PRE-DESIGN INVESTIGATION REPORT

PROPOSED SOLAR REDEVELOPMENT PROJECT

FORMER BAUXITE RESIDUE DISPOSAL AREAS

Operable Unit 1, North Alcoa Site

East St. Louis, Illinois

Prepared for:

Restoration Land Development Company, LLC
Wellesley, MA

Prepared by:

AMEC Environment & Infrastructure, Inc.
800 N. Bell Avenue, Suite 200
Pittsburgh, Pennsylvania 15106
(412) 279-6661

REV. 1 – April 9, 2012

Project No. 3410100782.10.2

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This report was prepared by the staff of AMEC Environment & Infrastructure, Inc. under the supervision of whose signature(s) appear hereon.

FOR

Pieter J. DePree, P.E.
Principal Engineer

Pat Pontoriero
Vice President, Project Manager

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LIST OF ACRONYMS AND ABBREVIATIONS

AMEC	AMEC Environment & Infrastructure, Inc.
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
COC	Chain of Custody
CPT	Cone Penetration Test
EPA	US Environmental Protection Agency
OU-1	Former Alcoa East St. Louis Operating Unit 1 (the Site)
gINT	Geotechnical Data Presentation Software
GPS	Global Positioning System
HASP	Health and Safety Plan
IBC-2006	International Building Code, 2006 Edition
IEPA	Illinois Environmental Protection Agency
Kips	Kilo-Pounds (1,000 lbs)
Ksf	Kips per square foot
M&TE	Measuring and Test Equipment
MSDS	Material Safety Data Sheet
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety and Health Agency
OW	Observation Well
PGA	Peak Ground Acceleration
PM	Project Manager
Psf	Pounds per Square Foot
QA	Quality Assurance
ReMi	Refraction Microtremor
RI, RIR	Remedial Investigation, RI Report
SPT	Standard Penetration Test
SSI	Soil Structure Interaction
USACE	US Army Corps of Engineers
WI	Work Instruction

EXECUTIVE SUMMARY

AMEC Environment & Infrastructure, Inc. (AMEC) has completed the Pre-Design Investigation for the installation of a two foot bridging layer and related work (Remedial Action Alternative No. 2 [RAA-2]) as well as the potential future development of a utility scale solar project at the Former Alcoa East St. Louis Operable Unit 1 (OU-1 or "Site") in East St. Louis, Illinois. The work was completed in accordance with our proposal dated August 18, 2011. Following are salient observations and conclusions from the project. The full text of the report as well as attachments and referenced documents should be reviewed for further discussion of these items.

1. Based on the data generated during the Field Test Strip and Test Load Program and this Pre-Design Investigation, installation of a two-foot bridging layer over the Residue Disposal Area (RDA) surfaces will be feasible, with sufficient long term stability to be a final remedy for the site. The bridging layer will provide an acceptable and stable platform to support solar panels should future solar redevelopment of the site occur.

2. Bauxite residue, unlike other waste fills such as municipal solid waste, does not contain significant organic or other materials that degrade and lose substantial volume over time due to chemical, physical, or biological processes. Therefore, differential settlement issues that are associated with typical solid waste landfills are not as much of a concern at this site.

3. The field exploration included site reconnaissance, soil test borings (some finished as piezometers), Cone Penetration Test (CPT) soundings, test pits, and Refraction Microtremor (ReMi) traverses. In addition, elevation readings of the test load installed in AMEC's earlier test strip installation were taken. The various investigative methods provide complimentary information that offset some of the limitations inherent of each method.

4. Following are some of the key findings from the geotechnical testing completed during this investigation. These findings, along with the data presented in this report, will be used by our engineers to complete final design of RAA-2. Final design will consider and accommodate the potential construction and operation of a future utility scale solar project at the Site.

    a. CPT correlations to Overconsolidation Ratio (OCR) indicate that most of the residue is slightly to substantially overconsolidated with respect to current loading. Addition of the relatively minor additional load of the bridge lift (2 feet of soil or about 250 psf), 6 inches of gravel (about 50 psf), and panels (equivalent to a distributed load of less than 50 psf) are unlikely to trigger significant additional consolidation of the residue and, therefore, settlement.

    b. The test load data indicate less than 2 inches of settlement under a substantially greater load (about 1,000 psf over a significant area or roughly 3 times that expected from the remedy and panels). CPT data from near the test load indicate that the test load was constructed over residue deposits as weak/soft as any on the Site. Thicker residue deposits in RDA 1 showed significantly greater strength parameters based on CPT.

c. Long term settlement is expected to be slightly greater toward the central portion of the RDAs (underlain by fine grained residue) than under perimeter areas near the dike. Therefore, differential settlement is not expected to interfere with drainage, which is designed to be toward the center of the pond.

d. The method of residue placement would have created relatively uniform conditions with significant change in the profile only possible over significant horizontal distances. Therefore, differential settlement under a 40 foot panel length should be 1 percent or less over the life of the project (~50 years). We understand that such differential settlement is tolerable for the panels and this magnitude of gradual settlement will not significantly damage the earth bridging layer.

1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC) has completed this Pre-Design Investigation for the installation of the bridging layer (Remedial Action Alternative No. 2 [RAA-2]) as well as the potential future development of a utility scale solar project at the Former Alcoa East St. Louis Operable Unit 1 (OU-1 or "Site") in East St. Louis, Illinois. The work was completed in general accordance with our proposal dated August 18, 2011.

Prior to completing this Pre-Design Investigation (PDI), AMEC completed work associated with placement of field scale strips of bridging material (test strips) and a conical test load at the Site. That work was completed in accordance with the Field Test Strip Investigation Work plan dated September 2, 2011 (approved by USEPA in a letter dated September 21, 2011). The report for that work, titled "Field Test Strip and Test Load Program Report, Operable Unit 1, North Alcoa Site, East St. Louis, IL" (AMEC, November 18, 2011) was previously submitted to EPA. EPA comments on that report were generated and responses to comments were provided to EPA on January 5, 2012.

1.1 SITE DESCRIPTION

The OU-1 Site is located near the eastern edge of East St. Louis. It is a roughly triangular shaped parcel, bounded on the southeast by the Alton and Southern Railroad (an active double track line), on the southwest by outparcels along Missouri Avenue (SR 15) formerly occupied by the Alcoa Plant, on the northwest by parcels fronting on North 29th Street, and on the north by Lake Drive. The general area is relatively level at elevations ranging around 415 to 420 feet. The Site is characterized by a large central mound comprising the three Residue Disposal Areas RDAs and stockpiles of gypsum of generally lesser size. A topographic site/exploratory location plan is provided as **Figure 1**. **Figures 2-8** provide subsurface cross sections that are based on data generated during this investigation.

1.2 SITE HISTORY

Alcoa formerly operated a bauxite refinery in East St. Louis from the early 1900's to the late 1950's. Documentation of details of many aspects of the operation is not available. The following is based on discussions with, and documents provided by, Alcoa as well as our experience with similar bauxite refining operations.

The operation removed aluminum from crushed bauxite using caustic liquor. The remaining material, termed "residue," generally would have consisted of sand-sized or smaller particles of bauxite minerals other than aluminum. Residue was stored in several areas, know as (RDAs), which were natural depressions related to Pittsburg Lake (an oxbow lake) and surrounding areas. Later, RDAs were expanded above grade by constructing perimeter dikes and filling the interior with residue. Perimeter dikes were constructed using other by-products of Alcoa's operation, either anhydrite ($CaSO_4$) or gypsum ($CaSO_4 \cdot 2H_2O$).

Residue was likely placed in the RDAs hydraulically, in a slurry of caustic liquor, which generally would have resulted in segregation and deposition of the sand size particles in the area near the residue outfalls (commonly known as mud "drops") and deposition of the finer grained portion more generally across the interior of the RDAs. The sand fraction of bauxite residue is generally small, representing only 10 to 20 percent of the total residue volume. Typically, liquor would have been decanted from one section of the RDA, and no drops would have been operated on the perimeter near the decant area. Piping and drops would generally be located along the perimeter dikes initially, though extension into the interior over sand deposits may have occurred as the RDA was filled. Access over the fresh residue fines is significantly more difficult, so extension of mud drops far from the dikes is less likely.

RDAs were likely filled from several drops, probably used alternately during the filling operation so that sand deposited near one drop may later have been covered by fines from a more distant drop. Only scattered remnants of the piping systems remain and the exact locations of the drops at the East St. Louis site are unknown. Sand deposits are likely concentrated near the dikes and sand may be more or less interbedded with fines. The residue in central areas of the RDAs and in some perimeter areas away from drops locations likely contains little sand.

By the late 1950s, three RDAs had been largely filled with residue and production of alumina and residue was terminated. These RDAs were variously named during the Alcoa operation as RDAs 1, 2, and 3 or "Old Pond", "Brown Mud Pond", and "Red Mud Pond", respectively. During the Remedial Investigation (RI), the site was divided into four investigative block (IB) areas (a total of 12 investigative sub-blocks) based on former or current Site land use, habitat, and other similar characteristics. Following is a list of the Investigative Blocks (IBs) by RDA that were the part of this PDI and located partially or wholly within OU-1:

Residue Disposal Areas

- IB-1a – RDA 1 (The Old Pond)
- IB-1b – RDA 2 (The Brown Mud Pond)
- IB-1c- RDA 3 (The Red Mud Pond)

IB-2 – Gypsum Dike Areas

IB-3 – Other Areas of Alcoa Activities

- IB-3b – Redevelopment Area (a southern parcel is now owned by John Paule Metal Recycling)

IB-4 – Other Areas of North Alcoa Site

- IB-4a – North Wet Area
- IB-4b – Triangle Wet Areas
- IB-4d – Berm Wet Area

Chronologically, 1a appears to be the oldest, followed by 1c. 1b is not evident on a 1940 aerial photograph and 4a does not appear to have been raised above the former lake level at that time. Area 4a appears to have been used for deposition of some residue, though it may have been constructed as a stormwater pond and is not generally indicated in Alcoa documents as an RDA.

Over time, fine residue in the central parts of the RDAs consolidated. This resulted in a lowering of the surface elevations at the center relative to areas near the perimeter dikes. All three RDAs and IB-4a continue to retain stormwater in shallow ponds. At some point, probably in the 1930's, residue was mined from the southwest portion of 1a and the perimeter dike was breached, allowing drainage of stormwater from 1a to the southwest. Since then, a network of erosion gullies and drainage channels has formed in the central part of 1a.

Over the years, the surface of much of the residue has desiccated and formed into a thin "crust" of slightly improved material. The pH of some of the surficial residue has apparently decreased to a level that supports the growth of reeds and other vegetation over large portions of the RDAs.

Typically, edge areas of the RDAs have improved or been improved for a distance of about 50 to 300 feet inboard of the perimeter dike crest. This edge area is generally firmer than the central areas and is vegetated with brush and a few trees. The paragraphs below describe the areas in more detail.

1.2.1 RDA 1

RDA 1 covers about 40 acres with the dike crest elevation generally around 460 feet. The southwest and western portions of RDA-1 have been mined in the past, producing substantially lower interior elevations ranging down to 425 feet and leaving slopes in the order of 1 horizontal to 1 vertical. The central portion of the RDA has been eroded, creating steep walled erosion gullies in the red residue. The eroded area extends to the southeast corner (see note on **Figure 1**) of the RDA, and the dike there is cut by a smaller erosion gully which drains toward RDA 2. Several other erosion gullies cut through the northern dike and allow surface drainage to flow north. However, the majority of the surface drains toward the southwest via the large gully system.

The eroded areas are exposed residue; however, the areas north and south of the gullies are thickly vegetated with brush and weeds with scattered trees near the dikes. A small pond is present in the southeast part of the mined area, as noted during recent site visits, and appears on several aerial photos from the past. The gypsum dike surrounding RDA 1 is breached at the west end of the south side, allowing most of the area to drain in that direction (see **Figure 1**). Elsewhere, the gypsum dike is relatively steep, with slopes of about 1.2 or 1.3 horizontal to 1 vertical. The south and east dike toes are in/beneath the surfaces of RDA 1 and 2, respectively.

Aerial photos taken in the late 1930's indicate that while the southwest portion of RDA 1 was being mined, the eastern portion was still being filled with residue (**Figures 9 and 10**). An interior dike (apparently comprised of residue based on site observations in the area) running southeast to northwest separated these areas. The current gully system appears to have formed in the more recently filled eastern portion of RDA 1, with an exit through a breach in the former splitter dike and into the mined southwestern portion.

1.2.2 RDA 2

RDA 2 covers about 50 acres and is bounded by RDA 1 to the northwest, RDA 3 to the northeast, and lower areas (designated as part of IB-3b in the RIR) to the southwest and southeast. The southwest dike has an effective crest elevation of about 443 feet. This dike was reportedly mined for gypsum around 1990, leaving very steep to near vertical slopes up to about 20 feet high in gypsum and dried residue.

The southeast dike has been extensively modified. Gypsum from elsewhere on the Site has been placed over the dike and residue, ostensibly to control dust from the residue surface. These dust control measures have raised the dike crest to approximately elevation 450 feet or higher and extended the inside gypsum dike toe in a gradual slope over the residue for up to about 500 feet into RDA 2.

The tops of two apparent splitter or interior dikes are still evident. A splitter dike with a crest of about 435 feet extends most of the way between RDAs 2 and 3. Another dike, with a crest elevation of about 440 feet, is located parallel to and about 300 feet southeast of the southeast dike of RDA 1. Both interior dikes appear to be comprised of gypsum.

Grades trend down from the dike peaks to about an elevation of 430 feet at the pond located in the northeast portion of RDA 2, near the toe of the interior gypsum slope. No evidence of significant surface drainage out of RDA 2 was noted, indicating that stormwater generally infiltrates into the subsurface. The surface of RDA 2 is generally vegetated with phragmites. Higher areas near the periphery are generally vegetated with brush and larger trees. The gypsum slopes in the southeast, as well as most of the dikes, are sparsely vegetated to bare, with only an occasional tree or shrub. Only small areas of bare residue remain in the interior of RDA 2, these areas are mostly in the south and west.

1.2.3 RDA 3

RDA 3 covers about 40 acres and is bounded on the southwest by RDA 2, on the west by RDA 1, on the southeast by the railroad, and on the north by a low area described in the RIR as 4b. The gypsum slope and dust control measures (similar to those at RDA 2) extend into the southeast portion of RDA 3. The northern dike of RDA 3 arcs around toward the northwest. At the southeast corner of RDA 3, the dike closely encroaches on the railroad right of way, with a steep slope and evidence of past grading. To the north, the dike curves away from the railroad to the northwest. The dike crest is generally about 10 feet above the RDA surface with interior and exterior slopes of about 1.5 horizontal to 1 vertical and a crest of about 452 feet. The RDA slopes gently from the dikes toward the interior, to a low elevation of about 432 feet. As with RDA 2, no significant surface drainage was noted. Some drainage may enter the RDA 2 pond through a densely vegetated area in the west where the splitter dike between RDA 2 and RDA 3 is not evident. RDA 3 is vegetated similarly to RDA 2, though with larger areas of bare residue in a wide arc around the central pond and phragmites area.

1.2.4 IB 4a

IB 4a is a long, narrow area along the northern edge of the Site covering about 25 acres. It is separated from RDA 1 and RDA 3 by a narrow depression, that may formerly have contained a railroad spur track (railroad gulch), and a large windrow of gypsum up to about 25 feet high. IB 4a overlies the northern edge of the former Pittsburg Lake and parts of the dike defining 4a may have been constructed to contain the lake or stormwater. The dike around the north, west, and east sides is generally 10 to 15 feet high with a crest elevation of about 425 feet. It generally does not appear to be comprised of gypsum, as evidenced by the thick vegetation present. The southern dike transitions into the large windrow of gypsum, but the surface elevation of 4a is similar to the surface elevation of the gulch in the west, so that the windrow is not a dike in that area. The vegetation characteristics of IB 4a are similar to those in the neighboring RDAs. However, the highest concentrations of phragmites reeds were present in the southwestern gulch. The eastern end of 4a contains a pond that gradually becomes shallower moving west along the interior. Continuing west along the interior leads to exposed residue.

1.2.5 IB 3b

IB 3b covers wide areas of the Site outside the RDAs. Generally, to the south of RDA 2, 3b comprises areas of significant gypsum stockpiles extending at an elevation of around 420 to 425 feet for about 300 feet out from the RDA 2 dike toe toward the southeast and southwest. Beyond this, the gypsum generally ends in a steep toe and the grades are around 410 to 415 feet with thick vegetation. Along the southeast Site boundary is a further gypsum stockpile about 1,400 feet long and up to 250 feet wide with a top elevation of about 420 to 425 feet. To the west, the gypsum continues along the former RDA 1 and RDA 2 southwest dikes, with lower areas to the southwest.

1.2.6 IB 4b

IB 4b covers a roughly triangular area between the railroad tracks to the east, IB 4a to the north, and RDA 3 to the southwest. The area is at elevation 415 or below and was generally flooded with shallow water during our site visits. The area is thickly vegetated with grasses and reeds. A windrow of gypsum about 15 feet high runs parallel to the northeast dike of RDA 3 in IB 4a.

Area 4b extends into the railroad gulch. This gulch is sparsely vegetated and flooded to approximately the junction of the north dikes of RDA 3 and RDA 1, then densely wooded along the toe of the RDA 1 north dike. The thick vegetation includes small trees on the better drained areas, and reeds in the less well drained areas. This type of vegetation also extends around the west side of RDA 1, which is also a former railroad corridor and where some railroad ties were observed during our site visits.

1.3 CONCEPTUAL REMEDIATION PLAN

In concept, the proposed remedy, RAA-2, will consist of the following steps:

1. Stabilize the surfaces of RDAs 1, 2, and 3. This will involve placing a "bridge lift" of fill over the residue and avoiding excavation so as not to disturb the existing residue "crust".

2. Clear vegetation and shape (grade) the edge areas of the RDAs. These areas appear to be stable under construction equipment and, therefore, will not require "bridging"; however, these areas will be covered with clean fill to meet ARARs.

3. Fill the formed drainage gullies in RDA 1 with granular fill to allow grading of the area to surrounding residue surface elevations and create a relatively level surface.

4. Make improvements to stormwater handling at the Site. Existing ponds on/in RDA 1, RDA 2, and IB 4a will remain and will not be bridged or otherwise disturbed. The stormwater ponds will be further defined by the installation of the bridging layers surrounding the storm water detention areas. Minor excavation into the residue may be made to create ditches or install piping to handle required storm water flows. The RDA 1 pond will require a dike at the southwest corner of the mined area and will be further defined by buttresses against existing, steep, residue slopes surrounding the former mined area.

5. Buttress and flatten existing dikes and residue slopes in steeper segments to create relatively uniform slopes of about 3 horizontal to 1 vertical. The bulk of dike regrading will make use of anhydrite/gypsum materials stockpiled around the Site.

6. Place a vegetative support layer of imported soil over the gypsum on regraded dikes and other areas that will be covered with a 2-ft. soil cover to enable establishment and maintenance of erosion control vegetation.

The most significant loadings associated with RAA-2 will occur from operation of the grading equipment during installation of the dike buttresses and bridging layer. Construction traffic required for placement of bridging material and gravel over the softer residue areas will represent the most significant loading over the residue.

1.4 CONCEPTUAL FUTURE SOLAR DEVELOPMENT PLAN

There are plans to install a utility scale solar project at the site after RAA-2 installation has been completed. Please note that the proposed solar development is not required as part of RAA-2. The future solar development plan takes advantage of the higher elevations of the site and broad expanses of the RDAs to facilitate the installation of solar arrays. This will involve the installation of a woven geotextile separation fabric and a 6-inch thick surficial layer of gravel over the bridge lift placed during the remediation to maintain a working surface for placement, operation, and maintenance of the panels and related equipment.

Solar arrays will likely consist of panels in groups angled to face south and supported on above ground frames. Compressive panel loads will be relatively minor (equivalent to a distributed load of less than 50 psf), with the primary loads coming from ballasts required to offset wind loads on the panel arrays. Such ballasts are concrete masses roughly analogous to large parking lot tire stops; therefore ground pressures will be minimal. Panels may be adjusted in the field and can tolerate differential settlement in the range of 1 percent or more across a single panel array. Solar arrays will be connected with flexible cabling and conduits to transformers and switchgear. The arrays must be protected from excessive dust, chemical attack, flooding, and vandalism. They will require infrequent routine maintenance, likely involving only light vehicular (pickup truck) and foot traffic.

The remedy will provide a stable base for construction of the solar project. Loads and traffic associated with delivery, installation, and maintenance of panels and frames will be relatively insignificant compared to the loads related to installation of the bridging layer during remedial construction.

2.0 EXPLORATORY METHODS

2.1 PURPOSE

The purpose of this work effort was to assess the general subsurface conditions as they related to constructability, feasibility, and long term stability of RAA-2, as well as the potential future construction and operation of a utility scale solar project at the Site. Our findings, along with the data presented in this body of report and the Appendices, will be used by our engineers to complete final design of RAA-2. Final Remedy design will consider and accommodate the potential construction and operation of a future utility scale solar project at the Site.

2.2 HEALTH AND SAFETY PLAN

AMEC developed a Site-specific Health and Safety Plan (HASP) for this work. The HASP addressed the potential hazards associated with the work and was followed by AMEC employees and subcontractors.

2.3 FIELD EXPLORATION

The field exploration included site reconnaissance, soil test borings (some finished as piezometers), Cone Penetration Test (CPT) soundings, test pits, and Refraction Microtremor (ReMi) traverses. In addition, final elevation readings of the test load installed in AMEC's earlier test strip installation were taken. The various investigative methods provided complimentary information that offset some of the limitations inherent of each method. **Table 1** provides a summary of information gathered in borings and piezometers. **Figure 2** depicts the location of interpreted subsurface cross sections we have developed, which are shown on **Figures 3 through 8**. Data from the methods must be interpreted using geotechnical engineering principles, recognizing the limitations of each method to develop subsurface logs and profiles.

2.3.1 Soil Test Borings

Twenty six soil test borings designated B-1 through B-22, B-7A, B-14A, B-17A, and B-18A, were advanced at the approximate locations indicated on the Subsurface Exploration Location Plan (**Figure 1**). Borings were advanced to depths ranging from 15 to 65 feet below existing grades. Borings were generally terminated in natural alluvial clay soils. If borings penetrated into natural alluvial sand, boreholes were grouted to reduce the potential for infiltration into the natural sands. Otherwise, boreholes were backfilled with drill cuttings.

Borings were advanced using hollow stem augers in drier materials and rotary drilling (using drilling mud) at locations where shallow groundwater, weak residue, or flowing sands were of concern. Standard Penetration Tests (SPTs) were conducted at intervals in all the borings to assess the consistency of subsurface materials and obtain disturbed samples. Vane shear tests were conducted in selected boreholes. Relatively undisturbed (UD) samples were obtained from selected strata in specified borings.

Soil borings allow for collection of samples and performance of vane shear tests at depth. SPTs are effective in sands and harder/firmer materials such as gypsum, but relatively crude and generally not valuable in assessing strength properties of very soft materials such as fine residue. Drilling techniques can penetrate deeper than test pits and through denser materials than Cone Penetration Tests (CPTs). Borings were, therefore, generally conducted at the periphery of, or outside the RDAs, where higher consistency materials such as gypsum, sand, and natural soils were expected, while CPTs were performed in the interior portions of the RDAs. Groundwater levels can be measured in open boreholes, though the levels are somewhat less reliable than levels measured in piezometers due to instability of borehole walls. Logs for each soil test boring are included in **Appendix A**.

2.3.2 Piezometers

Piezometers PZ-1 through PZ-4 were installed by water jetting 1 inch diameter PVC pipe into very soft residue near the test strips. No sampling was conducted during the installation of these 4 piezometers. Piezometers PZ-5 through PZ-18 were installed in boreholes used for sampling (SPT and UD) and vane shear testing. Most piezometers were installed in the RDA to provide reliable, stabilized water level readings. **Table 1** provides a summary of conditions encountered in borings drilled for installation of piezometers and logs for each piezometer are included in **Appendix A**.

2.3.3 Cone Penetration Test

CPT probes were advanced in areas where significant residue fines were anticipated. CPT involves pushing a pointed cone into the ground and measuring tip resistance (q_t), pore pressure (u_2), and friction sleeve resistance (fs). Correlations of these parameters to other data allow estimation of soil parameters including classification and undrained shear strength. The CPT does not allow for sample collection, but does collect more continuous data as well as provide greater sensitivity in very soft materials than SPT borings.

CPT does not provide a direct measurement of groundwater levels. The pore pressure measurement is a dynamic pressure measured as the cone is advanced. In clean sands, this may approach the hydrostatic pressure at the depth. However, in soft soils with significant fines, the dynamic pressure is typically greater than hydrostatic in soft soils. In stiff clays or silts, suction may develop at the cone shoulder where the pore pressure measurements are taken, creating low or negative pore pressure readings. The pore pressure transducer may become clogged or drained by suction, so that some data is lost; typically this is indicated by relatively straight lines on the pore pressure plots.

Classification using the cone is based on correlations of tip resistance and friction sleeve resistance. These are useful in relatively thick strata, however, the friction sleeve is 6 inches long and the tip is somewhat ahead of that; so the averaged friction in seams thinner than 6 inches may be misleading as to soil classification.

2.3.4 Test Pits

Test pits are open excavations which present a larger view of shallow subsurface materials and an indication as to the ease of excavation of the materials with the equipment used. They also provide an indication of the short term stability of open excavations.

In November 2010, AMEC excavated 16 test pits (TP-1 through TP-16) using a small rubber tired backhoe. After the backhoe became mired in the residue, additional shallow pits (TP-17 through TP-25) were excavated by hand using a shovel. The main purpose of these pits was to assess the thickness and composition of the shallow residue crust.

During the current effort, AMEC used a larger tracked excavator (John Deere 240D) to excavate additional test pits (TP-26 through TP-38). This larger machine has a longer reach and more power than that of the smaller rubber tired backhoe employed in 2010, which allowed for deeper excavations and excavation through harder materials. Logs for each test pit are included in **Appendix A**.

2.3.5 Vane Shear

The vane shear test involves pushing a four-bladed vane into the subsurface and then rotating it slowly using a torque wrench. This creates a shear failure along the cylindrical surface formed by the outside edge of the vertical blades. The undrained shear strength (s_u) can be calculated from the measured torque for a given blade geometry. For dynamic testing, the vane can be loaded cyclically, to assess whether repeated cyclic loading creates failure at lower strengths than static loading. After the initial failure, the vane is rotated a full revolution to completely fail the shear surface and the residual strength is measured. The ratio of static strength to residual strength provides an indication of soil "sensitivity" or thixotropy.

The vane is only effective in relatively soft, fine grained soils. Sand, sand seams, roots, gravel, or other obstructions can damage the vane, prevent rotation, and create ambiguous results. Vane shear testing was conducted in some of the borings/piezometers and also independently at shallow depths near other points. The majority of the vane testing was in the fine grained residue. Vane results are reported in **Table 2**.

2.3.6 Refraction Microtremor

Refraction Microtremor (ReMi) is a non-intrusive, geophysical method of assessing shear wave velocity profiles of the subsurface. Measurements are taken using a linear array of geophones commonly used for seismic refraction surveys placed at the surface in three foot intervals and using background vibrations (microtremors) from moving trains, road traffic, or other sources to create refraction waves. Background vibrations were augmented using foot traffic and hammer blows, along with moving construction equipment. Interpreted ReMi Shear Wave Velocity Profiles are included in **Appendix A**.

2.3.7 Test Load and Settlement Measurements

A test load was installed during the test strip program. The test load is a conical pile of soil approximately 15 feet high with 2 horizontal to 1 vertical side slopes. It has a volume of about 500 cubic yards and weighs approximately 800 tons. Settlement measurements were taken of the loaded area from prior to placement and periodically since that time. Additional measurements will be taken until the test load material is spread into the bridge lift during remedial construction. Interpreted settlement measurements for the test load are shown in **Figure 12**.

2.4 LABORATORY TESTING

The residue and gypsum materials were tested extensively by Tetra Tech, with results reported in the RI Report (RIR). Testing included moisture content, grain size, plasticity (Atterberg Limits) with a few permeability tests and strength tests (unconsolidated, undrained triaxial shear). These test methods are normally applied to natural soils and represent the physical behavior of the soil. Where material chemistry becomes an important part of behavior, interpretation may be more complex.

To augment the RIR results, AMEC performed laboratory moisture content, grain size, and swell pressure testing as well as conducting some qualitative tests on dynamic properties of the residue. Testing on the gypsum/anhydrite included chemical analysis by X-Ray Fluorescence and drying/burning at various temperatures to disassociate molecular water to assess the relative degree of hydration. The gypsum was also tested for swell magnitude and swell pressures. The following paragraphs discuss the various tests conducted and special conditions relating to the residue and gypsum. **Tables 3A and 3B** provide summaries of Laboratory Results on Residue and Gypsum, including results from the RIR. Laboratory test results from this program are included in **Appendix B**.

2.4.1 Moisture Content

The moisture content test is a routine test that involves preserving a sample from the field at its in-situ moisture content, weighing the wet sample in the laboratory, drying the sample in a controlled temperature oven (105 degrees centigrade), and weighing the dried sample to determine the moisture content. Moisture content can be described as the weight of water (assumed to be the weight lost in drying) to the weight of remaining solids after drying, expressed as a percentage. Moisture is critical to physical soil behavior and significantly impacts strength and compressibility of many soils.

With conventional soils, this test is routine and easily interpreted. However, the characteristics of the residue and gypsum/anhydrite caused some variation in the results. The liquid (moisture content) fraction of the residue was originally caustic liquor, containing dissolved solids that are part of the liquid (moisture content) in-situ, but remain as part of the solid fraction on drying. The original dissolved solids content of the liquor was relatively small and some dilution has likely occurred, so the impact on the moisture content results is likely low. For saturated samples, generally assumed to be any samples collected from below the groundwater level, knowing the moisture content and the specific gravity of the solid particles allow for the determination of the void ratio and dry density of the material. The calculation is not highly sensitive to the specific gravities, which are typically 2.7 to 2.8 for other bauxite residue we have seen.

The gypsum/anhydrite, however, is more complex. Gypsum ($CaSO_4 \cdot 2H_2O$) is anhydrite ($CaSO_4$) that has hydrated at a molecular level. Gypsum, anhydrite, and some intermediate variants form various crystal structures that disassociate water at differing temperatures ranging from about 50 to over 300 degrees centigrade. In any given sample of gypsum material, these crystalline forms are likely mixed and the sample may also contain impurities including free water. Therefore, the moisture content measured in the test may include free water as well as some of the molecularly bound water in the various crystals. However, at only 105 degrees centigrade, which is the temperature used in the standard test, all bound water would not necessarily be liberated from the gypsum samples.

AMEC performed a variation of the moisture content test, using a range of temperatures to assess loss of bound water at various temperatures. Samples were initially dried at 40, then at 105, 150, and finally 500 degrees centigrade. This allowed separation of bound water from crystal structure and an assessment of free water at normal field temperatures.

2.4.2 Plasticity (Atterberg Limits)

Plasticity, which is the tendency of soils to behave plastically on remolding rather than breaking apart, is measured using the Atterberg Limits test. The plastic limit (PL) is the moisture content at which the soil begins to behave plastically while the liquid limit (LL) is the moisture content at which the soil begins to behave like a viscous liquid. The difference between the LL and PL is termed the plasticity index (PI). A standard plot of PI and LL is used to characterize the soil into generally 4 categories: lean or low plasticity clay (CL), inelastic silt (ML), heavy or high plasticity clay (CH), and elastic silt (MH) as part of the unified soil classification system (USCS).

These methods are used to assess the clay-like behavior of the material. Clay is comprised of very small, plate-like particles for which water adhesion to and between particles is more important than other forces acting on the particles, thereby controlling the material's behavior. While the test method provided useful data from a number of the samples taken from borings, unique problems occurred when conducting these tests and interpreting the results on samples of the residue. For the more thixotropic of the residue samples, neither the PL nor LL test procedures are possible as the material liquefies when subjected to the level of disturbance required by the test.

2.4.3 Grain Size

Grain size tests are performed to determine the particle size distribution of soil samples. The grain size distribution of soils coarser than 0.074 mm in diameter is determined by passing the sample through a set of nested sieves. Material less than 0.074 mm in diameter is suspended in water (a hydrometer) and the grain size distribution measured by the rate of settlement. The results are presented in the form of a curve showing the distribution of particle diameters.

Again, these tests provided meaningful data for a number of the samples, while the peculiar behavior of the residue and gypsum materials may have impacted the results of a portion of the tests. The gypsum is a fine grained material, but is cemented with more or less strength into sand, gravel, or larger pieces. The grain size tested with sieves is substantially impacted by the cohesion of these larger pieces. More shaking on the sieves would tend to show a finer grained distribution of gypsum material. In the hydrometer, the finely divided anhydrite will tend to hydrate into gypsum, reducing its specific gravity and rate of settlement.

Residue has similar challenges in that the residue “sand” particles tend to be relatively weak and may break up during the sieve testing. These particles tend to be platy, that is, thin and flat rather than more equi-dimensional. The hydrometer calculation is based on the assumption of spherical particles settling through still water using Stokes’ Law. Chemistry interactions in the residue fines may create flocculation, or agglomeration of smaller particles into larger particles, which settle more quickly. A dispersant is normally added to the hydrometer, but the caustic in the sample may impact the effect of the dispersant.

2.4.4 Swell Pressure

Two samples of gypsum/anhydrite were tested for swell magnitude (free swell) and for swell pressure. The tests are similar in that both are conducted in an oedometer with the gypsum placed dry and then flooded with water. The automated oedometer is set to maintain a constant sample height or volume for the swell pressure test and measures the swell pressure developed. For the free swell test, the sample is confined under only nominal load and allowed to swell.

3.0 SUBSURFACE CONDITIONS

Below the Site surface, various materials are present, including man-made fill materials consisting of bauxite residue, gypsum/anhydrite, and other materials, as well as natural soils. The text in this Section describes these materials and provides a summary of the results of salient testing, which will be used by our engineers to complete final design of RAA-2. Final Remedy design will consider and accommodate the potential construction and operation of a future utility scale solar project at the Site.

3.1 SITE GEOLOGY

The Site is in the floodplain of the Mississippi River, which flows north to south about three miles east of the Site. As such, the natural ground consists of alluvial soils deposited by the river as it meandered in past history. Particle size deposition is generally a function of velocity or energy in the flow, so that fine grained (clayey or silty) deposition typically occurs only in oxbow lakes or backswamp conditions. Flowing water deposits primarily sand or gravel sized materials. Rivers typically create a natural levee along the sides of the channel which contain the channel during normal flows and also act to back up water outside the channel, creating backswamp conditions.

The published surficial geology map for St. Clair County produced by the Illinois State Geologic Survey, dated 2011, indicates that the Site Area is disturbed ground and is underlain by the Cahokia Formation, the Henry Formation, and Limestone Bedrock. Based on that map, the geology of the site can be summarized as follows:

- The Cahokia Formation, Sandy Facies appears to extend under the southern portions of the Site and is described as point bar and natural levee alluvial deposits of Holocene age (less than 12,000 years or since the last ice age), consisting primarily of non-calcareous sands up to about 35 feet thick and capped by about 5 feet of silt and clay. The northern portion of the Site, roughly coincident with the former Pittsburg Lake, is described as the Cahokia Formation, Clayey Facies, which are alluvial deposits of similar age but expected to consist of non-calcareous silty clay deposited in overbank, backswamp, oxbow, and similar quiescent conditions. In broad terms, the Cahokia may extend from about elevation 400 to elevation 370 feet.

- Beneath the Cahokia is the Henry Formation, generally consisting of fine to coarse sands deposited during higher energy periods of glacial outwash in the Wisconsin Episode of about 60,000 to 12,000 years before present. These are reported to contain some calcareous materials (limestone) and to be about 70 feet thick or to about elevation 300 feet.

- Beneath these formations is sedimentary bedrock of Mississippian age (a subdivision of the Paleozoic era which is more than 300 million years old) consisting of limestone, shale, siltstone, and sandstone.

3.2 SITE STRATIGRAPHY

This section provides our interpretation of subsurface conditions at the Site based on the subsurface data and our understanding of site use and development from various maps, aerial photos, plans, discussion with knowledgeable persons, etc. While some of this is not certain, we have used available information to develop a conceptual model of the Site.

The Cahokia Formation deposits left a gently undulating surface with little relief, sloping down very gently from the bluff toward the river. At some point, a meander of the river cut Pittsburg Lake into this surface, but this meander was later cut off. The natural site surface would then generally have sloped down from the southeast toward the lake in the north and northwest, with various swampy areas in the central part of the Site and only the southern and eastern portions were probably above the more frequent flood levels.

Alcoa took over the Site and began placing residue in the western end of Pittsburg Lake and associated swampy areas to the south. It is possible that other entities placed waste materials in Pittsburg Lake as well. The lake had been divided by the railroad embankment and probably was relatively shallow. The natural soils, consisting generally of a relatively thin layer of clay over relatively thick sand deposits, were probably locally excavated or eroded on a small scale by natural flooding as well as agricultural drainage projects, and possibly various industrial purposes.

When the lake volume had been filled, Alcoa would have created RDA 1 (or Old Pond) by means of dikes, constructed from gypsum. Foundation conditions for the dikes were likely poor, including soft alluvial soils and residue, so that gypsum and possibly other materials were used to create stability berms or fills extending out from the dike toe for some distance to resist rotational failures involving the dikes.

We suspect that the dikes would initially have been relatively low, probably 10-15 feet high. Low dikes would be more stable on the soft foundations and would provide initial storage capacity at lower cost than higher dikes. As the RDAs filled, the dikes were raised by adding step-in dikes with the original outside slope continuing up and the new dike supported partially over the old dike crest, but mostly over the previously deposited residue. We saw clear evidence of step-in dike construction in TP-35 at RDA 3 and it has been common practice for many industrial ponds.

By the 1930's, RDA 1 had been defined, again probably starting with lower dikes. The eastern portion of RDA 1 was probably still in use for residue placement and storage. Photographs from 1937 and 1940 (see **Figures 9 and 10**) suggest that there was an interior dike running approximately southeast to northwest along the east end of the mined area. Based on current exposures and exploration in the area, this interior dike appears to have been constructed of residue. The RDA 1 area east of this still appears to be depressed and holding liquor/residue in the late 1930's aerial photographs. Mining of residue from southwestern portion of RDA 1 appears to have commenced in a circa 1930 photograph and been near the existing extent by the 1937 photograph.

By 1955 (See **Figure 11**), RDA 1A had apparently filled and erosion of the central portion toward the southwest appears to have begun. RDA 2 and RDA 3 appeared to be operational, with the edges beginning to fill with residue.

IB 4a appears to still be the north shore area of Pittsburg Lake in the 1940 aerial photographs and is not easily visible on the later aerials. We suspect it was used for stormwater control and that an earth dike was constructed along the north, east, and west ends to control flooding of areas to the north. Eventually, this area may have been pressed into service for residue storage, possibly during peak production or when other RDAs were full.

By the late 1950's, Alcoa ceased placing residue on the Site. It appears that at this time, or as the RDAs were filled and completed, a sandy material containing small pieces of black slag was spread over portions of some of RDA 1 and vegetation was established. Some attempt to rework dry, edge areas of the other RDAs may have also been made. However, the central, weak residue in the RDAs probably would have been inaccessible to equipment and left untreated.

In the 1980's or 1990's, some mining of gypsum from the southwest dike of RDA 2 and spreading of gypsum over the residue in the southeast of RDA 2 and into RDA 1 took place. AMEC understands that some crushing of the excavated gypsum was conducted at that time.

Stormwater infiltration through the surface of the RDAs would have acted to leach caustic away from the surface. This process would have occurred more quickly in the more permeable residue sand areas than in residue fine areas. Eventually, in a process that continues, resistant vegetation would have developed along leached areas. Organic acids from decay of this vegetation would have further neutralized caustic, so that the vegetation could continue to advance. Larger trees growing in the RDAs likely represent sandy areas where deeper leaching allows the deeper root systems of trees to avoid caustic conditions.

Large areas of the Site can be characterized into one of the following general categories; however, there are many transition areas that are best described by a combination of the following categories:

Soft Residue – These are relatively thick deposits (15+ feet) of residue fines accumulated in the central portions of the RDAs as well as the RDA 1 pond (West Pond). This condition underlies portions of RDAs 1, 2, and 3 vegetated with phragmites reeds, but generally not areas vegetated with other brush or trees, although thinner layers of soft residue may occur at depth in these areas.

Edge Areas – These are perimeter areas of the RDAs probably underlain by residue sand "beaches"; a desiccated crust of fine residue, reworked residue, or other materials placed over the residue. These areas are generally identifiable by the presence of brush and trees. Softer residue deposits may underlie some of these areas at depth.

Gypsum Areas – These are areas underlain by substantial thicknesses of gypsum and include most of the dikes, gypsum stockpiles, the roadway and access areas south of RDA 2, and the large dust control gypsum area on RDA 2. Gypsum areas are generally bare to sparsely vegetated. Residue may underlie some of these areas at depth, though the weight of gypsum and drainage potential of the fractured gypsum may have allowed consolidation and improvement of thin layers or the upper portion of thicker layers of residue.

Natural Areas – These are areas underlain by principally natural soils and are generally thickly wooded. They include much of the south and southeast portions of the overall Site, between the RDAs and Missouri Avenue. Some of these natural soils may have been moved or disturbed by past grading activities.

Pittsburg Lake - The former extent of Pittsburg Lake and related swampy areas are partially filled with the oldest residue as well as various other fills (as indicated in B-1, PZ-7, B-5, and B-8). This condition principally underlies the northern and western portions of the Site between and around the RDAs. Fill consisting of gravel and other materials have generally improved these areas relative to the softer residue in the RDAs.

3.3 NATURAL SOILS

The RIR includes records of four relatively deep (extending to over 100 feet or near elevation 300 feet) monitoring wells (MW-1 through MW-4) which show generally sandy materials with some siltier soils at shallow depths and limestone near the base. AMEC's borings, wells, and CPT probes generally terminated in silty clays or sands interpreted as being natural alluvial deposits. These conditions are consistent with the expected geology of the Cahokia and Henry formations.

A circa 1900 map showing the extent of the former Pittsburg Lake was overlain on the boring data. Although the precision of the overlay is probably not high, the lake was relatively large so our general interpretation should be fairly reliable. The shallowest occurrence of natural soils is, at most, only slightly deeper in the lake and swamp areas than in other areas of the Site. Elevations of the natural soils appear to vary over a fairly narrow range of about 397 to 416 feet. There may be a slight trend downward from southeast to northwest, toward the former Pittsburg Lake. The relatively small difference in elevations suggest that, by the time of Alcoa's use of the Site and placement of residue, gypsum, or other materials, the lake had largely filled with natural, generally silty or clayey sediments.

Additional variation in the elevation of the natural-fill interface may have been caused by construction or other artificial processes. Ditches for drainage as well as small dikes may have been created when the Site was used for agriculture as well as later during the Alcoa use. Very soft, clayey surficial deposits may have been undercut or, more likely, displaced by mud-waving when placement of gypsum or other fill materials was used to stabilize foundation areas for dikes. Slightly firmer soils and/or soils with a relatively stable crust may have remained relatively undisturbed during placement of fill, including gypsum and other materials placed in relatively dry conditions, and the hydraulically placed residue, but the original surface may have subsided as the underlying soils consolidated under the new load. However, the natural alluvial silty clay deposits, expected to be fairly compressible, are relatively thin and the underlying sands are likely less compressible, so the subsidence magnitude from this phenomena may have been small, probably a foot or two at most.

3.4 MAN-MADE DEPOSITS

The Site subsurface is divided into undisturbed natural soils, described above, and various materials placed by Alcoa in their operations. The principal materials encountered consisted of the anhydrite/gypsum and the bauxite residue sand and fines.

3.4.1 Anhydrite/Gypsum

We understand that Alcoa produced large volumes of anhydrite in a fluorspar process and used them at the Site to create dikes around the RDAs as well as other stockpiles around the Site. Anhydrite or calcium sulphate ($CaSO_4$) is thought to have been created in an industrial process using lime (CaO) to neutralize sulphuric acid (H_2SO_4). Anhydrite has a molecular weight of about 120. It hydrates to calcium sulphate dihydrate ($CaSO_4 \cdot 2H_2O$) or gypsum by the bonding of two water (H_2O) molecules which have a total molecular weight of 36. The water molecules disassociate from the gypsum at various temperatures when heated.

Pure, dry (without free water) gypsum would, therefore, be expected to lose about 23 percent of its weight on dehydrating. Pure, dry anhydrite would be expected to gain about 30 percent of its weight on hydrating. The geotechnical moisture content is the ratio of the weight of water lost to the weight of remaining solids, so the measured moisture content of the gypsum on that basis would be about 30 percent, although the geotechnical drying standard temperature is only 105 degrees centigrade, which could leave some bound water. The hydration is largely irreversible for expected field conditions. Once anhydrite is hydrated to gypsum, temperatures much higher than any expected to occur on the Site would be required to dehydrate it.

The specific gravity of gypsum solids (depending on various crystal forms) is about 2.3. For anhydrite, the specific gravity is about 3.0. Therefore, 120 grams of anhydrite would have a solid volume of about 40 cubic centimetres (cc). Upon hydration, this would form 156 grams of gypsum with a solid volume of about 68 cc, or about 70 percent swell. In practice, anhydrite would typically be a collection of particles with voids between. Therefore, much of this swell would be absorbed into the void spaces between particles, especially if the material were confined under significant stress.

Laboratory testing of swell was conducted on selected gypsum samples. One sample of gypsum was dried/burned to remove all bound water, returning it to anhydrite. The other gypsum sample, which had hydrated to some extent on the Site, was a surface sample collected near boring B-12. Both samples were placed in the oedometer ring and statically compacted at a pressure up to 128 ksf prior to flooding. The dried sample should represent an approximately worst case for swell and would occur on Site only if grading and crushing exposed large amounts of fresh anhydrite. The other sample represents typical behavior to be expected from gypsum materials in-situ or gypsum materials that are hydrated during construction. Swell pressures on the dried sample ranged up to 1,200 psf. Swell magnitude at 100 psf was about 1 percent. In the sample of partially hydrated gypsum from the Site, which was approximately 70 percent hydrated based on heat testing, swell pressure was 200 psf and free swell was negligible.

Such relatively low swell pressures and magnitudes could explain formation of the swelling structures observed at the Site. The weight of material lifted is minimal, generally only a foot or so in thickness, indicating limited swell pressures were developed. Voids as evidence of swelling deeper in the gypsum were not observed. The magnitude of swell also would not need to be high to generate the features observed. Much like pavement failures observed during periods of record heat, where pavement expansion exceeds the capacity of expansion joints and pavement sections are pushed upward, only small incremental horizontal swell could force slab like segments into significant vertical rise.

Chemical analysis of several gypsum samples suggests that most of the anhydrite has hydrated into gypsum. The percentage of gypsum to anhydrite is lower in some of the larger pieces, suggesting that larger pieces of material may have hydrated on the surface, leaving the centers relatively unhydrated.

As anhydrite hydrates, it cements. Plaster of Paris is a commercial gypsum product that produces unconfined compressive strengths of about 2,000 psi under favorable conditions of hydration. Plaster of Paris is used for interior patching because it swells slightly on hydration, creating an effective fill of the hole to be patched. This is consistent with our test results.

Permeability of the gypsum/anhydrite would depend on the particle size and degree of fracturing. Flow through a solid, cemented mass would be very low, likely comparable to the fine residue or even less. However, the cemented gypsum is relatively brittle, causing some masses to fracture significantly. These fractures present potentially highly permeable secondary pathways. Similarly, the excavated material will likely require ripping and crushing;

producing a potentially wide range of particle sizes from boulders to fines, but generally gravel or sand sizes. Such material will also present good permeability. The combination of low primary permeability and high secondary permeability would explain why anhydrite in the center of larger pieces would remain unhydrated. The low permeability gypsum at the surface would resist rapid infiltration, while the high secondary permeability of the formation would tend to drain water rapidly away, so that individual pieces would be less likely to remain immersed for significant periods.

3.4.2 Residue

In terms of salient properties of the residue, there were no significant differences between the various RDAs and IB 4a, although the age of material in each of these ponds varies somewhat and the processing of the material may also have varied. Data suggest that the fine residue quickly reaches a stable condition of moisture-density and strength that does not change significantly over time or with incremental increase in load. The residue particles apparently form a “structure” that is somewhat resistant to compressibility if undisturbed.

3.4.2.1 Moisture-Density

Based on direct testing of dry density in the RIR as well as calculated densities (based on the assumption that residue below the free water/liquor surface is saturated) and moisture content tests by AMEC and Tetra Tech, the residue fines in the various RDAs seem fairly similar with respect to density, moisture content, total solids, and, hence, degree of consolidation achieved. Further, the variation with depth appears small. This is consistent with results of the cone load test (AMEC, November 18, 2011), which indicates that the residue achieves a structure that is somewhat resistant to consolidation. The residue appears to consolidate to a moisture content around 70 percent, which produces a dry density in the high 50 pcf range or a solids content in the high 50 percent range. This would equate to porosity (n) of about two thirds or a void ratio (e) of about 2, meaning that the void volume is roughly twice the solid volume in the residue. Local anomalies which are significantly higher density and lower moisture at depth below the water probably represent former residue surfaces that were exposed and able to desiccate prior to being covered with further residue.

3.4.2.2 Consolidation

Consolidation is a process by which soils respond to load. When first loaded, much of the additional vertical stress on the soil mass is carried by pressure in the pore water. Over time, water is squeezed out of the soil by this pressure and load is carried on the skeleton of soil particles. This process happens rapidly in well-drained soils such as sands, and much more slowly in fine grained soils.

Fine grained soils are often described in terms of an Overconsolidation Ratio (OCR) which is the ratio of the degree of consolidation of the material to the current overburden pressure. A soil mass that has fully consolidated under the existing overburden is considered normally consolidated and has an OCR of 1. Soils that have been recently loaded tend to be underconsolidated, so that pressure in the porewater supports part of the vertical stress and the OCR is less than 1. Soils that have been loaded in the past, allowed to consolidate under those loads, and then unloaded, are over consolidated with respect to the current loading and have an OCR greater than 1. Drainage, desiccation, and age can also cause the soil to appear overconsolidated. CPT data correlations to OCR indicate that the residue is generally normally to slightly overconsolidated with respect to current loadings.

3.4.2.3 Plasticity

Plasticity is measured using Atterberg Limits. As discussed, the plasticity of the residue may be significantly impacted by the chemistry of the bound water, notably, the pH and lime content of the water/liquor. In our opinion, much of the residue fines may be fairly plastic clay with reduced plasticity due to the caustic liquor effects, so that testing shows a wider range of behavior, tending toward silts.

3.4.2.4 Grain Size

As described previously, residue would have been placed hydraulically at low solids contents, probably in the range of 10 to 15 percent based on information from operational Alcoa plants. Discharge points would typically be varied over time at different locations around the perimeter and discharge piping might have been extended out over the residue if and where wide sand "beaches" formed. The result would be that the sand-sized particles would settle near the discharge and fines would spread more widely across the pond areas. Some mixing of sand and fines would occur near the edges of the drop areas and as a result of sand from nearer discharge points becoming interbedded with fines deposited earlier or later in the same location from more distant discharge. Data from the Site are insufficient to fully characterize the complex residue interbedding or segregation, but observations and data collected suggest that, sand represents about 10 to 20 percent of the total residue and appears to be concentrated in deposits near the perimeter dikes.

3.4.2.5 Compressibility

As indicated by the CPT probes, residue seems to be normally consolidated to slightly overconsolidated near the surface to normally consolidated at depth using correlations for clay. As indicated by the cone load test, the residue appears to have developed a significant structure that when undisturbed is relatively incompressible, at least up to the cone load of about 1 ksf. The CPT, SPT, and UD sampling appear to disrupt this structure significantly, showing values that suggest higher degrees of compressibility than the load test.

3.4.2.6 Strength

Vane Shear tests show undrained shear strength values ranging from about 130 to the limit of the vanes, of about 650 psf. CPT correlations to undrained shear strength indicate values roughly in the same range, with an average of about 350 psf in the residue fines. CPT 13 was conducted at the location of the liquefied residue zone observed near the test strip-test pad interface near the end of the test strip program (AMEC, November 18, 2011) and showed a minimal strength of about 80 psf. We suspect this may represent a zone where residue volume was lost during the cyclic softening event, resulting in a loss of density and corresponding lower strength. Residue that remains in situ, even after liquefying, appears to regain strength rapidly.

The lower range of strength values for the residue is likely impacted by disturbance inherent in pushing the CPT or vane into the residue. Strength, as indicated by the nearly continuous CPT data, does not seem to increase significantly with depth. This is also consistent with density data (see above) which appears to attain a certain level, with placement of additional material on top not appearing to cause significant additional consolidation or strength gain.

Recovery of residue strength was assessed by twisting the vane in a static test and then leaving it undisturbed for some time at the same elevation before twisting again. Based on limited testing conducted, the residue appeared to regain about a third of its static strength in less than one hour and about two thirds within 24 hours. The strength recovery of the residue was further confirmed by observations of residue at the surface disturbed when vehicles were mired or the residue was otherwise disturbed.

CPT data indicate only limited strength gain in fine soils adjacent to apparent sand seams or drainage paths. This suggests that drainage and consolidation of the residue is limited, once it reaches a stabilized condition of near normal consolidation and develops an apparent, relatively stable structure.

3.4.2.7 Thixotropy or Sensitivity

Thixotropy is a function of soil structure and describes the tendency of some soils to lose considerable strength under shearing, in some cases turning from a relatively solid material to a viscous liquid at constant moisture content. Vane shear testing was used to assess residue sensitivity or thixotropy. The ratio of initial strength measured at "failure" or the first twisting of the vane versus the residual strength as the vane continued to be twisted was in the range of 1 (no change) to over 20. Some of the strength loss at shallow depth may be due to voids (preserved subsurface desiccation cracks), which would have allowed for an increase in the volume in the disturbed/liquefied residue on which the residual strength was measured. Some of the lower levels may indicate seams of sand or other non-fine materials in the cylinder of material twisted by the vane. However, it appears that the sensitivity or thixotropy of the residue generally declines with depth. Since a corresponding increase in strength or density with depth is not apparent, this improvement is likely a function of increasing age.

3.4.2.8 Dynamic Strength

Dynamic strength properties of the residue were assessed by cyclically loading the vane at about 1 hertz (one cycle per second, Hz) and observing cycles to failure and the ratio of failure with vane tests in adjacent residue. The variation of residue strength observed in static testing of vanes pushed within a few feet of each other was considerable, making direct comparison difficult. However, cyclic loading appeared to create failure at not less than 60 percent of static loading, which is consistent with published values of cyclic strength of mine tailings. Qualitative dynamic testing included placing cylinders of residue on the concrete flow table (which drops ¾ inch at 1.67 Hz) and the aggregate shaker table (which vibrates at 60 Hz with a magnitude of 0.05 inch). The samples generally survived at least 30 cycles of either of these tests before substantially liquefying.

3.4.2.9 Age

Residue deposits would range from about 100 years old in the Pittsburg Lake to about 50 years old where most recently placed, probably in RDA 2. As noted above, strength and density do not appear to increase with depth or be significantly different between the RDAs of different age. Also, residue appears to recover relatively quickly after disturbance. Therefore, it appears that the residue achieves a fairly stable condition, probably within a relatively short period of time, and maintains that condition, barring disturbance, for relatively long periods.

3.4.2.10 Drainage/Consolidation

The RIR includes results of several permeability tests on relatively fine residue and obtained results between 3.8 x 10^{-7} and 2.0 x 10^{-6} centimeters per second. This comports with our previous experience with residue and calculations based on the coefficient of consolidation (C_v). These values should be considered as the primary permeability of a relatively homogeneous mass of fine grained residue.

Sand content would have only a slight effect on permeability until the sand fraction substantially predominated, probably 80 percent or more, causing a significant increase in permeability. Permeability of residue sand relatively free of significant fines would be expected to be significantly higher, likely on the order of 1 x 10^{-3} cm/sec.

Secondary permeability features are likely much more important in the groundwater flow regime. The observed open desiccation cracks, sand filled cracks and seams of relatively clean residue sand would be expected to transmit groundwater at higher rates.

3.4.3 Other Fills

Other materials have apparently been deposited artificially at the Site as discussed in the RIR. These include various materials of gravel to fine sizes, trash and debris, and probably some of the natural soils excavated and replaced and now generally indistinguishable from undisturbed natural soils. The volume of these materials relative to the residue and gypsum is expected to be small and the behavior of the materials should generally fall within the range of behavior expected between the residue and gypsum. Detection and rigorous identification of all such materials is impractical, given the large site, and likely unnecessary.

3.5 GROUNDWATER

The groundwater regime at the Site is somewhat complex. As reported in the RIR, the natural groundwater is relatively shallow, flowing through the sandy Cahokia Formation with a gentle gradient from the bluffs toward the river. Natural shallow surficial flow prior to development would have been generally from the higher areas in the southeast toward Pittsburg Lake to the north and west. Agricultural use of the property probably did not alter surficial drainage significantly. Pittsburg Lake was apparently without a surface outlet, so water entering the lake would have infiltrated into the subsurface or evaporated.

Development and filling of the RDAs created more complex conditions. Residue sands were fairly permeable. Residue fines were less permeable, but apparently developed desiccation cracks and possibly slip surfaces or other secondary permeability features that would have increased their permeability. Growth of vegetation would have further increased permeability within the shallow zone penetrated by roots.

We understand that the overall Site does not appear to have offsite surface drainage and, except possibly for severe flooding, precipitation landing on the Site infiltrates into the subsurface or evaporates. The infiltration process apparently is fairly rapid over much of the Site, though less so in areas underlain by fine residue, notably the standing water areas of RDA 1, RDA 2, and IB 4a, as well as IB 4b which also appears to hold water and may contain residue or low permeability sediment.

RDA 1 appears to have filled to the point where overtopping breached the perimeter dike at several locations along the north side as well as the southeast corner, as noted on **Figure 1**. The perimeter dike at the southwest was apparently removed during mining operations in the 1930's. The apparent interior dike that may once have separated the mined area from an active residue/liquor pond has also apparently been breached into the mine pit, though when and whether intentionally or accidentally is unknown.

Since RDA 1 has surface water outlets, it is not clear as to the infiltration possible there. However, RDA 2, RDA 3, and IB 4a do not appear to have surface water outlets. No evidence of significant overtopping of the perimeter dikes or of significant seepage through the perimeter dikes was noted. Therefore, it appears that stormwater falling into these areas must be infiltrating or evaporating. We expect infiltration to occur through thick residue sand deposits, generally at the edges of the ponds. However, since large areas of the central, fine residue remain unflooded, apparently there are sufficient secondary permeability features to allow infiltration there, as well.

Based on our limited piezometer measurements and observations in test pits and borings, groundwater depths at IB 4a, RDA 2, and RDA 3 are generally shallow in the fine residue and somewhat deeper in the residue sands. At the higher elevations of RDA 1, groundwater is generally over 20 feet deep, resulting in groundwater elevations that are similar to those in adjacent areas of RDA 2, RDA 3, and IB 4a.

4.0 CONCLUSIONS AND DESIGN RECOMMENDATIONS

Based on the data generated during the Field Test Strip and Test Load Program and this Pre-Design Investigation, installation of a two-foot-thick bridging layer over the RDA surfaces will be feasible and will provide acceptable support and long term stability for RAA-2. The bridging layer will provide an acceptable and stable platform to support solar panels should future solar redevelopment of the site occur. Bauxite residue, unlike other waste fills such as municipal solid waste, does not contain significant organic or other materials that degrade and lose substantial volume over time due to chemical, physical, or biological processes. Therefore, differential settlement issues that are associated with typical solid waste landfills are not as much of a concern at this site.

The following conclusions and design/construction recommendations are based on the previously discussed project information and assumptions, our observations at the site, interpretation of the field and laboratory data obtained during the investigation, and our experience with other sites having similar subsurface conditions. Subsurface conditions are variable and close coordination with the construction process by the geotechnical engineer should be anticipated to address unexpected or unusual conditions that may arise. These issues will be addressed by the technical specifications developed as a part of the detailed design.

4.1 PROPOSED REMEDY

The results of our investigation are favorable for the implementation of RAA-2 and potential future construction and operation of a utility scale solar project. The major construction elements of the plan will include:

1. Clearing and site preparation.
2. Excavation of gypsum and preparation for placement as fill.
3. Buttressing existing dikes and slopes with gypsum fill.
4. Construction of a detention pond dike at the west pond.
5. Minor fine grading of dried residue areas in edges of RDAs.
6. Placement of a two-foot-thick lift of imported soil over the softer central residue areas.
7. Placement of a two-foot-thick lift of imported soil over the remainder of the RDA surfaces.

8. Placement of a two-foot-thick lift of imported soil over the dikes and dike slopes to support vegetation.

9. Excavation of limited trenches or ditches in the RDAs as required for storm drainage.

Should installation of a utility scale solar project proceed, additional construction elements will include:

1. Placement of a separation geotextile and gravel to provide a clean, low-dust working surface over RDA areas to receive the panels, other equipment, and access roads.

2. Installation of panels and related equipment including lighting, fencing, access roads, etc. over the RDAs.

3. Installation of heavier equipment such as transformers, generally on the gypsum dike fills near the RDA perimeters.

4.2 CLEARING AND SITE PREPARATION

In general, areas to receive the bridge lift, gypsum fill, or other fills, should be cleared of significant vegetation. Grubbing should be very limited, with only removal of larger stumps and roots that might interfere with subsequent fill placement.

Removal of trash and debris should be generally limited to materials that might otherwise damage equipment, such as larger pieces of scrap metal, as well as significant accumulations of debris. Thin layers of scattered glass, cans, etc. can generally remain beneath the proposed fill material.

In soft residue areas, experience during the investigatory work completed by AMEC demonstrates that small, low pressure equipment can access the areas to remove vegetation. Some natural areas may also exhibit soft conditions, but these are principally outside the work areas. Removal of vegetation from pond areas that will remain in place is not required.

Clearing debris should be burned or chipped and spread in areas to be vegetated for mulch, as convenient and consistent with local regulations. Treatment to kill roots beneath panel areas may be advisable to prevent growth through the bridging materials.

After clearing, a thorough reconnaissance of exposed materials by the geotechnical engineer should be conducted to confirm the expected foundation conditions and look for localized areas of weaker or unacceptable materials. Where soils will support traffic after clearing, proofrolling with a piece of pneumatic tired equipment such as a dump truck to detect locally weak zones may be advisable. Otherwise, traversing with lower contact-pressure equipment, probing, and visual reconnaissance, possibly augmented by shallow excavation to investigate anomalous areas is recommended.

4.3 CUT SLOPES

Most grading will involve buttressing existing steep slopes with additional fill. However, in the southwest dike of RDA 2 and the southwest corner of RDA 3, the existing gypsum dike will be excavated and laid back to create the uniform 3 horizontal to 1 vertical slopes. Excavation of the gypsum will be difficult and will result in an uneven and broken surface. Therefore, cut slopes will need to be overexcavated slightly to allow placement of new fill to create a relatively uniform slope.

The southeast corner of the RDA 3 dike appears to be closely impinging, if not overlying, the railroad right of way. Historic aerial photographs indicate that the dike was constructed in approximately this condition (see **Figures 9 and 10**). The final design will include moving the dike toe back to or slightly behind the railroad right of way line and then excavating and flattening the slope to at least 3 horizontal to 1 vertical. Test pits (TP-31 and TP-35) and borings (B-12 through B-16) atop and behind the existing dike suggest that excavation of this slope will encounter mostly gypsum materials, though some residue materials may be encountered in the top or westernmost portion of this cut. After clearing of this area, we recommend careful surveying of the area to indicate the top of cut slope. Additional test pits should be conducted in this area prior to beginning the cut to determine if and to what extent residue will be encountered in the cut. If the cut is expected to encounter significant residue, which would present stability issues with the finished slope, one or more trenches could be excavated along the back of the slope to remove the residue and replace it with gypsum fill. Test pits behind the planned cut area demonstrate that temporary excavation trenches can be made to depths up to about 15 feet. Gypsum fill in such a case would be placed in thin lifts and compacted remotely, using the backhoe bucket, as personnel entry into the trench would not be feasible.

4.4 GYPSUM

A substantial portion of RAA-2 will involve excavating, handling, and placing gypsum/anhydrite materials as fill. These will be excavated from various areas of the Site and used mainly to flatten dikes and slopes.

4.4.1 Excavation

Excavation of cemented gypsum/anhydrite materials will be challenging. During our investigation, large trackhoes using rock teeth and ripper teeth could only slowly advance in the gypsum. Heating the gypsum to temperatures in the range of 250-350 degrees Fahrenheit will liberate water and reduce/reverse the cementation, turning the gypsum back into powdery anhydrite. However, heating the volumes involved is unlikely to be practical. The use of heavy equipment for ripping and/or hydraulic and pneumatic tools for breaking may need to be considered to loosen gypsum.

4.4.2 Wetting, Hydration, and Cementation

Breaking up the larger chunks of gypsum will tend to expose anhydrite. Anhydrite should hydrate to gypsum rapidly if thoroughly wetted. Anhydrite will only hydrate on the exposed face to a shallow depth in larger particles, but fine dust should hydrate throughout. The gypsum/anhydrite dust will need to be managed to limit worker exposure and airborne release off the Site. This will be accomplished by frequent wetting of the working area using spray from water trucks. Wetting should cause fairly rapid hydration of the exposed anhydrite surfaces and dust. Specific measures will be described in the Health and Safety Plan (HASP) that will be included with the Final Design.

The gypsum operations (cutting, hauling, placing, and compacting) are scheduled to occur over an approximate four month period early in the project schedule. The surface of the gypsum will be wetted prior to ripping and/or pushing with a dozer. Additional wetting will be implemented, as required, to control dust as the loosened material is loaded into trucks and dumped at its new location prior to grading and compaction. Water will be provided by a site water truck equipped with a water cannon.

Gypsum operations will be accomplished largely by heavy equipment. The equipment used on site, especially that used in the gypsum operations, will be equipped with positive pressure cabs to minimize the amount of dust that may enter the operators breathing zone. A minimal number of laborers on the ground will be needed to direct and spot trucks for loading and off-loading. Otherwise, the gypsum areas will be roped off and signage erected to indicate that the area is off-limits to personnel not engaged in the operation.

The current HASP calls for monitoring the work area for respirable dust during all invasive operations. This requirement will continue going forward and will be augmented, as the current HASP provides for, with periodic personal monitoring of workers actively engaged in invasive operations. The results of all monitoring, whether area or personal, will be analyzed in accordance with the HASP and adjustments made to the operation to prevent impacts to workers and the surrounding area.

4.4.3 In Place Density

Observations of test pits demonstrate that much of the gypsum occurs in relatively intact masses of solid material, similar to plaster of Paris. The anhydrite would have arrived at the site in a relatively fine powder that cemented and hydrated either during placement, due to water added, or afterwards, due to rainfall and humidity. Voids in the matrix of such solid masses would only be a few percent of the volume, similar to air-entrained concrete. As such, in place density is in the range of 140 pcf. The surficial materials over most of the stockpiles and materials that were formerly crushed to sand sizes are like compacted soils, with much higher void ratios and in place densities probably in the range of 100 to 120 pcf; however, this type of material appears to represent only a relatively small portion of the overall gypsum volume.

4.4.4 Placement as Dike Fill

Most of the planned regrading of the dikes and existing slopes will involve adding material to buttress the existing slopes, rather than cutting into the existing slopes. The material planned for this buttressing will be the anhydrite/gypsum excavated from existing on-site stockpiles, notably along the southwest dike of RDA 2; and the stockpiles along the south side of IB 4a, the southwest side of IB 4b parallel to the RDA 3 dike, and in the southeast portion of IB 3b. In cross section, these fill buttresses will be a wedge ranging from near vertical to steeply sloped placed against the existing dike face with a 3 horizontal to 1 vertical outer slope at the finished, exposed face.

The anhydrite/gypsum will either be excavated by conventional means or may require ripping with a dozer to loosen it before excavation. In either instance, some experimentation of field methods will likely be required, but we anticipate the following procedures will provide a good point of departure.

4.4.4.1 Anhydrite/Gypsum Excavated by Conventional Means

In the instance of anhydrite/gypsum that can excavated by conventional means (e.g., an excavator with a conventional bucket, no additional equipment required to assist), the resultant materials are expected to be granular with some apparent, observed variation in particle size. Provided that this is the case, and that maximum particle size is within an acceptable range (approximately 3” to 6” maximum), the anhydrite/gypsum material will be loaded, hauled to and placed at its new location on the project Site.

Material would be spread in 12 inch thick loose lifts, watered, and compacted with vibratory rollers. Watering would be required to control dust, but would also serve to lubricate particles to obtain a denser arrangement. Water would also hydrate anhydrite exposed by the excavation process. Density testing would likely be impractical for the particle size, so compaction testing on the material would be by observation of the soil technician, under the direction of the geotechnical engineer. The engineer would verify that the material surface had ceased to be lowered by repeated passes of the compactor. This would be accomplished by rolling the surface with a set number of passes (i.e., a method-based specification), then checking the elevation, then rolling with additional passes and rechecking the elevation, until the change had declined to near zero with additional passes. A test program conducted early in the construction process would define a number of passes and that further checking during construction would not be required unless there were other indications of lack of density. In-place densities on the order of 120 pcf could likely be achieved.

4.4.4.2 Anhydrite/Gypsum Requiring Ripping

In instances where the anhydrite/gypsum is well cemented, it is expected that ripping will be required to loosen the material prior to excavation. Ripping will be accomplished using a Caterpillar D-8 or D-9 dozer (or equivalent) pulling a single-tooth ripper. The resultant ripped material will be pushed into a stockpile(s) for processing through a static bar screen to separate oversize particles from acceptable material. After processing through the bar screen, all acceptable material (less than 4” to 6”) will be loaded, hauled to and placed at its new location on the project Site. Oversize material that does not pass the bar screen will either be crushed by further trafficking or incorporated into the fill by spreading larger pieces in a single layer and then adding sufficient of the finer material (material passing the bar screen) to generally fill voids between and around the larger pieces. Lift thicknesses may be increased up to 2 feet to accomplish the latter.

4.4.4.3 Mass Balance

For design purposes, it is necessary to estimate the volume of fill material placed relative to the volume excavated in order to balance earthwork. This is commonly done based on experience with area soils. Typically this change is called “shrinkage” as the in place volume of compacted fill tends to be less than the volume of natural soils excavated, although the shrinkage value also includes survey error, waste and losses, and other factors unrelated to soil density. Values for natural soils typically range between about 10 and 30 percent. Overestimating the shrinkage factor may result in more fill material than predicted from the excavation, which requires modifying the grading to reduce excavation or increase fill to avoid hauling material offsite. Typically this includes raising grades generally, flattening slopes, or building landscape berms. Underestimating shrinkage requires increasing excavation, lowering finished grades or importing off-site materials.

Due to the apparently high in-place density, the broken gypsum volume of fill placed will likely substantially exceed the current in-place volume, depending on the methods of crushing and compaction of the gypsum on excavation. Dehydrating the gypsum and returning it to anhydrite for placement with wetting could return the gypsum to the high density, but is impractical. A further complication in estimating relative volumes of material placed versus material excavated is that excavated material will include anhydrite which will hydrate and thereby gain weight and volume on placement, though this is likely to add only slightly to the overall uncertainty.

We anticipate that “shrinkage” for the Site Concept Plan will be a negative number. The volume excavated will be less than the volume filled. We anticipate that the shrinkage may range between about negative 15 and 30 percent, with lower value if greater crushing effort of the gypsum is undertaken.

4.4.4.4 Grading and Shaping Gypsum Fills

The in-situ cemented gypsum will generally not be amenable to fine grading. Ripping, breaking, or otherwise loosening the material will leave a rough, erratic surface. Gypsum crushed as described in 4.4.4.1, above, can likely be fine graded by repeated rolling until protuberances are knocked down and/or by adding finer material to fill voids and bury protuberances.

4.4.4.5 Gypsum Swell/Heave

As discussed, anhydrite can be expected to swell on hydration. The igloo, lean-to, or bubble shaped features where cemented gypsum is raised slightly above open voids, observed in some of the gypsum areas, were probably produced by this swelling. As the surficial anhydrite was hydrated, it swelled and cemented, pushing the layer laterally in all directions and creating shallow heave. Deeper voids attributable to the same process were not observed. These phenomena may be compared to pavement with inadequate expansion joints, which, on very hot days, may be forced upward significantly due to small incremental changes in volume due to thermal expansion.

Laboratory testing indicates that swell pressures developed by the swelling anhydrite are about 1.2 ksf under worst case conditions of purified anhydrite, compressed to substantial density. Free swell magnitudes are also apparently small, on the order of about a percent.

We anticipate risk of gypsum swelling is small in any case, for the following reasons:

1. Much of the anhydrite in place at the Site has already hydrated to gypsum, so additional swell is not expected.

2. Anhydrite that is already buried in dikes or is in the interior of pieces that will not be broken has resisted hydration for many years and that is unlikely to change under the proposed development.

3. Most anhydrite exposed by the excavation or crushing process should, if well wetted, hydrate during the construction process.

4. The gypsum fill will, like any granular fill, include voids which can act to absorb swell.

5. The majority of the planned gypsum fill areas will be in the dikes. The broken gypsum fill should drain well and the dike surfaces will be sloped and covered with a vegetative support layer of fine-grained, local soils. Thus, post-grading water entry into the gypsum fill mass should be limited.

6. Gypsum will generally not remain under panel areas, but any that does will be under the bridge lift and gravel which would confine the gypsum and work to spread the effect of local swelling over a wider area.

To further reduce the risk associated with swell of localized gypsum pockets that may be present and not detected under panel areas, we recommend that panels be designed to bear on their ballast elements, so that the bearing pressure of the panels will be as high as possible, probably several hundred psf, which will work to further confine swelling pressures and be more tolerant of swelling that might occur between ballast elements.

4.4.5 Surface Preparation

The upper surface of the gypsum fill on the dikes will be covered with a vegetative support layer consisting of fine grained soils. The surface of the gypsum should be well choked with finer granular materials to fill surficial voids and watered repeatedly prior to placement of the soil fill. This will provide a filter that will prevent ravelling of the vegetative support soil into the coarser, underlying gypsum.

