Prepared for:

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

CLOSURE PLAN

Per Requirements of 40 CFR §257.102

Brunner Island SES Ash Landfill 8
East Manchester Township, Pennsylvania

Prepared by:

Geosyntec consultants

10211 Wincopin Circle, Floor 4
Columbia, Maryland 21044

Project Number ME1207A

October 2016

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1. INTRODUCTION

1.1 Organization and Terms of Reference

Geosyntec Consultants (Geosyntec) has prepared this Closure Plan for Talen Generation, LLC (Talen) to demonstrate compliance of the existing Brunner Island SES Ash Landfill 8 (Ash Landfill 8) in East Manchester Township, Pennsylvania with the closure requirements 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 257.102 contains the requirements for conducting closure of CCR landfills. In this Closure Plan, the specific requirements of §257.102 are identified and addressed.

This Closure Plan 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

Ash Landfill 8 is located on Brunner Island, south of the Brunner Island Steam Electric Station (SES) located in East Manchester Township, York County, Pennsylvania. The site is shown on a United State Geological Survey 7.5-minute topographic map for the York Haven Quadrangle (Figure 1). Ash Landfill 8 is constructed on top of the closed CCR surface impoundment Ash Basin 5. Ash Landfill 8 and Ash Basin 5 are located adjacent to the Susquehanna River and south of the central portion of the power station.

1.3 Landfill Description and Permit Status

Ash Landfill 8, also called Disposal Area 8, is a CCR landfill constructed in 2008 to accept coal combustion residuals and other wastes produced by the Brunner Island SES, as described by Form R of the Pennsylvania Department of Environmental Protection (PADEP) Class II Residual Waste Disposal Facility permit (PADEP Permit) application package (PPL 2008b). Ash Basin 5 was closed in 1987 (ERM 2007) and was neither impounding water nor receiving CCR on the effective date of the CCR rule (i.e., 19 October 2015) and therefore is not regulated under the CCR rule.

Ash Landfill 8 is regulated under the Pennsylvania Residual Waste Regulations of Title 25 PA Code, Chapters 287 and 288. The unit is permitted as a PADEP Class II Residual Waste Disposal Facility. Ash Landfill 8 was constructed and is operated under Permit No. 301354 for a Landfill—Class I, II, or III (PADEP 2008), which was issued in August 2008.

A closure plan was submitted to and approved by PADEP as part of the residual waste disposal permit. It is presented as Attachment 5 of Volume 2 of the Design Package prepared by Civil and Environmental Consultants, Inc. and modified by PPL (PPL 2008a), which is appended to the PADEP Permit application. The PADEP-approved closure plan is for closure in place. As such, §257.102(b)(1)(ii) is not applicable.

2. CCR RULE REQUIREMENTS FOR WRITTEN CLOSURE PLAN (§257.102(B))

2.1 Written Closure Plan (§257.102(b)) Requirements

As described in §257.102(b) of the CCR Rule, a written closure plan must be prepared for Ash Landfill 8 that describes the steps necessary to close the CCR unit at any point during the active life of the CCR unit consistent with recognized and generally accepted good engineering practices. The written closure plan must include, at a minimum, the information specified in paragraphs (b)(1)(i) through (vi) of §257.102, including:

(i) A narrative description of how the CCR unit will be closed in accordance with §257.102.
(ii) If closure of the CCR unit will be accomplished through removal of CCR, a description of the procedures to remove the CCR and decontaminate the CCR unit in accordance with §257.102(c).
(iii) If closure of the CCR unit will be accomplished by leaving CCR in place, a description of the final cover, designed in accordance with §257.102(d), and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover will achieve the performance standards specified in §257.102(d).
(iv) An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.
(v) An estimate of the largest area of the CCR unit ever requiring a final cover as required by §257.102(d) at any time during the CCR unit's active life.
(vi) A schedule for completing all activities necessary to satisfy the closure criteria, including an estimate of the year in which all closure activities will be completed as well as duration of such activities. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, construction of the final cover, and the estimated timeframes to complete each step or phase of CCR unit closure. If the owner or operator of a CCR unit estimates that the time required to complete closure will exceed the timeframes specified in §257.102(f)(1), that is within six months of commencement of closure activities, supporting information must be provided to request an extension. The schedules should consider the requirements of §257.102(e) (Initiation of Closure Activities) and §257.102(f) (Completion of Closure Activities).

In addition, the owner or operator of the CCR landfill must comply with the requirements of §257.102(g), (h), (i), and (j), which pertain to notification of intent to close, notification of closure, deed notations, and recordkeeping requirements, respectively.

2.2 Compliance with Closure Requirements

Part 3 of this document presents the written closure plan required by the CCR Rule. The table below summarizes where the CCR Rule requirements are addressed in this document.

RULE SECTION	RULE REQUIREMENT	LOCATION WHERE ADDRESSED IN DOCUMENT
§257.102(b)(1)(i)	Narrative of How Unit will be Closed with CCR in Place	Section 3.1
§257.102(b)(1)(ii)	Narrative of How Unit Will be Closed by Removal of CCR Removal	NA
§257.102(b)(1)(iii)	Description of Final Cover	Section 3.2
	Discussion of How Final Cover System Will Meet Performance Standard of §257.102(d)	Section 3.3
§257.102(b)(1)(iv)	CCR Maximum Inventory Estimate	Section 3.4
§257.102(b)(1)(v)	Closure Area Estimate	Section 3.5
§257.102(b)(1)(vi)	Schedule for Completing Closure Activities	Section 3.6
§257.102(b)(4)	Written Certification by a Qualified Professional Engineer that the Written Closure Plan meets the requirements of §257.102(b)	Section 4

3. CLOSURE PLAN

3.1 Description of Closure

Per §257.102(b)(1)(i), this section provides a narrative description of the unit closure. This description is consistent with the approved Closure Plan for PADEP Permit 301354 (PPL 2008a), which is included in Appendix A.

Ash Landfill 8 will be closed by leaving CCR in place, constructing an alternative final cover over the active area of the unit, and complying with other requirements of the CCR Rule. The closure of each cell of the unit will occur as each cell reaches its capacity, according to the landfill phasing plan shown on Sheets 13 through 15 of the Final Land Development Plan and Permit Drawings (Permit Drawings) (CEC 2007) included in this demonstration as Appendix B.

3.2 Description of Final Cover

Per §257.102(b)(1)(iii), the following paragraphs provides a description of the proposed alternative final cover in accordance with the requirements of §257.102(d)(3)(ii). Details of the proposed final cover and the proposed final cover grading plan are included as part of the Permit Drawings (see Sheets 7 and 10 in Appendix B).

The final cover design includes a geosynthetic cover system with permeability less than or equal to the Ash Landfill 8 liner system. The final cover design includes (from bottom to top):

- 40-mil textured geomembrane;
- geocomposite drainage layer; and
- 24-inch protective cover and a vegetative support (i.e. erosion) layer.

The final cover will be installed according to the soil construction methodology described in Section 10 of the Construction Quality Assurance/Quality Control (CQA/QC) Plan (Attachment 2 of PPL 2008a) prepared as part of the PADEP Permit application. Prior to commencing closure construction activities, both geosynthetic and soil materials proposed for construction will be evaluated through a thorough quality control (QC) and quality assurance (QA) program, to verify that the specified materials achieve the design standard. The approved CQA/QC Plan will be implemented to monitor that the final cover and associated features are constructed in accordance with the design documents and applicable regulations.

As an alternative final cover, the proposed final cover presented in the Permit Drawings includes a 40-mil geomembrane infiltration layer. The final cover is also designed with a geocomposite drainage layer to provide lateral drainage, which will minimize the head on the geomembrane and thus, the infiltration through the final cover. Calculations demonstrating the capacity of the geocomposite drainage layer are presented in Attachment 1.6 of PPL (2008a).

Leachate generation calculations presented by PPL (2008a) and final cover percolation analysis presented in Appendix D.1 indicate that the proposed final cover will reduce leachate generation and will achieve an equivalent reduction in infiltration as the infiltration layer specified in §§257.102(d)(3)(i)(A) and (B) (§257.102(d)(3)(ii)(A)).

The geomembrane infiltration layer and geocomposite drainage layer will be overlain by a 24-inch protective cover soil layer, which will protect the geomembrane infiltration layer and provide vegetative support to minimize erosion of the final cover (§257.102(d)(3)(ii)(B)). A description of the cover soils is included in Attachments F-1 and F-2 of the PPL (2008b). Attachments F-1 and F-2 of the permit application package are included as Appendix C of this demonstration.

The final cover will be constructed of earthen and geosynthetic components that are sufficiently flexible to accommodate local differential settlements and subsidence (§257.102(d)(3)(ii)(C)), as indicated the final cover settlement analysis presented in Appendix D.2.

3.3 Performance Standard

The methods and materials of construction discussed above were specified such that the final cover meets the performance standard described by the CCR Rule (§257.102(d)(1)) as described below.

- The unit will be closed in a manner to control and minimize, to the extent feasible, post-closure infiltration of liquid into the waste (§257.102(d)(1)(i)) by incorporating a low-permeability final cover that meets the requirement of §257.102(d)(3)(ii)(A) through (C). The low permeability of the cover is achieved through the use of a geomembrane and geocomposite drainage layer, as described above. The final cover will preclude contact of surface water with underlying waste, thereby minimizing, to the extent feasible, releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

- The surface of the final cover will be graded and include stormwater control features (i.e. bench channels, downcomers) such that the cover system does not impound water, sediment, or slurry, even after settlement of the underlying waste has occurred (§257.102(d)(1)(ii)). The approved stormwater management plan (PPL 2008a, Attachment 1.7) provides for the control and conveyance of stormwater during operation and following closure of the unit. Results of the final cover settlement analysis indicate that the stormwater control features will continue to operate as designed following settlement of the unit.

- The approved CQA/QC Plan will be implemented such that the final cover will be constructed as designed and the cover system will maintain major slope stability and integrity throughout the closure and post-closure periods (§257.102(d)(1)(iii)). The

stability of the final cover system under design conditions is demonstrated by slope stability analysis included as Attachment 1.1.3 of PPL (2008a).

- The final cover will be vegetated with native, non-woody vegetation requiring minimal maintenance such as mowing (§257.102(d)(1)(iv)). Provisions for revegetation are summarized in Form H of PPL (2008b) (Appendix E), including the non-woody seed mixture to be used and maintenance such as quarterly inspections and filling erosion scars and reseeding as necessary. Additional provisions for revegetation and maintenance are discussed in Section 2.5 of the approved closure plan.

- The final cover system will be constructed according to the conceptual schedule presented in Section 3.6 (§257.102(d)(1)(v)).

3.4 Maximum Inventory of CCR

The CCR Rule (§257.102(b)(1)(iv)) requires that the written closure plan provide an estimate of the maximum inventory of CCR on site over the active life of the CCR unit. However, the preamble to the CCR Rule states that if portions of the unit are routinely closed, only the active portion should be considered for inventory. Because Ash landfill 8 is to be filled and closed in three separate cells, the maximum amount of CCR onsite during the active life of the unit is dependent on which cell is active at the time of closure. The estimated maximum inventory of CCR in the unit at one time, by active cell, is as follows (Sheets 13 through 15 of CEC 2007):

- Cell 1: 377,970 cubic yards
- Cell 2: 460,220 cubic yards
- Cell 3: 524,680 cubic yards

3.5 Maximum Area Requiring a Final Cover

The CCR Rule (§257.102(b)(1)(v)) requires that the written closure plan provide an estimate of the largest area of the CCR unit requiring final cover at any one time in the CCR unit's active life.. However, the preamble to the CCR Rule states that if portions of the unit are routinely closed, only the active portion should be considered to require closure. Because Ash landfill 8 is to be filled and closed in three separate cells, the largest area requiring final cover is dependent on which cell is active and requiring final closure. The area of final cover geomembrane is provided in the Permit Drawings. Using the geomembrane area as a surrogate for the area requiring final cover, the largest area of the CCR unit ever requiring closure, by active cell, is as follows (Sheets 13 through 15 of CEC 2007):

- Cell 1: 228, 430 square feet
- Cell 2: 287,030 square feet
- Cell 3: 458,840 square feet

3.6 Closure Schedule

Ash Landfill 8 is expected to remain open and active throughout the remaining operating life of the facility, if beneficial use of CCR continues. When a decision is made to close the unit, closure activities will commence within 30 days of the final receipt of waste (§257.102(e)(1)(i)) and all closure activities will be completed, as required by §257.102(f)(1)(i), within six months of the commencement of closure activities.

The conceptual schedule below list major milestones expected during closure activities. The time to reach each milestone, starting from the commencement of closure activities, are included.

Milestone	Maximum Anticipated Time for Completion (from date of decision to close unit)
Final Closure System Design	Prior to Commencing Closure
Approval and Permits Obtained from PADEP	Prior to Commencing Closure
Commencement of Closure System Construction Activities	Within 30 days of final receipt of CCR
Complete Construction of Closure System	Within 6 months of commencing closure

4. CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

Per §257.102(b)(4), the owner or operator of the unit must obtain a written certification from a qualified professional engineer that the Written Closure Plan meets the requirements of the CCR Rule.

Certification for Written Closure Plan

CCR Unit: Brunner Island SES Ash Landfill 8

Certification

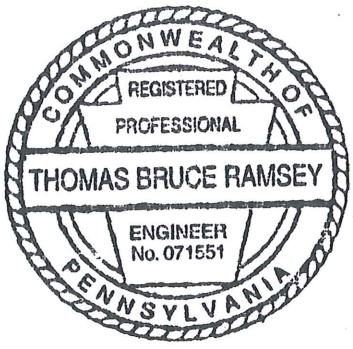
I, **Thomas B. Ramsey**, a registered professional engineer in the Commonwealth of Pennsylvania certify that the Written Closure Plan for the Brunner Island SES Ash Landfill 8 is in compliance with requirements of 40 CFR §257.102(b). This certification is based on my review of information described in this certification report.

Printed Name Thomas B. Ramsey

PE License Number PA071551 **State** Pennsylvania

Signature _____ **Date** 12 OCT 2016

Seal



5. REFERENCES

CEC (2007). "Final Land Development Plans and Permit Drawings." Civil & Environmental Consultants, Inc. March 2007.

ERM. (2007). "Technical Memorandum: Flood Impact on Ash Basin 4, 5, 6, and 7 Dikes Study – Brunner Island Station." Environmental Resource Management. October 2007.

PADEP (2008). "Permit for Solid Waste Disposal and/or Processing Unit; Permit No. 301354." Pennsylvania Department of Environmental Protection, Waste Management Division, Southcentral Region. Harrisburg, PA.

PPL (2008a). "Disposal Areas 8 Class II Residual Waste Disposal Facility Landfill Design Package and Plans." Volumes 1 & 2. PPL Generation, LLC. January 2008.

PPL (2008b). "Disposal Area 8 Class II Residual Waste Disposal Facility Permit Application Forms." PPL Generation, LLC. January 2008.

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

FIGURES

U.S. DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

The National Map US Topo

YORK HAVEN QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES

Brunner Island SES
Ash Landfill 8

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983
(south zone)

Imagery.....NAIP, July 2010
Roads.....©2006-2012 TomTom
Names.....GNIS, 2013
Hydrography.....National Hydrography Dataset, 2010
Contours.....National Elevation Dataset, 2002
Boundaries.....Census, IBWC, IBC, USGS, 1972 - 2012

UTM GRID AND 2013 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m square ID
UK
Grid Zone Designation
18T

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

PENNSYLVANIA

QUADRANGLE LOCATION

Steelton	Middletown	Elizabethtown
Dover	York Haven	Columbia West
West York	York	Red Lion

ADJOINING 7.5' QUADRANGLES

ROAD CLASSIFICATION

Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

Figure 1
Unit Location Map

YORK HAVEN, PA
2013

APPENDIX A

Approved Closure Plan (Attachment 5 of PPL 2008a)

DISPOSAL AREA 8
CLASS II RESIDUAL WASTE DISPOSAL FACILITY
CLOSURE PLAN

PPL GENERATION, LLC
BRUNNER ISLAND STEAM ELECTRIC STATION
EAST MANCHESTER TOWNSHIP, YORK COUNTY, PENNSYLVANIA

Prepared for:

PPL GENERATION, LLC
TWO NORTH NINTH STREET, PLAZA 6
ALLENTOWN, PENNSYLVANIA 18101-1179

Prepared by:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
333 BALDWIN ROAD
PITTSBURGH, PENNSYLVANIA 15205

CEC Project 060-338

JANUARY, 2008

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BRUNNER ISLAND STEAM ELECTRIC STATION
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PPL GENERATION, LLC
BRUNNER ISLAND STEAM ELECTRIC STATION
DISPOSAL AREA 8

CLOSURE PLAN

1.0 INTRODUCTION

This Closure Plan is for Disposal Area 8 at the PPL Generation, LLC, Brunner Island Steam Electric Station. The site is located in East Manchester Township, York County, on the west shore of the Susquehanna River. Disposal Area 8 is located over the previously filled and retired ash impoundment "Basin 5," where sluiced ash was disposed. Basin 5 was filled with approximately 35 to 40 feet of ash. Area 8 covers approximately 19 acres and will be used for residual waste disposal. The top of the landfill will be at approximately elevation 380 feet, which is 90 feet above the surface of Basin 5.

Disposal Area 8 will be developed in three phases as presented by the permit drawings. Consequently, closure of Area 8 will be performed in three phases and it will be performed after each phase is filled to capacity.

Pennsylvania residual waste Form 18R "Closure/Post-Closure Land Use Plan" was used as a reference during the development of this plan. Sections and subsections listed by Form 18R are referenced below followed by a narrative to address the issue.

2.0 Narrative Addressing Form 18R, Section B. Closure Plan

2.1 Plan for decontamination and removal of equipment, structures and related materials from the facility (Reference – Form 18R Section B.1).

Due to the characteristics of the waste, equipment used to handle the waste will be cleaned by manually removing waste buildup. Then, the equipment will be washed with water under high pressure within the limits of the disposal area or in a location where rinse water will be properly handled. Similar methods will be applied to structures and related materials.

2.2 An estimate of the year in which final closure will occur, including an explanation of the basis for the estimate (Reference – Form 18R Section B.2).

Waste to be disposed in Area 8 is projected to be generated at approximately 41,700 cubic yards per year (115 cubic yards per day). Based on this rate, the following table (copied here from the Attachment 3 - Operations and Maintenance Plan) presents the site's projected filling schedule:

CELL DESIGNATION	DISPOSAL CAPACITY (cy)	ACTIVE LIFE
Cell 1	400,000	9.6 years
Cell 2	475,000	11.4 years
Cell 3	534,000	12.8 years
Total	1,409,000	33.8 years

Assuming that filling commences in 2008 within Cell 1 of Area 8 and considering the projected site life information in the table, the disposal area is projected to fill to capacity some time in 2041.

2.3 If the facility will close in stages, a description of how and when the facility will begin and implement partial closure (Reference – Form 18R Section B.3)

Area 8 will be developed in three phases, where each phase will generally be filled to capacity as the next phase is developed and used for disposal. Once the previous phase is filled to capacity, areas within the phase that are filled to final waste grade will be closed. The limit of closure will be set near the phase limit and will encompass the maximum area on the phase that can reasonably be closed while following good engineering and constructability practices.

Phasing drawings F016, F017, and F018 graphically present the phased development and closure of Area 8, and Section 2.0 "Site Development" in the Construction Plan provides a narrative description of the phased development and closure.

2.4 A description of the steps necessary for closure if the facility closes prematurely.

As noted above, Area 8 will be developed and closed in three phases. As presented on the phasing drawings, the phases have been designed so that during development and filling stormwater management structures on the landfill will be connected to permanent stormwater management structures. If the facility needs to be prematurely closed, unless a design is needed to address field conditions at that time, the operator will implement the following:

- Grade slopes in active areas to blend into adjacent contours and promote positive stormwater drainage to permanent stormwater management structures;
- Perform closure by placing final cover on all disposal areas not previously closed;
- Grade areas outside of the disposal footprint to be free draining to prevent water ponding;
- Revegetate all disturbed areas within and outside the landfill footprint; and
- Perform all other closure activities as planned.

2.5 A narrative description, including a schedule, of measures that are proposed to be carried out after closure at the facility

Several measures are proposed following closure at the facility. These measures are described below:

a. Water Quality Monitoring - Groundwater quality monitoring will continue on a quarterly basis following facility closure for the entire post-closure period (30 years), as required by regulation.

b. Gas Control and Monitoring – Due to the nature of the waste that will be disposed at this facility, it does not generate landfill gas. Consequently, neither landfill gas control nor landfill gas monitoring is necessary.

c. Leachate Collection, Treatment, and Pumping – Leachate management will be performed through the post-closure period of the landfill, or until such time that leachate is no longer generated by the landfill.

d. Erosion and Sedimentation Control – The erosion and sedimentation controls will be used during closure until all surfaces are finally stabilized. They will be maintained as described by the Erosion & Sedimentation Control Plan in Attachment 4 and as shown on the drawings.

e. Revegetation Including Maintenance of the Final Cover – The final cover will be monitored during routine site inspections (see Item g below that defines "routine site inspections") and after heavy rains. Areas encountered that require maintenance due to erosion, equipment damage, or vegetation mortality will be repaired. Repairs may include soil addition to repair erosion damage, regrading, and revegetation (i.e., application of seed, mulch, fertilizer and any soil amendments needed).

f. Access Control – The disposal area is located within the Plant's property, and access to the disposal area is controlled by gates controlling access to the Plant. No change to the Plant's access is anticipated following closure of Area 8.

g. Other Maintenance Activities – Routine site inspections will be performed on a monthly basis for the first year following closure. Every year thereafter, Routine site inspections will be performed on a quarterly basis and after major storm events. Maintenance plans and a reasonable schedule to complete the work will be prepared for any corrective action needed with respect to maintenance needed for the site's access roads, channels, or final cover.

2.6 Description of means by which funds will be made available to cover cost of post-closure operations.

The facility will secure a bond based on the bond amount determined by Pennsylvania's standard bonding worksheets. The bond will be secured once the bond amount is accepted as part of the

issuance of a permit for Area 8. The attached bonding worksheets are based on the proposed design and current regulatory requirements.

2.7 Name, address, and telephone number at which the operator can be reached during the post-closure period.

PPL Generation, LLC, Brunner Island Steam Electric Station operates 7 days per week, 24 hours per day. Facility personnel can be reached with the following contact information:

Steven Marbaise – Manager – Fossil Generation Assets
Telephone – 717-266-7510
Fax – 717-266-7519

3.0 Narrative Addressing Form 18R, Section C. Post-Closure Land Use Plan

3.1 How the proposed post-closure land use is to be achieved and the necessary support activities which may be needed to achieve the proposed land use.

The intended post-closure land use plan is for the area to serve as grassland or open pasture. Area 8, any future expansions of Area 8, and portions of the retired ash impoundment "Basin 5" disturbed during the development and operation of Area 8 will be revegetated according to the erosion and sedimentation control plan with ground cover to achieve this final land use.

3.2 The consideration which has been given to making the proposed post-closure land use consistent with landowner plans and applicable State and local land use plans and programs

Following the proposed land use, this land will not be capable of supporting other uses beyond grassland or open pasture. Since it is located within the property for the existing power generation station, this post-closure land use is consistent with the landowner plans. This proposed post-closure land use is in-line with land use policies or plans for this area.

EXHIBIT 1

BONDING WORKSHEETS

BONDING WORKSHEETS
FOR
Landfills and Disposal Impoundments

Revised August 30, 2001

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF LAND RECYCLING AND WASTE MANAGEMENT

General Information

Permits: Please list all permits, approvals, licenses, registrations, other bonds, etc. for this facility.

I.D.#[1]	Authority[2]	Summary[3]

1. *List the permit I.D. number, registration number, etc. If there is no number, put in "none".*
2. *List the issuing authority's name, address and telephone number*
3. *List any closure features or monitoring requirements. As examples: For storage tanks, list the number, type and size of tanks. For NPDES permits list the number of outfalls to be monitored and ponds/plants to be maintained and/or closed.*

Date Prepared

May 24, 2007

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF LAND RECYCLING AND WASTE MANAGEMENT

I.D. Number

BONDING WORKSHEET A
DECONTAMINATING THE FACILITY

Project Summary[1]: The PPL Brunner Island, LLC Area 8 disposal area will be a captive residual waste landfill located in East Manchester Township, York County, Pennsylvania. Since it is a captive facility that shares equipment with the electric generating station on the same property, no equipment will be removed at closure. Therefore, no decontamination will be required as part of facility closure.

1.	Maximum volume of solid waste required to be moved or disposed as part of closure (includes cost for solidification).	0
2.	Estimated volume of contaminated soils or materials (from accidents, spills, prior remediations).	0
3.	Total volume of waste (line 1 + line 2).	0
4	Unit cost to dispose off-site (include any analyses or transportation cost).	N/A
5	Total cost to dispose of waste (line 3 x line 4).	N/A
6	Estimated volume of contaminated liquid generated during decontamination.	0
7.	Unit cost to treat/dispose of contaminated liquids (including any transportation)	N/A
8.	Total cost to dispose of contaminated liquids (line 6 x line 7).	N/A
9.	Estimated volume of fill material	0
10.	Unit cost of acquiring, transporting, placing and stabilizing (i.e. revegetating) fill material (include costs for off-site purchase if soil not available on-site).	N/A
11.	Total cost to fill (line 9 x line 10).	N/A
12.	Equipment decontamination cost	0 LS

Total cost – all Worksheet A **$ 0**
(Put final total on summary cost sheet – line 1)

[1] *List the areas/equipment that will need to be decontaminated and include any assumptions made. Multiple sheets should be used to estimate the costs for different areas.*

CALCULATION BRIEF
BONDING WORKSHEET A
DECONTAMINATING THE FACILITY
AREA 8

OBJECTIVE: **Determine the total bond amount required for the decontamination of the facility at the time of closure.**

METHODOLOGY: Estimate material quantities and disposal costs associated with decontamination of the Area 8 during closure, as required in DEP Bonding Worksheet A.

LINE ITEM ASSUMPTIONS AND CALCULATIONS:

1. Onsite wastes to be managed during closure and final-closure will be placed in the landfill and incorporated into the waste prior to final-closure is completed. Therefore, no offsite disposal is anticipated at the time of final-closure.

6. Due to the characteristics of the waste, equipment used to handle the waste will be cleaned by manually removing waste buildup. Then, the equipment will be washed with water under high pressure within the limits of the disposal area or in a location where rinse water will be properly handled (i.e., discharged into the site's waste water management system. Consequently, there is no cost associated with wash water handling.

Date Prepared

May 24, 2007

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF LAND RECYCLING AND WASTE MANAGEMENT

I.D. Number

BONDING WORKSHEET B
CAP AND FINAL COVER PLACEMENT

How do I start? Select a likely "worst case" scenario where you would have a maximum amount of the facility open and in need of closure. Provide a description of the scenario with references to site development stages.

My approved cap and final cover design consists of (top to bottom):

24 inches (min.) of final cover soil
Drainage geocomposite (HDPE geonet with 6 oz/sy nonwoven geotextile heat-bonded to both sides)
40-mil textured flexible geomembrane
Acceptable soil surface

1. Volume of fill required for area not at final/intermediate grade, but would require filling prior to capping: 0 CY
2. Maximum area to be capped and covered (this should include all areas at final grade and not capped, intermediate grades and areas to be filled to get to intermediate grades then capped): 9.2 acres
3. Closure design, surveying and development of construction drawings (use $750.00/acre of number 2). $ $15,000

   a. Construction and maintenance of access roads. $ $5,000LS

Material Volumes/Areas:

4. Earthen Materials

a.	Structural Fill	0 CY	(Specification[1])	
b.	Intermediate Cover	0 CY	(Specification[1])	
c.	Clay Cap Material	0 CY	(Specification[1])	
d.	Final Cover Soil	30,000 CY	(Specification[1])	
e.	Sand/Stone	402 SY	(Specification[1])	Channel Lining (Rip Rap)
f.	Other	640 Ton	(Specification[1])	Access Road

5. Synthetic Materials

a.	Geotextile	0	Sq.Ft.	(Type)	
b.	FML	400,800	Sq.Ft.	(Type)	
c.	Drainage Layer	400,800	Sq.Ft.	(Type)	
d.	Other	0	Sq.Ft.	(Type)	

6. Cap Penetrations: Estimate the number of cap penetrations that will need to be installed for closure of the facility including, but not limited to gas extraction wells, cleanouts, valve pits, etc. 0

[1] *Provide a brief description of the material specification (i.e. ¾" minus, 12" minus – 12" lifts, etc.)*

Material Unit Costs:

7. Unit cost to place or regrade material to reach final grades (this may include additional waste placement to reach grade) 0 $/CY

Are sufficient soils available in permitted on-site borrow areas to complete job? (Attach maps that identify sources and stockpiles) No

8. Earthen Materials	Stockpile	Borrow	Onsite	Offsite	Processing Req'd Yes	Processing Req'd No
a. Structural Fill	☐	☐	☐	☐	☐	☐
Unit cost to place[2] N/A $/CY						
b. Intermediate Cover	☐	☐	☐	☐	☐	☐
Unit cost to place[2] N/A $/CY						
c. Clay Cap Material	☐	☐	☐	☐	☐	☐
Unit cost to place[2] N/A $/CY						
d. Final Cover Soil	☒	☐	☐	☒	☐	☒
Unit cost to place[2] $13.25/cy $/CY						
e. Sand/Stone	☐	☐	☐	☒	☐	☒
Unit cost to place[2] $84/SY (means) $/SY						
f. Other – Access Road Aggregate	☐	☐	☐	☒	☐	☒
Unit cost to place[2] $22.50/ton $/ton						

9. Synthetic Materials

a. Geotextile
Unit cost to place[3] N/A $/sq. ft.

b. FML
Unit cost to place[3] $0.58/sf $/sq. ft.

c. Drainage Layer
Unit cost to place[3] $0.70/sf $/sq. ft.

d. Other
Unit cost to place[3] N/A $/sq. ft.

[2] *The unit costs should include all associated costs including, but not limited to cost of material, excavation, transportation, processing and placement.*
[3] *The unit price should include the material cost, transportation cost, handling cost and installation cost.*

10. Cap Penetration Unit Cost

List the unit cost to fabricate and install each cap penetration

Unit cost to place N/A $/each

11. Unit cost to construct E & S structures (i.e. channels, letdowns, etc.) N/A $.acre

12. Revegetation Cost

(Seeding rate used: _____ lbs/acre)

(Lime rate used: _____ tons/acre)

(Fertilizer rate used: _____ tons/acre)

(Mulch rate used: _____ tons/acre)

Unit cost to revegetate[3] $2,760/ac $/acre

13. Cost Summary

a.	Fill (line 1 x line 7)		$0
b.	Construction Drawings (line 3)		$15,000
c.	Construction Roads (line 3a)		$5,000
d.	Structural Fill (line 4a x line 8a)		$0
e.	Intermediate Cover (line 4b x line 8b)		$0
f.	Clay Cap Material (line 4c x line 8c)		$0
g.	Final Cover (line 4d x line 8d)		$397,500
h.	Sand/Stone (line 4e x line 8e)		$33,800
i.	Other (line 4f x line 8f)		$14,400
j.	Geotextile (line 5a x line 9a)		$0
k.	FML (line 5b x line 9b)		$232,500
l.	Drainage Layer (line 5c x line 9c)		$280,600
m.	Other (line 5d x line 9d)		$0
n.	Penetrations (line 6 x line 10)		$0
o.	E & S Structures (line 2 x line 11)		$0
p.	Revegetation (line 12 x line 2)		$25,400
		Subtotal	**$1,381,700**
	CQA costs (use 5% of subtotal)		$69,100
		Total	**$1,450,800**

(Place this total on Summary Cost Worksheet – line 2)

CALCULATION BRIEF
BONDING WORKSHEET B
CAP AND FINAL COVER PLACEMENT
AREA 8

OBJECTIVE: **Determine the total bond amount required for cap and final cover placement during closure under worst case conditions.**

METHODOLOGY: Estimate material quantities and installation costs associated with cap and final cover placement on Area 8, as required in PaDEP Bonding Worksheet B.

ASSUMPTIONS:

1. The "worst case" scenario for closure is based on Cell 1 (the largest disposal cell) being constructed, having received waste, and closing prematurely. The maximum amount of open area that would need to be closed would be approximately 9.2 acres (the Cell 1 footprint).

2. The proposed cap and final cover design will consist of from top to bottom):

   - 24 inches (min.) final cover soil;
   - Drainage composite (HDPE geonet with 6oz/sy nonwoven geotextile heat-bonded to both sides);
   - 40-mil textured flexible geomembrane; and
   - Acceptable soil surface.

   Refer to the design drawings for a detail of the final cover system.

LINE ITEM ASSUMPTIONS AND CALCULATIONS:

1. It is assumed that there will be no fill required for areas not at final/intermediate grade.

2. See Assumption No. 1 (9.2 acres).

4a. No structural fill placement is anticipated.

4b. No intermediate cover soil will be placed.

4c. No clay soil is included in the proposed cap cross section design.

4d. Final cover soil will be placed over the entire area.

V_{FC} = (9.2 ac) * (43,560 sf/ac) * (2 ft) * (1 cy/27 cf)
V_{FC} = 30,000 cy

4e. The estimated stone quantity is based on the material needed for stone (Riprap) lined channels.

A_{STONE} = 402 SY

4f. This item includes the estimated aggregate needed for the permanent access road into the landfill.

$W_{AGGREGATE}$ = 640 TONS

5. Synthetic material quantities were calculated for the entire 50 acre area to be closed in accordance with the cap and final cover system.

A = (9.2 ac) * (43,560 sf/ac)
A = 400,800 sf

6. Due to the nature of the waste a LFG collection system, including wells and cleanouts is not required.

7. There should be no additional placement/regrading to reach final grade.

8d. Only final cover soil will be needed in the cap, which will be purchased from an off-site vendor. The costs to purchase and place the final cover are based on similar prevailing wage projects. The cost for purchase and placement of final cover soil are as follows:

Purchase, Delivery, and Stockpiling on Site of Final Cover Soil = $10.00/cy
Excavation from Stockpile, Hauling, and Placement of Final Cover Soil = $3.25/cy
Total Cost for Final Cover Soil = $13.25/cy

8e. The unit cost to supply and place riprap is $84/sy based on the 2007 Means (Heavy Construction Cost Data).

8f. The unit cost to supply and place access road aggregate is $22.50/TON based on the 2007 Means (Heavy Construction Cost Data).

9. The synthetic material unit installation costs are based on similar prevailing wage projects.

10. Not Applicable

11. It is assumed that all of the benches have been constructed at the time of closure of the facility. All other erosion and sedimentation control structures already exist at the site.

12. Revegetation costs are estimated are based on similar prevailing wage projects. Seeding with the permitted seed mix, fertilizer, and mulch rates is included in the cost estimate.

Revegetation cost = Seeding, Fertilizer, Mulch application
Revegetation cost = $2,760/ac

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I.D. Number

BONDING WORKSHEET C
GROUNDWATER MONITORING SYSTEM

1. Number of wells in the approved monitoring plan. _____
   a. Shallowest well depth _____ ft.
   b. Deepest well depth _____ ft.
   c. Average well depth _____ ft.
   d. Number with dedicated pumps _____
2. Unit cost to upgrade an existing well with a dedicated pump _____ $/well
3. Unit cost to install a well (assume average well depth, and include drilling, installation, developing and pump installation) _____ $/well
4. Number of wells to be installed (wells in the approved plan that haven't been installed) _____
5. Number of wells to be replaced over the life of the monitoring period (use 10% of line 1 and round up) _____
6. Number of pumps to be replaced/repaired (use 25% of line 1 over the monitoring period) _____
7. Unit cost to purge and sample a well (assume average well depth, and include methane monitoring, record keeping and shipping) _____ $/well
8. Unit cost to analyze sample(s)
   a. Quarterly (25 PA Code §273.284, §277.284 or §288.254) _____ $/well
   b. Annually (25 PA Code §273.284, §277.284 or §288.254) _____ $/well
9. Unit cost to analyze data (includes review of lab QA/QC data, database input, form completion, statistical analysis and data review) _____ $/well
10. Cost to purge, sample and analyze – quarterly (line 7 + line 8a + line 9) _____ $/well
11. Cost to purge, sample and analyze – annually (line 7 + line 8b + line 9) _____ $/well
12. Number of years of sampling (30 + time to close) _____ years

13. Cost Summary –Groundwater Monitoring System

a. System upgrade ([line 1 – line 1d] x line 2) $_____

b. Wells to be Installed (line 3 x line 4) $_____

c. Wells to be replaced (line 3 x line 5) $_____

d. Pumps to be replaced (line 2 x line 6) $_____

e. Cost of Quarterly Monitoring
(line 1 x "4" x line 10 x line 12) $_____

f. Cost of Annual Monitoring
(line 1 x line 11 x line 12) $_____

Subtotal $_____

Adjustment for resampling, assessments, etc.

a. Use 0% of subtotal if no assessments in last 2 yrs.

b. Use 5% of subtotal if assessment in last 2 yrs.

c. Use 10% if currently in assessment, abatement or increase monitoring $_____

Total $_____
(Place this total on Summary Cost Worksheet – line 3)

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I.D. Number

BONDING WORKSHEET D
SURFACE WATER MONITORING

Solid Waste Surface Water Sampling

1. Number of surface points monitored for Solid Waste Permit _____
2. Unit cost to sample a surface point (record keeping and shipping) _____ $/point
3. Unit cost to analyze sample(s)
   a. Quarterly (25 PA Code §273.284 or §288.254) _____ $/point
   b. Annually (25 PA Code §273.284 or §288.254) _____ $/point
4. Unit cost to analyze data (includes review of lab QA/QC data, database input, form completion, and data review) _____ $/point
5. Cost to sample and analyze – quarterly (line 2 + line 3a + line 4) _____ $/point
6. Cost to sample and analyze – annually (line 2 + line 3b + line 4) _____ $/point
7. Number of years of sampling (30 + time to close) _____

NPDES Surface Discharge Sampling

8. Number of outfalls monitored _____
9. Monitoring frequency (i.e. monthly, quarterly, etc) _____
10. Number of samples to be taken per point/year _____
11. Unit cost to sample a surface point (record keeping and shipping) _____ $/point
12. Unit cost to analyze sample(s) (including data review and completing DMR) _____ $/point
13. Number of years of sampling (30 + time to close) _____
14. Cost Summary –Surface Water Monitoring
    a. Cost of Quarterly Surface Water Monitoring (line 1 x "4" x line 5 x line 7) $_____
    b. Cost of Annual Surface Water Monitoring (line 1 x line 6 x line 7) $_____
    c. Cost of NPDES Monitoring (line 8 x line 10 x [line 11 + line 12] x line 13) $_____
    d. NPDES renewals over post-closure period (includes application development, fees, etc.) use 10% of line 14c $_____

Subtotal$** **$_____

Adjustment for resampling, assessments, etc.

a. Use 0% of subtotal if no assessments in last 2 yrs.

b. Use 5% of subtotal if assessment in last 2 yrs.

c. Use 10% if in assessment, abatement or increased monitoring $\$$_____

Total $\$$_____

(Place this total on Summary Cost Worksheet – line 4)

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I.D. Number

BONDING WORKSHEET E
PRIVATE WATER SUPPLY MONITORING

1. Number of private water supplies monitored. _____

2. Unit cost to sample a well (include methane monitoring, record keeping and shipping) _____ $/well

3. Unit cost to analyze sample(s) quarterly (Act 101 Section 1103) _____ $/well

4. Unit cost to analyze data (includes review of lab QA/QC data, database input, form completion, and data review) _____ $/well

5. Total cost for quarterly sampling (line 2 + line 3 + line 4) _____ $/well

6. Number of years of sampling (30 + time to close) _____ years

7. Cost Summary –Private Water Supply Monitoring

   a. Cost of quarterly monitoring (line 5 x 4 x line 6) $_____

Total $_____

(Place this total on Summary Cost Worksheet – line 5)

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I.D. Number

BONDING WORKSHEET F
GAS MONITORING SYSTEM

1. Number of probes in the approved monitoring plan. N/A
   a. Shallowest probe depth N/A ft.
   b. Deepest probe depth N/A ft.
   c. Average probe depth N/A ft.
   d. Number of probes installed N/A
2. Unit cost to install a probe (including, drilling, and installation) N/A $/probe
3. Number of probes to be installed (probes in the approved plan that haven't been installed N/A
4. Number of probes to be replaced over the life of the monitoring period (use 5% of line 1 and round up) N/A
5. Unit cost to monitor a probe (include record keeping) N/A $/probe
6. Number of probes and structure monitoring events per year
7. Number of years of monitoring (30 + time to close) N/A years
8. Cost Summary –Gas Monitoring System
   a. System completion (line 3 x line 2) $ $ N/A
   b. Probe replacement (line 2 x line 4) $ $ N/A
   c. Probe Monitoring (line 1 x line 5 x line 6 x line 7) $ N/A

Subtotal $ N/A

Adjustment for resampling, assessments, etc.

a. Use 0% of subtotal if no assessments in last 2 yrs.
b. Use 5% of subtotal if assessment in last 2 yrs.
c. Use 10% if in assessment or increased monitoring

Total $ 0

(Place this total on Summary Cost Worksheet – line 6)

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I.D. Number

BONDING WORKSHEET G
GAS COLLECTION SYSTEM

1. Number of wells in the approved monitoring plan. N/A
   a. Shallowest well depth N/A ft.
   b. Deepest well depth N/A ft.
   c. Average well depth N/A ft.
   d. Number of wells installed N/A
   e. Number of pumping wells N/A
2. Cost for flare or other control device installation $ N/A LS
3. Unit cost to install a well (including, drilling, installation, and connection to active system) N/A $/well
4. Unit cost to install a gas well requiring liquid removal (including, drilling, installation, and connection to active system) N/A $/well
5. Number of wells to be installed (wells in the approved plan that haven't been installed)
6. Number of gas wells requiring liquid removal to be installed N/A
7. Estimate the length of collection piping to be installed N/A LF
8. Unit cost to install collection piping (include excavation, pipe bedding, pipe, backfilling, regrading, revegetating, surveying and QA/QC) N/A $/LF
9. Number of wells to be replaced/repaired over the life of the monitoring period (use 10% of line 1 and round up) N/A
10. Unit cost to monitor well and balance system monthly (include monitoring of methane, oxygen, carbon dioxide or nitrogen, temperature, pressure, and NSPS record keeping) N/A $/well
11. Unit cost to conduct surface monitoring (NSPS) N/A $/event
12. Control System Information N/A
    a. number and size of blowers N/A
    b. flare dimensions and capacity N/A
    c. current flow rate N/A
    d. other features N/A
13. Cost of electricity to run system N/A $/year
14. Cost to maintain system (including daily check, weekly charts, maintenance, etc.) N/A $/year
15. Cost of annual blower maintenance (including greasing, bearing check and alignment) N/A $/year

16. Cost of stack testing (once per five years) N/A $/event
17. Estimate the volume of condensate generated per year N/A gallons
18. Cost of condensate management (including pumping, testing and treatment/disposal) N/A $/year
19. Number of years to run system (30 + time to close) N/A years
20. Cost Summary –Gas Collection System N/A

System Installation

a. Additional well installation (line 5 x line 3) $ N/A

b. Additional pumping well installation (line 4 x line 6) $ N/A

c. Cost of collection piping (line 7 x line 8) $ N/A

d. Well replacement (line 3 x line 9) $ N/A

e. Enclosed ground flare system (line 2) $ N/A

System Installation Subtotal $ N/A
(sum lines a to e)

f. Cost of monitoring/balancing (line 1 x "12" x line 10 x line 19) $ N/A

g. Cost of surface monitoring (line 11 x "1.5" x line 19) $ N/A

h. Electric Cost (line 13 x line 19) $ N/A

i. System maintenance cost (line 14 x line 19) $ N/A

j. Blower maintenance cost (line 15 x line 19) $ N/A

k. Stack testing cost (line 16 x [line 19/5]) $ N/A

l. Condensate management cost (line 18 x line 19) $ N/A

System Monitoring and Maintenance Subtotal $ N/A
(sum lines f to l)

Adjustment for miscellaneous maintenance items (including; knockout pot maintenance, thermocouple replacement, flame detector replacement, flame arrester maintenance, flare maintenance, enrichment/startup gas replacement, pneumatic valve maintenance, sump maintenance, panel board maintenance, etc.)

a. Use 0% of subtotal if system[1] < 2yrs old

b. Use 5% of subtotal if system[1] is > 2 yrs old, but < 5yrs old

c. Use 10% if system[1] is > 5 yrs old

$ N/A

Total (Installation subtotal + M & M subtotal + Misc. Maintenance) **$ 0**
(Place this total on Summary Cost Worksheet – line 7)

[1] *The age of the system would be considered from the date that the active system went on-line. Expansions of the systems are assumed to occur, however, this does not change the age of the system unless a majority of the existing system is replaced/upgraded.*

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BONDING WORKSHEET H
OTHER MONITORING AND REPORTING

Please list the annual costs to maintain the following permits/registrations that apply. Additional space is provided for items applicable to your facility, but not listed.

1. Title V or other air permit (include the annual permit fee, cost to complete emissions inventory and emissions fees) $ N/A
2. NSPS Annual Report preparation cost $ N/A
3. Local permit or Host Agreement requirements $ N/A
4. UST/AST registration $ N/A
5. Other _____ $ _____
6. Other _____ $ _____
7. Other _____ $ _____
8. Other _____ $ _____
9. Other _____ $ _____
10. Number of years of monitoring/maintenance (30 + time to close) N/A years

Total (sum of lines 1 to 9 x line 10) **$ 0**

(Place this total on Summary Cost Worksheet – line 8)

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I.D. Number

BONDING WORKSHEET I
LEACHATE MANAGEMENT

Leachate Management System Narrative: Provide a detailed description of the leachate management system. You need to include all features of the system including but not limited to landfill sumps (with number and size of pumps and controllers), length of conveyance system, number and type of storage facilities, and treatment/disposal method. A schematic should be attached as back up.

1. Number of years of leachate management (30 years + closure period) _____ 30

2. Annual leachate volume generated _____ 0 gallons

3. Annual cost to manage leachate volume (include pump and pipe maintenance, electricity and monitoring)[1] $_____ N/A

Discharge to POTW

4. Unit cost to discharge leachate to a POTW _____ N/A $/gal

On-site Treatment (including pretreatment)

5. Unit cost for treatment of leachate (include equipment maintenance, electricity, personnel, chemicals, sludge disposal, etc.) _____ N/A $/gal

6. Annual cost to maintain NPDES permit (include sampling, analysis, report preparation, and factor in five year renewal application preparation and fees) $_____ N/A

Interim Trucking of Leachate

7. Unit cost to transport and dispose of leachate _____ N/A $/gal

8. NPDES Permit (cost to prepare application, fees and sampling/analysis) $_____ N/A

9. Cost to construct on-site treatment or pretreatment system or connection to POTW $_____ N/A

10. Unit cost for treatment of leachate (include equipment maintenance, electricity, personnel, chemicals, etc.) _____ N/A $/gal

11. Annual cost to maintain NPDES permit (include sampling, analysis, report preparation, and factor in five year renewal application preparation and fees) $_____ N/A

[1] *Does not include storage of leachate which is contained on Worksheet K*

12. Cost Summary:

a. Cost to manage/convey leachate (line 1 x line 3) $ $ N/A

If discharge to POTW

b. Discharge to POTW cost (line 1 x line 2 x line 4) $ N/A

If have on-site treatment

c. Treatment cost (line 1 x line 2 x line 5) $ N/A

d. NPDES maintenance cost (line 1 x line 6) $ N/A

If you currently truck leachate

e. Cost of trucking leachate for three years (line 1 x "3" x line 10 x line 12) $ N/A

f. NPDES permit (line 8) $ N/A

g. Cost to construct on-site treatment system or connection to POTW (line 9) $ N/A

h. Treatment cost ([line 1 – 3] x line 2 x line 10) $ N/A

i. NPDES maintenance cost ([line 1 – 3] x line 11) $ N/A

If you currently store leachate in impoundments

j. Size of pond(s) N/A acres

k. Estimate volume of material to be removed (including liner system and minimum of 12" of soil) N/A CY

l. Unit cost to dispose of materials (Worksheet A, line 4) N/A $/CY

m. Cost to dispose of materials (line k x line l) $ N/A

n. Volume of structural backfill N/A CY

o. Cost for backfill (line n x Worksheet B, line 8a) $ N/A

p. Revegetation cost $ N/A LS

Subtotal $ **$0**
(sum of a – i) +m+o+p)

Adjustment for maintenance, equipment replacement and contingencies, etc. Please note that these are cumulative and you must add all of the percentages that apply to arrive at the final adjustment percentage. The minimum adjustment is 10%.

a. Add 10% of subtotal if pumps are used to convey leachate.
b. Add 5 % of subtotal if flow volume to POTW is restricted.
c. Add 10% of subtotal if leachate is stored in ponds
d. Add 10% of subtotal if onsite treatment
e. Add 15% if trucking leachate
f. Add 10% if current leachate generation exceeds 5MG/year

Final adjustment factor: 20 %

g. Adjustment (subtotal x factor) $ $0

Total (subtotal + adjustment) $ **$0**
(Place this total on Summary Cost Worksheet – line 9)

CALCULATION BRIEF
BONDING WORKSHEET I
LEACHATE MANAGEMENT
AREA 8

OBJECTIVE: **Determine the total bond amount required for leachate management during closure.**

METHODOLOGY: Estimate sampling, analysis, and reporting costs associated with leachate management for Area 8, as required in PaDEP Bonding Worksheet I.

LINE ITEM ASSUMPTIONS AND CALCULATIONS

2. The proposed design consists of liner and cap systems that include geomembrane layers that are generally impermeable. Consequently, once capped Area 8's leachate generation will decrease to zero. Attachment 1.4 includes HELP model output supports this assumption. With final cover inplace, HELP predicts that there will be zero leachate generation following closure.

   Since there will be no predicted leachate generation following landfill closure, there will be no costs associated with maintaining the leachate management system.

Date Prepared

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I.D. Number

BONDING WORKSHEET J
BORROW AREA CLOSURE

How do I start? Select a likely "worst case" scenario where you would have a maximum amount of the borrow area open and in need of closure. Provide a description of the scenario with references to site development stages.

1. Size of borrow area _____ 0 acres

2. Volume of material required for regrading: _____ N/A CY

3. Unit cost to regrade (provide equipment and rates) _____ N/A $/CY

Are sufficient soils available to complete job?
(list deficit amount and attach maps that identify sources and stockpiles)

4. Earthen Materials			Stockpile	Borrow	Onsite	Offsite	Processing Req'd Yes	Processing Req'd No
a. Structural Fill	N/A	CY	☐	☐	☐	☐	☐	☐
b. Unit cost to place[1]	N/A	$/CY						
c. Topsoil	N/A	CY	☐	☐	☐	☐	☐	☐
d. Unit cost to place[1]	N/A	$/CY						

5. Revegetation Cost

(Seeding rate used: _____ N/A lbs/acre)
(Lime rate used: _____ N/A tons/acre)
(Fertilizer rate used: _____ N/A tons/acre)
(Mulch rate used: _____ N/A tons/acre)

Unit cost to revegetate _____ N/A $/acre

6. E & S Controls _____ N/A $/acre

7. Bond Maintenance Cost (required if off-site borrow area) $_____ N/A LS

8. Other costs (provide detail) $_____ N/A

[1] *The unit costs should include all associated costs including, but not limited to cost of material, excavation, transportation, processing and placement.*

9. Cost Summary

a.	Fill/Regrading (line 2 x line 3)	$ N/A
b.	Structural Fill (line 4a x line 4b)	$ N/A
c.	Topsoil (line 4c x line 4d)	$ N/A
d.	Revegetation (line 1 x line 5)	$ N/A
e.	E & S Controls (line 6)	$ N/A
f.	Bond maintenance (line 7)	$ N/A
g.	Other (line 8)	$ N/A
	Subtotal	$ N/A
	CQA/Project Management costs (use 5% of subtotal)	$ N/A
	Total	**$ 0**

(Place this total on Summary Cost Worksheet – line 10)

Date Prepared

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COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF LAND RECYCLING AND WASTE MANAGEMENT

I.D. Number

BONDING WORKSHEET K
FACILITY MAINTENANCE COSTS

1.	Size of facility *(Retired Ash Basin 5)*	98.6	acres
2.	Size of waste placement footprint	20	acres
3.	Size of borrow areas on site	0	acres
4.	Size of leachate ponds on site		acres
5.	Size of sedimentation ponds on site		acres
6.	Length of stormwater conveyance ditches	2,065	LF
7.	Number of years of site management (30 years + closure period)	30	years
8.	Annual Cost to repair cap and final cover[1]		
	a. Acres (use 1% of line 2)	0.2	acres
	b. Unit cost[2] to repair final cover	$3,300	$/acre
	c. Unit cost[2] to repair cap	$13,940	$/acre
	d. Unit cost[2] to repair vegetation	$2,760	$/acre
	e. Total unit cost (line b + line c + line d)	$20,000	$/acre
9.	Annual Cost to repair and maintain E&S facilities[1]		
	a. Channel repair length (use 3% of line 6)	62	LF
	b. Sedimentation pond repair volume (use 20% of line 5)		acres
	c. Unit cost[2] to repair channels	$46.80	$/LF
	d. Unit cost[2] to repair ponds		$/acre
	e. Total annual cost (line a x line c) + (line b x line d)	$2,902	$/YR
10.	Annual Cost to repair and maintain leachate ponds[1]		
	a. Leachate pond repair volume (use 20% of line 4)		acres
	b. Unit cost[2] to repair leachate pond(s)		$/acre
11.	Annual cost to repair and maintain leachate tanks		
	a. Number and size of tanks	N/A	
	b. Annual unit cost1 to maintain tanks	$ N/A	
12.	Annual cost to repair fences and gates (attach details)	$ N/A	LS

[1] *After the site is stabilized, the Department may allow a reduction in these requirements.*
[2] *Please refer to the instructions. This estimate should reflect unit costs to bring in a contractor to complete the work and should include mobilization, equipment cost, operator costs, material costs and clean-up and inspection costs.*

13. Annual cost to maintain site roads

a.	Length of site roads[2]	720	LF
b.	Annual length of site roads to be repaired (2% of line 13a)	15	LF
c.	Unit cost to repair roads[1]	$194	$/LF

14. Cost Summary – Facility Maintenance

a.	Cost to repair cap/cover (line 7 x line 8a x line 8e)	$	$102,670
b.	Cost to maintain E&S facilities (line 7 x line 9e)	$	$37,200
c.	Cost to maintain leachate ponds (line 7 x line 10a x line 10b)	$	N/A
d.	Cost to maintain leachate tanks (line 7 x line 11a x line 11b)	$	N/A
e.	Cost to repair fences and gates (line 7 x line 12)	$	N/A
f.	Cost to maintain site roads (line 7 x line 13b x line 13c)	$	$87,300
	Subtotal	**$**	$227,170

1. Please refer to the instructions. This estimate should reflect unit costs to bring in a contractor to complete the work and should include mobilization, equipment cost, operator costs, material costs and clean-up and inspection costs. Costs not incurred annually should be determine and divided among the years between events. The costs should also include replacements of pumps and meters, electricity used (pumps, heat tracing, etc.) valve replacement and sludge disposal.

2. This should include access to all maintenance and monitoring areas including but not limited to the disposal area, ponds, leachate conveyance system, tanks, discharge locations, gas extraction system wells, gas probes, groundwater monitoring system and surface water monitoring points.

Adjustment for maintenance, equipment replacement and contingencies, etc. Please note that these are cumulative and you must add all of the percentages that apply to arrive at the final adjustment percentage. The minimum adjustment is 10%.

a. Add 5% of subtotal if final slopes or benches have been modified from what is specified in 25 PA Code §273.234(f)

b. Add 5% of subtotal if more than 30 % stormwater channels are unlined

c. Add 5% of subtotal if the length of site access roads exceeds 5 miles

d. Add 10% for mowing

Final adjustment factor: 15 %

e. Adjustment (subtotal x factor) $ $34,080

Total (subtotal + adjustment) **$ $261,250**

(Place this total on Summary Cost Worksheet – line 11)

[1] *After the site is stabilized, the Department may allow a reduction in these requirements.*

[2] *Please refer to the instructions. This estimate should reflect unit costs to bring in a contractor to complete the work and should include mobilization, equipment cost, operator costs, material costs and clean-up and inspection costs.*

CALCULATION BRIEF
BONDING WORKSHEET K
FACILITY MAINTENANCE COSTS
AREA 8

OBJECTIVE: **Determine the total bond amount required for facility maintenance.**

METHODOLOGY: Estimate facility maintenance costs for Area 8, as required in PADEP Bonding Worksheet K.

