APPENDIX G SAFETY FACTOR ASSESSMENT §257.103(F)(1)(IV)(B)(8)

Bottom Ash Pond
Initial Safety Factor Assessment
and H&H Analysis
General James Gavin Power Plant
Cheshire, Ohio
S&ME Project No. 7217-15-006A

S&ME

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1.0 Introduction

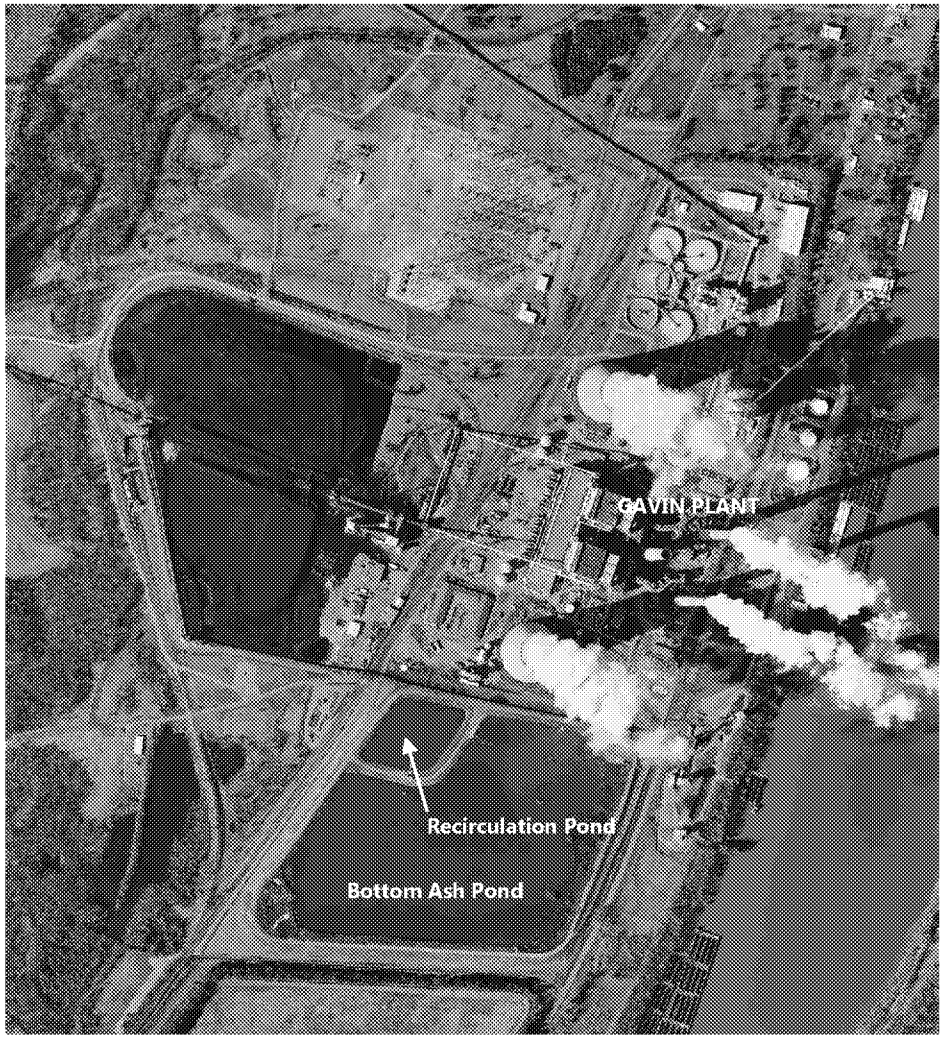
1.1 Background

In April of 2015, the US EPA formally published national regulations for disposal of coal combustion residuals (CCR) from electric facilities. As part of the rule, the owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that aspects of the CCR impoundments are in accordance with the rules. Based on our understanding of the Request for Fee Estimate received from AEP on April 29, 2015, AEP specifically requested P.E. certification to fulfill the requirements of 40 CFR § 257.73(e), *Periodic Safety Factor Assessments*. In the employment of BBC&M Engineering, Inc., the undersigned engineers conducted site investigations at the bottom ash pond in 2009 and 2010. Due to our familiarity with the site, S&ME was selected to perform the Safety Factor Assessment for this facility. Additionally, since the bottom ash pond has not had a recent hydrologic and hydraulic (H&H) analysis performed, S&ME was also tasked to conduct an H&H analysis to fulfill the requirements 40 CFR § 257.73 (d) (1) (v) (B). S&ME understands that certification and/or documentation for other structural integrity criteria will be performed by AEP or other consultants.

1.2 Location and Geologic Conditions

The Gavin Power Plant, as shown in Figure 1-1, is located along the Ohio River, approximately 10 miles north of Gallipolis, Ohio. The bottom ash pond, which was put into service in 1974, is located immediately south of the generating plant and consists of a four-sided upground earthen embankment structure. Within the pond is a smaller, non-structural, embankment separating the main pond from the recirculation pond. The total length of the exterior embankment is 6550 feet and the embankment varies in height, as measured above the exterior grade, from 28 to 39 feet. The pond is completely isolated from exterior surface water inflow. The original construction drawings indicated that the inboard and outboard slopes were designed with 2H:1V slope angles. Survey data taken at the boring locations reveal a range of outboard slope angles from 1.8H:1V to 2.2H:1V. The embankment was constructed as a homogenous dam.

Figure 1-1 – Gavin Plant



The natural soils at the site consist of a layer of alluvium silt, clay and fine sand over glacial outwash deposits of variable thickness overlying the bedrock surface. The alluvium clays and silts were deposited in the backwater of the Ohio River, while the outwash materials typically consist of sand, gravel and silt deposits deposited during the last ice age. Based on available geologic literature, the glacial outwash extends to the bedrock surface, estimated to be roughly 60 feet below the natural ground surface.

1.3 Previous Investigations

In 2009, the undersigned engineers, when in the employment of BBC&M Engineering, Inc., completed a subsurface investigation and geotechnical assessment of the Bottom Ash Pond embankments. This assessment, dated June 16, 2009, concluded that the embankment exhibited adequate factors of safety against slope failure under steady-state seepage and seismic loading conditions relative to typical US Army Corps of Engineers requirements. In 2010, BBC&M Engineering, Inc. performed additional

geotechnical analyses. As part of this work, the initial exploration was supplemented with additional borings and laboratory testing, and the updated slope stability analyses were updated and additional failure modes were examined, including rapid drawdown. A report documenting the additional geotechnical analysis, dated April 26, 2010, was submitted as an addendum to the 2009 report.

2.0 Scope of Work

In accordance with AEP's request, the following work items were performed by S&ME:

1. S&ME completed a cursory review of previously conducted assessment work performed by the undersigned engineers, as well as a limited number of construction documents made available by AEP.

2. S&ME visited the site along with personnel from AEP. The site visit was not a formal inspection, but rather served to verify that no significant modifications or changed conditions have taken place since the previous investigations.

3. Hydrologic and Hydraulic (H&H) analysis: An H&H analysis was performed to fulfill the requirements of Part 257.73 (d) (1) (v) (B).

4. Upon completing Tasks 1 through 3, S&ME's determined that there was sufficient information to certify the structural integrity of the surface impoundment in accordance with the requirements of 40 CFR § 257.73(e). A separate letter has been prepared to this effect.

3.0 Information Review and Site Visit

To support the safety factor assessment and hydrology and hydraulic analyses, S&ME conducted a cursory review of previous documents relating to the bottom ash pond and conducted a site visit at the facility. AEP provided S&ME with the following documents:

- Grading and Fence Plan, 1974 (Dr. No. 12-014-9)
- Excavation Plan, Not dated (Dr. No. MHD-SK-012887)
- Sections, 1971 (Dr. No. 12-3015-3)
- Topographic survey data generated from (year) LiDAR information
- Principal Spillway conduit and Impact Basin, 1973 (DWG No. 670 C 205 R1)
- Principal Spillway Plan and Sections, 1973 (DWG No. 670 C 201 R2)
- Principal Spillway Floating Platform and Skimmer, 1973 (DWG No. 670 C206)
- Reclaim Pond Outlet Structure – Plan and Profile, 1994 (DWG No. 12-30408-2)
- Modification of Bottom Ash Complex Pond & Outfall Pipe, 1994 (DWG 12-30401-2)
- Bottom Ash Pond Complex Pond Outfall – Plan and Profile, 1994 (DWG 12-30407-1)
- Bottom Ash Pond Investigation, BBC&M Engineering, Inc., July, 2009
- Assessment of Dam Safety Final Report, Clough Harbour, & Assoc., September, 2009
- Addendum to Bottom Ash Pond Investigation, BBC&M Engineer, Inc. April, 2010

On July 28, 2015, the undersigned S&ME personnel met with Mr. Shah Baig (AEP Civil Engineering) and Mr. Doug Workman (Gavin Plant Manager) at the Gavin Plant and conducted a site visit at the bottom ash pond. The participants discussed and observed the operations of the bottom ash and recirculation ponds, including the hydraulic structures within the ponds. The crest and inboard and outboard slopes were observed and no significant geometry changes appeared to have been made since the 2009 and 2010 assessments. While the site visit was not a formal inspection, visual observations of the bottom ash pond did not reveal any dam safety concerns, and the embankments appear to be in a similar condition as in 2009 and 2010 when our previous investigations were performed.

4.0 Hydrologic and Hydraulic Study

The purpose of this hydrologic and hydraulic study is to satisfy the requirements of 40 CFR § 257.73 (d) (1) (v) (B) published by the EPA in April 2015 for the Gavin Bottom Ash Pond Complex (Main Pond and Reclamation Pond). The Bottom Ash Pond Complex is classified by the Ohio Department of Natural Resources (ODNR) Division of Soil and Water Resources as a Class I Dam. The Bottom Ash Pond Complex is composed of two ponds that are connected by a single hydraulic structure on a shared interior dike. The Main Pond discharges through the shared structure into the Reclamation Pond for final treatment. The Reclamation Pond discharges through an outlet structure to a pipe network that discharges into the Ohio River.

4.1 Records Review and Data Collection

To support our analyses, S&ME requested available data from AEP with respect to the bottom ash pond, and the information received is summarized in Section 3.0 of this report. In particular, S&ME was interested in historical drawings and recent pond survey data (topographic data). An as-built drawing for the Reclamation Pond outlet structural was not available and assumptions were made with regard to structure dimensions based on a plan and profile of the structure (drawing 12-3015-3) and a site visit performed by S&ME on July 28, 2015. Additionally, S&ME was not provided with recent topographic survey data. The stage-storage curve for each pond was developed using the end-area method from the plan view contours within each pond starting at the normal (operating) pool elevation. Please note that the storage curve stops at the lowest elevation of the top of the embankment within each pond (EL. 585.0), not the highest part of the embankment. The contour areas were obtained using AutoCAD Civil 3D 2015 and based on topographic data obtained from Ohio State Imagery program (OSIP) LiDAR dataset (2006).

4.2 Elevation Datum Conversion

Elevations represented in this study refer to the North American Vertical Datum of 1988 (NAVD88) unless otherwise specified. Historical drawings were used to determine structure elevations for critical hydraulic components of this study and these drawings referenced the National Geodetic Vertical Datum of 1929 (NGVD29). The historical elevation data used in this study was converted to the NAVD88 datum using the VERTCON software package developed by the National Oceanic and Atmospheric Association (NOAA) using the best available data near the location of the impoundment. The VERTCON software estimated that the NGVD29 elevation data needs to be lowered by 0.650 feet to approximate the equivalent NAVD88 elevation. The output data from VERTCON is included in Appendix I.

4.3 Hydrologic Routing

The design storm was routed through each drainage area, corresponding to the footprint of each pond in the Bottom Ash Pond Complex, using both of the ODNR PMP distributions to determine the controlling rainfall distribution in accordance with the ODNR PMP guidance. The TR-20 hydrologic routing methodology developed by the Natural Resources Conservation Service (NRCS) was used to calculate the runoff volume for the PMP rainfall event. Following calculation of the hydrologic input parameters, rainfall runoff estimates, and the stage-storage relationship for the sedimentation pond, S&ME modeled the pond and outflow structure using the Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) version 4.1, developed by the U.S. Army Corps of Engineers. Input and output data from HEC-HMS is included in Appendix I and a summary of the peak flows and runoff volume is included in table 2 below.

Table 4-1 Hydrologic Routing Summary

Basin	ODNR Distribution	Estimated Peak Inflow (CFS)	Estimated Runoff Volume (AC-FT)
Main Pond	ODNR Type II – 24HR	396.3	131.1
Reclamation Pond	ODNR Type II – 24HR	8.7	2.9

4.4 Hydraulic Routing

Two scenarios were modeled as part of this study. Both scenarios are described below and a summary of the estimated maximum pool elevation within the pond is include in Table 3 below. Input and output data from HEC-HMS is included in Appendix I.

4.4.1 Scenario 1 - Normal Pool with active spillways during 100% PMP event

This scenario was calculated using the following assumptions:

1. Pond starting water elevation is normal (operating) pool
2. 100% PMP event
3. Plant pumped inflows and outflows are distributed evenly (hourly) throughout the storm event
4. Spillways are active and operational

Table 4-2 Hydraulic Modeling Summary – Scenario 1

Pond	Estimated Peak Inflow (CFS)	Estimated Peak Outflow (CFS)	Estimated Peak Elevation (ft-msl)	Estimated Freeboard (FT)
Main	398.1	39.2	580.2	4.8
Reclamation	40.1	39.4	577.6	7.4

4.4.2 Scenario 2 - Normal Pool with inoperable spillways during 100% PMP event

This scenario was calculated using SCS methodology for various alternatives as described below. The estimated maximum water surface elevation for each pond in Scenario 2 is indicated in Table 6 below. Calculation sheets from the runoff curve number method are included in the Attachments (A.20-A.21).

4.4.2.1 2A - Main Pond

Scenario 2A estimated the total runoff produced from the drainage area to the Main Pond, at both the 24HR rainfall depth and the 6HR rainfall depth, with an inoperable principal spillway.

4.4.2.2 2B - Reclamation Pond

Scenario 2B estimated the total runoff produced from the drainage area to the Reclamation Pond, at both the 24HR rainfall depth and the 6HR rainfall depth, with an inoperable principal spillway and no hydraulic connection to the Main Pond.

4.4.2.3 2C - Pond Complex

Scenario 2C estimated the total runoff produced from the drainage area to the entire pond complex, at both the 24HR rainfall depth and the 6HR rainfall depth, with an inoperable principal spillway and hydraulic connection to the Main Pond.

Table 4-3 Hydraulic Modeling Summary – Scenario 2

Scenario	Pond	Estimated Peak Elevation (ft-msl)[1]	Estimated Freeboard (FT)
2A	Main	582.6	2.4
2C	Reclamation	582.0	3.0

[1]Peak elevation chosen from Table 6 in H&H Technical Report in Appendix I.

4.5 Discussion

S&ME performed a hydrologic and hydraulic study on the bottom ash pond complex at the AEP Gavin Plant and a summary of the results are outlined below:

- The main pond can adequately store and pass the design storm with approximately 4.7 feet of freeboard available.
- The main pond spillway meets the requirements specified in paragraph (d)(1)(v)(A).
- The main pond meets the discharge requirements specified in paragraph (d)(1(v)(B).
- The reclamation pond can adequately store and pass the design storm with approximately 7.4 feet of freeboard available.
- The reclamation pond spillway meets the requirements specified in paragraph (d)(1)(v)(A).
- The reclamation pond meets the discharge requirements specified in paragraph (d)(1(v)(B).

5.0 Safety Factor Assessment

As part of the safety factor assessment, S&ME completed Parts 1 and 2 of Section 257.73(e) of the Final Rules for the Disposal of Coal Combustion Residuals from Electric Utilities published on April 17, 2015 in the Federal Register. In accordance with the Rule, the analysis was performed for the critical cross-sections(s) that are anticipated to be most susceptible of all cross-sections to structural failure based on appropriate engineering considerations. The Rule specified the following loading conditions for analysis:

i. Static Factor of Safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.

ii. Calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.50

iii. The calculated seismic factor of safety must equal or exceed 1.00

iv. For dikes constructed of soils susceptible to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

5.1 Limit Equilibrium Analyses

Our 2009 Investigation Report and the 2010 Addendum discuss in detail the subsurface investigation, laboratory testing, parameter justification, seepage analyses and limit equilibrium slope stability analyses that were performed to develop safety factors for the bottom ash pond embankments. In summary, one section on each side of the four-sided pond embankment was studied. Subsurface information for each section was obtained by performing borings through the crest and toe of the embankment. Additionally, four observation wells were installed to obtain groundwater readings within the embankment and foundation. These wells were supplemented with additional groundwater data supplied by AEP, as discussed in more detail in Section 6.0. Based on a review of all four sections explored, two were selected for detailed limit equilibrium stability analysis, one through the west side and one through the south side. The Plan of Borings, geotechnical cross-sections, and soil boring logs from the 2009 investigation are included in Appendix II. A summary of laboratory testing is provided in Appendix III.

Prior to performing the limit equilibrium stability analyses, seepage analyses were performed to develop a better understanding of the likely phreatic surface within the embankment and foundation. The models were calibrated by adding additional total head boundary conditions within the subsurface to best model the groundwater table as observed in the observation wells. The model results, in conjunction with the observation well readings, suggest that much of the seepage emanating from the ponds is moving downward into the more permeable alluvium soils rather than moving laterally through the less permeable embankments. For this reason, it appears that a classically shaped phreatic surface (as might be expected to form within an earth dam constructed on an impermeable foundation, Casagrande 1937) has not developed. In addition, the pool level within the pond is maintained well below the crest for operational purposes. The apparent effect of both of these conditions is a phreatic surface located well within the embankment and far from the outboard slope face.

The shear strength parameters developed for the embankment fill and alluvial layers for use with the pseudo-static seismic analysis were evaluated in consideration of the laboratory testing results. In accordance with NRCS practice, 80 percent of the CU strength values (USACE R-Envelope) were used as recommended for impervious soils, defined by soils exhibiting a coefficient of permeability less than $1x10^{-4}$ cm/sec. Critical failure surfaces were located through a deterministic search, with no limitations on failure depth or failure surface location. The results are based on the pool level recorded at the time of the survey and the groundwater measurements recorded from the observation wells.

Table 5-1 - Shear Strength Parameters

Material Description	γ_{wet} (pcf)	Total		Effective		Reference
		ϕ	c (psf)	ϕ'	c' (psf)	
Roadway Fill	125	34°	0	34°	0	NAVFAC
Cohesive Embankment Fill	125	17.3°†	1,430†	32°	100	CU-2 Triaxial Test (BBCM, 2010)
Upper Alluvium	125	11°†	800†	27.9°	470	CU-3 Triaxial Test (BBCM, 2010)
Lower Alluvium	125	18°†	250†	34.5°	0	CU-4 Triaxial Test (BBCM, 2010)
Loose to Med. Dense Glacial Outwash Sand and Gravel	120	32°	0	32°	0	SPT and Grain Size Correlations

† 80% of value used for pseudo-static slope stability analysis

5.2 Liquefaction Potential of Embankment Soils

S&ME evaluated the potential of the embankment soils to liquefy during a seismic event. The embankment material is classified as a fined grained material and the recovered samples with gradation testing were evaluated following guidelines presented in the 2003 NEHRP (National Earthquake Hazards Reduction Program) Recommended Provisions for Seismic Regulations for New Buildings and Other Structures. The provisions in Chapter 7 indicate that liquefaction potential in fine grained soils should be assessed provided the following criteria are met (Seed and Idriss 1982; Seed et al., 1983): the weight of the soil particles finer than 0.005 mm is less than 15 percent of the dry unit weight of a specimen of the soil; the liquid limit of soil is less than 35 percent; and the moisture content of the in-place soil is greater than 0.9 times the liquid limit. If all of these criteria are not met, the soils may be considered non-liquefiable.

Laboratory testing results from 24 samples were available from the 2009 and 2010 investigation for evaluation of the screening criteria. Of the 24 samples, 13 samples contained data to check all three screening criteria, and 11 samples contained data to check two screening criterion. Based on the results of the screening, no sample met all 3 criteria; therefore, these embankment fill can be considered non-liquefiable. A table depicting this evaluation is included in Appendix II.

5.3 Summary of Results

A summary of the computed safety factors for the critical cross-section is provided in Table 5-1. Also included in the table are the minimum values defined in 40 CFR § 257.73(e)(1) subparts (i) through (iv). Graphical output corresponding to the analysis cases are presented in Appendix IV.

Table 5-2 – Safety Factor Summary

Analysis Case	Minimum Safety Factor	Computed Safety Factor
Long-term, maximum storage pool	1.50	1.76
Maximum surcharge pool	1.40	1.75
Pseudo-static seismic loading	1.00	1.39
Embankment Liquefaction	1.20	Non-liquefiable

6.0 Certification

Based on our previous investigations and current assessment of the Bottom Ash Pond facility, S&ME certifies that this assessment meets the requirements of paragraphs (e)(1) and (e)(2) of Part 257.73 for the critical cross-section of the embankment.

We appreciate having been given the opportunity to be of service on this project. If you have any questions, please do not hesitate to contact this office.

Sincerely,

S&ME, Inc.

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Appendices

Appendix I – H&H Analysis

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CALCULATION SHEET

PROJECT NAME		SUBJECT		
AEP Gavin Bottom Ash Pond		Ash Pond H&H Study		
PROJECT NO.	CALC BY	REV BY	DATE	SHEET NO.
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BOTTOM ASH POND HYDROLOGY AND HYDRAULICS

The purpose of this hydrologic and hydraulic study is to satisfy the requirements of 40 CFR § 257.73 (d) (1) (v) (B) published by the EPA in April 2015 for the Gavin Bottom Ash Pond Complex (Main Pond and Reclamation Pond). Section (d)(1)(v)(B) states the following:

(B) The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a:
(1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or
(2) 1000-year flood for a significant hazard potential CCR surface impoundment; or
(3) 100-year flood for a low hazard potential CCR surface impoundment.

The Bottom Ash Pond Complex is classified by the Ohio Department of Natural Resources (ODNR) Division of Soil and Water Resources as a Class I Dam. The Pond Complex is composed of two ponds that are connected by a single hydraulic structure across a shared interior dike. The Main Pond discharges through this shared structure into the Reclamation Pond for treatment. The Reclamation Pond discharges through an outlet structure to a pipe network that discharges into the Ohio River. A site plan is included in the Attachments (A.1) and the ODNR Dam Inventory Sheet is included in the Attachments (A.10).

HYDROLOGIC STUDY

Elevation Datum Conversion

Elevations represented in this study refer to the North American Vertical Datum of 1988 (NAVD88) unless otherwise specified. Historical drawings were used to determine structure elevations for critical hydraulic components of this study and these drawings referenced the National Geodetic Vertical Datum of 1929 (NGVD29). The historical elevation data used in this study was converted to the NAVD88 datum using the VERTCON software package developed by the National Oceanic and Atmospheric Association (NOAA) using the best available data near the location of the impoundment. The VERTCON software estimated that the NGVD29 elevation data needs to be lowered by 0.650 feet to approximate the equivalent NAVD88 elevation. The output data from VERTCON is included in the Attachments (A.2).

Hydrologic Parameters

Plant Inflows

The Gavin Plant inflows within the Main Pond were provided by AEP in the Water Balance Diagram included in the Attachments (A.3). Table 1 below summarizes the sources of inflows and how the average daily flows were included in the study.

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Table 1 – Plant Inflows and Outflows

Type	Description	Average Daily Flow[1]	Hourly Flow (24HR)[2]	Hourly Flow (6HR)[3]
Inflow – Main Pond	Cooling Tower Blowdown	11.52	1.76 cfs	7.0 cfs
Inflow – Main Pond	Bottom Ash + Pyrites Sluice	7.24		
Inflow – Main Pond	Low Volume Wastewater	8.39		
Inflow – Main Pond	Coal Pile Runoff	0.17		
Inflow – Main Pond	Fly Ash Transfer Building Sumps	0.01		
	MAIN POND INFLOW TOTAL	**27.33**		

[1] Average Daily Flow given in Millions of Gallons per Day (MGD).
[2] Average Daily Flow distributed over 24 hours, given in Cubic Feet per Second (cfs).
[3] Average Daily Flow distributed over 6 hours, given in cfs.

Normal Pool Designation

Normal pool within each pond was based on field observation of staff gages on the outlet structures during a site visit to the AEP Gavin Plant on July 28, 2015. The normal (operating pool) within the Main Pond is approximately 578.0 ft-msl and the operating pool within the Reclamation Pond is approximately 575.0 ft-msl. (see the following photographs).

Date: 7/28/2015

Photographer: MGR/MTR

Location / Orientation	Main Pond Spillway Structure
Remarks	Note that the pond is currently at elevation 578.0

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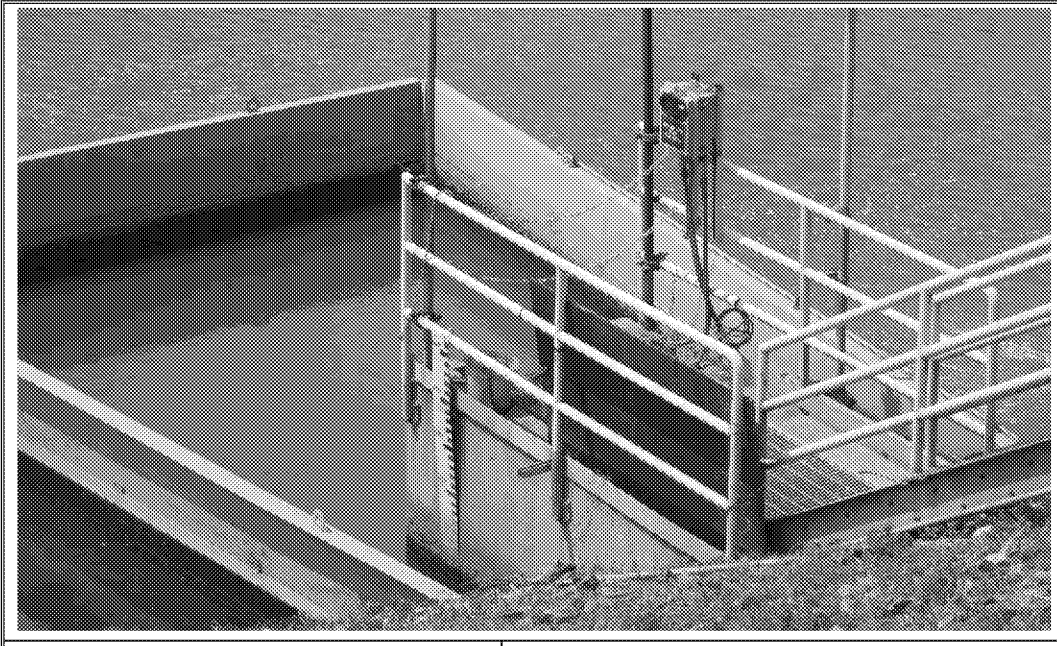

Date: 7/28/2015

Photographer: MGR/MTR

Location / Orientation	Reclamation Pond Spillway Structure
Remarks	Note the pond is currently at elevation 575.0

Drainage Area

The pond is an upground impoundment and the total drainage area is limited to the inboard slope of the four primary embankments. The drainage area for both the main pond and the reclamation pond were estimated using AutoCAD Civil3D 2015 with topographic data obtained from the Ohio State Imagery program (OSIP) LiDAR dataset (2006). The estimated drainage areas for the main pond and reclamation pond are 58.1 Acres and 1.3 Acres respectively. A figure depicting the drainage area delineation is included in the Attachments (A.1).

SCS Runoff Curve Number

The Soil Conservation Service Runoff Curve Number chosen for this study was 98 to reflect a drainage area that is primarily open water with very little exposed vegetated embankment for infiltration to affect the total runoff.

Time of Concentration / Lag Time

Due to the upground nature of the impoundment and the fact that impoundment is predominantly an open water surface, the time of concentration was assumed to be 5 minutes.

Probable Maximum Precipitation Calculation

Based on the Class I classification by the ODNR Division of Soil and Water Resources, the Gavin Bottom Ash Pond is required to pass the 100% of the Probable Maximum Flood (PMF)

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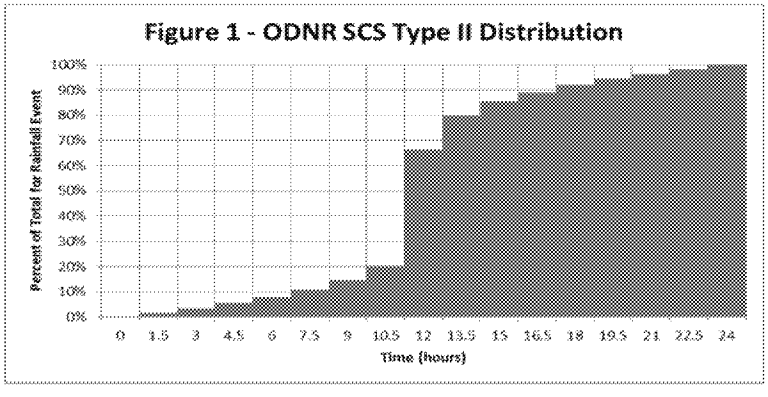
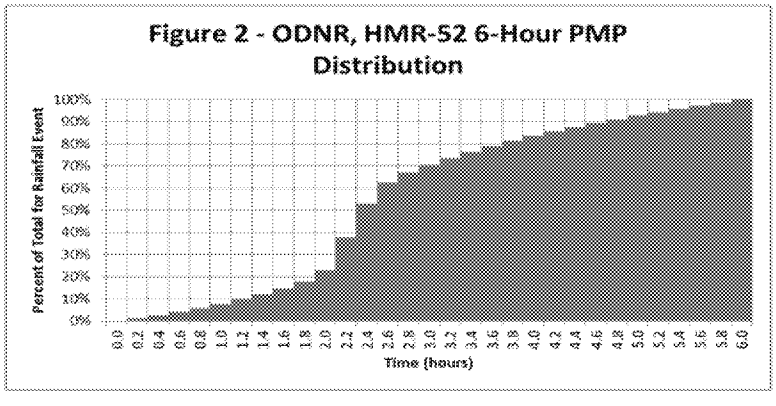
with a starting water surface elevation at normal pool. The Probable Maximum Precipitation (PMP) was used to estimate the PMF based on revised rainfall depth estimates for the state of Ohio from a statewide PMP study released by ODNR in 2013. Historical PMP values were conservatively high to account for a higher level of uncertainty associated with the predicted values. When the results of the new ODNR study reduced the values, new guidelines were released on the appropriate use of the values in the hydrologic and hydraulic analysis of dams. Specifically, the new guidelines require the evaluation of two separate rainfall distributions: a 24-hour SCS Type II distribution commonly used in the Midwest but modified slightly by ONDR; and a 6-hour PMP distribution developed by ODNR using techniques from Hydrometeorlogical Report No. 52. The distributions are presented in Figures 1 and 2 below. The time step (which influences peak duration and intensity) used in each distribution has been defined by ODNR. The time steps were further modified slightly to accommodate the modeling capabilities of HEC-HMS because a 90 minute and 12 minute time step are not available. The ODNR distributions were interpolated to produce a 60 minute interval across the SCS Type II distribution and a 10 minute interval across the ODNR Dimensionless distribution. The more conservative event (the one resulting in the higher peak water surface elevation) is used as the design event. Maps provided in the Attachments (A.4 – A.5) were used to estimate the total rainfall volumes applied to each of the rainfall distributions below.





Elevation Stage Storage Curve

The elevation stage-storage curve for both the main pond and the reclamation pond is included in the attachments (A.6 – A.7). The stage-storage curve was developed using the end-area method from the plan view contours within each pond starting at the normal pool elevation. Please note that the storage curve stops at the lowest elevation of the top of the embankment within each pond, not the highest part of the embankment. The contour areas were obtained using AutoCAD Civil 3D 2015 and based on topographic data obtained from Ohio State Imagery program (OSIP) LiDAR dataset (2006). The LiDAR topographic contours do not provide bathymetric data below the pool level within each pond at the time of the flyover, so the Reclamation pond volume was only available down to elevation 576. S&ME extrapolated down one additional foot to model the operating pool level at elevation 575.

Hydrologic Routing

The design storm was routed through each drainage area, corresponding to the footprint of each pond, using both the ODNR PMP distributions to determine the controlling rainfall distribution in accordance with the ODNR PMP guidance. Hydrologic routing methodology developed by the Natural Resources Conservation Service (NRCS) was used to calculate the runoff volume for the PMP rainfall event. Following calculation of the hydrologic input parameters, rainfall runoff estimates, and the stage-storage relationship for the sedimentation pond, S&ME modeled the pond and outflow structure using the Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) version 4.1, developed by the U.S. Army Corps of Engineers. Input and output data from HEC-HMS is included in the Attachments (A.14-A.18) and a summary of the peak flow and runoff volume is included in table 2 below.

Table 2 - Hydrologic Routing Summary

Basin	ODNR Distribution	Estimated Peak Inflow (CFS)	Estimated Runoff Volume (AC-FT)
Run 1 - Main Pond	Type II – 24HR	396.3	131.1
Run 2 - Main Pond	HMR-52 – 6HR	841.2	91.3
Run 1 - Reclamation Pond	Type II – 24HR	8.7	2.9
Run 2 - Reclamation Pond	HMR-52 – 6HR	18.5	2.0

HYDRAULIC STUDY

Hydraulic Structures

Two primary structures control runoff and pumped flow within the main pond, the reclamation pond and between ponds. These structures are outlined below and supporting information including historical drawings is included in the Attachments (A.8 – A.11).

S&ME

CALCULATION SHEET

PROJECT NAME		SUBJECT		
AEP Gavin Bottom Ash Pond		Ash Pond H&H Study		
PROJECT NO.	CALC BY	REV BY	DATE	SHEET NO.
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Interior Dike Spillway Structure

The primary spillway structure from the main pond is located within the intermediate dike between the main pond and reclamation pond. The spillway structure is composed of a concrete riser structure that controls the pool elevations with stop logs or large metal plates that are raised and lowered from a hoist. The structure is designed to allow flow to enter from two sides, with each side separated by an interior wall that has large holes to allow water to flow freely within the structure. Each vertical chamber of the structure is approximately 4 feet wide by 4 feet long. The large metal plates act as a weir for the water to flow into the structure and they are approximately 4 feet wide. The weir was modeled using a spillway rating curve developed using the Hydrologic Engineering Circular No. 22 equations for sharp-crested weirs. The calculations used to develop the weir spillway rating curve are included in the Attachments (A.8). The concrete structure discharges into a 42-inch diameter reinforced concrete pipe that runs beneath the interior dike and outlets into the reclamation pond. Characteristics of the outlet pipe are included in Table 3 below.

Table 3 – Main Pond Outlet Pipe Characteristics

Component	Description	Size / Pipe Diameter (FT)	Length (FT)	Slope (%)	Begin Invert El.	End Invert El.
Pipe 1	Rein. Conc. Pipe	3.5	188	1.0	558.35	556.35

Photos of the main pond spillway structure taken during a site visit on July 28, 2014 are included below.

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PROJECT NAME		SUBJECT		
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PROJECT NO.	CALC BY	REV BY	DATE	SHEET NO.
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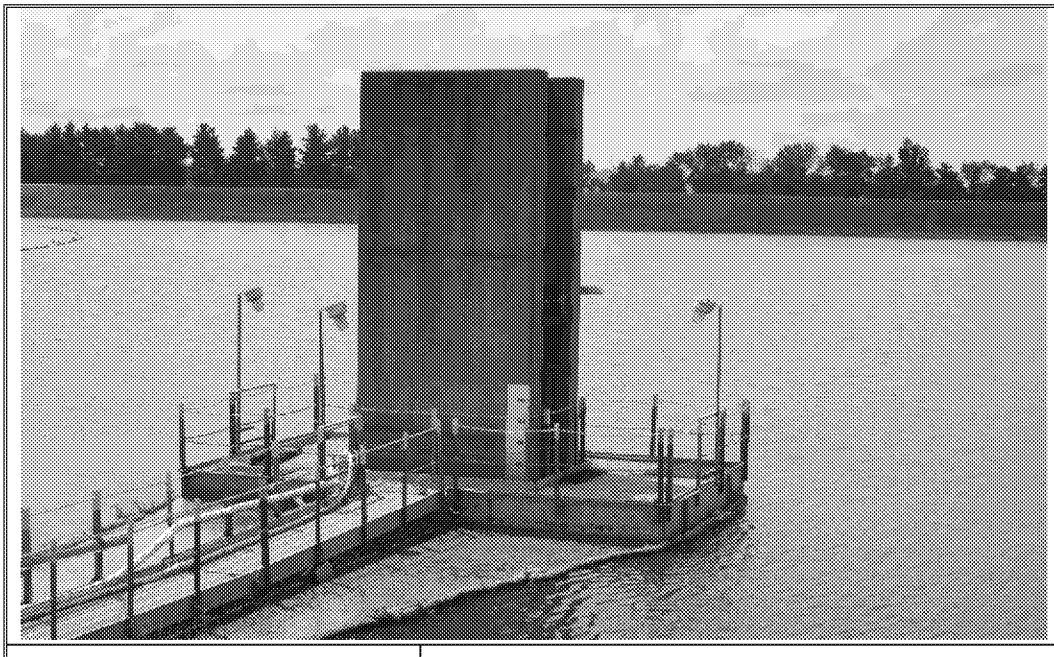
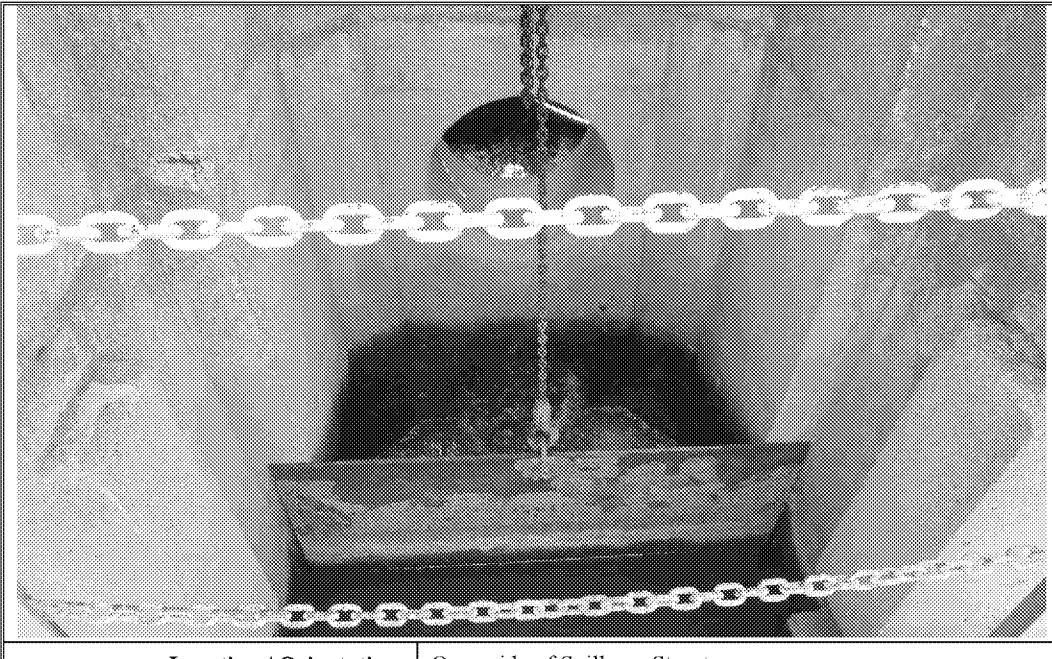


Date: 7/28/2015

Photographer: MGR/MTR

Location / Orientation	Main Pond Spillway Structure
Remarks	Right side is open, left side is closed currently.



Date: 7/28/2015

Photographer: MGR/MTR

Location / Orientation	Open side of Spillway Structure
Remarks	Note the metal plate used instead of stop logs.

CALCULATION SHEET

PROJECT NAME		SUBJECT		
AEP Gavin Bottom Ash Pond		Ash Pond H&H Study		
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7217-15-006A	MRM	PLM	9/21/2015	10 OF 14

Reclamation Pond Outlet Spillway Structure

The outlet structure in the reclamation pond consists of an open concrete channel that discharges into a 30-inch diameter HDPE Spirolite Pipe. The water surface elevation within the pond is controlled by wooden stop logs at the inlet to the concrete channel. The stop logs can be removed to an invert elevation of 572.33. The concrete channel is 2.5 feet wide and approximately 5 feet tall. The weir was modeled using a spillway rating curve developed using the Hydrologic Engineering Circular No. 22 equations for sharp-crested weirs. The calculations used to develop the weir spillway rating curve are included in the Attachments (A.9).When submerged, the side walls of the concrete channel will begin to perform as a long weir approximately 21.5 feet long at approximately elevation 577.33. The operating pool elevation within the reclamation pond is more or less approximately elevation 575.

Photos of the reclamation pond taken during a site visit on July 28, 2014 are included below.

Date: 7/28/2015

Photographer: MGR/MTR

Location / Orientation	Entrance to concrete channel
Remarks	No stop logs in place at time of visit.

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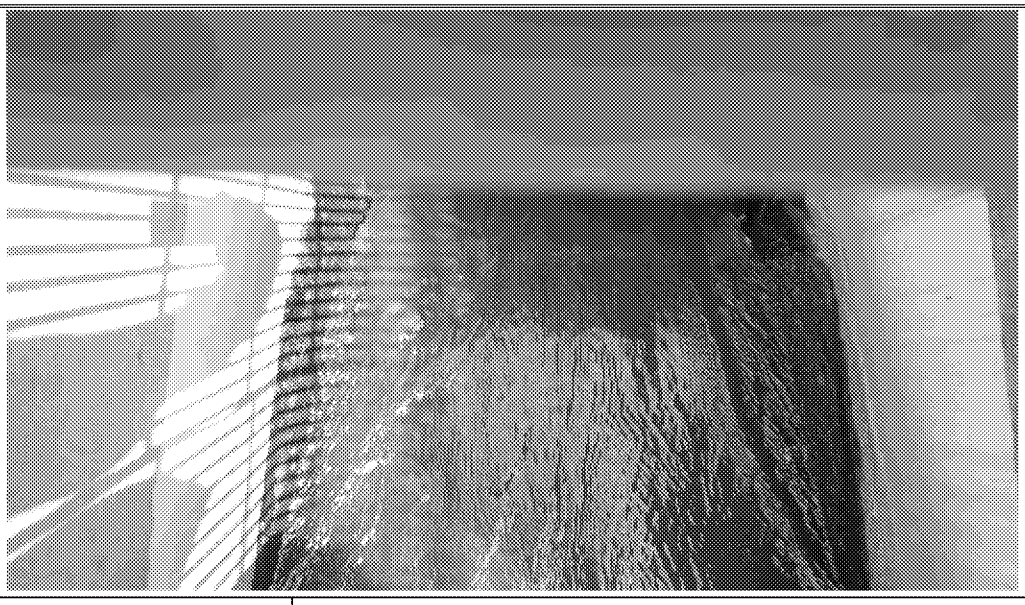
CALCULATION SHEET

PROJECT NAME		SUBJECT		
AEP Gavin Bottom Ash Pond		Ash Pond H&H Study		
PROJECT NO.	CALC BY	REV BY	DATE	SHEET NO.
7217-15-006A	MRM	PLM	9/21/2015	11 OF 14



Date: 7/28/2015

Photographer: MGR/MTR

Location / Orientation	Concrete channel looking through top grating
Remarks	Palmer Bowles Flume within concrete channel used to measure flow volume.

Reclamation Pond Outlet Pipe

The Reclamation pond outlet structure discharges into an outlet pipe network as described in Table 4 below. The characteristics found in the table reflect information obtained from As-built drawing 12-30407-1 included in the Attachments (A.12).

Table 4 – Reclamation Pond Outlet Pipe Network Characteristics

Component	Description	Size / Pipe Diameter (FT)	Length (LF)	Slope (%)	Begin Invert El.	End Invert El.
Pipe 1	Spirolite HDPE	2.5	150	0.37	572.33	571.78
Manhole 1	Concrete	-----	-----	-----	571.78	570.12
Pipe 2.1	Corrugated HDPE	2.5	1,028.4	0.5	570.12	564.35
Pipe 2.2	Spirolite HDPE	2.5	137.53	1.1	564.35	562.81
Manhole 2	Concrete	-----	-----	-----	562.81	562.81
Pipe 3	Spirolite HDPE	2.5	322.36	0.6	562.81	560.92
Manhole 3	Concrete	-----	-----	-----	560.92	560.92
Pipe 4	Corrugated HDPE	2.5	355.31	0.59	560.92	558.84

Manholes identified in this study were not included in the model and assumed to have a negligible effect on head loss across the outlet pipe network.

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CALCULATION SHEET

PROJECT NAME		SUBJECT		
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PROJECT NO.	CALC BY	REV BY	DATE	SHEET NO.
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Modeled Scenarios

Two scenarios were modeled as part of this study. Both scenarios are described below and a summary of the estimated maximum pool elevation within the pond is include in Table 5 below. Input and output data from HEC-HMS is included in the Attachments.

Scenario 1 - Normal Pool with active spillways during PMP event

This scenario was calculated using the following assumptions:

1. Pond starting water elevation is normal (operating) pool
2. 100% PMP event
3. Plant pumped inflows and outflows are distributed evenly (hourly) throughout the event
4. Spillways are active and operational

Table 5: Hydraulic Modeling Summary – Scenario 1

Scenario	Pond	ODNR Distribution	Estimated Peak Inflow (CFS)	Estimated Peak Outflow (CFS)	Estimated Peak Water Surface Elevation (feet-msl)
Scenario 1	Main	Type II – 24HR	398.1	39.2	580.2
Scenario 1	Main	HMR-52 – 6HR	848.2	31.8	579.9
Scenario 1	Reclamation	Type II – 24HR	40.1	39.4	577.6
Scenario 1	Reclamation	HMR-52 – 6HR	33.4	18.1	576.8

Scenario 2 - Normal Pool with inoperable spillways during PMP event

This scenario was calculated using SCS methodology for various alternatives as described below. The estimated maximum water surface elevation for each pond in Scenario 2 is indicated in Table 6 below. Calculation sheets from the runoff curve number method are included in the Attachments (A.19-A.20).

2A - Main Pond

Scenario 2A estimated the total runoff produced from the drainage area to the Main Pond, at both the 24HR rainfall depth and the 6HR rainfall depth, with an inoperable principal spillway.

2B - Reclamation Pond

Scenario 2B estimated the total runoff produced from the drainage area to the Reclamation Pond, at both the 24HR rainfall depth and the 6HR rainfall depth, with an inoperable principal spillway and no hydraulic connection to the Main Pond.

2C - Pond Complex

Scenario 2C estimated the total runoff produced from the drainage area to the entire pond complex, at both the 24HR rainfall depth and the 6HR rainfall depth, with an inoperable principal spillway and hydraulic connection to the Main Pond.

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PROJECT NAME		SUBJECT		
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7217-15-006A	MRM	PLM	9/21/2015	13 OF 14

Table 6: Hydraulic Modeling Summary – Scenario 2

Scenario	ODNR Distribution	Estimated Runoff (AC-FT)	Plant Flow Volume (AC-FT)[1]	Total Runoff (AC-FT)	Estimated Peak Water Surface Elevation (feet-msl)
Scenario 2A	Type II – 24HR	132.2	83.9	216.1	582.6
Scenario 2A	HMR-52 – 6HR	92.5	83.9	176.4	581.8
Scenario 2B	Type II – 24HR	3.0	--------	3.0	575.8
Scenario 2B	HMR-52 – 6HR	2.1	--------	2.1	575.6
Scenario 2C	Type II – 24HR	135.1	83.9	49.0	582.0
Scenario 2C	HMR-52 – 6HR	94.5	83.9	178.4	581.2

[1] Plant Flow Volume calculated as 27.33 MG X (0.1337 CF / 1 gal) X (1 AC / 43560 SF) = 83.9 AC-FT

DISCUSSION

S&ME performed a hydrologic and hydraulic study on the bottom ash pond complex at the AEP Gavin Plant and a summary of the results are outlined below:

- The main pond can adequately store and pass the design storm without overtopping the embankment.
- The main pond meets the discharge requirements specified in paragraph (d)(1(v)(B).
- The reclamation pond can adequately store and pass the design storm without overtopping the embankment.
- The reclamation pond meets the discharge requirements specified in paragraph (d)(1(v)(B).

REFERENCES

U.S. Army Corps of Engineers Institute for Water Resources, Hydrologic Engineering Center. *HMR52, Probable Maximum Storm (Eastern United States)*. March 1984. Revised April 1987.

S&ME

CALCULATION SHEET

PROJECT NAME		SUBJECT		
AEP Gavin Bottom Ash Pond		Ash Pond H&H Study		
PROJECT NO.	CALC BY	REV BY	DATE	SHEET NO.
7217-15-006A	MRM	PLM	9/21/2015	14 OF 14

ATTACHMENTS

- Site Plan [A.1]
- VERTCON Elevation Adjustment [A.2]
- Plant Water Balance Diagram [A.3]
- PMP Rainfall Estimates [A.4 – A.5]
- Main Pond Stage-Storage Curve [A.6]
- Reclamation Pond Stage-Storage Curve [A.7]
- Main Pond Spillway Rating Curve [A.8]
- Reclamation Pond Spillway Rating Curve [A.9]
- ODNR Dam Inventory Sheet [A.10]
- Drawing 12-30408-2 Reclaim Pond Outlet Structure P&P [A.11]
- Drawing 12-30407-1 Bottom Ash Pond Outfall Pipe P&P [A.12]
- Drawing 12-3015-3 Units 1&2 Bottom Ash Disposal Area Sections [A.13]
- Scenario 1 – HEC-HMS Input / Output Data [A.14 - A.18]
- Runoff Calculation using SCS Methodology [A.19 – A.20]

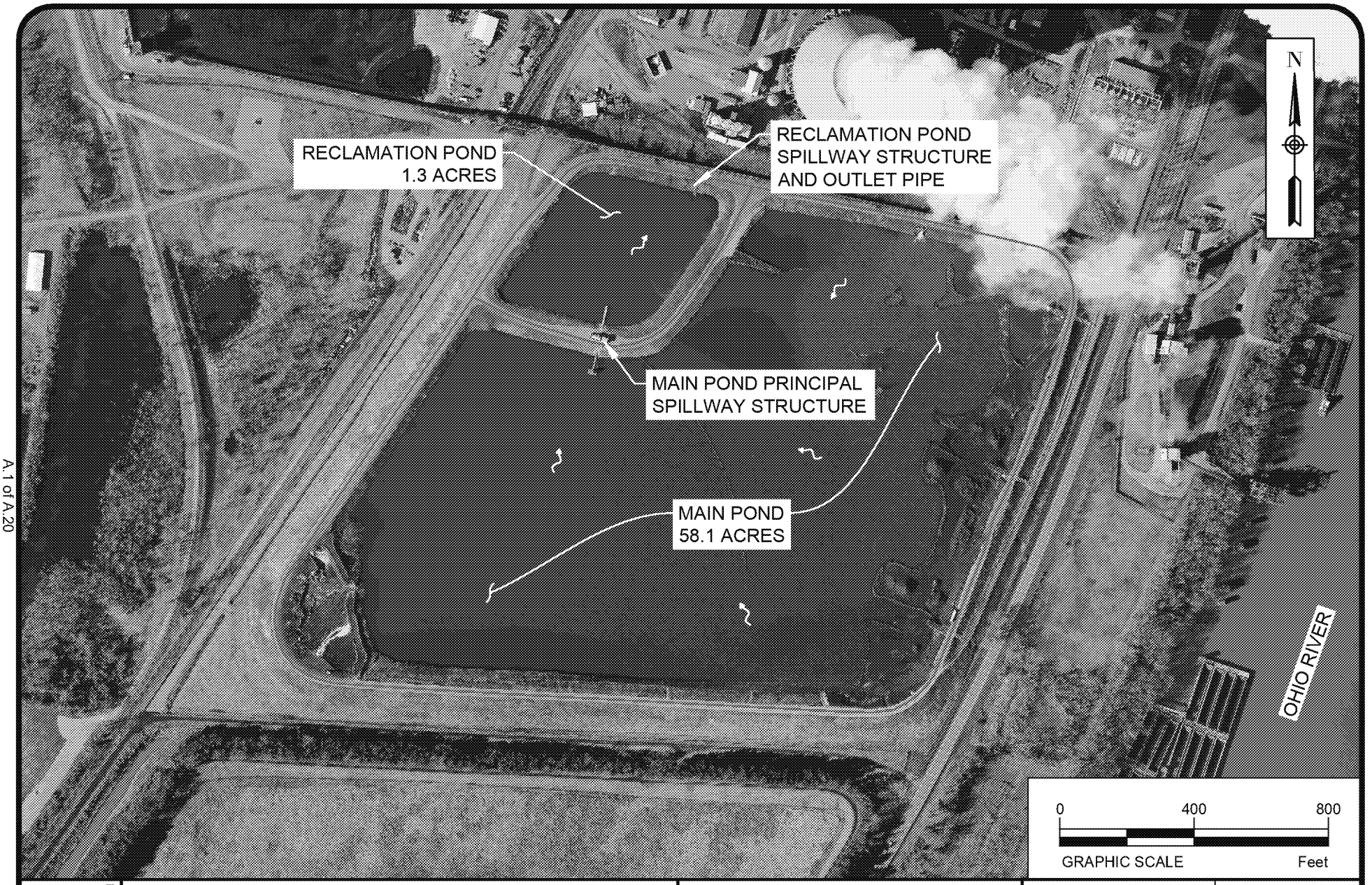


FIGURE NO.

SITE PLAN

AEP GAVIN BOTTOM ASH POND COMPLEX
GALLIA COUNTY, CHESHIRE, OHIO

S&ME
WWW.SMEINC.COM

SCALE:	DATE:
1" = 400'	9-16-2015
PROJECT NO.	DRAWN BY:
7217-14-006A	MRM

Drawing path: Q:\Projects\7217-Civil Columbus\7217-15-006 Gavin\7217-15-006A CCR Certification\Aerial Image.dwg

ED_005405A_00000217-00029

Questions concerning the VERTCON process may be mailed to NGS

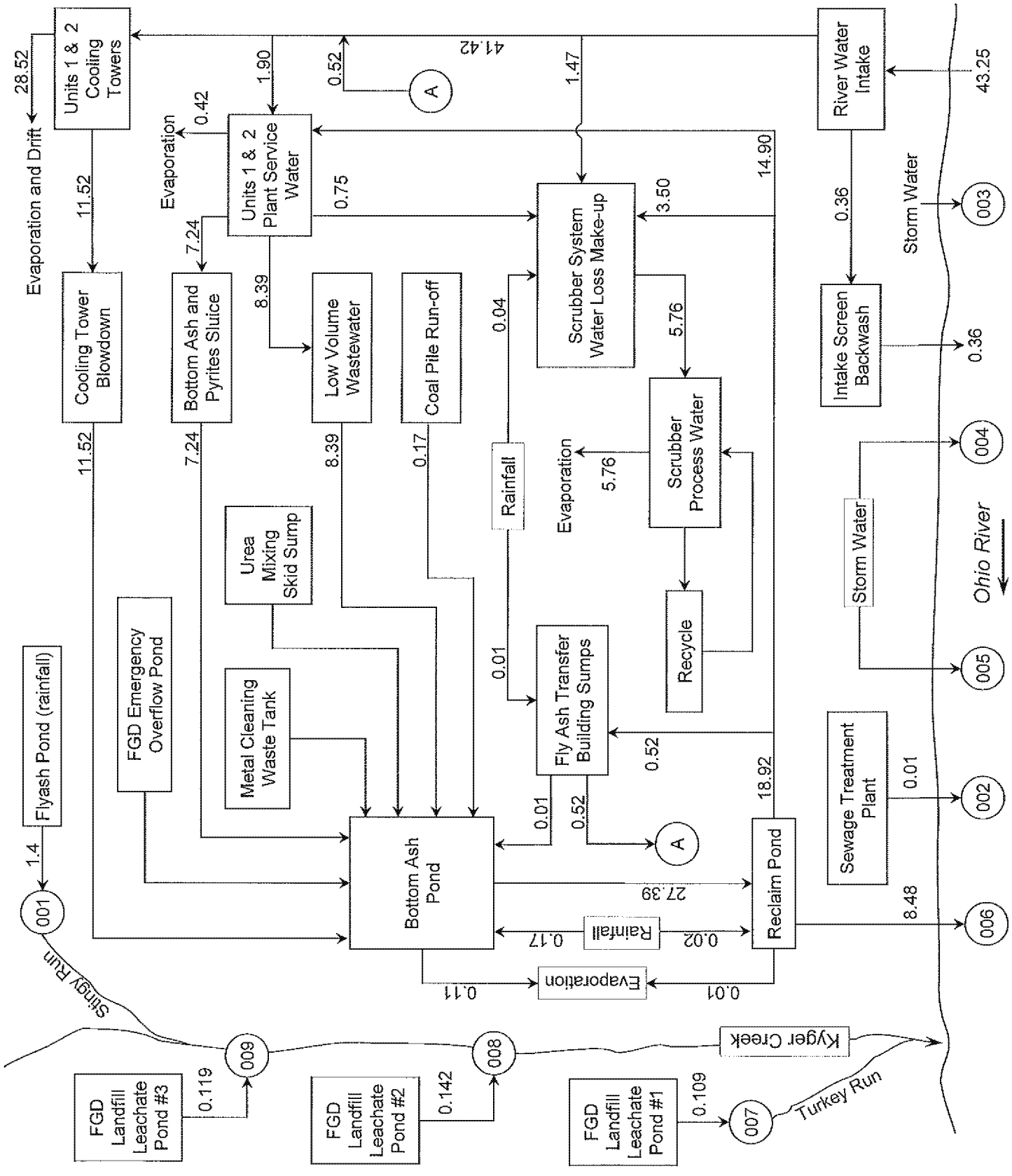
Latitude: 38 55 51.92

Longitude: 082 07 13.15

NGVD 29 height: 600.0 FT

Datum shift(NAVD 88 minus NGVD 29): -0.650 feet

Converted to NAVD 88 height: 599.350 feet



NOTE:
Flows represent average water usage.

ALL FLOWS MEASURED IN MILLION GALLONS PER DAY (MGD)

Ohio Power Company
Gavin Plant

(##) Outfall number

05.25.01 GV_water_bal.tif

AEP Water & Ecological Resource Services

Figure 2: Water Balance Diagram

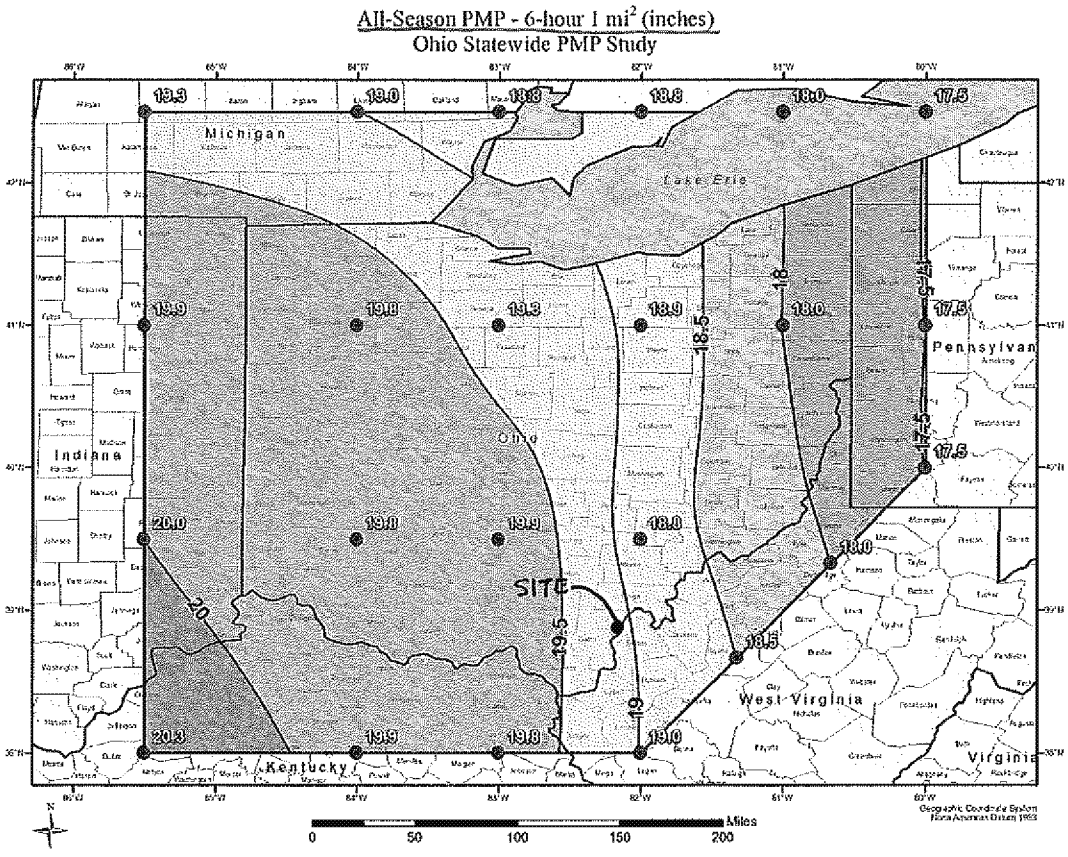


Figure 11.1 All-season PMP (inches) for 6-hour, 1-square mile

USE 19.1 INCHES

6HR PMP

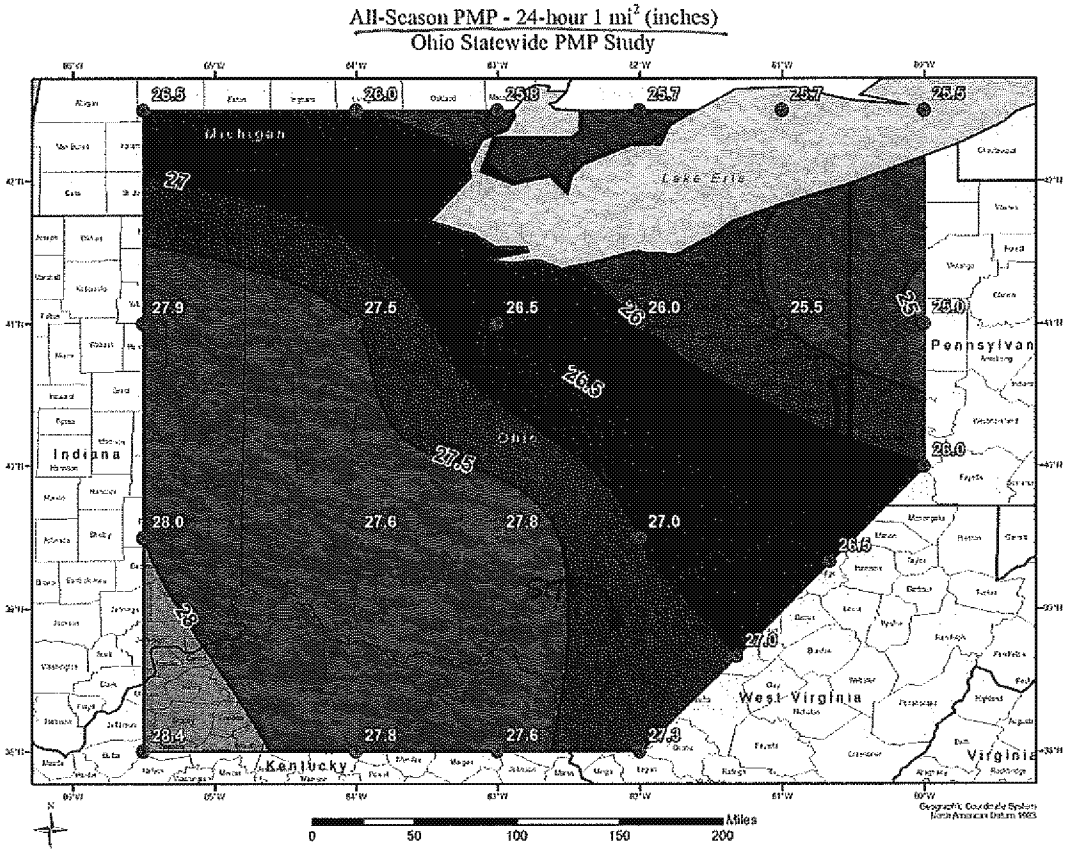


Figure 11.3 All-season PMP (inches) for 24-hour, 1-square mile

USE 27.3 INCHES

24 HR PMP

JOB NAME: AEP Gavin Bottom Ash Pond
SUBJECT: Bottom Ash Pond Stage-Storage Function

CUMPUTED BY: MRM DATE: 9/14/2015
CHECKED BY: PLM DATE: 9/18/2015

TASK: DETERMINE STAGE-STORAGE CURVE FOR GAVIN BOTTOM ASH POND (MAIN POND).
SOURCE: OGRIP LiDAR IMAGERY (2006)

CONTOUR	AREA (SF)	AVG. AREA (SF)	HEIGHT	VOLUME (CF)	CUM. VOL. (CF)	CUM. VOL. (AC-FT)
578	1829710				0	0
		1915287	1	1915287		
579	2000864				1915287	44
		2043994	1	2043994		
580	2087123				3959281	91
		2100397	1	2100397		
581	2113671				6059678	139
		2122728	1	2122728		
582	2131785				8182406	188
		2139903	1	2139903		
583	2148020				10322309	237
		2156991	1	2156991		
584	2165961				12479299	286
		2176221	1	2176221		
585	2186481				14655520	336

JOB NAME: AEP Gavin Bottom Ash Pond
SUBJECT: Bottom Ash Pond Stage-Storage Function

CUMPUTED BY: MRM DATE: 9/14/2015
CHECKED BY: PLM DATE: 9/18/2015

TASK: DETERMINE STAGE-STORAGE CURVE FOR GAVIN BOTTOM ASH POND (RECLAMATION POND).
SOURCE: OGRIP LiDAR IMAGERY (2006)

CONTOUR	AREA (SF)	AVG. AREA (SF)	HEIGHT	VOLUME (CF)	CUM. VOL. (CF)	CUM. VOL. (AC-FT)
576	170584				0	0
		179006	1	179006		
577	187428				179006	4
		190641	1	190641		
578	193855				369647	8
		195709	1	195709		
579	197564				565357	13
		199321	1	199321		
580	201078				764678	18
		202879	1	202879		
581	204679				967557	22
		206628	1	206628		
582	208576				1174184	27
		210855	1	210855		
583	213133				1385039	32
		216287	1	216287		
584	219441				1601326	37

Project: AEP GAVIN BOTTOM ASH POND
Location: GALLIA COUNTY, OHIO
S&ME PROJECT NUMBER: 7217-15-006A

Main Pond - Inlet Weir

Calculated By: MRM **Date:** 9/17/2015

Reviewed By: PLM **Date:** 9/21/2015

Source: Hydraulic Engineering Circular No. 22, Third Editio
Urban Drainage Design Manual (Rev. 2013)

Sharp Crested Weirs

Typical sharp crested weirs are illustrated in Figure 8-13. Equation 8-19 provides the discharge relationship for **sharp crested weirs** with no end contractions (illustrated in Figure 8-13a).

$$Q = C_{scw} L H^{1.5} \quad (8\text{-}19)$$

where:

Q = Discharge, m^3/s (ft^3/s)
L = Horizontal weir length, m (ft)
H = Head above weir crest (excluding velocity head), m (ft)
C_{scw} = 1.81 + 0.22 (H/H_c) [3.27 + 0.4 (H/H_c) in English units]

As indicated above, the value of the coefficient C_{scw} is known to vary with the ratio H/H_c (see Figure 8-13c for definition of terms). For values of the ratio H/H_c less than 0.3, a constant C_{scw} of 1.84 (3.33 in English units) is often used.

Equation 8-20 provides the discharge equation for **sharp-crested weirs with end contractions** (illustrated in Figure 8-13(b)). As indicated above, the value of the coefficient C_{scw} is known to vary with the ratio H/H_c (see Figure 8-13c for definition of terms). For values of the ratio H/H_c less than 0.3, a constant C_{scw} of 1.84 (3.33 in English units) is often used.

$$Q = C_{scw} (L - 0.2 H) H^{1.5} \quad (8\text{-}20)$$

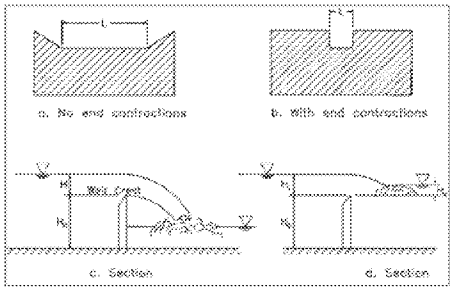


Figure 8-13. Sharp crested weirs.

	Value	Units	Description
Pool Elevation =	578	Feet MSL	Drawing 12-3015-3
Length of Weir =	4.0	Feet	From Site Visit
Height of Weir =	10.0	Feet	Drawing 12-3015-3

Headwater Elevation (FT)	L, Length (feet)	Hc, Feet	H/Hc	Cscw, Coefficient*	Q, Orifice Discharge (CFS) [Use EQ 8-20]**
558.00	4.0	10.00	-2.00	3.33	*0*
559.00	4.0	10.00	-1.90	3.33	*0*
560.00	4.0	10.00	-1.80	3.33	*0*
561.00	4.0	10.00	-1.70	3.33	*0*
562.00	4.0	10.00	-1.60	3.33	*0*
563.00	4.0	10.00	-1.50	3.33	*0*
564.00	4.0	10.00	-1.40	3.33	*0*
565.00	4.0	10.00	-1.30	3.33	*0*
566.00	4.0	10.00	-1.20	3.33	*0*
567.00	4.0	10.00	-1.10	3.33	*0*
568.00	4.0	10.00	-1.00	3.33	*0*
569.00	4.0	10.00	-0.90	3.33	*0*
570.00	4.0	10.00	-0.80	3.33	*0*
571.00	4.0	10.00	-0.70	3.33	*0*
572.00	4.0	10.00	-0.60	3.33	*0*
573.00	4.0	10.00	-0.50	3.33	*0*
574.00	4.0	10.00	-0.40	3.33	*0*
575.00	4.0	10.00	-0.30	3.33	*0*
576.00	4.0	10.00	-0.20	3.33	*0*
577.00	4.0	10.00	-0.10	3.33	*0*
578.00	4.0	10.00	0.00	3.33	*0.0*
579.00	4.0	10.00	0.10	3.33	*12.7*
580.00	4.0	10.00	0.20	3.33	*33.9*
581.00	4.0	10.00	0.30	3.39	*59.9*
582.00	4.0	10.00	0.40	3.43	*87.8*
583.00	4.0	10.00	0.50	3.47	*116.4*
584.00	4.0	10.00	0.60	3.51	*144.4*
585.00	4.0	10.00	0.70	3.55	*170.9*

* Cscw = 3.33 when H/Hc < 0.3

Project: AEP GAVIN BOTTOM ASH POND
Location: GALLIA COUNTY, OHIO
S&ME PROJECT NUMBER: 7217-15-006A

Reclamation Pond - Inlet Weir

Calculated By: MRM **Date:** 9/17/2015

Reviewed By: PLM **Date:** 9/21/2015

Source: Hydraulic Engineering Circular No. 22, Third Edition
Urban Drainage Design Manual (Rev. 2013)

Sharp Crested Weirs

Typical sharp crested weirs are illustrated in Figure 8-13. Equation 8-19 provides the discharge relationship for **sharp crested weirs** with no end contractions (illustrated in Figure 8-13a).

$$Q = C_{scw}\, L\, H^{1.5} \qquad (8\text{-}19)$$

where:

Q = Discharge, m^3/s (ft^3/s)
L = Horizontal weir length, m (ft)
H = Head above weir crest excluding velocity head, m (ft)
C_{scw} = $1.81 + 0.22\,(H/H_c)$ [$3.27 + 0.4\,(H/H_c)$ in English units]

As indicated above, the value of the coefficient C_{scw} is known to vary with the ratio H/H_c (see Figure 8-13c for definition of terms). For values of the ratio H/H_c less than 0.3, a constant C_{scw} of 1.84 (3.33 in English units) is often used.

Equation 8-20 provides the discharge equation for **sharp-crested weirs with end contractions** (illustrated in Figure 8-13(b)). As indicated above, the value of the coefficient C_{scw} is known to vary with the ratio H/H_c (see Figure 8-13c for definition of terms). For values of the ratio H/H_c less than 0.3, a constant C_{scw} of 1.84 (3.33 in English units) is often used.

$$Q = C_{scw}\,(L - 0.2\,H)\, H^{1.5} \qquad (8\text{-}20)$$

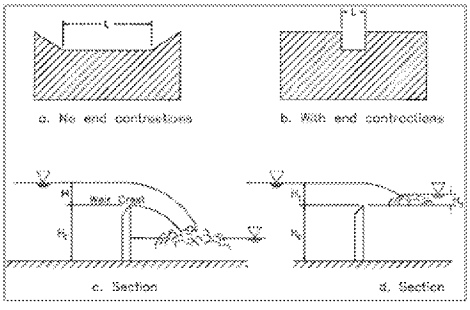


Figure 8-13. Sharp crested weirs.

