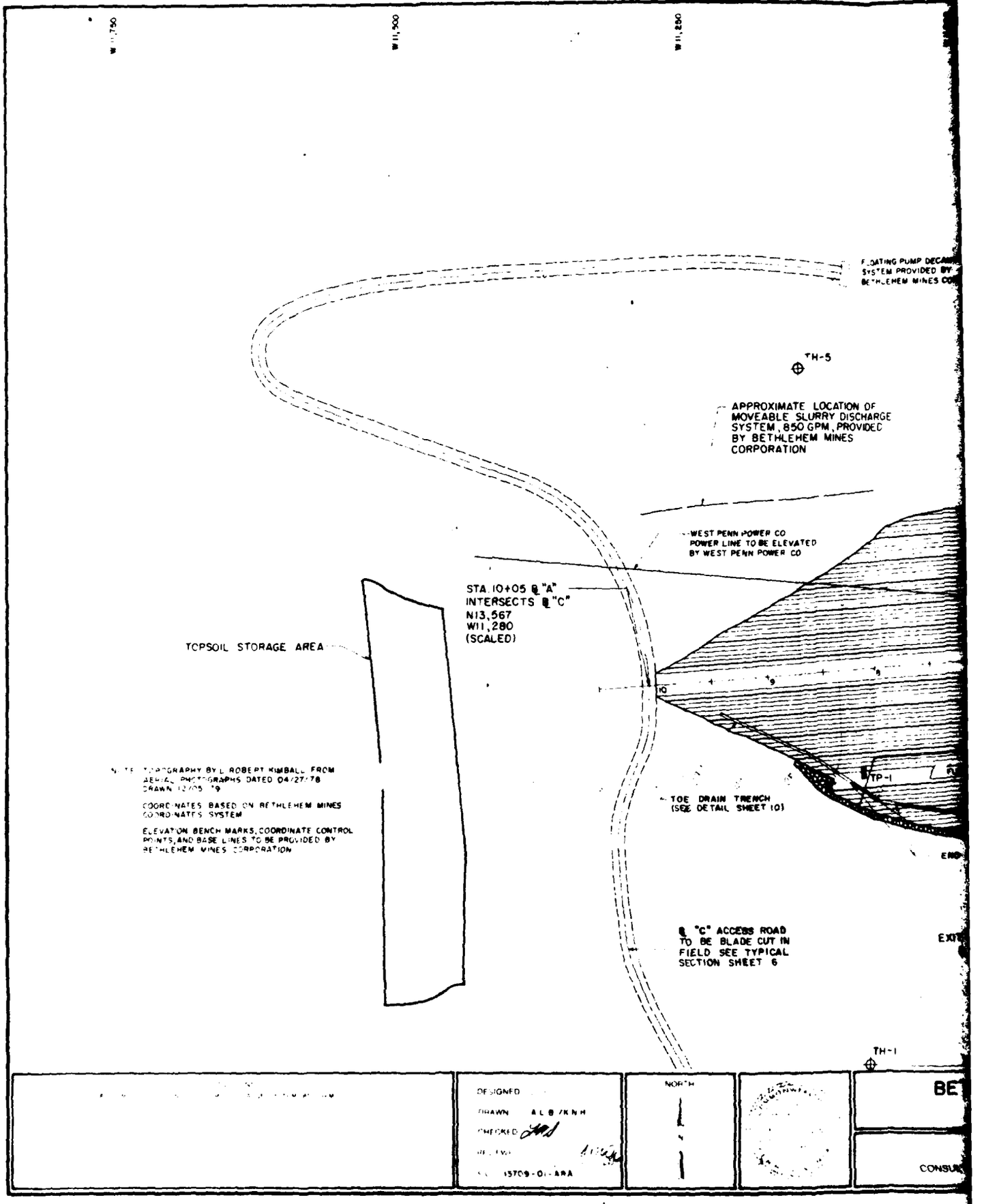
LIST OF PLATES

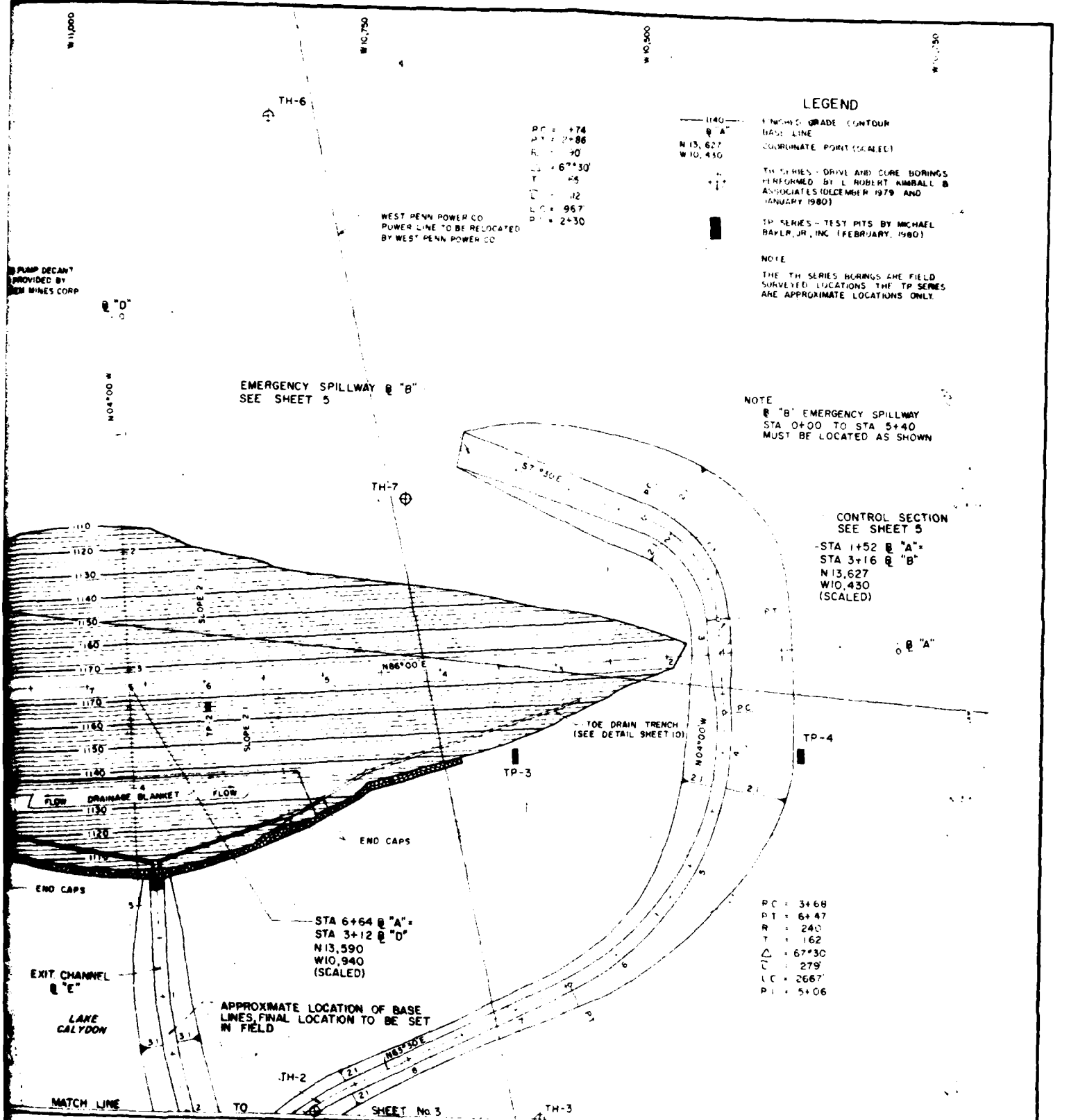
Plate I	Regional Vicinity Map.
Plate II	Sheet 2 of 17, General Plan, Test Pit and Test Boring Locations.
Plate III	Sheet 3 of 17, General Plan, Test Pit and Test Boring Locations.
Plate IV	Sheet 4 of 17, Slurry Impoundment, Profile of Dam Base Line "D".
Plate V	Sheet 5 of 17, Spillway Impoundment, Emergency Spillway.
Plate VI	Sheet 6 of 17, Slurry Impoundment, Exit Channel and Details.
Plate VII	Sheet 9 of 17, Slurry Impoundment, Cutoff Trench and Toe Drain Profile.
Plate VIII	Sheet 10 of 17, Slurry Impoundment, Drainage Details.
Plate IX	Sheet 11 of 17, Test Pit and Boring Records.
Plate X	Sheet 12 of 17, Stability Analyses and Triaxial Shear Results.
Plate XI	Sheet 14 of 17, Construction Specifications.



HACKETT U.S.G.S. 7½ min. QUADRANGLE

DATE: MAY 1981	MINE No. 60 – POND 6 NATIONAL DAM INSPECTION PROGRAM	REGIONAL VICINITY MAP
SCALE: 1" = 2000'		
DR: JF CK:	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH, PA 15216	
PLATE I		


W 11,750
W 11,500
W 11,250
FLOATING PUMP DECA
SYSTEM PROVIDED BY
BETHLEHEM MINES CO
TH-5
APPROXIMATE LOCATION OF MOVEABLE SLURRY DISCHARGE SYSTEM, 850 GPM, PROVIDED BY BETHLEHEM MINES CORPORATION
WEST PENN POWER CO POWER LINE TO BE ELEVATED BY WEST PENN POWER CO
STA. 10+05 ℄ "A" INTERSECTS ℄ "C" N13,567 W11,280 (SCALED)
TOPSOIL STORAGE AREA
TOPOGRAPHY BY L. ROBERT KIMBALL FROM AERIAL PHOTOGRAPHS DATED 04/27/78 DRAWN 12/05/79
COORDINATES BASED ON BETHLEHEM MINES COORDINATES SYSTEM
ELEVATION BENCH MARKS, COORDINATE CONTROL POINTS, AND BASE LINES TO BE PROVIDED BY BETHLEHEM MINES CORPORATION
TP-1
TOE DRAIN TRENCH (SEE DETAIL SHEET 10)
℄ "C" ACCESS ROAD TO BE BLADE CUT IN FIELD SEE TYPICAL SECTION SHEET 6
TH-1
DESIGNED
DRAWN A.L.B./K.N.H.
CHECKED
15709-01-ARA
NORTH
BE
CONSU