LINE ITEM ASSUMPTIONS AND CALCULATIONS

1. The size of the facility (98.6 ac) is the size of retired ash impoundment "Basin 5".

2. The waste placement footprint (20 ac).

6. The total length of the stormwater conveyance channels was measured from the design drawings.

8b. The unit cost is to regrade existing inplace cover soil to address erosion or equipment damage. From Means 2007 Heavy Construction Cost Data, the cost to grade steep slopes is $0.20/sy. It is assumed that a $500 mobilization cost would be encountered with each repair. Since the annual repair area is relatively small the mobilization cost becomes a large component of the per acre repair cost.

Unit Final Cover Repair Cost = ($0.17/sy) * (4,840 sy/ac) + $500/0.2 acres

= $3,300/ac

8c. The unit cost to repair the cap assumes 25 percent of the cost to construct the cap. The installed liner costs were taken from the cap cost estimates (Worksheet B). Based on the rates on Worksheet B, the cap installation costs are:

FML Installation Cost = (43,560 sf/ac) * ($0.58/sf) = $25,265/ac
Drainage Composite Installation Cost = (43,560 sf/ac) * ($0.70/sf) = $30,492/ac
Total Cap Installation Cost = $25,265/ac + $30,492/ac = $55,757/ac

Therefore, the unit cost to repair the cap is calculated as follows:

Cap Repair Cost = $55,757/ac * 0.25
Cap Repair Cost = $13,940/ac

8d. The unit cost to repair vegetation was assumed to be the same as the revegetation cost developed in Worksheet B, Item 12, and is $2,760/acre.

9c. The unit cost to repair channels assumes regrading will be performed to address erosion or equipment damage. It is assumed that 12 hours will be needed to perform this work. It also assumed that the hourly cost for the equipment and operator to perform this work would be $200/hr. It is also assumed that a $500 mobilization cost would be encountered with each repair. Since the annual repair area is relatively small the mobilization cost becomes a large component of the per acre repair cost.

Unit Channel Repair Cost = (($200/hr * 12 hrs) + $500 Mob)/62 LF of channel

= $46.80/LF of channel

11. Following closure zero leachate generation is predicted. Therefore, the proposed tanks will not be needed for leachate management. It is assumed that the tanks will be for other Plant needs and are not considered in post-closure maintenance.

12. The fence around the property also provides security for the Plant. Consequently, it is assumed that the Plant will perform any needed repairs as part of Plant operations. Therefore, fence repairs are not applicable in the bonding worksheet.

13c. The unit cost to repair access roads assumes regrading will be performed to address erosion or equipment damage. It is assumed that 12 hours will be needed to perform this work. It also assumed that the hourly cost for the equipment and operator to perform this

work would be $200/hr. It is also assumed that a $500 mobilization cost would be encountered with each repair. Since the annual repair area is relatively small the mobilization cost becomes a large component of the per acre repair cost.

Unit Access Road Repair Cost = (($200/hr * 12 hrs) + $500 Mob)/15 LF

= $193.33/LF of Access Road

Date Prepared: May 24, 2007

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF LAND RECYCLING AND WASTE MANAGEMENT

I.D. Number

BONDING WORKSHEET L
SUMMARY COST WORKSHEET

Cost Summary - Landfills

1.	Decontaminating the Facility	$ 0
2.	Capping/Closure	$ $1,450,800
3.	Groundwater Monitoring System	$??
4.	Surface Water Monitoring	$??
5.	Private Water Supply Monitoring	$??
6.	Gas Monitoring	$ N/A
7.	Gas Collection and Maintenance	$ N/A
8.	Other Monitoring	$ 0
9.	Leachate Management	$ 0
10.	Borrow Area Closure	$ N/A
11.	Maintenance Costs	$ $261,250
12.	Other Costs[1] _____	$ 0
13.	Other Costs[1] _____	$ 0
	Subtotal	$??

Inflation

14.	Inflation rate (projected inflation for the next three years based on the inflation for the prior three years).*	3.10 %
15.	Inflation cost for facility (subtotal x line 14)	$

Contingency and administrative fees

16.	Administrative fees (5%) (subtotal x 0.05)	$
17.	Project Management (5%) (subtotal x 0.05)	$
18.	Contingency fee amount (subtotal x rate of contingency fee from Table 1)**	$

Total (subtotal + line 15 + line 16 + line 17 + 18) **$** _____

*Inflation rate for the next 3 years was calculated as the average of the inflation for for 2004 (2.68%), 2005 (3.39%), and 2006 (3.24%).

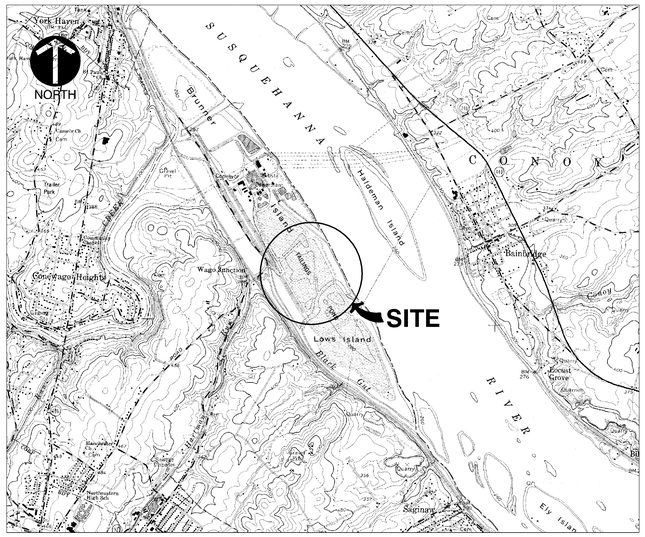
**Contingency fee from Table 1 is 10%.

[1] You should include any costs that would be incurred by the Department, but were not included in these sheets. Provide separate sheets for documentation.

APPENDIX B

Permit Drawings (CEC 2007)

PPL BRUNNER ISLAND, LLC
BRUNNER ISLAND STEAM ELECTRIC STATION
DISPOSAL AREA 8
CLASS II RESIDUAL WASTE DISPOSAL FACILITY
LANDFILL DESIGN DRAWINGS
EAST MANCHESTER TOWNSHIP, YORK COUNTY, PENNSYLVANIA
FINAL LAND DEVELOPMENT PLANS AND PERMIT DRAWINGS



REFERENCE:
7.5' U.S.G.S. TOPOGRAPHIC MAP YORK HAVEN, PA
QUADRANGLE DATED: 1964 PHOTOREVISED: 1990

SITE LOCATION MAP
SCALE IN FEET
0 600 1200

PREPARED FOR
APPLICANT/OWNER/OPERATOR
PPL BRUNNER ISLAND, LLC
P.O. BOX 221
YORK HAVEN, PA. 17370

PREPARED BY

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205
412.429.2324 800.365.2324

PROJECT NO.: 060-338

MARCH 2007

MODIFIED AS INDICATED BY:

ANDREW D. SPEAR P.E., CPESC
SENIOR ENGINEER
PPL CORPORATION
JANUARY, 2008

LIST OF DRAWINGS

PPL DWG # E325747 SHEET #	DRAWING NO.	DRAWING TITLE
1	F001	TITLE SHEET
2	F002	EXISTING SITE CONDITIONS & SEASONALLY HIGH GROUNDWATER CONTOURS
3	F003	BORING PROFILES (SHEET 1 OF 2)
4	F004	BORING PROFILES (SHEET 2 OF 2)
5	F005	BASE GRADE PLAN
6	F006	BASE GRADE ISOPACH
7	F010	FINAL COVER PLAN
8	F011	LANDFILL CROSS-SECTION
9	F012	LINER SYSTEM/FINAL COVER SYSTEM DETAILS (SHEET 1 OF 2)
10	F013	LINER SYSTEM/FINAL COVER SYSTEM DETAILS (SHEET 2 OF 2)
11	F014	LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 1 OF 2)
12	F015	LEACHATE MANAGEMENT SYSTEM DETAILS (SHEET 2 OF 2)
13	F016	LANDFILL PHASING PLANS CELL 1
14	F017	LANDFILL PHASING PLANS CELL 2
15	F018	LANDFILL PHASING PLANS CELL 3
16	F019	STORM WATER MANAGEMENT DETAILS
17	F030	EROSION AND SEDIMENTATION CONTROL PLAN – PHASE 1
18	F031	EROSION AND SEDIMENTATION CONTROL PLAN – PHASE 2
19	F032	EROSION AND SEDIMENTATION CONTROL PLAN – PHASE 3A
20	F033	EROSION AND SEDIMENTATION CONTROL PLAN – PHASE 3B
21	F034	EROSION AND SEDIMENTATION CONTROL DETAILS
22	F035	EROSION AND SEDIMENTATION CONTROL NOTES

* DRAWING NOS. F007 THROUGH F009 AND F020 THROUGH F029 RESERVED FOR FUTURE USE.

Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205
(412)429-2324 • (800)365-2324
Chicago, IL • Cincinnati, OH • Columbus, OH • Indianapolis, IN • Nashville, TN • St. Louis, MO

PPL BRUNNER ISLAND, LLC
BRUNNER ISLAND STEAM ELECTRIC STATION
DISPOSAL AREA 8
EAST MANCHESTER TWP., PENNSYLVANIA

DATE: 2/9/07	APPROVED BY:	DWN BY: DKS
SCALE: AS SHOWN	GDT	CHKD. BY: GDT
TITLE SHEET		SHEET
		DRAWING NUMBER F001

NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED
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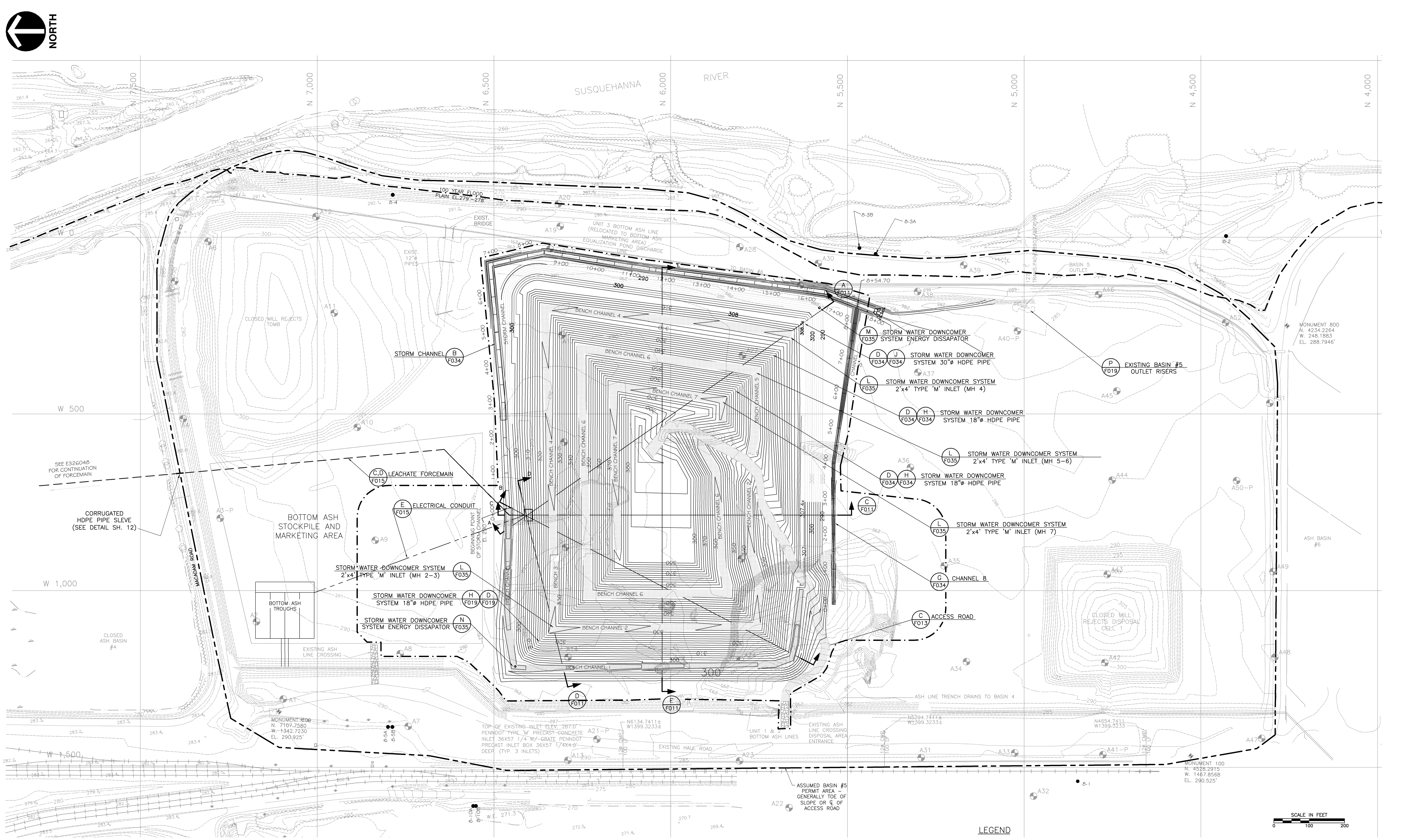

NORTH
SUSQUEHANNA RIVER
N 7,500
N 7,000
N 6,500
N 6,000
N 5,500
N 5,000
N 4,500
N 4,000
W 500
W 1,000
W 1,500
100 YEAR FLOOD PLAIN EL 279-278
CLOSED MILL REJECTS TOMB
BOTTOM ASH STOCKPILE AND MARKETING AREA
CLOSED ASH BASIN #4
BOTTOM ASH TROUGHS
ASH BASIN #6
CLOSED MILL REJECTS DISPOSAL CELL 1
STORM CHANNEL
LEACHATE FORCEMAIN
ELECTRICAL CONDUIT
STORM WATER DOWNCOMER SYSTEM ENERGY DISSAPATOR
STORM WATER DOWNCOMER SYSTEM 30"ø HDPE PIPE
STORM WATER DOWNCOMER SYSTEM 2'x4' TYPE 'M' INLET (MH 4)
STORM WATER DOWNCOMER SYSTEM 18"ø HDPE PIPE
STORM WATER DOWNCOMER SYSTEM 2'x4' TYPE 'M' INLET (MH 5-6)
STORM WATER DOWNCOMER SYSTEM 2'x4' TYPE 'M' INLET (MH 7)
STORM WATER DOWNCOMER SYSTEM 2'x4' TYPE 'M' INLET (MH 2-3)
EXISTING BASIN #5 OUTLET RISERS
CHANNEL 8
ACCESS ROAD
CORRUGATED HDPE PIPE SLEVE (SEE DETAIL SH. 12)
SEE E326048 FOR CONTINUATION OF FORCEMAIN
MONUMENT 800 N. 4234.2264 W. 248.1883 EL. 288.7946'
MONUMENT 100 N. 4528.2915 W. 1467.8568 EL. 290.525'
MONUMENT 600 N. 7107.7580 W. 1342.7230 EL. 290.925'
ASSUMED BASIN #5 PERMIT AREA - GENERALLY TOE OF SLOPE OR ℄ OF ACCESS ROAD
ASH LINE TRENCH DRAINS TO BASIN 4
SCALE IN FEET
0
100
200

LEGEND

295	EXISTING INDEX CONTOURS
	EXISTING INTERMEDIATE CONTOURS
291.2×	EXISTING SPOT ELEVATION
	EXISTING TREE LINE
	EXISTING RAILROAD
	EXISTING PIPE
	EXISTING STREAM
	EXISTING ROAD
MONUMENT 100	CONTROL MONUMENT
A24	1991 BORING
8-1	MONITORING WELL
1 / F003	CROSS-SECTION OR DETAIL DESIGNATION AND SHEET LOCATION
	100 YEAR FLOOD PLAIN
300	FINAL INDEX CONTOUR
298	FINAL INTERMEDIATE CONTOUR
	TOP OF PERIMETER BERM
	ACCESS ROAD
	ASSUMED ASH BASIN #5 PERMIT AREA
	LEACHATE DISCHARGE LINE
	DISPOSAL AREA 8 PERMIT BOUNDARY
	ELECTRICAL CONDUIT

NOTES:

1. THIS DRAWING REPRESENTS THE TOP OF FINAL COVER GRADES. WHEN FILLING, THE TOP OF WASTE GRADES SHALL ACCOUNT FOR THE 2-FEET THICK FINAL COVER LAYER AND APPLICABLE SLOPE CORRECTION.

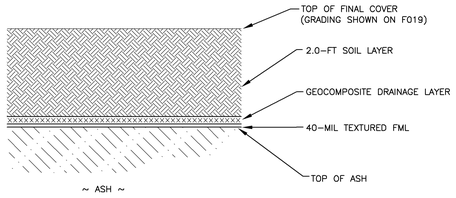
2. THE SLOPE STABILITY ANALYSIS FOR AREA 8 ASSUMES STRENGTH PARAMETERS FOR THE BASIN 5 WASTE. DURING INITIAL OPERATION OF AREA 8, THE WASTE STREAM SHALL BE SAMPLED, TESTED AND EVALUATED WITH THE DESIGN STABILITY ANALYSIS BY AN ENGINEER TO DETERMINE IF THE ANALYSIS IS VALID FOR THE FACILITY'S WASTE.

NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED
2	08/08	38005895	DIRECTED LEACHATE COLLECTION TO SCRUBBER WASTE WATER TREATMENT PLANT	JTE		ADS
1	06/08	38005895	REVISED DWG PER PPL ENGINEER'S COMMENTS AND MARKED PRINTS	JTE		ADS
0	11/07	36014405	ISSUED WITH PPL DRAWING NUMBER AND PPL ENGINEER'S ADDITIONS	JTE		ADS

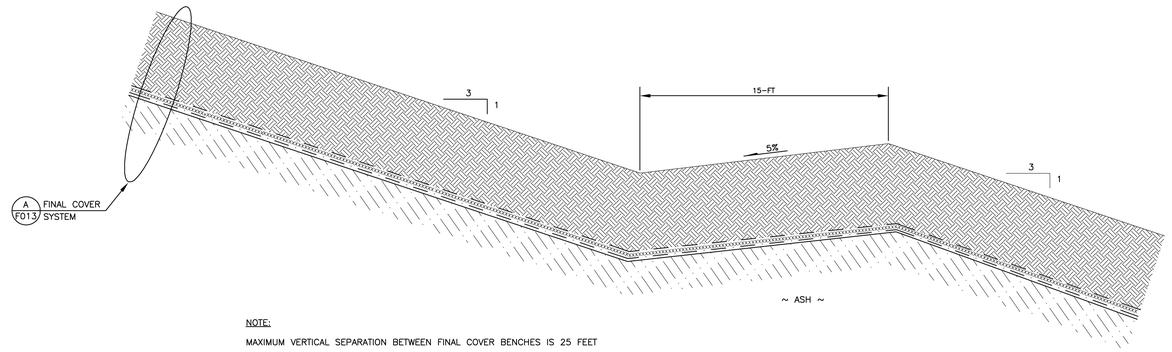
CEC
Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205
(412)429-2324 • (800)365-2324
Chicago, IL • Cincinnati, OH • Columbus, OH • Indianapolis, IN • Nashville, TN • St. Louis, MO

PPL BRUNNER ISLAND, LLC
BRUNNER ISLAND STEAM ELECTRIC STATION
DISPOSAL AREA 8
EAST MANCHESTER TWP., PENNSYLVANIA

DATE: 2/9/07	APPROVED BY: GDT	DWN BY: DKS
SCALE: 1" = 100'		CHKD. BY: GDT
FINAL COVER PLAN		SHEET
		DRAWING NUMBER F010



DETAIL A
FINAL COVER SYSTEM
N.T.S.



NOTE:

MAXIMUM VERTICAL SEPARATION BETWEEN FINAL COVER BENCHES IS 25 FEET

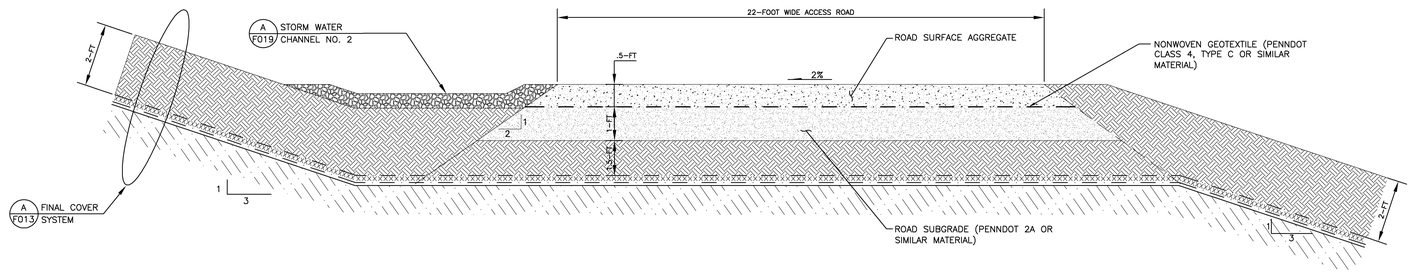
DETAIL B
SURFACE WATER CONTROL BENCH
N.T.S.

COMPONENT NAME	SYMBOL	REQUIRED PROPERTY SUMMARY
FINAL COVER SOIL LAYER		MINIMUM THICKNESS 2.0 FT.
FINAL COVER DRAINAGE LAYER		GEOCOMPOSITE: HDPE GEONET WITH 6 OZ/SY MARV GEOTEXTILE BONDED TO EACH SIDE
40-MIL FML		40 MIL TEXTURED HDPE (MINIMUM ASPERITY HEIGHT 20 MILS, OR AS DETERMINED BY SHEAR STRENTH TESTING)

NOTE:

SEE CQA/QC PLAN FOR TESTING AND CONSTRUCTION SPECIFICATIONS.

FINAL COVER SYSTEM COMPONENT SUMMARY TABLE
N.T.S.



DETAIL C
ACCESS ROAD
N.T.S.

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PPL BRUNNER ISLAND, LLC
BRUNNER ISLAND STEAM ELECTRIC STATION
DISPOSAL AREA 8
EAST MANCHESTER TWP., PENNSYLVANIA

DATE: 2/9/07	APPROVED BY:	DWN BY: SPS
SCALE: AS SHOWN	GDT	CHKD. BY: GDT
LINER SYSTEM/FINAL COVER SYSTEM DETAILS (SHEET 2 OF 2)		SHEET
		DRAWING NUMBER F013

NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED
0	11/07	360144405	ISSUED WITH PPL DRAWING NUMBER AND PPL ENGINEERS ADDITIONS	JTE		ADS

E325747 10 0

E325747_510.DWG

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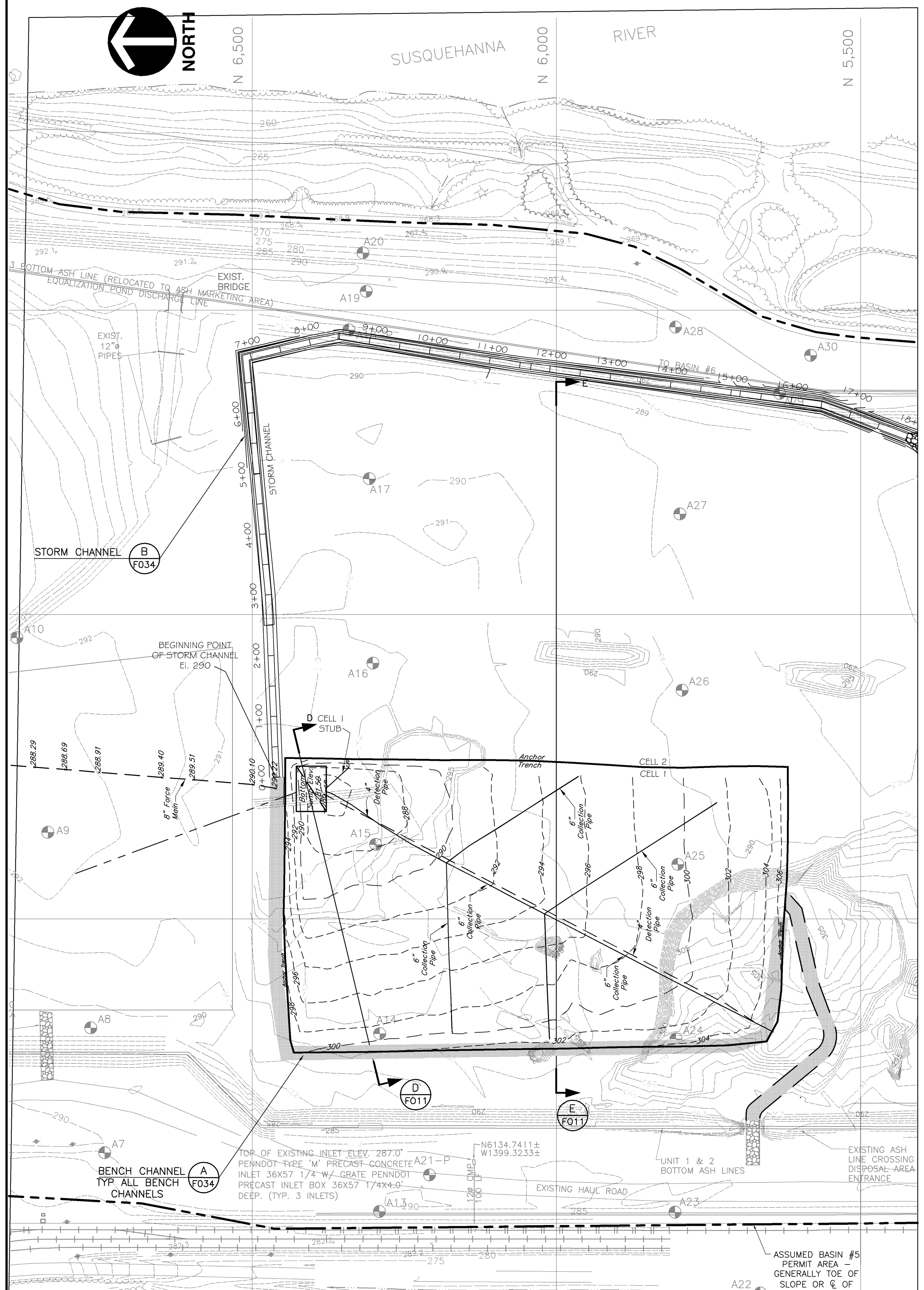
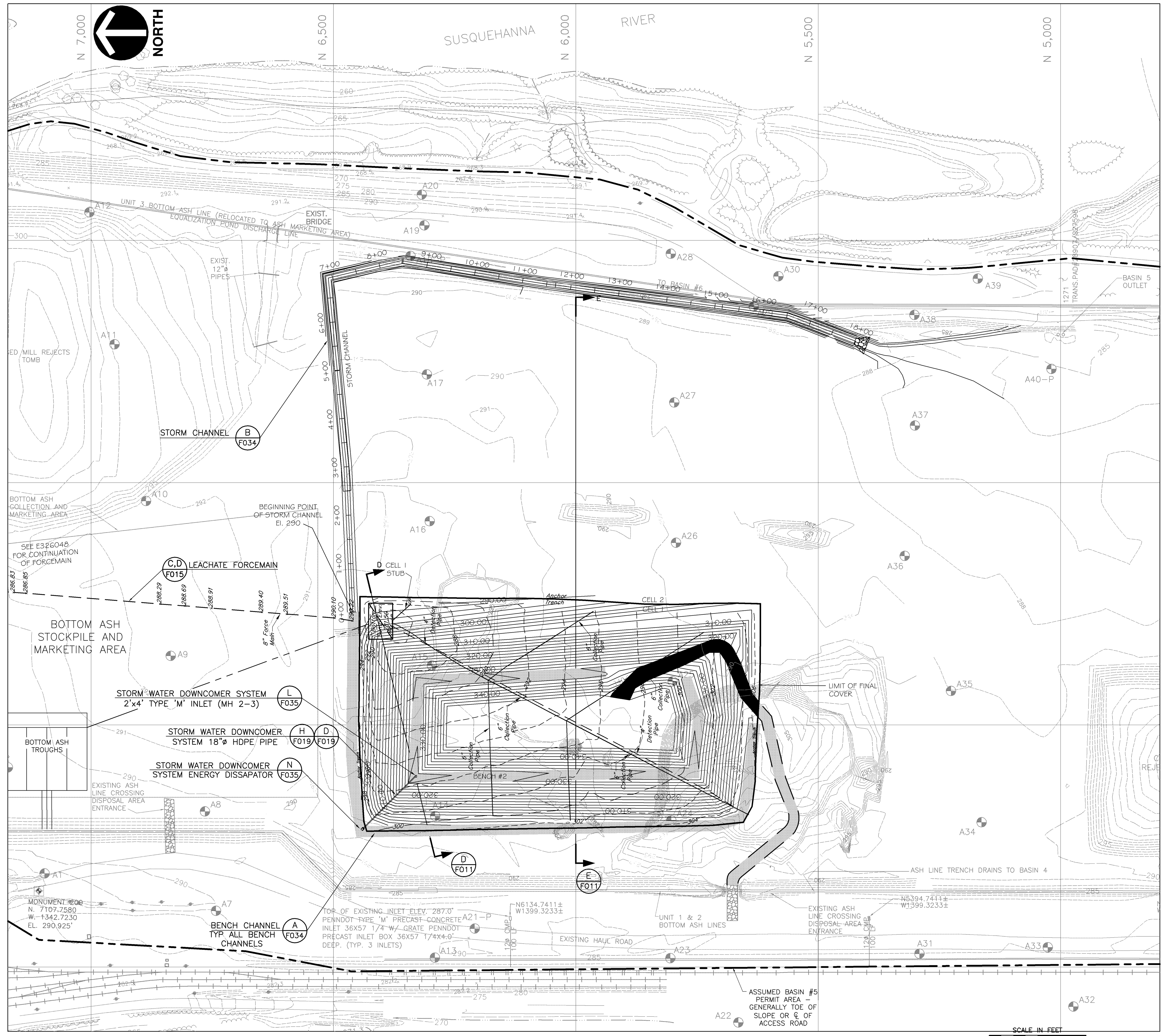
Feb. 19, 2008 - 11:47 AM



TOP OF LINER SYSTEM – CELL 1



FINAL COVER GRADES – CELL 1

NOTES:

1. THE BASE GRADE CUT/FILL QUANTITIES ARE THE MEASURED DIFFERENCE BETWEEN EXISTING TOPGRAPHIC CONTOURS AND DESIGN CONTOURS, AND HAVE NOT BEEN ADJUSTED FOR POTENTIAL SHRINK/SWELL. THE QUANTITIES ARE ACCURATE TO WITHIN 5 PERCENT.
2. THE DISPOSAL VOLUME IS THE VOLUME AVAILABLE FOR WASTE DISPOSAL BETWEEN THE TOP OF THE PROTECTIVE COVER AND THE BOTTOM OF THE FINAL COVER. THE DISPOSAL VOLUME HAS NOT BEEN REDUCED TO ACCOUNT FOR COVER SOIL THAT MAY CONSUME DISPOSAL VOLUME. COVER SOIL USE MAY VARY SIGNIFICANTLY THROUGH THE LIFE OF THE DISPOSAL AREA, AND THEREFORE CAN NOT BE ESTIMATED AND SUBTRACTED FROM THE DISPOSAL VOLUME AT THIS TIME. THE DISPOSAL VOLUME IS ACCURATE TO WITHIN 5 PERCENT.
3. THE LANDFILL LINER SYSTEM QUANTITIES (i.e., SUBBASE SOIL, GEOSYNTHETICS, AND PROTECTIVE COVER SOIL) HAVE BEEN INCREASED BY 5 PERCENT AS A CONTINGENCY WHICH ACCOUNTS FOR WASTE, OVERLAP, AND/OR SLOPE CORRECTION.
4. THE LANDFILL FINAL COVER SYSTEM (i.e., GEOSYNTHETICS AND FINAL COVER SOIL) HAVE BEEN INCREASED BY 5.3 PERCENT FOR A SLOPE CORRECTION AND BY 5 PERCENT AS A CONTINGENCY.

CELL 1 DEVELOPMENT QUANTITIES

Item		Quantity
CELL 1		
DISPOSAL VOLUME	=	377,970 cy
EARTHWORK		
BASE GRADE CUT	=	23,320 cy
FILL	=	85,260 cy
NET	=	61,940 cy
BASE LINER SYSTEM		
SUBBASE SOIL	=	7,440 cy
DETECTION ZONE GEOCOMPOSITE LAYER	=	401,630 sf
GEOSYNTHETIC CLAY LAYER	=	401,630 sf
PRIMARY GEOMEMBRANE	=	401,630 sf
COLLECTION ZONE GEOCOMPOSITE LAYER	=	401,630 sf
COLLECTION ZONE PROTECTIVE COVER	=	7,440 cy
LEACHATE COLLECTION PIPE (6" DIA. PERFORATED)	=	2050 ft
LEACHATE COLLECTION PIPE AGGREGATE BEDDING	=	486 cy
CLEAN OUT–LEACHATE COLLECTION PIPE (6" DIA. SOLID PIPE)	=	60 ft
BASE LINER SYSTEM (CONTINUED)		
LEAKAGE DETECTION PIPE (4" DIA. PERFORATED)	=	2050 ft
LEAKAGE DETECTION PIPE AGGREGATE BEDDING	=	190 cy
CLEAN OUT–LEAKAGE DETECTION PIPE (4" DIA. SOLID PIPE)	=	60 ft
LEACHATE COLLECTION RISER PIPE 18" DIA. SOLID PIPE	=	90 ft
ELBOW (18.4°)	=	2
18" DIA. PERFORATED PIPE (WITH END CAP)	=	30 ft
LEAKAGE DETECTION RISER PIPE 18" DIA. SOLID PIPE	=	45 ft
ELBOW (18.4°)	=	1
18" DIA. PERFORATED PIPE (WITH END CAP)	=	15 ft
RISER PIPE BEARING MATERIAL (6'x16'x1" HDPE SHEET STOCK)	=	2
SUMP AGGREGATE (AASHTO NO. 3) LEAKAGE DETECTION	=	4.2 cy
LEACHATE COLLECTION	=	40 cy
LEACHATE MANAGEMENT FACILITIES		
LEACHATE COLLECTION SYSTEM SUMP PUMP (EPG–WSD SERIES 5, SIZE 4(5))	=	2
LEAKAGE DETECTION SYSTEM SUMP PUMP (EPG–WSD SERIES 5, SIZE 4(5))	=	1
LEACHATE RISER VAULT	=	1
LEACHATE COLLECTION/DETECTION CONTROL PANEL	=	1
LEACHATE TRANSMISSION LINE TO BOTTOM ASH TROUGHS (4"&8")	=	1770 ft
LEACHATE TRANSMISSION LINE AGGREGATE BACKFILL	=	660 cy
ELECTRIC CONDUIT	=	600 ft
FINAL COVER SYSTEM		
CAP GEOMEMBRANE	=	228,430 sf
CAP GEOCOMPOSITE LAYER	=	228,430 sf
FINAL COVER SOIL	=	16,920 cy
ACCESS ROAD		
PERMANENT ACCESS ROAD (OUTSIDE DISPOSAL AREA)	=	380 ft
PERMANENT ACCESS ROAD (ON FINAL COVER)	=	150 ft

LEGEND

- 295 — EXISTING INDEX CONTOURS
- EXISTING INTERMEDIATE CONTOURS
- 291.2 x — EXISTING SPOT ELEVATION
- EXISTING TREE LINE
- EXISTING RAILROAD
- EXISTING PIPE
- EXISTING STREAM
- EXISTING ROAD
- MONUMENT 100 — CONTROL MONUMENT
- A24 — 1991 BORING
- 300 — BASE INDEX CONTOUR
- BASE INTERMEDIATE CONTOUR
- BENCH W/DITCH
- ACCESS ROAD
- 300 — FINAL INDEX CONTOUR
- FINAL INTERMEDIATE CONTOUR
- BENCH W/DITCH
- ACCESS ROAD
- MAXIMUM LIMIT OF FINAL COVER
- ASSUMED SH BASIN #5 PERMIT AREA
- LEACHATE DISCHARGE LINE
- ELECTRICAL CONDUIT

NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED
4	02/09	38005895	TOP OF LINER SYSTEM AS BUILT, CONTOURS AND LEACHATE COLLECTION	JTE		ADS
3	08/08	38005895	DIRECTED LEACHATE COLLECTION TO SCRUBBER WASTE WATER TREATMENT PLANT	JTE		ADS
2	06/08	38005895	REVISED DRAWING PER PPL ENGINEER'S COMMENTS AND MARKED PRINTS	JTE		ADS
1	06/08	38005895	REVISED DRAWING PER PPL ENGINEER'S COMMENTS AND MARKED PRINTS	JTE		ADS
0	11/07	36014405	ISSUED WITH PPL DRAWING NUMBER AND PPL ENGINEER'S ADDITIONS	JTE		ADS

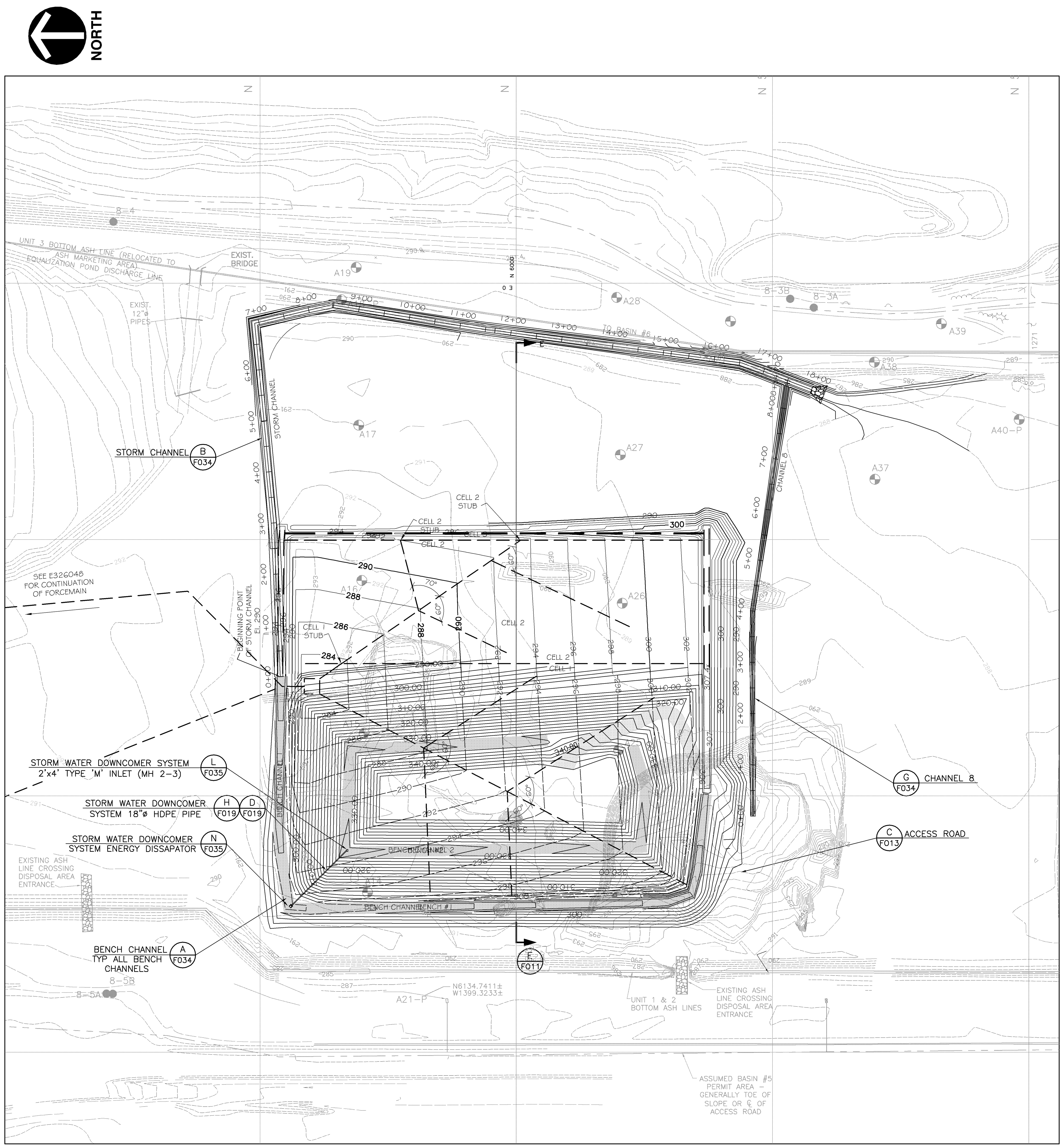
Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205
(412)429-2324 • (800)365-2324
Chicago, IL • Cincinnati, OH • Columbus, OH • Indianapolis, IN • Nashville, TN • St. Louis, MO

PPL BRUNNER ISLAND, LLC
BRUNNER ISLAND STEAM ELECTRIC STATION
DISPOSAL AREA 8
EAST MANCHESTER TWP., PENNSYLVANIA

DATE: 2/9/07	APPROVED BY: GDT	DWN BY: DKS
SCALE: 1" = 100'		CHKD. BY: GDT
LANDFILL PHASING PLANS CELL 1		SHEET
		DRAWING NUMBER F016

G:\PROJECTS\2006\060-338\DWG\P060338-F016.DWG (RSWIHART) – MAY 29, 2007 – 15:16:31

Apr. 7, 2010 - 9:17 AM



TOP OF LINER SYSTEM – CELL 2

FINAL COVER GRADES – CELL 2

REVISION RECORD	
DATE	DESCRIPTION
5–25–07	REVISED DEVELOPMENT QUANTITIES

SCALE IN FEET 0 100 200

NOTES:

1. THE BASE GRADE CUT/FILL QUANTITIES ARE THE MEASURED DIFFERENCE BETWEEN EXISTING TOPGRAPHIC CONTOURS AND DESIGN CONTOURS, AND HAVE NOT BEEN ADJUSTED FOR POTENTIAL SHRINK/SWELL. THE QUANTITIES ARE ACCURATE TO WITHIN 5 PERCENT.
2. THE DISPOSAL VOLUME IS THE VOLUME AVAILABLE FOR WASTE DISPOSAL BETWEEN THE TOP OF THE PROTECTIVE COVER AND THE BOTTOM OF THE FINAL COVER. THE DISPOSAL VOLUME HAS NOT BEEN REDUCED TO ACCOUNT FOR COVER SOIL THAT MAY CONSUME DISPOSAL VOLUME. COVER SOIL USE MAY VARY SIGNIFICANTLY THROUGH THE LIFE OF THE DISPOSAL AREA, AND THEREFORE CAN NOT BE ESTIMATED AND SUBTRACTED FROM THE DISPOSAL VOLUME AT THIS TIME. THE DISPOSAL VOLUME IS ACCURATE TO WITHIN 5 PERCENT.
3. THE LANDFILL LINER SYSTEM QUANTITIES (i.e., SUBBASE SOIL, GEOSYNTHETICS, AND PROTECTIVE COVER SOIL) HAVE BEEN INCREASED BY 5 PERCENT AS A CONTINGENCY WHICH ACCOUNTS FOR WASTE, OVERLAP, AND/OR SLOPE CORRECTION.
4. THE LANDFILL FINAL COVER SYSTEM (i.e., GEOSYNTHETICS AND FINAL COVER SOIL) HAVE BEEN INCREASED BY 5.3 PERCENT FOR A SLOPE CORRECTION AND BY 5 PERCENT AS A CONTINGENCY.

CELL 2 DEVELOPMENT QUANTITIES

Item		Quantity
CELL 2		
DISPOSAL VOLUME	=	460,220 cy
EARTHWORK		
BASE GRADE CUT	=	9,600 cy
FILL	=	44,640 cy
NET	=	35,040 cy
BASE LINER SYSTEM		
SUBBASE SOIL	=	4,630 cy*
DETECTION ZONE GEOCOMPOSITE LAYER	=	249,900 sf
GEOSYNTHETIC CLAY LAYER	=	249,900 sf
PRIMARY GEOMEMBRANE	=	249,900 sf
COLLECTION ZONE GEOCOMPOSITE LAYER	=	249,900 sf
COLLECTION ZONE PROTECTIVE COVER	=	4,628 cy
LEACHATE COLLECTION PIPE (6" DIA. PERFORATED)	=	480 ft
LEACHATE COLLECTION PIPE AGGREGATE BEDDING	=	135 cy
LEAKAGE DETECTION PIPE (4" DIA. PERFORATED)	=	480 ft
LEAKAGE DETECTION PIPE AGGREGATE BEDDING	=	55 cy
FINAL COVER SYSTEM		
CAP GEOMEMBRANE	=	287,030 sf
CAP GEOCOMPOSITE LAYER	=	287,030 sf
FINAL COVER SOIL	=	21,260 cy
ACCESS ROAD		
PERMANENT ACCESS ROAD (ON FINAL COVER)	=	230 ft

* OR 249,900 sf CLAY MAT

LEGEND

- 295 EXISTING INDEX CONTOURS
- EXISTING INTERMEDIATE CONTOURS
- 291.2× EXISTING SPOT ELEVATION
- EXISTING TREE LINE
- EXISTING RAILROAD
- EXISTING PIPE
- EXISTING STREAM
- EXISTING ROAD
- MONUMENT 100 CONTROL MONUMENT
- 300 BASE INDEX CONTOUR
- 298 BASE INTERMEDIATE CONTOUR
- TOP OF PERIMETER BERM
- ACCESS ROAD
- 300 FINAL INDEX CONTOUR
- FINAL INTERMEDIATE CONTOUR
- BENCH W/DITCH
- ACCESS ROAD
- MAXIMUM LIMIT OF FINAL COVER
- ASSUMED ASH BASIN #5 PERMIT AREA
- LEACHATE DISCHARGE LINE

NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED
2	08/08	38005895	DIRECTED LEACHATE COLLECTION TO SCRUBBER WASTE WATER TREATMENT PLANT	JTE		ADS
1	06/08	38005895	REVISED FINAL COVER GRADES & LEAKAGE DETECTION REFS PER PPL ENG'S COMMENTS	JTE		ADS
0	11/07	36014405	ISSUED WITH PPL DRAWING NUMBER AND PPL ENGINEER'S ADDITIONS	JTE		ADS

G:\PROJECTS\2006\060-338\DWG\P060338-F017.DWG (RSWIHART) – MAY 29, 2007 – 15:20:10

CEC
Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205
(412)429-2324 • (800)365-2324
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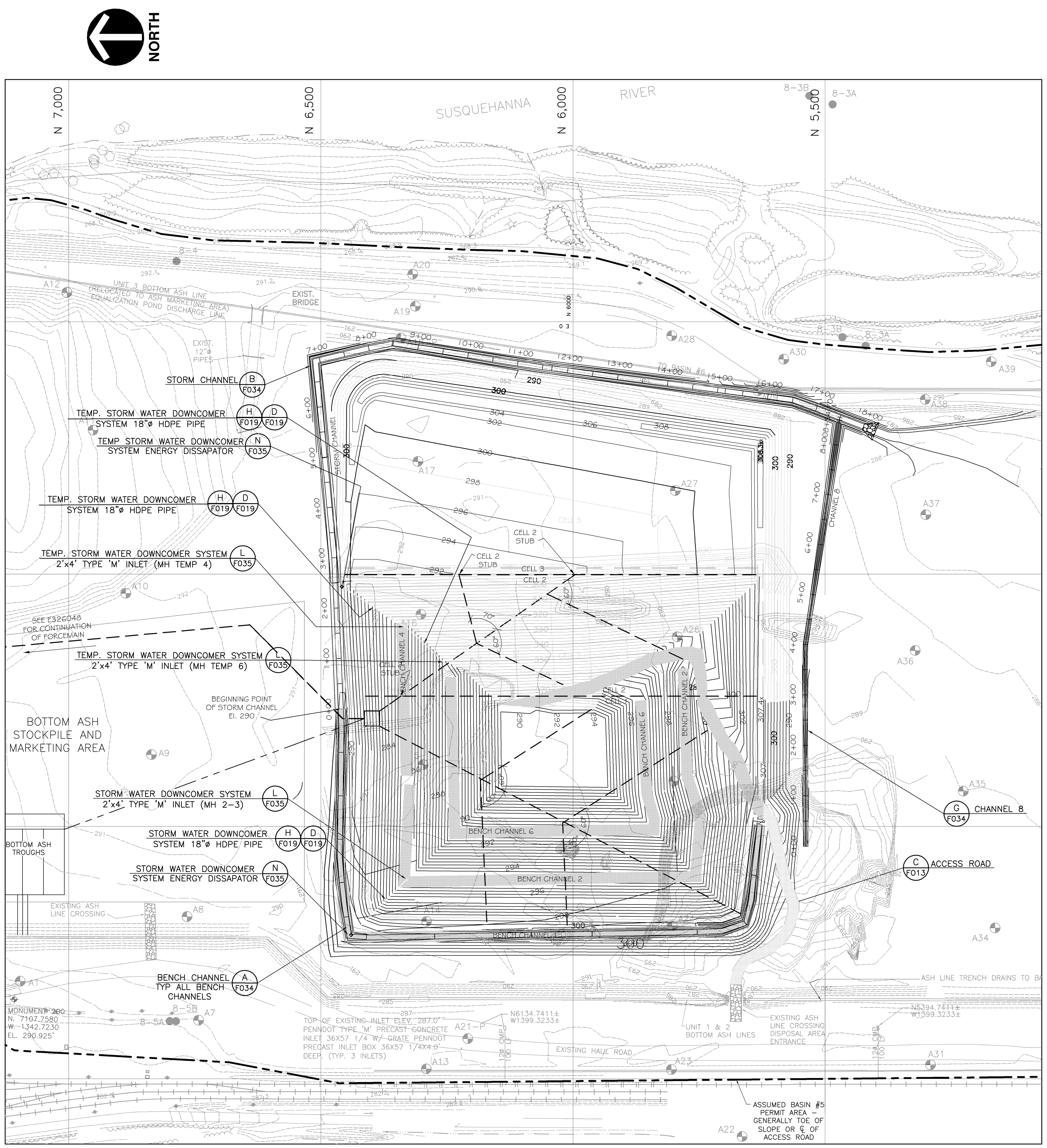
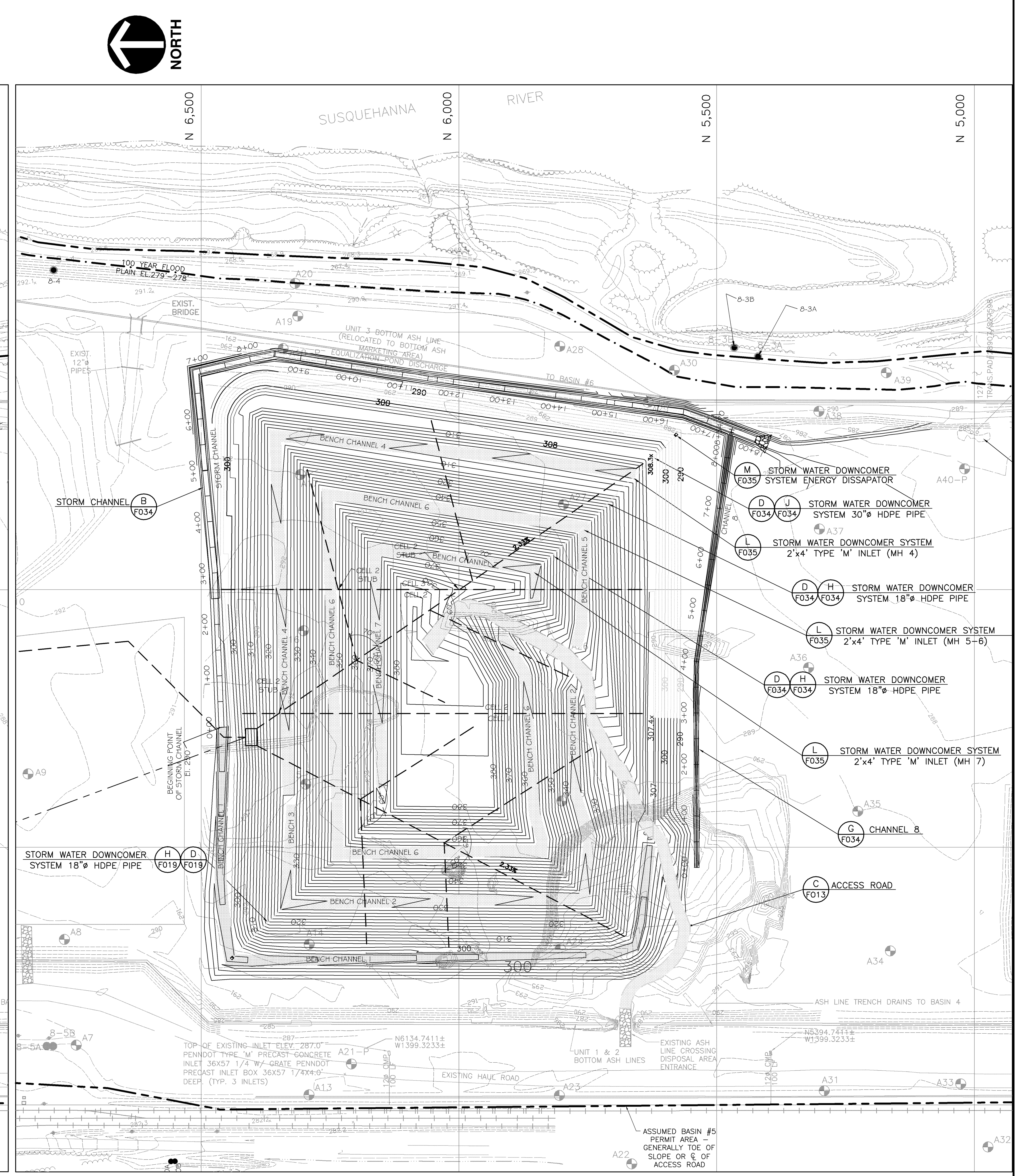
PPL BRUNNER ISLAND, LLC
BRUNNER ISLAND STEAM ELECTRIC STATION
DISPOSAL AREA 8
EAST MANCHESTER TWP., PENNSYLVANIA

DATE: 2/9/07	APPROVED BY:	DWN BY: DKS
SCALE: 1" = 100'		CHKD. BY: GDT
LANDFILL PHASING PLANS CELL 2		SHEET
		DRAWING NUMBER F017

Nov. 24, 2008 - 8:47 AM



TOP OF LINER SYSTEM – CELL 3



FINAL COVER GRADES – CELL 3

SCALE IN FEET 0 100 200

NOTES:

1. THE BASE GRADE CUT/FILL QUANTITIES ARE THE MEASURED DIFFERENCE BETWEEN EXISTING TOPGRAPHIC CONTOURS AND DESIGN CONTOURS, AND HAVE NOT BEEN ADJUSTED FOR POTENTIAL SHRINK/SWELL. THE QUANTITIES ARE ACCURATE TO WITHIN 5 PERCENT.

2. THE DISPOSAL VOLUME IS THE VOLUME AVAILABLE FOR WASTE DISPOSAL BETWEEN THE TOP OF THE PROTECTIVE COVER AND THE BOTTOM OF THE FINAL COVER. THE DISPOSAL VOLUME HAS NOT BEEN REDUCED TO ACCOUNT FOR COVER SOIL THAT MAY CONSUME DISPOSAL VOLUME. COVER SOIL USE MAY VARY SIGNIFICANTLY THROUGH THE LIFE OF THE DISPOSAL AREA, AND THEREFORE CAN NOT BE ESTIMATED AND SUBTRACTED FROM THE DISPOSAL VOLUME AT THIS TIME. THE DISPOSAL VOLUME IS ACCURATE TO WITHIN 5 PERCENT.

3. THE LANDFILL LINER SYSTEM QUANTITIES (i.e., SUBBASE SOIL, GEOSYNTHETICS, AND PROTECTIVE COVER SOIL) HAVE BEEN INCREASED BY 5 PERCENT AS A CONTINGENCY WHICH ACCOUNTS FOR WASTE, OVERLAP, AND/OR SLOPE CORRECTION.

4. THE LANDFILL FINAL COVER SYSTEM (i.e., GEOSYNTHETICS AND FINAL COVER SOIL) HAVE BEEN INCREASED BY 5.3 PERCENT FOR A SLOPE CORRECTION AND BY 5 PERCENT AS A CONTINGENCY.

