E-1507

Geotechnical Engineering Report for Project Order 177 A-E Support Services for Geotechnical Investigation of the Former Plant Area

March 1998
Revision C
(Draft for Agency Review)

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FDF Subcontract No. 2-21487

PARSONS

175 Tri-County Parkway
Cincinnati, Ohio 45246

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JUN 0 5 1998

DOE-0857-98

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U.S. Environmental Protection Agency
Region V-SRF-5J
77 West Jackson Boulevard
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Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF THE GEOTECHNICAL ENGINEERING REPORT FOR THE GEOTECHNICAL INVESTIGATION OF THE FORMER PLANT AREA

Reference: Letter from Reising to Saric and Schneider, "Transmittal of Responses to the U.S. Environmental Protection Agency Comments on the Geotechnical Sampling and Testing Plan for the Former Plant Area," dated August 23, 1997.

This letter transmits the Geotechnical Report for the Geotechnical Investigation of the Former Plant Area. As discussed in a meeting on August 6, 1997, and documented in the above referenced comment responses, most U.S. Environmental Protection Agency (U.S. EPA) comments on the Geotechnical Sampling and Testing Plan will be addressed in relevant Integrated Remedial Design Plans, however, as committed in the comment responses, stratigraphic cross-sections have been revised based on the geotechnical investigation, and the laboratory that performed the geotechnical analysis has been identified.

Recycled and Recyclable

If you have questions or concerns please contact Robert Janke at (513) 648-3124.

Sincerely,

Johnny Reising

FEMP:Nickel

Johnny W. Reising
Fernald Remedial Action
Project Manager

Enclosure: As Stated

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LIST OF ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
ATEC	American Testing and Engineering Company
ATT	Advanced Terra Testing, Inc.
CD	Consolidated, Drained
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CU	Consolidated, Undrained
DOE	United States Department of Energy
DS	Direct Shear
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
FOS	Factor of Safety
FPA	Former Plant Area
FRL	Final Remediation Level
FS	Feasibility Study
GMA	Great Miami Aquifer
gpm	gallons per minute
GSTP	Geotechnical Sampling and Testing Plan
H	Horizontal
NE	Northeast
NLO	National Lead Company of Ohio
NW	Northwest
ODOT	Ohio Department of Transportation
OSDF	On-Site Disposal Facility
OU	Operable Unit
pcf	pounds per cubic foot
PO	Project Order
ppm	parts per million
psf	pounds per square foot
psi	pounds per square inch
RI	Remedial Investigation
SAIC	Science Applications International Corporation
SE	Southeast
SW	Southwest
USCS	Unified Soil Classification System
V	Vertical
WAC	Waste Acceptance Criteria

SECTION 1

INTRODUCTION

This report summarizes the results of a geotechnical investigation performed at the Former Plant Area (FPA) at the Fernald Environmental Management Project (FEMP), Fernald, Ohio. Figure 1-1 shows the limits of the FPA considered during the investigation. The geotechnical investigation was performed to provide subsurface soil properties and parameters to support development of design criteria, and geotechnical parameters for excavation of contaminated soils that will be undertaken after removal of above grade structures. The report summarizes the data from geotechnical field and laboratory tests, and provides recommendations based on the analysis and evaluation of these data.

1.1 Description of Former Plant Area

The FPA which consists of the former process area and the immediately surrounding areas, is one of the largest and most complex of the FEMP Operable Units (OU), largely due to the wide variety of former processing facilities located in this approximate 136-acre area. When the mission of the FEMP was production of high-purity uranium metals for the U.S. Defense Programs and the processing of thorium to support other United States Department of Energy (DOE) programs, large quantities of radioactive materials and hazardous chemicals were used in the various plants involved in the process. Remediation of the FPA focuses on clean up of contamination that occurred as the result of the 37-year production mission of the FEMP. The primary contaminant of concern is uranium and the main focal points of the cleanup are contaminated buildings, equipment, soils and groundwater.

1.2 Scope and Objectives

PARSONS was tasked by Fluor Daniel Fernald (FDF) under Project Order 177 (PO-177) (PARSONS 1997) to provide geotechnical engineering services for a geotechnical design investigation at the FPA.

1.2.1 Scope

PARSONS' scope was to:

1) Provide geotechnical sampling oversight during field activities.

2) Provide geotechnical laboratory testing services.

3) Perform preliminary geotechnical engineering evaluations and analyses based on field and laboratory data.

4) Prepare a report that summarizes the field and laboratory data, and provide specific geotechnical recommendations.

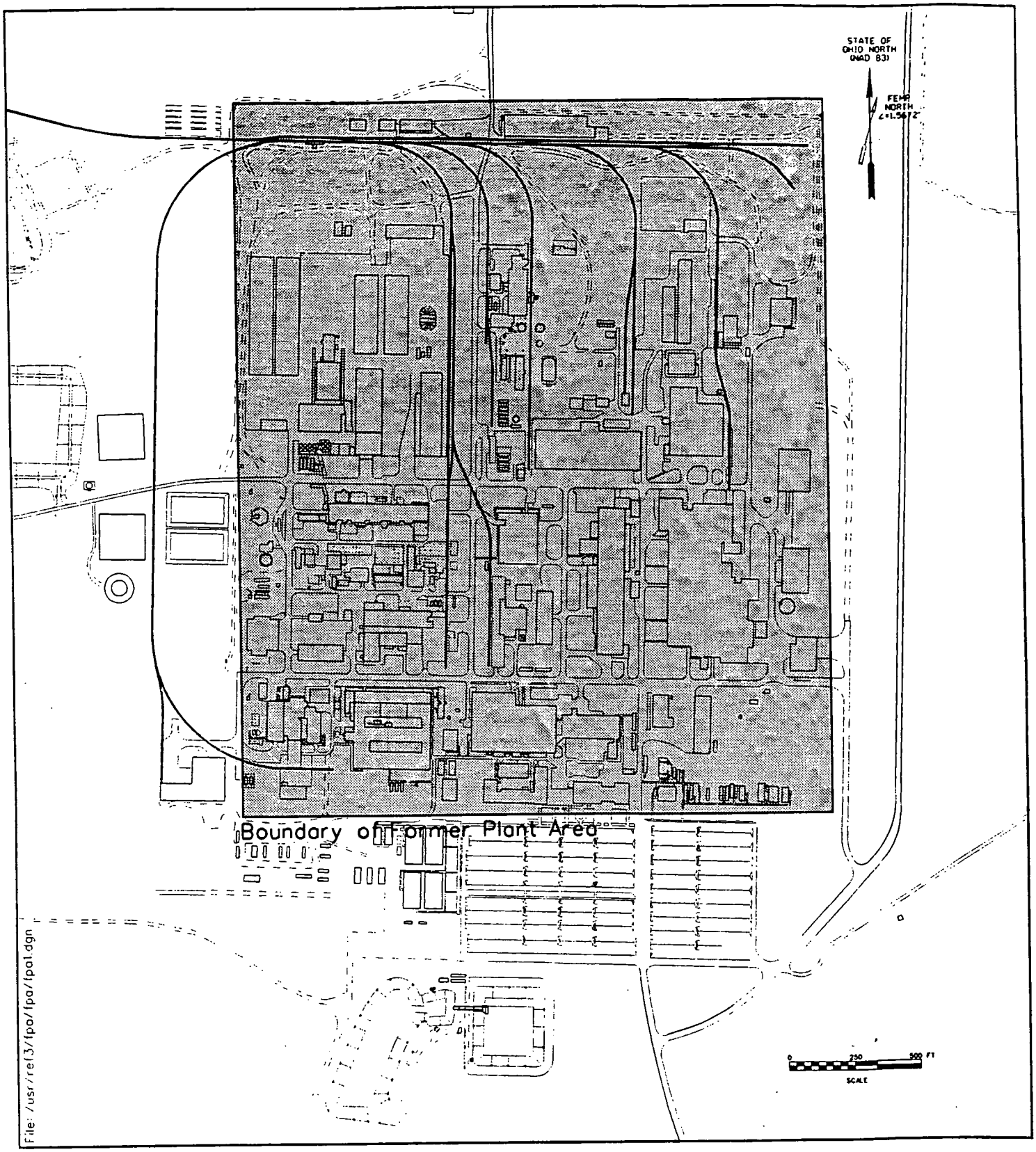

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Figure 1-1 - Former Plant Area (FPA)

1.2.2 Objectives

The overall objectives defined by FDF for the geotechnical investigation of the FPA are:

1) Develop additional and more precise information for the three-dimensional solid block model of the FPA to be refined by FDF.

2) Provide geotechnical properties and parameters for subsurface, native and granular soils for use in design of excavation, dewatering, grading and site restoration activities. From these properties also provide the following:

   - Characterize and define geotechnical properties of subsurface soils to support design slopes for remedial excavation,

   - Develop grading, stormwater controls, and dewatering recommendations for areas affected by soil removal, and

   - Make recommendations on the stability of temporary and permanent slopes.

3) Provide information regarding the hydraulic conductivity of the soils within the FPA.

In support of these objectives PARSONS conducted evaluations and analyses to provide preliminary geotechnical recommendations for the earthwork and dewatering requirements for removal of contaminated soils as well as site restoration of the areas affected by soils removal including the following:

1) Recommendations for excavation, including evaluation of difficulties that might be expected during excavation operations.

2) Recommendations for shrinkage and bulking factor to be used for earthwork estimating.

3) Recommendations for the construction of temporary slopes and slope protection during the removal of soil and perched groundwater and during placement of fill materials.

4) Recommendations for the construction of permanent slopes, slope protection and site restoration for areas affected by soil removal.

5) Recommendations for geotechnical monitoring and testing during soil removal.

6) Recommendations for dewatering and stormwater control.

Additional background information regarding the geotechnical investigation of the FPA is described in the subsections that follow. Section 2 provides a summary of prior geotechnical and soil hydraulic properties investigations. Section 3 describes the geotechnical field and laboratory testing performed as part of the PO-177 work. Section 4 summarizes the laboratory test results. Section 5 presents analyses, evaluations and recommendations.

1.3 Background

As stated in the Operable Unit 5 Record of Decision (DOE 1995a), the preferred alternative at FEMP includes the removal and permanent disposal of contaminated materials to an appropriate on- or off-property disposal facility. To accommodate this disposition of contaminated materials, an on-site disposal facility (OSDF) is being constructed near the eastern edge of the site. Waste Acceptance Criteria (WAC) have been developed for certain contaminants that can be disposed of in the OSDF. Any contaminated materials (including soils) that exceed the WAC are to be disposed of off-site. Contaminated materials meeting WAC can be disposed of in the OSDF. Final Remediation Levels (FRLs) have also been developed that establish the minimum concentrations for certain contaminants that require action. Soils exceeding FRLs are to be excavated and disposed in accordance with WAC. Within the excavation areas of the FPA, there are a significant number of existing groundwater monitoring wells, piezometers, and other similar subsurface features. Specific recommendations on the closure of these features is beyond the scope of this report. Subsequent planning documents will provide additional details on specific recommendations.

1.3.1 Remediation and Geotechnical Investigation Study Areas

For purposes of sequencing soil remediation activities, the Remedial Design Work Plan for Remedial Actions at Operable Unit 5 (DOE 1996) divided the FEMP into seven major soil remediation areas and further divided Soil Remediation Areas 1 and 2 into subareas, known as Phases. Figure 1-2 shows the approximate boundaries of these areas based on PARSONS' Scope of Work. From the Figure, the study area for the FPA geotechnical investigation includes Areas 3, 4A, 4B and part of 5. Implementation and construction plans should consider boundaries and interface criteria based on any supplemental data collected to define excavation extent as well as other administrative boundary criteria required by FDF. To facilitate discussion in this report the FPA will be discussed in terms of general quadrants: Northeast (NE), Southeast (SE), Southwest (SW) and Northwest (NW). Figure 1-3 shows the approximate boundaries of the quadrants used for discussion in this report. The quadrants are roughly defined by an intersection of lines along existing Second Street and B Street within the Former Process Area.

1.3.2 Modeled Extent of Excavation

To assist in remedial design of excavations to remove contaminated soils in the FPA, a post-Remedial Investigation/Feasibility Study (RI/FS) enhanced stratigraphic model of the glacial till was developed for the FPA by FDF using solid block modeling techniques (i.e., Intergraph's® MGE Voxel Analyst). Geotechnical borings associated with the design of plant area facilities were added to the OU5 RI/FS environmental boring data base. Coarse-grained material (i.e., silty sand through gravel) were identified at 6-inch intervals. A variogram was then developed and the area of interest and the data kriged. To further evaluate the heterogeneity of the area, contamination data was segregated into a coarse-grained material and fine-grained material subsets and kriged separately. The subsets were then integrated into a comprehensive impacted material model. Building foundations were added to the solid block model and the planned extent of excavation established to envelope impacted material and the foundations (DOE 1997). Figure 1-4 shows the planned extent of the excavation based on the block model. This excavation "footprint" provides the basis for the geotechnical analyses and evaluations described in Section 5. The footprint used is based on the January 1997 model provided to PARSONS by FDF.

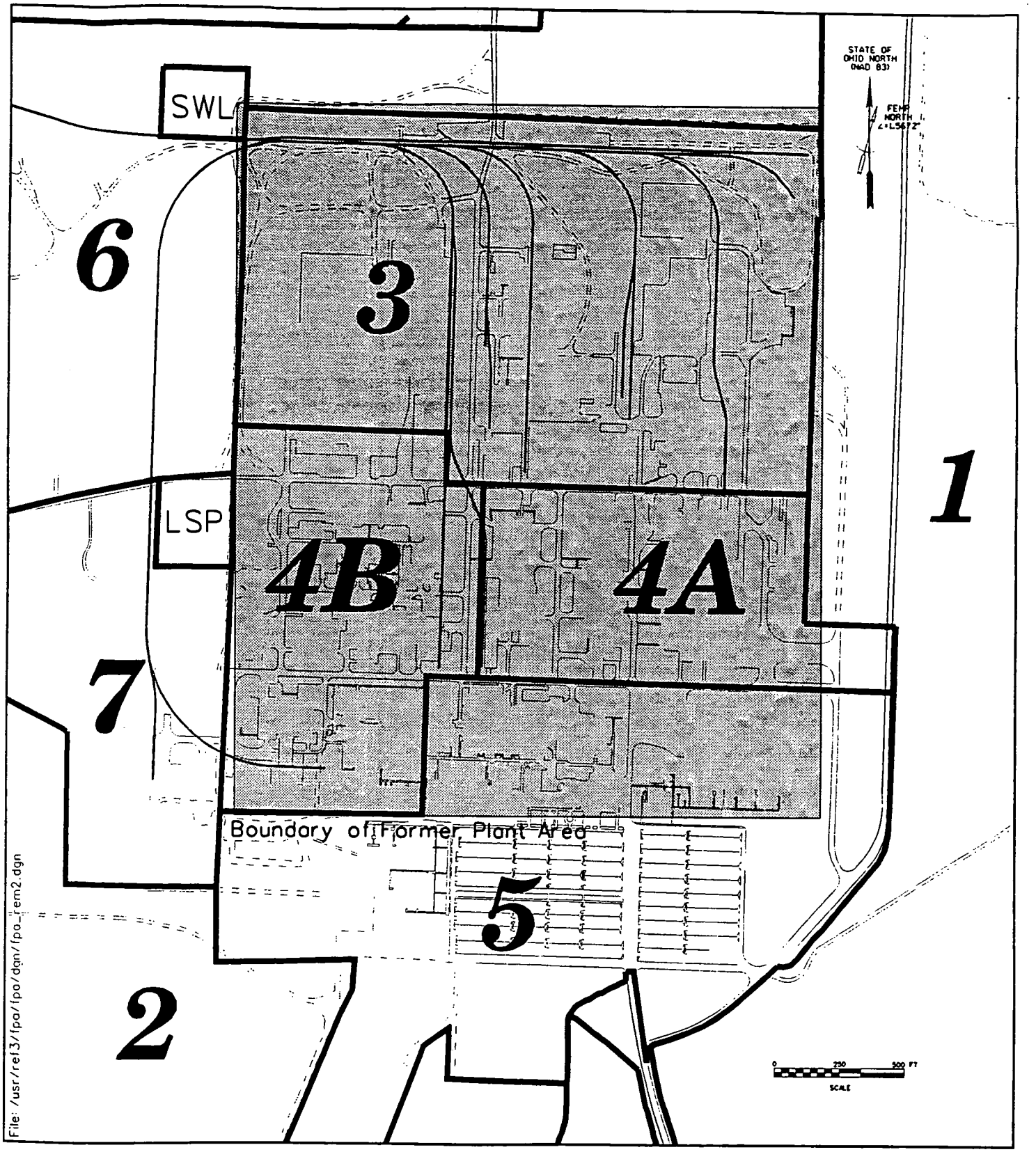

Figure 1-2 - Sitewide Remediation Areas

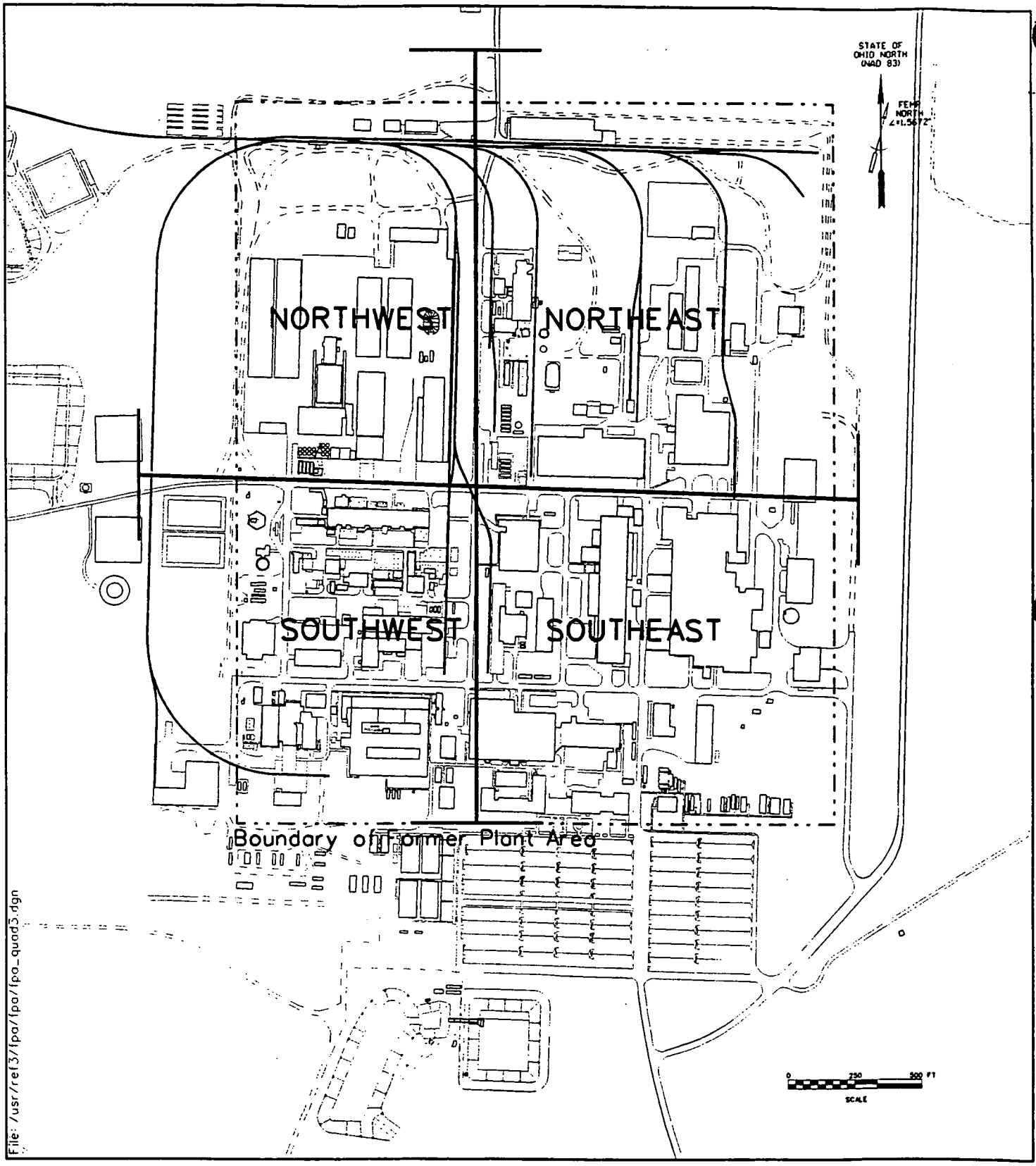

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Figure 1-3 - Quadrant Map Used for FPA Geotechnical Investigation

1.3.3 PO-177 Geotechnical Investigation

To support planning and design, additional geotechnical data were collected to evaluate slope stability and dewatering requirements; particularly for excavations penetrating significant zones of coarse-grained materials. A geotechnical sampling and testing program was undertaken to provide these additional data. The sampling and testing program that was implemented is described in *Geotechnical Sampling and Testing Plan for the Former Plant Area* (GSTP) (DOE 1997). The scope of PARSONS' work for the investigation is described in Subsection 1.2. As part of the investigation, ten new geotechnical test borings (G3-001/12266 through G3-010/12275) were completed and samples collected therein were tested by a geotechnical testing laboratory. Additionally, as part of the testing program, archived samples of coarse-grained materials collected during the FEMP Remedial Investigation (RI) were tested to evaluate the variability of permeable zones. To support evaluations and analyses, existing geologic and geotechnical data from the RI (e.g., boring logs, pumping test results) and other prior geotechnical investigations (e.g., grain-size and shear strength test data) were also used.

1.4 Subsurface Conditions

Subsurface material encountered in the FPA during the advancement of 10 borings as part of PO-177 is grouped into five categories. Fill is the only material that is not natural, inasmuch as it has been mechanically moved and placed. The remaining four categories of material consist of natural in-place deposits. Although the categorized materials are relatively common at various locations throughout the study area, it is typical to find some combination of them at any particular location, and not necessarily a complete section containing each material at all specific drilled locations. Section 5 presents Generalized Material Type Descriptions.

The in-place sediments as defined in this report have been previously described in the OU-5 Remedial Investigation (OU5 RI) (DOE 1995b) as Glacial Till, Lacustrine Deposits and Loess. These three units comprise what is termed the Glacial Overburden. In this report, because of geotechnical, engineering and hydrologic requirements, it is necessary to further delineate the OU5-RI lithologies. This categorization is based mainly on stratigraphic superposition and probable Pleistocene depositional modes for the area of the FEMP as defined in the OU5 RI.

The in-place sediment categories (generalized strata) are:

1) Brown Clay

   Equivalent to the brown-colored Till and Loess as discussed in the OU5 RI. These deposits overlay the Lacustrine Deposits as defined in the OU5 RI.

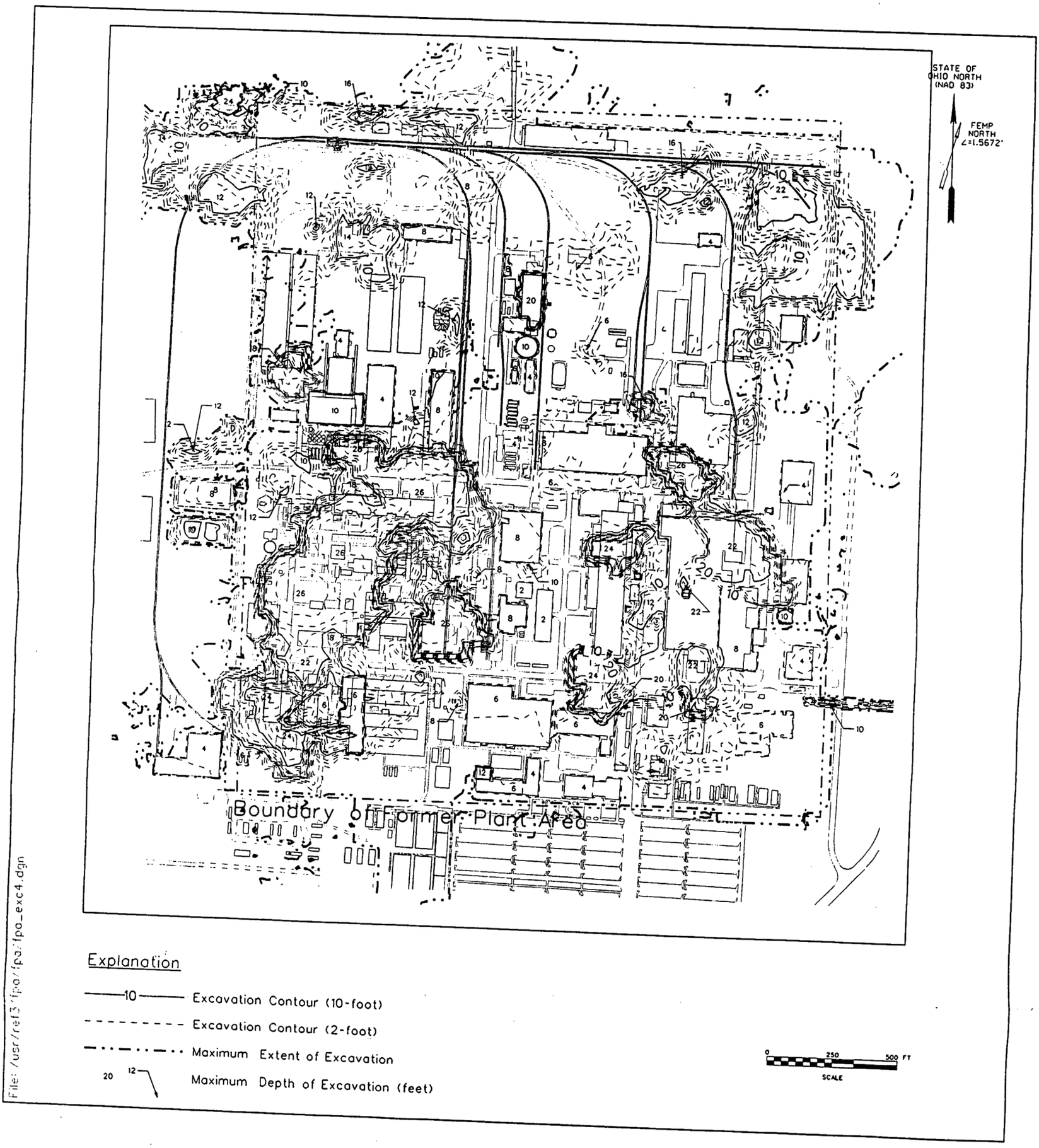

Figure 1-4 - Map Showing Excavation Extent and Depth

2) Muddy Stream Deposits

Equivalent to lenses and channels of coarser-grained sediment that lie within the Till as described in the OU5 RI. In this report, the Muddy Stream Deposits have been defined on the basis of subsurface mapping of the silt-, sand- and gravel-sized sediments that are not part of the Lacustrine Deposits.

3) Lacustrine Deposits

Equivalent to the Lacustrine Deposits of the OU5 RI.

4) Gray Till

Equivalent to the gray-colored Till of the OU5 RI.

The definition of the above lithologic units is based on the interpreted depositional paleo-environment as described in the OU5 RI. The RI states: "The depositional environment within the basin is that of a series of deltas formed by muddy streams flowing into the lake that filled the basin behind the dam formed by the terminal moraine." A more detailed discussion of these units is provided in Section 5.

It should be noted that the lithologic units (Glacial Till, Lacustrine Deposits and Loess) discussed in the OU5 RI are not annotated on the cross-sections that accompanied the RI report. On those cross-sections, the defining criteria for the sediment are based on lithologic types only. Those lithologies include bedrock, clay, silt, sand, gravel, sand and gravel and undifferentiated glacial outwash.

1.4.1 Conceptual Cross-Section

Figure 1-5 is a Conceptual Cross-Section that includes all of the categories of material and shows their generalized stratigraphic relationships. The Conceptual Cross-Section trends in a NE/SW direction through the middle of the FPA and is a view looking toward the NW. Additional cross- sections based on actual boring log analyses are presented on Figures 5-2 and 5-3. Section 5 in this report presents an interpretation and assessment of the information displayed on the cross-sections and the map (see Figure 1-6). Evaluation discussions are organized by quadrant, considering the NE quadrant first, next the SE quadrant followed by the SW quadrant, and finally the NW quadrant.

In the Conceptual Cross-Section, laterally-continuous sedimentary sequences are depicted because of geotechnical, hydrological and engineering analysis and modeling necessary for the PO-177 FPA excavation report. Though this Cross-Section appears to differ with the original OU5 RI, conceptual cross-sections, that is only due to the analysis approach being used. The Conceptual Cross-Section is based on the profile in cross-section E-E' (Figure 5-3) since this section takes into consideration all of the depositional environments believed to have occurred during the Pleistocene glaciation. It would not be feasible to model hydrologic conditions within the subsurface based on a series of generally discontinuous coarse-grained lenses and channels as depicted in the OU5 RI, consequently the PARSONS' Conceptual Cross-Section should be considered as a conservative approach to model the conditions beneath the FPA and as such, laterally continuous lithologic units must be maintained in the Conceptual Cross-Section.

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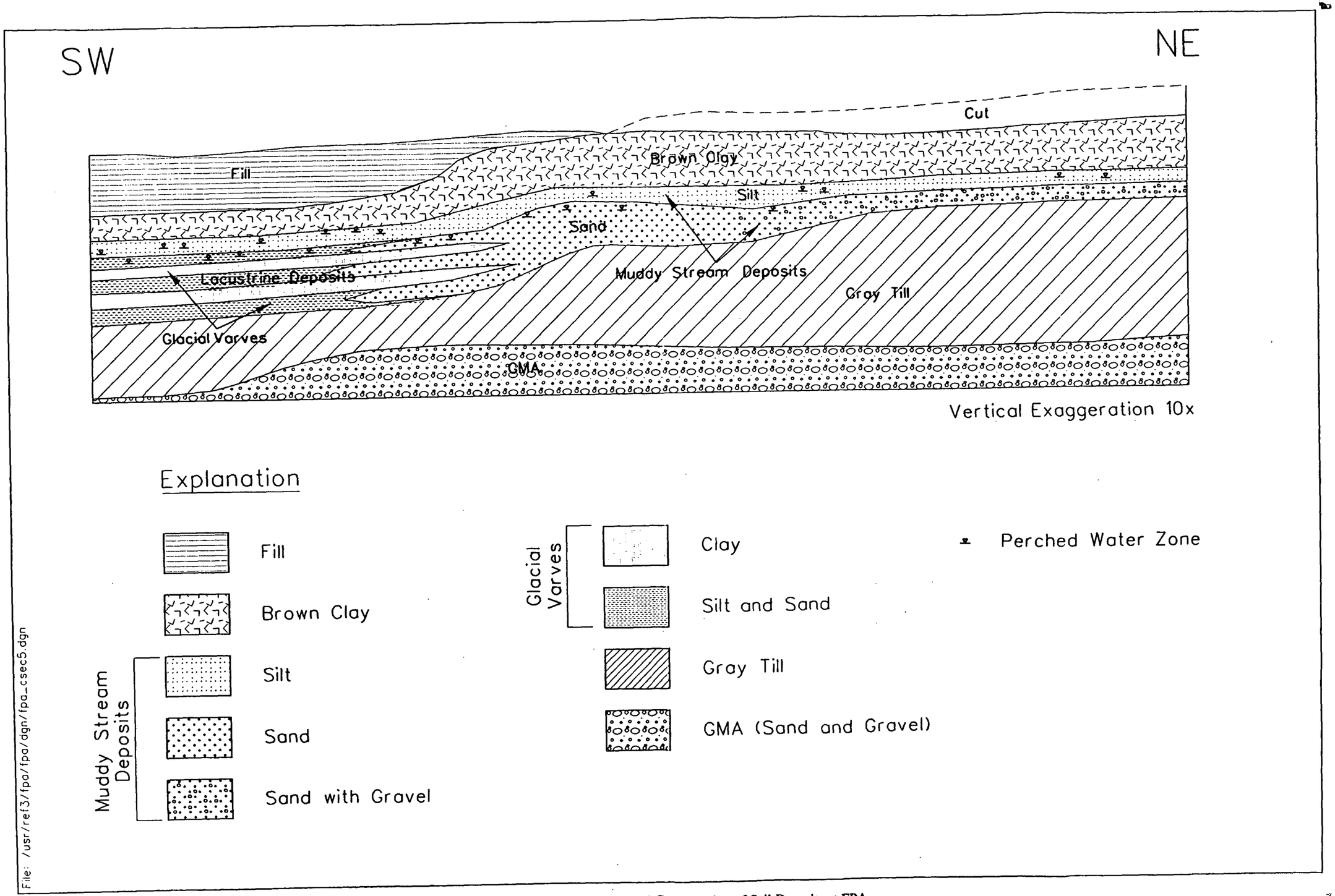


Figure 1-5 - Conceptual Cross-section of Soil Deposits at FPA

1.4.2 Extent of Coarse-Grained Deposits

Figure 1-6 is a map showing the general location and trends of the various interpreted deposits below or near to the brown/gray interface in the glacial overburden. Unit boundaries are based chiefly on trends in silt-, sand- and gravel-sized sediment within the glacial till clay "matrix." An overlay of the coarse-grained bodies map, as modeled by FDF, shows that PARSONS' map is an extension of the FDF model. The OU5 RI stated "Due to the variety of possible depositional environments the sand, silt and gravel units can rarely be correlated over distances greater than a few hundred feet in cross sections." Since PARSONS has had access to a number of borings that were not available at the time of the OU5 RI, as well as pre-RI/FS borings (not presented in the OU5 RI Report) for its subsurface interpretation, it has led to a further refining of the RI data, especially the delineation of probable water-bearing silt and coarse-grained sediment trends. The boundaries of these sediment trends are constrained in part by borings that encountered clay-only materials as annotated on the map of Figure 1-6. The PARSONS' map also includes coarse-grained sediment (sands and gravels) which were not mapped by the FDF model.

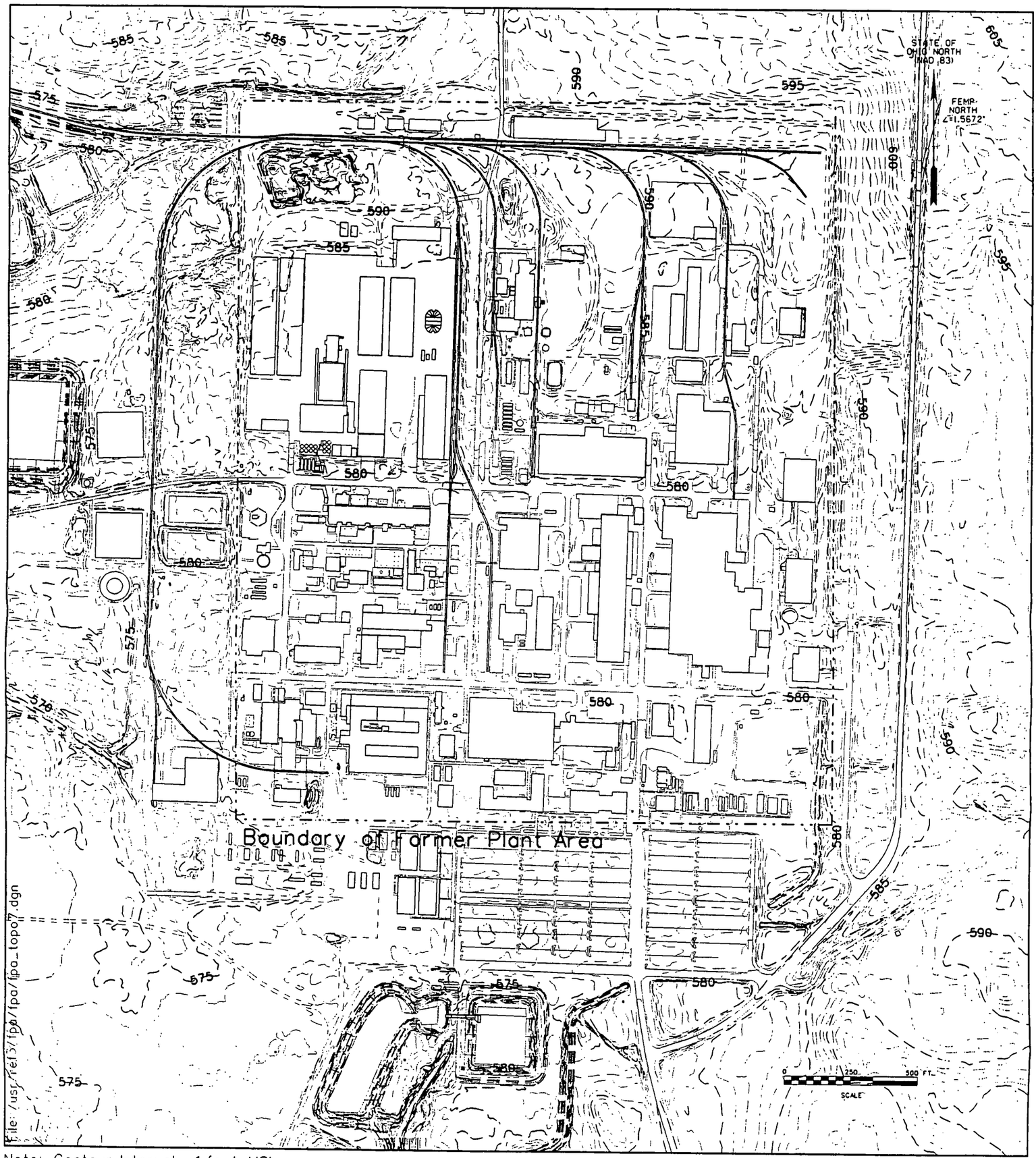
Figure 1-6 depicts the boundaries of ancient "muddy" streams which fed sediment into the lake created by glacial meltwaters during the glacial retreat. As noted on the map, paleo-stream channel trends (Pleistocene Age) are uncertain and approximated in some areas because of the lack of adequate subsurface control (borings). Though the trends represented by the silt-, sand- and gravel-sized sediments strongly corroborate the depositional model as defined in the OU5 RI, they are still interpretive to an extent because of occasional difficulties in correlating trends of coarse sediment within the glacial overburden, the often rapid transition of sediment types within the glacial overburden and the lack of borehole control in some areas of the FPA.

1.5 Topography and Perched Groundwater Conditions

Figure 1-7 shows the general land surface topography based on the data from the 1992 flyover. The topography will likely be modified somewhat prior to excavation of contaminated soils due to the other various activities associated with planned remediation activities within the FPA (e.g., construction of stormwater controls, demolition of buildings, construction of temporary access roads, etc.)

Figures 1-8 and 1-9 show contour maps for perched groundwater during October 1991 and March 1992 which were developed for the OU5 RI and Feasibility Studies (FS). According to the OU5 RI, "The glacial overburden is saturated from approximately 3 to 5 feet below the ground surface down to the base of the glacial overburden, where present. Unsaturated conditions exist just beneath the base of the glacial overburden. Approximately 3 to 45 feet of unsaturated sand and gravel exist between the base of the glacial overburden and the water table of the Great Miami Aquifer. Because of the unsaturated sediment below the glacial overburden, groundwater within the glacial overburden is "perched" above the water table of the Great Miami Aquifer.

This view of the perched water zone means that its presence is independent of subsurface lithology. In light of this, Figures 1-8 and 1-9 represent groundwater elevations (in feet above Mean Sea Level (MSL)) in lithologic units thought to have permeabilities high enough and sufficient thickness for possible seepage or flow of water which would be of concern to excavation activities. These maps also illustrate the range of typical groundwater elevation likely to be encountered during excavation within the FPA coarse-grained units (FDF Coarse-grained Model) and silt and sand zones (PARSONS, this report), and also provide a basis for the slope



Note: Contour Interval = 1 foot, MSL

Source: 1992 Flyover Data

Figure 1-7 - Topography of FPA

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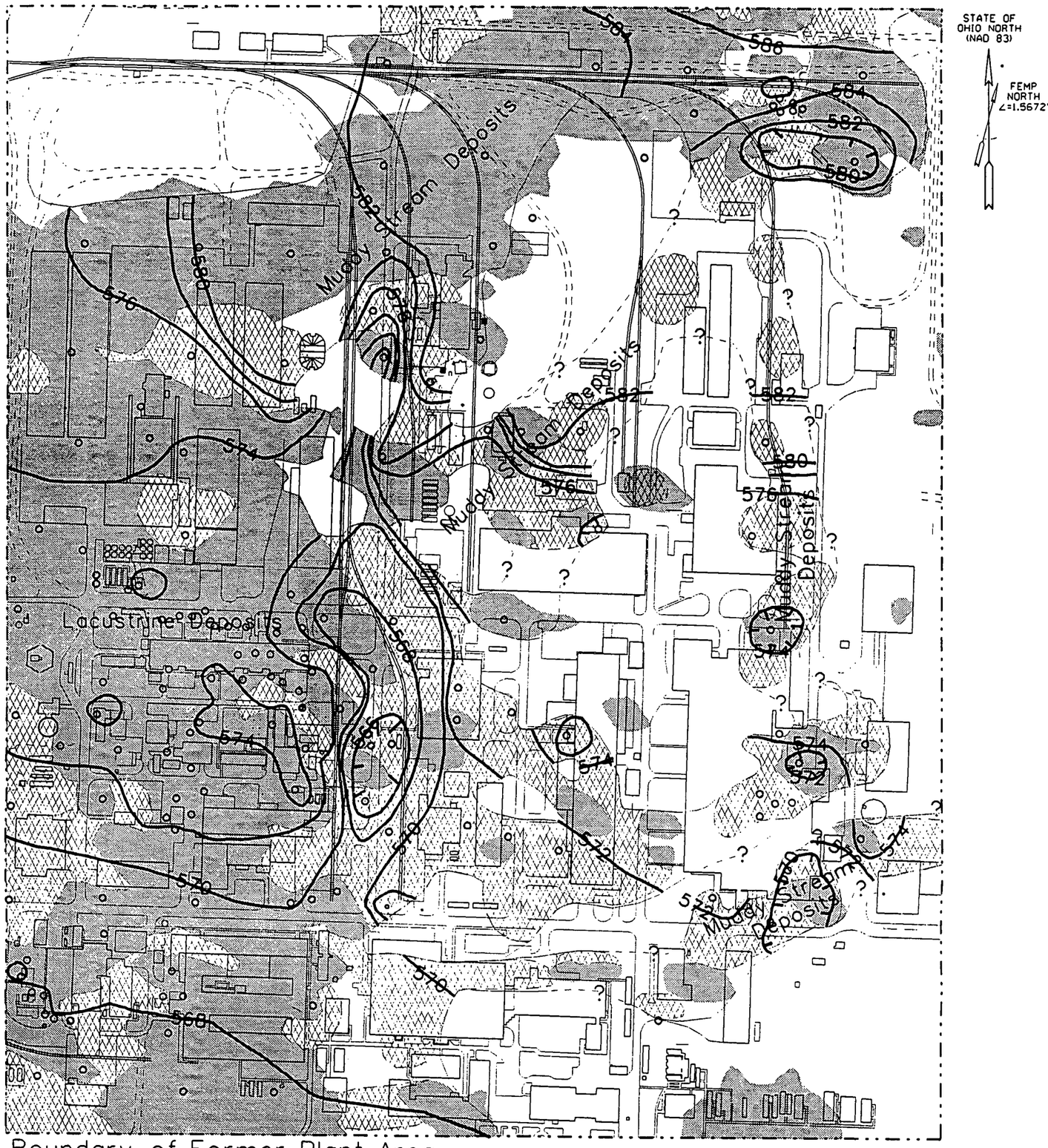

Explanation:

- ∘ 1000 Series Well Data Point
- —572— Perched Groundwater Contour (ft above MSL)
- Interpreted Lacustrine and Stream Deposits

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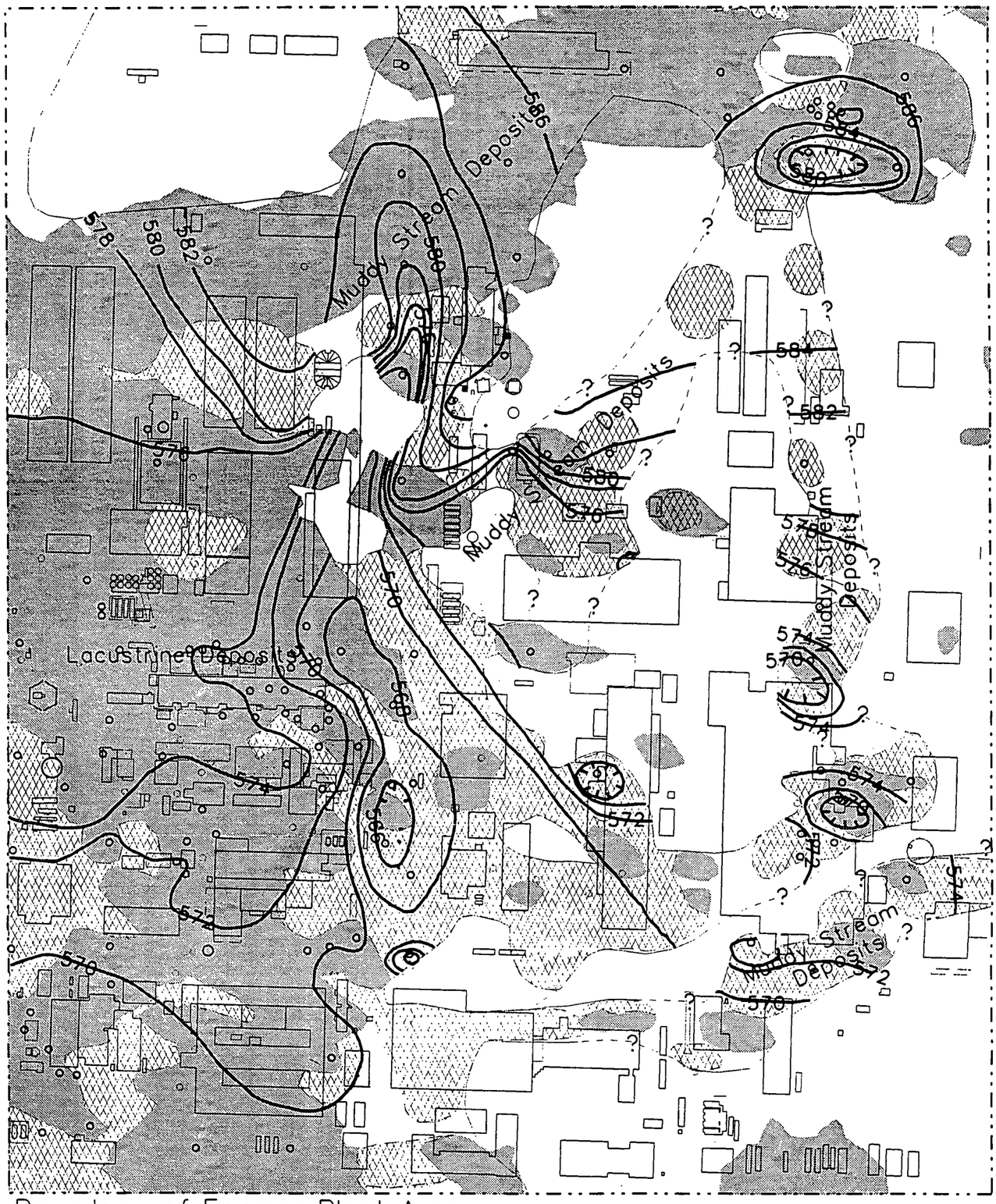
Figure 1-8 - Perched Groundwater Elevation Contour Map, FPA, October 1991



Explanation:

- ∘ 1000 Series Well Data Point
- —572— Perched Groundwater Contour (ft above MSL)
- Interpreted Lacustrine and Stream Deposits

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Figure 1-9 - Perched Groundwater Elevation Contour Map, FPA, March 1992

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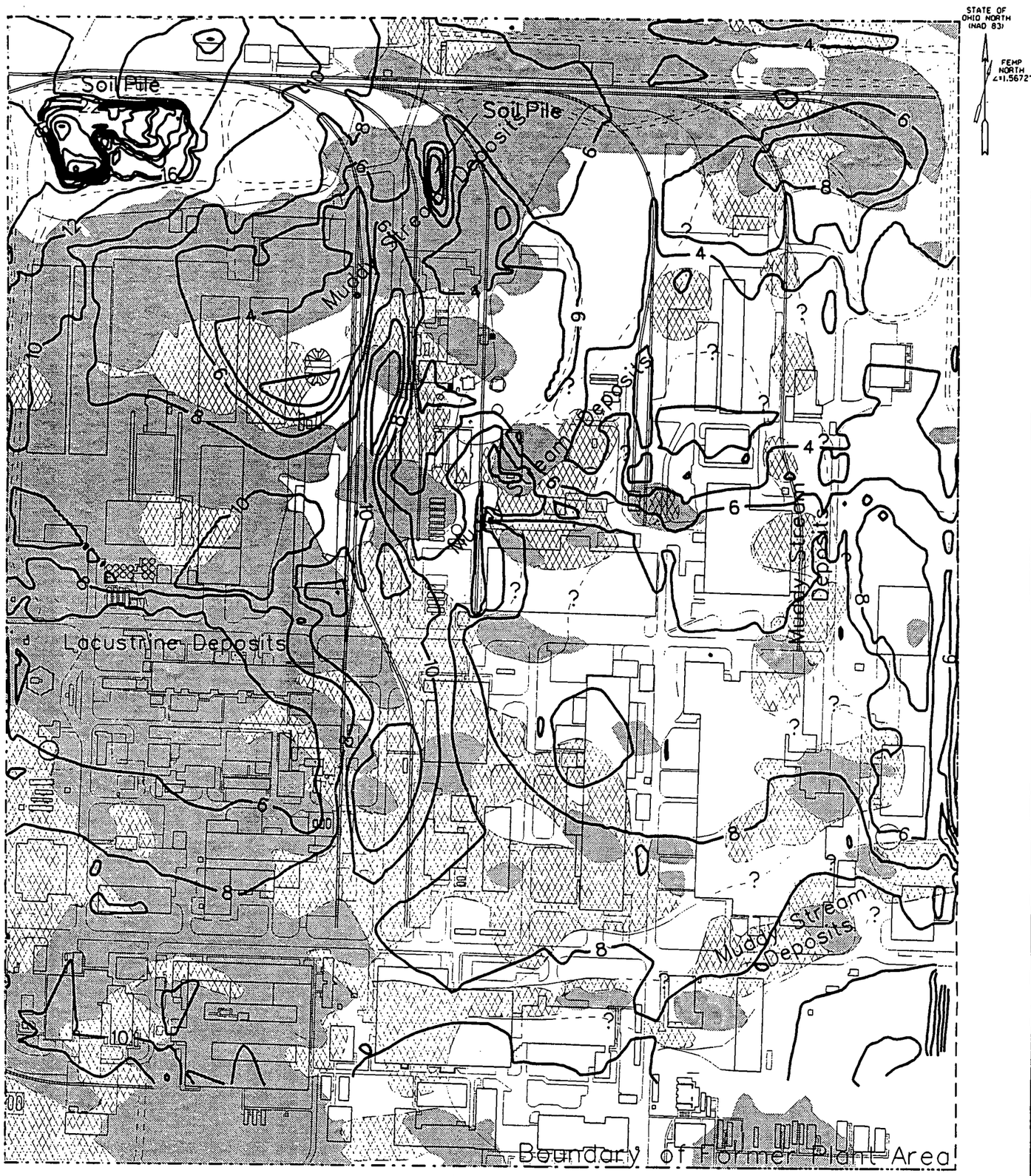
stability and dewatering evaluation presented in Section 5. Figures 1-10 and 1-11 are isopach maps showing the approximate depth to perched groundwater from the ground surface (units in feet). These figures were created using the 1992 ground surface topography and the October 1991 (Figure 1-8) and March 1992 (Figure 1-9) perched water elevations.

1.6 Excavation Location Map

In order to facilitate evaluations and discussions associated with this report, the primary excavation sites within each quadrant have been identified. Figure 1-12 shows the locations of the principal excavation sites. They are identified by a quadrant designator (e.g., NW) and an excavation site designator (e.g., A, B, C, etc.). The excavations identified generally have depths in excess of 10 to 15 feet.



Explanation

—— 8 —— Contour (Depth Below Surface)

Interpreted Lacustrine and Stream Deposits

0 250 500 FT
SCALE

File: /usr/ref3/fpa/fpa/dgn/fpa_oct10.dgn

Figure 1-10 - Approximate Depth to Groundwater Isopach Map, FPA, October 1991 Groundwater Elevations

Explanation

0 250 500 FT
SCALE

—— 8 —— Contour (Depth Below Surface)

Interpreted Lacustrine and Stream Deposits

File: /usr/ref3/fpa/fpa/dgn/fpa_mar11.dgn

Figure 1-11 - Approximate Depth to Groundwater Isopach Map, FPA, March 1992 Groundwater Elevations

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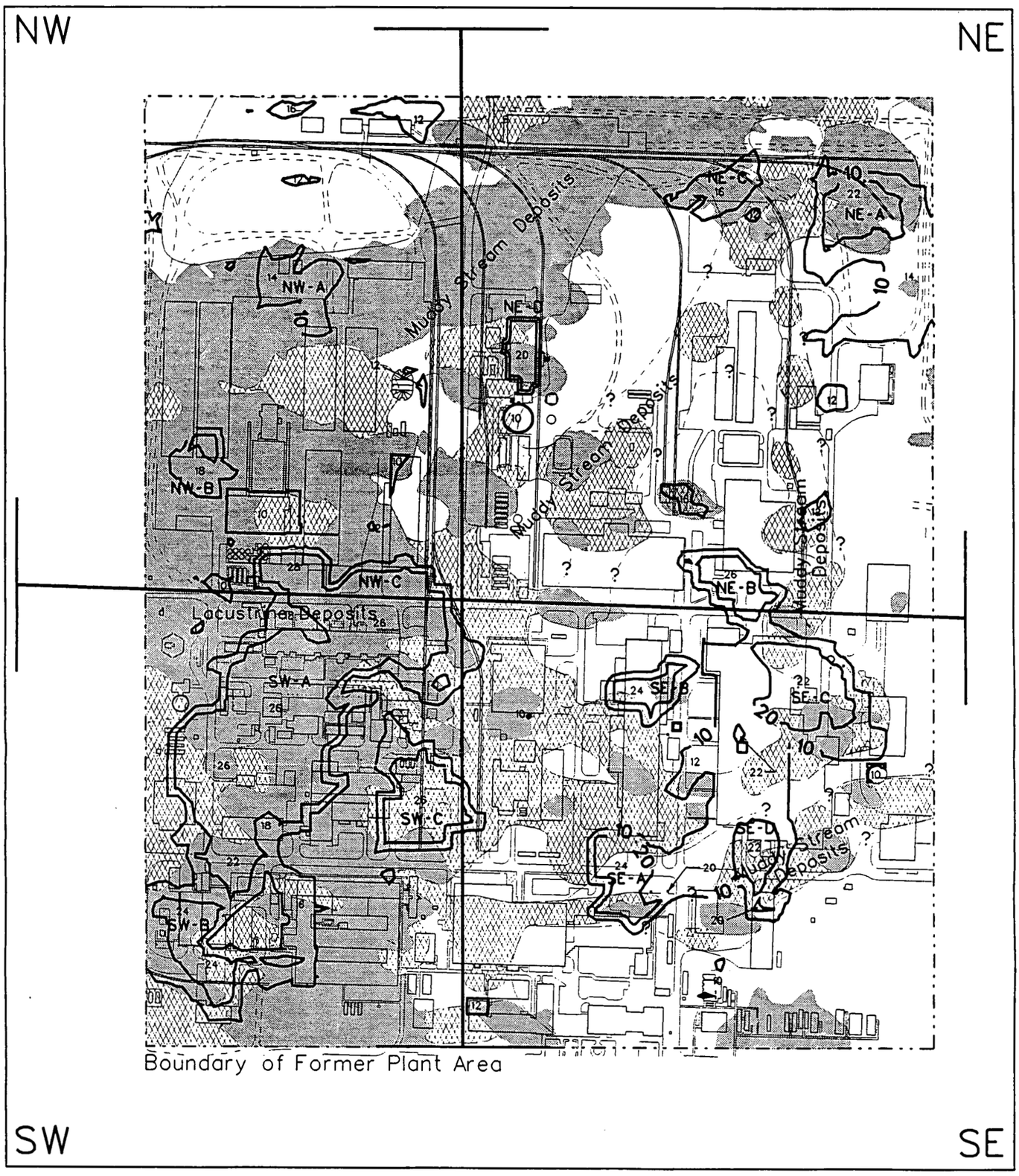

0 250 500 FT
SCALE

Explanation

—10— Excavation Contour (10-foot)

20 12 Maximum Depth of Excavation (feet)

Interpreted Lacustrine and Stream Deposits

File: /usr/rel3/lpa/lpa/lpa_exc12.dgn

OUDATA\OU-2\PO177\
REPORT\REVC

Figure 1-12 - Excavation Location Map

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SECTION 2

PRIOR INVESTIGATIONS

This section summarizes the existing geotechnical and soil hydraulic properties data reviewed and summarized during preparation of this report. Relevant existing data were used to support the evaluations and analyses described in Section 5.

2.1 Geotechnical Investigations

Existing FEMP reports and documents were reviewed to summarize geotechnical data and information that would be useful in planning the geotechnical investigation of the FPA and conducting the associated geotechnical evaluations. The reports containing data from geotechnical investigation conducted prior to the PO-177 Geotechnical Investigation are listed in Table 2-1. Figure 2-1 provides a boring location map for borings performed within the FPA. All of the borings except G3-001/12266 through G3-010/12275 were conducted prior to the PO-177 Geotechnical Investigation. In general, logs of these prior borings provide visual classification of soils and standard penetration test results to the depths explored. A summary of geotechnical laboratory data extracted from the prior geotechnical reports listed in Table 2-1 is found in Appendix A. Figure 2-2 shows the locations of borings associated with prior geotechnical laboratory test data.

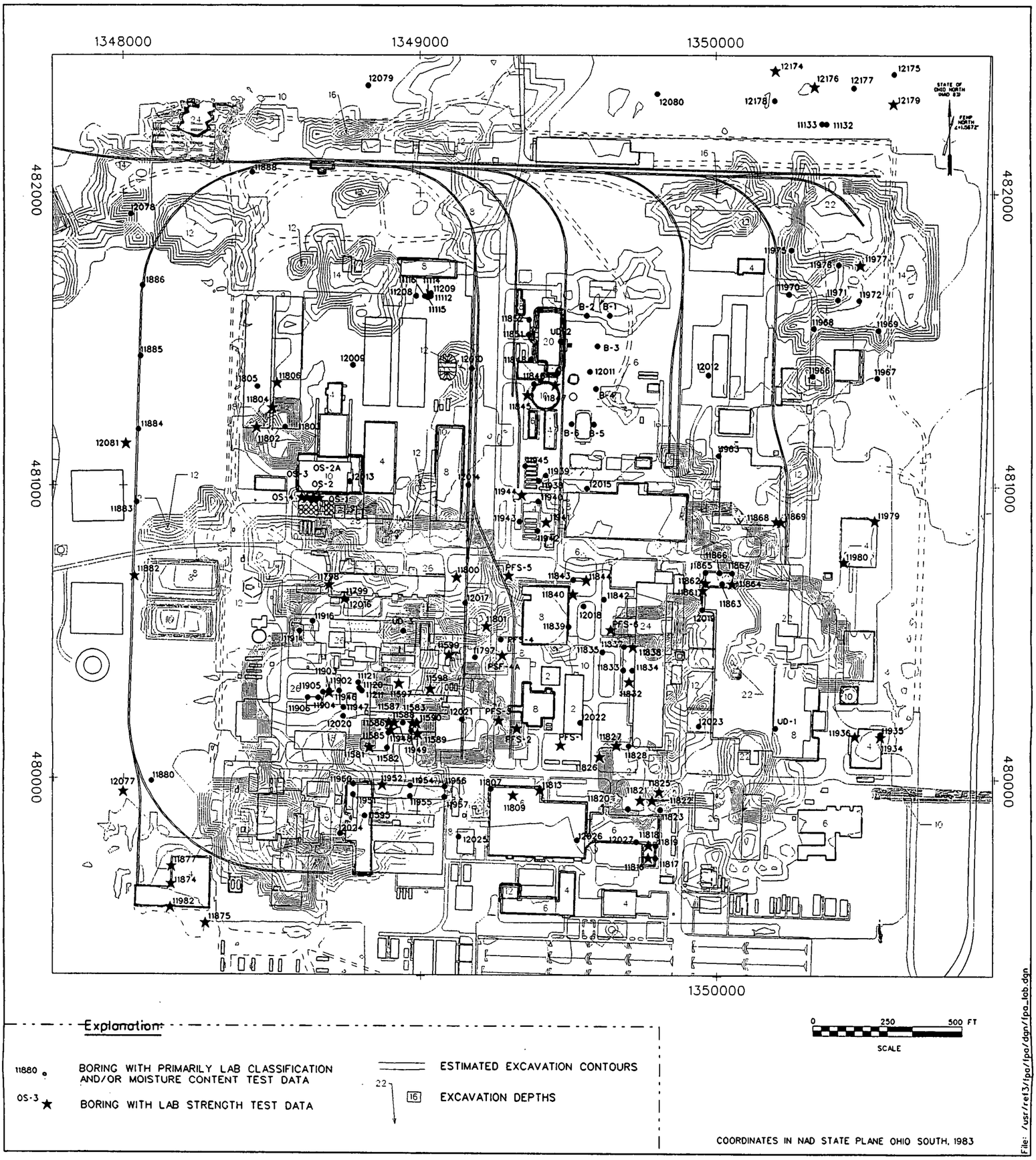

Figure 2-2 - Boring Location Map Showing Boring Locations with Prior Geotechnical Laboratory Test Data, FPA

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Table 2-1 - Summary of Reports Containing Existing Geotechnical Data, FPA Study Area

Author	Date	Report
U.S. Department of Energy	March 1995	"Remedial Investigation Report for Operable Unit 5", Reference Appendices N, O and P
S&ME	June 30, 1986	"Slag Leach Facility, Uranium Control Pad, Drum Reconditioning Building", Project No. 021-86-169
S&ME	June 9, 1986	"Buildings 6 and 8 Expansion", Project No. 021-86-162
S&ME	May 15, 1987	"Decladding and Box Furnace Facility", Project No. 1221-87-178-1.0
S&ME	May 18, 1987	"General Sump", Project No. 1221-87-178-2.0
S&ME	July 28, 1987	"Proposed Laundry Room Upgrade/Locker Room Upgrade", Project No. 1221-87-257
S&ME	January 19, 1986	"Proposed Training Center and In Vivo Building" Project No. 021-86-363
S&ME	September 4, 1984	"NLO Facility UF_6 - UF_4 Facilities Expansion", Project No. 021-84-215
S&ME	August 31, 1984	"NLO Fernald, Ohio Plant 5 Expansion", Project No. 021-84-215
S&ME	February 16, 1987	"Derby Breakout and Slag Milling Area", Project No. 1221-87-114
S&ME	May 21, 1987	"N_2 Systems", Project No. 1221-87-178-3.0
S&ME	August 29, 1986	"Existing Water Tank", Project No. 021-86-261
S&ME	September 9, 1987	"Water Treatment Plant", Project No. 1221-87-288-1
S&ME	September 21, 1987	"Nu-Sal Furnace", Project No. 1221-87-288-2.0
S&ME	November 12, 1984	"NLO Railroad Relocation", Project No. 021-84-269
S&ME	September 20, 1988	"Geotechnical Exploration, Coal Storage Pile", Project No. 4144-88-309
ATEC	1982	"FMPC Water Pollution Control", Job No. 22-23071
S&ME	March 14, 1988	"Receiving and Incoming Materials Inspection Area", Project No. 4144-88-119

Table 2-1 - Summary of Reports Containing Existing Geotechnical Data, FPA Study Area (Continued)

Author	Date	Report
H. C. Nutting	1984	"Report of Geotechnical Investigation, NLO Inc., Supply/Services Subcontract No. S-1143"
ATEC	1988	"Analytical Facilities Expansion", Job No. 22-831858
S&ME	April 9, 1987	"NO_x Destructor Facility", Project No. 1221-87-160-2.0
S&ME	April 27, 1987	"Decontamination and Decommissioning Facility", Project No. 1221-87-160-1.0
S&ME	April 22, 1987	"Proposed Warehouse", Project No. 1221-87-159
U.S. Army Corps of Engineers	February 1952	"Report of Foundation Investigation, Feed Materials Production Center, Fernald, Ohio"
PARSONS	September 1993	"Central Storage Facility Subsurface Exploration", Project Order 20
PARSONS	September 1993	"Subsurface Exploration Report, Plant 1 Ore Silos", Project Order 22
PARSONS	July 1993	"Plant 7 Dismantling Geotechnical Report", Project Order 32
PARSONS	May 1996	"Site Rail Improvements and WPRAP Load Out Facility Geotechnical Investigation Report", Project Order 167

Notes for Table 2-1:

Authors:
U.S. Department of Energy - Fernald Field Office, Ohio
PARSONS - PARSONS ERA Project, Cincinnati, Ohio
S&ME - Soils and Material Engineers, Inc., Cincinnati, Ohio
H. C. Nutting - The H. C. Nutting Company, Cincinnati, Ohio
U.S. Army Corps of Engineers - Ohio River Division

2.1.1 Remedial Investigation Report for Operable Unit 5

The *Remedial Investigation Report for Operable Unit 5 (OU5)*, Appendices N, O, and P contain a summary of geotechnical data and boring/well log data. The visual descriptions found in these logs and additional logs maintained by FDF provided a large geologic data base used to evaluate and analyze subsurface stratigraphic conditions at the FPA. Geotechnical laboratory data from tables in the OU-5 RI Report, Appendix N for borings within the FPA study area are summarized in the tables found in Appendix A.

2.1.2 Geotechnical Reports for Construction of Various Structures and Facilities

The geotechnical reports by S&ME, PARSONS, ATEC Associates, Inc. (ATEC) and H. C. Nutting Company (H.C. Nutting) typically summarize the boring logs and geotechnical laboratory test data for various projects within the Former Production Area conducted from 1982 through 1996. The subsurface explorations summarized in these reports, especially those by S&ME, often involved a foundation investigation for a proposed facility. The geotechnical laboratory tests summarized in these reports principally include soil classification tests (moisture content, specific gravity, grain size, unit weight and Atterberg limits), strength tests (unconfined compressive strength, and triaxial compression), consolidation tests, compaction tests, and California Bearing Ratio tests. Geotechnical laboratory data extracted from these reports are summarized in tables found in Appendix A.

2.1.3 Corps of Engineers Foundation Report

The *Report of Foundation Investigation, Feed Materials Production Center, Fernald, Ohio*, issued in 1952 by the U.S. Army Corps of Engineers summarizes the results of the foundation investigation for construction of the Feed Materials Production Center (currently the FEMP). The report includes boring logs and results of geotechnical laboratory testing. The geotechnical laboratory tests summarized in these reports principally include soil classification tests (moisture content, grain size, specific gravity, unit weight and Atterberg limits) and consolidation tests. Geotechnical laboratory data extracted from these reports are summarized in tables found in Appendix A.

2.2 Hydraulic Investigations

Table 2-2 presents a summary of the existing reports and papers containing FEMP site specific soil hydraulic properties data. Information and data from these reports provided the basis for establishing some of the hydrogeologic parameters used in the dewatering analyses and evaluations presented in Section 5.

Table 2-2 - Summary of Reports Containing Existing Soil Hydraulic Properties Data, FPA Study Area

Author	Date	Report
DOE	1990	"Groundwater Report"
PARSONS	1994	"FEMP Glacial Till/Vadose Zone Hydraulic Investigations Report", Project Order 37
ASI	May 30, 1991	"Hydrogeological Study for the Initial Design of Perched Groundwater Extraction System", Project No. 602.27.15, Internal Report
Frink	1995	"Hydraulic Conductivity" Determination in Glacial Till: A Comparison of Method and Scale"
DOE	1995	"Remedial Investigation Report for Operable Unit 5"

Notes for Table 2-2:

Authors:

DOE - United States Department of Energy, Fernald, Ohio
PARSONS - PARSONS ERA Project, Cincinnati, Ohio
ASI - ASI Oak Ridge, Waste Management Engineering Group, Oak Ridge, Tennessee
Frink - Paul Frink, a thesis submitted to the Division of Graduate Studies and Research of the University of Cincinnati, Department of Civil and Environmental Engineering, Committee Chair: Dr. Milovan S. Beljin

2.2.1 FEMP Glacial Till/Vadose Zone Hydraulic Investigations Report

The *FEMP Glacial Till/Vadose Zone Hydraulic Investigations Report*, summarizes the results of an investigation to obtain hydraulic conductivity data on the glacial overburden sediments, and to assess the properties of the gray clay contained within the overburden. Values of hydraulic conductivity contained within this report includes results of 44 slug tests, 4 yield test and 2 pumping tests within and in the immediate vicinity of the FPA. This report was prepared by PARSONS under PO-37 in support of the OU-5 RI/FS. Data from the report are also presented in the OU-5 RI Report. Because of the relevance of this report to dewatering aspects of the FPA and the amount of site specific slug test (Tables 2-2 and 2-7 of Appendix B) and pumping test (Tables 5-5 and 5-8 of Appendix B) data contained therein, Volume 1 of the report is included in its entirety in Appendix B.

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2.2.2 Hydrogeological Study for the Initial Design of Perched Groundwater Extraction System

This RI related report studies a groundwater extraction system alternative for handling contaminated perched groundwater. The report evaluates the preliminary design of a perched groundwater extraction system for the FPA, including information and data regarding the physical properties and characteristics and a preliminary extraction system configuration.

2.2.3 University of Cincinnati Thesis

A 1995 University of Cincinnati Thesis entitled "Hydraulic Conductivity Determination in Glacial Till: A Comparison of Method and Scale", used FEMP site specific data from the PO-37 Investigation to evaluate various test methods used to determine the hydraulic conductivity of glacial overburden sediments. This thesis summarized methods that use grain-size data to estimate hydraulic conductivity of soils.

SECTION 3

FIELD AND GEOTECHNICAL LABORATORY TESTING PROGRAM

This section describes the geotechnical field and laboratory test program implemented per the *Geotechnical Sampling and Testing Plan of the Former Plant Area* (GSTP) (DOE 1997). Geotechnical test borings, advanced at 10 locations, were performed at the FPA study area during April and May, 1997. Additionally, during this period, soil samples from RI archival storage were retrieved for testing. Samples from RI boring locations were submitted for geotechnical testing. Geotechnical laboratory testing was performed by Advanced Terra Testing, Inc. (ATT), Lakewood, Colorado, Inc., Golden, Colorado. Laboratory technicians from ATT tested samples at the FEMP on-site laboratory and at the ATT Lakewood, Colorado laboratory. The laboratory data sheets from this testing are compiled in a five-volume data report entitled *Former Plant Area Geotechnical Investigation, Geotechnical Data Report* (SAIC 1997). Geotechnical field and laboratory activities were conducted following the guidelines of the *Sitewide CERCLA Quality Assurance Project Plan* (DOE 1994a).

3.1 Geotechnical Test Borings

Ten geotechnical test borings (G3-001/12266 through G3-0010/12275) were advanced by FDF's drilling subcontractor, Alliance Environmental, Inc., at the locations which are shown on Figure 2-1. The boring locations were staked and surveyed by FDF.

The test borings were advanced with hollow-stem augers to depths ranging from 19 to 29 feet. During drilling operations, a PARSONS geotechnical engineer or geologist was present to visually classify the soil samples, log the borings, and record any encountered groundwater levels. During sampling activities, FDF sampling technicians screened the soil samples and drill cuttings, using hand-held instruments for volatile organics and radiation.

Soil samples were recovered continuously in the undisturbed material below the bottom of the augers using either the Standard Method for Penetration Resistance and Split-Barrel Sampling (American Society for Testing and Materials [ASTM] D 1586), 3-inch-diameter Shelby Tubes (ASTM D 1587), a Denison sampler, or a Dames & Moore ring-lined sampler. Samples were collected following the sampling plan described in the GSTP (DOE 1997). Variations in the sampling plan, due to conditions encountered in the field, were documented on Field Change Notice/Variance documents provided to FDF.

Upon completion of each boring, the soil test borings were backfiled throughout the entire length of the boring with a volclay grout. A FDF geologist oversaw the grouting operations.

Appendix C contains a field boring log and a Geotechnical Logging Report for each of the new geotechnical test borings completed during the PO-177 Geotechnical Investigation. The Geotechnical Logging Report updates the soil classification based on the results of laboratory classification tests. Appendix D summarizes the Ohio State Plane Coordinates and ground surface elevations for test borings.

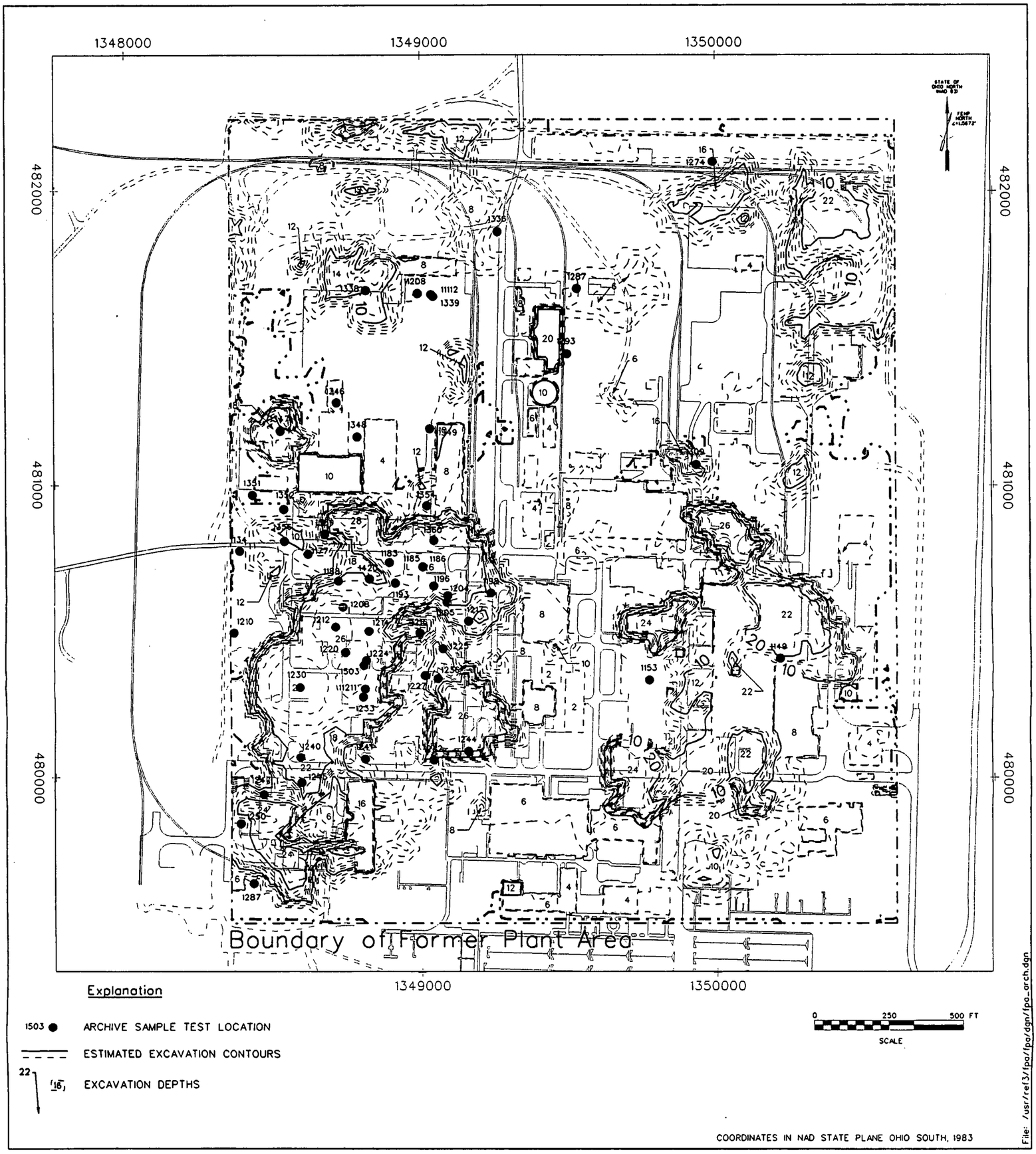

Figure 3-1 - Archive Sample Test Location Map

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3.2 Archived Samples

During preparation of the GSTP, RI boring logs were reviewed to identify intervals of coarse-grained soils (sands, gravels) and silts within the FPA, at or near the planned excavation sites. The FEMP RI Sample Archives were then searched to establish the availability and condition of the samples for potential geotechnical laboratory index properties testing (i.e., grain-size and Atterberg limits tests). The samples came from split-spoon samples collected during various phases and projects of the RI and were contained in sealed sample jars that were marked with appropriate sample identification. A FDF geologist estimated the volume of soil contained in each jar. A PARSONS geologist visually classified approximately half of the archive samples to evaluate the integrity of the sample and assure that the sample material contained in the jar corresponded to the visual description of the boring log. This activity provided a high level of confidence that sufficient volume and type of sample material would be available for the index properties testing. Additionally, this activity provided a high level of confidence in the visual descriptions found on the boring logs and the overall integrity of the archival process. Based on the available samples, a test matrix was developed in the GSTP for geotechnical laboratory testing of the RI archive sample. Figure 3-1 shows the locations with archive sample test results. Appendix C contains copies of boring logs for the borings which have associated PO-177 archive sample test data.

3.3 Geotechnical Laboratory Testing

Geotechnical laboratory testing of soil samples was performed by ATT at the FEMP on-site laboratory and at ATT's Lakewood, Colorado, geotechnical laboratory between April and November 1997.

The laboratory testing program was directed toward classifying in situ and remolded soils and determining their engineering properties for use in design and evaluation of excavation, dewatering, grading and site restoration. Classification tests of coarse-grained soils (primarily sands) within the glacial deposits were performed to provide data to evaluate the properties of soils in water bearing zones. Additionally, some tests on undisturbed samples were performed to provide strength data for evaluation and analyses of excavation slopes. A variety of index tests were performed on selected samples to aid in soil classification and to extend the utility of the more sophisticated strength and permeability tests.

Table 3-1 lists the type of tests performed and the laboratory test methods. The soil testing was performed on split-spoon samples (disturbed samples), bulk samples (collected from auger cuttings), Shelby tube, Denison Tube, and ring samples from the Dames & Moore sampler (relatively undisturbed samples) obtained during the field investigation. A PARSONS geotechnical engineer assigned laboratory tasks after reviewing the test plan, field boring logs, and sample recovery. Section 4 provides a summary of test results.

3.3.1 Test Conditions for Undisturbed Samples

Triaxial compression and vertical permeability tests were performed on undisturbed samples from Shelby tube, Denison tube or Dames & Moore ring samples. Confining pressures for triaxial strength tests were chosen to simulate the approximate range of confining pressures anticipated in the field during excavation. For the consolidated undrained (CU) triaxial compression tests, the effective confining pressures used were 5, 10 and 25 psi. For the direct shear (DS) tests, the normal pressures used were 4.9, 9.7 and 25 psi. Single point

consolidated drained (CD) triaxial compression tests were performed at an effective confining pressure of 10 psi. Triaxial back pressure permeability tests (P_{ch}) were performed at an effective confining pressure of 5 psi with a constant head of 2 psi.

3.3.2 Test Conditions for Remolded Specimens

Two permeability (P_{ch}) tests were performed on test specimens remolded sand soils from disturbed split-spoon samples. The samples were remolded to estimated in situ condition based on overburden depth and Standard Penetration blowcount data for the sample. Table 3-2 lists test conditions for these remolded permeability tests. Additionally, sand from a split-spoon sample (G3-006[13-15']/#412374) was combined at the laboratory with disturbed portion sand material from a Dames & Moore sample (G3-006[15-17']/#412376) to perform a remolded CD test. The sample was remolded to a target density measured from the Dames & Moore ring samples (G3-006[15-17']/#412375) that underwent a direct shear test.

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Table 3-1 - Summary of PO-177 Geotechnical Laboratory Program Tests

Test Method	Title	GSTP Test Code
ASTM D 2216	Method for Laboratory Determination of Water Content of Soil and Rock (oven method)	MC
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils	AL
ASTM D 422	Test Method for Particle-Size Analysis of Soils[1]	GS
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort	SP
ASTM D 5084	Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter	P_{ch}
ASTM D 2166	Test Method for Unconfined Compressive Strength of Cohesive Soil	UCS
ASTM D 3080	Test Method for Direct Shear Test of Soils under Consolidated Drained Conditions	DS
ASTM D 4767	Test Method for Consolidated-Undrained Triaxial Compression Test on Cohesive Soils (with pore pressure measurements)	CU
ASTM D 4767	Modified Test Method D 4767 for Consolidated-Drained Triaxial Compression Test	CD

Notes:

1 Specific gravity tests were performed in conjunction with hydrometer tests (i.e., grain-size analyses)

Table 3-2 - Test Parameters for Remolded Permeability Tests of Sand Samples

Boring	G3-004/12269	G3-005/12270
Depth	15 - 17 feet	13.5 - 15.5 feet
Effective Confining Pressure	15 psi	14 psi
Target Remold Dry Density	110 pcf	112 pcf
Constant Head	2 psi	2 psi

SECTION 4

SUMMARY OF LABORATORY TEST RESULTS

This section summarizes the results of the geotechnical laboratory testing conducted by ATT for the PO-177 Geotechnical Investigation. These data are presented in a series of tables found in Appendix F that incorporate the sample's identifier as well as the sample's color, Unified Soil Classification System (USCS) group symbol, and USCS group name. Additional details for individual tests can be found in the laboratory data sheets compiled in a five-volume data report entitled *Former Plant Area Geotechnical Investigation, Geotechnical Laboratory Data Report* (SAIC 1997). Appendix K, Table K-1 presents a summary of the PO-177 laboratory test data by the in-place sediment categories (general strata) listed in Section 1.4.

4.1 Index/Classification Test Results

Moisture content tests (ASTM D 2216) were performed on selected samples to provide soil moisture profiles of the G3-series borings. Moisture content was also determined as a routine part of test procedures for strength and permeability. Plasticity tests (ASTM D 4318) and grain-size analyses (ASTM D 422) were conducted for soil classification (ASTM D 2487) and to evaluate the hydraulic conductivity characteristics of the coarse-grained samples tested. Appendix E presents typical grain-size curves. Table F-1 (Appendix F) presents a summary of the moisture content test results for samples tested from borings G3-001/12266 through G3-010/12275. Table F-2 (Appendix F) presents index properties of the G3-series boring samples and the RI archive samples tested during the PO-177 laboratory testing program including Liquid Limit, Plastic Limit, Plasticity Index, grain-size, and specific gravity of the soil. Specific gravity tests were performed on the minus No. 10 sieve fraction of the soil samples.

4.2 Unit Weight Test Results

Wet and dry unit weights of the soils were determined in conjunction with other laboratory tests (i.e., permeability, unconfined compressive strength, and triaxial compression tests) and are presented in Table F-3 (Appendix F).

4.3 Undisturbed Strength and Permeability Test Results

This subsection summarizes the results of geotechnical laboratory strength tests performed on undisturbed samples collected from the G3-series borings during the PO-177 Geotechnical Investigation.

4.3.1 Unconfined Compressive Strength Tests

Unconfined compressive strength tests (ASTM D 2166) were performed on samples of cohesive materials from Shelby tube, Dames & Moore, or Denison samples. The results of these tests are presented in Table F-4 (Appendix F). Two samples (designated 412305 and 412381) exhibited considerably higher strengths than all other samples. The moisture content for these samples were significantly lower than most all other samples and showed a liquidity index well below zero, indicating moisture contents are well below the plastic limit.

This suggests a high degree of overconsolidation which would contribute to higher strengths. Cementation due to some degree of carbonate content in these soils may also contribute to higher strengths.

4.3.2 Consolidated Undrained (CU) Triaxial Compression Tests

Consolidated, undrained compressive strength tests (with pore pressure measurements) (ASTM D 4767) were performed on specimens from undisturbed samples. For each test, three specimens from a Shelby tube or Denison sample were tested under varying confining pressures to determine the effective and total shear strength parameters. When three specimens could not be obtained, a staged test was performed on a single specimen. Table F-5 (Appendix F) summarizes the cohesion and friction angles from Mohr circle constructions. Appendix G contains the Mohr strength envelopes.

4.3.3 Direct Shear Tests

Three-point direct shear tests (ASTM D 3080) were conducted under consolidated drained conditions on samples from a Shelby tube and a Dames & Moore ring sample. Table F-6 (Appendix F) summarizes the cohesion and friction angles from Mohr circle constructions. Appendix G contains the failure envelopes.

4.3.4 Consolidated Drained (CD) Triaxial Compression Tests

A single point, consolidated drained triaxial compression test (ASTM D 4767) was conducted on samples from a Shelby tube. The test was run on sample material that also underwent a direct shear test to allow for comparison of results of the friction angles obtained from the different test methods. Table F-6 (Appendix F) summarizes the results from Mohr circle constructions. Appendix G contains the Mohr strength envelope.

4.3.5 Triaxial Back-Pressure Permeability Tests

Triaxial permeability tests were performed on samples from Shelby tubes. Table F-7 (Appendix F) summarizes the test results.

4.4 Remolded Strength and Permeability Test Results

This subsection summarizes the results of geotechnical laboratory strength and permeability tests performed on remolded samples collected from the G3-series borings during the PO-177 Geotechnical Investigation. The permeabilities were determined by ASTM Test Method 5084 which used a triaxial test chamber to perform the test.

4.4.1 Remolded Consolidated Drained (CD) Triaxial Compression Tests

A single point, consolidated drained triaxial compression test (ASTM D 4767) was conducted on sand material from a split-spoon sample (G3-006[13-15']/#412374) that was combined at the laboratory with disturbed portion sand material from a Dames & Moore sample (G3-006[15-17']/#412376). The sample was remolded to a target density based on the undisturbed portion of the Dames & Moore ring sample (G3-006[15-

17']/#412375) that underwent a direct shear test. Table F-6 (Appendix F) summarizes the results from Mohr circle constructions. Appendix G contains the Mohr strength envelope.

4.4.2 Remolded Triaxial Back-Pressure Permeability Tests

Two triaxial permeability tests were performed on sand from split-spoon samples. The criteria for remolding the sample are listed in Table 3-2. Table F-7 (Appendix F) summarizes the test results.

4.5 Compaction Test Results

Standard Proctor compaction tests were performed soil materials from bulk samples of auger cuttings collected during the PO-177 geotechnical investigation. Table F-8 (Appendix F) summarizes the results of these tests. Appendix H contains the compaction curves.

SECTION 5

EVALUATION, ANALYSES, AND RECOMMENDATIONS

This section describes the engineering evaluations and analyses performed to support preliminary design recommendations for excavation and site restoration of the FPA. The evaluations and analyses are based on site-specific data from the geotechnical investigations described previously, and on supplemental technical data and methodologies, as required, from engineering literature. Also included are PARSONS' recommendations regarding specific preliminary geotechnical and civil engineering design aspects of the proposed FPA remediation requested by FDF under PO-177 (PARSONS 1997). These design recommendations are general in nature with the actual design and construction details to be defined during remedial design.

The recommendations in this report are based on soil data at test boring locations which are assumed to be representative of the FPA site. However, the actual area of the test borings is small and finite in relation to the area of the site, and the soils encountered are not necessarily typical for the entire site.

5.1 Subsurface Conditions Evaluation

Discussion of the subsurface conditions evaluation is structured in the following sections beginning with the general characteristics of the five categories of material, and continuing with a more specific discussion of each of the four quadrants shown on Figure 1-3 identified in Section 1.4. Discussions of the quadrants begin in the NE and continue to address each quadrant in turn in a clockwise direction with the SE quadrant next, followed by the SW, and finally the NW quadrant. Figure 5-1 shows boring and section line locations. Figures 5-2 and 5-3 show geologic cross-sections for the FPA.

5.1.1 General Characteristics of Subsurface Materials

For discussion and evaluation, the soil materials at the FEMP site can be generalized into the following general categories described below. Geotechnical parameters for soils comprising the in-place sediment categories (generalized strata) are summarized in Appendix K. The hydrogeologic parameters for the soils are summarized in Appendix L. Grain-size curves for typical sediments can be found in Appendix E.

Fill

Fill typically consists of mixtures of earth materials comprised of the other four categories of on-site materials identified within the study area; that is to say that they are composed of varying assemblages of clay, silt, sand, and gravel. These mixtures have been moved and/or mechanically placed, and are typically moist with a wide range of consistencies and thickness. It can be anticipated that during excavation of the upper few feet of fill materials, a greater abundance of gravel is expected compared to other types of earthen materials that comprise the fill. Gravel was imported for use in building pads and road subgrade.

Muddy Stream Deposits

These deposits are equivalent to the coarse-grained lenses and channels of the Till as described in the OU5 RI (DOE 1995b) and are often stratified in appearance. Although many deposits at the FEMP can be categorized as stratified at some scale, for the purpose of this discussion most of the Muddy Stream Deposits are characterized by deposits of interbedded silt, sand and gravel with bed thicknesses on the order of feet. The generally quartzose and sometimes clayey sands range from well-sorted to poorly-sorted and often contain accessory mafic minerals such as biotite and horneblende. The sands range from fine-grained to coarse-grained. As seen on Figure 1-6, the areas labeled Muddy Stream Deposits are considered generally to be stratified sediments, and can be correlated with boring log identifications that result in typically coarse-grained textures in multiple layers. The coarse-grained Muddy Stream Deposits range in relative density from loose to very dense, and are moist to wet.

Lacustrine Deposits

As described in the OU5 RI, "the lacustrine deposits consist of distinct thin layers of clay and silt with some sand and gravel in less distinctive layers. Lake clay, in field descriptions, is distinguished from till clay by the lack of sand and gravel within the clay layer."

In addition, many of the coarse-grained sediments in the FDF Coarse-grained Model are present in the western half of the FPA and correspond to the area defined in the OU5 RI as Lacustrine Deposits. Included in this, from this study, would be "varved" sediments which are interbedded and laminated sediments composed of sand, silt, and clay mixtures generally with bedding thicknesses on the order of fractions of an inch to one foot (NAVFAC DM 7.1). These are not typical lacustrine varves, which are consistently fine-grained layers of dark and light sediment representing seasonal deposition of material (winter and summer), but are glacial varves (Picard and High, 1970). Glacial varves contain coarser material than lacustrine varves which is reflected by the variations in water currents and velocities due to freezing and thawing episodes during the period of glacial retreat. Numerous borehole logs indicate that glacial varves are present throughout the western half of the FPA, further supporting the OU5 RI contention that the area represents a glacial lacustrine environment. Glacial varves have been encountered only rarely in the eastern portion of the study area, indicating sediment in that part of the site was not deposited under lacustrine conditions. The Lacustrine Deposits in the subsurface of the FPA exhibit a wide range of consistencies, densities, and moisture contents; from soft to stiff, loose to very dense, and moist to wet.

Brown Clay

The Brown Clay consists predominantly of low to medium plasticity silt/clay mixtures with localized areas of high plasticity clay or silt. The till matrix commonly has scattered gravel throughout, some locally, with silty or clayey sand lenses. Typically the Brown Clay unit is stiff to very stiff, and moist. The Brown Clay is likely a combination of till materials and possibly loess, though the OU5 RI indicated that loess deposits were present only to the north and east of the FPA. The gradations for the Brown Clay materials can be found in Appendix E.

000045

Gray Till

The Gray Till consists predominantly of low-plasticity sandy clay mixtures with scattered gravel throughout. Sand, silty sand, or clayey sand lenses with scattered gravel are present locally. This unit, which generally has low permeabilities as indicated in the OU5 RI, is believed to be the separation between the perched groundwater zone and the Great Miami Aquifer. Typically, the clays of the till are very stiff to locally hard, and moist. The gradations for the Gray Till can be found in Appendix E.

5.1.2 Northeast Quadrant

Figure 5-1 shows that borings G3-001/12266 and G3-003/12268 are located in the NE quadrant as well as portions of geologic sections C-C', D-D', E-E', and F-F'. Each of the borings, and the appropriate portions of the cross sections are discussed below. The boring logs can be found in Appendix C.

Borings (PO-177)

Boring G3-001/12266 is located in the far NE corner of the NE quadrant. Stratigraphy noted within the boring consists of approximately 9 feet of Brown Clay underlain by Gray Till to a total depth of 26 feet (bottom of borehole). From a depth of about 6 to 11 feet is a zone of alternating layers of clayey sand, silt, silty clay, and sand typical of the Muddy Stream Deposits and depicted in the FDF Coarse-grained Model. A zone of alternating fine-grained to coarse-grained sand and clay is apparent from about 17 to 22 feet. This zone would also classify as Muddy Stream Deposits. Below 5 feet all materials are wet, which indicates the extent of the Perched Water Zone in this area of the FPA. Soil consistency ranged from stiff to hard from 1 to 22.5 feet and is soft below 22.5 feet.

Boring G3-003/12268 is located in the central area of the west half of the NE quadrant. Stratigraphy identified in the boring consists in general of a nearly continuous section of sandy clay, with gravel becoming more evident below a depth of about 9 feet. This boring was advanced in Brown Clay to 8.5 feet and Gray Till from 8.5 feet to total depth. As expected from both the FDF Model and PARSON's interpretation, no Muddy Stream Deposits were encountered in this boring, the sediments being typical of clayey Till deposits. The clays are wet between 9 to 15 feet and 23 to 25 feet, and at all other depths the clays are moist. Plasticity measurements of the clays are generally low throughout the borehole with consistencies typically varying from stiff to very stiff.

Sections

Figure 5-1 shows the portion of Section C-C' that transects the NE quadrant and extends from the location of boring 1355 east to boring 1320. This area has been subject to several feet of cut since 1952, with a maximum cut of about 10 feet in the area of boring 1317. Additional cut is planned in this area ranging from about 3 to 5 feet along the line of section.

The SW corner of the NE quadrant in the area of boring 1355 is located near the transition boundary between Muddy Stream Deposits toward the NE and Lacustrine Deposits toward the SW. Geologic Section C-C' east of the transitional boundary shows Muddy Stream Deposits at varying elevations between borings 1316 and 1320 at or below the proposed excavation depth (Figure 5-2). The geologic signature of the stream deposits

depicted in Section C-C' is typical of the stream deposit signature throughout the area of the FPA. These deposits were laid down during a time of glacial retreat according to the OU5 RI and because of that, there would have been a fluctuation in both flow rate and depositional capability of the streams based on seasonal climatic effects, especially over a long period of time as would be expected for the thickness of the glacial deposits at the FEMP. The stream deposit between boreholes 1315 and 1320, which is included as part of the proposed excavation activities has been aerially exposed by previous excavation activities.

As seen in Figure 5-1 the eastern half of Section D-D' transects the northern half of the NE quadrant in an east/west direction from boring 1340 in the west to about 100 feet east of boring 3421 in the east. Since 1952, the area along Section D-D' has been subject to cuts on the order of 3 to 5 feet with an area of fill between borings 11088 and 1288 with a thickness of about 2 feet. Additional excavation locally in excess of 10 feet is planned between borings 1340 and 1363 placing the base of the proposed excavation well within the stream deposits and locally up to about 3 feet below indicated water levels from boring data. East of boring 1363, the proposed excavation will generally be less than 5 feet.

The western edge of the NE quadrant near boring 1340 is in the middle of a stream deposit composed of silty sand, sand, and gravel that extends east toward boring 1363 which appears to be proximal to the eastern edge of the stream deposit along the line of section. Eastward from boring 1363 to boring 1284, subsurface materials are clays which comprise the Brown Clay and Gray Till. From the area just west of boring 1285, east to boring 1290, a distance of about 200 feet, there is another probable stream deposit which, from extrapolation of adjacent boring logs, lies both above and below the level of proposed excavation.

As seen in Figure 5-1, Section E-E' extends in a NE/SW direction along the general axis of a thick Muddy Stream Deposit. About 350 feet of the section crosses the NW corner of the NE quadrant between borings 1336 and 1272. In this area along the section, the coarse-grained sands and gravels of the stream deposit extend vertically from 570 to 580 feet. The deepest excavation along the section reaches to approximately 573 feet; cutting through the coarse-grained material of the stream deposit. Water levels have been indicated by boreholes to be at or just below 580 feet.

As shown in Figure 5-1, Section F-F' is a north/south section just east of the center of the NE quadrant. The portion of the section within the NE quadrant extends from boring 1116 in the south to boring 11086 to the north. The entire section within the NE quadrant has been subject to excavation cuts ranging from about 2 to 8 feet since 1952. The deeper cuts were made in the southern half of the portion of the section that transects the quadrant. Proposed excavation along the section will be in the clays of the Brown Clay unit and will remain above known coarse-grained deposits. A near-surface coarse-grained stream deposit has been identified near boring 1277. At this location, the deposit is about 1 foot below the proposed excavation elevation and about 3 feet above a borehole-indicated water level.

Excavation Conditions

In the Northeast Quadrant, four excavation areas are of chief concern (areas having a greater than 15-foot excavation depth). These excavations are shown in Figure 1-12. The excavation designated NE-A will extend to a depth of 22 feet, mainly in Muddy Stream Deposits comprised of sands and to a lesser extent, silts. Groundwater is to be expected from the perched water zone in the northern end of the excavation in the interval from 5 to 12 feet below ground surface.

Excavation NE-B will extend to a depth of 26 feet and should be confined to glacial clays, both the Brown Clay unit and the Gray Till. It is not likely that any significant water-bearing zones will be encountered in this area of excavation.

Excavation NE-C will extend to a depth of 16 feet in Muddy Stream Deposits. Water-bearing sands are likely to be encountered from 6 to 12 feet. Area NE-D is proposed to excavate to a depth of 20 feet. This area will encounter Muddy Stream Deposits and likely permeable, water-bearing zones from the interval of 8 to 14 feet below ground surface.

The excavation bottom materials at NE-B, NE-C, and NE-D are anticipated to mostly consist of moist lean clay to sandy lean clays. The excavation bottom material at NE-A at the maximum depth (22 feet) is anticipated to consist of lean clay to sandy lean clay; whereas the shallower portions of the NE-A excavation will consist of a combination of interbedded wet silt and clay and areas of wet sand. The wet silts and sands will prove difficult to track with construction equipment. Pan-type excavators may need dozer assistance to traverse these areas, or these areas may require excavation by trackhoe.

It is anticipated that these excavation side slopes will be most similar to those simulated by excavations NE-A and NE-B in the slope stability analyses. However, other conditions could also be encountered within the excavations.

5.1.3 Southeast Quadrant

Figure 5-1 shows boring G3-009/12274 and portions of sections F-F' and G-G' as identified in the SE quadrant. Boring logs can be found in Appendix C.

Borings (PO-177)

Boring G3-009/12274 is located in the eastern edge of the quadrant and was advanced in Fill (upper 1 foot), Brown Clay to a depth of 11 feet, a two-foot bed of Muddy Stream Deposits (11 to 13 feet), and Gray Till to a depth of 19 feet. The lithologies encountered in Boring G3-009 corroborates the sand and silt units that were identified in adjacent borings in this area. It appears that this boring is located in one of the Muddy Stream Deposits that may have fed sediment into the Pleistocene glacial lake. No producing water zone was encountered in this boring, though moist sediments were noted throughout. The clay ranges from stiff to very hard in consistency and is generally a low plasticity type clay typical of the glacial Till deposits at the FEMP.

Sections

The portion of Section F-F' within the SE quadrant extends from the southern boundary of the quadrant (near boring 11110) to the area of boring 1116. Along this part of the section, the maximum depth of proposed excavation is about 15 feet which is below the Brown Clay/Gray Till interface. Some coarse-grained deposits of sand and sand-silt mixtures are at or near the interface. Elsewhere along this portion of the section there are locally identified zones of silt and sand/silt mixtures such as those identified in borings 2054, 12023, and 1114 respectively. Projection of boring 1114 into the section reveals a layer of 1-foot thick clayey silt near the base of the proposed excavation and a 1-foot thick layer of well graded sand less than ten feet below the proposed excavation depth.

The eastern half of Section G-G' extends from the area of boring 1154 to the area of boring 3120. Although coarse-grained stream deposits exist along this part of the section, in large part they are below the proposed depth of excavation. From borings 11829 to 2389 coarse-grained sediments are within about one foot of the excavation elevation. In the eastern half of the SE quadrant along the Section G-G', the proposed excavation will intercept several stream deposits between borings 1114 and 1111. Near borings 1608 and 1159 coarse-grained materials will be encountered in the bottom four feet of the excavation. These deposits are generally composed of silt, and silt/clay mixtures. Wet clayey gravel was encountered in boring 1111, about 2 feet below the proposed excavation depth.

Excavation Conditions

Four excavations will be made to a depth of over 20 feet in this quadrant (Figure 1-12). Excavations SE-A, SE-C and SE-D will all occur within a mix of probable Muddy Stream Deposits and glacial clays. In SE-A, water is likely to be encountered in sands and silts from a depth interval of 10 to 14 feet. In SE-C, water bearing sands and silts are likely to be encountered in localized sections of the excavation. In SE-D, localized water-bearing zones may be encountered with the main controlling factor being silts.

Excavation SE-B is mainly outside of the mapped Muddy Stream Deposit and will likely not encounter a sizeable water-bearing zone.

The bottom of excavation SE-B is anticipated to be mostly lean clay or sandy lean clay. Excavations SE-C and SE-D are anticipated to have bottom materials consisting mostly of lean clay with isolated areas of wet sand and silt. Excavation SE-A is anticipated to have bottom materials consisting mostly of damp to wet sands in the north and south portions and lean clay to sandy lean clay in the central portions. The wet silts and sands will make it difficult for rubber-tired vehicles to traffic these areas. As a result, pans may need to be pushed using bulldozers or excavations may have to be performed using trackhoe or similar equipment.

It is anticipated that these excavation side slopes will be most similar to those simulated by excavations NE-A and NE-B in the slope stability analyses. However, other conditions could also be encountered within the excavations. The conditions encountered in north and south portions of SE-A may be more similar to excavation NW-A in the slope stability analyses.

5.1.4 Southwest Quadrant

Figure 5-1 shows that borings G3-005/12270, G3-007/12272, G3-008/12273, and G3-010/12275 are located within the SW quadrant, as well as portions of sections A-A', B-B', and G-G'. The boring logs can be found in Appendix C.

Borings (PO-177)

Boring G3-005/12270, located in the central and western half of the southeast quadrant, was advanced to a depth of 29 feet, encountering a sediment mix typical of the Lacustrine Deposits as noted in the OU5 RI. Brown Clay is present from the surface to 8 feet, then a mixture of silts and sands predominate to 23 feet (Lacustrine Deposits) and Gray Till is encountered from 23 feet to total depth with a few, thin interbedded clayey sands. In the interval from 16 feet to 23 feet, coarse-grained Glacial Varves are present. Sands and

silts are wet below 9 feet. Water was measured in the borehole at 5.8 feet below the ground surface. Most brown sands are poorly sorted, most gray sands well sorted. Clays are generally of low plasticity and soft to hard in consistency.

Boring G3-007/12272, located south of G3-005/12270 near the center of the southwest quadrant, was also drilled in the Lacustrine Deposits of the OU5 RI. Brown Clay is present to 7 feet, then a series of sands, silts and clays are encountered to a depth of 23 feet (Lacustrine Deposits). Glacial Varved Units were encountered from 10 to 15 feet. Below 23 feet, Gray Till is present. Sands and silts are wet below 7 feet. Sands are generally poorly sorted and contain components high in mafic minerals. Clays are of low to medium plasticity and stiff to very hard in consistency.

Boring G3-008/12273 is located east of G3-007 (east-central portion of the southwest quadrant) and was advanced in the Lacustrine Deposits of the OU5 RI. Brown Clay is noted to 13 feet with two, thick wet sand lenses present at roughly 8 and 10 feet. Gray Till is present below 13 feet with two wet sand units interbedded at 17 to 19 feet and 24 to 26 feet respectively. The sands are poor to well sorted. Clays are generally of low plasticity. Consistencies range from stiff to very stiff, except for a gray fat clay at a depth of 21 feet which is very soft to soft and contains a medium to high plasticity.

Boring G3-010/12275 is located near the bottom-left corner of the quadrant. It was advanced in Lacustrine Deposits as indicated by the sediment recovered though the coarser-grained units were deeper than in the other three borings. Brown Clay is present to 15 feet with only one 2-inch sand seam at about 9 feet. At 15 feet, a series of interbedded clays and silts are present to the total depth of the boring at 21 feet. The unit appears to be Glacial Varves. The clayey silt units below 15 feet are wet. Clays are generally stiff to hard with a low plasticity. The exception is a brown fat clay between 3 to 5 feet which was soft with a medium plasticity.

Sections

The south half of Section A-A' generally bisects the SW quadrant in a north/south direction. The portion of Section A-A' within the SW quadrant displays a consistent profile composed in general of up to 5 feet of fill underlain by a thick section (up to 22 feet) of generally wet, interbedded layers of Lacustrine Deposits (silt/clay mixtures, silt, sand, and scattered gravel). The proposed excavation will extend to a depth of about 20 feet along this line of section, and as a result will be predominantly in wet, Lacustrine-type sediments.

The southern portion of Section B-B' from boring 1403 in the south to boring 1130 in the north, extends in a north/south direction near the eastern boundary of the quadrant. Excavation along this section generally remains well within the Brown Clay and above the Lacustrine Deposits. Two exceptions exist: 1) Between boring 1403 and boring 1840, the proposed excavation will dip below the Brown Clay/Gray Till interface intercepting the units of the Lacustrine Deposits as well as extending about 5 feet below water levels as indicated by boring logs. 2) In the area of borings 2007 and 1305, the proposed excavation dips into what are probable Lacustrine Deposits, though this area is close to the transitional boundary between the Lacustrine Deposits and the Muddy Stream Deposits. At its deepest point, the excavation will be below the water elevations as indicated by the boring log of 2007.

Section G-G' extends in an east/west direction across the central portion of the SW quadrant from boring 2042 to boring 1237. East of boring 12161, the depth of proposed excavation descends 20 feet below the existing ground surface and continues at about this depth to boring 1237. Throughout the entire area of this relatively deep excavation, materials which will be encountered generally consist of saturated Lacustrine Deposit sediments. Borehole log data in this area shows that the proposed depth of excavation will be about 15 feet below the indicated water levels.

Excavation Conditions

Three major excavation zones are noted in Figure 1-12 for the Southwest Quadrant. These excavations are SW-A (26 feet), SW-B (24 feet) and SW-C (26 feet). All three excavation zones will occur in primarily Lacustrine Deposits which will be comprised of both layered and massive sands, silts and clays. All excavation areas are expected to encounter significant thicknesses of water bearing zones. Water bearing zones will range from a few feet in thickness to over 15 feet in thickness. Sands will be a primary water source, but silts will also contribute. Glacial clays will be mainly restricted to the first 5-7 feet of the excavations and below 15 feet.

The bottom materials in excavations SW-A, SW-B and SW-C will consist of a mixture of wet silt, wet sand, and moist lean clay to sandy lean clay. Some wet soft to medium stiff clay areas should also be anticipated. The wet silt, sand and clay zones will be difficult to track with rubber-tired equipment, unless dewatering schemes are utilized.

According to the boring logs and cross-sections, it is anticipated that the slopes simulated by excavations SW-A (borings 1339 and 12272) in the slope stability analyses best represent the anticipated side slope conditions in the southwest quadrant. Due to the amount of sand encountered in the northwest quadrant, shallow sloughing failures will occur in saturated sands (due to precipitation, surface run off, or groundwater seepage) and should monitored during construction to ensure that they do not cause deeper failures by unloading the toe portions of slopes.

5.1.5 Northwest Quadrant

Borings G3-002/12267, G3-004/12269, and G3-006/12271 are located in the northwest quadrant, as well as portions of Sections A-A', B-B', C-C', D-D', and E-E'. The boring logs can be found in Appendix C.

Borings (PO-177)

Boring G3-002/12267, located in the north-central portion of the northwest quadrant, was advanced in Fill (0 to 2 feet), Brown Clay to 7.5 feet, Gray Till with interbedded silt from 7.5 to 13 feet and gravelly Gray Till to 25 feet. The silts are moist to wet. Below 11 feet the materials are generally wet. Clays are stiff to hard with no to low plasticity. The silts are believed to be indicative of the Muddy Stream deposits in the north of the FPA, which appear from adjacent boring logs to be silty in composition.

Boring G3-004/12269 is located in the south-central portion of the NW quadrant. Fill is present from 0 to 1 foot. Brown Clay is present from 1 foot to 9 feet. Thin interbedded clays and silts are present from 9 to 14 feet. From 14 to 21 feet, sands predominate over gray silts and clays. Below 21 feet, the Gray Till is the

dominant lithology. This boring was advanced in the Lacustrine Deposits as typified by the lithologies encountered. Probable Glacial Varves are present from 9 to 13 feet. Silts and sands are wet below 9 feet. Sands are poorly sorted. Clays are generally moist, stiff to very stiff and have a low to medium plasticity. A fat clay at 23 feet is very soft to medium stiff, with a high plasticity.

Boring G3-006/12271 is located to the east of G3-004, near the southeast corner of the northwest quadrant. Fill is present from 0 to 1 foot. Brown Clay is present from 1 to 12.5 feet. Interbeds of sand, silt and clay occur from 12.5 feet to 19.2 feet. Gray Till is present from 19.2 feet to total depth at 27 feet. This boring is located within the Lacustrine Deposits of the OU5 RI, close to the transitional zone of the Muddy Stream Deposits of this report. From 12.5 feet to 15 feet, coarse-grained Glacial Varves are apparent. Silts and sands are wet below 13 feet, the sands poorly sorted. Clays are generally low in plasticity and stiff to very stiff in consistency.

Sections

The northern half of Section A-A' bisects the NW quadrant. Near boring G3-004/12269, the subsurface materials are typical of the Lacustrine Deposits of the OU5 RI. Continuing north along the section to boring G3-002/12267, the Lacustrine units transition into Muddy Stream Deposits. Beneath boring G3-002/12267, the materials are generally clays typical of the Brown Clay and the Gray Till, but a section of Muddy Stream Deposits is also present. With the notable exception of the vicinity of boring G3-004/12269, the proposed depth of excavation remains well within the Brown Clay unit and above the stream deposits. In the area of G3-004, however, the proposed excavation dips about 10 feet into the Lacustrine Deposits some 8 to 10 feet below the water levels as indicated by boring log reports.

The northern half of Section B-B' extends along the eastern boundary of the NW quadrant. At boring 1305 the stratigraphy is comprised of typical Brown Clay/Gray Till clays with the subtle exception of a layer of sand and sand-silt mixtures associated with the Lacustrine Deposits located near the bottom of the boring. The proposed excavation remains within the Brown Clay deposits along this part of the section, except between borings 1344 and 1340. Between these borings, the excavation will extend less than ten feet into the Gray Till, and will intersect sediment composed of Muddy Stream Deposits.

The western half of Section C-C' is located near the southern boundary of the NW quadrant. Stratigraphy in this area consists of a layer of Lacustrine Deposits between the Brown Clay and the Gray Till. The proposed excavation generally remains far above the Lacustrine Deposits except between borings 1352 and 1353. The excavation appears to remain above indicated water levels as shown on the section (from boring log data).

Sections D-D' and E-E' depict a complex system of interlayered sediments and transitional zones that include the Lacustrine Deposits, Muddy Stream Deposits, the Brown Clay and Gray Till. Along Section D-D', an extensive deposit of Muddy Stream sediments lie above the gray till and the elevation of the Lacustrine Deposits. The proposed excavation will be generally above these silty and sandy sediments, with the exception of the area near boring 11194 and borings 11208, 11116, 11114, 11112 and 1339. In this area, the water elevations as indicated by boring logs, will be above the base of the excavation.

Along Section E-E', the Lacustrine Deposits are transitional with the Stream Deposits, all of which are overlain by the materials of the Brown Clay and underlain by the Gray Till. The proposed excavation along section E-E' is expected to remain above the Lacustrine Deposits and the stream deposits. Water levels, as shown by borehole logs, are above the level of the proposed excavation.

Excavation Conditions

Three primary excavations are proposed for the Northwest Quadrant, NW-A, NW-B and NW-C (see Figure 1-12). NW-C should be considered as the northern part of SW-A (Southwest Quadrant) and accordingly is described as being in Lacustrine Deposits as detailed in the previous section for SW-A.

Excavation NW-A is an area to be excavated to a depth of 14 feet in chiefly Lacustrine Deposits, but it is near to the transition zone between the northernmost Muddy Stream Deposit and the Lacustrine Deposits. Water will be encountered from a depth of approximately 6 feet to 14 feet. The main water-bearing, lithologic unit will be sands.

Excavation NW-B is proposed to go to a depth of 18 feet, primarily in Lacustrine Deposits. Water bearing zones will be encountered from depths around 10 feet to the bottom of the excavation. The chief lithology for the water-bearing zones will be Lacustrine sands.

Bottom conditions at excavation NW-A will mostly consist of wet sand with isolated areas of clay. The bottom materials at excavations NW-B and NW-C will mostly consist of lean clay to fat clay with isolated areas of clayey sand. The lean clays should support rubber tired equipment, provided water is controlled and not allowed to soften the clays. The wet sands will provide poor support for rubber-tired equipment unless dewatering is performed.

It is anticipated that the simulated SW-A and NW-A slopes from the slope stability analyses will best represent the excavations within the northwest quadrant. Due to the amount of sand encountered in the northwest quadrant, shallow sloughing failures will occur in saturated sands (due to precipitation, surface run off, or groundwater seepage) and should be monitored during construction to ensure that they do not cause deeper failures by unloading the toe portions of slopes.

5.2 Slope Stability of Excavations

This section summarizes the results of slope stability analyses performed to evaluate the temporary and long-term stability of excavated slopes at the FPA.

5.2.1 Analysis of Open Excavation Excavated Slopes

According to published literature (Duncan, Buchignani, and De Wet, 1987), excavation slopes of large open excavations should be analyzed using three cases, which are:

1) Short-Term Conditions (undrained analysis, $\phi_u=0$ for saturated cohesive soils),

2) Long-Term Conditions (drained or ϕ' and c' analysis), and

3) Rapid Drawdown Conditions.

5.2.1.1 Short-Term Analysis

The short-term analysis models the undrained, after construction condition. In this case it is assumed that there has not been adequate time to allow dissipation of the excess pore pressures which are developed as a result of the excavation activities. Undrained shear strengths of cohesive soils can be determined using either Unconsolidated-Undrained triaxial compression tests or Unconfined Compression Strength tests, which represents the $\phi=0°$ case. For sands, total stress values from Consolidated-Undrained triaxial tests can sometimes be used, although it is common practice to treat well-drained soils in terms of effective stresses, even for short-term analyses.

For cohesive soils, a $\phi=0°$ approach was used to evaluate the short-term (undrained) conditions for the cohesive soils. Unconfined compression strength (UCS) and unconsolidated-undrained (UU) triaxial compression test results were used to establish the undrained shear strength parameters of the cohesive soils. The UCS and UU tests are the most appropriate tests for the unconsolidated-undrained state present in the short-term condition. Past experience in similar soils in the southwest Ohio area indicates that total stress conditions at cut slopes should be based upon UCS and UU test results. The total stress parameters used for analyses of the cohesive soils (Table 5-2) were conservative when compared with the results of the UCS and UU test results (Appendices Tables A-4, A-6, and F-4). For cohesive soils, the use of total stress results from consolidated-undrained (CU) triaxial compression tests is only appropriate when considering intermediate cases of well-defined, phased construction activities. Use of CU total strength parameters would result in unconservative, higher factors of safety against temporary slope failure in cohesive soils.

For the cohesionless silt and sand soils, the total stress CU results were used to represent the short-term conditions. The total stress shear strength parameters for cohesionless soils (Table 5-2) used to evaluate the cut slopes are conservative when compared to interpreted parameters from the CU test results and the effective stress parameters (Appendices Tables A-5 and F-5).

5.2.1.2 Long-Term Analysis

Long-term analyses assume that the pore pressures within granular and fine-grained soils are allowed to dissipate from the soils. Effective stress shear strength values for cohesive soils can be estimated using Consolidated-Undrained triaxial compression tests and for granular soils using Consolidated-Undrained, Consolidated-Drained triaxial compression tests or direct shear tests.

The shear strength parameters used for the long-term analysis of the cut slopes in cohesive soils were estimated using the effective stress results from the CU tests. The shear strength parameters used to evaluate the long-term stability of the cohesive soils (Table 5-2) were conservative compared to the average values from the effective stress results of the CU tests (Appendices Tables A-5 and F-5).

The shear strength parameters from the long-term analysis of the cohesionless soils (silts and sands) were estimated using the effective stress results from the CU tests, Consolidated-Drained (CD) triaxial compression tests, and direct shear tests. The effective stress results for the silts were reduced since all laboratory tests were performed on sandy silts, which would have higher ϕ values than silt soils with no sand. The shear

strength values for the Great Miami Aquifer sand and gravel were taken from the PO-140 slope stability analysis (Parsons 1995b).

5.2.1.3 Rapid Drawdown Analysis

The rapid drawdown condition assumes the slope is consolidated under one loading condition and is then subjected to a rapid change in loading, such that excess pore pressures are not allowed to dissipate (such as rapid pumping of excavations during excavation operations). The shear strength values for this case can be interpreted from the Consolidated-Undrained triaxial compression tests, using the total stress analysis for cohesive soils and silts and using the effective stress analysis for free-draining sands.

The proposed interim excavated slopes (i.e., prior to site certification and final grading) in the FPA were analyzed for the short-term and long-term conditions only. However, the long-term permanent slopes were analyzed for rapid drawdown conditions. This models the rapid drawdown case, provided that a minimum 2 feet free-board is maintained in the ponds or lakes. Shear strength parameters for the cohesive soils and silts were obtained from the total stress results of the CU tests. Shear strength parameters for the free-draining sand soils were obtained from the effective stress results of the CU tests, CD tests, and the direct shear tests.

5.2.1.4 Method of Slope Stability Analyses

Stability of the slopes was analyzed using limit equilibrium methods. The Janbu Generalized Procedure of Slices was used to find the critical circular slip surface. The Janbu method was chosen because it satisfies all conditions of equilibrium (horizontal, vertical, and moment). The analyses were performed using slope stability analysis software XSTABL version 5.101a by Interactive Software Designs, Inc. 1994.

5.2.2 Geotechnical Parameters

The encountered subsurface soils within the FPA included existing fill, brown clay, gray glacial till, muddy stream deposit or lacustrine sand, silt and clay, and sand and gravel deposits of the Great Miami Aquifer, according to current and previous test borings. Geotechnical parameters necessary for performing a slope stability analysis include both unit weight and shear strength parameters. Data for determining these parameters were taken from several sources which are mentioned in Sections 2.0 and 4.0. In addition, data from PARSONS PO-161, OU-4, *Silos Superstructure Geotechnical Design Investigation* (PARSONS 1996a), was also used in determining unit weight and shear strength parameters.

5.2.2.1 Soil Unit Weight

Representative, wet and saturated unit weights were selected based on available undisturbed test samples and a couple published values for typical soils. Referenced values were used for two granular soils. One published value was used for the Great Miami Aquifer (GMA), since laboratory test data was not available. The second published value was used for the muddy stream and lacustrine sands, since all available data were for clayey sands. A majority of the sand samples tested were classified as silty sand, poorly graded sand or well graded sand. Therefore, the literature values better estimate the actual conditions. Table 5-1 outlines the unit weight values used for the slope stability analysis of the excavation slopes.

Table 5-1 - Wet and Saturated Unit Weights of Soils used in the Excavation Slope Stability Analyses

Soil Type	Wet Unit Weight (lb/ft^3)	Saturated Unit Weight (lb/ft^3)
Fill *	123	125
Brown Clay	130	133
Gray Till	135	140
Muddy Stream and Lacustrine Sand *	133	135
Muddy Stream and Lacustrine Silt	125	127
Muddy Stream and Lacustrine Clay	122	125
Great Miami Aquifer Sand and Gravel *	135	140

* Typical values reported in Holtz and Kovacs, 1981.

5.2.2.2 Shear Strength Parameters

As mentioned earlier, the other necessary geotechnical parameter required for slope stability analysis is shear strength. Table 5-2 reports the total stress (short-term/undrained), effective stress (long-term/drained) and rapid drawdown shear strength parameters used in the excavation slope stability analyses. These values are based upon data sources and selection methods reported earlier in Section 5.2.1.

Table 5-2 - Soil Shear Strength Parameters (Short-Term, Long-Term and Rapid Drawdown) used for the Excavation Slope Stability Analyses

Soil Type	Short-Term Parameters (Undrained)		Long-Term Parameters (Drained)		Rapid Drawdown Parameters	
	ϕ_u (deg)	c_u (psf)	ϕ'(deg.)	c'(psf)	ϕ(deg.)	c(psf)
Fill	0	800	22	50	20	200
Brown Clay	0	1000	28	100	24	180
Gray Till	0	1250	29	100	26	400
Muddy Stream or Lacustrine Sand	29	0	31	50	31	50
Muddy Steam or Lacustrine Silt	25	0	29	0	25	0
Muddy Stream or Lacustrine Clay	0	500	24	200	22	200
Great Miami Aquifer Sand and Gravel	33	0	33	0	33	0

5.2.3 Slope Stability Model Assumptions

Several assumptions regarding subsurface stratigraphy, groundwater conditions, surcharge loads adjacent to the excavations and seismic considerations were made to perform the slope stability analyses.

5.2.3.1 Soil Stratigraphy

Five representative subsurface conditions were chosen based upon the cross-sections A-A' through G-G' and interpretation of the soils presented in Section 5.1 of this report. The five selected conditions represent muddy stream sand areas (2 generalized profiles), lacustrine areas (2 generalized profiles) and glacial till (1 generalized profile) (consisting mostly of cohesive soils) areas.

Due to the complex geology and stratigraphy conditions present in the lacustrine and muddy stream sand areas and the large area being excavated, two boring logs representing each condition were chosen. The boring log for each area was chosen (in an attempt) to select a worst case condition, assumed to be a large thickness (at least 8-foot thick) of interbedded wet silts and sands. It was assumed that wet silts and sands interbedded with soft clays in the lacustrine and muddy stream sand areas and thick deposits of saturated sands would provide the least stable slopes due to the presence of seepage pressures within the granular soils. Figures 5-4 through 5-8 present the representative subsurface stratigraphy for the lacustrine, muddy stream sand, and glacial till areas. Figure 5-9 shows the locations of the excavation sites having the representative stratigraphy of Figures 5-4 through 5-8.

5.2.3.1.1 Brown Clay over Glacial Till

Throughout the eastern half of the proposed excavations, areas exist where brown clay overlies cohesive glacial till was the predominant material encountered above the GMA. Locally the cohesive glacial till matrix contains thin, more permeable silt or sand lenses or pockets. In addition, fill is also often encountered overlying the brown clay. Test boring 11825 was chosen to represent the glacial till areas, since the most recent G3- series borings encountered sand seams.

5.2.3.1.2 Muddy Stream Areas

Throughout the northern and eastern portions of the excavation areas, interbedded muddy stream sands, silts and clays or relatively thick units of sand were encountered between the brown clay and gray glacial till soils. Typically the silt and sand seams were saturated and ranged in thickness from several inches to several feet. Due to the variability in these deposits, two test borings were chosen to represent the muddy stream deposit areas. Test borings 12266 and 1339 were selected to represent the muddy stream deposit areas, due to the relatively thick granular muddy stream deposits encountered in the test borings.

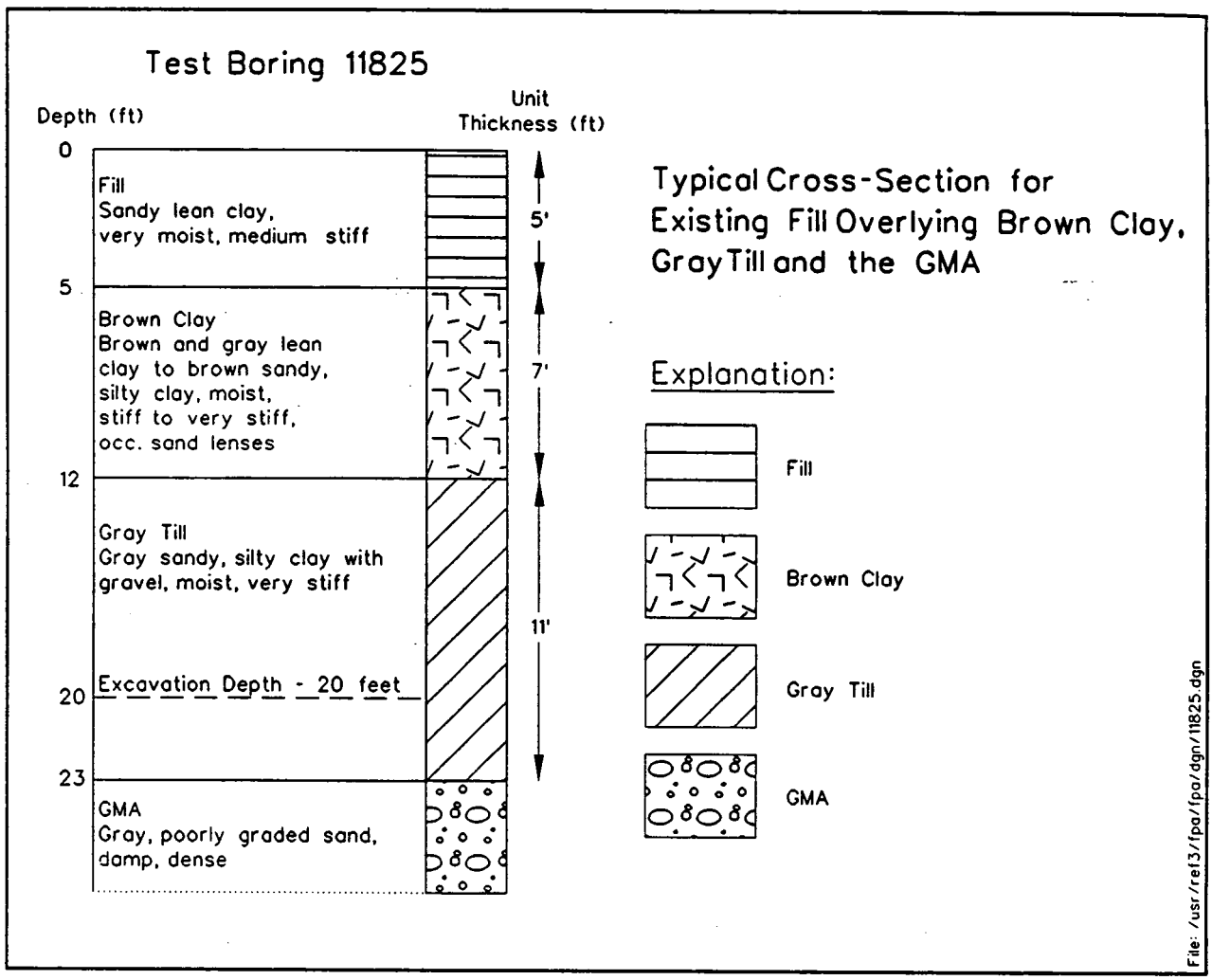

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Figure 5-4 - Generalized Stratigraphic Column 1 (Excavation Site NE-B)

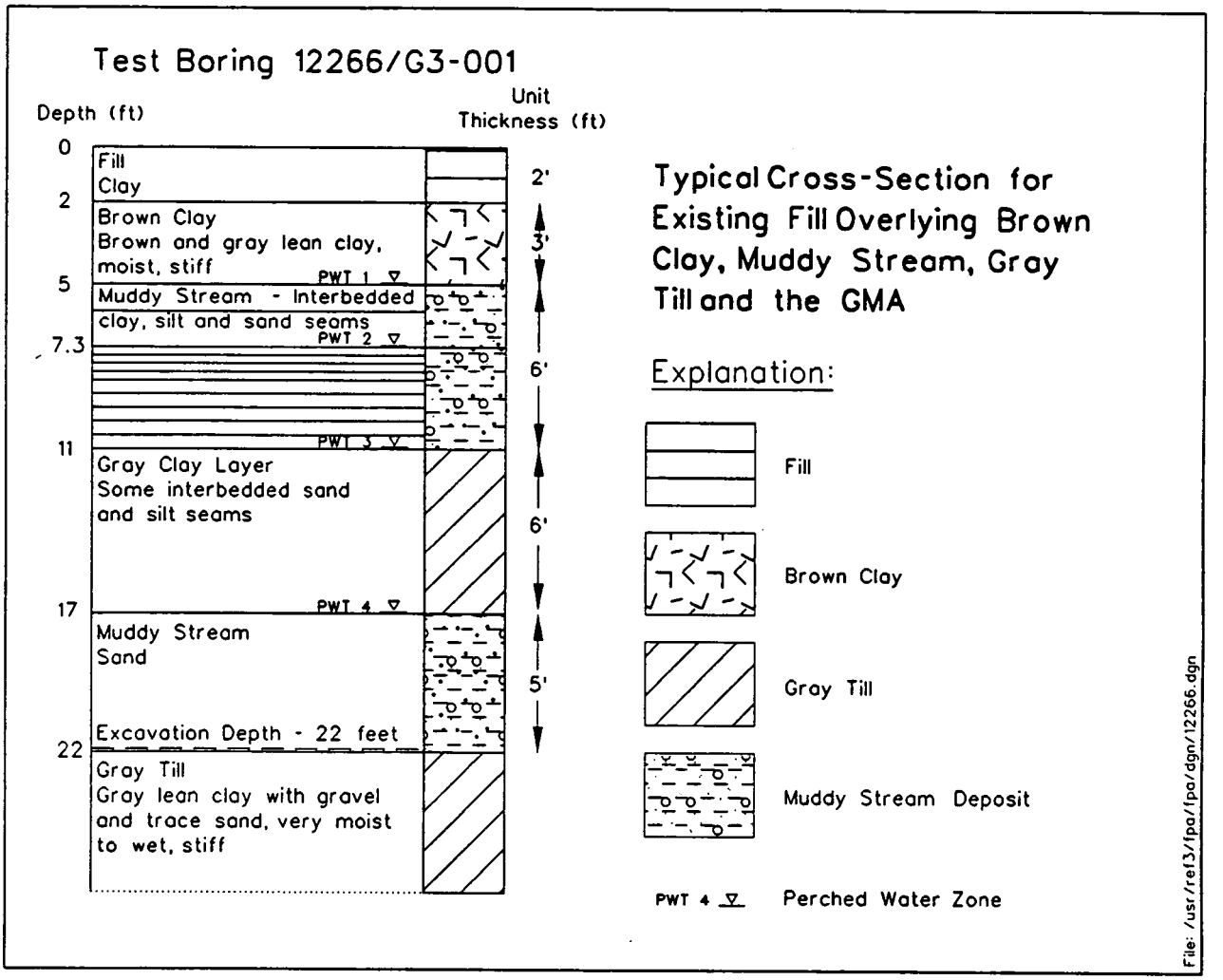

Figure 5-5 - Generalized Stratigraphic Column 2 (Excavation Site NE-A and Representing SE-A)

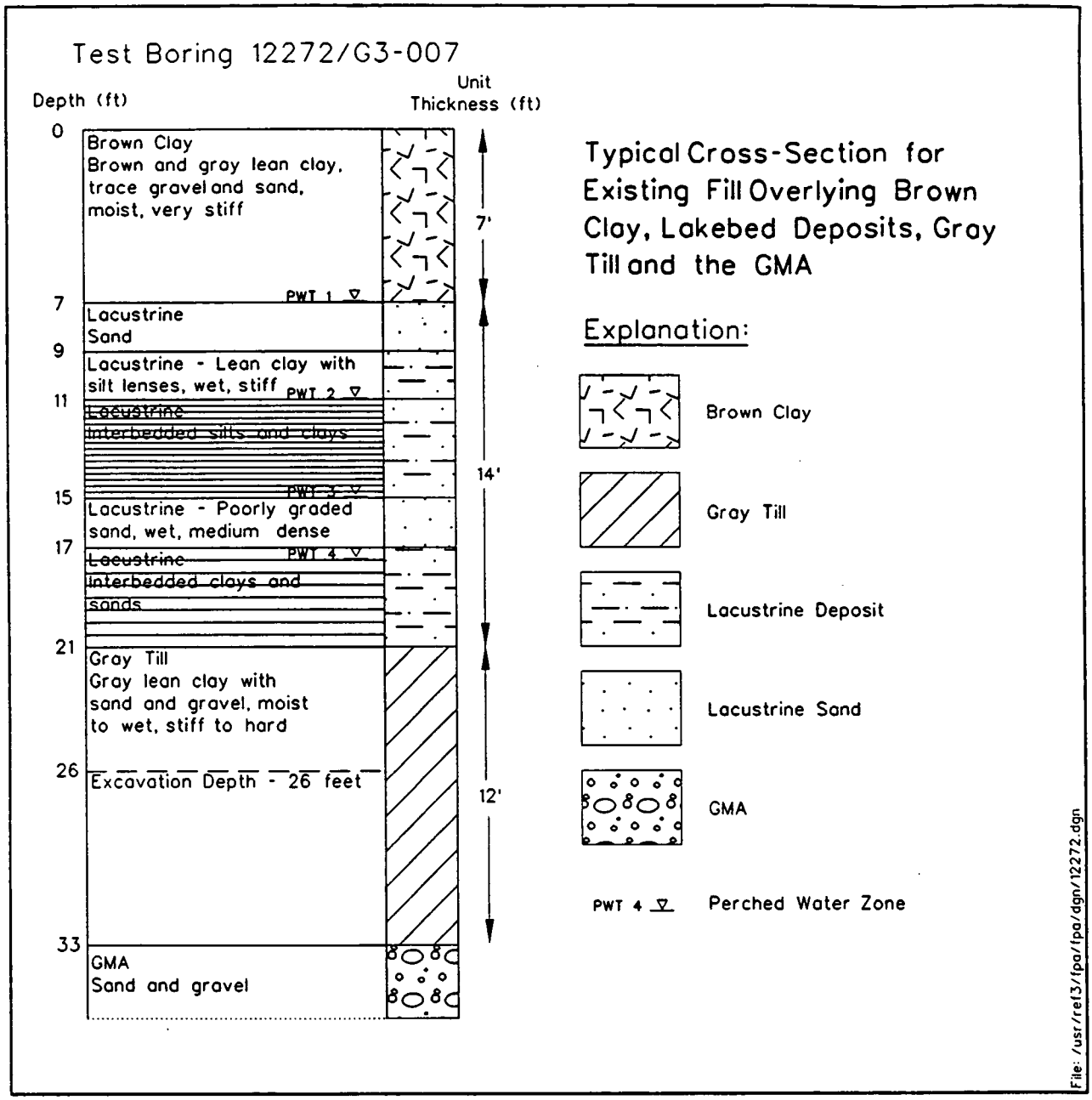

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Figure 5-6 - Generalized Stratigraphic Column 3 (Excavation Site SW-A)

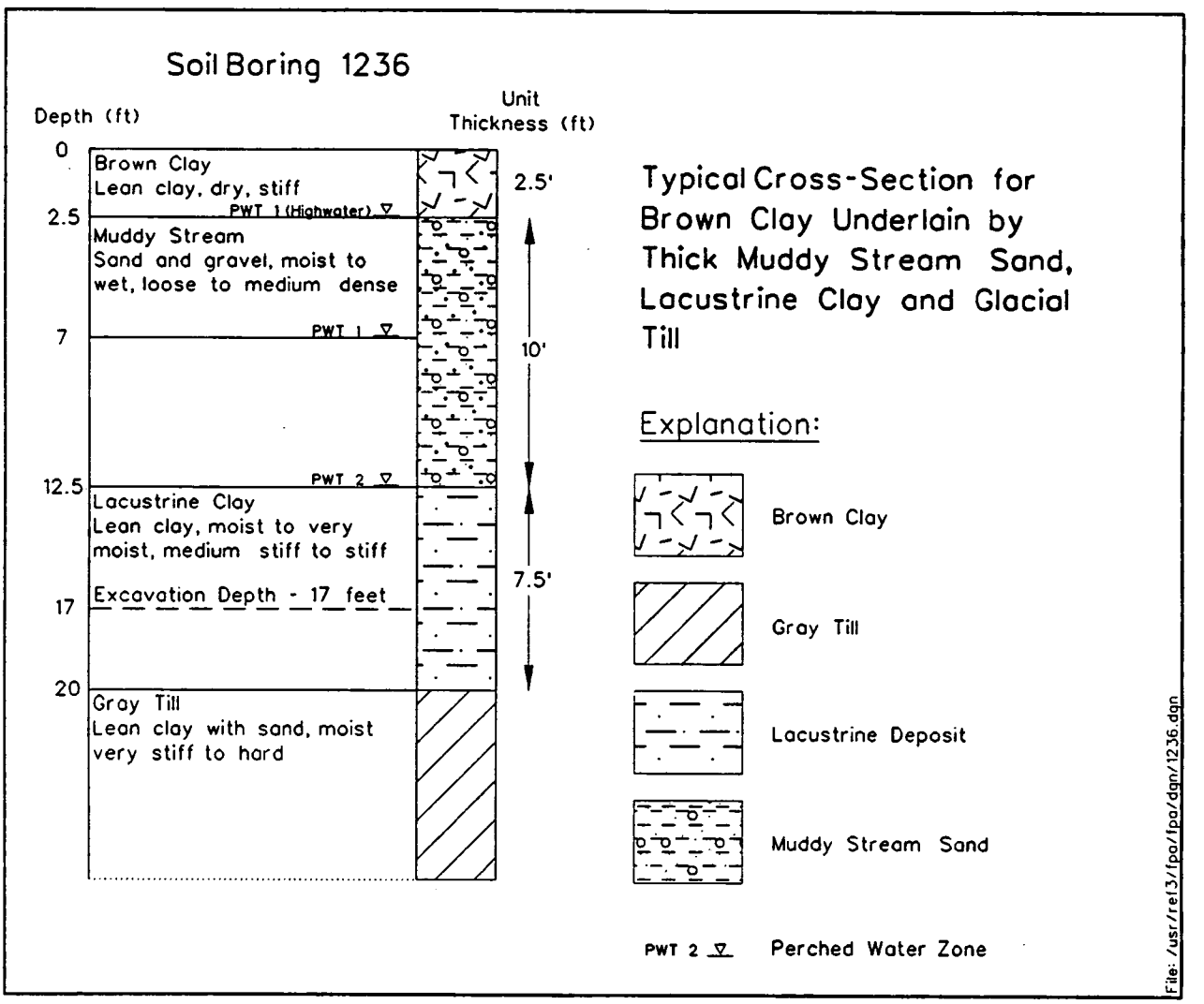

Figure 5-7 - Generalized Stratigraphic Column 4 (Excavation Site SW-A)

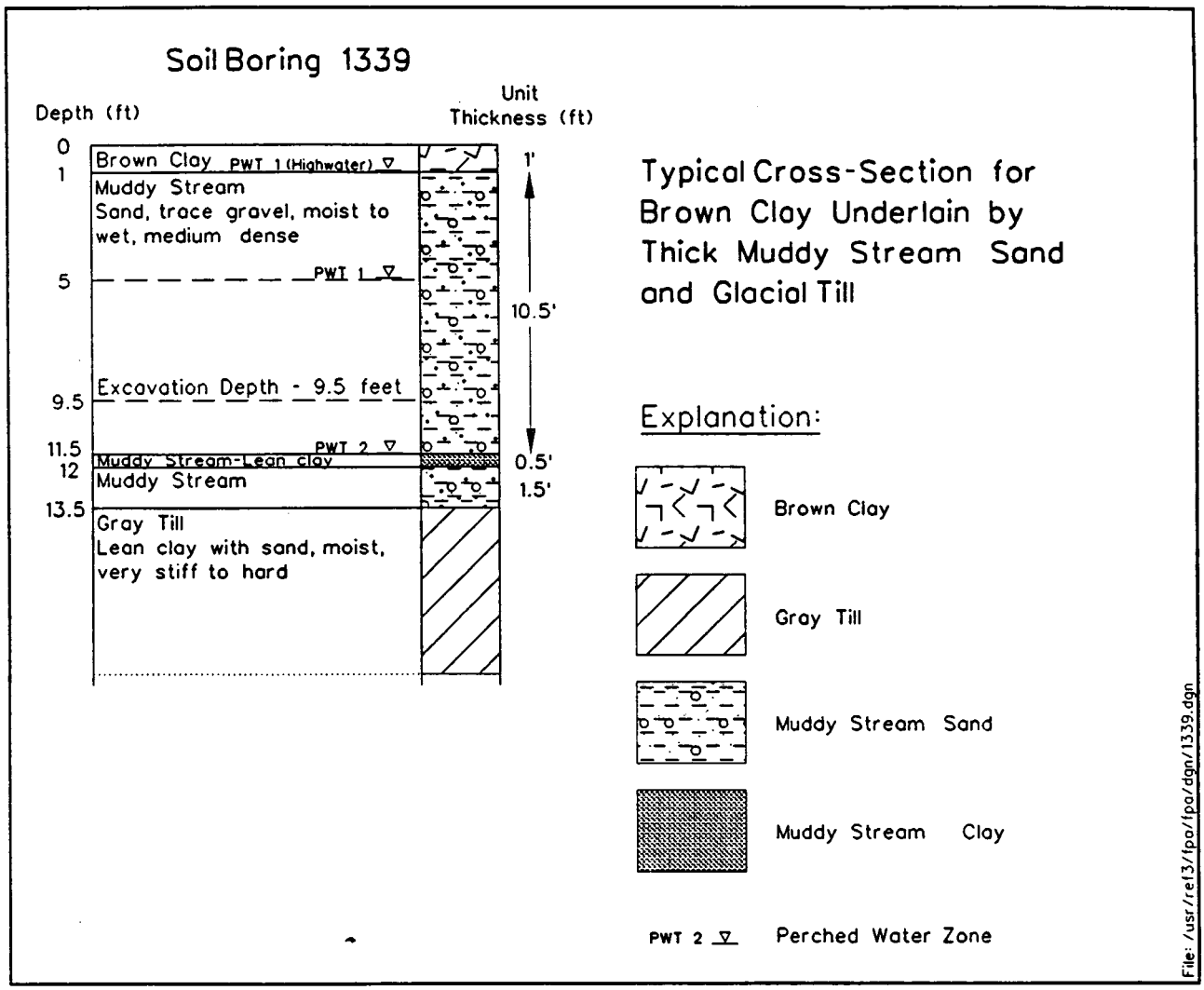

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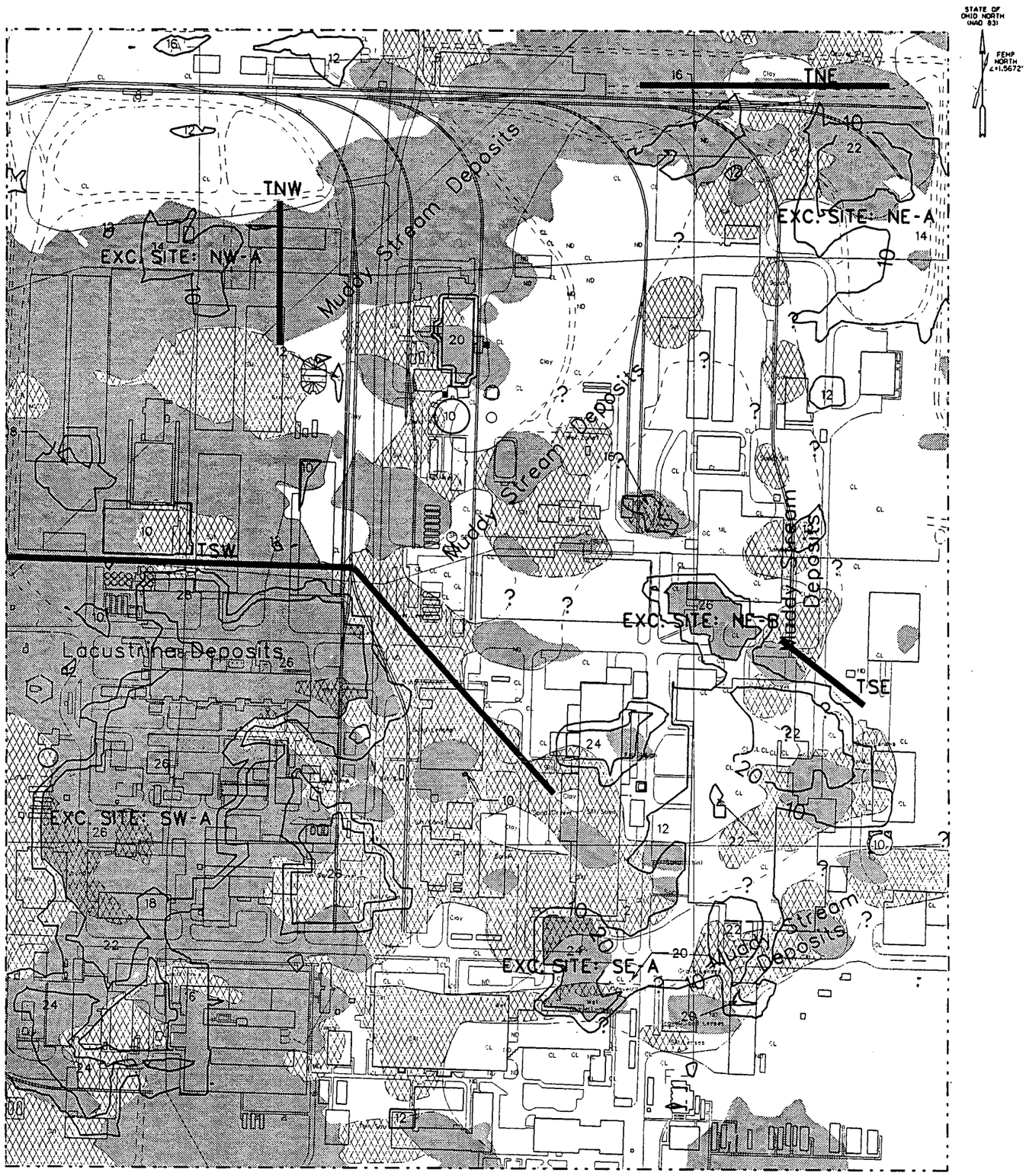
Figure 5-8 - Generalized Stratigraphic Column 5 (Excavation Site NW-A)



Explanation

Interpreted Lacustrine and Stream Deposits

24 Maximum Depth of Excavation (feet)

10 Excavation Contour (10-foot)

Channel/Lake Boundary Line

TNE Approximate Simulated Interceptor Trench Location

0 250 500 FT
SCALE

File:/usr/ref3/fpa/fpa/dgn/fpa_inter.dgn

Figure 5-9 - Location of Representative Excavations and Simulated Interceptor Trench Locations

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5.2.3.1.3 Lacustrine Areas

Lacustrine deposits were encountered in the southwestern to western portions of the proposed excavation areas. Typically the lacustrine deposits included interbedded silts, clays and sands ranging in thickness from a few inches to as great as 2 feet or relatively thick sand deposits underlain by lacustrine clays in isolated areas. At several locations the clay portions of the lacustrine deposits were varved and contained thin silt partings. Generally, the permeable lacustrine deposit sands and silts were wet, resulting in saturation of the adjacent clay layers. The saturated clay layers were often soft to medium stiff. Test borings 12272 and 1236 were chosen to represent the lacustrine deposit areas.

5.2.3.2 Perched Groundwater Conditions

Typically the perched groundwater conditions shown in Figure 1-11 or the conditions encountered in the recent test borings were used as the groundwater conditions simulated in the slope stability analyses. The higher level of the two (most conservative) was used. The groundwater conditions reported in Figure 1-11 were measured in the Spring of 1992, which represent high water conditions. Table 5-3 outlines the perched water level reported in the Spring of 1992 and the water level used in the slope stability models for each representative soil column. However, where shallow sands were encountered (test borings G3-001, 1236 and 1339), the water level was increased to model the entire sand layer being saturated during wet seasonal conditions. These water levels are designated PTW 1 (high water) in Generalized Soils Columns 1, 4 and 5 (Figures 5-5, 5-7 and 5-8). In all these cases, groundwater is assumed to daylight at the cut face of the excavation at the top of the saturated layer. This is conservative since some degree of drainage in the sands is expected to draw the phreatic surface down at the cut face. These cases also conservatively simulate pumping from open sumps and/or drawdown conditions.

Table 5-3 - Perched Groundwater Depths in March 1992 and Groundwater Depth in Slope Stability Simulations.

Soil Column	March '92 Perched Water depth below Ground Surface	Depth to Phreatic Surface Used in Simulations
1	9	9
2	7	5
3	7	7
4	6	2.5 (high water)
5	3	1 (high water)

A dewatered case was also evaluated. This case removed all perched groundwater above the proposed excavation level. This case was used to evaluate slope stability if a dewatering scheme is adopted prior to performing the excavations.

It should be noted that the groundwater that will be encountered during excavation will consist of perched water. The perched water levels will be highly susceptible to seasonal variations in precipitation and weather. Therefore, water levels encountered during excavation may vary significantly from those used in the slope

stability simulations. However, the most recent borings were performed during the wet spring of 1997 which represent high water conditions. The water conditions used in the slope stability analyses were at the water levels encountered in the recent test borings or above the water levels encountered in the recent test borings represented by March 1992 perched water readings. The high water conditions assumed for Soil Columns 4 and 5 demonstrate the effects of fluctuating water levels. Therefore, the water conditions used in the slope stability analyses are considered conservative.

The XSTABL slope stability model evaluates seepage pressures associated with perched water levels. Seepage forces that result from horizontal flow velocities were not included in these analyses (long or short-term). These forces were not included because:

- The relatively high permeability of the coarse-grained units and the relatively moderate pace at which excavation is expected to proceed,
- The relatively low peak and sustained yields from pumping tests, and
- The assumption that gradients are primarily vertical in these units.

5.2.3.3 Surcharge Loads

Two foreseeable surcharge load types were assumed for the excavations. The first type of surcharge load was an equipment load applied at the crest of the slopes or on benches. A CAT 350L track hoe was assumed for the excavation equipment. The track hoe weight was applied over the entire area between the tracks, which resulted in a load of 750 psf applied on a 10.8-foot by 14.75-foot area. The entire area between the tracks was used instead of the actual track area, since XSTABL assumes that surcharge loads are continuous line loads and not point loads (the track hoe would be considered a point load). Additional shear strength would be available on either side of the point load, from the unloaded areas, to resist the effects of the point load. Therefore, using a reduced surcharge load is justified to simulate actual loading conditions.

The equipment surcharge loads were used in both the short-term, total stress and the long-term, effective stress cases. It is anticipated that the equipment will be moved back from the excavations while the exposed soils in the excavations are tested and approved. Therefore, it is unlikely that equipment will rest at the top of the excavated slopes for extended periods of time. Placing large loads, such as equipment or large soil or spoil piles, at the top of the slopes during the approval process should be avoided.

The second type of surcharge load used was a 380 psf load over a 4-foot width to represent a berm at the top of the excavations to reduce surface water runoff from entering the excavations. This surcharge was only modeled for the long-term, effective stress case.

No adjacent building loads were considered in the stability calculations. Buildings near the crest of the excavated slopes could significantly reduce the stability of the slopes. Therefore, if buildings are to remain near the crest of the slopes, the stability of these slopes should be further analyzed on a case by case basis.

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5.2.3.4 Seismic Considerations

Seismic loads were not considered for analysis of the long-term interim slopes. It is appropriate to consider seismic conditions for long-term permanent slope stability analyses, when final land use is known. Final land use plans are not well defined at this time. Current plans suggest that some of the excavations will be completed as lakes or ponds. Thus, selection of the appropriate seismic coefficients to use for analyses would be an estimate at best. A seismic evaluation and related pseudo-static slope stability analyses should be performed for any critical slopes when the permanent final slope design is considered.

At the northeast quadrant, excavation limits planned outside the FPA approach and may encroach upon the western edge of the OSDF. In this case, a seismic coefficient of 0.065g (equivalent to a design acceleration of 0.13g) was applied in the stability analyses of the permanent slope configuration. This is consistent with the design coefficients used in analyses of the OSDF seismic stability (Parsons 1995c). The seismic analyses assumed no surcharge due to the OSDF, since it was assumed that the excavation of the northeast quadrant would occur prior to construction of the OSDF adjacent to this excavation. In addition, due to the encroachment of the northeast quadrant excavation into the OSDF, it was assumed that this excavation would require complete or partial backfilling to prevent global slope instability of the OSDF (an open excavation will result in cutting the toe out from the OSDF).

5.2.4 Slope Excavation Recommendations and Conclusions

The results of the slope stability analyses are reported in Tables 5-4a through 5-4e for each excavation site. The following sections provided recommendations concerning slope configurations, slope maintenance, erosional control, and monitoring of short and long-term slopes. Graphical output from the slope stability analyses are included in Appendix J for the recommended slope configurations.

Table 5-4a - Results of Slope Stability Analyses (Excavation Site NE-B)

CASE	WATER SURFACE DEPTH (ft)	FOS NO SURCHARGE		FOS w/ EQUIPMENT SURCHARGE		FOS w/ BERM SURCHARGE
		SHORT-TERM	LONG-TERM	SHORT-TERM	LONG-TERM	LONG-TERM
1H:1V 20' Ht.	9	2.44	0.89	1.90	---	---
1.5H:1V 20' Ht.	9	---	1.10	---	0.98	1.02
1.5H:1V (1)	9	---	1.48/1.36	---	1.17/1.06	1.28/1.36
2H:1V 20' Ht.	9	---	1.32	---	1.19	1.22
3H:1V 20' Ht.	9	---	---	---	---	1.60

Notes: (1) 15' wide bench with maximum 10' high slopes.

FOS = Factor of Safety

For benched case - FOS presented as: FOS of Slope Above Bench/FOS of Slope Below Bench.

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Table 5-4b - Results of Slope Stability Analyses (Excavation Site NE-A, SE-A)

CASE	WATER SURFACE DEPTH (ft)	FOS NO SURCHARGE		FOS w/ EQUIPMENT SURCHARGE		FOS w/ BERM SURCHARGE
		SHORT-TERM	LONG-TERM	SHORT-TERM	LONG-TERM	LONG-TERM
1.5H:1V 22' Ht.	5	1.47	1.01	1.13	---	---
1.5H:1V (1)	5	1.90/1.70	1.28/1.35	1.53/1.12	1.11/1.02	1.13/1.35
2H:1V 22' Ht.	5	1.66	1.38	1.32	---	---
2H:1V (1)	5	2.12/2.11	1.81/1.78	1.70/1.50	1.42/1.24	1.51/1.78
3H:1V 22' Ht.	5	2.11	2	1.72	1.76	1.91
1.5H:1V (1)(2)	5	---	1.56/1.68	---	1.30/1.24	1.36/1.68
2H:1V 22' Ht. (2)	5	---	1.63	---	1.46	1.54
3H:1V 22' Ht. (2)	5	---	2.26	---	2.01	2.2

Notes: (1) 15' wide bench with maximum 13' high slopes.

(2) Dewatered

FOS = Factor of Safety

For benched case - FOS presented as: FOS of Slope Above Bench/FOS of Slope Below Bench.

Table 5-4c - Results of Slope Stability Analyses (Excavation Site SW-A)

CASE	WATER SURFACE DEPTH (ft)	FOS NO SURCHARGE		FOS w/ EQUIPMENT SURCHARGE		FOS w/ BERM SURCHARGE
		SHORT-TERM	LONG-TERM	SHORT-TERM	LONG-TERM	LONG-TERM
1.5H:1V 26' Ht.	7	1.71	---	1.35	---	---
2H:1V 26' Ht.	7	1.91	1.34	1.48	---	---
2H:1V (1)	7	2.37/3.01	1.53/1.97	1.60/1.64	1.32/1.58	1.40/1.97
3H:1V 26' Ht.	7	---	1.82	---	1.73	1.79
3H:1V (1)	7	---	1.97/2.45	---	1.60/1.70	1.82/2.45
2H:1V 26' Ht. (2)	7	---	1.59	---	1.49	1.52
2H:1V (1)	7	---	1.83/2.03	---	1.57/1.63	1.67/2.03
3H:1V 26' Ht. (2)	7	---	2.22	---	2.04	2.21

Notes: (1) 15' wide bench with maximum 13 ft. high slopes.

(2) Dewatered

FOS = Factor of Safety

For benched case - FOS presented as: FOS of Slope Above Bench/FOS of Slope Below Bench.

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Table 5-4d - Results of Slope Stability Analyses (Excavation Site SW-A)

CASE	WATER SURFACE DEPTH (ft)	FOS NO SURCHARGE		FOS w/ EQUIPMENT SURCHARGE		FOS w/ BERM SURCHARGE
		SHORT-TERM	LONG-TERM	SHORT-TERM	LONG-TERM	LONG-TERM
2H:1V 17' Ht.	7	1.51	1.61	1.35	1.37	1.42
1.5H:1V (2)	17	1.77/6.07	1.33/3.03	1.29/2.01	1.12/1.55	1.22/3.03
1.5H:1V (1) (3)	2.5	1.57/6.06	1.10/3.03	1.16/2.01	0.96/1.55	1.03/3.03
1.5H:1V (1) (2)	17	1.99/6.06	1.59/3.03	1.44/2.01	1.31/1.55	1.45/3.03
3H:1V 17' Ht.	7	---	---	---	---	1.88
3H:1V 17' Ht. (3)	2.5	---	---	---	---	1.58

Notes: (1) 15' wide bench with maximum 12.5 ft. high slopes.

(2) Dewatered

(3) High water condition

FOS = Factor of Safety

For benched case - FOS presented as: FOS of Slope Above Bench/FOS of Slope Below Bench.

Table 5-4e - Results of Slope Stability Analyses (Excavation Site NW-A)

CASE	WATER SURFACE DEPTH (ft)	FOS NO SURCHARGE		FOS w/ EQUIPMENT SURCHARGE		FOS w/ BERM SURCHARGE
		SHORT-TERM	LONG-TERM	SHORT-TERM	LONG-TERM	LONG-TERM
2H:1V 9.5' Ht.	5	1.54	1.46	1.23	1.32	1.38
2H:1V 9.5' Ht. (3)	1	1.34	1.24	1.08	1.14	1.17
2H:1V 9.5' Ht. (2)	9.5	1.89	1.95	1.51	1.63	1.74
3H:1V 9.5' Ht.	5	---	---	---	---	1.78
3H:1V 9.5' Ht. (3)	1	---	---	---	---	1.53

Notes: (2) Dewatered

(3) High water condition

FOS = Factor of Safety

5.2.4.1 Temporary and Long-Term Slope Configurations

Temporary slopes were assumed to be slopes that are open for no more than a few days and are used to safely facilitate the excavations. The temporary slopes analyzed ranged in steepness from 1H:1V to 3H:1V using total stress parameters. Slopes steeper than 1H:1V were not considered. Benched slopes were also analyzed having maximum heights of 13 feet (between benches) and bench widths of 15 feet. The height of the benched slopes may vary depending on the elevation at which a stable bench material is encountered. Temporary slopes

were not analyzed for the dewatered conditions, since temporary slopes were generally stable without the use of dewatering.

Long-term slopes were analyzed for slopes ranging in steepness from 1H:1V to 3H:1V using effective stress parameters. Again benched slopes were also analyzed for the long-term cases. The geometry for the long-term slopes were the same as the short-term slopes. Dewatered slopes were analyzed for long-term slopes for both the muddy stream deposit and lacustrine deposit areas. The long-term slopes analyzed are only for the interim slopes that will be open during the anticipated 1 to 3 year long project. It is anticipated that these interim slopes will be open for no longer than a year. Once the excavation limits are approved, the interim slopes can be reconfigured to the permanent configurations.

Due to the amount of available subsurface data and laboratory data, the factors of safety greater than or equal to 1.2 and 1.3 for the short term and interim long-term slopes, respectively, are considered acceptable. For permanent long-term slopes a factor of safety greater than or equal to 1.5 is recommended. Recommended slope configurations are presented in Table 5-5.

Table 5-5 - Summary of Recommended Short-term, Interim Long-term, and Permanent Long-term Slope Configurations

Excavation (Soil Column)	Recommended Slope Configurations (1)		
	Short-Term	Interim Long-Term	Permanent Long-Term (2)
NE-B (1)	1H:1V Full height	1.5H:1V 10 ft. Slopes/ 15 ft. Bench	3H:1V Full height
NE-A (2)	2H:1V Full height	2H:1V 13 ft. Slopes/ 15 ft. Bench	3H:1V Full height
SW-A (3)	1.5H:1V Full height	1H:1V 13 ft. Slopes/ 15 ft. Bench	3H:1V Full height
SW-A (4)	1.5H:1V 12.5 ft. Slopes/15 ft. Bench	2H:1V Full Height (3)	3H:1V Full Height
NW-A (5)	2H:1V Full height	2H:1V Full Height (3)	3H:1V Full Height

(1) Assumes no dewatering performed prior to excavation.

(2) Considers Rapid Drawdown Condition

(3) Assumes perched water 7 ft. and 5 ft. below ground surface for SW-A (4) and NW-A (5), respectfully. Higher perched water conditions will require 3H:1V full height slopes.

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5.2.4.1.1 Temporary Slopes

For the temporary slopes, the equipment surcharge case controls the stability of the slopes. Recommended stable short-term slopes with equipment loads ranged from 1H:1V in the brown clay over glacial till to 2H:1V in the lacustrine and muddy stream deposit areas. Other recommended stable conditions in the lacustrine and muddy stream deposit areas included 1.5H:1V slopes with 13 ft. maximum height slopes and 15 ft. wide benches. Areas may be encountered during excavation that may require flatter slopes than those indicated. These areas should be evaluated by the contractor on a case by case basis. Saturated sand and silt seams, pockets and layers that may be encountered within the glacial till profile may require slopes flatter than 1H:1V.

Shallow excavations (less than 10 ft. deep) may be required for utility and other miscellaneous earthwork. Steeper slopes may stand temporarily and should be constructed per applicable OSHA guidelines for temporary trench excavations. The stable slope configurations only consider deep-seated failures. No shallow sloughing failures were considered. Sloughing failures, due to erosion and seepage forces, at the surface of the sands and silts should also be expected. These sloughing failures will require maintenance during the excavation process.

To reduce the amount of perched water (hydrostatic pressures) in the soils, dewatering may be required (see Section 5.3). Section 5.2.3.2 describes the groundwater conditions considered for the stability analyses. The computer program used calculates the hydrostatic head across the analyzed section as defined by the input piezometric elevations.

5.2.4.1.2 Interim Long-Term Slopes

For the interim long-term slopes, the equipment surcharge case controls the stability of the slopes. However, it is anticipated that the equipment will not be allowed to remain at the crest for the interim long-term. Therefore, the berm surcharge case was considered to be controlling.

The interim long-term stability of the excavated slopes are a function of the slope height, type of geology, and the elevation of any perched water. In the brown clay over glacial till and lacustrine areas with slope heights greater than 13 feet, 1.5H:1V slopes having maximum heights of 13-foot with 15-foot wide benches, are predicted to have acceptable factors of safety for the berm surcharge load case. In the muddy stream sand deposits with excavation depths greater than 13 feet, 2H:1V slopes with 13-foot maximum heights and 15-foot wide benches were estimated to have acceptable factors of safety. A 2H:1V benched configuration should be considered where thick saturated sand deposits are encountered. It is recommended that determination of the stable slope configurations be determined in the field by the contractor as the excavations near completion and the type of geology at the slope locations becomes known. Areas may exist that will require flatter long-term side slopes than those previously mentioned (possibly where shallower perched water conditions are encountered).

Where the slope heights are less than 13 feet, 2H:1V full height slopes can be considered. Again, these slope recommendations do not consider sloughing failures. Maintenance of slopes is anticipated before excavation filling can commence.

Stability of the interim long-term slopes can be increased using dewatering methods, such that 1.5H:1V benched slope configurations are stable in all the analyzed areas.

The above recommended slopes assume that groundwater seepage is not allowed to accumulate in the bottom of the excavations. Sumps and pumps should be utilized to remove collected water in the excavations as they progress to avoid rapid development of drawdown conditions. If any permanent surcharge loads, such as buildings, construction equipment, etc., are proposed at the slope crests, then these cases should be further analyzed on a case by case basis.

As discussed in Section 5.2.3.4, seismic conditions were not considered in the analyses at this time due to uncertainty in final land use.

No rapid drawdown analyses were performed for the interim long-term slope configurations. However, rapid drawdown analyses of the permanent slope configurations indicate marginally stable conditions at the northwest and southwest excavation sites. Therefore, unstable conditions should be expected for the interim long-term slopes under rapid drawdown conditions (i.e. rapid pumping of water from excavations after a storm event). As a result, controlled pumping should be considered for interim long-term slopes or the permanent slope configurations could be considered.

5.2.4.1.3 Permanent Long-Term Slopes

Permanent long-term slopes are those slopes that will remain along the edge of the excavations after construction is completed. Based on current land use concepts, the majority of the excavations will be allowed to fill with water, forming lakes or ponds. Permanent slopes are recommended to be constructed at 3H:1V or flatter for the full height of the slope. Converting the interim long-term slopes to the flatter permanent slopes can be achieved by either buttressing the toe of the interim slopes or by further cutting the crest for the interim slopes. These permanent long-term slopes are considered conservative since the presence of water in the lakes will give the slopes a buttressing effect.

Results of the permanent 3H:1V full-height slopes under seismic load at the northeast quadrant excavation indicated a factor of safety against slope failure of 1.58. whereas the static FOS was 1.91. This factor of safety is considered adequate. This scenario assumes that if the northeast quadrant excavation is partially left as a lake, the eastern lake shore is at least 100 ft. from the proposed western boundary of the OSDF. The buttressing effect of the lake or pond water was not considered in the analyses.

The rapid draw-down case was evaluated for the permanent slopes assuming that there is a 2 feet free-board in the lakes and ponds. Factors of safety for the long-term permanent slopes ranged from 1.08 to 2.00. As a result, controlled pumping of the lakes or ponds should be evaluated to prevent slope failures during rapid drawdown conditions. Laboratory tests indicated that the sand samples tested had an effective cohesion value of 50 psf. Sands may be encountered in the FPA excavations that have zero cohesion. Using a cohesion value of zero, slope simulations indicated that sloughing failures will occur during rapid drawdown conditions, indicating that controlled pumping should be considered in areas where massive sand deposits (greater than 3 feet thick) are encountered.

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5.2.4.1.4 Effect of Northeast Quadrant Excavation on OSDF

According to the model excavation footprint used for this report, the eastern edge of the northeast quadrant excavation is approximately 130 ft. beyond the eastern FPA boundary. Considering 3H:1V permanent slopes, the crest of the permanent slope will extend at least 160 ft. east of the FPA boundary. The toe of the proposed OSDF berm is approximately 80 ft. east of the FPA boundary, and the west side of the drainage ditch along the toe of the OSDF is approximately 20 ft east of the FPA boundary. As a result, the current northeast quadrant FPA excavation encroaches into the OSDF footprint. Performing the FPA excavation after construction of the OSDF cell would undercut the toe of the OSDF cell and possibly create an unstable condition. No calculations were performed to confirm unstable conditions upon undercutting the OSDF berm toe. However intuitively, removing a large portion of the soil mass which is resisting rotational failure of the western OSDF side slope could create an unstable condition. As a result, it is recommended that the northeast quadrant excavation be performed prior to the OSDF cell construction and then backfilled with structural fill to buttress the toe of the west OSDF side slope.

According to stability calculations performed by GeoSyntec and during PO-140, the critical failure circles of the OSDF extend a maximum of 36 ft. beyond the toe of the OSDF side slope. One of the top 10 most critical failure surfaces for the northeast quadrant permanent slope configurations extends 15 ft. beyond the crest of the permanent slope. Since only the most critical failure surface was reported for the OSDF and other failure surfaces may exist that extend further beyond the toe of the OSDF, it is recommended that the crest of any permanent northeast FPA quadrant slope be maintained a minimum of 100 ft. from the western boundary of the OSDF. This minimum distance can be achieved by first excavating the northeast FPA quadrant excavation and then backfilling the easternmost portion until the offset distance is achieved.

5.2.4.2 Slope Protection

During the excavation phase, equipment should enter and exit the excavations perpendicular to the slopes using temporary ramps. In addition, the amount of equipment allowed to travel or operate at the crest of the temporary slopes should be minimized. Any equipment operating at the slope crest should maintain a 3-foot horizontal offset from the slope crest. The edge of any stockpiled soils should be maintained a minimum of 30 feet from the excavation slope crests, to avoid surcharging the excavated slopes. This value is based upon the 10 most critical failure surfaces and the furthest distance that these surfaces extend beyond the crest of the slope. To reduce flow into the excavations and erosion of the temporary slopes, a perimeter silt fence should be installed. Finally, sumps and pumps should be used to prevent the ponding of water in the bottom of excavations.

For long-term interim slopes, a more permanent soil berm should be constructed of cohesive soil around the perimeter of the excavated slope crest. The berm will help reduce the surface water run-off that enters the excavations from the surrounding ground surface. Therefore, the water entering the excavations will be limited to groundwater and run-off due to precipitation collected on the slopes and the bottom of the excavations.

In order to reduce the sheet flow run-off from the exposed slope faces, drains or collection trenches should be considered at the back of any benches. These drains or trenches will aid in collection of the run-off from the upper slope and reduce the amount of water flowing over the lower slope. Drains should consist of

perforated or slotted pipe surrounded by free draining granular material such as Ohio Department of Transportation (ODOT) No. 57 gravel. Water collected in these drains or trenches should be gravity drained to collection pipes routed to sumps in the bottom of the excavation and then pumped from the excavation. The concentrated flow from the collection trenches should not be placed directly on the lower slopes to avoid erosion of the lower slopes.

Sodding of the long-term slopes and berms or covering the slopes with anti-erosional geotextile mats should be considered to reduce the erosion of the exposed slopes. Sodding or anti-erosional mats may also help reduce sloughing failures.

Finally, the bottom of the excavations should be kept relatively dry. All water collected in the bottom of the excavations should be routed to sumps and pumped from the excavations to help prevent excessive ponding in the excavations.

5.2.4.3 Monitoring and Testing During Excavations

Temporary slopes should be inspected at the beginning of each work day before construction activities commence. Any slopes that exhibit distress or failure should be flattened or stabilized using other methods before construction personnel are allowed to enter the excavations.

Permanent slopes can be monitored using survey stakes at the top and bottom of the excavations, as well as on the benches. The stakes should be considered in areas that exhibited slope stability problems during excavation. Any lateral or vertical movement of the stakes could indicate slope movement. Inclinometers could also be considered for monitoring the long-term slopes.

5.3 Storm Water and Perched Water (Problem Definition)

The remedial excavations in the FPA are anticipated to be up to 26 feet deep below existing ground surface and will penetrate the perched groundwater zone identified in Section 1.2.3 above. This zone varies in depositional environment (muddy stream vs lacustrine), strata thickness, lateral extent, elevations and hydraulic conductivity. Section 5.1 describes the depositional environment, strata thicknesses, etc., in detail.

Experience with excavations made during the Former Plant operations (NLO 1970) and pumping tests were reviewed. The review indicates that the perched groundwater that enters excavations is of sufficient volume that it must be considered for the remedial excavations. Utility trenches that are encountered during excavations may have some finite volume of groundwater "stored" in the backfill that would be released into the working area.

Remedial excavations are likely to remain open for periods up to six months or more. During these periods, precipitation events will cause direct surface water to accumulate in the excavations. Run-on can likely be avoided with the construction of low berms or other similar measures around the excavation. Storm water landing directly in the excavations must be handled by providing positive drainage to one or more open sumps and pumped.

5.3.1 Dewatering Evaluation (Technical Approach)

The primary steps used to perform this evaluation included the following:

5.3.1.1 Data Collection and Interpretation

- Review of field boring logs and laboratory data developed during the exploration for the preparation of this report as well as the database of existing geotechnical data from the OU5 RI Report (DOE, 1995b). This was used to develop cross-sections at selected locations in each of the four quadrants within the FPA.

- Review of various hydrogeological studies for the perched ground water (ASI Oak Ridge, 1991), the RI/FS Groundwater Report (DOE, 1990), the OU5 RI Report (DOE, 1995b), research by Frink (Frink, 1995), Pre-Design Investigation for the OSDF (DOE, 1995c) and the FEMP Glacial Till/Vadose Zone Report (Parsons, 1994).

- Review of geotechnical and geologic boring logs for evidence of potential interconnection of the brown and gray glacial overburden granular deposits (referred to as the "Coarse-Grained Deposits" in Section 1.4.2). The review included a refined evaluation of potential water-bearing silts. The OU5 RI Report (DOE, 1995b) identified the potential for "stair-step" and "short circuit" pathways through the glacial overburden, recognizing that the extent and permeability of the clay "keeps water from migrating any great distance quickly". The review resulted in a plan showing potential interconnection of water-bearing silt deposits and a series of cross-sections. Hydraulic flow through the silt zones will likely be at least one-half to one order of magnitude slower than through the coarse-grained deposits.

- Review of historical hydrographs of various groundwater monitoring wells and development of a map depicting perched groundwater level contours (as discussed in Section 1.5 which considers data obtained from this study and the OU5 RI Report [DOE, 1995b]).

5.3.1.2 Selection of Appropriate Dewatering Methods

Groundwater dewatering is typically done by one of three basic methods. These include open sumps and pumping from within the excavation, predraining the soil using wells, wellpoints or trenches, or lastly, a cutoff wall such as a slurry wall. To make this selection, the following items were considered:

- Hydraulic conductivity of the coarse- and fine-grained glacial overburden soils. As detailed in Appendix I, Table I-1, summaries of hydraulic conductivity from pumping tests, slug tests, laboratory permeability tests and empirical calculations based on geotechnical sample gradations were made. The coarse-grained materials are typically medium dense to dense, well-graded sands and silts, often with clay-sized materials. The fine-grained materials are glacial till with a significant clay fraction.

- Estimated source and volume of recharge. The muddy stream (channel) deposits (DOE, 1995b) have the potential to be interconnected and transition into the lacustrine deposits at the SW quadrant. Several reports on the hydrogeologic conditions (ASI, 1990), RI/FS Groundwater Report

(DOE, 1990), OSDF Pre-Design Report (DOE,1995c), and OU RI Report (DOE, 1995b) provide data suggesting recharge is from precipitation that falls directly on the Former Plant and the watershed area to the north of the plant (ASI, 1990). Estimates of recharge from precipitation (6 in/yr infiltration from OU 5 RI Report) indicate about 28 to 30 gallons per minute. The estimated average volume of perched groundwater within the plant area is about 28,310,000 gallons (ASI, 1990) based on estimated porosity and average perched groundwater elevations. These estimates reportedly were based on five-year precipitation records.

- Size and depth of excavations. There are over 20 planned individual excavations that will exceed 10 feet in depth. These excavations range in dimension from 30 feet wide to over 500 feet long in a few cases. The lateral and vertical extent of the excavations are still preliminary at this time. Section 5.1 provides detailed discussion on 14 excavations of primary concern.

- Proposed method of excavation. While it will likely be left up to the contractor, the size and depth of the excavations suggest that much of the work will be done with conventional construction equipment such as backhoes, hydraulic excavators, bulldozers, front-end loaders and scrapers. This equipment will have to work on the bottom of the excavation for the most part and thus will require a relatively stable base condition.

- Estimated schedule. The size of the excavations, the time required for the volume of the excavations and the monitoring and testing process to demonstrate clean closure conditions suggests that excavations will be open for at least six months. The implementation of Natural Resource Restoration Projects may establish long-term open water ponds in the FPA as a result of the remedial excavation activities (FEMP Natural Resource Restoration Plan, 1997).

- Miscellaneous factors. If any major structures are to remain within the area to be remediated, consideration must be given to the potential impact of dewatering on foundations.

Review of the CRU5 Feasibility Study (DOE, 1995) indicates that several groundwater extraction systems have been considered for the removal of contaminated groundwater. The application of these technologies is similar for construction dewatering. The consideration of these technologies as discussed in that report are summarized here:

- Horizontal Slurry Walls - should be eliminated from consideration due to questionable reliability, construction difficulty and high initial capital cost.

- Vertical Extraction Wells (or well points) - could be used to remove groundwater in the Former Plant Area. In some cases, currently existing wells could be used as part of the system. Wells are a proven and reliable process for removing groundwater. The construction of such wells is relatively simple and materials are readily available. Relatively close spacing would be required due to the small radius of influence expected with the coarse-grained material units. Capital costs are relatively low to moderate compared to slurry wall construction. Operations and maintenance costs are moderate.

- Interceptor Trenches - are a proven and reliable process. Materials and equipment are readily available. Capital costs are moderate while operation and maintenance costs are low.

- Open Pumping - from sumps within the excavation are a proven and reliable method when groundwater volumes are relatively low and recharge is nominal. Materials and equipment are readily available. The capital costs and O&M costs are both relatively low when compared to the methods mentioned above.