	Value	Units	Description
Pool Elevation =	575	Feet MSL	Drawing 12-30408-2
Length of Weir =	2.5	Feet	Drawing 12-30408-2
Height of Weir =	5.0	Feet	Drawing 12-30408-2

Headwater Elevation (FT)	L, Length (feet)	Hc, Feet	H/Hc	Cscw, Coefficient*	Q, Orifice Discharge (CFS) [Use EQ 8-20]**
558.00	2.5	5.00	-3.40	3.33	*0*
559.00	2.5	5.00	-3.20	3.33	*0*
560.00	2.5	5.00	-3.00	3.33	*0*
561.00	2.5	5.00	-2.80	3.33	*0*
562.00	2.5	5.00	-2.60	3.33	*0*
563.00	2.5	5.00	-2.40	3.33	*0*
564.00	2.5	5.00	-2.20	3.33	*0*
565.00	2.5	5.00	-2.00	3.33	*0*
566.00	2.5	5.00	-1.80	3.33	*0*
567.00	2.5	5.00	-1.60	3.33	*0*
568.00	2.5	5.00	-1.40	3.33	*0*
569.00	2.5	5.00	-1.20	3.33	*0*
570.00	2.5	5.00	-1.00	3.33	*0*
571.00	2.5	5.00	-0.80	3.33	*0*
572.00	2.5	5.00	-0.60	3.33	*0*
573.00	2.5	5.00	-0.40	3.33	*0*
574.00	2.5	5.00	-0.20	3.33	*0*
575.00	2.5	5.00	0.00	3.33	*0.0*
576.00	2.5	5.00	0.20	3.33	*7.7*
577.00	2.5	5.00	0.40	3.43	*20.4*
578.00	2.5	5.00	0.60	3.51	*34.7*
579.00	2.5	5.00	0.80	3.59	*48.8*
580.00	2.5	5.00	1.00	3.67	*61.5*
581.00	2.5	5.00	1.20	3.75	*71.6*
582.00	2.5	5.00	1.40	3.83	*78.0*
583.00	2.5	5.00	1.60	3.91	*79.6*
584.00	2.5	5.00	1.80	3.99	*75.4*

Dam Inventory Sheet

Name: GAVIN BOTTOM ASH POND
File No: 8720-003
National #: OH00971
Reservoir:
Permit No.:
Class (Ht-Vol): I (III - II)

Owner Information

Owner: AEP Generation Resources Inc.
Owner Type: Utility
Address: Gavin Plant
PO Box 271
Multi-Dams: Yes: 10, Class I:7
Parcel No.:
City: Cheshire **State:** OH **Zip:** 45620
Contact: Doug Workman **Phone No.:** 740-925-3135

Location Information

County: Gallia **Latitude Deg.:** 38 **Min.:** 55 **Sec.:** 52
Township: Cheshire & Addison **Longitude Deg.:** 82 **Min.:** 7 **Sec.:** 14
Stream: Kyger Creek - Offstream
USGS Quad.: Cheshire, Oh-wv **USGS Basin No.:** 05030202

Design/Construction Information

Designed By: Aep With Casagrande Consultants
Constructed By: J.j. Blazer Construction Co.
Completed: 1974 **Plan Available:** YES **At:** AMERICAN ELECTRIC POWER
Failure/Incident/Breach:

Structure Information

Purpose: Waste Retention
Type of Impound.: Upground
Type of Structure: Earthfill
Drainage Area (sq. miles): 0.1 **or (acres):** 62

Embankment Data

Length (ft): 6650 **Upstream Slope:** 2H:1V
Height (ft): 36.5 **Downstream Slope:** 2H:1V
Top Width (ft): 30 **Volume of Fill (cub. yds.):** 723870

Spillway Outlet Works Data

Lake Drain: NONE
Principal: CONCRETE CONTROL TOWER W/ STOPLOGS IN MAIN POND W/ 42-IN RCP
Emergency: 30-INCH HDPE W/CONCRETE FLUME AND SLUICEWAY
Maximum Spillway Discharge (cfs): 320 **Design Flood:** 1.0 **Flood Capacity:** 1.0

Dam Reservoir Data

	Elevation (ft-MSL)*	Area (acres)	Storage (acre-feet)
Top of Dam:	594	62.4	1530
Emergency Spillway:	575	59.1	860
Principal Spillway:	574	58.8	470
Streambed:	557.5		
Foundation:			

*Elevations are not necessarily related to a USGS benchmark

Inspection Information

Inspection History:
8/14/2012 WDE
8/20/2007 RAA
12/14/2004 TGL
8/9/1995 JDW

Phase I:
Other Visits:
Inspection Year: E

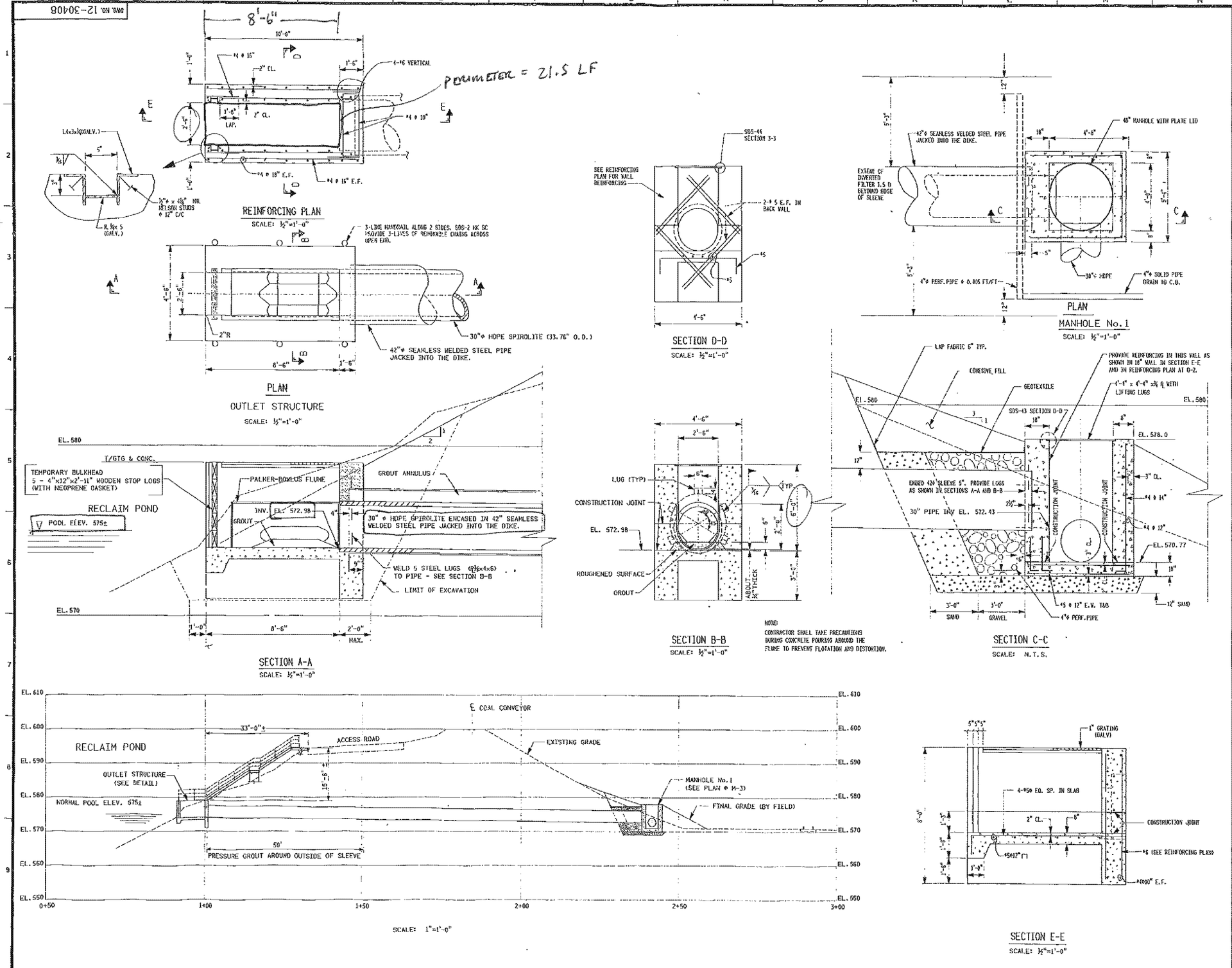
OPC3

Operation Information/Remarks

Main pond is a bottom ash retent. pond; reclamation pond in nw corner; overflow from main to reclam. pond; principal is overflow in main pond. Emerg. overflow is in reclam. pond. Elev. data is for former design.

Emergency Action Plan: Approved **Format:** Old **OMI:** Yes-with owner
Last Entry: 4/24/2014

DWG. NO. 12-30408



GENERAL NOTES

1) SEE DWG 12-30409 FOR ADD'L NOTES.
2) GRATING SHALL HAVE 1"x3/16" BEARING BARS @ 1 3/16" c/c WITH CROSS BARS @4" c/c. GRATING SHALL BE GALVANIZED.
3) STRUCTURAL STEEL SHALL CONFORM TO ASTM A36 AND SHALL BE GALVANIZED.
4) 30"ø HDPE CHANGES FROM SPIROLITE (ONLY) TO H-12 (OUTLET) AT MANHOLE No. 1

REFERENCE DRAWINGS

SDS - 44 MISC. STEEL DETAILS, SHT. 2 OF 2

12-30407 PLANT-SITE WASTE WATER DRY FLY ASH SYSTEM DISPOSAL - BOTTOM ASH COMPLEX POND OUTFALL PIPE (PLAN & PROFILE)

12-30409 PLANT-SITE WASTE WATER DRY FLY ASH SYSTEM RECLAIM POND OUTLET ACCESS STAIRS - STEEL FRAMING AND FOUNDATIONS

DATE	NO.	DESCRIPTION	APPD.
7/1/04	2	AS-BUILT	
6/18/04	1	ADDED DETAILS OF MANHOLE No. 1	GFZ
1/15/03	0	RELEASED FOR CONST.	GFZ
1/30/03	A	ISSUED FOR PERMIT	FMS

REVISIONS

IgsC /usr5/atrul/gavin/u12/30408.120

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OHIO POWER COMPANY

GAVIN PLANT

CHESHIRE OHIO

PLANT SITE - WASTE WATER DRY FLY ASH SYSTEM RECLAIM POND OUTLET STRUCTURE - PLAN AND PROFILE

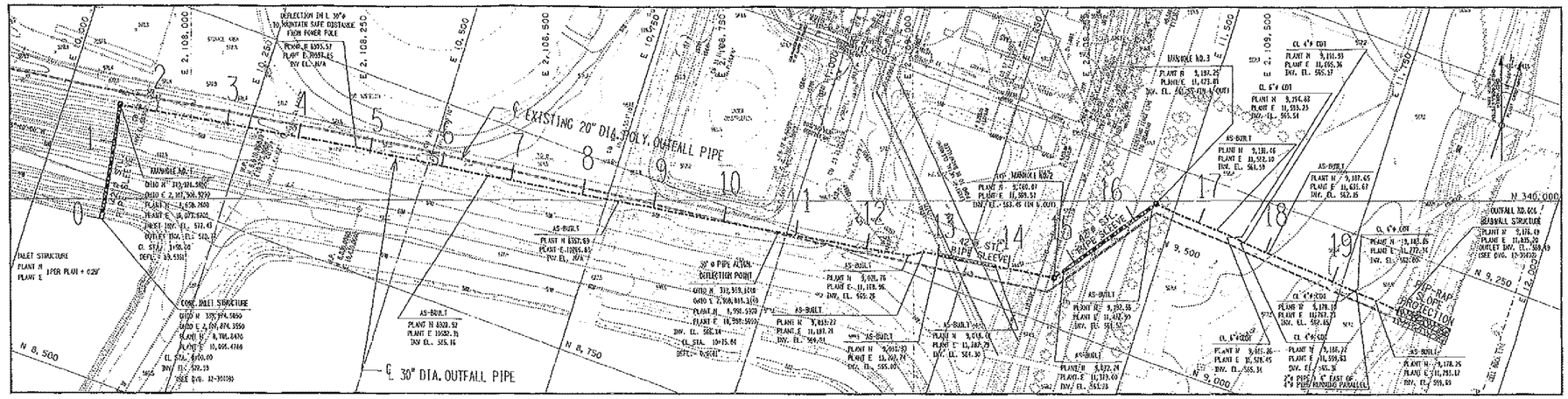
DWG. NO. 12-30408 - 2

SCALE: AS SHOWN — CIVIL ENGINEERING DIVISION

DR. JDEN
CK. SLP
ENGR.
FINAL CHECK GFZ
DATE 3/31/04
APPROVED BY F.M. Sams

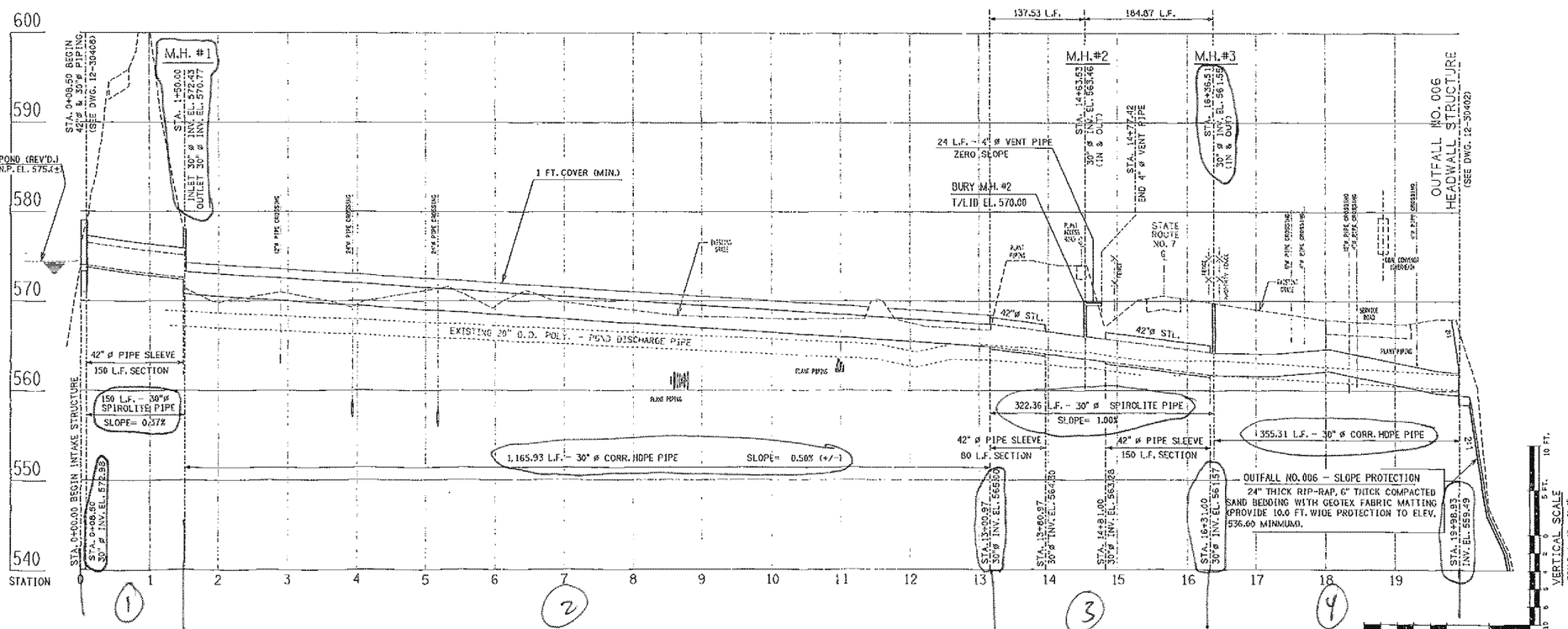
AMERICAN ELECTRIC POWER — 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

DWG. NO. 12-30407



PLAN – 30" DIA. OUTFALL NO. 006

SCALE: 1" = 60'-0"



PROFILE – 30" DIA. OUTFALL NO. 006

LEGEND

EXISTING

- SPOT ELEVATION
- INTERMEDIATE CONTOUR
- INDEX CONTOUR
- DEPRESSION CONTOUR
- TREES AND TREELINE
- STRUCTURE AND BUILDING
- FENCE
- POLE
- ROADS
- EDGE OF WATER
- MANHOLES / CATCH BASIN
- POWER POLE
- TOWER

PROPOSED

- X 659.4 SPOT ELEVATION
- INTERMEDIATE CONTOUR
- INDEX CONTOUR
- DEPRESSION CONTOUR
- PIPE CENTERLINE
- DRAINAGE STRUCTURE
- MANHOLE

REFERENCE DRAWINGS

12-30402 PLANT SITE - WASTE WATER DRY FLY ASH SYSTEM DISPOSAL - MODIFICATION OF BOTTOM ASH COMPLEX POND & OUTFALL PIPE.

12-30408 PLANT SITE - WASTE WATER DRY FLY ASH SYSTEM RECLAIM POND OUTLET STRUCTURE.

NOTES:

1. ELEVATION USED THROUGHOUT THIS DRAWING ARE REFERENCED TO THE GEODETIC VERTICAL DATUM OF 1929. NO CONVERSION FROM PLANT REFERENCE ELEVATION IS REQUIRED EXCEPT WHERE INDICATED.

2. THE PLANT REFERENCE ELEVATION HAS BEEN ESTABLISHED AS 100'-0". TO CONVERT TO THE PLANT ELEVATION, SUBTRACT 470'-0" FROM THE GEODETIC ELEVATION.

3. FOR PROFILE INFORMATION, REFER TO THIS DRAWING.

4. FOR STRUCTURE INFORMATION, REFER TO DWG. NO. 12-30408.

5. PIPE MATERIAL TO BE 30-INCH DIA., CORRUGATED POLYETHYLENE PIPE, A.D.S. N-12 OR EQUAL. PIPE COUPLINGS SHALL HAVE GASKETS.

6. MANHOLE 1 IS FORMED CONCRETE. MANHOLES 2 AND 3 ARE HDPE SPIROLITE SANITARY SEWER UNITS.

DATE	NO.	DESCRIPTION	APPR.
11/1/94	1	AS-BUILT	MFZ
20 APRIL 1994	0	ISSUED FOR CONSTRUCTION	MB

REVISIONS

lgsc /usr5/strucgavin/u12/30407.400

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OHIO POWER COMPANY
GAVIN PLANT
CHESHIRE OHIO

PLANT SITE - WASTE WATER DRY FLY ASH SYSTEM DISPOSAL - BOTTOM ASH COMPLEX POND OUTFALL PIPE (PLAN & PROFILE)

DWG. NO. 12-30407-1

SCALE: AS SHOWN
DR: S.R. Miller
CH: GFZ
ENGR.
FINAL CHK. GFZ
DATE: 4/20/94

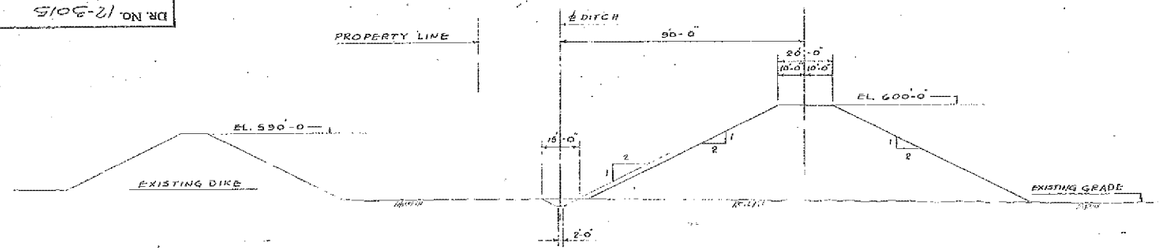
CIVIL ENGINEERING DIVISION

PREPARED BY: M. Bakheda

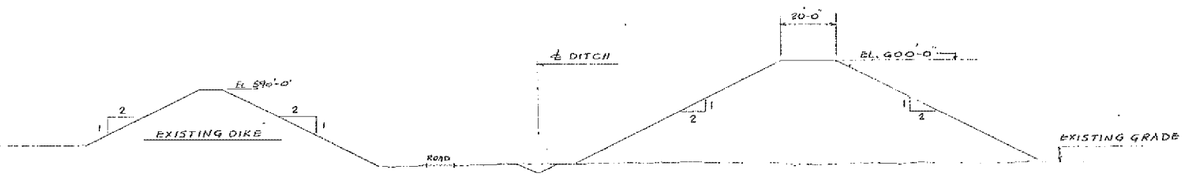
AMERICAN ELECTRIC POWER
1 RIVERSIDE PLAZA COLUMBUS, OH 43215

AEPGV002812

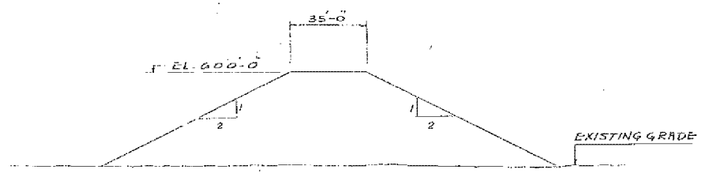
DR. No. 12-3015



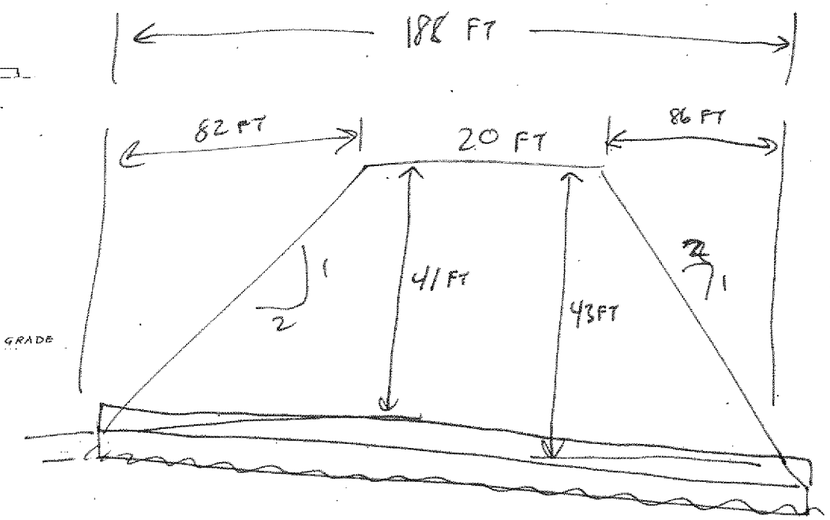
SECTION A-A
SCALE 1" = 20'-0"

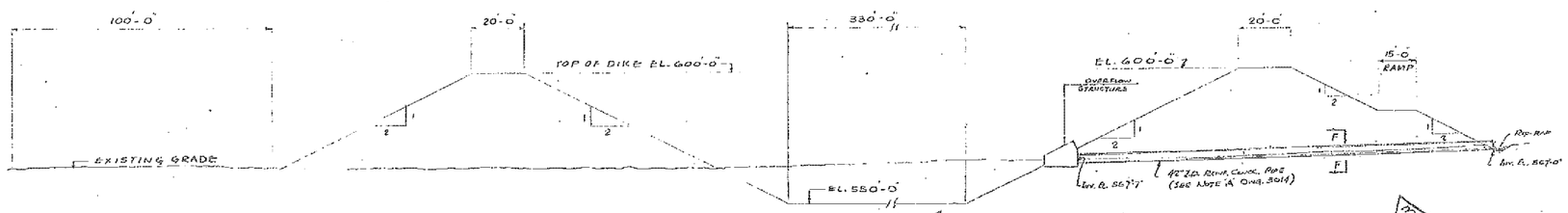


SECTION B-B
SCALE 1" = 20'-0"

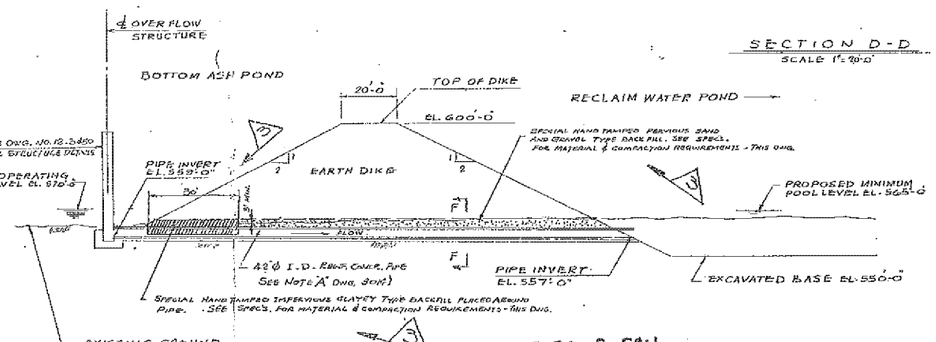


SECTION C-C
SCALE 1" = 20'-0"



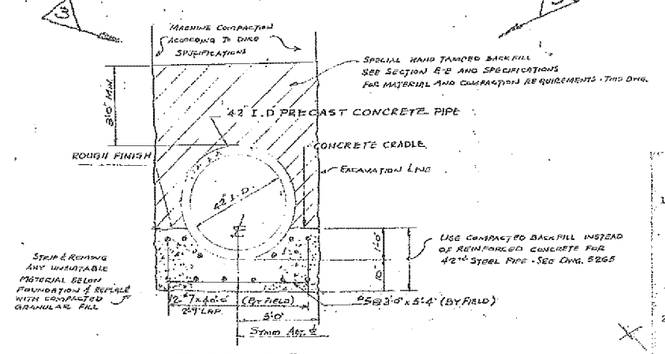


SECTION D-D
SCALE 1" = 20'-0"



SECTION E-E

$$\frac{2 \text{ FT of FALL}}{188 \text{ LF}} \approx 1\% \text{ FALL}$$



SECTION F-F

GENERAL NOTES
DO NOT SCALE THIS DWG.

TYPE BACKFILL SPECIFICATIONS

1. Specially Compacted Impervious Backfill Around Pipes

The compacted clayey type backfill material shown on the drawings shall be an impervious material with a water content between 0 and 2% above Standard Proctor optimum water content. This material shall be compacted with hand operated ram type compactors to a minimum of 95% of the maximum Standard Proctor dry density. Sheepsfoot rollers shall not be permitted to pass over the pipes until a minimum of 3 feet of specially tamped fill has been placed over the top of the pipes.

2. Specially Compacted Pervious Backfill Around Pipes

For portions of pipe shown on the drawings, which call for specially compacted pervious backfill the backfill material shall be a clean sand or a sand and gravel. The pervious material shall be saturated prior to compaction. Compaction shall consist of a minimum of 4 complete passes of a hand operated rammer type compactor a type comparable to the Barkes Model 300 or its approved equivalent. Three (3) feet of specially compacted backfill above the pipes is required before heavy equipment is permitted to pass over the portions.

DATE	NO.	DESCRIPTION	APPD.
9/4/74	3	Revised Sections E-E & F-F	
9/4/74	2	Added reinforcing to Sect. F-F. Revised lower ℄ to Sect. D-D	N.S.
9/4/74	1	Relocated "A" to 6' ℄ Sect. D-D	N.S.

REVISIONS

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UNITS 1 & 2
BOTTOM ASH DISPOSAL AREA
SECTIONS

OHIO POWER COMPANY
GAVIN PLANT
CHESHIRE OHIO

DR. No. 12-3015-3

ARCH. | ELEC. | MECH. | CIVIL | STR.
SCALE: 1" = 20'
DR. R.E.
CH. N.S.
EQ. ENGR. S.P.
DATE: 4-5-74
REGISTERED ENG.
REGISTRATION NO.
DATE
APPROVED BY

AMERICAN ELECTRIC POWER SERVICE CORP.
2 BROADWAY NEW YORK

AEPGV002809

Scenario 1—Main Pond

ODNR Dimensionless 6HR

Summary Results for Subbasin "Main Pond DA"

Project: Dimentionless Simulation Run: Run 2
Subbasin: Main Pond DA

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 1
End of Run:	01Jan2000, 06:00	Meteorologic Model:	Dimensionless
Compute Time:	18Sep2015, 22:57:48	Control Specifications:	6HR

Volume Units: IN AC-FT

Computed Results

Peak Discharge:	841.2 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 02:20
Precipitation Volume:	92.7 (AC-FT)	Direct Runoff Volume:	91.3 (AC-FT)
Loss Volume:	1.2 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	91.6 (AC-FT)	Discharge Volume:	91.3 (AC-FT)

Summary Results for Reservoir "Main Pond"

Project: Dimentionless Simulation Run: Run 2
Reservoir: Main Pond

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 1
End of Run:	01Jan2000, 06:00	Meteorologic Model:	Dimensionless
Compute Time:	18Sep2015, 22:57:48	Control Specifications:	6HR

Volume Units: IN AC-FT

Computed Results

Peak Inflow:	848.2 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 02:20
Peak Discharge:	31.8 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 06:00
Inflow Volume:	94.8 (AC-FT)	Peak Storage:	86.3 (AC-FT)
Discharge Volume:	8.4 (AC-FT)	Peak Elevation:	579.9 (FT)

Scenario 1—Rec Pond

ODNR Dimensionless 6HR

Summary Results for Subbasin "Rec Pond DA"

Project: Dimentionless Simulation Run: Run 2
Subbasin: Rec Pond DA

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 1
End of Run:	01Jan2000, 06:00	Meteorologic Model:	Dimensionless
Compute Time:	18Sep2015, 22:57:48	Control Specifications:	6HR

Volume Units: IN AC-FT

Computed Results

Peak Discharge:	18.5 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 02:20
Precipitation Volume:	2.0 (AC-FT)	Direct Runoff Volume:	2.0 (AC-FT)
Loss Volume:	0.0 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	2.0 (AC-FT)	Discharge Volume:	2.0 (AC-FT)

Summary Results for Reservoir "Rec Pond"

Project: Dimentionless Simulation Run: Run 2
Reservoir: Rec Pond

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 1
End of Run:	01Jan2000, 06:00	Meteorologic Model:	Dimensionless
Compute Time:	18Sep2015, 22:57:48	Control Specifications:	6HR

Volume Units: IN AC-FT

Computed Results

Peak Inflow:	33.4 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 05:51
Peak Discharge:	18.1 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 06:00
Inflow Volume:	10.4 (AC-FT)	Peak Storage:	7.3 (AC-FT)
Discharge Volume:	3.1 (AC-FT)	Peak Elevation:	576.8 (FT)

Scenario 1—Main Pond

ODNR SCS Type II 24HR

Summary Results for Subbasin "Main Pond DA"

Project: SCS Simulation Run: Run 1
Subbasin: Main Pond DA

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 1
End of Run:	02Jan2000, 00:00	Meteorologic Model:	SCS Type II
Compute Time:	18Sep2015, 22:30:10	Control Specifications:	24HR

Volume Units: IN AC-FT

Computed Results

Peak Discharge:	396.3 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 12:00
Precipitation Volume:	132.4 (AC-FT)	Direct Runoff Volume:	131.1 (AC-FT)
Loss Volume:	1.2 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	131.2 (AC-FT)	Discharge Volume:	131.1 (AC-FT)

Summary Results for Reservoir "Main Pond"

Project: SCS Simulation Run: Run 1
Reservoir: Main Pond

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 1
End of Run:	02Jan2000, 00:00	Meteorologic Model:	SCS Type II
Compute Time:	18Sep2015, 22:30:10	Control Specifications:	24HR

Volume Units: IN AC-FT

Computed Results

Peak Inflow:	398.1 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 12:00
Peak Discharge:	39.2 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 16:08
Inflow Volume:	134.5 (AC-FT)	Peak Storage:	100.8 (AC-FT)
Discharge Volume:	41.3 (AC-FT)	Peak Elevation:	580.2 (FT)

Scenario 1—Rec Pond

ODNR SCS Type II 24HR

Summary Results for Subbasin "Rec Pond DA"

Project: SCS Simulation Run: Run 1
Subbasin: Rec Pond DA

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 1
End of Run:	02Jan2000, 00:00	Meteorologic Model:	SCS Type II
Compute Time:	18Sep2015, 22:30:10	Control Specifications:	24HR

Volume Units: IN AC-FT

Computed Results

Peak Discharge:	8.7 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 12:00
Precipitation Volume:	2.9 (AC-FT)	Direct Runoff Volume:	2.9 (AC-FT)
Loss Volume:	0.0 (AC-FT)	Baseflow Volume:	0.0 (AC-FT)
Excess Volume:	2.9 (AC-FT)	Discharge Volume:	2.9 (AC-FT)

Summary Results for Reservoir "Rec Pond"

Project: SCS Simulation Run: Run 1
Reservoir: Rec Pond

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 1
End of Run:	02Jan2000, 00:00	Meteorologic Model:	SCS Type II
Compute Time:	18Sep2015, 22:30:10	Control Specifications:	24HR

Volume Units: IN AC-FT

Computed Results

Peak Inflow:	40.1 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 16:01
Peak Discharge:	39.4 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 18:08
Inflow Volume:	44.1 (AC-FT)	Peak Storage:	10.4 (AC-FT)
Discharge Volume:	33.9 (AC-FT)	Peak Elevation:	577.6 (FT)

Scenario 1—Plant Flows

Summary Results for Source "Plant Inflows"

Project: Dimentionless Simulation Run: Run 2
Source: Plant Inflows

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 1
End of Run:	01Jan2000, 06:00	Meteorologic Model:	Dimensionless
Compute Time:	18Sep2015, 22:57:48	Control Specifications:	6HR

Volume Units: IN AC-FT

Computed Results

Peak Discharge:	7.0 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 00:00
Volume:	3.5 (AC-FT)		

Summary Results for Source "Plant Inflows"

Project: SCS Simulation Run: Run 1
Source: Plant Inflows

Start of Run:	01Jan2000, 00:00	Basin Model:	Basin 1
End of Run:	02Jan2000, 00:00	Meteorologic Model:	SCS Type II
Compute Time:	18Sep2015, 22:30:10	Control Specifications:	24HR

Volume Units: IN AC-FT

Computed Results

Peak Discharge:	1.8 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 00:00
Volume:	3.5 (AC-FT)		

2A - Area of Main Pond - 24HR Storm: $A_M := 58.1\ acre$

$CN := 98 \quad S := \left(\frac{1000}{CN} - 10\right) in \quad I_a := 0.2 \cdot S \quad P := 27.3\ in$

$$Q := \frac{(P - I_a)^2}{(P - I_a) + S}$$

$Q = 27.057\ in$

$\frac{Q}{P} = 99.108\%$ $\quad Rainfall := P \cdot A_M = 132.178\ acre \cdot ft$

2A - Area of Main Pond - 6HR Storm: $A_M := 58.1\ acre$

$CN := 98 \quad S := \left(\frac{1000}{CN} - 10\right) in \quad I_a := 0.2 \cdot S \quad P := 19.1\ in$

$$Q := \frac{(P - I_a)^2}{(P - I_a) + S}$$

$Q = 18.857\ in$

$\frac{Q}{P} = 98.729\%$ $\quad Rainfall := P \cdot A_M = 92.476\ acre \cdot ft$

2B - Area of Rec Pond - 24HR Storm: $A_M := 1.3\ acre$

$CN := 98 \quad S := \left(\frac{1000}{CN} - 10\right) in \quad I_a := 0.2 \cdot S \quad P := 27.3\ in$

$$Q := \frac{(P - I_a)^2}{(P - I_a) + S}$$

$Q = 27.057\ in$

$\frac{Q}{P} = 99.108\%$ $\quad Rainfall := P \cdot A_M = 2.958\ acre \cdot ft$

Created with PTC Mathcad Express. See www.mathcad.com for more information.

2B - Area of Rec Pond - 6HR Storm: $A_M := 1.3\ acre$

$CN := 98 \quad S := \left(\frac{1000}{CN} - 10\right) in \quad I_a := 0.2 \cdot S \quad P := 19.1\ in$

$$Q := \frac{(P - I_a)^2}{(P - I_a) + S}$$

$Q = 18.857\ in$

$\frac{Q}{P} = 98.729\%$ $\quad Rainfall := P \cdot A_M = 2.069\ acre \cdot ft$

2C - Area of Pond Complex - 24HR Storm: $A_M := 59.4\ acre$

$CN := 98 \quad S := \left(\frac{1000}{CN} - 10\right) in \quad I_a := 0.2 \cdot S \quad P := 27.3\ in$

$$Q := \frac{(P - I_a)^2}{(P - I_a) + S}$$

$Q = 27.057\ in$

$\frac{Q}{P} = 99.108\%$ $\quad Rainfall := P \cdot A_M = 135.135\ acre \cdot ft$

2C - Area of Pond Complex - 6HR Storm: $A_M := 59.4\ acre$

$CN := 98 \quad S := \left(\frac{1000}{CN} - 10\right) in \quad I_a := 0.2 \cdot S \quad P := 19.1\ in$

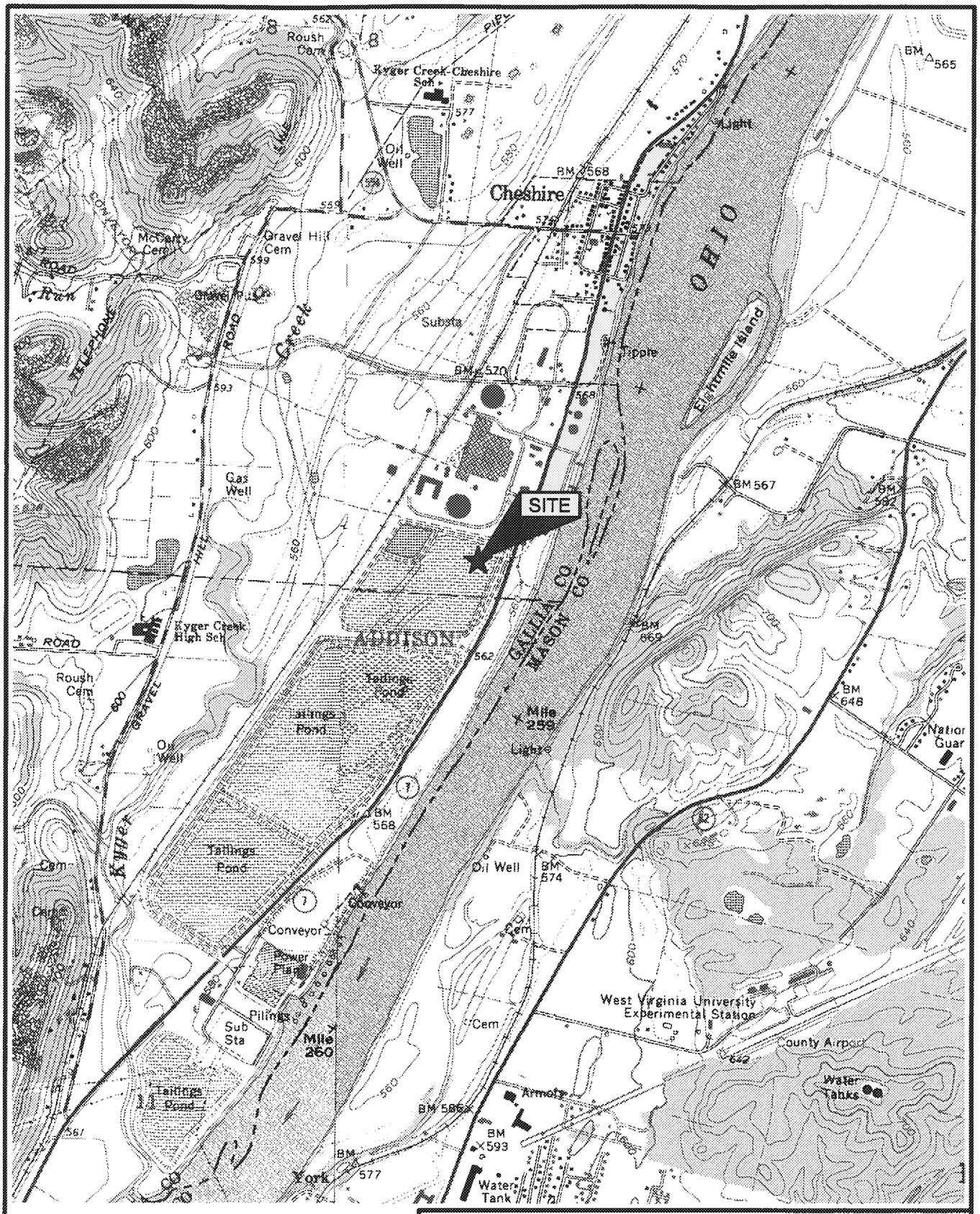
$$Q := \frac{(P - I_a)^2}{(P - I_a) + S}$$

$Q = 18.857\ in$

$\frac{Q}{P} = 98.729\%$ $\quad Rainfall := P \cdot A_M = 94.545\ acre \cdot ft$

Created with PTC Mathcad Express. See www.mathcad.com for more information.

Appendix II – 2009/2010 Site Investigation Figures



Project Location
Gallia County, Ohio

USGS Mapping:
CHESHIRE QUADRANGLE
ADDISON QUADRANGLE

VICINITY MAP

Gavin Generating Plant
Bottom Ash Pond Investigation
Cheshire, Ohio

Project: 011-11497-014	Drawn By: MTR
Drawing Date: 6-04-2009	Approved By: MGR
Last Updated: 6-4-2009	Scale: 1" = 2000' 1:1

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Columbus (614) 793-2226
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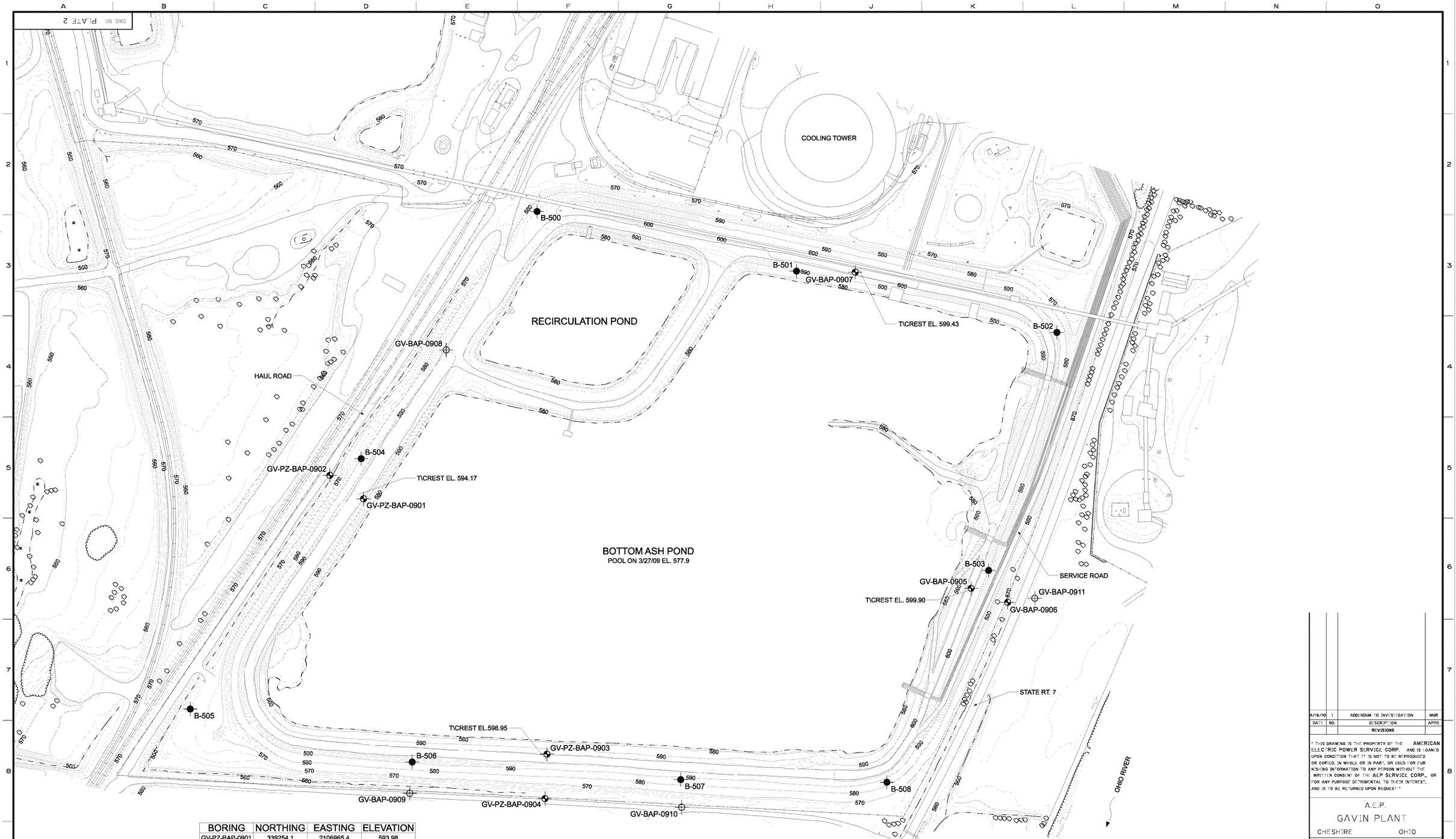
Dayton (937) 424-1011

PLATE 1

Images: ~Addison Ohio Quad Map.tif ~Cheshire Ohio Quad Map.tif ~gallia.tif
Xrefs:
File Last Updated: Jun 04, 2009
Plot Info: 6-4-2009 @ 1:42pm By: MRomanello
BBC&M Filename: I:\DEPTS\CADD\Drawings\Projects\011-11497-014\011-11497-014 VMap.dwg Layout: V-Map



BORING	NORTHING	EASTING	ELEVATION
GV-PZ-BAP-0901	339254.1	2106965.4	593.98
GV-PZ-BAP-0902	339323.7	2106865.5	567.75
GV-PZ-BAP-0903	338496.5	2107509.7	598.56
GV-PZ-BAP-0904	338376.6	2107504.2	559.80
GV-BAP-0905	338988.5	2108768.0	599.97
GV-BAP-0906	338947.0	2108876.5	569.53
GV-BAP-0907	339926.3	2108424.5	599.43
GV-BAP-0908	340056.0	2108453.1	570.49
GV-BAP-0909	339695.8	2107210.7	588.6
GV-BAP-0910	338380.4	2107102.6	562.2
GV-BAP-0911	338338.9	2107909.4	565.4
GV-BAP-0912	338959.0	2108957.0	565.9

DATUM: NAD 27/NGVD 29 OHIO SOUTH

REFERENCE: AEP GAVIN DRAWINGS

SCALE IN FEET
0 100 200

LEGEND

- 570 — EXISTING GRADE CONTOUR (2 FT. INTERVAL)
- EXISTING WATER SURFACE (AT TIME OF SURVEY)
- FENCE LINE
- EXISTING VEGETATION
- GV-BAP-0908 — BORING NUMBER AND LOCATION (BBCM 2009 SUPPLEMENTAL INVESTIGATION)
- GV-PZ-BAP-0901 — BORING NUMBER AND LOCATION (BBCM 2009 INVESTIGATION)
- B-500 — BORING NUMBER AND LOCATION (APPROXIMATE) PRECONSTRUCTION INVESTIGATION

PROJECT NUMBER:	011-11497-014	DRAWN BY:	TJM
DRAWING DATE:	5-22-2009	ENGINEER:	MTR
LAST UPDATED:	4-16-2010	APPROVED BY:	MGR
		SCALE:	1" = 100'

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Cincinnati (513) 771-6471
Dayton (937) 424-1011

DATE	NO.	DESCRIPTION	APPD.
4/16/10	1	ADDENDUM TO INVESTIGATION	MGR

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A.E.P.
GAVIN PLANT
CHESHIRE OHIO

BOTTOM ASH POND
INVESTIGATION
PLAN OF BORINGS

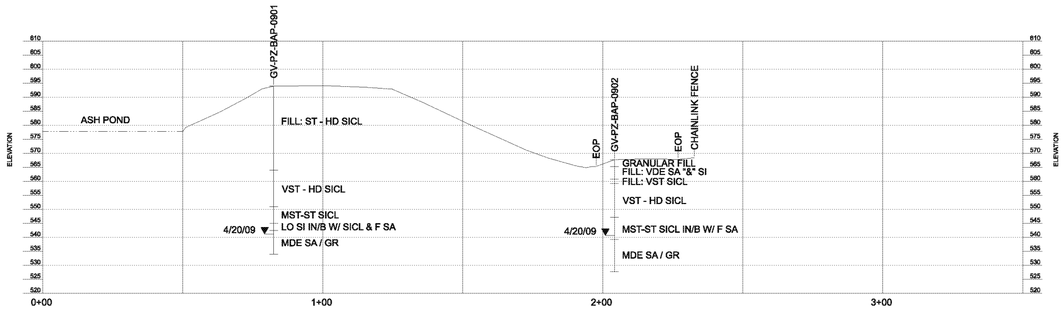
DWG. NO. PLATE 2

SCALE:
DR:
CH:
ENGR:
PROJ ENGR:
DATE:
CIVIL ENGINEERING
APPROVED BY

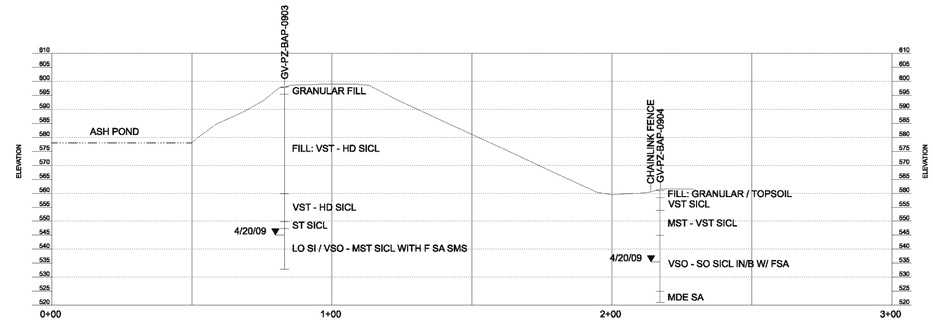
AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

SYSTEM DATE- DD-MMM-YYYY
SYSTEM TIME- HOUR:MINUTE

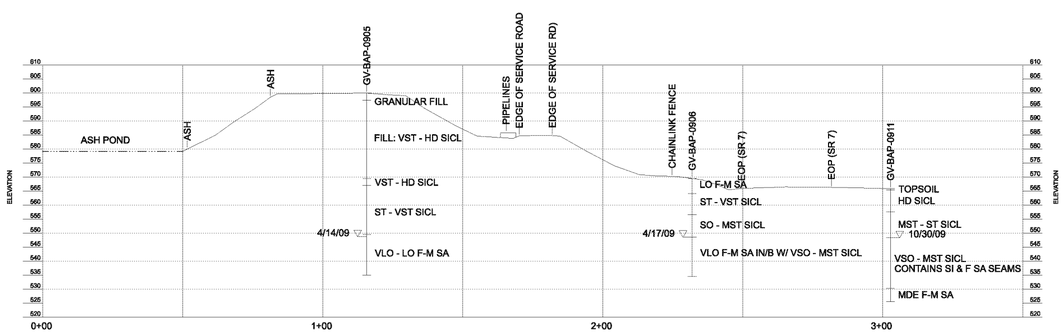
DWG. NO. PLATE 3



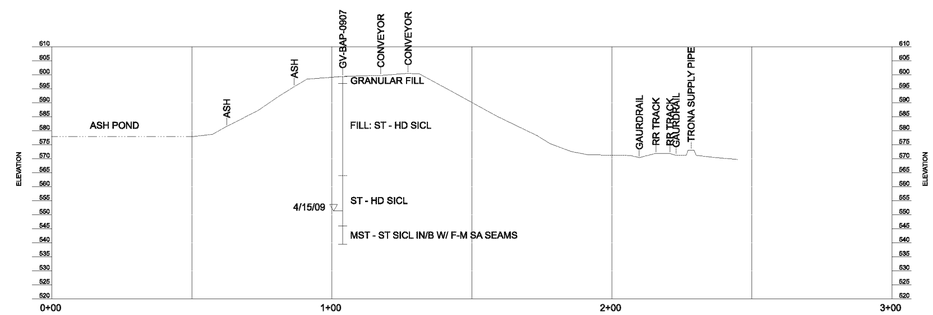
SECTION 'A'
Borings BAP-0901 & BAP-0902



SECTION 'B'
Borings BAP-0903 & BAP-0904

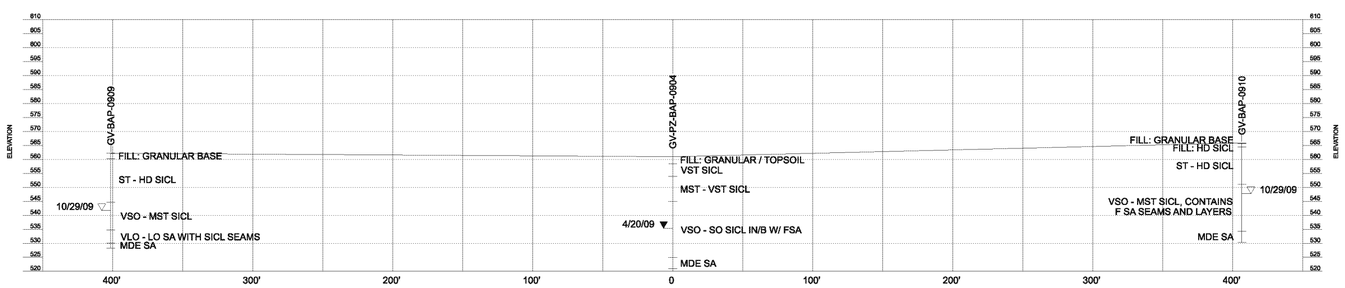


SECTION 'C'
Borings BAP-0905 & BAP-0906



SECTION 'D'
Boring BAP-0907

HORIZONTAL
SCALE IN FEET
0 20 40



PROFILE #1
Borings BAP-0904, BAP-0909, & BAP-0910

HORIZONTAL
SCALE IN FEET
0 40 80

LEGEND

4/20/09 ▼	OBSERVATION WELL READING: ELEVATION AND DATE
4/3/09 ▽	SEEPAGE ENCOUNTERED DURING DRILLING
V.SO / SO	SOFT / VERY SOFT
M.ST	M. STIFF
ST / V.ST	STIFF / VERY STIFF
HD	HARD
V.LO / LO	VERY LOOSE / LOOSE
M.DE	MEDIUM DENSE
DE / V.DE	DENSE / VERY DENSE
ORG	ORGANIC
—·—·—	EXISTING WATER SURFACE (AT TIME OF INVESTIGATION)

ELEVATION DATUM: NAD 27/NGVD 29 OHIO SOUTH

DATE	NO.	DESCRIPTION	APPD.
4/16/10	1	ADDENDUM TO INVESTIGATION	MGR

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A.E.P.
GAVIN PLANT
CHESHIRE OHIO

BOTTOM ASH POND
INVESTIGATION
SUBSURFACE
CROSS SECTIONS

DWG. NO. PLATE 3

SCALE: CIVIL ENGINEERING
DR.
CK.
ENGR.
PROJ. ENGR.
DATE:
APPROVED BY

PROJECT NUMBER:	011-11497-014	DRAWN BY:	TJM
DRAWING DATE:	6-4-2009	ENGINEER:	MTR
LAST UPDATED:	4-16-2010	APPROVED BY:	MGR
		SCALE:	1" = 20'

BBCM
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AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

SYSTEM DATE- DD-MMM-YYYY
SYSTEM TIME- HOUR:MINUTE

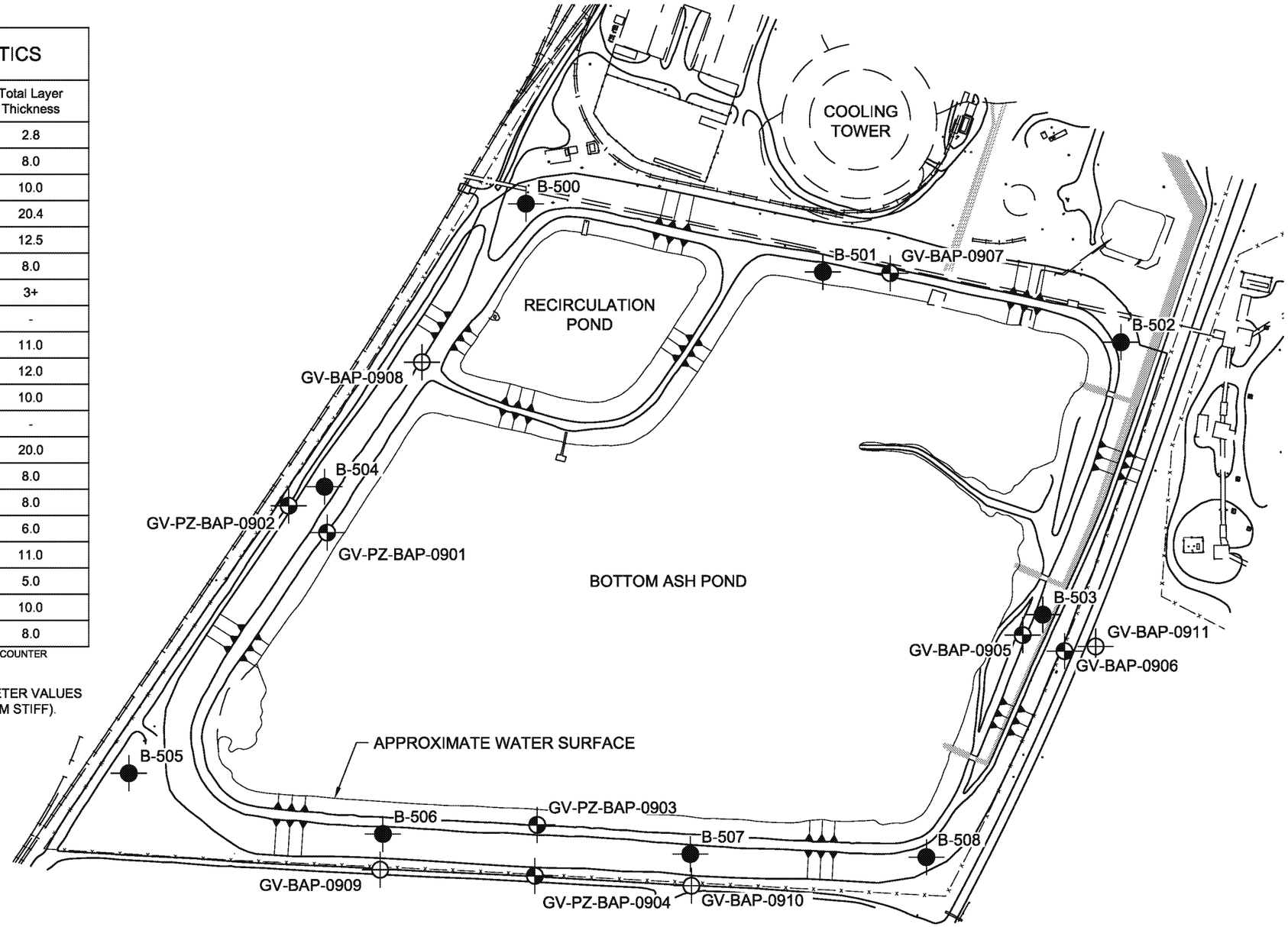
IOS0694

'LOWER ALLUVIUM' CHARACTERISTICS

Boring	Depth to Top of Layer*	Top of Layer Elevation	Total Layer Thickness
GV-PZ-BAP-0901	19.1	545.1	2.8
GV-PZ-BAP-0902	12.0	547.3	8.0
GV-PZ-BAP-0903	11.5	548.1	10.0
GV-PZ-BAP-0904	14.0	543.8	20.4
GV-BAP-0905	20.0	549.5	12.5
GV-BAP-0906	13.0	556.5	8.0
GV-BAP-0907	17.4	542.4	3+
GV-BAP-0908	-	-	-
GV-BAP-0909	17.5	542.2	11.0
GV-BAP-0910	13.5	550.4	12.0
GV-BAP-0911	17.5	548.4	10.0
B-500	-	-	-
B-501	8.0	555	20.0
B-502	10.0	558	8.0
B-503	15.0	555	8.0
B-504	10.0	553	6.0
B-505	13.0	550	11.0
B-506	14.0	547	5.0
B-507	24.0	542	10.0
B-508	16.0	553	8.0

*DEPTH TO TOP OF LAYER IS DEPTH BELOW NATURAL GROUND SURFACE ENCOUNTER

'LOWER ALLUVIUM' LAYER DEFINED BY HAND PENETROMETER VALUES RANGING FROM 0.0 TSF TO 1.0 TSF (VERY SOFT TO MEDIUM STIFF).



LEGEND

GV-BAP-0908 — BORING LOCATION BBCM 2009 SUPPLEMENTAL INVESTIGATION

GV-BAP-0901 — BORING LOCATION BBCM 2009 INVESTIGATION

B-500 — BORING LOCATION PRECONSTRUCTION INVESTIGATION

0 300 600
SCALE IN FEET

LOWER ALLUVIUM SUBSURFACE CHARACTERIZATION

Supplemental Geotechnical Investigation
AEP Gavin Plant Bottom Ash Pond
Cheshire, Ohio

Project: 011-11497-014	Drawn By: MTR	
Drawing Date: 10-07-2009	Approved By: MGR	
Last Updated: 1-21-2010	Scale: 1" = 300'	1:1

BBCM SOLUTIONS TO BUILD ON
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Cincinnati (513) 771-8471
Dayton (937) 424-1011

Images: ~Gavin Aerial.jpg
Xrefs:
File Last Updated: Jan 21, 2010
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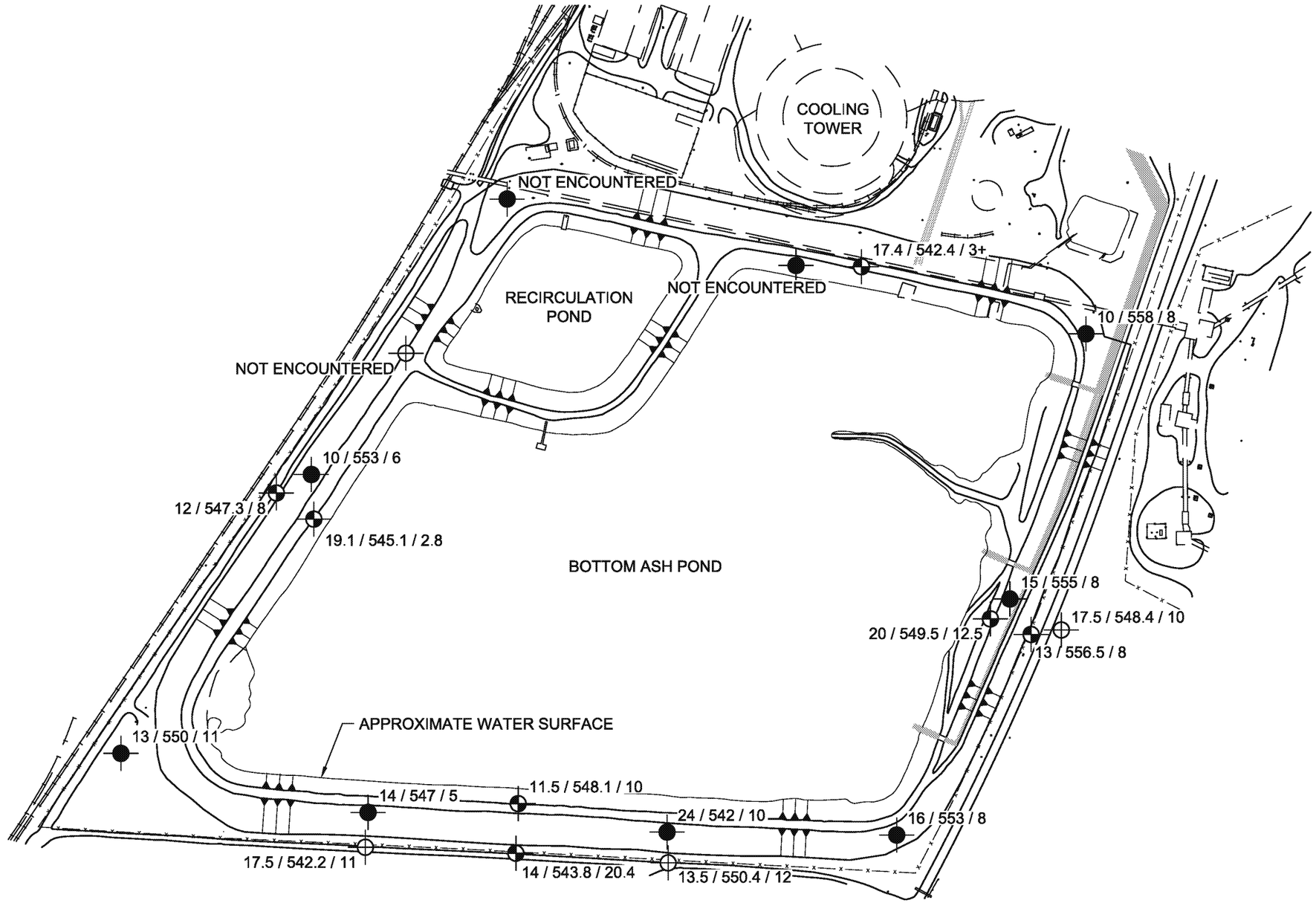
BBC&M Filename: I:\DEPTS\CADD\Drawings\Projects\011-11497-014\isopach Map.dwg Layout: POB



LEGEND

DEPTH BELOW NATURAL GROUND SURFACE TO 'LOWER' ALLUVIUM LAYER — 10 / 545 / 12

ELEVATION OF TOP OF LOWER ALLUVIUM LAYER

THICKNESS OF 'LOWER' ALLUVIUM LAYER

BORING LOCATION BBCM 2009 SUPPLEMENTAL INVESTIGATION

BORING LOCATION BBCM 2009 INVESTIGATION

BORING LOCATION PRECONSTRUCTION INVESTIGATION

0 300 600

SCALE IN FEET

LOWER ALLUVIUM SUBSURFACE CHARACTERIZATION		
Supplemental Geotechnical Investigation AEP Gavin Plant Bottom Ash Pond Cheshire, Ohio		
Project: 011-11497-014	Drawn By: MTR	
Drawing Date: 10-07-2009	Approved By: MGR	
Last Updated: 1-28-2010	Scale: 1" = 300'	1:1

BBCM SOLUTIONS TO BUILD ON
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Images: ~Gavin Aerial.jpg
Xrefs:
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BBC&M Filename: I:\DEPTS\CADD\Drawings\Projects\011-11497-014\isopach Map.dwg Layout: ISOPACH MAP

EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS FOR SAMPLING AND DESCRIPTION OF SOIL

SAMPLING DATA

- Blocked-in "SAMPLES" column indicates sample was attempted and recovered within this depth interval.

- Sample was attempted within this interval but not recovered.

2/5/9 - The number of blows required for each 6-inch increment of penetration of a "Standard" 2-inch O.D. split-barrel sampler, driven a distance of 18 inches by a 140-pound hammer freely falling 30 inches. The raw "blowcount" or "N" is equal to the sum of the second and third 6-inch increments of penetration. Addition of one of the following symbols indicates the use of a split-barrel other than the 2" O.D. sampler:

- 2S - 2½"O.D. split-barrel sampler
- 3S - 3" O.D. split-barrel sampler

N_{60} - Corrected Blowcount = [(BBCM Drill Rod Energy Ratio) / (0.60 Standard)] X N_{raw}

P - Shelby tube sampler, 3" O.D., hydraulically pushed.

R - Refusal of sampler in very-hard or dense soil, or on a resistant surface.

50-2" - Number of blows (50) to drive a split-barrel sampler a certain number of inches (2), other than the normal 6-inch increment.

SD - Split-barrel sampler (S) advanced by weight of drill rods (D),

SH - Split-barrel sampler (S) advanced by combined weight of rods and drive hammer (H).

SOIL DESCRIPTIONS

All soils have been classified basically in accordance with the Unified Soil Classification System, but this system has been augmented by the use of special adjectives to designate the approximate percentages of minor components as follows:

Adjective	Percent by Weight
trace	1 to 10
little	11 to 20
some	21 to 35
"and"	36 to 50

The following terms are used to describe density and consistency of soils:

Term (Granular Soils)	Blows per foot (N_{60})
Very-loose	Less than 5
Loose	5 to 10
Medium-dense	11 to 30
Dense	31 to 50
Very-dense	Over 50

Term (Cohesive Soils)	Qu (tsf)
Very-soft	Less than 0.25
Soft	0.25 to 0.5
Medium-stiff	0.5 to 1.0
Stiff	1.0 to 2.0
Very-stiff	2.0 to 4.0
Hard	Over 4.0

LOG OF BORING NO. GV-PZ-BAP-0901
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **594.0** DATE: **4/9/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **64.8'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	0						ROOTMAT - 12 INCHES		
593.0									
		1		3 / 3 / 8	15	80	FILL: Very-stiff to hard brown mottled with dark-brown silty clay, trace fine to medium sand, few pockets of silt, organic silt and silty clay, few roots near top of stratum, damp.		H=4.5+
		2		4 / 6 / 8	19	100			H=4.5+
	5	3		4 / 7 / 10	23	80			H=4.5+
		4		10 / 10 / 12	30	93			H=4.0
		5	P			60			G H=4.0
	10	6		3 / 4 / 6	14	100			H=2.5-3.75
		7		5 / 7 / 8	21	73			H=3.5-3.75
		8		2 / 4 / 6	14	87			H=3.75
		9		2 / 4 / 6	14				H=3.0-4.0
	15	10		6 / 8 / 9	23	73			H=2.0-2.5
		11		2 / 5 / 6	15	87			LL=53% H=2.75-3.5 G
576.0									
		12		2 / 3 / 5	11	73	FILL: Stiff to hard brown mottled with gray and dark-brown silty clay, trace fine to coarse sand, trace fine gravel, few roots near middle of stratum, few to many pockets of silt near bottom of stratum, damp.		H=2.5-4.5
	20	13	P						G H=3.5
		14		2 / 4 / 7	15	87			H=2.0-2.75
		15		4 / 7 / 9	22	100			H=1.75-2.5
	25								

WATER LEVEL:	53.4	52.8
WATER NOTE:	Inside HSA	Inside Well
DATE:	4/9/09	4/20/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. (See Separate Curves)

H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-PZ-BAP-0901
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **594.0** DATE: **4/9/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **64.8'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	25	16		9/14/17	42	80	FILL: Stiff to hard brown mottled with gray and dark-brown silty clay, trace fine to coarse sand, trace fine gravel, few roots near middle of stratum, few to many pockets of silt near bottom of stratum, damp.		H=4.5+
		17		5/10/4	19	100			H=4.5+ G
		18		7/11/10	29	100			H=4.5+
564.2		19A		10/12/16	38	100			H=4.5+
563.8	30	19B				57	Hard gray mottled with dark-gray organic silty clay, trace fine to medium sand, damp.		H=4.5+
		20		5/10/14	33	100	Very-stiff to hard dark-brown mottled with brown silty clay, trace to some fine sand, trace medium to coarse sand, few to many lenses of silt, few seams of fine sand, damp becoming wet at 46.0'.		H=4.5+
		21		6/10/14	33	100			H=3.0-4.5 G
	35	22		3/6/9	21	100			H=3.0-4.5
		23		3/6/8	19	100			H=2.25-2.75
	40	24		2/5/6	15	100			H=1.5-2.75
551.0		25		2/3/5	11	100	Stiff brown mottled with dark-brown clayey silt, some fine sand, trace medium sand, many lenses of silt, damp.		H=1.5-2.0 G
548.5	45	26		1/2/3	7	100	Medium-stiff to stiff brown mottled with dark-brown silty clay, little fine sand, many lenses and seams of silt and fine sand, wet.		H=0.75-1.5
545.1		27A		2/3/3	8	100			H=0.75-1.5
		27B				100	Loose brown and gray mottled with dark-brown silt interbedded with silty clay and fine sand,		
	50								

WATER LEVEL:	53.4	52.8
WATER NOTE:	Inside HSA	Inside Well
DATE:	4/9/09	4/20/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. (See Separate Curves)

H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-PZ-BAP-0901
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **594.0** DATE: **4/9/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **64.8'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	50						trace medium sand, wet.		
542.3		28A		2 / 2 / 7	12	100			G
		28B				100	Medium-dense brown and gray fine sand, trace medium sand, little to some fine gravel, trace silt, few seams of silty clay, contains zones of fine to coarse gravel, wet.		
		29		8 / 9 / 12	29	80			G
	55								
		30		6 / 11 / 15	36	53			
		31		7 / 14 / 20	46	100			
	60								
		32		10 / 38 / 50-3"R		53			
529.2	65						- Encountered water at 52.0' and 55.5'. - Boring location and elevation surveyed by AEP. - Drilled 5' additional feet on April 20, 2009 and installed observation well. See separate well log.		
	70								
	75								

WATER LEVEL:	53.4	52.8
WATER NOTE:	Inside HSA	Inside Well
DATE:	4/9/09	4/20/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. (See Separate Curves)

H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-PZ-BAP-0902
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **567.8** DATE: **4/15/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **40.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler, 3" O.D. Shelby Tube Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	0						ROADWAY GRANULAR BASE - 30 INCHES		
565.3									
		1		25/40/37	105	100	FILL: Very-dense gray and gray-black fine to coarse sand, little fine gravel (coal fragments), some to "and" silt, dry to damp.		
		2		18/26/24	68	100			
	5								
		3		10/12/11	31	100			
560.8									
		4		2/5/7	16	73	FILL: Very-stiff gray mottled with brown and dark-brown silty clay, some fine to coarse sand, trace fine gravel, moist.		H=3.0
559.3									
		5		2/6/10	22	87	Very-stiff to hard brown mottled with gray silty clay, little to some fine to medium sand, trace coarse sand, desiccated near bottom of stratum, moist.		H=3.5-4.5
	10								
		6		3/5/10	21	100			H=4.5+
		7		2/5/6	15	100			H=3.0-4.5
	15								
		8		3/5/7	16	100			H=3.0-3.5
		9		3/5/7	16	100			H=2.0-2.5 G
	20								
547.3									
		10		2/2/5	10	100	Medium-stiff to stiff brown mottled with gray silty clay, interbedded with fine to medium sand, trace coarse sand, trace fine gravel seams near bottom of stratum, moist to wet.		H=1.0-1.5
		11		1/2/5	10	100			H=0.5-1.5 G
	25								

WATER LEVEL:	29.0	30.0
WATER NOTE:	Inside HSA	Inside Well
DATE:	4/15/09	4/16/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. (See Separate Curves)

H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-PZ-BAP-0902
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **567.8** DATE: **4/15/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **40.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler, 3" O.D. Shelby Tube Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	TEST RESULTS
	25	12	SH	2/4	8	80	Medium-stiff to stiff brown mottled with gray silty clay, interbedded with fine to medium sand, trace coarse sand, trace fine gravel seams near bottom of stratum, moist to wet.	H=0.5-0.75
539.3		13		1/3/2	7	80	Loose brown fine to coarse sand, trace fine gravel, interbedded with very-soft silty clay, wet.	
	30							
536.8		14		2/4/10	19	80	Medium-dense brown fine to coarse sand, little fine gravel, trace silt, wet.	G
		15		4/6/7	18	47		
	35	16		3/4/9	18	93		
		17		4/6/11	23	80		
527.8	40							
	45							
	50							

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT LIQUID LIMIT
10 20 30 40

- Encountered seepage at 27.0'.
- Encountered water at 29.0'.
- Boring location and elevation surveyed by AEP.
- Borehole converted to observation well upon completion. See separate well log.