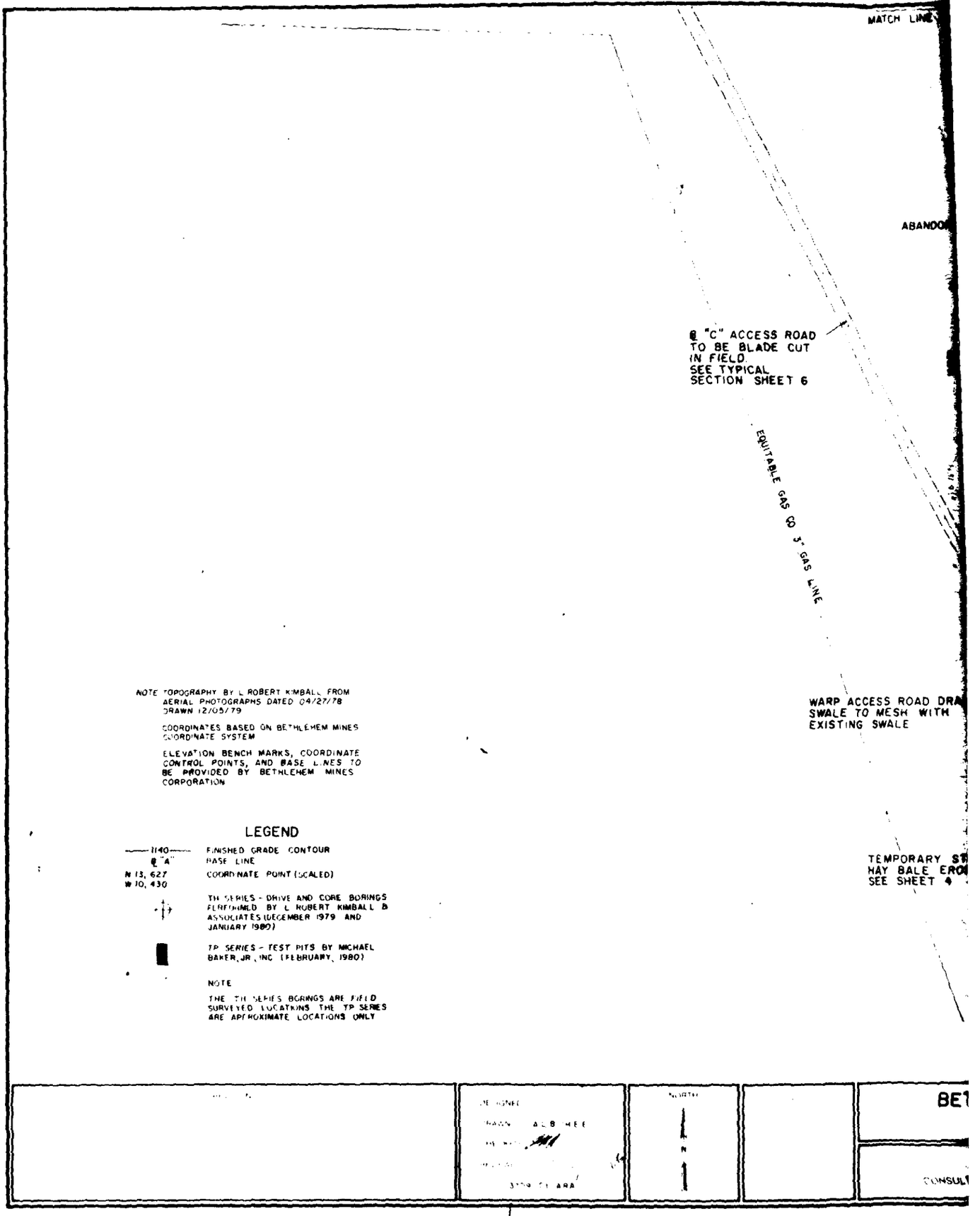
BETHLEHEM MINES CORPORATION
MINE NO 60
SLURRY IMPOUNDMENT

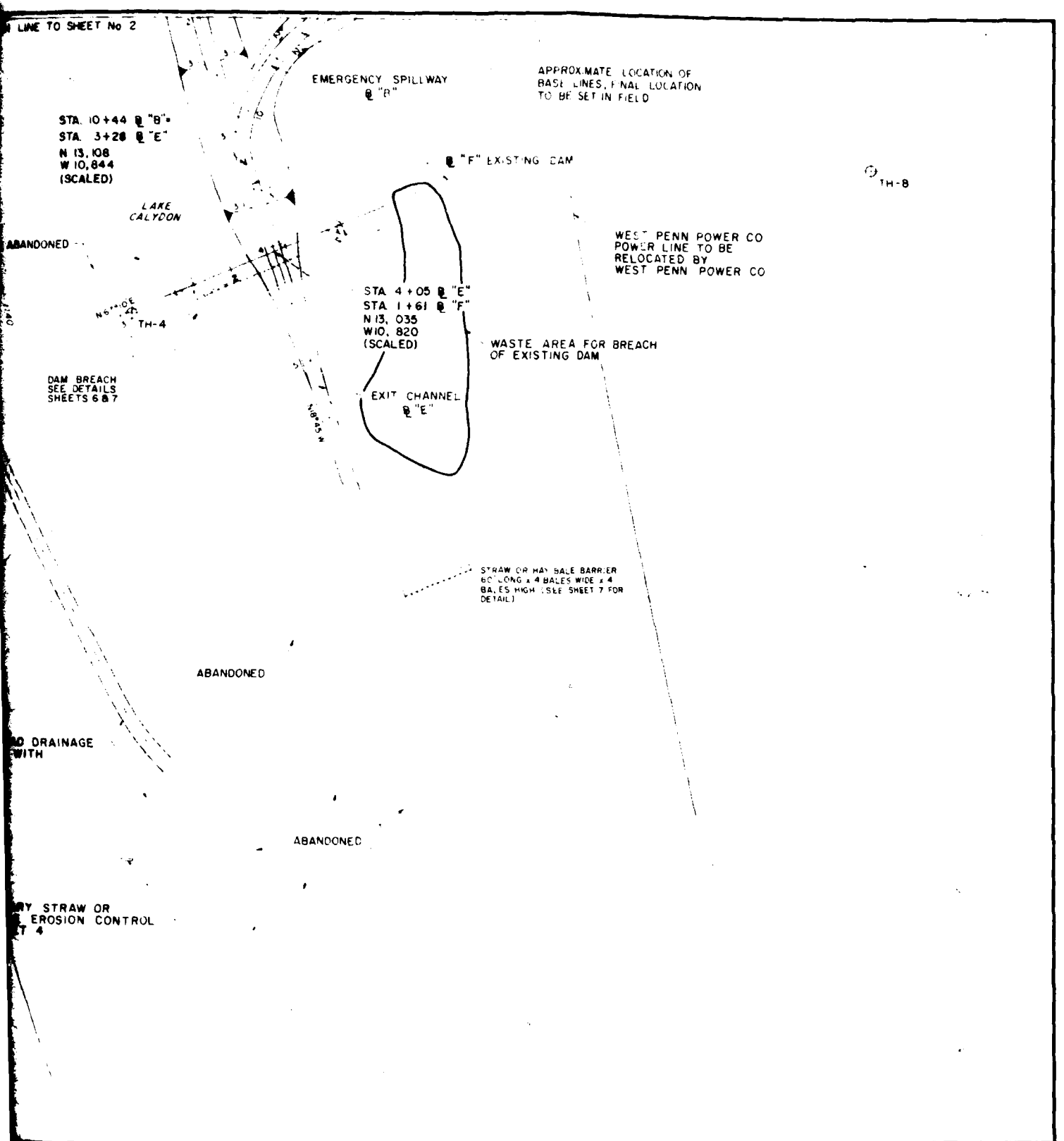
MICHAEL BAKER, JR., INC
CONSULTING ENGINEERS
BEAVER PENNSYLVANIA

GENERAL PLAN
TEST PIT & TEST BORING LOCATIONS

SHEET NO. **2**
17

PLATE II


MATCH LINE
ABANDO
℄ "C" ACCESS ROAD
TO BE BLADE CUT
IN FIELD.
SEE TYPICAL
SECTION SHEET 6
EQUITABLE GAS CO 3" GAS LINE
WARP ACCESS ROAD DRA
SWALE TO MESH WITH
EXISTING SWALE
TEMPORARY ST
HAY BALE ERO
SEE SHEET 4
NOTE TOPOGRAPHY BY L ROBERT KIMBALL FROM
AERIAL PHOTOGRAPHS DATED 04/27/78
DRAWN 12/05/79
COORDINATES BASED ON BETHLEHEM MINES
COORDINATE SYSTEM
ELEVATION BENCH MARKS, COORDINATE
CONTROL POINTS, AND BASE LINES TO
BE PROVIDED BY BETHLEHEM MINES
CORPORATION
LEGEND
1140
FINISHED GRADE CONTOUR
℄ "A"
BASE LINE
N 13, 627
W 10, 430
COORDINATE POINT (SCALED)
TH SERIES - DRIVE AND CORE BORINGS
PERFORMED BY L ROBERT KIMBALL &
ASSOCIATES (DECEMBER 1979 AND
JANUARY 1980)
TP SERIES - TEST PITS BY MICHAEL
BAKER, JR, INC (FEBRUARY, 1980)
NOTE
THE TH SERIES BORINGS ARE FIELD
SURVEYED LOCATIONS THE TP SERIES
ARE APPROXIMATE LOCATIONS ONLY
NORTH
BE
CONSULT

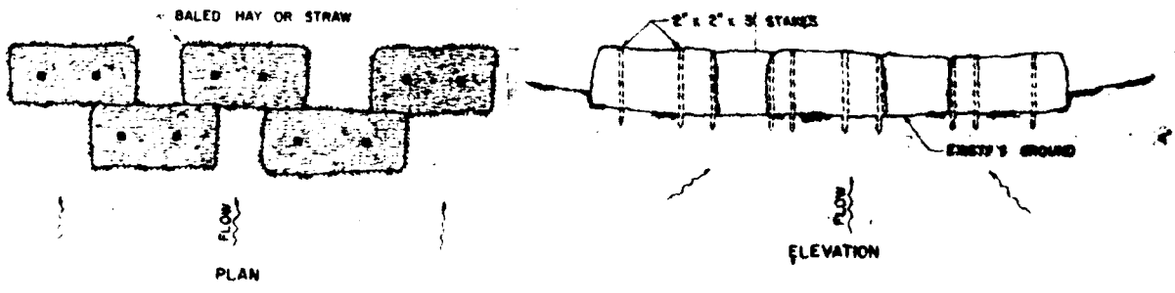


BETHLEHEM MINES CORPORATION MINE NO 60 SLURRY IMPOUNDMENT		GENERAL PLAN TEST PIT & TEST BORING LOCATIONS	**3**
MICHAEL BAKER, JR., INC. CONSULTING ENGINEERS BEAVER, PENNSYLVANIA		DATE MAY 98	17

PLATE III

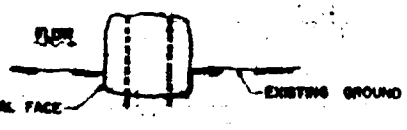
1 2

PROFILE OF [illegible] ED



TEMPORARY STRAW OR HAY BALE EROSION CONTRO

NO SCALE



EMBEDDING DETAIL

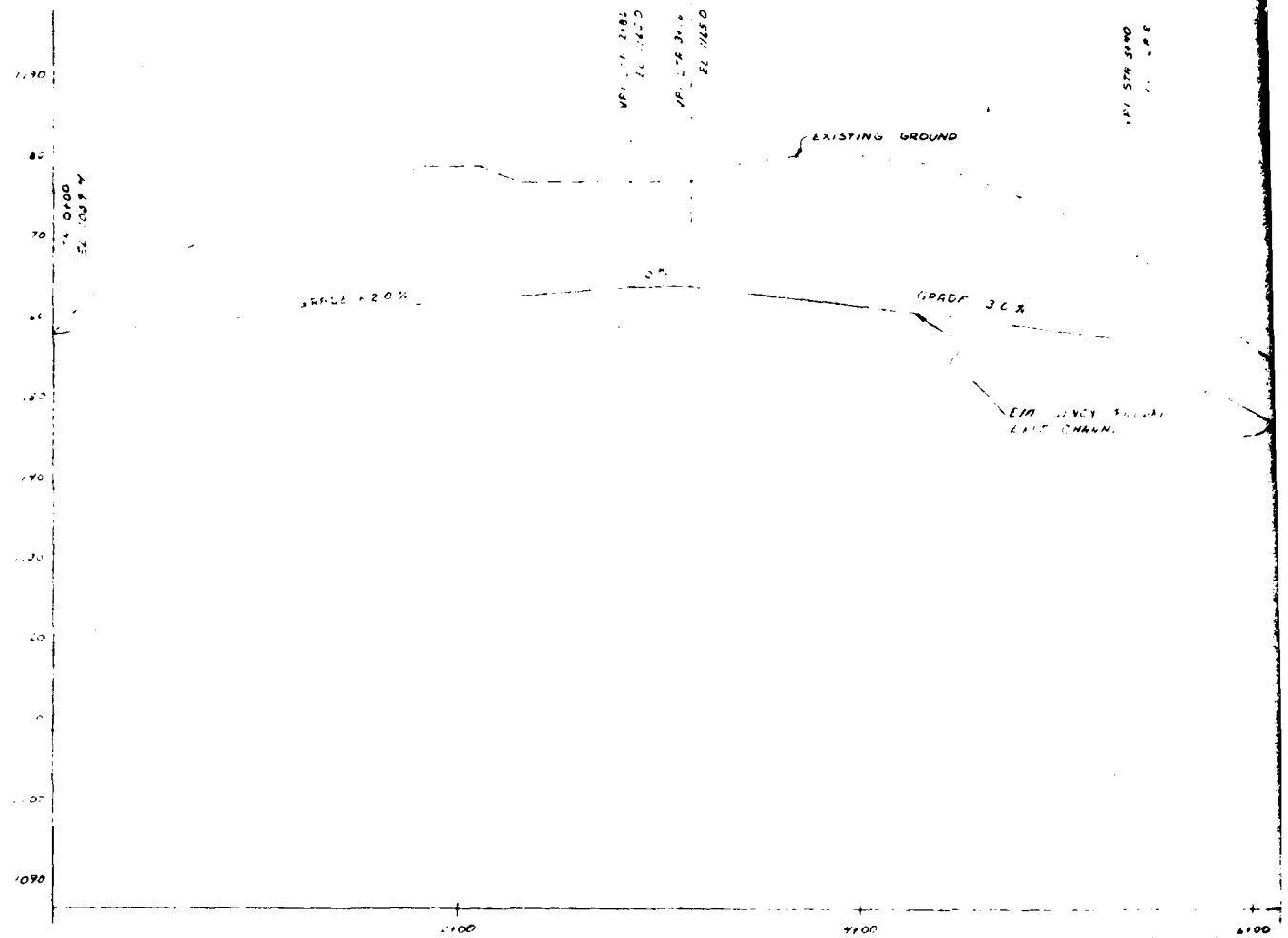
REVISIONS		
NO	DATE	NAME

BETHLEHEM MINES CORPORATION
MINE NO. 60

SLURRY IMPOUNDMENT
PROFILE OF DAM BASE LINE "D"