The factors cited above suggest that open pumping from sumps and ditches within the excavation may be the most feasible dewatering option. Due to the pore volume estimates and the noted variability of the hydraulic conductivity, it is possible that some form of pre-drainage such as interceptor trenches may be required at some of the excavations. Based on the hydraulic conductivity and yields indicated from the *FEMP Glacial Till/Vadose Zone Hydraulic Investigations Report* (Parsons, 1994), it is not likely that wellpoints would be an appropriate technique since the well spacing would have to be 10 feet or less to achieve drawdown within the radius of influence. Additionally, for excavations greater than 15 feet, the wellpoint system would have to be staged, resulting in higher costs.

Figure 1-5, discussed earlier in Section 1, suggests that groundwater flow within the perched water system flows through the muddy stream (channel) deposits from northeast to the southwest. This is consistent with the OU5 RI Report (DOE, 1995b) which indicates that the perched groundwater surface "slopes to the west-southwest". Figures 5-2 and 5-3 show detailed cross-sections which support the conceptual cross-sections shown in Figure 1-5.

5.3.1.3 Dewatering System Preliminary Calculations

The FPA was divided into four quadrants for the purposes of characterizing the hydrogeologic conditions. The description for each of these quadrants was provided in Section 5.1. Using typical excavation soil profiles for each of the quadrants that were used for the Slope Stability analyses in Section 5.2, calculations were made to evaluate a fully penetrating trench or well at each of the typical excavations. Hypothetical trenches were simulated at selected locations to estimate conservative flow rates and yields. Figure 5-9 shows the location of the hypothetical trenches considered for this calculation. The calculations were made using a code based on a model of an infinite trench described in *Dewatering and Groundwater Control* (NAVFAC P-418).

General assumptions made are as follows:

- the trench area perched groundwater zone coarse-grained material is homogeneous, nearly horizontal, isotropic and of uniform thickness within the area of influence by pumping (conservative, given the boundaries and extent of the clay till units).

- the analysis assumes a pre-existing uniform low gradient, consistent with the OU5 RI Report (DOE, 1995b) values of 0.008 to 0.015 (conservative, since pump test data suggests that sustained yields are not likely which in turn will cause the gradient to reduce with time under open trench conditions)

- Darcy's law applies throughout the system and non-laminar flow into the trench may be neglected

- the trench penetrates the perched groundwater zone and receives water from the entire thickness of the perched zone under steady state infiltration from precipitation at a rate of 6 inches per year from OU5 RI Report (DOE, 1995b)

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- the maximum observed seasonal groundwater surface is the starting condition

- gravity flow conditions apply even though the brown clay confining unit is present (since the maximum observed phreatic surface is most often found below the bottom of the brown clay).

Tables 5-6 through 5-9 below provide interpreted parameters assumed in the calculation specific to each quadrant as noted in the Table heading. These parameters were developed from review of hydrogeologic and geotechnical data developed for this report and from the FEMP Glacial Till/Vadose Zone Hydraulic Investigations report (Parsons, 1994).

The values of hydraulic conductivity for specific material types were taken directly from the OU5 RI Report (DOE, 1995b) and FEMP Glacial Till/Vadose Zone Report (Parsons, 1994). Porosity estimates were made using an empirical correlation (Vukovic and Soro, 1992) based on uniformity coefficient. The coefficient of uniformity and resulting porosity was calculated from particle size analyses for each material type described below. These porosities are also consistent with those determined for similar soil units in the OSDF Pre-Design Investigation (DOE, 1995c). The porosity calculated for the gray till (30.6 percent) agrees well with the high end of the range of 23 to 30 percent identified in the OU5 RI Report (DOE, 1995b) and is therefore conservative with regard to estimates of hydraulic conductivity and resulting flow volumes.

Table 5-6 - Assumed Hydraulic Parameters for Excavation Sites NE-A and SE-A (See Figure 5-5 - Generalized Stratigraphic Column 2)

Depth (feet)	Material Type	Hydraulic Conductivity (ft/day)	Porosity (%)
0-2	Fill (Clay)	0.006	35.0
2-5	Brown Clay	0.005	33.3
5-7.3	Interbedded Clay and Sand	0.073	36.0
7.3-9	Brown Sand	3.0	30.0
9-11	Interbedded Sand and Clay	0.298	36.0
11-17	Gray Clay	0.001	30.6
17-22	Gray Sand	0.073	28.0
below 22	Gray Till	0.001	30.6

Table 5-7 - Assumed Hydraulic Parameters for Excavation Site SW-A (See Figure 5-6 - Generalized Stratigraphic Column 3)

Depth (feet)	Material Type	Hydraulic Conductivity (ft/day)	Porosity (%)
0-7	Brown Clay	0.005	33.3
7-9	Sand	23.8	26.0
9-11	Interbedded Clay and Sand	0.073	36.0
11-15	Interbedded Silts and Clays	0.10	35.0
15-17	Sand	23.8	26.0
17-21	Interbedded Sand and Clay	0.31	32.0
21-33	Gray Till	0.001	30.6

Table 5-8 - Assumed Hydraulic Parameters for Excavation Site SW-A (See Figure 5-7 - Generalized Stratigraphic Column 4)			
Depth (feet)	Material Type	Hydraulic Conductivity (ft/day)	Porosity (%)
0-2.5	Brown Clay	0.005	33.3
2.5-12.5	Sand	59.8	36.1
12.5-20	Lacustrine Clay	0.275	36.0
below 20	Gray Till	0.001	30.6

Table 5-9 - Assumed Hydraulic Parameters for Excavation Site NW-A (See Figure 5-7 - Generalized Stratigraphic Column 5)			
Depth (feet)	Material Type	Hydraulic Conductivity (ft/day)	Porosity (%)
0-1	Brown Clay	0.005	33.3
1-11.5	Sand	38.6	25.7
11.5-12	Lacustrine Clay	0.239	30.0
12-13.5	Lower Sand	3.8	25.5
below 13.5	Gray Till	0.001	30.6

5.3.2 Dewatering Analysis (Results and Conclusions)

The results of the calculations generally include estimates of peak and sustained yields anticipated from the hypothetical trenches modeled. Anticipated yields were used to make an estimate of the probability that an interceptor trench would be needed at a given location. The relative probability of the need for interceptor trenches is listed in Table 5-10 for each quadrant considered. This is based on consideration of the peak yield, potential trench lengths and sustained yield results.

Table 5-10 - Calculated Yields for Interceptor Trenches (per foot of trench length)				
Quadrant/ Representative Boring	Assumed Trench Length (ft)	Peak Yield (gpm/ft)	Sustained Yield after 30 days (gpm/ft)	Interceptor Trench Probability
Northeast and Southeast (channel) / Boring 12266	500	0.23	0.01	Low
Southwest (lacustrine) / Boring 12272	300	0.58	0.03	Low to medium
Southwest (sand unit) / Boring 1236	500	1.25	0.08	Medium
Northwest (channel) / Boring 1339	500	0.45	0.02	Low to medium

To achieve an estimate of the flow into an excavation of the assumed length, the perimeter of the excavation should be multiplied by the flow per foot of excavation length reported in Table 5-10 at the appropriate time. For example, for an initial excavation trench having a length of 100 feet at excavation NW-A, the flow would be equal to:

0.45 gpm/ft x 100 ft x 2 sides = 90 gpm

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For a larger excavation having a perimeter of 1000 feet for the same location after approximately 30 days, the flow would be equal to:

$$0.02 \text{ gpm/ft} \times 1000 \text{ ft} = 20 \text{ gpm}$$

These results appear to confirm the earlier statement that flow rates will be low (even under very conservative assumptions of hydrogeologic conditions) and that open sumps and pumping will be the most common method for controlling groundwater. These systems will be needed in any event for stormwater control.

On the basis of these calculations, test trenches at selected locations would provide definitive data to determine the validity of these conclusions. Such trenches would be designed to evaluate effective yield rates, average hydraulic conductivity, drawdown and recharge information. Using the observed sustained yield data from pumping tests at the site, the test trenches would have to remain open for an extended period and protected from recharge by surface infiltration or precipitation. Alternately, observations made during initial excavations may be sufficient to make determinations with regard to the dewatering method required.

5.3.3 Dewatering Recommendations

Based on the information discussed previously in this report, the following recommendations are made:

- Test trench excavations could be made to determine the validity of the assumptions, observations and conclusions made above.

- Remedial excavations should be made working generally from the NE to the SW. This sequence is to avoid the potential for perched groundwater flow to recontaminate previously remediated areas.

- Contractors planning the remedial excavation should assume that, at a minimum, dewatering as a result of ground and surface water will be required using open sumps and pumping methods. Contingencies should also be made, particularly in excavations in the northwest and southwest quadrants of the Former Plant Area, for alternate means of groundwater control. These may include, but not be limited to, interceptor trenches and wellpoints.

- Pumping from open sumps and/or interceptor trenches should continue until excavations are developed to final planned grades or are backfilled at least 2 feet above the maximum observed seasonal groundwater elevations to avoid heave of the soils at the base of the excavation.

5.3.4 Stormwater/Groundwater Handling

During excavation of the site, water is expected to accumulate within the excavations as a result of perched water seepage and/or precipitation. Surface water run-on into the excavations will be limited to the extent practical by the use of berms, dikes, or ditches. Within the excavation, local sumps will be constructed to collect water.

The accumulated water is likely to be contaminated to some degree by site constituents of concern. The contamination could consist of radiological, inorganic, or organic constituents, or some combination of these constituents. Therefore, this water will be routed to the appropriate remediation wastewater treatment facility as defined in the Operations and Maintenance Master Plan for the "Aquifer Restoration and Wastewater Treatment Project", FDF Document 2505-OM-001.

5.4 Excavation and Site Restoration

This subsection summarizes possible excavation sequences and the anticipated excavation difficulties based on the subsurface conditions described in Section 5.1. Additionally, considerations regarding restoration of the site after excavation are presented.

5.4.1 Excavation Sequences

Due to the known perched water conditions, planning the sequence of excavation to accommodate dewatering is necessary. The steps taken during excavation will directly affect the groundwater collection and containment. Sumps and interceptor trenches or other groundwater controls will be required in some areas. Figure 5-10 presents three potential excavation sequence which should be considered by the excavation contractor for excavations encountering perched water.

5.4.1.1 Excavation Sequence 1

This excavation sequence involves installation of an interceptor trench on the up gradient side of the excavation. The excavation is then started at the center of the excavation and then progresses downward and outward. Open sumps can then be installed at either end of the excavations.

The advantages to this excavation sequence is that it helps to dewater the soils surrounding the excavations; thus reducing the amount of water encountered as the excavations progress laterally. Disadvantages to this sequence are that the sump location is constantly changing and running pump hoses and related items will require careful planning. In addition, the equipment may be constantly working in wet conditions at the excavation bottom. Finally, this sequence will require construction of access ramps into the excavation for hauling and excavation equipment, which will take away from excavation time.

5.4.1.2 Excavation Sequence 2

This excavation sequence does not include an interceptor trench or other dewatering methods. The excavation is started around the perimeter of the excavations and is then extended inward and downward. This method will act as a dewatering system on both the up gradient and down gradient sides of the excavation. Open sumps are then installed around the perimeter of the excavation.

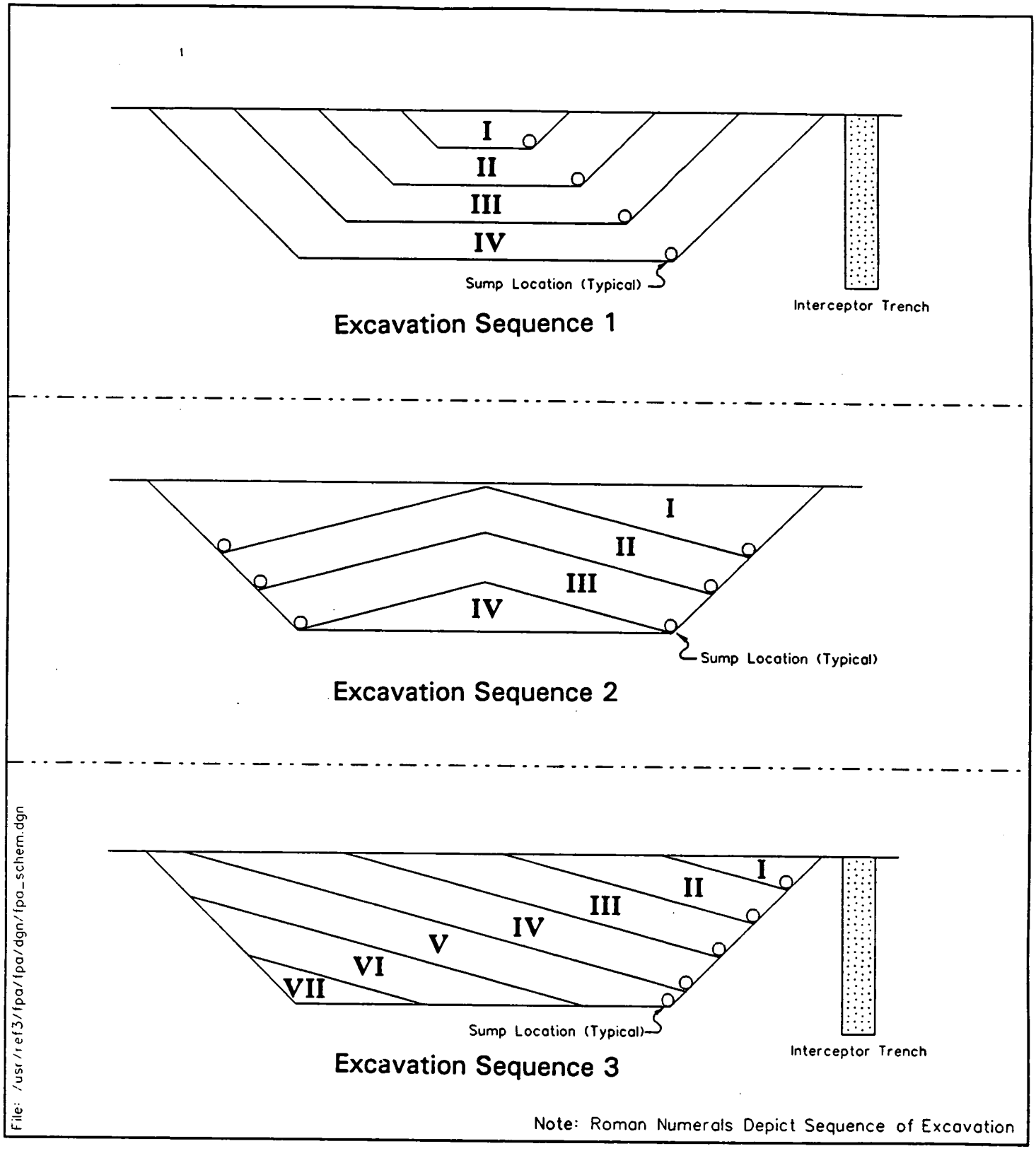

Figure 5-10 - Possible Excavation Sequences

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The advantage of this sequence is that the sump location is always at the same location (along the perimeter). In addition, the center portions of the excavation will remain drier, which should facilitate excavation. The interior slopes could be kept flatter than the exterior working slopes, which could act as access routes for hauling equipment and make hauling easier. Disadvantages include water collected at the toe of the slopes, may lead to sloughing or localized slope failures. However, the sump location could be moved inward slightly to reduce the effect on the slopes. Open sumps may not be able to control groundwater in higher flow conditions, and interceptor trenches or other dewatering methods will need to be considered.

5.4.1.3 Excavation Sequence 3

This excavation sequence involves installation of an interceptor trench or other dewatering method up gradient of the excavation. The excavation is started on one side of the excavation and is progressively extended deeper and wider. The sump is located on the side that the excavation was started. This method will dewater the down gradient side of the excavation and any water that remains on the up gradient side.

The primary advantage to this sequence is that a large portion of the excavation will remain dewatered throughout the excavation process, which will facilitate the ease the use of equipment. This sequence also has the advantage of a flatter slope on the down gradient side of the excavation, which will allow equipment to access the excavation more easily and prevent disturbance to the working slope. The major disadvantage is the sumps will be located at the toe of the side slopes, which may lend to greater frequency of sloughing failures or possible localized slope failures.

5.4.2 Anticipated Excavation Difficulties

The main problems that will be encountered during excavation are all related to groundwater. The foreseeable problems include shallow sloughing failures along slopes, keeping excavations dry, disturbance of silty or sandy materials when trafficked by construction equipment, and providing a stable foundation to begin placing new, clean structural backfill. Standard excavation equipment will be able to excavate the anticipated materials. However, perched water zones will make excavation difficult unless some precautions are taken.

5.4.2.1 Sloughing

Shallow sloughing failures will likely occur along temporary and permanent slopes cut into cohesionless soils (silts and sands). Sloughing failures will require maintenance throughout the project. Recommendations were made in Section 5.2 concerning methods to help reduce sloughing failures.

5.4.2.2 Groundwater Removal from Excavations

In perched water zones containing more permeable silts and sands, water will seep into the excavations and will require removal. Groundwater can be collected in temporary sumps constructed within the excavations. Groundwater can then be pumped from the sumps, allowing excavations to continue. Other dewatering methods have been discussed previously in Section 5.3.

5.4.2.3 Trafficking Difficulties

Moving equipment on very moist to wet silts and fine sands will cause rutting and pumping of the soils. In some instances, these soils could liquefy under the load and vibration of excavation equipment and cause equipment to "bog down" or get stuck. In these areas construction traffic should be minimized. If continual trafficking of the area is necessary, as in the case of a temporary haul road, a bed of No. 2 stone could be placed and choked off with a layer of ODOT 304 material. Geogrids and mats could also be used in conjunction with crushed stone to provide a suitable working surface.

In excavation areas where construction equipment cannot travel due to liquefying silt and sands, isolated areas could be dewatered as mentioned earlier or consideration could be given to the use of drag lines.

5.4.2.4 Unstable Structural Fill Foundation

It is anticipated that excavation NE-A will be completely or partially backfilled due to the proximity of the OSDF footprint. In addition, the toe of the long-term interim slopes may be buttressed with new fill to construct permanent slopes. Wet silt and sand layers may prove unstable for placement of new structural backfill. In isolated areas consideration could be given to placing a bridging lift of No. 2 stone choked off with ODOT 304 or similar material. The thickness of the bridging lift should be such that a stable subgrade is developed. Consideration could also be considered to placing a geotextile mat below the bridging lift to prevent migration of finer particles into the stone bridging lift.

Larger areas may require dewatering schemes such as trenches or installation of drains to develop a stable subgrade for fill placement. Bridging lifts of stone or use of geotextiles could then be used if isolated unstable conditions persist. Bridging lifts can be constructed by punching No. 2 crushed stone into the subgrade and placing at least a 12-inch thickness of crushed stone (layer thickness could vary depending on conditions). Punching the No. 2 stone into the soft layer is not necessary if geotextiles are used. The surface layer of the No. 2 crushed stone should then be choked off with a minimum 8-inch thickness of compacted ODOT 304 crushed stone. The backfill can then commence upon the bridging lift.

5.4.3 Site Restoration

The current plan for the FPA is to convert the excavation into wetlands consisting of ponds and lakes. No structures are proposed within the FPA. However, the excavation NE-A will be affected by the proposed OSDF footprint which is immediately adjacent to the FPA east boundary. See Section 5.2.4.1.4 for effects of the OSDF on excavation NE-A.

Once the excavations are approved, the long-term interim slopes will require reconfiguration to final permanent slopes. This reconfiguration can be performed by cutting back the crest of the interim slope or by placing buttress fill at the toe of the interim slope.

At excavation NE-A, due to its close proximity and overlap with the proposed OSDF footprint, the eastern portion (if not all) of this excavation will require backfilling with new structural fill. This will need to occur prior to construction of the adjacent OSDF cell.

Impacted excavated materials from the FPA are to be placed and compacted in the OSDF. The placement and compaction of these materials should be performed according to the Impacted Material Placement Plan (GeoSyntec, 1998). Clean excavated on-site material can be reused as new structural fill.

5.4.3.1 Filling of Excavated Areas

After the limits of the excavations are approved, restoration of the excavations should commence with an inspection of the existing slopes to evaluate their condition. Any slough or failed material at the toe of the slopes or accumulated on the benches should be removed prior to placing any new fill to buttress the slopes. In addition, sod and/or other vegetation should be stripped from the excavation side slopes and bottom. If desired, the vegetation could be removed in stages, starting from the base of the excavation and moving upward, to reduce the erosion of the slopes above the new fill. Finally, all pipes and other items associated with erosion control and slope maintenance should be removed prior to filling.

Since the backfill may be used to buttress the permanent slopes and support the OSDF, it is recommended that the excavations be buttressed with structural fill compacted to a minimum of 98 percent maximum dry density as determined by Standard Proctor (ASTM D 698) at ± 2 percent of the optimum moisture content. The new fill should be placed in maximum 8-inch thick lifts. Each lift should be tested and approved by qualified technicians before subsequent lifts are constructed.

New structural fill material should be free of deleterious substances. The maximum particle size in the new structural fill should be less than 4 inches in any dimension to prevent nesting of larger particles that could cause subsidence under load. If cohesive fill is used, it is recommended that the cohesive structural fill material have a plasticity index of 25 or less. Any proposed structural fill material should be subjected to laboratory testing to determine its suitability for use as structural fill. According to Proctor data, most on-site soils are suitable for reuse as structural fill but will likely require some moisture conditioning.

Horizontal stability benches should be cut along the lengths of the excavation slopes to accept new structural fill. The stability benches will help knit the new fill to the existing soils and improve the stability of the fill/natural soil interface as the fill is being placed. The bench widths should be at least as wide as the equipment used to place and compact the new fill.

Any permanent slopes should be maintained at 3H:1V or flatter for ease of maintenance and improved stability. Temporary fill slopes should conform to OSHA regulations. Once the filling operations are completed, the fill and any cut areas should be immediately sodded in order to reduce erosion of exposed soils until water levels can be established in the proposed ponds and lakes.

Once final grading plans and seismic Performance Categories are assigned, the final slopes should be analyzed under seismic load per DOE 1994b.

5.4.3.2 Placement of Excavated Material in Disposal Facility

All impacted materials from the FPA excavations will be placed in the OSDF. The impacted materials should be placed in the OSDF per the Impacted Material Placement Plan (IMPP) (GeoSyntec, 1998). According to the IMPP soil and soil-like (Category 1) materials are to be placed in 12- to 15-inch thick loose lifts,

compacted to at least 85% maximum dry density per ASTM D 698 with an average of 90% maximum dry density for the previous 10 tests, and placed at ±3% of optimum moisture content according to ASTM D 698. It is anticipated that the majority of the materials excavated from the FPA will fall into Category 1. Other types of materials from the FPA excavations should be placed in the OSDF per the IMPP.

Three Standard Proctor tests were performed on three bulk samples from the new test borings performed for this study. Two of the Standard Proctor tests were performed on lean clays, and one was performed on a silty, clayey sand sample.

According to the new (PO-177) lean clay proctors, the maximum dry densities ranged from 118.1 to 118.3 pcf at 14.1 to 14.4 percent optimum moisture content. Previous Standard Proctors indicate that optimum moisture contents range from 10.2 to 19.5 percent and maximum dry densities range from 105.9 to 129.7 pcf for lean clays with varying amounts of sand. Twelve Modified Proctors (ASTM D1557) were previously performed on the brown lean clays in the FPA and are reported in Appendix A, Table A-8. Additional compaction data for brown clay samples within the footprint of the OSDF from PO-140 (PARSONS 1995b) can be found in Appendix H. According to the new collected cohesive soils samples, the in situ moisture contents ranged from approximately 14 percent to 30 percent. Placing excavated lean clay soils at or near optimum moisture content will occasionally require drying of the excavated soils.

Per the clayey, silty sand proctor, the maximum dry density is 131.2 pcf at 8.8 percent optimum moisture content. The measured moisture content of tested new sand samples ranged from approximately 6 percent to 11 percent. This indicates that moisture conditioning of the excavated soils will not likely be required prior to placing them in the disposal facility.

Using a sandy silt Proctor from *Fly Ash Piles and South Field Waste Units Geotechnical Report* (PARSONS 1996b), PO-154, the estimated Standard Proctor maximum dry density is 120.9 pcf at 12.8 percent optimum moisture content. The newly collected samples had measured moisture contents ranging from approximately 12 percent to 23 percent, indicating that some moisture conditioning will be required prior to placement in the OSDF.

Using a gray glacial till Proctor from *Geotechnical Investigation Report On-Site Disposal Facility* (PARSONS 1995b), PO-140, the estimated Standard Proctor maximum dry density is 128.4 pcf at 10.5 percent optimum moisture content. Additional proctor data for gray till samples within the footprint of the OSDF from PO-140 (PARSONS 1995b) can be found in Appendix H. The newly collected gray till samples had measured moisture contents ranging from approximately 6 percent to 26 percent, indicating moisture adjustments will be required.

Excavating the in situ soils from the FPA and placing them in the disposal facility will result in volume changes, called bulking and shrinking. Bulking is where the recompacted volume is greater than the in situ or bank volume. Whereas, shrinkage is where the recompacted volume is less than the bank volume. Bulking also occurs as materials are excavated from the bank and loosely placed in trucks. Table 5-11 outlines the anticipated shrinkage and bulking factors for the anticipated excavated soils in a compacted state and for trucking. Bulking factors are indicated by values greater than one, and shrinkage factors are indicated by factors less than one. Bulking will occur within all the materials due to their generally compact natural state.

Table 5-11 - Estimated Shrinkage and Bulking Factors

Material	Avg. Dry Density (pcf)*	Avg. Moisture Content (%)	Wet Density (pcf)	Max. Dry Density (pcf)	90% Max. Dry Density (pcf)	Optimum Moisture (%)	Compacted Wet Density (pcf)	Compacted Bulking/ Shrinkage ***	Trucking Bulking
Brown Clay	110.2	18.8	130.9	118.3	106.5	14.4	121.8	1.075	1.11
Gray Till	126.9	11.7	141.7	128.4	115.6	10.5	127.7	1.110	1.43
Sand	134.6	12.2	151.0	131.2	118.1	8.8	128.5	1.175	1.43
Silt	109.7	19.6	131.2	120.9	108.8	12.8	122.7	1.069	1.25-1.33
Wet Lacustrine Clays	104.0**	23.6	128.5	118.1	106.3	14.1	121.3	1.059	1.43

Notes: * Based on PO-177 data
** Based on typical value from boring G3-010/12275
*** Assumes placement at 90% Relative Compaction at optimum moisture content based on Standard Proctor Test

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APPENDIX A

APPENDIX A

SUMMARY TABLES
GEOTECHNICAL LABORATORY DATA FROM PRIOR GEOTECHNICAL INVESTIGATION

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
NW		OS-1	OS1/3	SS	4.0	6.0	19.0	PARSONS PO 22
NW		OS-1	OS1/4B	ST	6.0	8.0	21.1	PARSONS PO 22
NW		OS-1	OS1/5	SS	8.0	10.0	22.8	PARSONS PO 22
NW		OS-2A	OS2A/3	ST	4.0	6.0	22.1	PARSONS PO 22
NW		OS-2A	OS2A/5	SS	8.0	10.0	22.6	PARSONS PO 22
NW		OS-2A	OS2A/6	SS	13.0	15.0	22.6	PARSONS PO 22
NW		OS-3	OS3/2	SS	2.0	4.0	13.5	PARSONS PO 22
NW		OS-3	OS3/5	ST	8.0	10.0	24.6	PARSONS PO 22
NW		OS-3	OS3/6	SS	13.0	15.0	23.2	PARSONS PO 22
NW		OS-4	OS4/4	ST	6.0	8.0	12.9	PARSONS PO 22
NW		OS-4	OS4/6	ST	13.0	15.0	32.6	PARSONS PO 22
NW		OS-4	OS4/7	SS	18.0	20.0	22.6	PARSONS PO 22
SE		PFS-1	P1/2	SS	2.0	4.0	15.8	PARSONS PO 32
SE		PFS-1	P1/4	ST	6.0	8.0	26.7	PARSONS PO 32
SE		PFS-1	P1/5	SS	8.0	10.0	28.2	PARSONS PO 32
SE		PFS-2	P2/4	SS	6.0	8.0	20.5	PARSONS PO 32
SE		PFS-2	P2/5	ST	8.0	10.0	18.8	PARSONS PO 32
SE		PFS-2	P2/6	SS	13.0	15.0	14.6	PARSONS PO 32
SE		PFS-3	P3/3	SS	4.0	6.0	27.4	PARSONS PO 32
SE		PFS-3	P3/4	ST	6.0	8.0	23.2	PARSONS PO 32
SE		PFS-3	P3/6	SS	13.0	15.0	23.6	PARSONS PO 32
SE		PFS-4A	P4A/4	ST	6.0	8.0	20.0	PARSONS PO 32
SE		PFS-4A	P4A/5	ST	8.0	10.0	22.6	PARSONS PO 32
SE		PFS-4A	P4A/6	SS	13.0	15.0	12.3	PARSONS PO 32
SE		PFS-5	P5/2	SS	2.0	4.0	20.4	PARSONS PO 32
SE		PFS-5	P5/3	SS	4.0	6.0	23.5	PARSONS PO 32
SE		PFS-5	P5/4	ST	6.0	8.0	20.6	PARSONS PO 32
SE		PFS-6	P6/3	SS	4.0	6.0	14.1	PARSONS PO 32
SE		PFS-6	P6/5	ST	8.0	10.0	11.3	PARSONS PO 32
SE		PFS-6	P6/7	SS	18.0	20.0	20.1	PARSONS PO 32
SW		UD-1	1 Bot	D	2.3	3.0	27.1	USACOE 1952
SW		UD-1	1 Top	D	1.5	2.3	13.9	USACOE 1952
SW		UD-1	10	D	18.5	20.0	11.7	USACOE 1952
SW		UD-1	11	D	20.5	22.0	11.5	USACOE 1952
SW		UD-1	2	D	3.5	6.0	17.3	USACOE 1952
SW		UD-1	3	D	5.5	7.0	17.6	USACOE 1952
SW		UD-1	4	D	7.5	9.0	17.1	USACOE 1952
SW		UD-1	5	D	9.5	11.0	14.1	USACOE 1952
SW		UD-1	6	D	11.5	13.0	14.8	USACOE 1952
SW		UD-1	7	D	13.6	15.0	12.3	USACOE 1952
SW		UD-1	8	D	15.5	17.0	13.3	USACOE 1952
SW		UD-1	9	D	17.5	18.5	12.5	USACOE 1952
NE		UD-2	1	D	1.5	3.5	26.5	USACOE 1952
NE		UD-2	10	D	21.5	23.5	12.0	USACOE 1952
NE		UD-2	11	D	23.5	25.5	12.8	USACOE 1952
NE		UD-2	12	D	25.5	27.5	10.0	USACOE 1952
NE		UD-2	13	D	27.5	29.5	10.3	USACOE 1952
NE		UD-2	14	D	29.5	31.5	12.0	USACOE 1952
NE		UD-2	15	D	31.5	32.5	14.3	USACOE 1952
NE		UD-2	16	D	32.5	34.5	9.9	USACOE 1952
NE		UD-2	2	D	3.5	5.5	11.5	USACOE 1952
NE		UD-2	3	D	5.5	7.5	12.1	USACOE 1952
NE		UD-2	5	D	11.5	13.5	8.0	USACOE 1952
NE		UD-2	7	D	15.5	17.5	14.6	USACOE 1952
NE		UD-2	8	D	17.5	19.5	11.4	USACOE 1952
NE		UD-2	9	D	19.5	21.5	10.7	USACOE 1952
SW		UD-3	1	D	1.5	3.5	25.1	USACOE 1952
SW		UD-3	2	D	3.5	5.5	24.4	USACOE 1952
SW		UD-3	3	D	5.5	7.5	26.3	USACOE 1952
SW		UD-3	4	D	7.5	9.5	20.8	USACOE 1952
SW		UD-3	5	D	9.5	11.5	19.1	USACOE 1952
SW		UD-3	6 Bot	D	13.0	13.5	18.5	USACOE 1952
SW		UD-3	6 Top	D	11.5	13.0	19.7	USACOE 1952
SW		UD-3	7	D	13.5	15.5	14.7	USACOE 1952

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
SW		UD-3	8	D	15.5	17.5	18.5	USACOE 1952
SW		UD-3	9	D	17.5	19.5	15.3	USACOE 1952
SW	11583	109(4)		ST	4.0	5.0	20.1	S&ME 021-86-162
SW	11585	111(6)		SS	0.0	1.5	15.9	S&ME 021-86-162
SW	11585	111(6)		SS	2.5	4.0	13.5	S&ME 021-86-162
SW	11585	111(6)		SS	5.0	6.5	12.4	S&ME 021-86-162
SW	11585	111(6)		SS	7.5	9.0	20.3	S&ME 021-86-162
SW	11586	112(1)		SS	0.0	1.5	8.2	S&ME 021-86-162
SW	11586	112(1)		SS	2.5	4.0	27.0	S&ME 021-86-162
SW	11587	113(2)		ST	4.0	6.0	20.5	S&ME 021-86-162
SW	11588	114(3)		SS	0.0	1.5	7.4	S&ME 021-86-162
SW	11588	114(3)		SS	2.5	4.0	22.7	S&ME 021-86-162
SW	11588	114(3)		SS	5.0	6.5	22.3	S&ME 021-86-162
SW	11589	115(7)		SS	0.0	1.5	5.4	S&ME 021-86-162
SW	11589	115(7)		SS	5.0	6.5	25.0	S&ME 021-86-162
SW	11590	116(5)		ST	7.0	9.0	27.1	S&ME 021-86-162
SW	11595	121(1)		SS	1.0	3.0	17.6	S&ME 1221-87-178-1.0
SW	11595	121(1)		BULK	4.5	9.0	20.0	S&ME 1221-87-178-1.0
SW	11595	121(1)		SS	5.0	6.5	17.6	S&ME 1221-87-178-1.0
SW	11597	123(2)		SS	0.0	2.0	3.7	S&ME 1221-87-178-1.0
SW	11597	123(2)		SS	2.0	3.5	13.7	S&ME 1221-87-178-1.0
SW	11597	123(2)		SS	3.5	5.0	24.0	S&ME 1221-87-178-1.0
SW	11598	124(3)		SS	1.0	2.0	18.7	S&ME 1221-87-178-1.0
SW	11598	124(3)		SS	2.0	3.0	18.0	S&ME 1221-87-178-1.0
SW	11598	124(3)		ST	3.0	5.0	22.0	S&ME 1221-87-178-1.0
SW	11598	124(3)		SS	5.0	6.5	23.5	S&ME 1221-87-178-1.0
SW	11598	124(3)		SS	7.5	9.0	22.1	S&ME 1221-87-178-1.0
SW	11599	125(7)		SS	1.5	3.0	14.1	S&ME 1221-87-178-2.0
SW	11599	125(7)		SS	3.0	4.5	20.3	S&ME 1221-87-178-2.0
SW	11599	125(7)		SS	5.0	6.5	21.3	S&ME 1221-87-178-2.0
SW	11599	125(7)		SS	7.5	9.0	22.8	S&ME 1221-87-178-2.0
SW	11797	126(6)		SS	2.0	2.5	13.6	S&ME 1221-87-178-2.0
SW	11797	126(6)		SS	2.5	3.0	19.4	S&ME 1221-87-178-2.0
SW	11797	126(6)		ST	3.0	5.0	33.7	S&ME 1221-87-178-2.0
SW	11798	127(1)		SS	0.0	1.5	21.5	S&ME 021-86-169
SW	11798	127(1)		SS	2.5	4.0	18.3	S&ME 021-86-169
SW	11798	127(1)		SS	5.0	6.5	26.1	S&ME 021-86-169
SW	11799	128(2)		SS	0.0	1.5	19.7	S&ME 021-86-169
SW	11799	128(2)		SS	2.5	4.0	21.1	S&ME 021-86-169
SW	11799	128(2)		ST	5.0	7.0	17.2	S&ME 021-86-169
SW	11800	129(4)		SS	1.0	2.0	14.2	S&ME 1221-87-178-2.0
SW	11800	129(4)		SS	3.0	4.5	26.2	S&ME 1221-87-178-2.0
SW	11800	129(4)		ST	5.0	7.0	18.7	S&ME 1221-87-178-2.0
SW	11800	129(4)		SS	7.5	9.0	28.9	S&ME 1221-87-178-2.0
SW	11800	129(4)		SS	10.0	11.5	21.7	S&ME 1221-87-178-2.0
SW	11801	130(5)		SS	0.5	1.0	16.5	S&ME 1221-87-178-2.0
SW	11801	130(5)		SS	1.5	3.0	19.6	S&ME 1221-87-178-2.0
NW	11802	131(1)		SS	0.0	1.5	17.4	S&ME 021-86-169
NW	11802	131(1)		SS	5.0	6.5	27.7	S&ME 021-86-169
NW	11803	132(2)		SS	0.0	1.5	18.8	S&ME 021-86-169
NW	11803	132(2)		SS	2.5	4.0	22.8	S&ME 021-86-169
NW	11804	133(3)		SS	2.5	4.0	28.2	S&ME 021-86-169
NW	11804	133(3)		ST	5.0	7.0	22.8	S&ME 021-86-169
NW	11805	134(4)		SS	0.0	1.5	15.1	S&ME 021-86-169
NW	11805	134(4)		SS	2.5	4.0	23.6	S&ME 021-86-169
NW	11806	135(5)		SS	5.0	6.5	16.5	S&ME 021-86-169
SE	11807	136(1)		SS	5.0	6.5	18.2	S&ME 1221-87-257
SE	11807	136(1)		SS	7.5	9.0	12.5	S&ME 1221-87-257
SE	11807	136(1)		SS	10.0	11.5	9.9	S&ME 1221-87-257
SE	11807	136(1)		SS	15.0	16.5	14.9	S&ME 1221-87-257
SE	11807	136(1)		SS	20.0	21.5	11.3	S&ME 1221-87-257
SE	11807	136(1)		SS	25.0	26.5	5.0	S&ME 1221-87-257
SE	11807	136(1)		SS	30.0	31.5	3.1	S&ME 1221-87-257
SE	11809	138(5)	3	ST	3.0	5.0	17.9	S&ME 1221-87-257

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
SE	11813	141(3)		SS	5.0	6.5	16.2	S&ME 1221-87-257
SE	11813	141(3)		SS	7.5	9.0	19.7	S&ME 1221-87-257
SE	11813	141(3)		SS	10.0	11.5	15.2	S&ME 1221-87-257
SE	11813	141(3)		SS	15.0	16.5	14.6	S&ME 1221-87-257
SE	11813	141(3)		SS	25.0	26.5	15.1	S&ME 1221-87-257
SE	11813	141(3)	3	ST	3.0	5.0	20.6	S&ME 1221-87-257
SE	11816	144(4)		SS	2.5	4.0	22.5	S&ME 021-86-363
SE	11818	146(3)		ST	2.5	4.5	24.4	S&ME 021-86-363
SE	11819	147(1)		ST	5.0	7.0	15.0	S&ME 021-86-363
SE	11820	148(1)		SS	4.0	5.5	23.9	S&ME 021-86-363
SE	11820	148(1)		SS	6.5	8.0	21.8	S&ME 021-86-363
SE	11821	149(3)		SS	4.0	5.5	23.0	S&ME 021-86-363
SE	11821	149(3)		ST	9.0	11.0	24.9	S&ME 021-86-363
SE	11822	150(4)		ST	2.0	4.0	15.0	S&ME 021-86-363
SE	11823	151(6)		ST	9.0	11.0	18.6	S&ME 021-86-363
SE	11825	153(5)		SS	5.0	6.5	21.8	S&ME 021-86-363
SE	11826	154(7)		SS	1.5	3.0	20.4	S&ME 021-84-215
SE	11826	154(7)		ST	7.0	9.0	22.7	S&ME 021-84-215
SE	11827	155(4)		ST	7.5	9.5	20.3	S&ME 021-84-215
SE	11828	156(2)		ST	14.0	16.0	21.4	S&ME 021-84-215
SE	11830	158(8)		BULK	0.0	3.0	17.9	S&ME 1221-87-114
SE	11830	158(8)		ST	2.0	4.0	21.4	S&ME 1221-87-114
SE	11830	158(8)		SS	5.0	6.5	22.7	S&ME 1221-87-114
SE	11830	158(8)		SS	7.5	9.0	17.9	S&ME 1221-87-114
SE	11832	160(5)		SS	2.5	4.0	23.6	S&ME 1221-87-114
SE	11832	160(5)		ST	5.0	7.0	20.7	S&ME 1221-87-114
SE	11833	161(7)		SS	5.0	6.5	13.4	S&ME 1221-87-114
SE	11833	161(7)		SS	7.5	9.0	15.2	S&ME 1221-87-114
SE	11834	162(2)		SS	2.5	4.0	15.8	S&ME 1221-87-114
SE	11834	162(2)		SS	5.0	6.5	15.3	S&ME 1221-87-114
SE	11835	163(6)		SS	1.5	3.0	24.4	S&ME 021-84-215
SE	11835	163(6)		SS	4.5	6.0	24.1	S&ME 021-84-215
SE	11835	163(6)		SS	7.0	8.5	26.1	S&ME 021-84-215
SE	11835	163(6)		SS	9.5	11.0	12.6	S&ME 021-84-215
SE	11835	163(6)		SS	14.5	16.0	11.7	S&ME 021-84-215
SE	11835	163(6)		SS	19.5	20.0	19.4	S&ME 021-84-215
SE	11835	163(6)		SS	24.5	26.0	3.7	S&ME 021-84-215
SE	11837	165(6)		SS	5.0	6.5	27.2	S&ME 1221-87-114
SE	11837	165(6)		SS	7.5	9.0	13.2	S&ME 1221-87-114
SE	11837	165(6)		SS	7.5	9.0	13.8	S&ME 1221-87-114
SE	11838	166(1)		ST	1.0	3.0	13.9	S&ME 1221-87-114
SE	11838	166(1)		SS	5.0	6.5	9.6	S&ME 1221-87-114
SE	11838	166(1)		SS	7.5	9.0	12.5	S&ME 1221-87-114
SE	11840	168(11)		ST	3.0	5.0	12.0	S&ME 1221-87-178-3.0
SE	11842	170(5)		ST	9.5	11.5	11.8	S&ME 021-84-215
SE	11843	171(9)		SS	0.5	1.0	14.0	S&ME 1221-87-178.3.0
SE	11843	171(9)		SS	1.0	1.5	17.4	S&ME 1221-87-178.3.0
SE	11843	171(9)		SS	1.5	2.0	10.8	S&ME 1221-87-178.3.0
SE	11844	172(8)		SS	1.0	1.5	6.7	S&ME 1221-87-178.3.0
SE	11844	172(8)		SS	3.0	5.0	11.3	S&ME 1221-87-178-3.0
SE	11844	172(8)		SS	7.5	9.0	12.1	S&ME 1221-87-178.3.0
NE	11845	173(1)		SS	5.0	6.5	12.4	S&ME 021-86-261
NE	11845	173(1)		SS	7.5	9.0	12.0	S&ME 021-86-261
NE	11845	173(1)		ST	15.0	16.5	10.8	S&ME 021-86-261
NE	11845	173(1)		SS	30.0	31.0	12.0	S&ME 021-86-261
NE	11845	173(1)		SS	35.0	36.5	5.3	S&ME 021-86-261
NE	11845	173(1)		SS	45.0	46.5	3.7	S&ME 021-86-261
NE	11845	173(1)		SS	55.0	56.0	2.9	S&ME 021-86-261
NE	11845	173(1)		SS	58.0	60.0	5.6	S&ME 021-86-261
NE	11846	174(2)		SS	5.0	6.5	13.3	S&ME 1221-87-288
NE	11846	174(2)		SS	7.5	9.0	8.7	S&ME 1221-87-288
NE	11847	175(3)		SS	5.0	6.5	12.3	S&ME 1221-87-288
NE	11847	175(3)		SS	7.5	9.0	12.3	S&ME 1221-87-288-1.0
NE	11847	175(3)		SS	10.0	11.5	8.3	S&ME 1221-87-288

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
NE	11848	176(1)		SS	5.0	6.5	9.7	S&ME 1221-87-288
NE	11848	176(1)		SS	7.5	9.0	8.5	S&ME 1221-87-288
NE	11848	176(1)		SS	10.0	11.5	9.4	S&ME 1221-87-288
NE	11848	176(1)		SS	15.0	16.5	9.9	S&ME 1221-87-288
NE	11848	176(1)		SS	20.0	21.5	12.3	S&ME 1221-87-288
NE	11848	176(1)		SS	25.0	26.5	10.0	S&ME 1221-87-288
NE	11848	176(1)		SS	28.5	30.0	10.4	S&ME 1221-87-288
SE	11861	188(7)		SS	0.0	1.5	15.9	S&ME 021-86-162
SE	11861	188(7)		SS	5.0	6.5	11.8	S&ME 021-86-162
SE	11862	189(4)		SS	0.0	1.5	24.5	S&ME 021-86-162
SE	11862	189(4)		ST	3.0	4.5	13.6	S&ME 021-86-162
SE	11862	189(4)		SS	4.5	5.0	11.9	S&ME 021-86-162
SE	11863	190(5)		ST	3.0	5.0	14.1	S&ME 021-86-162
SE	11864	191(6)		SS	0.0	1.5	15.6	S&ME 021-86-162
SE	11864	191(6)		SS	5.0	6.5	11.9	S&ME 021-86-162
SE	11865	192(1)		SS	0.0	1.5	4.8	S&ME 021-86-162
SE	11865	192(1)		SS	2.5	4.0	15.7	S&ME 021-86-162
SE	11866	193(2)		SS	0.0	1.5	12.7	S&ME 021-86-162
SE	11866	193(2)		SS	2.5	4.0	12.3	S&ME 021-86-162
SE	11867	194(3)		SS	0.0	1.5	11.8	S&ME 021-86-162
SE	11867	194(3)		SS	2.5	4.0	11.7	S&ME 021-86-162
SE	11867	194(3)		SS	10.0	11.5	14.1	S&ME 021-86-162
NE	11868	195(5)		SS	0.7	2.0	11.3	S&ME 1221-87-288.2.0
NE	11868	195(5)		SS	2.0	3.5	11.7	S&ME 1221-87-288.2.0
NE	11868	195(5)		NR	3.5	5.0	11.0	S&ME 1221-87-288-2.0
NE	11869	196(7)		SS	5.0	6.5	12.2	S&ME 1221-87-288-2.0
NE	11869	196(7)		SS	7.5	9.0	13.2	S&ME 1221-87-288-2.0
NE	11869	196(7)		SS	10.0	11.5	13.9	S&ME 1221-87-288-2.0
SW	11874	222(4)		ST	10.0	12.0	19.5	S&ME 021-84-215
SW	11875	223(2)		ST	2.5	4.5	21.6	S&ME 021-84-215
SW	11877	225(3)		ST	4.5	6.5	19.5	S&ME 021-84-215
SW	11880	228(2)		SS	0.0	1.5	14.7	S&ME 021-84-269
SW	11880	228(2)		SS	1.5	3.0	20.8	S&ME 021-84-269
SW	11882	230(4)		SS	0.0	1.5	20.8	S&ME 021-84-269
SW	11882	230(4)		SS	1.5	3.0	14.4	S&ME 021-84-269
SW	11882	230(4)		SS	3.0	4.5	41.2	S&ME 021-84-269
NW	11883	231(5)		SS	1.5	3.0	25.0	S&ME 021-84-269
NW	11884	232(6)		SS	0.0	1.5	19.2	S&ME 021-84-269
NW	11884	232(6)		SS	1.5	3.0	25.4	S&ME 021-84-269
NW	11885	233(7)		SS	0.0	1.5	13.3	S&ME 021-84-269
NW	11885	233(7)		SS	1.5	3.0	11.4	S&ME 021-84-269
NW	11885	233(7)		SS	3.0	4.5	27.7	S&ME 021-84-269
NW	11886	234(8)		SS	0.0	1.5	11.4	S&ME 021-84-269
NW	11886	234(8)		SS	1.5	3.0	10.3	S&ME 021-84-269
NW	11888	136(10)		SS	1.5	3.0	20.7	S&ME 021-84-269
SW	11916	261(7)	3	SS	5.0	6.5	26.0	ATEC 22-23071
SW	11916	261(7)	4	SS	7.5	9.0	21.0	ATEC 22-23071
SW	11916	261(7)	5	SS	10.0	11.5	23.0	ATEC 22-23071
SW	11916	261(7)	6	SS	13.5	15.0	27.0	ATEC 22-23071
SW	11916	261(7)	7	SS	18.5	20.0	26.0	ATEC 22-23071
SW	11916	261(7)	8	SS	23.5	25.0	30.0	ATEC 22-23071
SE	11934	279(B1)		ST	3.0	5.0	21.0	S&ME 4144-88-119
SE	11935	280(B2)		SS	7.5	9.0	23.0	S&ME 4144-88-119
SE	11935	280(B2)		SS	10.0	11.5	22.0	S&ME 4144-88-119
SE	11935	280(B2)		SS	13.5	15.0	14.0	S&ME 4144-88-119
SE	11935	280(B2)		SS	18.5	20.0	15.0	S&ME 4144-88-119
SE	11935	280(B2)		SS	23.5	25.0	4.0	S&ME 4144-88-119
SE	11935	280(B2)		SS	28.5	30.0	4.0	S&ME 4144-88-119
SE	11935	280(B2)		SS	33.5	35.0	4.0	S&ME 4144-88-119
SE	11936	281(B3)		ST	3.0	5.0	11.0	S&ME 4144-88-119
NE	11938	283(1)	1	SS	5.0	6.5	13.5	NUTTING S-1143
NE	11938	283(1)	2	SS	7.5	9.0	13.9	NUTTING S-1143
NE	11938	283(1)	3	SS	10.0	11.5	12.7	NUTTING S-1143
NE	11938	283(1)	4	SS	12.5	14.0	12.8	NUTTING S-1143

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
NE	11938	283(1)	5	SS	15.0	16.5	14.4	NUTTING S-1143
NE	11938	283(1)	6	SS	18.5	20.0	13.7	NUTTING S-1143
NE	11939	284(2)	4	SS	4.5	6.0	14.8	NUTTING S-1143
NE	11939	284(2)	6	SS	9.5	11.0	13.4	NUTTING S-1143
NE	11939	284(2)	9	SS	17.0	18.5	12.6	NUTTING S-1143
NE	11940	285(3)	1	SS	5.0	6.5	14.6	NUTTING S-1143
NE	11940	285(3)	2	SS	7.5	9.0	14.2	NUTTING S-1143
NE	11940	285(3)	3	SS	10.0	11.5	14.3	NUTTING S-1143
NE	11940	285(3)	4	SS	12.5	14.0	13.6	NUTTING S-1143
NE	11940	285(3)	6	SS	18.5	20.0	14.6	NUTTING S-1143
NE	11941	286(4)	3	SS	3.5	5.0	11.3	NUTTING S-1143
NE	11941	286(4)	5	SS	9.5	11.0	13.4	NUTTING S-1143
NE	11941	286(4)	7	SS	18.5	20.0	10.3	NUTTING S-1143
NE	11941	286(4)	S-1	ST	12.0	14.0	10.4	NUTTING S-1143
NE	11942	287(5)	10	SS	14.5	16.0	15.6	NUTTING S-1143
NE	11942	287(5)	12	SS	23.5	25.0	13.2	NUTTING S-1143
NE	11942	287(5)	6	SS	7.0	7.5	9.7	NUTTING S-1143
NE	11942	287(5)	8	SS	9.5	11.0	12.9	NUTTING S-1143
NE	11943	288(6)		SS	5.0	6.5	16.1	NUTTING S-1143
NE	11943	288(6)		SS	7.5	9.0	14.7	NUTTING S-1143
NE	11943	288(6)		SS	10.0	11.5	15.1	NUTTING S-1143
NE	11943	288(6)		SS	12.5	14.0	11.4	NUTTING S-1143
NE	11943	288(6)		SS	15.0	16.5	10.9	NUTTING S-1143
NE	11944	289(7)	2	SS	1.5	3.0	12.8	NUTTING S-1143
NE	11944	289(7)	4	SS	5.0	6.5	11.3	NUTTING S-1143
NE	11944	289(7)	8	SS	16.0	16.5	12.6	NUTTING S-1143
NE	11944	289(7)	S-1	ST	7.5	8.5	10.5	NUTTING S-1143
NE	11945	290(8)	3	SS	4.5	6.0	10.9	NUTTING S-1143
NE	11945	290(8)	5	SS	9.5	11.0	14.8	NUTTING S-1143
NE	11945	290(8)	8	SS	18.5	20.0	15.1	NUTTING S-1143
SW	11946	291(9)	4	SS	4.5	6.0	23.9	NUTTING S-1143
SW	11946	291(9)	5	SS	9.0	10.5	22.9	NUTTING S-1143
SW	11946	291(9)	6	SS	12.0	13.5	24.4	NUTTING S-1143
SW	11946	291(9)	9	SS	18.5	20.0	12.6	NUTTING S-1143
SW	11946	291(9)	S-1	ST	7.0	9.0	24.1	NUTTING S-1143
SW	11947	292(10)	3	SS	2.0	3.5	20.5	NUTTING S-1143
SW	11947	292(10)	4	SS	4.5	6.0	27.1	NUTTING S-1143
SW	11947	292(10)	5	SS	7.0	8.5	22.2	NUTTING S-1143
SW	11947	292(10)	7	SS	12.0	13.5	18.2	NUTTING S-1143
SW	11947	292(10)	8	SS	14.5	16.0	20.8	NUTTING S-1143
SW	11948	293(11)	4	SS	6.5	8.0	19.5	NUTTING S-1143
SW	11948	293(11)	S-1	ST	9.5	11.5	20.7	NUTTING S-1143
SW	11949	294(12)	11	SS	18.5	20.0	13.3	NUTTING S-1143
SW	11949	294(12)	4	SS	2.5	3.5	31.6	NUTTING S-1143
SW	11949	294(12)	5	SS	4.5	6.0	28.1	NUTTING S-1143
SW	11950	295(C-1)	10	SS	33.5	35.0	2.0	ATEC 22-831858
SW	11950	295(C-1)	3	SS	6.0	7.5	7.0	ATEC 22-831858
SW	11950	295(C-1)	4	SS	8.5	10.0	23.0	ATEC 22-831858
SW	11950	295(C-1)	5	SS	11.0	12.5	19.0	ATEC 22-831858
SW	11950	295(C-1)	6	SS	13.5	15.0	13.0	ATEC 22-831858
SW	11950	295(C-1)	7	SS	18.5	20.0	13.0	ATEC 22-831858
SW	11950	295(C-1)	8	SS	23.5	25.0	8.0	ATEC 22-831858
SW	11950	295(C-1)	9	SS	28.5	30.0	5.0	ATEC 22-831858
SW	11951	296(C-2)	10	SS	33.5	35.0	2.0	ATEC 22-831858
SW	11951	296(C-2)	2	SS	1.5	3.0	18.0	ATEC 22-831858
SW	11951	296(C-2)	3	SS	6.0	7.5	18.0	ATEC 22-831858
SW	11951	296(C-2)	4	SS	8.5	10.0	24.0	ATEC 22-831858
SW	11951	296(C-2)	5	SS	11.0	12.5	20.0	ATEC 22-831858
SW	11951	296(C-2)	6	SS	13.5	15.0	11.0	ATEC 22-831858
SW	11951	296(C-2)	7	SS	18.5	20.0	21.0	ATEC 22-831858
SW	11951	296(C-2)	8	SS	23.5	25.0	3.0	ATEC 22-831858
SW	11951	296(C-2)	9	SS	28.5	30.0	4.0	ATEC 22-831858
SW	11952	297(C-3)	10	SS	33.5	35.0	2.0	ATEC 22-831858
SW	11952	297(C-3)	2	SS	1.5	3.0	15.0	ATEC 22-831858

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
SW	11952	297(C-3)	3	SS	6.0	7.5	19.0	ATEC 22-831858
SW	11952	297(C-3)	4	SS	8.5	10.0	21.0	ATEC 22-831858
SW	11952	297(C-3)	5	SS	11.0	12.5	20.0	ATEC 22-831858
SW	11952	297(C-3)	6	SS	13.5	15.0	18.0	ATEC 22-831858
SW	11952	297(C-3)	7	SS	18.5	20.0	13.0	ATEC 22-831858
SW	11952	297(C-3)	8	SS	23.5	25.0	10.0	ATEC 22-831858
SW	11952	297(C-3)	9	SS	28.5	30.0	3.0	ATEC 22-831858
SW	11953	298(C-4)	10	SS	33.5	35.0	1.0	ATEC 22-831858
SW	11953	298(C-4)	3	SS	6.0	7.5	19.0	ATEC 22-831858
SW	11953	298(C-4)	4	SS	8.5	10.0	23.0	ATEC 22-831858
SW	11953	298(C-4)	5	SS	11.0	12.5	23.0	ATEC 22-831858
SW	11953	298(C-4)	6	SS	13.5	15.0	17.0	ATEC 22-831858
SW	11953	298(C-4)	7	SS	18.5	20.0	13.0	ATEC 22-831858
SW	11953	298(C-4)	8	SS	23.5	25.0	11.0	ATEC 22-831858
SW	11953	298(C-4)	9	SS	28.5	30.0	3.0	ATEC 22-831858
SW	11954	299(C-5)	10	SS	33.5	35.0	4.0	ATEC 22-831858
SW	11954	299(C-5)	3	SS	6.0	7.5	13.0	ATEC 22-831858
SW	11954	299(C-5)	4	SS	8.5	10.0	10.0	ATEC 22-831858
SW	11954	299(C-5)	5	SS	11.0	12.5	18.0	ATEC 22-831858
SW	11954	299(C-5)	6	SS	13.5	15.0	13.0	ATEC 22-831858
SW	11954	299(C-5)	7	SS	18.5	20.0	20.0	ATEC 22-831858
SW	11954	299(C-5)	8	SS	23.5	25.0	20.0	ATEC 22-831858
SW	11954	299(C-5)	9	SS	28.5	30.0	4.0	ATEC 22-831858
SW	11955	300(C-6)	10	SS	33.5	35.0	10.0	ATEC 22-831858
SW	11955	300(C-6)	2	SS	1.5	3.0	14.0	ATEC 22-831858
SW	11955	300(C-6)	3	SS	6.0	7.5	7.0	ATEC 22-831858
SW	11955	300(C-6)	4	SS	8.5	10.0	10.0	ATEC 22-831858
SW	11955	300(C-6)	5	SS	11.0	12.5	12.0	ATEC 22-831858
SW	11955	300(C-6)	6	SS	13.5	15.0	10.0	ATEC 22-831858
SW	11955	300(C-6)	7	SS	18.5	20.0	13.0	ATEC 22-831858
SW	11955	300(C-6)	8	SS	23.5	25.0	10.0	ATEC 22-831858
SW	11955	300(C-6)	9	SS	28.5	30.0	3.0	ATEC 22-831858
SW	11956	301(C-7)	10	SS	33.5	35.0	12.0	ATEC 22-831858
SW	11956	301(C-7)	3	SS	6.0	7.5	15.0	ATEC 22-831858
SW	11956	301(C-7)	4	SS	8.5	10.0	19.0	ATEC 22-831858
SW	11956	301(C-7)	5	SS	11.0	12.5	16.0	ATEC 22-831858
SW	11956	301(C-7)	6	SS	13.5	15.0	11.0	ATEC 22-831858
SW	11956	301(C-7)	7	SS	18.5	20.0	9.0	ATEC 22-831858
SW	11956	301(C-7)	8	SS	23.5	25.0	12.0	ATEC 22-831858
SW	11956	301(C-7)	9	SS	28.5	30.0	3.0	ATEC 22-831858
SW	11957	302(C-8)	10	SS	33.5	35.0	7.0	ATEC 22-831858
SW	11957	302(C-8)	3	SS	6.0	7.5	27.0	ATEC 22-831858
SW	11957	302(C-8)	4	SS	8.5	10.0	23.0	ATEC 22-831858
SW	11957	302(C-8)	5	SS	11.0	12.5	13.0	ATEC 22-831858
SW	11957	302(C-8)	6	SS	13.5	15.0	19.0	ATEC 22-831858
SW	11957	302(C-8)	7	SS	18.5	20.0	12.0	ATEC 22-831858
SW	11957	302(C-8)	8	SS	23.5	25.0	13.0	ATEC 22-831858
SW	11957	302(C-8)	9	SS	28.5	30.0	11.0	ATEC 22-831858
OU1	11962	307(5)		SS	5.0	6.5	26.0	4144-88-462
OU1	11962	307(5)		SS	7.5	9.0	29.0	4144-88-462
OU1	11962	307(5)		SS	10.0	11.5	24.0	4144-88-462
OU1	11962	307(5)		SS	15.0	16.5	18.0	4144-88-462
OU1	11962	307(5)		SS	20.0	21.5	21.0	4144-88-462
OU1	11962	307(5)		SS	25.0	26.5	15.0	4144-88-462
OU1	11962	307(5)		SS	30.0	31.5	12.0	4144-88-462
NE	11963	201(2)		SS	0.5	2.0	9.4	S&ME 1221-87-160-2.0
NE	11963	201(2)		SS	3.0	4.5	13.3	1221-87-160-2.0
NE	11963	201(2)		ST	3.0	4.5	1.2	S&ME 1221-87-160-2.0
NE	11963	201(2)		SS	5.0	6.5	11.4	S&ME 1221-87-160-2.0
NE	11963	201(2)		SS	5.0	6.5	11.3	1221-87-160-2.0
NE	11963	201(2)		SS	8.5	10.0	9.6	1221-87-160-2.0
NE	11963	201(2)		SS	10.0	11.5	14.2	S&ME 1221-87-160-2.0
NE	11965	201(3)		SS	13.5	15.0	11.2	S&ME 1221-87-160-2.0
				SS	2.5	4.0	12.2	S&ME 1221-87-160-2.0

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
NE	11965	201(3)		SS	5.0	6.5	10.5	S&ME 1221-87-160-2.0
NE	11966	204(9)		SS	3.0	4.5	11.5	S&ME 1221-87-160-1.0
NE	11967	205(10)		SS	3.0	4.5	13.1	S&ME 1221-87-160-1.0
NE	11968	206(7)		SS	3.0	4.5	13.1	S&ME 1221-87-160-1.0
NE	11969	207(8)		SS	3.0	4.5	14.3	S&ME 1221-87-160-1.0
NE	11970	208(6)		SS	3.0	4.5	23.0	S&ME 1221-87-160-1.0
NE	11971	209(3)	1	SS	3.0	4.5	10.9	S&ME 1221-87-160-1.0
NE	11971	209(3)	2	SS	5.0	6.5	12.7	S&ME 1221-87-160-1.0
NE	11971	209(3)	3	SS	7.5	9.0	11.2	S&ME 1221-87-160-1.0
NE	11971	209(3)	4	SS	10.0	11.5	11.5	S&ME 1221-87-160-1.0
NE	11971	209(3)	5	SS	12.5	15.0	10.0	S&ME 1221-87-160-1.0
NE	11971	209(3)	6	SS	18.5	20.0	13.4	S&ME 1221-87-160-1.0
NE	11971	209(3)	7	SS	23.5	25.0	12.5	S&ME 1221-87-160-1.0
NE	11972	210(4)	1	SS	3.0	4.5	24.1	S&ME 1221-87-160-1.0
NE	11972	210(4)	2	SS	5.0	6.5	14.2	S&ME 1221-87-160-1.0
NE	11972	210(4)	3	SS	7.5	9.0	9.5	S&ME 1221-87-160-1.0
NE	11975	213(5)		SS	3.0	4.5	13.8	S&ME 1221-87-160-1.0
NE	11976	214(1)	1	SS	3.0	4.5	15.8	S&ME 1221-87-160-1.0
NE	11976	214(1)	2	SS	5.0	6.5	13.3	S&ME 1221-87-160-1.0
NE	11976	214(1)	3	SS	7.5	9.0	18.0	S&ME 1221-87-160-1.0
NE	11977	215(2)		ST	3.0	5.0	15.3	S&ME 1221-87-160-1.0
NE	11977	215(2)	1	SS	5.0	6.5	12.4	S&ME 1221-87-160-1.0
NE	11977	215(2)	2	SS	7.5	9.0	21.5	S&ME 1221-87-160-1.0
NE	11979	217(2)		ST	3.0	5.0	27.4	S&ME 1221-87-159
NE	11980	218(1)		SS	0.0	1.5	28.2	S&ME 1221-87-159
NE	11980	218(1)		SS	2.5	4.0	21.0	S&ME 1221-87-159
NE	11980	218(1)		SS	5.0	6.5	27.9	S&ME 1221-87-159
NE	11980	218(1)		SS	7.5	9.0	23.8	S&ME 1221-87-159
NE	11980	218(1)		SS	10.0	11.5	29.5	S&ME 1221-87-159
SW	11982	220(5)		ST	12.5	14.5	12.3	S&ME 021-84-215
NW	12009	(1)	1	JAR	1.0	2.0	22.1	USACOE 1952
NW	12009	(1)	10	JAR	27.0	31.0	15.1	USACOE 1952
NW	12009	(1)	11	JAR	31.0	36.0	3.5	USACOE 1952
NW	12009	(1)	12	JAR	36.0	41.0	1.2	USACOE 1952
NW	12009	(1)	13	JAR	41.0	45.0	2.8	USACOE 1952
NW	12009	(1)	14	JAR	45.0	48.0	3.4	USACOE 1952
NW	12009	(1)	15	JAR	48.0	50.0	6.0	USACOE 1952
NW	12009	(1)	16	JAR	50.0	56.0	10.2	USACOE 1952
NW	12009	(1)	17	JAR	56.0	60.0	14.2	USACOE 1952
NW	12009	(1)	18	JAR	60.0	65.0	11.4	USACOE 1952
NW	12009	(1)	19	JAR	65.0	70.0	9.1	USACOE 1952
NW	12009	(1)	2	JAR	2.0	4.0	26.4	USACOE 1952
NW	12009	(1)	20	JAR	70.0	73.0	7.5	USACOE 1952
NW	12009	(1)	21	JAR	73.0	78.0	8.8	USACOE 1952
NW	12009	(1)	3	JAR	4.0	6.0	15.4	USACOE 1952
NW	12009	(1)	4	JAR	6.0	8.0	13.6	USACOE 1952
NW	12009	(1)	5	JAR	8.0	10.0	13.1	USACOE 1952
NW	12009	(1)	6	JAR	10.0	12.0	9.9	USACOE 1952
NW	12009	(1)	7	JAR	13.0	17.0	14.7	USACOE 1952
NW	12009	(1)	8	JAR	17.0	22.0	13.4	USACOE 1952
NW	12009	(1)	9	JAR	22.0	27.0	13.4	USACOE 1952
NW	12010	(2)	1	JAR	0.0	2.0	27.4	USACOE 1952
NW	12010	(2)	10	JAR	27.0	32.0	10.9	USACOE 1952
NW	12010	(2)	11	JAR	33.0	37.0	10.6	USACOE 1952
NW	12010	(2)	12	JAR	37.0	42.0	12.4	USACOE 1952
NW	12010	(2)	13	JAR	42.0	47.0	5.1	USACOE 1952
NW	12010	(2)	14	JAR	46.5	50.0	11.8	USACOE 1952
NW	12010	(2)	2	JAR	3.0	4.0	13.0	USACOE 1952
NW	12010	(2)	3	JAR	4.0	6.0	12.1	USACOE 1952
NW	12010	(2)	4	JAR	6.0	8.0	13.2	USACOE 1952
NW	12010	(2)	5	JAR	8.0	10.0	10.7	USACOE 1952
NW	12010	(2)	6	JAR	10.0	12.0	10.0	USACOE 1952
NW	12010	(2)	7	JAR	12.0	17.0	12.0	USACOE 1952
NW	12010	(2)	8	JAR	17.0	22.0	11.3	USACOE 1952

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
NW	12010	(2)	9	JAR	22.0	26.0	11.7	USACOE 1952
NE	12011	(3)	1	JAR	0.0	2.0	28.6	USACOE 1952
NE	12011	(3)	10	JAR	27.0	32.0	9.4	USACOE 1952
NE	12011	(3)	11	JAR	32.0	37.0	11.2	USACOE 1952
NE	12011	(3)	12	JAR	37.0	41.0	16.9	USACOE 1952
NE	12011	(3)	13	JAR	41.0	46.0	4.7	USACOE 1952
NE	12011	(3)	14	JAR	46.0	50.0	3.9	USACOE 1952
NE	12011	(3)	2	JAR	2.0	4.0	14.4	USACOE 1952
NE	12011	(3)	3	JAR	4.0	6.0	14.6	USACOE 1952
NE	12011	(3)	4	JAR	6.0	8.0	14.6	USACOE 1952
NE	12011	(3)	5	JAR	8.0	10.0	13.2	USACOE 1952
NE	12011	(3)	6	JAR	10.0	12.0	13.0	USACOE 1952
NE	12011	(3)	7	JAR	12.0	17.0	12.9	USACOE 1952
NE	12011	(3)	8	JAR	17.0	22.0	13.5	USACOE 1952
NE	12011	(3)	9	JAR	22.0	27.0	13.5	USACOE 1952
NE	12012	(4)	1	JAR	2.0	4.0	17.1	USACOE 1952
NE	12012	(4)	10&11	JAR	27.0	32.0	11.8	USACOE 1952
NE	12012	(4)	12	JAR	32.0	37.5	11.9	USACOE 1952
NE	12012	(4)	13&14	JAR	37.5	42.0	5.3	USACOE 1952
NE	12012	(4)	15	JAR	42.0	47.0	9.3	USACOE 1952
NE	12012	(4)	16	JAR	47.0	52.0	9.6	USACOE 1952
NE	12012	(4)	17	JAR	52.0	57.0	14.3	USACOE 1952
NE	12012	(4)	18	JAR	57.0	62.0	6.1	USACOE 1952
NE	12012	(4)	19	JAR	62.0	67.0	6.6	USACOE 1952
NE	12012	(4)	2	JAR	4.0	6.0	19.1	USACOE 1952
NE	12012	(4)	20	JAR	67.0	72.0	8.5	USACOE 1952
NE	12012	(4)	22	JAR	77.0	80.0	10.2	USACOE 1952
NE	12012	(4)	3	JAR	6.0	8.0	13.8	USACOE 1952
NE	12012	(4)	4	JAR	8.0	9.0	11.1	USACOE 1952
NE	12012	(4)	5	JAR	9.0	11.0	12.4	USACOE 1952
NE	12012	(4)	6	JAR	14.0	20.0	12.5	USACOE 1952
NE	12012	(4)	7&8	JAR	20.0	23.0	13.4	USACOE 1952
NE	12012	(4)	9	JAR	23.0	27.0	12.1	USACOE 1952
NW	12013	(5)	1	JAR	0.0	2.0	23.1	USACOE 1952
NW	12013	(5)	10	JAR	27.0	32.0	12.0	USACOE 1952
NW	12013	(5)	11	JAR	32.0	36.0	14.0	USACOE 1952
NW	12013	(5)	12	JAR	36.0	40.0	9.3	USACOE 1952
NW	12013	(5)	13	JAR	40.0	45.0	5.4	USACOE 1952
NW	12013	(5)	14	JAR	45.0	50.0	4.0	USACOE 1952
NW	12013	(5)	2	JAR	2.0	4.0	23.1	USACOE 1952
NW	12013	(5)	3	JAR	4.0	6.0	23.1	USACOE 1952
NW	12013	(5)	4	JAR	6.0	8.0	23.6	USACOE 1952
NW	12013	(5)	5	JAR	8.0	10.0	23.8	USACOE 1952
NW	12013	(5)	6	JAR	10.0	12.0	13.7	USACOE 1952
NW	12013	(5)	7	JAR	12.0	17.0	18.3	USACOE 1952
NW	12013	(5)	8	JAR	17.0	22.0	13.9	USACOE 1952
NW	12013	(5)	9	JAR	22.0	27.0	15.0	USACOE 1952
NW	12014	(6)	1	JAR	0.0	2.0	24.3	USACOE 1952
NW	12014	(6)	10	JAR	27.0	32.0	14.8	USACOE 1952
NW	12014	(6)	11	JAR	32.0	37.0	11.4	USACOE 1952
NW	12014	(6)	12	JAR	37.0	39.0	11.9	USACOE 1952
NW	12014	(6)	13	JAR	39.0	44.0	2.6	USACOE 1952
NW	12014	(6)	14	JAR	44.0	48.0	3.1	USACOE 1952
NW	12014	(6)	15	JAR	48.0	50.0	3.0	USACOE 1952
NW	12014	(6)	2	JAR	2.0	4.0	13.3	USACOE 1952
NW	12014	(6)	3	JAR	4.0	6.0	12.9	USACOE 1952
NW	12014	(6)	4	JAR	6.0	8.0	14.3	USACOE 1952
NW	12014	(6)	5	JAR	8.0	10.0	13.5	USACOE 1952
NW	12014	(6)	6	JAR	10.0	12.0	13.0	USACOE 1952
NW	12014	(6)	7	JAR	12.0	17.0	12.2	USACOE 1952
NW	12014	(6)	8	JAR	17.0	22.0	14.5	USACOE 1952
NW	12014	(6)	9	JAR	22.0	27.0	12.7	USACOE 1952
NE	12015	(7)	1	JAR	0.0	2.0	28.7	USACOE 1952
NE	12015	(7)	10	JAR	25.0	30.0	14.8	USACOE 1952

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
NE	12015	(7)	2	JAR	2.0	4.0	17.0	USACOE 1952
NE	12015	(7)	3	JAR	4.0	6.0	13.1	USACOE 1952
NE	12015	(7)	4	JAR	6.0	8.0	13.6	USACOE 1952
NE	12015	(7)	5	JAR	8.0	10.0	12.1	USACOE 1952
NE	12015	(7)	6	JAR	10.0	12.0	12.0	USACOE 1952
NE	12015	(7)	7	JAR	12.0	18.0	11.5	USACOE 1952
NE	12015	(7)	8	JAR	18.0	20.0	9.3	USACOE 1952
NE	12015	(7)	9	JAR	20.0	25.0	11.1	USACOE 1952
SW	12016	(9)	1	JAR	1.0	3.0	26.0	USACOE 1952
SW	12016	(9)	10	JAR	28.0	32.5	11.2	USACOE 1952
SW	12016	(9)	11	JAR	32.5	36.0	5.5	USACOE 1952
SW	12016	(9)	12	JAR	36.0	37.5	6.7	USACOE 1952
SW	12016	(9)	2	JAR	3.0	6.5	28.4	USACOE 1952
SW	12016	(9)	3	JAR	6.5	7.0	29.4	USACOE 1952
SW	12016	(9)	4	JAR	7.0	10.5	26.3	USACOE 1952
SW	12016	(9)	5	JAR	10.5	14.5	9.6	USACOE 1952
SW	12016	(9)	6	JAR	14.5	16.0	15.1	USACOE 1952
SW	12016	(9)	7	JAR	16.0	21.0	13.6	USACOE 1952
SW	12016	(9)	9	JAR	23.0	28.0	13.9	USACOE 1952
SW	12017	(10)	1	JAR	1.0	3.0	26.5	USACOE 1952
SW	12017	(10)	10	JAR	15.0	20.0	15.6	USACOE 1952
SW	12017	(10)	11	JAR	20.0	25.0	10.9	USACOE 1952
SW	12017	(10)	12	JAR	25.0	28.0	10.3	USACOE 1952
SW	12017	(10)	13	JAR	28.0	33.0	2.8	USACOE 1952
SW	12017	(10)	14	JAR	33.0	38.0	2.7	USACOE 1952
SW	12017	(10)	15	JAR	38.0	43.0	2.6	USACOE 1952
SW	12017	(10)	16	JAR	43.0	48.0	2.4	USACOE 1952
SW	12017	(10)	17	JAR	48.0	50.0	2.2	USACOE 1952
SW	12017	(10)	2	JAR	3.0	5.0	26.7	USACOE 1952
SW	12017	(10)	3	JAR	5.0	7.0	24.5	USACOE 1952
SW	12017	(10)	4	JAR	7.0	9.0	21.8	USACOE 1952
SW	12017	(10)	5	JAR	9.0	11.0	24.4	USACOE 1952
SW	12017	(10)	6	JAR	11.0	12.5	20.5	USACOE 1952
SW	12017	(10)	7	JAR	12.5	13.0	20.9	USACOE 1952
SW	12017	(10)	8	JAR	13.0	13.5	17.6	USACOE 1952
SW	12017	(10)	9	JAR	13.5	15.0	12.9	USACOE 1952
SE	12018	(11)	1	JAR	2.0	4.0	14.1	USACOE 1952
SE	12018	(11)	10	JAR	31.0	35.0	6.8	USACOE 1952
SE	12018	(11)	11	JAR	35.0	40.0	8.2	USACOE 1952
SE	12018	(11)	12	JAR	40.0	45.0	7.5	USACOE 1952
SE	12018	(11)	2	JAR	4.0	6.0	13.9	USACOE 1952
SE	12018	(11)	3	JAR	6.0	8.0	14.0	USACOE 1952
SE	12018	(11)	4	JAR	8.0	10.0	11.3	USACOE 1952
SE	12018	(11)	5	JAR	10.0	12.0	9.6	USACOE 1952
SE	12018	(11)	6	JAR	12.0	17.0	15.0	USACOE 1952
SE	12018	(11)	7	JAR	17.0	22.0	13.4	USACOE 1952
SE	12018	(11)	8	JAR	22.0	27.0	14.4	USACOE 1952
SE	12018	(11)	9	JAR	27.0	31.0	14.1	USACOE 1952
SE	12019	(12)	1	JAR	2.0	4.0	11.6	USACOE 1952
SE	12019	(12)	10	JAR	31.5	37.0	3.8	USACOE 1952
SE	12019	(12)	11	JAR	37.0	42.0	3.4	USACOE 1952
SE	12019	(12)	12	JAR	42.0	47.0	3.8	USACOE 1952
SE	12019	(12)	13	JAR	47.0	50.0	2.7	USACOE 1952
SE	12019	(12)	2	JAR	4.0	6.0	13.4	USACOE 1952
SE	12019	(12)	3	JAR	6.0	8.0	13.0	USACOE 1952
SE	12019	(12)	4	JAR	8.0	10.0	12.5	USACOE 1952
SE	12019	(12)	5	JAR	10.0	11.5	12.9	USACOE 1952
SE	12019	(12)	6	JAR	11.5	15.0	14.9	USACOE 1952
SE	12019	(12)	7	JAR	15.0	22.0	13.6	USACOE 1952
SE	12019	(12)	8	JAR	22.0	27.0	14.0	USACOE 1952
SE	12019	(12)	9	JAR	27.0	31.5	14.1	USACOE 1952
SW	12020	(13)	1	JAR	2.0	4.0	25.0	USACOE 1952
SW	12020	(13)	10	JAR	22.0	26.0	6.4	USACOE 1952
SW	12020	(13)	11	JAR	26.0	28.0	11.0	USACOE 1952

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
SW	12020	(13)	12	JAR	28.0	32.0	3.5	USACOE 1952
SW	12020	(13)	13	JAR	32.0	35.0	4.4	USACOE 1952
SW	12020	(13)	14	JAR	35.0	37.0	4.0	USACOE 1952
SW	12020	(13)	15	JAR	37.0	42.0	2.4	USACOE 1952
SW	12020	(13)	16	JAR	42.0	47.0	2.9	USACOE 1952
SW	12020	(13)	17	JAR	47.0	50.0	3.5	USACOE 1952
SW	12020	(13)	2	JAR	4.0	6.0	20.4	USACOE 1952
SW	12020	(13)	3	JAR	6.0	8.0	20.6	USACOE 1952
SW	12020	(13)	4	JAR	8.0	10.0	22.3	USACOE 1952
SW	12020	(13)	5	JAR	10.0	12.0	19.8	USACOE 1952
SW	12020	(13)	6	JAR	12.0	14.0	18.9	USACOE 1952
SW	12020	(13)	7	JAR	14.0	16.0	15.3	USACOE 1952
SW	12020	(13)	9	JAR	18.4	22.0	7.6	USACOE 1952
SW	12021	(14)	1	JAR	2.0	4.0	33.2	USACOE 1952
SW	12021	(14)	10	JAR	21.5	26.0	6.3	USACOE 1952
SW	12021	(14)	11	JAR	26.0	29.0	4.4	USACOE 1952
SW	12021	(14)	12	JAR	29.0	30.0	2.8	USACOE 1952
SW	12021	(14)	13	JAR	30.0	34.5	3.6	USACOE 1952
SW	12021	(14)	14	JAR	34.5	38.0	3.6	USACOE 1952
SW	12021	(14)	15	JAR	38.0	41.5	2.4	USACOE 1952
SW	12021	(14)	16	JAR	41.5	43.5	2.2	USACOE 1952
SW	12021	(14)	17	JAR	43.5	47.0	2.6	USACOE 1952
SW	12021	(14)	18	JAR	47.0	50.0	6.2	USACOE 1952
SW	12021	(14)	2	JAR	4.0	6.0	33.0	USACOE 1952
SW	12021	(14)	3	JAR	6.0	8.0	26.6	USACOE 1952
SW	12021	(14)	4	JAR	8.0	9.5	20.5	USACOE 1952
SW	12021	(14)	5	JAR	9.5	10.0	14.1	USACOE 1952
SW	12021	(14)	6	JAR	10.0	15.0	15.5	USACOE 1952
SW	12021	(14)	7	JAR	15.0	18.0	16.0	USACOE 1952
SW	12021	(14)	8	JAR	18.0	20.5	10.5	USACOE 1952
SW	12021	(14)	9	JAR	20.5	21.5	2.5	USACOE 1952
SE	12022	(15)	1	JAR	1.5	4.0	25.1	USACOE 1952
SE	12022	(15)	10	JAR	20.5	23.0	11.8	USACOE 1952
SE	12022	(15)	11	JAR	23.0	27.0	2.3	USACOE 1952
SE	12022	(15)	12	JAR	27.0	32.0	2.2	USACOE 1952
SE	12022	(15)	13	JAR	32.0	37.0	6.9	USACOE 1952
SE	12022	(15)	14	JAR	37.0	42.0	7.1	USACOE 1952
SE	12022	(15)	15	JAR	42.0	47.0	2.6	USACOE 1952
SE	12022	(15)	16	JAR	47.0	50.0	2.1	USACOE 1952
SE	12022	(15)	2	JAR	4.0	6.0	22.0	USACOE 1952
SE	12022	(15)	3	JAR	6.0	7.5	23.1	USACOE 1952
SE	12022	(15)	4	JAR	7.5	8.5	21.7	USACOE 1952
SE	12022	(15)	5	JAR	8.5	10.0	9.5	USACOE 1952
SE	12022	(15)	6	JAR	10.0	12.0	13.1	USACOE 1952
SE	12022	(15)	7	JAR	12.0	17.0	13.8	USACOE 1952
SE	12022	(15)	8	JAR	17.0	19.5	10.2	USACOE 1952
SE	12022	(15)	9	JAR	19.5	20.5	5.3	USACOE 1952
SE	12023	(16)	1	JAR	0.8	2.0	22.9	USACOE 1952
SE	12023	(16)	10	JAR	23.0	27.0	6.6	USACOE 1952
SE	12023	(16)	11	JAR	27.0	32.0	2.9	USACOE 1952
SE	12023	(16)	12	JAR	32.0	37.0	2.9	USACOE 1952
SE	12023	(16)	13	JAR	37.0	42.0	2.3	USACOE 1952
SE	12023	(16)	14	JAR	42.0	47.0	2.7	USACOE 1952
SE	12023	(16)	15	JAR	47.0	50.0	3.3	USACOE 1952
SE	12023	(16)	2	JAR	2.0	3.5	20.6	USACOE 1952
SE	12023	(16)	3	JAR	3.5	6.0	15.6	USACOE 1952
SE	12023	(16)	4	JAR	6.0	8.0	11.8	USACOE 1952
SE	12023	(16)	5	JAR	8.0	10.0	11.5	USACOE 1952
SE	12023	(16)	6	JAR	10.0	12.0	12.5	USACOE 1952
SE	12023	(16)	7	JAR	12.0	14.0	10.8	USACOE 1952
SE	12023	(16)	8	JAR	14.0	15.5	8.7	USACOE 1952
SE	12023	(16)	9	JAR	18.0	23.0	12.9	USACOE 1952
SW	12024	(17)	1	JAR	2.0	4.0	21.9	USACOE 1952
SW	12024	(17)	10	JAR	21.5	21.7	19.8	USACOE 1952

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
SW	12024	(17)	11	JAR	21.7	24.2	6.6	USACOE 1952
SW	12024	(17)	12	JAR	24.2	27.0	3.3	USACOE 1952
SW	12024	(17)	13	JAR	27.0	30.0	11.6	USACOE 1952
SW	12024	(17)	14	JAR	30.0	33.5	10.0	USACOE 1952
SW	12024	(17)	15	JAR	33.5	37.0	2.5	USACOE 1952
SW	12024	(17)	16	JAR	37.0	39.0	3.9	USACOE 1952
SW	12024	(17)	17	JAR	39.0	41.5	2.6	USACOE 1952
SW	12024	(17)	18	JAR	41.5	44.0	3.3	USACOE 1952
SW	12024	(17)	19	JAR	44.0	47.0	2.3	USACOE 1952
SW	12024	(17)	2	JAR	4.0	6.0	19.8	USACOE 1952
SW	12024	(17)	20	JAR	47.0	50.0	6.6	USACOE 1952
SW	12024	(17)	21	JAR	50.0	55.0	8.6	USACOE 1952
SW	12024	(17)	22	JAR	55.0	57.0	9.1	USACOE 1952
SW	12024	(17)	23	JAR	57.0	59.0	16.1	USACOE 1952
SW	12024	(17)	24	JAR	59.0	62.5	9.4	USACOE 1952
SW	12024	(17)	25	JAR	62.5	67.5	5.8	USACOE 1952
SW	12024	(17)	26	JAR	67.5	72.5	7.1	USACOE 1952
SW	12024	(17)	27	JAR	72.5	77.0	18.2	USACOE 1952
SW	12024	(17)	28	JAR	77.0	79.0	20.4	USACOE 1952
SW	12024	(17)	29	JAR	79.0	80.0	5.7	USACOE 1952
SW	12024	(17)	3	JAR	6.0	8.0	20.8	USACOE 1952
SW	12024	(17)	4	JAR	8.0	9.5	24.4	USACOE 1952
SW	12024	(17)	5	JAR	9.5	10.0	18.5	USACOE 1952
SW	12024	(17)	6	JAR	10.0	14.0	23.9	USACOE 1952
SW	12024	(17)	7	JAR	14.0	18.0	18.8	USACOE 1952
SW	12024	(17)	8	JAR	18.0	20.0	11.8	USACOE 1952
SW	12024	(17)	9	JAR	20.0	21.5	12.5	USACOE 1952
SW	12025	(18)	1	JAR	2.0	4.0	22.9	USACOE 1952
SW	12025	(18)	10	JAR	26.0	28.0	4.1	USACOE 1952
SW	12025	(18)	11	JAR	28.0	30.5	3.0	USACOE 1952
SW	12025	(18)	12	JAR	30.5	33.5	3.9	USACOE 1952
SW	12025	(18)	13	JAR	33.5	36.0	3.1	USACOE 1952
SW	12025	(18)	14	JAR	36.0	38.5	3.3	USACOE 1952
SW	12025	(18)	15	JAR	38.5	42.0	3.5	USACOE 1952
SW	12025	(18)	16	JAR	42.0	43.5	1.9	USACOE 1952
SW	12025	(18)	17	JAR	43.5	47.0	2.8	USACOE 1952
SW	12025	(18)	18	JAR	47.0	49.0	0.4	USACOE 1952
SW	12025	(18)	19	JAR	49.0	50.0	1.3	USACOE 1952
SW	12025	(18)	2	JAR	4.0	6.0	21.4	USACOE 1952
SW	12025	(18)	3	JAR	6.0	8.0	19.4	USACOE 1952
SW	12025	(18)	4	JAR	8.0	10.0	19.2	USACOE 1952
SW	12025	(18)	5	JAR	10.0	12.0	14.2	USACOE 1952
SW	12025	(18)	6	JAR	12.0	17.0	14.4	USACOE 1952
SW	12025	(18)	7	JAR	17.0	21.7	10.1	USACOE 1952
SW	12025	(18)	8	JAR	21.7	23.5	2.6	USACOE 1952
SW	12025	(18)	9	JAR	23.5	26.0	2.9	USACOE 1952
SE	12026	(19)	1	JAR	2.0	4.0	22.9	USACOE 1952
SE	12026	(19)	10	JAR	26.0	27.8	5.4	USACOE 1952
SE	12026	(19)	11	JAR	27.8	30.5	2.2	USACOE 1952
SE	12026	(19)	12	JAR	30.5	34.2	2.5	USACOE 1952
SE	12026	(19)	13	JAR	34.2	35.5	2.2	USACOE 1952
SE	12026	(19)	14	JAR	35.5	37.0	3.2	USACOE 1952
SE	12026	(19)	15	JAR	37.0	42.5	2.7	USACOE 1952
SE	12026	(19)	16	JAR	42.5	50.0	4.2	USACOE 1952
SE	12026	(19)	2	JAR	4.0	6.0	23.6	USACOE 1952
SE	12026	(19)	3	JAR	6.0	8.0	16.8	USACOE 1952
SE	12026	(19)	5	JAR	9.8	12.0	15.5	USACOE 1952
SE	12026	(19)	6	JAR	12.0	17.0	11.6	USACOE 1952
SE	12026	(19)	7	JAR	17.0	21.5	9.3	USACOE 1952
SE	12026	(19)	8	JAR	21.5	23.0	19.4	USACOE 1952
SE	12026	(19)	9	JAR	23.0	26.0	8.4	USACOE 1952
SE	12027	(20)	1	JAR	1.2	3.0	23.8	USACOE 1952
SE	12027	(20)	10	JAR	22.5	27.0	2.4	USACOE 1952
SE	12027	(20)	4	JAR	7.0	9.0	14.1	USACOE 1952

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
SE	12027	(20)	7	JAR	13.0	17.0	22.3	USACOE 1952
SE	12027	(20)	9	JAR	20.5	22.5	19.7	USACOE 1952
NW	12028	21	1	JAR	1.5	5.0	21.7	USACOE 1952
NW	12028	21	10	JAR	47.5	50.0	2.6	USACOE 1952
NW	12028	21	11	JAR	70.0	80.0	9.3	USACOE 1952
NW	12028	21	12	JAR	95.0	105.0	8.0	USACOE 1952
NW	12028	21	13	JAR	120.0	130.0	8.9	USACOE 1952
NW	12028	21	14	JAR	145.0	155.0	8.4	USACOE 1952
NW	12028	21	15	JAR	175.0	180.0	10.2	USACOE 1952
NW	12028	21	16	JAR	200.0	204.5	8.6	USACOE 1952
NW	12028	21	17	JAR	204.5	204.0	10.9	USACOE 1952
NW	12028	21	2	JAR	7.5	12.5	13.0	USACOE 1952
NW	12028	21	3	JAR	12.5	15.5	12.3	USACOE 1952
NW	12028	21	4	JAR	17.5	22.5	10.3	USACOE 1952
NW	12028	21	5	JAR	22.5	27.5	2.5	USACOE 1952
NW	12028	21	6	JAR	27.5	32.5	2.1	USACOE 1952
NW	12028	21	7	JAR	32.5	37.5	2.1	USACOE 1952
NW	12028	21	8	JAR	37.5	42.5	2.3	USACOE 1952
NW	12028	21	9	JAR	42.5	47.5	2.5	USACOE 1952
NW	12029	22	1	JAR	2.0	3.5	22.3	USACOE 1952
NW	12029	22	10	JAR	32.0	37.0	3.0	USACOE 1952
NW	12029	22	11	JAR	37.0	41.0	4.0	USACOE 1952
NW	12029	22	2	JAR	3.5	5.5	23.5	USACOE 1952
NW	12029	22	3	JAR	5.5	8.0	29.5	USACOE 1952
NW	12029	22	4	JAR	8.0	10.5	19.8	USACOE 1952
NW	12029	22	5	JAR	10.5	12.5	10.6	USACOE 1952
NW	12029	22	6	JAR	12.5	16.0	10.5	USACOE 1952
NW	12029	22	7	JAR	17.0	22.0	13.3	USACOE 1952
NW	12029	22	8	JAR	22.0	27.0	6.5	USACOE 1952
NW	12029	22	9	JAR	27.0	32.0	3.6	USACOE 1952
NW	12074		411847	BULK	1.5	5.0	14.8	PARSONS PO 167
NW	12074		411848	BULK	5.0	10.0	9.9	PARSONS PO 167
SW	12077		411817	ST	4.5	6.5	23.0	PARSONS PO 167
SW	12077		411818	BULK	4.5	8.0	23.4	PARSONS PO 167
SW	12077		411819	SS	9.5	11.0	21.8	PARSONS PO 167
SW	12077		411820	ST	14.0	16.5	18.9	PARSONS PO 167
SW	12077		411821	SS	18.5	20.0	22.5	PARSONS PO 167
NW	12078		411859	BULK	1.5	5.0	19.0	PARSONS PO 167
NW	12078		411860	ST	5.5	8.0	14.2	PARSONS PO 167
NW	12078		411861	SS	10.5	12.0	12.4	PARSONS PO 167
NW	12078		411862	SS	13.5	15.0	16.1	PARSONS PO 167
NW	12078		411863	SS	18.0	19.5	16.0	PARSONS PO 167
NW	12079		411810	BULK	1.5	5.0	24.7	PARSONS PO 167
NW	12079		411811	ST	5.5	7.5	14.2	PARSONS PO 167
NW	12079		411812	SS	10.5	12.5	13.6	PARSONS PO 167
NW	12079		411813	SS	13.5	15.0	13.1	PARSONS PO 167
NW	12079		411814	SS	18.0	19.5	15.0	PARSONS PO 167
NE	12080		411802	BULK	1.5	5.0	21.3	PARSONS PO 167
NE	12080		411803	ST	5.5	7.5	15.0	PARSONS PO 167
NE	12080		411804	SS	10.5	12.5	16.6	PARSONS PO 167
NE	12080		411805	SS	13.5	15.0	12.1	PARSONS PO 167
NE	12080		411806	SS	18.0	19.5	10.4	PARSONS PO 167
NW	12081		411834	BULK	1.5	5.0	18.7	PARSONS PO 167
NW	12081		411851	ST	6.0	8.0	22.5	PARSONS PO 167
NW	12081		411852	ST	8.0	10.5	15.9	PARSONS PO 167
NW	12081		411853	SS	11.0	12.5	21.2	PARSONS PO 167
NW	12081		411854	ST	15.0	17.0	15.6	PARSONS PO 167
NW	12081		411855	SS	18.5	20.0	13.1	PARSONS PO 167
NE	12174	CSF-1	C1/11	SS	38.0	40.0	11.8	PARSONS PO 20
NE	12174	CSF-1	C1/4	ST	6.0	8.0	28.3	PARSONS PO 20
NE	12174	CSF-1	C1/5	ST	8.0	10.0	14.0	PARSONS PO 20
NE	12174	CSF-1	C1/7	SS	18.0	20.0	12.3	PARSONS PO 20
NE	12174	CSF-1	C1/8	SS	23.0	25.0	11.5	PARSONS PO 20
NE	12175	CSF-2	C2/6	ST	13.0	15.0	12.0	PARSONS PO 20

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TABLE A-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
NE	12176	CSF-3	C3/10	ST	25.0	27.0	11.0	PARSONS PO 20
NE	12176	CSF-3	C3/3	SS	4.0	6.0	15.3	PARSONS PO 20
NE	12176	CSF-3	C3/6	ST	10.0	12.0	17.0	PARSONS PO 20
NE	12176	CSF-3	C3/7	SS	13.0	15.0	12.6	PARSONS PO 20
NE	12176	CSF-3	C3/9	SS	23.0	25.0	9.4	PARSONS PO 20
NE	12177	CSF-4	C4/6	ST	13.0	15.0	12.6	PARSONS PO 20
NE	12178	CSF-5	C5/13	SS	33.0	35.0	13.6	PARSONS PO 20
NE	12178	CSF-5	C5/14	SS	38.0	40.0	17.9	PARSONS PO 20
NE	12178	CSF-5	C5/2	SS	2.0	4.0	13.7	PARSONS PO 20
NE	12178	CSF-5	C5/3	SS	4.0	6.0	12.8	PARSONS PO 20
NE	12178	CSF-5	C5/5	SS	8.0	10.0	12.8	PARSONS PO 20
NE	12179	CSF-6	C6/8	ST	20.0	22.0	14.4	PARSONS PO 20
NE	B-1	B-1		ST	3.0	5.0	15.0	S&ME 4144-88-309
NE	B-2	B-2		ST	3.0	5.0	16.0	S&ME 4144-88-309
NE	B-3	B-3		ST	3.0	5.0	18.0	S&ME 4144-88-309
NE	B-4	B-4		ST	3.0	5.0	14.0	S&ME 4144-88-309
NE	B-4	B-4		ST	10.0	12.0	10.0	S&ME 4144-88-309
NE	B-6	B-6		ST	3.0	5.0	16.0	S&ME 4144-88-309
NE	B-6	B-6		ST	10.0	12.0	13.0	S&ME 4144-88-309

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TABLE A-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

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Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color	General Stratum	USCS Name	USCS Symbol	Sample Moisture Content (%)	Atterberg Limits			Grain Size							Specific Gravity	Reference
												LL	PL	PI	Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	D10	D30	D60		
NW		OS-1	OS1/4B	ST	6.0	8.0	Olive Brown and Gray	Gray Till	Lean Clay with Sand	CL	21.1	37	18	19.0	2.0	16.0	82.0	31.0		0.002	0.017	2.80	PARSONS PO 22
NW		OS-2A	OS2A/3	ST	4.0	6.0	Olive Brown	Brown Clay	Lean Clay with Sand	CL	22.1	37	18	19.0	3.0	19.0	78.0	28.0		0.002	0.023	2.77	PARSONS PO 22
NW		OS-3	OS3/5	ST	8.0	10.0	Very Dark Gray	Gray Till	Fat Clay	CH	24.6	52	21	31.0	0.0	1.0	99.0	40.0			0.0085	2.78	PARSONS PO 22
NW		OS-4	OS4/6	ST	13.0	15.0	Light Olive Brown	Brown Clay	Lean Clay	CL	32.6	27	19	8.0	1.0	2.0	97.0	28.0		0.0026	0.015	2.79	PARSONS PO 22
SE		PFS-1	P1/4	ST	6.0	8.0	Very Dark Gray	Fill?	Lean Clay	CL	26.7	45.2	22.8	22.4	0.0	14.3	85.7	34.0			0.015	2.73	PARSONS PO 32
SE		PFS-2	P2/5	ST	8.0	10.0	Olive Brown	Brown Clay	Lean Clay	CL	18.8	26	17	9.0	0.1	5.2	94.7	27.0		0.003	0.014	2.81	PARSONS PO 32
SE		PFS-3	P3/4	ST	6.0	8.0	Very Dark Gray	Fill	Lean Clay	CL	23.2	48.7	20.1	28.6	0.0	7.0	93.0	38.0		0.0013	0.011	2.76	PARSONS PO 32
SE		PFS-4A	P4A/5	ST	8.0	10.0	Dark Yellowish Brown	Brown Clay	Lean Clay	CL	22.6	40.1	19.7	20.4	0.0	5.4	94.6	37.0			0.003	2.79	PARSONS PO 32
SE		PFS-5	P5/4	ST	6.0	8.0	Dark Yellowish Brown	Brown Clay/Fill?	Silt with Sand	ML	20.6	NP	NP	NP	0.9	27.2	71.9	8.0	0.003	0.016	0.06	2.75	PARSONS PO 32
SE		PFS-6	P6/5	ST	8.0	10.0	Dark Gray	Gray Till	Sandy Silty Clay	CL-ML	11.3	19	14.1	4.9	5.5	27.9	66.6	17.0		0.009	0.065	2.82	PARSONS PO 32
SW		UD-1	1 Bot	D	2.3	3.0	Gray and Brown	Fill	Sandy Lean Clay	CL	27.1	38.6	21.4	17.2	14.0	21.0	65.0	18.0	0.0012	0.006	0.04	2.73	USACOE 1952
SW		UD-1	1 Top	D	1.5	2.3	Brown	Fill	Clayey Gravel with Sand	GC	13.9	27	17.8	9.2	54.0	21.0	25.0	5.0	0.006	0.3	6.5		USACOE 1952
SW		UD-1	10	D	18.5	20.0	Gray	Gray Till	Sandy Lean Clay	CL	11.7	23.2	15.8	7.4	8.0	22.0	70.0	23.0		0.0043	0.04	2.76	USACOE 1952
SW		UD-1	11	D	20.5	22.0	Gray	Gray Till	Sandy Lean Clay	CL	11.5	22.3	15.1	7.2	10.0	27.0	63.0	19.0		0.006	0.063		USACOE 1952
SW		UD-1	2	D	3.5	6.0	Gray and Brown	Brown Clay	Silty Clay	CL-ML	17.3	22.1	17.1	5.0	0.0	1.0	99.0	18.0	0.0007	0.0043	0.012		USACOE 1952
SW		UD-1	3	D	5.5	7.0	Gray and Brown	Muddy Stream	Silt	ML	17.6	NP	NP	NP	0.0	10.0	90.0	9.0	0.003	0.012	0.022	2.77	USACOE 1952
SW		UD-1	4	D	7.5	9.0	Gray and Brown	Brown Clay	Lean Clay with Sand	CL	17.1	28.7	18.5	10.2	3.0	12.0	85.0	25.0		0.003	0.011	2.75	USACOE 1952
SW		UD-1	5	D	9.5	11.0	Gray	Gray Till	Sandy Lean Clay	CL	14.1	24.7	16	8.7	8.0	22.0	70.0	18.0		0.006	0.033	2.76	USACOE 1952
SW		UD-1	6	D	11.5	13.0	Gray	Gray Till	Sandy Lean Clay	CL	14.8	23	15.1	7.9	8.0	22.0	70.0	23.5		0.004	0.031		USACOE 1952
SW		UD-1	7	D	13.6	15.0	Gray	Gray Till	Sandy Lean Clay	CL	12.3	24.2	15.7	8.5	8.0	22.0	70.0	23.5		0.004	0.031		USACOE 1952
SW		UD-1	8	D	15.5	17.0	Gray	Gray Till	Sandy Lean Clay	CL	13.3	24.4	16.1	8.3	12.0	25.0	63.0	20.0		0.0058	0.052		USACOE 1952
SW		UD-1	9	D	17.5	18.5	Gray	Gray Till	Sandy Lean Clay	CL	12.5	24.5	15.7	8.8	15.7	8.8	70.0	23.0		0.0043	0.04		USACOE 1952
NE		UD-2	1	D	1.5	3.5	Brown	Brown Clay	Fat Clay	CH	26.5	55.4	27.4	28.0	0.0	4.0	96.0	40.0			0.011	2.71	USACOE 1952
NE		UD-2	10	D	21.5	23.5	Gray	Gray Till	Sandy Silty Clay	CL-ML	12.0	19.8	14.3	5.5	4.0	33.0	63.0	19.0		0.0072	0.064		USACOE 1952
NE		UD-2	11	D	23.5	25.5	Gray	Gray Till	Sandy Silt	ML	12.8	17.7	13.8	3.9	8.0	27.0	65.0	12.0	0.0017	0.009	0.06	2.76	USACOE 1952
NE		UD-2	12	D	25.5	27.5	Gray	Gray Till	Silty Sand with Gravel	SM	10.0	15.3	12.7	2.6	18.0	34.0	48.0	13.0		0.02	0.2		USACOE 1952
NE		UD-2	13	D	27.5	29.5	Gray	Gray Till	Sandy Silt	ML	10.3	14.8	13.2	1.6	10.0	35.0	55.0	18.0		0.07	0.1		USACOE 1952
NE		UD-2	14	D	29.5	31.5	Gray	Gray Till	Sandy Silty Clay	CL-ML	12.0	19.9	13.7	6.2	6.0	32.0	62.0	15.0		0.008	0.065		USACOE 1952
NE		UD-2	15	D	31.5	32.5	Gray	Gray Till	Lean Clay with Sand	CL	14.3	23.8	15.7	8.1	2.0	26.0	72.0	23.0		0.004	0.025		USACOE 1952
NE		UD-2	16	D	32.5	34.5	Gray	Gray Till	Sandy Silty Clay	CL-ML	9.9	22.2	15.5	6.7	7.0	29.0	64.0	16.0		0.0075	0.05		USACOE 1952
NE		UD-2	2	D	3.5	5.5	Brown	Brown Clay	Lean Clay with Sand	CL	11.5	24.2	16.5	7.7	3.0	25.0	72.0	23.0		0.0045	0.036	2.74	USACOE 1952
NE		UD-2	3	D	5.5	7.5	Brown	Brown Clay	Sandy Silty Clay	CL-ML	12.1	20.5	14.1	6.4	0.0	50.0	50.0	15.0	0.0014	0.013	0.16	2.77	USACOE 1952
NE		UD-2	5	D	11.5	13.5	Gray	Muddy Stream	Silty, Clayey Sand with Gravel	SC-SM	8.0	18.9	12.9	6.0	5.0	61.0	34.0	12.0	0.0018	0.04	0.93		USACOE 1952
NE		UD-2	7	D	15.5	17.5	Gray	Gray Till	Sandy Lean Clay	CL	14.6	23.5	15.2	8.3	9.0	35.0	56.0	10.0	0.002	0.085	0.1	2.77	USACOE 1952
NE		UD-2	8	D	17.5	19.5	Gray	Gray Till	Sandy Silty Clay	CL-ML	11.4	18.7	13.5	5.2	10.0	37.0	53.0	13.0		0.012	0.15		USACOE 1952
NE		UD-2	9	D	19.5	21.5	Gray	Gray Till	Sandy Silty Clay	CL-ML	10.7	21.3	14.6	6.7	10.0	29.0	61.0	18.0		0.0072	0.065		USACOE 1952
SW		UD-3		D	13.0	13.5	Gray	Gray Till	Well Graded Sand (V)	SW (V)					0.0	95.0	5.0						USACOE 1952
SW		UD-3	1	D	1.5	3.5	Brown	Brown Clay	Fat Clay	CH	25.1	50.4	26.7	23.7	0.0	10.0	90.0	40.0			0.008	2.70	USACOE 1952
SW		UD-3	2	D	3.5	5.5	Brown	Brown Clay	Lean Clay	CL	24.4	42.7	24.3	18.4	0.0	0.0	100.0	45.0			0.005	2.72	USACOE 1952
SW		UD-3	3	D	5.5	7.5	Brown	Brown Clay	Lean Clay	CL	26.3	38.2	22.3	15.9	0.0	10.0	90.0	38.0			0.009		USACOE 1952
SW		UD-3	4	D	7.5	9.5	Brown	Muddy Stream	Silt	ML	20.8	NP	NP	NP	0.0	5.0	95.0	24.0		0.004	0.014	2.75	USACOE 1952
SW		UD-3	5	D	9.5	11.5	Brown	Muddy Stream	Silt	ML	19.1	NP	NP	NP	0.0	11.0	89.0	7.0		0.024	0.032		USACOE 1952
SW		UD-3	6 Bot	D	13.0	13.5	Brown	Muddy Stream	Silty Sand	SM	18.5	NP	NP	NP	0.0	85.0	15.0	0.0	0.08	0.15	0.25		USACOE 1952
SW		UD-3	6 Top	D	11.5	13.0	Brown	Muddy Stream	Silt	ML	19.7	NP	NP	NP	0.0	10.0	90.0	5.0	0.002	0.02	0.035		USACOE 1952
SW		UD-3	7	D	13.5	15.5	Gray	Gray Till	Silty Clay with Sand	CL-ML	14.7	18.7	14.6	4.1	0.0	24.0	76.0	16.0		0.0063	0.024	2.77	USACOE 1952
SW		UD-3	8	D	15.5	17.5	Gray	Gray Till	Lean Clay with Sand	CL	18.5	24.9	16.2	8.7	4.0	19.0	77.0	25.0		0.003	0.016	2.75	USACOE 1952
SW		UD-3	9	D	17.5	19.5	Gray	Gray Till	Lean Clay with Sand	CL	15.3	23.9	16	7.9	5.0	24.0	71.0	23.5		0.004	0.028		USACOE 1952
NW	11112		30920-11112-01	SS	1.0	1.5	Olive Yellow	Fill	Silty Sand with Gravel	SM					21.0	46.0	33.0	NR					50.03.24
NW	11112		30920-11112-02	SS	4.0	4.5	Brown	Muddy Stream	Poorly Graded Sand (V)	SP (V)					30.0	60.0	10.0	NR					50.03.24
NW	11112		30920-11112-04	SS	7.0	7.5	Brown	Muddy Stream	Well Graded Sand with Gravel	SW (V)					2.0	93.0	5.0	NR					50.03.24
NW	11112		30920-11112-07	SS	8.5	9.0	Light Olive Brown	Muddy Stream	Well Graded Sand with Gravel	SW (V)					29.0	66.0	5.0	NR					50.03.24
NW	11112		30920-11112-18	SS	14.0	14.5	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					6.0	27.0	67.0	NR					50.03.24
NW	11112		30921-11112-01	ST	14.5	17.0	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					7.0	34.0	59.0	NR					50.03.24
NW	11112		30921-11112-02	ST	17.0	19.0	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					9.0	29.0	62.0	NR					50.03.24
NW	11114		30913-11114-01	SS	1.0	1.5	Brown	Fill	Silty Gravel with Sand (V)	GM (V)					46.0	32.0	22.0	NR					50.03.24

TABLE A-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color	General Stratum	USCS Name	USCS Symbol	Sample Moisture Content (%)	Atterberg Limits			Grain Size							Specific Gravity	Reference
												LL	PL	PI	Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	D10	D30	D60		
NW	11114		30913-11114-03	SS	2.5	3.0	Brown	Brown Clay	Silty Sand with Gravel (V)	SM (V)					28.0	44.0	28.0	NR					50.03.24
NW	11114		30913-11114-04	SS	3.0	3.5	Brown	Muddy Stream	Silty Sand (V)	SM (V)					9.0	78.0	13.0	NR					50.03.24
NW	11114		30913-11114-05	SS	3.5	4.0	Brown	Muddy Stream	Silty Sand (V)	SM (V)					11.0	68.0	21.0	NR					50.03.24
NW	11114		30913-11114-08	SS	5.5	6.0	Brown	Muddy Stream	Poorly Graded Sand (V)	SP (V)					1.0	91.0	8.0	NR					50.03.24
NW	11114		30913-11114-13	SS	8.5	9.0	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					5.0	88.0	7.0	NR					50.03.24
NW	11114		30913-11114-23	SS	14.5	15.0	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					15.0	78.0	7.0	NR					50.03.24
NW	11114		30913-11114-27	SS	16.5	17.0	Brown and Gray	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					29.0	56.0	15.0	NR					50.03.24
NW	11114		30913-11114-28	SS	17.0	17.5	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					3.0	29.0	68.0	NR					50.03.24
NW	11115		30915-11115-01	SS	1.0	1.5	Brown	Fill	Silty Gravel with Sand (V)	GM (V)					40.0	33.0	27.0	NR					50.03.24
NW	11115		30915-11115-03	SS	2.0	2.5	Brown	Muddy Stream	Silty Sand (V)	SM (V)					9.0	71.0	20.0	NR					50.03.24
NW	11115		30915-11115-06	SS	4.0	4.5	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					35.0	48.0	17.0	NR					50.03.24
NW	11115		30915-11115-07	SS	5.5	6.0	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					42.0	50.0	8.0	NR					50.03.24
NW	11115		30915-11115-09	SS	7.0	7.5	Brown	Muddy Stream	Poorly Graded Sand (V)	SP (V)					7.0	87.0	6.0	NR					50.03.24
NW	11115		30915-11115-11	SS	8.0	8.5	Brown	Muddy Stream	Well Graded Sandy Gravel (V)	GW (V)					46.0	44.0	10.0	NR					50.03.24
NW	11115		30915-11115-12	SS	8.5	9.0	Brown	Muddy Stream	Well Graded Sand with Gravel (V)	SW (V)					35.0	60.0	5.0	NR					50.03.24
NW	11115		30915-11115-16	SS	11.5	12.0	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					36.0	57.0	7.0	NR					50.03.24
NW	11115		30915-11115-19	SS	13.0	13.5	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					12.0	82.0	6.0	NR					50.03.24
NW	11115		30915-11115-27	SS	17.0	17.5	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					6.0	29.0	65.0	NR					50.03.24
NW	11116		30911-1116-01	SS	1.0	1.5	Brown	Fill	Silty Sand with Gravel (V)	SM (V)					34.0	35.0	31.0	NR					50.03.24
NW	11116		30911-1116-05	SS	4.0	4.5	Brown	Brown Clay	Sandy Lean Clay (V)	CL (V)					12.0	38.0	50.0	NR					50.03.24
NW	11116		30911-1116-07	SS	5.0	5.5	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					16.0	51.0	33.0	NR					50.03.24
NW	11116		30911-1116-08	SS	5.5	6.0	Brown	Muddy Stream	Silty Sand (V)	SM (V)					13.0	57.0	30.0	NR					50.03.24
NW	11116		30911-1116-11	SS	7.0	7.5	Brown	Muddy Stream	Silty Sand (V)	SM (V)					14.0	71.0	15.0	NR					50.03.24
NW	11116		30911-1116-12	SS	8.5	9.0	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					15.0	56.0	29.0	NR					50.03.24
NW	11116		30911-1116-15	SS	10.0	10.5	Brown	Muddy Stream	Well Graded Sand (V)	SW (V)					4.0	89.0	7.0	NR					50.03.24
NW	11116		30911-1116-16	SS	10.5	11.0	Brown	Muddy Stream	Silty Sand (V)	SM (V)					7.0	83.0	10.0	NR					50.03.24
NW	11116		30911-1116-18	SS	11.5	12.0	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					20.0	66.0	14.0	NR					50.03.24
NW	11116		30911-1116-20	SS	13.0	13.5	Brown	Muddy Stream	Well Graded Sand (V)	SW (V)					7.0	83.0	10.0	NR					50.03.24
NW	11116		30911-1116-21	SS	13.5	14.0	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					18.0	38.0	44.0	NR					50.03.24
SW	11120		30914-11120-01	SS	1.0	1.5	Gray	Fill	Lean Clay with Sand (V)	CL (V)					7.0	19.0	74.0	NR					50.03.24
SW	11120		30914-11120-03	SS	2.0	2.5	Gray	Fill	Lean Clay (V)	CL (V)					0.0	12.0	88.0	NR					50.03.24
SW	11120		30914-11120-10	SS	6.0	6.5	Gray	Fill	Lean Clay (V)	CL (V)					0.0	8.0	92.0	NR					50.03.24
SW	11120		30915-11120-02	SS	8.0	8.5	Brown	Muddy Stream	Silt with Sand (V)	ML (V)					0.0	23.0	77.0	NR					50.03.24
SW	11120		30915-11120-05	SS	10.5	11.0	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					23.0	57.0	20.0	NR					50.03.24
SW	11120		30915-11120-06	SS	12.0	12.5	Brown	Muddy Stream	Silty Sand (V)	SM (V)					9.0	75.0	16.0	NR					50.03.24
SW	11120		30915-11120-06	SS	14.0	14.5	Brown	Muddy Stream	Silty Sand (V)	SM (V)					14.0	72.0	14.0	NR					50.03.24
SW	11120		30915-11120-09	SS	18.0	18.5	Brown	Muddy Stream	Well Graded Sand (V)	SW (V)					0.0	94.0	6.0	NR					50.03.24
SW	11120		30915-11120-16	SS	19.5	20.0	Brown	Muddy Stream	Well Graded Sand (V)	SW (V)					1.0	91.0	8.0	NR					50.03.24
SW	11120		30915-11120-19	SS	20.0	20.5	Brown	Muddy Stream	Silty Sand (V)	SM (V)					7.0	70.0	23.0	NR					50.03.24
SW	11120		30915-11120-21	SS	20.5	21.0	Brown	Muddy Stream	Sandy Silt (V)	ML (V)					8.0	30.0	62.0	NR					50.03.24
SW	11120		30915-11120-22	SS	21.0	21.5	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					2.0	30.0	68.0	NR					50.03.24
SW	11120		30915-11120-25	SS	23.0	23.5	Gray	Gray Till	Sandy Lean Clay with Gravel (V)	CL (V)					16.0	33.0	51.0	NR					50.03.24
SW	11121		30921-11121-01	SS	1.5	2.0	Gray	Fill	Lean Clay (V)	CL (V)					7.0	27.0	66.0	NR					50.03.24
SW	11121		30921-11121-05	SS	4.5	5.0	Gray	Fill	Lean Clay (V)	CL (V)					7.0	26.0	67.0	NR					50.03.24
SW	11121		30921-11121-08	SS	6.0	6.5	Brown	Brown Clay	Lean Clay (V)	CL (V)					0.0	12.0	88.0	NR					50.03.24
SW	11121		30921-11121-11	SS	8.5	9.0	Brown	Muddy Stream	Silty Sand (V)	SM (V)					0.0	61.0	39.0	NR					50.03.24
SW	11121		30921-11121-12	SS	10.5	11.0	Yellowish Brown	Muddy Stream	Silty Sand (V)	SM (V)					0.0	60.0	40.0	NR					50.03.24
SW	11121		30921-11121-19	SS	14.5	15.0	Brown	Muddy Stream	Silty Sand (V)	SM (V)					9.0	45.0	46.0	NR					50.03.24
SW	11121		30921-11121-20	SS	15.0	15.5	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					17.0	61.0	22.0	NR					50.03.24
SW	11121		30921-11121-23	SS	16.5	17.0	Brown	Muddy Stream	Silty Sand (V)	SM (V)					0.0	79.0	21.0	NR					50.03.24
SW	11121		30921-11121-30	SS	20.0	20.5	Brown	Muddy Stream	Poorly Graded Sand (V)	SP (V)					6.0	87.0	7.0	NR					50.03.24
SW	11121		30921-11121-37	SS	24.0	24.5	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					14.0	31.0	55.0	NR					50.03.24
NE	11132		30923-11132-01	SS	24.5	25.0	Gray	Gray Till	Lean Clay (V)	CL (V)					5.0	22.0	73.0	NR					50.03.24
NE	11133		30916-11133-01	SS	0.0	0.5	Brown	Fill	Silt with Sand (V)	ML (V)					6.0	21.0	73.0	NR					50.03.24
NE	11133		30916-11133-08	SS	4.5	5.0	Brown	Fill	Silt with Sand (V)	ML (V)					4.0	25.0	71.0	NR					50.03.24

TABLE A-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color	General Stratum	USCS Name	USCS Symbol	Sample Moisture Content (%)	Atterberg Limits			Grain Size							Specific Gravity	Reference
												LL	PL	PI	Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	D10	D30	D60		
NE	11133		30916-11133-12	SS	7.5	8.0	Brown	Brown Clay	Sandy Lean Clay with Gravel (V)	CL (V)					15.0	27.0	58.0	NR					50.03.24
NE	11133		30916-11133-15	SS	9.0	9.5	Brown	Brown Clay	Sandy Lean Clay with Gravel (V)	CL (V)					20.0	30.0	50.0	NR					50.03.24
NE	11133		30916-11133-17	SS	10.0	10.5	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					3.0	29.0	68.0	NR					50.03.24
NE	11133		30916-11133-19	SS	11.0	11.5	Brown	Muddy Stream	Silt with Sand (V)	ML (V)					2.0	26.0	72.0	NR					50.03.24
NE	11133		30916-11133-21	SS	12.0	12.5	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					8.0	33.0	59.0	NR					50.03.24
NE	11133		30916-11133-25	SS	14.0	14.5	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					6.0	30.0	64.0	NR					50.03.24
NE	11133		30917-11133-07	SS	21.0	21.5	Gray	Gray Till	Lean Clay with Sand (V)	CL (V)					1.0	24.0	75.0	NR					50.03.24
NE	11133		30917-11133-18	SS	27.0	27.5	Gray	Gray Till	Lean Clay with Sand (V)	CL (V)					2.0	20.0	78.0	NR					50.03.24
NE	11133		30917-11133-27	SS	31.5	34.5	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					6.0	26.0	68.0	NR					50.03.24
NE	11133		30918-11133-01	SS	31.5	32.0	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					10.0	26.0	64.0	NR					50.03.24
NE	11133		30918-11133-05	SS	35.0	35.5	Gray	Gray Till	Lean Clay with Sand (V)	CL (V)					12.0	15.0	73.0	NR					50.03.24
NE	11133		30918-11133-08	SS	34.5	37.5	Gray	Gray Till	Sandy Lean Clay with Gravel (V)	CL (V)					23.0	25.0	52.0	NR					50.03.24
NE	11133		30923-11133-01	SS	37.5	38.0	Gray	Gray Till	Silty Sand with Gravel (V)	SM (V)					21.0	36.0	43.0	NR					50.03.24
NE	11133		30923-11133-04	SS	39.0	39.5	Gray	Gray Till/GMA	Silt with Sand (V)	ML (V)					0.0	18.0	82.0	NR					50.03.24
NE	11133		30923-11133-06	SS	40.5	41.0	Gray	GMA	Silt with Sand (V)	ML (V)					3.0	24.0	73.0	NR					50.03.24
NE	11133		30923-11133-08	SS	42.0	42.5	Gray	GMA	Sandy Silt (V)	ML (V)					0.0	45.0	55.0	NR					50.03.24
NE	11133		30923-11133-10	SS	43.5	44.0	Gray	GMA	Poorly Graded Sand (V)	SP (V)					0.0	94.0	6.0	NR					50.03.24
NW	11208		30909-11208-01	SS	1.0	1.5	Brown	Fill	Silty Sand with Gravel (V)	SM (V)					19.0	54.0	27.0	NR					50.03.24
NW	11208		30909-11208-02	SS	1.5	2.0	Brown	Fill	Silty Sand (V)	SM (V)					0.0	77.0	23.0	NR					50.03.24
NW	11208		30909-11208-03	SS	2.5	3.0	Brown	Brown Clay	Lean Clay with Gravel (V)	CL (V)					18.0	27.0	55.0	NR					50.03.24
NW	11208		30909-11208-05	SS	3.5	4.0	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					31.0	58.0	11.0	NR					50.03.24
NW	11208		30909-11208-08	SS	5.5	6.0	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					10.0	79.0	11.0	NR					50.03.24
NW	11208		30909-11208-17	SS	10.0	10.5	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					20.0	73.0	7.0	NR					50.03.24
NW	11208		30909-11208-18	SS	10.5	11.0	Gray	Gray Till	Silty Sand with Gravel (V)	SM (V)					19.0	37.0	44.0	NR					50.03.24
NW	11208		30909-11208-19	SS	11.0	11.5	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					18.0	70.0	12.0	NR					50.03.24
NW	11208		30909-11208-20	SS	11.5	12.0	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					20.0	67.0	13.0	NR					50.03.24
NW	11208		30909-11208-24	SS	13.5	14.0	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					6.0	25.0	69.0	NR					50.03.24
NW	11209		30917-11209-01	SS	1.0	1.5	Brown	Fill	Silty Sand with Gravel (V)	SM (V)					17.0	39.0	44.0	NR					50.03.24
NW	11209		30917-11209-02	SS	1.5	2.0	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					22.0	60.0	18.0	NR					50.03.24
NW	11209		30917-11209-04	SS	2.5	3.0	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					17.0	68.0	15.0	NR					50.03.24
NW	11209		30917-11209-06	SS	4.0	4.5	Brown	Muddy Stream	Silty Sand (V)	SM (V)					9.0	77.0	14.0	NR					50.03.24
NW	11209		30917-11209-08	SS	5.0	5.5	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					19.0	71.0	10.0	NR					50.03.24
NW	11209		30917-11209-11	SS	7.0	7.5	Brown	Muddy Stream	Poorly Graded Sand (V)	SP (V)					16.0	76.0	8.0	NR					50.03.24
NW	11209		30917-11209-16	SS	10.0	10.5	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					21.0	68.0	11.0	NR					50.03.24
NW	11209		30917-11209-22	SS	13.0	13.5	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					12.0	84.0	5.0	NR					50.03.24
NW	11209		30917-11209-26	SS	16.0	16.5	Brown	Muddy Stream	Poorly Graded Sand with Gravel (V)	SP (V)					10.0	85.0	5.0	NR					50.03.24
NW	11209		30918-11209-01	SS	20.5	21.0	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					5.0	32.0	63.0	NR					50.03.24
NW	11211		30915-11211-01	SS	1.5	2.0	Gray	Fill	Lean Clay with Sand (V)	CL (V)					1.0	24.0	75.0	NR					50.03.24
NW	11211		30915-11211-07	SS	5.0	5.5	Gray	Fill	Lean Clay (V)	CL (V)					1.0	13.0	86.0	NR					50.03.24
NW	11211		30915-11211-11	SS	8.5	9.0	Gray	Fill	Lean Clay with Sand (V)	CL (V)					0.0	19.0	81.0	NR					50.03.24
NW	11211		30915-11211-12	SS	9.0	9.5	Brown	Muddy Stream	Lean Clay with Sand (V)	CL (V)					0.0	25.0	75.0	NR					50.03.24
NW	11211		30915-11211-14	SS	10.0	10.5	Brown	Brown Clay	Sandy Lean Clay (V)	CL (V)					1.0	47.0	52.0	NR					50.03.24
NW	11211		30915-11211-15	SS	10.5	11.0	Brown	Muddy Stream	Poorly Graded Sand (V)	SP (V)					1.0	89.0	10.0	NR					50.03.24
NW	11211		30915-11211-18	SS	12.0	12.5	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					5.0	43.0	52.0	NR					50.03.24
NW	11211		30915-11211-22	SS	14.0	14.5	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					33.0	43.0	24.0	NR					50.03.24
NW	11211		30915-11211-24	SS	15.0	15.5	Brown	Muddy Stream	Well Graded Sand (V)	SW (V)					7.0	83.0	10.0	NR					50.03.24
NW	11211		30915-11211-26	SS	16.0	16.5	Brown	Muddy Stream	Poorly Graded Sand (V)	SP (V)					1.0	89.0	10.0	NR					50.03.24
NW	11211		30915-11211-34	SS	20.0	20.5	Brown	Muddy Stream	Poorly Graded Sand (V)	SP (V)					3.0	93.0	4.0	NR					50.03.24
NW	11211		30915-11211-35	SS	20.5	21.0	Brown	Muddy Stream	Sandy Lean Clay (V)	CL (V)					4.0	42.0	54.0	NR					50.03.24
NW	11211		30915-11211-36	SS	21.0	21.5	Gray	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					22.0	43.0	35.0	NR					50.03.24
NW	11211		30915-11211-37	SS	22.5	23.0	Brown	Muddy Stream	Silty Sand (V)	SM (V)					0.0	87.0	13.0	NR					50.03.24
NW	11211		30915-11211-38	SS	23.0	23.5	Brown and Gray	Gray Till	Sandy Lean Clay (V)	CL (V)					6.0	33.0	61.0	NR					50.03.24
SW	11583	109(4)		ST	4.0	5.0	Brown	Fill	Lean Clay	CL	20.1	29.2	21	8.2	0.0	4.0	96.0	27.0		0.0026	0.011	2.64	S&ME 021-86-162
SW	11587	113(2)		NR	1.0	5.0	Gray	Fill	Clayey Sand with Gravel	SC		31.9	20	11.9	23.0	48.0	29.0	12.0	0.001	0.1	2.8		S&ME 021-86-162
SW	11587	113(2)		ST	4.0	6.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	20.5	45.6	28.3	17.3	4.0	23.0	73.0	21.0		0.0017	0.0094		S&ME 021-86-162

TABLE A-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color	General Stratum	USCS Name	USCS Symbol	Sample Moisture Content (%)	Atterberg Limits			Grain Size							Specific Gravity	Reference
												LL	PL	PI	Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	D10	D30	D60		
SW	11590	116(5)		ST	7.0	9.0	Brown and Gray	Brown Clay	Silty Clay	CL-ML	27.1	23.3	18.6	4.7	0.0	6.0	94.0	10.0	0.0019	0.008	0.016	2.78	S&ME 021-86-162
SW	11595	121(1)		ST	3.0	5.0	Gray and Brown	Brown Clay	Fat Clay	CH		51.6	15.5	36.1	0.0	2.0	98.0	41.0			0.0085		S&ME 1221-87-178-1.0
SW	11597	123(2)		BULK	1.0	5.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL		30.3	15.5	14.8	11.0	12.0	77.0	28.0		0.0027	0.026		S&ME 1221-87-178-1.0
SW	11599	125(7)		SS	3.0	4.5	Brown and Gray	Brown Clay	Lean Clay	CL	20.3	36.5	24	12.5	0.0	11.0	89.0	37.0		0.0026	0.014		S&ME 1221-87-178-2.0
SW	11797	126(6)		ST	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL	33.7	34.5	15.8	18.7	11.0	20.0	69.0	24.0		0.0036	0.25		S&ME 1221-87-178-2.0
SW	11799	128(2)		BULK	1.0	5.0	Brown	Muddy Stream	Lean Clay with Sand	CL		34.5	22.4	12.1	6.0	16.0	78.0	31.0		0.0018	0.017	2.66	S&ME 021-86-169
SW	11799	128(2)		ST	5.0	7.0	Brown and Gray	Muddy Stream	Lean Clay	CL	17.2	39.7	26.3	13.4	0.0	12.0	88.0	34.0		0.0013	0.011	2.67	S&ME 021-86-169
NW	11802	131(1)		SS	0.0	1.5	Brown	Brown Clay	Lean Clay	CL	17.4	32.8	16.6	16.2	0.0	12.0	88.0	32.0		0.0016	0.014		S&ME 021-86-169
NW	11803	132(2)		BULK	1.0	5.0	Brown	Brown Clay	Lean Clay with Sand	CL		30.7	19.7	11.0	0.0	22.0	78.0	31.0		0.001	0.017	2.73	S&ME 021-86-169
NW	11804	133(3)		ST	5.0	7.0	Gray	Gray Till	Lean Clay with Sand	CL	22.8	36.8	26.1	10.7	5.0	18.0	77.0	32.0		0.0016	0.013	2.61	S&ME 021-86-169
NW	11806	135(5)		ST	7.0	9.0	Brown	Brown Clay	Lean Clay	CL		40	21.6	18.4	0.0	12.0	88.0	35.0			0.011	2.65	S&ME 021-86-169
SE	11809	138(5)	3	ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	17.9	30.4	20.3	10.1	6.0	20.0	74.0	18.0		0.004	0.022		S&ME 1221-87-257
SE	11816	144(4)		SS	2.5	4.0	Brown and Gray	Brown Clay	Lean Clay	CL	22.5	37.4	20	17.4	0.0	9.0	91.0	31.0		0.0019	0.01		S&ME 021-86-363
SE	11817	145(2)		BULK	1.0	5.0	Brown	Brown Clay	Lean Clay with Sand	CL		35.5	24.1	11.4	5.0	20.0	75.0	33.0		0.0015	0.014		S&ME 021-86-363
SE	11818	146(3)		ST	2.5	4.5	Brown	Brown Clay	Lean Clay (V)	CL (V)	24.4	29.8	19.8	10.0									S&ME 021-86-363
SE	11819	147(1)		ST	5.0	7.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	15.0	30.4	19.7	10.7	4.0	19.0	77.0	34.0		0.0015	0.01		S&ME 021-86-363
SE	11821	149(3)		BULK	1.0	5.0	Brown and Gray/Gray	Brown Clay/Fill?	Sandy Lean Clay	CL		32	20	12.0	10.0	24.0	66.0	26.0		0.0035	0.027		S&ME 021-86-363
SE	11821	149(3)		ST	9.0	11.0	Gray	Gray Till	Silty Clay	CL-ML	24.9	28.4	22.1	6.3	0.0	5.0	95.0	27.0		0.0028	0.007		S&ME 021-86-363
SE	11823	151(6)		ST	9.0	11.0	Gray	Gray Till	Sandy Lean Clay	CL	18.6	23.7	16.2	7.5	11.0	30.0	59.0	15.0		0.0087	0.08		S&ME 021-86-363
SE	11825	153(5)		SS	5.0	6.5	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	21.8	43.7	24.3	19.4									S&ME 021-86-363
SE	11826	154(7)		SS	1.5	3.0	Brown	Fill	Lean Clay	CL	20.4	36.2	21.1	15.1									S&ME 021-84-215
SE	11826	154(7)		ST	7.0	9.0	Brown	Brown Clay	Fat Clay	CH	22.7	54.3	20.4	33.9	0.0	8.0	92.0	38.0					S&ME 021-84-215
SE	11827	155(4)		ST	7.5	9.5	Brown	Brown Clay	Lean Clay with Sand	CL	20.3	28	12.4	15.6	3.0	20.0	77.0	27.0					S&ME 021-84-215
SE	11830	158(8)		ST	2.0	4.0	Brown	Brown Clay	Fat Clay	CH	21.4	58.8	20.5	38.3	0.0	4.0	96.0	44.0			0.008	2.68	S&ME 1221-87-114
SE	11832	160(5)		ST	5.0	7.0	Brown	Brown Clay	Silty Clay	CL-ML	20.7	23.4	17.7	5.7	0.0	12.0	88.0	24.0		0.004	0.021		S&ME 1221-87-114
SE	11835	163(6)		SS	24.5	26.0	Gray	Muddy Stream	Poorly-graded Sand with Silt	SP-SM	3.7				7.0	86.0	7.0	NR	0.15	0.37	0.8		S&ME 021-84-215
SE	11837	165(6)		SS	7.5	9.0	Gray	Gray Till	Silty Clay with Gravel (V)	CL-ML (V)	13.2	20.5	14.5	6.0									S&ME 1221-87-114
SE	11838	166(1)		ST	1.0	3.0	Brown	Brown Clay	Lean Clay (V)	CL (V)	13.9	27.2	15.7	11.5									S&ME 1221-87-114
SE	11843	171(9)		BULK	1.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL		27.8	14.9	12.9	13.0	29.0	58.0	19.0		0.006	0.12		S&ME 1221-87-178-3.0
SE	11844	172(8)		SS	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL	11.3	23	14.7	8.3	5.0	29.0	66.0	21.0		0.062	0.042		S&ME 1221-87-178-3.0
NE	11845	173(1)		SS	7.5	9.0	Gray	Gray Till	Sandy Silty Clay	CL-ML	12.0	20.4	14.7	5.7	9.0	25.0	66.0	25.0		0.0035	0.034	2.79	S&ME 021-86-261
NE	11845	173(1)		ST	15.0	16.5	Gray	Gray Till	Silty, Clayey Sand with Gravel	SC-SM	10.8	21.7	15.6	6.1	27.0	27.0	46.0	18.0		0.011	0.8	2.82	S&ME 021-86-261
NE	11845	173(1)		SS	30.0	31.0	Brown	Gray Till	Sandy Silty Clay	CL-ML	12.0	21.6	16.2	5.4	6.0	30.0	64.0	22.0		0.005	0.042	2.79	S&ME 021-86-261
NE	11845	173(1)		SS	35.0	36.5	Brown	GMA	Silty Sand (V)	SM (V)	5.3				0.0	80.0	20.0	NR		0.12	0.2		S&ME 021-86-261
NE	11845	173(1)		SS	45.0	46.5	Brown	GMA	Poorly-graded Sand with Silt (V)	SP-SM (V)	3.7				3.0	90.0	7.0	NR	0.14	0.32	0.48		S&ME 021-86-261
NE	11845	173(1)		SS	55.0	56.0	Brown	GMA	Poorly-graded Sand with Silt and Gravel (V)	SP-SM (V)	2.9				38.0	57.0	5.0	NR	0.22	0.6	3.8		S&ME 021-86-261
NE	11845	173(1)		SS	58.0	60.0	Brown	GMA	Silty Gravel with Sand (V)	GM (V)	5.6				47.0	38.0	15.0	NR		1.3	5.8		S&ME 021-86-261
NE	11847	175(3)		SS	7.5	9.0	Gray	Lacustrine?	Sandy Lean Clay	CL	12.3	23.1	15.1	8.0	3.0	32.0	65.0	21.0		0.0047	0.04		S&ME 1221-87-288-1.0
SE	11862	189(4)		ST	3.0	4.5	Brown	Brown Clay	Sandy Silty Clay	CL-ML	13.6	22.8	15.9	6.9	7.0	40.0	53.0	18.0		0.073	0.4	2.72	S&ME 021-86-162
SE	11862	189(4)		SS	4.5	5.0	Brown	Brown Clay	Lean Clay with Sand (V)	CL (V)	11.9	41.9	28.5	13.4	2.0	20.0	78.0	22.0		0.0045	0.018		S&ME 021-86-162
SE	11863	190(5)		ST	3.0	5.0	Brown	Brown Clay	Lean Clay with Sand	CL	14.1	25.4	16.1	9.3	2.0	20.0	78.0	23.0		0.0026	0.025	2.83	S&ME 021-86-162
SE	11866	193(2)		BULK	1.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL		26.4	15.9	10.5	12.0	31.0	57.0	20.0		0.085	0.11		S&ME 021-86-162
SW	11874	222(4)		ST	10.0	12.0	Brown and Gray	Lacustrine	Silty Clay (V)	CL-ML (V)	19.5	21.5	15.5	6.0									S&ME 021-84-215
SW	11875	223(2)		ST	2.5	4.5	Mottled Brown	Brown Clay	Lean Clay (V)	CL (V)	21.6	41.7	18.7	23.0									S&ME 021-84-215
SW	11880	228(2)		SS	1.5	3.0	Brown	Brown Clay	Lean Clay (V)	CL (V)	20.8	35.2	18.7	16.5									S&ME 021-84-269
SW	11882	230(4)		BULK	0.5	4.0	Brown	Brown Clay	Lean Clay	CL		41.4	18.4	23.0	0.0	5.0	95.0	37.0			0.07		S&ME 021-84-269
NW	11883	231(5)		SS	1.5	3.0	Dark Brown to Brown	Brown Clay	Lean Clay (V)	CL (V)	25.0	42.8	20.4	22.4									S&ME 021-84-269
NW	11885	233(7)		BULK	0.5	4.0	Brown	Brown Clay	Sandy Lean Clay with Gravel	CL		29.4	16.5	12.9	22.0	28.0	50.0	13.0					S&ME 021-84-269
NW	11888	136(10)		SS	1.5	3.0	Brown	Brown Clay	Lean Clay (V)	CL (V)	20.7	39.6	21.5	18.1									S&ME 021-84-269
SE	11936	281(B3)		ST	3.0	5.0	Brown	Brown Clay	Sandy Silty Clay with Gravel	CL-ML	11.0	21	15	6.0	16.0	33.0	51.0	14.0		0.009	0.46		S&ME 4144-88-119
NE	11938	283(1)	3	SS	10.0	11.5	Gray	Gray Till	Silty Clay (V)	CL-ML (V)	12.7	20	14.1	5.9									NUTTING S-1143
NE	11941	286(4)	S-1	ST	12.0	14.0	Gray	Gray Till	Silty Clay (V)	CL-ML (V)	10.4	20	15.9	4.1									NUTTING S-1143
NE	11944	289(7)	S-1	ST	7.5	8.5	Brown, Gray, Reddish Brown	Brown Clay	Silty Clay (V)	CL-ML (V)	10.5	21.7	15	6.7									NUTTING S-1143
SW	11948	293(11)	S-1	ST	9.5	11.5	Gray	Lacustrine	Lean Clay (V)	CL (V)	20.7	26.6	18	8.6									NUTTING S-1143
SW	11951	296(C-2)	4	SS	8.5	10.0	Olive Brown	Lacustrine	Lean Clay (V)	CL (V)	24.0	34	19	15.0									ATEC 22-831858

TABLE A-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color	General Stratum	USCS Name	USCS Symbol	Sample Moisture Content (%)	Atterberg Limits			Grain Size							Specific Gravity	Reference
												LL	PL	PI	Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	D10	D30	D60		
SW	11952	297(C-3)	7	SS	18.5	20.0	Gray	Gray Till	Lean Clay (V)	CL (V)	13.0	23	14	9.0									ATEC 22-831858
SW	11956	301(C-7)	4	SS	8.5	10.0	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	19.0	29	17	12.0									ATEC 22-831858
SW	11957	302(C-8)	5	SS	11.0	12.5	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	13.0	28	17	11.0									ATEC 22-831858
SE	11960	305(3)		SS	5.0	6.5	Brown	Fill	Lean Clay	CL		33	19	14.0	0.0	6.0	94.0	36.0			0.0068		4144-88-462
SE	11960	305(3)		SS	10.0	11.5	Gray	Gray Till	Lean Clay	CL		28	18	10.0	0.0	1.0	99.0	36.0		0.0012	0.0075		4144-88-462
SE	11960	305(3)		SS	15.0	16.5	Brown	Muddy Stream	Silty Sand (V)	SM (V)					0.0	57.0	43.0	NR			0.15		4144-88-462
OU1	11962	307(5)		SS	30.0	31.5	Gray	Gray Till	Sandy Lean Clay	CL	12.0	23	14	9.0	3.0	30.0	81.0	24.0		0.0038	0.036		4144-88-462
NE	11963	201(2)		ST	3.0	4.5	Brown	Brown Clay	Lean Clay (V)	CL (V)	1.2	28.5	17.3	11.2								2.79	S&ME 1221-87-160-2.0
NE	11963	201(2)		BULK	3.0	8.0	Brown	Brown Clay	Sandy Lean Clay	CL		25.5	14.5	11.0	8.0	33.0	59.0	21.0		0.064	0.083		S&ME 1221-87-160-2.0
NE	11965	201(3)		SS	2.5	4.0	Brown and Gray	Brown Clay	Silty Clay with Sand	CL-ML	12.2	20.4	13.9	6.5	0.0	28.0	72.0	21.0		0.005	0.027		S&ME 1221-87-160-2.0
NE	11967	205(10)		SS	3.0	4.5	Brown	Brown Clay	Lean Clay (V)	CL (V)	13.1	25.6	15.1	10.5									S&ME 1221-87-160-1.0
NE	11967	205(10)		BULK	3.0	8.0	Brown	Brown Clay	Sandy Lean Clay	CL		26.2	14	12.2	1.0	33.0	66.0	24.0					S&ME 1221-87-160-1.0
NE	11968	206(7)		SS	3.0	4.5	Brown	Brown Clay	Lean Clay (V)	CL (V)	13.1	27.8	15.7	12.1									S&ME 1221-87-160-1.0
NE	11971	209(3)	2	SS	5.0	6.5	Brown	Brown Clay	Lean Clay (V)	CL (V)	12.7	23.7	16.4	7.3									S&ME 1221-87-160-1.0
NE	11977	215(2)		ST	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL	15.3	24.8	16	8.8	7.0	33.0	60.0	18.0				2.73	S&ME 1221-87-160-1.0
NE	11977	215(2)	2	SS	7.5	9.0	Gray	Gray Till	Lean Clay	CL	21.5	37.9	20.1	17.8	0.0	0.0	100.0	43.0					S&ME 1221-87-160-1.0
NE	11979	217(2)		ST	3.0	5.0	Brown	Brown Clay	Fat Clay (V)	CH (V)	27.4	50.6	18.2	32.4									S&ME 1221-87-159
NE	11980	218(1)		SS	7.5	9.0	Brown	Brown Clay	Lean Clay (V)	CL (V)	23.8	16.5	7.3	9.2									S&ME 1221-87-159
SW	11982	220(5)		ST	12.5	14.5	Gray	Muddy Stream	Silty Clay (V)	CL-ML (V)	12.3	18.3	12.3	6.0									S&ME 021-84-215
NW	12010	(2)	10	JAR	27.0	32.0	Gray	Gray Till	Sandy Silty Clay with Gravel	CL-ML	10.9	20	14.1	5.9	18.0	28.0	54.0	13.0	0.0015	0.012	0.15		USACOE 1952
NW	12010	(2)	13	JAR	42.0	47.0	Brown	GMA	Silty Sand	SM	5.1	NP	NP	NP	0.0	60.0	40.0	0.0	0.01	0.055	0.12		USACOE 1952
NW	12010	(2)	2	JAR	3.0	4.0	Gray and Brown	Brown Clay	Sandy Lean Clay	CL	13.0	23.9	16.2	7.7	8.0	29.0	63.0	13.0		0.007	0.07		USACOE 1952
NW	12010	(2)	6	JAR	10.0	12.0	Gray	Gray Till	Sandy Silty Clay	CL-ML	10.0	18.4	13.4	5.0	10.0	35.0	55.0	8.0		0.0013	0.14		USACOE 1952
NE	12011	(3)	12	JAR	37.0	41.0	Gray	GMA?	Silt	ML	16.9	NP	NP	NP	0.0	2.0	98.0	15.0		0.0062	0.013		USACOE 1952
NE	12011	(3)	13	JAR	41.0	46.0	Gray	GMA	Silty Sand	SM	4.7	NP	NP	NP	0.0	75.0	25.0	0.0	0.019	0.11	0.29		USACOE 1952
NE	12011	(3)	2	JAR	2.0	4.0	Gray and Brown	Brown Clay	Lean Clay with Sand	CL	14.4	28.7	18.4	10.3	3.0	22.0	75.0	19.0		0.005	0.027		USACOE 1952
NE	12011	(3)	7	JAR	12.0	17.0	Gray	Gray Till	Sandy Lean Clay	CL	12.9	24.7	15.9	8.8	8.0	25.0	67.0	19.0		0.005	0.036		USACOE 1952
NE	12015	(7)	3	JAR	4.0	6.0	Gray and Brown	Brown Clay	Lean Clay with Sand	CL	13.1	23.4	16.1	7.3	0.0	25.0	75.0	20.0		0.0054	0.03		USACOE 1952
NE	12015	(7)	8	JAR	18.0	20.0	Gray	Muddy Stream	Well-graded Sand with Silt and Gravel	SW-SM	9.3	NP	NP	NP	37.0	59.0	4.0	0.0	0.15	0.84	4		USACOE 1952
NE	12015	(7)	9	JAR	20.0	25.0	Gray	Gray Till	Sandy Silty Clay	CL-ML	11.1	20.2	14.7	5.5	10.0	33.0	57.0	14.0		0.01	0.08		USACOE 1952
SE	12019	(12)	10	JAR	31.5	37.0	Gray	GMA	Silty Sand	SM	3.8	NP	NP	NP	0.0	85.0	15.0	0.0		0.19	0.42		USACOE 1952
SE	12019	(12)	2	JAR	4.0	6.0	Gray and Brown	Brown Clay	Sandy Lean Clay	CL	13.4	26.9	17.6	9.3	8.0	24.0	68.0	20.0		0.005	0.036		USACOE 1952
SE	12019	(12)	6	JAR	11.5	15.0	Gray and Brown	Brown Clay	Lean Clay	CL	14.9	27.9	17.5	10.4	0.0	4.0	96.0	34.0		0.0014	0.008		USACOE 1952
SE	12019	(12)	7	JAR	15.0	22.0	Gray	Gray Till	Lean Clay with Sand	CL	13.6	24.4	16.2	8.2	4.0	21.0	75.0	22.0		0.004	0.027		USACOE 1952
SW	12020	(13)	1	JAR	2.0	4.0	Gray and Brown	Fill	Fat Clay	CH	25.0	55.5	25.7	29.8	0.0	5.0	95.0	30.0		0.0021	0.011		USACOE 1952
SW	12020	(13)	12	JAR	28.0	32.0	Brown	GMA	Silty Sand	SM	3.5	NP	NP	NP	0.0	80.0	20.0	2.5	0.018	0.16	0.38		USACOE 1952
SW	12020	(13)	15	JAR	37.0	42.0	Gray	GMA	Silty Sand with Gravel	SM	2.4	NP	NP	NP	30.0	57.0	13.0	0.0	0.015	0.26	2.7		USACOE 1952
SW	12020	(13)	3	JAR	6.0	8.0	Gray and Brown	Brown Clay	Silty Clay with Sand	CL-ML	20.6	19	15	4.0	0.0	25.0	75.0	16.0		0.009	0.05		USACOE 1952
SW	12020	(13)	5	JAR	10.0	12.0	Gray	Gray Till	Lean Clay	CL	19.8	22.6	16.9	5.7	0.0	5.0	95.0	30.0		0.002	0.012		USACOE 1952
SW	12020	(13)	6	JAR	12.0	14.0	Gray	Muddy Stream	Silt	ML	18.9	18.2	16.7	1.5	0.0	10.0	90.0	10.0	0.002	0.0062	0.015		USACOE 1952
SW	12020	(13)	9	JAR	18.4	22.0	Gray	Gray Till	Sandy Silty Clay	CL-ML	7.6	20.9	14.3	6.6	5.0	33.0	62.0	16.0		0.009	0.06		USACOE 1952
SE	12023	(16)	1	JAR	0.8	2.0	Brown	Brown Clay	Sandy Lean Clay	CL	22.9	44.2	23.3	20.9	0.0	20.0	80.0	33.0		0.0015	0.018		USACOE 1952
SE	12023	(16)	10	JAR	23.0	27.0	Gray	GMA?	Silty Sand	SM	6.6	NP	NP	NP	0.0	80.0	20.0	0.0	0.02	0.13	0.28		USACOE 1952
SE	12023	(16)	11	JAR	27.0	32.0	Gray	GMA	Silty Sand	SM	2.9	NP	NP	NP	0.0	75.0	25.0	0.0	0.011	0.096	0.42		USACOE 1952
SE	12023	(16)	4	JAR	6.0	8.0	Gray and Brown	Brown Clay	Sandy Lean Clay	CL	11.8	29.2	17.7	11.5	7.0	25.0	68.0	17.0		0.0045	0.035		USACOE 1952
SE	12023	(16)	9	JAR	18.0	23.0	Gray	Gray Till	Sandy Silty Clay	CL-ML	12.9	20.7	14.9	5.8	14.0	24.0	62.0	17.0		0.0075	0.052		USACOE 1952
SW	12024	(17)	11	JAR	21.7	24.2	Brown	GMA	Silty Sand	SM	6.6	NP	NP	NP	0.0	80.0	20.0	0.0	0.017	0.18	0.55		USACOE 1952
SW	12024	(17)	15	JAR	33.5	37.0	Brown	GMA	Silty Sand	SM	2.5	NP	NP	NP	3.0	59.0	38.0	3.5	0.006	0.045	0.28		USACOE 1952
SW	12024	(17)	2	JAR	4.0	6.0	Gray and Browsn	Brown Clay	Lean Clay	CL	19.8	36.1	22.3	13.8	0.0	5.0	95.0	38.0			0.004		USACOE 1952
SW	12024	(17)	5	JAR	9.5	10.0	Brown	Muddy Stream	Silty Sand	SM	18.5	NP	NP	NP	0.0	65.0	35.0	4.0	0.013	0.075	0.12		USACOE 1952
SW	12024	(17)	7	JAR	14.0	18.0	Gray	Gray Till	Silt	ML	18.8	20.3	17.5	2.8	0.0	10.0	90.0	14.0		0.013	0.037		USACOE 1952
SW	12024	(17)	8	JAR	18.0	20.0	Gray	Gray Till	Sandy Lean Clay	CL	11.8	23	14.8	8.2	8.0	25.0	77.0	18.0		0.006	0.033		USACOE 1952
SW	12025	(18)	13	JAR	33.5	36.0	Brown	GMA	Silty Sand	SM	3.1	NP	NP	NP	0.0	75.0	25.0	0.0		0.11	0.3		USACOE 1952
SW	12025	(18)	14	JAR	36.0	38.5	Brown	GMA	Poorly-graded Sand with Silt and Gravel	SP-SM	3.3	NP	NP	NP	40.0	52.0	8.0	0.0	0.15	0.38	4.7		USACOE 1952
SW	12025	(18)	17	JAR	43.5	47.0	Brown	GMA	Silty Sand with Gravel	SM	2.8	NP	NP	NP	25.0	49.0	26.0	0.0		0.16	1.9		USACOE 1952

TABLE A-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color	General Stratum	USCS Name	USCS Symbol	Sample Moisture Content (%)	Atterberg Limits			Grain Size							Specific Gravity	Reference
												LL	PL	PI	Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	D10	D30	D60		
SW	12025	(18)	2	JAR	4.0	6.0	Brown	Brown Clay	Lean Clay	CL	21.4	41.8	21.5	20.3	0.0	2.0	98.0	43.0			0.0077		USACOE 1952
SW	12025	(18)	4	JAR	8.0	10.0	Brown	Brown Clay	Lean Clay	CL	19.2	26	17.2	8.8	0.0	10.0	90.0	22.0		0.0047	0.016		USACOE 1952
SW	12025	(18)	7	JAR	17.0	21.7	Gray	Gray Till/Muddy Stream?	Sandy Silty Clay	CL-ML	10.1	21	14.7	6.3	4.0	26.0	70.0	18.0		0.0064	0.037		USACOE 1952
SE	12026	(19)	1	JAR	2.0	4.0	Brown	Brown Clay	Lean Clay	CL	22.9	43.7	21.1	22.6	0.0	5.0	95.0	38.0			0.0095		USACOE 1952
SE	12026	(19)	12	JAR	30.5	34.2	Gray	GMA	Well-graded Sand with Silt	SW-SM	2.5	NP	NP	NP	5.0	85.0	10.0	0.0	0.1	0.35	0.8		USACOE 1952
SE	12026	(19)	14	JAR	35.5	37.0	Gray	GMA	Silty Sand	SM	3.2	NP	NP	NP	2.0	80.0	18.0	0.0		0.2	0.28		USACOE 1952
SE	12026	(19)	6	JAR	12.0	17.0	Gray	Gray Till	Lean Clay	CL	11.6	23.7	14.8	8.9	6.0	24.0	70.0	25.0		0.0036	0.04		USACOE 1952
SE	12026	(19)	8	JAR	21.5	23.0	Gray	Muddy Stream	Poorly-graded Sand with Silt	SP-SM	19.4	NP	NP	NP	0.0	7.0	93.0	7.0	0.0058	0.013	0.02		USACOE 1952
SE	12027	(20)	1	JAR	1.2	3.0	Dark Gray and Brown	Fill	Lean Clay	CL	23.8	47.9	24.4	23.5	0.0	5.0	95.0	36.0			0.0095		USACOE 1952
SE	12027	(20)	10	JAR	22.5	27.0	Brown	GMA	Silty Sand	SM	2.4	NP	NP	NP	8.0	47.0	45.0	4.0	0.009	0.045	0.28		USACOE 1952
SE	12027	(20)	4	JAR	7.0	9.0	Brown	Muddy Stream	Silty Clay with Sand	CL-ML	14.1	20.5	14.8	5.7	0.0	21.0	79.0	22.0		0.0035	0.025		USACOE 1952
SE	12027	(20)	7	JAR	13.0	17.0	Gray	Gray Till/Muddy Stream?	Lean Clay with Sand	CL	22.3	22.3	14.9	7.4	3.0	25.0	72.0	19.0		0.0064	0.035		USACOE 1952
SE	12027	(20)	9	JAR	20.5	22.5	Gray	Muddy Stream	Silt	ML	19.7	NP	NP	NP	0.0	10.0	90.0	13.0	0.001	0.008	0.019		USACOE 1952
NW	12029	22	1	JAR	2.0	3.5	Gray and Brown	Fill	Lean Clay	CL	22.3	43.2	23.7	19.5	0.0	5.0	95.0	38.0			0.0065		USACOE 1952
NW	12029	22	2	JAR	3.5	5.5	Brown	Brown Clay	Silt with Sand	ML	23.5	20.7	18.6	2.1	0.0	25.0	75.0	12.5	0.001	0.0135	0.046		USACOE 1952
NW	12029	22	4	JAR	8.0	10.5	Brown	Muddy Stream	Clayey Sand with Gravel	SC	19.8	21.3	14.2	7.1	20.0	46.0	34.0	10.0	0.0019	0.04	0.95		USACOE 1952
NW	12029	22	6	JAR	12.5	16.0	Gray	Gray Till	Lean Clay with Sand	CL	10.5	24	15.6	8.4	5.0	23.0	72.0	20.0		0.0048	0.035		USACOE 1952
NW	12029	22	8	JAR	22.0	27.0	Gray	GMA	Silty Sand	SM	6.5	NP	NP	NP	1.0	83.0	16.0	0.0		0.18	0.36		USACOE 1952
NW	12074		411847	BULK	1.5	5.0	Olive Brown	Muddy Stream	Lean Clay with Sand	CL	14.8	28.8	15.6	13.2	5.6	23.8	70.6	22.5				2.81	PARSONS PO 167
NW	12074		411848	BULK	5.0	10.0	Olive Brown	Muddy Stream	Sandy Lean Clay	CL	9.9	23.8	13.6	10.2	11.8	27.5	60.7	19.3				2.82	PARSONS PO 167
SW	12077		411817	ST	4.5	6.5	Dark Yellowish Brown	Muddy Stream	Clayey Sand	SC	23.0	30.2	13.1	17.1	0.1	52.0	47.9	21.7				2.73	PARSONS PO 167
SW	12077		411818	BULK	4.5	8.0	Dark Yellowish Brown	Muddy Stream	Lean Clay with Sand	CL	23.4	38	16.4	21.6	0.7	24.2	75.1	25.3				2.77	PARSONS PO 167
SW	12077		411819	SS	9.5	11.0	Dark Gray	Muddy Stream	Lean Clay	CL	21.8	32.8	17.2	15.6	0.0	0.1	99.9	36.8				2.79	PARSONS PO 167
SW	12077		411821	SS	18.5	20.0	Dark Grayish Brown	Muddy Stream	Lean Clay	CL	22.5	26.7	17.1	9.6	0.0	1.5	98.5	28.0				2.78	PARSONS PO 167
NW	12078		411859	BULK	1.5	5.0	olive brown	Muddy Stream	Lean Clay with Sand	CL	19.0	40.7	17.7	23.0	3.0	16.9	80.1	30.4				2.76	PARSONS PO 167
NW	12078		411860	ST	5.5	8.0	light Olive Brown	Muddy Stream	Sandy Lean Clay	CL	14.2	31.4	16	15.4	12.3	18.1	69.6	24.3				2.78	PARSONS PO 167
NW	12079		411810	BULK	1.5	5.0	Dark Brown	Brown Clay	Lean Clay	CL	24.7	48	17.3	30.7	0.3	8.5	91.2	34.9				2.76	PARSONS PO 167
NW	12079		411812	SS	10.5	12.5	Dark Grayish Brown	Gray Till	Lean Clay with Sand	CL	13.6	23.5	13.2	10.3	6.6	21.0	72.4	21.7				2.78	PARSONS PO 167
NE	12080		411802	BULK	1.5	5.0	Dark Yellowish Brown	Brown Clay	Lean Clay	CL	21.3	45.6	19.1	26.5	0.3	7.3	92.4	32.0				2.79	PARSONS PO 167
NE	12080		411804	SS	10.5	12.5	Dark Gray	Gray Till	Sandy Lean Clay	CL	16.6	20.5	13.3	7.2	5.1	28.4	66.5	17.3				2.81	PARSONS PO 167
NE	12080		411806	SS	18.0	19.5	Dark Gray	Gray Till	Silty, Clayey Sand with Gravel	SC-SM	10.4	17.2	12	5.2	28.8	40.2	31.0	9.6				2.78	PARSONS PO 167
NW	12081		411834	BULK	1.5	5.0	Olive Brown	Muddy Stream	Lean Clay with Sand	CL	18.7	40.1	15.9	24.2	1.5	17.5	81.0	29.1				2.75	PARSONS PO 167
NW	12081		411851	ST	6.0	8.0	Olive Brown	Muddy Stream	Lean Clay	CL	22.5	33.6	17.2	16.4	0.0	1.2	98.8	31.1				2.78	PARSONS PO 167
NW	12081		411852	ST	8.0	10.5	Light Olive Brown	Muddy Stream	Lean Clay	CL	15.9	30.7	17.5	13.2	0.0	4.9	95.1	28.6				2.84	PARSONS PO 167
NW	12081		411853	SS	11.0	12.5	Dark Grayish Brown	Muddy Stream	Lean Clay	CL	21.2	26.7	15.7	11.0	0.0	1.2	98.8	27.5				2.84	PARSONS PO 167
NW	12081		411854	ST	15.0	17.0	Dark Grayish Brown	Muddy Stream	Sandy Lean Clay	CL	15.6	20.9	13.2	7.7	12.1	26.3	61.6	14.8				2.82	PARSONS PO 167
NE	12174	CSF-1	C1/4	ST	6.0	8.0	Dark Grayish Brown	Brown Clay	Lean Clay with Sand	CL	28.3	33	15	18.0	3.0	21.0	76.0	27.0		0.0029	0.023	2.75	PARSONS PO 20
NE	12174	CSF-1	C1/5	ST	8.0	10.0	Dark Yellowish Brown	Brown Clay	Sandy Lean Clay	CL	14.0	25	15	10.0	8.0	26.0	66.0	18.0		0.0063	0.062	2.78	PARSONS PO 20
NE	12175	CSF-2	C2/6	ST	13.0	15.0	Gray	Gray Till	Sandy Silty Clay	CL-ML	12.0	22	15	7.0	9.0	24.0	67.0	18.0		0.008	0.064	2.77	PARSONS PO 20
NE	12176	CSF-3	C3/6	ST	10.0	12.0	Light Olive Brown	Muddy Stream	Silty Clay with Sand	CL-ML	17.0	22	18	4.0	6.0	11.0	83.0	13.0		0.009	0.022	2.81	PARSONS PO 20
NE	12177	CSF-4	C4/6	ST	13.0	15.0	Dark Gray	Muddy Stream	Sandy Silty Clay	CL-ML	12.6	22	15	7.0	6.0	25.0	69.0	18.0		0.0075	0.048	2.74	PARSONS PO 20
NE	12178	CSF-5	C5/14	SS	38.0	40.0	Gray	Muddy Stream/Lacustrine	Silty Clay	CL-ML	17.9	23	18	5.0	0.0	1.0	99.0	15.0		0.0073	0.019	2.77	PARSONS PO 20
NE	12179	CSF-6	C6/8	ST	20.0	22.0	Dark Gray	Gray Till	Lean Clay	CL	14.4	23	14	9.0	0.0	14.0	86.0	22.0		0.005	0.018	2.75	PARSONS PO 20
SW	12297		412504	ST	3.0	5.0	Olive Brown		Sandy lean clay	CL	21.4	37.9	14.2	23.7	0.2	37.1	62.7	26.0		0.004	0.06	2.70	PARSONS PO 168/3221
SW	12297A		412532	ST	8.5	10.5	Olive Brown		Silty clay	CL-ML	21.7	22.9	18.5	4.4	0.0	5.4	94.6	13.0		0.009	0.025	2.77	PARSONS PO 168/3221
SW	12298		412520	ST	3.0	5.0	Light Olive Brown		Fat clay with sand	CH	23.7	50	15.4	34.6	0.1	26.4	73.5	32.0		0.0015	0.023	2.73	PARSONS PO 168/3221
SW	12298		412521	BULK	0.0	5.0	Brown		Lean clay with sand	CL		43.2	17.2	26.0	3.7	25.6	70.7	27.0		0.0035	0.04	2.73	PARSONS PO 168/3221
SW	12298		412530	ST	16.0	18.0	Dark Greenish Gray	Gray Till	Sandy lean clay	CL	21.8	26.8	13.9	12.9	8.7	23.4	67.9	26.0		0.0035	0.045	2.75	PARSONS PO 168/3221
NE	B-1	B-1		ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	15.0	27	17	10.0	7.0	21.0	72.0	21.0		0.004	0.027		S&ME 4144-88-309
NE	B-2	B-2		SS	2.0	3.0	Brown and Gray	Brown Clay	Lean Clay	CL		41	19	22.0	0.0	8.0	53.0	39.0			0.01		S&ME 4144-88-309

000114

TABLE A-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color	General Stratum	USCS Name	USCS Symbol	Sample Moisture Content (%)	Atterberg Limits			Grain Size							Specific Gravity	Reference
												LL	PL	PI	Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	D10	D30	D60		

Notes:

1. Grain Size: NR — Clay fraction not reported (No hydrometer data)
2. General Stratum:
   - Gray Till/Muddy Stream — Gray Till or Muddy Stream, unable to determine from boring log
   - Brown Clay/Fill — Sample is a combination of Brown Clay and Fill
   - ? — Could not be readily determined from description on boring log

000115

TABLE A-3
Summary of Unit Weight and Percent Saturation
Operable Unit 3
Former Plant Area

AREA	FEMP ID	Other ID	Sample Number	Specimen ID	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Color	General Stratum	USCS Name	USCS Symbol	Test Type	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Percent Saturation (%)	SG	Reference
NW		OS-1	OS1/4B	A	ST	6.0	8.0	Olive Brown and Gray	Gray Till	Lean Clay with Sand	CL	UCS	19.1	132.7	111.5		2.80	PARSONS PO 22
NW		OS-2A	OS2A/3		ST	4.0	6.0	Olive Brown	Brown Clay	Lean Clay with Sand	CL	UCS	18.7	130.6	110.0		2.77	PARSONS PO 22
NW		OS-3	OS3/5	A	ST	8.0	10.0	Very Dark Gray	Gray Till	Fat Clay	CH	UCS	24.7	124.4	99.8		2.78	PARSONS PO 22
NW		OS-4	OS4/4		ST	6.0	8.0	Olive Brown	Lacustrine	Sandy Clayey Silt (V)	ML/CL (V)	UCS	14.1	135.3	118.5			PARSONS PO 22
NW		OS-4	OS4/6	A	ST	13.0	15.0	Light Olive Brown	Brown Clay	Lean Clay	CL	UCS	23.5	129.7	118.5		2.79	PARSONS PO 22
SE		PFS-1	P1/4	P1/4B	ST	6.0	8.0	Very Dark Gray	Fill?	Lean Clay	CL	UCS	25.4	125.5	100.1		2.73	PARSONS PO 32
SE		PFS-2	P2/5	P2/5B	ST	8.0	10.0	Olive Brown	Brown Clay	Lean Clay	CL	UCS	21.8	132.0	108.3		2.81	PARSONS PO 32
SE		PFS-3	P3/4	P3/4A	ST	6.0	8.0	Very Dark Gray	Fill	Lean Clay	CL	UCS	24.6	127.3	102.1		2.76	PARSONS PO 32
SE		PFS-4A	P4A/4	P4/4	ST	6.0	8.0	Light Olive Brown	Brown Clay	Sandy Silty Clay (V)	CM-ML (V)	UCS	21.9	129.2	106.0			PARSONS PO 32
SE		PFS-4A	P4A/5	P4/5A	ST	8.0	10.0	Dark Yellowish Brown	Brown Clay	Lean Clay	CL	UCS	22.5	130.3	106.4		2.79	PARSONS PO 32
SE		PFS-5	P5/4	P5/4A	ST	6.0	8.0	Dark Yellowish Brown	Brown Clay/Fill?	Silt with Sand	ML	UCS	22.5	131.3	107.2		2.75	PARSONS PO 32
SE		PFS-6	P6/5	P6/5A	ST	8.0	10.0	Dark Gray	Gray Till	Sandy Silty Clay	CL-ML	UCS	11.3	146.3	131.5		2.82	PARSONS PO 32
SW	11581	107(1)			ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay	CL	CUpp	26.1	122.3	97.0	93.5		S&ME 021-86-169
SW	11581	107(1)			ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay	CL	CUpp	23.2	122.3	99.3	86.3		S&ME 021-86-169
SW	11581	107(1)			ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay	CL	CUpp	20.5	125.8	104.4	86.1		S&ME 021-86-169
SW	11583	109(4)			ST	4.0	5.0	Brown	Fill	Lean Clay	CL	UU	20.1		104.1		2.64	S&ME 021-86-162
SW	11586	112(1)			SS	2.5	4.0	Brown	Fill	Lean Clay with Sand (V)	CL (V)	UCS	27.0		94.7			S&ME 021-86-162
SW	11587	113(2)			ST	4.0	6.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	CUpp	20.5	123.5	102.5	86.5		S&ME 021-86-162
SW	11589	115(7)			SS	5.0	6.5	Brown	Fill	Well Graded Sand (V)	SW (V)	UCS	25.0		100.3			S&ME 021-86-162
SW	11590	116(5)			ST	7.0	9.0	Brown and Gray	Brown Clay	Silty Clay	CL-ML	UCS	27.1		97.5		2.78	S&ME 021-86-162
SW	11597	123(2)			SS	3.5	5.0	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	UCS	24.0		100.5			S&ME 1221-87-178-1.0
SW	11598	124(3)			SS	5.0	6.5	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	UCS	23.5		100.3			S&ME 1221-87-178-1.0
SW	11599	125(7)			SS	3.0	4.5	Brown and Gray	Brown Clay	Lean Clay	CL	UCS	20.3		107.2			S&ME 1221-87-178-2.0
SW	11797	126(6)			ST	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL	UCS	33.7		99.6			S&ME 1221-87-178-2.0
SW	11798	127(1)			SS	5.0	6.5	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	UCS	26.1		97.2			S&ME 021-86-169
SW	11799	128(2)			ST	5.0	7.0	Brown and Gray	Muddy Stream	Lean Clay	CL	CUpps	18.0	110.5	98.8	70.0	2.67	S&ME 021-86-169
SW	11800	129(4)			ST	5.0	7.0	Dark Gray and Brown	Fill	Lean Clay (V)	CL (V)	UCS	18.7		105.2			S&ME 1221-87-178-2.0
SW	11801	130(5)			SS	1.5	3.0	Brown	Brown Clay	Lean Clay (V)	CL (V)	UCS	19.6		110.4			S&ME 1221-87-178-2.0
NW	11802	131(1)			SS	0.0	1.5	Brown	Brown Clay	Lean Clay	CL	UCS	17.4		106.7			S&ME 021-86-169
NW	11804	133(3)			ST	5.0	7.0	Gray	Gray Till	Lean Clay with Sand	CL	UU	22.8		102.3		2.61	S&ME 021-86-169
NW	11806	135(5)			ST	7.0	9.0	Brown	Brown Clay	Lean Clay	CL	CUpp	25.4	128.3	102.3	100.0	2.65	S&ME 021-86-169
SE	11809	138(5)	3		ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	UCS	17.9		104.0			S&ME 1221-87-257
SE	11813	141(3)	3		ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	UCS	20.6		102.8			S&ME 1221-87-257
SE	11816	144(4)			SS	2.5	4.0	Brown and Gray	Brown Clay	Lean Clay	CL	UCS	22.5		99.9			S&ME 021-86-363
SE	11818	146(3)			ST	2.5	4.5	Brown	Brown Clay	Lean Clay (V)	CL (V)	UU	24.4		94.1			S&ME 021-86-363
SE	11819	147(1)			ST	5.0	7.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	CUpp	14.6	129.1	112.9	77.6		S&ME 021-86-363
SE	11819	147(1)			ST	5.0	7.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	CUpp	15.0	129.4	112.3	76.7		S&ME 021-86-363
SE	11819	147(1)			ST	5.0	7.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	CUpp	14.6	136.9	119.5	92.4		S&ME 021-86-363
SE	11821	149(3)			SS	4.0	5.5	Gray	Gray Till	Lean Clay (V)	CL (V)	UCS	23.0		98.4			S&ME 021-86-363
SE	11821	149(3)			ST	9.0	11.0	Gray	Gray Till	Silty Clay	CL-ML	UU	24.9		100.5			S&ME 021-86-363
SE	11822	150(4)			ST	2.0	4.0	Brown	Fill?	Sandy Silty Clay (V)	CL-ML (V)	UCS	15.0		115.8			S&ME 021-86-363
SE	11823	151(6)			ST	9.0	11.0	Gray	Gray Till	Sandy Lean Clay	CL	CON	18.6		117.6			S&ME 021-86-363
SE	11825	153(5)			SS	5.0	6.5	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	UCS	21.8		101.8			S&ME 021-86-363

TABLE A-3
Summary of Unit Weight and Percent Saturation
Operable Unit 3
Former Plant Area

1507

AREA	FEMP ID	Other ID	Sample Number	Specimen ID	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Color	General Stratum	USCS Name	USCS Symbol	Test Type	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Percent Saturation (%)	SG	Reference
SE	11826	154(7)			ST	7.0	9.0	Brown	Brown Clay	Fat Clay	CH	UU	22.7		103.4			S&ME 021-84-215
SE	11827	155(4)			ST	7.5	9.5	Brown	Brown Clay	Lean Clay with Sand	CL	UU	20.3		107.1			S&ME 021-84-215
SE	11830	158(8)			ST	2.0	4.0	Brown	Brown Clay	Fat Clay	CH	UCS	21.4		99.1		2.68	S&ME 1221-87-114
SE	11832	160(5)			ST	5.0	7.0	Brown	Brown Clay	Silty Clay	CL-ML	CUpp	20.7	130.7	108.3	100.0		S&ME 1221-87-114
SE	11832	160(5)			ST	5.0	7.0	Brown	Brown Clay	Silty Clay	CL-ML	CUpp	20.7	126.1	104.5	91.3		S&ME 1221-87-114
SE	11838	166(1)			ST	1.0	3.0	Brown	Brown Clay	Lean Clay (V)	CL (V)	UCS	13.9		120.2			S&ME 1221-87-114
SE	11840	168(11)			ST	3.0	5.0	Brown	Brown Clay?	Silty Clay (V)	CL-ML (V)	UCS	12.0		127.5			S&ME 1221-87-178-3.0
SE	11844	172(8)			SS	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL	UCS	11.3		128.4			S&ME 1221-87-178-3.0
NE	11845	173(1)			SS	5.0	6.5	Brown	Brown Clay	Lean Clay with Sand (V)	CL (V)	UCS	12.4		127.8			S&ME 021-86-261
NE	11845	173(1)			SS	7.5	9.0	Gray	Gray Till	Sandy Silty Clay	CL-ML	UCS	12.0		129.6		2.79	S&ME 021-86-261
NE	11845	173(1)			SS	30.0	31.0	Brown	Gray Till	Sandy Silty Clay	CL-ML	UCS	12.0		117.9		2.79	S&ME 021-86-261
NE	11847	175(3)			SS	7.5	9.0	Gray	Lacustrine?	Sandy Lean Clay	CL	UCS	12.3		123.5			S&ME 1221-87-288-1.0
SE	11861	188(7)			SS	5.0	6.5	Gray	Gray Till	Silty Clay with Sand (V)	CL-ML (V)	UCS	11.8		124.6			S&ME 021-86-162
SE	11862	189(4)			ST	3.0	4.5	Brown	Brown Clay	Sandy Silty Clay	CL-ML	CUpp	13.6	135.9	119.6	89.8	2.72	S&ME 021-86-162
SE	11862	189(4)			SS	4.5	5.0	Brown	Brown Clay	Lean Clay with Sand (V)	CL (V)	UU	11.9		126.3			S&ME 021-86-162
SE	11864	191(6)			SS	5.0	6.5	Brown	Brown Clay	Lean Clay with Sand (V)	CL (V)	UCS	11.9		120.3			S&ME 021-86-162
NE	11868	195(5)			NR	3.5	5.0	Brown	Brown Clay	Sandy Lean Clay (V)	CL (V)	UCS	11.0		126.0			S&ME 1221-87-288-2.0
NE	11869	196(7)			SS	5.0	6.5	Gray	Gray Till	Silty Clay (V)	CL-ML (V)	UCS	12.2		122.7			S&ME 1221-87-288-2.0
NE	11869	196(7)			SS	7.5	9.0	Gray	Gray Till	Silty Clay (V)	CL-ML (V)	UCS	13.2		121.7			S&ME 1221-87-288-2.0
NE	11869	196(7)			SS	10.0	11.5	Gray	Lacustrine?	Sandy Silty Clay with Gravel (V)	CL-ML (V)	UCS	13.9		122.1			S&ME 1221-87-288-2.0
SW	11874	222(4)			ST	10.0	12.0	Brown and Gray	Lacustrine	Silty Clay (V)	CL-ML (V)	UU	19.5		116.7			S&ME 021-84-215
SW	11875	223(2)			ST	2.5	4.5	Mottled Brown	Brown Clay	Lean Clay (V)	CL (V)	UCS	21.6		103.4			S&ME 021-84-215
SW	11877	225(3)			ST	4.5	6.5	Mottled Brown	Brown Clay	Silt (V)	ML (V)	UU	19.5		108.0			S&ME 021-84-215
SE	11934	279(B1)			ST	3.0	5.0	Brown	Fill?	Lean Clay (V)	CL (V)	UCS	21.0		103.5			S&ME 4144-88-119
SE	11936	281(B3)			ST	3.0	5.0	Brown	Brown Clay	Sandy Silty Clay with Gravel	CL-ML	UCS	11.0		128.3			S&ME 4144-88-119
NE	11941	286(4)	S-1		ST	12.0	14.0	Gray	Gray Till	Silty Clay (V)	CL-ML (V)	UCS	13.6		123.1			NUTTING S-1143
NE	11944	289(7)	S-1		ST	7.5	8.5	Brown, Gray, Reddish Brown	Brown Clay	Silty Clay (V)	CL-ML (V)	UCS	10.5		122.7			NUTTING S-1143
SW	11946	291(9)	S-1		ST	7.0	9.0	Brown and Gray	Lacustrine	Lean Clay (V)	CL (V)	UCS	24.1		103.2			NUTTING S-1143
SW	11948	293(11)	S-1		ST	9.5	11.5	Gray	Lacustrine	Lean Clay (V)	CL (V)	UCS	20.7		109.8			NUTTING S-1143
NE	11963	201(2)			ST	3.0	4.5	Brown	Brown Clay	Lean Clay (V)	CL (V)	UCS	1.2		127.0		2.79	S&ME 1221-87-160-2.0
NE	11965	201(3)			SS	2.5	4.0	Brown and Gray	Brown Clay	Silty Clay with Sand	CL-ML	UCS	12.2		131.2			S&ME 1221-87-160-2.0
NE	11965	201(3)			SS	5.0	6.5	Brown and Gray	Brown Clay	Silty Clay with Sand and Gravel (V)	CL-ML (V)	UCS	10.5		132.8		2.88	S&ME 1221-87-160-2.0
NE	11977	215(2)			ST	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL	UCS	15.3		120.4		2.73	S&ME 1221-87-160-1.0
NE	11977	215(2)	2		SS	7.5	9.0	Gray	Gray Till	Lean Clay	CL	UCS	21.5		108.2			S&ME 1221-87-160-1.0
NE	11979	217(2)			ST	3.0	5.0	Brown	Brown Clay	Fat Clay (V)	CH (V)	UCS	29.5		95.9			S&ME 1221-87-159
NE	11980	218(1)			SS	2.5	4.0	Brown	Brown Clay	Lean Clay (V)	CL (V)	UCS	21.0		106.6			S&ME 1221-87-159
SW	11982	220(5)			ST	12.5	14.5	Gray	Muddy Stream	Silty Clay (V)	CL-ML (V)	UU	12.3		122.6			S&ME 021-84-215
SW	12077		411817		ST	4.5	6.5	Dark Yellowish Brown	Muddy Stream	Clayey Sand	SC	CON	21.4	129.3	106.5	97.0	2.73	PARSONS PO 167
SW	12077		411817		ST	4.5	6.5	Dark Yellowish Brown	Muddy Stream	Clayey Sand	SC	UU	23.0	127.4	103.5	97.0	2.73	PARSONS PO 167
NW	12081		411851		ST	6.0	8.0	Olive Brown	Muddy Stream	Lean Clay	CL	CON	25.5	126.1	100.5	97.0	2.78	PARSONS PO 167
NW	12081		411851	A	ST	6.0	8.0	Olive Brown	Muddy Stream	Lean Clay	CL	CUpp	22.5	131.5	107.3	100.0	2.78	PARSONS PO 167
NW	12081		411851	C	ST	6.0	8.0	Olive Brown	Muddy Stream	Lean Clay	CL	CUpp	23.3	130.2	105.6	100.0	2.78	PARSONS PO 167
NW	12081		411854		ST	15.0	17.0	Dark Grayish Brown	Muddy Stream	Sandy Lean Clay	CL	CON	13.5	142.1	125.3	94.0	2.82	PARSONS PO 167

