Prepared for:

Talen Energy
835 Hamilton St., Suite 150
Allentown, PA 18101

UNSTABLE AREAS ASSESSMENT

Per Requirements of 40 CFR §257.64

Montour SES Ash Landfill 3

Washingtonville, Pennsylvania

Prepared by:

Geosyntec consultants

10211 Wincopin Circle, Floor 4
Columbia, Maryland 21044

Project Number ME1207A

December 2016

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1. INTRODUCTION

1.1 Organization and Terms of Reference

Geosyntec Consultants (Geosyntec) has prepared this Unstable Areas demonstration for Talen Generation, LLC (Talen) to demonstrate compliance of the existing Montour SES Ash Landfill 3 (Ash Landfill 3) in Washingtonville, Pennsylvania with the location restrictions of the Federal Coal Combustion Residuals (CCR) Rule. On 17 April 2015, the USEPA published the final rule for disposal of CCR from electric power utilities under Subtitle D of the Resource Conservation and Recovery Act (RCRA), contained in Section 257 of Title 40 of the Code of Federal Regulations (40 CFR 257 Subpart D), referred to here as the CCR Rule. Section 257.64 contains the requirements for demonstrating compliance with the Unstable Areas location restriction. In this demonstration, the specific requirements of §257.64 are identified and addressed.

This Unstable Areas demonstration was prepared by Mr. Mike Nolden, E.I.T., and it was reviewed in accordance with Geosyntec's internal review policy by Mr. Michael Houlihan, P.E. and Mr. Thomas Ramsey, P.E., all of Geosyntec. Mr. Ramsey is a registered Professional Engineer in the Commonwealth of Pennsylvania.

1.2 Site Location

Montour SES is located in Washingtonville, Montour County, Pennsylvania. The site can be found on a United State Geological Survey 7.5-minute topographic map for the Washingtonville Quadrangle (Figure 1). Ash Landfill 3 is located within the Montour SES site, southeast of the generating station.

1.3 Landfill Description

Ash Landfill 3, also called Ash Area 3 or Ash Storage Area 3, is a CCR landfill constructed in 1990 to accept coal combustion residuals produced by the Montour SES, as described by Form R of the Pennsylvania Department of Environmental Protection (PADEP) Class II Residual Waste Disposal Facility permit renewal (PADEP Permit) application package (PPL 2007). Ash Landfill 3 has been in service since 1991 (PPL 2007, Attachment 1 to Form 1R).

Ash Landfill 3 is regulated under the Pennsylvania Residual Waste Regulations of Title 25 PA Code, Chapters 287 and 288. The unit is permitted as a PADEP Residual Waste Disposal Facility. Ash Landfill 3 was constructed and is operated under a renewal of Permit No. 300987 for a Landfill—Class I, II, or III (PADEP 2007), which was issued in August 2007.

Ash Landfill 3 was designed as a two-phase landfill with each phase comprising three levels, as shown on drawing E-195972-3 in Appendix A. Currently, landfilling operations have only been performed in Phase I. The portion of the permit area designated for Phase II remains undeveloped.

2. CCR RULE REQUIREMENTS FOR UNSTABLE AREAS (§257.64)

2.1 Unstable Areas (§257.64) Requirements

CCR units are restricted from being located in unstable areas, defined as an area susceptible to forces capable of producing mass movements that could impair the integrity of some or all of the structural components responsible for preventing releases of CCR from the CCR unit. Section 257.64 requires an evaluation of the presence of natural or human-induced events or forces capable of impairing the integrity of the CCR unit's containment features. To comply with the requirement §257.64, units must be evaluated considering the following factors that could led to instability of the unit: onsite and local soil conditions that may result in significant differential settlement, onsite or local geologic or geomorphologic features, and onsite or local human-made features.

The preamble to the CCR Rule (p. 21367) prescribes that a geotechnical investigation be performed to identify the following site conditions that may be cause for instability:

- Potential thick layers of soil that are soft and compressible (e.g. loess, unconsolidated clays, wetland soils), which could cause a significant amount of post-construction differential settlement of foundation soils, adjacent embankments, and slopes unless improved;
- On-site or local soil conditions that are conducive to downslope movement of soil, rock and/or debris (alone or mixed with water) under the influence of gravity. Such conditions may include local topography, surface and subsurface soils, subsurface slope angles, surface drainage and run-off patterns, seepage patterns, rock mass orientations, joint patterns, fissures, and any other landscape factor that could influence downslope movement should be identified. The preamble also prescribes that the presence of karst terrain be considered during the investigation and demonstration.

The preamble suggests several anthropogenic activities that could induce instability to be considered in the demonstration such as mining, cut and fill activities during construction, excessive drawdown of groundwater, which may cause excessive settlement or bearing capacity failure of foundation soils, and use of an old landfill as the foundation for a new landfill without verification of complete settlement of the underlying wastes.

2.2 Compliance with Unstable Areas Requirements

Part 3 of this document presents the demonstration of compliance with §257.64 as required by the CCR Rule. The table below summarizes the minimum factors to be considered when evaluating the CCR unit per §257.64 and the CCR Rule Preamble (pp. 21367 and 21368).

RULE SECTION	RULE REQUIREMENT	LOCATION WHERE ADDRESSED IN DOCUMENT
§257.64(b)(1)	Onsite and Local Soil Conditions	Section 3.1
§257.64(b)(2)	Onsite or Local Geologic or Geomorphologic Features	Section 3.2
§257.64(b)(3)	Onsite or Local Human-made Features	Section 3.3
§257.64(c)	Certification that this demonstration meets the requirements of §257.64(a)	Section 4

3. COMPLIANCE WITH UNSTABLE AREA REQUIREMENTS

3.1 Onsite and Local Soil Conditions (§257.64(b)(1))

CCR Rule §257.64(b)(1) requires the owner or operator of a CCR unit to consider onsite and local soil conditions that may result in significant differential settlement when demonstrating that the unit is not located within an unstable area. Such soil conditions may include thick, compressible soil layers or soil conditions conducive to downslope movement of soil, rock, and/or debris.

TRC Environmental Consultants, Inc. conducted field investigations of the geotechnical subsurface conditions in the immediate and surrounding areas of Ash Landfill 3 in May 1983 (TRC 1983a) and September 1983 (TRC 1983b). TRC (1983b) includes a detailed description of the soil conditions, geotechnical evaluation, test pit logs, and cross-sections of the areas investigated (Appendix B). The geotechnical evaluation consisted of in-situ and laboratory testing of the subsurface materials to determine soil properties and interpretation of test results.

TRC (1983a) describes the unconsolidated material (i.e. soil) as a thin layer (< 1 ft) of topsoil and clay-silt subsoil overlying weathered till and shale rock. The total thickness of the soil layer is 1 ft to 5 ft and is generally between 2 ft and 4 ft. Results of classification tests presented by TRC (1983b) indicate that the site soils consist of mostly low to medium plasticity silt and clay (United Soil Classification System designation ML and CL) with some instances of high plasticity silt and clay (USCS designation MH and CH). With consideration of the soil properties evaluated and the thickness of the site soils, TRC (1983b) concludes that the till and bedrock are relatively incompressible and that there are no anticipated geotechnical issues under the proposed loading.

The results and conclusions presented by TRC (1983b) indicate that the onsite soils are free of thick, compressible layers and conditions conducive to downslope movement of soil, rock, and/or debris.

Based on a review of the information described above, Geosyntec found that onsite and local soils do not have potential to cause significant differential settlement beneath Ash Landfill 3.

3.2 On-site or Local Geologic or Geomorphologic Features (§257.64(b)(2))

CCR Rule §257.64(b)(2) requires the owner or operator of a CCR unit to consider onsite and local geologic and geomorphologic features when demonstrating that the unit is not located within an unstable area. Such geologic or geomorphologic features include local topography, surface and subsurface soils, surface slope angles, surface drainage and run-off patterns, seepage patterns, rock mass orientations, joint patterns, and fissures. Such conditions should be considered for their potential to cause downslope movement of portions of the CCR unit. Karst terrain, for its potential to include sinkholes capable of causing unit instability, is also considered in the evaluation of the site geology.

A description of the local and site geology, including a summary of TRC (1983), is included as Form 6R Attachment of PPL (2007).

TRC (1983a) and TRC (1983b) describe the surface and geologic conditions in the immediate and surrounding areas of Ash Landfill 3. The geology underlying Ash Landfill 3 consists of two predominant formations:

- Marcellus Shale, characterized by black carbonaceous shale with generally near-horizontal bedding planes, is predominant in the western portion of the Ash Landfill 3 area; and
- Onondaga Formation, characterized by platy limestone, dipping slightly (3.5%) to the southeast through the site, is predominant in the eastern portion of the Ash Landfill 3 area.

Boring logs, test pit logs, cross-sections, and maps associated with the TRC investigations are include in Appendix C. Cross-sections shown on Drawings D242632 Sheets 5 and 6 (Appendix C) show the slight dipping of the bedrock toward the center of the site and to the southeast. This trend is also apparent on Drawing E196008 Sheet 2.

GEOLOGIC OR GEOMORPHOLOGIC FEATURE	ASSESSMENT OF FEATURE AT ASH LANDFILL 3 SITE
local topography	Local topography is shown on Drawing E-195966-12. The topography does not include any features that are expected to contribute to instability of the unit or surrounding area.
surface and subsurface soils	The potential for local and site soils to contribute to instability of Ash Landfill 3 is addressed in Section 3.1 above.
surface slope angles	TRC (1983b) describes the ground surface in the area of Ash Landfill 3 as sloping at a grade of approximately 1% to 2% toward the stream bisecting the permitted disposal area (west of the disposal area developed thus far). These slopes are not expected to contribute to instability of the unit or surrounding area.
surface drainage and run-off patterns	The location of Ash Landfill 3 is such that overland flow of stormwater run-on is intercepted by a bordering tributary or by a perimeter access road and diverted to culverts beneath the Ash Landfill 3 (Attachment 1 to Form I of PPL 2007). Flow along the alignment of the stream is now carried by pipes (Attachment 1 for Form 12R of PPL 2007). With proper maintenance and operation of the stormwater management system, surface drainage and run-off patterns are not expected to contribute to instability of the unit or surrounding area.
seepage patterns	Groundwater is generally 3 to 5 feet below existing ground surface in the Ash Landfill 3 area. Groundwater flow is generally toward the center of the site (as represented by the trough in the bedrock topography) (Attachment 1 for Form 12R of PPL 2007). The documented groundwater flow regime is not expected to contribute to instability of the unit or surrounding area.
rock mass orientations	Bedrock formations underlying Ash Landfill 3 are nearly horizontal (TRC 1983a, 1983b) and are, therefore, not expected to contribute to instability of the unit or surrounding area.
joint patterns	TRC (1983b) notes that joint patterns observed in test pits in the shale were closely spaced in the shale bedrock but were less distinct in the bedrock of Onondaga Formation. One distinct fracture (strike N 65 deg W) was noted in the platy calcareous shale of the Onondaga. Beyond a depth of 15 feet, fracturing in the shale is minimal (TRC 1983). The documented joint patterns are not expected to contribute to instability of the unit or surrounding area.
fissures	Specific documentation of fissures was not available for Ash Landfill 3. However, based on the descriptions of the documented joint pattern, fissures are not expected to be present in a manner that would contribute to the instability of the unit or surrounding area.
karst	As demonstrated by the subsurface investigations performed by TRC (1983), there is no karst in the Ash Landfill 3 area.

A review of site geomorphologic features (e.g., surface topography, bedrock topography, groundwater flow) does not indicate a potential for instability. The surface and bedrock topography are relatively flat, with only slight slopes. Groundwater flow is variable, but there is no indication in the reports described above that it has the potential to cause instability of the Ash Landfill 3 area.

A review of the geologic studies performed in support of the design and permitting of Ash Landfill 3 does not indicate any geologic features (e.g. rock mass orientation, joint patterns, fissures, karst, etc.) with the potential to cause downslope movement of soil, rock, or debris.

Based on a review of the information described above, Geosyntec found that no geologic or geomorphologic features exist that may lead to the Ash Landfill 3 area to be considered an unstable area.

3.3 On-Site and Local Human-made Features or Events (§257.64(b)(3))

CCR Rule §257.64(b)(3) requires the owner or operator of a CCR unit to consider onsite and local human-made features or events when demonstrating that the unit is not located within an unstable area. Such human-made features or events include mining, cut and fill activities during construction, excessive drawdown of groundwater, and use of an old landfill as the foundation for a new landfill, all of which have the potential to cause significant differential settlement or failure of the CCR unit.

In combination with fill placement to raise the elevation of certain portions of the subgrade, a passive underdrain system, consisting of perforated pipe in stone-backfilled trenches beneath the liner, is installed to maintain groundwater to an acceptable elevation in the area of Ash Landfill 3 and the associated leachate basin (Attachment 1 to Form 12R of PPL 2007; see drawing E-195966-6 of Appendix A). A detailed description of the underdrain system and the associated design report are included as Attachments 1 and 1a to Form 16R of PPL (2007). Following the installation of the underdrain system, monitoring of groundwater levels showed that the system was unable to provide the required separation of the liner and seasonal high groundwater table. Therefore, additional fill was placed to achieve the required elevation.

Similarly, historical tile drainage lines known to exist beneath Ash Landfill 3 have the potential to create upward pressure on the liner and lead to instability. In a 1985 response to comments issued by PADEP regarding the solid waste permit (PPL 1985), PP&L (now Talen) planned to remediate and drainage tile located by grouting them at the upstream end. However, Geosyntec was unable to locate any records that the tiles were grouted.

Failure of the underdrain system or drainage tiles (if any remain in service) have the potential to allow a rise in groundwater, resulting in uplift pressure on the unit liner and lead to instability. However, since acceptable separation of the liner and groundwater was achieved through the placement of additional fill a failure of the underdrain system or drainage tiles are not likely to cause instability of Ash Landfill 3 area.

Geosyntec performed a review of relevant documentation regarding the human-made features prescribed by the CCR Rule preamble and found that none of the features had potential to induce instability. Form 10R of PPL (2007) indicates that there are no previous or current mining operations in the in the permit area or within ¼ mile of the permit area. A description of the structures and operations does not indicate that any cut-fill activities, beyond those performed during initial construction of Ash Landfill 3, are ongoing in the Ash landfill 3 area (Attachment 1 to Form 12R of PPL 2007,). There is no drawdown of groundwater in the area as groundwater is managed by a passive underdrain system, as described above. Ash Landfill 3 is not constructed on top of an old landfill, therefore no demonstration of settlement or stability of the underlying wastes is required.

Based on a review of the available information, Geosyntec did not identify any human made features or events with the potential to cause the Ash Landfall 3 area to be considered an unstable area.

4. CONCLUSIONS

In conclusion, based on a review of the available documentation relevant to Ash Landfill 3, including a thorough subsurface investigation and geologic characterization, no unstable areas were identified at Ash Landfill 3.

5. CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

Per §257.64(c), the owner or operator of the unit must obtain a written certification from a qualified professional engineer that the Unstable Areas assessment meets the requirements of the CCR Rule.

Certification for Unstable Areas Assessment

CCR Unit: Montour SES Ash Landfill 3

Certification

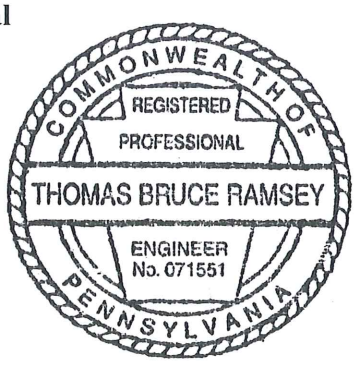
I, **Thomas B. Ramsey**, a registered professional engineer in the Commonwealth of Pennsylvania certify that the Unstable Areas assessment for the Montour SES Ash Landfill 3 is in compliance with requirements of 40 CFR §257.64. This certification is based on my review of information described in this certification report.

Printed Name Thomas B. Ramsey

PE License Number PA071551 **State** Pennsylvania

Signature _____ **Date** 22 DECEMBER 2016

Seal



6. REFERENCES

PADEP (2007). "Permit for Solid Waste Disposal and/or Processing Facility FORM NO. 8." Pennsylvania Department of Environmental Protection, Bureau of Land Recycling and Waste Management. August 2007.

PPL (1985). "Response to comments on Solid Waste Permit Application." Pennsylvania Power & Light Company.

PPL (2007). "PPL Montour, LLC – Ash Area #3 Permit Renewal Application – SWP 300987." PPL Services Corporation. Allentown, PA. March 2007.

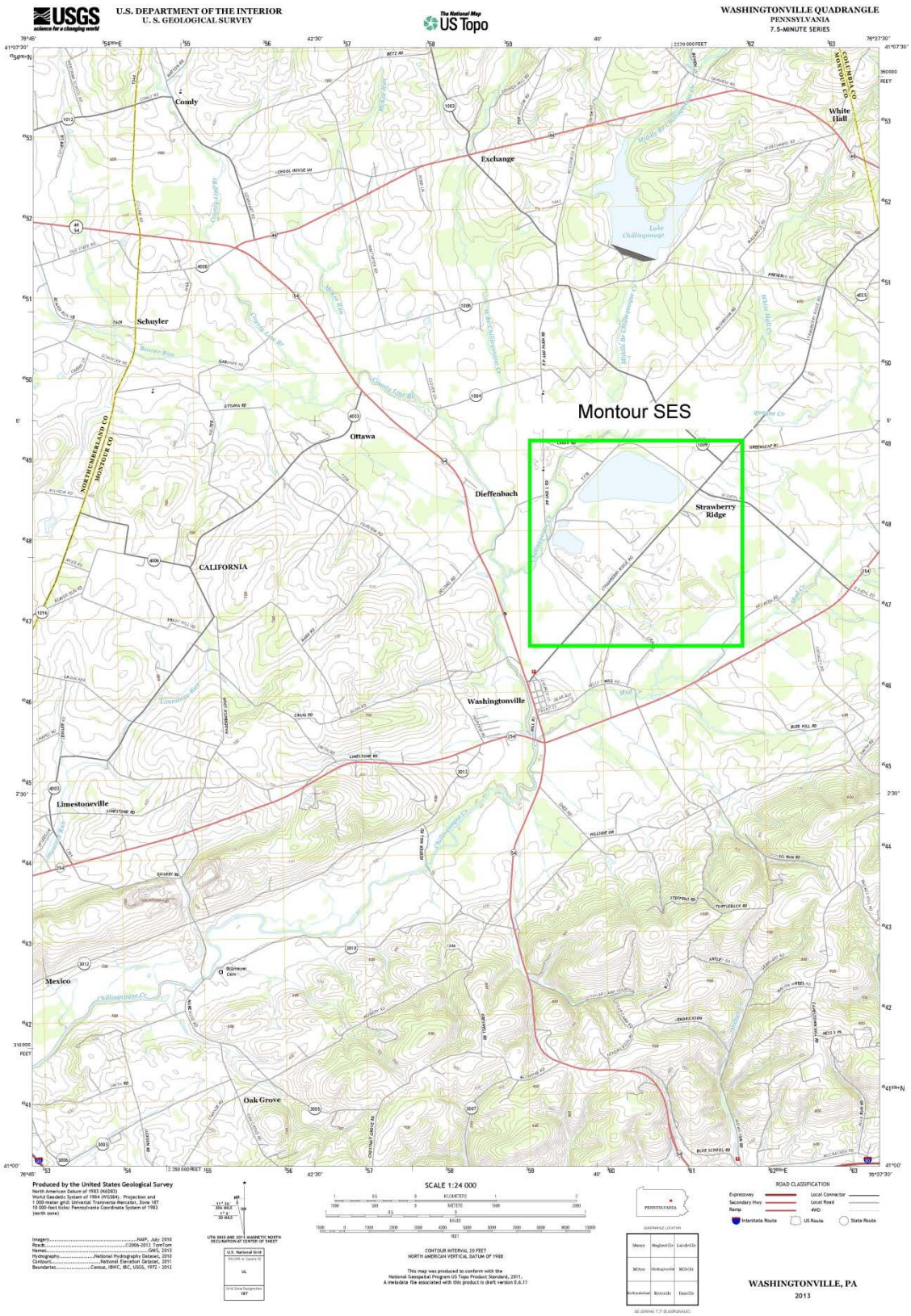
TRC (1983a). "Geologic and Soil Investigation for the 5-4, 5-5, and 5-6 Ash Disposal Survey Areas." TRC Environmental Consultants, Inc. September 1983.

TRC (1983b). "Supplementary Geologic and Soils Investigation for the 5-6 Ash Storage Area" TRC Environmental Consultants, Inc. November 1983.

TRC (1984). "Study on the Effects of Subsurface Drainage on Acid Production." TRC Environmental Consultants, Inc. February 1984.

United States Environmental Protection Agency (USEPA) (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule." Chapter 40 Code of Federal Regulations, Parts 257 and 261. 17 April 2015.

FIGURES



SITE LOCATION
MONTOUR SES

WASHINGTONVILLE, PA

Geosyntec consultants

FIGURE

1

Columbia, MD

12 April 2016

APPENDIX A

Relevant Drawings

1 2 3 4 5 6 7 8 9 10

A B C D E F G

E000 E500 E1000 E1500 E2000 E2500 E3000 E3500 E4000

N000 N-500 N-1000 N-1500 N-2000 N-2500

T-414

I-6-C EL 548.30

I-6-A EL 524.30

LR-47015

GRID MARKER
S3+51.41
E2+10.41
EL 555.63
(NTS)

GRID MARKER
S3+49.88
E16+38.31
EL 519.24
(NTS)

GRID MARKER
S18+40.22
E2+09.32
EL 521.87
(NTS)

GRID MARKER
S18+55.85
E11+88.99
EL 591.16
(NTS)

Ruins

530.94 529.54 524.64 523.48 528.74 527.7 523.7 521.4 519.9 519.8 517.18 517.18 523.48 518.23 515.73 514.83 521.73 513.33 519.6 515.64 522.33 527.27 532.6 530.3 518.0 512.94 516.2 51706 511.8 514.53 515.1 515.03 520.06 512.53 510.5 518.87 537.9 532.3

535 530 525 520 515

SHEET NO. 2 OF 10

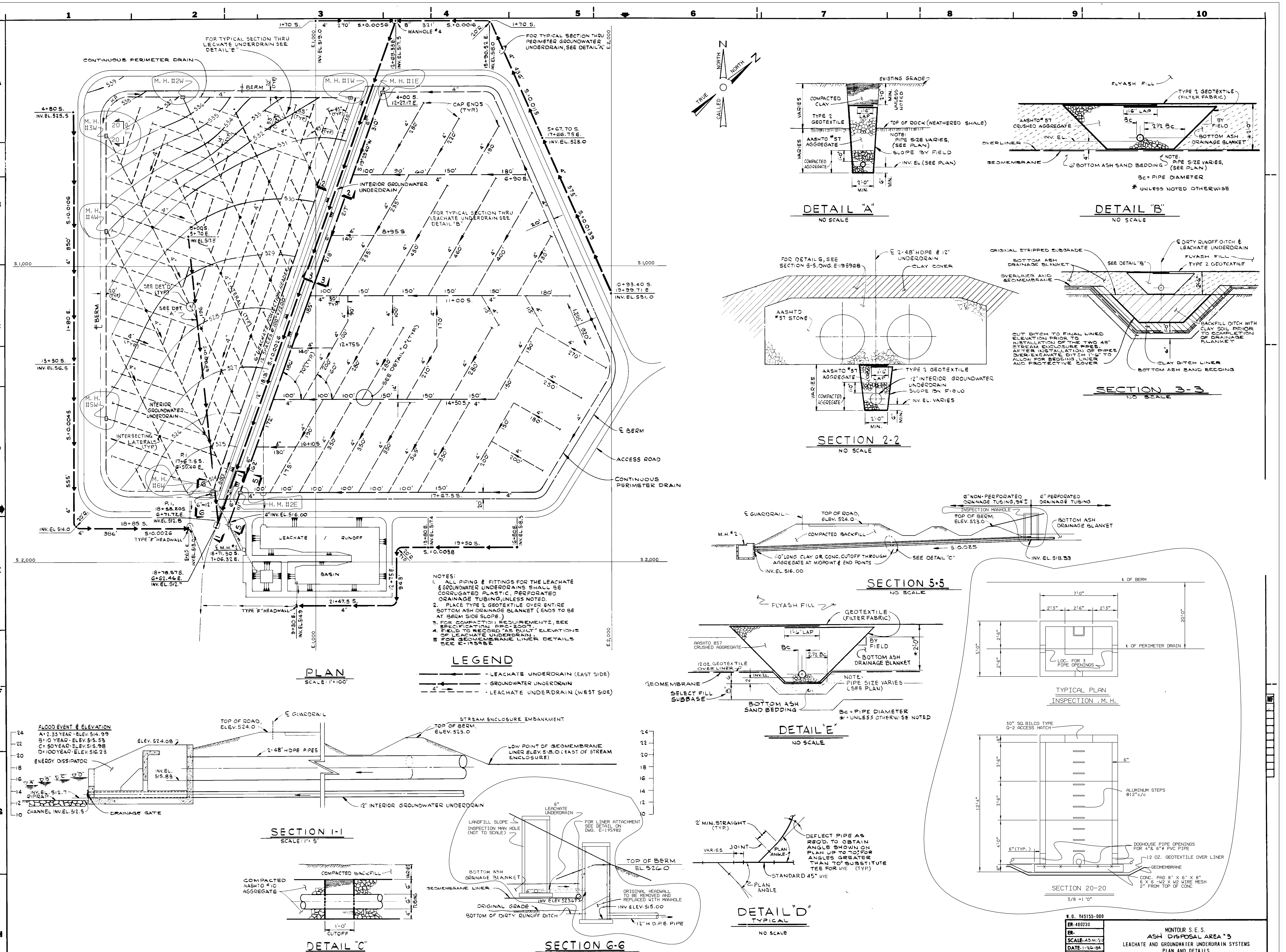
MONTOUR S.E.S. ASH DISPOSAL AREA #3

BEDROCK ELEVATION

(FEET)

PENNSYLVANIA POWER & LIGHT COMPANY

Engineering Drawing Standards Dwg. No. - 2/6", Title - 2/16", Subtitle - 8/32", Letter figures - 1/8" Min.



NOTES:
1. ALL PIPING & FITTINGS FOR THE LEACHATE & GROUNDWATER UNDERDRAINS SHALL BE CORRUGATED PLASTIC, PERFORATED DRAINAGE TUBING, UNLESS NOTED.
2. PLACE TYPE 2 GEOTEXTILE OVER ENTIRE BOTTOM ASH DRAINAGE BLANKET (ENDS TO BE AT BERM SIDE SLOPE.)
3. FOR COMPACTION REQUIREMENTS, SEE SPECIFICATION PPC-2007.
4. FIELD TO RECORD "AS BUILT" ELEVATIONS OF LEACHATE UNDERDRAIN.
5. FOR GEOMEMBRANE LINER DETAILS SEE E-195982

LEGEND
- LEACHATE UNDERDRAIN (EAST SIDE)
- GROUNDWATER UNDERDRAIN
- LEACHATE UNDERDRAIN (WEST SIDE)

REFERENCE TITLE	NUMBER
BILL OF MATERIAL	A-195980
ISOPACH OF FILL REQUIRED - PLAN & FINAL SUBGRADE - PLAN	E-195979
LEACHATE RUNOFF BASIN - ENLARGED PLAN	E-195975
PRELIMINARY GRADING, STREAM DIVERSION & ROADWAY - PLAN	E-195966-SHT. 1
ENERGY DISSIPATOR STRUCTURE - PLAN, SECTIONS, AND DETAILS	E-195977

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
6	1/19/97	750501	ADDED INSPECTION MANHOLES, SECTIONS & DETAILS	DM		
5	4-15-97	750501	REVISED LEACHATE DRAINS ON WEST SIDE OF PLAN & ADDED DET. E	DM		
4	6-7-96	750501	CHANGED DWG TITLE	JTE		

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
3	9-18-86	103069	CHANGED SECTIONS 1-1, 3-3 & 6-6 AND DETAIL "B" BY DELETION OF CLAY LINER AND ADDING GEOMEMBRANE LINER. DELETED 4-4	G.H.C.	FAC	A.L.M. WJB
2	4-15-86	103069	REVISED PLAN UNDERDRAIN SYSTEM, ADDED PERIMETER DRAIN, NOTE 3, AND DET. "D", REVISED DET. "A" AND SECT. 2-2.	FAC	G.H.C.	A.L.M. RHM
1	6-6-85	103069	CHANGED PIPE LENGTHS & LOCATIONS	G.H.C.	A.L.M.	A.L.M. RHM

LOC CODE: H-H70 DESCRIPTION: UNDERGROUND DRAIN SYSTEM SORT: C

W.O. 045155-000
ER-480230
ER-
SCALE- AS NOTED
DATE- 1-26-84
DRAWN- J.L.L.
CHECKED- FAC
LEADER- A.L.M.
APPR'D-
APPR'D-

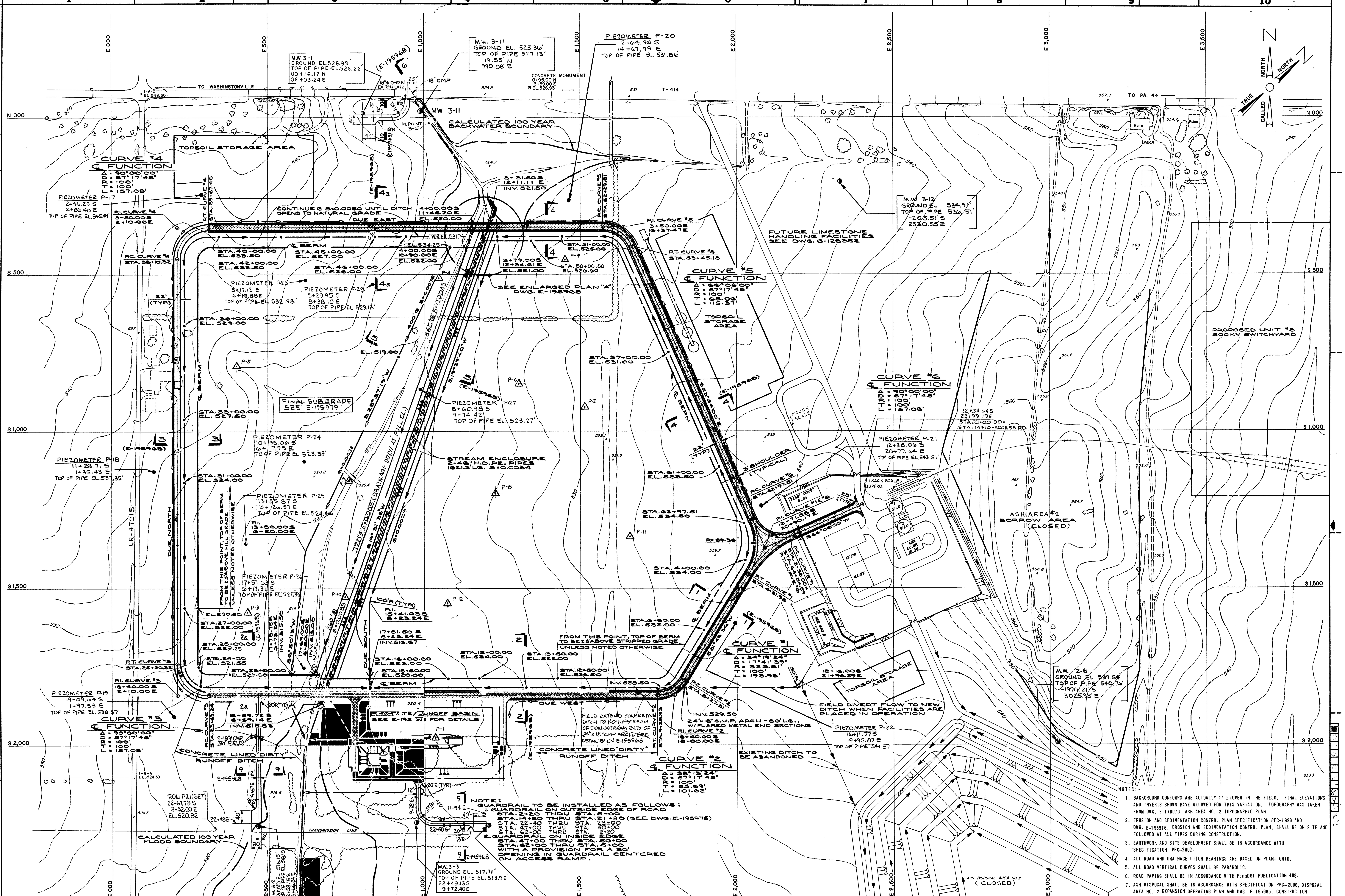
MONTOUR S.E.S.
ASH DISPOSAL AREA #3
LEACHATE AND GROUNDWATER UNDERDRAIN SYSTEMS
PLAN AND DETAILS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA. SHEET 2 OF 2

APPROVED 1/27/84 John A. Stefanik

E-195966-6

PP&L Letter-Height Drafting Standard: Dwg. No. - 3/8"; Title - 3/16"; Subtitle - 5/32"; Letter figures - 1/8" Min.



NOTES:-

1. BACKGROUND CONTOURS ARE ACTUALLY 1' ± LOWER IN THE FIELD. FINAL ELEVATIONS AND INVERTS SHOWN HAVE ALLOWED FOR THIS VARIATION. TOPOGRAPHY WAS TAKEN FROM DWG. E-176070, ASH AREA NO. 2 TOPOGRAPHIC PLAN.
2. EROSION AND SEDIMENTATION CONTROL PLAN SPECIFICATION PPC-1990 AND DWG. E-195978, EROSION AND SEDIMENTATION CONTROL PLAN, SHALL BE ON SITE AND FOLLOWED AT ALL TIMES DURING CONSTRUCTION.
3. EARTHWORK AND SITE DEVELOPMENT SHALL BE IN ACCORDANCE WITH SPECIFICATION PPC-2007.
4. ALL ROAD AND DRAINAGE DITCH BEARINGS ARE BASED ON PLANT GRID.
5. ALL ROAD VERTICAL CURVES SHALL BE PARABOLIC.
6. ROAD PAVING SHALL BE IN ACCORDANCE WITH PennDOT PUBLICATION 408.
7. ASH DISPOSAL SHALL BE IN ACCORDANCE WITH SPECIFICATION PPC-2006, DISPOSAL AREA NO. 2 EXPANSION OPERATING PLAN AND DWG. E-195965, CONSTRUCTION DEVELOPMENT SEQUENCE PLANS.

LEGEND

- DENOTES "DIRTY" RUNOFF DITCH
- DENOTES "CLEAN" RUNOFF DITCH
- ASPHALTIC CONCRETE ROAD SURFACE
- TEMPORARY GROUND WATER PIEZOMETER
- GROUND WATER MONITORING WELL
- PIEZOMETER LOCATION

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER
BILL OF MATERIAL	A-195980	TRACK LAYOUT PLAN	E-209916
CONSTRUCTION DEVELOPEMENT SEQUENCE PLANS	E-195965	HEADWALLS-PLAN, SECTIONS, AND DETAILS	E-195973
LEACHATE AND GROUNDWATER UNDERDRAIN SYSTEMS	E-195966, SHT. 2	LEACHATE/RUNOFF BASIN-ENLARGED PLAN	E-195975
ROADWAY PROFILE	E-195967	ENERGY DISSIPATOR STRUCT.-PLAN, SECT., AND DETAILS	E-195977
PRELIM. GRAD., STR. DIV., & ROADWAY-SECT. AND DET.	E-195968	EROSION AND SEDIMENTATION CONTROL PLAN	E-195978
INTERMEDIATE CELL DEVELOPMENT-LEVEL I	E-195969	ISOPACH OF FILL REQD.-PLAN & FINAL SUBGRADE-PLAN	E-195979

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
11	6/17/96	750501	REVISED TITLE, ADDED R.R. TRACK & REF. DWG. & REMOVED TRACKS	DM		JAS
10	3/20/91	103069	REVISED TO SHOW AS-BUILT COND. PER ENG. MARKED PRINTS	JEB		JAS
9		103069	ADDED PIEZOMETER LOCATIONS P17, P-18, P-19, P-20, P21, P22	JAC		
8	4/28/88	773129	ADDED GROUND WATER MONITORING WELL 2-8, 3-11, 3-12	JAC	EMB	
7	9-18-86	103069	RAISED BERM TO A MINIMUM 2.5 FT. ABOVE STRIPPED SUBGRADE.	G.H.C.	FAC	A.L.M. WJB JAS
6	4-15-86	103069	ADDED TEMPORARY GROUND WATER PIEZOMETER	FAC	G.H.C.	A.L.M. JAS
12	3-11-97	750501	ADDED PIEZOMETER LOCATIONS P-23, P24, P25, P-26, P-27 & P-28	DM		JAS
5	12-17-85	103069	ADDED ACCESS ROADS FOR MONITORING WELLS 3-2, 3-3 & 3-4 REVISED GUARDRAIL NOTE	B.A.S.	G.H.C.	A.L.M. JAS
4	11-21-85	773120	RELOCATED GROUND WATER MONITORING WELLS	GRB	EMB	
3	6-6-85	103069	CHANGED HEADWALL LOCATIONS & RD. WIDTH.	G.H.C.	A.L.M.	A.L.M. JAS
2	2-28-85	773120	ADD GROUND WATER MONITORING WELL LOCATION	GAV		
1	1-2-85	103069	RELOCATED SECTION MK., ADDED 18" C.M.P. AND CALCULATED 100 YEAR BACKWATER BOUNDARY.	JFS	A.L.M.	A.L.M. JAS

H-H70 (LOC CODE) — PRELIM GRAD, STR DIV, & RD. (DESCRIPTION) — C (SORT)

W.O. 045155-000
ER-480230
ER-
SCALE- 1"=100'
DATE- 1-19-84
DRAWN- G.H.C.
CHECKED- A.L.M.
LEADER- A.L.M.
APPR'D- WJB
APPR'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA NO. 3
PRELIMINARY GRADING, STREAM DIVERSION, AND ROADWAY

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA. SHEET 1 of 2

APPROVED 1/20/84 John A. Stefanik

E-195966-12

PP&L Letter-Height Drafting Standard: Dwg. No. - 3/8"; Title - 3/16"; Subtitle - 5/32"; Letter figures - 1/8" Min.

APPENDIX B

Geological and Geotechnical Reports (TRC 1983b)

PENNSYLVANIA POWER AND LIGHT CO.
MONTOUR STEAM ELECTRIC STATION
SUPPLEMENTARY GEOLOGIC
AND SOILS INVESTIGATION
FOR THE 5-6 ASH STORAGE AREA

TRC PROJECT NO. 2271-N61-53
November 29, 1983

TRC Environmental Consultants, Inc.

Prepared by:
Dennis F. Unites, P.G.
Project Manager

Frederick W. Johnson
Associate Geologist

Paul Lagace
Assistant Geologist

Robert C. Smith, P.E.
Principal Geotechnical Engineer

800 Connecticut Blvd.
East Hartford, CT 06108
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Dennis F. Unites CPGS 4873

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LIST OF MAPS

1.0 INTRODUCTION

In September 1983, TRC Environmental Consultants, Inc. conducted a geologic, hydrologic, and soils field investigation at the Pennsylvania Power and Light Company's (PP&L) Montour Steam Electric Station in Area 5-6, northwest of the existing Phase I ash storage area. This investigation was conducted to supplement TRC's reconnaissance hydrogeologic and soils survey of May 1983 (TRC Project No. 2271-N61-20). This preliminary investigation identified the 5-6 area as having the best potential for the development of an ash storage area of the three areas studied. The present investigation was designed to answer the specific questions that were generated from the previous investigation. These questions are as follows:

- What is the aerial extent of the competent bedrock (calcified, blocky shale) observed in the stream basin and at the crest of the topographic rise (northwest) including the feasibility of excavating this material with normal construction equipment?
- What is the permeability of the calcified, blocky shale?
- What is the depth of fracturing and rock quality of the shale in the 5-6 area?
- To what extent is the stream that bisects the site controlling ground water movement at the 5-6 area?
- Are the shallow depths of soil cover areas previously noted anomalous thin soil zones, or are they of large aerial extent?
- What is the depth of soil and ground water at the proposed leachate collection basin? What is the feasibility of excavating for this basin and what are recommended methods of ground water control?
- What are the surface infiltration rates and soil permeabilities of the existing site soils?
- What is the permeability of the existing surface soils and reworked soils?

1.1 Overview of Study

To conduct this study three TRC hydrogeologists and a PP&L engineer were on-site for all phases of the field investigation. Test pits were used to investigate the upper bedrock surface and unconsolidated materials, obtain hydrogeologic data, and evaluate the excavation properties of the bedrock. A total of 21 test pits were excavated by backhoe. At each test pit lithologies, water level data, and excavation properties were logged by a TRC geologist.

Test borings were conducted to investigate the site bedrock at depth. PP&L's boring contractor, Boring Soils and Testing Company, completed five test borings using double-barrel coring techniques. Each core hole was supervised and logged by a TRC geologist. The borings were backfilled with Portland cement upon completion. An upgradient ground water observation well was installed between the 5-6 area and the existing coal pile to establish predevelopment ground water quality.

Reference points to measure vertical distances to lithology changes and ground water levels were established at each test pit and boring. These points were later surveyed for location and vertical control by a PP&L survey crew (Map 1).

Permeability estimates of the saturated weathered shale and the blocky, calcified shale were made by conducting pit bailing tests. The permeability of the unweathered, more competent rock was determined by packer and open hole permeability tests in the coreholes. The ground water flow direction was determined by measuring the water levels in the borings and test pits and plotting ground water isopleths.

Tests were conducted on the site soils to establish selected physical and hydrologic characteristics. These tests included:

- Surface soil infiltration rates
- Undisturbed permeabilities
- Recompacted permeabilities
- Atterberg limits
- Unconfined compressive strength
- Standard compaction (moisture - density)

This report presents a summary and evaluation of the current data including the May 1983 data. In cases where there are seasonal variations in data (i.e., ground water evaluations), the data have been evaluated separately and dated.