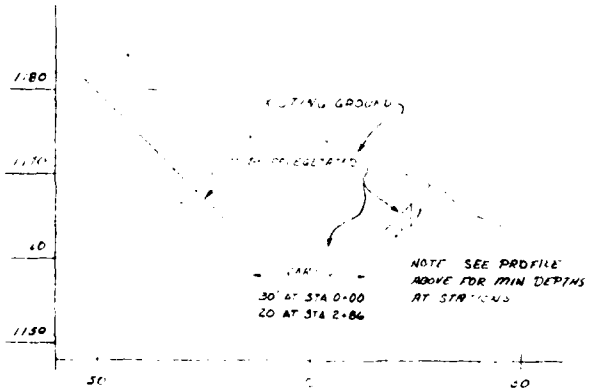
SHEET 4 OF 17	S.O. 13709-01-ARA
SCALE AS SHOWN	DATE MAY, 1980
MICHAEL BAKER, JR. INC Consulting Engineers BEAVER, PENNSYLVANIA	DESIGNED DRAWN / TRACED CHECKED FILE

PLATE IV



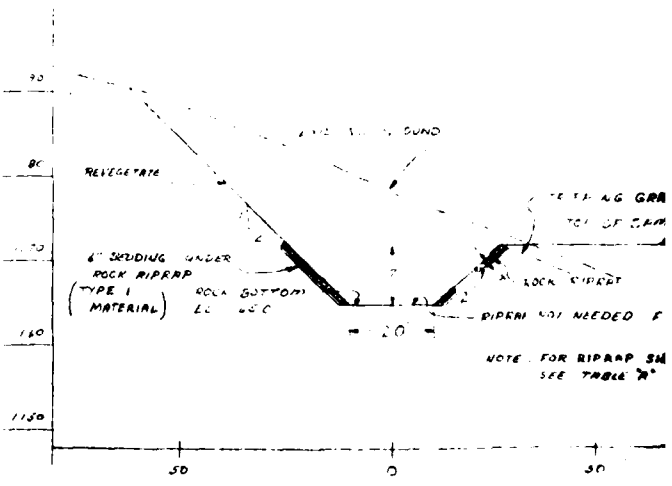
PROFILE EMERGENCY SPILL

SCALE 1" 40' H 1" 10' V.



TYPICAL EMERGENCY SPILLWAY ENTRANCE CHANNEL

SCALE 1" 20' H 1" 10' V

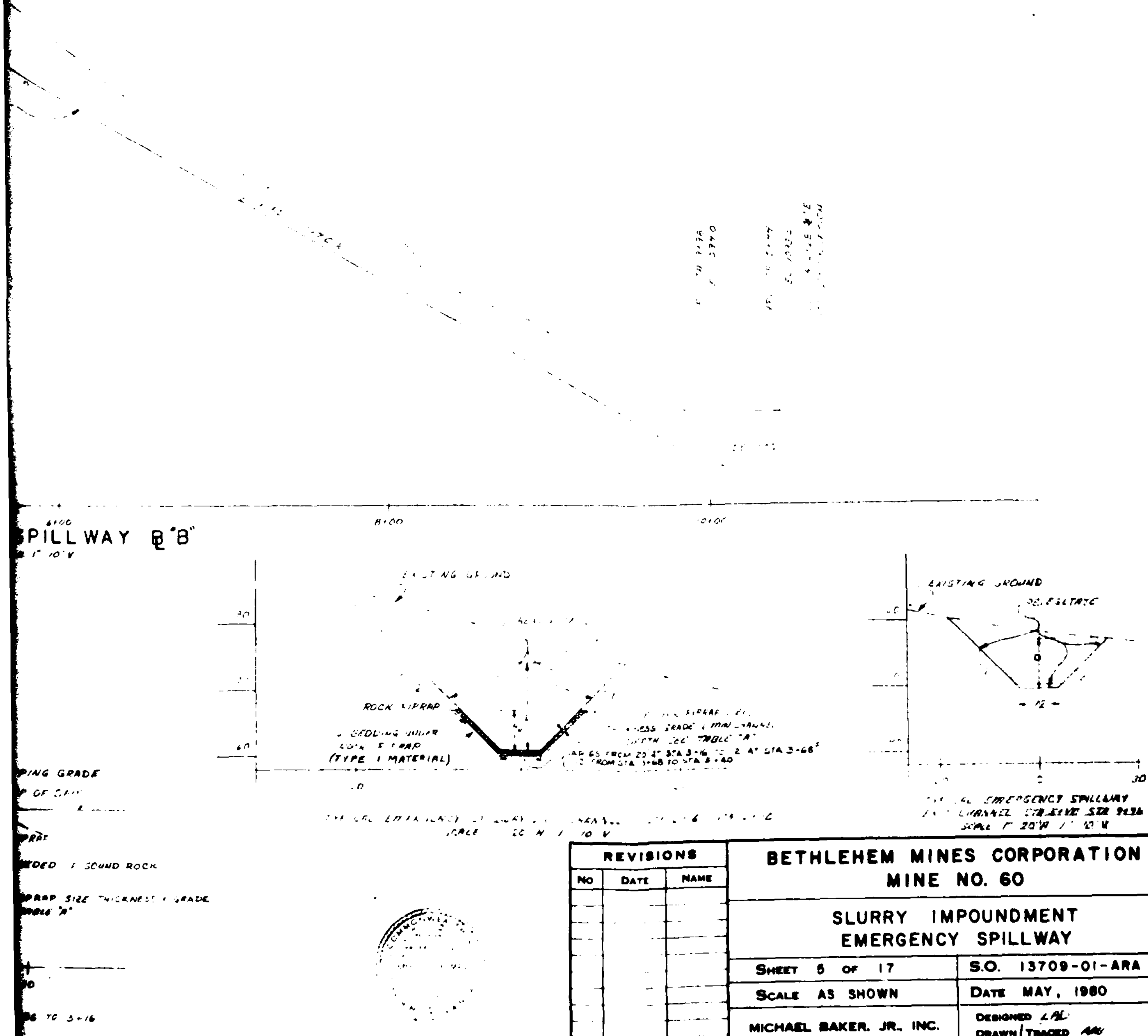


EMERGENCY SPILLWAY CONTROL SECTION STA 1+85 TO 3+

SCALE 1" 20' H 1" 10' V

TABLE "A"

STATION TO STATION	[illegible] (%)	DEPTH [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0 %	7.0 [illegible]	[illegible] IN MAX	[illegible] FT	7.0 FT
[illegible]	3 %	[illegible] FT	[illegible] IN MAX	2.[illegible] FT	6.0 FT
[illegible]	4 %	3.[illegible] FT	N/A	N/A	N/A
[illegible]	[illegible]	[illegible] FT	N/A	N/A	N/A