TABLE A-3
Summary of Unit Weight and Percent Saturation
Operable Unit 3
Former Plant Area

AREA	FEMP ID	Other ID	Sample Number	Specimen ID	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Color	General Stratum	USCS Name	USCS Symbol	Test Type	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Percent Saturation (%)	SG	Reference
NE	12174	CSF-1	C1/4	C1-4A	ST	6.0	8.0	Dark Grayish Brown	Brown Clay	Lean Clay with Sand	CL	UU	15.2	139.4	121.0		2.75	PARSONS PO 20
NE	12174	CSF-1	C1/4	C1-4B	ST	6.0	8.0	Dark Grayish Brown	Brown Clay	Lean Clay with Sand	CL	UU	28.3	124.4	96.9		2.75	PARSONS PO 20
NE	12174	CSF-1	C1/5		ST	8.0	10.0	Dark Yellowish Brown	Brown Clay	Sandy Lean Clay	CL	CON	14.3	138.2	120.9		2.78	PARSONS PO 20
NE	12175	CSF-2	C2/6		ST	13.0	15.0	Gray	Gray Till	Sandy Silty Clay	CL-ML	CON	11.9	144.5	129.1		2.77	PARSONS PO 20
NE	12176	CSF-3	C3/10		ST	25.0	27.0	Dark Gray	Muddy Stream	Sandy Silt (V)	ML (V)	CON	10.7	148.4	134.1			PARSONS PO 20
NE	12176	CSF-3	C3/6	C3/6A	ST	10.0	12.0	Light Olive Brown	Muddy Stream	Silty Clay with Sand	CL-ML	UU	16.9	137.6	117.7		2.81	PARSONS PO 20
NE	12176	CSF-3	C3/6	C3/6B	ST	10.0	12.0	Light Olive Brown	Muddy Stream	Silty Clay with Sand	CL-ML	UU	18.9	133.7	112.5		2.81	PARSONS PO 20
NE	12176	CSF-3	C3/6	C3/6C	ST	10.0	12.0	Light Olive Brown	Muddy Stream	Silty Clay with Sand	CL-ML	UU	14.8	140.2	122.1		2.81	PARSONS PO 20
NE	12179	CSF-6	C6/8	C6/8A	ST	20.0	22.0	Dark Gray	Gray Till	Lean Clay	CL	UU	13.9	142.8	125.4		2.75	PARSONS PO 20
NE	12179	CSF-6	C6/8	C6/8B	ST	20.0	22.0	Dark Gray	Gray Till	Lean Clay	CL	UU	14.7	141.1	123.0		2.75	PARSONS PO 20
NE	12179	CSF-6	C6/8	C6/8C	ST	20.0	22.0	Dark Gray	Gray Till	Lean Clay	CL	UU	14.7	141.5	123.3		2.75	PARSONS PO 20
NE	B-1	B-1			ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	Pbp	15.0	135.0	118.0			S&ME 4144-88-309
NE	B-2	B-2			ST	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay (V)	CL (V)	Pbp	16.0	131.0	113.0			S&ME 4144-88-309
NE	B-3	B-3			ST	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay (V)	CL (V)	Pbp	18.0	132.0	112.0			S&ME 4144-88-309
NE	B-4	B-4			ST	3.0	5.0	Brown	Brown Clay	Lean Clay with Sand (V)	CL (V)	Pbp	14.0	135.0	118.0			S&ME 4144-88-309
NE	B-4	B-4			ST	10.0	12.0	Brown	Brown Clay	Lean Clay with Sand (V)	CL (V)	Pbp	10.0	141.0	120.0			S&ME 4144-88-309
NE	B-6	B-6			ST	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay (V)	CL (V)	Pbp	16.0	123.0	105.0			S&ME 4144-88-309
NE	B-6	B-6			ST	10.0	12.0	Gray	Gray Till	Sandy Lean Clay (V)	CL (V)	Pbp	13.0	139.0	123.0			S&ME 4144-88-309

Notes:

1. Wet Density: Recorded only if reported, no wet densities were calculated (blank indicates not reported)
2. Percent Saturation: Recorded only if reported, no percent saturations were calculated (blank indicates not reported)
3. General Stratum: Brown Clay/Fill — Sample is a combination of Brown Clay and Fill
   ? — Could not be readily determined from description on boring log

TABLE A-4
Summary of Unconfined Compressive Strength Tests
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Color	General Stratum	USCS Name	USCS Symbol	Test Type	Test Method	Pre-Test Moisture Content (%)	Pre-Test Dry Density (pcf)	Axial Strain (%)	Unconfined Compressive Strength (psf)	Reference
NW		OS-1	OS1/4B	ST	6.0	8.0	Olive Brown and Gray	Gray Till	Lean Clay with Sand	CL	UCS	ASTM D 2166	21.1	111.5	15.13	1322	PARSONS PO 22
NW		OS-2A	OS2A/3	ST	4.0	6.0	Olive Brown	Brown Clay	Lean Clay with Sand	CL	UCS	ASTM D 2166	22.1	110.0	15.01	1781	PARSONS PO 22
NW		OS-3	OS3/5	ST	8.0	10.0	Very Dark Gray	Gray Till	Fat Clay	CH	UCS	ASTM D 2166	24.6	99.8	10.85	3529	PARSONS PO 22
NW		OS-4	OS4/6	ST	13.0	15.0	Light Olive Brown	Brown Clay	Lean Clay	CL	UCS	ASTM D 2166	32.6	118.5	12.03	1728	PARSONS PO 22
SE		PFS-1	P1/4	ST	6.0	8.0	Very Dark Gray	Fill?	Lean Clay	CL	UCS	ASTM D 2166	26.7	100.1	15.02	3243	PARSONS PO 32
SE		PFS-2	P2/5	ST	8.0	10.0	Olive Brown	Brown Clay	Lean Clay	CL	UCS	ASTM D 2166	18.8	108.3	12.66	3747	PARSONS PO 32
SE		PFS-3	P3/4	ST	6.0	8.0	Very Dark Gray	Fill	Lean Clay	CL	UCS	ASTM D 2166	23.2	102.1	6.68	2936	PARSONS PO 32
SE		PFS-4A	P4A/5	ST	8.0	10.0	Dark Yellowish Brown	Brown Clay	Lean Clay	CL	UCS	ASTM D 2166	22.6	106.4	9.49	3637	PARSONS PO 32
SE		PFS-5	P5/4	ST	6.0	8.0	Dark Yellowish Brown	Brown Clay/Fill?	Silt with Sand	ML	UCS	ASTM D 2166	20.6	107.2	5.93	921	PARSONS PO 32
SE		PFS-6	P6/5	ST	8.0	10.0	Dark Gray	Gray Till	Sandy Silty Clay	CL-ML	UCS	ASTM D 2166	11.3	131.5	14.98	5098	PARSONS PO 32
SW	11586	112(1)		SS	2.5	4.0	Brown	Fill	Lean Clay with Sand (V)	CL (V)	UCS	ASTM D 2166	27.0	94.7	10.10	13100	S&ME 021-86-162
SW	11589	115(7)		SS	5.0	6.5	Brown	Fill	Well Graded Sand (V)	SW (V)	UCS	ASTM D 2166	25.0	100.3	15.00	3570	S&ME 021-86-162
SW	11590	116(5)		ST	7.0	9.0	Brown and Gray	Brown Clay	Silty Clay	CL-ML	UCS	ASTM D 2166	27.1	97.5	15.00	920	S&ME 021-86-162
SW	11597	123(2)		SS	3.5	5.0	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	24.0	100.5	15.00	3200	S&ME 1221-87-178-1.0
SW	11598	124(3)		SS	5.0	6.5	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	23.5	100.3	15.00	2600	S&ME 1221-87-178-1.0
SW	11599	125(7)		SS	3.0	4.5	Brown and Gray	Brown Clay	Lean Clay	CL	UCS	ASTM D 2166	20.3	107.2	15.00	6600	S&ME 1221-87-178-2.0
SW	11797	126(6)		ST	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL	UCS	ASTM D 2166	33.7	99.6	10.70	2460	S&ME 1221-87-178-2.0
SW	11798	127(1)		SS	5.0	6.5	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	26.1	97.2	15.00	2060	S&ME 021-86-169
SW	11800	129(4)		ST	5.0	7.0	Dark Gray and Brown	Fill	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	18.7	105.2	10.80	3660	S&ME 1221-87-178-2.0
SW	11801	130(5)		SS	1.5	3.0	Brown	Brown Clay	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	19.6	110.4	8.00	1400	S&ME 1221-87-178-2.0
NW	11802	131(1)		SS	0.0	1.5	Brown	Brown Clay	Lean Clay	CL	UCS	ASTM D 2166	17.4	106.7	14.00	3020	S&ME 021-86-169
SE	11809	138(5)	3	ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	UCS	ASTM D 2166	17.9	104.0	14.00	2980	S&ME 1221-87-257
SE	11813	141(3)	3	ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	20.6	102.8	5.10	2500	S&ME 1221-87-257
SE	11816	144(4)		SS	2.5	4.0	Brown and Gray	Brown Clay	Lean Clay	CL	UCS	ASTM D 2166	22.5	99.9	15.00	2820	S&ME 021-86-363
SE	11821	149(3)		SS	4.0	5.5	Gray	Gray Till	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	23.0	98.4	15.00	4200	S&ME 021-86-363
SE	11822	150(4)		ST	2.0	4.0	Brown	Fill?	Sandy Silty Clay (V)	CL-ML (V)	UCS	ASTM D 2166	15.0	115.8	8.90	3800	S&ME 021-86-363
SE	11825	153(5)		SS	5.0	6.5	Brown and Gray	Brown Clay	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	21.8	101.8	14.30	5120	S&ME 021-86-363
SE	11830	158(8)		ST	2.0	4.0	Brown	Brown Clay	Fat Clay	CH	UCS	ASTM D 2166	21.4	99.1	13.40	3800	S&ME 1221-87-114
SE	11838	166(1)		ST	1.0	3.0	Brown	Brown Clay	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	13.9	120.2	15.00	3280	S&ME 1221-87-114
SE	11840	168(11)		ST	3.0	5.0	Brown	Brown Clay?	Silty Clay (V)	CL-ML (V)	UCS	ASTM D 2166	12.0	127.5	7.60	7400	S&ME 1221-87-178-3.0
SE	11844	172(8)		SS	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL	UCS	ASTM D 2166	11.3	128.4	9.80	12220	S&ME 1221-87-178-3.0
NE	11845	173(1)		SS	5.0	6.5	Brown	Brown Clay	Lean Clay with Sand (V)	CL (V)	UCS	ASTM D 2166	12.4	127.8	9.80	12980	S&ME 021-86-261
NE	11845	173(1)		SS	7.5	9.0	Gray	Gray Till	Sandy Silty Clay	CL-ML	UCS	ASTM D 2166	12.0	129.6	15.00	5400	S&ME 021-86-261
NE	11847	175(3)		SS	7.5	9.0	Gray	Lacustrine?	Sandy Lean Clay	CL	UCS	ASTM D 2166	12.3	123.5	15.00	8400	S&ME 1221-87-288-1.0
SE	11861	188(7)		SS	5.0	6.5	Gray	Gray Till	Silty Clay with Sand (V)	CL-ML (V)	UCS	ASTM D 2166	11.8	124.6	15.00	5000	S&ME 021-86-162
SE	11864	191(6)		SS	5.0	6.5	Brown	Brown Clay	Lean Clay with Sand (V)	CL (V)	UCS	ASTM D 2166	11.9	120.3	8.60	8560	S&ME 021-86-162
NE	11868	195(5)		NR	3.5	5.0	Brown	Brown Clay	Sandy Lean Clay (V)	CL (V)	UCS	ASTM D 2166	11.0	126.0	7.98	6160	S&ME 1221-87-288-2.0
NE	11869	196(7)		SS	5.0	6.5	Gray	Gray Till	Silty Clay (V)	CL-ML (V)	UCS	ASTM D 2166	12.2	122.7	11.51	9940	S&ME 1221-87-288-2.0
NE	11869	196(7)		SS	7.5	9.0	Gray	Gray Till	Silty Clay (V)	CL-ML (V)	UCS	ASTM D 2166	13.2	121.7	14.09	8720	S&ME 1221-87-288-2.0
NE	11869	196(7)		SS	10.0	11.5	Gray	Lacustrine?	Sandy Silty Clay with Gravel (V)	CL-ML (V)	UCS	ASTM D 2166	13.9	122.1	15.00	4440	S&ME 1221-87-288-2.0
SW	11875	223(2)		ST	2.5	4.5	Mottled Brown	Brown Clay	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	21.6	103.4	12.60	4360	S&ME 021-84-215
SE	11934	279(B1)		ST	3.0	5.0	Brown	Fill?	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	21.0	103.5	4.90	360	S&ME 4144-88-119
SE	11936	281(B3)		ST	3.0	5.0	Brown	Brown Clay	Sandy Silty Clay with Gravel	CL-ML	UCS	ASTM D 2166	11.0	128.3	8.10	2580	S&ME 4144-88-119
NE	11941	286(4)	S-1	ST	12.0	14.0	Gray	Gray Till	Silty Clay (V)	CL-ML (V)	UCS	ASTM D 2166	10.4	123.1	12.60	2900	NUTTING S-1143
NE	11944	289(7)	S-1	ST	7.5	8.5	Brown, Gray, Reddish Brown	Brown Clay	Silty Clay (V)	CL-ML (V)	UCS	ASTM D 2166	10.5	122.7	5.40	800	NUTTING S-1143
SW	11946	291(9)	S-1	ST	7.0	9.0	Brown and Gray	Lacustrine	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	24.1	103.2	7.20	2240	NUTTING S-1143
SW	11948	293(11)	S-1	ST	9.5	11.5	Gray	Lacustrine	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	20.7	109.8	8.70	3200	NUTTING S-1143
NE	11963	201(2)		ST	3.0	4.5	Brown	Brown Clay	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	1.2	127.0	6.27	8520	S&ME 1221-87-160-2.0
NE	11965	201(3)		SS	2.5	4.0	Brown and Gray	Brown Clay	Silty Clay with Sand	CL-ML	UCS	ASTM D 2166	12.2	131.2	10.20	6360	S&ME 1221-87-160-2.0
NE	11965	201(3)		SS	5.0	6.5	Brown and Gray	Brown Clay	Silty Clay with Sand and Gravel (V)	CL-ML (V)	UCS	ASTM D 2166	10.5	132.8	15.00	5240	S&ME 1221-87-160-2.0

TABLE A-4
Summary of Unconfined Compressive Strength Tests
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Color	General Stratum	USCS Name	USCS Symbol	Test Type	Test Method	Pre-Test Moisture Content (%)	Pre-Test Dry Density (pcf)	Axial Strain (%)	Unconfined Compressive Strength (psf)	Reference
NE	11977	215(2)		ST	3.0	5.0	Brown	Brown Clay	Sandy Lean Clay	CL	UCS	ASTM D 2166	15.3	120.4	5.40	4500	S&ME 1221-87-160-1.0
NE	11977	215(2)	2	SS	7.5	9.0	Gray	Gray Till	Lean Clay	CL	UCS	ASTM D 2166	21.5	108.2	15.90	7400	S&ME 1221-87-160-1.0
NE	11979	217(2)		ST	3.0	5.0	Brown	Brown Clay	Fat Clay (V)	CH (V)	UCS	ASTM D 2166	27.4	95.9	6.20	2440	S&ME 1221-87-159
NE	11980	218(1)		SS	2.5	4.0	Brown	Brown Clay	Lean Clay (V)	CL (V)	UCS	ASTM D 2166	21.0	106.6	10.70	3900	S&ME 1221-87-159

Notes:

1. Boring 11944, Sample S-1, 7.5 to 8.5 feet. The Shelby Tube was bent and test results are questionable.

2. General Stratum: Brown Clay/Fill — Sample is a combination of Brown Clay and Fill
   ? — Indicates could not be readily determined from description on test boring log

TABLE A-5
Summary of Consolidated Undrained Traixial Compression Tests
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Color	General Stratum	USCS Name	USCS Symbol	Test Type	Average Pre-Test Moisture (%)	Average Pre-Test Dry Density (pcf)	Effective Stress		Total Stress		Testing Condition	Reference
														Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)		
SW	11581	107(1)		ST	3.0	5.0	Brown and Gray	Brown Clay	Lean Clay	CL	CUpp	23.3	100.2	0	22.8	NR	NR	Saturated	S&ME 021-86-169
SW	11587	113(2)		ST	4.0	6.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	CUpp	20.5	102.5	300	23.8	NR	NR	Saturated	S&ME 021-86-162
SW	11799	128(2)		ST	5.0	7.0	Brown and Gray	Muddy Stream	Lean Clay	CL	CUpps	18.0	98.8	220	16.7	NR	NR	Saturated	S&ME 021-86-169
NW	11806	135(5)		ST	7.0	9.0	Brown	Brown Clay	Lean Clay	CL	CUpp	25.4	102.3	0	29.0	NR	NR	Saturated	S&ME 021-86-169
SE	11819	147(1)		ST	5.0	7.0	Brown and Gray	Brown Clay	Lean Clay with Sand	CL	CUpp	14.7	114.9	800	30.0	NR	NR	Saturated	S&ME 021-86-363
SE	11832	160(5)		ST	5.0	7.0	Brown	Brown Clay	Silty Clay	CL-ML	CUpp	20.7	106.4	0	32.0	NR	NR	Saturated	S&ME 1221-87-114
SE	11862	189(4)		ST	3.0	4.5	Brown	Brown Clay	Sandy Silty Clay	CL-ML	CUpp	13.6	119.6	1940	22.4	NR	NR	Saturated	S&ME 021-86-162
NW	12081		411851	ST	6.0	8.0	Olive Brown	Muddy Stream	Lean Clay	CL	CUpp	22.9	106.4	160	34.0	200	28	Saturated	PARSONS PO 167

Notes:

1. Total Stress: NR Not reported and tabular data not provided

000121

TABLE A-6
Summary of Unconsolidated-Undrained Triaxial Compression Tests
Operable Unit 3
Former Plant Area

Area	FEMP ID	Other ID	Sample Number	Sample Type	Top Depth (feet)	Bottom Depth (feet)	General Stratum	USCS Name	USCS Symbol	Test ID	Test Type	Test Method	Pre-Test Moisture (%)	Pre-Test Dry Density (pcf)	Confining Pressure (psf)	Total Cohesion (psf)	Axial Strain (%)	Reference
SW	11583	109(4)		ST	4.0	5.0	Fill	Lean Clay	CL		UU	ASTM D 2850	20.1	104.1	2880	4400	14.2	S&ME 021-86-162
NW	11804	133(3)		ST	5.0	7.0	Gray Till	Lean Clay with Sand	CL		UU	ASTM D 2850	22.8	102.3	2880	3380	15.2	S&ME 021-86-169
SE	11818	146(3)		ST	2.5	4.5	Brown Clay	Lean Clay (V)	CL (V)		UU	ASTM D 2850	24.4	94.1	2880	1760	12.5	S&ME 021-86-363
SE	11821	149(3)		ST	9.0	11.0	Gray Till	Silty Clay	CL-ML		UU	ASTM D 2850	24.9	100.5	2880	4100	20.0	S&ME 021-86-363
SE	11826	154(7)		ST	7.0	9.0	Brown Clay	Fat Clay	CH		UU	ASTM D 2850	22.7	103.4	1440	2840	11.7	S&ME 021-84-215
SE	11827	155(4)		ST	7.5	9.5	Brown Clay	Lean Clay with Sand	CL		UU	ASTM D 2850	20.3	107.1	1440	1580	8.1	S&ME 021-84-215
SE	11862	189(4)		SS	4.5	5.0	Brown Clay	Lean Clay with Sand (V)	CL (V)		UU	ASTM D 2850	11.9	126.3	2880	14760	13.5	S&ME 021-86-162
SW	11874	222(4)		ST	10.0	12.0	Lacustrine	Silty Clay (V)	CL-ML (V)		UU	ASTM D 2850	19.5	116.7	1440	3800	15.5	S&ME 021-84-215
SW	11877	225(3)		ST	4.5	6.5	Brown Clay	Silt (V)	ML (V)		UU	ASTM D 2850	19.5	108.0	1440	2580	15.2	S&ME 021-84-215
SW	11982	220(5)		ST	12.5	14.5	Muddy Stream	Silty Clay (V)	CL-ML (V)		UU	ASTM D 2850	12.3	122.6	2160	1280	5.0	S&ME 021-84-215
SW	12077		411817	ST	4.5	6.5	Muddy Stream	Clayey Sand	SC		UU	ASTM D 2850	23.0	103.5	792	881		PARSONS PO 167
NE	12174	CSF-1	C1/4	ST	6.0	8.0	Brown Clay	Lean Clay with Sand	CL	A	UU	ASTM D 2850	15.2	121.0	4000	2159	15.1	PARSONS PO 20
NE	12174	CSF-1	C1/4	ST	6.0	8.0	Brown Clay	Lean Clay with Sand	CL	B	UU	ASTM D 2850	28.3	96.9	2000	925	15.2	PARSONS PO 20
NE	12176	CSF-3	C3/6	ST	10.0	12.0	Muddy Stream	Silty Clay with Sand	CL-ML	A	UU	ASTM D 2850	16.9	117.7	8000	3906	13.5	PARSONS PO 20
NE	12176	CSF-3	C3/6	ST	10.0	12.0	Muddy Stream	Silty Clay with Sand	CL-ML	B	UU	ASTM D 2850	18.9	112.5	4000	3614	12.0	PARSONS PO 20
NE	12176	CSF-3	C3/6	ST	10.0	12.0	Muddy Stream	Silty Clay with Sand	CL-ML	C	UU	ASTM D 2850	14.8	122.1	2000	1991	15.2	PARSONS PO 20
NE	12179	CSF-6	C6/8	ST	20.0	22.0	Gray Till	Lean Clay	CL	A	UU	ASTM D 2850	13.9	125.4	8000	3068	15.1	PARSONS PO 20
NE	12179	CSF-6	C6/8	ST	20.0	22.0	Gray Till	Lean Clay	CL	B	UU	ASTM D 2850	14.7	123.0	4000	2775	15.1	PARSONS PO 20
NE	12179	CSF-6	C6/8	ST	20.0	22.0	Gray Till	Lean Clay	CL	C	UU	ASTM D 2850	14.7	123.3	2000	1714	15.1	PARSONS PO 20

TABLE A-7
Summary of Permeability Tests
Operable Unit 3
Former Plant Area

Area	FEMP ID	Other ID	Sample Number	Sample Type	Top Depth (feet)	Bottom Depth (feet)	General Stratum	USCS Name	USCS Symbol	Test Type	Test Method	Confining Pressure (psf)	Pretest Moisture (%)	Average Permeability (cm/sec)	Reference
NE	B-1	B-1		ST	3.0	5.0	Brown Clay	Lean Clay with Sand	CL	Pbp	EM 1110-2-1906	NR	15.0	8.00E-08	S&ME 4144-88-309
NE	B-2	B-2		ST	3.0	5.0	Brown Clay	Sandy Lean Clay (V)	CL (V)	Pbp	EM 1110-2-1906	NR	16.0	3.80E-08	S&ME 4144-88-309
NE	B-3	B-3		ST	3.0	5.0	Brown Clay	Sandy Lean Clay (V)	CL (V)	Pbp	EM 1110-2-1906	NR	18.0	6.20E-08	S&ME 4144-88-309
NE	B-4	B-4		ST	3.0	5.0	Brown Clay	Lean Clay with Sand (V)	CL (V)	Pbp	EM 1110-2-1906	NR	14.0	4.90E-08	S&ME 4144-88-309
NE	B-4	B-4		ST	10.0	12.0	Brown Clay	Lean Clay with Sand (V)	CL (V)	Pbp	EM 1110-2-1906	NR	10.0	5.00E-08	S&ME 4144-88-309
NE	B-6	B-6		ST	3.0	5.0	Brown Clay	Sandy Lean Clay (V)	CL (V)	Pbp	EM 1110-2-1906	NR	16.0	5.70E-08	S&ME 4144-88-309
NE	B-6	B-6		ST	10.0	12.0	Gray Till	Sandy Lean Clay (V)	CL (V)	Pbp	EM 1110-2-1906	NR	13.0	2.80E-08	S&ME 4144-88-309

Notes:

1. Test Method: EM 1110-2-190 Army Corps of Engineers Manual 1110-2-1906
2. Confining Pressure: NR Not Reported

000123

TABLE A-8
Summary of Standard and Modified Compaction Tests
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Other ID	Sample Number	Sample Type	Top Depth (feet)	Bottom Depth (feet)	General Stratum	USCS Name	USCS Symbol	LL	PL	PI	Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	SG	Test Type	Test Method	Optimum Moisture Content (%)	Maximum Dry Density (pcf)	Reference
SW	11582	108(2)		BULK	0.0	6.0	Brown Clay/Fill	Sandy Lean Clay with Gravel (V)	CL (V)								2.79	MP	ASTM D 1557	10.8	125.9	S&ME 021-86-169
SW	11587	113(2)		NR	1.0	5.0	Fill	Clayey Sand with Gravel	SC	31.9	20.0	11.9	23.0	48.0	29.0	12.0		MP	ASTM D 1557	6.7	138.3	S&ME 021-86-162
SW	11597	123(2)		BULK	1.0	5.0	Brown Clay	Lean Clay with Sand	CL	30.3	15.5	14.8	11.0	12.0	77.0	28.0		SP	ASTM D 698	10.2	127.6	S&ME 1221-87-178-1.0
SW	11799	128(2)		BULK	1.0	5.0	Muddy Stream	Lean Clay with Sand	CL	34.5	22.4	12.1	6.0	16.0	78.0	31.0	2.66	MP	ASTM D 1557	10.0	127.6	S&ME 021-86-169
NW	11803	132(2)		BULK	1.0	5.0	Brown Clay	Lean Clay with Sand	CL	30.7	19.7	11.0	0.0	22.0	78.0	31.0	2.73	MP	ASTM D 1557	10.7	128.0	S&ME 021-86-169
SE	11817	145(2)		BULK	1.0	5.0	Brown Clay	Lean Clay with Sand	CL	35.5	24.1	11.4	5.0	20.0	75.0	33.0		MP	ASTM D 698	14.8	110.6	S&ME 021-86-363
SE	11821	149(3)		BULK	1.0	5.0	Brown Clay/Fill?	Sandy Lean Clay	CL	32.0	20.0	12.0	10.0	24.0	66.0	26.0		MP	ASTM D 1557	14.1	117.3	S&ME 021-86-363
SE	11830	158(8)		BULK	0.0	3.0	Brown Clay	Fat Clay (V)	CH (V)									MP	ASTM D 1557	10.0	128.0	S&ME 1221-87-114
SE	11832	160(5)		BULK	0.0	3.0	Brown Clay	Silty Clay with Sand (V)	CL-ML (V)									MP	ASTM D 1557	10.0	128.0	S&ME 1221-87-114
SE	11843	171(9)		BULK	1.0	5.0	Brown Clay	Sandy Lean Clay	CL	27.8	14.9	12.9	13.0	29.0	58.0	19.0		MP	ASTM D 1557	7.6	135.4	S&ME 1221-87-178-3.0
SE	11866	193(2)		BULK	1.0	5.0	Brown Clay	Sandy Lean Clay	CL	26.4	15.9	10.5	12.0	31.0	57.0	20.0		MP	ASTM D 1557	7.5	135.7	S&ME 021-86-162
SW	11882	230(4)		BULK	0.5	4.0	Brown Clay	Lean Clay	CL	41.4	18.4	23.0	0.0	5.0	95.0	37.0		SP	ASTM D 698	18.0	107.5	S&ME 021-84-269
NW	11885	233(7)		BULK	0.5	4.0	Brown Clay	Sandy Lean Clay with Gravel	CL	29.4	16.5	12.9	22.0	28.0	50.0	13.0		SP	ASTM D 698	13.0	116.9	S&ME 021-84-269
NE	11963	201(2)		BULK	3.0	8.0	Brown Clay	Sandy Lean Clay	CL	25.5	14.5	11.0	8.0	33.0	59.0	21.0		MP	ASTM D 1557	7.5	136.0	S&ME 1221-87-160-2.0
NE	11967	205(10)		BULK	3.0	8.0	Brown Clay	Sandy Lean Clay	CL	26.2	14.0	12.2	1.0	33.0	66.0	24.0		MP	ASTM D 1557	9.3	134.2	S&ME 1221-87-160-1.0
NW	12074		411847	BULK	1.5	5.0	Muddy Stream	Lean Clay with Sand	CL	28.8	15.6	13.2	5.6	23.8	70.6	22.5	2.81	SP	ASTM D 698	13.9	117.4	PARSONS PO 167
NW	12074		411848	BULK	5.0	10.0	Muddy Stream	Sandy Lean Clay	CL	23.8	13.6	10.2	11.8	27.5	60.7	19.3	2.82	SP	ASTM D 698	10.8	129.7	PARSONS PO 167
SW	12077		411818	BULK	4.5	8.0	Muddy Stream	Lean Clay with Sand	CL	38.0	16.4	21.6	0.7	24.2	75.1	25.3	2.77	SP	ASTM D 698	14.9	117.0	PARSONS PO 167
NW	12078		411859	BULK	1.5	5.0	Muddy Stream	Lean Clay with Sand	CL	40.7	17.7	23.0	3.0	16.9	80.1	30.4	2.76	SP	ASTM D 698	17.6	111.2	PARSONS PO 167
NW	12079		411810	BULK	1.5	5.0	Brown Clay	Lean Clay	CL	48.0	17.3	30.7	0.3	8.5	91.2	34.9	2.76	SP	ASTM D 698	18.5	107.7	PARSONS PO 167
NE	12080		411802	BULK	1.5	5.0	Brown Clay	Lean Clay	CL	45.6	19.1	26.5	0.3	7.3	92.4	32.0	2.79	SP	ASTM D 698	19.5	105.9	PARSONS PO 167
NW	12081		411834	BULK	1.5	5.0	Muddy Stream	Lean Clay with Sand	CL	40.1	15.9	24.2	1.5	17.5	81.0	29.1	2.75	SP	ASTM D 698	15.7	113.6	PARSONS PO 167

Notes:

1. General Stratum: Brown Clay/Fill — Sample is a combination of Brown Clay and Fill
   ? — Could not be readily determined from description on test boring log

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APPENDIX B

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FEMP Glacial Till/Vadose Zone Hydraulic Investigations Report

Operable Unit 5
Project Order 37

Fernald Environmental Management Project
May 1994
Volume I of II

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FEMP Glacial Till/Vadose Zone Hydraulic Investigations Report Volume I

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LIST OF ACRONYMS AND ABBREVIATIONS

BGS	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CRT	Constant Rate Pumping Test
CRU	CERCLA/RCRA Unit
FEMP	Fernald Environmental Management Project
GMA	Great Miami Aquifer
gpd	gallons per day
gpm	gallons per minute
GT/VZ	Glacial Till/Vadose Zone
HSA	Hollow Stem Auger
ID	Inside Diameter
psi	pounds per square inch
PVC	Polyvinyl Chloride
RCRA	Resource Conservation and Recovery Act
SCDM	Site Characterization and Data Management

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SECTION 1

INTRODUCTION

1.1 Purpose and Objectives

The purpose of the Glacial Till/Vadose Zone (GT/VZ) Hydraulic Investigation Program was to obtain additional hydraulic conductivity data on the glacial overburden sediments, and to assess the barrier properties of the gray clay contained within the overburden. Hydraulic conductivity data contained within this report includes the results of 70 slug tests, seven yield tests, three pump tests, one packer test, and coefficient of permeability measurements from six Shelby tube samples of the gray clay. Data contained within this report on the barrier properties of the gray clay includes bulk density, specific gravity, moisture content, porosity, and water quality.

A strategy similar to that presented by Bradbury and Muldoon (Bradbury et al. 1990) was followed for the collection of hydraulic conductivity data. Bradbury and Muldoon explain that the "true" hydraulic conductivity of saturated near-surface materials is difficult to obtain due to measurement scale effects. Physical characteristics of geologic materials (particle size, roundness, sorting, etc.) vary spatially and this spatial variation can be large in many glacial and fluvial settings as a result of changes in depositional environments occurring over short distances. Tests and measurements of hydraulic conductivity of such variable material (such as glacial till) produce average values for the volume of the material being measured or tested. It is this "averaged" value that is used to address the problem at hand, not the "true" value.

As larger or smaller volumes of material are tested, a larger or smaller number of aquifer heterogeneities, which might be regarded as more or less conductive zones, are encountered. Hydraulic conductivity tests conducted for the GT/VZ Investigation Program can generally be grouped into three operational scales based upon the volume of material sampled.

1) Small Scale Tests ($< 1 m^3$): Core permeameter tests.

2) Site-Specific Tests ($1 m^3$ to Hundreds of Cubic Meters): Single well pumping tests, packer tests, and slug tests.

3) Local Tests (Hundreds of Cubic Meters to Thousands of Cubic Meters): Multiple well pumping tests.

The GT/VZ Investigation Program is based on the "Development of Glacial Till/Vadose Zone Investigation Program for Operable Unit 5 - November 13, 1992" (Ebasco and CH2M Hill 1992).

Activities 1 and 2 of that report identified tasks and general methodologies for evaluating the vertical and horizontal migration of groundwater through the glacial till into the Great Miami Aquifer (GMA). Following scoping meetings and a workshop on characterization of the Vadose Zone (Glacial Till), these tasks were formalized in the "FEMP Glacial Till/Vadose Zone Hydraulic Investigation Work Plan" (PARSONS 1993b). Data obtained from this investigation will be used to better understand fluid movement through the overburden sediments and to help construct an improved groundwater flow and solute transport model for the overburden sediments.

This report is divided into two volumes. Volume I describes the extent of the investigation, activities, analysis, and provides a summary of results and conclusions. Volume II contains background information and data to support the analyses presented in Volume I.

The intent of this report is to document the data collection activity and present the results. Hydrogeologic interpretations are limited. The reader should refer to the CRU5 RI Report for hydrogeologic interpretations.

1.2 Summary of Activities

Figure 1-1 shows the locations where tests and measurements were conducted. Below is a brief outline of the scope of the project.

Slug Tests

Seventy slug tests were performed on "1000 series" monitoring wells across the site to determine hydraulic conductivity in the "perched" groundwater zones. Slug test methods and results are discussed in Section 2.

Packer Tests

Packer tests were conducted to determine bulk hydraulic conductivities. Descriptions of activities, equipment, and results are discussed in Section 3.

Yield Tests

Seven yield tests were performed at 5 different locations to determine if a yield could be sustained and to establish discharge rates for the CRTs. Yield tests were also used to establish where CRTs could be conducted. Yield tests are discussed in Section 4.

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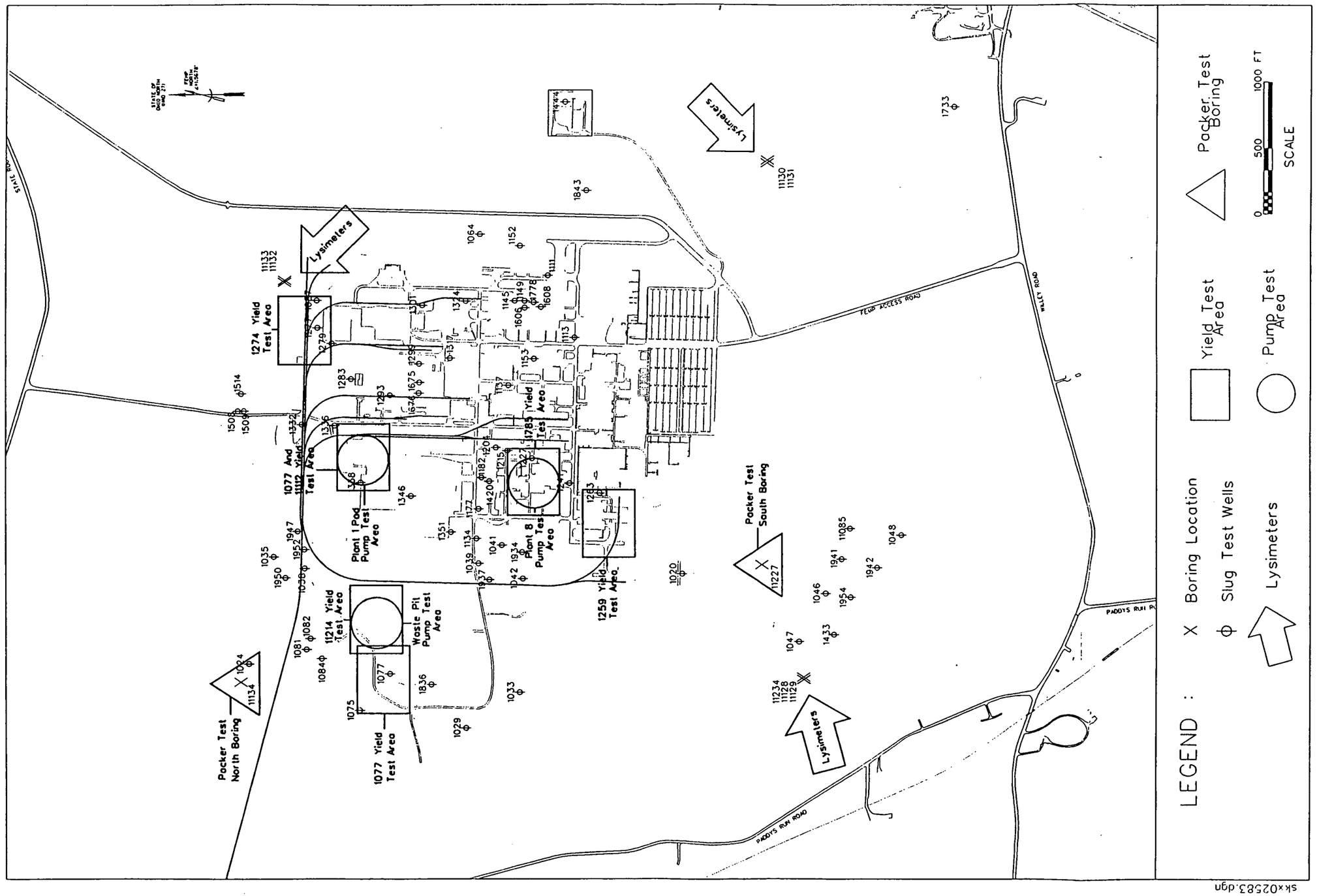

Figure 1-1 - Testing Locations

Constant Rate Pumping Tests (CRTs)

CRTs were performed at three separate locations. Drawdown trends were examined to provide insight into potential communication pathways and to determine hydraulic properties. Pumping test data and results are discussed in Section 5.

Lysimeter Installation

Three pairs of suction lysimeters were installed to obtain water samples from portions of the lower gray till and upper unsaturated GMA. Method and equipment descriptions and results are discussed in Section 6.

Geotechnical Data

Continuous split spoon samples were collected from the holes dug in support of this study and analyzed for grain size using a sieve analysis. Thirteen Shelby tube samples of gray clay were collected and tested for moisture content, bulk density, specific gravity, and coefficient of permeability. Test results from Shelby tube samples are presented and discussed in Section 7.

1.3 Management and Responsibilities

Activities described in this document were carried out jointly by FERMCO and PARSONS as defined in Subsection 1.4 of the GT/VZ Work Plan (PARSONS 1993b) and illustrated in Figure 1-2.

FERMCO CERCLA/RCRA Unit 5 (CRU-5) and Site Characterization and Data Management (SCDM) provided the procurement of all drilling, sampling, equipment installation, and testing. FERMCO SCDM was responsible for the direct daily oversight of all field activities while project oversight was the responsibility of CRU-5. PARSONS provided a technical representative in the field during all field activities. PARSONS provided the analysis and interpretation of the collected field data presented in this report.

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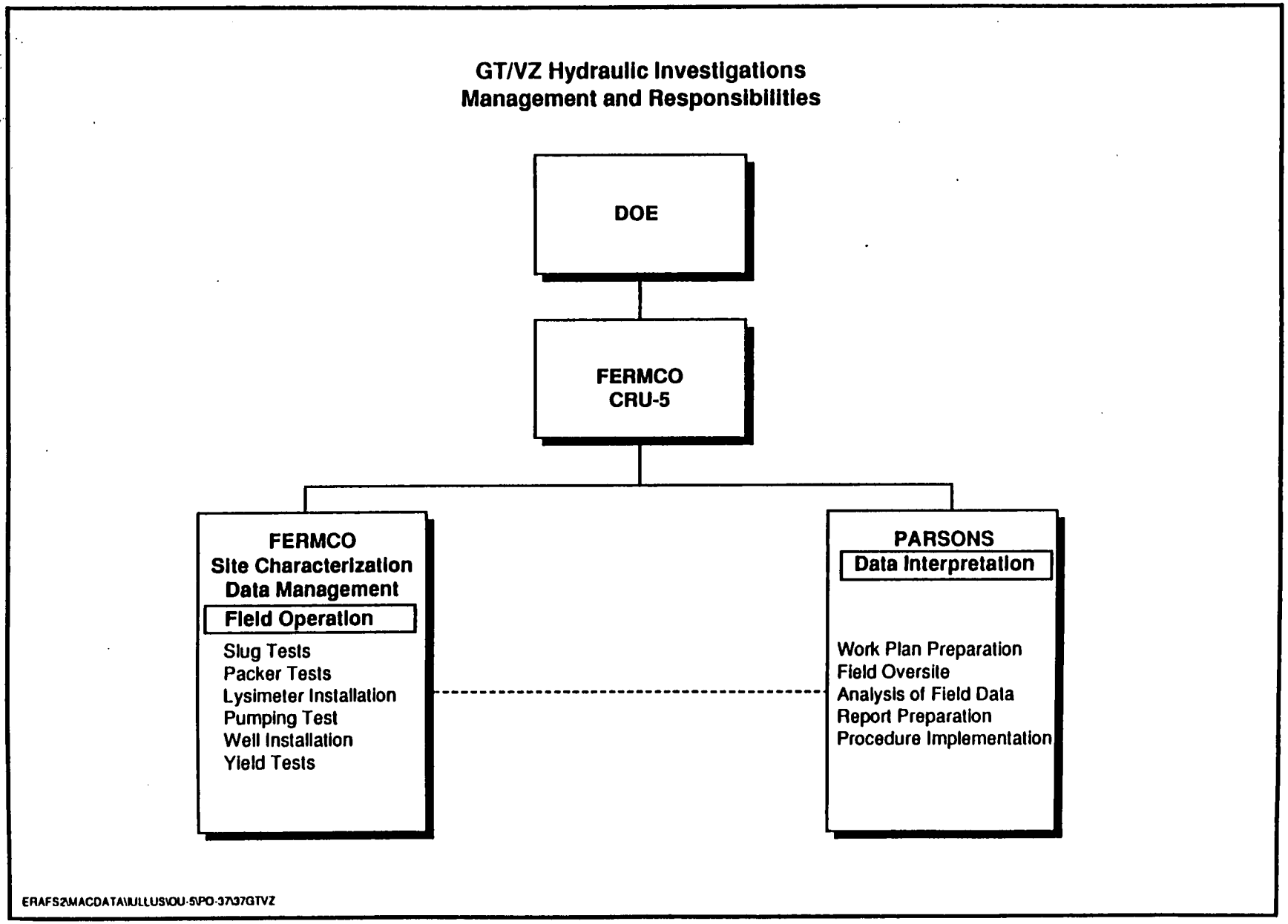


Figure 1-2 - GT/VZ Hydraulic Investigations Management and Responsibilities

SECTION 2

SLUG TESTING

Slug Testing was performed according to Section 2 of the FEMP Glacial Till/Vadose Zone Hydraulic Investigations Work Plan (GT/VZ Work Plan) (PARSONS 1993b) on 70 existing or newly constructed wells at the Fernald Environmental Management Project (FEMP). Figure 2-1 shows the locations of the tested wells. The analysis of the slug test data and the results of slug testing are presented below.

2.1 Methods

In a slug test, a small solid object or volume of water (slug) is suddenly added (Falling Head Test) or removed (Rising Head Test) from a well, after which the rate of fall or rise of the water level in the well is measured. From these measurements, the transmissivity or hydraulic conductivity of the water-bearing unit in close proximity to the well can be determined.

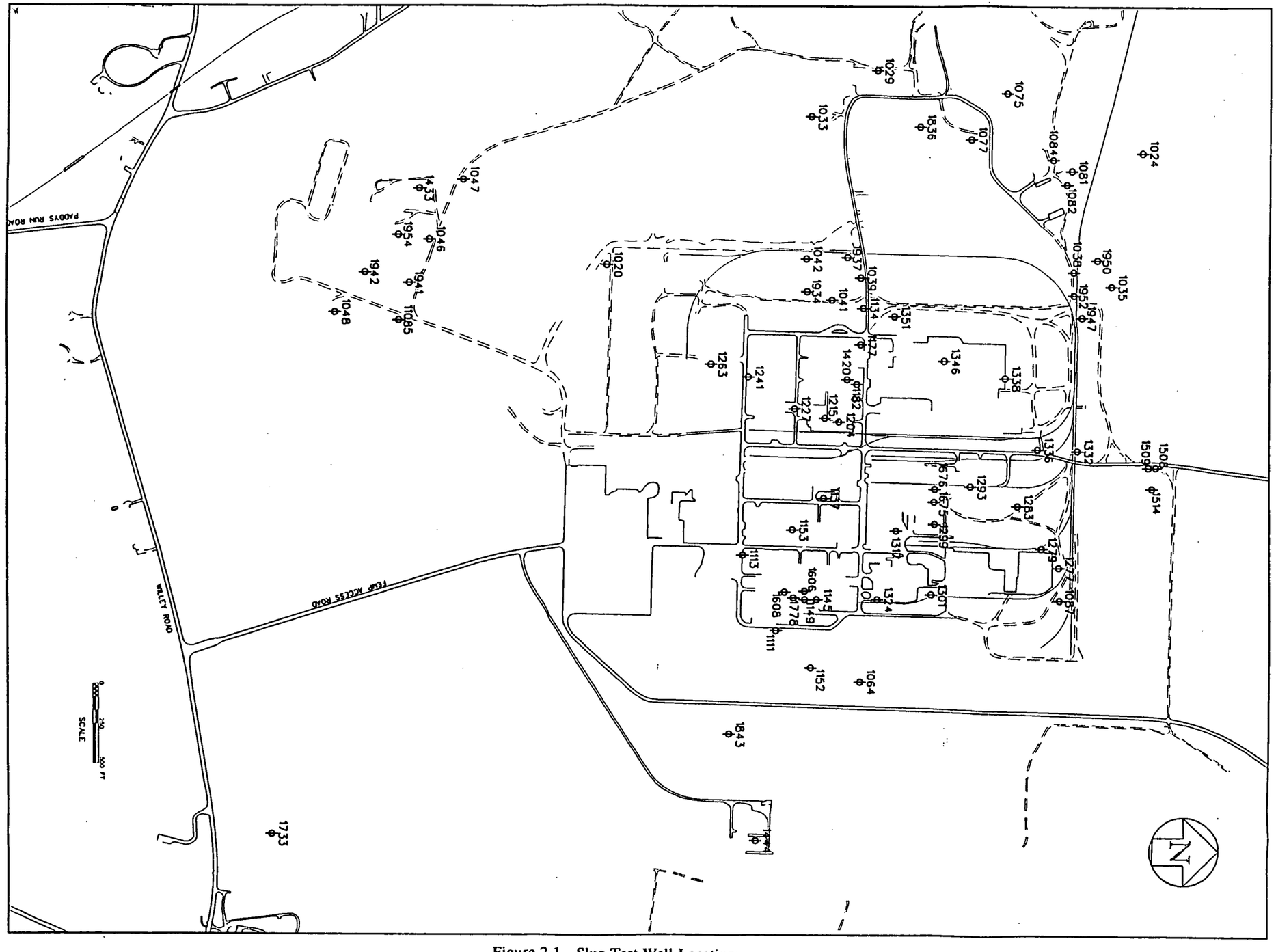
If the water level in a well is near the ground surface, the slug of water can be quickly removed with a bailer or a bucket (bail down method). Otherwise, a closed cylinder or other solid body is submerged in the well and then, after the water level has stabilized, the cylinder is pulled out (Kruseman and de Ridder 1990). A slug test determines the characteristics of a relatively small volume of material immediately surrounding the well. This volume may have been disturbed during well drilling and construction.

Each well identified for slug testing in the GT/VZ Work Plan was tested according to the following general methodology.

1) Water level and total depth of well were measured manually to determine acceptability of the well for slug testing. Wells with insufficient water for slug testing were tested using the alternate bail-down procedure. Wells without a water level (dry wells) were not tested.

2) Each well was instrumented with a pressure transducer and data logger to measure and record the water level in the well.

3) A falling head test was performed on the well by lowering a slug into the well and recording the instantaneous rise in water level followed by the gradual decline of the level to its previous static level.



Slug Test Well Locations

Figure 2-1 - Slug Test Well Locations

4) Once the water level returned to its original static level (or after the rate of level change had diminished) a rising head slug test was performed. This test was conducted by quickly retrieving the slug and recording the instantaneous drop in water level followed by a gradual recovery as the well again equalized to its previous static level.

The rate at which the original static water level is established following slug insertion/retrieval is a function of the hydraulic conductivity of the material near the well screen. Data obtained from slug testing was analyzed as described in Subsection 2.3.

Slug testing was not performed on nine of the wells listed by the work plan. Table 2-1 lists the wells along with the reasons why testing was not performed.

Table 2-1 - Wells That Were Not Slug Tested

Well	Reason Well not Slug Tested
1019	Well plugged and abandoned
1045	Insufficient water level
1072	Insufficient water level
1155	Insufficient water level
1220	Insufficient water level
1304	Well plugged and abandoned
1728	Insufficient water level
1754	Insufficient water level
1785	Constant rate pump test performed

2.2 Equipment

Slugs were constructed from varying lengths of 1- and 2-inch nominal polyvinyl chloride (PVC) pipe. The lengths of pipe were filled with gravel and sealed at both ends. The 4-inch-diameter monitoring wells were tested with 2-inch slugs, while the 2-inch-diameter wells were tested with 1-inch slugs. The slugs were lowered into and removed from the wells with a nylon cord.

Manual water level readings were taken with SOLINST electronic water measuring tapes.

Electronic water level measurements were taken and recorded with In Situ Hermit 2000 or 1000 series data loggers with pressure transducers.

2.3 Analysis

The methods of Bouwer and Rice (1976) and Cooper et al. (1967) were used to calculate hydraulic conductivity from the slug test data. These two methods of analysis were performed using AQTESOLV (Aquifer Test Solver) software, Version 1.1 (Duffield and Rumbaugh 1991). These methods are described below.

Bouwer and Rice

The Bouwer-Rice method calculates the hydraulic conductivity around a partially or fully penetrating well in an unconfined aquifer by measuring the rise of water level in the well, initially at equilibrium conditions, after a volume is quickly removed. The calculation is based on the Thiem equation of steady-state flow to a well. Using an electrical analog model, Bouwer and Rice developed a set of curves that relate the effective radius of a well to other known well dimensions and allows solution of the Thiem equation (Bouwer and Rice 1976).

The Bouwer-Rice method was originally developed for rising levels in an unconfined aquifer, however, the conductivity calculated by the Bouwer-Rice method for a confined aquifer should be of the same order of magnitude as that calculated with the procedure in Cooper et al. (1967) if the top of the screen is some distance below the upper confining layer (Bouwer 1989).

The Bouwer-Rice method also can be used for falling water levels (after the quick injection of water or solid volume) if the initial equilibrium water level is above the screened section of the well. However, if the equilibrium water level in the well is below the top of the screened section, then the subsequent flow of water into the aquifer not only takes place through the screen below the original water level but also through the vadose zone above the original water table. This leads to an over estimation of conductivity (Bouwer 1989).

For the rising head situation where the equilibrium water level in the well is within the screened interval, the effective screen length is only that which is below the static water table. Additionally, the thickness and porosity of the filter pack must be considered when calculating the equivalent value of the casing radius.

Cooper et al.

Cooper et al. (1967) presents a method that uses a family of type curves and a graphical solution technique to determine the transmissivity of a homogeneous isotropic confined aquifer in which a fully

penetrating well undergoes an instantaneous change in water level (slug test). Cooper et al. (1967) presents a solution for a well of finite diameter that is applicable for all times following the water level change.

This method has applicability to partially penetrating wells. Since the vertical permeability of most stratified aquifers is only a fraction of the horizontal permeability, the induced flow in the small radius of the cone that develops around the well during the short duration of the slug test is essentially two dimensional. The determined value of transmissivity approximates the transmissivity of that part of the water-bearing unit in which the well is screened.

2.3.1 Approach and Assumptions

The following assumptions were used during the slug test analysis.

1) General Assumptions
   (1) Preference was given to rising head data over falling head data.
   (2) Effective porosity of the sand pack surrounding the well screen is 0.3.
   (3) If the static water level is within the screened interval of the well, then the effective radius of the well includes the porosity of the surrounding sand pack.
   (4) If the static water level was within the screened interval of the well, falling head slug tests will overestimate hydraulic conductivity and are not used for parameter estimation.

2) Confined Conditions (Figure 2-2)
   (1) Effective screen length (L) is equal to the length of sand pack surrounding the well screen that is within the aquifer.
   (2) Height of static water (H) in the well is the distance from the bottom of the effective screen length (L) to static water level.
   (3) Groundwater is apparently confined beneath a layer of lower permeability. The static water level is higher then the top of the confined material.
   (4) Initial drawdown is that shown by the data logger as the earliest steadily changing level after the initial transient fluctuations (injection of the slug).

3) Unconfined Conditions (Figure 2-2)
   (1) Effective screen length (L) is equal to the length of sand pack surrounding the well screen that is below the static water level.
   (2) Height of static water (H) in the well is the distance from the bottom of effective screen length to static water level.
   (3) Vertical conductivity in the till is a fraction of horizontal conductivity such that flow to the well is essentially horizontal and the effective saturated thickness is equal to the distance from the bottom of the effective screened interval to static water level.

2.3.2 Analysis Methodology

The following steps were performed during the slug test analysis:

1) A schematic showing well construction and surrounding lithology was drawn using boring logs and the well construction logs. These well schematics are located in Appendix A.1.

2) Each well was categorized as confined or unconfined based on the relationship between the well screen, static water level, and lithology. Well parameters for confined and unconfined conditions were assigned as shown in Figure 2-2. The effective saturated thickness (D) and effective screen length (L) differ for confined and unconfined conditions. A list of input values for the tested wells is located in Appendices A2 and A3.

3) An AQTESOLV input file was prepared from the down-loaded data logger output file and the selected well parameters. Water level data is referenced to the initial static water level. For falling head tests the absolute value of the change in level is used.

4) If the static water level in the well was within the screened interval, an effective well radius (r_{eff}) was calculated for the well that considers the thickness and effective porosity of the filter pack. An equivalent value for casing radius was then calculated using the following equation (Dawson and Istok 1991):

$$r_{eff} = \sqrt{r_w^2(n) + r_c^2(1-n)}$$

where:

r_c = radius of well casing
r_w = radius of well (includes filter pack)
n = effective porosity of filter pack
r_{eff} = effective well radius

5) For wells with confined conditions, Cooper et al. (1967) was the primary method of analysis. These wells were also analyzed by Bouwer and Rice for comparative purposes. For unconfined conditions, Bouwer and Rice was the primary method of analysis.

6) Dominant sediment types (clay, silt, sand, or gravel) and color (brown or gray) was noted from the boring logs and a depositional category was assigned.

7) An estimate of hydraulic conductivity was determined by evaluating the results of each analysis for the well of concern; noting the goodness of fit of the data and the applicability of each method of analysis. Figure 2-3 shows the decision tree used to determine the type of test and analysis method used. Appendices A.2 and A.3 contain tables of all results by various analysis methods.

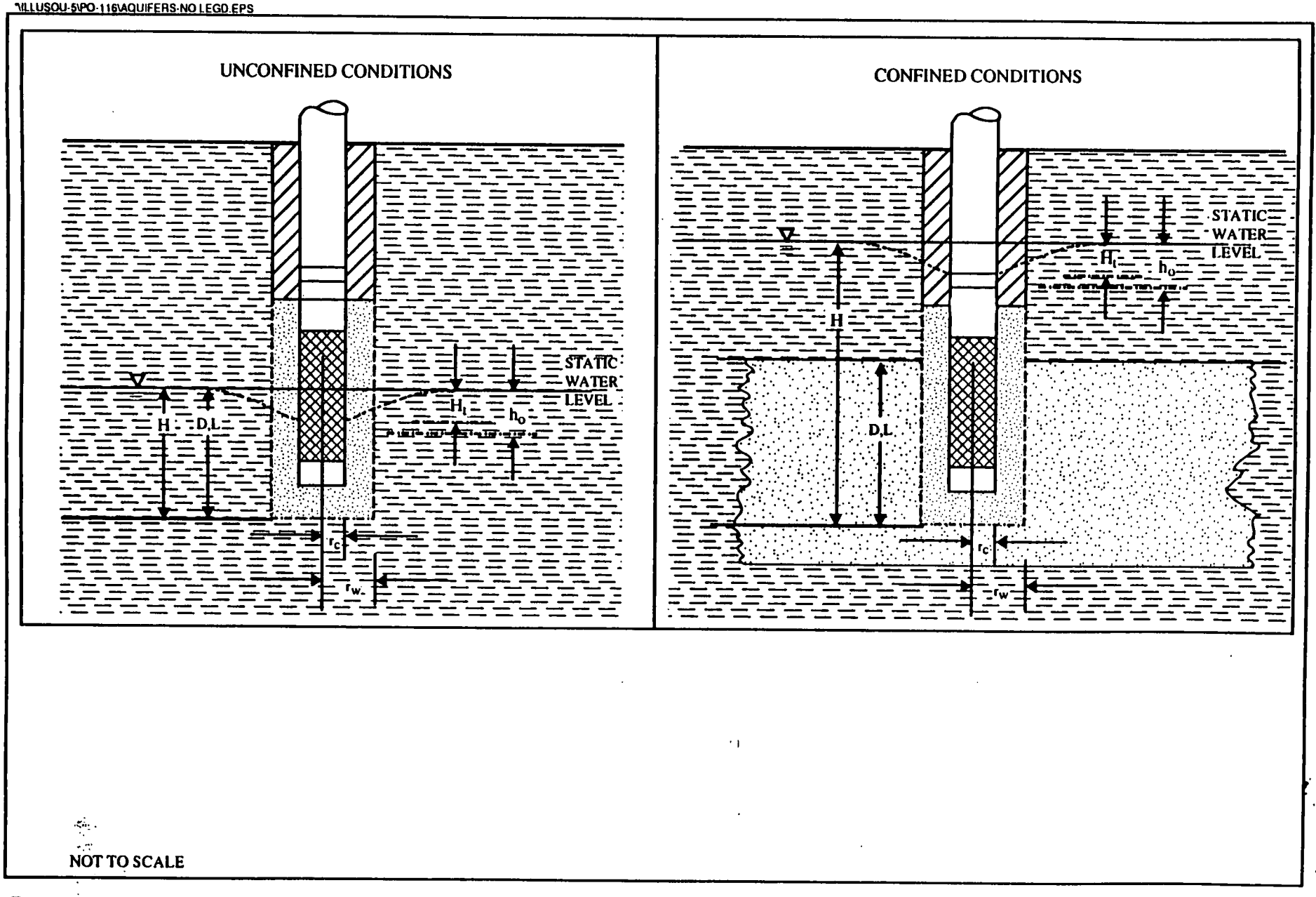


Figure 2-2 - Confined/Unconfined Conditions

2.4 Results

The results of the data analysis for the tested wells are shown in Table 2-2 and summarized in Table 2-3. The lithology of the tested wells varied greatly with location. Table 2-3 provides the high, low, and "average" of the calculated hydraulic conductivities for each general sediment type where the average conductivity is described by the geometric mean of the calculated values for that specific sediment type (Domenico and Schwartz 1990). Figure 2-4 presents this information graphically.

In general, slug test results are considered to be more accurate when conducted in less permeable sediments than in more permeable sediments. Highly permeable sediments produced a relatively quick response to the instantaneous change in level caused by the slug test. In several of the gravel or sand and gravel wells tested (Table 2-2), the response was so quick that it was partially obscured by the initial response caused by the slug being inserted into the well. For several of the tests performed in the tighter clay material (Table 2-2), the response was extremely slow taking several days to a week to equilibrate.

In wells installed in clay, the permeability of the sand pack was significantly greater then the surrounding material, a "double straight line" effect (Bouwer 1989) can be seen on the semi-log drawdown versus time plot. This effect is more or less pronounced depending on the difference between the permeabilities of the two materials.

Basic Analysis Tree Decision Method

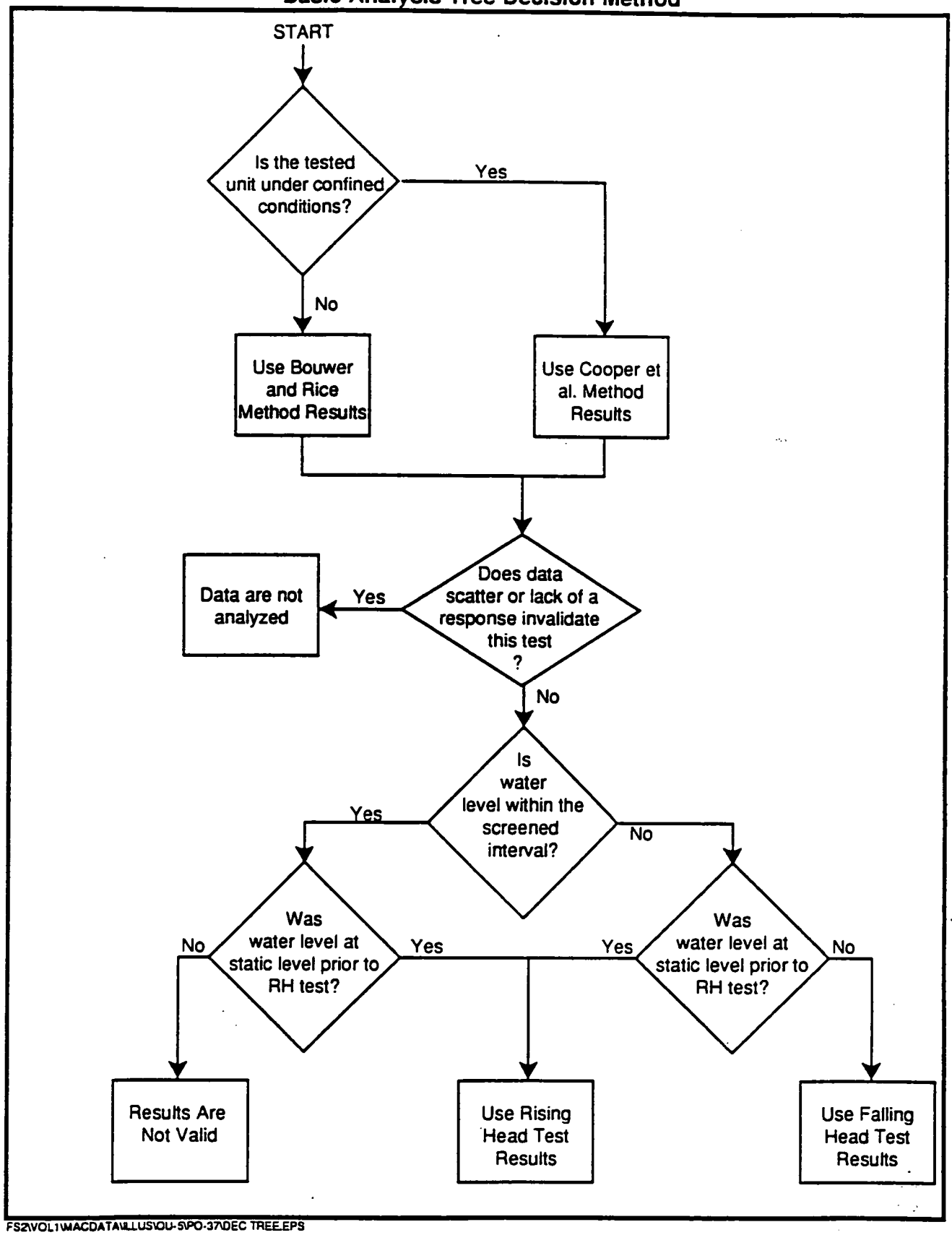


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Figure 2-3 - Method and Analysis Decision Tree

Table 2-2 - Summary of Slug Test Results by Material Type

Well Number	Material Type	Material Color	Dominant Material Description	Aquifer Type U = Unconfined C = Confined	Water Level within Effective Screened Interval YES or NO	Result by Optimal Method of Analysis K (ft/day)	Result by Optimal Metod of Analysis K (cm/sec) *	Optimal Method B = Bouwer - Rice C = Cooper et al FH = Falling Head RH = Rising Head	Comments	Geometric Mean of Conductivity for Mat'l Type (cm/sec)
1299	Clay	Grey	Grey clay trace sand and gravel	U	NO	1.25E-03	4.40E-07	B-FH	E	
1301	Clay	Grey	Grey silty gravelly clay	U	NO	2.22E-03	7.84E-07	B-FH	E	
1064	Clay	Grey	Silty grey gravelly clay some silt	U	NO	4.32E-03	1.52E-06	B-RH	C,E,A	
1317	Clay	Grey	Dark grey clay little gravel and sand	U	NO	6.76E-03	2.38E-06	B-RH		
1843	Clay	Grey	Grey silty clay with sand and gravel	U	NO	7.44E-03	2.62E-06	B-RH		
1047	Clay	Grey	Grey sandy clay some silt and gravel	U	YES	7.56E-03	2.67E-06	B-RH	C	
1084	Clay	Grey	Olive grey clay some gravel and sand trace silt	U	YES	1.68E-02	5.92E-06	B-RH	C,E,A	
1606	Clay	Grey	Grey to yellow brown silty clay	U	YES	2.11E-02	7.44E-06	B-RH	E	
1113	Clay	Grey	Brownish grey clay some sand	U	YES	4.11E-02	1.45E-05	B-FH	D,A	
1029	Clay	Grey	Olive grey gravelly clay	U	YES	1.38E-01	4.88E-05	B-FH	E,A	
1778	Clay	Grey	Grey silty clay trace gravel	U	YES	3.20E-01	1.13E-04	B-FH	D,A	
1041	Clay	Grey	Grey clay some silt	U	YES	8.14E-01	2.87E-04	B-FH	E,A	
1324	Clay	Grey	Dark grey clay little gravel trace sand	U	NO	6.28E+00	2.22E-03	B-RH	A	1.87E-06
1444	Clay	Brown	Light olive brown silty clay trace gravel	U	NO	2.70E-03	9.51E-07	B-RH	E	
1137	Clay	Brown	Brownish yellow clay	U	NO	6.47E-03	2.28E-06	B-FH	C,E,A	
1075	Clay	Brown	Olive brown clay some silt some gravel	U	NO	9.57E-03	3.38E-06	B-RH	C	
1145	Clay	Brown	Brownish yellow clay	U	NO	3.50E-02	1.24E-05	B-FH	E	
1082	Clay	Brown	Yellowish brown clay some silt trace gravel and sand	U	NO	3.85E-02	1.36E-05	B-FH	E	
1509	Clay	Brown	Light olive brown silty clay	U	YES	4.49E-02	1.58E-05	B-FH	D,A	
1952	Clay	Brown	Yellow brown silty clay	U	YES	4.93E-02	1.74E-05	B-RH		
1514	Clay	Brown	Light olive brown silty clay	U	YES	6.54E-02	2.31E-05	B-RH		
1279	Clay	Brown	Yellowish brown silty clay some gravel	U	NO	7.30E-02	2.58E-05	B-FH	E	
1676	Clay	Brown	Greyish brown silty clay trace gravel	U	NO	7.73E-02	2.73E-05	B-FH	E	
1934	Clay	Brown	Greyish olive brown silty clay	U	NO	9.23E-02	3.26E-05	B-RH		
1081	Clay	Brown	greyish brown clay some gravel silt and sand	U	NO	1.10E-01	3.87E-05	B-FH	E	
1283	Clay	Brown	Grey to yellowish brown silty clay	U	YES	2.39E-01	8.44E-05	B-FH	D,E,A	
1947	Clay	Brown	Yellowish brown silty clay	U	YES	2.50E-01	8.83E-05	B-RH		
1508	Clay	Brown	Light olive brown sandy clay	U	YES	2.67E-01	9.42E-05	B-RH		
1215	Clay	Brown	Olive brown silty clay	U	YES	2.75E-01	9.71E-05	B-RH		
1954	Clay	Brown	Grey silty clay with gravel	U	YES	3.27E-01	1.15E-04	B-RH		
1433	Clay	Brown	Olive brown silty clay with sand and gravel	U	YES	6.11E-01	2.15E-04	B-RH		
1020	Clay	Brown	Olive brown silty clay	U	NO	6.93E-01	2.44E-04	B-RH		
1152	Clay	Brown	Yellowish brown silty clay	U	YES	8.26E-01	2.91E-04	B-RH		3.59E-05
1950	Silt	Grey	Grey silt and sand	C	NO	3.23E-02	1.14E-05	C-FH		
1733	Silt	Grey	Grey clayey silt with some gravel	C	NO	4.52E-01	1.60E-04	C-FH	E	
1149	Silt	Grey	Yellowish brown clayey silt and sand	C	YES	1.07E+00	3.78E-04	C-RH		
1608	Silt	Grey	Grey clayey silt trace gravel	C	YES	4.86E+00	1.72E-03	B-RH	A	8.83E-05
1087	Silt	Brown	Brown silt trace gravel	U	YES	1.30E-03	4.58E-07	B-FH	E,A	
1836	Silt	Brown	Light olive brown clayey silt with intermitent sand lenses	U	YES	4.97E-02	1.75E-05	B-RH		
1942	Silt	Brown	Olive yellow silt and sand	C	YES	1.08E-01	3.81E-05	C-RH		

Table 2-2 - Summary of Slug Test Results by Material Type (Continued)

Well Number	Material Type	Material Color	Dominant Material Description	Aquifer Type U = Unconfined C = Confined	Water Level within Effective Screened Interval YES or NO	Result by Optimal Method of Analysis K (ft/day)	Result by Optimal Metod of Analysis K (cm/sec)	Optimal Method B = Bouwer - Rice C = Cooper et al FH = Falling Head RH = Rising Head	Comments	Geometric Mean of Conductivity for Mat'l Type (cm/sec)
1153	Silt	Brown	Interbedded brown clay sand and silt	C	YES	4.85E-01	1.71E-04	C-RH		
1263	Silt	Brown	Olive brown clayey silt trace sand	U	YES	5.41E-01	1.91E-04	B-RH		
1204	Silt	Brown	Olive brown clayey silt	C	NO	5.50E-01	1.94E-04	C-RH		
1346	Silt	Brown	Light brown silt and sand	C	NO	6.23E-01	2.20E-04	C-RH		9.88E-05
1038	Sand	Grey	Grey sand some silt trace gravel	C	NO	3.41E-01	1.20E-04	C-RH		
1035	Sand	Grey	Grey well graded sand-gravel mixture	C	NO	6.60E-01	2.33E-04	C-FH	E	
1937	Sand	Grey	Light olive grey silty fine sand	C	NO	8.59E-01	3.03E-04	C-FH	E	
1046	Sand	Grey	Grey silt clay and sand	C	YES	1.66E+00	5.85E-04	C-RH		
1033	Sand	Grey	Grey silty sand	C	YES	2.00E+00	7.06E-04	C-RH		
1048	Sand	Grey	Yellowish brown silt sand and gravel	C	YES	2.33E+00	8.22E-04	C-RH		
1042	Sand	Grey	Grey silty sand	C	NO	8.02E+00	2.83E-03	C-RH		
1332	Sand	Grey	Olive grey silt and sand	C	NO	1.02E+01	3.61E-03	C-RH		
1039	Sand	Grey	Grey well graded gravelly sand	C	NO	1.35E+01	4.76E-03	C-FH	B	8.04E-04
1293	Sand	Brown	Yellowish brown clayey sand some gravel	C	NO	1.64E-01	5.80E-05	C-RH		
1134	Sand	Brown	Brownish yellow fine sand	C	NO	2.46E-01	8.67E-05	C-RH		
1277	Sand	Brown	Yellow brown sand trace gravel and clay	U	YES	2.98E-01	1.05E-04	B-FH	E,A	
1241	Sand	Brown	Brownish yellow silty sand	C	NO	4.36E-01	1.54E-04	C-FH	D	
1941	Sand	Brown	Olive brown clayey sand	U	YES	1.02E+00	3.62E-04	B-RH		
1338	Sand	Brown	Brown pooly graded sand trace gravel	C	YES	3.61E+00	1.27E-03	C-RH		
11085	Sand	Brown	Light olive brown well graded sand some silt	C	YES	4.12E+00	1.45E-03	C-RH		
1420	Sand	Brown	Olive brown silty sand	C	NO	3.02E+01	1.06E-02	C-RH		
1351	Sand	Brown	Brown sand-silt mixture	C	NO	3.22E+01	1.14E-02	C-RH		
1177	Sand	Brown	Brown sand trace gravel	C	YES	4.19E+01	1.48E-02	C-RH		
1227	Sand	Brown	Brownish yellow silty sand	C	YES	5.98E+01	2.11E-02	C-RH		
1336	Sand	Brown	Brown well graded sand trace gravel	C	YES	6.72E+01	2.37E-02	C-RH		1.75E-03
1024	Gravel	Grey	Olive grey fine to coarse sand and gravel	C	NO	2.76E+00	9.73E-04	C-RH		
1077	Gravel	Grey	Grey well graded gravel with sand	C	NO	4.72E+01	1.67E-02	C-FH	E	4.03E-03
1675	Gravel	Brown	Yellow brown clayey gravel	C	YES	4.56E+01	1.61E-02	C-RH	E,C	
1182	Gravel	Brown	Light olive brown clayey gravel	C	NO	6.68E+01	2.36E-02	C-RH		
1111	Gravel	Brown	Brown clayey gravel some sand	C	YES	2.16E+02	7.62E-02	C-RH		3.07E-02

NOTES:
A - RESULTS NOT VALID, NOT INCLUDED IN HIGH, LOW, OR GEOMETRIC MEAN
B - TWO FALLING HEAD TESTS AVERAGED
C - FALLING HEAD DATA NOT VALID OR UNABLE TO ANALYZE
D - RISING HEAD DATA NOT VALID OR UNABLE TO ANALYZE
E - WATER LEVEL NOT EQUALIZED PRIOR TO START OF RISING HEAD TEST

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Table 2-3 - Summary of Results by Material Type

Material	Number of Wells Tested	Low Conductivity Value (cm/s)	High Conductivity Value (cm/s)	Geometric Mean (cm/s)
Gray Clay	6	4.4×10^{-7}	7.4×10^{-6}	1.87×10^{-6}
Brown Clay	17	9.5×10^{-7}	2.9×10^{-4}	3.6×10^{-5}
Gray Silt	3	1.14×10^{-5}	3.8×10^{-4}	8.8×10^{-5}
Brown Silt	6	1.7×10^{-5}	2.2×10^{-4}	9.9×10^{-5}
Gray Sand	9	1.2×10^{-4}	4.8×10^{-3}	8.0×10^{-4}
Brown Sand	11	5.8×10^{-5}	2.4×10^{-2}	1.7×10^{-5}
Gray Gravel	2	9.7×10^{-4}	1.7×10^{-2}	4.3×10^{-3}
Brown Gravel	3	1.6×10^{-2}	7.6×10^{-2}	3.1×10^{-2}

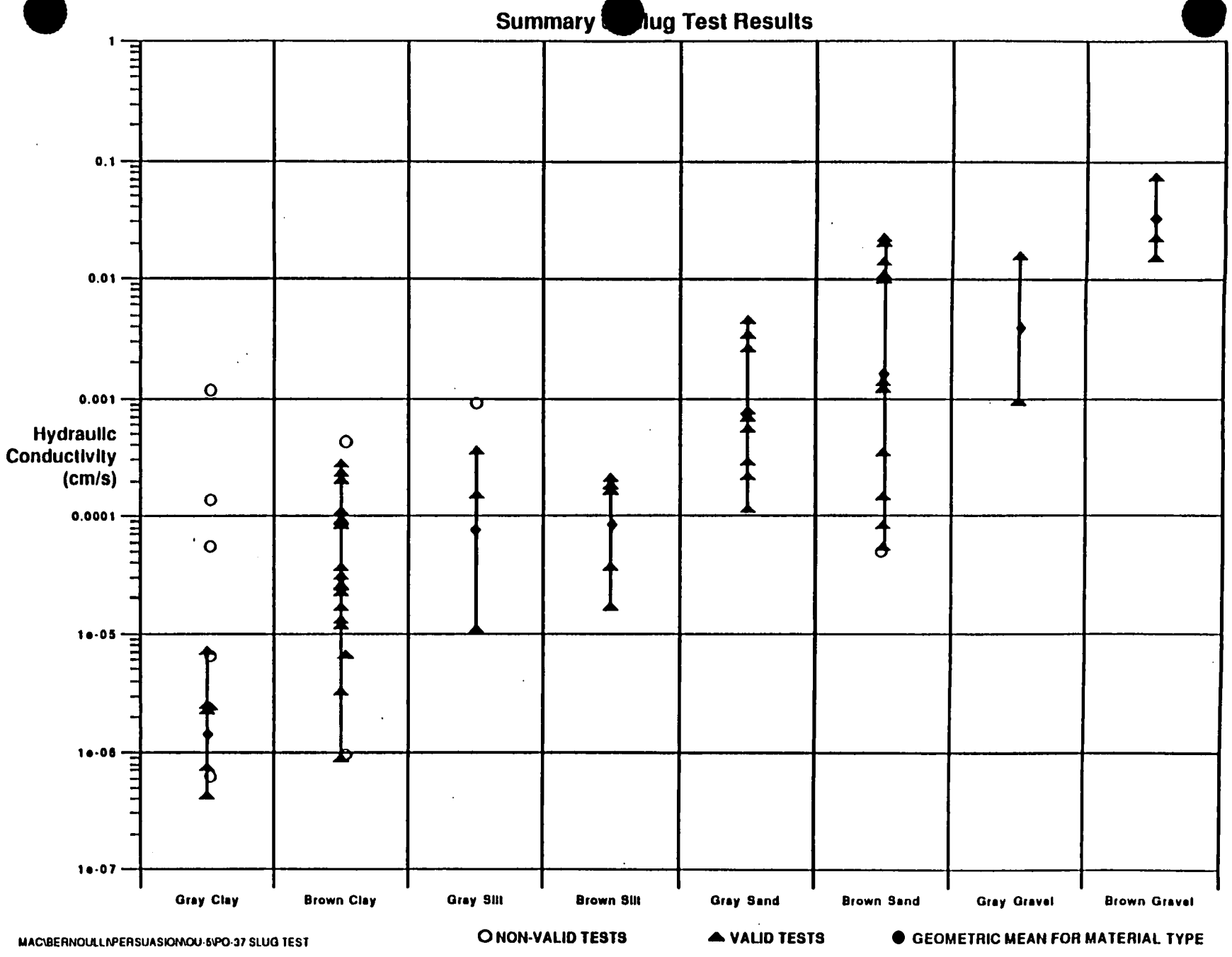

Figure 2-4 - Summary of Slug Test Results by Material Type

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SECTION 3

PACKER TESTS

Section 5 of the GT/VZ Work Plan (PARSONS 1993b) directed that packer tests be performed in two borings and in each of three pumping wells. The purpose of these packer tests was to collect data at different depths from one location which would provide a vertical profile of hydraulic conductivity of the gray clay. The locations of the two borings are shown in Figure 3-1 and are designated N (north) and S (south). Packer tests were to be performed on each distinct 5 foot interval of cohesive (clay) material in the borings, thus providing a vertical profile. Actual field conditions, though, did not allow for the vertical profiling and limited the number of tests conducted to one location.

3.1 Methods

Descriptions of methods used for packer testing are divided into the methods used for borehole advancement, geophysical sampling, and borehole abandonment (Subsection 3.1.1) and the methods used to conduct the actual packer testing (Subsection 3.1.2).

3.1.1 Borehole Advancement and Abandonment

Each boring was advanced by a Mobile Drill, B-80 hollow stem auger drilling rig using a 6-inch ID steel spin casing technique. Split spoon samples were collected continuously from the ground surface to the total depth of the borehole. To obtain undisturbed formation samples, the split spoon samplers were advanced ahead of the base of the spin casing.

Shelby tubes were collected within the lower clay unit of the clay till. To facilitate the collection of the Shelby tubes, an offset borehole was advanced and the tube was pushed into the desired horizon identified by split spoon samples from the initial borehole. Each Shelby tube was submitted to the laboratory for analysis for the following geotechnical parameters:

1) Grain size analysis with hydrometer
2) Moisture content
3) Soil density
4) Atterberg limits
5) Constant Head Permeability Tests (triaxial cell with back pressure)
6) Specific gravity
7) USCS classification

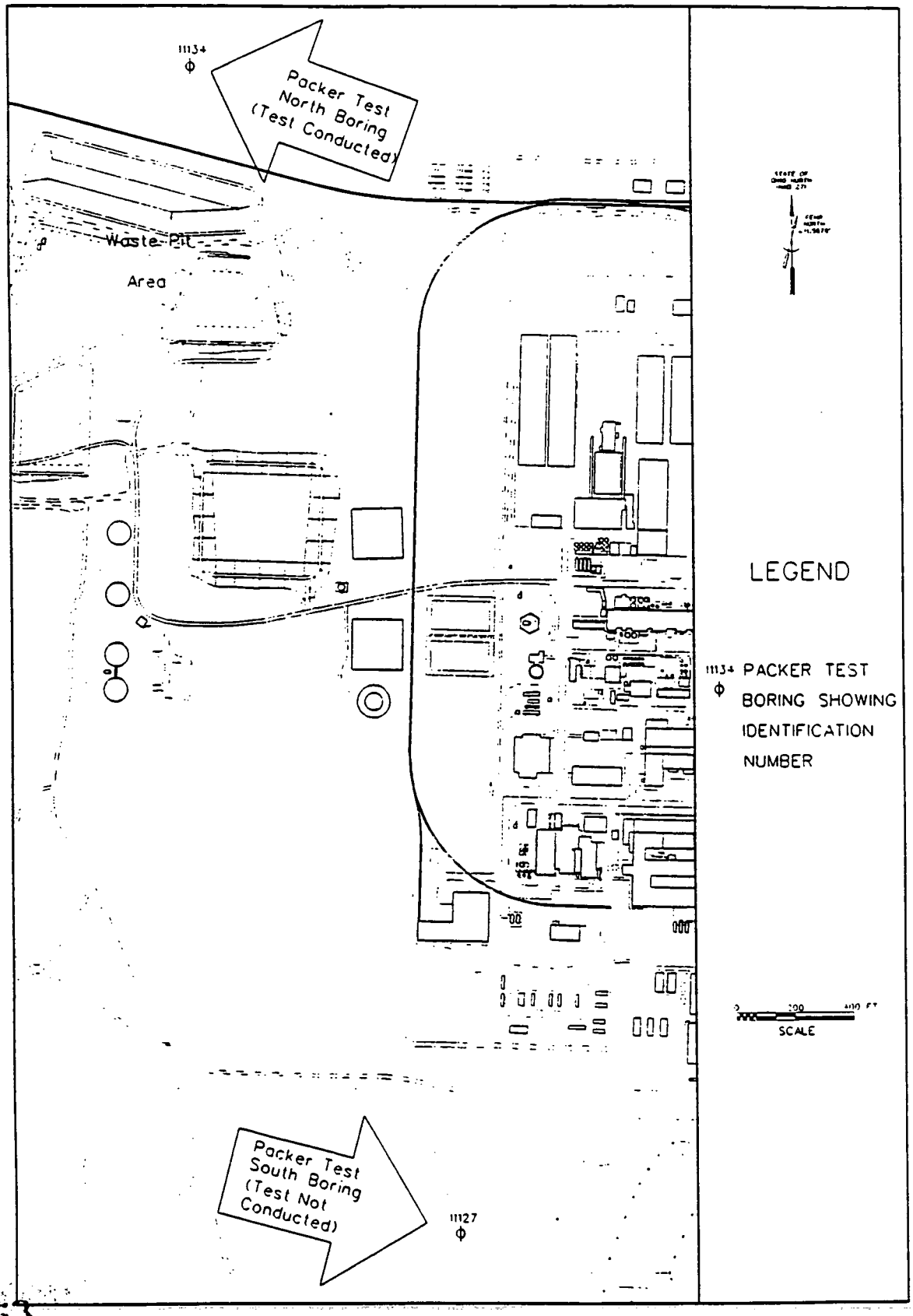

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Figure 3-1 - Packer Test Locations

Potable water from the FEMP was used to facilitate circulation of the drilling cuttings to the surface and to lubricate the spin casing. The water was pumped from a truck-mounted holding tank into the borehole through a hose and swivel attached to the drill rig top, head drive. A conductor casing was installed into the surface of the borehole to contain the water circulated back from the borehole conductor casing through a discharge pipe into a steel tub. The water was then recirculated back to the truck-mounted holding tank. By containing the water in a closed loop in this manner, the total volume of water introduced to the boring was minimized.

When an appropriate 5-foot-length zone in the boring was identified by sampling, the spin casing was pulled back a sufficient length to facilitate the installation of the packer against the borehole walls and to provide for the 5-foot open hole below the packer base.

The work plan specified that the borehole walls be brushed prior to testing, however, examination of the split spoon samples indicated the presence of soft moist zones within the clay horizons that were to be packer tested. To minimize the potential of smearing the walls and sealing any fractures, the bore hole walls were not brushed prior to installation of the packer.

After the completion of packer testing, each borehole was abandoned by pumping a volclay grout slurry to within 1.5 feet of the ground surface. The remaining 1.5 feet were then capped with a cement seal.

3.1.2 Packer Test Methods

The work plan specified two types of packer tests and data analysis techniques which could be used to obtain values for hydraulic conductivity. The Constant Head Pump-In Test was the primary method of analysis while the Pressure Pulse Test was to be utilized if permeability of the till proved to be insufficient for analysis by constant head testing. The Constant Head Pump Test is described below. The Pressure Pulse Test was not utilized.

Constant Head Pump-In Test

The Constant Head Pump-In test procedures are described in USBR 7310 (1990). The analysis of the data produced from these procedures is based on the Theim (1906) steady state (or equilibrium) pumping test analytical method. The method presumes the following assumptions:

1) The tested interval is homogeneous, isotropic, and of uniform thickness.

2) The test interval fully penetrates the tested interval and receives or delivers water from the entire thickness of the interval.

3) Discharge or inflow is constant and has continued for sufficient duration to reach steady state or equilibrium conditions.

4) Flow to the well is horizontal, radial, and laminar.

The constant head pump-in test consists, generally, of the following steps:

1) When an appropriate horizon is identified, a length of the boring is isolated with the pressurized packer.

2) Water is injected into the isolated horizon of the boring, below the packer, at a constant pressure.

3) The volumetric flow of water into the well is monitored for following the establishment of steady state conditions.

4) Steps 1-3 are performed at each of three successive constant pressures. Pressures are selected based on a maximum injection pressure of 0.5 pounds per square inch (psi)/foot of depth to the midpoint of the horizon being tested, and the 20 psi maximum limitation of the transducer that measured the packed off horizon.

5) Values for hydraulic conductivity are calculated from flow rate, length and radius of test interval, and effective total head.

6) Following completion of the third pressure step, the well pressure is shut-in and the decay of the shut-in pressure is monitored.

3.2 Equipment

The packer used for the tests was constructed by Pennsylvania Drilling Company staff, and consisted of a rubber inflatable gland with stainless steel end caps and a port for the transducer to pass through. A second transducer was attached to the top of the packer to monitor pressure changes that would be encountered above the packer zone or as a result of upward leakage. The packer was attached to a hollow steel rod which was used to raise and lower the packer into the borehole and to provide a conduit for water to pressurize the borehole. Pressurized nitrogen gas was used to inflate the packer. A schematic diagram of the packer assembly is presented in Figure 3-2.

An In Situ XD 20 psi, electronic pressure transducer was used to measure the water pressure in the packed horizon. A 10 psi transducer was used to monitor the zone above the top of the packer. These transducers were connected to an In Situ SE-2000, 16 channel, electronic data logger.

PACKER TEST SETUP

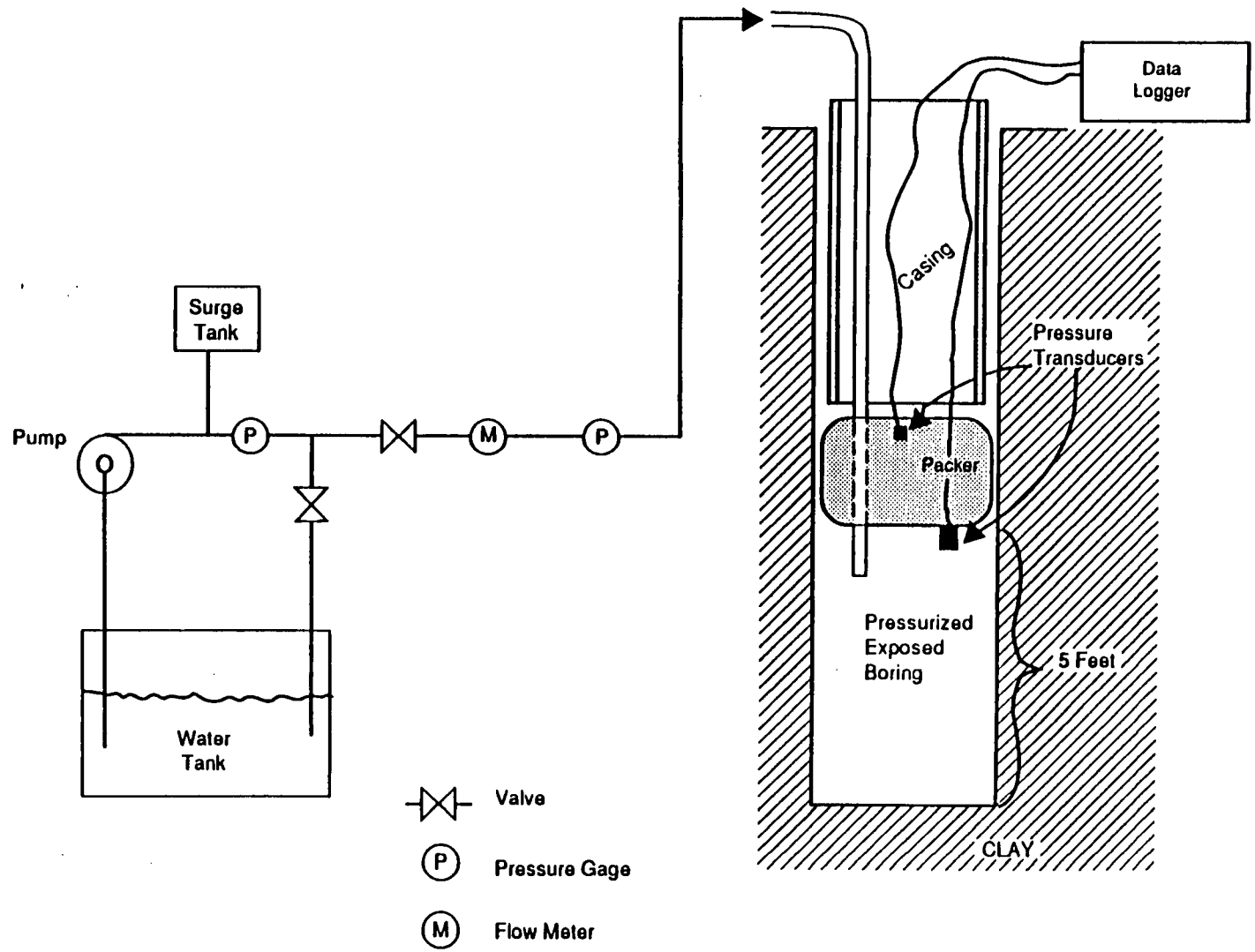

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Figure 3-2 - Packer Test Arrangement

Potable water from a FEMP source was used for pressurizing the tested horizon. This water was stored in a truck-mounted tank and pumped via a Moyno positive displacement pump which was powered by the drilling rig. Water flowed from the Moyno pump to a surge tank and through the upline pressure gage. A valve and tee was mounted down line from the pressure gauge. The valve and tee were used to provide a method of bleeding off excess water to the packer line while it was being pressurized. The valve was also used to shut in the down hole pressure. Down line from the valve and tee was a Rockwell 50 gpm mechanical flow meter with digital recorder and sweep hand. The second or down line pressure gauge was installed in line after the flow meter. The 1-inch ID pressure hose went directly from the pressure gauge to the swivel at the top of the packer rods.

3.3 Analysis

Hydraulic conductivity values, K, were calculated according to the following formula:

$$K = \frac{q}{2\pi LH} \ln\left(\frac{L}{r}\right)$$

Where:

q = Constant rate flow into the test interval (ft^3/yr)
L = Length of test interval (ft)
$H_t = H_g + H_p$ = Total Head
H_g = Gravity head (ft)
H_p = Applied pressure head (ft)
r = Radius of borehole (ft)
K = Hydraulic Conductivity (ft/yr)

3.4 Results

Actual field conditions did not facilitate the collection of profile data. A single horizon of boring N was suitable for testing during the packer testing phase of the GT/VZ Investigation. The Constant Head Pump-In Test methods and data analysis methods were used to calculate values for hydraulic conductivity for this horizon.

Down to a depth of 17 feet BGS there were no suitable sections of cohesive material identified due to repeated failures in recovery to a depth of 11.5 feet and the presence of thin fine grain sand lenses from 11.5 feet to 17 feet. A 5-foot section of cohesive materials was identified from 17 to 22 feet, and a series of packer tests were conducted over the interval. The borehole was advanced to a depth of 34 feet and no additional suitable cohesive horizons of a minimum thickness of 5 feet were encountered. The borehole was terminated at a depth of 34 feet.

The horizon that was successfully tested between 17 and 22 feet at boring N-1, is described as soft to stiff dark gray silty clay with traces of sand and gravel, and medium plasticity. While traces of sand and gravel were noted to be present within the cohesive material matrix, no discrete lenses of granular materials suggestive of zones of elevated hydraulic conductivity were present within the tested horizon.

Packer testing on this horizon was conducted for three total pressures (12, 15, and 18 psi). The packer was successively inflated at 40, 60, and 80 psi for each of three initial attempts to test the interval. These three attempts failed when the packer inflation pressures were insufficient to seal it against the borehole wall and the injected water broke through. The packer was subsequently inflated to 100 psi which effectively sealed the packer against the borehole wall. A pressure of 100 psi is the maximum pressure recommended by the driller for inflation in an unconsolidated matrix.

During step 1, approximately 0.2 gallons of water were injected into the formation at a rate of 0.02 gpm (1.40×10^3 ft/yr). The flow rate in step 2 was 0.05 gpm (3.51×10^3 ft/yr) and 0.02 gpm for step 3. Since these three flow rates were relatively low, each step was run for a time period of 10 minutes to provide for a more accurate average measurement of flow per step.

Following the third step, the pressure was shut in and the holding pressure allowed to decay for 938 minutes. After approximately 660 minutes, the nitrogen in the packer leaked off sufficiently to allow the packer to deflate and break the seal with the borehole wall.

The equations for calculating values for hydraulic conductivity from the constant head pump-in test have been discussed in Subsection 3.3. Based on these calculations, the values for the parameters to determine hydraulic conductivities and the values for hydraulic conductivities are presented in Table 3-1.

The results of the packer test were relatively consistent between the three steps. The range of hydraulic conductivity values calculated from the test fall within the mid-range of values expected for silt and glacial till, (Driscoll 1986, and Freeze & Cherry 1979) which are the predominant lithologies of the material that was tested.

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Table 3-1 - Packer Test Results

Step Number	Discharge, Q		Head (total)	Hydraulic Conductivity	
	(gpm)	(ft/yr)	(feet)	(ft/day)	(cm/sec)
1	0.02	1.4×10^{-3}	27.7	1.3×10^{-2}	4.6×10^{-6}
2	0.05	3.5×10^{-3}	34.5	2.6×10^{-2}	9.3×10^{-6}
3	0.02	1.4×10^{-3}	41.6	8.8×10^{-3}	3.1×10^{-6}
Geometric Mean				1.4×10^{-2}	5.1×10^{-6}

SECTION 4

YIELD TESTS

Seven yield tests were performed in accordance with Section 6 of the GT/VZ Work Plan (PARSONS 1993b). The purpose of these tests was to determine the yield capability of various sand units so as to select locations for CRTs. In addition, the closest wells surrounding the test well were monitored for water level changes. Although response in these wells was not expected due to the low permeability and high heterogeneity of the surrounding sediments, it was felt that an attempt to detect a response was warranted No response in any of the surrounding wells was noted, however.

Yield tests were completed at the following locations (Figure 1-1):

1) North of the Old Drum Bailing Area, Well 1274
2) South of the Pilot Plant Building, Well 1259
3) Waste Pit Area, Wells 1077 and 11214
4) Plant 1 Pad Area, Wells 1339 and 11112
5) Plant 8 Area, Well 1785

4.1 Methods

The GT/VZ Work Plan called for each well to be pumped at three successively higher rates, starting at 1 gpm, for a maximum total period of 8 hours. Each step was to be of equal duration, 1 hour long if the drawdown trend stabilized, or shorter if the well began to dewater. Pumping rates for the second and subsequent steps were determined in the field, based on the observed response during the first step.

Observation wells in close proximity to the test well were instrumented with electronic data loggers and pressure transducers, while the water levels in others were measured manually.

To verify data logger measurements, early time drawdown and recovery measurements were made manually in each test well. Manual measurements were also made periodically in the instrumented observation wells. All manual water level measurements were taken relative to the top of the casing, and recorded on forms as specified by the GT/VZ Work Plan.

During the pumping phase of the tests, flow rates were measured and recorded at every minute for the first 6 minutes, at 2-minute intervals from 6 minutes to 20 minutes, and at 10 minute intervals for the duration of each step. The discharge rate was maintained within ± 5 percent by monitoring the pump control box and the flow meter.

4.2 Equipment

Figure 4-1 shows the general equipment arrangement used for the yield tests.

All wells were initially pumped with a GRUNDFOS 1.8-inch outside diameter REDIFLO-2 submersible pump. This pump was selected because of its versatility for use in either 2-inch, or 4-inch wells and its variable flow range from < 1 gpm to 5 gpm. The discharge rate from the pump was manually adjusted on the pump control box.

Flow rates were measured with either a Hersey MVR 30 or Sensus mechanical flow meter with totalizer. The flow meter was installed in line with the discharge hose from the pump. Flow rates were periodically checked by comparison with a timed discharge into a graduated container.

Multi-channel data loggers (In Situ HERMIT 1000 and 2000 series), and In Situ pressure transducers were used to measure and record water levels.

Manual water level measurements were made with SOLINST electronic water level measuring tapes.

Water from wells 1274, 1259, 1077, and 1339 was discharged to truck-mounted 500-gallon tanks. Water produced from wells 11112 and 11214 was discharged to 1,860 and 1,900-gallon truck-mounted tanks. Discharged water was subsequently transferred to the FEMP general sump. Water from Well 1785 was pumped into a 500-gallon holding tank and subsequently transferred to the FEMP water treatment facility.

4.3 Analysis

The yield test data was analyzed to determine sustainable CRT pumping rates and to provide a pumping rate for the subsequent constant rate pumping tests, that were conducted within the GT/VZ Investigation.

The pumping rate for the CRT was derived from the step test data by projection of step drawdown data for each pumping rate to 10,000 minutes. Well drawdown for each step is plotted against time on a semi-logarithmic plot, the stable drawdown portion of each step response is then extrapolated to determine a time in the future at which the pump inlet would become uncovered if the discharge rate were held constant and steady state conditions were not reached. For the GT/VZ investigation, a maximum pumping time of 7 days or 10,000 minutes was targeted. It was felt that sustained low discharge pumping for 7 days would be needed to established communication for any great distance in the overburden sediments. This is due to the low permeability and heterogeneous nature. For each step test an estimate is made, based on the slopes of the individual rate steps, of a pumping rate which would not uncover the pump inlet during the first 10,000 minutes of pumping.

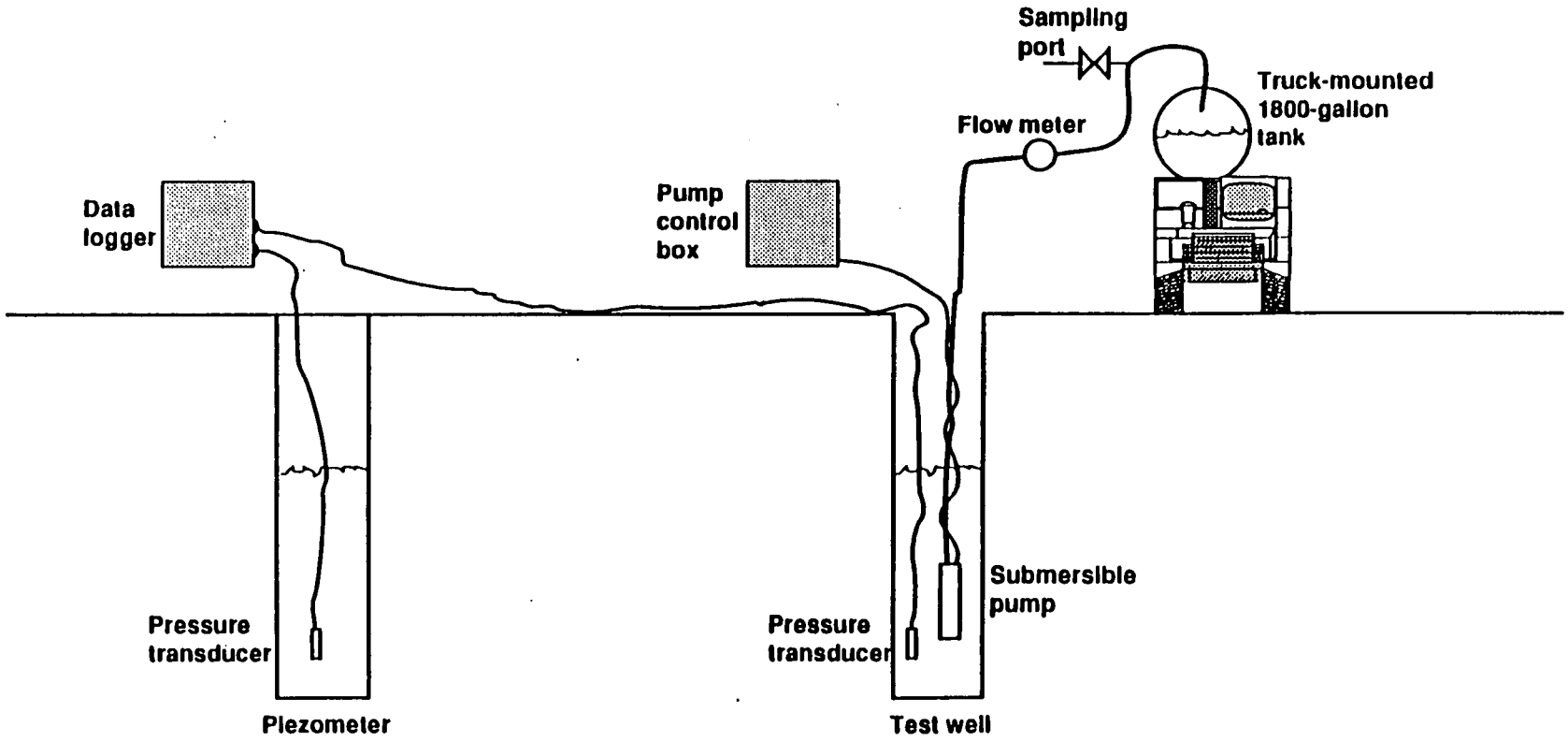

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Figure 4-1 - General Equipment Arrangement

4.4 Results

A narrative of the specific results is provided for each of the tested wells as follows:

4.4.1 South of the Pilot Plant Building (Well 1259)

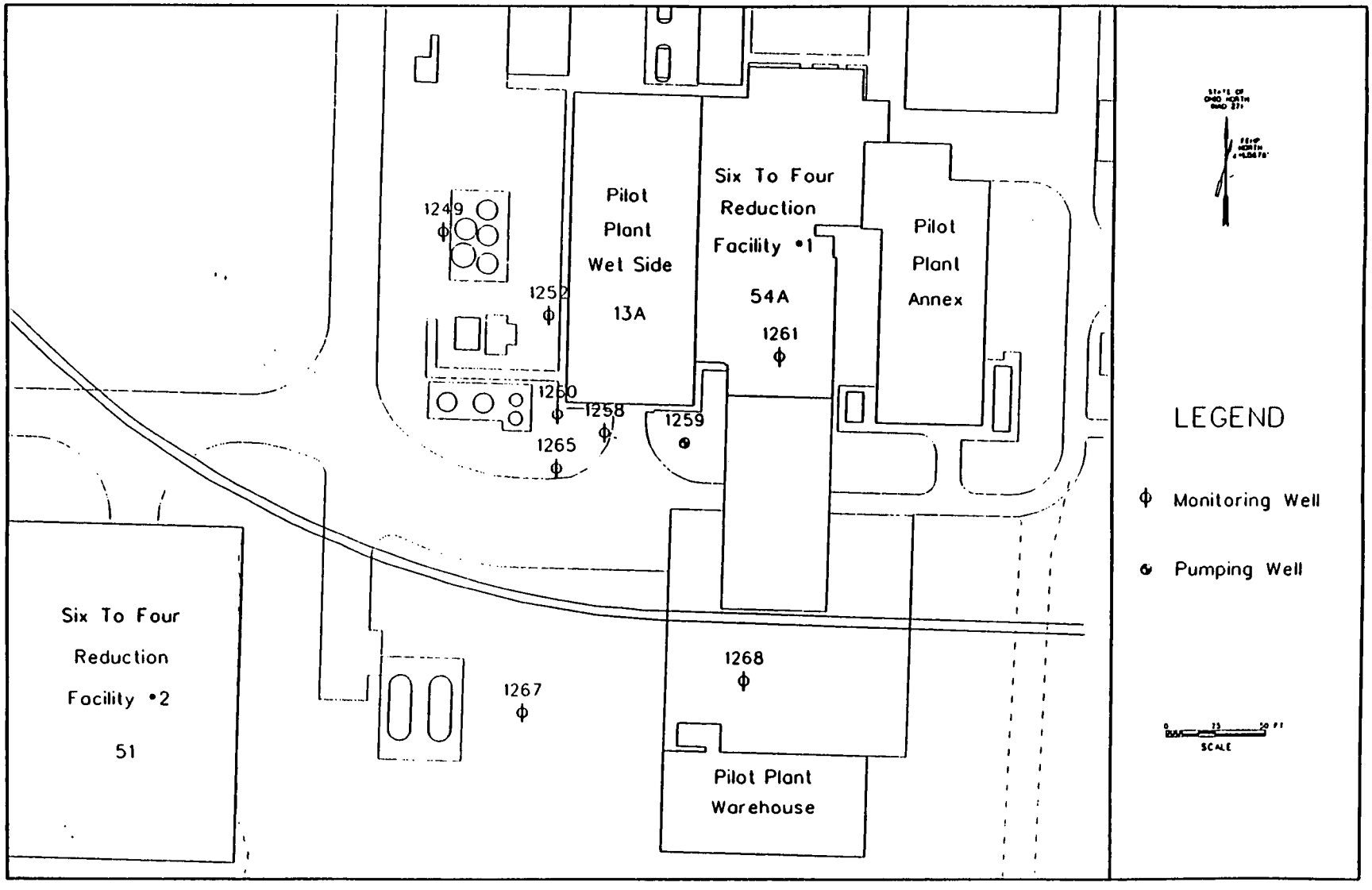
Well 1259 is located south of the Pilot Plant Building. The predominant lithology is brown silt. The observation wells used and their distances from the test well are listed in Table 4-1 and are shown in Figure 4-2.

Table 4-1 - Observation Wells, 1259 Yield Test

Well No.	Depth to Screen Bottom (Feet)	Distance from Well 1259 (Feet)
1249	7.5	160
1252	9.0	85
1258	20.2	40
1260	9.0	65
1261	20.0	65
1265	9.0	65
1267	16.5	155
1268	15.0	125

A yield test was performed on July 8, 1993 during which the well de-watered after 11 minutes of pumping at an average discharge rate of 0.65 gpm. During this short pumping period, a stable first step pumping rate of 1.0 gpm was not achieved. No drawdown was detected in any of the observation wells.

The limited yield from this well, coupled with the reported silt lithology, suggests that the hydraulic conductivities in the area are relatively low. Therefore, the sustainable pumping rate would be less than the minimum established rate of 1 gpm and additional yield or pump testing was not conducted.



MONITORING WELLS, 1259 YIELD TEST

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Figure 4-2 - 1259 Yield Test, Well Layout

4.4.2 North of the Old Drum Bailing Area (Well 1274)

Well 1274 is located in the northern part of the site, north of the old drum bailing area. The predominant lithology is gray clay with a 2.5-foot sand lense. The observation wells used and their distances from the test well are listed in Table 4-2 and shown in Figure 4-3.

Table 4-2 - Observation Wells, 1274 Yield Test

Well No.	Depth (Feet)	Distance from Well 1274 (Feet)
1088	18.0	225
1273	13.5	225
1277	9.0	106
1279	15.0	237

During a yield test performed on August 8, 1993, well 1274 de-watered after 3.5 minutes of pumping at an average rate of 0.85 gpm. It was not possible to achieve stable flow at 1.0 gpm. No drawdown was detected in any of the observation wells.

The limited yield of Well 1274 suggests that the area is not suitable for a CRT.

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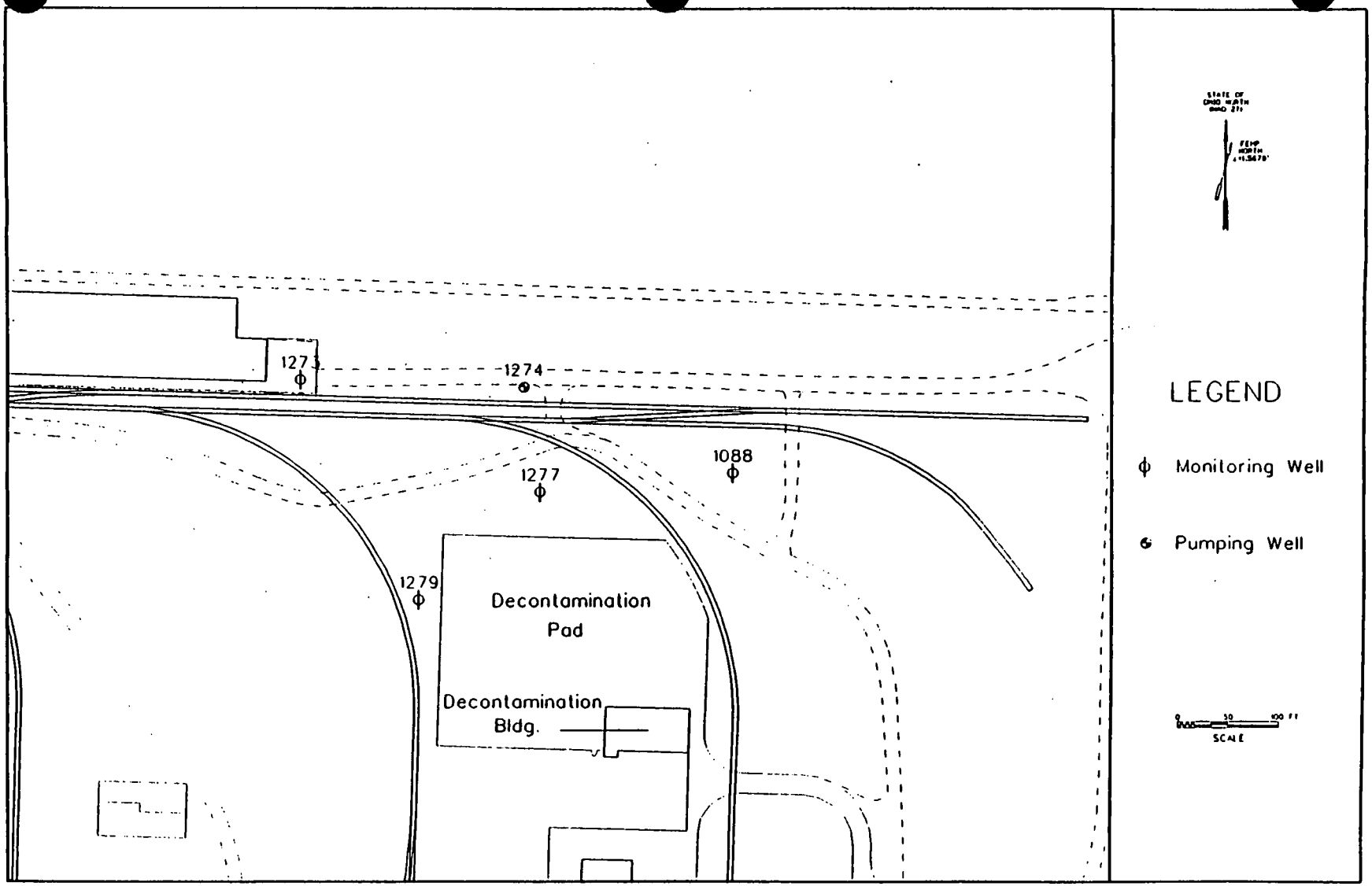

MONITORING WELLS, 1274 YIELD TEST

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Figure 4-3 - 1274 Yield Test, Well Layout

4.4.3 Waste Pit Area (Well 1077)

Well 1077 is located in the Waste Pit Area in the northwest portion of the FEMP. The predominant lithology of the well is clay with 9.0 feet of well-graded sand-gravel mixture under confined conditions. Observation wells and their distances from the test well are listed in Table 4-3 and shown in Figure 4-4.

Table 4-3 - Observation Wells, 1077 Yield Test

Well No.	Depth (Feet)	Distance from 1077 (Feet)
1076	50.0	66
1030	32.0	233
1765	22.5	526.5
1768	17.5	283.5
1775	30.0	281.4
11077	21.5	346.4

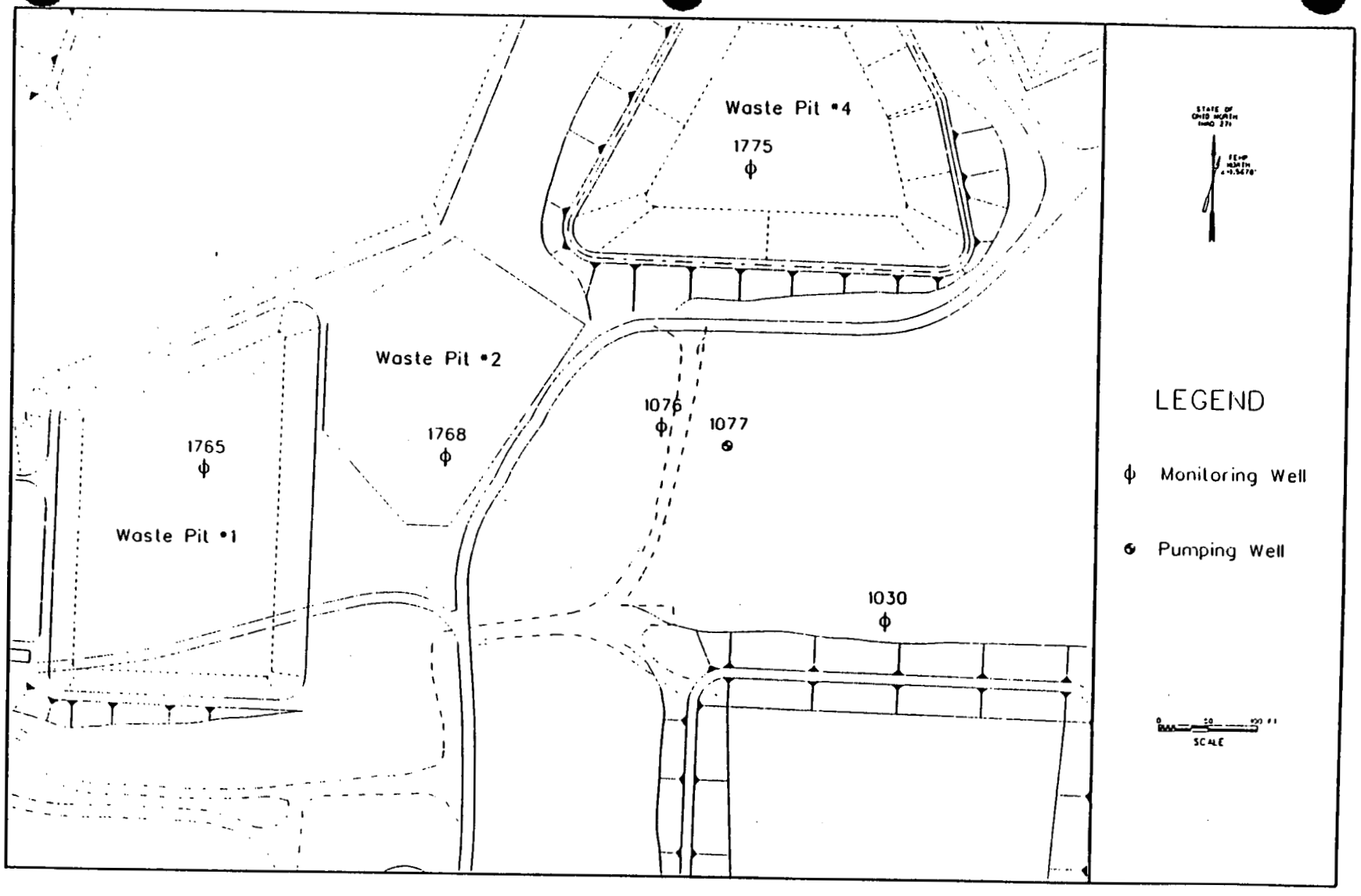
Well 1077 was initially pumped on July 30, 1993. During this test, three steps of 1 hour duration were achieved at the following discharge rates:

1) Step 1: 1.0 gpm
2) Step 2: 2.5 gpm
3) Step 3: 4.0 gpm

Step three brought the pumping level to within 0.5 feet of the pump inlet, and the test was subsequently terminated at the end of the step. No drawdown was detected in any of the observation wells, and after the pumping ceased, the well displayed a very slow rate of recovery.

Since the drawdown within the well was rather significant during the range of pumping steps during this test, it was subsequently retested on August 12, 1993. During this second test, the well was initially pumped in 2-hour step increments at the following rates:

1) Step 1: 1.0 gpm
2) Step 2: 1.5 gpm
3) Step 3: 2.0 gpm



MONITORING WELLS, 1077 YIELD TEST

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Figure 4-4 - 1077 Yield Test, Well Layout

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Discharge water holding capacity was a limiting factor, which limited Step 4 to 80 minutes and Step 5 to 50 minutes at the following discharge rates:

4) Step 4: 2.5 gpm
5) Step 5: 3.0 gpm

The well responded differently during the second yield test with a much lower rate of drawdown over time for steps 3, 4, and 5. This abrupt change in slope is attributed to a heavy rain which occurred during the test. Due to the inconsistency with the first two steps of both of the yield tests, the results from steps 3 through 5 are neglected. No drawdown was detected in any of the observation wells during the test. As in the first test, the well exhibited very slow recovery.

Time-drawdown plots for Step Tests A and B are shown in Figures 4-5 and 4-6. Projection of the drawdown curves for the first yield test (Test A), which was conducted on July 30, 1993, suggests that a pumping rate of 1.0 gpm could be sustained for a period > 10,000 minutes.

Projection of the drawdown curves for the first two steps of the second yield test (Test B) suggest that sufficient drawdown is not available in 1077 to pump the well at a rate of 1.0 gpm for a time period greater than 10,000 minutes. Since the first step rate (1.0 gpm) of the second test ran for a longer time period, it is considered a better indication of sustained yield. Sustained yield is thus conservatively estimated as < 1.0 gpm. The best actual specific capacity occurred when the well was pumped at a rate of 1.0 gpm during Test A.

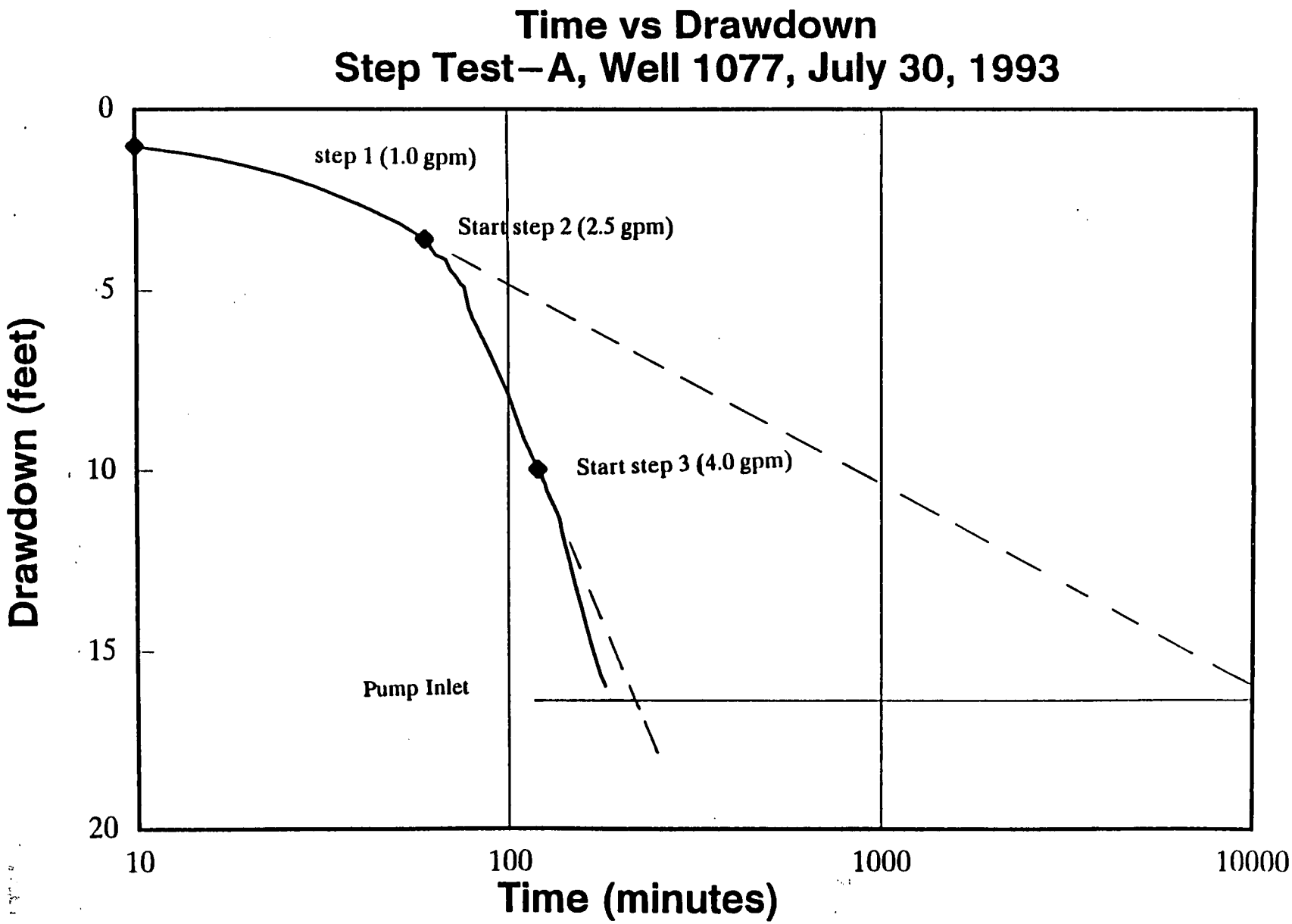

Figure 4-5 - Yield Test A, Well 1077

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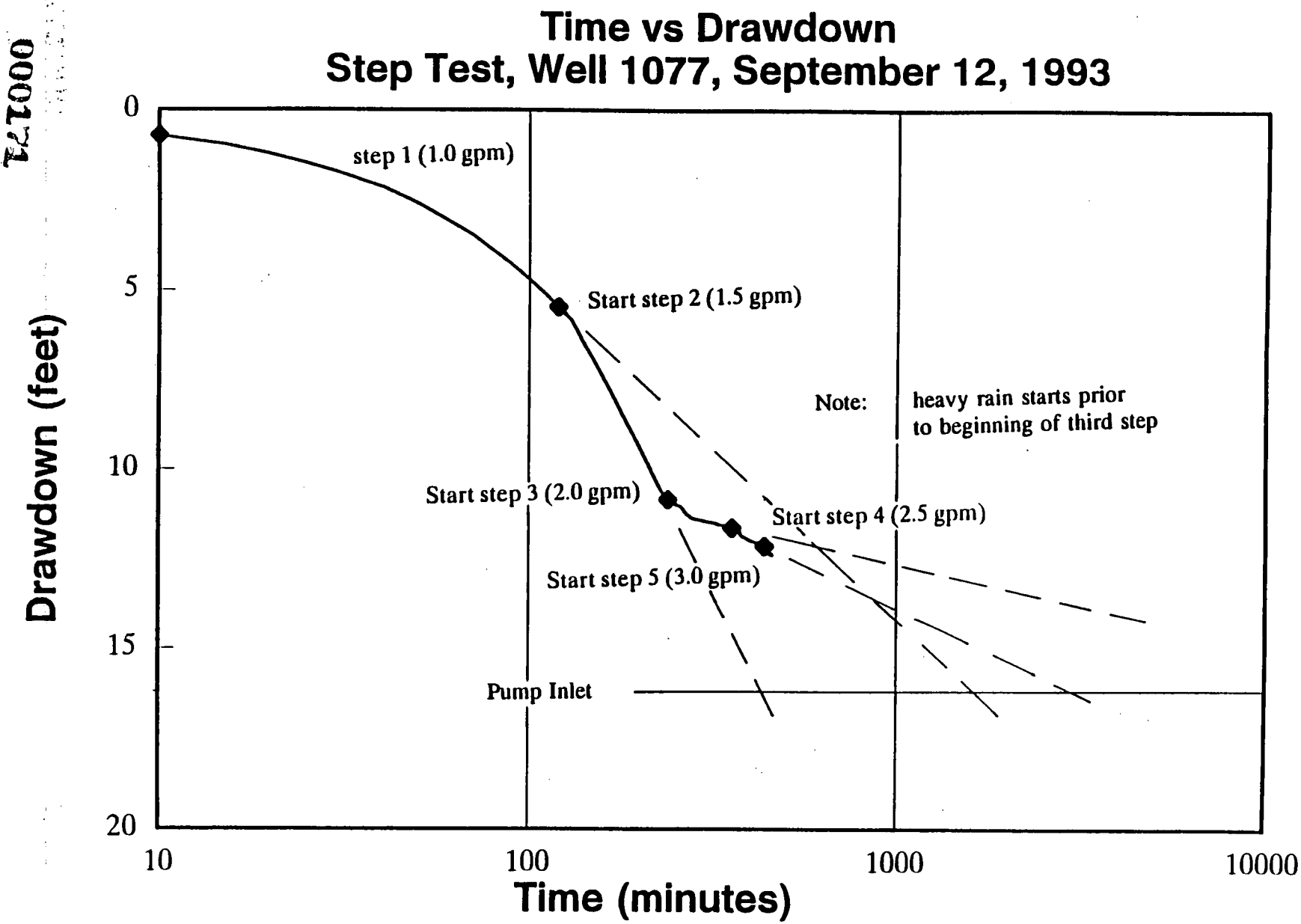

Figure 4-6 - Yield Test B, Well 1077

4.4.4 Plant 1 Pad Area (Well 1339)

Well 1339 is a 2-inch ID well located southwest of the boiler plant in the Pad 1 Area. The predominant lithology is brown sand under unconfined conditions at a depth of 5 to 11.5 feet BGS. The sand layer is fully penetrated by Well 1339. Observation wells and their distances from the test well are listed in Table 4-4 and shown in Figure 4-7.

Table 4-4 - Observation Wells, 1339 Yield Test

Well No.	Depth (Feet)	Distance from Well 1339 (feet)
1055	20.0	235
1336	20.8	312
1338	10.5	225
1340	20.0	230
1342	18.0	350
1343	10.5	267
1344	20.0	337

Well 1339 was initially tested on July 15, 1993. The first step pumping rate was 1.85 gpm for a period of 1 hour at which a stable drawdown was achieved. Two subsequent stable drawdown steps of 2.9 gpm and 4.0 gpm were also achieved during this test, but discharge water holding capacity limited the second and third steps to a duration of less than 60 minutes. No drawdown was detected in any of the observation wells during the test.

Projection of step drawdown curves from Test A, shown in Figure 4-8, suggest that pumping at a rate of 1.85 gpm could extend to >10,000 minutes. Although the time duration of Step 2 was only 20 minutes, the projection of the drawdown curve at the Step 2 rate of 2.9 gpm suggests that the well could not be pumped in excess of 10,000 minutes. If the well were pumped at a rate of 4.0 gpm, the projection of the drawdown curve suggests that it would dewater in less than 200 minutes. Subsequent yield testing of Well 1339 confirmed that a rate of 4 gpm could not be sustained. Sustainable yield for Well 1339 is estimated conservatively at 1.85 gpm for 10,000 minutes.

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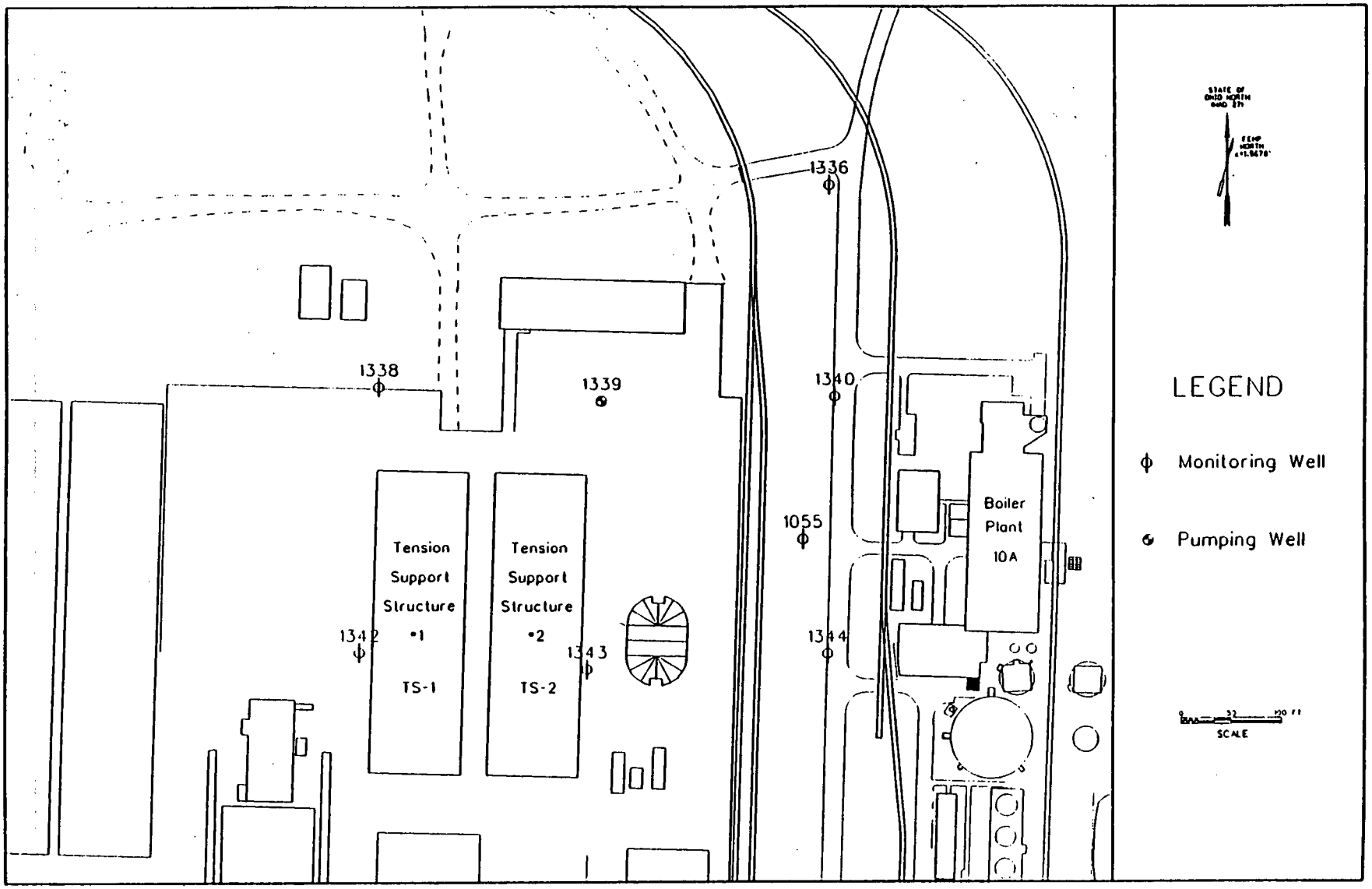

MONITORING WELLS, 1339 YIELD TEST

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Figure 4-7 - 1339 Yield Test, Well Layout

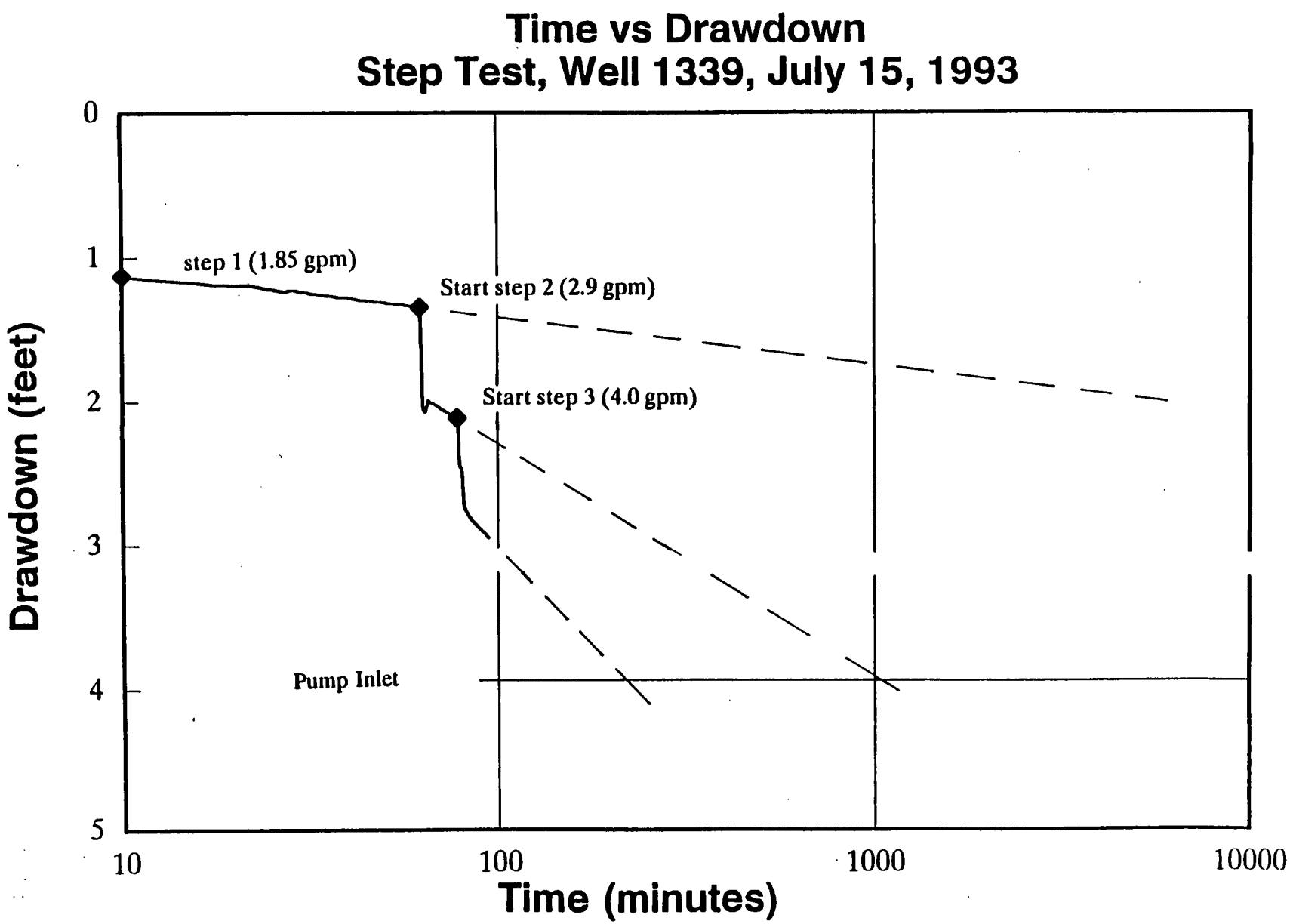

Figure 4-8 - Yield Test, Well 1339

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4.4.5 Waste Pit Area (Well 11214)

Well 11214 is a 4-inch ID well located in the waste pit area, approximately 400 feet east of Well 1077. The predominate lithology is 10 feet of fine sand and gravel under confined conditions overlain by an upper clayey sand unit. The sand and gravel layer is fully penetrated by Well 11214. Boring logs of adjacent observation wells suggest that the sand unit extends from 14 to 24 feet deep and is under confined conditions. The sand unit is believed to represent a 20-foot-wide channel that trends north-south (Figure 4-16). Observation wells and their distances from the test well are listed in Table 4-5 and shown in Figure 4-9.

Table 4-5 - Observation Wells, 11214 Yield Test

Well No.	Depth (Feet)	Distance from Well 11214 (Feet)
1077	33.0	411.3
1645	25.5	180
1774	31.0	407.1
1010	27.0	475.1

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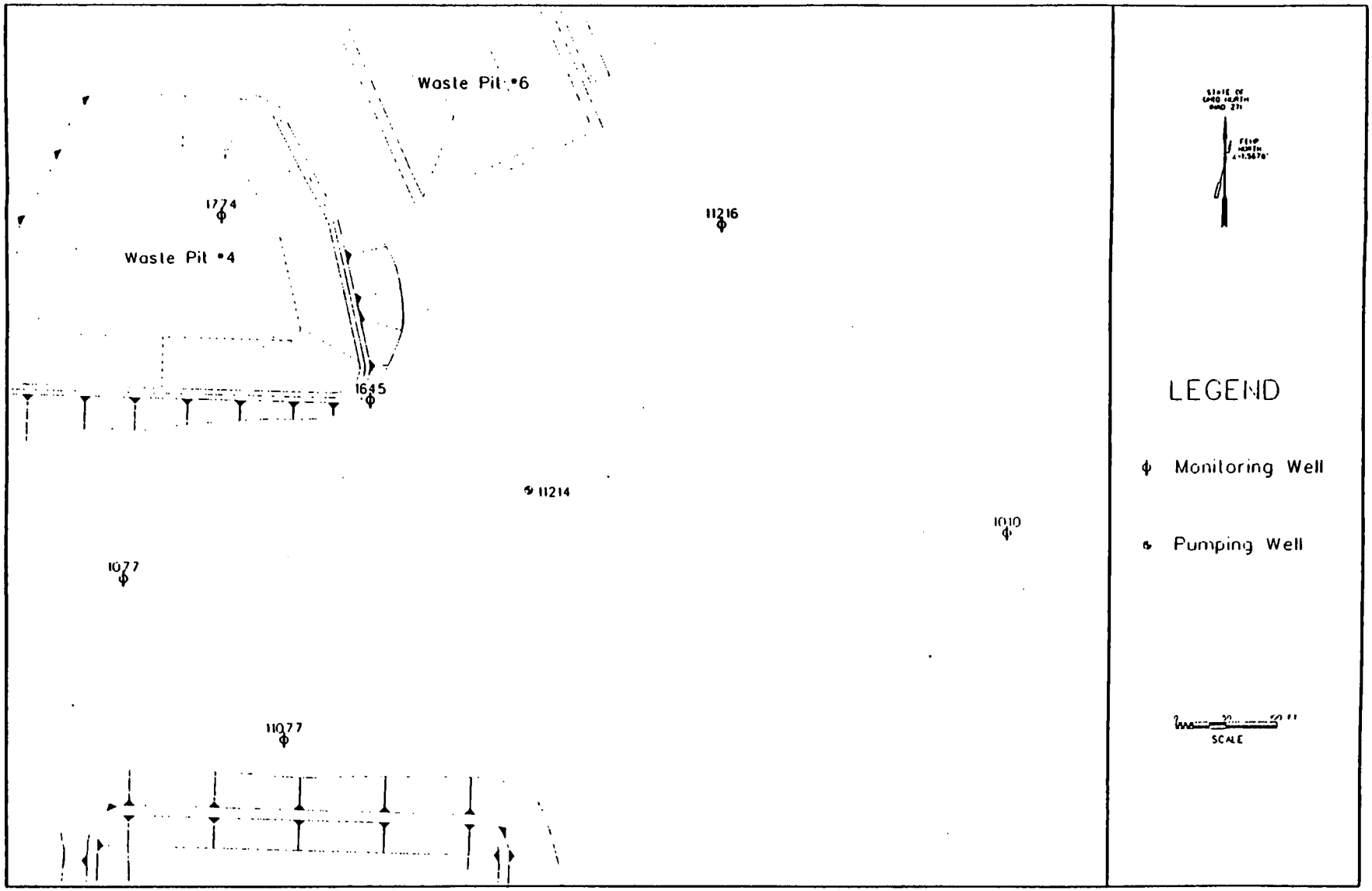

MONITORING WELLS, 11214 YIELD TEST

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Figure 4-9 - 11214 Yield Test, Well Layout

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Well 11214 was step/yield tested on September 2, 1993. During this test, five full steps were achieved at the following discharges and times:

1)	Step 1: 1.0 gpm	100 minutes
2)	Step 2: 1.5 gpm	100 minutes
3)	Step 3: 2.0 gpm	60 minutes
4)	Step 4: 2.5 gpm	70 minutes
5)	Step 5: 3.0 gpm	80 minutes
6)	Step 6: 3.5 gpm	77 minutes

The test was terminated when the pumping level reached the pump inlet 77 minutes into step 6 at a rate of 3.5 gpm. No drawdown was detected in any of the observation wells, but subsequent drilling for a pump test revealed all of the observation wells were outside of the channel. The well recovered to within 76 percent after 20 minutes, and 100 percent within 15 hours. Projection of step drawdown curves shown in Figure 4-10 suggest that the well could be pumped at a rate of 2.5 gpm for a time period greater than 10,000 minutes.

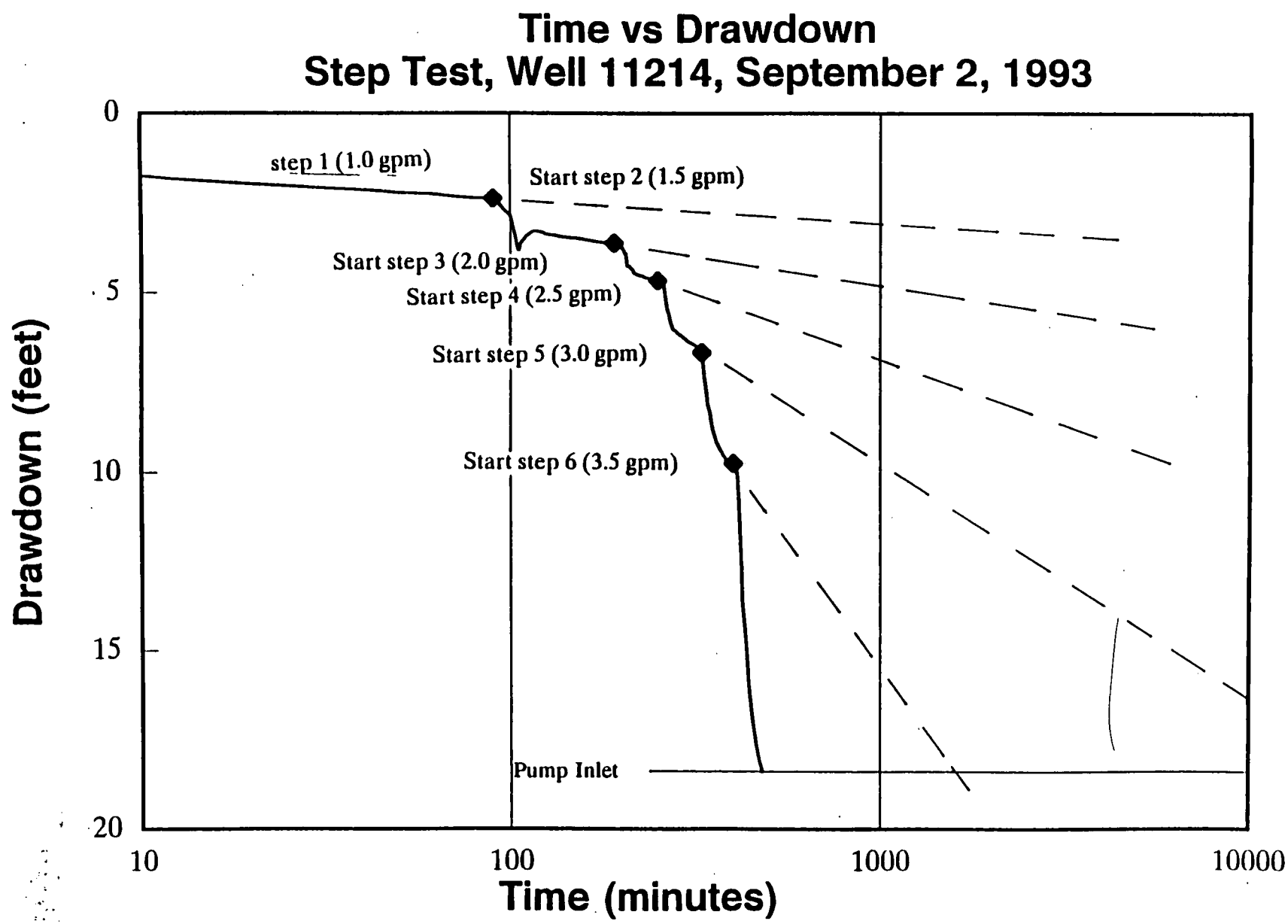

Figure 4-10 - Yield Test, Well 11214

4.4.6 Plant 1 Pad Area (Well 11112)

Well 11112 is a 4-inch ID well that was installed in the Pad 1 Area. The predominant lithology is fine to coarse sand and gravel that is present from 4 to 14 feet under unconfined conditions. The sand and gravel layer is fully penetrated by Well 11112. Boring logs of the adjacent observation wells and Well 1339 suggest that these lithologic conditions are typical of the Pad 1 Area. Observation wells and their distances from the test well are shown in Figure 4-11 and are listed in Table 4-6.

Table 4-6 - Observation Wells, 11112 Yield Test

Well No.	Depth (Feet)	Distance from Well 11112 (Feet)
11114	17.5	9.99
11115	20.5	10.86
11116	16.0	19.97
11208	14.5	49.67
11209	21.5	10.18

The yield of Well 11112 was tested on September 24, 1993. The test was conducted at the following discharges and times:

1) Step 1: 1.0 gpm 70 minutes
2) Step 2: 1.5 gpm 60 minutes
3) Step 3: 2.0 gpm 60 minutes
4) Step 4: 2.5 gpm 50 minutes (de-water)

The test was terminated when the pumping level reached the pump inlet. The well recovered to within 95 percent of the pre-pumping static water level after 30 minutes.

The yield test data from Well 11112 are summarized in Table 4-6. Projection of the step drawdown curves, shown in Figure 4-12, suggest that the well could be pumped at a rate of 2.0 gpm for a time period greater than 10,000 minutes.

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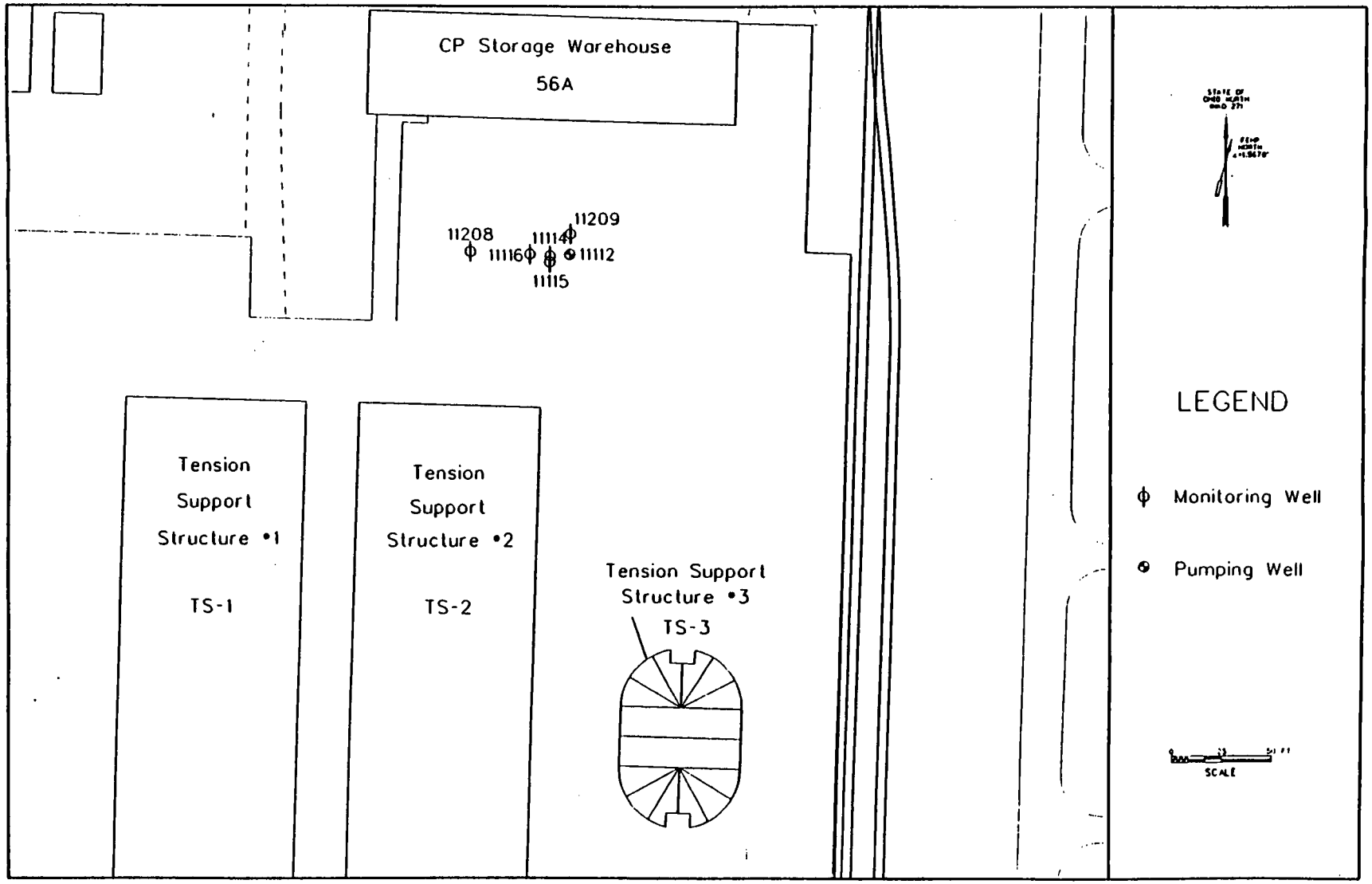

MONITORING WELLS, 11112 YIELD TEST

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Figure 4-11 - 11112 Yield Test, Well Layout

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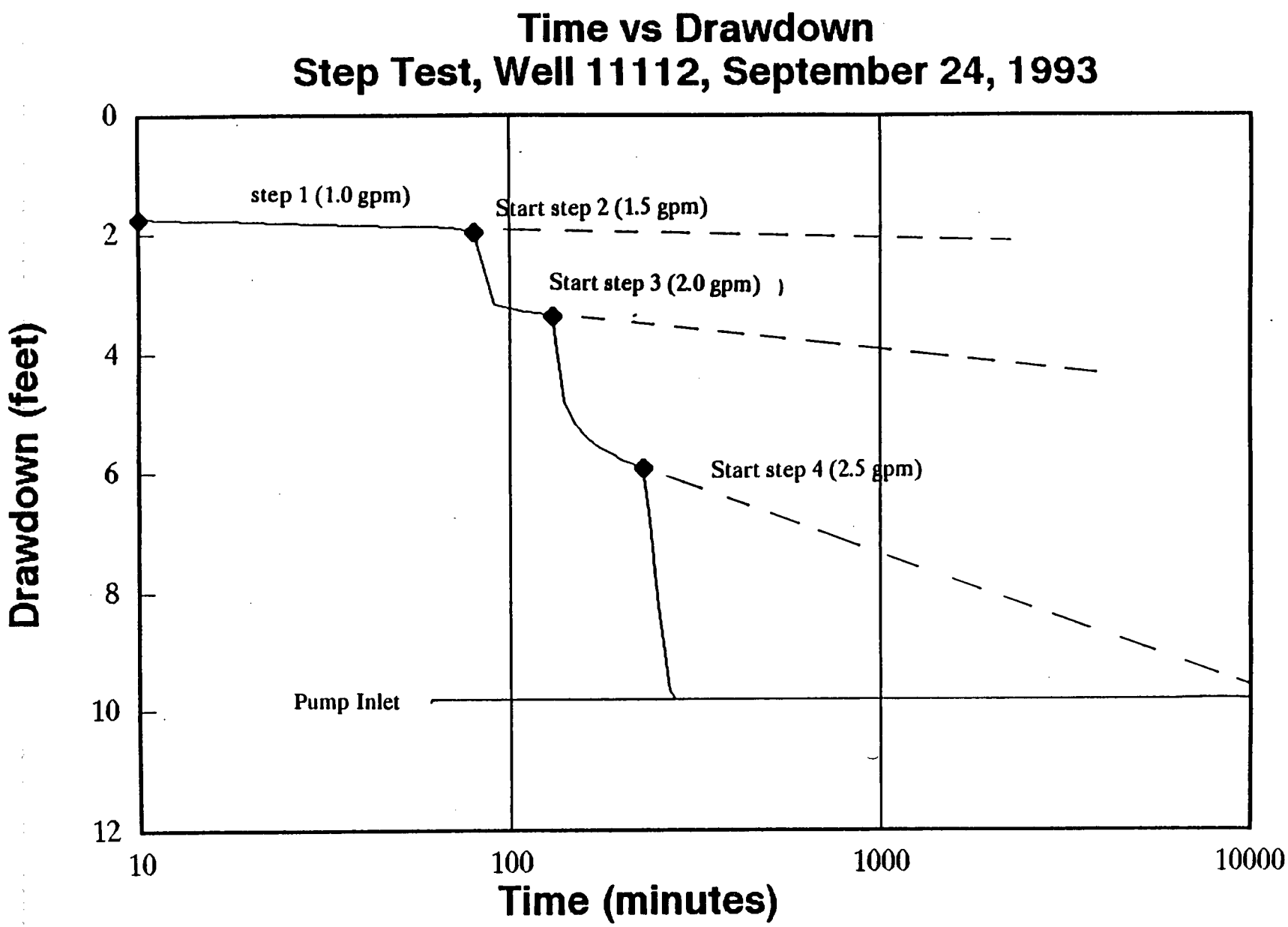

Figure 4-12 - Step Test, Well 11112

4.4.7 Plant 8 Area (Well 1785)

Well 1785 is a 6-inch ID stainless steel well located in the Plant 8 area. The predominant lithology is fine to coarse sand and gravel from 8 to 18 feet below ground surface. The sand and gravel layer is fully penetrated by Well 1785. Boring logs from the Plant 8 observation well network that was installed during the GT/VZ investigation suggest that similar lithologic conditions are present throughout the Plant 8 area and Plant 2/3 area. Observation wells and their distances from the test well are shown in Figure 4-13 and listed in Table 4-7.

Table 4-7 - Observation Wells, 1785 Yield Test

Well No.	Depth (Feet)	Distance from Well 1785 (Feet)
11120	21.0	10.58
11118	7.5	10.82
11121	19.6	29.67
11211	23.0	11.27
1232	19.6	31.46

Well 1785 was initially yield tested on October 27, 1993. During the test, an initial step lasting 100 minutes was achieved at a rate of 0.85 gpm, but the well dewatered during the second step after a period of 80 minutes, at a pumping rate of 1.35 gpm. The well was allowed to recover and was subsequently pumped at a rate of 1.0 gpm for a period of 100 minutes.

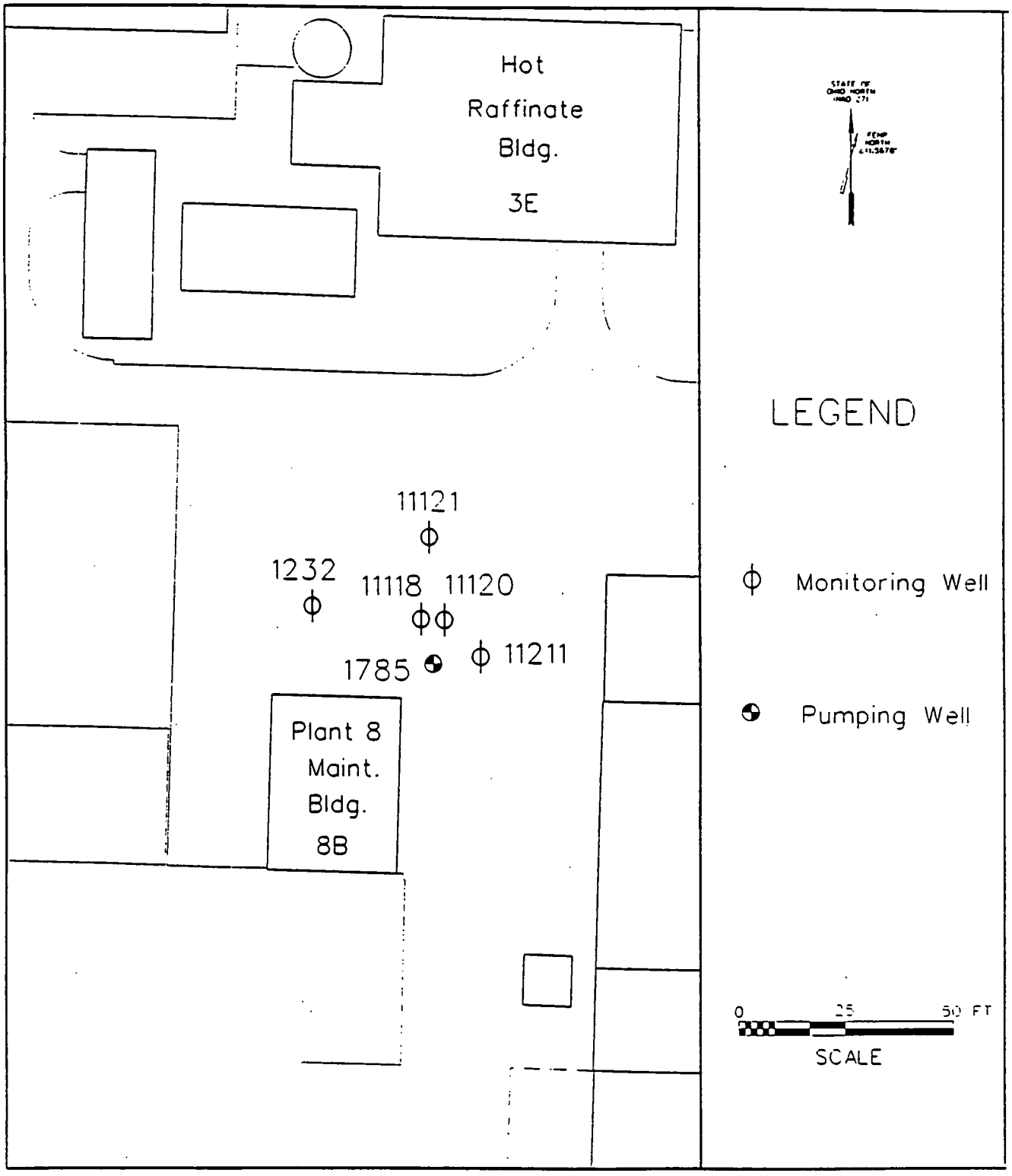

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Figure 4-13 - 1785 Yield Test, Well Layout

Based on these results, an attempt to conduct a Constant Rate Pumping Test at a flow of 0.85 gpm was started on October 28. The results indicated a highly inefficient, possibly improperly developed. well. The well was alternately surged with a slug and pumped to achieve additional development. A second step test was subsequently conducted on November 3, 1993. During the test, three full steps were achieved. The test was terminated after the pumping level reached the pump inlet at approximately 50 minutes into the fourth step. The well recovered to greater than 90 percent within 60 minutes.

1)	Step 1: 1.0 gpm	100 minutes
2)	Step 2: 1.5 gpm	100 minutes
3)	Step 3: 1.75 gpm	80 minutes
4)	Step 4: 2.0 gpm	50 minutes (de-water)

The data from the second step test at Well 1785 are summarized in Table 4-12. Projection of the step drawdown curves, shown in Figure 4-14, suggest that the well could be pumped at a rate of 1.5 gpm for a period approaching 10,000 minutes.

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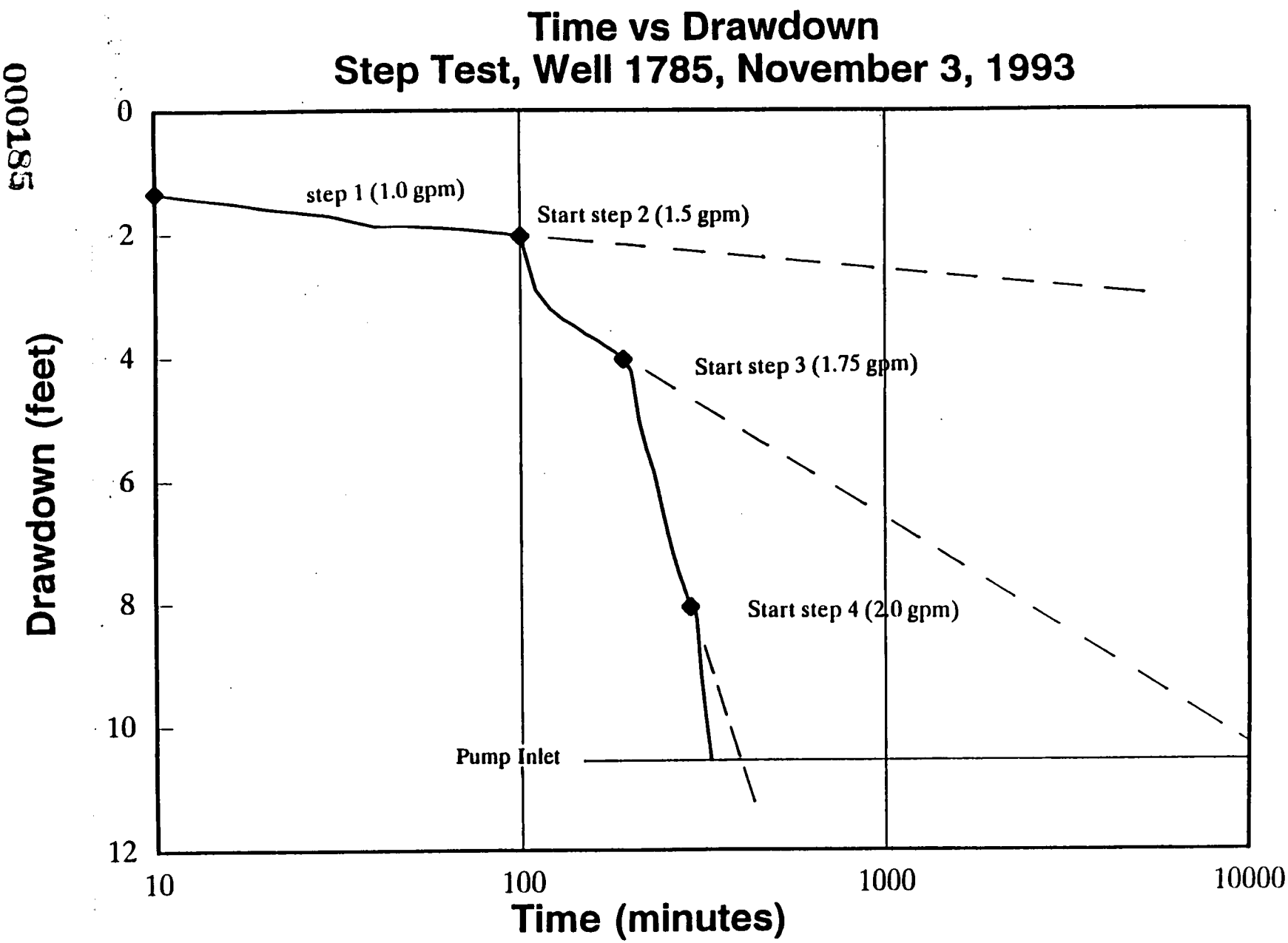

Figure 4-14 - Step Test, Well 1785

SECTION 5

PUMPING TESTS

Constant rate pumping tests (CRTs) were performed in three areas -- the Waste Pit Area, Plant 1 Pad, and Plant 8 Area according to Section 3 of the GT/VZ Work Plan (PARSONS 1993b).

The objective of these pumping tests was to calculate hydraulic properties of the water-bearing sand zones in the GT/VZ. Data from the tests are used to determine the hydraulic conductivity, storativity, and anisotropic conditions that may exist in the pump test area and to make observations concerning hydraulic barriers and drawdown orientations.

All three pumping test locations were on FEMP property and are shown in Figure 5-1 and more generally in Figure 1-1.

1) Plant 1 Pad Area (Well 11112)
2) Waste Pit Area (Well 11214)
3) Plant 8 Area (Well 1785)

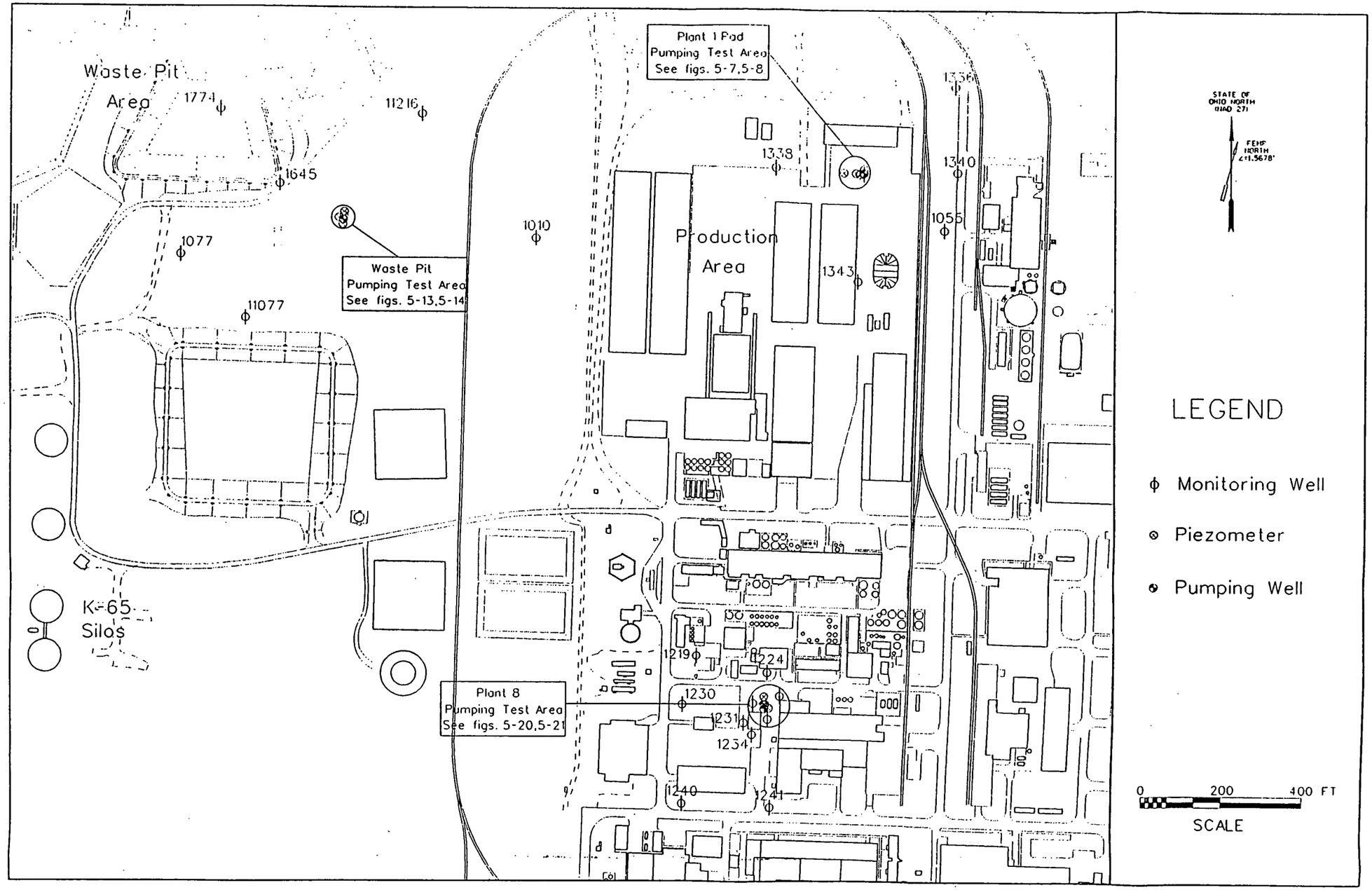

Figure 5-1 - Pumping Test Locations

5.1 General Methods

5.1.1 Equipment

Figure 5-2 shows the general piping and equipment set-up for the pumping tests. Table 5-1 lists and describes the equipment and instrumentation used to conduct the tests.

A Grundfos Redi-Flo 2, submersible pump was used for the pumping tests. The rate of discharge from the pump was regulated by a control box that governed the rotation speed of the pump motor and impellers.

Discharge from the pump flowed through a 3/4-inch ID Teflon hose. A Hersey MVR 30 mechanical flow meter with sweep hand and digital totalizer was used to record the volume and rate of flow from the well. A Sensus mechanical flow meter was used to record flow from the test at the Waste Pit Area. A sampling port was placed in line from and downstream of the flow meter.

For pumping tests at the Plant 1 Pad and the Waste Pit Area, the discharge subsequently flowed into a truck mounted 1,500 gallon or 1,800 gallon tank. These trucks rotated between water holding and disposal from the pumping well to the sump. For the pumping test at Plant 8, discharge was sent to a 500-gallon, truck-mounted tank and subsequently to the Plant 8 treatment system.

Table 5-1 - Pumping Test Components

Component	Description
Test Pump	GRUNDFOS, 1.8 inch O.D., REDIFLO-2 submersible
Primary Flow Meter/Totalizer	Hersey MVR 30
Secondary Flow Measurement	Timed fill of calibrated volume
Test Pump Power Supply	Local site power
Automatic Water Levels	In Situ, HERMIT Model SE 2000 16 Channel data logger
Manual Water Levels	SOLINST, electronic water level measuring tape

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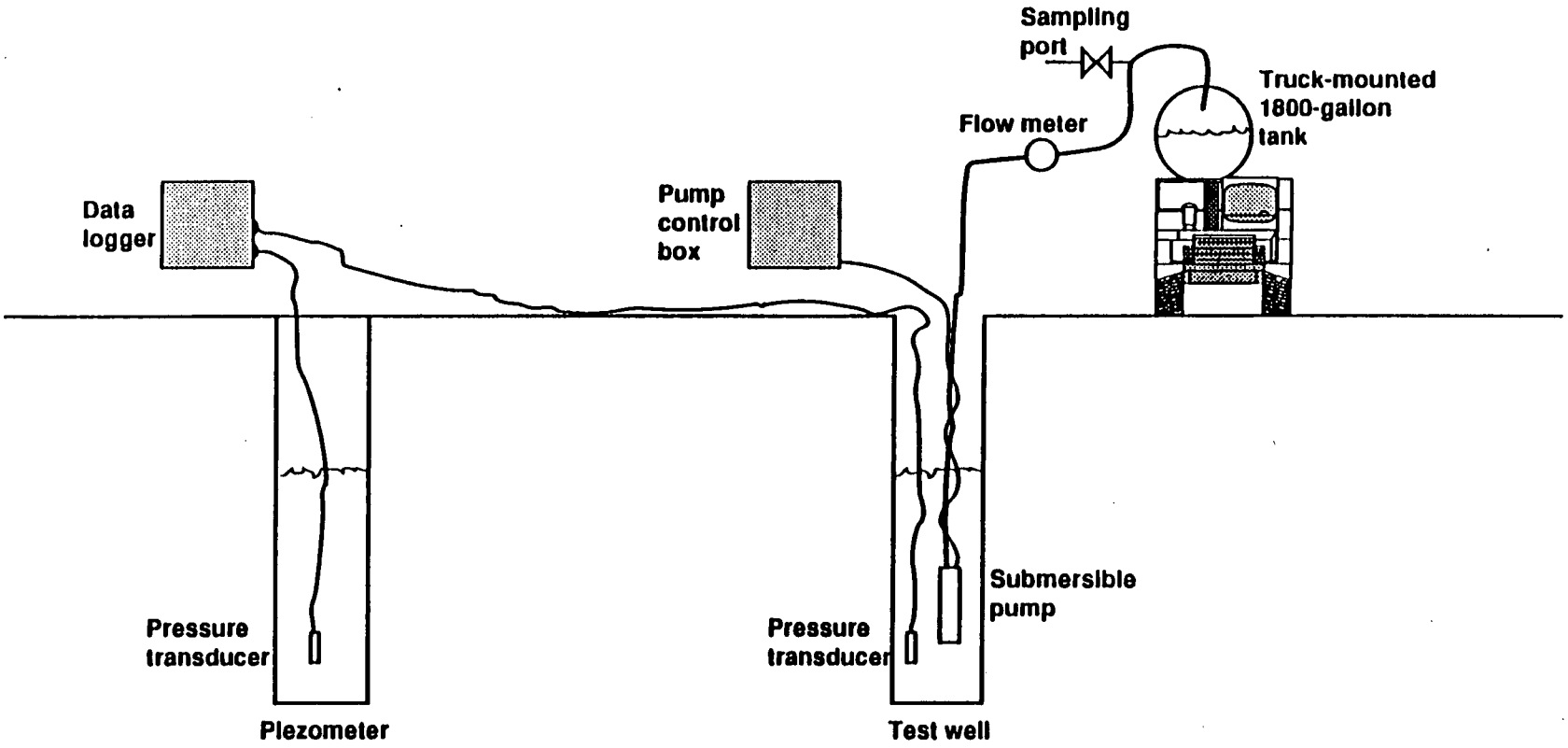

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Figure 5-2 - General Test Set-Up

5.1.2 Monitoring System Installation

An observation well network was designed for each pump test location. According to the GT/VZ Work Plan, this design was based on the following criteria:

1) Evaluation of anisotropic conditions within each saturated horizon.
2) Proximity to flow boundaries.
3) Assessment of aquitard vertical hydraulic conductivity.
4) Radius of pumping influence.