2.0 SITE GEOLOGY

2.1 Bedrock Geology

Bedrock east of the central stream in the 5-6 area is typical of that encountered in past subsurface investigations at and adjacent to the site and consists of a black carbonaceous (Marcellus Shale) of Devonian age. Bedding is thin and well developed, imparting a fissility to the rock. Test pits and borings indicated that the bedding is generally near horizontal with a few exceptions where dipping beds (up to 20°) were occasionally noted in the weathered shale. Iron sulfide (pyrite) is present as a minor constituent of the shale. Pyrite breakdown produces an acidic iron-bearing ground water.

To the west of the central stream, bedrock conditions change as a transition is made from the Marcellus Shale to the calcareous shales and platy limestones of the Onondaga Formation (Lower Devonian). The Onondaga bedrock observed at the 5-6 area varies north to south from black, platy/blocky, competent, calcareous shale, with calcite filled fractures (southwest Figure 2-1), to a dark gray, blocky/massive, shaly limestone with occasional fossil horizons (northwest). The Onondaga Formation dips 3.5 percent to the southeast through the site. This more competent Onondaga Formation is typically overlain by the more fissile Marcellus Shale, to a point where the Marcellus pinches out at the northwest corner of the site (Figure 2-2).

Iron sulfides (pyrites) in the Onondaga Formations occurred as discrete nodules and seams and were usually associated with calcite seams (Boring B-5).

Depth to bedrock was determined in the test holes and borings by measuring the distance from the bottom of the saprolite layer to the ground surface. Top of bedrock elevation was determined from the survey data and plotted with the May 1983 data to generate a top of bedrock elevation map (Map 2).

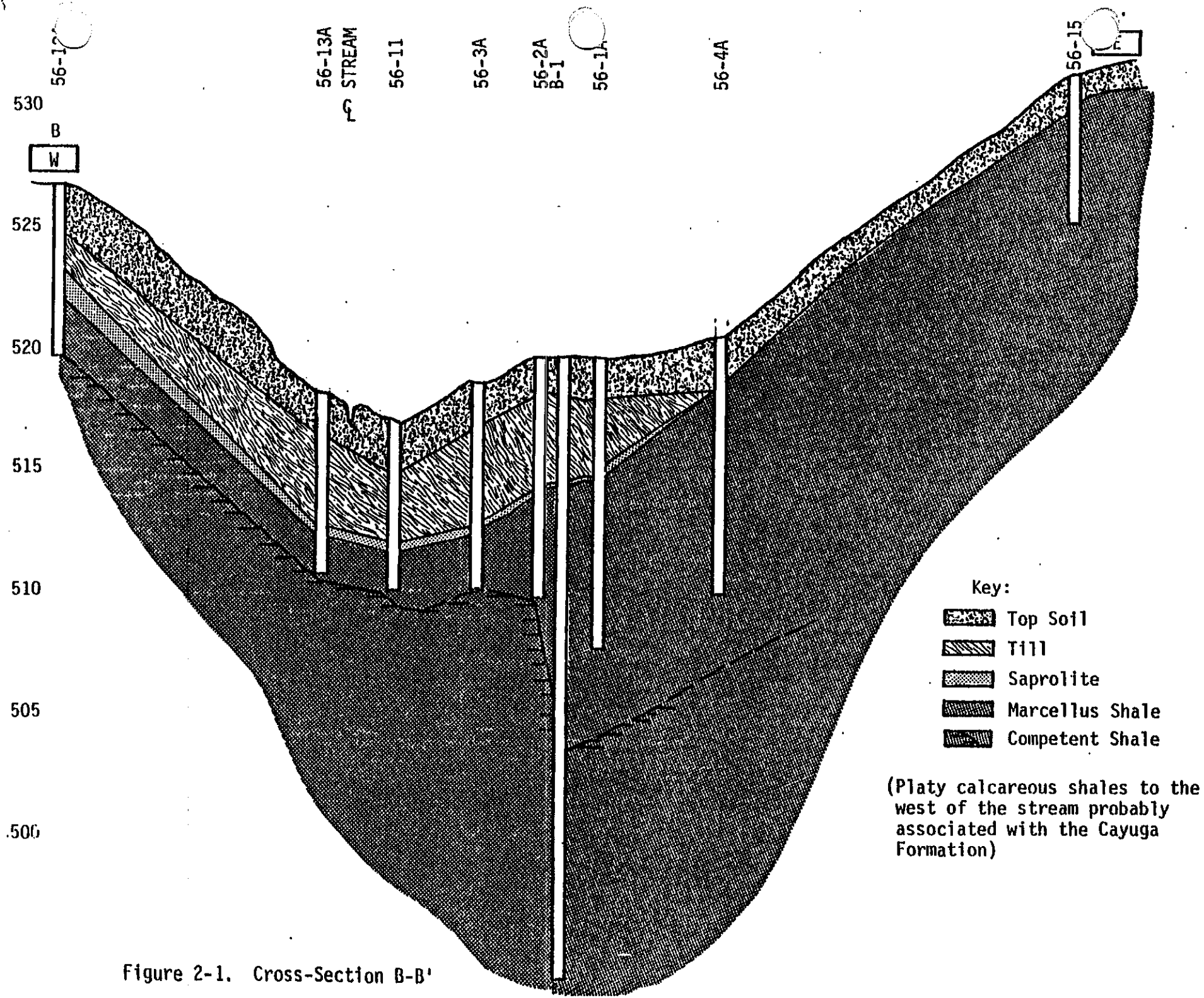

Figure 2-1. Cross-Section B-B'

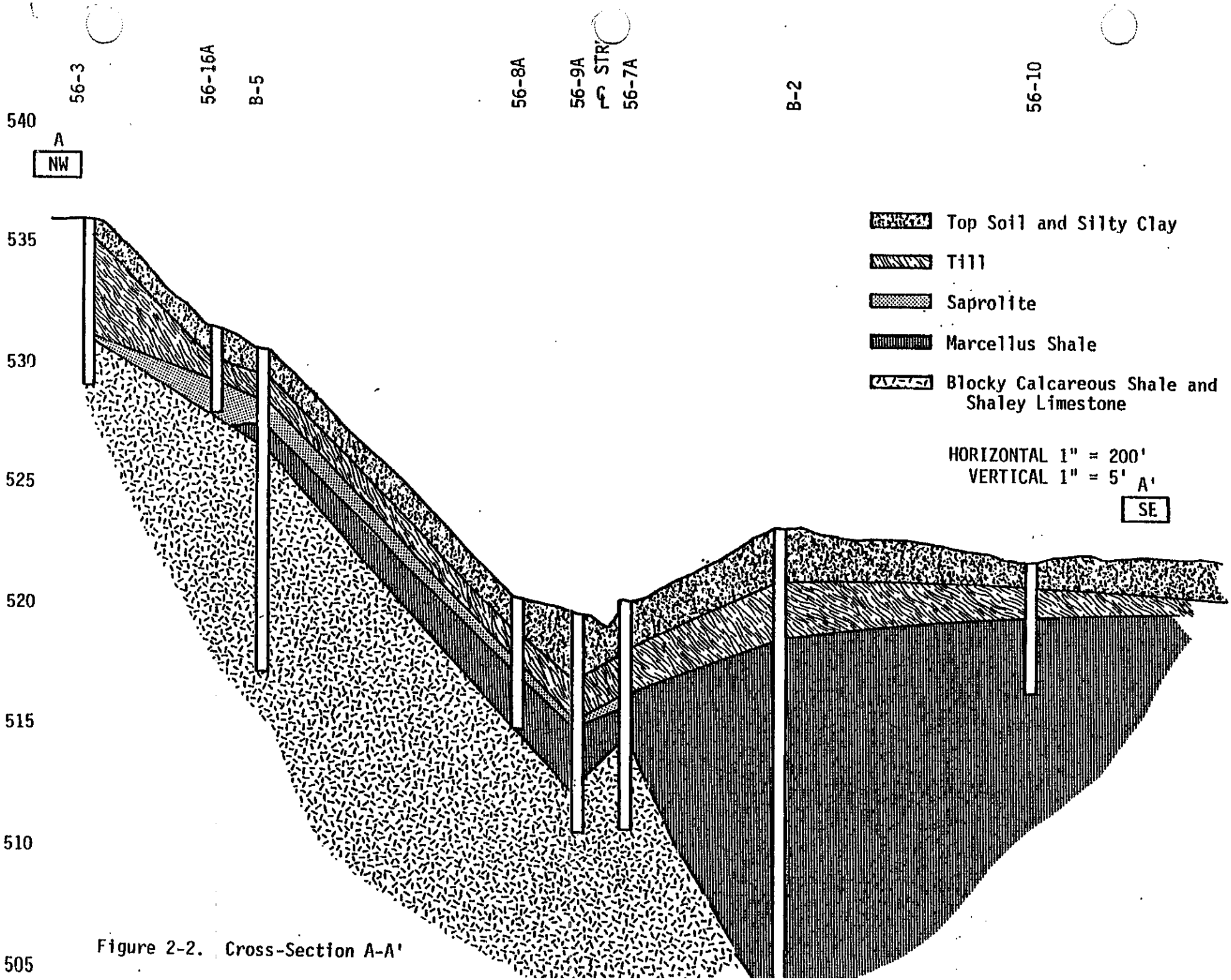

Figure 2-2. Cross-Section A-A'

The bedrock contours show a north-south trending bedrock trough that parallels the south flowing stream bisecting the parcel. The slope of the bedrock surface is nearly identical to the slope of the ground water table except at the northwest corner. At the northwest corner the rise of the more resistant bedrock causes a steeper slope of the bedrock surface (0.03 ft/ft).

Depth to bedrock data was plotted with the May 1983 data to generate a depth to bedrock (thickness of soil) map (Map 3). The deepest accumulations of soil are found in the central and southern portions of the 5-6 area where the bedrock trough has been filled with sediments. The depth to bedrock throughout this area averages three to five feet. To the east-southeast of the parcel the thickness of soil is only two feet over a very weathered and fissile shale. The only other area where soil is less than two feet thick is at a small area to the northwest where the more competent bedrock rises.

Joint patterns were observed and strikes measured in the test pits where possible. The joints were closely spaced in the fissile shales and had trends similar to those noted in previous studies (Map 4). In the blocky calcareous shales and shaly limestones of the Onondaga Formation joint patterns were not distinct, due to the random nature of the fracturing. However, one very distinct fracture (Strike N 65^{o} W) was noted at test pit 8-A in the platy calcareous shale.

2.2 Surficial Geology

The surficial deposits at the 5-6 area consist of one of three general types of unconsolidated deposits: silt-clay soils over glacial till, silt-clay soils directly over bedrock, or recent alluvial soils (Map 4). At one location (test pit 56-4A) a large block of disorientated rock dissimilar from

the country rock was overlying the Marcellus Shale. This feature is most likely a form of large bouldery till.

The majority of the 5-6 area is underlain by a dense, weathered clay till ranging in thickness from 0.5 to 7 feet. The thickest till deposits were found to be at the southwest and central areas of the parcel. The till is typically overlain by a one to two foot mantle of blocky silt-clay subsoil and silty top soil except at the stream where the till is overlain by recent alluvial or colluvial deposits.

In areas where the till is absent, 1.5 to 2 feet of silt-clay subsoils and top soils directly overlie bedrock. The areas where the till is absent roughly correspond to areas where the thickness of soil is less than two feet. These areas are at a small portion of the parcel in the northwest corner where the soils directly overlie the blocky, shaley limestone and at the far east-southeast of the parcel where the thin soils are underlain by extremely weathered fissile shale.

The recent alluvial soils occur on the 5-6 area along the west side of the stream. These soils are typically a dark brown, granular clay soil that is loosely compacted.

During this investigation, differences were noted between the spring time wet soil conditions and the September dry soil conditions. When the soils are dry, the subsoils shrink, emphasizing the blocky structure. The fractures formed between soil blocks were numerous and interconnected. In one instance (test pit 56-7A) a ground water seep was observed in a soil fracture while the rest of the soil horizon was dry. During the wet months, the clays in the subsoils swell closing the soil fractures. The underlying tills did not exhibit the same shrink-swell structure as the subsoils.

2.2.1 Soil Descriptions

The Soil Conservation Service (SCS) is presently updating the soils mapping in the Montour Area. Map 10 shows the soils classifications in the 5-6 area as mapped by the SCS on aerial photography.

The soils observed during the 5-6 site investigation generally correlate well with the soils described and mapped by the SCS. The SCS shows the central stream area soils as cherty, alluvial/colluvial soils derived from limestones. This description is accurate, except that these soils do not extend as far north and west as mapped by SCS. At the northwest corner of the parcel are the "Berks" shaly silt loams. These soils are described as shaly loams shallow to bedrock. This corresponds well with the soils observed in this area except that they do not extend as far south as shown on the published maps.

The remainder of the soils described on the 5-6 site are till soils, derived from either limestone, sandstone, or shale tills. These descriptions generally agree with the soils observed except at the east-southeast portion of the site where till was not observed.

2.3 Terrain Conductivity Survey

A terrain conductivity survey of the 5-6 area was conducted to aid in planning the subsurface investigations and to provide better resolution between data points. The survey was conducted using a Geonics EM 31 terrain conductivity meter. This instrument measures cumulative terrain conductivity of a semi-sphere of earth materials with a 20 foot radius. Conductivity is read in millimhos/meter. Conductivity surveys of this nature are well adapted to the measurement of relative changes in terrain conductivity. Elevated terrain conductivity in this instance is caused by high ground water tables,

thicker soil mantles, and finer grained soils with greater amounts of conductive clays.

Contours of conductivity (Map 9) in the 5-6 area show conductivity increasing toward the central stream. These conductivity increases are the result of the progressively shallower ground water table approaching the stream. An area of elevated conductivity was noted at the northwest of the parcel. These high conductivities are associated with the buried foundations rubble and tanks of the old home site in this area.

3.0 SITE HYDROGEOLOGY

3.1 Permeability Estimates

Estimates of permeability in the 5-6 area were made in the site soils (Shelby permeability and recompacted permeability), the saturated weathered rock (pit bailing permeability), and in the upper zones of the more competent bedrock (borehole permeability). Values of permeability for the very competent slightly fractured shale were obtained from past investigations.

3.1.1 Borehole Permeability

Four borehole permeability determinations were conducted according to the method described in Designation E-18 of the USBR "Earth Manual". These tests were conducted in selected sections of core holes that were representative of competent, fractured bedrock ranging from 0.29 ft/day to 8.22 ft/day (1×10^{-4} cm/sec to 3×10^{-3} cm/sec) (Table 3-1). These permeabilities are approximately one order of magnitude less than permeability determinations made in the more weathered shales just below the water table. As a frame of reference a permeability range of 0.26 to 11.3 ft/day (9×10^{-5} to 4×10^{-3} cm/sec) is representative of literature values typical of Pennsylvania Shales (Davis and DeWiest, 1966, Hydrogeology, Pg. 349, John Wiley and Sons, New York).

TABLE 3-1

BOREHOLE PERMEABILITIES

Boring Number	Section Tested (ft)	Head (ft)	Permeability (ft/day)	Permeability (cm/sec)
1	10 - 20.5	55.1*	2.5	8.8×10^{-4}
3	5.8 - 11.0	2.6	0.67	2.4×10^{-4}
4	4.8 - 15.5	2.1	8.22	3.0×10^{-3}
5	3.3 - 8.3	6.0	0.29	1.0×10^{-4}

*Test conducted under pressure.

The rock corings indicate that the fracturing in the shale is nearly negligible past a depth of 15 feet. Packer permeability determinations conducted during the Phase II and III site investigations showed the permeability of the competent slightly fractured shale to be less than 0.28 ft/day (1×10^{-4} cm/sec) and more typically in the 0.14 ft/day (5×10^{-5} cm/sec) range. In boreholes where little or no vertical fracturing was noted, permeability values ranged from 0.0048 ft/day (1.7×10^{-6} cm/sec) to permeabilities so low that they could not be measured with the test used (less than 5×10^{-7} cm/sec).

3.1.2 Pit Bailing Permeability

Permeability estimates were made by monitoring the recharge of ground water into six (6) freshly dug, squared off test pits. The data is then applied to a "pit bailing" permeability test. This method uses the theory of radial flow to a well with the test pit treated as a recharging well. The test measures the permeability of all saturated earth materials above the bottom of the test pit. Due to the relatively low ground water conditions during the test period, the primary earth materials tested were the weathered fractured shales below the ground water table. The test is well suited to measuring the permeability due to primary porosity and secondary permeability due to joint patterns or open bedding planes in the weathered rock.

The pit bailing tests showed permeabilities of the weathered rock ranging from 3.8 ft/day to 61 ft/day (1.4×10^{-3} cm/sec to 2.2×10^{-2} cm/sec) (Table 3-2). The permeability values along the central stream (pits 6A and 9A) were higher than those measured away from the stream. This higher permeability is due to the very open, blocky nature of the rock and the fact that there is little clay filling in the fractures. A permeability

determination made along the stream in May 1983 indicated a permeability of 850 ft/day (3 x 10^{-1} cm/sec). A permeability value of 30 ft/day (1 x 10^{-2} cm/sec) corresponds with literature values typical of well sorted sands.

TABLE 3-2

PIT BAILING PERMEABILITY

Test Pit Number	Depth of Earth Materials Below Water Table (ft)	Permeability* (ft/day)	Permeability* (cm/sec)	Date
56-1A	7.33	3.8	1.4 X 10^{-3}	Sept. 1983
56-2A	5.24	16.0	5.7 x 10^{-3}	Sept. 1983
56-3A	4.58	7.0	2.5 x 10^{-3}	Sept. 1983
56-4A	6.24	15.5	5.5 x 10^{-3}	Sept. 1983
56-6A	4.76	61.0	2.2 x 10^{-2}	Sept. 1983
56-9A	5.96	32.6	1.2 x 10^{-2}	Sept. 1983
56-10	4.00	12.4	4.4 x 10^{-3}	May 1983
56-8	5.40	17.6	6.2 x 10^{-3}	May 1983
56-12	0.90	432.0	3.0 x 10^{-1}	May 1983

* Permeability values shown are averages of permeability determinations calculated at both the beginning and end of the recharge period.

Permeability values of the weathered shales made in areas removed from the stream were in the 3.8 ft/day to 16 ft/day (1.4 x 10^{-3} cm/sec to 5.7 x 10^{-3} cm/sec) range. These values correspond with permeability values averaging 15 ft/day (5 x 10^{-3} cm/sec) that were obtained in test pits of similar lithology in the Phase I and the Phase II investigations.

3.1.3 Soil Permeability

The surficial soils are generally a silt/clay subsoil underlain by till consisting of pebbles in a silt/clay matrix. In order to determine the permeability of these soils, field observations and laboratory permeability testing (undisturbed and recompacted) were conducted. The results of the testing (see Section 4.3.2) indicated that the soils at the site have very low permeability and when recompacted they are particularly impermeable (1.7×10^{-6} cm/sec to 1.8×10^{-8} cm/sec).

The laboratory testing indicated, in terms of permeability, that the silt/clay and underlying till are suitable for use as a soil liner material. Compaction of the material will decrease the permeability and improve the suitability of the in-situ material.

3.1.4 Permeability Summary

Based upon the permeability data obtained from the past and present Montour SES investigations, a general cross-section of permeability ranges at the Montour Site is presented in Table 3-3.

TABLE 3-3

GENERAL PERMEABILITY CROSS-SECTION

Depth (ft)	Material Description	Permeability Range (cm/sec)
0 - 5	Soil	1.7×10^{-6} to 1.8 x 10-8
5 - 10	Highly weathered fractured shale	2.2×10^{-2} to 5.0×10^{-3}
10 - 15	Fractured competent shale	3.0×10^{-3} to 1.0×10^{-4}
15+	Competent shale very little to no fracturing	1.7×10^{-6} to less than 5×10^{-7}

3.2 Surface Infiltration Rates

Three determinations of surface soil infiltration were made at the 5-6 area using ASTM Standard Test Method Designation D 3385-75 (Table 3-4). The tests were conducted over an undisturbed ground surface, with only the vegetation cut down. Since the tests were conducted on dry soils, the starting infiltration rate is due to the initial wetting of the soil particles. The infiltration rates then gradually decline due to the swelling of the clays (Appendix C). If the tests were conducted over pre-saturated soil (spring time conditions) or conducted over an extended period (simulates a long soaking rain), the infiltration rates would typically be lower.

The infiltration results show that the alluvial soils have a significantly higher infiltration rate than the silt/clay soils. This is caused by the loose packed nature of the alluvium.

TABLE 3-4

SOIL INFILTRATION

Test Number	Soil Type	Average Infiltration Rate (in/hr)	(cm/hr)
I-1	Silt/Clay Top Soil	1.25	3.18
I-2	Alluvium	3.5	8.89
I-3	Silt/Clay Top Soil	0.75	1.91

3.3 Depth to Ground Water

Depth to the static ground water was measured in the 21 test pits and the 5 borings. All water levels were allowed to stabilize at least 24 hours after

digging. The data was plotted to generate a depth to ground water map (Map 5) of the 5-6 area.

The depth to ground water decreases toward the central stream, where ground water levels are two feet below ground surface. Throughout the remainder of the site the depth to ground water ranges from 3 to 5 feet. These depth to ground water levels are representative of conditions during a dry season. The May 1983 data (Map 6) represent ground water conditions during the wettest season. The data from the two seasons show an approximate 1.5 foot ground water fluctuation.

3.4 Ground Water Flow

Ground water elevations in the 21 test pits and four borings were determined from the survey data and plotted to generate a ground water elevation map (Map 7). The ground water elevation data represent ground water conditions during a dry period. Ground water contours of a wet period during the May 1983 investigation are shown for comparison (Map 8).

A north to south stream approximately bisects the area. Ground water throughout the site flows toward and eventually discharges to the stream forming a north south trending ground water trough. This ground water trough roughly parallels an underlying bedrock trough. The hydraulic gradient along the axis of the trough was 0.005 ft/ft. Ground water outside the trough flows toward the center in either a southeasterly or southwesterly gradient of 0.0125 ft/ft. The overall regional ground water flow is toward the south at an average gradient of 0.005 ft/ft.

Ground water discharge at the center of the trough is greater than that throughout the remainder of the site due to the high permeability of the earth materials underlying the stream. Based upon an average permeability of 45 ft/day (6.2×10^{-2} cm/sec) and a gradient of 0.005 ft/ft the ground water

discharge at the stream would be 1.68 gallons/day per square foot unit area normal to the flow direction.

Outside the stream basin ground water discharge rates were determined at 1.4 gallons/day per square foot area normal to flow directions. This estimate assumes an average permeability of 15 ft/day (5.3×10^{-3} cm/sec) and a gradient of 0.0125 ft/ft.

To estimate the flow of ground water through the entire 5-6 area a depth of 15 feet of saturated fractured bedrock with an average permeability of 15 ft/day (5.3×10^{-3} cm/sec) was assumed. The width of the area normal to the regional ground water flow is 2000 feet. At an average gradient of 0.005 ft/ft (Sept. 1983 data), the total site ground water discharge is 16,850 gallons/day.

The 5-6 site dry season ground water flow patterns are similar to those observed during the wet season (May 1983). The only difference noted was an approximately 1.5 foot drop in ground water elevation, and a decrease in the average site hydraulic gradient from 0.008 ft/ft during May to 0.005 ft/ft during September. The decrease in hydraulic gradient subsequently reduces site ground water discharge from 25,500 gallons/day (May 1983) to 16,850 gallons/day (September 1983).

As a check on the above calculations of ground water flow a water balance was calculated for the site. The method of Thornthwaite and Mather[1] was used. The water balance is essentially a mass balance calculation where evapotranspiration and runoff are subtracted from rainfall to give ground water flow. The values obtained with this method agree with those obtained from gradient and conductivity data within a factor of 2 (water balance values are higher).

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(1) Thornwaite, C.W. and J.R. Mather, 1955. The Water Balance, Publ. in Climatology, V. 8, No. 1. Drexel Institute Laboratory of Climatology, Centertown, N.J.

4.0 GEOTECHNICAL EVALUATION

4.1 General

Area 5-6 is located northwest of the Phase I development area under construction (directly west of the flyash storage silos). This area consists of approximately 65 to 70 areas. A small stream bisects the site, flowing north to south. The stream flows south and discharges to an unnamed tributary of Mud Creek. The site slopes gently (1 to 2 percent) toward the stream from the west and east.

Subsurface conditions consist of about 1 to 5 feet of unconsolidated material. Generally 2 to 4 feet thick, it is composed of a thin layer of topsoil (6 to 9 inches) and a clay/silt subsoil layer (1 to 3 feet) overlying a weathered till consisting of pebbles within a silt/clay matrix. A weathered blocky, calcareous shale underlies the site. The upper bedrock is weathered and highly fractured. Ground water is less than 1 foot below the existing ground in the vicinity of the stream. The depth of ground water increases slightly to 2.5 to 5.0 feet east and west of the stream. The ground water is generally within the bedrock, and the major flow is controlled by the relatively permeable broken and highly weathered/fractured shale.

4.2 Scope

The scope of the geotechnical work included: (1) exploration of the site to determine subsurface conditions; (2) in-situ and laboratory testing of the soils/rock to determine engineering properties; (3) interpretation, evaluation, and analysis of these conditions and properties.

The major focus of the supplementary geotechnical study was to evaluate the following factors:

- Soils and rock properties based on the additional borings and in situ and laboratory soils testing.
- Suitability of on-site material for use in constructing a soils/clay liner, with the required permeability and strength characteristics.
- Development of a suitable method to control maximum ground water levels.
- Siting of required leachate pond based on soils/rock conditions.
- Geotechnical features for design including - stability of slopes, foundation design criteria, site preparation techniques, and filter requirements.
- Excavation properties of bedrock at the site, especially the competent, blocky shale.

4.3 Laboratory Testing Program

The laboratory testing program consisted of gradation analysis, determination of Atterberg limits, permeability (undisturbed and recompacted), unconfined compression, and compaction tests. All geotechnical test results are reported in Appendix D.

4.3.1 Grain Size Distribution/Atterberg Limits

Gradation analysis of the subsoil and underlying till indicates a silt/clay material. The subsoil has more than 80 percent passing the 200 sieve. The till is a silt/clay mixture with some sand and fine gravel. The materials are inorganic and have low to medium plasticity. The natural water content of the soil is generally near the plastic limit of the soil. Table 4-1 summarizes the Atterberg limits and indicates the soils identification based on the unified soil classification system.

TABLE 4-1

ATTERBERG LIMITS

Sample	Description/Identification	Nat. WC	LL	PL	PI
S-1	Subsoil - Inorganic Clay of low to medium plasticity (CL)	27.2	43	25	18
S-1	Till - Inorganic Clay of low to medium plasticity (CL)	21.5	32	20	12
10A	Alluvium - Inorganic Silt (MH)	48.4	73	40	33
13A	Surface - Silty soil (MH)	32.5	72	34	38
19A	Subsoil - Inorganic Clay of low to medium plasticity (CL)	23.1	44	24	20
19A	Till - Inorganic Clay of low to medium plasticity (CL - ML)	9.9	22	16	6
20A	Subsoil - Inorganic Silt of low to medium plasticity (ML)	23.8	39	25	14
20A	Till - Inorganic Clay of low to medium plasticity (CL)	27.8	45	23	22
S-2	Subsoil - Inorganic Clay of low to medium plasticity (CL)	16.3	30	20	10
S-2	Till - Inorganic Clay of higher plasticity (CH)	26.0	57	28	29

4.3.2 Permeability

The permeability of undisturbed soil samples was determined by a "falling-head" type test or Shelby tube samples of the subsoil. Permeability varied from 1.7×10^{-6} cm/sec to 1.8×10^{-8} cm/sec. Table 4-2 indicates the results of laboratory permeability testing.

TABLE 4-2

COEFFICIENT OF PERMEABILITY

Undisturbed			
(A)	B-5	Silt/clay	2.3×10^{-7} cm/sec
(B)	S-1	Silt/clay	1.7×10^{-6} cm/sec
(C)	S-1	Till	4.7×10^{-6} cm/sec
(D)	14-A	Silt/clay	1.9×10^{-8} cm/sec
(E)	11-A	Till	7.8×10^{-8} cm/sec
Re-compacted			
	S-1	Silt/clay	2.2×10^{-7} cm/sec
	S-1	Till	2.3×10^{-8} cm/sec
	S-2	Till	1.8×10^{-8} cm/sec

The following conclusions should be observed when silt/clay soils are compacted in order to produce the lowest possible permeability:

- Compact at a moisture content on the wet-of-optimum moisture.
- Compactive implements which promote shear deformation of soils will generate a better oriented structure and consequently help obtain a soil blanket with a low permeability, that is, scarify and recompact.

4.3.3 Unconfined Compression

Unconfined compression tests of undisturbed samples of the soils at the site were conducted. The tests were conducted at natural water content. The samples were tested until a failure surface developed. The shear stress is

estimated to be on half the compressive stress. Results are summarized in Table 4-3.

TABLE 4-3

STRENGTH CHARACTERISTICS

Boring	Description	Comprehensive Stress PSF	Shear Stress	Strain %	Wc %	σD PCF
B-5	Silt/Clay	2,520	1260	2.3	22.8	85.3
S-1	Silt/Clay	2,480	1240	4.5	20.2	106.2
S-1	Till	1,990	995	4.2	33.2	82.9
14-A	Silt/Clay	5,990	2950	3.3	16.4	102.7
11-A	Till	2,520	1260	2.7	13.6	110.5

4.3.4 Compaction Tests

Standard proctor tests (ASTM D-698 Method A) were run on 3 disturbed samples. The material had the following compaction characteristics as summarized in Table 4-4.

TABLE 4-4

MOISTURE - DENSITY

Sample	σD PCF	Wc %
S-1 (Till)	112.8	16.4
S-1 (Silt/Clay)	94.0	26.0
S-2 (Till)	88.4	31.6

Compaction of the silt/clay (to place it in a dense state) is desirable for three reasons:

(a) to decrease permeability;
(b) to increase shear strength; and
(c) to decrease future settlements.

With the knowledge of the "moisture - density" relationship as determined in the laboratory, the on-site material can be compacted to optimum density and optimum water content.

4.4 Evaluation

4.4.1 Liner

Although empirical, the Atterberg limits are a powerful tool in assessing, as a first approximation, the mechanical behavior of a clayey soil. The limits are emphasized when classifying fine soils in accordance with the Unified Soil Classification (USC).

The Atterberg limits indicated that the silt/clay materials at the site can be improved in a soil liner. According to the U.S. EPA, soils belonging to the CL or CH group (USC) are considered most suitable. The most favorable are those with a liquid limit between 35 and 60, placed above the A-line in the PI versus LL chart of the Unified Soil Classification.

All samples of the silt/clay and till soils tested plotted above the A-line.

The properties of a soil, particularly those of importance for a soil liner, can be significantly altered by mechanical compaction. From the standpoint of liners, the most important effect of compaction is upon permeability. The permeability of recompacted liner soils decreased at maximum density/optimum moisture. Construction criteria will require that the liner material be scarified and then recompacted at 95 percent of the laboratory maximum density. This maximum density will vary somewhat with different soil types.

The permeability of the silt/clay soils is suitable for a liner (less than 1×10^{-7} cm/sec), and when compacted the permeability will decrease with increased density.

4.4.2 Ground Water

Measurements of ground water elevations were made during the initial investigation of site 5-6 (May 1983) and also during this supplementary study (September 1983). Water levels have decreased with time and are dependent on the recharge from precipitation. The levels have decreased by approximately 2 feet (±) after the dry summer months.

In order to maintain water levels a minimum of 2 feet below the proposed soil liner, a system of underdrains to provide positive control is recommended.

The major design consideration for subsurface drains is to determine the optimum spacing, depth, and hydraulic capacity. These criteria are usually based on practical experience, experimental data, and drainage formula calculations.

4.4.3 Leachate/Runoff Basin

The pond will be sited just south of the proposed ash disposal area, east of the stream that bisects the site. Leachate and "dirty runoff" will be directed to the basin.

Underdrains will maintain ground water levels below the pond invert during all conditions.

Bedrock at the proposed basin is about 5 feet below existing ground (competent rock at 9.5 to 12 feet). The invert is also approximately 5 feet below grade, and bedrock excavation is expected to be minimal.

Because the seasonally high ground water table will be at or above the bottom of the Leachate/Runoff Basin at certain times of the year, it is recommended that the basin be provided with a gravity underdrain system.

4.4.4 Geotechnical Features

The site soils are suitable for supporting the proposed fill loads. The recompaction effort will ensure that the silt/clay layer has an increased soil strength. The relatively thin silt/clay subsoil is underlain by a dense till and bedrock which will be relatively incompressible under proposed loading.

The site improvements will basically consist of topsoil excavation, stormwater handling facilities, and ground water control. Major geotechnical problems with development of the site are not anticipated.

4.5 Excavation Properties

During this site investigation, test pits were dug to refusal, the farthest reach of the backhoe (11-12'), or to a point where digging was impractical (ground water conditions, caving, etc.). During digging the general excavation properties of the earth and/or rock material were carefully observed. Particular consideration was given to the area of the proposed leachate/runoff basin.

In the basin area four test pits show the depth to competent (blocky) rock to be 9.5 to 12 feet below grade. The rock above the competent rock was typically weathered to a state where it could be excavated with a normal backhoe at a production rate similar to the overburden soil excavation. It should be noted that in test pit 3A excavation could have been continued past 9.5 feet but was abandoned since the backhoe had a broken bucket tooth.

At the eastern portion of the 5-6 site, excavation with a normal backhoe is possible to at least an 8 foot depth.

At the western portion of the site, the most competent blocky, calcareous shales limit the extent of normal backhoe excavation. The most shallow depths to competent bedrock exist at the topographic rise at the northwest corner of

the site where an excavation deeper than 4 feet is not practical. Another area of difficult excavation exists along the western edge of the stream where normal excavation is not practical past 5 feet. Throughout the remainder of the western half of the site, excavation is practical to depths of at least 8 feet, with the exception of the area around Test Pit 14-A where refusal was encountered at 4.3 feet (refusal on blocky/calcareous shale). It is expected that some minor drilling/blasting may be required to remove competent rock in trench for construction of underdrains in isolated areas.

APPENDIX A

LOGS OF BORINGS

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BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-B-1-9/83

Project PP&L 5-6

Client Pennsylvania Power & Light Co.

Location Montour, PA

~~Top of Casing~~ Elevation 520.13 Date Started 9/27/83 Completed 9/27/83

Drilling Contractor Borings, Soils, and Testing, Inc. Driller B. Bender

T.R.C. Inspector P. Lagace&F. Johnson Well Depth 25.5' Casing Stick Up

Water Level Top of Screen Bottom of Screen

Drilling Method

Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		5 9 9				Light Brown-Tan Claysilt with Rust Mottles	
2		10				Tan Claysilt with some shale fragments	
4							
		12 12	65%			Broken Gray-Black Shale with clay(.5') over rusted Shale Fragments (.8')	
6		20 30					
8							Roller Bit 7' - 10'
10							

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BORING LOG

Project # 2271-N61 Page 2 of 2 Boring No. 5-6-B-1-9/83

Project PP&L 5-6

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		50/.5'				Gray-Black, Soft, Carbonatious, Fissil Shale	
						Black Broken Shale pieces pea size to 1"	Run #1 10.5' - 15.5' RQD = 0
12			38%			Rusting ends at 11.0'	
16						Black broken shale, some competent pieces vertical fractures at 16.25 - 16.7' pyratized	Run #2 15.5'-20.5' RQD = .3 Slite Reaction with HCL 16-16.5'
18			96%			Calcite seam rock very competent few seams, no rusting or vugs	Strong reaction below 16.5'
20						Vertical Fracture 20.2-20.35'	
						Black competent shale, competency increasing with depth. Calcite & Pyrite Seam	Run #3 20.5'-25.5' RQD = .56
22			86%				
						Vertical Fracture and Calcite Seam	

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BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6 - B-2-9/83

Project PP + L 5-6

Client Pennsylvania Power & Light Co.

Location Montour, PA

Top of Casing Elevation 523.63 Date Started 9/27/83 Completed 9/27/83

Drilling Contractor Borings, Soils, & Testing, Inc. Driller W. Lucas

T.R.C. Inspector P. Lagace Hole Depth 19' Casing Stick Up

Water Level Top of Screen Bottom of Screen

Drilling Method

Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		7 F				Gray compact silt with shale fragments	
2		20					
		33 24				Dark gray compact silt with abundant shale fragments	
4		24					
		20 18				Black broken shale, trace of moist silt-clay some rust	
6		15					
		32 45				Black, broken, almost crumbely shale, some rust	
8		40					
		31 60				Black fissil shale	
			62%				Run #1 8.9-13.9'

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BORING LOG

Project # 2271-N61 Page 2. of 2 Boring No. 5-6 B-2 9/83

Project PP & L 5-6 Soils

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
						Uniform thin bedded Black shale Pyrite nodual, d = .03' fine vertical calcite vein	
						Fine pyrite crystals	
12							
14							Run #2 14-19'
16						Thin horizontal bedded Black shale finely desimenated Pyrite crystals throughout more concentrated lense of pyrite at 15'	
18						Clean straight horizontal fractures spaced .2' Calcite vien, near vertical	
20						Bottom of hole	

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BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6=B-3-9/83

Project PP&L 5-6 soils

Client Pennsylvania Power and Light Company

Location Montour, PA

Top of Casing Elevation 518.83 Date Started 9/27/83 Completed 9/28/83

Drilling Contractor Borings, Soils, and Testing, Inc. Driller W. Lucas

T.R.C. Inspector Paul Lagace Well Depth _____ Casing Stick Up _____

Water Level _____ Top of Screen _____ Bottom of Screen _____

Drilling Method _____

Completion and Development _____

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		3				Blue-gray clumpy plastic silt clay with rust mottles	
		3					
		2				Blue-gray silt-clay over dark brown silt-clay, pod of rusty fine sand.	
2		2					
		4					
		4					
		7				Clay with shale granules over soft black shale	
4		9				Some rusting	
		14					
		15	100%				
		19					
6		57				Run #1 6'-11'	RQD = .23
						Interbedded gray (70%) and black (30%) calcarious shale	Reacts to HCl below 6.0'
						Trace pyrite	
						clay seam at 7.33'-7.55'	
8			88%				

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BORING LOG

Project # 2271-N61 Page 2 of 2 Boring No. 5-6-B-3-9/83

Project PP&L 5-6 Soils

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
						Fractures mostly in black shale	
							Run #2 11'-16'
12			96%			Black shale with fine <.01' discontinuous white seams	
14						Competent uniform black shale	
						Gray shale over gray clay silt over broken shale	
16			100%				Run #3 16'-20' RQD = .65
						Interbedded black and gray shale fine pyrite crystals disseminated through gray shale at 16'-16.2', 18.6'-19', 19.5'-20'6"	
18							
20							

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BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-B-4-9/83

Project PP&L 5-6

Client Pennsylvania Power & Light Company

Location Montour, PA

Top of Casing Elevation 520.68 Date Started 9/27/83 Completed 9/28/83

Drilling Contractor Borings, Soils, & Testing, Inc. Driller W. Lucas

T.R.C. Inspector D. F. Unites Well Depth _____ Casing Stick Up _____

Water Level _____ Top of Screen _____ Bottom of Screen _____

Drilling Method _____

Completion and Development _____

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		2				Tan Silt Loam	
		5				Mottled Gray Silty clay, damp	
		7					
2		9				Mottled dark gray silty clay, damp	
		5					
		8					
		8					
4		12				Weathered, rusted black shale	
		12					
		13				Weathered, slightly rusted hard shale	
6		50/.4'				Very broken hard black shale no rusting	Run #1 5.5'-10.5
						Broken black hard shale average pieces approx. 0.1' irregular vertical fracture 7.3-7.5	
8			86%			More competent shale pieces approx. 0.25' broken zone 8.2'-8.4'	Reacts with HCl and contains pyrites below 7.7'
10						Broken shale	

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BORING LOG

Project # 2271-N61 Page 2 of 2 Boring No. 5-6-B-4-9/83

Project PP&L 5-6

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
12			82%			Dark black shale, no apparent calcarious or pyrite zones, no rusting vertical and oblique fractures at 10.5'-10.9' vertical fracture at 11.1-11.6 Broken zones, at 13.6', 13.9-14.2	Run #2 10.5'-15.5'
							Bottom of hole
16							
18							
20							
22							

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BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-b-5-9/83

Project PP&L 5-6 Soils

Client Pennsylvania Power & Light Company

Location Montour, PA

~~Top of Casing~~ Elevation 531.74 Date Started 9/28/83 Completed 9/28/83

Drilling Contractor Borings, Soils and Testing Driller W. Lucas

T.R.C. Inspector Paul Lagace ~~Well~~ Depth 13' Casing Stick Up

Water Level Top of Screen Bottom of Screen

Drilling Method

Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		7 10				Light brown clumpy silt over dark brown silt with black mottles	
2		12 10 25	88%			Very soft black shale becoming harder with depth. Some rust	Run #1 3.5'-8.5' RQD = .14
4		50				Broken interbedded gray and black shale beds approx. .05" thick Iron oxide lense .01'	
			94%			Very broken gray shale with clay	
6						Iron oxide nodule	
						Black shale with calcite seam	
8						Interbedded black and gray shale	
			96%			Interbedded black and dark gray shale	Run #2 8.5'-13.5'

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BORING LOG

Project # 2271-N61 Page 2 of 2 Boring No. 5-6-B-5-9/83

Project PP&L 5-6 soils

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
						Gray shale has fine white seams, crinkly, horizontal	
						Pyrite and calcite nodules at 10'	
12						Some vertical pyrite and calcite inclusions	
						Light gray volcanic ash bed	
16							
18							

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BORING LOG

Project # 2271-N61 Page 1 of 1 Boring No. 5-6-B1-11/83

Project PP&L 5-6 Ash Storage Area

Client Pennsylvania Power and Light Co,

Location Montour SES 5-6 Area

Top of Casing Elevation N/A Date Started 11/14/83 Completed 11/14/83

Drilling Contractor B.S. and T Driller Bill Mahalick

T.R.C. Inspector F. Johnson Well Depth 11.0' Casing Stick Up N/A

Water Level N/A Top of Screen N/A Bottom of Screen N/A

Drilling Method Split spoon samples and double barrel core

Completion and Development Bore holes back filled with portland cement

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
-0		7				Dark brown silt top soil with fill and roots	
-1		4 5	68%			Brown to light brown silt loam with trace shale fragments increasing with depth, trace mottles	
-2		6 3					
-3		7 14				Black saprolite with soil filling and competent shale plates rusting heavy between plates shale becoming more competent with depth	
-4		14 20	100%				
-5		15 50/.4'				Black weathered Shale with some saprolite zones	Refusal at 5.9' Tricone to 6.0'
-6						Black, broken plates of competent Shale .01' thick trace rusting	Coring started at 6.0'
						Black competent Shale in plates .01' to .05' thick, some vertical fracturing	Core Recovery 100% RQD = 0
-8							

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BORING LOG

Project # 2271-N61 Page 2 of 2 Boring No. 5-6-1- 11/83

Project PP&L Montour 5-6 Ash Storage Area

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
						Rusting becomes heavy between plates at 8.4'	Possible marcasite noted
9						Black unrusted shale in plates up to .05' thick, Plates competent with some vertical fractures. Slight occasional clay skins, no effervesance in HCL, no pyrites noted	
10							
11						Black unrusted Shale competent plates upto .25' thick, slight effervesance in HCL no pyrite noted	End of Run at 11.0'

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BORING LOG

Project # 2271-N61 Page 1 of 1 Boring No. 5-6 - B-2 - 11/83

Project PP & L 5-6 Ash Storage Area

Client Pennsylvania Power & Light Co.