WATER LEVEL:	29.0	30.0
WATER NOTE:	Inside HSA	Inside Well
DATE:	4/15/09	4/16/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 111497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-PZ-BAP-0903
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **598.6** DATE: **4/10/09 - 4/13/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **65.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler, 3" O.D. Shelby Tube Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	TEST RESULTS
	0						FILL: Cinders, dark-gray fine to medium sand, trace coarse sand, trace fine gravel, little silt, dry.	
		1		2 / 1 / 2	4	53		
596.1							FILL: Very-stiff to hard brown and dark-brown mottled with gray silty clay, trace fine to coarse sand, contains zones with trace fine gravel, contains pockets of bottom ash, few pockets of silt near bottom of stratum, damp becoming moist at 21.0'.	
		2		2 / 2 / 5	10	60		H=1.25-3.5
	5	3		3 / 4 / 5	12	87		H=4.0-4.5
		4		P		13		
		5		6 / 7 / 9	22	100		H=4.0
	10	6		3 / 4 / 5	12	73		H=2.0-4.0
		7		5 / 7 / 9	22	67		H=2.5-3.0
		8		5 / 6 / 7	18	73		H=2.0-3.0
		9		2 / 4 / 6	14	60		H=1.5-2.5
	15	10		4 / 7 / 10	23	67		LL=52% H=2.5-3.5 G
		11		3 / 4 / 6	14	73		H=1.5-2.0
		12A 12B 12C		4 / 5 / 7	16			H=2.0-2.5 H=1.75-2.5
	20	13		4 / 6 / 8	19	73		H=2.5-3.0
		14		3 / 5 / 7	16	100		H=2.5
		15		3 / 6 / 9	21	87		H=2.5-3.5
573.9		16A 16B		5 / 6 / 8	19	100 100		H=3.5-4.0 H=4.5+
	25							

NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT — 10 20 30 40

WATER LEVEL: 60.3 (▽) 53.2 (▼)
WATER NOTE: Inside HSA Inside Well
DATE: 4/13/09 4/14/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf)
W - Unit Dry Wt (pcf)
D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-PZ-BAP-0903
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **598.6** DATE: **4/10/09 - 4/13/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **65.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler, 3" O.D. Shelby Tube Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT / PLASTIC LIMIT / LIQUID LIMIT (10 20 30 40)	TEST RESULTS
	25	17		9/14/14	38	33	FILL: Very-stiff to hard brown mottled with dark-brown and gray silty clay, trace fine to coarse sand, slightly organic, thin seam of gray mottled with dark-gray silt at top of stratum, moist.		H=3.0-4.0
		18		3/7/10	23	93			H=3.5-4.0
		19		7/12/13	34	80			H=2.75-3.5
568.1	30								
		20		3/6/9	21	100	FILL: Hard brown silty clay intermixed with gray organic silt, trace fine to medium sand, moist.		H=3.5-4.5
565.6									
		21		3/6/10	22	80	FILL: Hard brown mottled with dark-brown and gray silty clay, trace fine to coarse sand, trace fine gravel, moist.		H=2.5-3.5 G
	35	22		4/9/13	30	100			H=3.0-4.5
559.6		23A		4/9/11	27	100			H=3.0-4.0
		23B				100	Stiff to hard brown mottled with dark-brown and gray silty clay, trace fine to medium sand, few lenses of silt and seams of fine sand near bottom of stratum, moist.		H=4.5+
	40	24		4/6/9	21	100			LL=53% H=2.0-3.5 G
		25		2/6/9	21	100			H=2.0-4.0
	45	26		2/5/8	18	100			H=2.0-2.5
550.6									
		27		1/4/5	12	100	Stiff brown mottled with dark-brown and gray silty clay, few lenses of silt and fine sand, moist.		H=1.0-1.75
	50								

WATER LEVEL:	60.3	53.2
WATER NOTE:	Inside HSA	Inside Well
DATE:	4/13/09	4/14/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. (See Separate Curves)

H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-PZ-BAP-0903
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **598.6** DATE: **4/10/09 - 4/13/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **65.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler, 3" O.D. Shelby Tube Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
548.1	50								
		28		1 / 3 / 3	8	100	Loose brown silt interbedded with silty clay, trace to little fine to medium sand, contains seams of fine sand, moist to wet.		H=0.5-1.0
		29		1 / 2 / 3	7	100			H=0.0-0.5
543.1	55								
		30		SH / 2 / 3	7	100	Very-soft to medium-stiff brown mottled with gray and dark-gray silty clay, trace to little fine sand, few lenses of silt and fine sand, contains decayed vegetation, wet.		H=0.8 G
		31		2 / 5 / 3	11	100			H=0.2-0.4
538.1	60								
		32		1 / 5 / 6	15	100	Medium-dense brown and gray fine sand interbedded with silty clay and silt, trace fine to medium sand, wet.		
535.6									
		33		3 / 4 / 6	14	100	Medium-dense gray silt interbedded with silty clay, little fine sand, few seams of fine sand, wet.		H=1.5
533.6	65								
							- Encountered water at 55.3'. - Boring location and elevation surveyed by AEP. - Borehole converted to observation well upon completion. See separate well log.		
	70								
	75								

WATER LEVEL:	60.3	53.2
WATER NOTE:	Inside HSA	Inside Well
DATE:	4/13/09	4/14/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves

H - Penetrometer (tsf)
W - Unit Dry Wt (pcf)
D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-PZ-BAP-0904
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **559.8** DATE: **4/16/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **40.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	TEST RESULTS
	0					TOPSOIL - 12 INCHES	
558.8							
557.8		1	24/36/14	68	67	FILL: Very-dense gray fine to coarse gravel "and" fine to coarse sand, some silt, dry.	
		2	3/5/8	18	80	Very-stiff gray mottled with brown and brown mottled with gray silty clay, little to some fine to coarse sand, trace fine gravel, dry.	H=2.0-3.0
	5	3	2/3/5	11	80		H=2.25-2.75
552.8		4	4/4/6	14	100		H=2.5-3.0
		5	SH/2/3	7	87	Medium-stiff to stiff brown mottled with gray silty clay, trace fine to coarse sand, moist.	H=0.50-1.0 G
	10	6	P				
548.8		7	3/4/7	15	100	Stiff to very-stiff brown mottled with gray and dark-brown silty clay, little to some fine to medium sand, trace coarse sand, dry.	H=2.5-3.25
	15	8	2/3/4	10	80		H=1.5-2.5
543.8		9	SH=14"/2	2	100	Very-soft to soft brown mottled with gray silty clay, interbedded with fine to medium sand, contains fine to medium sand seams and lenses, damp to moist becoming wet.	H=0.25-0.5
	20	10	SH/SH/1	1	87		H=0.0
		11	SR/2/2	5	67		H=0.0
536.3		12	SH/1/3	5	73	Very-soft to stiff gray silty clay, interbedded with fine to medium sand and silt seams/thin layers, wet.	H=0.25-1.0
	25						

NATURAL CONSISTENCY INDEX
NATURAL MOISTURE CONTENT
PLASTIC LIMIT — LIQUID LIMIT
10 20 30 40

WATER LEVEL:	23.1	17.5
WATER NOTE:	Inside HSA	Inside Well
DATE:	4/16/09	4/17/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 111497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-PZ-BAP-0904
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **559.8** DATE: **4/16/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **40.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	25						Very-soft to stiff gray silty clay, interbedded with fine to medium sand and silt seams/thin layers, wet.		
		13		SH/SH/2	2	80			
		14		SH/2/2	5	67			H=1.0-1.25 G
	30								
		15A		3/9/5	19	100			
		15B				75			H=1.5
		16		1/2/9	15	80			
	35								
523.4		17A		1/6/10	22	100			
		17B				55	Medium-dense brown fine to coarse sand, little to some fine to coarse gravel, trace silt, wet.		
		18		9/6/10	22	87			
519.8	40								
							- Encountered water at 21.0' - Boring location and elevation surveyed by AEP. - Borehole converted to observation well on 4/17/09. See separate well log.		
	45								
	50								

WATER LEVEL:	23.1	17.5
WATER NOTE:	Inside HSA	Inside Well
DATE:	4/16/09	4/17/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. (See Separate Curves)

H - Penetrometer (tsf)
W - Unit Dry Wt (pcf)
D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0905
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **600.0** DATE: **4/14/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **65.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	0						FILL: Medium-dense bottom ash.		
		1		4 / 6 / 5	15	100			H=4.0-4.5+
597.5							FILL: Very-stiff to hard brown mottled with gray silty clay, trace to some fine sand, trace medium to coarse sand, contains zones with trace fine gravel, dry to damp becoming moist at 16.0'.		
		2		6 / 7 / 8	21	100			H=4.0-4.5+
	5	3		4 / 4 / 6	14	73			H=3.5-4.0
		4		4 / 6 / 7	18	80			H=2.5-3.25
		5		2 / 3 / 5	11	80			H=2.5-2.75
		6		3 / 4 / 5	12	100			H=2.0-2.5
	10	7		7 / 7 / 8	21	87			H=2.0-4.0
		8		3 / 4 / 7	15	100			H=3.25-4.0 G
		9		3 / 4 / 7	15	87			H=1.5-3.0
	15	10		7 / 8 / 9	23	33			H=2.0-2.5
		11		2 / 4 / 7	15	87			H=3.0-4.5
		12		3 / 5 / 7	16	100			H=3.0-3.5
	20	13		6 / 9 / 12	29	67			H=2.75-4.0
		14		P		100			H=3.5 G
		15		5 / 7 / 8	21	87			H=3.5-4.5
	25	16		3 / 5 / 7	16	67			H=4.5+

WATER LEVEL: **57.5**
WATER NOTE: **Inside HSA**
DATE: **4/14/09**

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0905
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **600.0** DATE: **4/14/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **65.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	25	17		7 / 8 / 9	23	67	FILL: Very-stiff to hard brown mottled with gray silty clay, trace to some fine sand, trace medium to coarse sand, contains zones with trace fine gravel, dry to damp becoming moist at 16.0'.		H=3.75-4.25 G
		18		4 / 6 / 8	19	100			H=3.0-4.5+
		19		8 / 11 / 13	33	100			H=4.0-4.5
569.5	30								
		20		2 / 4 / 7	15	100	Very-stiff to hard dark-brown mottled with gray silty clay, some fine to medium sand, trace coarse sand, moist.		H=2.0-4.0
567.0									
		21		2 / 4 / 6	14	100	Very-stiff brown silty clay "and" fine to coarse sand, moist.		H=2.5-4.0 G
564.5	35								
		22		2 / 2 / 4	8	100	Stiff brown clayey silt, some fine sand, trace medium sand, moist.		H=1.0 G
562.0									
		23		2 / 4 / 5	12	100	Stiff to very-stiff brown mottled with gray silty clay, trace fine to coarse sand, contains lenses of silt near bottom of stratum, moist.		H=2.0-2.5
	40	24		4 / 5 / 7	16	100			H=1.5-2.0
		25		2 / 3 / 4	10	100			H=1.0-2.0 G
	45	26		1 / 2 / 4	8	100			H=1.0-1.5
		27		1 / 2 / 3	7	100			H=1.0-1.5
	50								

WATER LEVEL: 57.5
WATER NOTE: Inside HSA
DATE: 4/14/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0905
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **600.0** DATE: **4/14/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **65.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
549.5	50								
		28		1 / 1 / 2	4	100	Very-loose brown fine to medium sand, trace coarse sand, some silt, contains seams of brown silt and seams of silty clay, wet.		H=0.5
		29		1 / 1 / 1	3	100			G
	55								
		30		SH / SH / 4	5	100			
		31		2 / 2 / 2	5	100			
	60								
		32		2 / 2 / 6	11	100			
537.0									
536.1		33A		2 / 3 / 5	11	100	Loose to medium-dense gray fine to medium sand, trace silt, iron oxide stains, wet.		
		33B				100	Loose to medium-dense gray silt interbedded with fine sand and silty clay seams, wet.		
535.0	65								
							- Encountered water at 51.3'. - Boring location and elevation surveyed by AEP. - Boring backfilled with grout upon completion.		
	70								
	75								

WATER LEVEL: 57.5
WATER NOTE: Inside HSA
DATE: 4/14/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation Q - Uncon Comp T - Triax Comp C - Consol.	See Separate Curves	H - Penetrometer (tsf) W - Unit Dry Wt (pcf) D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0906
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **569.5** DATE: **4/17/09**

DRILLING METHOD: **3-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **35.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler, 3" O.D. Shelby Tube Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT / PLASTIC LIMIT / LIQUID LIMIT (10 20 30 40)	TEST RESULTS
	0						TOPSOIL - 12 INCHES		
568.5									
		1		3 / 2 / 3	7	33	Loose brown fine to medium sand, some silty clay, dry.		H=1.0-1.5
		2		1 / 3 / 4	10	53			H=1.0-1.25
	5	3		1 / 2 / 4	8	100			H=1.0-1.75
564.0									
		4		2 / 4 / 5	12	80	Very-stiff brown silty clay, some fine to medium sand, trace coarse sand, dry.		H=2.25-3.75 G
562.5									
		5		3 / 4 / 6	14	100	Stiff to hard brown mottled with gray silty clay, trace fine to medium sand, dry.		H=3.25-4.0
		6		3 / 5 / 7	16	100			H=3.0-3.75
	10								
		7		1 / 2 / 4	8	100			H=1.5-2.5
556.5									
		8		SH / 1 / 2	4	87	Soft to medium-stiff brown mottled with gray silty clay, trace to little fine to medium sand, many silt lenses near bottom of stratum, dry becoming damp.		H=0.5-0.75
	15								
		9		SH / 2 / 3	7	93			H=0.25-0.75
		10		SH / 1 / 1	3	100			H=0.25 G
	20								
548.5									
		11		SH / SH / 1	1	67	Very-loose brown fine to medium sand, interbedded with very-soft to medium-stiff silty clay, wet.		H=0.0
		12		SH / 1 / 3	5	47			
	25								

WATER LEVEL: **21.2**
WATER NOTE: **Inside HSA**
DATE: **4/17/09**

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0906
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **569.5** DATE: **4/17/09**

DRILLING METHOD: **3-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **35.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler, 3" O.D. Shelby Tube Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	25						Very-loose brown fine to medium sand, interbedded with very-soft to medium-stiff silty clay, wet.		
		13		SH / 2 / 3	7				
		14		1 / 1 / 2	4	100			G
	30								
		15		SH / 1 / 2	4	87			H=0.5
		16		1 / 2 / 2	5	80			H=0.75
534.5	35						- Encountered seepage at 18.5'. - Encountered water at 21.0'. - Boring location and elevation surveyed by AEP. - Boring backfilled with grout upon completion.		
	40								
	45								
	50								

WATER LEVEL: 21.2
WATER NOTE: Inside HSA
DATE: 4/17/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves

H - Penetrometer (tsf)
W - Unit Dry Wt (pcf)
D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0907
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **599.4** DATE: **4/14/09 - 4/15/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **60.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	TEST RESULTS
	0						FILL: Medium-dense bottom ash.	
		1		9 / 9 / 11	27	100		H=4.0-4.5+
596.9							FILL: Very-stiff to hard brown mottled with gray silty clay, trace fine to coarse sand, trace fine gravel, iron oxide stains near top of stratum, dry to damp.	
		2		7 / 8 / 11	26	100		H=4.0-4.5+
	5	3		3 / 5 / 7	16	100		H=3.5-4.5+
		4		6 / 8 / 8	22	100		H=1.0-2.0
592.4							FILL: Stiff to hard brown mottled with gray silty clay, some fine sand, trace medium to coarse sand, trace fine gravel, damp becoming moist at 17.5'.	
		5		2 / 3 / 6	12	100		H=2.0-3.5
		6		3 / 5 / 6	15	100		H=3.0-3.5
	10	7		6 / 7 / 8	21	100		H=3.0-3.5
		8		2 / 5 / 6	15	80		H=2.5-3.5
		9		2 / 4 / 5	12	73		H=2.5-3.5 G
	15	10		5 / 7 / 6	18	87		H=2.0-3.5
		11		3 / 4 / 6	14	80		H=1.5-2.5
		12		P				G H=2.0-2.5
	20	13		2 / 4 / 5	12	87		H=2.5-3.5
		14		2 / 2 / 6	11	67		H=2.0-2.5
		15		6 / 7 / 9	22	7		H=2.5-4.0
	25	16		2 / 4 / 6	14	100		H=2.0-3.5

NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT — 10 20 30 40

WATER LEVEL: "Dry"
WATER NOTE: Inside HSA
DATE: 4/15/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0907
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **599.4** DATE: **4/14/09 - 4/15/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **60.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	25	17		8 / 11 / 11	30	100	FILL: Stiff to hard brown mottled with gray silty clay, some fine sand, trace medium to coarse sand, trace fine gravel, damp becoming moist at 17.5'.		H=2.5-3.5
		18		3 / 5 / 7	16	100			H=2.0-4.0
		19		2 / 5 / 6	15	100			H=3.5-4.5
	30	20		3 / 5 / 6	15	100			H=2.0-3.5
		21		4 / 7 / 8	21	100			H=3.5-4.5 G
563.9	35	22		4 / 7 / 10	23	100	Very-stiff to hard brown mottled with gray silty clay, trace to little fine to coarse sand, moist.		H=4.5+
		23		4 / 6 / 8	19	100			H=4.5+ G
	40	24		1 / 2 / 5	10	80			H=2.5-4.5
	45	25		4 / 6 / 11	23	100			H=3.5-4.5
553.4		26		2 / 5 / 7	16	100	Stiff to very-stiff brown silty clay, some to "and" fine to coarse sand, contains zone of brown fine to medium sand, moist.		H=2.0-3.5 G
	50	27		2 / 5 / 6	15	100			H=2.0

WATER LEVEL: "Dry"
WATER NOTE: Inside HSA
DATE: 4/15/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0907
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **599.4** DATE: **4/14/09 - 4/15/09**

DRILLING METHOD: **4-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **60.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	50						Stiff to hard brown silty clay, some to "and" fine to coarse sand, contains zone of brown fine to medium sand, moist.		
		28		2 / 2 / 4	8	80			H=1.5-2.0 G
546.4									
		29		1 / 2 / 6	11	67	Stiff brown mottled with gray silty clay interbedded with fine to medium sand and silt seams, iron oxide stains near bottom of stratum, moist.		H=1.0-1.5
	55								
542.4		30		SH / 1 / 2	4	80			H=1.0-1.5
							Loose brown fine to medium sand, interbedded with silt and silty clay seams, iron oxide stains, moist..		
539.9		31A		1 / 2 / 5	10	100			H=0.5-1.0
539.4	60	31B				100	Medium-stiff gray silty clay "and" fine sand, iron oxide stains, moist.		H=0.5-1.0
							- Encountered seepage at 48.0'. - Boring location and elevation surveyed by AEP. - Boring backfilled with grout upon completion.		
	65								
	70								
	75								

WATER LEVEL: "Dry"
WATER NOTE: Inside HSA
DATE: 4/15/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation Q - Uncon Comp T - Triax Comp C - Consol.	See Separate Curves	H - Penetrometer (tsf) W - Unit Dry Wt (pcf) D - Relative Dens (%)

Drill Rod Energy Ratio : 0.82
Last Calibration Date : 11/19/07
Drill Rig Number : D50

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0908
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **588.6** DATE: **10/28/09**

DRILLING METHOD: **3-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **55.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	TEST RESULTS
588.3	0						ASH/BOILER SLAG	
		01	■	5/5/5	14	100	FILL: Very-stiff to hard brown mottled with dark brown silty clay, some fine sand, trace medium to coarse sand, trace fine gravel, damp.	H=3.25-4.5+
		02	■	2/4/4	11	87		H=3.75-4.5
	5	03	■	3/4/5	13	93		H=3.5
		04	■	P				T, H=3.5
	10							G
		05	■	3/3/6	13	100		H=3.25-4.5
575.6							FILL: Very-stiff to hard brown mottled with gray and dark-brown silty clay, some fine sand, trace medium to coarse sand, trace fine gravel, few lenses of silt.	
		06	■	2/4/5	13	100		H=3.25-4.5
	15							G
		07	■	3/4/6	14	100		H=3.25-4.5+
		08	■	5/8/11	27	100		H=4.5+
	20							
		09	■	4/6/7	18	100		H=4.5+
		10	■	P				H=4.5+
563.6	25							

NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT; 10 20 30 40

WATER LEVEL: 50.1
WATER NOTE: Inside HSA
DATE: 10/28/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. (See Separate Curves)
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.85
Last Calibration Date : 02/17/09
Drill Rig Number : ATV 550X

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0908
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **588.6** DATE: **10/28/09**

DRILLING METHOD: **3-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **55.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	TEST RESULTS
	25							
562.7		11A		4 / 6 / 9	21	100	Dark-gray silt, trace fine to coarse sand, trace fine gravel, slightly organic, damp.	H=4.5+
		11B					Hard brown mottled with gray and dark-brown silty clay, trace fine to coarse sand, trace fine gravel, damp.	H=4.5+
559.5		12A		2 / 3 / 4	10	100		H=4.5+
	30	12B					Hard dark-brown mottled with gray and brown and gray silty clay, trace fine sand, few lenses of silt, damp.	H=4.5+
556.9		13A		3 / 7 / 9	23	100		H=4.5+ G
		13B					Very-stiff to hard brown silty clay, little fine sand, few lenses of silt, damp.	H=4.5+
		14		3 / 6 / 8	20	100		H=4.5+
	35	15		3 / 6 / 7	18	100		H=3.1-3.4
553.1								
		16		3 / 5 / 7	17	100	Very-stiff to hard brown mottled with gray and dark-brown silty clay, little fine sand, few lenses of fine sand and silt, moist.	H=4.3
		17		3 / 3 / 7	14	100		H=2.7-3.3
550.1								
		18		2 / 3 / 4	10	100	Stiff to very-stiff brown mottled with dark-brown and gray silty clay interbedded with fine sand and silt, some fine sand, trace medium to coarse sand, trace fine gravel, moist becoming wet.	H=1.8 G
	40	19		2 / 3 / 3	9	100		H=2.0
547.1								
		20		1 / 3 / 5	11	100	Stiff to very-stiff brown silty clay, little to some fine to medium sand, few lenses of fine sand and silt near top of stratum, moist becoming wet.	H=2.4-3.1
		21	P					H=1.5
	45							
543.0								
		22A		4 / 5 / 4	13	100	Medium-dense brown and dark-brown fine sand, trace medium sand, trace silt, few silty clay seams.	
		22B						
540.9		23A		7 / 11 / 9	28	100	Medium-dense brown and dark-brown fine to coarse sand, some fine gravel, trace silt.	
		23B						
	50		3					

NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT — 10 20 30 40

WATER LEVEL: 50.1
WATER NOTE: Inside HSA
DATE: 10/28/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.85
Last Calibration Date : 02/17/09
Drill Rig Number : ATV 550X

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0908
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **588.6** DATE: **10/28/09**

DRILLING METHOD: **3-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **55.0'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	50	24		/ 6 / 9	21	93	Medium-dense brown and dark-brown fine to coarse sand, some fine gravel, trace silt.		
		25		1 / 2 / 7	13	53			
		26		WR / 2 / 8	14	100			
533.6	55						- Encountered seepage at 39.5'. - Encountered water at 46.1'. - Boring backfilled with cement-bentonite grout upon completion. - Boring location and elevation surveyed by AEP.		
	60								
	65								
	70								
	75								

WATER LEVEL: **50.1**
WATER NOTE: **Inside HSA**
DATE: **10/28/09**

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves

H - Penetrometer (tsf)
W - Unit Dry Wt (pcf)
D - Relative Dens (%)

Drill Rod Energy Ratio : 0.85
Last Calibration Date : 02/17/09
Drill Rig Number : ATV 550X

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0909
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: See Plate 2 of Appendix A | ELEVATION: 562.2 | DATE: 10/29/09

DRILLING METHOD: 3-1/4" I.D. Hollow-stem Auger | COMPLETION DEPTH: 33.9'

SAMPLER(S): 2" O.D. Split-barrel Sampler

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	0						ROADWAY GRANULAR BASE - 29 INCHES		
		01A		21/49/41	128				
559.7									
559.2							Hard brown clayey silt, trace fine to coarse sand, slightly organic, damp.		
		02		2/4/4	11				H=4.2-4.5+
							Very-stiff to hard brown mottled with gray and dark-brown silty clay, trace fine to coarse sand, damp.		
	5	03		3/4/4	11				
		04		2/2/3	7				H=3.25-3.5
									G
		05		2/2/3	7				H=2.75-3.25
				P					
	10	06							H=2.5
		07		1/3/5	11				H=2.25-2.5
549.7									
							Stiff to very-stiff brown mottled with gray and dark-brown silty clay, trace fine to coarse sand, few lenses of silt, moist.		G
		08		2/3/4	10				H=1.75-2.25
	15	09		1/3/3	9				H=1.5-2.25
546.2									
				P			Medium-stiff to stiff brown mottled with dark-brown silty clay, trace fine to medium sand, few lenses of silt, moist.		T
		10							H=0.75
544.7									
				WH-18"			Soft to medium-stiff brown silty clay, interbedded with silt, little fine sand, trace medium sand, wet.		G
		11							H=0.5-0.75
542.7									
	20	12		WH/1/2	4		Very-soft to soft brown silty clay interbedded with silt, trace fine sand, few lenses of fine sand, wet.		G
									H=0.25
		13							H=0.25
				WH-18"					
		13A							H=0.25
538.6									
		13B		WH/1/2	4		Soft to medium-stiff gray mottled with dark-gray and brown silty clay, little to some fine sand, few lenses of silt and fine sand, wet.		H=0.75
	25	14							H=1.75-

WATER LEVEL: 20.4
WATER NOTE: Inside HSA
DATE: 10/29/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.85
Last Calibration Date : 02/17/09
Drill Rig Number : ATV 550X

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0909
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **562.2** DATE: **10/29/09**

DRILLING METHOD: **3-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **33.9'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
	25						Soft to medium-stiff gray mottled with dark-gray and brown silty clay, little to some fine sand, few lenses of silt and fine sand, wet.		1.25
		15		WH / WH / 1	1				H=0.75 G
534.8		16A		WH					H=0.75
534.3		16B		2 / 3	7		Loose brown fine sand, trace medium sand, little silt, wet.		
533.6		16C							H=0.75 G
		17A		1			Soft gray silty clay, trace fine sand, wet.		
		17B		4 / 3	10		Very-loose to loose gray fine sand, trace medium sand, little silt, wet.		H=0.3
	30								
		18		WR / WH / 1	1				
530.1		19A		WR					
		19B		3 / 9	17		Medium-dense to very-dense brown fine to medium sand, and fine to coarse gravel, trace coarse sand, trace silt, wet.		
528.3		20		5 / 11 / 30	58				
	35						- Encountered water at 20.4'. - Boring backfilled with cement-bentonite grout upon completion. - Boring location and elevation surveyed by AEP.		
	40								
	45								
	50								

WATER LEVEL: **20.4**
WATER NOTE: **Inside HSA**
DATE: **10/29/09**

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation
Q - Uncon Comp
T - Triax Comp
C - Consol.
(See Separate Curves)

H - Penetrometer (tsf)
W - Unit Dry Wt (pcf)
D - Relative Dens (%)

Drill Rod Energy Ratio : 0.85
Last Calibration Date : 02/17/09
Drill Rig Number : ATV 550X

2009 NEW DEFAULT BORING LOG-W/ N60 11149701 4.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0910
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **565.4** DATE: **10/29/09**

DRILLING METHOD: **3-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **35.5'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	TEST RESULTS
565.1	0						GRAVEL - 3 INCHES	
564.0		1		30/12/10	31	27	FILL: Hard brown silty clay, intermixed with dark-gray silt, trace fine to coarse sand, slightly organic, damp.	H=4.5+
		2		4/5/6	16	57	Very-stiff to hard brown mottled with gray and dark-brown silty clay, trace fine to coarse sand, few lenses of silt.	H=3.75
	5	3		4/5/4	13	53		H=2.5-2.75
		4		P				
		5		4/5/5	14	100		H=2.5-3.25
	10	6		P				H=2.75
553.4		7		2/3/4	10	100	Stiff to very-stiff dark-brown mottled with brown and gray silty clay, trace fine to medium sand, few lenses of silt, moist.	H=1.8-2.3
		8		2/2/4	9	100		H=1.7-2.2
550.6	15	9		1/1/2	4	100	Medium-stiff to stiff brown silty clay, some fine sand, trace medium sand, few lenses and seams of silt, moist.	H=0.75-1.25 G
548.4		10		P			Soft to medium-stiff brown clayey silt, "and" fine sand, trace medium to coarse sand, few lenses of fine sand and silt.	H=0.7-1.1 T G
546.0	20	11		WH/1/1	3	100	Very-soft to soft brown mottled with dark-brown silty clay, some fine sand, trace medium sand, few lenses and seams of fine sand, many lneses of silt near top of stratum, wet.	H=0.5
543.4		12		WH/1/1	3	100		H=0.25-0.5 G
541.9		13		WH/1/1	3	100	Very-loose brown fine sand interbedded with silty clay, trace medium to coarse sand, wet.	H=0.2-0.3
	25	14		WH-18"		100	Soft brown mottled with gray and dark-brown silty clay, trace to little fine to medium sand, few lenses of fine sand.	H=0.25-0.3 G

NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT — 10 20 30 40

WATER LEVEL: 2.5
WATER NOTE: Inside HSA
DATE: 10/29/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf)
W - Unit Dry Wt (pcf)
D - Relative Dens (%)

Drill Rod Energy Ratio : 0.85
Last Calibration Date : 02/17/09
Drill Rig Number : ATV 550X

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0910
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **565.4** DATE: **10/29/09**

DRILLING METHOD: **3-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **35.5'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	TEST RESULTS
	25							
		15A		WH-18"		100	Soft brown mottled with gray and dark-brown silty clay, trace to little fine to medium sand, few lenses of fine sand.	H=-0.3
539.2								
		15B						H=0.25-0.5
		16A		WH / 2 / 3	7	100	Very-soft to medium-stiff gray mottled with brown clayey silt interbedded with silt and fine sand, trace medium to coarse sand, wet.	H=0.0-0.6
537.8								
537.6		16B						G
		16C		WH / 1 / 1			Medium-stiff brown silty clay, trace fine sand, wet.	H=0.75
		17A			3	100		
536.0								
		17B					Very-loose gray fine sand, trace medium sand, trace to little silt, wet.	H=0.2
	30	18		WH / 2 / 2	6	100	Very-soft to soft gray silty clay, trace fine sand, few seams of silt and fine sand, wet.	H=0.25 G
534.1		19A		WH / 4 / 7	2	100		
533.8		19B			16		Decayed wood with fine sand seams.	
		19C					Medium-dense orange-brown and dark-brown fine to medium sand, trace coarse sand, trace fine gravel, trace silt.	
		20		3 / 6 / 7	18	60		
		21		4 / 7 / 8	21	100		
529.9	35							
	40							
	45							
	50							

NATURAL CONSISTENCY INDEX — NATURAL MOISTURE CONTENT — PLASTIC LIMIT — LIQUID LIMIT — 10 20 30 40

- Encountered water at 19.4'.
- Boring backfilled with cement-bentonite grout upon completion.
- Boring location and elevation surveyed by AEP.

WATER LEVEL: 2.5
WATER NOTE: Inside HSA
DATE: 10/29/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves

H - Penetrometer (tsf)
W - Unit Dry Wt (pcf)
D - Relative Dens (%)

Drill Rod Energy Ratio : 0.85
Last Calibration Date : 02/17/09
Drill Rig Number : ATV 550X

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0911
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **565.9** DATE: **10/30/09**

DRILLING METHOD: **3-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **40.5'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
565.4	0						TOPSOIL/ROOTMAT - 6 INCHES		
		1		5 / 8 / 9	24		Hard brown mottled with dark-brown silty clay, trace fine to coarse sand, dry becoming damp.		H=4.5+
									H=4.5+
		2		5 / 6 / 8	20				
		3		5 / 6 / 6	17				H=4.5+
	5								
		4		6 / 9 / 8	24				H=4.5+
		5		4 / 5 / 5	14				H=4.0-4.5+
557.5							Medium-stiff to stiff brown silty clay, some to "and" fine sand, damp becoming moist.		
		6		2 / 2 / 4	9				H=1.5-2.25
	10								
		7		P					H=0.9
552.9									
		8		2 / 3 / 3	9		Stiff brown mottled with dark-brown silty clay, some fine sand, trace medium to coarse sand, few lenses of silt, moist.		H=1.5
		9		1 / 2 / 4	9				H=1.25-1.75
	15								
		10		P					H=1.25
548.3									
		11		WR / WH / 2	3		Soft to medium-stiff brown mottled with dark-brown silty clay, trace to little fine sand, trace medium sand, few lenses of silt, wet.		H=0.75 G
	20	12		WH / 2 / 2	6				H=0.3-0.5
544.3		13A		WH-18"					
		13B					Very-soft to soft gray mottled with brown silty clay, little fine sand, trace medium sand, many lenses of silt, wet.		H=0.1-0.2 G
		14		WR / WH / 3	4				H=0.0-0.3
541.9				WH / 1 / 3	6				
	25	15A					Medium-stiff to stiff gray mottled with brown silty clay, little fine sand, many lenses of silt,		H=0.6-1.2

WATER LEVEL: 29.5
WATER NOTE: Inside HSA
DATE: 10/30/09

SYMBOLS USED TO INDICATE TEST RESULTS
G - Gradation, Q - Uncon Comp, T - Triax Comp, C - Consol. — See Separate Curves
H - Penetrometer (tsf), W - Unit Dry Wt (pcf), D - Relative Dens (%)

Drill Rod Energy Ratio : 0.85
Last Calibration Date : 02/17/09
Drill Rig Number : ATV 550X

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

LOG OF BORING NO. GV-BAP-0911
AEP GAVIN PLANT BOTTOM ASH POND
CHESHIRE, OHIO

BBCM

LOCATION: **See Plate 2 of Appendix A** ELEVATION: **565.9** DATE: **10/30/09**

DRILLING METHOD: **3-1/4" I.D. Hollow-stem Auger** COMPLETION DEPTH: **40.5'**

SAMPLER(S): **2" O.D. Split-barrel Sampler**

ELEV.	DEPTH, FEET	SAMPLE NUMBER	SAMPLE	SAMPLE EFFORT	N_{60}	SAMPLE REC-%	DESCRIPTION	NATURAL CONSISTENCY INDEX / NATURAL MOISTURE CONTENT (PLASTIC LIMIT – LIQUID LIMIT; 10 20 30 40)	TEST RESULTS
540.7	25	15B					wet.		
538.9		16		WH / WH / 2	3		Very-soft brown mottled with dark-brown silty clay interbedded with silt and fine sand, trace medium sand, wet.		H=0.2 G
537.4		17		WH / 1 / 2	4		Very-loose gray, brown, and red-brown silt interbedded with silty clay, trace fine sand, few seams of fine sand, wet.		H=0.3-0.4
		18		WH / 1 / 2	4		Medium-stiff gray silty clay, interbedded with silt and fine sand, contains decayed vegetation, wet.		H=0.6-0.8
535.7	30	19A		WH / 2 / 2	6		Very-loose to loose gray silt interbedded with silty clay and fine sand, trace medium sand, wet.		H=0.1
532.9		19B							
		20		WR / WH / 2	3				H=0.1 G
		21		WH / 1 / 2	4		Medium-stiff gray clayey silt, trace fine sand, few lenses of silt and fine sand, wet.		H=0.8
530.2	35	22A		WH / 1 / 7	11				H=0.6
		22B					Medium-dense brown fine to medium sand, trace coarse sand, trace fine gravel, trace silt, wet.		
		23		WH / 2 / 5	10				
		24A		2 / 3 / 7	14				
		24B							
525.4	40	25		6 / 6 / 12	26				
	45						- Encountered seepage at 17.6'. - Boring backfilled with cement-bentonite grout upon completion. - Boring location and elevation surveyed by AEP.		
	50								

WATER LEVEL: 29.5
WATER NOTE: Inside HSA
DATE: 10/30/09

SYMBOLS USED TO INDICATE TEST RESULTS

G - Gradation Q - Uncon Comp T - Triax Comp C - Consol.	See Separate Curves	H - Penetrometer (tsf) W - Unit Dry Wt (pcf) D - Relative Dens (%)

Drill Rod Energy Ratio : 0.85
Last Calibration Date : 02/17/09
Drill Rig Number : ATV 550X

2009 NEW DEFAULT BORING LOG-W/ N60 11497014.GPJ BBCM.GDT 3/16/10

Appendix III – 2009/2010 Laboratory Testing Results

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	GRADATION			COMPACTION		TRIAXIAL					DIRECT SHEAR			UNCONFIN COMPRESS	CONSOLID.	SPECIFIC GRAVITY	UNIT WEIGHT DRY	REMOLDED	PERMEABILITY				RELATIVE DENSITY	LOI	ROCK CORE	SHELBY TUBE	CBR
							Hydrometer																									
						sieve	short	long	standard	modified	unconsn. undrain	consolid undrain	w/pores	drained	drained	undrain	residual							cohesive	non/cohes	rigid wall	flexible wall					
		%	%	%	%	* SEE INDIVIDUAL TEST CURVES															PCF						%	%			
BAP-0901	4.75	19																														
BAP-0901	7.50	20	41	22	19	*		*				*									104.4										*	
BAP-0901	12.75	23	48	23	25																											
BAP-0901	17.25	22	53	25	28	*		*																								
BAP-0901	19.75	21	42	22	20	*		*				*									105.6			*			*				*	
BAP-0901	20.50	22										*									104.8											
BAP-0901	26.75	16	34	17	17	*		*																								
BAP-0901	31.75	18	38	20	18																											
BAP-0901	34.25	15	29	18	11	*		*																								
BAP-0901	39.25	18	26	18	8																											
BAP-0901	44.25	23	30	21	9	*		*																								
BAP-0901	46.75	25																														
BAP-0901	49.45	29	24	19	5																											
BAP-0901	51.35					*																										
BAP-0901	54.25					*																										
BAP-0902	7.75	20	41	20	21																											
BAP-0902	11.75	18	35	20	15																											
BAP-0902	19.25	22	32	21	11	*		*																								
BAP-0902	24.25					*																										
BAP-0902	26.75	30	21	16	5																											

BBCM
SOLUTIONS TO BUILD ON

TESTING SUMMARY - STANDARD

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/2/09

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	GRADATION			COMPACTION		TRIAXIAL					DIRECT SHEAR			UNCONFIN COMPRESS	CONSOLID.	SPECIFIC GRAVITY	UNIT WEIGHT DRY	REMOLDED	PERMEABILITY				RELATIVE DENSITY	LOI	ROCK CORE	SHELBY TUBE	CBR
							Hydrometer																										
						sieve	short	long	standard	modified	unconsn.	undrain	consolid	undrain w/pores	drained	drained	undrain	residual						cohesive	non/cohes	rigid wall	flexible wall						
		%	%	%	%	* SEE INDIVIDUAL TEST CURVES																PCF						%	%				
BAP-0902	31.75					*																											
BAP-0903	4.75	23	38	21	17																												
BAP-0903	5.60																															*	
BAP-0903	8.25	20																															
BAP-0903	11.25	22	42	21	21																												
BAP-0903	15.75	23	52	24	28	*		*																									
BAP-0903	21.75	21	30	18	12																												
BAP-0903	27.75	19	41	22	19																												
BAP-0903	34.25	19	44	22	22	*		*																									
BAP-0903	41.75	24	53	22	31	*		*																									
BAP-0903	46.75	22	38	19	19																												
BAP-0903	51.75	25	24	19	5																												
BAP-0903	56.75	25	35	19	16	*		*																									
BAP-0904	4.75	24	44	22	22																												
BAP-0904	7.75	30	43	26	17	*		*																									
BAP-0904	11.75	23	42	20	22																												
BAP-0904	16.75	26																															
BAP-0904	19.25	28	30	20	10																												
BAP-0904	24.25	29	32	19	13	*																											
BAP-0904	29.25					*																											

BBCM
SOLUTIONS TO BUILD ON

TESTING SUMMARY - STANDARD

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/2/09

SUM REG 11497014.GPJ BBCM.GDT 6/2/09

PLATE 2

ED_005405A_00000217-00085

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	GRADATION			COMPACTION		TRIAXIAL				DIRECT SHEAR			UNCONFIN COMPRESS	CONSOLID.	SPECIFIC GRAVITY	UNIT WEIGHT DRY	REMOLDED	PERMEABILITY				RELATIVE DENSITY	LOI	ROCK CORE	SHELBY TUBE	CBR
							Hydrometer																								
						sieve	short	long	standard	modified	unconsn. undrain	consolid undrain	w/pores	drained	drained	undrain	residual						cohesive	non/cohes	rigid wall	flexible wall					
		%	%	%	%	* SEE INDIVIDUAL TEST CURVES															PCF						%	%			
BAP-0904	34.25	29	32	19	13																										
BAP-0905	4.75	18	38	20	18																										
BAP-0905	12.25	20	43	23	20	*		*																							
BAP-0905	15.25	22	44	24	20																										
BAP-0905	19.75	21																													
BAP-0905	21.25	21	40	23	17	*		*													108.0		*			*				*	
BAP-0905	26.25	18	39	19	20	*		*																							
BAP-0905	29.25	20																													
BAP-0905	31.75	17	29	18	11																										
BAP-0905	34.25					*																									
BAP-0905	36.75	19	28	18	10	*		*																							
BAP-0905	43.75	25	42	21	21	*		*																							
BAP-0905	49.25	28	38	22	16																										
BAP-0905	54.25					*																									
BAP-0906	6.25	18	35	20	15	*		*																							
BAP-0906	9.25	23	45	22	23																										
BAP-0906	14.25	25	33	21	12																										
BAP-0906	19.25	27	34	21	13	*		*																							
BAP-0906	29.25					*																									
BAP-0907	4.75	22	41	21	20																										

BBCM
SOLUTIONS TO BUILD ON

TESTING SUMMARY - STANDARD

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/2/09

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	GRADATION			COMPACTION		TRIAXIAL					DIRECT SHEAR			UNCONFIN COMPRESS	CONSOLID.	SPECIFIC GRAVITY	UNIT WEIGHT DRY	REMOLDED	PERMEABILITY				RELATIVE DENSITY	LOI	ROCK CORE	SHELBY TUBE	CBR
							Hydrometer																									
						sieve	short	long	standard	modified	unconsn. undrain	consolid undrain	w/pores	drained	drained	undrain	residual							cohesive	non/cohes	rigid wall	flexible wall					
		%	%	%	%	* SEE INDIVIDUAL TEST CURVES																PCF						%	%			
BAP-0907	9.25	17	34	18	16																											
BAP-0907	13.75	18	32	16	16	*		*																								
BAP-0907	17.75	20	35	20	15	*		*				*										107.5									*	
BAP-0907	18.25	21										*										108.4										
BAP-0907	26.25	20	41	20	21																											
BAP-0907	34.25	19	52	24	28	*		*																								
BAP-0907	39.25	21	47	24	23	*		*																								
BAP-0907	44.75	19	40	20	20																											
BAP-0907	47.25	18	31	17	14	*		*																								
BAP-0907	51.75	20	32	18	14	*																										
BAP-0907	56.75	24	31	18	13																											

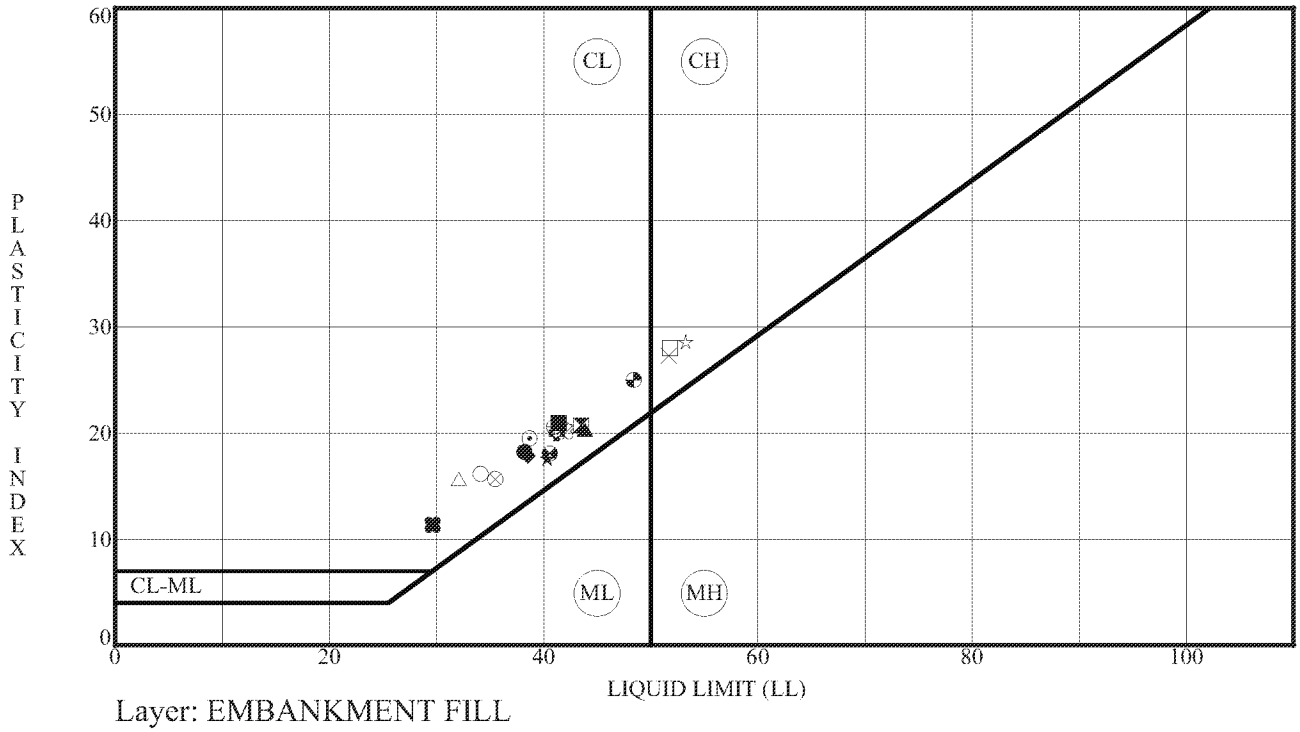
BBCM
SOLUTIONS TO BUILD ON

TESTING SUMMARY - STANDARD

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/2/09

ATTERBERG LIMITS' RESULTS

BBCM



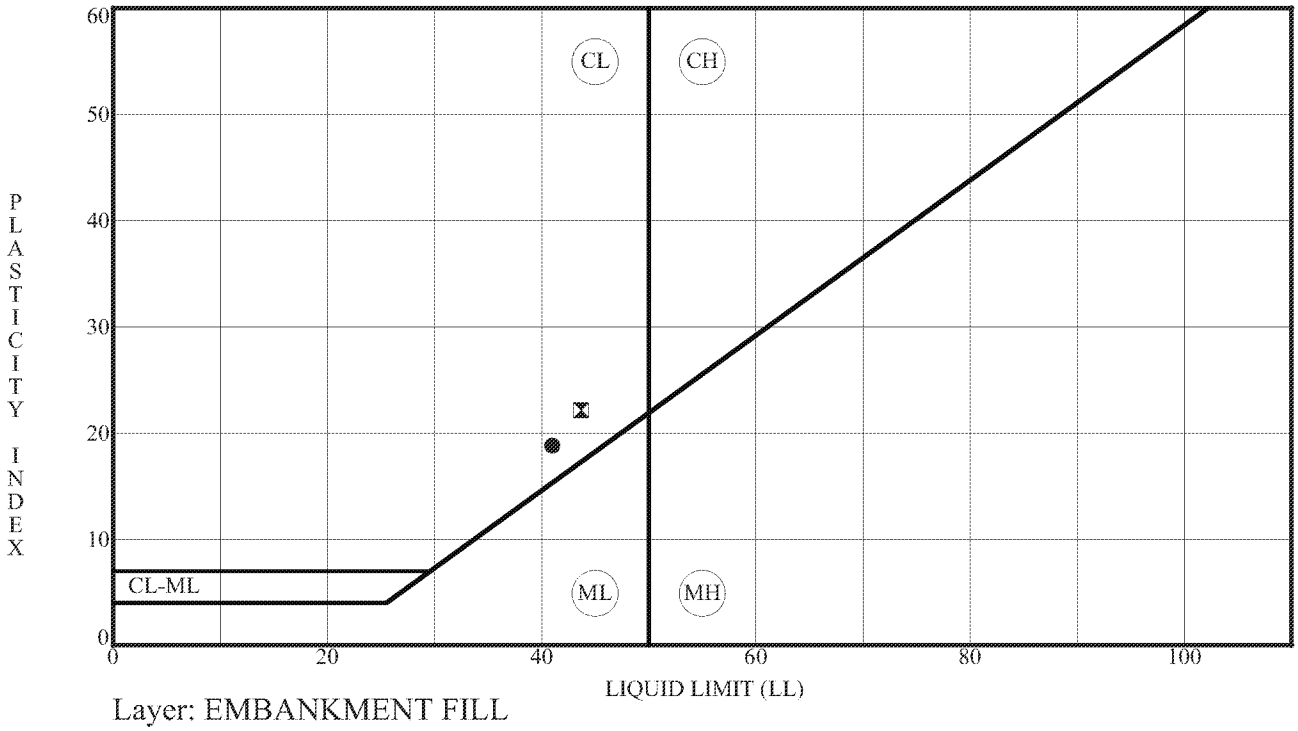
Layer: EMBANKMENT FILL

	Specimen Id.	Depth	MC	LL	PL	PI	Fines	ASTM Classification
●	BAP-0905	4.75	18	38	20	18		
⧗	BAP-0905	12.25	20	43	23	20	95.9	LEAN CLAY CL
▲	BAP-0905	15.25	22	44	24	20		
★	BAP-0905	21.25	21	40	23	17	89.2	LEAN CLAY CL
⊙	BAP-0905	26.25	18	39	19	20	88.9	LEAN CLAY CL
✪	BAP-0907	4.75	22	41	21	20		
○	BAP-0907	9.25	17	34	18	16		
△	BAP-0907	13.75	18	32	16	16	75.6	LEAN CLAY with SAND CL
⊗	BAP-0907	17.75	20	35	20	15	80.6	LEAN CLAY with SAND CL
⊕	BAP-0907	26.25	20	41	20	21		
□	BAP-0907	34.25	19	52	24	28	88.3	FAT CLAY CH
⊖	BAP-0901	7.50	20	41	22	19	91.8	LEAN CLAY CL
◕	BAP-0901	12.75	23	48	23	25		
☆	BAP-0901	17.25	22	53	25	28	93.1	FAT CLAY CH
⊗	BAP-0901	19.75	21	42	22	20	91.2	LEAN CLAY CL
■	BAP-0902	7.75	20	41	20	21		
◆	BAP-0903	4.75	23	38	21	17		
◇	BAP-0903	11.25	22	42	21	21		
╳	BAP-0903	15.75	23	52	24	28	93.8	FAT CLAY CH
⊠	BAP-0903	21.75	21	30	18	12		

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/9/09

ALPI-REG 11149701 4.GPJ BBCM.GDT 6/9/09

ATTERBERG LIMITS' RESULTS



Layer: EMBANKMENT FILL

	Specimen Id.	Depth	MC	LL	PL	PI	Fines	ASTM Classification
●	BAP-0903	27.75	19	41	22	19		
⧗	BAP-0903	34.25	19	44	22	22	88.4	LEAN CLAY CL

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
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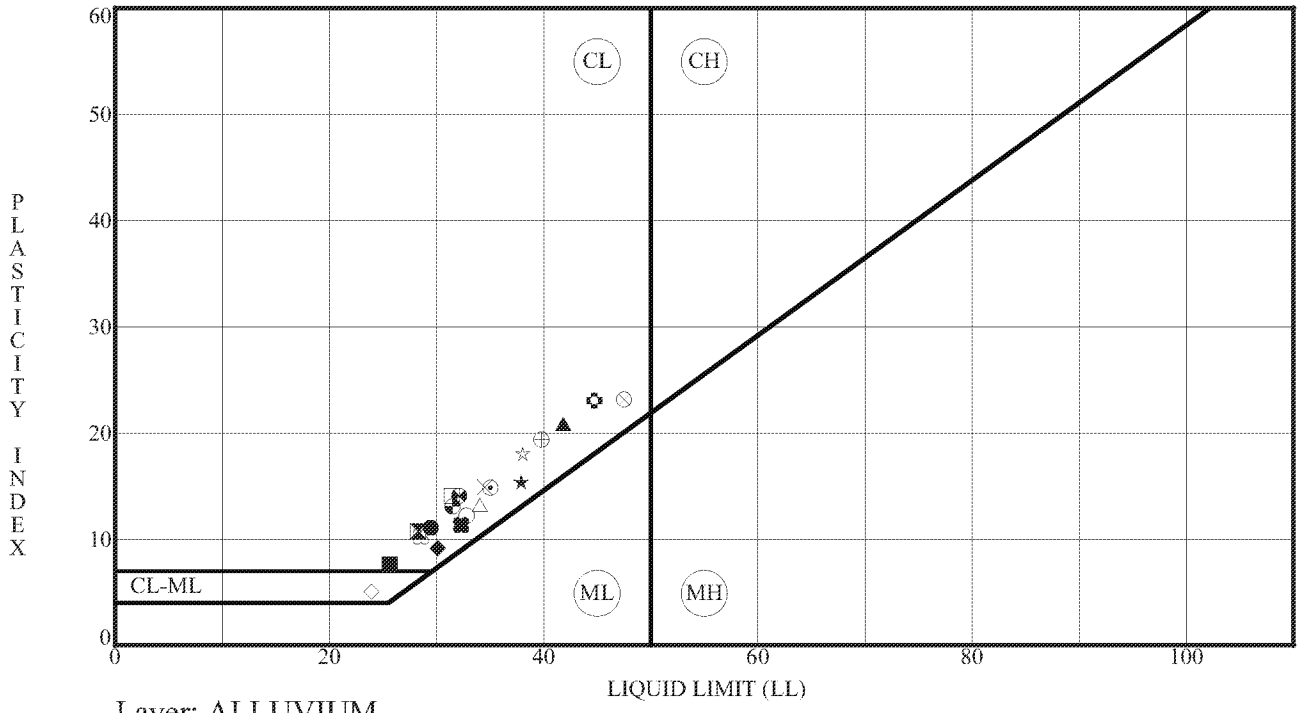
ATTERBERG LIMITS' RESULTS

BBCM



Layer: ALLUVIUM

	Specimen Id.	Depth	MC	LL	PL	PI	Fines	ASTM Classification
●	BAP-0905	31.75	17	29	18	11		
⧗	BAP-0905	36.75	19	28	18	10	66.3	SANDY LEAN CLAY CL
▲	BAP-0905	43.75	25	42	21	21	96.5	LEAN CLAY CL
★	BAP-0905	49.25	28	38	22	16		
⊙	BAP-0906	6.25	18	35	20	15	75.4	LEAN CLAY with SAND CL
✿	BAP-0906	9.25	23	45	22	23		
○	BAP-0906	14.25	25	33	21	12		
△	BAP-0906	19.25	27	34	21	13	87.1	LEAN CLAY CL
⊗	BAP-0907	39.25	21	47	24	23	92.4	LEAN CLAY CL
⊕	BAP-0907	44.75	19	40	20	20		
□	BAP-0907	47.25	18	31	17	14	69.1	SANDY LEAN CLAY CL
⊠	BAP-0907	51.75	20	32	18	14	69.0	SANDY LEAN CLAY CL
◕	BAP-0907	56.75	24	31	18	13		
☆	BAP-0901	31.75	18	38	20	18		
⊘	BAP-0901	34.25	15	29	18	11	67.9	SANDY LEAN CLAY CL
■	BAP-0901	39.25	18	26	18	8		
◆	BAP-0901	44.25	23	30	21	9	77.2	LEAN CLAY with SAND CL
◇	BAP-0901	49.45	29	24	19	5		
╳	BAP-0902	11.75	18	35	20	15		
⌘	BAP-0902	19.25	22	32	21	11	88.8	LEAN CLAY CL

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
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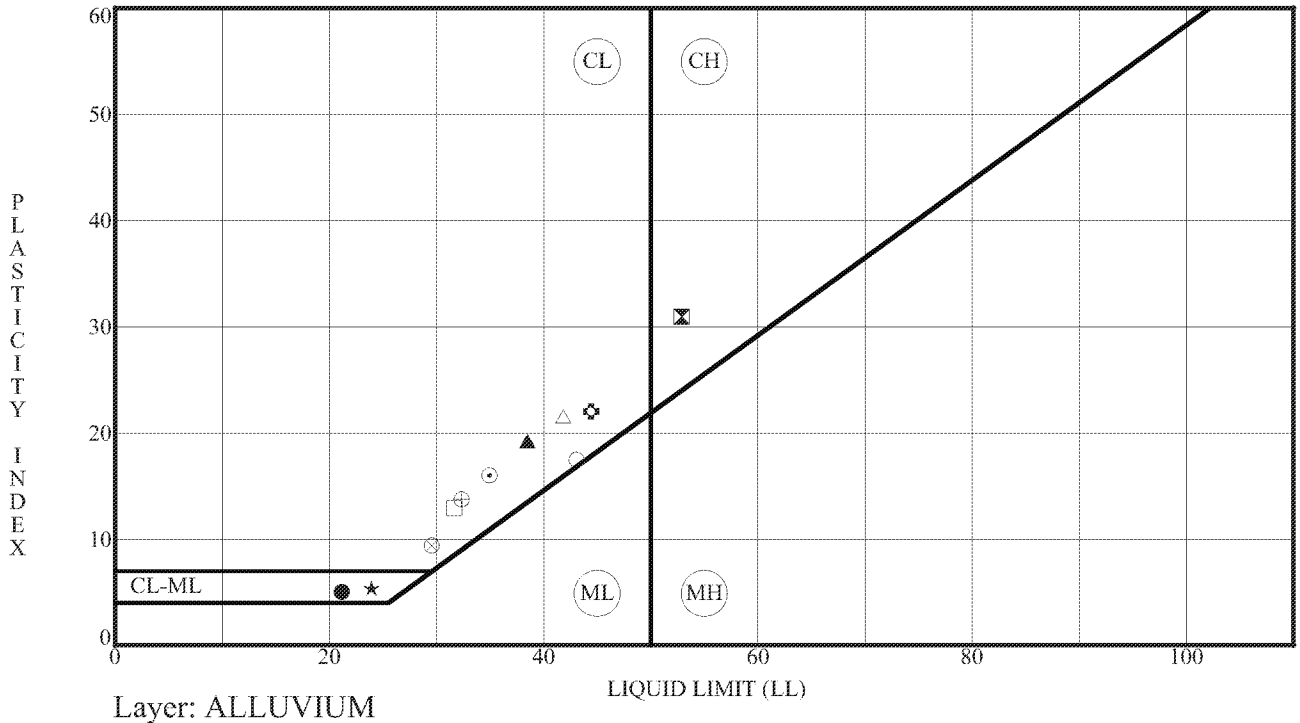
ATTERBERG LIMITS' RESULTS

BBCM



Layer: ALLUVIUM

	Specimen Id.	Depth	MC	LL	PL	PI	Fines	ASTM Classification
●	BAP-0902	26.75	30	21	16	5		
⧗	BAP-0903	41.75	24	53	22	31	92.9	FAT CLAY CH
▲	BAP-0903	46.75	22	38	19	19		
★	BAP-0903	51.75	25	24	19	5		
⊙	BAP-0903	56.75	25	35	19	16	86.8	LEAN CLAY CL
✿	BAP-0904	4.75	24	44	22	22		
○	BAP-0904	7.75	30	43	26	17	96.2	LEAN CLAY CL
△	BAP-0904	11.75	23	42	20	22		
⊗	BAP-0904	19.25	28	30	20	10		
⊕	BAP-0904	24.25	29	32	19	13	76.4	LEAN CLAY with SAND CL
□	BAP-0904	34.25	29	32	19	13		

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
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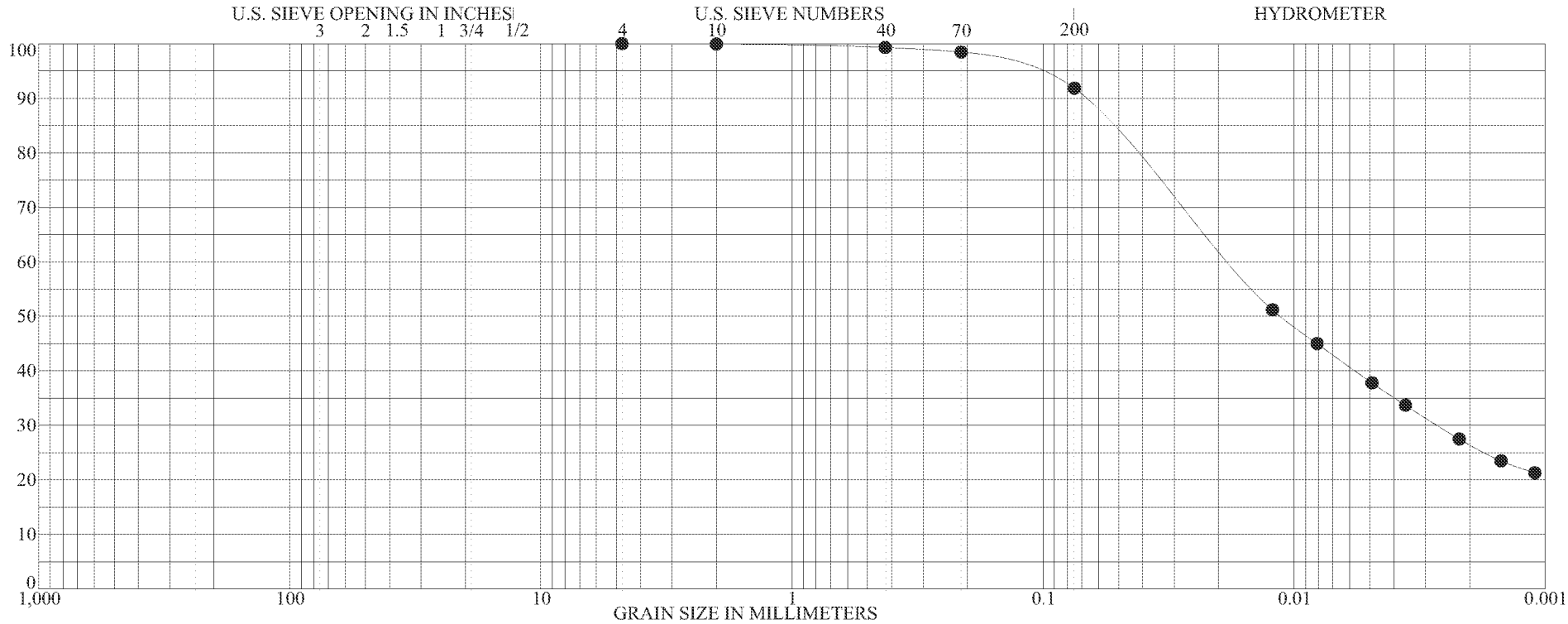

BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0901 S-5 II 7.0' to 7.9'**	**Hard brown and dark-brown silty clay, trace fine to medium sand.**	**20**	**41**	**22**	**19**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0901 S-5 II 7.0' to 7.9'**	**4.7500**	**0.1232**	**0.0181**	**0.0113**		**0.0**	**8.2**	**53.7**	**38.1**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
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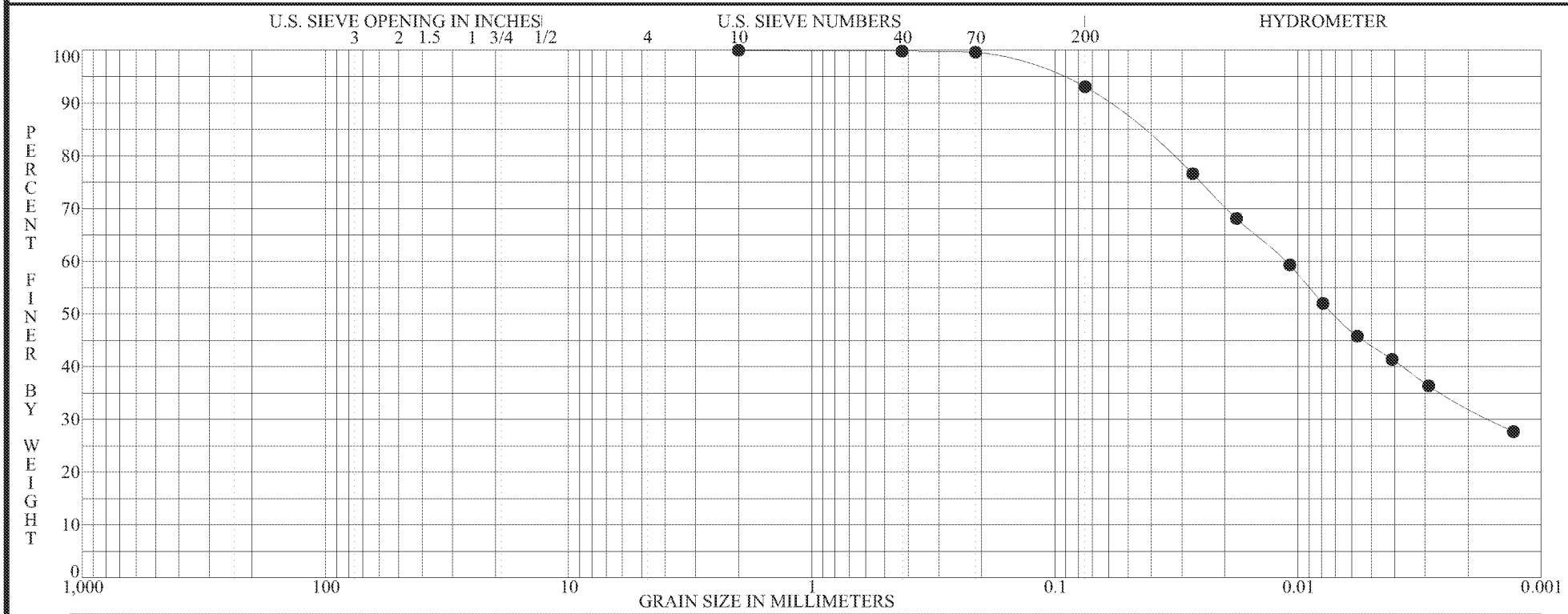
PLATE 9

ED_005405A_00000217-00092



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0901 S-11 16.5' to 17.8'**	**Brown mottled with dark-brown silty clay, trace fine to medium sand, few lenses of silt and gray organic silt.**	**22**	**53**	**25**	**28**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0901 S-11 16.5' to 17.8'**	**2.0000**	**0.1018**	**0.0112**	**0.0071**		**0.0**	**6.9**	**49.0**	**44.1**

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/2/09

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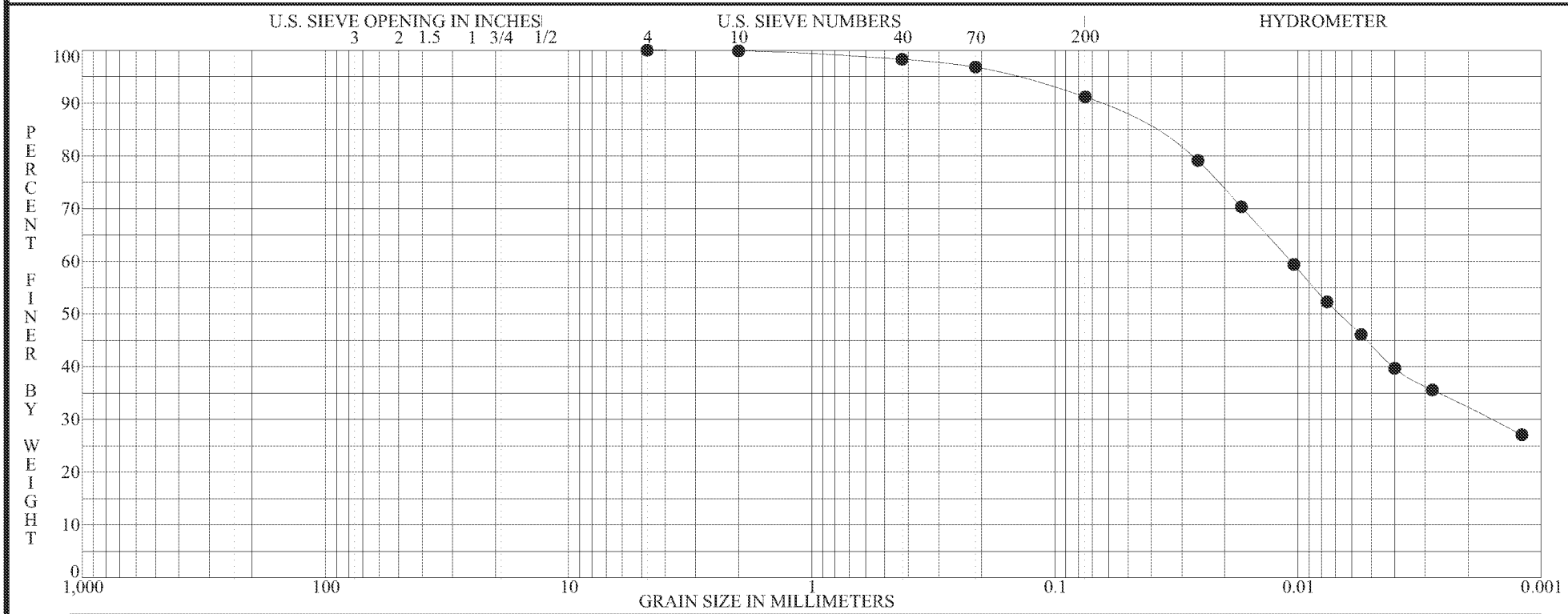
PLATE 10

ED_005405A_00000217-00093



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**BAP-0901 S-13 I 19.5' to 21.5'**	**Stiff to Hard brown mottled with gray and dark-brown silty clay, trace fine to coarse sand.**	**21**	**42**	**22**	**20**		

	Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**BAP-0901 S-13 I 19.5' to 21.5'**	**4.7500**	**0.1522**	**0.0107**	**0.0067**		**0.0**	**8.8**	**47.0**	**44.2**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
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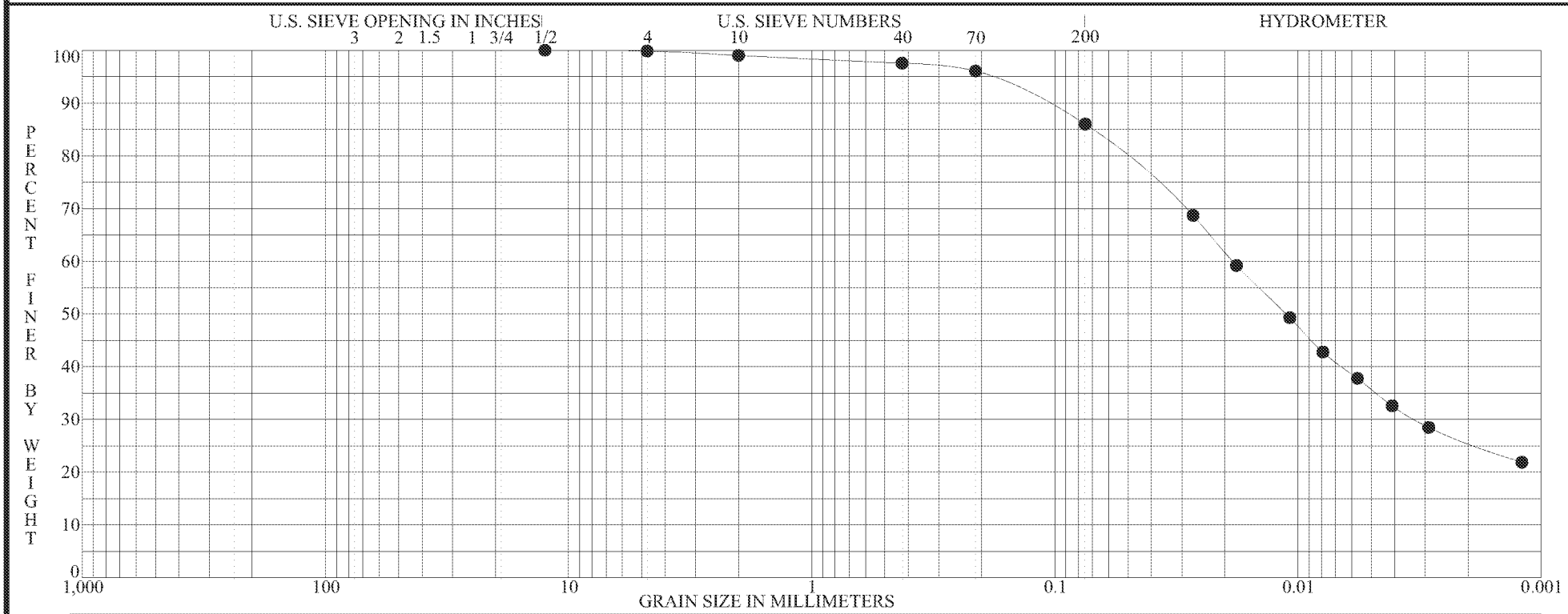
PLATE 11

ED_005405A_00000217-00094



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0901 S-17 26.0' to 27.5'**	**Brown mottled with gray and dark-brown silty clay, little fine sand, trace medium to coarse sand, trace fine gravel.**	**16**	**34**	**17**	**17**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0901 S-17 26.0' to 27.5'**	**12.5000**	**0.1899**	**0.0185**	**0.0112**		**0.1**	**13.9**	**50.3**	**35.7**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
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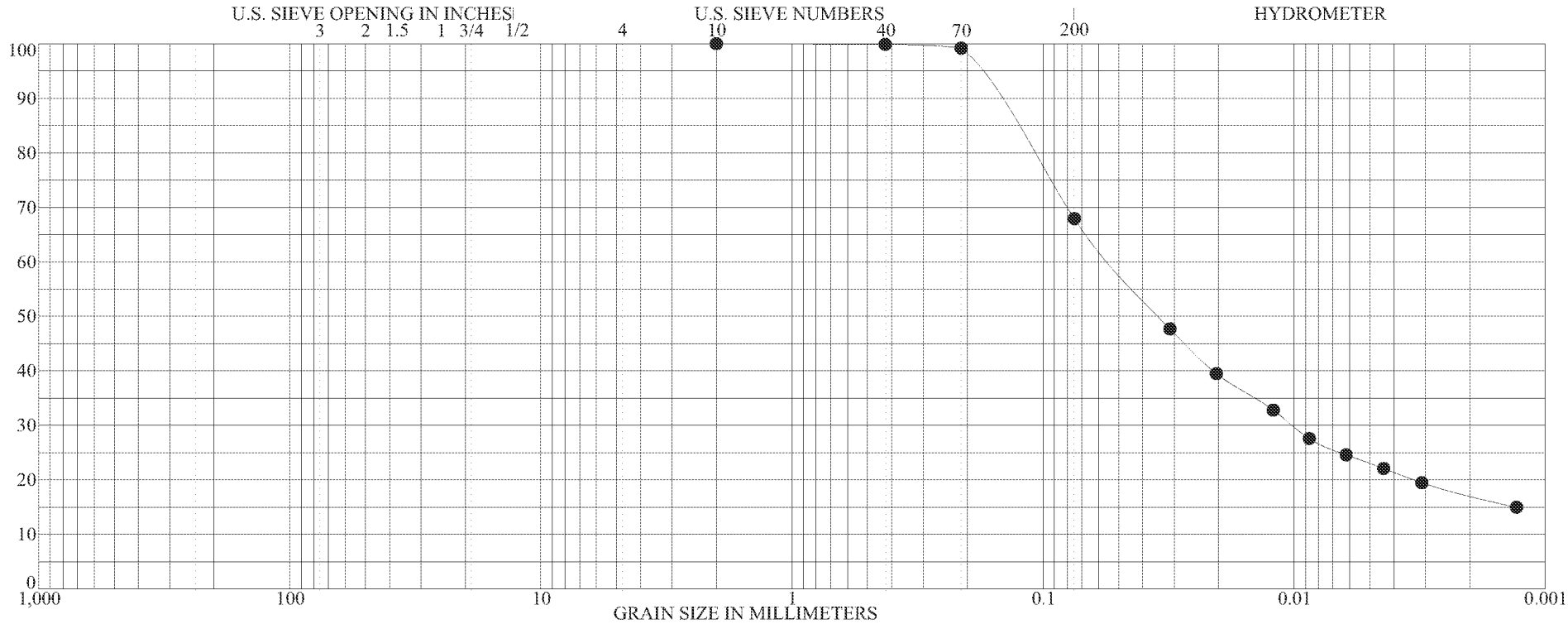
PLATE 12

ED_005405A_00000217-00095



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0901 S-21 33.5' to 35.0'**	**Brown silty clay, some fine sand, trace medium sand, few lenses of silt.**	**15**	**29**	**18**	**11**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0901 S-21 33.5' to 35.0'**	**2.0000**	**0.1845**	**0.0532**	**0.0345**		**0.0**	**32.1**	**44.9**	**23.0**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
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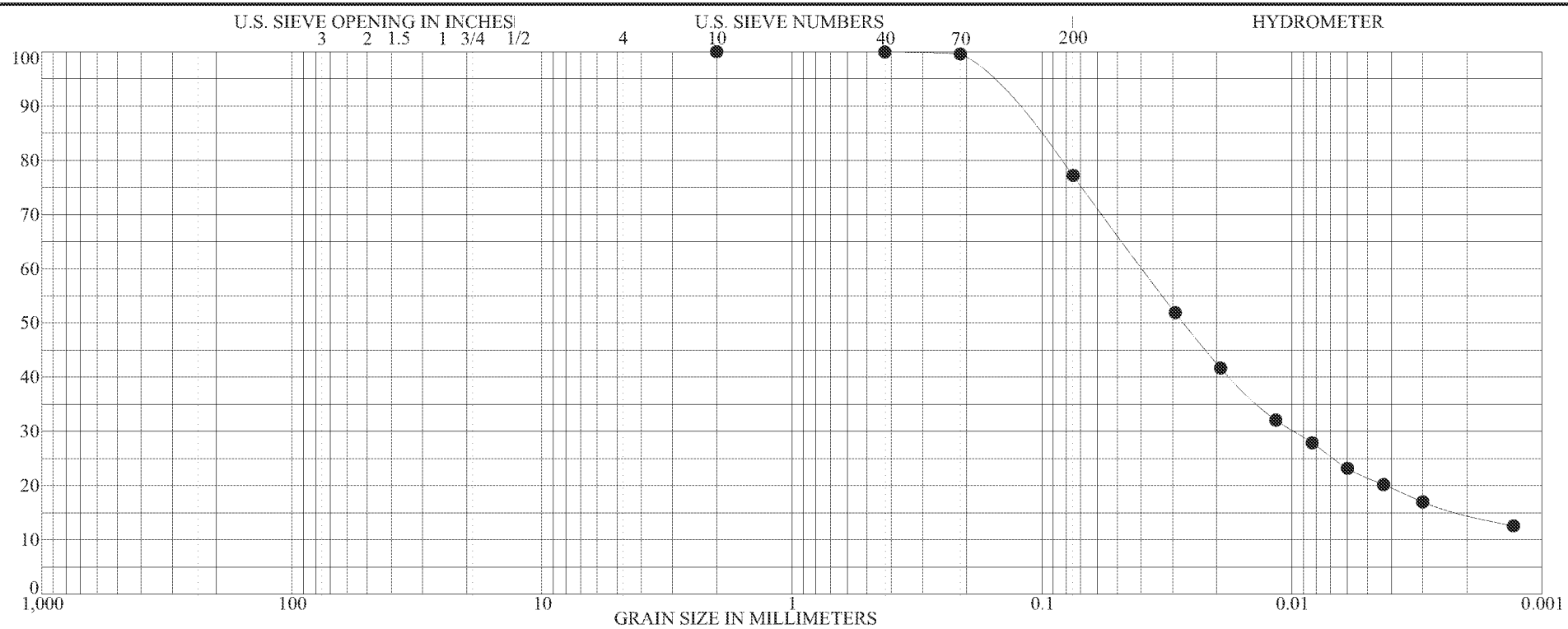
PLATE 13

ED_005405A_00000217-00096



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0901 S-25 43.5' to 45.0'**	**Brown motled with dark-brown clayey silt, some fine sand, trace medium sand.**	**23**	**30**	**21**	**9**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0901 S-25 43.5' to 45.0'**	**2.0000**	**0.1714**	**0.0396**	**0.0271**		**0.0**	**22.8**	**55.6**	**21.6**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
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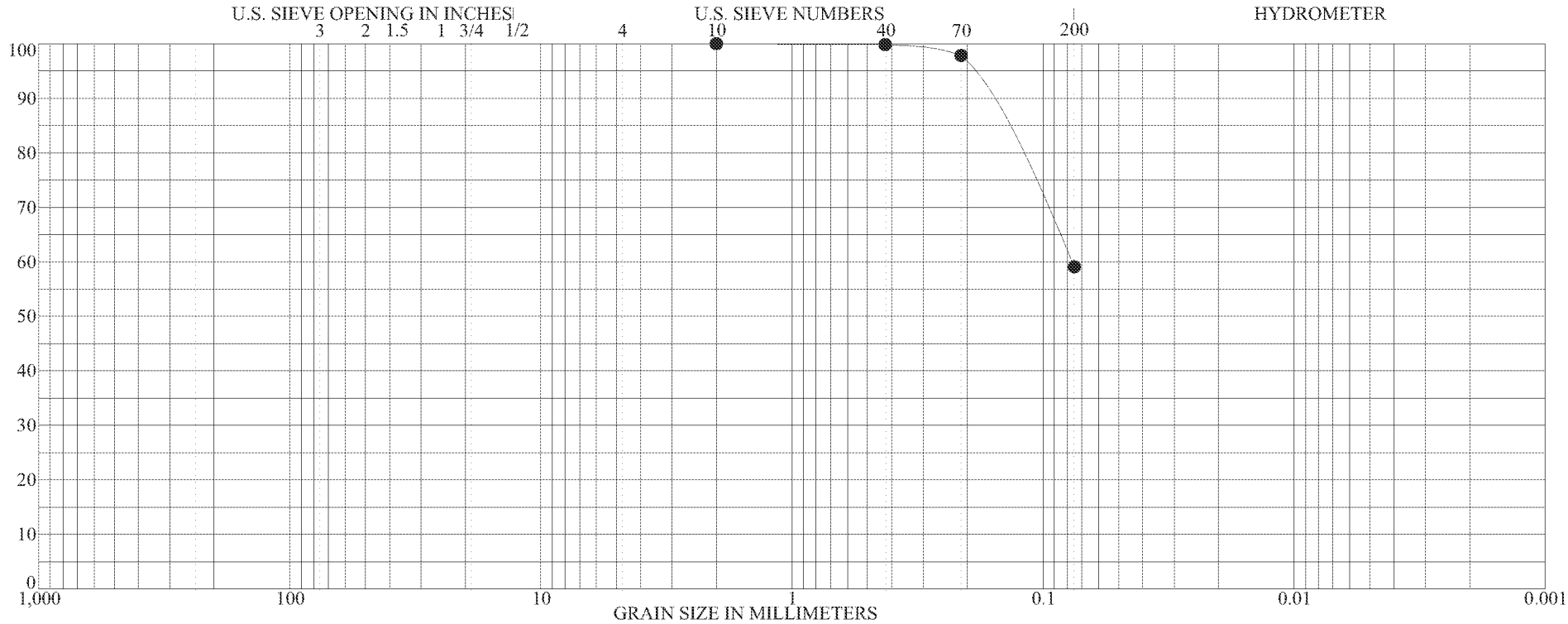
PLATE 14

ED_005405A_00000217-00097



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**BAP-0901 S-28A 51.0' to 51.7'**	**Gray mottled with brown silt inter-bedded with fine sand and silty clay, trace medium sand.**						

	Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**BAP-0901 S-28A 51.0' to 51.7'**	**2.0000**	**0.1965**	**0.0769**			**0.0**	**40.9**	**59.1**	

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
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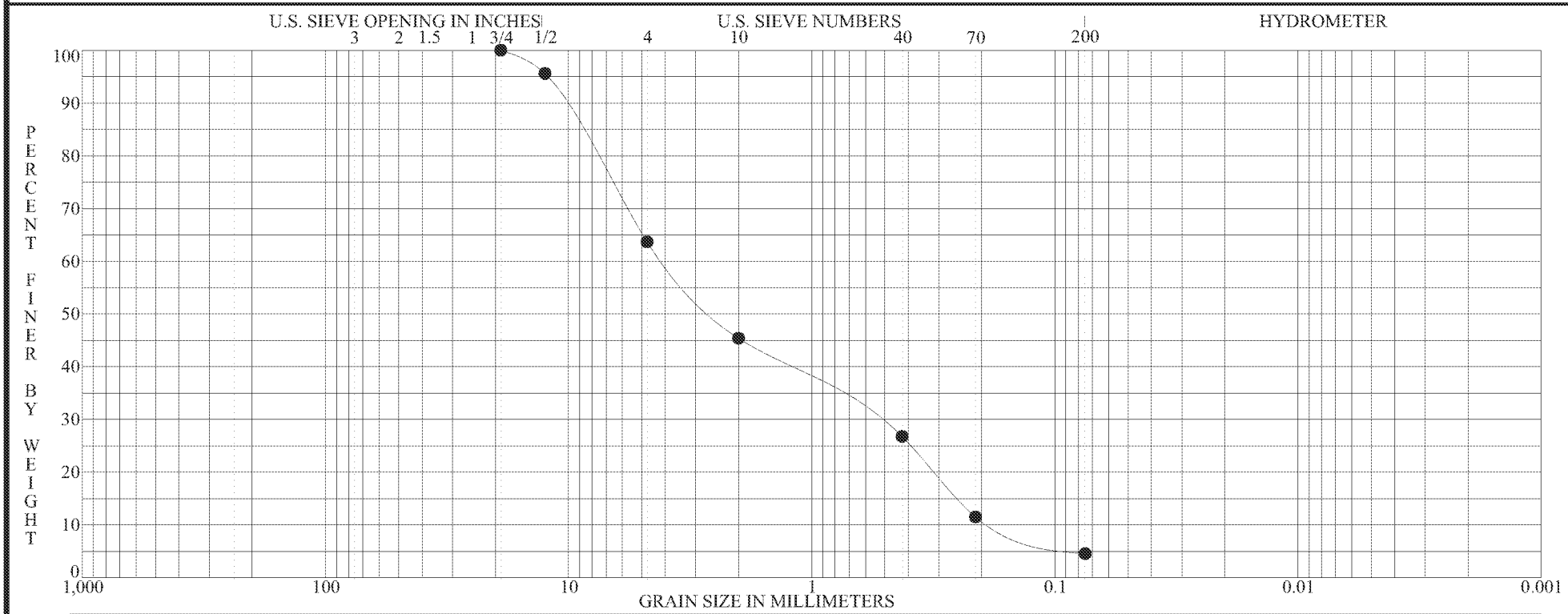
PLATE 15

ED_005405A_00000217-00098



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0901 S-29 53.5' to 54.7'**	**Brown and gray fine to coarse sand, "and" fine gravel, trace silt.**					**0.457**	**23.667**

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0901 S-29 53.5' to 54.7'**	**19.0000**	**12.2747**	**3.9909**	**2.4852**	**0.1686**	**36.3**	**59.1**	**4.6**	

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
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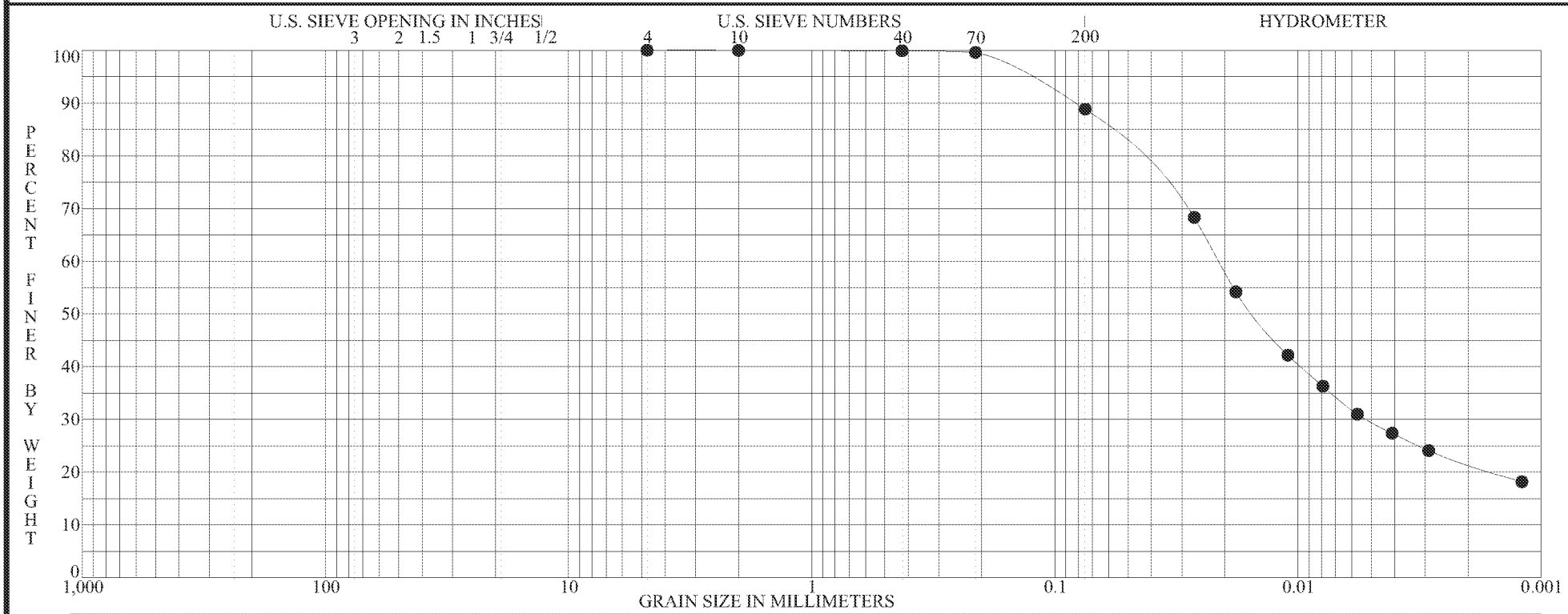
PLATE 16

ED_005405A_00000217-00099



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0902 S-9 18.5' to 20.0'**	**Brown mottled with gray silty clay, little fine to coarse sand, desiccation.**	**22**	**32**	**21**	**11**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0902 S-9 18.5' to 20.0'**	**4.7500**	**0.1360**	**0.0212**	**0.0152**		**0.0**	**11.2**	**59.3**	**29.6**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

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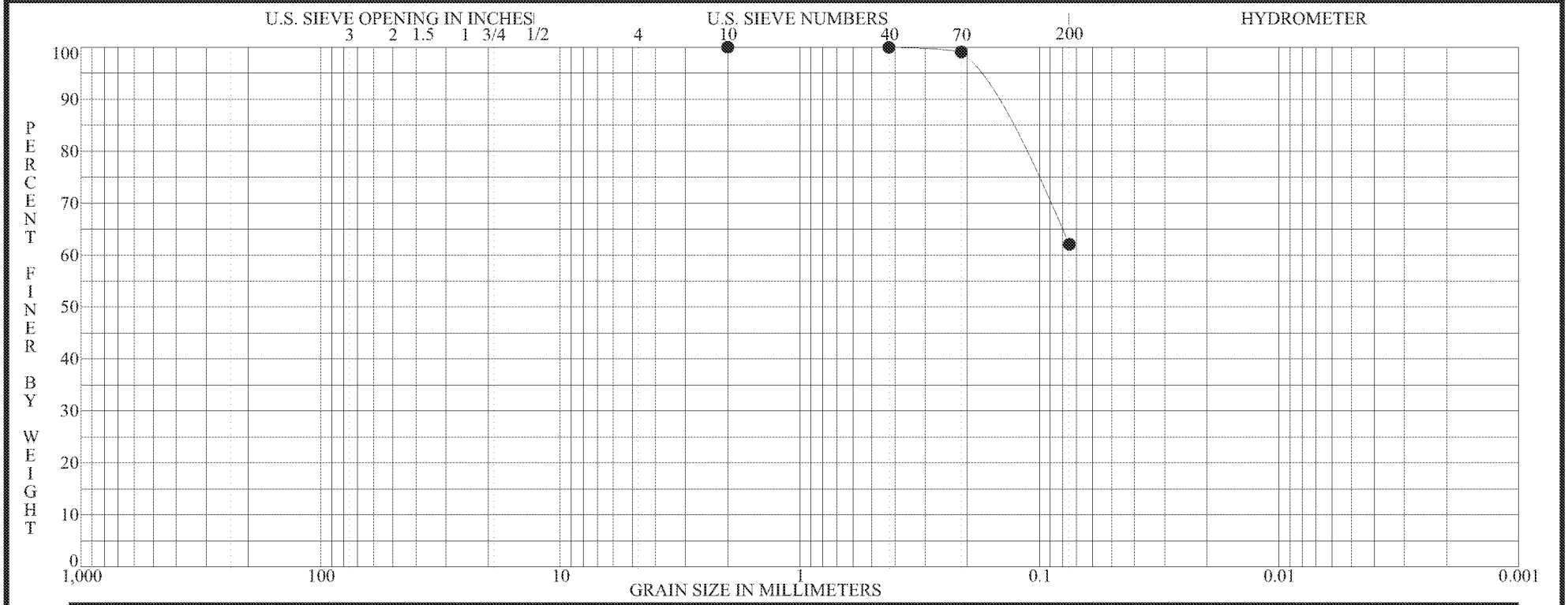
PLATE 17

ED_005405A_00000217-00100



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0902 S-11 23.5' to 25.0'**	**Brown silty clay interbedded with fine to medium sand.**						

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0902 S-11 23.5' to 25.0'**	**2.0000**	**0.1891**				**0.0**	**37.9**	**62.1**	

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
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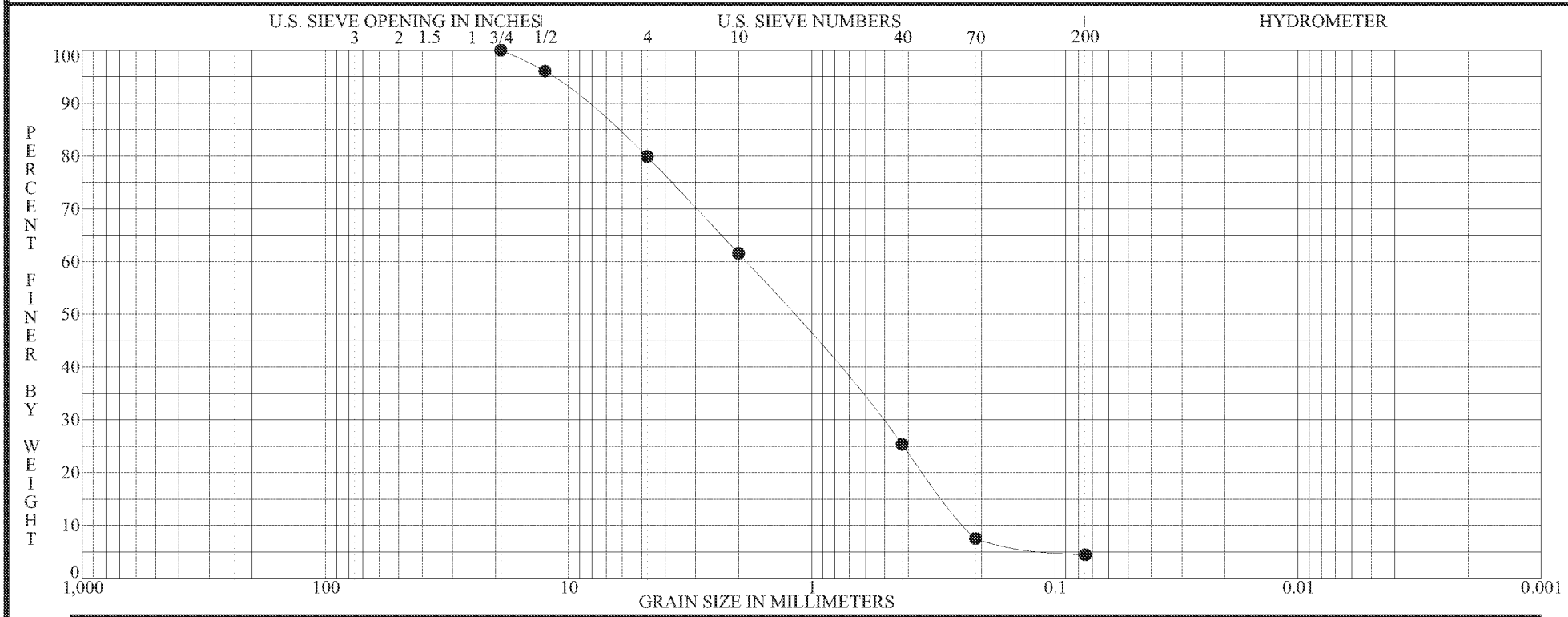
PLATE 18

ED_005405A_00000217-00101



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0902 S-14 31.0' to 32.2'**	**Brown fine to coarse sand, little fine gravel, trace silt.**					**0.614**	**8.024**

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0902 S-14 31.0' to 32.2'**	**19.0000**	**11.7255**	**1.8722**	**1.2198**	**0.2333**	**20.1**	**75.4**	**4.4**	

ASTM D422 | **GRADATION CURVE**

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LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

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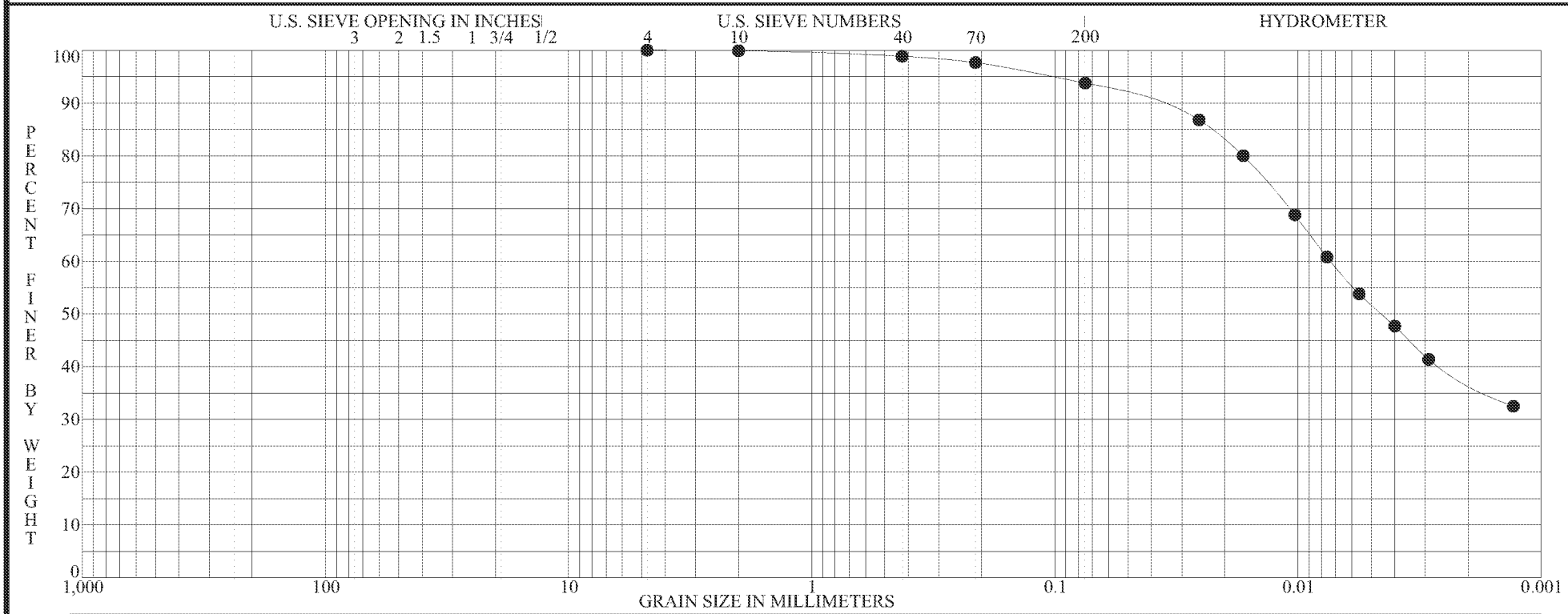
PLATE 19

ED_005405A_00000217-00102



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0903 S-10 15.0' to 16.0'**	**Brown mottled with dark-gray and gray silty clay, trace fine to coarse sand.**	**23**	**52**	**24**	**28**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0903 S-10 15.0' to 16.0'**	**4.7500**	**0.1039**	**0.0073**	**0.0045**		**0.0**	**6.2**	**42.0**	**51.7**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

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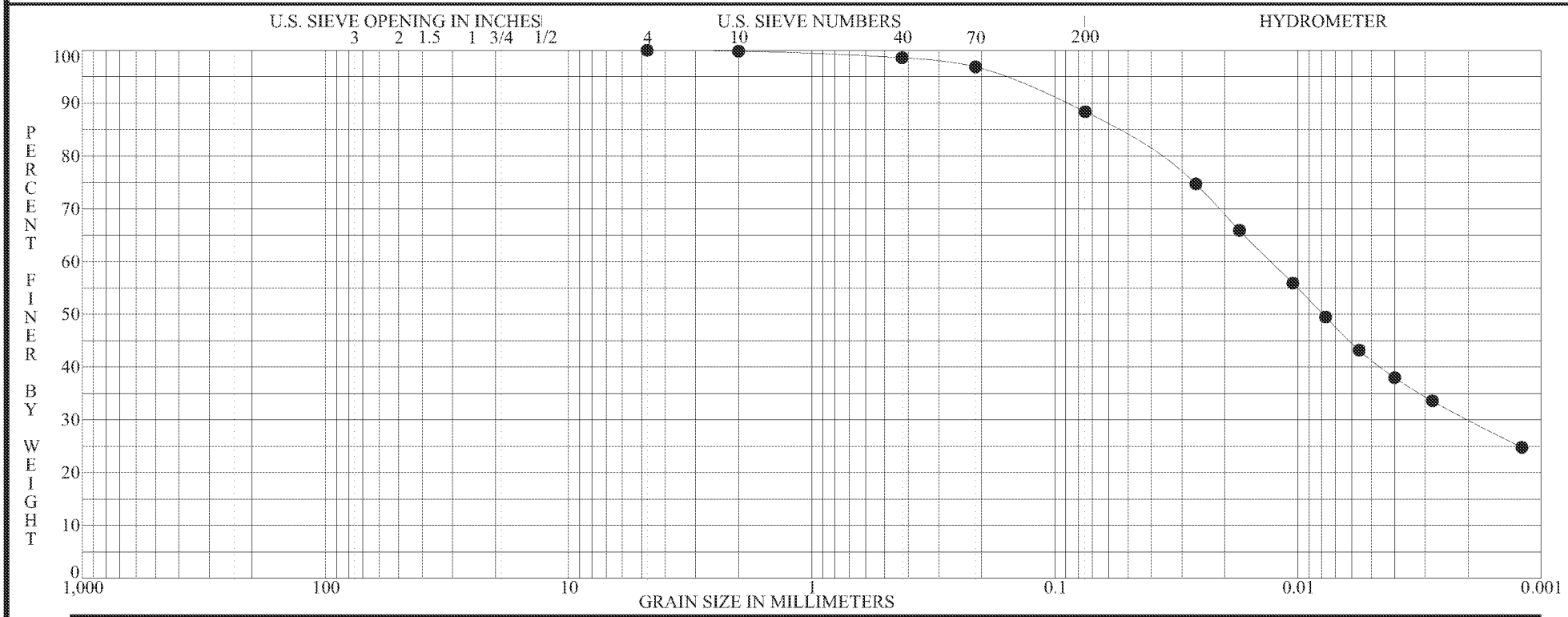
PLATE 20

ED_005405A_00000217-00103



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0903 S-21 33.5' to 34.7'**	**Brown mottled with dark-brown and gray silty clay, little fine to coarse sand.**	**19**	**44**	**22**	**22**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0903 S-21 33.5' to 34.7'**	**4.7500**	**0.1689**	**0.0129**	**0.0079**		**0.0**	**11.6**	**46.9**	**41.4**

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
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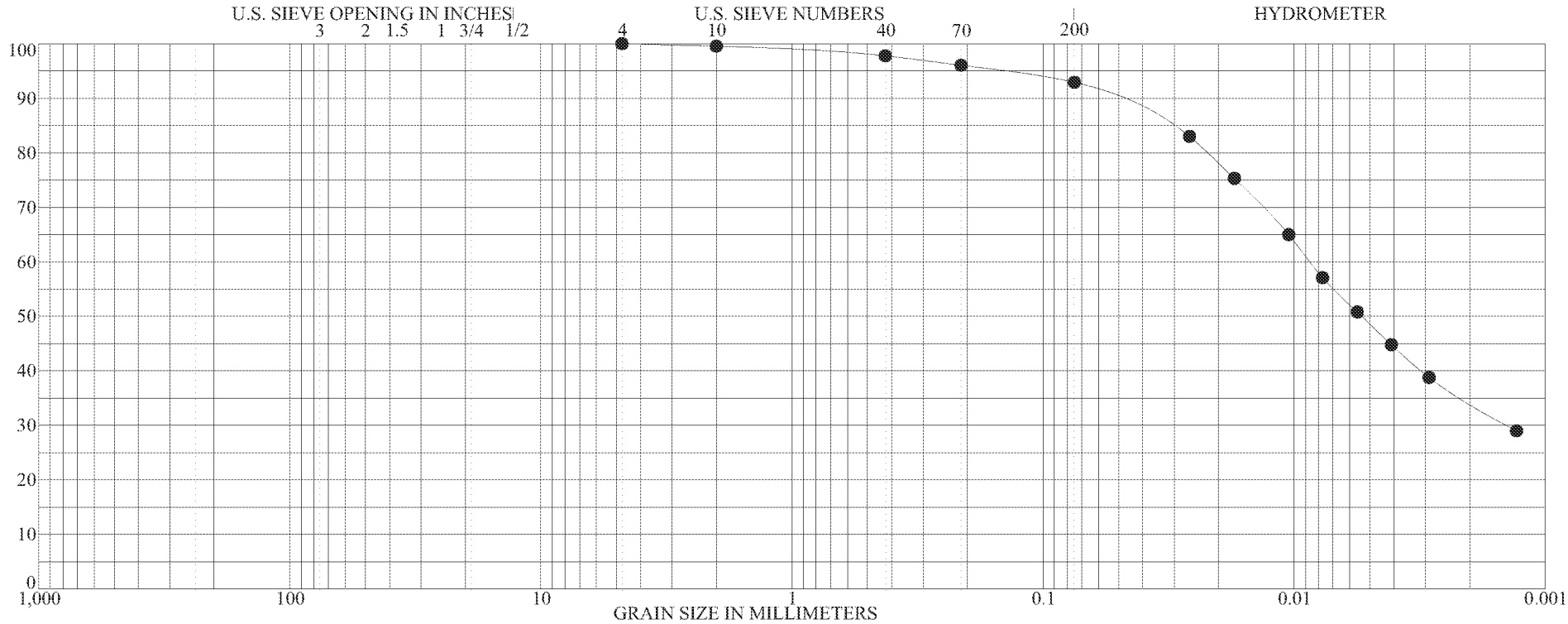
PLATE 21

ED_005405A_00000217-00104



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0903 S-24 41.0' to 42.5'**	**Brown mottled with dark-brown and gray silty clay, trace fine to coarse sand.**	**24**	**53**	**22**	**31**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0903 S-24 41.0' to 42.5'**	**4.7500**	**0.1501**	**0.0086**	**0.0054**		**0.0**	**7.1**	**44.3**	**48.6**

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
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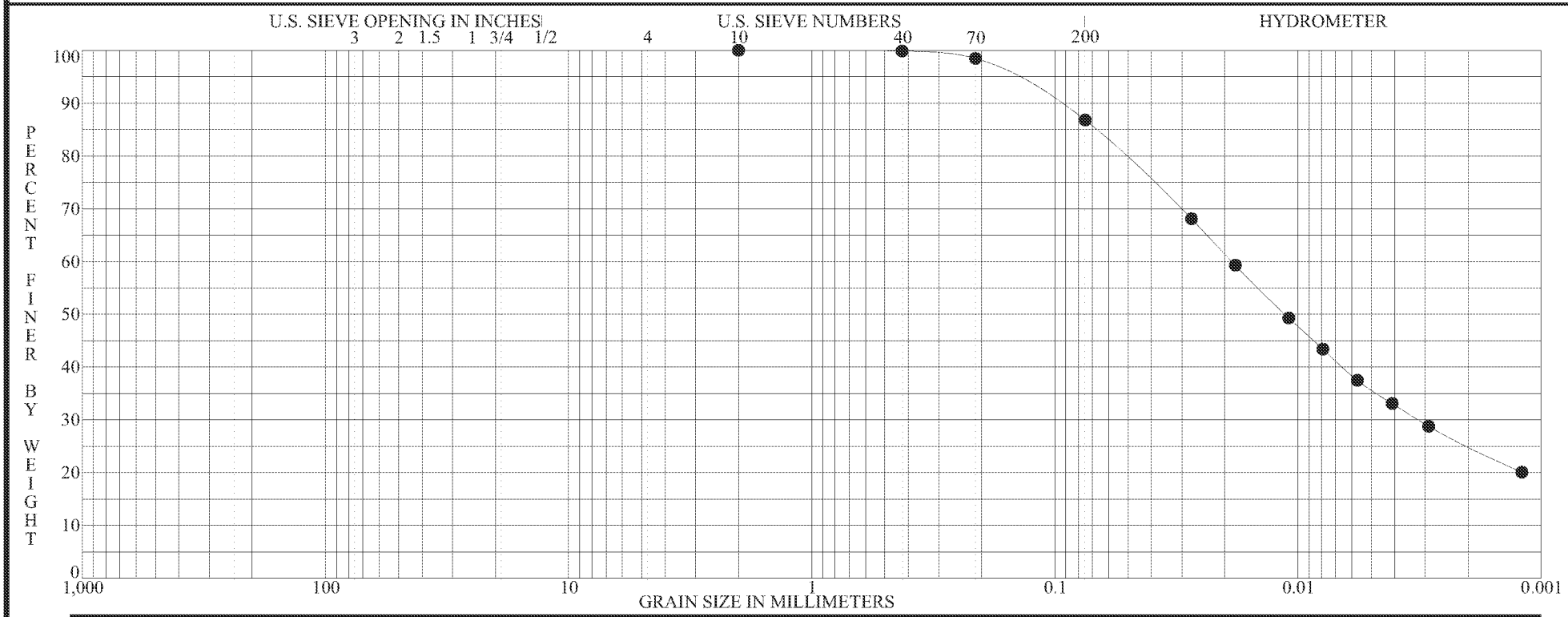
PLATE 22

ED_005405A_00000217-00105



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0903 S-30 56.0' to 57.5'**	**Brown mottled with gray and red-brown silty clay, little fine sand, trace medium sand, few lenses of silt and fine sand.**	**25**	**35**	**19**	**16**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0903 S-30 56.0' to 57.5'**	**2.0000**	**0.1557**	**0.0187**	**0.0113**		**0.0**	**13.2**	**51.1**	**35.8**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

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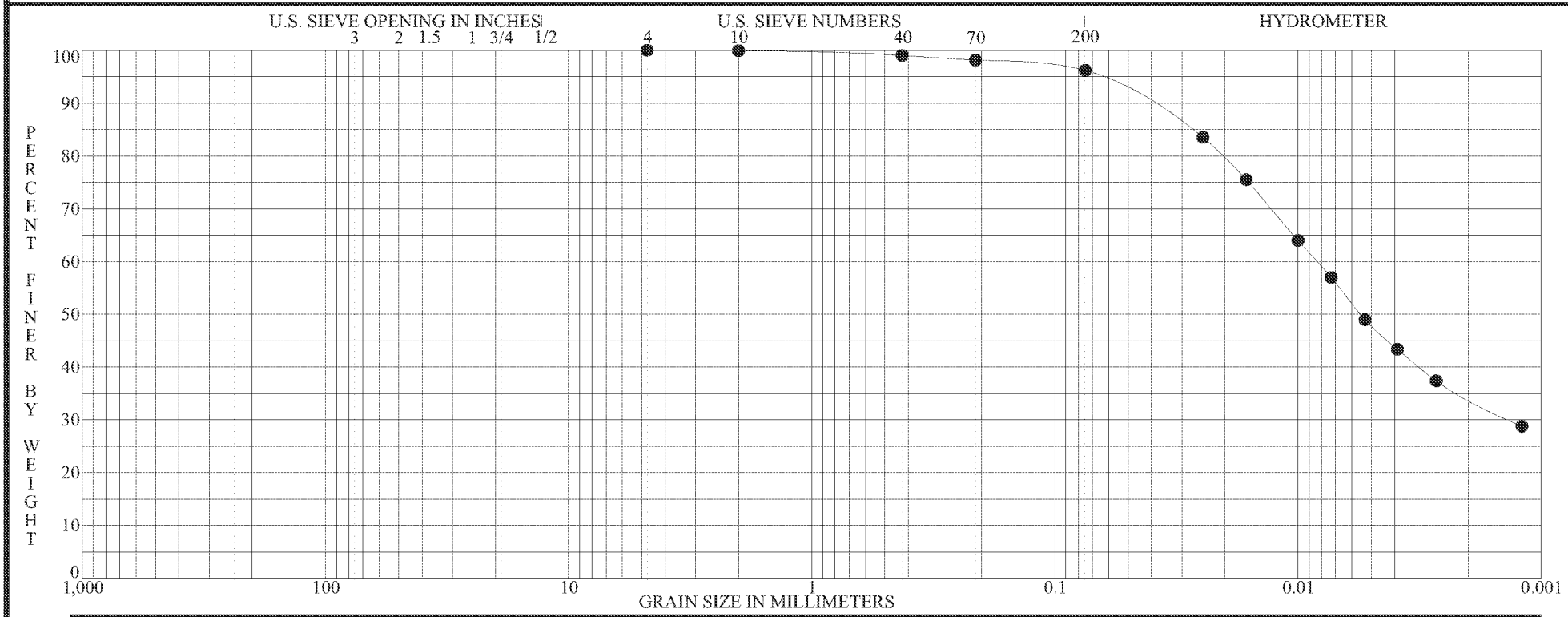
PLATE 23

ED_005405A_00000217-00106



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**BAP-0904 S-5 7.0' to 8.3'**	**Brown mottled with gray silty clay, trace fine to coarse sand.**	**30**	**43**	**26**	**17**		

	Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**BAP-0904 S-5 7.0' to 8.3'**	**4.7500**	**0.0674**	**0.0084**	**0.0055**		**0.0**	**3.8**	**48.3**	**47.9**

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/2/09

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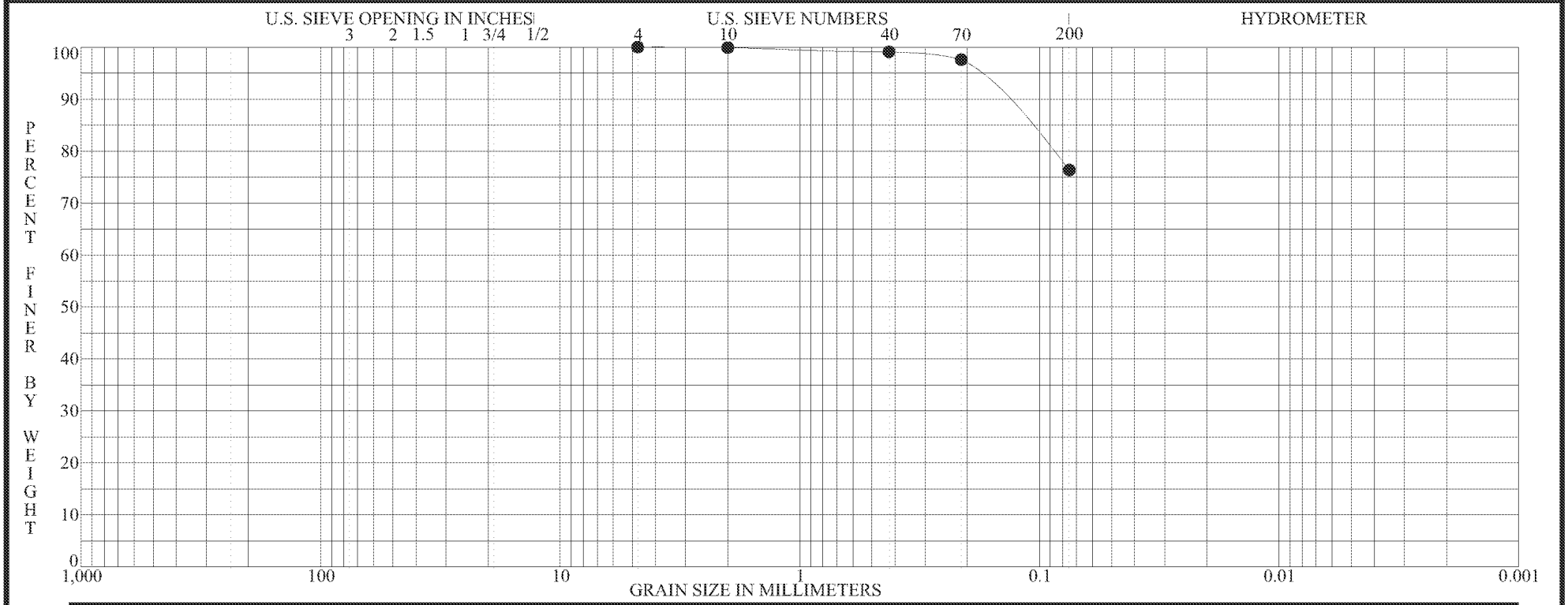
PLATE 24

ED_005405A_00000217-00107



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0904 S-12 23.5' to 24.6'**	**Gray silty clay, some fine sand, trace medium to coarse sand, contains silt and fine to medium sand lenses.**	**29**	**32**	**19**	**13**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0904 S-12 23.5' to 24.6'**	**4.7500**	**0.1866**				**0.0**	**23.6**	**76.4**	

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/2/09

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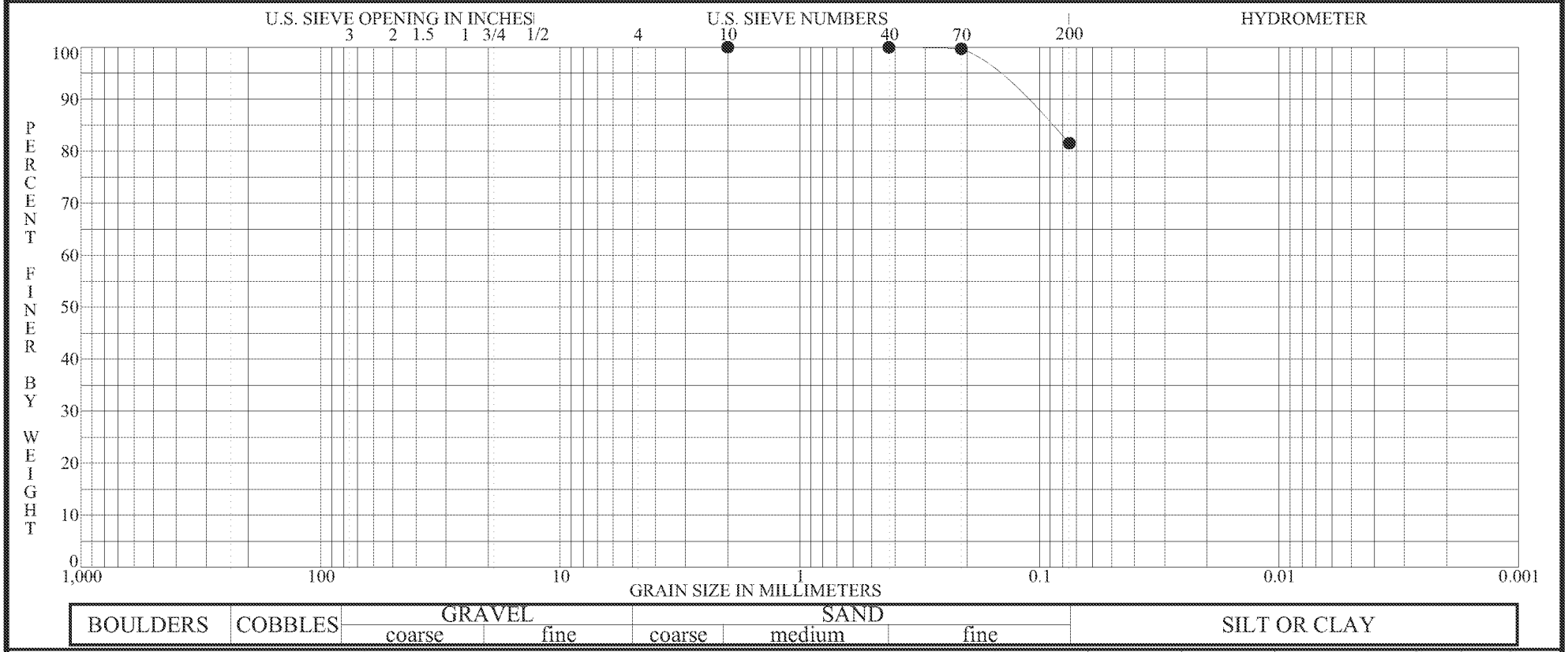
PLATE 25

ED_005405A_00000217-00108



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0904 S-14 28.5' to 29.5'**	**Gray silty clay, little fine to medium sand.**						

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0904 S-14 28.5' to 29.5'**	**2.0000**	**0.1621**				**0.0**	**18.5**	**81.5**	

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

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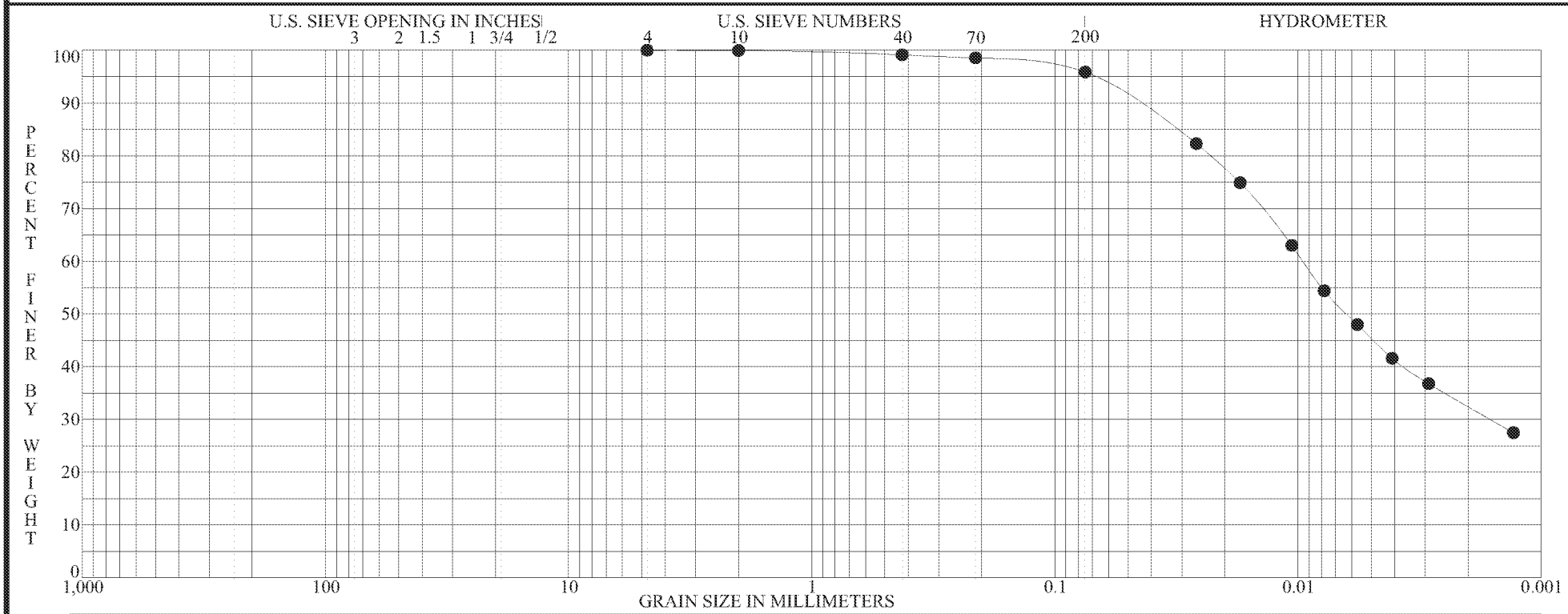
PLATE 26

ED_005405A_00000217-00109



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0905 S-8 11.5' to 13.0'**	**Brown mottled with gray silty clay, trace fine to coarse sand.**	**20**	**43**	**23**	**20**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0905 S-8 11.5' to 13.0'**	**4.7500**	**0.0701**	**0.0095**	**0.0063**		**0.0**	**4.1**	**50.4**	**45.5**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
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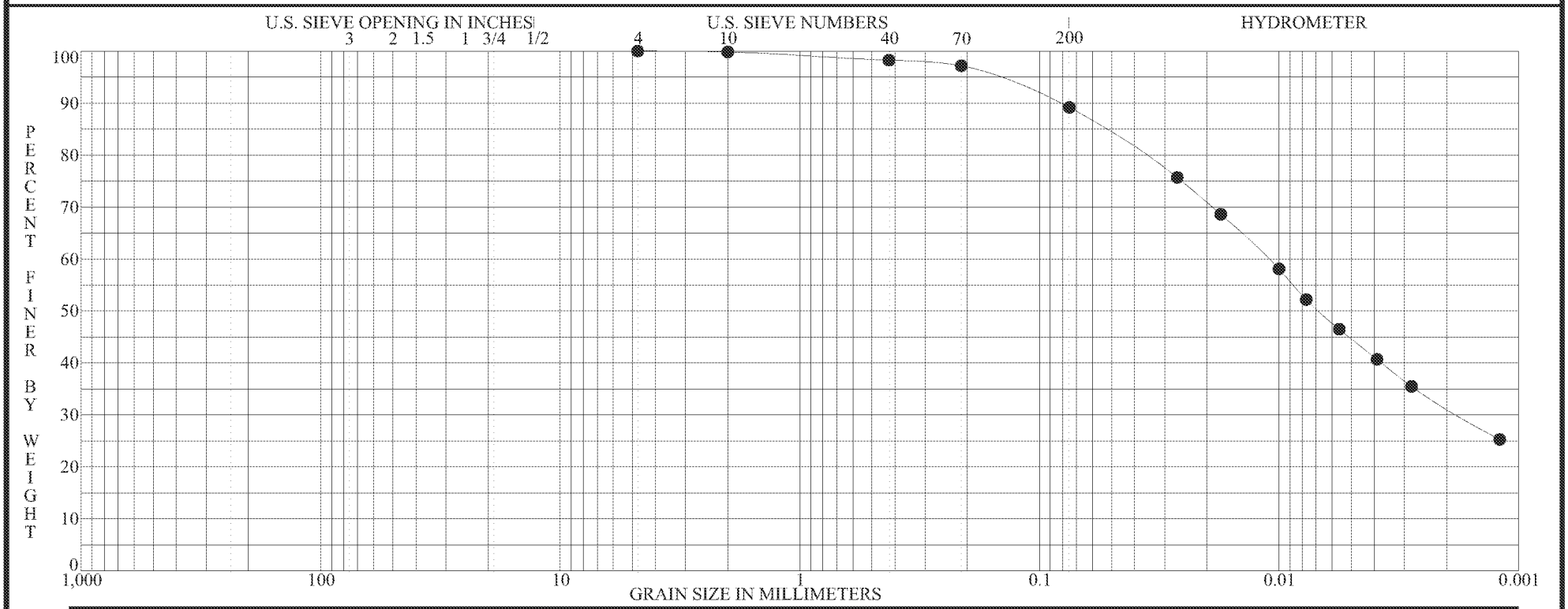
PLATE 27

ED_005405A_00000217-00110



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	**BAP-0905 ST-14 II 20.5' to 22.0'**	**Brown, dark-brown and gray silty clay, little fine to coarse sand.**	**21**	**40**	**23**	**17**		

	Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**BAP-0905 ST-14 II 20.5' to 22.0'**	**4.7500**	**0.1599**	**0.0111**	**0.0068**		**0.0**	**10.8**	**44.5**	**44.7**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

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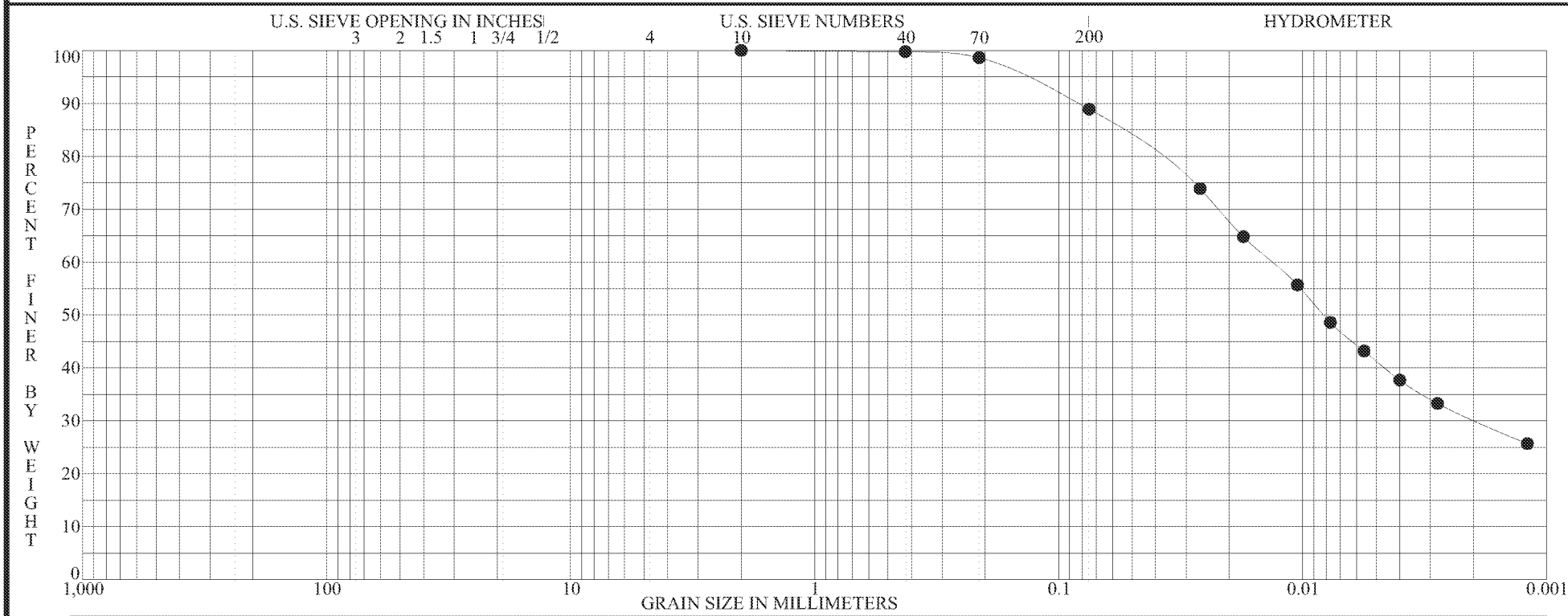
PLATE 28

ED_005405A_00000217-00111



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0905 S-17 25.5' to 26.5'**	**Brown mottled with dark-brown and gray silty clay, little fine to medium sand.**	**18**	**39**	**19**	**20**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0905 S-17 25.5' to 26.5'**	**2.0000**	**0.1439**	**0.0134**	**0.0082**		**0.0**	**11.1**	**47.5**	**41.3**

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
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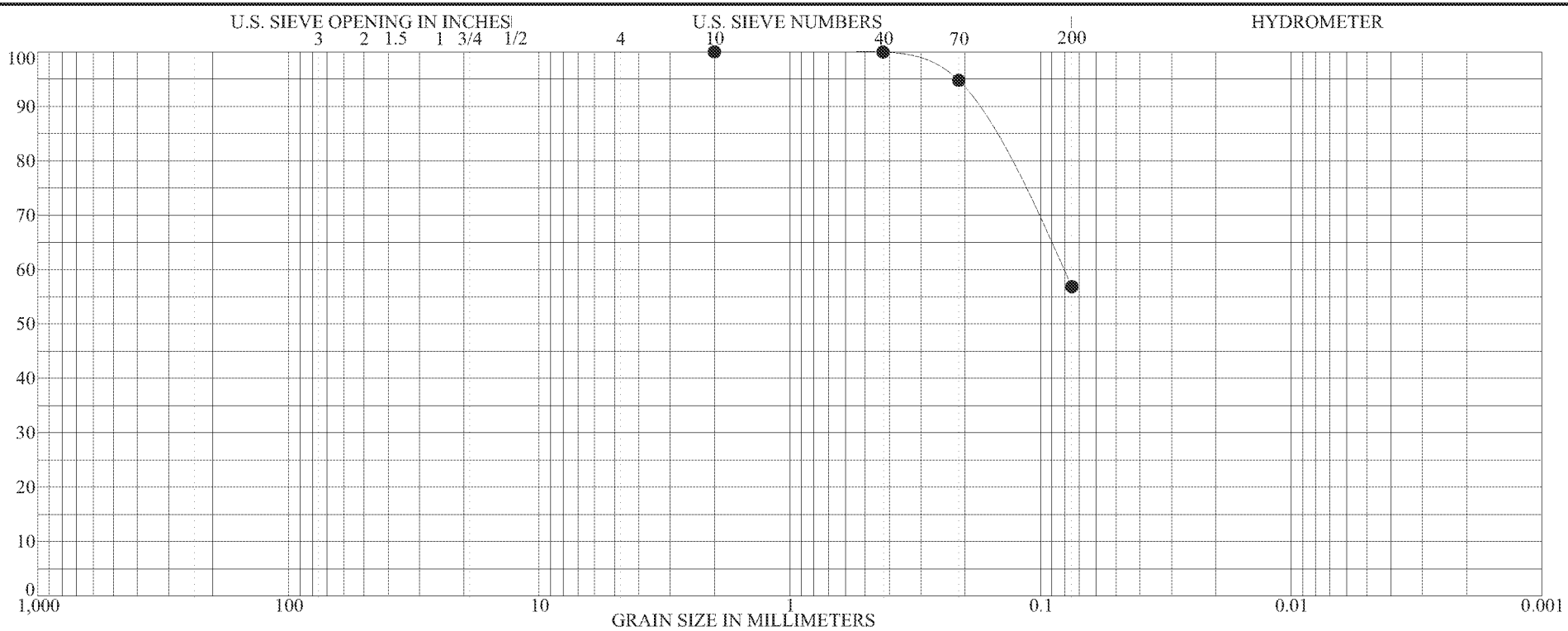
PLATE 29

ED_005405A_00000217-00112



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0905 S-21 33.5' to 35.0'**	**Brown silty clay, "and" fine to coarse sand.**						

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0905 S-21 33.5' to 35.0'**	**2.0000**	**0.2185**	**0.0818**			**0.0**	**43.1**	**56.9**	

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
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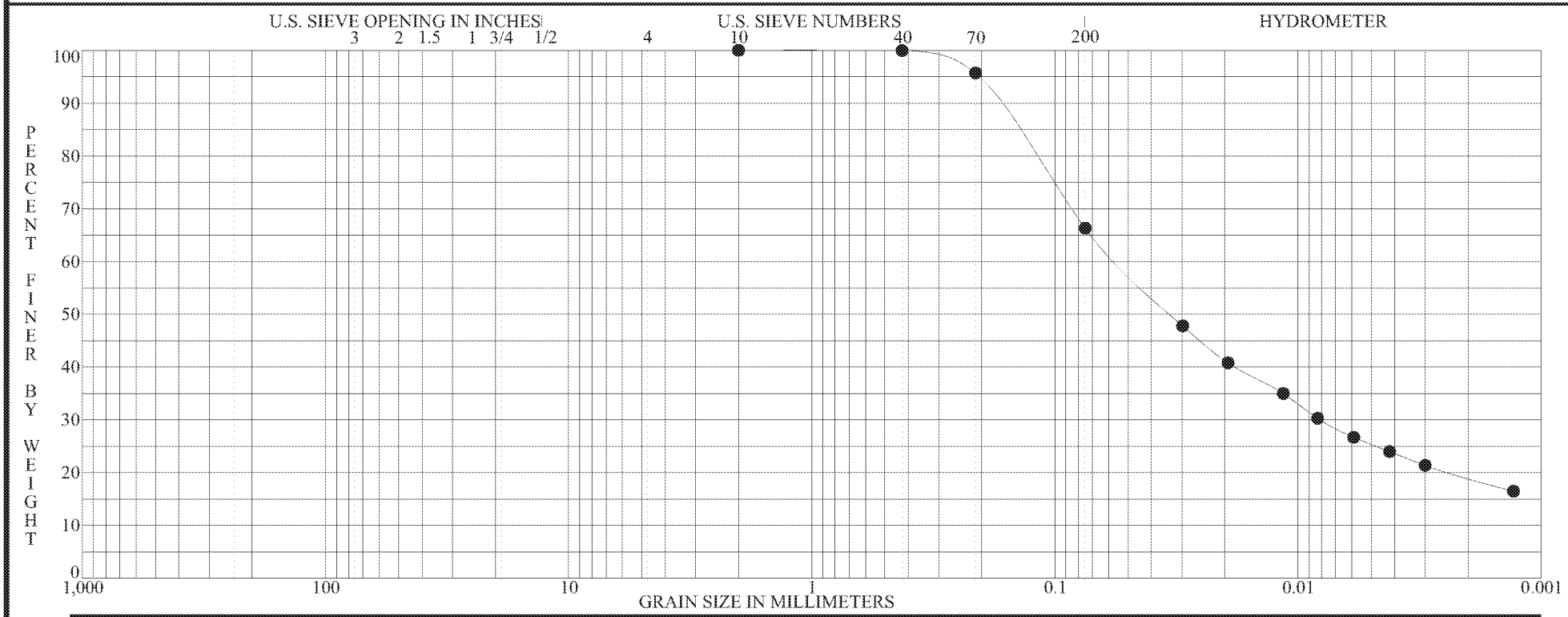
PLATE 30

ED_005405A_00000217-00113



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0905 S-22 36.0' to 37.5'**	**Brown clayey silt, some fine sand, trace medium sand.**	**19**	**28**	**18**	**10**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0905 S-22 36.0' to 37.5'**	**2.0000**	**0.2068**	**0.0548**	**0.0333**		**0.0**	**33.7**	**40.9**	**25.4**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

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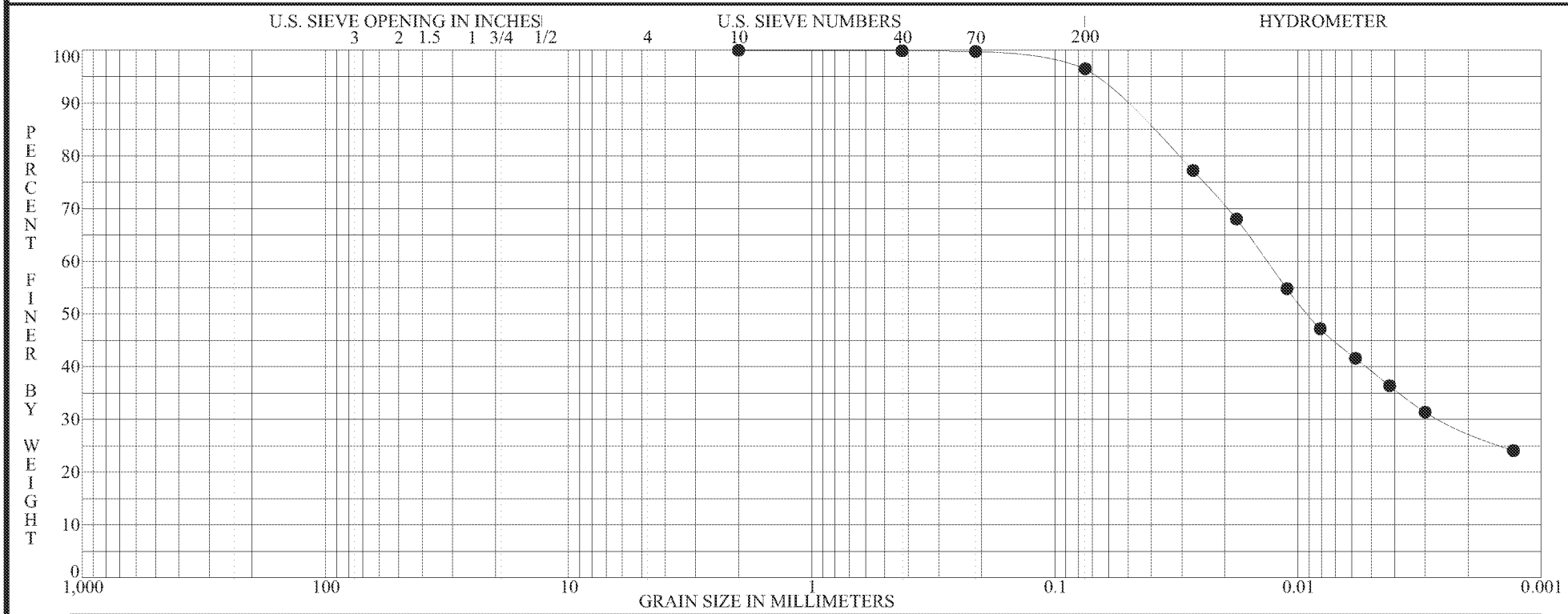
PLATE 31

ED_005405A_00000217-00114



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0905 S-25 43.0' to 45.0'**	**Brown mottled with gray silty clay, trace fine to medium sand, contains few silt lenses..**	**25**	**42**	**21**	**21**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0905 S-25 43.0' to 45.0'**	**2.0000**	**0.0693**	**0.0134**	**0.0091**		**0.0**	**3.5**	**57.3**	**39.2**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

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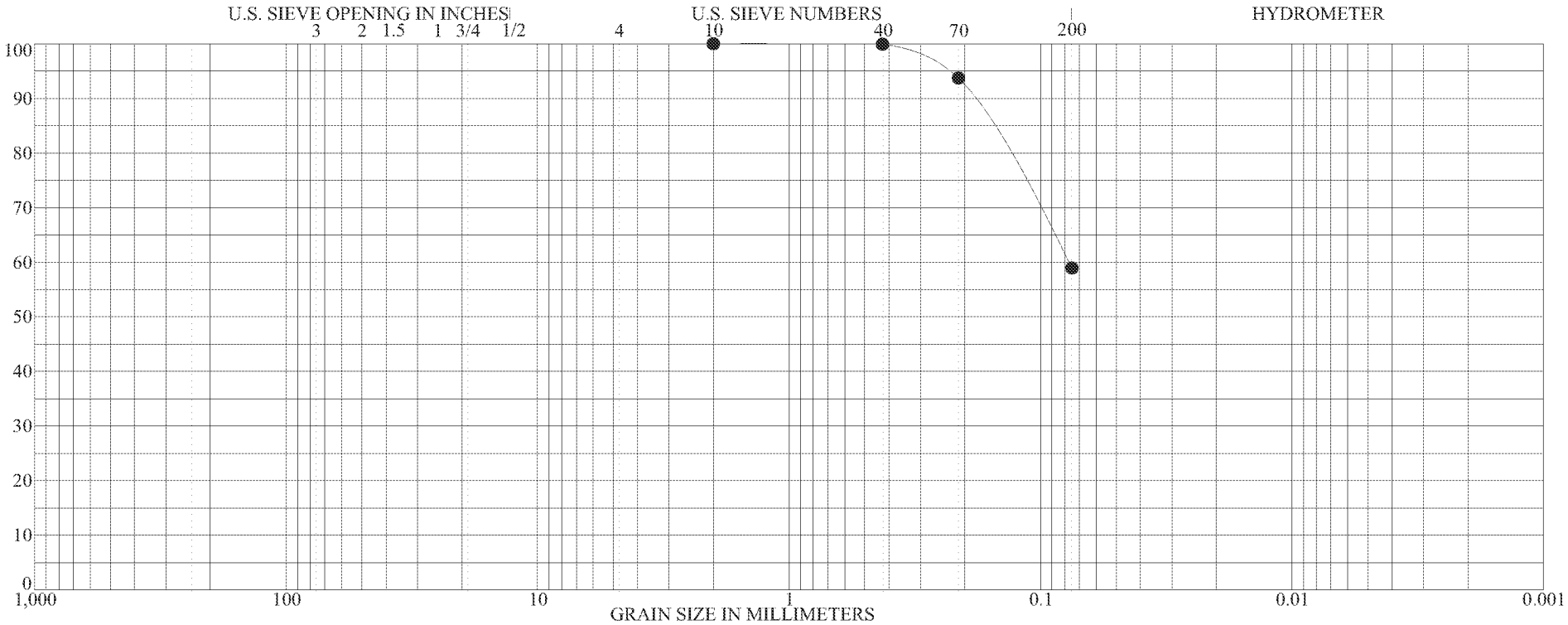
PLATE 32