REVISIONS		
No	DATE	NAME

BETHLEHEM MINES CORPORATION
MINE NO. 60

SLURRY IMPOUNDMENT
EMERGENCY SPILLWAY

SHEET 6 OF 17 | S.O. 13709-01-ARA

SCALE AS SHOWN | DATE MAY, 1980

MICHAEL BAKER, JR., INC.
Consulting Engineers
BEAVER, PENNSYLVANIA

DESIGNED
DRAWN/TRACED
CHECKED
FILE

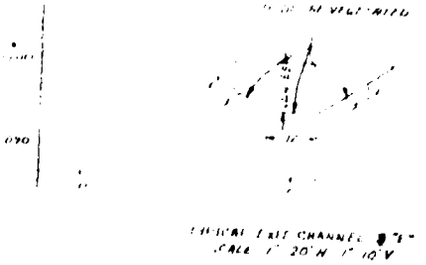
PLATE V

EXISTING GROUND

EXIT CHANNEL BOTTOM

PROFILE E

SCA



TYPICAL EXIT CHANNEL
SCALE 1" 20' H 1" 10' V

TYPICAL EMERGENCY
SCALE

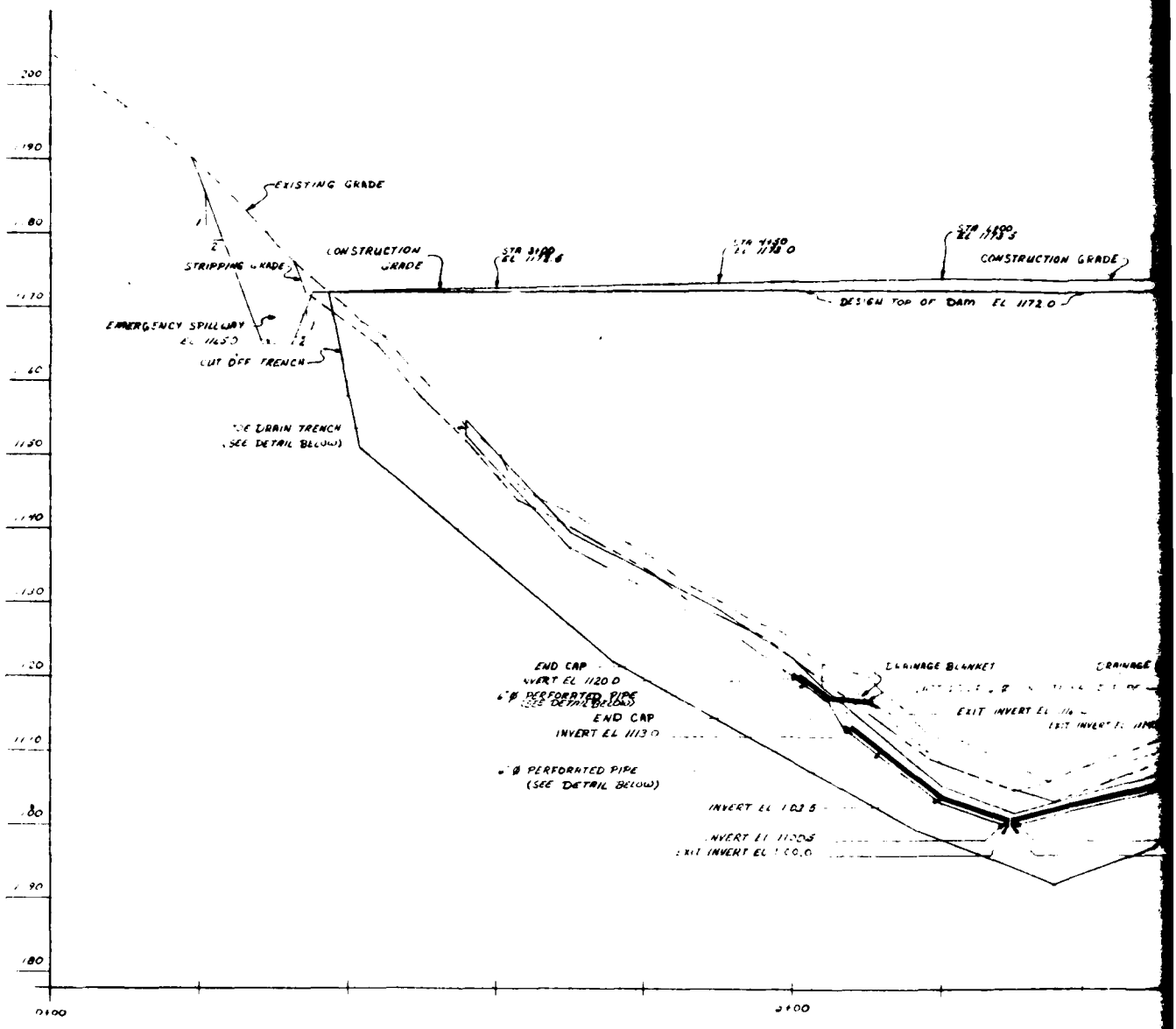
REVISIONS		
NO	DATE	NAME

BETHLEHEM MINES CORPORATION
MINE NO. 60

SLURRY IMPOUNDMENT
EXIT CHANNEL AND DETAILS

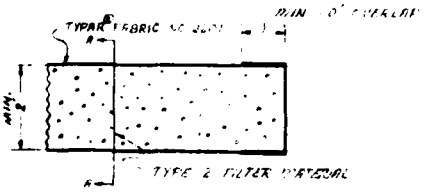
SHEET 8 OF 17	S.O. 13709-01-ARA
SCALE AS SHOWN	DATE MAY, 1980
MICHAEL BAKER, JR., INC. Consulting Engineers BEAVER, PENNSYLVANIA	DESIGNED LAF DRAWN / TRACED And CHECKED FILE

PLATE VI

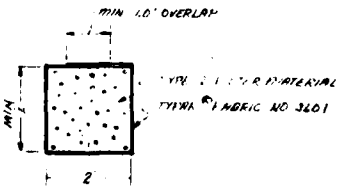


PROFILE ℄ "A" (LOOKING

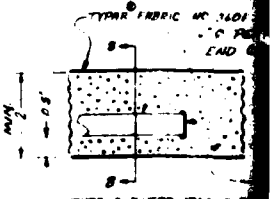
SCALE 1" = 50' H 1" = 10' V



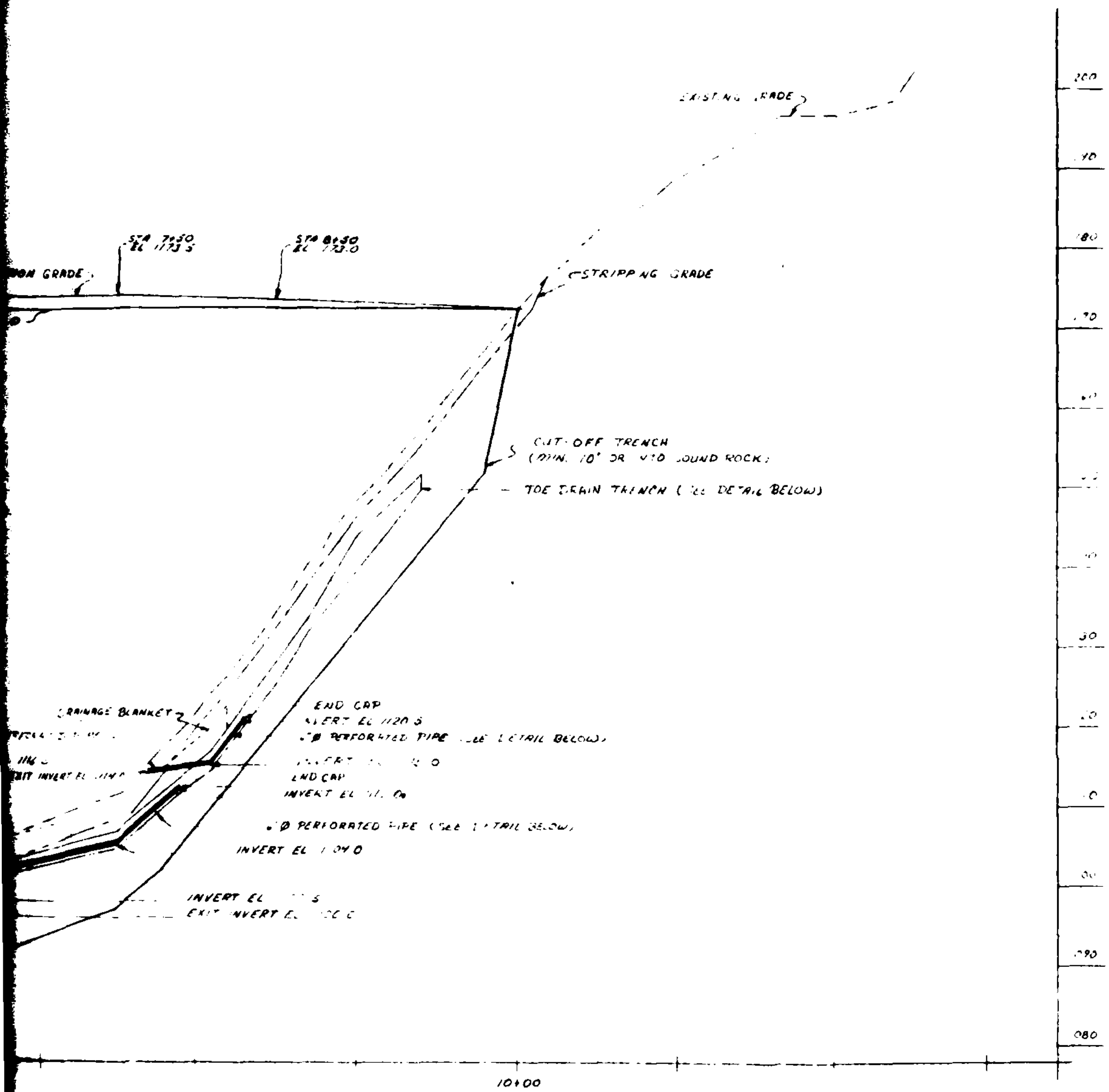
DETAIL TOE DRAIN TRENCH
SCALE 1" = 2'



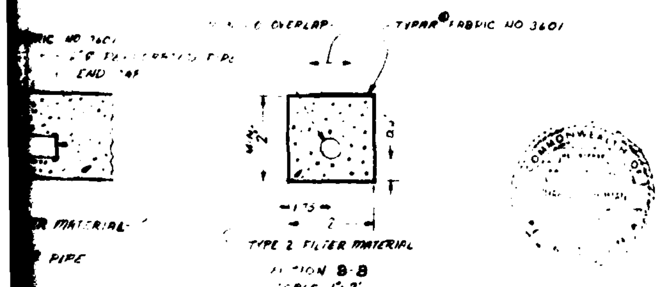
SECTION A-A
SCALE 1" = 2'



DETAIL TOE DRAIN PIPE
SCALE 1" = 2'



OKING DOWNSTREAM)



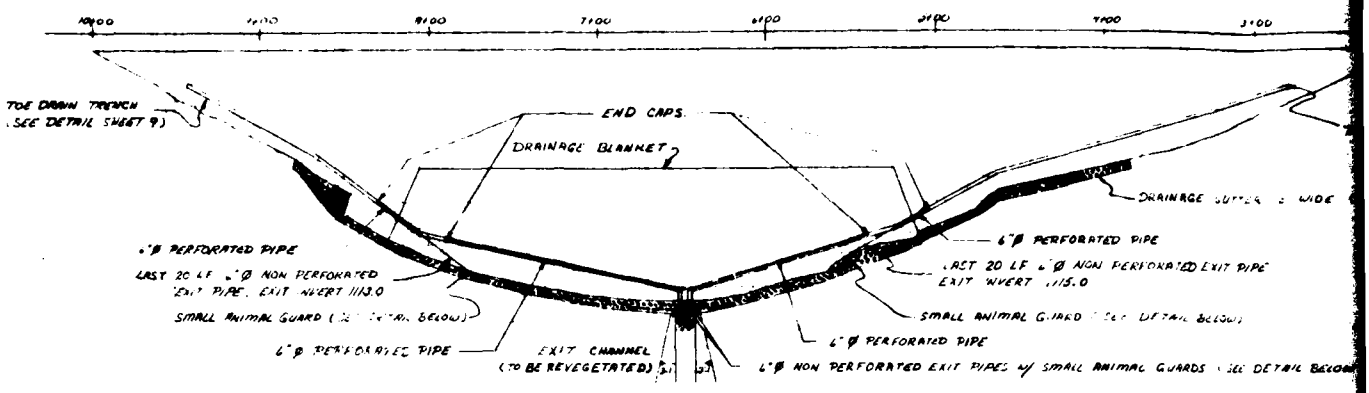
REVISIONS		
No.	Date	Name
1	3/[illegible]/80	KU/ALB

BETHLEHEM MINES CORPORATION
MINE NO. 60

SLURRY IMPOUNDMENT
CUT-OFF TRENCH AND TOE DRAIN PROFILE

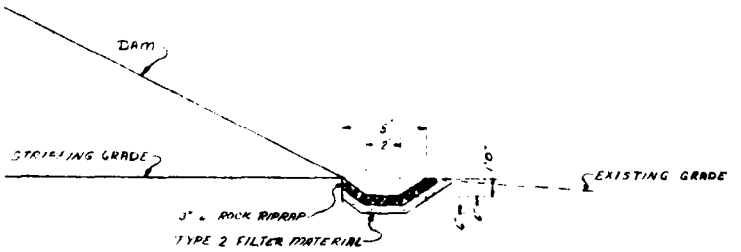
SHEET 9 OF 17	S.O. 13709-01-ARA
SCALE AS SHOWN	DATE MAY, 1980
MICHAEL BAKER, JR., INC. Consulting Engineers BEAVER, PENNSYLVANIA	DESIGNED J.G.G. DRAWN/TRACED CHECKED JND FILE

PLATE VII



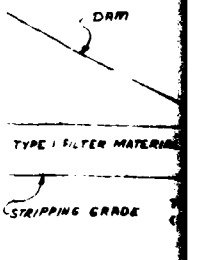
DRAINAGE DETAIL PLAN VIEW

SCALE 1" = 50'