Location Montour, SES 5-6 Area

Top of Casing Elevation N/A Date Started 11/14/83 Completed 11/15/83

Drilling Contractor Burnings, Soils & Testing, Inc. Driller Bob Karawitz

T.R.C. Inspector Paul Lagace Well Depth 8' Casing Stick Up N/A

Water Level N/A Top of Screen N/A Bottom of Screen N/A

Drilling Method Split spoon samples & double barrel core

Completion and Development Bore hole backfilled with Portland cement

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		1 2				Moist tan silt with blue gray and rust mottles. Bottom 1/3 has weathered shale	
2		5 2 53				Moist rusty silt w. gray mottles over broken black shale, some rusting	
4		.5'	100%			Run #1 3'-8' Mostly broken fractured Black shale . red & yellow Rusting 3' - 5' 2" Marcasite nodual 1/4" diameter at 4'6" pyrite layers 1/32" - 1/16" at 5' 4", 5'7"	RQD = 0 H cl reacts on all 5'4"
6							
8						other lenses of deseminated pyrites	Bottom of hole at 8'
10							

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BORING LOG

Project # 2271-N61 Page 1 of 1 Boring No. 5-6-B-3-11/83

Project PP&L 5-6

Client Pennsylvania Power & Light Co.

Location Montour, PA

~~Top of Casing~~ Elevation _____ Date Started 11/16/83 Completed 11/16/83

Drilling Contractor Borings, Soils, & Testing, Inc. Driller Bob Karawitz

T.R.C. Inspector Paul Lagace Well Depth 10.4' Casing Stick Up _____

Water Level _____ Top of Screen _____ Bottom of Screen _____

Drilling Method _____

Completion and Development _____

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		1				Brown clay-silt	
		3	71%			Blue-gray clay-silt with orange mottles	
		4					
2		9				Stiff blue-gray clay-silt with orange rust mottles 1/2" horizon with sand size shale frags. at 2'11"	
		7	67%				
		9				Till rusty clay-silt 70-80% shale frags.	
		17					
4		35				Shale frags with silt little rust.	
		30	100%				
		45				Fractured black shale, heavy rusting	Run #1 5.4-10.4'
6						Very broken and fractured black-gray shale. Well rusted on fractures. Rust staining mostly orange, some green, yellow, blue florescence.	
8						Rock slightly more competent rust all orange, forming crust rather than film	
10							

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BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-4-11/83

Project PP&L 5-6 Ash Storage Area

Client Pennsylvania Power and Light Company

Location Montour SES 5-6 Area

Top of Casing Elevation N/A Date Started 11/15/83 Completed 11/15/83

Drilling Contractor BS & T Driller Bill Mahalick

T.R.C. Inspector F. Johnson Well Depth 9.0' Casing Stick Up N/A

Water Level N/A Top of Screen N/A Bottom of Screen N/A

Drilling Method Split spoon sampling and double barrel core

Completion and Development Bore Hole backfilled with portland cement

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
0		1				Light brown-- brown silt top soil	
1		1 3		92%		Light brown to tan , to gray silt, clay loam, heavy rust and gray mottles throughout	
2		6 8					
3		20 50/.2				Dark brown dense weathered till, good pebble structure	Refusal in till at 3.2 ' Tricone to 4.0' Begin Core at 4.0'
4						Saprolite	
5						Black weathered shale in plates up to .02' thick, occasional vertical fractures, slightly rusted.	No effervesance in HCl No pyrites noted
6							
7						Black weathered shale in plates .01 to .03' thick, very heavy rusting between plates	No effervesance in HCl No pyrites noted
8						Black weathered shale in plates .01 to .03' thick rusting slight between	
9							

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BORING LOG

Project # 2271-N61 Page 2 of 2 Boring No. 5-6-4-11/83

Project PP&L Montour SES 5-6 Area

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
9						Plates, some clay skins, White "Sandy" precipitate at 8.75', does not effervese in HCL	Recovery on Core 100% RQD = 0 Boring terminated at 9.0'

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BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-5-11/83

Project PP&L 5-6 Ash Storage Area

Client Pennsylvania Power and Light Company

Location Montour S.E.S. 5-6 Area

Top of Casing Elevation N/A Date Started 11/16/83 Completed 11/16/83

Drilling Contractor B.S. and T Driller Bill Mahlick

T.R.C. Inspector F. Johnson Well Depth 12.0' Casing Stick Up N/A

Water Level N/A Top of Screen N/A Bottom of Screen N/A

Drilling Method Split spoon sampling and double barrel coring

Completion and Development Hole grouted with portland cement

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
0	-	1				Dark brown sticky clay top soil possible alluvium	No recovery on spoon dug by hand for soils soils classification
1		1 3	0%			Light brown clay silt loam, mottled	
2		5 6					
3		9 11				Gray clay loam, mottled	
4		15 16	100%				
5		15 2				Dark brown dense weathered till,	Some rusting on Pebbles
6		3 11				Saprolite, Black highly weathered shale not rusted	Trace rusting noted
7		53				Black fractured broken shale pieces competent approximate .05' thick shale unrusted	
8							
9							

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BORING LOG

Project # 2271-N61 Page 2 of 2 Boring No. 5-6-5-11/83

Project PP&L Montour SES 5-6 Area

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
9						No pyrites noted	
10						Black calcified shale in competent plates up to .2' thick some vertical fractures	Effervesance in HCL noted Pyrited zones at 10.2' and 11.0'
11							
12							Boring Terminated at 12.0' RQD = 0 Recovery = 100%

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Project # 2271-N61 Page 1 of 2 Boring No. 5-6-B-6-11/83

Project PP&L 5-6

Client Pennsylvania Power & Light Company

Location Montour, PA

~~Top of Casing~~ Elevation _____ Date Started 11/16/83 Completed 11/16/83

Drilling Contractor Borings, Soils, and Testing, Inc. Driller Bob Marawitz

T.R.C. Inspector Paul Lagace ~~Well~~ Depth 12.3' Casing Stick Up _____

Water Level _____ Top of Screen _____ Bottom of Screen _____

Drilling Method _____

Completion and Development _____

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		2				Light brown silt loam	
		3	80%			Brown silt with few shale fragments, rusting and iron oxide concretions	
		4					
2		6					
		10				Till, not compact, mostly orange rusted, some gray silt matrix. 50% shale frags.	
		11	100%				
		14				Brown till with gray mottles. Shale fragments. Smaller and more rounded than above. Little rusting.	
4		22					
		21					
		18	92%			Orange rusted till with larger (.1') shale frags.	
		19					
6		27					
		22					
		41	58%			Brown soft silt, some shale frags. (from side of hole?)	
		63					
8		29				Very broken shale with brown silt.	
		6					
		29	100%			Very fissile carbonatious black shale. 1" zone of heavy rusting at 9.2', some rust at 10'	
		45					
10		53/4"					

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BORING LOG

Project # 2271-N61 Page 2 of 2 Boring No. 5-6-B-6-11/83

Project PP&L 5-6

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
						Soft black shale	
			29%			Black shale some rusting on vertical fractures	
12							End of run at 12.3'
14							
16							
18							

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BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6- 7-11/83

Project PP&L Ash Storage Area

Client Pennsylvania Power and Light Company

Location Montour S.E.S.

Top of Casing Elevation N/A Date Started 11/17/83 Completed 11/17/83

Drilling Contractor B.S. and T Driller Bill Mahalick

T.R.C. Inspector F. Johnson Well Depth 12.1' Casing Stick Up N/A

Water Level N/A Top of Screen N/A Bottom of Screen N/A

Drilling Method Split spoon samples and double barrel core

Completion and Development Hole grouted with Portland Cement

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
0		2				Brown silt top soil	
1		3 6	72%			Light brown silt, clay loam firm, moist, some limestone fragments mottling starts at 2.5'	
2		10 10					
3		7 8	32%			Dark brown weathered till with trace limestone and chert fragments	
4		10 13					
5		7 5					
6		3 11	62%				
7		9 50/.1"				Black saprolite Gray black limey shale broken and fractured	Core starts 7.1' No rusting
8						Gray black limey shale in competent plates .1 thick	No rusting
9							

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(203) 522-9400

BORING LOG

Project # 2271-N61 Page 2 of 2 Boring No. 5-6-7-11/83

Project PP&L Montour SES 5-6 area

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
9						Gray black limey shale/shaly limestone. Very competent Pieces - 25' thick few fissle zones .02' thick. No rusting	
10							Boring terminated at 12.1'
11							
12							Recovery = 100% RQD = 0

TRC Environmental Consultants, Inc.

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East Hartford, CT 06108
(203) 522-9400

BORING LOG

Project # 2271-N61 Page 1 of 1 Boring No. 5-6-B-8-11/83

Project PP&L 5-6

Client Pennsylvania Power & Light Company

Location Montour, PA

~~Top of Casing~~ Elevation _____ Date Started 11/16/83 Completed 11/17/83

Drilling Contractor Borings, Soils and Testing, Inc. Driller Bob Karawitz

T.R.C. Inspector Paul Lagace ~~Well~~ Depth 10' Casing Stick Up _____

Water Level _____ Top of Screen _____ Bottom of Screen _____

Drilling Method _____

Completion and Development _____

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		1				Light brown silt loam no rusting	
		3 20	67%			Brown pieces of limestone with dark brown silt, no rusting	
2		30 25	42%			Dark brown silt Broken limestone pieces	
		35/.3'	49%			Broken pieces of shaley limestone with some brown clay silt, some iron oxide	Run #1 2.8-4'
4		28 60	33%			Broken pieces of shaley limestone, yellow to orange rusty fine sand size particles, dark brown silt.	Split spoon
						Shaley dark gray limestone some calcite, sparse invertical veins, no rusting.	Run #2 5'-10'
6						Fissile weathered shale	Reacts with HCl throughout
			80%			Dark gray shaley limestone with abundant vertical calcite veins 1/8" thick heavily rusted sandy material down center of veins.	
8						More competent limestone with vertical calcite veins, little rusting	
10							

APPENDIX B

TEST PIT LOGS

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-1

TEST PIT COORDINATES: N-878.444, E436.687

TOP OF GROUND ELEVATION: 526.66

TEST PIT DEPTH: 4.5ft.

STABILIZED WATER DEPTH: Dry

SEEPAGE DEPTH: N/A

DATE: 5/19/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - .9	Brown silty top soil, dense, with some cobbles
.9 - 2.25	Light brown clay- silt loam, medium compact.
2.225 - 2.80	Dark brown/black, dense, highly weathered clay till, faint pebble fabric.
2.80 - 3.0	Black saprolite.
3.0 - 4.5	Black. Weathered blocky shale no rusting.
4.5	Refusal in competant shale.
	Joints: N20E

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-2

TEST PIT COORDINATES: N-657.436, E309.202

TOP OF GROUND ELEVATION: 530.64'

TEST PIT DEPTH: 4.0'

STABILIZED WATER DEPTH: 1.7;

SEEPAGE DEPTH: 2.9' - 4.0'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 1.0	Dark brown black loose clay top-soil.
1.0 - 1.75	Light brown, silt clay loam medium compact.
1.75 - 2.9	Light - dark brown dense, moist, weathered till. Some blocky structure.
2.9 - 4.0	Black, blocky shale, no rusting.
4.0	Refusal.

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-3

TEST PIT COORDINATES: N-317.631, E356.578

TOP OF GROUND ELEVATION: 536.54'

TEST PIT DEPTH: 7.3'

STABILIZED WATER DEPTH: 6.7'

SEEPAGE DEPTH: N/A

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.9	Light brown, loose silt topsoil.
0.9 - 5.2	Brown, dense, clay till pebbles competent, becoming weathered with depth.
5.2 - 7.3	Saprolite grading to black shale. Shale laye vary between fissile saprolite layers and blocky limey shale. Joints: N80°E vertical N15°E vertical

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-4

TEST PIT COORDINATES: N-197.202, E532.842

TOP OF GROUND ELEVATION: 538.74

TEST PIT DEPTH: 5.0'

STABILIZED WATER DEPTH: Dry

SEEPAGE DEPTH: N/A

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.8	Light brown, silt topsoil with shale fragment
0.8 - 5.0	Friable, relatively unweathered Black shale, with clay skins, no saprolite, no rusting.
5.0	Refusal
	Joints: N70°E Dominant N36°W Complement
	Bedding: Dip 20°N

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-5

TEST PIT COORDINATES: N241.021, E1161.205

TOP OF GROUND ELEVATION: 523.01

TEST PIT DEPTH: 6.0'

STABILIZED WATER DEPTH: 0.5'

SEEPAGE DEPTH: 3.1' - 6.0'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 1.0	Brown/black clayey moist topsoil in clumps.
1.0 - 3.0	Dark brown-gray clay loam with mottles. Sub-blocky structure. Become more mottled at bottom.
3.0 - 3.1	Saprolite.
3.1 - 6.0	Fissile, black shale no rusting.

PP&L MONTOUR S.E.S.

TEST PIT NO. 56- 6

TEST PIT COORDINATES: N-568.181, E1004.711

TOP OF GROUND ELEVATION: 521.42

TEST PIT DEPTH: 3.8'

STABILIZED WATER DEPTH: 1.0*

SEEPAGE DEPTH:

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - .75	Dark brown, clay, topsoil
.75 - 3.8	Highly weathered dark brown - gray clay till with mottles at top.

* Hit clay tile drainage pipe at approximatly 2 feet. Pit filled with water.

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-7

TEST PIT COORDINATES: N-486.537, E 1342.940

TOP OF GROUND ELEVATION: 526.31

TEST PIT DEPTH: 6.75'

STABILIZED WATER DEPTH: 2.5'

SEEPAGE DEPTH: 5

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.8	Brown, clay topsoil.
0.8 - 2.9	Light brown/tan silty clay loam becomes gray and heavyly mottled at 1.4'.
2.9 - 4.8	Dark brown, very dense till pebbles competent.
4.8 - 4.9	Saprolite.
4.9 - 6.75	Black, fissile, weathered shale.
6.75	Refusal.
	Joints: N82°W vertical

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-8

TEST PIT COORDINATES: N-586.429, E1183.128

TOP OF GROUND ELEVATION: 522.41

TEST PIT DEPTH: 6.25'

STABILIZED WATER DEPTH: 0.9'

SEEPAGE DEPTH: 2.4

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 1.0	Brown clay topsoil, clumpy.
1.0 - 1.7	Light brown silty clay loam with orange and gr mottles, grading to solid gray.
1.7 - 2.4	Dark gray, very weathered silt-clay till, shale fragments in clay matrix weathered orange.
2.4 - 2.5	Saprolite.
2.5 - 6.25	Black, fissile, very weathered shale some rusting, some clay skims.
	Joints: N80°E Vertical

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-9

TEST PIT COORDINATES: N-995.472, E1213.694

TOP OF GROUND ELEVATION: 524.26

TEST PIT DEPTH: 6.4'

STABILIZED WATER DEPTH: 2.9'

SEEPAGE DEPTH: 4.5'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.8	Brown silt topsoil.
0.8 - 2.0	Light brown clay silt loam blocky structure, heavy gray and orange mottles at bottom.
2.0 - 4.0	Dark brown, very dense silt clay till pebbles competent. Many fractures in till filled with clay.
4.0 - 4.5	Saprolite.
4.5 - 6.4	Black, weathered shale some rusting.
	Joints: N70°W , 85°E

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-10

TEST PIT COORDINATES: N1715.131, E1184.551

TOP OF GROUND ELEVATION: 522.26

TEST PIT DEPTH: 5.5'

STABILIZED WATER DEPTH: 1.5'

SEEPAGE DEPTH: 2.5'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - .75	Brown clay topsoil, clumpy.
.75 - 1.25	Light brown, blocky, silt-clay loam, Heavy orange and gray mottles becoming heavier with depth.
1.25 - 2.3	Dark gray, blocky till.
2.3 - 2.5	Saprolite.
2.5 - 5.5	Weathered, fissile black shale, no rusting.
	Joints: N60°W, vertical

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-11

TEST PIT COORDINATES: N-1921.603. E702.708

TOP OF GROUND ELEVATION: 517.18

TEST PIT DEPTH: 6.5'

STABILIZED WATER DEPTH: 1.1'

SEEPAGE DEPTH: 4.0'

DATE: 5.18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0. - .75	Brown clay-silt topsoil.
.75 - 2.1	Light brown/gray, mottled moist, dense, plastic clay loam.
2.1 - 5.0	Dark Brown, weathered till.
5.0 - 5.4	Saprolite.
5.4 - 6.5	Weathered, fissile black shale,no rusting.

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-12

TEST PIT COORDINATES: N-1506.469, E410.842

TOP OF GROUND ELEVATION: 521.17

TEST PIT DEPTH: 3.5

STABILIZED WATER DEPTH: 2.6

SEEPAGE DEPTH: 2.7

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0. - 0.7	Brown topsoil.
0.7 - 1.5	Dark Brown, slightly blocky clay-silt loam.
1.5 - 3.2	Black/dark brown, very weathered till.
3.2 - 3.5	Massive limey black shale , cracks filled with clay. No rusting.

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-13

TEST PIT COORDINATES: N-1548, E524.702

TOP OF GROUND ELEVATION: 518.09

TEST PIT DEPTH: 3.2'

STABILIZED WATER DEPTH: 0.75'

SEEPAGE DEPTH: 1.9'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 1.0	Black to dark brown organic rich clay topsoil. (recent alluvium)
1.0 - 1.9	Dark brown highly weathered, saturated till.
1.9 - 3.2	Black, blocky, shale.
3.2	Refusal.

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-14

TEST PIT COORDINATES: N-1044.619, E1765.514

TOP OF GROUND ELEVATION: 534.21

TEST PIT DEPTH: 5.0'

STABILIZED WATER DEPTH: 4.2'

SEEPAGE DEPTH: 5.0

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.5	Light brown, silt-clay topsoil.
0.5- 1.3	Light Brown Blocky silt clay loam some gray and rust mottle.
1.3 - 1.6	Gray, highly weatherd till grading to thin saprolite layer.
1.6- 5.0	Fissile black shale some rusting.
	Joints: N22°E vertical N55°E vertical

PP&L MONTOUR S.E.S.

TEST PIT NO. 56-15

TEST PIT COORDINATES: N-1703, E1740.085

TOP OF GROUND ELEVATION: 531.65

TEST PIT DEPTH: 6.0'

STABILIZED WATER DEPTH: 4.5'

SEEPAGE DEPTH: 4.0'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.6	Brown/light brown silt clay topsoil with shale fragments.
.6 - 1.3	Light brown blocky silt clay loam with shale fragments. Some gray rust mottles.
1.3 - 6.0	Black fissile shale joints well developed. Some have jointed clay seams. Joints: N82°E Dominant N10°W Complement N60°E Bedding Dip 18°S

Test Pit No: 5-6 1A

Test Pit Coordinates: N-1978.68, E 1075.46

Top of Ground Elevation: 520.03

Test Pit Depth: 12.5

Stabilized Water Depth: 5.17'

Seepage Depth: 5.17'

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.1	Light brown silt-clay top soil.
.1-1.8	Light brown to tan, silt loam, some clay, blocky, dry, breaks into small (1/2 inch) clumps, slightly mottled.
1.8-5.0	Dark brown, relatively unweathered till, very dense, pebbles competent.
5.0-12.5	Black platy shale, plates 1-4" diameter and competent, some clay skins on plates, water seepage slow in shale.

Rippability: Excavated platey shale from 5.0' to 10.0' in 5 minutes, digging very easy. Dug to reach of hoe (12.5).

PP&L Montour SES

Test Pit No: 56-2A

Test Pit Coordinates: N-1916.73, E 946.11

Top of Ground Elevation: 520.03

Test Pit Depth: 10' (refusal)

Stabilized Water Depth: 4.76'

Seepage Depth:

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Light brown clay-silt top soil.
.4-1.5	Light brown to gray, silt loam with clay, mottled, blocky, dry
1.5-5.5	Dark brown clay till moderately well weathered, gray and rust mottles.
5.5-10.0	Black fissle shale, rusted at top. Little filling with clays.
10.0	Refusal in competent shale

Rippability: Excavated fissile weathered shale from 6 feet to 9 feet in 12 minutes, relatively easy to dig. At 10 feet shale becomes competent and very difficult to excavate. Backhoe broke tooth attempting to rip this material.

PP&L Montour SES

Test Pit No: 5-6-3A

Test Pit Coordinates: N-2085.81, E 913.65

Top of Ground Elevation: 518.53

Test Pit Depth: 9.5

Stabilized Water Depth: 4.92'

Seepage Depth: 5.5 (when digging)

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Brown clay-silt top soil
.5-2.0	Light brown, grading to gray. Silt loam, same clay, mottled (heavy in gray zone), blockey, dry.
2.0-3.0	Highly weathered clay till.
3.0-6.0	Moderately weathered, very dense clay till.
6.0-6.1	Thin sapprolite layer, absent in some places.
6.1-9.5	Weathered black shale, slightly rusted.

Rippability: Weathered shale in fissile plates, moderately easy to excavate. Shale becomes competent at 9.5 and is difficult to excavate.

PP&L Montour SES

Test Pit No: 5-6 4A

Test Pit Coordinates: N-1958.62, E 1216.5

Top of Ground Elevation: 521. 86

Test Pit Depth: 11.5'

Stabilized Water Depth: 5.26'

Seepage Depth: Moist at 5.0'

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Light brown - tan clay - silt top soil blocky dry.
.5-1.8	Light brown - tan silt loam some clay, blocky, dry, no mottles.
1.8-3.9	Black weathered shale, platey with competent plates. Dip 13° E-NE; joint strike: N48°E, possible dislocated block of shale.
3.9-11.5'	Highly weathered, almost saprolitic grading to moderately weathered black fissile shale, rusted well defined joints N85°E.

Rippability: Upper more competent block moderately easy to excavate, lower weathered shale very easy to excavate.

PP&L Montour SES

Test Pit No: 5-6 5A

Test Pit Coordinates: N-1321.05, E 1362.68

Top of Ground Elevation: 527.83

Test Pit Depth: 11.5'

Stabilized Water Depth:

Seepage Depth: 6.5'

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Light brown clay silt blocky top soil.
.5-1.5	Light brown silt loam, some clay dry blocky, rust and gray mottles.
1.5-4.2	Dark brown - black, moderately weathered till, very dense. Pebble fabric well defined.
4.2-5.5	Very dense clay saprolite
5.5-11.5	Weathered fissile black rusted shale, good jointing - N62°E, N45°W

PP&L Montour SES

Test Pit No: 56-6A

Test Pit Coordinates: N-1373.57, E 767.68

Top of Ground Elevation: 519.14

Test Pit Depth: 8.5

Stabilized Water Depth: 3.74'

Seepage Depth:

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5'	Light brown clay - silt blocky top soil.
.5-1.5	Light brown silt loam, some clay, blocky, no mottles.
1.5-3.5	Blocks of disoriented weathered shale up into subsoil layers. Shale pieces competent, filled with clays.
3.5-8.5	Black highly weathered shale (almost saprolite) grading to open platy calcified shale with no structure. Transmitts water rapidly. No rusting.

PP&L Montour SES

Test Pit No: 5-6-7A

Test Pit Coordinates: N-1054.31, E 904.74

Top of Ground Elevation: 520.13

Test Pit Depth: 10.0

Stabilized Water Depth: N/A

Seepage Depth: 1.7" in soil fracture, 5.2' in shale

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Brown clay - silt top soil
.5-1.25	Dark brown silt loam, some clay, blocky.
1.25-2.5	Gray highly mottled clay loam very dense, dry. water seep through soil fracture.
2.5-5.3	Black-gray-dark brown very dense moderately weathered clay till.
5.3-10.0	Blocky shale, more blocky and compentent with depth. Shale blocks calcareous water flow heavy through blocky shale.

PP&L Montour SES

Test Pit No: 5-6-8A

Test Pit Coordinates: N-947.26, E 762.67

Top of Ground Elevation: 520.73

Test Pit Depth: 5.4 refusal

Stabilized Water Depth: 5.0'

Seepage Depth: 5.4'

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Brown clay silt top soil.
.5-1.5	Brown silt and clay loam.
1.5-2.3	Dark brown - black weathered clay till.
2.3-2.5	Black-gray saprolite
2.5-5.4	Platy weathered shale with seams of highly weathered shale and saprolite, no rusting.
5.4	Refusal in very competent calcareous shale. Fracture at top of shale N65W.

PP&L Montour SES

Test Pit No: 5-6-9A

Test Pit Coordinates: N-988.03, E 855.66

Top of Ground Elevation: 519.83

Test Pit Depth: 9.0'

Stabilized Water Depth: 3.04'

Seepage Depth: 5.0 in shale

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-1.2	Dark brown, silt, clay, alluvial top soil, small (pea sized), loose granuals.
1.2-5.0	Very dense gray mottled clay loam grading to a very weathered gray clay till, moist.
5.0'-8.0'	Weathered black fissile and platey unrusted shale.
8.0-9.0	Very competent calcareous platey black shale, very hard to excavate.

PP&L Montour SES

Test Pit No: 5-6-10A

Test Pit Coordinates: N-1509.67, E 563.86

Top of Ground Elevation: 517.64

Test Pit Depth: 5.5 refusal

Stabilized Water Depth: 1.70'

Seepage Depth: 3.8'

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-1.1'	Dark brown alluvial clay top soil granular and loose.
1.1-3.8'	Dark brown, gray, black highly weathered clay till, moist.
3.8'-4.7'	Black clay saprolite
4.7-5.5	Very competent calcareous, blocky black shale, large (2-3') plates 5"-6" thick, calcite seams at edges of blocks, very tough to excavate, backhoe broke a tooth.

PP&L Montour SES

Test Pit No: 5-6-11A

Test Pit Coordinates: N-1630.14, E 232.97

Top of Ground Elevation: 525.56

Test Pit Depth: 8.5 refusal

Stabilized Water Depth: Dry to 8.5

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Light brown-brown clay silt blocky top soil.
.4-1.6	Light brown silt loam since clay blocky, granular when excavated, very dry, slightly mottled.
1.6-8.5	Dark brown-black very dense clay till, shale fragments unweathered pebble fabric distinct. Some loam inclusions at top.
8.5	Refusal in very competent rock. Could not be excavated.

PP&L Montour SES

Test Pit No: 5-6-12A

Test Pit Coordinates: N-2207.43, E 152.95

Top of Ground Elevation: 523.57

Test Pit Depth: 7.1 refusal

Stabilized Water Depth: Dry to 7.1

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.9	Light brown clay-silt top soil.
.9-2.2	Brown-light brown silt loam some clay, blocky, dry, slightly mottled.
2.2-3.3	Dark brown dense moderately weathered till.
3.3-4.4	Dense clay saprolite
4.4-7.1	Broken blocky shale with saprolite seams no structure, slightly damp.
7.1	Refusal in very competent rock, could not be dug.

PP&L Montour SES

Test Pit No: 5- 6-13A

Test Pit Coordinates: N-2048.69, E 566.70

Top of Ground Elevation: 516.50

Test Pit Depth: 7.5 refusal

Stabilized Water Depth: 3.9'

Seepage Depth:

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Brown clay top soil.
.4-1.6	Dark brown very dense blocky/columnar clay loam, dry slight rus mottles.
1.6-3.5	Dark brown very weathered dense clay till.
3.5-6.0	Dark brown till less dense, less clay
6.0-7.5	Black weathered fissile/platy shale, unrusted.
7.5	Refusal in competent shale.

PP&L Montour SES

Test Pit No: 56-14A

Test Pit Coordinates: N-1225.15, E 209.66

Top of Ground Elevation: 526.03

Test Pit Depth: 4.3 refusal

Stabilized Water Depth: dry to 4.3'

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Light brown clay - silt top soil.
.5-1.4	Light brown silt loam some clay, dry blockey. Some shale fragments.
1.4-2.9	Brown compact clay-silt loam.
2.9-4.3	Dark brown dense clay till with competent shale pebbles and lime stone blocks (.1-.6' diameter) near bottom.
4.3	Refusal in competent rock.

PP&L Montour SES

Test Pit No: 56 15A

Test Pit Coordinates: N-501.88, 345.72

Top of Ground Elevation: 532.94

Test Pit Depth: 6.0'

Stabilized Water Depth: Dry to 6.0'

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Light brown silt clay blocky top soil.
.4-1.0	Light brown silt loam some clay sub blocky structure, dry.
1.0-2.0	Dark brown weathered till.
2.0-6.0	Black broken meassive calcified shale and limestone in plates and blocks .5' thick some fissile plates and soil filling noted between blocks. Excavation difficult in this material.

PP&L Montour SES

Test Pit No: 56-16A

Test Pit Coordinates: N-500.24, E 505.18

Top of Ground Elevation: 533.54

Test Pit Depth: 4.0

Stabilized Water Depth: Dry to 4.0

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0.5	Light brown clay silt top soil.
.5-1.5	Brown-light brown silt loam some clay, blocky, dry, no mottles.
1.5-2.1	Dark brown-black very weathered dense clay till.
2.1-4.0	Black very dense clay saprolite
4.0	Refusal in competent calcified shale/limestone

PP&L Montour SES

Test Pit No: 5-6-17A

Test Pit Coordinates: N-499.95, E 614.05

Top of Ground Elevation: 530.14

Test Pit Depth: 5.5

Stabilized Water Depth: Dry to 5.5'

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4'	Brown clay-silt top soil.
.4-1.0	Brown silt loam, some clay blocky, dry, no mottles
1.0-2.2	Brown moderately weathered till dry, relatively friable
2.2-5.5	Black silt texture saprolite, friable with occasional seams (.1-.2' thick) of shale with thick gray clay skins
5.5	Refusal in competent calcified shale

PP&L Montour SES

Test Pit No: 5-6-18A

Test Pit Coordinates: N-504.89, E 852.67

Top of Ground Elevation: 525. 31

Test Pit Depth: 5.5'

Stabilized Water Depth: 5.5'

Seepage Depth: 5.5'

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Brown silt clay top soil
.4-1.1	Brown - light brown silt loam; some clay, dry, blocky slight rust mottles.
1.1-1.6	Dark brown moderately weathered dense till
1.6-5.5	Weathered black shale mostly fissile some platy horizons (.1' thick) and occasional saprolite seams. Well developed joints N85°W; N5°E
5.5	Refusal in calcified platy shale. Water seep slight at top of shale.

PP&L Montour SES

Test Pit No: 5-6-19A

Test Pit Coordinates: N-748.96, E 1482.35

Top of Ground Elevation: 528.88

Test Pit Depth: 8.5'

Stabilized Water Depth: 5.1'

Seepage Depth: 5.3'

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Brown silt clay top soil.
.4-1.4	Light brown silt loam, some clay blocky
1.4-2.2	Gray clay loam, blocky, mottled
2.2-5.3	Dark brown moderately weatherd dense till.
5.3-5.4	Black saprolite
5.4-8.5	Black fissile rusted shale

PP&L Montour SES

Test Pit No:	5-6 - 20A
Test Pit Coordinates:	N 709.89,E1098.16
Top of Ground Elevation:	521.68
Test Pit Depth:	7.5'
Stabilized Water Depth:	3.7'
Seepage Depth:	
Date Excavated:	9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0 - .5	Brown silt clay top soil
.5 - 1.5	Light brown to brown grading to gray clay and silt loam, dense, heavy mottles in gray zone.
1.5 - 4.5	Gray grading to dark brown highly weathered clay till very dense, mottled at top in gray zone.
4.5 - 7.5	Black slightly calcified platy shale trace rusting at bedding planes.

PP&L Montour SES

Test Pit No:	5-6 - 21A
Test Pit Coordinates:	N 1076.96, E 1514.18
Top of Ground Elevation:	528.97
Test Pit Depth:	8.5'
Stabilized Water Depth:	4.6'
Seepage Depth:	4.5'
Date Excavated:	9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0 - .5	Light brown silt clay top soil
.5 - 1.7	Brown silt loam, some clay blocky, dry, no mottles
1.7 - 8.5'	Black weathered fissile shale rusted, pieces competant

APPENDIX C

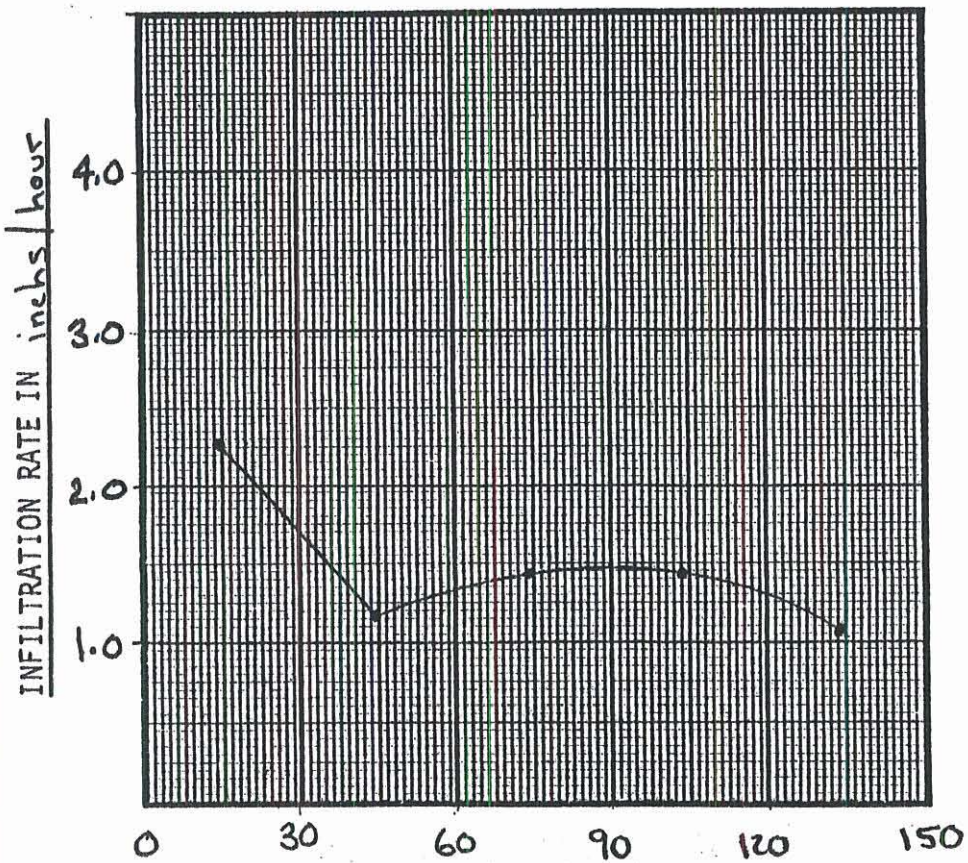
INFILTRATION TESTING

DATE 9/21/83 TECHNICIAN P. Lagace METHOD ASTM D5385-75

ELAPSED TIME,	QUANTITY OF WATER,	INFIL-TRATION RATE
min	ml	in/hr.
13	3700	2.29
43	4260	1.14
73	5390	1.44
103	5390	1.44
133	3930	1.05

CROSS-SECTION OF MOIST AREA AND GRAPH OF INFILTRATION RATE

HORIZONTAL DISTANCE IN N/A



DEPTH IN N/A

SOIL PROFILE DESCRIPTION

MISCELLANEOUS DATA Undisturbed

INFILTRATION RATE Average 1.25 in/hr

WATER LEVEL 1 inch

SITE Mentour SES 5-6

PROJECT PP&L 2271-086-52

LOCATION T-1

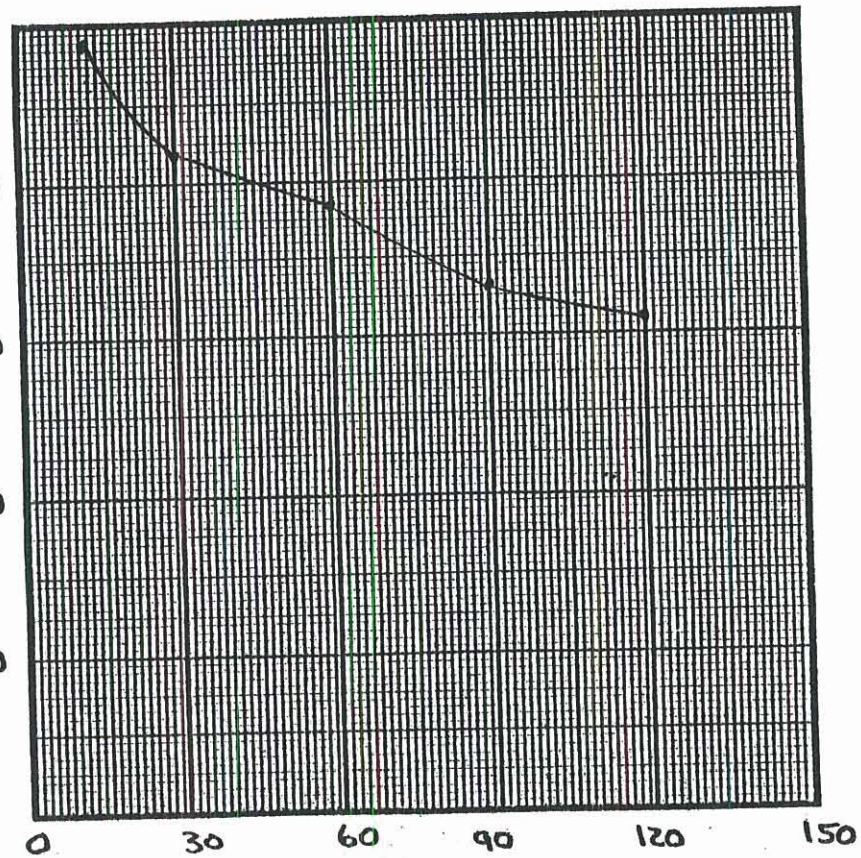
TRC Environmental Consultants, Inc.

DATE 9/2[illegible]/93 : TECHNICIAN P. Lagace METHOD ASTM D 5385 - 93

ELAPSED TIME,	QUANTITY OF WATER,	INFIL-TRATION RATE
min	ml	in/hr
12	7250	4.86
30	9350	4.17
60	14380	3.85
90	12310	3.30
120	11540	3.09

CROSS-SECTION OF MOIST AREA AND GRAPH OF INFILTRATION RATE

HORIZONTAL DISTANCE IN N/A



SOIL PROFILE DESCRIPTION

WATER LEVEL 1 inch PROJECT PP&L 2271-N61-52

TE Montour SES 5-6 LOCATION T-2

MISCELLANEOUS DATA Undisturbed Soil

INFILTRATION RATE Average @ 3.5 in/hr

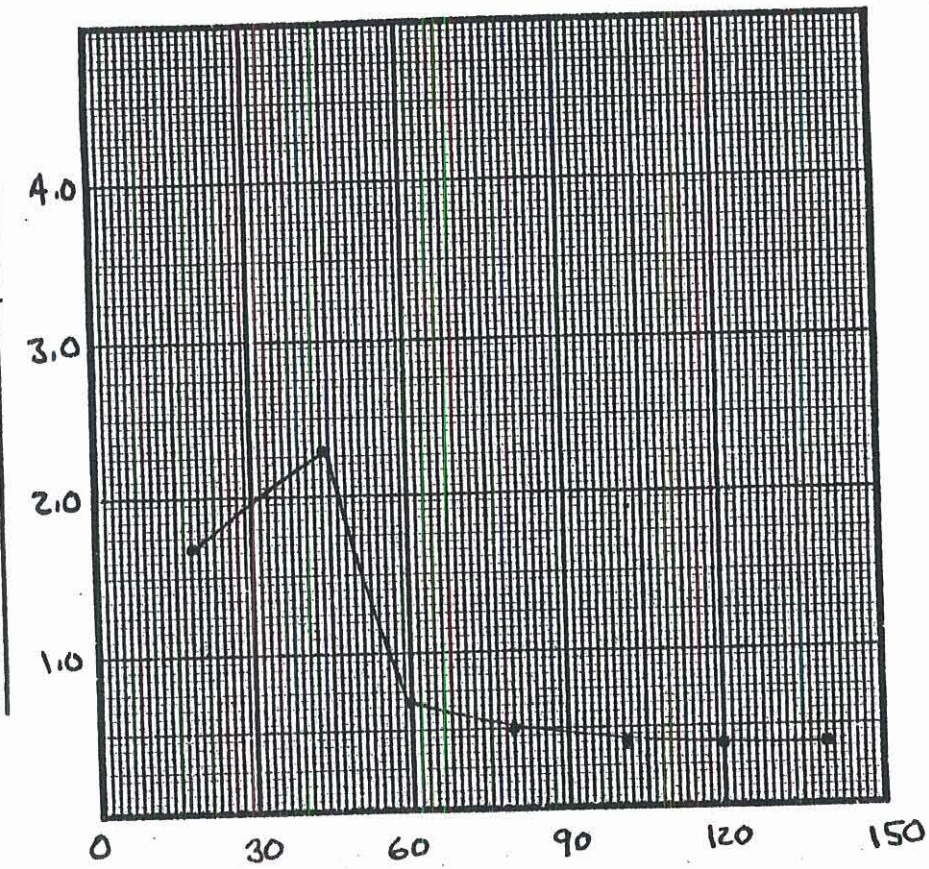
TRC Environmental Consultants, Inc.