ED_005405A_00000217-00115



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0905 S-29 53.5' to 55.0'**	**Brown silt, "and" fine to coarse sand.**						

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0905 S-29 53.5' to 55.0'**	**2.0000**	**0.2447**	**0.0774**			**0.0**	**41.1**	**58.9**	

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
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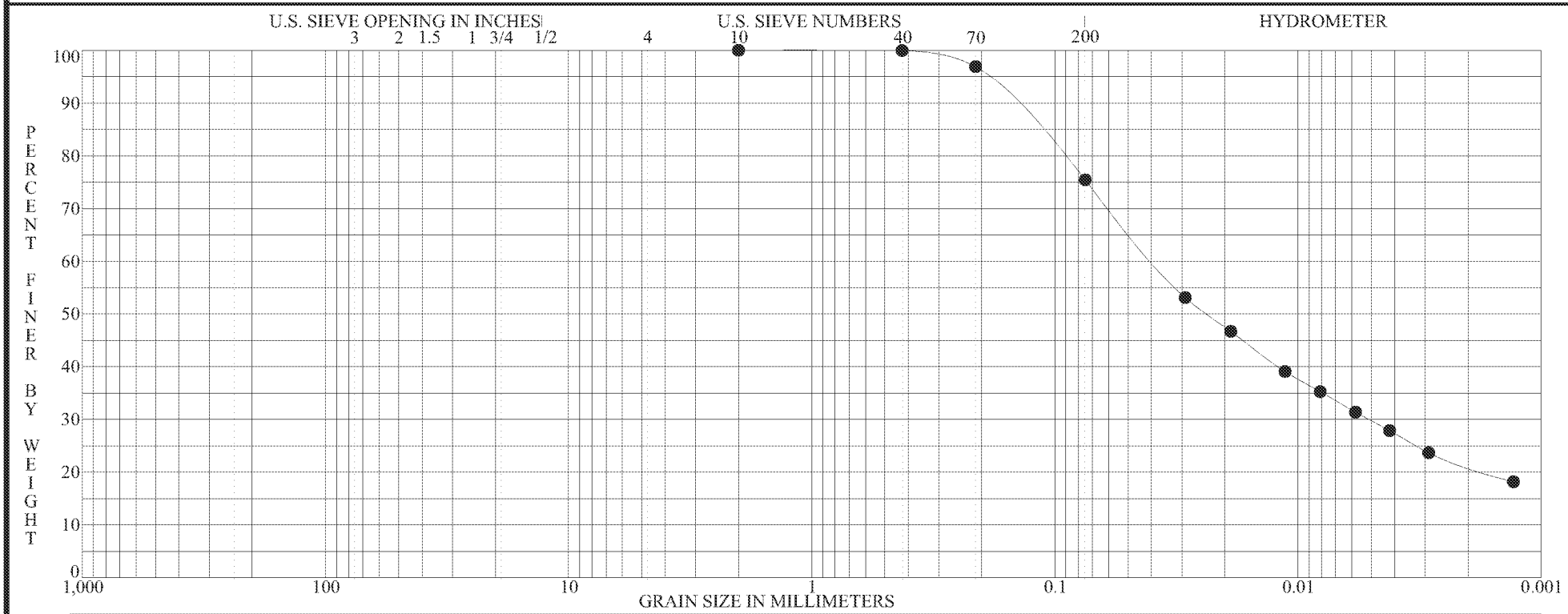
PLATE 33

ED_005405A_00000217-00116



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0906 S-4 5.5' to 6.7'**	**Brown silty clay, some fine sand, trace medium sand.**	**18**	**35**	**20**	**15**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0906 S-4 5.5' to 6.7'**	**2.0000**	**0.1934**	**0.0390**	**0.0236**		**0.0**	**24.6**	**45.6**	**29.8**

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/2/09

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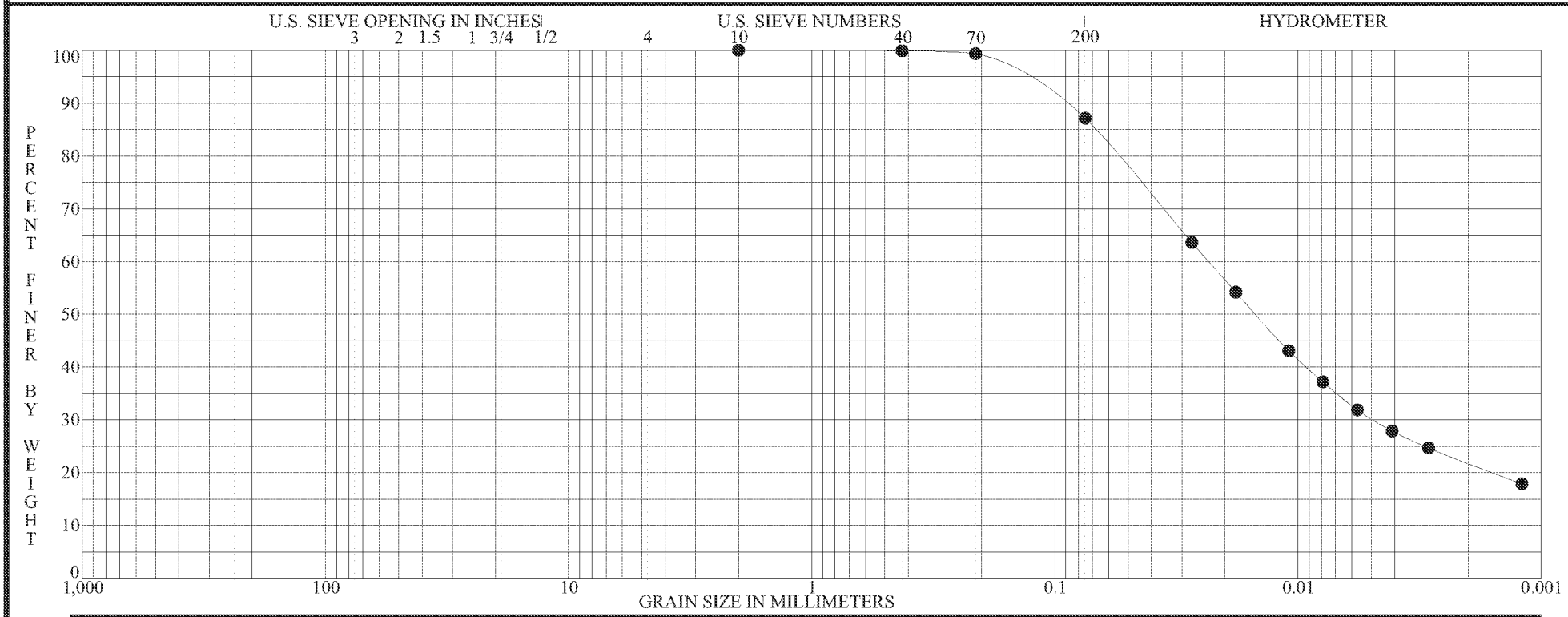
PLATE 34

ED_005405A_00000217-00117



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0906 S-10 18.5' to 20.0'**	**Brown silty clay, little fine to medium sand, contains many silt lenses.**	**27**	**34**	**21**	**13**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0906 S-10 18.5' to 20.0'**	**2.0000**	**0.1462**	**0.0233**	**0.0149**		**0.0**	**12.9**	**56.8**	**30.3**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
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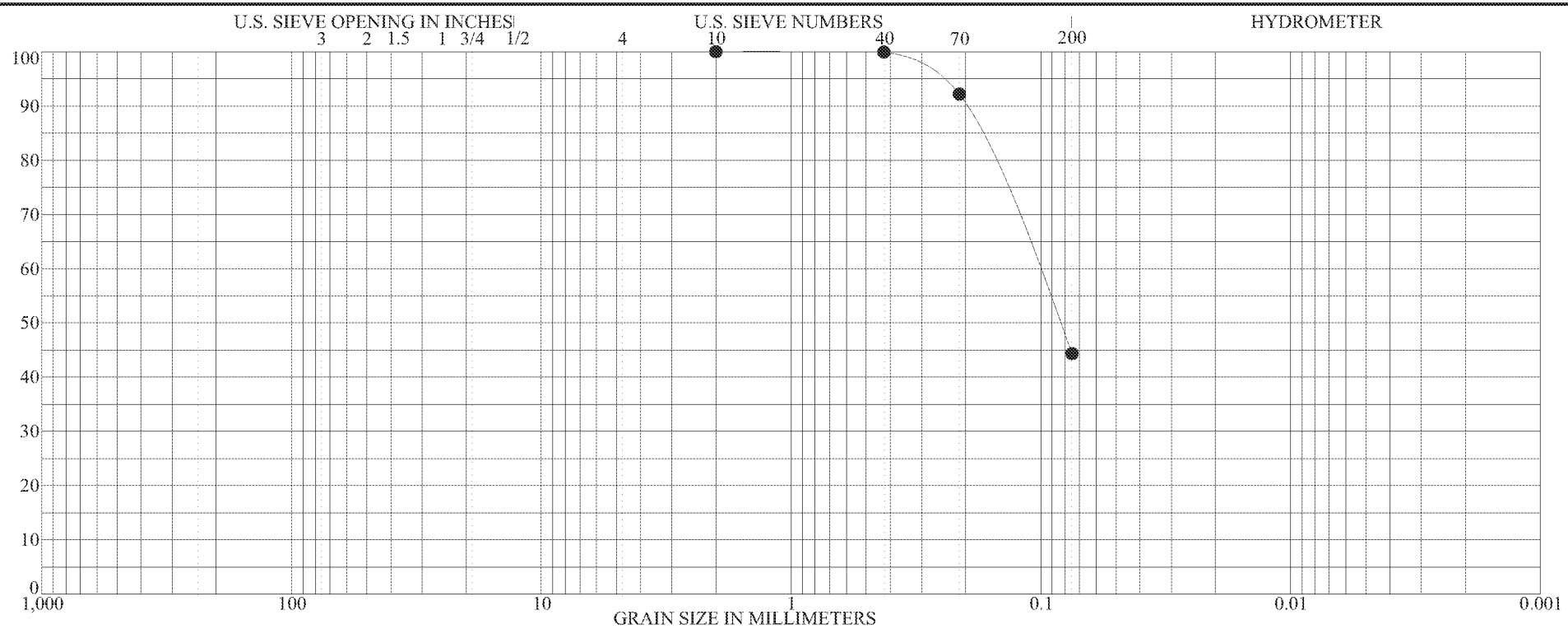
PLATE 35

ED_005405A_00000217-00118



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0906 S-14 28.5' to 30.0'**	**Brown fine sand, trace medium sand, "and" silty clay.**						

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0906 S-14 28.5' to 30.0'**	**2.0000**	**0.2729**	**0.1054**	**0.0848**		**0.0**	**55.7**	**44.3**	

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/2/09

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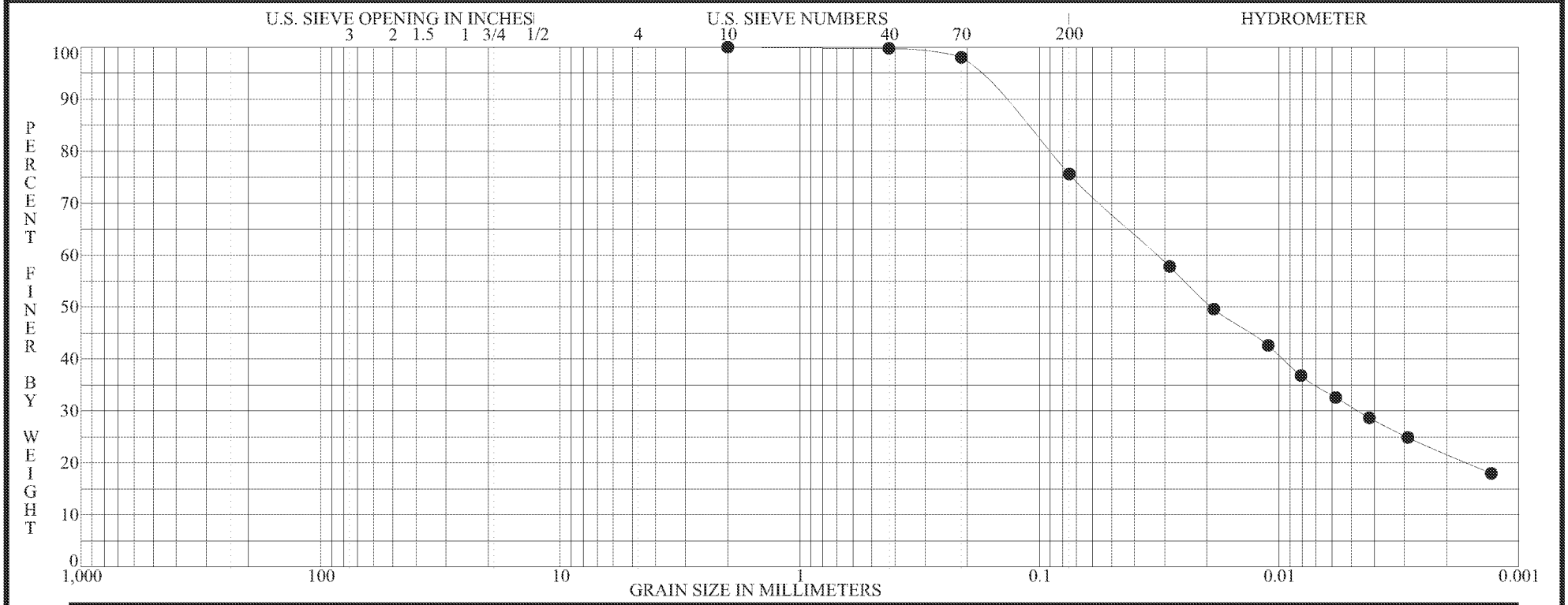
PLATE 36

ED_005405A_00000217-00119



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0907 S-9 13.0' to 14.1'**	**Brown mottled with gray silty clay, some fine sand, trace medium sand.**	**18**	**32**	**16**	**16**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0907 S-9 13.0' to 14.1'**	**2.0000**	**0.1842**	**0.0322**	**0.0191**		**0.0**	**24.4**	**44.8**	**30.8**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

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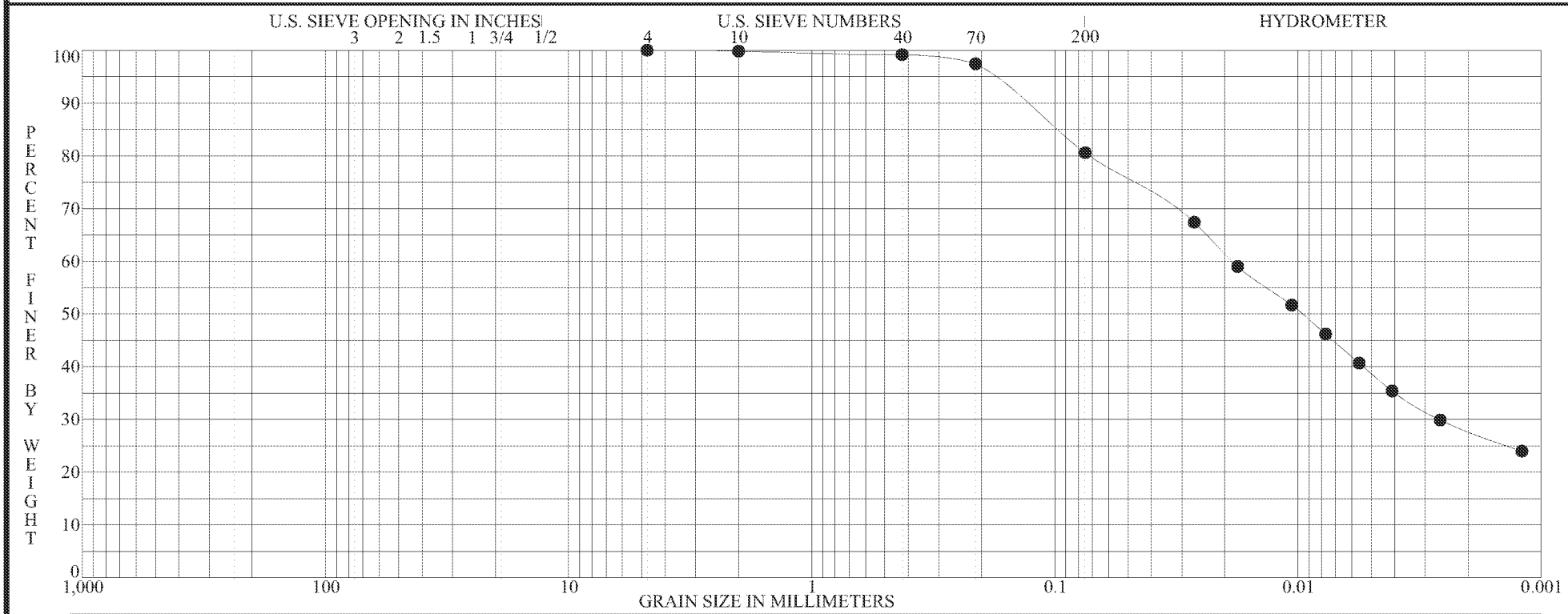
PLATE 37

ED_005405A_00000217-00120



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0907 S-12 I 17.5' to 19.1'**	**Brown mottled with gray silty clay, little fine to coarse sand.**	**20**	**35**	**20**	**15**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0907 S-12 I 17.5' to 19.1'**	**4.7500**	**0.1826**	**0.0186**	**0.0096**		**0.0**	**19.4**	**41.8**	**38.8**

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 6/2/09

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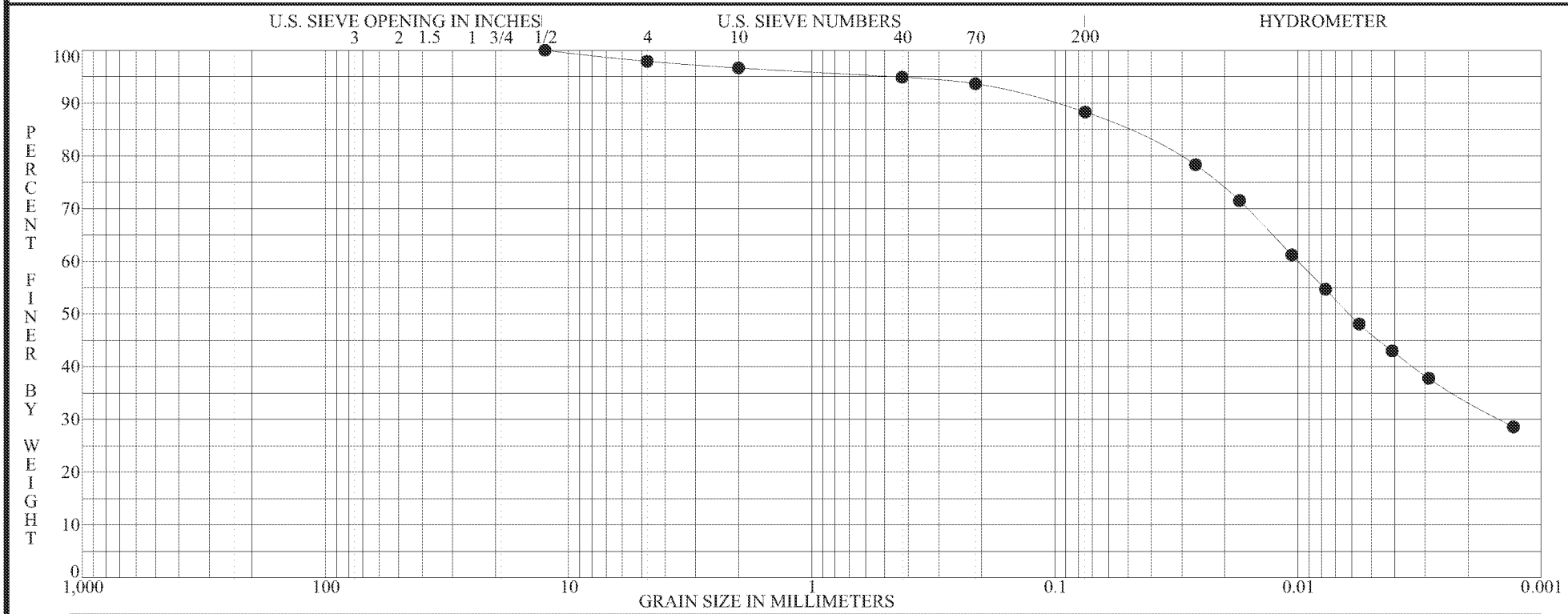
PLATE 38

ED_005405A_00000217-00121



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0907 S-21 33.5' to 35.0'**	**Brown mottled with gray silty clay, trace fine to coarse sand, trace fine gravel.**	**19**	**52**	**24**	**28**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0907 S-21 33.5' to 35.0'**	**12.5000**	**0.4745**	**0.0100**	**0.0061**		**2.1**	**9.6**	**42.0**	**46.2**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

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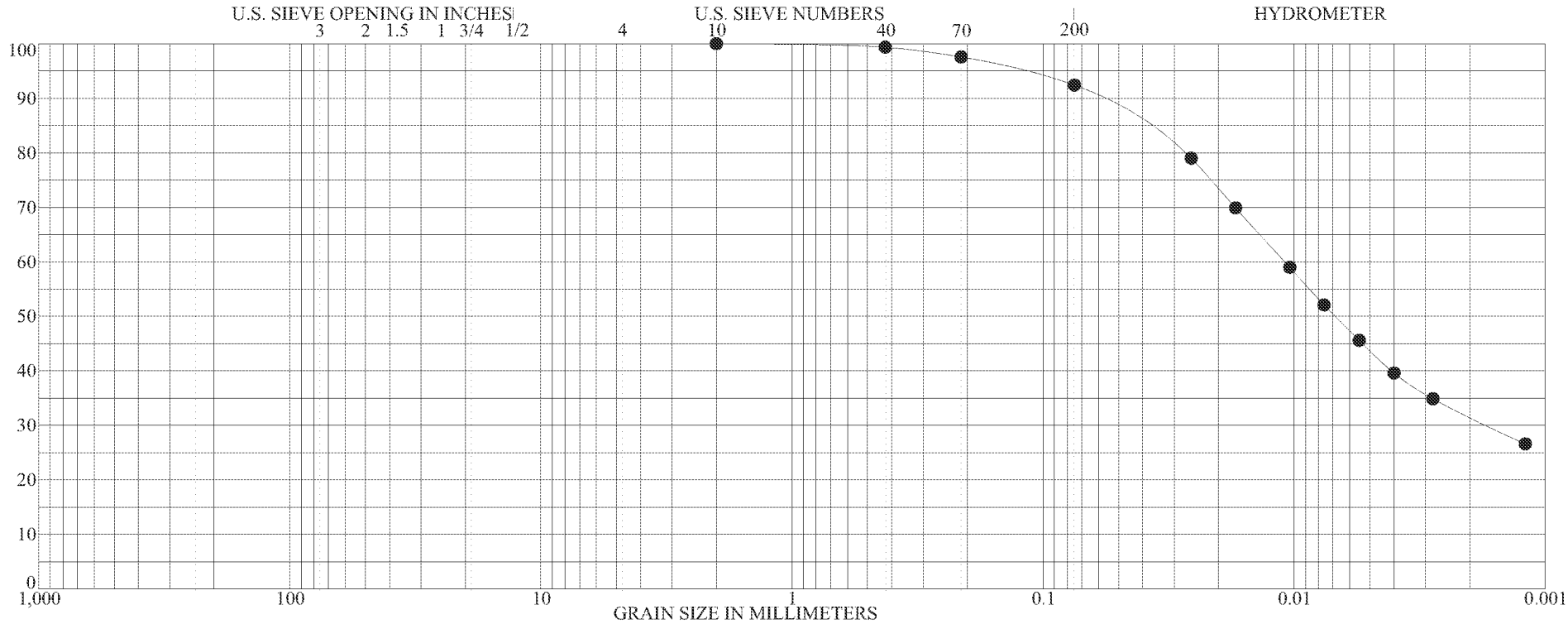
PLATE 39

ED_005405A_00000217-00122



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0907 S-23 38.5' to 40.0'**	**Brown mottled with dark-brown silty clay, trace fine to medium sand.**	**21**	**47**	**24**	**23**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0907 S-23 38.5' to 40.0'**	**2.0000**	**0.1265**	**0.0109**	**0.0068**		**0.0**	**7.6**	**48.6**	**43.8**

ASTM D422 **GRADATION CURVE**

PROJECT GAVIN PLANT BOTTOM ASH POND INVESTIGATION
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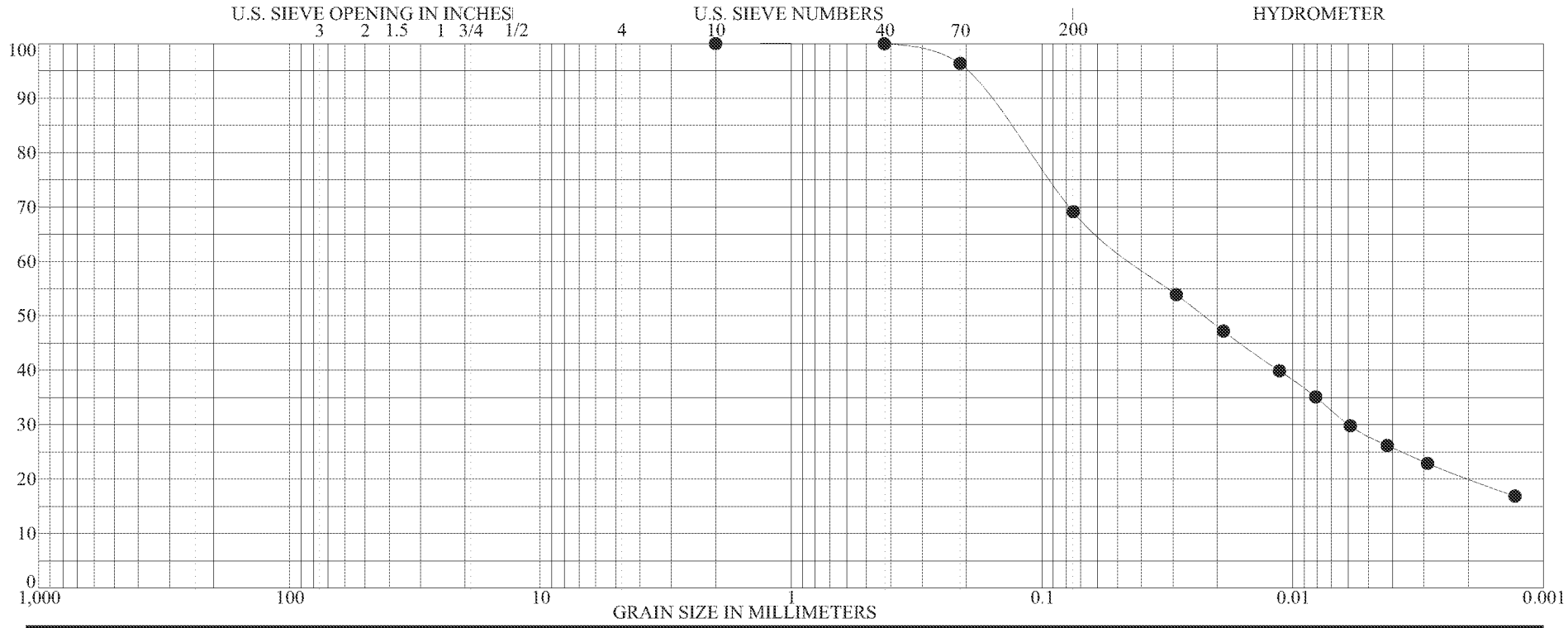
PLATE 40

ED_005405A_00000217-00123



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0907 S-26 46.5' to 48.0'**	**Brown silty clay, some fine sand, trace medium sand.**	**18**	**31**	**17**	**14**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0907 S-26 46.5' to 48.0'**	**2.0000**	**0.2012**	**0.0425**	**0.0226**		**0.0**	**30.9**	**41.1**	**28.0**

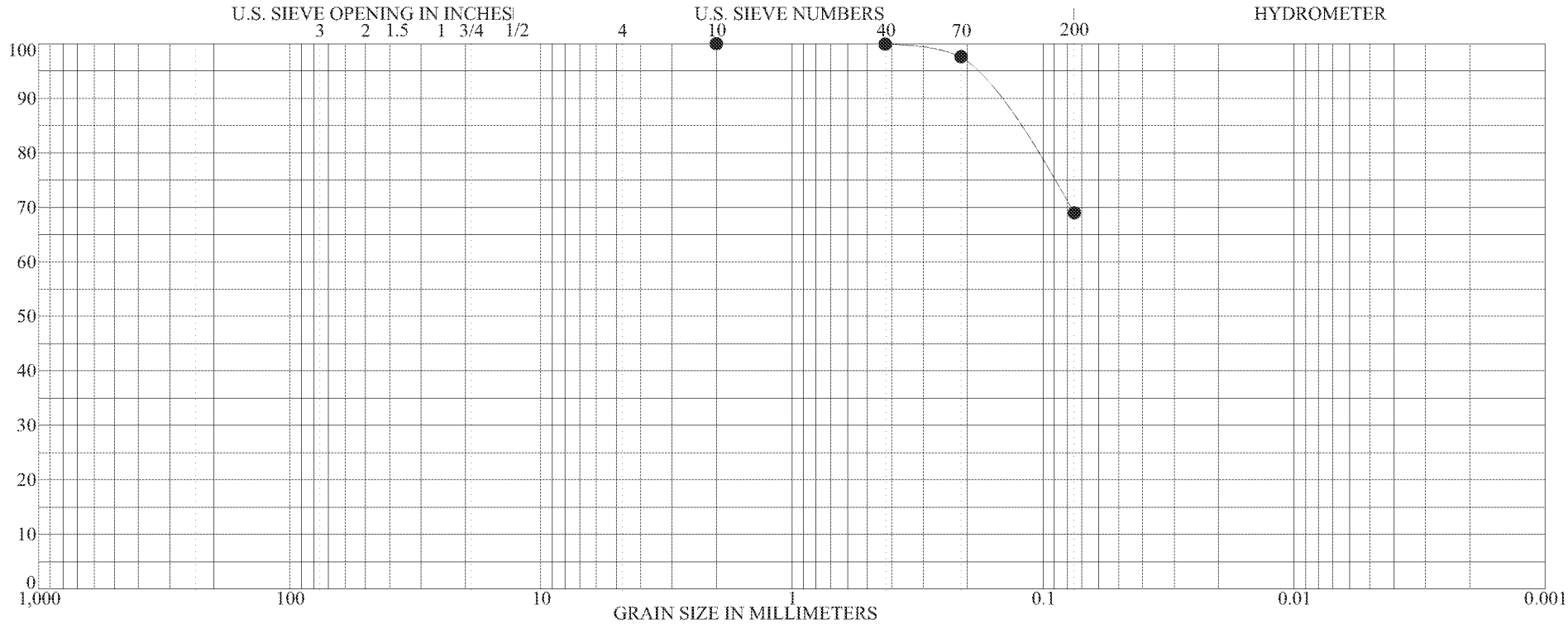
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

GRN-REG

PLATE 41

ED_005405A_00000217-00124



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	Cc	Cu
● **BAP-0907 S-28 51.0' to 52.2'**	**Brown silty clay, some fine to coarse sand.**	**20**	**32**	**18**	**14**		

Specimen Identification - Depth	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● **BAP-0907 S-28 51.0' to 52.2'**	**2.0000**	**0.1928**				**0.0**	**31.0**	**69.0**	

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 6/2/09

GRN-REG

PLATE 42

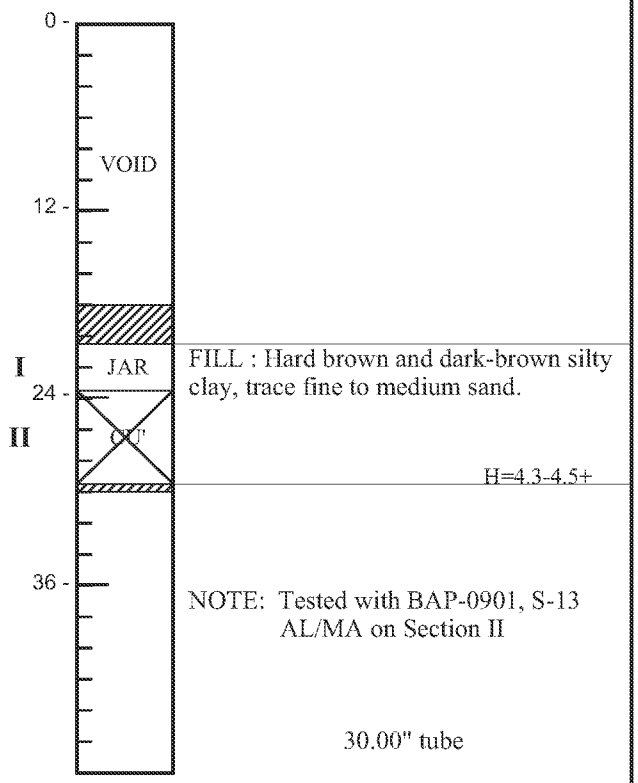
ED_005405A_00000217-00125

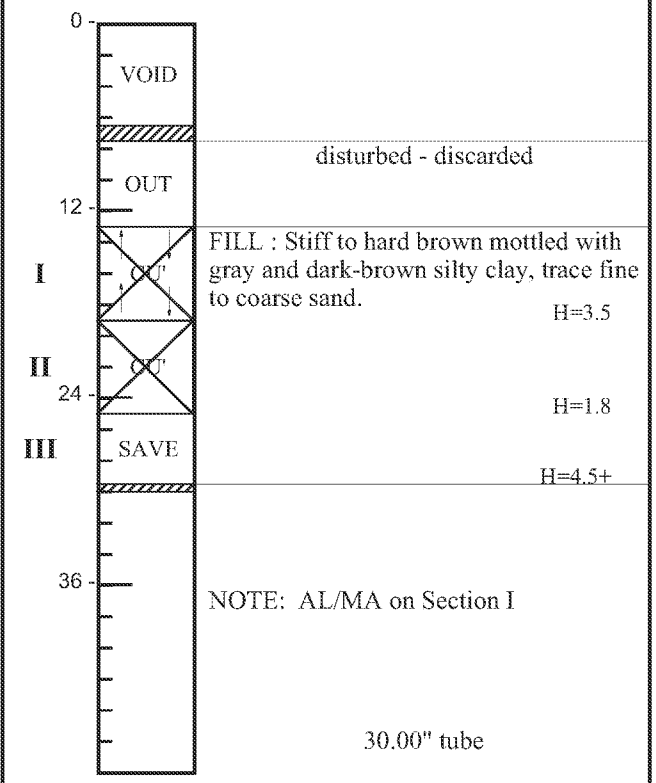
JOB NUMBER : 011.11497.014
PROJECT : GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION : CHESHIRE, OHIO

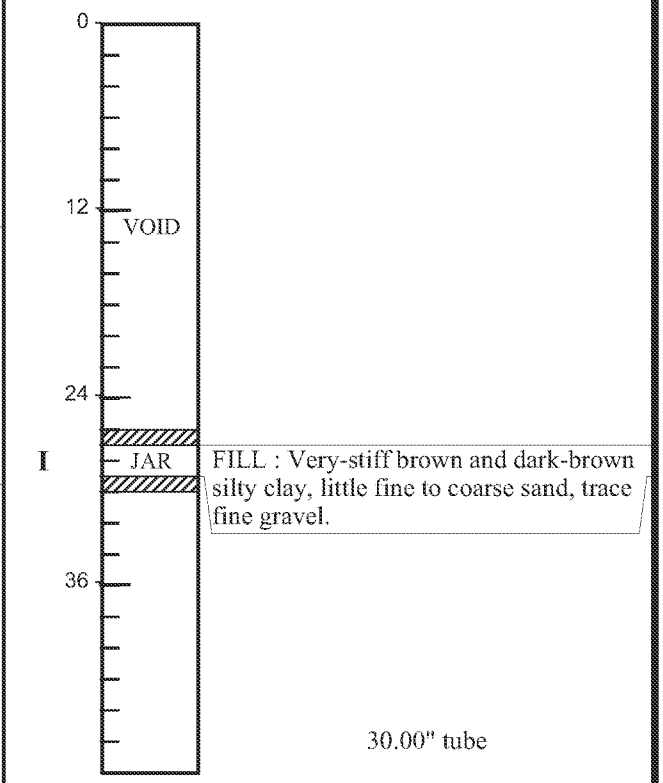
BBCM

LABORATORY LOG OF SHELBY TUBES

Boring : BAP-0901	Sample : 5	Boring : BAP-0901	Sample : 13	Boring : BAP-0903	Sample : 4
Depth : 7.0' to 7.9'	Recovery : 9.00"	Depth : 19.5' to 21.5'	Recovery : 16.50"	Depth : 5.5' to 5.7'	Recovery : 2.00"







LEGEND

- Consolidation, Incremental
- Swelling, Test
- Wax
- C R S - Consolidation, C R S
- P P - Permeability, Vertical / Horizontal
- Unconfined Compression Test
- Triaxial Compression Test

H - Hand Penetrometer (tsf)
Ds - Direct Shear
LOI - Loss on Ignition
AL - Atterberg Limits
MA - Sieve/Hydrometer
SG - Specific Gravity
SL - Shrinkage Limit
POR - Porosity
UDW - Unit Dry Weight
MC - Moisture Content
D_R - Relative Density
S - Sieve

SHELBY TUBE LOG 11497014.GPJ BBCM.GDT 6/2/09

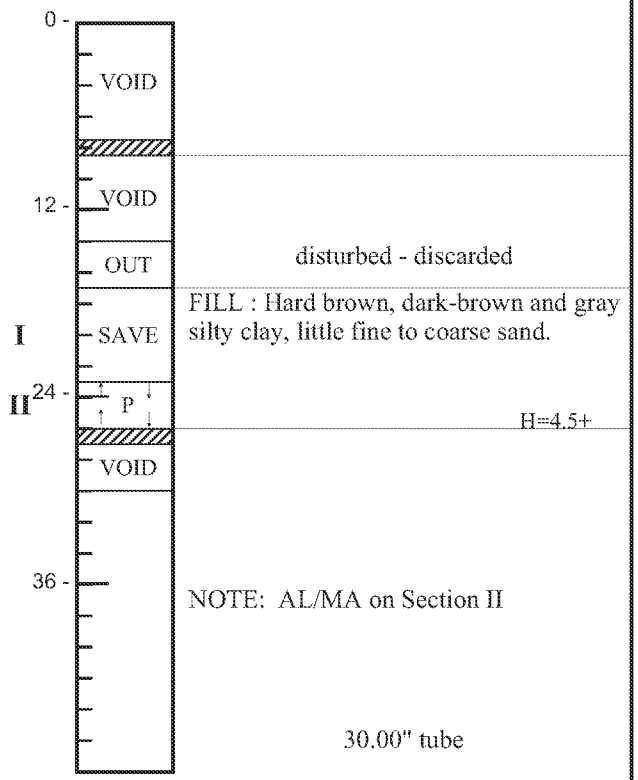
ED_005405A_00000217-00126

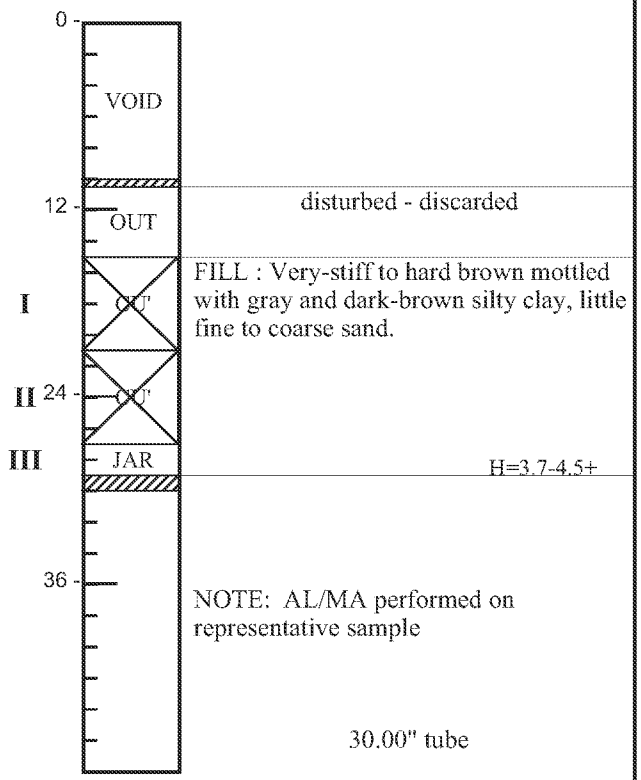
JOB NUMBER : 011.11497.014
PROJECT : GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION : CHESHIRE, OHIO

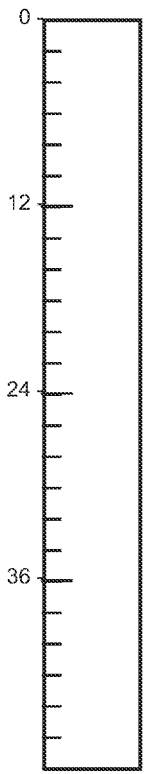
BBCM

LABORATORY LOG OF SHELBY TUBES

Boring : BAP-0905	Sample : 14	Boring : BAP-0907	Sample : 12	Boring :	Sample :
Depth : 20.5' to 22.0'	Recovery : 9.00"	Depth : 17.5' to 19.1'	Recovery : 14.00"	Depth :	Recovery :







LEGEND

- Consolidation, Incremental
- Swelling, Test
- Wax
- C R S - Consolidation, C R S
- P P - Permeability, Vertical / Horizontal
- Unconfined Compression Test
- Triaxial Compression Test

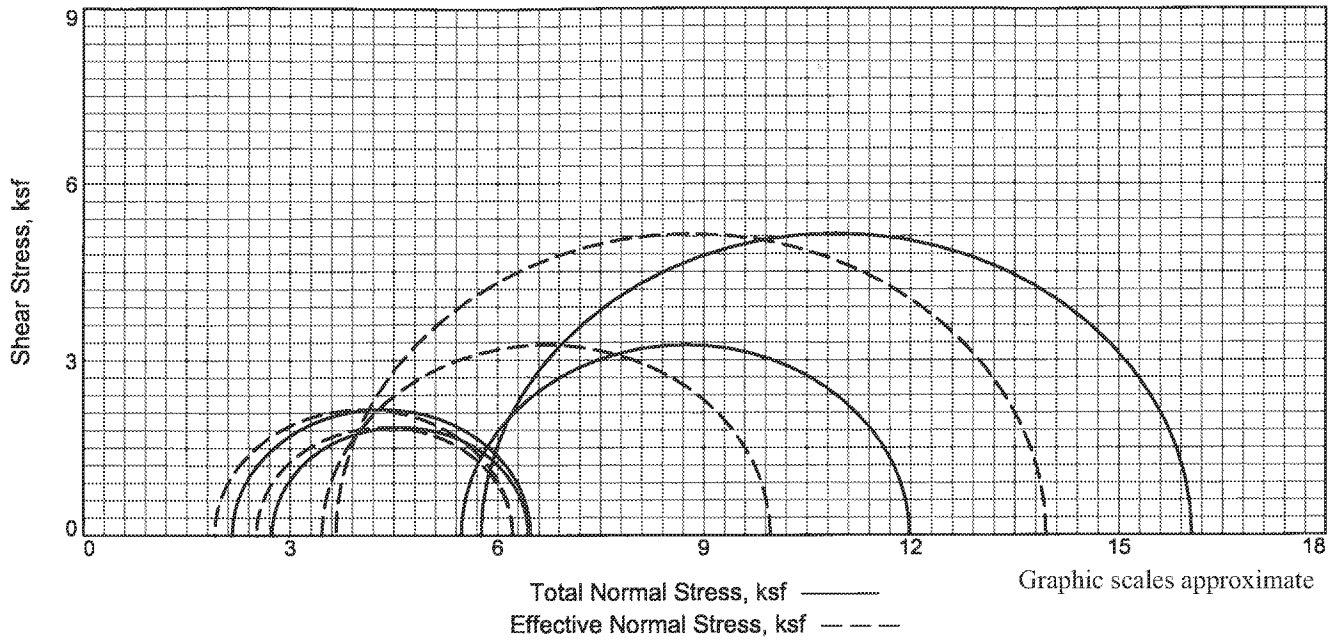
H - Hand Penetrometer (tsf)
Ds - Direct Shear
LOI - Loss on Ignition
AL - Atterberg Limits
MA - Sieve/Hydrometer
SG - Specific Gravity

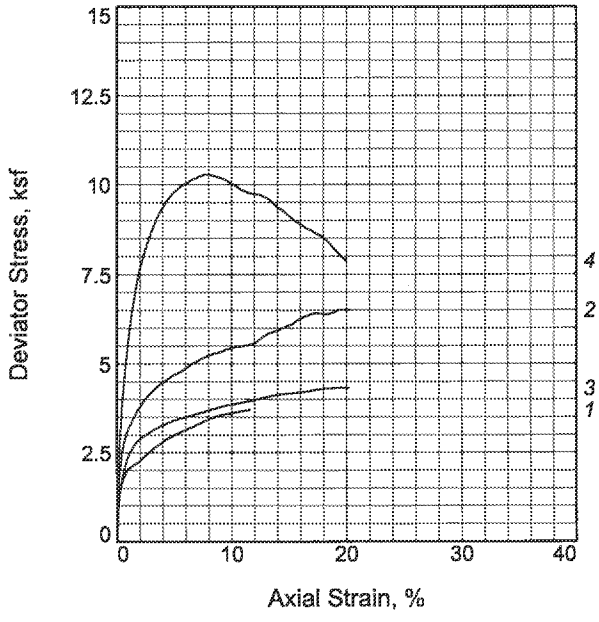
SL - Shrinkage Limit
POR - Porosity
UDW - Unit Dry Weight
MC - Moisture Content
D_R - Relative Density
S - Sieve

SHELBY TUBE LOG 11497014.GPJ BBCM.GDT 6/2/09

PLATE 44

ED_005405A_00000217-00127





Sample No.		1	2	3	4
Initial	Water Content, %	21.0	21.9	19.9	20.7
	Dry Density, pcf	105.6	104.8	107.6	109.2
	Saturation, %	95.1	97.0	94.7	99.7
	Void Ratio	0.5967	0.6080	0.5672	0.5719
	Diameter, in.	2.87	2.89	2.88	2.85
	Height, in.	5.60	5.59	5.59	5.59
At Test	Water Content, %	21.0	21.1	21.0	21.2
	Dry Density, pcf	107.7	106.9	110.1	113.1
	Saturation, %	100.5	98.9	106.8	112.6
	Void Ratio	0.5648	0.5762	0.5306	0.5183
	Diameter, in.	2.86	2.88	2.85	2.81
	Height, in.	5.55	5.51	5.55	5.54
Strain rate, in./min.		0.00	0.00	0.01	0.01
Back Pressure, ksf		5.8	5.8	5.8	5.8
Cell Pressure, ksf		8.5	11.2	7.9	11.5
Fail. Stress, ksf		3.7	6.5	4.3	10.3
Total Pore Pr., ksf		6.0	7.8	6.0	7.9
Ult. Stress, ksf		3.7	6.5	4.3	7.9
Total Pore Pr., ksf		6.0	7.7	6.0	8.6
$\bar{\sigma}_1$ Failure, ksf		6.2	10.0	6.2	13.9
$\bar{\sigma}_3$ Failure, ksf		2.5	3.5	1.9	3.7

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube
Description: FILL : Stiff to hard brown mottled with gray and dark-brown silty clay, trace fine to coarse
LL= 41 **PL=** 22 **PI=** 19
Assumed Specific Gravity= 2.7
Remarks:

Client: AEP

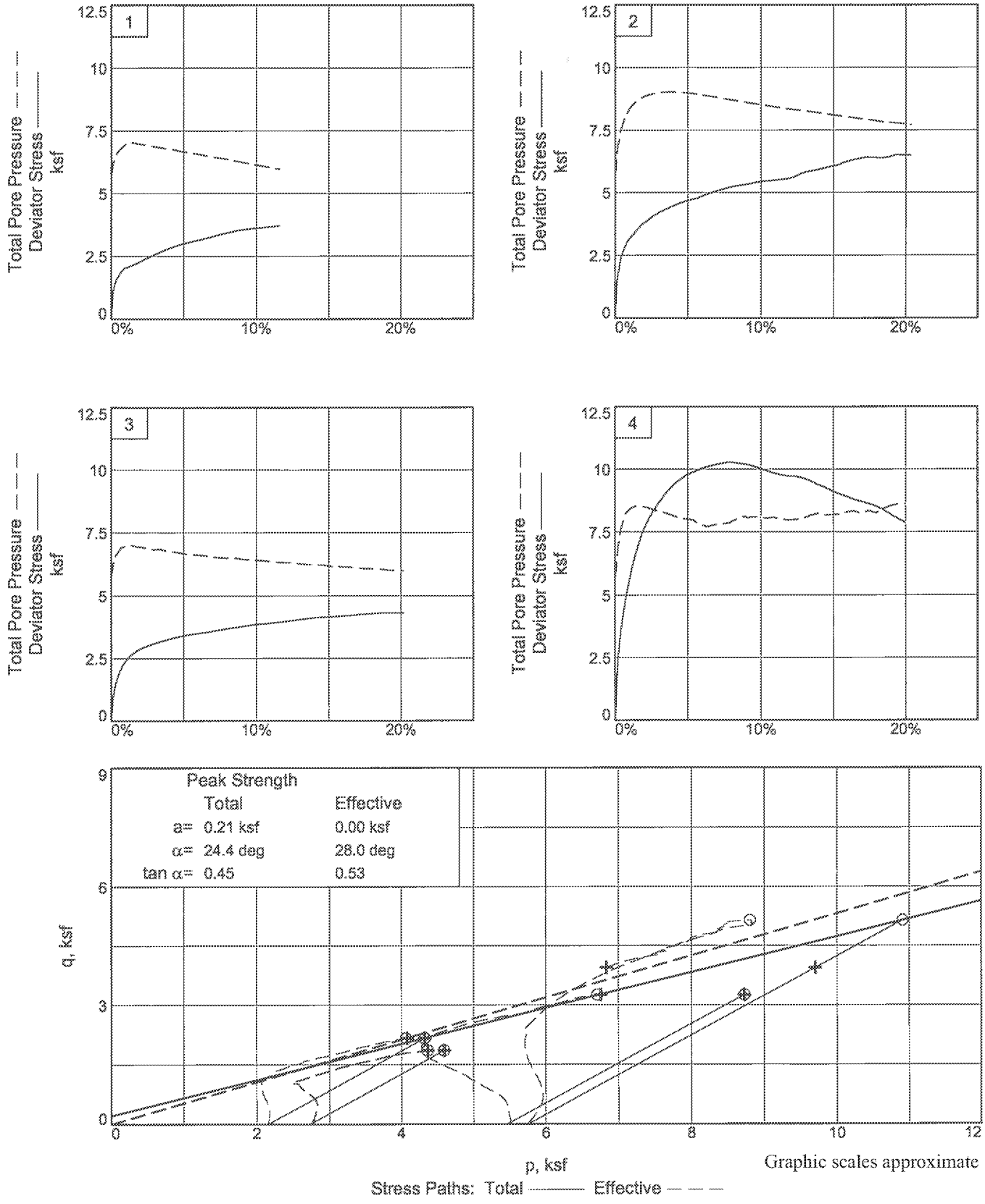
Project: GAVIN PLANT ASH POND INVESTIGATION
CHESHIRE, OHIO
Location: BAP-0901 & BAP-0907
Sample Number: S5II,S13II,S12I&II **Depth:** 7.0-21.5
Proj. No.: 011.11497.014 **Date Sampled:** 5/12/09

TRIAXIAL SHEAR TEST REPORT

BBC&M Engineering, Inc.

Figure 1

Tested By: PJM **Checked By:** JJ



Client: AEP

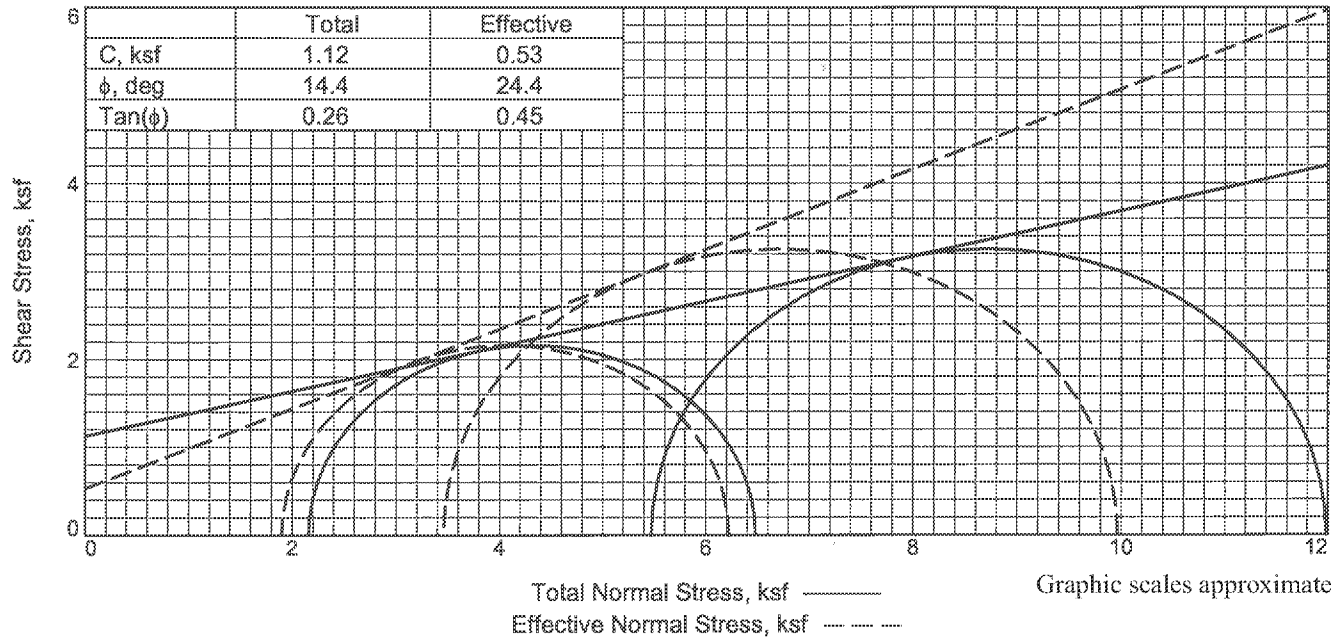
Project: GAVIN PLANT ASH POND INVESTIGATION

Location: BAP-0901 & BAP-0907 **Depth:** 7.0-21.5 **Sample Number:** S5II,S13II,S12I&II

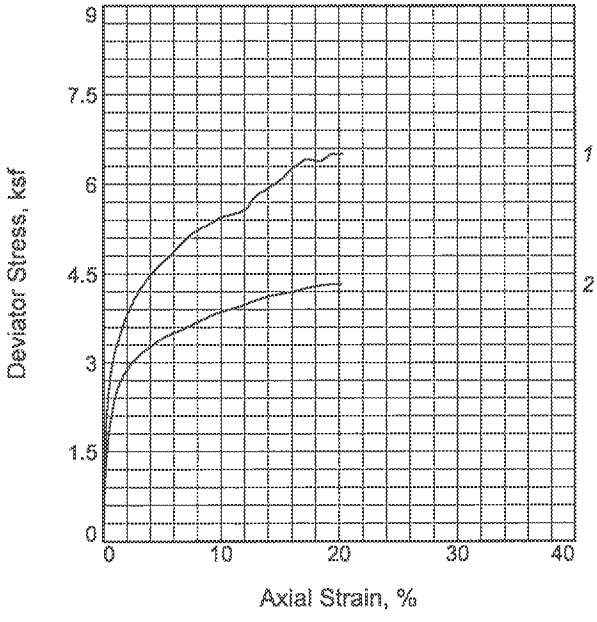
Project No.: 011.11497.014 **Figure 2**

BBC&M Engineering, Inc.

Tested By: PJM **Checked By:** JJ



	Total	Effective
C, ksf	1.12	0.53
ϕ, deg	14.4	24.4
Tan(ϕ)	0.26	0.45



Sample No.		1	2
Initial	Water Content, %	21.9	19.9
	Dry Density, pcf	104.8	107.6
	Saturation, %	97.0	94.7
	Void Ratio	0.6080	0.5672
	Diameter, in.	2.89	2.88
	Height, in.	5.59	5.59
At Test	Water Content, %	21.1	21.0
	Dry Density, pcf	106.9	110.1
	Saturation, %	98.9	106.8
	Void Ratio	0.5762	0.5306
	Diameter, in.	2.88	2.85
	Height, in.	5.51	5.55
Strain rate, in./min.		0.00	0.01
Back Pressure, ksf		5.76	5.76
Cell Pressure, ksf		11.23	7.92
Fail. Stress, ksf		6.51	4.32
Total Pore Pr., ksf		7.78	6.02
Ult. Stress, ksf		6.51	4.32
Total Pore Pr., ksf		7.73	6.00
$\bar{\sigma}_1$ Failure, ksf		9.97	6.22
$\bar{\sigma}_3$ Failure, ksf		3.46	1.90

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube
Description: FILL : Stiff to hard brown mottled with gray and dark-brown silty clay, trace fine to coarse
LL= 41 **PL=** 22 **PI=** 19
Assumed Specific Gravity= 2.7
Remarks:

Client: AEP

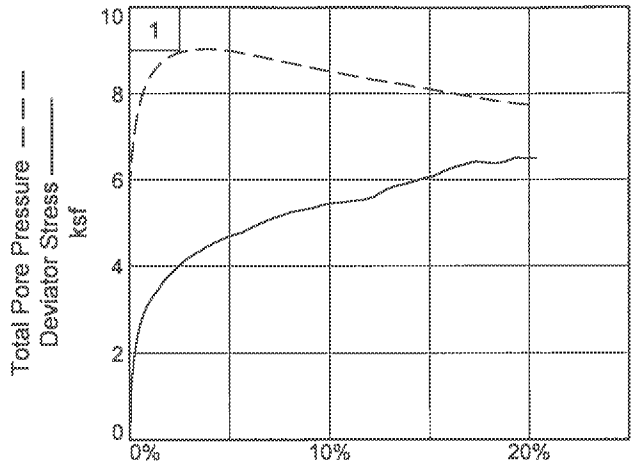
Project: GAVIN PLANT ASH POND INVESTIGATION
CHESHIRE, OHIO
Location: BAP-0901 & BAP-0907
Sample Number: S-13 II, S-12 I **Depth:** 17.5-21.5
Proj. No.: 011.11497.014 **Date Sampled:** 5/12/09

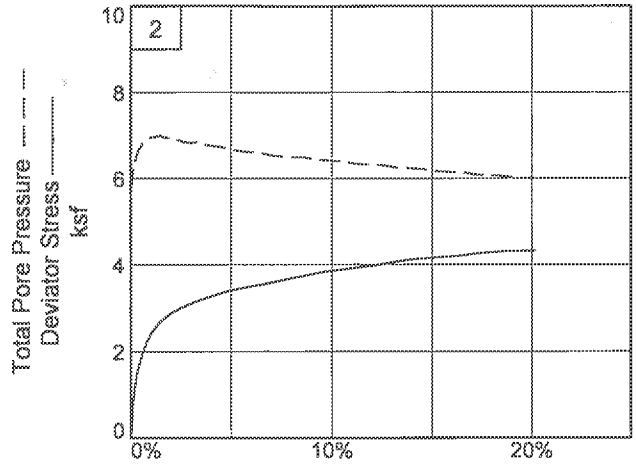
TRIAXIAL SHEAR TEST REPORT

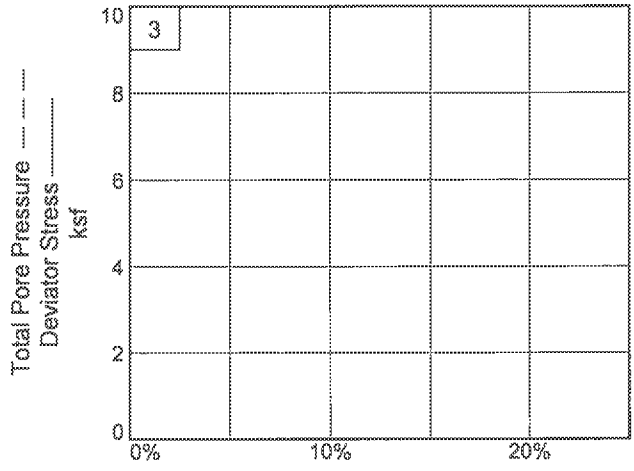
BBC&M Engineering, Inc.

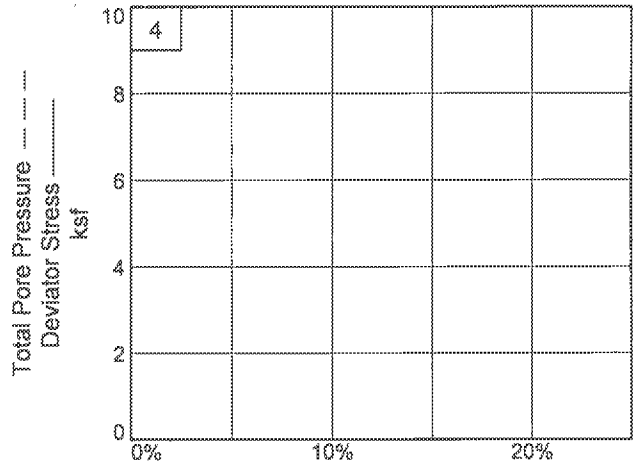
Figure 1

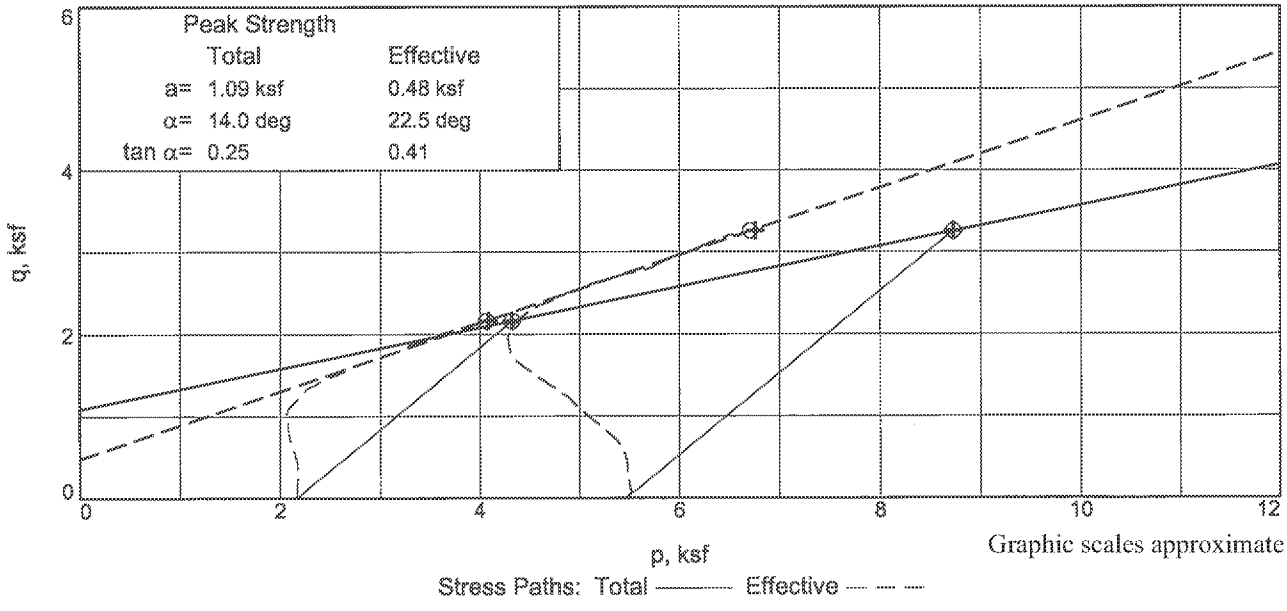
Tested By: PJM **Checked By:** JJ











Client: AEP

Project: GAVIN PLANT ASH POND INVESTIGATION

Location: BAP-0901 & BAP-0907 **Depth:** 17.5-21.5 **Sample Number:** S-13 II, S-12 I

Project No.: 011.11497.014 **Figure 2**

BBC&M Engineering, Inc.