4.5 DIKE/SLOPE STABILITY AND BUTTRESSING

Most slopes and dikes around the RDA are relatively steep, ranging from near vertical to about 1.5 horizontal to 1 vertical. Exceptions are the dikes along the southwest side of RDA 2, which have apparently been substantially flattened in the past by placement of additional gypsum material over the former dike and interior areas. The planned buttressing to flatten dikes will serve several purposes:

1. Improve dike/slope stability.
2. Reduce the surface area of gypsum on the Site.
3. Reduce slopes to grades that can be easily maintained (i.e. mowed with conventional mowers).

A worst-case condition (based on buttress height and foundation conditions) was selected for analysis using the Spencer Method. Output is included in **Appendix D**.

4.5.1 Foundation Conditions

Foundation conditions for the planned buttresses vary. In some areas, notably the southwest dike of RDA 2 where dikes were substantially mined as well as the mined area in RDA 1 (west pond), material has been removed in the past so that the foundation soils have been more or less preloaded with substantial weight, approaching the weight of the proposed buttress. Elsewhere, foundation soils include natural soils and gypsum deposits of greater competence.

In some areas, dikes extend significantly above the interior residue elevation, for example around most of the north dike of RDA 3. It is expected that these will be cut down to approximately the interior residue level before buttressing, so as to maintain a slope such that the interior surface flow is toward the pond up to approximately the existing dike centerline and down the buttress on the outside. Buttresses will be of varying heights, ranging from about less than 10 to over 40 feet and varying foundation conditions. **Table 4**, below, summarizes anticipated buttress heights and foundation conditions for the various dikes and slopes.

Table 4 Buttress Conditions

Area	Dike/Slope	Approx. Max. Height (feet)	Foundation Conditions
RDA 1	Slope SE End of West Pond	30	Residue, Preloaded
RDA 1	Slope N Side of West Pond	23	Residue, Preloaded
RDA 1	North Dike	43	Pittsburg Lake Deposits in RR Gulch
RDA 1	South and East Dikes	24	Residue, 1b & 1c
RDA 1	West Dike	16	Pittsburg Lake Deposits
RDA 2	SW Dike	24	Preloaded Gypsum
RDA 2	SE Dike	Cut to 15	Preloaded Gypsum
RDA 3	NE Dike	28	Pittsburg Lake Deposits, 4b
IB 4a	South Dike	10	Pittsburg Lake Deposits, 4b

Based on the height values above, the worst case conditions are expected to occur in stabilizing the interior slopes of the west pond and the south and east dikes of RDA 1, where of the dike/slope buttresses will bear on residue deposits. The greater height of the RDA 1 North Dike appears to have superior foundation conditions on the railroad gulch materials that currently appear it and the IB 4a south stockpile at a similar height and substantially steeper slopes.

4.5.2 Existing Conditions

Consideration of stability must take into account existing conditions. Many of the existing steep slopes/dikes have persisted for several decades and survived a significant seismic event without evidence of significant slides, suggesting a factor of safety of at least 1.0 under seismic loading. Our understanding of site conditions is that many of these structures bear on residue deposits in the former Pittsburg Lake. Thick zones of gravel discovered in boring B-5 and Piezometer PZ-7 in the railroad gulch north of RDA 1 as well as thick zones of gypsum observed along the south side of RDA 2 may represent stability berms placed for dike support during the original dike construction. Various large windrows or stockpiles of gypsum have been placed on the Site and the recently constructed test load also provides an indication of the loading that even relatively weak residue can withstand.

4.5.3 Factor of Safety Selection

The existing conditions will be substantially improved by the proposed buttressing. Somewhat conservative inputs, based on assumptions that the existing conditions are, under seismic loading of at least 0.1g from the 1974 event, at a factor of safety of 1.0 were used in our analysis.

A factor of safety of 1.3 is widely accepted for stability of slopes under static conditions where slope failure would not cause wider damage. A factor of safety of 1.5 is commonly used for dams where failure would result in widespread downstream damage. However, residue contained in the ponds, even when liquefied, is unlikely to spread widely or erode a small breach into a larger breach. Liquefaction of the residue is unlikely under static conditions. Due to consolidation under the weight of the buttress, the critical static condition will occur shortly after construction and improve with time. Therefore, a static factor of safety of 1.3 is acceptable for this project.

Under seismic loading, which is rare and of short duration, lower factors of safety are commonly acceptable. Therefore, a factor of safety of 1.1, as used by various State Dam Programs for seismic loading, is recommended for these dikes under the seismic loading of the 300 year event, that is, 0.1 g of horizontal acceleration.

4.5.4 Recommended Buttress Geometry

Buttress slopes of 3 horizontal to 1 vertical or flatter will provide acceptable factors of safety for most dikes. Flatter slopes or stability berms consisting of 4 to 6 feet of additional fill extending out 25 to 50 feet from the dike toe may be required if stability concerns arise during placement of buttresses, notably in the interior of the RDA 1 pond, the south and east dikes of RDA 1 over

RDA 3, the northeast dike of RDA 3, where it extends into the IB 4b areas, and possibly other localized weak/soft areas as discovered following clearing and under construction loading.

4.5.5 Buttress Construction

Buttresses generally will be constructed by placing gypsum fill in lifts as indicated above based on the crushing sizes and compacting the fill in horizontal layers. Where buttresses abut existing gypsum slopes, they should be benched (see **Figure 13**) into the existing slope so that fill is placed on horizontal surfaces and the potential slide surface along the former slope is eliminated. Where buttressing abuts steep residue slopes, benching and compaction of gypsum fill will necessarily be limited to avoid softening of the residue.

Where buttress construction will occur over relatively soft foundation soils, a thicker bridge lift of 2 to 4 feet of gypsum should be pushed initially. Piezometers should be installed after the bridge lift is placed to allow monitoring of free water head. Buttress fill should be placed to a maximum height of 15 feet with compaction of the first few lifts of additional gypsum accomplished using limited and generally non-vibratory effort to avoid softening of the underlying residue. After reaching the 15 foot height, a delay should be allowed for the excess pore pressures (indicated by raised free water head in the piezometers) to dissipate. We anticipate that this will occur in 4 to 8 weeks after placement, but a minimum delay of 4 weeks is recommended in any case. After the delay, additional fill may be placed in increments of 15 vertical feet, followed by a delay of 4 weeks or until the piezometer indicates groundwater levels have returned to within about 1 foot of initial levels, whichever is longer.

In any case, should liquefied residue, bulging, cracking, or unexpected subsidence of the buttress, or other indications of incipient slope failure be observed, operations should cease within 100 feet of the area until conditions have been evaluated by the geotechnical engineer. Further action could include stability berms, lowering the fill temporarily to allow recovery, or other measures as deemed appropriate.

4.5.6 Seismic Considerations

A worst case scenario for the seismic site response would be that large volumes of residue would liquefy and a dike segment would fail and allow the liquefied residue to flow out of the RDAs. This event appears unlikely since the current dike configurations survived a nearby

Magnitude 5.6 event in 1974 (see Section 4.6) and the risk will be further reduced when dikes are buttressed, flattened to 3 horizontal to 1 vertical.

Slope failure mechanisms principally would involve block sliding or rotational failure of the dike. This is especially of concern where foundations under the dike are weak, silty or clayey soils. Another potential failure mechanism would be liquefaction or cyclic softening of soils under the dike during a seismic event, which could increase the potential for block sliding or rotational failures.

We note that, unlike most dikes that retain significant water, these dikes do not contain free liquids. As outlined above, liquefaction of significant portions of the residue is unlikely in even fairly rare seismic events. Even so, liquefied residue would be relatively viscous and therefore much less likely than water to rapidly erode or widen small cracks or breaches that could open in the dike. A horizontal acceleration of 0.1 g (as expected for the approximately 300 year return frequency event) was applied to the slope stability analysis and provided an acceptable factor of safety.

4.6 SEISMIC HAZARD ASSESSMENT

East St. Louis is at the northern end of the New Madrid Seismic Zone, made famous by large earthquakes in 1811 and 1812, but which has experienced smaller, continuing earthquakes. The USGS maps indicate that an earthquake of Magnitude 5.6 occurred about 3 miles due south of the Site near the intersection of IL-157 (Camp Jackson Road) and Calvin Boulevard in Cahokia. This quake occurred on March 27, 1974 at 4:11 PM and reportedly at a depth of 10 km, but no other information, such as a Peak Ground Acceleration (PGA) map, was available for this event.

The concerns with an earthquake near the Site would be:

- Slope Stability, particularly with respect to dikes.
- Liquefaction of sands due to development of excess pore pressures.
- Cyclic Softening of residue fines that could trigger the loss of strength or liquefaction observed in these sensitive materials.

4.6.1 Soil Parameter Selection

Salient parameters from the exploration are density, undrained shear strength (s_u, for fines), SPT N-value (for sands), and groundwater levels. In the residue, the lower range of s_u from CPT data, without considering possible degradation of the strength due to the cone penetration, is about 260 psf. Minimum groundwater depth in the residue fines is about 5 feet and density would be about 100 pcf including the dry density of the residue plus the pore water. In the residue sand, SPT N-values are generally low, as low as 2 to 4 bpf with the automatic hammer, which would equate to N60 values of about 3 bpf. N60 values are significantly higher in the natural sands, generally 10 bpf or more. Groundwater was generally deeper in residue sand areas, about 20 feet, and will tend to remain deeper after the bridge lift is placed (which will tend to reduce surface water infiltration directly into the sand). Groundwater in the natural sands is shallower, about 5 feet in some areas. In-situ density of sands is higher, probably about 125 pcf.

4.6.2 Liquefaction of Sands

Liquefaction of sands occurs when seismic shaking increases pore pressures until the formation behavior is controlled by the pore water, which has no shear strength, rather than the sand particle interaction, and the strata or formation liquefies. Common effects of this include sand, mud, or water “boils” where wet sand, mud, and/or water emanates or is ejected from the ground to large areas going “quick” or turning to liquid (“quicksand”). This can result in bearing capacity failure of structures founded over the layer and settlement as the porewater pressures equalize and the ground settles into the voids left by the ejected material.

4.6.3 Cyclic Softening of Fines

Fine grained soils are generally immune from the liquefaction phenomenon that operates on sand. However, the earthquake does develop shear forces in the ground. In sensitive or thixotropic soils, sometimes called “quick clays,” this can result in a sudden loss of strength and flowing of the soil with effects similar to liquefaction in sands. This mechanism could occur in the residue fines.

4.6.4 Calculation Approach

The approach used to assessing the risk of liquefaction in sands and/or cyclic softening in fines is as follows:

- Determine the likely bedrock motion based on published USGS earthquake mapping data. AMEC used the software EZ-Frisk to develop probability data of various PGAs. Output is included in **Appendix C**.

- Determine the amplification through the soil overburden based on the soils characteristics. This was accomplished using published Site Class parameters based on the natural profile below the residue (ASCE 7-10, Table 11.8-1 Site Coefficient F_{PGA}).

- Calculate a cyclic stress ratio (CSR) based on soil parameters, depth, and earthquake acceleration. In general, CSR increases with depth to a point, then decreases.

- Calculate a cyclic resistance ratio (CRR) based on soil data, generally s_u for fine grained soils and SPT N-values for sands (Idriss and Boulanger 2008, figure 3.11).
- Compare the CSR and CRR. Where the CSR exceeds the CRR, liquefaction or cyclic softening is expected to occur.

4.6.5 Historical Perspective

The 1974 magnitude 5.6 earthquake occurred fairly close (about 3 miles due south) to the Site. At that time, the steep (approximately 1:1) and 20-30 foot high slopes would have been present in the excavated areas in the southwest portion of RDA 1, as this excavation was conducted in the late 1930's. The gullies in the central portion of RDA 1 probably would have had steeper slopes as well, since erosion would have been less than at present. Gypsum dikes would generally be as current, with relatively steep slopes, except on the southeast side of RDA 2, where slopes would probably have been steeper prior to the circa 1990 effort, and the southwest sides of RDA 1 and RDA 2, where slopes would have been flatter prior to the mining of dikes there. The residue is similar between the various RDAs, with residue strength measured in RDA 1 not significantly different from the other RDAs, though the groundwater is deeper in RDA 1.

Despite the fact that the site experienced this large earthquake, no evidence of slope failure is present. Had residue in the RDA 1 slopes liquefied in the 1974 event, evidence of slope failures and flows would remain. Similarly, dike slope failures in the gypsum should have left evidence, even after nearly 40 years. Liquefaction of residue sands or cyclic softening and liquefaction of residue fines within the flatter central areas of the RDAs could have occurred, with evidence in the form of sand boils or similar features that could have been eradicated by subsequent erosion and/or concealed in the vegetation.

Earthquake magnitude (the commonly referenced “Richter Scale”) is a measure of the total energy released by the earthquake. This can come from a relatively short duration of greater magnitude shaking or a longer duration of lesser magnitude shaking. Published correlations suggest a magnitude 5.0 to 5.9 earthquake might produce PGAs in the range of 0.09 to 0.34 gravity (g). PGA is typically described in terms of bedrock motion on USGS earthquake hazard mapping, and must be amplified through the soil overburden. Soils between the bedrock and the residue at the Site are generally medium dense sands of the Cahokia and Henry formations, so a seismic site class of D per the International Building Code (IBC) 2006 version would apply. For site class D, amplification of PGA would range from 1.6 for PGAs less than or equal to 0.1 to 1.1 for PGAs around 0.4. Hence, the PGA of the 1974 earthquake was probably between 0.14 and 0.40g.

4.6.6 Conclusion

Based on our analysis, the seismic event (earthquake) with an annual probability of exceedance of 0.003 or about once in 300 years, would produce a bedrock PGA of about 0.06g. Such an event would produce a maximum CSR of about 0.12 at a depth of 23 feet. Assuming 60 percent of the residue s_u of 260 or about 156 psf represents the weaker portion of the residue fines, residue fines below about 23 feet would start to liquefy. This would generally be below the bottom of residue in IB 4a, so no cyclic softening or liquefaction of residue should occur in there.

In RDAs 1, 2, and 3, some liquefaction or cyclic softening of residue fines would likely begin at these depths, which would be near the bottom of RDA 2 and RDA 3. When liquefied, the residue fines lose shear strength but remain somewhat viscid. Liquor/porewater does not separate from the solids and density does not, therefore, change. At these depths, the residue is apparently less thixotropic than at shallower depths. Therefore, we would not expect that liquefaction of the deeper residue, as may have occurred in 1974, would cause residue fines to be ejected at the surface or result in settlement during the relatively short duration of the earthquake. Over relatively short time periods, the residue fines would recover and return to the pre-liquefied conditions.

In the residue sand, similar PGAs would produce a maximum CSR of about 0.7 at a depth of nearly 30 feet. Per Idriss and Boulanger 2008, Figure 71, this CSR is below the range for which liquefaction has been observed in sands, even very loose sands like the residue.

For larger, rarer earthquakes, more and shallower deposits of residue fines and sands could liquefy, potentially creating sand and mud boils at the surface and settlement of the adjacent areas. For slightly larger/rarer events, such effects would likely be localized and likely to impact only a few panels (should future construction of the utility scale solar project occur). For major events, liquefaction and cyclic softening may be more widespread. However, the solar arrays are relatively light and the bridge lift and geotextile would, to some extent, act as a raft to float the panels. Even in relatively major shaking and widespread liquefaction of residue sands or liquefaction of fines, we anticipate that most panels would remain at the surface and, after a brief time to allow residue to recover strength for access, could be recovered.

4.6.7 Ground Improvement

Ground improvement methods to reduce the risk of liquefaction are available. Typical ground improvement methods include construction of stone columns, deep densification, consolidation with wicks and preload, and others. Each of these methods detrimentally impact the residue either through the dynamics of the process itself or the construction traffic related to its implementation. Additionally, the cost and time required to treat the large mass of residue would be prohibitive for the project.

4.7 VEGETATIVE SUPPORT LAYER

Current exposed gypsum slopes are relatively bare and generally do not support vegetation. Slopes appear relatively resistant to erosion and new gypsum slopes constructed should be similarly erosion resistant. However, we recommend a minimum of two feet of clean fill be placed over the gypsum as cover; the upper 6-inches must be soil that can support establishment and growth of erosion control grassing.

4.8 WEST POND STORMWATER DIKE

The planned stormwater ponds in RDA 2 and IB 4a are already in existence and will be further defined by the surrounding bridge layer and do not require new dikes, although drainage ditches or pipes may be added. The planned west pond in RDA 1 is expected to require a new dike along the southwest side of the mined area, in approximately the former RDA 1 dike location. We understand that the west pond will principally hold water as temporary detention, for a matter of hours or days, with only limited permanent storage at a relatively low elevation. As such, the dike may be constructed of gypsum, as outlined for planned buttresses, with a vegetative support layer of 2 feet of local fine grained (silty or clayey) soils over the gypsum above the normal pool elevation. Below that elevation, the existing residue should be bridged with, and the dike should be constructed using, local fine grained soils.

4.9 GRADING/DISTURBANCE OF RESIDUE

The results of our investigation reinforce our earlier opinion that excavation of most soft residue should be kept to a minimum. Disturbance of the finer grained residue deposits will likely result in loss of the residue structure, which will make disturbed areas difficult to access with construction equipment. Excavated residue would likely require substantial drying to allow it to be used as fill.

Firmer residue around the edges of the RDAs, as well as residue sand, will allow for greater grading. However, we anticipate that this material often forms a crust or layer only a few feet thick over softer material, so that grading should generally be kept to a minimum and principally to flatten local anomalies. Levelling of the area should generally be accomplished using fill.

Excavation of gypsum overlying the residue, especially on the southeast portion of RDA 2, should recognize that the removal of all gypsum may expose weak residue. Therefore, we recommend removal of this gypsum by working backwards off the gypsum surface. The gypsum surface will support equipment, while the exposed residue will probably require bridging to support equipment loads.

The necessary exception to disturbing fine grained residue may be to excavate local ditches and/or pipe trenches in the residue for storm drainage. Test pit excavations and experience with residue at RDAs elsewhere in the world suggest that limited, shallow excavation in the residue will be possible, though care will be required to avoid localized slope failure and equipment loss. Excavation through a bridge lift may provide better access to the excavation area, as working from the bare residue surface is likely to cause degradation of the surface. Timber pads may also be considered.

Difficulties with the excavation, including side sloughing, localized liquefaction, etc. should be anticipated and equipment operators should gain experience at the edges. Recognizing these difficulties, trenching and ditching should be kept to the minimum required. Rapid progress may not be feasible, as it may be best to perform limited excavation and allow the sides to drain prior to advancing the excavation, rather than risking more substantial failures. As is evident from the past mining operations, the residue can develop fairly steep slopes, if allowed to drain.

4.10 FILLING/GRADING DEEP GULLIES IN RDA 1

Deep, steep walled erosion gullies such as those in RDA 1 could, in most natural soils, be regraded by entering the gullies, cutting into the steep gully walls, and using the excavated material from the walls to fill the gullies. However, within a foot or two behind the desiccated crust, residue adjacent to the gullies is soft and relatively wet, so that excavation and disturbance could create access difficulties as outlined above and the excavated material could be difficult to compact.

Therefore, we recommend filling the gullies with granular material. This could be gypsum, crushed as described above, or imported natural sand or gravel. The intent would be to fill the gullies with minimal disturbance by pushing a thick enough lift of the material initially into the gully to fill the narrow, lower portion and allow equipment access in the wider area higher in the gully. The initial lift of several feet would likely not be compacted. Compaction of subsequent lifts by tracking, vibratory, or non-vibratory equipment may be possible, but care would be needed to ensure that the gully floor and walls were not in danger of liquefaction.

The deeper, granular fill should compress or consolidate under the weight of the overlying fill. The upper surface of the granular fill should be well choked and watered to provide a uniform, filtered, surface and prevent ravelling of the bridge lift into the granular materials. The bridge lift should be placed as for the other exposed residue areas.

The gullies were once filled with residue mass. Therefore, the underlying residue is generally normally consolidated with respect to the average elevations of RDA 1 (about 455 feet) rather than the current gully configuration which contains significantly less residue. Therefore, we expect relatively minor settlement due to the weight of the new gully fill. However, we recommend monitoring settlement of the gully fill by means of three monuments set into the upper bridge material shortly after placement. We anticipate the project schedule will allow at least 4 to 8 weeks of readings of these monument elevations prior to placement of the panels.

4.11 BRIDGE LIFT FILL PLACEMENT

Placement of the bridge lift was discussed in detail in the Test Strip and Test Load Report, submitted previously (AMEC, November 18, 2011). In brief, nothing in our investigation changes the recommendations in that report for installation of the bridge lift, or placement of geotextile and gravel over the bridge lift should construction of the solar project proceed.

4.12 SOLAR PANEL AND EQUIPMENT FOUNDATIONS

Should future construction of the utility scale solar project occur, panel foundation loads will be minimal, principally due to ballast elements. These loads will be much lower than equipment loads required to place the bridge lift and gravel layers. Nominal bearing pressures are expected to be 500 psf over the small bearing area of the ballast; however total load of the panels and ballasts will be distributed through the bridge lift to produce an areal load on the residue of less than 50 psf.

Heavier equipment, such as transformers, will be located on the gypsum of the perimeter dikes to reduce settlement risks in static or seismic conditions. Loads up to 100 kips may be supported at bearing pressures of 3 ksf on the gypsum placed and compacted as outlined above in the dikes and buttresses. Total and differential settlement expected to be in the order of 1 inch or less. Shaping of buttresses to provide wider flat crest areas as needed to accommodate equipment could be included in the final plan.

4.13 LIMESTONE SOLUTIONING

When bedrock is limestone, there can be a risk of sinkhole formation due to openings in the limestone created by solutioning of the limestone. Significant solutioning of limestone takes thousands of years (i.e., geologic time) and will not occur in the anticipated project life (i.e., engineering time). Sinkhole formation is caused by overburden soils ravelling into existing openings in the rock. Ravelling is normally caused by changes in the stress condition of the soil, primarily by dramatic changes in the groundwater level. Available exploratory technologies (geotechnical or geophysical) cannot reliably detect small openings in the rock, especially when rock is deep.

Risk of sinkhole formation is generally less if:

1. The Site and surrounding area has a well developed surface drainage pattern without observed evidence of disappearing streams, sinkholes, or subsidence. Urban and industrial development of the Site has largely obliterated natural drainage patterns, making this criterion inconclusive.

2. The area has a thick overburden of fine-grained soils that have relatively high strength and low permeability. Such soils will tend to resist ravelling and prevent vertical flow. A layer of natural clay generally overlies the Site below the current development.

3. The limestone occurs well below the static water level. RIR well logs indicate limestone is about 100 feet below the groundwater.

4. No evidence of sinkholes is observed in the surrounding area based on review of maps and aerial photographs. The urban and industrial development has largely obliterated the natural drainage patterns, making this criterion inconclusive.

5. The geologic formations in which the site occurs are not considered to have a high sinkhole risk based on historic experience. Review of two documents published by the Illinois Geologic Survey, namely *Sinkhole Plain Area Assessment, 1998* and *Sinkhole Density and Distribution of Cahokia Quadrangle, 2009,* documents sinkholes several miles southwest of the Site, but not in close proximity to the Site.

6. The area is in proximity to major surface water bodies that communicate with the groundwater and will act to reduce potential changes in the groundwater level. The Mississippi River and several lakes occur near the Site.

7. The surrounding area does not include major users of groundwater, such as well fields or large agricultural wells that would tend to draw down the groundwater level. Local regulations generally prohibit use of groundwater.

Therefore, although factors 1 and 4 are inconclusive and factor 2 is only partially met (the natural clay layer is not continuous to the limestone), based on factors 3, 5, 6, and 7 the risk of future sinkhole development in OU-1 should be small.

4.14 LONG TERM STABILITY

The residue, while relatively soft and weak, is stable in time as compared to other waste fills (such as municipal solid waste) that contain significant organic or other materials that degrade and lose substantial volume over time due to chemical, physical, or biological processes. The residue is approximately analogous to a soft, alluvial deposit as might occur in a pond or swamp, though without organic inclusions common in swamp deposits. As indicated by the test load and OCR correlations from CPT, the material is normally to over consolidated with respect to existing loads. The additional loads planned are relatively minor on a distributed basis (probably less than 300 psf over the entire area) and will cause only slight additional consolidation. We do not expect settlement that will adversely impact the proposed Remedy or solar panels (should future construction of the utility scale solar project occur).

The other long term stability consideration will be the potential for liquefaction/cyclic softening in the event of a major seismic event. As outlined above, we expect risks of significant impacts to stability to be small at less than the 300 year event and increasing risk and higher magnitude/lower frequency events.

Based on the data generated during the Field Test Strip and Test Load Program and this Pre-Design Investigation, we are confident that installation of a two-foot bridging layer over the RDA surfaces will be feasible, with sufficient long term stability to be a final remedy for the site. Furthermore, the bridging layer will provide an acceptable and stable platform to support solar panels should future solar redevelopment of the site occur.

4.15 FROST HEAVE

Per NRCS publications, the frost depth in East Saint Louis is 15 inches. The bridge layer will be 24 inches thick, therefore, frost will not reach the underlying residue.

5.0 LIMITATIONS

This document was prepared for the sole use of Restoration Land, LLC, the only intended beneficiary of our work. No other party shall rely on the information contained herein without prior written consent of AMEC. Our evaluation of construction conditions has been based on our understanding of the site and project information and is preliminary and subject to change. The forgoing discussion should be viewed in this light and considered only for preliminary conceptual development.

We note that man-made deposits have the potential to be extremely variable and non-uniform over short horizontal and vertical distances. Geotechnical practices such as interpolation between widely spaced borings, developed and reasonably effective in characterizing natural formations, are much less effective. In the absence of detailed records of placement of the various man-made materials, rigorous site characterization would have required an impractically large number of exploratory points at very close spacings. Our effort should not be considered a rigorous site characterization, but rather an assessment of average conditions and probably captured at least some information in relatively poor (perhaps lowest quartile) conditions prevailing across the Site. Design should consider this and apply appropriate risk and safety factors.

Our professional services have been performed, our findings derived, and our preliminary recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. This company is not responsible for the conclusions, opinions, or recommendations of others based on these data. The assessment of site environmental conditions or the detection of pollutants in the soil or groundwater was beyond the scope of this exploration.

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Subsurface Data

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Key to Symbols

CPT Logs

Boring Logs

Piezometer Logs

Test Pit Logs

ReMi Profiles

Monitoring Well Logs (by others)

Selected Boring Logs (by others)

APPENDIX B

Laboratory Data

Laboratory Procedures

Grain Size Curves

Consolidation Tests

Gypsum Drying Tests

Gypsum Chemistry Tests

APPENDIX C

EZ-Frisk Seismic Analysis

APPENDIX D

Slope Analysis Output

TABLES

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Table 1: Piezometer Summary
Former Alcoa East St. Louis Operable Unit 1
AMEC Project: 3410-10-0782.10

Area	Location	Top of Ground Elevation	Termination Elevation	Groundwater Elevation	Top of Natural Ground
		(feet)	(feet)	(feet)	(feet)
1C	PZ-1	432.0	410	426.7	NE
1C	PZ-2	432.0	410	426.2	NE
1C	PZ-3	432.0	413	426.0	NE
1C	PZ-4	432.4	419	427.8	NE
4A	PZ-5	422.6	403	419.1	407
4A	PZ-6	424.2	399	415.1	402
4B/Gulch	PZ-7	430.1	400	419.7	403
1A	PZ-8	458.3	398	423.0	401
1A	PZ-9	454.2	399	430.8	402
1C	PZ-10	433.2	409	428.2	NE
1A	PZ-11	458.3	401	430.1	403
1A	PZ-12	422.4	402	419.6	405
1C	PZ-13	431.7	408	431.6	408
1C	PZ-14	432.4	408	430.4	409
1B	PZ-15	434.0	414	425.1	NE
1B	PZ-16	429.5	410	427.8	413
3B	PZ-17	420.9	403	415.2	411
3B	PZ-18	411.1	391	404.4	411
W of 4A	B-1	418.2	401	411	406
4A	B-2	427.0	397	Cave 411	402
4A	B-3	426.5	402	Cave 410	405
4A	B-4	426.6	402	Cave 413.5	405
Gulch	B-5	427.9	393	Cave 410	406
1C	B-6	441.5	397	421	402
3B	B-7	423.3	393	403	408
3B	B-7A	422.5	407	Cave 415	409
W of 1A	B-8	418.9	402	418	405
1C	B-9	437.6	388	426	404
1C	B-10	442.8	383	421	406
1A	B-11	460.1	395	435	401
1C	B-12	443.7	404	Cave 432	415
1C	B-13	442.1	402	Cave 425	408
1C	B-14	438.8	425	NE	NE
1C	B-14A	439.5	400	NE	407
1C	B-15	442.5	407	418	408
1C	B-16	441.8	407	418	408
3B	B-17	421.2	386	416	407
3B	B-17A	421.5	381	416	398
3B	B-18	422.8	408	415	409
3B	B-18A	422.7	388	415	409
1B	B-19	441.8	402	431	409
1B	B-20	444.4	404	Cave 427	412
3B	B-21	421.7	397	420	402
3B	B-22	423.0	403	416	411

NE - Not Encountered
Cave - Boring Collapsed at This Elevation, Often, Borings Collapse near the Groundwater Level
Groundwater Levels in PZ-4 through PZ-18 measured 1-15 to 1-17-12.
Other levels measured at various times, typically shortly after drilling.
Comparison should recognize potential for several feet of variation over short time spans.

Table 2: Vane Shear Results
Former Alcoa East St. Louis Operable Unit 1
AMEC Project: 3410-10-0782.10

Area	Location	Depth feet	Su Initial psf	Residual psf	Sensitivity Ratio	Remarks
1A	PZ-9	10	650	130	5	
1A	PZ-9	17	650	320	2	
1A	PZ-9	32	650	320	2	
1A	PZ-9	42	650	390	2	
1A	PZ-8	57	260	260	1	
1A	VS-1	3	455	130	4	
1A	VS-2	3	650	260	3	
1A	VS-3	3	650	230	3	
1A	VS-4	3	650	130	5	
1A	VS-5	3	520	130	4	
1B	PZ-4	2	650	40	16	
1B	PZ-4	2	390	100	4	Recovery after 16 hours
1B	PZ-16	7	170	25	7	
1B	PZ-14	4	240	50	5	
1C	CPT-13	4	420	25	17	Static
1C	CPT-13	4	320+			Dynamic, 40+ Cycles at 1 Hz
1C	CPT-13	4	390			Dynamic, 28 Cycles at 1 Hz
1C	CPT-13	4	380	25	15	Static
1C	CPT-13	4	130	25	5	Recovery after 40 minutes
1C	CPT-15	4	360	40	9	
1C	CPT-15	4	180	25	7	
1C	CPT-15	4	450	25	18	
1C	CPT-15	4	260			Dynamic, 11 cycles at 1 Hz
1C	CPT-15	4	260			Dynamic, > 50 cycles at 1 Hz
1C	CPT-15	4	580	25	23	
1C	PZ-10	6	170	25	7	
1C	PZ-14	10	270	50	5	
1C	PZ-10	11	160	25	6	
1C	PZ-13	12	170	25	7	
1C	PZ-10	17	220	70	3	
1C	PZ-14	18	240	150	2	
1C	PZ-13	21	240	55	4	
1C	PZ-10	24	240	120	2	
4A	PZ-5	8	450	60	8	
4A	PZ-6	9	450	60	8	
4A	PZ-5	13	440	80	6	
4A	PZ-6	17	580	190	3	

Table 3A Summary of Laboratory Testing, Residue and Alluvium

RDA	Boring	Depth (feet)	Moisture Content	Fines	LL	PI	Dry Density (pcf)	Calc. Dry Density (pcf)	Calc. Solids by Weight	Permeability (cm/sec)	pH
1A	1aUP001	0-2	65%	87%							
1A	1aUP001	2-4	51%	89%			52				
1A	1aUP001	9-11					55				
1A	1aUP001	16-18					59				
1A	1aUP001	30-32					61				
1A	1aUP001	23-25					61				
1A	1aUP001	23.5-25	68%					59	59%		
1A	1aUP003	0-2	65%	98%	54	8	54			2.00E-06	
1A	1aUP003	2-4	63%		40	5	64				
1A	1aUP005	0-2	29%	94%							
1A	1aUP008	2-4	67%								
1A	1aUP008	9-11	70%					58	59%		
1A	1aUP008	13.5-15	64%					62	61%		
1A	1aUP008	16-18	81%				54	53	55%	3.80E-07	
1A	1aUP008	28-30	68%	99%	61	18		59	60%		
1A	1aUP008	30-32	66%	100%	62	17		61	60%		
1A	1aUP018	0-2	28%	26%							
1A	1aUP018	2-4	32%	68%							
1A	1aUP018	16-18	65%	81%	51	6	62	61	61%		
1A	1aUP018	18.5-20	41%					80	71%		
1A	1aUP018	25-27	68%	92%	39	5		59	60%		
1A	1aUP018	28.5-30	41%					80	71%		
1A	1aUP018	32-34	67%	92%	54	10	56	60	60%		
1A	1aUP018	33.5-35	65%					61	61%		
1A	1aUP018	38.5-40	44%					77	69%		
1A	1aUP018	43.5-45	72%					57	58%		
1A	1aUP018	48.5-50	75%					56	57%		
1A	1aUP018	53.5-55	59%					65	63%		
1A	PZ-11	3.5-5	41%								
1A	PZ-11	8.5-10	78%					54	56%		
1A	PZ-11	13.5-15									10.1
1A	PZ-11	53.5-55									10.8
1A	PZ-8	0-1.5	33%								8.2

RDA	Boring	Depth (feet)	Moisture Content	Fines	LL	PI	Dry Density (pcf)	Calc. Dry Density (pcf)	Calc. Solids by Weight	Permeability (cm/sec)	pH
1B	1bUP001	0-2	52%	11%	51	24					
1B	1bUP001	2-4	55%	13%	45	7.					
1B	1bUP001	9-11	36%	11%				85	74%		
1B	1bUP001	18-20	27%	24%				97	79%		
1B	1bUP001	23-25	51%	14%				71	66%		
1B	1bUP003	0-2	90%	99%	103	32	51				
1B	1bUP003	2-4	67%	45%	81	26	43				
1B	1bUP003	9-11	43%		37	3		78	70%		
1B	1bUP003	18-20	123%	97%	89	36		39	45%		
1B	1bUP003	23-25	97%	99%	112	28	45	45	51%		
1B	1bUP003	30-32	40%	97%	67	36	83	83	71%		
1B	1bUP005	0-2	59%	99%	66	8	72			5.30E-07	
1B	1bUP005	2-4	37%	54%	48	9					
1B	1bUP005	11-13	36%	54%	52	27		85	74%		
1B	1bUP005	13.5-15	75%					55	57%		
1B	1bUP005	18-20	70%	98%	54	10		58	59%		
1B	1bUP005	23-25	97%	96%	81	53	82	47	51%		
1B	1bUP005	30-32	37%	87%	so	23	79	84	73%		
1B	1bUP009	0-2	58%	91%	43	8	67				
1B	1bUP009	2-4	62%	62%	49	13	63			1.60E-06	
1B	1bUP009	3.5-5	66%					60	60%		
1B	1bUP009	8.5-10	73%					57	58%		
1B	1bUP009	9-11	68%	82%	53	6		59	60%		
1B	1bUP009	12-15	59%	45%	38	4		65	63%		
1B	1bUP009	18.5-20	100%					46	50%		
1B	1bUP009	18-20	75%	99%	61	15		56	57%		
1B	1bUP009	23-25	86%	81%	59	12	37	51	54%		
1B	1bUP009	30-32	36%	87%	32	10		85	74%		
1B	PZ-15	0-1.5	48%					74	68%		8.7
1B	PZ-15	13.5-15	77%					55	57%		
1B	PZ-16	0-1.5	72%					57	58%		

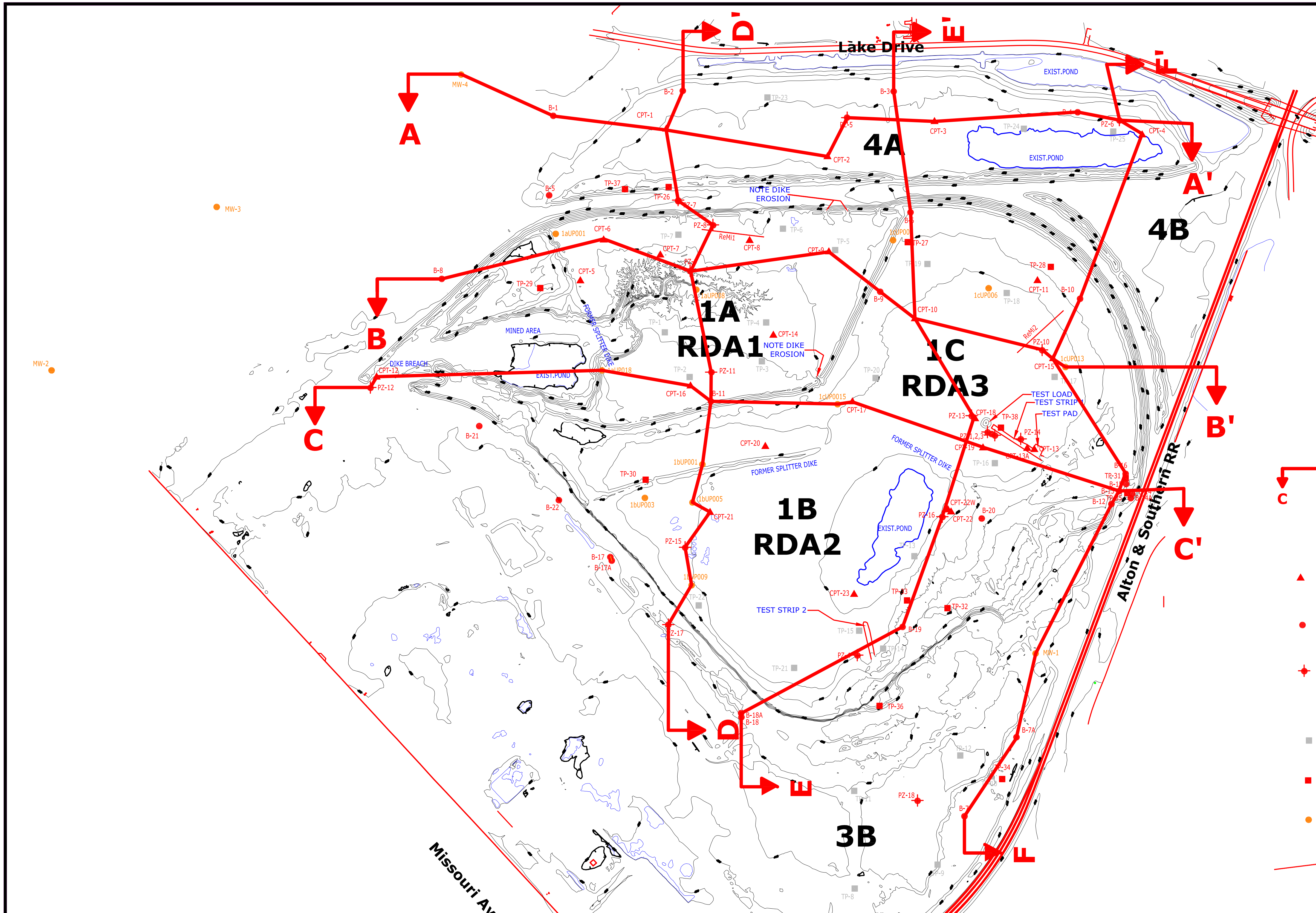
RDA	Boring	Depth (feet)	Moisture Content	Fines	LL	PI	Dry Density (pcf)	Calc. Dry Density (pcf)	Calc. Solids by Weight	Permeability (cm/sec)	pH
1C	1cUP001	0.2	55%	67%	49	18					
1C	1cUP001	2-4	41%	84%	32	1					
1C	1cUP001	9-11	81%	48%	52	0		53	55%		
1C	1cUP001	16-18	42%	83%	37	3		79	70%		
1C	1cUP006	0.2	31%	97%	44	9					
1C	1cUP006	2-4	70%	91%	49	7	70				
1C	1cUP006	9-11	67%	84%	52	8	57	60	60%		
1C	1cUP006	16-18	72%	100%	66	21		57	58%		
1C	1cUP006	23-25	83%	97%	59	13		52	55%		
1C	1cUP013	0.2	52%	67%	45	12	72				
1C	1cUP013	2-4	63%	98%	42	5					
1C	1cUP013	9-11	55%	84%			62	68	65%		
1C	1cUP013	16-18	50%	50%	40	1		72	67%		
1C	1cUP015	().2	38%	88%	34	3				1.10E-06	
1C	1cUP015	2-4	45%	91%	39	6					
1C	1cUP015	9-11	61%	98%	43	3	54	64	62%		
1C	1cUP015	16-18	64%	90%	45	4		62	61%		
1C	1cUP015	23-25	85%	94%	62	13	51	51	54%		
1C	B-9	0-1.5	46%								
1C	B-9	8.5-10	45%					76	69%		
1C	B-9	13.5-15	39%					82	72%		
1C	B-9	18.5-20	41%					80	71%		
1C	B-9	23.5-25	53%					70	66%		
1C	B-9	28.5-30	45%					76	69%		9.9
1C	PZ-10	0-1.5	55%								9.5
1C	PZ-10	8.5-10	72%					57	58%		
1C	PZ-10	13.5-15	74%					56	57%		
1C	PZ-10	20.5-22	75%					56	57%		
1C	PZ-13	0-1.5	47%								9.3
1C	PZ-13	2-4									9.3
1C	PZ-13	12-13.5	60%					65	63%		9.9
1C	PZ-13	13.5-15.5									10.2
1C	PZ-13	15.5-17	87%					50	53%		
1C	PZ-13	22.5-24	77%					55	57%		
1C	PZ-13	22.5-24	77%					55	57%		

RDA	Boring	Depth (feet)	Moisture Content	Fines	LL	PI	Dry Density (pcf)	Calc. Dry Density (pcf)	Calc. Solids by Weight	Permeability (cm/sec)	pH
4A	4aUP010	0.2	54%	90%			59				
4A	4aWL004	9-11	74%	100%	63	18	55	56	57%		
4A	PZ-5	0-1.5	76%					55	57%		10.2
4A	PZ-5	3.5-5	76%					55	57%		
4A	PZ-5	8.5-10	74%					56	57%		
4A	PZ-5	13.5-15	82%					53	55%		11.2
4A	PZ-6	0-1.5	83%					52	55%		
4A	PZ-6	6-7.5	80%					53	56%		
4A	PZ-6	13.5-15	64%					62	61%		

TABLE 3B Summary of Laboratory Testing, Gypsum

Boring	Depth (feet)	Moisture Content	Fines	LL	PI	Dry Density (pcf)
2UP001	0-2	23%	100%			
2UP001	2-4	13%	21%			
2UP001	9-11	25%	40%			
2UP001	10-12	13%	41%			
2UP002	2-4	59%	97%	48	2	
2UP002	9-11	20%	100%			
2UP004	0-2	21%	49%			
2UP004	2-4	19%	43%			
2UP004	16-18	23%	52%			
2UP004	30-32	43%	44%	39	2	
2UP005	0-2	49%	47%			
2UP005	2-4	58%	98%			
2UP005	9-11	41%	99%			
2UP006	0-2	18%	55%			
2UP007	0-2	29%	30%			
2UP007	2-4	41%	47%	43	0	
2UP008	0-2	23%	37%			
2UP008	2-4	17%	33%			
B-12	Surface	17%				
B-14	0-22	19%				
TP36	9	19%				
TP30	10-15	21%				
TP33	Surface	15%				
TP33	1	13%				
TP32	1	15%				
TP30	10	20%				
TP35	12	19%				
TP28	1	17%				

FIGURES



Legend

Subsurface Section (C — C')

0 500 1000
APPROX. SCALE IN FEET

▲ CPT PROBE (CPT-1 THRU CPT-23)

● SPT BORING (B-1 THRU B-22)

✦ SPT BORING WITH PIEZOMETER (PZ-5 THRU PZ-18)

■ TEST PIT (2010)

■ TEST PIT WITH HEAVY TRACKHOE (2011)

● WELLS/BORINGS FROM RIR

ReMi Traverse

0 500 1000
SCALE IN FEET

FORMER ALCOA EAST ST. LOUIS
OPERABLE UNIT 1
EAST ST. LOUIS, ILLINOIS

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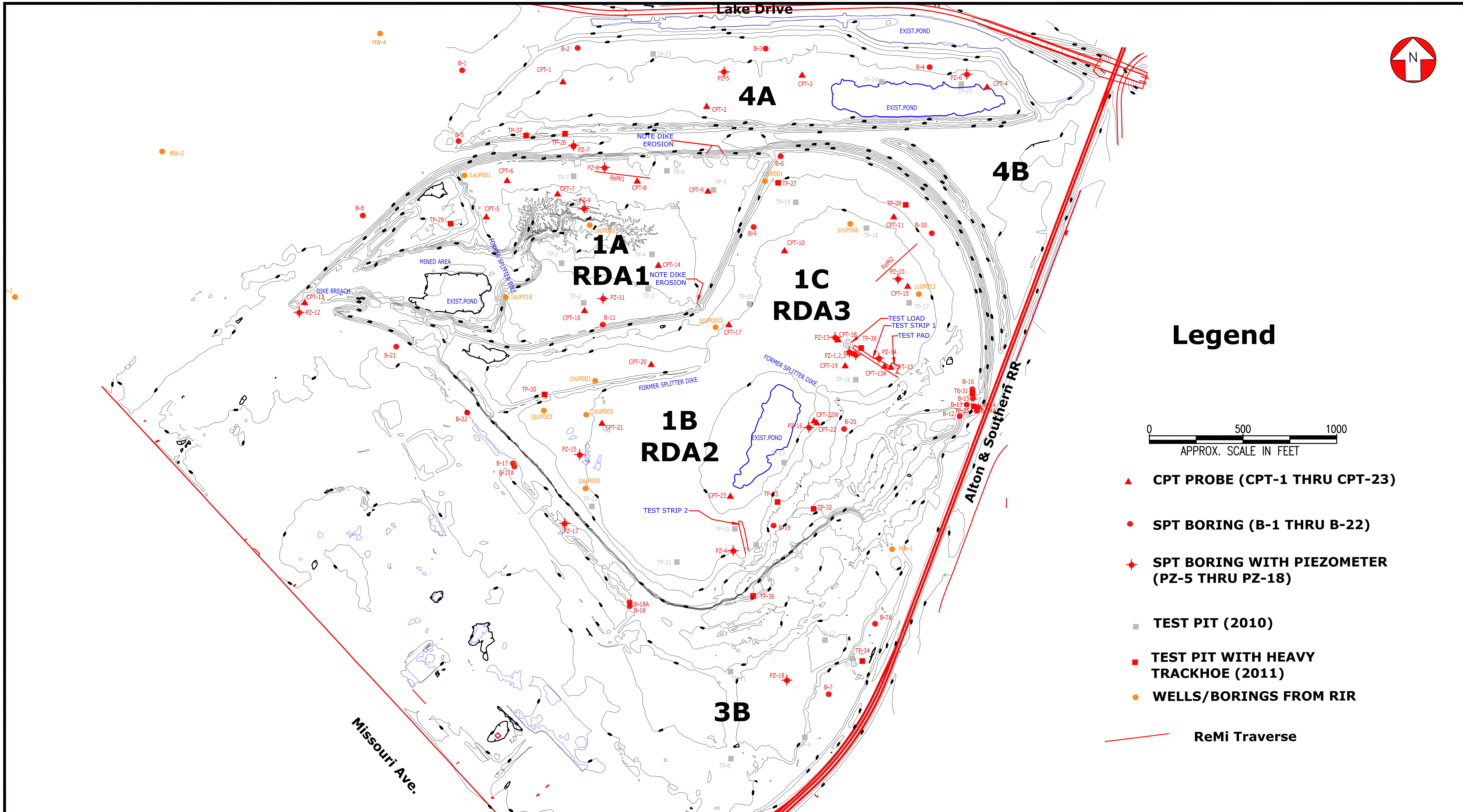
GEOTECHNICAL
CROSS SECTION
PLAN

JOB NO. 3410-10-0782.9.2 FIGURE 2

PREPARED BY/DATE AAW 2-1-2012
CHECKED BY/DATE PDP 2-1-2012



FORMER ALCOA EAST ST. LOUIS
OPERABLE UNIT 1
EAST ST. LOUIS, ILLINOIS

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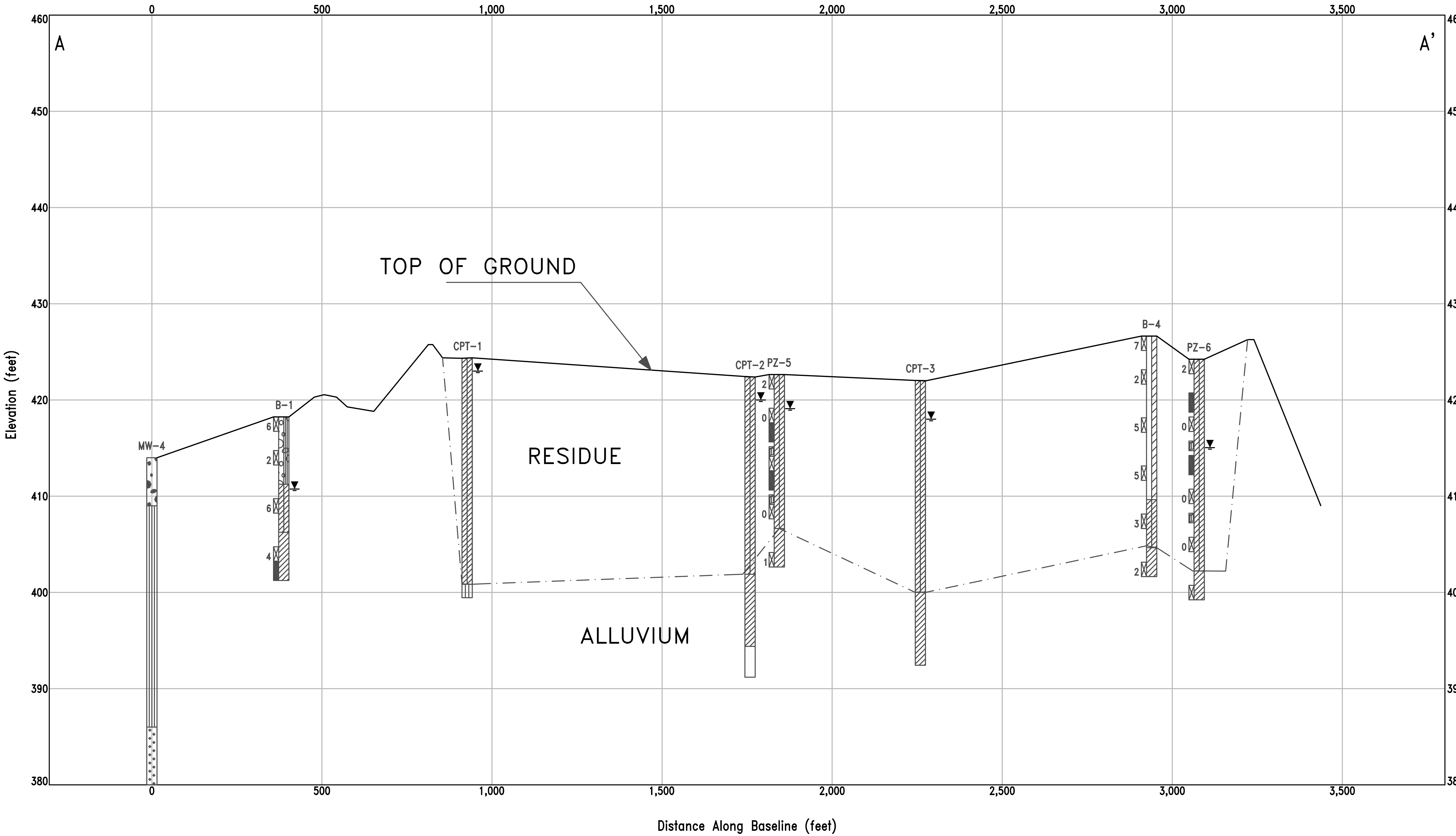
ATLANTA, GEORGIA 30324 (404) 873–4761

GEOTECHNICAL
EXPLORATION PLAN

JOB NO. 3410–10–0782.9.2 FIGURE 1

PREPARED BY/DATE AAW 2–1–2012
CHECKED BY/DATE PDP 2–1–2012



NOTES:

WHILE INDIVIDUAL TEST BORING RECORDS ARE CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS ON THE DATES SHOWN, IT IS NOT WARRANTED THAT THEY ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

THE SUBSURFACE CONDITIONS SHOWN ON THESE PROFILES ARE NOT WARRANTED BUT ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND ENGINEERING JUDGEMENTS.

LEGEND:

- USCS Poorly-graded Gravel with Silt
- USCS Low Plasticity Clay
- USCS Silty Sand
- USCS Well-graded Gravel
- USCS Well-graded Sand
- USCS Low Plasticity Silty Clay
- USCS Poorly-graded Sand with Clay
- USCS Poorly-graded Sand
- USCS Silt
- Groundwater Level After 24 Hours
- Standard Penetration Test
- Undisturbed Sample

SUBSURFACE PROFILE A-A'

Figure 3

Reviewed Pieter J. DePree

Drawn M. Herrera

Scale As Shown

Date 02-29-12

Task 10.1

Phase N/A

Project No. 3410-10-0782

FORMER ALCOA EAST ST. LOUIS
OPERABLE UNIT 1
EAST ST. LOUIS, ILLINOIS

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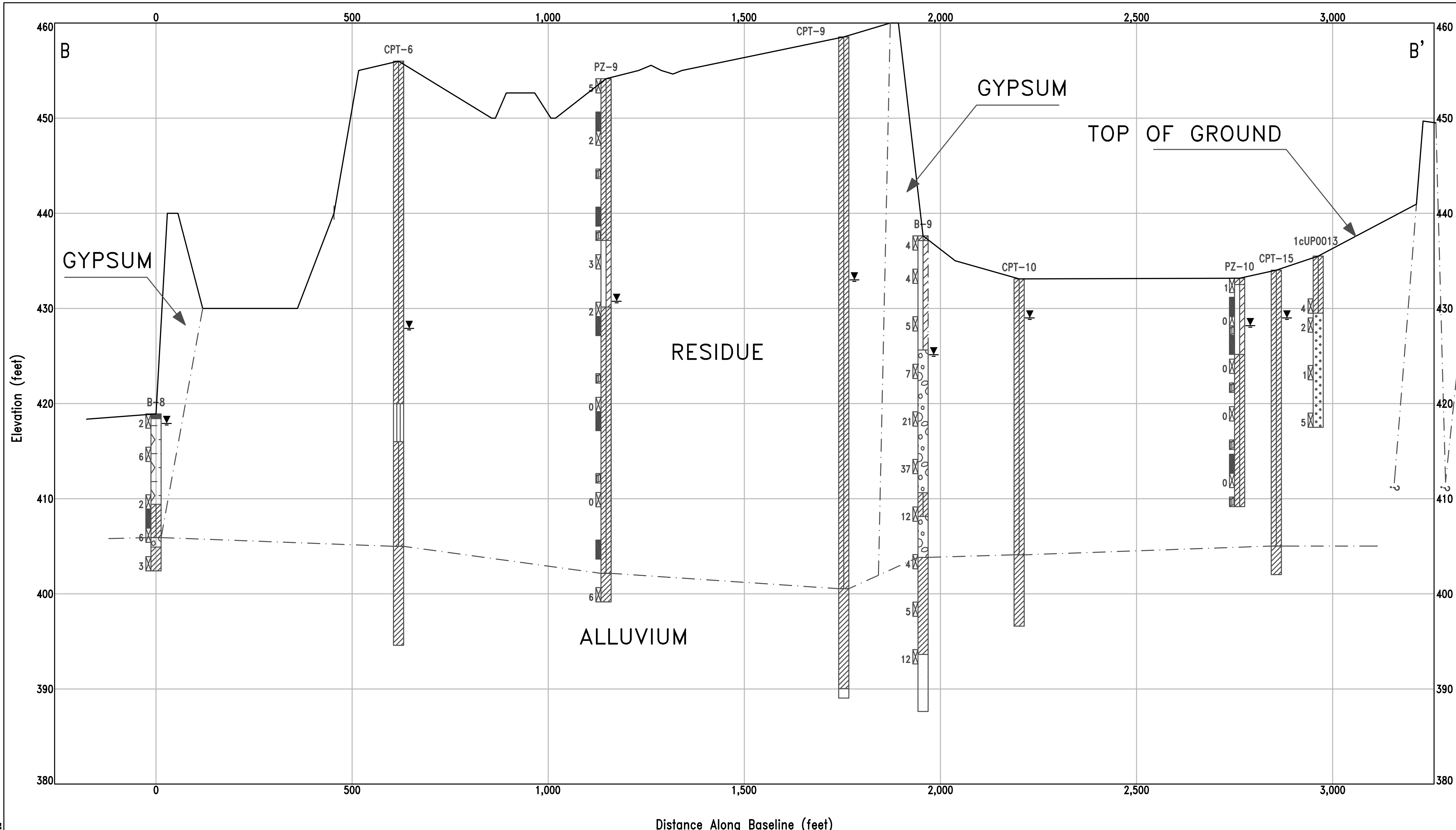

NOTES:

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THE SUBSURFACE CONDITIONS SHOWN ON THESE PROFILES ARE NOT WARRANTED BUT ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND ENGINEERING JUDGEMENTS.

LEGEND:

- USCS Low Plasticity Silty Clay
- Asphalt
- USCS Poorly-graded Sandy Gravel
- USCS Poorly-graded Sand with Clay
- USCS Silty Sand
- USCS Well-graded Sand
- Gypsum, Rocksalt, etc.
- USCS Low Plasticity Clay
- USCS Poorly-graded Sand
- Groundwater Level After 24 Hours
- Standard Penetration Test
- Undisturbed Sample

SUBSURFACE PROFILE B-B'

FORMER ALCOA EAST ST. LOUIS
OPERABLE UNIT 1
EAST ST. LOUIS, ILLINOIS

Figure	Reviewed	Drawn	Scale	Date	Task	Phase	Project No.
4	Pieter J. DePree	M. Herrera	As Shown	02-29-12	10.1	N/A	3410-10-0782

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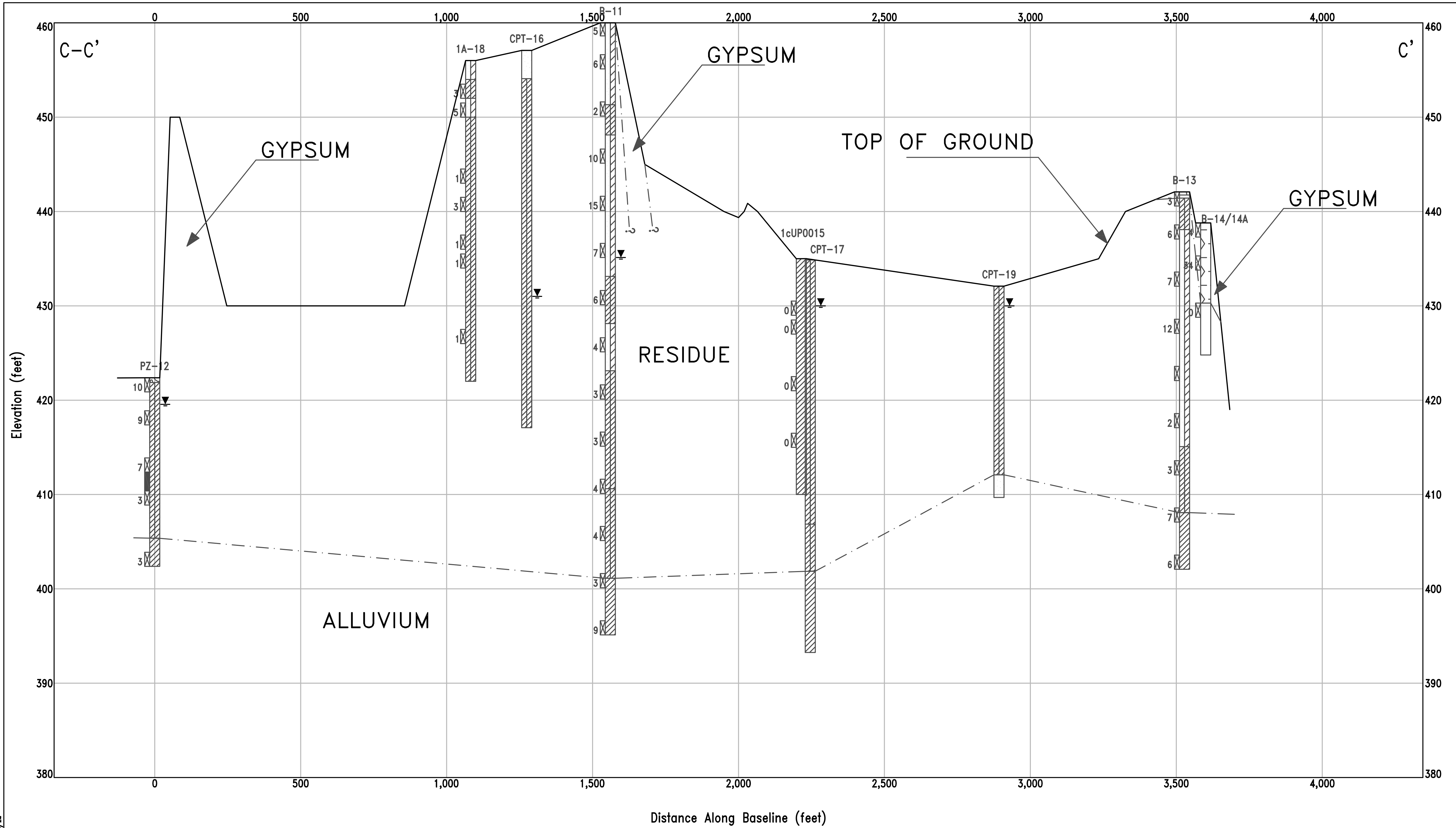

NOTES:

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THE SUBSURFACE CONDITIONS SHOWN ON THESE PROFILES ARE NOT WARRANTED BUT ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND ENGINEERING JUDGEMENTS.

LEGEND:

- USCS Poorly-graded Sand with Clay
- USCS Low Plasticity Clay
- Gypsum, Rocksalt, etc.
- Graded Aggregate Base
- USCS Low Plasticity Silty Clay
- Topsoil
- USCS Poorly-graded Sand
- AR Auger Refusal
- BT Boring Terminated
- Standard Penetration Test
- Undisturbed Sample
- Groundwater Level At Time Of Boring
- Groundwater Level After 24 Hours

FENCE 11X17 BORING LOGS.GPJ LAW_GIBB.GDT 2/3/12

SUBSURFACE PROFILE C–C'

FORMER ALCOA EAST ST. LOUIS
OPERABLE UNIT 1
EAST ST. LOUIS, ILLINOIS

Figure	5
Reviewed	Pieter J. DePree
Drawn	M. Herrera
Scale	As Shown
Date	02-29-12
Task	10.1
Phase	N/A
Project No.	3410-10-0782

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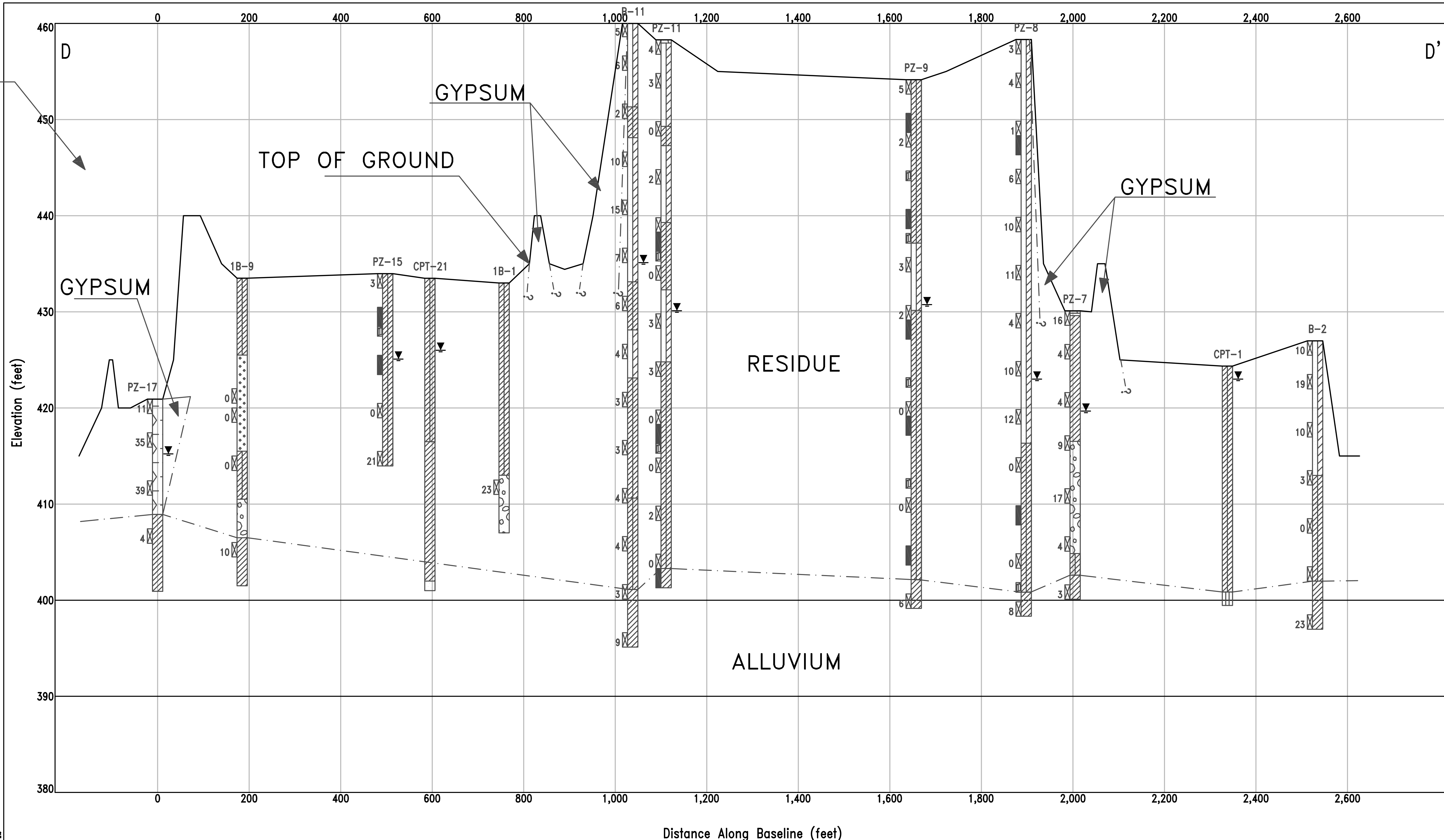

NOTES:

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THE SUBSURFACE CONDITIONS SHOWN ON THESE PROFILES ARE NOT WARRANTED BUT ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND ENGINEERING JUDGEMENTS.

LEGEND:

- USCS Low Plasticity Silty Clay
- USCS Well-graded Sand
- USCS Poorly-graded Sand with Clay
- USCS Poorly-graded Sand
- Gypsum, Rocksalt, etc.
- USCS Poorly-graded Sandy Gravel
- USCS Low Plasticity Clay
- USCS Silty Sand
- Topsoil
- AR Auger Refusal
- BT Boring Terminated
- Standard Penetration Test
- Undisturbed Sample
- Groundwater Level At Time Of Boring
- Groundwater Level After 24 Hours

SUBSURFACE PROFILE D-D'

FORMER ALCOA EAST ST. LOUIS
OPERABLE UNIT 1
EAST ST. LOUIS, ILLINOIS

Project No.	Phase	Task	Date	Scale	Drawn	Reviewed	Figure
3410-10-0782	N/A	10.1	02-29-12	As Shown	M. Herrera	Pieter J. DePree	6

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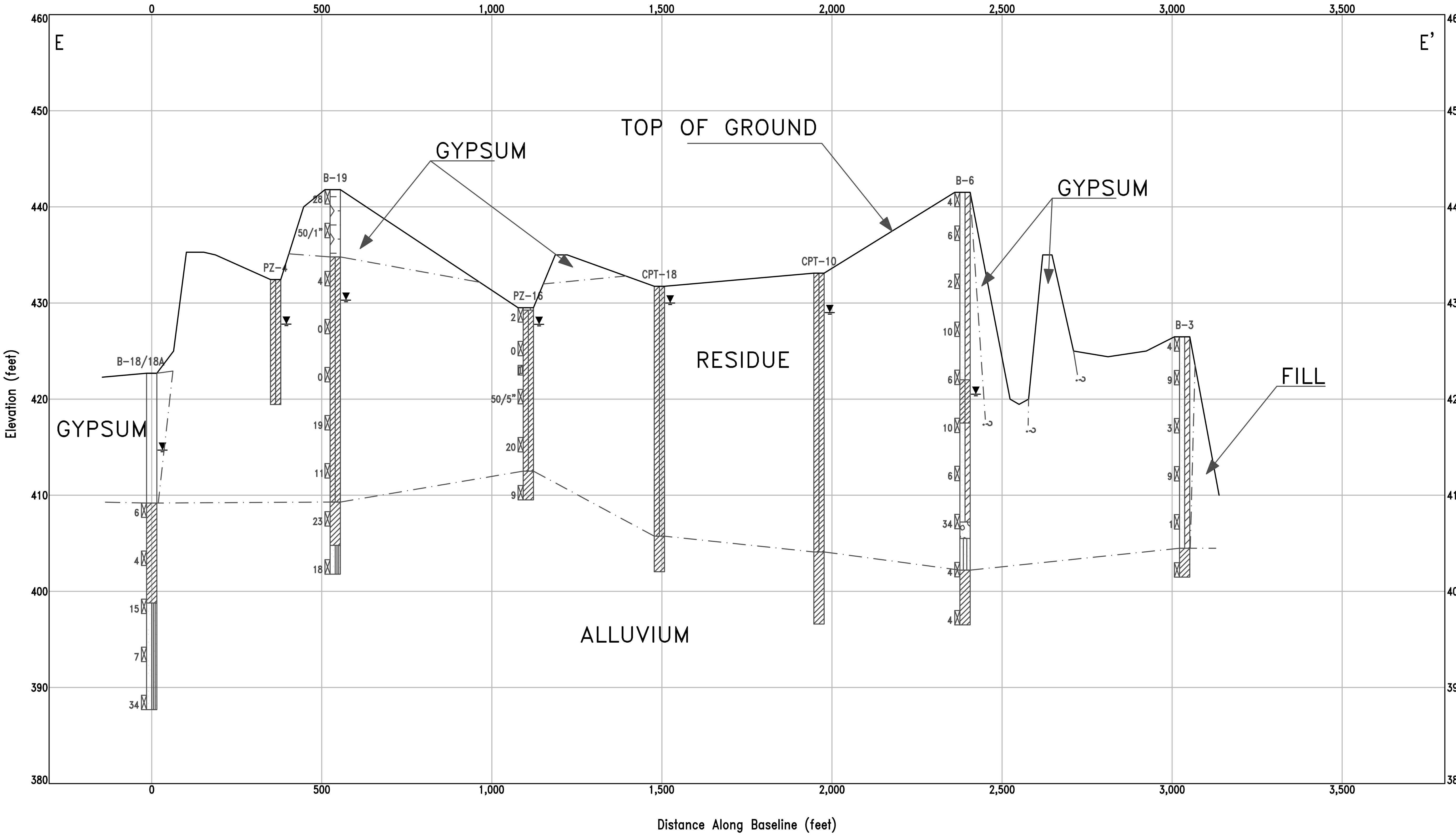
FENCE 11X17 BORING LOGS.GPJ LAW_GIBB.GDT 2/3/12



NOTES:

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THE SUBSURFACE CONDITIONS SHOWN ON THESE PROFILES ARE NOT WARRANTED BUT ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND ENGINEERING JUDGEMENTS.