DATE 9/21/83 TECHNICIAN P. Lagace METHOD ASTM D 3385-75

ELAPSED TIME,	QUANTITY OF WATER,	INFIL-TRATION RATE
20	4190	1.68
42	3380	2.27
60	1470	0.66
80	1240	0.50
100	1200	0.48
120	980	0.39
140	950	0.38

CROSS-SECTION OF MOIST AREA AND GRAPH OF INFILTRATION RATE

HORIZONTAL DISTANCE IN N/A



SOIL PROFILE DESCRIPTION

WATER LEVEL 1 inch PROJECT PP&L 2271-N61-52

SITE Manteur SES 5-6 LOCATION T-3

MISCELLANEOUS DATA Undisturbed Soil

INFILTRATION RATE Average ≈ .75 in/hr

TRC Environmental Consultants, Inc.

APPENDIX D

GEOTECHNICAL DATA

FALLING HEAD PERMEABILITY TEST

Sample No.: Shelby Tube A (1.5'-3.0')

Specimen Type: Undisturbed

Dry Density: 93.9 pcf

Moisture Content: 26.3% (Before Test)

Moisture Content: 29.4% (After Test)

Sample Area: 41.74 cm^2

Standpipe Area: .634 cm^2

Sample Length: 10.32 cm

Test No.	h (cm)	h (cm)	t (sec.)	k (cm/sec.)
1	90.49	80.96	86,340	2.0×10^{-7}
2	80.96	72.39	86,820	2.0×10^{-7}
3	117.16	66.04	229,500	3.9×10^{-7}

Average k = 2.3×10^{-7} cm/sec.

$$k = \frac{0.361}{t} \log_{10} \frac{h_0}{h_1}$$

Ash Storage Area No. 2 Expantion (10/83)
PS&I 480230-002

FALLING HEAD PERMEABILITY TEST

Sample No.: Shelby Tube B (3.0'-4.5')

Specimen Type: Undisturbed

Dry Density: 111.2 pcf

Moisture Content: 13.9% (Before Test)

Moisture Content: 18.8% (After Test)

Sample Area: 41.74 cm^2

Standpipe Area: .634 cm^2

Sample Length: 9.84 cm

Test No.	h (cm)	h (cm)	t (sec.)	k (cm/sec.)
1	15.24	4.44	86,340	2.1×10^{-6}
2	4.44	1.91	86,820	1.5×10^{-6}
3	92.39	6.99	229,500	1.7×10^{-6}

Average k = 1.7×10^{-6} cm/sec.

$$k = \frac{0.343}{t} \log_{10} \frac{h_0}{h_1}$$

FALLING HEAD PERMEABILITY TEST

Sample No.: Shelby Tube C (1.0'-2.0')

Specimen Type: Undisturbed

Dry Density: 84.5 pcf

Moisture Content: 28.2% (Before Test)

Moisture Content: 34.8% (After Test)

Sample Area: 41.74 cm^2

Standpipe Area: .634 cm^2

Sample Length: 14.29 cm

Test No.	h (cm)	h (cm)	t (sec.)	k (cm/sec.)
1	130.81	62.87	16,380	9.6×10^{-6}
2	130.81	42.55	88,440	2.7×10^{-6}
3	42.55	29.21	49,200	1.7×10^{-6}

Average k = 4.7×10^{-6} cm/sec.

$$k = \frac{0.499}{t} \log_{10} \frac{h_0}{h_1}$$

Ash Storage Area No. 2 Expansion (10/83)
PS&I 480230-002

FALLING HEAD PERMEABILITY TEST

Sample No.: Shelby Tube D (0.5'-2.5')

Specimen Type: Undisturbed

Dry Density: 112.2 pcf

Moisture Content: 16.7% (Before Test)

Moisture Content: 18.1% (After Test)

Sample Area: 41.74 cm^2

Standpipe Area: .634 cm^2

Sample Length: 5.44 cm

Test No.	h (cm)	h (cm)	t (sec.)	k (cm/sec.)
1	115.44	112.39	86,340	2.6×10^{-8}
2	112.39	110.81	86,820	1.3×10^{-8}
3	123.19	117.16	229,500	1.8×10^{-8}

Average k = 1.9×10^{-8} cm/sec.

$$k = \frac{0.190}{t} \log_{10} \frac{h_0}{h_1}$$

FALLING HEAD PERMEABILITY TEST

Sample No.: Shelby Tube E (1.5'-2.5')

Specimen Type: Undisturbed

Dry Density: 99.4 pcf

Moisture Content: 27.4% (Before Test)

Moisture Content: 26.8% (After Test)

Sample Area: 41.74 cm^2

Standpipe Area: .634 cm^2

Sample Length: 5.31 cm

Test No.	h (cm)	h (cm)	t (sec.)	k (cm/sec.)
1	98.74	90.81	86,340	7.8×10^{-8}
2	90.81	83.82	86,820	7.4×10^{-8}
3	114.62	90.81	229,500	8.2×10^{-8}

Average k = 7.8×10^{-8} cm/sec.

$$k = \frac{0.186}{t} \log_{10} \frac{h_0}{h_1}$$

FALLING HEAD PERMEABILITY TEST

Sample No.: 5-6 (S-1) Subsoil

Specimen Type: Remolded

Dry Density: 89.2 pcf

Moisture Content: 26.4% (Before Test)

Moisture Content: 35.1% (After Test)

Sample Area: 41.74 cm^2

Standpipe Area: .317 cm^2

Sample Length: 3.65 cm

Test No.	h (cm)	h (cm)	t (sec.)	k (cm/sec.)
1	90.81	54.61	53,520	2.6×10^{-7}
2	54.61	27.62	86,880	2.2×10^{-7}
3	113.03	29.40	229,500	1.6×10^{-7}

Average k = 2.2×10^{-7} cm/sec.

$$k = \frac{0.064}{t} \log_{10} \frac{h_0}{h_1}$$

FALLING HEAD PERMEABILITY TEST

Sample No.: 5-6 (S-1) Till

Specimen Type: Remolded

Dry Density: 105.8 pcf

Moisture Content: 16.9% (Before Test)

Moisture Content: 20.1% (After Test)

Sample Area: 41.74 cm^2

Standpipe Area: .317 cm^2

Sample Length: 3.02 cm

Test No.	h (cm)	h (cm)	t (sec.)	k (cm/sec.)
1	113.35	107.95	53,520	2.1×10^{-8}
2	107.95	98.74	86,880	2.4×10^{-8}
3	116.21	92.71	229,500	2.3×10^{-8}

Average k = 2.3×10^{-8} cm/sec.

$$k = \frac{0.053}{t} \log_{10} \frac{h_0}{h_1}$$

FALLING HEAD PERMEABILITY TEST

Sample No.: 5-6 (S-2) Till

Specimen Type: Remolded

Dry Density: 83.8 pcf

Moisture Content: 32.4% (Before Test)

Moisture Content: 37.0% (After Test)

Sample Area: 41.74 cm^2

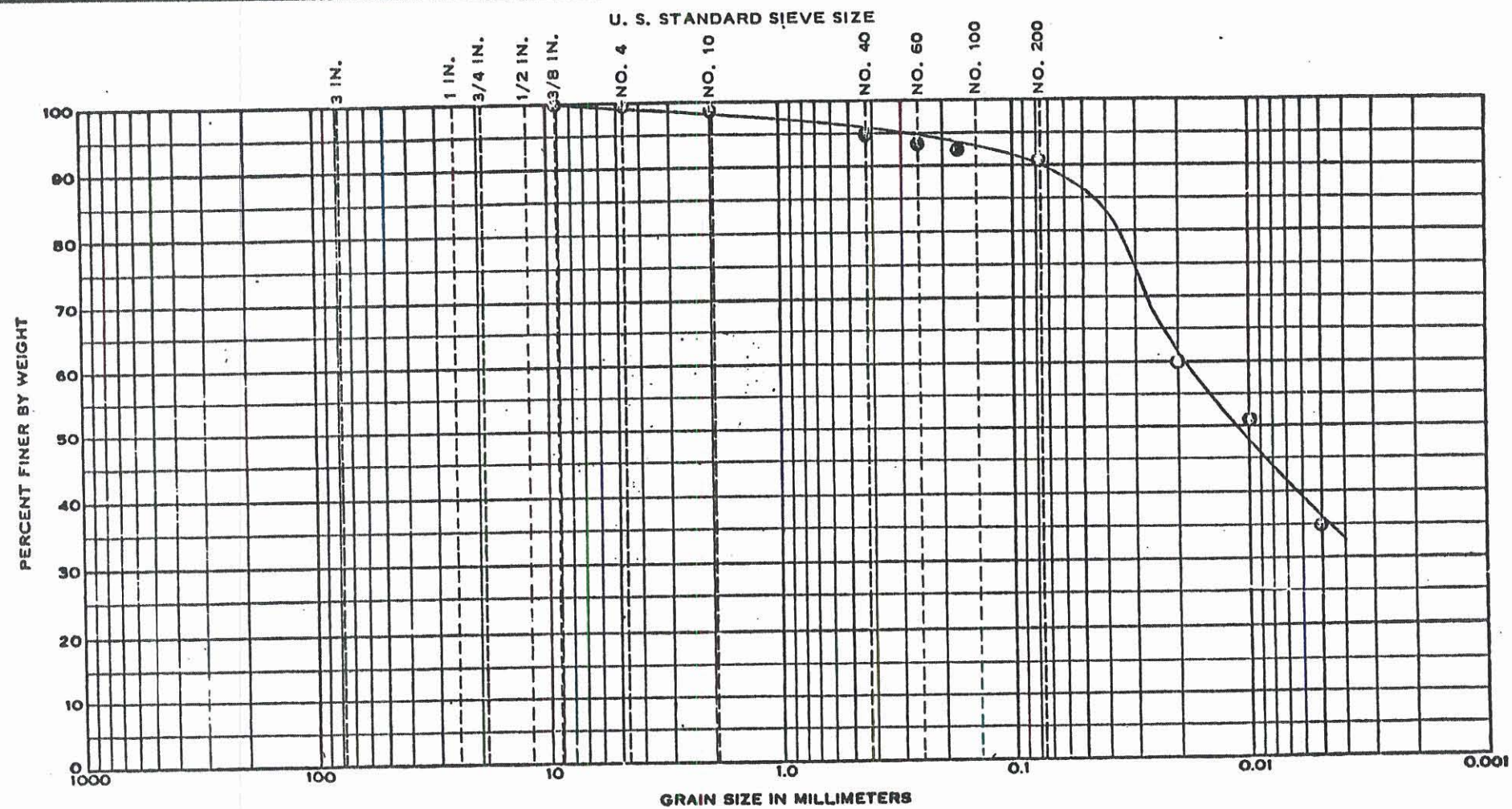
Standpipe Area: .317 cm^2

Sample Length: 3.65 cm

Test No.	h (cm)	h (cm)	t (sec.)	k (cm/sec.)
1	109.86	106.68	53,520	1.5×10^{-8}
2	106.68	99.06	86,880	2.4×10^{-8}
3	109.54	96.20	229,500	1.6×10^{-8}

Average k = 1.8×10^{-8} cm/sec.

$$k = \frac{0.064}{t} \log_{10} \frac{h_0}{h_1}$$



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	REMARKS:
S-6 (S-1)		CL	27.2	43	25	18	Subsoil

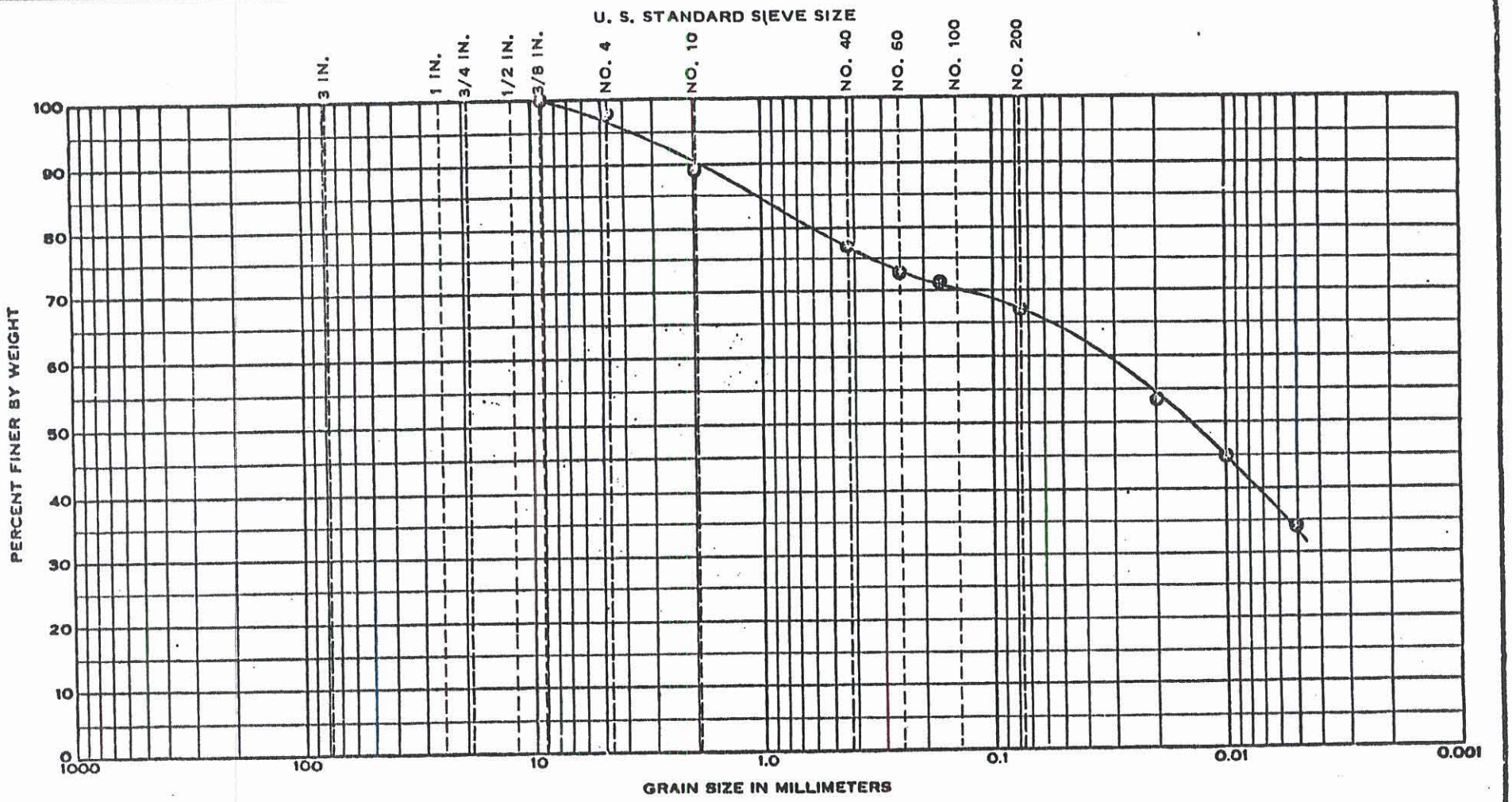
GRADATION CURVES

BORINGS, SOILS & TESTING CO.
FOUNDATION ENGINEERS
HARRISBURG, PENNSYLVANIA

Project: Ash Storage Area #2, Exp.

Location: Montour SES

Date 10/83 | Made By MH | Chkd By EML



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	REMARKS:
5-6 (S-1)		CL	21.5	32	20	12	Till

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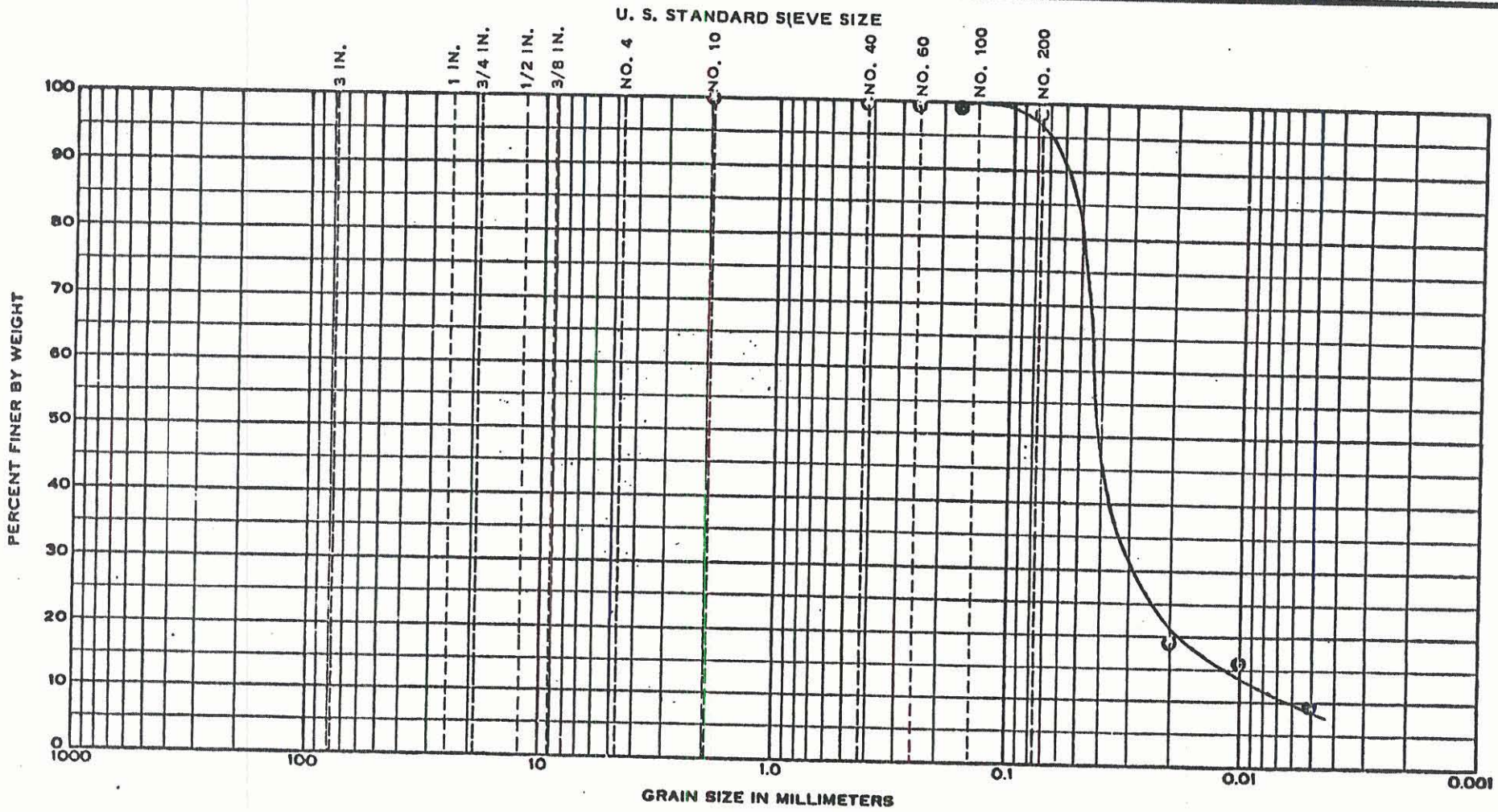
Project: Ash Storage Area #2, Exp.

Location: Montour SES

Date 10/83 | Made By MH | Chkd By EML

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	REMARKS:
5-6 (10A)		MH	48.4	73	40	33	Alluvium

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HARRISBURG, PENNSYLVANIA

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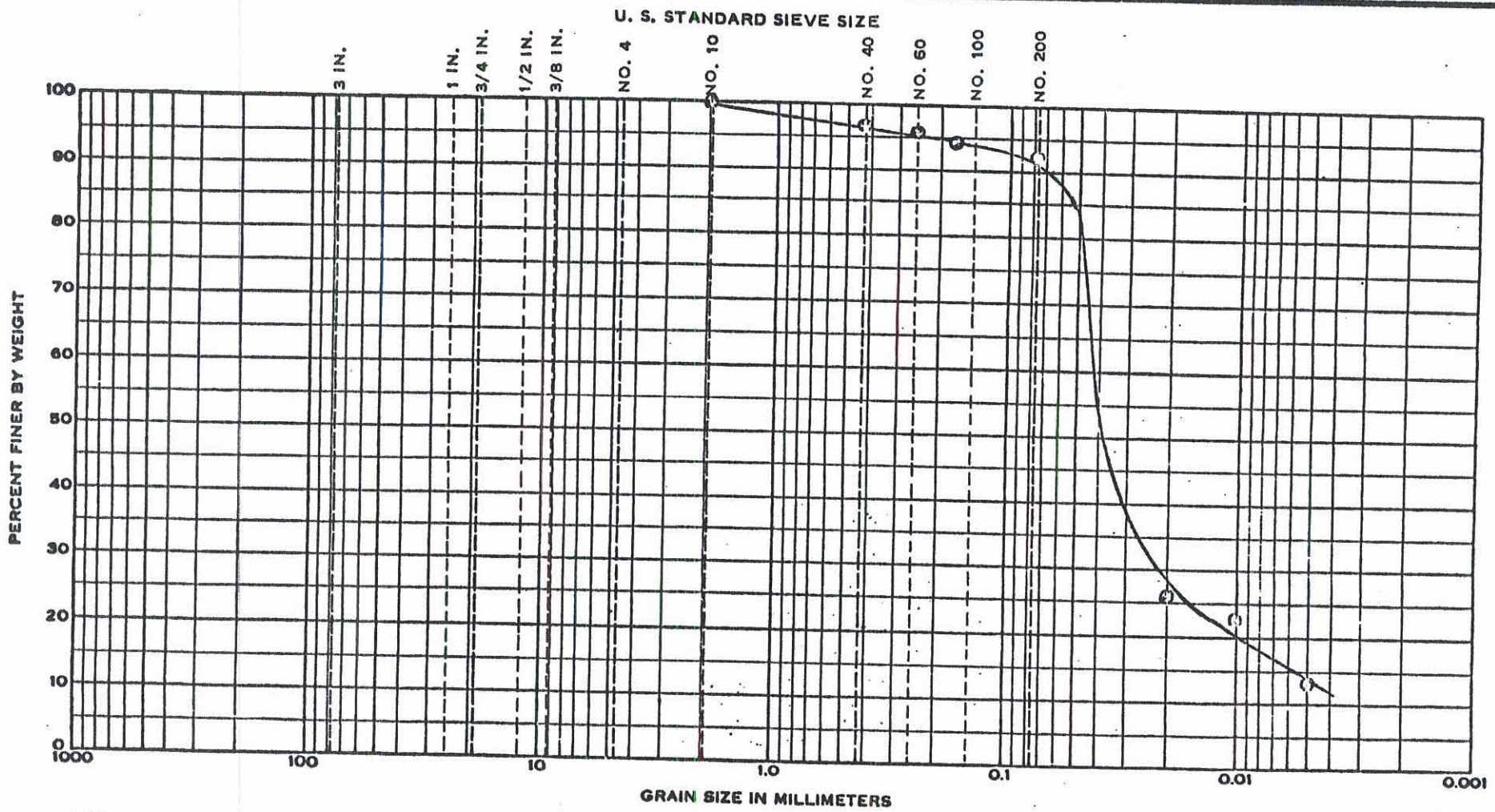

COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	REMARKS:
5-6 (13A)		MH	32.5	72	34	38	Clay Loam

GRADATION CURVES

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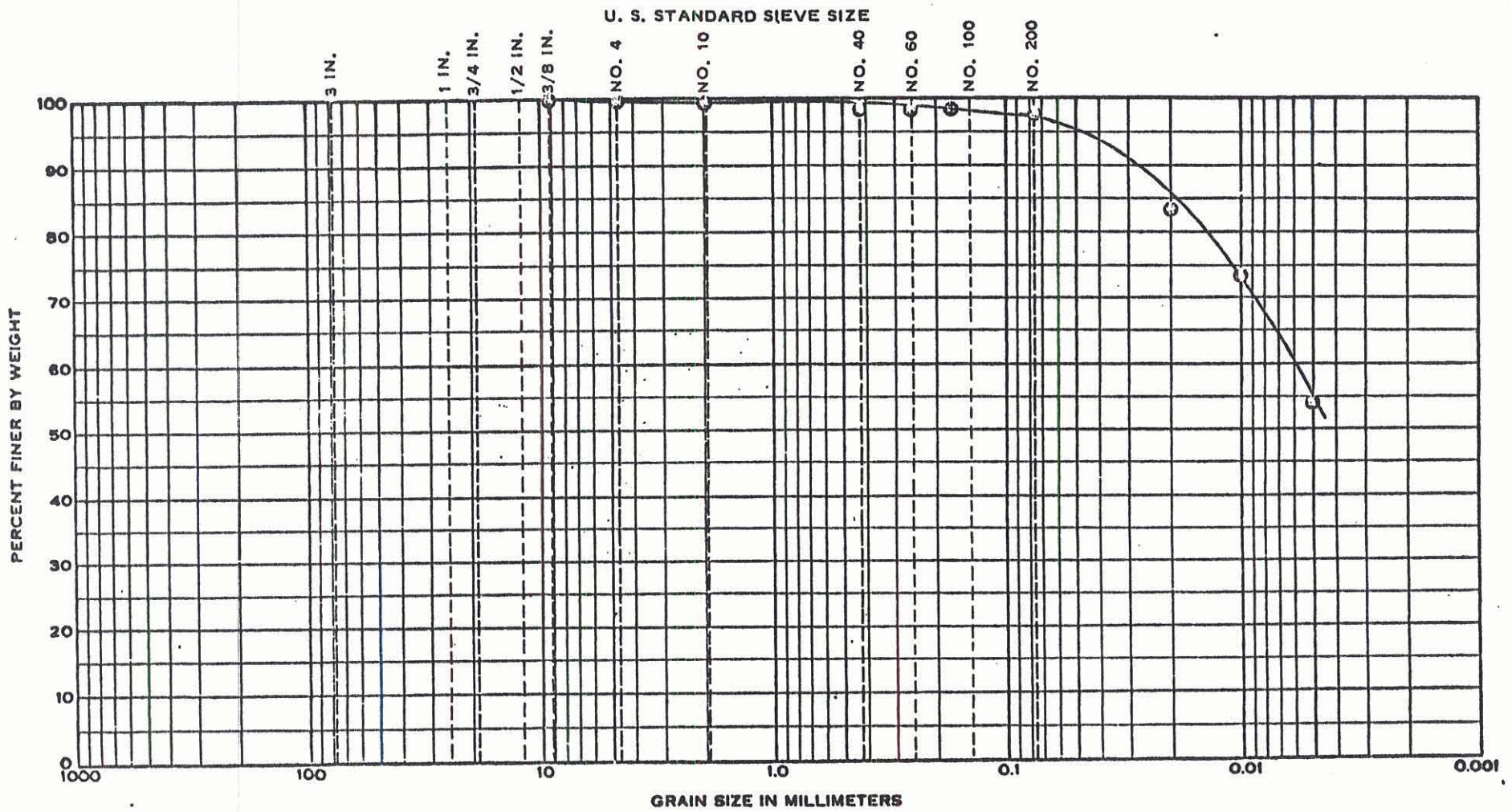
Location: Montour SES
Date 10/83 | Made By MH | Chkd By EML



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	REMARKS:
5-6 (19A)		CL	23.1	44	24	20	1.5' deep subsoil

GRADATION CURVES

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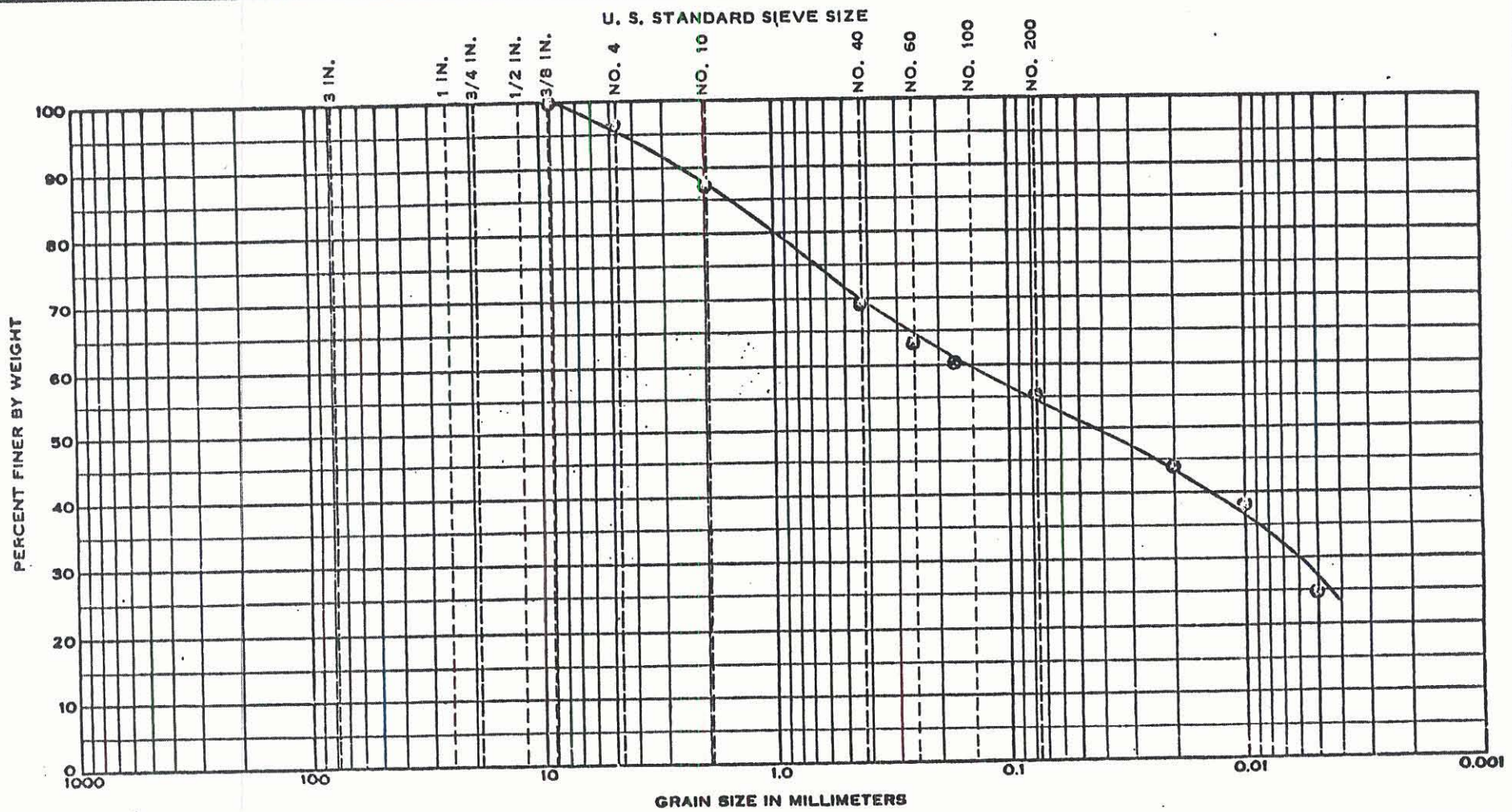
HARRISBURG, PENNSYLVANIA

Project: Ash Storage Area #2, Exp.

Location: Montour SES

Date 10/83 | Made By MH | Chkd By EML



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	REMARKS:
5-6 (19A)		CL-ML	9.9	22	16	6	3.0' deep Till

GRADATION CURVES

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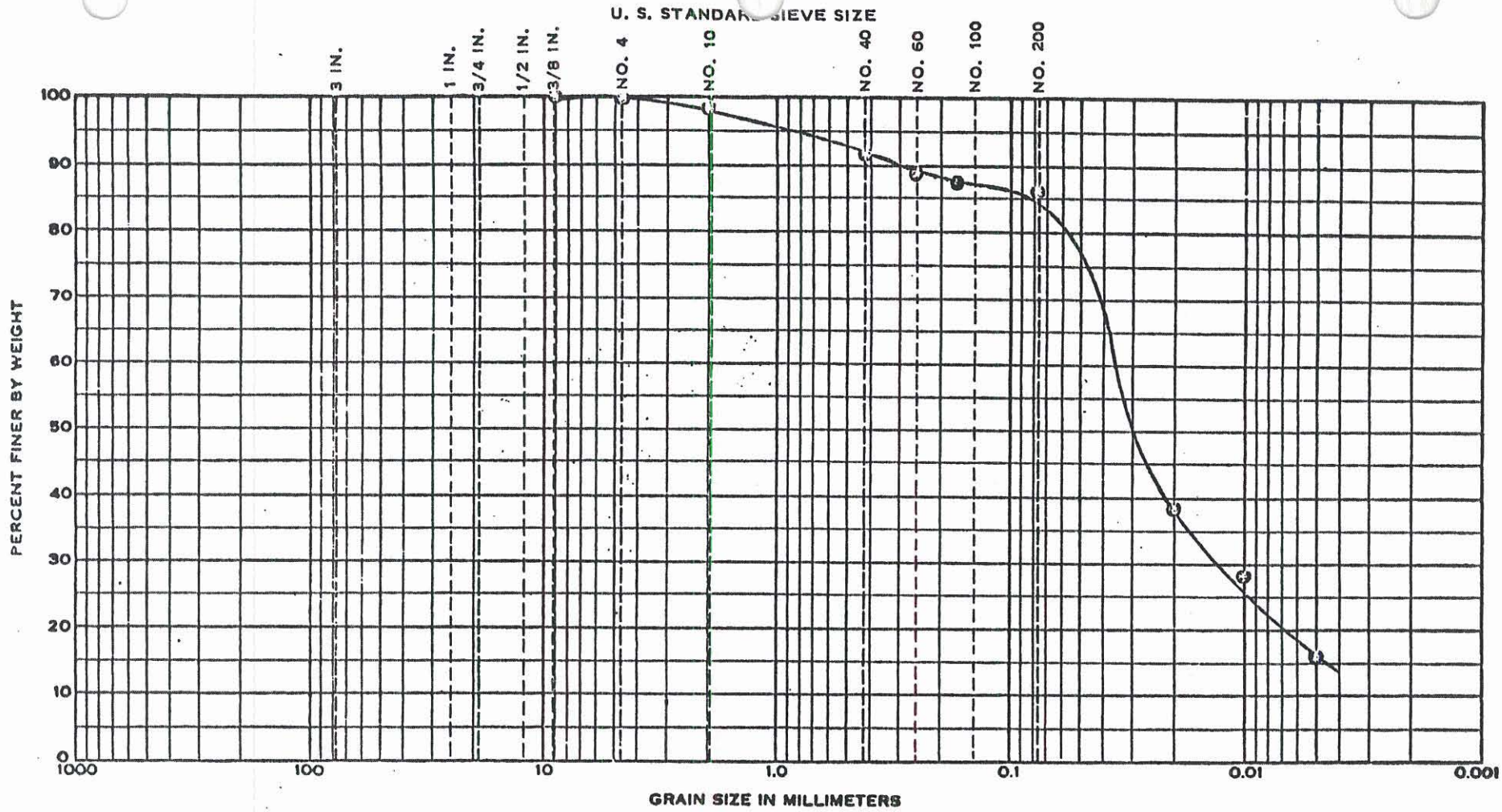
HARRISBURG, PENNSYLVANIA

Project: Ash Storage Area #2, Exp.

Location: Montour SES

Date 10/83 | Made By MH | Chkd By FML



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	REMARKS:
S-6 (20A)		ML	23.8	39	25	14	1.0' deep subsoil

GRADATION CURVES

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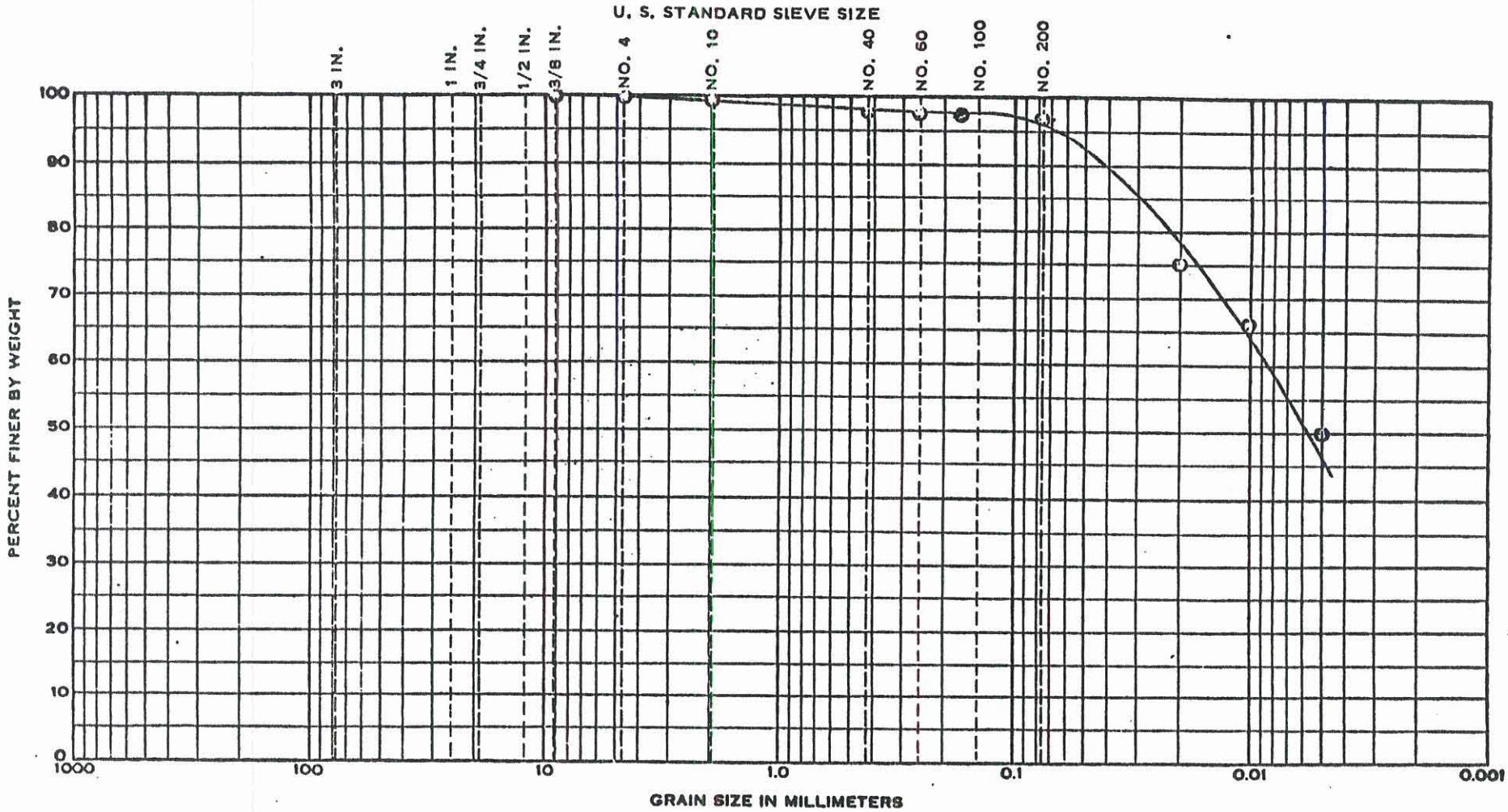
HARRISBURG, PENNSYLVANIA

Project: Ash Storage Area #2, Exp.

Location: Montour SES

Date 10/83 | Made By MH | Chkd By FML



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	REMARKS:
5-6 (20A)		CL	27.8	45	23	22	3.0' deep Till

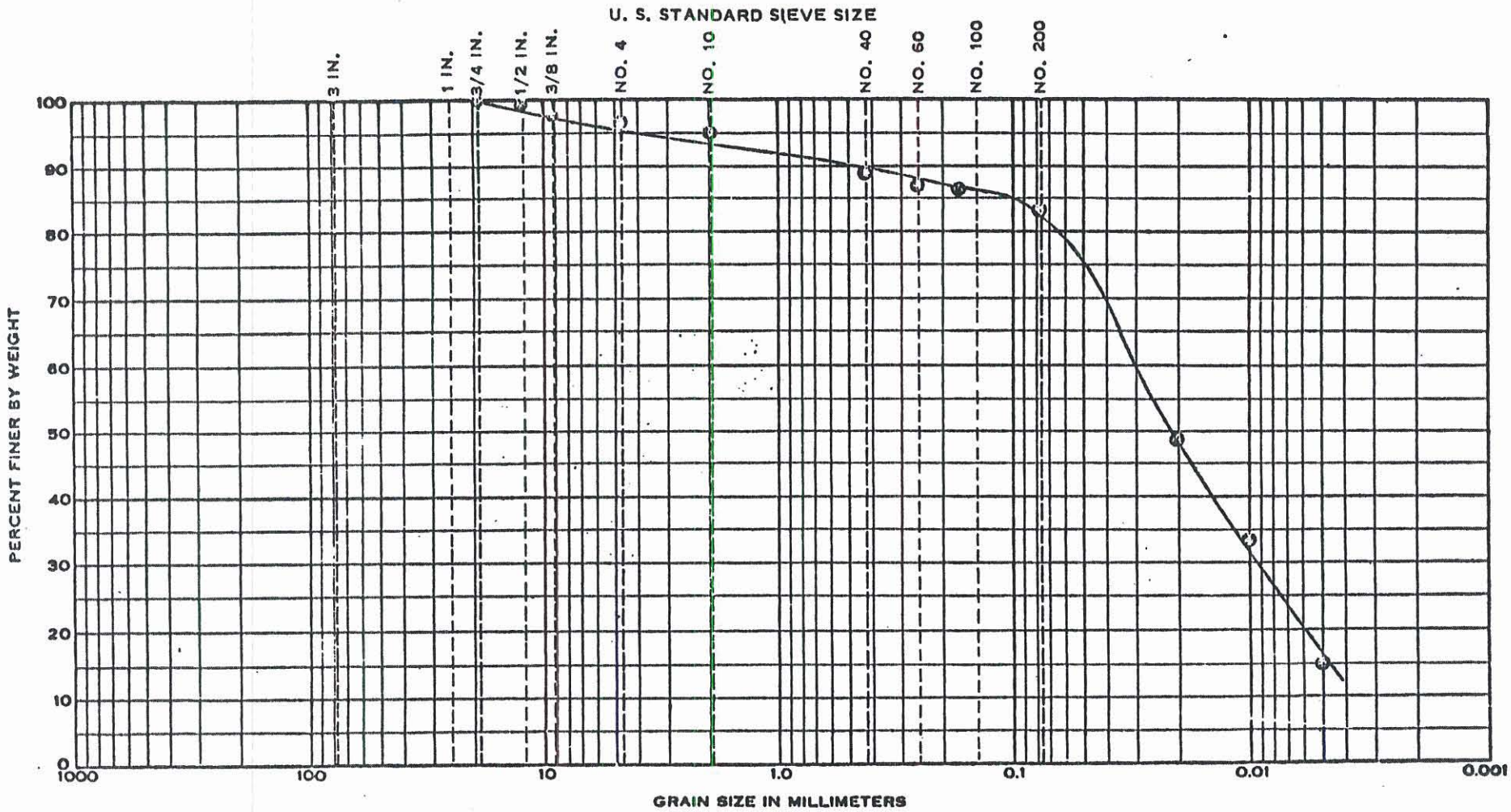
GRADATION CURVES

BORINGS, SOILS & TESTING CO.
FOUNDATION ENGINEERS
HARRISBURG, PENNSYLVANIA

Project: Ash Storage Area #2, Exp.