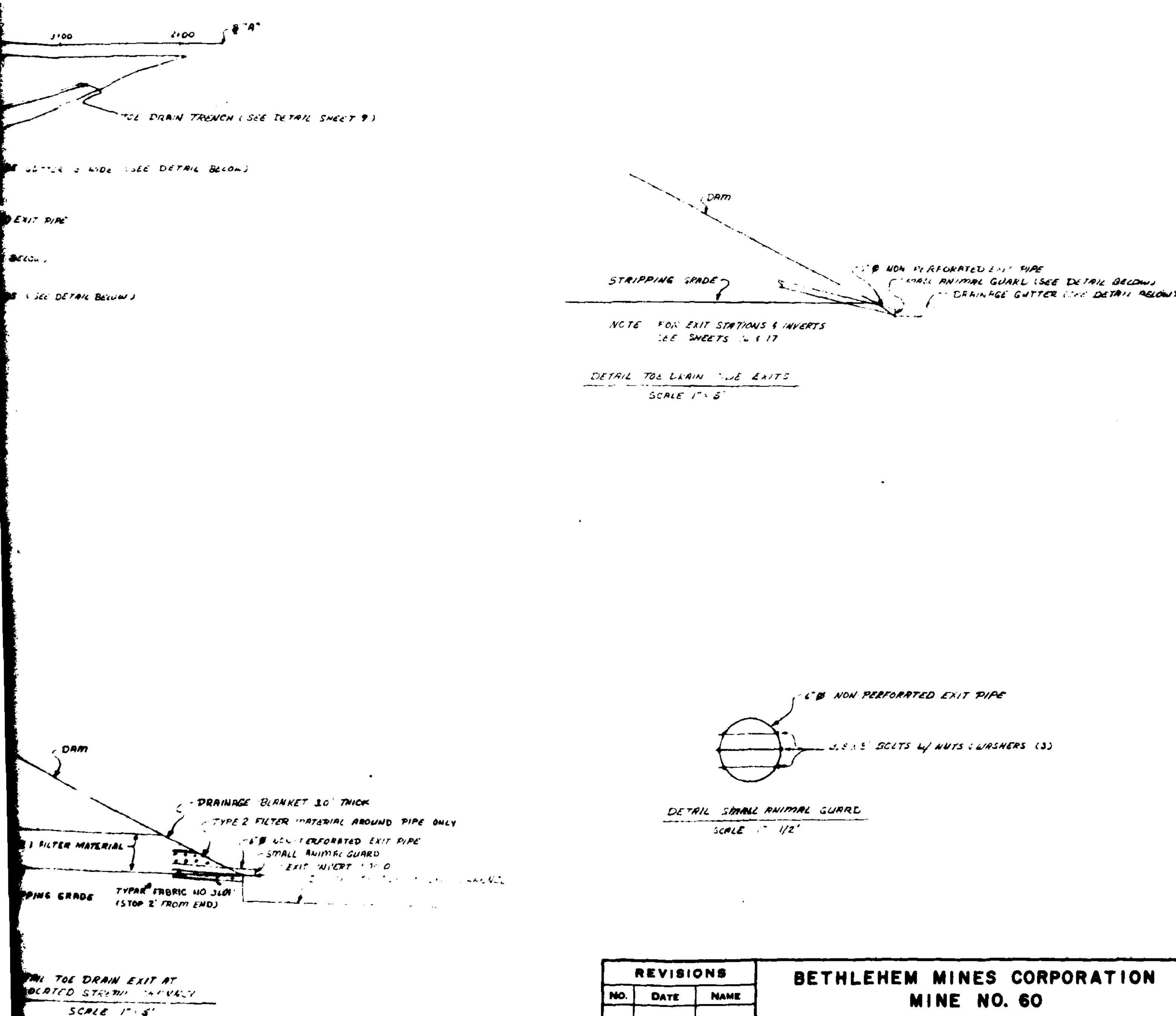
TYPICAL DRAINAGE GUTTER

SCALE 1" = 5'



DETAIL TOE DRAIN
RELOCATED STREAM

SCALE



REVISIONS		
NO.	DATE	NAME

BETHLEHEM MINES CORPORATION
MINE NO. 60

SLURRY IMPOUNDMENT
DRAINAGE DETAILS

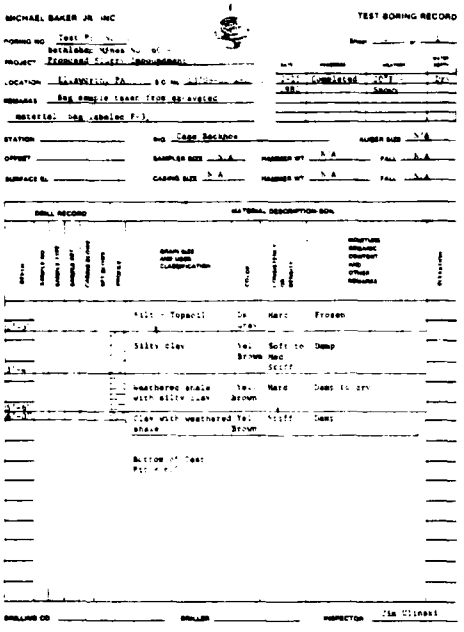
SHEET 10 OF 17	S.O. 13709-01-ARA
SCALE AS SHOWN	DATE MAY, 1980
MICHAEL BAKER, JR., INC. Consulting Engineers BEAVER, PENNSYLVANIA	DESIGNED J.G.U. DRAWN/TRACED CHECKED FILE

PLATE VIII

9

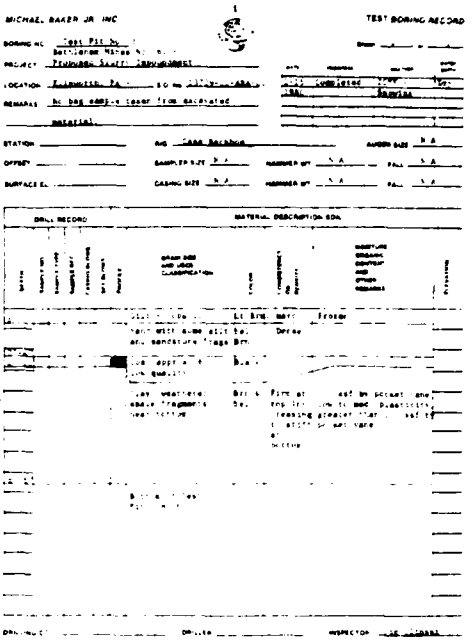
MICHAEL BAKER JR. INC

TEST BORING RECORD



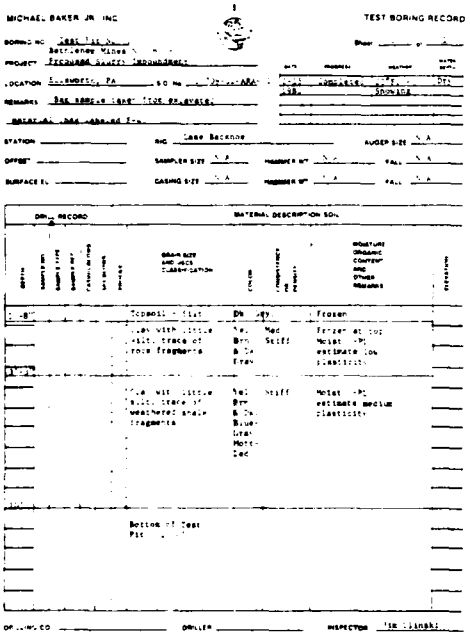
MICHAEL BAKER JR. INC

TEST BORING RECORD



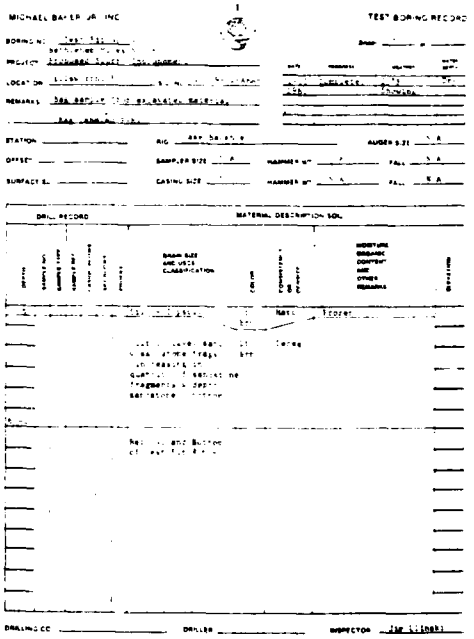
MICHAEL BAKER JR. INC

TEST BORING RECORD

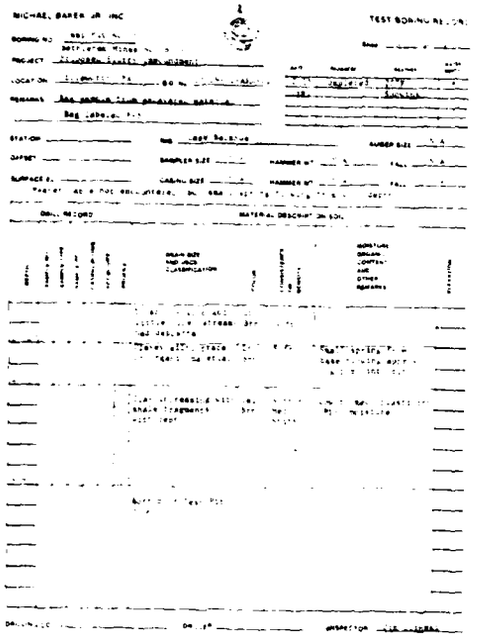


MICHAEL BAKER JR. INC

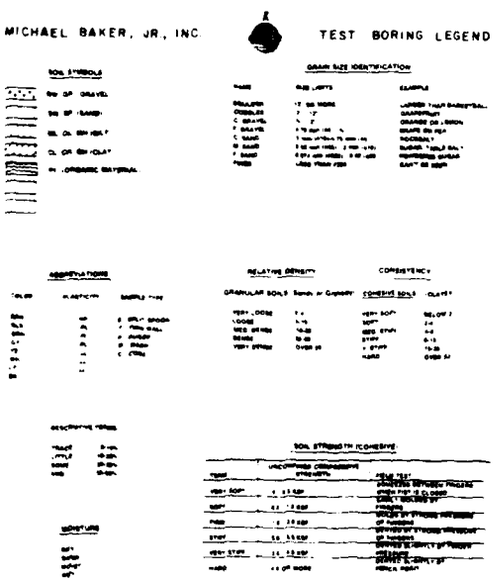
TEST BORING RECORD



REVISIONS	DESIGNED	NORTH		BE
	DRAWN			
	CHECKED			
	REVIEWED			
	SO 13709-02-ARA			



MICHAEL BAKER, JR., INC. TEST BORING LEGEND



See Sheet No 8 for Logs of TH-1, TH-2, and TH-3

TH-4, Elev. 1119.12
Logged by: John Zubal, L. Robert Kimball and Associates
Date: December 17, 1979
Drilling Equipment: Acker AD II

Hole Depth From Ft.	To Ft.	Description of Materials	STANDARD PENETRATION Blows Per 6"	No.	Type	SAMPLES From Ft.	To Ft.	Rec. Ft.
0.0	5.0	CLAY, silty, some rock fragments, brown, moist, stiff (fill-dam embankment)	22-27-21 14-40-50/0.3'	1 2 1 1	SPT SPT Bag Bag	3.0 4.5 0.0 5.0	4.5 5.8 4.5 7.0	1.3 1.3
5.0	7.1	SILT, brown, very stiff						
7.1		Bottom of hole, dry						

TH-5, Elev. 1135.35
Logged by: O. T. McConnell, L. Robert Kimball and Associates
Date: December 19, 1979
Drilling Equipment: Acker AD II

Hole Depth From Ft.	To Ft.	Description of Materials	No.	Type	SAMPLES From Ft.	To Ft.
0.0	0.6	TOPSOIL	1	Bag	0.0	4.5
0.6	3.4	CLAY, silty, brown, moist	2	Bag	4.5	14.0
3.4	4.5	CLAY, silty, gray	3	Bag	14.0	19.2
4.5	14.0	SILT, sandy, with weathered shale fragments, brown, moist				
14.0	19.2	SILT, clayey, with weathered shale fragments, light brown, moist				
19.2		Bottom of hole				

TH-6, Elev. 1130.72
Logged by: Ron Anthony, L. Robert Kimball and Associates
Date: December 13, 1979
Drilling Equipment: Acker AD II

Hole Depth From Ft.	To Ft.	Description of Materials	No.	Type	SAMPLES From Ft.	To Ft.
0.0	1.0	TOPSOIL, brown	1	Bag	0.0	4.0
1.0	4.0	CLAY, silty, with shale fragments, light brown, moist, stiff	2 3 4	Bag Bag Bag	4.0 6.0 13.0	6.0 13.0 18.0
4.0	6.0	CLAY, silty, with large shale fragments and cobbles, brown, dry, stiff				
6.0	10.0	CLAY, silty, with shale fragments, yellow, dry, stiff				
10.0	14.4	SHALE, decomposed, brown, dry, hard				
14.4	15.0	SHALE, decomposed, wet, soft				
15.0	18.0	SHALE, decomposed, brown, dry, hard				
18.0		Bottom of hole, WL 12 15 79; 15.1'				

TH-7, Elev. 1150.33
Logged by: Ron Anthony, L. Robert Kimball and Associates
Date: December 15, 1979
Drilling Equipment: Acker AD II