LEGEND:

- USCS Low Plasticity Clay
- Gypsum, Rocksalt, etc.
- USCS Poorly-graded Sand with Clay
- USCS Silty Sand
- USCS Poorly-graded Sand with Silt
- USCS Low Plasticity Silty Clay
- USCS Poorly-graded Sandy Gravel
- Topsoil
- AR Auger Refusal
- BT Boring Terminated
- Standard Penetration Test
- Vane Shear
- Groundwater Level At Time Of Boring
- Groundwater Level After 24 Hours

FENCE 11X17 BORING LOGS.GPJ LAW_GIBB.GDT 2/3/12

SUBSURFACE PROFILE E-E'

FORMER ALCOA EAST ST. LOUIS
OPERABLE UNIT 1
EAST ST. LOUIS, ILLINOIS

Project No.	Phase	Task	Date	Scale	Drawn	Reviewed	Figure
3410-10-0782	N/A	10.1	02-29-12	As Shown	M. Herrera	Pieter J. DePree	7

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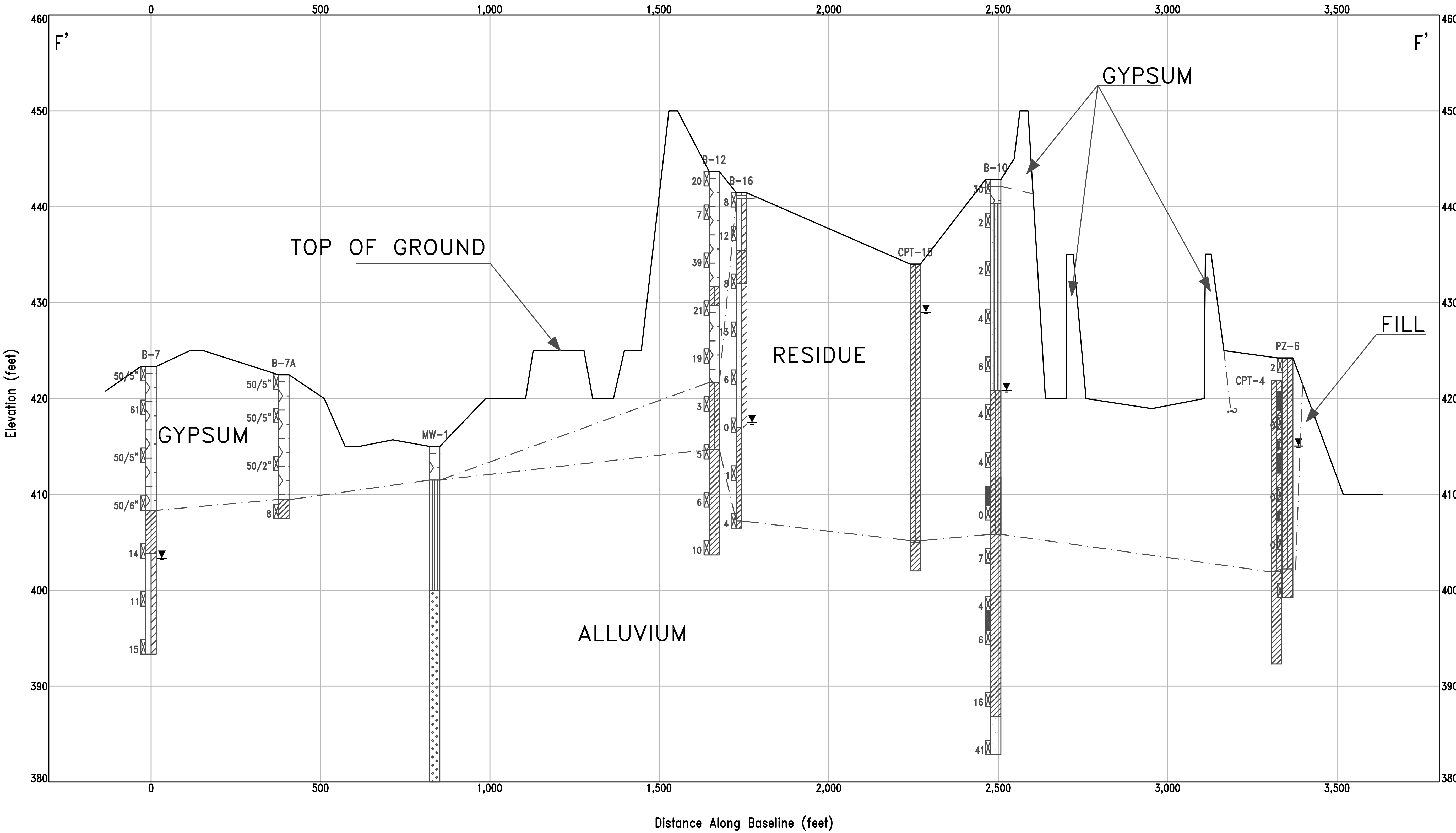

NOTES:

WHILE INDIVIDUAL TEST BORING RECORDS ARE CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS ON THE DATES SHOWN, IT IS NOT WARRANTED THAT THEY ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

THE SUBSURFACE CONDITIONS SHOWN ON THESE PROFILES ARE NOT WARRANTED BUT ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND ENGINEERING JUDGEMENTS.

LEGEND:

- Gypsum, Rocksalt, etc.
- USCS Low Plasticity Silty Clay
- USCS Poorly-graded Sand
- USCS Silt
- USCS Silty Sand
- USCS Low Plasticity Clay
- USCS Poorly-graded Sand with Clay
- USCS Well-graded Sand
- AR Auger Refusal
- BT Boring Terminated
- Standard Penetration Test
- Undisturbed Sample
- Groundwater Level At Time Of Boring
- Groundwater Level After 24 Hours

FENCE 11X17 BORING LOGS.GPJ LAW_GEBB.GDT 2/3/12

SUBSURFACE PROFILE F-F'

FORMER ALCOA EAST ST. LOUIS
OPERABLE UNIT 1
EAST ST. LOUIS, ILLINOIS

Figure	8
Reviewed	Pieter J. DePree
Drawn	M. Herrera
Scale	As Shown
Date	02-29-12
Task	10.1
Phase	N/A
Project No.	3410-10-0782

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Figure 9: Aerial Photo 7-4-1940

Former Alcoa East St. Louis Operating Unit 1

Not To Scale

Note:

1. Apparent Splitter Dike, 1A
2. Apparent Mined Area 1A
3. Splitter Dike 1C
4. 1B Absent

Figure 10: Aerial Photo 1937 Oblique From SE

Former Alcoa East St. Louis Operating Unit 1

Not To Scale

Note:

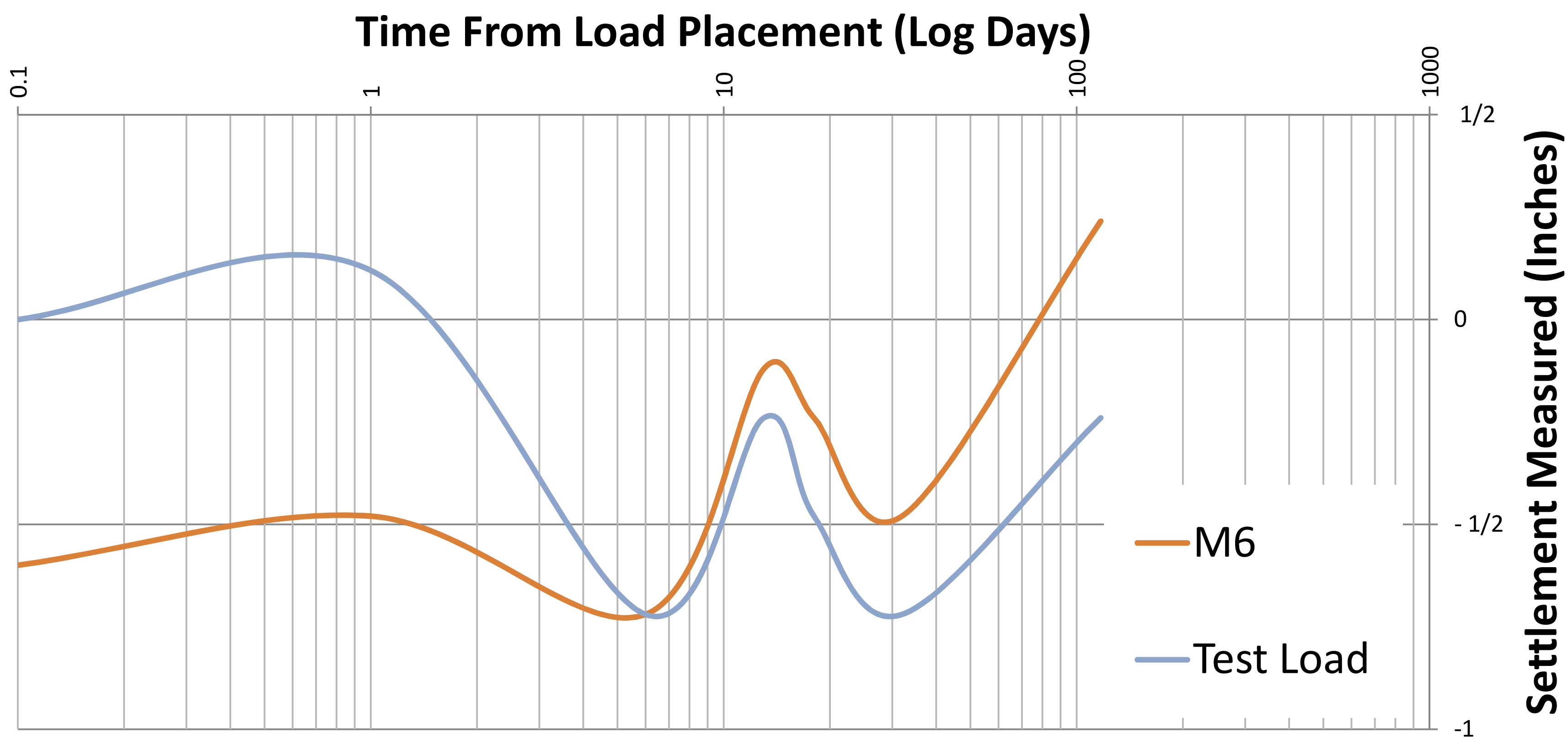
1. 1A Vegetation
2. 1A Eroded Area
3. 1A Mined Area
4. 1B/1C Filled edges

Figure 11: Aerial Photo 1955 Oblique From SE

Former Alcoa East St. Louis Operating Unit 1

Not To Scale

Figure 12: Test Load Settlement



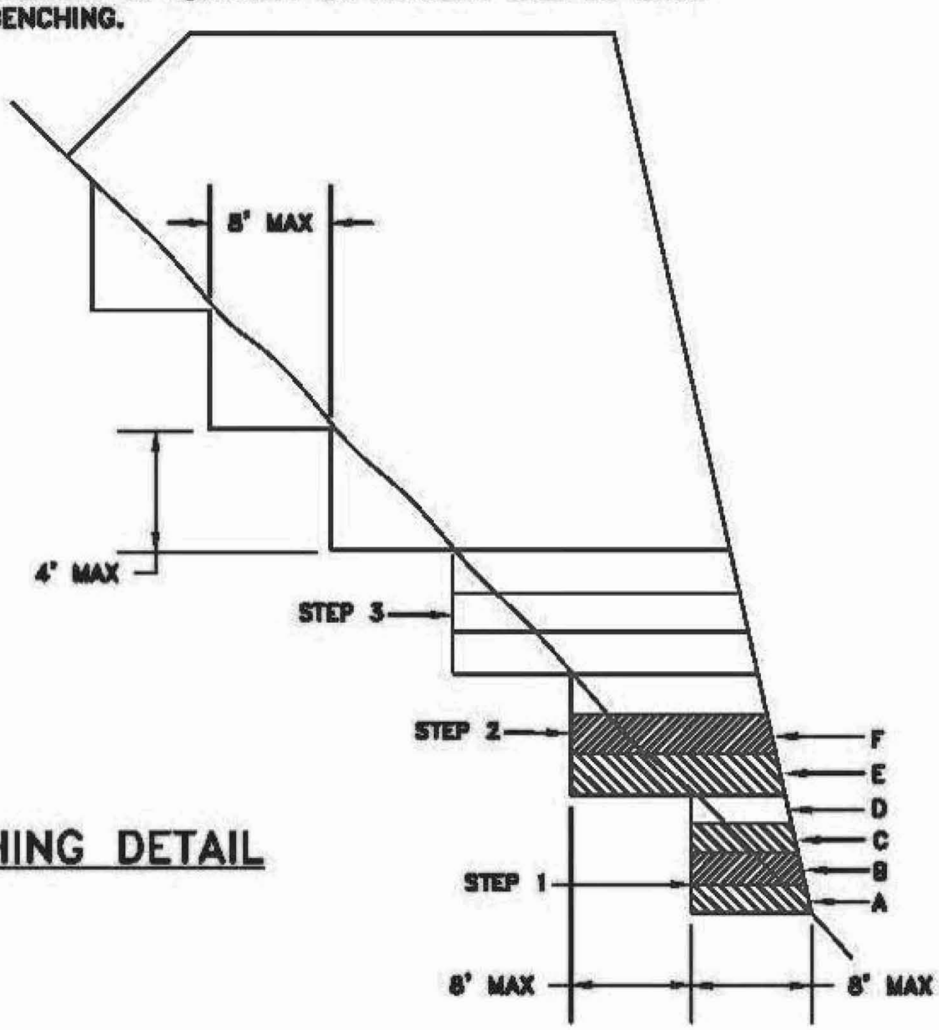
Notes:

1. Potential Survey Error about 1/2 Inch, based on Data Scatter
2. Sudden decline could indicate load rod was disturbed
   by Surveyor Climbing on Load

1. WHERE THE EMBANKMENT IS TO BE PLACED ON A HILLSIDE OR ANOTHER EXISTING EMBANKMENT HAVING A SLOPE OF 4 TO 1 OR STEEPER, THE FOUNDATION MUST BE BENCHED WHILE THE EMBANKMENT IS BEING MADE. (SEE DIAGRAM AT LEFT.)

2. THE DIAGRAM SHOWS THAT BEFORE LAYER "A" IS PLACED THE FIRST STEP (1) IS CUT INTO THE SLOPE A MAXIMUM DISTANCE OF ABOUT 8' (ABOUT 3/4 THE WIDTH OF THE USUAL D-8 BULLDOZER BLADE). SUCCESSIVE LAYER "E" IS PLACED, THE SECOND STEP IS CUT 8' INTO THE SLOPE AND SUCCESSIVE LAYERS ARE AGAIN PLACED. IF IT IS ANTICIPATED THAT THE VERTICAL PART OF THE STEP WILL EXCEED 4' IF AN 8' HORIZONTAL CUT IS MADE, THEN THE ACTUAL CUT STOPS WHEN THE VERTICAL PART REACHES A MAXIMUM OF 4' ALLOWING THE HORIZONTAL DISTANCE TO VARY.

3. THE PROCESS OF BENCHING IS CONSIDERED INCIDENTAL TO THE ITEM OF UNCLASSIFIED EXCAVATION AND BORROW IN CONSTRUCTION OF THE EMBANKMENT AND NO ADDITIONAL MEASUREMENT OF QUANTITY OR PAYMENT WILL BE MADE FOR BENCHING.



BENCHING DETAIL

AMEC E&I, Inc.
396 PLASTERS AVENUE, N.E.
ATLANTA, GEORGIA 30324
(404)873-4761

BENCHING DETAIL

Project Number	Date		Figure
3410-10-0782	January, 2012		8
Task	Drawn	Reviewed by	Scale
10.2	PDP		NTS

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APPENDIX A

CPT Logs
Boring Logs
Piezometer Logs
Test Pit Logs
ReMi Profiles
Monitoring Well Logs (by others)
Selected Boring Logs (by others)

FAESLOU1

AMEC Project 3410-10-0782.10.2

FIELD PROCEDURES

The general field procedures employed by AMEC E&I, Inc. (AMEC) were performed in general accordance with ASTM D 420, “Investigating and Sampling Soils and Rocks for Engineering Purposes.” This recommended practice lists recognized methods for determining soil and rock distribution and groundwater conditions. These methods include geophysical and in situ methods as well as borings.

Soil Test Borings

Borings are advanced into the subsurface using a wash rotary drill bit, so that cuttings are returned to the surface by the drilling fluid, or hollow stem augers, which returns cuttings to the surface with a continuous auger flighting.

These drilling methods are not capable of penetrating through material designated as “refusal materials.” Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

The subsurface conditions encountered during drilling are documented on a boring log by the field engineer. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. The engineer classifies the materials recovered in cutting and samples per visual manual methods and a limited number of samples are selected for laboratory classification, generally to confirm the visual manual classification. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The boring logs represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. The passage of time may result in a change in the subsurface soil and groundwater conditions at these boring locations. The lines designating the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report.

Standard Penetration Test

The standard penetration test (SPT) is used to assess soil consistency and obtain relatively undisturbed samples. The test is conducted at the bottom of the borehole by driving a standard 1.4-inch I.D., 2-inch O.D., split barrel sampler into the subsurface beyond the borehole. The sampler is first seated 6 inches to penetrate loose cuttings, then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated the “penetration resistance” or “N-value.” The penetration resistance has been correlated to a variety of soil properties, including stiffness, strength, and consistency. Representative portions of the soil sample from the split barrel sampler are retained for further reference and/or laboratory testing.

Undisturbed Sampling

Relatively undisturbed (UD) samples are obtained by using rig hydraulics to push a thin-walled, steel tube with a sharp cutting edge into the subsurface below the bottom of the borehole. The sample is then withdrawn and sealed using end caps and/or wax seals for return to the laboratory.

Piezometers

Water level readings taken in open boreholes are sometimes impacted by borehole collapse or other vagaries of the subsurface and so are less reliable than if the borehole is stabilized by installation of a piezometer. Piezometers include a screen of slotted casing (typically PVC) near the expected water table with solid riser casing above. Sand is placed around the screen in the borehole, or sometimes a pre-packed screen with sand pack between an inner and outer screen is used. A seal is placed above the screen to reduce the potential for surface water infiltration down the borehole that could impact groundwater levels.

Vane Shear Tests

Vane shear tests are conducted by inserting a four bladed vane into the subsurface and rotating the vane while measuring torque. This causes fine grained soils to shear along the cylinder created by the outer edges of the vane. Soils typically fail perceptibly at relatively low strains, in generally within one quarter turn (90 degrees) of rotation or less. The vane is then rotated completely and a second measurement, of the residual strength is taken. Undrained shear strength of the soil can be correlated to a function of the torque and vane dimensions.

Test Pits

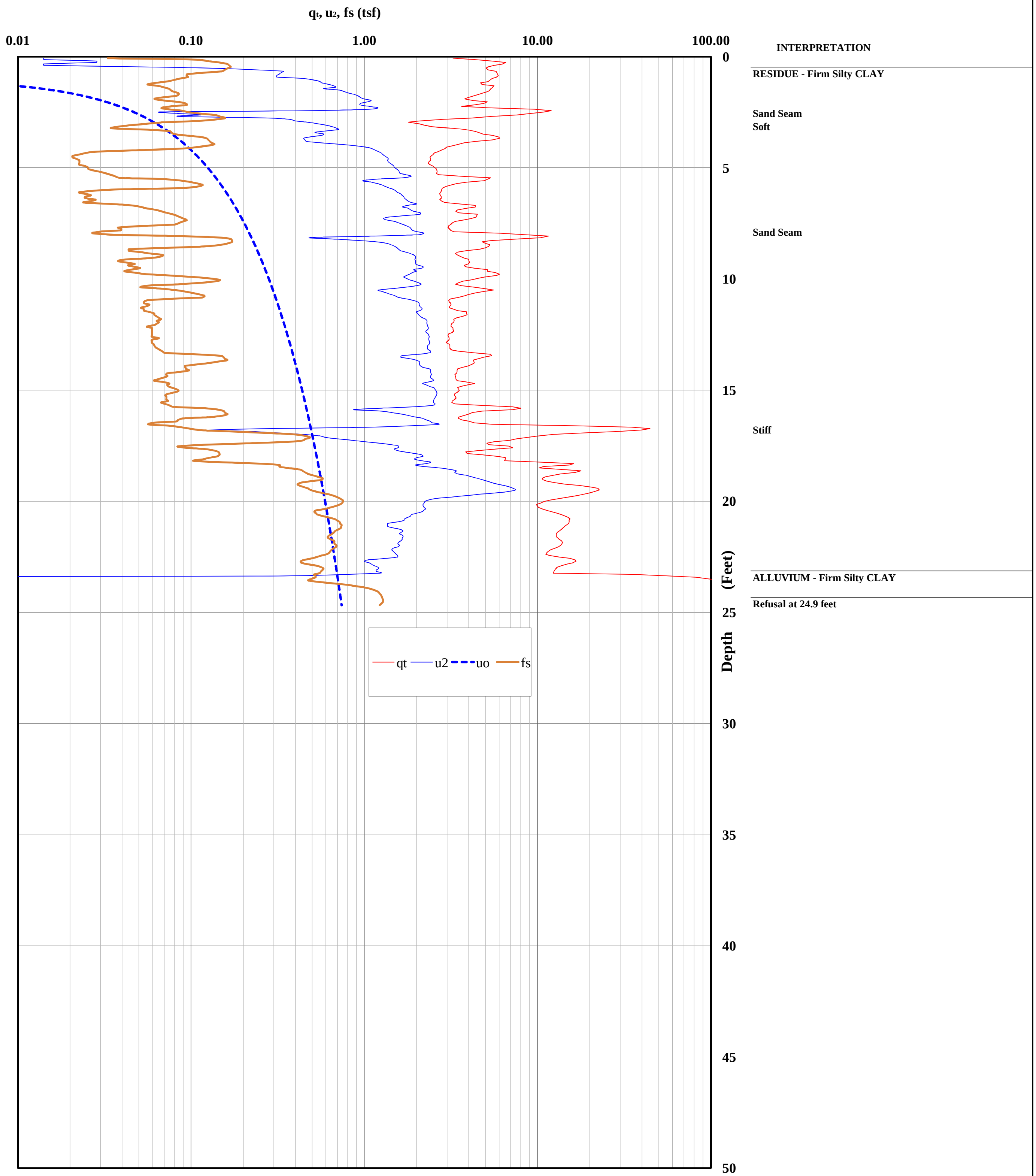
Test pits are open excavations excavated with a backhoe. Typically the excavation is one bucket (2 to 4 feet) wide and up to about 20 feet deep (depending on the backhoe reach and ability to excavate materials encountered) and as long as required to efficiently excavate, typically 6-12 feet. The test pit allows direct observation of large areas of the excavation walls, and is preferable to borings for assessing fills or materials that may include larger debris, boulders, or other objects that would not typically be recovered in the small samplers used in borings.

Cone Penetration Test Probes

The cone penetration test involves pushing an approximately 1 ½ inch diameter pointed cone continuously into the subsurface at a controlled rate of slightly less than 1 inch per second. As the cone is pushed, instrumentation within the cone reports tip resistance, friction along a sleeve about 6 inches long behind the tip, and dynamic pore pressure from a sensor immediately behind the tip. Correlations to various combinations of these parameters can be found for many soil properties.

Refraction Microtremor Traverses

Refraction Microtremor or ReMi is a geophysical surface-wave method for estimating in-situ shear wave velocities. An array of vertically oriented geophones are placed on the ground and noise from ambient sources such as traffic is analyzed.



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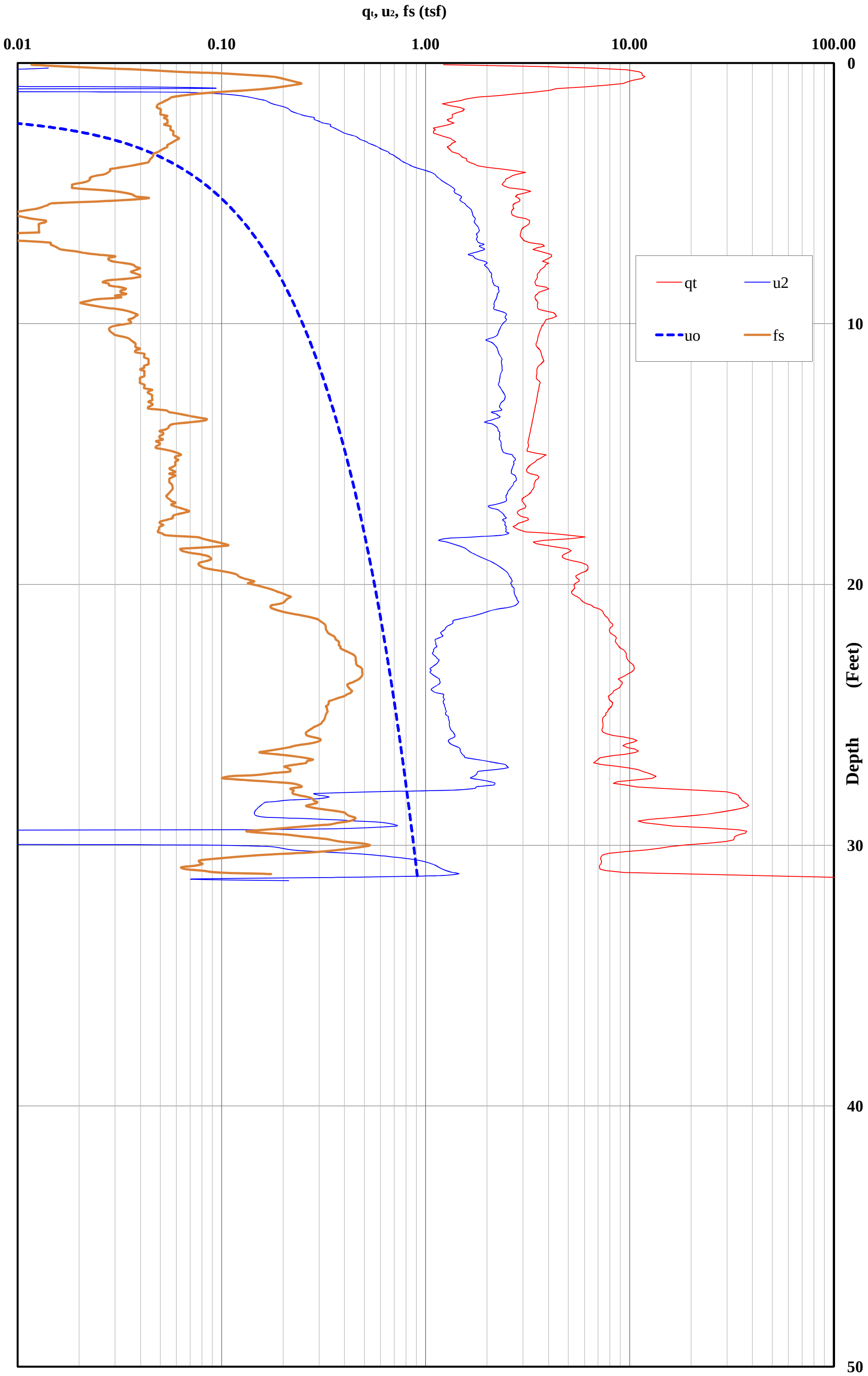
PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-01
DATE:	12/4/11
SURFACE ELEVATION	424 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



INTERPRETATION

RESIDUE - Firm Silty Clay

Soft

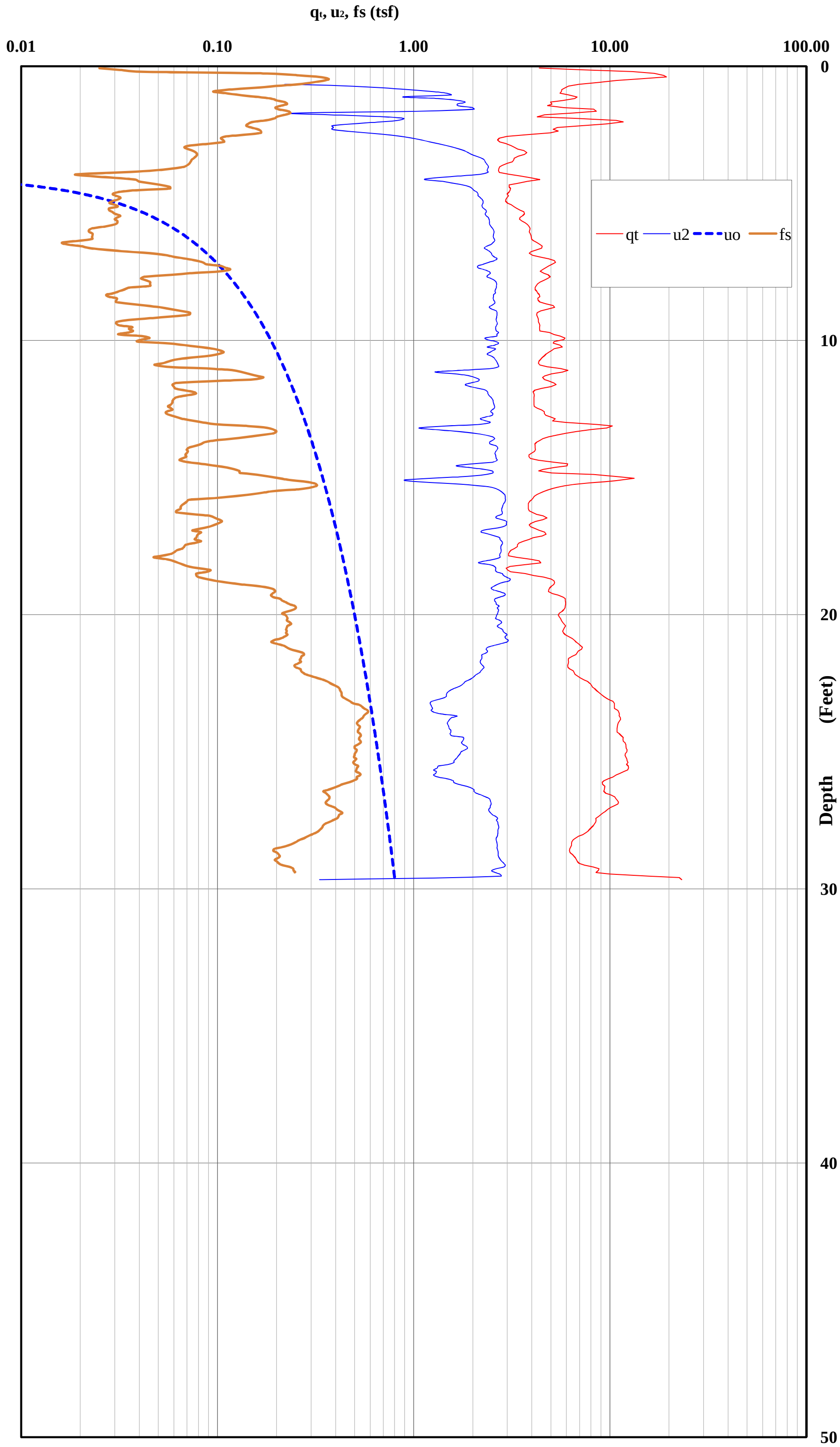
Firm

ALLUVIUM - Soft to Firm Silty CLAY

SAND

Refusal at 31.2 feet

PROJECT:	**FAESLOU1**
PROJECT NUMBER:	**3410-10-0782 10.2**
PROBE ID:	**CPT-2**
DATE:	**12/4/11**
SURFACE ELEVATION	**422 Feet**
PUSHED BY:	**Fugro (20 Ton Track)**
PREPARED BY:	**AAW**
CHECKED BY:	**PDP**



INTERPRETATION

RESIDUE - Firm Silty CLAY

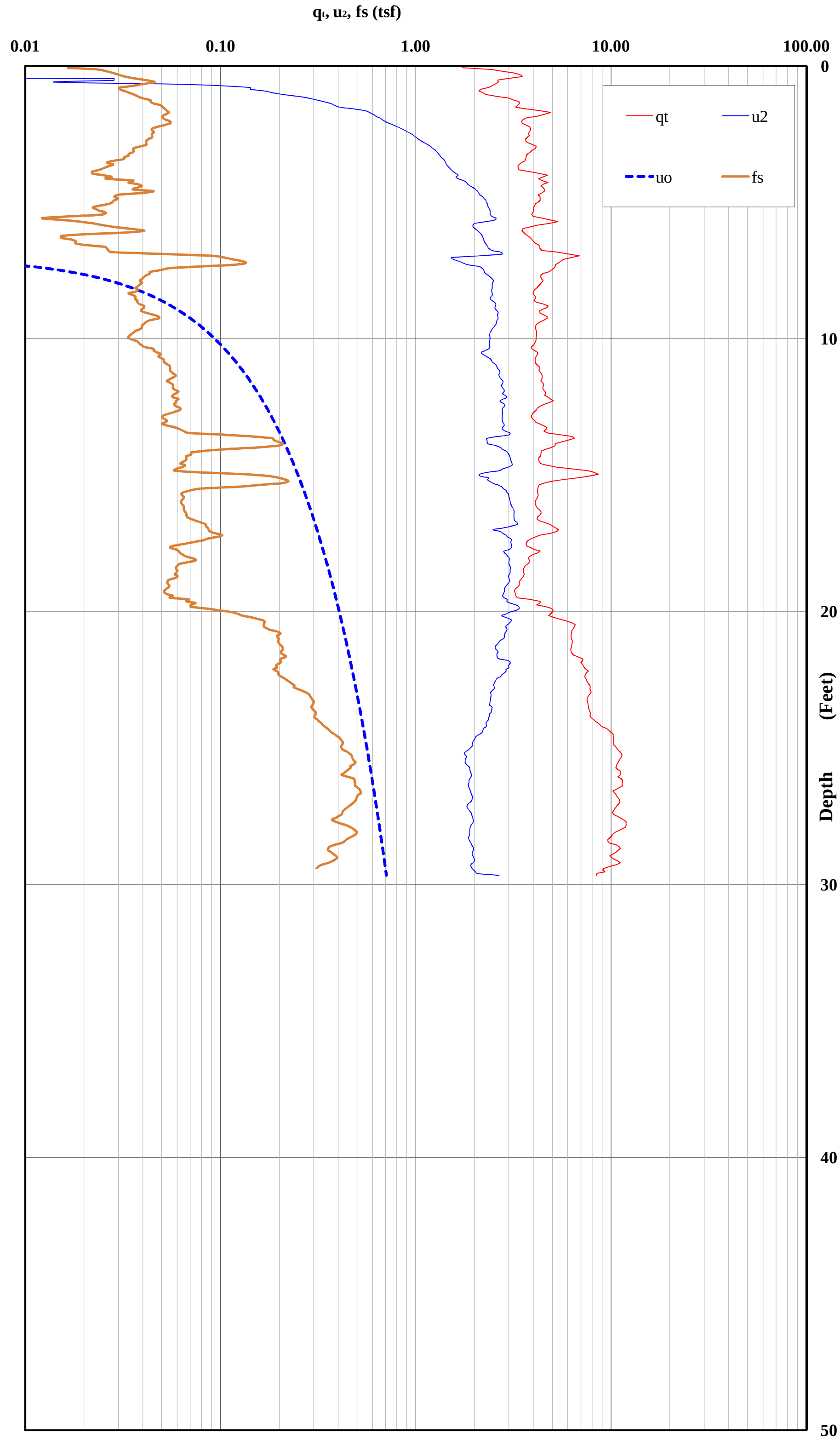
Soft

Firm Seams

ALLUVIUM - Firm Silty CLAY

Refusal at 29.6 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-3
DATE:	12/4/11
SURFACE ELEVATION	422 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



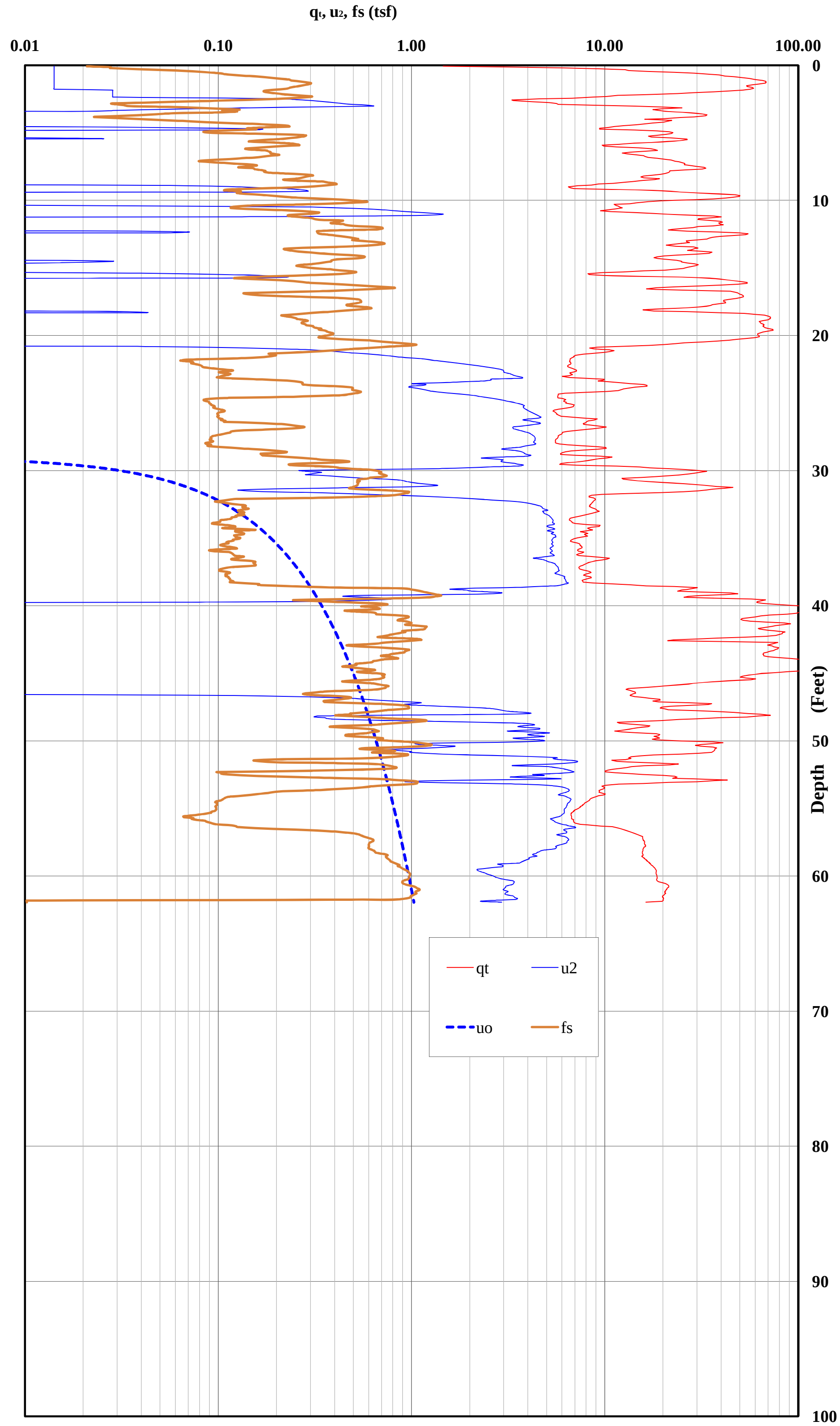
INTERPRETATION

RESIDUE - Soft Silty CLAY

ALLUVIUM - Soft to Firm Silty CLAY

Refusal at 29.6 feet

PROJECT:	**FAESLOU1**
PROJECT NUMBER:	**3410-10-0782 10.2**
PROBE ID:	**CPT-4**
DATE:	**12/4/11**
SURFACE ELEVATION	**422 Feet**
PUSHED BY:	**Fugro (20 Ton Track)**
PREPARED BY:	**AAW**
CHECKED BY:	**PDP**



INTERPRETATION

RESIDUE - Firm Silty CLAY

Sand Seam

Soft

Firm

Sand Seam

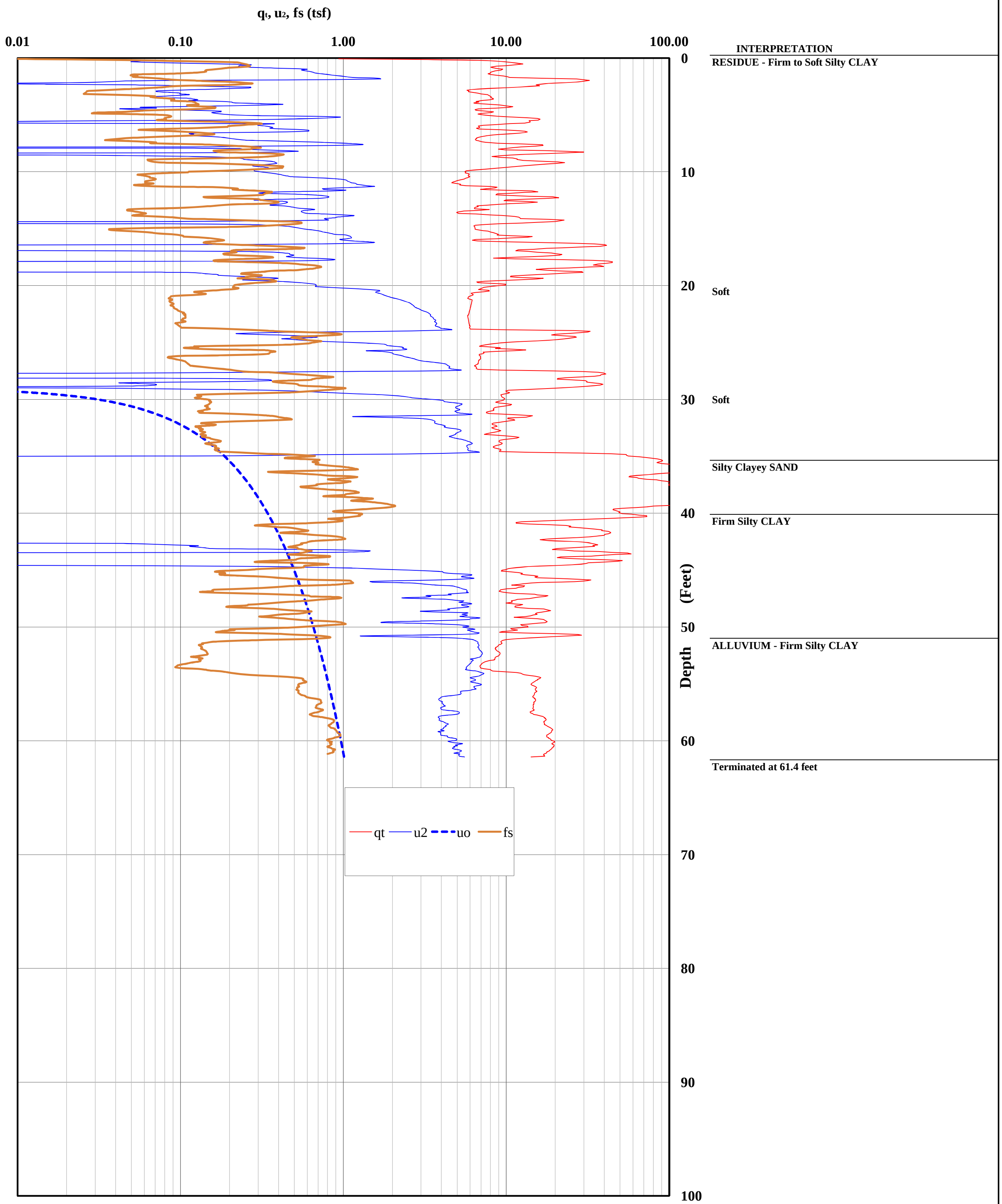
Soft

ALLUVIUM - Firm Silty CLAY

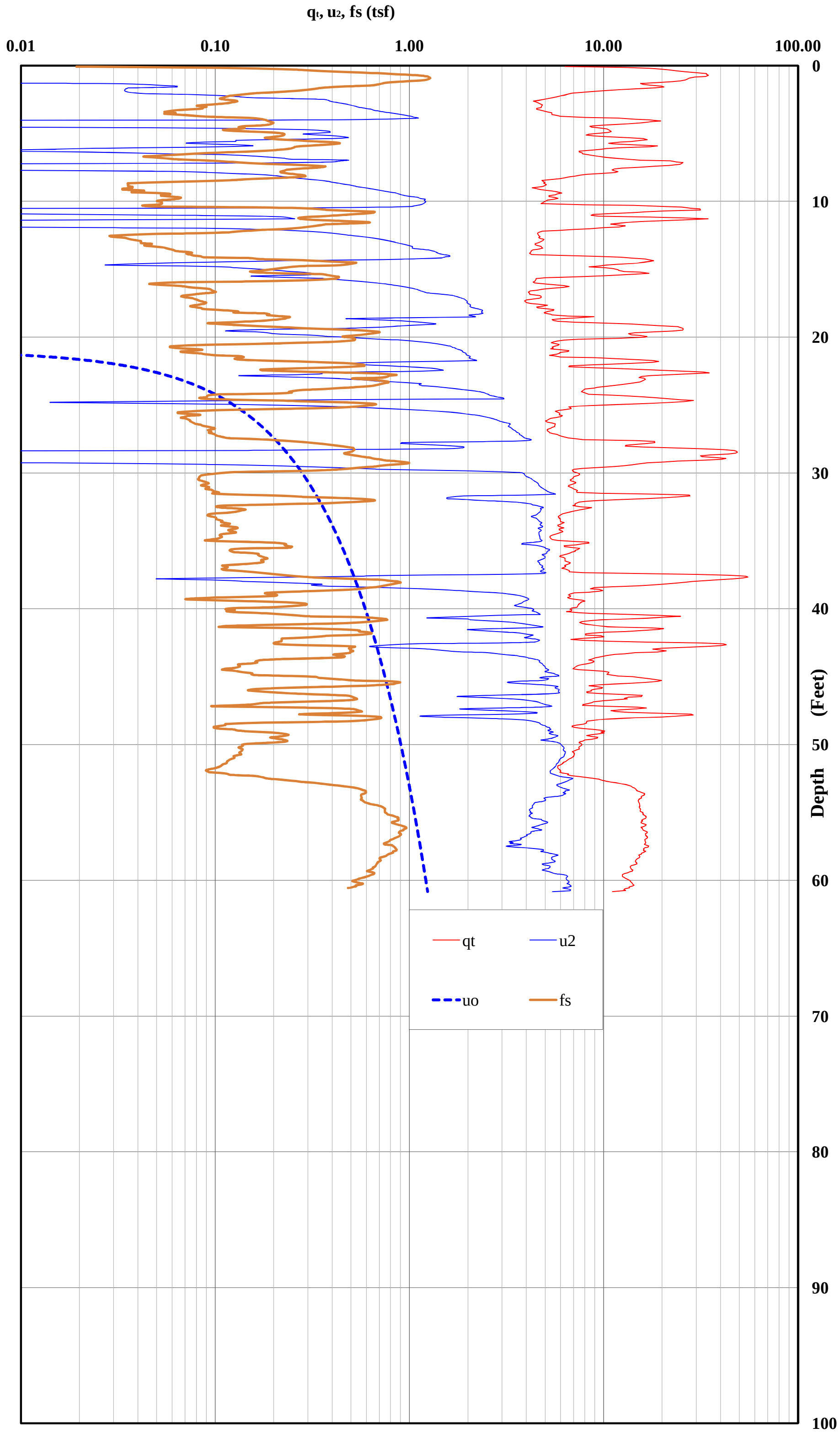
Refusal at 61.8 feet

amec

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-5
DATE:	12/1/11
SURFACE ELEVATION	458 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP

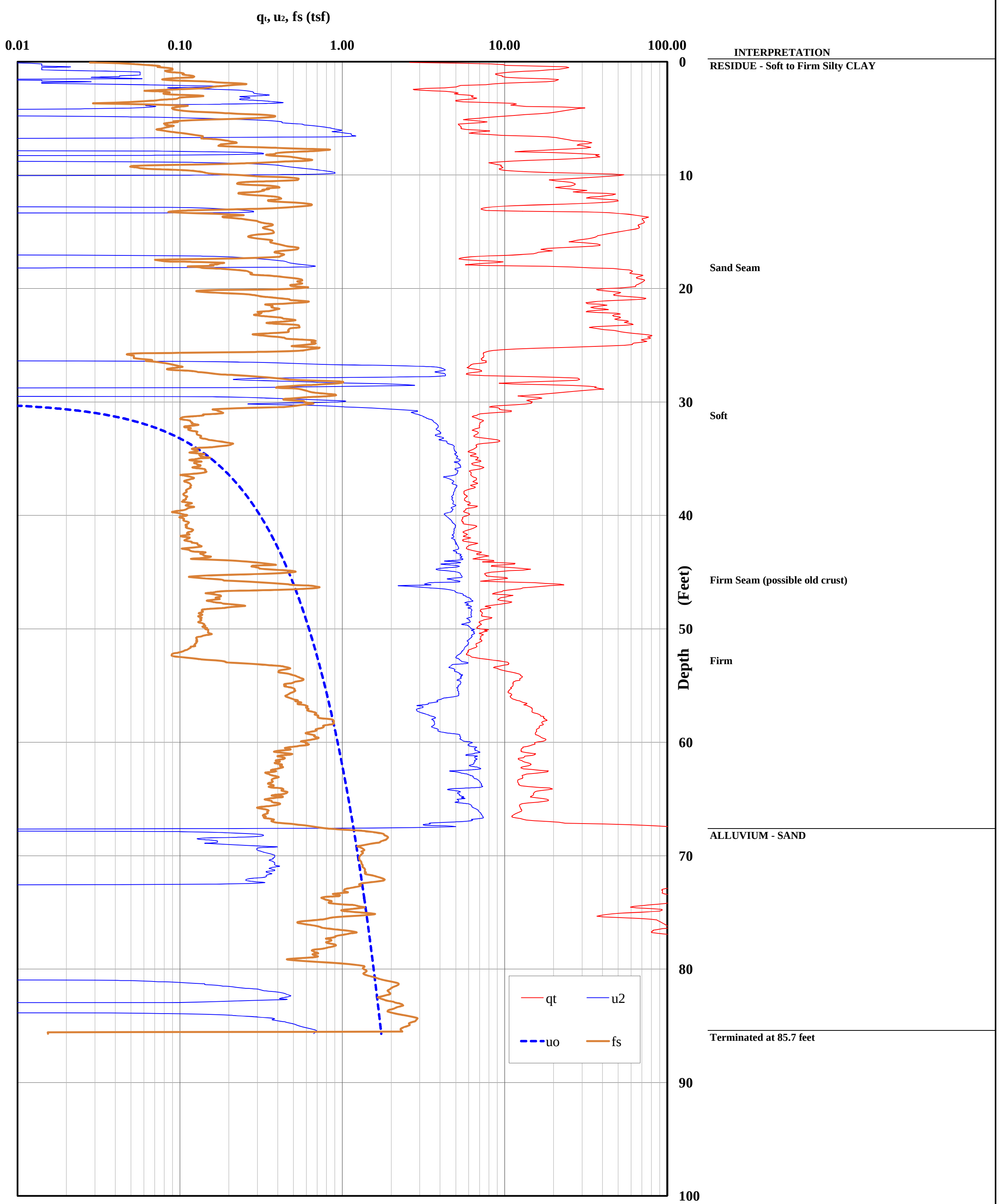


PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-6
DATE:	12/1/11
SURFACE ELEVATION	456 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



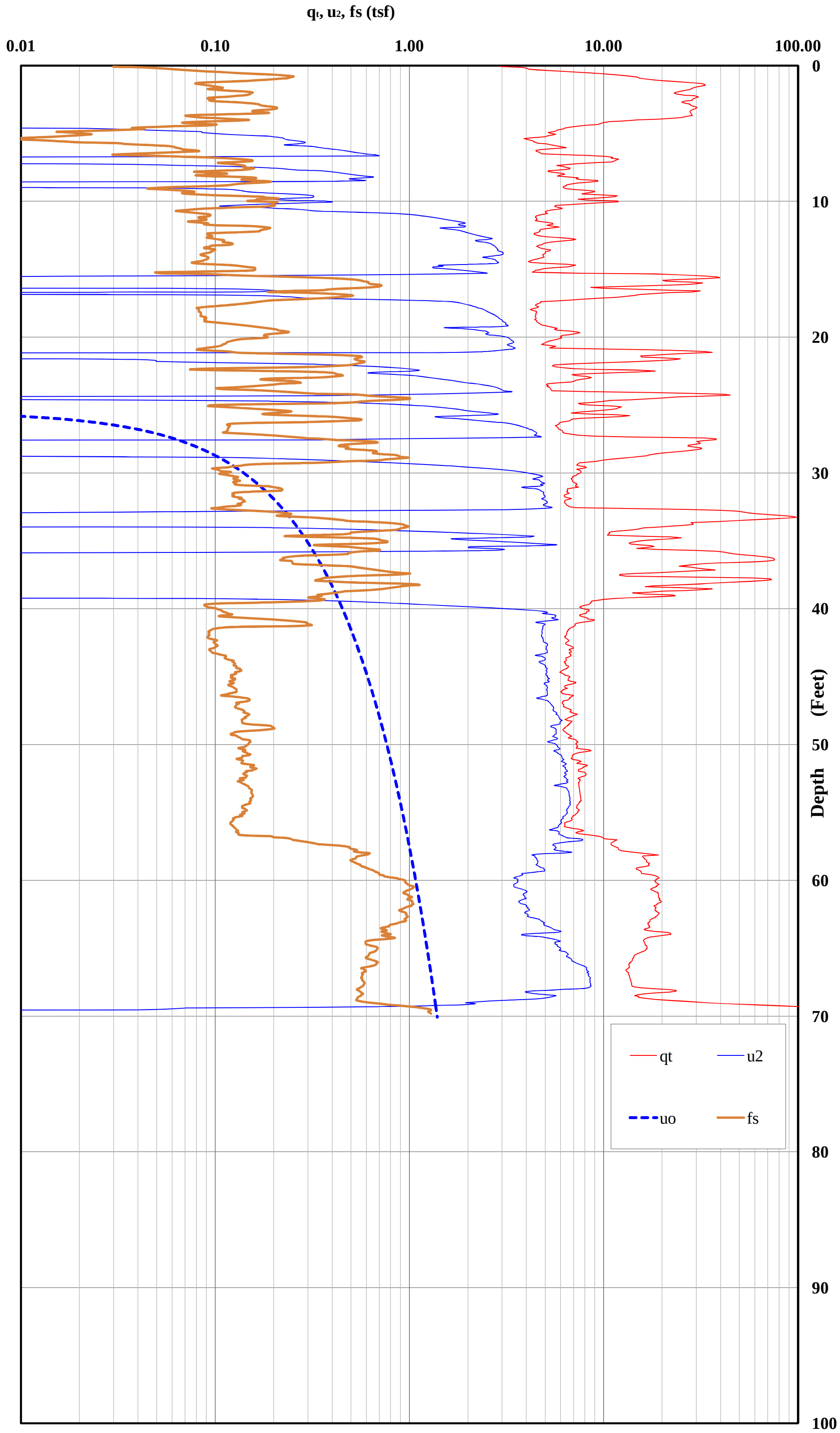
INTERPRETATION
RESIDUE - Firm to Soft Silty CLAY
ALLUVIUM - Firm Silty CLAY
Terminated at 60.8 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-7
DATE:	11/30/11
SURFACE ELEVATION	454 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



amec

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-8
DATE:	11/30/11
SURFACE ELEVATION	455 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



INTERPRETATION

RESIDUE - Firm Silty CLAY

Soft

Firm to Stiff Seam

Sand Seam

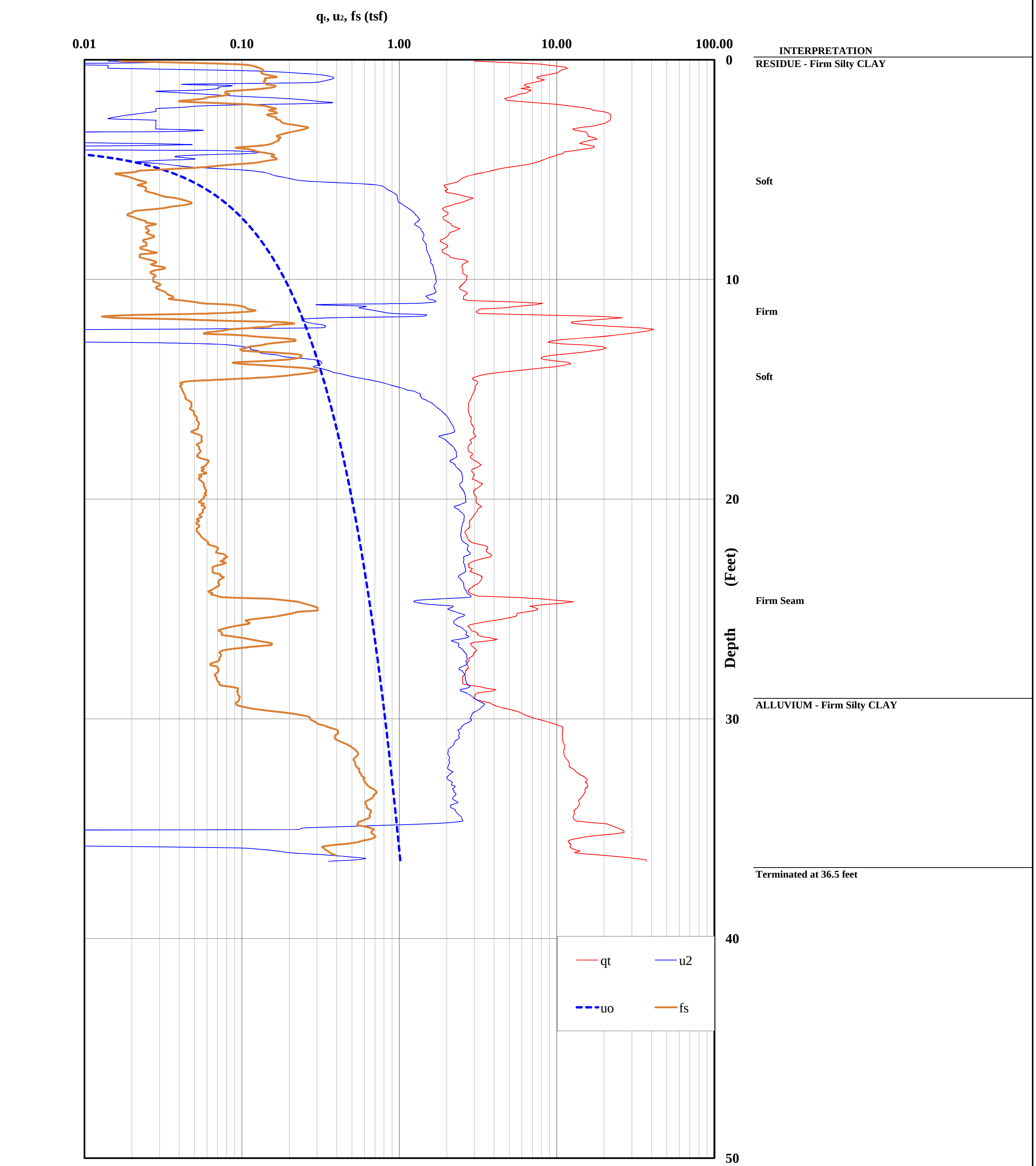
Soft

ALLUVIUM - Firm Silty CLAY

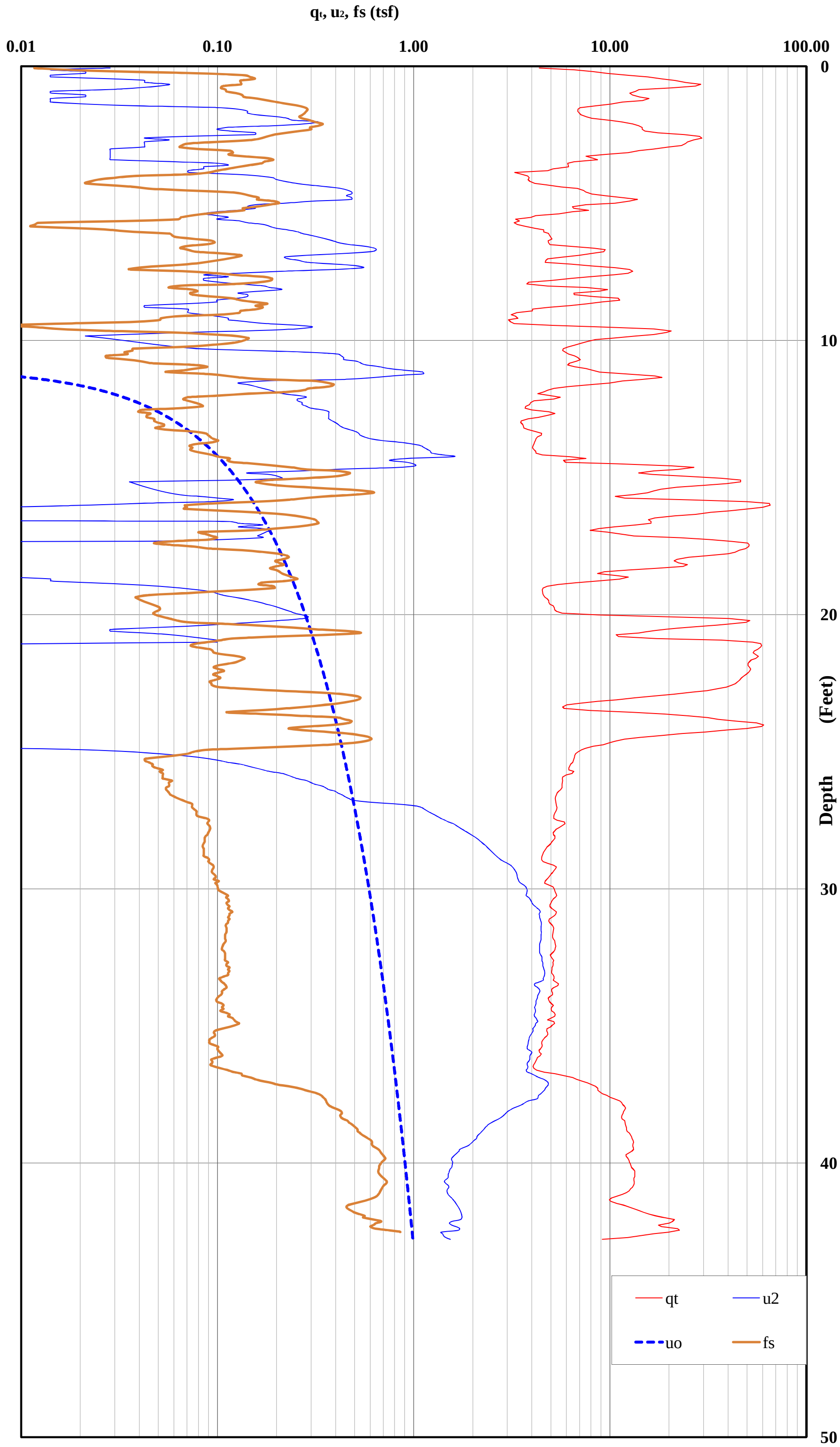
SAND

Terminated at 69.5 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-9
DATE:	11/30/11
SURFACE ELEVATION	459 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-10
DATE:	12/2/11
SURFACE ELEVATION	433 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



INTERPRETATION

RESIDUE - Firm Silty CLAY

Soft Seams

Soft

Sand Seams

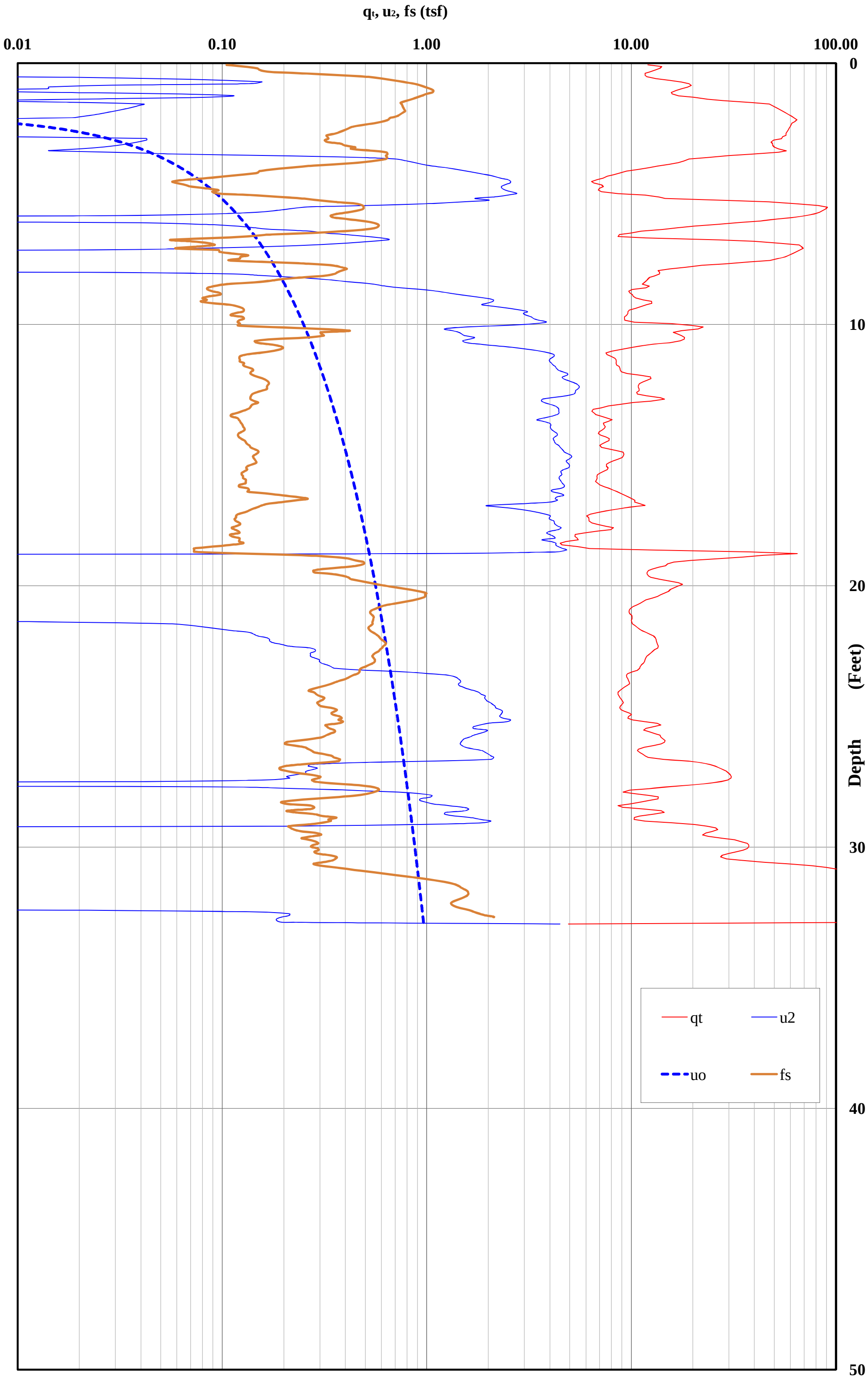
Soft

Soft

ALLUVIUM - Firm Silty CLAY

Terminated at 42.8 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-11
DATE:	12/3/11
SURFACE ELEVATION	440.0 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



INTERPRETATION

RESIDUE - Firm to Stiff Clayey SILT

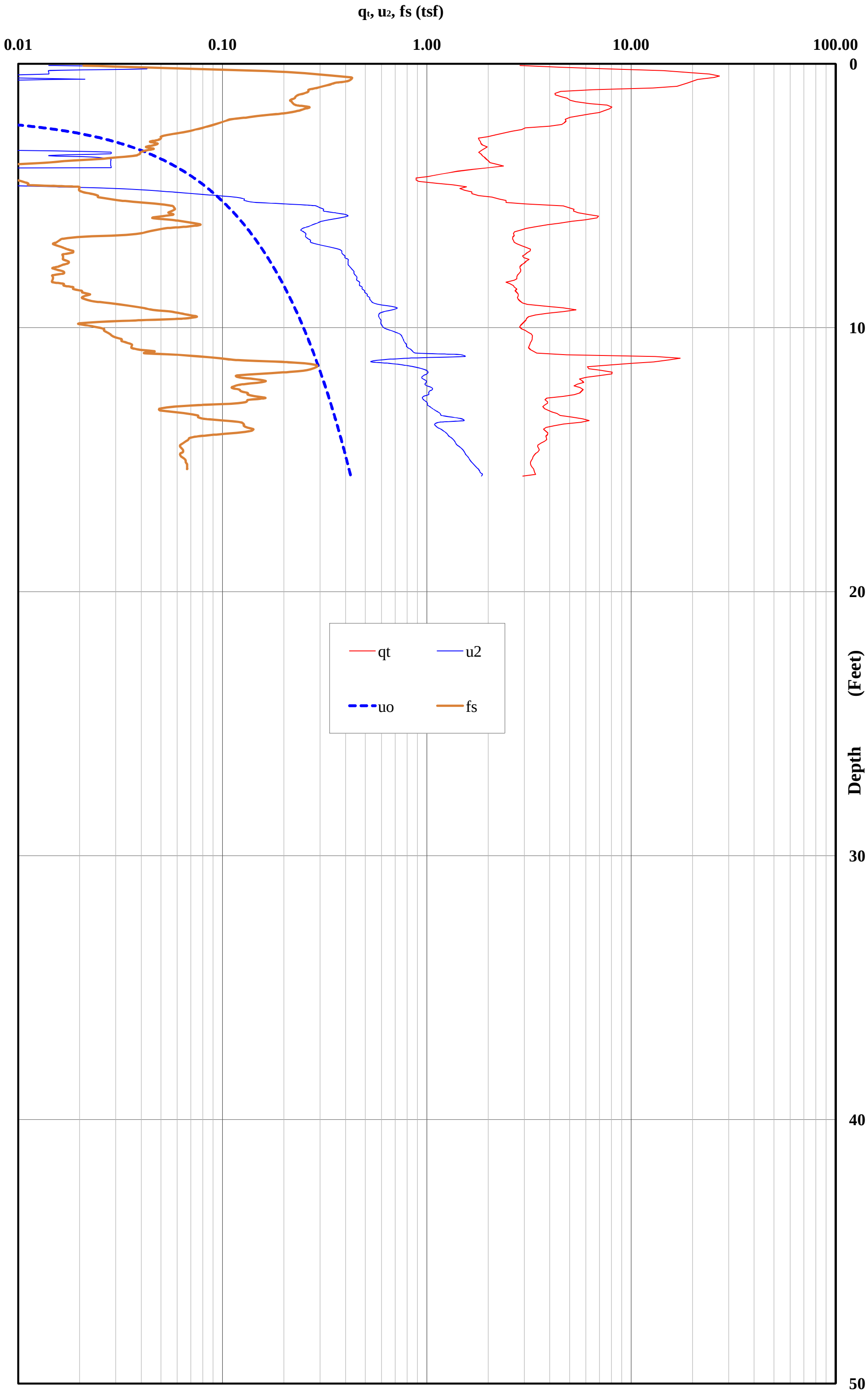
Soft

ALLUVIUM - Silty CLAY

SAND

Terminated at 32.7 feet

PROJECT:	**FAESLOU1**
PROJECT NUMBER:	**3410-10-0782 10.2**
PROBE ID:	**CPT-12**
DATE:	**12/3/11**
SURFACE ELEVATION	**423 Feet**
PUSHED BY:	**Fugro (20 Ton Track)**
PREPARED BY:	**AAW**
CHECKED BY:	**PDP**



INTERPRETATION

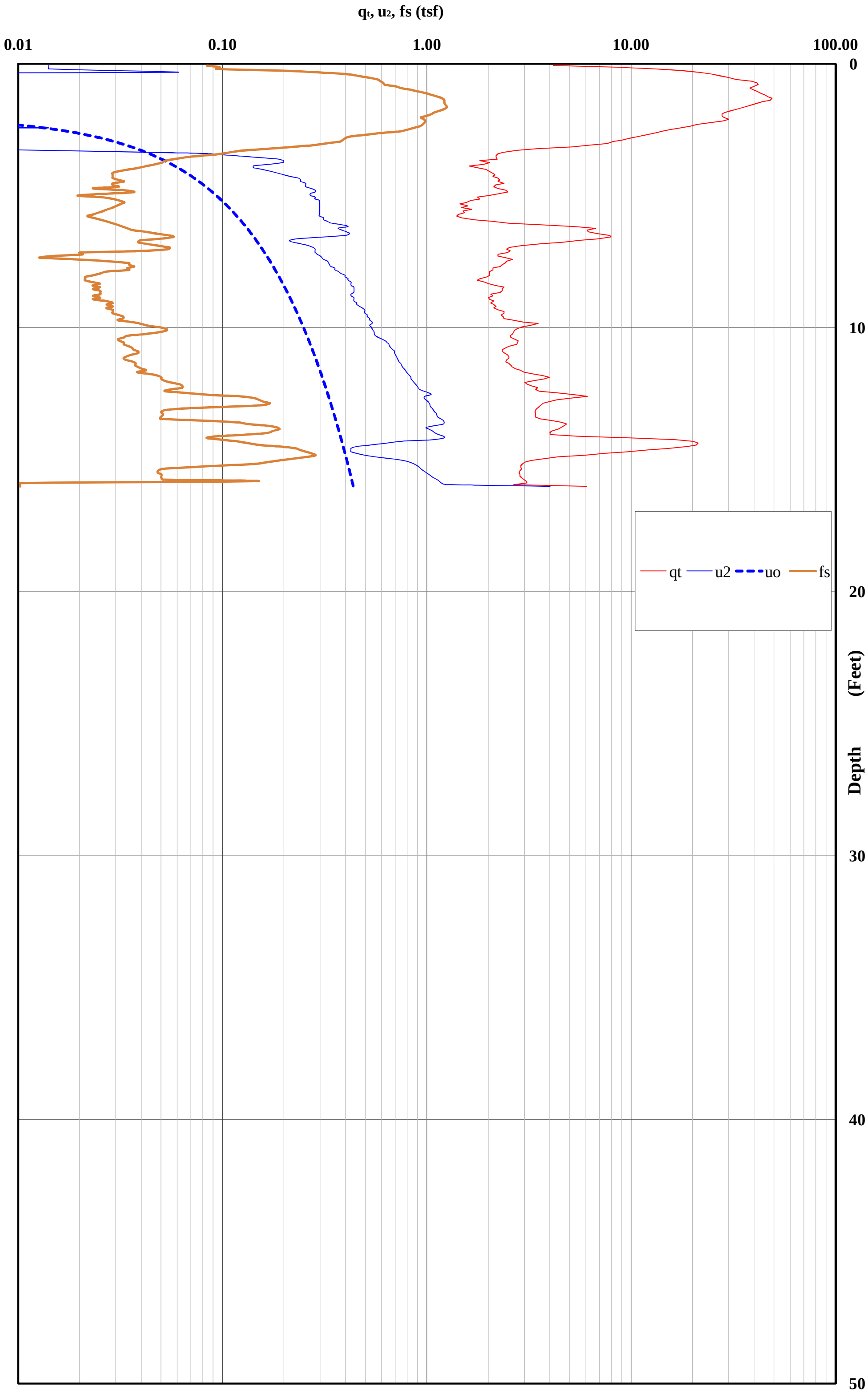
TEST STRIP - Firm SILT

RESIDUE - Firm to Soft Silty CLAY

Possible Liquefied Anomaly from Test Strip

Terminated at 15.6 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-13
DATE:	12/3/11
SURFACE ELEVATION	434 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