Location: Montour SES

Date 10/83 | Made By MH | Chkd By EML



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	REMARKS:
S-6 (S-2)		CL	16.3	30	20	10	Subsoil

GRADATION CURVES

BORINGS, SOILS & TESTING CO.
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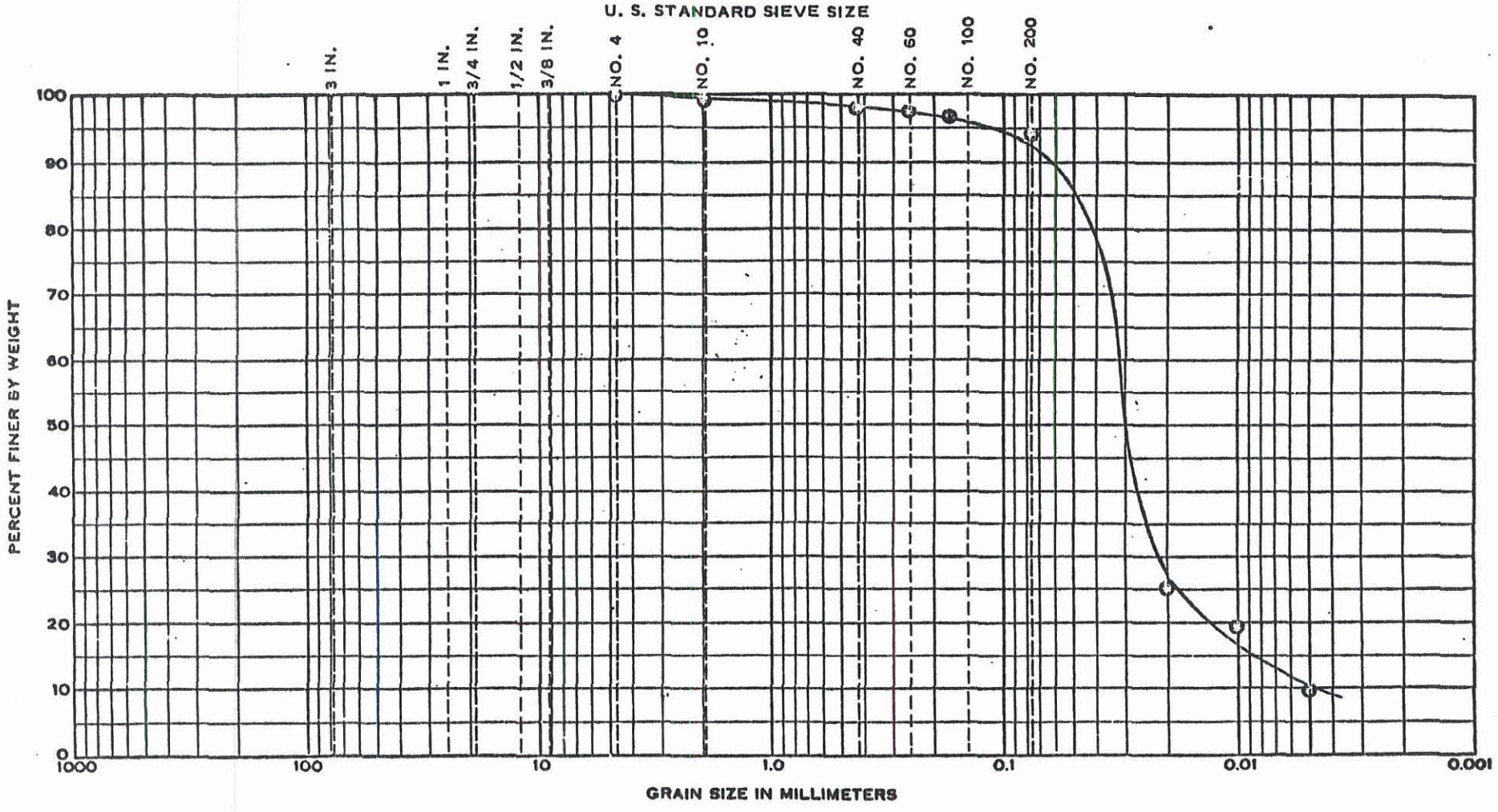
HARRISBURG, PENNSYLVANIA

Project: Ash Storage Area #2, Exp.

Location: Montour SES

Date 10/83 | Made By MH | Chkd By EML



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	REMARKS:
5-6 (S-2)		CH	26.0	57	28	29	Till

GRADATION CURVES

BORINGS, SOILS & TESTING CO.
FOUNDATION ENGINEERS
HARRISBURG, PENNSYLVANIA

Project: Ash Storage Area #2, Exp.

Location: Montour SES

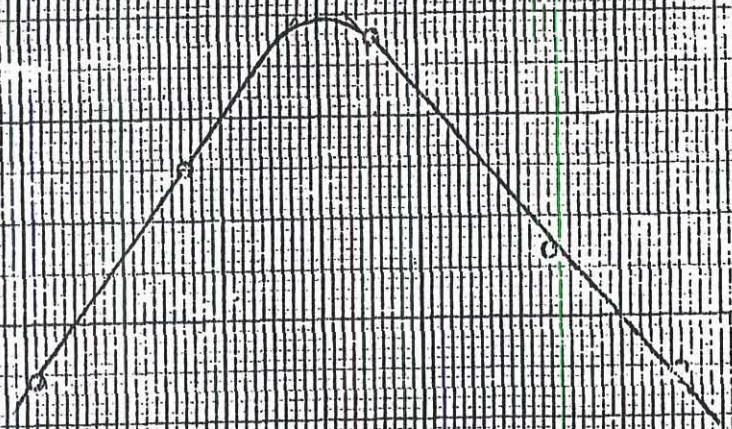
Date 10/83 | Made By MH | Chkd By EML

MONTOUR SES
ASH STORAGE AREA NO. 2 EXPANSION
PSEI NO. 480230-002

PROJECT: J-1444 STATION: DEPTH
TEST PIT NO: OFFSET: SOIL CLASS:
SAMPLE LOCATION: S-6 (S-1) Subsoil

MAX. DENSITY 93.8 pcf
OPT. MOISTURE 26.0%
STD. X XXXXXXX
MOD.

ASTM D-698
Method A



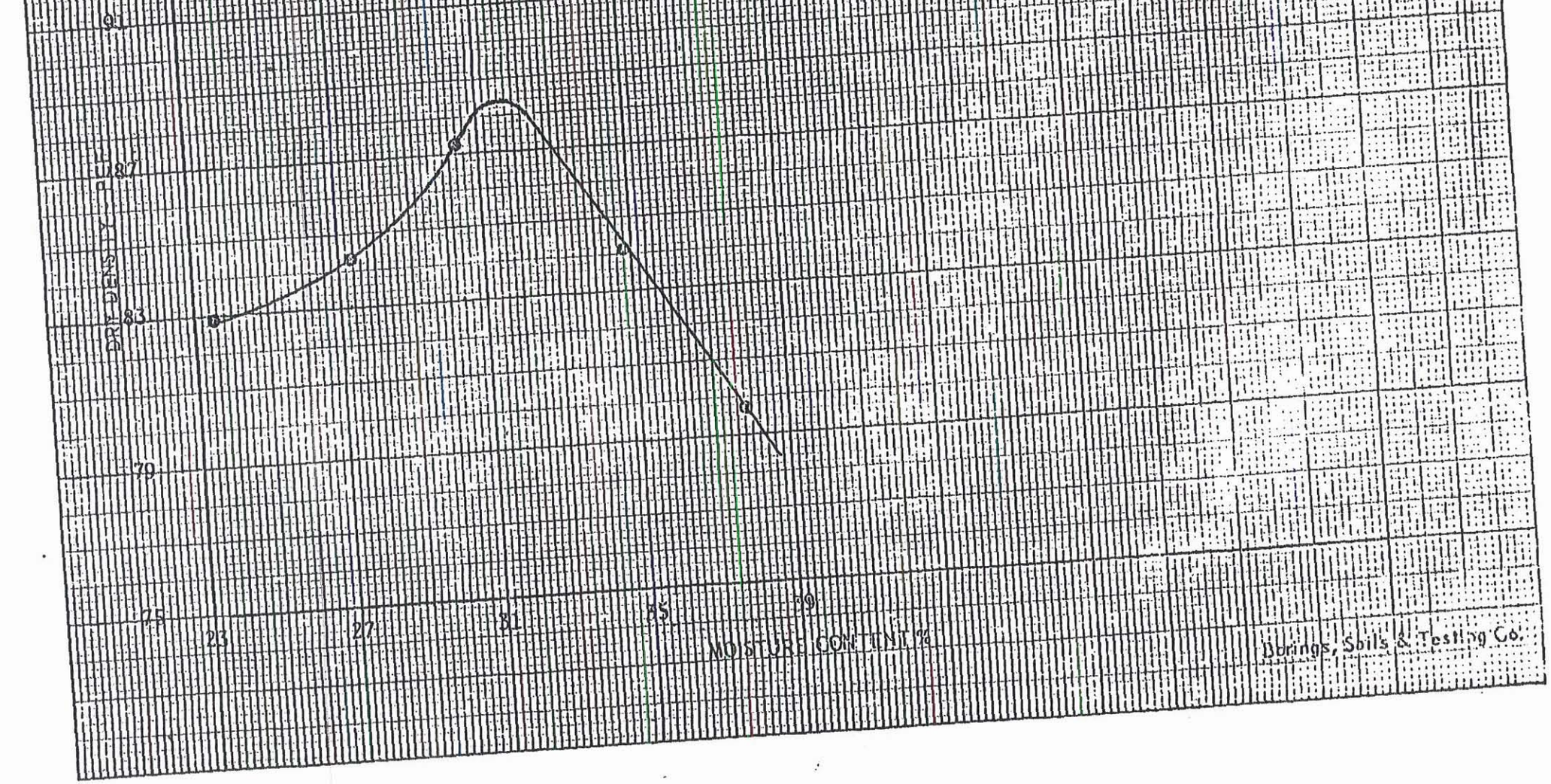
Borings, Soils & Testing Co.

MONTOUR SES
ASH STORAGE AREA NO. 2 EXPANSION
PSEG NO. 480230-002

PROJECT: J-1444 STATION:
TEST PIT NO. OFFSET:
SAMPLE LOCATION: S-10 (S-2) DEPTH:
SOIL CLASS:

MAX. DENSITY 88.4 pcf
OPT. MOISTURE 21.6 %
STD. (X) MOD.

ASTM D-698
Method A



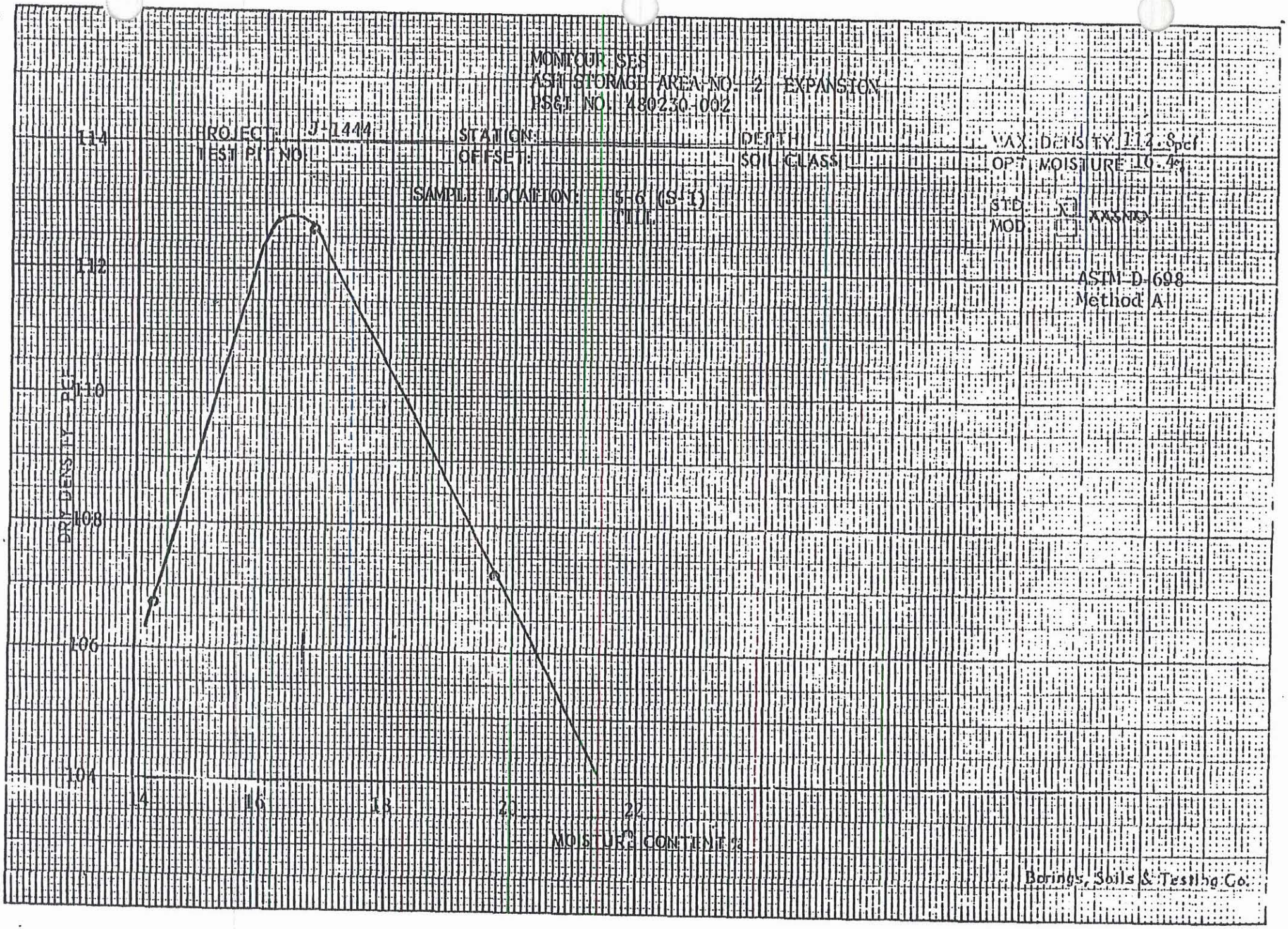
Borings, Soils & Testing Co.

MONTOUR, SES
AST STORAGE AREA NO. 2 EXPANSION
PS&T NO. 480230-002

PROJECT J-1444 STATION:
TEST PIT NO. OFFSET:
SAMPLE LOCATION: S-6 (S-1) DEPTH
TILL SOIL CLASS

MAX. DENSITY 112.5 pcf
OPT. MOISTURE 10.4%
STD. X ASSHTO
MOD.

ASTM D-698
Method A



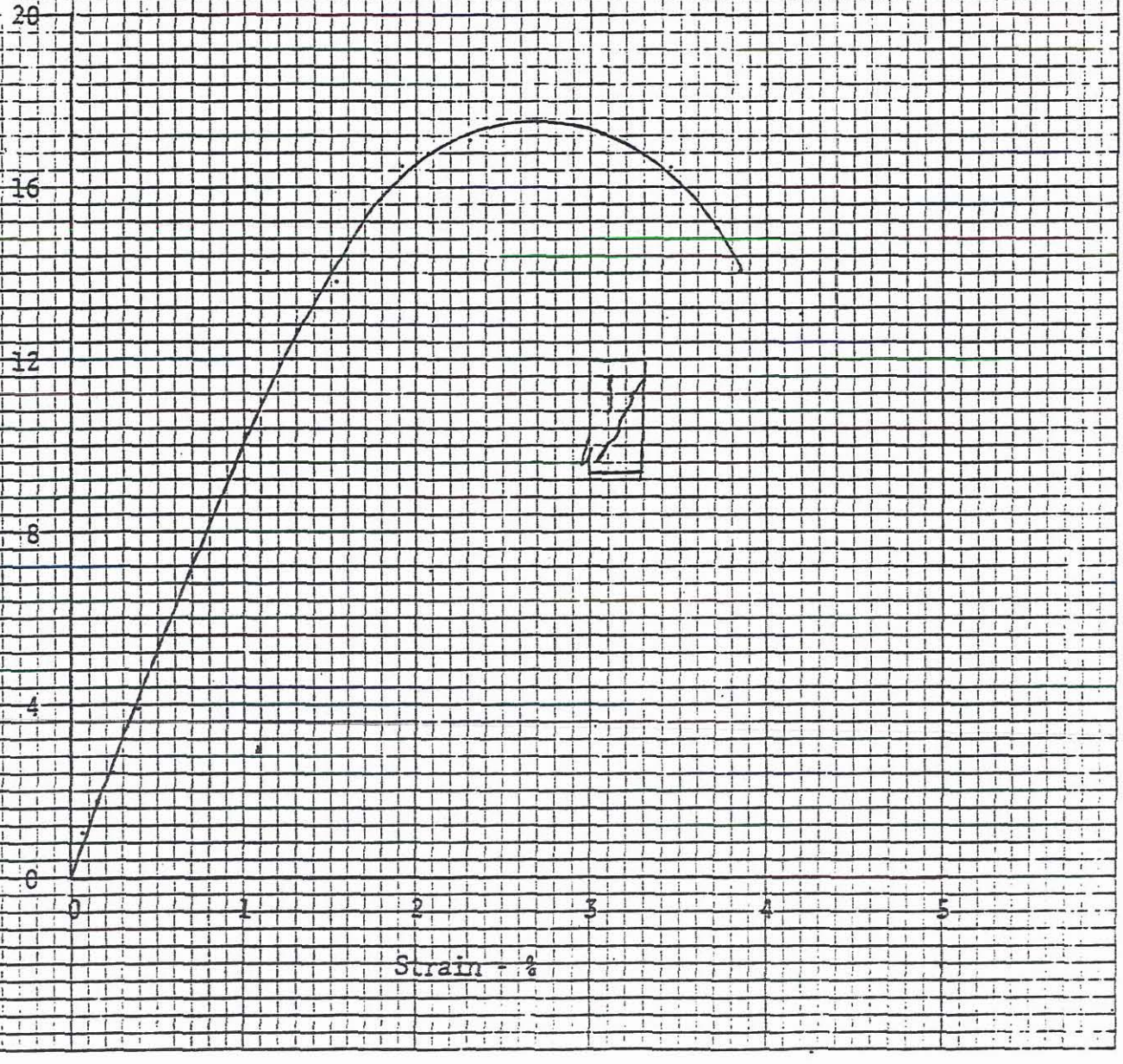
Borings, Soils & Testing Co.

J-1444

MONTOUR SES
ASH STORAGE AREA NO. 2 EXPANSION

Shelby Tube Sample: 5-6-E
Depth: 1.5'-2.5'

Sample Height:	6.5"
Sample Diameter:	2.87"
Wet Density:	125.6 pcf
Moisture Content:	13.6%
Dry Density:	110.5 pcf

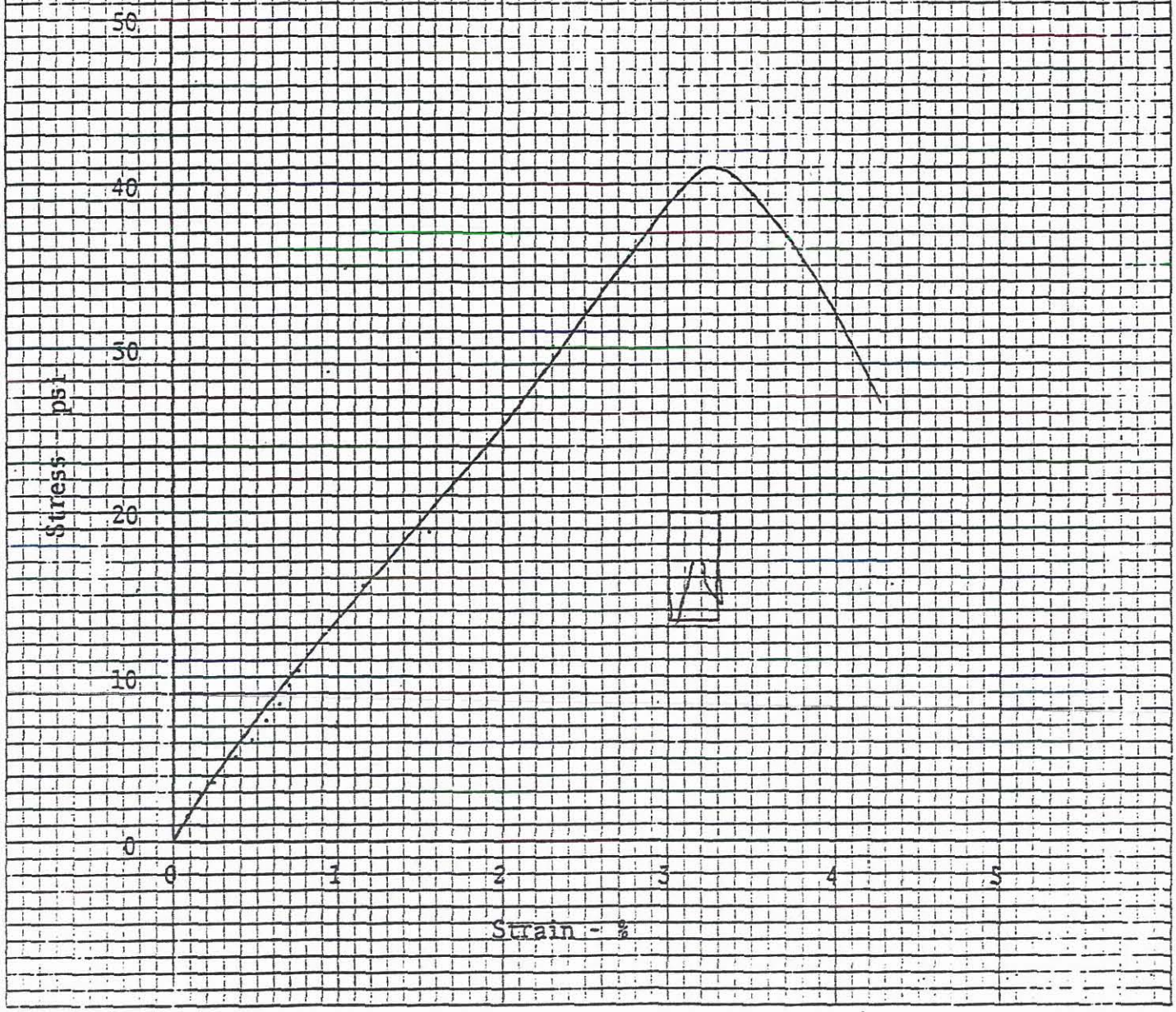


J-1444

MONTOUR-SES
ASH STORAGE AREA NO. 2 EXPANSION
PS&I NO. 480230-002

Shelby Tube Sample: S-6-D
Depth: 0.5'-2.5'

Sample Height:	6.5"
Sample Diameter:	2.87"
Wet Density:	119.4 pcf
Moisture Content:	16.4%
Dry Density:	102.7 pcf

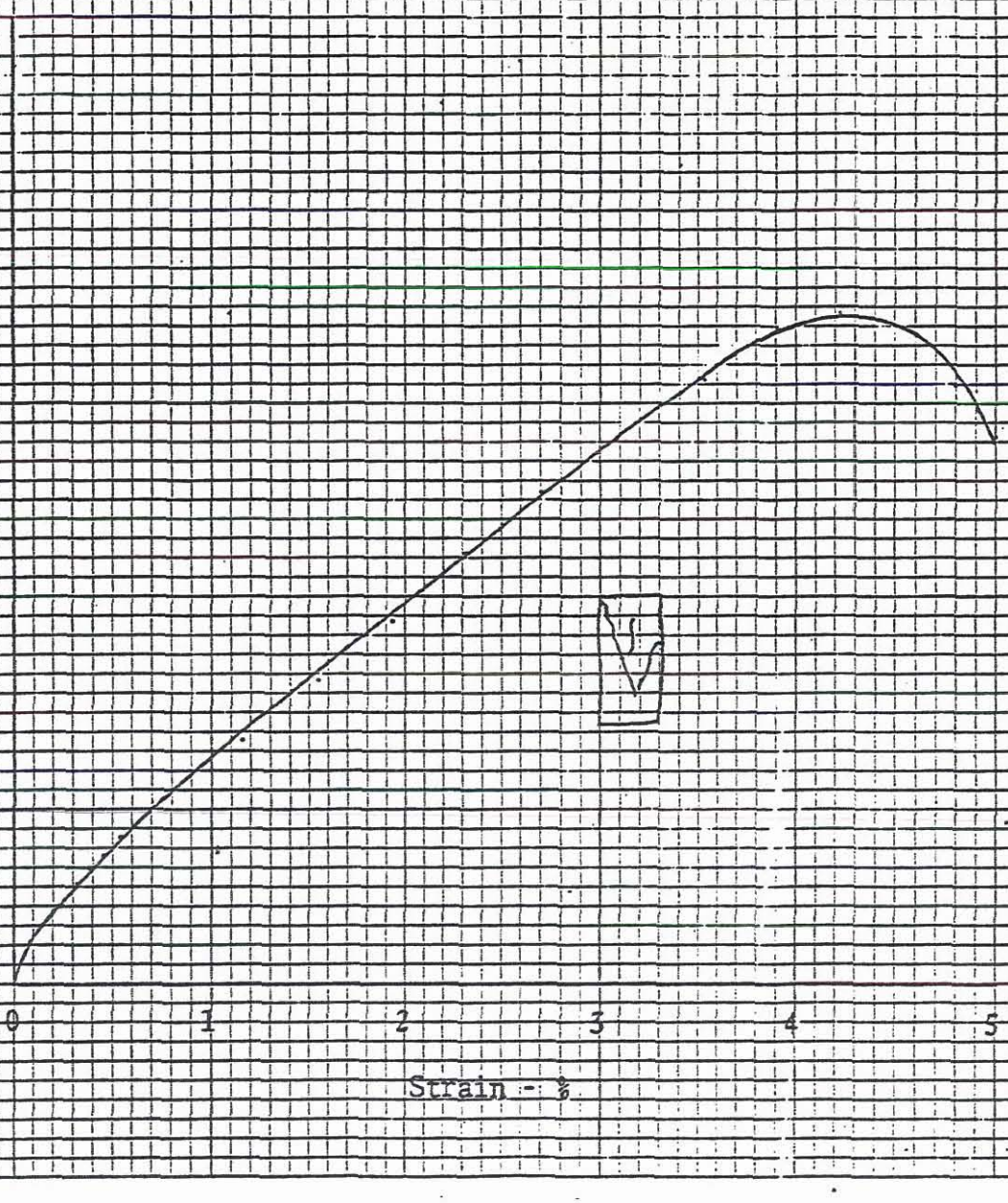


J-1444

MONTOUR SES
ASH STORAGE AREA NO. 2 EXPANSION
PS&I NO. 480230-002

Shelby Tube Sample: S-6-C
Depth: 1.0'-2.0'

Sample Height: 6.5"
Sample Diameter: 2.87"
Wet Density: 110.4 pcf
Moisture Content: 33.2%
Dry Density: 82.9 pcf

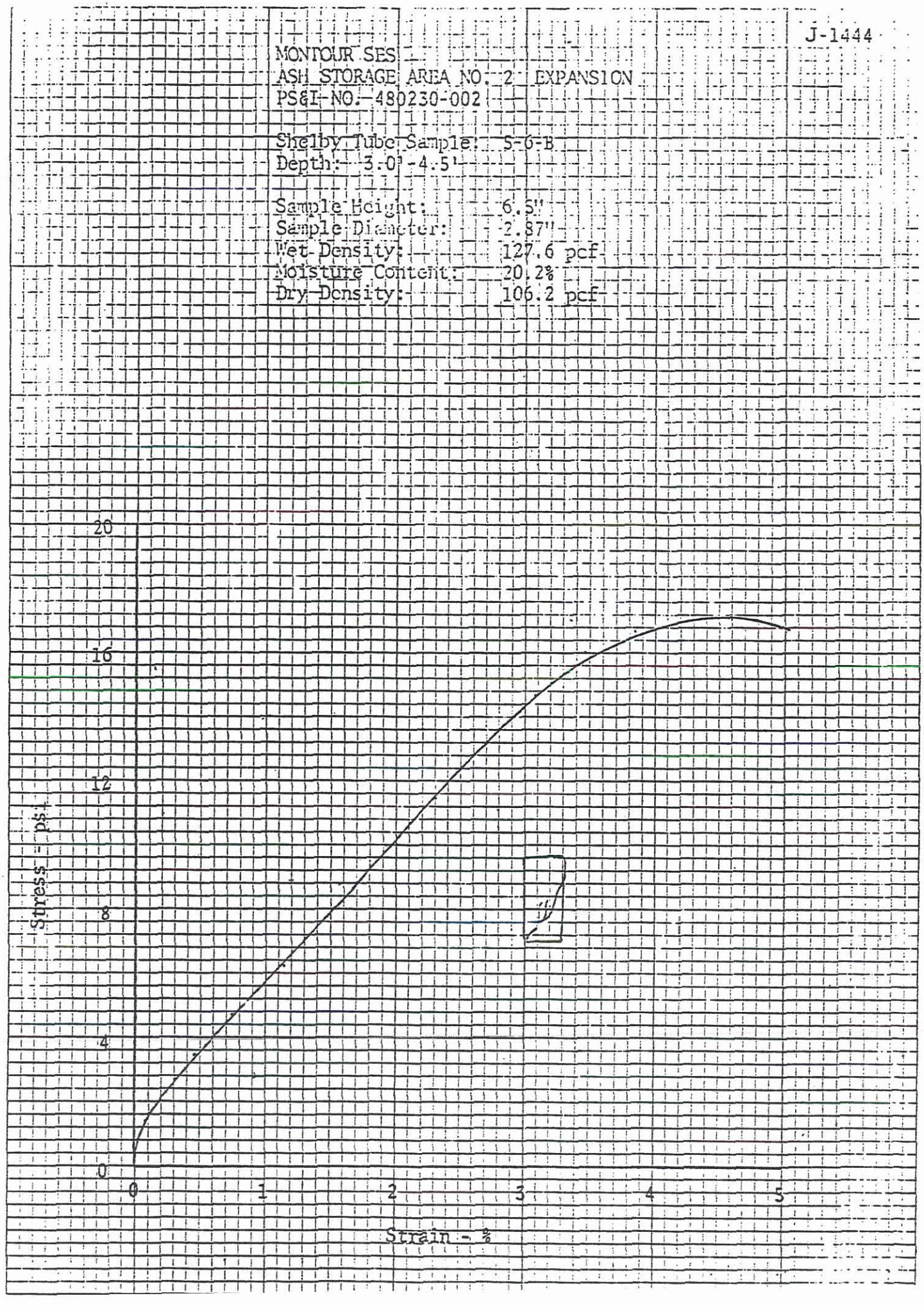


J-1444

MONTOUR SES
ASH STORAGE AREA NO. 2 EXPANSION
PS&I NO. 480230-002

Shelby Tube Sample: S-6-B
Depth: 3.0' - 4.5'

Sample Height:	6.5"
Sample Diameter:	2.87"
Wet Density:	127.6 pcf
Moisture Content:	20.2%
Dry Density:	106.2 pcf

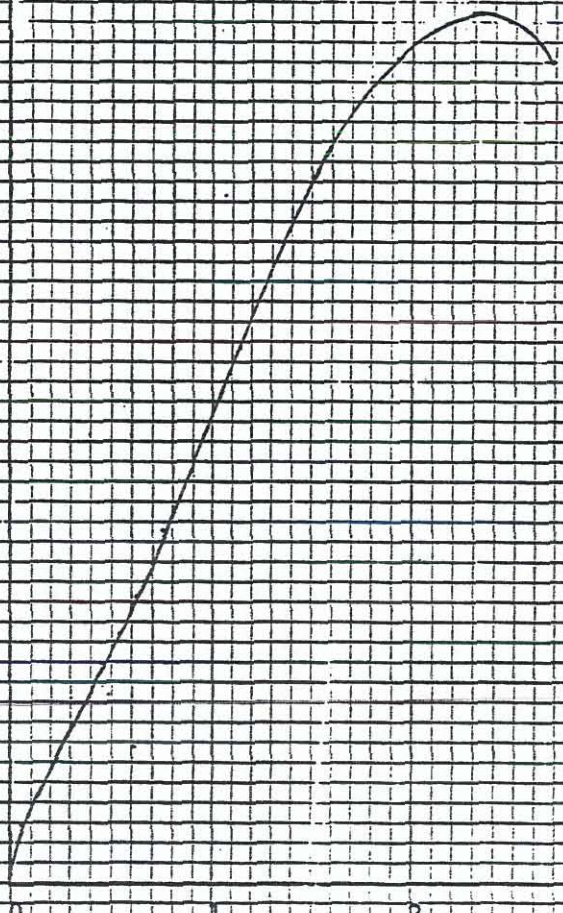


J-1444

MONTOUR SES
ASH STORAGE AREA NO. 2 EXPANSION
PS&I NO. 480230-002

Shelby Tube Sample: 5-6-B5-1A
Depth: 1.5'-3.0'

Sample Height:	6.5"
Sample Diameter:	2.87"
Wet Density:	104.7 pcf
Moisture Content:	22.8%
Dry Density:	85.3 pcf



40 U/U3

KEUFFEL & ESSER CO. MADE IN U.S.A.

Sheet No. 1 of 1

Date 9/27/83

--- REPORT OF WATER PRESSURE TESTING IN CORE DRILL HOLES

Dam Site: _____ River: _____ Hole No. 5-6-B1 Rig No. 34

Location of hole Fly Ash Basin No. 2

Contractor B.S.&T. Driller B.Bender Elev. top of Hole _____

Type of Pump Beam No. of Pump 12 No. of meter _____

PART I — DATA ON FLOW TEST

Section of whole tested				Pressure Gage lbs/sq. in.	Time Started	Time Stopped	Time minutes	Water meter readings			
Depth		Elevation						At start of test	At end of test	Total gals. water used	Gals. per min.
From	To	From	To								
10.0'	20.5'			20 psi	1:22	1:23	1	691.0	692.4		
10.0'	20.5'			20 psi	1:23	1:24	1	692.4	693.9		
10.0'	20.5'			20 psi	1:24	1:25	1	693.9	695.3		
10.0'	20.5'			20 psi	1:25	1:26	1	695.3	696.7		
10.0'	20.5'			20 psi	1:26	1:27	1	696.7	698.1		
10.0'	20.5'			25 psi	1:27	1:28	1	699.0	700.4		
10.0'	20.5'			25 psi	1:28	1:29	1	700.4	701.8		
10.0'	20.5'			25 psi	1:29	1:30	1	701.8	703.2		
10.0'	20.5'			25 psi	1:30	1:31	1	703.2	704.5		
10.0'	20.5'			25 psi	1:31	1:32	1	704.5	706.0		

PART II — HOLDING TEST - MAXIMUM PRESSURE 50 p.s i.

Data on Pressure Section of Hole Tested				Time on each 10 lb. Drop — Gage pressure at test intervals from				
Depth		Elevation		50-40 lb.	40-30 lb.	30-20 lb.	20-10 lb.	10-0 lb.
From	To	From	To	(or higher pressures if necessary)				

Description of Operations and general information:

Elev. Top Rock

Bottom Hole

Borings, Soils and Testing Company
Test Boring Report

Weather _____

Date 9/27/83 PA Power & Light Co. Sheet 1 of 1

Boring Location Area 56, Montour Plant

Project No.	J-1444
Boring No.	56-B-2
Ftg. Soil	8.9'
Ftg. Rock	10.1'
Driller	W.F.Lucas,Jr.

Spoon O.D.	2"		
Hammer	140#	Fall	30
Casing Dia.	4"		
Hammer	300#	Fall	18
Core Size	NX	Bit No.	

Ground Elev.	
Depth Ground Water	
Elev. Ground Water	
Depth Sound Rock	
Elev. Sound Rock	

lev.	Depth	Blows Casing	Blows Spoon	Sample / Run No.	Rock Rec.	Rock Lost	Description of Materials & Remarks
	0-1		4-7	S-1			0.0' to 1.0' TOPSOIL
	1-2		7-20	0.5'-2.0'			1.0' to 8.9' Dark Brown & Black Weathered SHALE
	2-3		31-33	S-2			Stiff-Moist
	3-4		24-24	2.5'-4.0'			(Wet near surface of rock)
	4-5		22-22	S-3			
	5-6		18-15	4.5'-6.0'			
	6-7		14-32	S-4			REFUSAL at 8.9' Started to Core 8.9'
	7-8		45-40	6.5'-8.0'			
	8-9		51-60	S-5			8.9' to 11.5' Black SHALE, Badly Broken, Soft
	9-10			8.0'-8.9'			(Poor Recovery)
	10-11						
	11-12			Run-1	3.1'	2.0'	11.5' to 19.0' Black SHALE, Slightly Fractured-
	12-13			8.9'-14.0'			Hard
	13-14			Run-2	4.9'	0.1'	
	14-15			14.0'-19	0'		
	15-16						
	16-17						
	17-18						
	18-19						
	19-20						End of Boring 19.0'
	20-21						
	21-22						GWL at Completion 6.0'
	22-23						Completed 9/27/83
	23-24						
	24-25						
	25-26						
	26-27						
	27-28						
	28-29						
	29-30						
	30-31						
	31-32						
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	39-40						
	40-41						
	41-42						
	42-43						
	43-44						
	44-45						

G.W.L. Depth _____ Time _____ Date _____ Inspector

Borings, Soils and Testing Company
Test Boring Report

Weather _____

Date 9/27/83 PA Power & Light Co. Sheet 1 of

Boring Location Area 56, Montour Plant

Project No.	J-1444
Boring No.	56-B-3
Ftg. Soil	6.0'
Ftg. Rock	15.0'
Driller	W.F.Lucas,Jr.

Spoon O.D.	2"	
Hammer	140#	Fall 30
Casing Dia.	4"	
Hammer	300#	Fall 18
Core Size	NX	Bit No.

Ground Elev.	
Depth Ground Water	
Elev. Ground Water	
Depth Sound Rock	
Elev. Sound Rock	

Elev.	Depth	Blows Casing	Blows Spoon	Sample / Run No.	Rock Rec.	Rock Lost	Description of Materials & Remarks
	0-1	10	3-3	S-1			0.0' to 0.5' TOPSOIL
	1-2	9	2-2	0.5'-2.0'			0.5' to 2.5' Gray Silty CLAY, Soft-Moist
	2-3	10	4-4	S-2			2.5' to 6.0' Gray Black Weathered SHALE, Stiff
	3-4	14	7-9	2.5'-4.0'			Moist
	4-5	26	14-15	S-3			
	5-6	59	19-57	4.5'-6.0			REFUSAL at 6.0' Started to Core 6.0'
	6-7						
	7-8			Run-1	4.3'	0.7'	6.0' to 15.5' Black SHALE, Slightly Fractured-
	8-9			6.0'-11.0'			Medium Hard
	9-10						
	10-11			Run-2	4.8'	0.0'	
	11-12			11.0'-15.8'			NOTE: Took permeability at 11.0'
	12-13						
	13-14						
	14-15			Run-3	5.0'	0.2'	
	15-16			15.8'-21.0'			15.5' to 15.8' Gray CLAY-Very Stiff
	16-17						15.8' to 21.0' Dark Gray SHALE-Hard
	17-18						
	18-19						
	19-20						
	20-21						
	21-22						End of Boring 21.0'
	22-23						
	23-24						GWL at Completion 3.0'
	24-25						Completed 9/28/83
	25-26						
	26-27						GWL 9/29/83 2.5'
	27-28						
	28-29						
	29-30						
	30-31						
	31-32						
	32-33						
	33-34						
	34-35						
	35-36						
	36-37						
	37-38						
	38-39						
	39-40						
	40-41						
	41-42						
	42-43						
	43-44						
	44-45						

G.W.L. Depth _____ Time Date Inspector

BORINGS, SOILS & TESTING CO.

PERMEABILITY TEST

Date 9/28/83 Project Location Montour Plant
PA Power & Light Co.

Project No. J-1444

Boring No. B-3 56 Boring Location _____

Ground Elevation _____ Size Casing 4" Size Hole Below Casing 3"

Permeability Test No. 1 Bottom of boring at 11.0'

Casing at 6.0 ' below ground Casing 0.0 ' above ground

Time (Minutes)	Water Level Below Top of Casing
6	2 Liters
6	2 Liters
6	2 Liters

Total water drop 6 Liters in 18 minutes

Total time consumed in test 18 minutes

Remarks _____

Permeability Test No. _____ Bottom of boring at _____'

Casing at _____' below ground Casing _____'above ground

Time (Minutes)	Water Level Below Top of Casing

Total water drop _____ in _____ minutes

Total time consumed in test _____ minutes

Remarks _____

By: _____

Borings, Soils and Testing Services

Test Boring Report

Weather _____

Date 9/27/83 | PA Power & Light Co. | Sheet 1 of 1

Boring Location Ash Storage Area No. 2 (Area 5-6) Montour Plant

Project No.	J-1444
Boring No.	5-6-B-4
Ftg. Soil	5.5'
Ftg. Rock	20.0'
Driller	B.Bender

Spoon O.D.	2"		
Hammer	140#	Fall	30
Casing Dia.	4"		
Hammer	300#	Fall	18
Core Size	NX	Bit No.	