Hole Depth From Ft.	To Ft.	Description of Materials	No.	Type	SAMPLES From Ft.	To Ft.
0.0	1.0	TOPSOIL	1	Bag	0.0	4.0
1.0	7.0	CLAY, silty, with small black seam, brown, moist, soft	2	Bag	4.0	10.0
7.0	17.0	CLAY, silty, with sand and shale fragments, light brown, dry, stiff	3	Bag	17.0	20.0
17.0	20.0	SHALE, decomposed, brown, dry, soft				
20.0		Bottom of hole, dry				

TH-8, Elev. 1166.84
Logged by: O. T. McConnell, L. Robert Kimball and Associates
Date: December 17, 1979
Drilling Equipment: Acker AD II

Hole Depth From Ft.	To Ft.	Description of Materials	No.	Type	SAMPLES From Ft.	To Ft.
0.0	0.7	TOPSOIL	1	Bag	0.7	3.0
0.7	3.0	CLAY, silty, brown, wet	2	Bag	3.0	8.0
3.0	8.0	SAND, silty, with weathered shale fragments, brown, moist	3	Bag	8.0	15.0
8.0	15.0	SILT, sandy, brown, moist				
15.0		Bottom of hole				

ETHLEHEM MINES CORPORATION
MINE NO. 60
SLURRY IMPOUNDMENT

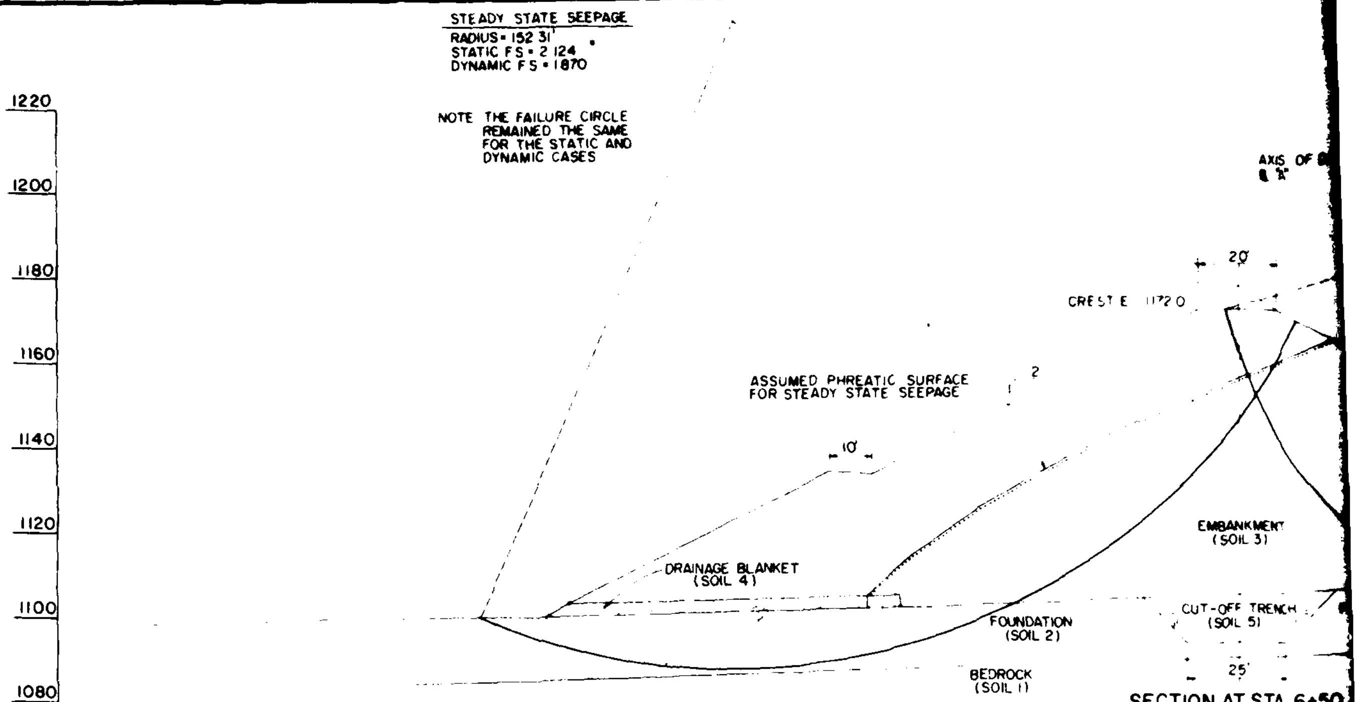
MICHAEL BAKER, JR., INC.
CONSULTING ENGINEERS BEAVER PENNSYLVANIA

TEST PIT AND BORING RECORDS

SCALE NONE DATE MAY, 1980

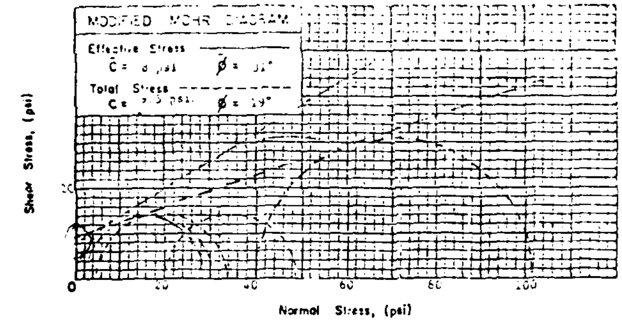
SHEET NO 11 OF 17

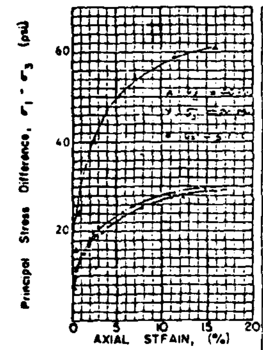
PLATE IX



SECTION AT STA 6+50

SCALE: HORIZ. VERT.





SPECIMEN NO.		1	2	3	4
INITIAL	Water Content, %	20.6	21.15	17.74	
	Dry Density, pcf	108.19	108.07	111.84	
	Void Ratio	0.61	0.62	0.56	
	Saturation, %	93.6	96.02	86.35	
BEFORE SHEAR	Water Content, %	26.3	26.0	19.1	
	Dry Density, pcf	108.19	108.35	112.12	
	Void Ratio	0.74	0.74	0.56	
	Saturation, %	100	100	93.74	
	Back Pressure, psi	75	70	87	
Minor Principal Stress, σ_3 psi		5	20	45	
Effective Minor Principal Stress, $\bar{\sigma}_3$ psi		0	7	17	
Max. Principal Stress Difference, $(\sigma_1 - \sigma_3)_{max}$		29	29	61	
Test time to failure, min.		24.41	51.7	46.4	
Specimen Diameter, in.		2.36	[illegible]	2.3[illegible]	
Specimen Height, in		5.63	5.71	5.67	

Project: [illegible] Mines - Ellsworth

Boring No. [illegible] | Depth/Elev. [illegible] | Date [illegible]

TRIAXIAL COMPRESSION TEST ([illegible])

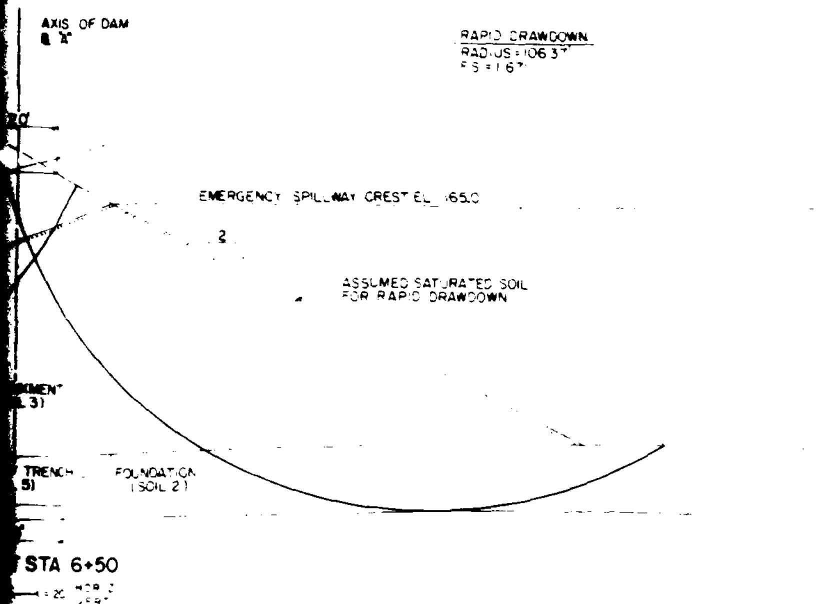
Type of Specimen: Remolded		
Classification:		
LL	PI	G_s 2.60
Remarks:		

L. ROBERT KIMBALL & ASSOCIATES
Consulting Engineers
EBENSBURG, PENNSYLVANIA

REVISIONS

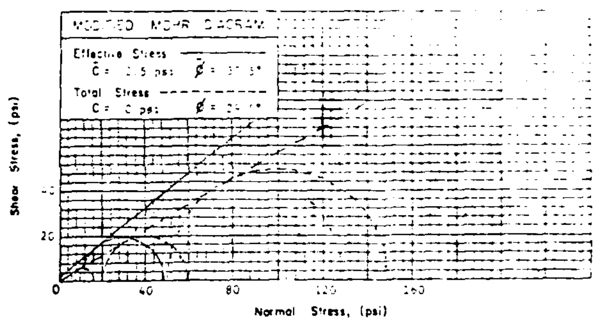
DESIGNED PSV / JGU
DRAWN W.A.G.
CHECKED JD
REVIEWED [illegible] DJC
S.O. 13709-02-ARA

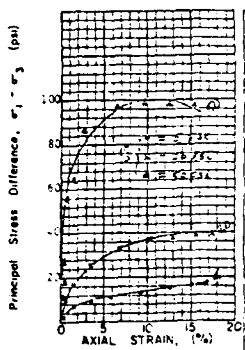
NORTH



STEADY STATE SEEPAGE AND RAPID DRAWDOWN SOIL PARAMETERS

SOIL	TOTAL UNIT WEIGHT δ_T (PCF)	EFFECTIVE STRESS – STRENGTH PARAMETERS $\bar{c}$ (PSF)	$\bar{\phi}$ (DEGREES)
1	145	3000	40
2	135	360	37.5
3	130	1152	31
4	135	0	38
5	130	1152	31





SPECIMEN NO		1	2	3	4
INITIAL	Water Content, %	[illegible]	[illegible]	[illegible]	
	Dry Density, pcf	[illegible]	[illegible]	[illegible]	
	Void Ratio	[illegible]	[illegible]	[illegible]	
	Saturation, %	[illegible]	[illegible]	[illegible]	
BEFORE SHEAR	Water Content, %	[illegible]	[illegible]	[illegible]	
	Dry Density, pcf	[illegible]	[illegible]	[illegible]	
	Void Ratio	0.655	[illegible]	[illegible]	
	Saturation, %	100	[illegible]	[illegible]	
	Back Pressure, psi	[illegible]	65	[illegible]	
Minor Principal Stress, σ_3 psi		[illegible]	[illegible]	[illegible]	
Effective Minor Principal Stress, $\bar{\sigma}_3$ psi		---	[illegible]	[illegible]	
Max. Principal Stress Difference, $(\sigma_1 - \sigma_3)_{max}$		[illegible]	[illegible]	[illegible]	
Test time to failure, min		[illegible]	[illegible]	[illegible]	
Specimen Diameter, in		[illegible]	[illegible]	[illegible]	
Specimen Height, in		[illegible]	[illegible]	[illegible]	

Type of Specimen Undisturbed
Classification
LL | PI | G_s [illegible]
Remarks

L. ROBERT KIMBALL & ASSOCIATES
Consulting Engineers
EBENSBURG, PENNSYLVANIA

Project Bethlehem Mines – [illegible]
Boring No. [illegible] Depth/Elev [illegible] Date [illegible]
TRIAXIAL COMPRESSION TEST ( )

BETHLEHEM MINES CORPORATION
MINE NO 60
SLURRY IMPOUNDMENT

MICHAEL BAKER, JR., INC.
CONSULTING ENGINEERS BEAVER, PENNSYLVANIA

STABILITY ANALYSES AND TRIAXIAL SHEAR TEST RESULTS

SCALE 1" = 20' HORIZ. VERT.
DATE MAY, 1980

SHEET NO. 12 OF 17

PLATE X

CONSTRUCTION SPECIFICATIONS

SITE PREPARATION

In preparing the site, all borrow areas and all areas under the embankment and any structural works shall be cleared, grubbed, and stripped of topsoil, trees, vegetation, roots or other objectionable material. In order to facilitate cleanout and restoration, the entire work area will be cleared of all brush, trees, and debris and topsoil will be stockpiled at the designated location to be used for revegetation of the project area.