CELL 3 DEVELOPMENT QUANTITIES

CELL 3		
DISPOSAL VOLUME	=	524,680 cy
EARTHWORK		
BASE GRADE	CUT =	1,090 cy
	FILL =	113,200 cy
	NET =	112,110 cy
BASE LINER SYSTEM		
SUBBASE SOIL	=	4,920 cy*
DETECTION ZONE GEOCOMPOSITE LAYER	=	265,650 sf
GEOSYNTHETIC CLAY LAYER	=	265,650 sf
PRIMARY GEOMEMBRANE	=	265,650 sf
COLLECTION ZONE GEOCOMPOSITE LAYER	=	265,650 sf
COLLECTION ZONE PROTECTIVE COVER	=	4,919 cy
LEACHATE COLLECTION PIPE (6" DIA. PERFORATED)	=	420 ft
LEACHATE COLLECTION PIPE AGGREGATE BEDDING	=	50 cy
LEACHATE DETECTION PIPE (4" DIA. PERFORATED)	=	420 ft
LEACHATE DETECTION PIPE AGGREGATE BEDDING	=	120 cy
FINAL COVER SYSTEM		
CAP GEOMEMBRANE	=	458,840 sf
CAP GEOCOMPOSITE LAYER	=	458,840 sf
FINAL COVER SOIL	=	33,990 cy
ACCESS ROAD		
PERMANENT ACCESS ROAD (ON FINAL COVER)	=	360 ft

* OR 265,650 sf CLAY MAT

LEGEND

- EXISTING INDEX CONTOURS (295)
- EXISTING INTERMEDIATE CONTOURS
- EXISTING SPOT ELEVATION (291.2)
- EXISTING TREE LINE
- EXISTING RAILROAD
- EXISTING PIPE
- EXISTING STREAM
- EXISTING ROAD
- CONTROL MONUMENT (MONUMENT 100)
- BASE INDEX CONTOUR (300)
- BASE INTERMEDIATE CONTOUR (298)
- TOP OF PERIMETER BERM
- ACCESS ROAD
- FINAL INDEX CONTOUR (300)
- FINAL INTERMEDIATE CONTOUR (298)
- BENCH W/DITCH
- ACCESS ROAD
- MAXIMUM LIMIT OF FINAL COVER
- ASSUMED ASH BASIN #5 PERMIT AREA
- LEACHATE DISCHARGE LINE
- ELECTRICAL CONDUIT

NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED
2	08/08	38005895	DIRECTED LEACHATE COLLECTION TO SCRUBBER WASTE WATER TREATMENT PLANT	JTE		ADS
1	06/08	36014405	REVISED DRAWING PER PPL ENGINEER'S COMMENTS AND MARKED PRINTS	JTE		ADS
0	11/07	36014405	ISSUED WITH PPL DRAWING NUMBER AND PPL ENGINEER'S ADDITIONS	JTE		ADS

G:\PROJECTS\2006\060-338\DWG\P060338-F018.DWG (RSWIHART) – MAY 29, 2007 – 15:22:32

CEC
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333 Baldwin Road - Pittsburgh, PA 15205
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PPL BRUNNER ISLAND, LLC
BRUNNER ISLAND STEAM ELECTRIC STATION
DISPOSAL AREA 8
EAST MANCHESTER TWP., PENNSYLVANIA

DATE: 2/9/07	APPROVED BY:	DWN BY: DKS	
SCALE: 1" = 100'		CHKD. BY: GDT	
LANDFILL PHASING PLANS CELL 3		SHEET	
		DRAWING NUMBER F018	

Sep 5, 2008 - 11:40 AM

APPENDIX C

Description of Cover Soils

(Attachments F-1 and F-2 of PPL 2008b)

BRUNNER ISLAND SES
DISPOSAL AREA 8
FORM F
SOILS INFORMATION - PHASE 1
NARRATIVE F-1

B. Soil Series

This disposal area will be built on top of retired Ash Basin No. 5. The original soils prior to basin construction were predominantly Ashton Lindside and Huntington Silt Loam. Soils from within the basin boundaries were used to build the Basin No. 5 dikes. Drawing A-324558, Sheet 3, shows the basin superimposed on a soils map (York County Survey, 2002) showing the basin while it was in service (water). The basin now contains about 35 feet of fly ash and bottom ash.

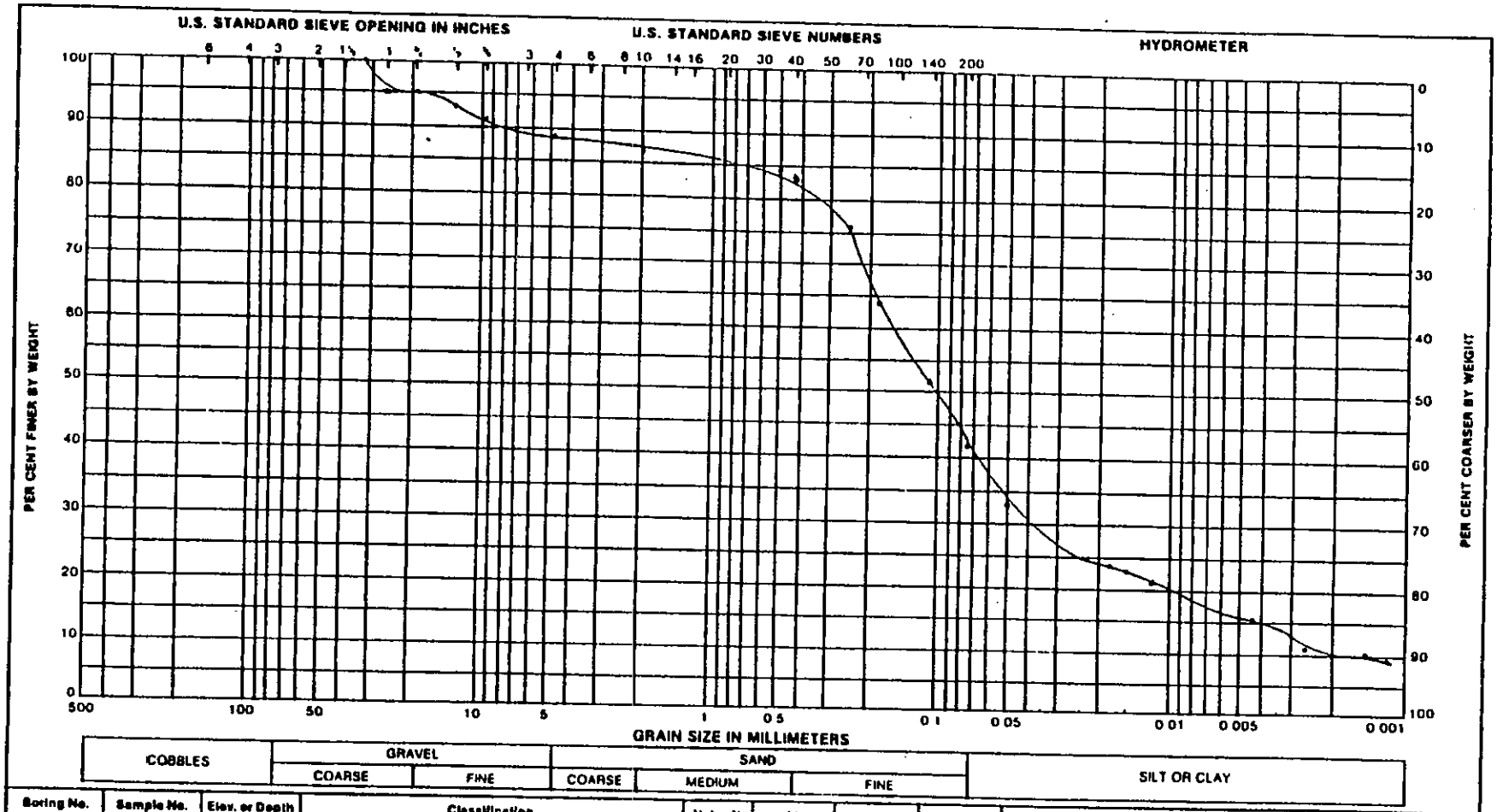
Soils taken from the Ash Basin No. 7 construction site in the late 1980's were used to cover closed Ash Basin No. 5 at varying thicknesses. Test borings were done within the project area to more accurately determine soil depths and to obtain samples for further laboratory testing. The test boring locations and soil and ash depths are shown on Drawing E-325747 sh 2,3 and 4 (CEC Drawing #'s F002-F004). Soil/ash descriptions and laboratory test results are contained in the Landfill Design Package, Vol. 1, Attachment 1.8.1.

C. Cover Soils

Cover soils have been stockpiled on Ash Basin No. 6 (200,000 cy). These soils were obtained from farmland located west of the island. That former farmland site has been developed as a golf course using Stabil-Fill as a structural fill (beneficial use of ash). The soil is rich and has shown through farming that it is very capable of supporting vegetation. The soils originally were approved for use as a cover soil on Ash Basin No.7, but they were not needed, as there is enough soil in the ash basin dikes to cover the basin. PPL has received approval from the DEP to use this soil mixed with bottom ash fines for use on the golf course. PPL also seeks permission to use the blended soils for cover on Area 8. A report by Civil and Environmental Consultants, Inc entitled 'Use of Coal Ash as a Soil Substitute or Soil Additive – Brunner Island SES' dated March 1, 2002 is attached and will also be a referenced by a Form Q requesting equivalency.

Attachment F-2 contains the laboratory test reports for the stockpiled soils without bottom ash amendment.

ATTACHMENT F2
DISPOSAL AREA 8
GEOTECHNICAL TEST RESULTS
(COVER SOILS)



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-A-1		0.0'-5.0'	A-4				NP	Ash Basin No. 7 Closure
			SM					Soil Borrow Area
			Fine Sandy Loam					ER 102147

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 5, 1993

OUR REPORT NO.: 491-35002

TEST DATA

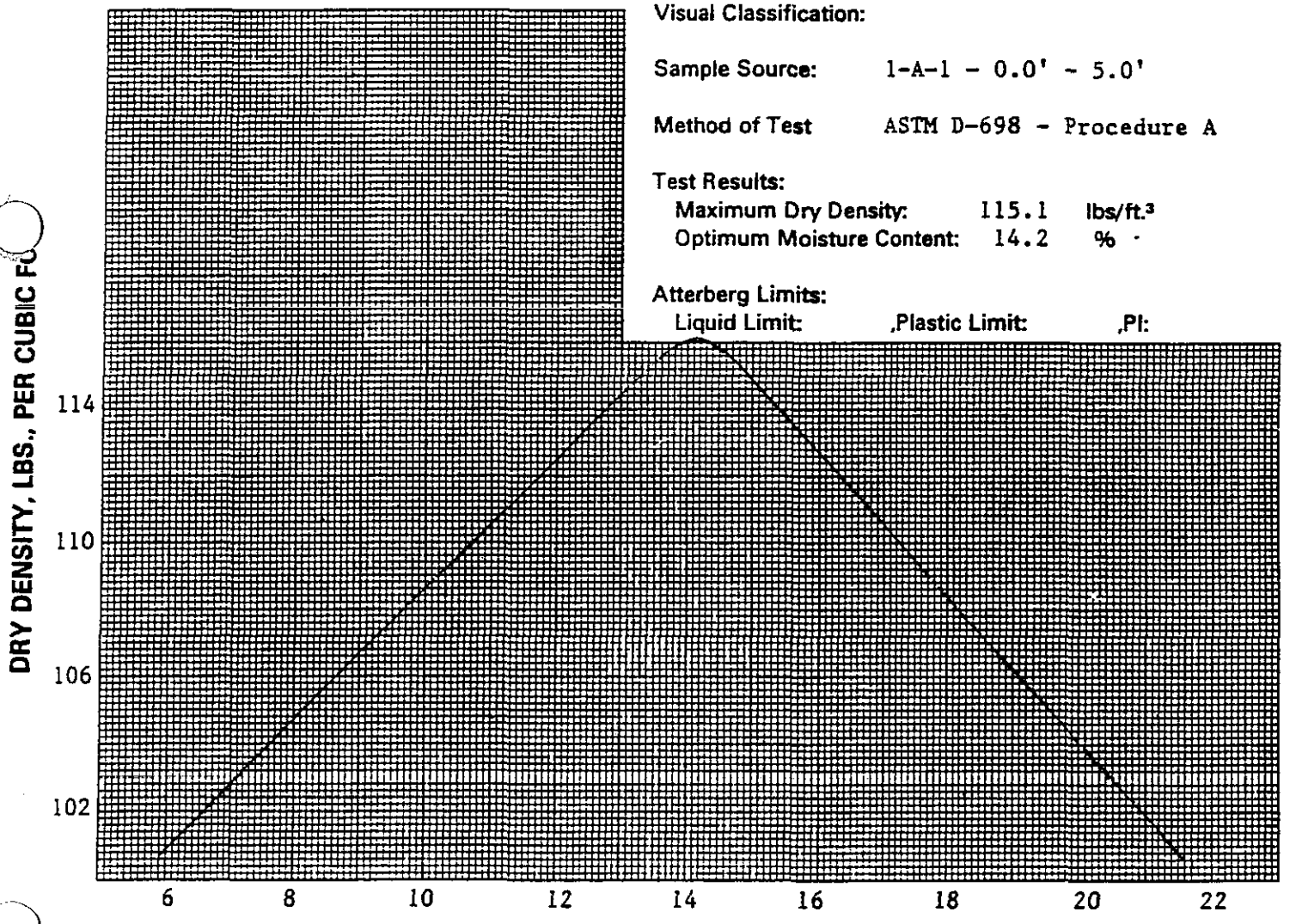
Visual Classification:

Sample Source: 1-A-1 - 0.0' - 5.0'

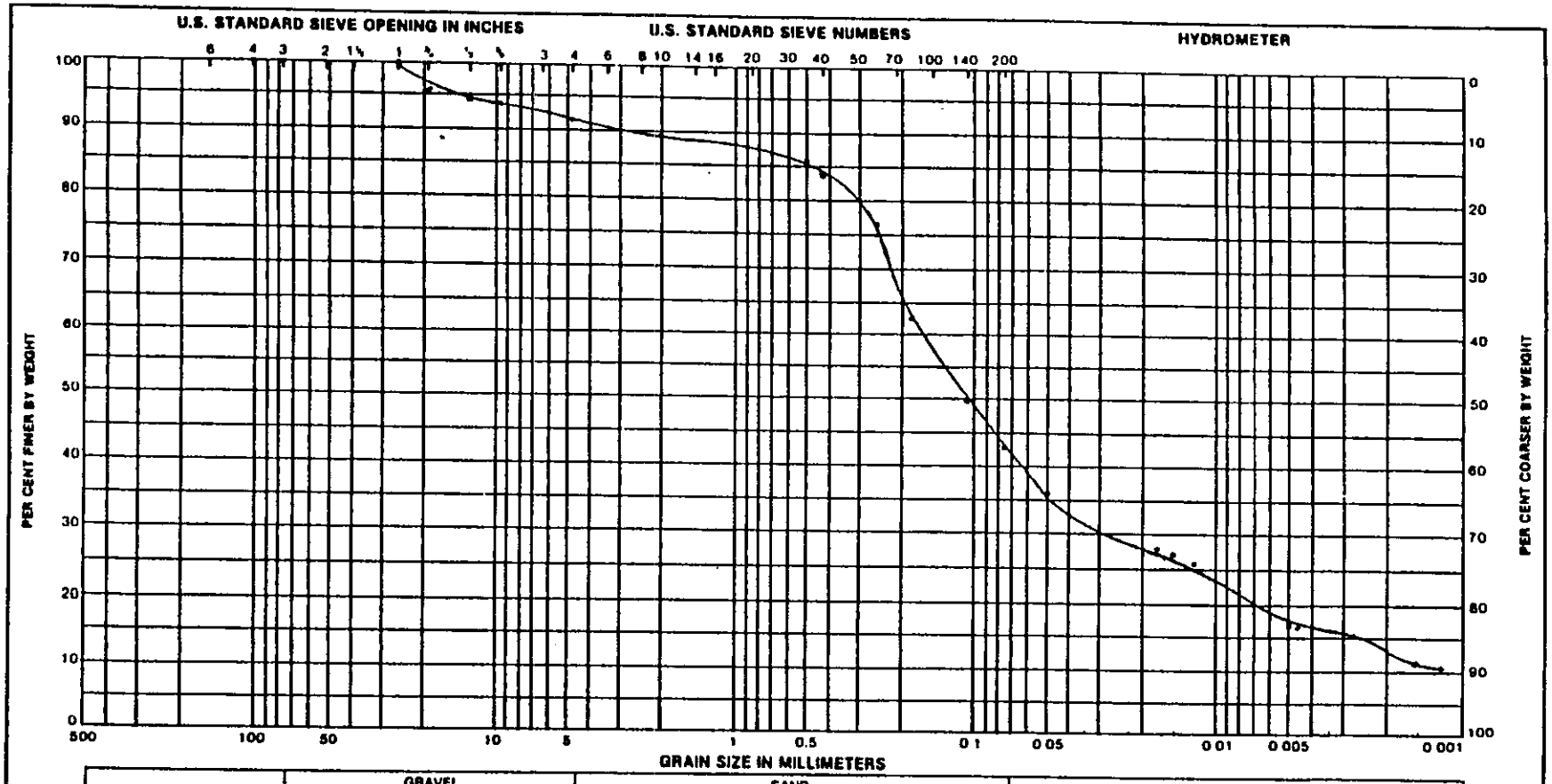
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 115.1 lbs/ft.³
Optimum Moisture Content: 14.2 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-A-3		1.0'-4.0'	A-4				NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Fine Sandy Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 4, 1993

OUR REPORT NO.: 491-35002

TEST DATA

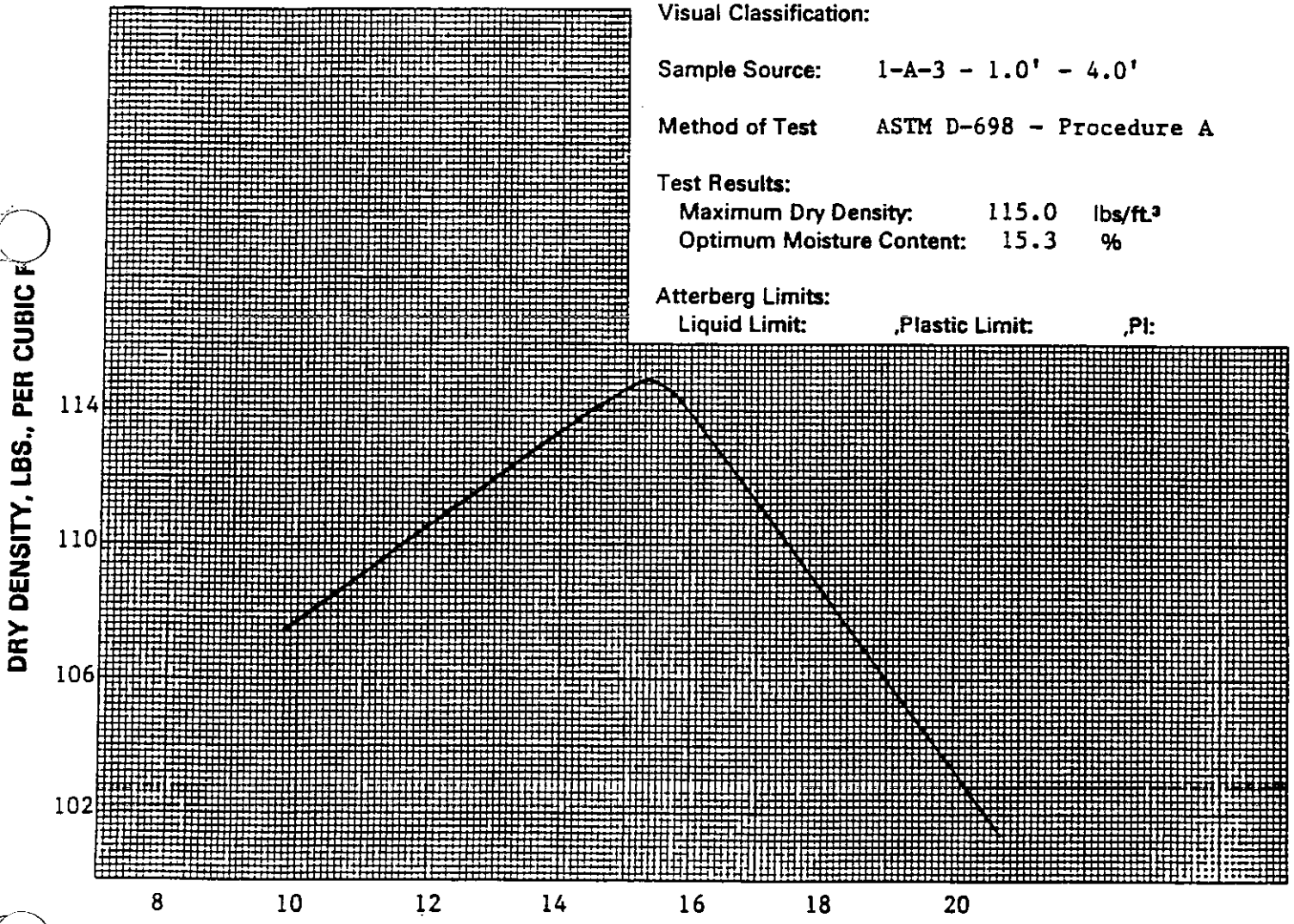
Visual Classification:

Sample Source: 1-A-3 - 1.0' - 4.0'

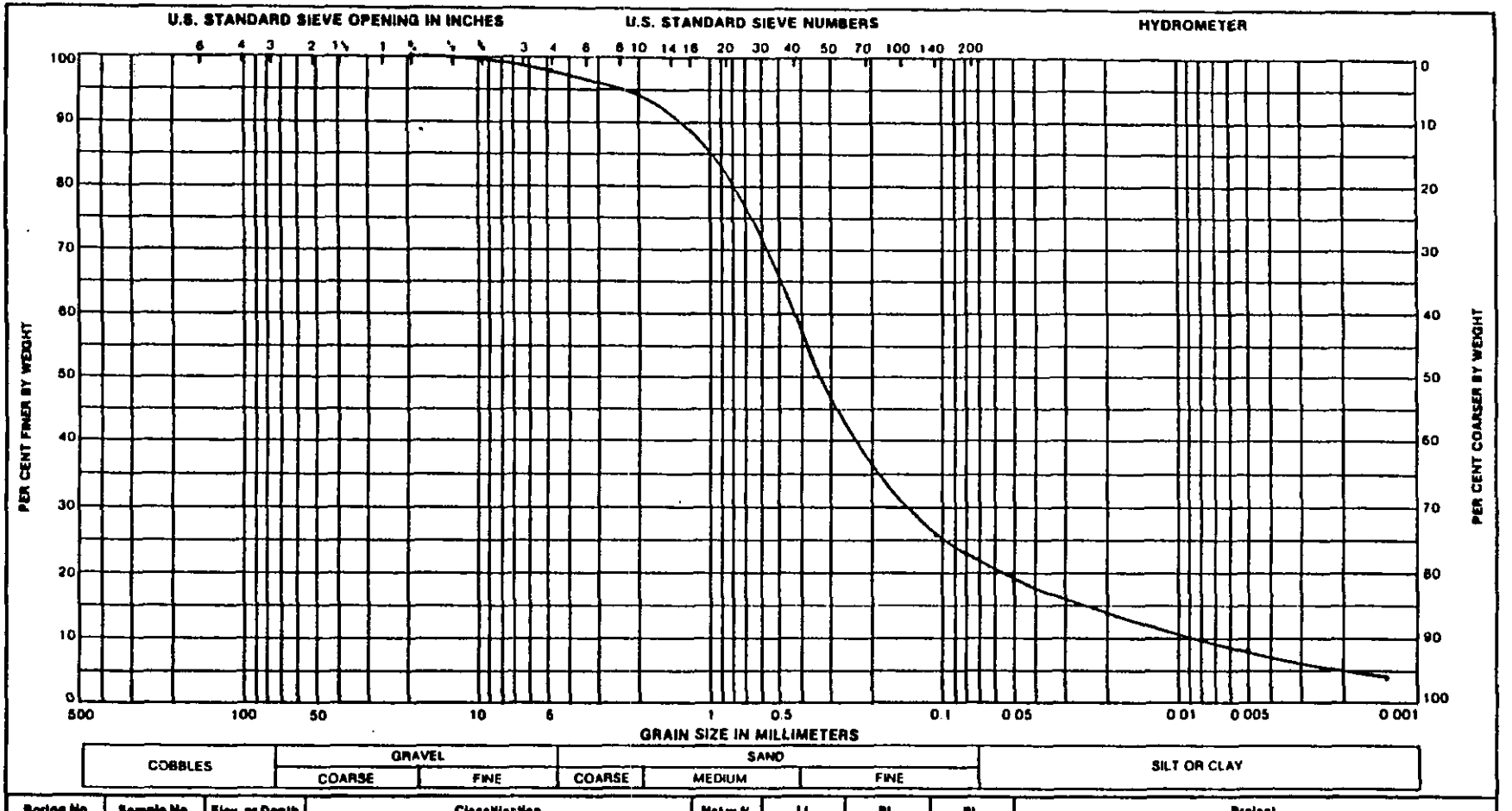
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 115.0 lbs/ft.³
Optimum Moisture Content: 15.3 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-A-8		5.0'-10.0'	A-2-4	6.32			NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Loamy Coarse Sand					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 20, 1993

OUR REPORT NO.: 491-35002

TEST DATA

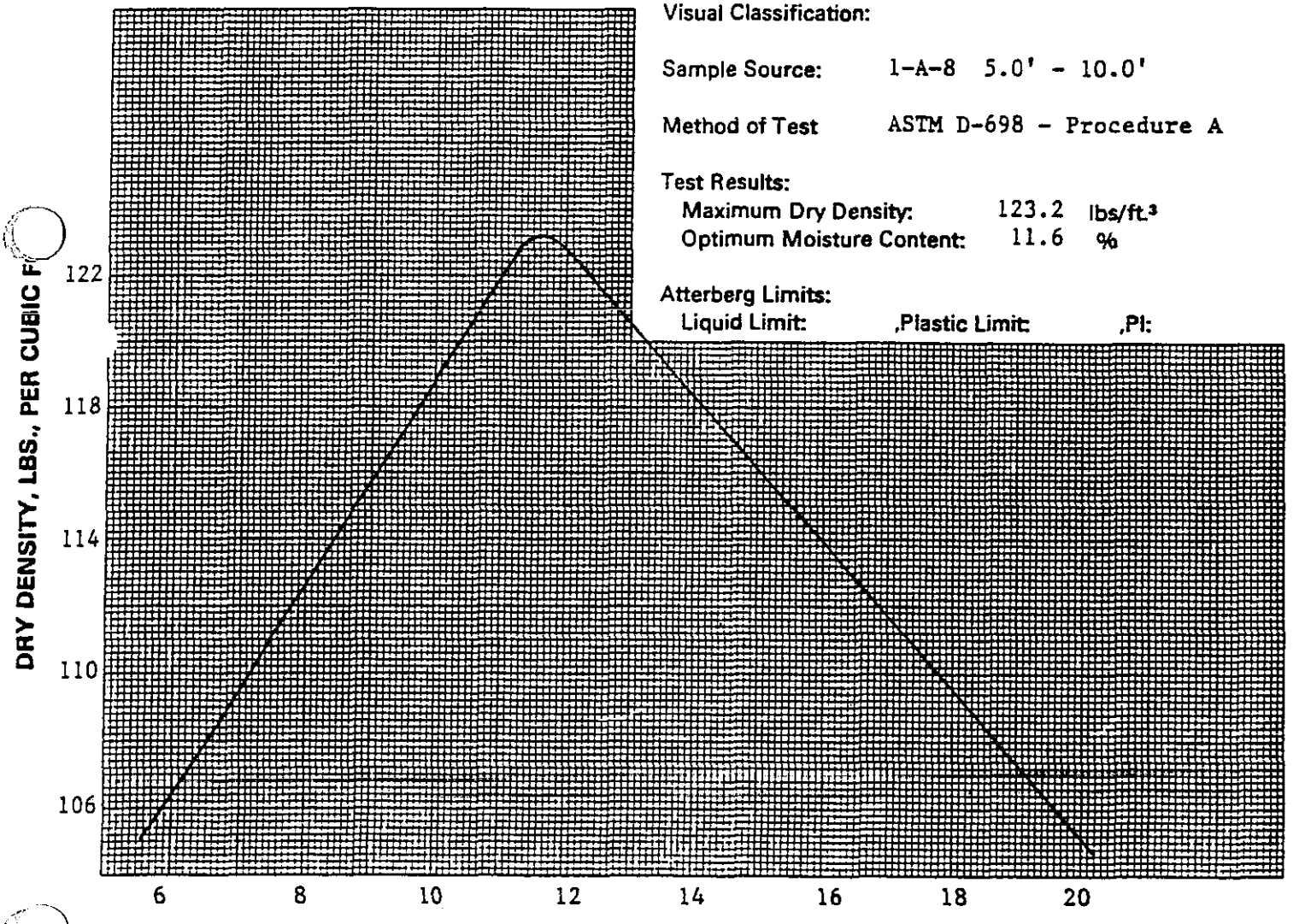
Visual Classification:

Sample Source: 1-A-8 5.0' - 10.0'

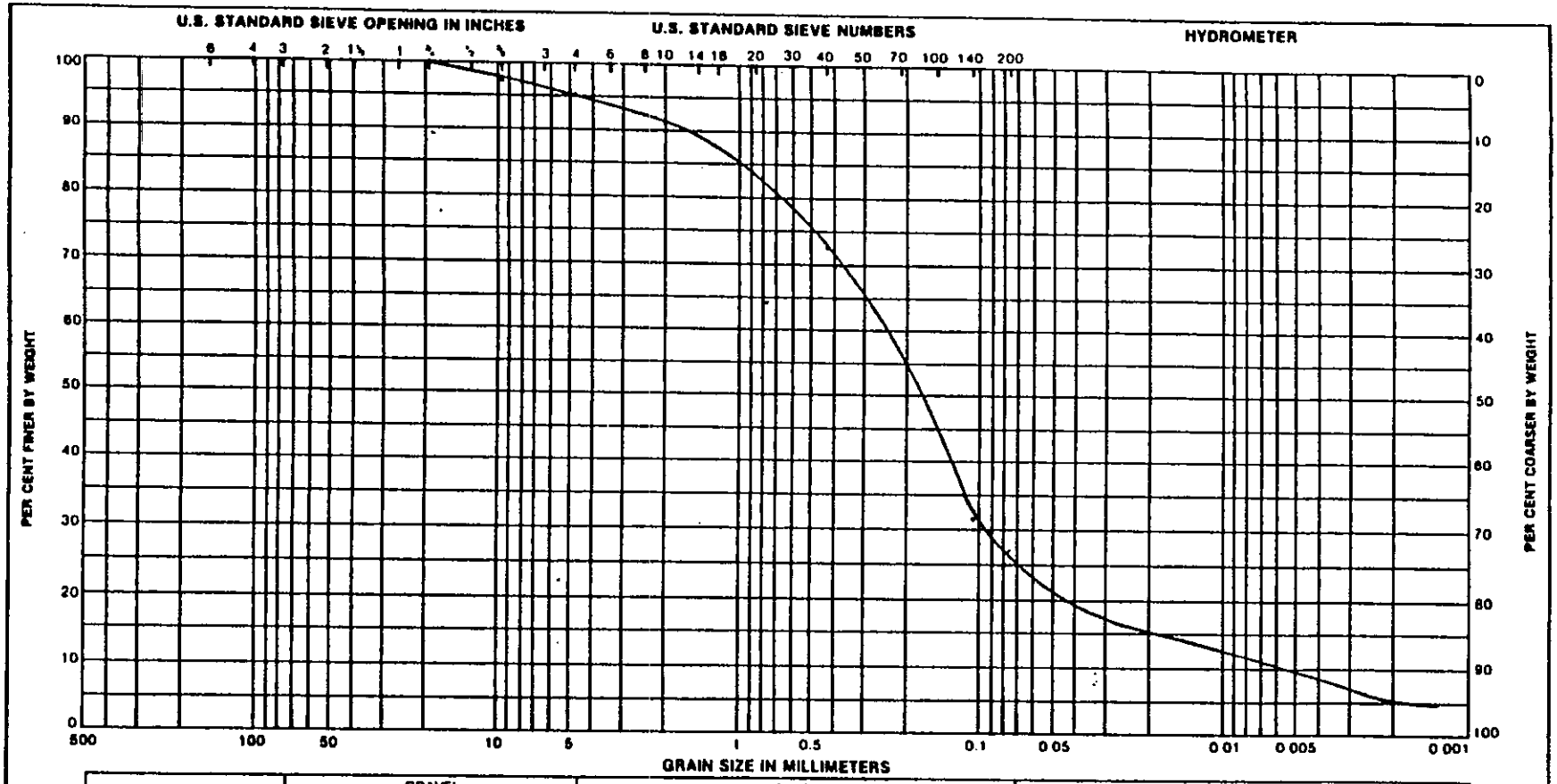
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 123.2 lbs/ft³
Optimum Moisture Content: 11.6 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-A-8		15.0'-16.0'	A-2-4	10.20			NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Loamy Sand					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 20, 1993

OUR REPORT NO.: 491-35002

TEST DATA

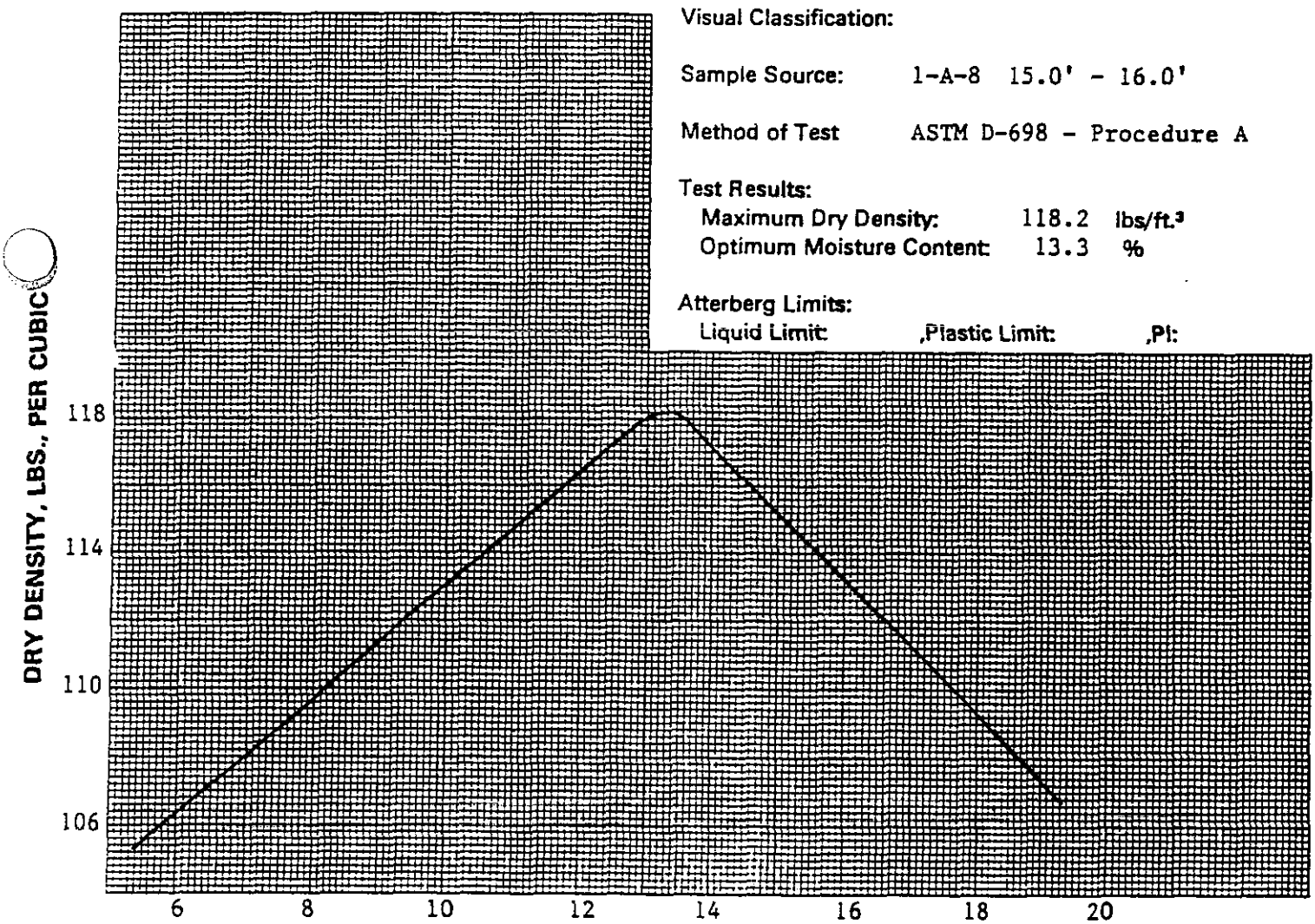
Visual Classification:

Sample Source: 1-A-8 15.0' - 16.0'

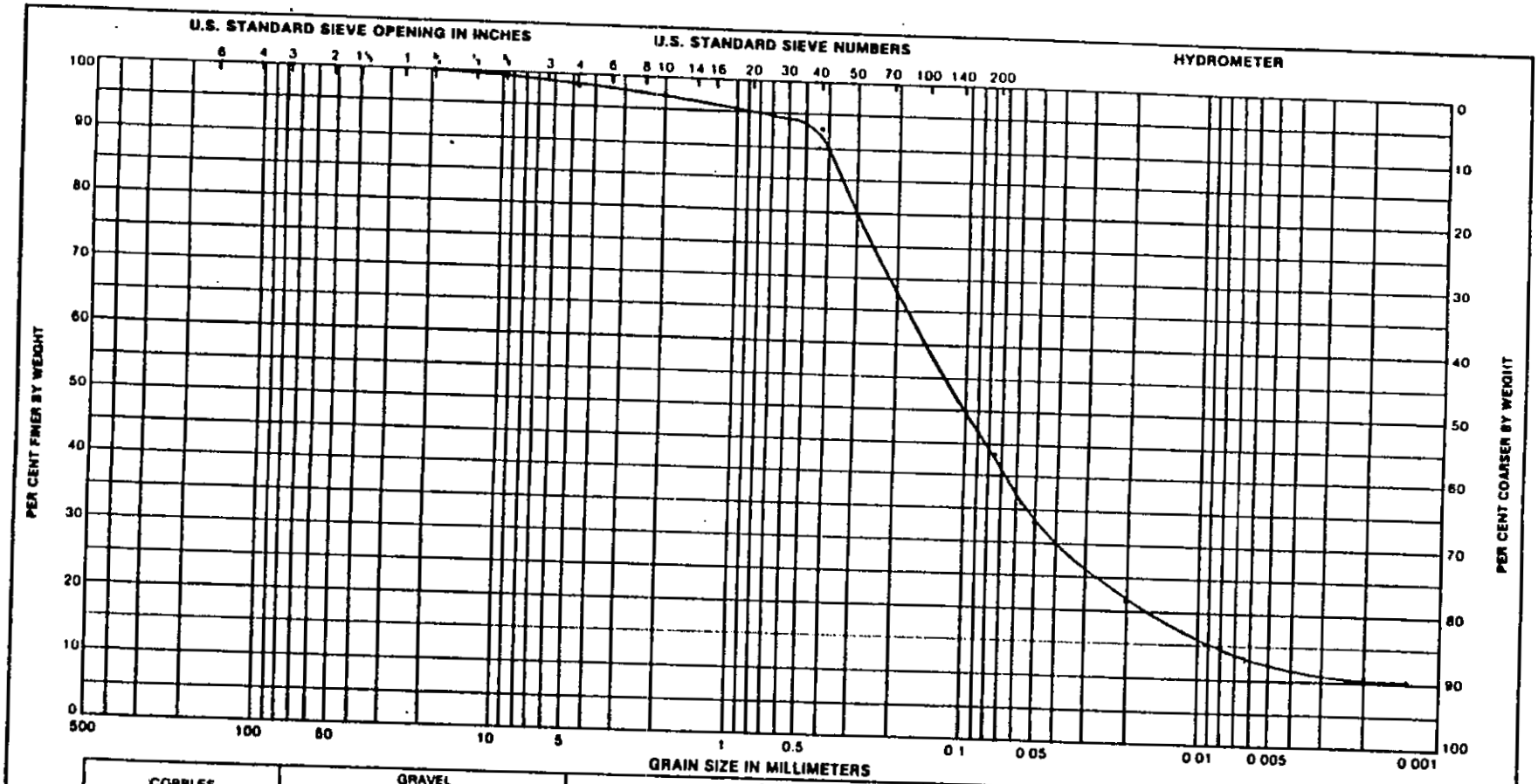
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 118.2 lbs/ft.³
Optimum Moisture Content: 13.3 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-A-12		1.0'-5.0'	A-4	5.7			NP	Ash Basin No. 7 Closure
			SM					Soil Borrow Area
			Fine Sandy Loam					ER 102147

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 22, 1993

OUR REPORT NO.: 491-35002

TEST DATA

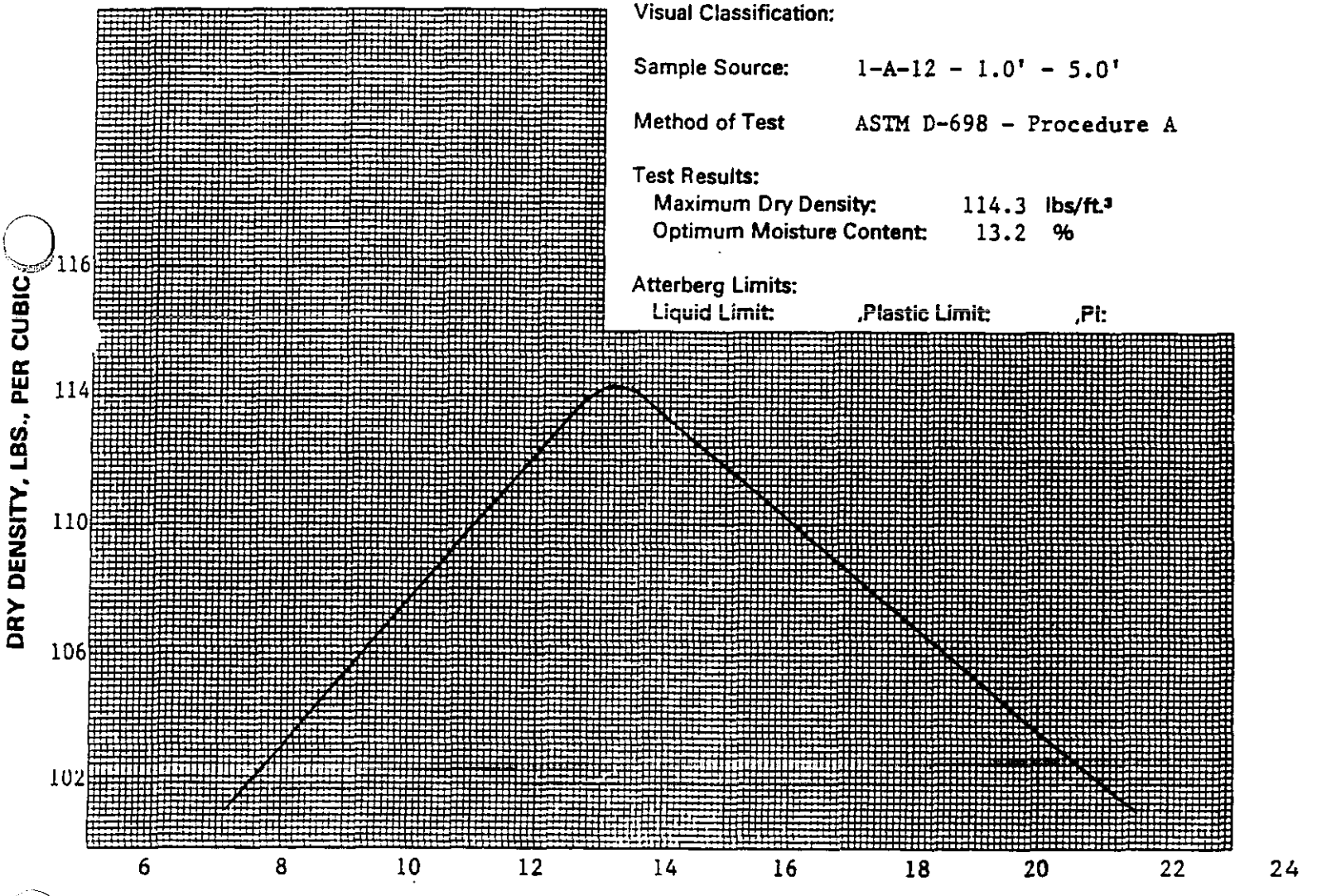
Visual Classification:

Sample Source: 1-A-12 - 1.0' - 5.0'

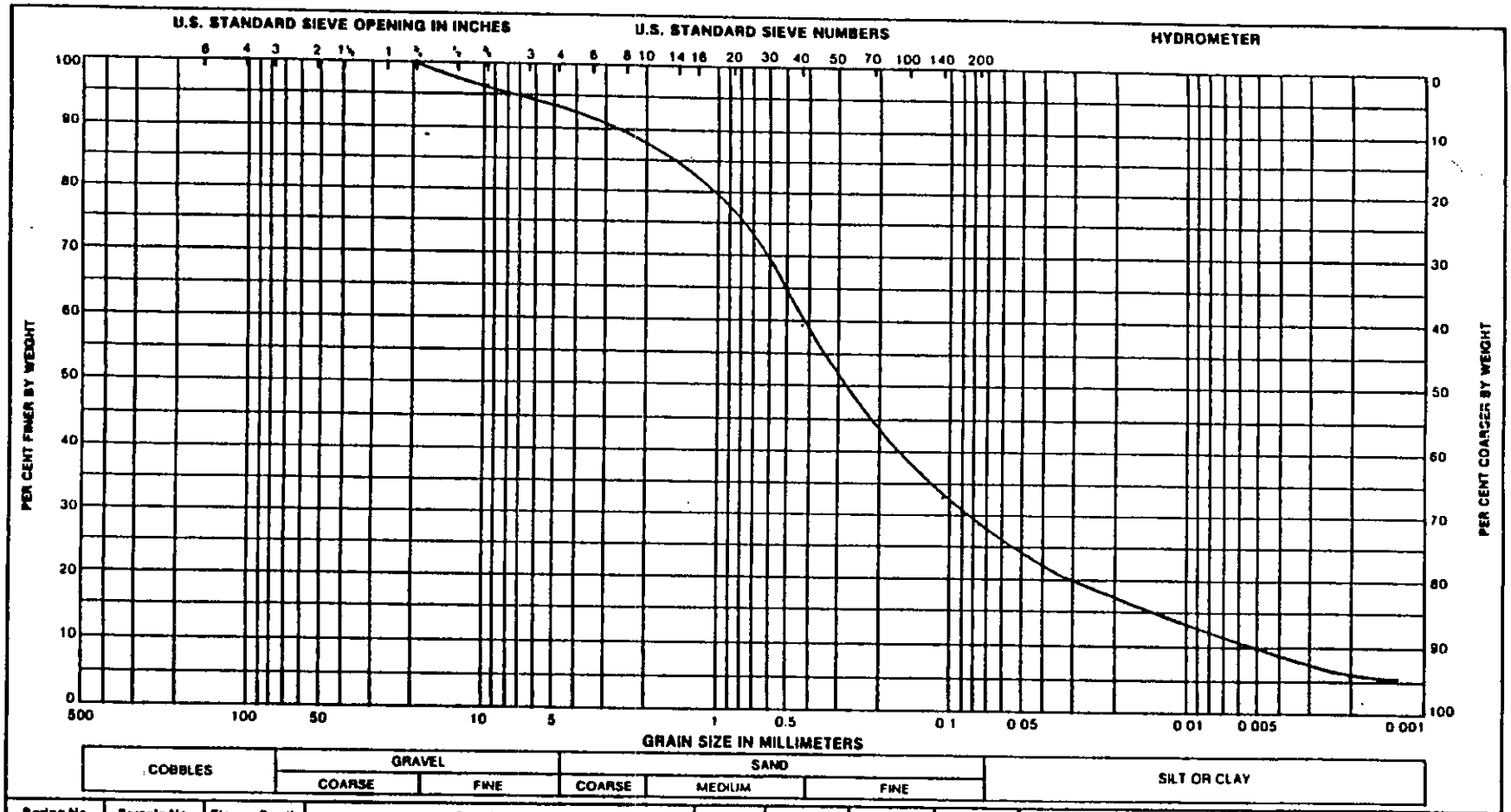
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 114.3 lbs/ft.³
Optimum Moisture Content: 13.2 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-A-12		5.0'-9.0'	A-2-4	11.6			NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Coarse Sandy Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 26, 1993

OUR REPORT NO.: 491-35002

TEST DATA

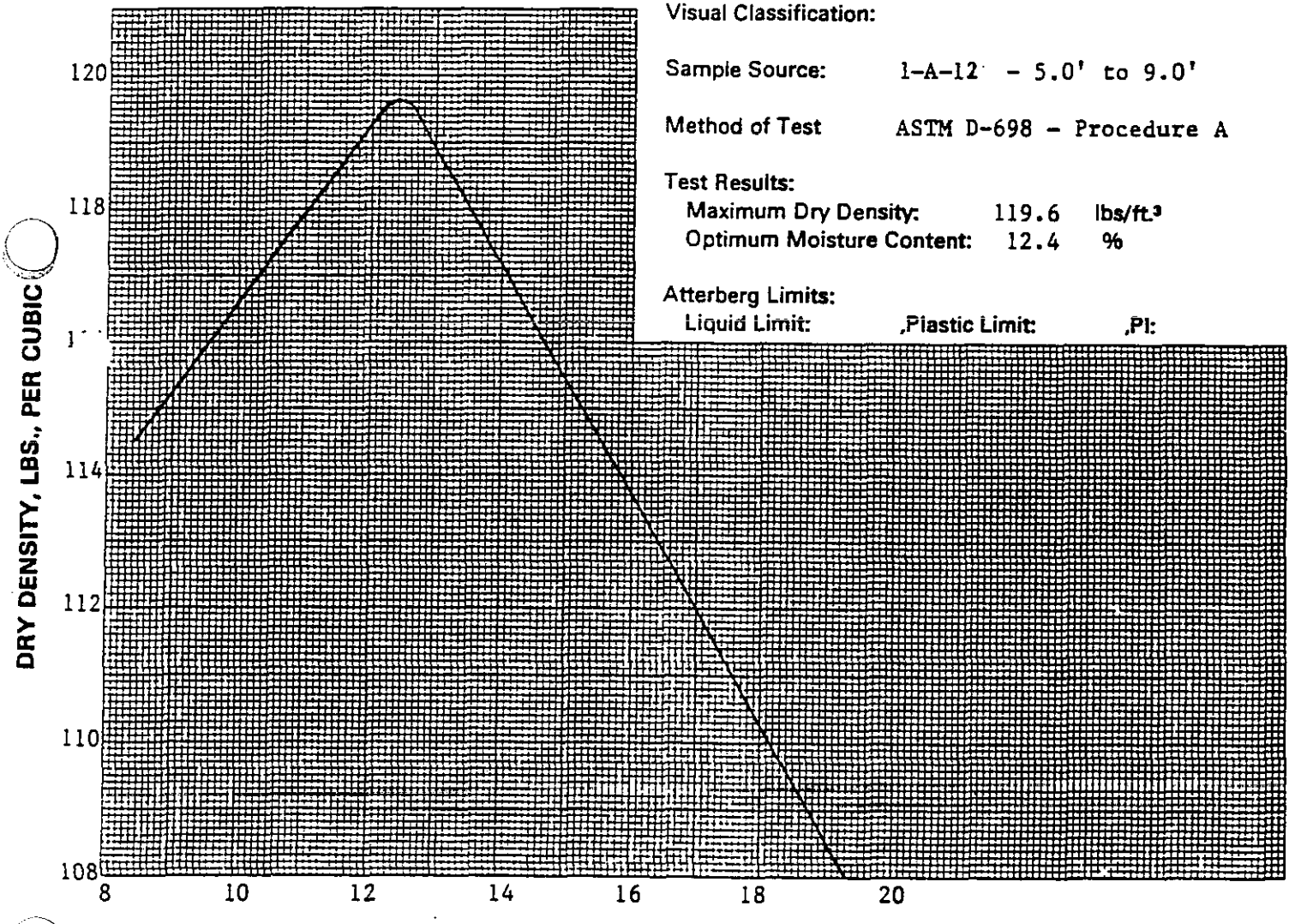
Visual Classification:

Sample Source: 1-A-12 - 5.0' to 9.0'

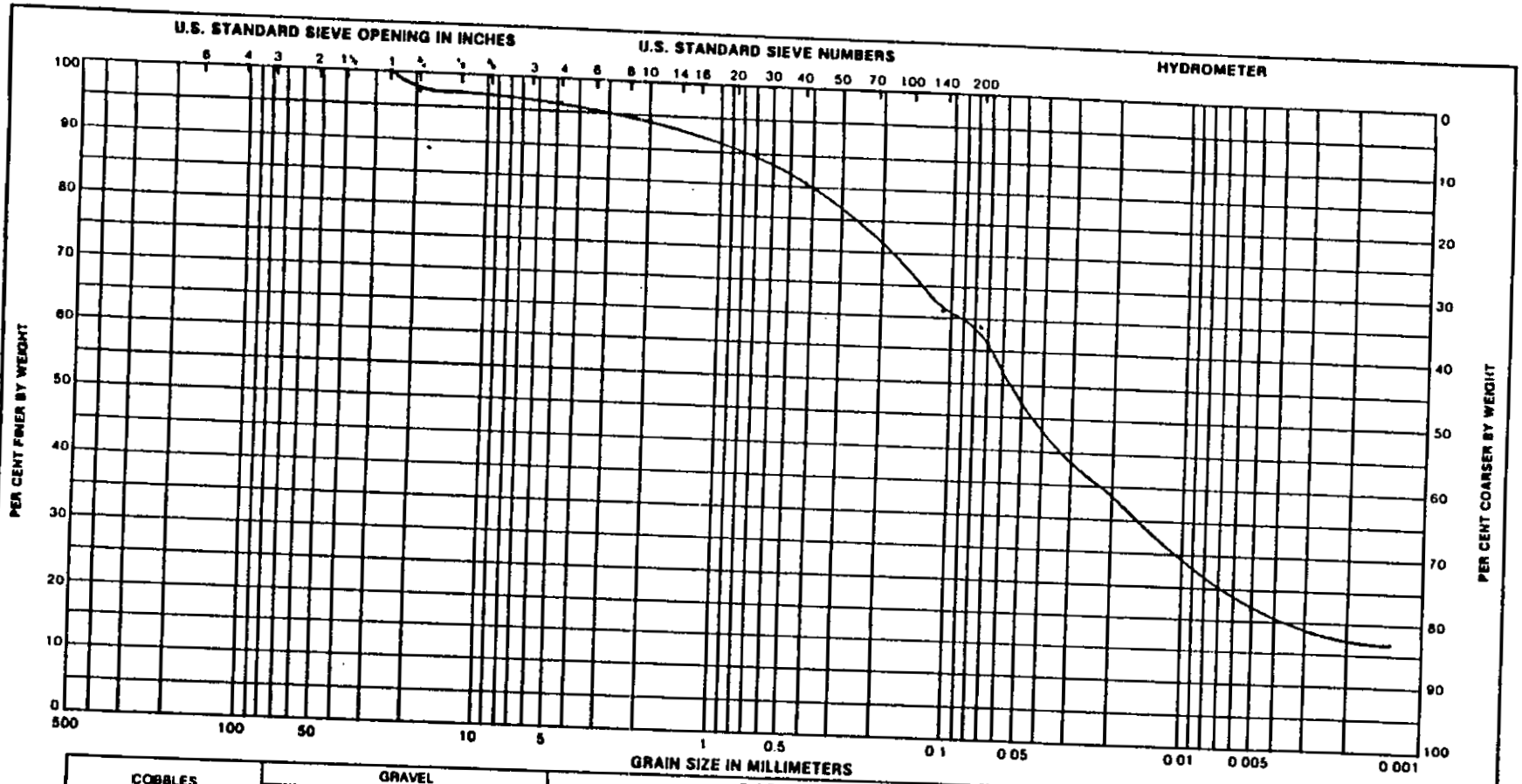
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 119.6 lbs/ft³
Optimum Moisture Content: 12.4 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI
1-A-14		1.0'-5.0'	A-4	9.0	27.4	21.1	6.3
			CL-ML				
			Loam				