Tested By: PJM **Checked By:** JJ

PERMEABILITY TEST DATA AND COMPUTATION SHEET

((ASTM D-5084) FALLING HEAD, METHOD C)

BBCM SOLUTIONS TO BUILD ON

Job Number:	011.11497.014	Date:	5/7-8/2009	Maximum Dry Density:	
Project Name:	Gavin Plant Ash Pond Investigation	Boring:	BAP-0905	Optimum Moisture Content:	
Project Location:	Cheshire, Ohio	Sample:	ST-14 Sec. II	% Compaction.:	
Tested By:	PJM	Depth:	20.5' to 22.0'	Optimum +/-:	
Remarks:				Natural:	X
Material:	FILL : Hard brown, dark-brown and gray silty clay, little fine to coarse sand.			Remolded:	

Sample:

Initial Length:	2.8858 in = 7.330 cm
Final Ave. Length (L):	2.9026 in = 7.373 cm
Diameter:	2.8760 in = 7.31 cm
Area (A):	6.496 sq in = 41.91 sq cm
Volume (V):	18.747 cu in = 307.21 cu cm
Wet Wt.:	640.82 grams
Unit Wet Wt.:	130.23 pcf
Unit Dry Wt.:	107.97 pcf

Test Conditions:

Chamber Pressure:	62 psi
Back Pressure:	58 psi
Confining Pressure:	4 psi
Temp. @ Start:	22.5 °C
Temp. @ End:	22.2 °C
Average Temp.:	22.4 °C
B Parameter:	0.96

Moisture Content:	Before Test	After Test
Pan No. =	H	H
Wet Wt. + Pan =	640.82	646.05
Dry Wt. + Pan =	531.29	531.29
Wt. of Pan =		
Wt. of Dry Soil =	531.29	531.29
Wt. of Water =	109.53	114.76
% Moisture =	20.62	21.60
% SATURATION	**99.18**	**102.26**

S.G.(est) = 2.7000

Pipette Pressures During Test:

Top Pipette:	60 psi	= 4220.3 cm
Bottom Pipette:	58 psi	= 4079.6 cm

Pipette:

Area (a): 0.3435 sq in = 0.8725 sq cm

Calculations:

$$k = \frac{a \cdot L}{2 \cdot A \cdot \Delta t} \ln\left(\frac{h_1}{h_2}\right)$$

where:
- k = Hydraulic Conductivity
- a = Pipette Cross-Sectional Area
- L = Length of Sample
- A = Sample Cross-Sectional Area
- Δt = Time Interval ($t_2 - t_1$)
- h_1 = Head Loss Across Permeameter/Specimen at t_1
- h_2 = Head Loss Across Permeameter/Specimen at t_2
- ln = Natural Logarithm (Base e = 2.71828)

Date	Time Readings	Time Interval Δt Seconds	Top Pipette cc	Hydraulic Head Headwater H_1 cm	Bottom Pipette cc	Hydraulic Head Tailwater H_2 cm	Head Loss $h = H_1 - H_2$ cm	$\ln(h_1/h_2)$	Temp. Corr. Permeability k cm/sec
5/7/2009	10:09 AM	0.00	49.20	4091.22	1.10	4287.03	-195.81	–	–
5/7/2009	11:10 AM	3,660	49.10	4091.33	1.20	4286.91	-195.58	0.00117	2.322E-08
5/7/2009	1:44 PM	9,240	48.80	4091.68	1.50	4286.57	-194.89	0.00352	2.766E-08
5/7/2009	2:50 PM	3,960	48.65	4091.85	1.60	4286.45	-194.60	0.00147	2.696E-08
5/7/2009	4:19 PM	5,340	48.50	4092.02	1.80	4286.22	-194.20	0.00206	2.804E-08
5/8/2009	8:22 AM	57,780	47.00	4093.74	3.50	4284.28	-190.54	0.01907	2.394E-08

Time Weighted Average, k [cm/sec] = **2.476E-08**

PERMEABILITY TEST DATA AND COMPUTATION SHEET

((ASTM D-5084) FALLING HEAD, METHOD C)

BBCM SOLUTIONS TO BUILD ON

Job Number:	011.11497.014	Date:	5/18-19/2009	Maximum Dry Density:	
Project Name:	Gavin Plant Ash Pond Investigation	Boring:	BAP-0901	Optimum Moisture Content:	
Project Location:	Cheshire, Ohio	Sample:	ST-13 Sec. I	% Compaction.:	
Tested By:	PJM	Depth:	19.5' to 21.5'	Optimum +/-:	
Remarks:				Natural:	
Material:	FILL: Stiff to hard brown mottled with gray and dark-brown silty clay, trace fine to coarse sand.			Remolded:	

Sample:

Initial Length:	5.6045 in = 14.235 cm
Final Ave. Length (L):	5.5595 in = 14.121 cm
Diameter:	2.8725 in = 7.30 cm
Area (A):	6.481 sq in = 41.81 sq cm
Volume (V):	36.320 cu in = 595.18 cu cm
Wet Wt.:	1217.04 grams
Unit Wet Wt.:	127.66 pcf
Unit Dry Wt.:	104.36 pcf

Test Conditions:

Chamber Pressure:	62 psi
Back Pressure:	58 psi
Confining Pressure:	4 psi
Temp. @ Start:	20.5 °C
Temp. @ End:	21.0 °C
Average Temp.:	20.8 °C
B Parameter:	0.97

Moisture Content:

	Before Test	After Test
Pan No. =		
Wet Wt. + Pan =	1217.04	1217.79
Dry Wt. + Pan =	994.93	994.93
Wt. of Pan =		
Wt. of Dry Soil =	994.93	994.93
Wt. of Water =	222.11	222.86
% Moisture =	22.32	22.40
% SATURATION	**97.98**	**100.43**

S.G.(est) = 2.7000

Pipette Pressures During Test:

Top Pipette:	60 psi	= 4220.3 cm
Bottom Pipette:	58 psi	= 4079.6 cm

Pipette:

Area (a): 0.3435 sq in = 0.8725 sq cm

Calculations:

$$k = \frac{a \cdot L}{2 \cdot A \cdot \Delta t} \ln\left(\frac{h_1}{h_2}\right)$$

where:
- k = Hydraulic Conductivity
- a = Pipette Cross-Sectional Area
- L = Length of Sample
- A = Sample Cross-Sectional Area
- Δt = Time Interval (t_2 - t_1)
- h_1 = Head Loss Across Permeameter/Specimen at t_1
- h_2 = Head Loss Across Permeameter/Specimen at t_2
- ln = Natural Logarithm (Base e = 2.71828)

Date	Time Readings	Time Interval Δt Seconds	Top Pipette cc	Hydraulic Head Headwater H_1 cm	Bottom Pipette cc	Hydraulic Head Tailwater H_2 cm	Head Loss $h = H_1 - H_2$ cm	$\ln(h_1/h_2)$	Temp. Corr. Permeability k cm/sec
5/18/2009	9:19 AM	0.00	35.10	4107.38	36.25	4246.74	-139.36	–	–
5/18/2009	10:52 AM	5,580	34.95	4107.55	36.30	4246.68	-139.13	0.00165	4.270E-08
5/18/2009	2:32 PM	13,200	34.90	4107.61	36.40	4246.57	-138.96	0.00124	1.356E-08
5/18/2009	4:16 PM	6,240	34.80	4107.72	36.50	4246.45	-138.73	0.00165	3.829E-08
5/18/2009	7:40 PM	12,240	34.50	4108.07	36.55	4246.39	-138.33	0.00290	3.424E-08
5/19/2009	7:55 AM	44,100	34.30	4108.30	37.10	4245.76	-137.47	0.00623	2.046E-08

Time Weighted Average, k [cm/sec] = **2.430E-08**

PLATE 50

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	GRADATION			COMPACTION		TRIAXIAL					DIRECT SHEAR			UNCONFIN COMPRESS	CONSOLID.	SPECIFIC GRAVITY	UNIT WEIGHT DRY	REMOLDED	PERMEABILITY				RELATIVE DENSITY	LOI	ROCK CORE	SHELBY TUBE	CBR
							Hydrometer																									
						sieve	short	long	standard	modified	unconsn.	undrain consolid	undrain w/pores	drained	drained	undrain	residual							cohesive	non/cohes	rigid wall	flexible wall					
		%	%	%	%	* SEE INDIVIDUAL TEST CURVES																PCF						%	%			
BAP-0908	8.75	21										*										107.7										
BAP-0908	9.25	21										*										108.6										
BAP-0908	9.75	21										*										108.1										
BAP-0908	10.25	20	37	21	16	*		*																							*	
BAP-0908	14.25	19	34	19	15	*		*																								
BAP-0908	21.75	16																														
BAP-0908	24.50																														*	
BAP-0908	31.35	18	33	19	14	*		*																								
BAP-0908	39.25	21	30	17	13	*		*																								
BAP-0908	44.50																														*	
BAP-0909	6.25	28	49	26	23	*		*																								
BAP-0909	10.00																														*	
BAP-0909	11.75	24				*		*																								
BAP-0909	16.25	28										*										95.4										
BAP-0909	16.75	27										*										96.4										
BAP-0909	17.25	27										*										97.2										
BAP-0909	17.75	27	34	21	13	*		*																							*	
BAP-0909	18.75	28	33	18	15	*		*																								
BAP-0909	26.25	42	33	19	14	*		*																								
BAP-0909	28.20	34	41	20	21	*		*																								

BBCM
SOLUTIONS TO BUILD ON

TESTING SUMMARY - STANDARD

PROJECT GAVIN PLANT FLY ASH DAM INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 1/7/10

SUM REG 11497014.GPJ BBCM.GDT 1/7/10

PLATE 1

ED_005405A_00000217-00134

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	GRADATION			COMPACTION		TRIAXIAL					DIRECT SHEAR			UNCONFIN COMPRESS	CONSOLID.	SPECIFIC GRAVITY	UNIT WEIGHT DRY	REMOLDED	PERMEABILITY				RELATIVE DENSITY	LOI	ROCK CORE	SHELBY TUBE	CBR
							Hydrometer																									
						sieve	short	long	standard	modified	unconsn. undrain	consolid undrain	w/pores	drained	drained	undrain	residual							cohesive	non/cohes	rigid wall	flexible wall					
		%	%	%	%	* SEE INDIVIDUAL TEST CURVES															PCF						%	%			
BAP-0910	8.75	24																														
BAP-0910	11.00																														*	
BAP-0910	15.75	24	31	16	15	*		*																								
BAP-0910	17.25	27										*									87.6											
BAP-0910	17.75	26										*									97.7											
BAP-0910	18.25	27										*									94.5											
BAP-0910	18.75	28	24	19	5	*		*																							*	
BAP-0910	21.25	29	30	17	13	*		*																								
BAP-0910	24.25	31	32	17	15	*		*																								
BAP-0910	27.05	30	26	18	8	*		*																								
BAP-0910	30.25	35	40	21	19	*		*																								
BAP-0911	9.25	19	32	19	13																											
BAP-0911	11.00																														*	
BAP-0911	17.00																														*	
BAP-0911	18.75	26	35	19	16	*		*																								
BAP-0911	22.05	28	33	17	16	*		*																								
BAP-0911	26.25	30				*		*																								
BAP-0911	32.25	32				*		*																								

BBCM
SOLUTIONS TO BUILD ON

TESTING SUMMARY - STANDARD

PROJECT GAVIN PLANT FLY ASH DAM INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 DATE 1/7/10

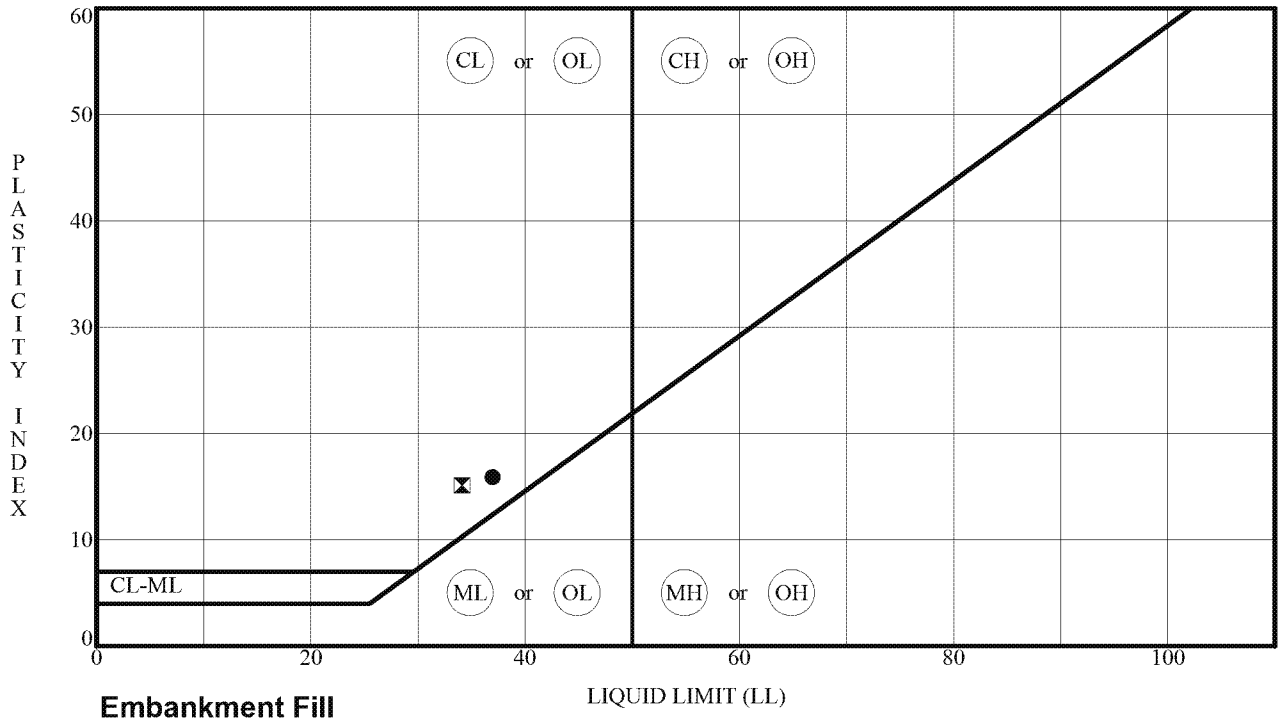
SUM REG 111497014.GPJ BBCM.GDT 1/7/10

PLATE 2

ED_005405A_00000217-00135

ATTERBERG LIMITS' RESULTS

BBCM



Embankment Fill

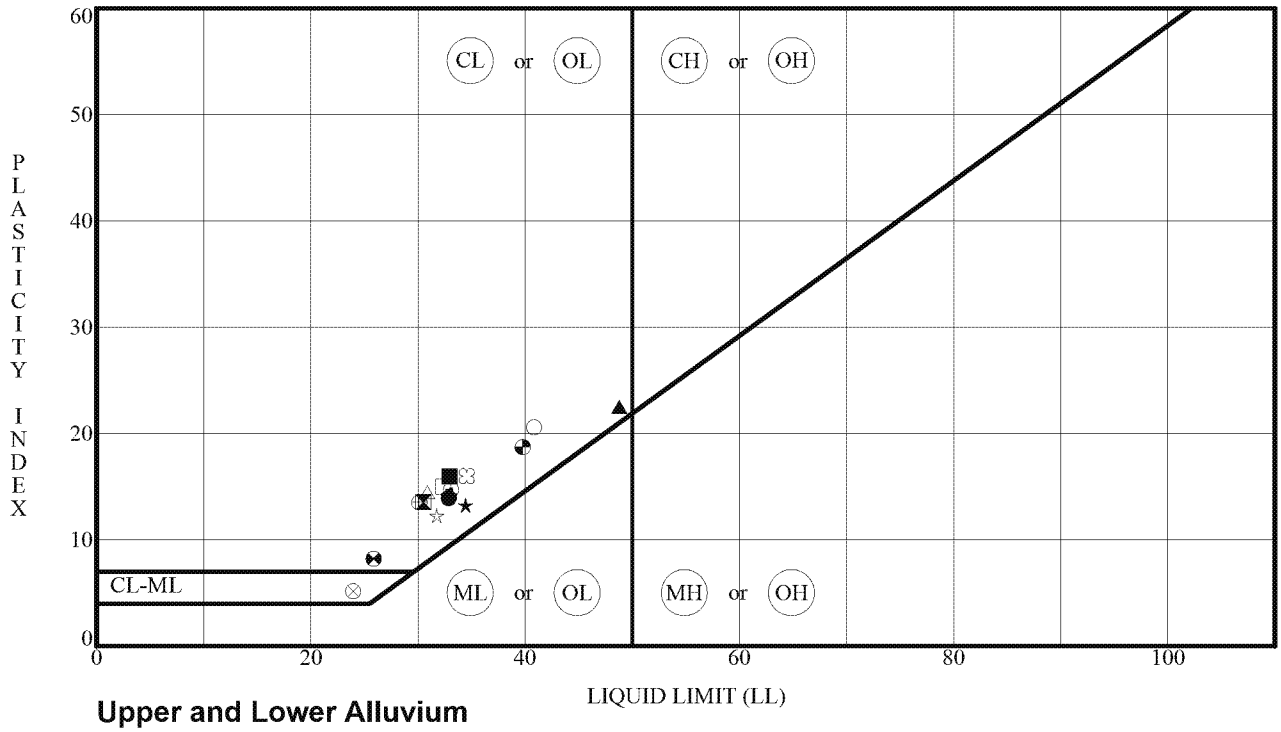
	Specimen Id.	Pt. ID	MC	LL	PL	PI	.002mm	ASTM Classification
●	**BAP-0908**	**10.25**	**20**	**37**	**21**	**16**	**25.4**	**LEAN CLAY with SAND CL**
⧗	**BAP-0908**	**14.25**	**19**	**34**	**19**	**15**	**25.6**	**LEAN CLAY with SAND CL**

PROJECT GAVIN PLANT FLY ASH DAM INVESTIGATION
LOCATION CHESHIRE, OHIO
JOB NO. 011.11497.014 **DATE** 1/7/10

ALPIEPA

ATTERBERG LIMITS' RESULTS

BBCM

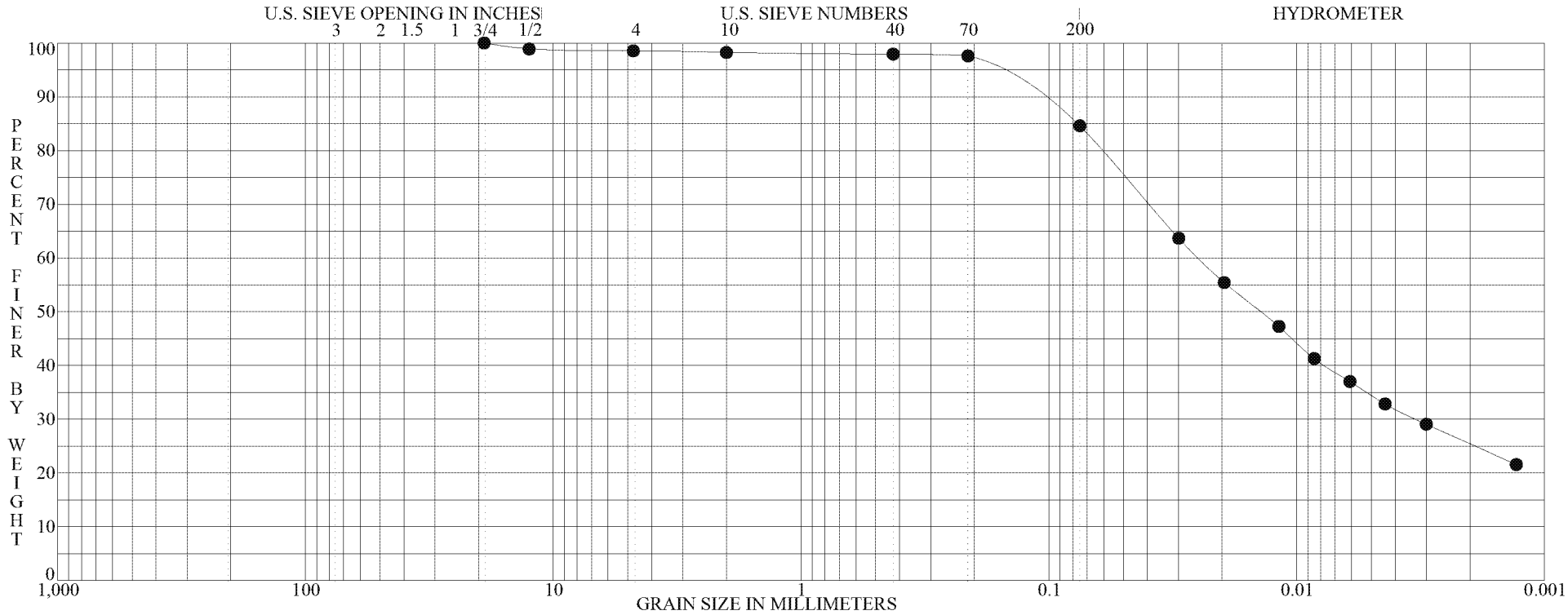


ALPIEPA

Upper and Lower Alluvium

	Specimen Id.	Pt. ID	MC	LL	PL	PI	.002mm	ASTM Classification
●	BAP-0908	31.35	18	33	19	14	23.9	LEAN CLAY CL
⧗	BAP-0908	39.25	21	30	17	13	16.8	LEAN CLAY with SAND CL
▲	BAP-0909	6.25	28	49	26	23	33.4	LEAN CLAY CL
★	BAP-0909	17.75	27	34	21	13	22.5	LEAN CLAY CL
⊙	BAP-0909	18.75	28	33	18	15	19.4	LEAN CLAY with SAND CL
✪	BAP-0909	26.25	42	33	19	14	18.5	LEAN CLAY with SAND CL
○	BAP-0909	28.20	34	41	20	21	27.5	LEAN CLAY with SAND CL
△	BAP-0910	15.75	24	31	16	15	19.3	SANDY LEAN CLAY CL
⊗	BAP-0910	18.75	28	24	19	5	14.3	SANDY SILTY CLAY CL-ML
⊕	BAP-0910	21.25	29	30	17	13	18.1	SANDY LEAN CLAY CL
□	BAP-0910	24.25	31	32	17	15	22.2	LEAN CLAY with SAND CL
⊠	BAP-0910	27.05	30	26	18	8	15.9	SANDY LEAN CLAY CL
◕	BAP-0910	30.25	35	40	21	19	25.1	LEAN CLAY CL
☆	BAP-0911	9.25	19	32	19	13		
⌘	BAP-0911	18.75	26	35	19	16	21.0	LEAN CLAY with SAND CL
■	BAP-0911	22.05	28	33	17	16	22.1	LEAN CLAY with SAND CL

PROJECT	GAVIN PLANT FLY ASH DAM INVESTIGATION		
LOCATION	CHESHIRE, OHIO		
JOB NO.	011.11497.014	DATE	1/7/10



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0908 S-4 IV 8.5' to 10.2'**	**LEAN CLAY with SAND CL**	**20**	**37**	**21**	**16**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0908 S-4 IV 8.5' to 10.2'**	**19.0000**	**0.1722**	**0.0248**	**0.0140**		**1.5**	**13.9**	**59.2**	**25.4**

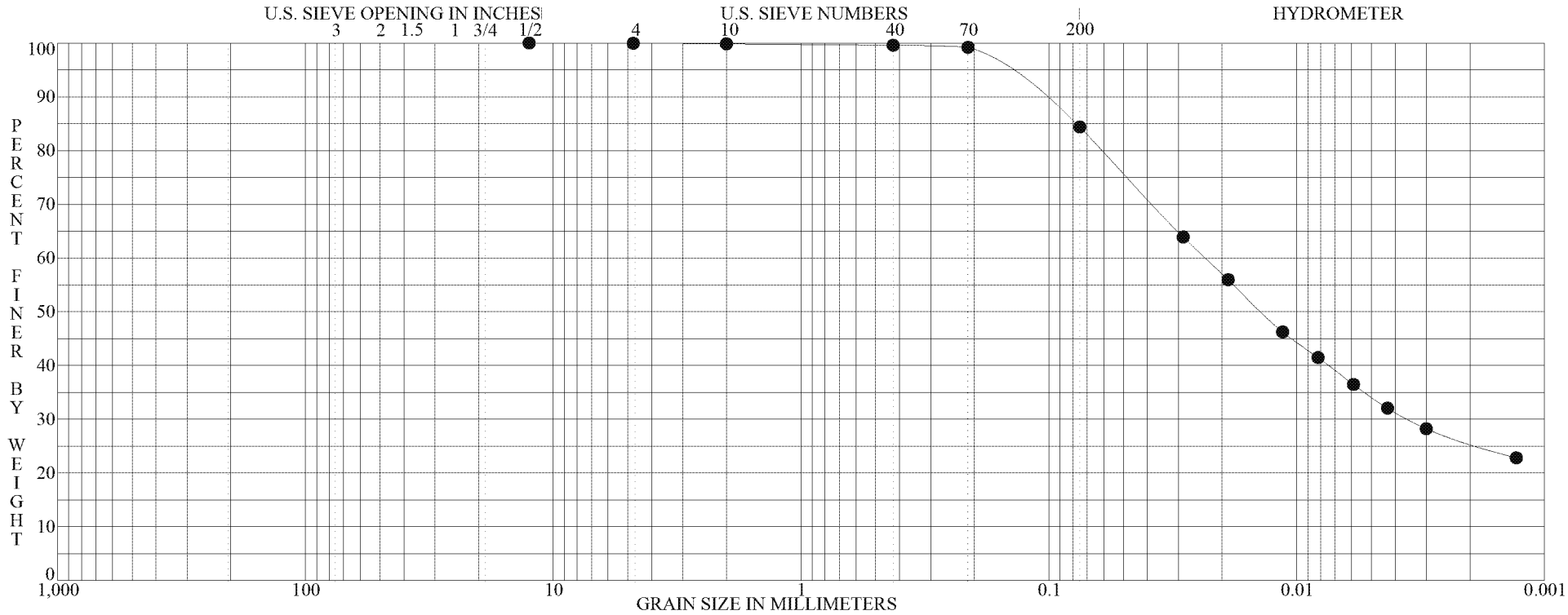
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 5

ED_005405A_00000217-00138



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0908 S-6 13.5' to 15.0'**	**LEAN CLAY with SAND CL**	**19**	**34**	**19**	**15**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0908 S-6 13.5' to 15.0'**	**12.5000**	**0.1579**	**0.0234**	**0.0139**		**0.0**	**15.6**	**58.8**	**25.6**

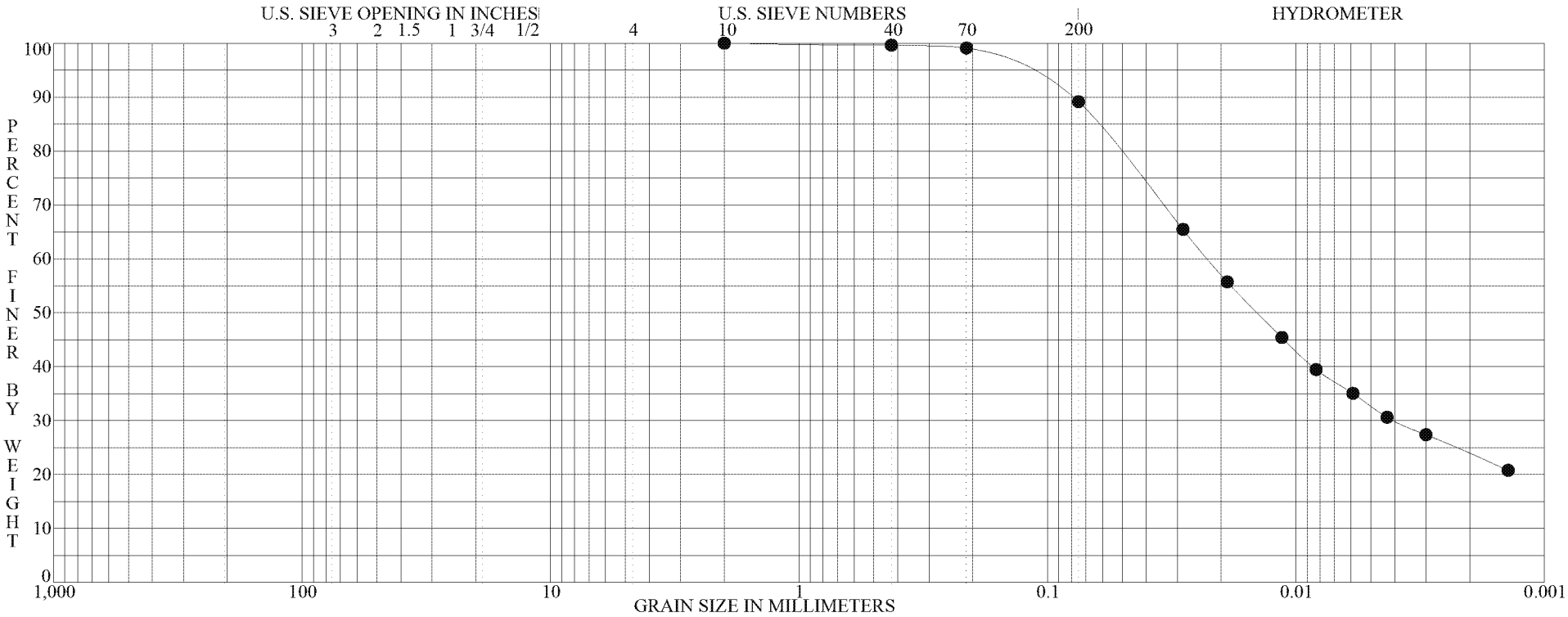
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 6

ED_005405A_00000217-00139



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
● GV-BAP-0908 S-13A 31.0' to 31.7'	LEAN CLAY CL	18	33	19	14		

Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● GV-BAP-0908 S-13A 31.0' to 31.7'	2.0000	0.1381	0.0226	0.0143		0.0	10.9	65.3	23.9

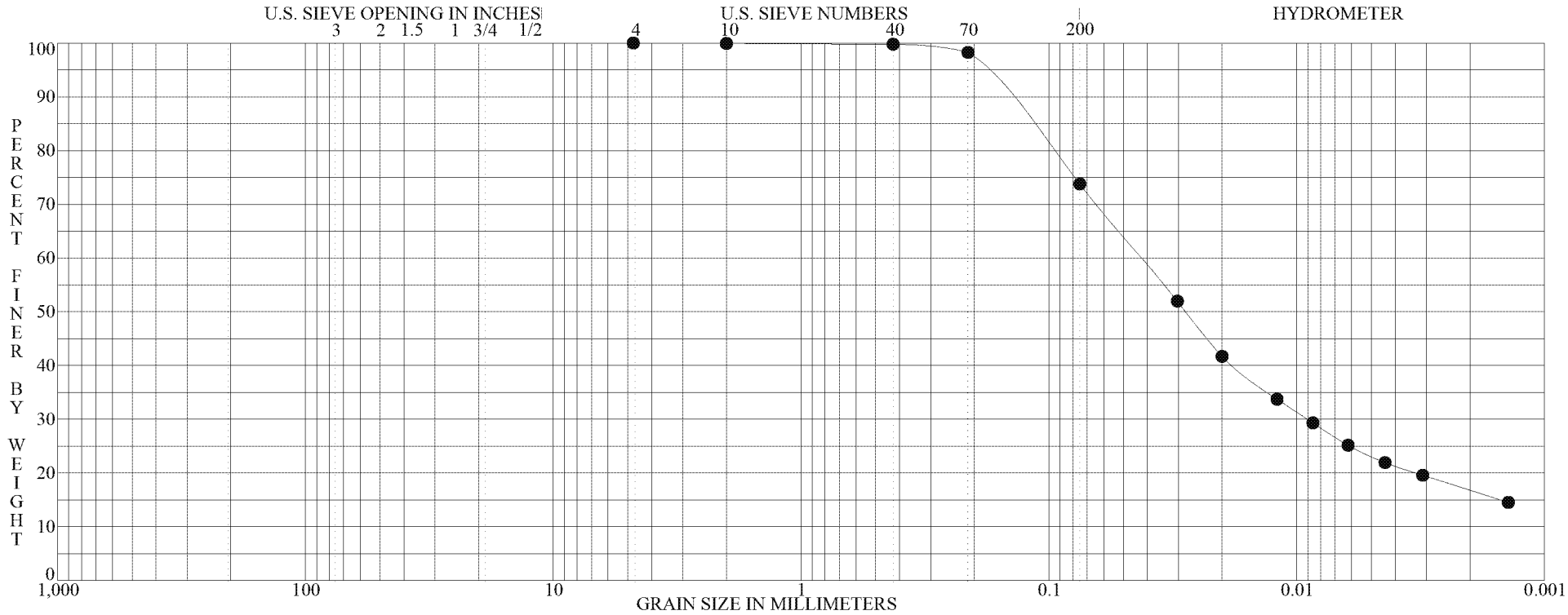
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 7

ED_005405A_00000217-00140



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0908 S-18 38.5' to 40.0'**	**LEAN CLAY with SAND CL**	**21**	**30**	**17**	**13**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0908 S-18 38.5' to 40.0'**	**4.7500**	**0.1846**	**0.0423**	**0.0280**		**0.0**	**26.2**	**57.0**	**16.8**

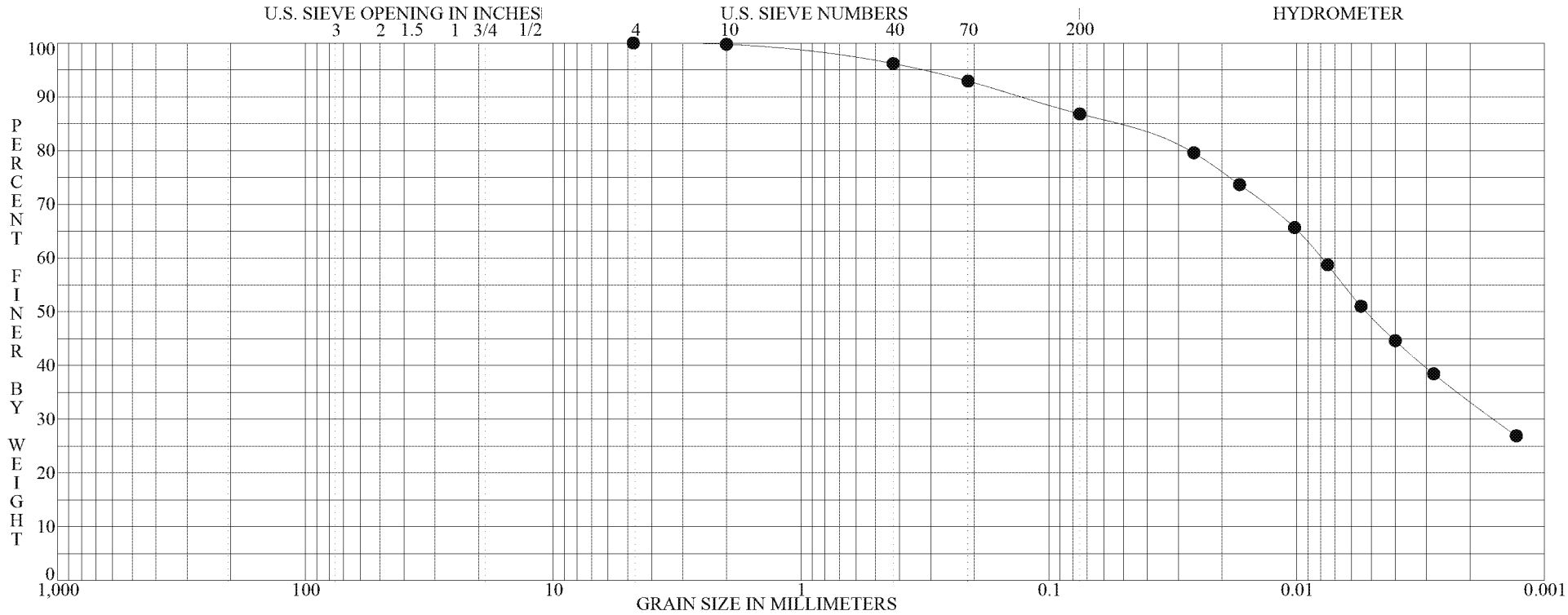
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 8

ED_005405A_00000217-00141



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0909 S-4 5.5' to 6.4'**	**LEAN CLAY CL**	**28**	**49**	**26**	**23**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0909 S-4 5.5' to 6.4'**	**4.7500**	**0.3306**	**0.0079**	**0.0052**		**0.0**	**13.2**	**53.4**	**33.4**

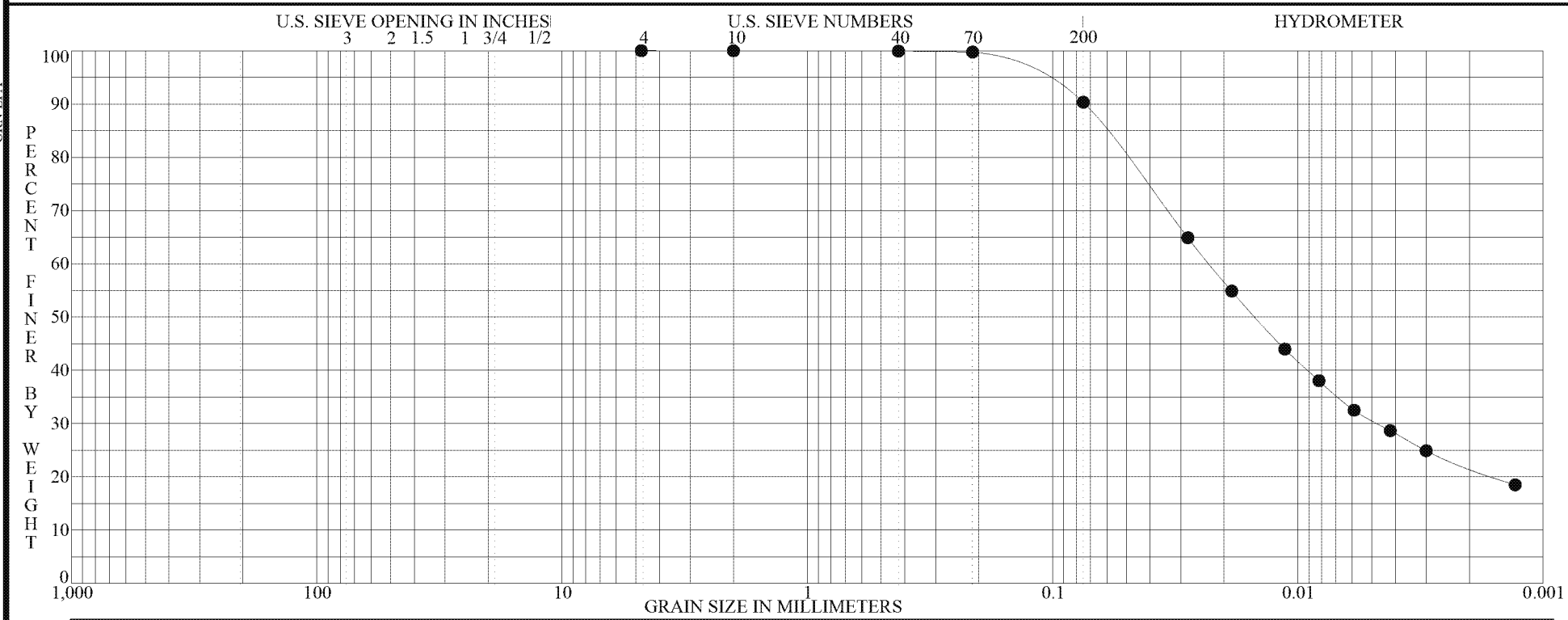
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 9

ED_005405A_00000217-00142



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0909 S-7 11.0' to 12.5'**		**24**					

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0909 S-7 11.0' to 12.5'**	**4.7500**	**0.1255**	**0.0230**	**0.0149**		**0.0**	**9.7**	**68.5**	**21.8**

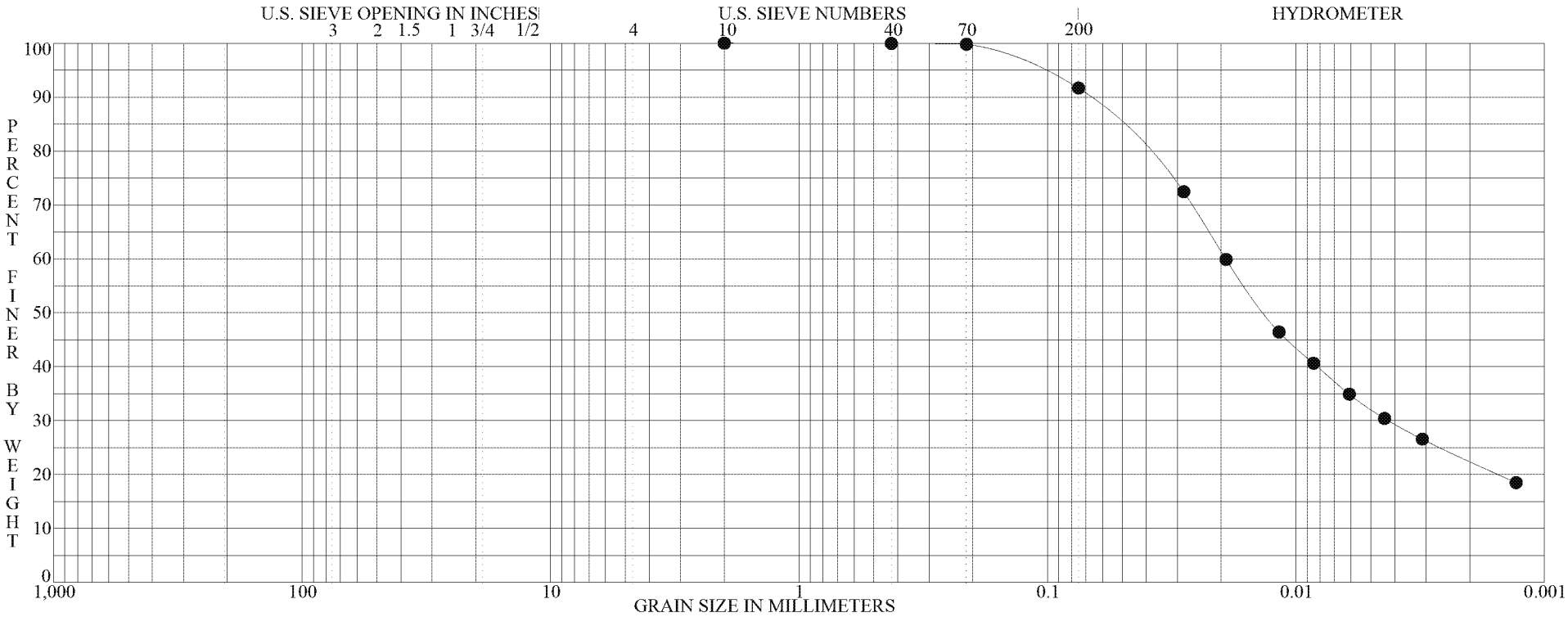
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 10

ED_005405A_00000217-00143



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
● GV-BAP-0909 S-10 IV 16.0' to 18.0'	LEAN CLAY CL	27	34	21	13		

Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● GV-BAP-0909 S-10 IV 16.0' to 18.0'	2.0000	0.1147	0.0192	0.0133		0.0	8.3	69.2	22.5

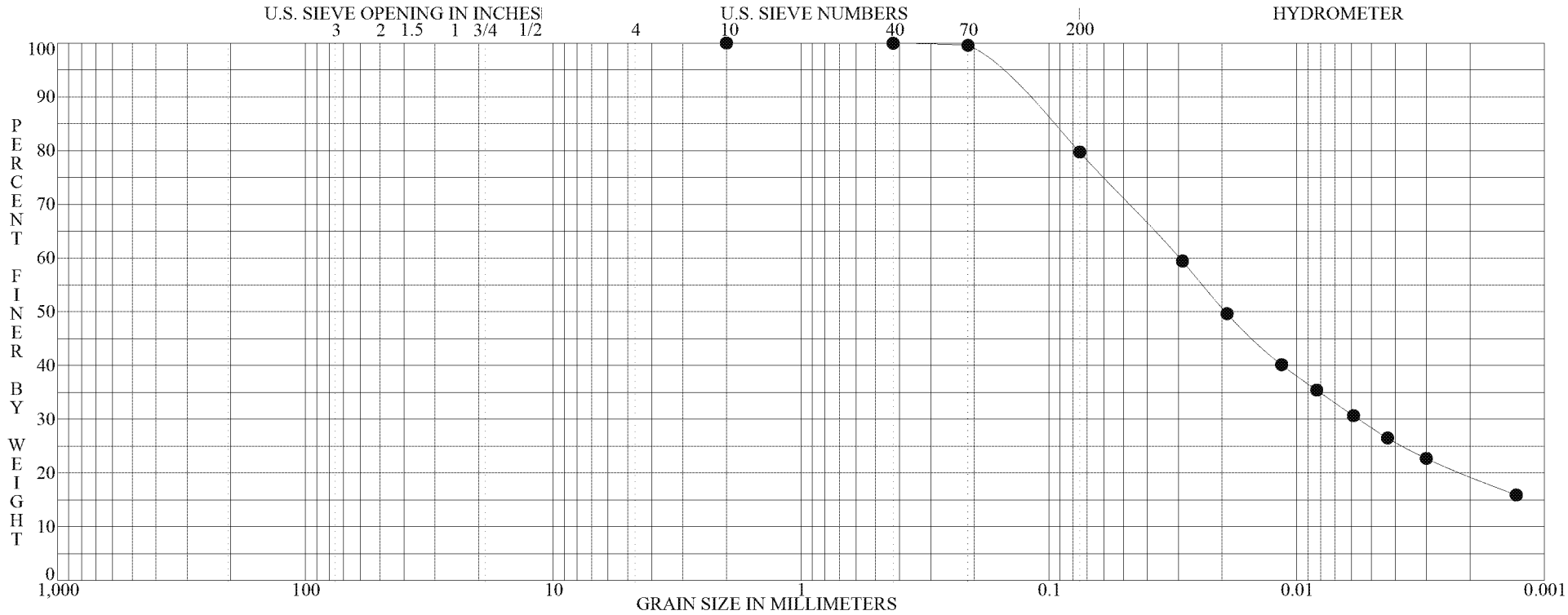
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 11

ED_005405A_00000217-00144



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0909 S-11 18.0' to 19.5'**	**LEAN CLAY with SAND CL**	**28**	**33**	**18**	**15**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0909 S-11 18.0' to 19.5'**	**2.0000**	**0.1669**	**0.0297**	**0.0194**		**0.0**	**20.3**	**60.3**	**19.4**

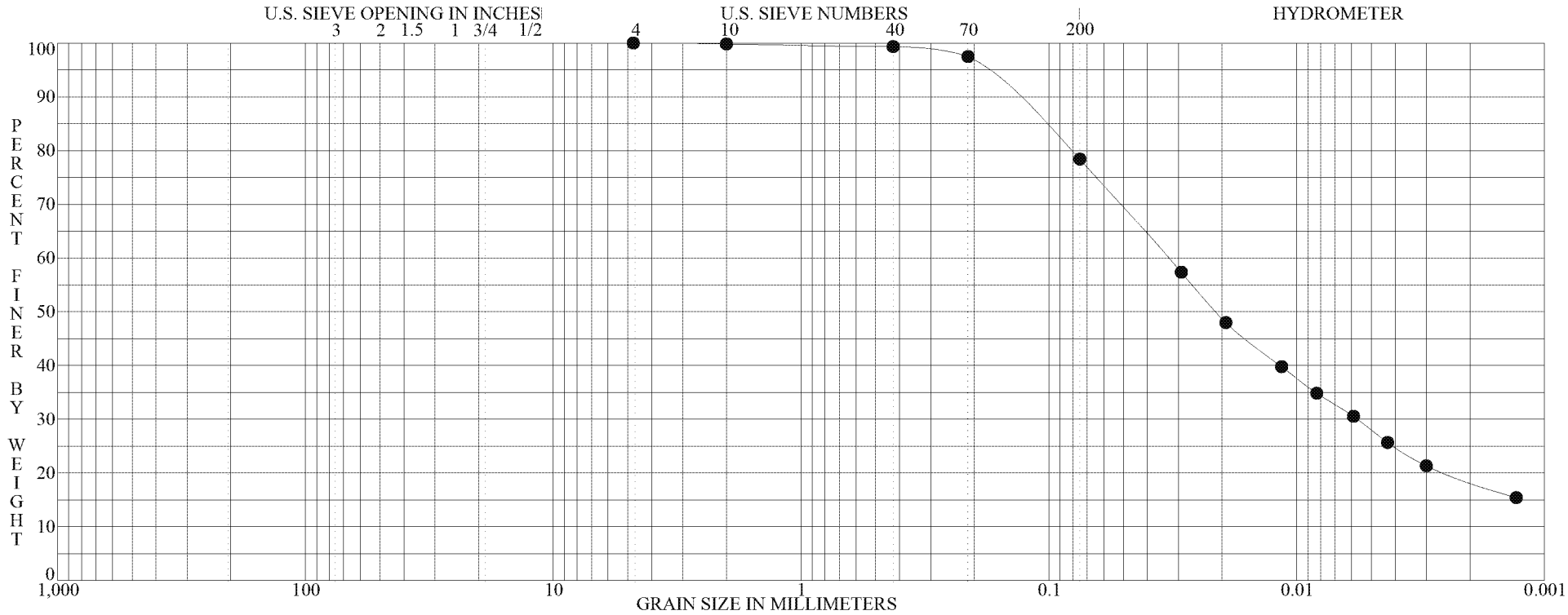
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 12

ED_005405A_00000217-00145



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0909 S-15 25.5' to 26.6'**	**LEAN CLAY with SAND CL**	**42**	**33**	**19**	**14**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0909 S-15 25.5' to 26.6'**	**4.7500**	**0.1852**	**0.0329**	**0.0211**		**0.0**	**21.6**	**59.9**	**18.5**

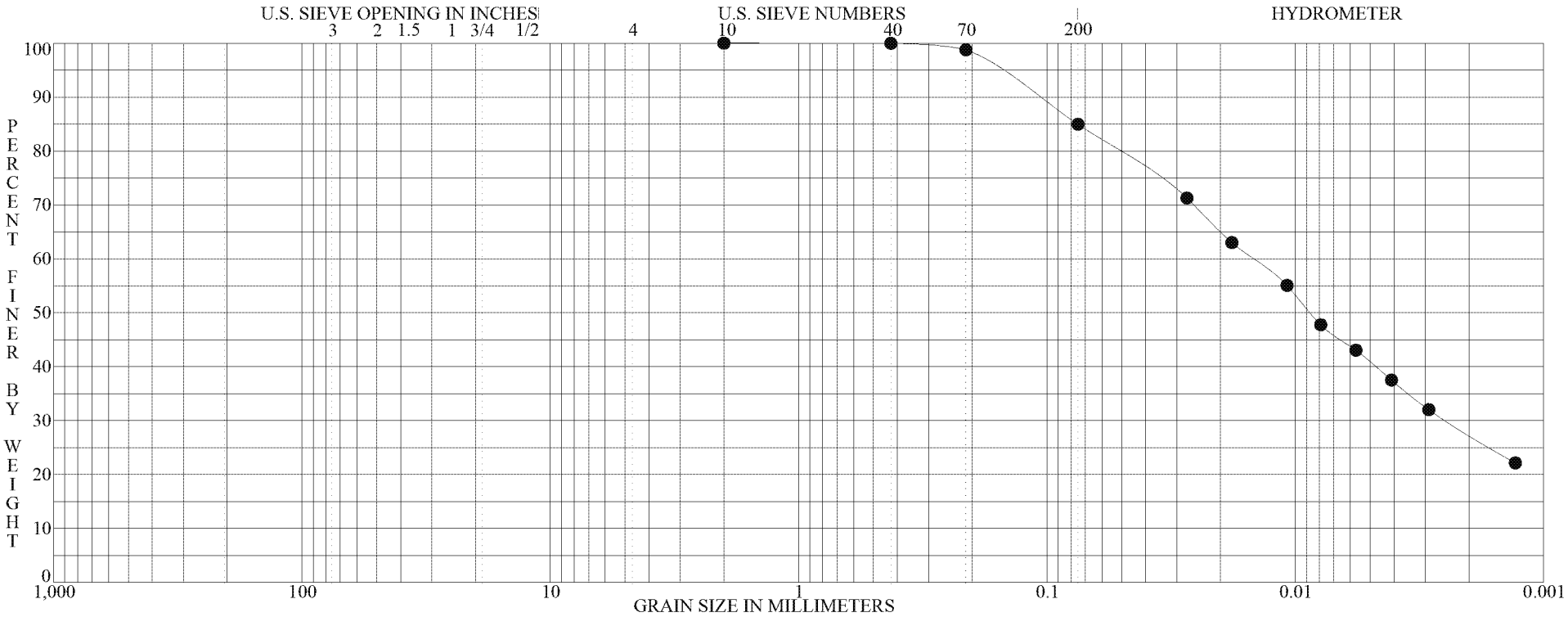
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 13

ED_005405A_00000217-00146



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
● GV-BAP-0909 S-16C 27.9' to 28.5'	LEAN CLAY with SAND CL	34	41	20	21		

Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● GV-BAP-0909 S-16C 27.9' to 28.5'	2.0000	0.1596	0.0148	0.0087		0.0	15.0	57.5	27.5

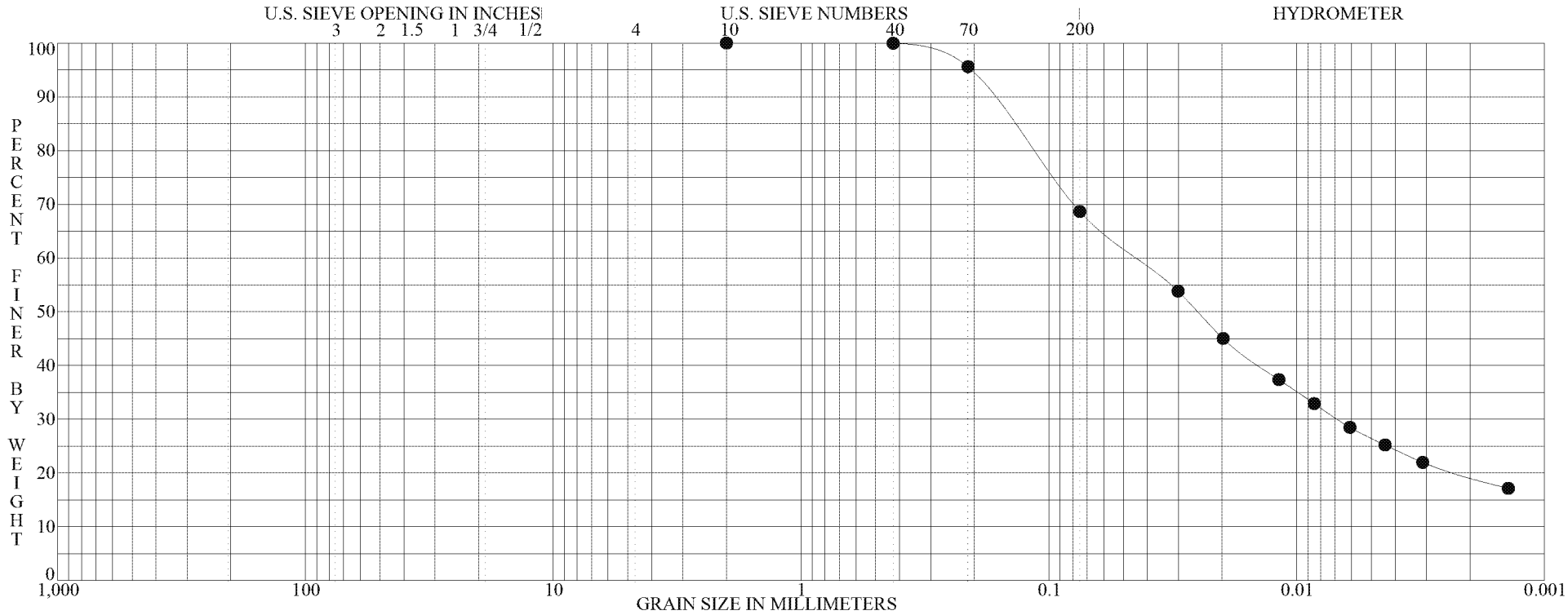
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 14

ED_005405A_00000217-00147



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0910 S-9 15.0' to 16.5'**	**SANDY LEAN CLAY CL**	**24**	**31**	**16**	**15**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0910 S-9 15.0' to 16.5'**	**2.0000**	**0.2071**	**0.0440**	**0.0251**		**0.0**	**31.3**	**49.3**	**19.3**

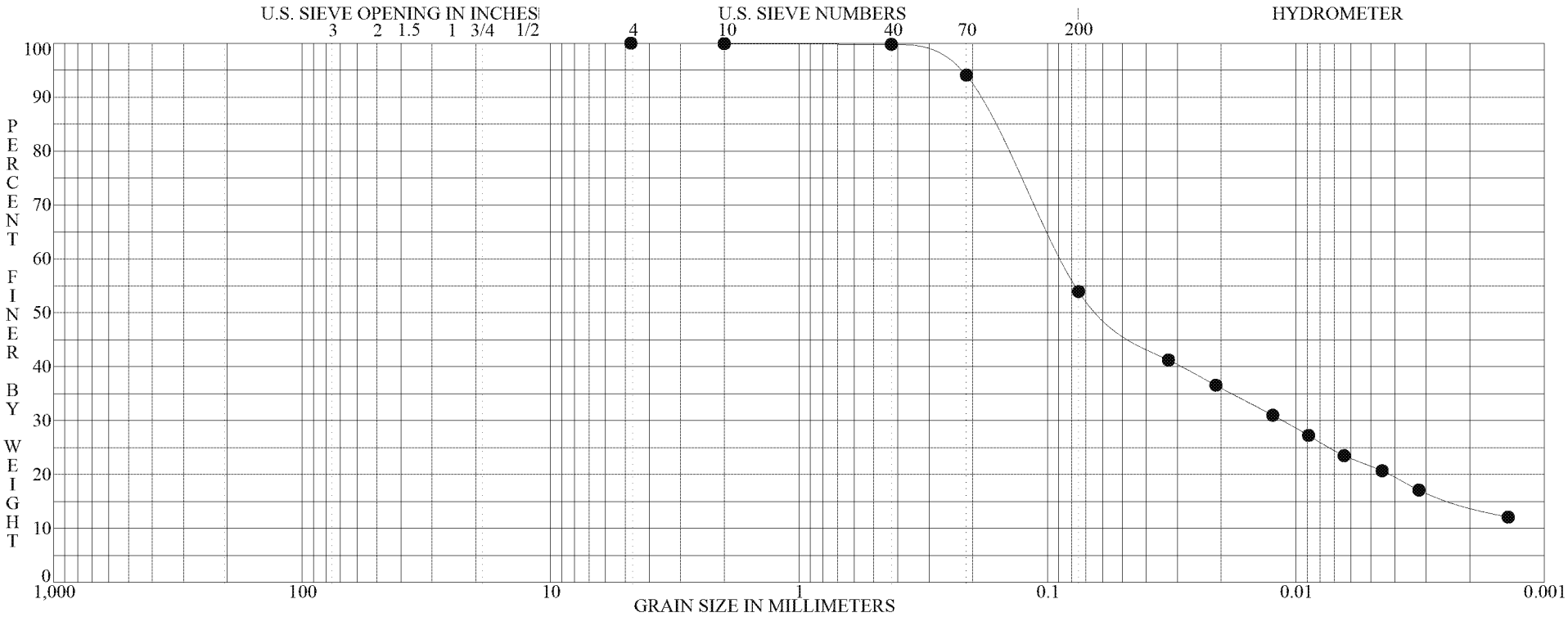
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 15

ED_005405A_00000217-00148



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
● GV-BAP-0910 S-10 IV 17.0' to 19.0'	SANDY SILTY CLAY CL-ML	28	24	19	5		

Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● GV-BAP-0910 S-10 IV 17.0' to 19.0'	4.7500	0.2374	0.0877	0.0579		0.0	46.1	39.7	14.3

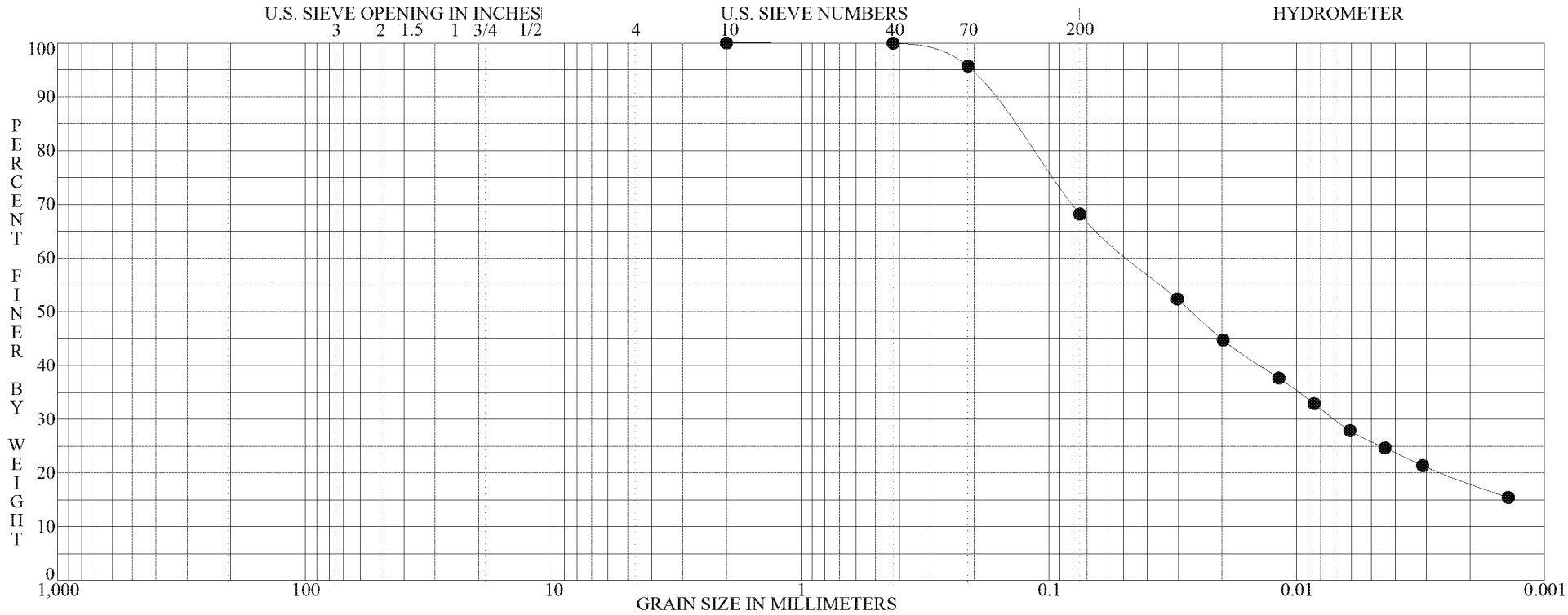
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014
DATE: 1/28/10

PLATE 16

GRN-EPA

ED_005405A_00000217-00149



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0910 S-12 20.5' to 22.0'**	**SANDY LEAN CLAY CL**	**29**	**30**	**17**	**13**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0910 S-12 20.5' to 22.0'**	**2.0000**	**0.2064**	**0.0469**	**0.0265**		**0.0**	**31.8**	**50.1**	**18.1**

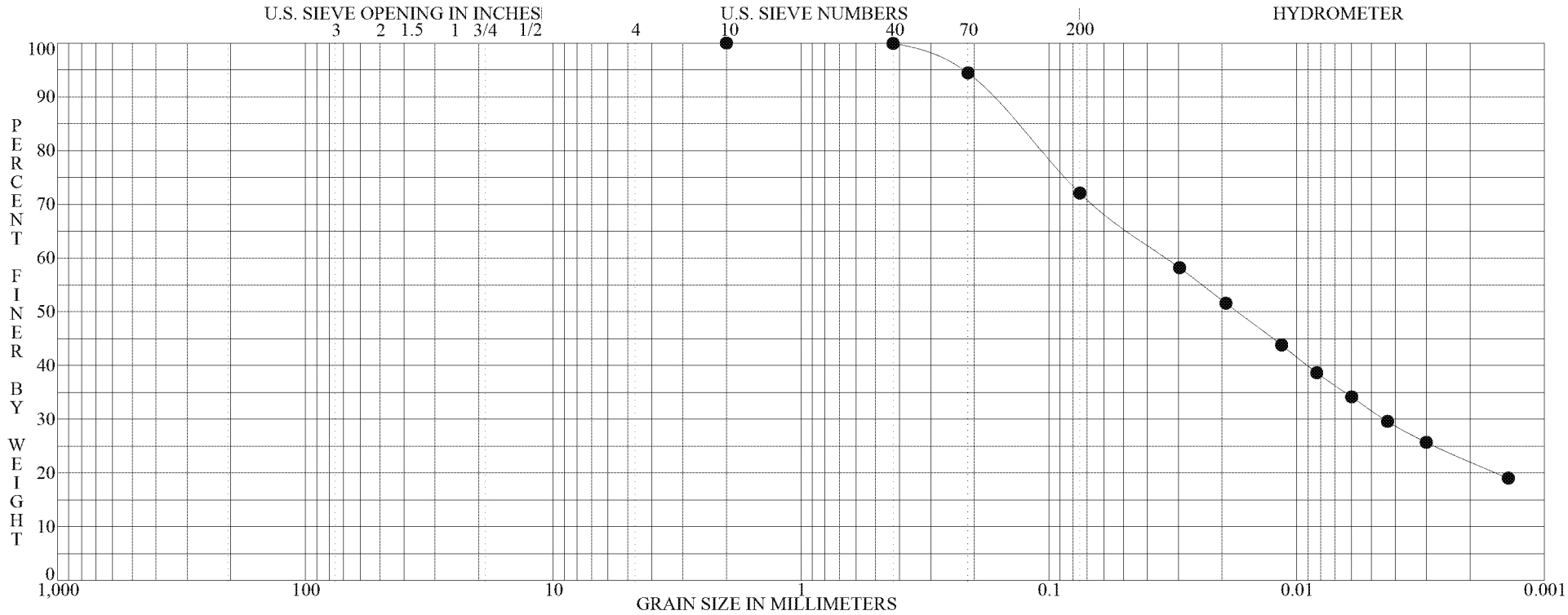
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 17

ED_005405A_00000217-00150



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0910 S-14 23.5' to 25.0'**	**LEAN CLAY with SAND CL**	**31**	**32**	**17**	**15**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0910 S-14 23.5' to 25.0'**	**2.0000**	**0.2273**	**0.0335**	**0.0173**		**0.0**	**27.9**	**49.9**	**22.2**

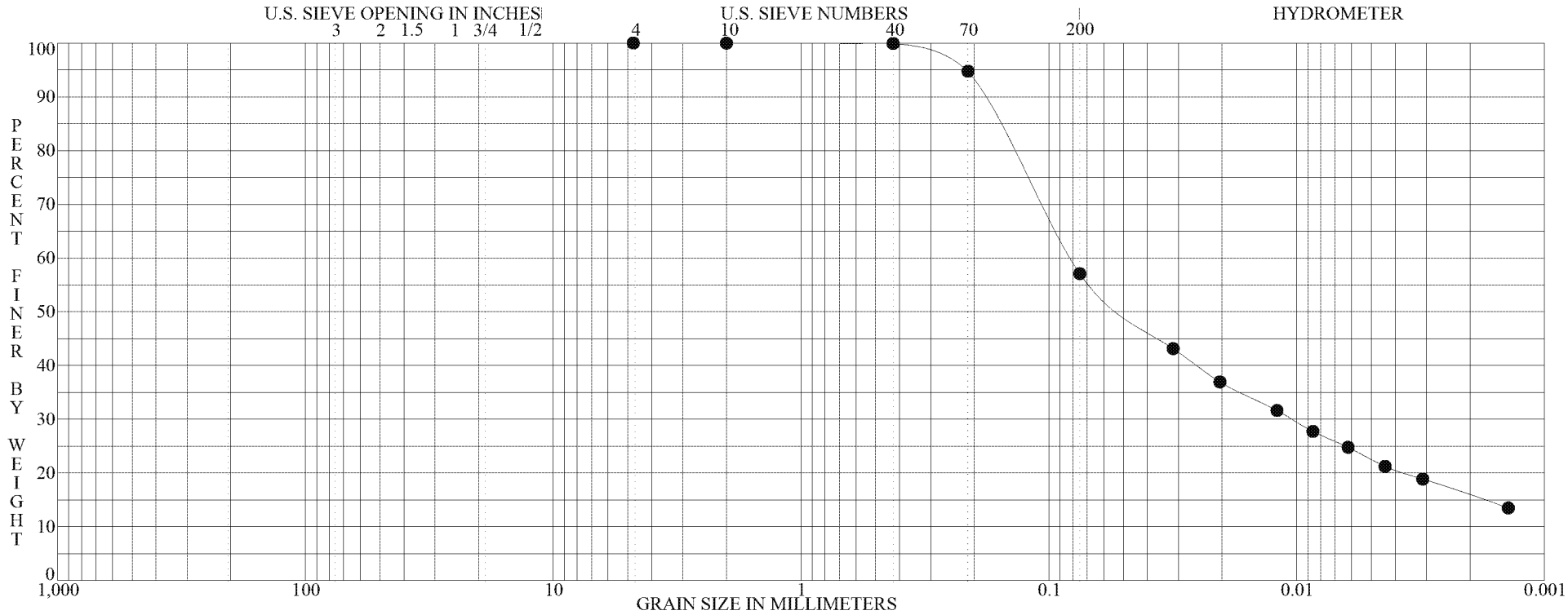
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 18

ED_005405A_00000217-00151



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
● GV-BAP-0910 S-16A 26.5' to 27.6'	SANDY LEAN CLAY CL	30	26	18	8		

Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● GV-BAP-0910 S-16A 26.5' to 27.6'	4.7500	0.2190	0.0813	0.0482		0.0	42.9	41.2	15.9

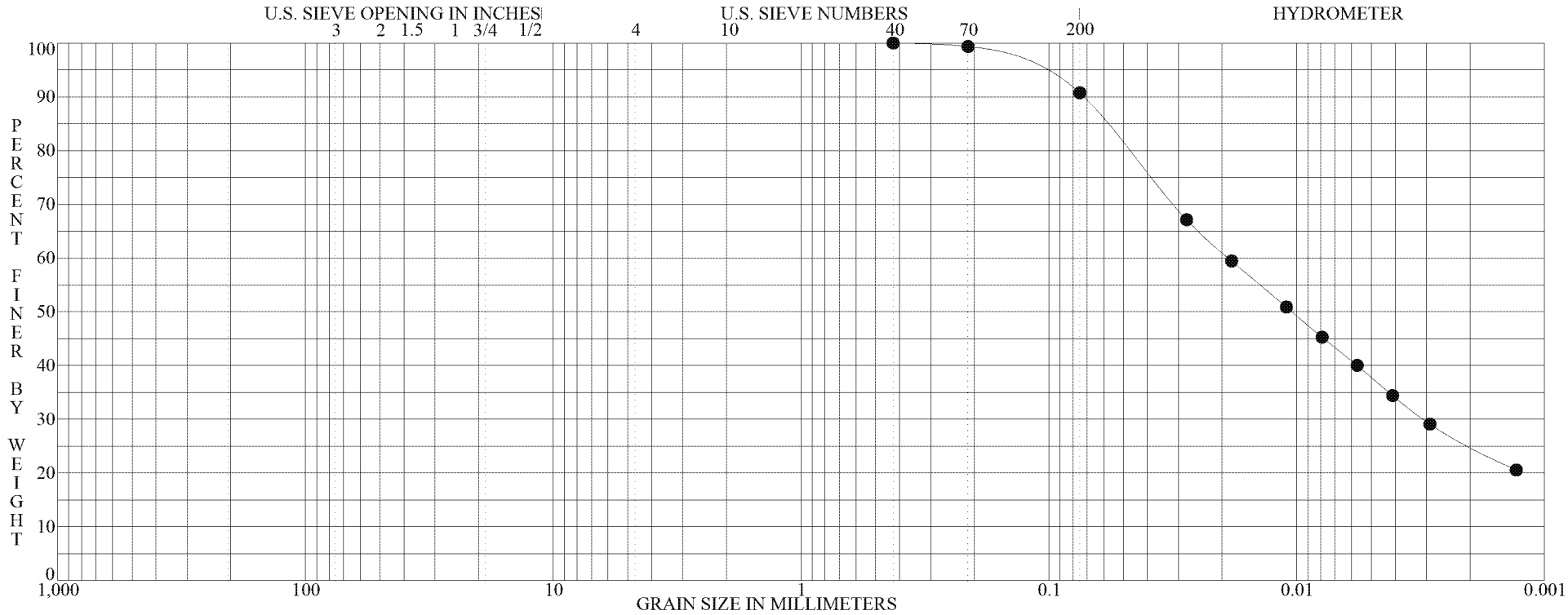
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014
DATE: 1/28/10

GRN-EPA

PLATE 19

ED_005405A_00000217-00152



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0910 S-18 29.5' to 31.0'**	**LEAN CLAY CL**	**35**	**40**	**21**	**19**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0910 S-18 29.5' to 31.0'**	**0.4250**	**0.1252**	**0.0189**	**0.0104**		**0.0**	**9.3**	**65.6**	**25.1**

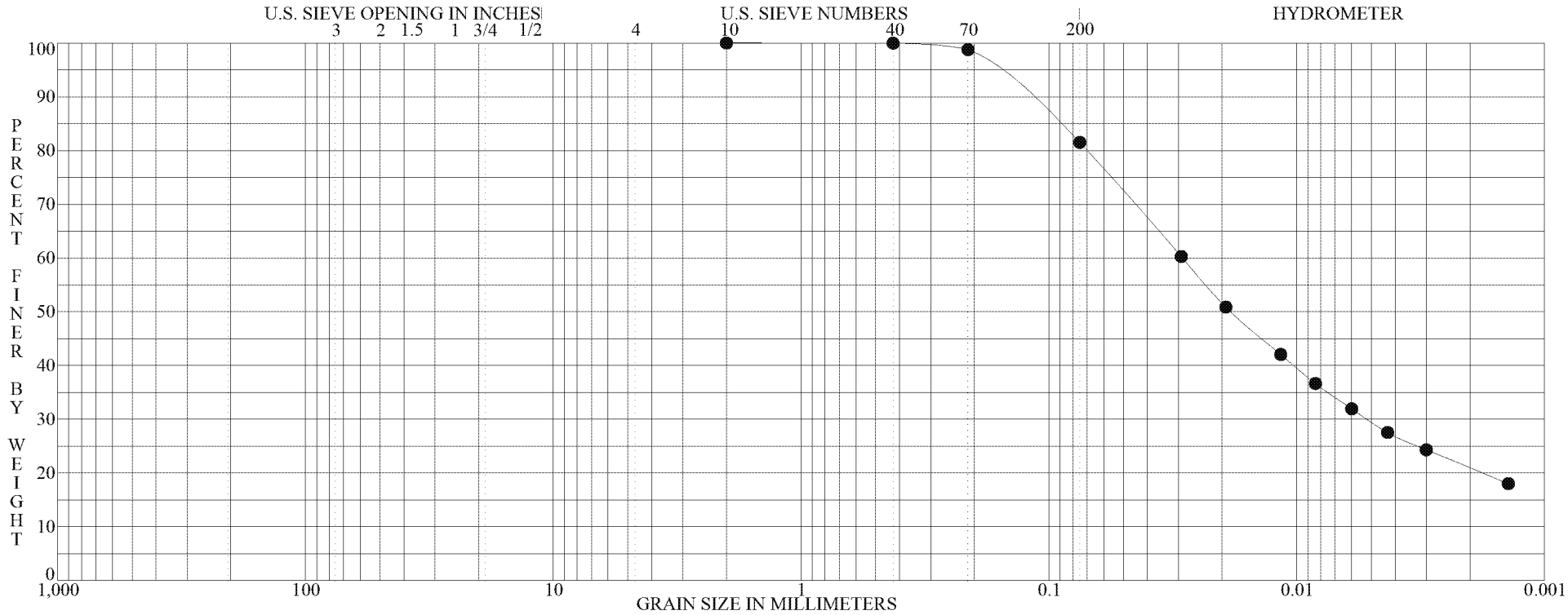
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 20

ED_005405A_00000217-00153



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0911 S-11 18.0' to 19.5'**	**LEAN CLAY with SAND CL**	**26**	**35**	**19**	**16**		

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0911 S-11 18.0' to 19.5'**	**2.0000**	**0.1689**	**0.0289**	**0.0184**		**0.0**	**18.5**	**60.6**	**21.0**

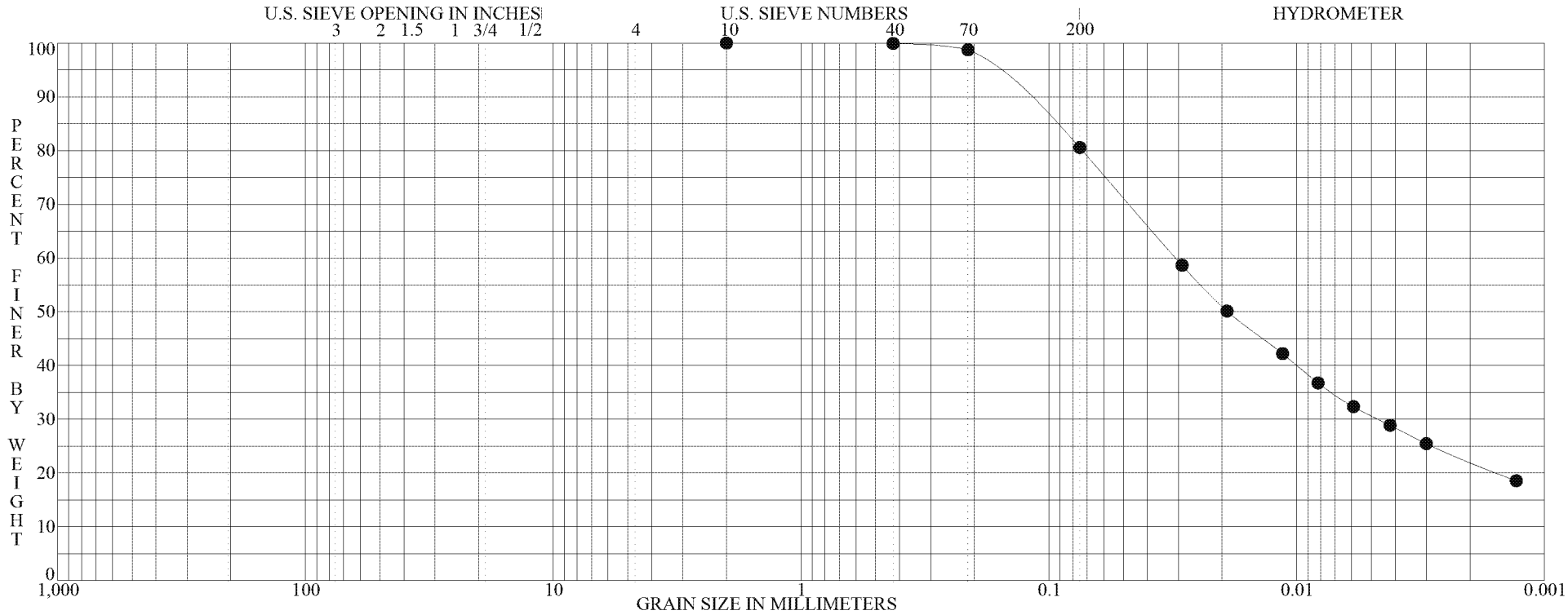
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 21

ED_005405A_00000217-00154



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
● GV-BAP-0911 S-13B 21.6' to 22.5'	LEAN CLAY with SAND CL	28	33	17	16		

Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
● GV-BAP-0911 S-13B 21.6' to 22.5'	2.0000	0.1712	0.0307	0.0189		0.0	19.4	58.4	22.1