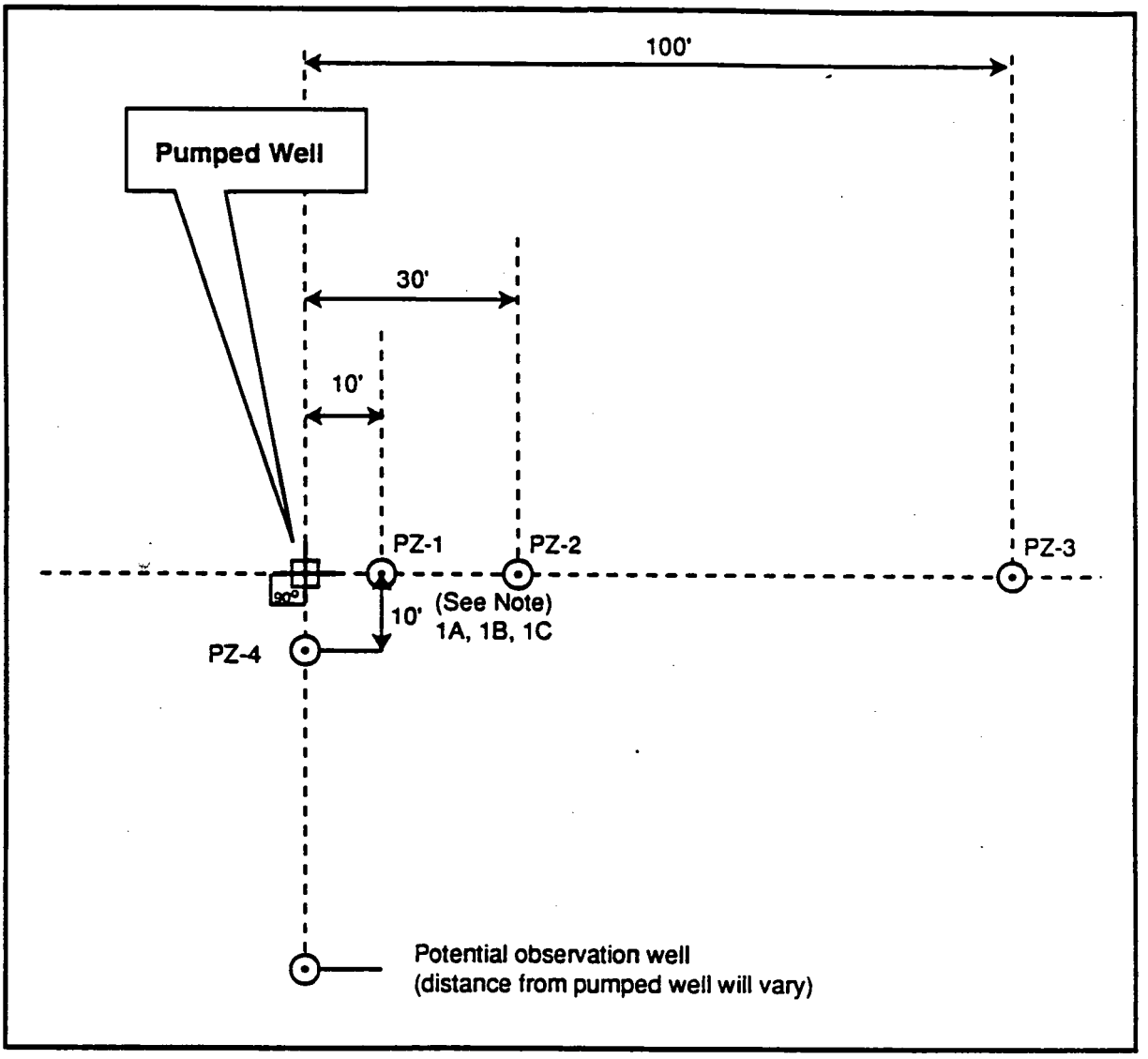
As shown in Figure 5-3, the design contains up to seven observation wells installed at varying distances from the pumping well. A cluster located 10 feet from the test well provided data on vertical hydraulic conductivity (Kv) and the influence of the upper and lower confining layers. The shallow observation well of the cluster (Pz-1A) was screened in the upper confining layer when possible. The deep observation well of the cluster (Pz-1C) was screened in the lower confining layer when possible. The third observation well in the cluster (Pz-1B) was installed at an intermediate depth screened within the sand body. A fourth (Pz-2) and fifth (Pz-3) observation well were linearly spaced 30 and 100 feet respectively from the test well. A sixth observation well (Pz-4) was installed at a distance of 10 feet perpendicular to the axis of the other observation wells.

During construction, each observation well borehole was advanced by a hollow stem auger (HSA) rig. Continuous split spoon samples were collected from the surface of the unconsolidated materials to the base of the borehole in the Pz-1C, Pz-2, Pz-3, and Pz-4 borings.

All observation wells installed within the sand or sand and gravel horizons were completed with 2-inch ID Schedule 40 PVC casing and 0.010 inch slot screens. Each screen length was selected to screen a minimum of 85 percent of the sand unit. A sand pack was installed in the annular space around the screened interval of the casing. The filter pack was capped by a bentonite pellet seal. Either a Volclay grout or a dry granular bentonite was placed above the pellet seal. The thickness and depth of the Volclay or granular Bentonite was dependent on the depth to the screened horizon. The remainder of the annular space was filled with cement. Flush mounts were installed at the Plant 1 Pad and Plant 8 Area. Protective steel casings and cement pads were installed at the waste pit area.

Geotechnical samples from the Plant 1 Pad and Plant 8 area observation wells, consisting of Shelby tubes for cohesive materials and split spoon samples of granular materials, were submitted to the laboratory and analyzed for the same physical characteristics as for Plant 8 Area test well (1785).

Some deviations from the GT/VZ Work Plan occurred to account for actual subsurface conditions. Documentation of these deviations are located in Appendix D.7. A brief description is provided below.



Observation Well

Pumped Well

Bearing Line

NOTE: PZ-1 consists of 1A, 1B, 1C

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Figure 5-3 - General Observation Well Layout

1) Drawdown data from the yield tests at both the Waste Pit Area and the Plant 1 Pad suggested that the radius of influence was considerably less than 100 feet. Therefore, the distance from the pumping well to the farthest observation well (Pz-3) was reduced from 100 feet to 50 feet, and the distance to Pz-2 was reduced from 30 feet to 20 feet for these pump tests.

2) For the pumping test in the Waste Pit Area, neither the deep or shallow observation well was installed to monitor the effects of vertical hydraulic conductivity in the upper or lower confining layer due to uncertainty over the location and existence of the layers.

3) A continuous upper confining layer in the Plant 1 Pad Area (pumping test 11112) was not present; therefore, a shallow observation well was not installed.

4) Since Well 1339 was in close proximity to Well 11112, it was used as an offset observation well instead of installing a new Pz-4.

Figures 5-8, 5-14, and 5-21 present the arrangement of the observation wells at each pump test location. Tables 5-4, 5-6, and 5-8 list the wells monitored during each pumping test along with well type, well depth, distance to test well, screen length, and well diameter.

5.1.3 Conduct of Pump Tests

During constant rate pumping tests, water levels in the test well and the close observation wells were recorded using either a 16-channel or 4-channel data logger and the logarithmic sampling cycle shown in Table 5-2. Water levels in the distant observation wells were measured manually. Appendix D in Volume II of this report contains data from manual measurements and the data logger. Manual levels were also obtained hourly in each close observation well to verify operation of the data logger.

5.1.4 Water Level Analysis

Four methods of analysis were used: Theis (1935), Cooper-Jacob (1946), Hantush-Jacob (1955), and Neuman (1974). Additionally, well recovery is analyzed by Theis (1935).

Effects due to background trends in water table elevations, barometric pressure, river stage, surface loading, and the effects of other wells were considered not to have a significant effect on the test results.

1) Background Trends in Water Level

The pump tests at the Plant 1 Pad and Plant 8 were located in areas where surface structures (buildings and pads) reduce the infiltration of surface water from precipitation events and the stormwater sewer system directs surface water away from the area. Figure 5-4 shows precipitation during the performance

of these pump tests. After analysis of background trend, only two pumping tests (Plant 1 Pad and Plant 8) required a correction for this effect. This analysis is discussed in Subsections 5.2.4 and 5.4.4 and is presented in Appendix D.4. Although a major precipitation event also occurred during the Waste Pit Area CRT, the event occurred late in the test after the onset of boundary conditions. That portion of the test data was not used due to the boundary conditions, so a correction for the storm event was not necessary.

2) Barometric Pressure Effects

An inverse relationship exists between barometric pressure and water level. This effect is more pronounced under confined conditions.

Some of the sand bodies tested by these pumping tests initially exhibited confined conditions. However, for pumping tests at the Plant 1 Pad and Waste Pit Area once the pumping tests began, the water level was lowered below the bottom of the upper confining layer and the sand unit responded in an unconfined or semi-confined manner. An analysis for the possible effects of changing barometric pressure is presented in Appendix D.6. The barometric efficiency for the wells used during these CRTs is insignificant and no correction is required.

3) Other Effects

Other factors that have been known to affect the indicated hydraulic head during a pumping test are:

1) River stage - Due to their distance from the pumping test site and significant difference in elevation, Paddys Run and the Great Miami River are not considered as a possible influence to the test data.

2) Surface Loading - Based on the hardened conditions at the Plant 1 Pad and the Plant 8 Area, and the fact that the Waste Pit Area responded as a semi-confined unit, the effect of a change in surface load during the pumping test would not be significant. Additionally, other than vehicular traffic at the test site, there were no known local changes in surface loading during the pumping tests. Surface loading is not considered a factor influencing the test results.

3) Other pumping wells - There were no other active pumping wells in the tested units or near the test locations during the pump test that could have affected the observed results.

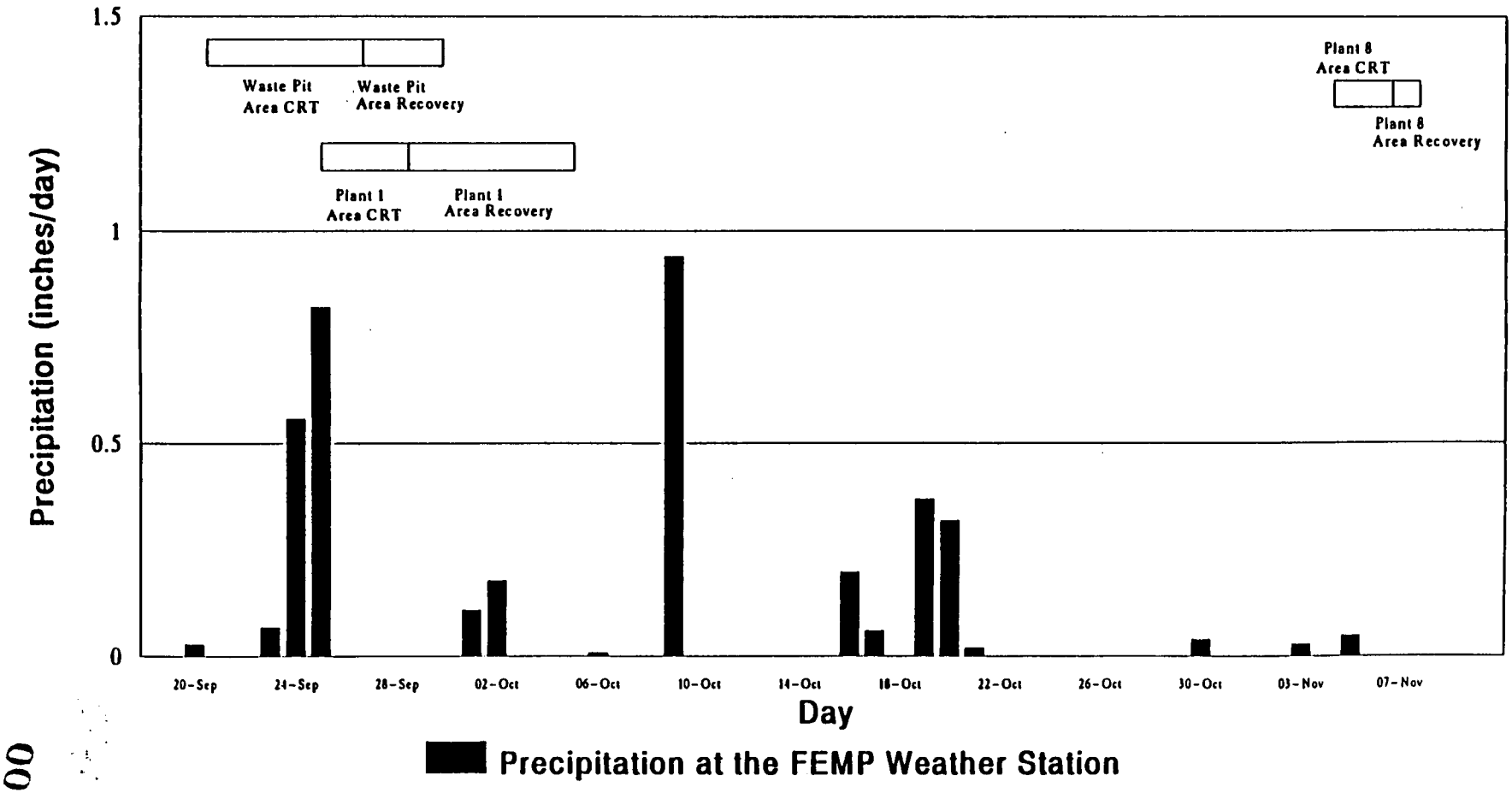

Figure 5-4 - Precipitation, September 20 through November 9, 1993

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Table 5-2 - Logarithmic Sampling Cycle

Log Cycle	Elapsed Time	Measurement Interval
1	0-20 seconds	0.5 seconds
2	20-60 seconds	1 second
3	1-10 minutes	12 seconds
4	10-100 minutes	2 minutes
5	> 100 minutes	15 minutes

Constant Rate Test and Recovery Period

Table 5-3 provides a brief chronology for each CRT and subsequent recovery period. The logarithmic data collection cycle on the data loggers was re-initiated simultaneously with pump shutdown from the CRT to record water level recovery measurements.

Table 5-3 - Constant Rate Test and Recovery Period Chronology

Event (information)	Plant 1 Pad (Well 11112)	Waste Pit Area (Well 11214)	Plant 8 Area (Well 1785)
Date/Time CRT Initiated (Discharge Rate)	9/25/93, 13:10 (1.75 gpm)	9/21/93, 13:45 (2.0 gpm)	11/04/93, 21:58 (1.25 gpm)
Date/Time CRT Terminated and Recovery Period Initiated (Total Pumping Time in Minutes)	9/29/93, 15:15 (5875)	9/27/93, 15:35 (8740)	11/07/93, 11:26 (3685)
Date and Time Recovery Period Terminated (Total Recovery Time in minutes / Percent Recovery)	10/5/93, 14:55 (8620 / 83.4%)	9/30/93, 13:15 (4180 / 66%)	11/08/93, 10:51 (1405 / 98%)

5.2 Plant 1 Pad (Well 11112)

5.2.1 Construction

Well 11112 was the pumped well for the CRT conducted in the Plant 1 Pad area. It is located adjacent to Well 1339. Figure 5-5 provides a diagram of the well and the surrounding lithology.

The well was completed on September 20, 1993 in a medium dense, yellowish brown, well graded sand, with a trace of gravel. The borehole was drilled with an 8-inch ID HSA drilling rig to a total depth of 19.5 feet BGS. In accordance with the GT/VZ Work Plan, continuous split spoon samples were collected from the concrete surface pad to the base of the borehole. Selected split spoon samples were submitted for sieve analysis.

Geotechnical samples of the lower gray gravelly clay were taken between 14.5 and 17.0 feet and 17.0 to 19.5 feet by Shelby tube. These samples were submitted for laboratory analysis for:

1) Grain Size (Hydrometer)
2) Moisture Content
3) Void Ratio
4) Atterberg Limits
5) Lab Density
6) Specific Gravity
7) Constant Permeability (triaxial cell with back pressure)

The well was completed with a 4-inch ID schedule 316 stainless steel casing to a depth of 16 feet BGS and screened with a 10 foot length of .020 inch slot screen between 4.0 and 14.0 feet BGS, which fully penetrated the saturated sand body. Yield test data from nearby observation well 1339 suggested that a 4-inch submersible pump, as specified by the GT/VZ Work Plan, would not be required and therefore, a 2-inch diameter submersible pump could be used in the well. A sand pack was installed in the annular space from the bottom of the borehole to 3.7 feet BGS. The shallow depth to the top of the screened zone would not permit the installation of a 5-foot thick bentonite seal. For the same reason, Volclay grout was not installed above the bentonite pellets. Instead, a dry granular bentonite seal was placed above the sand pack to a depth of 1.1 feet BGS to prevent the cement cap from sinking. The remainder of the annular space was finished with concrete and a flush mount steel vault was installed.

The well was developed by alternately pumping and surging with a slug. Following development, the well was sampled for total uranium, general chemistry constituents, and volatile organic compounds.

Well 11112

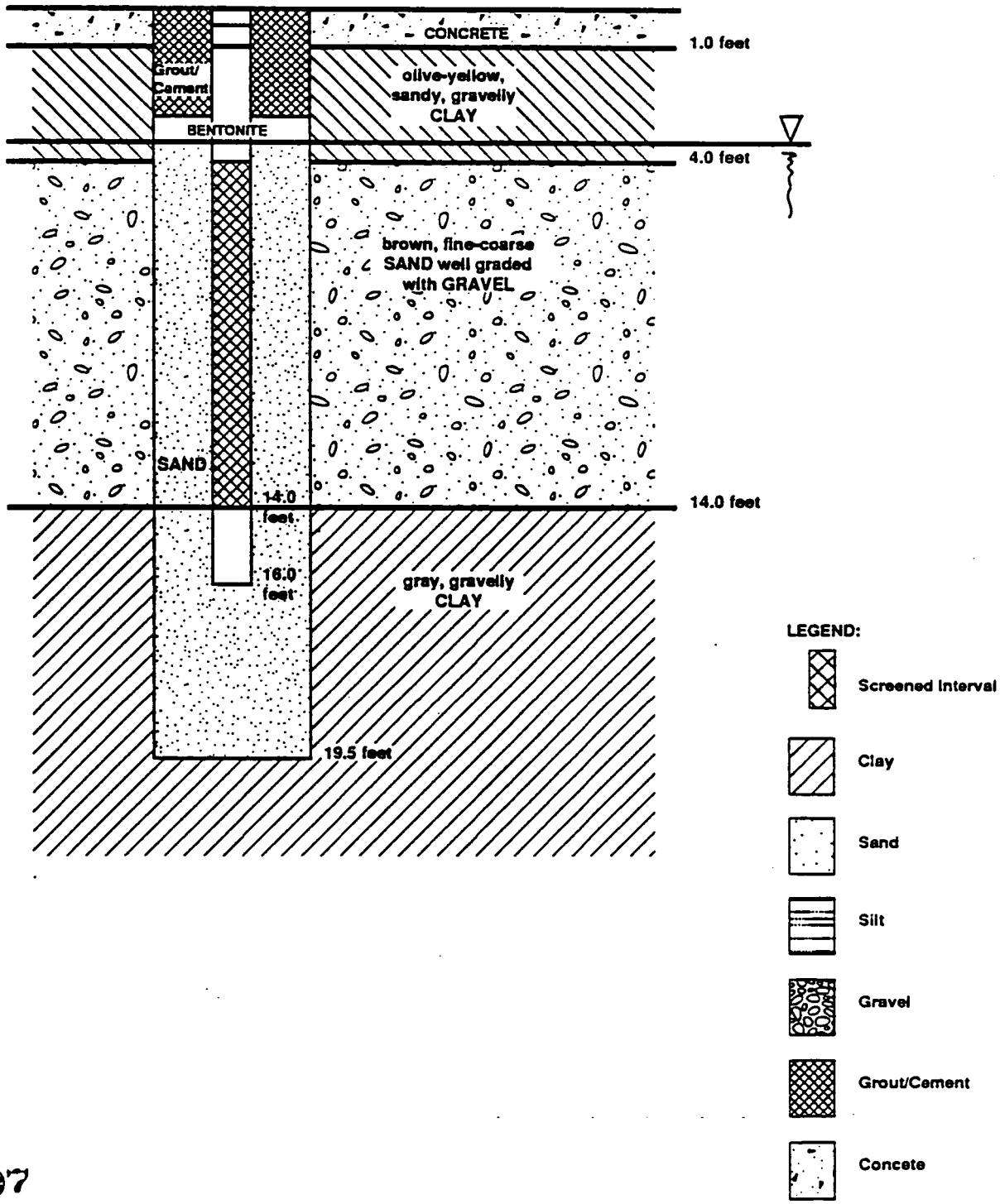

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Figure 5-5 - Well 11112: Construction and Surrounding Lithology

5.2.2 Conduct of Plant 1 Pad Pumping Test

The CRT started at 13:10 on September 25, 1993. A discharge rate of 1.75 gallons per minute (gpm) was maintained within ± 5 percent for the duration of the test. Drawdown in the test well reached 6.70 feet. Drawdown in Observation Well 11114 located 10 feet away reached 2.29 feet. The pump was turned off at 15:15 on September 29, 1993 beginning the recovery period. The well recovered slowly with 1.11 feet (16.6 percent) residual drawdown remaining after 6 days. Figure 5-6 shows a time-drawdown plot for the pump test while Figure 5-7 shows the total drawdown at the end of the test. Figure 5-8 shows the well arrangement in the immediate vicinity of Well 11112. This information is summarized in Table 5-4.

5.2.3 Analysis

The response was generally characteristic of unconfined conditions and the primary method of analysis is by the Neuman method (1974). The Theis (1935) method is used as a check of the results that were determined by the Neuman method. The applicability of the Theis method is based on the fact that an unconfined aquifer will initially respond to pumping as predicted by the Theis equation. The response only deviates from the Theis equation as the effects of delayed yield become evident. During these pumping tests, sufficient data are collected before these dewatering effects become prominent to allow the Theis equations to be used.

5.2.4 Background Trend

Figure 5-9 shows the levels of three wells, located near the Plant 1 Pad test area, immediately prior to and throughout the yield and pumping tests. Precipitation events are also shown in this figure over the same period.

During a 1-hour period ending at 8:00 on September 24th, 0.55 inches of precipitation fell. An additional 0.81 inches fell between 10:00 and 21:00 on September 25, 1993. These events occurred prior to and during the initial portion of the pumping test. These precipitation events caused the levels in the monitored wells to initially increase and then decrease over the period of the pump test. These wells are located north, east, and south of the test area and are screened in the same sand body. The average trend in these three wells is 0.120 ft/day. This correction factor is applied to the data from Plant 1 Pad observation wells which were used for parameter estimation (11114, 11209, 1339, 11116).

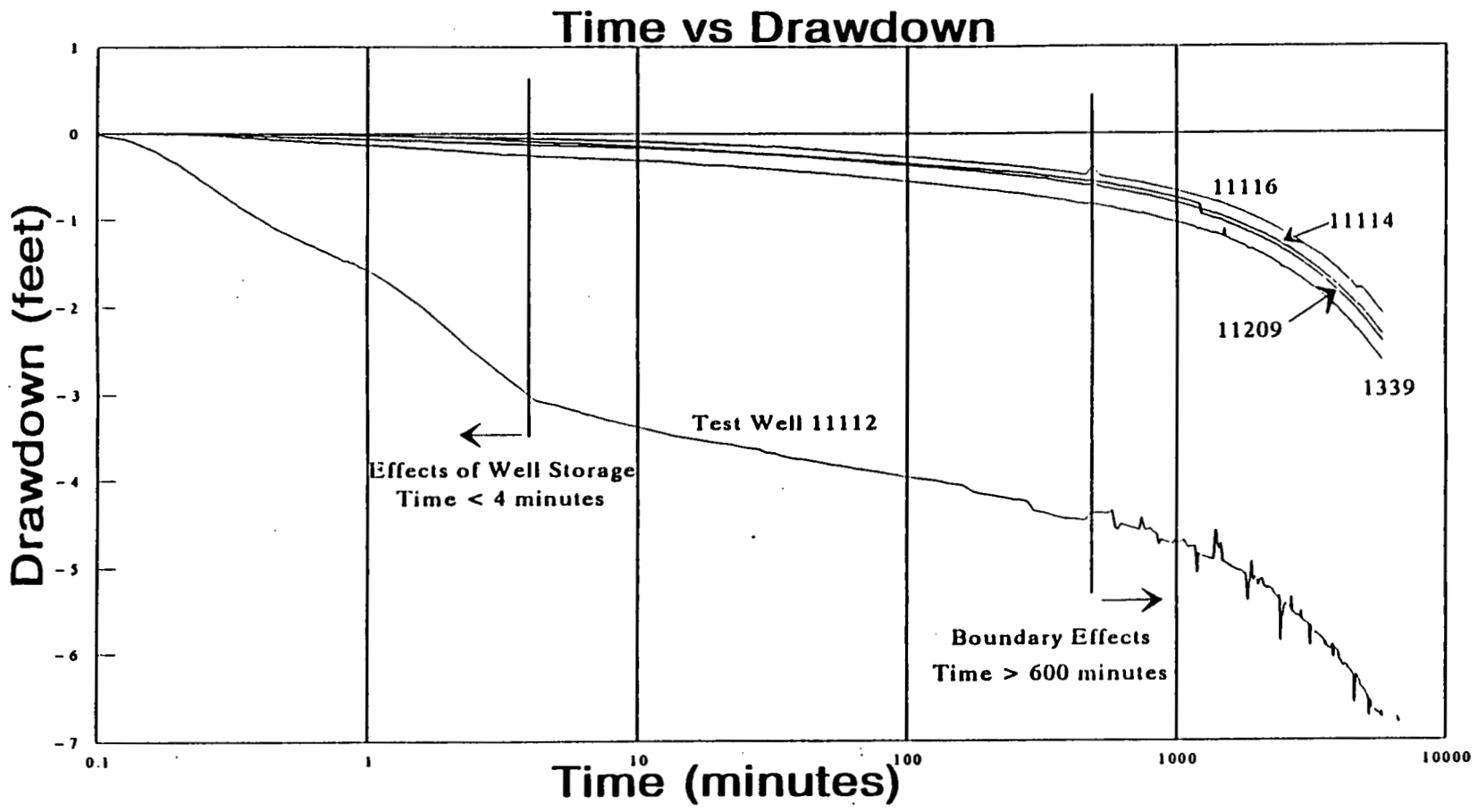


Figure 5-6 - Water Levels During the Plant 1 Pad CRT

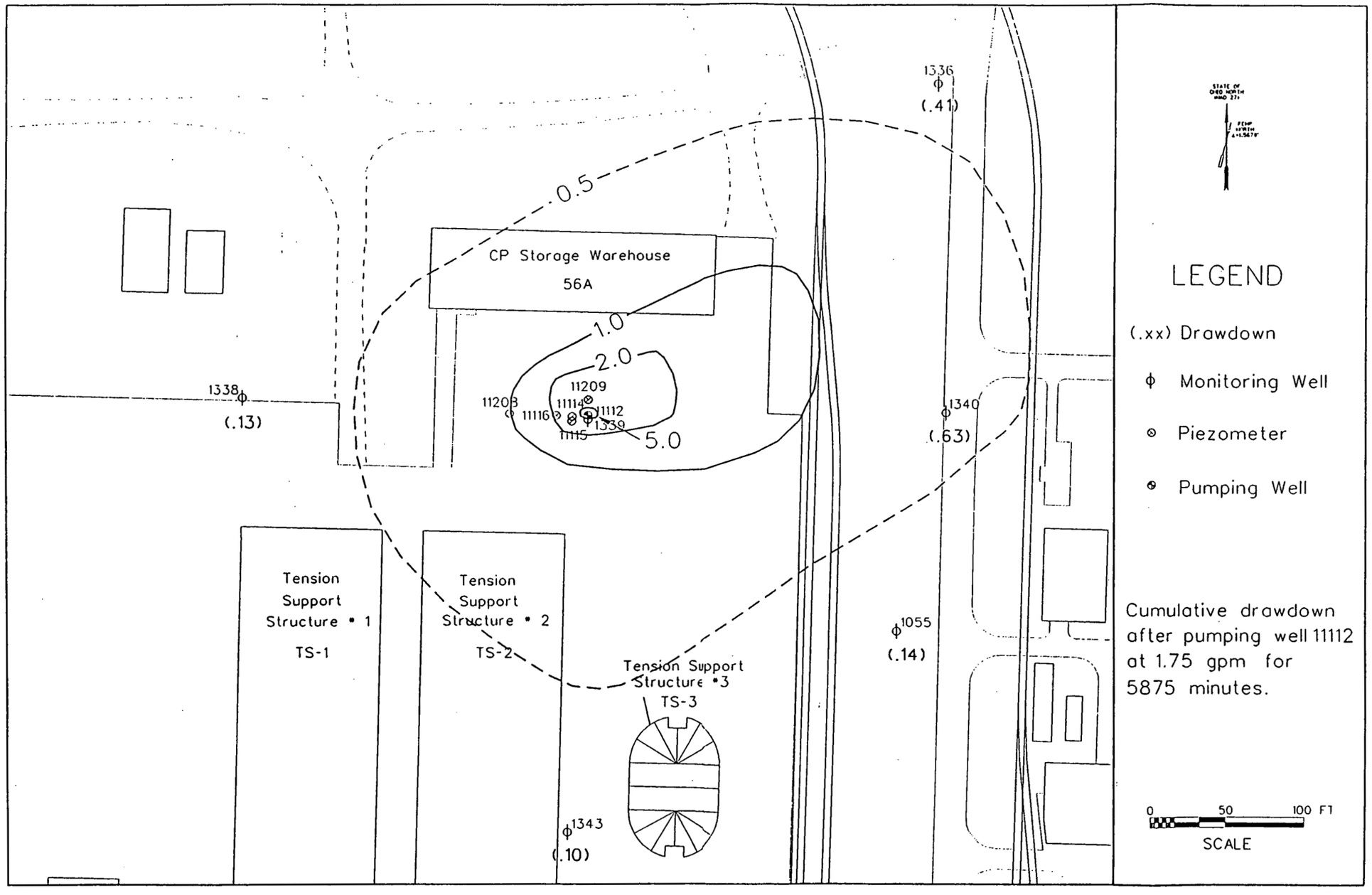


Figure 5-7 - Well Arrangement and Total Drawdown, Plant 1 Pad Pump Test

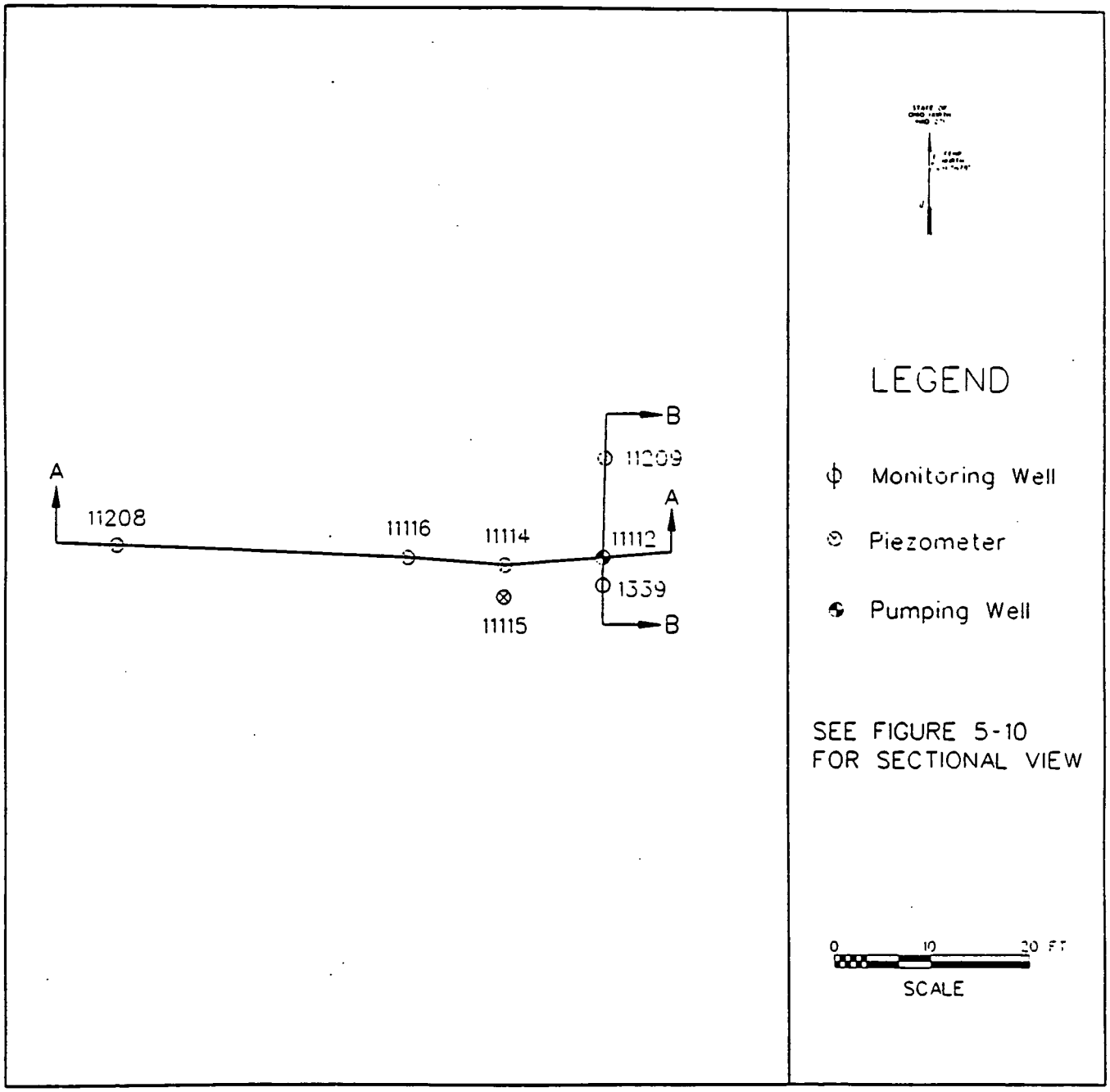


Figure 5-8 - Plant 1 Pad New Observation Well Locations

Table 5-4 - Test and Observation Wells, Plant 1 Pad Pumping Test

FEMP Well No.	Well Type	Depth to Screen Bottom (feet)	Distance to 11112 (feet)	Well Diameter, ID (inches)	Screen Length (feet)	Total Drawdown (ft)[1]	Notes
11112	Test Well	14.0	0.0	4	10	6.70	Test Well
11114 (Pz-1B)	New Observation Well	16.50	9.99	2	12.5	2.29	
11115 (Pz-1C)	New Observation Well	20.5	10.86	2	1.0	-3.00[2]	basal clay
11116 (Pz-2)	New Observation Well	13.5	19.97	2	7.5	2.05	
11208 (Pz-3)	New Observation Well	13.5	49.67	2	9.0	0.96	
11209 (Pz-4)	New Observation Well	20.5	10.18	2	14.0	2.36	90 degree offset
1339	Monitoring Well	12.0	2.67	2	7.0	2.59	
1055	Monitoring Well		243.7			.14	
1338	Monitoring Well	10.5	220.3	2	5.0	.13	
1340	Monitoring Well	20	230.6	2	10.0	.63	
1343	Monitoring Well	10.5	269.7	2	5.0	.10	
1336	Monitoring Well	20.8	309.01	2	13	.41	

1 Cumulative drawdown after 5,875 minutes at 1.75 gpm.

2 Well not equalized prior to start of pumping test; response is due to equalization following development.

000202

Two observation wells (11208 and 11115) and the test well (11112) were eliminated from consideration for parameter estimation for the following reasons:

1) Observation Well 11208 was unduly influenced by precipitation events during the pump test. Additionally, the monitored response for Observation Well 11208 generally occurred after boundary conditions were encountered. The boundary effects violate the assumption of infinite areal extent.

2) Observation Well 11115 was screened in the basal clay and exhibited a continuously rising water level throughout the pumping test. The initial water level was below the static water level in the surrounding wells. It is believed that the rising water level in this well was due to slow and incomplete recovery following development.

5.2.5 Results

The objectives of this pumping test were to determine conductivity and storativity of the sand body as well as to assess the degree of hydraulic connection between the test well and surrounding wells. A conceptual cross section of the Plant 1 Pad Area is provided in Figure 5-10.

For the Plant 1 Pad pumping test, four observation wells (1339, 11114, 11209, 11116) showed sufficient response to pumping to be considered for parameter estimation (Table 5-5). The observation wells exhibited responses characteristic of unconfined conditions. When analyzed by the Neuman method, they exhibited a tight correlation for values of horizontal hydraulic conductivity and ratio of vertical to horizontal conductivity. All four observation wells exhibited a greater drawdown at approximately 600 minutes into the test. This change likely occurred when the expanding cone of depression from the test well encountered a flow boundary; in this case, the edge of the sand body. The effects of well storage can be seen over approximately the first four minutes of pumping as indicated by the abrupt change in slope at that time (Figure 5-6).

000201

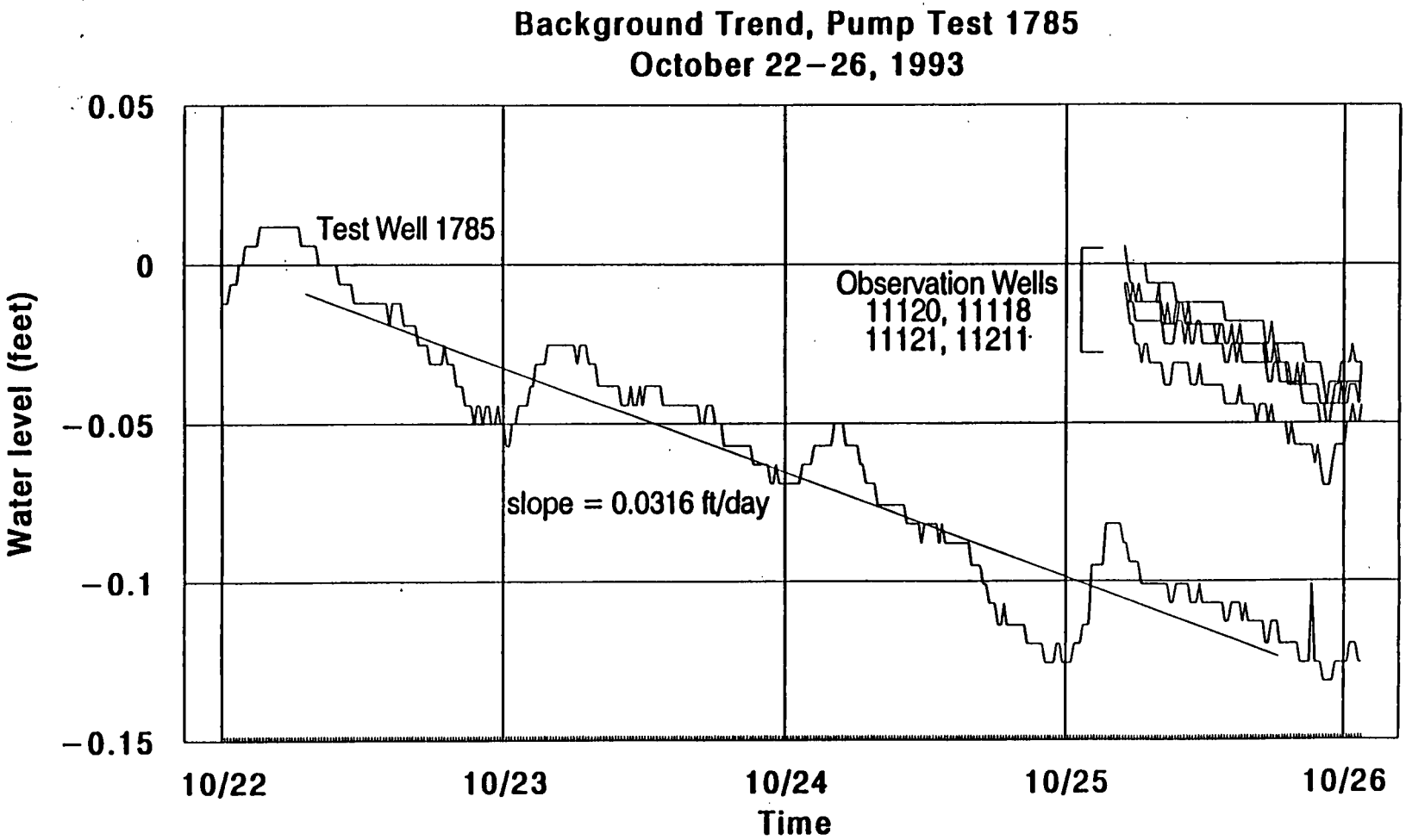
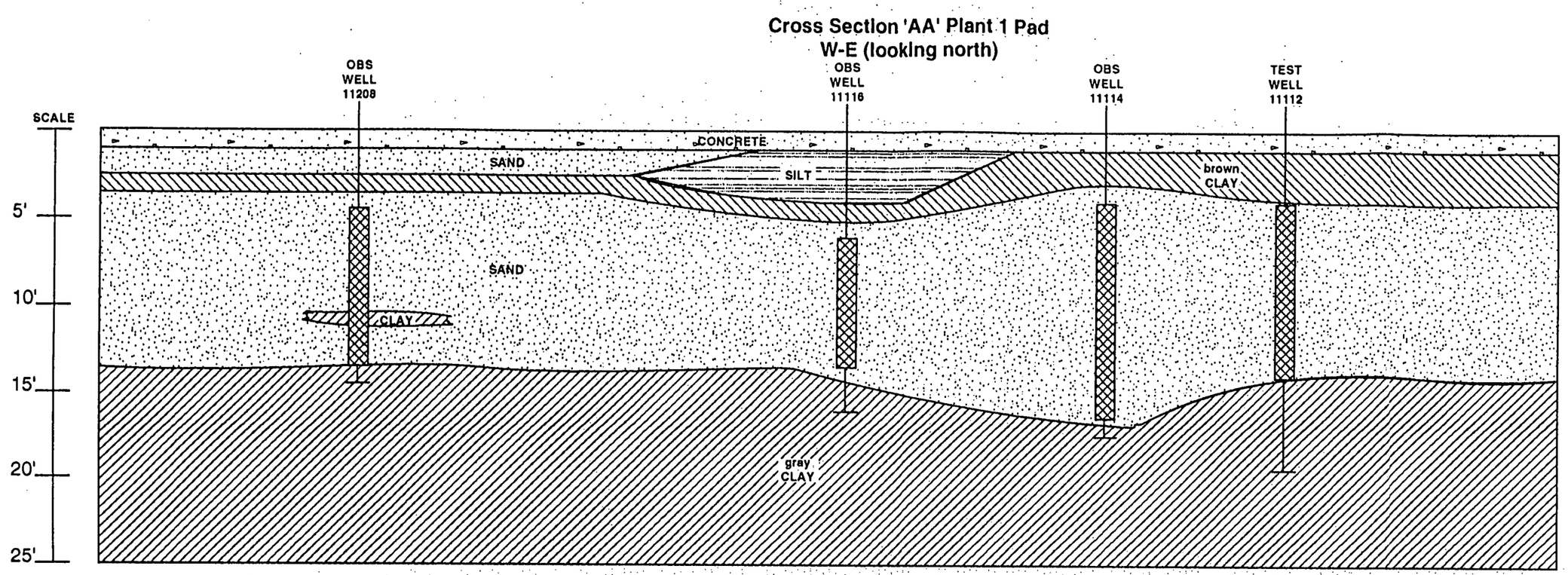


Figure 5-9 - Background Trend Pump Test, Plant 1 Pad



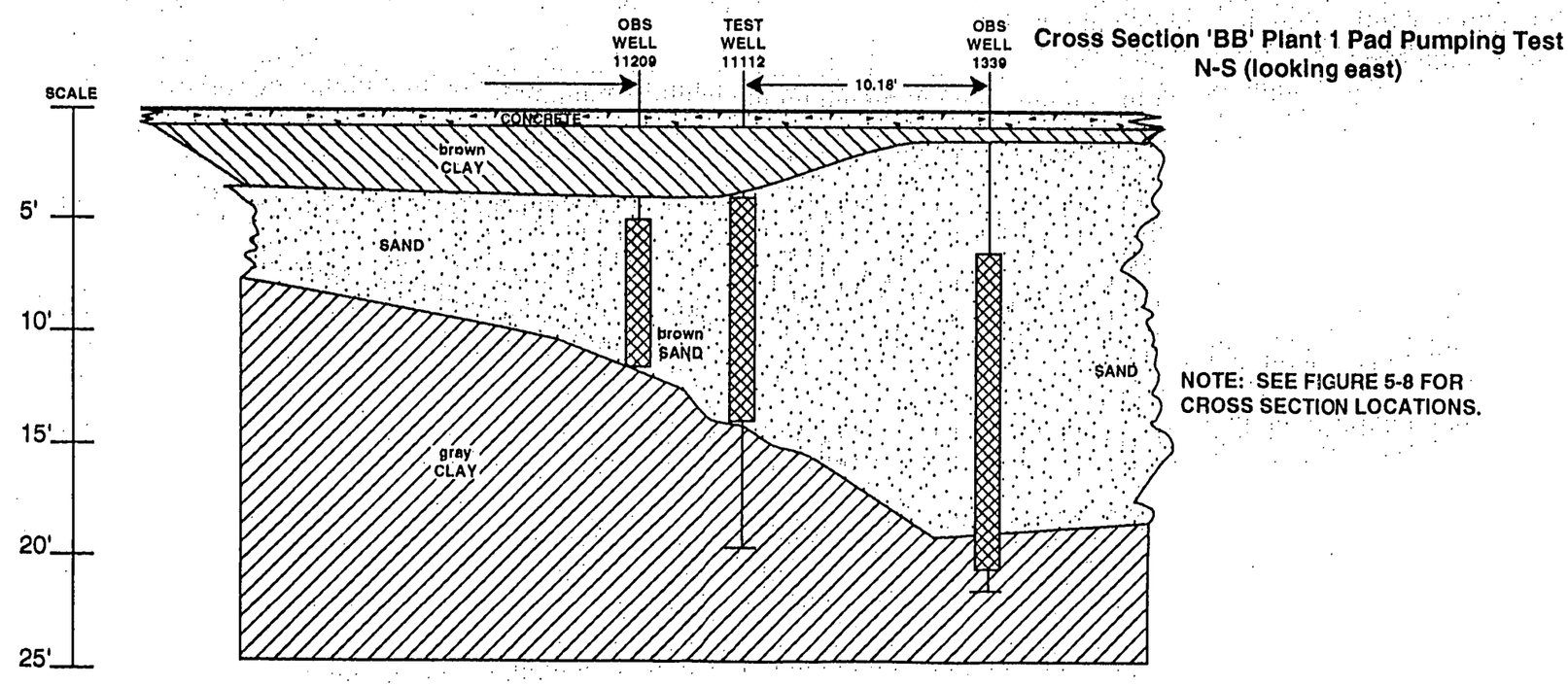


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Figure 5-10 - Conceptual Cross Section, Plant 1 Pad Area

Table 5-5 - Pumping Test Results, Plant 1 Pad

			Theis		Neuman (Primary Method)				Theis Recovery
Well to Number	Distance to Test Well (ft)	Thickness (ft)	K_h (ft/day)	S	K_h (ft/day)	S	S_y	K_y/K_h	K_h (ft/day)
1339	2.67	10.5	38.6	0.015	20.3	0.16	0.107	0.54	6.53
11114	9.99	13.2	25.0	0.009	12.1	0.006	0.028	0.35	4.05
11209	10.18	17	32.2	0.002	11.7	0.002	0.024	0.56	NP
11116	19.97	8.1	120.1	0.002	33.4	0.001	0.007	0.13	5.47
Geometric Mean					17.6 (6.8 x 10^{-3} cm/sec)	.0081			
Average						0.0023	0.042	0.395	

Notes:

NP - calculation not performed

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From the Neuman analysis, the sand body penetrated by the test well exhibits a horizontal hydraulic conductivity of 17.6 ft/day (6.18×10^{-3} cm/sec), a specific yield of approximately 0.042, a storativity of 0.0023, and a ratio of horizontal hydraulic conductivity to vertical conductivity of approximately 2.5:1.

Calculated conductivity using the Theis recovery method yielded lower values due to the slow recharge to the sand body which is controlled in part by the surrounding clay till.

The shape of the drawdown contours in Figure 5-7 indicates a northeast to southwest trend.

The value of conductivity calculated for the test well (11112) is lower than the corresponding observation wells due to head losses associated with pumping, and the test well data is not considered for parameter estimation.

5.3 Waste Pit Area (Well 11214)

5.3.1 Construction

Well 11214 was the pumped well for the CRT conducted in the waste pit area. It was installed in August 1993. Figure 5-11 provides a diagram of the well and the surrounding lithology. The well was drilled to a total depth of 34.5 feet BGS with an 8-inch ID hollow stem auger drilling rig. The borehole was subsequently backfilled with a mixture of Volclay grout and Portland cement to a depth of 26.5 feet. A 4-inch ID schedule 316 stainless steel casing was installed to a depth of 24.25 feet BGS and was screened from 14 to 24 feet BGS with a 0.010 inch slot screen. A sand pack was placed from 26.5 to 9.0 feet and a 2.0 foot seal of bentonite pellets was placed above the sand pack. The remainder of the annular space was filled with a Volclay grout/cement. The well was completed with a 10.75 inch OD steel protective riser casing.

Well 11214 is situated within a small 20-foot wide channel that tends roughly in a northeast to southwest direction.

5.3.2 Conduct of Test

The Waste Pit Area CRT started at 13:45 on September 21, 1993. A discharge rate of 2.0 gpm was maintained within ± 5 percent for the duration of the test. Maximum drawdown in the test well reached 10.88 feet. The CRT was concluded at 15:35 on September 27th after approximately 8,740 minutes of pumping. Figure 5-12 shows a time-drawdown plot for the pump test while Figure 5-13 shows the total drawdown at the end of the test. Figure 5-14 shows the well arrangement in the immediate vicinity of Well 11214. This information is summarized in Table 5-6.

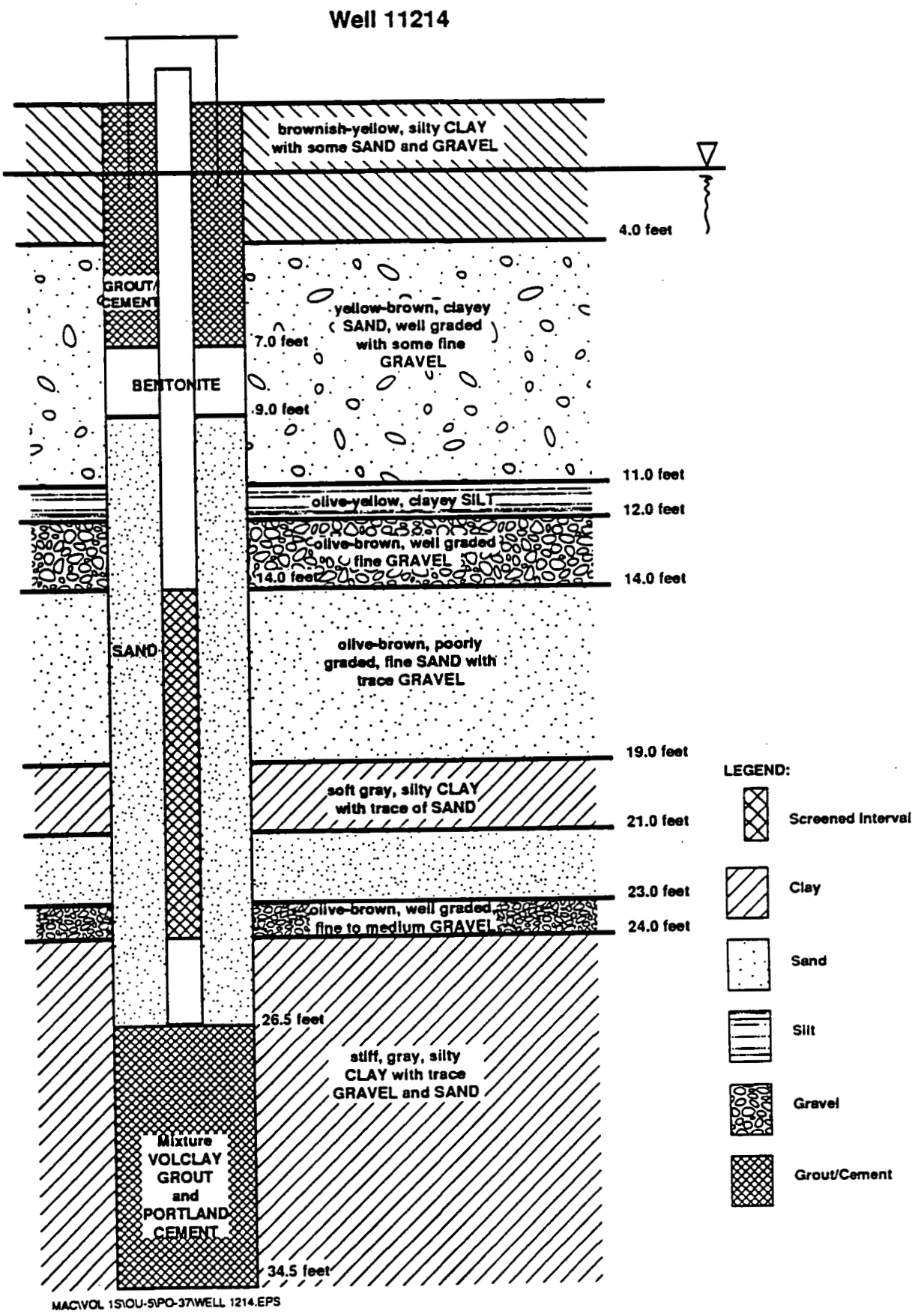

Figure 5-11 - Well 11214: Construction and Surrounding Lithology

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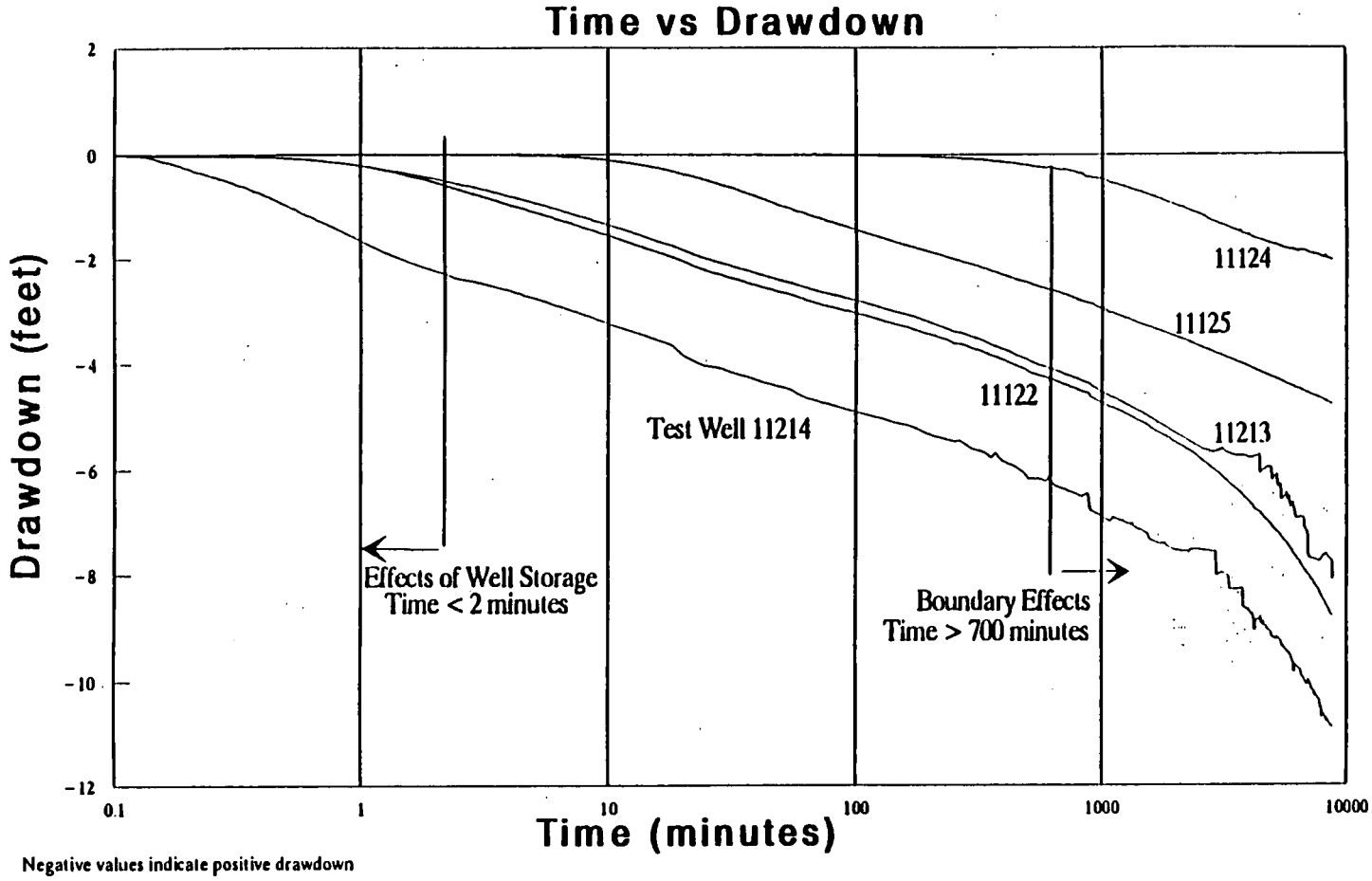

Figure 5-12 - Water Levels During the Waste Pit Area Test

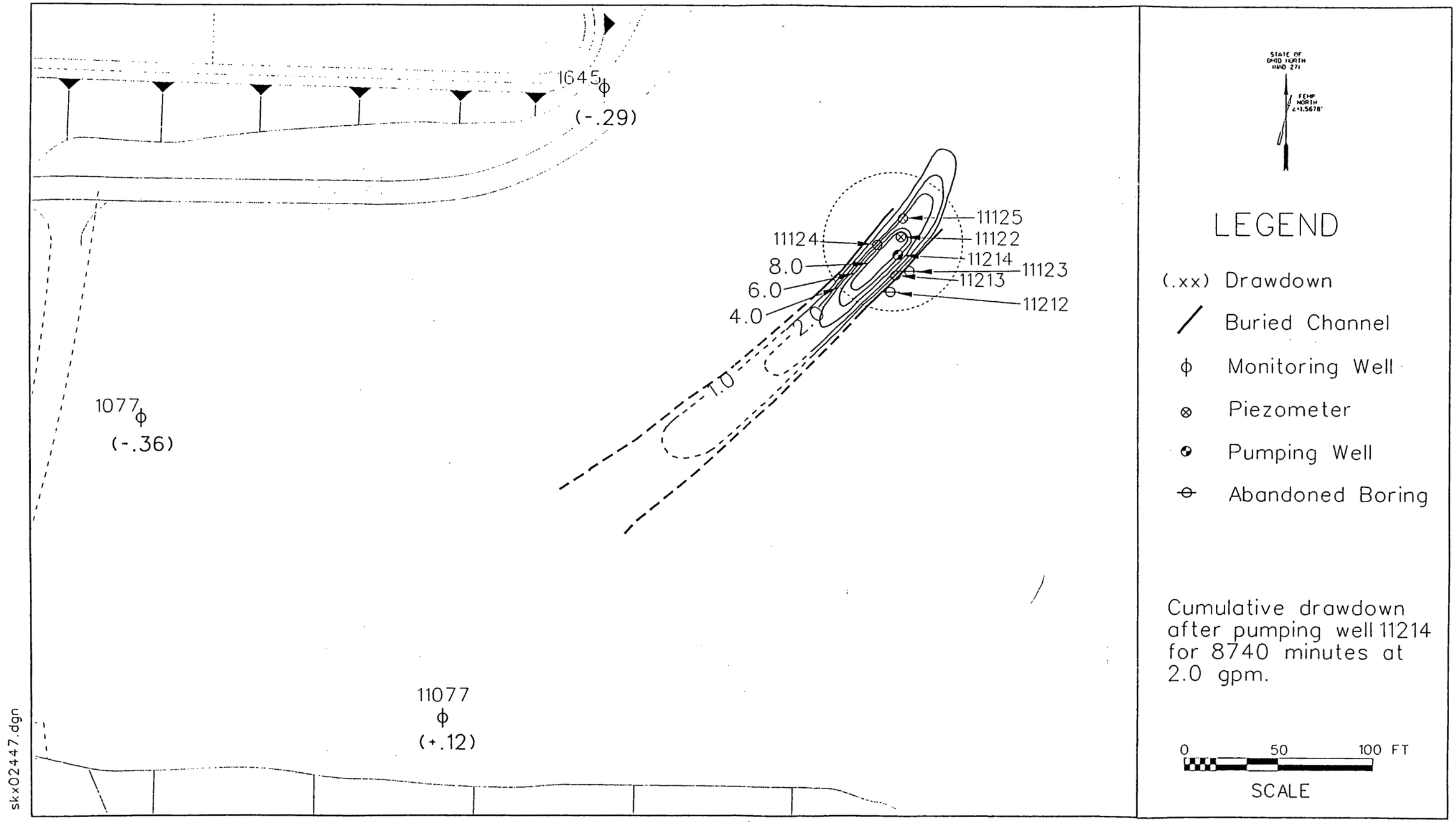

Figure 5-13 - Well Arrangement and Total Drawdown, Waste Pit Area Pump Test

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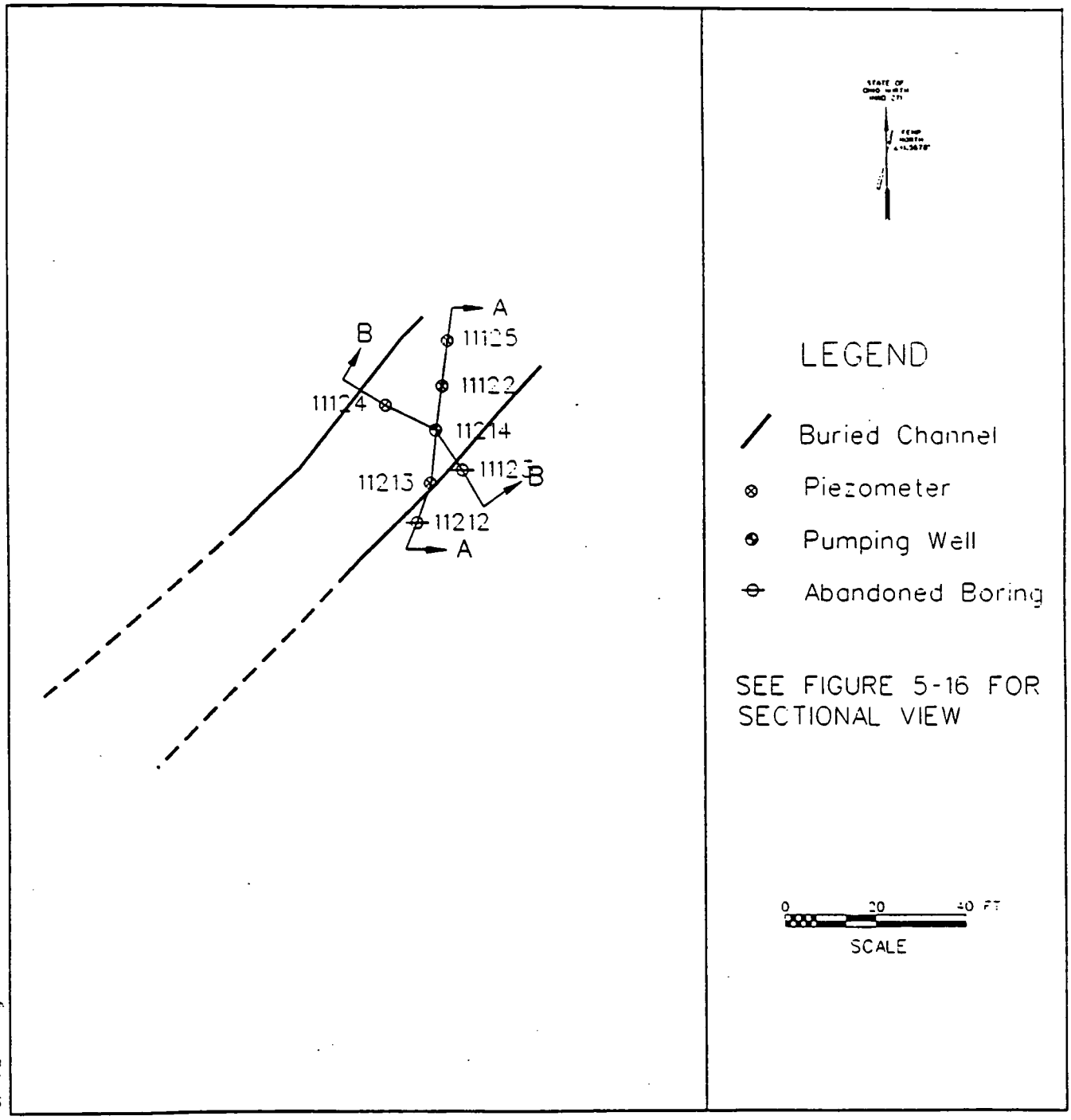

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Figure 5-14 - Waste Pit Area New Observation Well Locations

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Table 5-6 - Test and Observation Wells, Waste Pit Area Pumping Test

FEMP Well No.	Well Type	Depth to Screen Bottom (feet)	Distance to 11214 (feet)	Well Diameter, ID (inches)	Screen Length (feet)	Total Drawdown (ft)[A]	Notes
11214	Test Well	24.0	0.0	4	10.0	10.88	Test Well
11213	New Observation Well	16.0	11.15	2.0	11.0	8.11	
11122	New Observation Well	25.0	9.7	2.0	10.0	8.81	
11125	New Observation Well	11.5	19.65	2.0	6.0	4.77	
11124	New Observation Well	9.5	12.16	2.0	1.0	2.03	Shallow Sand Zone
1010	Monitoring Well	27	475.1	4	11	-0.03[B]	
1774	Monitoring Well	31	407.1	4	4	-0.302[B]	Waste Pit 4
1645	Monitoring Well	25.5	180.0	4	10	-0.29[B]	
11077	Monitoring Well	21.5	346.4	4	5	0.12	
1077	Monitoring Well	33	411.3	4	10	-0.36[B]	
11216	Monitoring Well	35	323.9	4	10	-0.08[B]	

A Cumulative drawdown after 8,740 minutes of pumping at 2.0 gpm.

B Overall negative drawdown due to rain event on September 24-25, 1993.

000212

Recovery was monitored from the time the pump was turned off on September 27 until 11:15 on September 30 when the test well had recovered 66 percent. On September 28, at 09:05, the pressure transducers were inadvertently removed from Wells 11124, 11125, and 11120 for approximately 10 minutes due to miscommunication between the test technicians. The transducers were returned to their wells at approximately the same depth and monitoring continued.

5.3.3 Analysis

The response to pumping was generally characteristic of semi-confined conditions. Data was analyzed primarily by the Hantush-Jacob method with Neuman and Theis analysis included for purposes of comparison.

5.3.4 Background Trend

Figure 5-15 is used to evaluate the background trend for the Waste Pit Area pump test. The figure shows the water level in the test well (11214) and associated observation wells. Water levels in each of five wells are referenced to level at the start of the background period and are plotted over the 36-hour period immediately prior to the constant rate test. Each well exhibited a relatively constant water level over this period with variations of less than 0.03 feet. Figure 5-4 presents precipitation data collected over this time period from the FEMP weather station. Precipitation totaling 1.8 inches fell on October 24 and 25. While this precipitation occurred during the constant rate pumping test, it occurred far enough into the test that the effects of boundary conditions had already been encountered. Since the Theis and Cooper-Jacob analysis were performed on data prior to the appearance of boundary effects, the precipitation events do not affect parameter estimation.

5.3.5 Results

The test well (11214) penetrates and is screened in a sand body interpreted to be a narrow buried channel approximately 20 feet wide. The objective of this test was to estimate hydraulic conductivity. A conceptual cross section is provided in Figure 5-16.

Well locations and the cumulative drawdown at the end of the pumping test are shown in Figure 5-13. The cone of depression steepens noticeably to the west of the pumping well where it intercepts the edge of the channel. The test well demonstrated no communication with wells outside the channel. Wells outside the channel eventually showed a rising water level due to the precipitation event that occurred on September 24 and 25 (Table 5-6, Figure 5-13).

Three methods of analysis were used: (1) Hantush-Jacob (semi-confined), (2) Theis (confined), and (3) Neuman (unconfined). The recovery data was also analyzed using the Theis method. The test well

exhibited confined characteristics as initially the water level was above the lower extent of an upper brown silty-clay layer. An additional confining or semi-confining layer is also present approximately 10-14 feet BGS. As the test proceeded, hydraulic head was reduced and conditions transitioned to either unconfined or semi-confined.

The results of this analysis are provided in Table 5-7. The best data for analysis is between 2 and approximately 700 minutes. This time is after the effects of well storage have dissipated and before the effects of boundary conditions and precipitation become significant. During the early portion of this time period the hydraulic conditions are still largely confined so there is strong agreement between all three methods of pump test analysis. During a later portion of the pump test, it is likely that some dewatering of the upper sand body occurred.

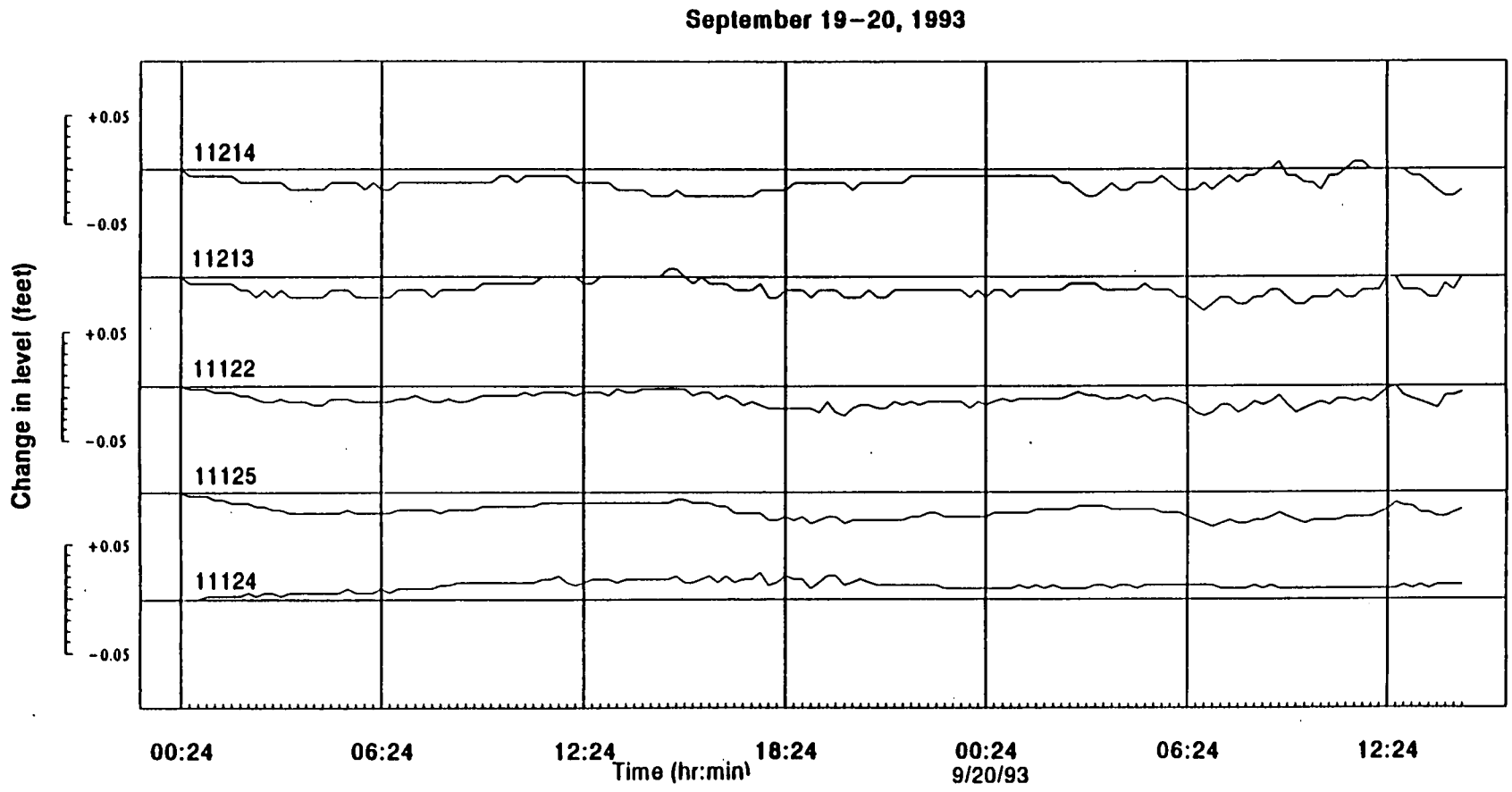
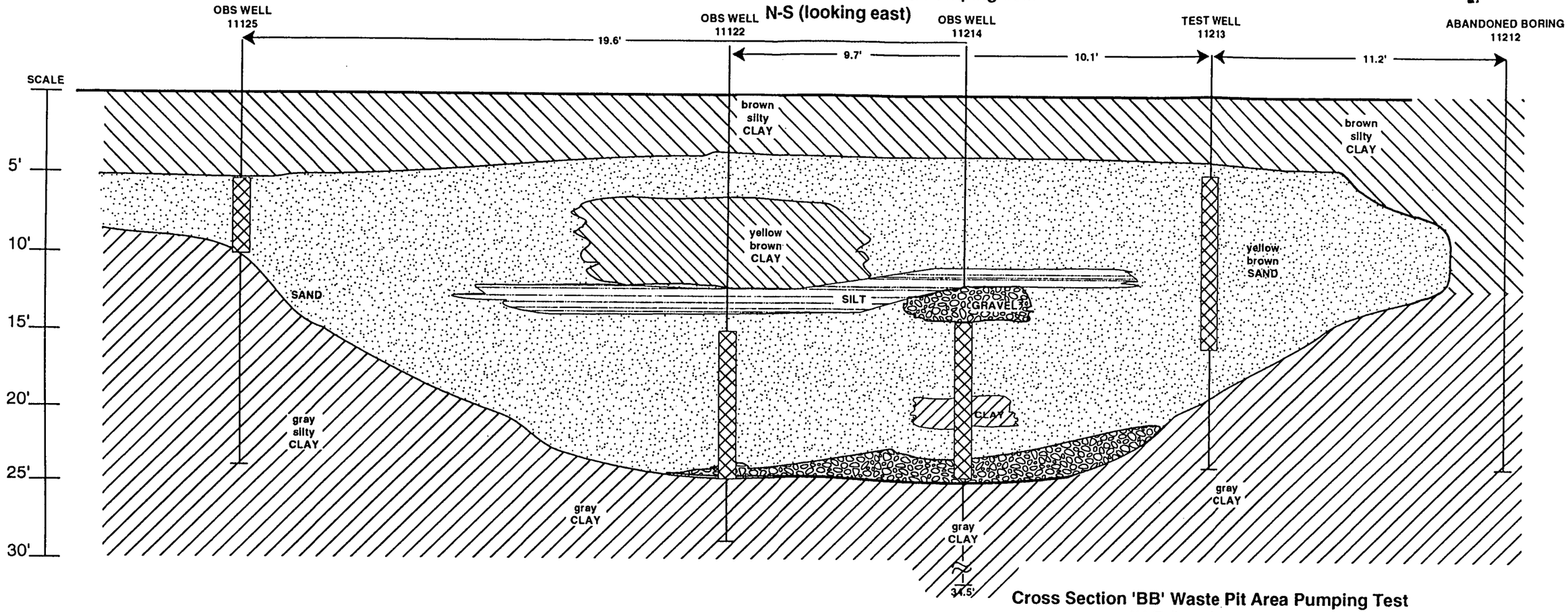
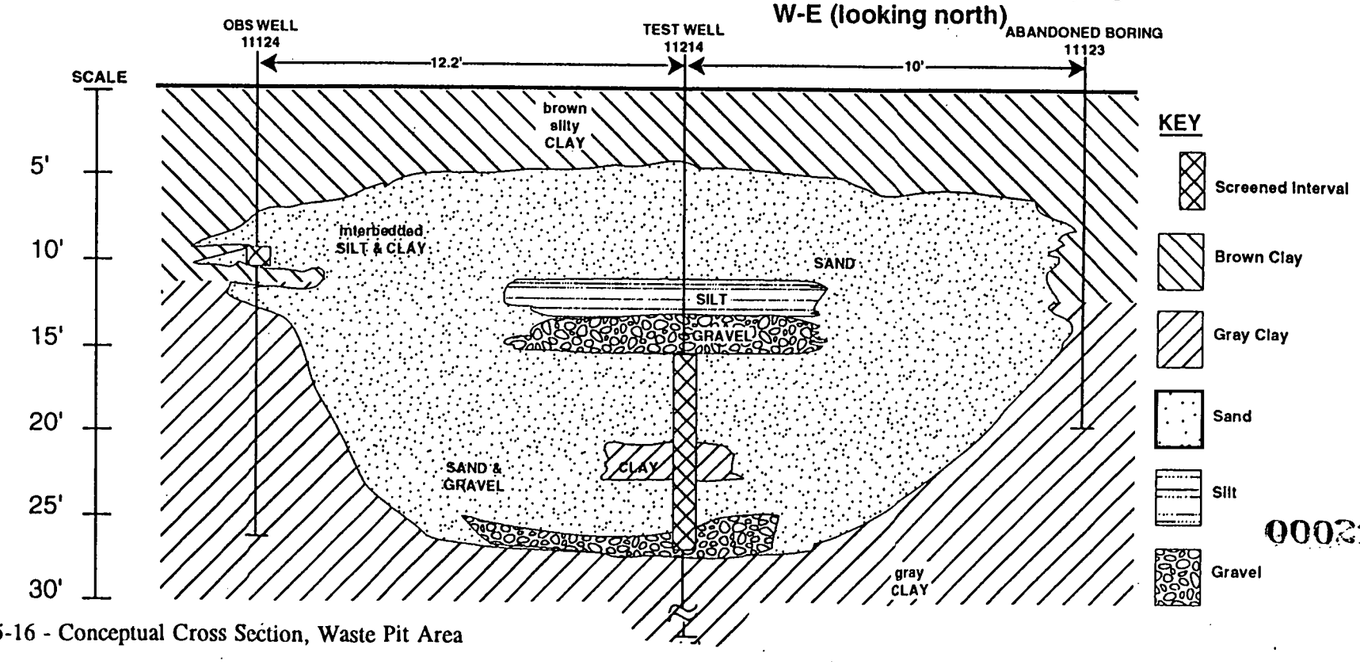


Figure 5-15 - Background Trend, Waste Pit Area Pump Test

Cross Section 'AA' Waste Pit Area Pumping Test
N-S (looking east)



Cross Section 'BB' Waste Pit Area Pumping Test
W-E (looking north)



NOTE: SEE FIGURE 5-14
FOR CROSS SECTION LOCATIONS.

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Figure 5-16 - Conceptual Cross Section, Waste Pit Area

Table 5-7 - Pumping Test Results, Waste Pit Area

Well Number	Distance to Test Well (ft)	Thickness (ft) (Unconfined/ Confined)	Theis		Neuman				Hantush-Jacob (Primary Method)		Theis Recovery
			K_h (ft/day)	S	K_h (ft/day)	S	S_y	K_v/K_h	K_h (ft/day)	S	K_h (ft/day)
11213	11.15	12.25	3.7	0.00083	3.7	0.00083	0.00049	0.036	3.7	0.00083	0.81
11122	9.7	15.25 / 11.25	4.0	0.00081	3.8	0.0014	0.0023	0.0099	3.9	0.0084	0.83
11125	19.65	6.75 / 6.25	5.6	0.0032	4.1	0.0031	0.0090	0.012	5.6	0.0029	2.47
Geometric Mean									4.3 (1.5×10^{-3} cm/sec)		
Average								0.0193		0.0040	

Notes:

NP - calculation not performed

000217

1507

Recharge to the sand body was controlled in part by the less permeable clay material which surrounds the buried channel. This effect can be observed in the recovery analysis where the calculated conductivity is lower then that predicted by any of the three pumping analyses. Due to the short period of data collection following the termination of the pump test, the assumptions of the Theis analysis are not valid: however, it still provides fairly representative values.

Data was collected from 10 observation wells and the test well. These wells are shown on Figure 5-13. Observation wells located outside the channel (1645 and 1077) exhibited a negative drawdown (rising level) during the pump test and are not considered to be in communication with the test well. They were not considered during parameter estimation.

Additionally, the test well (11214) is not included in parameter estimation due to the effects of pumping. Observation Well 11124 is not included because its relatively poor response indicates that it is not in good communication with the rest of the channel (Figure 5-16).

The three remaining observation wells exhibited responses characteristic of semi-confined conditions. When analyzed by Theis, Neuman, and Hantush-Jacob, they exhibited a tight correlation for values of horizontal hydraulic conductivity and storage coefficient. A steepened drawdown curve was observed approximately 600-800 minutes into the test. This change in slope occurs as the expanding cone of depression from the test well encounters a flow boundary.

From the Hantush-Jacob analysis, the sand body exhibits a horizontal hydraulic conductivity of 4.3 ft/day (1.5×10^{-3} cm/sec) and a storativity of 0.004. This agrees with slug test results and values of storativity for semi-confined conditions. Theis' recovery analysis yielded lower values of conductivity due to dewatering of the sand body and slow recharge through the less permeable surrounding clay till.

The drawdown contour plot of Figure 5-14 shows an elongation consistent with the buried channel. Figure 5-17 shows a distance drawdown plot 700 minutes into the pump test (prior to the rain event). This figure qualitatively shows that with the exception of Well 11124, which is thought to be screened at the inside edge of the buried channel, the drawdown associated with each well generally correlates linearly with the log of distance. This indicates that the observation wells screened in the buried channel (with the exception of 11124) are in good communication with the test well.

000218

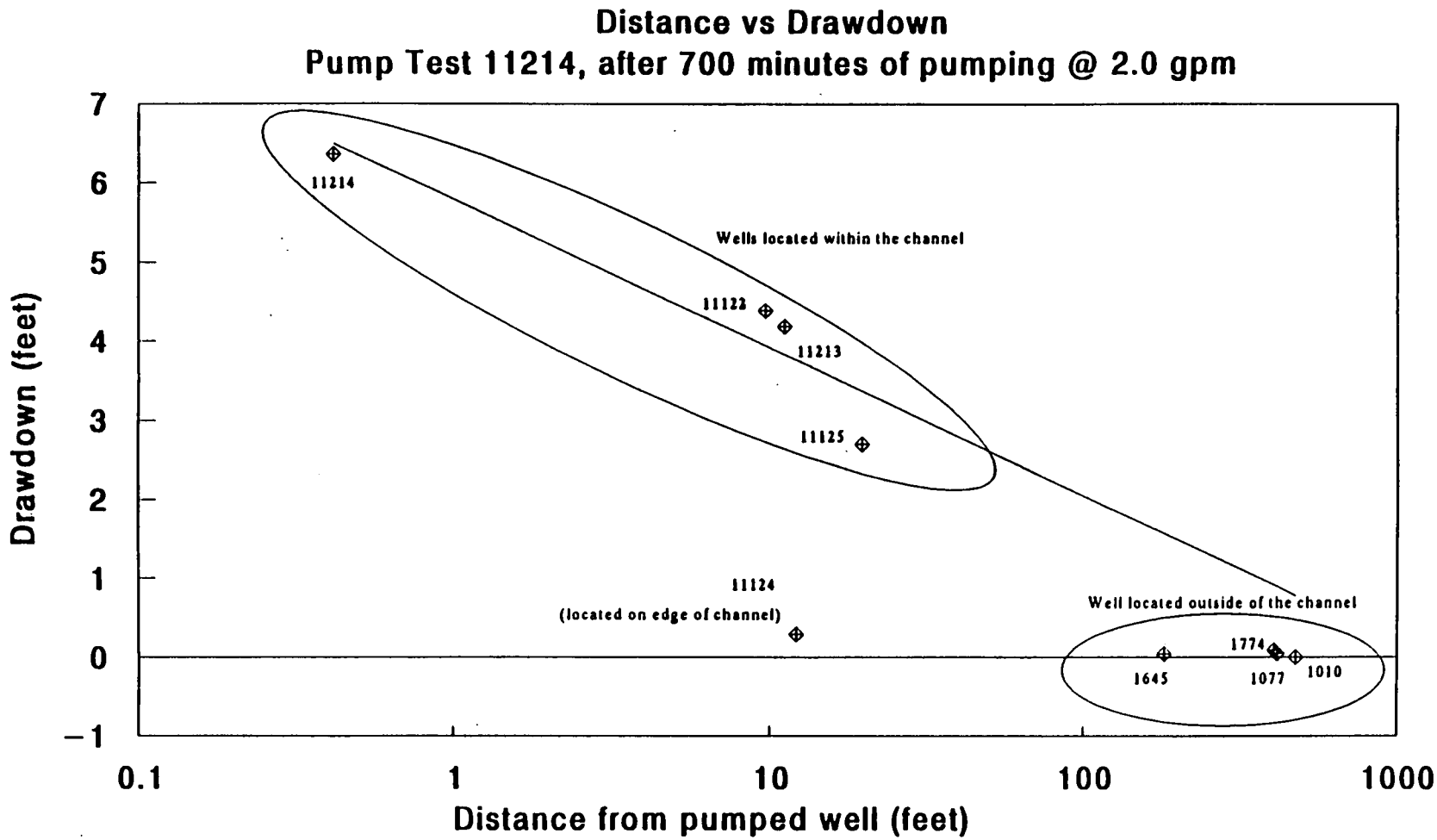

Figure 5-17 - Distance Drawdown, Waste Pit Area Pump Test

002219

1502

5.4 Plant 8 Area (Well 1785)

5.4.1 Construction

Well 1785 was the pumped well for the CRT conducted in the Plant 8 area. It was installed in August 1991. Figure 5-18 provides a diagram of the well and surrounding lithology. The borehole was advanced with a 12-inch Outer Diameter (OD) hollow stem auger (HSA) drilling rig to a total depth of 21 feet BGS. The well was completed with a 6-inch ID Schedule 316 stainless steel casing to a depth of 18.7 feet BGS, and screened from 8.2 to 18.2 feet BGS with a 0.010 inch slot screen. A sand pack was placed from the bottom of the borehole to 6.0 feet. A 4.7 foot seal of Bentonite pellets was placed above the sand pack. The well was completed as a flush mount.

5.4.2 Conduct of Test

The CRT was initiated on November 4, 1993, at 13:30 at a constant discharge rate of 1.5 gpm. The test was terminated after 370 minutes due to dewatering of the well. The water level quickly recovered once the pump was shut off, regaining 90 percent of the CRT drawdown in less than 8-1/2 minutes.

A second CRT was begun at 21:58 at a lower discharge rate. The discharge rate was established as 1.25 gpm and maintained within ± 5 percent for the duration of the CRT. Maximum drawdown in the test well was measured at 10.76 feet. The test was concluded at 11:26 on November 7 after 3,685 minutes of pumping due to dewatering. Figure 5-19 shows a time-drawdown plot for the pump test while Figure 5-20 shows the total drawdown at the end of the test. Figure 5-21 shows the well arrangement in the immediate vicinity of Well 1785. This information is summarized in Table 5-8.

Recovery was monitored from the time the pump was turned off on November 7 until 10:51 on November 8th. At this time, the test well had recovered 98 percent. The well recovered 90 percent within 34 minutes of the end of the CRT.

5.4.3 Analysis

The response to pumping was characteristic of confined conditions. Data was analyzed by the Theis and Cooper-Jacob methods.

000220

Well 1785

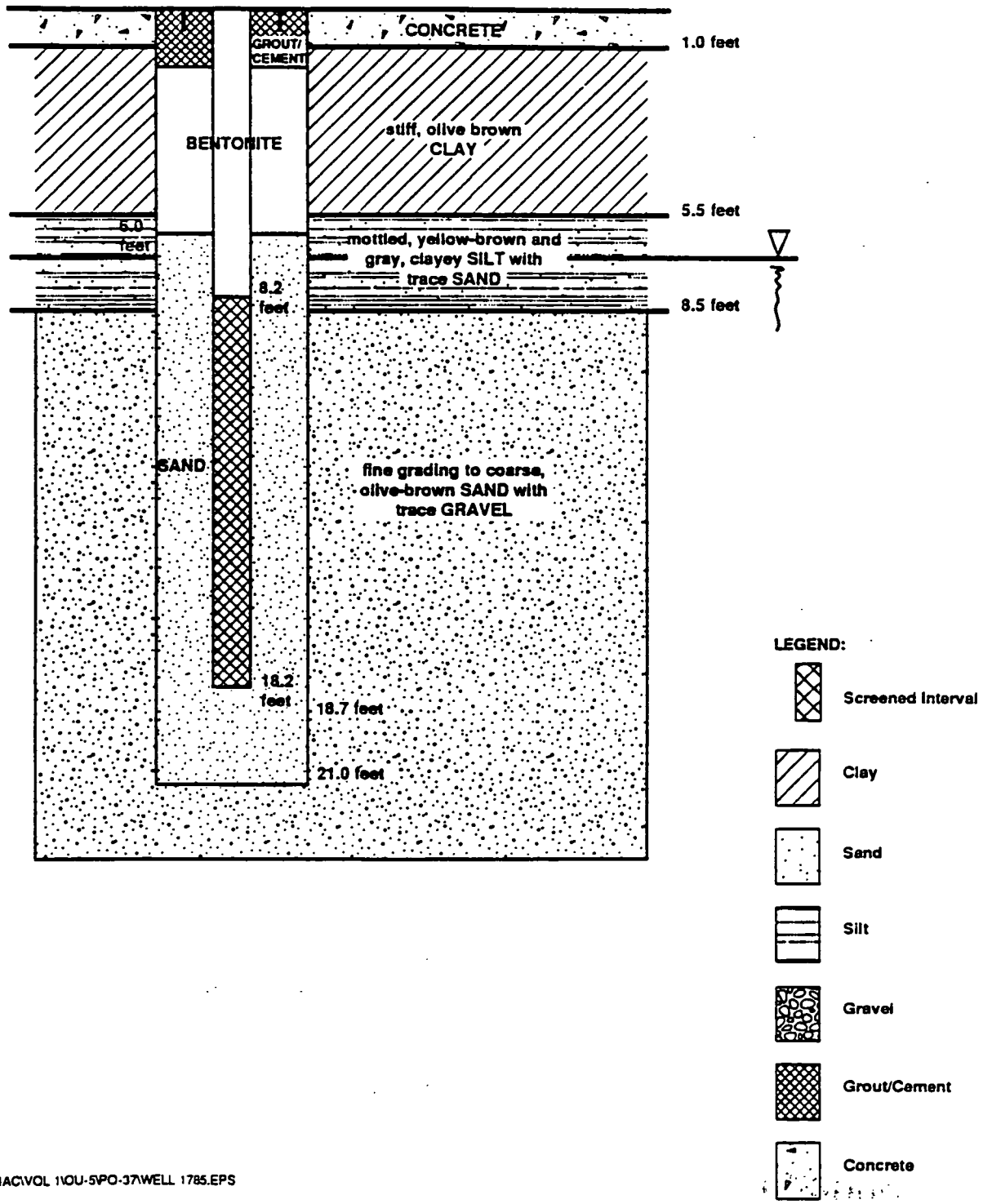

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Figure 5-18 - Well 1785: Construction and Surrounding Lithology

000222

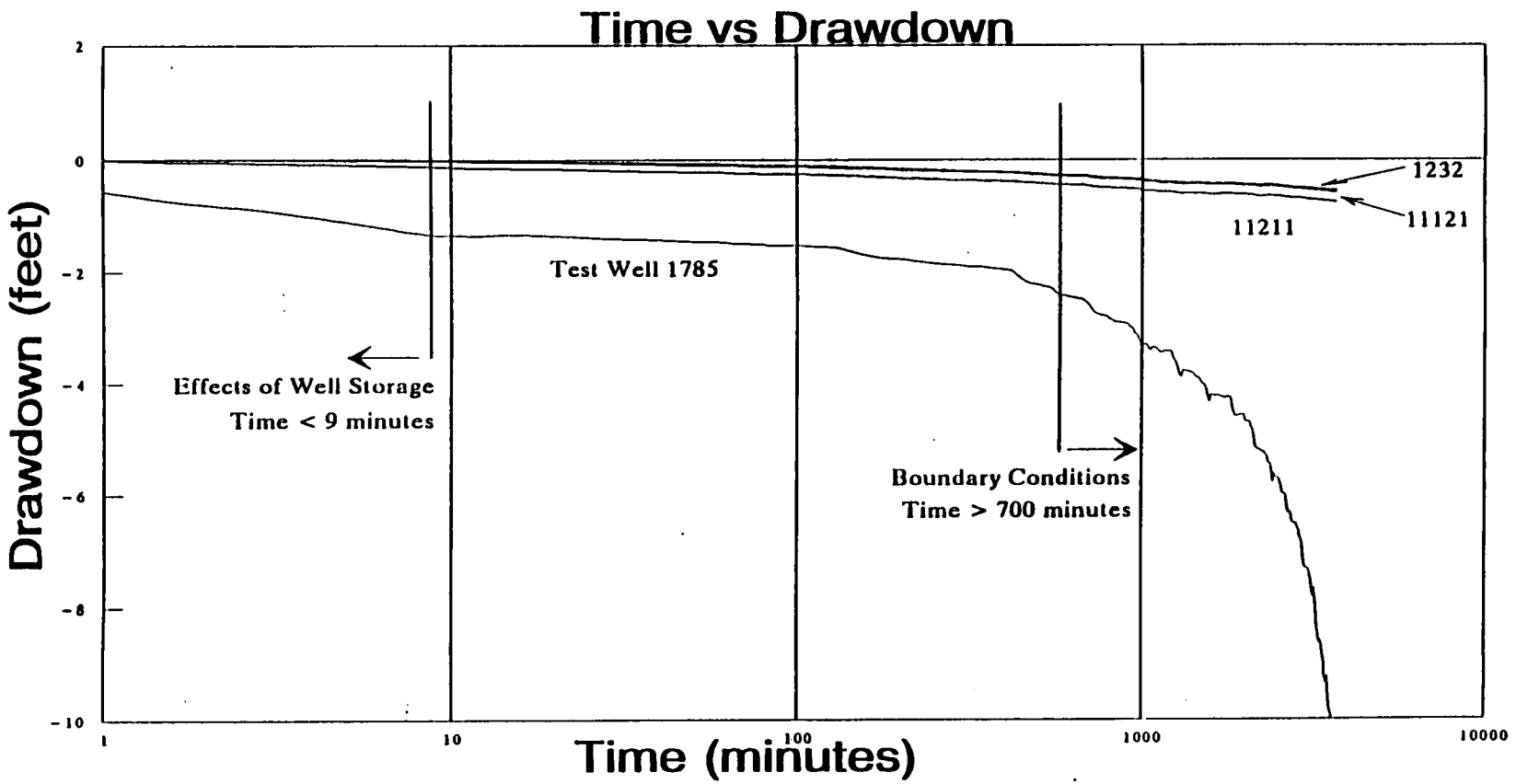

Figure 5-19 - Water Levels in the Plant 8 Area During the CRT

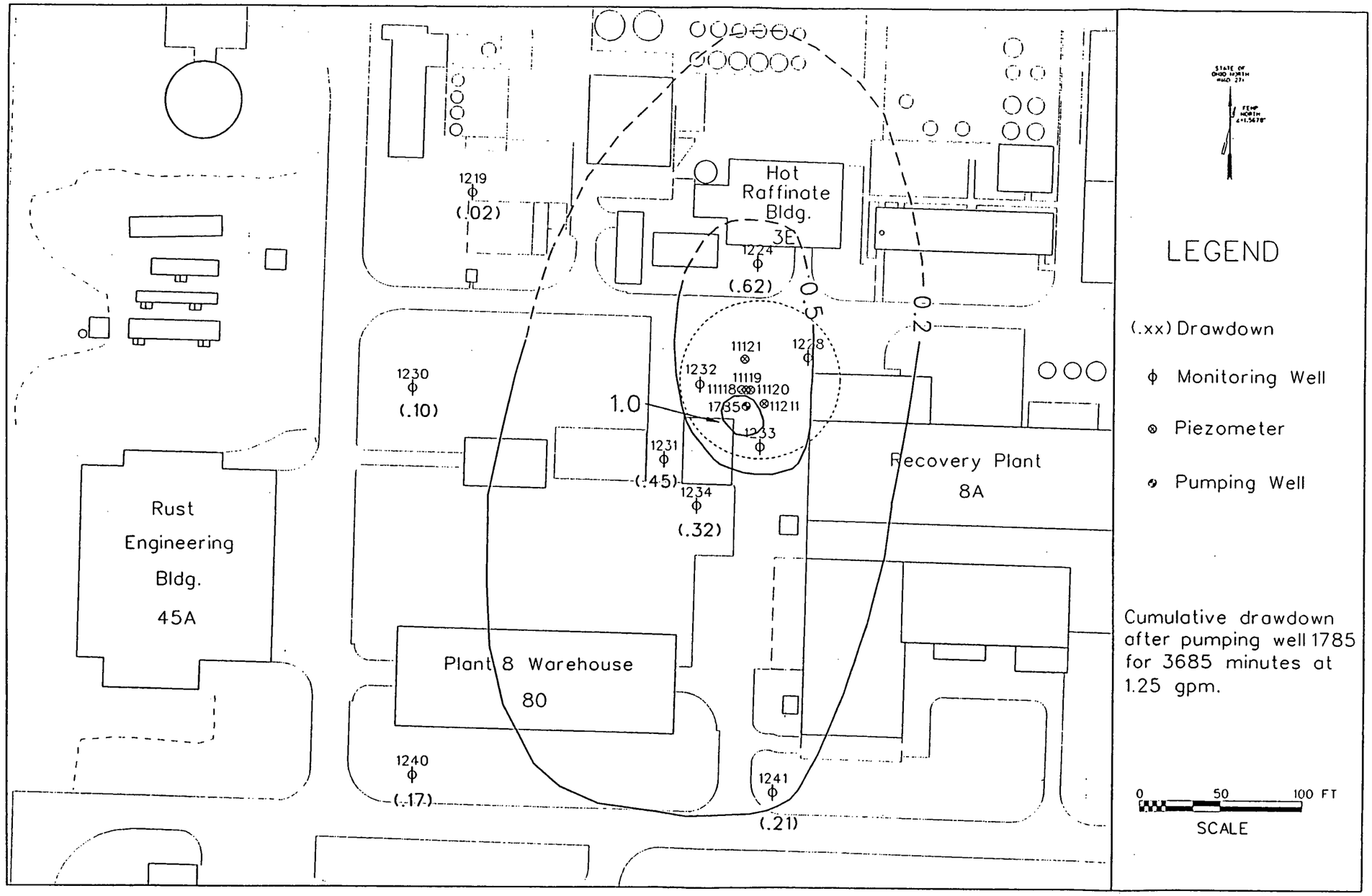

Figure 5-20 - Well Arrangement and Total Drawdown, Plant 8 Area Pump Test

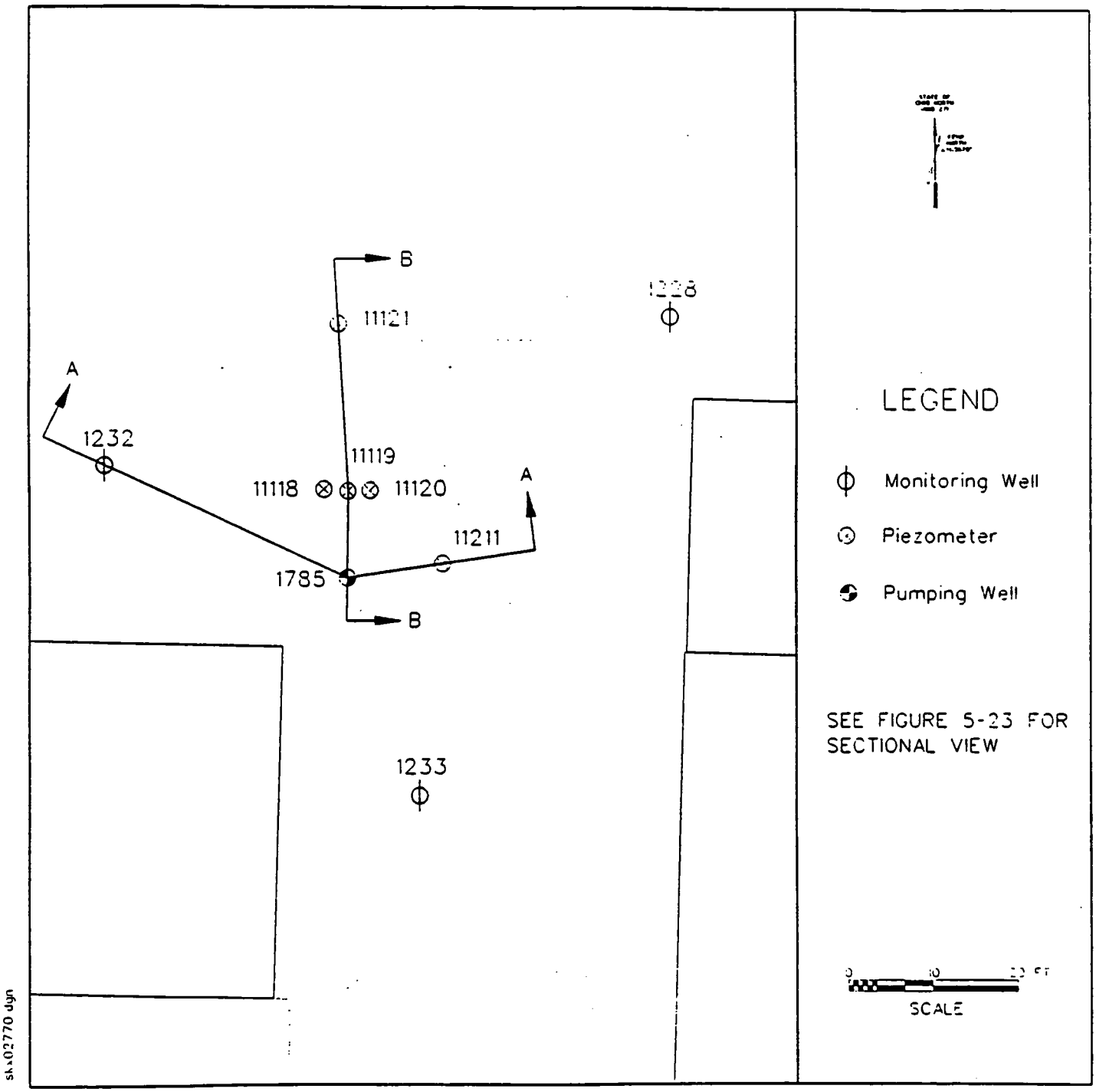

Figure 5-21 - Plant 8 Area New Observation Well Locations

Table 5-8 - Test and Observation Wells, Plant 8 Area Pumping Test

FEMP Well No.	Well Type	Depth to Screen Bottom (feet)	Distance to 1785 (feet)	Well Diameter, ID (inches)	Screen Length (feet)	Total Drawdown (ft)[A]	Notes
1785	Test Well	18.2	0.0	6	10	10.76	Test well
11119 (Pz-1C)	New Observation Well	24.5	10.18	2	1.0	0.79	basal clay
11120 (Pz-1B)	New Observation Well	21.0	10.58	2	11.5	1.00	
11118 (Pz-1A)	New Observation Well	7.5	10.82	2	1.5	0.08	upper clay
11211 (Pz-4)	New Observation Well	23.0	11.27	2	12.5	0.84	
1233	Monitoring Well	19.8	26.83	2	13	0.74	
11121 (Pz-2)	New Observation Well	24.0	29.67	2	14.5	0.66	
1232	Monitoring Well	19.6	31.46	2	15	0.63	
1228	Monitoring Well	14.6	48.88	2	4.8	0.50	
1231	Monitoring Well	20.0	61.36	2	12	0.45	
1234	Monitoring Well	10.5	69.53	2	3	0.32	
1224	Monitoring Well	20.0	88.98	2	10	0.62	
1230	Monitoring Well	20.0	206.13	2	10	0.10	
1219	Monitoring Well	12.0	214.90	2	5	0.02	
1241	Monitoring Well	15.5	241.07	2	4.8	0.21	
1240	Monitoring Well	13.5	309.07	2	5	0.17	

[A] Cumulative drawdown after 3,685 minutes of pumping at 1.25 gpm.

000225

5.4.4 Background Trend

Figure 5-22 is used to evaluate the background trend for the Plant 8 Area pump test. This figure shows the water level in the test well (Well 1785) for the period October 22 through October 26, 1993. Water levels are referenced to an arbitrary reference point at the beginning of the monitoring period. Water levels in the associated observation wells are shown for the period of October 25-26 but were not available before this time. Well 1785 exhibited a daily cyclical trend imbedded on a consistently decreasing trend throughout the period. The steady decline over the 4-day period occurs at an average rate of 0.0316 ft/day. The response of the associated observation wells over the shorter period of time shows a similar trend. The observed background trend is also supported by the fact that during the recovery period following the constant rate test, the level in Well 1785 and the associated observation wells recovered quickly to a level approximately 0.2 feet below the original static water levels.

As shown in Figure 5-4, approximately 0.05 inches of rain fell during the Plant 8 pump test over a 2 hour period ending at 01:00 on November 5, 1993. The correction factor of 0.0316 ft/day, discussed above, has been applied to account for the background trend.

One observation well and the test well were eliminated from parameter estimation for the following reasons:

1) As mentioned above, a minor precipitation event occurred during the Plant 8 pump test that ultimately limited the interpretation of the collected data. Due to flooding of the Observation Well 11120 casing from surface water, this well is removed from the analysis.

2) The Plant 8 pump test only moderately stressed the sand body due to the inefficiency of the test well. Except for the test well, which lost available drawdown, the remaining wells responded under confined conditions. Due to its inefficiency, significant drawdown, and the resultant deviations from the assumptions of Theis and Jacobs, the test well is not considered for parameter analysis.

3) Observation Wells 11118 and 11119 were screened entirely within the upper (brown) and lower (gray) clay confining layers. Observation Well 11118 showed a very minimal response and 11119 exhibited approximately 80 percent of the response seen at 11120 that was screened at the same distance within the sand body. Observation Wells 11118 and 11119 thus are not analyzed for parameter estimation.

5.4.5 Results

For the Plant 8 Area pumping test, data from 15 observation and monitoring wells and the test well were collected. Figure 5-23 shows a conceptual cross section of the wells in the immediate area.

Data collected from three wells were considered adequate for parameter estimation. The responses from these wells were characteristic of confined conditions. When analyzed using the Theis and Cooper-Jacob methods, they exhibited a tight correlation for values of horizontal hydraulic conductivity and storativity. As seen in Figure 5-19, the effects of well storage for this test extend over the first 8 minutes of pumping due to a larger well casing radius and smaller discharge rate. A steepened drawdown curve was observed approximately 700 minutes into the test. This change in slope likely occurs as the expanding cone of depression from the test well encounters a flow boundary.

From the Theis analysis, the sand body exhibits a horizontal conductivity of 23.8 ft/day (8.4×10^{-3} cm/sec) and a storativity of .0054. These results fall within the range of the conductivity calculate from slug tests conducted in sand (Section 2) and typical values of storativity for similar materials under confined conditions.

A distance drawdown plot is shown at Figure 5-24. This figure shows that with the exception of Well 11118 all the wells generally responded linearly with the log of distance. This would indicate that all the wells (with the exception of 11118 are in relatively good communication with the test well.

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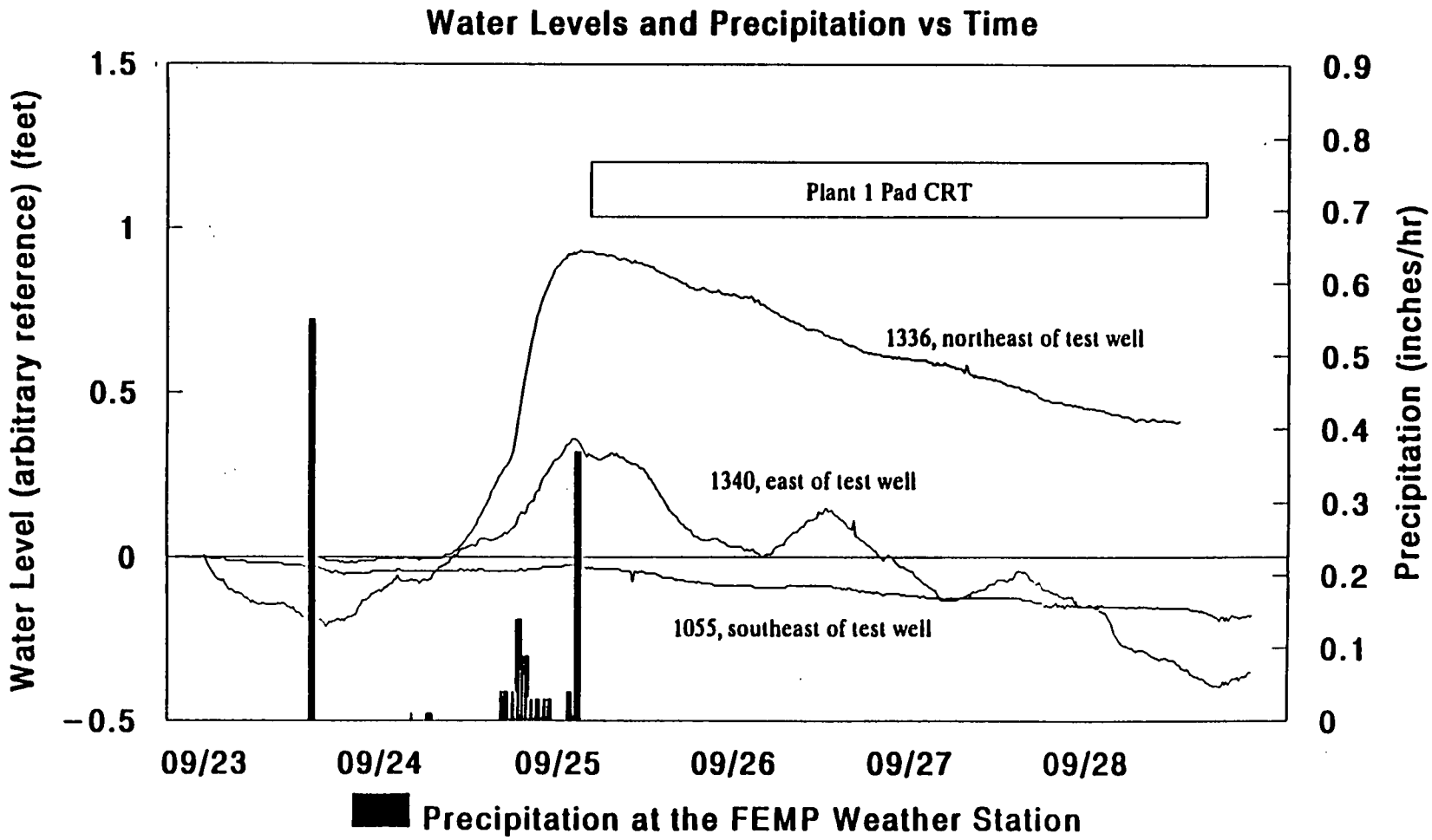

Figure 5-22 - Background Trend, Plant 8 Area Pump Test

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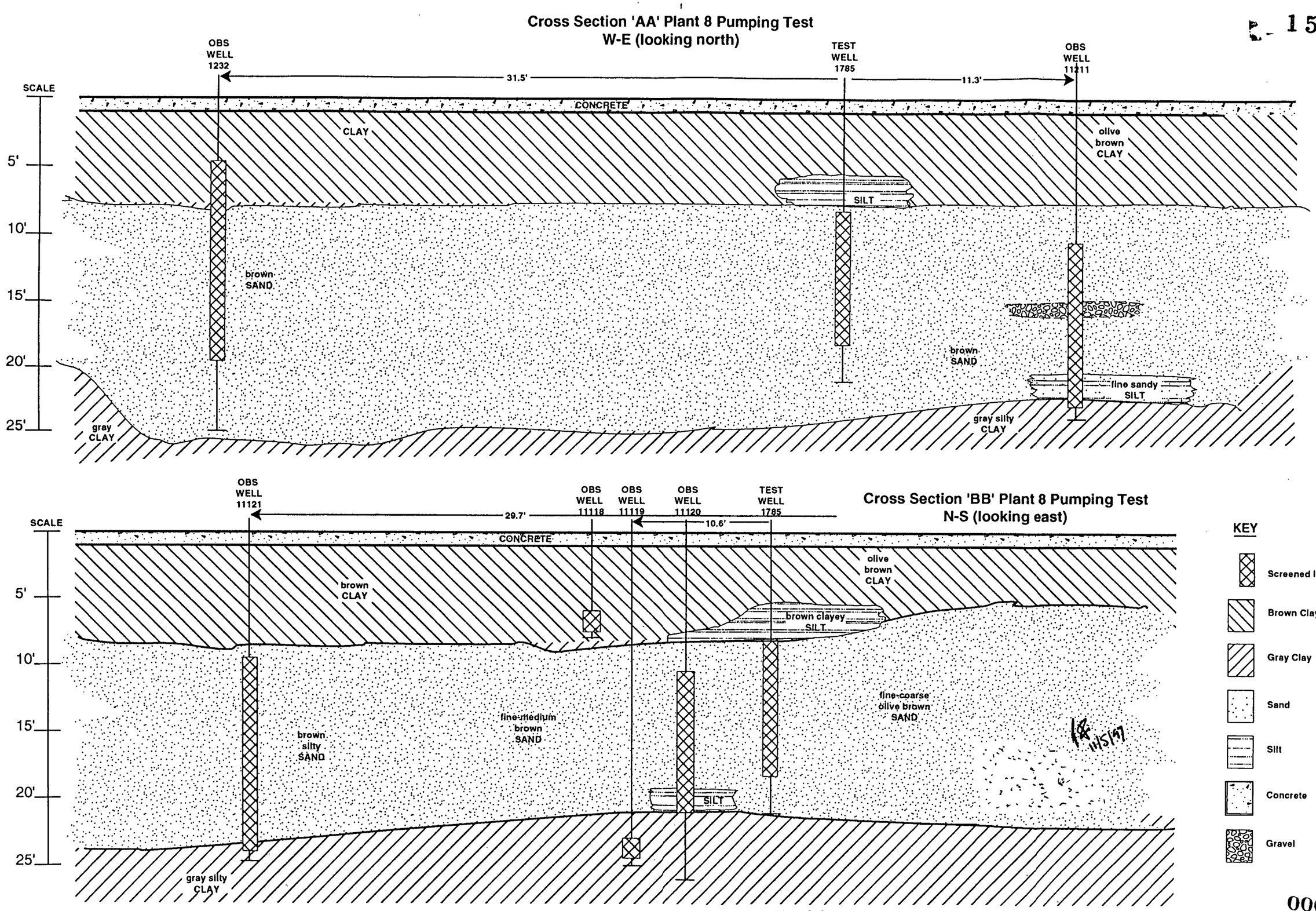

Figure 5-23 - Conceptual Cross Section, Plant 8 Area

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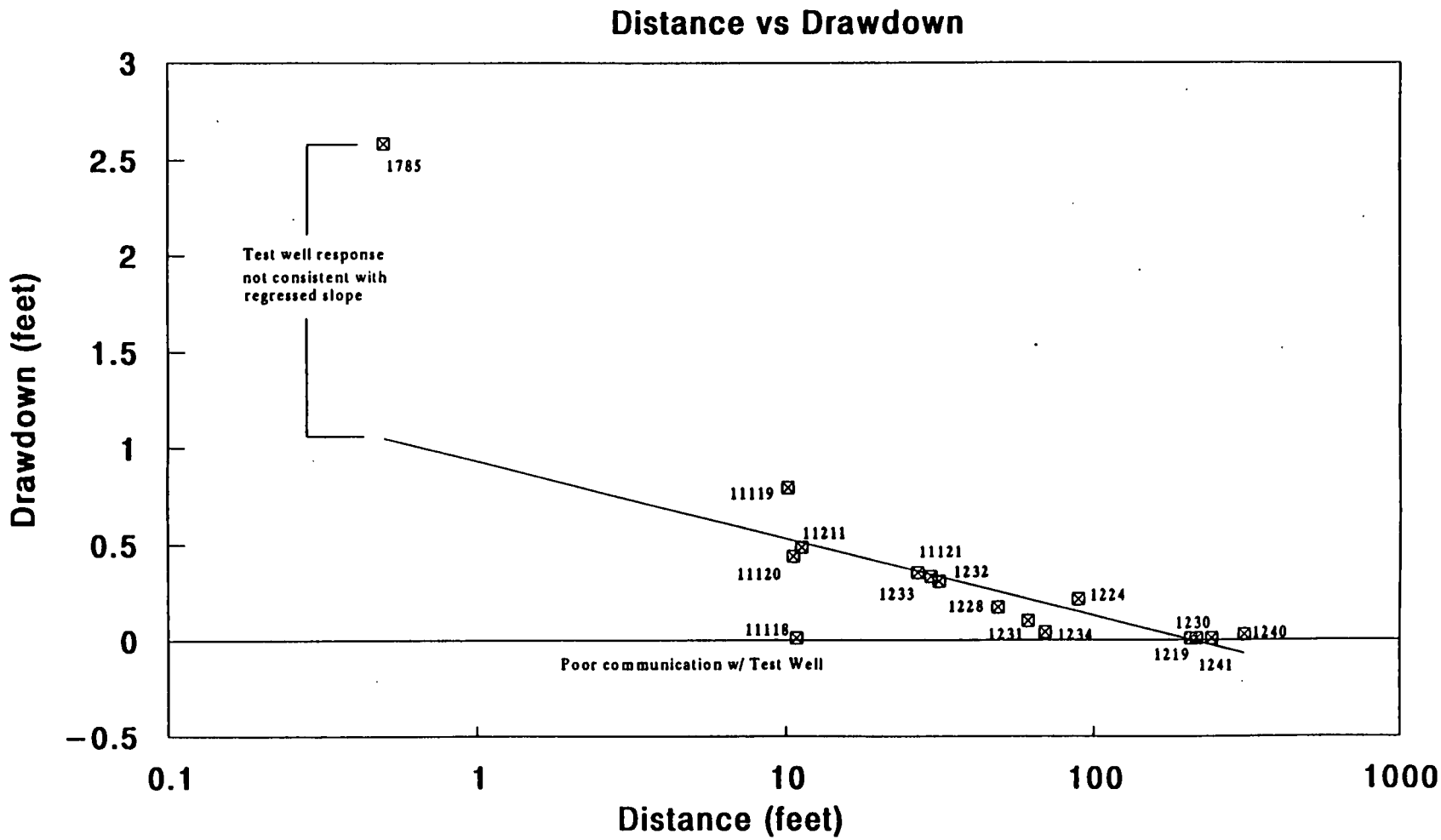

Figure 5-24 - Distance-Drawdown, Plant 8 Pump Test

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Table 5-9 - Pump Test Results, Plant 8 Area

			Theis (Primary)		Cooper-Jacob		Theis Recovery
Well Number	Distance to Test Well (ft)	Saturated Thickness (ft)	K_h (ft/day)	S	K_h (ft/day)	S	K_h (ft/day)
11120	10.58	17	18.2	0.0085	20.0	0.0066	8.8
11121	29.67	15.5	26.9	0.0037	29.1	0.0032	9.5
11211	11.27	11.25	27.5	0.0040	30.8	0.0028	13.0
Geometric Mean			23.8 (8.4×10^{-3} cm/sec)				
Average				0.0054			

Notes:

NP - Analysis not performed

SECTION 6

LYSIMETERS

Six deep-sampling lysimeters were installed in accordance with the GT/VZ Work Plan (PARSONS 1993b). Pairs of lysimeters were installed in three areas on site property. The locations are shown in Figure 6-1. One lysimeter in each pair was used for sampling pore moisture in the lower clay at the base of the glacial overburden and the other was used for sampling pore moisture in the unsaturated sand and gravel above the water table of the GMA. In area A, an additional shallow lysimeter was installed to replace a lysimeter which failed.

6.1 Equipment

The installed lysimeters are 2-inch diameter, vacuum/pressure soil pore water samplers with a ceramic cup-type filter media. They are manufactured by Timco and a general arrangement is shown in Figure 6-2. This type of lysimeter allows water to enter a micro-porous ceramic cup at the instrument's base through capillary forces. The ceramic cup is attached to an 18 inch PVC cylindrical body with full depth riser and a PVC head. The head assembly attaches to the riser and connects the sample and pressure ports to the lysimeter via 1/4 inch nylon tubing. The nylon tubes extend from the lysimeter body up to the riser head at the surface and are used for vacuum extraction and pressure sampling. The sample tube extends from the head through the lysimeter to a point just in contact with the inside base of the lysimeter. The vacuum extraction tube extends into the lysimeter to a point approximately 3 inches below the inside of the cap.

6.2 Methods

The lysimeter borings were advanced by cable tool methods to a target depth. Table 6-1 provides completion details of the lysimeter borings.

A 16-inch ID steel casing was driven to the basal clay and the hole was allowed to set for a period of 24 hours to check for leakage from the upper till. Casings for the shallow lysimeters were advanced from 1.4 to 6 feet into the basal clay, and casings for the deep lysimeters were advanced from 3.9 to 22 feet to ensure that the potential for moisture to migrate downward from the granular material above the lower clay horizon was minimized and to stabilize the borehole. Following the installation of the surface casing(s), each borehole was advanced to total depth with 4.25 inch ID (8-inch OD) hollow stem augers.

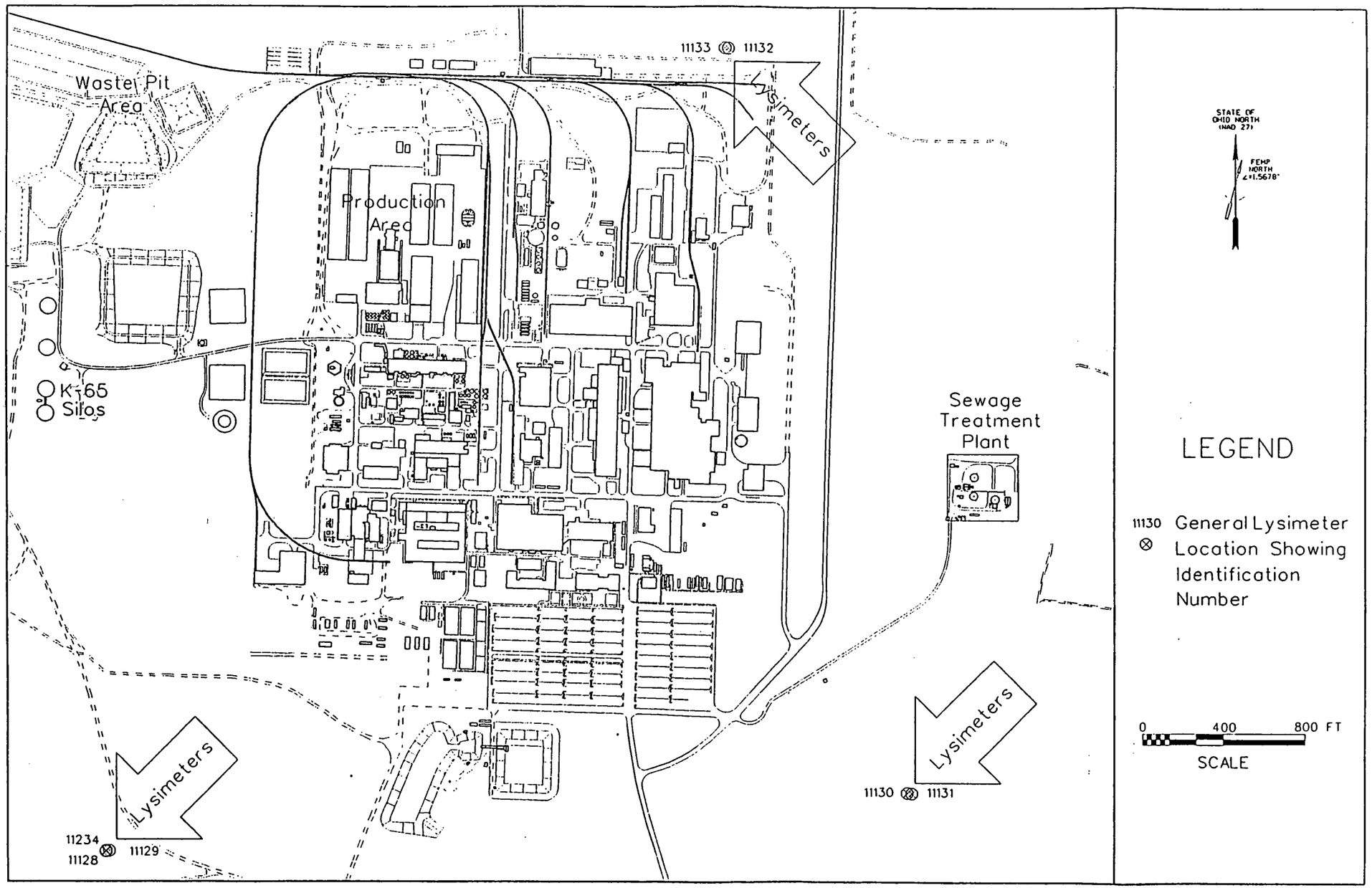

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Figure 6-1 - Lysimeter Locations

General Lysimeter Arrangement

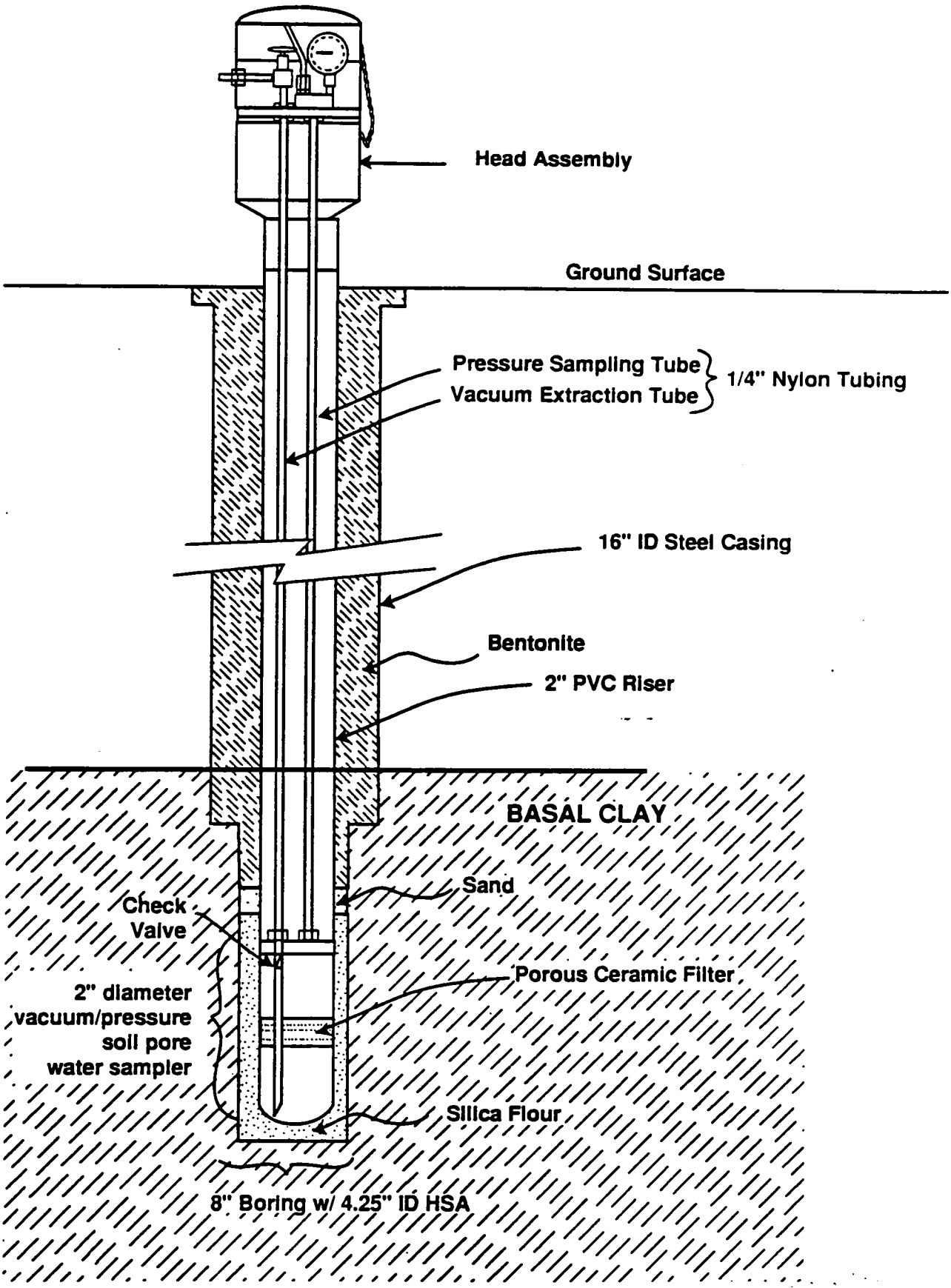

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Figure 6-2 - General Lysimeter Arrangement

Table 6-1 - Lysimeter Completion Details

FEMP Well Number	Lysimeter ID	16 Inch Casing Depth (Ft)	Depth to Basal Clay (Ft)	Depth of Casing in Basal Clay (Ft)	Depth of Lysimeter Tip (Ft)	Depth of Lysimeter in GMA (Ft)	Depth of Lysimeter in Basal Clay (Ft)
11128	AL-1	12.0	16.0	1.4	15.0	n/a	4.4
11129	AL-2	15.0	10.2	4.8	22.0	5.0	n/a
11130	BL-1	20.0	16.0	4.0	22.5	n/a	6.5
11131	BL-2	20.4	16.5	3.9	36.0	2.7	n/a
11132	CL-1	18.0	12.0	6.0	26.0	n/a	14.0
11133	CL-2	34.0	12.0	22.0	48.0	7.5	n/a

The tips of the shallow lysimeters were set at the midpoint within the basal clay to minimize the effects of vertical migration of moisture by capillarity either downward from the granular materials above the basal clay or upward from the upper GMA. The depths of the deep lysimeter tips ranged from 2.5 feet to 7.5 feet into the GMA.

Two undisturbed Shelby tube samples were collected from the lower clay. Selected split-spoon samples and the Shelby tube samples were submitted to IT Corp. laboratory. Laboratory tests performed on the samples included grain-size analysis, moisture content, Atterberg limits, unit weight, specific gravity, and hydraulic conductivity.

As shown by Figure 6-2, the lysimeter components were assembled and installed with a full-depth, 2-inch PVC riser screwed on to the lysimeter body to house the nylon tubing. The tubing was cut to allow approximately 2 feet of stick-up at the surface. A 3 to 6 inch thick slurry of silica flour and distilled water was tremied into the open borehole. The lysimeter and riser were lowered into the boring and secured to prevent floating. Additional slurry was placed 2 to 4 inches above the top of the ceramic tip of the lysimeter. At this point, number 7 mesh sand was poured to a minimum 3 to 6 inches above the top of the lysimeter, followed by a column of Volclay grout to within 0.4 feet of the surface at AL-2 and BL-2. The grout column was brought flush to the surface in the remaining boreholes. This grout was placed to prohibit shallow water from draining into the lysimeter zone.

6.3 Analysis

All six lysimeters were sampled for total uranium and common anions/cations. The results are shown on Table 6-2. Data indicate that uranium is present at the base of the glacial overvburden deposit and also in the upper unsaturated portions of the GMA.

The lysimeters which were installed in the lower clay at the base of the glacial overburden required very little to no vacuum for sampling. This indicates that the sampling conditions are very close to saturation. The lysimeters which are installed in the sand and gravel, beneath the glacial overburden deposit but above the water table of the GMA require a vacuum for sampling. This indicates that the sand and gravel is not saturated. The lysimeters set in the sand and gravels of the GMA are well above the water table of the GMA (approx. 15 feet) and well above the seasonal fluctuation of the water table (approx. 6-8 feet).

Table 6-2 - Lysimeter Results

Location	Date	Parameter	Result	Units
11129	09/24/93	Alkalinity as CaCO3	250.00	mg/L
		Bicarbonate Alkalinity	300.00	mg/L
		Calcium	79500.00	µg/L
		Carbonate Alkalinity	< 1.00	mg/L
		Chloride	46.00	mg/L
		Gross Alpha	< .12	pCi/mL
		Gross Beta	< .19	pCi/mL
		Magnesium	19100.00	µg/L
		Potassium	5900.00	µg/L
		Sodium	29200.00	mg/L
		Sulfate	88.00	µg/L
		Uranium, Total	15.00	µg/L
	03/21/94	Uranium, Total	16.00	µg/L
	03/22/94	Uranium, Total	29.00	µg/L
	03/23/94	Uranium, Total	28.00	µg/L
11130	09/30/93	Calcium	99300.00	µg/L
		Gross Alpha	< .14	pCi/mL
		Gross Beta	< .26	pCi/mL
		Magnesium	40000.00	µg/L
		Potassium	3820.00	µg/L
		Sodium	16300.00	µg/L
		Uranium, Total	7.90	µg/L
	03/21/94	Uranium, Total	13.00	µg/L
	03/22/94	Uranium, Total	2.90	µg/L
	03/23/94	Uranium, Total	2.80	µg/L
	03/24/94	Uranium, Total	2.80	µg/L

000237

Table 6-2 - Lysimeter Results (Continued)

Location	Date	Parameter	Result	Units
11131	09/24/94	Alkalinity as CaCO3	190.00	mg/L
		Bicarbonate Alkalinity	240.00	mg/L
		Calcium	59800.00	µg/L
		Carbonate Alkalinity	< 1.00	mg/L
		Chloride	57.00	mg/L
		Gross Alpha	< .12	pCi/mL
		Gross Beta	< .19	pCi/mL
		Magnesium	23200.00	µg/L
		Potassium	2860.00	µg/L
		Sodium	29000.00	µg/L
		Sulfate	62.00	mg/L
		Uranium, Total	11.00	µg/L
	03/21/94	Uranium, Total	3.40	µg/L
	03/22/94	Uranium, Total	12.00	µg/L
	03/23/94	Uranium, Total	12.00	µg/L
	03/23/94	Uranium, Total (Duplicate)	12.00	µg/L
11132	09/29/93	Alkalinity as CaCO3	190.00	mg/L
		Bicarbonate Alkalinity	240.00	mg/L
		Calcium	59500.00	µg/L
		Carbonate Alkalinity	< 1.00	mg/L
		Chloride	25.00	mg/L
		Magnesium	23900.00	µg/L
		Potassium	2280.00	µg/L
		Sodium	19500.00	µg/L
		Sulfate	62.00	mg/L
	03/21/94	Uranium, Total	4.60	µg/L
	03/22/94	Uranium, Total	2.50	µg/L
	03/23/94	Uranium, Total	2.30	µg/L
	03/24/94	Uranium, Total	3.50	µg/L

Table 6-2 - Lysimeter Results (Continued)

Location	Date	Parameter	Result	Units
11133	09/28/93	Alkalinity as CaCO3	250.00	mg/L
		Bicarbonate Alkalinity	310.00	mg/L
		Calcium	87400.00	µg/L
		Carbonate Alkalinity	< 1.00	mg/L
		Chloride	39.00	mg/L
		Magnesium	24200.00	µg/L
		Potassium	4270.00	µg/L
		Sodium	27700.00	µg/L
		Sulfate	67.00	mg/L
		Uranium, Total	52.00	µg/L
	03/21/94	Uranium, Total	47.00	µg/L
	03/22/94	Uranium, Total	16.00	µg/L
	03/23/94	Uranium, Total	17.00	µg/L
	03/23/94	Uranium, Total (Duplicate)	14.00	µg/L
	03/24/94	Uranium, Total	16.00	µg/L
11234	03/21/94	Uranium, Total	4.10	µg/L
	03/22/94	Uranium, Total	3.90	µg/L
	03/23/94	Uranium, Total	4.60	µg/L
	03/23/94	Uranium, Total (Duplicate)	4.20	µg/L
	03/24/94	Uranium, Total	4.90	µg/L

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SECTION 7

GEOTECHNICAL DATA

7.1 Textural Analysis of Glacial Overburden Sediments

Sieve analyses were conducted on 206 sediment samples collected during the installation of pump test wells, lysimeters, and packer borings for this study. The textural triangle shown in Figure 7-1 shows the grain size distributions determined from these sediment samples. A high density of data points is concentrated in a relatively small area of the textural triangle. The majority of the data fall within the "60 to 80 percent silt and clay" and "20 to 40 percent sand" zone of the textural triangle, which corresponds to the USCS groupings ML/MH and CL/CH. These sediments are described generally as silty or clayey fine sands, sandy clays, sandy silts, silty clays, silts, or clays.

Both Freeze and Cherry (1979) and Fetter (1980) have developed tables that correlate soil types to hydraulic conductivity. Based on the Freeze and Cherry table, the area with the greatest density of points in the textural triangle correlates to material with hydraulic conductivities from 10^{-5} cm/s to 10^{-10} cm/s. Using the Fetter table to convert the same data, a range of hydraulic conductivities from 10^{-4} cm/s to 10^{-6} cm/s would be expected.

7.2 Physical Properties of the Gray Clay

Shelby tube samples collected from six locations were measured for bulk density, specific gravity, volumetric moisture content, and the coefficient of permeability Figure 7-2 and Table 7-1.

The porosity of the gray clay has been calculated from the density measurements (Table 7-1). Both bulk density and particle mass density were measured according to the Corps of Engineers laboratory soil testing method EM1110-2-1906, Appendix II. The following relationship was used to calculate porosity (Freeze and Cherry 1979):

$$n = 1 - (\text{bulk density} / \text{particle mass density})$$

Porosity calculations ranged from 23 to 30 percent with an average porosity of 26 percent.

The moisture content of the gray clay located beneath the FEMP (Table 7-1) has been determined according to ASTM D2216. Moisture content measurements ranged from 10.3 to 25.4 percent with an average moisture content of 14.3 percent.

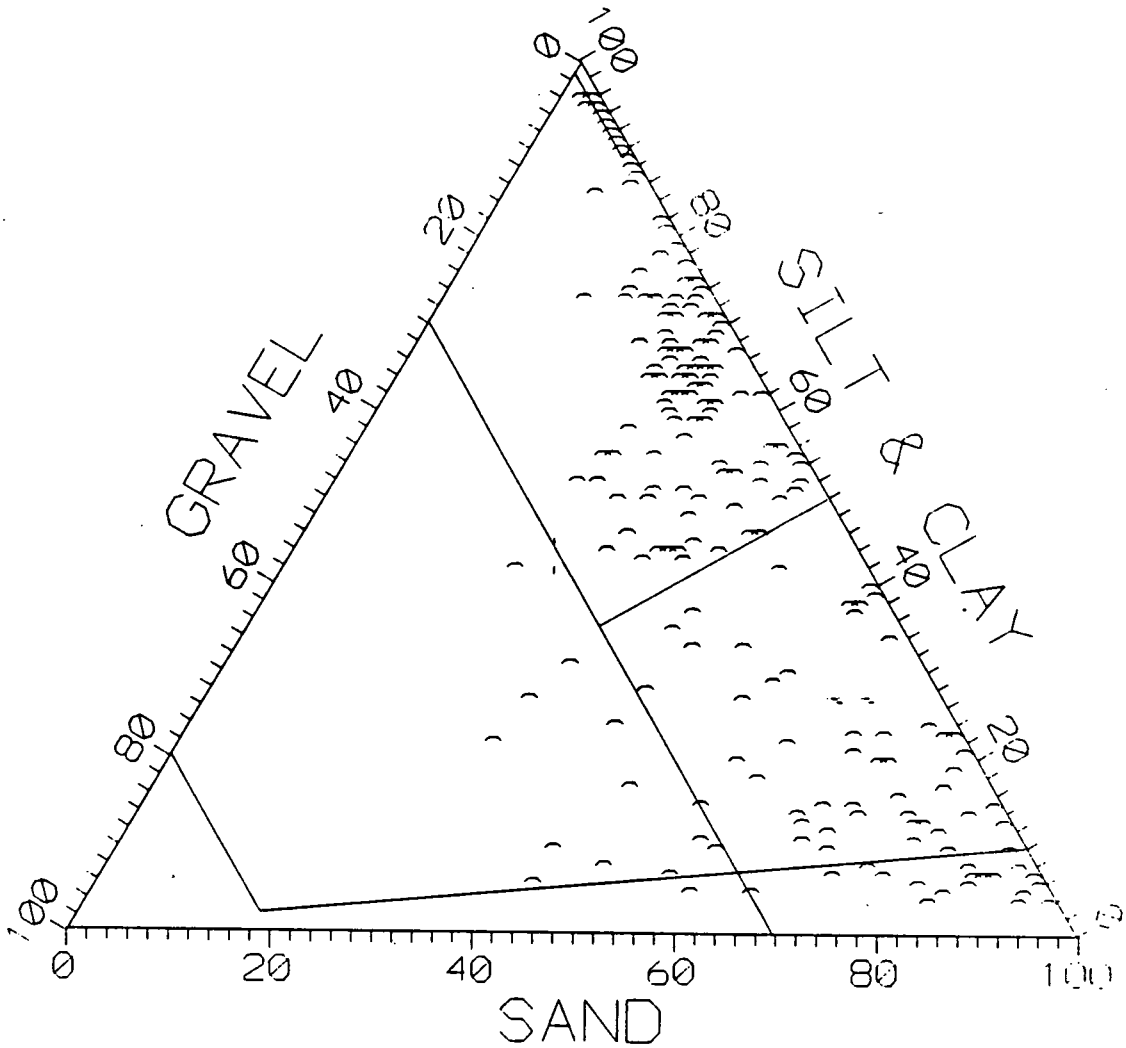

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Figure 7-1 - Textural Triangle

Table 7-1 - Properties of Gray Clay

Well Number	Depth (BGS)	Bulk Density (g/cm_3)	Specific Gravity (g/cm_3)	Porosity (%)	Moisture Content	Coef. of Permeability	Soil Content
11112	14.5 to 17.0	2.1827	2.7380	20.28	13.8	1.9E-08	Gray Clay
11112	17.0 to 19.5	2.2065	2.7417	19.52	14.3	1.6E-08	Gray Clay
11113	31.5 to 34.5	2.3126	2.7486	15.86	25.4	2.4E-09	Gray Clay
11113	34.5 to 37.5	2.2413	2.7302	17.91	13.8	6.7E-08	Gray Clay
11133	10.5 to 13.0	2.2937	2.7452	-	-	1.5E-08	Brown/gray Clay
11133	18.0 to 20.5	2.2757	2.7341	16.77	12.5	2.7E-08	Gray Clay
11131	20.5 to 25.0	2.2320	2.7392	18.52	10.3	1.7E-08	Gray Clay
11127	21.5 to 22.5	2.3057	2.7460	16.03	13.0	2.3E-08	Gray Clay
11127	20.5 to 22.5	2.2929	2.7526	16.70	14.9	1.9E-08	Gray Clay
11129	10.5 to 13.0	2.2548	2.7432	17.80	10.6	2.7E-08	Gray Clay
11129	13.0 to 15.0	2.3387	2.7625	15.34	15.6	3.5E-08	Gray Clay
11134	16.5 to 19.0	2.3719	2.7563	13.95	12.2	2.4E-08	Gray Clay
11134	19.0 to 21.5	2.2607	2.7531	17.89	11.3	6.4E-08	Gray Clay

000242

1502

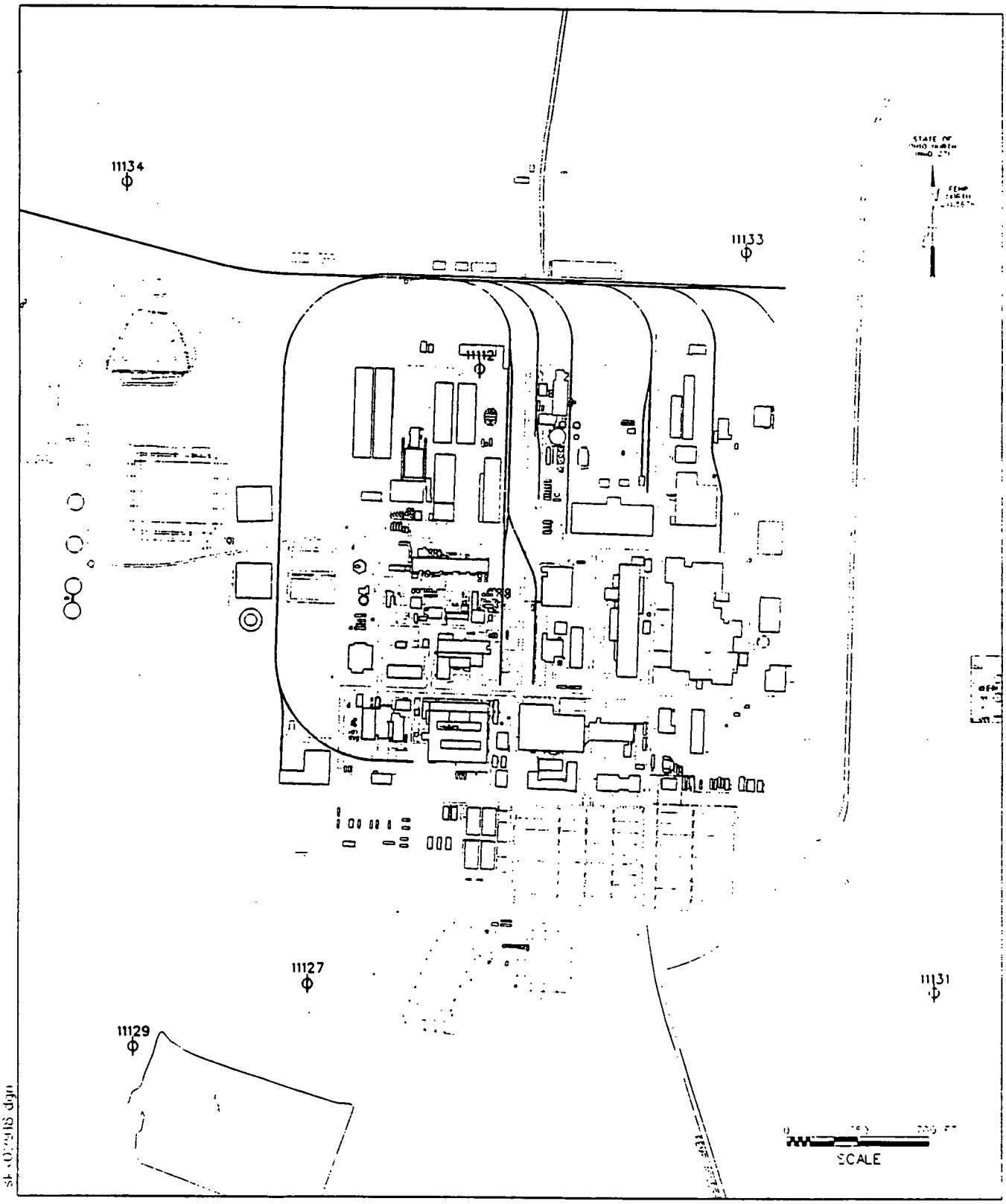

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Figure 7-2 - Locations of Shelby Tube Samples

SECTION 8

CONCLUSIONS

8.1 Slug Tests

Seventy slug tests were performed across a wide variety of sediment types ranging from clay to gravel. Table 8-1 shows the range of values obtained. The majority of the tests performed on non-cohesive materials (sands and gravel) exhibited confined conditions while unconfined conditions were predominantly encountered during the majority of the tests performed on cohesive (clay) materials.

Table 8-1 - Comparison of Hydraulic Conductivities

Material Type	Slug Test Results Geometric Mean (cm/sec)	Packer Test Result (cm/sec)
Gray Clay	1.9×10^{-6}	5.1×10^{-6} [a]
Brown Clay	3.6×10^{-5}	
Gray Silt	8.8×10^{-5}	
Brown Silt	9.9×10^{-5}	
Gray Sand	8.0×10^{-4}	
Brown Sand	1.8×10^{-3}	
Gray Gravel	4.0×10^{-3}	
Brown Gravel	3.1×10^{-2}	

[a] Geometric mean of three packer steps

8.2 Yield Tests

The yield tests showed that several areas containing water bearing sediments could not support a sustainable yield. Three areas listed in Table 8-2 were identified where sustainable yields less than 1 gpm for 7 days were calculated. The yield tests were invaluable in selecting locations for longer term constant rate pumping tests.

Table 8-2 - Yield Test Results

Location	Well No.	Sustainable Yield (gpm)
South of Pilot Plant Building	1259	< 1.0
North of Old Drum Bailing Area	1274	< 1.0
Waste Pit Area	1077	< 1.0
Plant 1 Pad Area	1339	1.85
Waste Pit Area	11214	2.5
Plant 1 Pad Area	11112	2.0
Plant 8 Area	1785	1.5

8.3 Pumping Tests

Constant rate pumping tests were performed on a small confined channel (waste pit area) and on sand bodies of larger areal extent (Plant 8 and Plant 1 pad areas). In all three cases (Table 8-3), the pumping tests indicate boundary effects, most probably resulting from sediment changes. This deviation is evidenced in the semi-log plot of distance versus drawdown (Figures 5-17 and 5-24) where drawdown (the slope of the curve) steepens (grows more negative) as the effects of boundaries are experienced. Once pumping is stopped, the recovery of water level in the sand body is substantially slower than would be expected from the unbounded case. This can be seen in Tables 5-5, 5-7, and 5-9 where the values of conductivity calculated by the Theis recovery method are typically half or less than the values calculated from the pumping test data. The apparent permeability of the sand body is smaller during recovery because the groundwater recharging the sand unit is derived from the less permeable surrounding clay.

These tests again concluded that the potential for movement of fluids and contaminants at the FEMP is largely controlled by the clay till matrix that surrounds the sand and not the individual sand bodies themselves.

Table 8-3 - Pumping Test Results

Parameter	Units	Plant 1 Pad Area	Waste Pit Area	Plant 8 Area
Horizontal Hydraulic Conductivity (K_h)	cm/sec	6.2×10^{-3}	1.5×10^{-3}	8.4×10^{-3}
Storativity	dimensionless	0.0023	.0040	0.0054
Specific Yield	dimensionless	0.042		
K_h/K_v	dimensionless	0.395	0.019	

8.4 Packer Tests

The packer tests produced values of hydraulic conductivity for the lower gray clay which were consistent with the slug testing results. This tends to suggest that slug tests may be a good indication of hydraulic properties in the gray clay.

Table 8-4 - Packer Test Results

Packer Step Number	Hydraulic Conductivity (cm/sec)
1	4.6×10^{-6}
2	9.3×10^{-6}
3	3.1×10^{-6}
Geometric mean	5.1×10^{-6}

8.5 Lysimeters

A total of 6 lysimeters were installed in the base of the glacial overburden and in the upper portion of the sand and gravel of the Great Miami Aquifer. Sampling indicated that the conditions close to being saturated exist at base of the glacial overburden and uranium is present at the base of the glacial overburden.

8.6 Geotechnical Data

The majority of sediments (206 sieve analyses) can be described as silty of clayey fine sands, sandy clays, sandy silts, silty clays, silts or clays.

The coefficient of permeability of the gray clay ranges from 1.5×10^{-8} cm/s to 2.4×10^{-9} cm/s. The average porosity of the gray clay is 26 percent and the average moisture content of the gray clay is 14.3 percent.

000247

SECTION 9

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APPENDIX C

PO-177 Geotechnical Logging

Reports and Field Logs

OUDATA\OU-2\PO177\
REPORT\REVC

3/24/98

Parsons Infrastructure and Technology, Inc.
25 Merchant St.
Cincinnati, OH 45246
Phone (513) 648-6700 Fax (513) 648-6892

Log of Boring G3-001/12266

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Sheet 1 of 2
Job Number: 50.03.52/PO-177
Elevation: 588.7

Driller: Alliance, Env., Inc	**Drilling**	**Date**	**Time**
Drill Method: 8" Hollow Stem Auger	**Started**	5/22/97	
Sample Method: Split Spoon, Shelby Tube	**Finished**	5/22/97	
Borehole Diameter: 8 in. / **Water Level:** N/A	**Logged By:** J. Erjavec	**Checked By:** K. Ernst	

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
				1		Fill and brown clay to 2'.	CL			
412461	10:53 5/22/97	9"	SS 4 4 6	2, 3		Mottled greenish gray (5BG,5/1) and yellowish brown (10YR,5/8) stiff clay, moist low plasticity. Fill? Some gravel.	CL			
412462	11:00 5/22/97	12"	SS 2 4 4	4		Mottled gray (10YR,5/1) and dark yellowish brown (10YR,4/6) clay, moist, stiff.	CL		MC	
412463	11:25 5/22/97	23"	ST	5, 6		Olive brown (2.5Y,4/4) clayey sand and clay, wet, sand fg., well sorted.	CL SP-SC		MC GS AL UCS	
412464	11:35 5/22/97	20"	SS 2 2 5 6	7, 8		Olive brown (2.5Y, 4/4) clayey sand and silt, grading to gray (2.5Y, 5/1) sands, silts and clays. Wet, trace gravel throughout. Beds 2-4" thick.	CL ML SP-SM ML SP-SC ML		MC	
412465	11:43 5/22/97	22"	SS 2 2 4 4	9, 10		Greenish gray (10Y,5/1) silty clays alternating with clayey silts, wet. Two thin olive brown sands in core, fg, wet.	CL ML		MC GS AL	
412466	11:58 5/22/97	27"	ST	11, 12		Dark greenish gray (10Y,4/1) clay with gravel. Wet, high plasticity. Gravel to 1/2", subangular-subrounded. Clay sandy (?) throughout.	CL		MC GS AL CU	
412468	12:07 5/22/97	14"	3 3 4 7	13		Dark greenish gray (10Y,4/1) fat clay and sandy lean clay. Wet, some gravel.	CH CL		MC	

Parsons Infrastructure and Technology, Inc.
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Log of Boring G3-001/12266

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Pit. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 588.7

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
412468	12:07 5/22/97	14"	3 3 4 7				CH CL		MC	
412469	12:16 5/22/97	18"	SS 3 8 8 14	15 16		Dark greenish gray (10Y,4/1) clay with sand lenses. Wet, low plasticity, some gravel throughout. Sand, fg to cg.	CL		MC	
412470	12:22 5/22/97	18"	SS 2 4 8	17 18		Dark greenish gray (10Y,4/1) sand, fg to cg, poorly sorted, wet. Silt in bottom 2" of core. Some clay throughout.	**SM** SW-SC ML		MC GS AL	
412471	12:33 5/22/97	20"	SS 10 11 14 18	19 20		Dark greenish gray (10Y,4/1) sand, fg to cg, poorly sorted, wet. Interbeds of dark greenish gray clay, low plasticity, hard.	SW-SC CL SW-SC		MC	
412472	12:49 5/22/97	7"	SS 3 5 7	21 22		Dark greenish gray (10Y,4/1) poorly sorted sand with clay, fg-cg, wet. 3" of dark greenish gray clay with gravel and sand, stiff to very stiff.	SW-SC CL		MC	
412473	12:58 5/22/97	13"	SS 1 2 4	23		Dark greenish gray (10Y,4/1) fat clay with gravel and trace sand. Wet, high plasticity, soft.	CL		MC	
412474	15:01 5/22/97	28"	ST	24 25		Dark greenish gray (10Y,4/1) clay. Wet, trace gravel. Evidence of sand in tube.	**CL** SP-SW?		MC GS AL UCS	
						Dark greenish gray (10Y,4/1) clay with gravel.	**CL**			
				26		*Bottom of boring at 26 feet.*				
				27 28 29		**Notes:** Samples collected per ASTM D 1586 and ASTM D 1587. Colors identified using Munsell Color Chart. Consistency based on Standard Penetration Resistance Value. Soils visual description per ASTM D 2488 and soil classification per ASTM D 2487. SS = Split Spoon, 2" OD, no liner ST = Shelby Tube, 3" OD D = Denison, 2 13/16" ID DM = Dames & Moore, 2.41" ID, 3" OD USCS Symbols: **Bold** = Lab; Normal = Visual				

Boring NAD 1983 Coordinates:
1350367.2E; 481935.0N

FEMP

LITHOLOGIC LOG

CONTROL NO.: 500352-12266-018

PAGE 1 OF 4

PROJECT NAME: Geotech Investigation Former Plant Area			PROJECT NO.: 50.03.52
LOCATION/NUMBER: G3-001 / 12266	COORDINATES: N/A	DATE STARTED: 5/22/97	DATE COMPLETED: 5/22/97

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	GROUNDWATER LEVEL	DATE:	TIME:
N/A	N/A	N/A	N/A	N/A	N/A	N/A

GEOLOGIST:	DRILLING CONTRACTOR:	DRILLING EQUIPMENT	DRILLER
J. Erjavec	Alliance Env. Inc.	Mobile B-55 HSA	Robert/~~Mohan~~ Scott JE 5/22

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	WATER LOST DURING DRILLING
N/A GAL.	N/A GAL.	N/A GAL.

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
		5/22/97 JE		Brown clay & fill to 2'. JE 5/22 ORIGINAL	CL		B-2' SS sample for lead analysis. 900cpm 412450(A/B)
	JE 5/22/97 1053 ~~1050~~ 5/22/97 412461						
2	2-3.5'	4 6 4 6	SS 9"	(5PB,5/1) & (10YR,5/8) mottled greenish gray & yellowish brown clay, moist, low plasticity. Fill? Some stiff clay. JE 5/22 stained	CL		PID-background
4	1100 5/22/97 412462	2 4 4	SS 12"	(10YR5/1) & (10YR,4/6) Mottled gray & dark yellowish brown clay, moist, stiff.	CL		PID-background
5 6 7	1125 5/22/97 412463		ST 23"	(2.5Y,4/4) olive brown clayey sand & clay, wet, sand fg, well sorted &	CL SP-SC		PID background

METER	BKGD	DATE	TIME
PID	0 ppm	5/22/97 JE 7/11/92	1020
ALPHA	N/A		
BETA / GAMMA	100cpm	5/22/97	1030

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Varies - see log
DIAMETER OF SAMPLER	N/A
WEIGHTS OF HAMMER	140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (07-10-95)

JFR 11/20/97

CONTROL NUMBER: 500352-12266-OR 19 JW 5-29-97

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
Geotech. Inv. FPA	50.03.52	63-001/12266

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7	1135 5/22/97 412464	2 2 5 6	55 20"	(2.5Y, 4/4) Olive brown clayey sand & silt grading to (2.5Y, 5/1) gray sands, silts & clays. Wet, trace gravel throughout. Beds about 2-4" in thickness.	CL ML SP-SM ML SP-SC ML		PID-background
9	1143 5/22/97 412465	2 2 4 4	55 22"	(10Y, 5/1) Greenish gray silty clays alternating with clayey silts, wet. Thin olive brown sands, fg, in core, wet.	CL ML		PID-background
11 12	1158 5/22/97 412466		55 27"	(10Y, 4/1) Dark greenish gray clay, wet, with gravel. High plasticity. Gravel to ½", subangular-subrounded. Could be sand throughout in clay.	CL OR CH		PID-background
13 14	1207 5/22/97 412468	3 3 4 7	55 14"	(10Y, 4/1) Dark greenish gray fat clay & sandy lean clay. Wet, some gravel.	CH CL		412467 (A/B) ✓ PID-background
15 16	1216 5/22/97 412469	3 8 8 14	55 18"	(10Y, 4/1) Dark greenish gray clay with sand lenses, fs, ms & cg. Wet, low plasticity, some gravel throughout	CL		PID-background

ORIGINAL

METER	BKGD	DATE	TIME
PID	JE 2/11/97		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:	NOTES:
TYPE OF SAMPLER: Vanes - See log	
DIAMETER OF SAMPLER: N/A	
WEIGHTS OF HAMMER: 140 lbs	

JRR 11/18/97

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

G:\WPSC\95-0140.DRW

CONTROL NUMBER: 500352 - 12266 - 020

FEMP LITHOLOGIC LOG (Continuation Page)

PROJECT NAME: Geotech Inv. FRA

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: G3-001 / 12266

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16	412469 (cont)						
17	1222 5/22/97 412470	2 4 8	SS 18"	(10Y, 4/1) Dark grenish gray ~~clayey~~ sand, fg to cg, poorly sorted, wet. Silt in bottom 2" of core. Sand throughout	SW-SC ML		PID-background ORIGINAL
19	1233 5/22/97 412471	10 11 14 18	SS 20"	(10Y, 4/1) Dark grenish gray sand, fg to cg, poorly sorted, wet. Interbeds (~2" ea) of dark grenish gray clay, low plasticity, hard.	SW-SC CL SW-SC		PID-background
21	1249 5/22/97 412472	3 5 8	SS 24"	(10Y, 4/1) Dark grenish gray poorly sorted sand, fg-cg, wet, with clay. 3" of dark grenish gray ~~very stiff~~ clay with gravel + sand, stiff to hard	SW-SC CL		PID-background ~~412472 field~~ ~~Blm~~
23	1256 5/22/97 412473	1 2 4	SS 13"	(10Y, 4/1) Dark grenish gray fat clay, with gravel, trace sand, wet, high plasticity, soft.	CL		PID-background 412475 (1/8)
24	1501 5/22/97 412474		ST 28"	(10Y, 4/1) Dark grenish gray clay, wet, trace gravel. Evidence of sand in tube.	CL SP-SW?		PID-background
25							

METER	BKGD	DATE	TIME
PID			
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Barrel - see log

DIAMETER OF SAMPLER: N/A

WEIGHTS OF HAMMER: 140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

G:\WPSC\95-0140.DRW

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER: 500352-12266-021

PROJECT NAME: Geotech. Inv. FPA

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-001/12266

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
25	412474 (cont)			Dark greenish gray clay with gravel	CL		
~~26~~	~~BOB 26~~						

ORIGINAL

METER	BKGD	DATE	TIME
PID	2 7/11/97		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Varies - Selog

DIAMETER OF SAMPLER: N/A

WEIGHTS OF HAMMER: 140 lbs

NOTES:

JFR 11/20/97

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/96

000258

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Cincinnati, OH 45246
Phone (513) 648-6700 Fax (513) 648-6892

Log of Boring G3-002/12267

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Sheet 1 of 2
Job Number: 50.03.52/PO-177
Elevation: 587.8

Driller: Alliance, Env., Inc	**Drilling**	**Date**	**Time**
Drill Method: 8" Hollow Stem Auger	**Started**	5/5/97	
Sample Method: Split Spoon, Shelby Tube, Denison	**Finished**	5/7/97	
Borehole Diameter: 8 in. / **Water Level:** N/A	**Logged By:** J. Erjavec/R. Nicks	**Checked By:** K. Ernst	

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
				1		Fill L=1.0 Dark yellowish brown (10YR,4/5) mottled clay with gravel (to 1"). Dry to moist, low plasticity, very stiff. Root material and some sand. Probably fill.				
412349	16:10 5/5/97	8"	SS 7 7 6 7	2			CL	2.0-3.0	MC	
412351	16:15 5/5/97	17"	SS 7 8 9 10	3 4		Dark yellowish brown (10YR,4/6) clay with trace gravel. Mottled with organic material, reddish brown to orange in color. Clay, medium plasticity, very stiff, moist.	CL	3.5	MC GS AL	
412352	16:24 5/5/97	18"	SS 4 10 12 14	5 6		Olive yellow (2.5Y,6/8) clay with some silt intervals. Trace to some gravel, subangular to subrounded (to 0.25"). Clay, moist, low to no plasticity, very hard. Continued orange to reddish brown organic mottling.	CL	>4.5	MC GS AL	
412353	16:35 5/5/97	20"	SS 6 10 10 12	7 8		Light olive brown (2.5Y,5/6) silty clay to light olive brown clayey silt (~6" in center of core). Clay, moist, medium to no no plasticity, very stiff to hard. Silt, wet. Trace to some gravel in clay (to 0.75"). Gray mottled clay within silty clay.	CL ML	3.0- >4.5	MC GS AL	
412354	08:55 5/6/97	5"	ST	9 10		Light olive brown (2.5Y,5/6) clayey silt, moist, no plasticity, very hard.	CL ML	>4.5	MC GS AL	
412355	09:15 5/6/97	22"	SS 8 21 24 18	11 12		Dark greenish gray (10y,4/1) clay, wet, very stiff. Trace gravel. Olive brown (2.5Y,4/4) clayey silt, wet, stiff.	CL ML	1.75- 3.75	MC	
412357	09:25 5/6/97	15"	6 9 14 15	13		Dark greenish gray (10Y,4/1) clay with silt, wet, low plasticity, very stiff. Trace gravel to 0.5", subangular-subrounded.	CL	3.25	MC GS AL	

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Log of Boring G3-002/12287

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 587.8

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
412357	09:25 5/6/97	15"	6 9 14 15				**CL**	3.25	MC GS AL	
				15						
412358	09:40 5/6/97	6"	D	16		Dark greenish gray (10Y,4/1) clay with gravel (to 3"). Wet, low plasticity, very stiff. 3" cobble is Upper Ordovician bedrock with fossil brachiopods, gastropods and other invertebrate material.	**CL**	2.5-3.5	MC GS AL UCS	
				17		Overdrill to 17.5' with 17" auger. Grouted hole. Started SS at 18'.				
				18						
412359	08:20 5/7/97		SS 6 11 12	19		Dark greenish gray (10Y,4/1) clay with gravel (to 2.5"). Wet, low plasticity, very stiff. Gravel from Ordovician bedrock, angular, fossiliferous.	**CL**	3.0		
412360	08:50 5/7/97	3"	SS 2 6 11	20		Greenish gray (10Y,5/1) clay with some gravel (to 0.25"). Wet, low plasticity, very stiff. Gravel smaller than in 18-19.5 interval. No Ordovician bedrock noted.	**CL**	2.0-3.0	MC	
				21						
412361	09:20 5/7/97	22"	ST	22		Greenish gray (10Y,5/1) clay with gravel, moist. (Description from bottom of tube.)	**CL**		MC GS AL UCS	
				23						
412362	09:31 5/7/97	25"	SS 3 6 8 10	24		Greenish gray (10Y,5/1) clay with gravel. Moist, stiff to very stiff, low to medium plasticity. Gravel to 0.25", subangular-subrounded, quartzose and lithic.	**ML** CL	1.5-2.5	MC	
				25		*Bottom of boring at 25 feet.*				
				26		**Notes:** Samples collected per ASTM D 1586 and ASTM D 1587. Colors identified using Munsell Color Chart. Consistency based on Standard Penetration Resistance Value. Soils visual description per ASTM D 2488 and soil classification per ASTM D 2487.				
				27		SS = Split Spoon, 2" OD, no liner ST = Shelby Tube, 3" OD D = Denison, 2 13/16" ID DM = Dames & Moore, 2.41" ID, 3" OD				
				28		UCSC Symbols: **Bold** = Laboratory Normal = Visual				
				29		**Boring NAD 1983 Coordinates: 1348876.8E; 481728.7N**				

FEMP

LITHOLOGIC LOG

CONTROL NO.: 500352-12267-018

PROJECT NAME: Geotech Investigation Former Plant Area			PROJECT NO.: 50.03.52
LOCATION/NUMBER: GB-002/12267	COORDINATES: N/A	DATE STARTED: 5/5/97	DATE COMPLETED: 5/7/97
SURFACE ELEVATION: NA	GROUNDWATER LEVEL: No water level taken JE 7/11/97	DATE: N/A	TIME: N/A
GROUNDWATER LEVEL: N/A	DATE: NA	TIME: NA	
GEOLOGIST: J. Sejavec/R. Nicks	DRILLING CONTRACTOR: Alliance Env., Inc	DRILLING EQUIPMENT: Mobile B-59 HSA	DRILLER: Roberts/McAdam
WATER USED DURING DRILLING: N/A GAL	WATER RECOVERED DURING DRILLING: N/A GAL	WATER LOST DURING DRILLING: N/A GAL	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				ORIGINAL			Augured to 1'
1	1610 5/5/97 412349	7 7 6 7	SS 8"	(10YR,4/6) Dark yellowish brown, mottled clay with gravel (to 1"). Dry to moist, low plasticity. Root matted + some sand. Probably fill. Very stiff.	CL	20-3.0	PID-Ø
2	412350 ABSorbent JE 5/5/97						412350 ABSorbent
3	1615 5/5/97 412350 ABSorbent 5/5/97 412351	7 8 9 10	SS 17"	(10YR/4/6) Dark yellowish brown clay with trace gravel. Mottled with organic material (reddish-brown to orange) med plasticity, very stiff, moist.	CL	3.5	PID - ~~0.7ppm~~ 0.2 JE 8/21/97
4							
5	1624 5/5/97 412352	4 10 12 14	SS 18"	(2.5Y/6/8) Olive yellow clay with some silt intervals. Trace to some gravel, no water to subangular to 3/4". Moist, low to no plasticity, very hard. Contained orange to reddish brown organic? mottling.	CL	4.5+	PID - 0.
6							
7							

METER	BKGD	DATE	TIME
PID	0.6 JE 8/21/97 ~~0.3ppm~~	5/5/97	1610
ALPHA JE 8/21/97	BKGD HD changed to 0.6 ppm	—	JE 5/5/97
BETA / GAMMA	100cpm	5/5/97	

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Varies - see log

DIAMETER OF SAMPLER: Varies - see log

WEIGHTS OF HAMMER: 140 lbs

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

Per sample collected log JE 7/11/97

G:/WPSC/95-0037.DRW (07-10-95)

JFR 11/21/97

CONTROL NUMBER: 50/0352-12267-019

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
Geotech. Inv. Former Plant Area	50.03.52	63-002/12267

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7	1635 5/5/97 412353	6 10 10 12	SS 20"	(2.5Y, 5/6) Light olive brown silty clay to light olive brown clayey silt (~6" in auger of core). Moist, med to no plasticity, very stiff to hard clay, silt, wet. Trace to some gravel in clay (to 3/4"), clay mottled with gray clay	CL & ML	3.0 to 4.5+	clay / SILT / CLAY 6"
9	0855 5/6/97 412354		ST 5"	(2.5Y, 5/6) Light olive brown clayey silt, moist, no plasticity, very hard	ML	>4.5	Tube crushed PID-Ø
11	0915 5/6/97 412355	8 21 24 18	SS 22"	(10Y, 4/1) Dark greenish gray clay, wet, very stiff. With trace gravel.	CL	3.75 clay stiff	PID-Ø
12				(2.5, 4/4) olive brown clayey silt, wet, stiff.	ML	1.75 Brown silt	412356 (A/B Screen)
13	0925 5/6/97 412357	6 9 14 15	SS 15"	(10Y, 4/1) Dark greenish gray clay with silt, wet, low plasticity, very stiff. With some to trace gravel (to about 1/2", subrounded, subangular).	CL	3.25	PID-Ø
15	0940 5/6/97 412358	8 11 19	Dames & Moore	(10Y, 4/1) Dark greenish gray clay with gravel (to 3"). Wet, low plasticity, very stiff. 3" cobble is Upper Ordovician bedrock	CL	2.5-3.5	6 Rings recovered for sample
16							

METER	BKGD	DATE	TIME
PID	Ø ppm	5/6/97	0835
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:	NOTES:
TYPE OF SAMPLER: Varies - see log	
DIAMETER OF SAMPLER: Varies - see log	
WEIGHTS OF HAMMER: 140 lbs	

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

ORIGINAL

FS-F-3681-1 7/11/95

000262

G:\WPSC\95-0140.DRW

JFR 11/20/97

CONTROL NUMBER: 50Φ352-12267-020

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME: Geotech Investigation Former Plant Area

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-002/12267

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16				with fossil brachiopods, gastropods & other invertebrate material.			Overdrill to 17½' with 17" auger. Greater hole. Start SS at 18' Driller wanted to reduce chance of grout in SS
17				ORIGINAL			
18	0820 5/7/97 412359	6 11 12	SS	(10Y, 4/1) Dark greenish gray clay with gravel (to 2½"). Moist, low plasticity, very stiff. Gravel than ord bedrock, angular, fossiliferous.	CL	3.0	SS 18-19½' PID-~~0.6~~ 0.2 ppm 5/7/97
19							
20	0850 5/7/97 412360	2 6 11	SS 3"	(10Y, 5/1) Greenish gray clay with some gravel (to ~¼") . Moist, low plasticity, very stiff. Gravel smaller than in 18-19½' interval. No ord. bedrock noted.	CL	2.0-3.0	PID-0.2
21							
22	0920 5/7/97 412361		ST with piston 22"	(10Y, 5/1) Greenish gray clay with gravel. Moist. (Description from bottom of tube)	CL		Tube crumpled slightly PID = background.
23							
24	0931 5/7/97 412362	3 6 8 10	SS 25"	(10Y, 5/1) Greenish gray clay with gravel. Moist, stiff to very stiff, low-med plasticity. Gravel to ¼", subangular-subrounded, quartzose & lithic.	CL	1.5-2.5	
25	BOB 25'			cuttings - gray clay			412363 - AB Sample 412364 - 10 gallon from cuttings

METER	BKGD	DATE	TIME
PID	0.2 ppm	5/7/97	0815
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: Varies - see log
DIAMETER OF SAMPLER: Varies - see log
WEIGHTS OF HAMMER: 140 lb

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

G:\WPSC\95-0140.DRW

JFR 11/20/97

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Log of Boring G3-003/12268

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: No Data

Driller: Alliance, Env., Inc	**Drilling**	**Date**	**Time**
Drill Method: 8" Hollow Stem Auger	**Started**	4/29/97	
Sample Method: Split Spoon, Shelby Tube, Denison	**Finished**	4/29/97	
Borehole Diameter: 8 in. / **Water Level:** 6'11' BGS	**Logged By:** J. Erjavec/R. Nicks	**Checked By:** K. Ernst	

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
				1						
412301	15:10 4/28/97	18"	SS 18 17 15	2		10" of coal fragments and dust. 9" of light olive brown (2.5Y, 5/6) clay, mottled with black coal dust. Some fg to cg sand. Clay, moist to dry, low plasticity.	CL SM	>4.5	MC	
412302	15:18 4/28/97	10"	SS 8 10 14 14	3 4		Light olive brown (2.5Y,5/6) clay with trace cg sand, gravel, coal fragments and dust. Clay, moist, low plasticity.	CL	>4.5	MC	
412303	15:30 4/28/97	13"	ST	5 6		Light olive brown (2.5Y,5/6) clay with trace sand and gravel. Clay, moist. (Described from bottom of tube).	CL		MC GS AL	
412304	15:48 4/28/97	22"	SS 10 11 12 15	7 8		Light olive brown (2.5Y,5/4) clay with trace sand and gravel. Iron stain partings. Transition to dark greenish gray (10Y,4/1) clay near bottom of core. Brown clay, very stiff, moist, low plasticity. Gray clay, very stiff, moist, low plasticity.	CL	3.0-4.0	MC	
412305	16:18 4/28/97	21	D	9 10		Dark greenish gray (10Y,4/1) clay with sand and gravel. Stiff to very stiff, low to medium plasticity, moist to wet. Gravel fine to coarse. Sand, mg to cg.	SC CL	1.5-2.5	MC GS AL UCS	
412306	08:47 4/29/97	18"	SS 1 3 7 11	11 12		Dark greenish gray (10Y,3/1) sandy clay with gravel. Very stiff, wet. Gravels to 0.5", angular.	CL	3.0	MC	
412307	09:25 4/29/97	24"	D	13		Dark greenish gray (10Y,4/1) sandy clay with gravel. Stiff to very stiff, wet. Gravels to 0.5", angular to subrounded.	CL	1.0-1.75	MC GS AL CU	

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Log of Boring G3-003/12268
Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Pit. Area. Geot. Investigation

Sheet 2 of 2
Job Number: 50.03.52/PO-177
Elevation: No Data

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
412307	09:25 4/29/97	24"	D	15			CL	1.0-1.75	MC GS AL CU	
	10:30 4/29/97	0"	D	16		Dark greenish gray (10YR,4/1) clay with gravel. Moist, stiff to very stiff. Gravels to 0.25", subangular to subrounded.	CL			
412308	10:47 4/29/97	21"	SS 4 6 10 12	17 18		SAA	CL	1.5-2.0	MC	
412309	11:00 4/29/97	11"	SS 8 10 14 12	19 20		SAA, except gravels to 1".	CL	2.5-4.0	MC	
412310	13:55 4/29/97	17"	D	21 22		Dark greenish gray (10YR,4/1), clay, some sand, cg, trace to some gravel. Moist, very stiff to hard, none to low plasticity (silt?). Gravel to 0.5", subangular-subrounded.	CL	3.75-4.25	MC GS AL UCS	
412311	14:15 4/29/97	18"	SS 7 9 10 15	23 24		Dark greenish gray (10YR,4/1) sandy clay, moist to wet, grading to dark gray (10Y,4/1) clay with some sand. Silt likely throughout. Low to medium plasticity, very stiff. Sand, fg-cg, poorly sorted. Trace to some gravel.	CL	2.0-4.0	MC	
				25 26 27 28 29		*Bottom of boring at 25 feet.*				

Notes: Samples collected per ASTM D 1586 and ASTM D 1587. Colors identified using Munsell Color Chart. Consistency based on Standard Penetration Resistance Value. Soils visual description per ASTM D 2488 and soil classification per ASTM D 2487.