INTERPRETATION

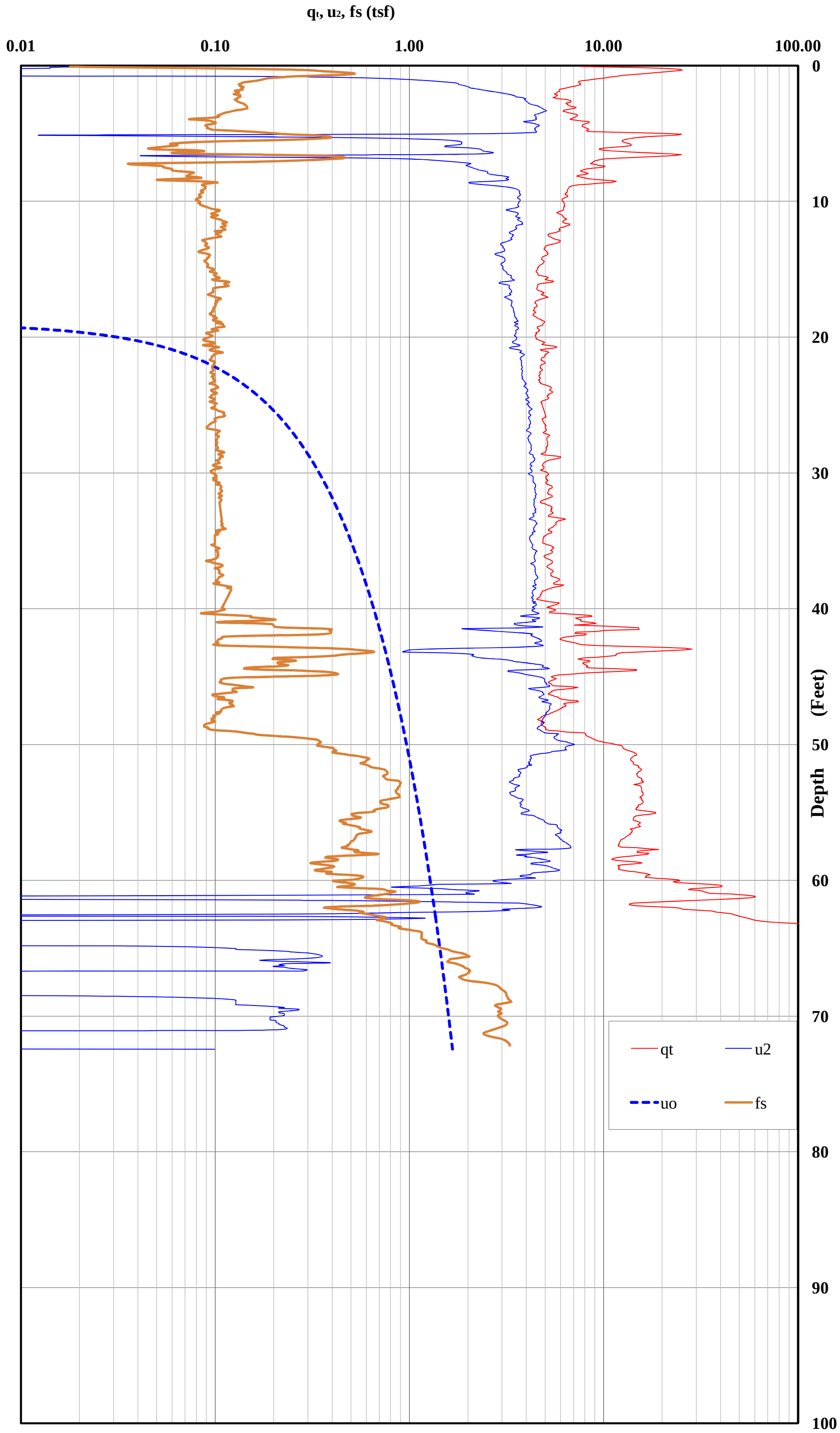
TEST STRIP - Firm SILT

RESIDUE - Firm to Soft Silty CLAY

Firm Seam

Terminated at 16 Feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-13A
DATE:	12/3/11
SURFACE ELEVATION	434 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



INTERPRETATION

RESIDUE - Soft to Firm Silty CLAY

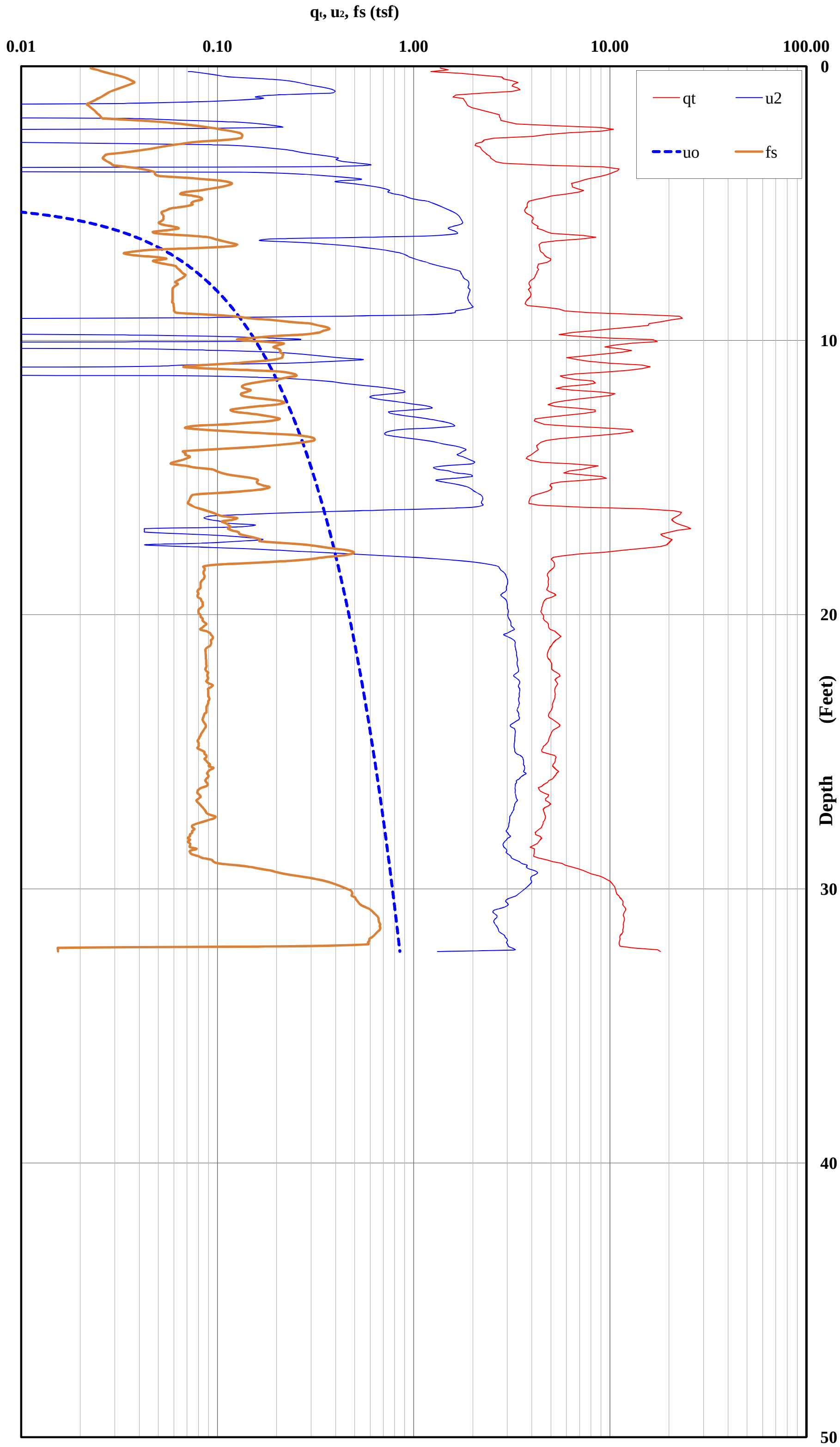
Sand Seams

ALLUVIUM - Soft to Firm Silty CLAY

SAND

Terminated at 72.2 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-14
DATE:	12/2/11
SURFACE ELEVATION	451 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



INTERPRETATION

RESIDUE - Firm to Soft Silty CLAY

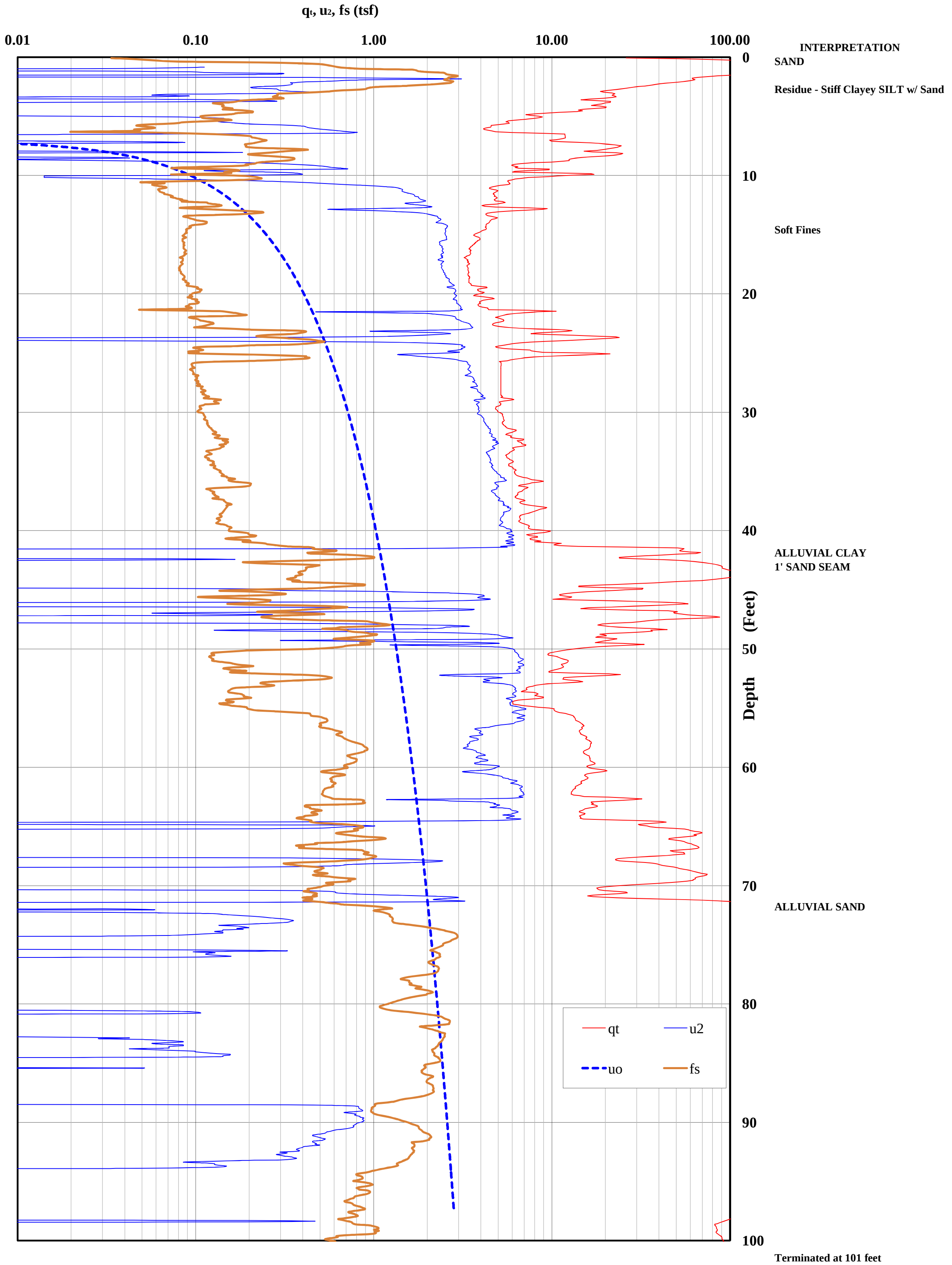
Sand Seams

Sand Seams

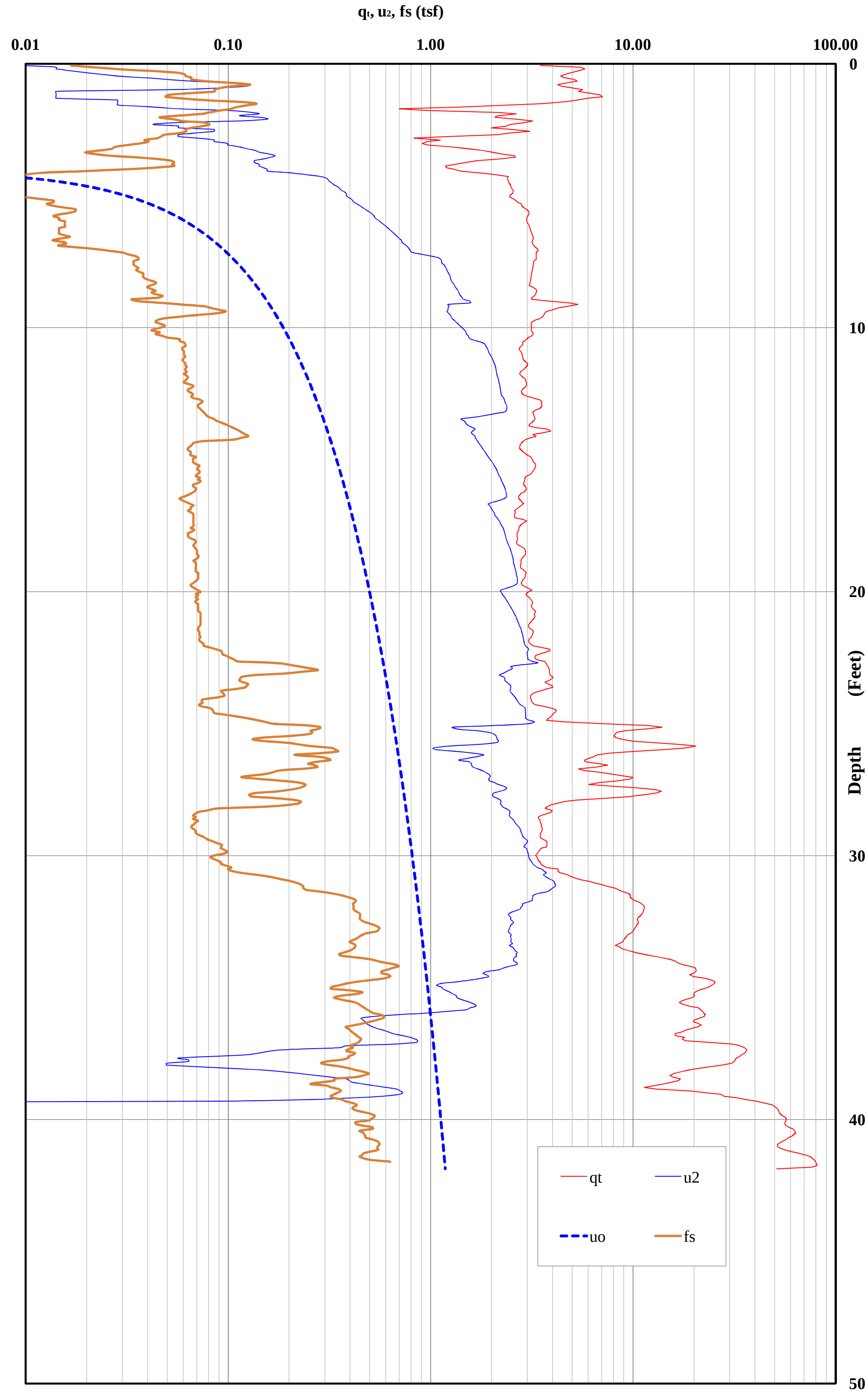
ALLUVIUM- Firm Silty CLAY

Terminated at 32 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT-15
DATE:	11/29/11
SURFACE ELEVATION	434.0 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



PROJECT:	**FAESLOU1**
PROJECT NUMBER:	**3410-10-0782 10.2**
PROBE ID:	**CPT-16**
DATE:	**12/2/11**
SURFACE ELEVATION	**425.0 Feet**
PUSHED BY:	**Fugro (20 Ton Track)**
PREPARED BY:	**AAW**
CHECKED BY:	**PDP**



INTERPRETATION

RESIDUE - Firm to Soft Silty CLAY

Firm

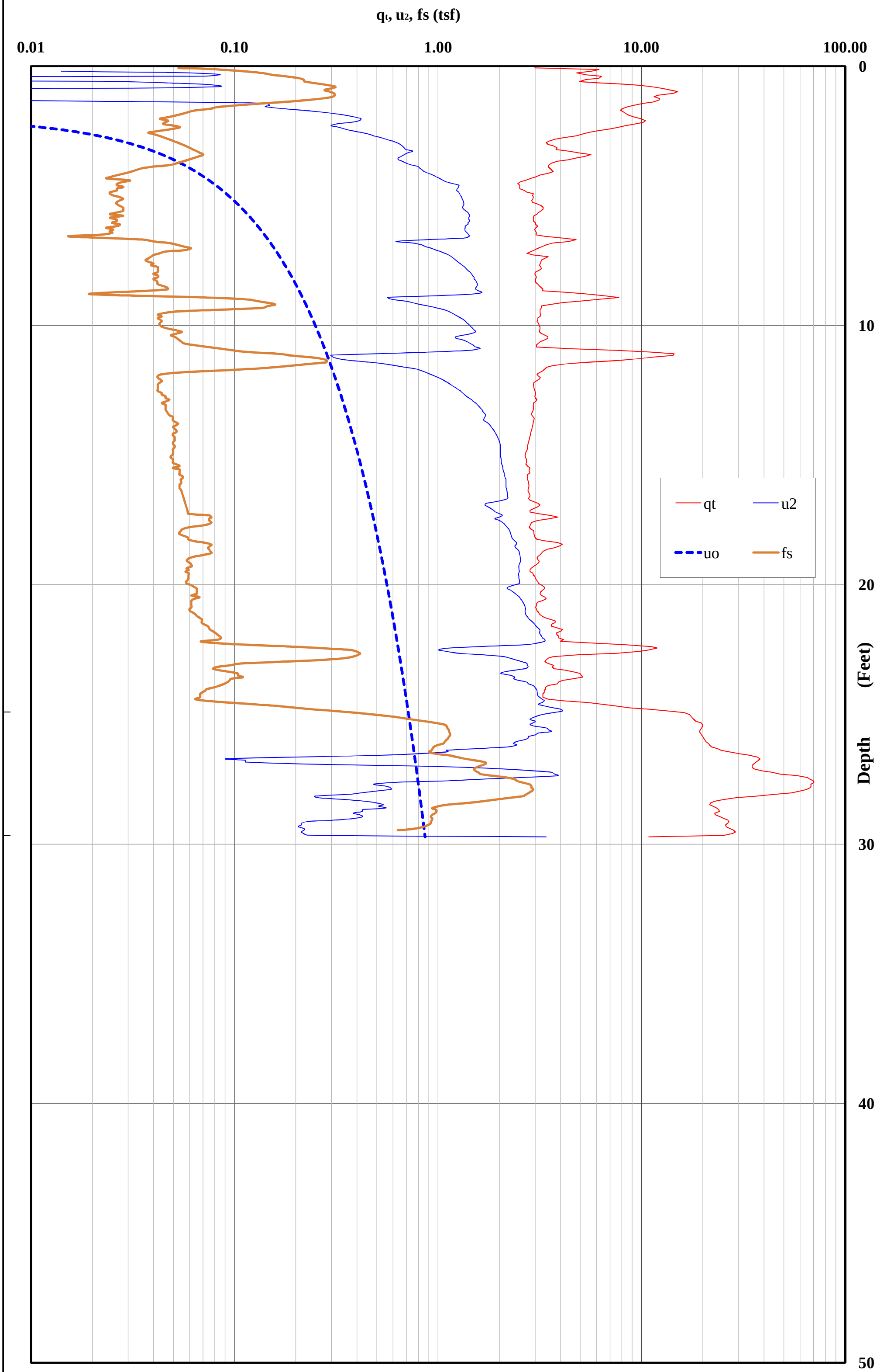
ALLUVIUM - Firm Silty CLAY

SAND

Terminated at 41.6 Feet

amec

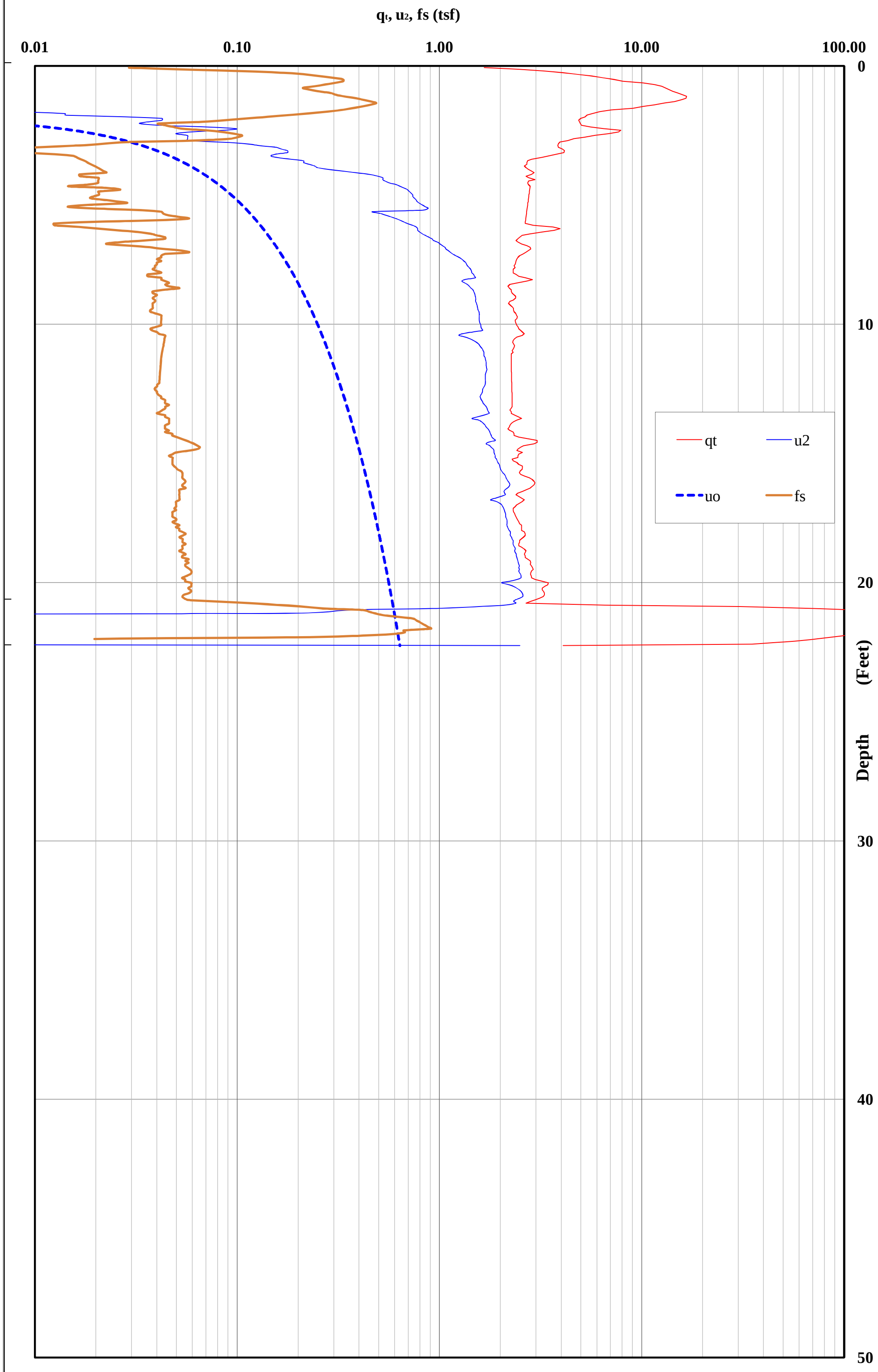
PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT 17
DATE:	12/2/11
SURFACE ELEVATION	434 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



INTERPRETATION

Depth	Interpretation
0	RESIDUE - Firm Clayey SILT
	Soft
	Sand Seam
	Sand Seam
	Sand Seam
	ALLUVIUM - Firm Clayey SILT
	Terminated at 29.7 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT 18
DATE:	11/28/11
SURFACE ELEVATION	432 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



INTERPRETATION

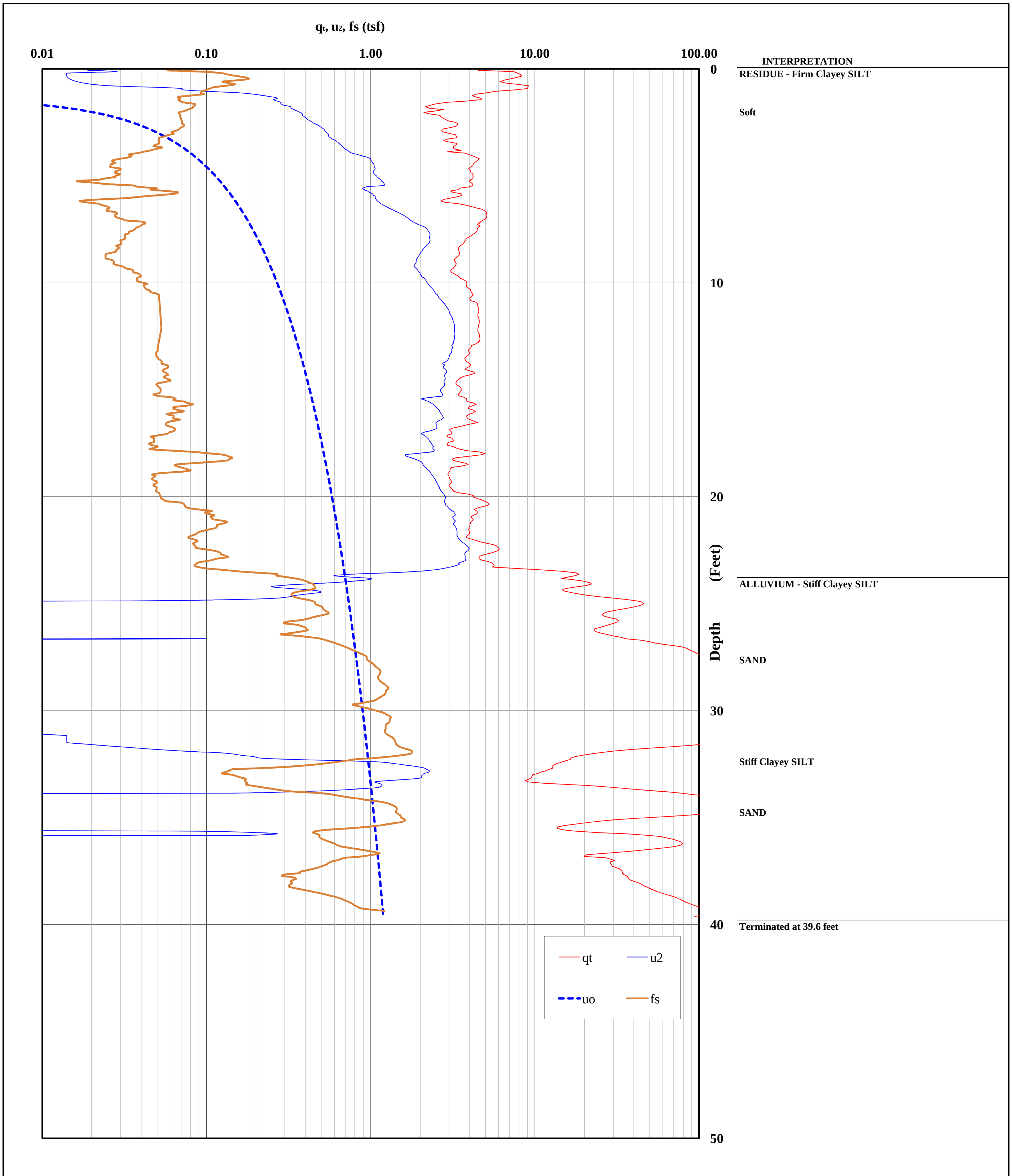
RESIDUE - Firm Clayey SILT

Soft

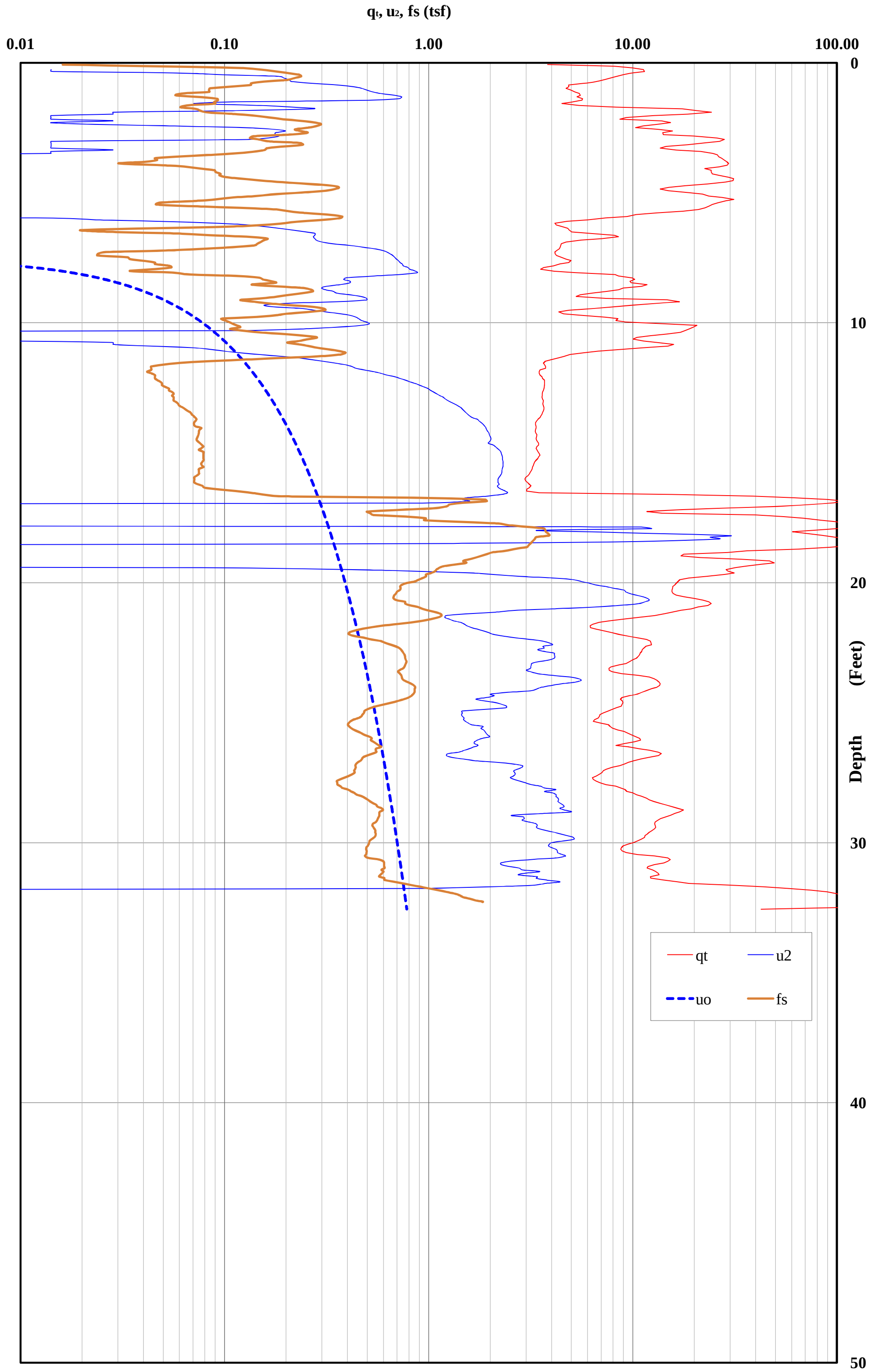
ALLUVIUM - SAND

Terminated at 22.4 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT 19
DATE:	11/28/11
SURFACE ELEVATION	432 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT 20
DATE:	12/2/11
SURFACE ELEVATION	431 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



INTERPRETATION

RESIDUE - Firm Clayey SILT w/Sand

Soft

Sand Seam

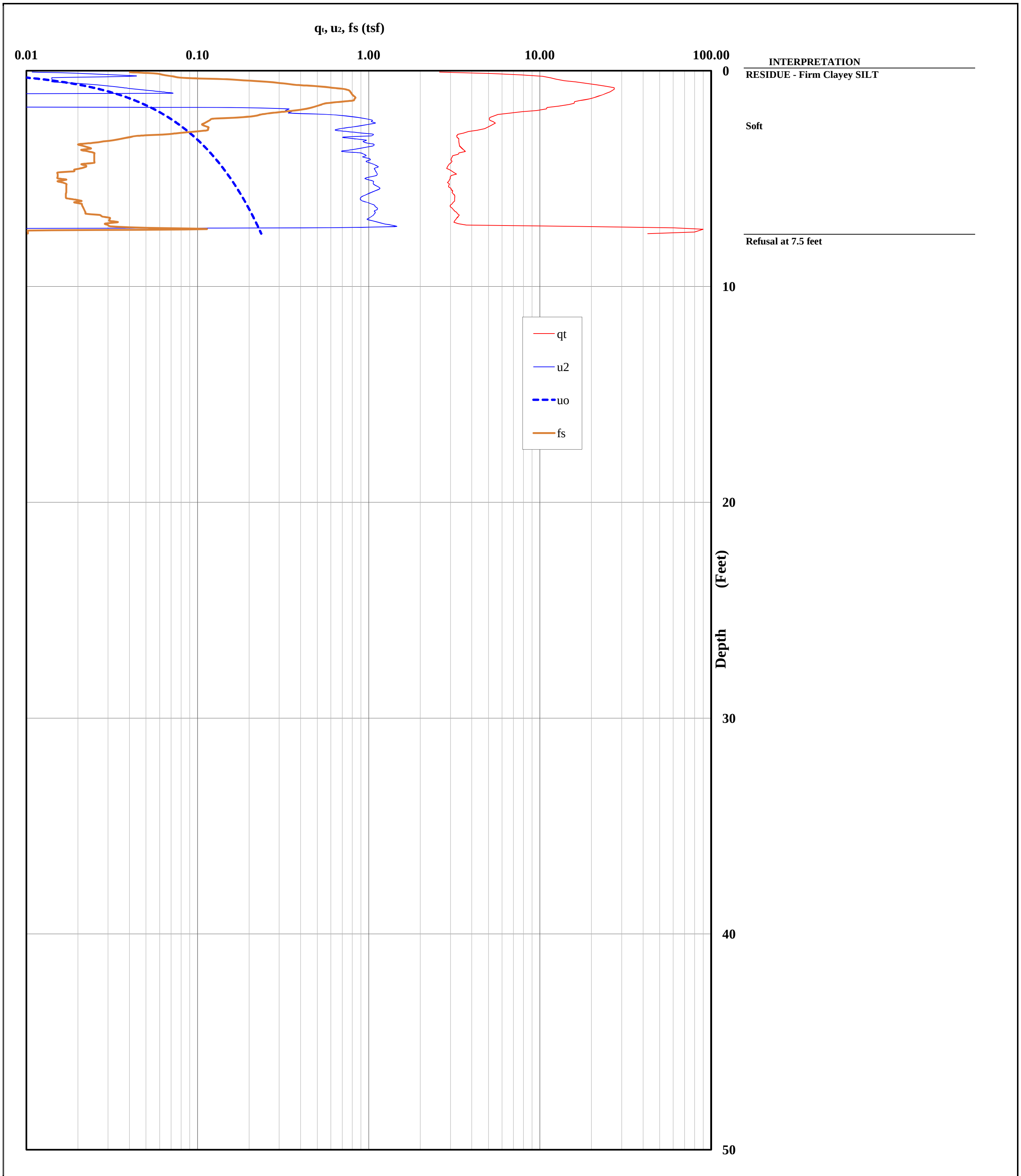
Soft

ALLUVIUM - Firm to Stiff Clayey SILT

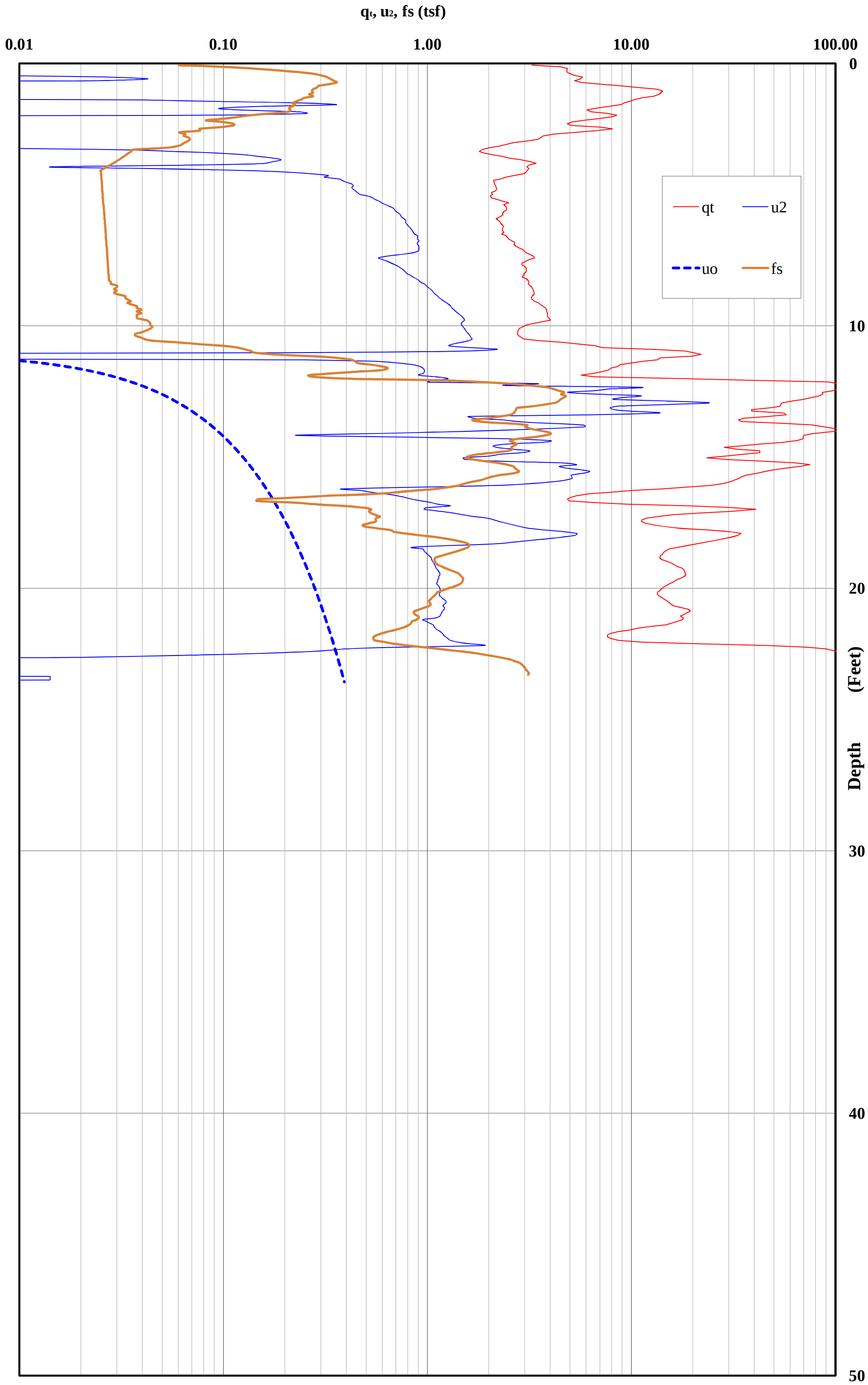
SAND

Terminated at 32.5 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT 21
DATE:	12/3/11
SURFACE ELEVATION	434 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT 22
DATE:	11/28/11
SURFACE ELEVATION	430 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP



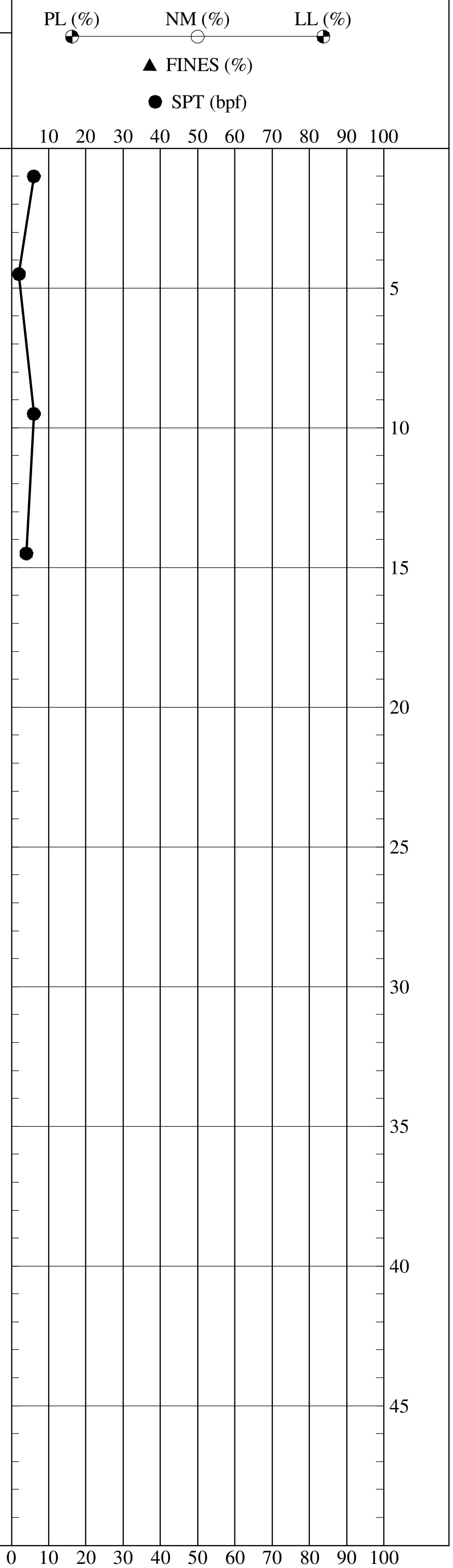
INTERPRETATION

RESIDUE - Soft to Firm Silty CLAY with sand

Terminated at 23.6 feet

PROJECT:	FAESLOU1
PROJECT NUMBER:	3410-10-0782 10.2
PROBE ID:	CPT 23
DATE:	11/28/11
SURFACE ELEVATION	429.0 Feet
PUSHED BY:	Fugro (20 Ton Track)
PREPARED BY:	AAW
CHECKED BY:	PDP

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	Black Gravel with Sand and Silt	418	SPT-1		2-2-4 (N = 6)
	Contained pieces of metal		SPT-2		2-1-1 (N = 2)
5		413			
	Firm Tan Silty Clay				
10		408	SPT-3		1-3-3 (N = 6)
	ALLUVIUM Soft Dark Grey Silty Clay				
15		403	SPT-4		1-2-2 (N = 4)
			UD-1		
	Boring terminated at 17 feet				
20		398			
25		393			
30		388			
35		383			
40		378			
45		373			
50		368			



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Boring caved at 14 feet.

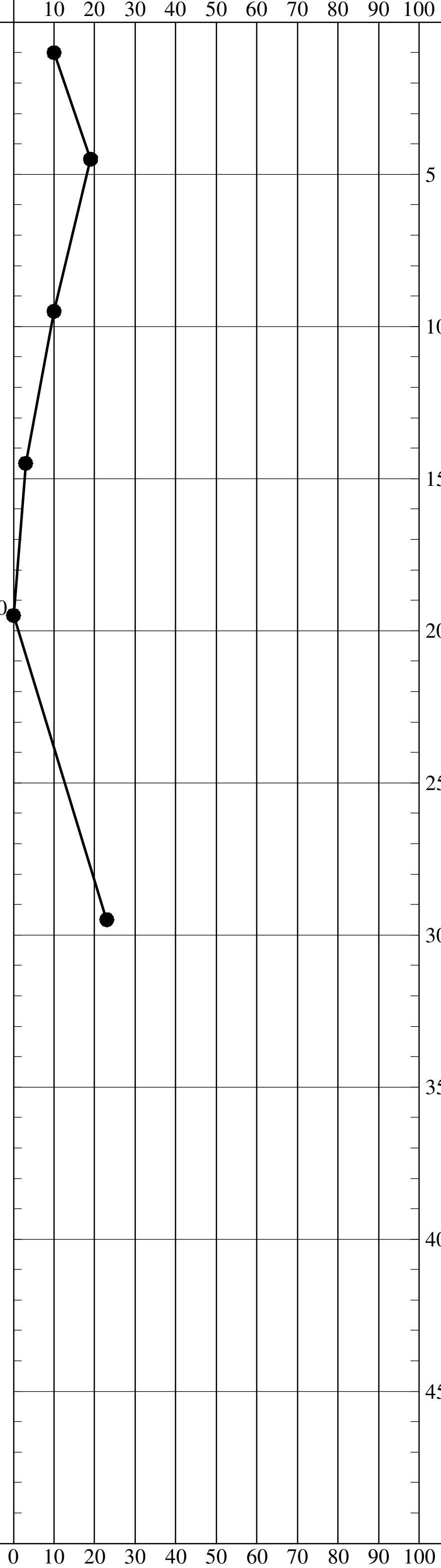
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-1
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 7, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**RESIDUE** Loose to Medium Dense Red, Black, and Tan Sand with Silt and Clay	427	SPT-1	4-4-6 (N = 10)
			SPT-2	3-6-13 (N = 19)
5		422		
	Black and Tan		SPT-3	5-2-8 (N = 10)
10		417		
	Very Soft to Soft Tan and Red Clayey Silt		SPT-4	1-2-1 (N = 3)
15		412		
			SPT-5	WOH/18"-0-0 (N = 0)
20		407		
			SPT-6	1-WOH-1
25	**ALLUVIUM** Very Stiff Dark Grey Silty Clay	402		
			SPT-7	7-11-12 (N = 23)
30	Boring terminated at 30 feet	397		
35		392		
40		387		
45		382		
50		377		



AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Dry, boring caved at 16 feet. Boring performed on the crest of the dike.

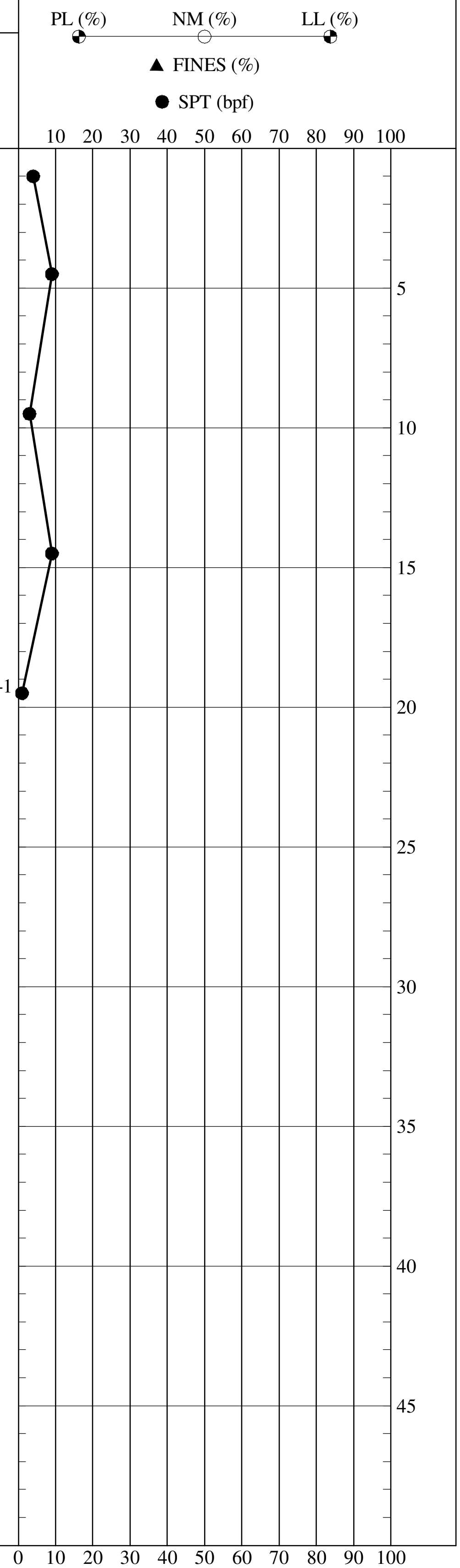
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-2
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 8, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**RESIDUE** Very Loose to Loose Black, Tan, and Red Sand with Clay and Silt		426	SPT-1		2-2-2 (N = 4)
5			421	SPT-2		4-4-5 (N = 9)
10	Black, Tan, and Red Sand mixed with Tan Silty Clay		416	SPT-3		6-2-1 (N = 3)
15			411	SPT-4		4-4-5 (N = 9)
20	No Recovery		406	SPT-5		WOH/12"-0-1 (N = 1)
25	**ALLUVIUM** Very Soft Dark Grey Silty Clay		401	SPT-6		1-WOH-1
25	Boring Terminated at 25 feet		401			
30			396			
35			391			
40			386			
45			381			
50			376			



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Dry, boring caved at 16 feet. Boring performed 20 feet south of the dike crest.

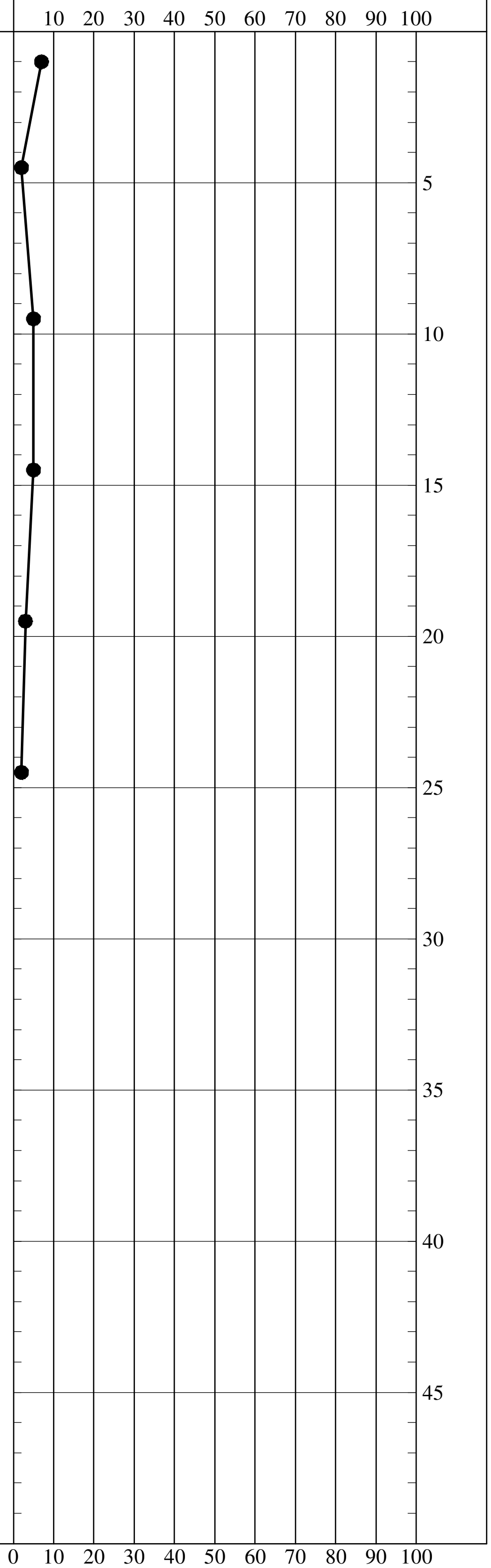
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-3
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 8, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	**RESIDUE** Loose to Loose Black, Tan, and Red Sand with Clay and Silt	427	SPT-1	1-3-4 (N = 7)
	Black, Tan, and Red Sand mixed with Tan Clayey Silt		SPT-2	4-1-1 (N = 2)
5		422		
10		417	SPT-3	5-3-2 (N = 5)
15		412	SPT-4	4-2-3 (N = 5)
	Very Soft Tan and Red Clayey Silt		SPT-5	2-2-1 (N = 3)
20		407		
	ALLUVIUM Very Soft Dark Grey Silty Clay		SPT-6	1-1-1 (N = 2)
25	Boring Terminated at 25 feet	402		
30		397		
35		392		
40		387		
45		382		
50		377		



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Dry, boring caved at 13.5 feet. Boring performed 5 feet south of the dike crest.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-4
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 8, 2011
PROJECT NO.: 3410-10-0782

amec

AUGER BORING RECORD

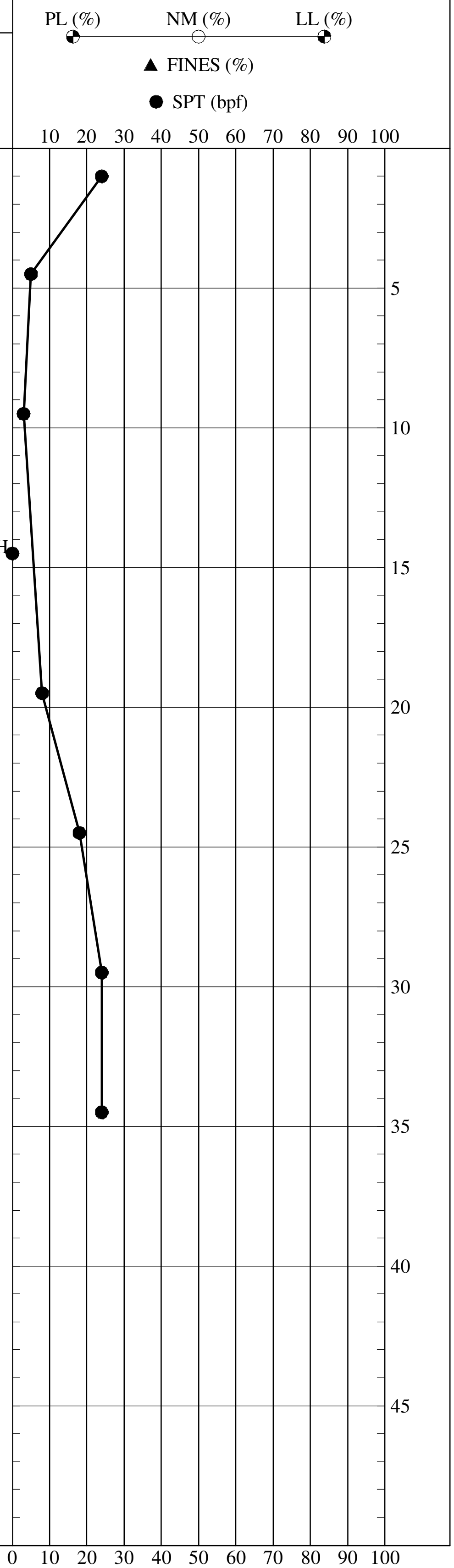
BORING NO.: B-5
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 7, 2011
PROJECT NO.: 3410-10-0782

SOIL CLASSIFICATION AND REMARKS

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	**TOPSOIL** 2 inches	428
	GYPSUM Medium Dense Light Gray Sand with Silt and Gravel	
	Medium Dense Black Sandy Gravel	
	Firm Tan and Red Silty Clay	
7	Very Loose Black and Tan Sand with Clay and Silt	
12	Very Soft Tan Silty Clay	
17	Loose Black and Tan Sand with Clay and Silt	
22	**ALLUVIUM** Medium Dense Dark Grey Sand with Silt	
35	Boring Terminated at 35 feet	393

SAMPLES

IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
SPT-1	4-9-15 (N = 24)
SPT-2	3-3-2 (N = 5)
SPT-3	1-1-2 (N = 3)
SPT-4	1-WOH-WOH
SPT-5	4-4-4 (N = 8)
SPT-6	7-12-6 (N = 18)
SPT-7	7-12-12 (N = 24)
SPT-8	11-12-12 (N = 24)

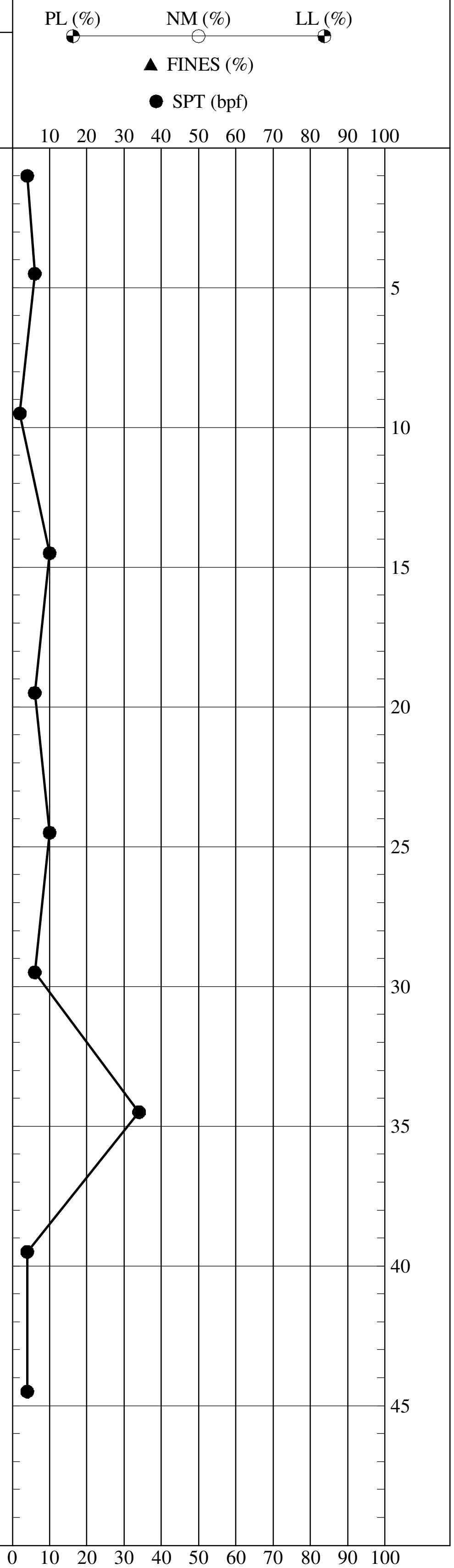


DRILLER:	R. Landeros (AMEC)
EQUIPMENT:	CME-550 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Dry, boring caved at 18 feet.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**RESIDUE** Loose to Very Loose Red, Black, and Tan Sand with Clay and Silt	442	SPT-1	2-2-2 (N = 4)
5		437	SPT-2	2-3-3 (N = 6)
10	Orange Brown Sitly Clay (2" seam)	432	SPT-3	3-1-1 (N = 2)
15		427	SPT-4	4-4-6 (N = 10)
20	Firm Black and Dark Grey Silty Clay	422	SPT-5	1-3-3 (N = 6)
25	Loose to Medium Dense Black and Dark Grey Sand with Clay and Silt	417	SPT-6	2-5-5 (N = 10)
30		412	SPT-7	2-3-3 (N = 6)
35	Dense Black Sandy Gravel	407	SPT-8	10-11-23 (N = 34)
	Very loose Red, Black, and Orange Sand with Clay and Silt			
40	**ALLUVIUM** Soft Dark Grey Silty Clay	402	SPT-9	4-2-2 (N = 4)
45	Boring terminated at 45 feet	397	SPT-10	2-2-2 (N = 4)
50		392		



DRILLER:	R. Landeros (AMEC)
EQUIPMENT:	CME-550 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Boring caved at 40.5 feet.

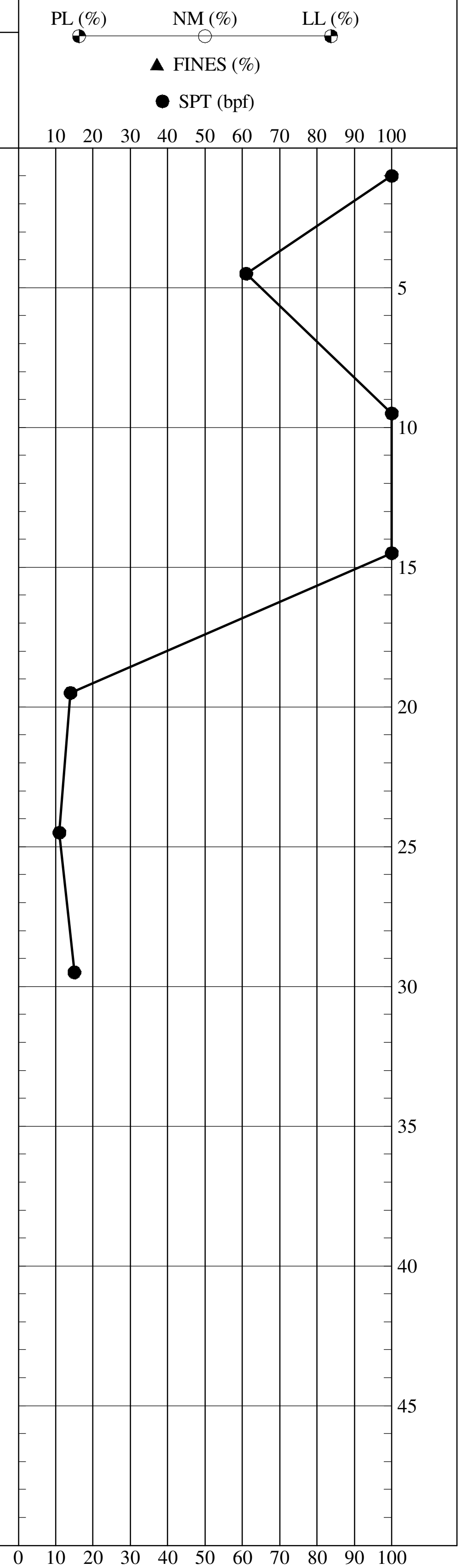
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-6
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 12, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**GYPSUM** Very Dense White and Grey Sand with Silt	423	SPT-1		50/5"
5		418	SPT-2		21-32-29 (N = 61)
10		413	SPT-3		5-13-50/5"
15	**ALLUVIUM** Stiff Grey and Black Silty Clay	408	SPT-4		50/6"
20	Medium Dense Grey Sand with Grey and Black Silty Clay	403	SPT-5		3-6-8 (N = 14)
25		398	SPT-6		2-4-7 (N = 11)
30	Boring Terminated at 30 feet	393	SPT-7		8-7-8 (N = 15)
35		388			
40		383			
45		378			
50		373			



AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: 3 1/4" HSA
HOLE DIA.: 6 inches
REMARKS: Boring caved at 7 feet.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

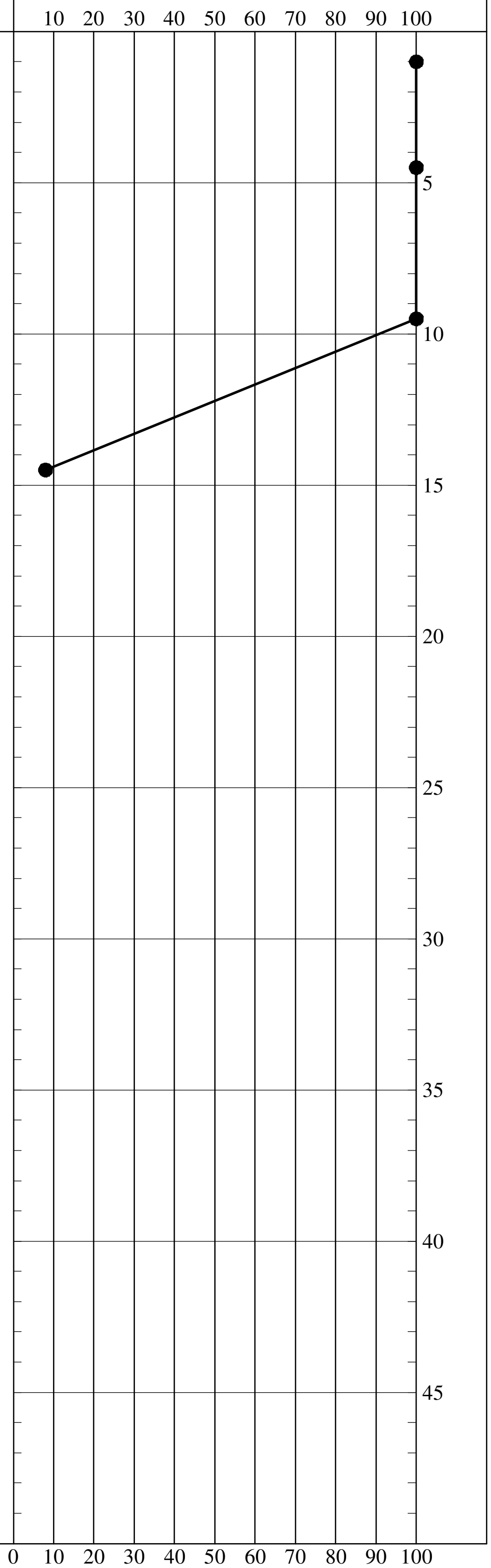
AUGER BORING RECORD

BORING NO.: B-7
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 30, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**GYPSUM** Very Dense White and Grey Sand with Silt	422	SPT-1	4-50/5"
			SPT-2	16-50/5"
5		417		
			SPT-3	40-30-50/2"
10		412		
	ALLUVIUM Firm Grey and Black Silty Clay		SPT-4	17-4-4 (N = 8)
15	Boring Terminated at 15 feet	407		
20		402		
25		397		
30		392		
35		387		
40		382		
45		377		
50		372		

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)



AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: 3 1/4" HSA
HOLE DIA.: 6 inches
REMARKS: Dry, boring caved at 7 feet.

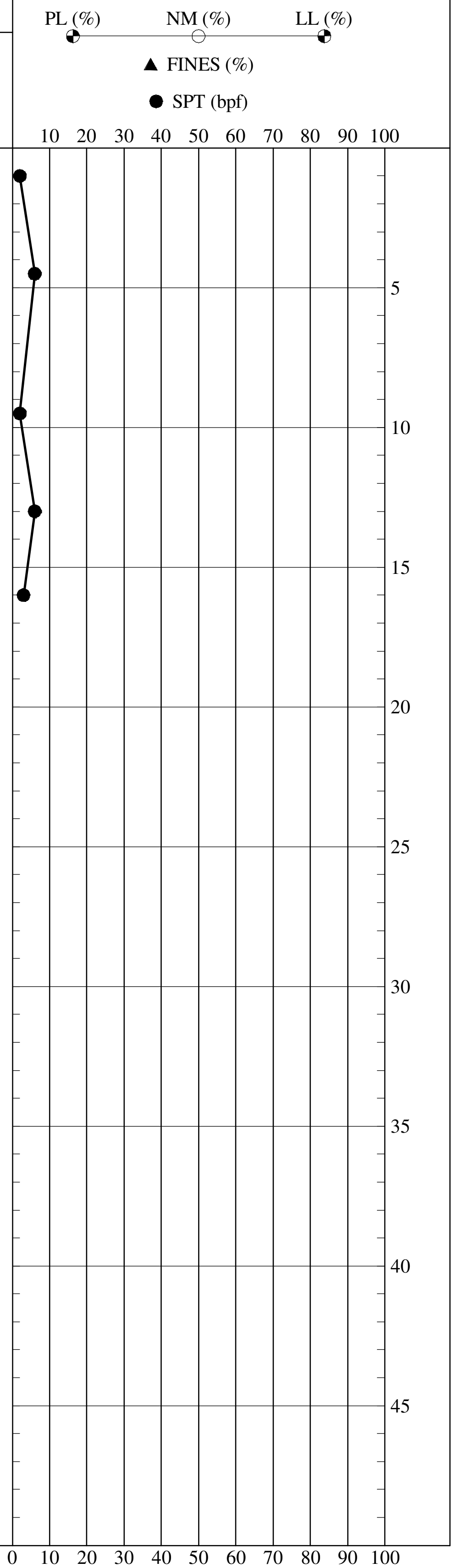
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-7A
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 1, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**ASPHALT** 5 inches	419			
	GYPSUM Very Loose to Loose Black Gravel with Sand and Silt		SPT-1		WOH-1-1 (N = 2)
			SPT-2		2-3-3 (N = 6)
5		414			
	Light Grey		SPT-3		4-1-1 (N = 2)
10	Soft Tan Silty Clay	409			
			UD-1		
	Loose Black Sandy Gravel		SPT-4		1-1-5 (N = 6)
	ALLUVIUM Soft Dark Grey Silty Clay				
15		404	SPT-5		1-1-2 (N = 3)
	Boring Terminated at 16.5 feet				
20		399			
25		394			
30		389			
35		384			
40		379			
45		374			
50		369			



AUGER BORING LOGS BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER:	R. Landeros (AMEC)
EQUIPMENT:	CME-550 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Boring caved at 6.5 feet.

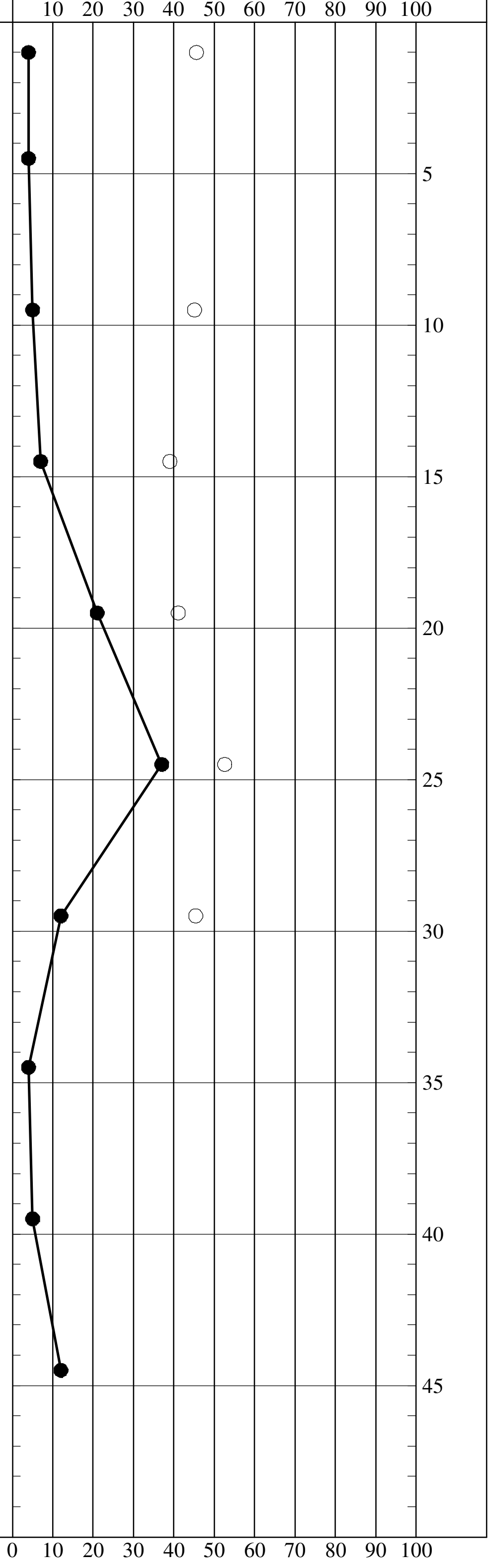
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-8
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 7, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6", 2nd 6", 3rd 6")
0	**RESIDUE** Soft Red and Tan Clayey Silt	438			
	Very Loose to Loose Black Sand with Silt and Clay		SPT-1		1-2-2 (N = 4)
5	Black Slity Clay (2" seam)	433	SPT-2		2-2-2 (N = 4)
10		428	SPT-3		1-2-3 (N = 5)
	Loose to Dense Black and Grey Sandy Gravel				
15		423	SPT-4		3-5-2 (N = 7)
20		418	SPT-5		8-9-12 (N = 21)
25	Pieces of Wood	413	SPT-6		12-10-27 (N = 37)
	Stiff Black and Grey Silty Clay				
	pH of soil 9.9		SPT-7		14-10-2 (N = 12)
30	Medium Dense Black and Grey Sandy Gravel	408			
	Very Loose				
35	**ALLUVIUM** Soft to Stiff Dark Grey Silty Clay	403	SPT-8		3-2-2 (N = 4)
40		398	SPT-9		3-2-3 (N = 5)
	Medium Dense Dark Grey Sand		SPT-10		2-2-10 (N = 12)
45		393			
50	Boring terminated at 50 feet	388			



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Boring caved at 37 feet.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

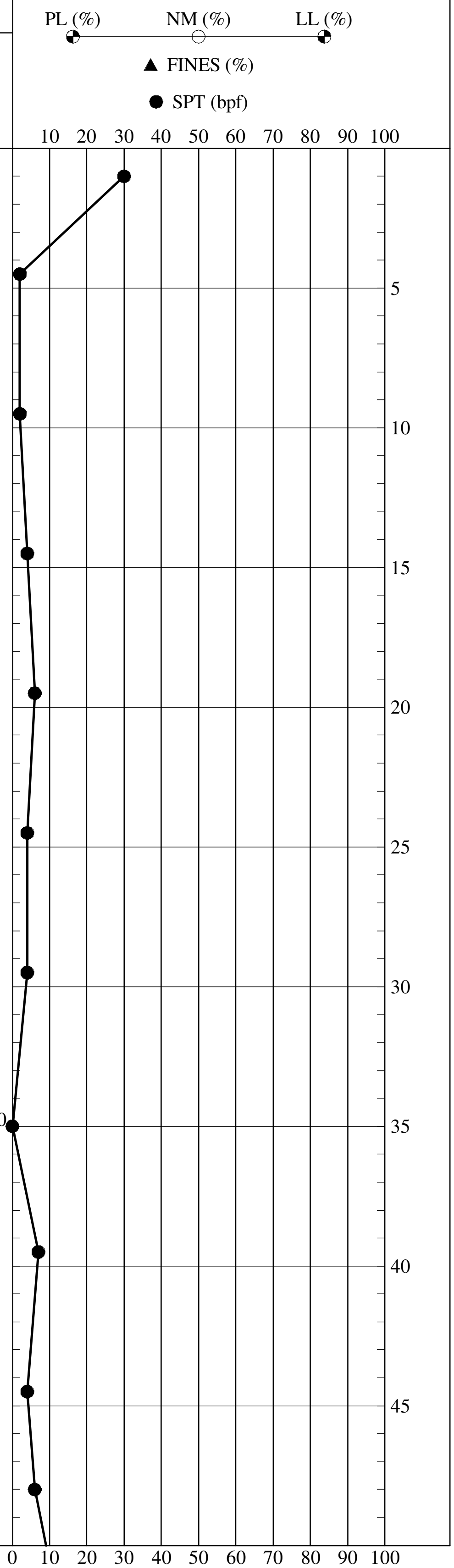
AUGER BORING RECORD

BORING NO.: B-9
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 15, 2011
PROJECT NO.: 3410-10-0782

amec

AUGER BORING RECORD

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**GYPSUM** Medium Dense Light Grey Silty Sand	443			
			SPT-1		16-13-17 (N = 30)
	RESIDUE Very Loose to Loose Red Silty Sand with Clayey Silt Seams				
			SPT-2		2-1-1 (N = 2)
5		438			
			SPT-3		3-1-1 (N = 2)
10		433			
			SPT-4		1-2-2 (N = 4)
15		428			
			SPT-5		4-4-2 (N = 6)
20		423			
	Soft Silty Clay with Tan, Black, and Red Fine Sand seams				
			SPT-6		1-2-2 (N = 4)
25		418			
	No Recovery		SPT-7		1-2-2 (N = 4)
30		413			
	Very Soft				
			UD-1		
35		408	SPT-8		WOH/18"-0-0 (N = 0)
	ALLUVIUM- Firm to Soft Dark Grey Sitly Clay				
			SPT-9		2-3-4 (N = 7)
40		403			
			SPT-10		2-2-2 (N = 4)
45		398			
			UD-2		
			SPT-11		2-3-3 (N = 6)
50		393			



AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Boring caved at 28 feet.