REPORT OF SOIL ANALYSIS

Project
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

File No
491-35002

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 22, 1993

OUR REPORT NO.: 491-35002

TEST DATA

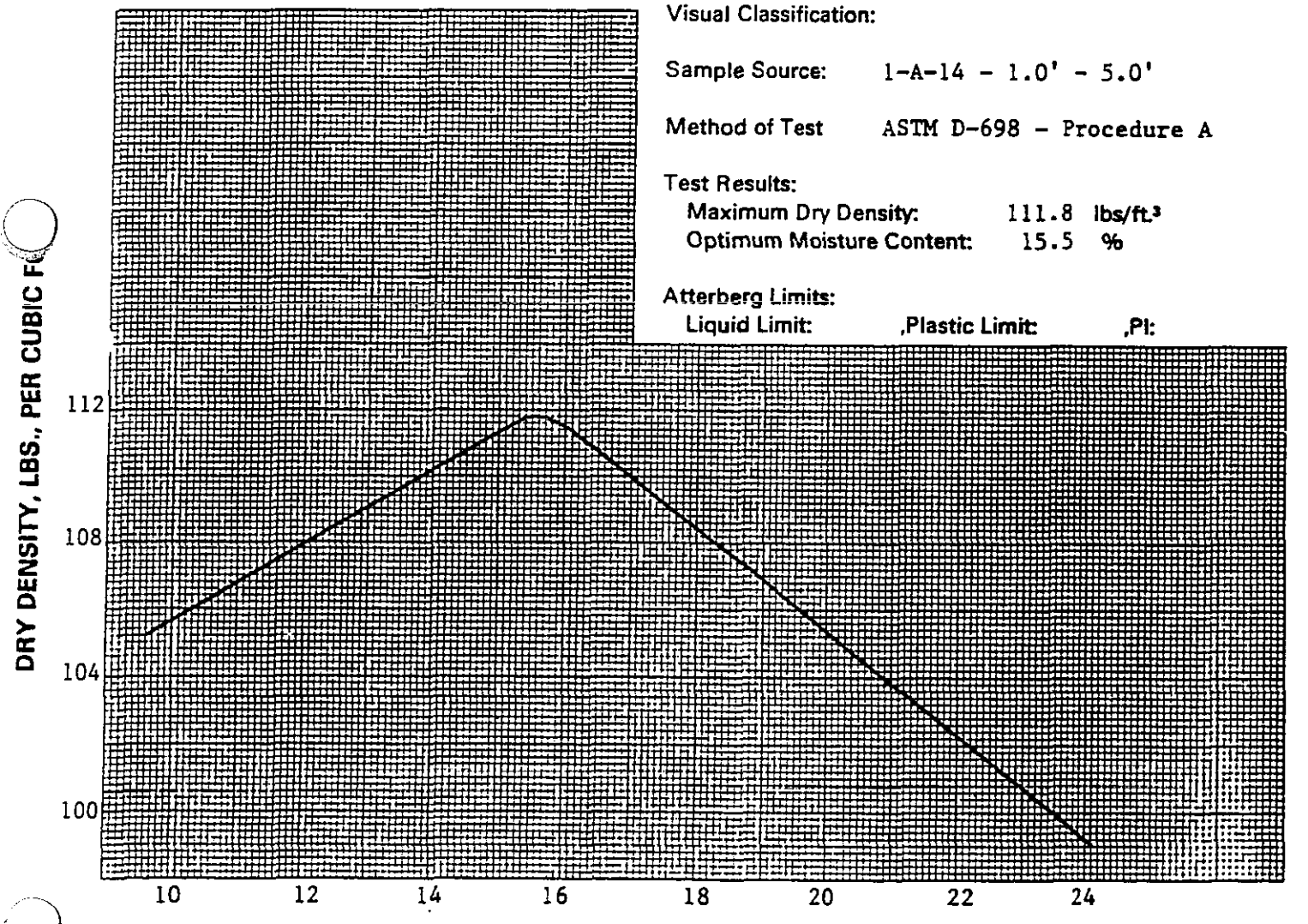
Visual Classification:

Sample Source: 1-A-14 - 1.0' - 5.0'

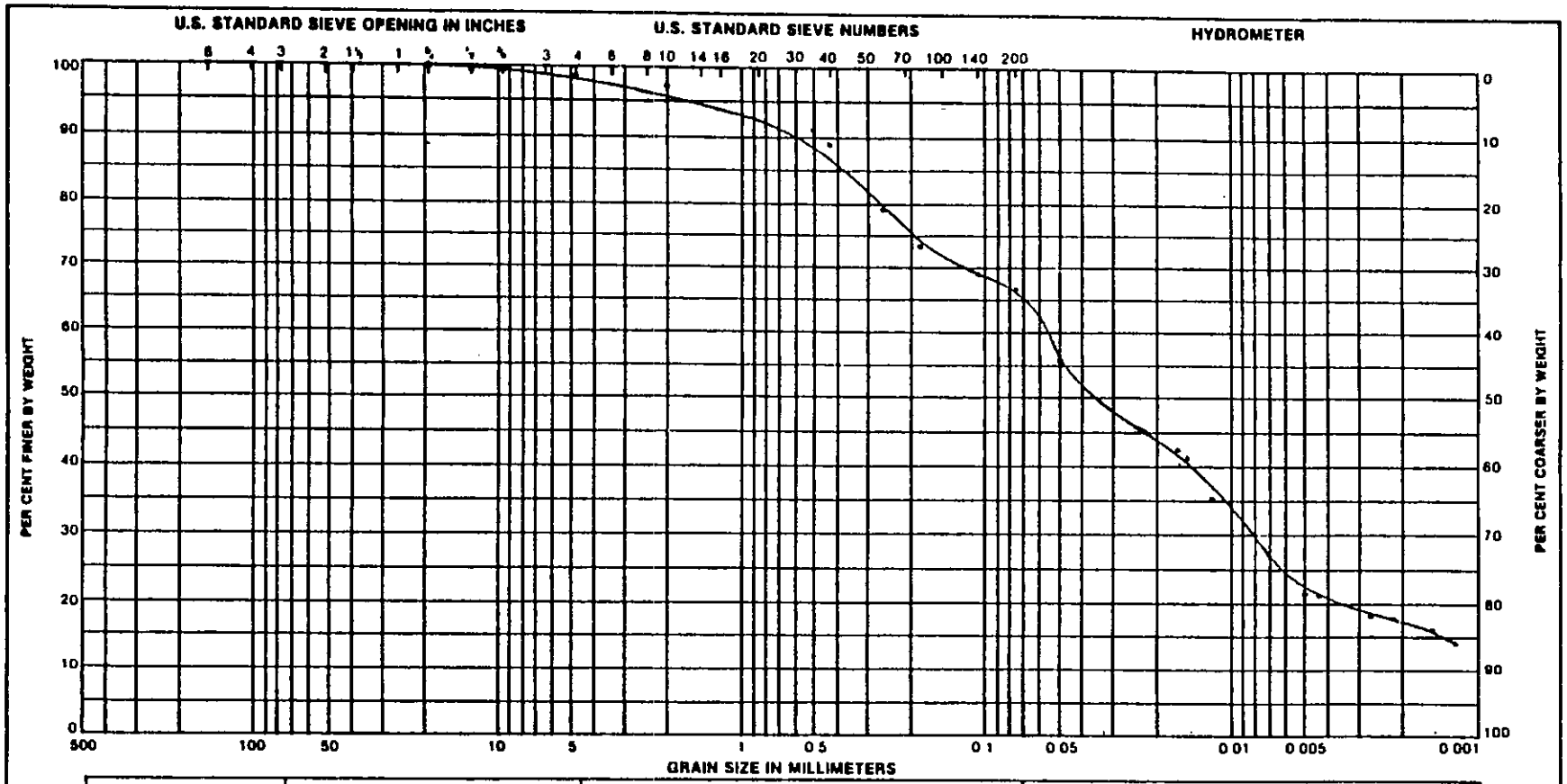
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 111.8 lbs/ft.³
Optimum Moisture Content: 15.5 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-A-14		5'-10'	A-4		24.2	18.1	6.1	Ash Basin No. 7 Closure
								Soil Borrow Area
			CL-ML					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 14, 1993

OUR REPORT NO.: 491-35002

TEST DATA

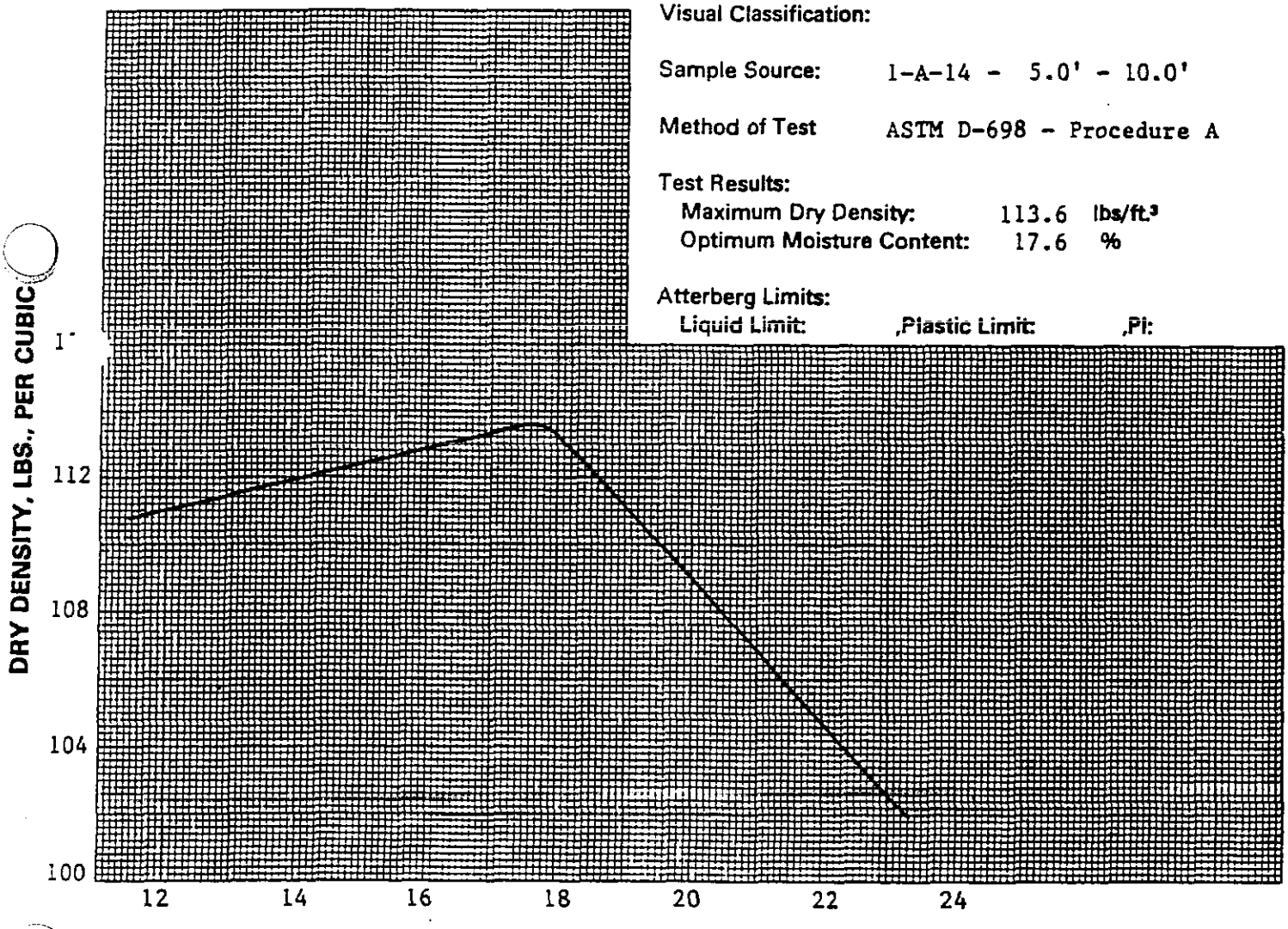
Visual Classification:

Sample Source: 1-A-14 - 5.0' - 10.0'

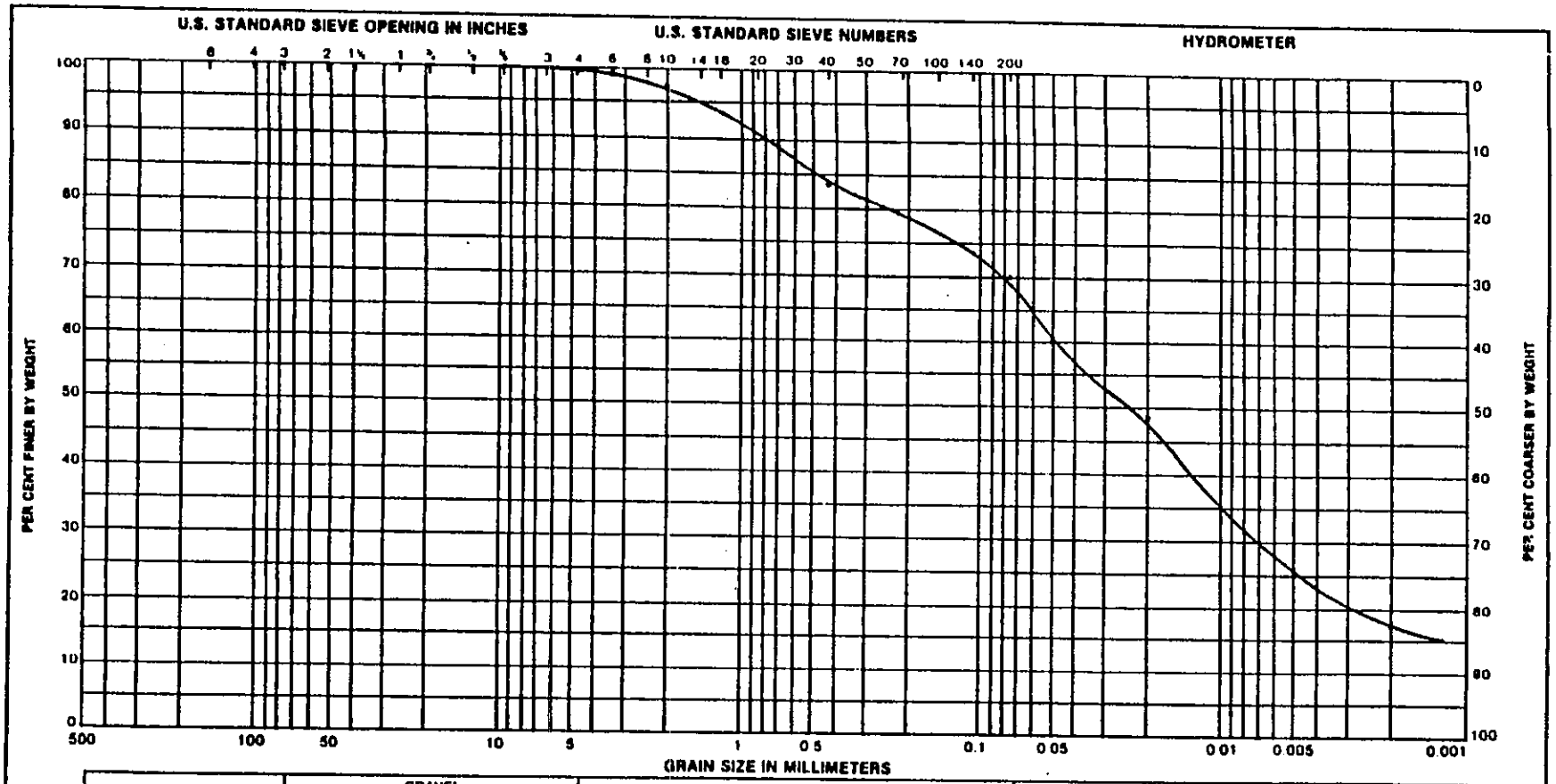
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 113.6 lbs/ft³
Optimum Moisture Content: 17.6 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-B-6		10.0'-14.0'	A-4	22.9	32.1	25.0	7.1	Ash Basin No. 7 Closure
								Soil Borrow Area
			ML					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power and Light Company
Two North Ninth Street
Allentown, PA 18101

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 24, 1993

OUR REPORT NO.: 491-35002

TEST DATA

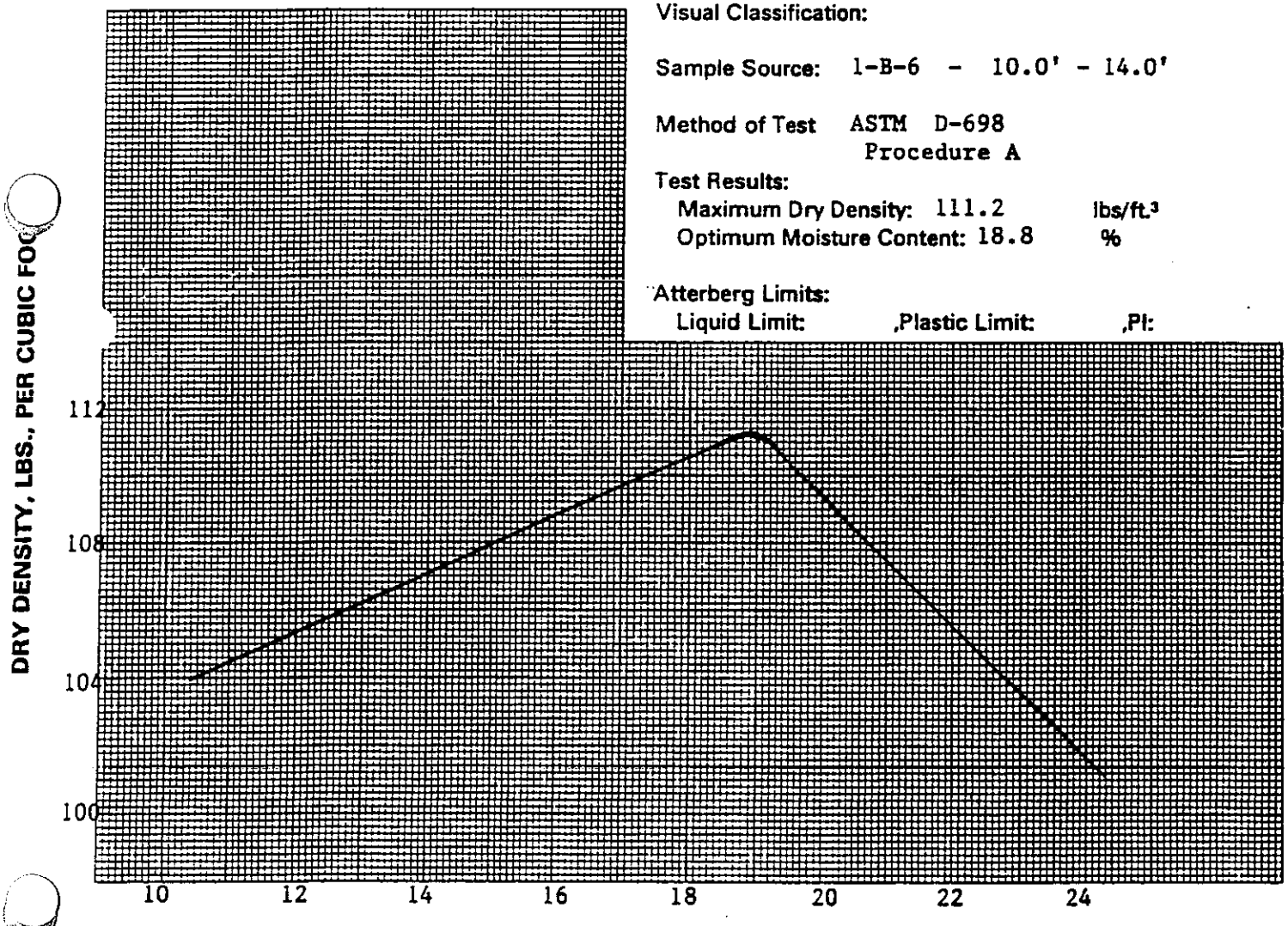
Visual Classification:

Sample Source: 1-B-6 - 10.0' - 14.0'

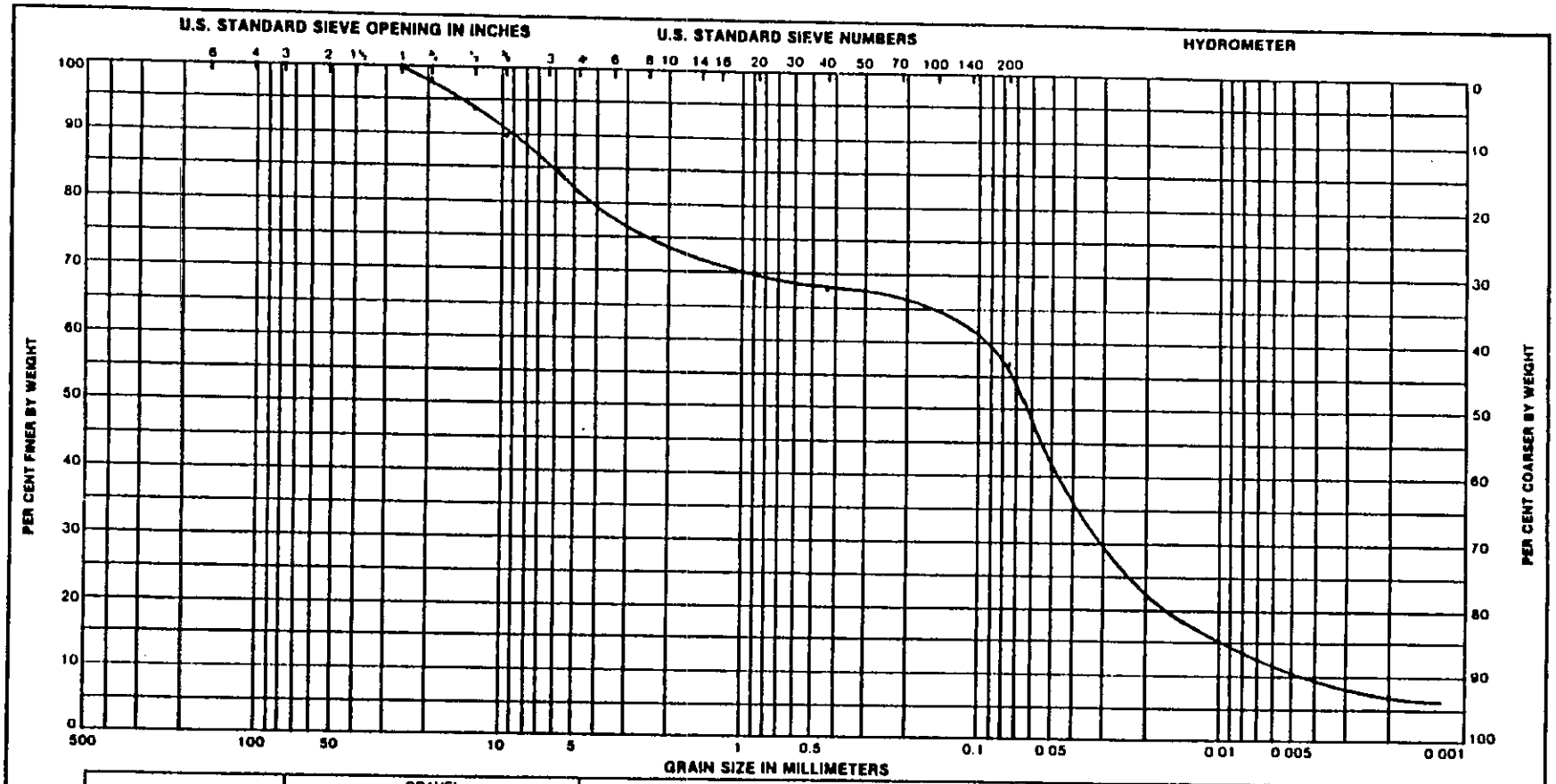
Method of Test ASTM D-698
Procedure A

Test Results:
Maximum Dry Density: 111.2 lbs/ft.³
Optimum Moisture Content: 18.8 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-B-9		9.0'-13.0'	A-4	8.39	22.5	20.6	1.9	Ash Basin No. 7
								Soil Borrow Area
			ML					ER 102147
			Gravelly Loam					

REPORT OF SOIL ANALYSIS

File No. 491-35002

Professional Service Industries

A-100-7

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power and Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 20, 1993

OUR REPORT NO.: 491-35002

TEST DATA

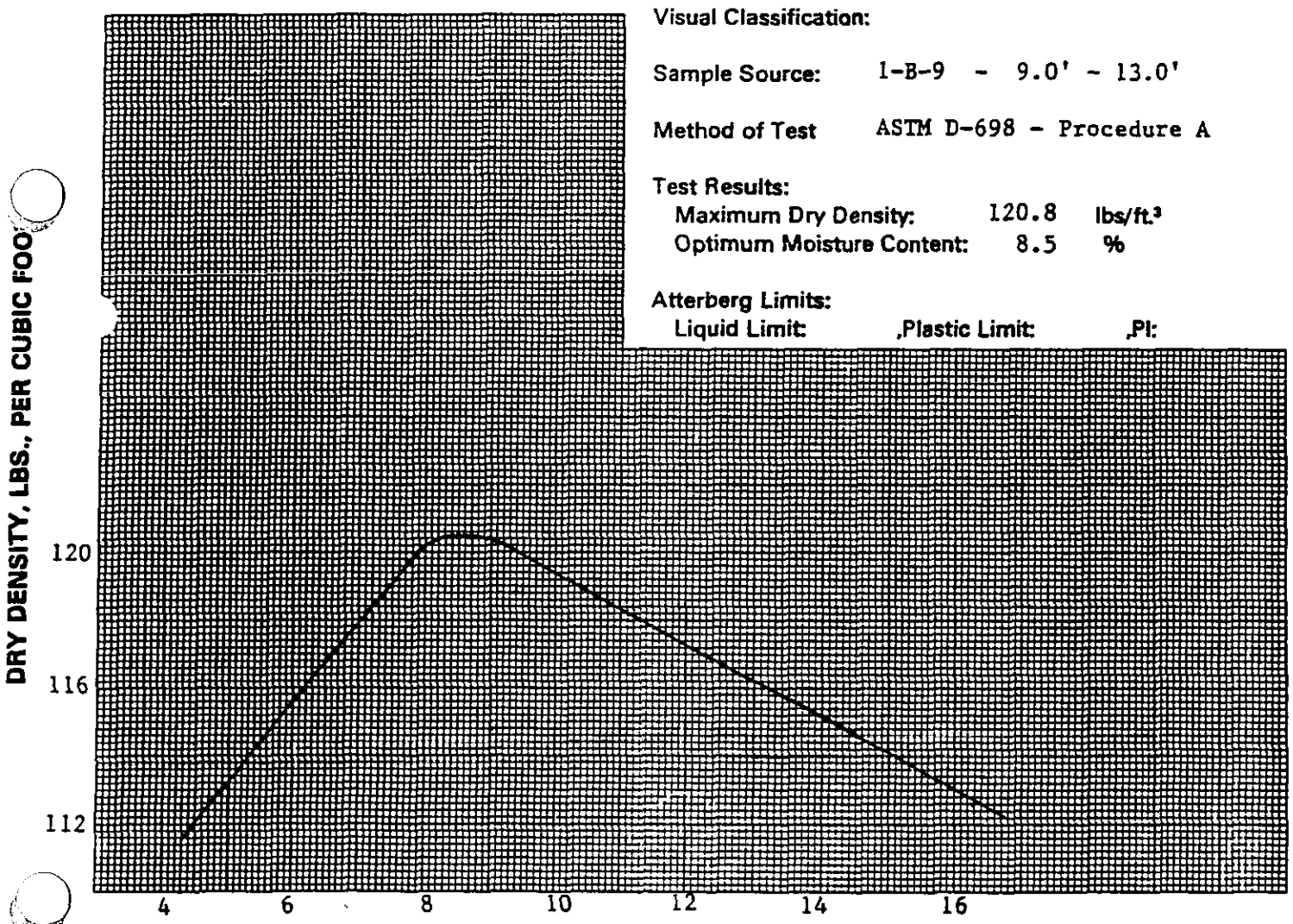
Visual Classification:

Sample Source: 1-B-9 - 9.0' - 13.0'

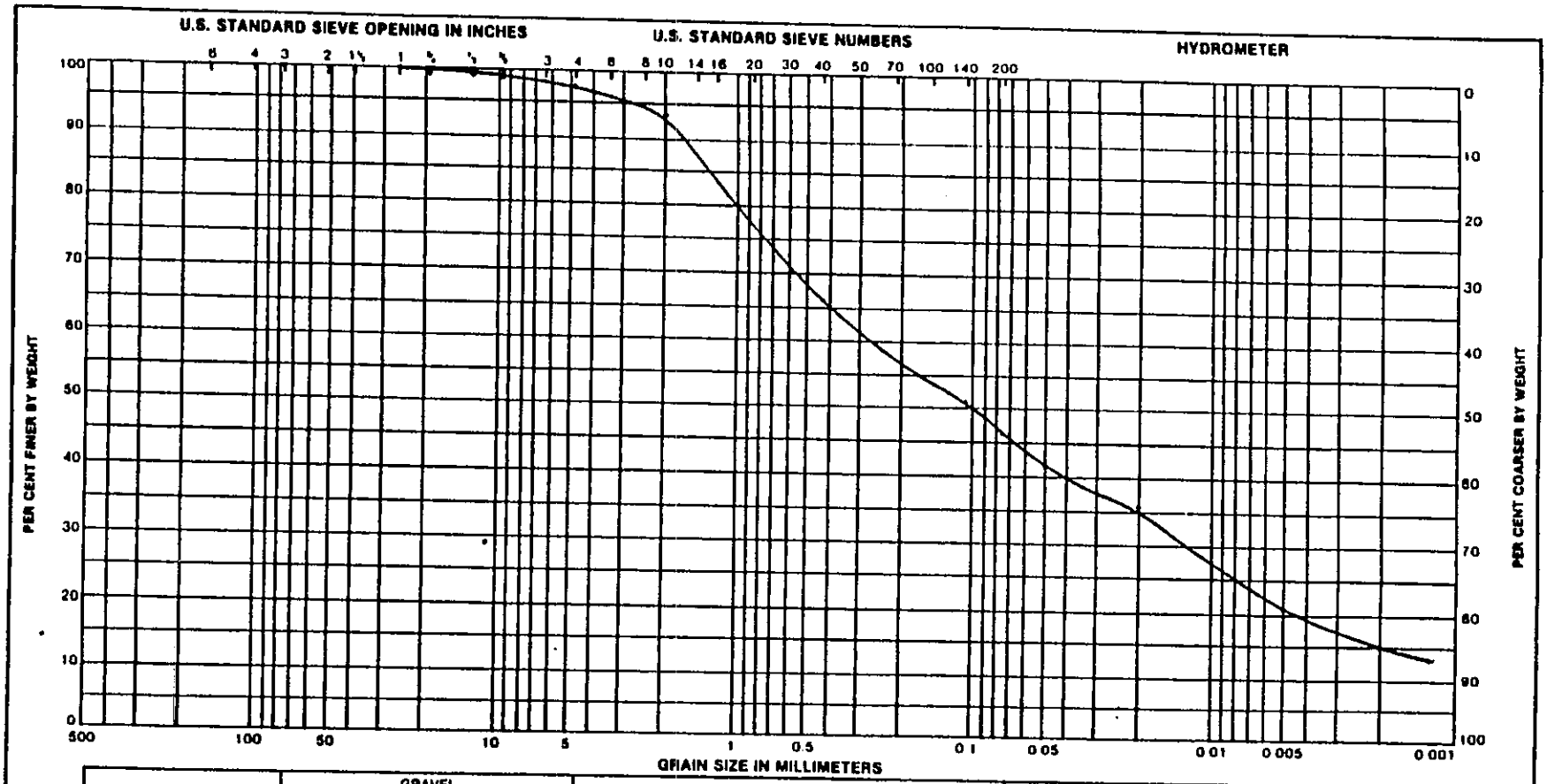
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 120.8 lbs/ft.³
Optimum Moisture Content: 8.5 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-B-11		1.0'-5.0'	A-4	23.99	25.47	21.29	4.18	Ash Basin No. 7 Closure
								Soil Borrow Area
			SC - SM					ER 102147
			Sandy Loam					

REPORT OF SOIL ANALYSIS

File No. 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power and Light Company
Two North Ninth Street
Allentown, PA 18101

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 25, 1993

OUR REPORT NO.: 491-35002

TEST DATA

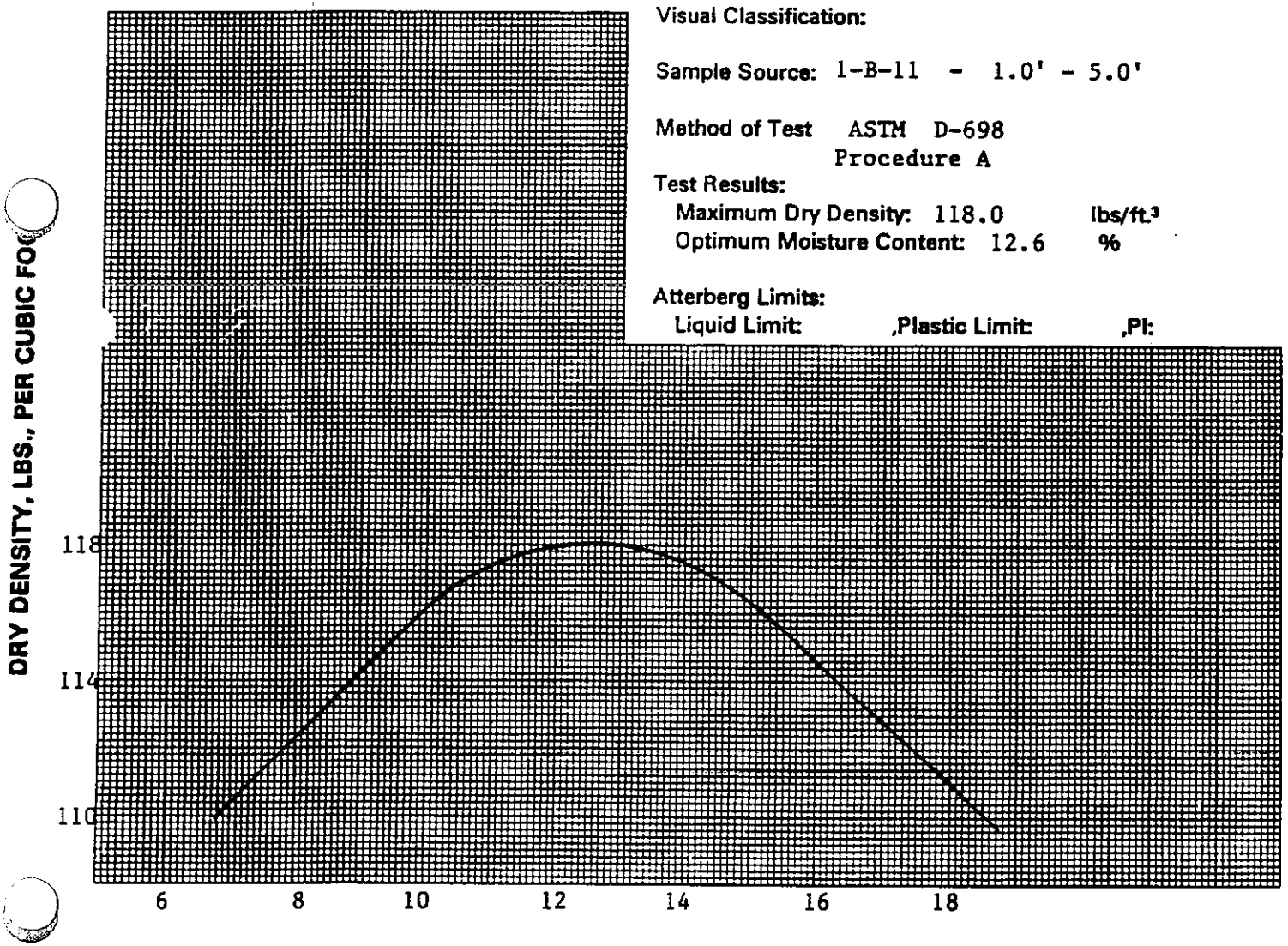
Visual Classification:

Sample Source: 1-B-11 - 1.0' - 5.0'

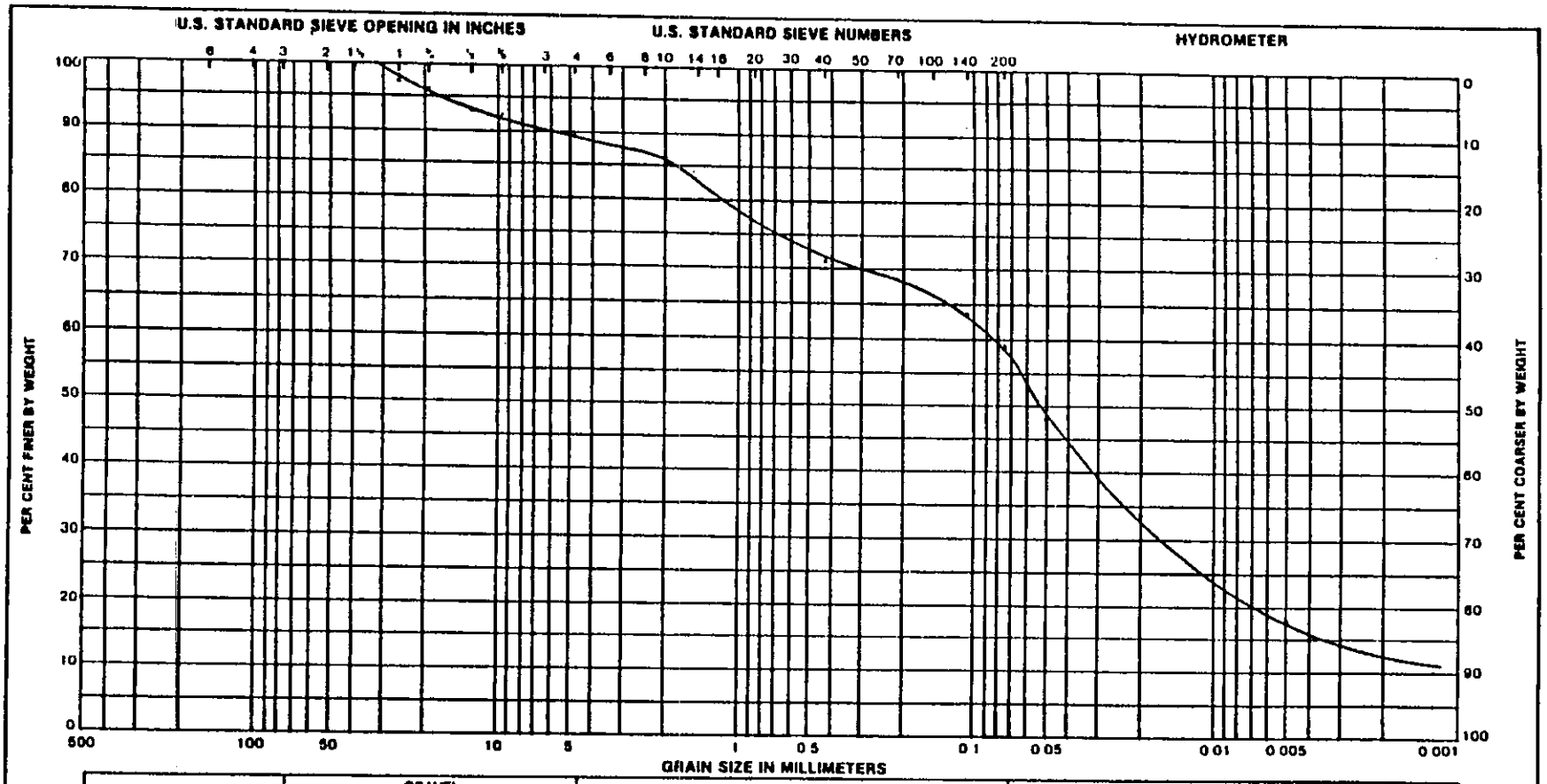
Method of Test ASTM D-698
Procedure A

Test Results:
Maximum Dry Density: 118.0 lbs/ft.³
Optimum Moisture Content: 12.6 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.

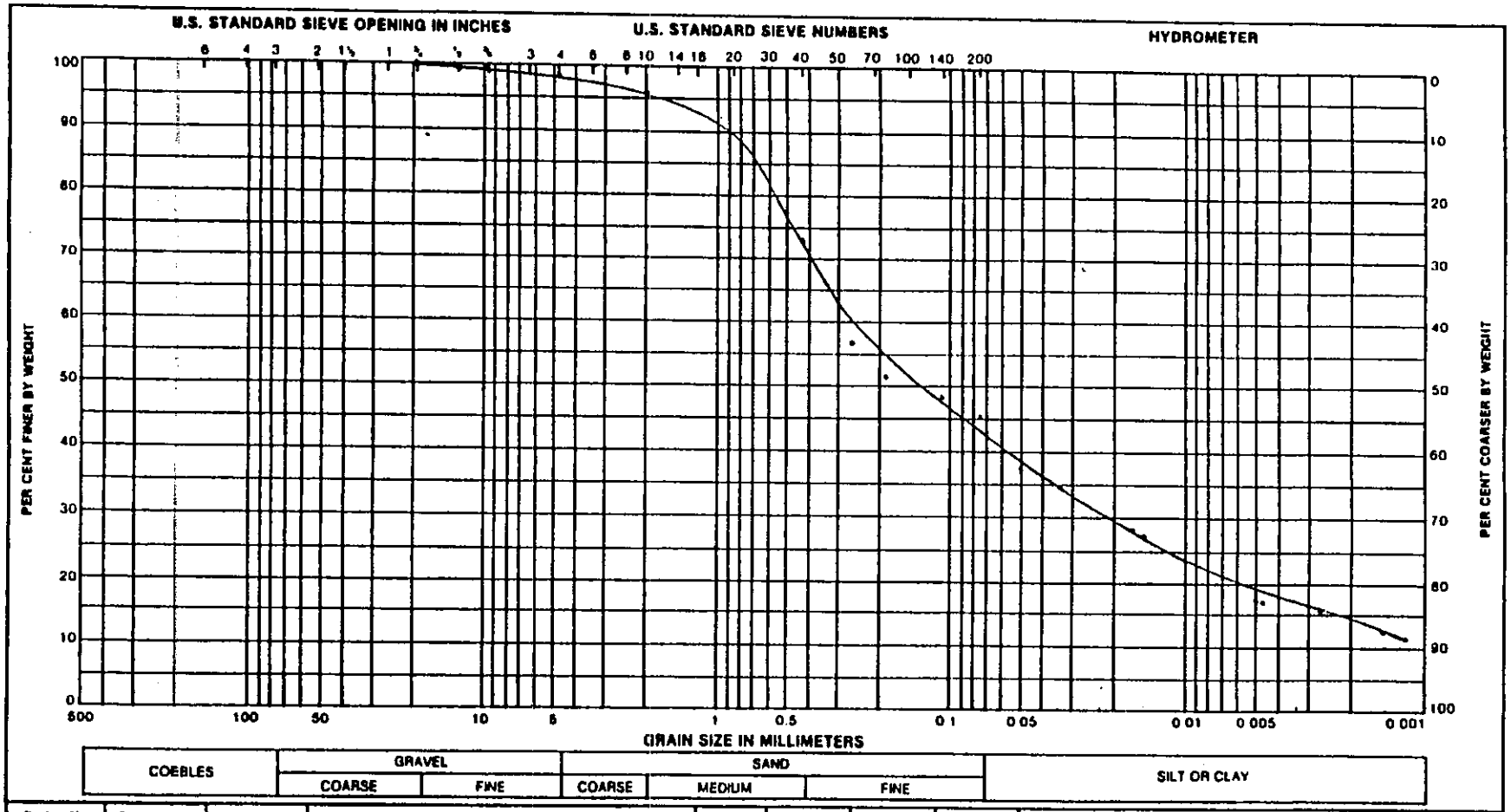


Boring No.	Sample No.	Elev. or Depth	Classification	Nat'l %	LL	PL	PI	Project
1-B-11		5.0'-9 0'	A-4	12.3	23.95	20.0	3.95	Ash Basin No. 7
								Soil Borrow Area
			ML					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-B-12		1.0'-5.0'	A-4		23.6	18.0	5.6	Ash Basin No. 7 Closure
								Soil Borrow Area
			SC-SM					ER 102147
			Sandy Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 14, 1993

OUR REPORT NO.: 491-35002

TEST DATA

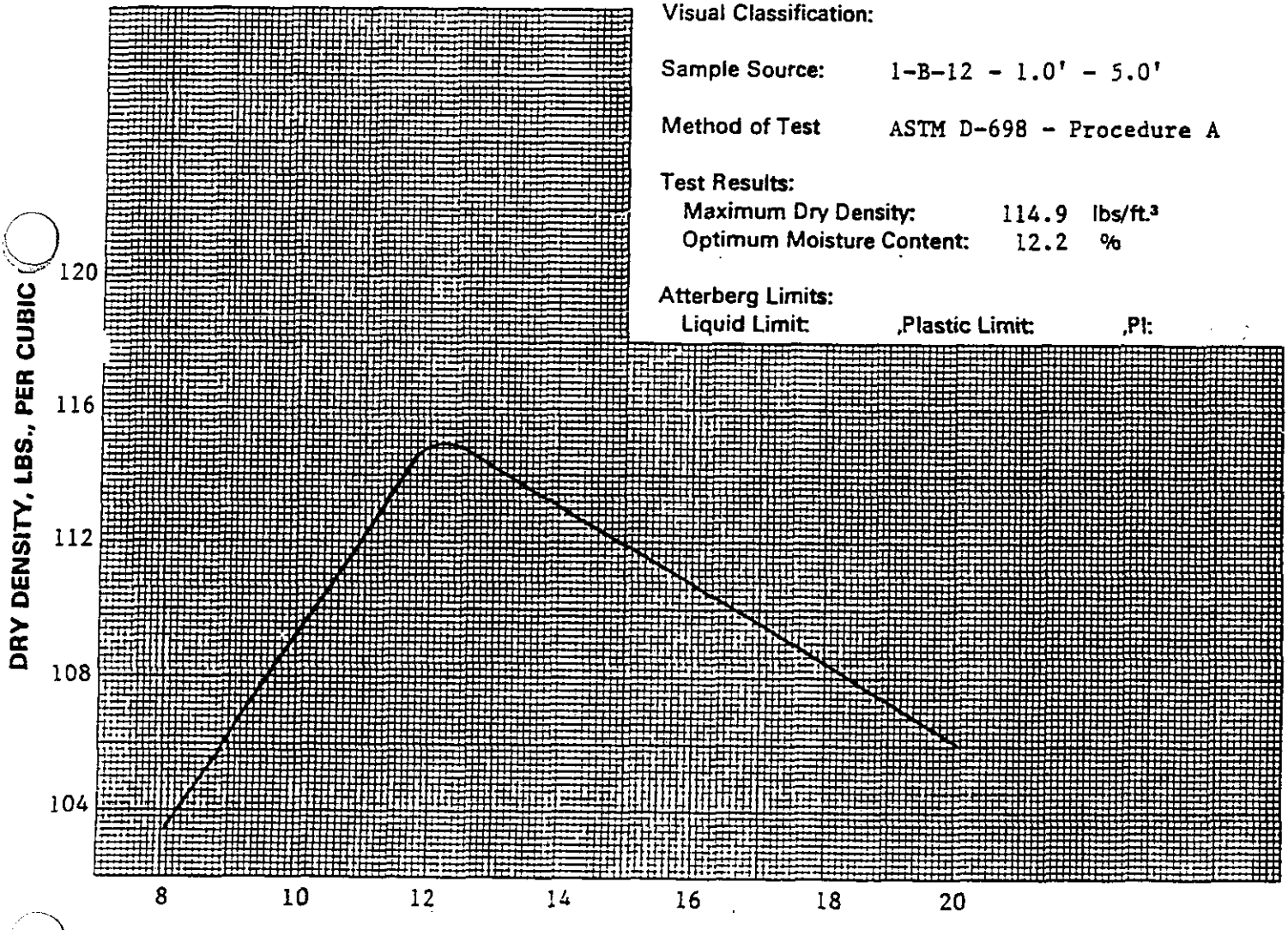
Visual Classification:

Sample Source: 1-B-12 - 1.0' - 5.0'

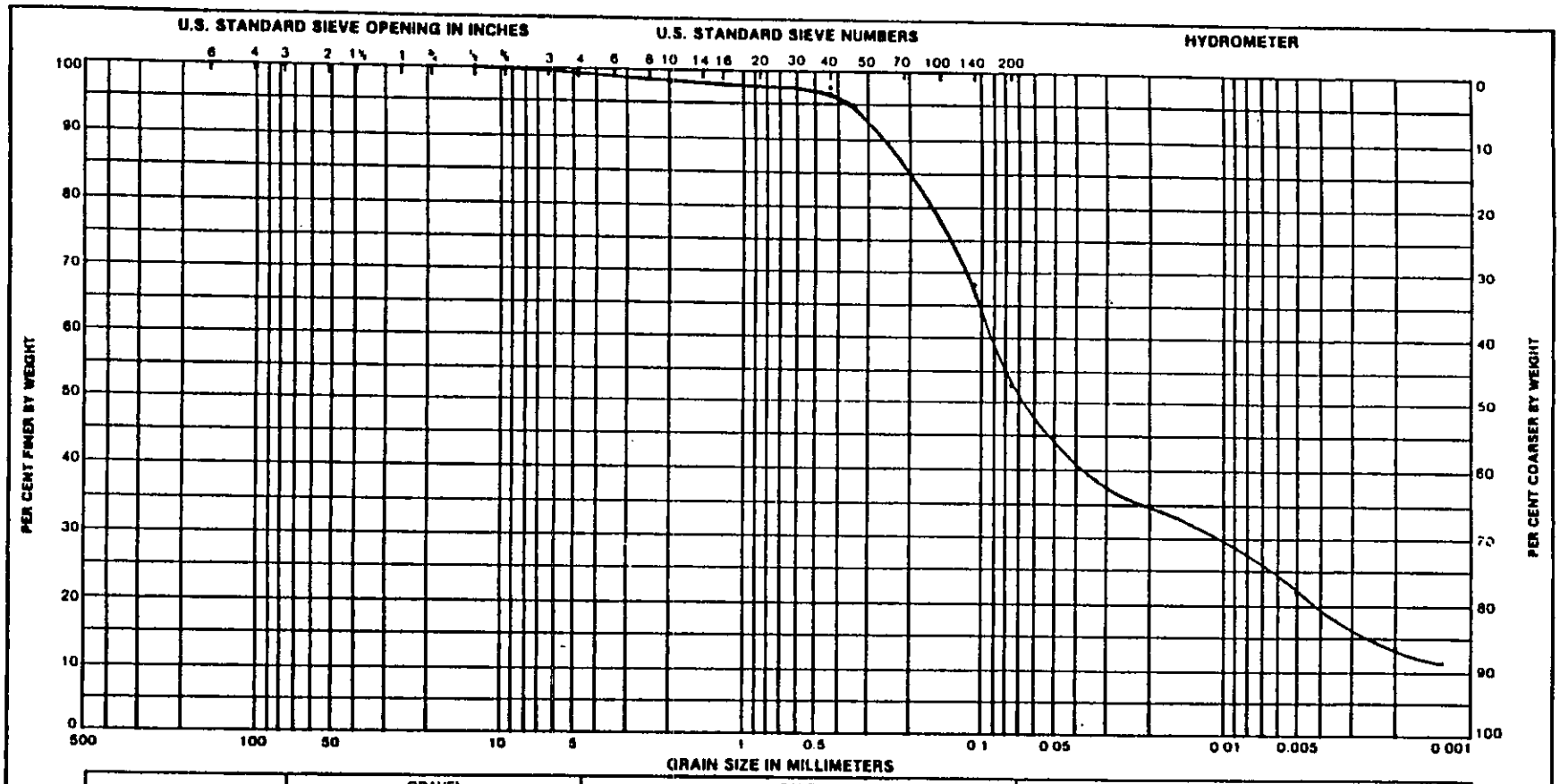
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 114.9 lbs/ft.³
Optimum Moisture Content: 12.2 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-C-7		4.0'-8.0'	A-4	16.38	21.62	20.57	1.05	Ash Basin No. 7 Closure
								Soil Borrow Area
			ML					ER 102147
			Fine Sandy Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power and Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 24, 1993

OUR REPORT NO.: 491-35002

TEST DATA

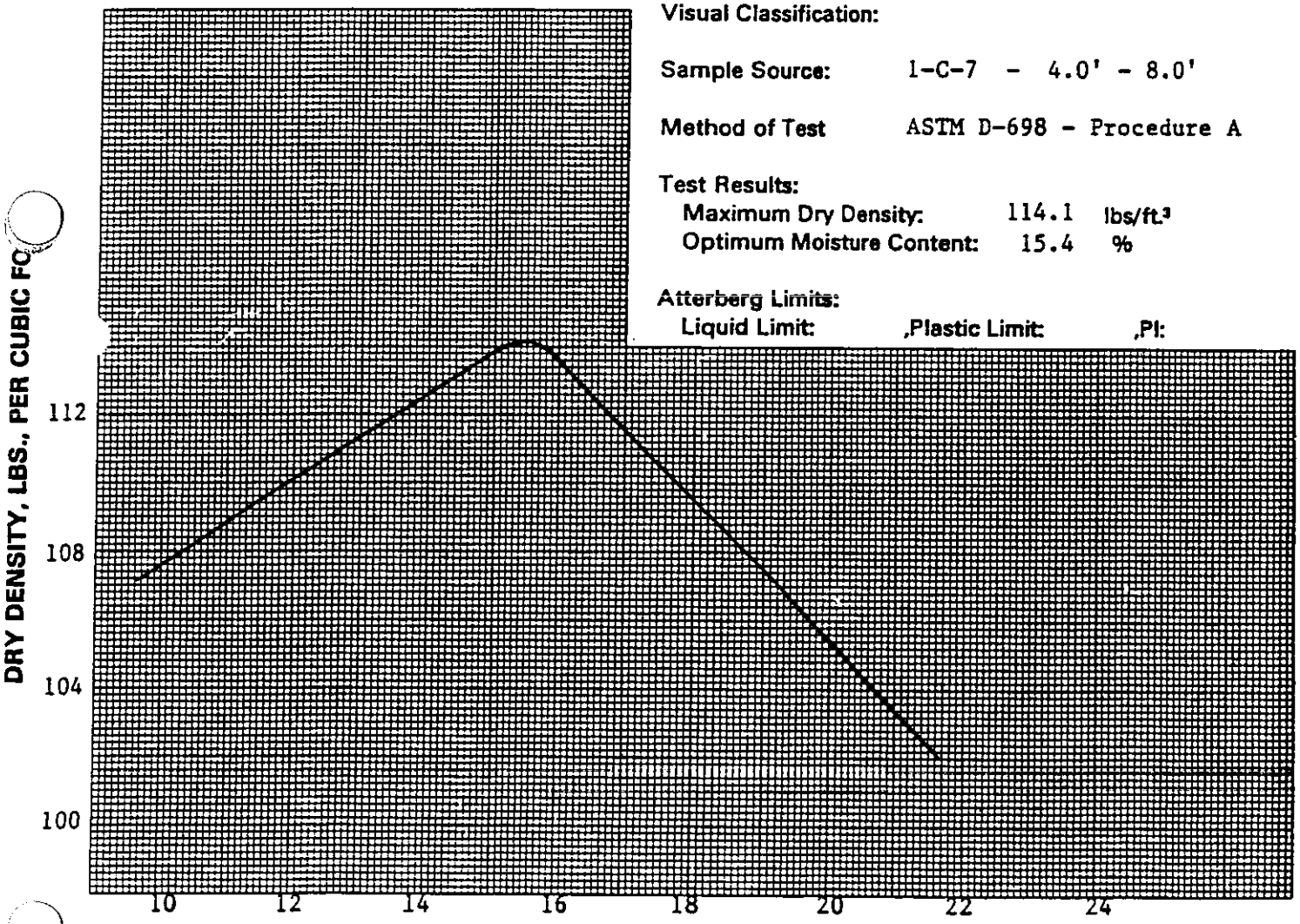
Visual Classification:

Sample Source: 1-C-7 - 4.0' - 8.0'

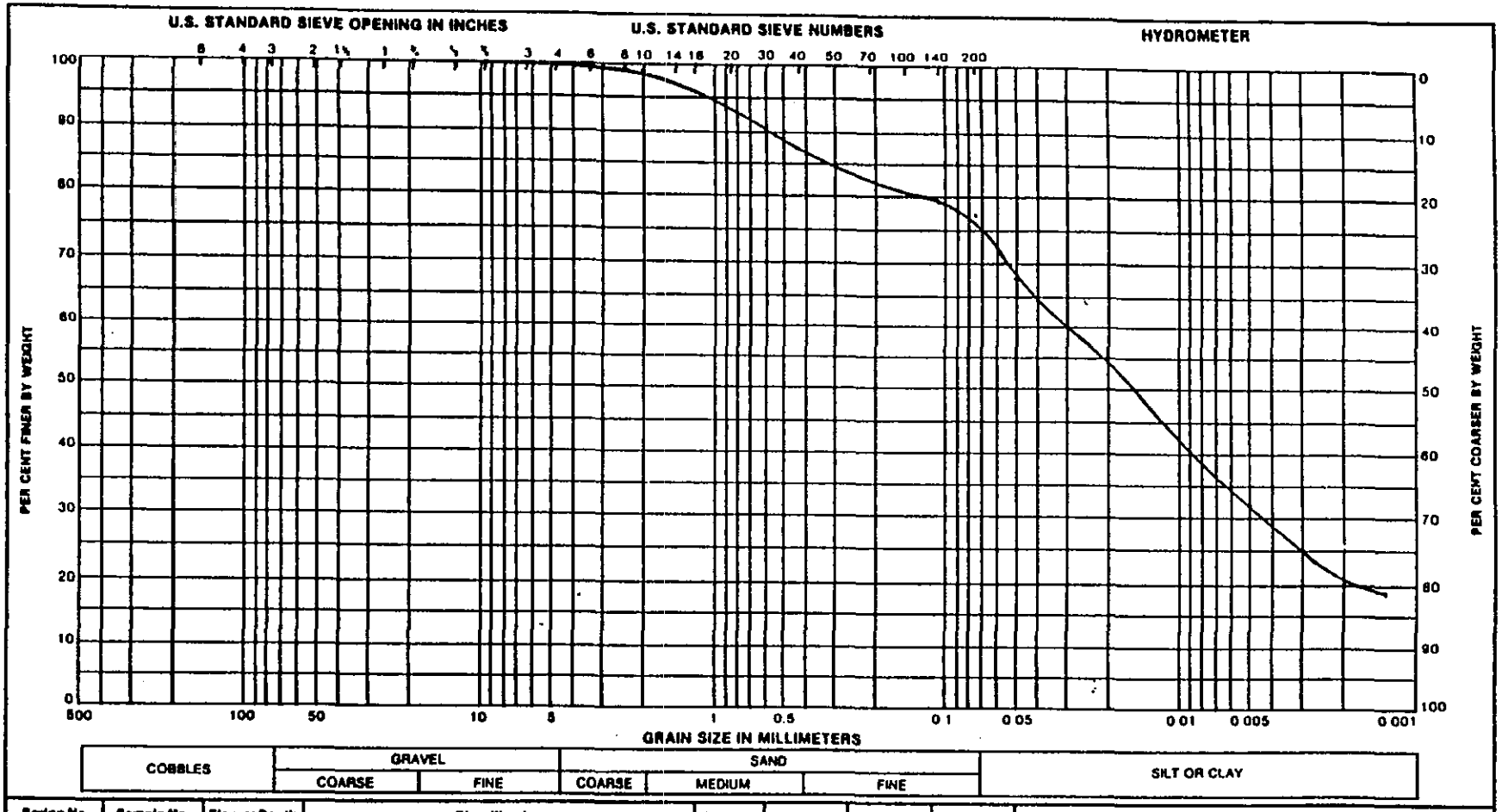
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 114.1 lbs/ft³
Optimum Moisture Content: 15.4 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-C-9		4.0'-8.0'	A-4	17.99	28.5	19.9	8.6	Ash Basin No.7
								Soil Borrow Area
			CL					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No. 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101
Attention: Mr. Andy Spear

PROJECT: Brunner Island
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 20, 1993

OUR REPORT NO.: 491-35002

TEST DATA

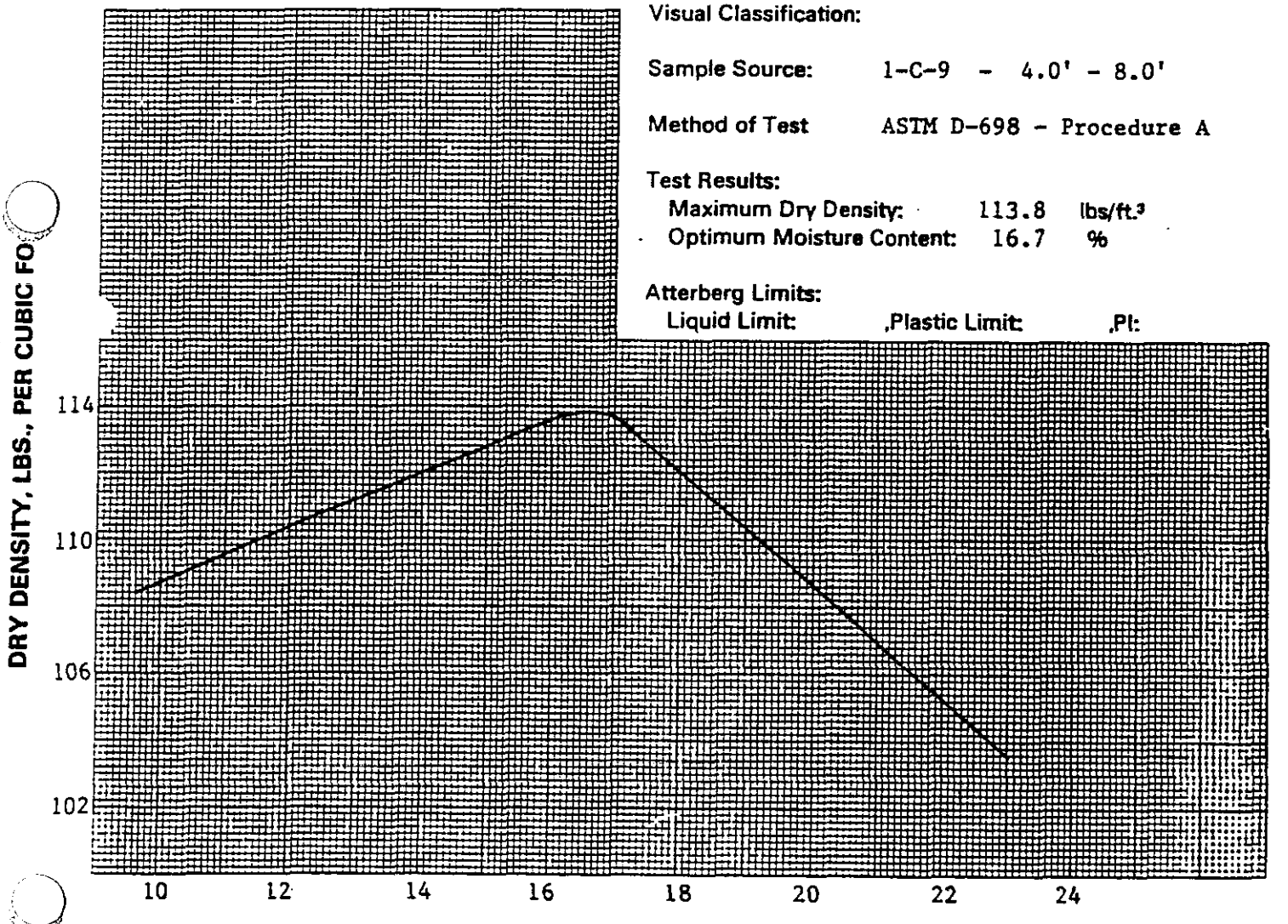
Visual Classification:

Sample Source: 1-C-9 - 4.0' - 8.0'

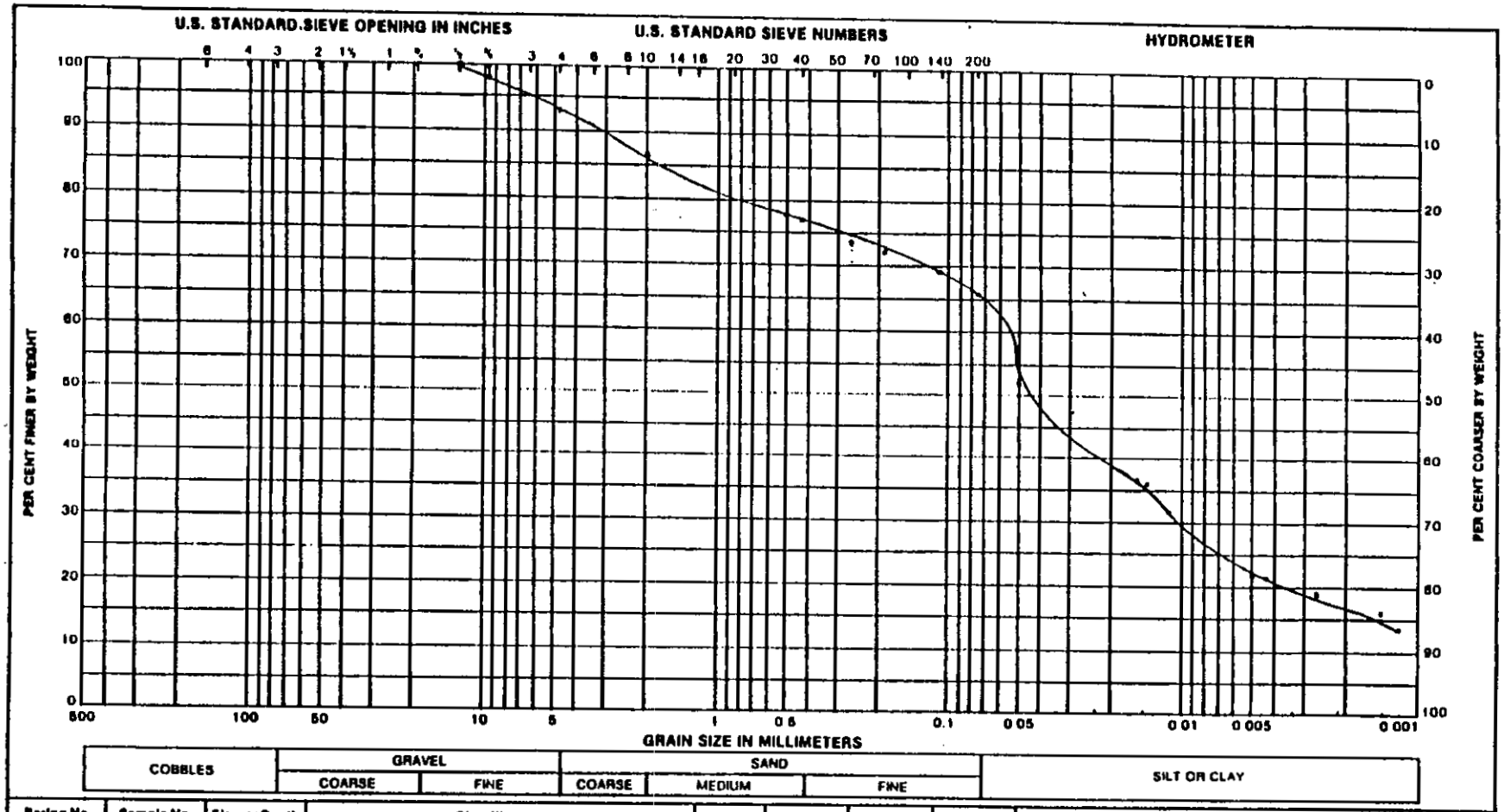
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 113.8 lbs/ft.³
Optimum Moisture Content: 16.7 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-C-9		10'-18'	A-4	9.5	24.4	16.3	8.1	Ash Basin No. 7
								Soil Borrow Area
			CL					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No. 491-35002

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 16, 1993

OUR REPORT NO.: 491-35002

TEST DATA

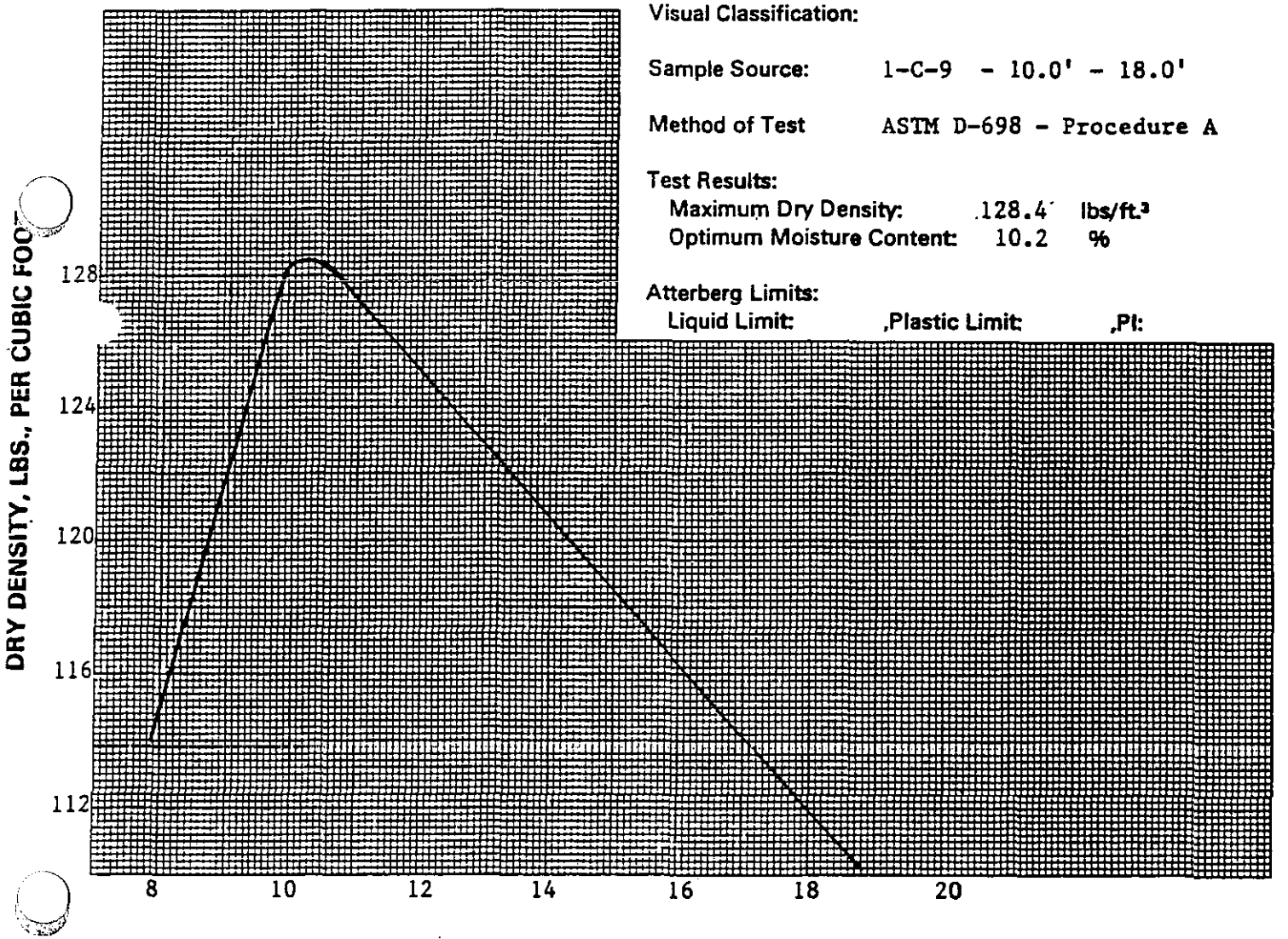
Visual Classification:

Sample Source: 1-C-9 - 10.0' - 18.0'

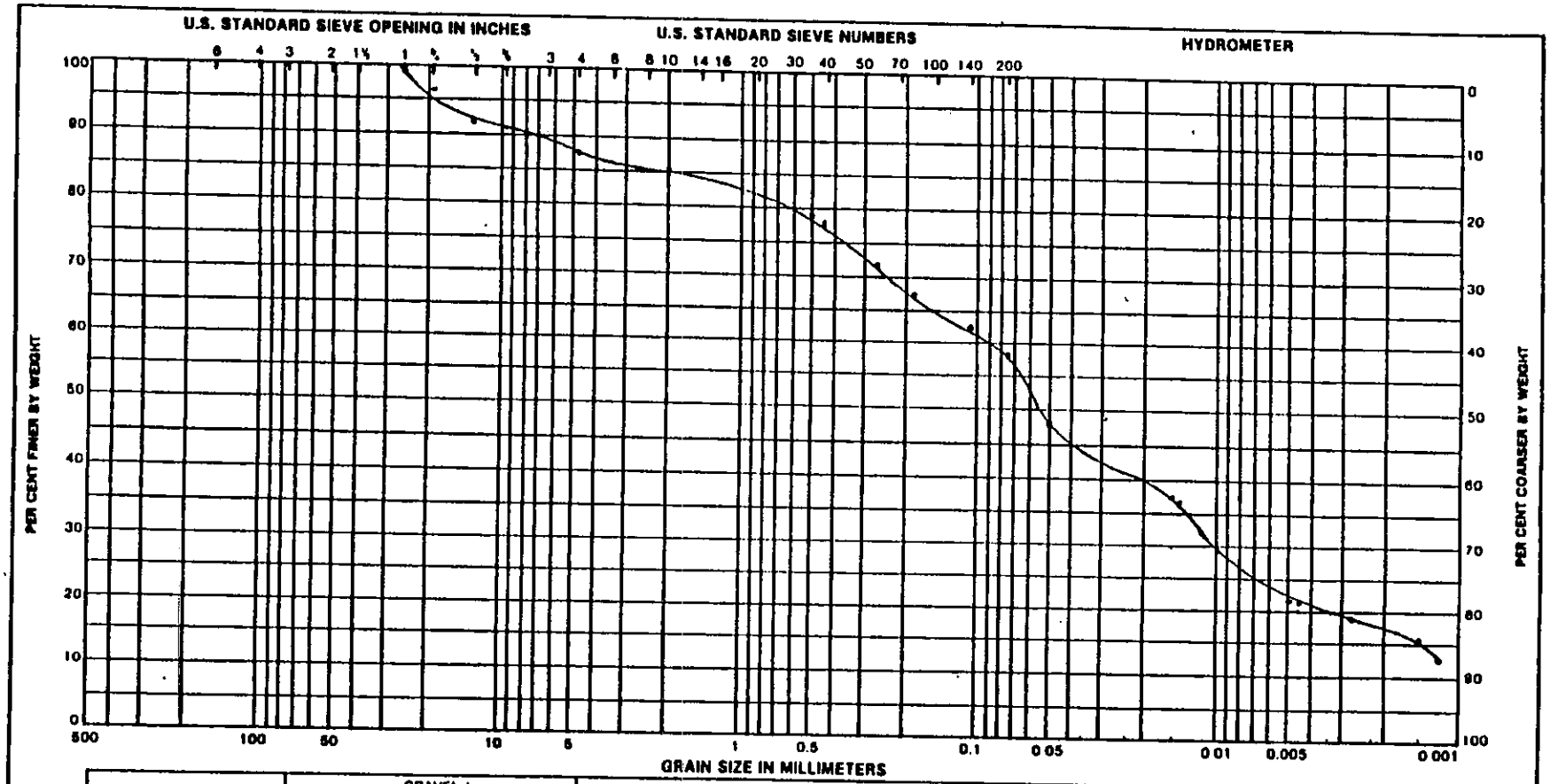
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 128.4 lbs/ft.³
Optimum Moisture Content: 10.2 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
I-C-10		4'-8'	A-4	15.0	22.71	17.8	4.9	Ash Basin No. 7 Closure
								Soil Borrow Area
			CL-ML					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No. 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 19, 1993

OUR REPORT NO.: 491-35002

TEST DATA

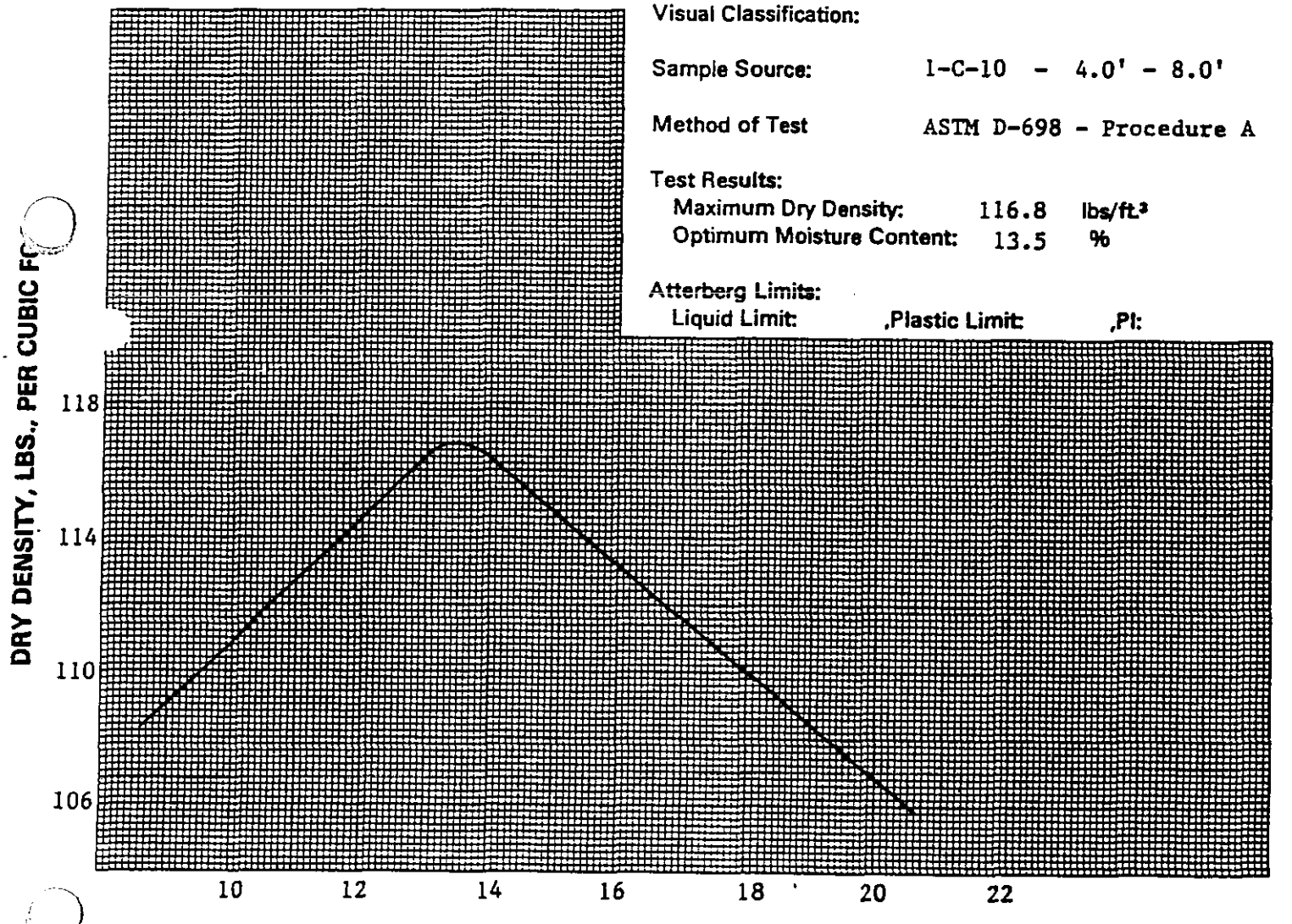
Visual Classification:

Sample Source: 1-C-10 - 4.0' - 8.0'

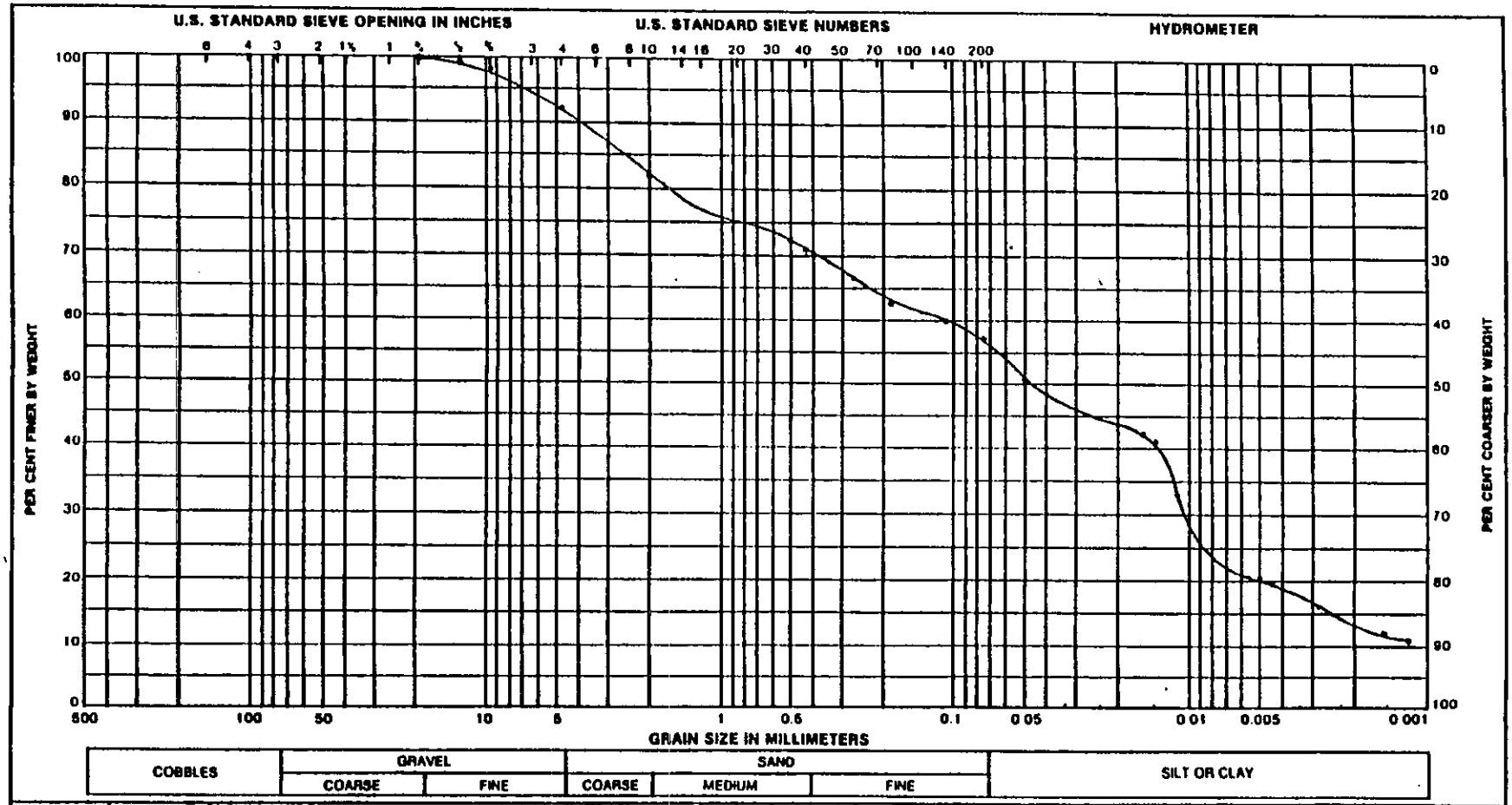
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 116.8 lbs/ft³
Optimum Moisture Content: 13.5 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-C-11		10'-18'	A-4	11.4	28.1	23.1	5.0	Ash Basin No. 7 Closure
								Soil Borrow Area
			ML					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No. 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 16, 1993

OUR REPORT NO.: 491-35002

TEST DATA

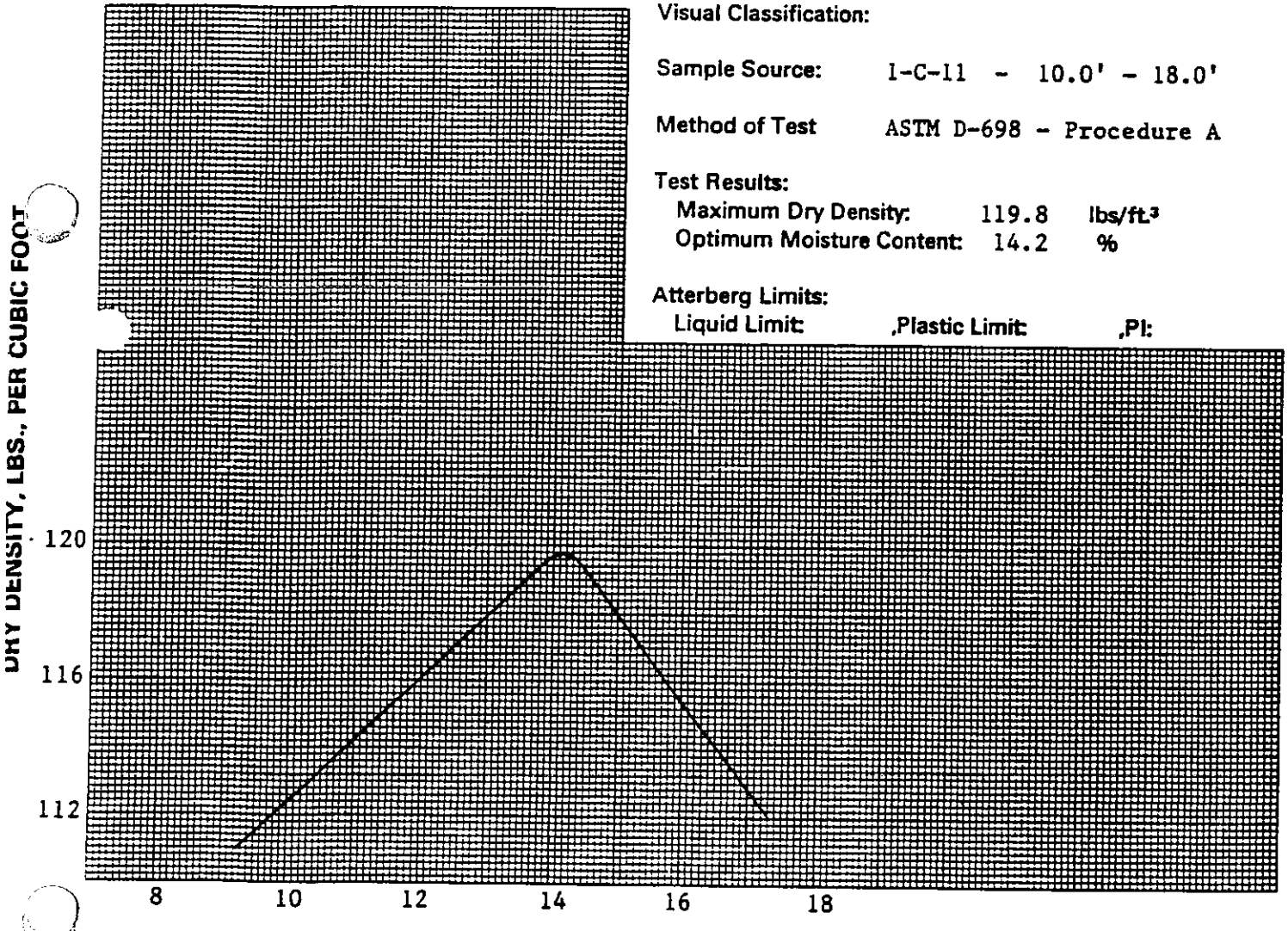
Visual Classification:

Sample Source: I-C-11 - 10.0' - 18.0'

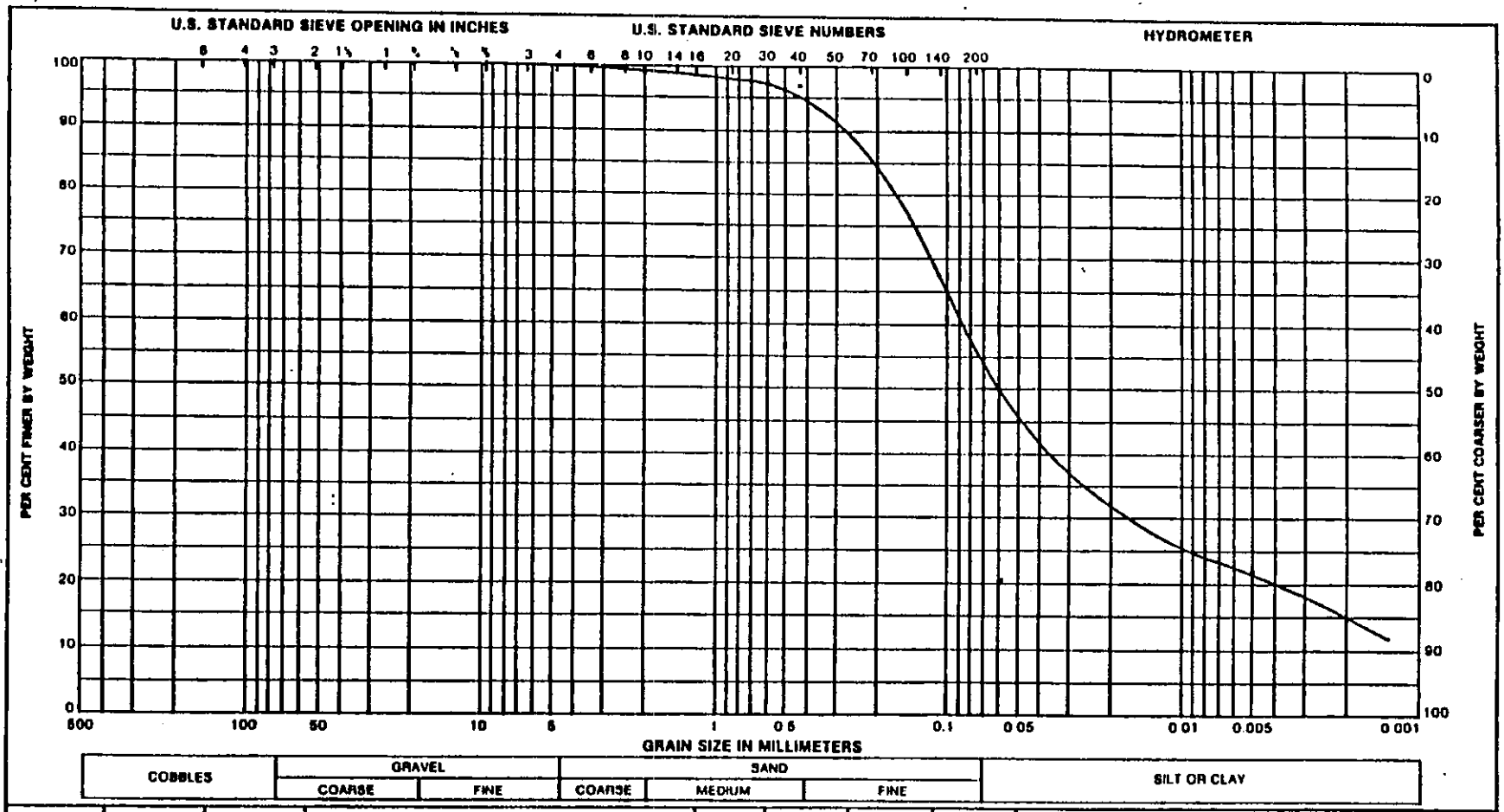
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 119.8 lbs/ft³
Optimum Moisture Content: 14.2 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-C-12		4.0'-8.0'	A-4	12.6			NP	Ash Basin No. 7 Closure Soil Borrow Area ER 102147
			ML Fine Sandy Loam					

REPORT OF SOIL ANALYSIS

File No. 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 11, 1993

OUR REPORT NO.: 491-35002

TEST DATA

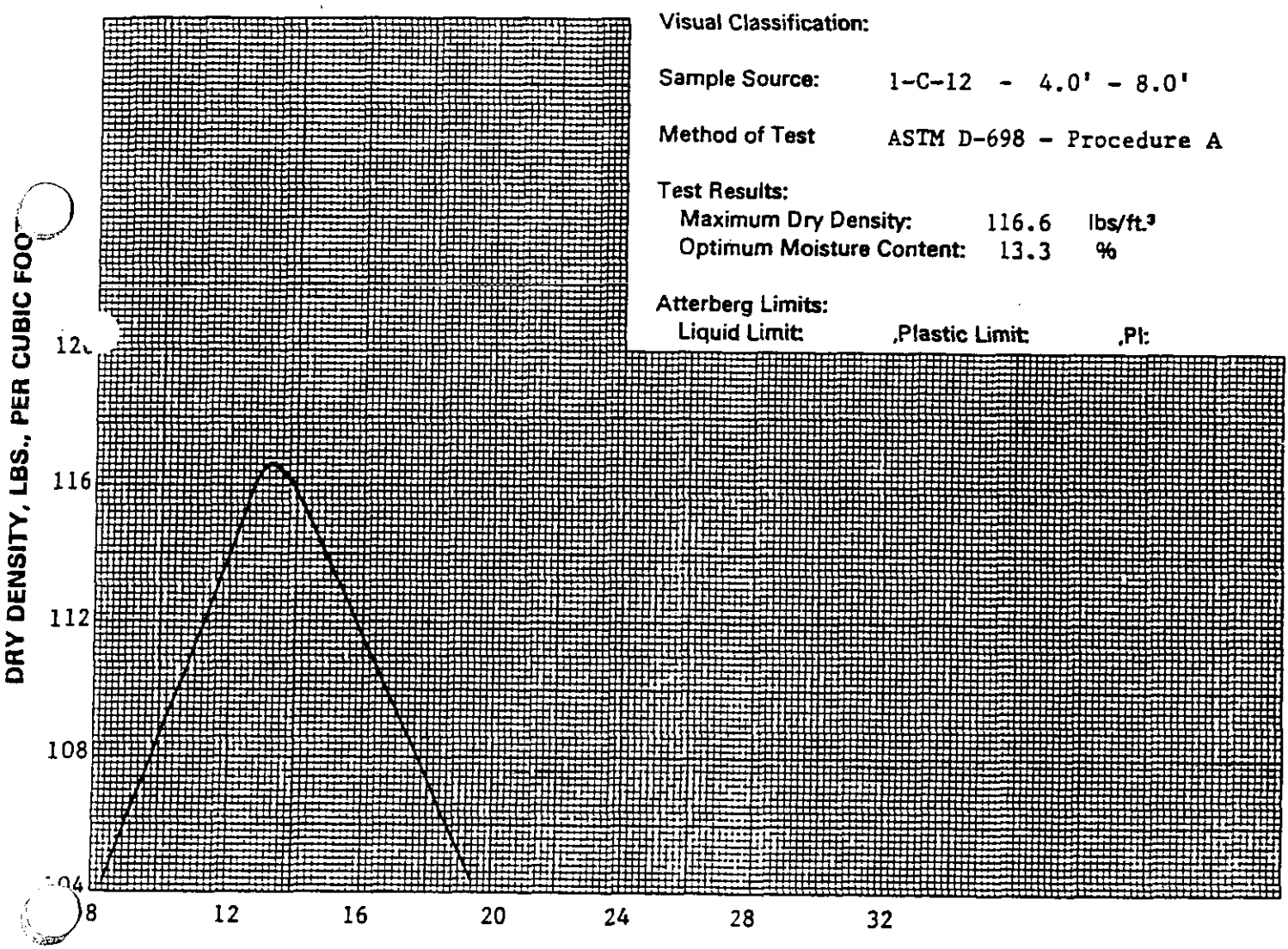
Visual Classification:

Sample Source: 1-C-12 - 4.0' - 8.0'

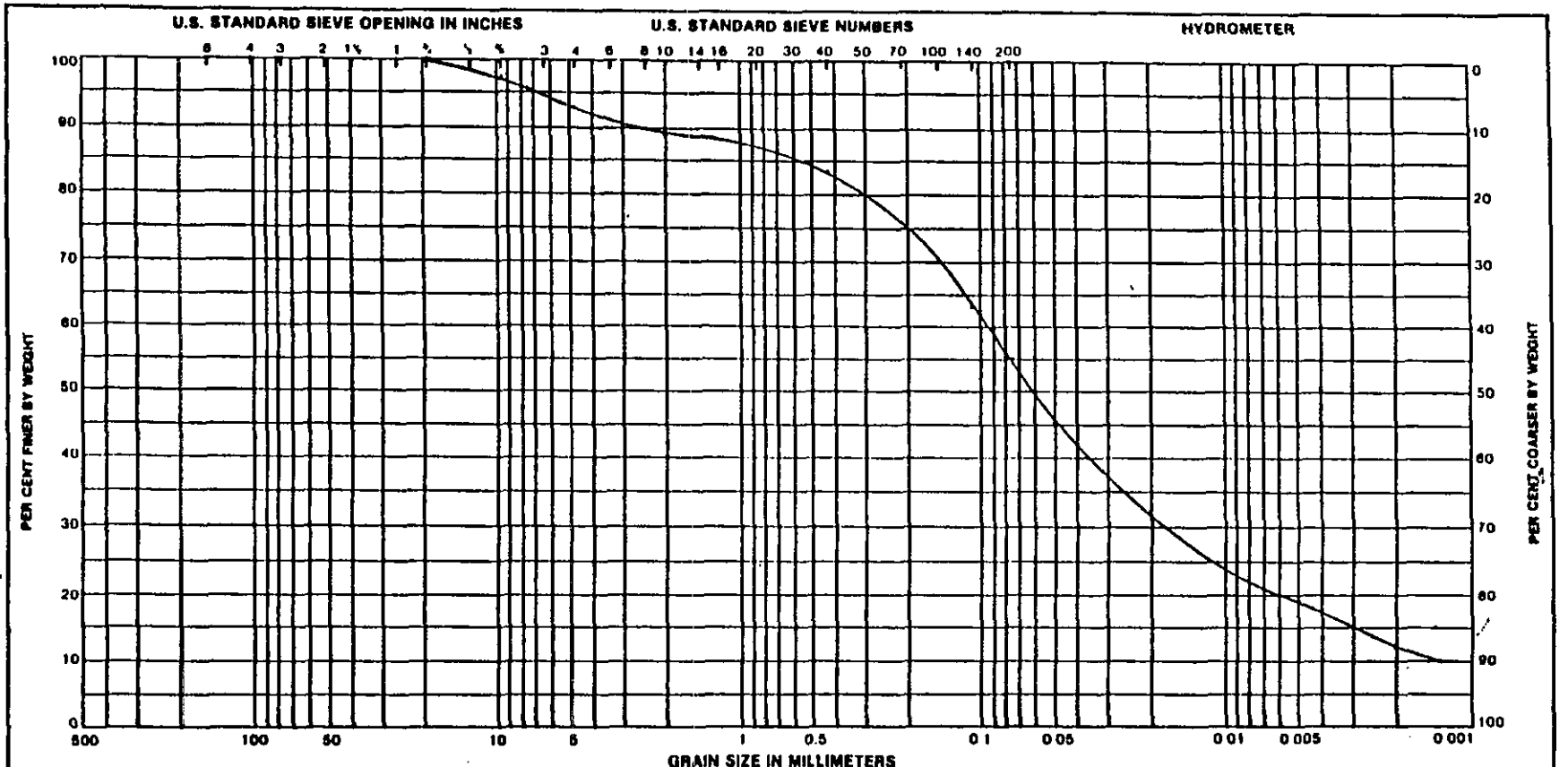
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 116.6 lbs/ft.³
Optimum Moisture Content: 13.3 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-C-12		8.0'-16.0'	A-4	9.0			NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			ML					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No. 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 10, 1993

OUR REPORT NO.: 491-35002

TEST DATA

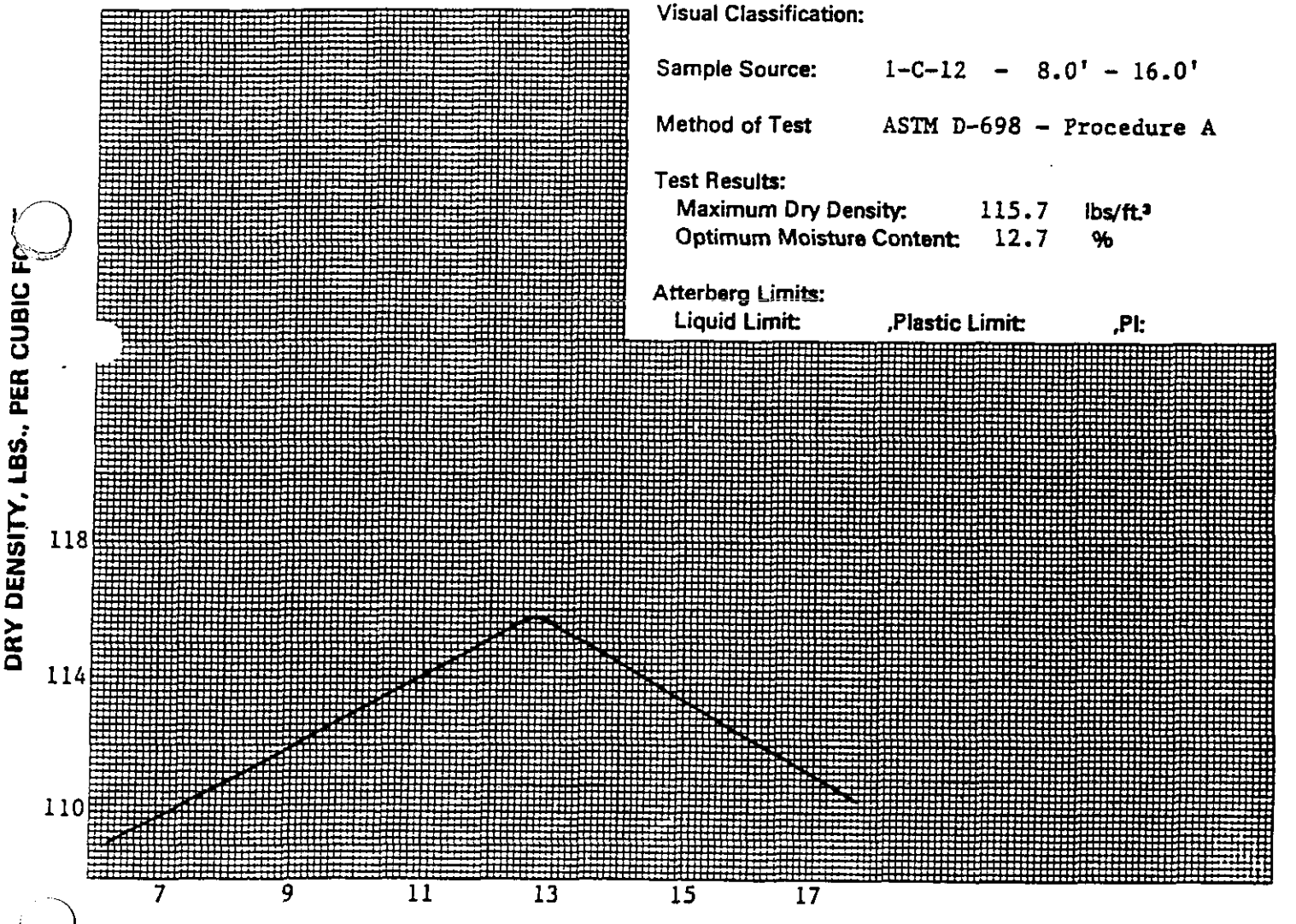
Visual Classification:

Sample Source: 1-C-12 - 8.0' - 16.0'

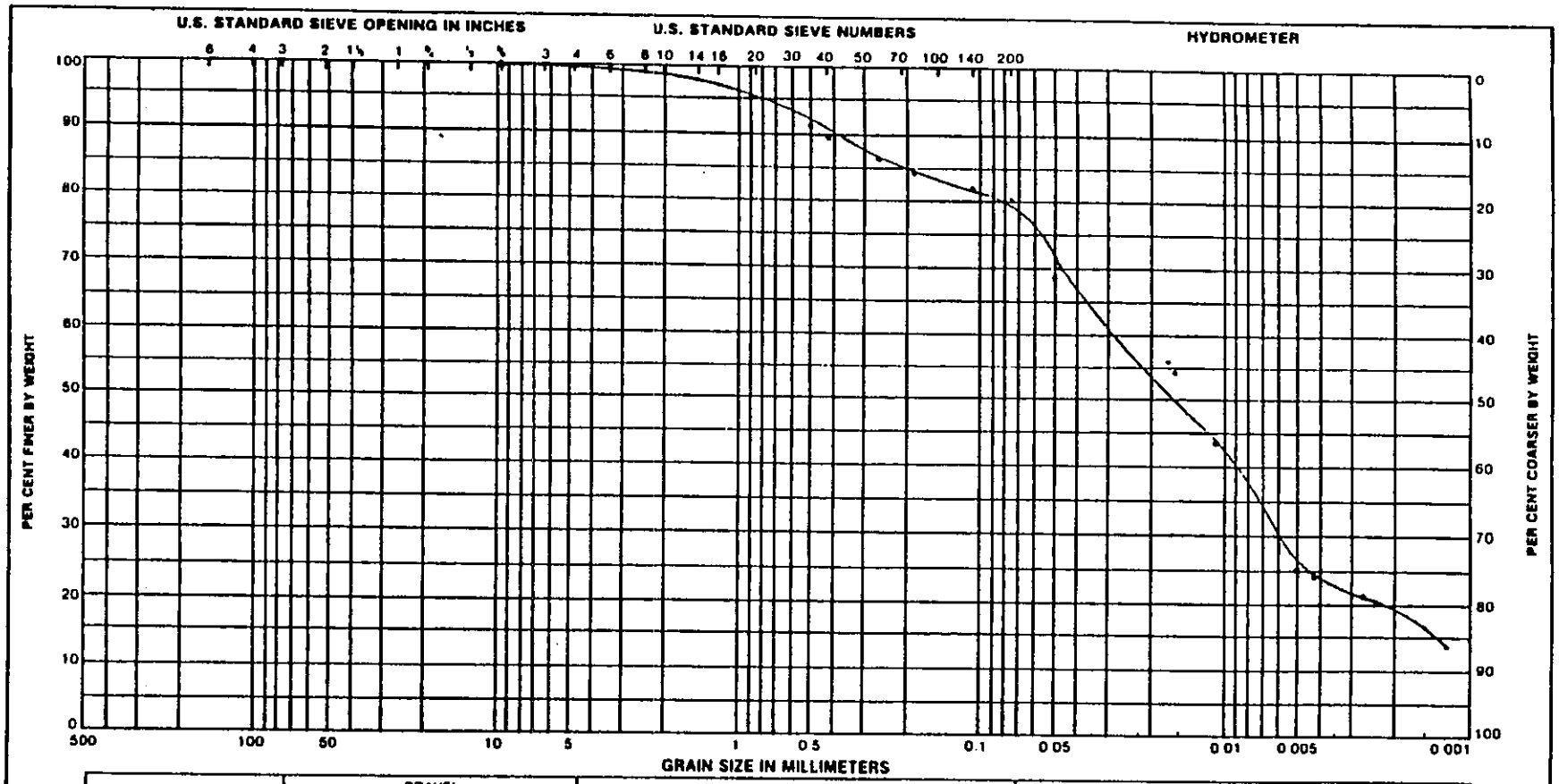
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 115.7 lbs/ft³
Optimum Moisture Content: 12.7 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-E-4		4'-10'	A-4		27.3	20.4	6.9	Ash Basin No. 7 Closure
								Soil Borrow Area
			CL-ML					ER 102147
			Silt Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 14, 1993

OUR REPORT NO.: 491-35002

TEST DATA

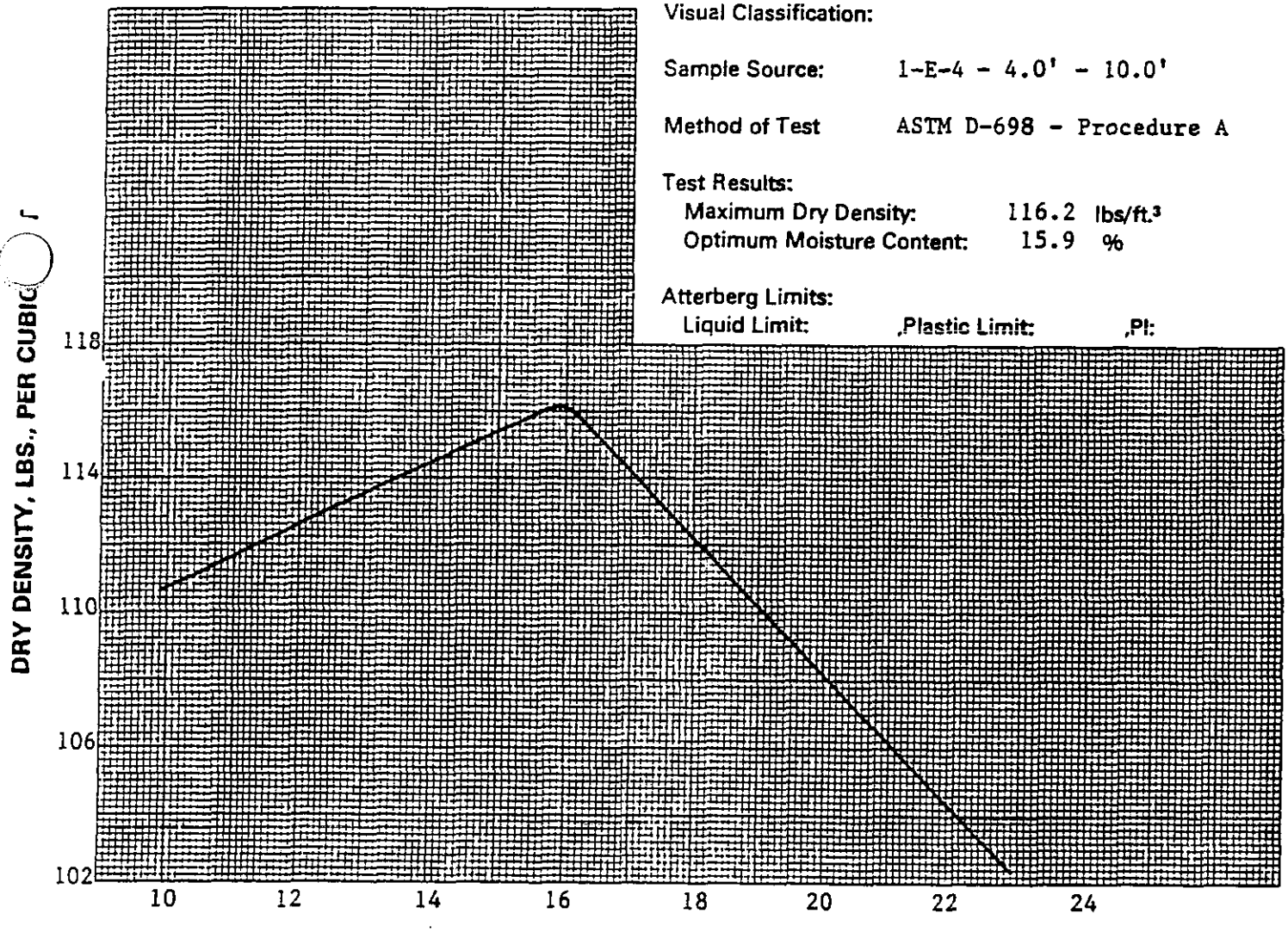
Visual Classification:

Sample Source: 1-E-4 - 4.0' - 10.0'