CUT-OFF TRENCH

A cut-off trench shall be excavated along the centerline of the embankment. The depths of the cut-off trench on the drawings are approximate. Actual depths will be determined by the Owner's Representative after examination of materials encountered. The bottom of the excavation shall meet the requirements discussed under "Foundation Preparation." Side slopes shall be no steeper than 1H:1V. The trench shall be kept dewatered during the excavation and backfilling-compacting operations. The fill material for the cut-off trench shall consist primarily of clay (CL) material, obtained from the Borrow Area, and shall meet the requirements of the embankment material

EMBANKMENT

Material Classification

All excavation and embankment shall be un-classified. All material encountered regardless of hardness, type, durability and size shall be removed to the lines and grades as indicated on the Contract Drawings.

Suitability of Fill

Fill material shall be taken from approved borrow areas. Excavated material from the emergency spillway, cut-off trench excavation, and drainage trench excavation may be used for the embankment if approved by the Owner's Representative and placed in accordance with the specifications for the embankment. All fill material shall be clean soil, free of topsoil, roots, vegetation, stones or rock greater than 8 inches in diameter, frozen material or other objectionable material considered unsuitable by the Owner's Representative for use in embankment construction. In no case shall unburned coal processing waste be used. All borrow areas shall be adequately drained to provide a dry working area and the required moisture content of the embankment material.

Foundation Preparation

Immediately prior to placing the first layer of fill, all surfaces to receive fill shall be cleaned of all vegetation, debris, topsoil and other objectionable material. All roots shall be grubbed. All rock foundations shall be free of loose rock fragments and thoroughly cleaned to a solid bed and sidewall to the satisfaction of the Owner's Representative. All rock foundations shall not have overhanging portions under which embankment material cannot be satisfactorily placed. After the necessary stripping and excavation has been completed, all earth foundations shall be moistured conditioned (sprinkled or scarified and dried) and compacted. The first lift of the embankment, except for the area of the drainage blanket, shall then be placed to a maximum thickness of 6 inches and thoroughly disced prior to compaction to provide a satisfactory bond between the first layer of fill and the earth foundation.

In the area of the former Lake Calydon where embankment is to be placed, the lake sediment deposits shall be totally removed. Final depth of stripping in this area shall be inspected by the Owner's Representative and approved prior to placement of the embankment. It is anticipated that this stripping will average approximately 3 feet deep.

Placement and Compaction

The combined borrow excavation and embankment placing operations shall be handled such that the materials when compacted in the embankment will be blended sufficiently to secure the best practicable degree of compaction, impermeability, and stability. The distribution and gradation of materials throughout the embankment shall be handled such that the embankment will be free of [illegible] pockets, streaks, or layers of material differing materially in texture or gradation from the surrounding material. The material shall be handled in the embankment in such a manner that segregation during placement [illegible] materials with a greater rock content shall be placed in [illegible] the embankment. All fill material shall be placed in uniform horizontal layers of not more than 8 inches loose depth for the full width of the cross section. Fill material shall not be placed on surfaces that are muddy, frozen, or contain frost or ice. Each layer for its full width shall be compacted to not less than 95 percent of the maximum dry density at a moisture content not exceeding two percentage points above the optimum moisture content and not more than two percentage points below optimum. If necessary, each layer shall be moistened or aerated before compaction to provide the required moisture content of the soil material. The maximum dry density and optimum moisture content shall be determined in accordance with ASTM D-1557-78 (Modified Proctor Test).

CREST PROTECTION

The crest of the embankment shall be protected with a coarse aggregate as shown in the construction drawings. The coarse aggregate shall be compacted to a depth of 5 inches and shall meet the requirements of PennDOT Form 408 Type 2A Aggregate

Field Quality Control

The subgrade and fill layers shall be inspected and approved by the Owner's Representative before further construction work may be performed thereon. To determine that the moisture content and dry density requirements of the compacted fill have been met, field and laboratory tests shall be made at frequent intervals by the Owner's Representative

Prior to the earthwork operations, at least one laboratory compaction test will be performed in accordance with ASTM D-1557-78 for typical materials. During the earthwork operations, at least one additional laboratory compaction test will be performed for every material change or for every twenty (20) field tests. Compaction equipment is subject to the approval of the Owner's Representative. If fill compaction does not achieve specified densities due to existing compaction equipment, it shall be replaced with more effective equipment.

Field density tests will be performed for every 4,000 cubic yards of typical soil material in accordance with ASTM D1556-64 (1974), "Density of Soil In-Place by the Sand-Cone Method." A minimum of one field density test shall be performed for each day embankment fill is placed. Additional tests shall be performed where moisture is determined to vary substantially. Field determinations of the moisture content of soils will be in accordance with AASHO T 217-67, "Determination of Moisture in Soils by Means of a Calcium Carbide Gas Pressure Moisture Tester."

Materials not meeting the specified moisture content and dry density requirements, as determined by these tests, shall be reworked until approved results are obtained. Material that cannot be dried to the specified moisture content before the next lift of fill is placed, shall be removed before continuing subsequent fill placement

DRAINAGE

Filter Fabric

The filter fabric shall be Typar® Fabric No. 3601 or equivalent. Approval of alternate filter fabric is subject to prior notification of the Owner's Representative and approval by the Owner's Representative

Type 1 Filter Material

Type 1 filter material shall meet the gradation requirements of PennDOT CC sand Type A as defined in Section 703.1 of the PennDOT Form 408 and shall be obtained from an approved source. It is the intent that this material will be placed adjacent to the existing site soils to act as a filter of the soil fines. The materials shall be reasonably uniform in physical properties and composed of hard, tough, durable, uncoated particles, thoroughly cleaned by washing, free from harmful amounts of clay, silt, vegetation, or other substances determined to be undesirable. The Type 1 filter material shall be natural sand resulting from glacial or water action. Limestone or slag fine aggregate is unacceptable.

Type 2 Filter Material

Type 2 filter material shall meet the gradation requirements of the PennDOT Form 408 Section 703.3 for Coarse Aggregate 1B and shall be obtained from an approved source. It is the intent that this material will be placed adjacent to the pipe perforations to prevent migration of material into the pipe. The materials shall be reasonably uniform in their physical properties and shall be composed of hard, tough, durable, uncoated particles, free of harmful amounts of

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clay, silt, vegetation, or other substances determined to be undesirable. The Type 2 filter material shall be rounded, natural "pea" gravel resulting from glacial or water action. The crushed limestone aggregate, if used, shall be resistant to abrasion and water solutioning, and shall be free of fine material resulting from handling, in addition to the other requirements previously mentioned in this paragraph. Slag aggregate is unacceptable.

Drainage Trench

The drainage trench shall be installed to the lines and grades as shown on the drawings except where field conditions require that the trench be installed deeper when approved by the Owner's Representative. The trench shall be kept dewatered during the excavation, backfilling, and compacting operations.

Toe Drain Pipe

The 6-inch-diameter drain pipe shall be bituminous coated corrugated metal pipe, 16 gage, perforated with 1/4" size perforations and shall meet the requirements of AASHTO Designation M 190-78, "Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches." The pipe shall be fully coated. The size of the perforations shall be 1/4 inch. The pipe to carry the flow from the toe drain to the outlet channel shall be of the same gauge, size and requirement as specified above, but shall not be perforated. The upgrade ends of the drains shall be closed with commercially manufactured galvanized end caps. The discharge end of the pipe shall be suitably protected with an animal guard, either commercially available or as detailed on the drawings.

Drainage Blanket

The drainage blanket material, Type 1 Filter Material, shall meet the gradation requirements of PennDOT CC Sand Type A as defined in Section 703.1 of the PennDOT Form 408 and shall be obtained from an approved source. It is the intent that this material will provide adequate drainage of the downstream prism of the embankment and to act as a filter of the soil fines. The materials shall be reasonably uniform in physical properties and composed of hard, tough, durable, uncoated particles, thoroughly cleaned by washing, free from harmful amounts of clay, silt, vegetation, or other substances determined to be undesirable. The drainage blanket material shall be natural sand resulting from glacial or water action. Limestone or slag fine aggregate is unacceptable.

Prior to placing the first layer of the drainage blanket fill, the area shall be prepared in accordance with the requirements discussed under "Foundation Preparation," except that the first layer of drainage blanket fill shall not be disced and mixed with the foundation soil after initial compaction. The drainage blanket fill shall be placed in uniform horizontal layers of not more than 8 inches loose depth for the full width of the drainage blanket. Care shall be exercised by the Contractor to prevent contamination of the drainage blanket with other soils. If such contamination occurs it will be removed and replaced at the Contractor's expense. Drainage blanket fill shall not be placed on surfaces that are muddy, frozen, or contain frost or ice. Each layer for its full width shall be compacted to not less than 95 of the maximum dry density. The maximum dry density shall be determined in accordance with ASTM D-1557-78 (Modified Proctor Test).

Revegetation

The following seed mixture shall be used in revegetating the embankment, the entrance channel of the emergency spillway, and other areas disturbed during construction:

Mixture	Seeding Rate - lbs/acre
Perennial Ryegrass	20
Kentucky 31 Fescue	25
Crownvetch with innoculant	20

If the embankments are hydroseeded, the legume innoculant shall be added to the slurry just prior to seeding at 4 times the rate recommended on the package. Lime, fertilizer and hydromulch shall be applied with the seed application. Lime shall be applied at a rate of 2 tons per acre. Liming materials shall be agricultural ground limestone of sufficient fineness so that 98% will pass a 20-mesh sieve and 40% will pass a 100-mesh sieve. TNP (calcium carbonate equivalent) shall be 90 or higher. Six hundred pounds of 10-20-20 fertilizer shall be applied per acre at the time of seeding.

The embankments shall be mulched with hay mulch, blown onto seeded areas at a rate of 2.5 tons per acre. Mulch shall be anchored with asphalt spray applied at a rate of 80 gallons per acre.

ACCESS ROAD

The access road shall be blade cut in the field as shown in the construction drawings. The road surface shall be a coarse aggregate compacted to a depth of 5 inches and shall meet the requirements of PennDOT Form 408 Type 2A Aggregate.

RIPRAP

Suitability of Material

Riprap shall consist of well graded limestone or sandstone aggregate obtained from an approved source. Riprap stone shall be dense, sound, resistant to abrasion, free of elongated and/or slabby stones, and free of cracks, seams, and other defects that would tend to increase unduly their destruction by water and frost actions. In no case shall coal-processing waste be used.

Placement

Riprap shall be placed to the lines and grades as shown on the construction plans and as directed for the protection of slopes, structures, gutters and channels. All riprap shall be placed in a manner to insure that the larger stones are uniformly distributed and the smaller stones serve to fill the spaces between the larger stones in such a manner as will result in well-keyed, densely placed mass of the specified thickness.

Bedding

In all areas, bedding, 6 inches in depth, shall be placed between the riprap and earth fill embankment or subgrade to prevent water from removing fine material through voids in the stone. Bedding material shall be Type 1 filter material.