SS = Split Spoon, 2" OD, no liner
ST = Shelby Tube, 3" OD
D = Denison, 2 13/16" ID
DM = Dames & Moore, 2.41" ID, 3" OD

USCS Symbols:
Bold = Laboratory
Normal = Visual

Boring NAD 1983 Coordinates:
1345917.5E; 481488.5N

FEMP

LITHOLOGIC LOG

CONTROL NO.: 500352-12268-015

PROJECT NAME: Geotech Investigation Former Plant Area	PROJECT NO.: 5003.52
LOCATION/NUMBER: 63-003/12268	COORDINATES: N/A
DATE STARTED: 4/28/97	DATE COMPLETED: 4/29/97
SURFACE ELEVATION: N/A	GROUNDWATER LEVEL: 6'11" Below Surface — DATE: 4/29/97 — TIME: 0845
GROUNDWATER LEVEL: ~24' below surface — DATE: 4/29/97 — TIME: 14:30	
GEOLOGIST: J. Erjavec / R. Widis	DRILLING CONTRACTOR: Alliance Env. Inc
DRILLING EQUIPMENT: Mobile B-61 HSA	DRILLER: Dengel Roberts / Paul McAdams
WATER USED DURING DRILLING: N/A GAL	WATER RECOVERED DURING DRILLING: N/A GAL
WATER LOST DURING DRILLING: N/A GAL	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							14:50 Augured to 1' Coal cuttings, black
1	15:10 4/28/97 412301	11 18 17 15	19"	10" coal fragments & dust. 9" very hard light olive-brown clay, mottled with black coal dust, with some fine grained to coarse sand; (2.5Y 5/6) moist to dry, low plasticity	SM / CL	4.5 (4.5+)	11-18-17-15 SS 19" recovery PID-Ø
3	15:18 4/28/97 412302	6 10 14 14	10"	very hard, light olive brown clay with trace coarse sand, gravel & coal fragments & dust, moist, low plasticity, lean clay; (2.5Y 5/6).	CL	4.5+	PID-Ø SS
5	15:30 4/28/97 412303		estimate 13" probl. less	Light olive brown clay with trace sand & gravel, moist, (2.5Y 5/6).			Tube crimped ST slightly Pushed 19" Not a good structural sample; index properties only PID Ø

6'11" ▽ 4/29/97 0845

METER	BKGD	DATE	TIME
PID	Ø	4/28/97	0735
ALPHA JFR 5/11/97	—	—	—
BETA / GAMMA JFR 5/11/97	60cpm ~~80cpm~~	4/28/97	

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Varies-see log
DIAMETER OF SAMPLER	Varies-see log
WEIGHTS OF HAMMER	140 lbs

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (07-10-95)

JFR 11/24/97

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER: 500352-12268-016

PROJECT NAME: Geotech Inv. Former Plat Area

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-003/12268

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7	15:48 4/28/97 412304	10 11 12 15 Brown clay / Gray clay	22"	(2.5Y 5/4) Light olive brown clay with trace sand, gravel & ironstain partings. Transition to gray clay near bottom of core (10Y, 4/1) (dark greenish gray clay). Brown clay very stiff, moist, low plastic. Gray clay very stiff, moist, low plastic.	Brown CL / CL Gray	3.0 to 4.0 brown / 3.5 gray	PID-Ø 55
9	16:18 4/28/97 412305	DENISON	21"	(10Y, 4/1) Dark greenish gray clay with sand & gravel, stiff to very stiff, low plasticity to med. plasticity, moist to wet. Gravel fine to coarse, sand coarse to med. - sandy lean clay with gravel	CL	1.5-2.5	PID-Ø Den.
11	0847 4/29/97 412306	1 3 7 11	18"	(10Y, 3/1) SANDY CLAY WITH GRAVEL, dark greenish gray, very stiff, wet. gravels angular to ½"	CL	3.0	water level @ 6'11" Below ground surface 0845, 4-29-97 PID-Ø
13	0925 4/29/97 412307	DENISON	24"	(10Y 4/1) SANDY CLAY WITH GRAVEL dark greenish gray, stiff to very stiff, wet. Gravels to ½" angular to subrounded	CL	1.0-1.75	NO WATER ADDED TO drill sample. Sample pushed from one lexan tube into another. Difficulty in removing Lexan tube from sampler PID-Ø
15	1030 4/29/97 NO SAMPLE	DENISON	0"				

METER	BKGD	DATE	TIME
PID	0	4/29/97	0800
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: James Salog
DIAMETER OF SAMPLER: James Salog
WEIGHTS OF HAMMER: 140 lbs

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

000267

FS-F-3681-1 7/11/95

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FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER: 500352-12268-017

PROJECT NAME: Geotech. Inv. Former Plant Area

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-003/12268

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16	NO SAMPLE	NA	0"	SANDY CLAY WITH GRAVEL 10YR 4/1, dark greenish gray, moist, stiff to very stiff. Gravels to 1/4", subangular to subrounded	CL		
17	1047 4/29/97	4	4	4/29/97		1.5-	
	7/11/97	6	6	4/27/11/97		2.0	
18	4/30/97	10	10	(Sample from 17-19') JE 8/12/97			
	412308	12	12				
19	1100	6					
		10				2.5	
20	4/29/97	14	11"			4.0	
	412309	12		gravels to 1"			
21	1355 4/29/97 412310	DO NOT USE	17"	Dark, greenish gray clay (10Y 4/1) moist, very stiff to very hard, some sand, coarse, trace to some gravel, low plasticity to none (silt?) Gravel to 1/2", subangular-subrounded	CL	3.75-4.25	PID-Ø Denisity plastic sheath cracked 1/2"-1" at bottom
22							
23	14:15 4/29/97 412311	7 9 10 15	SS 4/29/97 JE 16" 18"	Dark greenish gray, sandy clay (10Y, 4/1) moist to wet, grading to dark greenish gray (10Y, 4/1) clay with some sand. Silt component likely throughout. Low to med plasticity. Very stiff. Sand-coarse to fine, poorly sorted. Trace to some gravel.	CL	2.0-4.0	PID-Ø
24							
25	BOB 25'						

METER	BKGD	DATE	TIME
PID JE	—	—	—
ALPHA 7/11/97	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Varies - see log
DIAMETER OF SAMPLER	Varies - see log
WEIGHTS OF HAMMER	140 lb

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

JFR 11/29/97

FS-F-3681-1 7/11/95 000268 G:\WPSC\95-0140.DRW

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Log of Boring G3-004/12269

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Pit. Area. Geot. Investigation

Sheet 1 of 3
Job Number: 50.03.52/PO-177
Elevation: 579.6

Driller: Alliance, Env., Inc	**Drilling**	**Date**	**Time**
Drill Method: 8" Hollow Stem Auger	**Started**	5/12/97	
Sample Method: Split Spoon, Shelby Tube, Dames & Moore	**Finished**	5/13/97	
Borehole Diameter: 8 in. / **Water Level:** 13' BGS	**Logged By:** J. Erjavec	**Checked By:** K. Ernst	

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
				1						
412383	14:10 5/12/97	13"	SS 7 8 9 9	2		Grayish brown (2.5Y,5/2) clay to light olive brown (2.5Y,5/3) clay. Dry to moist, low plasticity, hard to very hard. Trace gravel. 2" of gravel and sand at top of core, fill.	CL	4.0-->4.5	MC	
412384	14:20 5/12/97	13"	SS 4 5 6 9	3, 4		Light olive brown (2.5Y,5/3) mottled clay with greenish black (10Y,2.5/1) clay (bottom 7"). Moist, low to medium plasticity, very stiff. Trace to some organics in brown clay. Trace gravel in gray clay to .25".	CL	2.0-3.5	MC	
412385	14:52 5/12/97	17"	ST	5, 6		Mottled mix of dark greenish gray (10Y,4/1) and light olive brown (2.5Y,5/3) clay. Moist, low plasticity.	CH CL		MC GS AL UCS	
412386	14:55 5/12/97	15"	SS 3 4 6 6	7, 8		Mix of light olive brown (2.5Y,5/3) clay to dark greenish gray (10Y,4/1) clay. Moist, low plasticity, very stiff. Trace gravel. More brown clay than gray clay in core.	CL	2.5-3.5	MC	
412387	15:02 5/12/97	17	SS 2 3 4 5	9, 10		Light olive brown (2.5Y,5/4) and greenish gray (10Y,4/1) clay, silty clay and silts. Silt beds wet, .5-.75" thick. Clay, moist to wet, very stiff, low plasticity.	CL ML	2.5-3.5	MC	
412388	15:07 5/12/97	16"	SS 3 4 4 5	11, 12		Light olive brown (2.5Y,5/4) and greenish gray (10Y,4/1) mottled clay, silty clay and silts. Clay, moist to very stiff, low to high plasticity. Silts, moist to wet, .5-.75" thick. Fat clay near bottom of core.	CL CH	2.5-3.5		
412389	15:13 5/12/97	18"	3 4 6 14	13		Light olive brown (2.5Y, 5/4) silty clay grading to greenish gray (10Y,5/1) clayey silt. Bottom 8" of core gray silt. Clay, moist, very stiff, low plasticity.	CL ML	2.0-3.5	MC GS AL	

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Log of Boring G3-004/12269

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 579.6

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
412389	15:13 5/12/97	18"	3 4 6 14				CL ML	2.0-3.5	MC GS AL	
412391	15:40 5/12/97	22"	SS 1 11 11 7	15 16		Dark yellowish brown (10YR,4/4) clayey sand to sand. Sand, fg-cg, well sorted in zones, but varies throughout. Trace gravel to 0.25", subangular-subrounded. Sand moist to wet.	SC SP-SC		MC GS AL Pch	
412393/94	15:55 5/12/97	~18"	SS 3 5 9 9	17 18		Dark yellowish brown (10YR,4/4) clayey sand overlying gray (2.5Y,5/1) sandy clay. Sand, fg-mg, well graded, wet. Clay, wet, very stiff, low plasticity. Trace to some gravel throughout to .25". Sand ~ 10" thick, clay ~ 8"	SM SC CL	2.0-3.0	MC GS AL	
412395/96	16:05 5/12/97	~17"	SS 2 6 6 8	19 20		Dark yellowish brown (10YR,4/4) clayey sand with gravel. Wet, fg-mg. Gray (2.5Y,5/1) silty clay grading to clayey silt. Clay, wet, very stiff. Silt, wet. Trace gravel throughout to .25"	SM SC CL ML	2.0-3.5	MC GS AL	
412397/98	16:15 5/12/97	~18"	SS 2 3 5 5	21 22		Gray (2.5Y,5/1) sandy fat clay with gravel, moist to wet, high plasticity,soft. Gravel to .25". Dark yellowish brown (10YR,4/4) sand in top of core, probably slough, wet.	CL CH	<0.25	MC GS AL	
412399	16:28 5/12/97	~14"	SS 3 3 4 6	23 24		Gray (2.5Y,5/1) fat clay with gravel (to 1"). Wet, high plasticity, very soft to medium stiff. 4" of sand in top of core, probably slough.	CH	0.25-1.0		
				25		Gray (2.5Y,5/1) fat clay and 3" Ordovician bedrock piece containing brachiopod fossils.				
412400	08:45 5/13/97	18"	DM 25 65 80	26 27		Dark greenish gray (10Y,4/1) sandy clay with gravel. Moist to wet, very hard, low plasticity. Gravel abundant to .5", mostly subangular-subrounded quartzose and lithic fragments.	CL	>4.5	MC GS AL CU	
412402	09:15 5/13/97	18"	DM 19 49 100	28		Dark greenish gray (10Y,4/1) sandy clay with gravel. Moist, very hard, low plasticity. Gravel as above.	CL		MC GS AL UCS	
				29		*Bottom of boring at 29 feet.*				

Notes: Samples collected per ASTM D 1586 and ASTM D 1587. Colors identified using Munsell

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Log of Boring G3-004/12269
Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 579.6

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
				31		Color Chart. Consistency based on Standard Penetration Resistance Value. Soils visual description per ASTM d 2488 and soil classification per ASTM D 2487.				
				32		SS = Split Spoon, 2" OD, no liner ST = Shelby Tube, 3" OD D = Denison, 2 13/16" ID DM = Dames & Moore, 2.41" ID, 3" OD				
				33		USCS Symbols: **Bold** = Laboratory Normal = Visual				
				34		**Boring NAD 1983 Coordinates:** **1348835.9E; 480832.0N**				
				35						
				36						
				37						
				38						
				39						
				40						
				41						
				42						
				43						
				44						
				45						

CONTROL NO.: 014
500352-12269-014

FEMP
LITHOLOGIC LOG

PROJECT NAME: Geotech Investigation Former Plant Area	PROJECT NO.: 500352
LOCATION/NUMBER: G3-004/12269	COORDINATES: N/A
DATE STARTED: 5/12/97	DATE COMPLETED: 5/13/97
SURFACE ELEVATION: N/A	GROUNDWATER LEVEL: 13' BGS — DATE: 5/13/97 — TIME: 0817
GROUNDWATER LEVEL: N/A — DATE: N/A — TIME: N/A	
GEOLOGIST: J. Erjavec	DRILLING CONTRACTOR: Alliance Env, Inc
DRILLING EQUIPMENT: Mobile B-59 HSA	DRILLER: McAdams/Roberts
WATER USED DURING DRILLING: N/A GAL.	WATER RECOVERED DURING DRILLING: N/A GAL.
WATER LOST DURING DRILLING: N/A GAL.	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							Augered to 1'
1	1410 5/12/97 412383	7 8 9 9	SS 13"	(2.5Y, 5/2) Grayish brown clay, to (2.5Y, 5/3) light olive brown clay. Dry to moist, low plasticity, hard to very hard. Trace gravel. 2" of gravel & sand at top of core - SM.	CL	4.0 to 4.5+	+20ppm > bkgnd for top 2" of core PID - ~~0.6ppm~~ 0.2 JEW 5/21/97 412382 AB Screen
3 4 5	1420 5/12/97 412384	4 5 6 9	SS 13"	(2.5Y, 5/2) Light olive brown, mottled Clay to (10Y, 2.5/1) greenish black Clay (bottom 7"). Moist, low to med. plasticity, very stiff, Trace to some organics staining in brown clay. Trace gravel into gray clay (<.25")	CL	2.0-3.5	PID - 0.3ppm
6 7	1452 5/12/97 412385		ST 17"	(10Y, 4/1 to 2.5Y, 5/2) (mottled mix of dark greenish gray & light olive brown Clay. Moist. Low plasticity.	CL		

METER	BKGD	DATE	TIME
PID	0.2ppm	5/12/97	1415
ALPHA	N/A	N/A	N/A
BETA / GAMMA	80cpm	5/12/97	1400

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: Varies - see log
DIAMETER OF SAMPLER: Varies - see log
WEIGHTS OF HAMMER: 140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681 000272

JFR 11/20/97

G: / WPSC / 95-0037.DRW (07-10-95)

CONTROL NUMBER: 500352-12269-~~012~~ 015 8-13-97

FEMP LITHOLOGIC LOG (Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
Geotech Inv. Former Plant Area	50.03.52	63-004/12269

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7							
8	1455 ✓ 5/12/97 412386	3 4 6 6	SS 15"	(2.5Y, 5/2; 10Y, 4/1) Mix of light olive brown to dark greenish gray clay. Moist, low plasticity, very stiff. Trace gravel. More brown clay than gray clay in core.	CL	2.5-3.5	PID = background
9							
10	1502 ✓ 5/12/97 412387	2 3 4 5	SS 17"	(2.5Y, 5/4; 10Y, 4/1) Light olive brown & greenish gray clay, silty clay & silts. Silt beds, wet, ½" to ¾" thick. Clay moist to wet, very stiff, low plasticity.	CL	2.5-3.5	PID - background.
11							
12	1507 ✓ 5/12/97 412388	3 4 4 5	SS 16"	(2.5Y, 5/4; 10Y, 4/1) Light olive brown & greenish gray mottled clay, silty clay & silts. Clay moist, very stiff low to high plasticity. Silts wet to moist, ½" to ¾" thick. Fat clay near bottom of core.	CL CH	2.5-3.5	PID - background.
13							
14	1513 ✓ 5/12/97 412389 ✓	3 4 6 14	SS 18"	(2.5Y, 5/4) Light olive brown silty clay grading to (10Y, 5/1) greenish gray silty clay to clayey silt. Bottom 8" of core silt, gray. Clay moist, very stiff, low plasticity.	CL ML	2.0-3.5	PID - Background 412380 A/B Screen sand sorted in auger cuttings.
15							
16	1540 ✓ 5/12/97 412391	1 11 11 7	SS 22"	(10YR, 4/4) Dark yellowish brown clayey sand to sand. fg-cg, well sorted in zones, but varies throughout. Trace gravel to 1/2", subangular to subrounded. Sand wet	SC OR SP-SC		

METER	BKGD	DATE	TIME
PID	—	—	—
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: Varies with log
DIAMETER OF SAMPLER: Varies See log
WEIGHTS OF HAMMER: 140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

G:\WPSC\95-0140.DRW

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER: 500352-12269-016 ~~015~~

PROJECT NAME: Geotech Investig. Fernald Plant Area

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: G3-004/12269

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16				to moist.	SC		Start 1550 5/12/97 412392 10 gallon for SP (sand)
17							
18	1555 5/12/97 412393 (Sand)	3 5 9 9	SS ~18"	(10YR,4/4) Dark yellowish brown clayey sand overlying (2.5Y,5/1) gray sandy clay. Sand fg-mg, well graded, wet. Clay wet, very stiff, low plasticity. Trace to some gravel throughout (to ~1/4"). Sand ~10", clay ~8".	SC CL	2.0-3.0	PID - backsand 1555 5/12/97 412394 (Clay)
19				(10YR,4/4) Dark yellowish brown clayey sand with gravel, wet, mg to fg.	SC?		could be sloughed
20	1605 5/12/97 412395 (Sand)	2 6 6 8	SS ~17"	(2.5Y,5/1) Gray ~~sandy~~ silty clay (LS 5/12) grading to gray clayey silt. Clay very stiff, wet. Silt, wet. Trace gravel throughout to 1/4".	CL ML	2.0-3.5	PID - backsand 1605 5/12/97 412396 (Clay/silt)
21							
22	1615 5/12/97 412397 (Sand)	2 3 5 5	SS ~18"	(2.5Y,5/1) Gray sandy fat clay with gravel, wet to moist, high plasticity. Gravel to ~1/4". Clay soft. ~~(2.5Y,5~~ (LS 5/12) (10YR,4/4) Dark yellowish brown clay (~8") ~~in top of core~~ - probably slough. Wet.	CH	<.25	PID - backsand 1615 5/12/97 412398 (Clay)
23					CH	.25-1.0	
24	1624 5/12/97 412399	3 3 4 6	SS ~14"	(2.5Y,5/1) Gray fat clay with gravel (to 1"), wet, high plasticity, very soft to medium stiff. 4" of sand as above (sloughin hole)			
25							

Start 1550 5/12/97 Stop 0915 5/13/97

METER	BKGD	DATE	TIME
PID	—	—	—
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Vanes - see log
DIAMETER OF SAMPLER	—
WEIGHTS OF HAMMER	140 lbs

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER: 500352-12269-017 014

PROJECT NAME: Geotech Invest. Forma Plat Area (8-12-97)

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-004/12269

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
25			ST 2" Dones + Moore	Gray hard clay (2.5Y,5/1) + 3" ord bedrock with brachiopods.			Pushed ST 2" - hit hard object - 3-4" piece of Ordovician bedrock - stuck in tube.
26	5/12/97 412400 5/13/97 0845	25 65	18"	(10Y,4/1) Dark greenish Gray sandy clay with gravel. Moist to wet, very hard, low plasticity. Gravel abundant to (1/2" size) Mostly subangular-subrounded quartzose + lithic fragments	CL	4.5+	Likely hit limestone float boulder ~~augered to~~ ~26' pushing block down. Dones + Moore used to try to break limestone piece.
27	(6 RINGS)	80					
28	5/13/97 0910 412402 (6 rings undisturbed)	19 48 100	Dones + Moore 18"	(10Y,4/1) Dark greenish gray sandy clay with gravel. Moist, very hard, low plasticity. Gravel as above.	CL		PID - 0 5/13/97 412401 3 Rings 0845 (TOP) 27.5-29" push 19/49/100-4" 5/13/97 0910 412403 4 Rings (disturbed) (412404 A/B Screen) 412405 10 gallon ctgs ~ 1-2 gallons collected. time - 1010 8/21/97
29		8 08	29"				

METER	BKGD	DATE	TIME
PID	0	5/13/97	0830
ALPHA	—	—	—
BETA / GAMMA	60cpm	5/13/97	0830

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: Varies - See Log
DIAMETER OF SAMPLER:
WEIGHTS OF HAMMER: 140 lbs

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

G:\WRSC\95-0140.DRW

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Log of Boring G3-005/12270

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 579.1

Driller: Alliance, Env., Inc	**Drilling**	**Date**	**Time**
Drill Method: 8" Hollow Stem Auger	**Started**	5/19/97	
Sample Method: Split Spoon, Dames & Moore	**Finished**	5/20/97	
Borehole Diameter: 8 in. / **Water Level:** 5.8' BGS	**Logged By:** J. Erjavec	**Checked By:** K. Ernst	

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
						Fill.				
412419	09:17 5/19/97	12"	SS 8 8 8 9	1, 2		Olive (5Y,4/3) clay with trace gravel, moist, stiff. 4-5" of slough (gravel, concrete) in top of core.	CL		MC	
412420/21	09:25 5/19/97	17"	DM 6 10 12	3, 4		Light olive brown (2.5Y,5/6) clay overlying dark greenish gray (10Y,3/1) clay. Moist, low plasticity, trace gravel. Brown clay mottled. Greenish gray clay may be fill.	CL		MC GS AL UCS	
412422	09:38 5/19/97	16"	SS 3 3 4 4	5, 6		Light olive brown (2.5Y,5/6) clay, mottled, moist, trace gravel. Sand or silt in bottom 4" of core, fg.	CL ML		MC	
412423	09:43 5/19/97	18"	SS 3 3 3 5	7, 8		Light olive brown (2.5Y,5/6) clay grading to a clayey silt (12" of core). Moist to wet, trace sand and gravel?	CL ML		MC	
412424	09:50 5/19/97	16	DM 4 8 6	9, 10		Light olive brown (2.5Y,5/6) clay and clayey silt with sand. Moist to wet.	CL ML		MC GS AL	
				11						
412425	14:00 5/19/97	14"	SS 8 10 14	12, 13		Brown (10YR,4/3) sand with clay and gravel. Poorly sorted, wet. Abundant mafic minerals.	SW-SC		MC	
412426	14:08 5/19/97	18"				Brown (10YR,4/3) sand grading to gray (2.5Y,5/1) sand, wet, well sorted in zones.	SP-SC			

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Log of Boring G3-005/12270

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 579.1

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
412426	14:08 5/19/97	18"	SS 7 11 13 12	15		Sand, fg-cg, abundant mafics. Clay throughout.	SP-SC		MC GS AL Pch	
412428	14:15 5/19/97	15"	SS 13 13 12	16		Greenish gray (10Y,5/1) clayey sand, grading to greenish gray sandy clay with gravel. Clay, stiff to hard, low plasticity.	SP CL		MC	
412429	14:22 5/19/97	21"	SS 10 10 12 13	17, 18		Greenish gray (10Y,5/1) sand with interbeds of greenish gray silt. Sand, fg, wet, well sorted, poorly graded. Gravel trace to some.	ML SP-SM		MC GS AL	
412430	14:30 5/19/97	21"	SS 8 10 12 14	19, 20		Dark greenish gray (10Y,4/1) sand to sandy silt. Sand, fg, moist to wet, well sorted, mafics and clay throughout. Gravel, trace to some.	SP-SM ML SP-SM		MC	
412431	14:40 5/19/97	22"	SS 14 10 10 12	21, 22		Dark greenish gray (10Y,4/1) sand to sandy silt. Sand, fg, wet, well sorted, mafics and clay throughout. Gravel trace.	SM SP-SM ML		MC GS AL	
412432	09:08 5/20/97	18"	SS 2 4 8 12	23, 24		Greenish gray (10Y,5/1) clay, wet, soft to stiff, low plasticity. Some sand and gravel. 2" of cg sand with gravel at top of core, probably slough.	CL			
412433	09:20 5/20/97	18"	SS 5 15 31 15	25, 26		Mix of greenish gray (10Y,5/1) sandy clay and clayey sand. Sand, wet, fg-cg, poorly sorted. Clay (3"), wet, stiff to hard, generally sandy throughout. Gravel througout to 1".	SW-SC CL		MC	
412434	09:36 5/20/97	22"	SS 33 49 65 70	27, 28		Greenish gray (10Y,5/1) clayey sand, fg-cg, wet, poorly sorted. 3-3.5" cobble below sand, Ordovician bedrock. 18" of very hard greenish gray (10Y,5/1) clay, moist to wet, low plasticity. Trace to some gravel.	CL SW-SC		MC GS AL	
				29		*Bottom of boring at 29 feet.*				

Notes: Samples collected per ASTM D 1586 and ASTM D 1587. Colors identified using Munsell

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Log of Boring G3-005/12270
Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 579.1

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
				31		Color Chart. Consistency based on Standard Penetration Resistance Value. Soils visual description per ASTM D 2488 and soil classification per ASTM D 2487.				
				32		SS = Split Spoon, 2" OD, no liner ST = Shelby Tube, 3" OD D = Denison, 2 13/16" ID DM = Dames & Moore, 2.41" ID, 3" OD				
				33		USCS Symbols: **Bold** = Laboratory Normal = Visual				
				34		**Boring NAD 1983 Coordinates:** **1348629.6E; 480668.2N**				
				35						
				36						
				37						
				38						
				39						
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				41						
				42						
				43						
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				45						

FEMP

LITHOLOGIC LOG

CONTROL NO.: 500352-1270-021

PROJECT NAME: Geotech Investigation Former Plant Area	PROJECT NO.: 56.03.52
LOCATION/NUMBER: 63-005/1227Ø	COORDINATES: N/A
DATE STARTED: 5/19/97	DATE COMPLETED: 5/20/97
SURFACE ELEVATION: N/A	GROUNDWATER LEVEL: 5.8' below GS — DATE: 5/19/97 — TIME: 1036
GROUNDWATER LEVEL: 7' BGS — DATE: 5/20/97 — TIME: 0822	
GEOLOGIST: J. Erjavec	DRILLING CONTRACTOR: Alliance Env. INC.
DRILLING EQUIPMENT: Mobile B-59 4Sd	DRILLER: Roberts/McAdams
WATER USED DURING DRILLING: N/A GAL.	WATER RECOVERED DURING DRILLING: N/A GAL.
WATER LOST DURING DRILLING: N/A GAL.	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							.5' of concrete-reinforced cut to 0.5'
							Augered to 1'
1			SS	(5Y, 4/3) Olive clay with trace gravel. Moist, stiff. 4-5' of slough (gravel, concrete) in top of core	CL		418 JE 5/19 412349 (1/B Sram)
2	0917 5/19/97 412354 JE 417 5/19	8 8 8 9	12"				PID - bckgnd 250 cpm in sample
3			Dames + Moore	(2.5Y, 5/6) Light olive brown clay overlying (10Y, 3/1) Dark greenish gray clay. Low plasticity, moist, trace gravel, Brown clay mottled. Greenish gray clay may be fill.	CL		PID - bckgnd
4	(6 Rings) 0925 5/19/97 412355 JE 420 5/19	6 10 12	17"				421 JE 5/19/97 412352 (remaining rings) Augered to 5'
5		3 3	SS	(2.5Y, 5/6) Light olive brown clay, mottled, moist, trace gravel; fg sand or silt in bottom 4" of core.	CL		
6	0938 5/19/97 412353 JE 422 5/19	4 4	16"				
7							

METER	BKGD	DATE	TIME
PID	4.0 ppm	5/19/97	0830
ALPHA	NA	JE 5/19	
BETA / GAMMA	50 cpm	5/19/97	0830

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Varies - see log

DIAMETER OF SAMPLER: —

WEIGHTS OF HAMMER: 140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (07-10-95)

CONTROL NUMBER: SCC352-12270.022

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME: Geotech. Inv. FPA

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-005/12274

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7		3	SS	(2.5Y, 5/6) Light olive brown clay	CL		PID-bckgnd
	0943	3		grading to a clayey silt (~12" of one)			
8	5/19/97	3	18"	moist to wet, trace? sand, trace?	ML		
	412354	5		gravel.			
	JE 423 5/19						
9							
	0950	4	Drives + moved 6 exists top disturbed 16"	(2.5Y, 5/6) Light olive brown clay	CL		Overdrill 18" tries to 11' Bracted to 11'
	5/19/97	8		to l.o.b. clayey silt with sand. moist	ML		
10	412355	6		to wet.			
	JE 424 5/19/97						
11							Augured to 12' to clear grout
12	1400	8	SS	(10YR, 4/3) Brown sand with	JE 5/21 SW-SC		PID-Bckgnd
	5/19/97	10	14"	clay & gravel. Poorly sorted, wet.			
13	412425	14		Abundant mafic minerals			
14	1408	7	SS	(10YR, 4/3 to 2.5Y, 5/1) Brown sand	JE 5/21 SP-SC		PID-Ø
	5/19/97	11	18"	grading to gray sand, wet, well sorted			
	412426	13		in sand, fg, mg & cg. Abundant mafics			
15		12		Clay content in sand throughout	JE 5/19		
			SS (See below)				
16							

METER	BKGD	DATE	TIME
PID	Ø ppm	5/19	
ALPHA	N/A	JE 5/19	
BETA / GAMMA	N/A	—	—

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Various - See Log

DIAMETER OF SAMPLER: —

WEIGHTS OF HAMMER: 140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

G:\WPSC\95-0140.DRW

JFR 11/26/97

CONTROL NUMBER: 50352-12270-023

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME: Geo Inv. RFA

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-065/12270

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16	1415 5/19/97 412428	13 13 12	SS 15"	(10Y 5/1) Greenish gray clayey sand grading to greenish gray sandy clay with gravel. Wet, stiff to hard, low plasticity	SP CL		412427(AB) PID-backg.
17 18	1422 5/19/97 412429	10 10 12 13	SS 21"	(10Y,5/1) Greenish gray fg sand with interbeds of greenish gray silt. Wet, sand well sorted, poorly graded. Gravel some to trace.	SP-SM ML	1.5 TSF	PID-backg.
19 20	1430 5/19/97 412430	6 10 12 14	SS 21"	(10Y,4/1) Dark greenish gray fg sand to sandy silt. Wet to moist. Clay throughout. Gravel trace to some. Sand well sorted. Mafics throughout.	SP-SM ML SP-SM	1.5 TSF	PID-backg.
21 22	1440 5/19/97 412431	14 10 10 12	SS 22"	(10Y,4/1) Dark greenish gray fg sand to sandy silt. Wet, clay throughout. Gravel trace. Sand well sorted. Mafics.	SP-SM ML		PID-backg.
23 24 25	0908 5/20/97 412432	2 4 6 12	SS 18"	(10Y,5/1) Greenish gray clay, wet, soft to stiff, low plasticity. Some sand & gravel. 2" cg sand with gravel at top of core - prob. sloughs.	CL		PID backgrd.

METER	BKGD	DATE	TIME
PID	1.2 ppm	5/20/97	0825
ALPHA	N/A		
BETA / GAMMA	60cpm	5/20/97	0905

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Vibro-Seis
DIAMETER OF SAMPLER	N/A
WEIGHTS OF HAMMER	140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

000281

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CONTROL NUMBER: 500352-12270-024

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME: Geot. Inv. FPA

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-065/12270

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
25			SS				
	0920 5/20/97 412433	5 15 31 15	18"	(10r,5/1) Mix of sandy clay (greenish gray) & clayey sand (greenish gray). Sand, wet cg to fg, poorly sorted, Clay (~3"), hard to stiff, wet, Generally, sandy throughout. Gravel fragment to 1".	~~SP~~ SW-SC CL	~~PS~~ 5/21 ~~SP~~ SW-SC PE 5/21	PID - Background
27			SS (3")				
28	0936 5/20/97 412434	33 49 65 74	22"	(10r,5/1) 5" clayey (greenish gray) sand, cg to fg, poorly sorted wet. 3-3½" cobble below sand. Ord. bedrock. 16" of very hard greenish gray clay, moist to wet, low plasticity. Trace to some gravel throughout.	~~SP~~ SW-SC CL	5/2	412435 (AB)
29	BOB 29'						

METER	BKGD	DATE	TIME
PID	N/A	PS 5/20	—
ALPHA	N/A	—	
BETA / GAMMA	N/A	—	—

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Vanes - Geolog
DIAMETER OF SAMPLER	N/A
WEIGHTS OF HAMMER	140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

G:\WPSC\95-0140.DRW

FR 11/20/97

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Log of Boring G3-006/12271

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Sheet 1 of 3
Job Number: 50.03.52/PO-177
Elevation: 580.7

Driller: Alliance, Env., Inc	**Drilling**	**Date**	**Time**
Drill Method: 8" Hollow Stem Auger	**Started**	5/7/97	
Sample Method: Split Spoon, Shelby Tube, Dames & Moore	**Finished**	5/9/97	
Borehole Diameter: 8 in. / **Water Level:** N/A	**Logged By:** J. Erjavec	**Checked By:** K. Ernst	

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
						Fill.				
412365	14:53 5/7/97	11"	SS 8 11 10 10	1, 2		Olive brown (2.5Y,4/4) clay with gravel. Dry, very hard, low to no plasticity. Gravel in top 2" of core and sporadic throughout. Probably fill.	CL	>4.5	MC	
412367	14:58 5/7/97	<1"	SS 5 5 8 11	3, 4		Light olive brown (2.5Y,5/4) clayey sand. Dry to moist, fg, friable. Gravel to .25".	SC			
412368	15:11 5/7/97	18"	SS 6 7 8 9	5, 6		Dark greenish gray (10Y,4/1) clay. Moist, stiff, low to medium plasticity. Orange mottling in bottom 3" of core. Trace gravel througout.	CL	2.0	MC	
412369	15:35 5/7/97	18"	ST	7, 8		Mottled greenish gray and light olive brown (10Y,5/1;2.5Y,5/6) clay with some sand and trace gravel. Moist.	CH CL		MC GS AL UCS	
412370	15:43 5/7/97	12"	SS 3 4 3 6	9, 10		Mottled greenish gray and light olive brown (10Y,5/1;2.5Y,5/6) clay. Moist, very stiff, low plasticity. Trace gravel, 1" cobble at 3" from top of core, white.	CL	2.0-3.5	MC	
412371	15:55 5/7/97	19"	SS 3 3 6 8	11, 12		Light olive brown (2.5Y,5/3) clay in top 18" of core. Some greenish gray mottling througout. Grades to 1" fg light olive brown sand, then 2" of silty clay to silt with sand and gravel. Clay, moist, high plasticity. Trace gravel in clay with increase toward bottom of core.	CL CH SC ML		MC GS AL	
412373/74	16:20 5/7/97	6"	DM 17 21 25	13		Olive brown (2.5Y,5/4) clay, silt and fg sand. Moist, large amount of gravel to 3" diameter. Clay, stiff, low plasticity. Sand, fg-cg, poorly sorted, wet, ~ 2" recovery.	CL SC ML	2.0		

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Log of Boring G3-006/12271

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 580.7

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
412373/74	16:20 5/7/97	8"	DM 17 21 25				CL SC ML	2.0		
412375/76	16:45 5/7/97	8"	DM 7 13 21	15 16		Olive brown (2.5Y,5/4) clayey sand and clay. Clay, wet, very stiff, low plasticity. Sand, fg-cg, poorly sorted, contains abundant gravel to .75".	SC CL		MC GS AL CD DS Pch	
412377	16:55 5/7/97	18"	SS 5 6 7 8	17 18		Olive brown (2.5Y,5/4) clayey sand, wet, fg-mg, poorly sorted, well graded. 2" silt at top of core. Sand contains abundant gravel to .5"	SM ML SC	4.0	MC GS AL	
412378	17:02 5/7/97	21"	SS 4 6 10 12	19 20		Olive brown (2.5Y, 5/4) clay with sand and silt. Clay, wet, low plasticity, very stiff to hard. Gray (10Y,5/1) mottling increases in clay with depth. 2" fg brown sand at top of core. Wet, clayey. 1" cg sand at bottom of core, clayey.	SC CL SC	2.0-3.0	MC	
412379	09:05 5/8/97	26"	SS 4 5 7 10	21 22		Greenish gray (10Y,5/1) clay with gravel and some sand. Wet, low plasticity, stiff to very stiff. Gravel in clay to 1", subangular-subrounded. 2" mg-cg sand at 23-25" in core. Sand, wet, poorly sorted, large quartzose grains evident. Some gravel.	CL		MC	
412380	10:12 5/8/97	26"	ST	23 24		Greenish gray (10Y,5/1) clay with gravel and sand?. Moist to wet. Gravel abundant to 1". Sample could be classified as gravelly clay from abundance of gravel in material.	CL		MC	
412381	10:58 5/8/97	18"	ST	25 26		Greenish gray (10Y,5/1) clay with gravel. Moist, appears stiff to hard. Gravel througout (from end of tube). Gravel to .5". Could be sand in clay.	CL		MC GS AL UCS	
				27 28 29		*Bottom of boring at 27 feet.*				

Notes: Samples collected per ASTM D 1586 and ASTM D 1587. Colors identified using Munsell Color Chart. Consistency based on Standard Penetration Fesistance Value. Soils visual description per ASTM d 2488 and soil classification per ASTM D 2487.

SS = Split Spoon, 2" OD, no liner
ST = Shelby Tube, 3" OD
D = Denison, 2 13/16" ID
DM = Dames & Moore, 2.41" ID, 3" OD

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Log of Boring G3-006/12271
Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Sheet 3 of 3
Job Number: 50.03.52/PO-177
Elevation: 580.7

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
						USCS Symbols: **Bold** = Laboratory Normal = Visual				
				31		**Boring NAD 1983 Coordinates:** **1349048.4E; 480833.8N**				
				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
				40						
				41						
				42						
				43						
				44						
				45						

CONTROL NO.: 014
500352-12271-015

FEMP
LITHOLOGIC LOG

PROJECT NAME: TR 8-14-97 Geotech Investigation Fernald Plant Area	PROJECT NO.: 50.03.52
LOCATION/NUMBER: G3-006/12271	COORDINATES: N/A
DATE STARTED: 5/7/97	DATE COMPLETED: 5/8/97
SURFACE ELEVATION: N/A	GROUNDWATER LEVEL: N/A
DATE: N/A	TIME: N/A
GROUNDWATER LEVEL N/A	DATE: N/A
TIME: N/A	
GEOLOGIST: J. Erjavec	DRILLING CONTRACTOR: Alliance Env, Inc.
DRILLING EQUIPMENT Mobile B-59 dsl	DRILLER Roberts/McAdton
WATER USED DURING DRILLING: N/A GAL.	WATER RECOVERED DURING DRILLING: GAL.
WATER LOST DURING DRILLING GAL.	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				ORIGINAL			Ascend to 1'
1–2	1453 5/7/97 412365	8 11 10 10	SS 11"	(2.5Y, 4/4) Olive brown clay with gravel. Dry, very hard, low to no plasticity. Gravel in top 2" of core + sporadic throughout. Probably fill.	CL	4.5+	PID-Ø 412366 (A/B Seam)
3–4	1458 5/7/97 412367	5 5 8 11	SS <1"	(2.5Y, 5/4) Light olive brown clayey sand. Dry to moist. Fg. with gravel to (1/4"). Sand friable.	SC		PID- possible rock hit during push.
5–6	1511 5/7/97 412368	6 7 8 9	SS 18"	(10Y, 4/1) Dark greenish gray clay with trace gravel, moist, stiff, med to low plasticity. Orange clay mottling in bottom 3" of core.	CL	2.0	PID-Ø
7							

METER	BKGD	DATE	TIME
PID	Ø	5/7/97	14:40
ALPHA	5/12	—	—
BETA / GAMMA	60	5/7/97	1445

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	VARIES-Seal og
DIAMETER OF SAMPLER	—
WEIGHTS OF HAMMER	140 lb

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.
FS-F-3681

000286

G: / WPSC / 95-0037.DRW (07-10-95)

JFT 11/21/97

CONTROL NUMBER: 015
500352-12271-016

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
Geotech Inv. Former Plant Area (RZ 8-14-97)	50.03.52	63-006/12271

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7	1535 5/7/97 412369		ST with piston 16"	(10Y, 5/1 & 2.5Y, 5/6) mottled greenish gray & light olive brown clay with some sand & trace gravel. Moist.	CL		PID-Ø
8				ORIGINAL			
9	1543 5/7/97 412370	3 4 3 6	SS 12"	(10Y, 5/1 & 2.5Y, 5/6) mottled greenish gray & light olive brown clay with trace gravel. 1 gravel cobble at 3" white top of core, moist, very stiff, low plasticity.	CL	2.0-3.5	PID-Ø
10							
11	1555 5/7/97 412371	3 3 6 9	SS 19"	(2.5Y, 5/3) Light olive brown clay top 16" of core. Some greenish gray mottling throughout. Grades to 1" fg light olive brown sand, then 2" of silty clay to silt, with sand & gravel. Trace gravel in clay with increase toward bottom of core. Clay - high plasticity. Moist throughout.	CH		PID-Ø
12							
13	1620 5/7/97 412372 (1620)	17 31 25	Dames & Moore 4" Not in liner 2" SS	(2.5Y, 5/4) olive brown clay & silt & fg sand. Moist, large amount of gravel to 3". Clay stiff, low plasticity. SS - fg-cg sand, poorly sorted, wet ~ 2" recovery	SC ML CL SC ML	2.0	4" recovery in Dames & Moore, but not in liner. SS to recover sample wet sand 2". 412372 (4/8 Screen)
14							
15	1645 5/7/97 412375	7 13 21	Dames & Moore 6 liners + 6"	(2.5Y, 5/4) olive brown fg-cg clayey sand, & clay, wet, clay very stiff, low plasticity. Sand contains abundant gravel	CL SC		PID-Ø
16							

METER	BKGD	DATE	TIME
PID	N/A	N/A	N/A
ALPHA	N/A	N/A	N/A
BETA / GAMMA	N/A	N/A	N/A

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Varies - see Log
DIAMETER OF SAMPLER	2.5"
WEIGHTS OF HAMMER	140 lb

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

000387

95-0140.DRW

JSF 11/24/97

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER: 016
500352-12271-017

PROJECT NAME: Geotech Inv. Former Plant Area — RL 8-14-97

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 53-006/12271

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16	16:45 5/7/97 412376			to 3/4". Sand poorly sorted, well graded.			Sample 412376 is remainder of Dames & Moore ~6" sand & clay. Augered to 17'
17	16:55 5/7/97 412377	5 6 7 8	SS 18"	(2.5Y, 5/4) Olive brown clayey sand, wet, fg-mg, well graded, poorly sorted. 2" silt at top of core. Sand contains abundant gravel to 1/2"	ML SC		PID-Ø
19	17:02 5/7/97 412378	4 6 10 12	SS 21"	(2.5Y, 5/4) Olive brown clay with sand & silt. wet, low plasticity, very stiff to hand, (10Y, 5/1) gray mottling increases with depth. 2" fg sand at top (brown), wet, clayey. 1" cg gray sand at bottom, clayey.	SC CL SC	4.0	PID-Ø
21	9:05 5/8/97 412379	4 5 7 10	SS 34 26"	(10Y, 5/1) Greenish gray clay with gravel & some sand. wet, low plasticity, stiff. 2" cg-mg sand in 23-25" interval. wet, poorly sorted, large quartzose grains evident, some gravel. Gravel in clay to 1", subrnd/subang. Stiff to very stiff	CL	2.0-3.0	PID-Ø
23	10:12 5/8/97 412380		ST 26"	(10Y, 5/1) Greenish gray clay with gravel (and sand?), moist to wet. Gravel appears abundant, ~~out~~ to 1" maximum length. Could be classified as a gravelly clay from amount of gravel in material	CL		Slight chip in tool.
25							

METER	BKGD	DATE	TIME
PID	0.7ppm	5/8/97	0905
ALPHA	5/12	—	—
BETA / GAMMA	50cpm	5/8/97	0830

SAMPLING EQUIPMENT:	NOTES:
TYPE OF SAMPLER: Vanes - sa lg	
DIAMETER OF SAMPLER:	
WEIGHTS OF HAMMER: N/A	

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

000288

ORIGINAL

FS-F-3681-1 7/11/95

G:\WPSC\95-0140.DRW

5/21/97

CONTROL NUMBER: 500352-12271-081 017 018

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME: Geotech Inv. Former Plant Area TL 8-14-97

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-006/12271

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY(TSF)	REMARKS
25			ST	(10Y, 5/1) Greenish gray clay with gravel. Moist. Appears stiff to hard. Gravel throughout (from visual end of tube). Gravel fine (≤ ½"). Could be sand in clay	CL		
	10:58 5/8/97 412381		18"				412382 A/B Screen @ 2.2/8/97
26							
27	BOB 27'						
28							

ORIGINAL

METER	BKGD	DATE	TIME
PID	5/12	—	—
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Vanes-Sealog

DIAMETER OF SAMPLER:

WEIGHTS OF HAMMER: 140 lb

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

G:\WPSC\95-0140.DRW

FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NAME / NO.:	PAGE 1 OF 3
500352-12271-~~010~~ 009	50.03.52	
[redacted]	BADGE NO.: 8852	DATE: 5-7-97
	BADGE NO.:	DATE:

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:
GEOTECHNICAL TESTING AND SAMPLING IN FORMER PROCESS AREA	BORING # 12267 / LOCATION 63-002 AND

WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (in Hg):
CLEAR, SUNNY, LT WIND	N/A	N/A

COMPLETE THE FOLLOWING PRIOR TO BEGINNING DAILY FIELD ACTIVITY: BORING #12271/63-006

NOTE: IF "NO" IS INDICATED FOR ANY ITEM, CONTACT FIELD SUPERVISOR.

	YES	NO	N/A		YES	NO	N/A
1) FIELD DATA PACKAGE AVAILABLE?	✓			8) FIELD EQUIPMENT CHECKLIST REVIEWED?	✓		
2) PROJECT SPECIFIC PLAN AVAILABLE?	✓			9) PERMIT EXPIRATION DATES VALID?	✓		
3) HEALTH AND SAFETY DOCUMENT AVAILABLE?	✓			10) EXCLUSION ZONE ESTABLISHED AND POSTED?	✓		
4) CONTROLLED PROCEDURES AVAILABLE?	✓			11) DAILY SAFETY MEETING CONDUCTED AND DOCUMENTED?	✓		
5) CONTROL / COMMUNICATIONS CENTER CONTACTED?	✓			12) LOCATION ON MARKER AGREES WITH PROJECT SPECIFIC PLAN?	✓		
6) EYEWASH AT ACCEPTABLE PRESSURE?	✓			13) BOREHOLE LOCATION ON PENETRATION PERMIT?	✓		
7) EYEWASH INSPECTED (WITHIN LAST 7 DAYS)?	✓			14) WASTE CONTAINERS PRESENT AND LABELLED?	✓		

TIME	DESCRIPTION OF ACTIVITY — *NOTE: IF ADDITIONAL SPACE IS REQUIRED, COMPLETE FS-F-3582-1, FIELD ACIVITY LOG (CONTINUATION PAGE).*
0700	CREWS ARRIVE ONSITE, HOLD SAFETY MEETING AND DISCUSS SAMPLING ACTIVITIES FOR DAY.
0730	CREWS GATHER SUPPLIES, DRESS OUT, PROCEED INTO PLANT AREA
0745	DRILLERS SETTING UP
0810	DRILLING ACTIVITIES BEGIN.
	NOTE: DUE TO GROUT SEAL, DRILLER PUSHED SPLIT SPOON
	FROM 18.0-19.5' (And skipped 17-18 FT INTERVAL to AVOID
	FILLING SPOON w/ GROUT)
0820	SPLIT SPOON RECOVERED FROM 18.0-19.5' (PARTIAL RECOVERY)
	DRILLER DIRECTED TO USE RING SAMPLER (DAMES & MOORE)
	SAMPLER NEXT. DRILLERS PREPARING / ASSEMBLING SAMPLER.
TL 5-7-97 ~~0842~~	TL 5-7-97 ~~DRILLER~~ NOTE: DENNISON, DAMES & MOORE SAMPLERS
	CANNOT BE USED IN 3.25" inch I.D. AUGER FLIGHTS DUE
	TO THEIR O.D. SIZE — DRILLER WILL PUSH 3" inch Split
	SPOON TO GET THROUGH NEXT INTERVAL (WHICH LIKELY CONTAINS
	GRAVEL)
0842	DRILLER PUSHES 3 INCH SPOON

COPY

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	ID. NO.:	INITIALS:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
N/A	N/A	N/A	N/A	N/A	N/A	N/A

PHOTOIONIZATION DETECTOR

MFR. NAME:	ID. NO.: PA	INITIALS:	TIME:	ppm:	PROBE eV:
PHOTOVAC	930082	K.R.	0810	100	N/A

PID CALIBRATION GAS:

MFR.:	MFR. DATE:	TYPE:	CONC.:
MAZCO	7-96	ISOBUTE	100 ppm

By BKG = 100 c.p.m

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
N/A	N/A	LUDLUM	77088	

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED
HENRY FULLER	RAD SAFETY	1140	12:00
BRUCE LEDBETTER	CON OP.	1515	1615

THIS IS A COPY. ORIGINAL IS IN DATA PACKAGE FOR LOCATION 63-002.

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Log of Boring G3-007/12272

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Sheet 1 of 3
Job Number: 50.03.52/PO-177
Elevation: No Data

Driller: Alliance, Env., Inc	**Drilling**	**Date**	**Time**
Drill Method: 8" Hollow Stem Auger	**Started**	4/30/97	
Sample Method: Split Spoon, Shelby Tube, Dames/Moore, Den.	**Finished**	5/1/97	
Borehole Diameter: 8 in. **Water Level:** 9" BGS	**Logged By:** J. Erjavec/K. Ernst	**Checked By:** K. Ernst	

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
						Fill.				
412312	11:28 4/30/97	8"	SS 8 11 12 12	1 2		Olive brown (2.5Y,4/4) clay with sand and gravel. Moist, stiff, low plasticity. Gravel and sand in top 2" of core may be slough?	CL	2.0	MC	
412313	11:38 4/30/97	18"	SS 5 10 11 13	3 4		Greenish black (10Y,2.5/1) to dark greenish gray (10Y,3/1) clay. Moist, very hard, medium plasticity. Trace gravel. Homogenous lithology throughout.	CL	4.0- >4.5	MC	
412314	11:43 4/30/97	7"	SS 3 6 9 11	5 6		Olive brown (2.5Y,5/4) to light olive brown (2.5Y,4/4) clay. Moist, medium plasticity, very stiff. Mottled with orange partings and possible organics. Trace sand and gravel.	CL	3.0	MC	
	12:00 4/30/97	0"	ST	7 8		Sand, wet, no recovery.				
412315	13:46 4/30/97	18"	SS 2 3 5 5	9 10		Light olive brown (2.5Y,5/6) silty to sandy clay, wet, stiff to very stiff, none to low plasticity. Some mottling of grayish-green clay or silt within the clay. Trace gravel to none.	CL ML	2.0- 3.0	MC GS AL	
412316	13:57 4/30/97	14"	SS 3 9 10 10	11 12		Light olive brown (2.5Y,5/6) silty sand with clay, wet. Interbedded with light olive brown clayey silt with sand. Silt, medium stiff to stiff, no plasticity. Matic mineral component noted throughout.	ML SP-SM	1.0- 1.5	MC GS AL	
412317	14:15 4/30/97	16"	6 6 12 12	13		Interbedded dark greenish gray (10Y,4/1) fg sands, silts and clays. Beds about 1-3" in thickness. Some to trace gravel, fine. Clay zones tend to be light olive brown (2.5Y,5/6),	SM ML CL	2.0	MC	

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Log of Boring G3-007/12272

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: No Data

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
412317	14:15 4/30/97	18"	8 8 12 12	15		wet, stiff, no plasticity. Mafics througout core.	SM ML CL	2.0	MC	
412318	15:12 4/30/97	4"	D	16		Greenish gray (10Y,5/1) sand, wet, poorly sorted, fg-mg. Trace gravel and some silt. Abundant mafics througout.	SM SW		MC GS AL	
412319	15:45 4/30/97	5"	DM 13 19 31	17 18		Dark greenish gray (10Y,4/1) clayey sand, wet to moist, fg-mg. Some to trace gravel. Interbeds of dark greenish gray (10Y,4/1) clay, wet, some to trace gravel. Sand, poorly sorted. 2" cobble in disturbed sample.	SW-SC CL		MC	
412321	18:22 4/30/97	10"	ST	19 20		Dark greenish gray (10Y,4/1) clayey sand and sandy clay, wet. Sand, fg. Sand probably 1/2 of core.	CL SW-SC		MC GS AL	
412322	18:38 4/30/97	15"	SS 3 9 12	21 22		Dark greenish gray (10Y,4/1) clay, wet, some sand. Hard to very hard, low to medium plasticity. 1" sand lense at bottom of core.	CL	>4.5	MC	
412324	09:05 5/1/97	13"	ST	23 24		Gray clay, wet. Sand? (From bottom of tube).	CL		MC GS AL CU	
412325	09:28 5/1/97	17"	SS 18 55 38	25 26		Dark greenish gray (10Y,4/1) clay with sand (fg-mg) in pockets and trace throughout. Clay, wet, very hard, low plasticity. Some gravel to 1". Sand in .25-1" thick pockets, with gravel - fine to coarse.	CL	>4.5	MC	
412328	10:35 5/1/97	4"	ST	27		Greenish gray (10Y,5/1) clay with gravel and some sand. Clay, wet, very stiff to hard, low to medium plasticity. Gravel to 1", subangular-subrounded.	CL		MC	
				28 29		*Bottom of boring at 28 feet.* **Notes:** Samples collected per ASTM D 1586 and ASTM D 1587. Colors identified using Munsell Color Chart. Consistency based on Standard Penetration Resistance Value. Soils visual description per ASTM D 2488 and soil classification per ASTM D 2487.				

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Log of Boring G3-007/12272
Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: No Data

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
				31		SS = Split Spoon, 2" OD, no liner ST = Shelby Tube, 3" OD D = Denison, 2 13/16" ID DM = Dames & Moore, 2.41" ID, 3" OD USCS Symbols: **Bold** = Laboratory Normal = Visual **Boring NAD 1983 Coordinates:** **1348559.9E; 480276.3N**				
				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
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				44						
				45						

FEMP

LITHOLOGIC LOG

CONTROL NO.: 500352-12272-015

PROJECT NAME: Geotech Investigation Former Plant Area			PROJECT NO.: 50.03.52
LOCATION/NUMBER: G3-007/12272	COORDINATES: N/A	DATE STARTED: ~~4/3/97~~ 4/30/97	DATE COMPLETED: 5-1-97
SURFACE ELEVATION: N/A	GROUNDWATER LEVEL: 9" below surface	DATE: 5-1-97 / TIME: 0815	GROUNDWATER LEVEL: N/A / DATE: N/A / TIME: N/A
GEOLOGIST: J. Erjavec / K. Ernst	DRILLING CONTRACTOR: Alliance Env. Inc.	DRILLING EQUIPMENT: Mobile B-59 HSA	DRILLER: Roberts / McAdam
WATER USED DURING DRILLING: N/A GAL	WATER RECOVERED DURING DRILLING: N/A GAL	WATER LOST DURING DRILLING: N/A GAL	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							Augered to 1' ✓ 412328 (1400) 5/1/97 H/B Screen
1	11:28 4/30/97 412312	6 11 12 12	SS 8"	(2.5Y, 4/4) Olive brown clay with sand & gravel, moist, stiff, low plasticity. Gravel & sand top 2" of core from sloughing into sampler? - (slough prior to push)	CL	2.0	PID-Ø
				? BROWN CLAY / GRAY CLAY ? ?			
3	11:38 4/30/97 412313	5 10 11 13	SS 16"	(10Y, 2.5/1) & (10Y, 3/1) Greenish black to dark greenish gray clay. Trace gravel. Moist, very hard, med. plasticity. Homogenous lithology throughout.	CL	4.0-4.5+	PID-Ø
				? ? GRAY CLAY / BROWN CLAY ? ?			
5	11:43 4/30/97 412314	3 6 9 11	SS 7" (Thin recovery)	(2.5Y, 5/4 to 4/4) Olive brown to light olive brown clay. Trace sand & gravel, mottled with orange patches + possible organics. Moist, med-plasticity, very stiff.	CL	3.0	PID-Ø
7							

METER	BKGD	DATE	TIME
PID	Ø	4/30	1120
ALPHA	7/11/97	—	—
BETA / GAMMA	60cpm	4/30	1120

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: 2" O.D SS 3" ØST

DIAMETER OF SAMPLER: 2.5" O.D Dames & Moore

WEIGHTS OF HAMMER "V" (ring O.D): 140 lb, Denison

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G:/WPSC/95-0037.DRW (07-10-95)

000291

11/21/97

CONTROL NUMBER: 500352-12272-016

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
Geotech. Inv. Former Plant Area	50.03.52	63-007 / 12272

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7	1200 4/30/97 ~~412315~~ 412312 4/30/97		ST 0" water in tube	sand, wet No recovery			
8	13:46 4/30/97 412315	2 3 5 5	SS wet tube 18"	(2.5Y, 5/6) Light olive brown silty clay to sandy clay, wet, stiff to very stiff, low – no plasticity. Some mottling of grayish-green clay or silt. Trace to no gravel Could be silt. Varied unit type	CL ML?	2.0 - 3.0	Upper 4" 20 cpm above background PID-Ø
11	13:57 4/30/97 412316	3 9 10 10	SS tube wet 14"	(2.5Y, 5/6) Light olive brown silty sand with clay, wet, interbedded with light olive brown clayey silt with sand. Med stiff to stiff, no plasticity. Mafic mineral component noted throughout.	SM SM + ML	1.0 - 1.5 4/30/97	PID-Ø
13	14:15 4/30/97 412317	6 6 12 12	SS tube wet 16"	(10Y, 4/1) Interbedded fg sands, silts & clays – beds ~ 1-3" in thickness. Some to trace gravel, fine. Clay zones tend to be (2.5Y, 5/6) light olive brown, sands & silts are dark greenish gray. Wet, no plasticity, stiff. Varied Unit. Mafics throughout	SM + ML + CL	2.0	PID-Ø
15	15:12 4/30/97 412318		Denison 4"	(10Y, 5/1) Greenish gray mg-fg sand, wet, poorly sorted, abundant mafic grains, trace gravel, some silt.	SW-SM		PID-Ø
16							

METER	BKGD	DATE	TIME
PID	—	—	—
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:	NOTES:
TYPE OF SAMPLER: Varies see log	
DIAMETER OF SAMPLER: N/A see log	
WEIGHTS OF HAMMER: 140 lbs	

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

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1/12/97

CONTROL NUMBER: 500352-12272-017

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
Geotech Inv. Former Plant Area	50.03.52	G3-007/12272

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16							
17	15:45 4/30/97 412319 Dames & Moore undisturbed 412320 (disturbed)	13 19 31	Dames & Moore 5" undisturb.	(10Y,4/1) Dark greenish gray clayey sand, wet to moist, mg-fg sand. Some to trace gravel. Interbeds of dark greenish gray clay, wet, some to trace gravel. Poorly sorted sand. Large cobble 2"- in disturbed sample	SM SW-SC to CL		5" of D&M undisturbed sample
18							
19	16:22 4/30/97 412321		ST 10" disturbed	(10Y,4/1) Dark greenish gray clayey sand & sandy clay. wet, fg sand. Bob ½ tube was sand.	SW-SC & CL		wet, water in tube. Recovery only partial - cored to side of tube sample jamed.
20							
21	16:38 4/30/97 412322	3 8 12	SS 15"	(10Y,4/1) Dark greenish gray clay wet, some sand, 1" sand lense at bottom of core. Hard to very hard, low to med plasticity.	—	4.5+	
22							
23			ST 13"	Estimate - Gray clay, wet. Sand? from tube	CL?		Augered to 23' 412323 = 4D screen 500 lbs pressure on ST - 1' push only PID - 0.6
24	9:05 5/1/97 412323 4/30/97		13" 4/30/97				
25							

METER	BKGD	DATE	TIME
PID	Ø	5/1/97	0850
ALPHA	5/1/97	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:	NOTES:
TYPE OF SAMPLER: Varies - see log	water level on 5/1, 9" Below
DIAMETER OF SAMPLER: Varies - see log	Ground surface
WEIGHTS OF HAMMER: 140 lbs	

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

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CONTROL NUMBER: 500352-12272-018

FEMP LITHOLOGIC LOG (Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
Geotech Investig. Former Plant Area	50.03.52	63-007/X2272

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
25	0828 5/1/97 412324	18 55 38	SS 17"	(10r, 4/1) Dark grayish gray clay with sand (mg-fg) in pockets + trace throughout. Very hard, wet, low plasticity. Also gravel, some to 1". Sand pockets ¼"-1" thick, with gravel fine to coarse. Pockets — JS	CL	4.5+	PID-0.5
26	5/1/97		ST	(10r, 5/1) Grayish gray clay with gravel. Some sand. wet, gravel to 1", angular-subrounded. Very stiff-hard, low-med plasticity.			Tube crimped Gravel in sample 412327 A/B Screen JS 8/8/97
27	1035 5/1/97 412326		4"				
28	~~Box 28~~						

METER	BKGD	DATE	TIME
PID JS	7/11/97	—	—
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: varies - see log
DIAMETER OF SAMPLER: varies - see log
WEIGHTS OF HAMMER: 140 lbs

NOTES:
Sample 412328 0-1' for A/B Screen taken 1400 on 5/1/97 JS 8/8/97

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

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11/21/97

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Log of Boring G3-008/12273

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Pit. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 579.5

Driller: Alliance, Env., Inc	**Drilling**	**Date**	**Time**
Drill Method: 8" Hollow Stem Auger	**Started**	5/1/97	
Sample Method: Split Spoon, Shelby Tube	**Finished**	5/5/97	
Borehole Diameter: 8 in. **Water Level:** N/A	**Logged By:** K. Ernst/J. Erjavec	**Checked By:** K. Ernst	

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
						Fill.				
412330	15:35 5/1/97	13"	SS 6 8 8 8	1 2		Yellowish brown (10YR,5/6) clay, moist, very stiff, low plasticity. Mottled brown and gray grading to gray at depth. Some gravel to 1", subangular-subrounded.	CL	2.75-4.0		
412331	15:45 5/1/97	17"	SS 4 11 15 13	3 4		Yellowish brown (10YR,5/6) and dark gray (2.5Y,4/1) clay. Brown clay, moist, medium stiff to very stiff, low plasticity. With gravel. Gray clay, moist, very stiff, medium plasticity.	CL	1.0-3.0	MC	
412332	16:10 5/1/97	20"	ST	5 6		Brownish yellow (10YR,6/6) clay with light gray mottling. Moist, low plasticity, very stiff. (Description from bottom of shelby).	CL	3.5	MC GS AL UCS	
412333/34	16:20 5/1/97	11"	SS 4 5 7 11	7 8		SAA with some subangular-subrounded gravel, .25-3". Clay, moist, stiff. Light olive brown (2.5Y,5/4) clayey sand, moist to wet.	SM CL SC	1.5-1.75	GS AL	
412335/36	08:33 5/5/97	20"	SS 7 8 9 12	9 10		Light olive brown (2.5Y,5/6) silty clay (14") with sand and 8" of light olive brown (2.5Y,5/6) silty sand. Clay, wet, very stiff, no plasticity. Sand, vfg, poorly graded, wet. Trace gravel to .75". Trace of gray clay in core.	ML CL SM CL	3.25-4.0	MC GS AL	
412338	08:47 5/5/97	21.5"	SS 6 6 7 12	11 12		Grayish brown (2.5Y,5/2) clay, wet, very stiff, medium plasticity. Trace of sand?	CL	2.25-2.75	MC	
412339	08:55 5/5/97	23"	4 4	13		Gray (2.5Y,5/1) clay, wet, low plasticity to none, stiff to very stiff. Trace to some silt. 1" silt zone 5" from bottom of core.	CL	2.0	MC	

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Log of Boring G3-008/12273

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 579.5

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
412339	08:55 5/5/97	23"	4 4				CL	2.0	MC	
				15						
412340	09:08 5/5/97	20"	SS 2 3 7 9	16		Dark gray to dark grayish brown (2.5Y,4/1 to 4/2) clay to silty clay. Wet, low plasticity to none, stiff to very stiff. Silt varies from some to abundant.	CL	2.0	MC	
				17						
412341	09:57 5/5/97	22"	ST	18		Dark grayish brown (10YR,4/2) sand with gravel. Wet, fg-mg, poorly sorted, well graded.	**ML** SW		MC GS AL CD DS Pch UCS?	
				19						
412343	10:20 5/5/97	8"	SS 4 4 3 2	20		Dark grayish brown (2.5Y,4/2) sandy clay with gravel, wet. Gravel to .5", subangular-subrounded. Could be clayey sand.	CL or SC		MC	
				21						
412344	10:40 5/5/97	20"	SS 1 2 3 4	22		Dark grayish brown (2.5Y,4/2) clay to gray (2.5Y5/1) clay with sand and gravel (to .5"). Clay, very soft to soft, wet, medium to high plasticity. 1-2" of dark grayish brown sand near bottom of core, wet, fg, well sorted.	CL CH	0.50-1.25		
				23						
412345/47	10:52 5/5/97	21"	SS 7 40 65 50 (3")	24		Olive brown (2.5Y,4/3) clayey sand with gravel, wet, fg, well sorted, poorly graded. Dark greenish gray (10Y,4/1) clay with sand and gravel to .5". Wet, very stiff, low plasticity.	CL SC	2.0-3.0	MC	
				25						
412348	5/5/97	17"				Sand.				
				26		*Bottom of boring at 26 feet.*				
				27		**Notes:** Samples collected per ASTM D 1586 and ASTM D 1587. Colors identified using Munsell Color Chart. Consistency based on Standard Penetration Resistance Value. Soils visual description per ASTM D 2488 and soil classification per ASTM D 2487.				
				28		SS = Split Spoon, 2" OD, no liner ST = Shelby Tube, 3" OD D = Denison, 2 13/16" ID DM = Dames & Moore, 2.41" ID, 3" OD				
				29		USCS Symbols: **Bold** = Lab; Normal = Visual				

Boring NAD 1983 Coordinates:
1348911.5E; 480383.7N

CONTROL NO.: 500352-12273-008

FEMP

LITHOLOGIC LOG

PROJECT NAME: Geotechnical INv. Former Plant Area			PROJECT NO.: 50.03.52
LOCATION/NUMBER: G3-008/12273	COORDINATES: N/A	DATE STARTED: 5-1-97	DATE COMPLETED: 5/5/97
SURFACE ELEVATION: N/A	GROUNDWATER LEVEL: ~~N/A~~ 3'4" BGS	DATE: ~~N/A~~ 5/5/97	TIME: N/A
GROUNDWATER LEVEL: N/A	DATE: N/A	TIME: N/A	
GEOLOGIST: K. Ernst/J. Erquec	DRILLING CONTRACTOR: Alliance Env. Inc	DRILLING EQUIPMENT: Mobile B-59 HSA	DRILLER: Roberts/McAddams
WATER USED DURING DRILLING: N/A GAL.	WATER RECOVERED DURING DRILLING: N/A GAL.	WATER LOST DURING DRILLING: N/A GAL.	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	AB screen 412329 5-1-97 1515						Augered to 1' Cuttings of brown clay and gravel
1	1535 5-1-97 412330	6 6 8 8	13"	very stiff Lean Clay with gravel, gravel subrounded to sub angular to 1", low plasticity, moist, yellowish (10 YR 5/6) brown and gray mottled (grading to gray with depth)	CL	2.75 - 4.0	SS - 2" OD PID = 1.1 ppm B-γ = 60 cpm
3	1545 5-1-97 412331	4 11 15 13	17"	~~very~~ stiff to very stiff Lean clay with gravel (10 YR 5/6) yellowish brown with gravel low plasticity, moist	CL	1.0 - 3.0	Split Spoon 2" OD PID = 1.0 ppm B-γ = 60 cpm
4				very stiff, Lean Clay (2.5 Y 4/1) dark gray, medium plasticity, moist	CL	2.5	
5	1610 5-1-97 412332		20"	?? from bottom of Shelby Lean Clay, very stiff, (10 YR 6/6) brownish yellow mottled w/ light gray, low plasticity, moist		3.5	ST 3" O.D. w/ piston sampler Tube in good condition PID = 0.5 ppm B-γ = 60 cpm
7							

METER	BKGD	DATE	TIME
PID	1.1 ppm	5/1/97	1515
ALPHA	—	—	—
BETA / GAMMA	60 cpm	5/1/97	1515

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Various - See log
DIAMETER OF SAMPLER	Various - See log
WEIGHTS OF HAMMER	140 lbs

NOTES: Gravel at ground surface, (limestone gravel)

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

000300

Per sample collection log

G: / WPSC / 95-0037.DRW (07-10-95)

CONTROL NUMBER: 500352-12273-009

FEMP LITHOLOGIC LOG (Continuation Page)

1507

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
Geotech Inv. Former Plant Area	50.03.52	G3-008/12273

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7	1620 5-1-97 412333 (clay) 412334 (sand)	4 5 7 11	11"	SAA, with few subrounded to subangular gravel, moist, stiff, 1/4 - 3	CL	1.5-1.75	2" SS O.D. PID = 0.8 ppm B-γ = 60 cpm
8				clayey, fine grained sand (2.5Y 5/4) light olive brown, moist to wet	SC		
9	0833 5/5/97 (clay) 412335 412336 (sand) 412337 - Alpha/beta screen	7 8 9 12	SS 20"	Light olive brown (2.5Y, 5/6) 14" silty clay with sand & 8" of light olive brown (2.5Y/5/6) silty sand. Trace gravel to 3/4". Clay, very stiff, wet, no plasticity. Sand - vfg, poorly graded, wet. Trace of gray clay in core.	CL SM CL	3.25-4.0	PID - 0.2ppm
11	0847 5/5/97 412338	6 6 7 12	SS 21.5"	(2.5Y 5/2) Grayish brown clay, very stiff, wet. Trace sand? clay - wet plasticity.	CL	225-275	PID - Ø
13	0855 5/5/97 412339	4 4 6 8	SS 23"	(2.5Y, 5/1) Gray clay, trace to some silt. 1" silt zone 5" from bottom of core. Clay, wet, low plasticity to none. Stiff to very stiff.	CL	20	PID - Ø
15	0906 5/5/97 412340	2 3 7 9	SS 20"	(2.5Y, 4/1 to 4/2) Dark gray to dark grayish brown clay to silty clay. Wet, low plasticity to none. Stiff to very stiff. Silt varies from none to abundant	CL	20	PID - Ø
16							

METER	BKGD	DATE	TIME
PID	0.2-0.4	5/5/97	825
ALPHA	7/11/97	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Varies - see log
DIAMETER OF SAMPLER	Varies - see log
WEIGHTS OF HAMMER	140 lbs

NOTES:

- SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

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000301

7/21/97

CONTROL NUMBER: 500352-12273-010

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME: Geotech. Inv. Former Plant Area

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: G3-008/12273

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16							
17	0957 5/5/97 412341		ST 21" Rock 22" Recovery	(10YR, 4/2) Dark grayish brown fg-mg sand with gravel. wet. Poorly-sorted, well graded.	SW		PID-Ø 412342 - 10 gallon can 1005 Pu SP
18							
19	1020 5/5/97 412342	4 4 3 2	SS 8"	(2.5Y, 4/2) Dark grayish brown sandy clay with gravel, wet. Gravel to 1/2" subrounded to subangular Could be clayey sand.	CL or possibly SC		PID-Ø
20							
21	1040 5/5/97 412343	1 2 3 4	SS 20"	(2.5Y, 4/2) Dark grayish brown clay to (2.5Y, 5/1) gray clay with sand + gravel (to 1/2"). 1-2" of dark grayish brown sand near bottom of core, wet, fg, ~~4 blows~~ well sorted. Clay, very soft to soft, wet, med-high plasticity (fat clay).	CL + CH	1.25 - 0.5	PID-Ø
22							
23	1052 5/5/97 412345 (sand) 412347 (clay)	7 40 65 3"-50	SS 21"	(2.5Y, 4/3) Olive brown clayey sand with gravel wet, fg, well-sorted, poorly graded. (10Y, 4/1) Dark greenish gray clay, wet with sand + gravel to 1/2". Low plasticity, very stiff.	SC + CL	2.0 - 3.0	PID-Ø 4" clay over 12" sand 412346 (ABsand)
24							
25							

METER	BKGD	DATE	TIME
PID	—	—	—
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Varies - see log
DIAMETER OF SAMPLER	Varies - see log
WEIGHTS OF HAMMER	140 lbs

NOTES:

- SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

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E-1507

CONTROL NUMBER: 500352-12273-011

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
Geotech. Inv. Former Plant Area	50.03.52	63-008 / 12273

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY(TSF)	REMARKS
~~25~~							
	5/5/97 412348			Sand.			Ream to 26' to collect cuttings for sample 10 gal sample 412348
~~26~~		~~BOB~~	~~26'~~				

METER	BKGD	DATE	TIME
PID	2	9/11/97	—
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Varies-see log
DIAMETER OF SAMPLER	Varies-see log
WEIGHTS OF HAMMER	140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

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000303

JPN 11/21/97

Parsons Infrastructure and Technology, Inc.
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Log of Boring G3-009/12274

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Pit. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 579.3

Driller: Alliance, Env., Inc	**Drilling**	**Date**	**Time**
Drill Method: 8" Hollow Stem Auger	**Started**	5/13/97	
Sample Method: Split Spoon, Shelby Tube, Dames & Moore	**Finished**	5/13/97	
Borehole Diameter: 8 in. / **Water Level:** Dry	**Logged By:** J. Erjavec	**Checked By:** K. Ernst	

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
						Fill.				
412407	13:10 5/13/97	11"	SS 4 6 7 9	1, 2		Dark olive brown (2.5Y,3/3) clay with orange mottling. Moist, stiff to very stiff, low plasticity.	CL	2.75-4.0	MC	
412408	13:14 5/13/97	15"	SS 4 5 5 7	3, 4		Light olive brown (2.5Y,5/3) clay with orange mottling. Moist, very stiff, high plasticity. Trace gravel to .5".	CH	1.0-3.0	MC	
412409	13:38 5/13/97	12"	ST	5, 6		Light olive brown (2.5Y,5/3 to 5/6) mottled clay, moist, very stiff, low plasticity. Trace gravel. Some very dark gray (2.5Y,3/1) clay interbedded within the l.o.b. clay.	CL	3.5	MC GS AL UCS	
412410	14:03 5/13/97	18"	ST	7, 8		Light olive brown (2.5Y,5/4) clay with some gravel. Moist, low plasticity.	CL	1.5-1.75	MC GS AL CU	
412411	14:10 5/13/97	20"	SS 9 19 21 31	9, 10		Light olive brown (2.5Y,5/6) clay to sandy clay, grading to 2-3" of light olive brown sand, moist. Grading to greenish gray (10Y,5/1) clay with gravel (to 1.5"). Clays, moist, very hard, low plasticity. Sand, fg, poorly graded.	CL SC CL	3.25-4.0	MC	
412413	14:30 5/13/97	5"	DM 19 28 28	11, 12		Light olive brown (2.5Y,4/4) sandy clay with abundant gravel (to 2.5"). Probably a gravelly clay due to abundance of gravel. Clay, moist. Sand, poorly sorted, clayey. Gravel, mostly subrounded.	GW-GC	2.25-2.75	MC	
				13						
412414	14:44 5/13/97	10"	DM 9 17 21			Dark greenish gray (10Y,4/1) clay with gravel. Moist, hard to very hard, low plasticity. Gravel to 0.5".	CL	2.0	MC GS AL UCS	

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Log of Boring G3-008/12274

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 579.3

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
412414	14:44 5/13/97	10"	DM 9 17 21	15			**CL**	2.0	MC GS AL UCS	
412415	14:54 5/13/97	20"	SS 5 12 14 25	16		Dark greenish gray (10Y,4/1) clay, moist, very hard, low to medium plasticity. Trace to some gravel. 2" silt at bottom of core, moist.	CL **ML**	2.0		
412416	15:35 5/13/97	8"	DM	17 18		Gray (2.5Y,5/1) clay, moist to dry, very hard, no plasticity. Appearance is shale-like.	CL	>4.5	MC	
				19		*Bottom of boring at 19 feet.*				
				20 21 22 23 24 25 26 27 28 29						

Notes: Samples collected per ASTM D 1586 and ASTM D 1587. Colors identified using Munsell Color Chart. Consistency based on Standard Penetration Resistance Value. Soils visual description per ASTM D 2488 and soil classification per ASTM D 2487.

SS = Split Spoon, 2" OD, no liner
ST = Shelby Tube, 3" OD
D = Denison, 2 13/16" ID
DM = Dames & Moore, 2.41" ID, 3" OD

USCS Symbols: **Bold** = Laboratory
Normal = Visual

Boring NAD 1983 Coordinates:
1350356.3E; 480499.6N

CONTROL NO.: 500352-12274-015

FEMP

LITHOLOGIC LOG

PROJECT NAME: Geotechnical Investigation Former Plant Area			PROJECT NO.: 50.03.52
LOCATION/NUMBER: 63-009/12274	COORDINATES: N/A	DATE STARTED: 5/13/97	DATE COMPLETED: 5/13/97

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	GROUNDWATER LEVEL	DATE:	TIME:
N/A	Dry	5/13/97	—	—	—	— 5/13/97

GEOLOGIST:	DRILLING CONTRACTOR:	DRILLING EQUIPMENT	DRILLER
J. Erjavec	Alliance Env. Inc.	Mobile B-59 HSA	McAdams / Roberts

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	WATER LOST DURING DRILLING
N/A GAL.	N/A GAL.	N/A GAL.

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							Augered to 1'
1	1310 5/13/97 412407	4 6 7 9	SS 11"	(2.5Y, 3/3) Dark olive brown clay with orange mottling. Stiff to very stiff, low plasticity, moist.	CL	2.0-2.25	412406 (ABS screen)
3	1314 5/13/97 412408	4 5 5 7	SS 15"	(2.5Y, 5/3) Light olive brown clay with orange mottling, very stiff, high plasticity, moist. Trace gravel to ½".	CH	2.75	
5	1338 5/13/97 412409		SS 12"	(2.5Y 5/3 to 5/6) Light olive brown mottled clay, moist, low plasticity, trace gravel, very stiff. Some (2.5Y, 3/1) very dark clay interbedded within the 1.0 b. clay.	CL	3.0 to 3.5	PID-0.5 Sample slipped out of tube 8" lost
7							

METER	BKGD	DATE	TIME
PID	0.3ppm	5/13/97	1325
ALPHA	5/13/97 —	—	—
BETA / GAMMA	60cpm	5/13/97	1302

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: Varies - See log
DIAMETER OF SAMPLER: — 5/13/97
WEIGHTS OF HAMMER: 140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

000306

G: / WPSC / 95-0037.DRW (07-10-95)

9/11/97

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER: 500352-12274-016

PROJECT NAME: Geotech. Inv. FPA

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: G3-009/12274

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (Inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7			ST	(2.5Y, 5/4) Light olive brown clay with some gravel. Moist, low plasticity	CL		
8	1403 5/13/97 412410		18"				
9	1410 5/13/97 412411	9 19 21 31	SS 20"	(2.5Y, 5/6) Light olive brown clay to sandy clay - grading to 2-3" well sorted light olive brown sand, moist, grading to (10Y, 5/1) greenish gray clay with gravel (to 1.5"). Clays very hard, moist, with low plasticity. Sand - fs, poorly sorted.	CL SC/SP CL	4.5+	PID - background 412412 (A/B) screen
11	1430 5/13/97 412413	19 26 26	ST Dames & Moore 5"	(2.5Y, 4/4) Light olive brown sandy clay with abundant gravel (to 2.5"). Gravel mostly subrounded. Clay moist, Sand, poorly sorted, probably clayey, sandy, gravel -	GW-GC		ST wash push. Changed to Dames + Moore PID - background Augered to 13'
13	1444 5/13/97 412414 (7 rings)	9 17 21	Dames & Moore 10"	(10Y, 4/1) Dark greenish gray clay with gravel. Moist, hard to very hard, low plasticity. Gravel to ~ 1/2".	CL	4.0 to 4.5+	PID - background Augered to 15'
15	1454 5/13/97 412415	5 12 14 25	SS 20"	(10Y, 4/1) Dark greenish gray clay with one to trace gravel. moist, very hard, low to medium plasticity. 2" silt at bottom of core, moist	CL	4.5+	PID - background

METER	BKGD	DATE	TIME
PID		5/13/97	
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Varies - See logs

DIAMETER OF SAMPLER: 5/13/97

WEIGHTS OF HAMMER: 140 lbs

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

11/24/97

FS-F-3681-1 7/11/95

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CONTROL NUMBER: 500352-12274-017

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME: Geotech. Inv. FRA

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-009/12274

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16					CL		
17					ML		
18	1535 5/13/97 412416		Dem 8" disturbed	(2.5Y, 5/1) gray clay, moist to dry, very hard, no plasticity. Appearance is shiley.	CL	4.5+	✓ aBscm. (412417) per L. Lowe 6/16/97
19	808 19'						

METER	BKGD	DATE	TIME
PID	—	—	—
ALPHA	—	—	—
BETA / GAMMA	—	—	—

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Varies - see log

DIAMETER OF SAMPLER: — 5/13/97

WEIGHTS OF HAMMER: 140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

G:\WPSC\95-0140.DRW

11/24/97

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Log of Boring G3-010/12275

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Sheet 1 of 2
Job Number: 50.03.52/PO-177
Elevation: 577.9

Driller: Alliance, Env., Inc	**Drilling**	**Date**	**Time**
Drill Method: 8" Hollow Stem Auger	**Started**	4/30/97	
Sample Method: Split Spoon, Shelby Tube	**Finished**	5/21/97	
Borehole Diameter: 8 in. **Water Level:** Dry	**Logged By:** J. Erjavec	**Checked By:** K. Ernst	

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
						Fill.				
412437	15:51 5/20/97	16"	SS 4 5 5 6	1 2		Dark grayish brown (2.5Y,4/2) clay, moist, stiff to very stiff, low plasticity. Trace gravel. Top 2" of core, sandy, contaminated, probably fill.	CL		MC	
412438	15:55 5/20/97	12"	SS 2 3 3 4	3 4		Light olive brown to olive brown (2.5Y,5/3 to 2.5Y,4/3) mottled clay with some gravel to .0.25". Clay, moist, soft to stiff, low to medium plasticity. Could be fat clay.	CL or CH		MC	
412439	16:16 5/20/97	25"	ST	5 6		Light olive brown (2.5Y,5/6) clay with gravel, moist.	CL		MC GS AL UCS	
412440	16:25 5/20/97	13"	SS 3 2 3 3	7 8		Olive brown (2.5Y,4/3) clay (11") with sand and gravel. Clay, moist, stiff, low plasticity. 2" of olive brown sand at bottom of core, mg-cg, poorly sorted, wet.	CL SW		MC	
412442	16:28 5/20/97	19"	SS 2 2 4 5	9 10		Light olive brown (2.5Y,5/4) silty and sandy clay grading to light olive brown clay. Trace gravel throughout. Clay, moist, stiff to hard, low plasticity.	CL		MC	
412443	09:15 5/21/97	22"	ST	11 12		Light olive brown (2.5Y,5/4) clay with sand, moist to wet.	CL		MC GS AL	
412444	09:21 5/21/97	19"	2 3 5 6	13		Light olive brown (2.5Y,5/6) clay to silty clay - silt content increasing with depth. Clay, moist to wet, stiff, low plasticity. Gravel to 0.5", subangular-subrounded, decreasing in	CL-ML		MC GS AL	

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Log of Boring G3-010/12275

Geotechnical Logging Report
Fernald Environmental Mgmt. Project
Former Plt. Area. Geot. Investigation

Job Number: 50.03.52/PO-177

Elevation: 577.9

Sample No.	Date/Time	Recovery (in.)	Blow Count (6")	Depth (feet)	Graphic Log	Materials Description	USCS Symbol	Meas. Consist.	Lab Tests	Remarks
412444	09:21 5/21/97	19"	2 3 5 6	15		abundance as silt content increases. May be silt at bottom of core.	**CL-ML**		MC GS AL	
412445	09:28 5/21/97		SS 6 6 5 11	16		Light olive brown (2.5Y,5/4) clay interbedded with silt zones. Clay, silty, wet, stiff to hard, trace gravel. Silt, wet, clayey, trace gravel.	**CL ML**		MC GS AL	
412446	09:35 5/21/97	17"	SS 6 6 9 11	17 18		Light olive brown (2.5Y,5/4) silty clays interbedded with clayey silts. Clays, moist to wet, stiff to hard, low plasticity. Silts, wet. Trace gravel throughout to 0.25"	**CL ML**		MC GS AL	
412447	09:58	24"	ST	19 20		Light olive brown (2.5Y,5/3) sandy clay with gravel, wet. Gravel to 0.5" and probably scattered throutout. May be silt or sand in tube (visual description from end of shelby tube).	**SM** CL		MC GS AL UCS	
				21		*Bottom of boring at 21 feet.*				

Notes: Samples collected per ASTM D 1586 and ASTM D 1587. Colors identified using Munsell Color Chart. Consistency based on Standard Penetration Resistance Value. Soils visual description per ASTM D 2488 and soil classification per ASTM D 2487.

SS = Split Spoon, 2" OD, no liner
ST = Shelby Tube, 3" OD
D = Denison, 2 13/16" ID
DM = Dames & Moore, 2.41" ID, 3" OD

USCS Symbols:
Bold = Laboratory
Normal = Visual

Boring NAD 1983 Coordinates:
1348517.2E; 479760.8N

FEMP

LITHOLOGIC LOG

CONTROL NO.: 500352-12275-007-JW 6-23-97

PROJECT NAME: Geotech Investigation Former Plant Area			PROJECT NO.: 50.03.52
LOCATION/NUMBER: G3-010/12275	COORDINATES: N/A	DATE STARTED: 4/30/97	DATE COMPLETED: 5/21/97

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	GROUNDWATER LEVEL	DATE:	TIME:
N/A	NONE	5/21/97	1018	N/A	—	—

GEOLOGIST:	DRILLING CONTRACTOR:	DRILLING EQUIPMENT	DRILLER
J. Srijavec	Alliance Env. Inc.	Mobile B59 HSA	Roberts/McAddam

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	WATER LOST DURING DRILLING
N/A GAL.	NA GAL.	NA GAL.

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							tugged to 1' 800cpm B/G at surface of boring location. Moved to another borehole location. Restart hole on 5/20/97 150cpm
1							
2	1551 5/20/97 412437	4 5 5 6	58 16"	(2.5Y, 4/2) Dark grayish brown clay, moist, trace gravel. Top 2", sandy, contaminated, probably fill. Clay low plasticity, stiff to very stiff.	CL		412436 A/B PID-Background slough 100cpm
3							
4	1555 5/20/97 412438	2 3 3 4	55 12"	(2.5Y, 5/3 to 2.5Y 4/3) Light olive brown to olive brown mottled clay with some gravel to 1/4". Moist, low to med plasticity - stiff to soft. Could be fat clay.	CL CH?		
5							PID-Ø
6	1616 5/20/97 412439		5T 25"	Light olive brown clay with gravel. Moist (2.5Y, 5/6).	CL		
7							

METER	BKGD	DATE	TIME
PID	Ø	4/30/97	0955
ALPHA	NA		
BETA / GAMMA	50cpm	5/20/97	1555

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Vanes-Sea log

DIAMETER OF SAMPLER: N/A

WEIGHTS OF HAMMER: 140 lbs

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (07-10-95)

CONTROL NUMBER: 50.0352-12275-002 22 6-23-97 JW

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME: Geotech. Inv. FPA

PROJECT NUMBER: 50.03.52

LOCATION NUMBER: 63-010/12275

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7							
8	1625 5/20/97 412440	3 2 3 3	SS 13"	(2.5Y, 4/3) Olive brown clay (11"), moist, low plasticity, with sand + gravel. Stiff	CL		PID - background.
				2" of olive brown sand, SP-MS, poorly sorted, wet.	~~SP~~ SW	JE 5/21	
9							
10	1628 5/20/97 412442	2 2 4 5	SS 18"	(2.5Y, 5/4) Light olive brown silty + sandy clay, then light olive brown clay. Trace gravel throughout, low plasticity, moist, stiff to hard.	CL		PID - background 412441 (A/B)
11							
12	0915 5/21/97 412443		ST 22"	(2.5Y, 5/4) Light olive brown clay with sand, moist to wet.	CL		PID - background
13							
14	0921 5/21/97 412444	2 3 5 6	SS 19"	(2.5Y, 5/6) Light olive brown clay to silty clay with depth. Moist to wet. Stiff, low plasticity. Gravel to ½", subangular to subrounded, decreasing as silt content increases - may be silt by bottom of core	CL ML?		PID - background
15	0928 5/21/97 412445	6 6 5 11	SS	(2.5Y, 5/4) Light olive brown clay interbedded with silt zones. Clay, silty, trace gravel, stiff to hard, wet.	CL ML		PID - background 60cpm BK above background
16							

METER	BKGD	DATE	TIME
PID	~~0ppm~~	5/21/97	0910
ALPHA	JE 5/20/97		
BETA / GAMMA	60cpm	5/21/97	0900

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See logs
DIAMETER OF SAMPLER	N/A
WEIGHTS OF HAMMER	140 lb

NOTES:

• SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

JE 7/24/97

CONTROL NUMBER: 500352-12275-002 6-23-17

FEMP
LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME: Geotech. Inv. FPA

PROJECT NUMBER: 50.0352

LOCATION NUMBER: 63-010/12275

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY(TSF)	REMARKS
16	412445 cont.			silt, wet, clayey, trace gravel.	CL ML		
17							
18	0935 5/21/17 412446	6 6 9 11	SS 17"	(2.5Y, 5/4) Light olive brown silty clays interbedded with clayey silts. Clays stiff to hard, moist to wet. Silts, wet, Trace gravel throughout to ¼". Low plasticity clays	CL ML CL ML		PID-Ø 412448 (2/6 Screen)
19							
20	0958 5/21/17 412447		ST 24"	(2.5Y, 5/3) Light olive brown sandy clay with gravel. Wet. Gravel to ½" & probably scattered throughout. May be silt/sand in tube.	CL SC?		Tube crimped ~½" r PID-Background 1030 412449 13-14' estimate 10gal bucket off augers for practice.
21	BOB 21'						

METER	BKGD	DATE	TIME
PID	Ø	5/21/17	
ALPHA			
TA / GAMMA			

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See Log
DIAMETER OF SAMPLER	N/A
WEIGHTS OF HAMMER	140 lbs

NOTES:

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681-1 7/11/95

G:\WPSC\95-0140.DRW

RI Boring Logs for Locations with

PO-177 Archive Sample Test Data

FERNALD RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1100	COORDINATES:	DATE: 7/11/89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 7-15-89	
ENGINEER/GEOLOGIST: Charlie E. Trollinger	Depth Date/Time	DATE COMPLETED: 7-17-89	
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN.	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				cement			HNU = 6
				cement			α = 0
1							BZ = 900
	15957 7-16 1350	6	6	(5y 5/1) gray silty clay some sand, low (very stiff) plasticity, moist	CL	3.0	
				~~med. dense (10y 5/3) medium gray gravel, moist~~	GC	NA	
2	15958 7-16 1350	6	6	very stiff (2.5y 2/0) black, silty clay, some sand, trace fine to med gravel, low plasticity, moist	CL	2.75	HNU = 6
	15959 7-16 1350	7	6	stiff SAA	CL	1.25	α = 0
							BZ = 900
3	15960 7-16 1350	9	3	stiff SAA	CL	1.50	
	15961 7-16 1450	5	6	medium stiff (5y, 4/1) dark gray silty clay, some sand, low plasticity, moist	CL	.75	HNU = 5
4	15962 7-16 1450	6	6	SAA	CL	1.0	α = 0
	15963 7-16 1451	9	3	SAA	CL	.75	BZ = 1000-1100
							Attempted 3 times with trap on last try.
15964	~~15965~~ 1500 7-16	7	6	stiff (5y, 3/2) dark olive gray clay, some silt & sand, med plasticity, moist	CL	1.75	HNU = 5
5							α = 0
15965	~~15966~~ 1500 7-16	10	6	stiff (5y, 4/1) dark gray, silty clay, trace sand, med plasticity, moist	CL	.75	BZ = 900-1000
15966	~~15967~~ 1500 7-16	12	4	med. stiff (5y, 4/2) olive gray, clay, trace sand & silt med plasticity moist	CL	.5	
6							
15967	~~15968~~ 1530	6	6	med stiff (5y 2.5/1) black, silty clay, trace sand, low plasticity, moist	CL	.5	HNU = 7
15968	~~15969~~ 7-16 1530	7	6	med stiff (5y, 3/1) very dark gray clay, trace silt & sand, low plasticity moist	CL	.75	α = 0
7	~~15970~~ 15970 1530	4	6	med stiff (5y, 5/3) olive, silty clay, trace sand, low plasticity, moist	CL	.5	BZ = 900-1000

NOTES: CONTRACTOR: PENNDRILL
RIG: 393
DRILLER: Jim, DAVE
ASSISTANT: Kyle, Chris

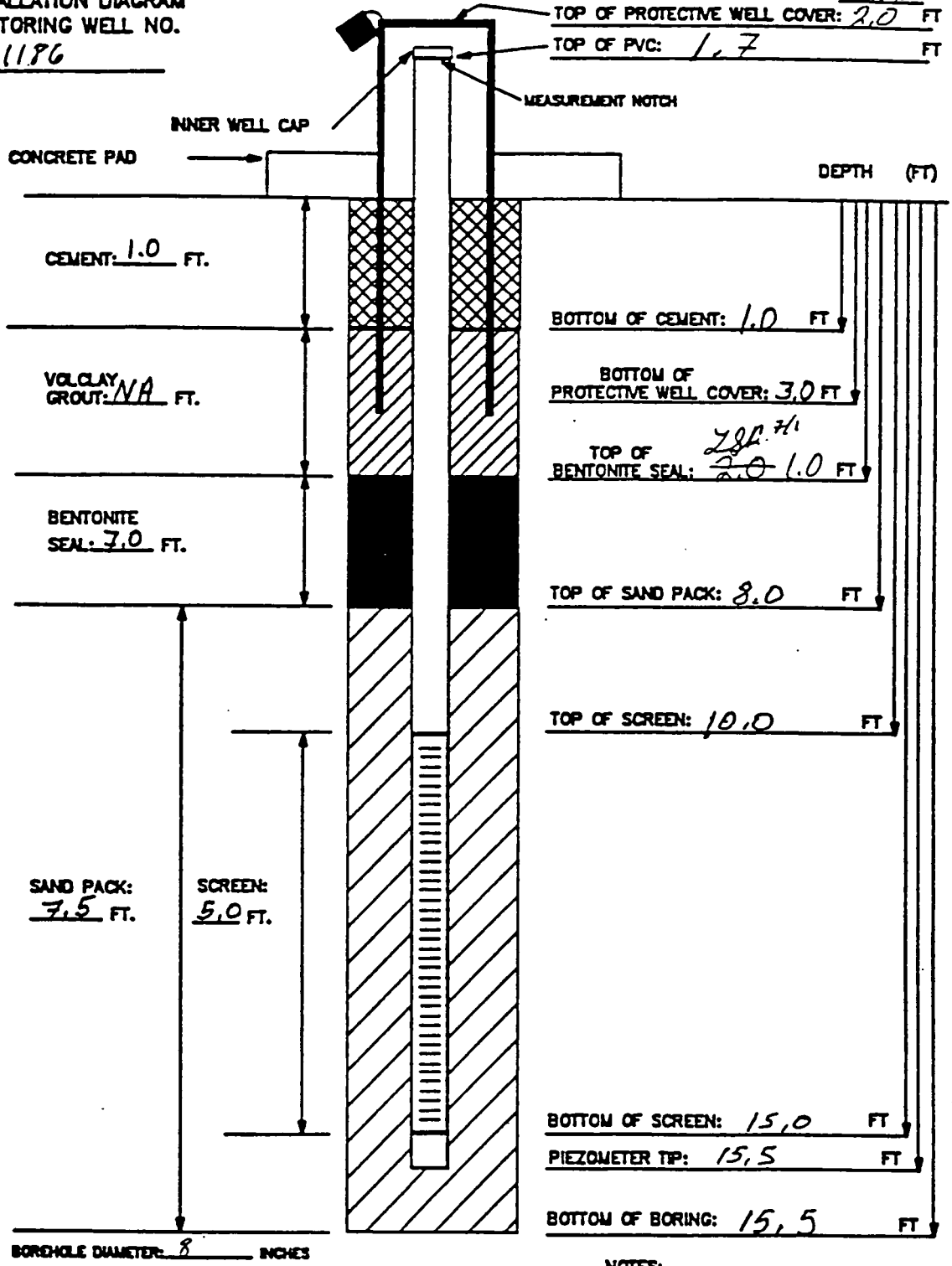
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0.0 PPM
α = 0 CPM
BZ = 1200-1400 CPM

LEL/O2: LEL: 0 ~~PPM~~ % UAN 7.00
O2: 21.0 %

INSTALLATION DATE: 7/1/89

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1186



BOREHOLE DIAMETER: 8 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY:
BENTONITE PELLETS (5-GALLON BUCKETS):
BAGS OF VOLCLAY GROUT:
AMOUNT OF CEMENT:
AMOUNT OF WATER USED:
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 3.7.1

GEOLOGIST/ENGINEER: T. Santangelo

FERNALD
RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER:	COORDINATES:	DATE: 7-16-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 7-15-89
ENGINEER/GEOLOGIST: E. Trollinger	Depth Date/Time	DATE COMPLETED: 7-17-89
DRILLING METHODS: MOBILE DRILL HSA 8 IN		PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	15971 1535 7-16	10	6	MEDIUM STIFF TO STIFF, OLIVE GRAY (5Y 5/2) SILTY CLAY, MEDIUM PLASTICITY, TRACE OF SAND, MOIST.	CL	1.5	H_{max} = 1-5 ppm; α = 0; $\beta\gamma$ = 900-1000 CPM
	15972 1535 7-16	12	6			.5	
9	15973 1535 7-16	15	6			1.75	
	15974 1630 7-16	21	6	STIFF, YELLOWISH BROWN (10YR 5/6) SILTY CLAY, TRACE OF SAND, LOW PLASTICITY, MOIST.	CL	1.25	H_{max} = 5 ppm; α = 0; $\beta\gamma$ = 800-900 CPM
WATER ZONE @ 10.0 FT	15975 1630 7-16	14	6			1.75	
10	15976 1630 7-16	16	6	MEDIUM DENSE, OLIVE BROWN (2.5Y 4/4) CLAYEY SAND, TRACE OF FINE GRAVEL, MOIST TO WET	SC	N/A	
11	15977 1758 7-16	2	6	LOOSE, YELLOWISH BROWN (10YR 4/3), CLAYEY SILT, MOIST TO WET.	ML	N/A	H_{max} = 10 ppm; α = 0-10 CPM; $\beta\gamma$ = 1000 CPM
	15978 1758 7-16	3	3				
	51415 1758 7-16	7		NO RECOVERY			
12	51416 1805 7-16	2	6	STIFF, GRAY (10YR 5/2), SILTY CLAY, TRACE OF FINE GRAVEL, WET.	CL	1.0	H_{max} = 0.8 ppm; α = 0-10 CPM; $\beta\gamma$ = 800-900 CPM
	51417 1805 7-16	3	6	LOOSE, GRAYISH BROWN (10YR 5/3) CLAYEY SILT, WET.	ML	N/A	
13	51418 1805 7-16	8	5	STIFF, GRAY (10YR 5/2) CLAY, MOIST TO WET.	CL	2.0	
14	51419 1820 7-16	13	6	STIFF, GRAY (10YR 5/2) CLAY MEDIUM PLASTICITY, MOIST.	CL	2.0	H_{max} = 0.4 ppm; α = 0-10 CPM; $\beta\gamma$ = 900 CPM
	51420 1820 7-16	19	6	MEDIUM DENSE, BROWN (10YR 4/3) SILTY SAND, MOIST.	SM	N/A	
	51421 1820 7-16	19	6	GRAY (10YR 5/2) VERY STIFF CLAY, MEDIUM PLASTICITY MOIST.	CL	2.5	

NOTES:

DRILLER: DAVE NEUMAN
HELPER: CHRIS CATER

INSTRUMENT BACKGROUND
H_{max} = 0.2 ppm
α = 0-10 CPM
$\beta\gamma$ = 1200 CPM

000317

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1149	COORDINATES:	DATE: 7-16-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 7-15-89
ENGINEER/GEOLOGIST: E. Trollinger	Depth Date/Time	DATE COMPLETED: 7-17-89
DRILLING METHODS: Mobile Drill HSA		PAGE 3 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15	51422 1930 7-16	6	6	STIFF GRAY (10YR 4/1), CLAY, MED. PLASTICITY, MOIST.	CL	1.5	Hnu = 0.6 ppm
16	51423 1938 7-16	5		BOTTOM OF BORING AT 15.5 FT. LAST SAMPLE 15.0-15.5 FT.			α = 0-10 CPM
	51424 1938 7-16	3		NO RECOVERY			βγ = 900 CPM
17							
18							
19							
20							
				BOTTOM OF BORING. NOT TO EXCEED 20.0 FT FROM GROUND SURFACE			

NOTES:

DRILLER: Dave Newman
HELPER: Chris Colter

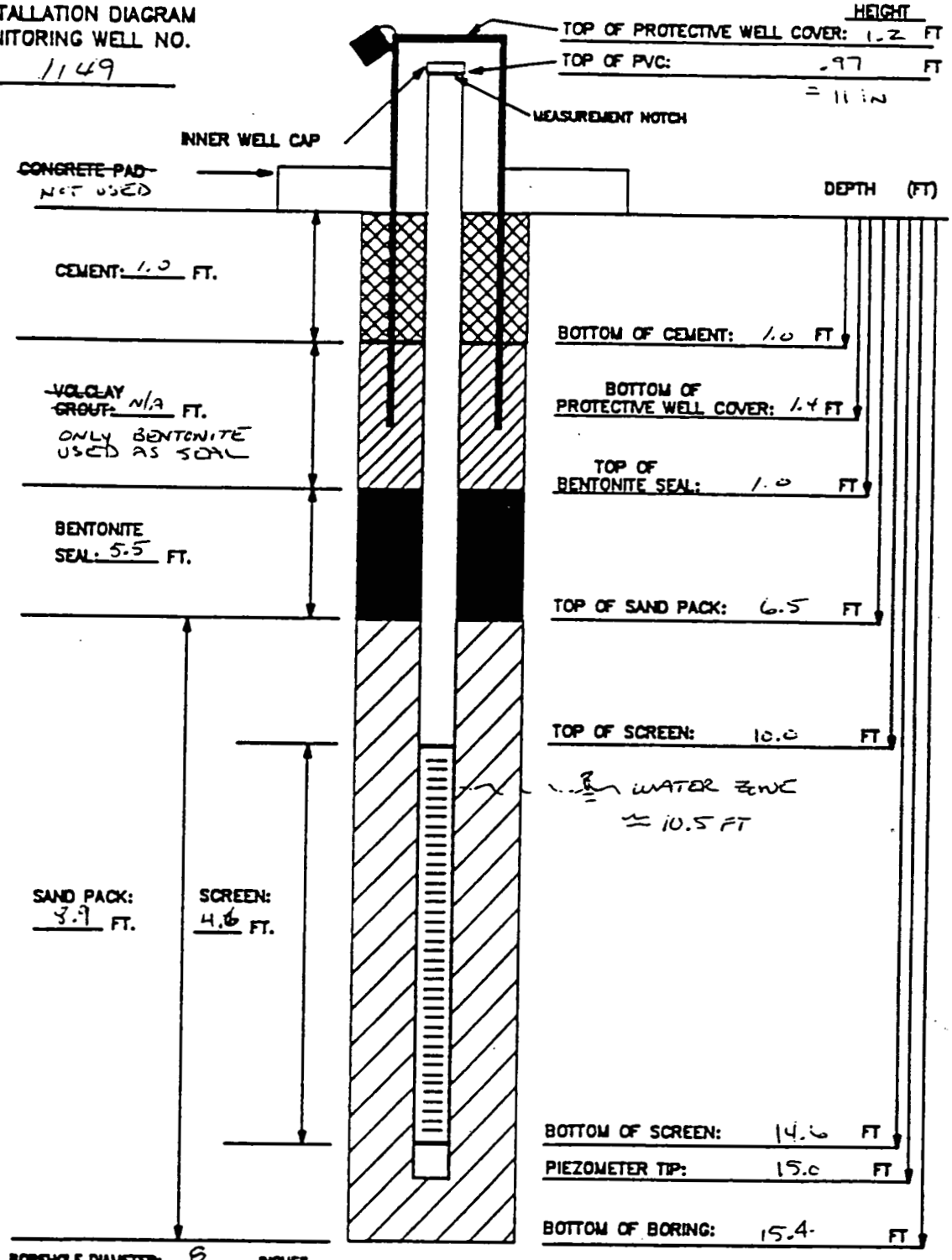
INSTRUMENT BACKGROUND
Hnu = 0.4 ppm
α = 0 CPM
βγ = 1000-1200 CPM

000318

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1149

INSTALLATION DATE: 7-17-89



BOREHOLE DIAMETER: 8 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 2 BAGS 80 lbs. ea.
BENTONITE PELLETS (5-GALLON BUCKETS): 2 buckets
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1/2 bag (50 lb)
AMOUNT OF WATER USED: 6 GALS.
OTHER:

NOTES:

1) RISER PIPE IS 4.0 IN 8-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 4 IN 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE: 8.0 FT @ 7-17-89

TASK: 3.7.1

GEOLOGIST/ENGINEER: E. Trollinger

QA QC WAH 7-20-89

FERNALD RI/FS

COPY

	Initial	Field Check	1st Key In	2nd Key In	Hard Copy Verification

Office Copy

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: ~~#58~~ 1153	COORDINATES:	DATE: 8-13-89
ELEVATION: 9/21/89	GWL: Depth Date/Time	DATE STARTED: 8-9-89
ENGINEER/GEOLOGIST: L. Sinfield	Depth Date/Time	DATE COMPLETED: 8-9-89
DRILLING METHODS: Acton Truck-Mounted Rig: Hollow Stem Auger with Split Spoon S.		PAGE 1 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				BG = 1200-1400 cpm Concrete at Surface: α = 60-90 cpm			8/9/89 Start = 1900
0.5	NR 16155 NR wmco	N/A	N/A	Concrete core: BG = 160-200 cpm α = 0 cpm 0.6 ft Base: BG = 160-200 cpm α = 0 cpm	N/A 0.6'	N/A	HNU = 0 ppm α = 0 cpm BG = 160-200 cpm
1.0	16156	Grab Sample		Loose, Sand and Gravel, dry, massive.	SW	Loose	
1.5	16157	Grab Sample		8/9/89 @ 1940		TSF	
2.0	16158	7		Loose, Sand with Gravel, dry, massive 2.0 ft	SW 2.0'	Loose	HNU = 0 ppm α = 0 cpm BG = 220-230 cpm
2.5	16159 wmco	9	14 in.	Very Stiff, Lean Clay, dry, massive, mottled, medium plastic, with gravel, Gray (10YR, 5/1) with Dark Brown (7.5YR, 4/4) mottled. 8/9/89 @ 1945	CL	2.9 ↓ 2.6 TSF	
3.0	16160	11					
3.5	16161	10		Very stiff, Same as above 1.5-3.0 ft, but Very mottled, Brownish Yellow (10YR, 6/8) predominating.	CL	2.7 ↓ 3.2 TSF	HNU = 0 ppm α = 0 cpm BG = 220-280 cpm
4.0	16162	13	10 in.				
4.5	NR 16163 NR	17		8/9/89 @ 1950			
5.0	16164	7		Same as 3.0-4.5 ft above	~~2.6~~ CL CL	8-13-89 ~~CL~~ 2.6 TSF	HNU = 0 ppm α = 0 cpm BG = 220-280 cpm
5.5	16165 wmco	11	18 in.				
6.0	16166	13		8/9/89 @ 2000			
6.5	16167	5		Same as above. 6.5 ft	~~1.8~~ CL	1.8	HNU = 0 ppm α = 0 cpm BG = 220-280 cpm
7.0	16168	8	18 in.	Stiff to very stiff, Lean Clay, massive, mottled, dry, medium plastic, Brownish Yellow (6/8, 10YR) and Gray (10YR, 5/1).	CL	2.6 ↓ 1.7 TSF	
7.5	16169	10		8/9/89 @ 2020			

NOTES: Contractor: Penn Drill
Driller: Dave Newman
Helper: C. Coulter
Sample Tech: B. Briar = H&S
Weather: Warm and Clear
HNU #: B-00222AS1

NR = No Recovery, No Sample Taken

8/9/89 Background @ 1900

	HNU = 0 ppm
Air	α = 0 cpm
Air	BG = 240-280 cpm
Gnd	α = 60-90 cpm
Gnd	BG = 1200-1400 cpm

000320

FERNALD RI/FS

8663

Office Copy

E-1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program FMPC RI/FS		
BORING NUMBER: ~~1158~~ 1153	COORDINATES:	DATE: 8-14-87	
ELEVATION: BD. 9/21/89	GWL: Depth / Date/Time	DATE STARTED: 8/9/89	
ENGINEER/GEOLOGIST: L. Sinfield	Depth / Date/Time	DATE COMPLETED: 8/9/89	
DRILLING METHODS: See Page 1 of 4		PAGE 2 OF 4	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.5							
8.0	16170	5		Soft, Lean Clay, Very plastic, Massive, dry, Brownish Yellow (10YR, 6/8)	CL	<0.5	HNU = ø ppm α = ø cpm Bγ = 220-280 cpm
8.5	16171	6	18 in.				
	16172	5		8/9/89 @ 2025		TSF	
9.0							
9.5	16173	3		Soft, Interbedded Lean Clay, Sand with Gravel, and Silt. Lean Clay = Very plastic, moist, Brownish Yellow (10YR, 6/8). Sand with Gravel = WET, Massive, Well-graded, poorly sorted. Silt = WET, massive, Brownish Yellow (10YR, 6/8)	CL / SW	9.25' / 9.5'	HNU = ø ppm α = ø cpm Bγ = 220-280 cpm
	16174	5	18 in.		CL	0.5	
10.0							
10.5	16175	6		8/9/89 @ 2030	10.25' ML / CL	0.5' TSF	
11.0	16176	6		Stiff, Lean Clay, Medium plastic, massive, dry, gray (5Y1, 10YR)	CL	1.5	HNU = ø ppm α = ø cpm Bγ = 220-280 cpm
11.5	51495	8	18 in.				
	51496	9		8/9/89 @ 2130		TSF	
12.0							
12.5				TD = 12.0 ft. Well Set			HNU = ppm α = cpm Bγ = cpm
13.0			in.				
13.5				@		TSF	
14.0							HNU = ppm α = cpm Bγ = cpm
14.5			in.				
15.0				@		TSF	

NOTES: Contractor: Driller: Helper: Sample Tech: Weather: HNU #: } See page 1 of 4

NR = No Recovery, No Sample Taken

8/9/89 Background @ 2130

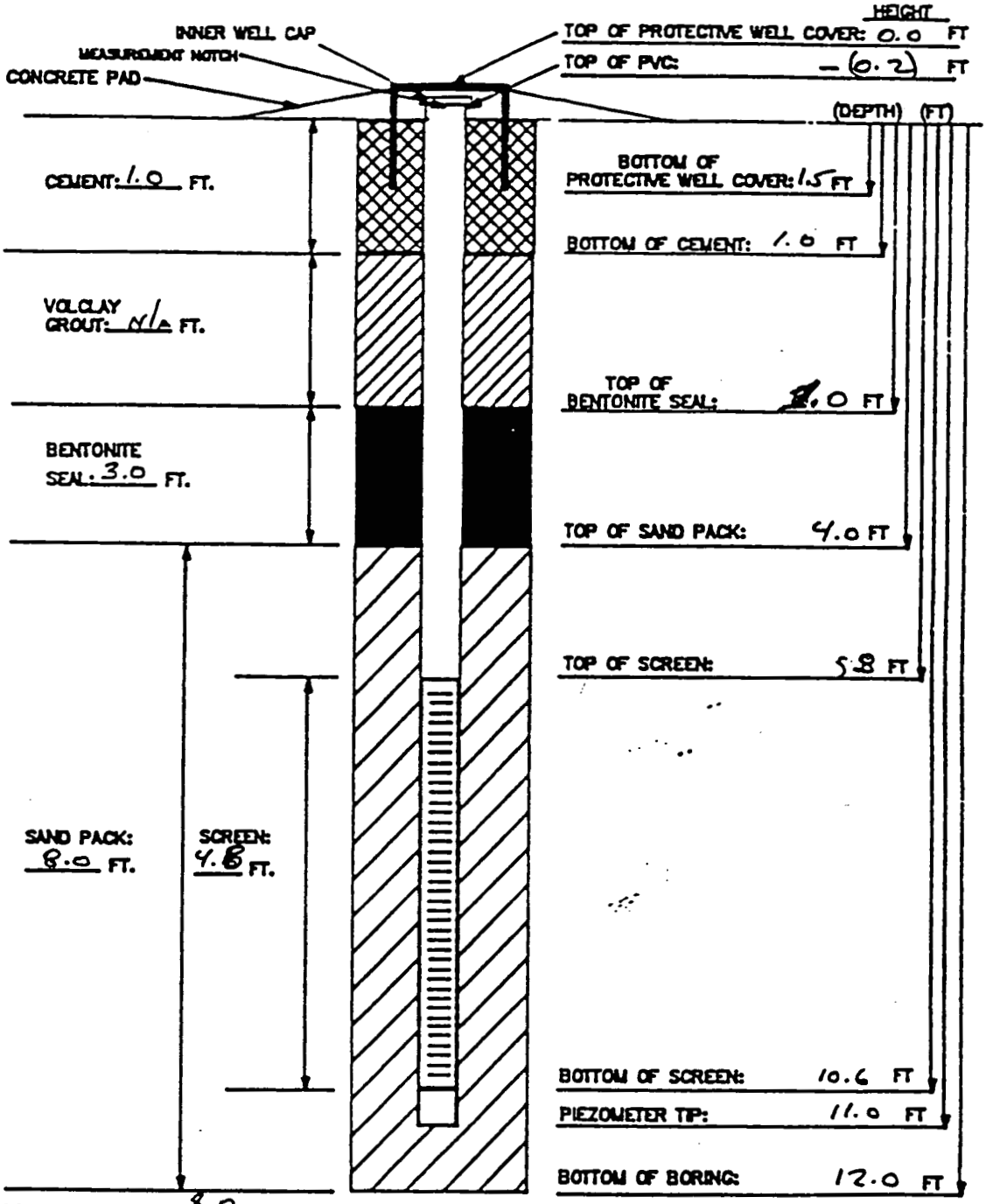
	HNU = ø ppm
Air	α = ø cpm
Air	Bγ = 220-280 cpm
gnd	α = 80-120 cpm
gnd	Bγ = 1,200-1,400 cpm

000321

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
~~1158~~ 1153

INSTALLATION DATE: 8-9-89



MATERIALS USED:
SAND TYPE AND QUANTITY: 2 Bags 10x20
BENTONITE PELLETS (5-GALLON BUCKETS): 1 Bucket
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1 Bag
AMOUNT OF WATER USED: 70 gallons
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7.1 GEOLOGIST/ENGINEER: L. Sinfield

000322

FERNALD RI/FS

1507

Date	9/1/89			
Initial	BD			
	Field Check	1st Rev'n	2nd Rev'n	Final Copy Verification

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1177	COORDINATES:	DATE: 8-13-89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 8-13-89	
ENGINEER/GEOLOGIST: E. Trollinger	Depth Date/Time	DATE COMPLETED: 8-21-89	
DRILLING METHODS: MOBILE DRILL HSA 8 in		PAGE 1 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 in	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1	16463 1032 8-13			CONCRETE SLAB			
	16464 1032 8-13						
	16465 1034 8-13	5	6	VERY STIFF, GRAY (10YR 4/1) CLAY TRACE OF FINE GRAVEL, MOIST, LOW TO MEDIUM PLASTICITY.	CL	2.5	Hnu = 0.4 ppm α = 0 cpm BY = 800 cpm
2	16466 1034 8-13	5	Ø	NO RECOVERY - 2 ATTEMPTS WITH TRAPS INSTALLED IN SPOON	N/A	N/A	Hnu = 0.4 ppm α = 0 cpm BY = 600-800 cpm
	16467 1034 8-13	5	Ø				
3	16468 1034 8-13	4	Ø				
4	16469 1043 8-13	6	10	STIFF, DARK GRAY (10YR 3/1) CLAY, TRACE OF SILT THROUGHOUT, LOW PLASTICITY, MOIST.	CL	2.0	Hnu = 0.4 ppm α = 0 cpm BY = 600-800 cpm
	16470 1043 8-13	6	6				
	16471 1043 8-13	11	6				
5	16472 1104 8-13	3	6		CL	2.0	Hnu = 0.4 ppm α = 0 cpm BY = 600 cpm
	16473 1104 8-13	3	4				
6	16474 1104 8-13	3	Ø	NO RECOVERY			
7	16475 1110 8-13	3	6	STIFF, DARK GRAY (10YR 3/2) TO BROWNISH GRAY (10YR 4/2) CLAY, TRACE OF SILT @ 7.0-7.5 FT., MEDIUM PLASTICITY, MOIST.	CL	1.5	Hnu = 0.4 ppm α = 0 cpm BY = 700 cpm
	16476 1110 8-13	4	6				
	16477 1110 8-13	5	2				

NOTES: DRILLING CO.: Penn. Drill
DRILLER: Harold Andrews
HELPER: Charles Elkowitz

MATERIALS USED:
10/30 14 80 lb. SACKS
3½ BUCKETS BENTONITE
½ BAG CEMENT
10 GALS WATER.

SAMPLING IN ACCORDANCE WITH ASTM STANDARDS, DESCRIPTION OF SOIL COLOR BY MUNSELL COLOR CHART. SAMPLES TAKEN FOR WMCO AT INTERVALS 0.0-5 FT., 2-2.5 FT., 5-5.5 FT, 10-10.5 FT., 15-15.5 FT.

INSTRUMENT BACKGROUND
Hnu = 0.4 ppm
α = 0-10 cpm.
BY = 800-1000 cpm
LEL = 0
O_2 = 21.2%

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 37	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1177	COORDINATES:	DATE: 8-13-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 8-13-89
ENGINEER/GEOLOGIST: E. Trollinger	Depth Date/Time	DATE COMPLETED: 8-24-89
DRILLING METHODS: CABLE TOOL DRILLING 8 in		PAGE 2 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	16478 1120 8-13	4	6	STIFF, GRAYISH BROWN (10YR 5/3) CLAY, TRACE OF SILT, SOME SAND AT 8.5 FT, LOW PLASTICITY, MOIST TO WET	CL	1.5	Hnu = 0.4 ppm α = 0 CPM βγ = 600 CPM
	16479 1120 8-13	6	6				
9	16480 1120 8-13	7	0	NO RECOVERY			
approximate WATER TABLE — SPRING ONE	16481 1351 8-13	2	6	STIFF, GRAYISH BROWN (10YR 5/3) CLAY, LOW PLASTICITY, MOIST TO WET.	CL	2.0	Hnu = 0.4 ppm α = 0 CPM βγ = 600-760 CPM
10	16482 1351 8-13	3	4	LOOSE, BROWN (10YR 4/3) POORLY GRADED SAND, WET.	SP	N/A	
	16483 1351 8-13	6	0	NO RECOVERY			
11	16484 1356 8-13	17	6	DENSE, BROWN (10YR 4/3) POORLY GRADED SAND, WET	SP	N/A	Hnu = 0.4 ppm α = 0 CPM βγ = 600 CPM
	51605 1356 8-13	23	6				
12	51606 1356 8-13	16	0	NO RECOVERY			
13	51617 1408 8-13	20	6	MEDIUM DENSE, BROWN (10YR 5/3) POORLY GRADED SAND, TRACE OF GRAVEL (.5-.75 IN), WET.	SP	N/A	Hnu = 0.4 ppm α = 0 CPM βγ = 500-600 CPM
	51618 1408 8-13	13	6				
	51619 1408 8-13	17	6				
14	51620 1437 8-13	2	6		SP	N/A	Hnu = 0.4 ppm α = 0 CPM βγ = 600 CPM
	51621 1437 8-13	6	0	NO RECOVERY			
	51622 1437 8-13	13	0				

NOTES:

INSTRU. BACKGROUND

Hnu = 0.4 ppm

α = 0-10 CPM

βγ = 500 - 900 CPM

ACZ-11-86

FERNALD
RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1177	COORDINATES:		DATE: 8-13-89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 8-13-89
ENGINEER/GEOLOGIST: E. TROLLINGER	Depth	Date/Time	DATE COMPLETED: 8-24-89
DRILLING METHODS: MOBILE DRILL HSA 8 in			PAGE 3 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15							
16	51623 1610 8-13	3	10	MEDIUM DENSE, BROWN (10YR 4/3) POORLY GRADED SAND TRACE OF FINE ROUNDED GRAVEL (.5 in), WET.	SP	N/A	Hnu = 0.4 ppm α = 0 CPM βγ = 500 CPM
	51624 1610 8-13	8	6				
	51625 1610 8-13	19	4				
17	51626 1625 8-13	14	6		SP	N/A	Hnu = 0.4 ppm α = 0 CPM βγ = 500 CPM
	51627 1625 8-13	17	6				
18	51628 1625 8-13	21	6				
	51629 1642 8-13	18	E.T. 6	MEDIUM DENSE, GRAYISH BROWN (10YR 5/2) WELL GRADED GRAVELLY SAND, ROUNDED GRAVEL (.5 in) WET.	SW	N/A	Hnu = 0.4 ppm α = 0 CPM βγ = 500 CPM
19	51630 1642 8-13	14	6				
	51631 1642 8-13	11	6				
20	51632 1642 8-13	16	6		SW	N/A	Hnu = 0.4 ppm α = 0 CPM βγ = 500 CPM
				BOTTOM OF BORING. NOT TO EXCEED 20.0 FT FROM GROUND SURFACE AUGERS STOPPED AT 20.0 FT. SAMPLING ENDED AT 20.0 FT.			

NOTES:

DRILLER: Harold Andrews
HELPER: Charles Elkinuts

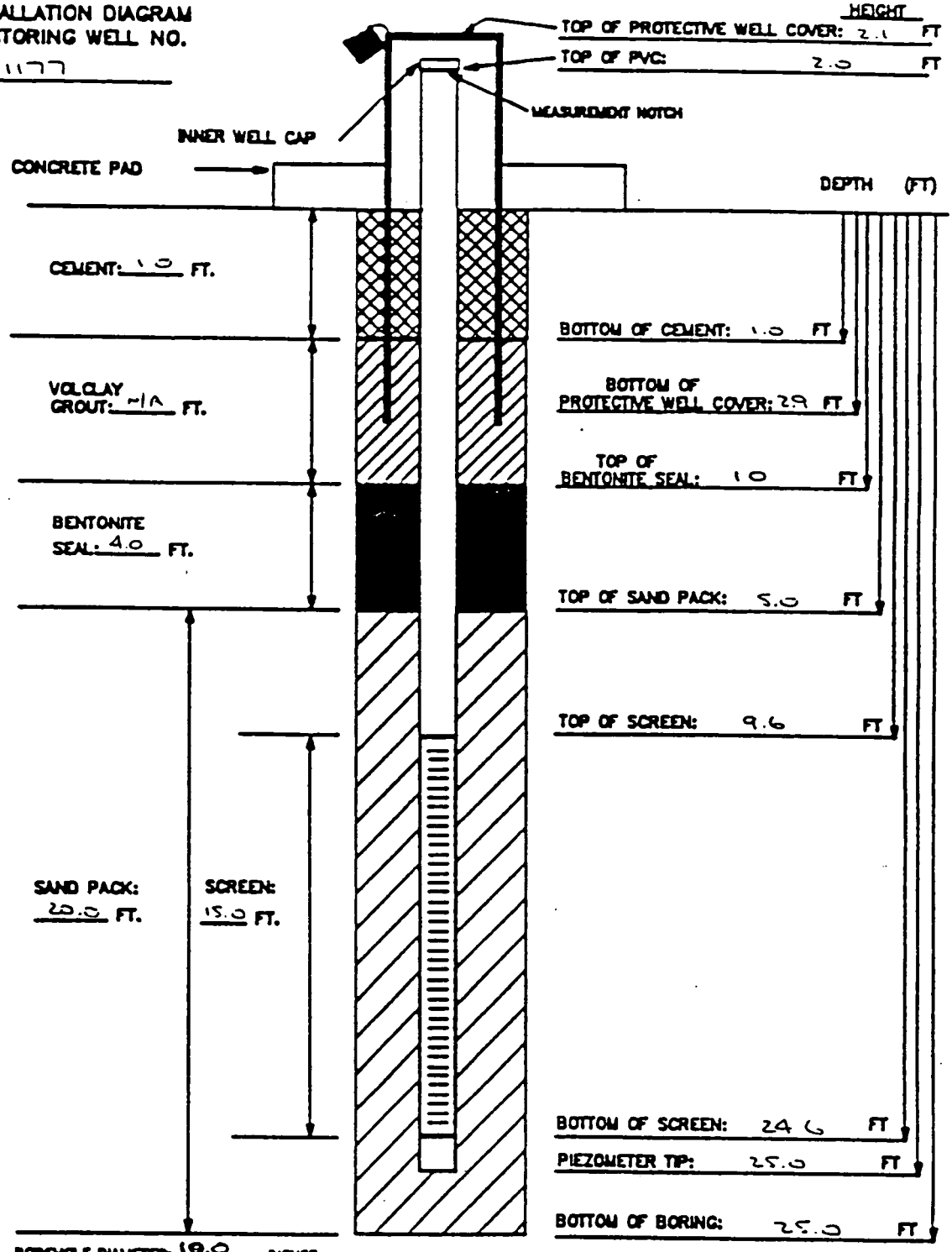
Boring was actually drilled to 25' in order to set piezometer due to Blow Sands.

INSTRUMENT BACKGROUND
Hnu = 0.4 ppm
α = 0 CPM
βγ = 500 CPM

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1177

INSTALLATION DATE: 08 24 89



BOREHOLE DIAMETER: 10.0 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: 10-20 : 14 80LB. SACKS
BENTONITE PELLETS (5-GALLON BUCKETS): 3.5 : 5-GAL BUCKETS
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: .5 : 94 LB BAG.
AMOUNT OF WATER USED: 10 GAL
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7.1 GEOLOGIST/ENGINEER: M. SLUSARSKI

FERNALD RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1183	COORDINATES:	DATE: 10/23/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 10/23/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 10/23/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	16596 1335 10-23	NA	6	Surface gravel ~~Loose (2.5Y 3/2) very dark brown poorly graded gravelly sand, dry~~	GW ~~SP~~	NA ~~NA~~	HNU: 0 ppm α: 815 cpm Bγ: 6,000 cpm ← 1st 6 inch
	16598 1339 10-23		6	SAA ~~Stiff (2.5Y 3/4) olive brown silty clay, low plasticity, moist~~	SP ~~CL~~	NA ~~1.25~~	
1	16599 1420 10-23	2	6	Stiff (2.5Y 4/4) olive brown silty clay, low plasticity moist	CL	1.75	HNU: 0 α: 0 cpm Bγ: 550-600 cpm ← 2nd 6 inch
	16600 1420 10-23	2	6	Stiff (2.5Y 4/4) olive brown silty clay, trace of sand, medium plasticity moist	CL	1.50	HNU: 0 ppm α: 0 cpm Bγ: 400-450 cpm
2	16601 1420 10-23	3	0	NR	NA	NA	
	16602 1420 10-23	4	0	NR	NA	NA	
3	16603 1423 10-23	3	6	Medium Stiff (2.5Y 4/2) dark grayish brown silty clay, medium plasticity, moist	CL	.5	HNU: 0 ppm α: 0 cpm Bγ: 220-240 cpm
	16604 1423 10-23	2	2	SAA	CL	.75	
4	16605 1423 10-23	2	0	NR	NA	NA	
	16606 1426 10-23	2	6	Loose (2.5Y 4/4) olive brown clayey gravel, wet Stiff (5Y 4/2) olive gray silty clay, trace of sand, medium plasticity, moist	~~GC~~ CL	~~NA~~ 1.5	HNU: 2 ppm α: 0 cpm Bγ: 200-210 cpm
5	16607 1426 10-23	3	3	SAA	CL	.75	
	16608 1426 10-23	4	0	NR	NA	NA	
6	16609 1443 10-23	2	6	Stiff (5Y 4/2) olive gray clay, trace of silt low plasticity moist	CL	1.0	HNU: 0 ppm α: 0 cpm Bγ: 190-200 cpm
	16610 1443 10-23	3	6	SAA	CL	1.25	
7	16611 1443 10-23	4	0	NR	NA	NA	

NOTES: CONTRACTOR: PENN DRILL
RIG: CME-45
DRILLER: Jim Saccini
ASSISTANT: Chris Coulter
Geo Assistant: Ben Brier

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α : 0 CPM
Bγ : 150-220 CPM

SAA = Same As Above
NR = No Recovery

LEL O_2: LEL: 0% ~~ppm~~ eq.
O_2: 20.6%

HNU # 00199

000327

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1183	COORDINATES:	DATE: 10/23/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 10/23/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 10/23/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	16612 1449 10-23	5	6	Medium stiff (2.5 Y 5/4) light olive brown silty clay, some fine gravel, low plasticity moist	CL	.75	HNU = 0 ppm α = 0 cpm BG = 200-210 cpm w/ screen
	16613 1449 10-23	7	0	NR	NA	NA	
9	16614 1449 10-23	8	0	NR	NA	NA	
	16615 1453 10-23	6	6	Medium dense (5 Y 5/1) gray clayey silt, moist	ML	NA	HNU = 2 ppm α = 0 cpm BG = 220-220 cpm w/ screen
10	16616 1453 10-23	9	0	NR	NA	NA	
	51735 1459 10-23	8	0	NR.	NA	NA	
11	51736 1500 10-23	5	6	Loose (2.5 Y 4/4) olive brown clay silt, moist	ML	NA	HNU = 1.0 ppm α = 0 cpm BG = 220-230 cpm
	51737 1500 10-23	2	6	Loose (5 Y 5/2) olive gray clayey silt, trace sand moist	ML	NA	
Water record 11.5 FT 12	51738 1500 10-23	4	2	Loose (2.5 Y 4/4) olive brown silty sand, wet	SM	NA	
13	51739 1507 10-23	6	6	Med. Dense (2.5 Y 4/4) olive brown clayey gravel wet Med. Dense (10 YR 5/3) brown poorly graded sand wet	GC SP	NA NA	HNU = 0 ppm α = 0 cpm BG = 180-190 cpm
	51740 1507 10-23	9	6	Med Dense (2.5 Y 4/4) olive brown clayey silt very moist	ML	NA	
	51741 1507 10-23	11	6	Med Dense (5 Y 5/2) olive gray silt wet Medium dense (10 YR 5/4) yellowish brown poorly graded sand, wet	ML SP	NA NA	
14	51742 1523 10-23	10	6	Medium dense (2.5 Y 5/4) light olive brown, well graded sand, wet	SW	NA	HNU = 0 ppm α = 0 cpm BG = 200-210 cpm
	51743 1523 10-23	12	6	SAA Med. Dense (2.5 Y 4/4) olive brown silt wet	SW ML	NA NA	
	51744 1523 10-23	15	16	medium dense (5 Y 5/2) olive gray sandy silt wet	ML	NA	

NOTES:

SAA = Same As Above
NR = No Recovery

000328

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1183	COORDINATES:	DATE: 10/23/89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 10/23/89	
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 10/23/89	
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 5	

DEPTH	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER	RECOVERY	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S1745 1612 10-23	7	6	medium dense (2.5Y 4/4) olive brown clayey silt, very moist	ML	NA	HNU = 0ppm α = 0 cpm BG = 140-150 cpm
water ring zone 5.5FT	S1746 1612 10-23	9	6	medium dense (5Y 4/1) dk gray clayey silt + trace of sand and fine gravel moist	ML	NA	
16	S1747 1612 10-23	11	6	very stiff (5Y 4/1) dark gray silty clay, trace of sand and fine gravel (colluvium), moist	CL	2.5	
				SAA	CL	2.25	
	S1748			Bottom of Boring + sampling at 16.5FT			HNU = α = BG =
17	S1749						
	S1750						
18							HNU = α = BG =
19							
20							HNU = α = BG =

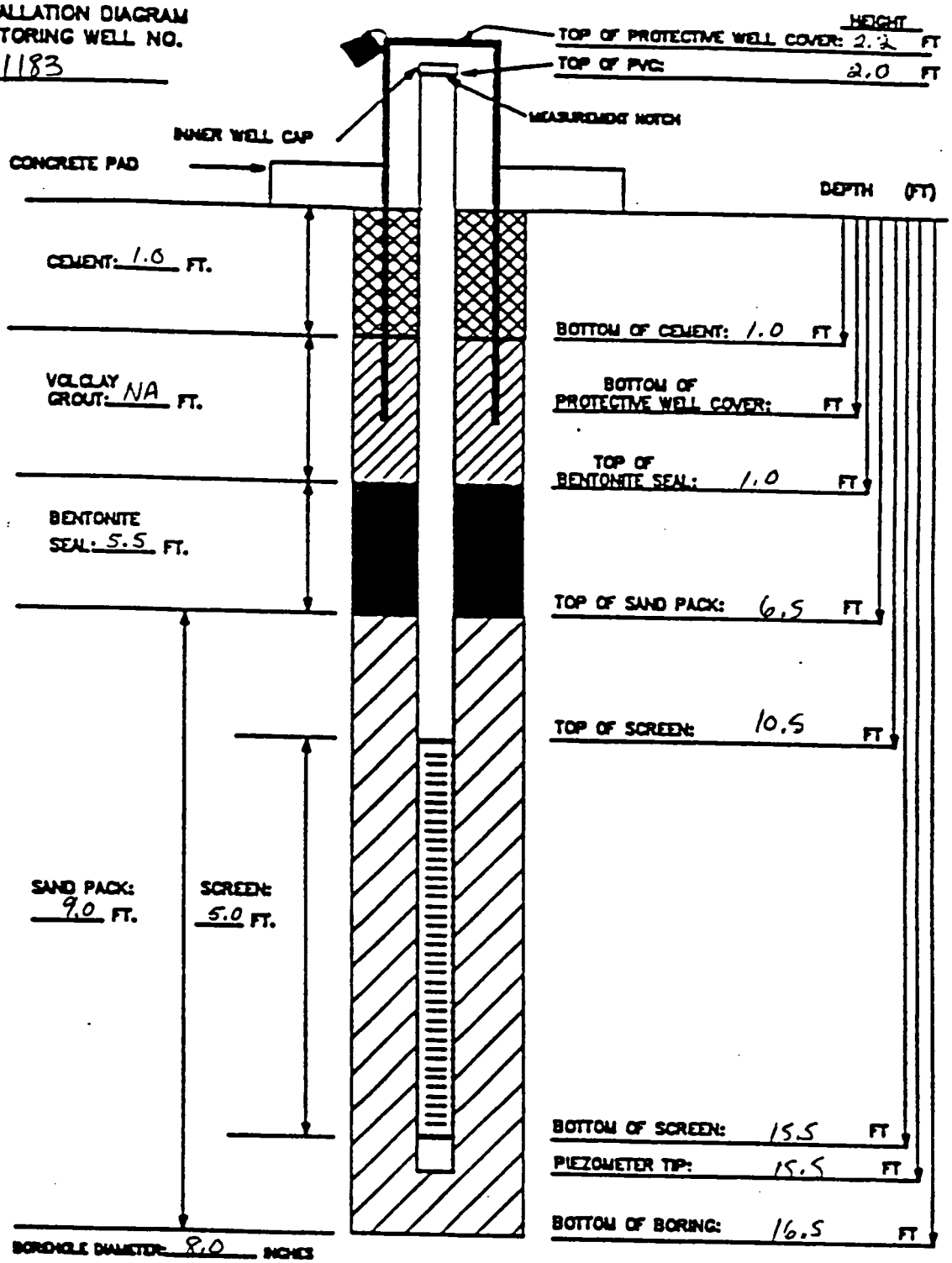
NOTES:

SAA = Same As Above
NR = No Recovery

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1183

INSTALLATION DATE: 10/23/89



MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 sand - 2 (90#) sacks
BENTONITE PELLETS (5-GALLON BUCKETS): 2½ buckets
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: ½ (94#) sk.
AMOUNT OF WATER USED: 10 gal
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube

FERNALD RI/FS

1507

Data Check		1st Key In	2nd Key In	Hard Copy Verification
BV	Initial			
10/31/89	Date			

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1/85	COORDINATES:	DATE: 10/24/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 10/24/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 10/25/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	16639 1423 10-24	2	6	medium dense light olive brown (2.5Y 5/4) gravel, dry	GC	NA	HNU = 0 ppm α = 0 cpm Bγ = 650-700 cpm
1	16640 1423 10-24	5	6	medium dense (2.5Y 4/4) olive brown clayey silt dry.	ML	NA	
	16641 1428 10-24	7	0	NR	NA	NA	
2	16642 1434 10-24	6	6	medium dense (2.5Y 6/4) light yellowish brown silt, very moist	ML	NA	HNU = 0 ppm α = 0 cpm Bγ = 150-160 cpm w/screen
	16643 1434 10-24	6	0	NR	NA	NA	
3	16644 1434 10-24	5	0	NR	NA	NA	
	16645 1436 10-24	5	6	Stiff (5Y 4/1) dark gray clay trace of silt medium plasticity, moist	CL	1.25	HNU = 0 ppm α = 0 cpm Bγ = 150-160 cpm
4	16646 1436 10-24	3	6	very soft (5Y 4/2) olive gray clay medium plasticity moist	CL	<.25	
	16647 1436 10-24	7	2	SAA	CL	<.25	
5	16648 1440 10-24	4	6	SAA	CL	<.25	HNU = 0 ppm α = 0 cpm Bγ = 140-150 cpm
	16649 1440 10-24	3	6	St. Pf (5Y 4/3) olive clay, medium plasticity moist	CL	1.0	
6	16650 1440 10-24	4	3	SAA	CL	1.25	
	16651 1503 10-24	3	6	SAA	CL	1.75	HNU = 0 ppm α = 0 cpm Bγ = 100-110 cpm
7	16652 1503 10-24	3	6	SAA	CL	1.75	
	16653 1503 10-24	3	3	SAA	CL	1.5	

NOTES: CONTRACTOR: PENNDRILL
RIG: CME-45
DRILLER: Jim Saccini
ASSISTANT: Chris Coulter
GeoAssistant: Ben Brier

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0 CPM
Bγ = 100-150 CPM
LEL: 0%
O_2: 20.6%

Same As Above = SAA
No Recovery = NR
LEL O_2:

HNU # 00199

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1185	COORDINATES:	DATE: 10/24/89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 10/24/89	
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 10/25/89	
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	16654 1506 10-24	7	6	Stiff (5Y 4/2) olive gray silty clay, lowplasticity moist	CL	1.0	HNU = 0 ppm α = 0 cpm Bβ = 160-180 cpm
	16655 1506 10-24	6	6	Loose (5Y 5/1) gray to (2.5Y 4/4) olive brown clayey silt, moist	ML	NA	
9	16656 1506 10-24	4	0	NR	NA	NA	
10	16657 1510 10-24	5	6	SAA	ML	NA	HNU = 0 ppm α = 0 cpm Bβ = 140-150 cpm
	16658 1510 10-24	5	6	SAA	ML	NA	
	16659 1510 10-24	4	0	NR	NA	NA	
11	16660 1523 10-24	4	6	Loose (2.5Y 5/4) light olive gray to (5Y 5/2) olive gray clay silt to silt, moist	ML	NA	HNU = 0 ppm α = 0 cpm Bβ = 130-140 cpm
	51775 1523 10-24	5	6	SAA	ML	NA	
12	51776 1523 10-24	5	6	SAA	ML	NA	
13	51777 1526 10-24	5	6	SAA	ML	NA	HNU = 0 ppm α = 0 cpm Bβ = 140-150 cpm
	51778 1526 10-24	6	6	Loose (2.5Y 5/4) light olive brown sandy silt trace of clay moist	ML	NA	
	51779 1526 10-24	4	5	Loose (5Y 5/1) gray, silt, moist	ML	NA	
14 (Bg)	51780 1538 10-24	3	6	medium dense (5Y 5/1) gray to (2.5Y 4/6) light olive brown clayey silt, moist	ML	NA	HNU = 0 ppm α = 0 cpm Bβ = 150-160 cpm
(Bg)	51781 1538 10-24	4	6	SAA medium dense (5Y 4/2) olive gray poorly graded sand, some silt, wet	ML SP	NA NA	
(Bg)	51782 1538 10-24	7	6	SAA	SP	NA	

NOTES:

SAA = Same As Above
NR = No Recovery

000332

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1185	COORDINATES:		DATE: 10/24/89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 10/24/89
ENGINEER/GEOLOGIST: C. Grube	Depth	Date/Time	DATE COMPLETED: 10/25/89
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 3 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 (in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S1783 1544 10-24	3	6	medium dense (5Y 4/2) olive gray poorly graded sand, some silt wet	SP	NA	Hnu = 0 ppm α = 0 cpm BG = 150-160 cpm
	S1784 1544 10-24	10	6	medium dense (5Y 4/2) olive gray well graded sand, trace of fine gravel, wet	SW	NA	
16	S1785 1544 10-24	11	5	SAA	SW	NA	
	S1786 1549 10-24	4	6	SAA	SW	NA	Hnu = 0 ppm α = 0 cpm BG = 130-140 cpm
17	S1787 1549 10-24	9	6	SAA	SW	NA	
	S1788 1549 10-24	11	6	medium dense (5Y 5/2) olive gray clayey silt, very moist	ML	NA	
18	S1789 1600 10-24	5	6	medium dense (5Y 4/2) olive well graded sand trace of fine gravel, wet	SW	NA	Hnu = 0 ppm α = 0 cpm BG = 110-120 cpm
Top of water bearing zone at 19.0 ft 19	S1790 1600 10-24	6	6	SAA	SW	NA	
	S1791 1600 10-24	10	6	Stiff (5Y 4/1) dark gray silty clay, trace of fine gravel, medium plasticity, moist	CL	1.25	
20	S1792 1600 10-24	12	5	SAA	CL	1.25	Hnu = 0 ppm α = 0 cpm BG = 110-120 cpm
			*	Bottom of Boring & Sampling at 20.0 ft Piezometer Installed			

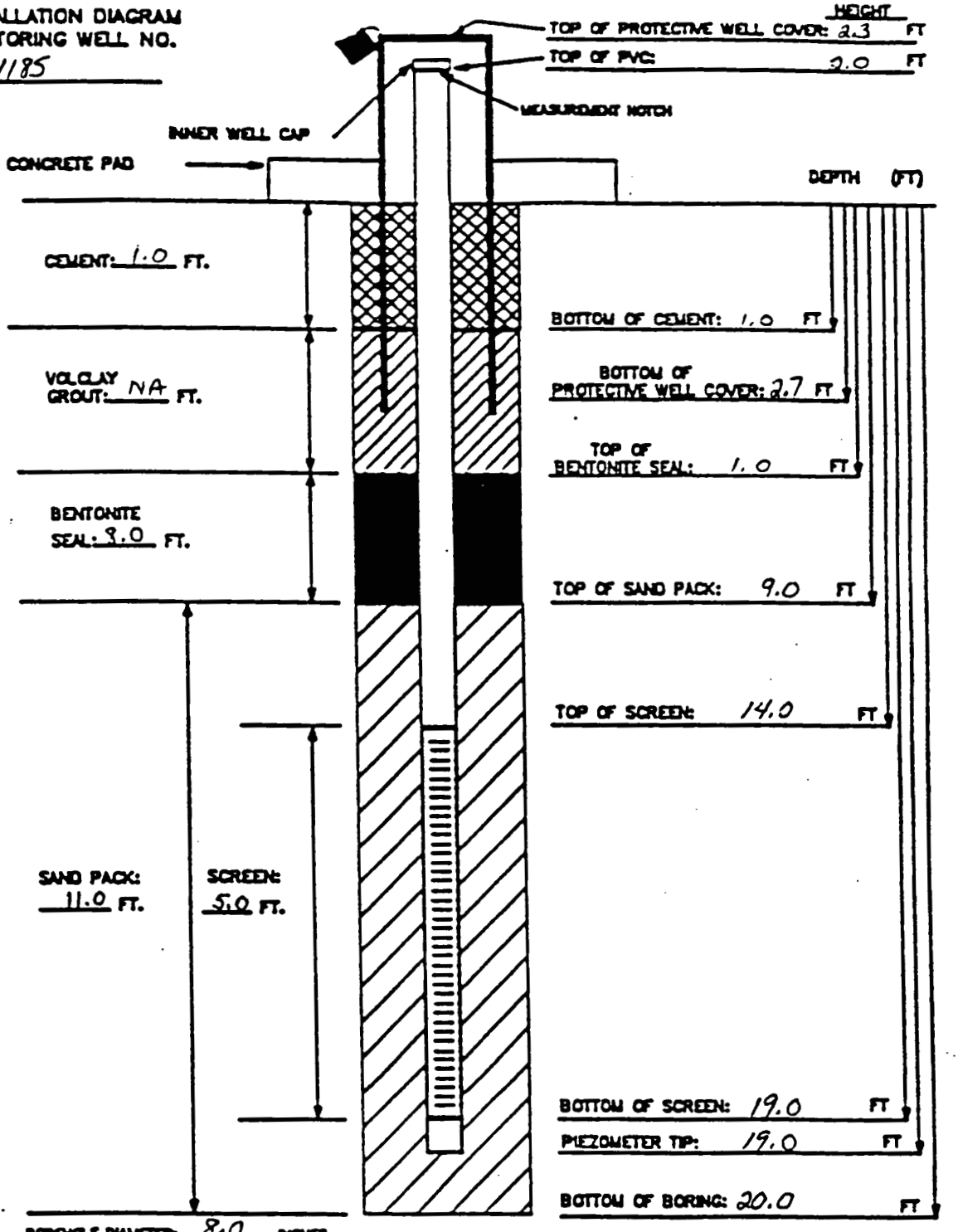
NOTES:

SAA = Same As Above
NR = No Recovery

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1185

INSTALLATION DATE: 10-25-89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand - 2 sks (80#)
BENTONITE PELLETS (5-GALLON BUCKETS): 3 buckets
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: ½ (94#) sk
AMOUNT OF WATER USED: 10 gal
OTHER: 5.0 FT Protective casing w/cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube

1507

FERNALD RI/FS

	Field Check	1st Key In	2nd Key In	Hard Copy Verification
Initial				
	11/89	8/28/89		

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: Fernald	
BORING NUMBER: ~~1314~~ 1186	COORDINATES:	DATE: 7/1/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 7/1/89
ENGINEER/GEOLOGIST: TSD	Depth Date/Time	DATE COMPLETED: 7/1/89
DRILLING METHODS: Hollow Auger		PAGE 1 OF 5

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 in	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0.5	16661 1008 7-1	14	6	Dense (10YR 4/3) dark brown sand some gravel & clay, dry.	SC	—	HNU=3 ppm, α=0 cpm, BΔ=120-14 cpm
1.0	16662 1008 7-1	14	6	Hard (2.5Y 5/4) light olive brown silty sandy clay some sand, trace of gravel dry, low plasticity	CL	74.0	
1.5	16663 1008 7-1	11	0	NR	—	—	
2.0	16664 1010 7-1	11	6	Hard (2.5Y 5/4) light olive brown silty clay, some sand, trace of gravel low plasticity, moist	CL	74.0	HNU=6 ppm, α=0 cpm, BΔ=80-100 cpm
2.5	16665 1010 7-1	8	5	SAA	CL	3.5	
3.0	16666 1010 7-1	8	0	NR	—	—	
3.5	16667 1013 7-1	7	6	Stiff (2.5Y 5/4) light olive brown silty clay some sand, trace of gravel mod plasticity, moist	CL	1.75	HNU=2 ppm, α=0 cpm, BΔ=100 cpm
4.0	16668 1013 7-1	6	2	Soft (5Y 4/1) dark gray silty clay trace of sand & gravel, mod plasticity moist	CL	0.5	
4.5	16669 1013 7-1	5	0	NR	—	—	
5.0	16670 1016 7-1	3	6	Stiff (5Y 4/1) dark gray silty clay trace of sand, med. plasticity, moist	CL	2.0	HNU=4 ppm, α=0 cpm, BΔ=100 cpm
5.5	16671 1016 7-1	2	4	SAA	CL	1.5	
6.0	16672 1016 7-1	3	0	NR	—	—	
6.5	16673 1024 7-1	3	6	Med. stiff (2.5Y 5/4) light olive brown sandy clay, trace of gravel, mod. plasticity moist	CL	0.75	HNU=1 ppm, α=0 cpm, BΔ=120 cpm
7.0	16674 1024 7-1	5	6	Stiff (2.5Y 4/4) olive brown silty clay trace of sand, mod plasticity, moist.	CL	1.75	
	16675 1024 7-1	8	3	Very stiff SAA	CL	4.0	

NOTES: CONTRACTOR: Penn Drill
Rig: ~~model 80~~ B-53
Driller: ~~Craig Coulter~~ 7/1/89 J. Sacconi
ASSISTANT: ~~Bill Anderson~~ K. Felty
SAA = Same As Above

SAMPLES collected as per ASTM standard penetration test.
Colors identified by Munsell Color Cha
Background Levels: HNU = 0 ppm
α = 0 cpm
BΔ = 80-120 cpm
LEL = ppm
O_2 = %

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: Fernald		
BORING NUMBER: 1186	COORDINATES:		DATE: 7 / 1 / 89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 7/1/89
ENGINEER/GEOLOGIST: TSD	Depth	Date/Time	DATE COMPLETED: 7/1/89
DRILLING METHODS: Holland Auger			PAGE 2 OF 5

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 in.	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8.0	16676 1041 7-1	7	6	Stiff (2.5Y 6/8) olive yellow (5Y5/1) gray mottled silty clay, trace of sand med plasticity moist	CL	1.75	HNU = 1 ppm, α = 0 cpm, βγ = 140-160 cpm
8.5	16677 1041 7-1	7	6	very stiff (2.5Y 6/8) olive yellow (5Y5/1) gray mottled silty clay trace of sand med plasticity moist	CL	3.5	
9.0	16678 1041 7-1	8	1	SAA	CL	2.75	
9.5	16679 1050 7-1	7	6	SAA	CL	2.75	HNU = 0 ppm, α = 1 cpm, βγ = 120-140 cpm
10.0	16680 1050 7-1	7	6	SAA / very stiff (10YR 5/3) brown sandy silt wet	CL / ML	2.5	
10.5	16681 1050 7-1	9	3	SAA w/ 1" clean fine sand seam	ML	2.25	
11.0	16682 1058 7-1	3	6	Mod. stiff (5Y5/2) olive gray silty clay some sand, med. plasticity moist	CL	1.0	HNU = 1 ppm, α = 0 cpm, βγ = 100-120 cpm
11.5	51795 1058 7-1	5	3	stiff SAA / med. dense (2.5Y 5/4) light olive brown silty fine sand very moist	CL / SM	1.25	
12.0	51796 1058 7-1	7	0	NR	—	—	
12.5	51797 1127 7-1	8	6	Mod dense (5Y5/2) olive gray sandy silt, wet	ML	—	HNU = 0 ppm, α = 0 cpm, βγ = 140-120 cpm
13.0	51798 1127 7-1	6	6	med dense (2.5Y 5/4) light olive brown silty sand, wet, w/ 1" clean fine sand at the bottom.	SM	—	
13.5	51799 1127 7-1	11	4	med dense (2.5Y 5/4) light olive brown fine-med. sand, wet.	SP	—	
14.0	51800 1140 7-1	10	6	Dense (2.5Y 4/2) dark grayish brown fine to med. sand some clay, wet	SP	—	HNU = 0 ppm, α = 0 cpm, βγ = 80-100 cpm
14.5	51801 1140 7-1	10	6	SAA	SP	—	
	51802 1140 7-1	12	6	dense (2.5Y 5/4) light olive brown silty sand wet / dense (2.5Y 5/4) light olive brown fine to med sand some silt, trace of clay wet	SM / SP	— / —	

NOTES: Contractor: Penn Drill
Rig: B-53
Driller: J. Succuni
Assistant: M. Felty

SAA = Same As Above

Samples collected as per ASTM standard penetration test.
Colors identified by Munsell color chart
Background Levels: HNU = 0 ppm
α = 0 cpm
βγ = 180-120 cpm
LEL = ppm
O_2 = %

FERNALD RI/FS

1507

	Initial	Date
1st Key In		
2nd Key In		
Copy Verification		

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: Fernald		
BORING NUMBER: 1186	COORDINATES:	DATE: 7/1/89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 7/1/89	
ENGINEER/GEOLOGIST: TSD	Depth Date/Time	DATE COMPLETED: 7/1/89	
DRILLING METHODS: Hollow Augers		PAGE 3 OF 5	

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 in	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (tsf)	REMARKS
15.5	51803 1212 7-1	6	6	med. stiff (2.5Y5/4) light Olive brown silty Clay Some Sand, med. plasticity, moist med. stiff (2.5Y5/2) grayish brown sandy Clay Trace of gravel, moist	CL CL	0.75	HNU = 0 ppm α = 0 cpm βγ = 120-140 cpm
16.0	51804 1212 7-1	9	6	Stiff (2.5Y 5/2) grayish brown sandy clay/ Clayey sand, Trace of gravel, moist.	CL/SC	1.75	
16.5	51805 1212 7-1	9	5	SAA	CL/SC	1.75	
17.0	51806 1221 7-1	8	6	Very Stiff (2.5Y5/2) grayish brown Sandy Clay, Trace of gravel, med. plasticity, moist	CL	2.75	HNU = 0 ppm α = 0 cpm βγ = 180-200 cpm
17.5	51807 1221 7-1	10	3	SAA	CL	2.50	
18.0	51808 1221 7-1	11	0	NR	—	—	
18.5				BOTTOM of Boring @ 18.0 ft.			HNU = ppm α = cpm βγ = cpm
19.0							
19.5							
20.0							HNU = ppm α = cpm βγ = cpm
							HNU = ppm α = cpm βγ = cpm

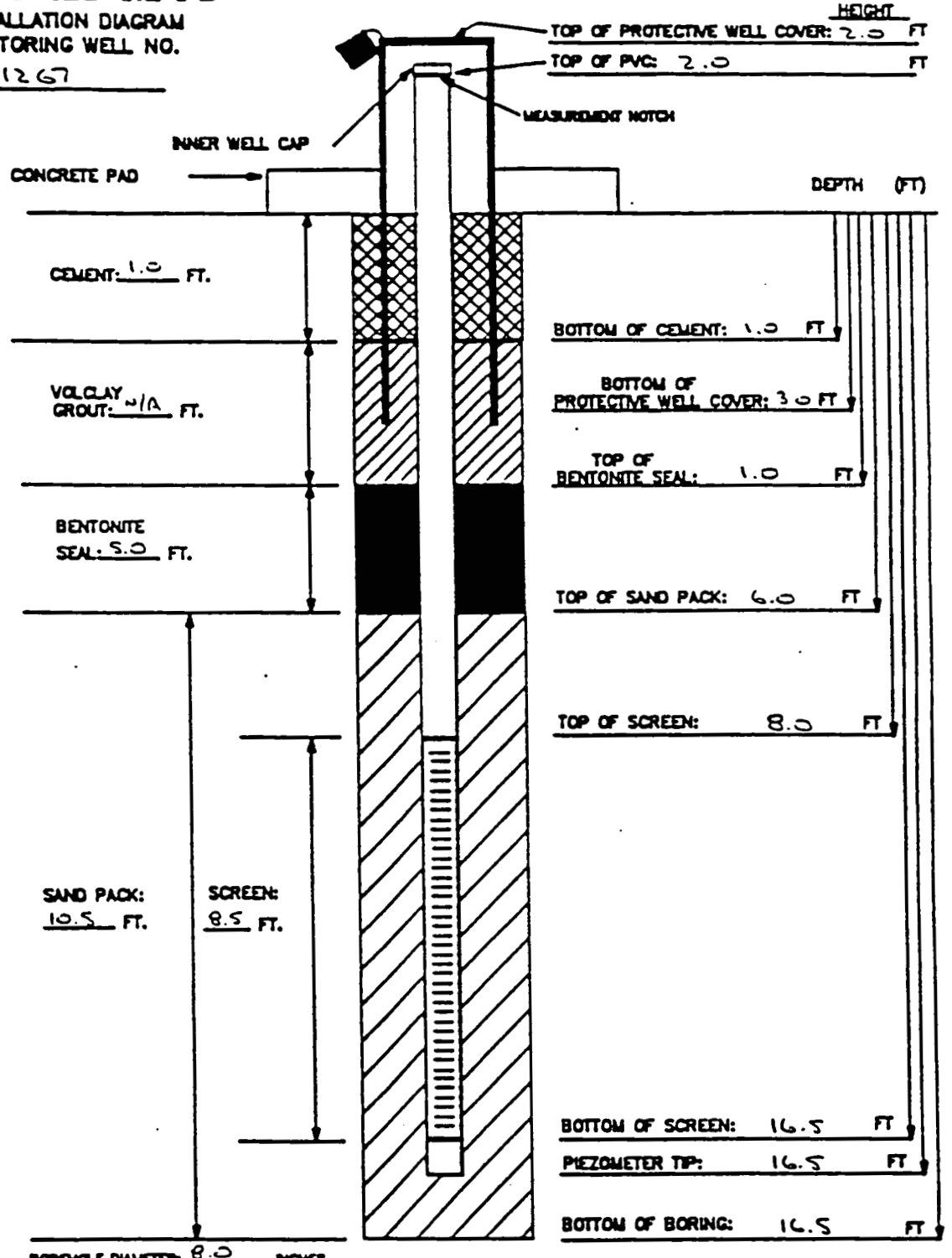
NOTES: CONTRACTOR: Penn Drill
Rig: B-53
Driller: J. Saccuni
Assistant: K. Felty
SAA = SAME AS ABOVE

Samples Collected as per ASTM Standard Penetration Test.
Colors Identified by Munsell color chart
Background Levels: HNU = 0 ppm
α = 0 cpm
βγ = 80-120 cpm
LEL = ppm
O_2 = %

INSTALLATION DATE: 06-14-89

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
#1267



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: (10-20) .4 - 80LB SACKS
BENTONITE PELLETS (5-GALLON BUCKETS): 2.5 - 5 GAL BUCKETS
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2-50 LB BAG
AMOUNT OF WATER USED: NA
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7.1

GEOLOGIST/ENGINEER: M. Sluzarski

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1183	COORDINATES:		DATE: 1/31/90
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 1/31/90
ENGINEER/GEOLOGIST: C. Grube	Depth	Date/Time	DATE COMPLETED: 2/3/90
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 1 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	1/31	NA	6	Cement	NA	NA	HNU = 0 ppm α = 140-160 cpm Bβ = 700-900 cpm
	1/31		6	Cement	NA	NA	
1	16705 1545 1-31	5	6	Loose (2.5Y 4/4) olive brown well graded sand, trace of fine to coarse gravel, wet	SW	NA	
2	16706 1545 1-31	5	6	medium stiff (5Y 4/3) olive silty clay, some sand, trace fine to coarse gravel, low plasticity, moist	CL	.75	HNU = 0 ppm α = 0 cpm Bβ = 70-80 cpm
	16707 1545 1-31	3	0	NR	NA	NA	
3	16708 1545 1-31	3	0	NR	NA	NA	
	16709 1550 1-31	5	6	Medium dense (2.5Y 4/4) olive brown well graded sand trace of fine gravel, very moist to wet	SW	NA	HNU = 0 ppm α = 0 cpm Bβ = 80-90 cpm
4	16710 1550 1-31	12	6	SAA very stiff (2.5Y 4/4) light olive brown silty clay, some sand, trace fine gravel, high plasticity, moist	SW CL	NA 3.75	
	16711 1550 1-31	11	4	Stiff SAA	CL	1.25	
5	16712 1555 1-31	11	6	medium dense (2.5Y 5/4) light olive brown well graded sand trace fine to med. coarse gravel, wet	SW	NA	HNU = 0 ppm α = 0 cpm Bβ = 80-100 cpm
	16713 1555 1-31	8	0	NR	NA	NA	
6	16714 1555 1-31	8	0	NR	NA	NA	
	16715 0946 2-1	2	6	Stiff (2.5Y 5/4) light olive brown silty clay trace of sand, medium plasticity, moist	CL	1.50	HNU = 0 ppm α = 0 cpm Bβ = 110-120 cpm
7	16716 0946 2-1	3	6	SAA	CL	1.25	
	16717 0946 2-1	4	2	SAA	CL	1.0	

NOTES: CONTRACTOR: PENN DRILL
RIG: CME-45
DRILLER: Dave Newman
ASSISTANT: Bob Johnson
Geo Assistant/H2S Officer: Ben Brier

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TE
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 60-80 CPM
Bβ = 900-1000 CPM
LEL = 0% ~~PPM~~
O_2 = 20.6%

SAA = Same As Above
NR = No Recovery

LEL O_2:

HNU # 1234

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1188	COORDINATES:	DATE: 2/1/90
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/31/90
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 2/3/90
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	16719 0952 2-1	6	6	Med. dense (2.5Y 5/4) light olive brown silty clay trace of sand & fine gravel, medium plasticity, moist	CL	.5	HNU = 0 ppm α = 0 cpm Bβ = 100-110 cpm
	16719 0952 2-1	6	6	SAA	CL	.75	
	16720 0952 2-1	8	3	Med. dense (2.5Y 5/4) light olive brown clayey silt trace of fine gravel, moist	ML	NA	
9	16721 0957 2-1	8	6	Loose (2.5Y 5/4) light olive brown clayey silt very moist to wet	ML	NA	HNU = 0 ppm α = 0 cpm Bβ = 90-100 cpm
	16722 0957 2-1	4	6	SAA	ML	NA	
10	16723 0957 2-1	3	6	NR	NA	NA	
11	16724 1010 2-1	1	6	Med. dense (2.5Y 5/4) light olive brown clayey silt to silty sand, wet	ML to SM	NA	HNU = 0 ppm α = 0 cpm Bβ = 90-110 cpm
	16725 1010 2-1	3	6	SAA	ML to SM	NA	
	16726 1010 2-1	7	6	SAA	ML to SM	NA	
12	51835 1018 2-1	2	6	Loose (10YR 5/4) yellowish brown silty sand trace of clay, wet	SM	NA	HNU = 0 ppm α = 0 cpm Bβ = 100-110 cpm
	51836 1015 2-1	4	6	Loose (2.5Y 5/4) light olive brown to (5Y 4/2) olive gray silt to silty sand, wet	ML to SM	NA	
13	51837 1018 2-1	5	6	Loose (5Y 4/2) olive gray clayey silt, very moist to wet	ML	NA	
	51838 1024 2-1	7	6	Med. dense (5Y 4/2) olive gray clayey silt to silty sand, wet	SM to ML	NA	HNU = 0 ppm α = 0 cpm Bβ = 100-120 cpm
14	51839 1024 2-1	8	6	SAA	ML to SM	NA	
	51840 1024 2-1	8	6	Med. dense (5Y 4/2) olive gray clayey silt very moist to wet	ML	NA	

0 of water
ring and
9.5 ft

NOTES:

SAA = Same As Above
NR = No Recovery

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1188	COORDINATES:	DATE: 2/1/90
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/31/90
ENGINEER/GEOLOGIST: C. Gaylor	Depth Date/Time	DATE COMPLETED: 2/3/90
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 5

DEPTH	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6"	RECOVERY 6"	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S1841 1040 2-1	2	6	Medium dense (2.5Y 4/4) light olive brown clayey silt, moist to wet	ML	NA	HNU = 0 ppm α = 0 cpm BG = 130-150 cpm
	S1842 1040 2-1	5	6	Medium dense (5Y 4/1) olive gray clayey silt to silt, wet	ML	NA	
16	S1843 1040 2-1	7	5	Medium dense (5Y 4/2) olive gray silt, wet	ML	NA	
	S1844 1047 2-1	7	6	Medium dense (2.5Y 4/4) olive brown silty sand, wet	SM	NA	HNU = 0 ppm α = 0 cpm BG = 70-80 cpm
17	S1845 1047 2-1	12	6	SAA	SM	NA	
	S1846 1047 2-1	17	6	Medium dense (2.5Y 4/4) olive brown well graded sand, trace of fine to medium gravel, wet	SW	NA	
18	S1847 1054 2-1	12	6	Dense (2.5Y 4/4) olive brown poorly graded sand trace of silt, wet	SP	NA	HNU = 0 ppm α = 0 cpm BG = 70-80 cpm
	S1848 1054 2-1	16	6	SAA	SP	NA	
19	S1849 1054 2-1	17	6	Dense (2.5Y 4/4) olive brown silty sand, wet	SM	NA	
20	S1850 1054 2-1	20	6	Dense (2.5Y 4/4) olive brown well graded gravelly sand (angular gravel) wet	SW	NA	HNU = 0 ppm α = 0 cpm BG = 70-80 cpm
				Bottom of boring at 20.0 ft			

NOTES:

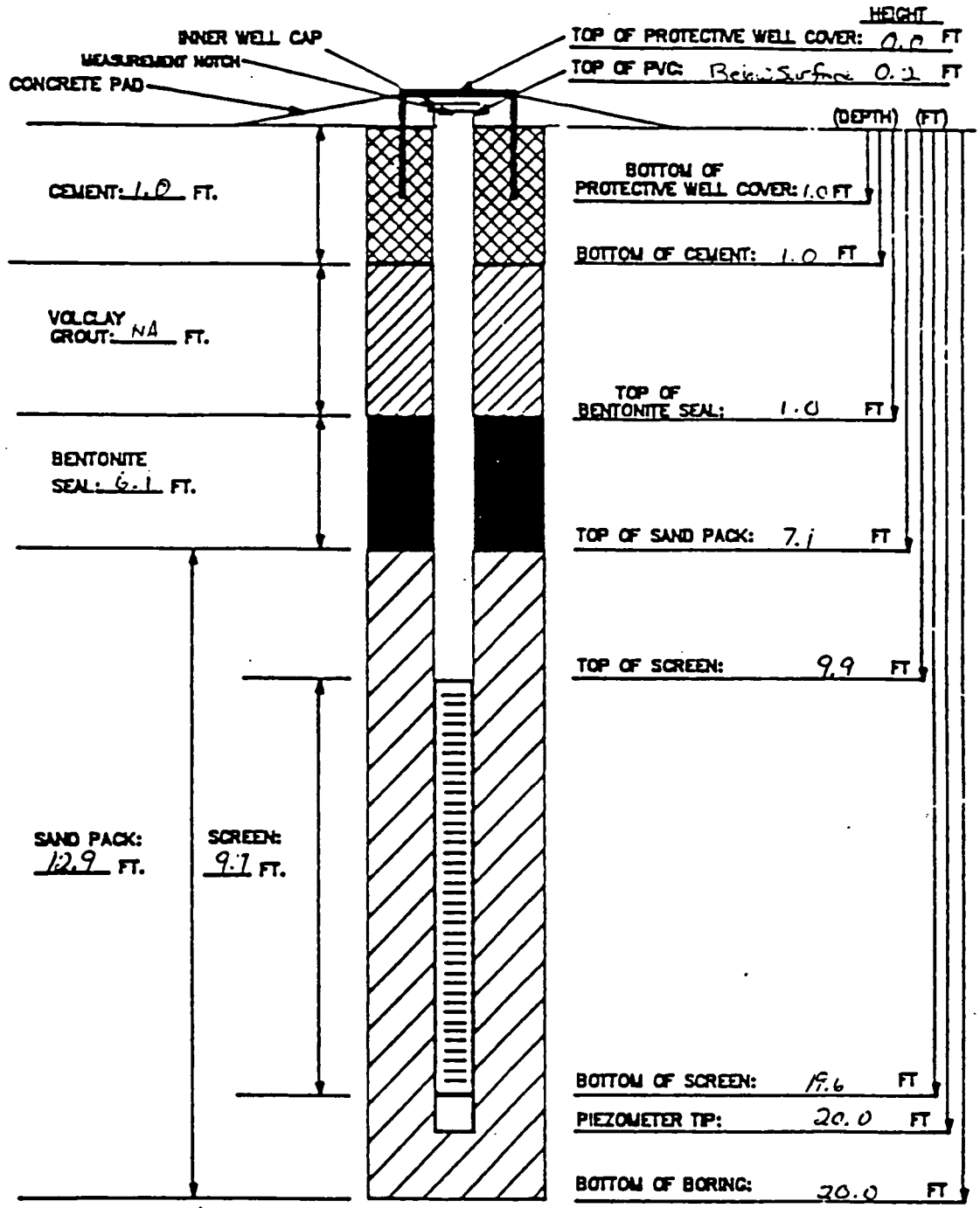
SAA = Same As Above
NR = No Recovery

000341

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1188

INSTALLATION DATE: 2-3-90



BOREHOLE DIAMETER: 15.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 6 sks (50#) 1/40 sand
BENTONITE PELLETS (5-GALLON BUCKETS): 5
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2 (94#) sk
AMOUNT OF WATER USED: 10 gal
OTHER: Flush mount protective cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1193	COORDINATES:	DATE: 11/30/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11/20/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 12/03/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	11-20	NA	6	Acid Brick & Cement	NA	NA	HNU = 0 ppm α = 0 cpm Bγ = 900-1500 cpm
	11-20 11-30		6	Cement	NA	NA	
1	16815 1022 12-1	4	6	medium stiff (2.5Y5/4) light olive brown sandy clay, trace of fine gravel, low plasticity, wet due to drilling fluid	CL	0.5	
	16816 1022 12-1	4	6	SAA	CL	0.75	HNU = 0-3 ppm α = 0-10 cpm Bγ = 100-120 cpm
2	16817 1022 12-1	6	6	SAA	CL	1.0	
	16818 1022 12-1	8	0	NR	NR	NA	
3	16819 1033 12-1	3	6	Very stiff (5Y4/1) dark gray silty clay, trace of sand & fine gravel low plasticity moist	CL	2.25	HNU = 0-3 ppm α = 0-5 cpm Bγ = 90-110 cpm
	16820 1033 12-1	9	6	SAA	CL	3.5	
4	16821 1033 12-1	14	2	SAA	CL	3.25	
	16822 1112 12-1	4	6	very stiff (10YR5/4) yellowish brown, silty clay, trace of sand & fine gravel, low plasticity, moist	CL	2.0	HNU = 20-30 ppm α = 0 cpm Bγ = 120-130 cpm
5	16823 1112 12-1	6	6	very stiff (5Y4/1) dark gray clay, trace of silt, low plasticity, moist	CL	2.5	
6	16824 1112 12-1	7	6	SAA	CL	1.75	
	16825 1455 12-1	3	6	Stiff (5Y4/2) olive gray clay, trace of silt medium plasticity, moist	CL	1.75	HNU = 0-5 ppm α = 0 cpm Bγ = 60-80 cpm
7	16826 1455 12-1	4	6	SAA	CL	1.75	
	16827 1455 12-1	7	5	SAA	CL	1.5	

NOTES: CONTRACTOR: PENNDRILL
RIG: CME-45
DRILLER: Jim Saccini
ASSISTANT: ~~Bob Jones~~ Charlie Elkowitz + Chris Coulter
Geo-Assistant: Ben Brier

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0 CPM
Bγ = 70-150 CPM
LEL/O2: LEL = 0% ~~PPM~~
O2 = 20.6%

SAA - Same As Above
NR = No Recovery

HNU # 7000 25 + 1234

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1193	COORDINATES:		DATE: 12/01/89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 11/20/89
ENGINEER/GEOLOGIST: C. Grube	Depth	Date/Time	DATE COMPLETED: 12/03/89
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	16828 1550 12-1	2	6	Stiff (10YR 5/4) yellowish brown silty clay, trace of sand & fine gravel, low plasticity moist	CL	1.5	HNU = 0 ppm α = 0 cpm Bγ = 80-90 cpm
	16829 1550 12-1	4	6	Stiff (5Y 4/2) olive gray clay, trace of silt medium plasticity moist	CL	1.75	
9	16830 1550 12-1	6	6	Very stiff (5Y 4/2) olive gray silty clay, trace of fine gravel, low plasticity moist	CL	2.25	
	16831 1607 12-1	10	6	Medium stiff (5Y 4/2) olive gray silty clay, trace of fine gravel low plasticity, moist	CL	.75	HNU = 0 ppm α = 0 cpm Bγ = 50-60 cpm
10	16832 1607 12-1	15	6	SAA	CL	.75	
	16833 1607 12-1	13	0	NR	NA	NA	
11	16834 1627 12-1	2	6	Stiff (5Y 4/2) olive gray silty clay trace of fine gravel low plasticity moist	CL	1.75	HNU = 0 ppm α = 0 cpm Bγ = 60-70 cpm
	16835 1627 12-1	6	6	medium dense (10YR 5/4) yellowish brown silty sand trace of fine gravel, wet	SM	NA	
12	16836 1627 12-1	8	0	NR	NA	NA	
	51935 1635 12-1	11	6	Medium dense (10YR 5/4) yellowish brown to (5Y 4/2) olive gray silt, some sand, wet	ML	NA	HNU = 0 ppm α = 0 cpm Bγ = 60-70 cpm
13	51936 1635 12-1	13	6	medium dense (5Y 4/2) olive silty sand, wet	SM	NA	
	51937 1635 12-1	16	6	medium dense (5Y 4/2) olive sandy silt, wet	ML	NA	
14	51938 1646 12-1	9	6	Dense SAA	ML	NA	HNU = 0 ppm α = 0 cpm Bγ = 60-70 cpm
	51939 1640 12-1	20	6	Dense (2.5Y 5/4) light olive brown poorly graded sand, trace of silt wet	SP	NA	
	51940 1640 12-1	16	0	NR	NA	NA	

End of auger boring zone 11.0 FT

NOTES:

SAA = Same As Above
NR = No Recovery

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1193	COORDINATES:	DATE: 12/01/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11/20/89
ENGINEER/GEOLOGIST: S. Grube	Depth Date/Time	DATE COMPLETED: 12/03/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 in.)	RECOVERY (in.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S1941 1700 12-1	2	6	Loose (10YR5/4) Yellowish brown sandy to clayey silt wet	ML	NA	HNU = 0 ppm α = 0 cpm BG = 80-90 cpm
16	S1942 1700 12-1	3	6	Very stiff (5Y 4/1) dark gray silty clay, some sand, trace of fine gravel / lenses of silty wet	CL	2.5	
	S1943 1700 12-1	5	6	SAA	CL	.75	
				Bottom of Boring & Sampling at 16.5 FT			HNU = α = BG =
18							HNU = α = BG =
19							
20							HNU = α = BG =

NOTES:

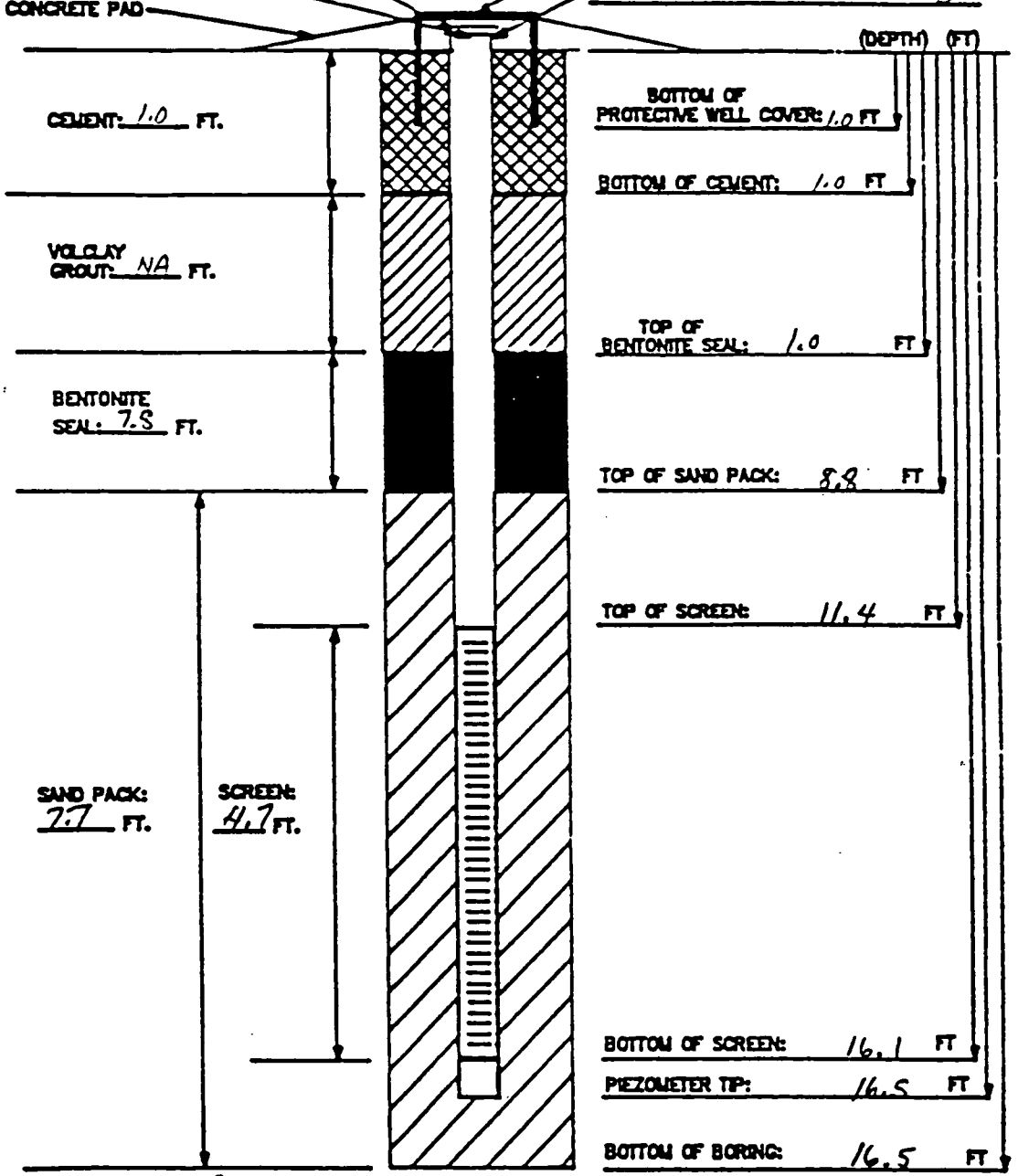
SAA = Same As Above
NR = No Recovery

000345

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1193

INSTALLATION DATE: 12/03/87



BOREHOLE DIAMETER: ~~8.0~~ 10.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand - 4 - 80 sacks
BENTONITE PELLETS (5-GALLON BUCKETS): 6 buckets
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2 (94 #) sk
AMOUNT OF WATER USED: 10 gal water
OTHER: 1 FT protective flush mount cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS. SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
2) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7 GEOLOGIST/ENGINEER: C. Grube

FERNALD
RI/FS

Field checked BD. 11/07/89

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1196	COORDINATES:	DATE: 11/07/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11/07/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 11/08/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1. OF 4

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1	11-7	NA	6	Cement	NA	NA	HNU: 0 ppm α: 0 cpm BG: Top of cement 1700 cpm Side of cement 380-390 cpm Bottom " " 190-200 cpm
	11-7		6	Cement	NA	NA	
	16881 0850 11-8	2	6	Stiff (10YR5/3) brown silty clay, trace of fine to coarse gravel, low plasticity moist	CL	2.0	
2	16882 0850 11-8	3	6	SAA	CL	1.25	HNU: 0 ppm α: 0 cpm BG: 230-240 cpm
	16883 0850 11-8	5	4	SAA	CL	1.0	
3	16884 0850 11-8	6	0	NR	NA	NA	
	16885 0857 11-8	5	6	Stiff (10YR5/4) yellowish brown silty clay, trace of fine to coarse gravel, low plasticity moist	CL	1.75	HNU: 0 ppm α: 0 cpm BG: 240-250 cpm
4	16886 0857 11-8	7	6	SAA	CL	1.75	
	16887 0857 11-8	17	6	medium dense (10YR5/4) yellowish brown clayey gravel, some sand, moist to very moist	GC	NA	
5	16888 0904 11-8	5	6	SAA very stiff (5Y3/1) very dark gray clay, trace of silt, low plasticity, moist	GC CL	NA 3.5	HNU: 0 ppm α: 0-10 cpm BG: 250-260 cpm
	16889 0904 11-8	7	6	SAA	CL	3.25	
6	16890 0904 11-8	13	3	SAA	CL	3.25	
	16891 0920 11-8	2	6	SAA	CL	3.0	HNU: 0 ppm α: 0 cpm BG: 220-230 cpm
7	16892 0920 11-8	5	6	Stiff (5Y4/2) olive gray clay, trace of silt, low plasticity, moist	CL	1.5	
	16893 0920 11-8	7	4	SAA	CL	2.0	

NOTES: CONTRACTOR: PENN DRILL
RIG: CME-45
DRILLER: Dave Newman
ASSISTANT: Bob Johnson
Geo Assistant: Ben Brier

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0-5 CPM
BG: 240-330 CPM
LEL/O_2: LEL: 0%
O_2: 20.6%

SAA = Same As Above
NR = No Recovery

HNU = 1234

000347

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1196	COORDINATES:	DATE: 11/08/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11/07/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 11/08/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	16894 0924 11-8	7	6	very stiff (2.5Y4/2) dark grayish brown clay trace of silt. low plasticity moist	CL	2.5	HNU = 0 ppm α = 0 cpm BG = 250-260 cpm
	16895 0934 11-8	9	6	Stiff SAA	CL	1.5	
9	16896 0934 11-8	12	0	NR	NA	NA	
	16897 0937 11-8	7	6	SAA (8.0-8.5 FT)	CL	1.5	HNU = 0 ppm α = 0-10 cpm BG = 260-270 cpm
10	16898 0937 11-8	13	6	medium dense (2.5Y.5/4) light olive brown clayey silt, moist	ML	NA	
water	16899 0937 11-8	15	2	SAA	ML	NA	
11	16900 0953 11-8	3	6	Loose (2.5Y5/4) light olive brown clayey silt very moist	ML	NA	HNU = 0 ppm α = 0 cpm BG = 180-190 cpm
	16901 0953 11-8	3	6	SAA	ML	NA	
12	16902 0953 11-8	5	6	SAA	ML	NA	
	51995 0958 11-8	9	6	medium dense (2.5Y5/4) Light olive brown clayey silt very moist to wet	ML	NA	HNU = 0 ppm α = 0 cpm BG = 240-260 cpm
13	51996 0958 11-8	10	6	SAA	ML	NA	
	51997 0958 11-8	10	6	SAA plus trace of sand	ML	NA	
14	51998 1001 11-8	10	6	medium dense (2.5Y5/4) light olive brown clayey silt wet	ML	NA	HNU = 0 ppm α = 0 cpm BG = 230-240 cpm
	51999 1001 11-8	10	6	medium dense (2.5Y5/4) light olive brown clayey silt very moist	ML	NA	
water zone at 14.8 FT	52000 1001 11-8	15	6	SAA	ML	NA	
				Stiff (5Y5/3) olive gray silty clay, high plasticity moist	CL	1.5	

NOTES:

* Bottom of Boring & Sampling at 15.0 FT

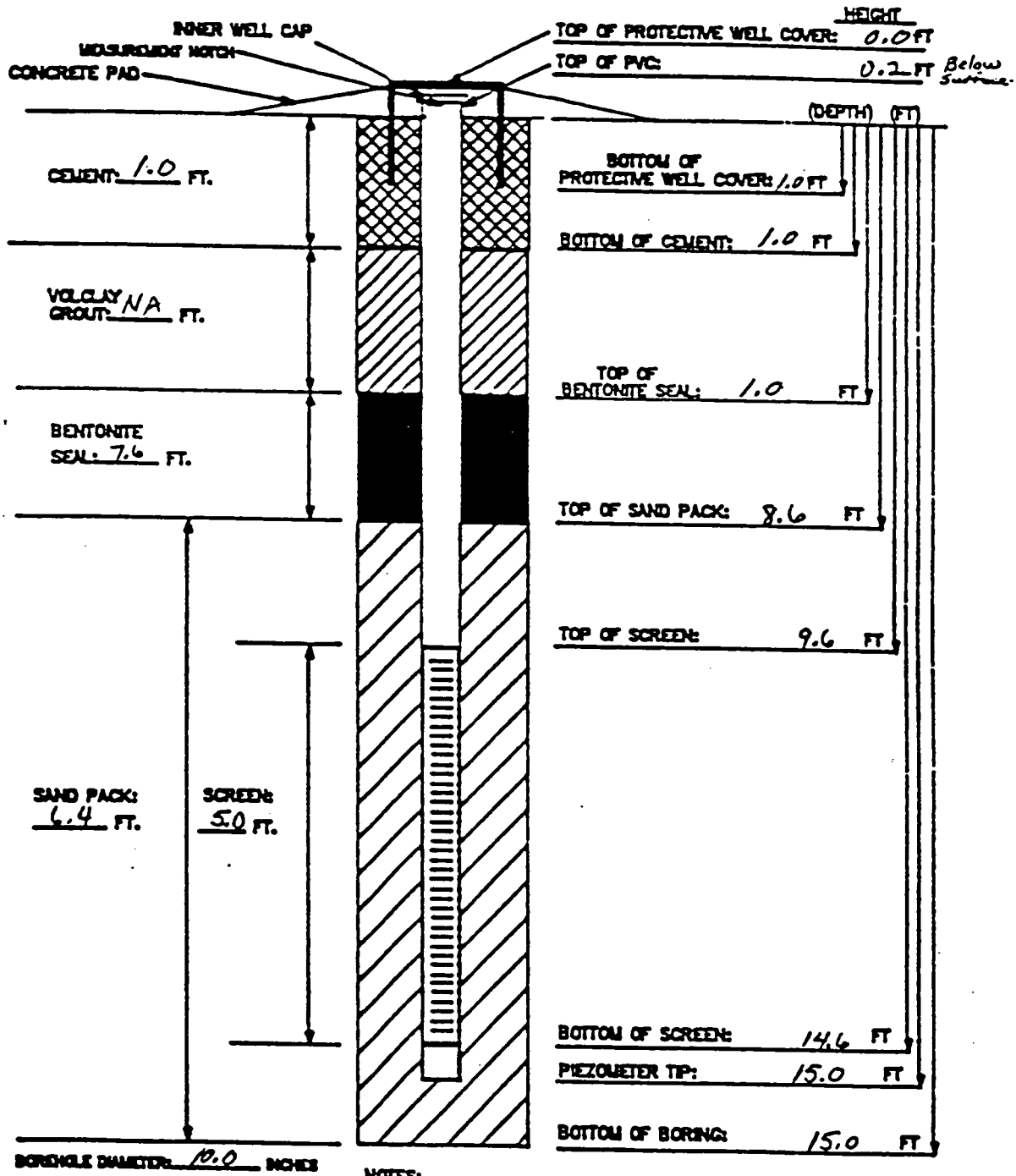
SAA = Same As Above

NR = No Recovery

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1196

INSTALLATION DATE: 11/09/89



BOREHOLE DIAMETER: 10.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand - 2 (50 lbs)
BENTONITE PELLETS (5-GALLON BUCKETS): 2½
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: ½ sack (94#)
AMOUNT OF WATER USED: 10 gal
OTHER: 1 FT Flush mount cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESIS INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7 GEOLOGIST/ENGINEER: C. Grube

	Field Check	1st Key In	2nd Key In	Hard Copy Verification
7/2/89				

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1198	COORDINATES:	DATE: 6/2/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6/2/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 6/2/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN.	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	16925 1455 6-2	10	6	VERY DENSE (2.5y, 5/2) grayish brown clayey gravel, trace sand slightly moist	GC	NA	HNU: 1 ppm α: 0 cpm Bβ: 80-100 cpm
1	16926 1455 6-2	22	6	Very Dense (10yr, 5/3) Brown clayey sand, trace fine to med gravel, slightly moist	SC	NA	
	16927 1455 6-2	35	3	SAA very moist	SC	NA	
2	16928 1500 6-2	10	6	Very stiff (10yr 5/3) brown to (2.5y, 3/0) very dark gray, gravelly clay, slightly moist, trace sand	CL	2.5	HNU: 0 ppm α: 0 cpm Bβ: 60-80 cpm
	16929 1500 6-2	3	6	Stiff (5y, 4/3) olive, clay trace fine gravel, low plasticity, moist	CL	1.75	
	16930 1500 6-2	5	0	NR	NA	NA	
3	16931 1504 6-2	5	6	STIFF (5y, 5/3) olive sandy clay, trace fine gravel, low plasticity, moist	CL	1.0	HNU: 0 ppm α: 0 cpm Bβ: 50-70 cpm
	16932 1504 6-2	7	6	STIFF (2.5y, 4/2) dark grayish brown, silty clay, trace sand, low plasticity, moist	CL	1.25	
4	16933 1504 6-2	8	6	STIFF ( ) SAA	CL	1.0	
	16934 1507 6-2	8	6	very soft (2.5y, 4/2) dark grayish brown, clay, trace sand & fine gravel moist, low plasticity	CL	<.25	HNU: 0 ppm α: UK ← Alpha meter not working correctly Bβ: 100-120 cpm
5	16935 1507 6-2	7	6	Stiff (2.5y, 4/2) dark grayish brown clay (silty), trace sand and fine gravel, low plasticity, moist	CL	1.75	
	16936 1507 6-2	7	6	med. Stiff ( ) SAA	CL	.75	
6	16937 1510 6-2	4	6	very soft (2.5y, 4/2) dark grayish brown silty clay, trace sand, low plasticity, moist med Dense (2.5y 4/2) dark grayish brown gravelly clay, some sand, very moist	CL GC	<.25	HNU: 0 ppm α: UK Bβ: 100-120 cpm
	16938 1510 6-2	3	6	med stiff (5y, 5/3) olive sandy clay low plasticity, very moist	CL	.5	
7	16939 1510 6-2	2	0	NR	NA	NA	

NOTES: CONTRACTOR: PENNDRILL
RIG: Model 80
DRILLER: Craig Coulter
ASSISTANT: Chris Coulter
Geo Assistant: Cindy Melroy

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0 CPM
Bβ = 40-80 CPM
LEL: 0% 6/2/89
O_2: 20.6%

SAA = Same As Above
NR = No Recovery
LEL O_2:

HNU # 00221

000350

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1198	COORDINATES:	DATE: 6/2/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6/2/89
ENGINEER/GEOLOGIST: C. Gaube	Depth Date/Time	DATE COMPLETED: 6/2/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 4

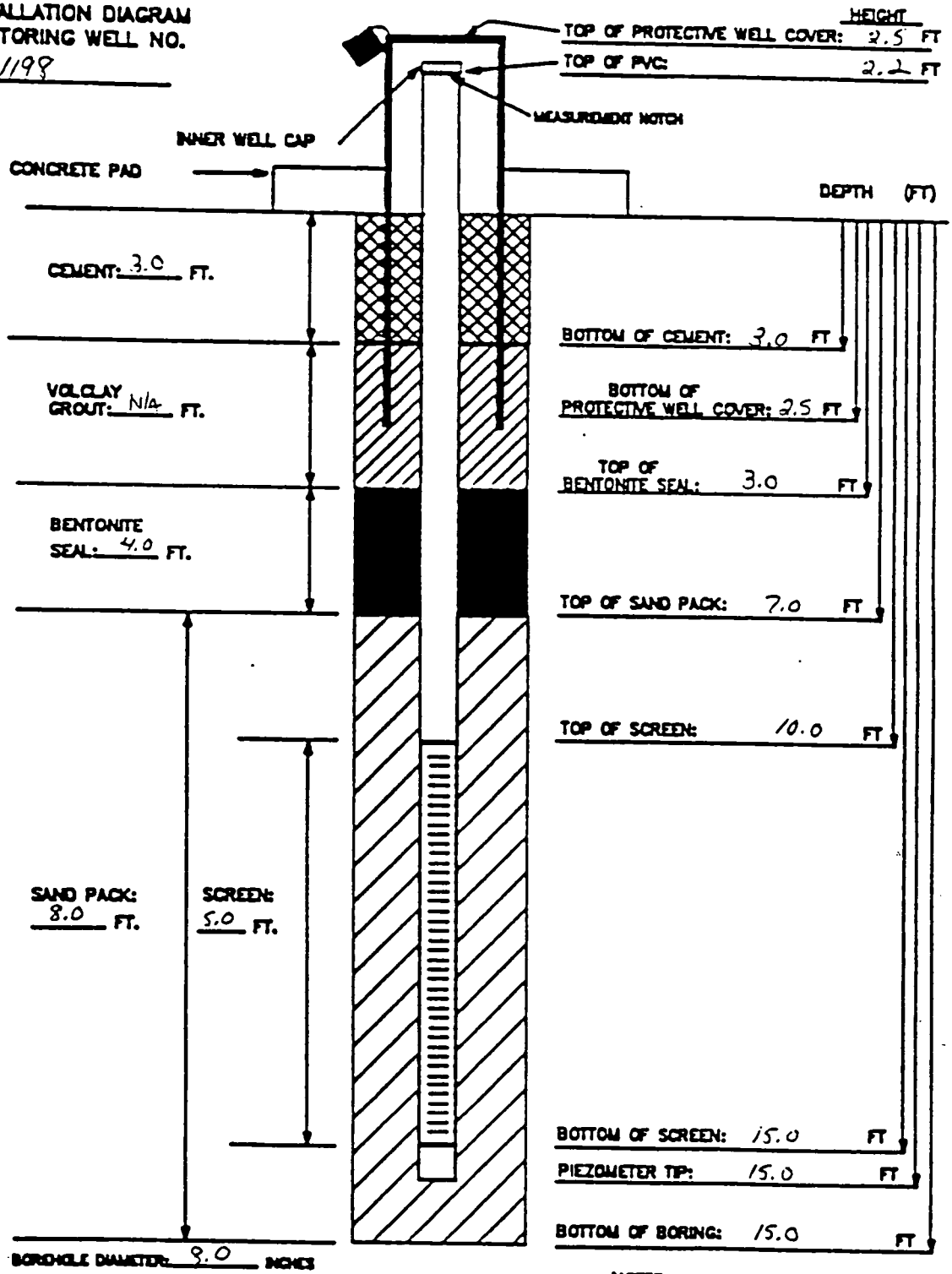
DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	16940 1515	5	6	Very Soft (2.5y 4/2) dark grayish brown silty clay, some sand, moist, med plasticity	CL	<.25	HNU = 0 ppm α = UK BG = 60-80 cpm
	16941 1515	4	3	Med Stiff (5y 5/3). olive sandy clay, low plasticity, trace fine gravel	CL	.75	
9	16942 1515	9	0	NR	NA	NA	
	16943 1550 6-2	4	6	Med Stiff (2.5y 4/2) Dark grayish brown sandy clay, med plasticity, moist	CL	.5	HNU = 0 ppm α = UK BG = 50-60 cpm
10	16944 1550 6-2	2	0	NR	NA	NA	
	16945 1550 6-2	½	0	NR	NA	NA	
11	16946 1556 6-2	4	6	Very Soft (2.5y 4/4) olive brown sandy clay, to (5y 4/1) dark gray sandy clay, low plasticity, very moist	CL	<.25	HNU = 0 ppm α = UK BG = 80-90 cpm
	52035 1556 6-2	3	6	LOOSE (2.5y 5/6) light olive brown to (2.5y 5/2 grayish brown, silt, some sand wet	ML	NA	⇐ WET
12	52036 1556 6-2	2	2	LOOSE (2.5y 4/4) olive brown clayey sand, trace fine gravel wet	SC	NA	⇐ WET
	52037 1558 6-2	7	6	SOFT (2.5y 4/2) dark grayish brown sandy clay, trace silt and fine gravel low plasticity, very moist	CL	.25	HNU = 0 ppm α = UK BG = 80-90 cpm
13	52038 1558 6-2	8	6	M. Dense (5y 4/4) olive, clayey sand some silt, trace fine gravel, very wet	SC	NA	⇐ VERY WET
	52039 1558 6-2	9	6	M. Dense (2.5y 5/4) olive brown sandy gravel, very wet (16in) well graded	GP	NA	
				M. Dense (5y 4/2) olive gray, clayey silt trace fine gravel, very moist	ML	NA	
	52040 1600 6-2	7	6	M. Dense (5y 4/3) olive clayey gravel, trace sand, very wet	GC	NA	HNU = 0 ppm α = UK BG = 60-80 cpm ⇐ very wet
	52041 1600 6-2	9	6	Very Stiff (5y 4/3) olive, sandy clay moist, low plasticity	CL	2.75	
	52042 1600 6-2	13	6	STIFF (5y 5/2) olive gray, gravelly clay some sand, low plasticity, moist	CL	2.0	

NOTES:

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1198

INSTALLATION DATE: 1-2-7



MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 sand - 3 (80#) sacks
BENTONITE PELLETS (5-GALLON BUCKETS): 1½ bucket
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1 (94#) sack
AMOUNT OF WATER USED: 20 gal.
OTHER: 5.0 FT Protective casing

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube

	Initial	Date
Field Check	E.T.	2/6/90
1st Key In		
2nd Key In		
Hard Copy Verification		

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07	PROJECT NAME: FMPC RI/FS - (Facility Testing Program)		
BORING NUMBER: 1204	COORDINATES:	DATE: 01-04-90	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 01-04-90	
ENGINEER/GEOLOGIST: M. GARMAN	Depth Date/Time	DATE COMPLETED: 01-04-90	
DRILLING METHODS: HOLLOW STEM AUGER(SPLIT SPOON SAMPLING)		PAGE 1 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6-Inches	RECOVERY (Inch)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0.5	17057 01-04 0930	NA	NA	CONCRETE	NA	NA	Hnu = 0
1.0	17058 01-04 0930	NA	NA	CONCRETE	NA	NA	α = 0
1.5	17059 01-04 0950	3	6	VERY STIFF (5Y, 3/2) DARK OLIVE GRAY MOTTLED CLAY. SLIGHTLY MOIST. HIGH PLASTICITY.	CL	3.0	βB = 200 - 300 cpm.
2.0	17060 01-04 0950	7	6	SAA	CL	3.0	Hnu = 0
2.5	17061 01-04 0950	5	0	NO RECOVERY	NA	NA	α = 0
3.0	17062 01-04 0950	9	0	NO RECOVERY	NA	NA	βB = 200-300 cpm
3.5	17063 01-04 0954	8	6	STIFF (2.5Y, 4/0) DARK GRAY SILTY CLAY (MOTTLED). HIGH PLASTICITY. SLIGHTLY MOIST.	CL	1.0	Hnu = 0
4.0	17064 01-04 0954	8	4	SAA	CL	1.5	α = 0
4.5	17065 01-04 0954	10	0	NO RECOVERY	NA	NA	βB = 180-220 cpm.
5.0	17066 01-04 0955	9	6	VERY STIFF (2.5Y, 4/0) DARK GRAY MOTTLED CLAY. MEDIUM PLASTICITY. SLIGHTLY MOIST.	CL	2.0	Hnu = 0
5.5	17067 01-04 0955	12	6	SAA	CL	2.0	α = 0
6.0	17068 01-04 0955	13	2	SAA	CL	2.0	βB = 220 cpm.
6.5	17069 01-04 1000	3	6	STIFF (2.5Y, 4/2) DARK GRAYISH BROWN, TRACE OF COARSE SAND, MEDIUM PLASTICITY, SLIGHTLY MOIST.	CL	1.5	Hnu = 0
7.0	17070 01-04 1000	5	6	VERY STIFF (5.0Y, 4/1) DARK GRAY MOTTLED CLAY, MEDIUM PLASTICITY, SLIGHTLY MOIST.	CL	2.5	α = 0
7.5	17071 01-04 1000	7	2	SAA	CL	2.5	βB = 200 cpm.