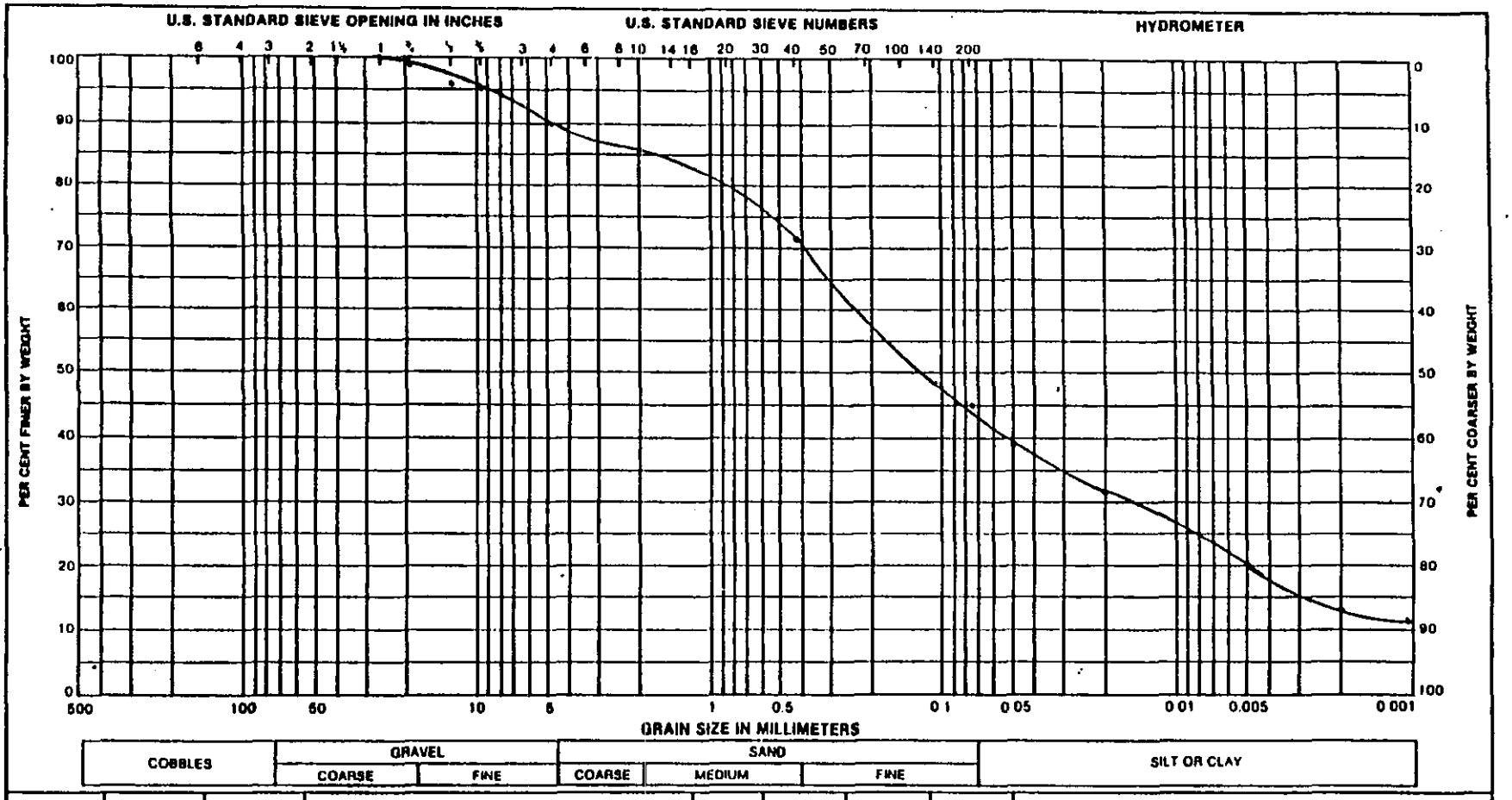
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 116.2 lbs/ft.³
Optimum Moisture Content: 15.9 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-E-5		6.0'-8.0'	A-4	24.4			NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Fine Sandy Loam					

REPORT OF SOIL ANALYSIS

File No. 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 16, 1993

OUR REPORT NO.: 491-35002

TEST DATA

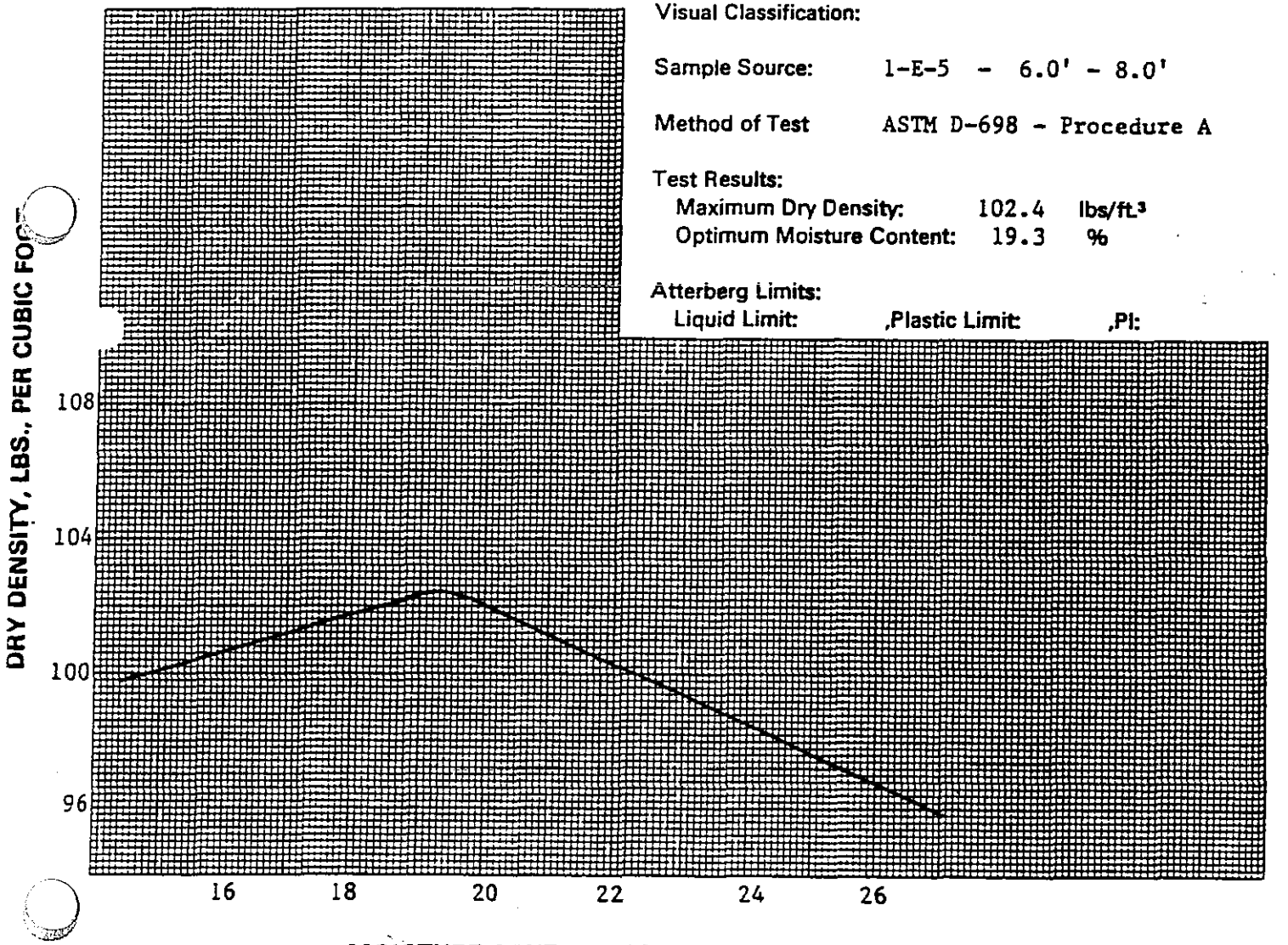
Visual Classification:

Sample Source: 1-E-5 - 6.0' - 8.0'

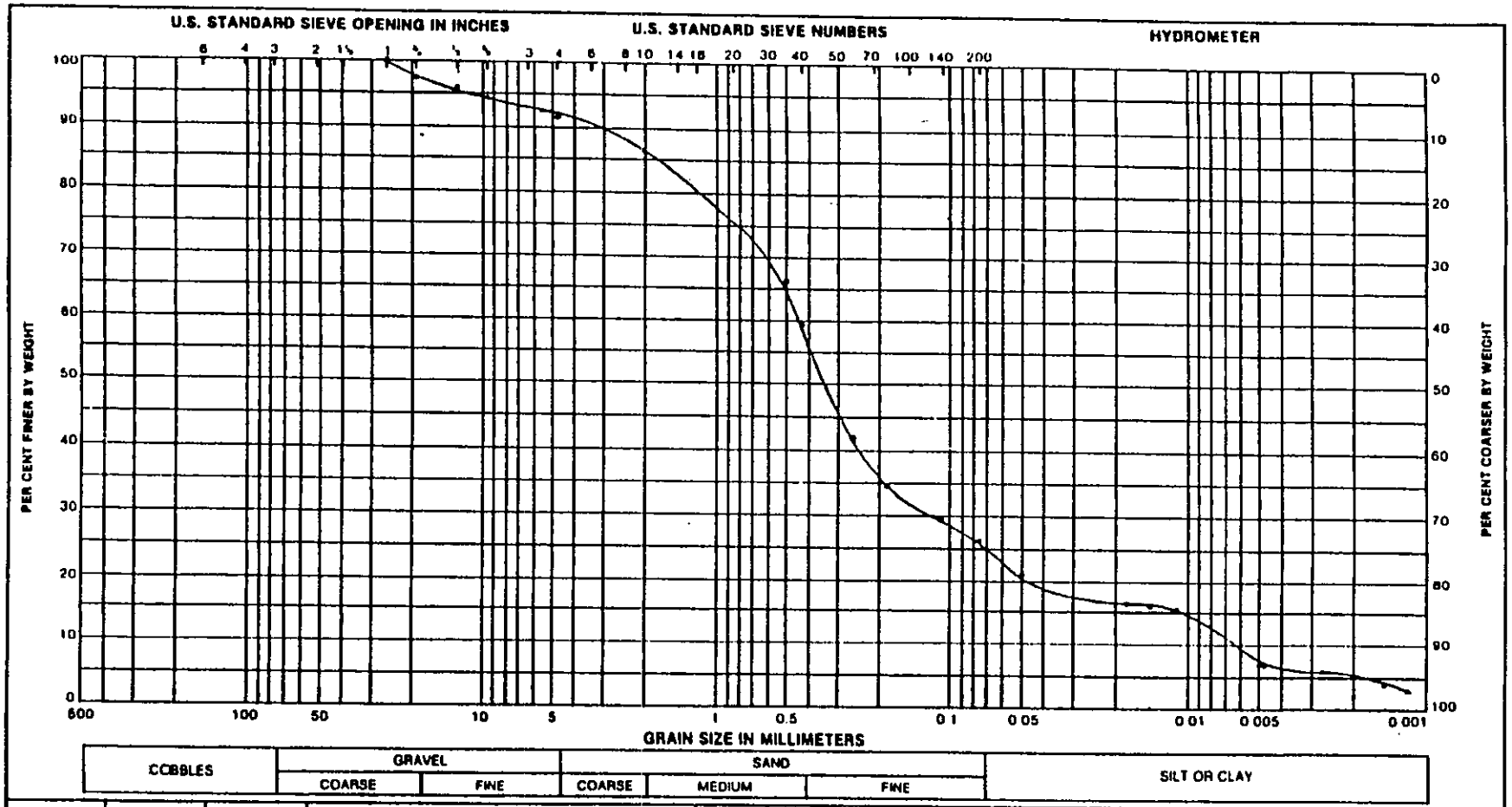
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 102.4 lbs/ft³
Optimum Moisture Content: 19.3 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-E-7		10.0'-13.0'	A-2-4				NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Loamy Sand					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

SI A-100-7

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 10, 1993

OUR REPORT NO.: 491-35002

TEST DATA

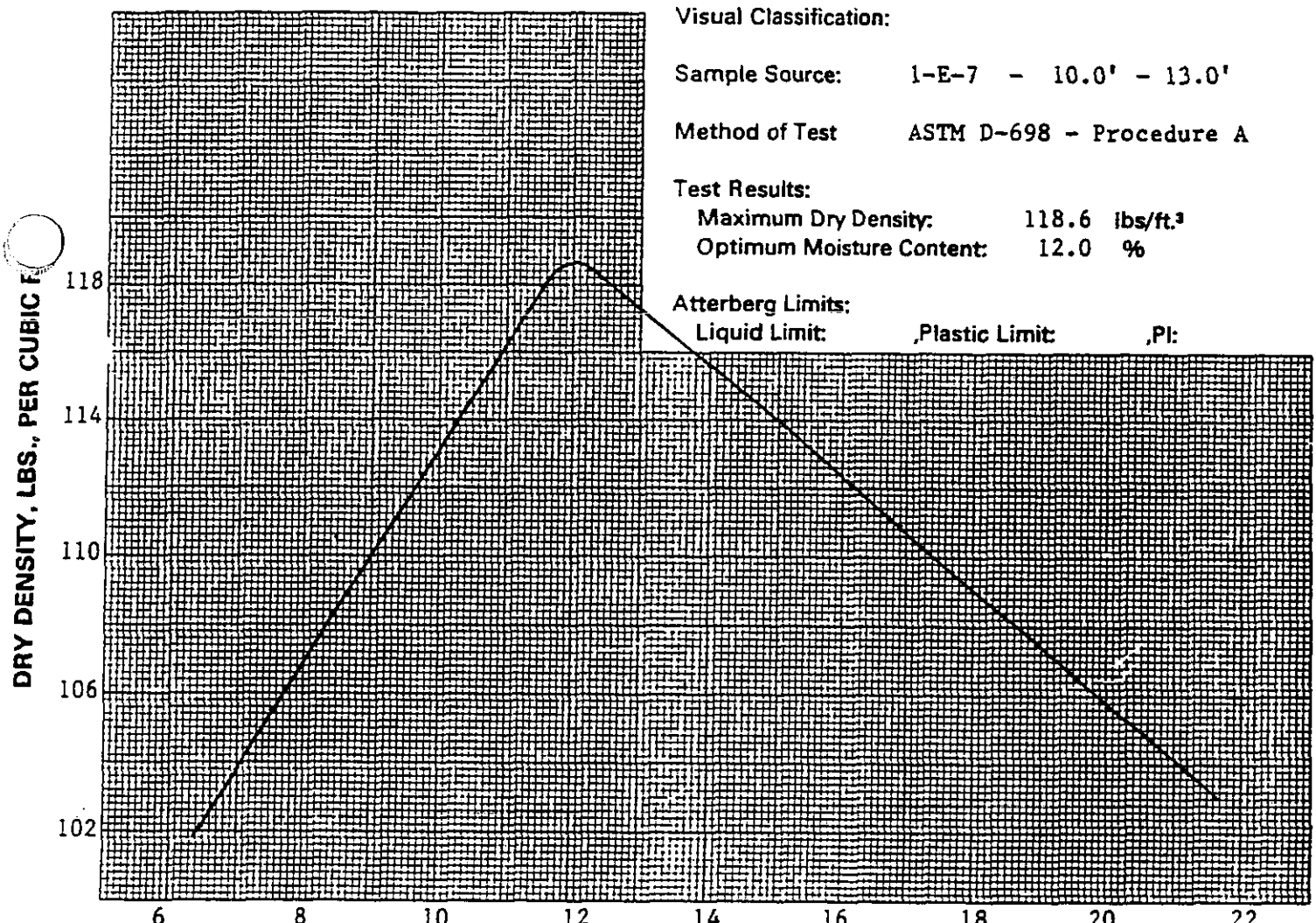
Visual Classification:

Sample Source: 1-E-7 - 10.0' - 13.0'

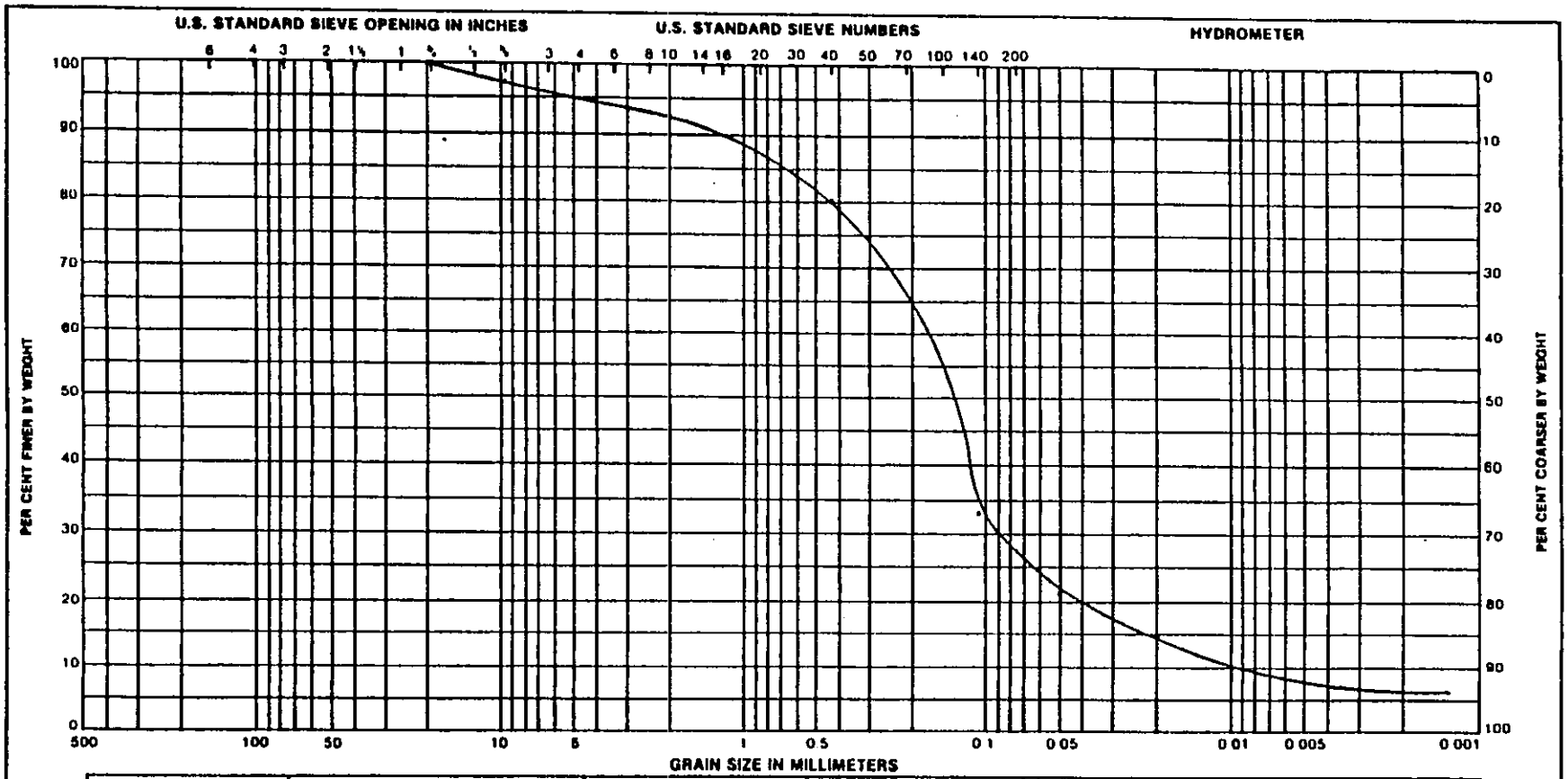
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 118.6 lbs/ft.³
Optimum Moisture Content: 12.0 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-E-8		3.5'-8.5'	A-2-4	14.2			NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Loamy Sand					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 26, 1993

OUR REPORT NO.: 491-35002

TEST DATA

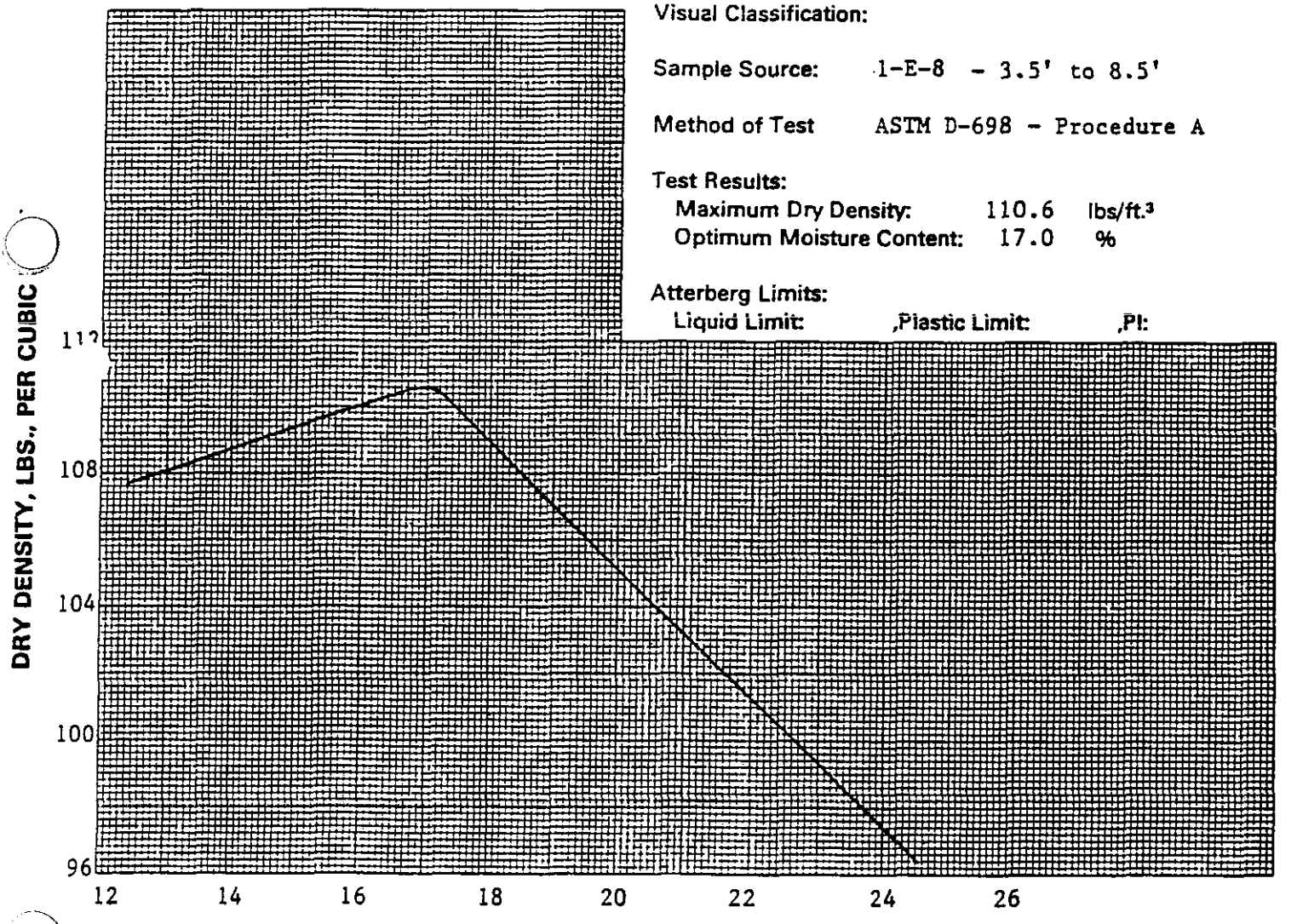
Visual Classification:

Sample Source: 1-E-8 - 3.5' to 8.5'

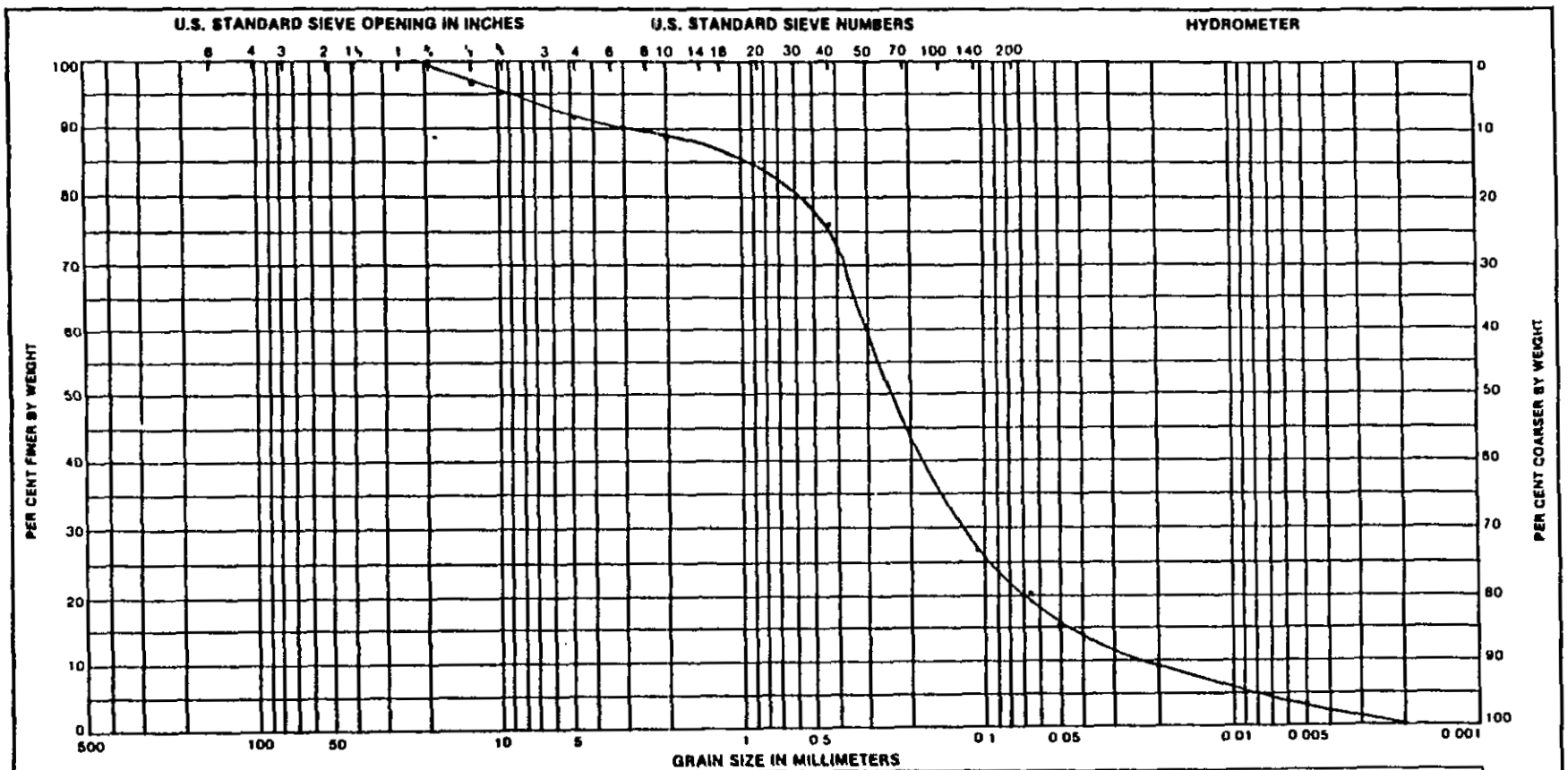
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 110.6 lbs/ft.³
Optimum Moisture Content: 17.0 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-E-8		8.5'-13.5'	A-2-4				NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Loamy Sand					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 5, 1993

OUR REPORT NO.: 491-35002

TEST DATA

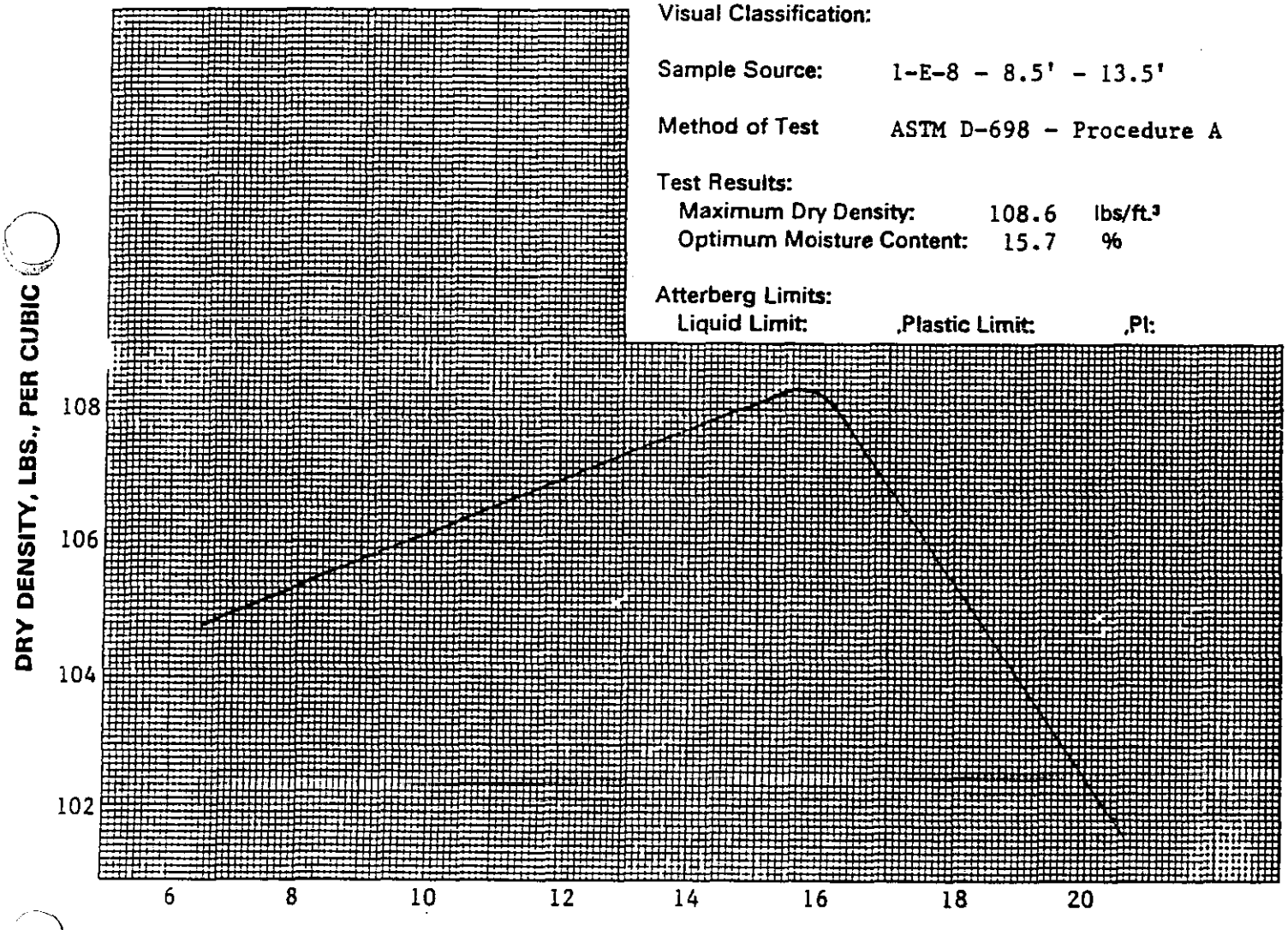
Visual Classification:

Sample Source: 1-E-8 - 8.5' - 13.5'

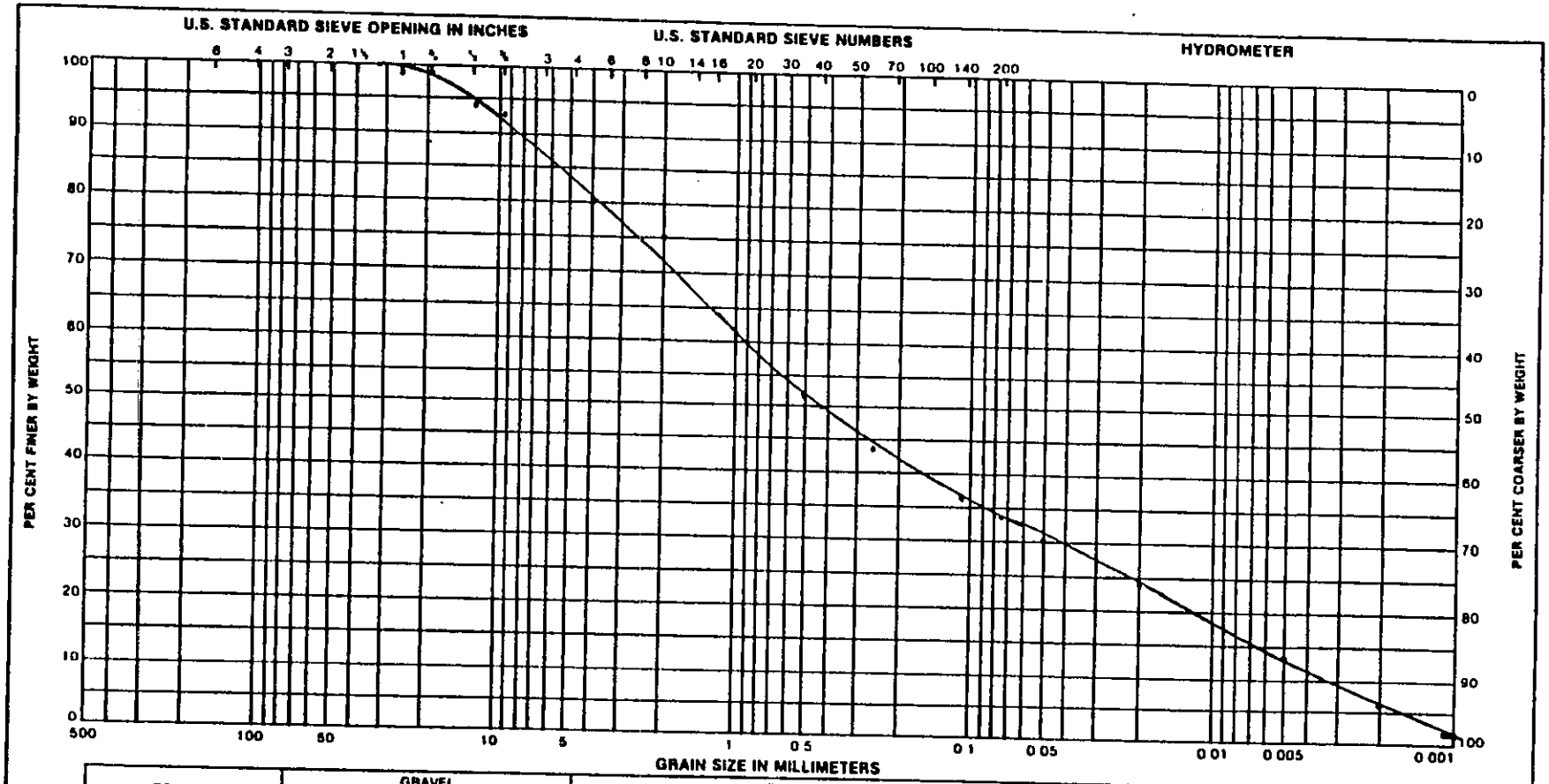
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 108.6 lbs/ft.³
Optimum Moisture Content: 15.7 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
1-E-8		13.5'-18.5'	A-2-4	15.03	28.0	24.5	3.5	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Gravelly Sandy Loam, Coarse					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 9, 1993

OUR REPORT NO.: 491-35002

TEST DATA

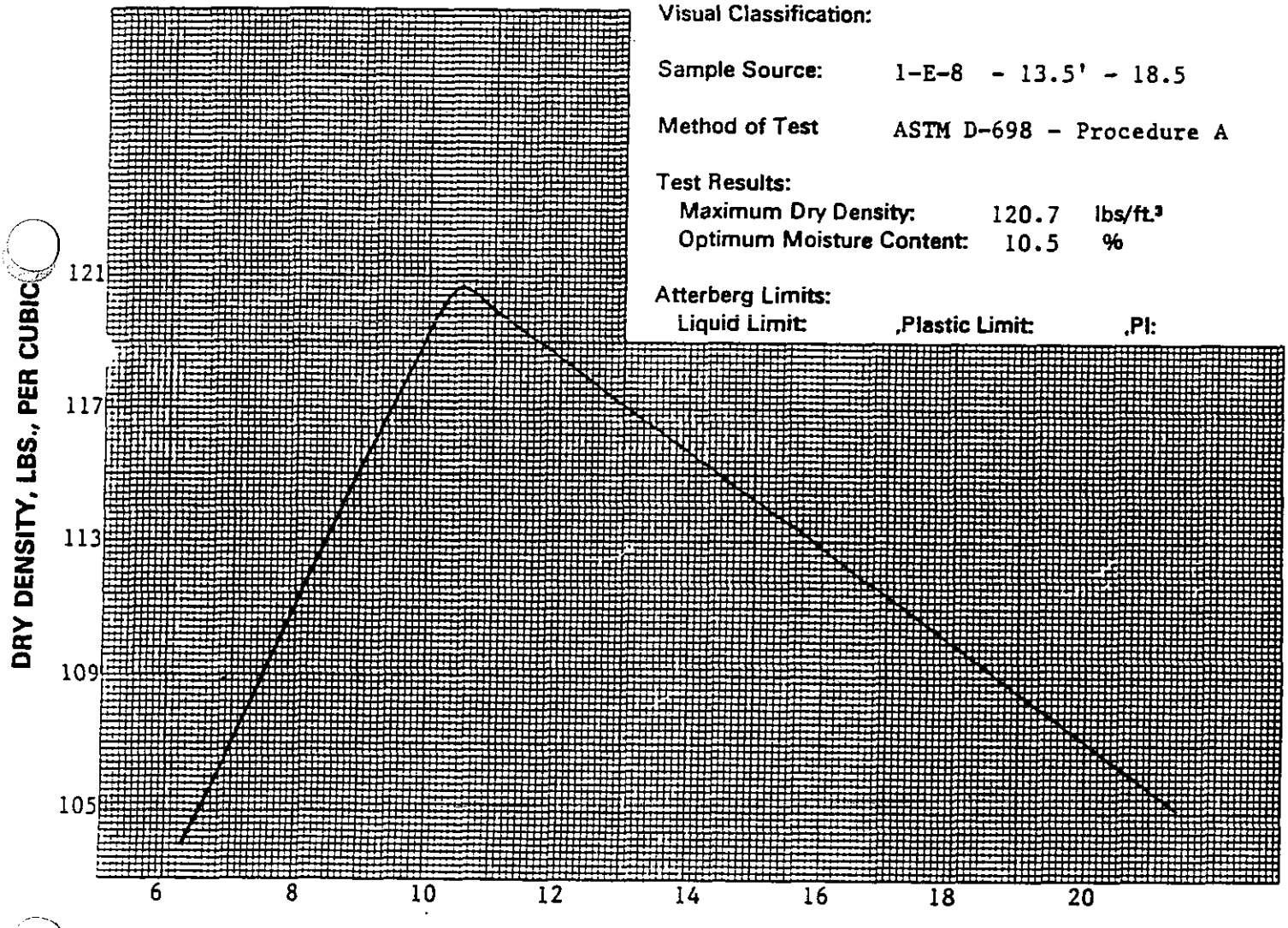
Visual Classification:

Sample Source: 1-E-8 - 13.5' - 18.5

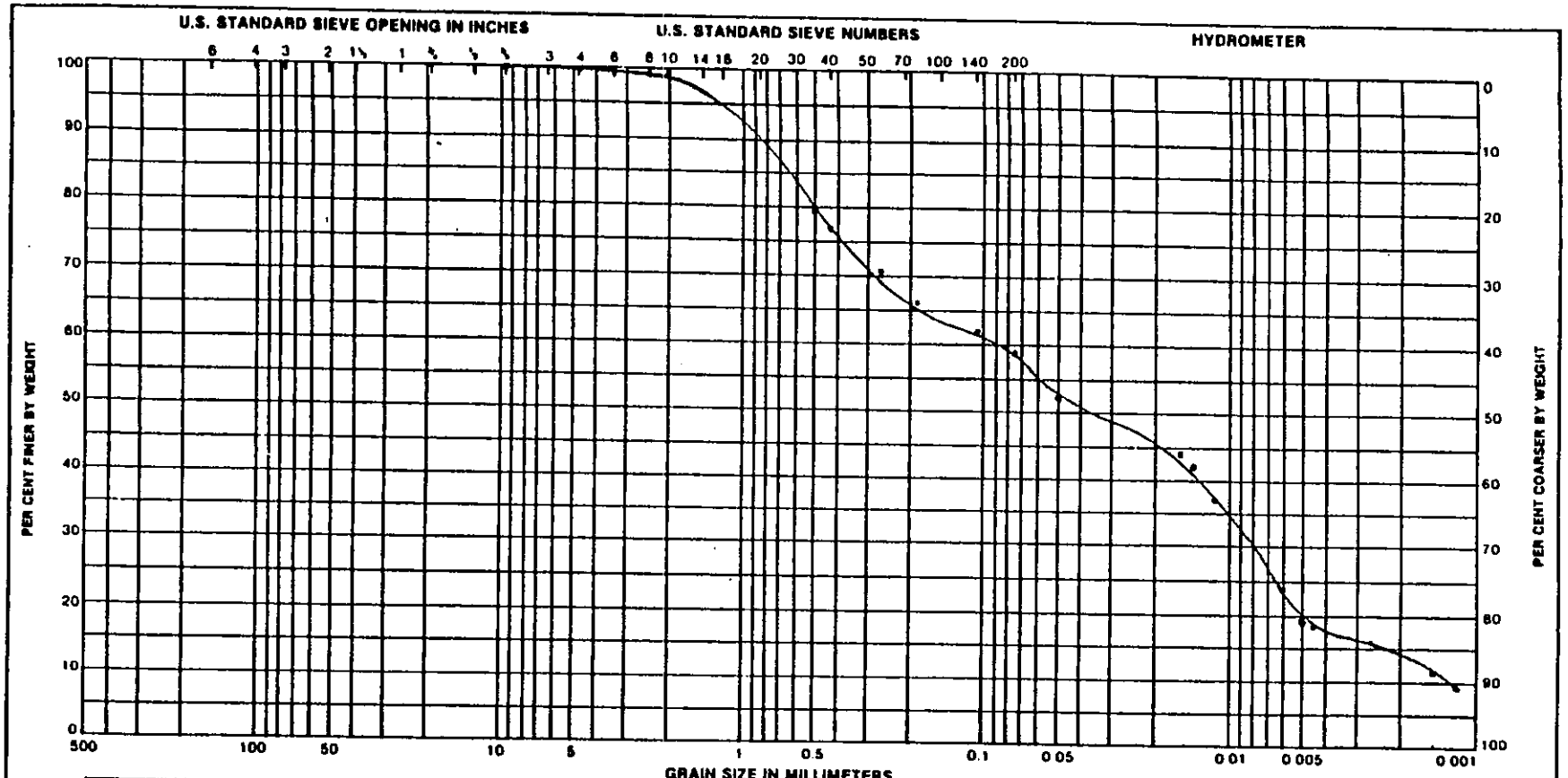
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 120.7 lbs/ft.³
Optimum Moisture Content: 10.5 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
2-B-1		10.0'-15.0'	A-4		25.7	17.4	8.3	Ash Basin No. 7 Closure
								Soil Borrow Area
			CL					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

SL A 100-7

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 9, 1993

OUR REPORT NO.: 491-35002

TEST DATA

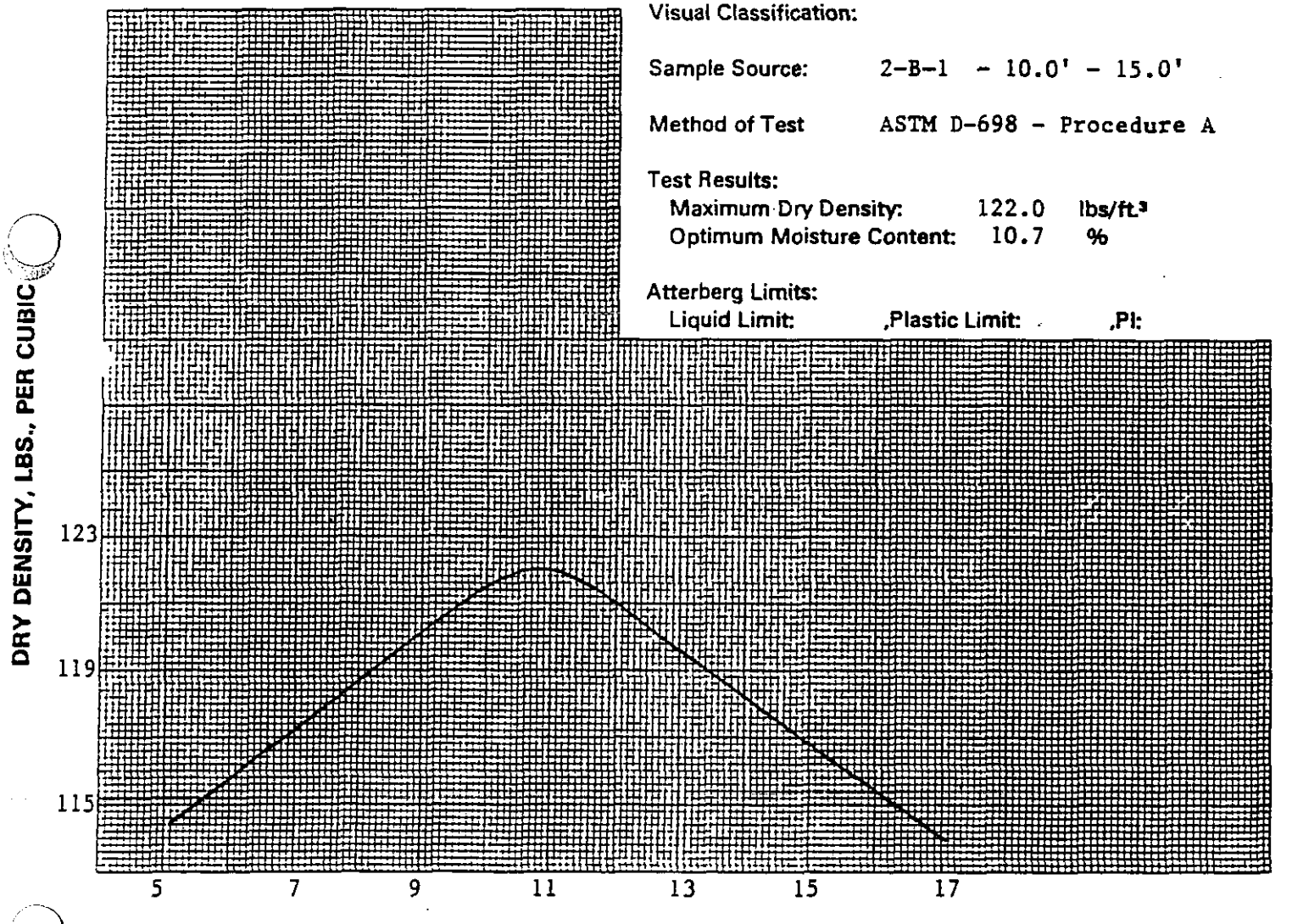
Visual Classification:

Sample Source: 2-B-1 - 10.0' - 15.0'

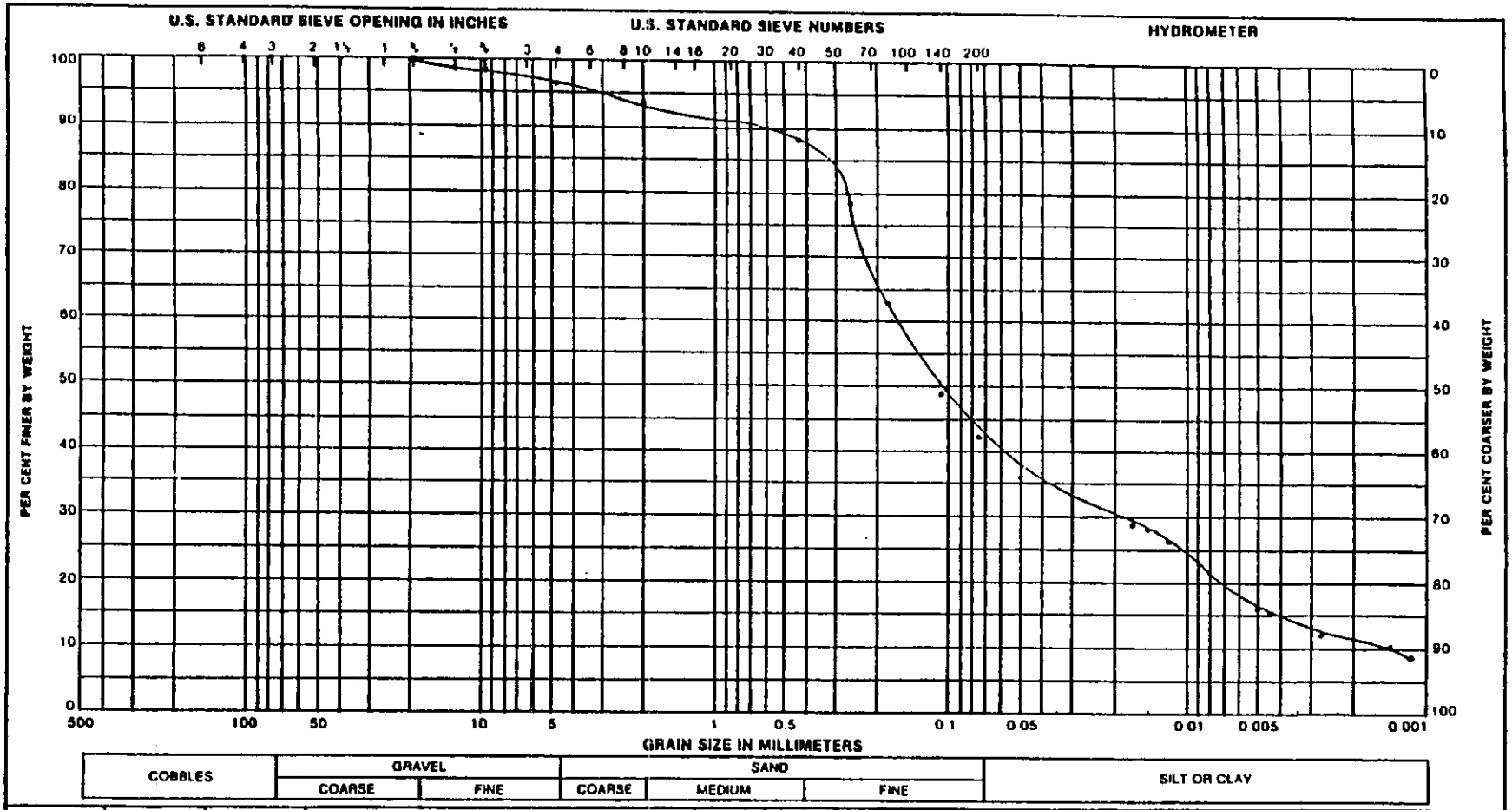
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 122.0 lbs/ft³
Optimum Moisture Content: 10.7 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
2-B-3		1.0'-5.0'	A-4				NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Fine Sandy Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 10, 1993

OUR REPORT NO.: 491-35002

TEST DATA

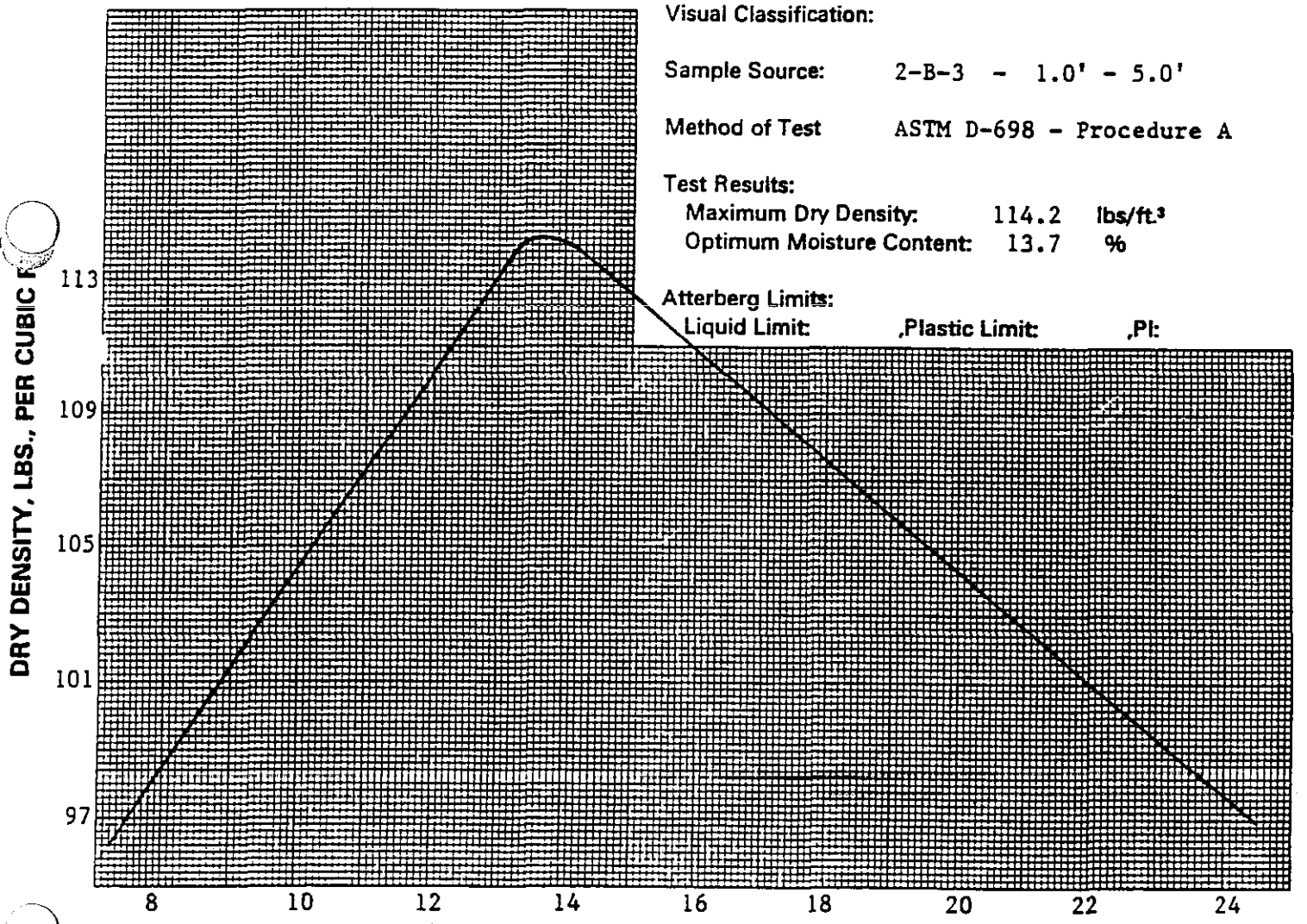
Visual Classification:

Sample Source: 2-B-3 - 1.0' - 5.0'

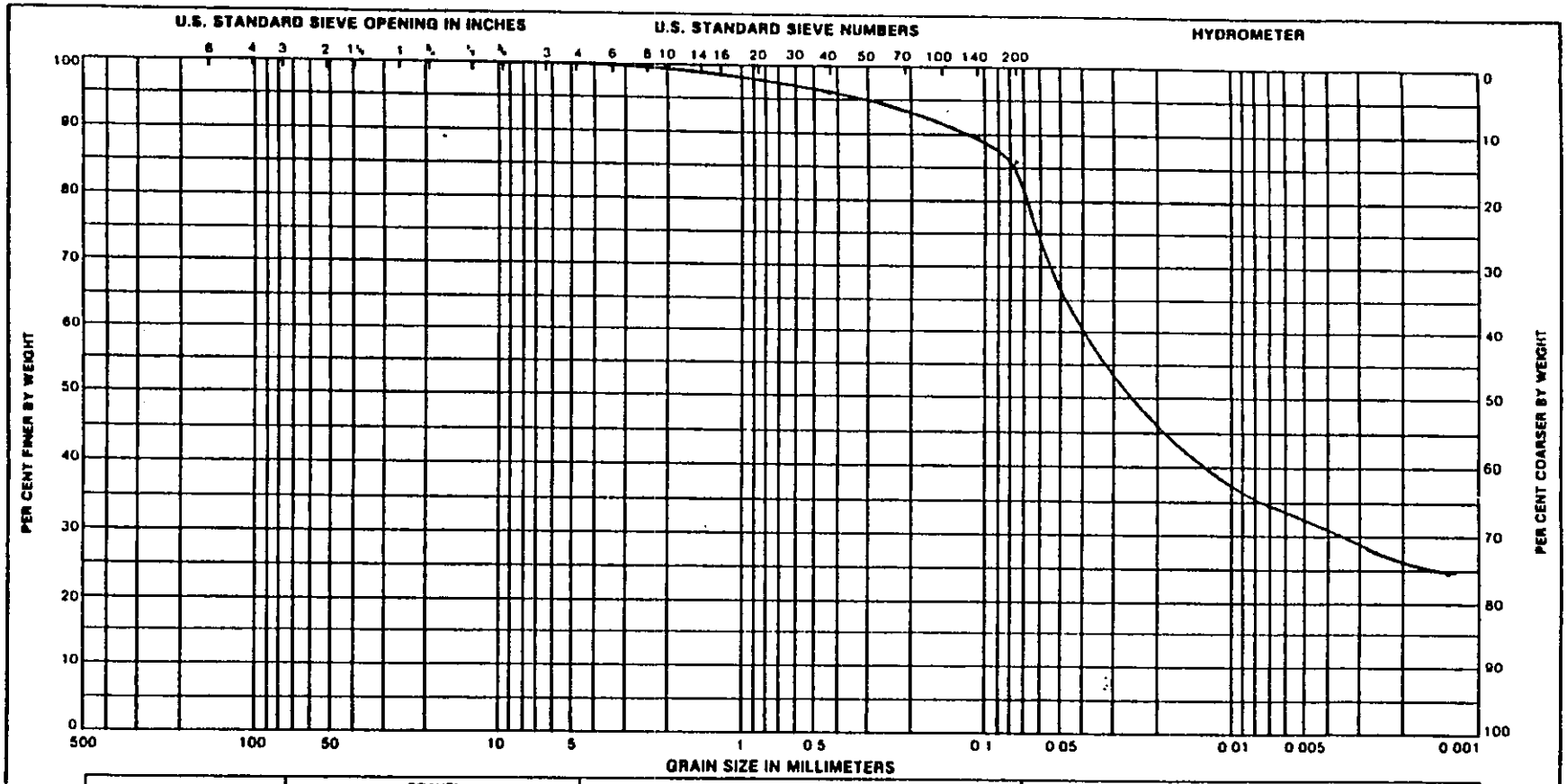
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 114.2 lbs/ft³
Optimum Moisture Content: 13.7 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
3-B-1		3.5'-8.5'	A-4	7.6	29.4	21.5	7.9	Ash Basin No. 7 Closure
								Soil Borrow Area
			CL					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 26, 1993