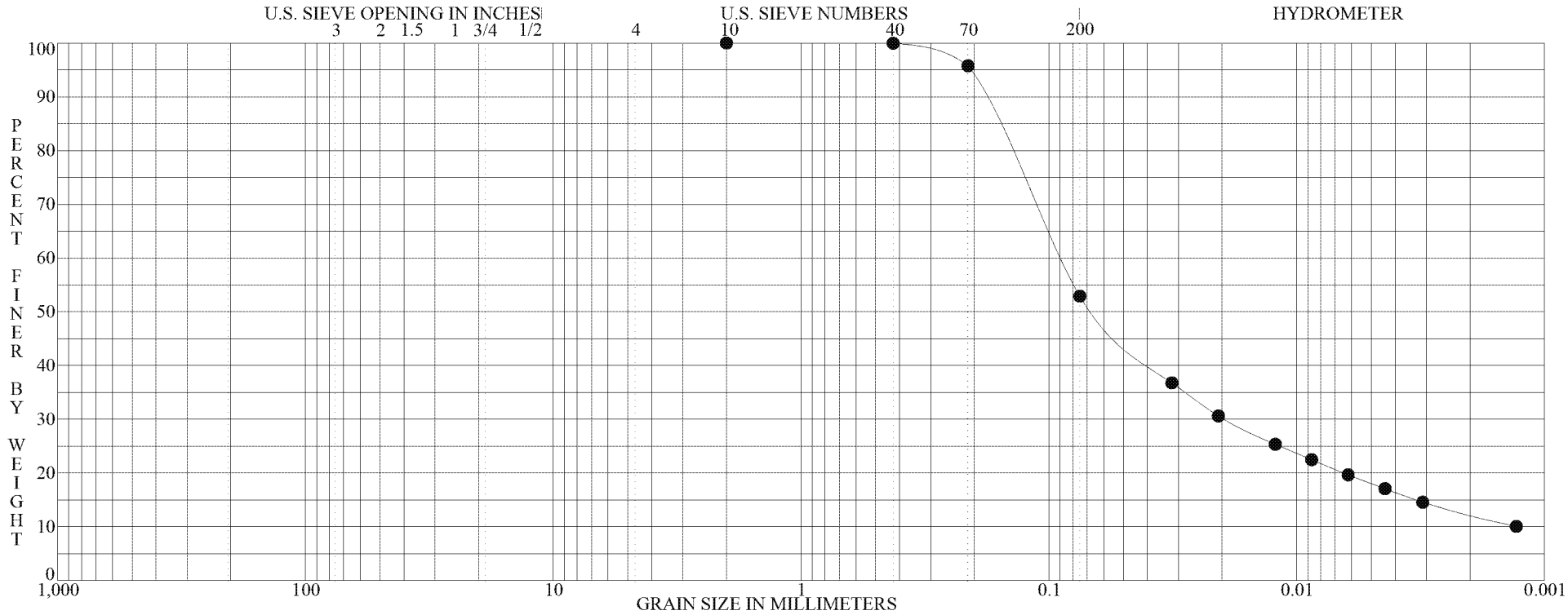
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 22

ED_005405A_00000217-00155



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0911 S-16 25.5' to 27.0'**		**30**					

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0911 S-16 25.5' to 27.0'**	**2.0000**	**0.2081**	**0.0891**	**0.0643**		**0.0**	**47.1**	**40.6**	**12.3**

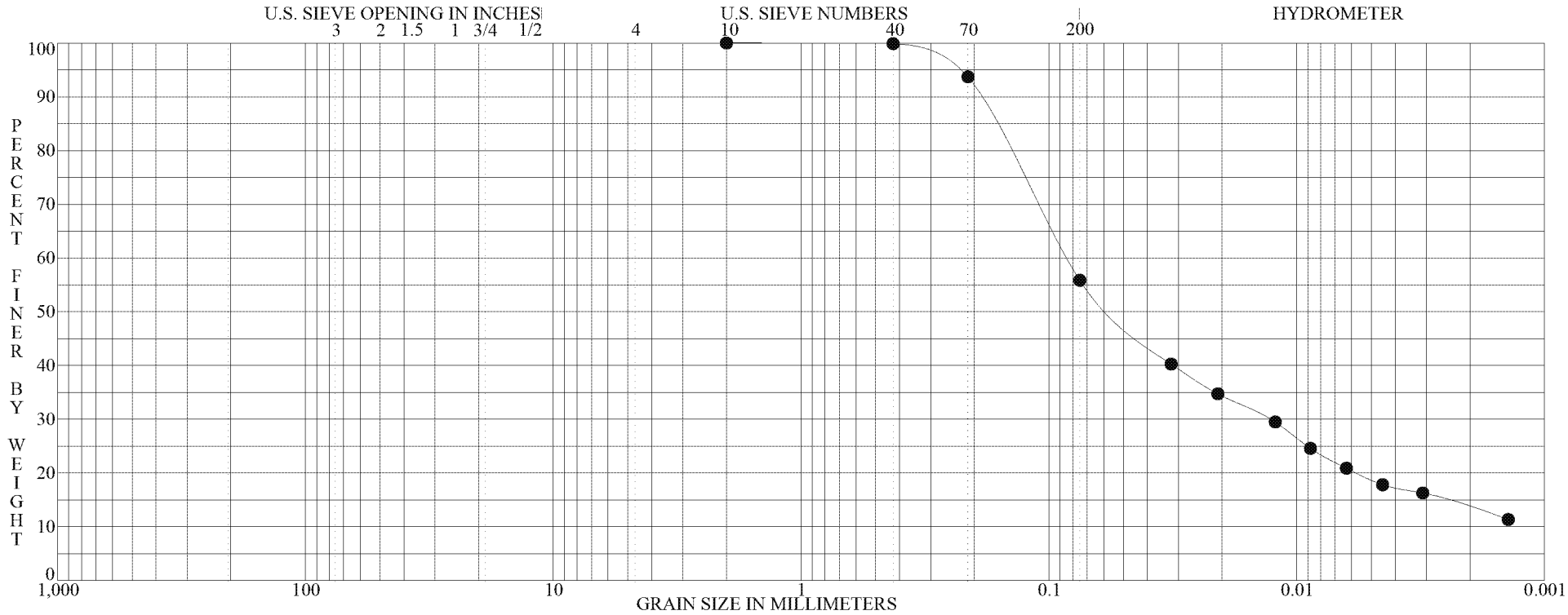
ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 23

ED_005405A_00000217-00156



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	opt mc%	max pcf
●	**GV-BAP-0911 S-20 31.5' to 33.0'**		**32**					

	Specimen Identification	D100	D95	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	**GV-BAP-0911 S-20 31.5' to 33.0'**	**2.0000**	**0.2452**	**0.0840**	**0.0545**		**0.0**	**44.1**	**42.3**	**13.6**

ASTM D422 | **GRADATION CURVE**

PROJECT: GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION: CHESHIRE, OHIO
JOB NO.: 011.11497.014 DATE: 1/28/10

GRN-EPA

PLATE 24

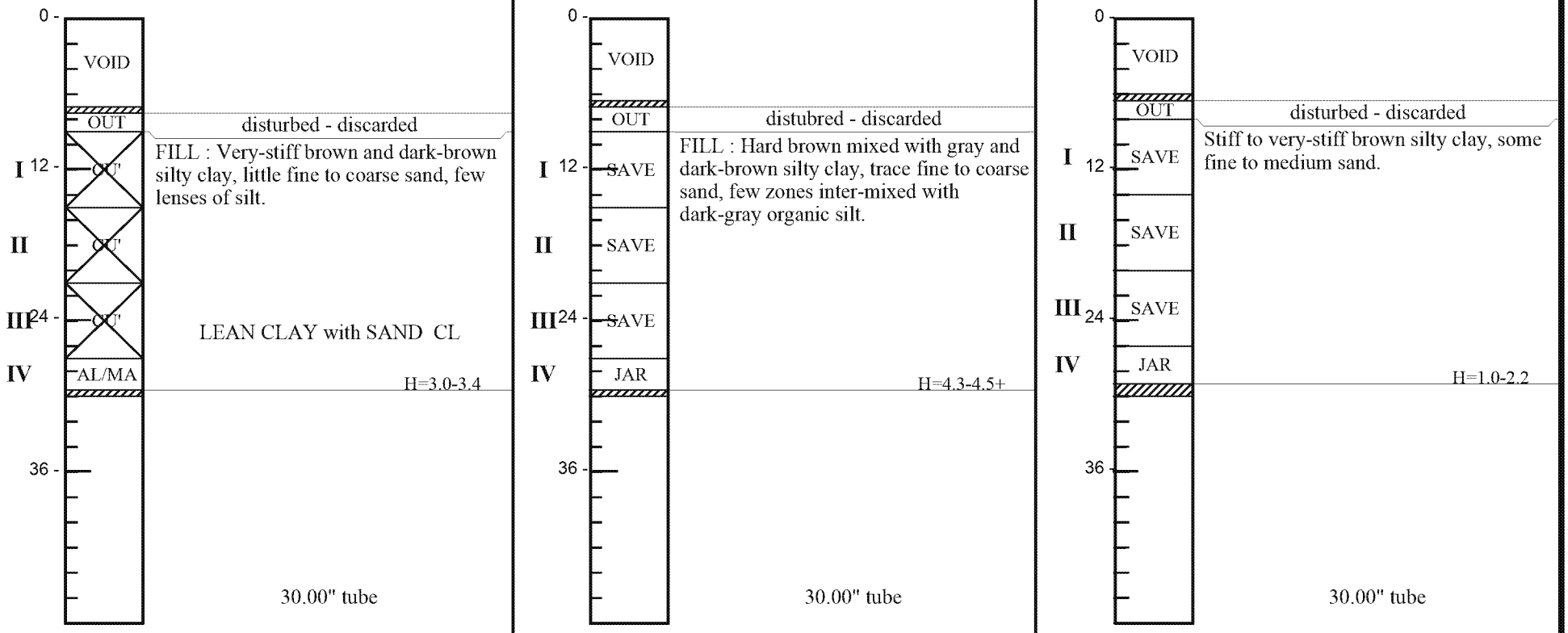
ED_005405A_00000217-00157

JOB NUMBER : **011.11497.014**
PROJECT : **GAVIN PLANT BOTTOM ASH POND INVESTIGATION**
LOCATION : **CHESHIRE, OHIO**

BBCM

LABORATORY LOG OF SHELBY TUBES

Boring : GV-BAP-0908	Sample : 4	Boring : GV-BAP-0908	Sample : 10	Boring : GV-BAP-0908	Sample : 21
Depth : 8.5' to 10.2'	Recovery : 20.50"	Depth : 23.5' to 25.4'	Recovery : 20.50"	Depth : 43.5' to 45.5'	Recovery : 21.00"



LEGEND

- Consolidation, Incremental
- Swelling, Test
- Wax
- C R S - Consolidation, C R S
- P P - Permeability, Vertical / Horizontal
- Unconfined Compression Test
- Triaxial Compression Test

H - Hand Penetrometer (tsf)
Ds - Direct Shear
LOI - Loss on Ignition
AL - Atterberg Limits
MA - Sieve/Hydrometer
SG - Specific Gravity
SL - Shrinkage Limit
POR - Porosity
UDW - Unit Dry Weight
MC - Moisture Content
D_R - Relative Density
S - Sieve

SHELBY TUBE LOG 11497014.GPJ BBCM.GDT 1/28/10

PLATE 25

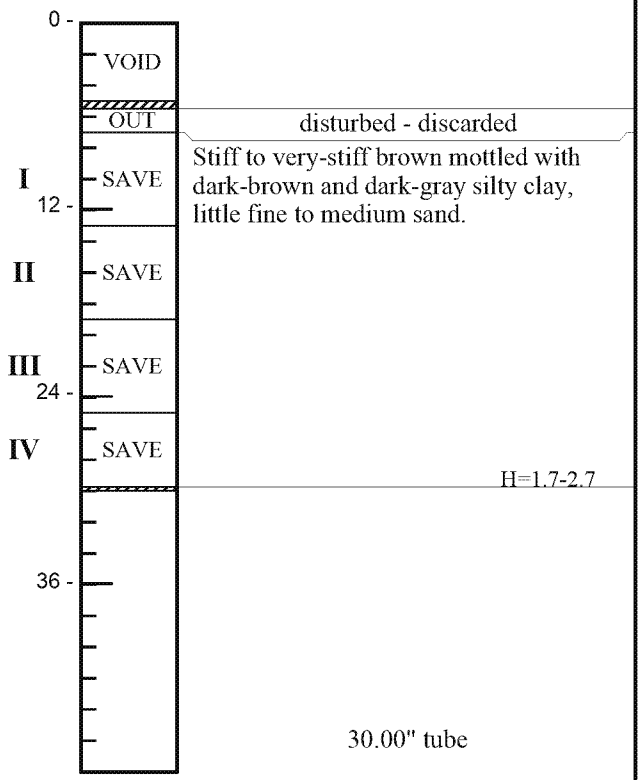
ED_005405A_00000217-00158

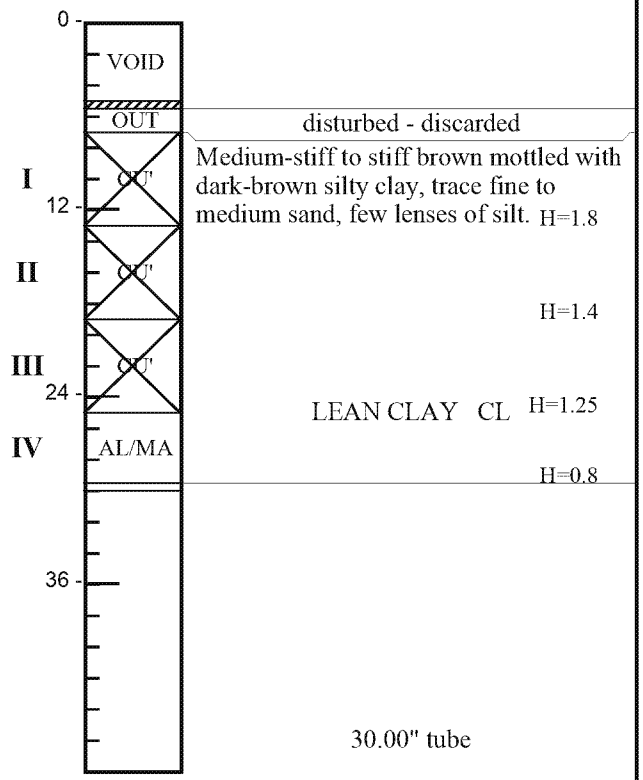
JOB NUMBER : 011.11497.014
PROJECT : GAVIN PLANT BOTTOM ASH POND INVESTIGATION
LOCATION : CHESHIRE, OHIO

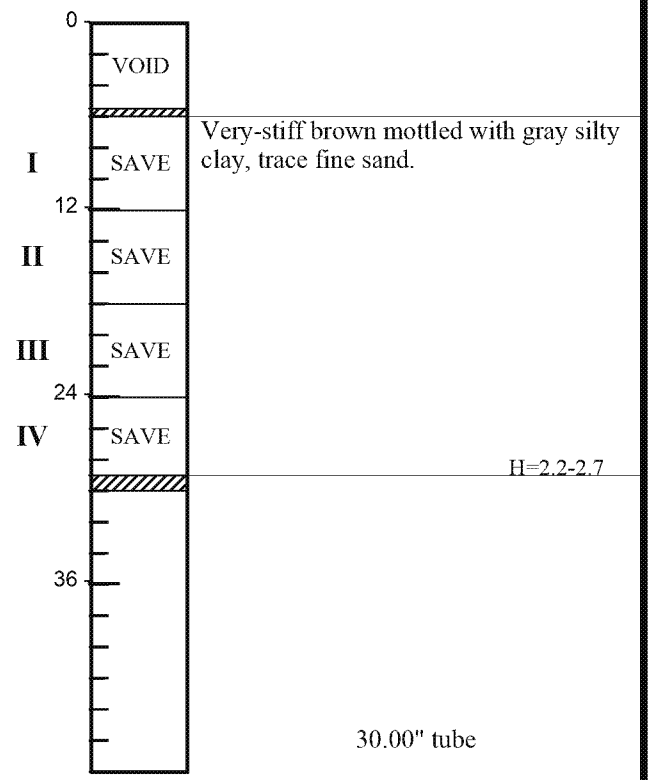
BBCM

LABORATORY LOG OF SHELBY TUBES

Boring : GV-BAP-0909	Sample : 6	Boring : GV-BAP-0909	Sample : 10	Boring : GV-BAP-0910	Sample : 6
Depth : 9.0' to 11.0'	Recovery : 22.75"	Depth : 16.0' to 18.0'	Recovery : 22.50"	Depth : 10.0' to 12.0'	Recovery : 23.00"







LEGEND

- Consolidation, Incremental
- Swelling, Test
- Wax
- C R S - Consolidation, C R S
- P P - Permeability, Vertical / Horizontal
- Unconfined Compression Test
- Triaxial Compression Test

H - Hand Penetrometer (tsf)
Ds - Direct Shear
LOI - Loss on Ignition
AL - Atterberg Limits
MA - Sieve/Hydrometer
SG - Specific Gravity
SL - Shrinkage Limit
POR - Porosity
UDW - Unit Dry Weight
MC - Moisture Content
D_R - Relative Density
S - Sieve

SHELBY TUBE LOG 11497014.GPJ BBCM.GDT 1/28/10

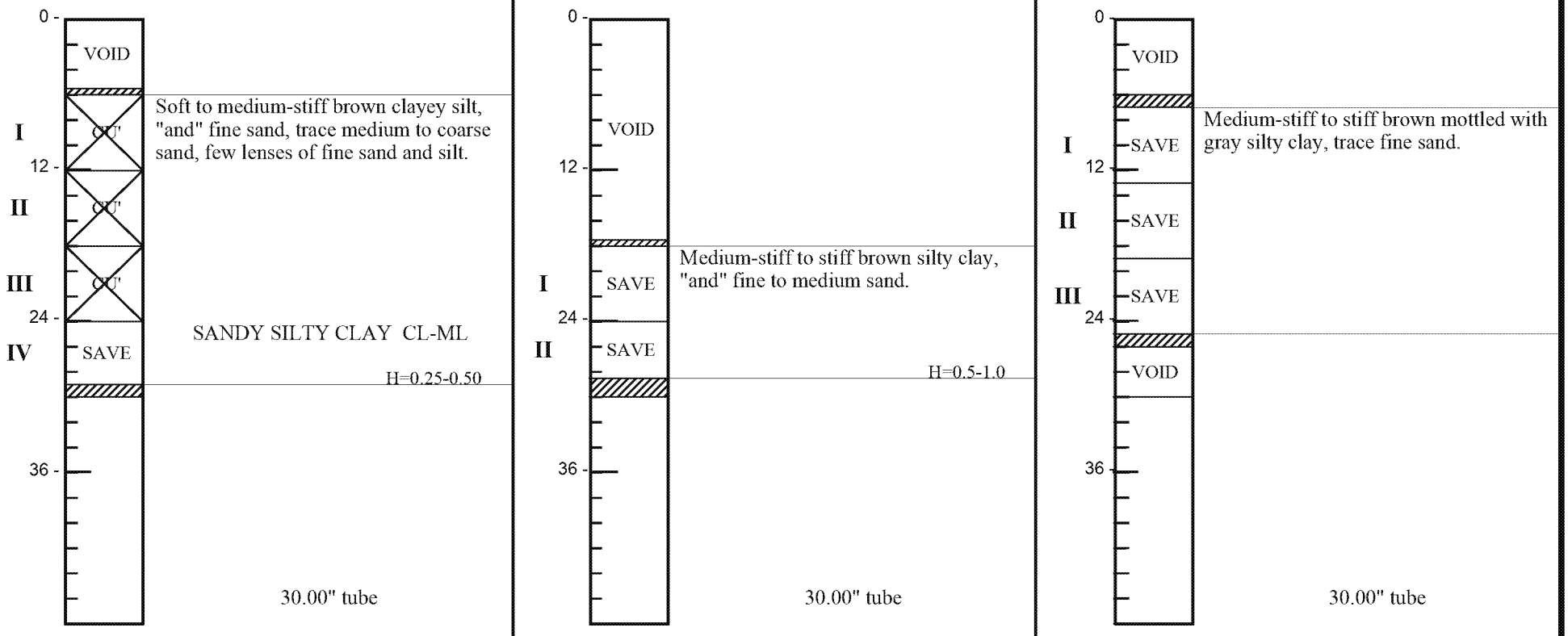
ED_005405A_00000217-00159

JOB NUMBER : **011.11497.014**
PROJECT : **GAVIN PLANT BOTTOM ASH POND INVESTIGATION**
LOCATION : **CHESHIRE, OHIO**

BBCM

LABORATORY LOG OF SHELBY TUBES

Boring : GV-BAP-0910	Sample : 10	Boring : GV-BAP-0911	Sample : 7	Boring : GV-BAP-0911	Sample : 10
Depth : 17.0' to 19.0'	Recovery : 23.00"	Depth : 10.5' to 11.5'	Recovery : 10.50"	Depth : 16.0' to 17.6'	Recovery : 18.00"



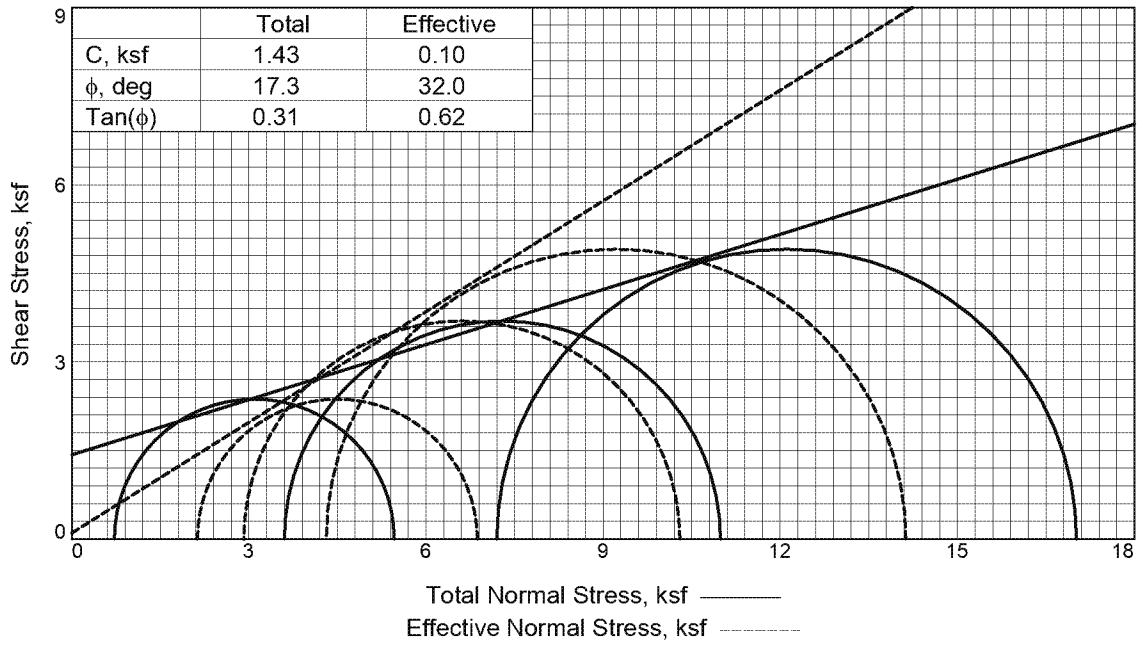
LEGEND

- Consolidation, Incremental
- Swelling, Test
- Wax
- C R S - Consolidation, C R S
- P P - Permeability, Vertical / Horizontal
- Unconfined Compression Test
- Triaxial Compression Test

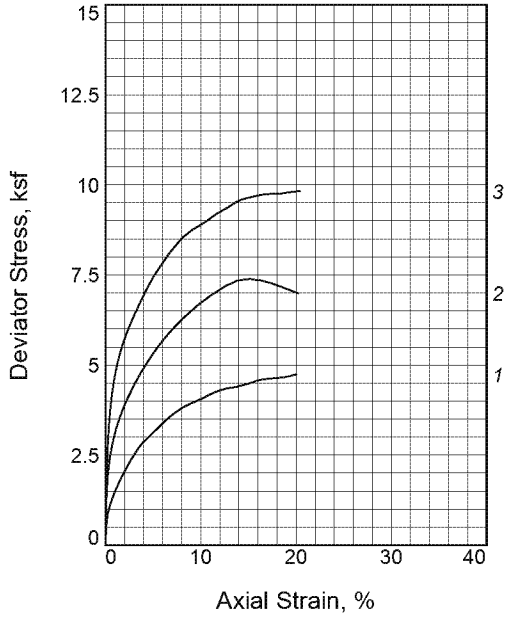
H - Hand Penetrometer (tsf)
Ds - Direct Shear
LOI - Loss on Ignition
AL - Atterberg Limits
MA - Sieve/Hydrometer
SG - Specific Gravity
SL - Shrinkage Limit
POR - Porosity
UDW - Unit Dry Weight
MC - Moisture Content
D_R - Relative Density
S - Sieve

SHELBY TUBE LOG 11497014.GPJ BBCM.GDT 1/28/10

ED_005405A_00000217-00160



	Total	Effective
C, ksf	1.43	0.10
ϕ, deg	17.3	32.0
Tan(ϕ)	0.31	0.62



Sample No.		1	2	3
Initial	Water Content, %	20.7	20.7	20.6
	Dry Density, pcf	107.7	108.5	108.1
	Saturation, %	95.8	97.7	96.4
	Void Ratio	0.5933	0.5817	0.5884
	Diameter, in.	2.88	2.87	2.88
	Height, in.	5.60	5.59	5.59
At Test	Water Content, %	21.6	20.3	19.0
	Dry Density, pcf	108.4	111.5	113.3
	Saturation, %	101.8	103.5	101.4
	Void Ratio	0.5842	0.5393	0.5148
	Diameter, in.	2.87	2.85	2.84
	Height, in.	5.60	5.53	5.48
Strain rate, in./min.		0.01	0.02	0.02
Eff. Cell Pressure, ksf		0.7	3.6	7.2
Fail. Stress, ksf		4.7	7.4	9.8
Total Pore Pr., ksf		7.2	9.3	11.9
Strain, %		20.0	15.2	19.9
Ult. Stress, ksf		4.7	7.0	9.8
Total Pore Pr., ksf		7.2	9.4	11.9
Strain, %		20.0	20.2	20.4
$\bar{\sigma}_1$ Failure, ksf		6.9	10.3	14.1
$\bar{\sigma}_3$ Failure, ksf		2.1	2.9	4.3

Type of Test: CU with Pore Pressures

Sample Type: Shelby Tube

Description: FILL : Very-stiff brown and dark-brown silty clay, little fine to coarse

LL= 37 **PL=** 21 **PI=** 16

Assumed Specific Gravity= 2.75

Remarks: ASTM : LEAN CLAY with SAND CL

Figure 1 **CU-2**

Client: AEP

Project: GAVIN PLANT ASH POND INVESTIGATION CHESHIRE, OHIO

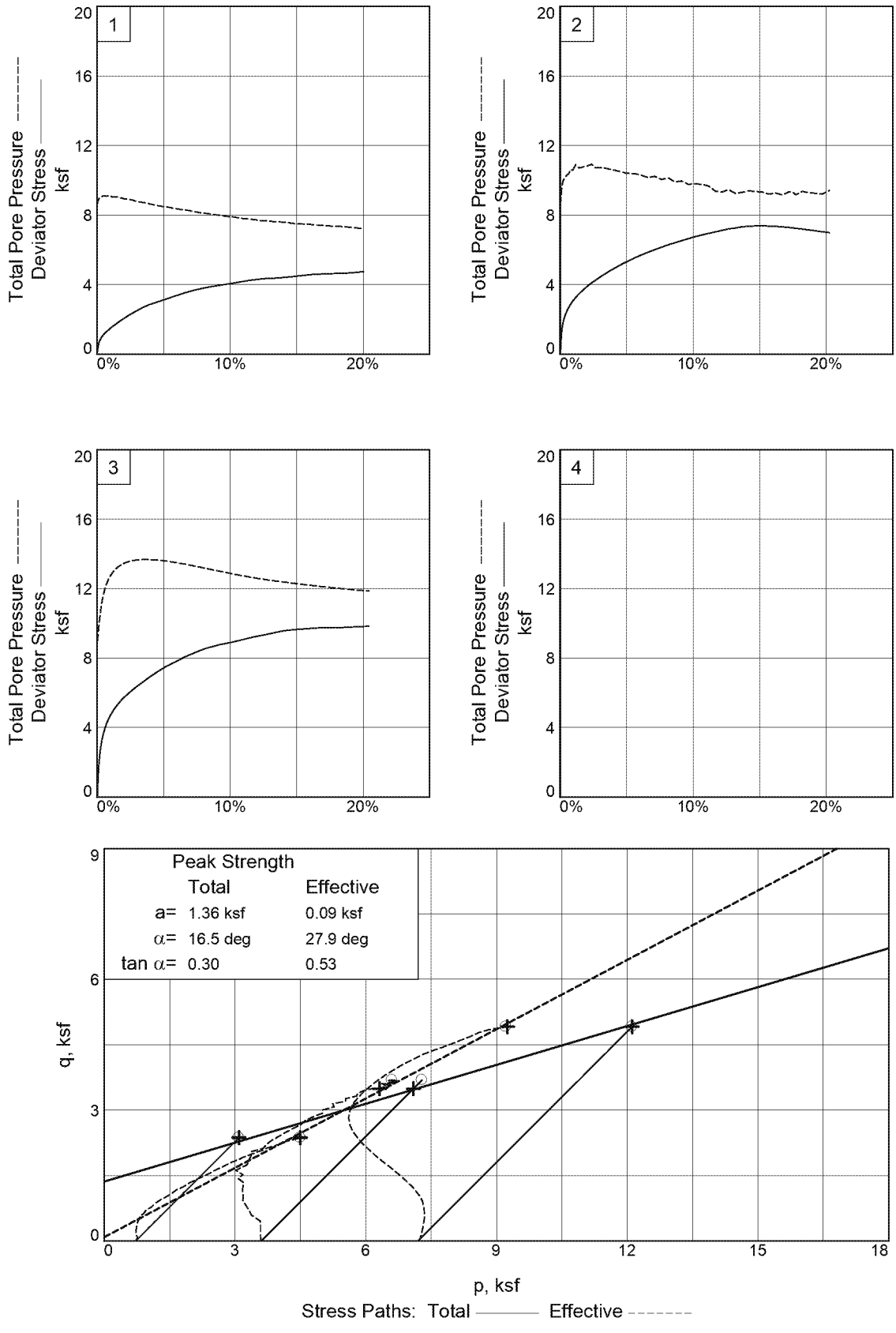
Location: GV-BAP-0908

Sample Number: S-4 I,II,III **Depth:** 8.5' to 10.2'

Proj. No.: 011.11497.014 **Date Sampled:** 12/21-29/09

TRIAXIAL SHEAR TEST REPORT
BBC&M Engineering, Inc.
Dublin, Ohio

Tested By: JJ **Checked By:** JJ



Client: AEP

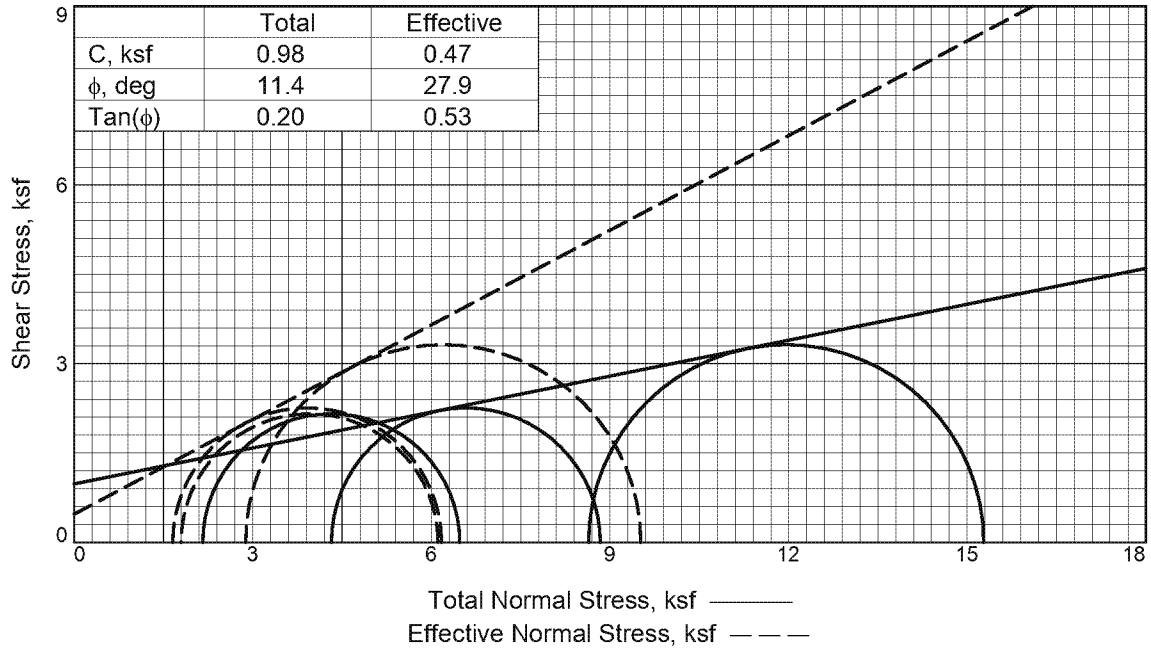
Project: GAVIN PLANT ASH POND INVESTIGATION

Location: GV-BAP-0908 **Depth:** 8.5' to 10.2' **Sample Number:** S-4 I,II,III

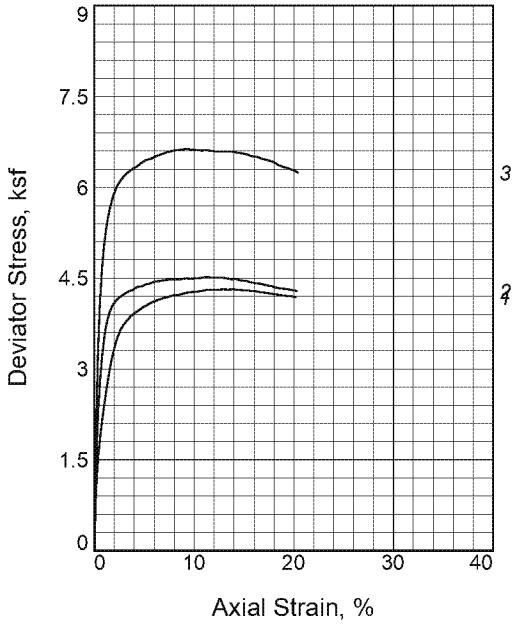
Project No.: 011.11497.014 **Figure** 2

BBC&M Engineering, Inc.

Tested By: JJ **Checked By:** JJ



	Total	Effective
C, ksf	0.98	0.47
ϕ, deg	11.4	27.9
Tan(ϕ)	0.20	0.53



Sample No.		1	2	3
Initial	Water Content, %	28.1	27.3	27.5
	Dry Density, pcf	95.4	96.5	97.2
	Saturation, %	96.8	96.1	98.6
	Void Ratio	0.7996	0.7798	0.7667
	Diameter, in.	2.86	2.87	2.86
	Height, in.	5.60	5.59	5.60
At Test	Water Content, %	28.2	27.2	25.2
	Dry Density, pcf	97.2	99.3	103.2
	Saturation, %	101.1	102.7	104.4
	Void Ratio	0.7661	0.7294	0.6638
	Diameter, in.	2.84	2.85	2.80
	Height, in.	5.56	5.52	5.49
Strain rate, in./min.		0.02	0.02	0.02
Eff. Cell Pressure, ksf		2.16	4.32	8.64
Fail. Stress, ksf		4.32	4.52	6.64
Total Pore Pr., ksf		6.12	8.42	11.52
Strain, %		13.9	11.2	9.2
Ult. Stress, ksf		4.19	4.29	6.24
Total Pore Pr., ksf		5.96	8.46	11.17
Strain, %		20.2	20.3	20.4
$\bar{\sigma}_1$ Failure, ksf		6.11	6.17	9.52
$\bar{\sigma}_3$ Failure, ksf		1.80	1.66	2.88

Type of Test: CU with Pore Pressures

Sample Type: Shelby Tube

Description: Medium-stiff to stiff brown mottled with dark-brown silty clay, trace

LL= 34 **PL=** 21 **PI=** 13

Assumed Specific Gravity= 2.75

Remarks: ASTM : LEAN CLAY CL

Client: AEP

Project: GAVIN PLANT ASH POND INVESTIGATION CHESHIRE, OHIO

Location: GV-BAP-0909

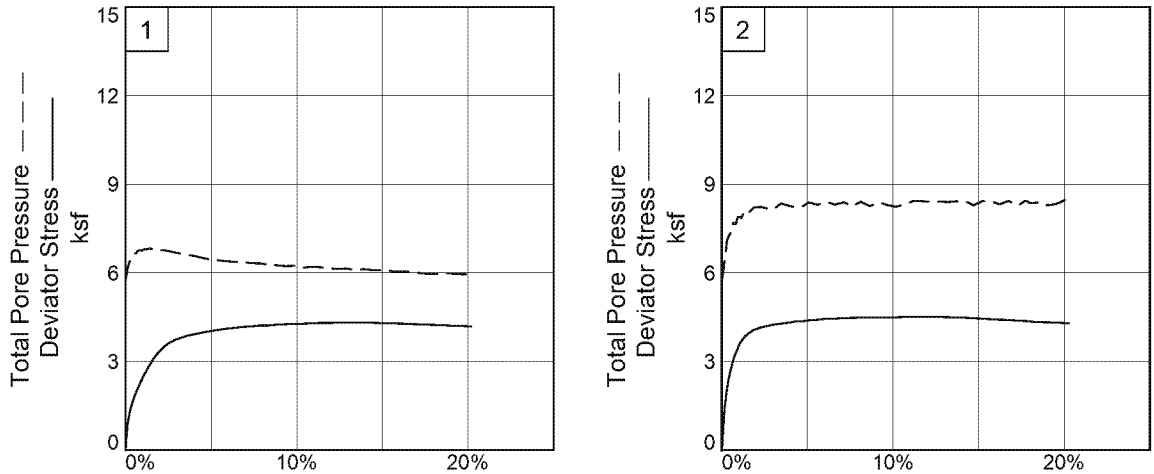
Sample Number: S-10 I,II,III

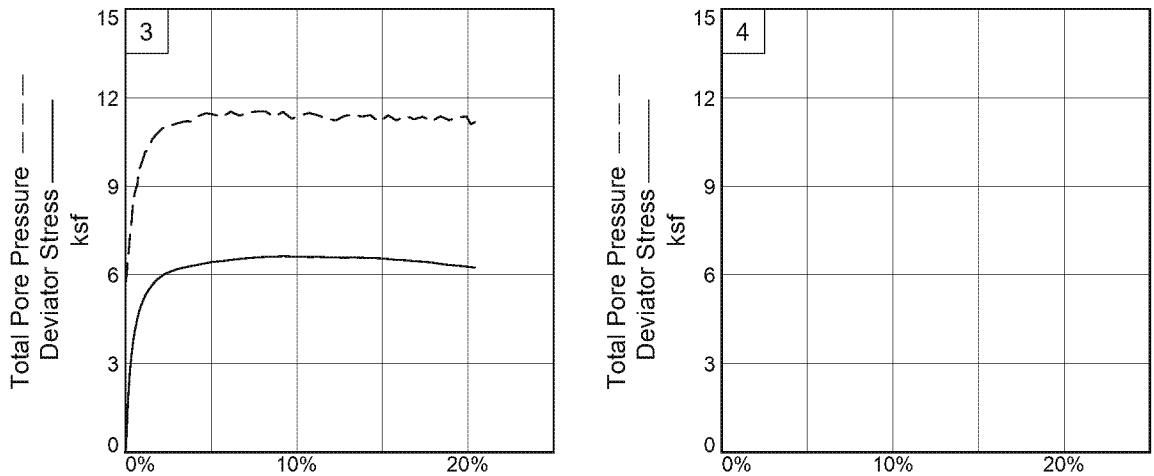
Proj. No.: 011.11497.014 **Date Sampled:** 12/9-16/09

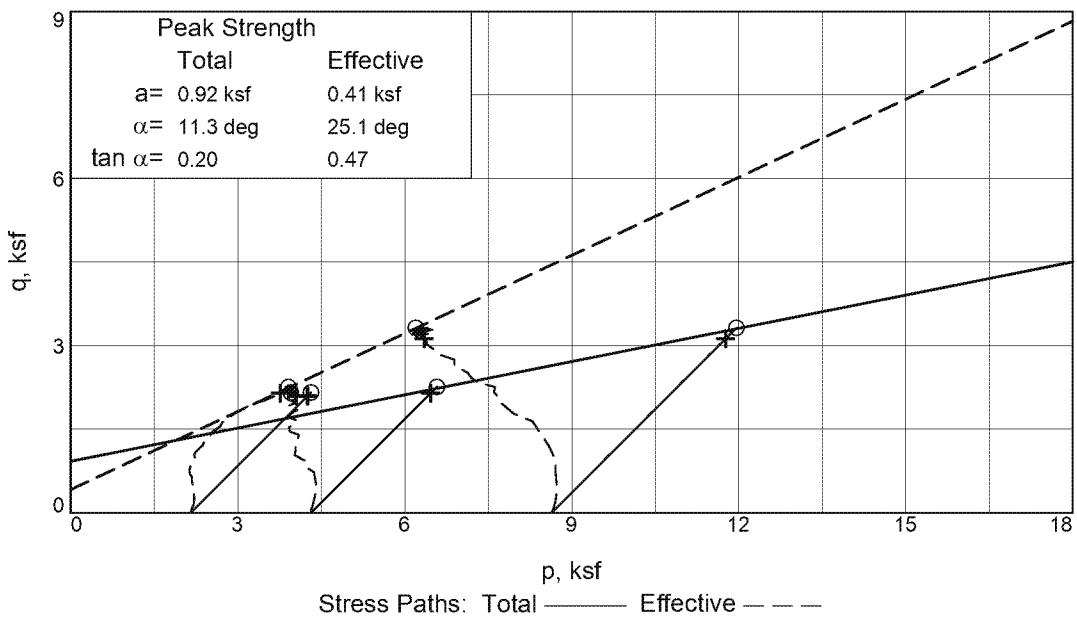
Figure 1 **CU-3**

TRIAXIAL SHEAR TEST REPORT
BBC&M Engineering, Inc.
Dublin, Ohio

Tested By: JJ **Checked By:** JJ



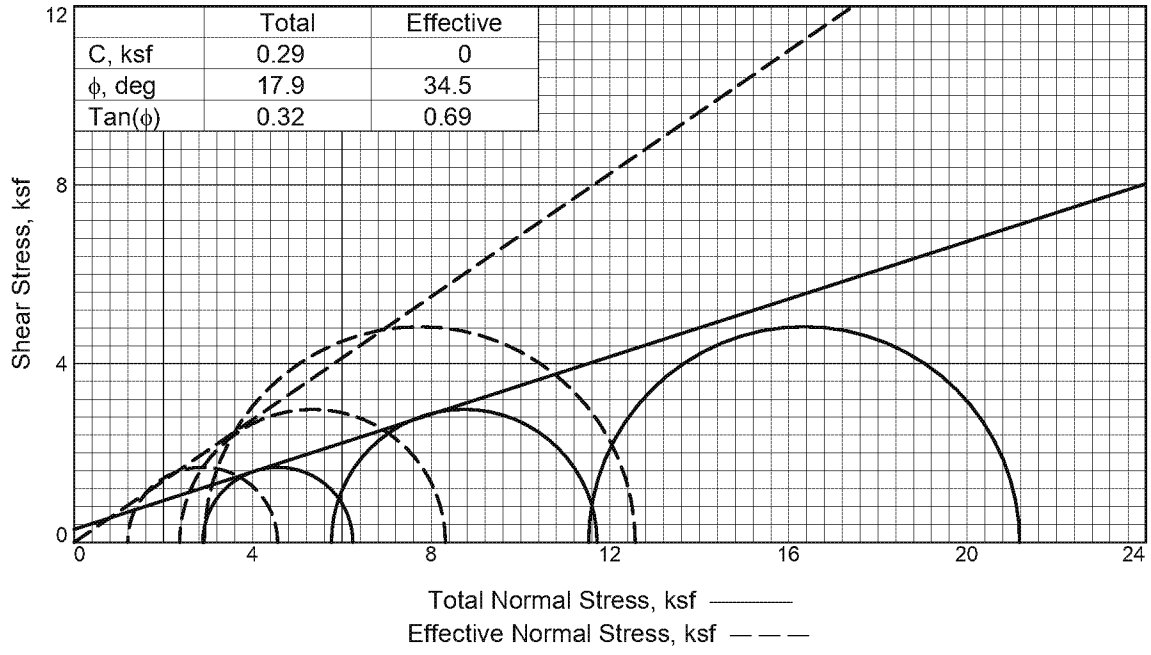




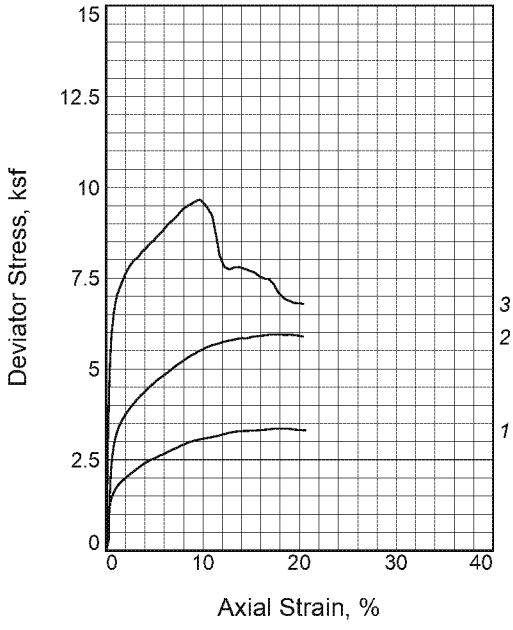
Client: AEP
Project: GAVIN PLANT ASH POND INVESTIGATION
Location: GV-BAP-0909 **Depth:** 16.0' to 18.0' **Sample Number:** S-10 I,II,III
Project No.: 011.11497.014 **Figure** 2

BBC&M Engineering, Inc.

Tested By: JJ **Checked By:** JJ



	Total	Effective
C, ksf	0.29	0
ϕ, deg	17.9	34.5
Tan(ϕ)	0.32	0.69



Sample No.		1	2	3
Initial	Water Content, %	26.9	25.9	27.1
	Dry Density, pcf	87.6	97.6	94.5
	Saturation, %	80.2	98.6	95.8
	Void Ratio	0.8877	0.6946	0.7511
	Diameter, in.	2.90	2.87	2.91
	Height, in.	5.61	5.62	5.57
At Test	Water Content, %	24.3	21.3	21.5
	Dry Density, pcf	98.7	104.7	104.0
	Saturation, %	95.1	97.0	96.4
	Void Ratio	0.6770	0.5808	0.5914
	Diameter, in.	2.77	2.80	2.80
	Height, in.	5.46	5.53	5.47
Strain rate, in./min.		0.01	0.02	0.02
Eff. Cell Pressure, ksf		2.9	5.8	11.5
Fail. Stress, ksf		3.4	6.0	9.7
Total Pore Pr., ksf		7.4	9.2	14.4
Strain, %		17.5	17.0	9.7
Ult. Stress, ksf		3.3	5.9	6.8
Total Pore Pr., ksf		7.4	9.1	15.5
Strain, %		20.6	20.3	20.4
$\bar{\sigma}_1$ Failure, ksf		4.6	8.3	12.6
$\bar{\sigma}_3$ Failure, ksf		1.2	2.4	2.9

Type of Test: CU with Pore Pressures

Sample Type: Shelby Tube

Description: Soft to medium-stiff brown clayey silt, "and" fine sand, trace medium

LL= 28 **PL=** 23 **PI=** 5

Assumed Specific Gravity= 2.65

Remarks: ASTM : SANDY SILTY CLAY CL-ML

Figure 1 **CU-4**

Client: AEP

Project: GAVIN PLANT ASH POND INVESTIGATION CHESHIRE, OHIO

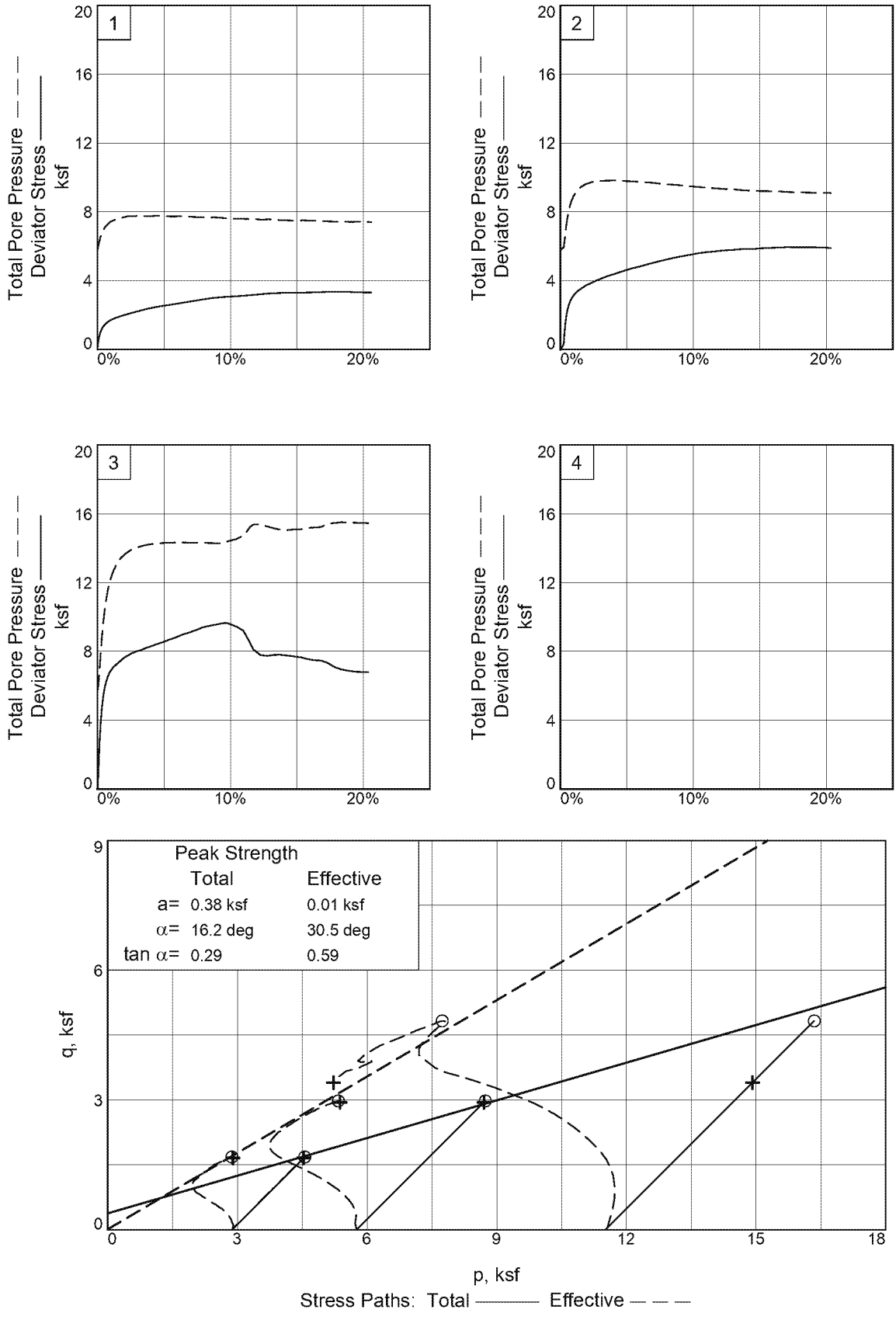
Location: GV-BAP-0910

Sample Number: S-10 I,II,III

Proj. No.: 011.11497.014 **Date Sampled:** 12/17-28/09

TRIAXIAL SHEAR TEST REPORT
BBC&M Engineering, Inc.
Dublin, Ohio

Tested By: JJ **Checked By:** JJ



Client: AEP

Project: GAVIN PLANT ASH POND INVESTIGATION

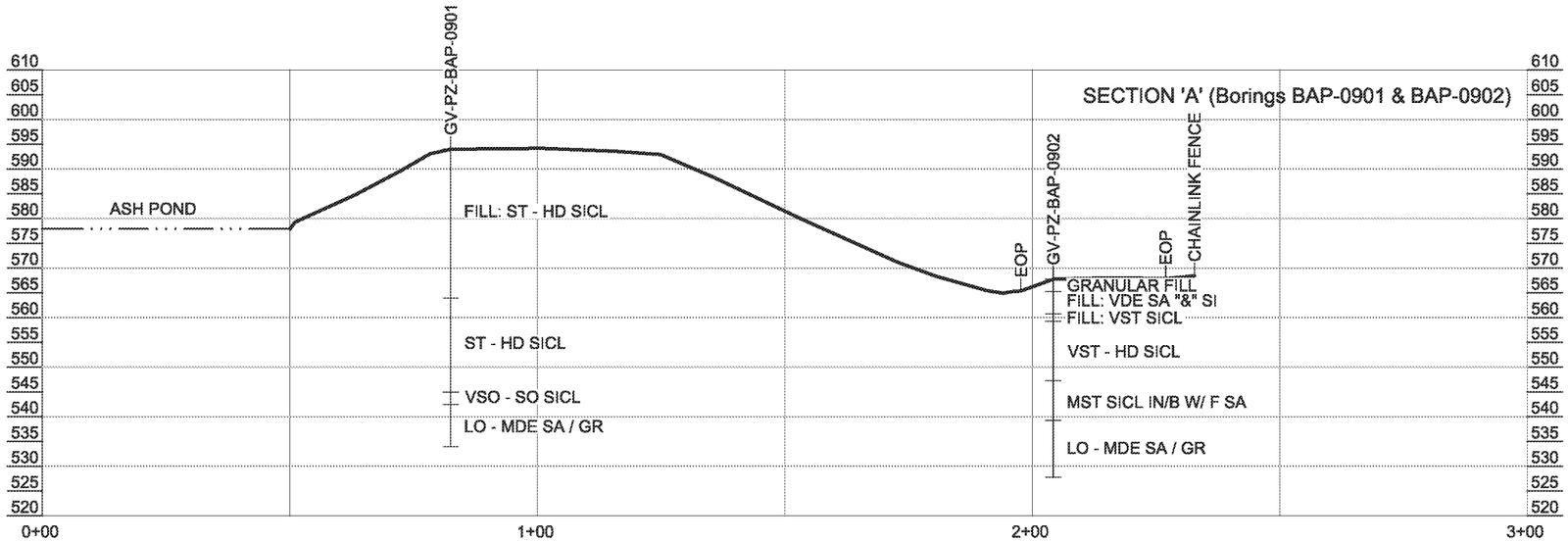
Location: GV-BAP-0910 **Depth:** 17.0' to 19.0' **Sample Number:** S-10 I,II,III

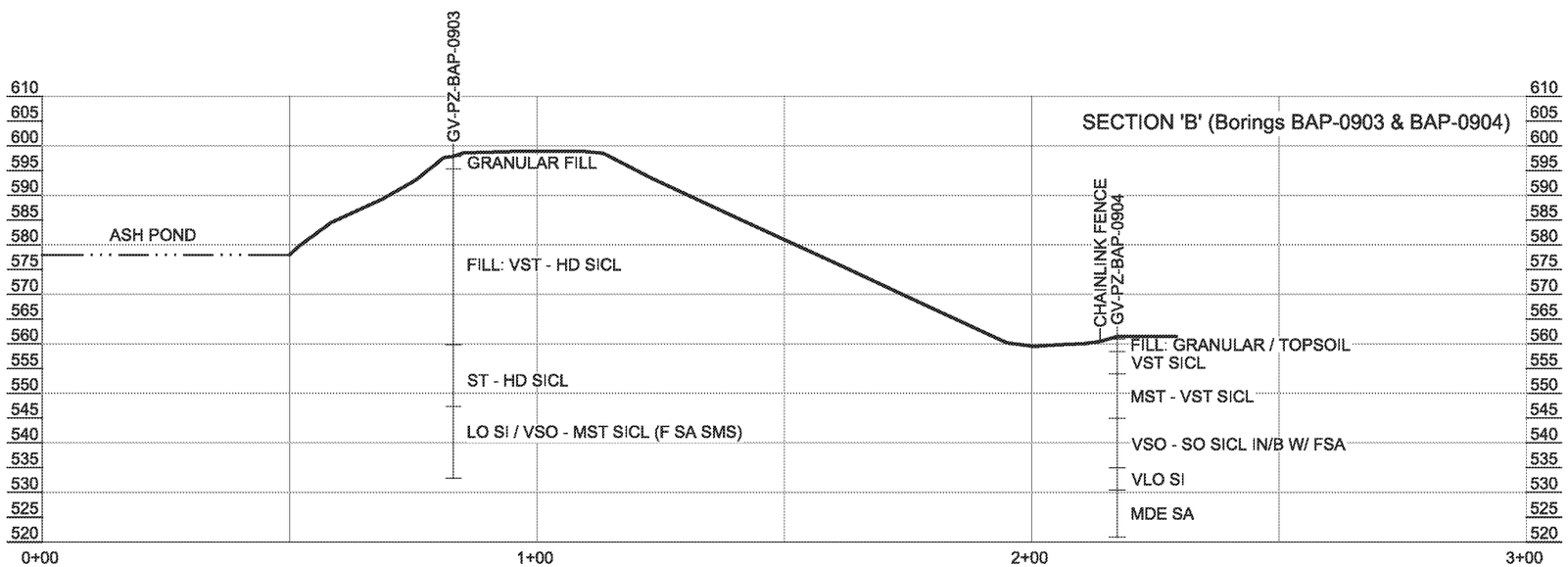
Project No.: 011.11497.014 **Figure** 2

BBC&M Engineering, Inc.

Tested By: JJ **Checked By:** JJ

Appendix IV – Shear Strength Parameter Justification





DATUM: NAD27 / NGVD 29

SUBSURFACE SECTIONS A & B

Gavin Plan Ash Pond Investigation
Chesire, Ohio

Project: 011-11497-014	Drawn By: MTR	
Drawing Date: 5-5-2009	Approved By: MGR	
Last Updated: 6-3-2009	Scale: 1" = 30'	1:1

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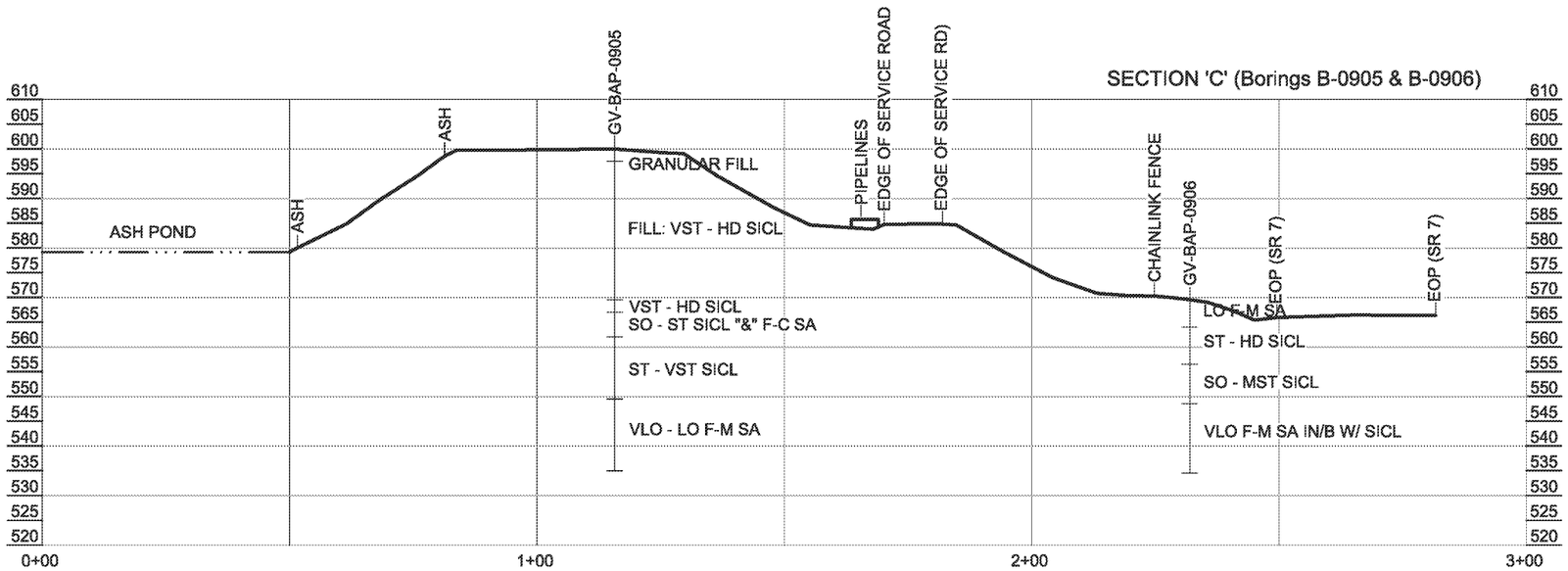
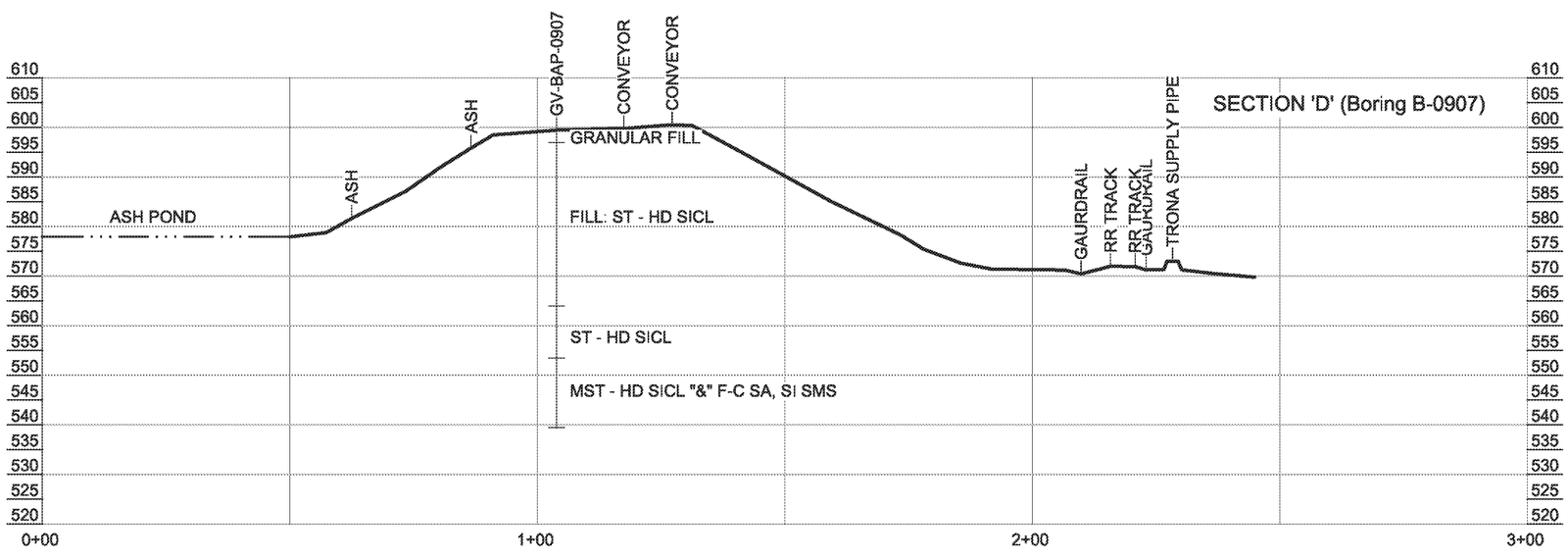
Images: ~Gavin Aerial.jpg ~Gavin Site Plan.JPG
Xrefs: ~Gavin Ash Pond.dwg
File Last Updated: Jun 03, 2009
Plot Info: 6-4-2009 @ 9:19am By: MRomanello
BBC&M Filename: I:\DEPTS\CADD\Drawings\Projects\011-11497-014\EaglePoint\011-11497-014 BASE.dwg Layout: Sec A-B





DATUM: NAD27 / NGVD 29

SUBSURFACE SECTIONS C & D

Gavin Plan Ash Pond Investigation
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Drawing Date: 5-5-2009	Approved By: MGR	
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Images: ~Gavin Aerial.jpg ~Gavin Site Plan.JPG
Xrefs: ~Gavin Ash Pond.dwg
File Last Updated: Jun 03, 2009
Plot Info: 6-4-2009 @ 9:2cm By: MRomanello
BBC&M Filename: I:\DEPTS\CADD\Drawings\Projects\011-11497-014\EaglePoint\011-11497-014 BASE.dwg Layout: Sec C-D

Layer: EMBANKMENT FILL

BORING NUMBER	SAMPLE DEPTH	NATURAL MOISTURE CONTENT	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTIC INDEX %	GRAVEL %	SAND %	SILT %	CLAY .002 mm %	SILT/CLAY %	USCS CLASSIFICATION
BAP-0901	4.75	19									
BAP-0901	7.5	20	41	22	19	0	8	65	27	92	LEAN CLAY CL
BAP-0901	12.75	23	48	23	25						
BAP-0901	17.25	22	53	25	28	0	7	61	32	93	FAT CLAY CH
BAP-0901	19.75	21	42	22	20	0	9	59	32	91	LEAN CLAY CL
BAP-0901	20.5	22									
BAP-0901	26.75	16	34	17	17	0	14	60	26	86	LEAN CLAY CL
BAP-0902	7.75	20	41	20	21						
BAP-0903	4.75	23	38	21	17						
BAP-0903	5.6										
BAP-0903	8.25	20									
BAP-0903	11.25	22	42	21	21						
BAP-0903	15.75	23	52	24	28	0	6	57	37	94	FAT CLAY CH
BAP-0903	21.75	21	30	18	12						
BAP-0903	27.75	19	41	22	19						
BAP-0903	34.25	19	44	22	22	0	12	58	30	88	LEAN CLAY CL
BAP-0905	4.75	18	38	20	18						
BAP-0905	12.25	20	43	23	20	0	4	63	32	95	LEAN CLAY CL
BAP-0905	15.25	22	44	24	20						
BAP-0905	19.75	21									
BAP-0905	21.25	21	40	23	17	0	11	58	31	89	LEAN CLAY CL
BAP-0905	26.25	18	39	19	20	0	11	59	30	89	LEAN CLAY CL
BAP-0905	29.25	20									
BAP-0907	4.75	22	41	21	20						
BAP-0907	9.25	17	34	18	16						
BAP-0907	13.75	18	32	16	16	0	24	54	22		LEAN CLAY with SAND CL
BAP-0907	17.75	20	35	20	15	0	19.4	41.8	38.8		LEAN CLAY with SAND CL
BAP-0907	26.25	20	41	20	21						
BAP-0907	34.25	19	52	24	28	2	10	55	34		FAT CLAY CH

Sample Size	29	28	23	23	23	12	12	12	12	9
Minimum	4.75	16	30	16	12	0	4	42	22	86
Maximum	34.25	23	53	25	28	2	24	65	39	95
Mean	16.59	20	41.1	21	20	0	11	58	31	91
Median	15.75	20	41.0	21	20	0	11	59	32	91
Mode	4.75	20	41.0	22	20	0	11	59	32	89
Std Dev	-	1.8	6.1	2.4	4.1	0.6	5.7	5.8	4.6	3.0

PLATE 3

Layer: ALLUVIUM SILT AND CLAY

BORING NUMBER	SAMPLE DEPTH	NATURAL MOISTURE CONTENT	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTIC INDEX %	GRAVEL %	SAND %	SILT %	CLAY .002 mm %	SILT/CLAY %	USCS CLASSIFICATION
BAP-0901	31.75	18	38	20	18						
BAP-0901	34.25	15	29	18	11	0	32	51	17	68	SANDY LEAN CLAY CL
BAP-0901	39.25	18	26	18	8						
BAP-0901	44.25	23	30	21	9	0	23	62	15	77	LEAN CLAY with SAND CL
BAP-0901	46.75	25									
BAP-0901	49.45	29	24	19	5						
BAP-0902	11.75	18	35	20	15						
BAP-0902	19.25	22	32	21	11	0	11	67	22	89	LEAN CLAY CL
BAP-0902	24.25					0	38			62	
BAP-0902	26.75	30	21	16	5						
BAP-0903	41.75	24	53	22	31	0	7	59	34	93	FAT CLAY CH
BAP-0903	46.75	22	38	19	19						
BAP-0903	51.75	25	24	19	5						
BAP-0903	56.75	25	35	19	16	0	13	62	25	87	LEAN CLAY CL
BAP-0904	4.75	24	44	22	22						
BAP-0904	7.75	30	43	26	17	0	4	62	34	96	LEAN CLAY CL
BAP-0904	11.75	23	42	20	22						
BAP-0904	16.75	26									
BAP-0904	19.25	28	30	20	10						
BAP-0904	24.25	29	32	19	13	0	24			76	LEAN CLAY with SAND CL
BAP-0904	29.25					0	18			82	
BAP-0904	34.25	29	32	19	13						
BAP-0905	31.75	17	29	18	11						
BAP-0905	34.25					0	43			57	
BAP-0905	36.75	19	28	18	10	0	34	47	19	66	SANDY LEAN CLAY CL
BAP-0905	43.75	25	42	21	21	0	4	69	28	97	LEAN CLAY CL
BAP-0905	49.25	28	38	22	16						
BAP-0906	6.25	18	35	20	15	0	25	54	21	75	LEAN CLAY with SAND CL
BAP-0906	9.25	23	45	22	23						
BAP-0906	14.25	25	33	21	12						
BAP-0906	19.25	27	34	21	13	0	13	65	22	87	LEAN CLAY CL
BAP-0907	39.25	21	47	24	23	0	8	61	32	93	LEAN CLAY CL
BAP-0907	44.75	19	40	20	20						
BAP-0907	47.25	18	31	17	14	0	31	49	20	69	SANDY LEAN CLAY CL
BAP-0907	51.75	20	32	18	14	0	31			69	SANDY LEAN CLAY CL
BAP-0907	56.75	24	31	18	13						

Sample Size	36	33	31	31	31	17	17	12	12	17
Minimum	4.75	15	21	16	5	0	4	47	15	57
Maximum	56.75	30	53	26	31	0	43	69	34	97
Mean	32.14	23	34.6	20	15	0	21	59	24	79
Median	34.25	24	33.0	20	14	0	23	62	22	77
Mode	34.25	18	32.0	20	13	0	13	62	22	-
Std Dev	-	4.2	7.4	2.1	6.0	0.0	12.4	7.2	6.5	12.6

PLATE 4

Layer: LO-MDE SAND / GRAVEL

BORING NUMBER	SAMPLE DEPTH	NATURAL MOISTURE CONTENT	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTIC INDEX %	GRAVEL %	SAND %	SILT %	CLAY .002 mm %	SILT/CLAY %	USCS CLASSIFICATION
BAP-0901	51.35					0	41			59	
BAP-0901	54.25					36	59			5	POORLY GRADED SAND with GRAVEL SP
BAP-0902	31.75					20	75			4	POORLY GRADED SAND with GRAVEL SP
BAP-0905	54.25					0	41			59	
BAP-0906	29.25					0	56			44	

Sample Size	5	-	-	-	-	5	5	-	-	5
Minimum	29	-	-	-	-	0	41	-	-	4
Maximum	54	-	-	-	-	36	75	-	-	59
Mean	44	-	-	-	-	11	54	-	-	34
Median	51	-	-	-	-	0	56	-	-	44
Mode	54.25	-	-	-	-	0	41	-	-	59
Std Dev	12.6	-	-	-	-	16.3	14.2	-	-	27.8

PLATE 5

ED_005405A_00000217-00172

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Project/Proposal Name GAVIN PLANT ASH POND Checked By MGR Date 6-3-09
Subject STRENGTH & PERM. PARAMETERS Sheet 1 of 5

The shear strength values estimated from the following correlations were updated based on results of consolidated-undrained triaxial tests performed as part of the 2010 Follow-Up Investigation.

ONLY DRAINED STRENGTH PARAMETERS ARE REQUIRED FOR STABILITY ANALYSIS SINCE POND IN SERVICE SINCE 1974 ±

+ DRAINED STRENGTH PARAMETERS
FOR EMBANKMENT FILL & ALLUVIUM LAYERS, ESTIMATE THE EFFECTIVE ANGLE OF INTERNAL FRICTION, ϕ', FROM THE FOLLOWING METHODS:

1) CORRELATIONS TO LL, CLAY SIZED FRACTION, AND OVERBURDEN STRESS DEVELOPED BY STARK ET AL. FOR FULLY SOFTENED FRICTION ANGLE.

2) RELATIONSHIP BETWEEN ϕ' AND PLASTICITY INDEX (TERZAGHI, PECK AND MESRI, 1996)

3) CORRELATION TO CLAY SIZED FRACTION FOR NORMALLY CONSOLIDATED CLAY (DISSERTATION BY G.A. HALL, UNV, 1974)

WHERE $\phi'_{NC} = 36 - 0.2665$ (% CLAY)

4) FOR EMBANKMENT FILL ONLY, A SPT CU TRIAXIAL TEST WAS PERFORMED ON AN UNDISTURBED SAMPLE.

5) FOR FILL SOILS, ESTIMATE DRAINED STRENGTH VALUES FROM NAVFAC DESIGN MANUAL 7.2 USING TABLE 1 - 'TYPICAL PROPERTIES OF COMPACTED SOILS'

+ GRANULAR FOUNDATION LAYERS (GLACIAL OUTWASH SAND & GRAVEL)
ESTIMATE ϕ' BASED SPT CORRELATIONS AND GRAIN SIZE ANALYSIS

1) $\phi' = \sqrt{15.4\,(N_{60})} + 20°$ (HANTANAKA AND UCHIDA, 1996)

2) COMPARE EQN 1) WITH TYPICAL VALUES ESTABLISHED BY SCHNEIDER ET. AL.