NOTES: Contractor : Pennsylvania Drilling
Driller : J. SACCANI
Drillers Assistant: C. COULTER
All Samples collected according to ASTM Standards Soil Colors Described by Munsell Soil Color Charts.

Background Readings/Levels
Hnu = 0 ppm.
Alpha (α) = 0 ppm
Unfilm. Beta = 300-500 cpm.

000353

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07	PROJECT NAME: FMPC: RI/FS Facility Testing)		
BORING NUMBER: 1204	COORDINATES:		DATE: 01-04-90
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 01-04-90
ENGINEER/GEOLOGIST: M. GARMAN	Depth	Date/Time	DATE COMPLETED: 01-04-90
DRILLING METHODS: HOLLOW STEM AUGER - (Split Spoon Sampling)			PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 (in.)	RECOVERY (in.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8.0	17072 01-04 1004	5	6	SAA	CL	2.0	Hmm = 0 α = 0 ΣB = 200 cpm.
8.5	17073 01-04 1004	6	6	SAA	CL	2.0	
9.0	17074 01-04 1004	12	0	NO RECOVERY	NA	NA	
9.5	17075 01-04 1010	3	6	STIFF (5Y, 4/2) OLIVE GRAY SILTY CLAY. TRACE OF GRAVEL. MEDIUM PLASTICITY. SLIGHTLY MOIST.	CL	1.5	Hmm = 0 α = 0 ΣB = 240 cpm.
10.0	17076 01-04 1010	5	6	VERY STIFF (2.5Y, 5/2) GRAYISH BROWN MOTTLED CLAY. HIGH PLASTICITY. SLIGHTLY MOIST.	CL	2.0	
10.5	17077 01-04 1010	4	6	SAA	CL	2.0	
11.0	17078 01-04 1119	3	6	VERY STIFF (10YR, 5/3) BROWN SILTY CLAY, LOW PLASTICITY. SLIGHTLY MOIST.	CL	3.0	Hmm = 0 α = 0 ΣB = 220 cpm.
11.5	52135 01-04 1119	5	6	SAA	CL	2.5	
12.0	52136 01-04 1119	7	3	SAA	CL	3.5	
12.5	52137 01-04 1121	3	6	STIFF (10YR, 5/3) BROWN SILTY CLAY, TRACE OF VERY FINE SAND, MEDIUM PLASTICITY SLIGHTLY MOIST	CL	2.0	Hmm = 0 α = 0 ΣB = 160-180 cpm.
13.0	52138 01-04 1121	5	6	SAA + MOIST	CL	1.5	
13.5	52139 01-04 1121	6	0	NO RECOVERY	NA	NA	
14.0	52140 01-04 1125	9	6	STIFF (10YR, 5/2) BROWN SILTY CLAY, TRACE OF VERY FINE SAND, MEDIUM PLASTICITY, MOIST.	CL	1.5	Hmm = 0 α = 0 ΣB = 210 cpm.
14.5	52141 01-04 1125	10	6	MEDIUM DENSE (2.5Y, 5/4) LIGHT OLIVE BROWN CLAYEY SILT, SOME FINE SAND. VERY MOIST.	ML	NA	
15.0	52142 01-04 1125	12	0	NO REOVERY	NA	NA	

NOTES:

SEE PAGE 1

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07	PROJECT NAME: FMPC RI/FS - (Facility Testing Program)		
BORING NUMBER: 1204	COORDINATES:	DATE: 01-04-90	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 01-04-90	
ENGINEER/GEOLOGIST: M. GARMAN	Depth Date/Time	DATE COMPLETED: 01-04-90	
DRILLING METHODS: HOLLOW STEM AUGER - (Split Spoon Sampling)		PAGE 3 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15.5	52143 01-04 1135	6	6	SAA + WET	ML	NA	Ham = 0 α = 0 γB = 200 cpm.
H_2O 16.0	52144 01-04 1135	3	6	SAA	ML	NA	
ZONE 16.5	52145 01-04 1135	9	0	NO RECOVERY	NA	NA	
17.0	52146 01-04 1137	7	6	MEDIUM DENSE (2.5Y, 5/4) LIGHT OLIVE BROWN CLAYEY SILT. SOME FINE SAND. WET.	ML	NA	Ham = 0 α = 0 γB = 200 cpm.
17.5	52147 01-04 1137	8	6	SAA	ML	NA	
18.0	52148 01-04 1137	8	6	STIFF (2.5Y, 4/2) DARK GRAYISH BROWN SILTY CLAY. SOME SAND AND FINE GRAVEL. MEDIUM PLASTICITY. MOIST.	CL	2.0	
18.5	52149 01-04 1153	7	6	SAA	ML	NA	Ham = 0 α = 0 γB = 220 cpm.
19.0	52150 01-04 1153	7	MG. 0 ~~6~~	NO RECOVERY	NA	NA	
19.5	52151			BOTTOM OF BORING PIEZOMETER INSTALLED BOTTOM OF BORING @ 19.0 FT KT 2-1-90			
20	52152						Ham = α = γB =

NOTES:

SEE PAGE 1

15.0 FT - BEGIN H_2O ZONE

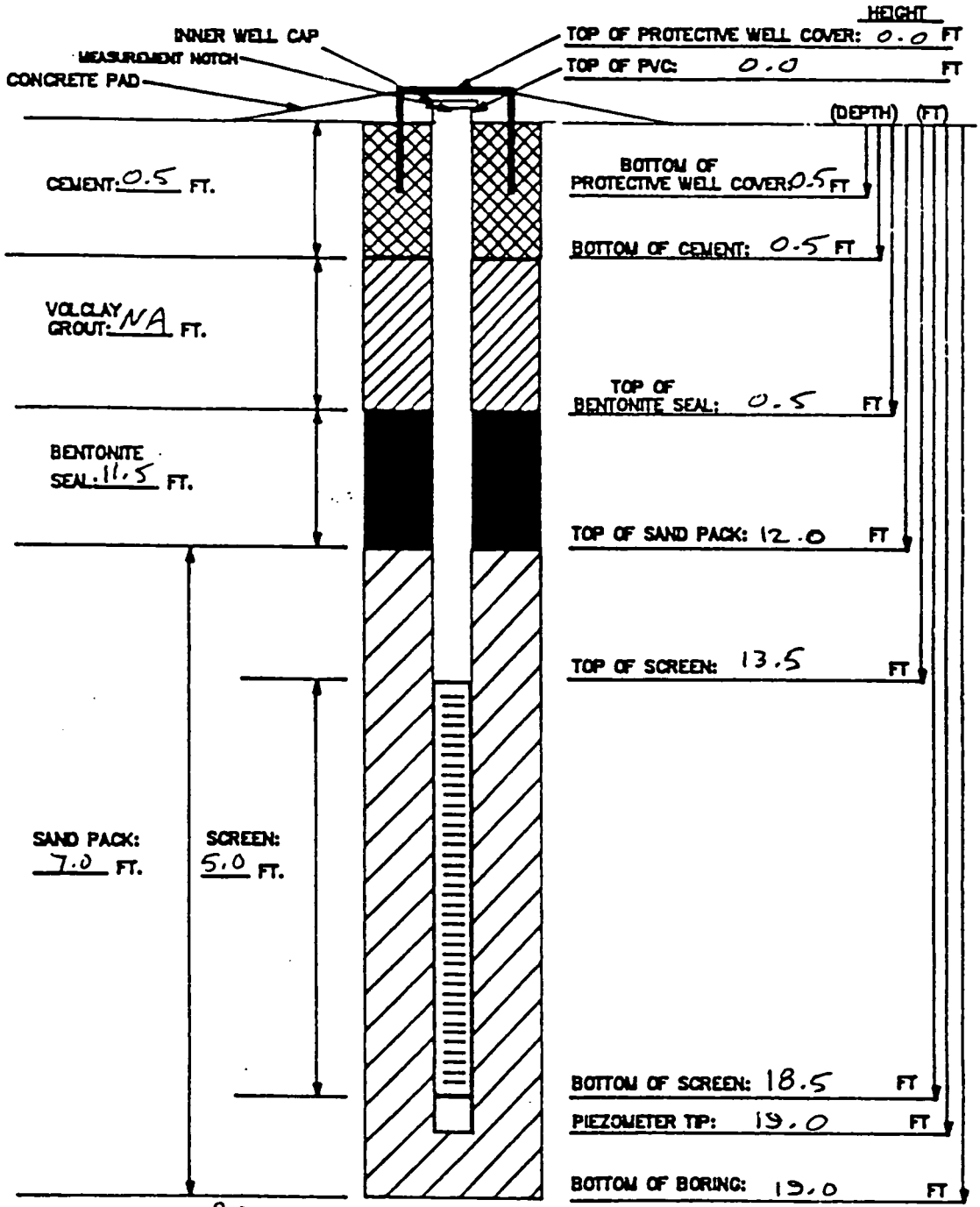
17.5 FT. - END H_2O ZONE

000355

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1204

INSTALLATION DATE: 01-04-90



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: (1020) 2 80 lb. sacks
BENTONITE PELLETS (5-GALLON BUCKETS): 0
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT:
AMOUNT OF WATER USED: 5 gal.
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 03.07.01 GEOLOGIST/ENGINEER: [signature]

Date	7/21/89			
Initial	[illegible]			
Field Check	1st Rev'n	2nd Rev'n	Hard Copy Verification

FERNALD RI/FS

Note: Log starts at Base of Concrete Slab at 0.7 feet depth.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1205	COORDINATES:	DATE: 6-3-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-3-89
ENGINEER/GEOLOGIST: L. Sinfield	Depth Date/Time	DATE COMPLETED: 6-3-89
DRILLING METHODS: B-45 Rig: Hollow Stem Augers with Split Spoon Sampler		PAGE 1 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				Start of Core = Bottom of Concrete Slab = 0.7 ft thick. Concrete ~~at Surface to~~ 0-7 ft deep (Sample # 52163) @ 0900			Start = 830
0.5	17079 wmco	2	8in	Very stiff, dark gray, (5Y, 4/1) Lean clay with silt, moist, massive, medium plastic.	CL	2.6 ↓ 2.2 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 200-240 cpm
1.0	17080	3					
1.5	17081 NR	4		@ 0915			
2.0	17082	4	8in	Very stiff, mottled Dark gray (5Y, 4/1) to pale yellow (5Y, 7/3) Lean Clay, moist, medium plastic, massive	CL	2.2 ↓ 2.8 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 180-280 cpm
2.5	17083 wmco	6					
3.0	17084 NR	7		@ 0920			
3.5	17085 NR	6	12in	Soft to medium stiff to very stiff, mottled Dark gray (5Y 4/1) to pale Yellow (5Y, 7/3) Lean Clay, moist, medium plastic, massive	CL	2.2 ↓ 0.4 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 100-130 cpm
4.0	17086	7					
4.5	17087	8		@ 0925			
5.0	17088	8	18in	Very stiff, mottled Very Dark Gray (5Y, 5/1) Lean Clay, dry medium plastic, massive	CL	2.2 ↓ 3.1 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 100-120 cpm
5.5	17089 wmco	10					
6.0	17090	14		@ 0930			
6.5	17091	8	18in	Very Stiff, Dark Gray (5Y, 7/3), dry, medium plastic massive Lean clay with rare Sand and Gravel	CL	2.0 ↓ 2.3 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 100-120 cpm
7.0	17092	8					
7.5	17093	10		@ 1020			

NOTES: Contractor: Penn Drill
Driller: D. Newman
Helper: W. Anderson
Sample Tech: D. Foster
Weather: WARM - partially Cloudy - 85 F
HNU #: 905513 10.2 EV Probe
NR = No Recovery, No Sample Taken

Log starts at Base of Concrete Slab at 0.7 ft depth

Background @ 0830
HNU = Ø ppm
Air α = Ø cpm
Air Bγ = 100-180 cpm
Gnd α = Ø cpm
Gnd Bγ = 140-180 cpm

Note: Concrete is highly fractured

100035

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.71	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1205	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6-3-89
ENGINEER/GEOLOGIST: L. Sinfield	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS: See page 1 of 4		PAGE 2 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8.5 / 8.0	17094 DD	7	8 in	Very Stiff, mottled Gray (10YR, 5/1) to Brownish yellow (10YR, 6/8) Lean Clay, massive, dry, medium plastic, Silty in places	CL	2.0 ↓ 2.2 TSF	Start= HNU= Ø ppm; α= Ø cpm; BG= 100-120 cpm
8.5	17095	12					
	17096	15		Base = Silt, Gray, dry @1030			
9.0 / 9.5	17097 NR	17	6 in	Stiff to Very Stiff, mottled light Gray (10YR, 7/1) to yellow (10YR, 7/6) Lean Clay with Silt, dry to moist medium plastic massive	CL	1.5 ↓ 3.5 TSF	HNU= Ø ppm; α= Ø cpm; BG= 100-120 cpm
9.5 / 10.0	17098 NR	19					
	17099	20		@1035			
10.5	17100	4	18 in	Same as Above 9.0-10.5ft 11.0ft	CL	3.5	HNU= Ø ppm; α= Ø cpm; BG= 100-120 cpm
11.0	52157	5		Loose, Brownish Yellow (10YR, 6/6) WET, Silt with Clay, massive	ML	N/A	
11.5	52156	9		@1045		TSF	
12.0	52157	3	18 in	Loose, Brownish Yellow (10YR, 6/6) WET, Silty Sand, massive, Coarse Sand.	SM	N/A	HNU= Ø ppm; α= Ø cpm; BG= 100-120 cpm
12.5	52158	7					
13.0	52159	4		@1050		TSF	
13.5	52160	4	18 in	Same as above 12.0-13.5ft 14.5	SM	N/A	HNU= Ø ppm; α= Ø cpm; BG= 100-120 cpm
14.0	52161	5					
14.5 / 14.5ft	52162	5		Stiff, Gray (10YR, 4/1), Silty gravelly Clay, dry, massive, med. plastic @1100	CL	1.5 TSF	
15.0							

Water Bearing Zone

NOTES: Contractor: Driller: Helper: Sample Tech: Weather: HNU #:

TD = 15.0 ft

See page 1 of 4

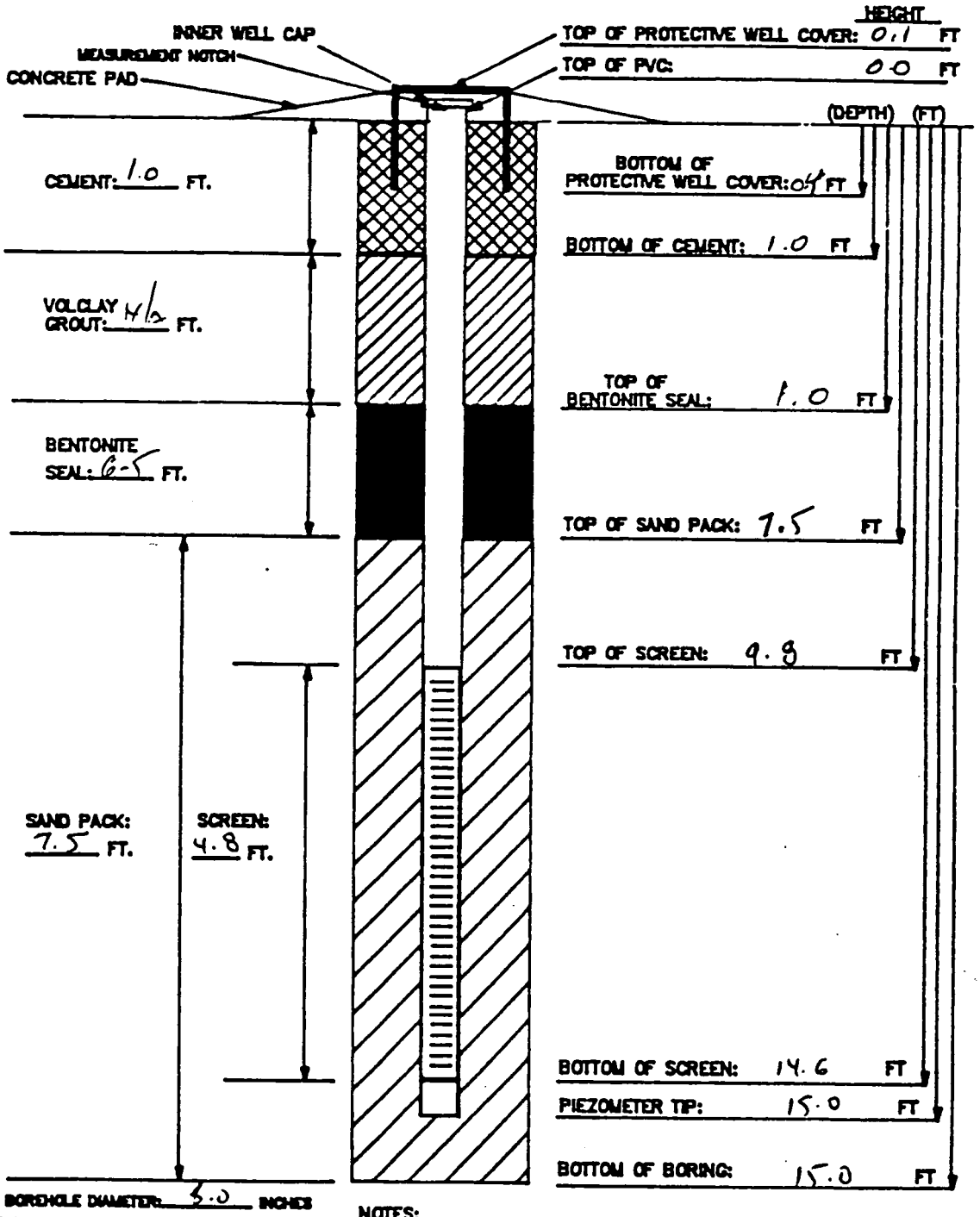
6-3-89 Background @1100
HNU= Ø ppm
Air α= Ø cpm
Air BG= 100-100 cpm
gnd α= Ø cpm
gnd BG= 140-180 cpm

NR = No Recovery, No Sample Taken

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1205

INSTALLATION DATE: 6-3-89 / 6-3-89



MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 - 3 Bags
BENTONITE PELLETS (5-GALLON BUCKETS): 3 buckets
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1/2 Bag
AMOUNT OF WATER USED: 10 gallons
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESIS INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7.1 GEOLOGIST/ENGINEER: L. Sintfield

FERNALD RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1208	COORDINATES:	DATE: 5-31-89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-31-89	
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 5-31-89	
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	17145 1008 5-31	10	6	Medium Dense clayey gravel (surface) trace sand (10y 5/3) Brown dry	GC	NA	HNU: 0 ppm α: 0 cpm Bγ: 500 cpm
1	17146 1008 5-31	9	6	HARD (10yr, 5/4) yellowish brown sandy clay, trace fine gravel, low plasticity, dry	CL	4.5	
	17147 1008 5-31	8	3	SAA	CL	4.5	
2	17148 1020 5-31	4	6	~~Medium~~ Very Stiff SAA slightly moist	CL	3.25	HNU: 0 ppm α: 0 cpm Bγ: 120-140 cpm
	17149 1020 5-31	8	5	Medium stiff (5y 4/4) OLIVE SANDY CLAY, low plasticity, slightly moist	CL	.5	
3	17150 1020 NR	11	0	NR	NA	NA	
	17151 1022 5-31	11	6	Very Stiff (2.5y, 5/4) light olive brown SANDY CLAY, TRACE FINE GRAVEL, low plasticity, slightly moist	CL	2.75	HNU: 0 ppm α: 0 cpm Bγ: 120→150 cpm
4	17152 1022 5-31	14	6	STIFF (10yr 3/3) Dark Brown silty clay, low plasticity, slightly moist	CL	1.75	
	17153 1022 5-31	13	4	STIFF (10yr 3/2) very dark greyish brown sandy clay, low plasticity, moist	CL	1.0	
5	17154 1041 5-31	4	6	medium stiff (10YR 4/2) dark grayish Brown, sandy clay, medium plasticity, moist	CL	.5	HNU: 0 ppm α: 0 cpm Bγ: 140-160 cpm
	17155 1041 5-31	4	5	Stiff, (2.5Y 4/2) dark grayish brown, silty clay, trace of sand, medium plasticity, moist	CL	1.0	
6	17156 1041 NR	4	0	NR	N/A	N/A	
	17157 1044 5-31	6	6	SOFT (2.5y, 4/4) olive brown sandy clay, trace fine gravel, medium plasticity, moist	CL	.25	HNU: 0 ppm α: 0 cpm Bγ: 100-120 cpm
7	17158 1044 5-31	6	4	SOFT (2.5y 4/2) dark greyish brown sandy clay, trace fine gravel, medium plasticity, moist	CL	.25	
	17159 1044 NR	7	0	NR	NA	NA	

NOTES: CONTRACTOR: PENN DRILL
RIG: Model 80
DRILLER: Craig Coulter
ASSISTANT: Chris Coulter
Geo. Assistant: Cindy Melroy

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α: 0 CPM
Bγ: 100-140 CPM

SAA = Same As Above
NR = No Recovery
LEL/O_2: LEL: 0% ~~PPM~~ @ 5/31/89
O_2: 20.6 %

HNU = 00221

000360

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1208	COORDINATES:	DATE: 05/31/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 05/31/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: [illegible]
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN.	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	17160 1049 5-31	2	6	Very loose (10yr, 5/4) yellowish brown poorly graded gravelly sand, very wet	SP	NA	HNU = 0 ppm ⇐ VERY WET; α = 0 cpm; Bβ = 200-240 cpm ⇐ WET
	17161 1049 5-31	2	6	Very loose (10yr, 5/4) yellowish brown clayey sand, trace fine gravel, wet	SC	NA	
9	17162 1049 NR	1	0	NR	NA	NA	
	17163 1125 5-31	1	6	SAA (8.0-8.5ft)	SC	NA	HNU = 0 ppm ⇐ WET; α = 0 cpm; Bβ = 120-140 cpm ⇐ WET
10	17164 1125 5-31	1	4	SAA (~~8.0-8.5 ft~~) poorly graded gravelly sand	SP	NA	
	17165 1125 NR	1	0	NR	NA	NA	
11	17166 1130 5-31	8	6	Medium Dense (2.5y 4/2) well graded, gravelly sand (dark greyish brown), wet.	SW	NA	HNU = 0 ppm ⇐ WET; α = 0 cpm; Bβ = 100-120 cpm ⇐ WET
	52195 1130 5-31	8	6	SAA (10.5-11.0ft)	SW	NA	
12	52196 1130 5-31	7	6	Medium Dense (10yr, 5/4) yellowish brown well graded sand, trace fine gravel, trace clay, wet	SW	NA	⇐ WET
	52197 1320 5-31	6	6	SAA (11.5-12.0ft)	SW	NA	HNU = 0 ppm ⇐ WET; α = 0 cpm; Bβ = 60-80 cpm ⇐ WET
13	52198 1320 5-31	3	6	SAA "	SW	NA	
	52199 1320 5-31	10	6	SAA "	SW	NA	⇐ WET
14	52200 1325 5-31	6	6	SAA "	SW	NA	HNU = 0 ppm ⇐ WET; α = 0 cpm; Bβ = 100-120 cpm ⇐ WET
	52201 1325 5-31	8	6	SAA "	SW	NA	
	52202 1325 5-31	10	6	Med. Dense (10yr 4/6) dark yellowish brown poorly graded sand, wet	SP	NA	⇐ WET
				Med. Dense (10yr, 4/6) dark yellowish brown silty sand, wet	SM	NA	⇐ WET

NOTES:

SAA = Same As Above
NR = No Recovery

000301

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1208	COORDINATES:	DATE: 5/31/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5/31/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 6-1-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 5

DEPTH	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER	RECOVERY	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	50203 1340 5-31	12	6	Med Dense (10yr, 5/4) yellowish brown clayey sand, trace fine gravel, wet	SC	NA	HNU = 0 ppm α = 0 cpm ⇐ WET BG = 120-140 cpm
16	50204 1340 5-31	14	6	Med Dense (2.5y, 4/2) dark grayish brown poorly graded sand, WET	SP	NA	⇐ WET
...m of water ...ing ...e 16.5ft	50205 1340 5-31	15	6	SAA - (15.5->16.0 ft)	SP	NA	⇐ WET
17	50206 1345 5-31	7	6	SAA (15.5->16.0 ft) VERY MOIST	SP	NA	HNU = 0 ppm α = 0 cpm BG = 80-100 cpm
	50207 1345 5-31	13	6	SAA (15.5->16.0 ft) VERY MOIST	SP	NA	
	50208 1345 5-31	12	6	SAA (15.5->16.0 ft) Very moist	SP	NA	
18	50209 1520 5-31	8	6	SAA	SP	N/A	HNU = 0 ppm α = 0 cpm BG = 80-100 cpm
	50210 1520 5-31	10	6	SAA	SP	N/A	
19	50211 1520 5-31	10	6	SAA	SP	N/A	
	50212 1520 5-31	10	6	SAA	SP	N/A	HNU = 0 ppm α = 0 cpm BG = 80-100 cpm
20				Bottom of Boring and sampling at 20.0 FT			

NOTES:

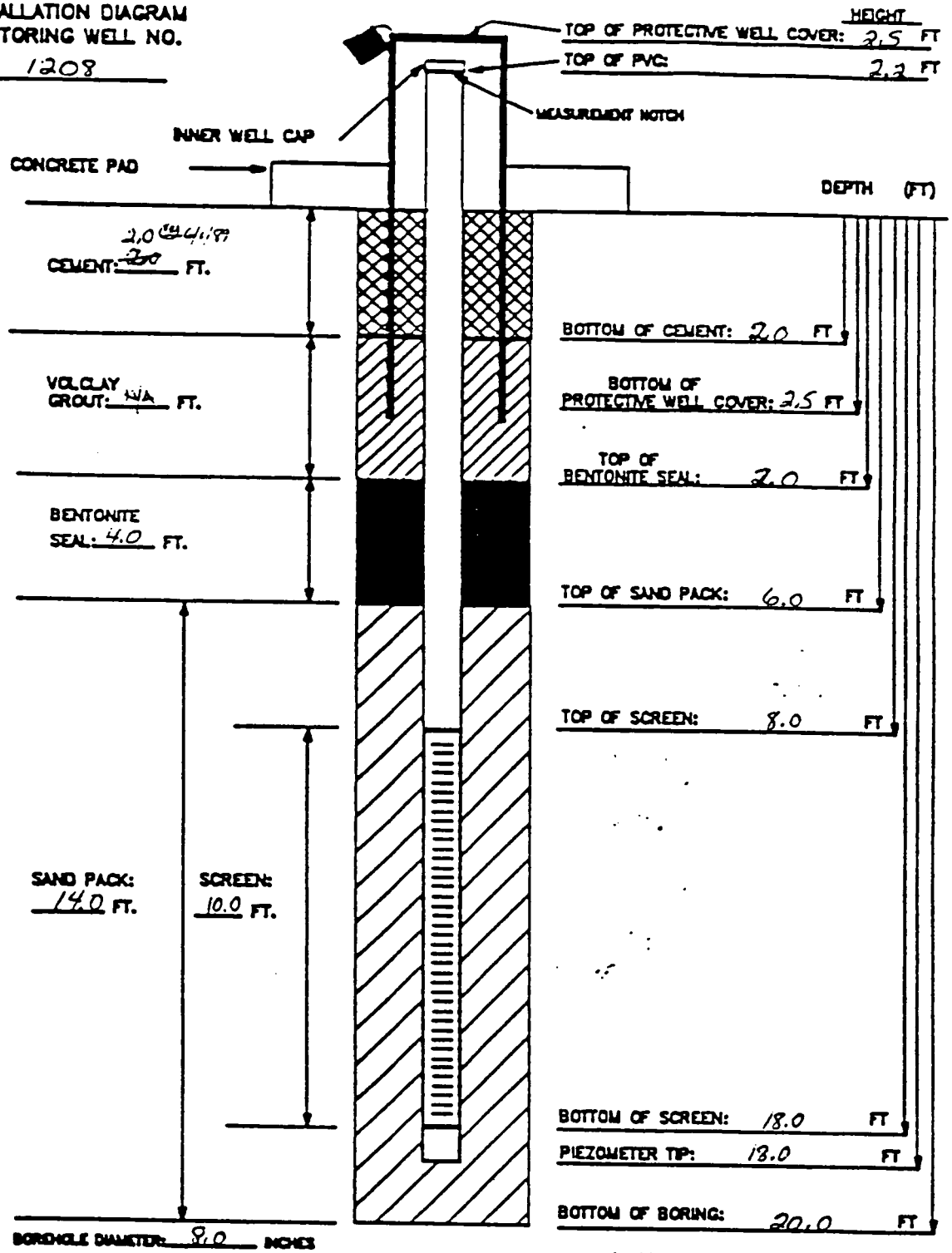
SAA = Same As Above
NR = No Recovery

Note: It is believed that Alphameter was not registering properly

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1208

INSTALLATION DATE: 6/1/89 ~~[illegible]~~ 112 4/1/89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: 5.0 [illegible] 10/20 sand
BENTONITE PELLETS (5-GALLON BUCKETS): 2 buckets.
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1/3 sack (94 lb)
AMOUNT OF WATER USED: 10 gal
OTHER: 5.0 FT Protective casing

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 6023.7

GEOLOGIST/ENGINEER: C. Grabe

FERNALD
RI/FS

1507

Date	6/5/89			
Initial				
	Field Check	1st Rev'n	2nd Rev'n	Final Copy Verification

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1210	COORDINATES:	DATE: 5-3-89	
ELEVATION:	GWL: Depth 8.0 ft Date/Time 5-3-89/1330	DATE STARTED: 5-3-89	
ENGINEER/GEOLOGIST: E. TROWINGER, C. CRUISE	Depth Date/Time	DATE COMPLETED: 5-3-89	
DRILLING METHODS: MOBILE DRILL 8" HSA		PAGE 1 OF 4	

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 (IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1	17189 1000 05-03-89	2	12	VERY STIFF, BROWN (10YR 3/3) SILTY CLAY, TRACE OF ORGANICS (GRASS, ROOTS), LOW PLASTICITY, MOIST.	CL	2.5	H_{au} = 0.0 ppm - 0.2 ppm α = 0 cpm $\beta\gamma$ = 80 cpm
	17190 1000 05-03-89	6		VERY STIFF, BROWN, (10YR 3/3), SILTY CLAY, TRACE OF FINE GRAVEL, LOW PLASTICITY MOIST	CL	3.5	
	17191 1000 05-03-89	15		NO RECOVERY	N/A	N/A	
2	17192 1007 05-03-89	7	12	VERY STIFF, BROWN, (10YR 4/4). SILTY CLAY, TRACE OF FINE GRAVEL, LOW PLASTICITY, MOIST.	CL	4.0	H_{au} = 0.2 ppm α = 0 cpm $\beta\gamma$ = 80 cpm
	17193 1007 05-03-89	11		VERY STIFF, BROWN (10YR 4/4), SILTY CLAY, TRACE OF SAND AND FINE GRAVEL, LOW PLASTICITY, MOIST	CL	3.0	
3	17194 1007 05-03-89	15		NO RECOVERY	N/A	N/A	
4	17195 1014 05-03-89	9	14	VERY STIFF, YELLOWISH BROWN, (10YR 5/6), SILTY CLAY TRACE OF FINE GRAVEL, LOW PLASTICITY, MOIST.	CL	4.0	H_{au} = 0.2 ppm α = 0 cpm $\beta\gamma$ = 80 cpm
	17196 1014 05-03-89	18		VERY STIFF, YELLOWISH BROWN (10YR 5/6) & GRAY (10YR 5/1), CLAY, MEDIUM PLASTICITY, MOIST (2 in. RECOV. ON 17191)	CL	3.0	
	17197 1014 05-03-89	25				2.0	
5	17198 1023 05-03-89	19	15	STIFF, YELLOWISH BROWN, (10YR 5/4) CLAY, MEDIUM PLASTICITY, MOIST.	CL	1.75	H_{au} = 0.2 ppm α = 0 cpm $\beta\gamma$ = 80 cpm
	17199 1023 05-03-89	23		STIFF, YELLOWISH BROWN, (10YR 5/4), CLAY, TRACE OF COARSE SAND, MEDIUM PLASTICITY, MOIST. (3 in RECOV. on 17200)	CL	1.50	
6	17200 1023 05-03-89	26					
7	17201 1325 05-03-89	3	18	VERY STIFF, OLIVE GRAY (5Y 5/2) TO YELLOWISH BROWN (10YR 4/6) SILTY CLAY, LOW TO MEDIUM PLASTICITY, MOIST.	~~CL~~ E.T. CL	3.25	H_{au} = 0.2 ppm α = 0 cpm $\beta\gamma$ = 80 cpm
	17202 1325 05-03-89	6			~~CL~~ E.T.	3.0	
	17203 1325 05-03-89	7		~~VERY STIFF~~ E.T., MEDIUM DENSE, YELLOWISH BROWN, (10YR 5/6) SILT, WET-SATURATED	ML	N/A	

NOTES: DRILLING CO.:
DRILLER: DAVE NEWMAN
HELPER: BILL ANDERSON

MATERIALS USED:
2 BAGS 10/20 SAND (80 lb) ea.
1 BUCKET BENTONITE PELLETS (5 gal.)
½ SACK CEMENT TYPE I
3 GAL. WATER

SAMPLING IN ACCORDANCE WITH ASTM STANDARDS, DESCRIPTION OF SOIL COLOR BY MUNSELL COLOR CHART. SAMPLES TAKEN FOR WMCO AT INTERVALS 0.0-.5 FT., 2-2.5 FT., 5-5.5 FT, 10-10.5 FT., 15-15.5 FT.

INSTRUMENT BACKGROUND
H_{au} = 0.2 ppm
α = 0 cpm
$\beta\gamma$ = 60-80 cpm
LEL = 0.0 ppm
O_2 = 20.6%

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1210	COORDINATES:	DATE: 5-3-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-3-89
ENGINEER/GEOLOGIST: E. TRELLINGER C. ANDERSON	Depth Date/Time	DATE COMPLETED: 5-3-89
DRILLING METHODS: MOBILE DRILL HSA		PAGE 2 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	17204 1330 05-03-89	4	17	DENSE, BROWN (10 YR 5/3 CLAYEY SILT, SATURATED.	ML	N/A	H_{net} = 0.2 ppm
	17205 1330 05-03-89	14		DENSE, YELLOWISH BROWN (10YR 5/6) SILT, WET.	ML	N/A	α = 0 cpm
9	17206 1330 05-03-89	18					$\beta\gamma$ = 80 cpm
	17207 1335 05-03-89	10	18	MEDIUM DENSE, YELLOWISH BROWN, (10 YR 5/6), SILT, WET	ML	N/A	H_{net} = 0.2 ppm
10	17208 1335 05-03-89	16					α = 0 cpm
	17209 1335 05-03-89	19		VERY STIFF, YELLOWISH BROWN (10 YR 5/6) SILTY CLAY, MOIST.	CL	2.75	$\beta\gamma$ = 80 cpm
11				BOTTOM OF BORING AT 10.5 FT. SAMPLING ENDED AT 10.5 FT.			
12							
13							
14							

ECHED ATER COUNTED - 8.0 FT.

TOM OF TER BEARING ONE @ 10.0 FT.

NOTES.

DRILLER: DAVE NEWMAN
HELPER: BILL ANDERSON

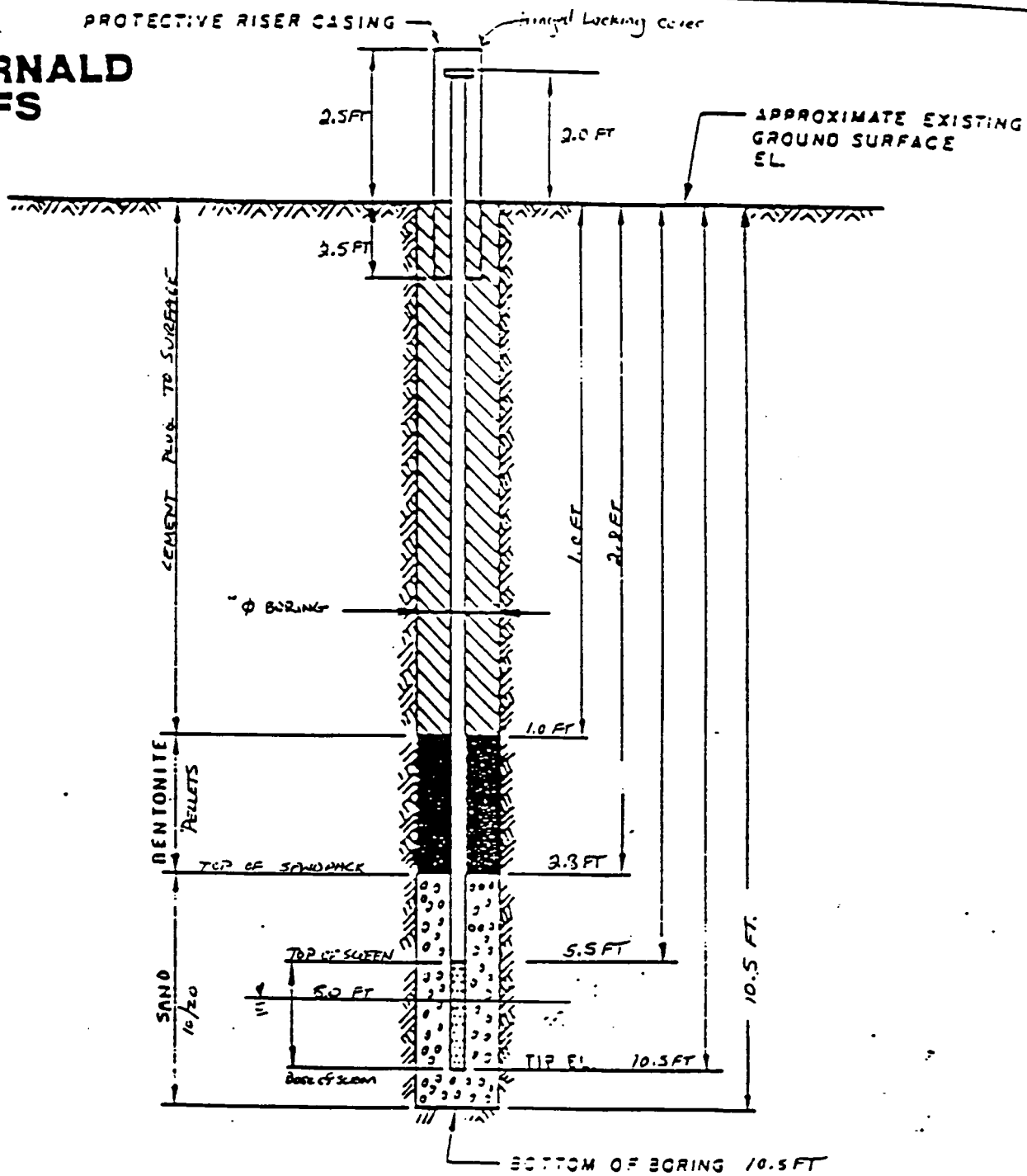
INSTRUMENT BACKGROUND
H_{net} = 0.2 ppm
α = 0 cpm
$\beta\gamma$ = 60-80 cpm

000365

FIELD COPY

1507 4/4

FERNALD RI/FS



DRAWING NUMBER Boring 1210

CHECKED BY / APPROVED BY

E.T.

DRAWN BY

NOTES:

1. RISER PIPE IS 2 IN I.D. SCHEDULE PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 2 IN I.D. SCH 40 PVC PIPE CONTINUOUS SLOT SCREEN (0.020 IN SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

MATERIALS USED:

2 BAGS 10/20 SAND (80 lb) ea.
1 BUCKET BENTONITE PELLETS (5 gal)
½ SACK TYPE I CEMENT
3 gal. WATER

INSTALLATION DETAILS
MONITORING WELL #1210

PREPARED FOR FMPC RI/FS

PVC WELL SCREEN AND RISER PIPE:

1 - 5.0 FT. SCREENED SECTION
1 - 7.5 FT. SCH. 40 RISER PVC

000366

FERNALD RI/FS

Date	11/9/89			
Initial				
	Field Check	1st Rev'n	2nd Rev'n	Final

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1212	COORDINATES:	DATE: 11-1-89 / 11-2/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11-1-89
ENGINEER/GEOLOGIST: E. TROLLINGER	Depth Date/Time	DATE COMPLETED: 11-02-89
DRILLING METHODS: AUGER (HOLLOW STEM) in		PAGE 1 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				CEMENT CONCRETE PAD			HNU = 0.0 α = 1600 cpm surface BG = 8000 cpm surface
1	17233 1543 11-01	3	6	VERY STIFF, BRUNNISH GRAY (10YR 4/2) CLAY, TRACE OF FINE GRAVEL (MAINLY FROM BASE COARSE) (.25-.5 in) LOW PLASTICITY, MOIST.	CL	3.0	HNU = 0.0 α = 0.0 cpm BG = 120 cpm
2	17234 1543 11-01	5	6		CL	3.0	HNU = 0.0 α = 0 cpm BG = 120 cpm - 200 cpm
	17235 1543 11-01	5	5				
	17236 1543 11-01	5	0	NO RECOVERY			
3	17237 1547 11-01	5	6	VERY STIFF, BROWN (10YR 4/3) CLAY, TRACE OF SILT, TRACE OF FINE GRAVEL, LOW PLASTICITY, MOIST.	CL	2.5	HNU = 0.0 α = 0 cpm BG = 180 cpm
4	17238 1547 11-01	7	6	VERY STIFF, VERY DARK GRAY TO BLACK (5Y 3/1), SILTY CLAY, LOW PLASTICITY, MOIST.	CL	3.0	
	17239 1547 11-01	10	0	NO RECOVERY			
5	17240 1556 11-01	8	6	STIFF, GRAYISH BROWN (10YR 4/2) CLAY, TRACE OF FINE GRAVEL, (.25-.50 in), MEDIUM PLASTICITY, MOIST.	CL	2.0	HNU = 0.2 ppm α = 0 cpm BG = 180-200 cpm
	17241 1556 11-01	10	6				
6	17242 1556 11-01	12	4				
	17243 0833 11-02	4	6	MEDIUM STIFF, GRAYISH BROWN (10YR 4/2) CLAY, TRACE OF GRAVEL, (.25-.50 in), MEDIUM PLASTICITY, MOIST	CL	1.0	HNU = 0.3 ppm α = 0 cpm BG = 180-200 cpm
7	17244 0833 11-02	8	5				
	17245 0833 11-02	10	0	NO RECOVERY			

NOTES: CONTRACTOR: PENN DRILL
RIG: ACKER #369
DRILLER: DAVE Newman
ASSISTANT: Bob Johnson

2 BAGS 10/20 SAND 50 lbs. ea.
2 buckets Bentonite pellets. 5 gal ea.
1/2 bag TYPE I cement, 5 gal water

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0.0 PPM
α = 0-5 CPM
BG = 100-140 CPM
LEL = 0 PPM
O_2 = 21.5 %

LELO2:

000367

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 662 371	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1212	COORDINATES:	DATE: 11-2-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11-1-89
ENGINEER/GEOLOGIST: E. TROLLINGER	Depth Date/Time	DATE COMPLETED: 11-02-89
DRILLING METHODS: AUGER (HOLLOW STEM) in		PAGE 2 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 (IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	17246 0845 11-02	3	6	SOFT, GRAYISH BROWN (10YR 4/3) CLAY, TRACE OF COARSE SAND (.25 in), MEDIUM PLASTICITY, MOIST TO WET.	CL	1.0	HNU = 0.0 ppm α = 0 CPM BS = 110-130 cpm
	17247 0845 11-02	2	6		CL	.50	
9	17248 0845 11-02	2	3	VERY LOOSE, BROWN (10YR 4/4) POORLY GRADED SAND, TRACE OF SILT, WET.	SP	N/A	
	17249 0850 11-02	3	6	LOOSE, BROWN (10YR 4/3) SILTY SAND, POORLY GRADED, WET	SM	N/A	HNU = 0.0 ppm α = 0 CPM BS = 200 CPM
10	17250 0850 11-02	3	6				
	17251 0850 11-02	3	0	NO RECOVERY			
11	17252 0920 11-02	1	6	LOOSE, BROWN (10YR 4/3) SILTY SAND, TRACE OF SAND (.25 COARSE) WET.	SM	N/A	HNU = 0.0 ppm α = 0 CPM BS = 180-200 CPM
	17253 0920 11-02	2	4				
12	17254 0920 11-02	3	0	NO RECOVERY			
13	52235 0922 11-02	4	6	LOOSE, BROWN (10YR 4/3) SILTY SAND, TRACE OF FINE GRAVEL (.50 in), WET.	SM	N/A	HNU = 0.0 ppm α = 0 CPM BS = 180 CPM
	52236 0922 11-02	4	6				
	52237 0922 11-02	7	0	NO RECOVERY			
14	52238 0930 11-02	13	6	MEDIUM DENSE, BROWN (10YR 4/3) SILTY SAND, TRACE OF COARSE SAND (.25 in), WET.	SM	N/A	HNU = 0.0 ppm α = 0 CPM BS = 120 CPM
	52239 0930 11-02	13	6				
	52240 0930 11-02	15	3				

WATER BEARING ZONE STARTS @ 8.5 FT

END OF WATER BEARING ZONE

NOTES:

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1212	COORDINATES:		DATE: 11/02/89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 11-1-89 / 11-2-89
ENGINEER/GEOLOGIST: E. Trollinger	Depth	Date/Time	DATE COMPLETED: 11/02/89
DRILLING METHODS: AUGER (HOLLOW STEM) air			PAGE 3 OF 5

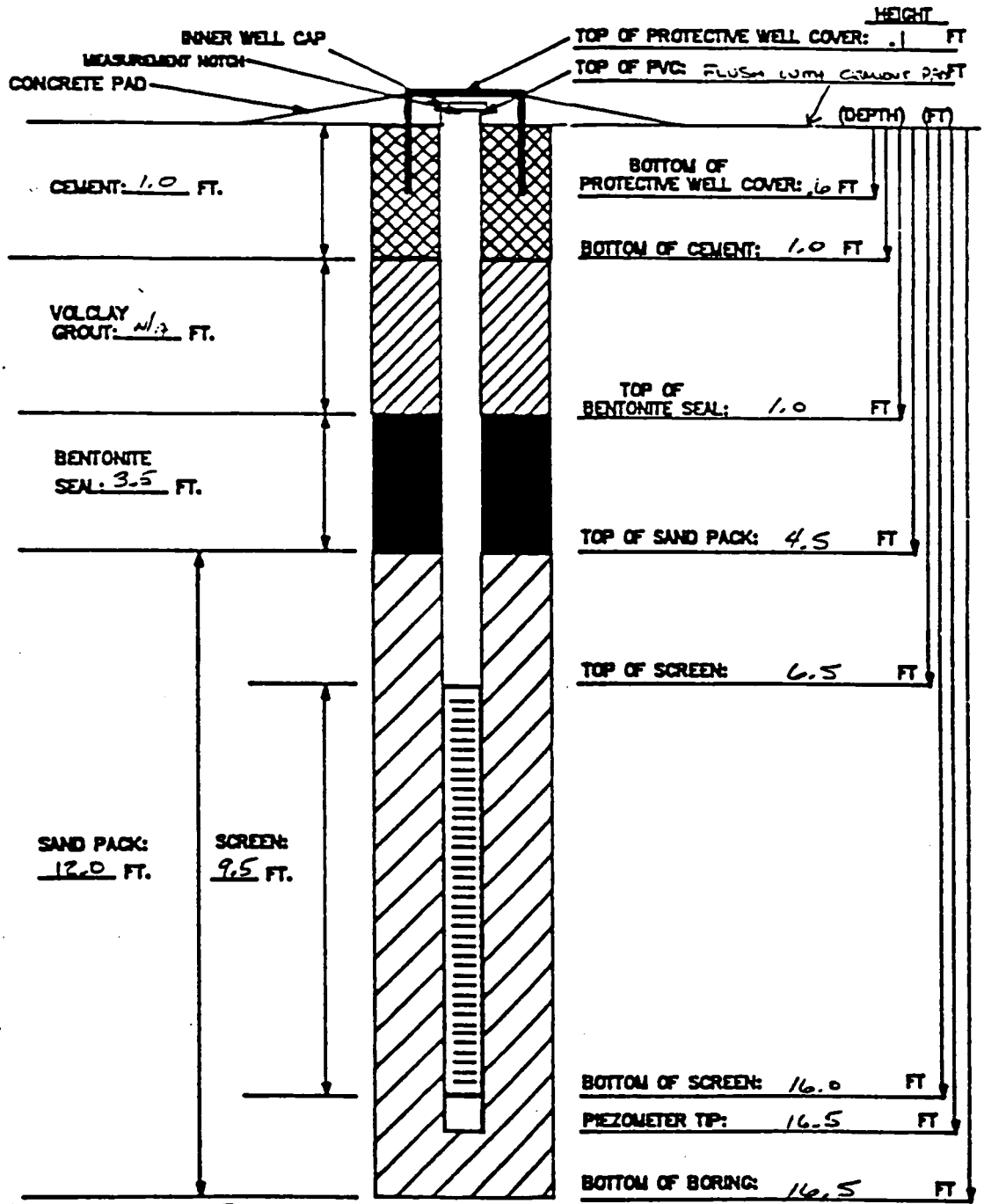
DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	52241 0945 11-02	1	4	MEDIUM STIFF, GRAY (10YR 4/1) CLAY, TRACE OF GRAVEL (.25-.50 in), MEDIUM PLASTICITY, MOIST.	CL	1.0	HNU = 0.0 ppm α = 0 cpm BG = 110-130 cpm
	52242 0945 11-02	3	0				
16	52243 0945 11-02	3	0	NO RECOVERY			
17				BOTTOM OF BORING AT 16.5 FT., SAMPLING ENDED AT 16.5 FT, WELL TIP SET AT 16.5 FT.			HNU = α = BG =
18							HNU = α = BG =
19							
20							HNU = α = BG =

NOTES:

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1212

INSTALLATION DATE: 11-02-89



	HEIGHT	
TOP OF PROTECTIVE WELL COVER:	.1	FT
TOP OF PVC: FLUSH WITH CONCRETE PAD		FT

	(DEPTH) (FT)	
BOTTOM OF PROTECTIVE WELL COVER:	.6	FT
BOTTOM OF CEMENT:	1.0	FT
TOP OF BENTONITE SEAL:	1.0	FT
TOP OF SAND PACK:	4.5	FT
TOP OF SCREEN:	6.5	FT
BOTTOM OF SCREEN:	16.0	FT
PIEZOMETER TIP:	16.5	FT
BOTTOM OF BORING:	16.5	FT

MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 2 bags
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1/2 bag.
AMOUNT OF WATER USED: 5 gals
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 3.7.1 GEOLOGIST/ENGINEER: E. Trollinger

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 12/14	COORDINATES:		DATE: 12/14/89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 12/14/89
ENGINEER/GEOLOGIST: C. Gnabe	Depth	Date/Time	DATE COMPLETED: 12/15/89
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 1 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	12-14	NA	6	Cement	NA	NA	HNU: 0 ppm α = 10-20 cpm Bγ = 3000-3500 cpm on surface
	12-14		6	cement	NA	NA	
1	17277 1525 12-14	5	6	Loose (2.5 Y 5/4) light olive brown clayey sand, some silt, slightly moist	SC	NA	
	17278 1525 12-14	3	4	SAA	SC	NA	HNU: 0 ppm α = 10-15 cpm Bγ = 260-280 cpm
2	17279 1525 12-14	3	0	NR	NA	NA	
	17280 1525 12-14	3	0	NR	NA	NA	
3	17281 1530 12-14	3	6	medium stiff (2.5 Y 5/4) light olive brown silty clay, trace of sand & fine gravel, low plasticity very moist	CL	.5	HNU: 0 ppm α = 0-10 cpm Bγ = 180-200 cpm w/ screen
4	17282 1530 12-14	2	0	NR	NA	NA	
	17283 1530 12-14	3	0	NR	NA	NA	
	17284 1535 12-14	2	3	medium dense (2.5 Y 5/4) light olive brown silty clay, trace of sand & fine gravel, low plasticity very moist	CL	.75	HNU: 0 ppm α = 0 cpm Bγ = 180-200 cpm w/ screen
5	17285 1535 12-14	3	0	NR	NA	NA	
	17286 1535 12-14	3	0	NR	NA	NA	
6	17287 1555 12-14	2	6	medium stiff (10 YR 5/3) brown silty clay, some sand, trace of fine gravel, low plasticity, moist	CL	.75	HNU: 0 ppm α = 0 cpm Bγ = 240-260 cpm
	17288 1555 12-14	3	4	Stiff SAA	CL	1.75	
7	17289 1555 12-14	3	0	NR	NA	NA	

NOTES: CONTRACTOR: PENN DRILL
RIG: CME-45
DRILLER: Dave Newman
ASSISTANT: Bob Johnson
Geo Assistant: Ben Brier

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α : 0 CPM
Bγ : 250-350 CPM

SAA = Same As Above
NR = No Recovery

LEL O_2: LEL: 0% ~~ppm~~
O_2: 20.6%

HNU # 1235

000371

FERNALD
RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1214	COORDINATES:	DATE: 12/14/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 12/14/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 12/15/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN.	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	17290 1602 12-14	3	6	Stiff (5Y5/3) olive silty clay trace of sand medium plasticity moist	CL	1.5	HNU = 0 ppm α = 0 cpm Bγ = 360-380 cpm
	17291 1602 12-14	5	6	Stiff (5Y 4/4) olive silty clay, medium plasticity moist	CL	1.0	
9	17292 1602 12-14	5	0	NR	NA	NA	
	17293 1610 12-14	5	6	Very soft (2.5Y5/4) light olive brown silty clay, some sand, medium plasticity, wet	CL	<.25	HNU = 0 ppm α = 18-20 cpm Bγ = 400-420 cpm
10	17294 1610 12-14	5	6	Stiff (10YR 5/1) brown silty clay, less plasticity, moist	CL	1.5	
	17295 1610 12-14	5	5	SAA	CL	1.0	
11	17296 1620 12-14	2	6	Medium dense (2.5Y5/4) light olive brown clayey silt, trace sand, very moist	ML	NA	HNU = 0 ppm α = 0 cpm Bγ = 260-280 cpm
	17297 1620 12-14	3	6	SAA	ML	NA	
	17298 1620 12-14	10	3	SAA	ML	NA	
12	52275 1630 12-14	9	6	Medium dense (2.5Y 5/4) light olive brown clayey silt, trace of sand, wet	ML	NA	HNU = 0 ppm α = 0 cpm Bγ = 240-260 cpm
	52276 1630 12-14	11	6	Medium dense (5Y 4/3) olive gray clayey silt moist to very moist	ML	NA	
13	52277 1630 12-14	13	6	SAA	ML	NA	
	52278 1644 12-14	7	6	Medium Dense (5Y4/2) olive gray clayey silt very wet	ML	NA	HNU = 0 ppm α = 0 cpm Bγ = 320-340 cpm
14	52279 1644 12-14	8	6	Medium Dense (5Y 4/2) olive gray silty some clay, moist	ML	NA	
	52280 1644 12-14	13	6	SAA ~~Stiff (5Y~~ (5Y4/2) olive gray silty clay, medium plasticity, moist	ML CL	NA 1.75	

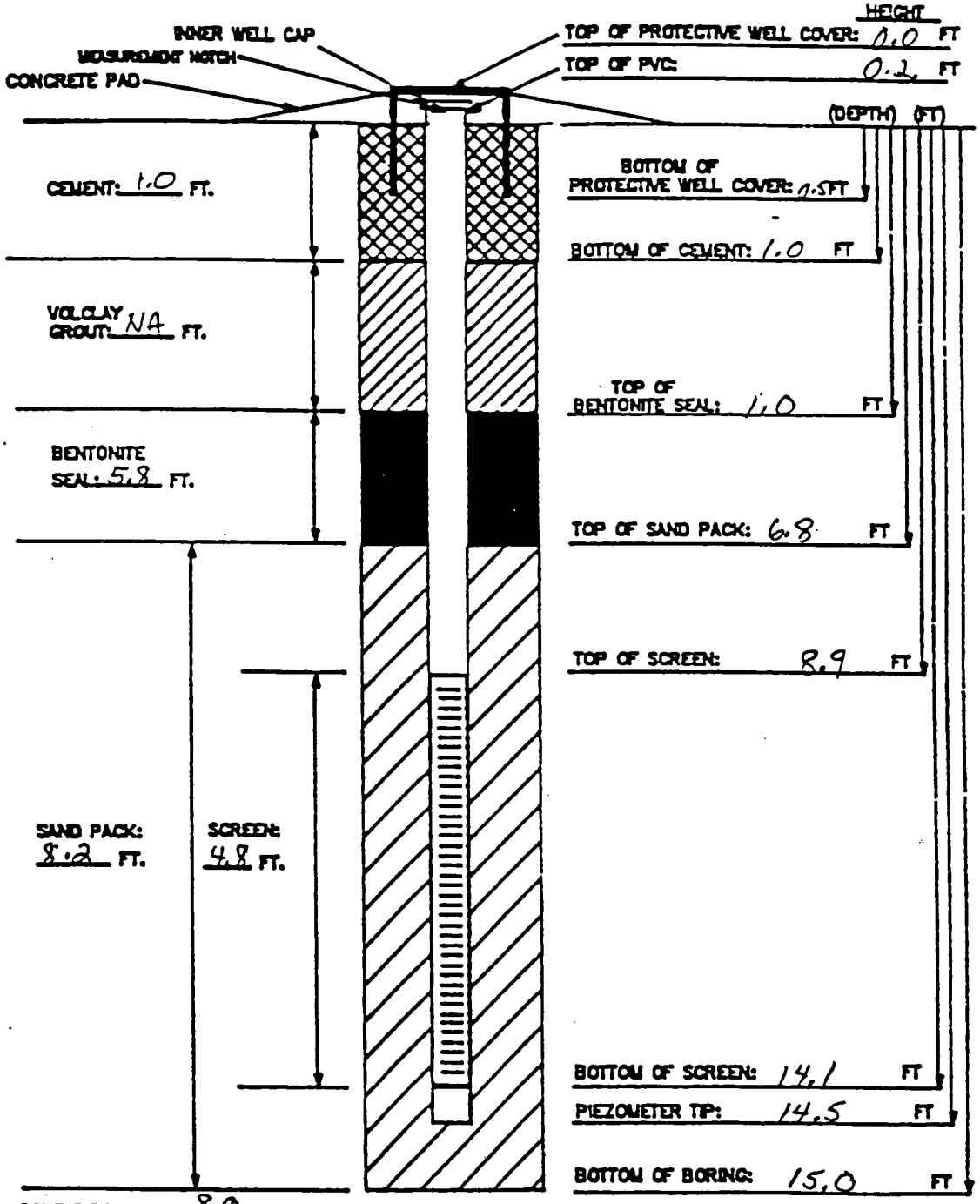
NOTES:

Bottom of Boring & Sampling at 15.0 FT
SAA = Same As Above
NR = No Recovery

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1214

INSTALLATION DATE: 12/15/89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand - 4 (80#) sks
BENTONITE PELLETS (5-GALLON BUCKETS): 3
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2 sk (94#)
AMOUNT OF WATER USED: 10 gal
OTHER: Protective flush mount cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 6023.7 GEOLOGIST/ENGINEER: C. Grube

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 6023.7	PROJECT NAME: Fernald RI/FS		
BORING NUMBER: 1216	COORDINATES: NA	DATE: 10/20/89	
ELEVATION: NA	GWL: Depth Date/Time	DATE STARTED: 10/20/89	
ENGINEER/GEOLOGIST: M. HARDNER	Depth ~~Date/Time~~	DATE COMPLETED: 10/21/89	
DRILLING METHODS: Hollowstem Auger Split Spoon Sampling		PAGE 1 OF ~~3~~ 5	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6"	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (BL 11/21/89)
							10-20-89 begin coring
		—	NA	CEMENT			HNU = 0 concrete @1030
		—	NA				Bγ = ~~100~~ 90cpm
							α = 0
1	17321 1530 10/20	2	6	Stff (10yr 5/4) yellowish brown silty clay, med plastic, very moist	CL	1.25	HNU = 0
	10/20 17322 1530	3	16	very stff SAA. ~~very stff (5y 4/2) olive gray clay med plasticity moist~~	CL	3.0	Bγ = 160cpm
2	10/20 17323 1530	6	5	very stff (5y 4/2) olive gray clay med plasticity, moist	CL	3.0	α = 0
	10/20 17324 1530	10	0	NR	NA	NA	—
3	17325 1600	8	6	stff (10yr 5/4) yellowish brown silty clay, med plastic very moist ~~stff (5y 4/1) dark gray gravelly clay med plasticity, moist, some gravel, angular 1 cobbles 15, tr fossil.~~	CL	1.25 / 1.5	HNU = 0
	10/20 17326 1615	18	~~9~~ NR	NR	~~CL~~ NA	NA	Bγ = 90cpm
4	17327 1615	16	0	NR	NA	NA	α = ~~0~~
	17328 1630 10/20	6	6	Med Stiff (10yr 5/4) yellowish brown silty clay trace gravel, med plast. wet	CI	.75	HNU = 0
5	17329 1630 10/20	11	6	very Stff (5y 3/2) Dark olive gray clay, med plastic, moist	CI	2.5	Bγ = 90 cpm
	17330 1630 10/20	13	3	SAA	CI	2.5	α = 0
6	17331 0915 10/21	5	6	soft (5y 4/4) ~~yellowish brown~~ olive brown, clay high ~~med~~ plastic, moist, tr gravel	CI	0.50	Begin @ 0900 - 10/21 HNU = 0 ppm Bγ = 0 cpm α = 0 cpm
	17332 0920 10/21	7	6	Stiff (5y 5/2) ~~yellow brown~~ olive gray, clay med plastic, moist.	CI	1.75	
7	17333 0920 10/21	8	6	Stiff (5y 5/2) ~~yellow brown~~ olive gray, clay, med plastic moist.	CI	1.75	

10/20/89 10/21/89

10/21/89 • 30 background 160 cpm • background 0

NOTES: Bean Drill
Driller: Dave Newman
Drillers: Bob Johnson
Rig: Acker SS.
SAA = Same as above
NR = No recovery
NA = not applicable

Samples collected per ASTM St. Penetration test.
Augers 4¼" ID
8" OD

Colors ID by Munsell Color chart

Bkgrond Levels
Bγ = 90 MeLELD%
α = 0 α 21%
HNU = 1.4 ppm
Note: Reading on HNU indicates NO reading above background

HNU: B001944
Explosimeter: 0184302
α: #13
Bγ: #11

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 6023.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1216	COORDINATES: NA	DATE: 10/21/89	
ELEVATION: NA	GWL: Depth Date/Time	DATE STARTED: 10/20/89	
ENGINEER/GEOLOGIST: M. HARDNER	Depth Date/Time	DATE COMPLETED: 10/21/89	
DRILLING METHODS: Hollow Stem Auger Split Spoon Samples		PAGE 2 OF 2-5	

DEPTH FT	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER	RECOVERY	DESCRIPTION (v dark gy)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (BW. 10/26/89)
8	17334 0930 10/21	12	6	Stiff, (5Y, 3/1), mottled, ~~mgy~~, yl/orange, clay, red plastic, sl damp, tr gravel (limestone)	Cl	2.0	HNU = 0.0 β/γ = 160 cpm α = 0
	17335 0930	12	6	SAA	Cl	2.0	
9	17336 0930 10/21	12	6	Very stiff (2.5Y, 5/4) olive mottled, mgy, orange, clay, red plastic, dry	Cl	2.5	
9	17337 ~~0900~~ 10/21	36	6	Red stiff, (5Y, 4/3) olive ~~red brown~~, clay, red plastic, moist	Cl	0.75	HNU = 0 β/γ = 140 cpm α = 0
	17338 ~~0900~~ 10/21	89	6	V. stiff, (5Y, 4/4) olive ~~red brown, gray~~, clay, silty, low plastic, damp	Cl	3.25	
10	17339 ~~0900~~ 10/21	39	6	SAA	Cl	3.25	
11	17340 ~~0900~~ 1015	3	4	Stiff, (5Y, 3/2) dk olive gy ~~red-dk gy brown~~, clay, sl silty, tr gravel, red plastic, damp	Cl	2.0	HNU = 0 β/γ = 120 cpm α = 0
	17341 ~~0900~~ 1015	8	NR	No Recovery	—	—	NR
	17342 ~~0900~~ 1015	13	NR	No Recovery	—	—	NR
12	~~17343~~ 52315 1020 10/21	11	6	(5Y, 4/4) olive ~~red brown~~, sand, vf-f, silty, some clay, wet	SC	—	HNU = 0 β/γ = 140 cpm α = 0
13	~~17344~~ 52316 1020 10/21	16	2	SAA wet	SC	—	
	~~17345~~ 52317 1020 10/21	11	—	No Recovery	—	—	HNU = 0 β/γ = 120 cpm α = 0
14	~~17346~~ 52318 1025 10/21	12	6	(5Y, 4/4) olive ~~red brown~~, sand, vf-f, clayey, sl silty, wet	SC	—	
	~~17347~~ 52319 1025 10/21	16	6	SAA wet	SC	—	
15	~~17348~~ 52320 1025 10/21	13	6	SAA wet	SC	—	

NOTES: See p.1

SAA = Same as above

NR = No Recovery

000375

402-11-88

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 6023.7	PROJECT NAME: Fernald RI/FS		
BORING NUMBER: 1216	COORDINATES: NA		DATE: 10/21/89
ELEVATION: NA	GWL: Depth	Date/Time	DATE STARTED: 10/20/89
ENGINEER/GEOLOGIST: M. HARDNER	Depth	Date/Time	DATE COMPLETED: 10/21/89
DRILLING METHODS: Split spoon, Hollow Stem Auger			PAGE 3 OF 3 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (")	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (B. 10/26/89)
	1055	3	6	Stiff (5Y, 4/2) olive gray, clay, med plastic, moist, mixed w/ sand	CI	1.5	HNU=0 R/B = 120 cpm
16	1056	6	5	SAA w/ sand layer in clay, 2" thick @ 15.75'	CI	1.5	α = 0
	1056	10	NR	No Recovery	—	—	No Recovery
17	1110	7	6	(5Y, 4/4) olive Sand, vfgr, s/clayey, wet	SC	—	HNU = 0
	1110	7	6	" sand from 16.5–17.25'	"	"	R/B = 140 cpm
				Stiff (5Y 4/1) dk gy, clay, damp	CI	1.5	α = 0
18	1110	12	6	med plastic clay 17.25'	CI	1.5	
				Bottom of Boring @ 18' @ 1100 Spoon to 18' Auger to 16.5 + set @ 16.5			

NOTES: See p. 1 SAA = Same as Above
NR = No recovery

402-11-86

1216

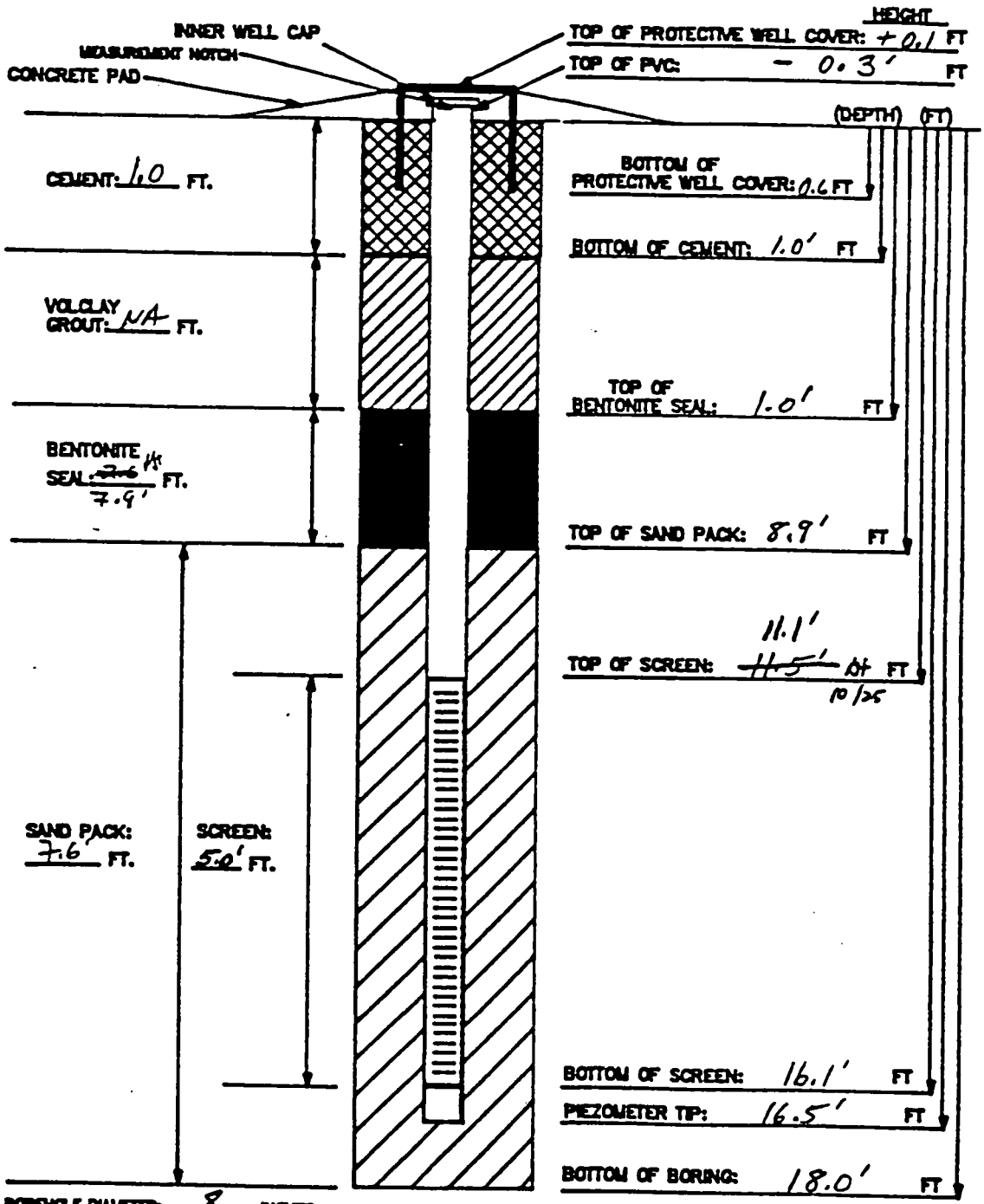
4/45

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1216

INSTALLATION DATE: 10/21/89

Flush Mount



BOREHOLE DIAMETER: 8 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: #430 sand, 2 bags
BENTONITE PELLETS (5-GALLON BUCKETS): 3
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 0.5 bags
AMOUNT OF WATER USED:
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602.3.7 GEOLOGIST/ENGINEER: M. HARDNER

000377

Materials for Construction
2 bags 430 sand pack
3 buckets bentonite pellets (3/8")

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.3.7	PROJECT NAME: FERNALD FMPC RI/FS		
BORING NUMBER: 1217	COORDINATES: NA		DATE: 11-18-89
ELEVATION: NA	GWL: Depth	Date/Time	DATE STARTED: 11-18-89
ENGINEER/GEOLOGIST: B. Nies	Depth	Date/Time	DATE COMPLETED: 11-18-89
DRILLING METHODS: Hollow Stem Auger			PAGE 1 OF 2

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (INCHES)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0.5	17343 11-18 1440	5	6	(10YR, 3/3) dark brown gravelly silt trace m-f sand, damp. w/wood	SM			HNu = 0 ppm α = 100 cpm βγ = 600 cpm
1.0	17344 11-18 1440	10	0	No Rec	–			
1.5	17345 11-18 1440	9	0	No Rec	–			
2.2	17346 11-18 1448	9	6	hard (2.5Y/3/2) v. dark grayish brown clay, high plastic, damp.	cl	4.5		HNu = 0 ppm α = 0 cpm βγ = 880 cpm
2.5	17347 11-18 1448	7	2	SAA	cl	4.5		
3.0	17348 11-18 1448	8	0	No Rec.	–	–		
3.5	17349 11-18 1454	BR 77	6	v. stiff (2.5Y/4/1) olive brown clay, trace m-f sand trace gravel, med. plastic, damp. to 3.4	cl	3.75		HNu = 0 ppm α = 0 cpm βγ = 300 cpm small percched H_2O zone at ~3.0'
4.0	17350 11-18 1454	17	2	(2.5Y 3/1) v. dark gray clay, high plastic, damp	cl	3.75		
4.5	17351 11-18 1454	20	0	No Rec.	–	–		
5.0	17352 11-18 1502	5	6	v. stiff (2.5Y, 3/0) v. dark gray clay, mottled, high plastic, damp	cl	3.5		HNu = 0 ppm α = 0 cpm βγ = 150 cpm
5.5	17353 11-18 1502	6	6	SAA	cl	3.0		
6.0	17354 11-18 1502	7	3	SAA (stiff toward)	cl	3.25		
6.5	17355 11-18 1510	8	6	v. stiff (2.5Y, 3/0) v. dark gray clay, high plastic, damp grading to (2.5Y, 5/4) light olive brown clay, high plastic, damp.	cl	4.25		HNu = 0 ppm α = 20 ppm βγ = 120 cpm
7.0	17356 11-18 1510	11	6		cl	3.25		
7.5	17357 11-18 1510	13	3	SAA	cl	3.5		

NOTES:

Drilling Contractor: PENN DRILL

Drilling Equipment: RIG B-53

Driller: J. SALCANI, E. Coulter

EQUIPMENT SERIAL NUMBERS:

HNu: 00194 | LELO: 072595

α: 00768

βγ: 50773

BACKGROUND LEVELS:

HNu = 0 ppm

α = 20 cpm

βγ = 120 cpm

LEL = -1 %

O_2 = 21.4 %

DATE: 11-18-89

Note: - Samples Collected per ASTM St. Penetration Test
- Colors ID using Munsell Color chart
- SAA = SAME AS ABOVE
- NR = No Recovery

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.3.7	PROJECT NAME: FERNALD FMPC RI/FS		
BORING NUMBER: B-1217	COORDINATES: NA		DATE: 11-18-89
ELEVATION: NA	GWL: Depth	Date/Time	DATE STARTED: 11-18-89
ENGINEER/GEOLOGIST: B. Nies	Depth	Date/Time	DATE COMPLETED: 11-18-89
DRILLING METHODS: Hollow Stem Auger			PAGE 2 OF 2

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6"	RECOVERY (INCHES)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
8.0	17359 11-18 1520	10	6	v. stiff (2.5Y, 3/0) v. dark gray clay, high plastic, damp grading to (2.5Y 5/4) light olive brown clay, mottled, high plastic, damp. w/ .5" seam silt, moist.	cl	3.25		HNu = 0 ppm α = 0 cpm βγ = 340 cpm
8.5	17354 11-18 1520	12	6		cl	2.75		
9.0	17360 11-18 1520	14	3	SAA.	cl	3.5		
9.5	17361 11-18 1530	2	6	~~Brown silty sandy clayey silt~~ BN 11-18 v. stiff (2.5Y, 3/0) v. dark gray, high plastic, damp to 9.5'.	cl	2.75		HNu = 0 ppm α = 30 cpm βγ = 420 cpm
10.0	17362 11-18 1530	5	6	v. stiff (2.5Y 5/6) light olive brown clay grading to silty clay to clayey silt, mod plastic, damp.	cl	2.50		
10.5	17363 11-18 1530	5	6		SM	—		
11.0	17364 11-18 1535	5	6	(2.5Y 5/4) light olive brown silt, grading to m-f sand, trace c-sand, moist to wet.	SM	-		HNu = 0 ppm α = 20 cpm βγ = 100 cpm
11.5	52335 11-18 1535	7	6	SAA	SM	—		
12.0	52336 11-18 1555	6	4	SAA.	SP	—		
12.5	52337 11-18 1540	6	6	(2.5Y, 4/4) olive brown silt, little clay, grading to a silty clay, mod. plastic, moist	SM	-		HNu = 0 ppm α = 20 cpm βγ = 200 cpm
13.0	52338 11-18 1540	8	6		SM			
13.5	52339 11-18 1540	10	6		cl	3.5		
14.0	52340 11-18 1546	5	6	~~Sandy~~ stiff (2.5Y, 4/4) olive brown silty clay, med. plastic, moist.	cl	2.0		HNu = 0 ppm α = 20 cpm βγ = 180 cpm
14.5	52341 11-18 1546	7	6	v. stiff (5Y, 4/1) ~~dark~~ DK gray clay, trace silt & f-sand, high plastic, damp.	cl	3.25		
15.0	52342 11-18 1546	10	6	SAA.	cl	3.25		

NOTES:

Drilling Contractor PENN DRILL

Drilling Equipment RIG

Driller:

EQUIPMENT SERIAL NUMBERS:

HNu: LEL:

α:

βγ:

BACKGROUND LEVELS:

HNu = ppm

α = cpm

βγ = cpm

LEL = %

O_2 = %

DATE:

Note: - Samples Collected per ASTM ST. Penetration Test
- Colors ID using Munsell Color chart
- SAA = SAME AS ABOVE
- NR = No Recovery

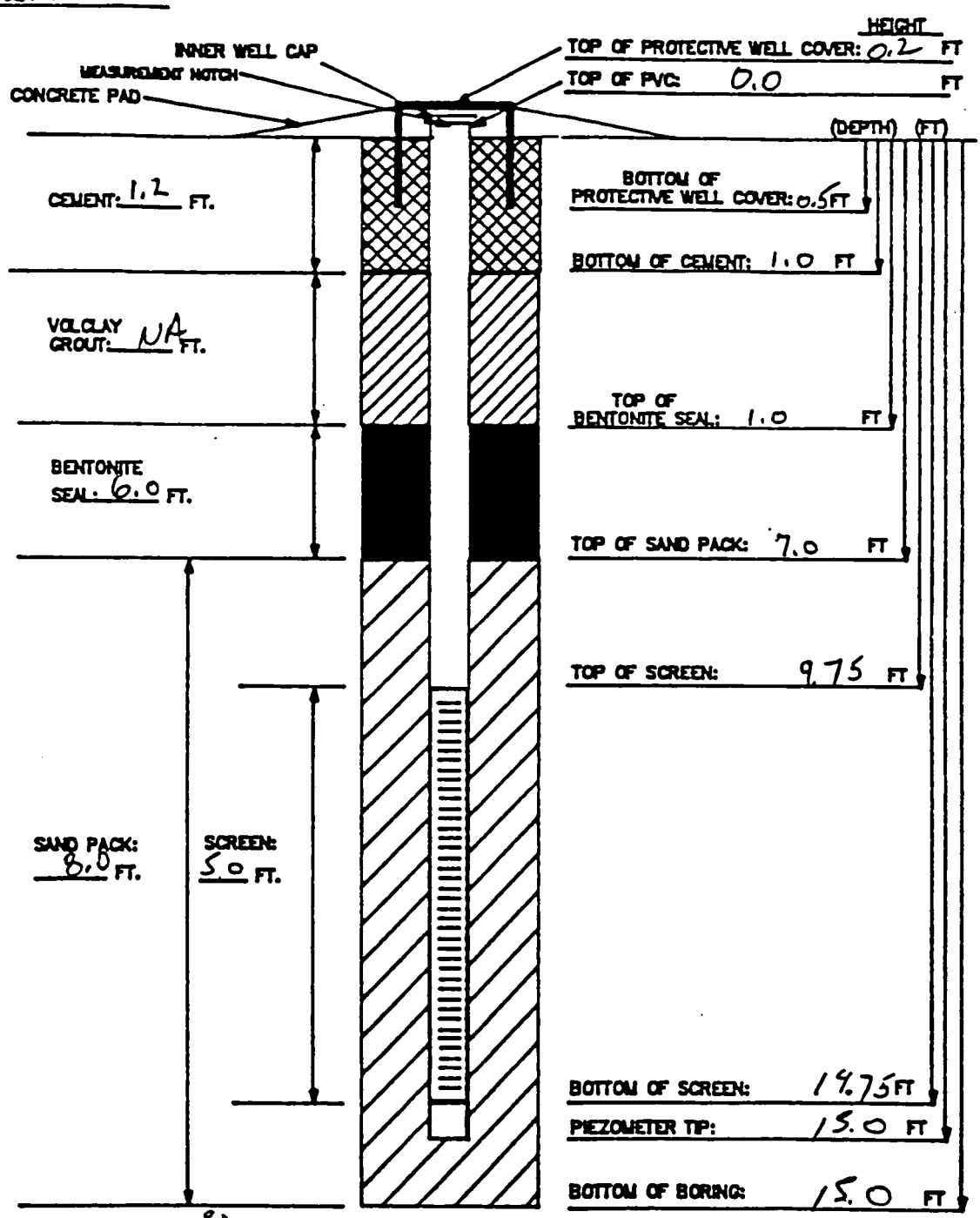
000379

2438-3-88

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1217

INSTALLATION DATE: 11-18-89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 1020/3
BENTONITE PELLETS (5-GALLON BUCKETS): 2 B.
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 0.5
AMOUNT OF WATER USED: 3 gals
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602.3.7 GEOLOGIST/ENGINEER: B. Nies

FERNALD
RI/FS

Date				
Initial				
	Field Check	1st Rev'n	2nd Rev'n	Hard Copy Verification

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: Facilities Testing	
BORING NUMBER: 1220	COORDINATES:	DATE: 5/25/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5/25/89
ENGINEER/GEOLOGIST: L. Sixfield	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS: B-45 Rig: Hollow Stem Auger with Split Spoon Sampler		PAGE 1 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				Gravel at Surface			START = 1030
0.5	17409 WMCO	9	12in	Loose, to Medium Dense, Gravel, Massive, dry	GW	N/A	HNU = Ø ppm α = 60-80 cpm Bγ = 1,500-1,800 cpm
1.0	17410	15					
1.5	17411 NR	15		@ 1035			
2.0	17412	4	6in	Stiff to Very Stiff, Very Dark Grayish Brown (2.5Y, 3/2) Lean Clay with Gravel, dry massive, medium plastic	CL	1.7 ↓ 2.2	HNU = Ø ppm α = 140-200 cpm Bγ = 260-380 cpm
2.5	17413 NR	5					
3.0	17414 NR	8		@ 1040			
3.5	17415	6	12in	Soft, Very dark grayish Brown (2.5Y, 3/2) Lean Clay, dry, massive 3.5ft	CL	<0.5	HNU = Ø ppm α = 10 cpm Bγ = 380-460 cpm
	17416	13		Medium Dense, Silty Gravelly SAND, dry, massive.	SM	N/A	
4.0							
4.5	17417 NR	15		@ 1045			
5.0	17418	10	12in	Medium Dense, Silty Sandy Gravel, becomes wet at Base, massive	GM	N/A	HNU = Ø ppm α = 20-40 cpm Bγ = 400-460 cpm
5.5	17419	10					
6.0	17420 NR	9		@ 1050			
6.5	17421	7	12in	Medium Dense to Loose, Silty Sandy Gravel, wet, massive Grades to Sand at Base	GM	N/A	HNU = Ø ppm α = Ø cpm Bγ = 380-420 cpm
7.0	17422	7					
7.5	17423 NR	8		@ 1055			

NOTES:
Contractor: Penn Drill
Driller: D. Newman
Helper: B. Anderson
Weather: Cloudy-Humid
HNU = B00221
NR = No Recovery, No Sample Taken

Background @ 1030
air Bγ = 200-240 cpm
air α = Ø cpm
HNU = Ø ppm
gnd Bγ = 200-400 cpm
~~gnd α = 40-60 cpm~~ 5-25-89
α(gnd) 180-260 cpm

4C2-11-86

FERNALD
RI/FS

E-1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program		
BORING NUMBER: 1220	COORDINATES:		DATE: 5-25-89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 5-25-89
ENGINEER/GEOLOGIST: L Sinfield	Depth	Date/Time	DATE COMPLETED:
DRILLING METHODS: See Page 1 of 5			PAGE 2 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 1 6IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.5							Start =
8.0	17424	7	6in	Loose, Brownish Yellow (10YR, 6/8) Silty SAND, WET, massive	SM	N/A	HNU = Ø ppm α = Ø cpm Bγ = 180-220 cpm
	NR						
8.5	17425	10					
9.0	17426 NR	10		@ 1115		TSF	
9.5	17427	7		Loose, Same as Above 7.5-9.0 ft	SM	N/A	HNU = Ø ppm α = Ø cpm Bγ = 100-140 cpm
	17428	8	18in				
10.0	17429	10					
10.5				@ 1135		TSF	
11.0	17430	10		Medium Dense, Silty Gravelly SAND, WET, massive,	SM	N/A	HNU = Ø ppm α = Ø cpm Bγ = 100-140 cpm
	52355	15	18in				
11.5	52356	18					
12.0				@ 1145		TSF	
12.5	52357	25		Medium Dense to dense, Silty Gravelly SAND, WET, massive Coarse Sand	SM	N/A	HNU = Ø ppm α = Ø cpm Bγ = 100-140 cpm
	52358	30	18in				
13.0	52359	30					
13.5				@ 1150		TSF	
14.0	52360	8		Loose to Medium Dense Silty Sand, Coarse Sand, WET, massive	SM	N/A	HNU = Ø ppm α = Ø cpm Bγ = 100-120 cpm
	52361	13	18in				
14.5							
15.0	52362 NR	16		@ 1400		TSF	

NOTES: Contractor:
Driller:
Helper:
Sample Tech:
Weather:
HNU #:

See page 1 of 5

Background @ 1500
HNU = Ø ppm
gwd α = 140-160 cpm
AM
YS 5-25-89 Bγ = 140-180 cpm
AM
α = Ø cpm
YS 5-25-89 Bγ = 700-800 cpm

NR = No Recovery, No Sample Taken

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-37.1	PROJECT NAME: Facilities Testing Program		
BORING NUMBER: 1220	COORDINATES:	DATE: 5-25-89	
ELEVATION:	GWL: Depth / Date/Time	DATE STARTED: 5-25-89	
ENGINEER/GEOLOGIST: C. Sinfield	Depth / Date/Time	DATE COMPLETED: 5-25-89	
DRILLING METHODS: See Page 1 of 5		PAGE 3 OF 5	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15.0							Start =
15.5	S2363	6	–	Loose, Silty Coarse Sand, Brownish yellow (10YR 6/6) WET, massive.	SM	N/A	HNU = Ø ppm α = Ø cpm BG = 100-120 cpm
16.0	S2364	8	18in				
16.5	S2365	10		@ 1410		TSF	
17.0	S2366	7		Loose, Silty Coarse to Silty Medium Sand, Brownish Yellow (10YR 6/6) WET, Massive.	SM	N/A	HNU = Ø ppm α = Ø cpm BG = 100-120 cpm
17.5	S2367	8	18in				
18.0	S2368	10		@ 1420		TSF	
18.5	S2369	8	↑	Same As Above 16.5-18.0 ft	SM	N/A	HNU = Ø ppm α = Ø cpm BG = 100-120 cpm
19.0	S2370	8	18in				
19.5	S2371	7	↓	@ 1430.		TSF	
20.0	S2372	6	NR	No Recovery @ 1430	SM	N/A TSF	HNU = N/A ppm α = N/A cpm BG = N/A cpm
				TD = 20.0 ft @ 1430 on 5/25/89			

NOTES: Contractor:
Driller:
Helper:
Sample Tech:
Weather:
HNU #:
} See Page 1 of 5

Background @
HNU = Ø ppm
Air α = Ø cpm
Air BG = 140-180 cpm
good α = 100-140 cpm
good BG = 100-80 cpm

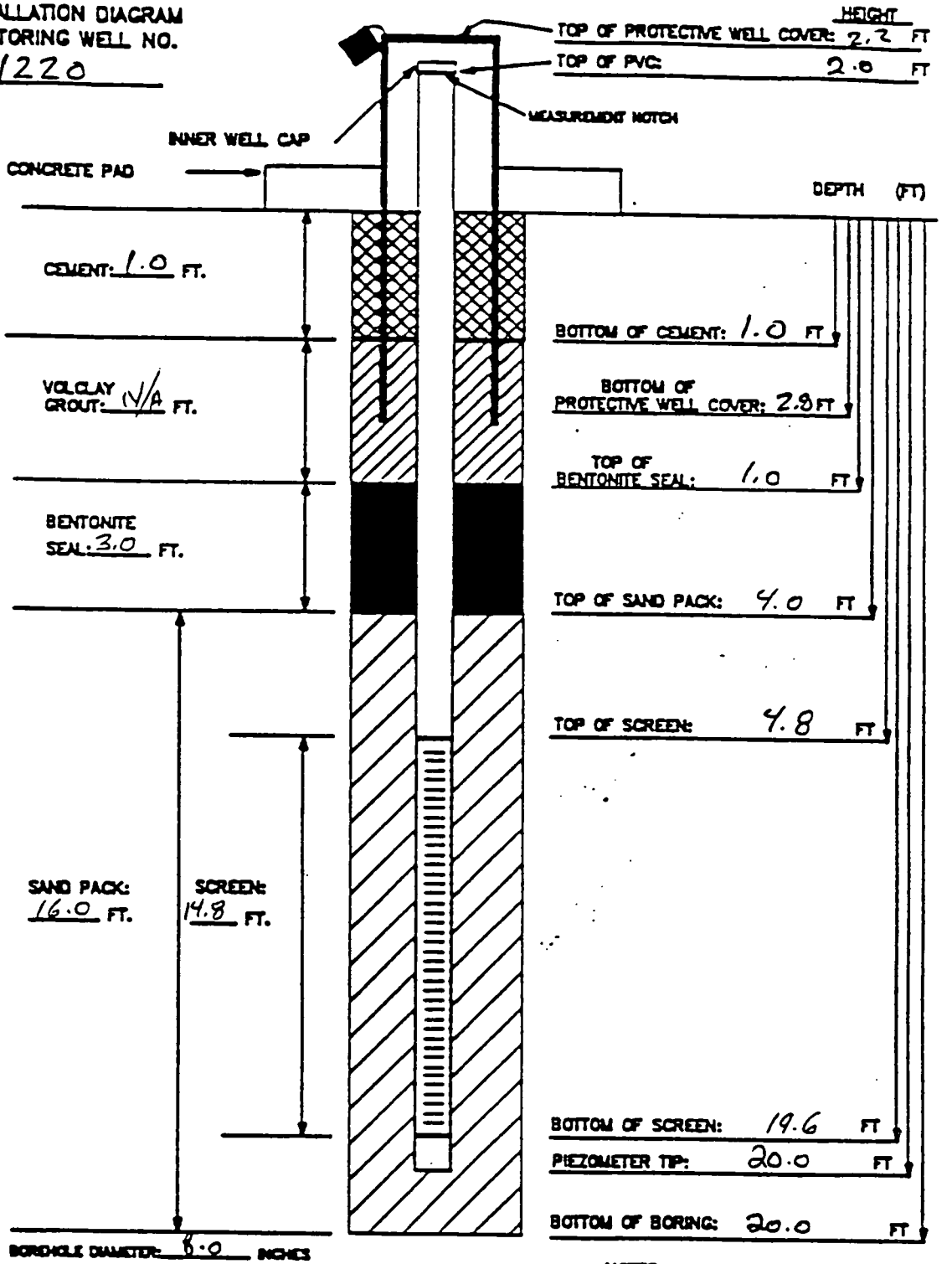
NR = No Recovery, No Sample Taken

ACZ-11-86

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1220

INSTALLATION DATE: 5-25-89



19.6
4.8
14.8

MATERIALS USED:
SAND TYPE AND QUANTITY: 3 Bags 10/20 (30 lb)
BENTONITE PELLETS (5-GALLON BUCKETS): 1
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1 Bag
AMOUNT OF WATER USED: 10 gallons
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE: 8.5 ft gwl

TASK: 602 3.7.1

GEOLOGIST/ENGINEER: L. Sinfield

NALD
FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program				
BORING NUMBER: 1224	COORDINATES:		DATE: 5-16-89		
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 5-15-89		
ENGINEER/GEOLOGIST: L. Sinfield	Depth	Date/Time	DATE COMPLETED: 5-16-89		
DRILLING METHODS: B-45 Hollow Stem Auger with Split spoon Sampler			PAGE 1	OF 5	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 1 6IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							Start = 1515 5/15/89
0.5	17497 WMC	5		Loose, gravel, wet, massive.	GW		HNU = Ø ppm α = Ø cpm Bγ = 700 cpm
1.0	17498	6	10in	Very Stiff, Brownish Yellow (10YR 6/6) Lean Clay, CL - Dry, massive, medium plastic, with Silt, mottled 5/15/89 @ 1515	CL	3.9	
1.5	17499 NR	10				TSF	
2.0	17500	6		Very Stiff, Brownish Yellow (10YR 6/6), Lean clay, CL - Dry, massive, medium plastic with Silt, mottled to grayish Brown (2.5Y, 5/2) 5/15/89 @ 1530	CL	2.7	HNU = Ø ppm α = Ø cpm Bγ = 750-800 cpm
2.5	17501 NR WMC	8	6in				
3.0	17502 NR	9				TSF	
3.5	17503	7		Very Stiff, Grayish Brown (2.5Y, 5/2) mottled, Lean Clay, CL - Dry, massive, medium plastic to Olive Gray (5Y, 4/2 5/15/89 @ 1540	CL	2.0 ↓ 2.4	HNU = Ø ppm α = Ø cpm Bγ = 320-380 cpm
4.0	17504	9	8in				
4.5	17505 NR	10				TSF	
5.0	17506	7		Stiff to Very Stiff, Olive Gray (5Y, 4/2) to Brownish yellow (10YR, 6/8) Lean Clay, Dry massive, medium plastic. 5/15/89 @ 1545	CL	1.2 ↓ 2.4	HNU = Ø ppm α = Ø cpm Bγ = 320-380 cpm
5.5	17507 NR WMC	8	6in				
6.0	17508 NR	9				TSF	
6.5	17509	2		Stiff, dry, Same as above 4.5 → 6.0 ft 5/15/89 @ 1610	CL	1.5 ↓ >7	HNU = Ø ppm α = 5 cpm Bγ = 280-320 cpm
7.0	17510	3	12in				
7.5	17511 NR	5				TSF	

NOTES: Contractor: Penn Drill
Driller: D. Newman
Helper: W. Anderson
Sample Tech: N/A
Weather: Cloudy-cool
HNU #: HH18

5/15/89 Background @ 1400
HNU = Ø ppm
α = Ø cpm
Bγ = 320-380 cpm

NR = No Recovery, No Sample Taken

AC2-11-86

000385

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program		
BORING NUMBER: 1224	COORDINATES:	DATE: 5/17/89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5/15/89	
ENGINEER/GEOLOGIST: L. Sinfield	Depth Date/Time	DATE COMPLETED: 5/16/89	
DRILLING METHODS: See Page 1 of 5		PAGE 2 OF 5	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.5							Start @
8.0	17512	4		Stiff, olive Gray (5Y, 4/2) to Brownish Yellow (10YR, 6/8) lean Clay, Dry, massive, medium plastic	CL	1.1 ↓ 1.7	HNU = ø ppm α = ø cpm Bγ = 300-340 cpm
	17513	7	12in				
8.5							
	17514 NR	7		@ 1615		TSF	
9.0							
	17515	8		Same as above 7.5-9.0 ft	CL	1.1 ↓ 1.8	HNU = ø ppm α = ø cpm Bγ = 300-340 cpm
9.5	17516	12	18in				
10.0				10.0 ft			
	17517 NRCO	14		Medium Dense, Silty, WET, massive 5/15/89 @ 1630	ML	TSF	
10.5							
	17518	6		Very Stiff, Brownish yellow (10YR, 6/8) to Gray (10YR, 4/1) lean Clay, dry, with thin (1/4 in) Silt layers - moist	CL/ML	2.6 ↓ 3.3	HNU = ø ppm α = ø cpm Bγ = 300-400 cpm
11.0	50792	11	18in				
11.5	50793	11		5/16/89 @ 0830		TSF	
12.0							
	50794	10		Very Stiff, Gray (10YR, 4/1) lean Clay, dry, massive, medium plastic	CL	2.6 ↓ 3.0	HNU = ø ppm α = ø cpm Bγ = 300-400 cpm
12.5	50795	14	18in				
13.0							
	50796	16		Medium Dense, Silty Sand, WET, massive 5/16/89 @ 0840	SM	TSF	
13.5							
	50797	6		Loose, Coarse Sand, WET, massive with Silt.	SM	n/a	HNU = ø ppm α = ø cpm Bγ = 300-400 cpm
14.0	50798	7	12in				
14.5							
	50799	11		5/16/89 @ 0850		TSF	
15.0							

NOTES: Contractor:
Driller:
Helper:
Sample Tech:
Weather:
HNU #:
} See Page 1 of 5

5/16/89 Background @ 0800
HNU = ø ppm
α = ø cpm
Bγ = 320-380 cpm

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1224	COORDINATES:	DATE: 5-17-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-15-89
ENGINEER/GEOLOGIST: L. Sinfield	Depth Date/Time	DATE COMPLETED: 5-16-89
DRILLING METHODS: See Page 1 of 5		PAGE 3 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15.0							Start=
	50800 WMCO	10		Very Stiff, Brownish Yellow (10YR, 6/8) 15.9ft	CL	3.7	HNU= 0 ppm
15.5				Medium Dense, Silty Coarse Sand, WET, massive.	SM	N/A	α= 0 cpm
	50801	14	18in				BG= 320-380 cpm
16.0							
	50802	17		@ 0915		TSF	
16.5							
	50803	14		Medium Dense, Silty Coarse Sand, Massive, WET, grading to Medium Dense, Silt, massive, gray (10YR, 4/1)	SM	N/A	HNU= 0 ppm
17.0							α= 0 cpm
	50804	14	18in				BG= 320-380 cpm
17.5							
	50805	15		@ 0925	ML	TSF	
18.0							
	50806	14		Medium Dense to Dense, Silty Coarse Sand, massive, WET.	SM	N/A	HNU= 0 ppm
18.5							α= 0 cpm
	50807	32	18in				BG= 320-380 cpm
19.0							
	50808	35		@ 1008		TSF	
19.5							
	50809	50	6in	Same as above 18.0-19.5ft @ 1008	SM	N/A TSF	HNU= 0 ppm
20.0							α= 0 cpm
				TD=20.0ft.			BG= 320-380 cpm

NOTES: Contractor:
Driller:
Helper:
Sample Tech:
Weather:
HNU#:
See page 1 of 5

5/16/89

Background @ 0800
HNU= 0 ppm
α= 0 cpm
BG= 320-380 cpm

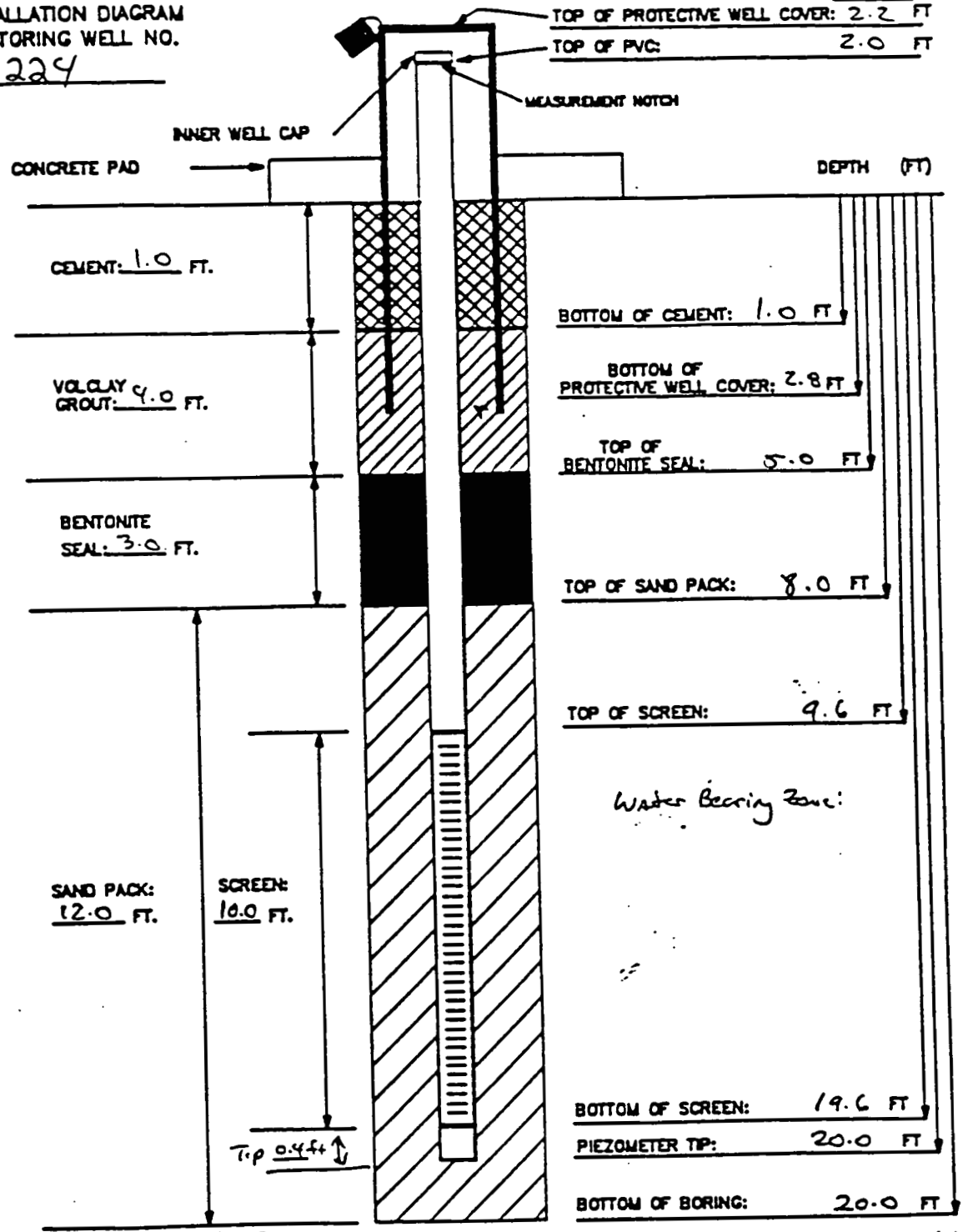
AC2-11-86

000387

INSTALLATION DATE: 5-24-89

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1224



BOREHOLE DIAMETER: 10.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 8 Bags 10/20 80lb
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: 1 Bag (50lb)
AMOUNT OF CEMENT: 1 Bag (50lb)
AMOUNT OF WATER USED: 40 gallons
OTHER: Protector Cover 5' x 4 3/8"

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE: 8.22 TOC 5/24/89 @1000 (8.22 gwl)

Hole 15.00
Cut 6.78
8.22

TASK: 607 3.7.1

GEOLOGIST/ENGINEER: L. Sinfield

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07.01	PROJECT NAME: FMPC RI/FS (Facility Testing)		
BORING NUMBER: 1225	COORDINATES:	DATE: 11/17/89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11/17/89	
ENGINEER/GEOLOGIST: Brad Dunning	Depth Date/Time	DATE COMPLETED: 11/18/89	
DRILLING METHODS: Auger / Hollow Stem - Split Spoon Sampling		PAGE 1 OF 5	

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6-Inches	RECOVERY (Inch)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0.5		N/A	6	CONCRETE			Hnu = 0 α = 0 γβ = 80-100 cpm.
1.0		N/A	6				
1.5	17519 11-17 1435	10	5	Very STIFF OLIVE GRAY (5Y, 4/2) CLAY WITH A TRACE OF GRAVEL Dry Medium Plasticity	CL	3.5	
2.0	17520 11-17 1435	15	4				Hnu = 0 α = 0 γβ = 80-100 cpm.
2.5	17521 11-17 1435	13	NR	~~VERY STIFF MOTTLED OLIVE BROWN (2.5 Y, 4/4) WITH TR GRAVEL. Dry.~~ MG. 11/17/89	CL	3.0	
3.0	17522 11-17 1444	14	NR				
3.5	17523 11-17 1444	20	6	Very STIFF OLIVE BROWN MOTTLED CLAY (2.5 Y, 4/4) WITH A TRACE OF FINE GRAVEL	CL	3.0	Hnu = 0 α = 0 γβ = 80
4.0	17524 11-17 1444	24	4	3.9 Black Very STIFF CLAY (2.5 Y, N/2) Dry medium plasticity			
4.5	17525 11-17 1444	26	NR	NR	NR	—	
5.0	17526 11-17 1508	3	6	VERY STIFF VERY DARK GREY MOTTLED CLAY (10YR, 3/1) 5.4 DRY M.G. 11/17/89	CL	2.5	Hnu = 0 α = 0 γβ = 100-120 cpm
5.5	17527 11-17 1508	6	6				
6.0	17528 11-17 1508	7	6				
6.5	17529 11-17 1514	5	6	VERY STIFF DARK GRAYISH BROWN MOTTLED CLAY (2.5Y, 4/2) 6.7 Medium-Moderate plasticity, Dry	CL	3.0	Hnu = 0 α = 0 γβ = 100-120 cpm
7.0	17530 11-17 1514	7	6	VERY STIFF OLIVE BROWN MOTTLED CLAY (2.5Y, 4/4) Dry			
7.5	17531 11-17 1514	9	6				

NOTES: Contractor : Pennsylvania Drilling
Driller : Craig Coulter
Driller's Assistant : Larry Booth
All Samples collected according to ASTM Standards. Soil Colors described by Munsell Soil Color Charts.

Background Readings/Levels
Hnu = 0 ppm.
Alpha (α) = 0 d.p.m.
Gamma - Beta = 80 d.p.m.

000389

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07	PROJECT NAME: FMPC RI/FS (Facility Testing)	
BORING NUMBER: 1225	COORDINATES:	DATE: 11-17-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11-17-89
ENGINEER/GEOLOGIST: B. Dunning M. Barman	Depth Date/Time	DATE COMPLETED: 11-18-89
DRILLING METHODS: Hollow Stem Auger - Split Spoon Sampling		PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 INCH)	RECOVERY (INCH)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8.0	17532 11-17 1522	6	6	MEDIUM DENSE VERY DARK GRAY MOTTLED CLAYEY SILT (5Y, 3/1)	ML	NA	Hnu = 0 α = 0 γβ = 100-120 cpm
8.5	17533 11-17 1522	7	6	STIFF OLIVE BROWN MOTTLED CLAY (2.5Y, 4/4) MEDIUM PLASTICITY, DRY	CL	1.75	
9.0	17534 11-17 1522	6	6				
9.5	17535 11-17 1604	6	6	MEDIUM DENSE LIGHT OLIVE BROWN (2.5Y, 5/4) MOTTLED SILT. TRACE OF FINE TO COARSE GRAVEL. SLIGHTLY MOIST.	ML	NA	Hnu = 0 α = 0 γβ = 100 cpm
10.0	17536 11-17 1604	7	2	MEDIUM DENSE LIGHT OLIVE BROWN (2.5Y, 5/4) CLAYEY SILT TRACE OF SAND. MOIST.	ML	NA	
10.5	17537 11-17 1604	9	0	NO RECOVERY			
11.0	17538 11-17 1608	9	6	STIFF GRAYISH BROWN (2.5Y, 5/2) CLAY. TRACE OF FINE TO COARSE GRAVEL. MOIST.	CL	2	Hnu = 0 α = 0 γβ = 100 cpm
11.5	17539 11-17 1608	11	6	SAA			
12.0	17540 11-17 1608	13	6	MEDIUM DENSE LIGHT OLIVE BROWN (2.5Y, 5/4) SILTY SAND. VERY MOIST.	SM ~~ML~~ M.G.	NA	
12.5	52435 11-17 1612	9	6	MEDIUM DENSE LIGHT OLIVE BROWN (2.5Y, 5/4) SILTY SAND. TRACE OF FINE TO COARSE GRAVEL. WET	SM	NA	Hnu = 0 α = 0 γβ = 100 cpm
	52436 11-17 1612	14	6	SAA			
13.0	52437 11-17 1612	13	6	STIFF LIGHT OLIVE BROWN (2.5Y, 5/4) CLAYEY SILT. WET. SAA	ML ~~CL~~ M.G.	2	
13.5	52438 11-17 1622	15	0	No Recovery			Hnu = 0 α = 0 γβ = 0 } NR
14.0	52439 11-17 1622	19	0				
14.5	52440 11-17 1622	13	0				
15.0							

NOTES:

SEE PAGE 1

402-11-86

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07	PROJECT NAME: FMPC RI/FS (Facility Testing)		
BORING NUMBER: 1225	COORDINATES:	DATE: 11-17-89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11-17-89	
ENGINEER/GEOLOGIST: B. Dunning M. Garman	Depth Date/Time	DATE COMPLETED: 11-18-89	
DRILLING METHODS: Hollow Stem Auger - Split Spoon Sampling		PAGE 3 OF 5	

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 Inch)	RECOVERY (Inch)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15.5	52441 11-17 1630	4	6	MEDIUM DENSE LIGHT OLIVE BROWN (2.5Y, 5/6) CLAYEY SILT. TRACE OF SAND. WET.	ML	NA	Hum = C α = D γB = 100
16.0	52442 11-17 1630	7	6	SAA			
	52443 11-17 1630	8	6	SAA			
16.5				MEDIUM STIFF GRAYISH BROWN (2.5Y, 5/2) SILTY CLAY. MOIST.	CL	.75	
17.0				Boring Drilled To A Total Depth of 16.5 Ft.			Hum = α = γB =
17.5				- Piezometer Installed. -			
18.0							
18.5							Hum = α = γB =
19.0							
19.5							
20							Hum = α = γB =

NOTES:

SEE PAGE 1

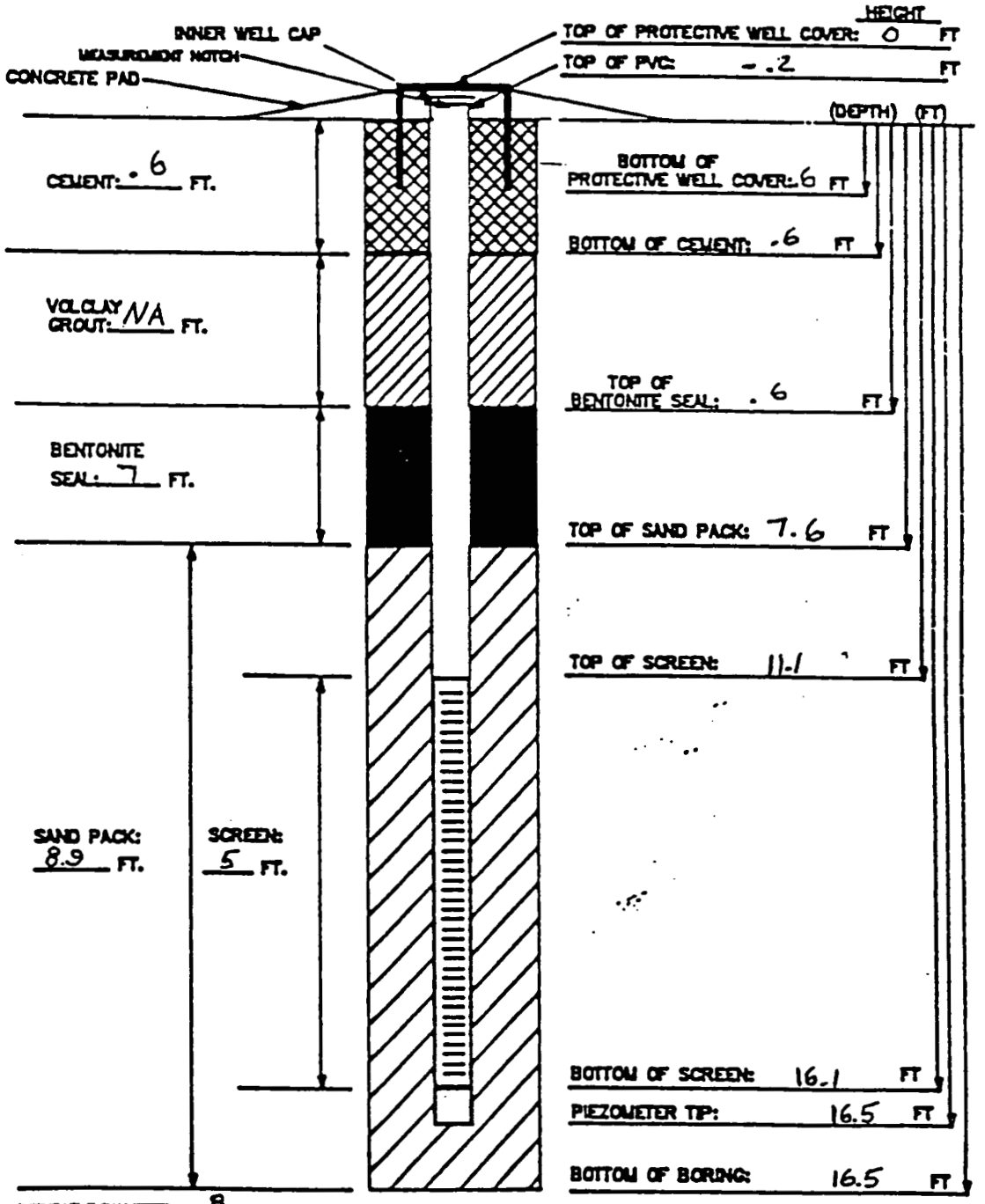
000391

402-11-88

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1225

INSTALLATION DATE: 11\18\89



BOREHOLE DIAMETER: 8 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: (1020) 3 80lb. sks
BENTONITE PELLETS (5-GALLON BUCKETS): 3
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: .75 gal.
AMOUNT OF WATER USED: 3 gal.
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 3.7. GEOLOGIST/ENGINEER: Mark Garman

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program		
BORING NUMBER: 1227	COORDINATES:	DATE: 5-12-89	
ELEVATION:	GWL: Depth / Date/Time	DATE STARTED: 5-12-89	
ENGINEER/GEOLOGIST: L. Sinfield	Depth / Date/Time	DATE COMPLETED: 5-14-89	
DRILLING METHODS: B-53 Rig: Hollow Stem Auger with Split Spoon Sampler		PAGE 1 OF 4	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	Note: 6 Total pages with field copies enclosed REMARKS Start = 1600
0.5	17563 wmco	@1500 N/a	N/a	Asphalt 0.0 → 0.25 ft	N/a		HNU = ∅ ppm
	17564	N/a	N/a	Concrete 0.25 → 1.0 ft	N/a		α = 10-15 cpm
1.0							BG = 200-250 cpm
	17565	4	2in	Loose, gravel, with Silt and sand, massive, ~~wet~~ moist 5-14-89 @ 1600	GM	TSF	BG = 80-120 cpm @ 1.0→1.5 ft
1.5							
2.0	17566 NR	4	12in	Loose, Sand with gravel, micaceous, massive, moist 2.5 ft	SM		HNU = ∅ ppm α = ∅ cpm BG = 80-120 cpm
2.5	17567 wmco	4					
	17568	5		Stiff to Very Stiff, Dark greyish brown (2.5Y 4/2) Clay, dry, massive @ 1605	CL	1.1→2.7 TSF	
3.0							
3.5	17569 NR	4	6in	Very Stiff, Dark Greyish Brown (2.5Y, 4/2) Lean Clay, dry massive, medium plastic	CL	2.3	HNU = ∅ ppm α = ∅ cpm BG = 120-140 cpm
	17570	5					
4.0							
	17571 NR	6		@ 1607		TSF	
4.5							
	17572	5	12in	Loose, Silty Sand, ~~with~~ clay ~~dry~~, massive, moist. 5-14-89	SM	Soft 0.2	HNU = ∅ ppm α = ∅ cpm BG = 80-120 cpm
5.0							
	17573 wmco	7		Grades to Soft, Brownish yellow (10YR, 6/6) clay, moist, massive medium plastic @ 1612	CL		
5.5							
	17574 NR	9				TSF	
6.0							
	17575	5	12in	Soft, Brownish Yellow (10YR, 6/6) clay, moist, massive, medium plastic	CL	0.2 Soft	HNU = ∅ ppm α = ∅ cpm BG = 80-120 cpm
6.5							
	17576	7					
7.0							
	17577 NR	5		@ 1645		TSF	
7.5							

NOTES: Contractor: Penn Drill
Driller: J. Saccani
Helper: G. Dye
Sample Tech: C. Melroy
Weather: Cloudy
HNU #: HH18

Water Bearing Zone: 8.0 → 11.0 ft.

Background @ 1600
HNU = ∅ ppm
Air α = ∅ cpm
Air BG = 80-120 cpm
gnd α = ∅ cpm
gnd BG = 300-500 cpm

NR* = No Recovery, No Sample Taken

000393

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program		
BORING NUMBER: 1227	COORDINATES:	DATE: 5-12-89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-12-89	
ENGINEER/GEOLOGIST: L. Sintzel	Depth Date/Time	DATE COMPLETED: 5-14-89	
DRILLING METHODS: See Page 1 of 4		PAGE 2 OF 4	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.5							Start=
8.0	17578	5		Soft, Brownish Yellow (10YR 6/6), Clay, moist, massive, medium plastic. 7.0 ft	CL		HNU= ø ppm α= ø cpm Bγ= 100-120 cpm
8.5	17579	7	12in	Loose, Silty Sand, Brownish Yellow (10YR, 6/8), Wet, massive, @ 1649	SM	TSF	
9.0	17580 NR	8					
9.5	17581	6		Same as above 8.0-9.0 ft			HNU= ø ppm α= ø cpm Bγ= 100-110 cpm
10.0	17582	7	18in	Laminated in places	SM		
10.5	17583 NRCO	9		@ 1655		TSF	
11.0	17584	5		Same as above 8.0-10.5 ft	SM		HNU= ø ppm α= ø cpm Bγ= 80-100 cpm
11.5	50753	5	18in	Soft to Very Stiff, Gray (10YR, 4/1) Lean clay - dry, massive medium plastic	CL	0.2 ↓ 3.2	
12.0	50754	6		@ 1700		TSF	
12.5				TD= 12.0 ft on 9/12/89 @ 1700			HNU= ppm α= cpm Bγ= cpm
13.0							
13.5						TSF	
14.0							HNU= ppm α= cpm Bγ= cpm
14.5							
15.0						TSF	

Water Bearing Zone

NOTES: Contractor:
Driller:
Helper:
Sample Tech:
Weather:
HNU #:
} See page 1 of 4

Water Bearing Zone: 8.0 → 11.0 ft

See Page 1 of 4 →

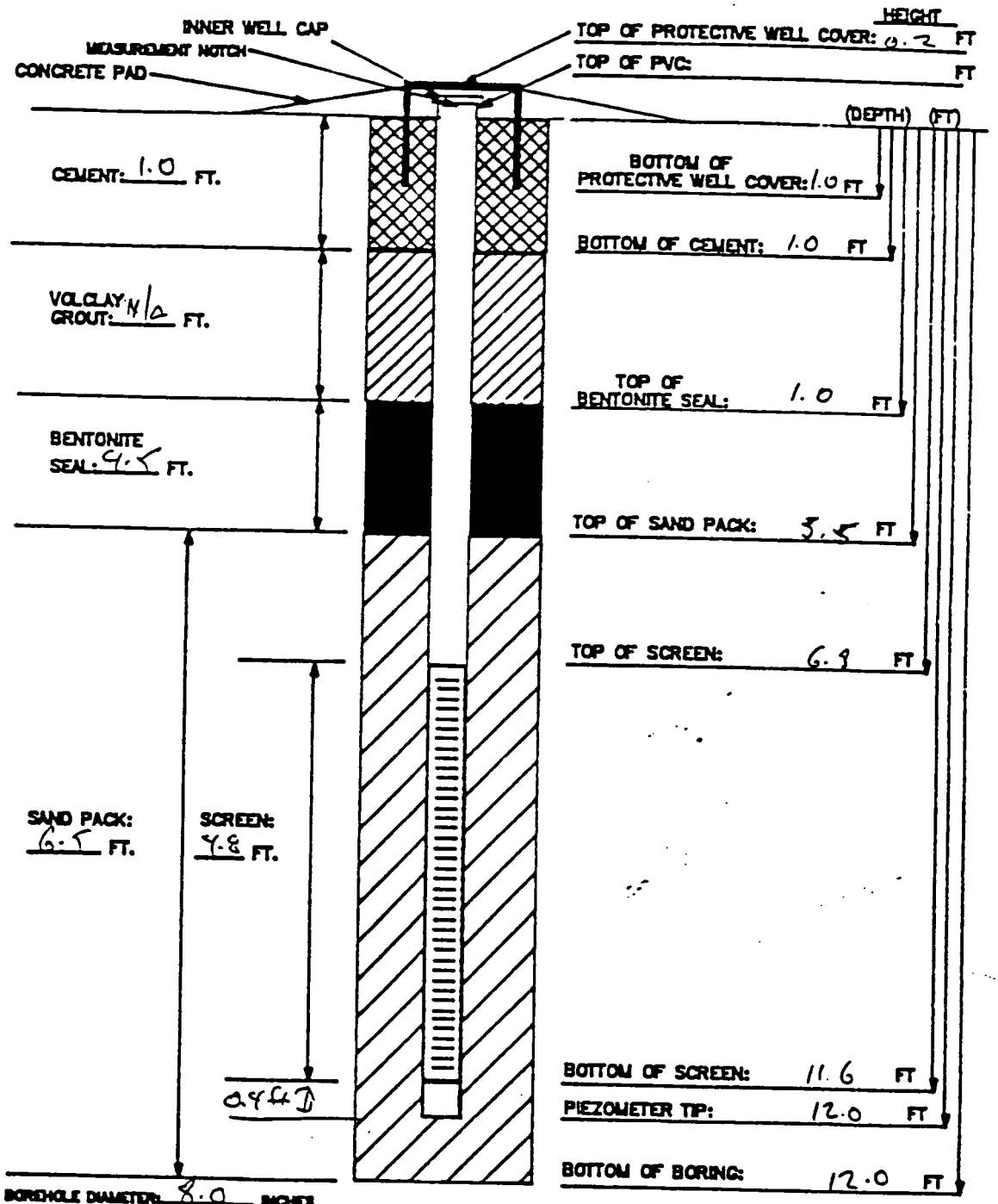
Background @
HNU= ppm
α= cpm
Bγ= cpm

NR= No Recovery, No Sample Taken

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1227

INSTALLATION DATE: 5-14-89



MATERIALS USED:

SAND TYPE AND QUANTITY: 3 bags 10/20 Sand
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: N/a
AMOUNT OF CEMENT: 1 Bag (50 lb)
AMOUNT OF WATER USED: 60 gal (10 gal)
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 6C 2 3.7.1 GEOLOGIST/ENGINEER: C. Sinfield

000395

FERNALD RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1230	COORDINATES:	DATE: 5/11/89	
ELEVATION:	GWL: Depth / Date/Time	DATE STARTED: 5/11/89	
ENGINEER/GEOLOGIST: C. Grubb / L. Adams	Depth / Date/Time	DATE COMPLETED: 5/12/89	
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	17629 1406 5-11-89	12	6	Surface gravel. 10yr 3/6, dark yellowish brown (10yr 3/6) silty sandy clay, trace fine gravel, dry	SM	N/A	HNU: 0ppm α: 0cpm Bγ: 90-100 cpm
1	17630 1406 5-11	13	6	Very stiff, yellowish brown (10yr 5/6) silty clay moist, low plasticity	CL	3.0	
	17631 1406 5-11	8	0	no recovery	N/A	N/A	
2	17632 1424 5-11-89	10	6	Stiff, yellowish brown, (10yr 5/4) sandy clay, low plasticity, slightly moist.	CL	1.5	HNU: 0ppm α: 0cpm Bγ: 60-80 cpm
	17633 1424 5-11-89	12	0	no recovery	N/A	N/A	
3	17634 1424 5-11-89	15	0	no recovery	N/A	N/A	
	17635 1429 5-11-89	15	1	Dark yellowish brown (10yr 4/4) silty clay, moist, med. plasticity	CL	*	HNU: 0 ppm α: 0 cpm Bγ: 60-70 cpm
4	17636 1429 5-11-89	25	0	no recovery	N/A	N/A	*unable to measure due to small amount of recovery
	17637 1429 5-11-89	25	0	no recovery	N/A	N/A	
5	17638 1435 5-11-89	24	6	Very stiff, dark gray, (5Y 4/1) to yellowish brown (10yr 5/6) silty clay, med. plasticity. 1 in. surface gravel-size section moist	CL	2.25	HNU: 0 ppm α: 0 cpm Bγ: 60-80 cpm
	17639 1435 5-11-89	26	6	Very stiff, yellowish brown (10yr 5/6) silty clay, low plasticity moist	CL	2.5	
6	17640 1435 5-11-89	23	2	Stiff, Same as above	CL	1.0	
	17641 1522 5-11-89	2	6	Very stiff, yellowish brown (10yr 5/6) med. plasticity clay. Moist	CL	2.75	HNU: 0ppm α: 0 cpm Bγ: 40-60 cpm
7	17642 1522 5-11-89	6	5	Very stiff Same as above	CL	2.5	
	17643 1522 5-11-89	6	0	no recovery	N/A	N/A	

NOTES: CONTRACTOR: PENN DRILL
RIG: Model 80
DRILLER: Craig Coulter
ASSISTANT: Chris Coulter

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0 CPM
Bγ = 30-70 CPM
LEL/O_2: LEL = 0 %
O_2 = 20.6 %

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1230	COORDINATES:	DATE: 5/11/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5/11/89
ENGINEER/GEOLOGIST: C.Grubel L.Adams	Depth Date/Time	DATE COMPLETED: 5/12/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	17644 1526 5-11-89	9	6	Mot. stiff, yellowish brown (10yr 5/6) silty clay. low plasticity, moist.	CL	.75	HNU = 0ppm α = 0cpm Bγ = 60-80 cpm
	17645 1526 5-11-89	8	6	very stiff same as above	CL	3.5	
	17646 1526 5-11-89	11	3	very stiff, yellowish brown (10yr 5/6) silty clay (very silty) low plasticity very moist.	CL	2.25	
FT 9	17647 ~~1531~~ 1552 5-11-89	5	6	Yellowish brown (10yr 5/6) silt wet.	ML	N/A	HNU = 0ppm α = 0cpm Bγ = 60-80 cpm
10	17648 ~~1531~~ 1552 5-11-89	11	4	* SAA	ML	N/A	
	17649 ~~1531~~ 1552 5-11-89	14	0	no recovery	N/A	N/A	
11	17650 1555 5-11-89	3	6	Yellowish brown (10yr 5/6) silt. very wet.	ML	N/A	HNU = 0ppm α = 0 cpm Bγ = 80-100 cpm
	50724 1555 5-11-89	4	6	SAA	ML	N/A	
12	50725 1555 5-11-89	7	5	Brown (10yr 5/3) silt. Trace sand. wet.	ML	N/A	
13	50726 1604 5-11-89	11	6	Grayish Brown (2.5Y 5/2) silt wet.	ML	N/A	HNU = 0 ppm α = 0 cpm Bγ = 60-80 cpm
	50727 1604 5-11-89	8	6	same as above	ML	N/A	
	50728 1604 5-11-89	12	2	Grayish brown (2.5Y 5/2) sandy silt. wet.	ML	N/A	
14	50729 1614 5-11-89	10	6	Grayish brown (2.5Y 5/2) silty sand. Poorly graded. very moist	ML	N/A	HNU = 0ppm α = 0cpm Bγ = 60-70 cpm
	50730 1614 5-11-89	17	6	SAA	ML	N/A	
	50731 1614 5-11-89	24	6	SAA very moist to wet	ML	N/A	

NOTES:

* SAA = same as above

000397

FERNALD
RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1230	COORDINATES:	DATE: 5/11/89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5/11/89	
ENGINEER/GEOLOGIST: C. Grubb/L. Ahmad	Depth Date/Time	DATE COMPLETED: 5/12/89	
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	50732 1630 5-11	3	6	med. dense, grayish brown (2.5Y 5/2) silt Trace coarse sand. moist	ML	N/A	HNU = 0 α = 0 BS = 60-80
	50733 1630 5-11	5	6	* SAA	ML	N/A	
16	50734 1630 5-11	8	4	med. dense, grayish brown clayey silt (2.5Y-5/2) Trace coarse sand. wet.	ML	N/A	
	50735 1640 5-11	8	6	med. dense, Grayish brown (2.5Y 5/2) very silty sand, well graded, some gravel wet.	ML	N/A	HNU = 0 α = 0 BS = 60-80
17	50736 1640 5-11	12	6	med. dense, Grayish brown (2.5Y 5/2) sandy silt. very moist.	ML	N/A	
	50737 1640 5-11	15	6	SAA wet	ML	N/A	
18	50738 1652 5-11	8	6	SAA w/ trace fine gravel	ML	N/A	HNU = 0 α = 0 BS = 60-80
	50739 1652 5-11	8	6	SAA	ML	N/A	
19	50740 1652 5-11	12	6	SAA	ML	N/A	
19.5 FT							
	50741 1652 5-11	13	6	St. ff, grayish brown (2.5Y 5/2) silty clay trace sand + gravel (to .25-1.5 in.) very moist	CL	3.25	HNU = 0 α = 0 BS = 60-80
20				Bottom of boring + sampling at 20.0 FT.			

NOTES:

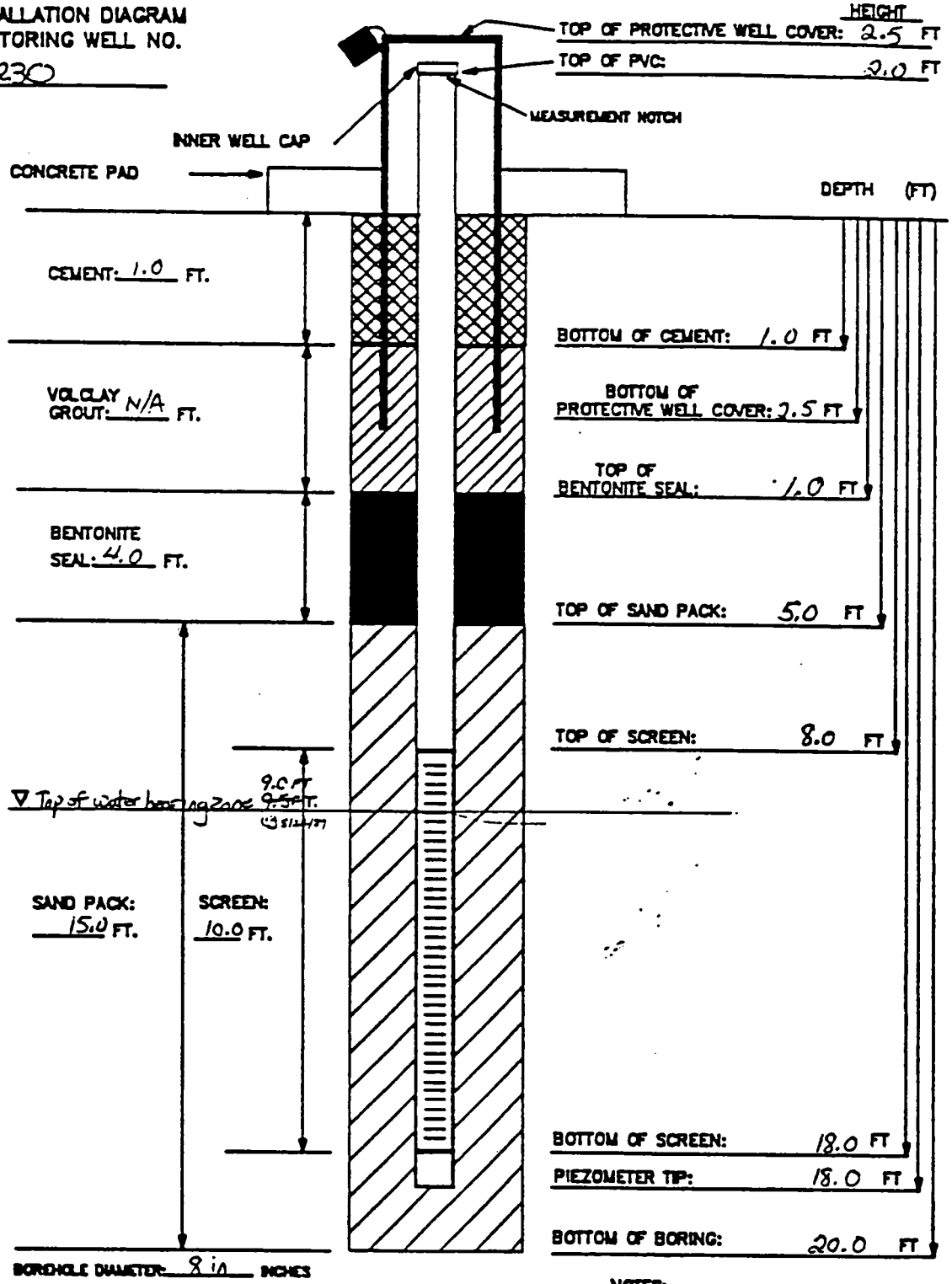
* SAA = Same as above.

000398

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1230

INSTALLATION DATE: 5-12-89



BOREHOLE DIAMETER: 8 in INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand - 6 bags (80#)
BENTONITE PELLETS (5-GALLON BUCKETS): 2 buckets
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: ½ sack (50# bag)
AMOUNT OF WATER USED: 70 gal.
OTHER: 5.0 FT protective casing

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube / L. Adams

FERNALD RI/FS

1507

Initial				
	Field Check	1st Ker.	2nd Ker.	Final Copy Verification

8608 → 788
Greg C. Coord

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: ~~1233~~ 1233	COORDINATES:	DATE: 6-1-89
ELEVATION: 5	GWL: Depth Date/Time	DATE STARTED: 5-31-89
ENGINEER/GEOLOGIST: L. Sinfield	Depth Date/Time	DATE COMPLETED: ~~6-1-89~~ 6-1
DRILLING METHODS: B-45 Rig: Hollow Stem Auger with Split Spoon Sampler		PAGE 1 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				Surface = Concrete			Start = 1110
0.5	17695 wmco	n/a	Grab	Concrete	n/a	n/a	HNU = Ø ppm α = 10 cpm Bγ = 140-180 cpm
	17696	n/a	Grab	0.3ft			
1.0	17697	n/a	Grab	Soft, silty sandy Gravelly Clay Dry, massive @1150	CL	— TSF	concrete α = 60-80 cpm Bγ = 380-420 cpm
1.5	17698 NR	6	12in	Stiff to Very Stiff, Brownish Yellow (10YR, 6/8) Lean Clay with silt, dry, massive medium plastic, rare gravel @1350	CL	1.6 ⇓ 2.6 TSF	HNU = Ø ppm α = Ø cpm Bγ = 280-320 cpm
2.0	17699 wmco	7					
2.5	17700	15					
3.0	17701 NR	12	12in	Stiff to Hard, Dark Gray (10YR, 4/4) Lean Clay, dry, massive, medium plastic, mottled @1355	CL	1.6 ⇓ 4.5 TSF	HNU = Ø ppm α = Ø cpm ~~Bγ = 260-320 cpm~~ YS 5-31-89 Bγ = 100-120 cpm
3.5	17702	8					
4.0	17703	8					
4.5	NR 17704	8	6in	Stiff, Brownish Yellow (10YR, 6/6-6/8) mottled Lean Clay with Silt, dry massive, medium plastic @1400	CL	1.7 TSF	HNU = Ø ppm α = Ø cpm Bγ = 100-120 cpm
5.0	NR 17705 wmco	11					
5.5	17706	11					
6.0	17707	3	18in	Stiff, Mottled Dark Gray (10YR, 4/4) to Brownish Yellow (10YR, 6/8) Lean Clay with Silt and Sand, dry, massive, base = Silty Sand @1430	CL	1.7 TSF	HNU = Ø ppm α = Ø cpm Bγ = 100-120 cpm
6.5	17708	3					
7.0	17709	3			NL		
7.5							

7.25 ▽

NOTES: Contractor: Pease Drill
Driller: Dave Newman
Helper: W. Anderson
Sample Tech: D. Foster
Weather: Clear, warm (90°F), Humid
HNU #: HH10

5/31/89 Background @0900
HNU = Ø ppm
α = Ø cpm
NR Bγ = 180-240 cpm
gsl α = 60-80 cpm
gsl Bγ = 380-440 cpm

NR = X/o Recovery, X/o Sample Taken

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program		
BORING NUMBER: 1233	COORDINATES:	DATE: 6-1-89	
ELEVATION:	GWL: Depth / Date/Time	DATE STARTED: 5-31-89	
ENGINEER/GEOLOGIST: L. Sinfield	Depth / Date/Time	DATE COMPLETED: 6-1-89	
DRILLING METHODS: See Page 1 of		PAGE 2 OF 5	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.5							Start =
8.0	17710 NR	2	6IN	Loose, Brownish Yellow (10YR, 6/8) Silty Sand, WET, massive	SM	N/A	HNU = Ø ppm α = Ø cpm Bγ = 100-120 cpm
8.5	17711 NR	7					
	17712	8		@1440		TSF	
9.0							
9.5	17713	7	18IN	Same as Above 7.5-9.5ft Becomes coarse silty sand at 10ft	SM	N/A	HNU = Ø ppm α = Ø cpm Bγ = 100-120 cpm
	17714	8					
10.0	17715 NRCO	10		@1450		TSF	
10.5							
11.0	17716 NR	6	6IN	Loose, Brownish Yellow (10YR, 6/8) Silty Sand (Coarse) WET, massive. 0.5ft thick Gray (10YR, N5) Lean Clay, WET, Stiff, medium plastic	SM	N/A	HNU = Ø ppm α = Ø cpm Bγ = 100-120 cpm
11.5	52535 NR	6			? CL	1.6	
12.0	52536	9		@1520	SM	TSF	
12.5	52537	3	18IN	Same as Above 10.5-12.0ft	SM	N/A	HNU = Ø ppm α = Ø cpm Bγ = 100-120 cpm
13.0	52538	5		12.2ft 12.8ft	CL	1.7	
13.5	52539	8		@1540	SM	N/A TSF	
14.0	52540	10	18IN	Medium Dense Brownish Yellow (10YR, 6/8) Silty Sand with gravel, massive, WET	SM	N/A	HNU = Ø ppm α = Ø cpm Bγ = cpm
14.5	52541	13					
15.0	52542	15		@1555		TSF	

NOTES: Contractor:
Driller:
Helper:
Sample Tech:
Weather:
HNU #:
} See page 1 of 5

Background @ 1330
HNU = Ø ppm
Air α = Ø cpm
Air Bγ = 180-220 cpm
gnd α = 60-80 cpm
gnd Bγ = 380-440 cpm

000401

FERNALD
RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1233	COORDINATES:	DATE: 6-1-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-31-89
ENGINEER/GEOLOGIST: L. Sinfield	Depth Date/Time	DATE COMPLETED: 6-1-89
DRILLING METHODS: See Page 1 of 5		PAGE 3 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15.0				JK 5-31-89			Start=
15.5	52543	5		Loose, Mot Brownish Yellow (10YR,6/8) to Gray (10YR,6/1) Silty SAND, Coarse, WET, massive	SM	N/A	HNU= ø ppm α= ø cpm BG= 100-120 cpm
16.0	52544	7	18in				
16.5	52545	9		@1620		TSF	
17.0	52546	8		Loose, Gray (10YR,6/1) Coarse Silty Sand, WET massive with gravel and 1/2in clay layers.	SM	N/A	HNU= ø ppm α= ø cpm BG= 100-120 cpm
17.5	52547	9	18in				
18.0	52548	10		@1630		TSF	
18.5	52549	7	24in	Same as above	SM	N/A	HNU= ø ppm α= ø cpm BG= 100-120 cpm
19.0	52550	7					
19.5	52551	8		@1640		TSF	
20.0	52552	9		@1640	SM	N/A TSF	HNU= ø ppm α= ø cpm BG= 100-120 cpm
				TD = 20.0 ft @1640 5/31/89			

NOTES: Contractor:
Driller:
Helper:
Sample Tech:
Weather:
HNU#:

See page 1 of 5

Background @ 1605
HNU= ø ppm
Air α= ø cpm
Air BG= 180-220 cpm
gnd α = 60-80 cpm
gnd BG= 380-440 cpm

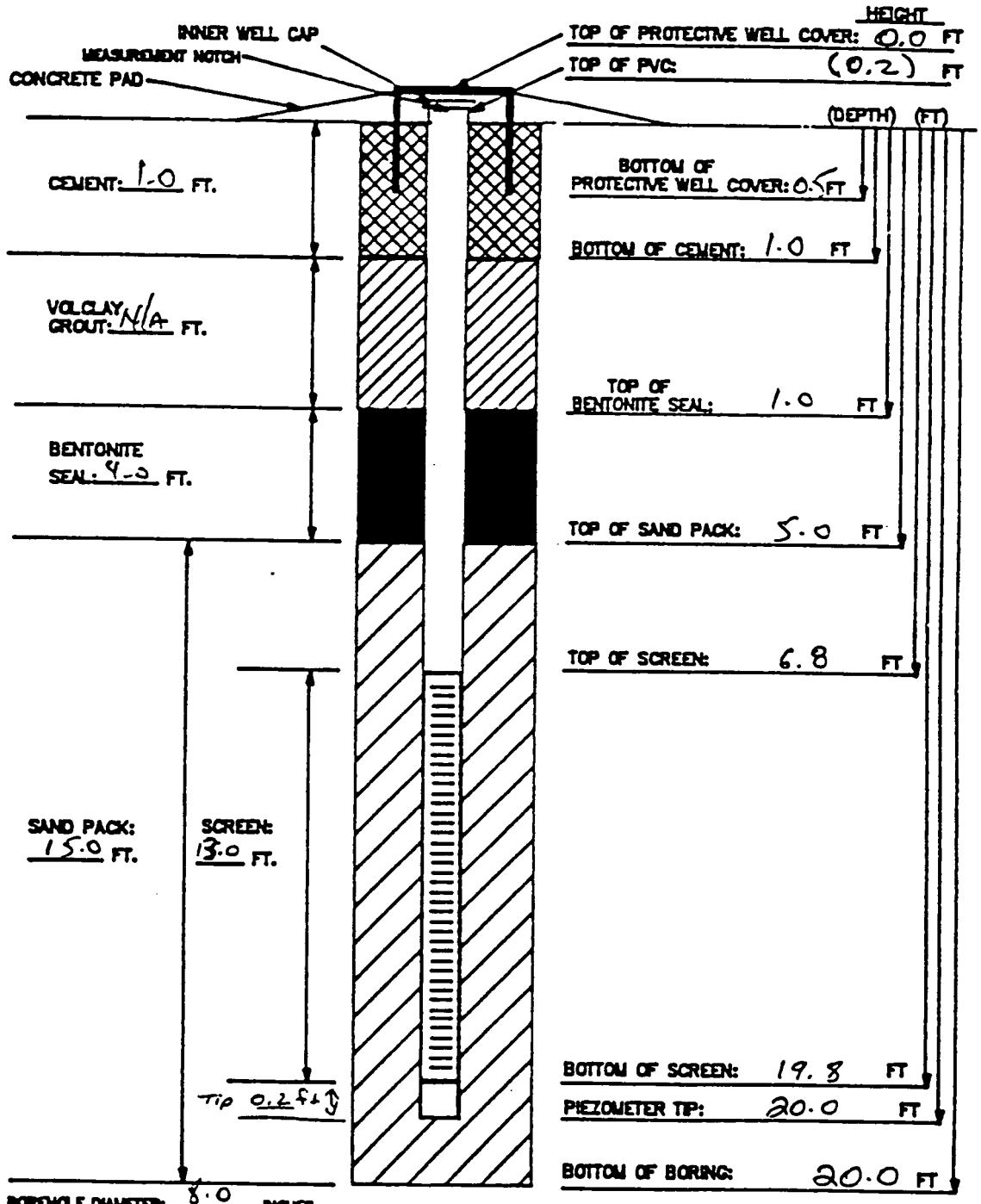
1/1

000402

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1233

INSTALLATION DATE: 6-1-89



MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 SAND - 80 lb Bags
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1/2 Bag
AMOUNT OF WATER USED: 20 gallons
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE: 7.2 ground surface / 5-1-89 0930
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7.1 GEOLOGIST/ENGINEER: L. Sinfield

FERNALD RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602- 3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1236	COORDINATES:	DATE: 5-14-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-14-89
ENGINEER/GEOLOGIST: L. Sintrecl	Depth Date/Time	DATE COMPLETED: 5-14-89
DRILLING METHODS: B-53, Hollow Stem Auger with Split Spoon Sampler		PAGE 1 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (Note: 6 total pages with field copies enclosed.) Start = 1030
0.5	17761 WMCO	3	6in	Loose, Gravel, dry, massive, angular, with Base of Stiff, Lean Clay, Brownish Yellow (10YR 6/8), dry, medium plastic, mottled. @ 1040	GM ↓ CL	1.5 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 600-700 cpm; α = Ø cpm, Bγ = 600-700 @ 1.0-1.5 ft
1.0	17762 NR	3	NR				
1.5	17763 NR	2	NR				
2.0	17764	1	6in	Poor Recovery due to large Amounts of Gravel, wet, massive, rounded @ 1042	CL ↓ GP	0.2 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 600-700 cpm
2.5	17765 NR WMCO	↑ 1 for 1.0 ft ↓	NR				
3.0	17766		NR				
3.5	17767	3	6in	Loose, Gravel, clean, wet, massive @ 1045	GP	Loose TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 200 cpm
4.0	17768	↑ 1 for 1.0 ft ↓	NR				
4.5	17769		NR				
5.0	17770	5	6in	Loose, Gravel, Clean, wet, massive, little to no fines @ 1050	GP	Loose TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 200-240 cpm
5.5	17771 WMCO	5	NR				
6.0	17772	2	NR				
6.5	17773	2	6in	Loose, Sand and Gravel, Wet, massive, with clay, CL-Brown Yellow (10YR, 6/8). @ 1105	SM ↓ GM	Loose TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 600 cpm
7.0	17774	5	6in				
7.5	17775	10	NR				

Top of Water Bearing Zone

NOTES: Contractor: Penn Drill
Driller: J. Saccani
Helper: G. Dye
Sample Tech: D. Da
Weather: cloudy-cool
HNU #: HH18

Water Bearing Zone: 7.0 - 12.5 ft

Background @ 0930
HNU = Ø ppm
Air α = Ø cpm
Air Bγ = 200-260 cpm
gnd α = Ø cpm
gnd Bγ = 1000-1200 cpm

NR* = No Recovery, No Sample Taken

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1236	COORDINATES:	DATE: 5-14-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-14-89
ENGINEER/GEOLOGIST: L. Sinfield	Depth Date/Time	DATE COMPLETED: 5-14-89
DRILLING METHODS: B-53, Hollow Stem Auger with Split Spoon Sampler		PAGE 2 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.5							Start=
8.0	17776	4	6in	Loose, gravel with silt, massive, wet	GM	N/A	HNU= ø ppm; α= ø cpm; Bγ=300-500 cpm
8.5	17777	4	6in	Loose, silty sand, wet massive with clay.	SM	Loose	
9.0	NR 17778	4	NR1	@ 1110		TSF	
9.5	17779	5	6in	Loose, silty sand, wet massive, some laminations Brownish yellow (10YR 6/8)	SM	Loose	HNU= ø ppm; α= ø cpm; Bγ=300-500 cpm
10.0	17780	5	6in				
10.5	17781	7	NR	@ 1115		TSF	
11.0	17782 N	10	6in	Loose to Medium Dense, Same as above	SM	Loose	HNU= ø ppm; α= ø cpm; Bγ=300-500 cpm
11.5	50776	12	6in				
12.0	50776 NR	14	NR	@ 1120		TSF	
12.5	50777	3	6in	Same as above 12.5ft	SM		HNU= ø ppm; α= ø cpm; Bγ=300-500 cpm
13.0	50778	5	6in	Stiff, Brg (10YR 4/1), Lean Clay, Dry, massive, medium plastic.	CL	1.2	
13.5	50779 NR	9	NR	@ 1150		TSF	
14.0				TD= 13.5 ft on 5/14/89 @ 1150			HNU= ppm; α= cpm; Bγ= cpm
14.5							
15.0				@		TSF	

NOTES: Contractor:
Driller:
Helper:
Sample Tech:
Weather:
HNU #:

See page 1 of 4

Water Bearing Zone: 7.0 - 12.5 ft.