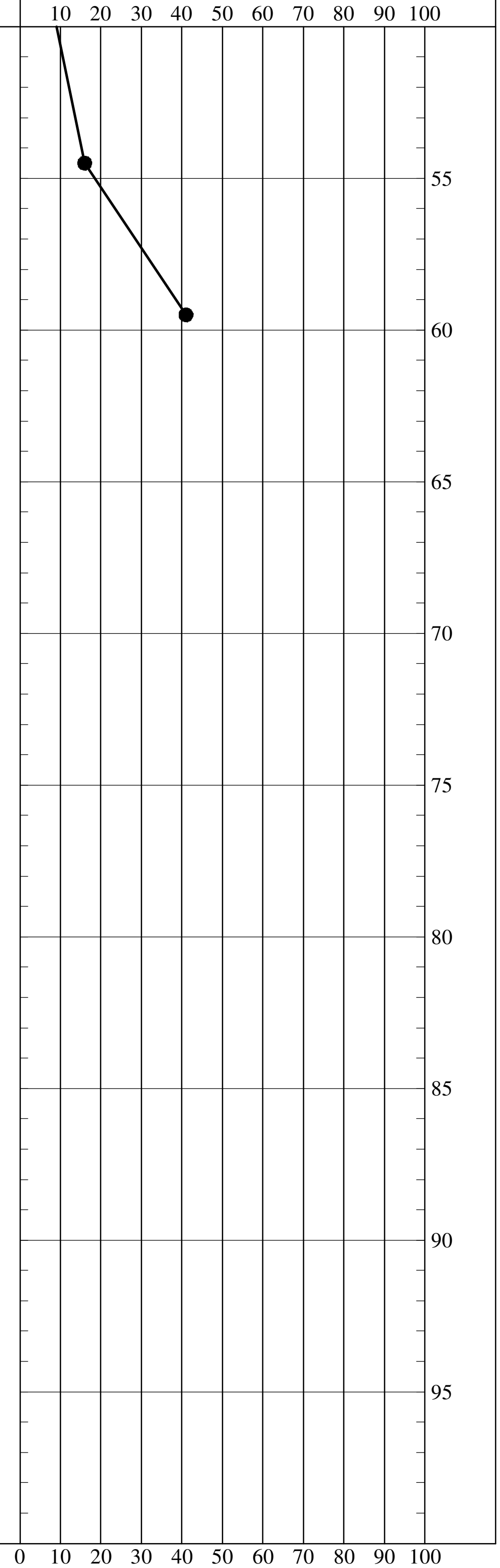
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

BORING NO.: B-10
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 12, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
50	**ALLUVIUM**- Firm to Soft Dark Grey Sitly Clay		393			
	No Recovery			SPT-12		3-7-9 (N = 16)
55			388			
	Dense Grey Sand					
				SPT-13		10-20-21 (N = 41)
60	Boring terminated at 60 feet		383			
65			378			
70			373			
75			368			
80			363			
85			358			
90			353			
95			348			
100			343			

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Boring caved at 28 feet.

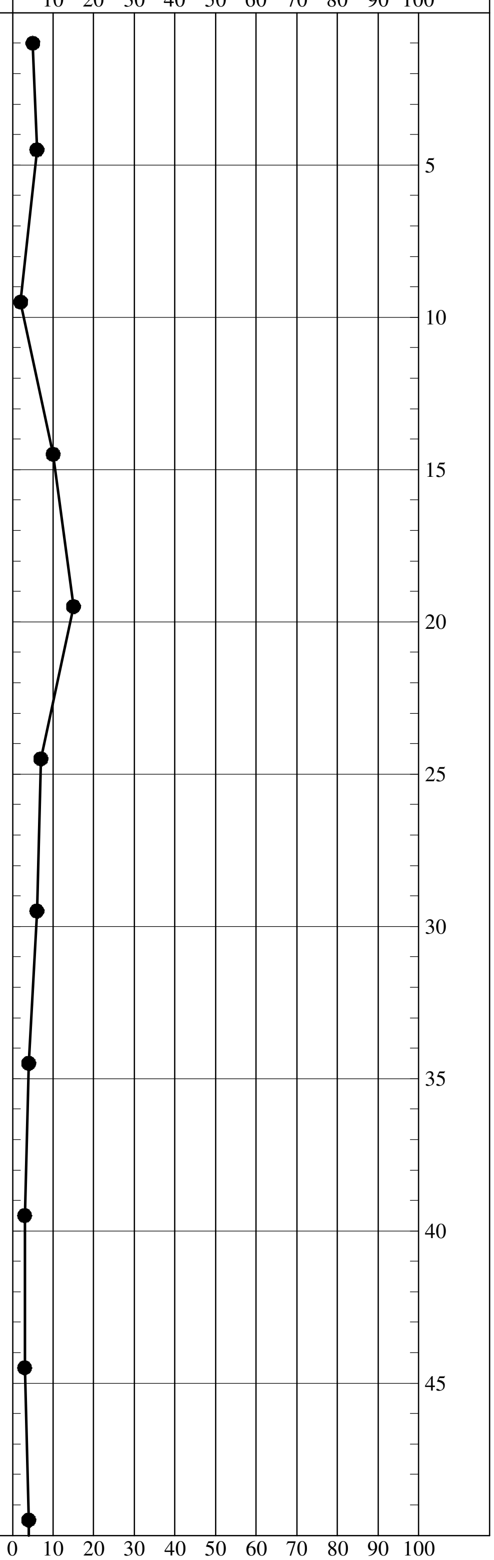
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-10
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 12, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	**POSSIBLE RESIDUE** Loose to Very Loose Red and Black Sand with Silt and Clay	460	SPT-1	1-2-3 (N = 5)
	Thin Clayey Silt Seams		SPT-2	3-4-2 (N = 6)
5		455		
	Very Soft Red and Tan Silty Clay		SPT-3	1-1-1 (N = 2)
10		450		
	Loose to Medium Dense Red, Black, and Tan Sand with Silt and Clay		SPT-4	4-6-4 (N = 10)
15		445		
			SPT-5	7-7-8 (N = 15)
20		440		
	▼		SPT-6	2-2-5 (N = 7)
25		435		
	Firm Tan Silty Clay		SPT-7	WOH-1-5 (N = 6)
30		430		
	Very Loose Red, Black, and Tan Sand with Silt and Clay		SPT-8	3-2-2 (N = 4)
35		425		
	Soft Red and Tan Silty Clay		SPT-9	1-2-1 (N = 3)
40		420		
	Tan, Black, and Red Sand with Sand and Silt (9" seam)		SPT-10	3-2-1 (N = 3)
45		415		
	Tan and Black Sand with Sand and Silt (3" seam)		SPT-11	2-2-2
50		410		



AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS:

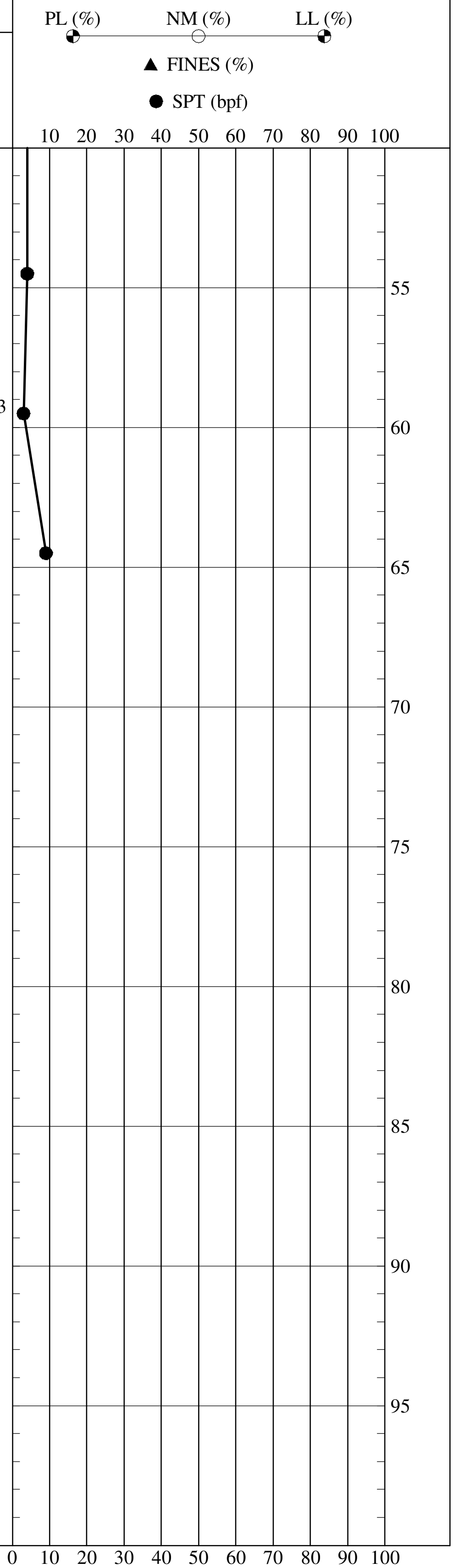
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-11
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 17, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
50	Soft to Very Soft Red Tan Silty Clay		410			(N = 4)
55			405	SPT-12		2-2-2 (N = 4)
60	**ALLUVIUM** Stiff Dark Grey Silty Clay		400	SPT-13		WOH/12"-0-3 (N = 3)
65	Boring terminated at 65 feet		395	SPT-14		3-4-5 (N = 9)
70			390			
75			385			
80			380			
85			375			
90			370			
95			365			
100			360			



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS:

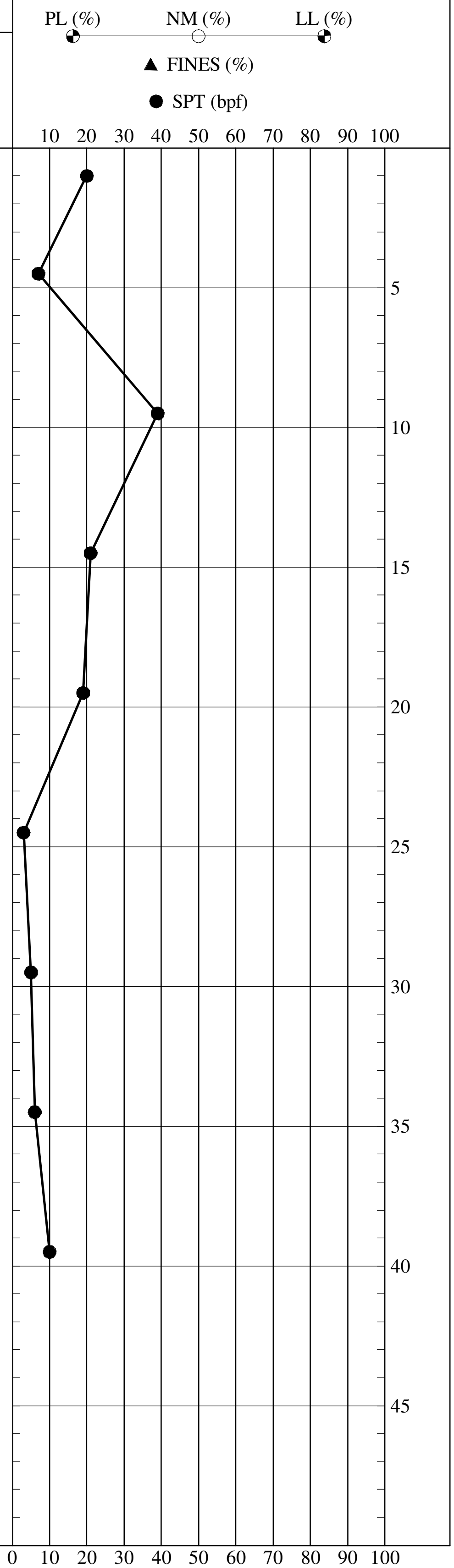
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-11
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 17, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**GYPSUM** Medium Dense Light Gray Silty Sand	444	SPT-1	X	7-7-13 (N = 20)
	Red, Tan, Black Sand with Silt and Clay (6" seam)		SPT-2	X	1-2-5 (N = 7)
5		439			
			SPT-3	X	5-15-24 (N = 39)
10		434			
	RESIDUE Tan and Red Clayey Silt				
	GYPSUM Medium Dense Light Gray Silty Sand		SPT-4	X	5-14-7 (N = 21)
15		429			
			SPT-5	X	3-7-12 (N = 19)
20		424			
	RESIDUE Soft Tan and Red Clayey Silt				
			SPT-6	X	1-2-1 (N = 3)
25		419			
	ALLUVIUM Firm to Stiff Dark Grey and Blue Silty Clay		SPT-7	X	1-2-3 (N = 5)
30		414			
			SPT-8	X	WOH-2-4 (N = 6)
35		409			
			SPT-9	X	3-5-5 (N = 10)
40	Boring terminated at 40 feet	404			
45		399			
50		394			



AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: 3 1/4" HSA
HOLE DIA.: 6 inches
REMARKS: Dry, boring caved at 12 feet.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-12
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 9, 2011
PROJECT NO.: 3410-10-0782

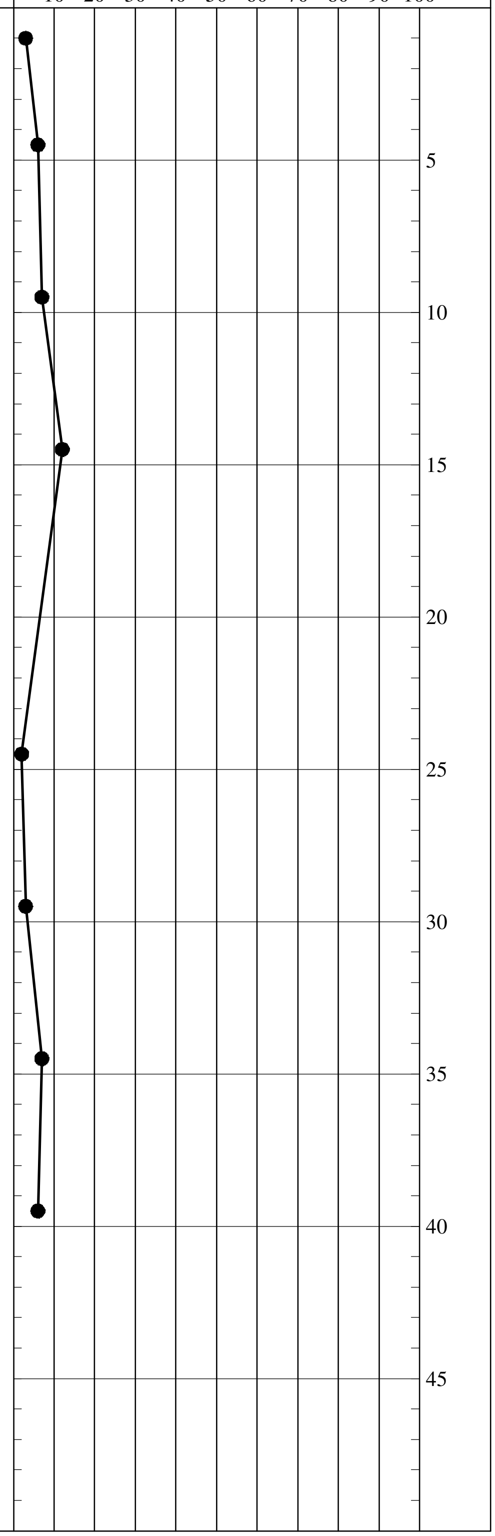
amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	**TOPSOIL** 4 inches **GYPSUM** Very Loose Light Gray Sitly Sand **RESIDUE** Soft Red and Tan Clayey Silt with Sand	442
4	Very Loose to Medium Dense Black Tan and Red Sand with Silt and Clay	
27	Very Soft to Firm Tan and Red Orange Brown Silty Clay with Sand	
34	**ALLUVIUM** Firm Dark Grey and Blue Silty Clay	
40	Boring terminated at 40 feet	402

DEPTH (ft)	ELEV (ft)
0	442
5	437
10	432
15	427
20	422
25	417
30	412
35	407
40	402
45	397
50	392

SAMPLES

IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
SPT-1		4-2-1 (N = 3)
SPT-2		2-2-4 (N = 6)
SPT-3		3-3-4 (N = 7)
SPT-4		3-5-7 (N = 12)
SPT-5		2-2
SPT-6		WOH-1-1 (N = 2)
SPT-7		WOH-2-1 (N = 3)
SPT-8		2-4-3 (N = 7)
SPT-9		2-3-3 (N = 6)



AUGER BORING LOGS BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER:	R. Landeros (AMEC)
EQUIPMENT:	CME-550 (Auto-Hammer)
METHOD:	3 1/4" HSA
HOLE DIA.:	6 inches
REMARKS:	Dry, boring caved at 17 feet.

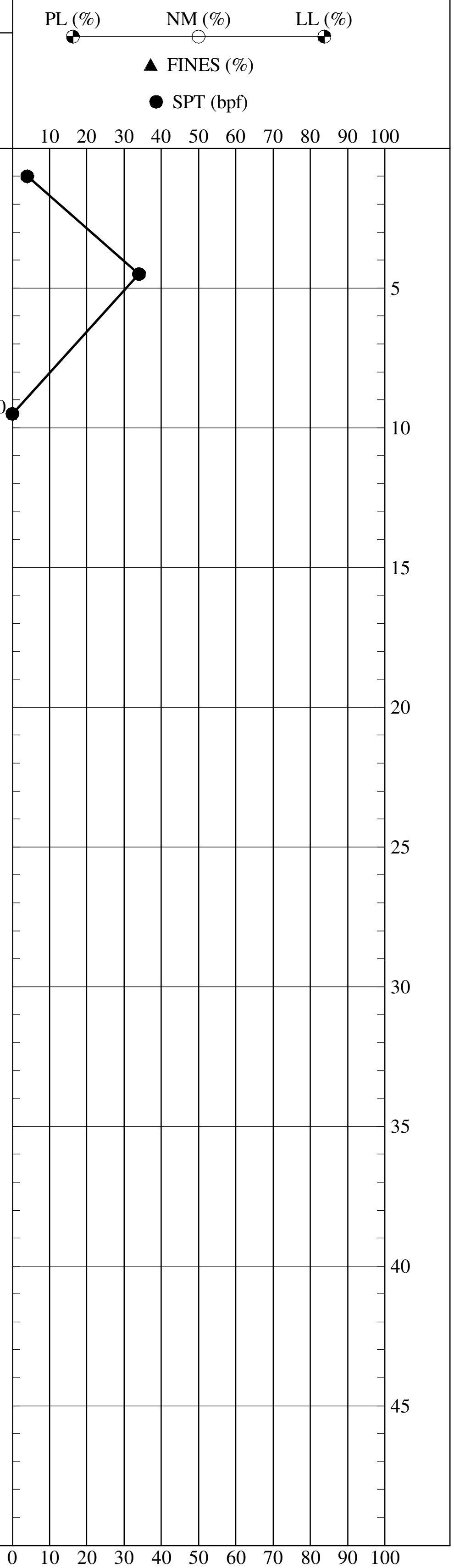
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-13
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 9, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**GYPSUM** Loose to Dense Light Grey Silty Sand	439	SPT-1		1-3-1 (N = 4)
			SPT-2		6-22-12 (N = 34)
5		434			
	Void		SPT-3		WOR/18"-0-0 (N = 0)
10		429			
	Boring Terminated. Boring Offset to B-14A.				
15		424			
20		419			
25		414			
30		409			
35		404			
40		399			
45		394			
50		389			



AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: 3 1/4" HSA
HOLE DIA.: 6 inches
REMARKS: Groundwater not encountered at TOD.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

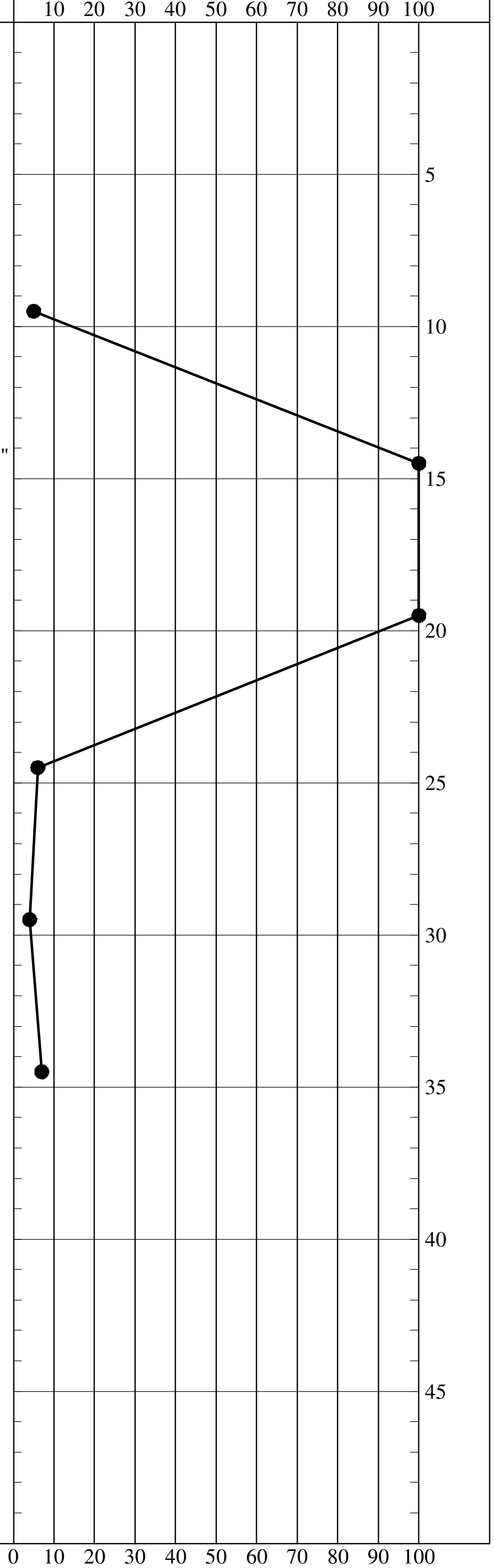
BORING NO.: B-14
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 9, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**Boring Augered to 8.5 feet**	439			
8.5	**GYPSUM** Loose Light Grey Silty Sand mixed with Tan, Black, and Orange Sand with Silt and Clay		SPT-3		7-2-3 (N = 5)
	Very Dense		SPT-4		49-50/6'-50/6"
			SPT-5		40-50/3"
22	**RESIDUE** Loose Tan, Black, and Orange Fine Sand with Clayey Silt seams		SPT-6		9-3-3 (N = 6)
29.5	Soft Tan and Red Clayey Silt		SPT-7		2-2-2 (N = 4)
32	**ALLUVUIM** Firm Dark Grey and Blue Silty Clay		SPT-8		2-3-4 (N = 7)
			UD-1		
39	Boring terminated at 39 feet				

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50 ft; Elevation scale: 439, 434, 429, 424, 419, 414, 409, 404, 399, 394, 389 ft.

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)



AUGER BORING BOREING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER:	R. Landeros (AMEC)
EQUIPMENT:	CME-550 (Auto-Hammer)
METHOD:	3 1/4" HSA
HOLE DIA.:	6 inches
REMARKS:	Groundwater not encountered at TOD.

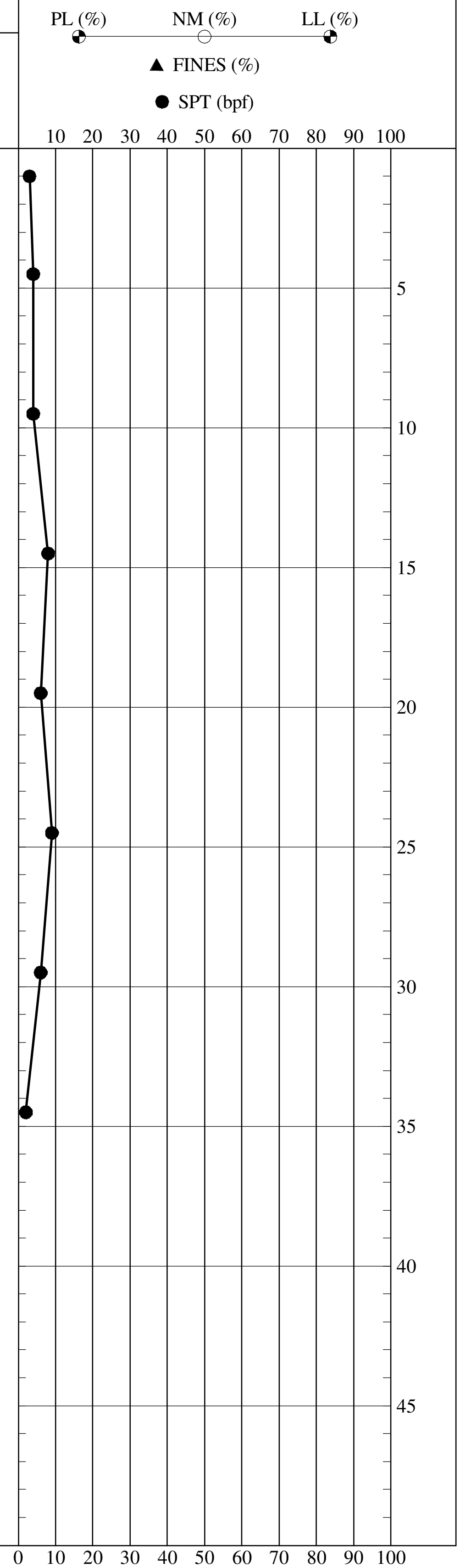
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-14A
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 9, 2011
PROJECT NO.: 3410-10-0782 **PAGE** 1 **OF** 1

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	**RESIDUE** Very Loose Red and Orange Sand with Silt and Clay	442	SPT-1		2-2-1 (N = 3)
	GYPSUM Very Loose Light Grey Silty Sand				
	RESIDUE Very Loose Red and Orange Sand with Silt and Clay				
5		437	SPT-2		3-2-2 (N = 4)
10		432	SPT-3		3-2-2 (N = 4)
15		427	SPT-4		3-5-3 (N = 8)
20	Red, Tan, Orange Silty Clay (10" seam)	422	SPT-5		1-2-4 (N = 6)
25		417	SPT-6		4-4-5 (N = 9)
30		412	SPT-7		4-1-5 (N = 6)
35	**ALLUVIUM** Very Soft Dark Grey and Blue Silty Clay	407	SPT-8		5-1-1 (N = 2)
	Boring terminated at 35 feet				
40		402			
45		397			
50		392			



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: 3 1/4" HSA
HOLE DIA.: 6 inches
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

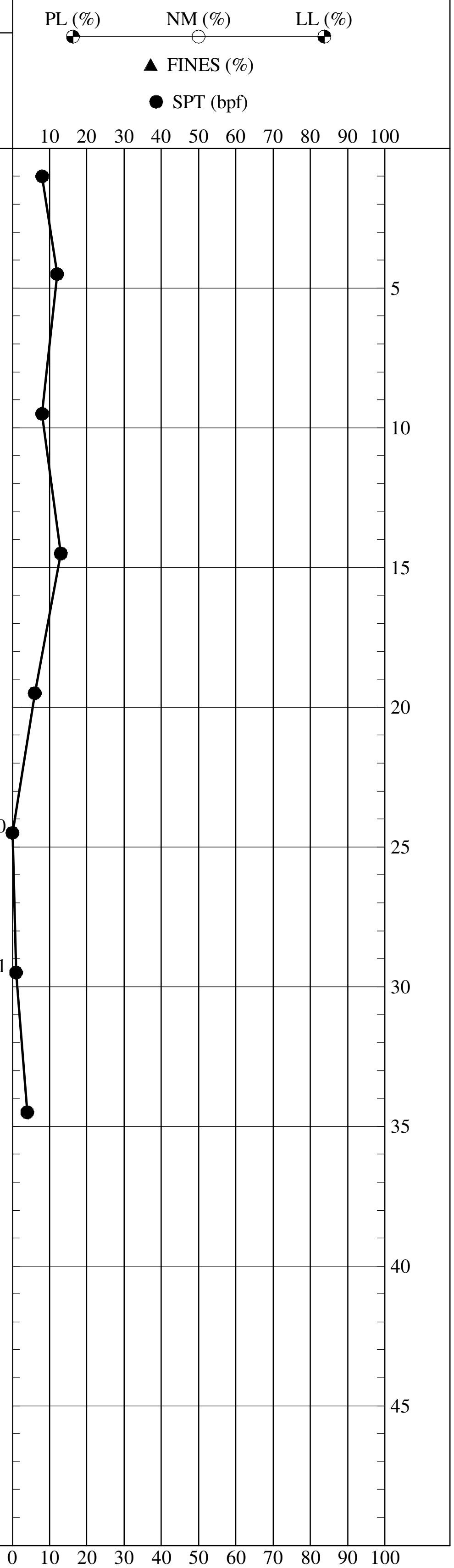
BORING NO.: B-15
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 10, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	**RESIDUE** Loose Red and Orange Sand with Silt and Clay	441
	GYPSUM Loose Light Grey Silty Sand	
	RESIDUE Loose Red and Orange Sand with Silt and Clay	
5		436
	Firm Orange Brown Silty Clay	
10	Medium Dense Tan and Black Sand with Silt and Clay	431
15		426
	Loose	
20		421
	Very Loose	
25	Very Soft to Soft Orange Brown Silty Clay with Tan, Black, and Red Fine Sand seams	416
30		411
35	**ALLUVIUM** Very Soft Dark Grey and Blue Silty Clay	406
	Boring terminated at 35 feet	
40		401
45		396
50		391

SAMPLES

IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
SPT-1		2-5-3 (N = 8)
SPT-2		4-6-6 (N = 12)
SPT-3		5-4-4 (N = 8)
SPT-4		3-5-8 (N = 13)
SPT-5		2-4-2 (N = 6)
SPT-6		WOR/18"-0-0 (N = 0)
SPT-7		WOH/12"-0-1 (N = 1)
SPT-8		WOH-2-2 (N = 4)



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: 3 1/4" HSA
HOLE DIA.: 6 inches
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

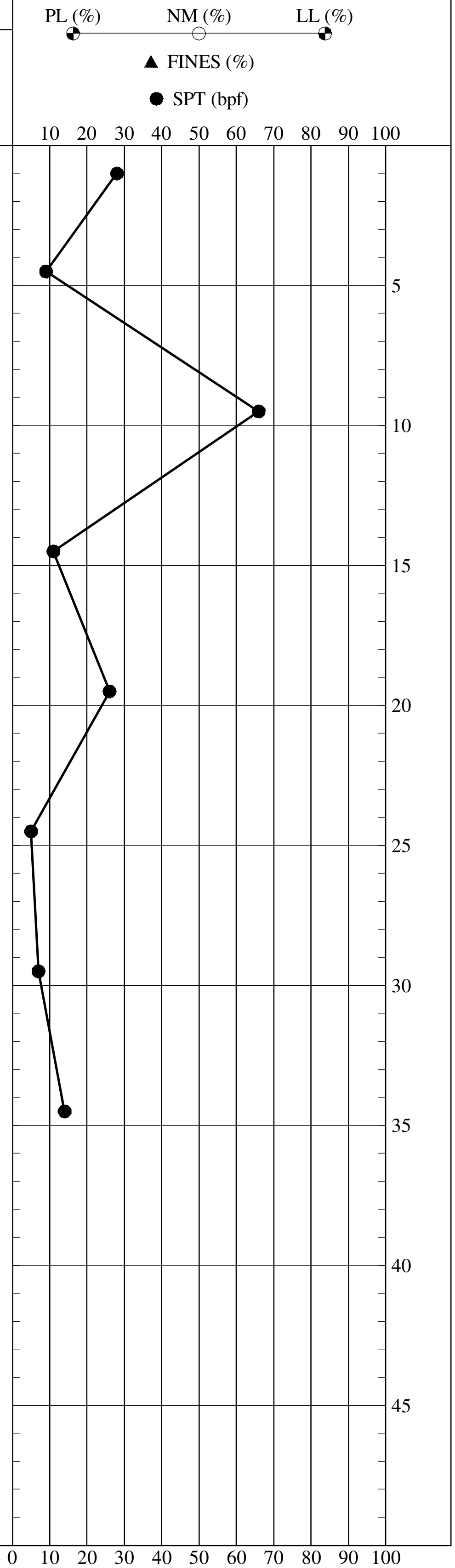
BORING NO.: B-16
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 9, 2011
PROJECT NO.: 3410-10-0782

PAGE 1 **OF** 1

amec

AUGER BORING RECORD

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	TYPE	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	**GYPSUM** Medium Dense Light Grey Silty Sand	421	SPT-1		5-23-5 (N = 28)
2.5	Loose to Dense Gray Black Sand with Silt				
5	▼	416	SPT-2		3-3-6 (N = 9)
10		411	SPT-3		9-33-33 (N = 66)
15	**ALLUVIUM** Very Stiff to Firm Dark Grey Silty Clay	406	SPT-4		6-6-5 (N = 11)
20		401	SPT-5		13-15-11 (N = 26)
25		396	SPT-6		2-2-3 (N = 5)
30		391	SPT-7		3-5-2 (N = 7)
32	Medium Dense Sand with Silt				
35	Boring terminated at 35 feet due to hard drilling. Hole offset 25 feet southwest.	386	SPT-8		8-7-7 (N = 14)
40		381			
45		376			
50		371			



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: 3 1/4" HSA
HOLE DIA.: 6 inches
REMARKS: Boring caved at 12 feet.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-17
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 30, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**Boring Advanced to 23.5 feet**	421		
23.5	**ALLUVIUM** Medium Dense Gray Sand with Silt		SPT-9	4-10-12 (N = 22)
			SPT-10	5-8-8 (N = 16)
			SPT-11	7-6-6 (N = 12)
			SPT-12	11-13-11 (N = 24)
40	Boring Terminated at 40 feet	381		

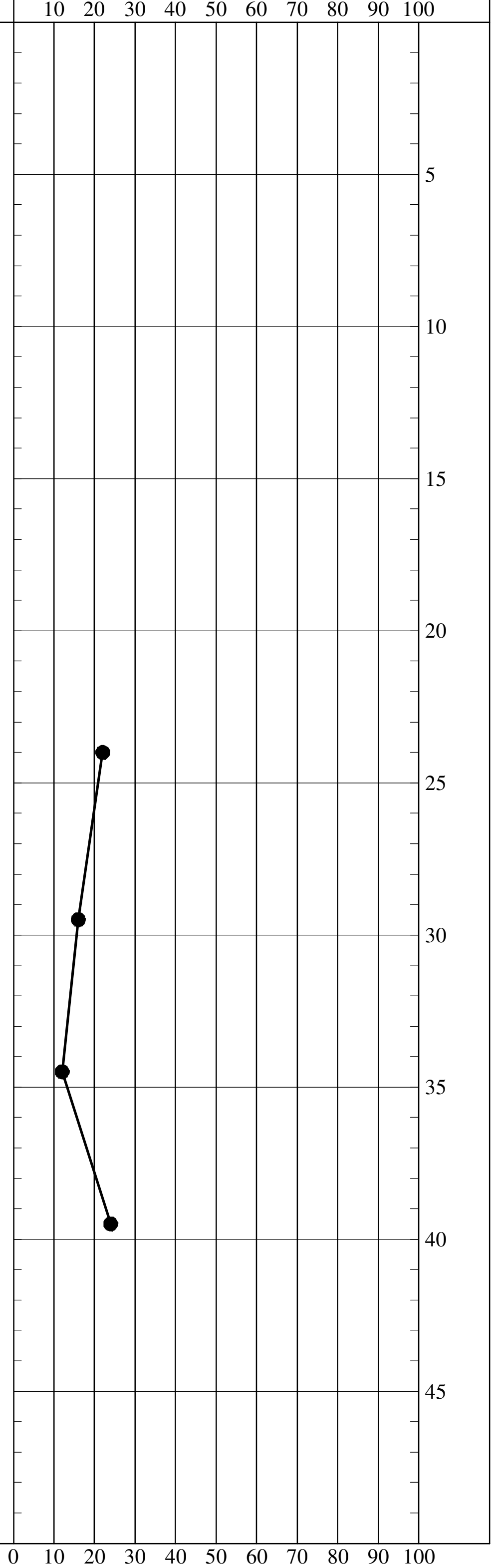
Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

Elev (ft): 421, 416, 411, 406, 401, 396, 391, 386, 381, 376, 371

PL (%) NM (%) LL (%)

▲ FINES (%)

● SPT (bpf)



AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Boring caved at 7 feet.

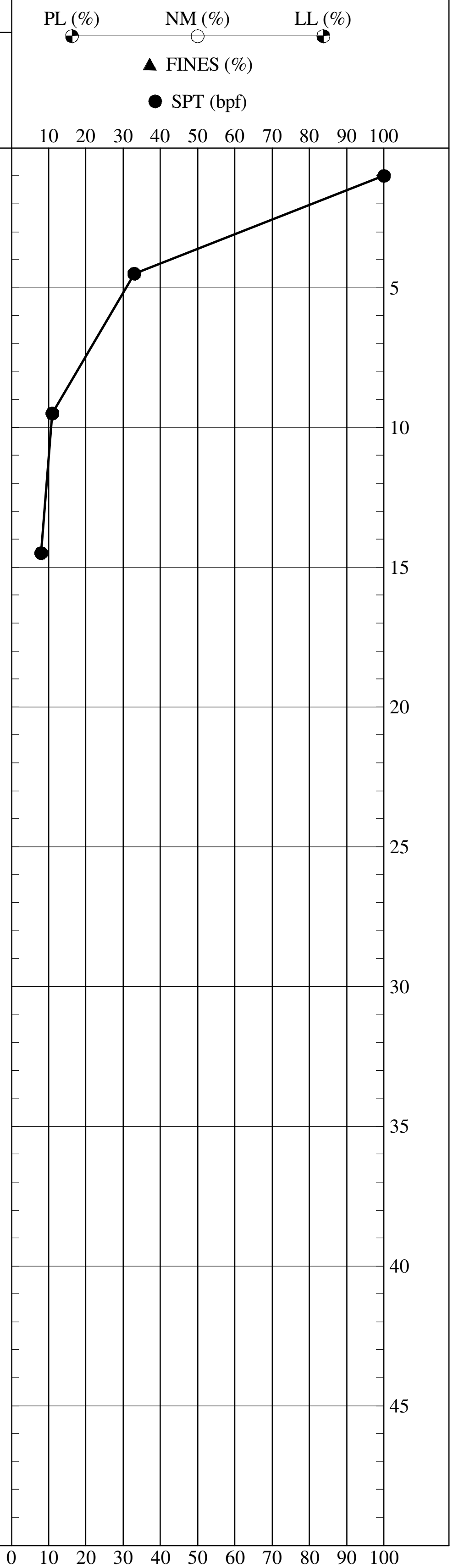
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-17A
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 1, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**TOPSOIL** 2 inches	423			
	GYPSUM Loose Light Grey Silty Sand		SPT-1		23-50/5"
			SPT-2		15-20-13 (N = 33)
5		418			
			SPT-3		2-3-8 (N = 11)
10		413			
	Dark Grey Gravel				
	ALLUVIUM Firm Dark Grey Silty Clay		SPT-4		3-4-4 (N = 8)
15	Refusal on obstruction. Boring offset 10 feet north	408			
20		403			
25		398			
30		393			
35		388			
40		383			
45		378			
50		373			



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Boring caved at 1 foot.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

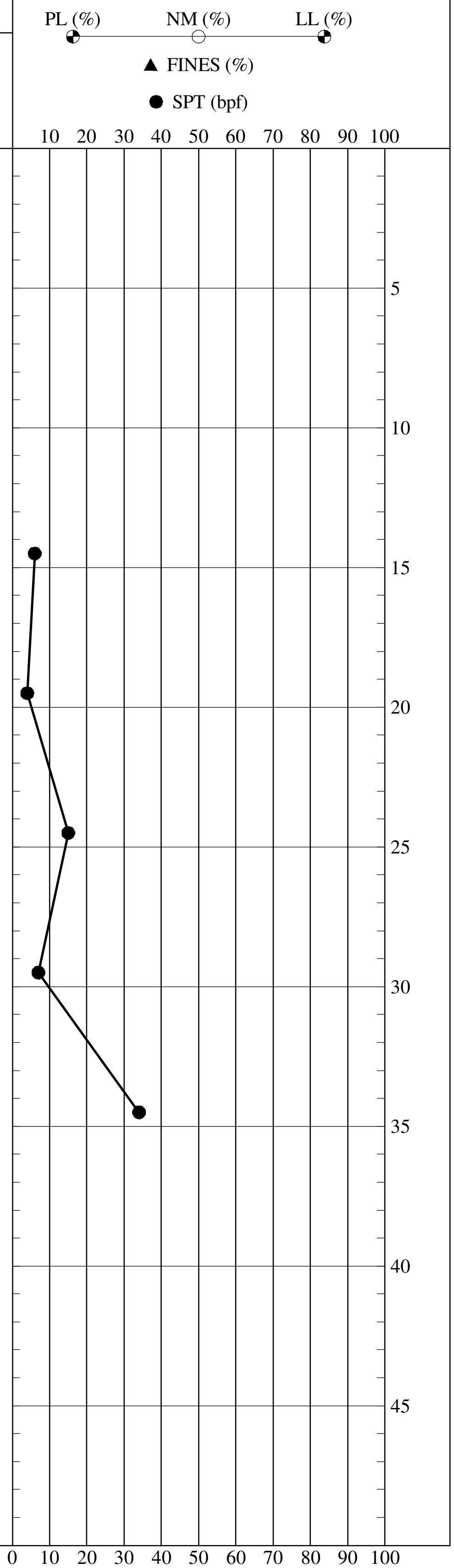
AUGER BORING RECORD

BORING NO.: B-18
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 14, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	IDENT	TYPE	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	**Boring Advanced to 15 feet**	423			
13.5	**ALLUVIUM** Firm Dark Grey Silty Clay				
14.5			SPT-4		3-3-3 (N = 6)
19.5			SPT-5		1-2-2 (N = 4)
24	Medium Dense Grey Sand with Silt				
24.5			SPT-6		4-6-9 (N = 15)
28	No Recovery				
29	Loose		SPT-7		3-1-6 (N = 7)
34	Dense		SPT-8		5-14-20 (N = 34)
35	Boring terminated at 35 feet	388			

Water level symbol shown at approximately 8 feet.



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Boring caved at 27 feet.

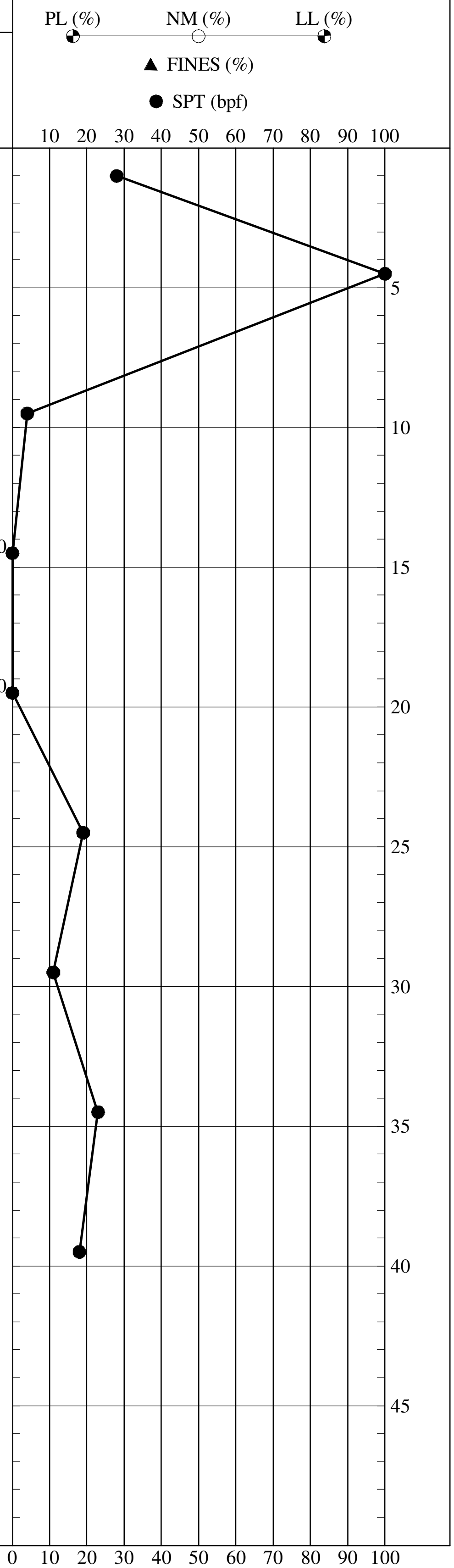
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-18A
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 15, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**GYPSUM** Dense to Very Dense Light Grey Silty Sand	442	SPT-1		13-16-12 (N = 28)
5		437	SPT-2		50/1"
	RESIDUE Soft to Very Soft Orange Brown Clayey Silt				
10		432	SPT-3		2-2-2 (N = 4)
	No Recovery				
15		427	SPT-4		WOH/18"-0-0 (N = 0)
20		422	SPT-5		WOH/18"-0-0 (N = 0)
	Very Stiff to Stiff Tan				
25		417	SPT-6		11-12-7 (N = 19)
30		412	SPT-7		5-5-6 (N = 11)
	ALLUVIUM Stiff Dark Grey Clay				
35		407	SPT-8		6-10-13 (N = 23)
	Medium Dense Grey Sand with Silt				
40	Boring terminated at 40 feet	402	SPT-9		8-10-8 (N = 18)
45		397			
50		392			



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Boring caved at 18 feet.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

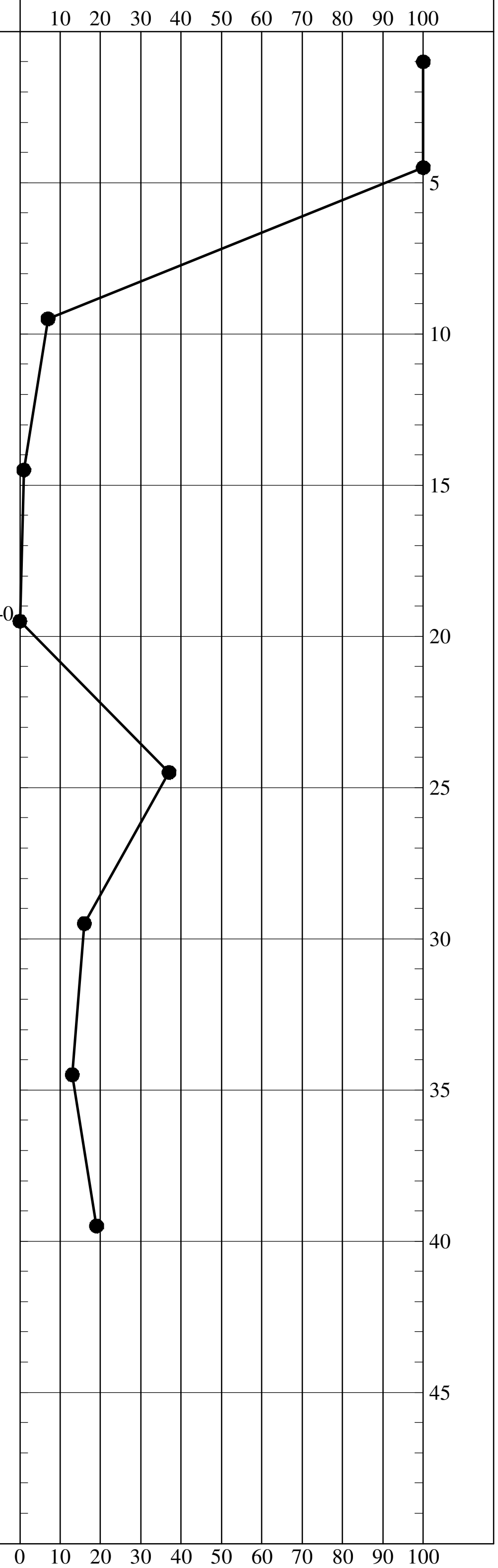
BORING NO.: B-19
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 12, 2011
PROJECT NO.: 3410-10-0782

PAGE 1 **OF** 1

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	**GYPSUM** Very Dense Light Gray Silty Sand	444	SPT-1	8-15-50/2"
5		439	SPT-2	50/2"
	<<B>RESIDUE **Loose Orange Brown Sand with Clay and Silt**			
	Very Soft Orange and Tan Silty Clay with Black, Tan, and Red Sand seams		SPT-3	6-5-2 (N = 7)
10		434		
15		429	SPT-4	2-1-0 (N = 1)
20		424	SPT-5	WOH/18"-0-0 (N = 0)
	Hard		SPT-6	12-13-24 (N = 37)
25		419		
	Very Stiff		SPT-7	9-6-10 (N = 16)
30		414		
	ALLUVIUM Very Stiff Grey Silty Clay			
35		409	SPT-8	10-7-6 (N = 13)
	Medium Dense Grey Sand with Silt		SPT-9	10-9-10 (N = 19)
40	Boring terminated at 40 feet	404		
45		399		
50		394		

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Dry, boring caved at 17 feet.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

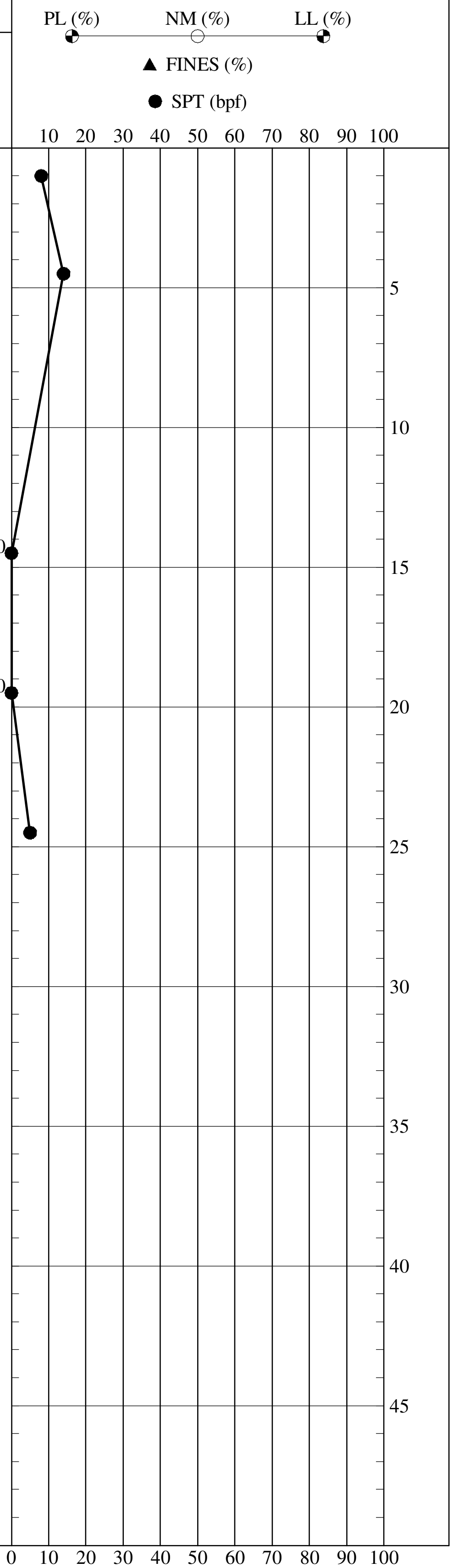
AUGER BORING RECORD

BORING NO.: B-20
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 11, 2011
PROJECT NO.: 3410-10-0782

PAGE 1 **OF** 1

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**TOPSOIL** 3 inches	422		
	GYPSUM Loose to Medium Dense Grey Sand with Silt and Gravel		SPT-1	2-4-4 (N = 8)
	RESIDUE Tan and Red Sand with Clay and Silt		SPT-2	3-8-6 (N = 14)
5	Very Soft Orange. Tan, and Red Sandy Silty Clay	417	SPT-3	
			UD-1	
10		412		
15		407	SPT-4	WOH/18"-0-0 (N = 0)
	No Recovery		SPT-5	WOH/18"-0-0 (N = 0)
20	**ALLUVIUM** Firm Dark Grey Silty Clay	402		
			SPT-6	WOH-3-2 (N = 5)
25	Boring terminated at 20 feet	397		
30		392		
35		387		
40		382		
45		377		
50		372		



DRILLER: R. Landeros (AMEC)
EQUIPMENT: CME-550 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Boring caved at 13 feet.

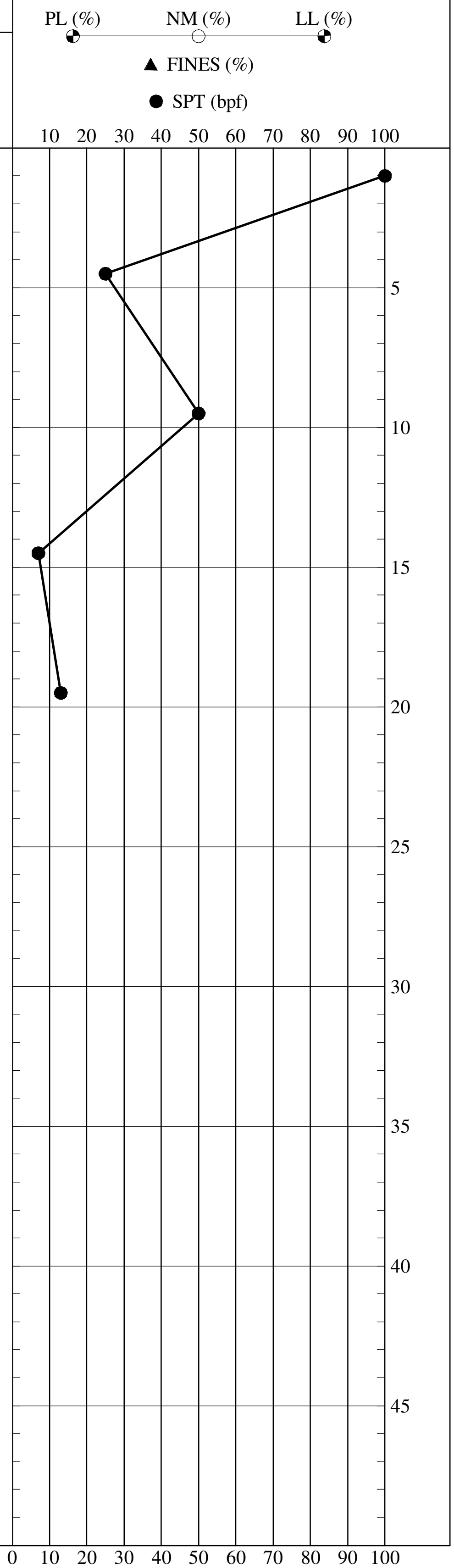
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-21
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 2, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**GYPSUM** Very Dense Light Grey Sand with Silt and Gravel		423	SPT-1		20-50/5"
	Dense Blue and Red			SPT-2		14-12-13 (N = 25)
5			418			
	Black			SPT-3		11-29-21 (N = 50)
10			413			
	ALLUVIUM Firm Grey and Brown Silty Clay			SPT-4		1-3-4 (N = 7)
15			408			
	Medium Dense Dark Grey Sand with Silt			SPT-5		3-6-7 (N = 13)
20	Boring Terminated at 20 feet		403			
25			398			
30			393			
35			388			
40			383			
45			378			
50			373			



AUGER BORING LOGS BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER:	R. Landeros (AMEC)
EQUIPMENT:	CME-550 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Boring caved at 12 feet.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: B-22
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 1, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	**RESIDUE** Soft Red, Orange, and Tan Clayey Silt	432
5		427
10	Lost Circulation	422
15		417
20		412
22	Refusal to Jetting at 22 feet	
25		407
30		402
35		397
40		392
45		387
50		382

LEGEND; SAMPLES: IDENT, TYPE, N-COUNT (1st 6", 2nd 6", 3rd 6")

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

AUGER BORING LOGS BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: Piet DePree (AMEC)
EQUIPMENT: Pump
METHOD: Advanced by Hand with Jetting Water with 1 inch PVC pipe
HOLE DIA.: 1.5 inches
REMARKS: No Sampling.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-1
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: October 10, 2011
PROJECT NO.: 3410-10-0782

amec

AUGER BORING RECORD

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	**RESIDUE** Soft Red, Orange, and Tan Clayey Silt	432
5		427
10	Lost Circulation	422
15		417
20		412
22	Refusal to Jetting at 22 feet Lost Circulation	
25		407
30		402
35		397
40		392
45		387
50		382

SAMPLES: IDENT, TYPE, N-COUNT (1st 6", 2nd 6", 3rd 6")

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
0 10 20 30 40 50 60 70 80 90 100

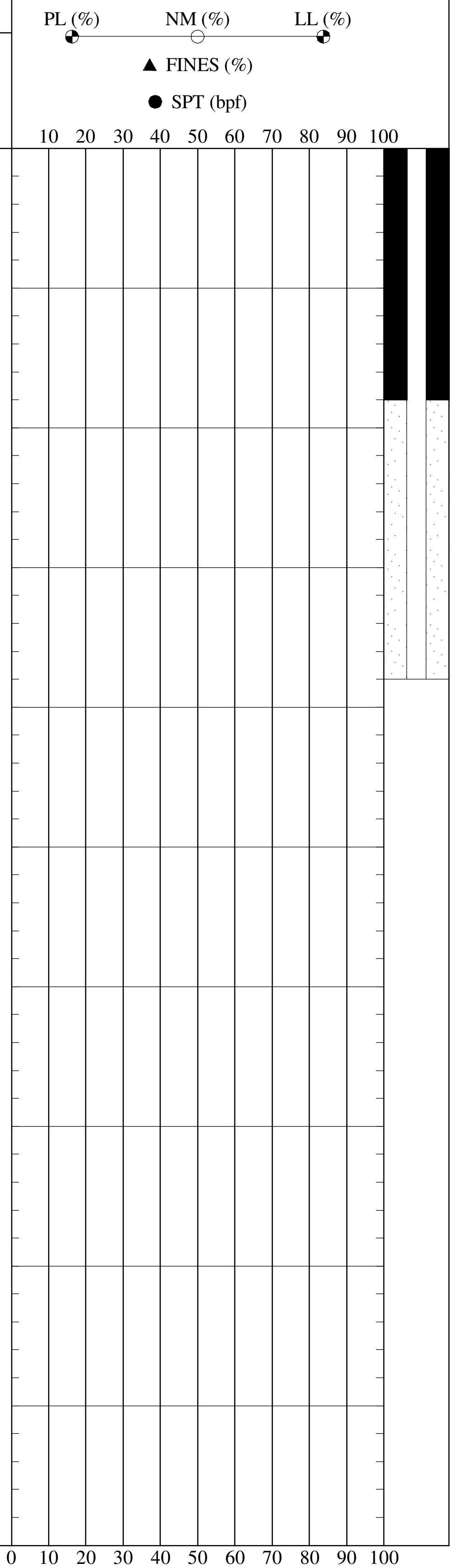
DRILLER: Piet DePree (AMEC)
EQUIPMENT: Pump
METHOD: Advanced by Hand with Jetting Water with 1 inch PVC pipe
HOLE DIA.: 1.5 inches
REMARKS: No Sampling.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

BORING NO.: PZ-2
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: October 10, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"
0	**RESIDUE** Soft Red, Orange, and Tan Clayey Silt		432					
5			427					
10			422					
15	Lost Circulation		417					
20	Refusal to Jetting at 22 feet		412					
25			407					
30			402					
35			397					
40			392					
45			387					
50			382					



DRILLER: Piet DePree (AMEC)
EQUIPMENT: Pump
METHOD: Advanced by Hand with Jetting Water with 1 inch PVC
HOLE DIA.: pipe
REMARKS: 1.5 inches
No Sampling.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-3
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: October 10, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"
0	**RESIDUE** Soft Red, Orange, and Tan Clayey Silt		432					
5			427					
10			422					
13	Refusal to Jetting at 13 feet							
15			417					
20			412					
25			407					
30			402					
35			397					
40			392					
45			387					
50			382					

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: Piet DePree (AMEC)
EQUIPMENT: Pump
METHOD: Advanced by Hand with Jetting Water with 1 inch PVC pipe
HOLE DIA.: 1.5 inches
REMARKS: No Sampling.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

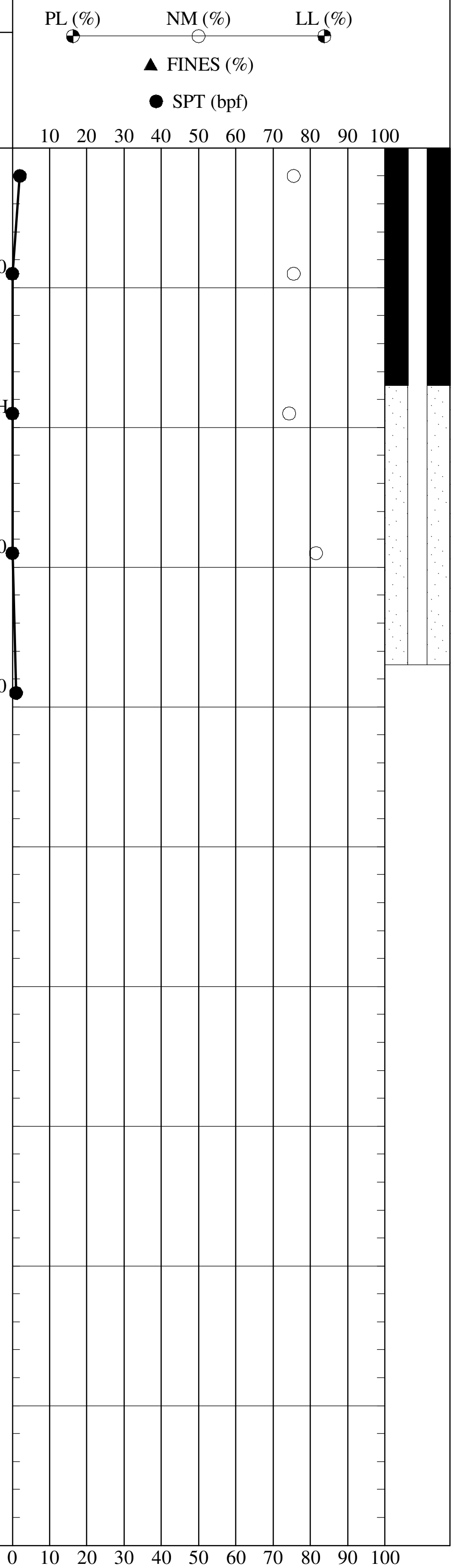
AUGER BORING RECORD

BORING NO.: PZ-4
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: October 11, 2011
PROJECT NO.: 3410-10-0782

amec

AUGER BORING RECORD

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**RESIDUE** Very Soft Red Orange Clayey Silt pH of soil 10.2	423	SPT-1	1-1-1 (N = 2)
			SPT-2	WOH/18"-0-0 (N = 0)
5	No Recovery	418	UD-1	
	Su= 450 psf Rb= 6 0psf		VANE-1	
			SPT-3	WOH-1-WOH
10	No Recovery	413	UD-2	
	Su= 440 psf Rb= 80 psf pH of soil 11.2		VANE-2	
15		408	SPT-4	WOH/18"-0-0 (N = 0)
	ALLUVIUM Very Soft Dark Grey Silty Clay			
			SPT-5	WOH/12"-1-0 (N = 1)
20	Piezometer Terminated at 20 feet	403		
25		398		
30		393		
35		388		
40		383		
45		378		
50		373		



DRILLER: Ruben Landeros (AMEC)
EQUIPMENT: CME-55 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Piezometer backfilled to 8.5 feet using sand. Backfilled to surface using residue and bentonite.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-5
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 8, 2011
PROJECT NO.: 3410-10-0782

PAGE 1 **OF** 1

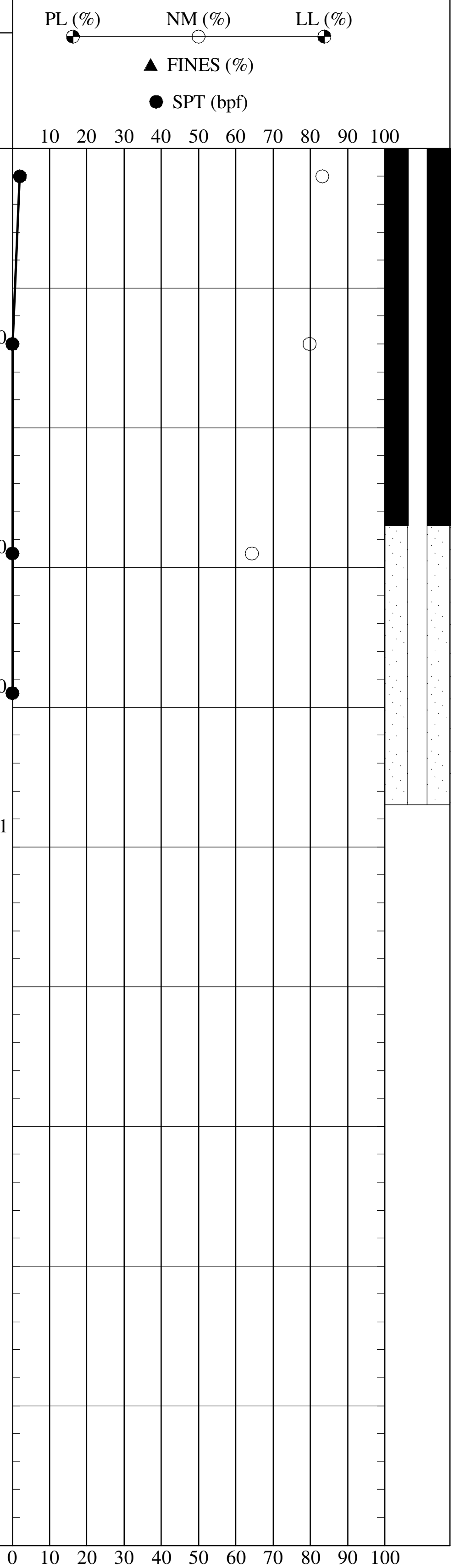
amec

AUGER BORING RECORD

BORING NO.: PZ-6
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 8, 2011
PROJECT NO.: 3410-10-0782

PAGE 1 **OF** 1

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**RESIDUE** Very Soft Red Tan Clayey Silt	424	SPT-1	1-1-1 (N = 2)
	No Recovery		UD-1	
5		419		
			SPT-2	WOH/18"-0-0 (N = 0)
	Su= 450 psf Rb= 60 psf		VANE-1	
10	No Recovery	414	UD-2	
			SPT-3	WOH/18"-0-0 (N = 0)
15		409		
	Su= 580 psf Rb= 190 psf		VANE-2	
			SPT-4	WOH/18"-0-0 (N = 0)
20		404		
	ALLUVIUM Very Soft Dark Grey Silty Clay			
			SPT-5	WOH-WOH-1
25	Piezometer Terminated at 25 feet	399		
30		394		
35		389		
40		384		
45		379		
50		374		



DRILLER:	Ruben Landeros (AMEC)
EQUIPMENT:	CME-55 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Piezometer backfilled to 13.5 feet using sand. Backfilled to surface using residue and bentonite.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

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DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	**TOPSOIL** 2 inches	430
	GYPSUM Medium Dense Sand with Silt	
	Soft Brown Orange Silty Clay glass, wood chips, plastic pieces, and other miscellaneous debris	
5		425
10	▼	420
	Loose to Medium Dense Black Gravel with Sand	
15		415
20		410
25	Tan Silty Clay	405
	ALLUVIUM Soft Dark Grey Silty Clay	
30	Piezometer Terminated at 30 feet	400
35		395
40		390
45		385
50		380

SAMPLES

IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
SPT-1	⊠	3-4-12 (N = 16)
SPT-2	⊠	1-2-2 (N = 4)
SPT-3	⊠	4-1-3 (N = 4)
SPT-4	⊠	3-4-5 (N = 9)
SPT-5	⊠	3-9-8 (N = 17)
SPT-6	⊠	4-1-3 (N = 4)
SPT-7	⊠	1-2-1 (N = 3)

PL (%) NM (%) LL (%)

▲ FINES (%)

● SPT (bpf)

10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

DRILLER:	Ruben Landeros (AMEC)
EQUIPMENT:	CME-55 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Piezometer backfilled to 18.5 feet using sand. Backfilled to surface using residue and bentonite.

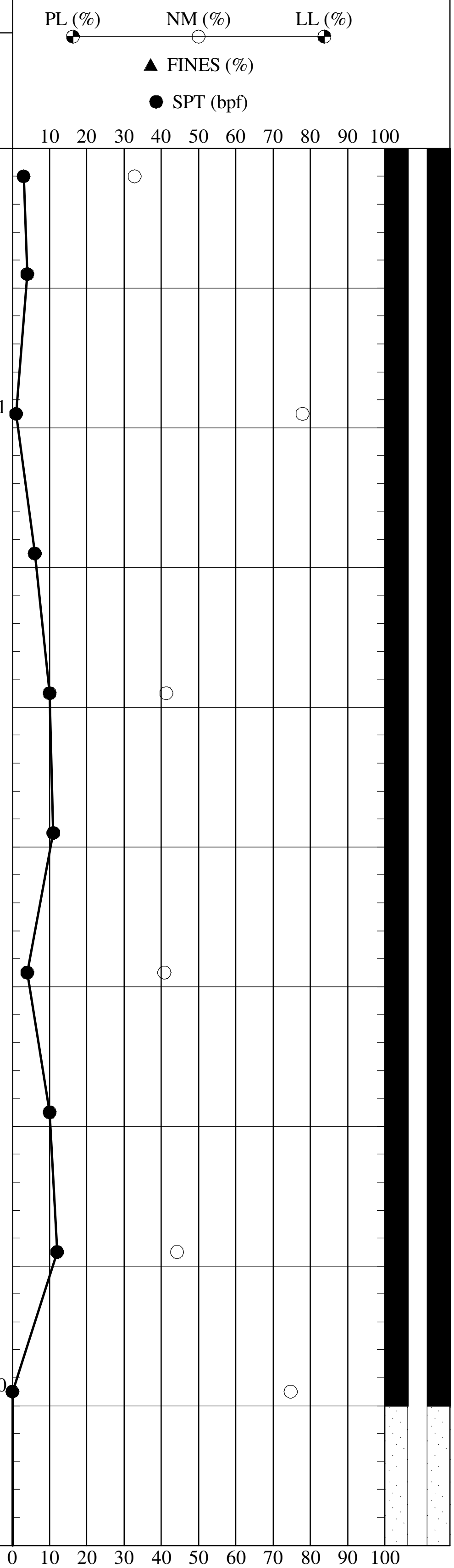
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-7
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 7, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**RESIDUE** Very Loose Tan, Red, and Black Fine Sand with seams of Clayey Silt pH of soil 8.2	458	SPT-1	2-1-2 (N = 3)
5		453	SPT-2	4-2-2 (N = 4)
10		448	SPT-3	WOH/12"-0-1 (N = 1)
			UD-1	
15	Loose	443	SPT-4	1-4-2 (N = 6)
20		438	SPT-5	4-5-5 (N = 10)
25	Medium Dense	433	SPT-6	4-5-6 (N = 11)
30	Very Loose	428	SPT-7	2-2-2 (N = 4)
35	Loose (water level ▼)	423	SPT-8	2-4-6 (N = 10)
40	Medium Dense	418	SPT-9	2-5-7 (N = 12)
45	Very Soft Red and Tan Silty Clay	413	SPT-10	WOH/18"-0-0 (N = 0)
50		408	UD-2	



AUGER BORING LOGS BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER:	Ruben Landeros (AMEC)
EQUIPMENT:	CME-55 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Piezometer backfilled to 42 feet using sand. Backfilled to surface using residue and bentonite.