Ground Elev.	
Depth Ground Water	
Elev. Ground Water	
Depth Sound Rock	
Elev. Sound Rock	

Elev.	Depth	Blows Casing	Blows Spoon	Sample / Run No.	Rock Rec.	Rock Lost	Description of Materials & Remarks
	0-1		2-5	S-1	1.5'	0.5'	0.0' to 3.0' Light Gray & Brown Silty CLAY wi
	1-2		7-9	0.0'-2.0			Trace of ROCK Fragments-Medium Stiff
	2-3		5-8	S-2	1.5'	0.5'	
	3-4		8-12	2.0'-4.0			3.0' to 5.5' Light Brown & Gray Black Weathere
	4-5		12-13	S-3	1.0'	0.5'	SHALE with Trace of CLAY Seams-Medium Stiff
	5-6		50/.5	4.0'-5.5			
	6-7						REFUSAL at 5.5' Started to Core 5.5'
	7-8			Run-1	4.3'	0.7'	
	8-9			5.5'-10.5'			5.5' to 25.5' Black SHALE, Badly Broken-Medium
	9-10						Hard (Gray CLAY Seams 20.7' to 21.5')
	10-11			Run-2	4.1'	0.9'	
	11-12			10.5'-15.5'			
	12-13						
	13-14						
	14-15			Run-3	4.4'	0.6'	
	15-16			15.5'-20.5'			NOTE: Took permeability test at 15.5'
	16-17						
	17-18						
	18-19						
	19-20			Run-4	4.8'	0.2'	
	20-21			20.5'-25.5'			
	21-22						
	22-23						
	23-24						
	24-25						
	25-26						End of Boring 25.5'
	26-27						
	27-28						GWL at Completion 2.1'
	28-29						Completed 9/28/83
	29-30						
	30-31						GWL 9/29/83 3.5'
	31-32						
	32-33						
	33-34						
	34-35						
	35-36						
	36-37						
	37-38						
	38-39						
	39-40						
	40-41						
	41-42						
	42-43						
	43-44						
	44-45						

G.W.L. Depth _____ Time _____ Date _____ Inspector _____

BORINGS, SOILS & TESTING CO.

PERMEABILITY TEST

Date 9/28/83 Project Location Montour Plant
PA Power & Light Co.

Project No. J-1444

Boring No. B-4 5-6 Boring Location _____

Ground Elevation _____ Size Casing 4" Size Hole Below Casing 2-1/2"

Permeability Test No. 1 Bottom of boring at 15.5'

Casing at 5.0' ' below ground Casing 0.0 ' above ground

Time (Minutes)	Water Level Below Top of Casing
5	1 cubic foot
5	1 cubic foot

Total water drop 2c.f. in 10 minutes

Total time consumed in test 15 minutes

Remarks _____

Permeability Test No. _____ Bottom of boring at _____'

Casing at _____' below ground Casing _____'above ground

Time (Minutes)	Water Level Below Top of Casing

Total water drop _____ in _____ minutes

Total time consumed in test _____ minutes

Remarks _____

By: _____

Borings, Soils and Testing Company
Test Boring Report

Weather _____

Date 9/28/83 PA Power & Light Co. Sheet 1 of 1

Boring Location Area 56, Montour Plant

Project No.	J-1444
Boring No.	56-5
Ftg. Soil	3.5'
Ftg. Rock	10.0'
Driller	W.F.Lucas,Jr.

Spoon O.D.	2"		
Hammer	140#	Fall	30
Casing Dia.	4"		
Hammer	300#	Fall	18
Core Size	NX	Bit No.	

Ground Elev.	
Depth Ground Water	
Elev. Ground Water	
Depth Sound Rock	
Elev. Sound Rock	

Depth	Blows Casing	Blows Spoon	Sample / Run No.	Rock Rec.	Rock Lost	Description of Materials & Remarks
0-1	14	4-7	S-1			0.0' to 1.0' TOPSOIL
1-2	20	10-12	0.5'-2.0'			1.0' to 2.0' Brown Silty CLAY-Moist
2-3	41	10-25	S-2			2.0' to 3.5' Dark Brown & Black Weathered SHALE,
3-4	65/.5	50	2.0'-3.5'			Stiff-Moist
4-5						
5-6			Run-1	4.6'	0.4'	REFUSAL at 3.5' Started to Core 3.5'
6-7			3.5'-8.5'			
7-8			Run-2	4.8'	0.2'	3.5' to 6.0' Gray, Black SHALE, Badly Broken,
8-9			8.5'-13.5'			Some Soft Seams
9-10						6.0' to 13.5' Dark Gray & Black SHALE, Slightly
10-11						Fractured-Medium Hard
11-12						
12-13						
13-14						End of Boring 13.5'
14-15						
15-16						GWL at Completion 3.0'
16-17						Completed 9/28/83
17-18						
18-19						
19-20						
20-21						
21-22						
22-23						
23-24						
24-25						
25-26						
26-27						
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42-43						
43-44						
44-45						

G.W.L. Depth Time Date Inspector

PA Power & Light Co.

Montour Plant
Washingtonville, PA

Summary of Shelby Tube Samples

Boring No.	Depth
56-B5-A	1.5' to 3.0'
56 B	3.0' to 4.5'
56 C	1.0' to 2.0'
56 D	0.5' to 2.5'
56 E	1.5' to 2.5'

Test Boring Report

Weather _____

Date 9/28/83 PA Power & Light Co. Sheet 1 of 1

Boring Location Ash Storage Area No. 2 (Area 56) Montour Plant

Project No.	J-1444
Boring No.	56-OB
Ftg. Soil	6.0'
Ftg. Rock	10.0'
Driller	B.Bender

Spoon O.D.	2"		
Hammer	140#	Fall	30
Casing Dia.	4"		
Hammer	300#	Fall	18

Core Size NX Bit No.

Ground Elev.	
Depth Ground Water	
Elev. Ground Water	
Depth Sound Rock	
Elev. Sound Rock	

Elev.	Depth	Blows Casing	Blows Spoon	Sample / Run No.	Rock Rec.	Rock Lost	Description of Materials & Remarks
	0-1						0.0' to 6.0' Light Brown Silty CLAY with Trace
	1-2						Gray CLAY & ROCK Fragments-Medium Stiff
	2-3						NOTE: Used 6" Auger to make hole.)
	3-4						
	4-5			S-1			
	5-6		14-50	5.0'-6.0			REFUSAL at 6.0' Started to Core 6.0'
	6-7						
	7-8						6.0' to 16.0' Black SHALE, Badly Broken-Medium
	8-9						Hard (Used Tricone)
	9-10						
	10-11						
	11-12						
	12-13						
	13-14						
	14-15						
	15-16						
	16-17						End of Boring 16.0'
	17-18						
	18-19						GWL at Completion 3.1'
	19-20						Completed 9/28/83
	20-21						
	21-22						GWL 9/29/83 6.5'
	22-23						
	23-24						NOTE: This hole was a well point.
	24-25						
	25-26						
	26-27						
	27-28						
	28-29						
	29-30						
	30-31						
	31-32						
	32-33						
	33-34						
	34-35						
	35-36						
	36-37						
	37-38						
	38-39						
	39-40						
	40-41						
	41-42						
	42-43						
	43-44						
	44-45						

G.W.L. Depth Time _____ Date _____ Inspector _____

Borings, Soils and Testing Company
Test Boring Report

Weather _____

Date 9/29/83 PA Power & Light Co. Sheet 1 of 1

Boring Location Ash Basin No. 1, Montour Plant

Project No.	J-1444
Boring No.	2-A
Ftg. Soil	6.0'
Ftg. Rock	10.0'
Driller	B.Bender

Spoon O.D.	2"		
Hammer	140#	Fall	30
Casing Dia.	4"		
Hammer	300#	Fall	18
Core Size	NX	Bit No.	

Ground Elev.	
Depth Ground Water	
Elev. Ground Water	
Depth Sound Rock	
Elev. Sound Rock	

ev.	Depth	Blows Casing	Blows Spoon	Sample / Run No.	Rock Rec.	Rock Lost	Description of Materials & Remarks
	0-1		5-18	S-1	2.0'	0.0'	0.0' to 3.5' Weathered SHALE with Silty SAND &
	1-2		33-15	0.0'-2.0'			ROCK Fragments-Medium Stiff
	2-3		12-12	S-2	1.0'	1.0'	
	3-4		8-10	2.0'-4.0'			3.5' to 5.5' Light Gray Silty CLAY with ROCK
	4-5		10-12	S-3	2.0'	0.0'	Fragments, Medium Stiff
	5-6		13-50	4.0'-6.0'			5.5' to 6.0' Weathered SHALE-Medium Stiff
	6-7						
	7-8			Run-1	2.8'	2.2'	REFUSAL at 6.0' Started to Core 6.0'
	8-9			6.0'-11.0'			
	9-10						6.0' to 7.3' Light Brown & Black Weathered SHAL
	10-11			Run-2	5.0'	0.0'	with Trace of Gray CLAY Seams, Medium Hard
	11-12			11.0'-16.0'			7.3' to 16.0' Black SHALE with Trace of CLAY Se
	12-13						Badly Broken-Medium Hard
	13-14						
	14-15						
	15-16						
	16-17						End of Boring 16.0'
	17-18						
	18-19						GWL at Completion 8.5'
	19-20						Completed 9/29/83
	20-21						
	21-22						
	22-23						
	23-24						
	24-25						
	25-26						
	26-27						
	27-28						
	28-29						
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	42-43						
	43-44						
	44-45						

G.W.L. Depth Time Date _____ Inspector _____

Test Boring Report

Weather _____

Date 9/27/83 PA Power & Light Co. Sheet 1 of 1

Boring Location Ash Storage Area No. 2 (Area 5-6) Montour Plant

Project No.	J-1444
Boring No.	5-6-B-1
Ftg. Soil	10.5'
Ftg. Rock	15.0'
Driller	B.Bender

Spoon O.D.	2"		
Hammer	140#	Fall	30
Casing Dia.	4"		
Hammer	300#	Fall	18
Core Size	NX	Bit No.	

Ground Elev.	
Depth Ground Water	
Elev. Ground Water	
Depth Sound Rock	
Elev. Sound Rock	

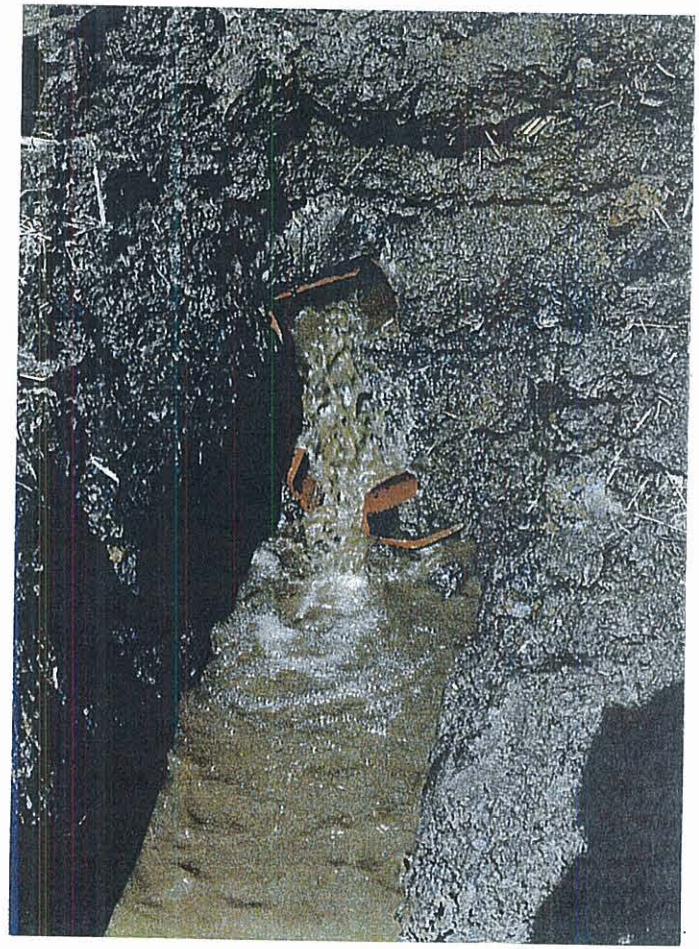
ev.	Depth	Blows Casing	Blows Spoon	Sample / Run No.	Rock Rec.	Rock Lost	Description of Materials & Remarks
	0-1		5-9	S-1	1.5'	0.5'	0.0' to 5.0' Light Brown Silty CLAY with Trace o
	1-2		9-10	0.0'-2.0			ROCK Fragments, Medium Stiff-Damp
	2-3						
	3-4						
	4-5			S-2	1.3'	0.7'	
	5-6		12-12	5.0'-7.0			5.0' to 10.5' Black, Brown Weathered SHALE with
	6-7		20-30				Trace of Soft Seams of CLAY, Medium Stiff-Wet
	7-8						
	8-9						REFUSAL at 10.5' Started to Core 10.5'
	9-10			S-3	0.5'	0.0'	
	10-11		50/.5	10.0'-10.	5'		10.5' to 25.5' Black SHALE, Badly Broken & Weatl
	11-12						Medium Hard
	12-13			Run-1	1.9'	3.1'	
	13-14			10.5'-15.	5'		
	14-15			Run-2	4.8'	0.2'	
	15-16			15.5'-20.	5'		
	16-17						
	17-18						
	18-19						
	19-20			Run-3	4.7'	0.3'	
	20-21			20.5'-25.	5'		
	21-22						
	22-23						
	23-24						
	24-25						
	25-26						End of Boring 25.5'
	26-27						
	27-28						GWL at Completion 5.9'
	28-29						Completed 9/27/83
	29-30						
	30-31						GWL 9/28/83 5.7'
	31-32						
	32-33						
	33-34						
	34-35						
	35-36						
	36-37						
	37-38						
	38-39						
	39-40						
	40-41						
	41-42						
	42-43						
	43-44						
	44-45						

G.W.L. Depth _____ Time _____ Date _____ Inspector _____

APPENDIX E

TEST PIT PHOTOGRAPHS

1) Test Pit 56-2

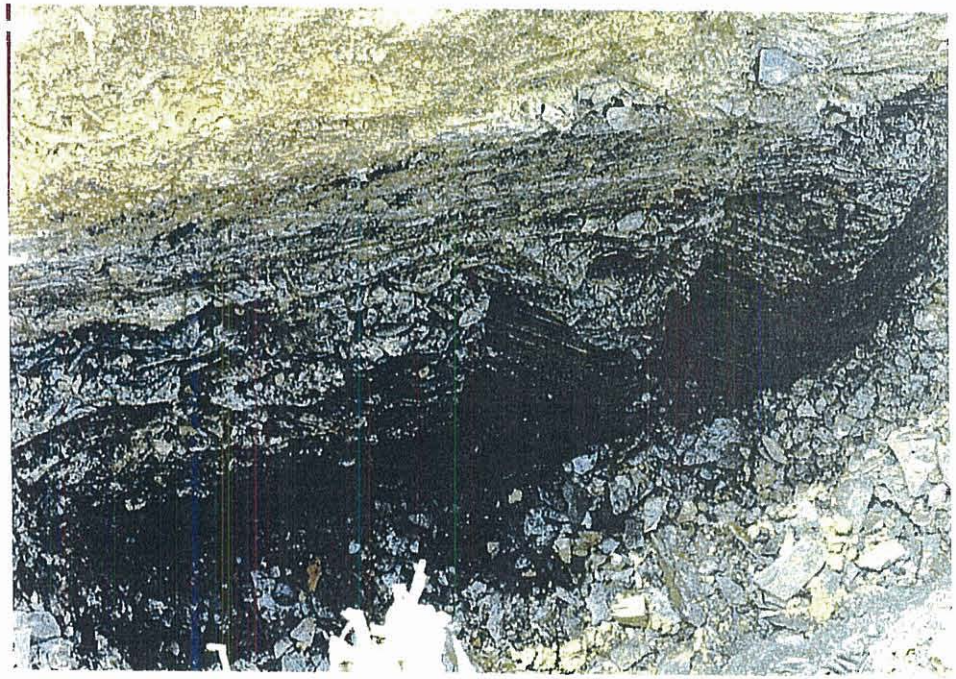


2) Test Pit 56-6

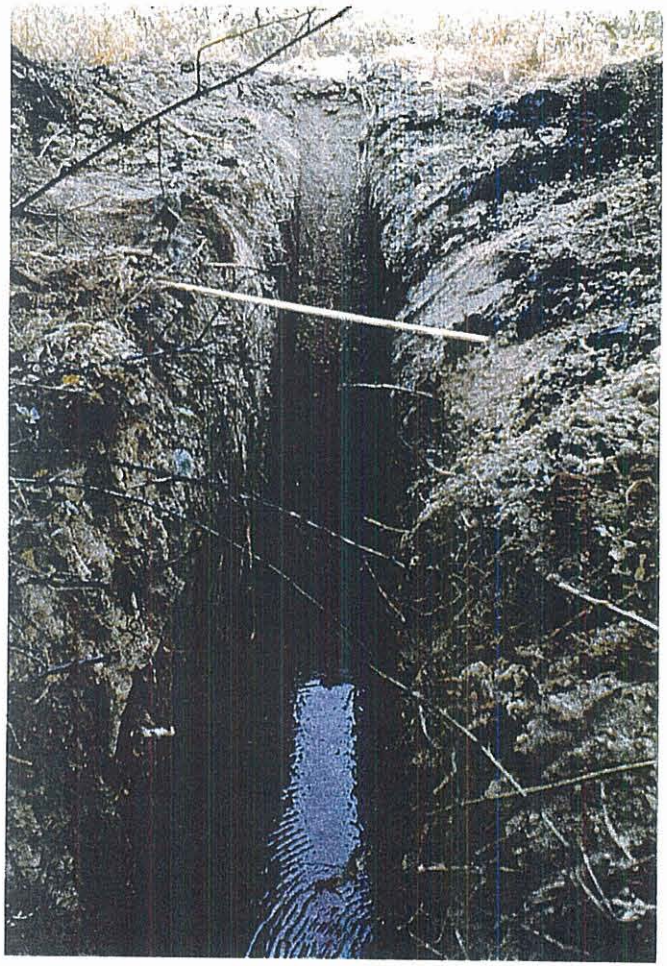
3) Test Pit 56-10

4) Test Pit 56-13

5) Test Pit 56-14

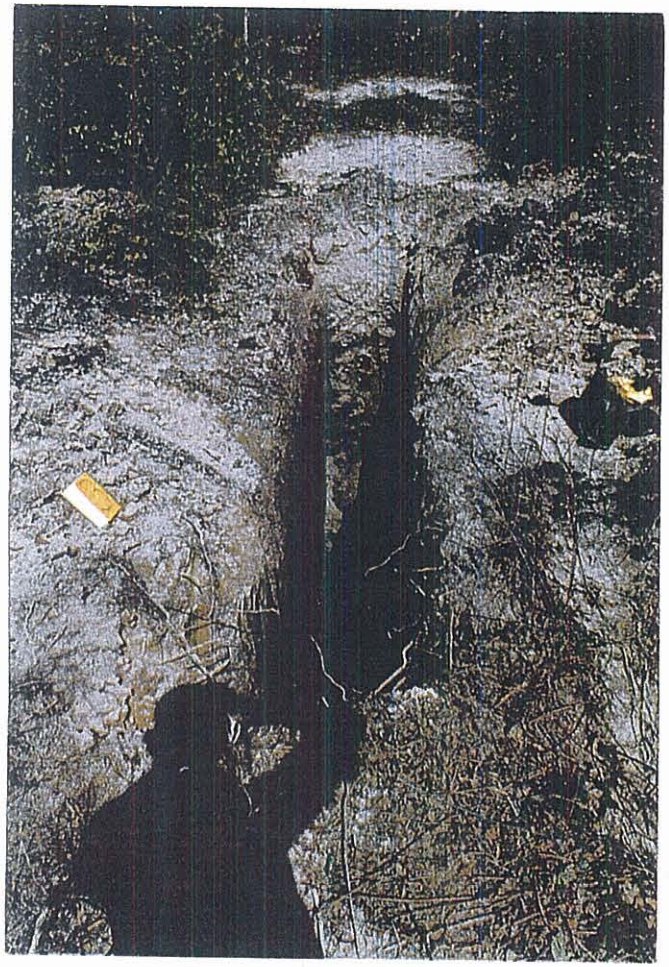


6) Test Pit 56-15



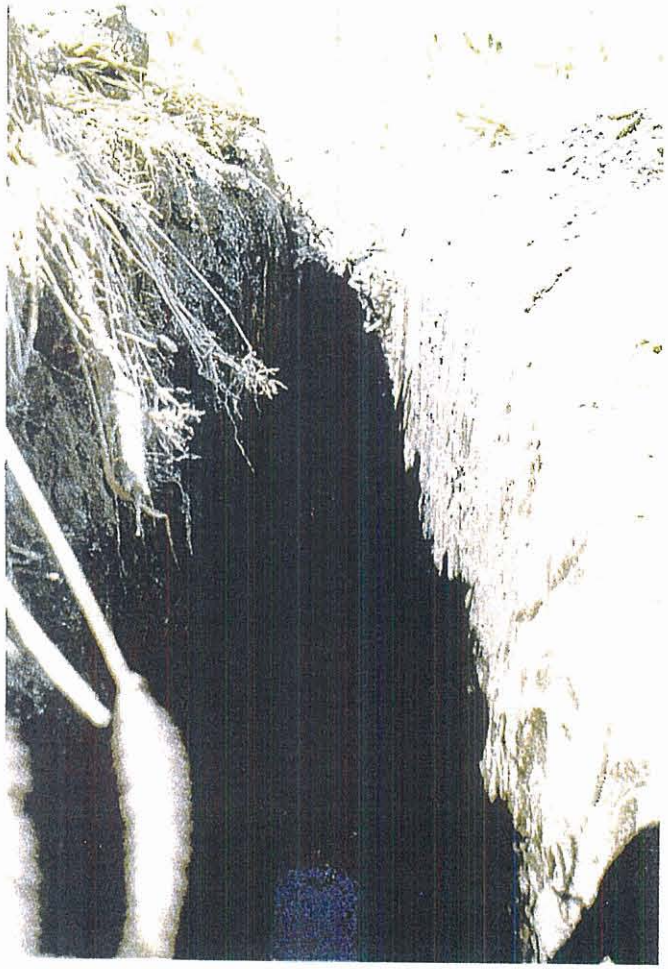
7) Test Pit 56-1A

8) Test Pit 56-2A



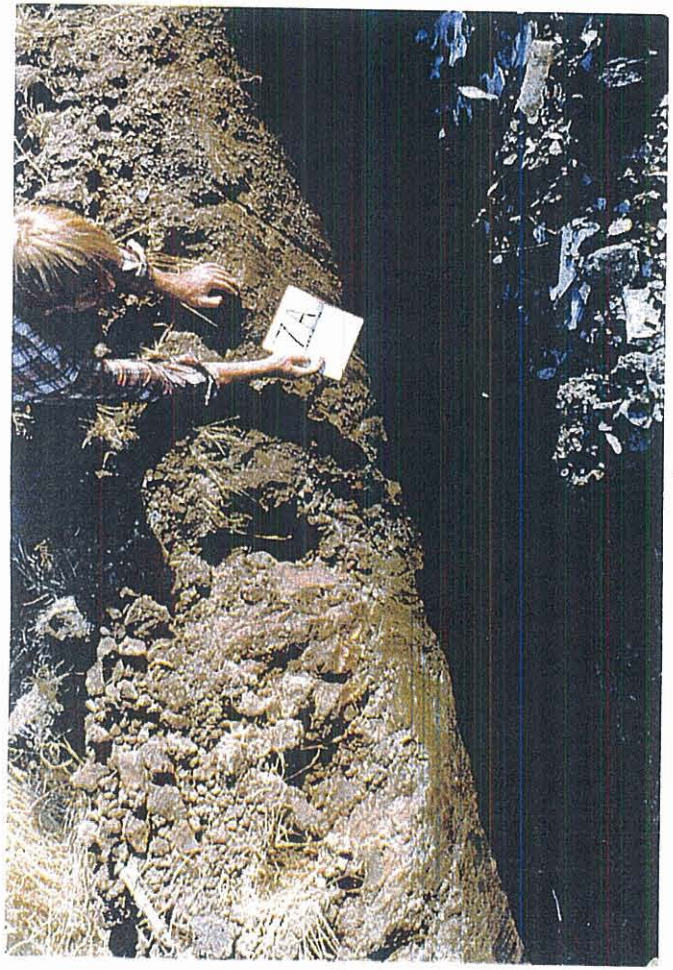
9) Test Pit 56-3A

10) Test Pit 56-4A



11) Test Pit 56-5A

12) Test Pit 56-6A

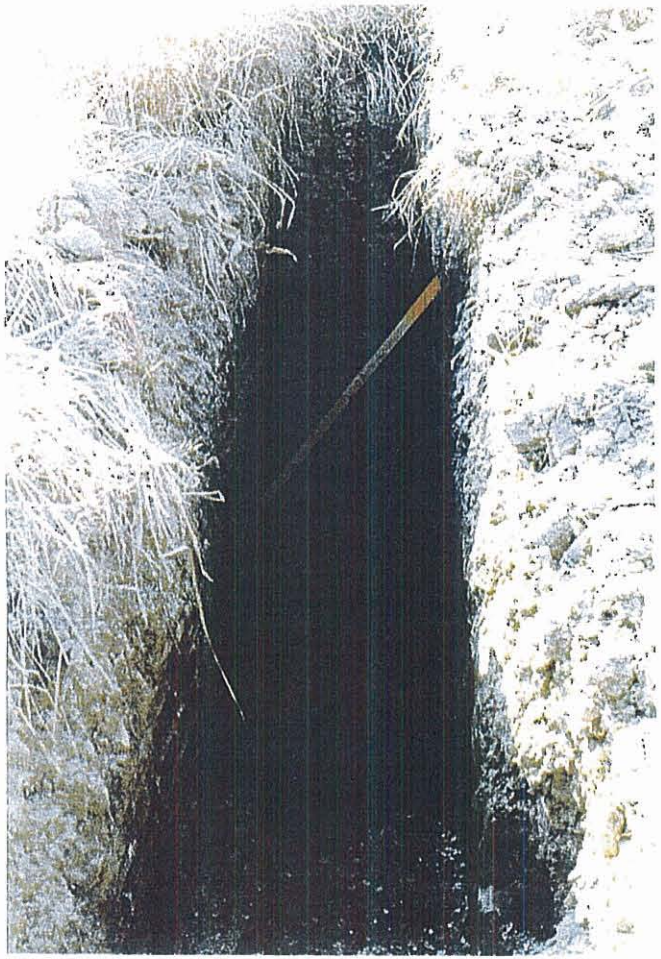


13) Test Pit 56-7A

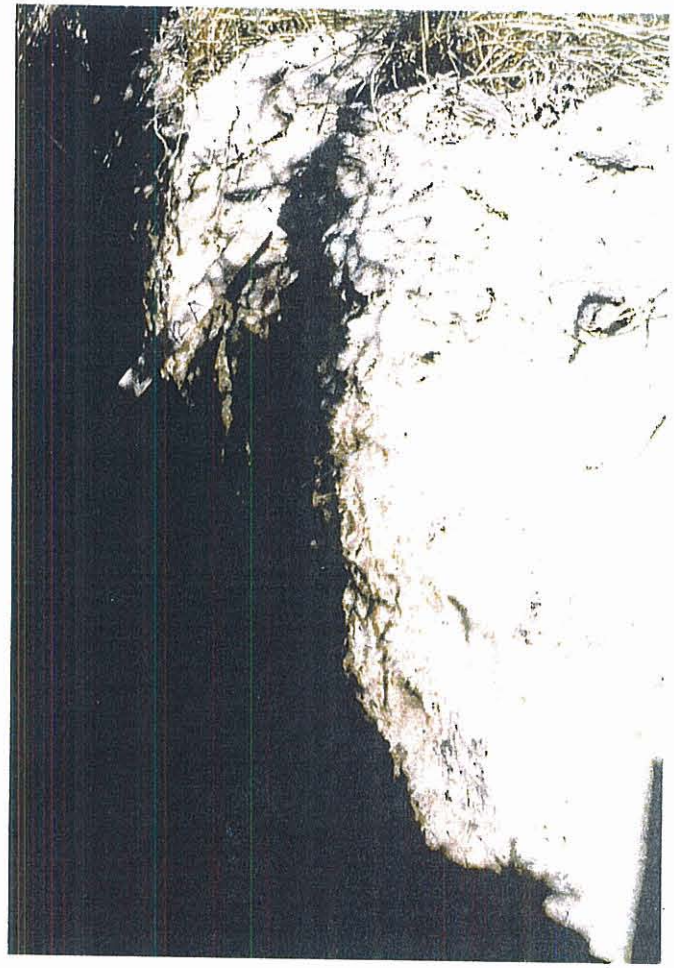
14) Test Pit 56-8A

15) Test Pit 56-9A

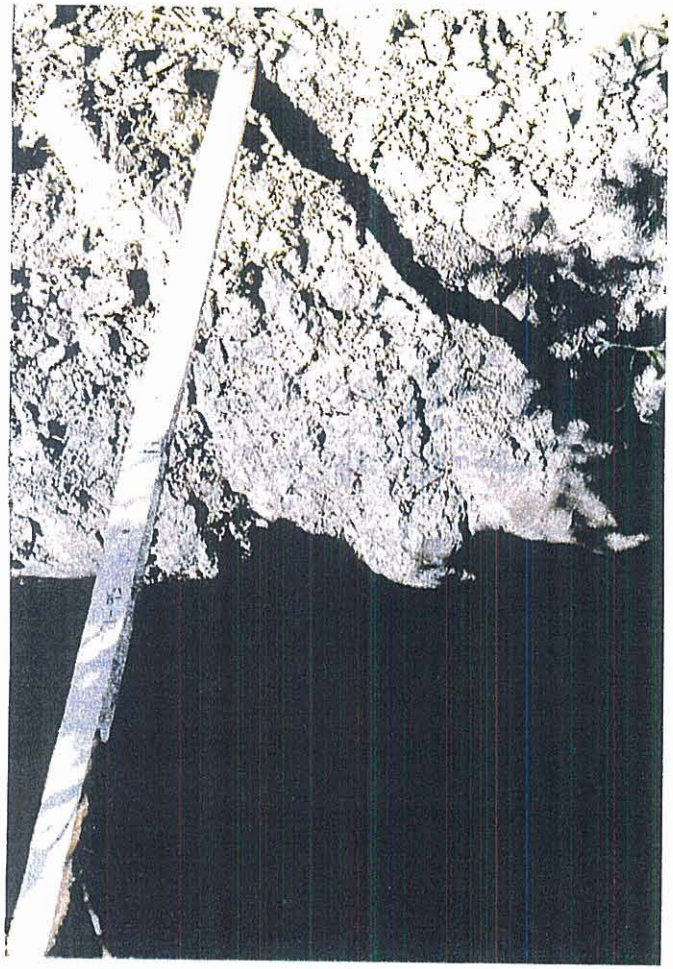
16) Test Pit 56-10A



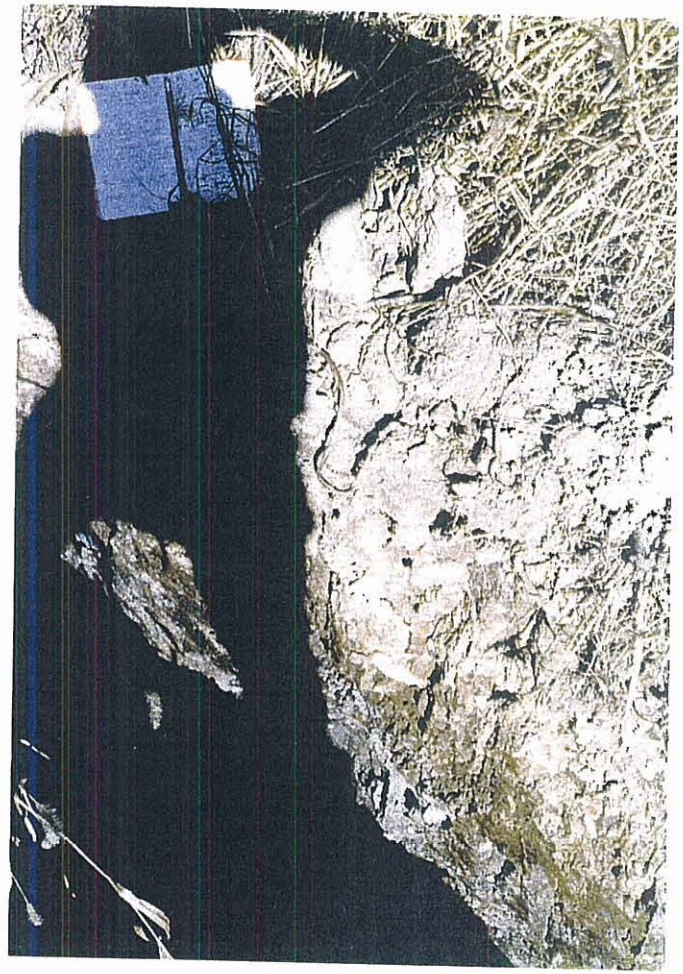
17) Test Pit 56-11A



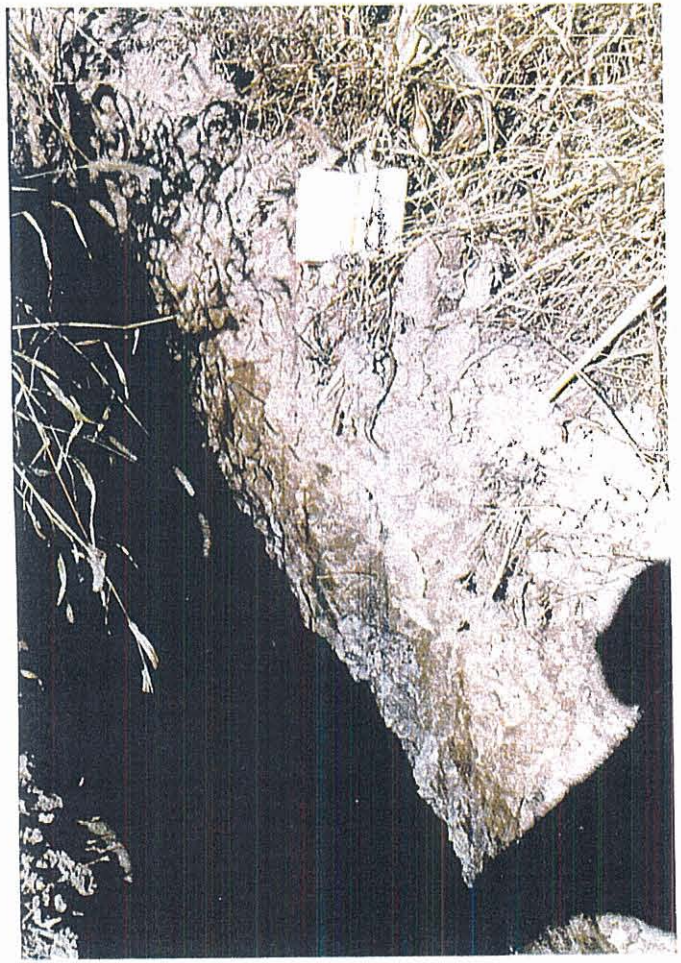
18) Test Pit 56-12A



19) Test Pit 56-13A

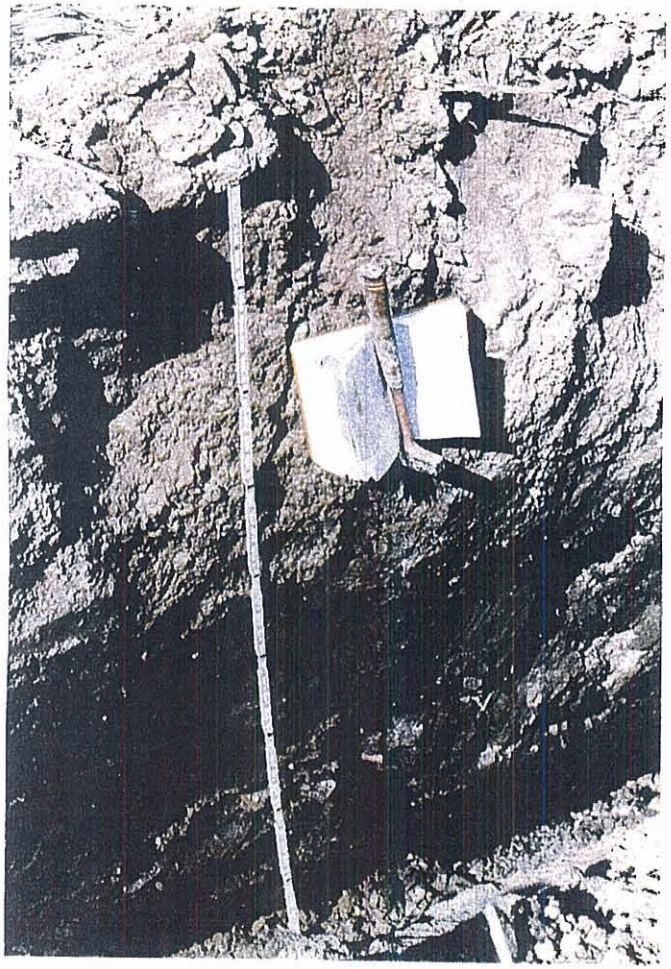


20) Test Pit 56-14A

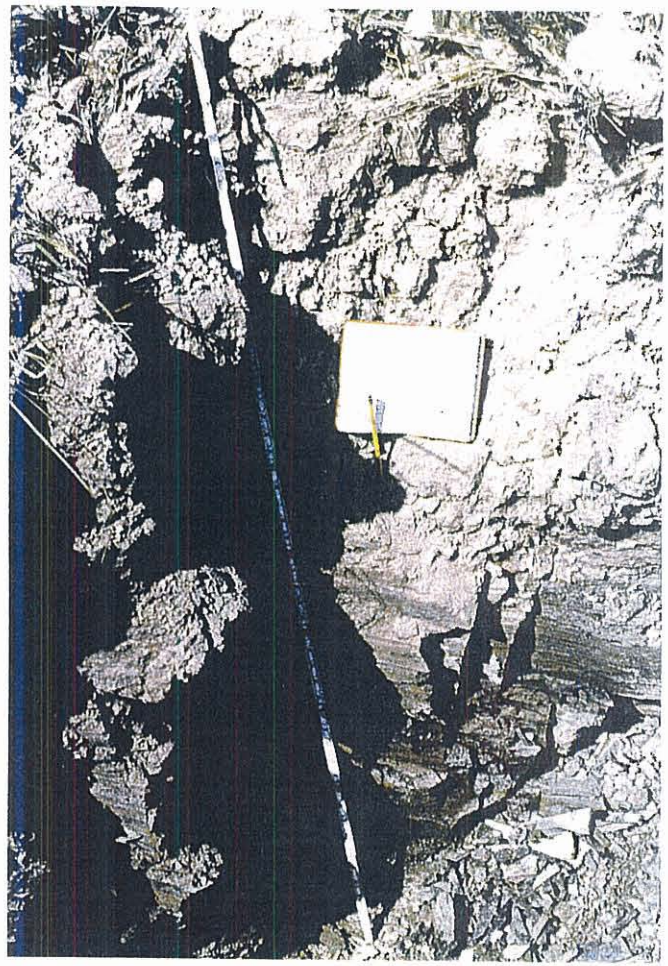


21) Test Pit 56-15A

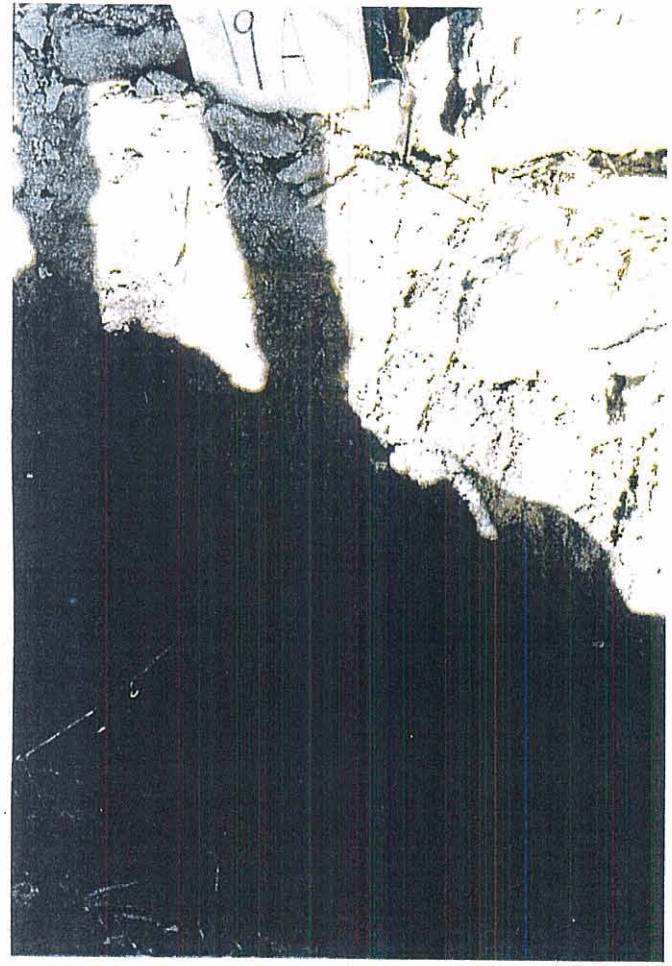
22) Test Pit 56-16A



23) Test Pit 56-17A

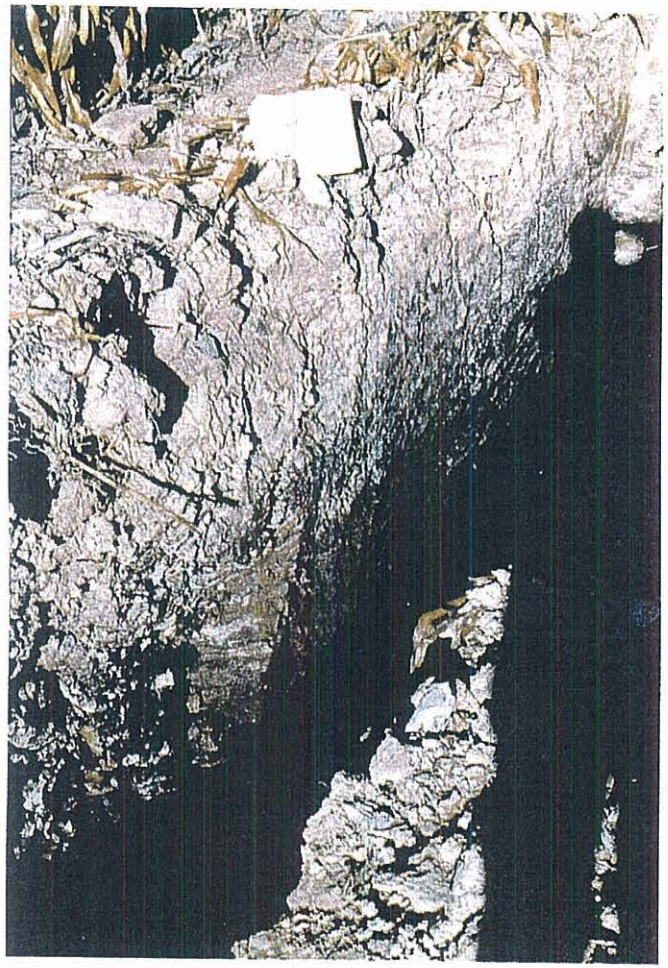


24) Test Pit 56-18A



25) Test Pit 56-19A

26) Test Pit 56-20A



27) Test Pit 56-21A

APPENDIX F

MARCH 1982 REPORT ON MONTOUR FRACTURE TRACE AND LINEAMENT ANALYSIS

TRC Environmental Consultants, Inc.