Background @ 0730
HNU= ppm
α= cpm
Bγ= cpm
See page 1 of 4

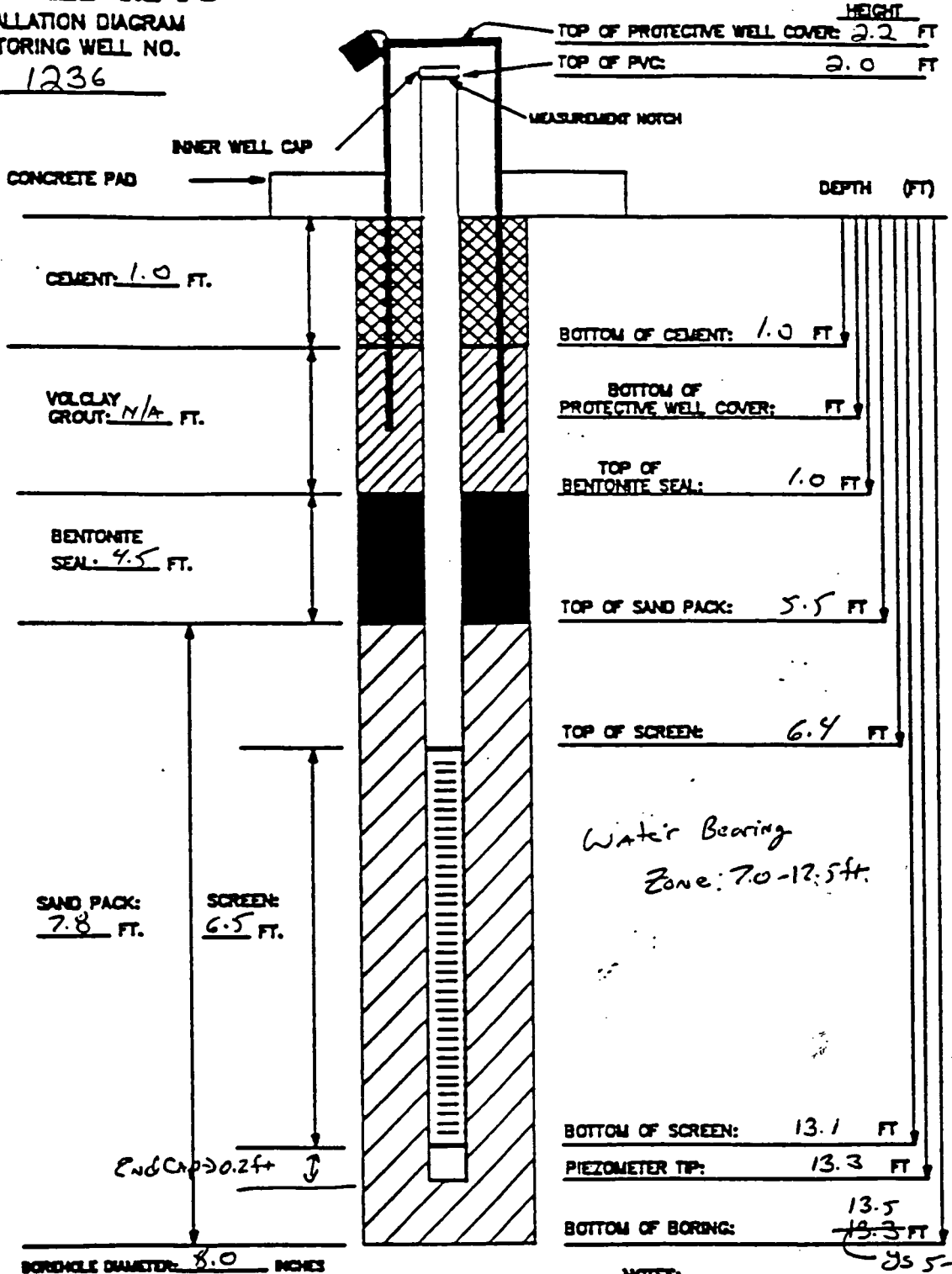
Bottom of well screen

602-11-88

INSTALLATION DATE: 5-14-89

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1236



MATERIALS USED:
SAND TYPE AND QUANTITY: 3 Bags 10/20 - 80lb
BENTONITE PELLETS (5-GALLON BUCKETS): 4 Buckets
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1 Bag - 50lb
AMOUNT OF WATER USED: 50 gallons
OTHER: Protective Cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 60 & 371

GEOLOGIST/ENGINEER: L. Sinfield

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS				
BORING NUMBER: 1240	COORDINATES:			DATE: 5/10/89	
ELEVATION:	GWL: Depth	Date/Time		DATE STARTED: 5/10/89	
ENGINEER/GEOLOGIST: C. Grubell, A. Hand	Depth	Date/Time		DATE COMPLETED: 5/11/89	
DRILLING METHODS: AUGER (HOLLOW STEM)				PAGE 1 OF 4	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (NOTE: Total of 7 pages with field copies enclosed. BD. 6/6/89)
	17849 1533 5-10-89	1	6	Very stiff, yellowish brown (10yr 5/4) silty clay. Trace surface gravel + asphalt, trace sand. Med. plasticity, very moist	CL	3.0	HNU = 0 ppm α = 0 cpm Bβ = 60-80 cpm
	17850 1533 5-10-89	3	6	Very stiff, yellowish brown (10yr 5/4) silty clay. Trace coarse sand. Low plasticity, moist.	CL	4.0	
1	17851 1533	5	1	SAA	CL	2.5	
1	17852 1535 5-10-89	3	6	Stiff, yellowish brown (10yr 5/4) silty clay. Trace sand. Med. Plasticity, moist.	CL	1.25	HNU = 0 ppm α = 0 cpm Bβ = 100-110 cpm
2	17853 1535 5-10-89	3	2	Soft, yellowish brown (10yr 5/4) silty clay, trace sand. Med. Plasticity, very moist.	CL	.25	
	17854 1535 5-10-89	7	0	no recovery			
3	17855 1540 5-10-89	5	6	Med. stiff, yellow. sh brown (10yr 5/4) silty clay. Trace sand + fine gravel (gravel to .25in) med. Plasticity, moist	CL	.5	HNU = 0 ppm α = 0 cpm Bβ = 60-80 cpm
	17856 1540 5-10-89	7	6	Stiff, yellowish brown (10yr 5/4) silty clay. Trace sand + fine gravel (gravel to .25in) med. plasticity, moist.		1.75	
4	17857 1540 5-10-89	8	6	Very stiff, dark gray (5Y 4/1) silty clay. low plasticity, slighty moist.	CL	3.75	
	17858 1544 5-10-89	12	6	Stiff, olive gray (5Y 4/2) silty clay. Med. plasticity, moist.	CL	1.5	HNU = 0 ppm α = 0 cpm Bβ = 70-90 cpm
5	17859 1544 5-10-89	11	6	Very stiff, dark yellow brown (10yr 4/6) silty clay. Med. to low plasticity. Moist	CL	2.25	
	17860 1544 5-10-89	15	6	Stiff, yellowish brown (10yr 5/4) silty clay. Low plasticity, moist.	CL	1.0	
6	17861 1615 5-10-89	4	6	Soft, yellowish brown (10yr 5/6) silty clay, low plasticity. Very moist.	CL	.25	HNU = 0 ppm α = 0 cpm Bβ = 90-110 cpm
	17862 1615 5-10-89	4	6	Med. stiff SAA	CL	.5	
7	17863 1615 5-10-89	5	3	Loose, yellowish brown (10yr 5/4) clayey silt. Moist.	ML	N/A	

NOTES: CONTRACTOR: PENNDRILL
RIG: Model 80
DRILLER: Craig Coulter
ASSISTANT: Chris Coulter

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0 CPM
Bβ = 80-100 CPM

LEL/O_2: LEL = 0% ~~PPM~~ AA 5/11/89
O_2 = 20.6%

SAA = Same as above

000102

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

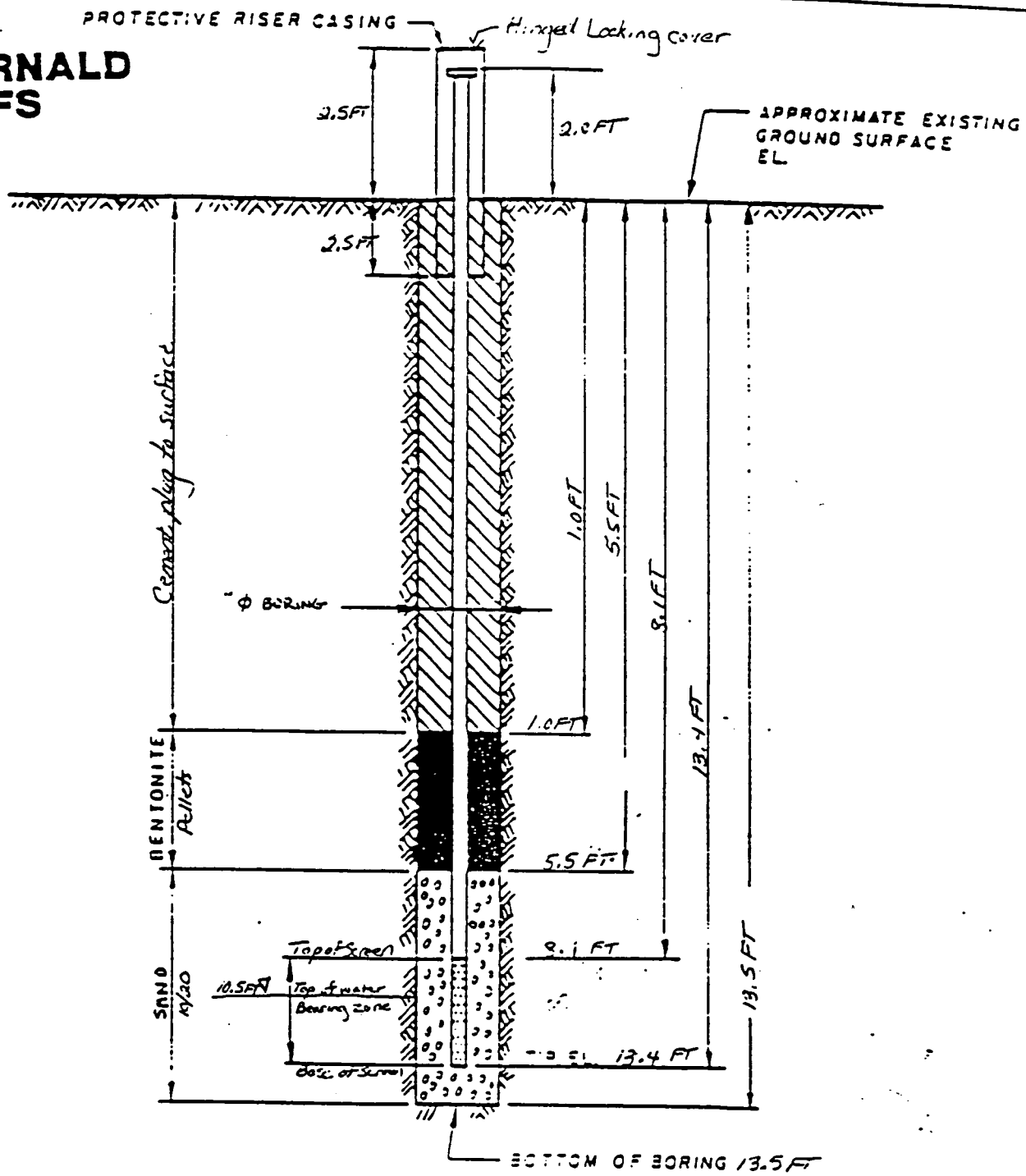
PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1240	COORDINATES:	DATE: 5/10/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5/10/89
ENGINEER/GEOLOGIST: C Gruhe / L Adams	Depth Date/Time	DATE COMPLETED: 5/11/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN.	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	17864 1621 5-10	8	6	Very stiff, very dark grayish brown (5y 3/1) clay, some gravel. Low plasticity, moist. Very stiff, yellowish brown (10yr 5/4) silty clay. Trace sand. Low plasticity. Very moist.	CL	2.5 / 2.25	HNU = 0 ppm α = 0 cpm Bγ = 80-90 cpm
	17865 1621 5-10	7	6	Med. Dense, brownish yellow (10yr 6/6) silt. Moist.	ML	N/A	
9	17866 1621 5-10	9	6	Med. Dense, Dark yellowish brown (10yr 5/4) to (10yr 4/6) silt. Trace sand. Moist.	ML	N/A	
	17867 1635 5-10	5	6	Loose, yellowish brown (10yr 5/4) silty clay. Trace sand + fine gravel. Moist, low plasticity	CL	.75	HNU = 0 ppm α = 0 cpm Bγ = 60-80 cpm
10	17868 1635 5-10	3	5	Loose, dark gray to yellowish brown (5y 4/1 to 10yr 5/6) silty clay. Low plasticity, moist.	CL	.75	
10.5 FT	17869 1635 5-10	9	0	No recovery	N/A	N/A	
11	17870 1646 5-10	9	6	Med. dense, yellowish brown (10yr 5/4) silty sand. Poorly graded. Very fine grained. Very moist	SM	N/A	HNU = 0 ppm α = 0 cpm Bγ = 60-80 cpm
	1646 5-10	9	6	*SAA wet.	SM	N/A	
12	1646 5-10	12	6	Med. dense, gray (5y 5/1) silt. Very moist.	ML	N/A	
	1654 5-10	4	6	Loose, yellowish brown (10yr 5/4) silty sand. Poorly graded. wet.	SM	N/A	HNU = 0 ppm α = 0 cpm Bγ = 60-80 cpm
13.5 FT	1654 5-10	6	6	SAA	SM	N/A	
	1654 5-10	3	6	Med. stiff, gray (5y 5/1) silt to silty clay grading to clay in last 3 inches. Moist.	CL	.5	
14				Bottom of sampling and borehole at 13.5 ft.			HNU = α = Bγ =

NOTES:

* SAA = Same as above.

FERNALD RI/FS



NOTES:

1. RISER PIPE IS 2.0 IN 10 SCHEDULE PIPE, THREADED. FLUSH-JOINTED.
2. SCREEN IS 2.0 IN 1.0 SCH. 40 PVC PIPE CONTINUOUS SLOT SCREEN (0.020 IN SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED with sediment sump
4. ELEVATION OF WATER LEVEL
5. WATER LEVEL READING ON

Materials used:
2 ½ sks 80# 10/20 sand
2 buckets (5 gal) bentonite pellets
½ sk cement (50 #)
20 gal water

INSTALLATION DETAILS
MONITORING WELL #1240

PREPARED FOR FMPC RI/FS

PVC well screen and Riser Pipe:
1 - .4 in long sediment sump cap
1 - 5.0 FT screened section
1 - 10.1 FT sch. 40 Riser PVC

DRAWING NUMBER Boring #1240
CHECKED BY / APPROVED BY
DRAWN BY

FERNALD
RI/FS

- 1507

Date				
Initials				
	Field Check	1st Rev'n	2nd Rev'n	Hard Copy Verification

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1241	COORDINATES:	DATE: 5-11-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-11-89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth Date/Time	DATE COMPLETED: 5-11-89
DRILLING METHODS: B-53 Hollow Stem Auger w/ Split Spoon Sampler		PAGE 1 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	Note: Final of 6 pages with Field copies enclosed. REMARKS Start = 0915
0.5	17871 wmco	7	10IN	Loose gravel, massive, moist 0.75	GM		HNU = Ø ppm; α = Ø cpm; Bγ = 400-450 cpm
1.0	17872	8					
1.5	17873 NR	9		Hard, mottled, brownish yellow (10yr, 6/6) to gray (10yr, 6/1) clay dry, massive @ 0920	CL	>4.5 TSF	
2.0	17874	6	6IN	Very stiff, brownish yellow (10yr, 6/6) to gray (10yr, 6/1) dry, massive, lean clay with occasional gravel medium plastic @ 0922	CL	2.7 to 3.5 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = ~~100-120~~ cpm CAM 5-11-89 80-100
2.5	17875 NR wmco	7					
3.0	17876 NR	7					
3.5	17877	9	10IN	Very Stiff, same as above (1.5 to 3.0 ft) @ 0927	CL	2.6 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 100-120 cpm
4.0	17878	11					
4.5	17879 NR	11					
5.0	17880	9	11IN	Very Stiff, mottled, brownish yellow (10yr, 6/8) to pale brown (10yr, 6/3) Lean clay, CL = dry, massive, medium plastic @ 0935	CL	1.5 to 2.6 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 80-120 cpm
5.5	17881 wmco	10					
6.0	17882 NR	10					
6.5	17883	3	18IN	Very Stiff, mottled brownish yellow (10yr, 6/8) LEAN clay - dry massive, medium plastic with 1/4 to 1 inch silt and sand seams - (moist) @ 0945	CL / ML / SM	3.4 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 100-120 cpm
7.0	17884	6					
7.5	17885	8					

NOTES: Contractor: PENN DRILL
Driller: WILLIAM SACCANI
Helper: GREY DYE
Sample Tech: CINDY MELROY
Weather: CLEAR/WARM
HNU #: HH18

Water Bearing Zone: 9.0 - 14.5 ft.

Background @ 0930
HNU = Ø ppm
AIR α = 0 cpm
AIR Bγ = 80-100 cpm
GRO α = Ø cpm
GRO Bγ = 80-100 cpm

NR = No Recovery; No Sample Taken.

AG2-11-88

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1241	COORDINATES:	DATE: 5-11-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-11-89
ENGINEER/GEOLOGIST: L. SINFIELD	Depth Date/Time	DATE COMPLETED: 5-11-89
DRILLING METHODS: B-53 Hollow Stem Auger w/ Split Spoon Sampler		PAGE 2 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.5	17886	6	12in	Interbedded small silt and sand seams in clay - very stiff, brownish yellow (10yr, 6/8) dry to slightly moist, massive - silty sand, moist to wet 1/4 to 1/2 inch thick @ 0950	CL	3.5 TSF	Start= HNU=Ø ppm α=Ø cpm BG=100-120 cpm
8.0	17887	9					
8.5	17888	11			SM CL SM		
9.0	NR						
9.5	17889	6	18in	Loose, silty sand, brownish yellow (10yr, 6/8) wet, massive @ 0955	SM	Loose TSF	HNU=Ø ppm α=Ø cpm BG=100-120 cpm
10.0	17890	6					
10.5	17891	8					
11.0	17892	5	12in	Loose, silty sand - same as above (9.0→10.5ft) grades to silt at base @ 1000	SM ↓ ML	Loose TSF	HNU=Ø ppm α=Ø cpm BG=100→140 cpm
11.5	50716	6					
12.0	50717 NR	18					
12.5	50718	5	18in	Loose, silty sand, same as above with clay seam 6 inches thick - very stiff, massive, gray. silt at base @ 1008	SM CL ML	3.7 TSF	HNU=Ø ppm α=Ø cpm BG=100-120 cpm
13.0	50719	6					
13.5	50720	18					
14.0	50721	12	18in	Same as above 14.0ft	SM	2.3 to 2.7 TSF	HNU=Ø ppm α=Ø cpm BG=80-100 cpm
14.5	50722	5		Very stiff, lean clay - gray (10yr, 4/1) dry, massive, med plastic @ 1010	CL		
15.0	50723	6					

NOTES: Contractor: Penn Drill
Driller: William Saccei
Helper: Gary Dye
Sample Tech: Cindy Melray
Weather: clear/warm
HNU #: HH18

TD = 15.0 ft

Water Bearing Zone 9.0-14.5ft.

Background ⊗
HNU = ppm
α = See cpm
BG = Page 1 of 4 cpm

NR = No Recovery, No Sample Taken

602-11-88

000411

FERNALD RI/FS

Field Copy

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1241	COORDINATES:	DATE: 9-11-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 9-11-89
ENGINEER/GEOLOGIST: L. Sintfeld	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS: B-53. Hollow Stem Auger with Split Spoon Sampler		PAGE 1 OF 2

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							Start = 915
0.5	17871 wmco	7	10in	Loose, gravel, massive, moist @ 0.75	GM		HNU = Ø ppm; α = Ø cpm; Bγ = 400-450 cpm
1.0	17872	8		Hard, mottled, Brownish yellow (10YR, 6/6) to gray (10YR, 6/1) dry, massive clay @ 0920	CL	74.5 TSF	
1.5	17873 NR	9					
2.0	17874	6	6in	Very Stiff, Brownish yellow (10YR, 6/6) to Gray (10YR, 6/1) Dry, massive, lean clay with occasional gravel medium plastic @ 0922	CL	2.7 to 3.5 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 60-100 cpm
2.5	17875 NR wmco	7					
3.0	17876 NR	7					
3.5	17877	9	10in	Very stiff, same as above 1.5 to 3.0 ft @ 0927	CL	2.6 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 100-120 cpm
4.0	17878	11					
4.5	17879 NR	11					
5.0	17880	9	11in	Very Stiff, mottled Brownish yellow (10YR 6/8) to pale brown (10YR, 6/3) lean clay, CL - dry, massive medium plastic @ 0931	CL	1.5 to 2.6 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 80-120 cpm
5.5	17881 wmco	10					
6.0	17882 NR	10					
6.5	17883	3	18in	Very Stiff, mottled Brownish yellow (10YR, 6/8) lean clay - dry, massive, medium plastic with ½ to 1 inch silt and sand seams - moist @ 0941	CL/ML/SM	3.4 TSF	HNU = Ø ppm; α = Ø cpm; Bγ = 100-120 cpm
7.0	17884	6					
7.5	17885	9					

NOTES: Contractor:
Driller:
Helper:
Sample Tech:
Weather:
HNU #:

Background @ 0930
HNU = ppm
gas α = cpm
Air Bγ = 80-100 cpm
Air α = 0 cpm
gas Bγ

000412

FERNALD
RI/FS

Field Copy

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1241	COORDINATES:	DATE: 5-11-87
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-11-87
ENGINEER/GEOLOGIST: C. Sintrick	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS: B-53		PAGE 2 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 (IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				15-58-1107			Start=
7.5	17886	6		~~Top~~ interbedded	CL	3.5	HNU= Ø ppm
8.0	17887	9	12in	small silt & sand seams in clay - very stiff, Brownish yellow (10YR, 6/8), dry to v. slightly moist massive - silty sand, moist to wet 1/4 to 1/2 inch thick @ 0950	SM / CL / SM	TSF	α = Ø cpm; BY= 100 120 cpm
8.5	17888						
9.0	NR	11					
9.5	50716 17889	6	18in	Loose, Silty Sand, Brownish yellow (10YR 6/8) Wet, massive, @ 0955	SM	Loose TSF	HNU=Ø ppm; α= Ø cpm; BY= 100 120 cpm
10.0	50717 17890	6					
10.5	50718 17891	8					
11.0	17892 50719	5		Loose, Silty Sand - same as above 10.0-10.5ft Grades to silt at base @ 1000	SM / ML	Loose TSF	HNU= Ø ppm; α= Ø cpm; BY= 100 140 cpm
11.5	50716 50720	6	12in				
12.0	50721 50717 NR	18					
12.5	50722 50718	5	18in	Loose, Silty Sand - same as above with clay seam given moist - very stiff massive, gray silt at base @ 1005	SM / CL / ML	3.0 TSF	HNU= Ø ppm; α= Ø cpm; BY= 100-120 cpm
13.0	50723 50719	6					
13.5	50724 50720	10					
14.0	50725 50721	12		Same as above very stiff lean clay - Gray (10YR 5/1) dry, massive, med plastic @ 1015	SM / CL	2.3 / 2.0 TSF	HNU= Ø ppm; α= Ø cpm; BY= 80-100 cpm
14.5	50726 50722	5	18in				
15.0	50727 50723	6					

NOTES: Contractor:
Driller:
Helper:
Sample Tech:
Weather:
HNU #:

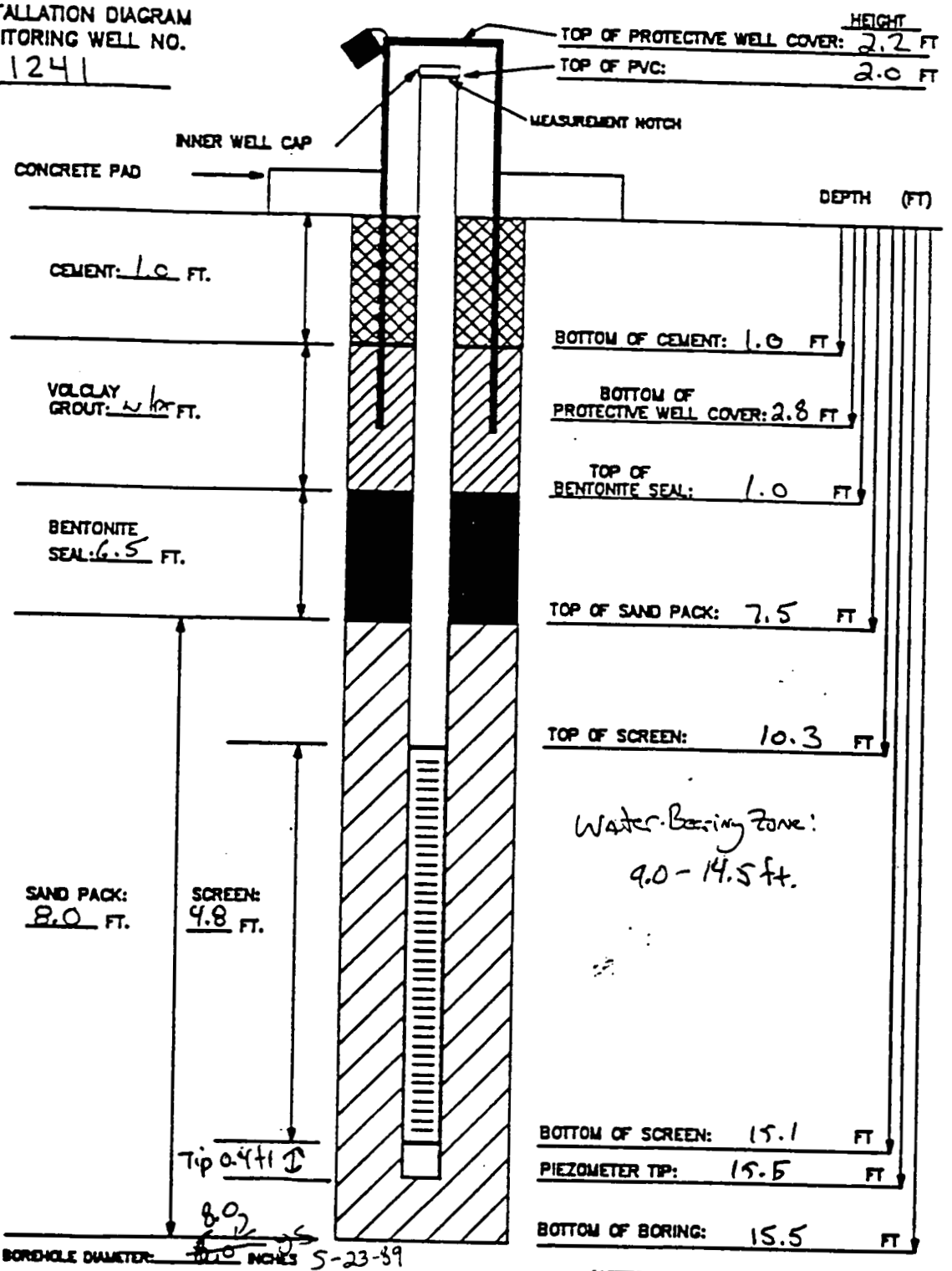
Background @
HNU= ppm
α= cpm
BY= cpm

1507

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1241

INSTALLATION DATE: 5-11-89



BOREHOLE DIAMETER: ~~10.0~~ 8.0 INCHES 5-23-89

MATERIALS USED:
SAND TYPE AND QUANTITY: 3 Bags 10/20 - 90 lb
BENTONITE PELLETS (5-GALLON BUCKETS): 4
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1 Bag - 50 lb
AMOUNT OF WATER USED: 10 gallons
OTHER: Protective Cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602.03.07

GEOLOGIST/ENGINEER: L. SINFIELD

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program			
BORING NUMBER: 1242	COORDINATES:		DATE: 5-10-89	
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 5-10-89	
ENGINEER/GEOLOGIST: L. Sinfield	Depth	Date/Time	DATE COMPLETED: 5-10-89	
DRILLING METHODS: B-53, Hollow Stem Auger with Split Spoon Sampler			PAGE 1	OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION 5/10/89	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS Total of 6 pages with field copies enclosed. Start = 1330
0.5	17893 wmco	5	9 in.	Hard, Yellowish Brown (10YR, 6/6) Clay with silt and gravel, Dry, massive, low plasticity. Top 6 in. is loose gravel @ 1345	GM		HNU = Ø ppm; α = Ø cpm; Bγ = 200-240 cpm Gravel
1.0	17894	15				7.5	
1.5	17895 NR	7			CL	TSF	Bγ = 100-140 cpm Clay
2.0	17896	9	12 in.	Hard, Mottled light Olive Brown (2.5Y, 5/4) to gray (2.5Y, N5) Lean clay with silt and Gravel, Dry, massive, medium plastic @ 1348	CL	7.5	HNU = Ø ppm; α = Ø cpm; Bγ = 100-140 cpm
2.5	17897 wmco	10					
3.0	17898 NR	10				TSF	
3.5	17899	14	9 in.	Stiff to Very Stiff, Slightly Mottled Grayish Brown (2.5Y, 5/2) Lean clay, Dry, massive, medium plastic, rare gravel @ 1400	CL	1.7 ↓ 3.1	HNU = Ø ppm; α = Ø cpm; Bγ = 100-140 cpm
4.0	17900	15					
4.5	17901 NR	9				TSF	
5.0	17902	11	8 in.	Stiff to Very Stiff, Mottled Gray (2.5Y, N6) to (2.5Y, N5) Lean Clay with Wood Fragments, Dry, massive, medium plastic @ 1415	CL	1.5 ↓ 3.6	HNU = Ø ppm; α = Ø cpm; Bγ = 100-140 cpm
5.5	17903 wmco	10					
6.0	17904 NR	11				TSF	
6.5	17905	3	18 in.	Very Stiff, Mottled, Gray (2.5Y, N6) Lean Clay, Dry massive, medium plastic @ 1515	CL	2.2 ↓ 3.1	HNU = Ø ppm; α = Ø cpm; Bγ = 100-140 cpm
7.0	17906	6					
7.5		8				TSF	

NOTES: Contractor: Renn Drill
Driller: J. Saccani
Helper: G. Dye
Sample Tech: C. Inelroy
Weather: Cloudy - cool
HNU #: HH18

Background @ 1400
HNU = Ø ppm
Air & gnd α = Ø cpm
Air & Air Bγ = 100-140 cpm

NR = No Recovery, No Sample Taken

000615

FERNALD
RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-37.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1242	COORDINATES:	DATE: 5-10-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-10-89
ENGINEER/GEOLOGIST: L. Sinfield	Depth Date/Time	DATE COMPLETED: 5-10-89
DRILLING METHODS: See Page 1 of 4		PAGE 2 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.5							Start =
8.0	17908	7	12in	Very Stiff, Yellowish Brown, mottled, (10YR, 6/6) to Gray (2.5Y, N5) Lean Clay, dry, massive, medium plastic. @ 1520	CL	1.2 ↓ 3.2 TSF	HNU = ø ppm; α = ø cpm; Bγ = 120→140 cpm
8.5	17909	8					
9.0	17910 NR	11					
9.5	17911	9	18in	Very Stiff, mottled Yellowish Brown (10YR, 6/6) to gray (2.5Y, N5) Lean Clay, massive, dry, with 1 inch Silt layer - moist, massive, Yellowish Brown (10YR, 6/6) @ 1525	CL	2.7 TSF	HNU = ø ppm; α = ø cpm; Bγ = 120→140 cpm
10.0	17912	11			ML		
10.5	17913 NRC0	10			CL		
11.0	17914	5	18in	Same as Above 9.0→10.5 ft	CL	1.7	HNU = ø ppm; α = ø cpm; Bγ = 100-140 cpm
11.5	50687	7		11.5 ft			
12.0	50688	11		Loose, Brownish Yellow (10YR 2, 6/6) Silty Sand, Wet @ 1535	SM	Loose TSF	
12.5	50689	5	18in	Same as above 11.5-12.0 ft grades to Silt at Base @ 1540	SM ↓ ML	Loose TSF	HNU = ø ppm; α = ø cpm; Bγ = 100-120 cpm
13.0	50690	7					
13.5	50691	6					
14.0	50692	26	↑ 18in	Same as above 12.0→13.5 ft	SM ↓ ML		HNU = ø ppm; α = ø cpm; Bγ = 100-120 cpm
14.5	50693	38		14 ft			
15.0	50694	40	↓	Clay, dry, massive, medium plastic @ 1545	CL	TSF	

Current Zone

NOTES: Contractor: Driller: Helper: Sample Tech: Weather: HNU #: } See Page 1 of 4

Background @ 1400
HNU = ø ppm
Air Blnd α = ø cpm
Air Blnd Bγ = 100-140 cpm

NR = No Recovery, No Sample Taken

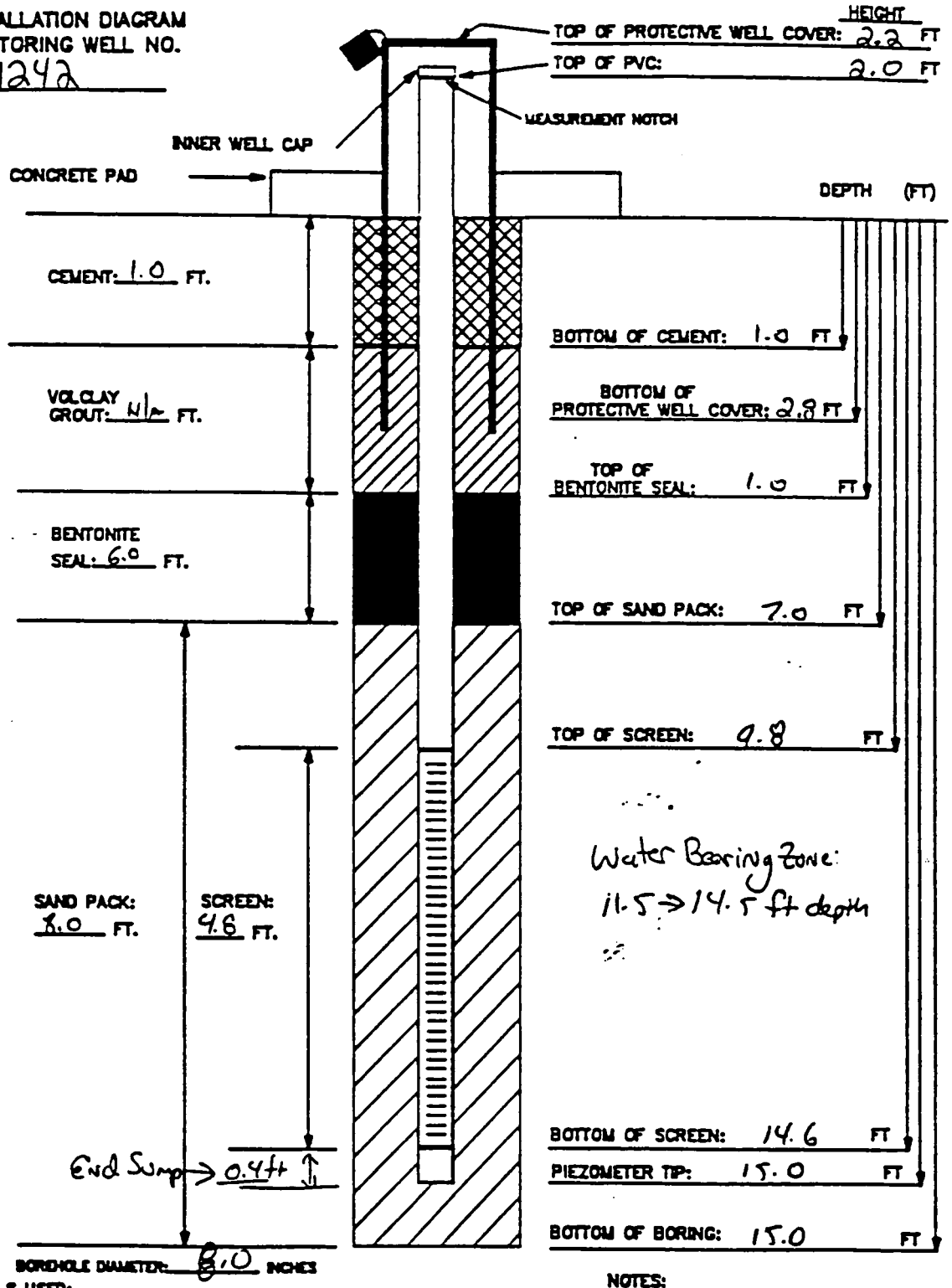
000416

AC2-11-88

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1242

INSTALLATION DATE: 5-10-89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 3 Bags 10/20 (80lb Bag)
BENTONITE PELLETS (5-GALLON BUCKETS): 3
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1 Bag - 50lb
AMOUNT OF WATER USED: 10 gallons
OTHER: Protective Cover 5.0ft x 4 3/8 inch

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 60 2 3 7 1

GEOLOGIST/ENGINEER: L. Sintfield

FERNALD
RI/FS

1507

	Field Check	1st Key In	2nd Key In	Hard Copy Verified

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1244	COORDINATES:	DATE: 5-8-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-8-89
ENGINEER/GEOLOGIST: L. Sintfield	Depth Date/Time	DATE COMPLETED: 5-8-89
DRILLING METHODS: B-53, Hollow Stem Auger with Split Spoon Sampler		PAGE 1 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 1 6IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (6 Total pages with Field Copies included. 5/8/89) Start = 1445
0.5	17937 wmco	7	8IN	Hard, Yellowish Brown (10YR 5/6) Lean Clay with Gravel, CL - Dry, medium plastic, massive	GM ↓	>4.5	HNU = Ø ppm; α = 5-10 cpm; Bγ = 80-120 cpm at top of sample; ↳ = surface; Bγ = 1,000-1,400 cpm
1.0	17938	10					
1.5	17939 NR	27		@ 1355	CL	TSF	
2.0	17940	32	12IN	Hard, SAME as above	CL	4.2 to 4.5	HNU = Ø ppm; α = Ø cpm; Bγ = 80-120 cpm
2.5	17941 wmco	14					
3.0	17942 NR	8		@ 1400		TSF	
3.5	17943 NR	8	6IN	medium Stiff to Stiff Dark grayish Brown (2.5Y, 4/2) Lean Clay with Gravel, CL - dry medium plastic, massive, Silt at top, ML - Loose, yellowish brown (10YR 6/6) massive @ 1405	ML/CL	0.5 to 1.2	HNU = Ø ppm; α = Ø cpm; Bγ = 180-220 cpm silt; Bγ = 100-1200 cpm clay
4.0	17944	8					
4.5	17945 NR	12				TSF	
5.0	17946	11	9IN	Stiff to Very Stiff, Dark grayish brown (2.5Y, 4/2) Lean Clay with Gravel, CL - dry massive, medium plastic, Slightly mottled. @ 1410	CL	1.1 to 2.6	HNU = Ø ppm; α = Ø cpm; Bγ = 100-140 cpm
5.5	17947 wmco	10					
6.0	17948 NR	10				TSF	
6.5	17949 NR	5	4IN	Stiff, mottled Yellowish brown (10YR, 5/4) to (10YR, 5/5) Lean Clay with Gravel, CL - Dry, massive, medium plastic @ 1421	CL	1.2(?)	HNU = Ø ppm; α = Ø cpm; Bγ = 140-200 cpm
7.0	17950 NR	8					
7.5	17951	9				TSF	

NOTES: Contractor: Penn Drill
Driller: J. Saccani
Helper: G. Dye
Sample Tech: C. Melroy
Weather: Clear & warm
HNU #: HH18

Using Lead shield to SCAN samples for Bγ.

NR = No Recovery, No Sample Taken

Background @ 1340
HNU = Ø ppm
Air α = Ø cpm
Air Bγ = 200-300 cpm
gnd α = 20-700 cpm
gnd Bγ = 1,200-1,500 cpm

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program	
BORING NUMBER: 1244	COORDINATES:	DATE: 5-8-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-9-89
ENGINEER/GEOLOGIST: L. Sintfield	Depth Date/Time	DATE COMPLETED: 5-8-89
DRILLING METHODS: B-53 Hollow Stem Auger with Split Spoon Sampler		PAGE 2 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.5							Start=
8.0	17952	9	18in	Very Stiff, mottled Gray (10YR, 6/4) to Brownish yellow (10YR, 6/6) Lean Clay with Sand, CL- Dry, massive, medium plastic with occasional Gravel @ 1450	CL	3.1 to 3.2 TSF	HNU=0.5-1.0 ppm α= ø cpm Bγ=230-260 cpm
	17953	12					
8.5							
	17954	14					
9.0							
	17955	10	8in	Stiff, same as above 7.5 to 9.0 ft, but more gravel @ 1455	CL	1.1 to 1.3 TSF	HNU= 0.5 ppm α= 1 cpm Bγ=200-240 cpm
9.5							
	17956	8					
10.0	NR						
	17957	10					
10.5	NR						
	17958	10	12in	Very Stiff, Dark Grayish Brown (2.5Y, 4/2) to Olive Brown (2.5Y, 4/4) Lean Clay, CL- Dry, massive. 11.5	CL	2.2	HNU= ø ppm α= ø cpm Bγ=80-100 cpm
11.0							
	50651	12					
11.5				Loose, silty sand, Brownish Yellow (10YR, 5/6), WET, massive @ 1505	SM	Loose TSF	
11.5ft							
	50652	10					
12.0							
	50653	5	18in	Loose, Brownish Yellow (10YR, 5/6) SILTY Sand, SM- WET, massive grades to silt at Base @ 1530	SM ↓ ML	Loose TSF	HNU= ø ppm α= ø cpm Bγ=80-120 cpm
12.5							
	50654	10					
13.0							
	50655	12					
13.5							
	50656	10	18in	Loose, Brownish yellow (10YR 5/6) Silty Sand, SM- WET, massive. 14.75ft	SM	Loose	HNU= ø ppm α= ø cpm Bγ= 80-100 cpm
14.0							
	50657	12					
14.5							
14.75ft							
	50658	5		Loose, Compacted silt and Clay, DRY- @ 1540	ML	TSF	
15.0							

NOTES: Contractor: Penn Drill
Driller:
Helper:
Sample Tech:
Weather:
HNU #:
} See page 1 of 4

Water Bearing Zone = 11.5 to 14.75 ft depth

Background @ 1340
HNU= See ppm
α= Page 1 of 4 cpm
Bγ= cpm

NR = No Recovery, No Sample Taken.

000419

AC2-11-88

FERNALD
RI/FS

E-1507
Field Copy

VISUAL CLASSIFICATION OF SOILS

FMPC-RI/FS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program 602-3.7.1	
BORING NUMBER: 244	COORDINATES:	DATE: 5-8-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-8-89
ENGINEER/GEOLOGIST: L. Swofford	Depth Date/Time	DATE COMPLETED: 5-8-89
DRILLING METHODS: B-53, Hollow Stem Auger with Split Spoon Sampler		PAGE 1 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							Start = 1330
0.5	17937 wmco	7	8in	Hard yellowish brown (10YR, 5/6) Lean Clay with Gravel, dry; med. plastic, massive.	GM ↓	74.5	HNU = Ø ppm; α = 5-10 cpm at; Bγ = 80-120 cpm, cut 1/2 ft; Bγ = 1,000-1,400 cpm at surface
1.0	17938	10					
1.5	17939 NR	27		@1355	CL	TSF	
2.0	17940	32	12in	Hard, Lean clay. Same as above 0.0-1.5 ft	CL	4.2 / 4.5	HNU = Ø ppm; α = Ø cpm; Bγ = 80-120 cpm
2.5	17941 wmco	14					
3.0	17942 NR	8		@1400		TSF	
3.5	17943 NR	8	6in	Medium stiff to Stiff Dark grayish brown (2.5Y, 4/2) Lean clay with Gravel, dry med. plastic massive. with Silt at top - Loose, dry (6) massive, Yellowish Brown @1405.	ML/CL	0.5 / 1.2	HNU = Ø ppm; α = Ø cpm; Bγ = 180-220 cpm silt; Bγ = 100-120 cpm clay
4.0	17944	8					
4.5	17945 NR	12				TSF	
5.0	17946	11	9in	Same as above Clay occasional Gravel. Dry, Stiff to very stiff, massive, medium plastic Slightly mottled @1410	CL	1.1 / 6 / 26	HNU = Ø ppm; α = Ø cpm; Bγ = 100-140 cpm
5.5	17947 wmco	10					
6.0	17948 NR	10				TSF	
6.5	17949 NR	5	4in	Stiff, mottled ~~Brown~~ yellowish Brown (10YR 5/4) to (10YR 5/6) Lean clay with gravel, dry massive, medium plastic @1427	CL	1.2(?)	HNU = Ø ppm; α = Ø cpm; Bγ = 140-200 cpm
7.0	17950 NR	8					
7.5	17951	9				TSF	

NOTES: Contractor: Penn Drill
Driller: J. Saccani
Helper: G. Dye
Sample Tech: C. Melroy
Weather: clear & warm
HNU #: HH18

Using lead shield to screen samples for Bγ.

Background @1340
HNU = Ø ppm
Air α = Ø cpm
Air Bγ = 200-300 cpm
gnd α = 20-100 cpm
gnd Bγ = 1,200-1,500

NR = No Recovery, No Sample Taken

FERNALD RI/FS

Field Copy

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602-3.7.1	PROJECT NAME: Facilities Testing Program FMPC RI/FS	
BORING NUMBER: 1244	COORDINATES:	DATE: 5-8-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 5-8-89
ENGINEER/GEOLOGIST: L. Sinfield	Depth Date/Time	DATE COMPLETED: 5-8-89
DRILLING METHODS: B-53, Hollow Stem Auger with Split Spoon Sampler.		PAGE 2 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.5							Start =
8.0	17952	9		Very Stiff, mottled Gray (10YR, 6/1) to Brownish yellow (10YR, 6/6) Lean clay with Sand, dry, massive med. plastic isolate gravel. @ 1450	CL	3.1 to 3.2	HNU = 0.5-1.0 ppm α = Ø cpm Bγ = 230-260 cpm
	17953	12	18in				
8.5							
	17954	14					
9.0						TSF	5-8-89
	17955	10		Same as above, but stiff but more gravel Dry, massive @ 1455	CL	~~3.1~~ ~~3.2~~ 1.1 to 1.3	HNU = 0.5 ppm α = 1 cpm Bγ = 200-240 cpm
9.5							
	17956	8	8in				
10.0	NR 17957 NMCO	10				TSF	
10.5							
	17958 NR	10		Very Stiff, Dark gray to Brown (2.5Y, 4/2) to olive Brown (2.5Y, 4/4) Lean clay, dry, massive 11.5 ft	CL	2.2	HNU = Ø ppm α = Ø cpm Bγ = 80-100 cpm
11.0							
	50651	12	12in	Loose, Silty Sand, Brownish yellow (10YR, 5/6), WET, massive. @ 1505	SM	Loose	
11.5							
	50652	10				TSF	
12.0							
	50653	8		Loose, Silty Sand - same as above 11.5-12.0 ft Grades to Silt, brownish yellow (10YR, 6/6) saturated, massive. @ 1530	SM	Loose	HNU = 0 ppm α = Ø cpm Bγ = 80-120 cpm
12.5							
	50654	10	18in				
13.0							
	50655	12			ML	TSF	
13.5							
	50656	10		Loose Silty Sand, Brownish yellow (10YR, 6/6), massive, ~~Satu~~ Wet	SM	Loose	HNU = Ø ppm α = Ø cpm Bγ = 60-80 cpm
14.0							
	50657	12	18in				
14.5							
	50658	5		Loose Silt - Well graded, dry, Brownish yellow (10YR) 14.75 @ 1540	ML	TSF	
15.0							

NOTES: Contractor: Penn Drill
Driller: J. Saccasi
Helper: G. Dye
Sample Tech: C. Melroy
Weather: Clear and warm
HNU #: HH18

Water Bearing Zone: CL
11.5 → 14.75 ft depth

Background @ 1340
HNU = ppm
α = Ø cpm
Bγ = 60-80 cpm

NR = No Recovery, No Sample Taken

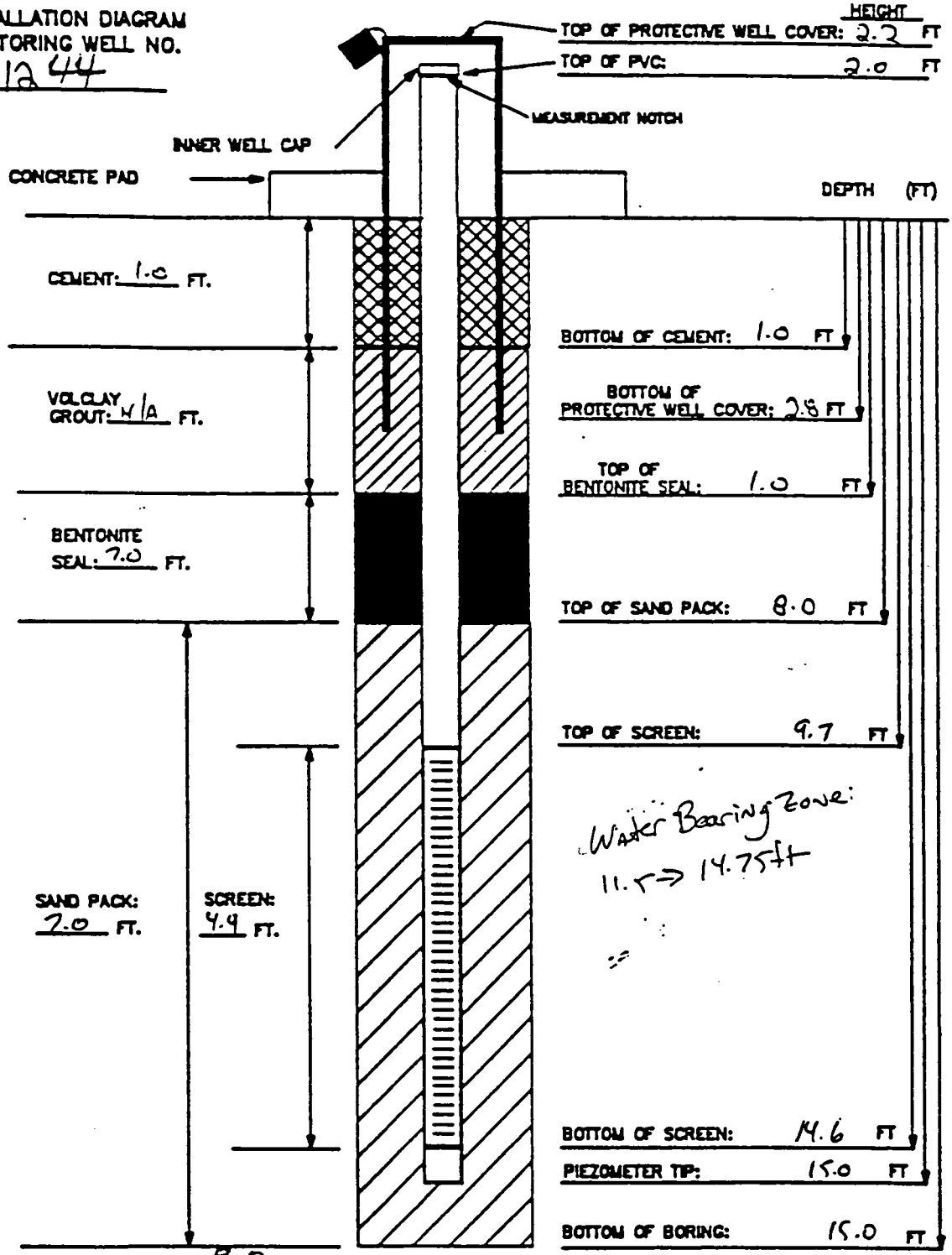
4G2-11-86

E. 1507

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1244

INSTALLATION DATE: 5-8-89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 3 Bags 10/20 8016
BENTONITE PELLETS (5-GALLON BUCKETS): 3
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1 Bag
AMOUNT OF WATER USED: 15 gallons
OTHER: 5 ft x 4 3/8 inch Protective Cover.

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7.1 GEOLOGIST/ENGINEER: L. Sinfield

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 6023.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1245	COORDINATES:		DATE: 10-10-89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 10-16-89
ENGINEER/GEOLOGIST: C. Grube	Depth	Date/Time	DATE COMPLETED: 10-10-89
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 1 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	17959 1010 10-10	6	-	Hard, (2.5 Y 4/1) [illegible] clay, trace gravel, moist	CL	>4.5	HNU = 0 ppm
	17960 1010 10-10	12	6	Hard SAA	CL	>4.5	α = 0 cpm
1	17961 1010 10-10	17	0	NR	NR	NA	Bγ = 200-210 cpm
	17962 1015 10-10	6	6	Very stiff (2.5 Y 5/4) light olive brown silty clay, trace fine gravel, low plasticity, moist	CL	3.5	HNU = 0 ppm
2	17963 1015 10-10	5	2	SAA	CL	2.75	α = 0 cpm
	17964 1015 10-10	5	0	NR	NA	NA	Bγ = 190-200 cpm
3	17965 1017 10-10	6	6	Medium stiff (2.5 Y 5/4) light olive brown clay, slow site, trace fine gravel, medium plasticity, moist	CL	.75	HNU = 0 ppm
	17966 1017 10-10	5	0	NR	NA	NA	α = 0 cpm
4	17967 1017 10-10	4	0	NR	NA	NA	Bγ = 200-210 cpm w/spring
	17968 1020 10-10	4	6	Medium stiff (2.5 Y 5/4) light olive brown clay, trace of fine gravel, medium plasticity, moist	CL	.75	HNU = 0 ppm
5	17969 1020 10-10	5	2	Soft, (2.5 Y 5/4) light olive brown clay, trace of fine gravel, medium plasticity, moist	CL	.25	α = 0 cpm
	17970 1020 10-10	6	0	NR	NA	NA	Bγ = 200-210 cpm
6	17971 1140 10-10	4	5	Medium stiff (2.5 Y 5/3) olive silty clay, trace fine gravel, medium plasticity, moist	CL	.5	HNU = 0 ppm
	17972 1140 10-10	4	0	NR	NA	NA	α = 0 cpm
7	17973 1140 10-10	5	0	NR	NA	NA	Bγ = 180-190 cpm w/ spring

NOTES: CONTRACTOR: PENNDRILL
RIG: B-80
DRILLER: Joe Sirile
ASSISTANT: Charlie Elkowitz

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0 CPM
Bγ = 180-280 CPM
LEL = 0% ~~PPM~~ (v)
O_2 = 20.1%

SAA = Same As Above
NR = No Recovery
LEL O_2:

HNU# 00199

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1245	COORDINATES:	DATE: 10-10-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 10-10-89
ENGINEER/GEOLOGIST: C. [illegible]	Depth Date/Time	DATE COMPLETED: 10-10-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	17974 1150 10-10	3	6	very soft (5Y4/3) olive silty clay, trace fine gravel medium plasticity moist	CL	<.25	HNU = 0 ppm α = 0 cpm Bγ = 170-180 cpm
	17975 1150 10-10	5	6	medium stiff (5Y4/1) dark gray, clay, trace silt, low plasticity, moist	CL	.75	
9	17976 1150 10-10	6	6	medium stiff (5Y4/2) olive gray, silty clay, medium plasticity moist	CL	.75	
1	17977 1407 10-10	3	3	Soft (5Y4/1) dark gray, clay, trace of fine to medium gravel, medium plasticity, moist	CL	.50	HNU = 0 ppm α = 0 cpm Bγ = 170-180 cpm w/ spring
10	17978 1407 10-10	4	0	NR	NA	NA	
	17979 1407 10-10	5	0	NR	NA	NA	
11	17980 1420 10-10	4	6	Stiff (2.5Y4/4) olive brown silty clay, trace fine to medium gravel, low plasticity moist	CL	1.0	HNU = 0 ppm α = 0 cpm Bγ = 160-170 cpm
	52595 1420 10-10	5	6	Stiff SAA Loose (5YR 5/2) olive gray [illegible] silty sand, moist	CL ML	1.75 NA	
12	52596 1420 10-10	5	6	SAA Loose (10YR 4/6) dark yellow brown silty sand, wet	ML SM	NA NA	
13	52597 1428 10-10	10	6	Medium dense (5Y 5/2) olive gray clay, [illegible], moist	ML	NA	HNU = 0 ppm α = 0 cpm Bγ = 180-200 cpm
	52598 1428 10-10	9	6	medium dense (10YR 4/6) dark yellow brown silty sand, wet	SM	NA	
	52599 1428 10-10	14	6	medium dense (10YR 4/6) dark yellow brown silty sand, wet medium dense (5Y 4/1) [illegible] wet	SM ML	NA NA	
14	52600 1435 10-10	6	6	medium dense (10YR 4/6) dark yellowish brown clayey sand, wet	SC	NA	HNU = 0 ppm α = 0 cpm Bγ = 130-190 cpm
	52601 1435 10-10	7	6	medium dense (10YR 4/6) dark yellowish brown silty sand, wet	SM	NA	
	52602 1435 10-10	9	6	medium dense (5Y 5/1) gray clayey silt, trace sand wet	ML	NA	

NOTES:

SAA = Same As Above
NR = No Recovery

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1245	COORDINATES:	DATE: 10 - 10 - 89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 10 - 10 - 89
ENGINEER/GEOLOGIST: C. Crooke	Depth Date/Time	DATE COMPLETED: 10 - 10 - 89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 (IN)	RECOVERY (FT)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	52663 1240 1010	9	6	med. Dense (0.5 TSF/4) light brown to brown, clayey silt, sand, wet	SC to SM	NA	HNU = 0 ppm α = 0 cpm BG = 180-190 cpm
	52664 1240 1010	6	6	SAA	SC to SM	NA	
16	52665 1440 10-10	5	6	medium dense (0.5 TSF) light gray clayey silt, moist	ML	NA	
				Soft (0.5 TSF) light gray silty clay, low plasticity, moist	CL	0.5	
			X	Bottom of Boring - sampling at 16.5 FT			HNU = α = BG =
17							
18							HNU = α = BG =
19							
20							HNU = α = BG =

NOTES:

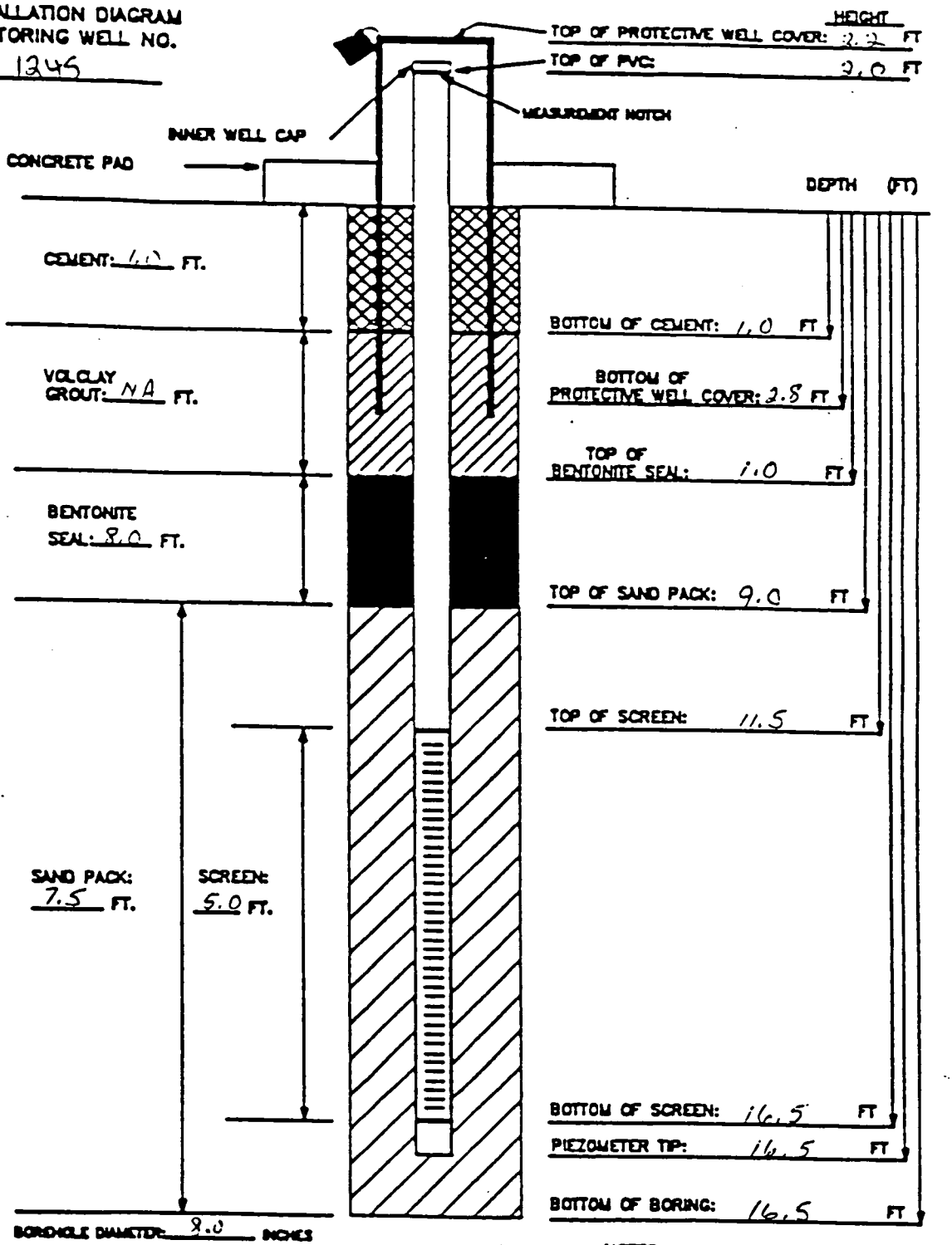
SAA = Same As Above
NA = No Recovery

000425

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1245

INSTALLATION DATE: 10-10-89



MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 sand 2 80# sacks
BENTONITE PELLETS (5-GALLON BUCKETS): 3 1/2
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2 (94#) sk.
AMOUNT OF WATER USED: 10 gal water
OTHER: 5.0 FT Protective casing w/ cover

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 602 3.7	PROJECT NAME FMPC RI/FS		
ING NUMBER 1247	COORDINATES	DATE 12-4-90	
ATION:	GWL: Depth Date/Time	DATE STARTED 12/2/90	
ENGINEER/GEOLOGIST J. Lear	Depth Date/Time	DATE COMPLETED 12/4/90	
DRILLING METHODS Auger 8 in HSA		PAGE 1 OF 5	

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				S.A.A - Same as above N.R - No Recovery 0.0 - 1.5ft is concrete			
2	18003 1410 12-2-90	1	2	Stiff, yellowish brown (10y/5/4) clayey silt, Trace sand & gravel moist	ML	2.0	Hnu = 0 ∝ = 0
	18004 1410 12-2-90	6	3	~~Loose~~ soft, yellowish brown (10yr, 5/4) Gravelly clay, med. plasticity, moist	CL	0.3	BY = 1500 cpm
3	18005 1410 12-2-90	2	0	N.R.	NA	NA	
	18006 1420 12-2-90	1	0	N.R	NA	NA	Hnu = 0 ∝ = 2 cpm
	18007 1420 12-2-90	10	4	Stiff, yellowish brown to gray (10yr, 5/4 to 10yr, 5/1) silty clay, some gravel med plasticity, moist.	CL	1.5	BY = 1500 cpm
4	18008 1420 12-2-90	8	4	Stiff, gray (10yr, 5/1) silty clay, some gravel, med plast. ~~N.R.~~ moist. J.L. 12-4-90	CL	1.5	
5	18009 1435 12-2-90	5	0	N.R	NA	NA	Hnu = ∝ = BY = NA
	18010 1435 12-2-90	5	0	N.R	NA	NA	
6	18011 1435 12-2-90	5	0	N.R	NA	NA	
	18012 1445 12-2-90	5	6	very soft, yellowish brown (10y, 5/4) gravelly clay high plasticity, wet.	CL	.25	Hnu = <1.0 ppm ∝ = 0
7	18013 1445 12-2-90	6	6	Soft, yellowish brown to dark grayish brown (10yr, 5/4 To 10yr, 4/2) silty clay, some gravel high plasticity, wet	CH	.50	BY = 1500 cpm
	18014 1445 12-2-90	7	6	Soft, dark grayish brown (10yr, 4/2) silty clay Trace gravel, high plasticity, moist	CH	.50	
8	18015 1457 12-2-90	12	6	very soft, dark grayish brown (2.5y, 4/2) silty clay, some gravel, high plasticity, wet	CH	<.25	Hnu = 0 ∝ = 1 cpm
	18016 1457 12-2-90	14	6	S.A.A	CH	<.25	BY = 1500 cpm
9	18017 1457 12-2-90	16	6	soft, dark grayish brown (2.5y, 4/2) silty clay some gravel, med plasticity, ~~moist~~ wet. J.L. 12-4-90	CH	.50	

NOTES: CONTRACTOR: Penn Drill
DRILLER: Bob Yost
ASSISTANT: Brian Strappazzon

Hnu: 0-1 ppm
∝: 0-2 cpm
BY: 1500 cpm

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION
COLOR I.D. BY MUNSELL COLOR CHART
BACKGROUND LEVELS: Hnu: 0
∝: 5 cpm
BY: 1500 cpm

402-11-46

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 602 3.7	PROJECT NAME. FMPC RI / FS		
ING NUMBER 1247	COORDINATES.	DATE 12-3-90	
cVATION:	GWL: Depth Date/Time	DATE STARTED 12/2/90	
ENGINEER/GEOLOGIST J. Lear	Depth Date/Time	DATE COMPLETED 12/4/90	
DRILLING METHODS Auger		PAGE 2 OF 5	

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	18018 1515 12-3-90	11	3	Soft, dark gray, gray to yellowish brown (10yr. 4/1 To 10yr. 5/1 To 10y. 5/6) clayey silt. Trace gravel, very moist	ML	.50	Hnu = <1.0 ppm
	18019 1515 12-3-90	13	3	S.A.A. except M. stiff	ML	.60	α = 1 cpm βγ = 1500 cpm
10	18020 1515 12-3-90	15	4	SAA	ML	.6	
	18021 1000 12-7-90	10	6	very soft, yellowish brown to gray (10yr, 5/4 To 10yr. 5/1) gravelly clay, some silt, wet. high plasticity	CH	<.25	Hnu = 0
11	18022 1000 12-7-90	15	6	Dense, yellowish brown (10yr, 5/4) clayey silt sand mixture, wet.	SC	NA	α = 0 βγ = 800 cpm
	18023 1000 12-7-90	18	6	Dense, yellowish brown (10yr. 5/4) well graded subangular, silty sand, wet.	SM	NA	
12	18024 1010 12-7-90	10	6	medium dense, yellowish brown (10yr. 5/4 well graded subangular silty sand, some gravel, Trace clay, wet	SM	NA	Hnu = 0
	52635 1010 12-7-90	2	0	N.R			α = 0 βγ = 800 cpm
13	52636 1010 12-7-90	10	6	medium dense, yellowish brown (10yr, 5/4) well graded sub angular silty sand Trace clay & gravel, wet	SM	NA	
	52637 1020 12-7-90	11	6	SAA	SM	NA	Hnu = 0
14	52639 1020 12-7-90	12	6	SAA	SM	NA	α = 0 βγ = 800 cpm
	52638 1020 12-7-90	15	6	SAA	SM	NA	
15	52640 1020 12-7-90	7	6	S.AA.	SM	NA	Hnu = 0
	52641 1030 12-7-90	17	0	N.R.	NA	NA	α = 0 βγ = 800 cpm
16	52642 1030 12-7-90	31	6	very dense, yellowish brown to gray (10yr, 5/1) Gravel sand clay mixture, wet	GC	NA	

NOTES: CONTRACTOR: Penn Drill
DRILLER: B. Yost
ASSISTANT: B. Strappazzon

Hnu: <1.0 ppm
α: 1 cpm
βγ: 800-1500 cpm

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION
COLOR I.D. BY MUNSELL COLOR CHART
BACKGROUND LEVELS: Hnu: 0
α: 5
βγ: 1500 cpm

402-11-86

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 602 3.7	PROJECT NAME. FMPC RI / FS	
RING NUMBER 1247	COORDINATES.	DATE 12 4 90
EVATION:	GWL: Depth 90 ft Date/Time 12/4/90 @ 0930	DATE STARTED: 12/2/90
ENGINEER/GEOLOGIST J. Lear	Depth Date/Time	DATE COMPLETED: 12/4/90
DRILLING METHODS Auger		PAGE 3 OF 5

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 16 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
17	52643 1415 12-3-90	40	6	very dense, gray brown (10yr, 5/2) gravelly sand (well graded), wet	SP	NA	Hnu = 0
							α = 0
	52644 1415 12-3-90	47	6	S.A.A	SP	NA	βγ = 800-1000 cpm
	52645 1415 12-3-90	43	6	very dense, grayish brown (10yr, 5/2) silt Trace gravel, wet.	SP	NA	
18	42646 1450 12-3-90	15	0	N.R.	NA	NA	Hnu = 0
							α = 0
	42647 1450 12-3-90	37	6	very dense, gray (2.5Y, 5/1) sandy silt some gravel, wet	ML	NA	βγ = 1000 cpm
19	42648 1450 12-3-90	23	6	very dense, gray (2.5Y, 5/1) gravelly silt some sand, wet	GM	NA	
20	42649 1450 12-3-90	30	5	very dense, gray (2.5Y, 5/1) clayey silt Trace gravel, wet.	ML	NA	Hnu = 0
							α = 0
							βγ = 1000 cpm
				End of Sampling at 20.0 ft Sample No. 42652 - TCLP " " 42653 - Total U.IT " " 42654 - Total U. WMCO (Drum samples)			
							Hnu =
							α =
							βγ =
							Hnu =
							α =
							βγ =

NOTES: CONTRACTOR: Penn Drill
DRILLER: Bob Yost
ASSISTANT: B. Strapazzon

Hnu: 0
α: 0
βγ: 1000 cpm

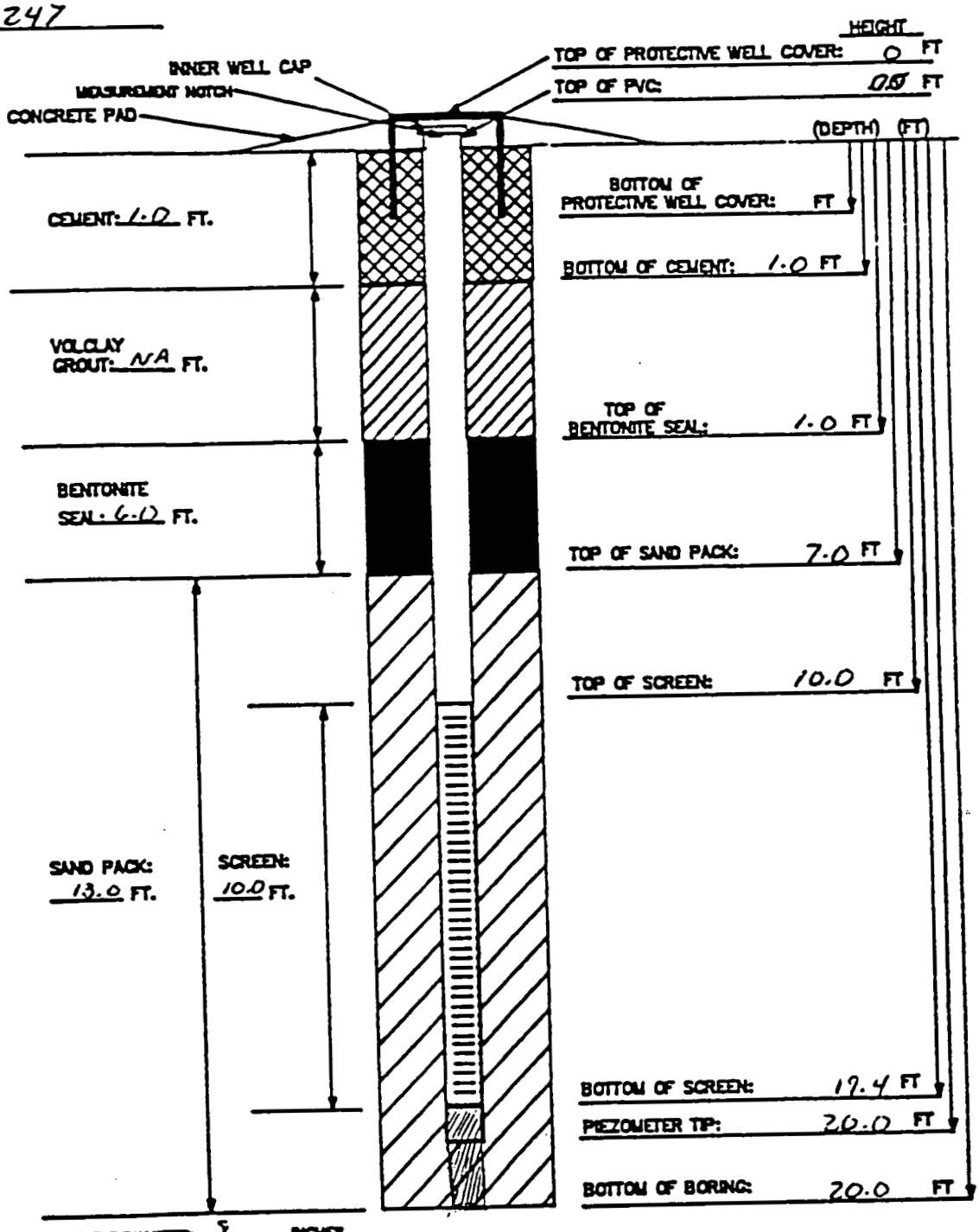
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION
COLOR I.D. BY MUNSELL COLOR CHART
BACKGROUND LEVELS: Hnu: 0
α: 5 cpm
βγ: 1500 cpm

402-11-88

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1247

INSTALLATION DATE: 12-4-90



	HEIGHT	(DEPTH) (FT)
TOP OF PROTECTIVE WELL COVER:	0 FT	
TOP OF PVC:	0.5 FT	
BOTTOM OF PROTECTIVE WELL COVER:	FT	
BOTTOM OF CEMENT:	1.0 FT	
TOP OF BENTONITE SEAL:	1.0 FT	
TOP OF SAND PACK:	7.0 FT	
TOP OF SCREEN:	10.0 FT	
BOTTOM OF SCREEN:	19.4 FT	
PIEZOMETER TIP:	20.0 FT	
BOTTOM OF BORING:	20.0 FT	

BOREHOLE DIAMETER: 8 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10-20, 4 bags
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: ½ bag
AMOUNT OF WATER USED: 2 gals
OTHER: NA

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602.3.7 GEOLOGIST/ENGINEER: J. Leor

Date	Initial			
1/6/	T.			
	Field Check	1st Key In	2nd Key In	Final Copy Validation

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07	PROJECT NAME: FMPC RI/FS - (Facility Testing Program)		
BORING NUMBER: 1250	COORDINATES:	DATE: 01-06-90	
ELEVATION: ~~N~~ NA 1-6-90	GWL: Depth Date/Time	DATE STARTED: 01-06-90	
ENGINEER/GEOLOGIST: M. GARMAN	Depth Date/Time	DATE COMPLETED: 01-08-90	
DRILLING METHODS: HOLLOW STEM AUGER(SPLIT SPOON SAMPLING)		PAGE 1 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6-inches)	RECOVERY (Inch)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0.5	18070 01-06 1029	8	6	MEDIUM DENSE FILL GRAVEL WITH A TRACE OF CLAY. MOIST.	GC	NA	Hnu = 0 α = 5 cpm βγ = 3000 cpm
1.0	18072 01-06 1029	8	2	SAA	GC	NA	
1.5	18073 01-06 1028	12	0	NO RECOVERY	NA	NA	
2.0	18074 01-06 1030	8	6	STIFF (2.5Y, 4/4) OLIVE BROWN CLAY. HIGH PLASTICITY. WET.	CL	1.5	Hnu = 0 α = 0 βγ = 1200 cpm
2.5	18075 01-06 1030	8	0	NO RECOVERY	NA	NA	
3.0	18076 01-06 1030	10	0	NO RECOVERY	NA	NA	
3.5	18077 01-06 1033	3	0	NO RECOVERY	NA	NA	Hnu = NA α = NA βγ = NA
4.0	18078 01-06 1033	4	0	NO RECOVERY	NA	NA	
4.5	18079 01-06 1033	5	0	NO RECOVERY	NA	NA	
5.0	18080 01-06 1037	8	6	MEDIUM DENSE (2.5Y, 4/4) OLIVE BROWN CLAYEY COARSE SAND. TRACE OF FINE GRAVEL. WET.	SC	NA	Hnu = 0 α = 0 βγ = 1000 cpm
5.5	18081 01-06 1037	4	6	SAA	SC	NA	
6.0	18082 01-06 1037	7	0	NO RECOVERY	NA	NA	
6.5	18083 01-06 1038	8	6	LOOSE (2.5Y, 4/4) OLIVE BROWN CLAYEY COARSE SAND. SOME COARSE GRAVEL. WET	SC	NA	Hnu = 0 α = 0 βγ = 1000 cpm
7.0	18084 01-06 1038	4	6	STIFF (2.5Y, 4/4) OLIVE BROWN SILTY CLAY. TRACE OF FINE SAND. MEDIUM PLASTICITY. WET.	CL ~~1-6~~ NG 1-6-90	1.5	
7.5	18085 01-06 1038	5	0	NO RECOVERY	NA	NA	

H_2O ZONE

NOTES: Contractor : Pennsylvania Drilling
Driller : J. SACCANI
Drillers Assistant: C. COULTER
All Samples collected according to ASTM Standards Soil Colors Described by Munsell Soil Color Charts.

000431

Background Readings/Levels
Hnu = 0 ppm.
Alpha (α) = 0 dpm
Gamma - Beta = 500 dpm.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07	PROJECT NAME: FMPC RI/FS Facility Testing)		
BORING NUMBER: 1250	COORDINATES:	DATE: 01-06-90	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 01-06-90	
ENGINEER/GEOLOGIST: M. GARMAN	Depth Date/Time	DATE COMPLETED: 01-08-90	
DRILLING METHODS: HOLLOW STEM AUGER - (Split Spoon Sampling)		PAGE 2 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 Tenth	RECOVERY (In.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8.0	18086 01-06 1045	4	6	STIFF (2.5Y, 4/4) OLIVE BROWN MOTTLED SILTY CLAY. MEDIUM PLASTICITY. MOIST.	CL	1.5	Hnu = 0 α = 0 SB = 600 cpm
8.5	18087 01-06 1045	6	6	SAA	CL	1.5	
9.0	18088 01-06 1045	9	6	MEDIUM STIFF (2.5Y, 4/4) OLIVE BROWN SANDY CLAY. TRACE OF FINE GRAVEL. LOW PLASTICITY. VERY MOIST.	CL	0.75	
9.5	18089 01-06 1127	2	6	LOOSE (2.5Y, 4/4) OLIVE BROWN CLAYEY SAND. WET.	~~CL~~ SC	NA	Hnu = 0 α = 0 SB = 800 cpm
10.0	18090 01-06 1127	2	0	NO RECOVERY	NA	NA	
10.5	52695 01-06 1127	4	0	NO RECOVERY	NA	NA	
11.0	52696 01-06 1130	4	6	MEDIUM DENSE (2.5Y, 4/4) OLIVE BROWN CLAYEY ~~+ SAA~~ SAND. WET.	SC	NA	Hnu = 0 α = 0 SB = 700 cpm
11.5	52697 01-06 1130	5	5	VERY STIFF (10YR, 4/4) DARK YELLOWISH BROWN SANDY CLAY. LOW PLASTICITY. VERY MOIST.	CL	>2.0	
12.0	52698 01-06 1130	7	0	NO RECOVERY	NA	NA	
12.5	52699 01-06 1134	10	6	MEDIUM DENSE (10YR, 4/4) DARK YELLOWISH BROWN CLAYEY SAND. WET.	SC	NA	Hnu = 0 α = 0 SB = 700 cpm
13.0	52700 01-06 1134	10	6	SAA	SC	NA	
13.5	52701 01-06 1134	12	6	SAA	SC	NA	
14.0	52702 01-06 1139	3	6	SAA	SC	NA	Hnu = 0 α = 0 SB = 800 cpm
14.5	52703 01-06 1139	4	6	MEDIUM DENSE (10YR, 4/1) DARK GRAY CLAYEY SILT. TRACE OF FINE SAND. WET.	ML	NA	
15.0	52704 01-06 1139	7	6	SAA	ML	NA	

NOTES:

SEE PAGE 1

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07	PROJECT NAME: FMPC RI/FS - (Facility Testing Program)	
BORING NUMBER: 1250	COORDINATES:	DATE: 01-06-90
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 01-06-90
ENGINEER/GEOLOGIST: M. GARMAN	Depth Date/Time	DATE COMPLETED: 01-08-90
DRILLING METHODS: HOLLOW STEM AUGER - (Split Spoon Sampling)		PAGE 3 OF 5

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN.	RECOVERY (in.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15.5	S2705 01-06 1449	4	6	MEDIUM STIFF (2.5Y, 5/4) LIGHT OLIVE BROWN CLAY, HIGH PLASTICITY VERY MOIST. SILTY	CL	<1.0	Ham = 0 α = 0 βD = 800 ppm
16.0	S2706 01-06 1449	5	6	MEDIUM DENSE (10YR, 4/1) DARK GRAY SILT. TRACE OF FINE SAND. WET.	ML	NA	
16.5	S2707 01-06 1449	7	5	SAA	ML	NA	
17.0	S2708 01-06 1452	7	6	SAA	ML	NA	Ham = 0 α = 0 βD = 700 ppm
17.5	S2709 01-06 1452	7	6	SAA	ML	NA	
18.0	S2710 01-06 1452	7	4	STIFF (10YR, 4/1) DARK GRAY SILTY CLAY. HIGH PLASTICITY. WET.	CL	1.5	
18.5	S2711 01-06 1458	4	6	MEDIUM DENSE (10YR, 5/4) DARK GRAY SANDY SILT. TRACE OF FINE GRAVEL. WET.	ML	NA	Ham = 0 α = 0 βD = 600
19.0	S2712 01-06 1458	7	6	MEDIUM DENSE (10YR, 5/4) DARK GRAY CLAYEY SILT. VERY MOIST.	ML	NA	
19.5	S2713 01-06 1458	9	6	SAA	ML	NA	
20	S2714 01-06 1458	11	5	STIFF (10YR, 5/4) DARK GRAY SILTY CLAY. HIGH PLASTICITY. MOIST.	CL	1.5	Ham = 0 α = 0 βD = 600
				BOTTOM OF BORING PIEZOMETER INSTALLED			

NOTES: 1) WATER LEVEL IN BORING DROPPED FROM APPROX. 0.5 FT. FROM GROUND SURFACE TO >9.0 FT. AFTER DRIVING THE 7.5 - 9.0 FT. SPOON. THIS INDICATES THAT THE FIRST H_2O ZONE WAS PROBABLY AN ISOLATED PERCHED "POCKET" OF H_2O.

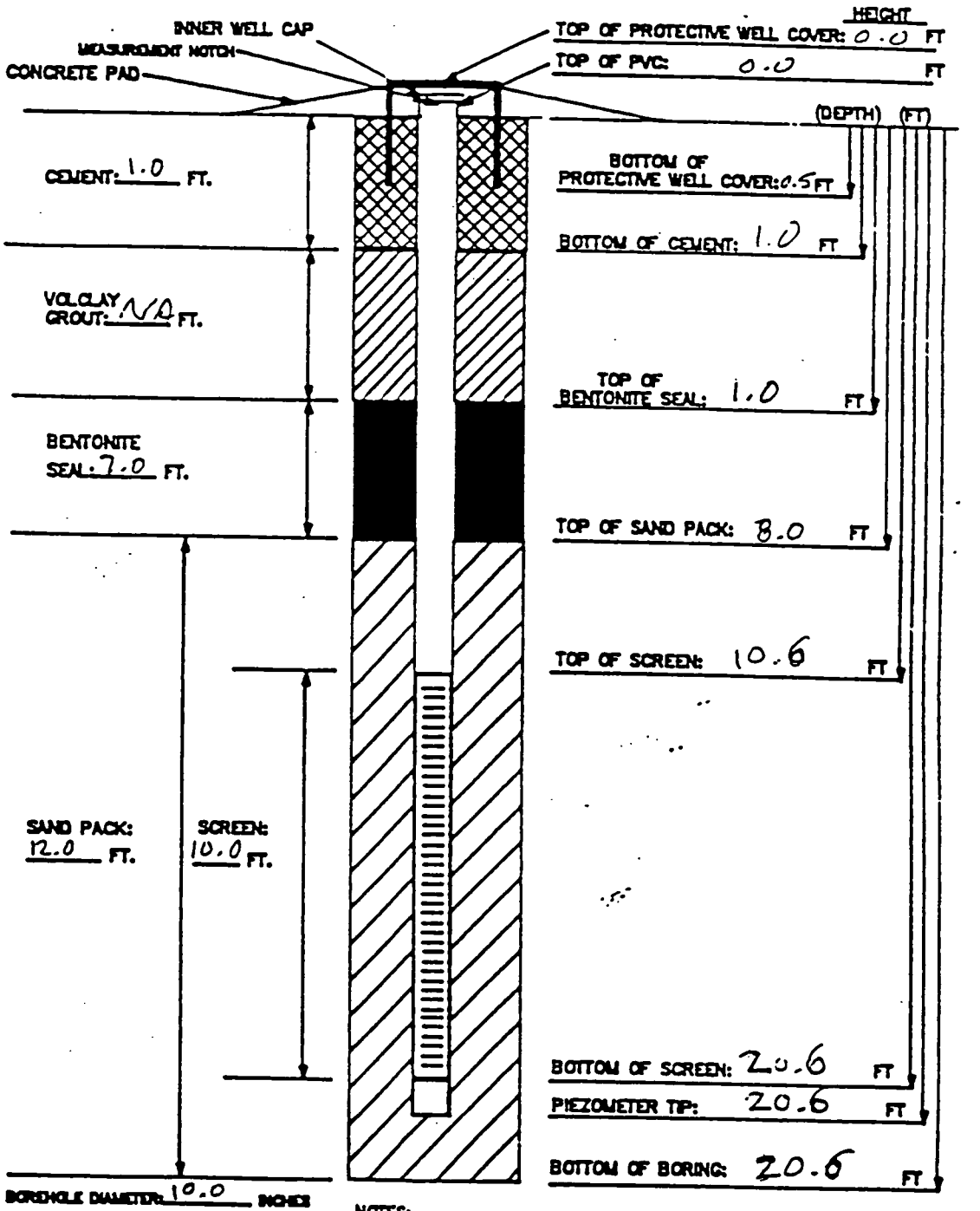
2) DUE TO CAVING IN, A 10 IN. DIAMETER AUGER WAS USED TO BORE OUT THE HOLE SO THAT THE PIEZOMETER COULD BE INSTALLED INSIDE IT.

SEE PAGE 1

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1250

INSTALLATION DATE: 01-07-90 THRU 01-08-90



MATERIALS USED:

SAND TYPE AND QUANTITY: (1020) 16,180 lbs
BENTONITE PELLETS (5-GALLON BUCKETS): 7 m.g. 10.0
BAGS OF VOLCLAY GROUT: NONE
AMOUNT OF CEMENT:
AMOUNT OF WATER USED:
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESIS INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 03.07

GEOLOGIST/ENGINEER: [illegible]

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: #1267	COORDINATES:	DATE: 06-14-89	
ELEVATION:	GWL: Depth / Date/Time	DATE STARTED: 06-14-89	
ENGINEER/GEOLOGIST: M. SLUCZAKI	Depth / Date/Time	DATE COMPLETED: 06-14-89	
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 85	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (DJ 4/22/89)
1	18443 1500 06-14	3	9	HARD, BROWN (10YR 4/2) SILTY CLAY, DRY	CL	>4.0	HNU: 0 PPM α: 0 CPM Bγ: 700-800 CPM
	18444 1500 06-14	6		A.A	CL	>4.0	
	18445 1500 06-14	7	—	NO RECOVERY FROM 1.0-1.5 FT	—		
2	18446 1503 06-14	6	6	VERY STIFF, BROWN (10YR 4/2) SILTY CLAY, TRACE GRAVEL (.50 IN) DRY	CL	3.0	HNU: 0 PPM α: 0 CPM Bγ: 700-800 CPM
	18447 1503 06-14	9	—	NO RECOVERY FROM 2.0-2.5 FT	—	—	
3	18448 1503 06-14	13	—	NO RECOVERY FROM 2.5-3.0 FT	—	—	
	18449 1507 06-14	12	12	VERY STIFF, BROWN (10YR 3/3) SILTY CLAY, SOME GRAVEL (.50-1.0 IN) DRY	CL	3.0	HNU: 0 PPM α: 0 CPM Bγ: 700-800 CPM
4	18450 1507 06-14	12		VERY STIFF, DK. GRET-BROWN (10YR 4/1) SILTY CLAY, TRACE SAND, DAMP	CL	3.5	
	18451 1507 06-14	9	—	NO RECOVERY FROM 4.0-4.5 FT	—	—	
5	18452 1510 06-14	13	12	VERY STIFF, DK. GRET-BROWN (10YR 4/1) SILTY CLAY, TRACE SAND, DAMP	CL	2.75	HNU: 0 PPM α: 0 CPM Bγ: 700-800 CPM
	18453 1510 06-14	11		STIFF, BROWN (10YR 4/4) SILTY CLAY, ~~MOIST~~/DAMP	CL	1.75	
6	18454 1510 06-14	11	—	NO RECOVERY FROM 5.5-6.0 FT	—	—	
	18455 1521 06-14	4	6	VERY STIFF, BROWN (10YR 3/3) SILTY CLAY DAMP	CL	2.5	HNU: 0 PPM α: 0 CPM Bγ: 700-800 CPM
7	18456 1521 06-14	4	6	STIFF, BROWN (10YR 3/3) SILTY CLAY, DAMP	CL	1.5	
	18457 1521 06-14	7	3	STIFF, GRETISH-BROWN (10YR 4/2) CLAY DAMP	CL	2.0	

NOTES: CONTRACTOR: PENNDRILL
RIG: MOBILE B-53
DRILLER: JIM SACCANI
ASSISTANT: MIKE FELTY

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU: 0 PPM
α: 0 CPM
Bγ: 700-800 CPM
LEL/O_2: LEL: 0% DJ 4/22/89
O_2: 20.6%

A.A = AS ABOVE

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: # 1267	COORDINATES:	DATE: 06-14-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 06-14-89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth Date/Time	DATE COMPLETED: 06-14-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 65

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (6/22/89)
8	18458 1524 06-14	5	12	STIFF, BROWN (10YR 4/3) SILTY CLAY, DAMP	CL	2.0	HNU = 0 PPM α = 0 CPM Bγ = 700-800 CPM
	18459 1524 06-14	5		A.A.	CL	1.5	
9	18460 1524 06-14	7	—	NO RECOVERY FROM 8.5-9.0 FT	—	—	
START OF WATER BEARING ZONE	18461 1529 06-14	5	18	STIFF, GREYISH-BROWN (10YR 5/3) SILTY CLAY, MOIST	CL	1.0	HNU = 0 PPM α = 0 CPM Bγ = 700-800 CPM
10	18462 1528 06-14	8		~~STIFF~~ MEDIUM DENSE, GREYISH-BROWN (10YR 5/2) CLAYEY SILT, WET	ML	N/A	
	18463 1529 06-14	9		A.A.	ML	N/A	
11	18464 1538 06-14	3	18	~~LOOSE~~ STIFF, DK. GREYISH-BROWN (10YR 4/2) SILTY CLAY, MOIST	CL	1.5	HNU = 0 PPM α = 0 CPM Bγ = 600-700 CPM
	53035 1538 06-14	5		MEDIUM DENSE, GREYISH-BROWN (10YR 5/3) SILT, WET	ML	N/A	
12	53036 1539 06-14	9		A.A	ML	N/A	
	53037 1558 06-14	5	12	MEDIUM DENSE, GREY (5Y 5/2) CLAYEY SILT, WET	ML	N/A	HNU = 0 PPM α = 0 CPM Bγ = 600 CPM
13	53038 1558 06-14	7		A.A	ML	N/A	
	53039 1558 06-14	9	—	NO RECOVERY FROM 13.0 - 13.5 FT.	—	—	
14	53040 1600 06-14	9	12	MEDIUM DENSE, BROWN (10YR 5/3) SILT, WET 14.2	ML	N/A	HNU = 0 PPM α = 0 CPM Bγ = 600 CPM
	53041 1600 06-14	9		MEDIUM DENSE, GREY, (5Y 5/2) CLAYEY SILT, MOIST	ML	N/A	
Bottom of water bearing zone	53042 1600 06-14	7	—	NO RECOVERY FROM 14.5 - 15.0 FT.	—	—	

NOTES: TOP OF WATER PRODUCING ZONE - 9.5 FT.
BOTTOM OF WATER PRODUCING ZONE - 15.0 FT

A.A = AS ABOVE

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: #1267	COORDINATES:	DATE: 06-14-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 06-14-89
ENGINEER/GEOLOGIST: M. SWIDERSKI	Depth Date/Time	DATE COMPLETED: 06-14-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 35

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 in.)	RECOVERY (in.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	57043 1615 06-14	3		STIFF, GREY (5Y 5/1) CLAY, DAMP	CL		HNU = 0 PPM
	57044 1615 06-14	6	16	A.A.			α = 0 CPM
16							BG = 600 CPM
	57045 1615 06-14	15		A.A	CL		
				16.5 ft BOTTOM OF BORING			

NOTES:

AA. = As Above

000437

6/22/89

1507

	Initial	Date
Field Check	BW	9/12/89
1st Key In		
2nd Key In		
Final Quality Verification		

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1274	COORDINATES:	DATE: 06-19-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 06-19-89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth Date/Time	DATE COMPLETED: 06-19-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1	18597 1414 06-19	3	6	M. STIFF BROWN (10YR 5/3) SILTY CLAY, SOME GRAVEL (.25-1.0 in), SOME ORGANIC MATERIAL, DRY	CL	.5	HNU: 0 ppm; α: 0 cpm; Bβ: 80-100 cpm
	18598 1414 06-19	7	—	NR	—	—	
	18599 1414 06-19	5	—	NR	—	—	
2	18600 1417 06-19	7	6	STIFF, BROWN (10YR 4/4) SILTY CLAY, TRACE SAND, TRACE ORGANIC MATERIAL DAMP	CL	2.0	HNU: 0 ppm; α: 0 cpm; Bβ: 120-140 cpm
	18601 1417 06-19	11	3	A. A	CL	2.0	
	18602 1417 06-19	11	—	NR	—	—	
3	18603 1420 06-19	11	6	STIFF, YELLOW-BROWN (10YR 5/6) MOTTED GREY (10YR 4/2) CLAY TRACE GRAVEL (.25 in) DAMP	CL	2.0	HNU: 0 ppm; α: 0 cpm; Bβ: 100-120 cpm
4	18604 1420 06-19	11	3	A.A.	CL	2.0	
	18605 1420 06-19	12	—	NR	—	—	
5	18606 1424 06-19	13	18	STIFF, YELLOW-BROWN (10YR 5/3) SILTY CLAY, TRACE SAND, TRACE GRAVEL (.25 in - .50 in) DAMP	CL	2.0	HNU: 0 ppm; α: 0 cpm; Bβ: 80-100 cpm
	18607 1424 06-19	14		A.A	CL	2.0	
6	18608 1424 06-19	14		A A	CL	2.0	
7	18609 1432 06-19	9	18	A.A	CL	2.0	HNU: 0 ppm; α: 0 cpm; Bβ: 120-140 cpm
	18610 1432 06-19	13		A.A	CL	2.0	
	18611 1432 06-19	15		A.A.	CL	2.0	

NOTES: CONTRACTOR: PENNDRILL
RIG: MOBILE B-53
DRILLER: J. SACCANI
ASSISTANT: W. FELTY

A.A = AS ABOVE
NR = NO RECOVERY

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α : 0 CPM
Bβ : 140-160 CPM
LEL/O_2: LEL = 0 PPM
O_2 = 20.6 %

000438

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 37.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1274	COORDINATES:	DATE: 06-19-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 06-19-89
ENGINEER/GEOLOGIST: H. SLUYTERSKI	Depth Date/Time	DATE COMPLETED: 06-19-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (CM w/ANT)
8	19612 1436 06-19	14	18	STIFF, BROWN (10YR 5/4) SILTY CLAY, TRACE SAND, DAMP	CL	2.0	HNU = 0 ppm α = 0 cpm Bβ = 120-140 cpm
	18613 1436 06-19	16		A.A	CL	2.0	
9	19614 1436 06-19	22		A.A	CL	2.0	
	19615 1440 06-19	16	18	VERY STIFF, BROWN (10YR 5/4) SILTY CLAY, TRACE GRAVEL (.25-.50 in) TRACE COARSE GRAVEL (1.0-1.5 in) DAMP	CL	2.5	HNU = 0 ppm α = 0 cpm Bβ = 100-120 cpm
10	19616 1440 06-19	20		A.A	CL	2.5	
	19617 1440 06-19	21		VERY STIFF, GREY (5Y 4/1) SILTY CLAY, TRACE SAND, TRACE GRAVEL (.25 in) DAMP	CL	2.5	
11	18618 1442 06-19	9	6	A.A	CL	2.5	HNU = 0 ppm α = 0 cpm Bβ = 100-120 cpm
	53175 1442 06-19	10	6	A.A	CL	2.5	
12	53176 1448 06-19	10	—	NR	—	—	
	53177 1450 06-19	9	18	VERY STIFF, GREY (5Y 4/1) SILTY CLAY, TRACE SAND, TRACE GRAVEL (.25 in) DAMP	CL	2.5	HNU = 0 ppm α = 0 cpm Bβ = 100-120 cpm
13	53178 1450 06-19	10		A.A	CL	2.5	
	53179 1450 06-19	11		STIFF, GREY (5Y 4/1) CLAY, SOME SAND, MOIST	CL	2.0	
∇ 420 ZONE 14	53180 1454 06-19	12	18	MEDIUM DENSE, GREY (5Y 4/1) POORLY GRADED SAND, TRACE GRAVEL (.25 in) WET	SP	N/A	HNU = 0 ppm α = 0 cpm Bβ = 100-120 cpm
	53181 1454 06-19	13		MEDIUM DENSE, GREY (5Y 4/1) ~~POORLY~~ WELL GRADED SAND, TRACE GRAVEL (.25 in) WET	SW	N/A	
	53182 1454 06-19	15		A.A	SW	N/A	

NOTES:

000439

A.A = AS ABOVE
NR = NO RECOVERY

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1274	COORDINATES:		DATE: 06-19-89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 06-19-89
ENGINEER/GEOLOGIST: M. SLUSZAKI	Depth	Date/Time	DATE COMPLETED: 06-19-89
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 3 OF 3 5

GW 4/22/91

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 1 (FT)	RECOVERY (FT)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
H_2O	S3183 1517 06-19	12		MEDIUM DENSE, GREY (5Y 4/1) WELL GRADED SAND, TRACE GRAVEL (.25-.75 IN) WET	SW	N/A	HNU = 0 ppm α = 0 cpm Bδ = 120-190 cpm
	S3184 1517 06-19	10	18	A.A	SW	N/A	
16	S3185 1517 06-19	16		STIFF, GREY (5Y 4/1) SILTY CLAY, TRACE SAND, TRACE GRAVEL (.25 IN) DAMP	CL	2.0	
17				BOTTOM OF BORING . 16.5 FT			HNU = α = Bδ =
18							HNU = α = Bδ =
19							
20							HNU = α = Bδ =

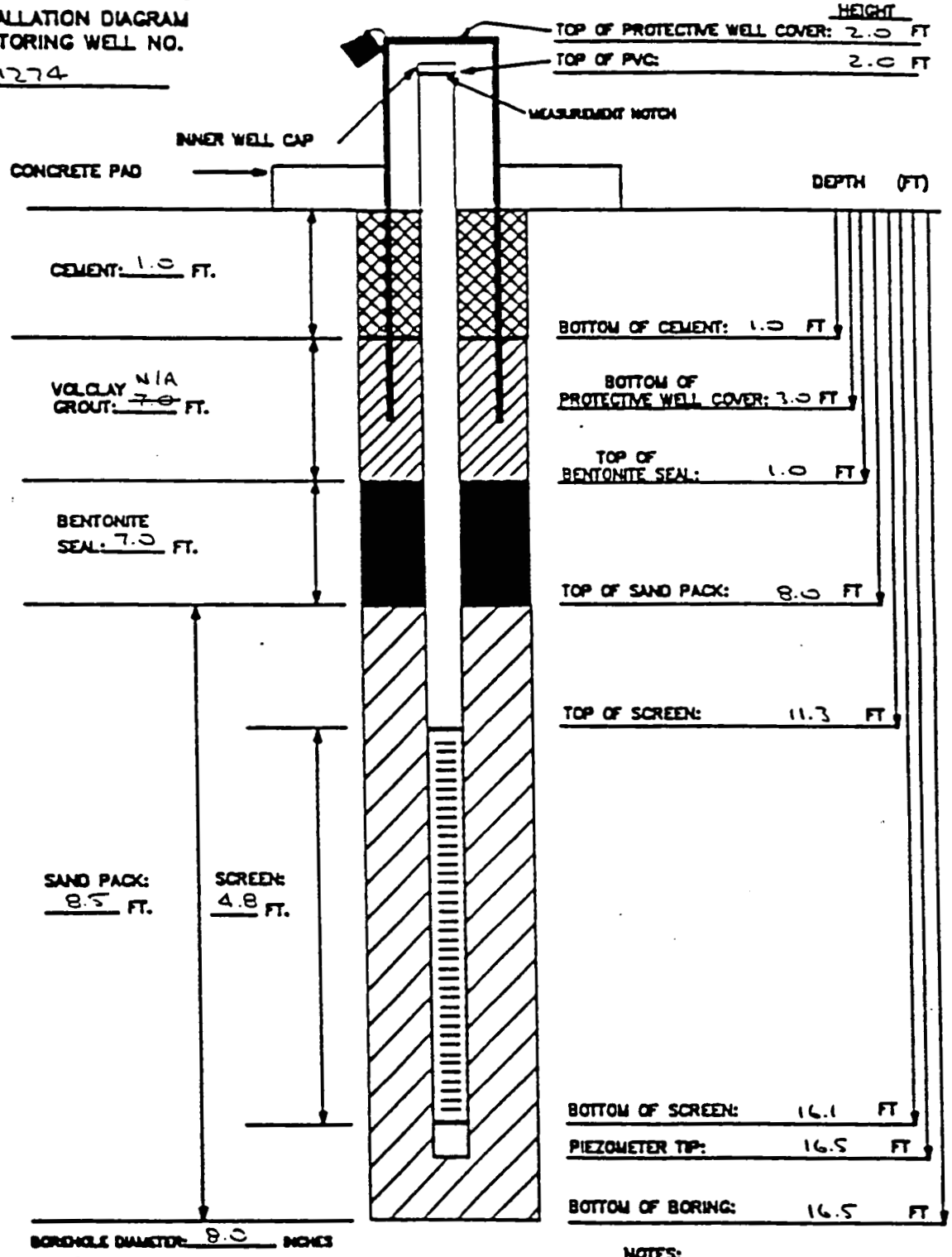
NOTES:

A.A. = AS ABOVE

INSTALLATION DATE: 06-19-89

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1274



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10-20 3-80LB SKS
BENTONITE PELLETS (5-GALLON BUCKETS): 2.5 BUCKETS
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1/2 - 94 LB BAG
AMOUNT OF WATER USED: N/A
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7.1

GEOLOGIST/ENGINEER: M. SLUSARSKI

FERNALD RI/FS

1507

Date	7-18-89			
Initial	JA			
	Field Check	1st Review	2nd Review	Final Copy Initial/Date

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1287	COORDINATES:	DATE: 7/17/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 7/17/89
ENGINEER/GEOLOGIST: L. Adams	Depth Date/Time	DATE COMPLETED: 7/18/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
*	18885 1545 0940 7-18	6	6	Very stiff to hard, very dark brown (10yr 3/2) very silty clay. Some surficial coal chunks surficial roots & grass. Some sand & gravel. damp.	CL	4.5+	HNU: Bkg α: Bβ: ↓
1	18886 1545 0940 7-18	7	6				
	18887 1545 0940 7-18	8	0	SAA fewer roots, no grass, damp.		4.5+	
				no recovery	N/A		
1	18888 1545 7-17	5	6	Very stiff, to hard, very dark grayish brown (10yr 3/2) silty clay. Roots present. Some gravel. Damp	CL	4.5+	HNU: Bkg α: Bβ: ↓
2	18889 1545 7-17	7	6	Very stiff, grayish brown to yellowish brown (10yr 5/2 to 5/8) silty clay. Some roots. Trace sand and gravel. Damp.	CL	4.5+	
	18890 1545 7-17	8	3			3.75	
3	18891 1609 7-17	7	6	very stiff, grayish brown to yellowish brown to gray (10yr 5/2 to 5/8 to 5/1) silty clay. Trace sand, roots, gravel. Some dark brown spotty staining.	CL	2.25	HNU: Bkg α: Bβ: ↓
4	18892 1609 7-17	7	4				
	18893 1609 7-17	8	0	no recovery	N/A		
5	18894 1611 7-17	4	6	SAA but med. stiff, moist.	CL	.5	HNU: Bkg α: Bβ: ↓
	18895 1611 7-17	3	6	SAA becoming sandier, soft.		0	
6	18896 1611 7-17	0	0	Med. stiff, gray to yellowish brown (10yr 5/8 to 5/1) Some sand, very moist. clay	CL	.5	
7	18897 1621 7-17	5	6	Med. dense, brown (10yr 5/3) silty sand and gravel. well graded. Moist.	GM	N/A	HNU: 2ppm α: Bkg Bβ: Bkg
	18898 1621 7-17	6	1				
	18899 1621 7-17	10	0	No recovery	N/A		

NOTES: CONTRACTOR: PENNDRILL
RIG: Mobile B-57
DRILLER: J. Saccani
ASSISTANT: Kyle Felty
Bβ probe = ASI #10
α probe = ASI #6
Helper - D. Nelson

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU: 0 PPM
α: 0 CPM
Bβ: 110 CPM
LEL: 0%
O_2: 20.7% 1A

000442

Hnu = HH18

SAA = same as above

* - 0.0-1.5 offset due to special analysis samples. [illegible]

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1287	COORDINATES:		DATE: 7/17/89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 7/17/89
ENGINEER/GEOLOGIST: L. Adams	Depth	Date/Time	DATE COMPLETED: 7/18/89
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 2 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	18900 1635 7/17	12	6	Med. Dense, brown (10yr 5/3) silty sand and gravel. Some small lenses of clay (≈0.0 in clay). Wet.	SM	N/A	HNU = Bkg α = ↓ BZ =
	18901 1635 7/17	13	6				
9	18902 1635 7/17	13	6	Med. Dense, brown (10yr 5/3) very fine silty sand. Well sorted. Wet.	SM	N/A	
1.5 ft	18903 1640 7/17	8	6	SAA except yellowish brown (10yr 5/6) color.	SM	N/A	HNU = Bkg α = ↓ BZ =
	18904 1640 7/17	12	6				
10	53435 1640 7/17	9	3				
4.5 ft	53436 0845 7/17	9	5	Med. Dense, silty sand + gravel. Brown to gray (10yr 5/3 to 5/1) Some clay. Some roots. Wet.	GC	N/A	HNU = Bkg. α = ↓ BZ =
11	53436 0845 7/18	8	0				
water	53436 0845 7/18	7	0	No recovery	N/A		
12	0848	5	2	SAA. Loose. also large piece of gravel.	GC	N/A	HNU = Bkg α = ↓ BZ =
13	0848	5	0	No recovery	N/A		
	0848	1	0				
14	0856	3	6	SAA	GC	N/A	HNU = Bkg α = ↓ BZ =
	0856	2	6				
	0856	5	6	Soft, gray (10yr 5/1) Clay. Some gravel, sand. High plasticity. Moist.	CL	.25	

NOTES:

SAA = Same as above

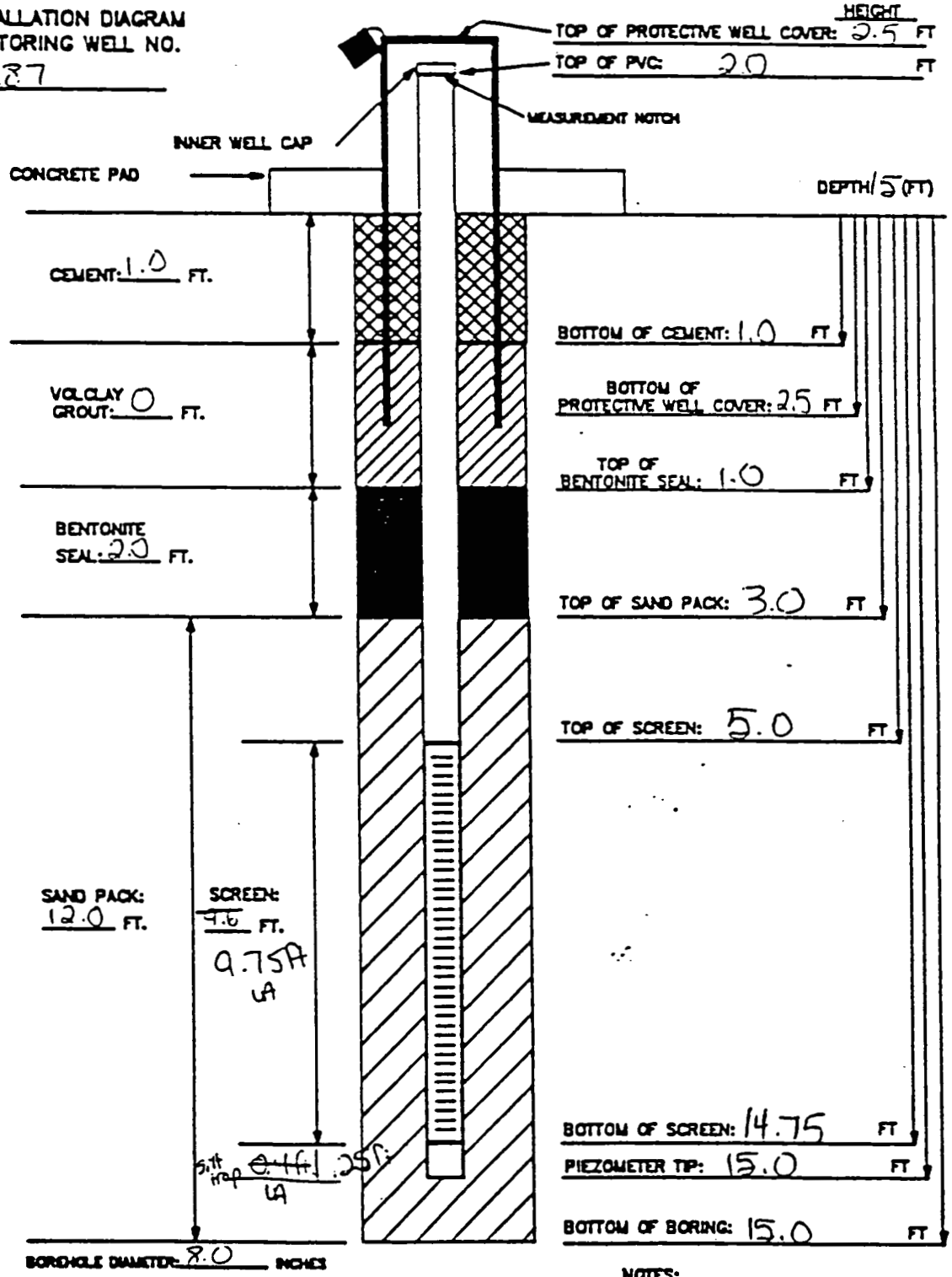
Water bearing zone 7.5-14.5 ft.

Total depth of hole - 15.0 ft.

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1287

INSTALLATION DATE: 7/18/89



MATERIALS USED:
SAND TYPE AND QUANTITY: 2 bags 10/20
BENTONITE PELLETS (5-GALLON BUCKETS): 1 bucket
BAGS OF VOLCLAY GROUT: none
AMOUNT OF CEMENT:
AMOUNT OF WATER USED:
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 1202 3.7.1 GEOLOGIST/ENGINEER: L. Adams

Water zone: 7.5 - 14.5 ft.

QA/QC 7-20-89 by WAH

FERNALD
RI/FS

Initial				
	Field Check	1st Key In	2nd Key In	Hard Copy Verification

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1293	COORDINATES:	DATE: 7/25/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 7/25/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 7/25/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	19015 1000 7-25	5	6	FINE GRAINED COAL trace clay (10yr, 6/4) Light yellowish brown moist	NA	NA	HNU = 0 ppm α = 0 cpm Bγ = 70-80 cpm
	19016 1000 7-25	6	6	SAA	NA	NA	
1				med. dense (10yr 4/6) Dark yellowish brown sandy gravel, trace coal, moist	GW	NA	
	19017 1000 7-25	11	0	NR	NA	NA	
	19018 1005 7-25	6	6	Stiff (10yr, 5/4) yellowish brown sandy clay, trace coal & fine gravel low plasticity, very moist	CL	1.0	HNU = 0 ppm α = 0 cpm Bγ = 80-90 cpm
2	19019 1005 7-25	6	6	SAA	CL	1.0	
	19020 1005 7-25	10	3	med. Dense (5y, 6/2) light olive gray POORLY GRADED SAND, some fine to med gravel, wet.	SP	NA.	⟸ WET
3	19021 1009 7-25	10	0	NR	NA	NA	HNU = α = Bγ = } NA No Recovery with catcher
	19022 1009 7-25	6	0	NR	NA	NA	
4	19023 1009 7-25	6	0	NR	NA	NA	
	19024 1025 7-25	2	6	Stiff, (2.5y 5/4) light olive brown, silty clay, some sand, medium plasticity, very moist	CL	1.0	HNU = 0 ppm α = 0 cpm Bγ = 80-90 cpm
5	19025 1025 7-25	4	6	SAA	CL	1.5	
	19026 1025 7-25	5	2	SAA	CL	1.25	
6	19027 1030 7-25	5	6	Very Stiff (2.5y 4/4) olive brown, silty clay, trace sand and fine gravel, low plasticity, moist	CL	2.25	HNU = 0 ppm α = 0 cpm Bγ = 90-100 cpm
	19028 1030 7-25	15	6	SAA	CL	2.75	
7	19029 1030 7-25	17	0	NR	NA	NA	

NOTES: CONTRACTOR: PENNDRILL
RIG: Model 45-C
DRILLER: Craig Coulter
ASSISTANT: Bill Anderson
Geo-Assistant: Cindy Melroy
HNU ~~[illegible] 7-25-89~~ 00222

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α : 0 CPM
Bγ : 70-100 CPM
SAA = Same As Above
NR = No Recovery
LEL/O2: LEL = 0% ~~PPM~~ 7/19/89
O2 = 20.6 %

000445

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1293	COORDINATES:	DATE: 7/25/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 7/25/89
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 7/25/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
Top of water Bearing zone at 7.5 FT	19030 1240 7-25	10	6	Med. Dense (10yr 5/4) yellowish brown to (2.5y 3/2) very Dark grayish brown, trace fine to med gravel, wet clayey sand	SC	NA	HNU = 0 ppm α = 0 cpm Bγ = 80-90 cpm
8	19031 1340 7-25	11	6	SAA	SC	NA	
	19032 1340 7-25	11	0	NR	NA	NA	
9	19033 1355 7-25	4	6	Med. Dense (10yr 5/4) yellowish brown clayey sand, some fine to med gravel wet	SC	NA	HNU = 0 ppm α = 0 cpm Bγ = 90-100 cpm
	19034 1355 7-25	5	0	NR	NA	NA	
10	19035 1355 7-25	5	0	NR	NA	NA	
	19036 1400 7-25	2	6	LOOSE (2.5y 4/2) Dark grayish brown clayey sand, trace fine to med gravel wet	SC	NA	HNU = 0 ppm α = 0 cpm Bγ = 160-180 cpm
11	53555 1400 7-25	5	6	SAA	SC	NA	
Bottom of water Bearing zone 11.5 FT	53556 1400 7-25	5	3	STIFF (5y 4/1) Dark Gray silty clay some sand, trace fine gravel, med plasticity, moist	CL	1.25	
12	53567			Bottom of boring + sampling at 12.0 FT			HNU = α = Bγ =
	53568						
13	53569						
	53570						HNU = α = Bγ =
14	53571						
	53572						

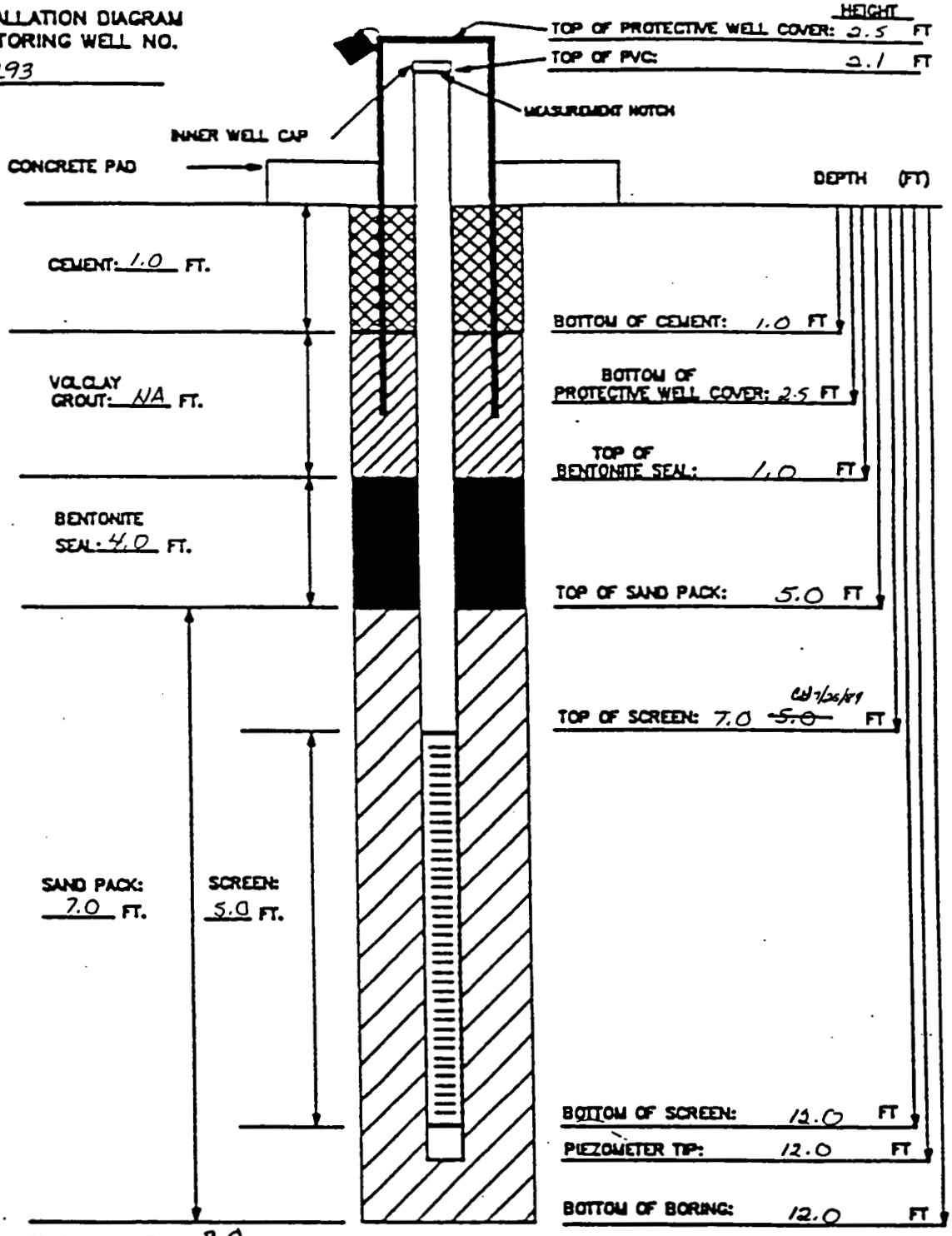
NOTES:

SAA = Same As Above
NR = No Recovery

INSTALLATION DATE: 7-25-89

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1293



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 1020 sand - 4-80# sacks
BENTONITE PELLETS (5-GALLON BUCKETS): 2 buckets
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: ½ (94#) sack
AMOUNT OF WATER USED: 10 gal
OTHER: 5.0 ft Protective Casing

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7.1

GEOLOGIST/ENGINEER: C. Grube

1507

Date				
Initial				
	Final Check	Ill. Key	Zip Key	Hard Copy Verification

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.2.1	PROJECT NAME: Fernald	
BORING NUMBER: 1309	COORDINATES:	DATE: 6/30/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6/30/89
ENGINEER/GEOLOGIST: TSD	Depth Date/Time	DATE COMPLETED: 6/30/89
DRILLING METHODS: Hollow Auger		PAGE 1 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0.5	19367 0959 6-30	6	6	Very stiff (2.5Y 4/4) olive brown silty clay, some sand, trace of gravel, med. plasticity, moist	CL	3.5	HNU = 9 ppm; α = 0 cpm; Bδ = 200 cpm
1.0	19368 0959 6-30	7	2	SAA	CL	4.0	
1.5	19369 0959 6-30	9	0	NR	—	—	
2.0	19370 1003 6-30	20	3	Very dense (2.5Y 4/4) olive brown clayey sand some gravel, dry.	SC	NA	HNU = 3 ppm; α = 0 cpm; Bδ = 160-180 cpm
2.5	19371 1003 6-30	50/1	0	NR	—	—	
3.0	19372 1003 6-30	NA	0	NR	—	—	
3.5	19373 1024 6-30	7	6	Dense (2.5Y 4/4) olive brown clayey gravel, some sand, moist	GC	—	HNU = 9 ppm; α = 0 cpm; Bδ = 300 cpm
4.0	19374 1024 6-30	13	6	SAA	GC	—	
4.5	19375 1029 6-30	13	4	SAA	GC	—	
5.0	19376 1029 6-30	10	6	SAA	GC	—	HNU = 6 ppm; α = 0 cpm; Bδ = 240-260 cpm
5.5	19377 1029 6-30	13	6	Dense (10YR 4/1) dark gray clayey gravel some sand, moist	GC	—	
6.0	19378 1029 6-30	21	4	Very stiff (10YR 4/1) dark gray sandy clay, some gravel, med plasticity, moist	CL	3.75	
6.5	19379 1033 6-30	13	6	Dense (2.5Y 4/4) olive brown clayey sand, some gravel dry Hard (5Y 4/1) dark gray sandy clay, trace of gravel, moist, med plasticity	SC CL	74.0	HNU = 0 ppm; α = 0 cpm; Bδ = 220-260 cpm
7.0	19380 1033 6-30	14	6	Very stiff (5Y 4/1) dark gray sandy clay trace of gravel, med plasticity, moist.	CL	3.75	
	19381 1033 6-30	15	6	Hard (5Y 4/1) dark gray silty clay, some sand & gravel, med. plasticity, moist.	CL	74.0	

NOTES: CONTRACTOR: Penn Drill
Rig: Model 80
Driller: Craig Coulter
Assistant: Bill Anderson
SAA = Same As Above

SAMPLES collected as per ASTM Standard Penetration Test.
Colors identified by Munsell Color Ch
Background Levels: HNU = 0 ppm
α = 0 cpm
Bδ = 240-280 cpm
LEL = ppm
O_2 = %

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: Fernald		
BORING NUMBER: 1309	COORDINATES:		DATE: 6/30/89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 6/30/89
ENGINEER/GEOLOGIST: TSD	Depth	Date/Time	DATE COMPLETED: 6/30/89
DRILLING METHODS: Hollow Auger			PAGE 2 OF 3

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 in.	RECOVERY (in.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8.0	19382 1042 6-30	18	6	Very dense (5Y 4/3) olive clayey sand trace of gravel, moist	SC	—	HNU = 0 ppm α = 0 cpm βγ = 260-280 cpm
8.5	19383 1042 6-30	20	6	Very stiff (5Y 4/1) dark gray sandy clay trace of gravel, med plasticity, moist.	CL	2.75	
9.0	19384 1042 6-30	21	0	NR	—	—	
9.5	19385 1300 6-30	10	6	Very stiff (2.5Y 5/4) light olive brown silty clay, some sand, trace of gravel med. plasticity, moist	CL	2.25	HNU = 0 ppm α = 0 cpm βγ = 200-220 cpm
10.0	19386 1300 6-30	16	6	SAA	CL	2.25	
10.5	19387 1300 6-30	22	0	NR	—	—	
11.0	19388 1304 6-30	9	6	Dense (10YR 4/2) dark grayish brown clayey sand, some gravel, moist.	SC	—	HNU = 0 ppm α = 0 cpm βγ = 200-240 cpm
11.5	53875 1304 6-30	11	0	NR	—	—	
12.0	53876 1304 6-30	11	0	NR	—	—	
12.5	53877 1309 6-30	11	6	Dense (10YR 4/1) dark gray clayey sand, some gravel, very moist	SC	—	HNU = 0 ppm α = 0 cpm βγ = 180 cpm
13.0	53878 1309 6-30	14	6	SAA	SC	—	
13.5	53879 1309 6-30	16	3	SAA	SC	—	
14.0	53880 1317 6-30	15	6	Stiff (2.5Y 4/2) olive brown sandy clay some gravel, med plasticity, very moist to moist	CL	1.5	HNU = 0 ppm α = 0 cpm βγ = 160-220 cpm
14.5	53881 1317 6-30	16	6	Very stiff (2.5Y 4/2) olive brown sandy clay trace of gravel, med. plasticity, moist	CL	2.0	
	53882 1317 6-30	17	6	Very stiff (SAA	CL	2.5	

NOTES: Contractor: Penn Drill
Rig, model 80
Driller: Craig Coulter
Assistant: Bill Anderson

Samples collected as per ASTM standard penetration test.
Colors identified by munsell color char
Background Levels: HNU = 0 ppm
α = 0 cpm
βγ = 240-280 cpm
LEL = ppm
O_2 = %

SAA - Same As Above.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: Fernald	
BORING NUMBER: 1309	COORDINATES:	DATE: 6/30/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 6/30/89
ENGINEER/GEOLOGIST: TSD	Depth Date/Time	DATE COMPLETED: 6/30/89
DRILLING METHODS: Hollow Auger		PAGE 3 OF 5

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 in	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15.5	53883 1331 6-30	6	6	Med. Dense (5Y 4/2) olive gray clayey sand, trace of gravel, moist.	SC	–	HNU = 0 ppm α = 0 CPM βγ = 220-240 CPM
16.0	53884 1331 6-30	8	6	Stiff (5Y 4/2) olive gray silty Clay, some sand, trace of gravel, roots, med plasticity moist.	CL	2.0	
16.5	53885 1331 6-30	10	5	SAA	CL	1.5	
17.0	53886 1400 6-30	5	4	Soft (5Y 4/1) dark gray sandy Clay trace of gravel, med plasticity moist	CL	0.5	HNU = 0 ppm α = 0 CPM βγ = 280-300 CPM
17.5	53887 1400 6-30	8	0	NR	—	—	
18.0	53888 1400 6-30	10	0	NR	—	—	
18.5	53889 1400 6-30	7	6	Med stiff (5Y 4/1) dark gray silty Clay some sand + gravel, med plasticity moist	CL	0.75	HNU = 0 ppm α = 0 CPM βγ = 260-280 CPM
19.0	53890 1400 6-30	10	6	Stiff (5Y 4/1) dark gray silty Clay, some sand, trace of gravel, med. plasticity moist	CL	1.0	
19.5	53891 1400 6-30	14	6	SAA	CL	1.0	
20.0	53892 1400 6-30	12	6	SAA	CL	2.0	HNU = ppm α = CPM βγ = CPM
				Bottom of Sampling & drilling @ 20.0 ft			
			*	WELL LEFT OPEN FOR 24 HRS. NO WATER – Plugged & Abandoned. 7/1/89			HNU = ppm α = CPM βγ = CPM

NOTES: CONTRACTOR: Penn Drill
Rig: Model 80
Driller: Craig Coulter
Assistant: Bill Anderson

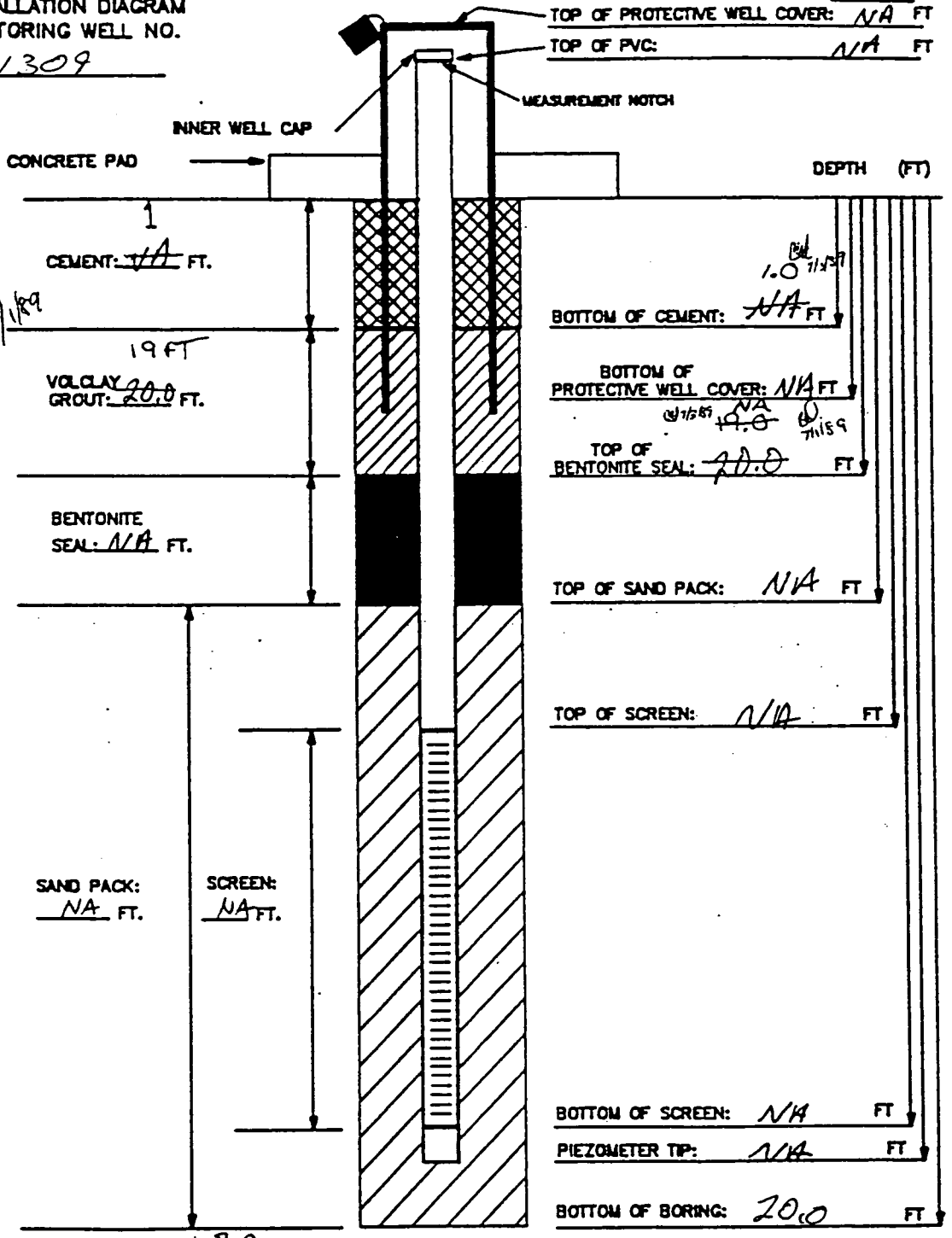
SAA = SAME AS ABOVE

Samples collected as per ASTM Standard Penetration Test.
Colors Identified by Munsell color Cha.
Background Levels: HNU = 0 ppm
α = 0 CPM
βγ = 240-280 CPM
LEL = ppm
O_2 = %

INSTALLATION DATE: _____

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1309



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand - NA
BENTONITE PELLETS (5-GALLON BUCKETS): NA
BAGS OF VOLCLAY GROUT: 3 sacks grout, 3 bags initiator
AMOUNT OF CEMENT: ½ (94#) sack
AMOUNT OF WATER USED: 50 gal.
OTHER: NA

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE: NA

TASK: 3.7.1

GEOLOGIST/ENGINEER: L. Santangelo

FERNALD RI/FS

Date	8/3/6			
Initial	BD			
	1st Ch	1st Sa	2nd Ch	2nd Sa

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1336	COORDINATES:	DATE: 08-02-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 08-02-89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth Date/Time	DATE COMPLETED: 08-02-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 3

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1	19961 1019 08-02	20	6	DENSE, BROWN-GRAY (10YR5/2) GRAVEL CLAY MIXTURE, GRAVEL RANGING FROM (.25-2.0 IN) DRY	GC	MA	HNU = 0 PPM α = 0 CPM BG = 100-200 CPM
	19962 1019 08-02	19	6	VERY STIFF, YELLOW-BROWN (10YR5/6) SILTY CLAY, TRACE GRAVEL (.25-1.0 IN) DRY	CL	3.0	
	19963 1019 08-02	11	—	NO RECOVERY 1.0-1.5	—	—	
2	19964 1027 08-02	4	6	VERY STIFF, BROWN (10YR 4/4) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP	CL	2.5	HNU = 0 PPM α = 0 CPM BG = 80-120 CPM
	19965 1027 08-02	6	—	NO RECOVERY 2.0-2.5 FT	—	—	
	19966 1027 08-02	6	—	NO RECOVERY 2.5-3.0 FT.	—	—	
3	19967 1030 08-02	6	6	VERY STIFF, BROWN (10YR4/4) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP	CL	2.5	HNU = 0 PPM α = 0 CPM BG = 80-180 CPM
4	19968 1030 08-02	6	6	A.A	CL	2.5	
	19969 1030 08-02	6	—	NO RECOVERY 4.0-4.5	—	—	
5	19970 1032 08-02	5	6	MEDIUM STIFF (BROWN (10YR4/4) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP 4.9	CL	1.0	HNU = 0 PPM α = 0 CPM BG = 80-180 CPM
	19971 1032 08-02	4	—	SOFT, BROWN (10YR4/4) SILTY CLAY WET	CL	0.5	
				NO RECOVERY 5.0-5.5	—	—	
6	19972 1032 08-02	3	—	NO RECOVERY 5.5-6.0 FT.	—	-	
7	19973 1345 08-02	2	6	MEDIUM STIFF, BROWN (10YR4/4) SILTY CLAY, SOME SAND, MOIST	CL	1.0	HNU = 0 PPM α = 0 CPM BG = 100-200 CPM
	19974 1345 08-02	3	6	A.A.	CL	1.0	
	19975 1345 08-02	4	6	A.A.	CL	1.0	

NOTES: CONTRACTOR: PENN DRILL
RIG: MOBILE B-53
DRILLER: J. SACCA
ASSISTANT: W. FELTY

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TE
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0 CPM
BG = 100-200 CPM
LEL/O2: LEL = 0 PPM
O2 = 20.6 %

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1336	COORDINATES:	DATE: 08-02-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 08-02-89
ENGINEER/GEOLOGIST: M. SLOWINSKI	Depth Date/Time	DATE COMPLETED: 08-02-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 (IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	19976 1348 08-02	7	6	STIFF BROWN (10YR4/4) SILTY CLAY SOME SAND, MOIST.	CL	2.0	HNU = 0 PPM
	19977 1349 08-02	7	6	MEDIUM DENSE, BROWN (10YR4/4) POORLY GRADED SAND, TRACE GRAVEL (.25-.50 IN) WET	SP	N/A	α = 0 CPM Bγ: 100-200 CPM
9	19978 1349 08-02	12	6	A.A.	SP	N/A	
	19979 1350 08-02	11	6	MEDIUM DENSE, BROWN (10YR4/4) WELL GRADED SAND, TRACE GRAVEL (.25-.50 IN) WET	SW	N/A	HNU = 0 PPM α = 0 CPM Bγ: 100-200 CPM
10	19980 1350 08-02	12	6	A.A	SW	N/A	
	19981 1350 08-02	12	6	MEDIUM DENSE, BROWN (10YR4/4) POORLY GRADED SAND, TRACE GRAVEL (.25-.50 IN) WET	SP	N/A	
11	19982 1412 08-02	10	6	MEDIUM DENSE, BROWN (10YR4/4) SAND-CLAY MIXTURE, WET.	SC	N/A	HNU = 0 PPM α = 0 CPM Bγ = 100-200 CPM
	54415 1412 08-02	11	6	MEDIUM DENSE, BROWN (10YR4/4) POORLY GRADED SAND, TRACE GRAVEL (.25-.50 IN) WET	SP	N/A	
12	54416 1412 08-02	14	6	A.A	SP	N/A	
	54417 1417 08-02	11	6	MEDIUM DENSE, BROWN (10YR4/4) WELL GRADED SAND, TRACE GRAVEL (.25-.50 IN) WET	SW	N/A	HNU = 0 PPM α = 0 CPM Bγ = 100-200 CPM
13	54418 1417 08-02	14	6	A.A.	SW	N/A	
	54419 1417 08-02	16	6	MEDIUM DENSE, GREY (5Y4/1) POORLY GRADED SAND, TRACE GRAVEL (.25-.50 IN) WET	SP	N/A	
14	54420 1425 08-02	9	6	MEDIUM DENSE, BROWN (10YR4/4) WELL GRADED SAND, TRACE GRAVEL (.25-.50 IN) WET	SW	N/A	HNU = 0 PPM α = 0 CPM Bγ = 100-200 CPM
	54421 1425 08-02	11	6	MEDIUM DENSE, GREY (5Y4/1) POORLY GRADED SAND, TRACE GRAVEL (.25-.50 IN) WET	SP	N/A	
	54422 1425 08-02	15	6	A.A.	SP	N/A	

NOTES:

A.A. = AS ABOVE

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1336	COORDINATES:	DATE: 08-02-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 08-02-89
ENGINEER/GEOLOGIST: M. Sl[illegible]	Depth Date/Time	DATE COMPLETED: 08-02-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 3

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S4423 1442 08-02	5	6	MEDIUM DENSE, BROWN (10YR4/6) SAND-CLAY MIXTURE, WET	SC	N/A	HNU = 0 PPM α = 0 CPM BG = 100-200 CPM
16	S4424 1442 08-02	6	6	MEDIUM DENSE, GREY (5Y 4/1) POORLY GRADED SAND, TRACE GRAVEL (.25-.50 in) WET "BLOW SAND"	SP	N/A	
	S4425 1442 08-02	6	6	A.A.	SP	N/A	
17	S4426 1446 08-02	6	6	A.A	SP	N/A	HNU = 0 PPM α = 0 CPM BG = 100-200 CPM
	S4427 1446 08-02	5	6	A.A.	SP	N/A	
	S4428 1446 08-02	2	6	A.A.	SP	N/A	
18	S4429 1452 08-02	7	6	A.A	SP	N/A	HNU = 0 PPM α = 0 CPM BG = 100-200 CPM
19	S4430 1452 08-02	7	6	MEDIUM DENSE, GREY (5Y 4/1) WELL GRADED SAND, TRACE GRAVEL (.25-.50 in) WET "BLOW SAND"	SW	N/A	
	S4431 1452 08-02	6	6	A.A	SW	N/A	
20	S4432 1452 08-02	8	6	VERY STIFF, GREY (5Y 4/1) SILTY CLAY TRACE GRAVEL (.25 in) DAMP 20.8	CL	2.5	HNU = 0 PPM α = 0 CPM BG = 100-200 CPM
				BOTTOM OF BORING @ 20.8 FT			

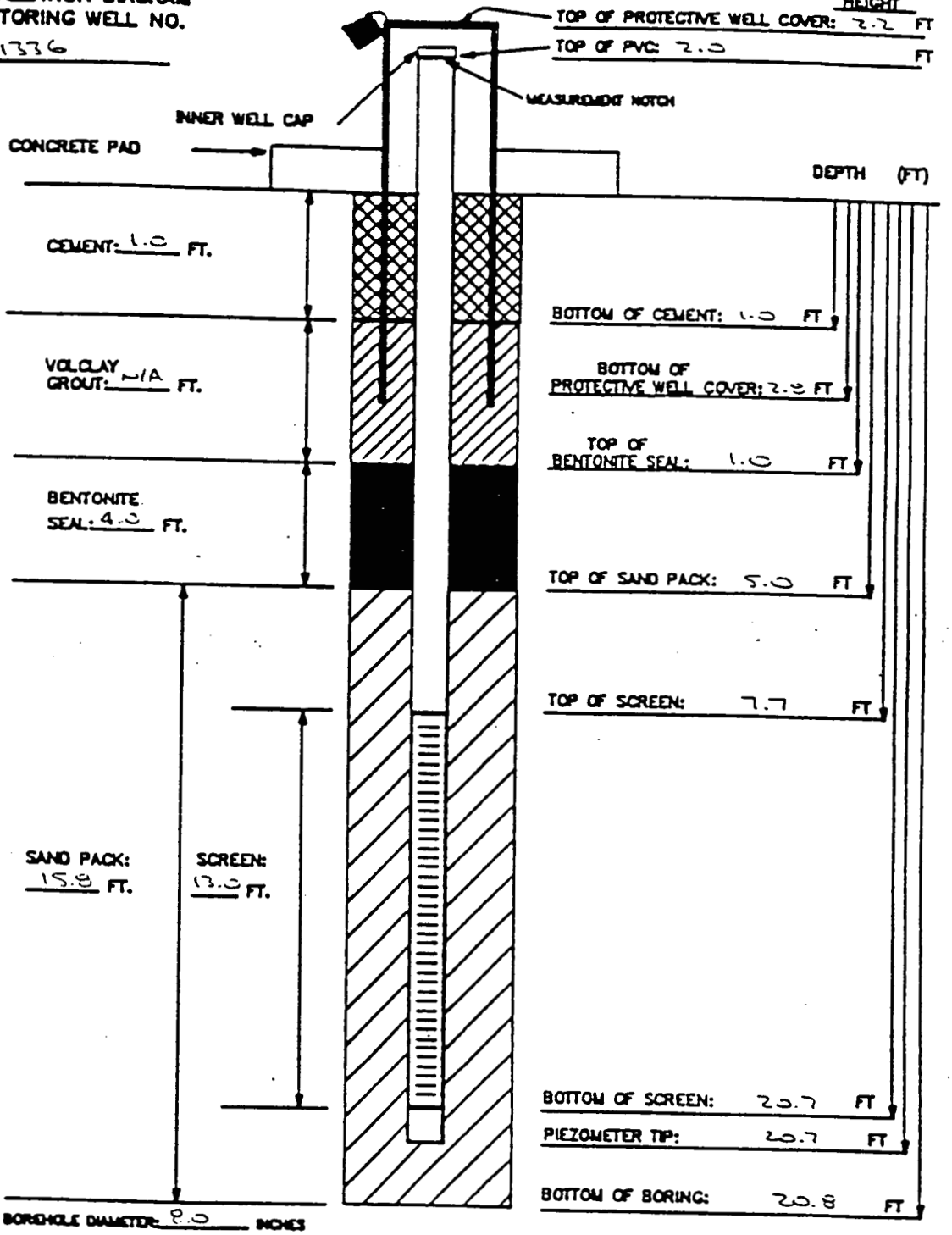
NOTES:

A.A = AS ABOVE

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1336

INSTALLATION DATE: 08-02-89



MATERIALS USED:

SAND TYPE AND QUANTITY: 10-20 : 3-80LB BAGS
BENTONITE PELLETS (5-GALLON BUCKETS): 2 - 5 GAL BUCKETS
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1/2 BAG (94 LB BAG)
AMOUNT OF WATER USED: 10 GAL
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: G02 3 7.1

GEOLOGIST/ENGINEER: M. SLUSINSKI

1507

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 37.1	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1338	COORDINATES:	DATE: 08-08-89	
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 08-08-89
ENGINEER/GEOLOGIST: M. Sc[illegible] / [illegible]	Depth	Date/Time	DATE COMPLETED: 8-8-89
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 1 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	SOC05 1630 08-08	3		MEDIUM DENSE, DARK BROWN (10YR 3/2) SILT, SOME CLAY, TRACE OF GRAVEL (.5m) MOIST TO DRY.	ML	N/A	HNU = 0.2 ppm α = 0 cpm BG = 300 cpm
1	SOU6 1630 08-08	9	6	NO RECOVERY 2-ATTEMPTS			
	SOU7 1630 08-08	11					
2	SOU8 1632 08-08	8		MEDIUM DENSE, BROWN, (10YR 4/2) SILT, TRACE TO SOME CLAY, MOIST.	ML	N/A	HNU = 0.4 ppm α = 0 cpm BG = 300 cpm
	SOU9 1632 08-08	8	6	NO RECOVERY 2-ATTEMPTS			MAT'L VERY DENSE AND GRAVELLY, PUSHED SAMPLE DOWN WITH SPOON
	SOU10 1632 08-08	7					
3	SOU11 1634 08-08	10		SOFT, YELLOWISH BROWN, (10YR 4/3) SILTY CLAY, SOME SAND, FINE, LOW PLASTICITY, MOIST TO SATURATED.	CL	0.5	HNU = 0.4 ppm α = 0 cpm BG = 300 cpm
4	SOU12 1634 08-08	10	15				
	SOU13 1634 08-08	11					
	SOU14 1639 08-08	8					HNU = 0.4 ppm α = 0 cpm BG = 280-300 cpm
5	SOU15 1639 08-08	4	17	VERY LOOSE, DARK BROWN (10YR 3/3) CLAYEY SAND - MEDIUM TO FINE GRAINED, MOIST TO SATURATED.	SC	N/A	
	SOU16 1639 08-08	3					
6	SOU17 1652 08-08	2			SC	N/A	HNU = 0.4 ppm α = 0 cpm BG = 300 cpm
	SOU18 1652 08-08	6	12				
7	SOU19 1652 08-08	8		NO RECOVERY			

SATURATED WATER BEARING ZONE ≈ 6.5 FT. TO 9.75 FT.

NOTES: CONTRACTOR: PENN DRILL
RIG: 653
DRILLER: Jim Saccuni
ASSISTANT: Kyle Felty

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0.4 PPM
α = 0 CPM
BG = 300 CPM
LEL/O2: LEL = 0 PPM
O_2 = 21.6 %

000456

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 133E	COORDINATES:	DATE: 08-08-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 08-08-89
ENGINEER/GEOLOGIST: E. TRUNINGER H. SLUMSKI	Depth Date/Time	DATE COMPLETED: 4-8-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 4

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 (IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	S0010 1657 08-08	3		MEDIUM DENSE, BROWN (10YR 4/3) POORLY GRADED SAND, TRACE OF FINE GRAVEL (ROUNDED); SATURATED	SP	N/A	HNU = 0.4 ppm α = 0 CPM BG = 300 CPM
	S0011 1657 08-08	6	18				
	S0012 1657 08-08	8					
9	S0023 1702 08-08	13			SP	N/A	HNU = 0.4 ppm α = 0 CPM BG = 300 CPM
	S0024 1702 08-08	14	17				
10	S0025 1702 08-08	16		VERY STIFF, GRAY (10YR 4/2) CLAY @ 9.75 FT, MEDIUM PLASTICITY, MOIST.	CL	2.5	
	S0026			* BOTTOM OF BORING AT 10.5 FT. SAMPLING ENDED AT 10.5 FT. HUSERING STOPPED AT 10.5 FT.			HNU = α = BG =
11	S9455						
	S9456						
12	S9457						HNU = α = BG =
	S9458						
13	S9459						
	S9460						HNU = α = BG =
14	S9461						
	S9462						

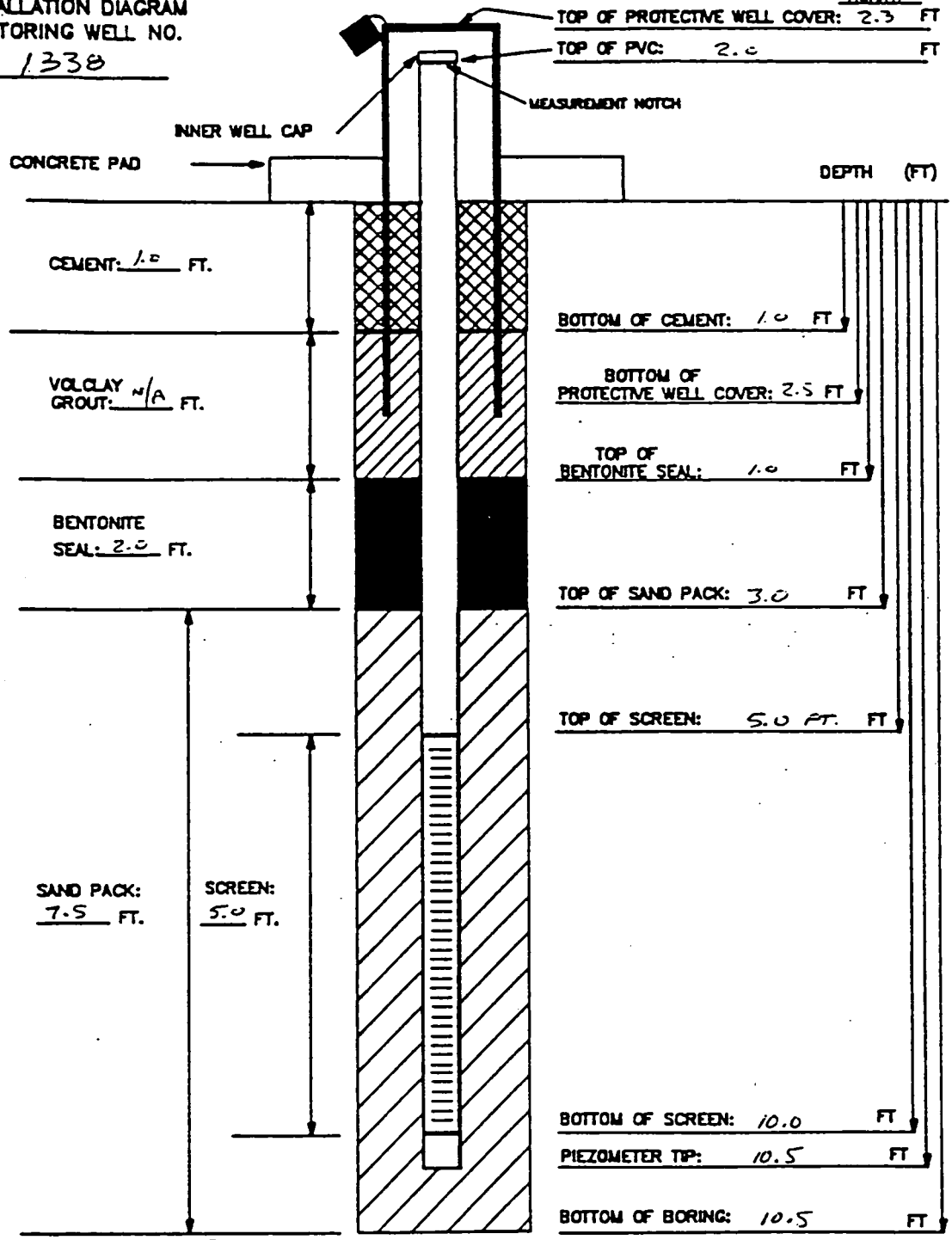
NOTES:

000457

INSTALLATION DATE: 8-8-89

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1338



BOREHOLE DIAMETER: 8 in INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 2 BAGS
BENTONITE PELLETS (5-GALLON BUCKETS): 1 1/2 BUCKETS
BAGS OF VOLCLAY GROUT: NONE USED
AMOUNT OF CEMENT: 1/2 BAG (PLUG)
AMOUNT OF WATER USED:
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 3.7.1

GEOLOGIST/ENGINEER: EVERETT TROLLINGER

FERNALD RI/FS

Date	4/10/89			
Initial	[illegible]			
	Field Check	1st Rev'n	2nd Rev'n	Final Copy Verification

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 60203.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1339	COORDINATES:	DATE: 10-4-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 10-4-89
ENGINEER/GEOLOGIST: C. Graber	Depth Date/Time	DATE COMPLETED: 10-5-89
DRILLING METHODS: AUGER (Hollow stem)		PAGE 1 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	NA		6	Cement	NA	NA	HNU = 0 ppm α = 0 cpm Bγ = 300-310 cpm
1	NA		6	Cement, medium gravel & base	NA	NA	
	50027 1520	3	6	Dense (10yr 4/3) brown clayey sand, trace fine gravel moist	SC	NA	
1	50028 1540	17	6	Dense (10yr 5/4) yellowish brown silty sand, trace fine rounded gravel & clay, moist	SM	NA	HNU = 0 ppm α = 0 cpm Bγ = 300-310 cpm
2	50029 1550	18	6	SAA	SM	NA	
	50030 1500 10-4	16	0	NR	NA	NA	
3	50031 1555 10-4	10	6	Med Dense (10yr 5/4) yellowish brown poorly graded gravelly sand, trace silt & clay, moist	SP	NA	HNU = 0.2 ppm α = 0 ppm Bγ = 300 cpm with trap
4	50032 1555 10-4	12	3	Med Dense (10yr 5/4) yellowish brown, well graded sand, trace fine to coarse gravel, trace silt, v. moist	SW	NA	
	50033 1555 10-4	12	0	NR	NA	NA	
5	50034 1602 10-4	6	6	Med Dense (10yr 5/4) yellowish brown silty gravel, some sand, very moist	GM	NA	HNU = 0 ppm α = 0 cpm Bγ = 200-240 cpm ← WET with trap
	50035 1602 10-4	4	6	Med Dense (10yr 5/4) yellowish brown well graded gravelly sand, trace clay & silt, wet	SW	NA	
6	50036 1602 10-4	6	0	NR	NA	NA	
	50037 1608 10-4	6	6	Med Dense (10yr 5/4) yellowish brown well graded sand, trace fine to coarse gravel, trace silt, wet	SW	NA	HNU = 0 ppm α = 0 cpm Bγ = 200-220 cpm with trap
7	50038 1608 10-4	6	5	SAA	SW	NA	
	50039 1608 10-4	6	0	NR	NA	NA	

← H2O →

NOTES: CONTRACTOR: PENNDRILL
RIG: B-80
DRILLER: Joe Barrio
ASSISTANT: Chuck Ernsbe
GEOLOGIST: Carl Graber

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0 CPM
Bγ = 200-350 CPM
LEL = 0% PPM
O_2 = 20.6%

NR = No Recovery
SAA = SAME AS ABOVE

HNU = 0.99

000459

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 60223.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1339	COORDINATES:		DATE: 10-4-89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 10-4-89
ENGINEER/GEOLOGIST: C. Grube	Depth	Date/Time	DATE COMPLETED: 10-5-89
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 2 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	50646 1623 10-4	6	6	Med Dense (10yr 5/4) yellowish brown well graded sand, trace fine-coarse gravel, trace silt, wet	SW	NA	HNU = 0.1 ppm α = 0 cpm Bγ = 300-320 cpm
	50647 1623 10-4	6	6	SAA	SW	NA	
9	50648 1623 10-4	8	6	Med Dense (10yr 3/6) dark yellowish brown, poorly graded sand, trace silt, wet	SP	NA	
	50645 1636 10-4	12	6	Med Dense (10yr 5/4) yellowish brown well graded sand, some fine-coarse gravel, wet	SW	NA	HNU = 0.1 ppm α = 0 cpm Bγ = 180-190 cpm
10	50644 1636 10-4	13	5	Med Dense (10yr 5/4) yellowish brown poorly graded sand, trace fine gravel, wet Med Dense (7.5yr 4/6) strong brown, poorly graded sand, trace fine gravel, wet	SP SP	NA NA	
	50645 1636 10-4	8	0	NR	NA	NA	
11	50646 1640 10-4	3	6	Med Dense (10yr 5/4) yellowish brown well graded sand, trace fine to med gravel, wet	SW	NA	HNU = 0 ppm α = 0 cpm Bγ = 210-230 cpm
	50647 1640 10-4	6	6	Med Dense (10yr 5/4) yellowish brown to (7.5yr 4/6) strong brown, poorly graded sand trace fine gravel, wet	SP	NA	
12	50648 1640 10-4	8	6	Stiff (5y 4/1) dark grey silty clay trace fine gravel, med. plastic, moist	CL	1.25	
			*	Bottom of Boring at 12.0 FT Bottom of Sampling at 12.0 FT			HNU = α = Bγ =
13							
14							HNU = α = Bγ =

NOTES:

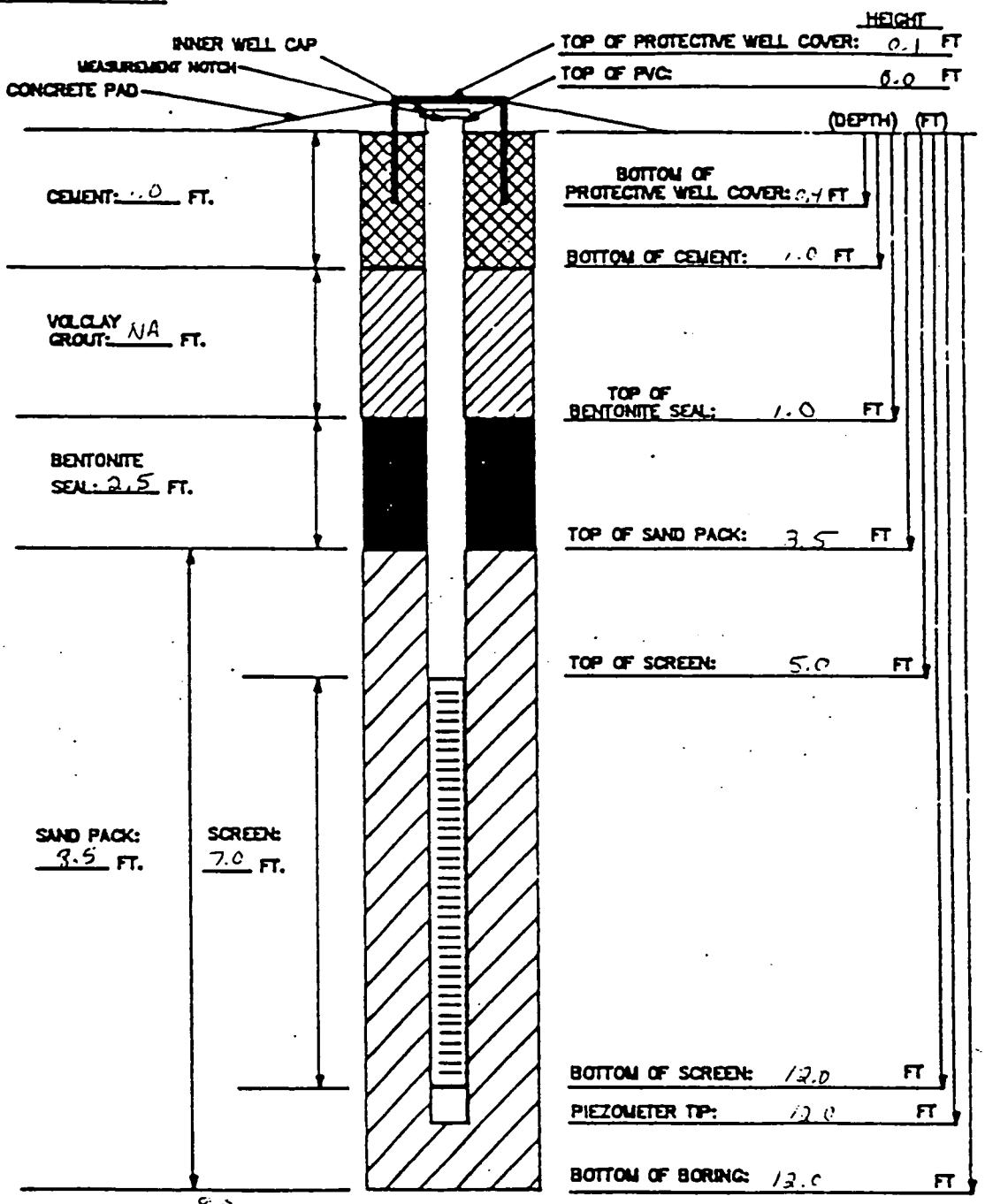
NR = No Recovery
SAA = Same As Above

H_2O

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1339

INSTALLATION DATE: 10-5-89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand (1 1/3 (80#) sk
BENTONITE PELLETS (5-GALLON BUCKETS): 2 1/2
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2 (94#) sack
AMOUNT OF WATER USED: 10 gal
OTHER: Protective flushmount cover

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 603 2.3.57 GEOLOGIST/ENGINEER: C. Gaches

000461

1507

FERNALD RI/FS

Date	2/6/90			
Initial				
Field Check	1st Review	2nd Review		

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 6023.7	PROJECT NAME: FERNALD RI/FS	1/6/90
BORING NUMBER: 1346	COORDINATES:	DATE: ~~12/16/89~~ 1/4/90
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: ~~12/16/89~~ 1/4/90
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: ~~12/17/89~~ 1/4/90
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5 1/6/90

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	1-6	NA	6	Cement	NA	NA	HNU = 0 ppm α = 0-10 cpm Bγ = Top 600 cpm Bottom 100 cpm
	1-6		6	gray gravel-fill	GP	NA	
1	50181 1600 1-6	4	5	Very stiff (2.5Y5/4) light olive brown silty clay trace of sand and fine gravel, low plasticity, slightly moist	CL	3.25	
	50182 1600 1-6	3	0	NR	NA	NA	HNU = 0 ppm α = 0 cpm Bγ = 80-100 cpm
2	50183 1600 1-6	3	0	NR	NA	NA	
	50184 1600 1-6	5	0	NR	NA	NA	
3	50185 1610 1-6	5	6	Stiff (5Y3/2) dark olive gray silty clay, trace of sands, medium plasticity, moist	CL	1.25	HNU = 0 ppm α = 0 cpm Bγ = 90-100 cpm
	50186 1610 1-6	5	5	Stiff (5Y3/1) very dark gray silty clay, trace of sand low plasticity, moist Stiff (5Y4/4) olive silty clay, trace of sand low plasticity moist	CL	1.5	
4	50187 1623 1-6	21	6	Soft (5Y4/4) olive to 2.5Y5/4) light olive brown mottled silty clay, medium plasticity, moist (trace rock fragments)	CL	.25	
	50188 1623 1-6	9	6	Stiff SAA	CL	1.75	HNU = 0 ppm α = 0 cpm Bγ = 90-100 cpm
5	50189 1623 1-6	8	2	Medium stiff (5Y4/1) olive silty clay, trace of sand, medium plasticity moist	CL	.75	
	50190 1623 1-6	7	0	NR	NA	NA	
6	50191 0953 1-7	6	6	Medium stiff (2.5Y5/4) light olive brown silty clay, trace of sand, low plasticity, moist	CL	.75	HNU = 0 ppm α = 0 cpm Bγ = 80-100 cpm
	50192 0953 1-7	10	0	NR	NA	NA	
7	50193 0953 1-7	12	0	NR	NA	NA	

NOTES: CONTRACTOR: PENNDRILL
RIG: CME-45
DRILLER: Dave Newman
ASSISTANT: Bob Johnson
GeoAssistant: Ben Brier

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0-10 PPM
Bγ = 80-130 CPM
LEL: LEL = 0%
O_2 = 20.6%

SAA = Same As Above
NR = No Recovery

HNU # 1234

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1346	COORDINATES:	DATE: 17 7 90	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 17 7 90	
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 17 7 90	
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	50194 0958 1-7	5	6	Stiff (2.5Y5/4) light olive brown silty clay, some sand, trace of fine gravel, medium plasticity moist	CL	1.75	HNU = 0 ppm α = 0 cpm Bγ = 90-100 cpm
	50195 0958 1-7	3	6	SAA	CL	1.75	
1/7/90	50196 0958 1-7	6	0	Stiff (10YR5/4) yellowish brown silty clay, some sand and fine gravel, low plasticity, moist NR	NA	1.25 NA	
9	50197 1003 1-7	9	6	medium stiff (10YR5/4) yellowish brown silty clay, some sand & fine gravel, medium plasticity moist	CL	.75	HNU = 0 ppm α = 0 cpm Bγ = 100-120 cpm
	50198 1003 1-7	9	6	SAA	CL	1.0	
10	50199 1003 1-7	9	4	Stiff (5Y3/1) very dark gray silty clay, trace of sand, low plasticity, moist	CL	1.5	
	50200 1012 1-7	3	6	medium stiff (5Y4/1) dark gray clay, trace of silt & sand, medium plasticity moist	CL	.5	HNU = 0 ppm α = 0 cpm Bγ = 90-100 cpm
11	50201 1012 1-7	5	6	Stiff SAA	CL	1.5	
	50202 1012 1-7	5	6	STIFF SAA	CL	1.75	
12	54617 1018 1-7	6	6	medium stiff SAA	CL	.75	HNU = 0 ppm α = 0 cpm Bγ = 100-120 cpm
	54618 1018 1-7	9	6	Stiff (10YR5/4) yellowish brown silty clay, some sand and fine gravel, low plasticity, moist	CL	1.25	
13	54619 1018 1-7	10	2	SAA	CL	2.0	
	54620 1025 1-7	7	6	SAA	CL	<.25	HNU = 0 ppm α = 0 cpm Bγ = 90-100 cpm
14	54621 1025 1-7	6	6	SAA	CL	<.25	
	54622 1025 1-7	5	6	very soft (5Y4/2) olive gray clay, trace of silt medium plasticity, very moist	CL	<.25	

NOTES:

000463

SAA = Same As Above
NR = No Recovery

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1346	COORDINATES:	DATE: ~~10/1~~ -90/~~09~~ 08 1/6/90
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: ~~10/1~~ -90/~~09~~ 12 1/6
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: ~~10/1~~ -90/~~09~~
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN.	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
Top of water bearing zone at 15.0 FT	54623 1040 1-7	5	6	Dense (2.5Y5/4) light olive brown silt, trace sand wet	ML	NA	HNU = 0 ppm α = 0 cpm BG = 100-110 cpm
16	54624 1040 1-7	16	6	Dense (2.5Y5/4) light olive brown silt to silty sand, wet	ML to SM	NA	
	54625 1040 1-7	16	6	SAA	ML to SM	NA	
17	54626 1050 1-7	12	6	SAA very wet	ML to SM	NA	HNU = 0 ppm α = 0 cpm BG = 90-100 cpm
	54627 1050 1-7	20	6	SAA wet	ML to SM	NA	
	54628 1050 1-7	21	6	SAA	ML to SM	NA	
18	54629 1100 1-7	2	6	Medium dense (2.5Y5/4) light olive brown silty sand very wet	SM	NA	HNU = 0 ppm α = 0 cpm BG = 80-100 cpm
	54630 1100 1-7	5	6	SAA	SM	NA	
19	54631 1100 1-7	13	6	Medium dense (2.5Y5/4) light olive brown silty sand very moist	SM	NA	
Bottom of water bearing zone at 19.5	54632 1100 1-7	13	6	Medium Dense (5Y 4/2) olive gray sandy silt, trace fine gravel moist	ML	NA	HNU = 0 ppm α = 0 cpm BG = 80-100 cpm
20			*	Bottom of Boring & Sampling at 20.0 FT			

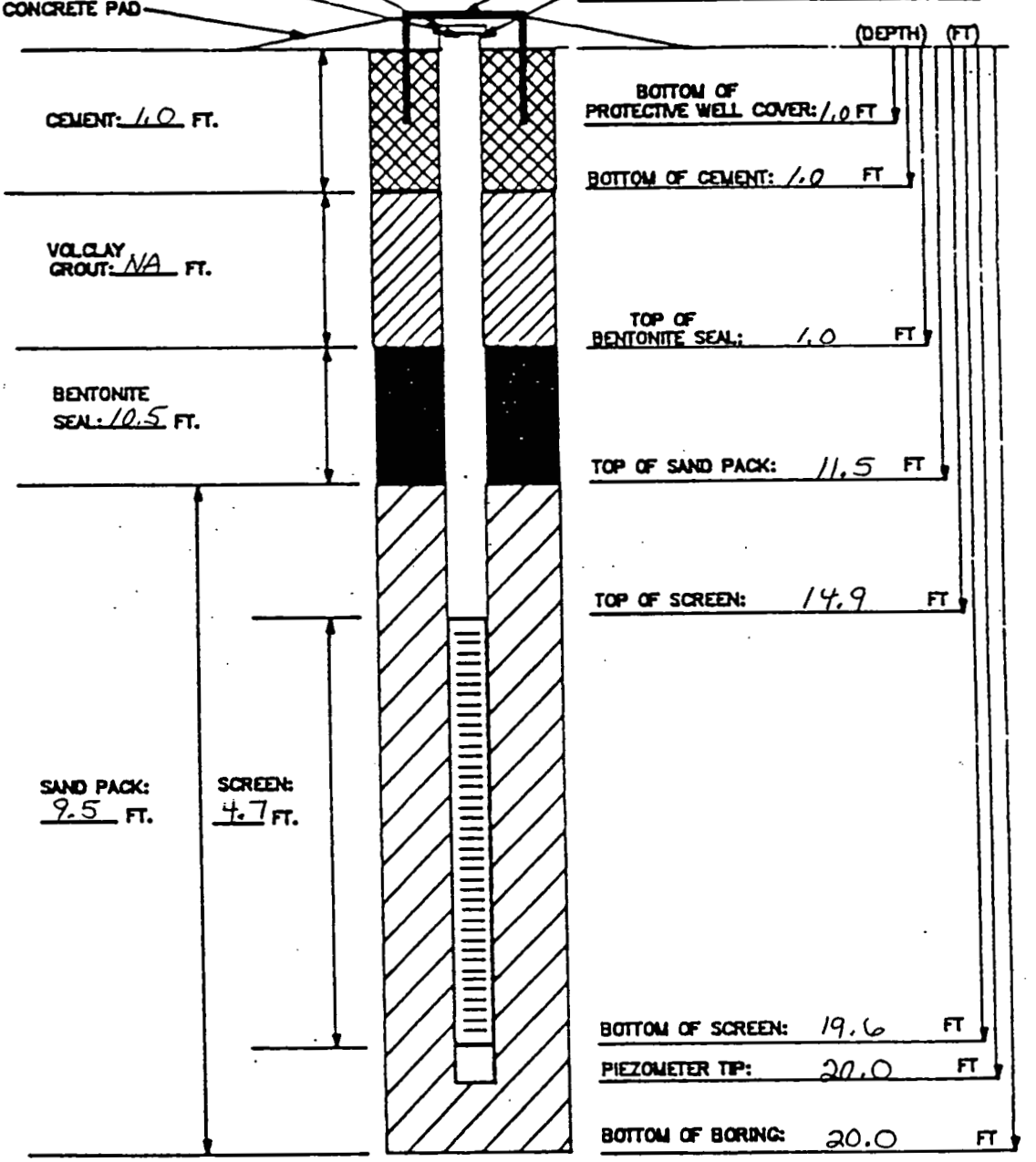
NOTES:

SAA = Same As Above
NR = No Recovery

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1346

INSTALLATION DATE: 1-7-90



	HEIGHT	
TOP OF PROTECTIVE WELL COVER:	0.0	FT
TOP OF PVC: Below Surface	0.3	FT

	(DEPTH)	(FT)
BOTTOM OF PROTECTIVE WELL COVER:	1.0	FT
BOTTOM OF CEMENT:	1.0	FT
TOP OF BENTONITE SEAL:	1.0	FT
TOP OF SAND PACK:	11.5	FT
TOP OF SCREEN:	14.9	FT
BOTTOM OF SCREEN:	19.6	FT
PIEZOMETER TIP:	20.0	FT
BOTTOM OF BORING:	20.0	FT

BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 sand - 3(80#) sks
BENTONITE PELLETS (5-GALLON BUCKETS): 2½
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: ½ (94#) sk
AMOUNT OF WATER USED: 10 gal.
OTHER: 1 FT Protective Flush mount cover.

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube

FERNALD RI/FS

Date	8/1/89		
Initial			
	Field Check	1st Rev'n	2nd Rev'n

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: MW7	COORDINATES:	DATE: 08-09-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 08-09-89
ENGINEER/GEOLOGIST: M. SLUSARCZ	Depth Date/Time	DATE COMPLETED: 08-09-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 (IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1	SD203 0954 08-09	3	6	VERY STIFF, BROWN (10YR 5/4) SILTY CLAY, TRACE GRAVEL (.25-.50 IN) TRACE ROOTLETS/ORGANIC MATERIAL, DAMP	CL	2.5	HNU = 0 PPM α = 0 CPM βγ = 900 CPM
	SD204 0954 08-09	4	2	A.A	CL	2.5	
	SD205 0954 08-09	6	—	NO RECOVERY 1.0-1.5	—	—	
2	SD206 0958 08-09	6	6	VERY STIFF, BROWN (10YR 5/4) SILTY CLAY, TRACE GRAVEL (.25-.75 IN) DAMP	CL	2.5	HNU = 0 PPM α = 0 CPM βγ = 400 CPM
	SD207 0958 08-09	6	6	A.A.	CL	2.5	
	SD208 0958 08-09	8	—	NO RECOVERY 2.5-3.0 FT.	—	—	
3	SD209 1000 08-09	10	6	VERY STIFF, BROWN (10YR 5/4) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP	CL	2.0	HNU = 0 PPM α = 0 CPM βγ = 400 CPM
	SD210 1000 08-09	10	6	A.A.	CL	2.0	
4	SD211 1000 08-09	10	—	NO RECOVERY 4.0-4.5 FT.	—	—	
5	SD212 1003 08-09	10	6	VERY STIFF, BROWN (10YR 5/4) SILTY CLAY, TRACE GRAVEL (.25 IN) DAMP	CL	2.0	HNU = 0 PPM α = 0 CPM βγ = 400 CPM
	SD213 1003 08-09	9	6	A.A	CL	2.0	
6	SD214 1003 08-09	7	—	NO RECOVERY 5.5-6.0 FT.	—	—	
7	SD215 1029 08-09	3	—	NO RECOVERY 6.0-6.5 FT	—	—	HNU = - α = - βγ = -
	SD216 1029 08-09	4	—	NO RECOVERY 6.5-7.0 FT	—	—	
	SD217 1029 08-09	5	—	NO RECOVERY 7.0-7.5 FT	—	—	

NOTES: CONTRACTOR: PENN DRILL
RIG: MOBILE B-53
DRILLER: J. SACCANI
ASSISTANT: W. FELTY

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TE
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0 CPM
βγ = 1000 CPM
LEL/O2: LEL = 0 PPM
O2 = 20.6 %

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1347	COORDINATES:	DATE: 06-09-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 06-09-89
ENGINEER/GEOLOGIST:	Depth Date/Time	DATE COMPLETED: 06-09-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 (IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	S0218 1031 06-09	9	6	VERY STIFF, BROWN (2.5Y 4/4) SILTY CLAY, TRACE GRAVEL (.25 in) DAMP	CL	2.0	HNU = 0 PPM α = 0 CPM BG: 400 CPM
	S0219 1031 06-09	10	—	NO RECOVERY 8.0 - 8.5 FT.	—	—	
9	S0220 1031 06-09	12	—	NO RECOVERY 8.5 - 9.0 FT.	—	—	
	S0221 1033 06-09	13	6	VERY STIFF, BROWN (2.5Y 4/4) SILTY CLAY, TRACE GRAVEL (.25 - .75 in) DAMP	CL	2.0	HNU = 0 PPM α = 0 CPM BG: 400 CPM
10	S0222 1033 06-09	13	4	A.A	CL	2.0	
	S0223 1033 06-09	10	—	NO RECOVERY 10.0 - 10.5 FT.	—	—	
11	S0224 1043 06-09	8	6	VERY STIFF, BROWN (2.5Y 4/4) SILTY CLAY, TRACE GRAVEL (.25 - .50 in) DAMP	CL	2.0	HNU = 0 PPM α = 0 CPM BG: 400 CPM
	S4637 1043 06-09	8	6	A.A	CL	2.0	
12	S4638 1043 06-09	6	6	A.A 11.8	CL	2.0	
	S4639 1050 06-09	5	6	VERY STIFF, GREY (5Y 4/1) SILTY CLAY TRACE GRAVEL (.25 in) DAMP A.A	CL	2.0	HNU = 0 PPM α = 0 CPM BG: 400 CPM
13	S4640 1050 06-09	5	6	A.A	CL	2.0	
	S4641 1050 06-09	6	—	NO RECOVERY 13.0 - 13.5 FT	—	—	
14	S4640 1054 06-09	2	6	VERY STIFF, GREY (5Y 4/1) SILTY CLAY TRACE GRAVEL (.25 in) MOIST	CL	2.0	HNU = 0 PPM α = 0 CPM BG = 400 CPM
	S4641 1054 06-09	4	6	A.A	CL	2.0	* MUCH WATER IN SPOON TO SAMPLE MATERIAL CLAY DAMP TO MOIST
	S4642 1054 06-09	4	—	NO RECOVERY 14.5 - 15.0	—	—	

NOTES:

000467

A.A. = AS ABOVE

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1347	COORDINATES:	DATE: 08-09-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 08-09-89
ENGINEER/GEOLOGIST: M. SLIMINSKI	Depth Date/Time	DATE COMPLETED: 08-09-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	SA643 1349 08-09	3	6	VERY STIFF, GREY (5Y 4/1) SILTY CLAY, TRACE GRAVEL (LEAN) DAMP	CL	2.0	HNU = 0 PPM α = 0 CPM BG = 400 CPM
16	SA644 1349 08-09	2	6	A A.	CL	2.0	
	SA645 1349 08-09	3	—	NO RECOVERY 16.0 - 16.5	—	—	
WATER ZONE TOP	SA646 1355 08-09	4	6	VERY STIFF, GREY (5Y 4/1) SAND CLAY - SILT MIXTURE, WET	SC	2.0	HNU = 0 PPM α = 0 CPM BG = 400 CPM
17	SA647 1355 08-09	3	6	A.A.	SC	2.0	
	SA648 1355 08-09	5	6	VERY STIFF, GREY (5Y 4/1) CLAYEY SILT, WET	ML	2.0	
18	SA649 1402 08-09	10	6	A A	ML	2.0	HNU = 0 PPM α = 0 CPM BG = 400 CPM
19	SA650 1402 08-09	6	6	VERY STIFF, GREY (5Y 4/1) SAND - CLAY MIXTURE, WET	SC	2.0	
	SA651 1402 08-09	6	6	A A	SC	2.0	
20	SA652 1402 08-09	14	6	A A 20.0	SC	2.0	HNU = 0 PPM α = 0 CPM BG = 400 CPM
				BOTTOM OF BOREHOLE 20.0 PIEZOMETER INSTALLED			

NOTES:

TOP OF WATER PRODUCING ZONE: 16.5 FT

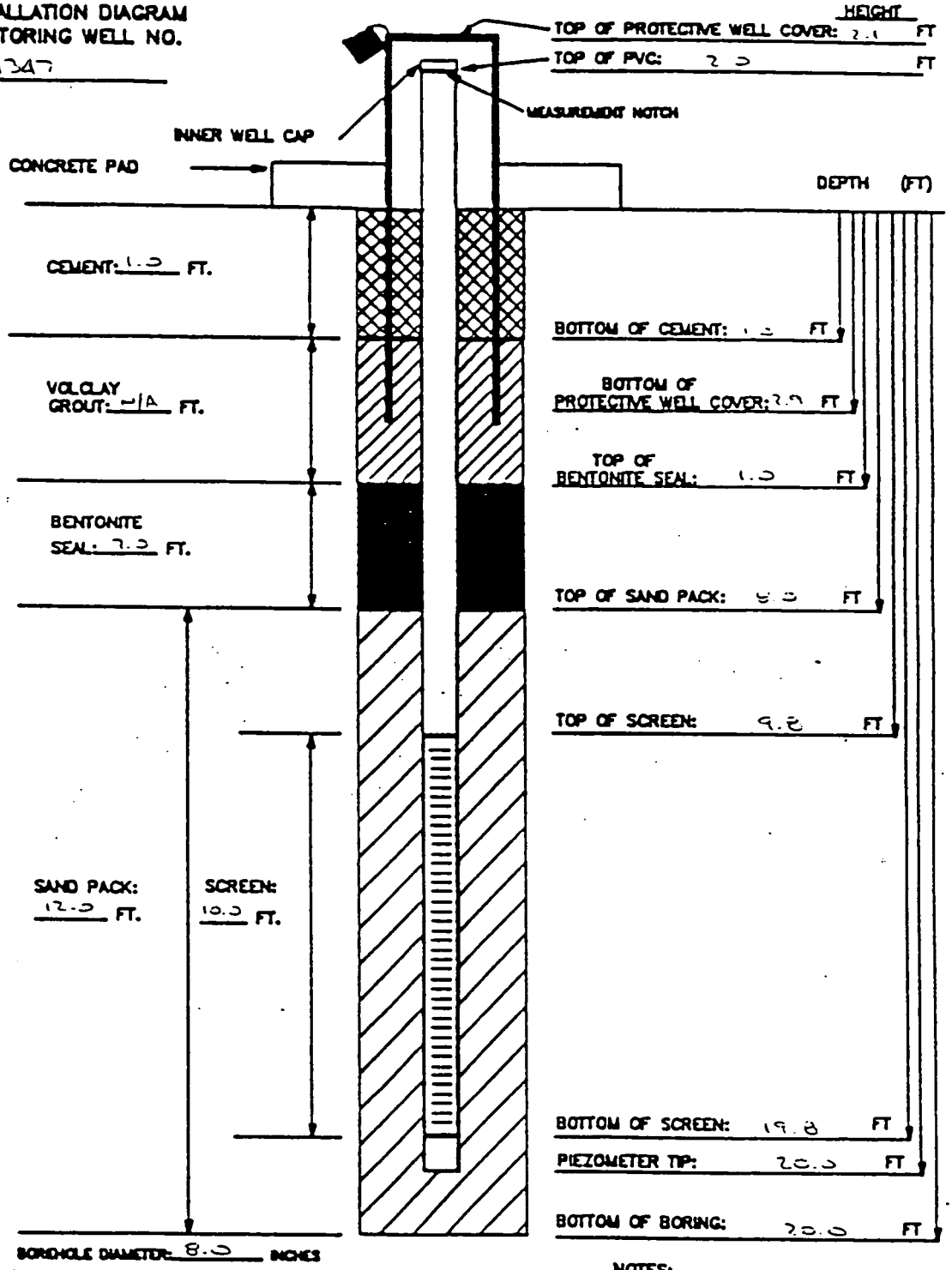
BASE OF WATER PRODUCING ZONE: 20.0 FT. (STILL IN WATER PRODUCING ZONE AT TIME THAT BOTTOM OF BORING WAS REACHED)

A A: AS ABOVE.