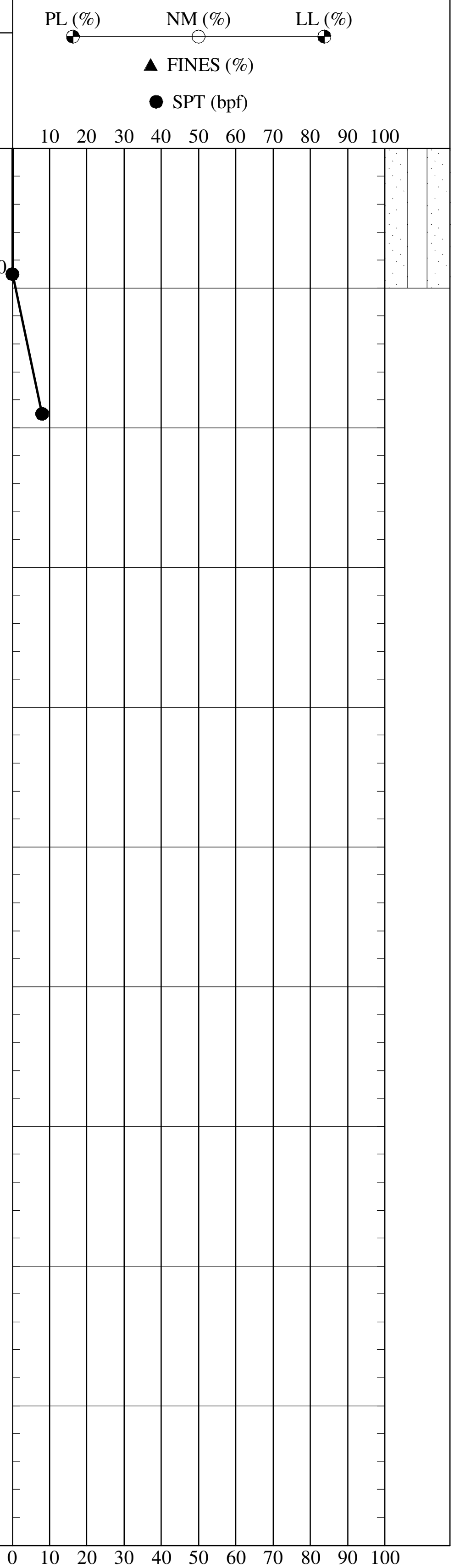
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-8
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 6, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
50	Very Soft Red and Tan Silty Clay		408			
55			403	SPT-11		WOH/18"-0-0 (N = 0)
	Su=260 psf Intial Attempt Su=650 psf Rb= 260 psf			VANE-1		
	ALLUVIUM Firm Dark Grey Silty Clay			SPT-12		3-4-4 (N = 8)
60	Piezometer Terminated at 60 feet		398			
65			393			
70			388			
75			383			
80			378			
85			373			
90			368			
95			363			
100			358			



AUGER BORING LOGS BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER:	Ruben Landeros (AMEC)
EQUIPMENT:	CME-55 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Piezometer backfilled to 42 feet using sand. Backfilled to surface using residue and bentonite.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-8
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 6, 2011
PROJECT NO.: 3410-10-0782

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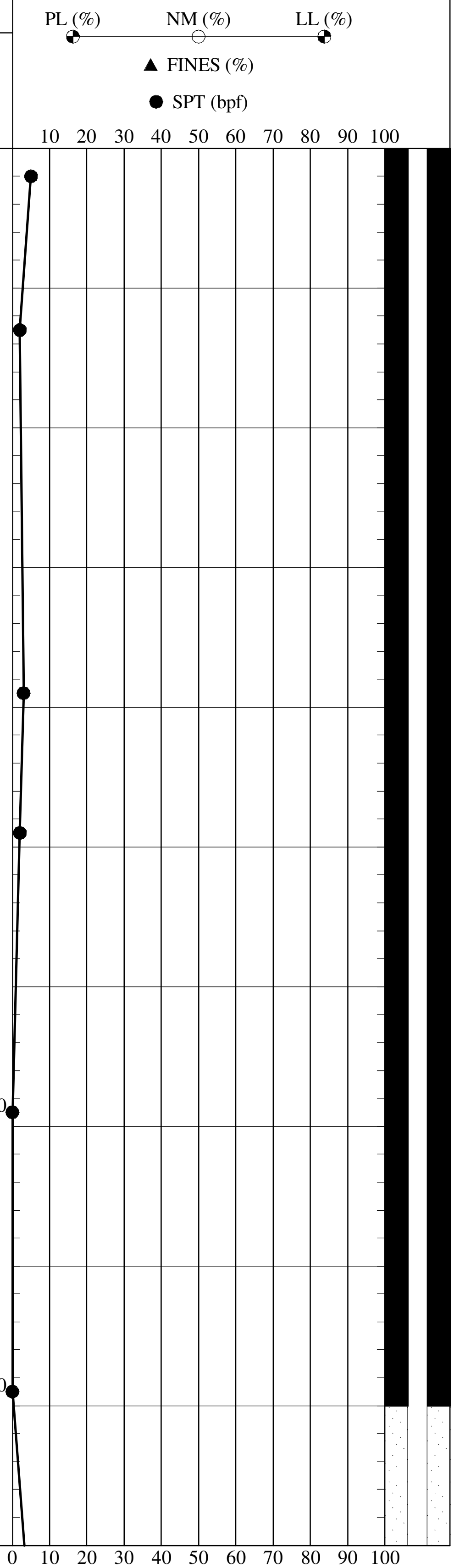
SOIL CLASSIFICATION AND REMARKS

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	**RESIDUE** Firm to Very Soft Black and Red Clayey Silt	454	SPT-1	3-2-3 (N = 5)
			UD-1	
5	Red and Tan Sand with Silt and Clay (thin seams)	449	SPT-2	1-1-1 (N = 2)
10	Su= 650 psf Rb= 130 psf	444	VANE-1	
			UD-2	
15		439		
	Su= 650 psf Rb= 320 psf		VANE-2	
	Very Loose Tan and Black Sand with Silty Clay seams		SPT-3	1-2-1 (N = 3)
20		434		
	Very Soft Red and Tan Silty Clay		SPT-4	1-1-1 (N = 2)
25		429	UD-3	
30	Su= 650 psf Rb= 320 psf	424	VANE-3	
			SPT-5	WOH/18"-0-0 (N = 0)
35		419	UD-4	
40	Su= 650 psf Rb= 390 psf	414	VANE-4	
			SPT-6	WOH/18"-0-0 (N = 0)
45		409		
50		404	UD-5	



DRILLER: Ruben Landeros (AMEC)
EQUIPMENT: CME-55 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Piezometer backfilled to 33 feet using sand. Backfilled to surface using residue and bentonite.

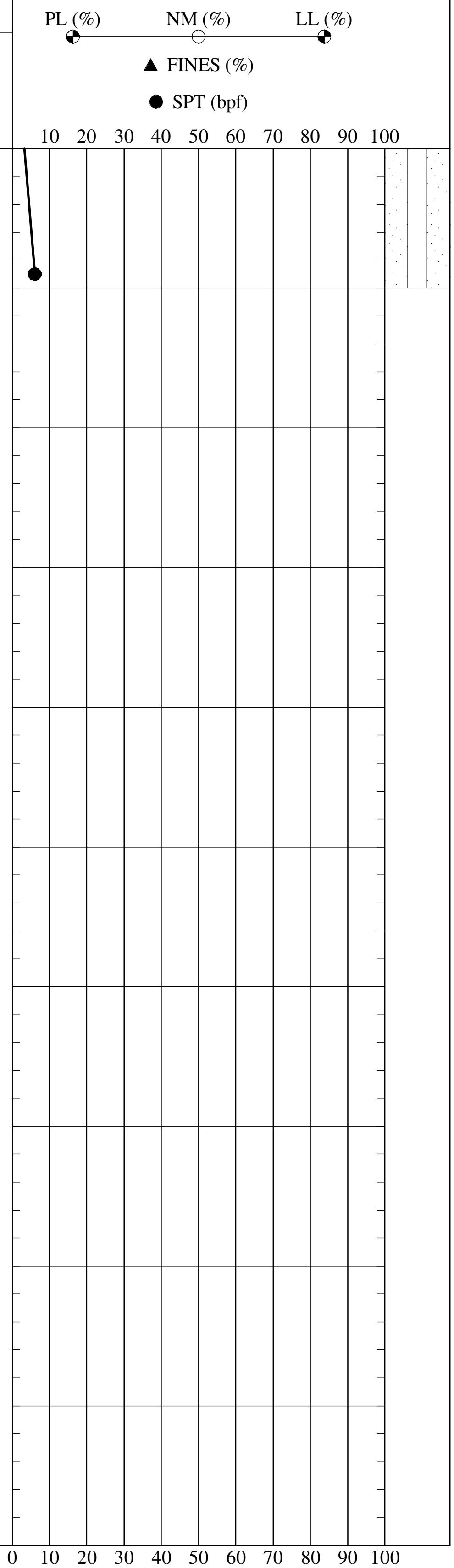
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-9
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 5, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
50	Very Soft Red and Tan Silty Clay		404			
	ALLUVIUM Firm Dark Grey Silty Clay			SPT-7		2-3-3 (N = 6)
55	Piezometer Terminated at 55 feet		399			
60			394			
65			389			
70			384			
75			379			
80			374			
85			369			
90			364			
95			359			
100			354			



DRILLER: Ruben Landeros (AMEC)
EQUIPMENT: CME-55 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Piezometer backfilled to 33 feet using sand. Backfilled to surface using residue and bentonite.

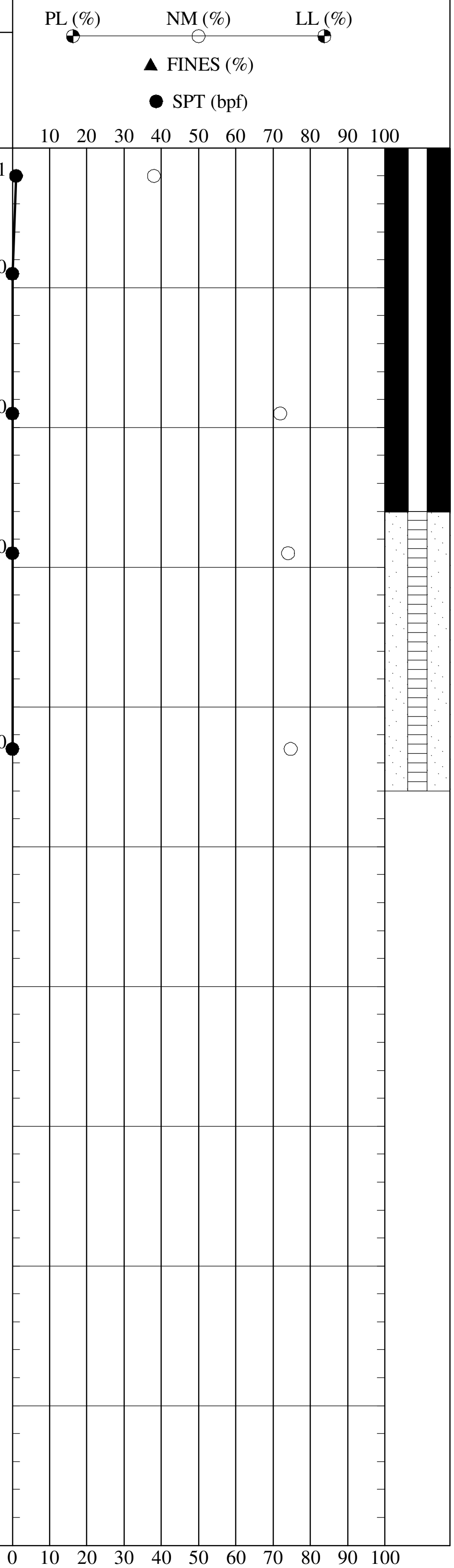
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-9
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 5, 2011
PROJECT NO.: 3410-10-0782

amec

Depth (ft)	Soil Classification and Remarks	Elev (ft)	Sample Ident	N-Count
0	**RESIDUE** Very Soft Red Orange Clayey Silt	433		
	Red, Tan, and Black Sand with Silt and Clay pH of soil 9.5		SPT-1	WOH/12"-0-1 (N = 1)
			UD-1	
	Very Loose		SPT-2	WOH/18"-0-0 (N = 0)
5	Su= 170 psf Rb= 25 psf	428	VANE-1	
			UD-2	
	Very Soft Red Orange Clayey Silt with Red, Tan, and Black Fine Sand seams		SPT-3	WOH/18"-0-0 (N = 0)
10		423		
	Su= 160 psf Rb= 25 psf		VANE-2	
15		418	SPT-4	WOH/18"-0-0 (N = 0)
	Su= 220 psf Rb= 70 psf		VANE-3	
20		413	UD-3	
			SPT-5	WOH/18"-0-0 (N = 0)
	Su= 240 psf Rb= 120 psf		VANE-4	
24	Piezometer Terminated at 24 feet			
25		408		
30		403		
35		398		
40		393		
45		388		
50		383		



DRILLER: Ruben Landeros (AMEC)
EQUIPMENT: CME-55 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Piezometer backfilled to 13 feet using sand. Backfilled to surface using residue and bentonite.

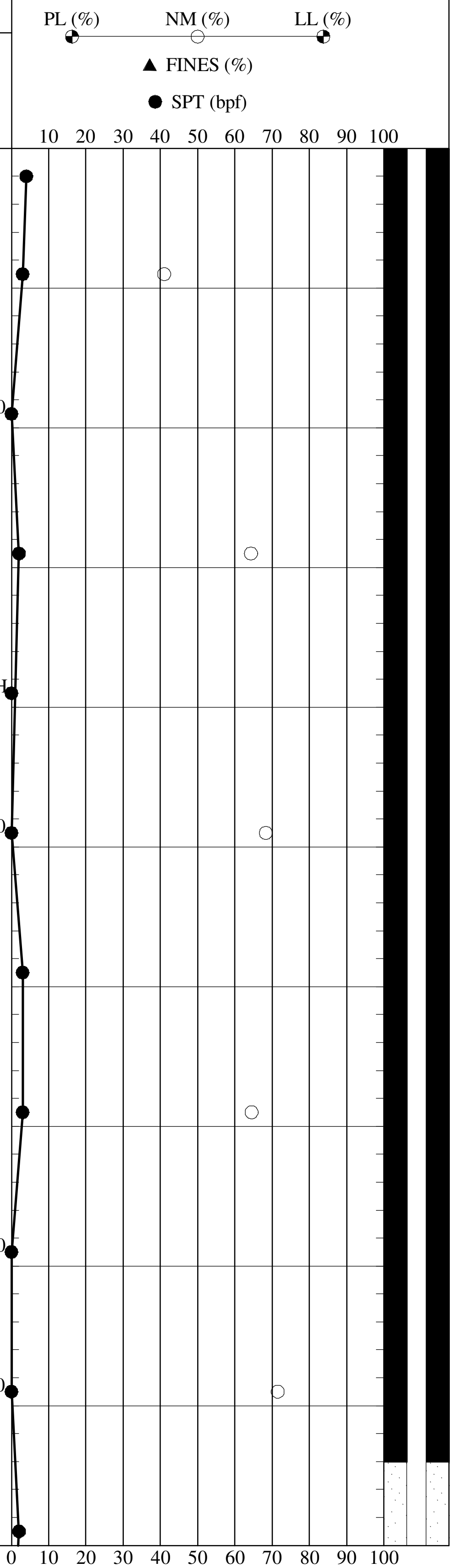
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-10
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 12, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLE IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	**TOPSOIL** 4 inches	458		
	RESIDUE Very Loose Tan, Red, and Black Sand with Silt and Clay		SPT-1	2-2-2 (N = 4)
5		453	SPT-2	2-2-1 (N = 3)
	Very Soft Red Silty Clay		SPT-3	WOH/18"-0-0 (N = 0)
10		448		
	Very Loose Black and Grey Sand with Silt and Clay			
	pH of soil 10.1		SPT-4	WOH-1-1 (N = 2)
15		443		
	Very Soft Red Sitly Clay		SPT-5	1-WOH-WOH
20		438	UD-1	
	Attempted vane. Unable to push vane to bottom of borehole.		VANE-1	
			SPT-6	WOH/18"-0-0 (N = 0)
25		433		
	Very Loose Tan and Grey Sand with Silt and Clay			
			SPT-7	WOH-2-1 (N = 3)
30		428		
	Very Soft to Soft Tan Silty Clay with Tan and Black Fine Sand seams		SPT-8	1-2-1 (N = 3)
35		423		
			SPT-9	WOH/18"-0-0 (N = 0)
40	No Recovery	418	UD-2	
	Attempted vane. Unable to push vane to bottom of borehole.		VANE-2	
			SPT-10	WOR/18"-0-0 (N = 0)
45		413		
			SPT-11	2-1-1
50		408		



AUGER BORING LOGS BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER: Ruben Landeros (AMEC)
EQUIPMENT: CME-55 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Piezometer backfilled to 40 feet using sand. Backfilled to surface using residue and bentonite.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-11
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 4, 2011
PROJECT NO.: 3410-10-0782

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DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
50	Very Soft to Soft Tan Silty Clay with Tan and Black Fine Sand seams		408			(N = 2)
	pH of soil 10.8			SPT-12		WOH/18"-0-0 (N = 0)
55	**ALLUVIUM** Dark Grey Silty Clay		403	UD-3		
	Piezometer Terminated at 57 feet					
60			398			
65			393			
70			388			
75			383			
80			378			
85			373			
90			368			
95			363			
100			358			

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER:	Ruben Landeros (AMEC)
EQUIPMENT:	CME-55 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Piezometer backfilled to 40 feet using sand. Backfilled to surface using residue and bentonite.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-11
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 4, 2011
PROJECT NO.: 3410-10-0782

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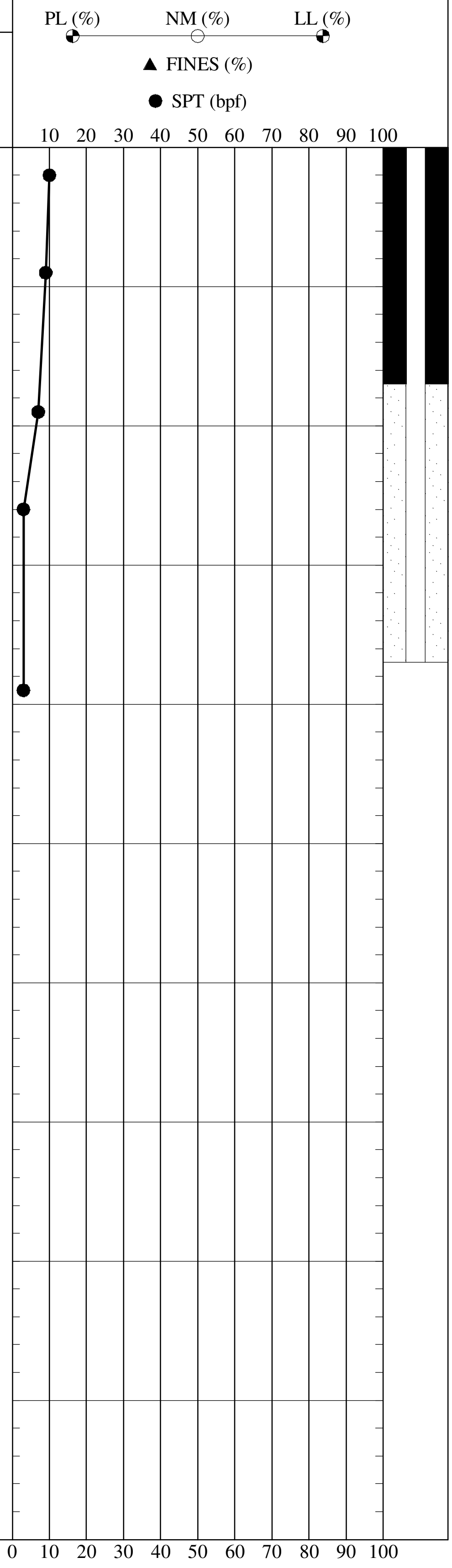
DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	**GRADED AGGREGATE BASE** Gray Gravel with Sand and Silt- Used for road bed	422
0.5	**RESIDUE** Stiff to Soft Orange Red Clayey Silt	
17	**ALLUVIUM** Soft Dark Grey Silty Clay	
20	Piezometer Terminated at 20 feet	402

SAMPLES IDENT	TYPE	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
SPT-1	SPT	2-3-7 (N = 10)
SPT-2	SPT	4-4-5 (N = 9)
SPT-3	SPT	2-4-3 (N = 7)
UD-1	UD	
SPT-4	SPT	1-2-1 (N = 3)
SPT-5	SPT	2-1-2 (N = 3)



DRILLER: Ruben Landeros (AMEC)
EQUIPMENT: CME-55 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Piezometer backfilled to 6 feet using sand. Backfilled to surface using residue and bentonite.

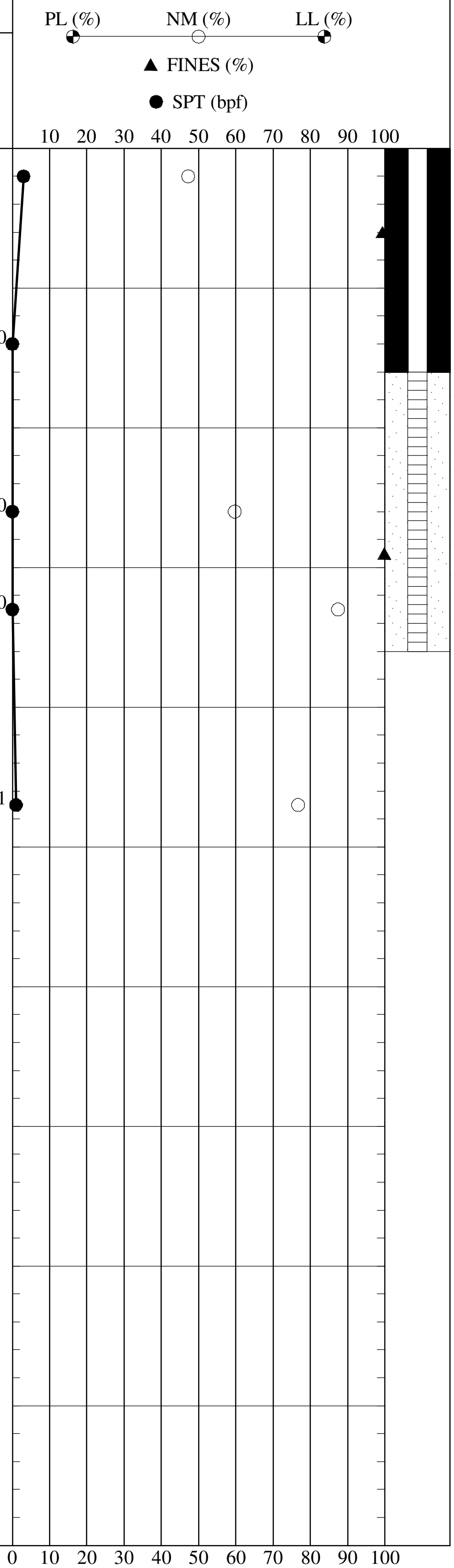
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-12
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 4, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**RESIDUE** Very Soft to Soft Red Orange Clayey Silt pH of soil 9.3 pH of soil 9.3		432	SPT-1		2-1-2 (N = 3)
				UD-1		
5	Su= 170 psf Rb= 15 psf		427	VANE-1		
				SPT-2		WOH/18"-0-0 (N = 0)
	No Recovery					
10			422	UD-2		
				VANE-2		
	Su= 170 psf Rb= 25 psf pH of soil 9.9 pH of soil 10.2			SPT-3		WOH/18"-0-0 (N = 0)
15			417	UD-3		
				SPT-4		WOH/18"-0-0 (N = 0)
20			412			
				VANE-3		
	Su= 240 psf Rb= 55 psf			SPT-5		WOH/12"-0-1 (N = 1)
	ALLUVIUM Dark Grey Silty Clay Piezometer Terminated at 24 feet					
25			407			
30			402			
35			397			
40			392			
45			387			
50			382			



AUGER BORING BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER:	Ruben Landeros (AMEC)
EQUIPMENT:	CME-55 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Piezometer backfilled to 8 feet using sand. Backfilled to surface using residue and bentonite.

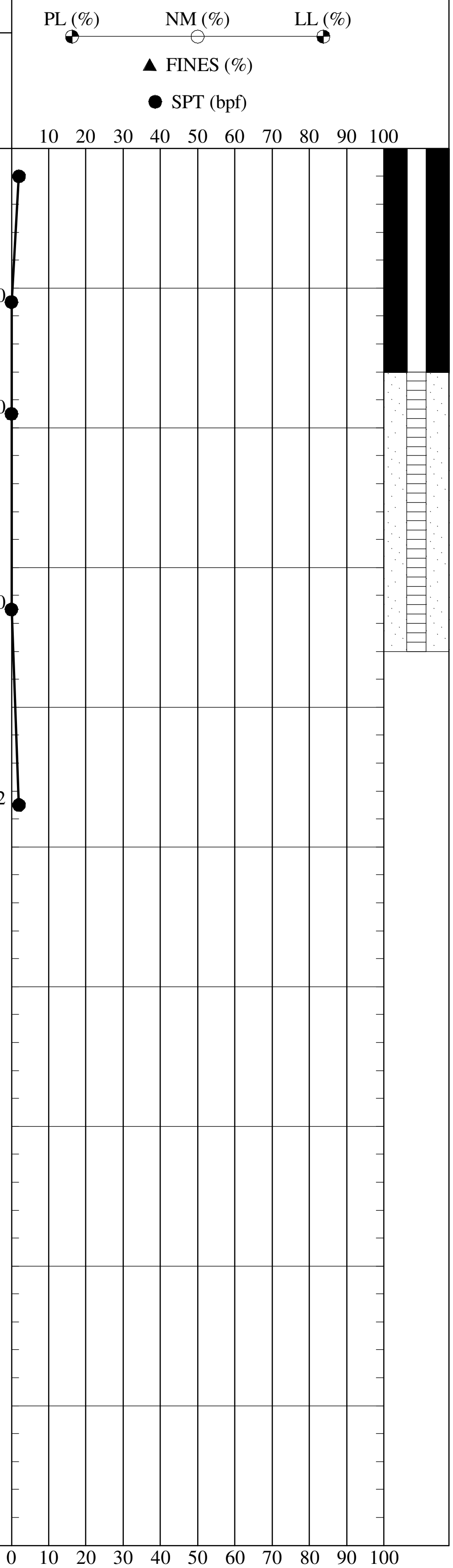
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-13
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 11, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**RESIDUE** Very Soft Red Orange Clayey Silt with Sand	432	SPT-1	2-1-1 (N = 2)
			UD-1	
			VANE-1	
5	Su= 240 psf Rb= 50 psf	427	SPT-2	WOH/18"-0-0 (N = 0)
			SPT-2	WOH/18"-0-0 (N = 0)
10	Su= 220 psf Rb= 50 psf	422	VANE-2	
	No Recovery		UD-3	
15		417	SPT-3	WOH/18"-0-0 (N = 0)
	Su= 240 psf Rb= 150 psf		VANE-3	
20	No Recovery	412	UD-4	
	ALLUVIUM Dark Grey Silty Clay		SPT-4	WOH/12"-0-2 (N = 2)
	Piezometer Terminated at 24 feet			
25		407		
30		402		
35		397		
40		392		
45		387		
50		382		



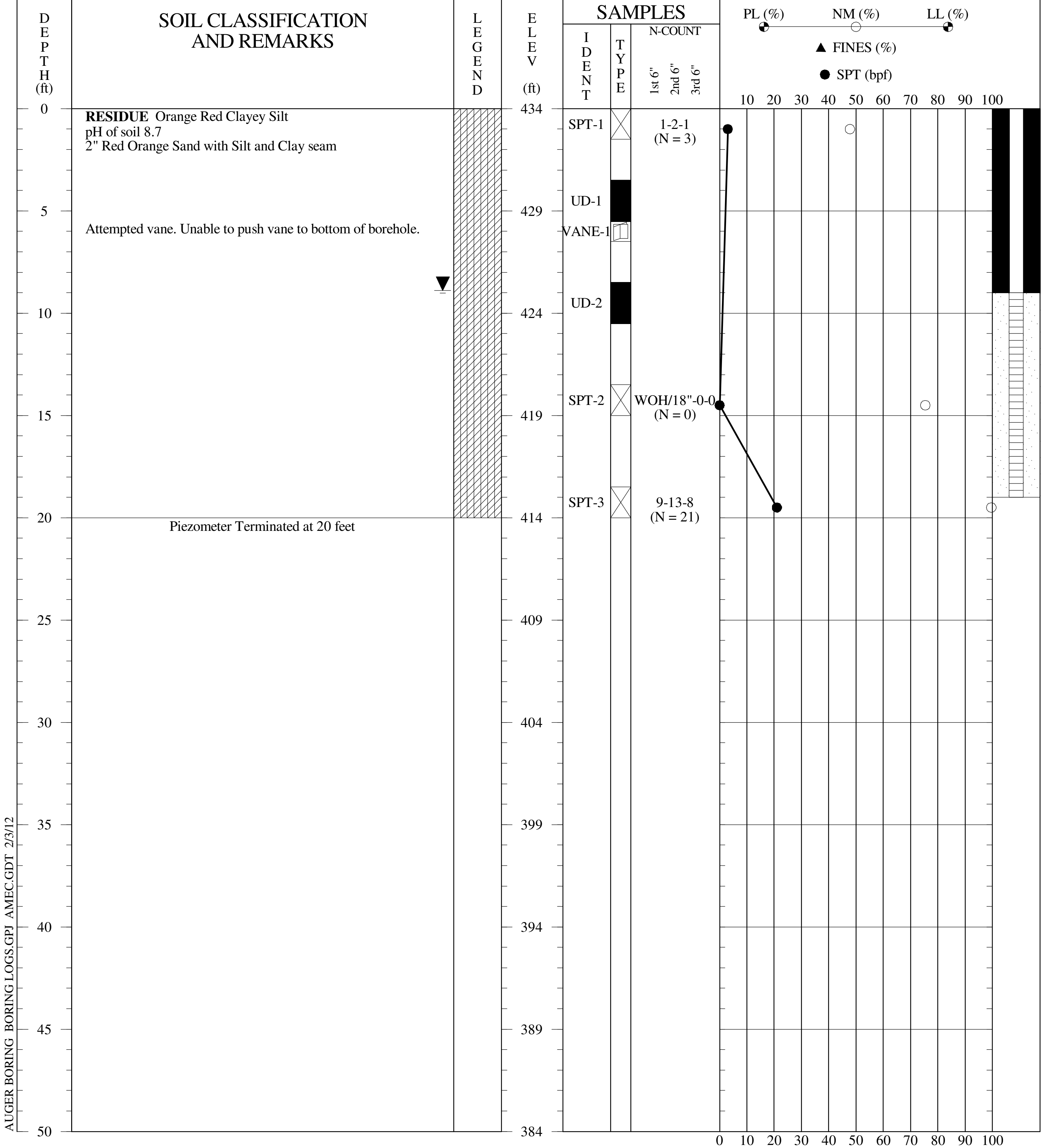
DRILLER: Ruben Landeros (AMEC)
EQUIPMENT: CME-55 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Piezometer backfilled to 8 feet using sand. Backfilled to surface using residue and bentonite.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-14
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 11, 2011
PROJECT NO.: 3410-10-0782

amec



DRILLER: Ruben Landeros (AMEC)
EQUIPMENT: CME-55 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Piezometer backfilled to 9 feet using sand. Backfilled to surface using residue and bentonite.

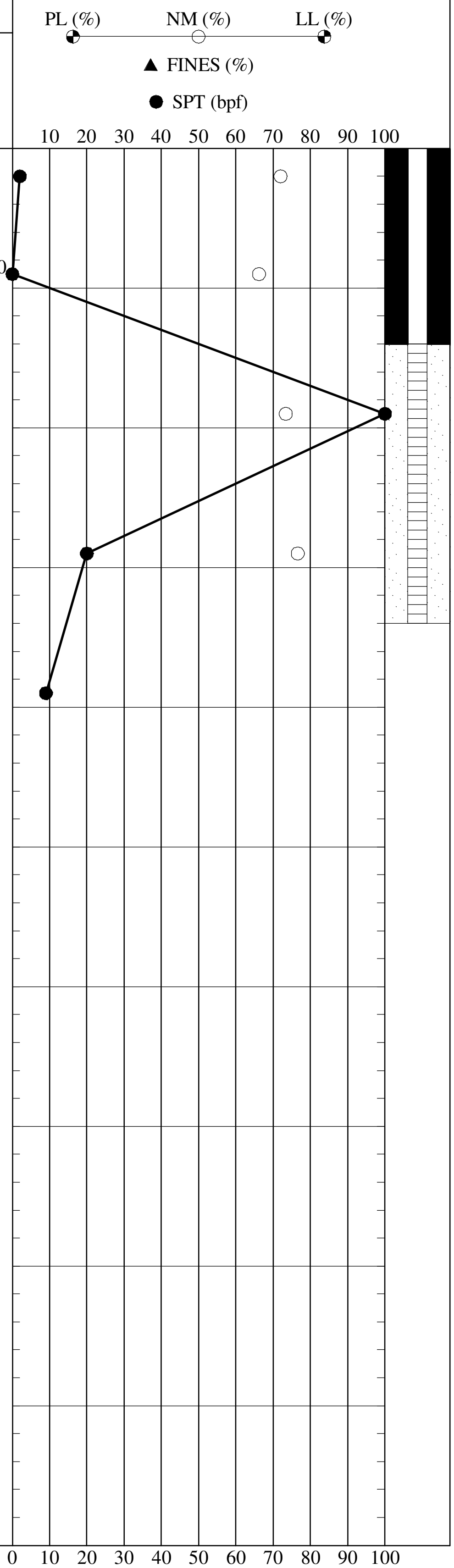
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-15
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 16, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**TOPSOIL** 3 inches		430			
	RESIDUE Very Soft to Very Hard Red, Orange, and Tan Clayey Silt			SPT-1		1-1-1 (N = 2)
5			425	SPT-2		WOH/18"-0-0 (N = 0)
	Su=170 psf Rb= 25 psf			VANE-1		
10			420	SPT-3		6-50/5"
15			415	SPT-4		6-9-11 (N = 20)
	ALLUVIUM Stiff Dark Grey Silty Clay					
20			410	SPT-5		8-4-5 (N = 9)
	Piezometer Terminated at 20 feet					
25			405			
30			400			
35			395			
40			390			
45			385			
50			380			



AUGER BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER:	Ruben Landeros (AMEC)
EQUIPMENT:	CME-55 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Piezometer backfilled to 7 feet using sand. Backfilled to surface using residue and bentonite.

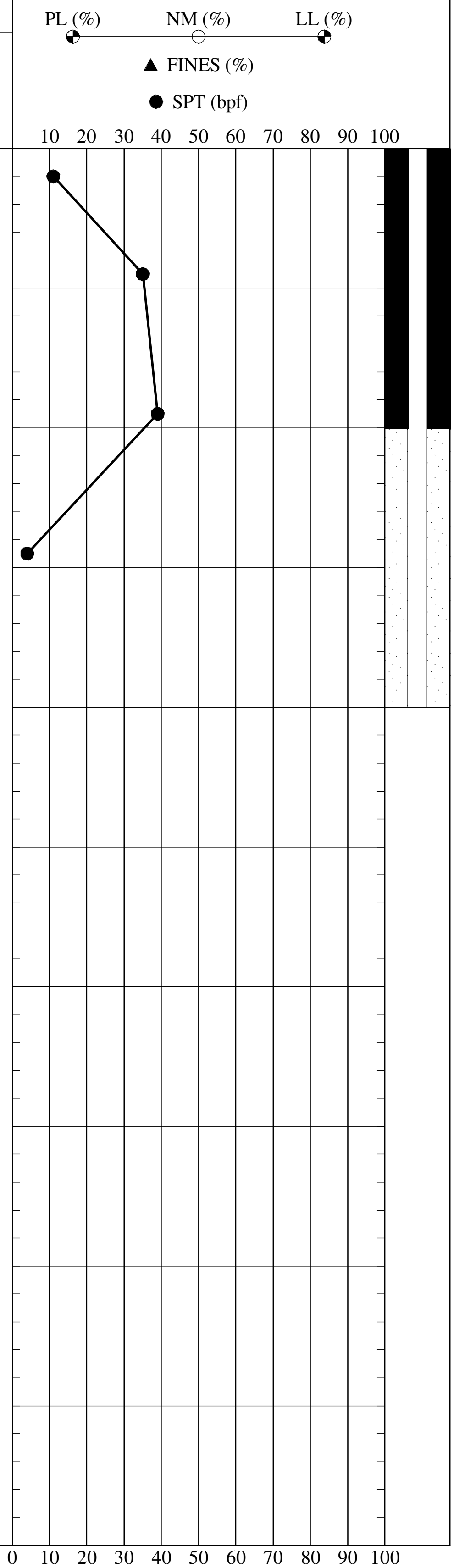
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-16
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 14, 2011
PROJECT NO.: 3410-10-0782

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**GYPSUM** Medium Dense Grey Silty Sand with Gravel	421	SPT-1		6-6-5 (N = 11)
	Dense Grey Clayey Sand		SPT-2		22-20-15 (N = 35)
5		416			
	Dense Dark Grey Sand with Silt		SPT-3		23-16-23 (N = 39)
10		411			
	ALLUVIUM Soft Grey Silty Clay		SPT-4		WOH-2-2 (N = 4)
15		406			
20	Piezometer Terminated at 20 feet	401			
25		396			
30		391			
35		386			
40		381			
45		376			
50		371			



DRILLER: Ruben Landeros (AMEC)
EQUIPMENT: CME-55 (Auto-Hammer)
METHOD: Rotary Wash with Mud
HOLE DIA.: 6 inches
REMARKS: Piezometer backfilled to 4 feet using sand. Backfilled to surface using residue and bentonite.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-17
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: December 1, 2011
PROJECT NO.: 3410-10-0782

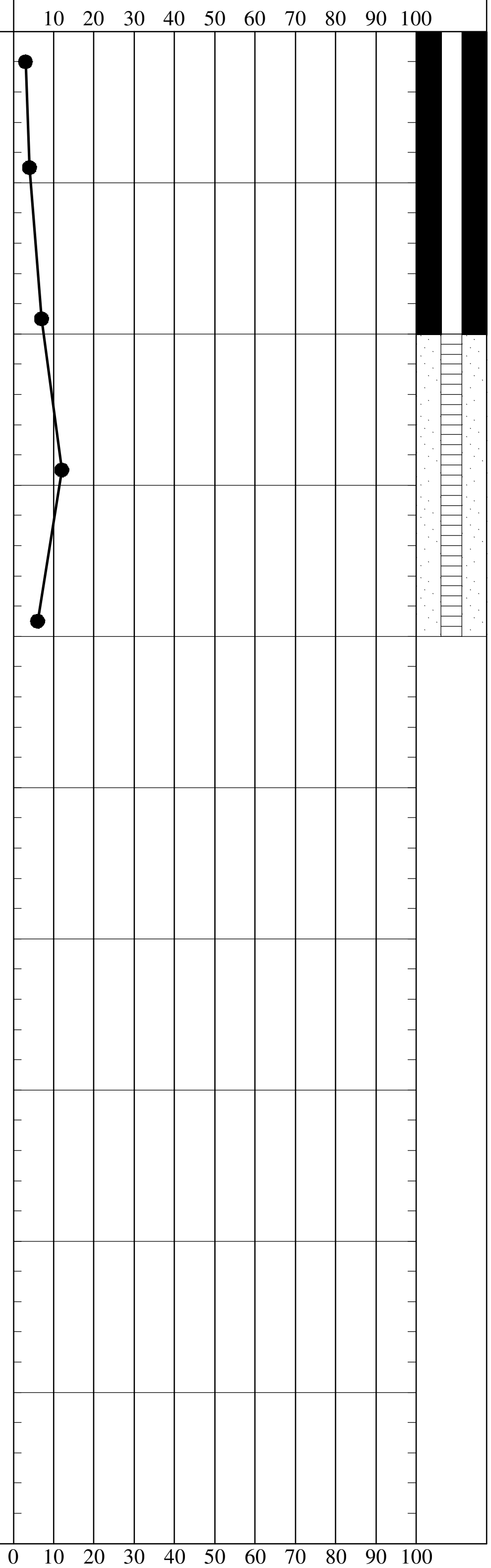
amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	**TOPSOIL**	411			
	ALLUVIUM Soft Dark Grey Silty Clay		SPT-1		1-1-2 (N = 3)
	Loose to Medium Dense Grey Sand with Silt				
5		406	SPT-2		2-2-2 (N = 4)
10		401	SPT-3		2-4-3 (N = 7)
15		396	SPT-4		5-7-5 (N = 12)
20	Piezometer Terminated at 20 feet	391	SPT-5		4-4-2 (N = 6)
25		386			
30		381			
35		376			
40		371			
45		366			
50		361			

PL (%) NM (%) LL (%)

▲ FINES (%)

● SPT (bpf)



AUGER BORING LOGS BORING LOGS.GPJ AMEC.GDT 2/3/12

DRILLER:	Ruben Landeros (AMEC)
EQUIPMENT:	CME-55 (Auto-Hammer)
METHOD:	Rotary Wash with Mud
HOLE DIA.:	6 inches
REMARKS:	Piezometer backfilled to 10 feet using sand. Backfilled to surface using drilling spoils and bentonite.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER.

AUGER BORING RECORD

BORING NO.: PZ-18
PROJECT: North Alcoa Site
LOCATION: East St. Louis, Illinois
DRILLED: November 14, 2011
PROJECT NO.: 3410-10-0782

amec

TP-1, Ground Elevation: ~451 feet

Excavation Date: 11-2-2010

Depth (feet)	Description
0- 5	**RESIDUE –** Tan Red Clayey Silt, Softer and Moister with Depth
	Test pit terminated at 5 feet No Groundwater Observed

TP-2, Ground Elevation: ~457 feet

Excavation Date: 11-2-2010

Depth (feet)	Description
0-0.5	**TOPSOIL –** Gray Silty SAND w/roots and litter
0.5-3	Tan Silty SAND
3 - 5	**RESIDUE** - Red Tan Sandy Silty CLAY
	Test pit terminated at 5 feet No Groundwater Observed

TP-3, Ground Elevation: ~454 feet

Excavation Date: 11-2-2010

Depth (feet)	Description
0- 5	**RESIDUE –** Dry White Gray Crust with Tan Red Clayey Silt beneath, Softer and Moister with Depth
	Test pit terminated at 5 feet No Groundwater Observed

TP-4, Ground Elevation: ~451 feet

Excavation Date: 11-2-2010

Depth (feet)	Description
0- 5	**RESIDUE –** Dry White Gray Crust with Tan Red Clayey Silt beneath, Softer and Moister with Depth
	Test pit terminated at 5 feet No Groundwater Observed

TP-5, Ground Elevation: ~459 feet

Excavation Date: 11-2-2010

Depth (feet)	Description
0-0.5	**TOPSOIL –** Gray Silty SAND w/roots and litter
0.5-4	Tan Silty SAND
4 - 5	**RESIDUE -** Red Tan Sandy Silty CLAY
	Test pit terminated at 5 feet No Groundwater Observed

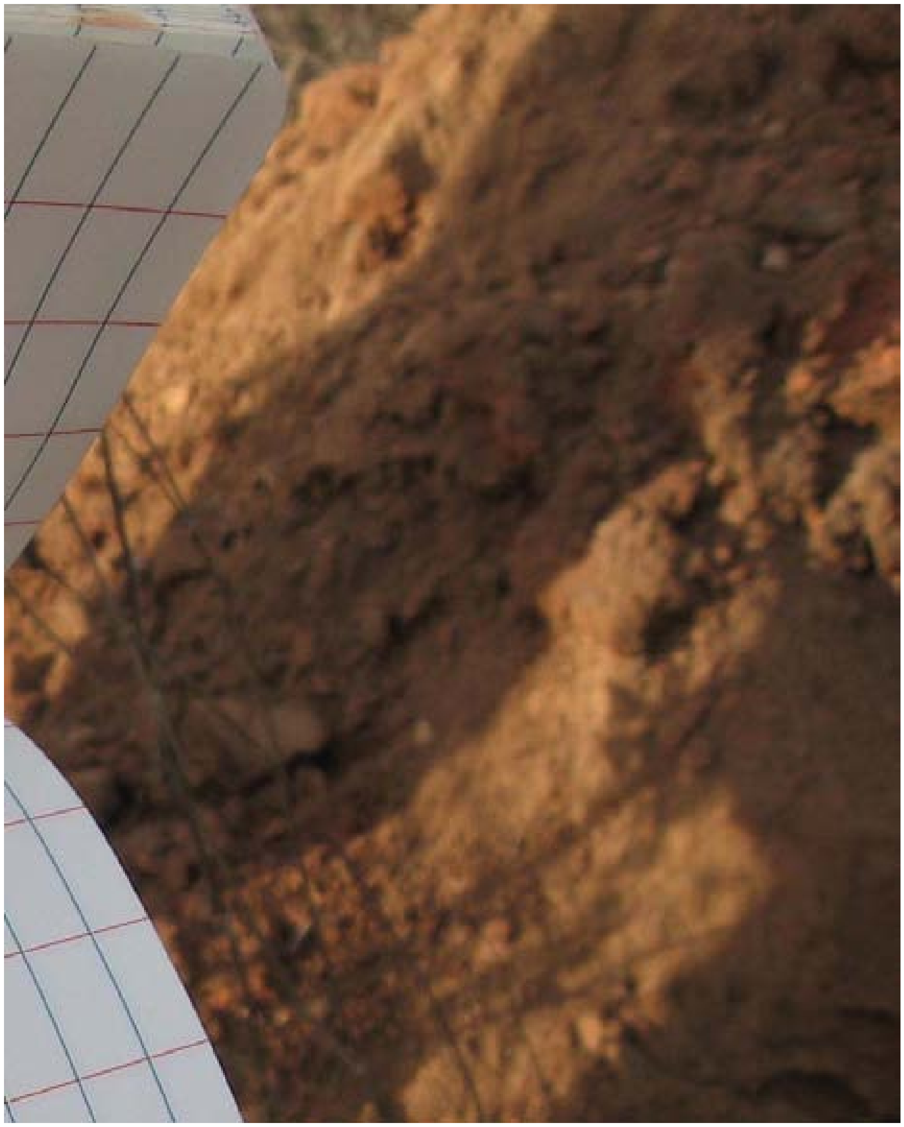
TP-6, Ground Elevation: ~456 feet

Excavation Date: 11-2-2010

Depth (feet)	Description
0-0.3	**TOPSOIL –** Tan Silty SAND w/roots and litter
0.3-2	**RESIDUE –** Tan Red Silty SAND
2 - 5	Red Tan Sandy Silty CLAY
	Test pit terminated at 5 feet No Groundwater Observed

TP-7, Ground Elevation: ~457 feet

Excavation Date: 11-2-2010



Depth (feet)	Description
0-0.3	**TOPSOIL –** Tan Silty SAND w/roots and litter
0.3-2	**RESIDUE –** Tan Red Clayey Silty SAND
2 - 5	Red Tan Sandy Silty CLAY
	Test pit terminated at 5 feet No Groundwater Observed

TP-8, Ground Elevation: ~417 feet

Excavation Date: 11-2-2010

Depth (feet)	Description
0-0.5	**TOPSOIL –** Tan Silty SAND w/roots and litter
0.5-2	**ALLUVIUM –** Tan Silty SAND
2 - 5	Dark Gray Silty CLAY
	Test pit terminated at 5 feet No Groundwater Observed

TP-9, Ground Elevation: ~423 feet

Excavation Date: 11-3-2010

Depth (feet)	Description
0-0.5	**GYPSUM**-Dark Gray Weakly Cemented Fine Sandy SILT
0.5-1.5	White Gray Strongly Cemented Fine Sandy SILT
	Test pit terminated at 1.5 feet (refusal) No Groundwater Observed

TP-10, Ground Elevation: ~424 feet

Excavation Date: 11-3-2010

Depth (feet)	Description
0-0.5	**GYPSUM-**Dark Gray Weakly Cemented Fine Sandy SILT
0.5-1.5	White Gray Strongly Cemented Fine Sandy SILT
	Test pit terminated at 1.5 feet (refusal) No Groundwater Observed

TP-11, Ground Elevation: ~415 feet

Excavation Date: 11-3-2010

Depth (feet)	Description
0 – 0.5	**TOPSOIL** –Red Brown Clayey SILT with roots and litter
0.5 - 2	Red Brown Clayey SILT
2 - 5	**ALLUVIUM –** Dark Gray Silty CLAY
	Test pit terminated at 5 feet No Groundwater Observed

TP-12, Ground Elevation: ~410 feet

Excavation Date: 11-3-2010

Depth (feet)	Description
0 – 1	**TOPSOIL** – Tan Silty SAND with roots and litter
1 - 3	**ALLUVIUM** – Tan Silty SAND
3-5	Dark Gray Silty CLAY
	Test pit terminated at 5 feet No Groundwater Observed

TP-13, Ground Elevation: ~435 feet

Excavation Date: 11-3-2010

Depth (feet)	Description
0 – 1	**GYPSUM** – Gray Silty Gravel mixed with red clayey silt, roots, and trash
	Test pit terminated at 1 foot (refusal) No Groundwater Observed

TP-14, Ground Elevation: ~440 feet

Excavation Date: 11-3-2010

Depth (feet)	Description
0 – 1	**TOPSOIL** –Red Brown Clayey SILT with roots and litter
1 - 5	**RESIDUE** – Red Brown Clayey SILT
	Test pit terminated at 5 feet No Groundwater Observed

TP-15, Ground Elevation: ~432 feet

Excavation Date: 11-3-2010

Depth (feet)	Description
0 – 3	**RESIDUE** –Red Brown Clayey SILT, Dry at Surface, Increasing Moisture with Depth
3-3.3	Tan Sand Seam
3.3-5	Red Brown Clayey SILT
	Test pit terminated at 5 feet No Groundwater Observed

TP-16, Ground Elevation: ~433 feet

Excavation Date: 11-3-2010

Depth (feet)	Description
0 – 6.0	**RESIDUE** –Red Brown Clayey SILT, Dry at Surface, Increasing Moisture with Depth
	Test pit terminated at 6 feet Groundwater Observed at 5 feet

TP-17, Ground Elevation: ~434 feet

Excavation Date: 11-4-2010

Depth (feet)	Description
0 – 1.5	**RESIDUE** –Red Brown Clayey SILT, Dry at Surface, Increasing Moisture with Depth
	Test pit terminated at 1.5 feet No Groundwater Observed

TP-18, Ground Elevation: ~434 feet

Excavation Date: 11-4-2010

Depth (feet)	Description
0 – 1.4	**RESIDUE** –Red Brown Clayey SILT, Dry at Surface, Increasing Moisture with Depth
	Test pit terminated at 1.4 feet No Groundwater Observed

TP-19, Ground Elevation: ~436 feet

Excavation Date: 11-4-2010

Depth (feet)	Description
0 – 1.1	**RESIDUE** –Red Brown Clayey SILT, Dry at Surface, Increasing Moisture with Depth
	Test pit terminated at 1.1 feet No Groundwater Observed

TP-20, Ground Elevation: ~433 feet

Excavation Date: 11-4-2010

Depth (feet)	Description
0 – 1.0	**RESIDUE** –Red Brown Clayey SILT, Dry at Surface, Increasing Moisture with Depth
	Test pit terminated at 1.0 feet No Groundwater Observed

TP-21, Ground Elevation: ~433 feet

Excavation Date: 11-4-2010

Depth (feet)	Description
0 – 1.2	**RESIDUE** –Red Brown Clayey SILT, Dry at Surface, Increasing Moisture with Depth
	Test pit terminated at 1.2 feet No Groundwater Observed

TP-22, Ground Elevation: ~433 feet

Excavation Date: 11-4-2010

Depth (feet)	Description
0 – 1.0	**RESIDUE** –Red Brown Clayey SILT, Dry at Surface, Increasing Moisture with Depth
	Test pit terminated at 1.0 feet No Groundwater Observed

TP-23, Ground Elevation: ~425 feet

Excavation Date: 11-4-2010

Depth (feet)	Description
0 – 0.2	Tan Black Fine to Medium SAND
0.2-1.2	**RESIDUE** –Red Brown Clayey SILT
	Test pit terminated at 1.2 feet No Groundwater Observed

TP-24, Ground Elevation: ~425 feet

Excavation Date: 11-4-2010

Depth (feet)	Description
0 – 1	**RESIDUE** –Red Tan Clayey SILT
	Test pit terminated at 1.0 feet No Groundwater Observed

TP-25, Ground Elevation: ~425 feet

Excavation Date: 11-4-2010

Depth (feet)	Description
0 – 0.1	**RESIDUE** –Red Brown Clayey SILT w/Lime Precipitate
0.1-1	Red Clayey SILT
1 – 1.2	Tan Brown Silty Fine SAND
	Test pit terminated at 1.2 feet No Groundwater Observed

TP-26, Ground Elevation: ~440 feet

Excavation Date: 11-17-2011

Depth (feet)	Description
0-6	**GYPSUM-**White Gray Strongly Cemented, Fractured Fine Sandy SILT
	Test pit terminated at 6 feet (refusal) No Groundwater Observed

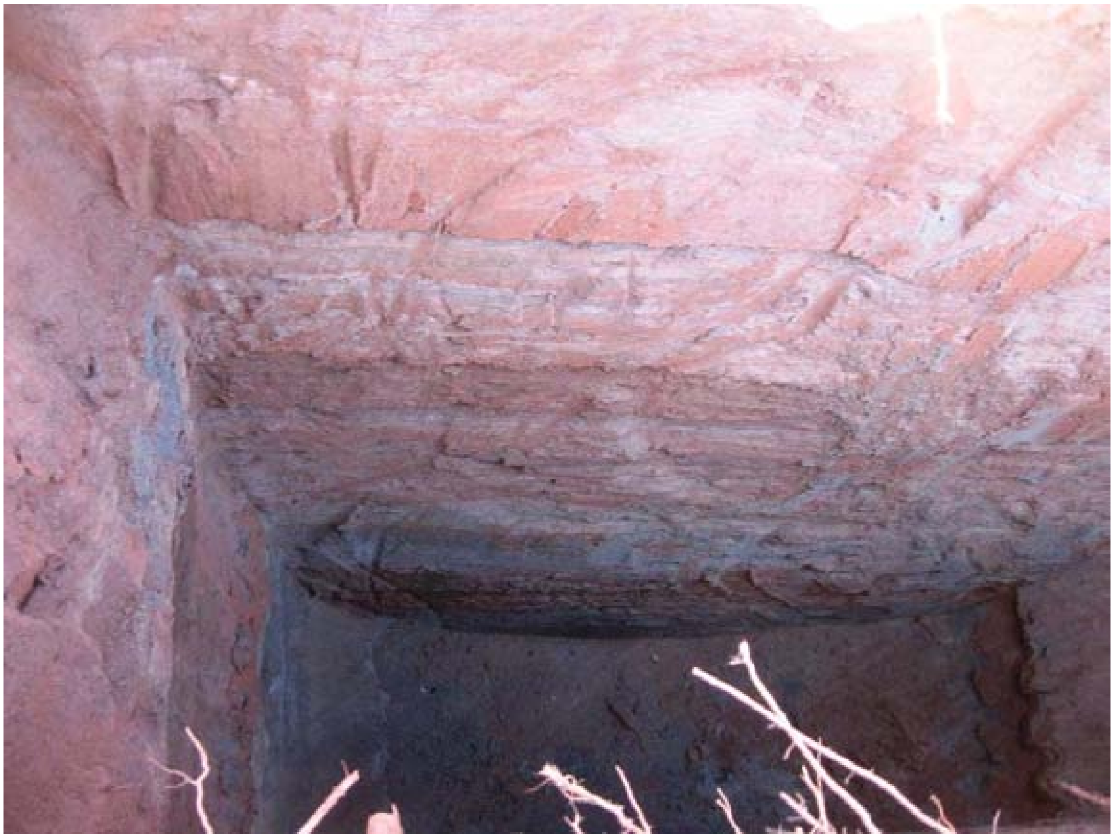
TP-27, Ground Elevation: ~439 feet

Excavation Date: 11-16-2011

Depth (feet)	Description
0 - 1	**TOPSOIL –** Red Silty Fine SAND with Roots
1-2	**RESIDUE** –Red Thixotropic Clayey SILT w/Sand Seams
2 - 9	Tan Red SAND with Clayey Silt Seams
9-10	Black Clayey SILT w/Sand Seams
10-12	Tan Red SAND with Clayey Silt Seams
12-14	Black Clayey SILT w/Sand Seams
	Test pit terminated at 14 feet Groundwater (or Liquefied Material) observed at 13 feet

TP-28, Ground Elevation: ~439 feet

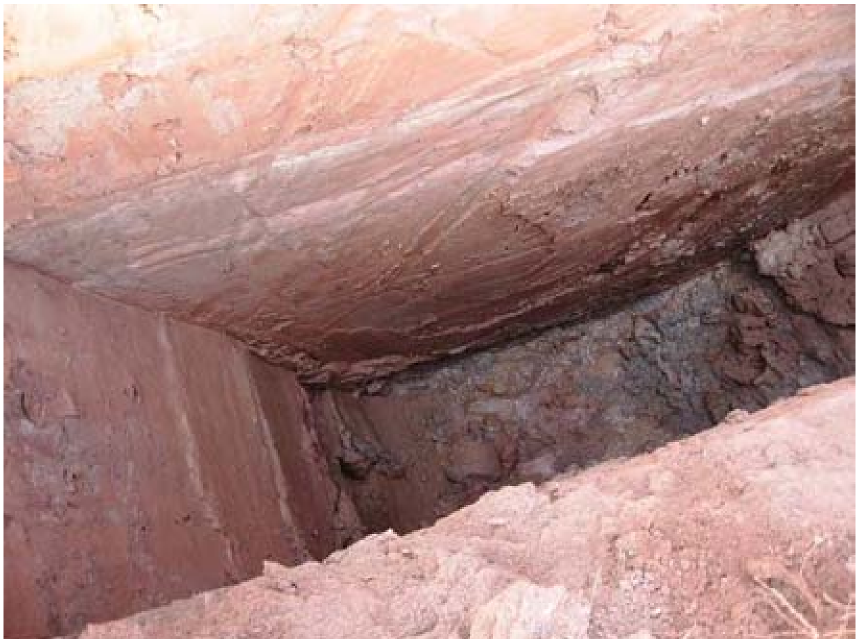
Excavation Date: 11-16-2011



Depth (feet)	Description
0-0.5	**TOPSOIL –** Red Sandy Clayey SILT with Roots
0.5-1	**GYPSUM-**Dark Gray Cemented Fine Sandy SILT
1-3	**RESIDUE** – Red Thixotropic Clayey SILT
3-6	Red Tan Silty Fine SAND
6-17	Gray Silty Fine SAND
	Test pit terminated at 17 feet No Groundwater Observed

TP-29, Ground Elevation: ~436 feet

Excavation Date: 11-16-2011



Depth (feet)	Description
0-15	**RESIDUE** – Red Thixotropic Clayey SILT w/1 Inch Sand Seams at 2 and 4 feet
	Test pit terminated at 15 feet (caving) Groundwater Observed at 13 feet

TP-30, In Side of Dike, Top of Dike ~441, base ~ 432

Excavation Date: 11-16-2011

Depth (feet)	Description From Top of Dike	Description From Base
0-3	**GYPSUM-**Dark Gray Cemented Fine Sandy SILT	
3-7	Black Cemented Material	
7-10	**GYPSUM-**Dark Gray Cemented Fine Sandy SILT	
10-11	**TOPSOIL –** Red Brown Silty Sand with Roots, Rising toward base	
12-20	Tan Silty Fine SAND w/Gypsum Inclusions	**RESIDUE** – Red Clayey SILT
20-22	**GYPSUM-**White Cemented Fine Sandy SILT	
	Test pit terminated at 22 feet (from Top of Dike) No Groundwater Observed	

TP-31, Ground Elevation: ~442 feet

Excavation Date: 11-16-2011

Depth (feet)	Description Near Dike	Description Away from Dike
0-2	**GYPSUM**-Gray White Cemented Fine Sandy SILT (apparent Step-In Dike)	**TOPSOIL –** Red Sandy Clayey SILT with Roots
2-9		**RESIDUE** – Red Brown Black Sandy Clayey SILT, Thixotropic Seams
9-20	Tan Sandy Clayey SILT, Thixotropic Seams	
	Test pit terminated at 20 feet No Groundwater Observed	

TP-32, Ground Elevation: ~447 feet

Excavation Date: 11-16-2011

Depth (feet)	Description
0-0.5	**GYPSUM**-Dark Gray Weakly Cemented Fine Sandy SILT
0.5-2	White Gray Strongly Cemented Fine Sandy SILT
	Test pit terminated at 2 feet (refusal) No Groundwater Observed

TP-33, Ground Elevation: ~440 feet

Excavation Date: 11-16-2011

Depth (feet)	Description
0-0.5	**GYPSUM-**Dark Gray Weakly Cemented Fine Sandy SILT w/Red Fine Sandy Silt
0.5-2	White Gray Strongly Cemented Fine Sandy SILT
	Test pit terminated at 2 feet (refusal) No Groundwater Observed

TP-34, Ground Elevation: ~421 feet

Excavation Date: 11-17-2011

Depth (feet)	Description
0-0.5	**GYPSUM-**Dark Gray Weakly Cemented Fine Sandy SILT
0.5-2	White Gray Strongly Cemented Fine Sandy SILT
	Test pit terminated at 2 feet (refusal) No Groundwater Observed

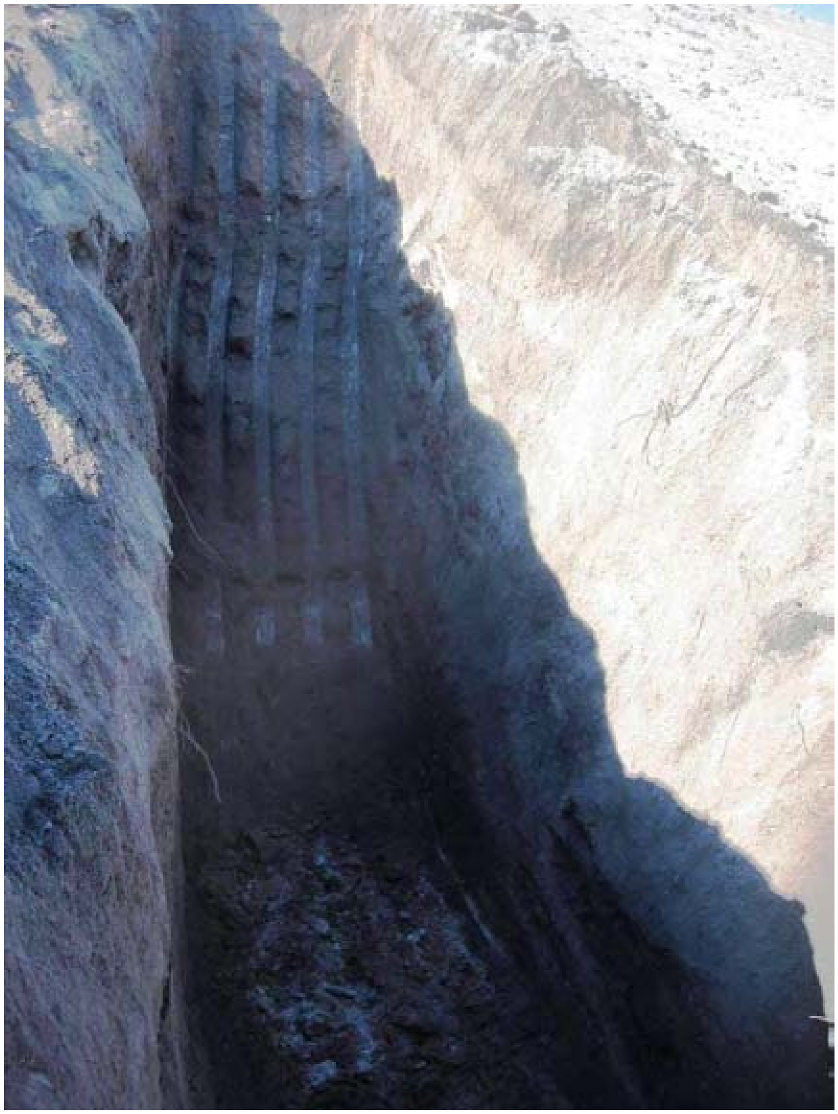
TP-35, Ground Elevation: ~441 feet

Excavation Date: 11-16-2011

Depth (feet)	Description
0-14	**GYPSUM-**White Gray Strongly Cemented and Fractured Fine Sandy SILT
	Test pit terminated at 14 feet (refusal) No Groundwater Observed

TP-36, Into Bank, Top Elevation ~436, Bottom ~420

Excavation Date: 11-17-2011



Depth (feet)	Description
0-15	**GYPSUM**-Gray Uncemented Silty Fine SAND
	Test pit terminated at 15 feet No Groundwater Observed

TP-37, Ground Elevation: ~436 feet

Excavation Date: 11-17-2011

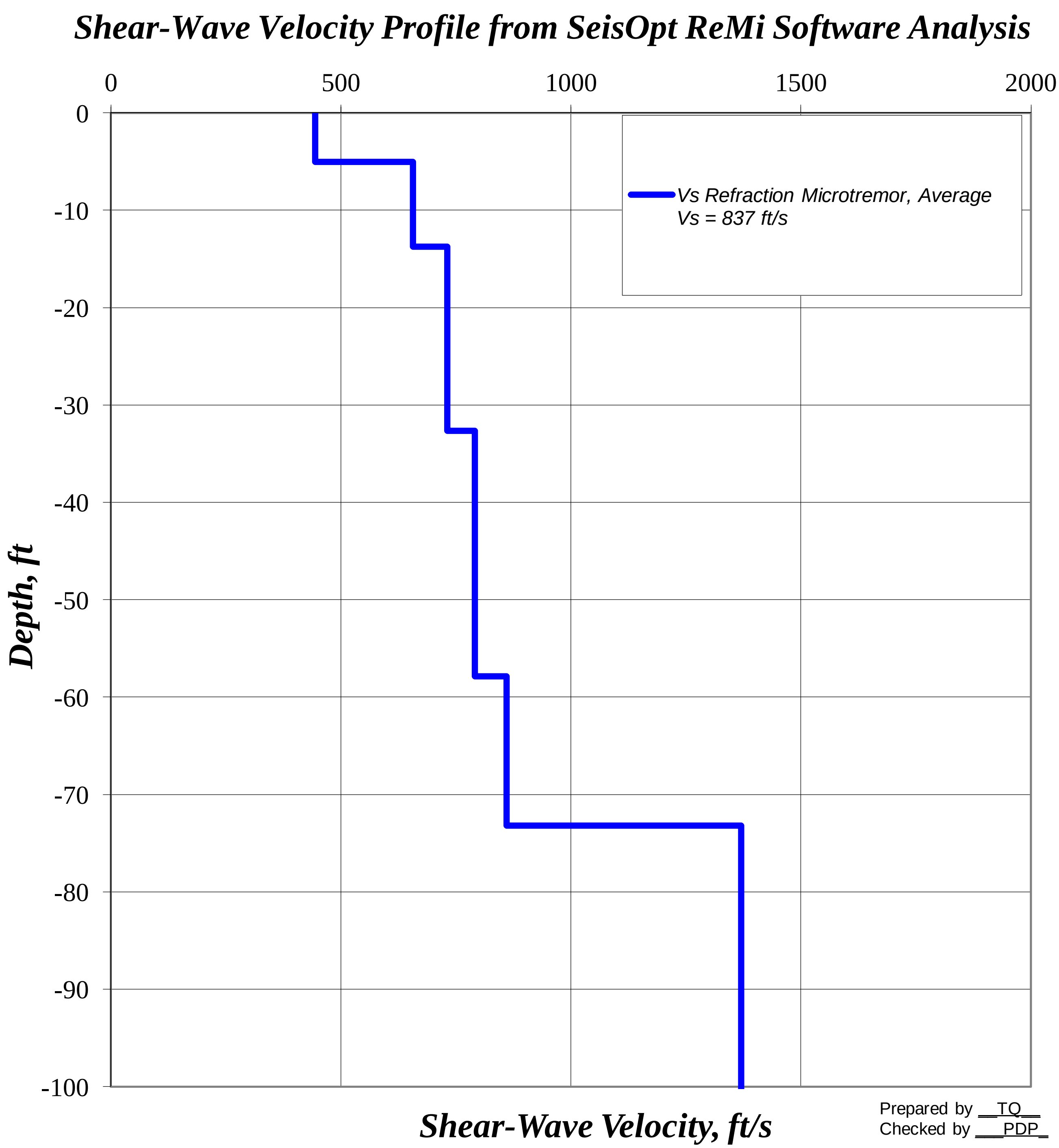
Depth (feet)	Description
0-1	**TOPSOIL -**Dark Gray Silty Sand w/4 Inch Slabs of Cemented Fine Sandy SILT
1-2	**GYPSUM-**White Gray Strongly Cemented Fine Sandy SILT
	Test pit terminated at 2 feet (refusal) No Groundwater Observed

TP-38, Ground Elevation: ~436 feet

Excavation Date: 11-16-2011

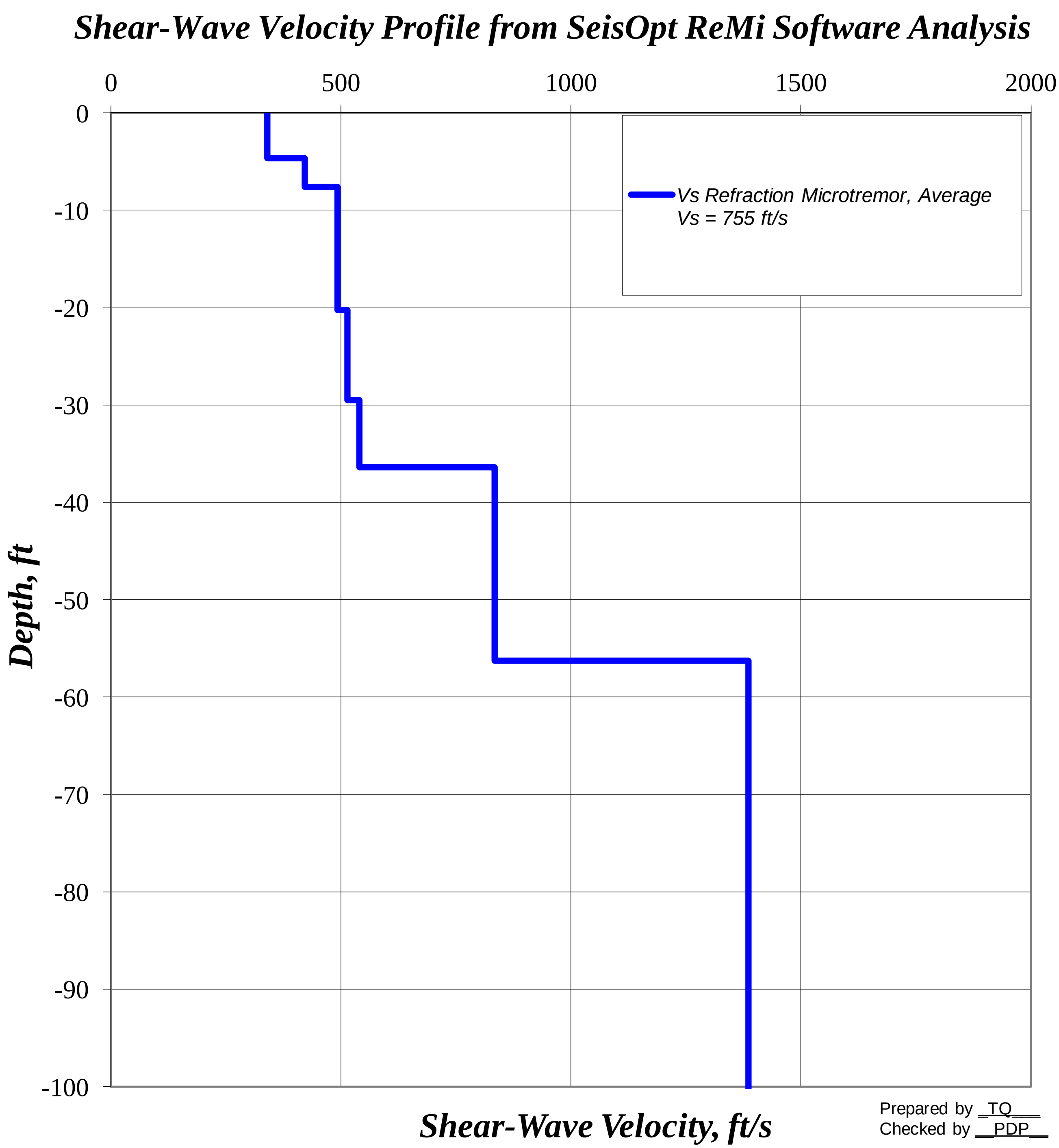
Depth (feet)	Description
0-1.8	**TEST STRIP –Tan SILT**
1.8-2.6	**RESIDUE** – Red Clayey SILT, w/Phragmites Roots (No evidence of disturbance/subsidence at fill/residue interface)
	Test pit terminated at 2.6 feet No Groundwater Observed

North Alcoa Site - East St Louis, IL
Shear Wave Velocity Profile for ReMi Array 1
AMEC Project No. 3410-10-0782



Prepared by __TQ__
Checked by ___PDP_

North Alcoa Site - East St Louis, IL
Shear Wave Velocity Profile for ReMi Array 2
AMEC Project No. 3410-10-0782



Prepared by _TQ___
Checked by __PDP__

MFG, Inc.
Consulting Scientists and Engineers

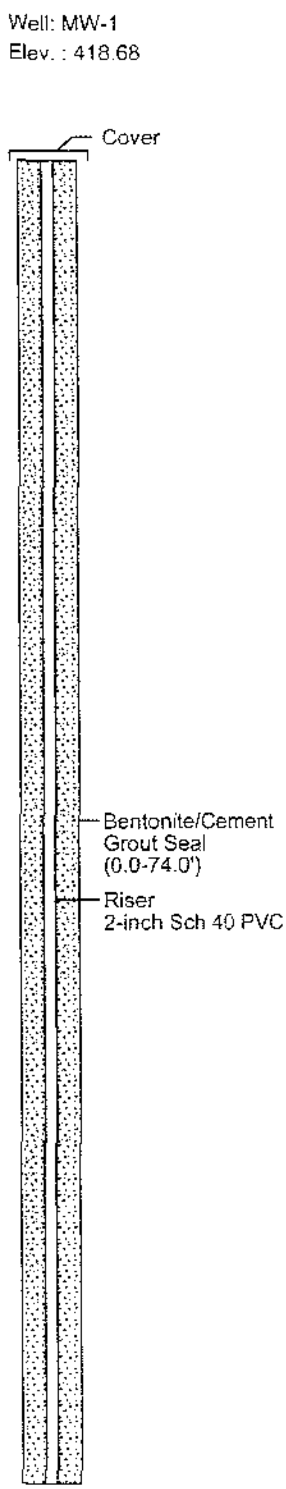
LOG OF BORING MW-1

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: East Side	Logged By	: B. Brown
Date	: 11/25/03	Northing	: 703883.69
Hole Diameter	: 4.25" ID	Easting	: 2311247.42
Drilling Method / Rig	: HSA / CME 750	Elevation	: 418.68 ft.

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	REMARKS
0	GW		GYPSUM RESIDUE, cream to light gray, hard.	
3.5	SW		SAND, gray, very fine grained, loose, moist.	
5	SW		SAND, gray, very fine grained, loose, damp.	
8.5	ML		SILT, gray, loose, w/some very fine grained sand, wet.	
10	ML/SW		SILT & SAND, gray to brown, loose,bery fine grained, saturated.	
15	SW		SAND, gray brown, fine grained, loose w/some silt, saturated.	
19	SW		SAND, gray brown, fine to medium grained, loose, little silt, saturated.	
24	SW		SAND, gray brown, medium to fine grained, loose	
29	SW		SAND, gray brown, medium to fine grained, loose w/occ coarse grain	
35	SW		SAND, gray, medium to fine grained, loose w/ occ coarse grain.	