OUR REPORT NO.: 491-35002

TEST DATA

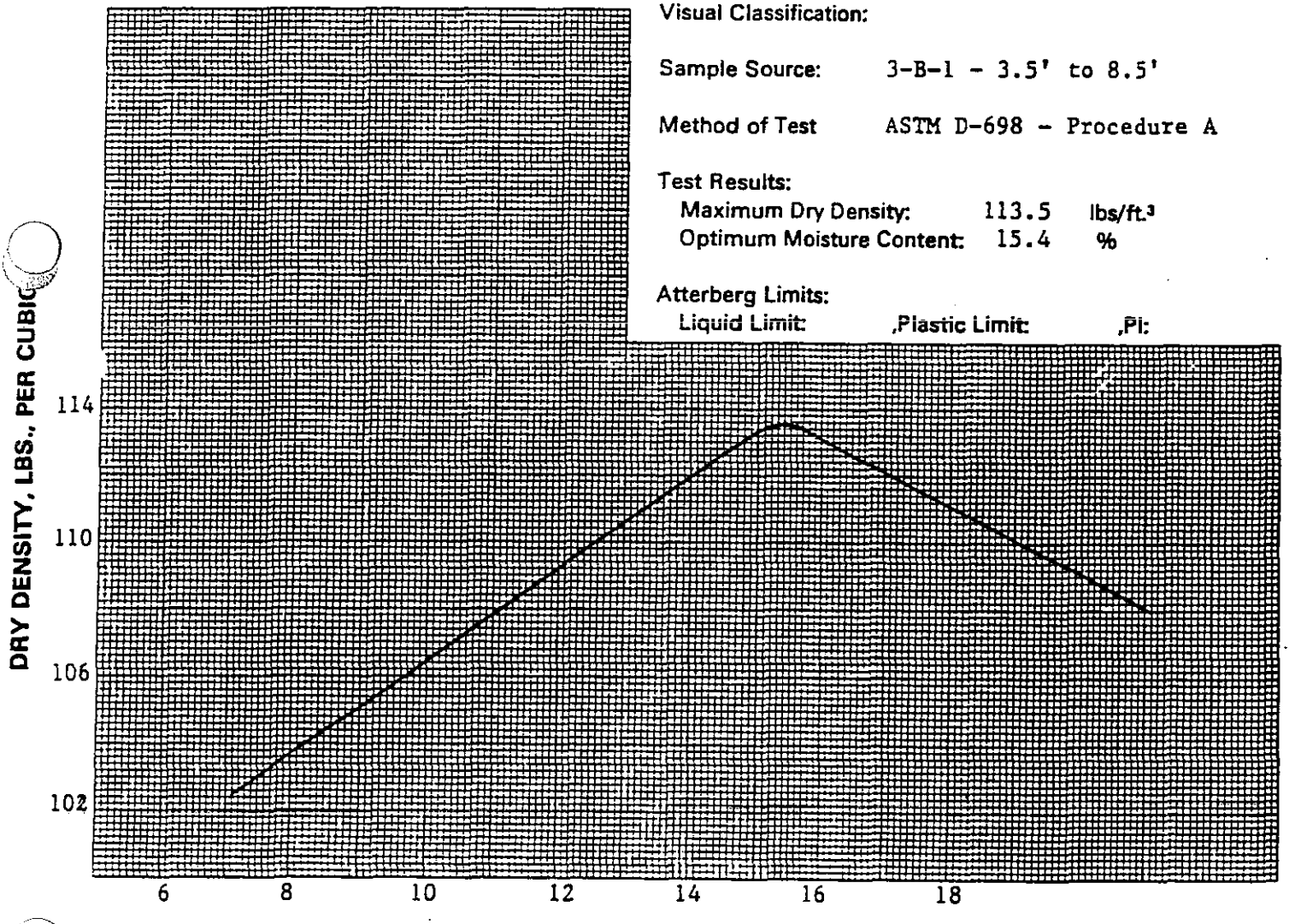
Visual Classification:

Sample Source: 3-B-1 - 3.5' to 8.5'

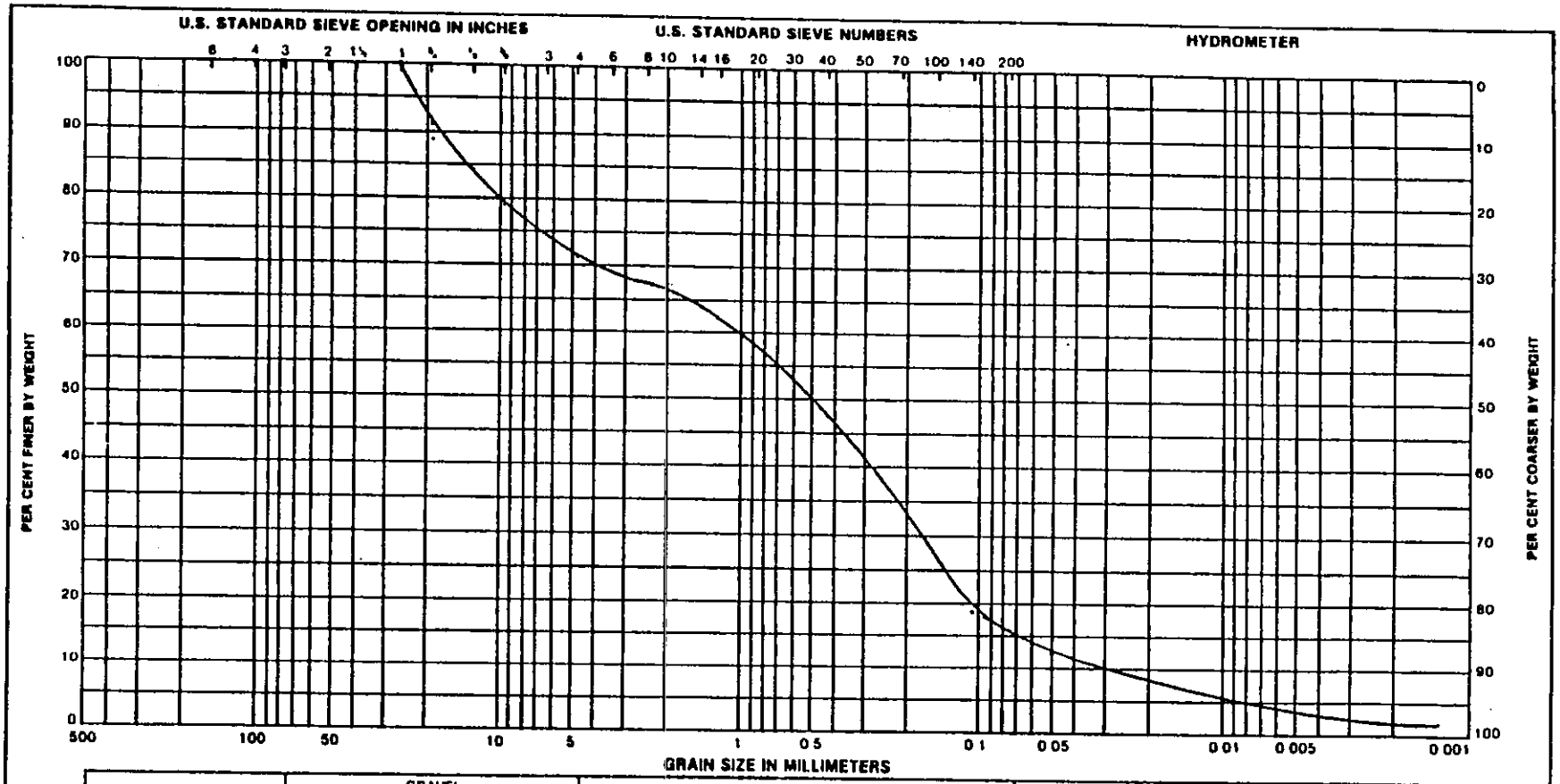
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 113.5 lbs/ft.³
Optimum Moisture Content: 15.4 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
4-A-1		1.0'-8.0'	A-1-B	7.3			NP	Ash Basin No. 7 Closure
			SM					Soil Borrow Area
			Loamy Sand					ER 102147

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 26, 1993

OUR REPORT NO.: 491-35002

TEST DATA

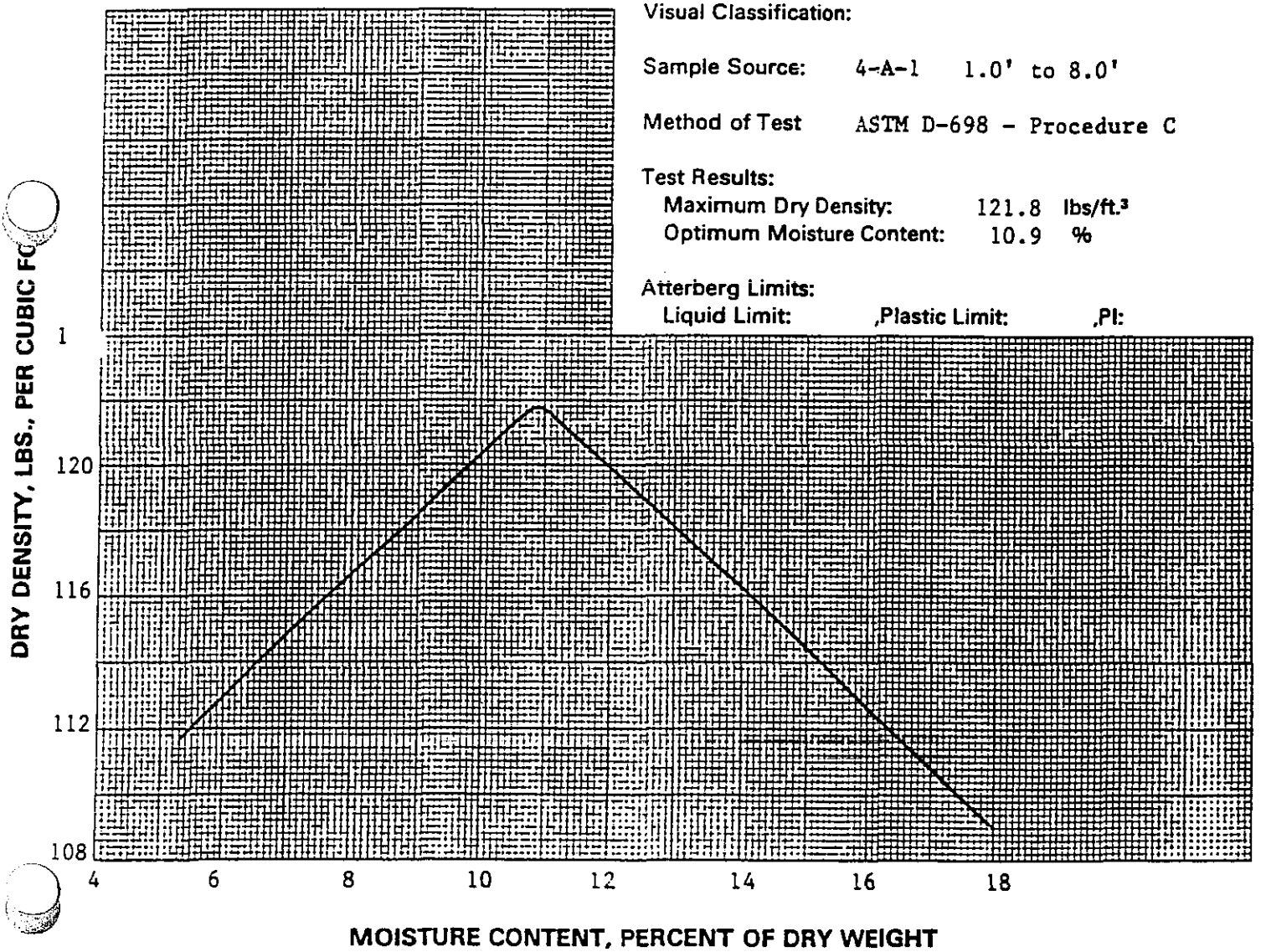
Visual Classification:

Sample Source: 4-A-1 1.0' to 8.0'

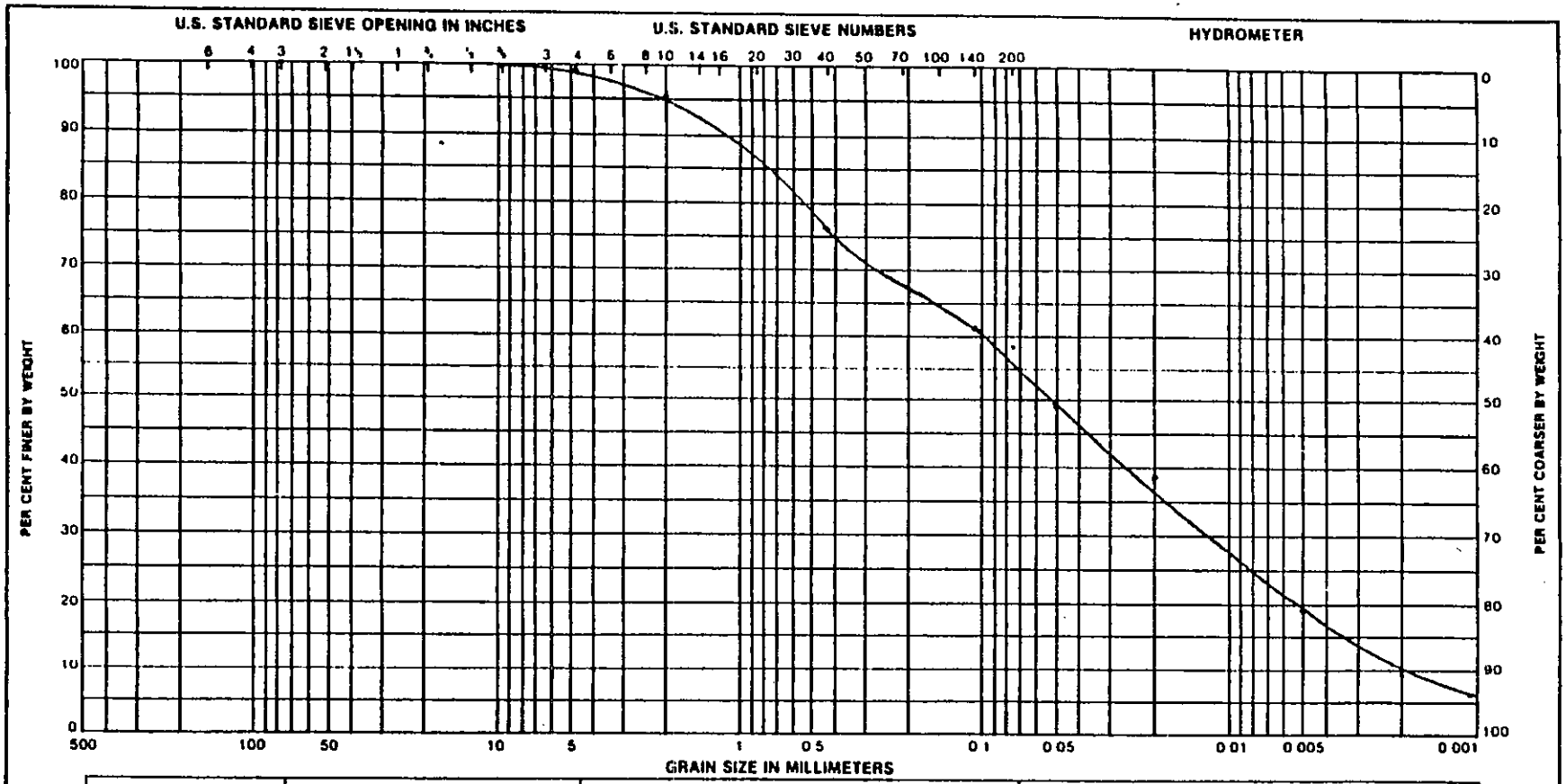
Method of Test ASTM D-698 - Procedure C

Test Results:
Maximum Dry Density: 121.8 lbs/ft.³
Optimum Moisture Content: 10.9 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
4-A-2		5.0'-10.0'	A-4	16.70	29.8	24.5	5.3	Ash Basin No. 7 Closure
								Soil Borrow Area
			ML					ER 102147
			Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 9, 1993

OUR REPORT NO.: 491-35002

TEST DATA

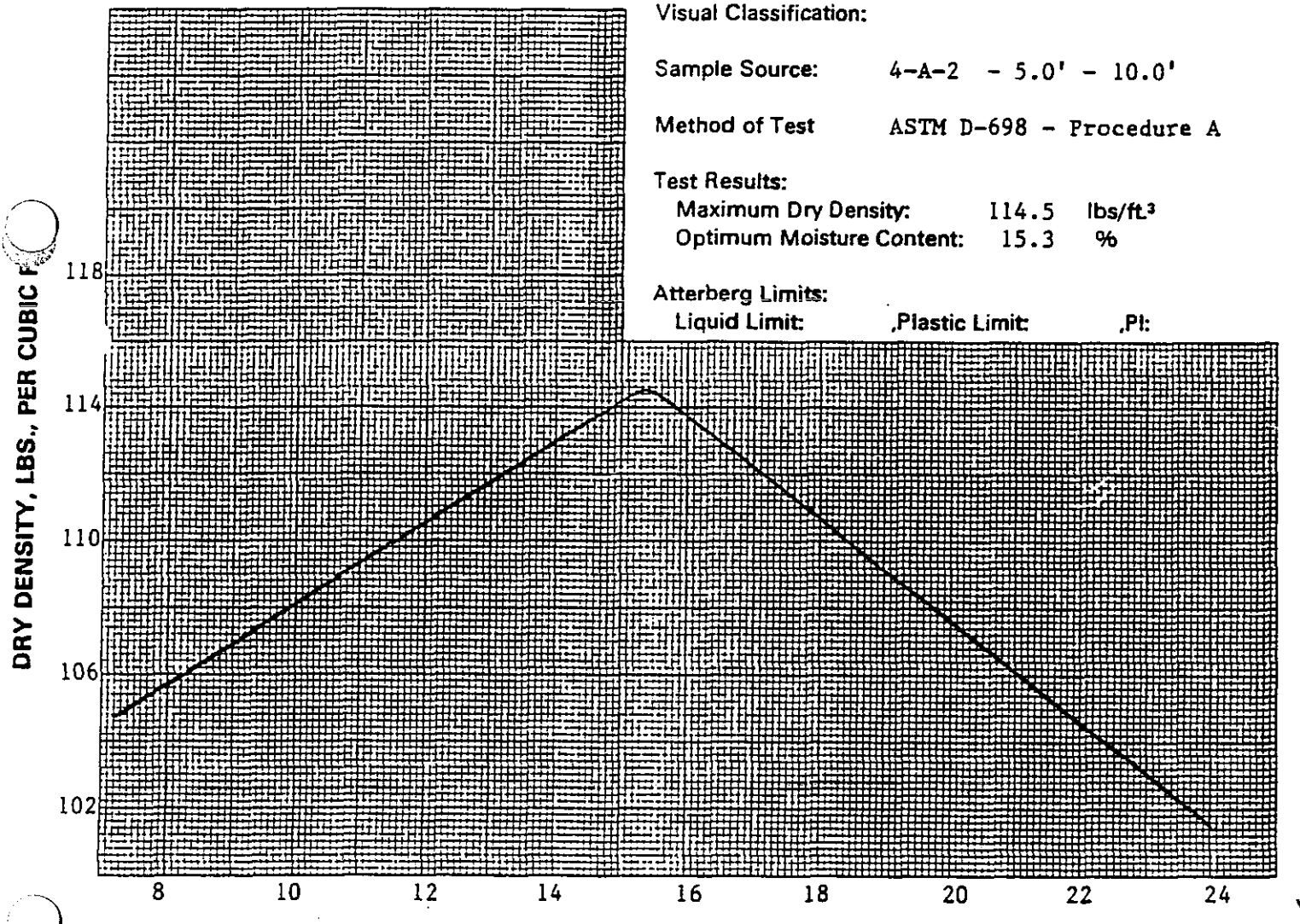
Visual Classification:

Sample Source: 4-A-2 - 5.0' - 10.0'

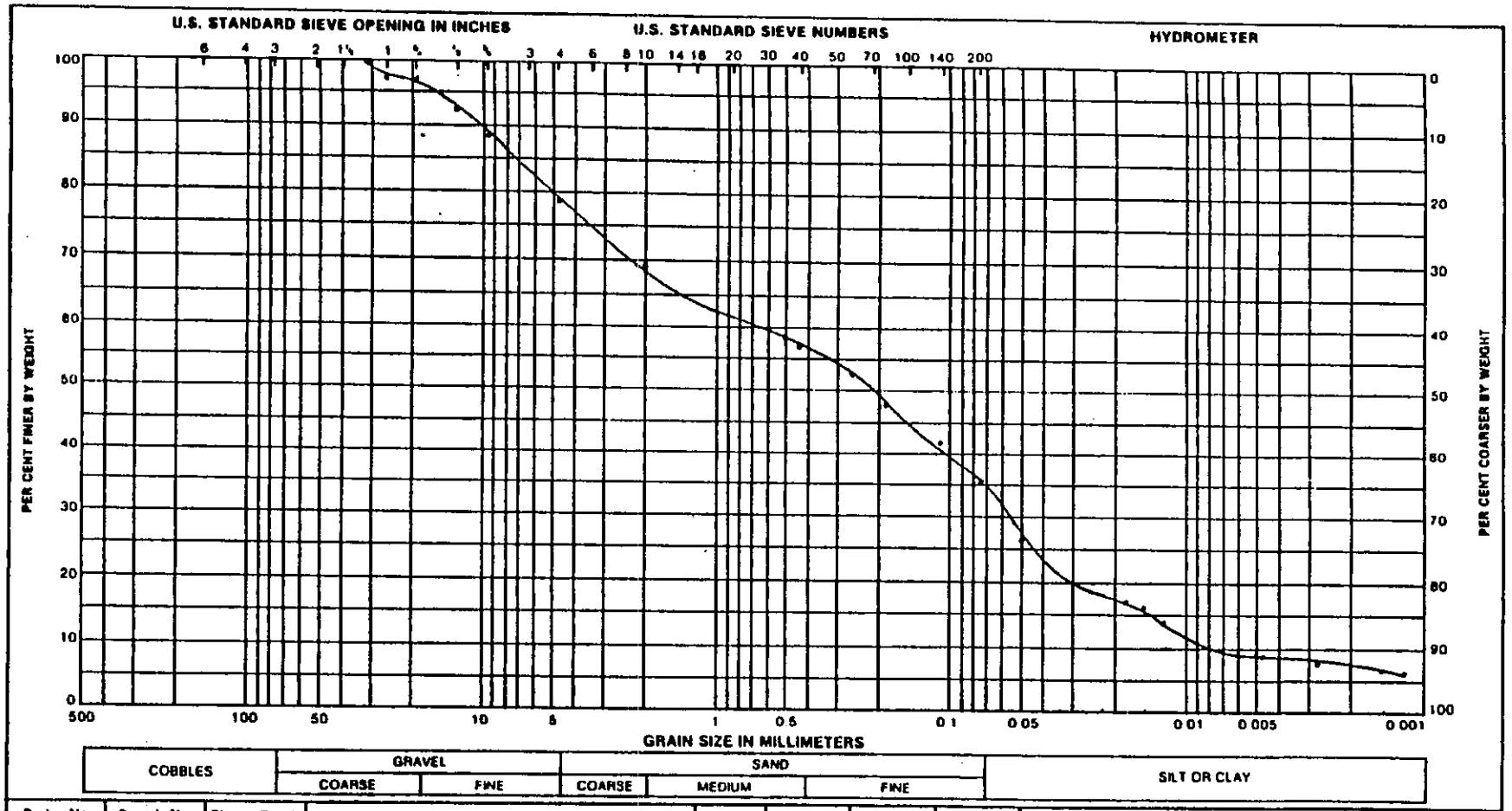
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 114.5 lbs/ft³
Optimum Moisture Content: 15.3 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
4-B-2		3.5'-8.5'	A-4				NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Gravelly Fine Sandy Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

SI A-100-7

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 4, 1993

OUR REPORT NO.: 491-35002

TEST DATA

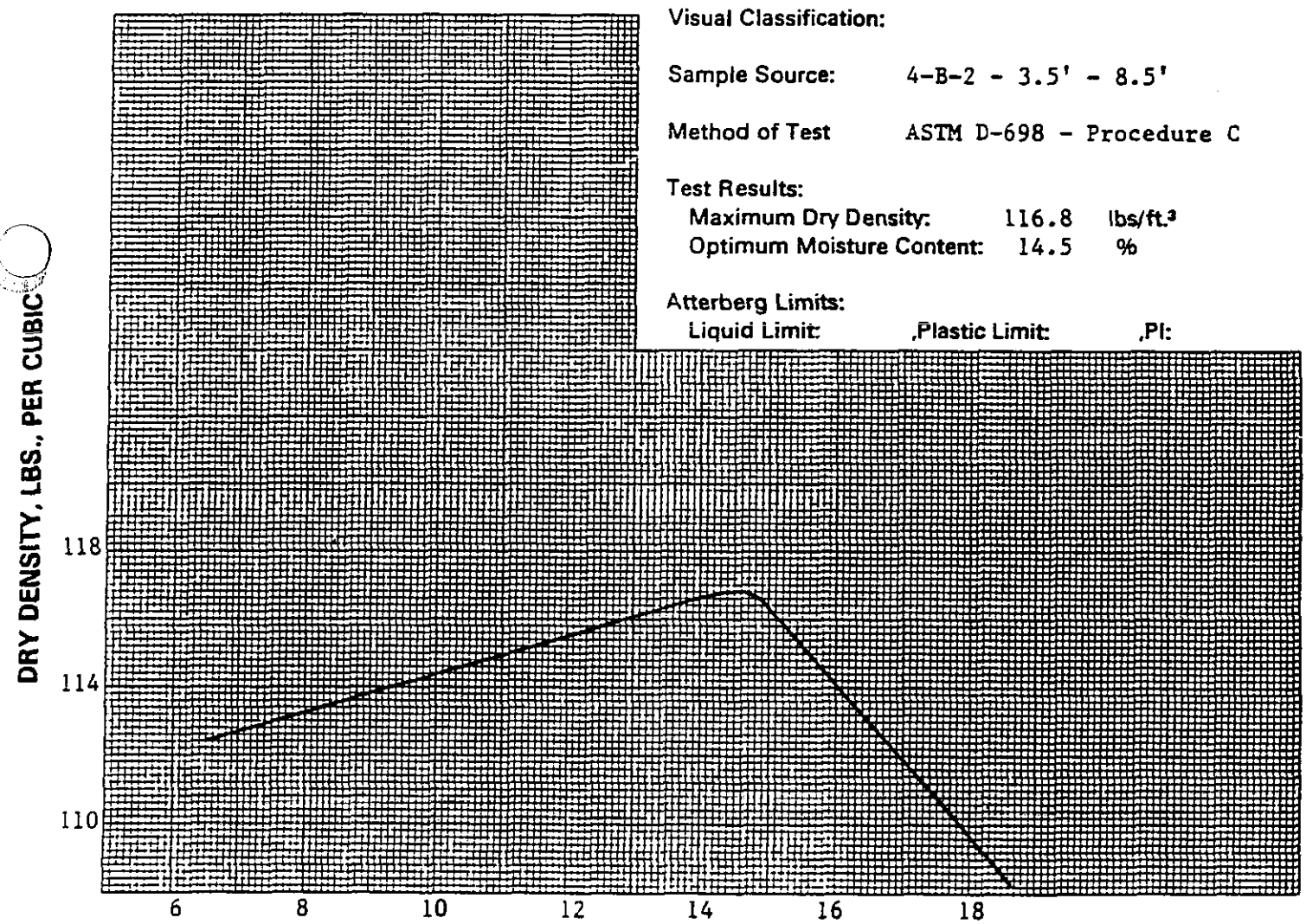
Visual Classification:

Sample Source: 4-B-2 - 3.5' - 8.5'

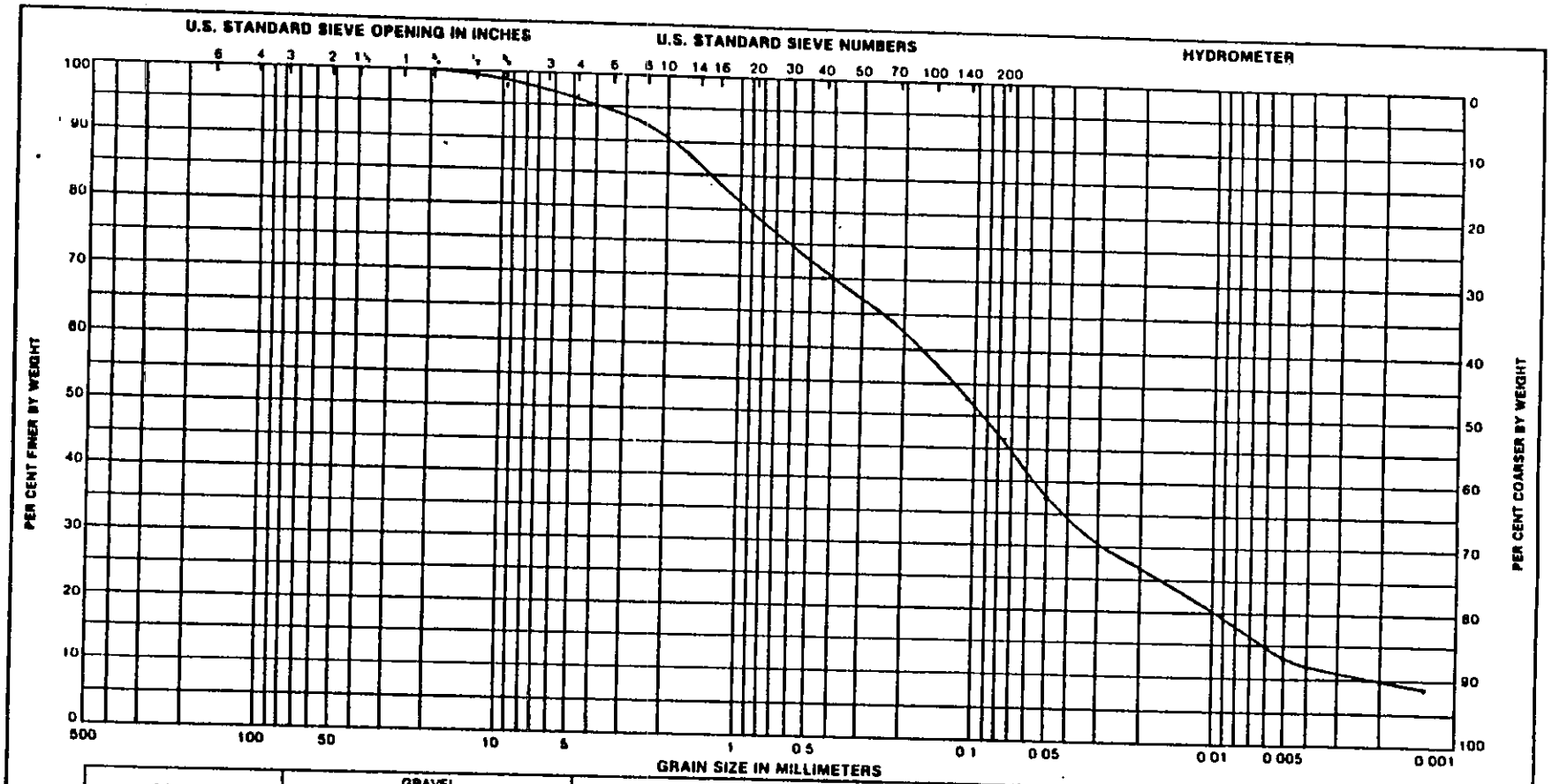
Method of Test ASTM D-698 - Procedure C

Test Results:
Maximum Dry Density: 116.8 lbs/ft.³
Optimum Moisture Content: 14.5 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
4-B-2		25.0'-28.5'	A-4	9.62	24.95	19.74	5.21	Ash Basin No. 7 Closure
			SC-SM					Soil Borrow Area
			Sandy Loam					ER 102147

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: July 20, 1993

OUR REPORT NO.: 491-35002

TEST DATA

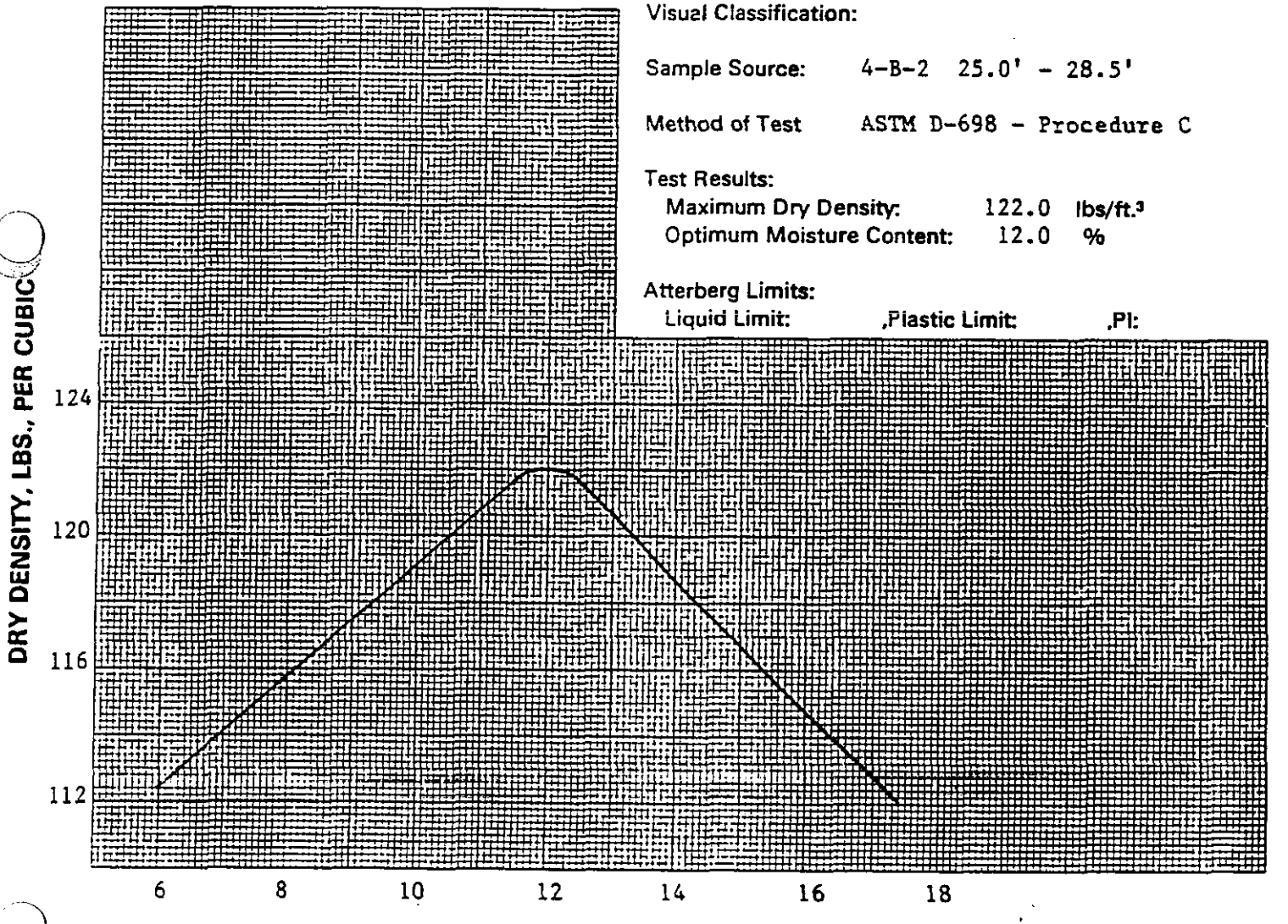
Visual Classification:

Sample Source: 4-B-2 25.0' - 28.5'

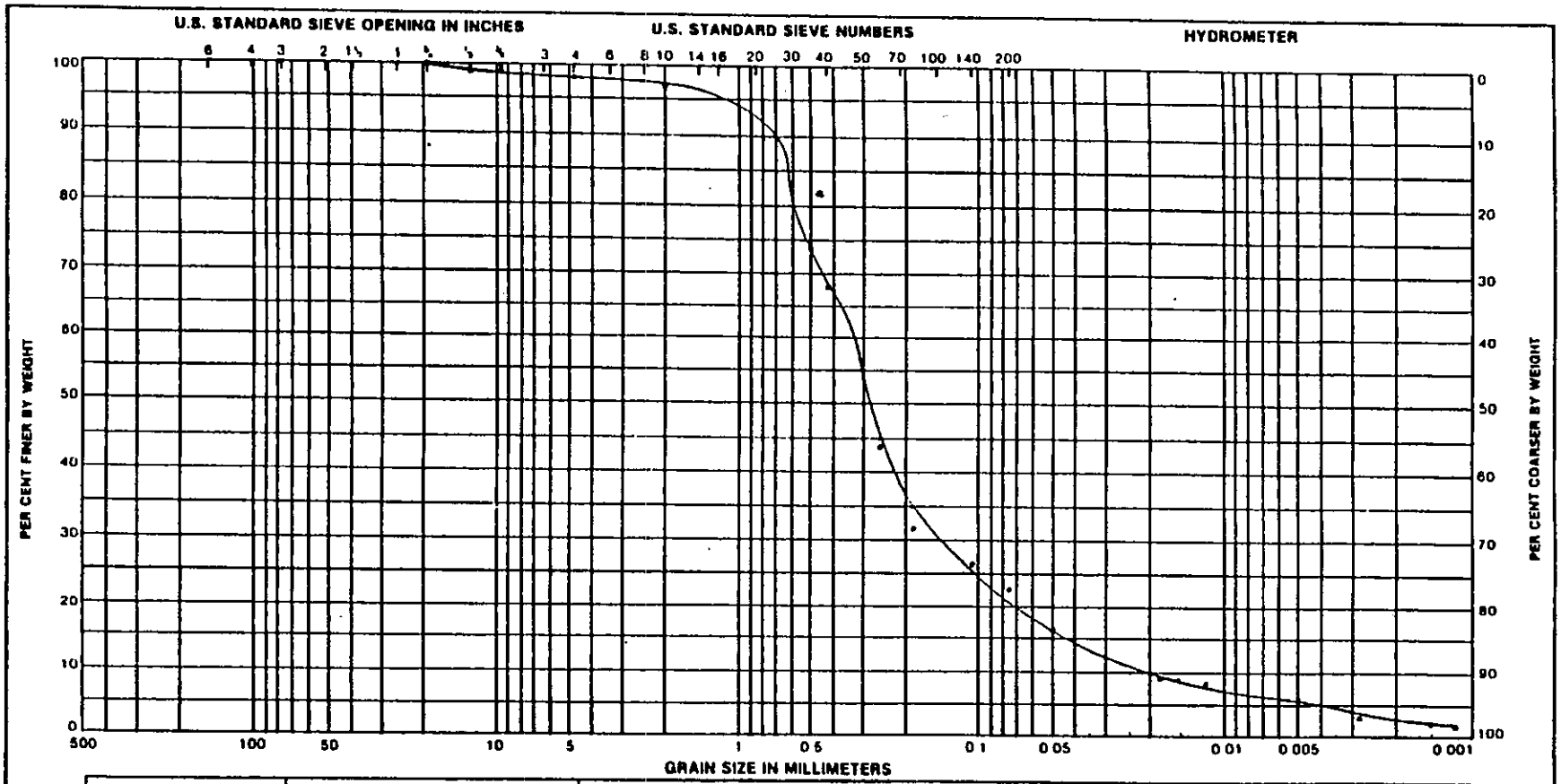
Method of Test ASTM D-698 - Procedure C

Test Results:
Maximum Dry Density: 122.0 lbs/ft.³
Optimum Moisture Content: 12.0 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
4-C-1		1.0'-8.5'	A-2-4				NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Loamy Sand					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

PSI A-100-7

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 4, 1993

OUR REPORT NO.: 491-35002

TEST DATA

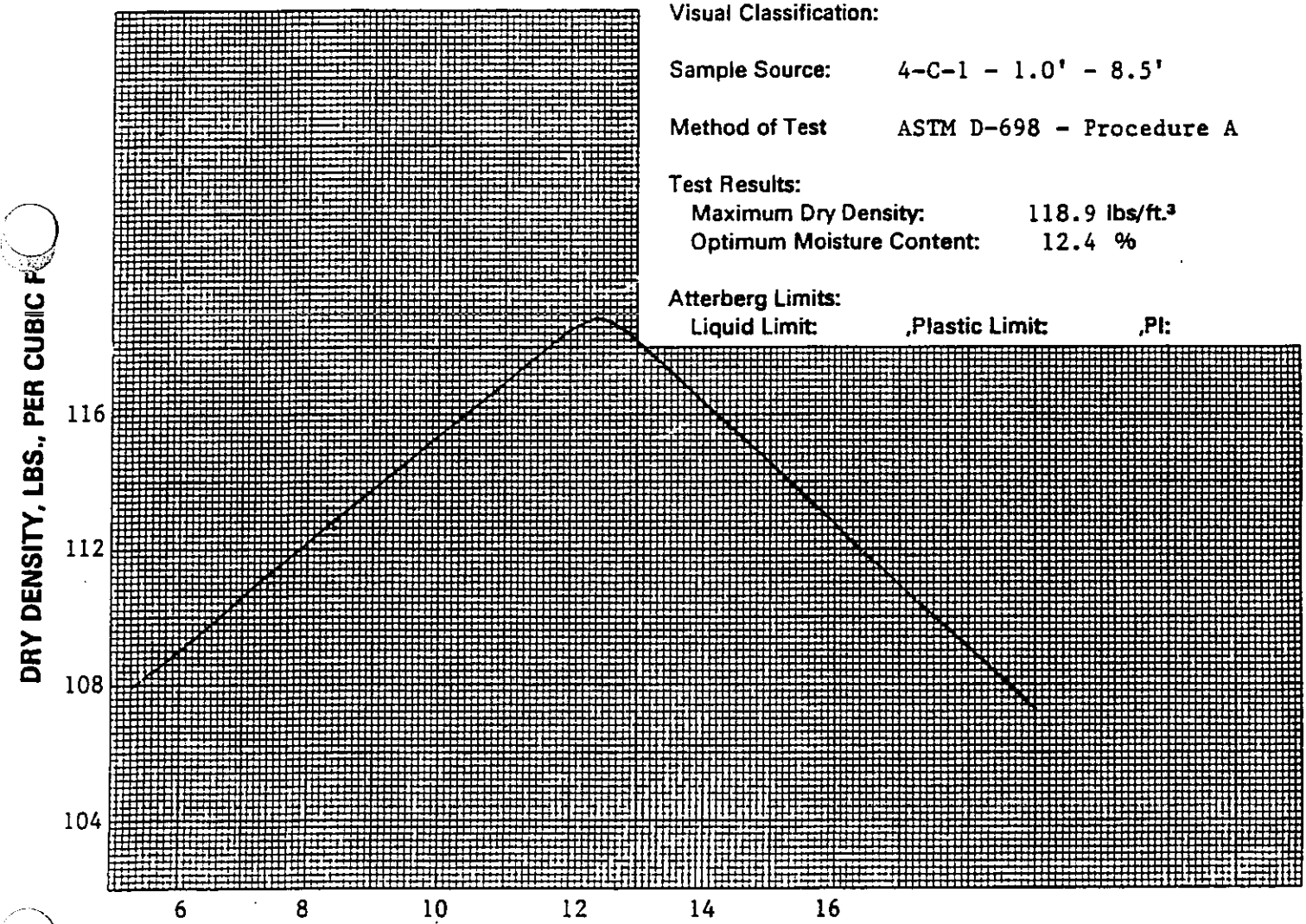
Visual Classification:

Sample Source: 4-C-1 - 1.0' - 8.5'

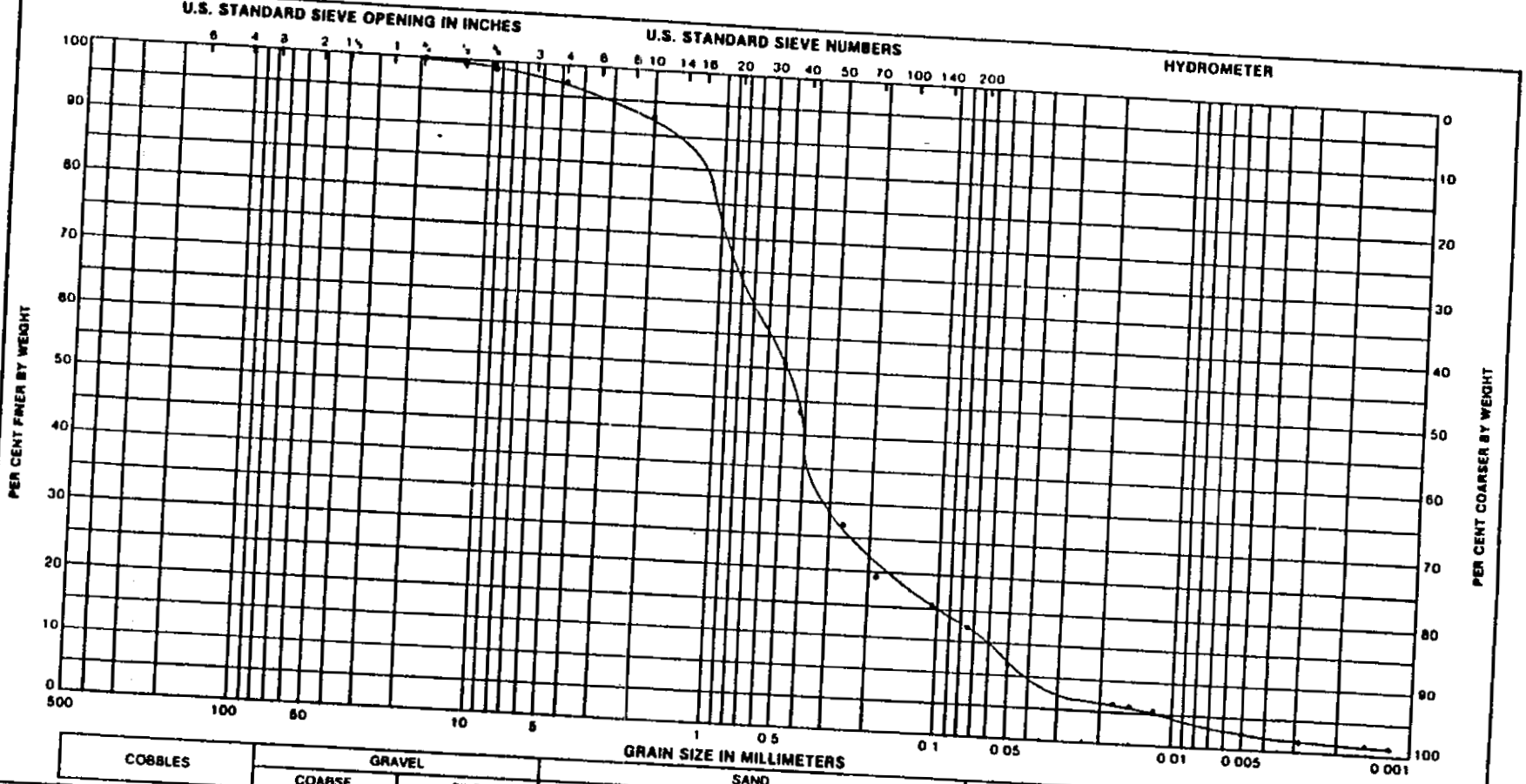
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 118.9 lbs/ft.³
Optimum Moisture Content: 12.4 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI
4-C-1		8.5'-15.0'	A-1-B				NP
			SM				
			Coarse Sand				

REPORT OF SOIL ANALYSIS

Project: Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

File No: 491-35002

Professional Service Industries

A 100-7

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 4, 1993

OUR REPORT NO.: 491-35002

TEST DATA

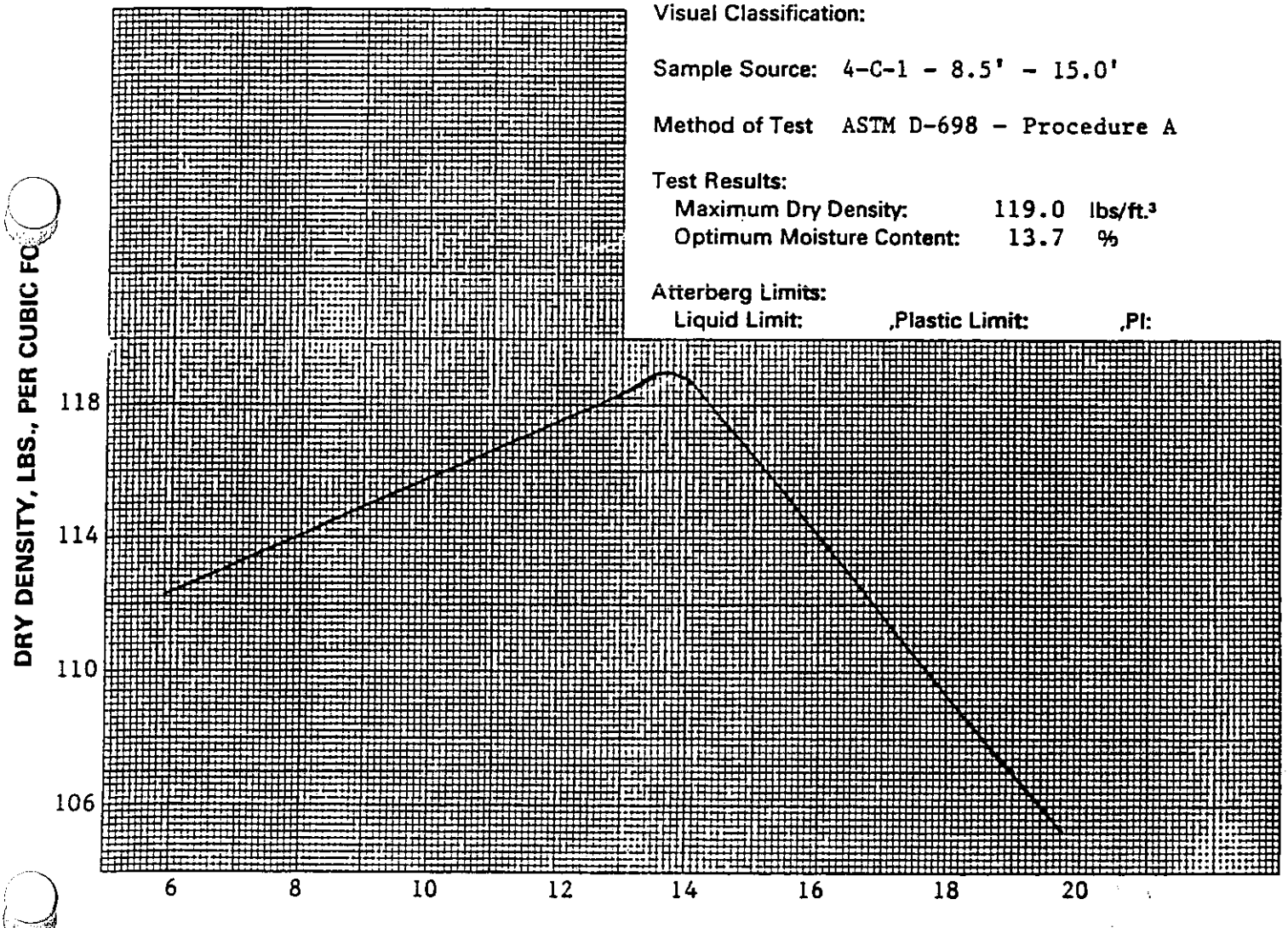
Visual Classification:

Sample Source: 4-C-1 - 8.5' - 15.0'

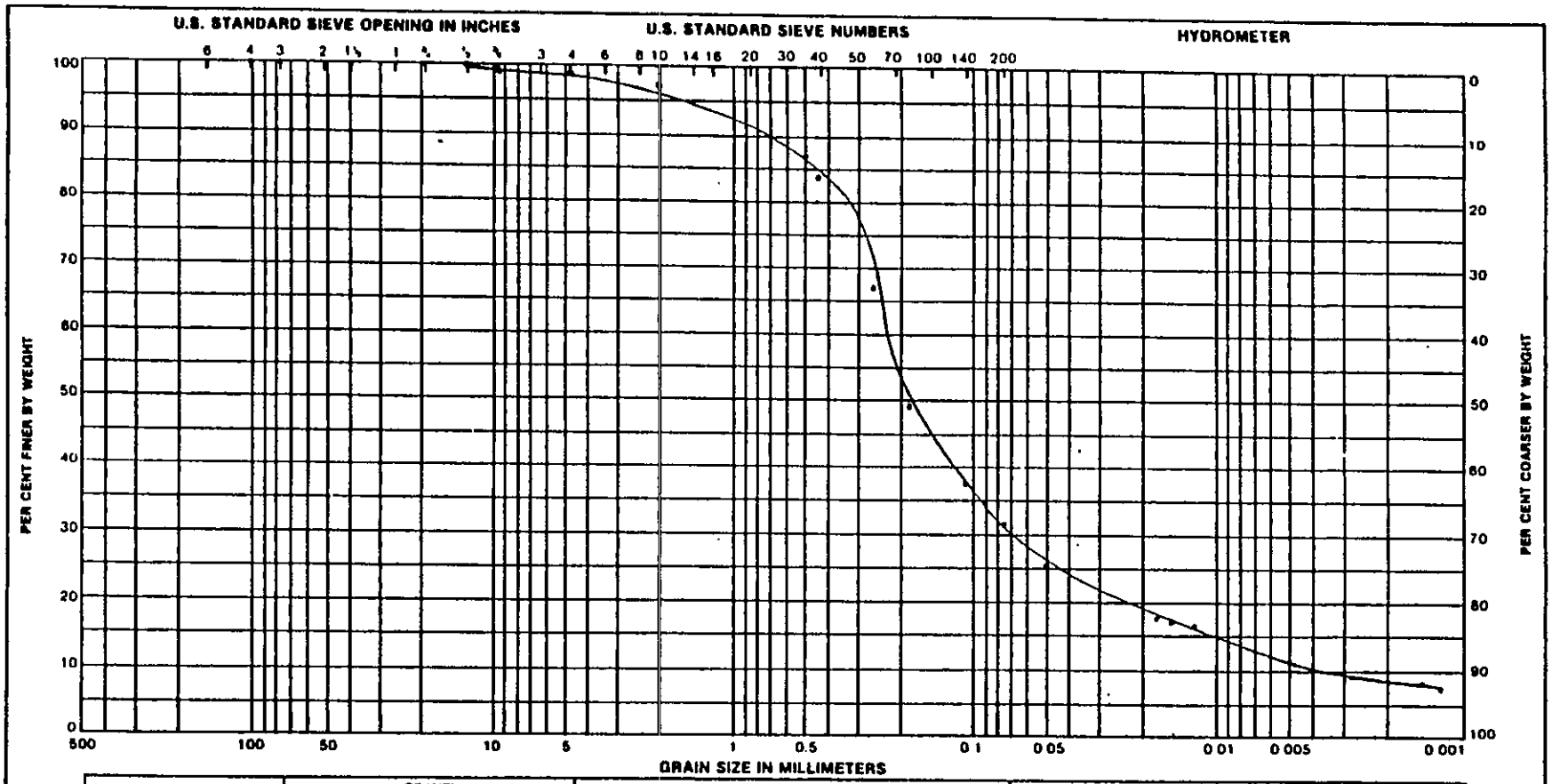
Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 119.0 lbs/ft.³
Optimum Moisture Content: 13.7 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.