TABLE 7.1 Relative Density of Cohesionless Soils

Relative Density Designation	γ_{moist} (pcf)	*Approximate Relative Density, %*	*N_{60} Standard Penetration Resistance*	*Approximate Angle of Friction of Soil ϕ, degrees*
Very loose	70-100	0–5	0–4	25–28
Loose	90-115	5–30	4–10	28–30
Medium	110-130	30–60	10–30	30–36
Dense	110-140	60–85	30–50	36–41
Very dense	130-150	>85	Over 50	>41

PLATE 6

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Subject Sheet 2 of 5

+ PERMEABILITY

- EMBANKMENT FILL
  PERMEABILITY BASED ON FLEX WALL PERMEABILITY TEST PERFORMED ON UNDISTURBED SAMPLE. ESTIMATE PERM. SLIGHTLY GREATER THAN TEST RESULTS TO ACCOUNT FOR PERM ON MACRO SCALE.

- ALLUVIUM SILT & CLAY
  ESTIMATE PERMEABILITY BASED ON TYPICAL PUBLISHED VALUES USING SOIL DESCRIPTIONS & GRAIN SIZE ANALYSIS

- GRANULAR FOUNDATION LAYERS
  ESTIMATE PERMEABILITY USING TYPICAL PUBLISHED VALUES BASED ON RELATIVE DENSITY AND GRAIN SIZE ANALYSIS

  AS A GUIDE, USE $K = (100\ D_{10})^2$ cm/sec ($cm \times 10^{-4}$/sec)
  (HAZEN)

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Subject Sheet 3 of 5

+ LAYER: COHESIVE EMBANKMENT FILL:

DESCRIPTION: STIFF TO HARD BROWN MOTTLED WITH GRAY SILTY CLAY, TRACE TO LITTLE FINE TO COARSE SAND, TR FINE GRAVEL

HAND PENETROMETER: H = 1.25 TO 4.5+ tsf

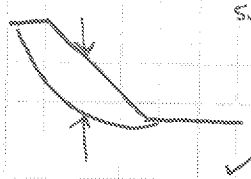
INDEX TESTING:

	MC	LL	PI	% CLAY (0.002 mm)
MODE VALUE:		41	20	32

- STRENGTH PARAMETER:

1) STARK CORRELATION FOR SECANT FULLY SOFTENED FRICTION ANGLE:

HEIGHT OF FILL RANGES BETWEEN 30 – 40 FT.
OBSERVATION WELL READINGS BELOW FILL. CONSIDER FAILURE SURFACES FROM 15' TO 40



$\therefore \sigma_{v_0}' = 15\ ft \times 125\ pcf = 1875\ psf = 90\ kPa$
$\sigma_{v_0}' = 40\ ft \times 125\ pcf = 5000\ psf = 240\ kPa$

✓ FOR CORRELATION, CONSIDER BOTH $\sigma_{v_0}' = 50\ kPa$ AND $100\ kPa$ TO ACCOUNT FOR PROBABLE DEPTH OF FAILURE SURFACE
RESULTS: $\phi_{FS}' = 29°$ (SEE CORRELATION THIS APPENDIX)

2) USING GRAPH OF ϕ' VRS PI, FOR PI = 20, $\phi' = 31°$ (SEE GRAPH THIS APPENDIX)

3) $\phi_{NC}' = 36 - 0.2665(\%\ CLAY)$
$= 36 - 0.2665(32\%)$ } HALL THESIS

$\phi_{NC}' = 27.5°$

4) BASED ON RESULTS OF CU TRIAXIAL TEST, $\phi' = 24.4°$ & $C' = 530\ psf$ (SEE DISCUSSION IN TEXT & PLATES THROUGH OF APP.

5) NAVFAC TABLE 1. FOR INORGANIC CLAY FILL OF LOW TO MED PLASTICITY $\phi' = 28°$ & COHESION (SATURATED) = 270 psf (SEE TABLE THIS APPENDIX)

DESIGN STRENGTH VALUE: BASED ON RESULTS, USE $\phi' = 28°$ AND $C' = 100\ psf$

- PERMEABILITY: FROM FLEX WALL PERM TEST, $K = 2.5 \times 10^{-8}$ cm/sec
USE $K_v = 1 \times 10^{-7}$ cm/s TO ACCOUNT FOR PERMEABILITY ON A MACRO SCALE.
ANISOTROPIC CONDITIONS: SET $K_H/K_v = 5$ DUE TO STRATIFICATIONS AS A RESULT OF COMPACTING FILL IN LAYERS.

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Subject Sheet 4 of 5

+ LAYER: ALLUVIUM SILT & CLAY

DESCRIPTION: STIFF TO HARD SILTY CLAY CONTAINING ZONES AND/OR THIN SEAMS OF
1) SOFT TO STIFF CLAYEY SILT
2) LOOSE SILT
3) VERY LOOSE TO LOOSE FINE TO MED SAND

HAND PENETROMETER: 1.0 - 4.5+ tsf ON SILTY CLAY SAMPLES
0.25 - 1.0 tsf ON CLAYEY SILT SAMPLES

INDEX TESTING

	MC	LL	PI	% CLAY
MODAL VALUE	18	32	13	22

- STRENGTH PARAMETER

1) STARK CORRELATION
DEPTH OF ALLUVIUM LAYER RANGES FROM 30' - 58' BELOW CREST TO 0 TO 35' BELOW GROUND SURFACE @ TOE.

CONSIDER BOTH $\sigma_{v_0}' = 100$ KPa & $\sigma_{v_0}' = 400$ KPa FOR STRENGTH CORRELATION.

RESULTS: $\phi_{PS}' = 28°$ (SEE CORRELATION THIS APPENDIX)

2) TERZAGHI, PECK & MESRI ϕ' VRS PI GRAPH (SEE GRAPH THIS APPENDIX)

RESULTS $\phi' = 32°$

3) $\phi'_{NC} = 36 - 0.2665\,(\%\ CLAY)$
$= 36 - 0.2665\,(22\%)$ $\phi'_{NC} = 30°$ } HALL THESIS

DESIGN STRENGTH PARAMETER: BASED ON RESULTS FROM ALL 3 CORRELATION METHODS, USE $\phi' = 29°$

- PERMEABILITY: USE $K_v = 1 \times 10^{-5}$ cm/s BASED ON PRESENCE OF COARSE GRAINED SEAMS/ZONES

ANISOTROPIC CONDITIONS: SET $K_H / K_V = 2$ BASED ON NATURAL STRATIFICATION

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Subject Sheet 5 of 5

+ LAYER: LOOSE TO MED. DENSE GLACIAL OUTWASH SAND & GRAVEL

- DESCRIPTION: LOOSE TO MED DENSE BROWN AND GRAY FINE TO COARSE SAND, TRACE TO SOME FINE TO COARSE GRAVEL TRACE SILT

- N_{60} RANGE:

		FRICTION ANGLE	
		GJN 72	TABLE 7.1
LOW	3	26.7°	27°-28°
HIGH	46	46.6°	40-41°
AVG	15	35°	31°-32°

USE $\phi' = 32°$

- PERMEABILITY: D_{10} SIZE ON SIEVED SAMPLES: D_{10} = 0.1686, 0.2333, < 0.0774, < 0.0848

USING HAZEN CORRELATION,

$K = (100 \cdot 0.2333)^2$ m/sec = $5.4\,E^{-2}$ cm/sec

$K = (100 \cdot 0.1686)^2$ m/sec = $2.8\,E^{-2}$ cm/sec

USE $K_v = 1.0 \times 10^{-3}$ cm/sec ✓

+ LAYER: ROADWAY FILL

- DESCRIPTION: GRANULAR ROADWAY BASE FOR SECTION B (NO SAMPLING)

FOR SECTION A, 2-3' OF GRANULAR ROADWAY BASE OVER VERY DENSE GRAY / GRAY-BLACK SAND "AND" SILT. *

* LAYER EXTRAPOLATED AS FILL MATERIAL BENEATH RR EMBANKMENT.

N_{60} RANGE: 31 - 105

FROM NAVFAC TABLE 1, $\phi' = 34°$, $C' = 0$, $K = 5 \times 10^{-5}$ cm/sec FOR SILTY SANDS (SEE TABLE THIS APPENDIX)

BBCM SOLUTIONS TO BUILD ON

DRAINED SHEAR STRENGTH PARAMETER CORRELATION

Project No: 011-11497-014 Date: 5/29/09
Project: Gavin Plant Bottom Ash Pond Investigation

Reference:
Drained Shear Strength Parameters for Analysis of Landslides. Timothy D. Stark; Hangseok Choi; and Sean McCone. Journal of Geotechnical Engineering, May 2005. pp 575 - 588

Purpose:
Estimate effective stress, or drained, shear strength parameters of cohesive soils through emperical correlations using laboratory index testing and the effective normal stress. Secant residual and secant fully softened friction angles can be estimated from charts developed by Stark et al.

Laboratory Data

Soil Layer: Embankment Fill

Statistical Results from 4 Borings

	PI	LL	MC	% Passing #200 Sieve (.075 mm)	Clay Sized Fraction (.002 mm)
Number in Statistical Sample	22	22	27	9	11
Minimum	12	30	16	86	22
Maximum	28	53	23	95	37
Mean	20.2	41.4	20.2	90.8	30.3
Median	20	41	20	91	31
Mode	20	41	20	89	32
Std Dev	4.1	6.1	1.9	3.0	4.1
Design Value	*20*	41	-	-	32

Adjustment Factor for ASTM Derived Values

$$\frac{\textit{ball-milled derived LL}}{\textit{ASTM derived LL}} = .003\ (\textit{ASTM derived LL}) + 1.23$$

LL_{ASTM} = 41
LL_{BM} = 55.5

$$\frac{\textit{ball-milled derived CF}}{\textit{ASTM derived CF}} = 0.0003\ (\textit{ASTM derived CF})2 - 0.037(\textit{ASTM derived CF}) + 2.254$$

CF_{ASTM} = 32
CF_{BM} = 44.1

where: LL = Liquid Limit
CF = Clay-sized Fraction

PLATE 11

BBGM SOLUTIONS TO BUILD ON

DRAINED SHEAR STRENGTH PARAMETER CORRELATION

Soil Layer: Embankment Fill

LL_{BM} = 55.5

CF_{BM} = 44.1

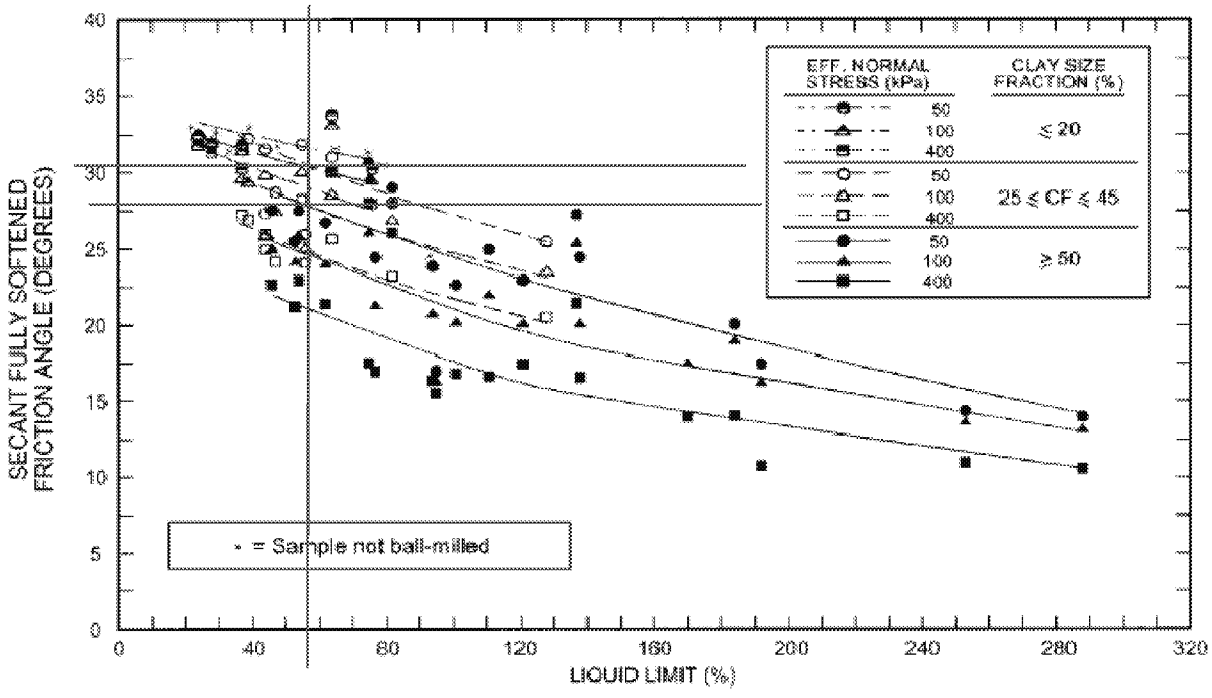


Fig. 5. Secant fully softened friction angle relationships with liquid limit, clay-size fraction, and effective normal stress

Secant Fully Softened Friction Angle

Clay Sized Fraction, %	Effective Normal Stress: *50 kPa*	*100 kPa*
24 ≤ CF ≤ 45	31°	28°
≥ 50	-	-

Design Friction Angle Value	29°

PLATE 12

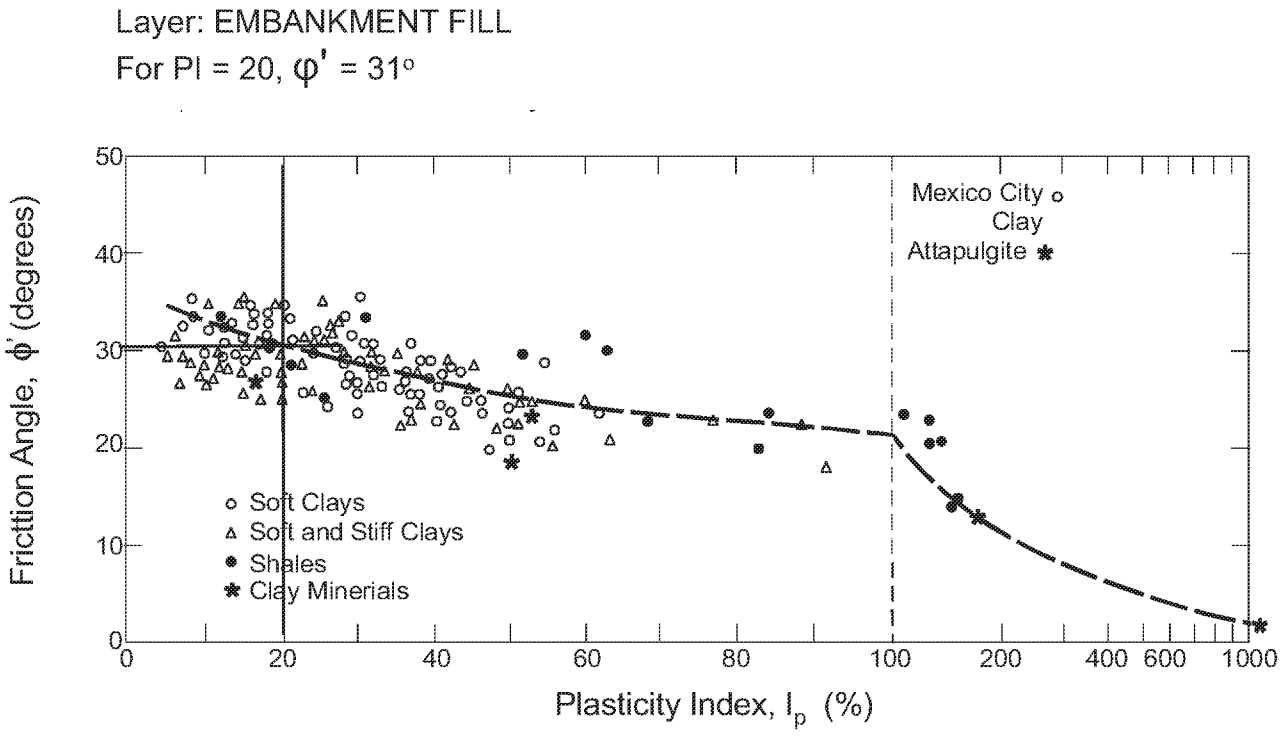


Figure 74. Relationship between ϕ' and PI (Terzaghi, Peck, and Mesri, 1996).

Report No. FHWA-IF-02-034
Geotechnical Engineering Circular No. 5
Evaluation of Soil and Rock Properties
April, 2002

BBCM SOLUTIONS TO BUILD ON

DRAINED SHEAR STRENGTH PARAMETER CORRELATION

Project No: 011-11497-014 Date: 5/29/09
Project: Gavin Plant Bottom Ash Pond Investigation

Reference:
Drained Shear Strength Parameters for Analysis of Landslides. Timothy D. Stark; Hangseok Choi; and Sean McCone. Journal of Geotechnical Engineering, May 2005. pp 575 - 588

Purpose:
Estimate effective stress, or drained, shear strength parameters of cohesive soils through emperical correlations using laboratory index testing and the effective normal stress. Secant residual and secant fully softened friction angles can be estimated from charts developed by Stark et al.

Laboratory Data

Soil Layer: Alluvium Silt and Clay

Statistical Results from 7 Borings

	PI	LL	MC	% Passing #200 Sieve (.075 mm)	Clay Sized Fraction (.002 mm)
Number in Statistical Sample	31	31	33	17	12
Minimum	5	21	15	57	15
Maximum	31	53	30	97	34
Mean	14.7	34.6	23.2	79	24.1
Median	14	33	24	77	22
Mode	13	32	18	-	22
Std Dev	6.0	7.4	4.2	12.6	6.5
Design Value	*13*	32	-	-	22

Adjustment Factor for ASTM Derived Values

$$\frac{\textit{ball-milled derived LL}}{\textit{ASTM derived LL}} = .003\ (\textit{ASTM derived LL}) + 1.23$$

LL_{ASTM} = 32
LL_{BM} = 42.4

$$\frac{\textit{ball-milled derived CF}}{\textit{ASTM derived CF}} = 0.0003\ (\textit{ASTM derived CF})2 - 0.037(\textit{ASTM derived CF}) + 2.254$$

CF_{ASTM} = 22
CF_{BM} = 34.9

where: LL = Liquid Limit
CF = Clay-sized Fraction

BBGM SOLUTIONS TO BUILD ON

DRAINED SHEAR STRENGTH PARAMETER CORRELATION

Soil Layer: Alluvium Silt and Clay

LL_{BM} = 42.4

CF_{BM} = 34.9

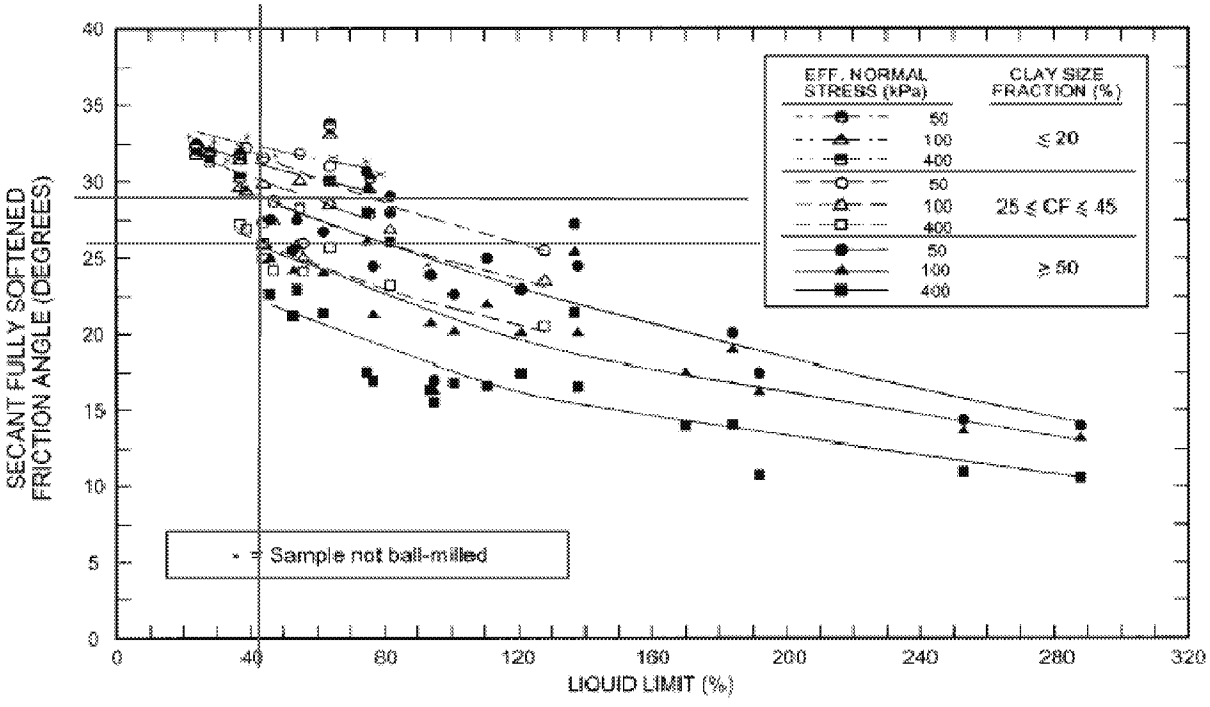


Fig. 5. Secant fully softened friction angle relationships with liquid limit, clay-size fraction, and effective normal stress

Secant Fully Softened Friction Angle

Clay Sized Fraction, %	Effective Normal Stress: *100 kPa*	*400 kPa*
24 ≤ CF ≤ 45	29°	26°
≥ 50	-	-

Design Value	28°

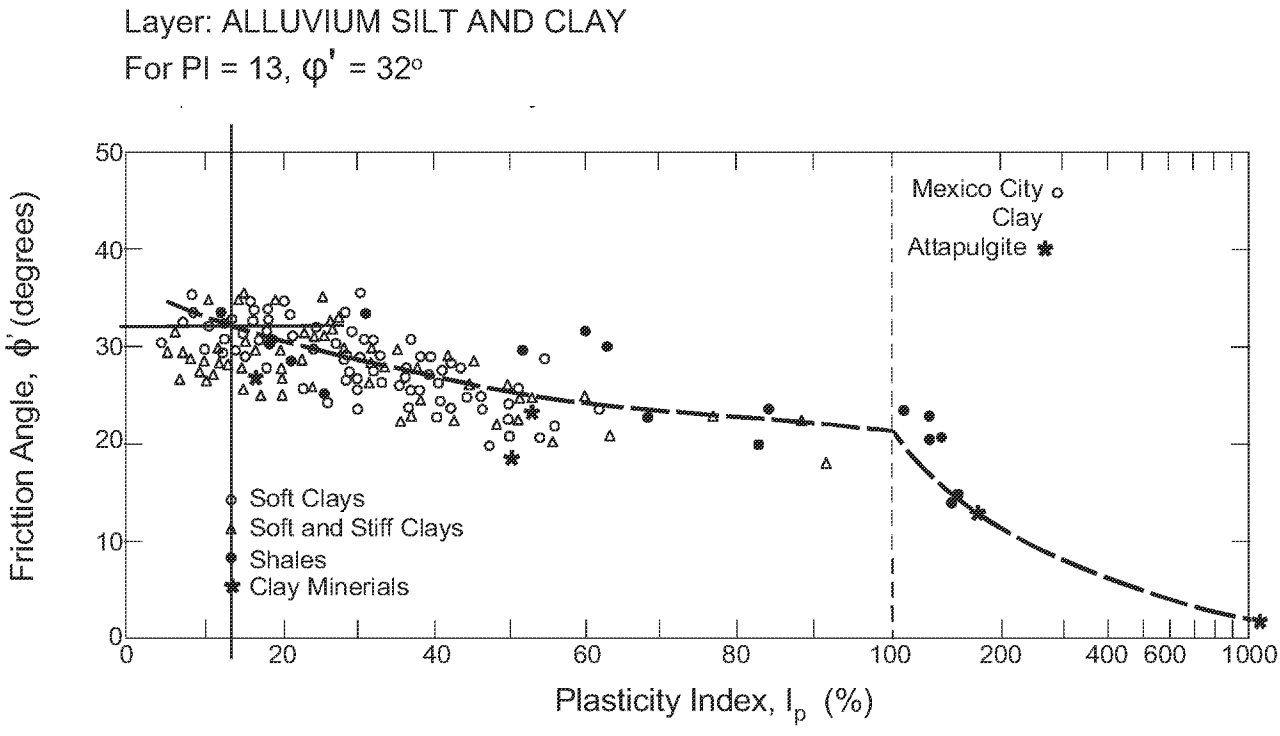


Figure 74. Relationship between ϕ' and PI (Terzaghi, Peck, and Mesri, 1996).

Report No. FHWA-IF-02-034
Geotechnical Engineering Circular No. 5
Evaluation of Soil and Rock Properties
April, 2002

TABLE 1
Typical Properties of Compacted Soils

	Group Symbol	Soil Type	Range of Maximum Dry Unit Weight, pcf	Range of Optimum Moisture, Percent	Typical Value of Compression: At 1.4 ksf (20 psi)	Typical Value of Compression: At 3.6 ksf (50 psi)	Typical Strength Characteristics: Cohesion (as compacted) psf	Typical Strength Characteristics: Cohesion (saturated) psf	Typical Strength Characteristics: φ (Effective Stress Envelope Degrees)	Typical Strength Characteristics: Tan φ	Typical Coefficient of Permeability ft./min.	Range of CBR Values	Range of Subgrade Modulus k lbs/cu in.
					Percent of Original Height								
Roadway Fill	GW	Well graded clean gravels, gravel-sand mixtures.	125 - 135	11 - 8	0.3	0.6	0	0	>38	>0.79	5×10^{-2}	40 - 80	300 - 500
	GP	Poorly graded clean gravels, gravel-sand mix	115 - 125	14 - 11	0.4	0.8	0	0	>37	>0.74	10^{-1}	30 - 60	250 - 400
	GM	Silty gravels, poorly graded gravel-sand-silt.	120 - 135	12 - 8	0.5	1.1	.....	.....	>34	>0.67	$>10^{-8}$	20 - 60	100 - 400
	GC	Clayey gravels, poorly graded gravel-sand-clay.	115 - 130	14 - 9	0.7	1.5	.....	.....	>31	>0.60	$>10^{-7}$	20 - 40	100 - 300
	SW	Well graded clean sands, gravelly sands.	110 - 130	16 - 9	0.6	1.2	0	0	38	0.79	$>10^{-3}$	20 - 40	200 - 300
	SP	Poorly graded clean sands, sand-gravel mix.	100 - 120	21 - 12	0.8	1.4	0	0	37	0.74	$>10^{-3}$	10 - 40	200 - 300
	SM	Silty sands, poorly graded sand-silt mix.	110 - 125	16 - 11	0.8	1.6	1050	420	34	0.67	$5 \times >10^{-5}$	10 - 40	100 - 300
	SM-SC	Sand-silt clay mix with slightly plastic fines.	110 - 130	15 - 11	0.8	1.4	1050	300	33	0.66	$2 \times >10^{-6}$	5 - 30	100 - 300
	SC	Clayey sands, poorly graded sand-clay-mix.	105 - 125	19 - 11	1.1	2.2	1550	230	31	0.60	$5 \times >10^{-7}$	5 - 20	100 - 300
	ML	Inorganic silts and clayey silts.	95 - 120	24 - 12	0.9	1.7	1400	190	32	0.62	$>10^{-5}$	15 or less	100 - 200
	ML-CL	Mixture of inorganic silt and clay.	100 - 120	22 - 12	1.0	2.2	1350	460	32	0.62	$5 \times >10^{-7}$	.....	
	CL	Inorganic clays of low to medium plasticity.	95 - 120	24 - 12	1.3	2.5	1800	270	28	0.54	$>10^{-7}$	15 or less	50 - 200
	OL	Organic silts and silt-clays, low plasticity.	80 - 100	33 - 21	.....	.....	.....	.....	.....	.....	.....	5 or less	50 - 100
Embankment Fill	MH	Inorganic clayey silts, elastic silts.	70 - 95	40 - 24	2.0	3.8	1300	420	25	0.47	$5 \times >10^{-7}$	10 or less	50 - 100
	CH	Inorganic clays of high plasticity	75 - 105	36 - 19	2.6	3.9	2150	230	19	0.35	$>10^{-7}$	15 or less	50 - 150
	OH	Organic clays and silty clays	65 - 100	43 - 21	.....	.....	.....	.....	.....	.....	.....	5 or less	25 - 100

Notes:

1. All properties are for condition of "Standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density.
2. Typical strength characteristics are for effective strength envelopes and are obtained from USBR data.
3. Compression values are for vertical loading with complete lateral confinement.
4. (>) indicates that typical property is greater than the value shown.
   (..) indicates insufficient data available for an estimate.

ED_005405A_00000217-00184

USGS National Seismic Hazard Maps - 2008

Peak Horizontal Acceleration with 2% Probability of Exceedence in 50 Years

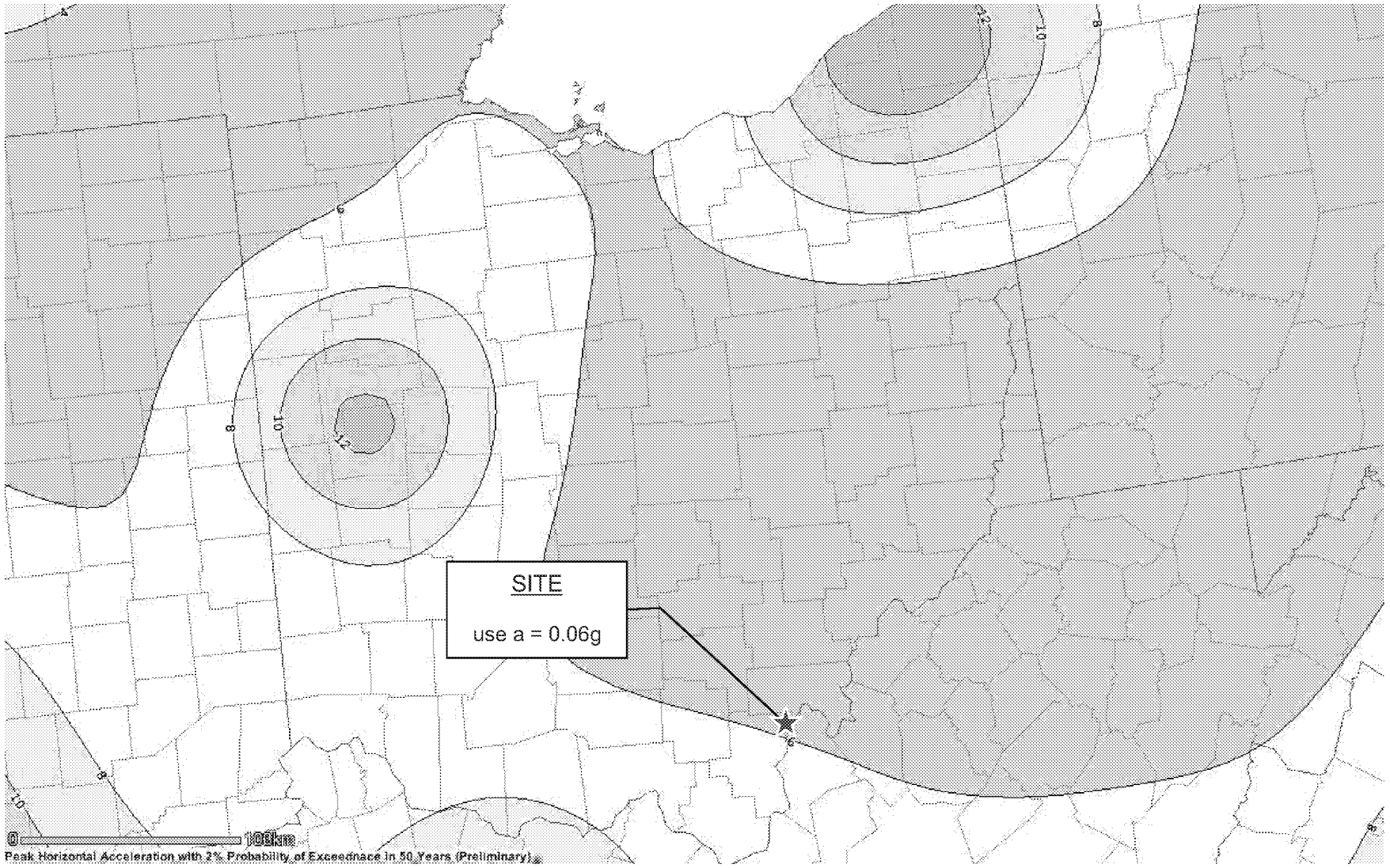
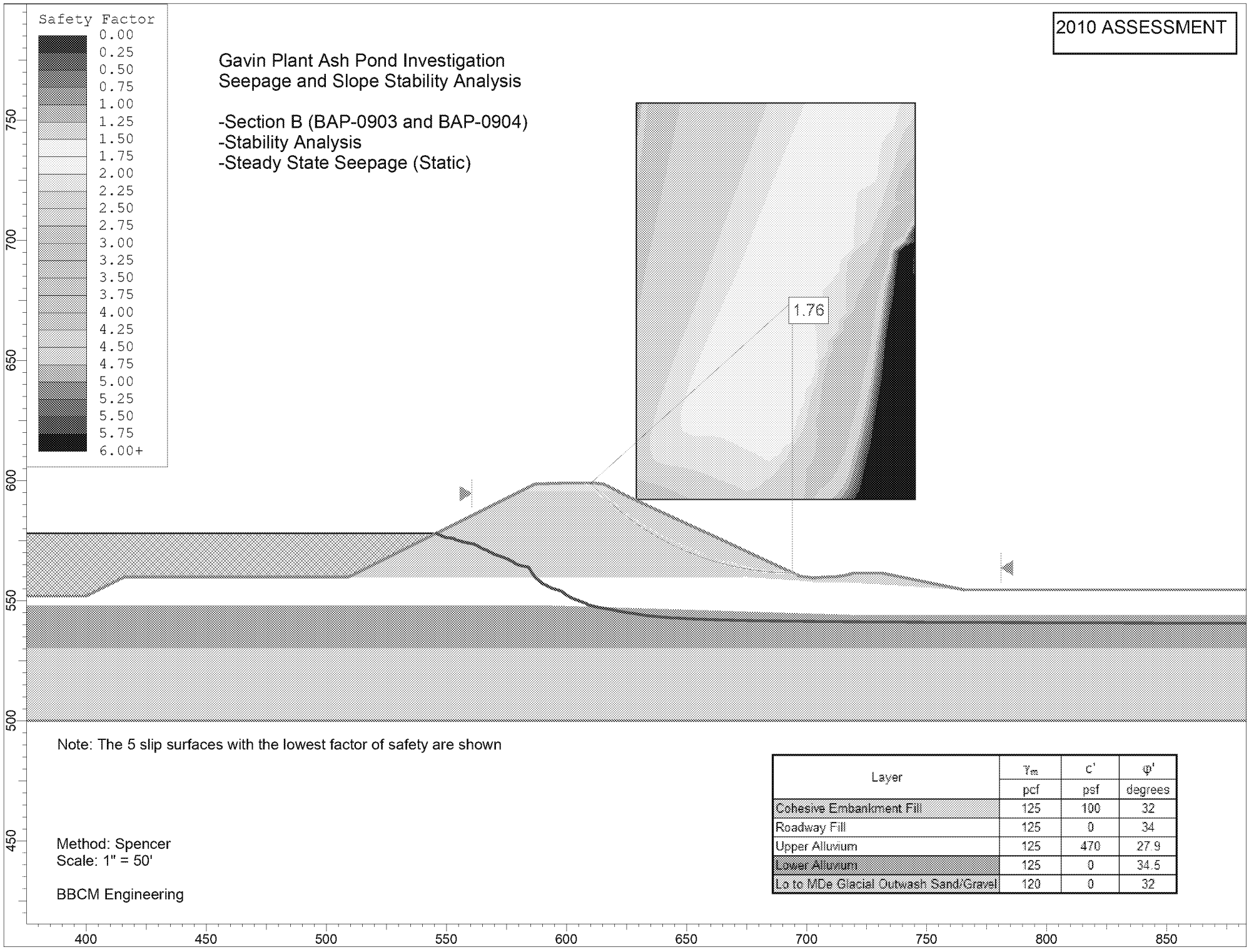
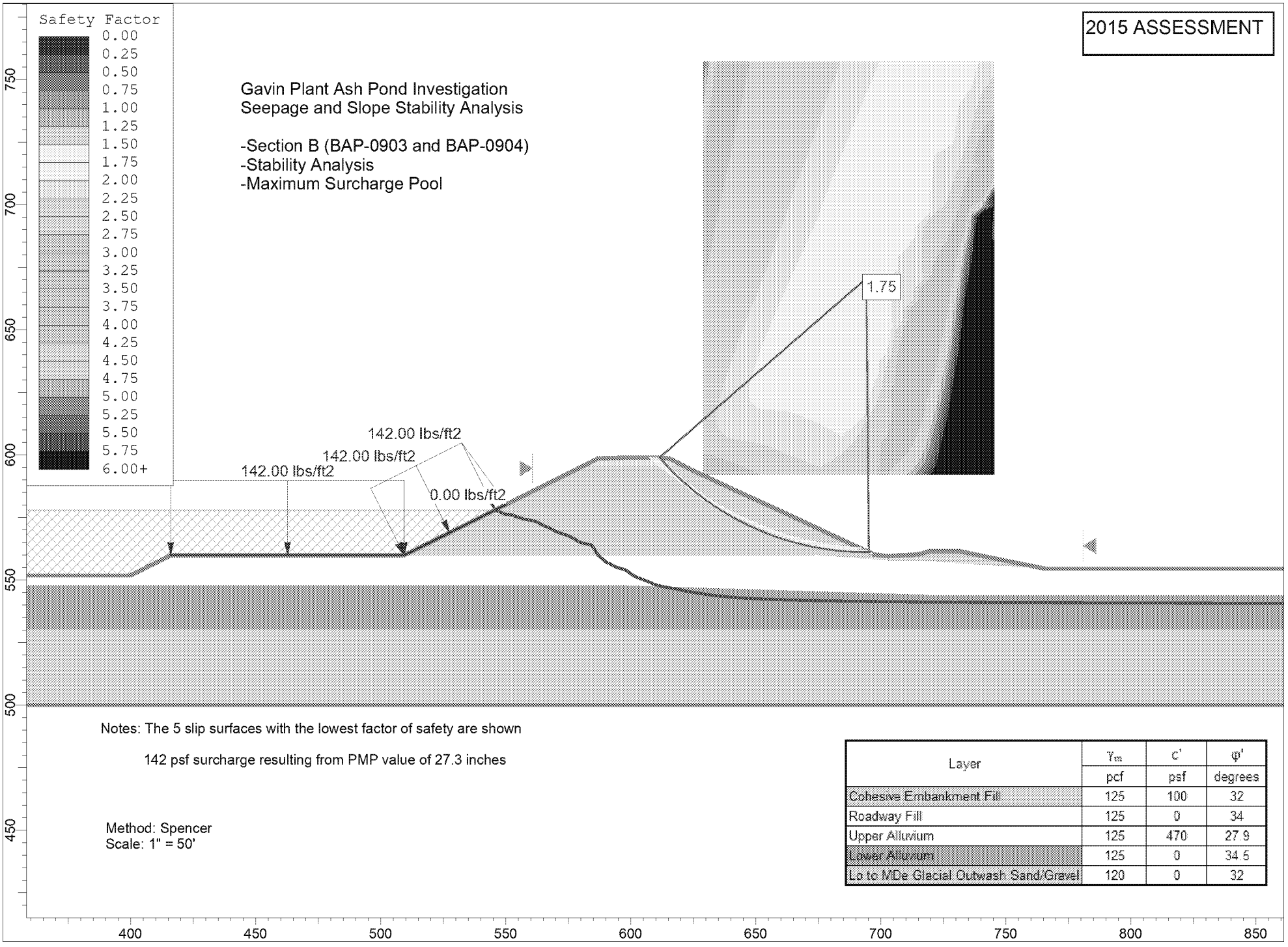


PLATE 18

Appendix V - Limit Equilibrium & Liquefaction Analysis



Layer	γ_m	c'	φ'
	pcf	psf	degrees
Cohesive Embankment Fill	125	100	32
Roadway Fill	125	0	34
Upper Alluvium	125	470	27.9
Lower Alluvium	125	0	34.5
Lo to MDe Glacial Outwash Sand/Gravel	120	0	32

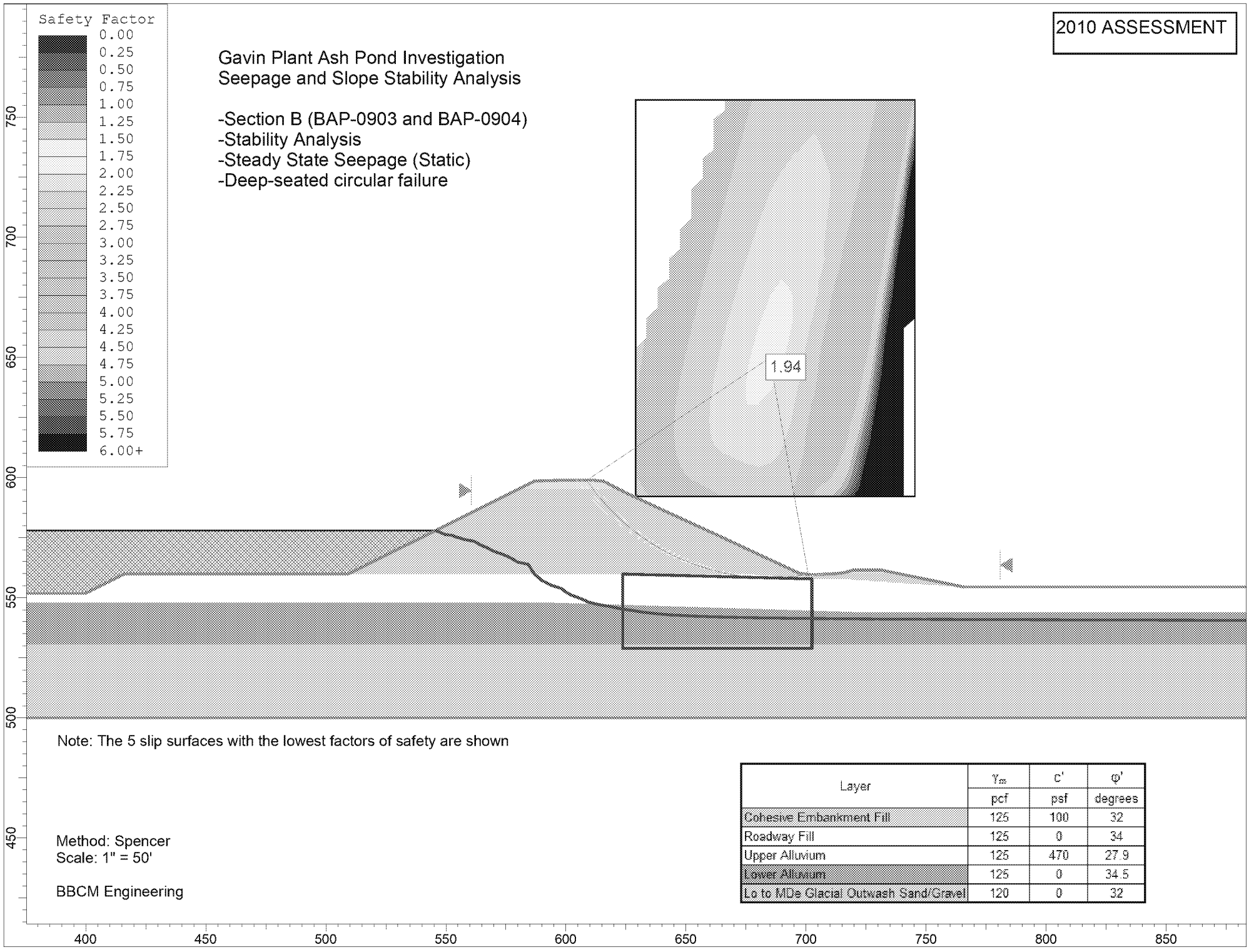


Notes: The 5 slip surfaces with the lowest factor of safety are shown

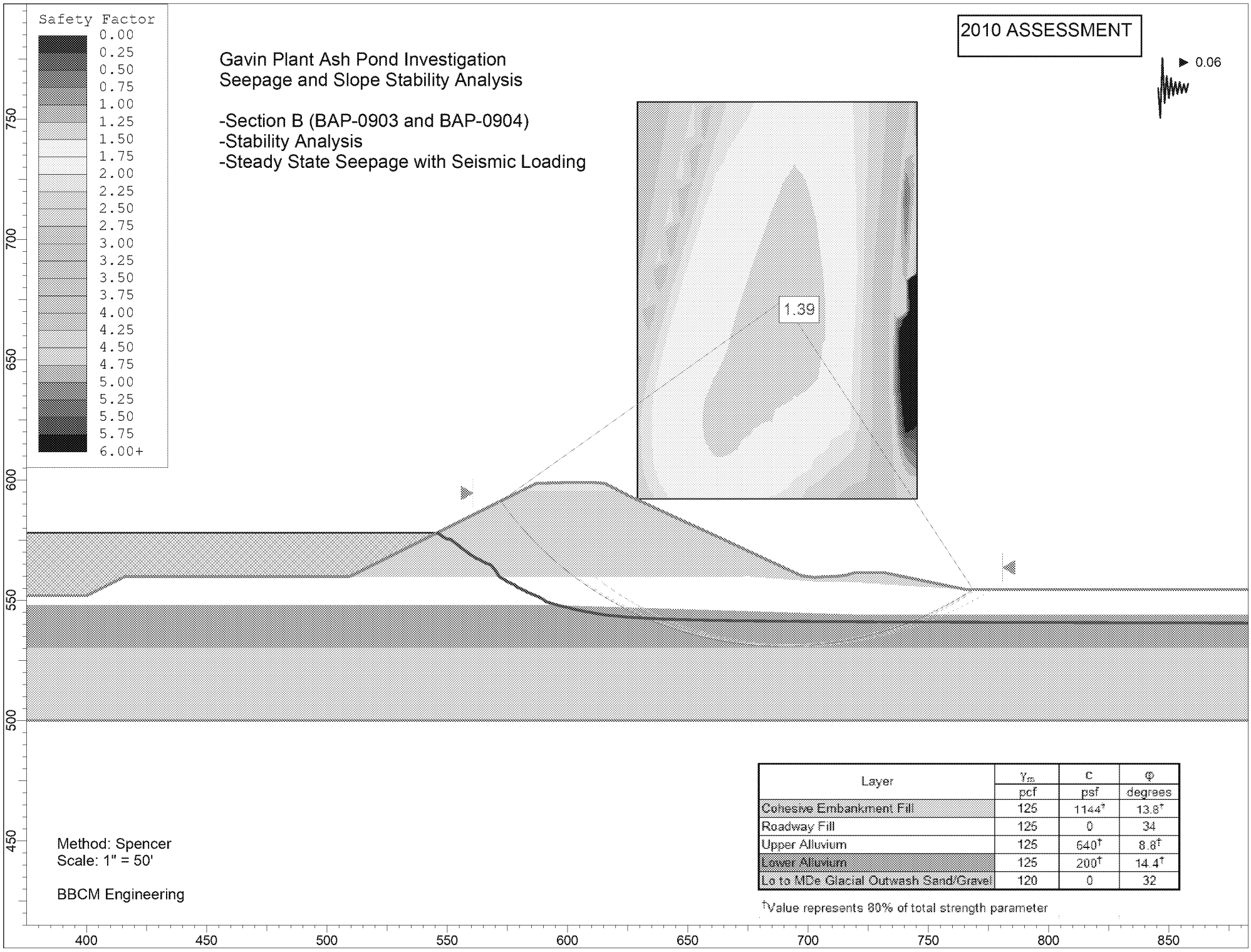
142 psf surcharge resulting from PMP value of 27.3 inches

Method: Spencer
Scale: 1" = 50'

Layer	γ_m	c'	φ'
	pcf	psf	degrees
Cohesive Embankment Fill	125	100	32
Roadway Fill	125	0	34
Upper Alluvium	125	470	27.9
Lower Alluvium	125	0	34.5
Lo to MDe Glacial Outwash Sand/Gravel	120	0	32



Layer	γ_m	c'	φ'
	pcf	psf	degrees
Cohesive Embankment Fill	125	100	32
Roadway Fill	125	0	34
Upper Alluvium	125	470	27.9
Lower Alluvium	125	0	34.5
Lo to MDe Glacial Outwash Sand/Gravel	120	0	32



Gavin Plant Ash Pond Investigation
Seepage and Slope Stability Analysis

-Section B (BAP-0903 and BAP-0904)
-Stability Analysis
-Steady State Seepage with Seismic Loading

Layer	γ_m	c	φ
	pcf	psf	degrees
Cohesive Embankment Fill	125	1144†	13.8†
Roadway Fill	125	0	34
Upper Alluvium	125	640†	8.8†
Lower Alluvium	125	200†	14.4†
Lo to MDe Glacial Outwash Sand/Gravel	120	0	32

†Value represents 80% of total strength parameter

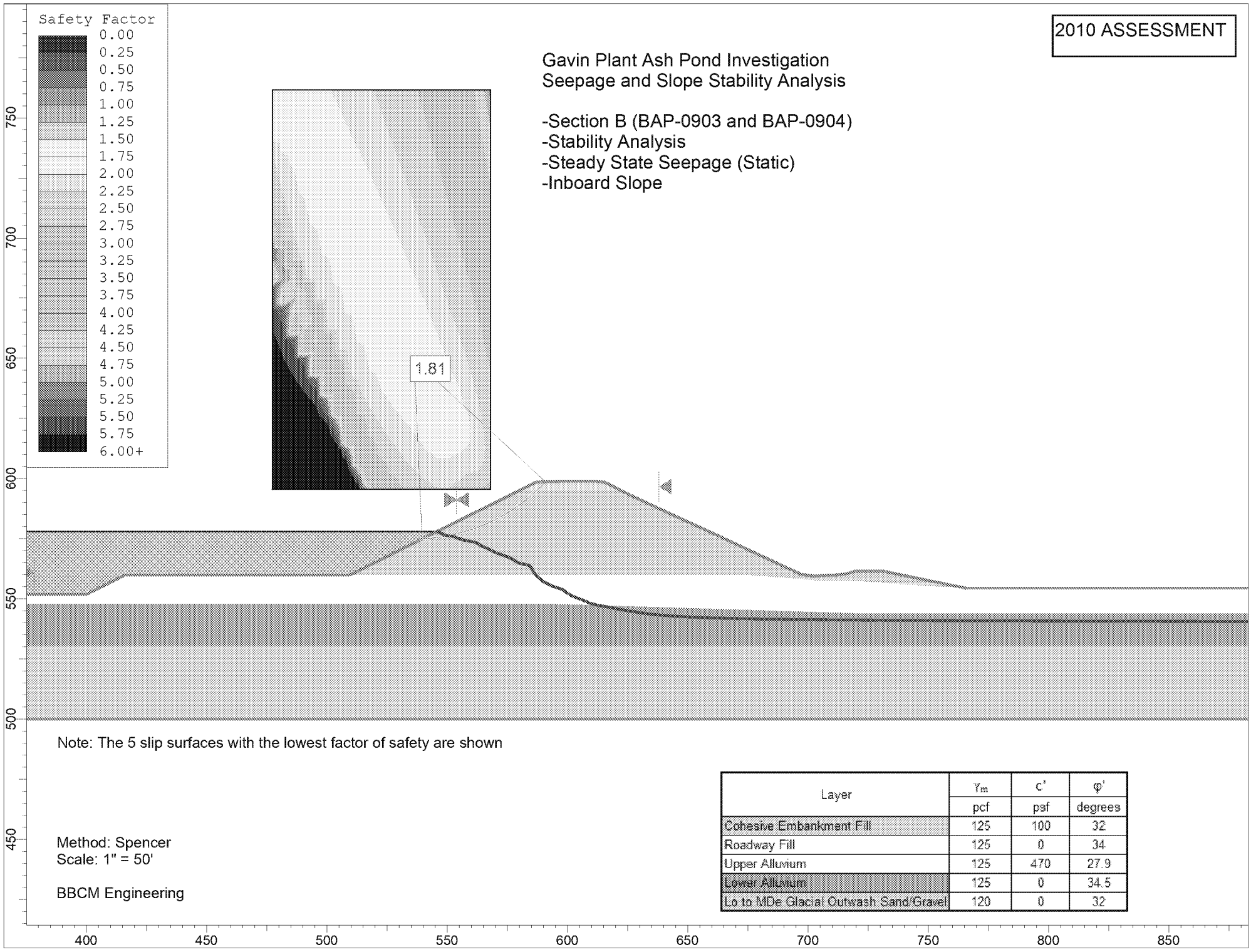
Method: Spencer
Scale: 1" = 50'

BBCM Engineering

2010 ASSESSMENT

Gavin Plant Ash Pond Investigation
Seepage and Slope Stability Analysis

-Section B (BAP-0903 and BAP-0904)
-Stability Analysis
-Steady State Seepage (Static)
-Inboard Slope

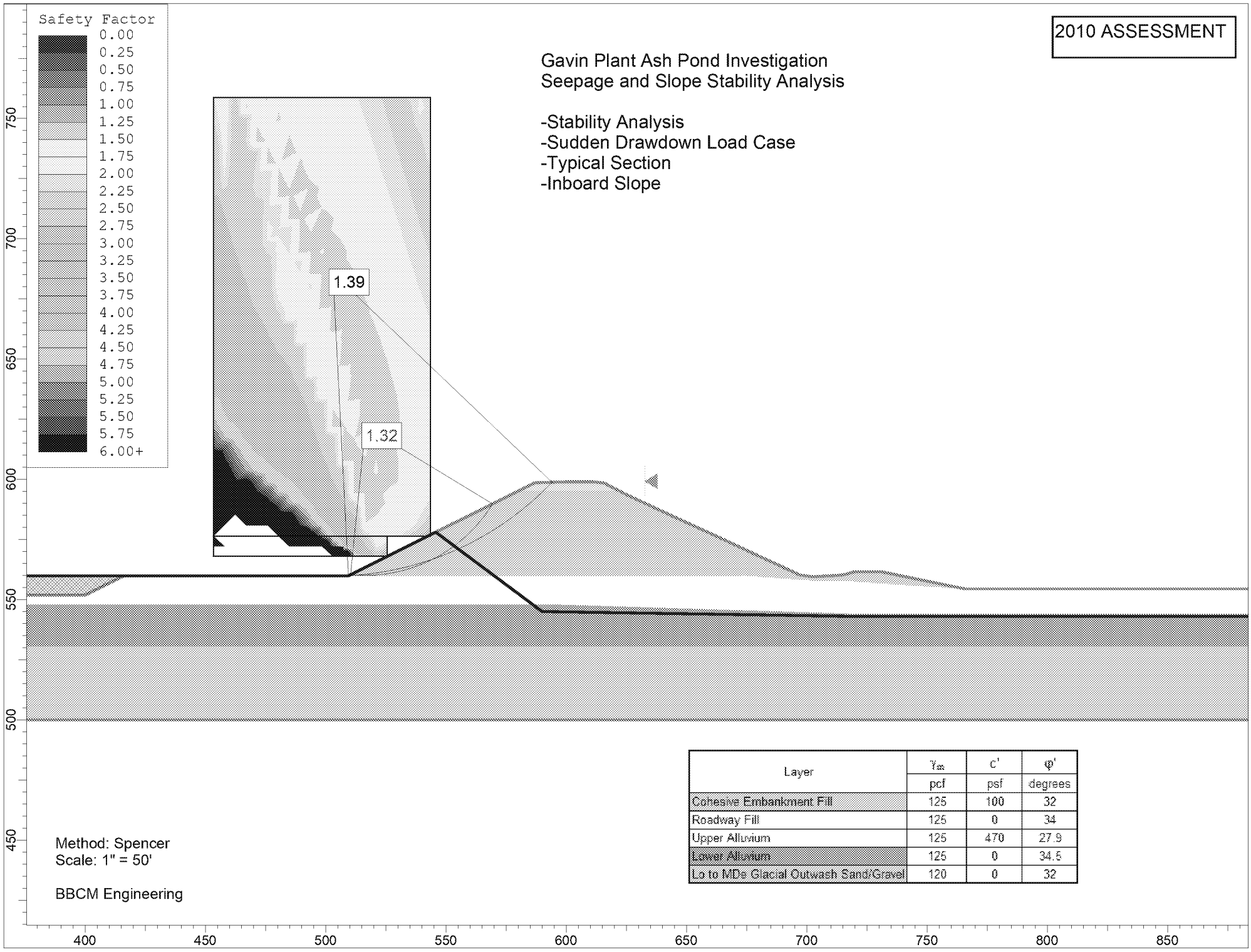


Note: The 5 slip surfaces with the lowest factor of safety are shown

Layer	γ_m	c'	φ'
	pcf	psf	degrees
Cohesive Embankment Fill	125	100	32
Roadway Fill	125	0	34
Upper Alluvium	125	470	27.9
Lower Alluvium	125	0	34.5
Lo to MDe Glacial Outwash Sand/Gravel	120	0	32

Method: Spencer
Scale: 1" = 50'

BBCM Engineering



2010 ASSESSMENT

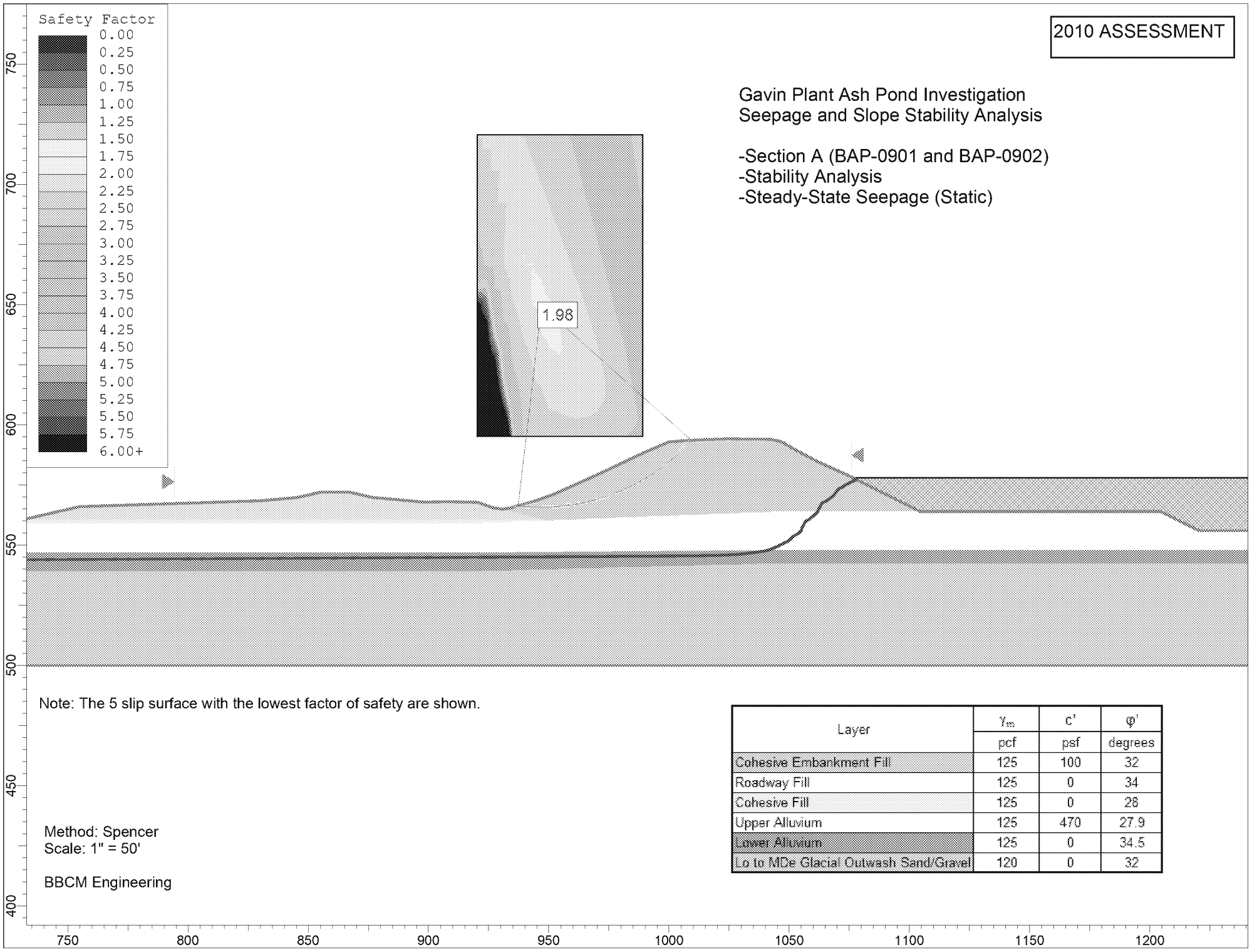
Gavin Plant Ash Pond Investigation
Seepage and Slope Stability Analysis

-Stability Analysis
-Sudden Drawdown Load Case
-Typical Section
-Inboard Slope

Layer	γ_m	c'	φ'
	pcf	psf	degrees
Cohesive Embankment Fill	125	100	32
Roadway Fill	125	0	34
Upper Alluvium	125	470	27.9
Lower Alluvium	125	0	34.5
Lo to MDe Glacial Outwash Sand/Gravel	120	0	32

Method: Spencer
Scale: 1" = 50'

BBCM Engineering



2010 ASSESSMENT

Gavin Plant Ash Pond Investigation
Seepage and Slope Stability Analysis

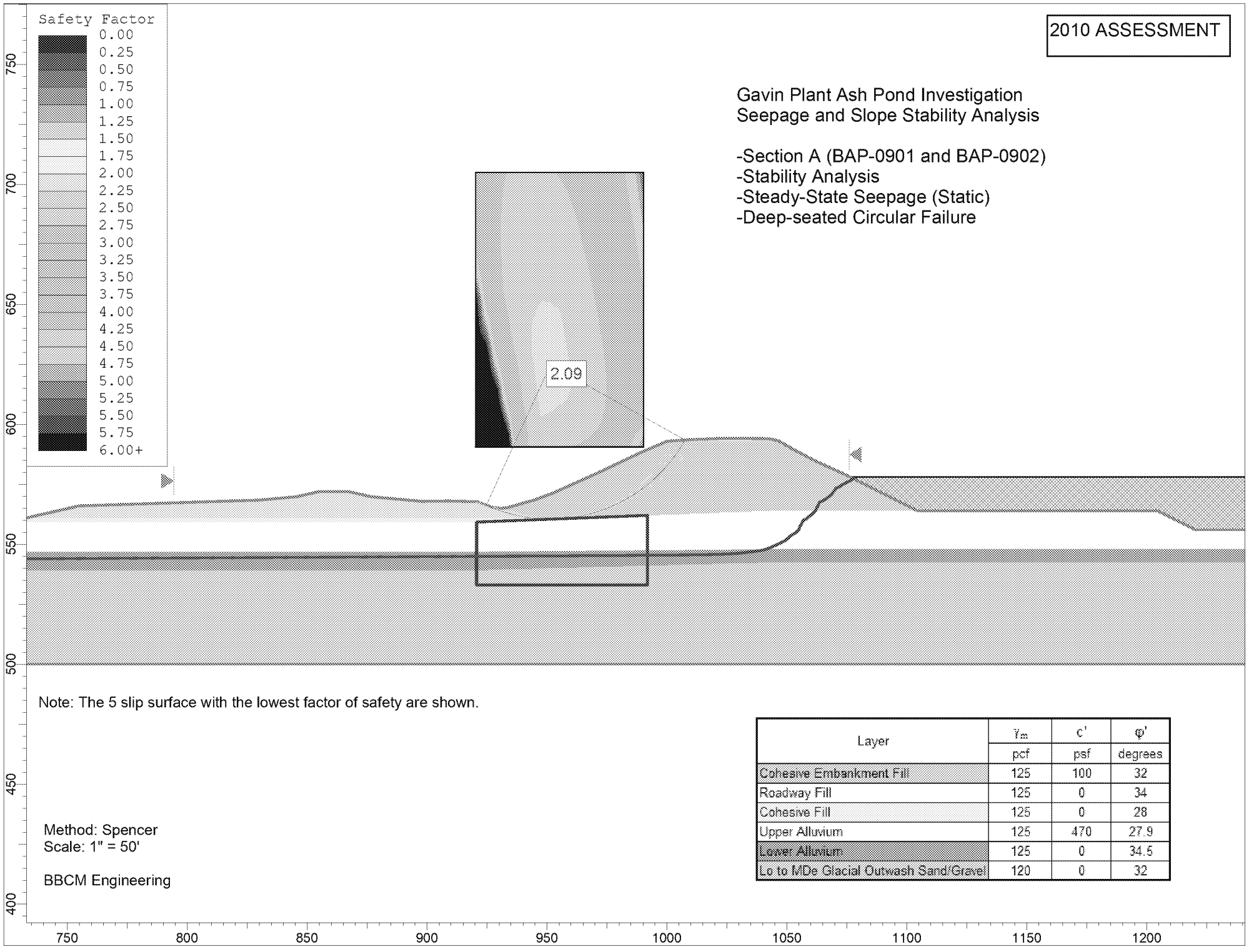
-Section A (BAP-0901 and BAP-0902)
-Stability Analysis
-Steady-State Seepage (Static)

Note: The 5 slip surface with the lowest factor of safety are shown.

Layer	γ_m	c'	φ'
	pcf	psf	degrees
Cohesive Embankment Fill	125	100	32
Roadway Fill	125	0	34
Cohesive Fill	125	0	28
Upper Alluvium	125	470	27.9
Lower Alluvium	125	0	34.5
Lo to MDe Glacial Outwash Sand/Gravel	120	0	32

Method: Spencer
Scale: 1" = 50'

BBCM Engineering



2010 ASSESSMENT

Gavin Plant Ash Pond Investigation
Seepage and Slope Stability Analysis

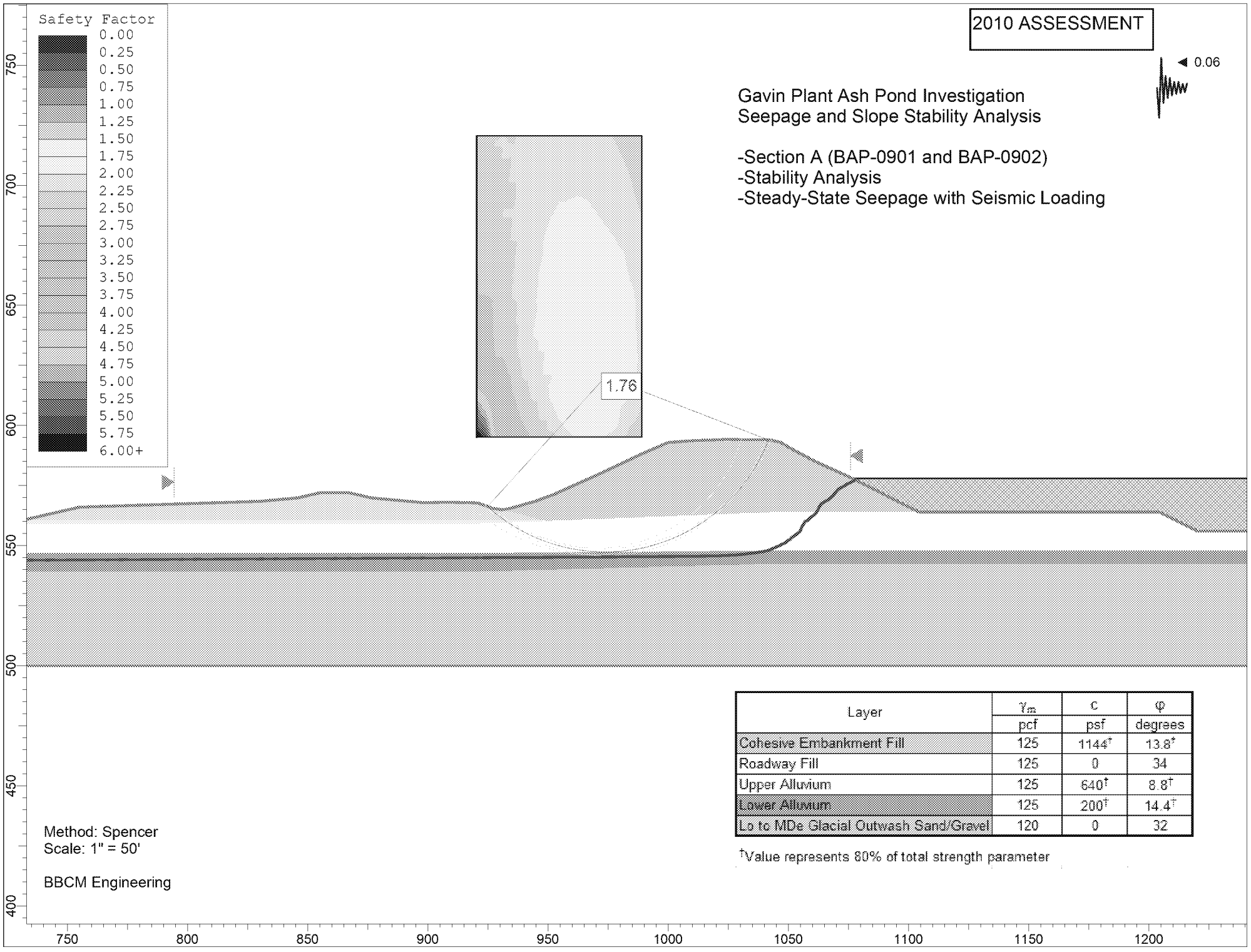
-Section A (BAP-0901 and BAP-0902)
-Stability Analysis
-Steady-State Seepage (Static)
-Deep-seated Circular Failure

Note: The 5 slip surface with the lowest factor of safety are shown.

Layer	γ_m	c'	φ'
	pcf	psf	degrees
Cohesive Embankment Fill	125	100	32
Roadway Fill	125	0	34
Cohesive Fill	125	0	28
Upper Alluvium	125	470	27.9
Lower Alluvium	125	0	34.5
Lo to MDe Glacial Outwash Sand/Gravel	120	0	32

Method: Spencer
Scale: 1" = 50'

BBCM Engineering



Layer	γ_m	c	φ
	pcf	psf	degrees
Cohesive Embankment Fill	125	1144†	13.8†
Roadway Fill	125	0	34
Upper Alluvium	125	640†	8.8†
Lower Alluvium	125	200†	14.4†
Lo to MDe Glacial Outwash Sand/Gravel	120	0	32

†Value represents 80% of total strength parameter

Fine Grained Soil Liquefaction Screening
Gavin Bottom Ash Pond

Layer: EMBANKMENT FILL

BORING		SAMPLE DEPTH I.D.	NATURAL MOISTURE CONTENT	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTIC INDEX %	GRAVEL %	SAND %	SILT %	CLAY .002 mm %	SILT/CLAY %	USCS CLASSIFICATION	Fines Content and Plasticity Index Screening			
														% Passing		Is Soil Sample Liqefiable (meets all three criteria)
													LL < 35	0.005 < 15(*)	WC > 0.9LL	
BAP-0901		7.5	20	41	22	19	0	8	65	27	92	LEAN CLAY CL	No	No	No	No
BAP-0901		12.75	23	48	23	25							No	-	No	No
BAP-0901		17.25	22	53	25	28	0	7	61	32	93	FAT CLAY CH	No	No	No	No
BAP-0901		19.75	21	42	22	20	0	9	59	32	91	LEAN CLAY CL	No	No	No	No
BAP-0901		26.75	16	34	17	17	0	14	60	26	86	LEAN CLAY CL	Yes	No	No	No
BAP-0902		7.75	20	41	20	21							No	-	No	No
BAP-0903		4.75	23	38	21	17							No	-	No	No
BAP-0903		11.25	22	42	21	21							No	-	No	No
BAP-0903		15.75	23	52	24	28	0	6	57	37	94	FAT CLAY CH	No	No	No	No
BAP-0903		21.75	21	30	18	12							Yes	-	No	No
BAP-0903		27.75	19	41	22	19							No	-	No	No
BAP-0903		34.25	19	44	22	22	0	12	58	30	88	LEAN CLAY CL	No	No	No	No
BAP-0905		4.75	18	38	20	18							No	-	No	No
BAP-0905		12.25	20	43	23	20	0	4	63	32	95	LEAN CLAY CL	No	No	No	No
BAP-0905		15.25	22	44	24	20							No	-	No	No
BAP-0905		21.25	21	40	23	17	0	11	58	31	89	LEAN CLAY CL	No	No	No	No
BAP-0905		26.25	18	39	19	20	0	11	59	30	89	LEAN CLAY CL	No	No	No	No
BAP-0907		4.75	22	41	21	20							No	-	No	No
BAP-0907		9.25	17	34	18	16							Yes	-	No	No
BAP-0907		13.75	18	32	16	16	0	24	54	22	76	LEAN CLAY with SAND CL	Yes	No	No	No
BAP-0907		17.75	20	35	20	15	0	19	42	39	81	LEAN CLAY with SAND CL	No	No	No	No
BAP-0907		26.25	20	41	20	21							No	-	No	No
BAP-0907		34.25	19	52	24	28	2	10	55	34	89	FAT CLAY CH	No	No	No	No
BAP-0908		14.25	19	34	19	15	0	16	59	26	85	LEAN CLAY with SAND CL	Yes	No	No	No

(*) by comparison to % Passing .002 mm