800 Connecticut Boulevard
East Hartford, Connecticut 06108
(203) 289-8631

March 3, 1982

Mr. James Villaume
Environmental Management Section
Pennsylvania Power & Light Company
Two North Ninth Street
Allentown, PA 18101

RE: TRC Project No. 1491-N60-31

Dear Mr. Villaume:

Fracture Trace and Lineament Analysis
of the Area Surrounding the PP&L
Montour Power Station; Montour, PA

INTRODUCTION

A regional fracture trace and lineament map was constructed of an area approximately 225 square miles around the Pennsylvania Power & Light Montour Power Station. This map was constructed in order to observe if any regional trends in fracture trace and lineaments exist in the area. Fracture traces and lineaments normally reflect underlying zones of joint and fracture concentrations in the underlying bedrock. Better knowledge of directional trends in joints and fractures will enhance the understanding of the bedrock hydrogeology. For the purposes of this analysis, a fracture trace is defined as a natural linear feature less than one mile long. A lineament is defined as a similar linear feature greater than one mile long. (Lattman & Nickelson, 1958)

PROCEDURE

A NASA aircraft false color infared photograph in 1:128,000 scale was examined using stereo viewing methods to locate fracture traces and lineaments. These surface features were than transposed to a sheet of tracing paper for analysis. (Figure 1)

All lineaments from the photograph were plotted. Only the more obvious fracture traces were plotted, except for an area eight miles in diameter around the Montour Station Power plant. This area was analyzed in detail in order to locate all lineaments and fracture traces. Care was taken as

not to confuse the minor fracture traces with cultural features such as fence lines, roads and discontinuities in plowing patterns. The fracture traces were not field checked and interpretation of a cultural feature as a fracture trace may be probable. Conversely, the masking of a fracture trace by a cultural feature is also just as probable.

Aerial photographs in 1:7200 scale of the immediate Montour plant flyash disposal area were also available for fracture trace analysis. After finding a suspected fracture trace on the NASA photographs, the feature was checked against the larger scale photograph. A few suspected fracture traces were visible on the larger scale aerial photography that were not visible in the NASA photographs. It was more difficult to distinguish these minor fracture traces from the cultural features on the larger scale photos, especially with the extensive agricultural activity in the area. It should be noted that a greater concentration of minor fracture traces in the flyash disposal area is simply due to the greater resolution of the photographs available for analysis in this area.

FRACTURE TRACE AND LINEAMENT ANALYSIS

In the review of the fracture trace and lineament map, a few major and minor directional trends can be noticed. The major lineaments such as those formed by the dominant mountain ridges all show a distinct directional trend of northeast to southwest; in fact, nearly all the lineaments show the same directional trend. This uniformity of lineament directional trends is easily explained by the structural geology of the area.

By examining the fracture traces, it can be seen that the majority of these either are parallel to the major lineaments or are perpendicular to the major lineaments. The northeast-southwest trending fracture traces are simply a reflection of the underlying geology, as explained previously. The majority of the perpendicular fracture traces appear to be in areas of stream incision through various ridges. It is likely that these incisions may have obtained their direction by finding the weakest path of flow through perpendicular jointing in the sedimentary ridges.

CONCLUSION

The lineament and fracture trace directional trends are strongly influenced by the underlying geology of the area. With this information, it can be reasonably assumed that the major regional flow direction due to secondary permeability and porosity is from the southwest to the northeast. It is also possible that another flow component exists that is perpendicular to the flow direction of the lineaments. The porosity and permeability along this flow

compnent would also be of secondary nature, flowing through joints in the bedrock. The length of these flow components would not be expected to be as long as those along the major lineaments, but may be greater in number.

Very truly yours,

TRC ENVIRONMENTAL CONSULTANTS, INC.

Fred Johnson
Assistant Environmental Scientist

Dennis F. Unites, P.G.
Manager - Hazardous Waste
Services

FJ:DFU:jps

Enclosure

TRC

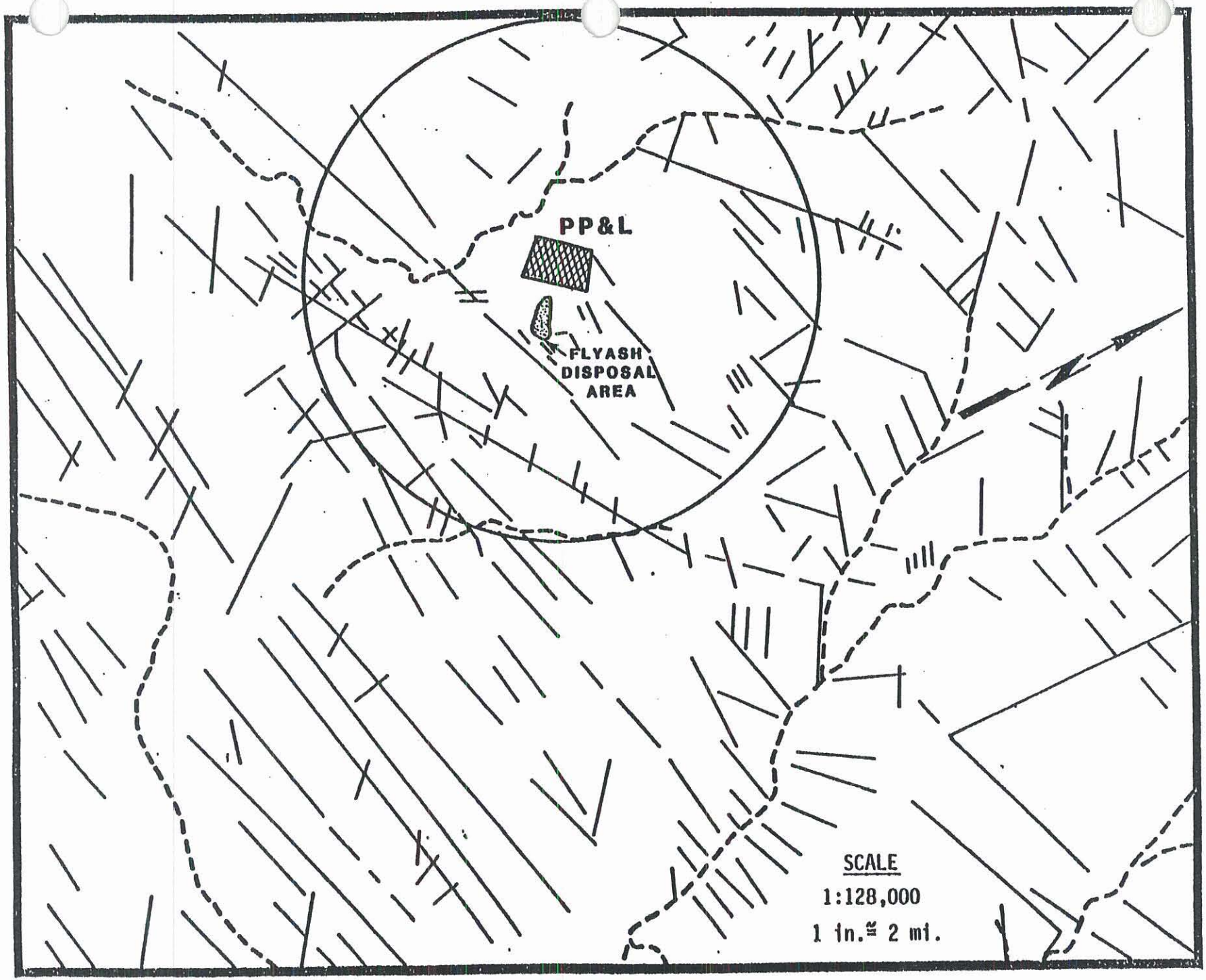


Figure 1. Fracture trace and lineament map for PP&L Montour Station.

APPENDIX C

Subsurface Investigation Logs, Cross-Sections, and Maps

TEST PIT NO. 56-1

TEST PIT COORDINATES: N-878.444, E436.687

TOP OF GROUND ELEVATION: 526.66

TEST PIT DEPTH: 4.5ft.

STABILIZED WATER DEPTH: Dry

SEEPAGE DEPTH: N/A

DATE: 5/19/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - .9	Brown silty top soil, dense, with some cobbles
.9 - 2.25	Light brown clay- silt loam, medium compact.
2.225 - 2.80	Dark brown/black, dense, highly weathered clay till, faint pebble fabric.
2.80 - 3.0	Black saprolite.
3.0 - 4.5	Black. Weathered blocky shale no rusting.
4.5	Refusal in competant shale.
	Joints: N20E

TEST PIT NO. 56-2

TEST PIT COORDINATES: N-657.436, E309.202

TOP OF GROUND ELEVATION: 530.64'

TEST PIT DEPTH: 4.0'

STABILIZED WATER DEPTH: 1.7;

SEEPAGE DEPTH: 2.9' - 4.0'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 1.0	Dark brown black loose clay top-soil.
1.0 - 1.75	Light brown, silt clay loam medium compact.
1.75 - 2.9	Light - dark brown dense, moist, weathered till. Some blocky structure.
2.9 - 4.0	Black, blocky shale, no rusting.
4.0	Refusal.

TEST PIT NO. 56-3

TEST PIT COORDINATES: N-317.631, E356.578

TOP OF GROUND ELEVATION: 536.54'

TEST PIT DEPTH: 7.3'

STABILIZED WATER DEPTH: 6.7'

SEEPAGE DEPTH: N/A

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.9	Light brown, loose silt topsoil.
0.9 - 5.2	Brown, dense, clay till pebbles competent, becoming weathered with depth.
5.2 - 7.3	Saprolite grading to black shale. Shale layer vary between fissile saprolite layers and blocky limey shale.
	Joints: N80°E vertical
	N15°E vertical

TEST PIT NO. 56-4

TEST PIT COORDINATES: N-197.202, E532.842

TOP OF GROUND ELEVATION: 538.74

TEST PIT DEPTH: 5.0'

STABILIZED WATER DEPTH: Dry

SEEPAGE DEPTH: N/A

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.8	Light brown, silt topsoil with shale fragments
0.8 - 5.0	Friable, relatively unweathered Black shale, with clay skins, no saprolite, no rusting.
5.0	Refusal
	Joints: N70°E Dominant N36°W Complement
	Bedding: Dip 20°N

TEST PIT NO. 56-5

TEST PIT COORDINATES: N241.021, E1161.205

TOP OF GROUND ELEVATION: 523.01

TEST PIT DEPTH: 6.0'

STABILIZED WATER DEPTH: 0.5'

SEEPAGE DEPTH: 3.1' - 6.0'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 1.0	Brown/black clayey moist topsoil in clumps.
1.0 - 3.0	Dark brown-gray clay loam with mottles. Sub-blocky structure. Become more mottled at bottom.
3.0 - 3.1	Saprolite.
3.1 - 6.0	Fissile, black shale no rusting.

TEST PIT NO. 56- 6

TEST PIT COORDINATES: N-568.181, E1004.711

TOP OF GROUND ELEVATION: 521.42

TEST PIT DEPTH: 3.8'

STABILIZED WATER DEPTH: 1.0*

SEEPAGE DEPTH:

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - .75	Dark brown, clay, topsoil
.75 - 3.8	Highly weathered dark brown - gray clay till with mottles at top.

* Hit clay tile drainage pipe at approximatly 2 feet. Pit filled with water.

TEST PIT NO. 56-7

TEST PIT COORDINATES: N-486.537, E 1342.940

TOP OF GROUND ELEVATION: 526.31

TEST PIT DEPTH: 6.75'

STABILIZED WATER DEPTH: 2.5'

SEEPAGE DEPTH: 5

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.8	Brown, clay topsoil.
0.8 - 2.9	Light brown/tan silty clay loam becomes gray and heavyly mottled at 1.4'.
2.9 - 4.8	Dark brown, very dense till pebbles competent.
4.8 - 4.9	Saprolite.
4.9 - 6.75	Black, fissile, weathered shale.
6.75	Refusal.
	Joints: N82°W vertical

TEST PIT NO. 56-8

TEST PIT COORDINATES: N-586.429, E1183.128

TOP OF GROUND ELEVATION: 522.41

TEST PIT DEPTH: 6.25'

STABILIZED WATER DEPTH: 0.9'

SEEPAGE DEPTH: 2.4

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 1.0	Brown clay topsoil, clumpy.
1.0 - 1.7	Light brown silty clay loam with orange and gra mottles, grading to solid gray.
1.7 - 2.4	Dark gray, very weathered silt-clay till,shale fragments in clay matrix weathered orange.
2.4 - 2.5	Saprolite.
2.5 - 6.25	Black, fissile, very weathered shale some rusting, some clay skims.
	Joints: N80°E Vertical

TEST PIT NO. 56-9

TEST PIT COORDINATES: N-995.472, E1213.694

TOP OF GROUND ELEVATION: 524.26

TEST PIT DEPTH: 6.4'

STABILIZED WATER DEPTH: 2.9'

SEEPAGE DEPTH: 4.5'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.8	Brown silt topsoil.
0.8 - 2.0	Light brown clay silt loam blocky structure, heavy gray and orange mottles at bottom.
2.0 - 4.0	Dark brown, very dense silt clay till pebbles competent. Many fractures in till filled with clay.
4.0 - 4.5	Saprolite.
4.5 - 6.4	Black, weathered shale some rusting.
	Joints: N70°W , 85°E

TEST PIT NO. 56-10

TEST PIT COORDINATES: N1715.131, E1184.551

TOP OF GROUND ELEVATION: 522.26

TEST PIT DEPTH: 5.5'

STABILIZED WATER DEPTH: 1.5'

SEEPAGE DEPTH: 2.5'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - .75	Brown clay topsoil, clumpy.
.75 - 1.25	Light brown, blocky, silt-clay loam, Heavy orange and gray mottles becoming heavier with depth.
1.25 - 2.3	Dark gray, blocky till.
2.3 - 2.5	Saprolite.
2.5 - 5.5	Weathered, fissile black shale, no rusting.
	Joints: N60°W, vertical

TEST PIT NO. 56-11

TEST PIT COORDINATES: N-1921.603. E702.708

TOP OF GROUND ELEVATION: 517.18

TEST PIT DEPTH: 6.5'

STABILIZED WATER DEPTH: 1.1'

SEEPAGE DEPTH: 4.0'

DATE: 5.18.83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0. - .75	Brown clay-silt topsoil.
.75 - 2.1	Light brown/gray, mottled moist, dense, plastic clay loam.
2.1 - 5.0	Dark Brown, weathered till.
5.0 - 5.4	Saprolite.
5.4 - 6.5	Weathered, fissile black shale,no rusting.

NOTES.

INFORMATION SHOWN IS FROM THE "SUPPLEMENTARY GEOLOGIC AND SOILS INVESTIGATION FOR THE 5-6 ASH STORAGE AREA," TRC ENVIROMENTAL CONSULTANTS, INC. NOVEMBER 29, 1983

TEST PIT & BORING LOCATION SHT. 1 E-196008

REFERENCE TITLE NUMBER

REFERENCE TITLE NUMBER

NO. DATE ER. REVISION BY CH. APPROVED

LOCATION CODES H H 7 0 SORTS C

ER- 750501
SCALE- NONE
DATE-
DRAWN- DM
CHECKED-
SQUAD SUPV-
APPV'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA #3
TEST PIT LOGS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

ENGINEER APPROVAL John A. Stefanik 5/14/84 DATE

PP&L DRAWING NO. D-242632 SHEET NO. 1 REV. 0

TEST PIT NO. 56-12

TEST PIT COORDINATES: N-1506.469, E410.842

TOP OF GROUND ELEVATION: 521.17

TEST PIT DEPTH: 3.5

STABILIZED WATER DEPTH: 2.6

SEEPAGE DEPTH: 2.7

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0. - 0.7	Brown topsoil.
0.7 - 1.5	Dark Brown, slightly blocky clay-silt loam.
1.5 - 3.2	Black/dark brown, very weathered till.
3.2 - 3.5	Massive limey black shale , cracks filled with clay. No rusting.

TEST PIT NO. 56-15

TEST PIT COORDINATES: N-1703, E1740.085

TOP OF GROUND ELEVATION: 531.65

TEST PIT DEPTH: 6.0'

STABILIZED WATER DEPTH: 4.5'

SEEPAGE DEPTH: 4.0'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.6	Brown/light brown silt clay topsoil with shale fragments.
.6 - 1.3	Light brown blocky silt clay loam with shale fragments. Some gray rust mottles.
1.3 - 6.0	Black fissile shale joints well developed. Some have jointed clay seams.

Joints: N82°E Dominant
N10°W Complement
N60°E
Bedding Dip 18°S

Test Pit No: 5-6-3A

Test Pit Coordinates: N-2085.81, E 913.65

Top of Ground Elevation: 518.53

Test Pit Depth: 9.5

Stabilized Water Depth: 4.92'

Seepage Depth: 5.5 (when digging)

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Brown clay-silt top soil
.5-2.0	Light brown, grading to gray. Silt loam, same clay, mottled (heavy in gray zone), blockey, dry.
2.0-3.0	Highly weathered clay till.
3.0-6.0	Moderately weathered, very dense clay till.
6.0-6.1	Thin sapprolite layer, absent in some places.
6.1-9.5	Weathered black shale, slightly rusted.

Rippability: Weathered shale in fissile plates, moderately easy to excavate. Shale becomes competent at 9.5 and is difficult to excavate.

Test Pit No: 56-6A

Test Pit Coordinates: N-1373.57, E 767.68

Top of Ground Elevation: 519.14

Test Pit Depth: 8.5

Stabilized Water Depth: 3.74'

Seepage Depth:

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5'	Light brown clay - silt blocky top soil.
.5-1.5	Light brown silt loam, some clay, blocky, no mottles.
1.5-3.5	Blocks of disoriented weathered shale up into subsoil layers. Shale pieces competent, filled with clays.
3.5-8.5	Black highly weathered shale (almost saprolite) grading to open platy calcified shale with no structure. Transmitts water rapidly. No rusting.

TEST PIT NO. 56-13

TEST PIT COORDINATES: N-1548, E524.702

TOP OF GROUND ELEVATION: 518.09

TEST PIT DEPTH: 3.2'

STABILIZED WATER DEPTH: 0.75'

SEEPAGE DEPTH: 1.9'

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 1.0	Black to dark brown organic rich clay topsoil. (recent alluvium)
1.0 - 1.9	Dark brown highly weathered, saturated till.
1.9 - 3.2	Black, blocky, shale.
3.2	Refusal.

Test Pit No: 5-6 1A

Test Pit Coordinates: N-1978.68, E 1075.46

Top of Ground Elevation: 520.03

Test Pit Depth: 12.5

Stabilized Water Depth: 5.17'

Seepage Depth: 5.17'

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.1	Light brown silt-clay top soil.
.1-1.8	Light brown to tan, silt loam, some clay, blocky, dry, breaks into small (1/2 inch) clumps, slightly mottled.
1.8-5.0	Dark brown, relatively unweathered till, very dense, pebbles competent.
5.0-12.5	Black platy shale, plates 1-4" diameter and competent, some clay skins on plates, water seepage slow in shale.

Rippability: Excavated platey shale from 5.0' to 10.0' in 5 minutes, digging very easy. Dug to reach of hoe (12.5).

Test Pit No: 5-6 4A

Test Pit Coordinates: N-1958.62, E 1216.5

Top of Ground Elevation: 521. 86

Test Pit Depth: 11.5'

Stabilized Water Depth: 5.26'

Seepage Depth: Moist at 5.0'

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Light brown - tan clay - silt top soil blocky dry
.5-1.8	Light brown - tan silt loam some clay, blocky, dry, no mottles.
1.8-3.9	Black weathered shale, platey with competent plates. Dip 13° E-NE; joint strike: N48°E, possible dislocated block of shale.
3.9-11.5'	Highly weathered, almost saprolitic grading to moderately weathered black fissile shale, rusted well defined joints N85°E.

Rippability: Upper more competent block moderately easy to excavate, lower weathered shale very easy to excavate.

Test Pit No: 5-6-7A

Test Pit Coordinates: N-1054.31, E 904.74

Top of Ground Elevation: 520.13

Test Pit Depth: 10.0

Stabilized Water Depth: N/A

Seepage Depth: 1.7" in soil fracture, 5.2' in shale

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Brown clay - silt top soil
.5-1.25	Dark brown silt loam, some clay, blocky.
1.25-2.5	Gray highly mottled clay loam very dense, dry. water seep through soil fracture.
2.5-5.3	Black-gray-dark brown very dense moderately weathered clay till.
5.3-10.0	Blocky shale, more blocky and compentent with depth. Shale blocks calcareous water flow heavy through blocky shale.

TEST PIT NO. 56-14

TEST PIT COORDINATES: N-1044.619, E1765.514

TOP OF GROUND ELEVATION: 534.21

TEST PIT DEPTH: 5.0'

STABILIZED WATER DEPTH: 4.2'

SEEPAGE DEPTH: 5.0

DATE: 5/18/83

DEPTH (FEET)	DESCRIPTION OF MATERIALS
0 - 0.5	Light brown, silt-clay topsoil.
0.5- 1.3	Light Brown Blocky silt clay loam some gray and rust mottle.
1.3 - 1.6	Gray, highly weatherd till grading to thin saprolite layer.
1.6- 5.0	Fissile black shale some rusting.

Joints: N22°E vertical
N55°E vertical

Test Pit No: 56-2A

Test Pit Coordinates: N-1916.73, E 946.11

Top of Ground Elevation: 520.03

Test Pit Depth: 10' (refusal)

Stabilized Water Depth: 4.76'

Seepage Depth:

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Light brown clay-silt top soil.
.4-1.5	Light brown to gray, silt loam with clay, mottled, blocky, dry
1.5-5.5	Dark brown clay till moderately well weathered, gray and rust mottles.
5.5-10.0	Black fissle shale, rusted at top. Little filling with clays.
10.0	Refusal in competent shale

Rippability: Excavated fissile weathered shale from 6 feet to 9 feet in 12 minutes, relatively easy to dig. At 10 feet shale becomes competent and very difficult to excavate. Backhoe broke tooth attempting to rip this material.

Test Pit No: 5-6 5A

Test Pit Coordinates: N-1321.05, E 1362.68

Top of Ground Elevation: 527.83

Test Pit Depth: 11.5'

Stabilized Water Depth:

Seepage Depth: 6.5'

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Light brown clay silt blocky top soil.
.5-1.5	Light brown silt loam, some clay dry blocky, rust and gray mottles.
1.5-4.2	Dark brown - black, moderately weathered till, very dense. Pebble fabric well defined.
4.2-5.5	Very dense clay saprolite
5.5-11.5	Weathered fissile black rusted shale, good jointing - N62°E, N45°W

FOR NOTES & REFERENCES SEE SHT. #1

REFERENCE TITLE	NUMBER

REFERENCE TITLE	NUMBER

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED

LOCATION CODES

ER- 750501
SCALE- None
DATE-
DRAWN- DM
CHECKED-
SQUAD SUPV-
APPV'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA #3
TEST PIT LOGS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

ENGINEER APPROVAL John A. Rifkind DATE 5/14/84
PP&L DRAWING NO. D 242632
SHEET NO. 2
REV. 0

Test Pit No: 5-6-8A

Test Pit Coordinates: N-947.26, E 762.67

Top of Ground Elevation: 520.73

Test Pit Depth: 5.4 refusal

Stabilized Water Depth: 5.0'

Seepage Depth: 5.4'

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Brown clay silt top soil.
.5-1.5	Brown silt and clay loam.
1.5-2.3	Dark brown - black weathered clay till.
2.3-2.5	Black-gray saprolite
2.5-5.4	Platy weathered shale with seams of highly weathered shale and saprolite, no rusting.
5.4	Refusal in very competent calcareous shale. Fracture at top of shale N65W.

Test Pit No: 5-6-11A

Test Pit Coordinates: N-1630.14, E 232.97

Top of Ground Elevation: 525.56

Test Pit Depth: 8.5 refusal

Stabilized Water Depth: Dry to 8.5

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Light brown-brown clay silt blocky top soil.
.4-1.6	Light brown silt loam since clay blocky, granular when excavated, very dry, slightly mottled.
1.6-8.5	Dark brown-black very dense clay till, shale fragments unweathered pebble fabric distinct. Some loam inclusions at top.
8.5	Refusal in very competent rock. Could not be excavated.

Test Pit No: 56-14A

Test Pit Coordinates: N-1225.15, E 209.66

Top of Ground Elevation: 526.03

Test Pit Depth: 4,3 refusal

Stabilized Water Depth: dry to 4.3'

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.5	Light brown clay - silt top soil.
.5-1.4	Light brown silt loam some clay, dry blockey. Some shale fragments.
1.4-2.9	Brown compact clay-silt loam.
2.9-4.3	Dark brown dense clay till with competent shale pebbles and lime stone blocks (.1-.6' diameter) near bottom.
4.3	Refusal in competent rock.

Test Pit No: 5-6-17A

Test Pit Coordinates: N-499.95, E 614.05

Top of Ground Elevation: 530.14

Test Pit Depth: 5.5

Stabilized Water Depth: Dry to 5.5'

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4'	Brown clay-silt top soil.
.4-1.0	Brown silt loam, some clay blocky, dry, no mottles
1.0-2.2	Brown moderately weathered till dry, relatively friable
2.2-5.5	Black silt texture saprolite, friable with occasional seams (.1-.2' thick) of shale with thick gray clay skins
5.5	Refusal in competent calcified shale

Test Pit No: 5-6-9A

Test Pit Coordinates: N-988.03, E 855.66

Top of Ground Elevation: 519.83

Test Pit Depth: 9.0'

Stabilized Water Depth: 3.04'

Seepage Depth: 5.0 in shale

Date Excavated: 9/27/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-1.2	Dark brown, silt, clay, alluvial top soil, small (pea sized), loose granuals.
1.2-5.0	Very dense gray mottled clay loam grading to a very weathered gray clay till, moist.
5.0'-8.0'	Weathered black fissile and platey unrusted shale.
8.0-9.0	Very competent calcareous platey black shale, very hard to excavate.

Test Pit No: 5-6-12A

Test Pit Coordinates: N-2207.43, E 152.95

Top of Ground Elevation: 523.57

Test Pit Depth: 7.1 refusal

Stabilized Water Depth: Dry to 7.1

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.9	Light brown clay-silt top soil.
.9-2.2	Brown-light brown silt loam some clay, blocky, dry, slightly mottled.
2.2-3.3	Dark brown dense moderately weathered till.
3.3-4.4	Dense clay saprolite
4.4-7.1	Broken blocky shale with saprolite seams no structure, slightly damp.
7.1	Refusal in very competent rock, could not be dug.

Test Pit No: 56 15A

Test Pit Coordinates: N-501.88, 345.72

Top of Ground Elevation: 532.94

Test Pit Depth: 6.0'

Stabilized Water Depth: Dry to 6.0'

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Light brown silt clay blocky top soil.
.4-1.0	Light brown silt loam some clay sub blocky structure, dry.
1.0-2.0	Dark brown weathered till.
2.0-6.0	Black broken meassive calcified shale and limestone in plates and blocks .5' thick some fissile plates and soil filling noted between blocks. Excavation difficult in this material.

Test Pit No: 5-6-18A

Test Pit Coordinates: N-504.89, E 852.67

Top of Ground Elevation: 525. 31

Test Pit Depth: 5.5'

Stabilized Water Depth: 5.5'

Seepage Depth: 5.5'

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Brown silt clay top soil
.4-1.1	Brown - light brown silt loam; some clay, dry, blocky slight rust mottles.
1.1-1.6	Dark brown moderately weathered dense till
1.6-5.5	Weathered black shale mostly fissile some platy horizons (.1' thick) and occasional saprolite seams. Well developed joints N85°W; N5°E
5.5	Refusal in calcified platy shale. Water seep slight at top of shale.

Test Pit No: 5-6-10A

Test Pit Coordinates: N-1509.67, E 563.86

Top of Ground Elevation: 517.64

Test Pit Depth: 5.5 refusal

Stabilized Water Depth: 1.70'

Seepage Depth: 3.8'

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-1.1'	Dark brown alluvial clay top soil granular and loose.
1.1-3.8'	Dark brown, gray, black highly weathered clay till, moist.
3.8'-4.7'	Black clay saprolite
4.7-5.5	Very competent calcareous, blocky black shale, large (2-3') plates 5"-6" thick, calcite seams at edges of blocks, very tough to excavate, backhoe broke a tooth.

Test Pit No: 5- 6-13A

Test Pit Coordinates: N-2048.69, E 566.70

Top of Ground Elevation: 516.50

Test Pit Depth: 7.5 refusal

Stabilized Water Depth: 3.9'

Seepage Depth:

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Brown clay top soil.
.4-1.6	Dark brown very dense blocky/columnar clay loam, dry slight rus mottles.
1.6-3.5	Dark brown very weathered dense clay till.
3.5-6.0	Dark brown till less dense, less clay
6.0-7.5	Black weathered fissile/platy shale, unrusted.
7.5	Refusal in competent shale.

Test Pit No: 56-16A

Test Pit Coordinates: N-500.24, E 505.18

Top of Ground Elevation: 533.54

Test Pit Depth: 4.0

Stabilized Water Depth: Dry to 4.0

Seepage Depth: N/A

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0.5	Light brown clay silt top soil.
.5-1.5	Brown-light brown silt loam some clay, blocky, dry, no mottles.
1.5-2.1	Dark brown-black very weathered dense clay till.
2.1-4.0	Black very dense clay saprolite
4.0	Refusal in competent calcified shale/limestone

FOR NOTES & REFERENCES SEE SHT. #1

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED

LOCATION CODES

H H 7 0 C

SORTS

ER- 750501
SCALE- None
DATE-
DRAWN- BMW
CHECKED-
SQUAD SUPV-
APPV'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA #3
TEST PIT LOGS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

ENGINEER APPROVAL	DATE	PP&L DRAWING NO.	SHEET NO.	REV.
John A. Stefanik	5/14/84	D-242632	3	0

MF 0

Test Pit No: 5-6-19A

Test Pit Coordinates: N-748.96, E 1482.35

Top of Ground Elevation: 528.88

Test Pit Depth: 8.5'

Stabilized Water Depth: 5.1'

Seepage Depth: 5.3'

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0-.4	Brown silt clay top soil.
.4-1.4	Light brown silt loam, some clay blocky
1.4-2.2	Gray clay loam, blocky, mottled
2.2-5.3	Dark brown moderately weatherd dense till.
5.3-5.4	Black saprolite
5.4-8.5	Black fissile rusted shale

Test Pit No: 5-6 - 20A

Test Pit Coordinates: N 709.89,E1098.16

Top of Ground Elevation: 521.68

Test Pit Depth: 7.5'

Stabilized Water Depth: 3.7'

Seepage Depth:

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0 - .5	Brown silt clay top soil
.5 - 1.5	Light brown to brown grading to gray clay and silt loam, dense, heavy mottles in gray zone.
1.5 - 4.5	Gray grading to dark brown highly weathered clay till very dense, mottled at top in gray zone.
4.5 - 7.5	Black slightly calcified platy shale trace rusting at bedding planes.

Test Pit No: 5-6 - 21A

Test Pit Coordinates: N 1076.96, E 1514.18

Top of Ground Elevation: 528.97

Test Pit Depth: 8.5'

Stabilized Water Depth: 4.6'

Seepage Depth: 4.5'

Date Excavated: 9/28/83

DEPTH (Feet)	DESCRIPTION OF MATERIALS
0 - .5	Light brown silt clay top soil
.5 - 1.7	Brown silt loam, some clay blocky, dry, no mottles
1.7 - 8.5'	Black weathered fissile shale rusted, pieces competant

FOR NOTES & REFERENCES SEE SHT #1

ER-750501
SCALE- NONE
DATE-
DRAWN- JM
CHECKED-
SQUAD SUPV-
APPV'D-

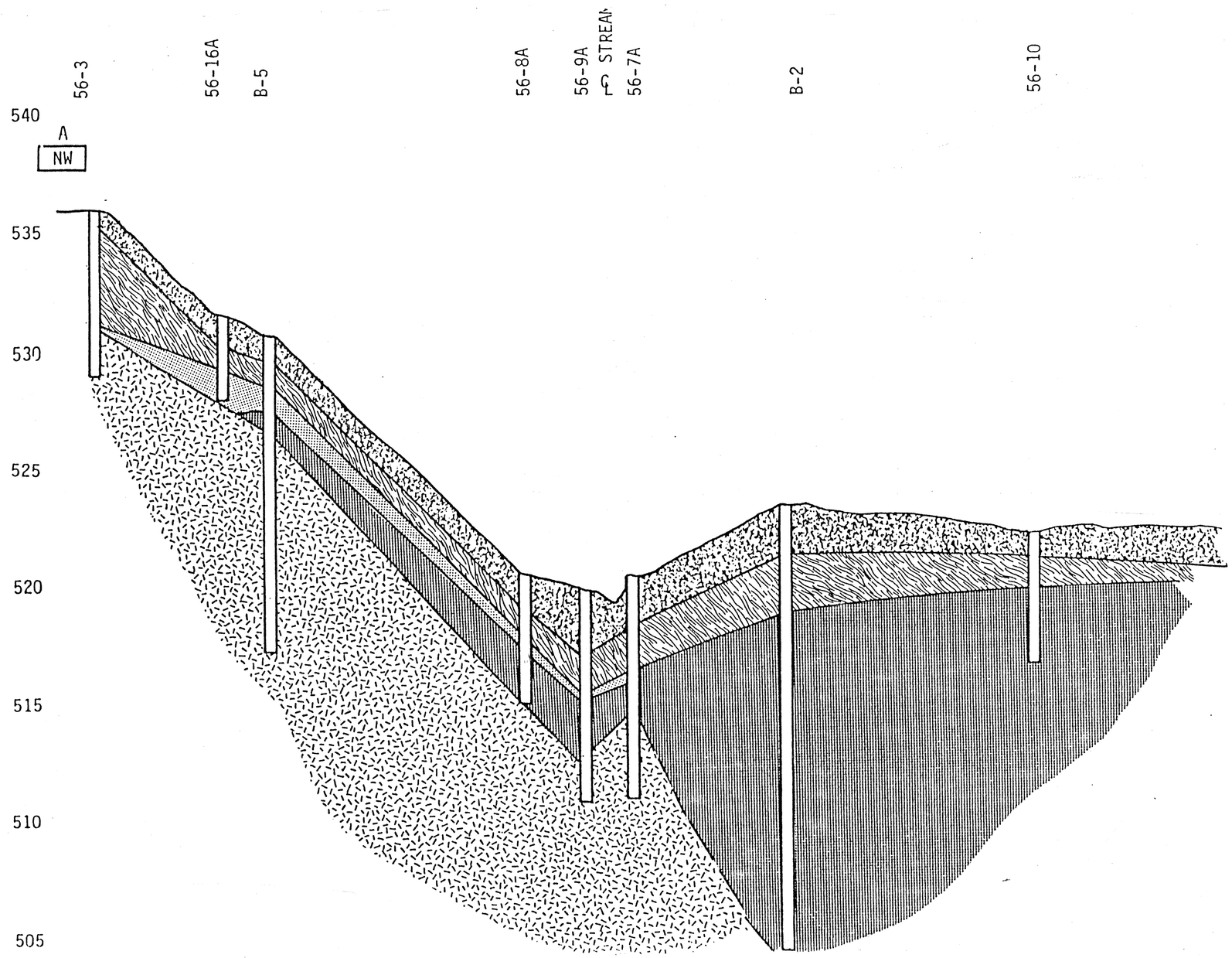
MONTOUR S.E.S.
ASH DISPOSAL AREA #3
TEST PIT LOGS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

ENGINEER APPROVAL John A. Stefanik DATE 5/14/96
PP&L DRAWING NO. D 242632
SHEET NO. 4
REV. 0

REFERENCE TITLE | NUMBER | REFERENCE TITLE | NUMBER | NO. | DATE | ER. | REVISION | BY | CH. | APPROVED

LOCATION CODES | H | H | 7 | 0 | C | SORTS



Top Soil and Silty Clay

Till

Saprolite

Marcellus Shale

Blocky Calcareous Shale and Shaley Limestone

SECTION A-A (SEE DWG E-196008 SHT. 1)

HORIZONTAL 1" = 100'
VERTICAL 1" = 2½'

FOR NOTES & REFERENCES SEE SHT. 1

ER-750501
SCALE-NONE
DATE-
DRAWN-DM
CHECKED-
SQUAD SUPV-
APPV'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA #3
CROSS SECTION A-A

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

ENGINEER APPROVAL John A. Stefanich 5/14/76
DATE
PP&L DRAWING NO. D 242632
SHEET NO. 5
REV. 0

REFERENCE TITLE	NUMBER

REFERENCE TITLE	NUMBER	NO.	DATE	ER.