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38



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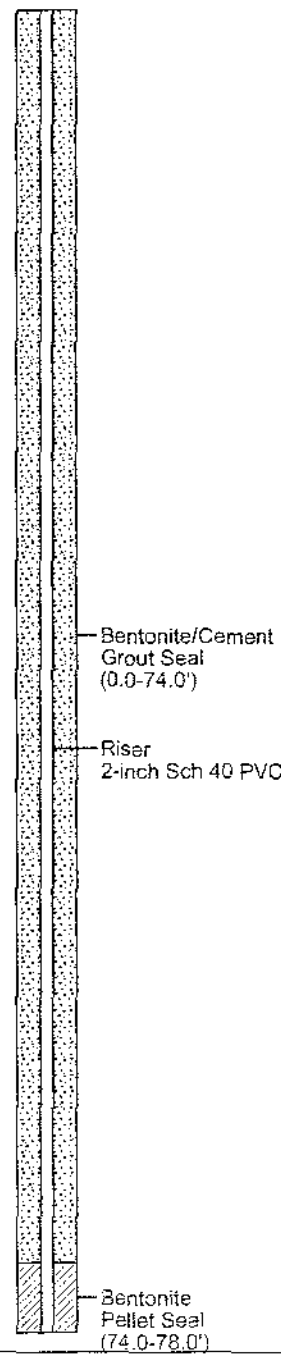
LOG OF BORING MW-1

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: East Side	Logged By	: B. Brown
Date	: 11/25/03	Northing	: 703883.69
Hole Diameter	: 4.25" ID	Easting	: 2311247.42
Drilling Method / Rig	: HSA / CME 750	Elevation	: 418.68 ft.

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	REMARKS
38	SW			
39–41	SW		SAND, gray, medium grained, loose	
41–43	SW		SAND, gray, medium to coarse grained, loose	
43–44	SW		SAND, gray, medium grained, loose	
44–49	SW		SAND, gray, medium grained, loose	
49–53	SW		SAND, gray, medium grained, loose	
53–54	SW		SAND, gray medium to coarse, loose	
54–72	SW		SAND, gray, medium to coarse grained, loose	
72–74	SW		SAND, gray, medium grained, loose	
74–76	SW		SAND, gray, medium grained, loose, occ coarse grain	

Well: MW-1
Elev. : 418.68



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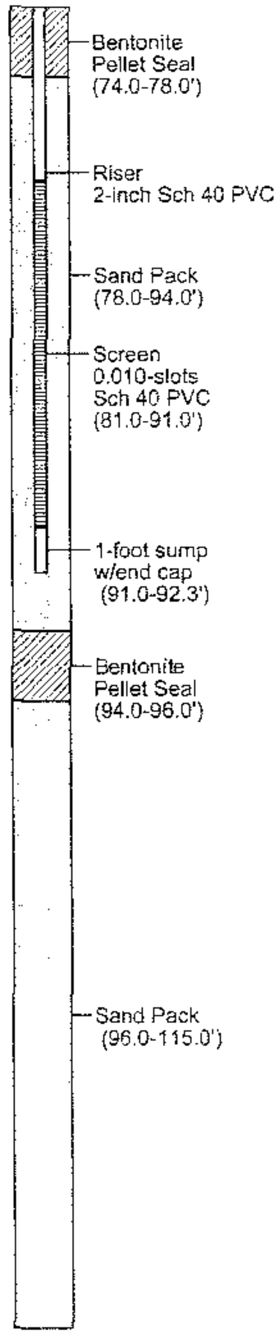
LOG OF BORING MW-1

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: East Side	Logged By	: B. Brown
Date	: 11/25/03	Northing	: 703883.69
Hole Diameter	: 4.25" ID	Easting	: 2311247.42
Drilling Method / Rig	: HSA / CME 750	Elevation	: 418.68 ft.

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	REMARKS
76–79	SW			
79–89	SW		SAND, gray, medium to coarse grained, loose	
89–94	SW		SAND, gray, medium to coarse grained, loose (extra flow)	
94–99	SW		SAND, gray, medium grained, loose	
99–102.5	SW		SAND, gray, medium grained, loose	
102.5–109	LS		LIMESTONE, cream color, hard, dense	
109–114	SW		SAND, gray, medium to coarse grained w/ limestone layers	

Well: MW-1
Elev. : 418.68



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MFG, Inc.
Consulting Scientists and Engineers

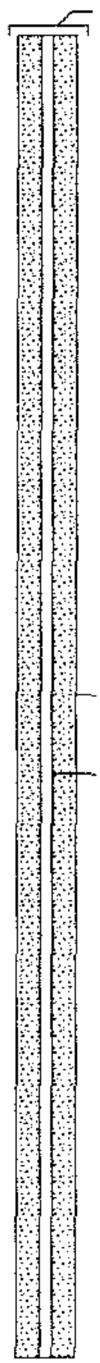
LOG OF BORING MW-2

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: Upchurch Cement	Logged By	: B. Brown
Date	: 11/19/03	Northing	: 705216.1
Hole Diameter	: 4.25" ID	Easting	: 2306556.58
Drilling Method / Rig	: HSA / CME 750	Elevation	: 417.83 ft.

Depth in Feet	USCS	DESCRIPTION	REMARKS
0	GW	Limestone Gravel	
	Fill	Concrete Slab	
	ML	SILT, dark brown/black, fill, bricks, concrete, other construction debris.	
2–15	ML	SILT, dark brown/black, w/sand & gravel, saturated at approx 6.0 ft-bgs.	
15–19	ML	SILT, brown, loose, some sand, saturated.	
19–28	ML	SILT, red brown, loose, some sand, saturated.	
28–39	ML	SILT, gray, loose, little very fine grained sand.	

Well: MW-2
Elev.: 417.83



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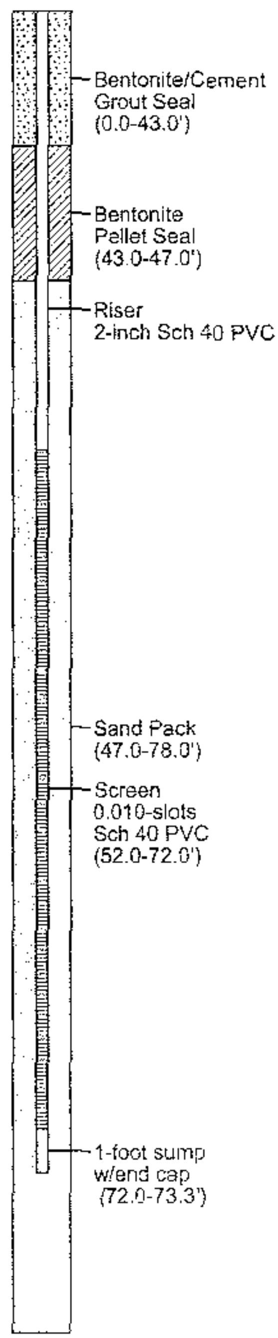
LOG OF BORING MW-2

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: Upchurch Cement	Logged By	: B. Brown
Date	: 11/19/03	Northing	: 705216.1
Hole Diameter	: 4.25" ID	Easting	: 2306556.58
Drilling Method / Rig	: HSA / CME 750	Elevation	: 417.83 ft.

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	REMARKS
39	SW		SAND, gray, loose, medium to fine grained, - sand heaving into augers-start mud rotary.	
			SAND, gray, medium grained, loose	
41–49	SW		SAND, gray, medium to fine grained, loose to slightly dense	
51–67	SW		SAND, gray, medium to coarse grained, loose	
69–71	GW		GRAVEL, gray, with coarse to medium sand, 0.5 ft cobble approx 72.0 ft-bgs.	
73–77	SW		SAND, gray, medium to coarse grained, loose to slightly dense	

Well: MW-2
Elev.: 417.83



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LOG OF BORING MW-2

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: Upchurch Cement	Logged By	: B. Brown
Date	: 11/19/03	Northing	: 705216.1
Hole Diameter	: 4.25" ID	Easting	: 2306556.58
Drilling Method / Rig	: HSA / CME 750	Elevation	: 417.83 ft.

Well: MW-2
Elev.: 417.83

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Well	REMARKS
78-80	SW			Bentonite Pellet Seal (78.0-81.0')	
80-110	SW		SAND, gray, medium to fine grained, loose to slightly dense, w/gravel zones at (92.0-93.5') (98.0-99.0')	Sand Pack (81.0-117.5')	
110-112	GW		GRAVEL, light gray, cream, limestone, hard.		
112-117.5	SW		SAND, vari colored, predominately gray, loose, coarse to medium grained.		

Depth scale: 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116

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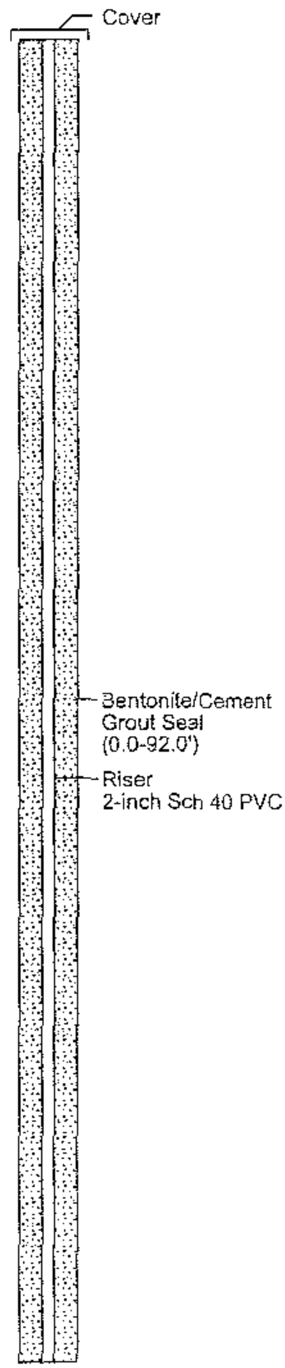
LOG OF BORING MW-3

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: Illinois Power Co	Logged By	: B. Brown
Date	: 11/21/03	Northing	: 705953.5
Hole Diameter	: 4.25" ID	Easting	: 2307338.33
Drilling Method / Rig	: HSA / CME 750	Elevation	: 409.75 ft.

Depth in Feet	USCS	DESCRIPTION	Sample	Rec. (ft)	REMARKS
0	Fill	Asphalt			Strong diesel odor
		Limestone subbase mixed w/ dark gray silt. strong diesel odor.			
	ML	SILT, dark gray, w/minor clay, soft, damp, strong diesel odor			Diesel odor
6	ML	SILT, gray green, w/minor clay, soft, damp, disel odor.			
7.5	SW	SAND, gray, fine to very fine grained, loose, slight to no diesel odor, wet at 14.0 ft-bgs.			Slight diesel odor
15	ML	SAND, gray, medium to fine grained, loose, saturated, slight diesel odor, approx 1.0 ft sand heaved into augers.			Slight diesel odor
18	ML	SAND, gray, medium-fine grained, loose to slightly dense	1	1.0	
20	GW	SAND, gray, medium-fine grained, loose.			
23	SW	SAND, gray, medium-fine grained, loose to slightly dense	2	1.7	
25	SW	SAND, gray, medium to fine grained, loose			
28	SW	SAND, gray, medium - fine grained, loose to slightly dense.	3	1.6	
30	SW	SAND, gray, medium-fine grained, loose			
33	SW	SAND, gray, medium to fine grained, loose to slightly dense.	4	1.3	
35	SW	SAND, gray, medium to fine grained, loose.			
38	SW	SAND, gray, fine to medium grained, slightly dense, very fine layers of black silt around 39.5 ft-bgs.	5	1.8	

Well: MW-3
Elev.: 409.75



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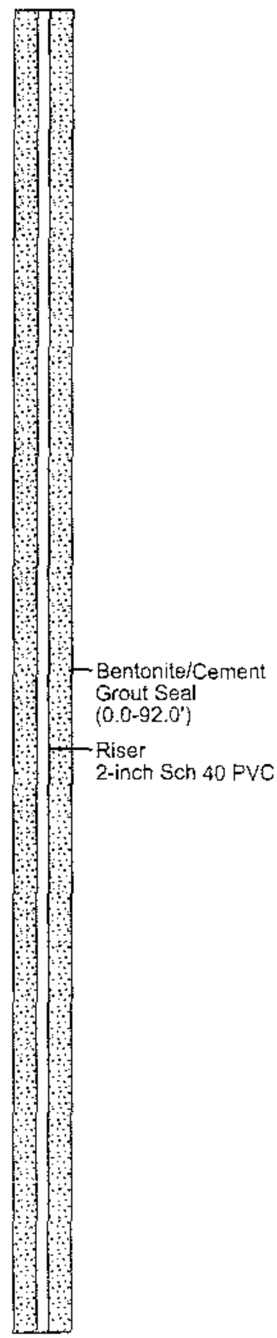
LOG OF BORING MW-3

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: Illinois Power Co	Logged By	: B. Brown
Date	: 11/21/03	Northing	: 705953.5
Hole Diameter	: 4.25" ID	Easting	: 2307338.33
Drilling Method / Rig	: HSA / CME 750	Elevation	: 409.75 ft.

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Sample	Rec. (ft)
39	SW			5	1.8
41	SW		SAND, gray, loose, medium to fine grained, loose to slightly dense.		
43	SW		SAND, gray, fine grained, slightly dense.	6	1.1
45, 47	SW		SAND, gray, fine grained, slightly dense		
49	SW		SAND, gray, fine grained, slightly dense	7	1.7
51	SW		SAND, gray, fine grained, slightly dense		
53	SW		SAND, gray, fine grained, slightly dense, firm	8	2.0
55, 57	SW		SAND, gray w/occesional black, fine to medium grained, slightly dense, cobble at 58 ft.		
59	GW		GRAVEL, gray, varicolored, subrounded to subangular w/coarse to medium grained sand, loose.	9	1.0
61	SW		SAND, gray, coarse to medium grained, loose. GRAVEL 62.0-63.0')		
63	GW		GRAVEL 63.0-64.0' w/coarse sand, gray, varicolored, 64.0-64.6 sand, med to fine grained, gray, loose to slightly dense.	10	1.6
65, 67	SW		SAND, gray to dark gray, coarse to fine grained, loose, appear more coarse w/depth.		
69	GW/SW		GRAVEL & SAND, gray varicolored, subangular to subrounded, medium to coarse sand, loose. lost 1.5' to 2.0' of hole, bit on bottom at 66.5. large grain size.	11	1.6
71	SW		SAND, gray, medium to coarse grained, loose		
73	SW		SAND, gray, medium to coarse grained. Have 1.0' of slough falling into hole.	12	1.0
75, 77	SW		SAND, gray, medium to coarse grained, loose.		

Well: MW-3
Elev.: 409.75



REMARKS

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LOG OF BORING MW-3

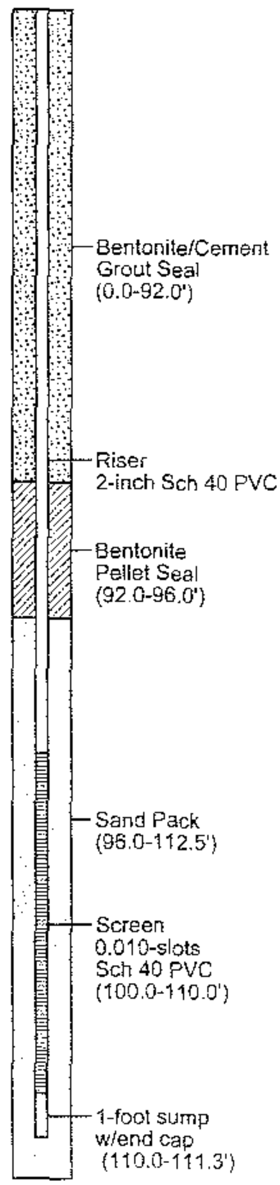
North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: Illinois Power Co	Logged By	: B. Brown
Date	: 11/21/03	Northing	: 705953.5
Hole Diameter	: 4.25" ID	Easting	: 2307336.33
Drilling Method / Rig	: HSA / CME 750	Elevation	: 409.75 ft.

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Sample	Rec. (ft)
78–80	SW		SAND, gray, medium to coarse grained w/occ. cobble, loose. 1.0' slough on top.	13	1.0
80–83	SW		SAND, gray, medium to coarse grained, loose		
83–85	SW		SAND, gray, medium to coarse grained, loose w/cinders, slough on top.	14	1.5
85–88	SW		SAND, gray, medium grained, loose.		
88–90	SW		SAND, gray, medium grained, loose. lost 60 ft of hole collapse to 30 ft-bgs.	15	1.85
90–95	SW		SAND, gray, medium grained, loose.		
95–100	SW/GW		SAND & GRAVEL, medium to coarse grained sand w/gravel from 96 to 98 ft-bgs, subangular to subrounded, loose, grading back to coarse sand to 100 ft-bgs.		
100–105	SW/GW		SAND & GRAVEL, gray, medium to coarse grained sand w/gravel from 103 to 104 ft-bgs, subangular to subrounded, loose.		
105–110	SW/GW		SAND & GRAVEL, gray to light gray, medium to coarse grained sand w/some gravel as above. Limestone ledge @ 107 to 110.5 ft-bgs, hard.		
110–113	SW/GW		SAND & GRAVEL, gray, coarse grained sand to fine gravel, loose from 110.5 to 113.0'		

Total Depth = Bedrock

Well: MW-3
Elev.: 409.75



REMARKS

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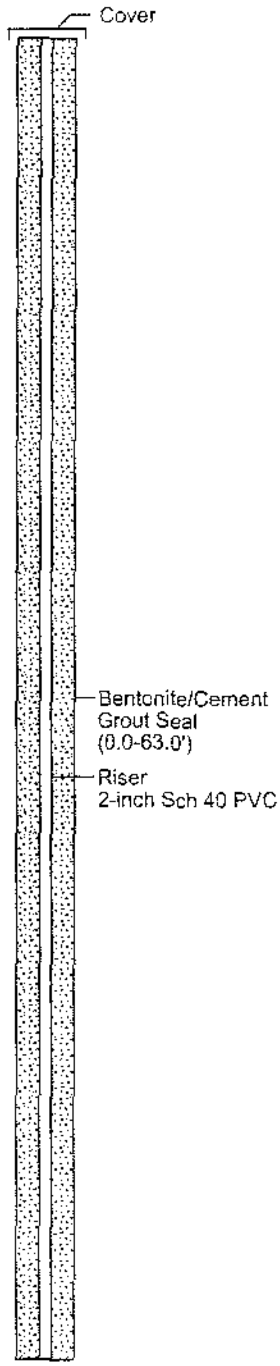
LOG OF BORING MW-4

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: Baseball Field	Logged By	: B. Brown
Date	: 11/23/03	Northing	: 706558.43
Hole Diameter	: 6.25" ID	Easting	: 2308543.7
Drilling Method / Rig	: HSA / CME 750	Elevation	: 414.58 ft.

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Sample	Rec. (ft)	REMARKS
0–5	GW		FILL, Black cinders, coare grained sand to gravel sized, damp to wet.			
5–8	ML		SILT, brown, soft, saturated.			
8–14	ML		SILT, orange brown, soft, saturated, residue.			
14–15	ML		SILT, gray, semi firm, slightly dense, wet. will attempt shelby tube.			
15–17	ML		SHELBY TUBE, SILT, gray, slightly dense, wet.	1	1.6	
17–28	ML		SILT, gray, slightly dense, wet, grading to very fine grained sand between 26 and 28 ft-bgs.			
28–30	SW		SAND, gray, fine to very fine grained sand, loose, saturated. base of augers at30 ft-bgs. approx 7 ft. sand heave into boring.			
30–33	SW		SAND, gray, medium-fine grained, w/occ coarse grain, loose, saturated			
33–37	SW		SAND, gray, medium to fine grained, loose, saturated.			

Well: MW-4
Elev.: 414.58



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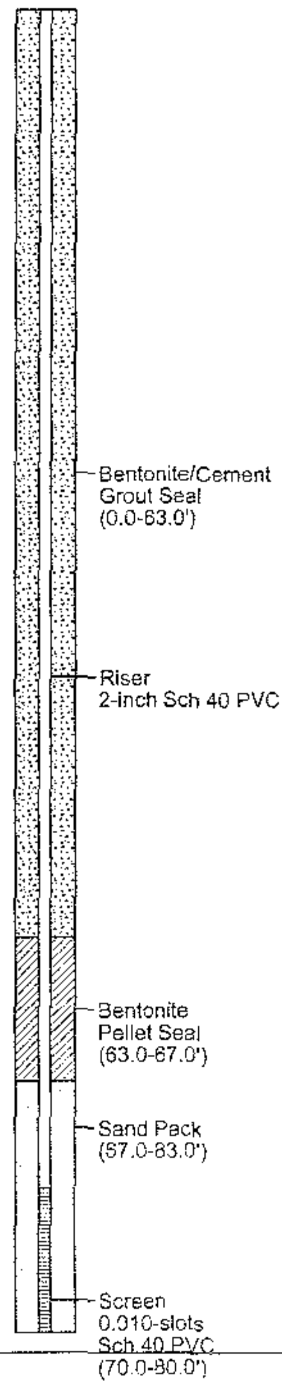
LOG OF BORING MW-4

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: Baseball Field	Logged By	: B. Brown
Date	: 11/23/03	Northing	: 706558.43
Hole Diameter	: 6.25" ID	Easting	: 2308543.7
Drilling Method / Rig	: HSA / CME 750	Elevation	: 414.58 ft.

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Sample	Rec. (ft)	REMARKS
37	SW					
38–43	SW		SAND, gray, medium to fine grained, loose, saturated.			
43–48	SW		SAND, gray, medium to fine grained, loose			
48–50	SW		SAND, gray, medium to fine grained, loose			
50–52	SW		SAND, gray, medium to coarse grained, loose			
52–53	SW		SAND, gray, medium grained, loose			
53–58	SW		SAND, gray, medium grained, loose			
58–63	SW		SAND, gray, medium to fine grained, loose			
63–68	SW		SAND, gray to dark gray @ 68 ft, medium grained, loose.			
68–70	SW		SAND, gray to dark gray, coarse grained w/some gravel, loose			
70–73	SW		SAND, gray, medium to coarse grained, loose			
73	SW		SAND, gray, medium grained, loose, w/some fines.			



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LOG OF BORING MW-4

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Driller	: Geotechnology, Inc.
Area	: Baseball Field	Logged By	: B. Brown
Date	: 11/23/03	Northing	: 706558.43
Hole Diameter	: 6.25" ID	Easting	: 2308543.7
Drilling Method / Rig	: HSA / CME 750	Elevation	: 414.58 ft.

Well: MW-4
Elev.: 414.58

USCS	DESCRIPTION	REMARKS
SW		
SW	SAND, gray, medium grained, loose, w/some fines.	
SW	SAND, gray, medium grained, loose	
SW	SAND, gray, medium to coarse grained,w/some gravel, loose.	
SW	SAND, gray, medium grained, loose.	
SW	SAND, gray to varicolored, medium to coarse grained, loose.	
SW	SAND, gray, medium to coarse grained, w/GRAVEL at 98 ft-bgs.	
SW/GW	SAND & GRAVEL, gray to varicolored, coarse grained sand w/gravel subangular to subrounded, loose.	
LS	LIMESTONE LEDGE, cream, hard, dense	
SW/GW	SAND & GRAVEL, gray to varicolored, coarse grained sand w/gravel subangular, slightly loose mixed with limestone.	

Depth in Feet: 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 105, 103, 110

Well construction:
- Sand Pack (67.0-83.0')
- Screen 0.010-slots Sch 40 PVC (70.0-80.0')
- 1-foot sump w/end cap (80.0-81.3')
- Bentonite Pellet Seal (83.0-85.0')
- Sand Pack (85.0-112.0')

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LOG OF BORING 1aUP001

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30' drop
Area	: RDA 1 (1a)	Driller	: Geotechnology, Inc.
Date	: 09/05/03 & 09/06/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0	CL/GW	10 R 5/8 Red, CLAY mixed with GYPSUM, moist.				Sample (0.0-2.0') 1aUP001090503SO01 Modified TAL Other Inorganics
2	CL	10 R 6/6 Iron red, very soft CLAY, plastic, wet. (RED MUD)	1		100	Residue Suite (0.0-1.0'), (1.0-2.0')& (9.0-11.0') 1aUP001090503SO01 Shelby Tube (0.0-2.0') UW-MC,SC,SA 100% Recovery 1aUP001090603SO01
4			2	0 0 0 2	50	Shelby Tube (2.0-4.0') UW-MC,SC 100% Recovery 1aUP001090603SO04
6			3	0 0 0 0	100	Sample (2.0-10.0') 1aUP001090503SO02 Modified TAL Other Inorganics
8						
10						Shelby Tube (9.0-11.0') UW-MC,SC 100% Recovery 1aUP001090603SO05
12			4	0 0 1 1	100	
14			5	0 0 1 1	100	
16						Shelby Tube (16.0-18.0') UW-MC,SC 100% Recovery 1aUP001090603SO06
18	CL	10 R 6/6 Iron red, soft CLAY, interbedded with fine sand and silt, high plasticity, wet. (RED MUD)	6	2 2 0 1	75	
20						

08-06-2004

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LOG OF BORING 1aUP001

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 1 (1a)	Driller	: Geotechnology, Inc.
Date	: 09/05/03 & 09/06/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
20–22				7	4, 3, 2, 2	100	
22–26	CL						Shelby Tube (23.0-25.0') UW-MC,SC 100% Recovery 1aUP001090603SO07
26–28			10 R 6/6 iron red, soft CLAY, interbedded with fine sand and silt, wet becomes dry in silt/sand. (RED MUD)	8	4, 3, 4, 4	60	
28–32	CL						Shelby Tube (30.0-32.0') UW-MC,SC 100% Recovery 1aUP001090603SO08

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

04-06-2004

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LOG OF BORING 1aUP003

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 1 (1a)	Driller	: Geotechnology, Inc.
Date	: 09/06/03	Logged By	: D. Cercone
Hole Diameter	: 2"		
Drilling Method / Rig	: Direct Push / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0			10 R 5/8 Interbedded Red, stiff CLAY, (RED MUD) and tan SILT, moist, wet at contacts.				Sample (0.0-2.0') 1aUP003090603SO01 Modified TAL Other Inorganics TCL
2				1		100	Residue Suite (0.0-1.0'), (1.0-2.0') 1aUP003090603SO01 Shelby Tube (0.0-2.0') UW-MC,SC,SA,PT 100% Recovery 1aUP003090603SO01
4							Shelby Tube (2.0-4.0') UW-MC,SC 100% Recovery 1aUP003090603SO02
5	CL/ML						
6				2		100	Sample (2.0-10.0') 1aUP003090603SO02 Modified TAL Other Inorganics
8							
9				3		100	
10							
12							

08-06-2004

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LOG OF BORING 1aUP005

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 1 (1a)	Driller	: Geotechnology, Inc.
Date	: 09/06/03	Logged By	: D. Cercone
Hole Diameter	: 2"		
Drilling Method / Rig	: Direct Push / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0	ML		6 N Gray, SILT, trace red mud, dry.				
	CL		10 R 6/6 Iron red, stiff CLAY, (RED MUD) interbedded with silty fine sand stringers, moist.				Sample (0.0-2.0') 1aUP005090603SO01 Modified TAL Other Inorganics
2				1		100	Residue Suite (0.0-1.0'), (1.0-2.0') 1aUP005090603SO01
4							Sample (2.0-10.0') 1aUP005090603SO02 Modified TAL Other Inorganics
6				2		100	
8							
				3		100	
10							
12							

08-06-2004

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LOG OF BORING 1aUP008

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 1 (1a)	Driller	: Geotechnology, Inc.
Date	: 09/06/03	Logged By	: D. Cercons
Hole Diameter	: 2" & 4.25"		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0	CL		10 R 6/6 Iron red, very soft CLAY, plastic, wet. (RED MUD)				Sample (0.0-2.0') 1aUP008090603SO01 Modified TAL Other Inorganics
2				1		100	Residue Suite (0.0-1.0'), (1.0-2.0')& (9.0-11.0') 1aUP008090603SO01 Shelby Tube (0.0-2.0') UW-MC,SC,SA,PT,MD 100% Recovery 1aUP008090603SO01
4				2	0 0 1 1	75	Shelby Tube (2.0-4.0') UW-MC,SC 100% Recovery 1aUP008090603SO04
6				3	0 0 0 0	0	Sample (2.0-10.0') 1aUP008090603SO02 Modified TAL Other Inorganics
8–10							Shelby Tube (9.0-11.0') UW-MC,UC,SC 100% Recovery 1aUP008090603SO05
12				4	0 0 0 0	100	
14				5	0 0 0 0	0	
16							Shelby Tube (18.0-20.0') UW-MC,SC 100% Recovery 1aUP008090603SO05
18							
20							

LOG OF BORING 1aUP008

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 1 (1a)	Driller	: Geotechnology, Inc.
Date	: 09/06/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25"		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
20–22	ML		7.5YR 5/3 Buff brown, SILT, trace red mud, dry.	6	3 3 3 2	50	
22–32	CL		10 R 5/8 Red, soft CLAY, wet. (RED MUD)				Shelby Tube (28.0-30.0') UW-MC,SC No Recovery ("2" 500-ml Glass Jars) 1aUP008090603SO07
28–30				7	0 0 0 0	100	Shelby Tube (30.0-32.0') UW-MC,SC No Recovery ("2" 500-ml Glass Jars) 1aUP008090603SO08

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

LOG OF BORING 1aUP018

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (060207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 1 (1a)	Driller	: Geotechnology, Inc.
Date	: 09/07/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0–2	SW		7.5YR 5/3 Gray tan, loose SAND, with silt, cinders at 1.0-1.1' bgs, dry.				Sample (0.0-2.0') 1aUP018090703SO01 Modified TAL Other Inorganics
2–4	CL		10 R 5/8 Red, CLAY, with silt and sand, moist. (RED MUD)	1	1 2 1 2	25	Residue Suite (0.0-1.0'). (1.0-2.0')& (9.0-11.0') 1aUP018090703SO01 Shelby Tube (0.0-2.0') UW-MC,SC,SA,PT,MD 100% Recovery 1aUP018090603SO01
4–6	ML/SW		10 R 5/8 Red, loose SILT and SAND, trace clay, dry. (RED MUD)	2	3 2 2 3	75	Shelby Tube (2.0-4.0') UW-MC,SC 100% Recovery 1aUP018090603SO04
6–20	CL		10 R 5/8 Red, soft CLAY, wet. (RED MUD)				Sample (2.0-10.0') 1aUP018090703SO02 Modified TAL Other Inorganics
9–11							Shelby Tube (9.0-11.0') UW-MC,UC,SC No Recovery
11–13				3	0 0 0 1	0	
14–16				4	0 0 2 1	25	
16–18							Shelby Tube (16.0-18.0') UW-MC,SC 0.5' Recovery 1aUP018090703SO06
18–20				5	0 1 0 1	58	

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LOG OF BORING 1aUP018

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 1 (1a)	Driller	: Geotechnology, Inc.
Date	: 09/07/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
20–22	CL		Sand and silt laminations at 21.0-22.0' bgs.	6	0 1 0 1	100	
23–25	CL						Shelby Tube (23.0-25.0') UW-MC,SC No Recovery ('2" 500-ml Glass Jars) 1aUP018090703SO07
28–30	CL		Sand layer at 28.5-28.75' bgs.	7	0 0 0 1	100	
30–34	CL						Shelby Tube (32.0-34.0') UW-MC,SC 1.5' Recovery 1aUP018090703SO08

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

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LOG OF BORING 1bUP001

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 2 (1b)	Driller	: Geotechnology, Inc.
Date	: 09/11/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push HSA/ CME 50		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0			10 R 5/8 Red, SILT and SAND, wet. (RED MUD)				Sample (0.0-2.0') 1bUP001091103SO01 Modified TAL Other Inorganics
2							Residue Suite (0.0-1.0'), (1.0-2.0')& (9.0-11.0') 1bUP001091103SO01 Shelby Tube (0.0-2.0') UW-MC,SC, 100% Recovery 1bUP001091103SO01
4							Shelby Tube (2.0-4.0') UW-MC,SC 100% Recovery 1bUP001091103SO04
6							Sample (2.0-10.0') 1bUP001091103SO02 Modified TAL Other Inorganics
8							Shelby Tube (9.0-11.0') UW-MC,SC,UC,SA,CT 75% Recovery 1bUP001091103SO05
10	ML/SW						
12							
14							
16							Shelby Tube (16.0-18.0') UW-MC,SC, 100% Recovery (18-20') interval 1bUP001091103SO06
18							
20							

09-10-2004

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LOG OF BORING 1bUP001

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (060207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 2 (1b)	Driller	: Geotechnology, Inc
Date	: 09/11/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push HSA/ CME 50		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
20	GW		2.5 N Black, loose GYPSUM and CINDERS mixed, wet.	1	10 10 12 11	75	
23							Shelby Tube (23.0-25.0') UW-MC,SC 8" Recovery 1bUP001091103SO07
26			Auger refusal at 26 ft. bgs. Wood fragment stopped advancement of shelby tube.				Auger Refusal at 26 ft. bgs.

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

09-10-2004

LOG OF BORING 1bUP005

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 2 (1b)	Driller	: Geotechnology, Inc.
Date	: 09/11/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push HSA/ CME 50		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0–18	CL		10 R 5/8 Red, CLAY, wet. (RED MUD)				Sample (0.0-2.0') 1bUP005091103SO01 Modified TAL Other Inorganics Residue Suite (0.0-1.0'), (1.0-2.0')& (9.0-11.0') 1bUP005091103SO01 Shelby Tube (0.0-2.0') UW-MC,SC,PT 100% Recovery 1bUP005091103SO01 Shelby Tube (2.0-4.0') UW-MC,SC 100% Recovery 1bUP005091103SO04 Sample (2.0-10.0') 1bUP005091103SO02 Modified TAL Other Inorganics TCL Shelby Tube (9.0-11.0') UW-MC,SC,UC,SA,CT 4" Recovery (11-13') interval 1bUP005091103SO05 Shelby Tube (16.0-18.0') UW-MC,SC, No Recovery ("2" 500-ml Glass Jars) (18-20') interval 1bUP005091103SO06
18–20	CL		4 Y 5/4 Brown tan, soft CLAY, wet, (BROWN MUD)	1	0 0 0 0	100	

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LOG OF BORING 1bUP005

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 2 (1b)	Driller	: Geotechnology, Inc.
Date	: 09/11/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push HSA/ CME 50		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
20							
22							
23							Shelby Tube (23.0-25.0') UW-MC,SC 100% Recovery 1bUP005091103SO07
24							
26	CL						
28							
30							Shelby Tube (30.0-32.0') UW-MC,SC 6" Recovery 1bUP005091103SO08
32							
34							
36							
38							
40							

09-10-2004

LOG OF BORING 1bUP009

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 2 (1b)	Driller	: Geotechnology, Inc.
Date	: 09/10/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push HSA/ CME 50		

Depth in Feet	USCS	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0–8	CL	10 R 5/8 Red, CLAY, wet. (RED MUD)				Sample (0.0-2.0') 1bUP009091003SO01 Modified TAL Other Inorganics Residue Suite (0.0-1.0'), (1.0-2.0')& (9.0-11.0') 1bUP009091003SO01 Shelby Tube (0.0-2.0') UW-MC,SC 100% Recovery 1bUP009091003SO01 Shelby Tube (2.0-4.0') UW-MC,SC 100% Recovery 1bUP009091003SO04 Sample (2.0-10.0') 1bUP009091003SO02 Modified TAL Other Inorganics TCL
8–13	SW	6 N Gray, loose, fine, SAND, wet.	1	0 0 0 0	15	Shelby Tube (9.0-11.0') UW-MC,SC No Recovery ("2" 500-ml Glass Jars) (12-15') interval 1bUP009091003SO05
13–18	SW	6 N Gray, loose, fine, SAND, some clayey sand lenses, wet.	2	0 0 0 0	60	Shelby Tube (15.0-16.0') UW-MC,SC,UC,PT No Recovery ("2" 500-ml Glass Jars) (18-20') interval 1bUP009091003SO06
18–20	CL	10 R 5/8 Reddish brown, CLAY, high plasticity, wet. (RED MUD)	3	0 0 0 0	100	

LOG OF BORING 1bUP009

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 2 (1b)	Driller	: Geotechnology, Inc.
Date	: 09/10/03	Logged By	: D. Cercone
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push HSA/ CME 50		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec (%)	REMARKS
20–23	CL						
23–27	GW		6 N Gray, Gypsum				Shelby Tube (23.0-25.0') UW-MC,SC 100% Recovery 1bUP009091003SO07
27–32	CL		Gley 5/5G Olive gray, stiff, CLAY, dry.	4	4 5 6 4	100	Shelby Tube (32.0-34.0') UW-MC,SC 100% Recovery 1bUP009091003SO08

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LOG OF BORING 1cUP001

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 3 (1c)	Driller	: Geotechnology, Inc.
Date	: 09/10/03	Logged By	: H. Brown
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0–4	CL		10 R 5//8 Red, CLAY, trace sand, moist. (Red Mud)				Sample (0.0-2.0') 1cUP001091003SO01 Modified TAL Other Inorganics Shelby Tube (0.0-2.0') UW-MC, SC 100% Recovery 1cUP001091003SO01 Residue Suite (0.0-1.0'),(1.0-2.0') & (9.0-11.0') 1cUP001091003SO01 1cUP001091003SO05
4–6	SW		4 Y 5/4 Brown, soft SAND and SILT, wet.	1	2 1 1 1	25	
6–11	ML		2.5 N Black, soft SILT, trace sand, moist.	2	1 1 2 1	25	Shelby Tube (2.0-4.0') UW-MC, SC 100% Recovery 1cUP001091003SO04 Sample (2.0-10.0') 1cUP001091003SO02 Modified TAL Other Inorganics Shelby Tube (9.0-11.0) UW-MC, SC,CT 100% Recovery 1cUP001091003SO05
11–20	ML		2.5 N Black, very soft SILT, wet.	3		60	Shelby Tube (16.0-18.0') UW-MC, SC No Recovery (ziplock) 1cUP001091003SO06

01-20-2005

LOG OF BORING 1cUP001

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (060207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 3 (1c)	Driller	: Geotechnology, Inc.
Date	: 09/10/03	Logged By	: H. Brown
Hole Diameter	: 2" & 4.25" ID		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
20–31	ML			4		50	
				5		50	
				6		50	
31–36	CL		4 Y 5/4 Brown, CLAY silty, moist.	7		25	
36			Heving sands and to much water to get Shelby tubes. Direct push down to see lithology.				

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LOG OF BORING 1cUP006

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 3 (1c)	Driller	: Geotechnology, Inc.
Date	: 09/10/03	Logged By	: H. Brown
Hole Diameter	: 2" &4.25" ID		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0			10 R 5/8 Red, CLAY, trace sand, wet. (RED MUD)				Sample (0.0-2.0') 1cUP006091003SO01 Modified TAL Other Inorganics Shelby Tube (0.0-2.0') UW-MC, SC,PT 100% Recovery 1cUP006091003SO01
2							Residue Suite (0.0-1.0'),(1.0-2.0') & (9.0-11.0') 1cUP006091003SO01 1cUP006091003SO05
4				1	0 0 0 0	50	
6				2	1 1 1 1	50	Shelby Tube (2.0-4.0') UW-MC, UC, SC 100% Recovery 1cUP006091003SO04
8							Sample (2.0-10.0') 1cUP006091003SO02 Modified TAL Other Inorganics TCL
10	CL						Shelby Tube (9.0-11.0) UW-MC, SC,CT 100% Recovery 1cUP006091003SO05
12							
14				3	0 0 1 0	25	
16				4	0 1 1 0	50	Shelby Tube (16.0-18.0') UW-MC, SC No Recovery (ziplock) 1cUP006091003SO05
18							
20							

09-10-2004

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LOG OF BORING 1cUP006

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 3 (1c)	Driller	: Geotechnology, Inc.
Date	: 09/10/03	Logged By	: H. Brown
Hole Diameter	: 2" &4.25" ID		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
20–23	CL						
23–35	CL		4 Y 5/4 Brown, CLAY, trace silt, wet. (BROWN MUD)	5	1 0 0 0	25	Shelby Tube (23.0-25.0') UW-MC, SC No Recovery (ziplock) 1cUP006091003SO07
				6	1 0 4 6	25	
35–38	SW		Gley 4/5G Dark greenish gray, stiff CLAY, moist.				Shelby Tube (36.0-38.0') UW-MC, SC 100% Recovery 1cUP006091003SO08

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

09-10-2004

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LOG OF BORING 1cUP013

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 3 (1c)	Driller	: Geotechnology, Inc.
Date	: 09/10/03	Logged By	: H. Brown
Hole Diameter	: 2"		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0–4	CL		10 R 5/8 Red, CLAY, trace sand, moist.				Sample (0.0-2.0') 1cUP013091003SO01 Modified TAL Other Inorganics TCL Shelby Tube (0.0-2.0') UW-MC, SC,SA,MD 100% Recovery 1cUP013091003SO01 Residue Suite (0.0-1.0')&(1.0-2.0') & (9.0-11.0') 1cUP013091003SO01 1cUP013091003SO05
4–6	CL		10 R 5/8 Red, CLAY, trace silt, moist to wet. (RED MUD)	1	1 2 2 2	50	Shelby Tube (2.0-4.0') UW-MC, UC, SC 100% Recovery 1cUP013091003SO04
6–18	SW		4Y 5/4 Brown, SAND, trace silt, wet	2	1 1 1 1	50	Sample (2.0-10.0') 1cUP013091003SO02 Modified TAL Other Inorganics Shelby Tube (9.0-11.0) UW-MC, UC, SC 100% Recovery 1cUP013091003SO05
				3	0 0 1 0	25	Shelby Tube (13.0-15.0') UW-MC, SC 100% Recovery 1cUP013091003SO06
				4	2 1 1 4	50	

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

10-10-2004

LOG OF BORING 1cUP015

North Alcoa Site
East Saint Louis, IL

Project	: Phase I RI (080207)	Sample Method	: 140lb hammer, 30" drop
Area	: RDA 3 (1c)	Driller	: Geotechnology, Inc.
Date	: 09/11/03	Logged By	: H. Brown
Hole Diameter	: 2"		
Drilling Method / Rig	: Direct Push & HSA / CME 750		

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Rec. (%)	REMARKS
0–1	CL		10 R 5/8 Red, CLAY, trace sand, moist.				Sample (0.0-2.0') 1cUP015091103SO01 Modified TAL Other Inorganics Shelby Tube (0.0-2.0') UW-MC, SC,PT 100% Recovery 1cUP015091103SO01
1–10	CL		10 R 5/8 Red, CLAY, trace sand, wet. (RED MUD)	1	0 0 0 0	25	Residue Suite (0.0-1.0'),(1.0-2.0') & (9.0-11.0') 1cUP015091103SO01 1cUP015091103SO05 Shelby Tube (2.0-4.0') UW-MC, SC 100% Recovery 1cUP015091103SO04
				2	0 0 0 0	25	Sample (2.0-10.0') 1cUP015091103SO02 Modified TAL Other Inorganics
10–17	CL		4 Y 5/4 Brown, CLAY, trace silt, wet. (BROWN MUD)	3	0 0 0 0	80	Shelby Tube (9.0-11.0) UW-MC, SC,CT 100% Recovery 1cUP015091103SO05
							Shelby Tube (16.0-18.0') UW-MC, SC 1.5' Recovery 1cUP015091103SO06
17–25	CL		4 Y 5/4 Brown, medium stiff CLAY, moist.	4	0 0 0 0	60	Shelby Tube (23.0-25.0') UW-MC,SC 100% Recovery 1cUP015091103SO07

APPENDIX B
Laboratory Data

Laboratory Procedures
Grain Size Curves
Consolidation Tests
Gypsum Swell Tests
Gypsum Drying Tests
Gypsum Chemistry Tests

FAESLOU1

AMEC Project 3410-10-0782.10.2

LABORATORY PROCEDURES

Moisture Content: The moisture content of soil is defined as the weight of water in a given soil mass divided by the weight of dry soil solids in the same mass. Drying is conducted at 105 degrees centigrade or about 220 degrees Fahrenheit. Natural moisture contents are determined in general accordance with ASTM designation D 2216.

Moisture Content/Loss on Ignition: The moisture content was further measured at various temperatures up to about 500 degrees centigrade. The higher temperatures result in further disassociation of bound water particles as well as combustion of any organic matter.

Soil Plasticity Test: A representative sample of soil is tested to determine its plasticity characteristics as an indication of the shrink-swell potential. The soil's plastic index (PI) is representative of this characteristic and is bracketed by the liquid limit (LL) and the plastic limit (PL). The LL is the moisture content at which the soil will flow as a heavy viscous fluid. The PL is the moisture content at which the soil begins to lose its plasticity. These determinations are in general accordance with ASTM D 4318.

Grain Size Distribution Test: Grain size tests are performed to determine the particle size and distribution of soil samples. The grain size distribution of soils coarser than 0.75 mm in diameter is determined by passing the sample through a set of nested sieves. Material less than 0.075 mm in diameter is suspended in water and the grain size distribution measured by the rate of settlement. These tests are in general accordance with ASTM D 1140 and D 422. The results are presented in the form of a curve showing the distribution of particle diameters.

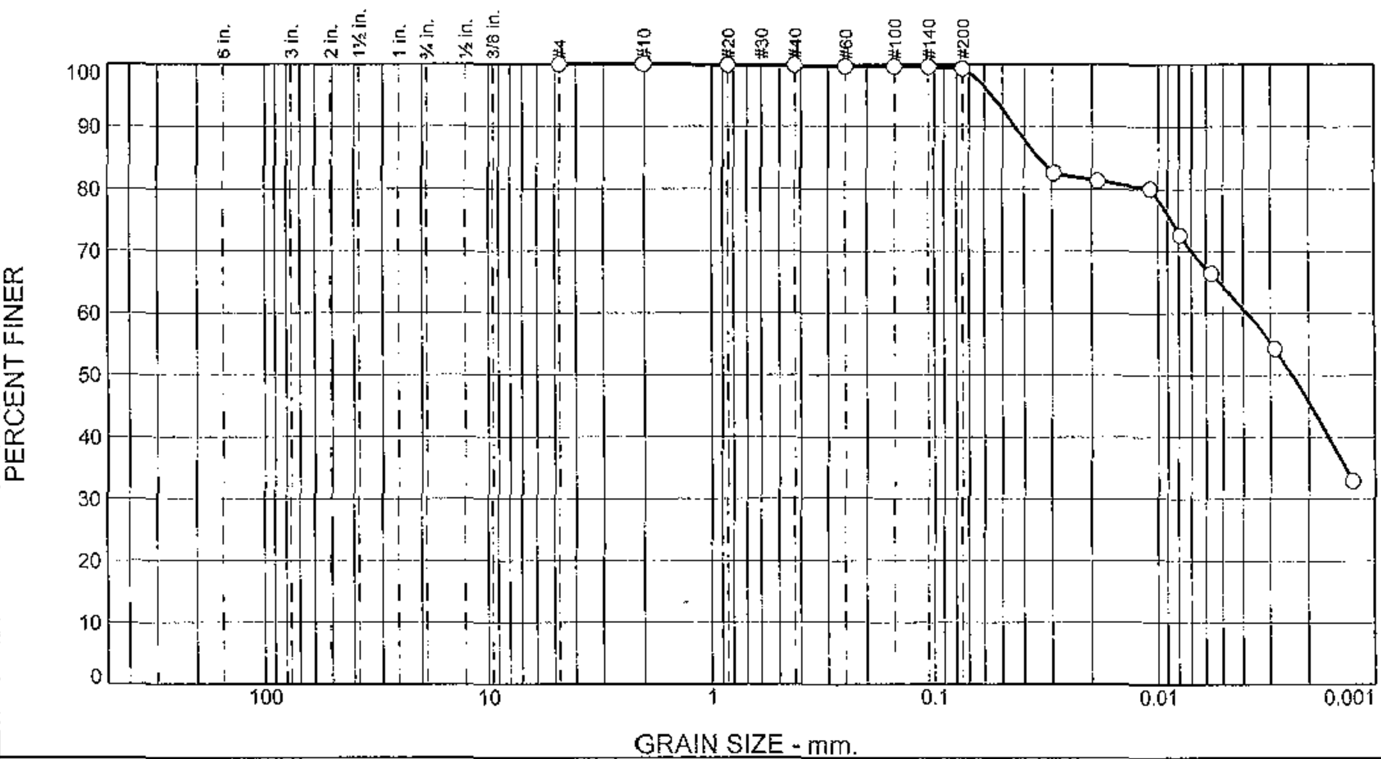
Consolidation Test: The one-dimensional or oedeometric consolidation test involves placing an undisturbed sample in a smooth sided, stainless steel ring and then applying load in increments. The sample may be saturated by inundation or tested at other moisture contents as representative of field conditions. At each load increment, the vertical strain is measured over time. Based on the time measurements, an estimate of the end of primary consolidation is made. The time/strain curves provide a coefficient of consolidation (C_v) from which the time rate of settlement due to consolidation can be calculated. A stress-strain curve based on the end of primary consolidation strains for each load increment allows calculation of the magnitude of expected settlement related to additional load.

Swell Magnitude Test: The swell magnitude test is conducted in the oedometer used for the consolidation test. A sample is placed in the ring and confined under a nominal load. The sample is then inundated and swell is measured over time.

Swell Pressure Test: The swell pressure test is conducted in the oedometer used for the consolidation test. A sample is placed in the ring and confined under automatically increasing load to maintain a constant sample height and volume. This measures the pressure developed by the material due to swelling.

Chemistry Testing: X-Ray Flourescence and Thermal Analysis were used to assess the relatively proportions of gypsum, anhydrite, and other materials in various gypsum samples.

Particale Size Distribution (ASTM D422-63 (2007))



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	0.5	35.0	64.3

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.8		
#40	99.8		
#60	99.7		
#100	99.6		
#140	99.6		
#200	99.3		
0.0295 mm.	82.5		
0.0187 mm.	81.3		
0.0109 mm.	80.1		
0.0079 mm.	72.6		
0.0057 mm.	66.4		
0.0029 mm.	54.3		
0.0013 mm.	32.9		

* (no specification provided)

Material Description

Yellowish Red Silt

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 0.0441 D_{85}= 0.0347 D_{60}= 0.0039
D_{50}= 0.0024 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

11133

Date Received: 11/26/11 Date Tested: 11/28/11
Tested By: EH
Checked By: JW
Title:

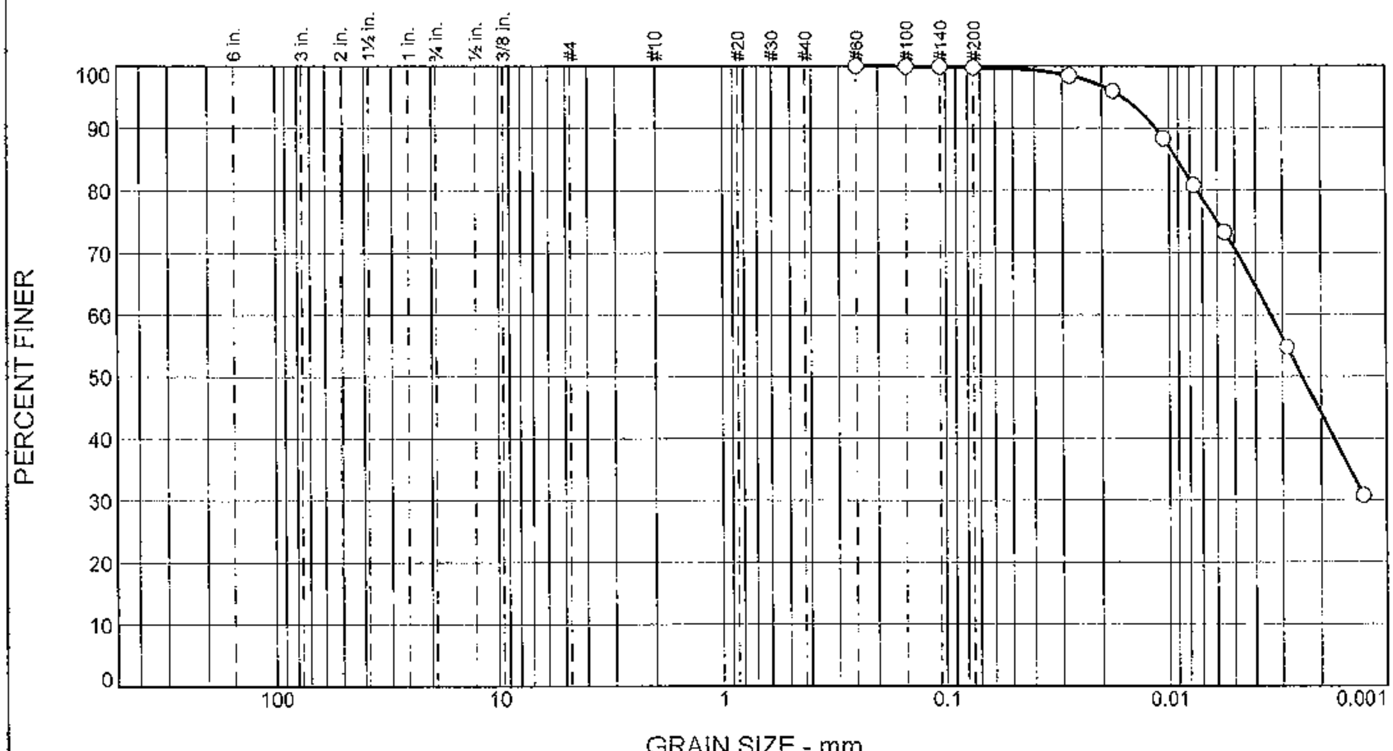
Source of Sample: PZ-13 Depth: 2-4 ft Date Sampled: N/A
Sample Number: UD

amec

Client:
Project: North Alcoa Site - East St. Louis, Illinois

Project No: 3410-10-0782.10.1 Figure

Particale Size Distribution (ASTM D422-63 (2007))



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	0.2	29.2	70.6

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#60	100.0		
#100	99.9		
#140	99.9		
#200	99.8		
0.0280 mm.	98.4		
0.0179 mm.	95.9		
0.0106 mm.	88.4		
0.0077 mm.	80.8		
0.0056 mm.	73.3		
0.0029 mm.	54.8		
0.0013 mm.	30.7		

* (no specification provided)

Material Description

Brown Silt

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 0.0115 D_{85}= 0.0091 D_{60}= 0.0034
D_{50}= 0.0024 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

11134

Date Received: 11/26/11 Date Tested: 11/28/11
Tested By: EH
Checked By: JW
Title:

Source of Sample: PZ-13 Depth: 13.5-15.5 ft Date Sampled: N/A
Sample Number: UD

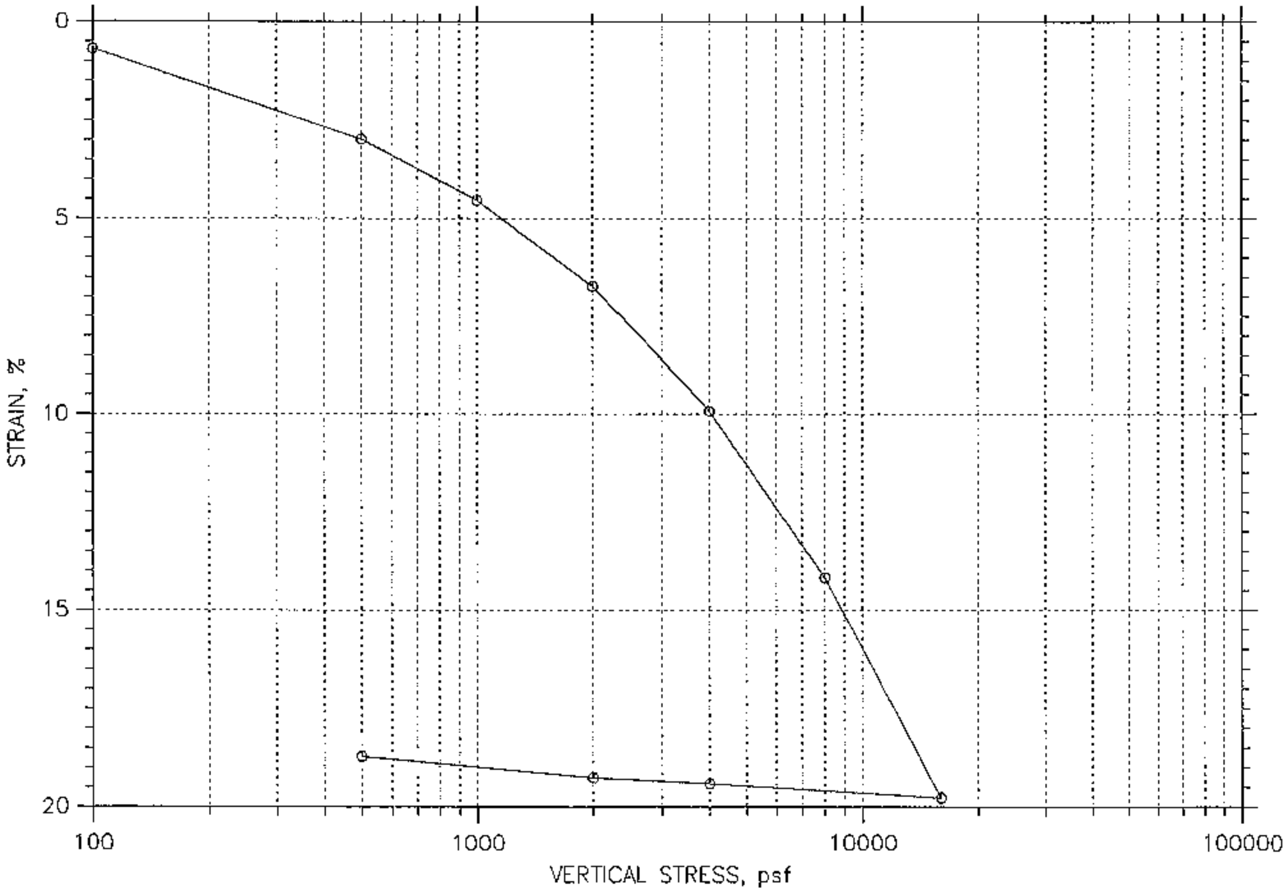
amec

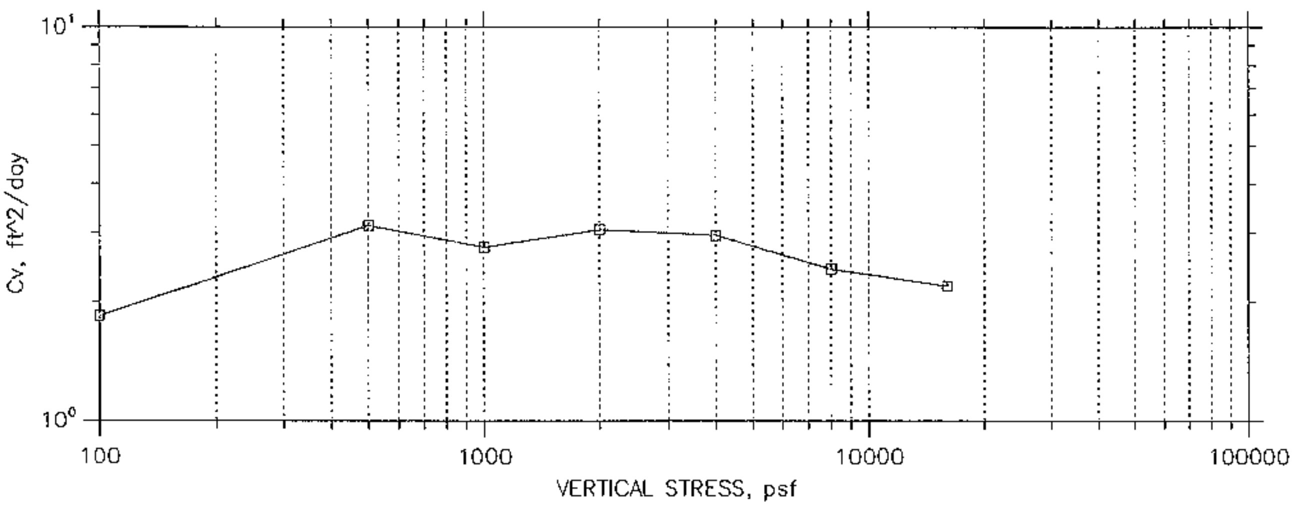
Client:
Project: North Alcoa Site - East St. Louis, Illinois

Project No: 3410-10-0782.10.1 Figure

CONSOLIDATION TEST DATA

SUMMARY REPORT



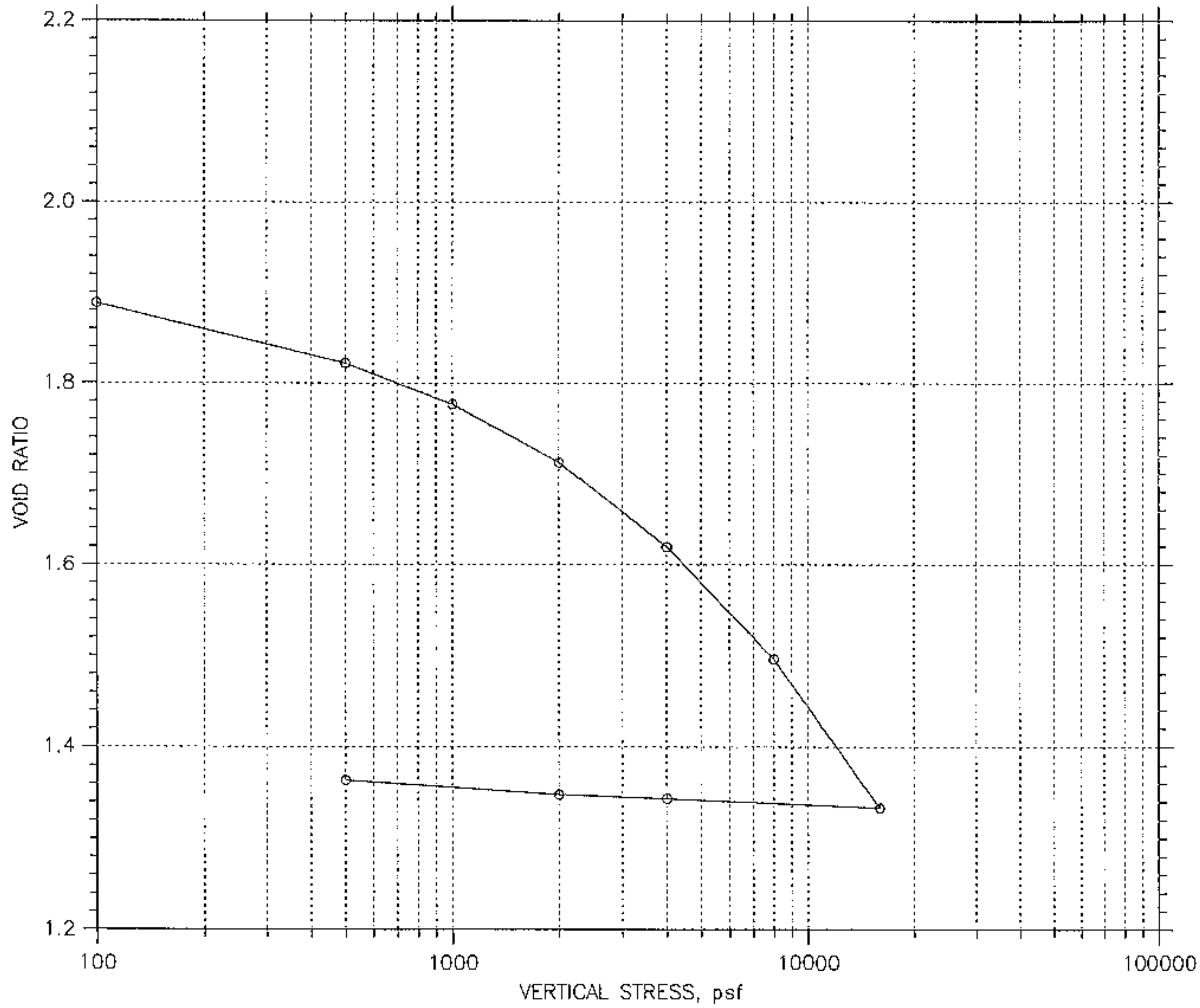


amec	Project: N Alcoa Site-E. St. Louis	Location: PZ-13	Project No.: 3410100782
	Boring No.: PZ-13	Tested By: JW	Checked By:
	Sample No.: UD	Test Date: 11/28/11	Depth: 2-4 ft
	Test No.: 11133	Sample Type: UD	Elevation: N/A
	Description: Yellowish Red Silt		
	Remarks: ASTM D2435-04		

Wed, 18-JAN-2012 14:39:25

CONSOLIDATION TEST DATA

SUMMARY REPORT



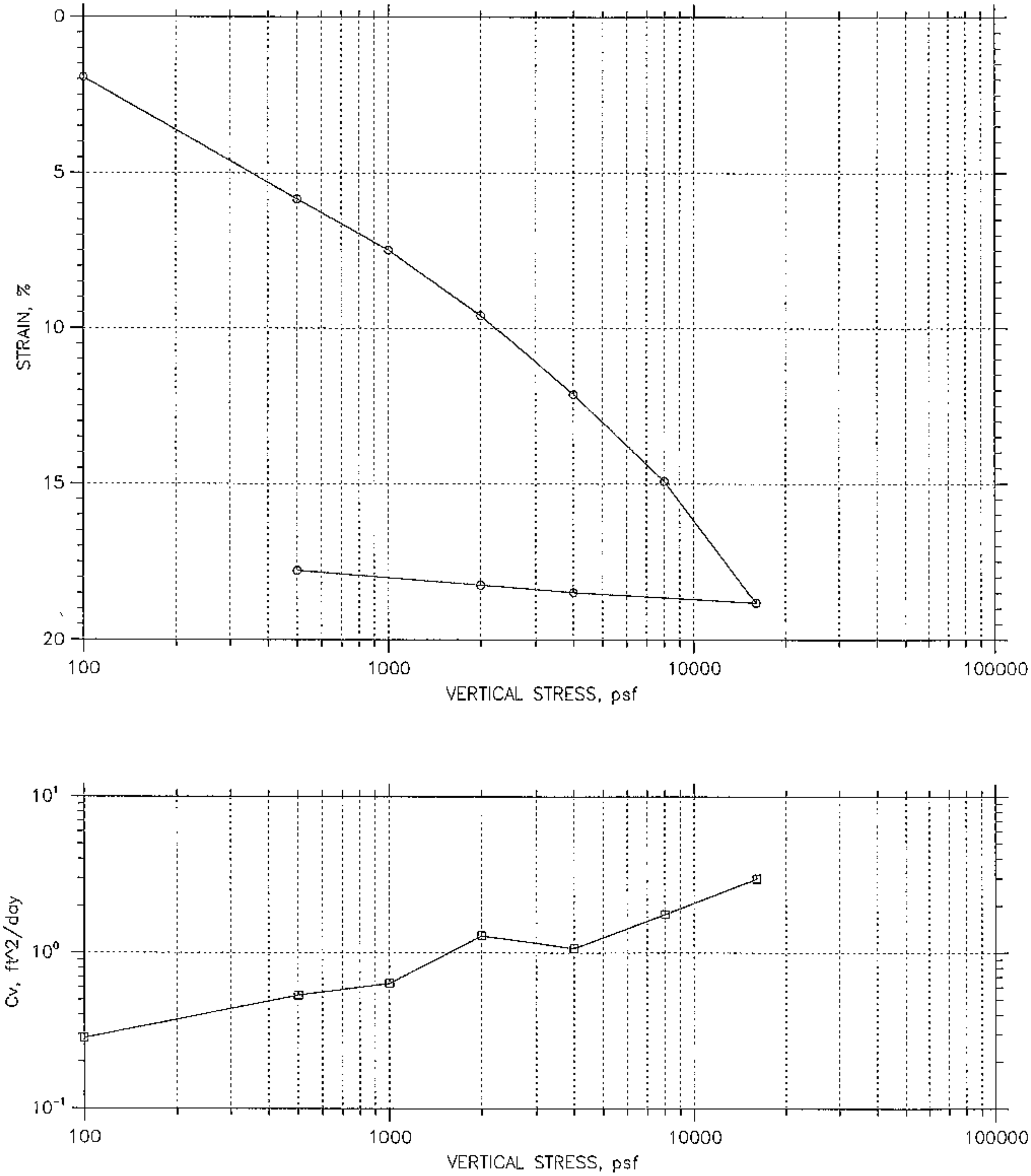
					Before Test	After Test
Overburden Pressure: 0 psf				Water Content, %	72.26	58.91
Preconsolidation Pressure: 0 psf				Dry Unit Weight, pcf	56.88	69.98
Compression Index: 0				Saturation, %	100.34	114.46
Diameter: 2.499 in		Height: 1.004 in		Void Ratio	1.91	1.36
LL: ---	PL: ---	PI: ---	GS: 2.65			

amec	Project: N Alcoa Site-E. St. Louis	Location: PZ-13	Project No.: 3410100782
	Boring No.: PZ-13	Tested By: JW	Checked By:
	Sample No.: UD	Test Date: 11/28/11	Depth: 2-4 ft
	Test No.: 11133	Sample Type: UD	Elevation: N/A
	Description: Yellowish Red Silt		
	Remarks: ASTM D2435-04		

Wed, 18-JAN-2012 14:39:53

CONSOLIDATION TEST DATA

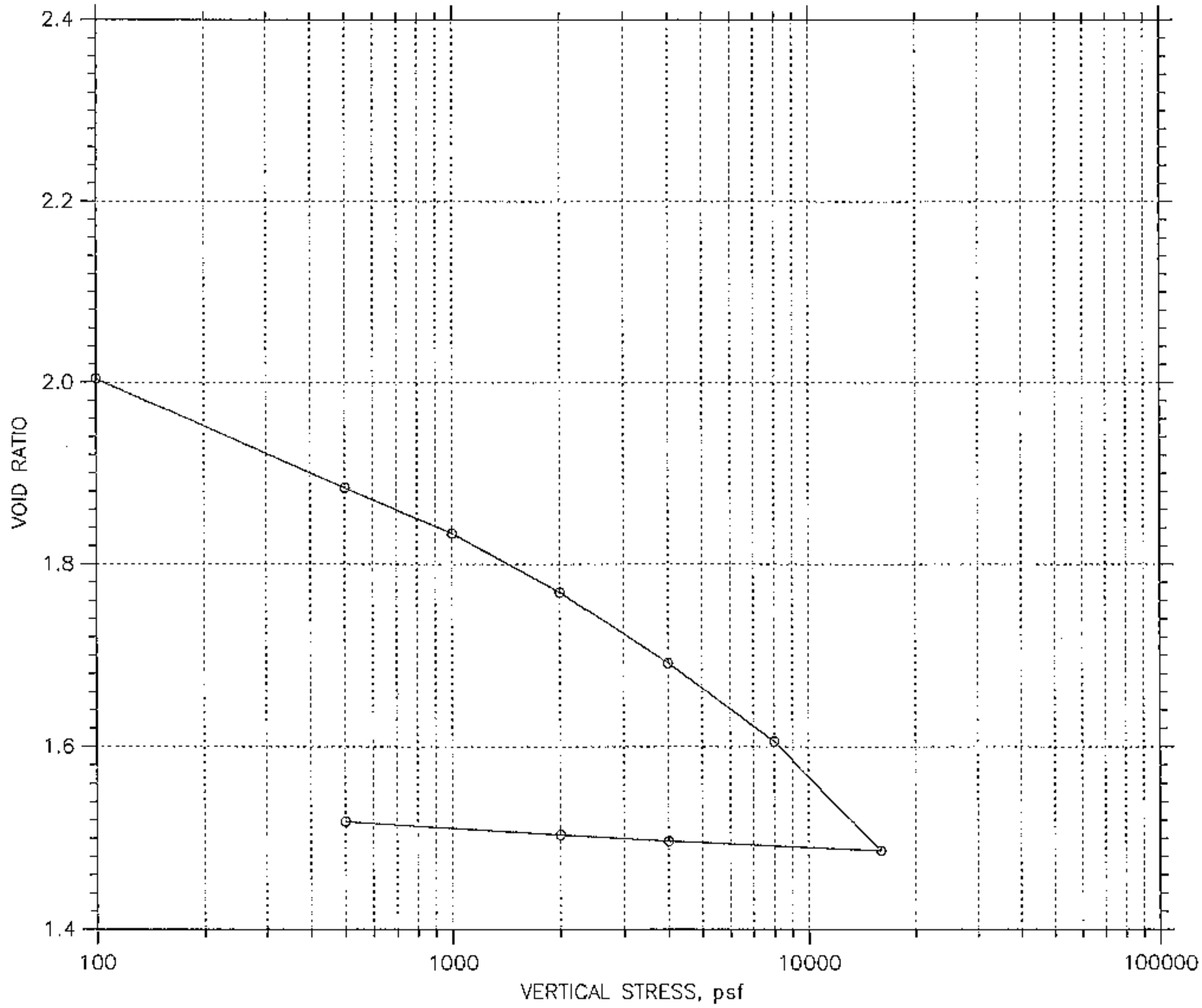
SUMMARY REPORT



amec			
	Project: N Alcoa Site-E. St. louis	Location: PZ-13	Project No.: 3410100782
	Boring No.: PZ-13	Tested By: JW	Checked By:
	Sample No.: UD	Test Date: 11/28/11	Depth: 13.5-15.5ft
	Test No.: 11134	Sample Type: UD	Elevation: N/A
	Description: Brown Silt		
	Remarks: ASTM D2435-04		

Wed, 18-JAN-2012 14:41:55

CONSOLIDATION TEST DATA
SUMMARY REPORT



					Before Test	After Test
Overburden Pressure: 0 psf				Water Content, %	84.54	59.96
Preconsolidation Pressure: 0 psf				Dry Unit Weight, pcf	54.02	65.69
Compression Index: 0				Saturation, %	108.61	104.64
Diameter: 2.5 in		Height: 1 in		Void Ratio	2.06	1.52
LL: ---	PL: ---	PI: ---	GS: 2.65			

amec			
	Project: N Alcoa Site-E. St. louis	Location: PZ-13	Project No.: 3410100782
	Boring No.: PZ-13	Tested By: JW	Checked By:
	Sample No.: UD	Test Date: 11/28/11	Depth: 13.5-15.5ft
	Test No.: 11134	Sample Type: UD	Elevation: N/A
	Description: Brown Silt		
	Remarks: ASTM D2435-04		