Gradation

Rock riprap sizes listed in the construction details are mean outside dimensions required and fifty percent of the stones shall be equal to or larger than the tabulated outside dimensions. All riprap shall meet the following gradation requirements:

Rock Riprap Size	Maximum weight of stone required	Minimum and maximum range in weight of stones	Weight range of 75% of stones
10 in	75 lbs	25- 75 lbs	50- 75 lbs
19 in	500 lbs	25-500 lbs	150-500 lbs

EROSION CONTROL

Construction operations shall be performed such that erosion and water pollution shall be minimized. The minimization shall take place by constructing a straw or hay bale barrier as shown on the Slurry Impoundment "General Plan and construction drawings prior to construction. This barrier shall remain in place until revegetation of the embankment slopes and other disturbed areas has occurred. When sediment behind the barrier exceeds 1.0 foot in depth, the contractor shall remove the sediment and it shall be placed at a location upstream of the barrier in such a manner that it will not erode from the site.

MAINTENANCE

Revegetated areas will be inspected and limed and fertilized as required.

FIELD SURVEY INFORMATION

Elevation bench marks, coordinate control points, and project base lines shall be provided by Bethlehem Mines Corporation.

PROTECTION OF PERSONS AND PROPERTY

(a) The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to (i) employees, (ii) all other persons who may be affected, (iii) the work and all materials and equipment to be incorporated, (iv) other property at the site or in the vicinity thereof.

(b) The Contractor shall comply with all applicable laws, ordinances, rules, regulations, and orders of any public authority and Bethlehem Mines Corporation having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. He shall erect and maintain, as required by existing conditions and progress of the work, all reasonable safeguards for safety and protection including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent utilities.

BETHLEHEM MINES CORPORATION
MINE NO. 60
SLURRY IMPOUNDMENT

MICHAEL BAKER, JR., INC.
CONSULTING ENGINEERS BEAVER, PENNSYLVANIA

CONSTRUCTION SPECIFICATIONS

SCALE: NONE | DATE: MAY, 1980

SHEET NO. 14 OF 17

PLATE XI

APPENDIX F

GEOLOGY

GEOLOGY

Geomorphology

The Mine No. 60-Pond 6 Dam is located within the Pittsburgh Plateau section of the Appalacian 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 at the head of an unnamed tributary to the Center Branch of 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

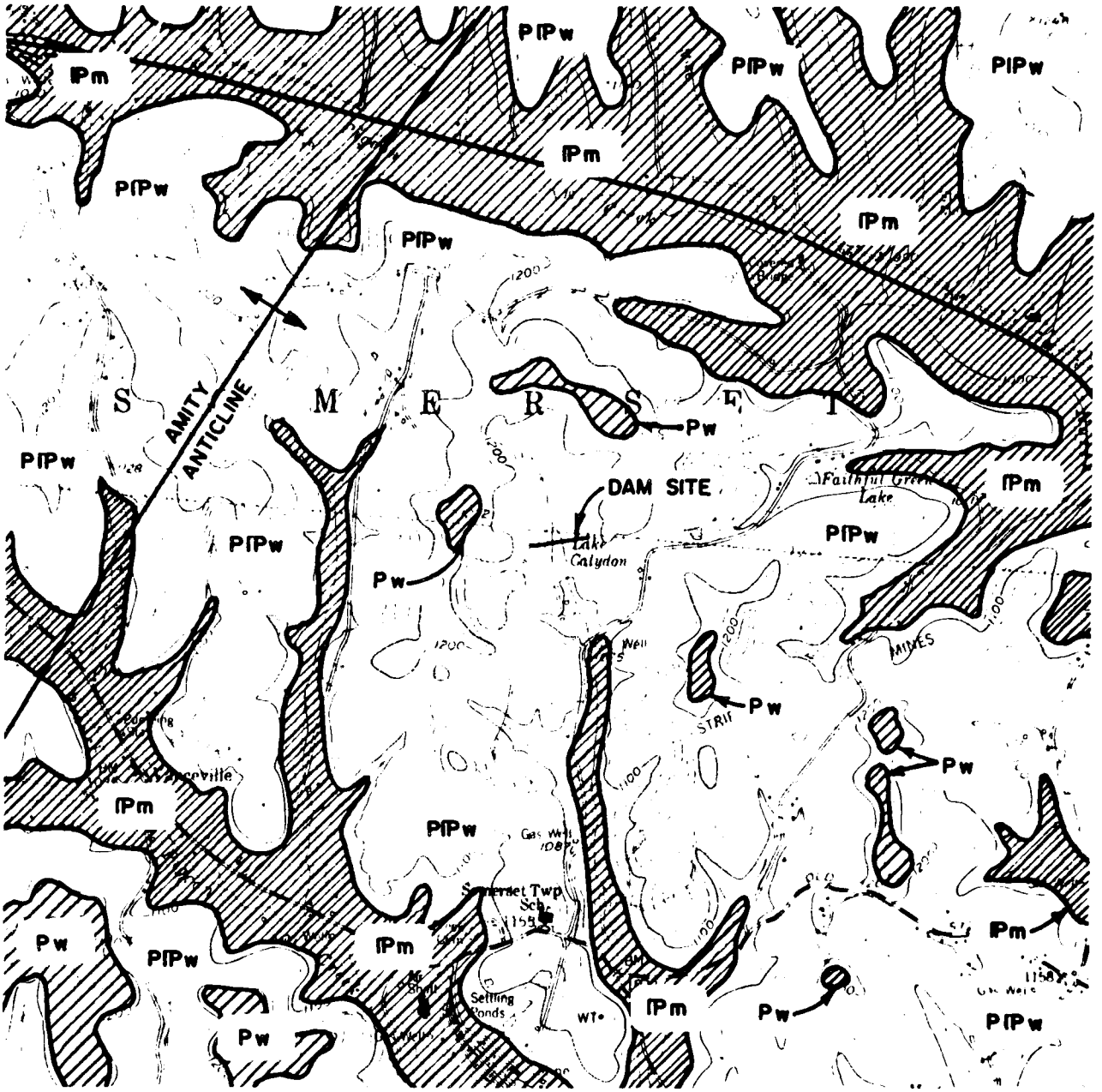
The site lies on the eastern flank of the Amity Anticline, the axis of which plunges to the southwest. Strata in the immediate vicinity of the dam dip to the south at an average rate of about 0.3°. Faulting has not been documented in the area of the dam and no observations were made that would indicate faulting in the rocks outcropping around the dam.

Stratigraphy

Rocks outcropping in the immediate vicinity of the site belong to the Pennsylvanian Age, Casselman and Monongahela Formations 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 300 feet below the dam and has been extensively deep mined. The Waynesburg Coal Seam, which is the lowermost unit of the Waynesburg Formation, lies beneath the dam and has been unaffected by deep mining.



HACKETT QUADRANGLE, WASHINGTON COUNTY, PENNSYLVANIA

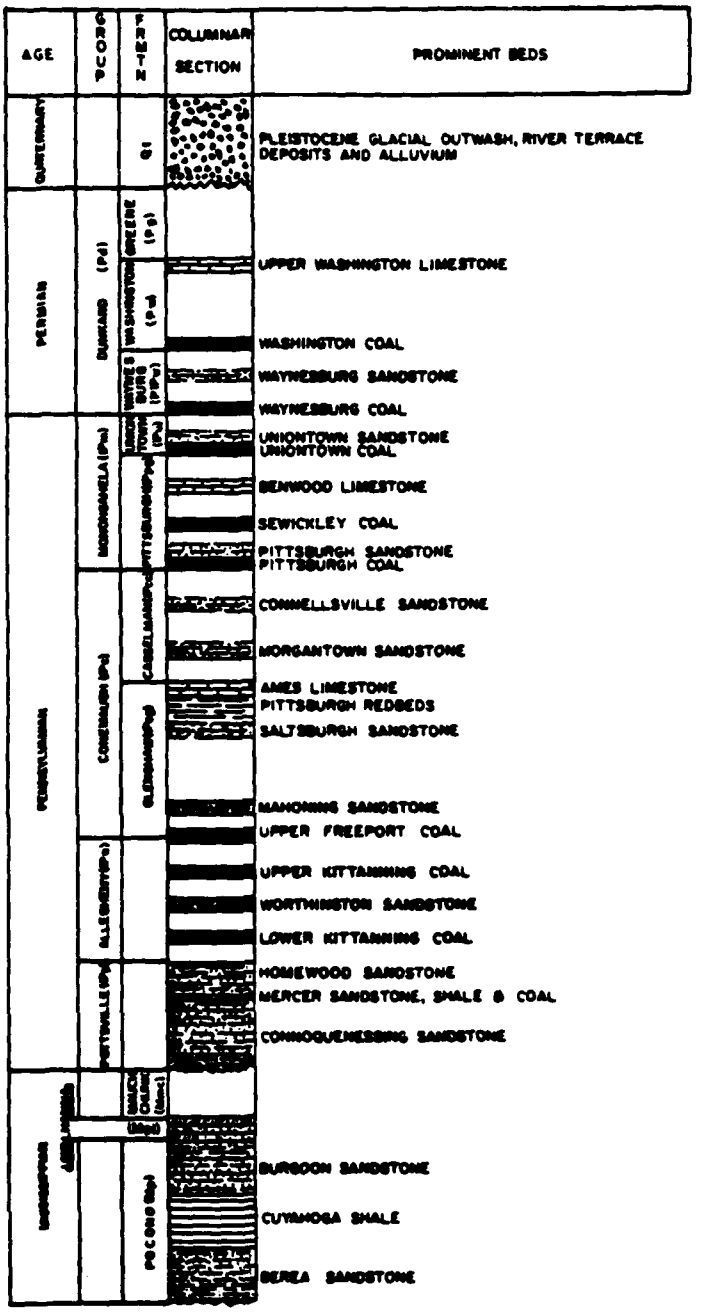
SCALE: 0 ½ MILE 1:24000

CONTOUR INTERVAL 20 FT. DATUM IS MEAN SEA LEVEL

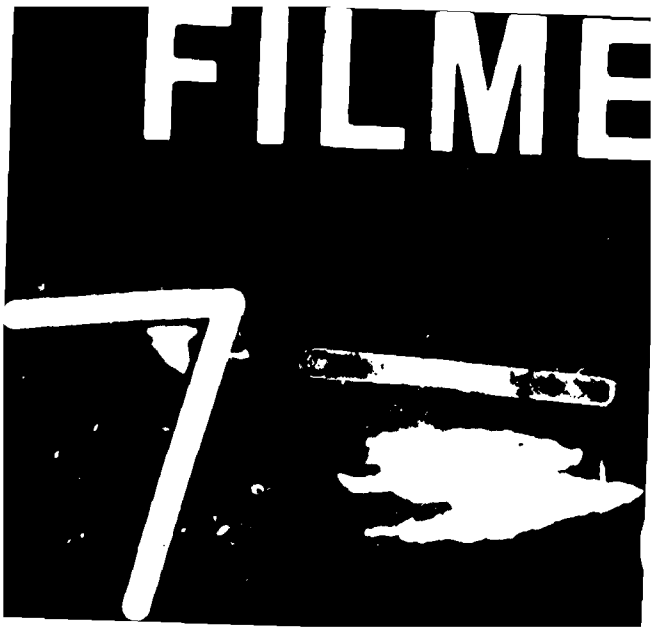
FORMATION CONTACT

DATA OBTAINED FROM PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY GREATER PITTSBURGH REGION GEOLOGIC MAP AND CROSS SECTIONS, 1975 and GREATER PITTSBURGH REGION STRUCTURE CONTOUR MAP, 1975

DATE: MAY 1981		MINE No. 60 – POND 6 NATIONAL DAM INSPECTION PROGRAM	GEOLOGIC MAP
SCALE: 1" = 2000'			
DR: JF	CK:	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS GEO SYSTEMS, INC. 1000 BANKSVILLE RD / PITTSBURGH, PA 15216	



DATE: MAY 1981		MINE No. 60 - POND 6	GEOLOGIC COLUMN
SCALE: 1"=360		NATIONAL DAM INSPECTION PROGRAM	
DR: JF	CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS	
801386		GEO SYSTEMS, INC. 1000 BANKSVILLE RD./PITTSBURGH, PA 15216	


FILME