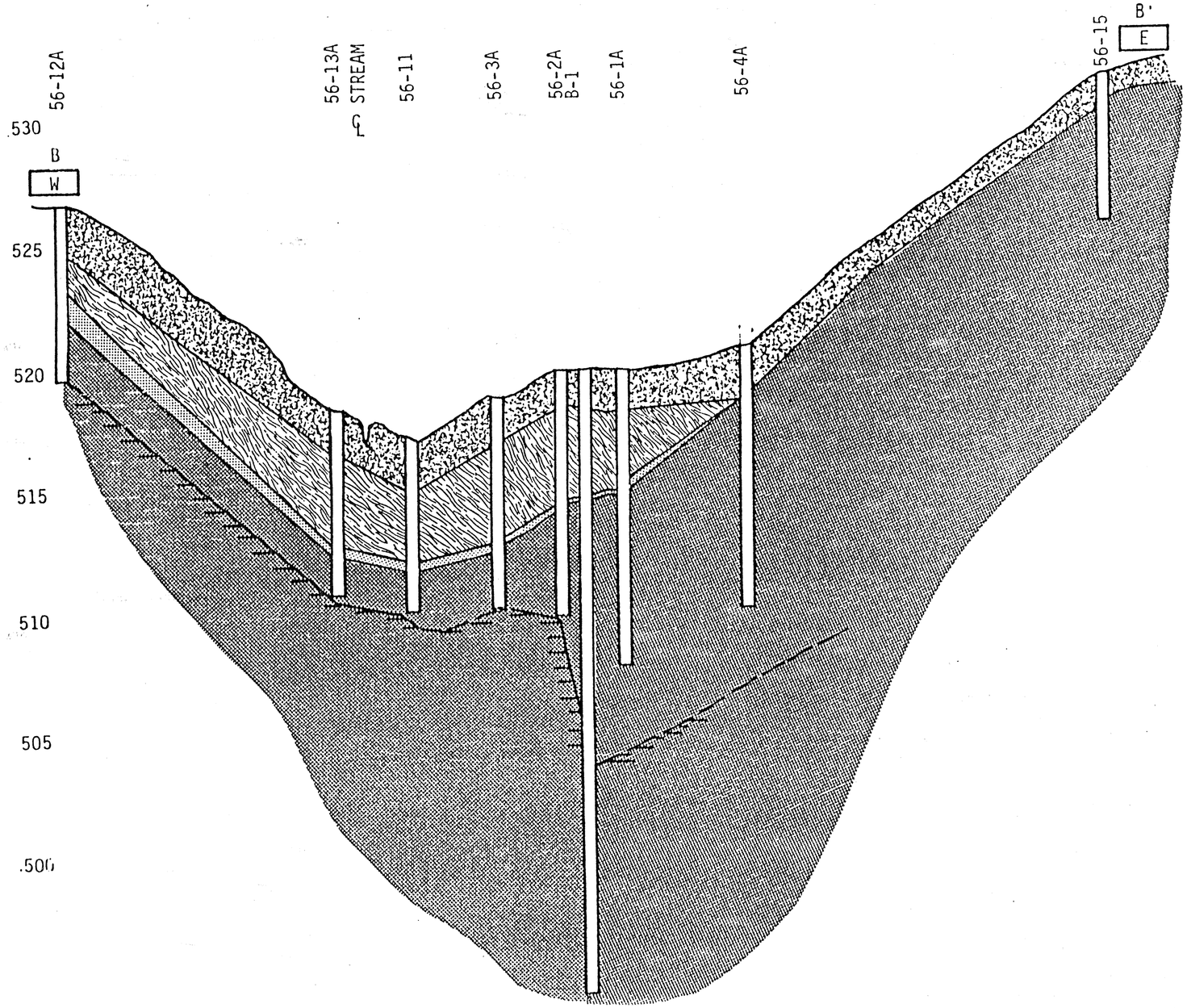
REVISION

BY CH. APPROVED

H H70

LOCATION CODES

C SORTS



Key:

- Top Soil
- Till
- Saprolite
- Marcellus Shale
- Competent Shale

(Platy calcareous shales to the west of the stream probably associated with the Cayuga Formation)

SECTION B-B (SEE DWG. E-196008 SHT. 1)

HORIZONTAL 1"=100'
VERTICAL 1"=2½'

FOR NOTES & REFERENCES SEE SHT. #1

ER-750501
SCALE-NONE
DATE-
DRAWN-
CHECKED-DN
SQUAD SUPV-
APPV'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA #3
CROSS SECTION B-B

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

ENGINEER APPROVAL John A. Stefanik 5/14/96
DATE
PP&L DRAWING NO. D 242632
SHEET NO. 6
REV. 0

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER	NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
								H	H70	C

LOCATION CODES SORTS

BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-B-1-9/83
Project PP&L 5-6
Client Pennsylvania Power & Light Co.
Location Montour, PA
Top of Casing Elevation 520.13 Date Started 9/27/83 Completed 9/27/83
Drilling Contractor Borings, Soils, and Testing, Inc. Driller B. Bender
T.R.C. Inspector P. Lagace&F. Johnson Well Depth 25.5' Casing Stick Up
Water Level Top of Screen Bottom of Screen
Drilling Method
Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		5 9 9				Light Brown-Tan Claysilt with Rust Mottles	
2		10				Tan Claysilt with some shale fragments	
4							
		12 12	65%			Broken Gray-Black Shale with clay(.5') over rusted Shale Fragments (.8')	
6		20 30					
8							Roller Bit 7' - 10'
10							
		50/.5'				Gray-Black, Soft, Carbonatious, Fissil Shale Black Broken Shale pieces pea size to 1"	Run #1 10.5' - 15.5' RQD = 0
12			38%			Rusting ends at 11.0'	
14							
16						Black broken shale, some competent pieces vertical fractures at 16.25 - 16.7' pyratized	Run #2 15.5'-20.5' RQD = .3 Slite Reaction with HCL 16-16.5'
18			96%			Calcite seam rock very competent few seams, no rusting or vugs	Strong reaction below 16.5'
20						Vertical Fracture 20.2-20.35' Black competent shale, competency increasing with depth. Calcite & Pyrite Seam	Run #3 20.5'-25.5' RQD = .56
22			86%				
						Vertical Fracture and Calcite Seam	

BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6 - B-2-9/83
Project PP + L 5-6
Client Pennsylvania Power & Light Co.
Location Montour, PA
Top of Casing Elevation 523.63 Date Started 9/27/83 Completed 9/27/83
Drilling Contractor Borings, Soils, & Testing, Inc. Driller W. Lucas
T.R.C. inspector P. Lagace HoleDepth 19' Casing Stick Up
Water Level Top of Screen Bottom of Screen
Drilling Method
Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		7 F				Gray compact silt with shale fragments	
2		20					
		33 24				Dark gray compact silt with abundant shale fragments	
4		24					
		20 18				Black broken shale, trace of moist silt-clay some rust	
6		15					
		32 45				Black, broken, almost crumbely shale, some rust	
8		40					
		31 60	62%			Black fissil shale	Run #1 8.9-13.9'
10						Uniform thin bedded Black shale Pyrite nodual, d = .03' fine vertical calcite vein Fine pyrite crystals	
12							
14							Run #2 14-19'
16						Thin horizontal bedded Black shale finely desimenated Pyrite crystals throughout more concentrated lense of pyrite at 15' Clean straight horizontal fractures spaced .2' Calcite vien, near vertical	
18							
20						Bottom of hole	

BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-B-3-9/83
Project PP&L 5-6 soils
Client Pennsylvania Power and Light Company
Location Montour, PA
Top of Casing Elevation 518.83 Date Started 9/27/83 Completed 9/28/83
Drilling Contractor Borings, Soils, and Testing, Inc. Driller W. Lucas
T.R.C. Inspector Paul Lagace Well Depth Casing Stick Up
Water Level Top of Screen Bottom of Screen
Drilling Method
Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		3 3				Blue-gray clumpy plastic silt clay with rust mottles	
2		2 2				Blue-gray silt-clay over dark brown silt-clay, pod of rusty fine sand.	
		4 4					
4		7 9				Clay with shale granules over soft black shale Some rusting	
		14 15 19	100%				
6		57				Run #1 6'-11' Interbedded gray (70%) and black (30%) calcarious shale Trace pyrite clay seam at 7.33'-7.55'	RQD = .23 Reacts to HCl below 6.0'
8			88%				
10						Fractures mostly in black shale	Run #2 11'-16'
12			96%			Black shale with fine <.01' discontinuous white seams	
14						Competent uniform black shale	
						Gray shale over gray clay silt over broken shale	
16			100%				Run #3 16'-20' RQD = .65
						Interbedded black and gray shale fine pyrite crystals disseminated through gray shale at 16'-16.2', 18.6'-19', 19.5'-20'6"	
18							
20							

BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-B-4-9/83
Project PP&L 5-6
Client Pennsylvania Power & Light Company
Location Montour, PA
Top of Casing Elevation 520.68 Date Started 9/27/83 Completed 9/28/83
Drilling Contractor Borings, Soils, & Testing, Inc. Driller W. Lucas
T.R.C. Inspector D. F. Unites Well Depth Casing Stick Up
Water Level Top of Screen Bottom of Screen
Drilling Method
Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		2				Tan Silt Loam	
		5 7				Mottled Gray Silty clay, damp	
2		9 5				Mottled dark gray silty clay, damp	
		8 8					
4		12				Weathered, rusted black shale	
		12 13				Weathered, slightly rusted hard shale	
6		50/.4'				Very broken hard black shale no rusting Broken black hard shale average pieces approx. 0.1' irregular vertical fracture 7.3-7.5	Run #1 5.5'-10.5
8			86%			More competent shale pieces approx. 0.25' broken zone 8.2'-8.4'	Reacts with HCl and contains pyrites below 7.7'
10						Broken shale Dark black shale, no apparent calcarious or pyrite zones, no rusting vertical and oblique fractures at 10.5'-10.9' vertical fracture at 11.1-11.6 Broken zones, at 13.6', 13.9-14.2	Run #2 10.5'-15.5'
12							
			82%				
14							
							Bottom of hole
16							
18							
20							

FOR NOTES & REFERENCES SEE SHT. #1

ER- 750501	MONTOUR S.E.S.
SCALE- None	ASH DISPOSAL AREA # 3
DATE-	BORING LOGS
DRAWN- DM	
CHECKED-	
SQUAD SUPV-	
APPV'D-	PENNSYLVANIA POWER & LIGHT COMPANY ALLENTOWN, PA.

ENGINEER APPROVAL	DATE	PP&L DRAWING NO.	SHEET NO.	REV.
John A. Stefanik	5/14/96	D 242632	7	0

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER	NO.	DATE	ER.	REVISION	BY	CH.	APPROVED

LOCATION CODES H H 7 0 SORTS C

BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-b-5-9/83
Project PP&L 5-6 Soils
Client Pennsylvania Power & Light Company
Location Montour, PA
~~Top of Casing~~ Elevation 531.74 Date Started 9/28/83 Completed 9/28/83
Drilling Contractor Borings, Soils and Testing Driller W. Lucas
T.R.C. inspector Paul Lagace ~~Well~~ Depth 13' Casing Stick Up
Water Level Top of Screen Bottom of Screen
Drilling Method
Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		7				Light brown clumpy silt over dark brown silt with black mottles	
		10					
2		12					
		10	88%			Very soft black shale becoming harder with depth. Some rust	Run #1 3.5'-8.5' RQD = .14
		25					
4		50				Broken interbedded gray and black shale beds approx. .05" thick Iron oxide lense .01'	
			94%			Very broken gray shale with clay	
6						Iron oxide nodule	
						Black shale with calcite seam	
8						Interbedded black and gray shale	
			96%			Interbedded black and dark gray shale	Run #2 8.5'-13.5'
10						Gray shale has fine white seams, crinkly, horizontal	
						Pyrite and calcite nodules at 10'	
12						Some vertical pyrite and calcite inclusions	
						Light gray volcanic ash bed	

BORING LOG

Project # 2271-N61 Page 1 of 1 Boring No. 5-6-B1-11/83
Project PP&L 5-6 Ash Storage Area
Client Pennsylvania Power and Light Co,
Location Montour SES 5-6 Area
Top of Casing Elevation N/A Date Started 11/14/83 Completed 11/14/83
Drilling Contractor B.S. and T Driller Bill Mahalick
T.R.C. Inspector F. Johnson Well Depth 11.0' Casing Stick Up N/A
Water Level N/A Top of Screen N/A Bottom of Screen N/A
Drilling Method Split spoon samples and double barrel core
Completion and Development Bore holes back filled with portland cement

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
0		7				Dark brown silt top soil with fill and roots	
		4					
1		5	68%			Brown to light brown silt loam with trace shale fragments increasing with depth, trace mottles	
2		6					
		3					
3		7					
		14				Black saprolite with soil filling and competent shale plates rusting heavy between plates shale becoming more competent with depth	
4		14	100%				
		20					
5		15					
		50/.4'				Black weathered Shale with some saprolite zones	Refusal at 5.9' Tricone to 6.0' Coring started at 6.0'
6						Black, broken plates of competent Shale .01' thick trace rusting	Core Recovery 100%
7						Black competent Shale in plates .01' to .05' thick, some vertical fracturing	RQD = 0
8						Rusting becomes heavy between plates at 8.4'	Possible marcasite noted
9						Black unrusted shale in plates up to .05' thick, Plates competent with some vertical fractures. Slight occasional clay skins, no effervesance in HCL, no pyrites noted	
10							
11						Black unrusted Shale competent plates upto .25' thick, slight effervesance in HCL no pyrite noted	End of Run at 11.0'

BORING LOG

Project # 2271-N61 Page 1 of 1 Boring No. 5-6 - B-2 - 11/83
Project PP & L 5-6 Ash Storage Area
Client Pennsylvania Power & Light Co.
Location Montour, SES 5-6 Area
Top of Casing Elevation N/A Date Started 11/14/83 Completed 11/15/83
Drilling Contractor Burnings, Soils & Testing, Inc. Driller Bob Karawitz
T.R.C. Inspector Paul Lagace Well Depth 8' Casing Stick Up N/A
Water Level N/A Top of Screen N/A Bottom of Screen N/A
Drilling Method Split spoon samples & double barrel core
Completion and Development Bore hole backfilled with Portland cement

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		1				Moist tan silt with blue gray and rust mottles. Bottom 1/3 has weathered shale	
		2					
2		5				Moist rusty silt w. gray mottles over broken black shale, some rusting	
		2					
		53					
4		.5'	100%			Run #1 3'-8'	RQD = 0
						Mostly broken fractured Black shale . red & yellow Rusting 3' - 5' 2" Marcasite nodual 1/4" diameter at 4'6"	H cl reacts on all
							5'4"
6						pyrite layers 1/32" - 1/16" at 5' 4", 5'7"	
						other lenses of deseminated pyrites	
8							Bottom of hole at 8'
10							

BORING LOG

Project # 2271-N61 Page 1 of 1 Boring No. 5-6-B-3-11/83
Project PP&L 5-6
Client Pennsylvania Power & Light Co.
Location Montour, PA
~~Top of Casing~~ Elevation Date Started 11/16/83 Completed 11/16/83
Drilling Contractor Borings, Soils, & Testing, Inc. Driller Bob Karawitz
T.R.C. Inspector Paul Lagace Well Depth 10.4' Casing Stick Up
Water Level Top of Screen Bottom of Screen
Drilling Method
Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		1				Brown clay-silt	
		3	71%			Blue-gray clay-silt with orange mottles	
		4					
2		9				Stiff blue-gray clay-silt with orange rust mottles 1/2" horizon with sand size shale frags. at 2'11"	
		7	67%			Till rusty clay-silt 70-80% shale frags.	
		9					
4		17					
		35				Shale frags with silt little rust.	
		30	100%				
		45				Fractured black shale, heavy rusting	Run #1 5.4-10.4'
6						Very broken and fractured black-gray shale. Well rusted on fractures. Rust staining mostly orange, some green, yellow, blue florescence.	
8						Rock slightly more competent rust all orange, forming crust rather than film	
10							

FOR NOTES & REFERENCES SEE SHT. #1

REFERENCE TITLE	NUMBER

REFERENCE TITLE	NUMBER

NO.	DATE	ER.	REVISION	BY	CH.	APPROVED
				H	H7	O C

LOCATION CODES

ER-750501
SCALE- None
DATE-
DRAWN- DW
CHECKED-
SQUAD SUPV-
APPV'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA # 3
BORING LOGS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

ENGINEER APPROVAL John A. Blatchford 5/14/86 DATE
PP&L DRAWING NO. D 242632
SHEET NO. 8
REV. 0

BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-4-11/83
Project PP&L 5-6 Ash Storage Area
Client Pennsylvania Power and Light Company
Location Montour SES 5-6 Area
Top of Casing Elevation N/A Date Started 11/15/83 Completed 11/15/83
Drilling Contractor BS & T Driller Bill Mahalick
T.R.C. Inspector F. Johnson Well Depth 9.0' Casing Stick Up N/A
Water Level N/A Top of Screen N/A Bottom of Screen N/A
Drilling Method Split spoon sampling and double barrel core
Completion and Development Bore Hole backfilled with portland cement

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
0		1				Light brown - brown silt top soil	
1		1 3			92%	Light brown to tan , to gray silt, clay loam, heavy rust and gray mottles throughout	
2		6 8					
3		20 50/.2				Dark brown dense weathered till, good pebble structure	Refusal in till at 3.2' Tricone to 4.0' Begin Core at 4.0'
4						Saprolite	
5						Black weathered shale in plates up to .02' thick, occasional vertical fractures, slightly rusted.	No effervesance in HCl No pyrites noted
6							
7						Black weathered shale in plates .01 to .03' thick, very heavy rusting between plates	No effervesance in HCl
8						Black weathered shale in plates .01 to .03' thick rusting slight between	No pyrites noted
9						Plates, some clay skins, White "Sandy" precipitate at 8.75', does not effervese in HCL	Recovery on Core 100% RQD = 0 Boring terminated at 9.0'

BORING LOG

Project # 2271-N61 Page 1 of 1 Boring No. 5-6-B-8-11/83
Project PP&L 5-6
Client Pennsylvania Power & Light Company
Location Montour, PA
~~Top of Casing~~ Elevation Date Started 11/16/83 Completed 11/17/83
Drilling Contractor Borings, Soils and Testing, Inc. Driller Bob Karawitz
T.R.C. Inspector Paul Lagace ~~Well~~ Depth 10' Casing Stick Up
Water Level Top of Screen Bottom of Screen
Drilling Method
Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		1				Light brown silt loam no rusting	
		3 20	67%			Brown pieces of limestone with dark brown silt, no rusting	
2		30 25	42%			Dark brown silt Broken limestone pieces	
		35/.3'	49%			Broken pieces of shaley limestone with some brown clay silt, some iron oxide	Run #1 2.8-4'
4		28 60	33%			Broken pieces of shaley limestone, yellow to orange rusty fine sand size particles, dark brown silt.	Split spoon
						Shaley dark gray limestone some calcite, sparse invertical veins, no rusting.	Run #2 5'-10'
6						Fissile weathered shale	Reacts with HCl throughout
			80%			Dark gray shaley limestone with abundant vertical calcite veins 1/8" thick heavily rusted sandy material down center of veins.	
8						More competent limestone with vertical calcite veins, little rusting	

BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-5-11/83
Project PP&L 5-6 Ash Storage Area
Client Pennsylvania Power and Light Company
Location Montour S.E.S. 5-6 Area
Top of Casing Elevation N/A Date Started 11/16/83 Completed 11/16/83
Drilling Contractor B.S. and T Driller Bill Mahlick
T.R.C. Inspector F. Johnson Well Depth 12.0' Casing Stick Up N/A
Water Level N/A Top of Screen N/A Bottom of Screen N/A
Drilling Method Split spoon sampling and double barrel coring
Completion and Development Hole grouted with portland cement

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
0		1				Dark brown sticky clay top soil possible alluvium	No recovery on spoon dug by hand for soils soils classification
1		1 3	0%			Light brown clay silt loam, mottled	
2		5 6					
3		9 11				Gray clay loam, mottled	
4		15 16	100%				
5		15 2				Dark brown dense weathered till,	Some rusting on Pebbles
6		3 11				Saprolite, Black highly weathered shale not rusted Black fractured broken shale pieces competent approximate .05' thick shale unrusted	Trace rusting noted
7		53					
8							
9						No pyrites noted	
10						Black calcified shale in competent plates up to .2' thick some vertical fractures	Effervesance in HCL noted Pyrited zones at 10.2' and 11.0'
11							
12							Boring Terminated at 12.0' RQD = 0 Recovery = 100%

BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6-B-6-11/83
Project PP&L 5-6
Client Pennsylvania Power & Light Company
Location Montour, PA
~~Top of Casing~~ Elevation Date Started 11/16/83 Completed 11/16/83
Drilling Contractor Borings, Soils, and Testing, Inc. Driller Bob Marawitz
T.R.C. Inspector Paul Lagace ~~Well~~ Depth 12.3' Casing Stick Up
Water Level Top of Screen Bottom of Screen
Drilling Method
Completion and Development

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
		2				Light brown silt loam	
		3 4	80%			Brown silt with few shale fragments, rusting and iron oxide concretions	
2		6 10				Till, not compact, mostly orange rusted, some gray silt matrix. 50% shale frags.	
		11	100%				
4		14 22				Brown till with gray mottles. Shale fragments. Smaller and more rounded than above. Little rusting.	
		21					
		18 19	92%			Orange rusted till with larger (.1") shale frags.	
6		27 22					
		41	58%			Brown soft silt, some shale frags. (from side of hole?)	
8		63 29				Very broken shale with brown silt.	
		6 29	100%			Very fissile carbonatious black shale. 1" zone of heavy rusting at 9.2', some rust at 10'	
10		45 53/4"				Soft black shale	
			29%			Black shale some rusting on vertical fractures	
12							End of run at 12.3'

BORING LOG

Project # 2271-N61 Page 1 of 2 Boring No. 5-6- 7-11/83
Project PP&L Ash Storage Area
Client Pennsylvania Power and Light Company
Location Montour S.E.S.
Top of Casing Elevation N/A Date Started 11/17/83 Completed 11/17/83
Drilling Contractor B.S. and T Driller Bill Mahalick
T.R.C. inspector F. Johnson Well Depth 12.1' Casing Stick Up N/A
Water Level N/A Top of Screen N/A Bottom of Screen N/A
Drilling Method Split spoon samples and double barrel core
Completion and Development Hole grouted with Portland Cement

DEPTH	ELEVATION	BLOW ON SPLIT SPOON	PERCENT RECOVERY	LITHOLOGY	WELL CONST.	SAMPLE DESCRIPTION	REMARKS
0		2				Brown silt top soil	
1		3 6	72%			Light brown silt, clay loam firm, moist, some limestone fragments mottling starts at 2.5'	
2		10 10					
3		7 8	32%			Dark brown weathered till with trace limestone and chert fragments	
4		10 13					
5		7 5					
6		3 11	62%				
7		9 50/.1				Black saprolite	Core starts 7.1'
8						Gray black limey shale broken and fractured	No rusting
9						Gray black limey shale in competent plates .1 thick	No rusting
10						Gray black limey shale/shaly limestone. Very competent Pieces - 25' thick few fissle zones .02' thick. No rusting	Boring terminated at 12.1'
11							
12							Recovery = 100% RQD = 0

FOR NOTES & REFERENCES SEE SHT. #1

ER-750501
SCALE- NONE
DATE-
DRAWN- DM
CHECKED-
SQUAD SUPV-
APPV'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA # 3
BORING LOGS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

ENGINEER APPROVAL John A. Stefanik 5/14/84 DATE
PP&L DRAWING NO. D 24 26 32
SHEET NO. 9
REV. 0

REFERENCE TITLE | NUMBER | REFERENCE TITLE | NUMBER | NO. | DATE | ER. | REVISION | BY | CH. | APPROVED

LOCATION CODES H H 7 0 SORTS C

FRACTIONAL DECIMAL

Test Pit ID: MA3-1 **Soil Type:** Evendale cherty silt loam **Date:** 11/26/96
Northing: -1558.64 **Elevation (MSL):** 520.51 **Described by:** John K. Buck, Civil & Environmental Consultants, Inc.
Easting: 396.93

Depth (inches) Upper	Lower	Color	USDA Texture	Structure	Consistence	Mottling	Roots, Other Notes
0	3	olive gray	silty clay loam	subangular blocky	friable	none	weeds, disturbed (truncated? surface soils, many fine, medium, coarse roots
3	10	brownish yellow	silty clay loam	subangular blocky	firm		
10	30	dark gray shale	rock		loose	none, but some gray ped coatings	pit bottom at 30"

Test Pit ID: MA3-2 **Soil Type:** Evendale cherty silt loam **Date:** 11/26/96
Northing: -1440.86 **Elevation (MSL):** 522.01 **Described by:** John K. Buck, Civil & Environmental Consultants, Inc.
Easting: 412.30

Depth (inches) Upper	Lower	Color	USDA Texture	Structure	Consistence	Mottling	Roots, Other Notes
0	6	yellowish brown	silty clay loam	subangular blocky	friable	-	disturbed surface soil (truncated?), many fine, medium, coarse roots, weeds
6	13	yellowish brown	silty clay loam	subangular blocky to prismatic	firm	faint dark gray mottles, gray ped faces	some fine roots
13	46	dark brown	silty clay loam	subangular blocky	very firm	-	medium, fine roots to 24 inches
46	48	white decomposed rock on dark shale					

Sampled 6-46" (Sample MA3-2) - USDA silty clay loam, 6.6% coarse fragments

Test Pit ID: MA3-3 **Soil Type:** Evendale cherty silt loa **Date:** 11/26/96
Northing: -1216.18 **Elevation (MSL):** 523.16 **Described by:** John K. Buck, Civil & Environmental Consultants, Inc.
Easting: 416.67

Depth (inches) Upper	Lower	Color	USDA Texture	Structure	Consistence	Mottling	Roots, Other Notes
0	10	medium grayish brown	silty clay loam	subangular blocky	friable	-	many fine, medium roots
10	18	yellowish brown	silty clay loam	subangular blocky	friable	-	some fine, medium roots
18	46	grayish yellow brown	silty clay loam	prismatic	very firm	light gray	few fine, medium roots
46	59	dark brown decomposed shale					59" water level at 1:55 PM

Sampled 0-10" (Sample MA3-3 B-1) USDA silty clay loam, 5.7% coarse fragments
Sampled 10-46" (Sample MA3-3 B-2) USDA silty clay loam, 9.7% coarse fragments

Test Pit ID: MA3-4 **Soil Type:** Evendale cherty silt loam **Date:** 11/26/96
Northing: -898.35 **Elevation (MSL):** 522.74 **Described by:** John K. Buck, Civil & Environmental Consultants, Inc.
Easting: 648.20

Depth (inches) Upper	Lower	Color	USDA Texture	Structure	Consistence	Mottling	Roots, Other Notes
0	14	medium brownish gray	silty clay loam	subangular blocky	friable	-	soybean/small grain stubble; many medium, fine roots
14	23	brownish gray	silty clay loam	subangular blocky	friable to firm	some light gray mottles, some MnO2	some medium, fine roots
23	38.5	gray brown with dark gray shale	silt loam	fissile decomposed shale	very friable	-	water filling into pit bottom, no roots

Sampled 0-23" (Sample MA3-4) USDA silty clay loam, 3.3% coarse fragments

Test Pit ID: MA3-5 **Soil Type:** Evendale cherty silt loa **Date:** 11/26/96
Northing: -484.62 **Elevation (MSL):** 526.05 **Described by:** John K. Buck, Civil & Environmental Consultants, Inc.
Easting: 841.97

Depth (inches) Upper	Lower	Color	USDA Texture	Structure	Consistence	Mottling	Roots, Other Notes
0	11	medium brownish gray	silty clay loam	subangular blocky	friable	-	corn/soybean stubble, many medium, fine roots
11	15	brownish yellow	silty clay	subangular blocky to prismatic	firm	light gray	some medium, fine roots
15	22	light gray w/reddish yellow mottles	silty clay	subangular blocky	very firm	reddish yellow	few medium, fine roots
22	35.5+	dark and middle gray	decomposed shale	fissile	very friable		35.5 inches to water covering pit floor at 2:50 PM

Sampled 11-22" (Sample MA3-5) USDA silty clay, 6.5% coarse fragments

Test Pit ID: MA3-6 **Soil Type:** Evendale cherty silt loam **Date:** 11/26/96
Northing: -515.63 **Elevation (MSL):** 534.36 **Described by:** John K. Buck, Civil & Environmental Consultants, Inc.
Easting: 397.01

Depth (inches) Upper	Lower	Color	USDA Texture	Structure	Consistence	Mottling	Roots, Other Notes
0	6	light yellowish brown	silty clay	subangular blocky	friable	-	corn/soybean stubble, many medium, fine
6	18	yellowish brown	silty clay	subangular blocky to prismatic	friable	black Mn	few medium, fine
18	26	dark brownish grey to black	silty clay	subangular blocky to prismatic	friable to firm	black Mn coatings on ped faces	few medium, fine
26	50	dark gray decomposed shale		fissile	loose	-	no water in pit

Sampled 18-26" (Sample MA-6) USDA silty clay, 1.1% coarse fragments

Test Pit ID: MA3-7 **Soil Type:** Evendale cherty silt loam **Date:** 11/26/96
Northing: -926.04 **Elevation (MSL):** 531.96 **Described by:** John K. Buck, Civil & Environmental Consultants, Inc
Easting: 238.85

Depth (inches) Upper	Lower	Color	USDA Texture	Structure	Consistence	Mottling	Roots, Other Notes
0	6	brownish gray and yellowish brown	silt loam	subangular blocky	friable		disturbed surface (truncated?) many fine, medium, coarse roots
6	15	grayish brown	silt loam	platy	firm	black Mn	some fine, medium roots
15	27	grayish brown	chunnery silt loam w/sandstone conrse fragments up to 5"	platy	firm		
27	42	white to dark gray decomposed shale		fissile	friable		

Sampled 0-15" (Sample MA3-7) USDA silt loam, 5.9% coarse fragments

Test Pit ID: MA3-8 **Soil Type:** Evendale cherty silt loam **Date:** 11/26/96
Northing: -1173.44 **Elevation (MSL):** 526.56 **Described by:** John K. Buck, Civil & Environmental Consultants, Inc.
Easting: 251.27

Depth (inches) Upper	Lower	Color	USDA Texture	Structure	Consistence	Mottling	Roots, Other Notes
0	8	olive gray	clay	prismatic	very firm	gleyed	disturbed soil (truncated?) many medium, coarse, fine roots
8	21	yellowish red	clay	prismatic to subangular blocky	very firm		many medium, fine roots
21	28	reddish brown or dark grayish brown	clay	subangular blocky to massive	extremely firm	black Mn	
28	40	brown sandstone and dark gray shale					

Sampled 0-21" (Sample MA3-8) USDA clay, 2.6% coarse fragments

Test Pit ID: MA3-9 **Soil Type:** Evendale cherty silt loam **Date:** 11/26/96
Northing: -1436.8142 **Elevation (MSL):** 526.06 **Described by:** John K. Buck, Civil & Environmental Consultants, Inc.
Easting: 250.07

Depth (inches) Upper	Lower	Color	USDA Texture	Structure	Consistence	Mottling	Roots, Other Notes
0	6	olive gray	clay	medium, strong prismatic	very firm	gleyed	disturbed soil (truncated?) many medium, coarse, fine roots
6	18	reddish yellow	silty clay loam	subangular blocky	very firm	light gray, y-llow on ped faces	some medium, fine roots
18	31	olive brown	silty clay loam		extremely firm	black Mn	
31	40	dark brown decomposed shale					

Sampled 6-31" (Sample MA3-9) USDA silty clay loam, 2.6% coarse fragments

INFORMATION FROM TEST PITS MA3-1 THRU M3-9 IS SUPPLIED BY JOHN K BUCK OF CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

ER- 750501
SCALE- NONE
DATE-
DRAWN- DM
CHECKED-
SQUAD SUPV-
APPV'D-

MONTOUR S.E.S.
ASH DISPOSAL AREA #3
TEST PIT LOGS

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

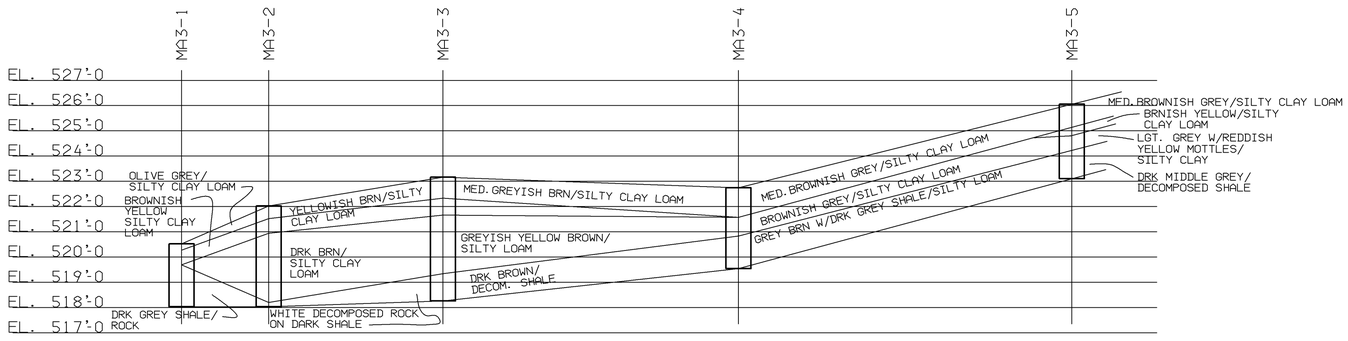
ENGINEER APPROVAL John A. Bilfinick 3/7/97 DATE
PP&L DRAWING NO. D-242632
SHEET NO. 1 0
REV. 0

TEST PIT LOCATION	E-196008
REFERENCE TITLE	NUMBER

REFERENCE TITLE	NUMBER	NO.	DATE	ER.	REVISION	BY	CH.	APPROVED

LOCATION CODES: H H T O
SORTS: C

FRACTIONAL 0 1 2 DECIMAL 2 1 0



SECTION D-D

SCALE HORZ. 1"=100'
VERT. 1"= 3'

T-414
LR-47015
GRID MARKER
S3+31.41
E2+10.41
EL 535.65
(NTS)
GRID MARKER
S2+49.88
E16+38.31
EL 529.26
(NTS)
GRID MARKER
S18+40.22
E2+09.37
EL 521.81
(NTS)
GRID MARKER
S18+85.85
E17+88.99
EL 531.16
(NTS)
5-6-4
538.74
5-6-3
536.54
5-6-5
523.01
5-6-7
526.31
5-6-6
521.42
5-6-8
522.41
5-6-2
530.64
5-6-1
526.66
5-6-9
524.26
5-6-14
534.21
5-6-10
522.26
5-6-15
531.65
5-6-11
517.18
MA3-5
524.05
MA3-4
522.74
MA3-7
531.96
MA3-8
526.56
MA3-3
523.16
MA3-9
526.06
MA3-2
522.01
MA3-1
520.51
D-242632 SHT. 5
D-242632 SHT. 11
D-242632 SHT. 6
B-1
B-2
B-3
B-4
B-5
B-6
B-7
B-8
S-1
S-2
LEGEND
12/10/96 TEST PIT (MA3-) (GROUND ELEV. SHOWN)
CROSS SECTION LINE
5-6-7A SEPT. 1983 TEST PIT (GROUND ELEVATION SHOWN BELOW PIT)
5-6-7 MAY 1983 TEST PIT (GROUND ELEVATION SHOWN BELOW PIT)
5-6-B2 SEPT. 1983 TEST BORING
PP&L PIEZOMETER
NOV. 1983 TEST BORING
SHEET NO. 1 OF 10
MONTOUR SES ASH DISPOSAL AREA
TEST PIT AND BORING LOCATIONS

1 2 3 4 5 6 7 8 9 10

A B C D E F G

E000 E500 E1000 E1500 E2000 E2500 E3000 E3500 E4000

N000 N-500 N-1000 N-1500 N-2000 N-2500

T-414

I-6-C EL 548.30

I-6-A EL 524.30

LR-47015

GRID MARKER
S3+51.41
E2+10.41
EL 555.63
(NTS)

GRID MARKER
S3+49.88
E16+38.31
EL 519.24
(NTS)

GRID MARKER
S18+40.22
E2+09.32
EL 521.87
(NTS)

GRID MARKER
S18+55.85
E11+88.99
EL 591.16
(NTS)

Ruins

530.94 529.54 524.64 523.48 528.74 527.7 523.7 521.4 519.9 519.8 517.18 517.18 523.48 518.23 515.73 514.83 521.73 513.33 519.6 515.64 522.33 527.27 532.6 530.3 518.0 512.94 516.2 51706 511.8 514.53 515.1 515.03 520.06 512.53 510.5 518.87 537.9 532.3

535 530 525 520 515

SHEET NO. 2 OF 10

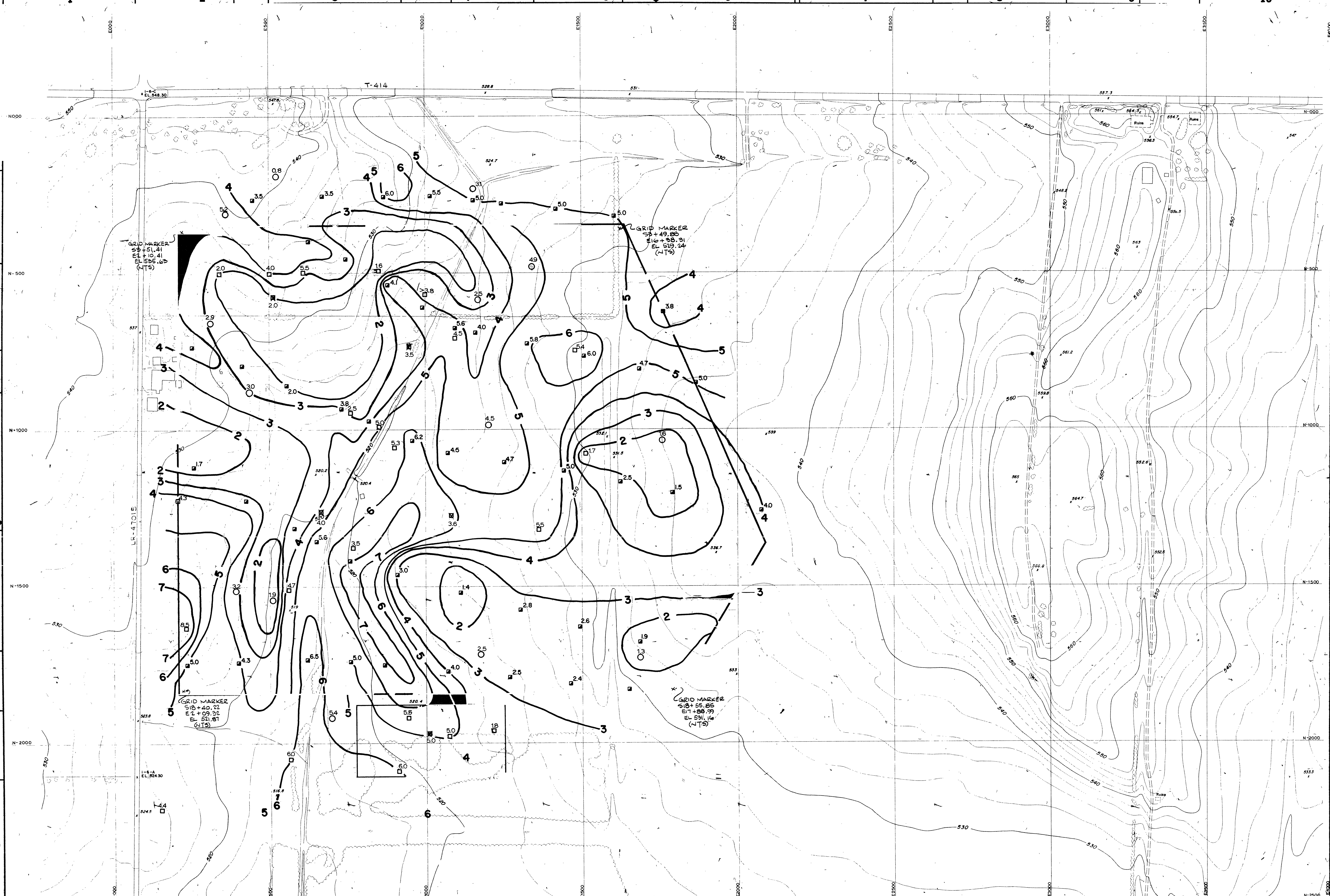
MONTOUR S.E.S. ASH DISPOSAL AREA #3

BEDROCK ELEVATION

(FEET)

PENNSYLVANIA POWER & LIGHT COMPANY

Engineering Drawing Standards Dwg. No. - 2/6", Title - 2/16", Subtitle - 8/32", Letter figures - 1/8" Min.



LEGEND

- SEPTEMBER, 1983 TEST PIT
- MAY, 1983 TEST PIT
- SEPTEMBER, 1983 TEST BORING
- NOVEMBER, 1983 TEST BORING
- P.P.&L. PIEZOMETER
- MARCH, 1986 TEST PIT

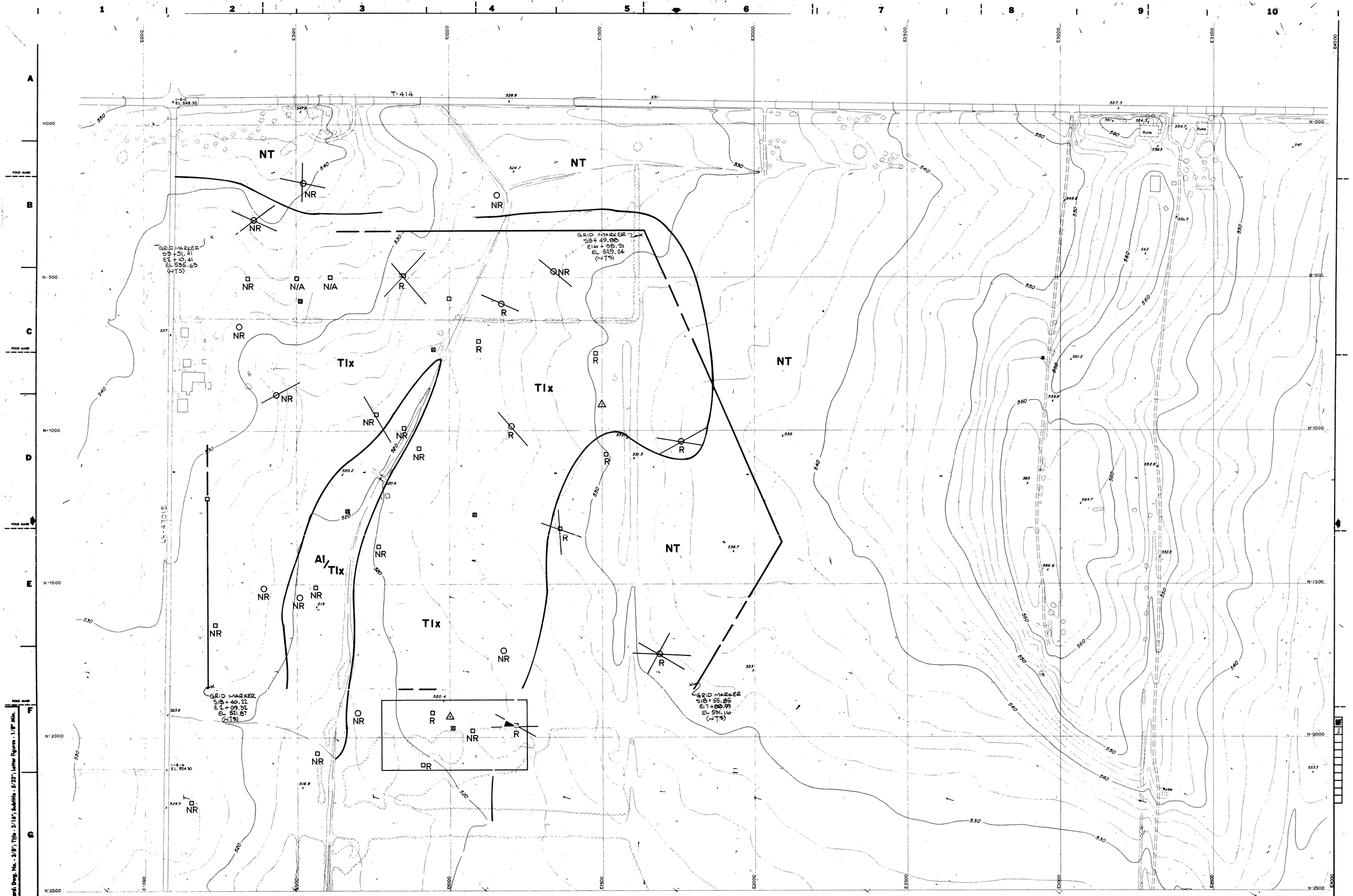
SHEET NO. 3 OF 10

MONTOUR SES ASH DISPOSAL AREA 3

DEPTH TO BEDROCK
(SOIL THICKNESS) (FEET)

PENNSYLVANIA POWER & LIGHT COMPANY

196008-



LEGEND

Al/TIx	ALLUVIAL SOILS OVER TILL	R	RUSTING OF SHALE NOTED
TIx	WEATHERED TILL	NR	NO RUSTING NOTED
NT	TILL ABSENT	N/A	RUSTING DATA NOT AVAILABLE
	TREND OF FRACTURE STRIKES		

SHEET NO. 4 OF 10

MONTOUR SES ASH DISPOSAL AREA

SITE GEOLOGY

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PA.

E196008-1

Lehigh Heights Drafting Standard Dwg. No. - 3/8"; Title - 3/16"; Subtitle - 9/32"; Letter Figures - 1/8" Min.