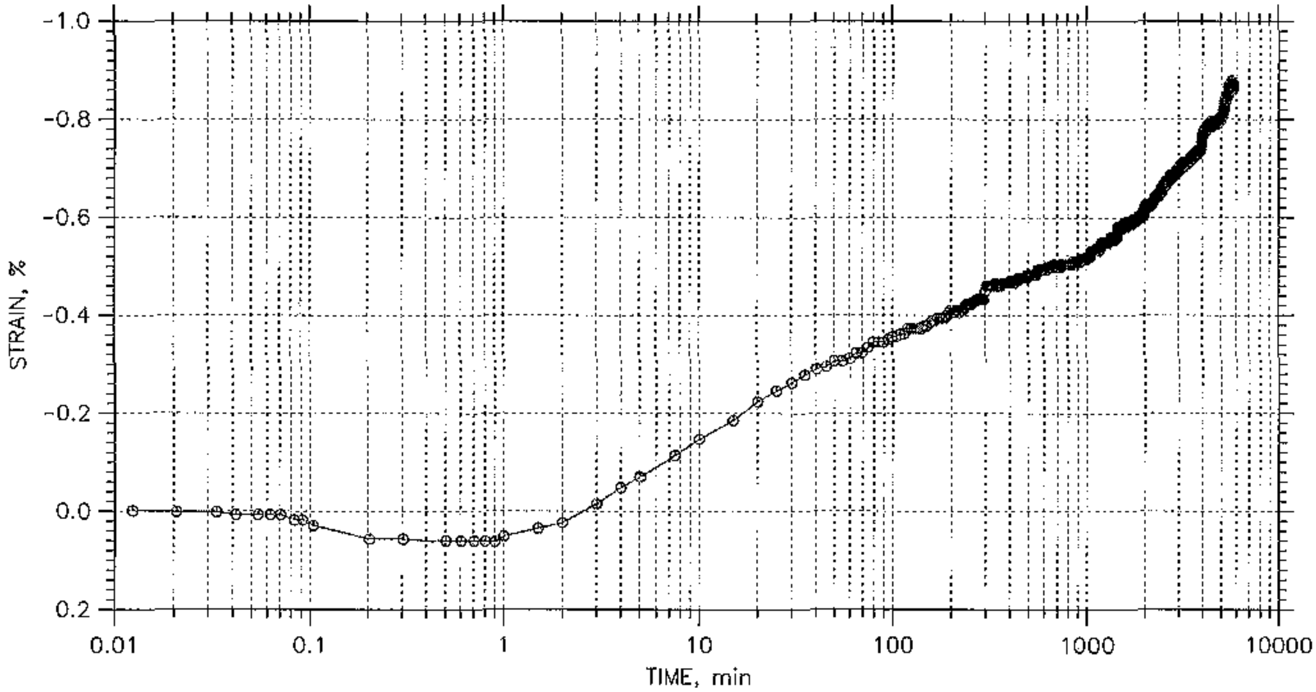
Wed, 18-JAN-2012 14:42:06

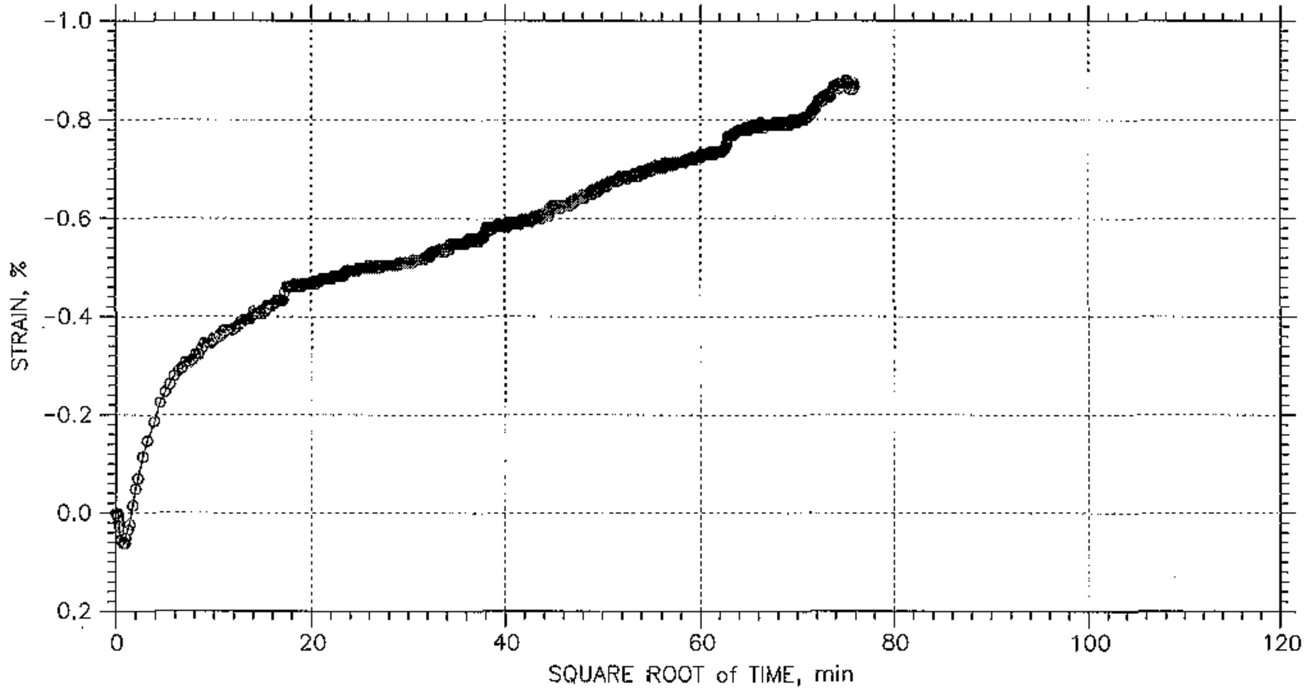
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 2

Stress: 100. psf





amec			
	Project: North Alcoa Site	Location: Composite	Project No.: 3410100782
	Boring No.: Composite	Tested By: JW	Checked By:
	Sample No.: B	Test Date: 1/20/12	Depth: N/A
	Test No.: N/A	Sample Type: N/A	Elevation: N/A
	Description:		
	Remarks: composite of four samples		

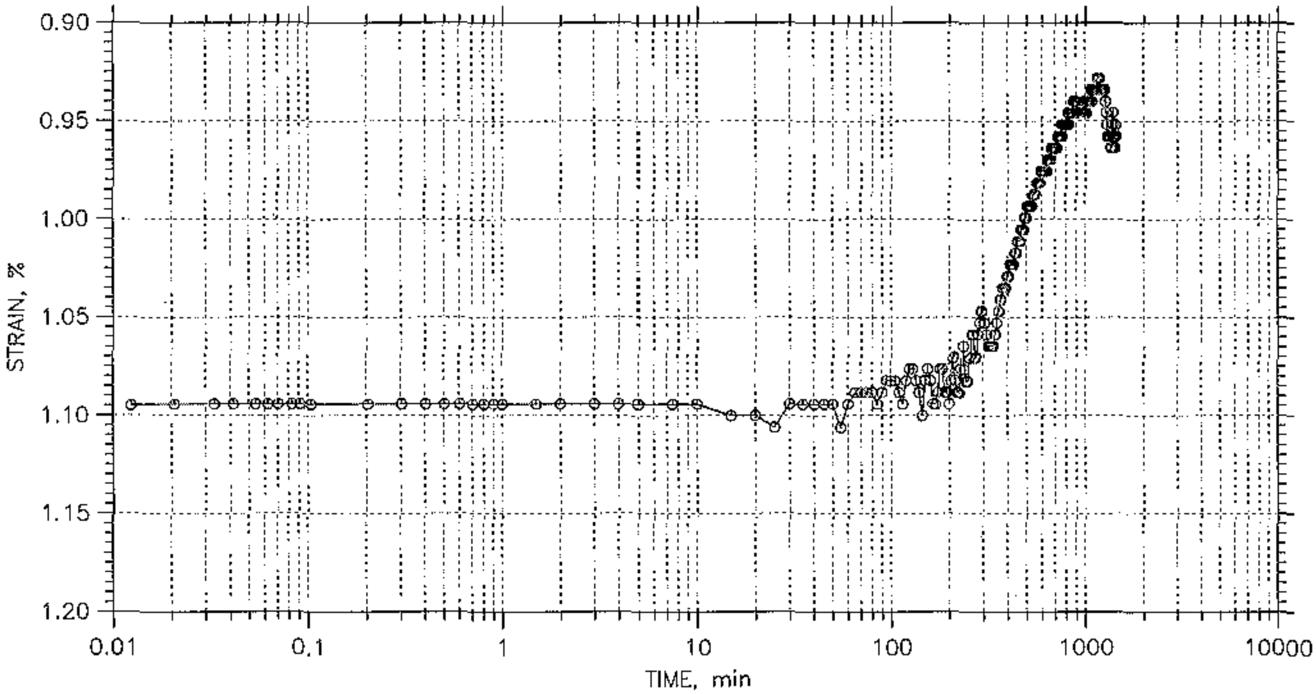
Thu, 26-JAN-2012 09:37:17

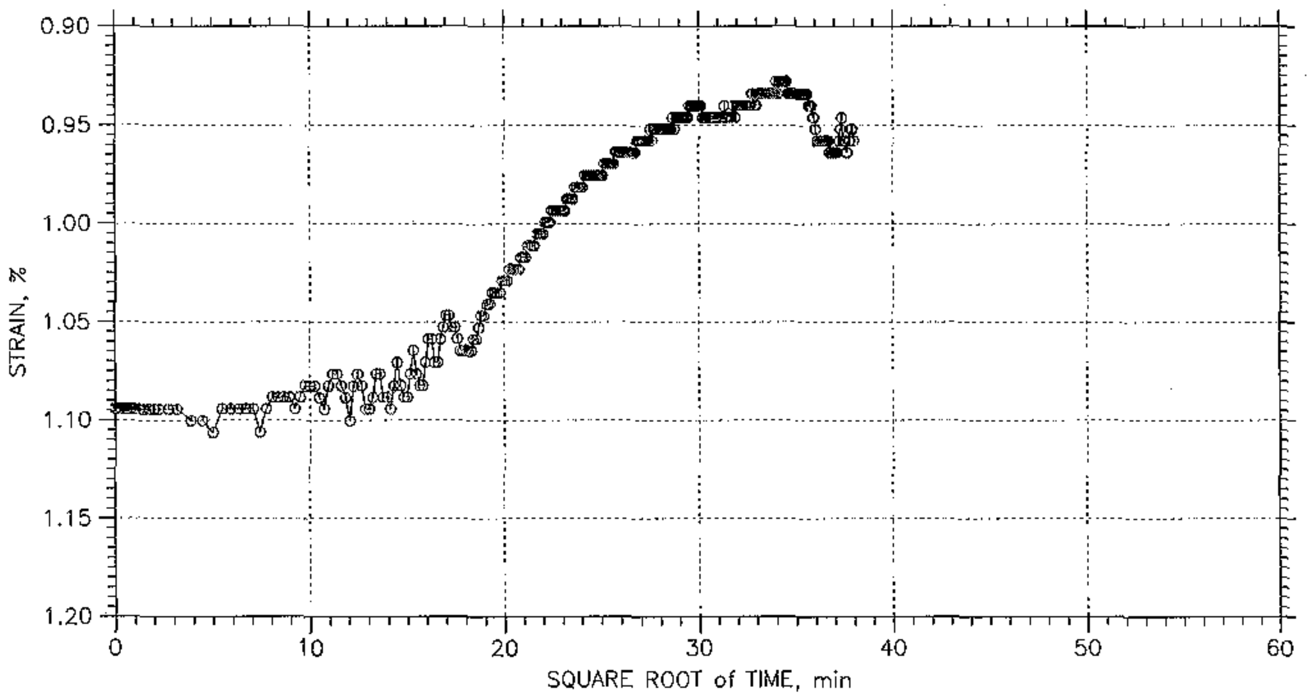
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 2

Stress: 100. psf





amec	Project: North Alcoa	Location: B-12	Project No.: 3410100782
	Boring No.: B-12	Tested By: JW	Checked By:
	Sample No.: Bulk	Test Date: 1/20/12	Depth: Surface
	Test No.: 11129CL	Sample Type: Remolded	Elevation: N/A
	Description:		
	Remarks:		

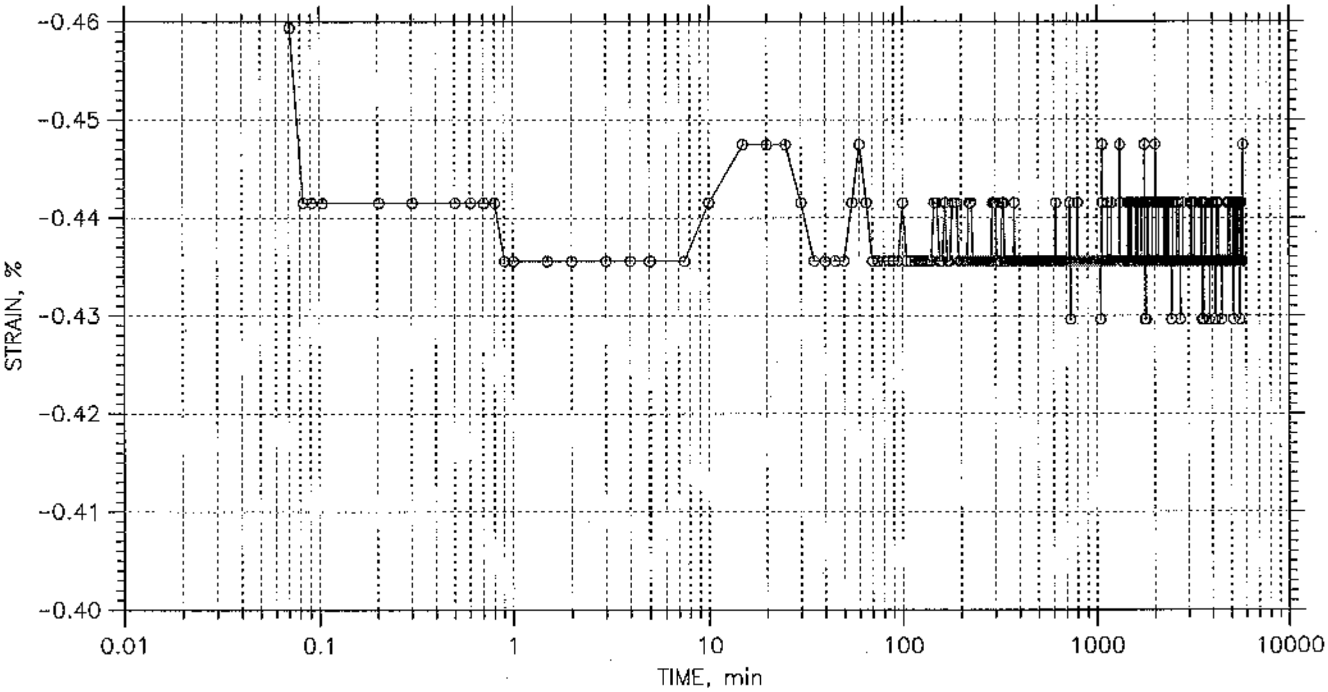
Thu, 26-JAN-2012 09:40:45

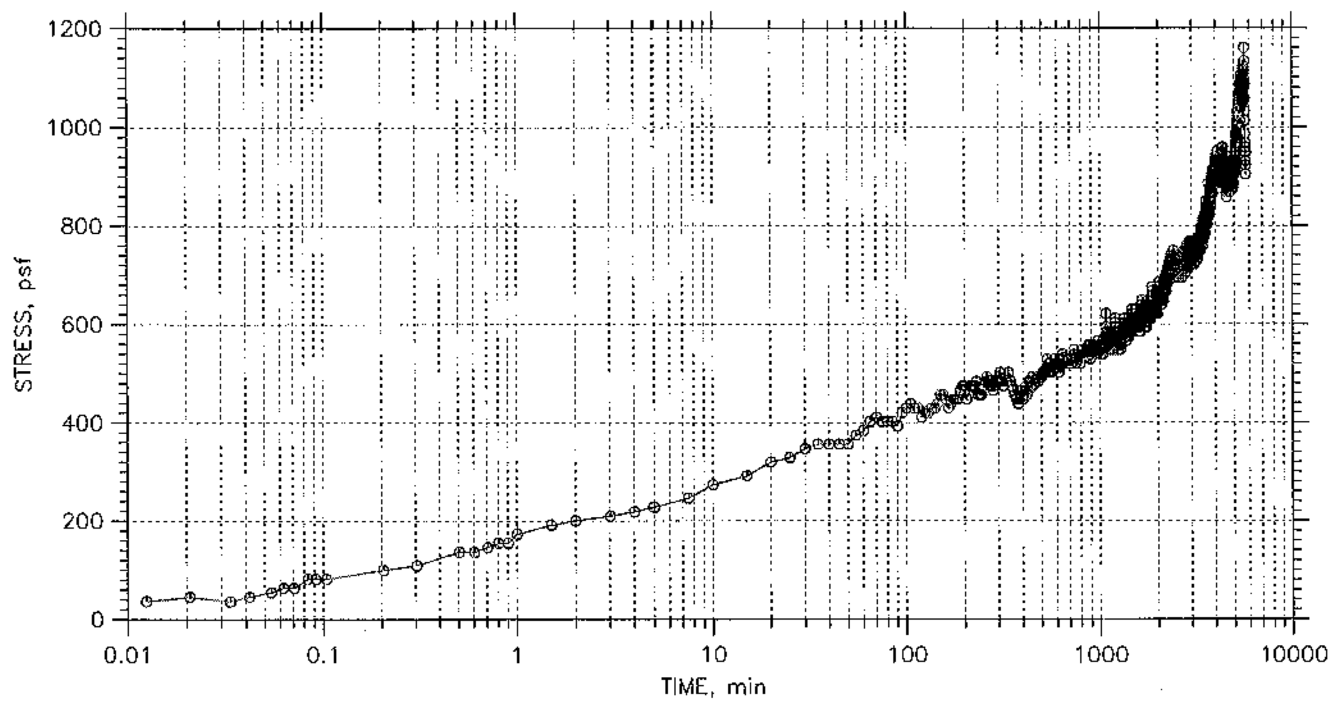
CONSOLIDATION TEST DATA

TIME CURVES

Constant Volume Step: 2 of 2

Stress: 100. psf





Project: North Alcoa Site	Location: Composite	Project No.: 3410100782
Boring No.: Composite	Tested By: JW	Checked By:
Sample No.: A	Test Date: 1/20/2012	Depth: N/A
Test No.: N/A	Sample Type: Remolded	Elevation: N/A
Description:		
Remarks: Composite of four samples		

Thu, 26-JAN-2012 09:32:23

GYPSUM DRYING TEST

Location/Depth	Moisture Content (%)	Moisture Content (%)	Moisture Content (%)	Moisture Content (%)	Moisture Content (%)
Temp. Deg. F	104	220	266	300	824
Temp. Deg. C	40	105	130	150	440
B12 Surface	0.0	16.5	22.8	23.0	30.3
B14 0-22'	2.1	19.3	21.6	22.7	
TP36 9'	3.6	19.4	23.6	24.1	
TP30 15'	4.8	21.3	24.2	25.1	33.1
TP33 Surface	0.0	15.4	22.0	22.5	
TP33 1'	0.2	12.9	20.5	22.1	
TP32 1'	0.9	15.2	18.7	18.9	23.5
TP30 10'	0.8	19.6	21.9	22.8	
TP 35 12'	2.9	18.6	24.2	24.6	30.9
TP28 1'	2.7	17.2	22.7	22.9	

February 3, 2012

Mr. Pieter DePree
AMEC
396 Plasters Avenue
Atlanta, GA 30324
e. Pieter.DePree@amec.com

Results of Analysis of Calcium Sulfate Material Samples from Brightfields-Alcoa Geotech
AMEC P.O. 2011 15092
CTLGroup Project No. 391094

Dear Mr. DePree,

You submitted five samples of granular material identified as TP-35, TP-33A, B-12-D, B-12-W, TP-33B. The samples arrived at CTLGroup on December 8, 2011. In your email dated November 21, 2011, you requested testing of the material to determine composition.

All five submitted samples were analyzed using X-ray Fluorescence. Based on the test results, two samples were selected to further evaluate *Sulfate Form and Content by Thermal Analysis - Differential Scanning Calorimetry (DSC)*. The same two samples were also evaluated by a semi-quantitative XRF scan to determine the presence of elements not typically calibrated for in our standard X-ray Fluorescence programs. . All results are attached.

We appreciate this opportunity to conduct specialized testing services for you. Should you have any questions, please contact me.

Sincerely,

CTLGroup
AN AASHTO ACCREDITED LABORATORY – AGGREGATES, CEMENT & CONCRETE

Karin T. O'Brien, LEED AP
Materials Laboratory Services
e: KOBrien@CTLGroup.com
p: 847.972.3250

CTLGroup

Client:	**Amec**	CTL Project No.:	**391094**
Project:	**Chemical Analysis**	CTL Proj. Mgr.:	**Karin O'Brien**
		Analyst:	**S. Vaidya**
Contact:	**Katherine Brown**	Approved:	*R W Stevenson*
Submitter:	**Katherine Brown**	Date Analyzed:	**December 20, 2011**
Date Received:	**December 8, 2011**	Date Reported:	**December 21, 2011**

REPORT OF CHEMICAL ANALYSIS

Client's Sample ID:	TP-35	TP-33A	B-12-D	B-12-W	TP-33B
Material type:	Gypsum	Gypsum	Gypsum	Gypsum	Gypsum
CTL Sample ID:	3004201	3004202	3004203	3004204	3004205
Analyte	Wt. %	Wt. %	Wt. %	Wt. %	Wt. %
SiO_2	0.07	0.02	0.02	0.09	0.08
Al_2O_3	0.16	0.12	0.13	0.13	0.16
Fe_2O_3	0.06	<0.01	0.02	0.08	0.05
CaO	34.07	33.77	39.20	33.55	33.44
MgO	<0.01	<0.01	<0.01	<0.01	<0.01
SO_3	46.95	47.26	53.71	45.90	46.66
Na_2O	0.06	0.03	0.06	0.04	0.03
K_2O	<0.01	<0.01	<0.01	<0.01	<0.01
TiO_2	0.02	<0.01	0.01	0.02	0.02
P_2O_5	<0.01	<0.01	<0.01	<0.01	<0.01
Mn_2O_3	<0.01	<0.01	<0.01	<0.01	<0.01
SrO	<0.01	<0.01	<0.01	<0.01	<0.01
Cr_2O_3	<0.01	<0.01	<0.01	<0.01	<0.01
ZnO	<0.01	<0.01	<0.01	<0.01	<0.01
BaO	<0.01	<0.01	<0.01	<0.01	<0.01
L.O.I. (950°C)[3]	17.91	18.31	5.89	19.20	18.94
Total	99.29	99.51	99.03	99.00	99.38
Calculated per ASTM C 471					
Gypsum % purity	83.39	85.33	26.16	89.65	88.18
SO_3 combined as Gypsum	38.78	39.68	12.17	41.69	41.01
excess SO_3	8.17	7.58	41.55	4.21	5.65
% Anhydrite, $CaSO_4$	13.90	12.88	70.63	7.15	9.61
%CaO combined as Gypsum	27.16	27.79	8.52	29.20	28.72
%CaO combined as Anhydrite	5.72	5.31	29.09	2.95	3.96
excess CaO	1.18	0.67	1.58	1.41	0.76
%$CaCO_3$	2.11	1.20	2.83	2.51	1.36
% $MgCO_3$	0.00	0.00	0.00	0.00	0.00
Thermogravimetric Analysis					
L.O.I. (ambient-45 °C)	0.07	0.16	0.09	0.12	0.09
L.O.I. (45-220 °C)	17.44	17.83	5.47	18.74	18.44
L.O.I. (220-550 °C)	0.37	0.36	0.33	0.37	0.39
L.O.I. (550-950 °C)	0.09	0.09	0.09	0.07	0.10

Notes:

1. This analysis represents specifically the sample submitted.
2. Oxide analysis by X-ray fluorescence spectrometry. Samples fused at 1000°C with $Li_2B_4O_7/LiBO_2$.
3. Oxide analysis reported on an oven dry 45°C basis.
4. Volatile elements may be lost during high temperature ignition and fusion.
5. Calculated compounds per ASTM C471M-01(2006)ε1, Section 16.
6. This report may not be reproduced except in its entirety.

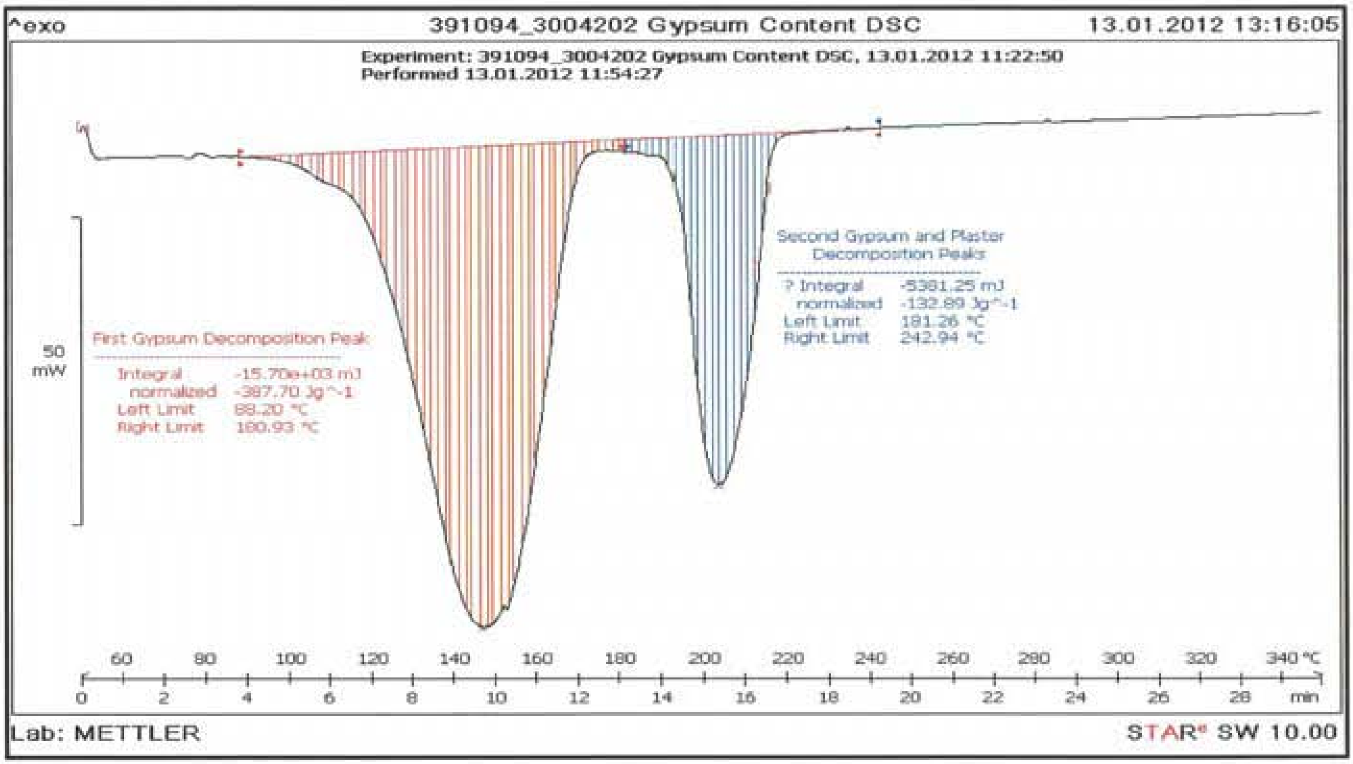
CTLGROUP

Client:	**Amec**	CTL Project No:	**391094**
Project:	**Thermal Analysis**	CTL Project Mgr.:	**Karin O'Brien**
		Analyst:	**Ross Kelly**
Contact:	**Pieter DePree**	Approved:	*R W Stevenson*
Submitter:	**Katherine Brown**	Date Analyzed:	**January 13, 2012**
Date Received:	**December 8, 2012**	Date Reported:	**January 13, 2012**

DIFFERENTIAL SCANNING CALORIMETRY (DSC) ANALYSIS REPORT

SAMPLE IDENTIFICATION :

CTLGroup ID	Client ID	Material
3004202	TP-33A	Gypsum



RESULTS :

Sulfate Form	Weight %
Gypsum	85.354
Plaster	1.675
Syngenite	--

Notes:

1. This analysis represents specifically the sample submitted.
2. This analysis does not identify anhydrite, soluble anhydrite, or clinker SO_3.
3. This report may not be reproduced except in its entirety.

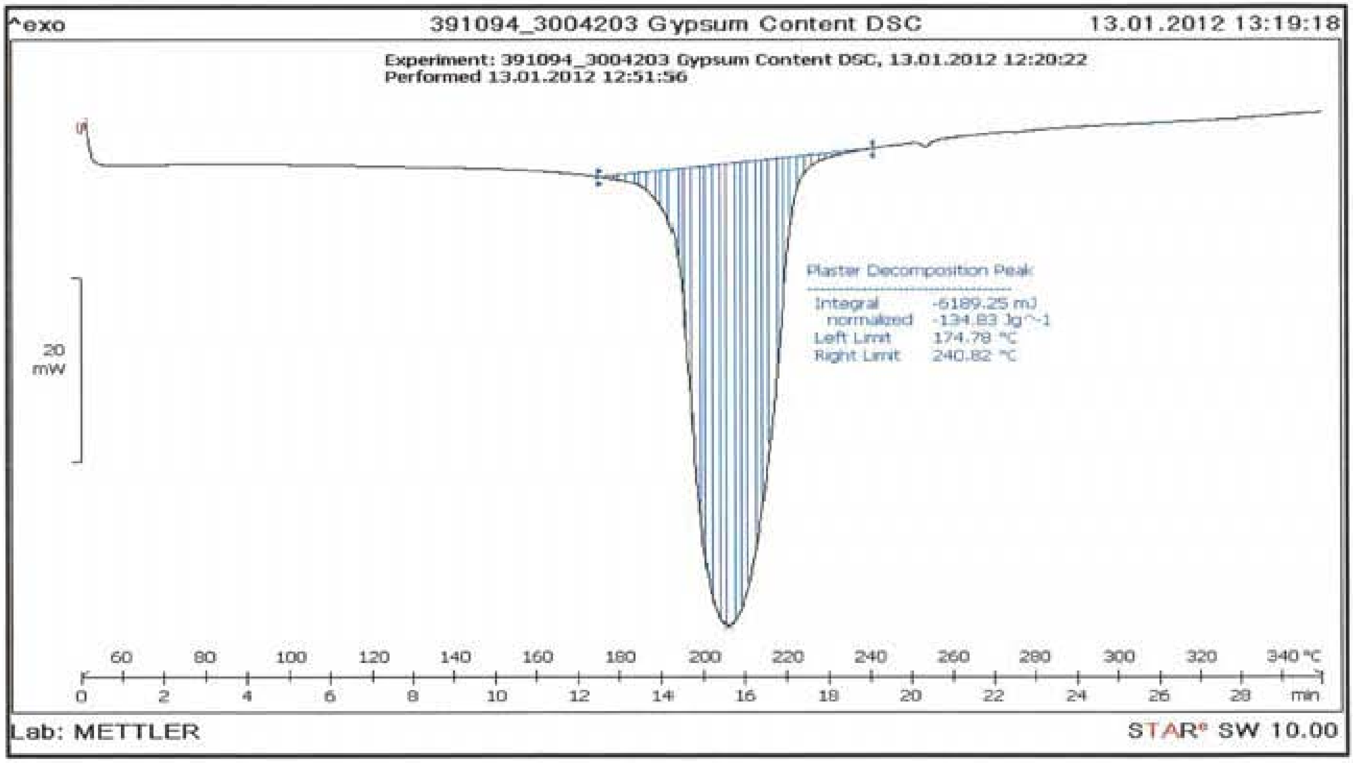
CTLGroup

Client:	Amec	CTL Project No:	391094
Project:	Thermal Analysis	CTL Project Mgr.:	Karin O'Brien
		Analyst:	Ross Kelly
Contact:	Pieter DePree	Approved:	R W Stevenson
Submitter:	Katherine Brown	Date Analyzed:	January 13, 2012
Date Received:	December 8, 2012	Date Reported:	January 13, 2012

DIFFERENTIAL SCANNING CALORIMETRY (DSC) ANALYSIS REPORT

SAMPLE IDENTIFICATION :

CTLGroup ID	Client ID	Material
3004203	B-12-D	Gypsum



RESULTS :

Sulfate Form	Weight %
Gypsum	--
Plaster	64.638
Syngenite	--

Notes:

1. This analysis represents specifically the sample submitted.
2. This analysis does not identify anhydrite, soluble anhydrite, or clinker SO_3.
3. This report may not be reproduced except in its entirety.

Client:	**Amec**	CTL Project / ID:	**391094**
Project:	**Brightfields-Alcoa Geotech**	CTL Project Mgr.:	**Karin O'Brien**
		Analyst:	**Ross Kelly**
Contact:	**Pieter DePree**	Approved:	***R W Stevenson***
Submitter:	**Katherine Brown**	Date Received:	**December 8, 2011**
Client ID:	**B-12-D**	Date Analyzed:	**January 16, 2012**
CTLGroup ID:	**3004203**	Date Reported:	**January 16, 2012**

REPORT of ANALYSIS

(Powdered X-ray Semi-quantitative)

Sum before normalization:	74.20%
Normalised to:	100.00%
Sample type:	Pressed powder
Correction applied for medium:	No
Correction applied for film:	None
Used Compound list:	OXIDES

LOI 5.98

Analyte	Compound	Weight %	As Received Weight %
Si	SiO2	0.04	0.03
S	SO3	52.19	49.07
Ca	CaO	47.64	44.79
Sr	SrO	0.01	0.01
Ba	BaO	0.06	0.06
Pb	PbO	0.07	0.06
Total		100.00	100.00

Notes:

1. This analysis represents specifically the sample submitted.
2. Sample results reported on an as received weight basis.
3. Oxide analysis by X-ray fluorescence spectrometry using PANalytical IQ+ Quantification program.
4. "Overlap" indicates interfering elements are present. The percent analyte could not be estimated.
5. This report may not be reproduced except in its entirety.

CTLGroup

Client:	Amec	CTL Project / ID:	391094
Project:	Brightfields-Alcoa Geotech	CTL Project Mgr.:	Karin O'Brien
		Analyst:	Ross Kelly
Contact:	Pieter DePree	Approved:	R W Stevenson
Submitter:	Katherine Brown	Date Received:	December 8, 2011
Client ID:	TP-33A	Date Analyzed:	January 16, 2012
CTLGroup ID:	3004202	Date Reported:	January 16, 2012

REPORT of ANALYSIS

(Powdered X-ray Semi-quantitative)

Sum before normalization:	67.30%
Normalised to:	100.00%
Sample type:	Pressed powder
Correction applied for medium:	No
Correction applied for film:	None
Used Compound list:	OXIDES

LOI 18.44

Analyte	Compound	Weight %	As Received Weight %
Na	Na2O	0.03	0.02
Al	Al2O3	0.05	0.04
Si	SiO2	0.04	0.03
S	SO3	51.22	41.77
Ca	CaO	48.21	39.32
Pb	PbO	0.39	0.32
F	F	0.09	0.07
Total		100.00	100.00

Notes:

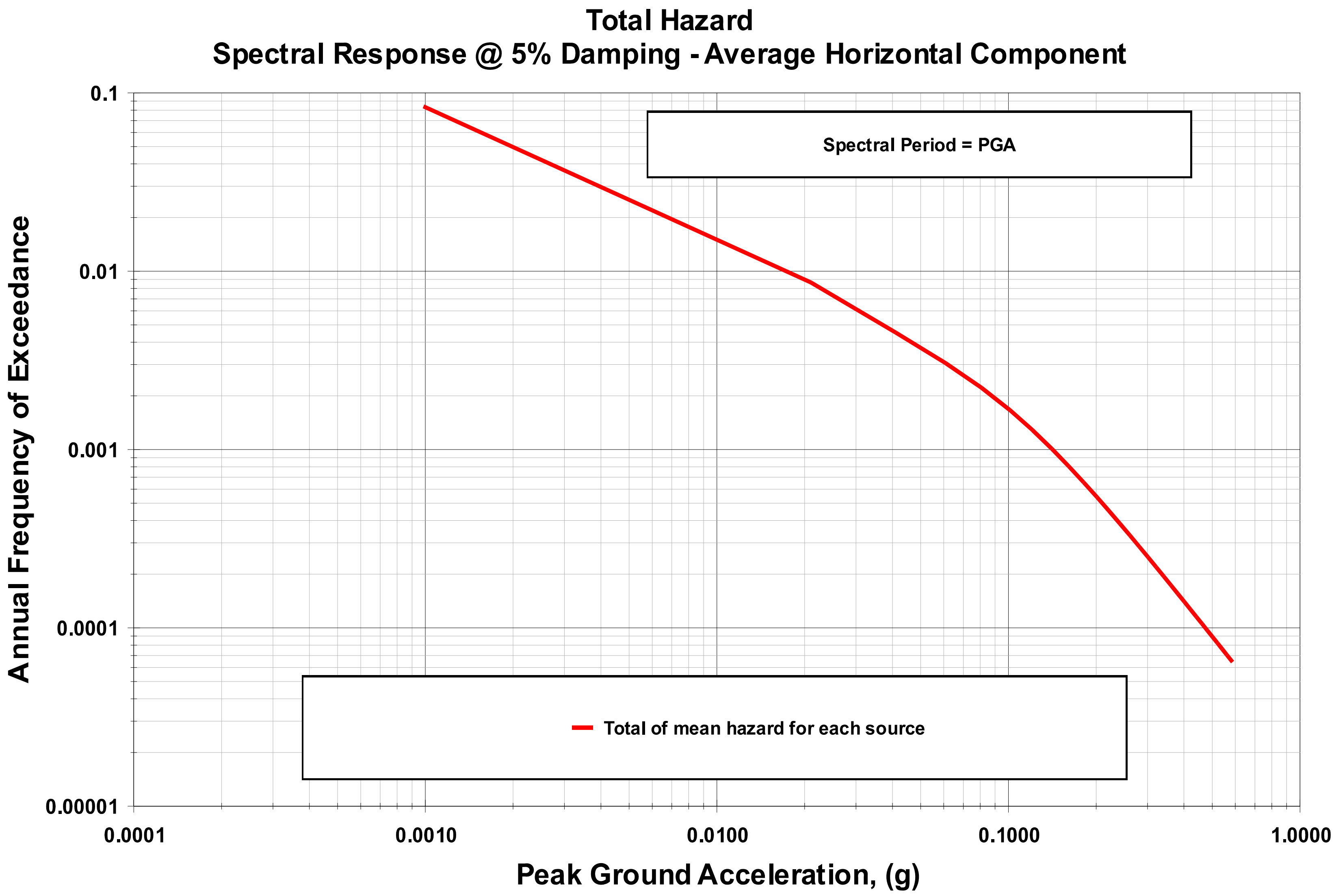
1. This analysis represents specifically the sample submitted.
2. Sample results reported on an as received weight basis.
3. Oxide analysis by X-ray fluorescence spectrometry using PANalytical IQ+ Quantification program.
4. "Overlap" indicates interfering elements are present. The percent analyte could not be estimated.
5. This report may not be reproduced except in its entirety.

APPENDIX C

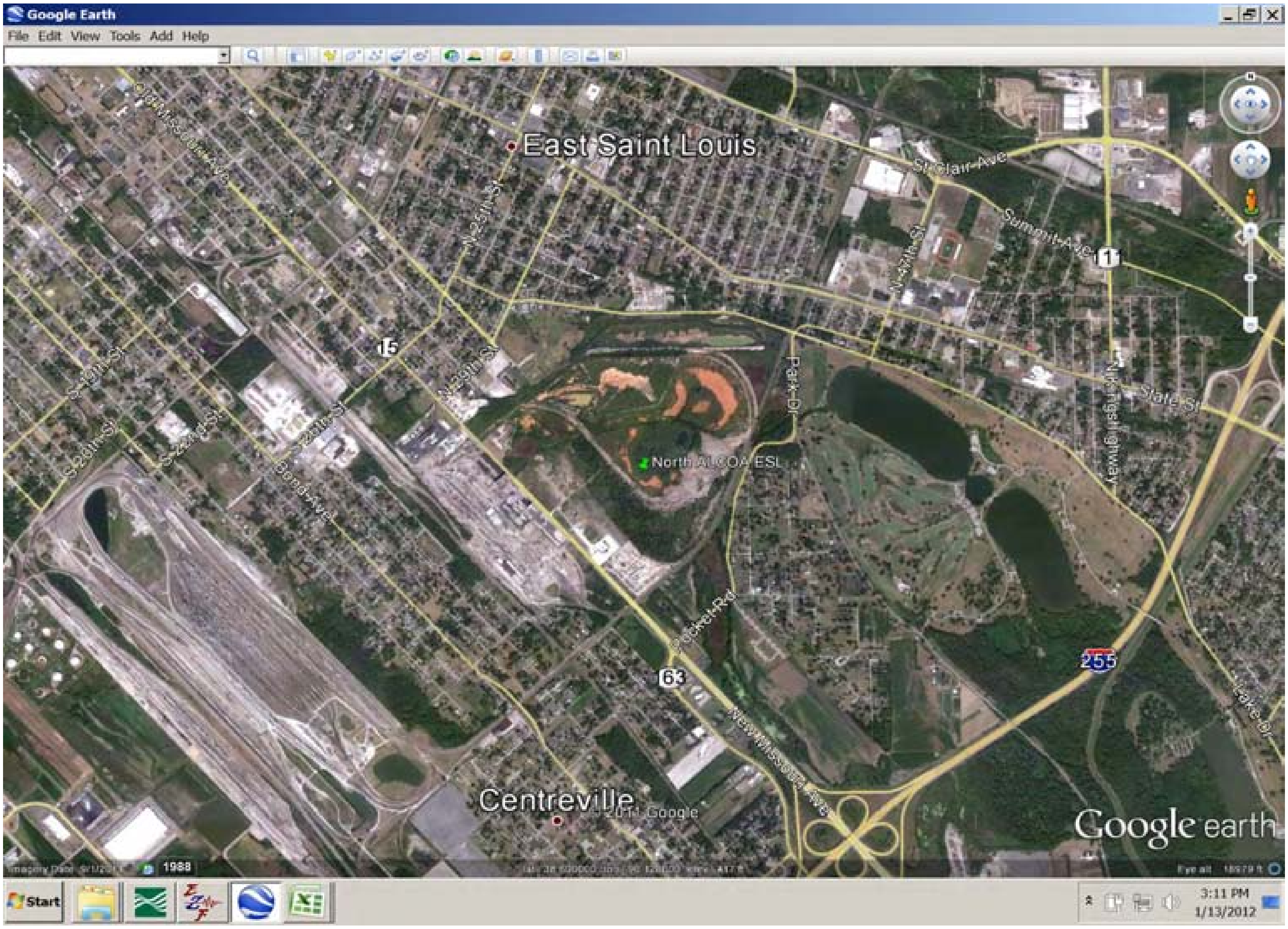
EZ-FRISK OUTPUT

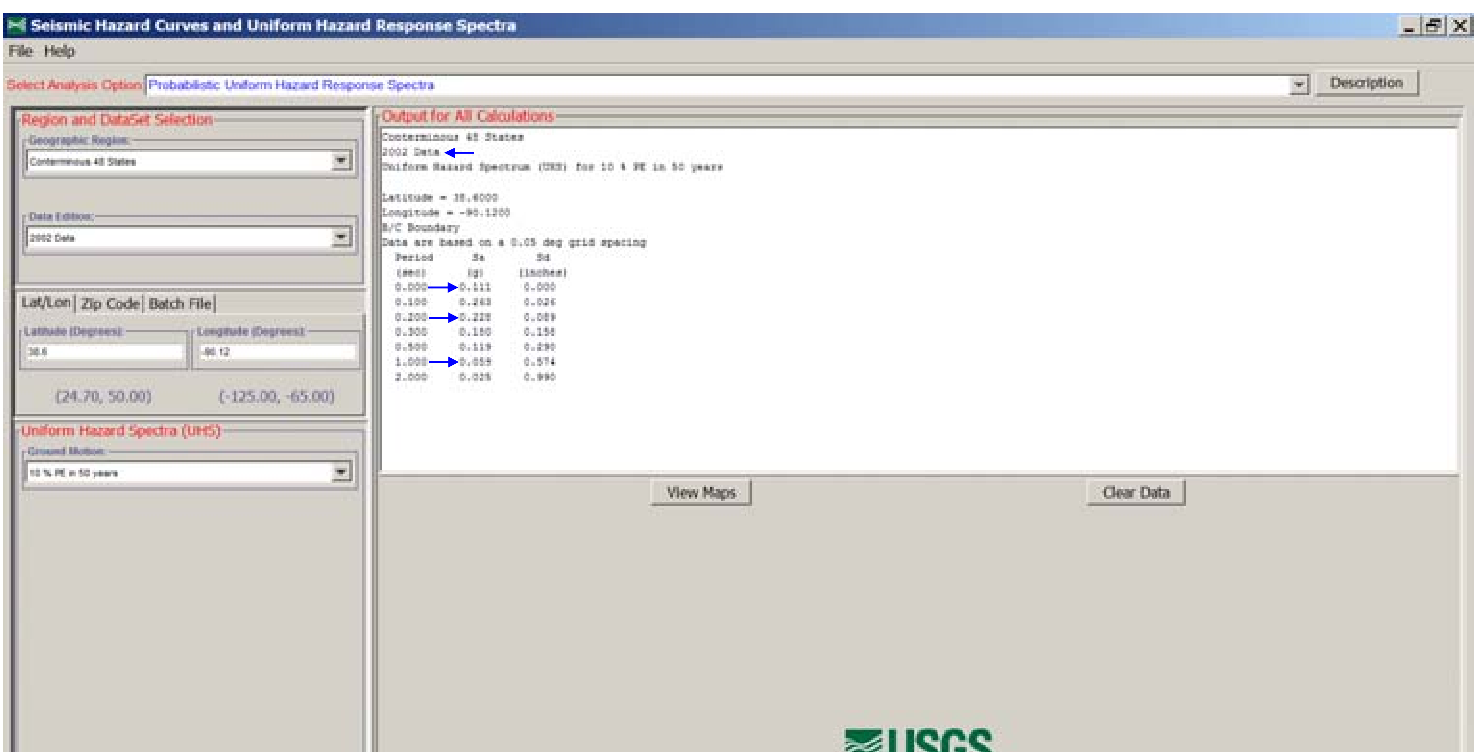
FAESLOU1

AMEC Project 3410-10-0782.10.2


Total Hazard
Spectral Response @ 5% Damping - Average Horizontal Component
Spectral Period = PGA
Total of mean hazard for each source
Annual Frequency of Exceedance
Peak Ground Acceleration, (g)
0.1
0.01
0.001
0.0001
0.00001
0.0001
0.0010
0.0100
0.1000
1.0000

Project Information	
Project Name:	North ALCOA ESL
Project Location:	St. Louis, Missouri
Project No.:	3410-10-0782 Task 10.2





PROBABILISTIC ANALYSIS USING EZ-FRISK 7.62

Project Information	
Project Name:	North ALCOA ESL
Project Location:	St. Louis, Missouri
Project No.:	3410-10-0782 Task 10.2

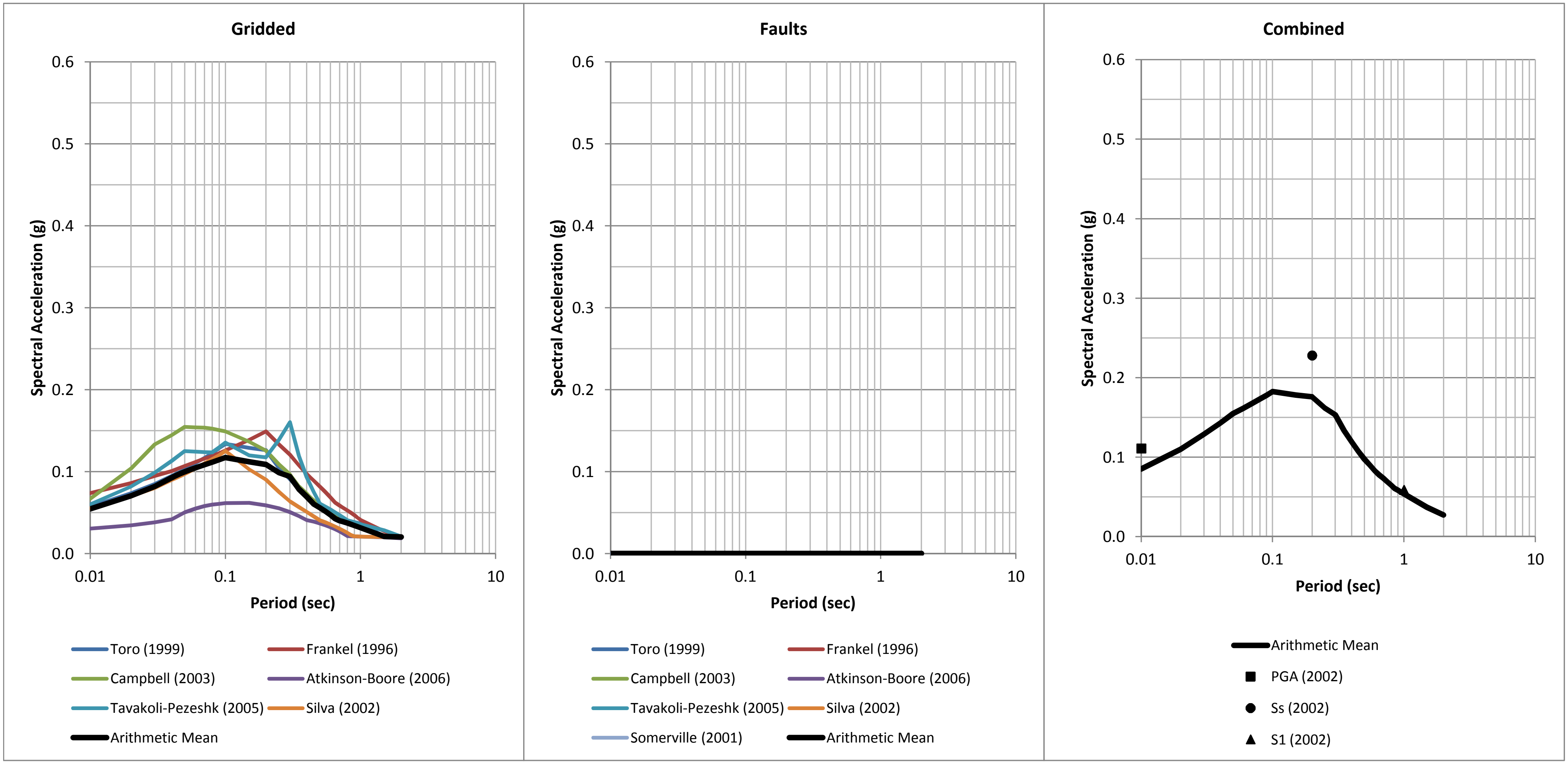
Site Coordinates			
Latitude	North	38.6000	degrees
Longitude	West	90.1200	degrees

Calculation Parameters	
Mean Type	Arithmetic
Earthquake Probability	10 PE 50
Attenuation Weighting	USGS

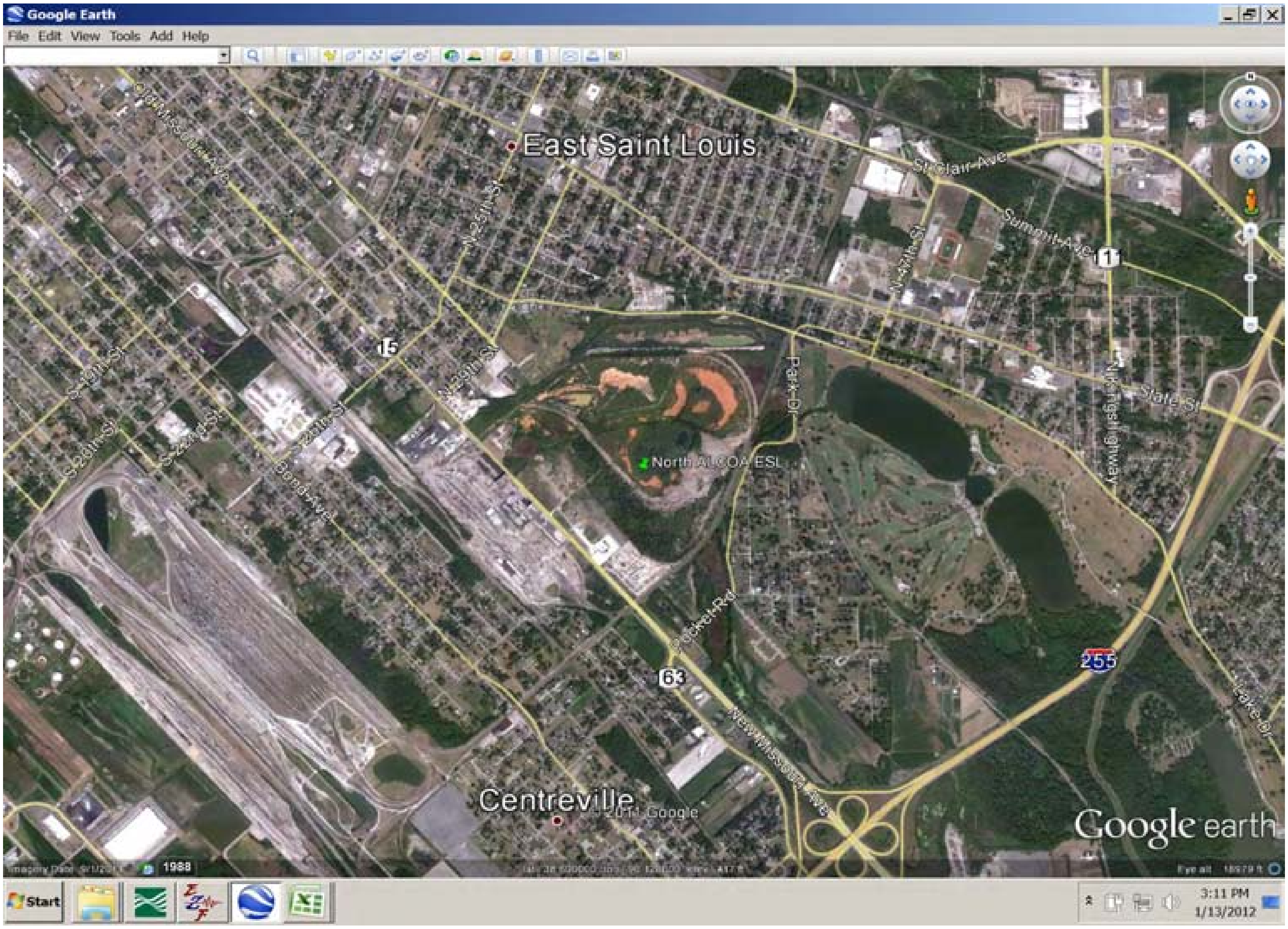
Attenuation Relationships	Gridded	Faults
Toro (1999)	0.250	0.200
Frankel (1996)	0.125	0.100
Campbell (2003)	0.125	0.100
Atkinson-Boore (2006)	0.250	0.200
Tavakoli-Pezeshk (2005)	0.125	0.100
Silva (2002)	0.125	0.100
Somerville (2001)	0.000	0.200

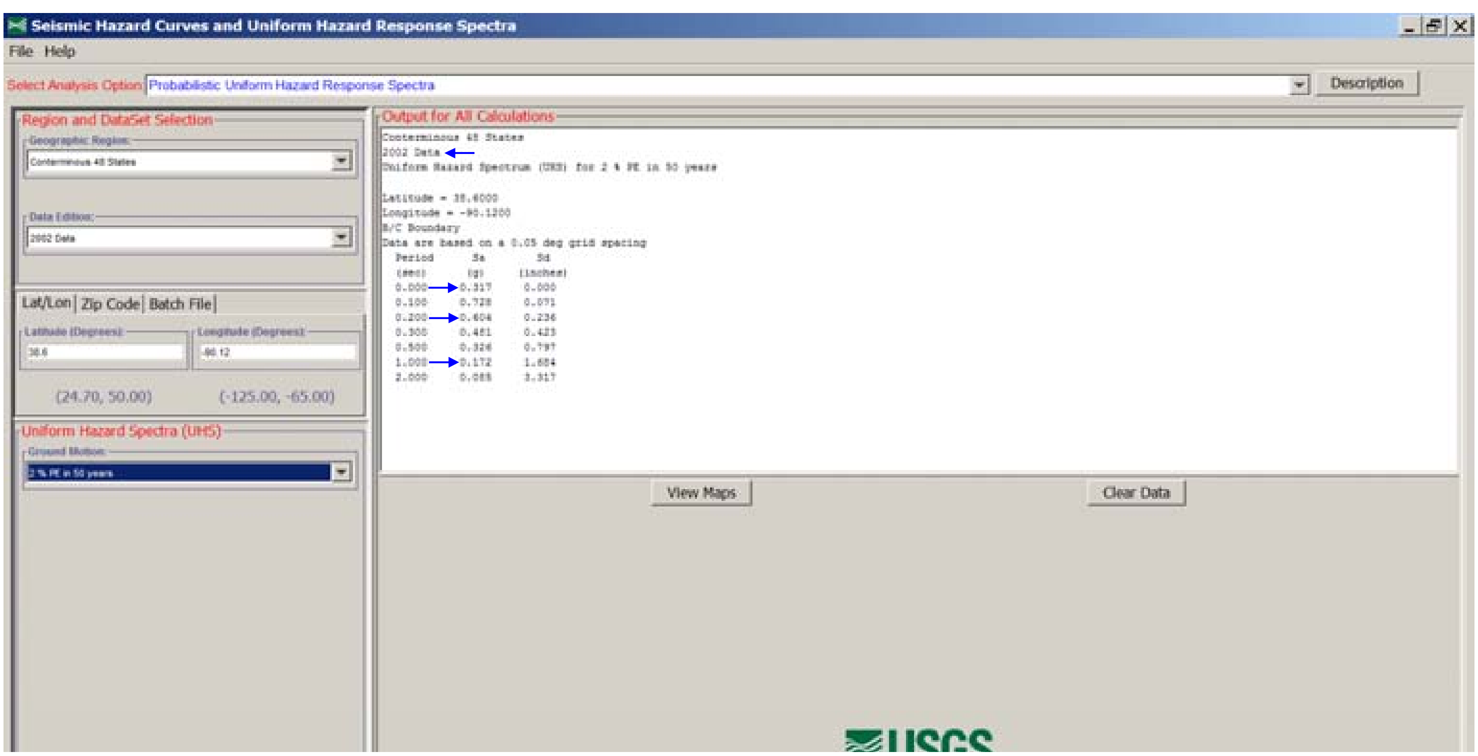
Period (sec)	USGS 2002 (g)	PSHA (g)	Percent of Code	Apply Additional Rules	No
0.01	0.111	0.085	76.6	0.085	76.6
0.2	0.228	0.176	77.2	0.176	77.2
1.0	0.059	0.054	91.5	0.054	91.5

Governing (g)	
Ss	0.182
S1	0.054



Project Information	
Project Name:	North ALCOA ESL
Project Location:	St. Louis, Missouri
Project No.:	3410-10-0782 Task 10.2





Project Information	
Project Name:	North ALCOA ESL
Project Location:	St. Louis, Missouri
Project No.:	3410-10-0782 Task 10.2

PROBABILISTIC ANALYSIS USING EZ-FRISK 7.62

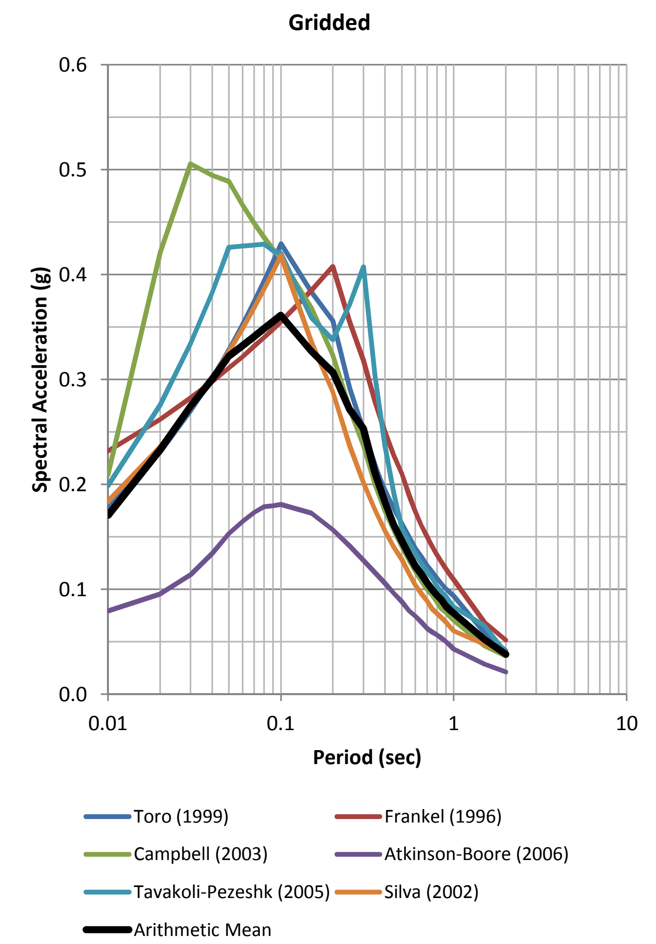
Site Coordinates			
Latitude	North	38.6000	degrees
Longitude	West	90.1200	degrees

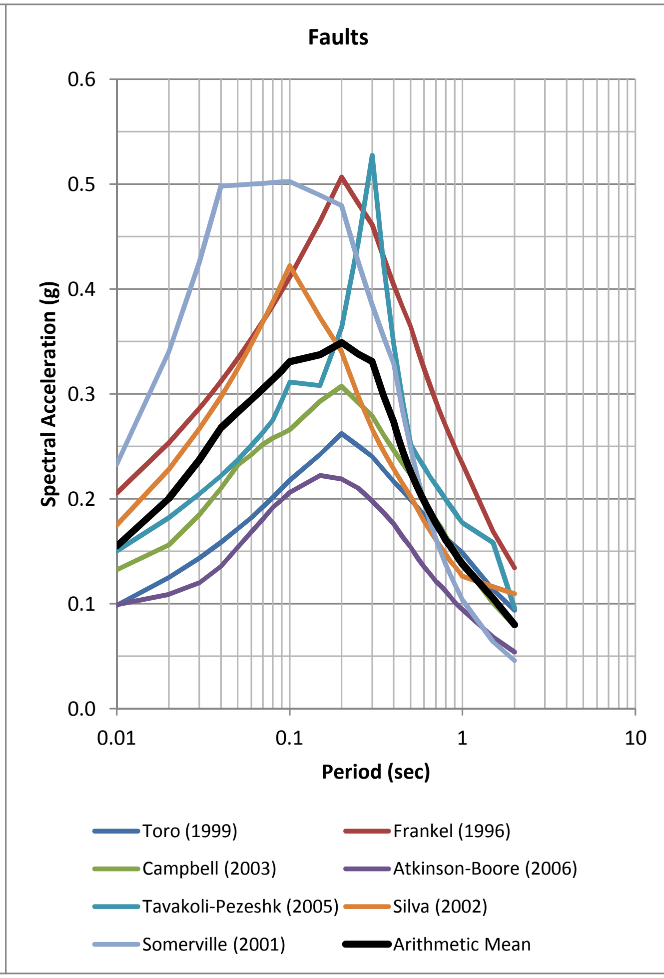
Calculation Parameters	
Mean Type	Arithmetic
Earthquake Probability	2 PE 50
Attenuation Weighting	USGS

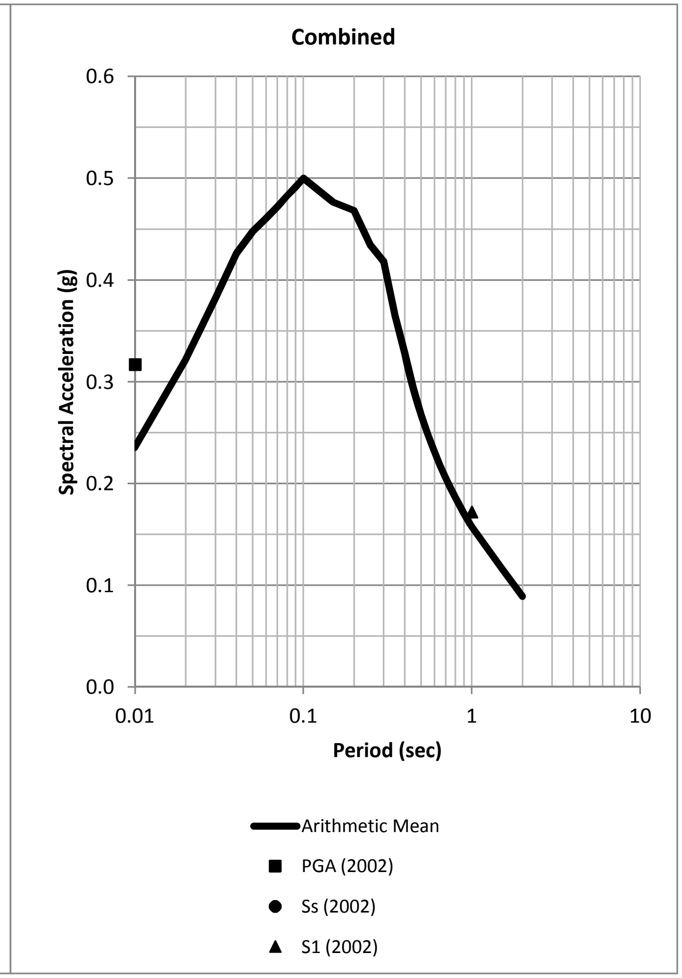
Attenuation Relationships	Gridded	Faults
Toro (1999)	0.250	0.200
Frankel (1996)	0.125	0.100
Campbell (2003)	0.125	0.100
Atkinson-Boore (2006)	0.250	0.200
Tavakoli-Pezeshk (2005)	0.125	0.100
Silva (2002)	0.125	0.100
Somerville (2001)	0.000	0.200

Period (sec)	USGS 2002 (g)	PSHA (g)	Percent of Code	Apply Additional Rules	No
0.01	0.317	0.235	74.1	0.235	74.1
0.2	0.604	0.468	77.5	0.468	77.5
1.0	0.172	0.158	91.9	0.158	91.9

Governing (g)	
Ss	0.483
S1	0.158



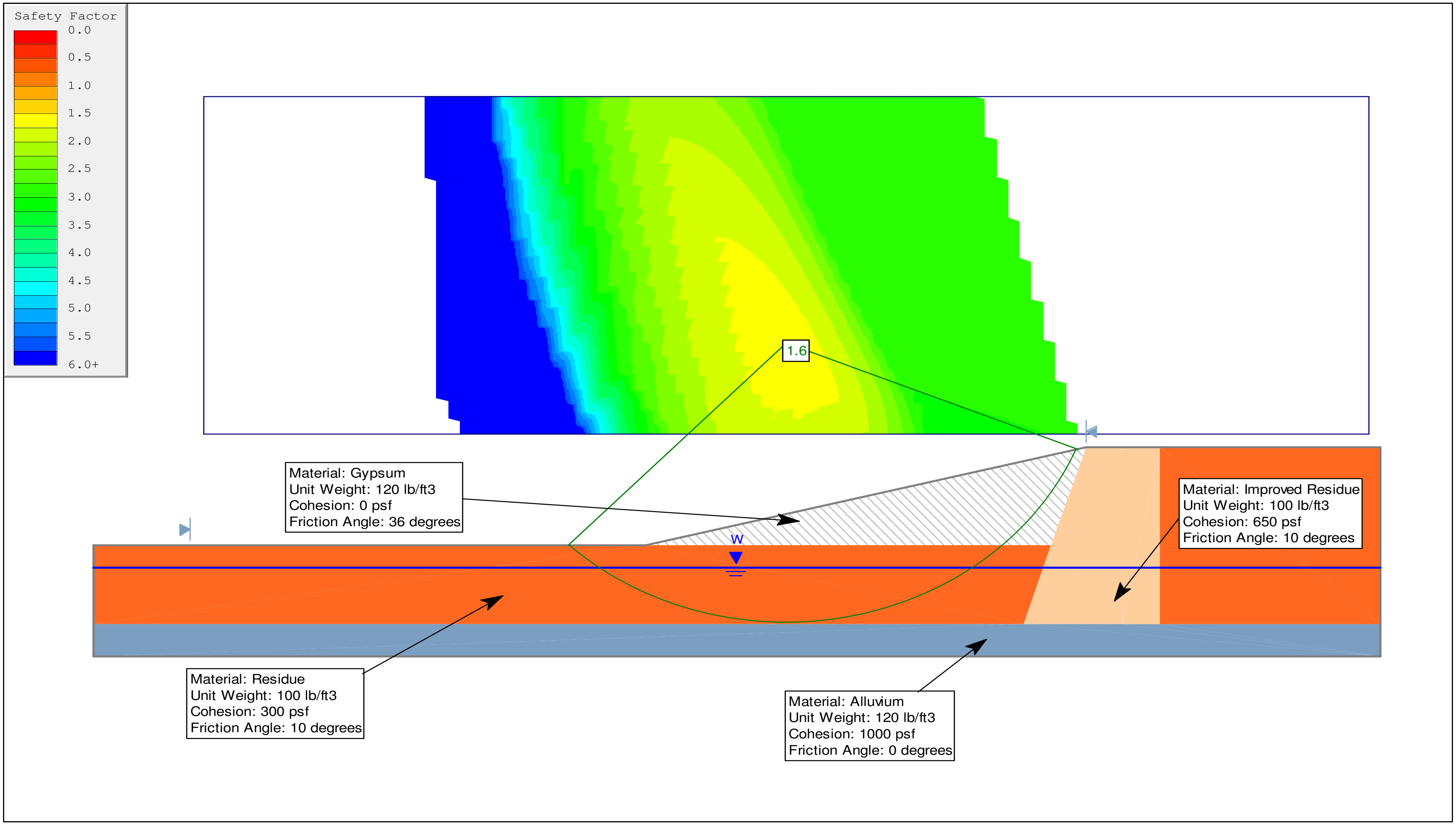




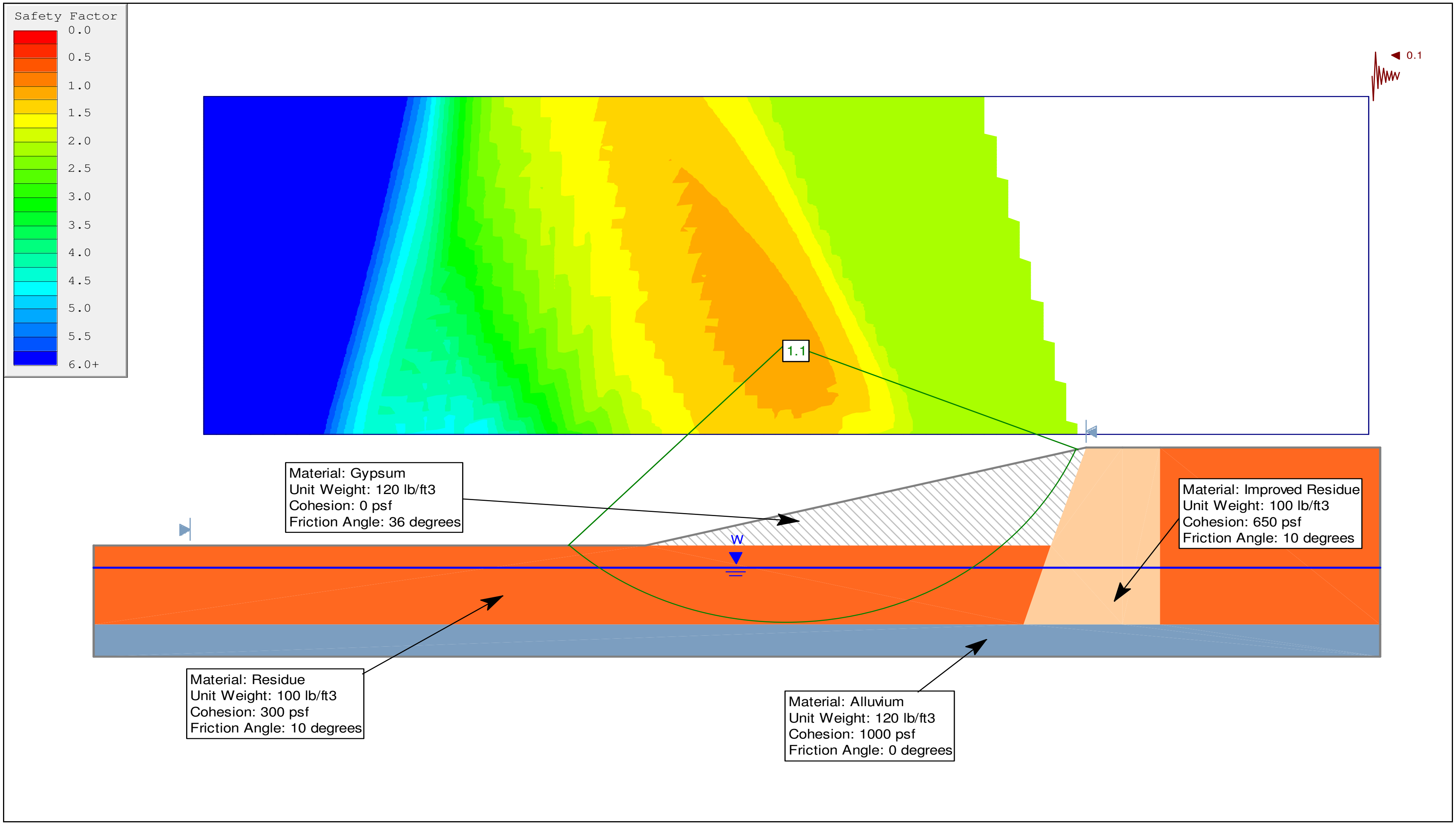
APPENDIX D

Roc-Test Slope D Output

Case 1, without Seismic Loading
Case 1, with 0.1g of Seismic Loading



Former Alcoa East St. Louis Operable Unit 1 East St. Louis, Illinois 3410-10-0782	amec	**Slope Stability Analysis**



Former Alcoa East St. Louis Operable Unit 1 East St. Louis, Illinois 3410-10-0782	amec	**Slope Stability Analysis** **with 0.1g Seismic Event**