Boring No.	Sample No.	Elev. or Depth	Classification	Nat w %	LL	PL	PI	Project
4-C-3		5.0'-8.5'	A-2-4				NP	Ash Basin No. 7 Closure
								Soil Borrow Area
			SM					ER 102147
			Fine Sandy Loam					

REPORT OF SOIL ANALYSIS

File No 491-35002

Professional Service Industries

Professional Service Industries, Inc.

REPORT OF MOISTURE DENSITY RELATIONSHIP OF SOIL

TESTED FOR: PA Power & Light Company
Two North Ninth Street
Allentown, PA 18101

Attention: Mr. Andy Spear

PROJECT: Brunner Island SES
Ash Basin No. 7 Closure
Soil Borrow Area
ER 102147

DATE: August 4, 1993

OUR REPORT NO.: 491-35002

TEST DATA

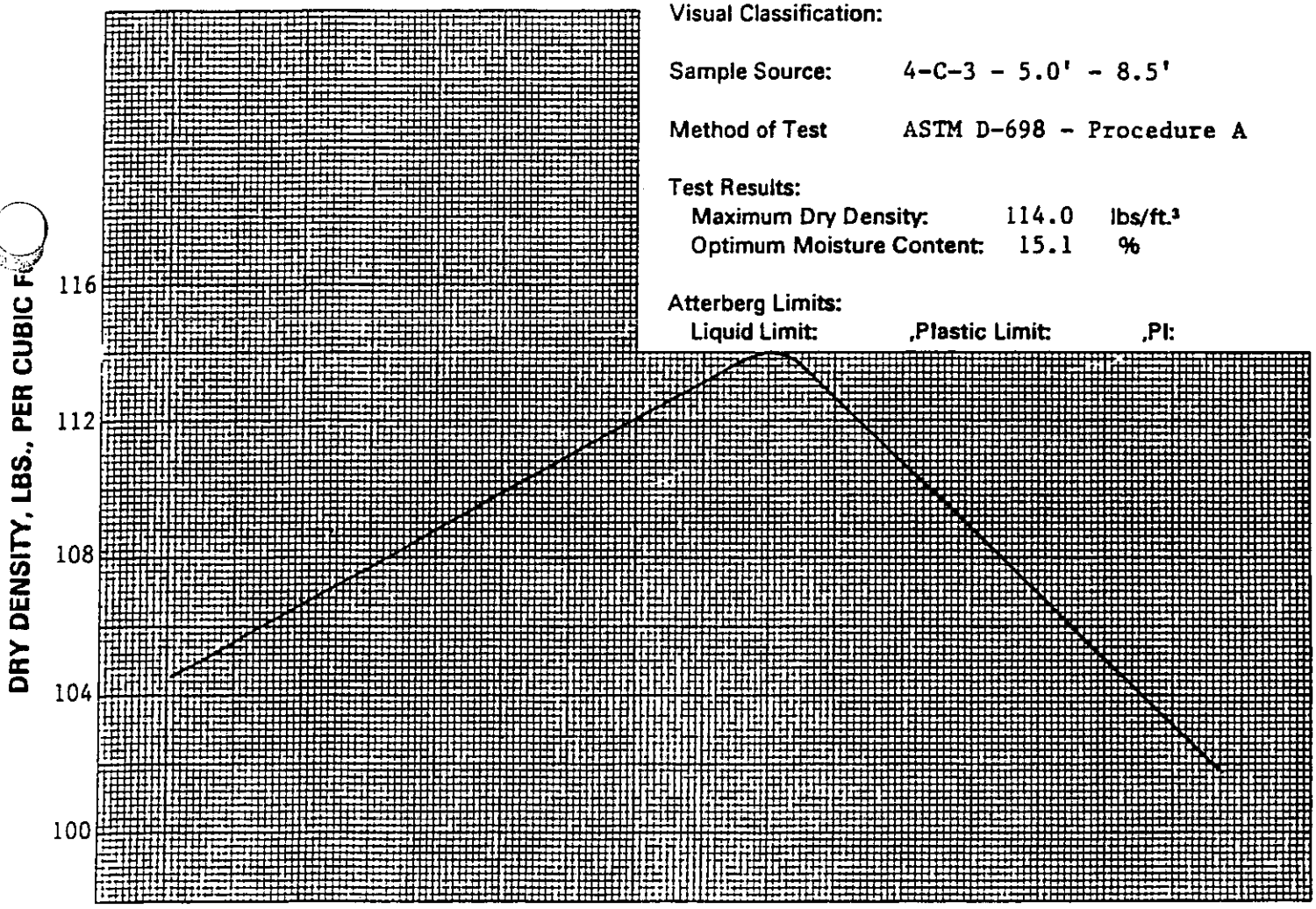
Visual Classification:

Sample Source: 4-C-3 - 5.0' - 8.5'

Method of Test ASTM D-698 - Procedure A

Test Results:
Maximum Dry Density: 114.0 lbs/ft.³
Optimum Moisture Content: 15.1 %

Atterberg Limits:
Liquid Limit: ,Plastic Limit: ,PI:



Respectfully submitted,
Professional Service Industries, Inc.

Professional Service Industries, Inc.

REPORT FOR: Pennsylvania Power & Light PROJECT: Brunner Island

REPORT TO: Professional Service Industries, Inc.
7800 Witmer Drive
Harrisburg, PA 17111

Attn: Mr. Thomas Poole

DATE: August 4, 1993 PSI FILE NUMBER: 491-35002

PERMEABILITY TEST RESULTS

	Remolded Data			
Sample No.	Dry Density (pcf)	Moisture Content (%)	Compaction (%)	Coefficient of Permeability (cm/sec)
1-A-14 (5'-10')	107.8	17.6	94.9	3.28×10^{-7}
1-B-12 (1'-5')	109.0	12.2	94.9	5.37×10^{-6}
1-E-4 (4'-10')	110.3	14.8	94.9	4.33×10^{-7}

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.
Pittsburgh Testing Laboratory Division
Geotechnical Services

mcs

Professional Service Industries, Inc.

REPORT FOR: Pennsylvania Power & Light PROJECT: Brunner Island

REPORT TO: Professional Service Industries, Inc.
7800 Witmer Drive
Harrisburg, PA 17111

Attn: Mr. Thomas Poole

DATE: August 11, 1993 PSI FILE NUMBER: 491-35002

PERMEABILITY TEST RESULTS

	Remolded Data			
Sample No.	Dry Density (pcf)	Moisture Content (%)	Compaction (%)	Coefficient of Permeability (cm/sec)
1-A-8 (5'-10')	117.3	11.5	94.9	1.07×10^{-4}
1-A-8 (15'-16')	112.2	12.5	94.9	7.52×10^{-6}
B4-B2 (25'-28.5')	115.8	12.0	94.9	4.06×10^{-7}
1-A-12 (1'-5')	108.5	13.2	95.0	9.67×10^{-6}

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.
Pittsburgh Testing Laboratory Division
Geotechnical Services

mcs

Professional Service Industries, Inc.

REPORT FOR: Pennsylvania Power & Light PROJECT: Brunner Island

REPORT TO: Professional Service Industries, Inc.
7800 Witmer Drive
Harrisburg, PA 17111

Attn: Mr. Thomas Poole

DATE: August 16, 1993 PSI FILE NUMBER: 491-35002

PERMEABILITY TEST RESULTS

	Remolded Data			
Sample No.	Dry Density (pcf)	Moisture Content (%)	Compaction (%)	Coefficient of Permeability (cm/sec)
1-A-14 (1.0'-5.0')	106.1	15.5	94.9	4.89×10^{-6}

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.
Pittsburgh Testing Laboratory Division
Geotechnical Services

mcs

PSI/Professional Service Industries, Inc.

Report for: Pennsylvania Power & Light
Project: Brunner Island
PSI File No: 491-35002

August 27, 1993

PERMEABILITY TEST RESULTS

	Remolded Data			
Sample No.	Dry Density (pcf)	Moisture Content (%)	Compaction (%)	Coefficient of Permeability (cm/sec)
1-A-1 (0.0'-5.0')	109.2	14.2	94.9	6.45×10^{-6}
2-B-1 (10.0'-15.0')	115.8	10.7	94.9	9.55×10^{-7}
2-B-3 (1.0'-5.0')	108.4	13.7	94.9	7.16×10^{-6}
1-E-7 (10.0'-13.0')	112.5	12.0	94.9	1.27×10^{-5}
1-E-8 (8.5'-13.5')	103.0	15.7	94.9	1.83×10^{-4}
1-E-8 (13.5'-18.5')	114.5	10.5	94.9	3.94×10^{-6}
4-A-2 (5.0'-10.0')	108.7	15.3	94.9	2.58×10^{-6}

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.
Pittsburgh Testing Laboratory Division
Geotechnical Services

mcs

APPENDIX D

Final Cover System Analyses

Appendix D.1

Final Cover Settlement Analysis

BRUNNER ISLAND ASH LANDFILL 8

FINAL COVER SETTLEMENT ANALYSIS

PURPOSE

The purpose of this engineering calculation is to provide an evaluation of the settlement of the proposed final cover system for existing Brunner Island SES Ash Landfill 8 (Ash Landfill 8) in East Manchester Township, Pennsylvania. The calculations provide an estimate of settlement of the final cover system due to primary compression of the coal combustion residual (CCR) waste following construction of the final cover system. Based on the calculated settlement, an analysis is made of the maximum differential settlement and the maximum tensile strains expected in the final cover system.

This calculation was completed to support the preparation of a written closure plan for Ash Landfill 8. The Closure Plan was prepared to demonstrate compliance of Ash Landfill 8 with the closure requirements of the Federal Coal Combustion Residuals (CCR) Rule §257.102. Section 257.102 requires, in part, that the unit is closed to preclude the probability of future impoundment of water, sediment, or slurry (§257.102(d)(1)(ii)) and that the final cover be designed and constructed to accommodate settlement and subsidence to minimize the disruption of the integrity of the final cover system (§257.102(d)(3)(i)(D)). An evaluation of the maximum expected differential settlement and tensile strain of the cover system is required to demonstrate that the Ash Landfill 8 final cover system will continue to effectively manage stormwater run-off and maintain integrity following settlement.

PROCEDURE

Construction of the final cover system will result in primary settlement of the underlying waste layer under the weight of the final cover system. Geosyntec (2012) reports that Tu et al. (2007) conducted compressibility tests on re-sedimented fly ash samples and found that coefficients of secondary compression were low, leading to the conclusion that secondary settlement of fly ash is negligible. Therefore, secondary settlement is not considered in this calculation.

A literature review of the compressibility and settlement behavior of CCR presented by Geosyntec (2012) (Appendix A) concludes that the compression of CCR occurs over a short period of time and is generally due to the reorientation of particles. Geosyntec (2012) references Yoon (2009), which reported that settlement of an instrumented test embankment constructed of CCR stabilized 5 months after the end of construction. Narrative 12R-1 of PPL (2008b) indicates that Ash Landfill 8 will be filled and operated in a series of three cells. The estimated minimum active life of Cells 1, 2, and 3 are 4.0, 4.8, and 5.3 years, respectively. As such, the minimum active life of any one cell requiring closure will be 4 years and the active life of Ash Landfill 8 is approximately 14 years. Therefore, based on the 5-month stabilization period reported by Yoon (2009), it can be assumed that, upon final closure, a majority of the CCR waste placed in Ash

Landfill 8 will have completed settlement under the stress of the overlying waste and that only the additional vertical stress of the final cover will induce additional settlement.

Primary settlements of the waste and underlying materials were calculated using equations for conventional one-dimensional compression settlement of normally consolidated materials (i.e. $p_c' = \sigma'_{vo} < \sigma'_{vo} + \Delta\sigma$) as given below (Holtz and Kovacs 1981). This equation was entered into a Microsoft Excel™ spreadsheet to calculate the final settlements.

Primary Compression Settlement, S_p (or Δh)

$$S_p = \frac{C_C}{1+e_0} H \log\left(\frac{\sigma'_{vo} + \Delta\sigma}{\sigma'_{vo}}\right) \qquad \text{for } p_c' = \sigma'_{vo} < \sigma'_{vo} + \Delta\sigma$$

where

S_p = primary settlement, ft;

C_c = compression index;

H = initial thickness of compressible layer, ft;

σ'_{vo} = initial vertical effective stress, psf;

p_c' = pre-consolidation pressure, psf; and

$\Delta\sigma$ = increment of vertical effective stress, psf.

Using the total settlement calculated at each point along a cross section of the landfill, the differential settlement, grade change, and tensile strain between pairs of adjacent points along the geomembrane are calculated by the equations shown below.

Differential Settlement, Δs

$$\Delta s = \Delta h_1 - \Delta h_2$$

where

Δh_1 = total settlement at Point 1 (ft)

Δh_2 = total settlement at Point 2 (ft)

Grade Change

$$\text{Grade change \%} = (\Delta s / L) \times 100$$

where

L = horizontal distance between points of concern

Tensile Strain in Geomembrane

$$\varepsilon = \frac{8}{3}\left[\frac{\Delta s}{L}\right]^2 \times 100 \qquad \text{(Giroud 1977)}$$

INPUT PARAMETERS

Settlement of the final cover system due to waste settlement is evaluated along the generalized cross-section shown on Figure 1. The cross-section is taken through the short axis of the landfill. It is assumed that any differential settlement along this axis would be most likely to affect the grades of the stormwater infrastructure, as the channel length in the direction of the cross-section are shortest. Calculation of the final cover total settlement, grade change, and differential settlement is performed between sets of 13 points separated by a horizontal distance of approximately 180 ft or less. Those points, and their pre-settlement elevations are identified on Figure 1.

The material properties used in this settlement analysis are presented in the table below.

Material	Unit Weight (γ) (pcf)	Compression Index (C_c)	Initial Void Ratio (e_0)	Initial Thickness (ft)
CCR waste	104[(1)]	0.113[(1)]	0.62[(3)]	variable
Final Cover	130[(2)]	-	-	2

Notes:
(1) Average value presented in Attachment 1.8 of PPL (2008a)
(2) Attachment 1.1.3 of PPL (2008a)
(3) Average value for Ottawa Sand (Holtz and Kovacs 1981)

The unit weight of the final cover material is the same used for the veneer stability calculation presented in Attachment 1.1.3 of PPL (2008a).

The unit weight and compression index of the CCR waste are taken from laboratory tests performed during the Ash Landfill 8 design, as noted in the table above. Fly ash gradation typically ranges from fine sand to silt with well-rounded to spherical particles (Geosyntec 2012). Therefore, the initial void ratio of the CCR waste was selected as a typical value for medium-dense Ottawa sand, assuming the CCR waste is compacted during landfilling (PPL 2008b). Tables showing the respective material properties are included in Appendix B.

RESULTS

Table 1 presents the results of the waste settlement calculations due to primary compression. As indicated in the table, the maximum calculated settlement of the final cover system is 0.22 ft. The maximum calculated grade change is 0.63 percent on the 3H:1V sideslope and 0.02 percent on the top slope. These magnitudes in grade change are not expected to adversely affect the drainage system of the final cover system.

Finally, the maximum calculated strain in the cover system geosynthetics is 0.01 percent. This value of tensile strain is well below the recommended maximum values of 5 percent for HDPE geomembrane (Berg and Bonaparte 1993). Therefore, the calculated tensile strains are not expected to damage the geomembrane.

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TABLE

TABLE 1
FINAL COVER SETTLEMENT DUE TO WASTE COMPRESSION
Brunner Island Landfill 8
East Manchester Township, Pennsylvania

Surcharge from Final Cover	$\Delta\sigma_v$	260	psf
Compression Index of Waste	C_c	0.113	
Unit Weight of Waste	γ	104	pcf
Initial Void Ratioof Waste	e_0	0.62	

Location	Horizontal Distance (ft)	Waste Thickness (ft)	Depth to Midlayer (ft)			Initial Vert. Effective Stress (psf)			Final Vert. Effective Stress (psf)			Settlement (ft)			Total Settlement (ft)	Differential Settlement (ft)	Grade Change (%)	Strain (%)	Sideslope/Top Slope
			Top Layer	Middle Layer	Bottom layer	Top Layer	Middle Layer	Bottom layer	Top Layer	Middle Layer	Bottom layer	Top Layer	Middle Layer	Bottom layer					
1	24	0	0.0	0.0	0.0	0	0	0	260	260	260	0	0	0	0.00				
2	53	17	2.8	8.5	14.1	292	884	1467	552	1144	1727	0.11	0.04	0.03	0.18	0.18	0.63	0.0105	S
3	142	47	7.8	23.5	39.0	807	2444	4057	1067	2704	4317	0.13	0.05	0.03	0.21	0.03	0.03	0.0000	S
4	234	69.5	11.5	34.8	57.7	1193	3614	5999	1453	3874	6259	0.14	0.05	0.03	0.22	0.01	0.01	0.0000	S
5	324	91.5	15.1	45.8	75.9	1570	4758	7898	1830	5018	8158	0.14	0.05	0.03	0.22	0.00	0.00	0.0000	T
6	437	91.5	15.1	45.8	75.9	1570	4758	7898	1830	5018	8158	0.14	0.05	0.03	0.22	0.00	0.00	0.0000	T
7	552	92	15.2	46.0	76.4	1579	4784	7941	1839	5044	8201	0.14	0.05	0.03	0.22	0.00	0.00	0.0000	T
8	631	68	11.2	34.0	56.4	1167	3536	5870	1427	3796	6130	0.14	0.05	0.03	0.22	0.00	0.01	0.0000	T
9	724	40	6.6	20.0	33.2	686	2080	3453	946	2340	3713	0.13	0.05	0.03	0.21	0.01	0.01	0.0000	T
10	783	28	4.6	14.0	23.2	480	1456	2417	740	1716	2677	0.12	0.05	0.03	0.20	0.01	0.02	0.0000	T
11	836	15	2.5	7.5	12.5	257	780	1295	517	1040	1555	0.11	0.04	0.03	0.18	0.02	0.04	0.0000	S
12	866	0	0.0	0.0	0.0	0	0	0	260	260	260	0.00	0.00	0.00	0.00	0.18	0.59	0.0093	S

FIGURE

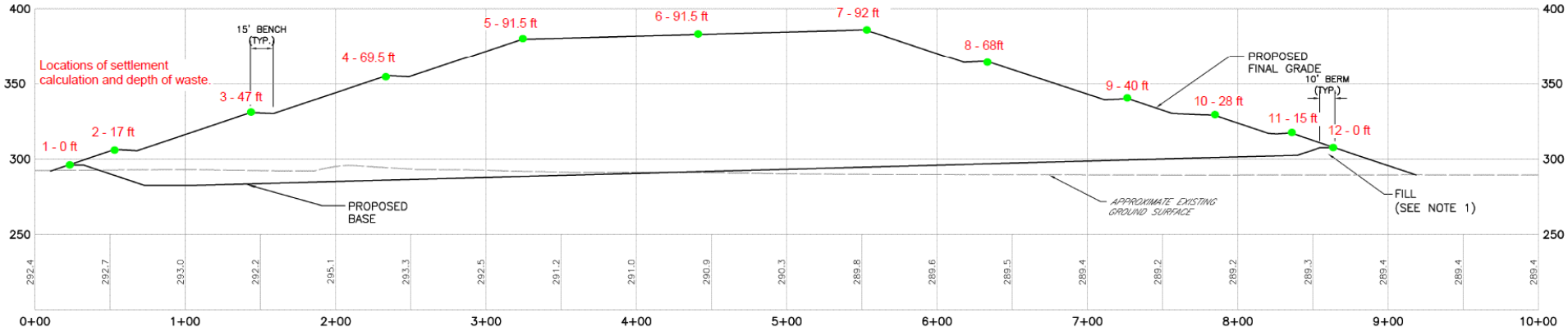

Figure 1 Generalized Landfill Cross Sections with Settlement Points

APPENDIX A

Compressibility of CCB and Final Cover Settlement (Geosyntec 2012)

COMPRESSIBITY OF CCB AND FINAL COVER SETTLEMENT

INTRODUCTION

The tensile strain induced in the geomembrane component of the final cover system depends on the long term settlement of the underlying Coal Combustion By-Products (CCB). A review on the compressibility of CCB is presented in this package. Greater parts of these studies were conducted to investigate the potential use of CCB as a structural fill material or its large scale utilization in highway applications. Conclusions are deduced on the compressibility characteristics of CCB based on the reviewed literature. The following section summarizes the findings from the literature review and its application to the settlements of the final cover.

COMPRESSIBILTY OF CCB

The by-product of the coal burning power plants, CCB, primarily consists of fly ash and bottom ash. Fly ash refers to fine ash particles suspended in the boiler furnace during coal combustion, while bottom ash consists of coarse particles that settle at the bottom of the boiler furnace. Before discussing the compressibility characteristics of CCB, its gradation and morphology in general are briefly discussed to understand its compressibility characteristics. Fly ash is classified into Class-F and Class-C fly ash based on its chemical composition. Class-F fly ash differs from Class-C fly ash in that it does not exhibit cementitious properties unless combined with both lime and water. Figure 1 shows the typical range in gradation for CCB [Leonard et.al., 1982]. The gradation of fly ash ranges from fine sand to silt and the particles are well rounded to spherical. Fly ash is generally non plastic nature. Bottom ash particles are angular and irregular in shape. The size of bottom ash particles ranges from sand to gravel. Physical properties of the potential CCB to be disposed of in the proposed Lot-15 Landfill are described in "Report on Material Characteristics of Soil, CCB and Geosynthetic material."

Numerous studies have been conducted in the laboratory to investigate the compressibility characteristics of fly ash, bottom ash and fly ash-bottom ash mixtures to explore its potential use in high-volume construction projects [Seals et.al 1972; Leonards, et.al., 1982; Karim 1997, Srivasthava and Collins 1989; Kim 2005; Tu, et. al. 2007; Yoon et. al 2009]. Seals et. al performed a series of one-dimensional compression tests on West Virginia bottom ash. They showed that the compressibility of bottom ash was comparable to natural granular soils placed at the same relative density. As part of construction of a new landfill over an existing fly ash pond at Cardinal Power Plant at Brilliant, Ohio Tue et. al, conducted compressibility study on re-sedimented Class F fly ash samples. Compression index were found to be relatively low ranging from 0.039 to 0.064 with an

average of 0.052. They also measured coefficient of consolidation (C_v) and hydraulic conductivity (k) and were comparable to fine sands and inorganic silts and the settlement will occur at faster rate. The measured coefficient of secondary compression ($C_{\alpha\varepsilon}$) was relatively low (0.0003 to 0.0005) and Tu et. al., concluded that the secondary settlement fly ash would not be of a great concern.

Based the results of the plate load test conducted on compacted ash structural fill (consists of fly ash with varying percentage of bottom ash), Leonards and Bailey [1982] reported that compacted ash materials are significantly less compressible than very dense sand in the pressure range of interest (up to 5ksf) (See Figure 2). Kim et.al. [2005] reported that when CCB (fly ash and bottom ash) are used as fill materials, the settlement of the ash layer may be estimated using elasticity-based equations. Figure 3 shows the constrained modulus vs applied pressure for Class F fly ash and fly ash bottom ash mixtures. The constrained modulus of sand at 85% and 99% relative density enveloped those of CCB, such that the values for CCB lies near the lower end of sand moduli range. This suggest that, for the same compaction levels, CCB may be slightly more compressible than sand. As part of the construction and instrumentation of a demonstration embankment built with an ash mixture (60:40 by weight of fly ash: bottom ash) in Indiana, Yoon [2009] reported that the settlement of the embankment stabilized approximately 5 months after the end of its construction (See Figure 4).

Conclusion

Based on the above discussion compressibility of CCB is elastic in nature and will occur within a short period. Compressibility of CCB is primarily due to reorientation of particles. Assume the life of Lot-15 Landfill is about 25 years, the average age of the CCB at the time the cover is constructed will be 21, 12 and 4 years for the bottom, middle and top layer, respectively. It is expected that the settlement of the CCB underlying the HDPE geomembrane layer will be finished by the time the cover system is place (i.e., the settlement of CCB is managed during landfill construction).

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Yoon, S., Balunaini, U., Yildrium, I., Z, Prezzi, M and Siddiki, N., 2009 "Construction of an Embankment with a Fly Ash Bottom Ash Mixture: Field Performance Study", Journal of material in Engieering (Article in Prezz).

FIGURES

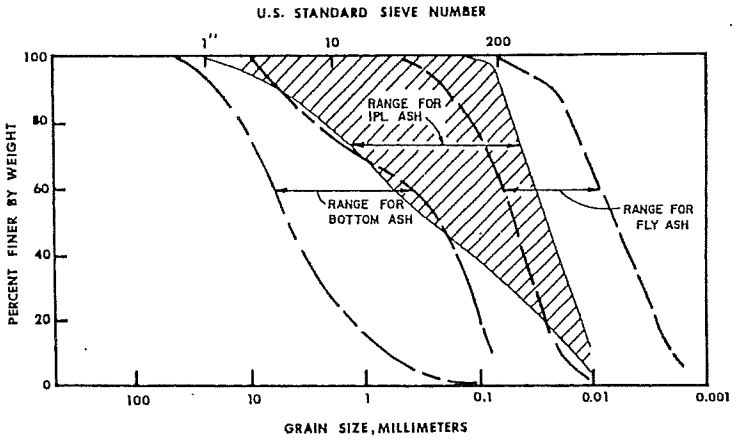
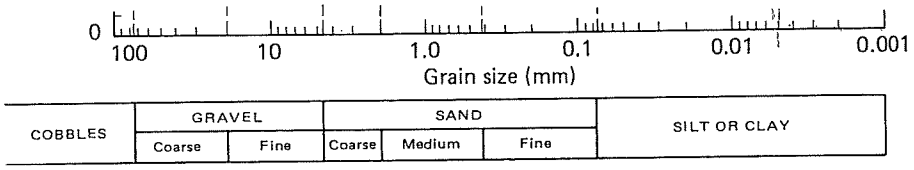


FIG. 2.—Grain-size Distribution of Ash Materials



Leonards, et.al. [1982]

Figure 1

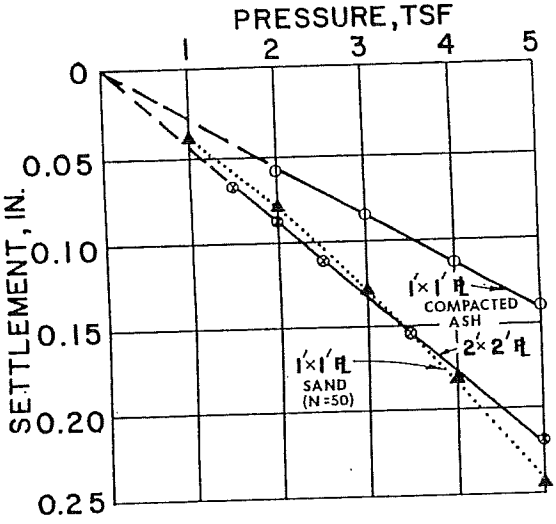


FIG. 8.—Comparison of Plate Load Tests on Compacted Ash with that of Dense Sand (1 tsf = 96 kN/m^2; 1 in. = 25.4 mm; 1 ft = 0.305 m)

Source: Leonards and Bailey [1982]

Figure 2

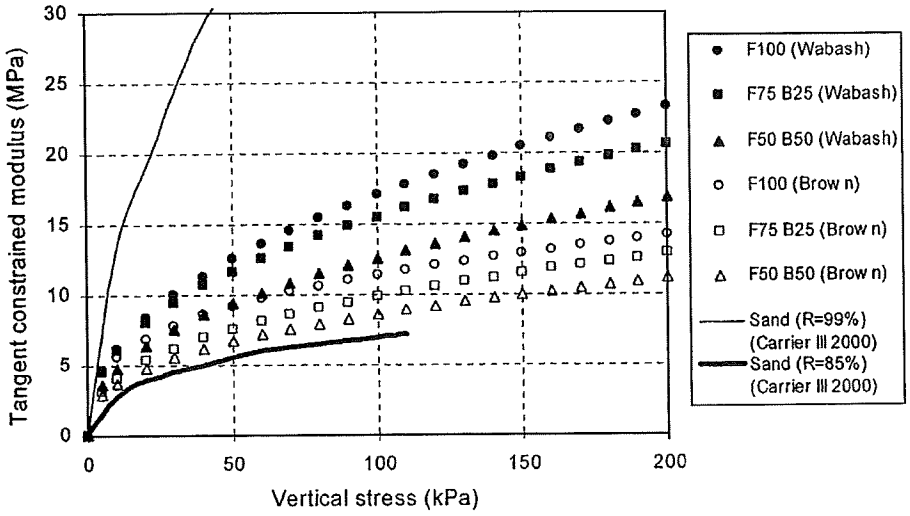


Fig. 6. Tangent constrained moduli of ash mixtures and sands

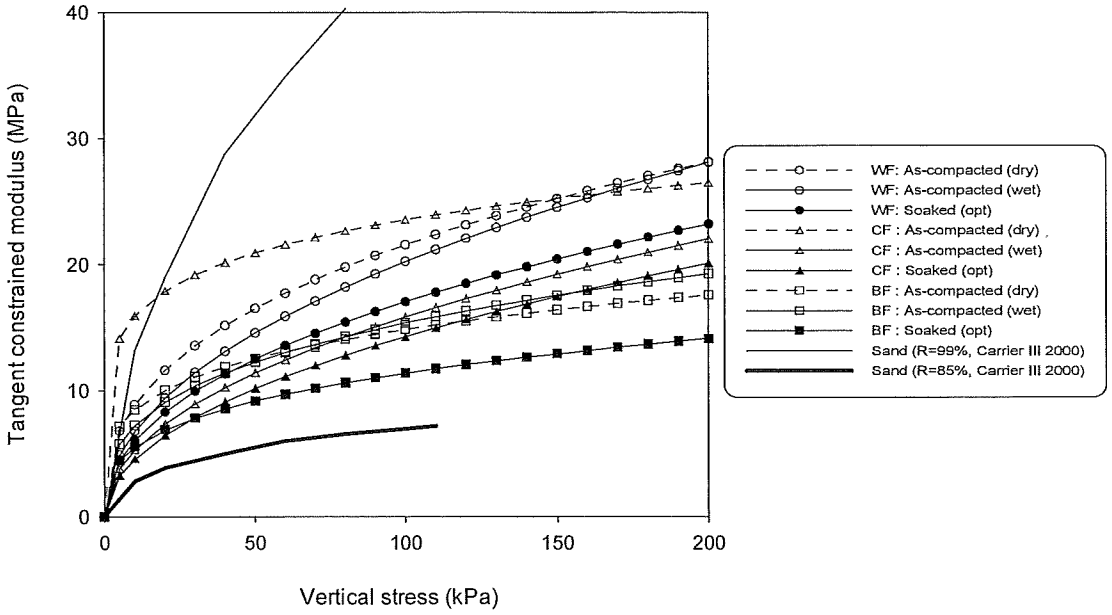


Fig. 6. Tangent constrained moduli of fly ash and sand.

Kim, et. al. [2005]

Figure 3

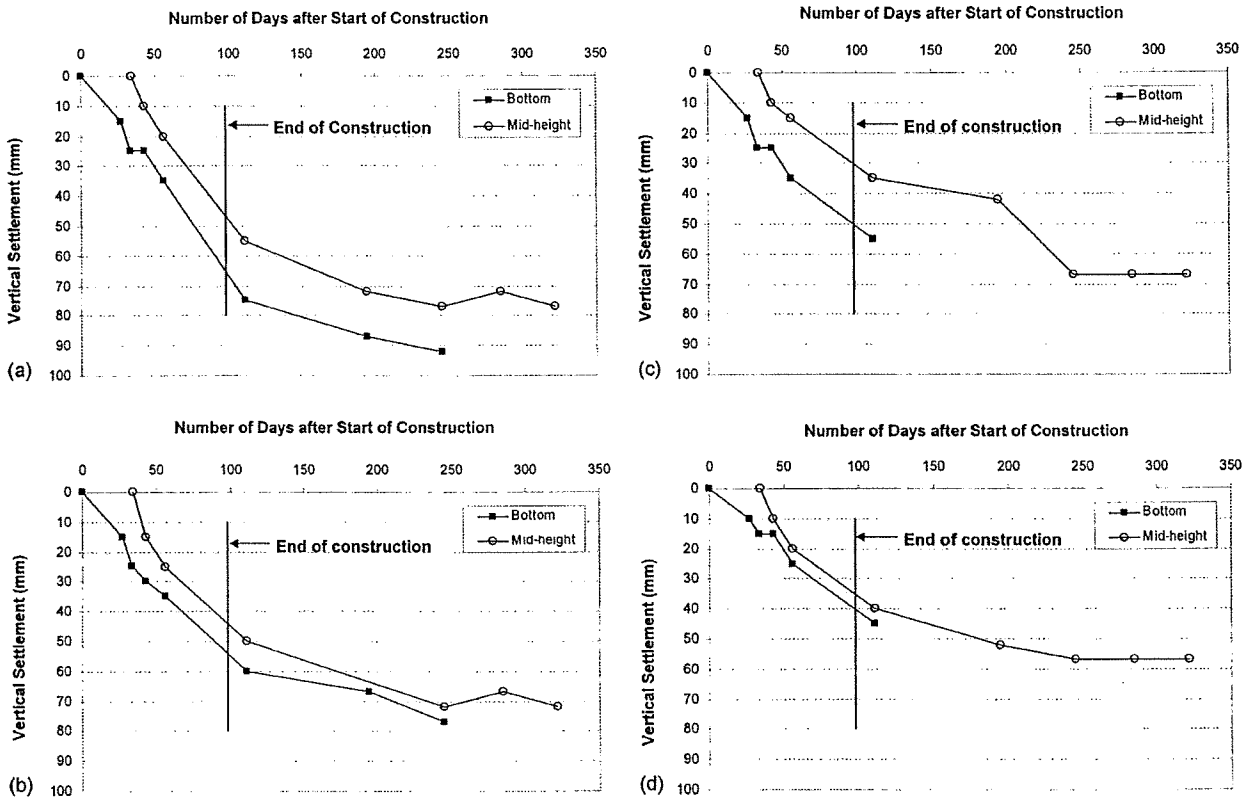


Fig. 8. Settlement versus number of days after start of construction: (a) 7.8 m northwest side; (b) 17.7 m northwest side; (c) 7.8 m southeast side, and (d) 17.7 m southeast side

Source: Yoon et. al. [2209]

Figure 4

APPENDIX B

Material Properties

ASH BASIN 5 EXISTING ASH MATERIALS
SAMPLES OBTAINED FROM ABOVE OBSERVED SATURATED ZONE

TEST BORING	SHELBY TUBE SAMPLE DEPTH	DESCRIPTION	USCS SOIL CLASS	ATTERBERG LIMITS			unCONSOLIDATED-UNDRAINED TRIAXIAL SHEAR STRENGTH		ONE-DIMENSIONAL CONSOLIDATION	
				LL	PL	PL	ANGLE	COHESION	Cc	Cr
A-3	11.5-13.5'	Gray Sandy Silt	SM	NP*	NP	NP	35.4°	0	0.1950	0.020
A-18	11.5-13.5'	Gray Silty Sand	SM	NP	NP	NP	27.3°	0	0.1965	0.022
A-26	18.5-20.5'	Gray Silty Sand	SM	NP	NP	NP	30.1°	0	0.1105	0.016

*Non-Plastic

ASH BASIN 5 EXISTING ASH MATERIALS
SAMPLES OBTAINED FROM WITHIN THE SATURATED ZONE

TEST BORING	SHELBY TUBE SAMPLE DEPTH	DESCRIPTION	USCS SOIL CLASS	ATTERBERG LIMITS			CONSOLIDATED-UNDRAINED TRIAXIAL SHEAR STRENGTH		ONE-DIMENSIONAL CONSOLIDATION	
				LL	PL	PI	ANGLE	COHESION	Cc	Cr
A-8	34.5-36.5'	Gray Silt	ML	NP*	NP	NP	30.60°	0	0.0560	0.0150
A-15	33.5-35.5'	Gray Sandy Silt	ML	NP	NP	NP	28.94°	0	0.0745	0.0160
A-16	26.5-28.5'	Gray Sandy Silt	ML	NP	NP	NP	34.15°	0	0.1000	0.0232
A-45	26.5-28.5'	Gray Sandy Silt	ML	NP	NP	NP	24.93°	0	0.0590	0.0145

*Non-Plastic

Average C_c = 0.113

TYPICAL FLY ASH SAMPLE FOR DISPOSAL IN ASH AREA 8

DESCRIPTION	USCS SOIL CLASS	ATTERBERG LIMITS			CONSOLIDATED-UNDRAINED TRIAXIAL SHEAR STRENGTH		MOISTURE DENSITY RELATIONSHIP (ASTM D 1557)		PERMEABILITY (REMOLDED @ 90% MAXIMUM DRY DENSITY @ OPTIMUM MOISTURE CONTENT, cm/sec)
		LL	PL	PI	ANGLE	COHESION	DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT	
Gary Silt	ML	NP*	NP	NP	31.52°	0	83.72	23.8%	6.35×10^{-5}

$\gamma = \gamma_d^*(1+w) = 104$ pcf

Material properties of CCR samples generated by Brunner Island SES (Attachment 1.8 of PPL 2008).

EXISTING COVER MATERIAL

TEST BORING	SAMPLE DEPTH	DESCRIPTION	USCS SOIL CLASS	ATTERBERG LIMITS			% SAND	% SILT	% CLAY	USDA SOIL CLASS
				LL	PL	PI				
A-24	0-6.5'	Reddish-Brown Lean Clay with Sand	CL	25	17	8	25	53	22	Silt Loam
A-25	0-1.5'	Reddish-Brown Clayey Gravel with Sand	GC	25	16	9	40	48	12	Loam
A-34	0-1.5'	Reddish-Brown Sandy Silt	SM	NP*	NP	NP	34	66	--	Silt Loam
A-42 and A-44	0-1.5'	Reddish-Brown Sandy Lean Clay with Gravel	CL	26	16	9	28	39	33	Clay Loam
Composite of Above Samples		Reddish-Brown Clayey Gravel with Sand	GC	24	16	8	38	50	12	Loam-Silt Loam

*Non-Plastic

Composite of Samples: Standard Proctor Maximum Dry Density: 121.7 pcf
Optimum Moisture Content: 11.51%
Permeability at 90% of Standard Proctor: 2.03×10^{-8} cm/sec

$\gamma = \gamma_d^*(1+w) = 136$ pcf

Material properties of the existing cover material, which is considered representative of the proposed material (Attachment 1.8 of PPL 2008).

TABLE 11-2 Angle of Internal Friction of Cohesionless Soils*

No.	General Description	Grain Shape	D_{10} (mm)	C_u	Loose e	Loose ϕ(deg)	Dense e	Dense ϕ(deg)
1	Ottawa standard sand	Well rounded	0.56	1.2	0.70	28	0.53	35
2	Sand from St. Peter sandstone	Rounded	0.16	1.7	0.69	31	0.47	37†
3	Beach sand from Plymouth, MA	Rounded	0.18	1.5	0.89	29	—	—
4	Silty sand from Franklin Falls Dam site, NH	Subrounded	0.03	2.1	0.85	33	0.65	37
5	Silty sand from vicinity of John Martin Dam, CO	Subangular to subrounded	0.04	4.1	0.65	36	0.45	40
6	Slightly silty sand from the shoulders of Ft. Peck Dam, MT	Subangular to subrounded	0.13	1.8	0.84	34	0.54	42
7	Screened glacial sand, Manchester, NH	Subangular	0.22	1.4	0.85	33	0.60	43
8‡	Sand from beach of hydraulic fill dam, Quabbin Project, MA	Subangular	0.07	2.7	0.81	35	0.54	46
9	Artificial, well-graded mixture of gravel with sands No. 7 and No. 3	Subrounded to subangular	0.16	68	0.41	42	0.12	57
10	Sand for Great Salt Lake fill (dust gritty)	Angular	0.07	4.5	0.82	38	0.53	47
11	Well-graded, compacted crushed rock	Angular	—	—	—	—	0.18	60

*By A. Casagrande.

†The angle of internal friction of the undisturbed St. Peter sandstone is larger than 60° and its cohesion so small that slight finger pressure or rubbing, or even stiff blowing at a specimen by mouth, will destroy it.

‡Angle of internal friction measured by direct shear test for No. 8, by triaxial tests for all others.

Void ratio for loose and dense arrangements for Ottawa Sand (Holtz and Kovacs 1981).

Appendix D.2

Final Cover Permeability Analysis

BRUNNER ISLAND SES ASH LANDFILL 8

FINAL COVER PERCOLATION ANALYSIS

PURPOSE

The purpose of this analysis is to estimate percolation through the proposed final cover of Brunner Island Steam Electric Station Ash Landfill 8 (Ash Landfill 8) in East Manchester Township, Pennsylvania. Specifically, this analysis compares the estimated percolation through the proposed final cover to the estimated percolation through the final cover prescribed by the Federal Coal Combustion Residuals (CCR) Rule. The proposed final cover is considered an alternative cover under the CCR Rule.

This calculation was completed to support the preparation of a written closure plan for Ash Landfill 8. The Closure Plan was prepared to demonstrate compliance of Ash Landfill 8 with the closure requirements of the Federal Coal Combustion Residuals (CCR) Rule §257.102. Section 257.102 requires, in part, that the unit is closed to control, minimize, or eliminate, to the extent feasible, post-closure infiltration of liquids into the waste. This analysis is required to demonstrate compliance of the proposed final cover with the alternative final cover infiltration requirements of §257.102(d)(3)(ii)(A).

The remainder of this calculation package presents the following:

- description of the final cover;
- procedure;
- input parameters;
- results; and
- conclusions.

DESCRIPTION OF THE PROPOSED FINAL COVER

The proposed alternative final cover design (i.e., proposed final cover) is a geosynthetic cover system. The proposed final cover design includes three components (from bottom to top):

- 40-mil textured geomembrane;
- geocomposite drainage layer; and
- 24-inch protective cover and a vegetative support (i.e. erosion) layer.

The proposed final cover cross-section is shown in detail on Figure 1.

Section 257.102(d)(3) of the CCR Rule includes requirements for the prescribed final cover system (CCR Rule-prescribed cover). Minimum requirements for the cover are prescribed by §257.102(d)(3)(i)(A) through (C) as follows:

- permeability no greater than 1×10^{-5} cm/s;
- minimum 18-inch earthen infiltration layer; and
- minimum 6-inch erosion layer capable of sustaining native plant growth.

Based on these requirements, the CCR Rule-prescribed cover was assumed to include three components (from bottom to top):

- 18-inch earthen infiltration layer with hydraulic conductivity no greater than 1×10^{-5} cm/s;
- geocomposite drainage layer; and
- 24-inch vegetative support (i.e. erosion) layer.

To allow for a relevant comparison of the infiltration layer of the proposed final cover and CCR Rule-prescribed cover, all other components of the final cover systems were assumed to be the same. Where specific material properties or layer thicknesses of the CCR Rule-prescribed cover are not specified by the CCR Rule (e.g., lateral drainage layer) or not the same as the proposed final cover (i.e., vegetative support layer thickness), the values of the proposed final cover were used to evaluate the CCR Rule-prescribed cover. The thicker vegetative support layer assumed for the CCR Rule-prescribed cover is a conservative assumption for this analysis.

PROCEDURE

Overview

The leakage through the surficial geomembrane was estimated as the sum of leakage by permeation through the geomembrane and as flow through defects in the geomembrane, after Giroud and Bonaparte (1989). The leakage was estimated as a flow rate considering a final cover area of 1 acre (4,000 m^2). The leakage through one acre of geomembrane due to permeation was computed as shown in Equations 1:

$$Q_g = \frac{m_g \times A}{T_g} \qquad \text{Equation 1}$$

Where:

Q_g = leakage rate due to geomembrane permeation (m^3/sec);

m_g = coefficient of migration of the geomembrane (m^2/sec);

A = considered surface area of geomembrane (m^2); and

T_g = geomembrane thickness (m).

The leakage through pinholes and holes was computed as shown in Equations 2 and 3, respectively.

$$Q_p = \frac{\pi \times \rho \times g \times h_w \times d^4}{128 \times \eta \times T_g}$$ Equation 2

Where:

Q_p = leakage rate through pinholes (i.e., manufacturing defects) (m^3/s);

h_w = depth of liquid on sacrificial geomembrane (m);

ρ = density of water at 20° C (kg/m^3);

g = acceleration due to gravity (m/s^2);

d = pinhole diameter (m); and

η = dynamic viscosity of water at 20° C (kg/m-s).

$$Q_h = C_B \times a \times \sqrt{2 \times g \times h_w}$$ Equation 3

Where:

Q_h = leakage rate through holes (i.e., installation defects) (m^3/s);

C_B = dimensionless coefficient = 0.6;

a = hole area (m^2); and

g = acceleration due to gravity (m/s^2).

The leakage through the CCR Rule-prescribed cover was estimated using Darcy's Law (Equation 4), as presented by Holtz and Kovacs (1981):

$$q = k \times \frac{\Delta h}{L} \times A$$ Equation 4

Where:

q = leakage rate through CCR Rule-prescribed infiltration layer (m^3/s);

k = hydraulic conductivity of earthen infiltration layer (m/s);

Δh = head loss through infiltration layer (m);

L = thickness of earthen infiltration layer (m); and

A = cross-sectional area in direction of flow (m^2);

INPUT PARAMETERS

Geomembrane Properties and Defects

Based on the proposed final cover described above, the geomembrane was assumed to be a 40-mil (0.001 m) HDPE geomembrane with a coefficient of migration (m_g) equal to 1.8×10^{-16} m^2/s (Giroud and Bonaparte 1989). The geomembrane was modeled with manufacturing defects (pinholes) and installation defects (holes).

This analysis assumes two pinholes per acre, corresponding to a manufacturer with a "good" quality control program (Schroeder et al. 1994a and 1994b). Pinhole diameter was taken as the larger of the two diameters modeled by Giroud and Bonaparte (1989).

Installation defects are the result of seaming faults and punctures during installation. Schroeder et al. (1994b) and Giroud and Bonaparte (1989) recommend using a flaw density of 1 hole per acre for intensively monitored projects. This analysis conservatively assumes two defects per acre, corresponding to installation with a "good" quality assurance program (Schroeder et al. 1994a). Giroud and Bonaparte (1989) recommends a 1 cm^2 (0.0001 m^2) hole for design calculations.

Other Input Parameters

Head on the geomembrane or earthen infiltration layer (h_w) was taken as 6.35×10^{-3} meters, which assumes the head is equal to the thickness of the lateral drainage layer (i.e., a 250-mil geocomposite). As required by the CCR Rule, the thickness of the earthen infiltration layer of the CCR Rule-prescribed cover is taken as 0.457 meters (18 inches) with a maximum hydraulic conductivity of 1×10^{-7} m/s (1×10^{-5} cm/s). Head loss through the earthen infiltration layer (Δh) is taken as the head on the geomembrane plus the thickness of the earthen infiltration layer. For both cover systems, the area of flow (A) is taken as 4,000 m^2 (1 acre).

RESULTS

Tables showing the input parameters and results of the leakage calculations for the proposed final cover and CCR Rule-prescribed cover are presented in Appendix A.

Leakage through the proposed final cover is estimated to be 4.2×10^{-5} m^3/s per acre of final cover. Leakage through the CCR Rule-prescribed cover is estimated to be 4.1×10^{-4} m^3/s.

CONCLUSION

As shown by the analysis and results presented in this calculation package, the proposed Ash Landfill 8 final cover, as designed, is expected to achieve an equivalent or greater reduction in infiltration as the CCR Rule-prescribed cover.

REFERENCES

Giroud, J. P., and Bonaparte, R. (1989). "Leakage through liners constructed with geomembrane liners" Geotextiles and Geomembranes 8(1), 27-67, 8(2), 71-111, and 8(4), 337-340.

Holtz, R.D. and Kovacs, W.D. (1981). "An Introduction to Geotechnical Engineering." Prentice Hall, Englewood Cliffs, NJ.

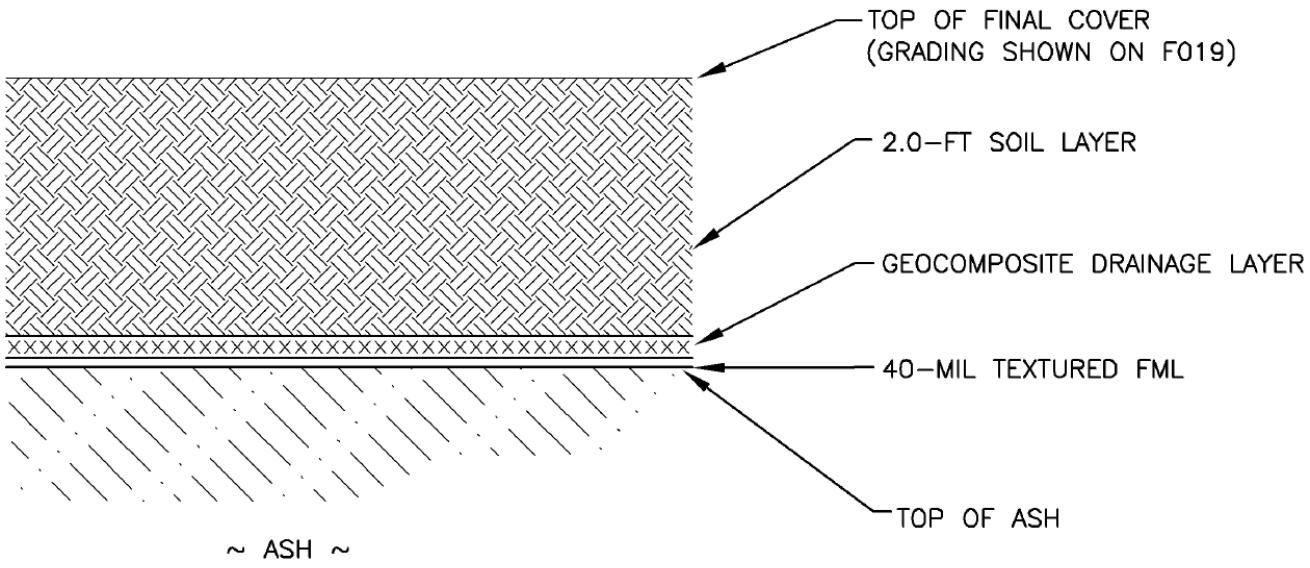
PPL (2008a). "Disposal Areas 8 Class II Residual Waste Disposal Facility Landfill Design Package and Plans." Volumes 1 & 2. PPL Generation, LLC. January 2008.

Schroeder, P. R., Aziz, N. M., Lloyd, C. M. and Zappi, P. A. (1994a). "The Hydrologic Evaluation of Landfill Performance (HELP) Model: User's Guide for Version 3", EPA/600/R-94/168a, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC.

Schroeder, P.R., Dozier, T.S., Zappi, P.A., McEnroe, B.M., Sjostrom, J.W., and Peyton, R. L. (1994b). "The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3", EPA/600/R-94/168b, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC.

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

FIGURE



FINAL COVER CROSS-SECTION
BRUNNER ISLAND ASH LANDFILL 8

East Manchester Township, PA

Geosyntec consultants

Columbia, MD | 27 May 2016

FIGURE

1

CEC (2007). "Final Land Development Plans and Permit Drawings." Civil & Environmental Consultants, Inc. March 2007.

APPENDIX A

CALCULATION TABLES

Leakage Through 1 Acre of Proposed Final Cover Geosynthetic Infiltration Layer		
Permeation (1a)	7.2E-10	m^3/s
Pinhole Leakage (1b)	2.4E-08	m^3/s
Hole Leakage (1c)	4.2E-05	m^3/s
Total Leakage	4.2E-05	m^3/s

Notes (1) From Giroud and Bonaparte (1989): (a) Eqn 5; (b) Eqn 21; and (c) Eqn 22

head on GM	h_w	0.00635	m
area considered	A	4000	m^2
GM thickness	T_g	0.001	m
GM coeff. migration	m_g	1.80E-16	m^2/s
pinhole frequency		2	(#/acre)
pinhole diameter	d	0.0003	m
hole frequency		2	(#/acre)
hole area	a	0.0001	m^2
density water	ρ	1000	kg/m^3
dynamic viscosity water	η	0.001	kg/m-s
accel. due to gravity	g	9.8	m/s^2
coefficient	C_B	0.6	

Leakage Through 1 Acre of CCR Rule-Prescribed Earthen Infiltration Layer		
Permeation	4.1E-04	m^3/s

Notes (1) After Holtz and Kovacs (1981)

soil hydraulic conductivity	k	1.00E-07	m/s
head on liner	h_w	0.00635	m
soil thickness	L	0.457	m
Area	A	4000	m^2

APPENDIX E

Provisions for Revegetation (Form H of PPL 2008b)

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WASTE MANAGEMENT

Date Prepared/Revised
DEP USE ONLY
Date Received

FORM H
REVEGETATION

This form must be fully and accurately completed. All required information must be typed or legibly printed in the spaces provided. If additional space is necessary, identify each attached sheet as Form H, reference the item number and identify the date prepared. The "date prepared/revised" on attached sheets should match the "date prepared/revised" on this page.

General References: Sections 273.142, 277.142, 281.131, 288.142, 289.142, 291.415, 295.131

SECTION A. SITE IDENTIFIER

Applicant/permittee: PPL Brunner Island LLC

Site Name: Disposal Area 8

Facility ID (as issued by DEP):

SECTION B. SOIL TEST PLAN

Provide a soil test plan for determining plant nutrients and soil amendments required to establish temporary and final cover.

SECTION C. TEMPORARY COVER

a)

Seed Mixture			Seed Quality		
No.	Species	lbs./acre	Min. % Germ.	Min. % Purity	Seeding Dates
	annual rye	50	99	98	any time

b) The proposed use of each seed mixture. Include where and when each mixture is to be used.
Temporary seed will probably nbot be used on this project, except perhaps on topsoil piles

c) The seedbed preparation, including lime and fertilizer application and incorporation procedures. 2.2 tons of lime per acre and 880 pounds of 10-6-4 fertilizer per acre

d) Method(s) of seeding. hydro-seeding

e) Type(s) of mulch to be used and rate(s) of application. straw mulch at 3 tons per acre or hydromulch at 0.75 tons per acre.

f) The technique to be used to evaluate the success of revegetation. observation

g) Proposed maintenance procedures. backfill erosion scars and reseed

SECTION D. PERMANENT COVER

a)

Seed Mixture			Seed Quality		
No.	Species	lbs./acre	Min. % Germ.	Min. % Purity	Seeding Dates
B	kentucky 31 tall fescue	90	95	99	March 15 to October 15
	chewings red fescue	30	95	99	
	annual rye grass	30	95	99	
CV	crown vetch	20	95	90	March 15 to October 15
	rye grass	40	95	95	

b) The proposed use of each seed mixture. Include where and when each mixture is to be used. PPL's Type B seed mis will be used to seed the sruface of Area 8. Crown vetch may be used on Basin 5 dikes should they become disturbed some how.

c) The seedbed preparation, including lime and fertilizer application and incorporation procedures. lime at 2 tons per acre and 10-6-4 fertilizer at 880 lbs per acre.

d) Method(s) of seeding. hydroseed

e) Type(s) of mulch to be used and rate(s) of application. wood cellulose fiber at 1500 lbs per acre

f) The technique to be used to evaluate the success of revegetation. 75% coverage - visual

g) Proposed maintenance procedures. Inspected weekly and after rain events until see has germinated. Then inspecting quarterly. Mainenance will include filling erosion scars and reseeding as necessary.