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1347

INSTALLATION DATE: 06-09-8[illegible]



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: 10-20: 3.5 - 80 LB SACKS
BENTONITE PELLETS (5-GALLON BUCKETS): 3 - 5 GAL BUCKETS
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: .5 - 94 LB SACK
AMOUNT OF WATER USED: 40 GAL
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 3.7.1

GEOLOGIST/ENGINEER: M. SUSMSKI

1507

Initial	Date			
	BD	9/1/89		
	Field Check	1st Key In	2nd Key In	Hard Copy Validation

FERNALD RI/FS

50225

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1348	COORDINATES:	DATE. 8-29-89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 8-29-89	
ENGINEER/GEOLOGIST: E. TRULLINGER	Depth Date/Time	DATE COMPLETED. 8-30-89	
DRILLING METHODS: McBIE DRILL HSA		PAGE 1 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				6 in CONCRETE SLAB			
1	50225 1526 8-29	5	6	STIFF, GRAY, (10YR 4/2) GRAVELLY CLAY, LOW PLASTICITY, MOIST.	CL	1.5	Hnu – 0.6 ppm α = 0 CPM βγ = 600
	50226 1526 8-29	4	Ø	NO RECOVERY			
2	50227 1526 8-29	3	Ø	NO RECOVERY			Hnu = 0.6 ppm α = 0 CPM βγ = 500 cpm
1534	50228 8-29	2	6	STIFF, DARK GRAY (10YR 4/1) CLAY, LOW PLASTICITY, MOIST.	CL	1.5	
3	50229 1534 8-29	1	Ø	NO RECOVERY			
4	50230 1534 8-29	3	6	MEDIUM STIFF, BROWNISH GRAY (10YR 4/3) SILTY CLAY, LOW PL. TRACE OF COARSE SAND, MOIST.	CL	1.0	Hnu = 0.6 ppm α = 0 cpm βγ = 400 cpm
	50231 1536 8-29	7	6				
	50232 1536 8-29	21	Ø	NO RECOVERY			
5	50233 1537 8-29	9	6	STIFF, DARK BROWN (10YR 5/1) SILTY; CLAY, LOW PLASTICITY, MOIST.	CL	2.0	Hnu = 0.6 ppm α = 0 CPM βγ = 400 cpm
	50234 1537 8-29	6	6				
6	50235 1537 8-29	7	Ø	NO RECOVERY			
7	50236 1541 8-29	2	6	STIFF, GRAYISH BROWN (10YR 4/3) SILTY CLAY, TRACE OF MEDIUM TO COARSE SAND, LOW PLASTICITY, MOIST.	CL	1.5	Hnu = 0.6 ppm α = 0 CPM βγ = ~~300~~ ET 300-400 CPM
	50237 1541 8-29	2	6				
	50238 1541 8-29	5	4				

NOTES: DRILLING Co.:
DRILLER: J. Salvani
HELPER: Charles Elkowitz

MATERIALS USED:
2 BAGS 10/20 SAND (80 lb. ea.)
3½ buckets BENTONITE (5 gal. ea.)
10 gals WATER
½ SACK CEMENT TYPE I

SAMPLING IN ACCORDANCE WITH ASTM STANDARDS, DESCRIPTION OF SOIL COLOR BY MUNSELL COLOR CHART. SAMPLES TAKEN FOR WMCO AT INTERVALS 0.0-5 FT., 2-2.5 FT., 5-5.5 FT, 10-10.5 FT., 15-15.5 FT.

INSTRUMENT BACKGROUND
Hnu = 0.6 ppm - 1.0 ppm
α = 0-30 CPM
βγ = 400-600 CPM
LEL = 0
O_2 = 20.2%

000470

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 662 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1348	COORDINATES:		DATE: 8-29-89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 8-29-89
ENGINEER/GEOLOGIST: E. Tollinger	Depth	Date/Time	DATE COMPLETED: 8-30-89
DRILLING METHODS: Mobile Drill HSA			PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MI ASSIFIED CONSISTENCY (TSF)	REMARKS
8	50239 1545 8-29	6	6	MEDIUM STIFF, GRAY, (10YR 5/1) SILTY CLAY, LOW PLASTICITY, MOIST.	CL	1.0	Hnu = 0.6 ppm
	50240 1543 8-29	10	0	NO RECOVERY			α = 0 CPM
9	50241 1543 8-29	14	0				βγ = 300-400 CPM
	50242 1547 8-29	11	6	MEDIUM STIFF, GRAY (10YR 5/1) CLAY, MEDIUM PLASTICITY, MOIST.	CL	1.0	Hnu = 0.6 ppm
10	50243 1547 8-29	8	6	STIFF, DARK GRAY (10YR 3/1) CLAY, TRACE OF COARSE SAND, LOW PLASTICITY, MOIST,	CL	2.0	α = 0 CPM
	50244 1547 8-29	10	6				βγ = 400 CPM
11	50245 1603 8-29	2	6		CL	2.5	Hnu = 0.6 ppm
	50246 1603 8-29	5	6				α = 0 CPM
12	54655 1603 8-29	4	6				βγ = 300 CPM
	54656 1605 8-29	3	6	STIFF, GRAY (10YR 4/2) CLAY, TRACE OF GRAVEL (.5-.75 in), MEDIUM PLASTICITY, MOIST.	CL	2.0	Hnu = 0.6 ppm
13	54657 1605 8-29	4	6				α = 0 CPM
	54658 1605 8-29	3	2				βγ = 300 CPM
14	54659 1608 8-29	4	6		CL	2.0	Hnu = 0.6 ppm
	54660 1608 8-29	4	6				α = 0 CPM
	54661 1608 8-29	4	0	NO RECOVERY			βγ = 300 CPM

NOTES

DRILLER: Jim Soccani
HELPER: Charles Elkuite

INSTRUMENT BACKGROUND
Hnu = 0.6 ppm
α = 0 CPM
βγ = 600 CPM

000471

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1348	COORDINATES:		DATE: 8-29-89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 8-29-89
ENGINEER/GEOLOGIST: E. Trollinger	Depth	Date/Time	DATE COMPLETED: 8-30-89
DRILLING METHODS: Mobile Drill HSA			PAGE 3 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15							
16	54662 1613 8-29	2	6	STIFF, GRAYISH BROWN (10YR 4/2) CLAY, TRACE OF GRAVEL (.5 IN), MEDIUM PLASTICITY, MOIST.	CL	1.8	Hnu = 0.6 ppm α = 0 CPM β/γ = 400 cpm
	54663 1613 8-29	4	6				
	54664 1613 8-29	5	6	LOOSE, GRAY (10YR 5/1) CLAYEY SILT, TRACE OF GRAVEL (.5 IN), WET.	ML	N/A	
17	54665 1617 8-29	13	6	STIFF, GRAYISH BROWN (10YR 4/2) SILTY CLAY, TRACE OF FINE GRAVEL, LOW PLASTICITY, MOIST.	CL	1.5	Hnu = 0.6 ppm α = 0 CPM β/γ = 300 CPM
	54666 1617 8-29	17	6	MEDIUM DENSE, BROWN (10YR 4/2) WELL GRADED GRAVELLY SAND, WET.	SW	N/A	
18	54667 1617 8-29	13	6				
	54668 1628 8-29	10	6		SW	N/A	Hnu = 0.6 ppm α = 0 CPM β/γ = 300 CPM
19	54669 1628 8-29	13	6				
	54670 1628 8-29	14	6	MEDIUM DENSE, GRAYISH BROWN (10YR 5/3) CLAYEY SAND, TRACE OF FINE GRAVEL, NON COHESIVE, WET.	SC	N/A	
20	54671 1628 8-29	17	4	STIFF, GRAY, (10YR 5/2) CLAY, MEDIUM PLASTICITY, MOIST.	CL	1.5	Hnu = 0.6 ppm α = 0 CPM β/γ = 300 CPM
				BOTTOM OF BORING. NOT TO EXCEED 20.0 FT FROM GROUND SURFACE * BOTTOM OF BORING AT 20.0 FT, SAMPLING ENDED AT 20.0 FT.			

WATER BEARING ZONE ≈ 16.0 FT

NOTES:

DRILLER: Jim Succani
HELPER: Charles Elkowitz

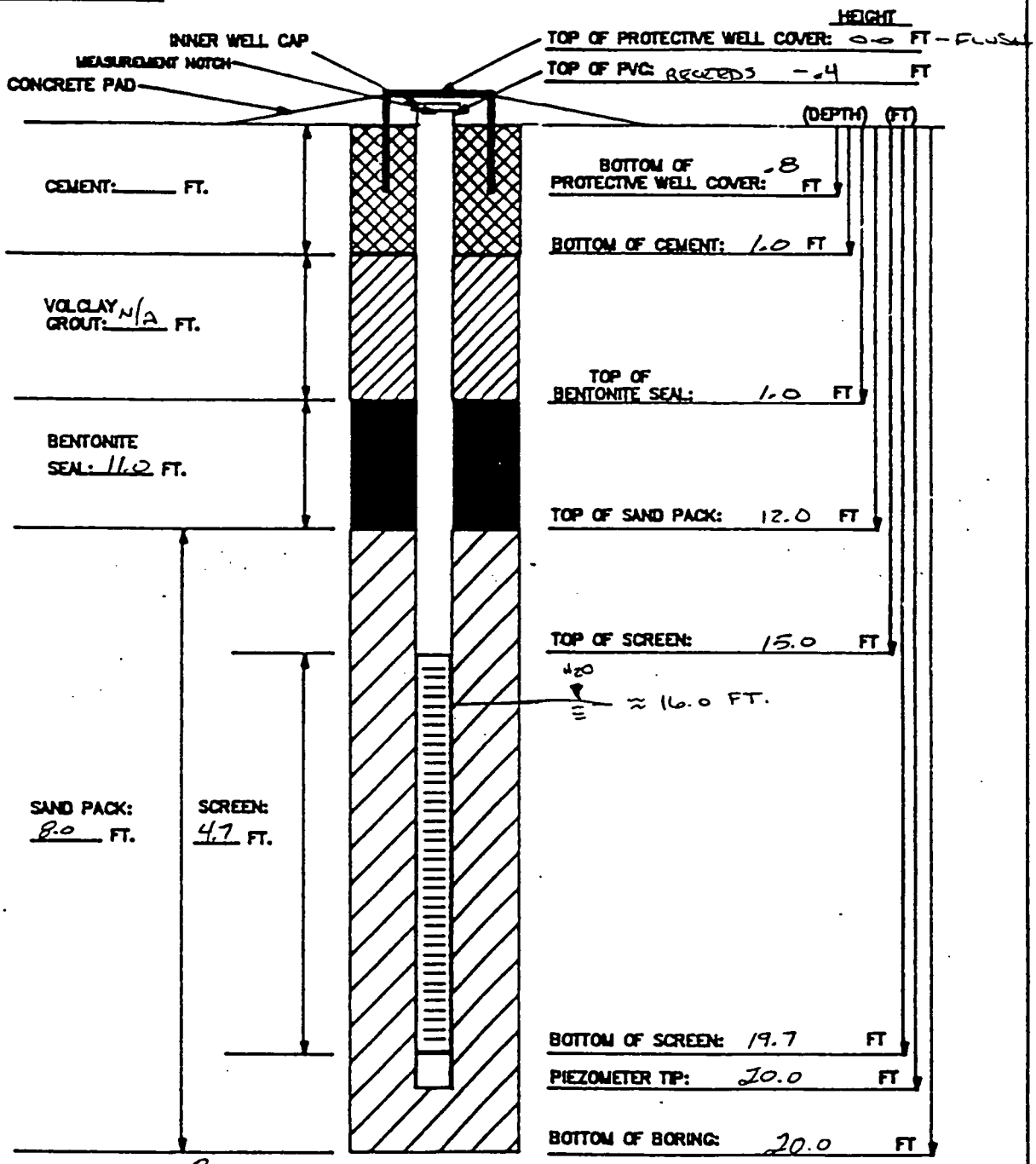
INSTRUMENT BACKGROUND

Hnu = 0.6 ppm
α = 0 CPM
β/γ = 400 CPM

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1348

INSTALLATION DATE: 8-30-89



BOREHOLE DIAMETER: 8 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 2 BAGS (80 lb.)
BENTONITE PELLETS (5-GALLON BUCKETS): 3½
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1/4 sack
AMOUNT OF WATER USED: 10 gals
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 3.7.1 GEOLOGIST/ENGINEER: E. Trollinger

FERNALD RI/FS

Date	9/1/89			
Initial	[illegible]			
	Field Check	1st Rev'n	2nd Rev'n	Final Review

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1349	COORDINATES:	DATE: 8-28-89	
ELEVATION:	GWL: Depth / Date/Time	DATE STARTED: 8-28-89	
ENGINEER/GEOLOGIST: E. Troninger	Depth / Date/Time	DATE COMPLETED: 8-29-89	
DRILLING METHODS: McBLE DRILL HSA		PAGE 1 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1	50247			3 in ASPHALT			
	50248			9 in CONCRETE			
	50249 1343 8-28	3	6	VERY STIFF, OLIVE (5Y 3/3) SILTY CLAY, TRACE OF FINE GRAVEL, (.5 in), LOW PLASTICITY, MOIST.	CL	3.0	Hmu = 0.6 ppm α = 0 cpm βγ = 90 cpm
2	50250 1343 8-28	5	6	↓	CL	3.0	Hmu = 0.6 ppm α = 0 cpm βγ = 100 cpm
	50251 1343 8-28	8	3				
3	50252 1343 8-28	8	0	NO RECOVERY			
	50253 1346 8-28	3	6	STIFF, OLIVE GRAY (5Y 4/2) SILTY CLAY, SOME COARSE SAND, LOW PLASTICITY, MOIST.	CL	2.0	Hmu = 0.6 ppm α = 0 cpm βγ = 100 cpm
4	50254 1346 8-28	4	6				
	50255 1346 8-28	9	0	NO RECOVERY			
5	50256 1350 8-28	5	6	STIFF, GRAYISH BROWN (10YR 4/3) SILTY, CLAY, MEDIUM PLASTICITY MOIST.	CL	1.5	Hmu = 0.6 ppm α = 0 cpm βγ = 110 cpm
	50257 1350 8-28	10	0	NO RECOVERY			
6	50258 1350 8-28	15	0				
	50259 1356 8-28	3	6	STIFF, YELLOWISH BROWN (10YR 4/4) SILTY CLAY, TRACE OF COARSE SAND, LOW PLASTICITY, MOIST	CL	1.5	Hmu = 0.6 ppm α = 0 cpm βγ = 120 cpm
7	50260 1356 8-28	5	6	↓			
	50261 1356 8-28	5	3				

NOTES: DRILLING Co.:
DRILLER: Jim Saccani
HELPER: Charles Eckowitz

MATERIALS USED:
2 BAGS VOLCLAY grout
25 gals WATER
1/2 SACK CEMENT.

SAMPLING IN ACCORDANCE WITH ASTM STANDARDS, DESCRIPTION OF SOIL COLOR BY MUNSELL COLOR CHART. SAMPLES TAKEN FOR WMCO AT INTERVALS 0.0-.5 FT.; 2-2.5 FT., 5-5.5 FT, 10-10.5 FT., 15-15.5 FT.

H H 18 INSTRUMENT BACKGROUND
Hmu = 0.6 ppm
α = 0-10 cpm
βγ = 100-150 cpm
LEL = 0
O_2 = 20%

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1349	COORDINATES:	DATE: 8-28-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 8-28-89
ENGINEER/GEOLOGIST: E. Trollinger	Depth Date/Time	DATE COMPLETED: 8-29-89
DRILLING METHODS: Mobile Drill HSA		PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	50262 1358 8-28	4	6	STIFF, GRAYISH BROWN, (10YR 4/3) CLAY, TRACE OF FINE TO MEDIUM SAND LAYERS, LOW PLASTICITY, MOIST.	CL	1.5	Hnu = 0.6 ppm α = 0 CPM βγ = 110 CPM
	50263 1358 8-28	4	6				
9	50264 1358 8-28	4	6				
	50265 1400 8-28	4	6		CL	1.25	Hnu = 0.6 ppm α = 0 CPM βγ = 100 CPM
10	50266 1400 8-28	5	6				
	50267 1400 8-28	6	6				
11	50268 1507 8-28	4	6		CL	1.5	Hnu = 0.6 ppm α = 0 CPM βγ = 120 CPM
	54675 1507 8-28	7	6				
12	54676 1507 8-28	9	4				
	54677 1510 8-28	7	6	SOFT, BROWN (10YR 4/3) SILTY CLAY, LOW PLASTICITY TO NON COHESIVE, MOIST TO WET. (NON WATER BEARING)	CL	0.5	Hnu = 0.6 ppm α = 0 CPM βγ = 120 CPM
13	54678 1510 8-28	11	6				
	54679 1510 8-28	14	0	NO RECOVERY			
14	54680 1515 8-28	14	6	MEDIUM DENSE, BROWN (10YR 4/3) CLAYEY SAND, TRACE OF FINE GRAVEL, LOW PLASTICITY, MOIST.	SC	N/A	Hnu = 0.6 ppm α = 0 CPM βγ = 100-120 CPM
	54681 1515 8-28	17	6	MEDIUM DENSE, BROWN (10YR 4/2) CLAYEY SILT, TRACE OF FINE TO MEDIUM SAND, MOIST.	ML	N/A	
	54682 1515 8-28	19	4				

NOTES:

DRILLER: Jim Saccani
HELPER: Charles Elkowitz

INSTRUMENT BACKGROUND
Hnu = 0.6 ppm
α = 0 CPM
βγ = 100-150 CPM

000475

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1349	COORDINATES:		DATE: 8-28-89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 8-28-89
ENGINEER/GEOLOGIST: E. Trollinger	Depth	Date/Time	DATE COMPLETED: 8-29-89
DRILLING METHODS: Mobile Drill HSA			PAGE 3 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15							
16	54683 1530 8-28	11	6	MEDIUM DENSE TO DENSE, GRAYISH BROWN (10YR 4/2) CLAYEY SAND, TRACE OF FINE GRAVEL, MOIST. ↓	SC	N/A	Hnu = 0.6 ppm α = 0 cpm βγ = 100 cpm
	54684 1530 8-28	20	6				
	54685 1530 8-28	22	5				
17	54686 1535 8-28	3	6	(10YR 4/1) CLAY TRACE OF FINE GRAVEL AND COARSE SAND, MEDIUM PLASTICITY, MOIST. ↓	CL	1.5	Hnu = 0.6 ppm α = 0 cpm βγ = 100 cpm
	54687 1535 8-28	4	6				
18	54688 1535 8-28	6	5				
	54689 1542 8-28	34	6		CL	2.0	Hnu = 0.6 ppm α = 0 cpm βγ = 100-120 cpm
19	54690 1542 8-28	20	6				
	54691 1542 8-28	20	6				
20	54692 1542 8-28	18	0	NO RECOVERY			Hnu = N/A α = N/A βγ = N/A
				BOTTOM OF BORING. NOT TO EXCEED 20.0 FT FROM GROUND SURFACE * BOTTOM OF BORING AT 20.0 FT., SAMPLING ENDED AT 20.0 FT. * HOLE PLUGGED, NO WATER BEARING ZONES ENCOUNTERED			

NOTES

DRILLER: Jim Saccani
HELPER: Charles Elkowitz

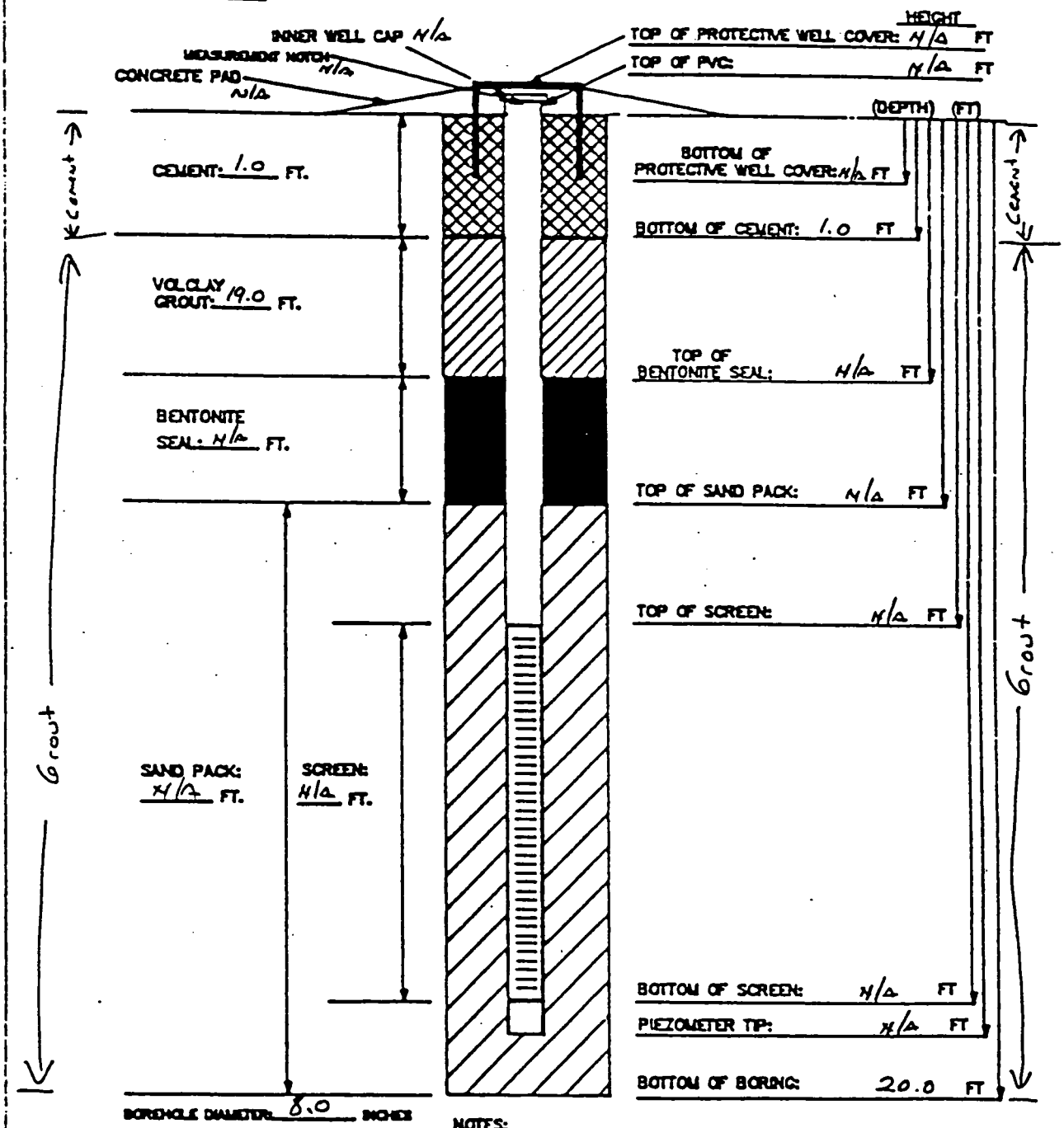
INSTRUMENT BACKGROUND

Hnu = 0.6 ppm
α = 0 cpm
βγ = 150 cpm

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1349

INSTALLATION DATE: 8-28-85



MATERIALS USED:
SAND TYPE AND QUANTITY: N/A
BENTONITE PELLETS (5-GALLON BUCKETS): N/A
BAGS OF VOLCLAY GROUT: 2
AMOUNT OF CEMENT: ~~min~~ 1/2 sack
AMOUNT OF WATER USED: 25 gals.
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7.1 GEOLOGIST/ENGINEER: E. Trollinger

1507

Date	8/17/89			
Initial	BJ			
	Field Check	1st Rev'n	2nd Rev'n	Hard Copy Verification

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1351	COORDINATES:	DATE: 08-11-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 08-10-89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth Date/Time	DATE COMPLETED: 08-11-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 2

BJ. 8/17/

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1	S0291 1519 08-10	5	3	VERY STIFF, BROWN (10YR 4/6) SILTY CLAY, SOME GRAVEL (.25-.75 in) DAMP	CL	2.0	HNU = 0 PPM; α = 0 CPM; BG = 400-600 CPM
	S0292 1519 08-10	5	—	NO RECOVERY .5 - 1.0 FT.	—	—	
	S0293 1519 08-10	6	—	NO RECOVERY 1.0 - 1.5 FT.	—	—	
2	S0294 1521 08-10	5	6	VERY STIFF, BROWN (10YR 4/6) SILTY CLAY, TRACE GRAVEL (.25 in) DAMP	CL	2.0	HNU = 0 PPM; α = 0 CPM; BG = 400-600 CPM
	S0295 1521 08-10	6	6	A.A.	CL	2.0	
	S0296 1521 08-10	8	—	NO RECOVERY. 2.5 - 3.0 FT.	—	—	
3	S0297 1524 08-10	10	6	VERY STIFF, OLIVE GREY (5Y 4/2) SILTY CLAY, TRACE GRAVEL (.25 in) DAMP	CL	2.0	HNU = 0 PPM; α = 0 CPM; BG = 400-600 CPM
4	S0298 1524 08-10	10	—	NO RECOVERY 3.5 - 4.0 FT.	—	—	
	S0299 1524 08-10	7	—	NO RECOVERY 4.0 - 4.5 FT	—	—	
5	S0300 1531 08-10	8	6	VERY STIFF, OLIVE-GREY (5Y 4/2) SILTY CLAY, TRACE GRAVEL (.25 in) DAMP	CL	2.0	HNU = 0 PPM; α = 0 CPM; BG = 400-600 CPM
	S0301 1531 08-10	7	6	VERY STIFF, BROWN (7.5Y 5/4) SILTY CLAY, TRACE GRAVEL (.25 in) DAMP	CL	2.0	
6	S0302 1531 08-10	7	—	NO RECOVERY 5.5 - 6.0 FT	—	—	
7	S0303 1552 08-10	3	6	VERY STIFF, GREENISH-BROWN (2.5Y 4/4) SILTY CLAY, TRACE GRAVEL (.25 in) DAMP	CL	2.0	HNU = 0 PPM; α = 0 CPM; BG = 400-600 CPM
	S0304 1552 08-10	4	3	VERY STIFF, OLIVE-GREY (5Y 4/2) SILTY CLAY, TRACE SAND, DAMP	CL	2.0	
	S0305 1552 08-10	5	—	NO RECOVERY 7.0 - 7.5 FT	—	—	

NOTES: CONTRACTOR: PENN DRILL
RIG: MOBILE B-53
DRILLER: J. SACCANI
ASSISTANT: W. FELTY

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TE
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM
α = 0 CPM
BG = 1400 CPM (GAMMA)
LEL/O2: LEL = 0 PPM
O2 = 20.6 %

A.A = AS ABOVE

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1351	COORDINATES:	DATE: 08-11-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 08-10-89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth Date/Time	DATE COMPLETED: 08-11-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 2 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	50306 1554 08-10	6	6	STIFF, OLIVE-GRAY (5Y 5/2) SILTY CLAY TRACE GRAVEL (.25 in) DAMP	CL	1.5	HNU = 0 PPM
	50307 1554 08-10	8	6	A.A.	CL	1.5	α = 0 CPM BG: 400-600 CPM
9	50308 1554 08-10	9	6	STIFF, OLIVE-GREY (5Y 3/1) SILTY CLAY TRACE GRAVEL (.25 in) DAMP	CL	1.5	
	50309 1625 08-10	10	6	STIFF, OLIVE-GREY (5Y 4/1) SILTY-CLAY, TRACE GRAVEL (.25 in) DAMP	CL	1.5	HNU = 0 PPM α = 0 CPM BG: 400-600 CPM
10	50310 1625 08-10	5	6	A.A.	CL	1.5	
	50311 1625 08-10	4	—	NO RECOVERY 10.0 - 10.5	—	—	
11	50312 1630 08-10	2	6	STIFF, OLIVE-GREY (5Y 4/1) SILTY CLAY TRACE GRAVEL (.25 in) DAMP	CL	1.5	HNU = 0 PPM α = 0 CPM BG = 400-600 CPM
	54715 1630 08-10	2	6	STIFF, GREENISH-GREY (5Y 5/1) SILTY CLAY, GRAVEL (.25 in) DAMP	CL	1.5	
12	54716 1630 08-10	2	2	A.A.	CL	1.5	
	54717 1632 08-10	2	6	A.A	CL	1.5	HNU = 0 PPM α = 0 CPM BG = 400-600 CPM
13	54718 1632 08-10	2	6	A.A	CL	1.5	
	54719 1632 08-10	2	—		—	—	
14	54720 1638 08-10	2	6	MEDIUM STIFF, GREENISH-BROWN (2.5Y 5/3) SILTY CLAY, WET MOIST	CL	1.0	HNU = 0 PPM α = 0 CPM BG = 400-600 CPM
	54721 1638 08-10	1	6	A.A.	CL	1.0	
	54722 1638 08-10	1	—	NO RECOVERY 14.5 - 15.0	—	—	

TOP OF WATER ZONE

NOTES:

TOP OF SATURATED ZONE: 13.5 FT.

AT 20.0 FT. BOREHOLE STILL PENETRATED SATURATED ZONE

A.A: AS ABOVE

000479

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1351	COORDINATES:	DATE: 08-11-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 08-10-89
ENGINEER/GEOLOGIST: M. SLUSARSKI	Depth Date/Time	DATE COMPLETED: 08-11-89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 3 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S4723 1650 08-10	2	6	LOOSE, BROWN (2.5Y 5/4) SAND-SILT MIXTURE, WET	SM	N/A	HNU = 0 PPM α = 0 CPM Bβ = 400-600 CPM
16	S4724 1650 08-10	3	6	A.A	SM	N/A	
	S4725 1650 08-10	3	6	LOOSE, WET (5Y 4/1) SAND-SILT MIXTURE, WET	SM	N/A	
17	S4726 1654 08-10	2	6	A.A	SM	N/A	HNU = 0 PPM α = 0 CPM Bβ = 400-600 CPM
	S4727 1654 08-10	3	6	A.A	SM	N/A	
18	S4728 1654 08-10	4	6	A.A	SM	N/A	
	S4729 1704 08-10	2	6	A.A	SM	N/A	HNU = 0 PPM α = 0 CPM Bβ = 400-600 CPM
19	S4730 1704 08-10	3	6	A.A.	SM	N/A	
	S4731 1704 08-10	3	6	A.A.	SM	N/A	
20	S4732 1704 08-10	5	6	A.A 20.0	SM	N/A	HNU = 0 PPM α = 0 CPM Bβ = 400-600 CPM
				BOTTOM OF BORING 20.0 FT.			

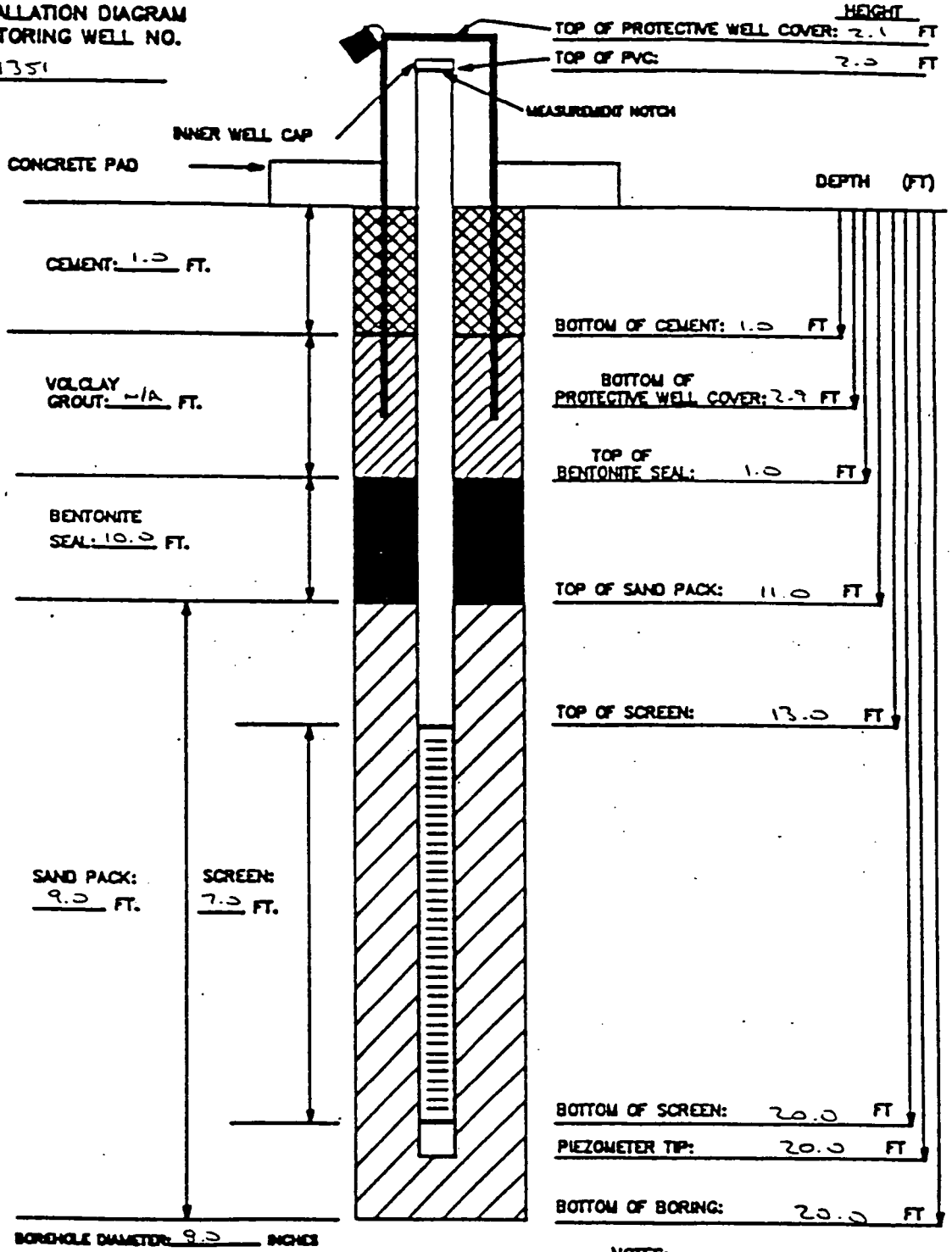
NOTES:

A.A = AS ABOVE

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1351

INSTALLATION DATE: 08-11-89



BOREHOLE DIAMETER: 9.0 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 : 2 - 50 LB BAGS
BENTONITE PELLETS (5-GALLON BUCKETS): 5 - 5 GAL BUCKETS
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: .5 - 94 LB BAG.
AMOUNT OF WATER USED: 40 GAL.
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 602 7.7.1 GEOLOGIST/ENGINEER: M. SLUSARUCI

FERNALD RI/FS

Date	9/1/89			
Initial	BD			
	Field Check	1st Key In	2nd Key In	Hard Copy Verification

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1352	COORDINATES:	DATE: 8-16-89	
ELEVATION:	GWL: Depth / Date/Time	DATE STARTED: 8-16-89	
ENGINEER/GEOLOGIST: E. Trollinger	Depth / Date/Time	DATE COMPLETED: 8-24-89	
DRILLING METHODS: MOBILE DRILL HSA 8 in		PAGE 1 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	50313 1510 8-16	3	6	UNIFORM GRAVEL USED AS PARKING LOT FILL (6 in)	GP	N/A	H_{nu} = 0.4 ppm
1	50314 1510 8-16	4	4	STIFF, OLIVE GRAY (5Y 4/2) SILTY CLAY, LOW PLASTICITY, MOIST.	CL	2.0	α = 0 CPM
	50315 1510 8-16	6	0	NO RECOVERY			$\beta\gamma$ = 1200 CPM
2	50316 1515 8-16	6	4	STIFF, OLIVE GRAY (5Y 3/2) CLAY TRACE OF COARSE SAND, LOW PLASTICITY, MOIST.	CL	1.5	H_{nu} = 0.4 ppm
	50317 1515 8-16	8	0	NO RECOVERY 2 ATTEMPTS			α = 0 ppm
3	50318 1515 8-16	8	0				$\beta\gamma$ = 1000 CPM
	50319 1521 8-16	5 7	6	STIFF, OLIVE GRAY (5Y 3/2) SANDY CLAY, LOW PLASTICITY, MOIST.	CL	2.0	H_{nu} = 0.4 ppm
4	50320 1521 8-16	11	4				α = 0 CPM
	50321 1521 8-16		0	NO RECOVERY			$\beta\gamma$ = 900 CPM
5	50322 1535 8-16	6	6	STIFF OLIVE BROWN (5Y 4/3) CLAY, LOW TO MEDIUM PLASTICITY, MOIST.	CL	1.5	H_{nu} = 0.4 ppm
	50323 1535 8-16	7	0	NO RECOVERY			α = 0 CPM
6	50324 1535 8-16	8					$\beta\gamma$ = 900 CPM
	50325 1552 8-16	8	6	STIFF, GRAYISH BROWN (10YR 5/2) CLAY, MEDIUM PLASTICITY, MOIST.	CL	2.0	H_{nu} = 0.4 ppm
7	50326 1552 8-16	9	4				α = 0 CPM
	50327 1552 8-16	7	0	NO RECOVERY			$\beta\gamma$ = 900 CPM

NOTES: DRILLING CO.:
DRILLER: Dave Newman
HELPER: Chris Colter

MATERIALS USED:
2 bags H2O Sand
2 bags Bentonite

SAMPLING IN ACCORDANCE WITH ASTM STANDARDS, DESCRIPTION OF SOIL COLOR BY MUNSELL COLOR CHART. SAMPLES TAKEN FOR WMCO AT INTERVALS 0.0-.5 FT., 2-2.5 FT., 5-5.5 FT, 10-10.5 FT., 15-15.5 FT.

INSTRUMENT BACKGROUND
H_{nu} = 0.4 ppm
α = 0 CPM
$\beta\gamma$ = 1500-2000 CPM
LEL = 0
O_2 = 21.0%

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1352	COORDINATES:	DATE: 8-16-89 & 8-24-89
ELEVATION: B. Dunning	GWL: Depth Date/Time	DATE STARTED: 8-16-89
ENGINEER/GEOLOGIST: E. Trollinger	Depth Date/Time	DATE COMPLETED: 8-24-89
DRILLING METHODS: Auger 8 in HSA		PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	50328 1555 8-16	11	6	STIFF TO VERY STIFF, DARK OLIVE (5Y 3/2) CLAY, TRACE OF GRAVEL (.5 in), MEDIUM PLASTICITY, MOIST.	CL	2.0	Hnu = 0.4 ppm α = 0 cpm βγ = 800-900 cpm
	50329 1555 8-16	10	6				
9	50330 1555 8-16	11	4				
	50331 1605 8-16	17	6	SAME AS ABOVE	CL	3.0	Hnu = ~~50~~ 0.4 ppm α = 0 cpm βγ = 800-900 cpm
10	50332 1605 8-16	11	6				
	50333 1605 8-16	11	3				
11	50334 1845 8-24	2	6"	MEDIUM STIFF TO STIFF, DARK OLIVE (5Y 3/2) clay, trace of gravel moist.	CL	1.0	Hnu = 0 α = 0 βγ = 1000 dpm
	54735 1945 8-24	2	6"	11.25 Loose, yellowish brown, sand (10 YR 5/4) silty & wet. poorly graded	SC		
12	54736 1945 8-24	5	NR -0-	- NO RECOVERY -	~~SC~~ N.R.	N/A	
	54737 1953 8-24	5	6	MEDIUM DENSE, yellowish BROWN SAND (10 YR. 5/4) silty and WET.	SM	-	Hnu = 0 α = 0 βγ = 1000
13	54738 1953 8-24	12	6				
	54739 1953 8-24	12	6				
14	54740 1500 8-24	11	6	DENSE, yellowish-brown ~~clay~~ sand (10 YR. 5/5) becoming increasingly coarse grain, WET	SP	-	Hnu = 0 α = 0 βγ = 1,000 dpm.
	54741 1500 8-24	15	6				
	54742 1500 8-24	17	6				

NOTES

Approximate WATER BEARING ZONE 11.25 Ft. to 15.0 Ft.

SEE Page 1

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1352	COORDINATES:	DATE: 8-24-89	
ELEVATION:	GWL: Depth / Date/Time	DATE STARTED: 8-16-89	
ENGINEER/GEOLOGIST: B. Dunning	Depth / Date/Time	DATE COMPLETED: 8-24-89	
DRILLING METHODS: MOBILE DRILL HSA		PAGE 3 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15	54743 1520 8-24	12	6"	VERY STIFF, Olive Gray Clay (5Y, 4/2) with TR of gravel < 3% good plasticity wet	CL	2.75	Hnu = 0
16	54744 1520 8-24	16	STIFF 6"	~~Dense~~ stiff clayey & silty yellowish-Brown clay (10 YR, 5/8), wet	CL	2.0	α = 0
	54745 1520 8-24	20	6"	16.25 soft, silty, gray (5Y, 5/1) clay. no-poor plasticity grading to a clayey silt. 16.25	CL	.5	βγ = 800-1000 c.p.m.
17				* Boring T.D. at 16.5 Ft. * plugged back with Bentonite pellets to 15.0 FT & piezometer Installed.			
18							
19							
20							
				Bottom of Boring. Not to exceed 20.0 FT from Ground Surface			

NOTES:

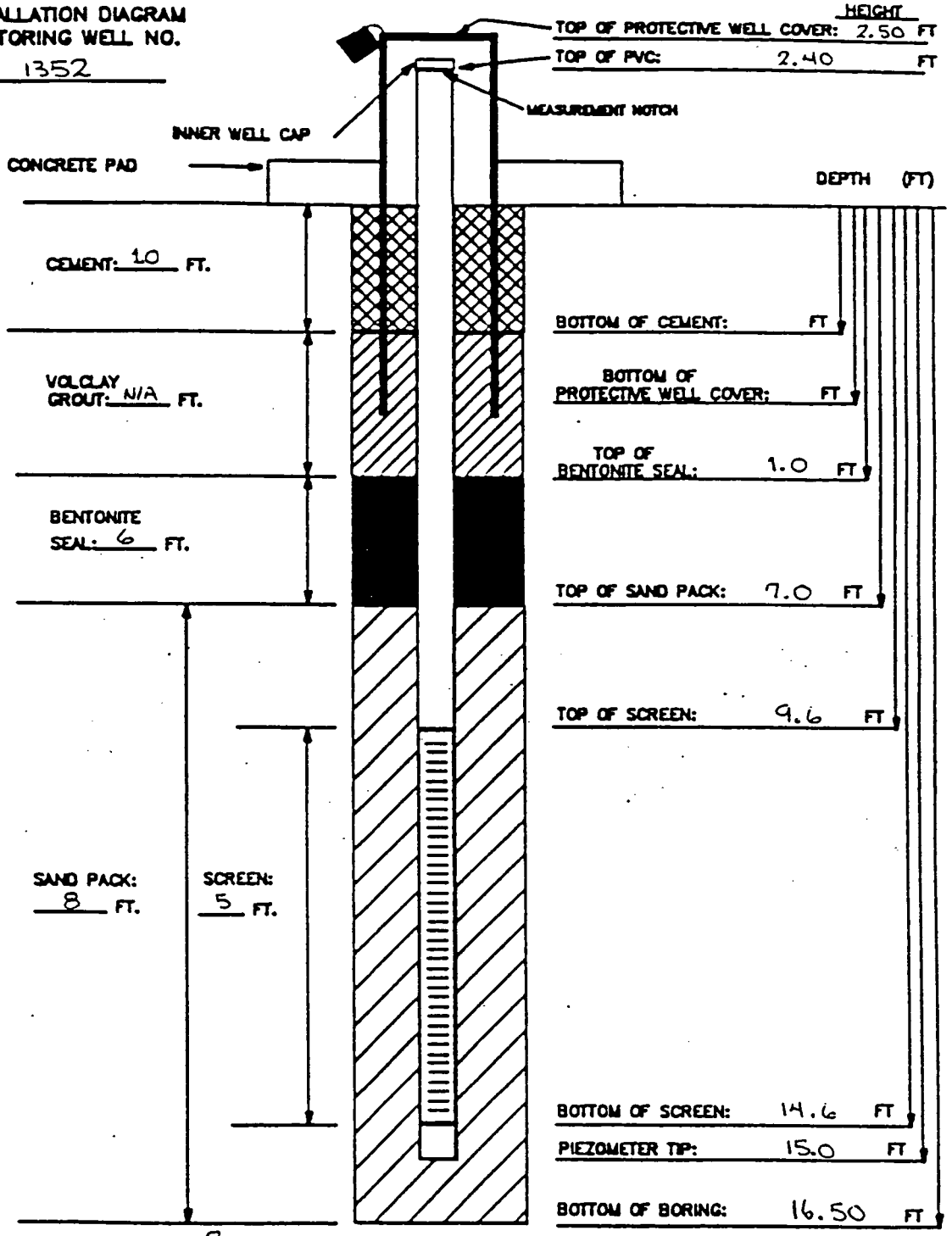
DRILLER:
HELPER: SEE PAGE 1

INSTRUMENT BACKGROUND
Hnu = 0
α = 0
βγ = 800-1000 c.p.m.

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1352

INSTALLATION DATE: 8-24-89



BOREHOLE DIAMETER: 8 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 2, sc 6 ds 1020
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: None
AMOUNT OF CEMENT: ½ bag
AMOUNT OF WATER USED: 5 gallons
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE: N/A

TASK: 3.7.1

GEOLOGIST/ENGINEER: B. Dunning
E. Trollinger

FERNALD RI/FS

1507

Date				
Initial				
	Field Check	1st Key In	2nd Key In	Final Copy Verification

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1354	COORDINATES:	DATE: 8/28/89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 8/27/89
ENGINEER/GEOLOGIST: C. Gruber	Depth Date/Time	DATE COMPLETED: 8/28/89
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	50357 1642 8-27	NA	0	Asphalt	NA	NA	HNU = 0 ppm α = 0 cpm Bγ = 700cpm with (screen catcher)
1	50358 1642 8-27	NA	0	Asphalt (+ old electric conduit)	NA	NA	
	50359 1642 8-27	3	2	LOOSE (10yr 5/3) brown clayey gravel, some sand, moist	GC	NA	
2	50360 1642 8-27	7	0	NR	NA	NA	HNU = NA α = NA Bγ = NA w/ screen
	50361 1642 8-27	6	0	NR	NA	NA	
3	50362 1642 8-27	3	0	NR	NA	NA	
	50363 0955 8-28	2	5	LOOSE (10yr 5/3) Brown) clayey sand, trace fine to coarse gravel moist	SC	NA	HNU = 0 ppm α = 0 cpm Bγ 85-95 cpm w/screen
4	50364 0955 8-28	2	0	NR	NA	NA	
	50365 0955 8-28	3	0	NR	NA	NA	
	50366 0958 8-28	6	6	SAA (3.0-3.5ft)	SC	NA	HNU = 0 ppm α = 0 cpm Bγ = 100 cpm w/ screen
5	50367 0958 8-28	5	4	SOFT (5y 5/3) olive clay, some silt, med plasticity, moist	CL	.25	
6	50368 0958 8-28	5	0	NR	NA	NA	
	50369 1015 8-28	2	6	LOOSE (10y 5/3) Brown silty sand, trace fine to med gravel, moist	SM	NA	HNU = 0 ppm α = 0 cpm Bγ = 120-130 cpm w/screen
7	50370 1015 8-28	2	0	NR	NA	NA	
	50371 1015 8-28	3	0	NR	NA	NA	

NOTES: CONTRACTOR: PENN DRILL
RIG: Acker Soil Sentry
DRILLER: Dave Newman
ASSISTANT: Bob Johnson
Geo Assistant: Cindy Melroy

SAA = Same As Above
NR = No Recovery

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0.0 PPM
α = 0.0 CPM
Bγ = 700-200 CPM on 8/27/89 100-170 cpm on 8/28/89

LEL O_2: LEL = 0% ~~ppm~~ 8/27/89
O_2 = 20.6%

HNU - 905513 27

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1354	COORDINATES:		DATE: 8/28/89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 8/27/89
ENGINEER/GEOLOGIST: C. Grube	Depth	Date/Time	DATE COMPLETED: 8/28/89
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	50372 1020 8-28	3	6	LOOSE (10yr 5/3) Brown clayey SAND, trace fine gravel, very moist	SC	NA	HNU = 0 ppm α = 0 cpm BG = 140-150 cpm
	50373 1020 8-28	4	3	STIFF (2.5y, 3/2) Very dark grayish brown clay, low plasticity, moist	CL	1.5	
9	50374 1020 8-28	4	0	NR	NA	NA	
10	50375 1026 8-28	5	6	M. Dense SAA (7.5-8.0)	SC	NA	HNU = <1 ppm α = 0 cpm BG = 140-150 cpm
				very soft (10yr 5/3) brown clay, trace fine gravel, med plasticity, moist	CL	<.25	
	50376 1026 8-28	10	6	Med. Dense (5y, 5/3) olive clayey gravel, trace sand, very moist	GC	NA	
	50377 1026 8-28	8	3	Med Stiff (2.5y, 5/4) light olive brown, gravelly clay, med plasticity very moist	CL	.5	
11	50378 1038 8-28	4	6	Soft (5y 4/3) olive clay, trace sand & silt, ~~tow~~ cam 8-28 med PLASTIC, moist	CL	.25	HNU = <1 ppm α = 0 cpm BG = 150-160 cpm
	54775 1038 8-28	3	3	SAA	CL	.25	
12	54776 1038 8-28	3	0	NR	NA	NA	
	54777 1315 8-28	4	6	V. Soft (5y 5/2) olive gray SILTY CLAY, trace sand & fine gravel, med plastic, moist	CL	<.25	HNU = 1 ppm α = 0 cpm BG = 200 cpm
13	54778 1315 8-28	4	6	Stiff (10y 5/3) Brown SILTY CLAY to (10y 5/6) yellowish brown, low plasticity, very moist	CL	1.0	
	54779 1315 8-28	5	2	LOOSE, (2.5y 5/4) OLIVE BROWN, SILT, SOME CLAY, moist	ML	NA	
14	54780 1320	6	6	M. Dense (2.5y 5/2) to (2.5y 5/4) olive brown clayey silt trace fine gravel & sand, moist	ML	NA	HNU = 1 ppm α = 0 cpm BG = 120-130 cpm
	54781 1320	12	6	M. Dense 2.5y 5/4 light olive brown silt some sand, very moist	ML	NA	
	54782 1320	11	6	M. Dense SAA	ML	NA	
				M. Dense (5y, 4/3) olive gray, silt, some sand very moist	ML	NA	

NOTES:

SAA = Same As Above.
NR = No Recovery

000487

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1354	COORDINATES:		DATE: 8/28/89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 8/27/89
ENGINEER/GEOLOGIST: C. Grube	Depth	Date/Time	DATE COMPLETED: 8/28/89
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 3 OF 5

DEPTH	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER	RECOVERY	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
Top of water boring zone at 15.0 FT	S4783 1335 8-28	3	6	M. Dense (2.5y 5/4) lt. olive brown clayey sand, trace fine → coarse gravel, wet	SC	NA	HNU = 0 ppm α = 0 cpm BG = 190-200 cpm
16	S4784 1335 8-28	3	6	M. Dense (2.5y 4/4) olive brown silty sand, wet	SM	NA	
	S4785 1335 8-28	11	0	NR	NA	NA	w/ screen
17	S4786 1340 8-28	11	6	M. Dense, (10yr 5/3) Brown well graded sand, some clay, trace fine to coarse gravel, wet	SW	NA	HNU = 0 ppm α = 0 cpm BG = 200 cpm
	S4787 1340 8-28	10	6	SAA	SW	NA	
18	S4788 1340 8-28	10	6	M. Dense (2.5y 4/4) olive brown silt, some clay, wet	ML	NA	
	S4789 1405 8-28	17	6	Dense (10yr 5/3) Brown poorly graded sand, trace fine to coarse gravel, trace clay, wet	SP	NA	HNU = 0 ppm α = 0 cpm BG =
19	S4790 1405 8-28	16	6	Dense (5y 5/2) olive gray silt some sand, wet	ML	NA	
	S4791 1405 8-28	16	6	Dense (2.5y 4/2) dark grayish brown poorly graded sand, some silt, wet	SP	NA	
Bottom of water boring zone at 20.0 FT	S4792 1405 8-28	21	6	Dense SAA	SP	NA	HNU = 0 ppm α = 0 cpm BG =
				Bottom of Boring + Sampling at ± 20.0 FT			

NOTES:

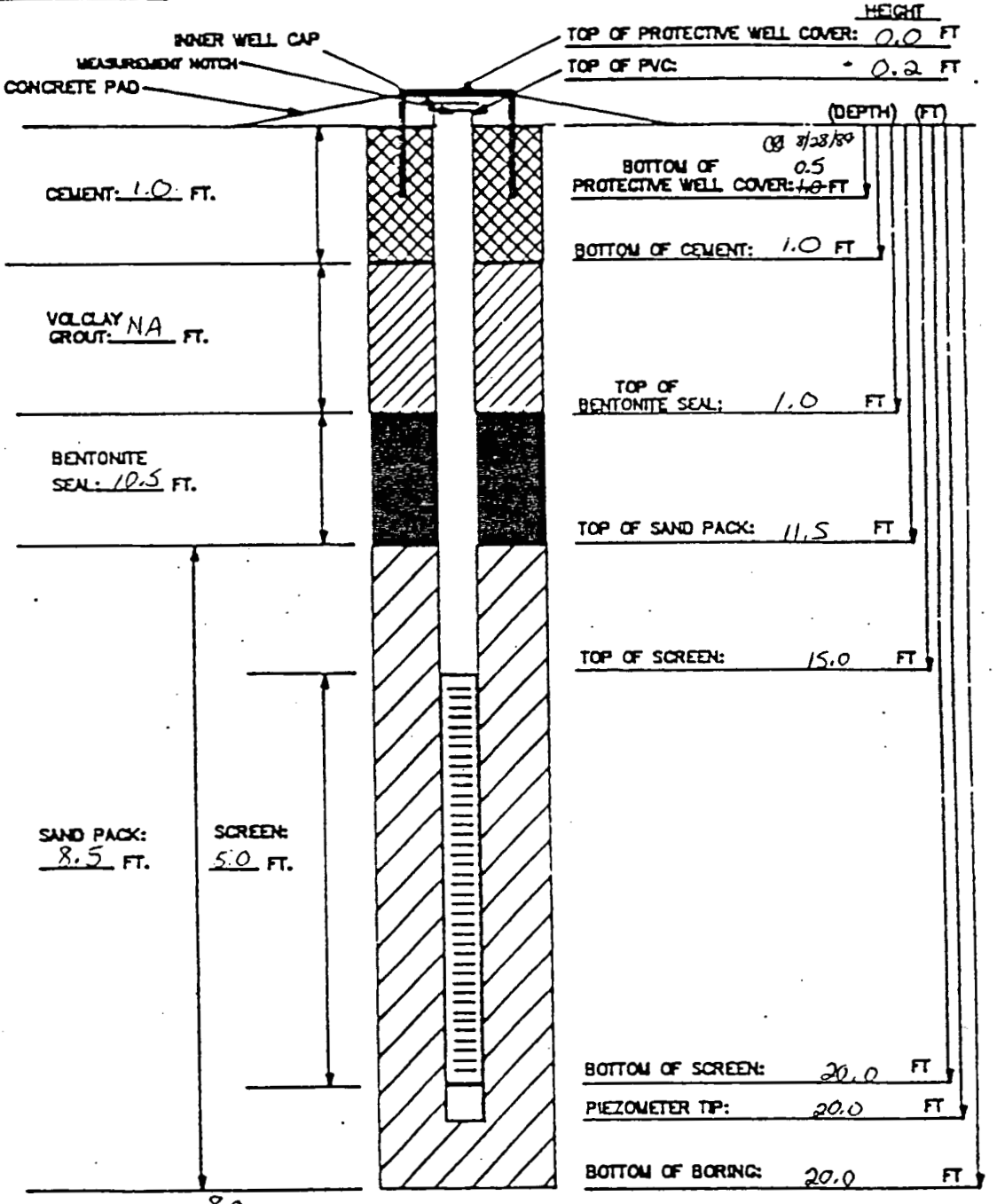
SAA = Same As Above
NR = No Recovery

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1354

INSTALLATION DATE: 8-28-89

P. 5 of 5



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 sand - 1½ (30 sacks)
BENTONITE PELLETS (5-GALLON BUCKETS): 4 5gal buckets
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: ½ sack (94#)
AMOUNT OF WATER USED: 10 gal
OTHER: 5.0 Protective cover - Flush Mount (in 8/28/89)

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7.1

GEOLOGIST/ENGINEER: C. Grube

000489

FERNALD RI/FS

1507

Date	9/1/89			
Initials	[illegible]			
	Field Check	1st Rev In	2nd Rev In	Hard Copy Verification

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1356	COORDINATES:	DATE: 8-25-89	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 8-25-89	
ENGINEER/GEOLOGIST: E. Trollinger	Depth Date/Time	DATE COMPLETED: 8-25-89	
DRILLING METHODS: MOBILE DRILL HSA 8"		PAGE 1 OF 5	

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 (IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1	50401 1024 8-25	2	6	VERY STIFF, DARK BROWN (10YR 3/2) SILT, TRACE OF CLAY, NON COHESIVE, MOIST.	ML	2.0	Hnu = 0.6 ppm; α = 0 CPM; βγ = 600-800 CPM
	50402 1024 8-25	2	Ø	NO RECOVERY			
	50403 1024 8-25	5	Ø				
2	50404 1027 8-25	5	6	VERY STIFF, DARK OLIVE GRAY (5Y 3/2) CLAY, LOW PLASTICITY, MOIST.	CL	3.0	Hnu = 0.6 ppm; α = 0 CPM; βγ = 600 CPM
	50405 1027 8-25	8	6				
3	50406 1027 8-25	10	Ø	NO RECOVERY			
4	50407 1035 8-25	10	6	VERY STIFF, GRAYISH BROWN (10YR 3/2) CLAY, LOW TO MEDIUM PLASTICITY, MOIST.	CL	3.5	Hnu = 0.6 ppm; α = 0 CPM; βγ = 400-500 CPM
	50408 1035 8-25	10	3				
	50409 1035 8-25	8	Ø	NO RECOVERY			
5	50410 1045 8-25	6	6	VERY STIFF, DARK GRAY (10YR 4/1) CLAY, LOW PLASTICITY, SOME SILT, MOIST.	CL	3.0	Hnu = 0.6 ppm; α = 0 CPM; βγ = 400-500 CPM
	50411 1045 8-25	7	6				
6	50412 1045 8-25	8	Ø	NO RECOVERY			
7	50413 1310 8-25	4	6	VERY STIFF, DARK GRAY, (10YR 3/1) SILTY CLAY, LOW PLASTICITY, TRACE OF SAND, MOIST.	CL	2.5	Hnu = 0.6 ppm; α = 0 CPM; βγ = 400 CPM
	50414 1310 8-25	5	6				
	50415 1310 8-25	9	4				

NOTES: DRILLING CO.:
DRILLER: Dave Newman
HELPER: Bob Johnson

MATERIALS USED:
2 BUCKETS BENTONITE
2 BAGS SAND 10/20
1/2 BAG CEMENT

SAMPLING IN ACCORDANCE WITH ASTM STANDARDS, DESCRIPTION OF SOIL COLOR BY MUNSELL COLOR CHART. SAMPLES TAKEN FOR WMCO AT INTERVALS 0.0-.5 FT., 2-2.5 FT., 5-5.5 FT, 10-10.5 FT., 15-15.5 FT.

HIT-18 Mod. A INSTRUMENT BACKGROUND
Hnu = 0.6 ppm
α = 0 CPM
βγ = 1000-1200 CPM
LEL = 0
O_2 = 20%

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.1	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1356	COORDINATES:	DATE: 8-25-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 8-25-89
ENGINEER/GEOLOGIST: E. Trollinger	Depth Date/Time	DATE COMPLETED: 8-25-89
DRILLING METHODS: HSA 8 in		PAGE 2 OF 5

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	50416 1317 8-25	5	6	STIFF, DARK GRAY (10YR 4/2) CLAY, TRACE OF COARSE SAND, MEDIUM PLASTICITY, VERY MOIST.	CL	1.5	H_{au} = 0.6 ppm; α = 0 cpm; $\beta\gamma$ = 400 cpm
	50417 1317 8-25	6	6				
	50418 1317 8-25	6	0	NO RECOVERY			
9	50419 1330 8-25	2	6	MEDIUM STIFF, GRAYISH BROWN (10YR 4/3) CLAY, MEDIUM PLASTICITY	CL	1.0	H_{au} = 0.6 ppm; α = 0 cpm; $\beta\gamma$ = 300-400 cpm
10	50420 1330 8-25	2	4				
	50421 1330 8-25	2	0	NO RECOVERY			
11	50422 1340 8-25	2	6	MEDIUM STIFF, BROWN (10YR 4/3) CLAY, SOME SILT THROUGHOUT, LOW PLASTICITY, MOIST.	CL	1.0	H_{au} = 0.6 ppm; α = 0 cpm; $\beta\gamma$ = 400 cpm
	54815 1340 8-25	2	6				
12	54816 1340 8-25	4	0	NO RECOVERY			
13	54817 1342 8-25	2	6	LOOSE, BROWN (10YR 4/3) TO (10YR 4/4) SAND WITH CONSIDERABLE CLAY, NON TO LOW COHESION, WET!	SC	N/A	H_{au} = 0.6 ppm; α = 0 cpm; $\beta\gamma$ = 400 cpm
	54818 1342 8-25	2	6				
	54819 1342 8-25	4	3				
14	54820 1350 8-25	2	6	LESS CLAY BECOMING POORLY SORTED	SP	N/A	H_{au} = 0.6 ppm; α = 0 cpm; $\beta\gamma$ = 400 cpm
	54821 1350 8-25	4	6				
	54822 1350 8-25	5	6				

WATER BUILDING ZONE STARTS @ ≈120 ft

NOTES

000491

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1356	COORDINATES:		DATE: 8-25-89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 8-25-89
ENGINEER/GEOLOGIST: C. Trollinger	Depth	Date/Time	DATE COMPLETED: 8-25-89
DRILLING METHODS: MOBILE DRILL HSA			PAGE 3 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 1 (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15							
16	54823 1500 8-25	4	6	MEDIUM DENSE, BROWN (10YR 4/3) POORLY GRADED SAND, SOME SILT, TRACE OF FINE GRAVEL, WET.	SP	N/A	Hnu = 0.6 ppm α = 0 CPM βγ = 400-500 CPM
	54824 1500 8-25	5	0				
	54825 1500 8-25	7	0	NO RECOVERY			
17	54826 1503 8-25	4	6	MEDIUM DENSE BROWN (10YR 4/2) WELL GRADED SAND BECOMING SILTY AT 18.0 FT, TRACE OF FINE GRAVEL (.5 IN), WET.	SW	N/A	Hnu = 0.6 ppm α = 0 CPM βγ = 400 CPM
	54827 1503 8-25	8	6				
18	54828 1503 8-25	6	6				
19	54829 1513 8-25	21	6		SP	N/A	Hnu = 0.6 ppm α = 0 CPM βγ = 400 CPM
	54830 1513 8-25	22	6				
	54831 1513 8-25	23	6				
20	54832 1513 8-25	20	6	STIFF, GRAY (10YR 3/3) CLAY, SOME SAND AND GRAVEL, LOW PLASTICITY, MOIST.	CL	2.0	Hnu = 0.6 ppm α = 0 CPM βγ = 400 CPM
				BOTTOM OF BORING. NOT TO EXCEED 20.0 FT FROM GROUND SURFACE * BORING ENDED AT 20.0 FT. SAMPLING ENDED AT 20.0 FT (WELL PLACED IN BORING) ACCORDING TO ATTACHED.			

NOTES:

DRILLER: DAVE NEWMAN
HELPER: BOB JOHNSON

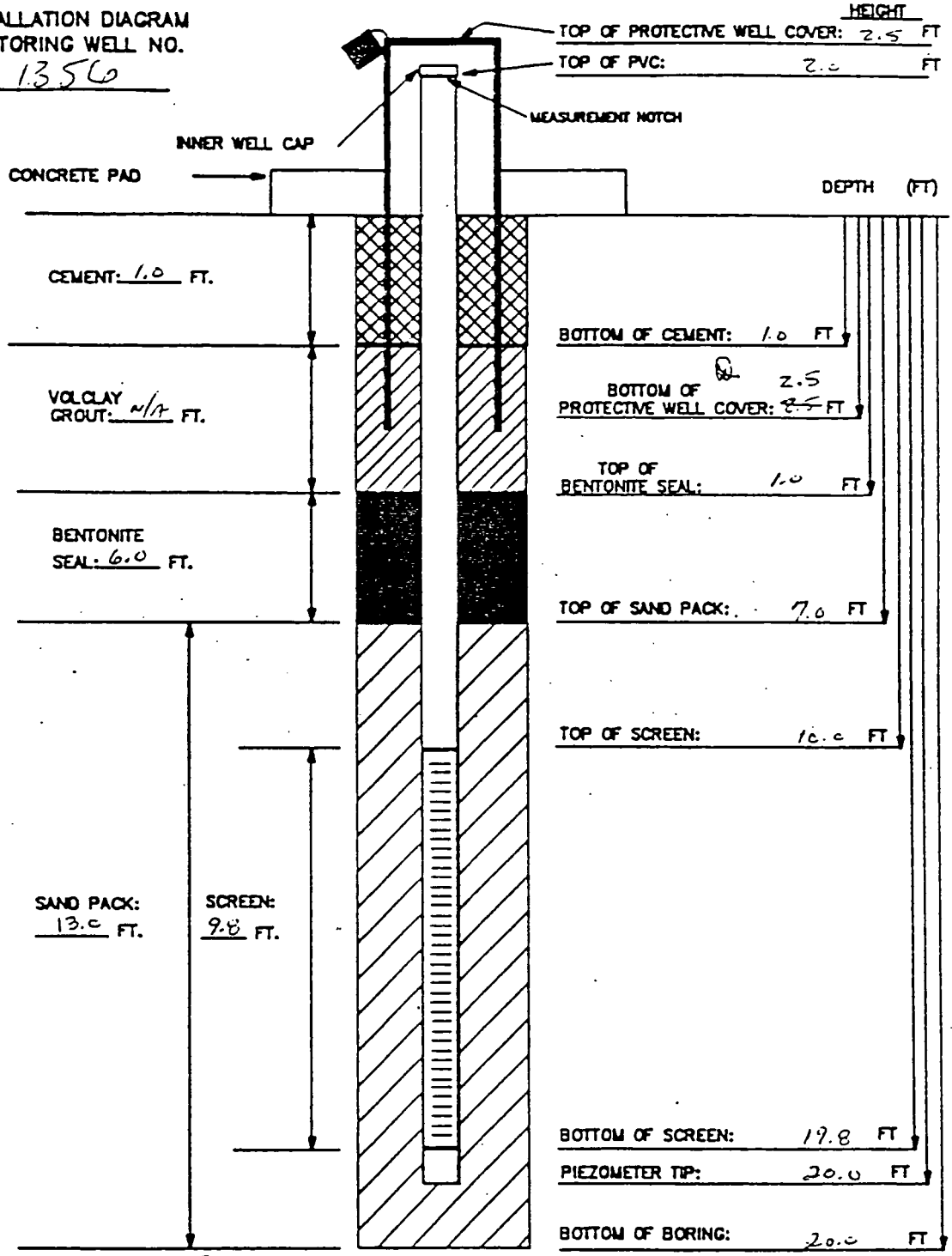
INSTRUMENT BACKGROUND
Hnu = 0.6 ppm
α = 0 CPM
βγ = 600-1000 CPM

4/5

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1356

INSTALLATION DATE: 8-25-89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20 3 BAGS
BENTONITE PELLETS (5-GALLON BUCKETS): 2 BUCKETS
BAGS OF VOLCLAY GROUT: n/a
AMOUNT OF CEMENT: 1/2 bag
AMOUNT OF WATER USED: 5 gals
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:

TASK: 3.7.1

GEOLOGIST/ENGINEER: E. Trollinger

000493

FERNALD RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07.01	PROJECT NAME: FMPC RI/FS (Facility Testing)		
BORING NUMBER: 1359	COORDINATES:	DATE: 8-25-89 @ 1330	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 8-25-89	
ENGINEER/GEOLOGIST: Brad Dunning	Depth Date/Time	DATE COMPLETED: 8-25-89	
DRILLING METHODS: Auger / Hollow Stem - Split Spoon Sampling		PAGE 1 OF 4	

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6-Inches)	RECOVERY (Inch)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0.5	50467 1333 8-25	1	6	Stiff, olive clay (5Y, 4/1) w/ some gravel at the surface, damp. Moderate to good plasticity	GP	N/A	Hnu = 0 ppm
					CL	1.5	α = 0 cpm
1.0	50468 1333 8-25	2	0 NR	No Recovery			βγ = 150-200 cpm
1.5	50469 1333 8-25	3	0 NR		NR.	NR.	
2.0	50470 1337 8-25	3	6	Stiff olive clay (5Y, 4/1) as above to gravel		1.5	Hnu = 0 ppm
2.5	50471 1337 8-25	4	6				α = 0 cpm
							βγ = 150-200 cpm
3.0	50472 1337 8-25	3	NR	No Recovery			
3.5	50473 1340 8-25	3	6	Stiff, very dark gray clay (5Y, 3/1) Damp-moist, good plasticity	CL	1.5	Hnu = 0 ppm
4.0	50474 1340 8-25	4	6				α = 0 cpm
							βγ = 200 cpm
4.5	50475 1340 8-25	7	NR	No Recovery (4.5 – 4.5)	NR	—	
5.0	50476 1347 8-25	9	6	Medium Dense, brownish-yellow sand (10 YR, 5/6) Dry-Damp (4.5 – 4.5)	SM	2.0	Hnu = 0 ppm
5.5	50477 1347 8-25	10	6	Stiff to very stiff, dark gray clay (5Y/3/1) Damp-Dry, good plasticity	CL		α = 0 cpm
							βγ = 200 cpm
6.0	50478 1347 8-25	10	NR	No Recovery	NR	—	
6.5	50479 1455 8-25	2	6	Stiff dark gray clay as above (5Y/3/1) Moist. good plasticity	CL	20	Hnu = 0 ppm
7.0	50480 1455 8-25	3	6				α = 0 cpm
					CL		βγ = 150-200 cpm
7.5	50481 1455 8-25	5	6				

NOTES: Contractor: Pennsylvania Drilling
Driller: Jim Succani
Driller's Assistant: Charlie Elkowitz
All samples collected according to ASTM standards. Soil colors described by Munsell Soil Color Charts.

NR = No Recovery

Background Readings/Levels
Hnu = 0 ppm.
Alpha (α) = 0 dpm
Gamma-Beta = 180-220 dpm.

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602.03.07	PROJECT NAME: FMPC RI/FS (Facility Testing)	
BORING NUMBER: 1359	COORDINATES:	DATE: 8-25
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 8-25-89
ENGINEER/GEOLOGIST: B. Damming	Depth Date/Time	DATE COMPLETED: 8-25-89
DRILLING METHODS: Hollow Stem Auger - Split Spoon Sampling		PAGE 2 OF 4

DEPTH	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER	RECOVERY	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8.0	S0482 1500 8-25	6	6	Stiff Dark Gray Clay As Above	CL	1.5	Hnu = 0 ppm α = 0 cpm βB = 100-150 d.p.m.
8.5	S0483 1500 8-25	7	6	Very Stiff, Olive Gray Clay (5Y, 5/2) good plasticity. Damp - Dry	CL	2.5	
9.0	S0484 1500 8-25	9	NR	No Recovery	NR	NR	
9.5	S0485 1503 8-25	8	6	Stiff Dark to Olive Gray Clay (5Y, 5/2) As Above 10.0 10.0'	CL	2.5	Hnu = 0 ppm α = 0 cpm βB = 100 d.p.m
10.0	S0486 1503 8-25	9	6				
10.5	S0487 1503 8-25	8	3	Loose, Yellowish-Brown very fine, silty, poorly graded sand (10 YR, 5/6) Moist	SM	N/A	
11.0	S0488 1530 8-25	2	6	Medium Dense, Yellowish Brown silty-clayey fine sand (10 YR, 5/6) WET	SC	N/A	Hnu = 0 ppm α = 0 cpm βB = 80-100 d.p.m.
11.5	S4815 1545 8-25	3	6				
12.0	S4816 1545 8-25	5	6				
12.5	S4817 1545 8-25	4	6	Same As Above Becoming Increasingly Clayey. WET		N/A	Hnu = 0 ppm α = 0 cpm βB = 80-100 d.p.m
13.0	S4818 1545 8-25	6	NR	No Recovery	NR		
13.5	S4819 1545 8-25	7	2"	8/25/89	SC		
14.0	S4880 1553 8-25	4	6	Medium Dense, Yellowish Brown (10 YR, 5/6) Clayey Sand. WET			Hnu = 0 ppm α = 0 cpm βB = 80-100 d.p.m.
14.5	S4881 1553 8-25	4	6	Soft - Very Soft Gray Clay (5Y, 5/1) Silty At the Top grading downwards into a very high plasticity clay Dry - Moist -	CL	.5	
15.0	S4882 1553 8-25	4	6				

Bottom of core

NOTES: Drilled To A Total Depth Of 15.0 Ft. Water Zone Encountered At ≈ 10.5 Ft. to 14.0 Ft.

Piezometer Installed.

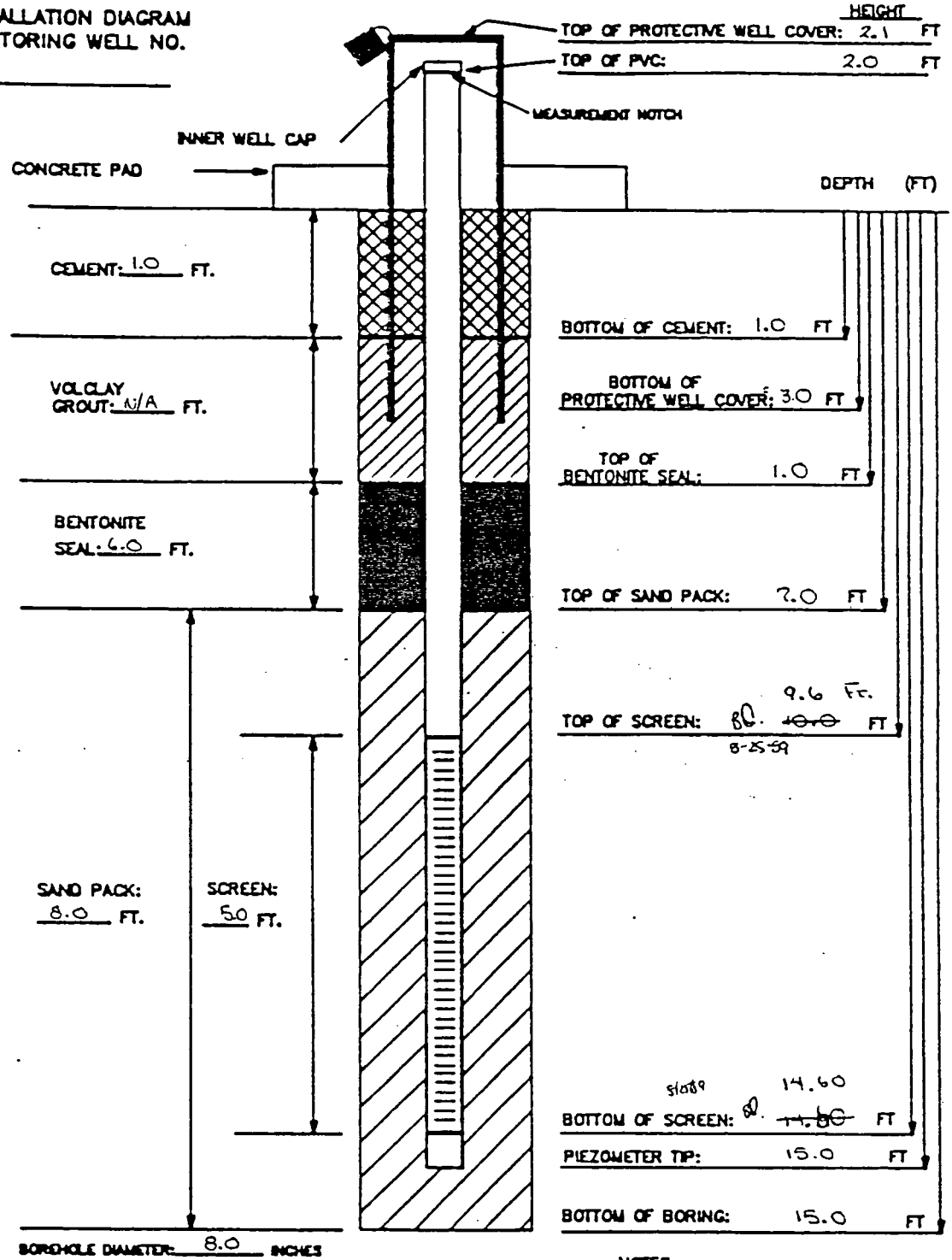
See Page 1

402-11-86

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. _____

INSTALLATION DATE: 8-25-89



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: 3-80 lb sks of 1020 Sand
BENTONITE PELLETS (5-GALLON BUCKETS): 2
BAGS OF VOLCLAY GROUT: None
AMOUNT OF CEMENT: 1/2 bag (94#)
AMOUNT OF WATER USED: 5 gallons
OTHER:

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE: N/A

TASK: 3.7.1

GEOLOGIST/ENGINEER: B. Dunning

FERNALD RI/FS

Date	9/1/89			
Initial				
	1st Check	2nd Check	3rd Check	4th Check

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1360	COORDINATES:	DATE: 8-27-89	
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 8-27-89
ENGINEER/GEOLOGIST: E. Trollinger	Depth	Date/Time	DATE COMPLETED: 8-27-89
DRILLING METHODS: MOBILE DRILL HSA 8 in			PAGE 1 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 in	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							LARGE (2 in) GRAVEL FILL ON SURFACE
1	50489 0912 8-27	11	6	MEDIUM DENSE, GRAY (10YR 4/1) WELL GRADED SANDY GRAVEL (.5-1.5 in), MOIST.	GW	N/A	Hnu = 0.6 ppm
	50490 0912 8-27	15	6	MEDIUM DENSE, BROWN (10YR 4/3) POORLY GRADED SAND, MOIST.	SP	N/A	α = 0 CPM βγ = 90 CPM
	50491 0912 8-27	10	0	NO RECOVERY			
2	50492 0917 8-27	10	6	MEDIUM DENSE, BROWN (10YR 4/3) POORLY GRADED SAND, TRACE OF FINE GRAVEL (.5 in.), MOIST.	SP	N/A	Hnu = 0.6 ppm α = 0 CPM βγ = 90-100 CPM
	50493 0917 8-27	6	6				
3	50494 0917 8-27	6	3				
	50495 0919 8-27	3	6		SP	N/A	Hnu = 0.6 ppm
4	50496 0919 8-27	3	4	STIFF, GRAYISH BROWN, (10YR 4/2) CLAY, MEDIUM PLASTICITY, MOIST.	CL	1.5	α = 0 CPM βγ = 100 CPM
	50497 0919 8-27	4	0	NO RECOVERY			
5	50498 0921 8-27	5	6	STIFF, GRAYISH BROWN, (10YR 4/2) SANDY CLAY, LOW PLASTICITY, MOIST.	CL	1.5	Hnu = 0.6 ppm
	50499 0921 8-27	5	0	NO RECOVERY			α = 0 CPM βγ = 90 CPM
6	50500 0921 8-27	4	0				
	50501 1025 8-27	3	6	STIFF, GRAY (10YR 4/1) CLAY, LOW PLASTICITY, MOIST.	CL	2.0	Hnu = 0.6 ppm
7	50502 1025 8-27	3	6				α = 0 CPM βγ = 90 cpm
	50503 1025 8-27	4	0	NO RECOVERY			

NOTES

DRILLING Co.:
DRILLER: Jim Saccani
HELPER: Charles Elkowitz

MATERIALS USED:
1½ BUCKETS BENTONITE (5 gals ea.)
3 BAGS 10/20 SAND (80 lb ea.)
½ bag CEMENT / 5 gals. WATER.

SAMPLING IN ACCORDANCE WITH ASTM STANDARDS, DESCRIPTION OF SOIL COLOR BY MUNSELL COLOR CHART. SAMPLES TAKEN FOR WMCO AT INTERVALS 0.0-.5 FT.; 2-2.5 FT., 5-5.5 FT, 10-10.5 FT., 15-15.5 FT

INSTRUMENT BACKGROUND
Hnu = 0.6 ppm
α = 0-10 CPM
βγ = 90-110 CPM
LEL = 0
O_2 = 20%

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS	
BORING NUMBER: 1360	COORDINATES:	DATE: 8-27-89
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 8-27-89
ENGINEER/GEOLOGIST: E. Trowinger	Depth Date/Time	DATE COMPLETED 8-27-89
DRILLING METHODS: Mobile Drill HSA		PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	50504 1028 8-27	7	6	STIFF, BROWNISH GRAY (10YR 4/2) SILTY CLAY OR CLAYEY SILT, TRACE OF COARSE SAND, NON COHESIVE, MOIST	CL-ML	1.5	Hnu = 0.6 ppm; α = 0 cpm; βγ = ~~[illegible]~~ 90 cpm
	50505 1028 8-27	8	6				
9	50506 1028 8-27	8	0	NO RECOVERY			
10 (WATER BEARING ZONE ~ FT.)	50507 1030 8-27	6	6	STIFF, BROWN (10YR 4/4) CLAYEY SILT, WET TO VERY MOIST.	ML	1.5	Hnu = 0.6 ppm; α = 0 cpm; βγ = 80-90 cpm
	50508 1030 8-27	5	6				
	50509 1030 8-27	7	0	NO RECOVERY			
11	50510 1036 8-27	4	6	SOFT, GRAYISH BROWN (10YR 4/2) CLAY, TRACE OF SILT, WET.	CL	.50	Hnu = 0.6 ppm; α = 0 cpm; βγ = 80 cpm
	54895 1036 8-27	9	6				
12	54896 1036 8-27	8	3	MEDIUM DENSE, GRAYISH BROWN (10YR 4/2) CLAYEY SILT, SOME SAND, NON COHESIVE, WET. ↓	ML	<.25	Hnu = 0.6 ppm; α = 0 cpm; βγ = 70 cpm
	54897 1040 8-27	3	6		ML	<.25	
13	54898 1040 8-27	9	6				
	54899 1040 8-27	12	0	NO RECOVERY			
14	54900 1044 8-27	10	6	MEDIUM DENSE, GRAY, (10YR 4/1) SILT, NON COHESIVE, WET	ML	N/A	Hnu = 0.6 ppm; α = 0 cpm; βγ = 100 cpm
	54901 1044 8-27	9	6				
	54902 1044 8-27	10	3	MEDIUM DENSE, (10YR 5/3) BROWN SILTY SAND, TRACE OF FINE GRAVEL WET	SM	N/A	

NOTES

DRILLER:
HELPER:

INSTRUMENT BACKGROUND
Hnu = 0.6 ppm
α = 0 cpm
βγ = 100 cpm

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1360	COORDINATES:		DATE: 8-27-89
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 8-27-89
ENGINEER/GEOLOGIST: E. TROLLINGER	Depth	Date/Time	DATE COMPLETED: 8-27-89
DRILLING METHODS: MOBILE DRILL HSA			PAGE 3 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 (IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15	54903 1407 8-27	2	6	LOOSE, BROWNISH GRAY (10YR 4/2) CLAYEY SAND, TRACE OF FINE GRAVEL (.5 in), WET.	SC	N/A	H_{nu} = 0.6 ppm
	54904 1407 8-27	5	6	STIFF, GRAY, (10YR 4/1) CLAY, MEDIUM PLASTICITY, MOIST.	CL	2.0	α = 0 CPM
16	54905 1407 8-27	7	4				$\beta\gamma$ = 100 CPM
17	54906			BOTTOM OF BORING AT 16.5 FT, AUGERS STOPPED AT 16.5, SAMPLING ENDED AT 16.5			H_{nu} = α = $\beta\gamma$ =
	54907						
	54908						
18							H_{nu} = α = $\beta\gamma$ =
19							
20							H_{nu} = α = $\beta\gamma$ =
				BOTTOM OF BORING. NOT TO EXCEED 20.0 FT FROM GROUND SURFACE			

NOTES

DRILLER: JIM SALLANI
HELPER: Charles Elkewite

INSTRUMENT BACKGROUND

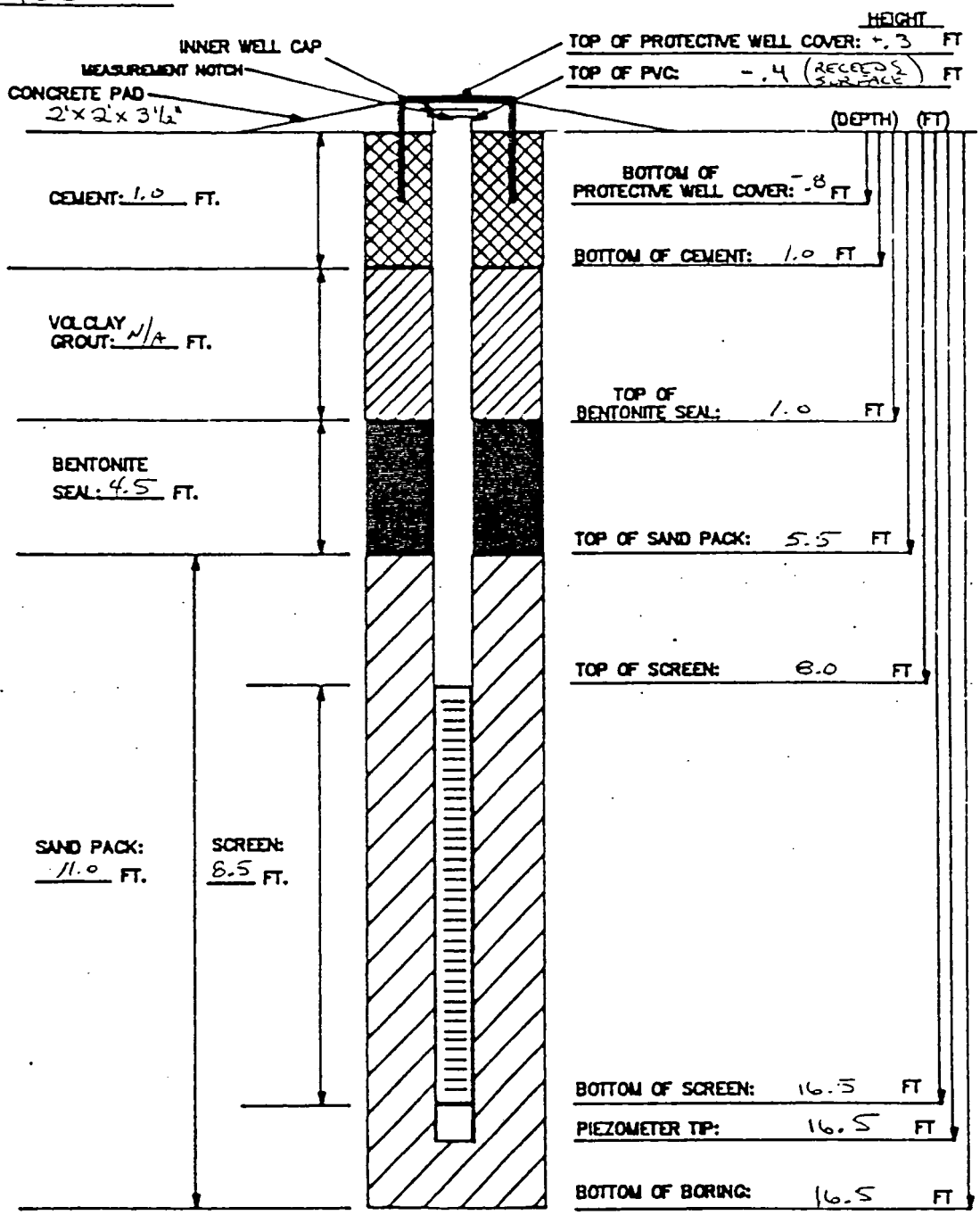
H_{nu} = 0.6 ppm
α = 0 CPM
$\beta\gamma$ = 100 CPM

000499

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1360

INSTALLATION DATE: 8-27-89



BOREHOLE DIAMETER: _____ INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 1020-3 bags
BENTONITE PELLETS (5-GALLON BUCKETS): 1.5
BAGS OF VOLCLAY GROUT: N/A
AMOUNT OF CEMENT: 1½ SACK (80 lb.)
AMOUNT OF WATER USED: 5 gals.
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 3.7.1

GEOLOGIST/ENGINEER: E. Trollinger

FERNALD RI/FS

Date	Initial	Date	Initial	Date	Initial
1/19/90	C.T.				

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS	
BORING NUMBER: 1420 Redrill (1191)	COORDINATES:	DATE: 1/18/90
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/18/90
ENGINEER/GEOLOGIST: C. Grube	Depth Date/Time	DATE COMPLETED: 1/20/90
DRILLING METHODS: AUGER (HOLLOW STEM)		PAGE 1 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	1-18	NA	6	Acid Brick & Cement	NA	NA	HNU = 0 ppm α = 0 cpm Bγ = 280-300 cpm
1	1-18		6	Cement	NA	NA	
	15517 1542 1-18	5	6	Stiff (2.5Y5/4) light olive brown silty clay, trace of sand & fine gravel, medium plasticity, very moist	CL	2.0	
2	15518 1542 1-18	7	6	Hard (5Y5/1) gray silty clay, trace of fine gravel, low plasticity, moist	CL	4.5	HNU = 0 ppm α = 0 cpm Bγ = 60-70 cpm
	15519 1542 1-18	8	0	NR	NA	NA	
3	15520 1542 1-18	13	0	NR	NA	NA	
	15521 1547 1-18	9	6	Very stiff (2.5Y4/4) olive brown silty clay, trace of sand & fine gravel, medium plasticity, moist	CL	2.25	HNU = 0 ppm α = 0 cpm Bγ = 80-90 cpm
4	15522 1547 1-18	13	6	Very stiff (5Y5/1) gray silty clay, trace of fine gravel, low plasticity, moist	CL	3.0	
	15523 1547 1-18	18	6	Hard. SAA Hard (5Y3/2) dark olive gray clay trace of silt, low plasticity moist	CL	>4.5	
5	15524 1553 1-18	13	6	Very stiff (5Y3/2) dark olive gray clay, trace of silt, low plasticity, moist	CL	3.0	HNU = 0 ppm α = 0 cpm Bγ = 80-90 cpm
	15525 1553 1-18	15	6	Stiff SAA	CL	1.75	
6	15526 1553 1-18	19	0	NR	NA	NA	
	15527 1608 1-18	3	6	Stiff (2.5Y4/2) dark grayish brown, clay trace of silt, medium plasticity moist	CL	1.0	HNU = 0 ppm α = 0 cpm Bγ = 90-100 cpm
7	15528 1608 1-18	4	6	SAA	CL	1.25	
	15529 1608 1-18	4	0	NR	NA	NA	

NOTES: CONTRACTOR: PENNDRILL
RIG: CME-45
DRILLER: Dave Newman
ASSISTANT: Bob Johnson
GeoAssistant: Ben Brier
H&S officer
HNU #1105 & 1104 on 1/19/90

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST
COLORS IDENTIFIED USING MUNSELL COLOR CHART
BACKGROUND LEVELS: HNU = 0 PPM (0 1/18/90)
α 10-40 CPM Bγ = 90-140 cpm w/ local bricks
Bγ : 1400-1600 CPM w/o local bricks
LEL = 0% (1/18/90)
O_2 : 20.6 %

SAA = Same As Above
NR = No Recovery

LELO$_2$:

000501

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1420	COORDINATES:		DATE: 1/18/90
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 1/18/90
ENGINEER/GEOLOGIST: C. Grube	Depth	Date/Time	DATE COMPLETED: 1/20/90
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 2 OF 5

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (IN.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8	15530 1612 1-18	6	6	Stiff (2.5Y 5/4) light olive-brown clay, trace of silt, low plasticity, moist	CL	1.25	HNU = 0 ppm α = 0-10 cpm Bγ = 100-120 cpm
	15531 1612 1-18	8	6	Very Stiff (2.5Y 5/4) light olive brown silty clay low plasticity, moist	CL	3.0	
9	15532 1612 1-18	10	2	SAA	CL	2.75	
	15533 1618 1-18	15	3	SAA	CL	2.0	HNU = 0 ppm α = 0 cpm Bγ = 90-100 cpm
10	15534 1618 1-18	15	0	NR	NA	NA	
	15535 1618 1-18	15	0	NR	NA	NA	
11	15536 1000 1-19	4	6	Medium Dense (2.5Y 5/4) light olive brown clayey silt, moist	ML	NA	HNU = 0 ppm α = 0 cpm Bγ = 100-110 cpm
	15537 1000 1-19	5	6	SAA plus very moist	ML	NA	
12	15538 1000 1-19	7	2	SAA plus very moist	ML	NA	
	51135 1007 1-19	7	6	Medium dense (6Y 5/4) olive clayey silt, some sand, wet	ML	NA	HNU = 0 ppm α = 0 cpm Bγ = 90-100 cpm
13	51136 1007 1-19	7	6	SAA	ML	NA	
	51137 1007 1-19	7	6	SAA	ML	NA	
14	51138 1015 1-19	13	6	SAA	ML	NA	HNU = 0 ppm α = 0 cpm Bγ = 100-110 cpm
	51139 1015 1-19	7	6	SAA Medium dense (10YR 4/6) dark yellowish brown silty sand traces of fine gravel, wet	ML SM	NA NA	
	51140 1015 1-19	13	6	SAA Medium dense (5Y 5/4) olive silty sand, trace of fine gravel, wet	SM SM	NA NA	

Top of water bearing zone at 11.0 FT

NOTES:

SAA = Same As Above

NR = No Recovery

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7	PROJECT NAME: FERNALD RI/FS		
BORING NUMBER: 1420	COORDINATES:		DATE: 1/19/90
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 1/18/90
ENGINEER/GEOLOGIST: C. Grube	Depth	Date/Time	DATE COMPLETED: 1/20/90
DRILLING METHODS: AUGER (HOLLOW STEM)			PAGE 3 OF 5

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S1141 1033 1-19	7	6	Dense (5Y 4/3) olive clayey to sandy silt, wet	ML	NA	HNU = 0 ppm α = 0 cpm Bβ = 100-120 cpm
16	S1142 1033 1-19	17	6	Dense (5Y 4/3) olive silt to silty sand, wet	ML to SM	NA	
	S1143 1033 1-19	21	5	Dense (2.5Y 4/4) olive brown well graded sand. Some fine to coarse gravel, wet	SW	NA	
17	S1144 1040 1-19	17	6	Dense (2.5Y 4/4) olive brown, poorly graded sand trace of fine gravel, wet	SP	NA	HNU = 0 ppm α = 0 cpm Bβ = 90-100 cpm
	S1145 1040 1-19	18	6	Dense (2.5Y 4/4) olive brown poorly to well graded sand, trace of fine to medium gravel, wet	SP to SW	NA	
18	S1146 1040 1-19	19	6	Dense (2.5Y 4/4) olive brown well to poorly graded sand trace of fine gravel, wet	SW to SP	NA	
	S1147 1050 1-19	7	6	Dense (2.5Y 4/4) olive brown poorly graded sand, trace of fine gravel, wet	SP	NA	HNU = 0 ppm α = 0 cpm Bβ = 80-90 cpm
19	S1148 1050 1-19	9	6	SAA	SP	NA	
	S1149 1050 1-19	18	6	SAA	SP	NA	
Bottom of borehole at 20.0 FT 20	S1150 1050 1-19	20	6	SAA	SP	NA	HNU = 0 ppm α = 0 cpm Bβ = 80-90 cpm
				Bottom of Boring sampling at 20.0 FT			

NOTES:

SAA = Same As Above
NR = No Recovery

000503

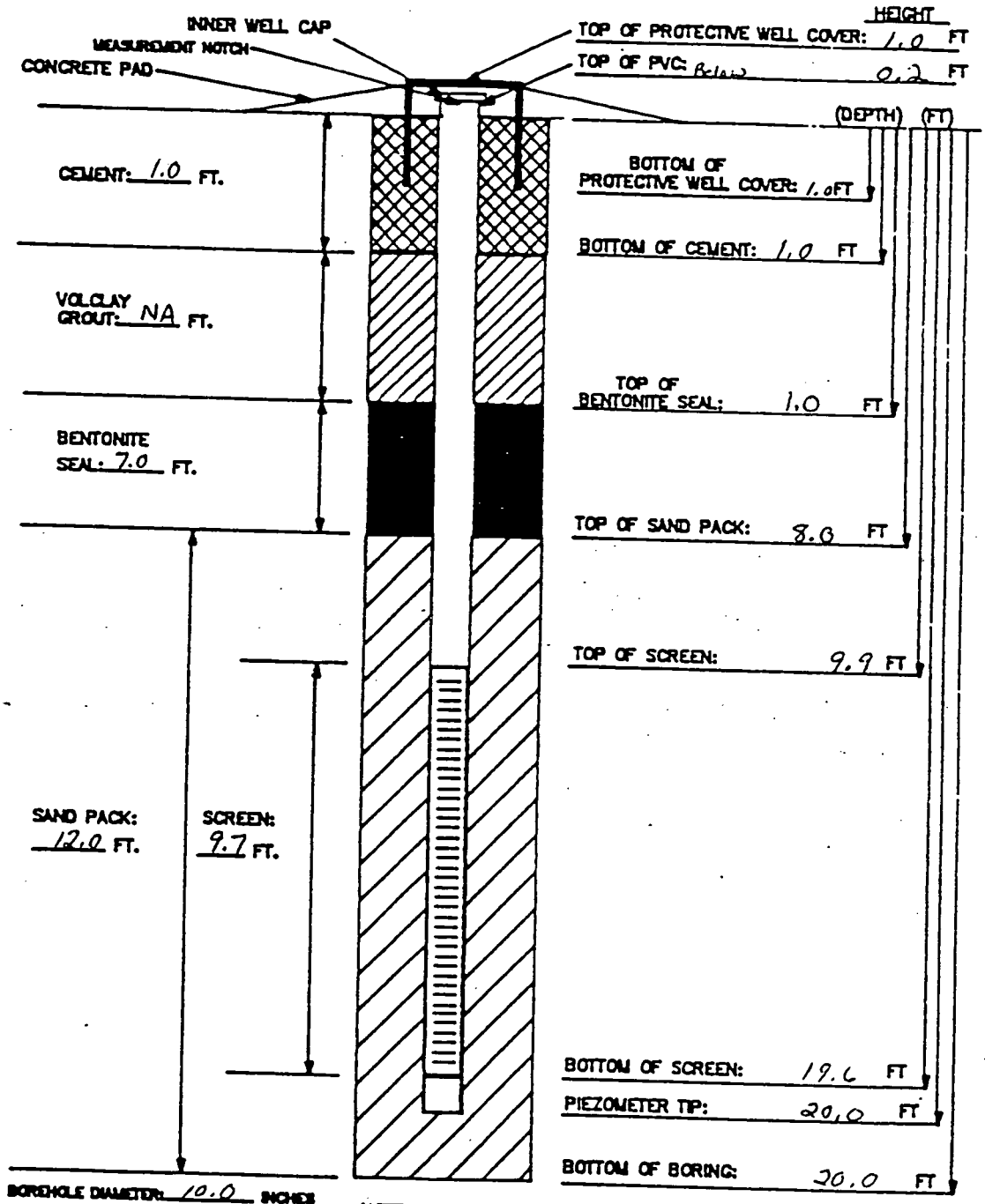
1507 4 of 5

FERNALD RI/FS

INSTALLATION DIAGRAM

MONITORING WELL NO. 1420

INSTALLATION DATE: 1/20/90



MATERIALS USED:

SAND TYPE AND QUANTITY: 10/20 Sand - 6 - 80# sks
BENTONITE PELLETS (5-GALLON BUCKETS): 5
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2 (94#) sk
AMOUNT OF WATER USED: 10 gal
OTHER: 1.0 FT Flush mount cover

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7

GEOLOGIST/ENGINEER: C. Grube

FERNALD RI/FS

Date	1-12			
Initial	NW3			
	Field Check	1st Rev Lev	2nd Rev Lev	Final Check Verification

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 602 3.7.5	PROJECT NAME FMPC RI/FS		
BORING NUMBER 1501	COORDINATES N. 482,775 / E. 1,378,000	DATE 1-11-90	
ELEVATION:	GWL: Depth / Date/Time	DATE STARTED: 1-11-90	
ENGINEER/GEOLOGIST E. Trollinger	Depth / Date/Time	DATE COMPLETED 1-16-90	
DRILLING METHODS Mobile 80		PAGE 1 OF 4	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER (/6 in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WATER CONDITION	REMARKS
1	15495 0920 1-11	6	6	FIRM, DARK BROWN (7.5YR 3/2) SILT, TRACE OF CLAY, ROOTS & GRASS TOP 6in, SLIGHTLY COHESIVE, MOIST.	ML	1.5		Hnu = 0.0 ppm α = 0 cpm βγ = 40 cpm
	15496 0920 1-11	6	6					
	15497 0920 1-11	5	4					
2	15498 0925 1-11	4	6	FIRM, GRAYISH BROWN (10YR 4/2) SILTY CLAY, TRACE OF COARSE SAND (.25in) ROUNDED, LOW PLASTICITY MOIST.	CL	2.0		Hnu = 0.2 ppm α = 0 cpm βγ = 60 cpm
	15499 0925 1-11	11	6					
3	15500 0925 1-11	13	0	NO RECOVERY				
4	15501 0928 1-11	12	6	FIRM, GRAYISH BROWN (10YR 4/3) CLAYEY SILT, TRACE OF GRAVEL (.5in), LOW PLASTICITY, DAMP.	ML	2.0		Hnu = 0.2 ppm α = 0 cpm βγ = 40-60 cpm
	15502 0928 1-11	17	6					
	15503 0928 1-11	12	3	MEDIUM DENSE, BROWN (10YR 4/2) SILTY SAND, TRACE OF GRAVEL (.5-1.0in), DRY TO DAMP. (Rounded)	SM	N/A		
5	15504 0935 1-11	22	6	↓	SM	N/A		Hnu = 0.2 ppm α = 0 cpm βγ = 40-50 cpm
	15505 0935 1-11	24	6					
6	15506 0935 1-11	16	0	NO RECOVERY				
7	15507 0945 1-11	15	6	HARD, GRAYISH BROWN (10YR 4/3) SILTY CLAY WITH FINE GRAVEL, LOW PLASTICITY, MOIST.	CL	3.5		Hnu = 0.2 ppm α = 0 cpm βγ = 40-60 cpm
	15508 0945 1-11	22	6					
	15509 0945 1-11	25	5	↓				

NOTES

Drilling Contractor: Penn Drill

Drilling Equipment: Mobile 80

Driller: Rob Yost

Brian Stramazzon

MATERIALS USED FOR COMPLETION:

1 BAG VOLCLAY GROUT

1/2 BAG CEMENT, 20 GALS WATER.

INSTRUMENT BACKGROUND

Hnu = 0.2-0.4 ppm

α = 0 cpm

βγ = 40-60 cpm

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 602 3.7.5	PROJECT NAME FMPC RI/FS		
BORING NUMBER 1501	COORDINATES	DATE 1-11-90	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1-11-90	
ENGINEER/GEOLOGIST E. Trollinger	Depth Date/Time	DATE COMPLETED 1-16-90	
DRILLING METHODS Mobile 80		PAGE 2 OF 4	

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER (6 in.)	RECOVERY (in.)	DESCRIPTION	USCS SYMBOL	MEASURED GROUNDWATER LEVEL	WELL CONSTRUCTION	REMARKS
8	15510 0950 1-11	19	6	VERY DENSE, INORGANIC SILT AND VERY FINE SAND, TRACE OF GRAVEL (.5-1.0 in) ROUNDED, DRY TO DAMP.	ML	N/A		Hnu = 0.2 ppm, α = 0 cpm, βγ = 40-50 cpm
	15511 0950 1-11	23	6					
9	15512 0950 1-11	30	3					
	15513 1000 1-11	17	6	HARD, GRAYISH BROWN (10YR 5/2) SILTY CLAY, TRACE OF FINE GRAVEL (.5-.75 in), LOW PLASTICITY, DAMP TO MOIST.	CL	3.5		Hnu = 0.2 ppm, α = 0 cpm, βγ = 60 cpm
	15514 1000 1-11	28	6					
10	15515 1000 1-11	23	6					
	15516 1015 1-11	8	6		CL	3.5		Hnu = 0.2 ppm, α = 0 cpm, βγ = 40 cpm
11	51115 1015 1-11	10	6					
	51116 1015 1-11	16	0	NO RECOVERY				
12	51117 1025 1-11	22	6	HARD, GRAY (10YR 5/1) CLAY, TRACE OF GRAVEL (.5-1.5 in), ROUNDED AND ANGULAR, LOW TO MEDIUM PLASTICITY, MOIST.	CL	3.5		Hnu = 0.2 ppm, α = 0 cpm, βγ = 40 cpm
	51118 1025 1-11	20	6					
13	51119 1025 1-11	23	6					
	51120 1035 1-11	23	6		CL	2.5		Hnu = 0.2 ppm, α = 0 cpm, βγ = 40 cpm
14	51121 1035 1-11	20	6					
	51122 1035 1-11	17	6					
15								

NOTES

Drilling Contractor: Penn Drill

Drilling Equipment: Mobile 80

Driller: Deb. Yost
Brian Sheppard

INSTRUMENT BACKGROUND

Hnu = 0.0-0.4 ppm
α = 0 cpm
βγ = 40-60 cpm

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 602 3.7.5	PROJECT NAME: FMPC RI/FS		
BORING NUMBER: 1501	COORDINATES:		DATE: 1-11-90
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 1-11-90
ENGINEER/GEOLOGIST: E. Trollinger	Depth	Date/Time	DATE COMPLETED: 1-16-90
DRILLING METHODS: Mobile B0			PAGE 3 OF 4

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 in.	RECOVERY (in.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (tsf)	WELL CONSTRUCTION	REMARKS
	51123 1055 1-11	4	6	FIRM, GRAY (10YR 5/1) CLAY, TRACE OF MEDIUM SAND AND FINE GRAVEL, LOW TO MEDIUM PLASTICITY, MOIST.	CL	2.0		Hnu = 0.2 ppm α = 0 cpm βγ = 40 cpm
	51124 1055 1-11	7	0	NO RECOVERY				
16	51125 1055 1-11	3	0					
	51126 1100 1-11	23	6	MEDIUM DENSE, GRAY (10YR 4/1) POORLY GRADED SAND, TRACE OF GRAVEL (.5-1.0 in), ROUNDED, WET.	SP	N/A		Hnu = 0.2 ppm α = 0 cpm βγ = 40 cpm
17	51127 1100 1-11	17	6					
	51128 1100 1-11	20	6	HARD, GRAY, (10YR 4/1) SILTY CLAY, TRACE OF FINE GRAVEL; LOW PLASTICITY, MOIST.	CL	3.0		
18	51129 1105 1-11	33	6	↓	CL	3.0		Hnu = 0.2 ppm α = 0 cpm βγ = 40 cpm
19	51130 1105 1-11	37	6					
	51131 1105 1-11	35	4					
20	51132 1105 1-11	32	0	NO RECOVERY				
				BOTTOM OF BORING @ 20.0 FT. SAMPLING ENDED @ 20.0 FT. P/A - VOLCLAY GROUT CAPPED W/ CEMENT PLUG.				

NOTES:

Drilling Contractor: Penn Drill

Drilling Equipment: Mobile B0

Driller: Rob Yost

Brian Stroyazzan

INSTRUMENT BACKGROUND

Hnu = 0.2-0.4 ppm

α = 0 cpm

βγ = 40-60 cpm

000507

FERNALD RI/FS

1507

GEOCHEM BORING
VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 602 3.7	PROJECT NAME FMPC RI/FS			
BORING NUMBER 1503	COORDINATES		DATE 7-1-90	
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED 7/1/90	
ENGINEER/GEOLOGIST J. MASON	Depth	Date/Time	DATE COMPLETED: 7/1/90	
DRILLING METHODS CME 45 AUGER			PAGE 1 OF 3	

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1	00688 7-1-90 1115	6	3	medium stiff 10yr 5/6 yellowish brown to brown gravelly clay	CL	1.0	Hnu = 0
	00689 7-1-90 1115	11	0	NR			α = 40 cpm
	00690 7-1-90 1115	8	0	NR			βγ = 250 cpm
2	00691 7-1-90 1120	6	4	SAA	CL	1.0	Hnu = 4 ppm
	00692 7-1-90 1120	5	0	NR			α = 40 cpm
	00693 7-1-90 1120	7	0	NR			βγ = 200 cpm
3	00694 7-1-90 1123	5	6	stiff 10yr 5/6 yellowish brown gravelly silty clay, slightly moist	CL	1.5	Hnu = 0
	00695 7-1-90 1123	4					α = 100 cpm
4	00696 7-1-90 1123	6					βγ = 250 cpm
5	00697 7-1-90 1125	5	6	loose 10yr 5/6 yellowish brown to brown sandy silty gravel, moist, poorly graded sand & gravel	GM	NA	Hnu = 4
	00698 7-1-90 1125	2	0	NR			α = 40-60 cpm
	00699 7-1-90 1125	4	0	NR			βγ = 250 cpm
6	00700 7-1-90 1144	3	6	SAA	GM	NA	Hnu = 0
	00701 7-1-90 1144	3	2	SAA	GM	NA	α = 0
7	00702 7-1-90 1144	2		NR			βγ = 150

NOTES: CONTRACTOR: PENNDRILL
DRILLER: BOB YOST
ASSISTANT: BRIAN STRAPAZZON

Hnu: B 221
α: ASI #6
βγ: ASI #11

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION
COLOR I.D. BY MUNSELL COLOR CHART
BACKGROUND LEVELS: Hnu: 4.5 ppm
α: 0
βγ: 250 cpm
(READINGS IN SPOON EXAMINATION AREA)

402-11-86

DRILL PALLET

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 602 3.7	PROJECT NAME FMPC RI/FS	
BORING NUMBER 1503	COORDINATES	DATE 7-1-90
ELEVATION	GWL: Depth Date/Time	DATE STARTED 7/1/90
ENGINEER/GEOLOGIST J. MASON	Depth Date/Time	DATE COMPLETED 7/1/90
DRILLING METHODS CME 45 AUGER		PAGE 3 OF 3

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	00718 7-1-90 1230	5	6	medium dense 10yr 4/3 brown to 10yr 5/6 yellowish brown poorly graded sand, some silt, wet	SP	NA	Hnu = 4 ∝ = 0 βγ = 200 cpm
(16)	00719 7-1-90 1230	6	2	SAA			
	00720 7-1-90 1230	9	0	NR			
	00730 7-1-90 1240	12	6	SAA except trace silt, some gravel	SP		Hnu = 4 ∝ = 0 βγ = 200 cpm
(17)	00731 7-1-90 1240	24	6	SAA except trace of silt, some gravel	SP		
	00732 7-1-90 1240	25	0	NR			
(18)	00733 7-1-90 1250	9	6	dense 10yr 3/3 dark brown poorly graded sand; some gravel, and in some sections gravelly - Wet.	SP	NA	Hnu = 4 ppm ∝ = 0 cpm βγ = 100 cpm
	00734 7-1-90 1250	12	6	SAA			
(19)	00735 7-1-90 1250	18	6	SAA			
	00736 7-1-90 1250	20	6	SAA			Hnu = ∝ = βγ =
(20)				BORING/SAMPLING STOPPED @ 20 FT. HOLE PLUGGED WITH BENTONITE CLAY AND CAPPED WITH CEMENT.			
				~~NO WATER ENCOUNTERED~~ E.T. 7-2-90			Hnu = ∝ = βγ =

NOTES: CONTRACTOR: PENNDRILL
DRILLER: BOB YOST
ASSISTANT: BRIAN STRAPAZZON

Hnu: B 221
∝: AS1 #6
βγ: AS1 #11

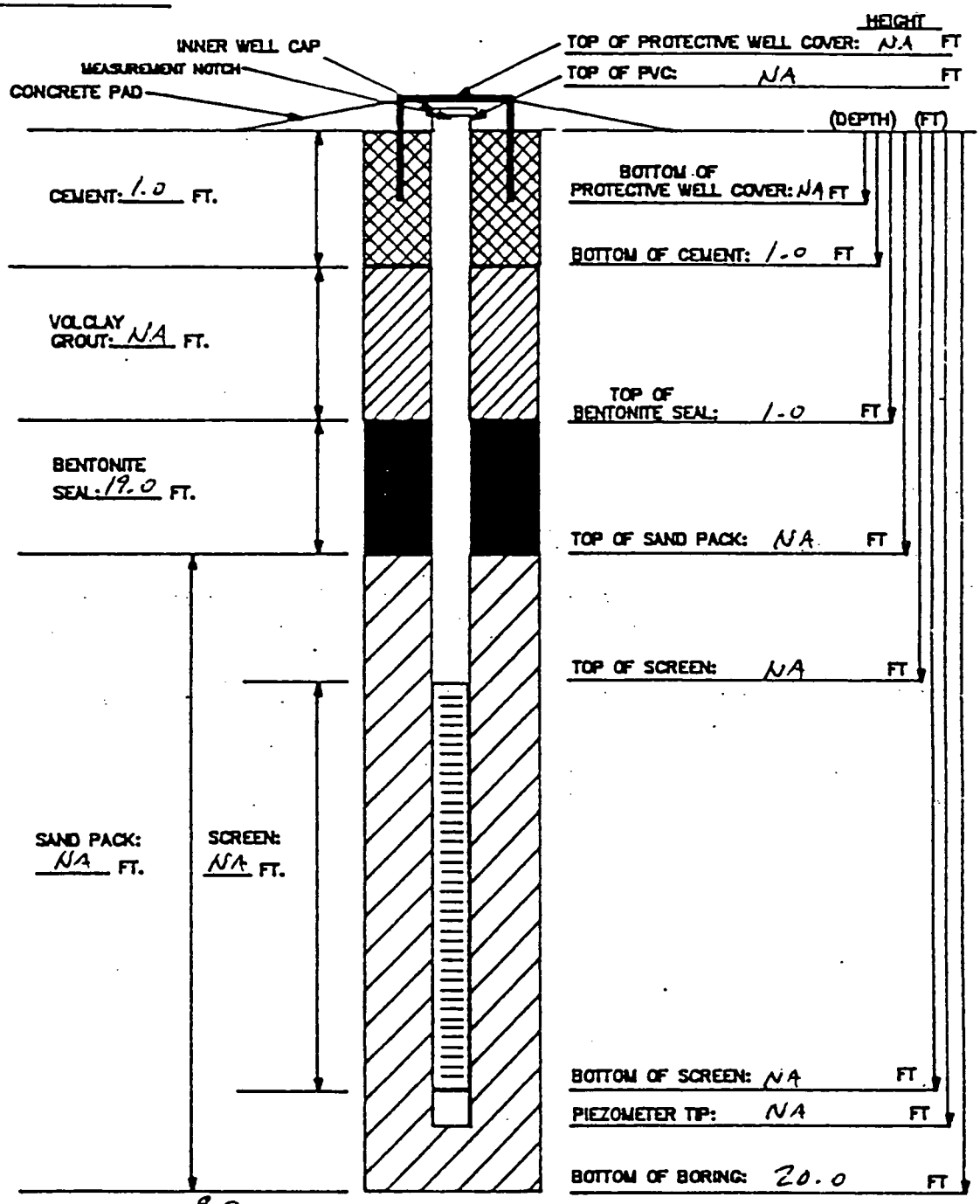
SAMPLES COLLECTED PER ASTM STANDARD PENETRATION
COLOR I.D. BY MUNSELL COLOR CHART
BACKGROUND LEVELS: Hnu: 4 ppm
∝: 5 cpm
βγ: 300 cpm

402-11-46

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO.
1503

INSTALLATION DATE: 7-2-90



BOREHOLE DIAMETER: 8.0 INCHES

MATERIALS USED:

SAND TYPE AND QUANTITY: NA
BENTONITE PELLETS (5-GALLON BUCKETS): 3
BAGS OF VOLCLAY GROUT: NA
AMOUNT OF CEMENT: 1/2 BAG
AMOUNT OF WATER USED: 5 GAL
OTHER: NA

NOTES:

1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE:
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESIS INDICATE DEPTH BELOW GROUND LEVEL.

TASK: 602 3.7 GEOLOGIST/ENGINEER: J. MASON

VISUAL CLASSIFICATION OF SOILS

TEST WELL

PROJECT NUMBER: 50.03.24	PROJECT NAME: Glacial Till Vadose Zone Hydraulic Invest.	
BORING NUMBER: ~~1339~~ 11112	COORDINATES:	DATE 9/20/93
ELEVATION:	GWL: Depth Date/Time	DATE STARTED 9/20/93
ENGINEER/GEOLOGIST: D. O'Brien	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
		NA	NA	Cement	NA	NA	Mt= 0 ppm Bk= 300 cpm
		NA	NA	Cement	NA	NA	Mt= 0 ppm Bk= 300 cpm
1	1348 30920 1339-1	5	6	V. Stiff. 2.5Y(6/6) olive yellow sandy, gravelly clay, no plasticity, wet	CL	2.5	Mt= 3.0 ppm Bk= 250 cpm
		8	0	No Recovery	NA	NA	Mt= NA Bk= NA
2		3	0	No Recovery	NA	NA	Mt= NA Bk= NA
	1350	3	0	No Recovery	NA	NA	Mt= NA Bk= NA Tried again twice
3		1	0	No Recovery	NA	NA	Mt= NA Bk= NA
		1	0	No Recovery	NA	NA	Mt= NA Bk= NA
4	1355 30920 1339-2	1	4	V. Loose. 2.5Y(5/6) olive brown fine sand, poorly graded, wet	SP	NA	Mt= 2.0 ppm Bk= 350 cpm
		1	0	No Recovery	NA	NA	Mt= NA Bk= NA

NOTES

Drilling Contractor: Pennsylvania Drilling

Drilling Equipment: ~~Alaskaster~~ Mobil B50

Driller: Bobby Lost ~~Bob Ford Walter~~ Bob Erickson

Samples collected per ASTM standard penetration test

Colors identified using Munsell Color Chart

SAA - same as above
NA - not applicable

Bkgd: Mt = 0 ppm
Bk = 300-350 cpm

673 1746

VISUAL CLASSIFICATION OF SOILS

1507

PROJECT NUMBER: 50.03.24	PROJECT NAME: Glacial Till \ Vadose Zone Hydraulic Invest.	
BORING NUMBER: ~~1339~~ 11112	COORDINATES:	DATE: 9/20/93
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 9/20/93
ENGINEER/GEOLOGIST: D. O'Brien	Depth Date/Time	DATE COMPLETED:
DRILLING METHODS: Hollow Stem Auger		PAGE 2 OF

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 1 (FT)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
		1	0	No Recovery	NA	NA	Mt= NA Bk= NA
6	1400 3990 1339-2	1	5	V. Loose 2.5Y(5/6) Lt. olive brown fine to coarse sand w/ gravel well graded, wet	SW	NA	Mt= 0 ppm Bk= 350 cpm
		1	0	No Recovery	NA	NA	Mt= NA Bk= NA
7		1	0	No Recovery	NA	NA	Mt= NA Bk= NA
	1405 3990 1339-4	1	6	V. Loose. 2.5Y(5/6) Lt. olive brown fine to coarse sand w/ gravel well graded, wet	SW	NA	Mt= 0 ppm Bk= 300 cpm
8	1405 3990 1339-5	1	6	SAA	SW	NA	Mt= 0 ppm Bk= 300 cpm
	1405 3990 1339-6	2	6	SAA 9/20/93	SW	NA	Mt= 0 ppm Bk= 300 cpm
9	1410 3990 1339-7	2	6	~~SAA, coarse-med~~ Loose. 2.5Y(5/6) Lt olive brown coarse sand w/ gravel, well graded, wet	SW	NA	Mt= 0 ppm Bk= 300 cpm
	1410 3990 1339-8	3	6	SAA	SW	NA	Mt= 0 ppm Bk= 300 cpm
	1410 3990 1339-9	5	6	SAA	SW	NA	Mt= 0 ppm Bk= 300 cpm

NOTES

Drilling Contractor: Pennsylvania Drilling

Drilling Equipment: ~~Acker~~ Mobile B-53

Driller: Bobby Cost ~~Fred Phillips Bob Erickson~~ 9/20/93

Samples collected per ASTM standard penetration test

Colors identified using Munsell Color Chart

SAA - same as above
NA - not applicable

Bkgd: Mt = 0 ppm
Bk = 300-350 cpm

000512

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 50.03.24	PROJECT NAME: Glacial Till Vadose Zone Hydraulic Invest.		
BORING NUMBER: ~~1339~~ 11112	COORDINATES:		DATE: 9/20/93
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 9/20/93
ENGINEER/GEOLOGIST: D. O'Brien	Depth	Date/Time	DATE COMPLETED:
DRILLING METHODS: Hollow Stem Auger			PAGE 3 OF

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 (IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	1415 30920 1339-10	5	6	Med Dense. 2.5Y (5/6) Lt. olive brown coarse sand & gravel well graded. wet	SW	NA	Mt = 0 ppm Bk = 320 cpm
	1415 30920 1339-11	7	6	SAA	SW	NA	Mt = 0 ppm Bk = 320 cpm
11	1415 30920 1339-12	10	6	SAA	SW	NA	Mt = 0 ppm Bk = 320 cpm
	1425 30920 1339-13	4	6	SAA	SW	NA	Mt = 0 ppm Bk = 300 cpm
12	1425 30920 1339-14	2	6	SAA	SW	NA	Mt = 0 ppm Bk = 300 cpm
	1425 30920 1339-15	11	6	SAA	SW	NA	Mt = 0 ppm Bk = 300 cpm
13	1435 30920 1339-16	8	6	SAA	SW	NA	Mt = 0 ppm Bk = 300 cpm
	1435 30920 1339-17	8	6	SAA	SW	NA	Mt = 0 ppm Bk = 300 cpm
14	1435 30920 1339-18	10	6	V. Stiff. 2.5Y (5/1) Gray clay low plasticity moist	CL	~~NA~~ 2.5	Mt = 0 ppm Bk = 300 cpm
	0845 30921 1339-A	NA	Shelby 11	SAA	CL	2.0	Mt = 0 ppm Bk = 300 cpm

NOTES

Drilling Contractor: Pennsylvania Drilling DSO 9/20/93

Drilling Equipment: ~~Acker~~ Mobile B

Driller: Bobby Lost

~~Steve and Phillips Rob Erickson~~

Samples collected per ASTM standard penetration test.

Colors identified using Munsell Color Chart

SAA - same as above

NA - not applicable

Bkgd: Mt = 0 ppm
Bk = 300-350 cpm

VISUAL CLASSIFICATION OF SOILS

1507

PROJECT NUMBER: 50.03.24	PROJECT NAME: Glacial Till/Vadose Zone Hydraulic Invest.		
BORING NUMBER: ~~1339~~ 11112	COORDINATES:		DATE 9/21/93
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 9/20/93
ENGINEER/GEOLOGIST: D. O'Brien	Depth	Date/Time	DATE COMPLETED:
DRILLING METHODS: Hollow Stem Auger			PAGE 4 OF

DEPTH (ft)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 (in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
		NA	6				Mt= Bk=
		NA	3	V. Stiff 2.5Y(5/1) Gray gravelly clay, low plasticity, moist	cl	2.8	Mt= Bk=
16		NA	0	No Recovery	NA	NA	Mt= Bk=
		NA	0	No Recovery	NA	NA	Mt= Bk=
17	0915 30921-1339-20	NA	17	V. Stiff 2.5Y(5/1) Gray gravelly clay, low plasticity, moist	cl	2.5	Mt= 0ppm Bk= 300cpm
		NA					Mt= Bk=
18		NA					Mt= Bk=
		NA					Mt= Bk=
19		NA		V. Stiff. 2.5Y(5/1) Gray gravelly clay, low plasticity, moist	cl	2.8	Mt= 0ppm Bk= 300cpm
							Mt= Bk=

NOTES

Drilling Contractor: Pennsylvania Drilling

Drilling Equipment: ~~DSS Acker~~ Mobile B

Driller: 9/21 Bobby Lost

~~Geo Drillers~~ Bob Erickson

Samples collected per ASTM standard penetration test

Colors identified using Munsell Color Chart

SA - same as above
NA - not applicable

Bkgd: Mt = 0 ppm
Bk = 300-350 cpm

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 50.03.24	PROJECT NAME: Glacial Till/Vadose Zone Hydraulic Invest.	
BORING NUMBER: 11115	COORDINATES:	DATE 9/15/93
ELEVATION:	GWL: Depth 6.0 ft Date/Time 9/17/93 1340	DATE STARTED: 9/18/93
ENGINEER/GEOLOGIST: D. O'Brien	Depth Date/Time	DATE COMPLETED: 9/11/93
DRILLING METHODS: Hollow Stem Auger		PAGE 1 OF 7

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 1 (IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
		NA	NA	Cement	NA	NA	Mt= 0 ppm Bk= 350 cpm
		NA	NA	Cement	NA	NA	Mt= 0 ppm Bk= 300 cpm
1	1425 30915-11115-1	5	6	V. Stiff. 2.5Y(8/4) Lt. olive brown silty clay w/gravel, no plasticity, dry	Cl	2.0	Mt= 472 ppm Bk= 300 cpm
2	1425 30915A 11115-2	21	6	SAA ~~Dense. 2.5Y(5/4) Lt. olive brown, med to coarse sand w/gravel, poorly graded, moist~~	Cl / SP	2.0 / NA	Mt= 472 ppm Bk= 300 cpm
	1425 30915-11115-3	18	3	~~Dense. 2.5Y(5/4) Lt olive brown med to coarse sand w/gravel poorly graded, moist~~	SP	NA	Mt= 472 ppm Bk= 300 cpm
3	1430 30915A 11115-4	21	6	SAA, ~~Med. Dense~~	SP	NA	Mt= 14 ppm Bk= 300 cpm
	1430 30915A 11115-5	18	5	SAA	SP	NA	Mt= 14 ppm Bk= 300 cpm
		12	0	No Recovery	NA	NA	Mt= NA Bk= NA
4	1435 30915-11115-6	21	6	~~Med. Dense. 2.5Y(5/4) Lt olive brown med to fine sand w/gravel well graded, wet~~	SW	NA	Mt= 135 ppm Bk= 320 cpm
		18	0	No Recovery	NA	NA	Mt= NA Bk= NA

PRELIMINARY

NOTES

Drilling Contractor: Pennsylvania Drilling

Drilling Equipment: Acker

Driller: Bobby Lost

Helper: Fred Phillips

Samples collected per ASTM standard penetration test

Colors identified using Munsell Color Chart

SAA - same as above
NA - not applicable

Bkgd: Mt = 0 ppm
Bk = 300-350 cpm

RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 50.03.24	PROJECT NAME: Glacial Till Vadose Zone Hydraulic Invest.	
BORING NUMBER: 11115	COORDINATES:	DATE 9/15/93
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 9/15/93
ENGINEER/GEOLOGIST: D. O'Brien	Depth Date/Time	DATE COMPLETED: 9/16/93
DRILLING METHODS: Hollow Stem Auger		PAGE 2 OF 7

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6")	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
		12	0	No Recovery	NA	NA	Mt= NA Bk= NA
6	1440 309B 11115-7	14	6	Med. Dense. 2.5Y(5/4) Lt olive brown medium sand w/ gravel, poorly graded, wet	SP	NA	Mt= 0 ppm Bk= 300 cpm
	1440 309B A 11115-8	9	5	SAA	SP	NA	Mt= 0 ppm Bk= 300 cpm
		12	0	No Recovery	NA	NA	Mt= NA Bk= NA
7	1450 309B 11115-9	18	6	Med Dense. 2.5Y(5/4) Lt. olive brown coarse sand, poorly graded, wet.	SP	NA	Mt= 0 ppm Bk= 300 cpm
	1450 309B A 11115-10	12	6	SAA	SP	NA	Mt= 0 ppm Bk= 300 cpm
8	1450 309B 11115-11	12	6	Med. Dense. 2.5Y(5/4) Lt olive brown sandy gravel, well graded wet	GW	NA	Mt= 0 ppm Bk= 300 cpm
	1455 309B 11115-12	12	6	Med. Dense. 2.5Y(5/4) Lt. olive brown coarse sand w/ gravel, well graded, wet.	SW	NA	Mt= 0 ppm Bk= 300 cpm
9	1455 309B A 11115-13	9	6	SAA	SW	NA	Mt= 0 ppm Bk= 300 cpm
	1455 309B A 11115-14	14	6	SAA	SW	NA	Mt= 0 ppm Bk= 300 cpm

NOTES

Drilling Contractor: Pennsylvania Drilling

Drilling Equipment: Acker

Driller: Bobby Lost, Fred Phillips

Samples collected per ASTM standard penetration test

Colors identified using Munsell Color Chart

SAA - same as above
NA - not applicable

Bkgd: Mt= 0 ppm
Bk= 300-350 cpm

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 50.03.24	PROJECT NAME: Glacial Till/Vadose Zone Hydraulic Invest.	
BORING NUMBER: 1111B	COORDINATES:	DATE 9/15/93
ELEVATION:	GWL: Depth Date/Time	DATE STARTED 9/15/93
ENGINEER/GEOLOGIST: D. O'Brien	Depth Date/Time	DATE COMPLETED: 9/16/93
DRILLING METHODS: Hollow Stem Auger		PAGE # 3 OF 7

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 INCHES	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	1515 309B5A 1111B-18	11	6	Med. Dense. 2.5Y(5/4) Lt olive brown coarse sand & gravel, poorly graded, wet	SP	NA	Mt= 0ppm Bg= 300cpm
		9	0	No Recovery	NA	NA	Mt= NA Bg= NA
11		11	0	No Recovery	NA	NA	Mt= NA Bg= NA
	1520 309B5A 1111B-16	9	6	Med. Dense 2.5Y(5/4) Lt. olive brown coarse sand & gravel poorly graded, wet.	SP	NA	Mt= 0ppm Bg= 300cpm
12	1520 309B5A 1111B-17	9	6	SAA	SP	NA	Mt= 0ppm Bg= 300cpm
	1520 309B5A 1111B-18	13	6	SAA	SP	NA	Mt= 0ppm Bg= 300cpm
13	1540 309B5A 1111B-19	15	6	Med Dense. 2.5Y(5/4) Lt. olive brown med to fine sand w/gravel poorly graded, wet	SP	NA	Mt= 0ppm Bg= 300cpm
	1540 309B5A 1111B-20	8	6	SAA	SP	NA	Mt= 0ppm Bg= 300cpm
14	1540 309B5A 1111B-21	11	6	SAA ~~DED 9/15/93~~	SP	NA	Mt= 0ppm Bg= 300cpm
	1550 309B5A 1111B-22	6	6	SAA, ~~wet~~	SP	NA	Mt= 0ppm Bg= 300cpm

NOTES

Drilling Contractor: Pennsylvania Drilling

Drilling Equipment: Acker

Driller: Bobby Lost

Fred Phillips

Samples collected per ASTM standard penetration test

Colors identified using Munsell Color Chart

SAA - same as above

NA - not applicable

Bkgd: Mt= 0ppm Bg= 300-350cpm

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 50.03.24	PROJECT NAME: Glacial Till/Vadose Zone Hydraulic Invest.	
BORING NUMBER: 1111B	COORDINATES:	DATE 9/13/93
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 9/13/93
ENGINEER/GEOLOGIST: D. O'Brien	Depth Date/Time	DATE COMPLETED: 9/16/93
DRILLING METHODS: Hollow Stem Auger		PAGE 4 OF 7

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 INCHES	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	1630 309113A 1111B-23	9	6	Mod. Dense 2.5Y(5/4) Lt. olive brown med to fine sand w/ gravel, poorly graded, wet	SP	NA	Mt= 0 ppm Bk= 300 cpm
	1630 309113A 1111B-24	10	6	SAA	SP	NA	Mt= 0 ppm Bk= 300 cpm
16	1645 309113A 1111B-25	2	6	SAA	SP	NA	Mt= 0 ppm Bk= 300 cpm
	1645 309113A 1111B-26	8	6	SAA	SP	NA	Mt= 0 ppm Bk= 300 cpm
17	1645 309113A 1111B-27	11	6	V. Stiff. 2.5Y(5/1) Gray silty clay w/ trace gravel, low plasticity moist	CL	2.0	Mt= 0 ppm Bk= 300 cpm
	1655 309113A 1111B-28	4	6	SAA	CL	2.5	Mt= 0 ppm Bk= 300 cpm
18	1655 309113A 1111B-29	6	6	SAA	CL	2.0	Mt= 0 ppm Bk= 300 cpm
	1655 309113A 1111B-30	9	6	SAA	CL	2.0	Mt= 0 ppm Bk= 300 cpm
19	1705 309113A 1111B-31	6	6	SAA	CL	2.5	Mt= 0 ppm Bk= 300 cpm
	1705 309113A 1111B-32	13	6	SAA	CL	2.5	Mt= 0 ppm Bk= 300 cpm

NOTES

Drilling Contractor: Pennsylvania Drilling

Drilling Equipment: Acker

Driller: Bobby Lost

Fred Phillips

Samples collected per ASTM standard penetration test

Colors identified using Munsell Color Chart

SAA - same as above

NA - not applicable

Bkgd: Mt= 0 ppm Bk= 300-350 cpm

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 50.03.24	PROJECT NAME: Glacial Till Vadose Zone Hydraulic Invest.		
BORING NUMBER: 1111K	COORDINATES:	DATE 9/13/93	
ELEVATION:	GWL: Depth Date/Time	DATE STARTED 9/13/93	
ENGINEER/GEOLOGIST: D. O'Brien	Depth Date/Time	DATE COMPLETED: 9/13/93	
DRILLING METHODS: Hollow Stem Auger		PAGE K OF 7	

DEPTH (ft)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 1 (in)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
		11	0	No Recovery	N/A	NA	Mt= N/A Bk= N/A
				Boring terminated at 20.5ft			Mt= Bk=
50.00 1bgs 21							Mt= Bk=
							Mt= Bk=
							Mt= Bk=
							Mt= Bk=
							Mt= Bk=
							Mt= Bk=
							Mt= Bk=
							Mt= Bk=

NOTES

Drilling Contractor: Pennsylvania Drilling

Drilling Equipment: Acker

Driller: Bobby Lost, Fred Phillips

Samples collected per ASTM standard penetration test

Colors identified using Munsell Color Chart

SAM - same as above
NA - not applicable

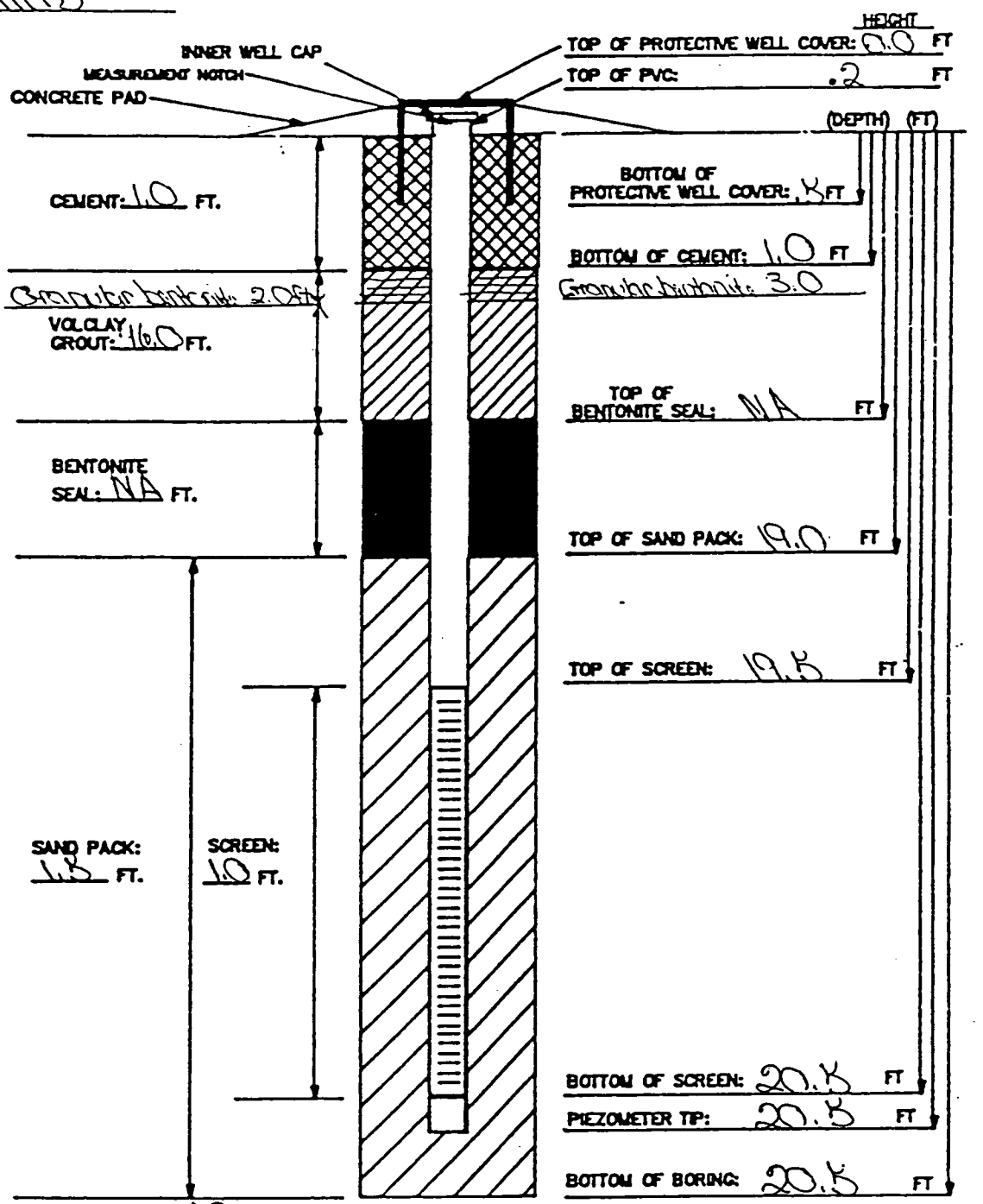
Bkgd: Mt = 0 ppm
Bk = 300-350 cpm

1507 6047

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1113

INSTALLATION DATE: 9/16/93



MATERIALS USED:
SAND TYPE AND QUANTITY: #7, 1 bag
BENTONITE PELLETS (5-GALLON BUCKETS): NA
BAGS OF VOLCLAY GROUT: 2 bag
AMOUNT OF CEMENT: 1 bag
AMOUNT OF WATER USED: 15 gal
OTHER: 1 bag granular bentonite

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE: 6.04 9/17/93
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

1 soil drum

TASK: 30.03.24 GEOLOGIST/ENGINEER: D. O'Brien

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 50.03.24	PROJECT NAME CRUS/PHASE II PACKER N-1		
BORING NUMBER 11134	COORDINATES	DATE 05 SEP 93	
ELEVATION	GWL. Depth Date/Time	DATE STARTED 05 SEP 93	
ENGINEER/GEOLOGIST B.E. MILLER	Depth Date/Time	DATE COMPLETED 14 SEP 93	
DRILLING METHODS HOLLOW STEM AUGER/SPIN CASING		PAGE 1 OF 8	

PRELIMINARY

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	05 SEP 30909 A11134 01	7	6	HARD (2.5Y, 5/4) LIGHT OLIVE BROWN, SILTY CLAY, ORGANICS, TRACE SAND, LOW PLASTICITY, SLIGHTLY MOIST	CL	>4.5	MT: 0 BY: 60
		10	0	NR	–	–	
1	~~30909 A11134 02~~ ~~30909 A11134 03~~ BGN 29 SEP 93						
	0840	10	0	NR	–	–	TIME: 0840
	05 SEP 30909 A11134 ~~01~~ 02	10	6	VERY STIFF (2.5Y, 4/3) OLIVE BROWN SILTY CLAY, TRACE SAND, LOW PLASTICITY, SLIGHTLY MOIST	CL	3.5	MT: 0 BY: 60
2	29 SEP 93 BGN						
		12	0	NR	–	–	
	~~30909 A11134 05~~ ~~30909 A11134 06~~						
	0843	13	0	NR	–	–	TIME: 0843
3	05 SEP 30909 A11134 03	13	3	VERY STIFF (2.5Y, 5/1) GRAY, SILTY CLAY, TRACE BLACK ORGANICS, MEDIUM PLASTICITY, MOIST	CL	2.25	MT: 0 BY: 60
		12	0	NR	–	–	
4		14	0	NR	–	–	TIME 0846
	0846 05 SEP 30909 A11134 04	13	6	VERY STIFF (2.5Y, 4/4) OLIVE BROWN, SILTY CLAY, TRACE ORGANICS, MEDIUM PLASTICITY, MOIST	CL	2.75	MT: 0 BY: 60
5	30909 A11134 05	13	6	SAA	CL	2.25	
	30909 A11134 06	17	2	SAA	CL	1.5	TIME: 1005
	1005						

NOTES

DRILLING FIRM: FERN DRILL
DRILLERS: JIM SALLANI, DALE NELSON
RIG: MOBIL B80
DESCRIPTION BASED ON MUNSELL

UNITS MEASURED:
MICROTIP = PPM
BY = CPM
α = CPM

BACKGROUND READINGS:
MICROTIP: 0 PPM
BY: 60-80 CPM
α: — CPM

NO RECOVERY (NR)
SAME AS ABOVE (SAA)

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 50.03.24	PROJECT NAME OU5 / PHASE II PACKER N-1	
BORING NUMBER 11134	COORDINATES	DATE 05/10 SEP 93
ELEVATION	GWL. Depth Date/Time	DATE STARTED 05 SEP 93
ENGINEER/GEOLOGIST R.F. MULLER	Depth Date/Time	DATE COMPLETED 14 SEP 93
DRILLING METHODS HOLLOW STEM AUGER / SPUN CASING		PAGE 2 OF 8

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	05SEP	10	0	NR	—	—	MT: — BY: —
		10	0	NR	—	—	
7		12	0/0	NR	—	—	TIME: 1014
	1014 05SEP	NONE REPORTED	0	NR	—	—	MT: — BY: —
8		NONE REPORTED	0	NR	—	—	TIME: 1020
	1020 05SEP 30909	A11134 7	07 6	VERY STIFF (2.5Y, 5/4) LIGHT OLIVE BROWN, SILTY CLAY, TRACE SAND, ORANGE MOTTLES, MEDIUM PLASTICITY, MOIST	CL	2.75	TIME: 1028
9	1028 05SEP 30909	7 A11134	2 08	SAA - TRACE FINE GRAVEL	CL	2.25	MT: 0 BY: 60
		9	0	NR	—	—	
05SEP 10SEP 10	1028 10SEP 30910 29SEP93 0935	A11134 3	01 6	STIFF (2.5Y, 5/4) LIGHT OLIVE BROWN SILTY CLAY, TRACE SAND AND GRAVEL MEDIUM PLASTICITY, MOIST	CL	1.75	TIME 0935
	10SEP 30910	A11134 6	02 6	SAA	CL	1.75	MT: 0 BY: 30
11	30910 0935	A11134 9	03 6	SAA	CL	2.25	
				CONTINUED ON NEXT PAGE			TIME: N/A

NOTES

DRILLING FIRM: FRANN DRILL
DRILLERS: JIM SACCANI, DOUG NELSON
RIG: MOBIL B80
DESCRIPTION BASED ON MUNSELL

UNITS MEASURED.
MICROTIP = ppm
BY = CPM
α = CPM

BACKGROUND READINGS:
MICROTIP: 0 ppm
BY: 30 CPM
α: — CPM
NO RECOVERY (NR)
SAME AS ABOVE (SAA)

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 50.02.24	PROJECT NAME CRUE / PHASE II PACKER N-1		
BORING NUMBER 11134	COORDINATES	DATE 10 SEP 93	
ELEVATION	GWL. Depth Date/Time	DATE STARTED 09 SEP 93	
ENGINEER/GEOLOGIST M.E. MULLER	Depth Date/Time	DATE COMPLETED 14 SEP 93	
DRILLING METHODS HOLLOW STEM AUGER / SPIN CASING		PAGE 3 OF 8	

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
12	1050EP 30910 A11134	5	6 04	VERY STIFF (2.5Y 4/4) OLIVE BROWN, SILTY CLAY, TRACE GRAVEL, MEDIUM PLASTICITY, MOIST - SOME SANDY HORIZONS	CL	2.25	MT: 0 BY: 20-30
	30910 A11134	7	6 05	SAA	CL	3.25	
13	30910 A11134 1010	9	6 06 3	HARD (2.5Y 5/4) LIGHT OLIVE BROWN, SILTY CLAY, TRACE SAND, GRAVEL, MEDIUM PLASTICITY, MOIST - FINE WET SAND AT BOTTOM	CL	4.25	TIME: 1010
	1050EP 30910 A11134	9	6 07	MEDIUM DENSE (2.5Y 5/4) LIGHT OLIVE BROWN SAND, TRACE CLAY, POORLY GRADED, WET	SP	—	MT: 0 BY: 20-30
14	30910 A11134	9	6 08	SAA	SP	—	
	30910 A11134 1022	10	6 09 3	MEDIUM DENSE (2.5Y 5/4) LIGHT OLIVE BROWN, CLAYEY SILT, TRACE SAND, GRAVEL, MOIST	ML	—	
				SAA - WET SAND, GRAVEL AT BOTTOM	ML	—	TIME: 1022
15	1050EP 30910 A11134	7	6 10	STIFF (2.5Y 5/4) LIGHT OLIVE BROWN, SILTY CLAY, TRACE SAND, GRAVEL, MEDIUM PLASTICITY, MOIST	CL	1.25	MT: 0 BY: 60
	30910 A11134	9	6 11	SAA PLUS - 1-2 IN SAND AND GRAVEL SEAMS	CL	3.00	
16	30910 A11134 1317	9	6 12	VERY STIFF (2.5Y 3/2) GRAYISH BROWN, SANDY, SILTY CLAY, TRACE GRAVEL, ORANGE MOTTLES, MEDIUM PLASTICITY, MOIST	CL	3.25	TIME 1317
	1050EP 30910 A11134	7	6 13	STIFF (2.5Y 4/1) DARK GRAY SILTY CLAY, TRACE SAND, GRAVEL, MEDIUM PLASTICITY, MOIST, - SOME LAYERS INCREASED GRAVEL	CL	1.0	MT: 0 BY: 20-30
17	30910 A11134	8	6 14	SOFT (2.5Y 4/1) DARK GRAY, SILTY CLAY, TRACE SAND, GRAVEL, MEDIUM PLASTICITY, MOIST	CL	0.25	
	30910 A11134 1335	10	6 15	SAA	CL	2.25	TIME: 1335

NOTES

DRILLING FIRM: PENN DRILL

DRILLERS: JIM SACCAN, DOUG NELSON

RIG: MOBIL B80

DESCRIPTION BASED ON MUNSELL

UNITS MEASURED.
MICROTIP = PPM
BY = CPM
α = CPM

BACKGROUND READINGS:
MICROTIP: 0 PPM
BY: 40 CPM
α: — CPM

NO RECOVERY (NR)
SAME AS ABOVE (SAA)

000523

FERNALD
RI/FS

E-1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER SD.03.24	PROJECT NAME CLUS/PHASE II SD.03.24 PACKER A 1		
BORING NUMBER 11134	COORDINATES	DATE 10 SEP 93	
ELEVATION	GWL. Depth Date/Time	DATE STARTED 09 SEP 93	
ENGINEER/GEOLOGIST B. E. MULLER	Depth Date/Time	DATE COMPLETED 14 SEP 93	
DRILLING METHODS HOLLOW STEM AUGER / SPIN CASING		PAGE 4 OF 8	

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
18	10SEP 30910 A11134	7 16	6	SOFT (2.5Y 5/1) GRAY, SILTY CLAY TRACE SAND, GRAVEL, MEDIUM PLASTICITY, MOIST	CL	0.25	MT: 0 BY: 40
	30910 A11134	10 17	6	SAA	CL	1.0	
	30910 A11134	10 18	5	SAA PLUS TRACE MEDIUM GRAVEL	CL	3.5	TIME: 1350
19	1350 10SEP 30910 A11134	7 19	6	STIFF (5Y 4/1) DARK GRAY, SILTY CLAY, TRACE SAND, GRAVEL, MEDIUM PLASTICITY, MOIST	CL	1.25	MT: 0 BY: 20
20	30910 A11134	7 20	3	SAA	CL	3.75	
	1405	7	0	NR	—	—	TIME: 1405
21	10SEP 30910 A11134	7 21	6	VERY STIFF (2.5Y 4/1) DARK GRAY, SILTY CLAY, TRACE SAND, GRAVEL, COBBLES, MEDIUM PLASTICITY, MOIST - SOME HORIZONS OF INCREASED SILT	CL	3.0	MT: 0 BY: 40
		8	0/0	NR	—	—	
22	1555	12	0/0	NR	—	—	TIME: 1555
	10SEP 1600	NOT REPORTED —	0	NR	—	—	MT: — BY: — TIME: 1600
23				CONTINUED ON NEXT PAGE			TIME: —

NOTES

DRILLING FIRM: VIRA DRILL
DRILLERS: JIM SALCANI, DOUG NELSON
RIG: MODEL B80
DESCRIPTION BASED ON MUNSELL

UNITS MEASURED.
MICROTIP = PPM
BY = CPM
α = CPM

BACKGROUND READINGS:
MICROTIP: 0 PPM
BY: 40 CPM
α: — CPM
NO RECOVERY (NR)
SAME AS ABOVE (SAA)

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER CRUS 50.03.24	PROJECT NAME CRUS/PNASET PACKER N-1		
BORING NUMBER 11134	COORDINATES		DATE 13SEP93
ELEVATION	GWL. Depth	Date/Time	DATE STARTED 09SEP93
ENGINEER/GEOLOGIST B.E. MULLER	Depth	Date/Time	DATE COMPLETED 14SEP93
DRILLING METHODS HOLLOW STEM AUGER			PAGE 5 OF 8

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
23	1350P	9	0	NR	—	—	MT: — BY: —
		10	0	NR	—	—	
24	1008	10	0	NR	—	—	TIME: 1008
	1350P 30513 A11134 01	9	3	SOFT (2.5Y, 4/1) DARK GRAY, SILTY CLAY, TRACE SAND, GRAVEL, MEDIUM PLASTICITY, MOIST	CL	0.25	MT: — BY: —
25		9	0	NR	—	—	
	1042	11	0/0	NR	—	—	TIME: 1042
26		NOT REPORTED	0	NR	—	—	MT: BY:
	~~1400P~~ 30914 A11134 01	2	6	STIFF (5Y, 4/1) DARK GRAY, SILTY CLAY, TRACE COARSE SAND, GRAVEL MEDIUM PLASTICITY, MOIST - INCREASED SILT FROM 4-5 IN	CL	1.25	
	30914 A11134 02	9	6	SAA	CL	1.0	0930 TIME: ~~1400~~
27	~~1400P~~ 30914 A11134 03 1100	15	5	SAA	CL	35	MT: 0 BY: 40
				CONTINUED ON NEXT PAGE			
28							TIME:

NOTES

DRILLING FIRM: PENN DRILL
DRILLERS: JIM SACCON, JOE RAABE
RIG: MOBIL B80
DESCRIPTION BASED ON MUNSELL

UNITS MEASURED.
MICROTIP = PPM
BY = CPM
α = CPM

BACKGROUND READINGS:
MICROTIP: 0 PPM
BY: 40 CPM
α: — CPM

NO RECOVERY (NR)
SAME AS ABOVE (SAA)

FERNALD
RI/FS

E- 1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER 50.03.24	PROJECT NAME CRUS/PHASE II PACKER N-1		
BORING NUMBER 111341	COORDINATES		DATE 14SEP93
ELEVATION	GWL. Depth	Date/Time	DATE STARTED 09SEP93
ENGINEER/GEOLOGIST B. E. MULLER	Depth	Date/Time	DATE COMPLETED 14SEP93
DRILLING METHODS HOLLOW STEM AUGER			PAGE 6 OF 8

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	14SEP			VERY DENSE (5GY, 4/1) DARK GREENISH GRAY CLAYEY SILT, TRACE SAND GRAVEL, MOIST	ML		MT: 0
3	09 14	22 A111341	04 6	VERY DENSE (2.5Y, 5/1) GRAY SILTY, SAND, TRACE COBBLES, POORLY GRADED, WET	SP	—	BY: 40
	30914	20 A111341	05 1	SAA		—	
29	1048	22	0	NR VERY STIFF 22SEP93 1330		—	TIME: 1048
	14SEP 30914	12 A111341	06 6	~~VERY DENSE~~ (5GY, 4/1) DARK GREENISH GRAY, SILTY CLAY, TRACE SAND, GRAVEL, ORGANICS, MEDIUM TO HIGH PLASTICITY, MOIST	CL	3.0	MT: 0 BY: 40
30				0-2 IN SAA	CL	3.0	
	30914	17 A111341	07 4	2-4 IN VERY DENSE (5Y, 4/1) GRAY, SILTY SAND, TRACE CLAY, WELL GRADED, VERY MOIST	SW	—	
	1125	30	0	NR	—	—	TIME: 1125
31	14SEP 30914	7 A111341	08 6	MEDIUM DENSE (N5/,) GRAY, CLAYEY, SILT, TRACE SAND, FINE GRAVEL, VERY MOIST. 1 IN SAND SEAM AT 3 IN	ML	—	MT: 0 BY: 40
	30914	9 A111341	09 6	SAA	ML	—	
32	30914	A111341	10	0-3 MEDIUM DENSE (5Y, 6/1) GRAY SILTY, SAND, POORLY GRADED, MOIST	SP	—	
	1532	13	10 4	3-4 VERY STIFF (2.5Y 4/1) DARK GRAY SILTY CLAY, TRACE GRAVEL, MEDIUM PLASTICITY, MOIST	CL	2.5	TIME 1533
	14SEP 30914	NOT RECORDED A111341	11 6	— (5Y, 5/1) GRAY, CLAYEY SILT, TRACE COARSE SAND, FINE GRAVEL, ORGANICS, MOIST "TWIGS"	ML	—	MT: 0 BY: 40
33	30914	NOT RECORDED A111341	12 4	SAA	ML	—	
	1550		0	NR			TIME: 1550

NOTES BOTTOM OF BORING

DRILLING FIRM: PENN DRILL

DRILLERS: JIM SYCLAN, DOUG NELSON

RIG: MOBIL 1380

DESCRIPTION BASED ON MUNSELL

UNITS MEASURED.
MICROTIP = PPM
BY = CPM
α = CPM

BACKGROUND READINGS:
MICROTIP: 0 PPM
BY: 40 CPM
α: — CPM

NO RECOVERY (NR)
SAME AS ABOVE (SAA)

000526

4 of 8

PIEZOMETER INSTALLATION SHEET

PROJECT NAME CRUS/PHASE II
PROJECT NO. 50.03.24
BORING NO. 11341
PIEZOMETER NO. N/A

FIELD ENG./GEO. B.E. Bullen DATE 22SEP93
CHECKED BY _____ DATE _____
DATE OF INSTALLATION 14SEP93

BOREHOLE DRILLING

DRILLING METHOD SPIN CASING	TYPE OF BIT SPIN CASING
DRILLING FLUID (S) USED:	CASING SIZE (S) USED:
FLUID N FROM _____ TO _____	SIZE 6IN FROM 0 TO 34
FLUID _____ FROM _____ TO _____	SIZE N/A FROM N/A TO N/A

PIEZOMETER DESCRIPTION

TYPE NONE	RISER PIPE MATERIAL N/A
DIAMETER OF PERFORATED SECTION N/A	RISER PIPE DIAMETERS:
PERFORATION TYPE: N/A	O.D. N/A I.D. N/A
SLOTS ☐ HOLES ☐ SCREEN ☐	LENGTH OF PIPE SECTIONS N/A
AVERAGE SIZE OF PERFORATIONS N/A	JOINING METHOD N/A
TOTAL PERFORATED AREA N/A	

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH N/A	OTHER PROTECTION N/A
PROTECTIVE PIPE O.D. N/A	

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE (FT)		ELEVATION ( )	
TOP OF RISER PIPE	N/A			
GROUND SURFACE	0.0			
BOTTOM OF PROTECTIVE PIPE	N/A			
BOREHOLE FILL MATERIALS:				
GROUT/SLURRY (CEMENT)	TOP 0	BOTTOM 1.5	TOP	BOTTOM
	TOP 1.5	BOTTOM 34	TOP	BOTTOM
BENTONITE	TOP N/A	BOTTOM N/A	TOP	BOTTOM
SAND	TOP ↓	BOTTOM ↓	TOP	BOTTOM
GRAVEL	TOP ↓	BOTTOM ↓	TOP	BOTTOM
PERFORATED SECTION	TOP N/A	BOTTOM N/A	TOP	BOTTOM
PIEZOMETER TIP	N/A			
BOTTOM OF BOREHOLE	34 FT			
GWL AFTER INSTALLATION	N/A			

WAS THE PIEZOMETER FLUSHED AFTER INSTALLATION? N/A YES ☐ NO ☐
WAS A SENSITIVITY TEST PERFORMED ON THE PIEZOMETER? N/A YES ☐ NO ☐
REMARKS N/A

409-11-86

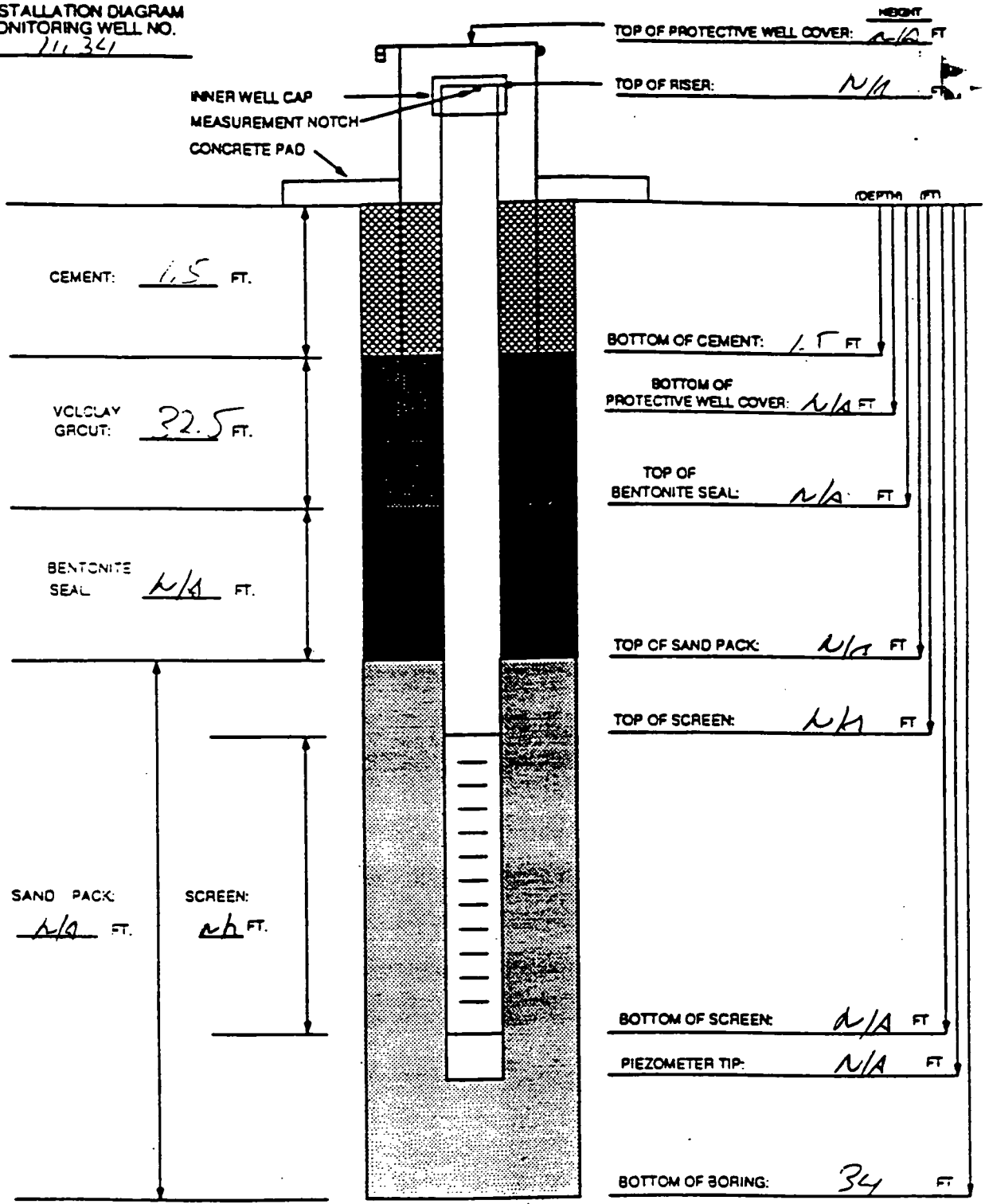
FERNALD RI/FS
INSTALLATION DIAGRAM
MONITORING WELL NO. 11,341

INSTALLATION DATE: 14 SEPS

TOP OF PROTECTIVE WELL COVER: N/A FT (HEIGHT)

TOP OF RISER: N/A FT

1507



BOREHOLE DIAMETER: 6.5 IN.

MATERIALS USED:

SAND TYPE AND QUANTITY: N/A
BENTONITE PELLETS (5-GALLON BUCKETS): N/A
BAGS OF VOLCLAY GROUT: 4
AMOUNT OF CEMENT: 1/2 BAG
AMOUNT OF WATER USED: 96
[illegible]: N/A
510.03.24

NOTES:

1) RISER PIPE IS N/A IN. ID. 316 STAINLESS STEEL PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS N/A IN. ID. 316 STAINLESS STEEL PIPE WITH 0.N/A IN. SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH AND DATE N/A FT N/A
5) TOP OF CASING IS SECURED WITH A STAINLESS STEEL CAP
6) PARENTHESIS INDICATE DEPTH BELOW GROUND LEVEL
7) WELL CASING HAS A PROTECTIVE COVER WITH PADLOCK

GEOLOGIST/ENGINEER: B.F. Bulter

[illegible] FORM 0157 REV. [illegible]

000528

PROJECT NUMBER: 50.03.24	PROJECT NAME: Fecal Tail Wood Fan Hydraulic Invest		
BORING NUMBER: [illegible]	COORDINATES:		DATE: [illegible]
ELEVATION: 1120.5 PZ-3	GWL: Depth:	Date/Time:	DATE STARTED: [illegible]
ENGINEER/GEOLOGIST: [illegible]	Depth:	Date/Time:	DATE COMPLETED:
DRILLING METHODS: Hollow Stem Auger			PAGE 1 OF

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 IN	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
		NA	NA	Cement	NA	NA	PA = [illegible] BS = 100 cpm
		NA	NA	Cement	NA	NA	PA = [illegible] BS = 100 cpm
	[illegible]	[illegible]	6	Fine [illegible] brown, [illegible]	[illegible]	NA	PA = [illegible] BS = 100 cpm
	[illegible]	11	4	Fine [illegible] brown, fine sand, [illegible] moist, dry	[illegible]	NA	PA = [illegible] BS = 100 cpm
		0	0	No Recovery	NA	NA	PA = NA BS = NA
	[illegible]	[illegible]	6	V. stiff [illegible] brown [illegible] sandy clay w/ [illegible] [illegible] plasticity moist	CL	2.5	PA = 25 cpm BS = 100 cpm
	[illegible]	11	6	SAA	CL	2.5	PA = 40 cpm BS = 100 cpm
	[illegible]	[illegible]	7	Fine [illegible] brown, [illegible] sand, [illegible] moist, [illegible]	[illegible]	NA	PA = 40 cpm BS = 100 cpm
	[illegible]	7	6	SAA	[illegible]	NA	PA = [illegible] BS = 100 cpm
	[illegible]	9	2	SAA	[illegible]	NA	PA = 9 cpm BS = 100 cpm

NOTES:

Drilling Contractor: [illegible]

Driller: [illegible]

Driller: [illegible]

SAA: Same As Above

NA: Not Applicable

Field Geologist or Hydrogeologist: [illegible]

Office Geologist or Hydrogeologist: [illegible]

CCCS Limit

000529

PROJECT NUMBER: [illegible]	PROJECT NAME: Circuit Tilt Wooster Fan Hydraulic Inquiry	
BORING NUMBER: 1120X	COORDINATES:	DATE: 9/01/93
ELEVATION:	GW: Depth: Date/Time:	DATE STARTED: 9/8/93
ENGINEER/GEOLOGIST: D. O'Brien	Depth: Date/Time:	DATE COMPLETED:
DRILLING METHODS: Hollow Stem Auger		PAGE 2 OF

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DEPTH	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6"	RECOVERY	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY	REMARKS
		12	0	NO RECOVERY	NA	NA	PH= NA BZ= NA
	CD 3909A 1120X-9	4	6	[illegible] CONC. [illegible] SAA, COARSE SAND	SP	NA	PH= [illegible] BZ= [illegible]
	CD 3909A 1120X-9	11	6	SAA, COARSE SAND	SP	NA	PH= [illegible] BZ= [illegible]
	CD 3909A 1120X-10	10	6	SAA	SP	NA	PH= [illegible] BZ= [illegible]
	CD 3909A 1120X-11	5	6	SAA	SP	NA	PH= 15 ppm BZ= 100 cpm
	CD 3909A 1120X-12	3	6	SAA	SP	NA	PH= 12 ppm BZ= 100 cpm
	CD 3909A 1120X-13	10	6	SAA	SP	NA	PH= 12 ppm BZ= 100 cpm
	CD 3909A 1120X-14	9	6	SAA	SP	NA	PH= .5 ppm BZ= 100 cpm
	3909A 1120X-15	14	6	SAA	SP	NA	PH= .5 ppm BZ= 100 cpm
	3909A 1120X-16	17	6	SAA	SP	NA	PH= .5 ppm BZ= 100 cpm

NOTE:

Drilling Contractor: Professional Drilling

Driller: [illegible]

Driller: [illegible]

[illegible] PH = [illegible] ppm PH [illegible] 100-150 cpm

DSC 9/14/93

SAA: SAMPLE [illegible] NA: NOT APPLICABLE

[illegible] CONSISTENCY PER ASTM [illegible]

COLOR: DESCRIPTION [illegible] COLOR CHART

BORING NUMBER: 1120?	PROJECT NAME: [illegible]		
STATION:	COORDINATES:		DATE: 9/2/03
ENGINEER/GEOLOGIST: D. O'Brien	GWL: Depth:	Date/Time:	DATE STARTED: 9/?/03
DRILLING METHODS: Hollow Stem Auger	Depth:	Date/Time:	DATE COMPLETED:
			PAGE: 3 OF

DEPTH (FT)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	1040 30909A 11203-17	11	6	Med Dense. 10YR (5/4); Yellowish brown coarse sand & gravel, poorly graded, wet	SP	NA	PID = 0 ppm BG = 100 cpm
11	1040 30909A 11203-18	7	6	V. Stiff. 2.5Y (5/1) Gray clay w/ gravel & sand, high plasticity, wet.	CL	1.75	PID = 0 ppm BG = 100 cpm
	1040 30909A 11203-19	9	6	Med Dense. 10YR (5/4) Yellowish brown clayey sand & gravel wet	SC	NA	PID = 0 ppm BG = 100 cpm
12	1045 30909A 11203-20	12	6	Loose. 10YR (5/6) Yellowish brown coarse sand w/ gravel, trace clay poorly graded, wet	SP	NA	PID = 0 ppm BG = 100 cpm
	1045 30909A 11203-21	7	6	SAA	SP	NA	PID = 0 ppm BG = 100 cpm
13	1045 30909A 11203-22	3	6	SAA	SP	NA	PID = 0 ppm BG = 100 cpm
	1105 30909A 11203-23	4	6	SAA	SP	NA	PID = 0 ppm BG = 100 cpm
14	1105 30909A 11203-24	14	6	Soft. 2.5Y (5/1) Gray silty clay trace gravel, high plasticity moist	CL	.25	PID = 0 ppm BG = 100 cpm
	1105 30909A 11203-25	7	6	SAA	CL	.25	PID = 0 ppm BG = 100 cpm
				Boring terminated @ 14.5'			PID = BG =

NOTES:

Drilling Contractor: Pennsylvania Drilling [illegible]

Driller: [illegible]

Driller: [illegible]

[illegible] 0 ppm [illegible] 100 cpm

[illegible] 105.0001 [illegible]

[illegible]

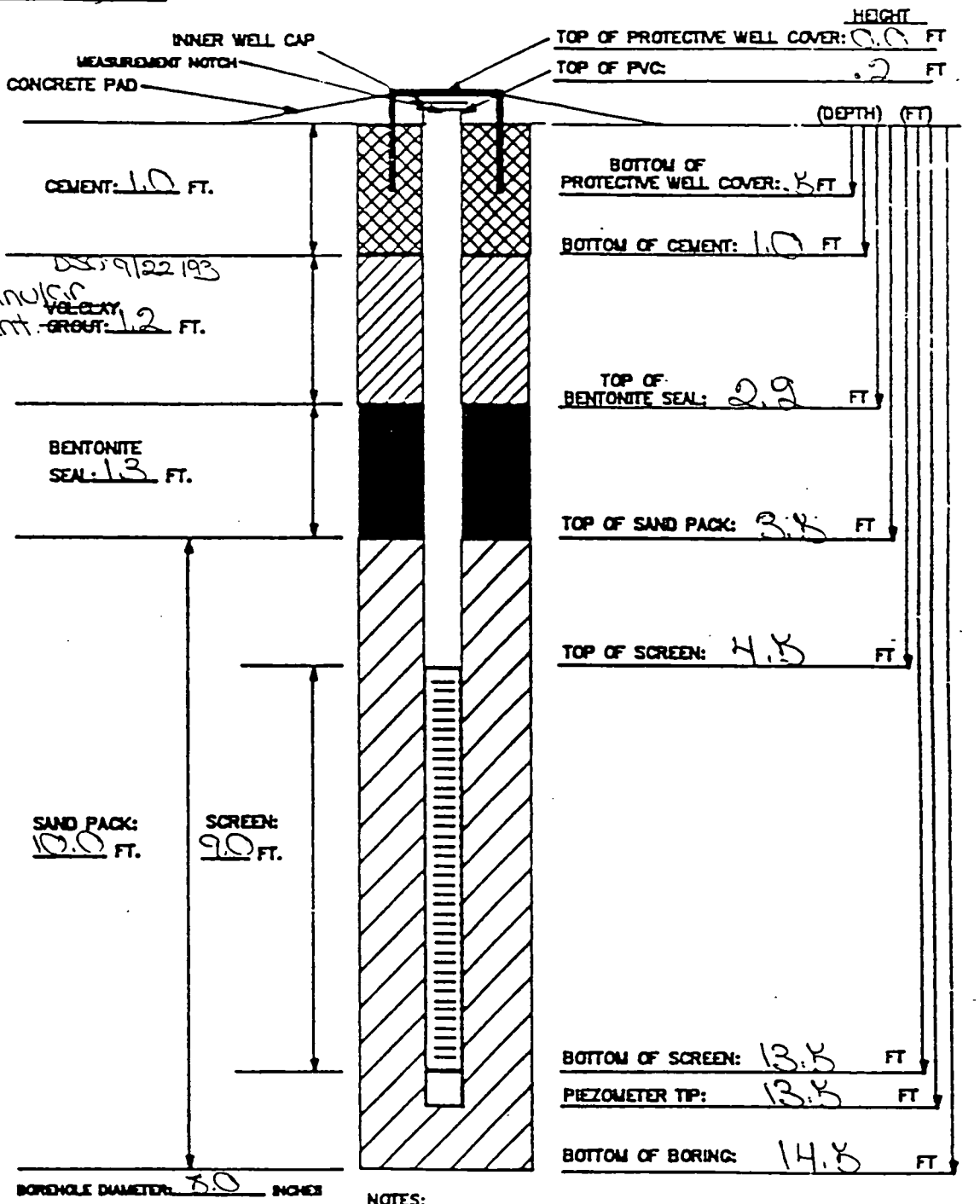
Color Chart

000531

FERNALD RI/FS

INSTALLATION DIAGRAM
MONITORING WELL NO. 1203

INSTALLATION DATE: 9/11/93



BOREHOLE DIAMETER: 5.0 INCHES

MATERIALS USED:
SAND TYPE AND QUANTITY: 10/20, 3 bags
BENTONITE PELLETS (5-GALLON BUCKETS): 1 bucket
BAGS OF ~~VOLCLAY GROUT~~: gran. bent - 1 bag
AMOUNT OF CEMENT: 1 bag
AMOUNT OF WATER USED: 10 gal.
OTHER:

NOTES:
1) RISER PIPE IS 2-INCH SCHEDULE 40 PVC PIPE, FLUSH-THREADED JOINTS.
2) SCREEN IS 2-INCH I.D. SCHEDULE 40 PVC PIPE WITH 0.020-INCH SLOTS.
3) LOWER END OF SCREEN IS CAPPED WITH AN END CAP OR THREADED SUMP.
4) WATER DEPTH/DATE: 3.54 ft 9/13/93
5) TOP OF PVC IS SECURED WITH EXPANDABLE RUBBER PLUG AND PADLOCK.
6) PARENTHESES INDICATE DEPTH BELOW GROUND LEVEL.

1 soil, 1 water drum TASK: 50.03.24 GEOLOGIST/ENGINEER: D.O. Brian

FERNALD RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 20.03.24	PROJECT NAME: Glacial Till Vadose Zone Sampling		
BORING NUMBER: 11211	COORDINATES: —	DATE: 09.15.93	
ELEVATION: N/A	GWL: Depth — Date/Time —	DATE STARTED: 9-15-93	
ENGINEER/GEOLOGIST: Terry Kunkel	Depth — Date/Time —	DATE COMPLETED: 09.16.93	
DRILLING METHODS: HSA		PAGE 1 OF 7	

DEPTH (Feet)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 inch	RECOVERY (inch)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0.5	9-15-93	N/A	N/A	concrete	N/A	N/A	MICROTIP = 1.1 ppm; BG = 100 cpm
1.0	9-15-93	N/A	N/A	concrete	N/A	N/A	
1.5	9-15-93	N/A	N/A	not sampled	N/A	N/A	
2.0	9-15-93 1010 -01	7	6	~~A still~~ DARK ~~[illegible]~~ gray (10YR4/1) silty, CLAY, trace plastic, moist	CL	2.0	MICROTIP = 1.1 ppm; BG = 100 cpm; 30915-1124-01
2.5	9-15-93 1010 -02	8	4	SAA	CL	2.0	30915A11211-02
3.0	9-15-93 1010	10	0	no recovery.	N/A	N/A	~~30915A11211-03~~ NR PR 10-6-93
3.5	9-15-93 1018 -03	6	6	SAA, DARK (10YR4/1) ~~gray~~ mottled to red/brown	CL	2.0	MICROTIP = 1.1 ppm; BG = 80 cpm; 30915A11211-03
4.0	9-15-93 1018 -04	8	6	SAA	CL	2.0	30915A11211-~~03~~ 04 NR 10-6-93
4.5	9-15-93 1018 -05	9	3	SAA	CL	2.0	30915A11211-~~04~~ 05 NR 10-6-93
5.0	9-15-93 1030 -06	1	6	SAA	CL	2.0	MICROTIP = 1.1 ppm; BG = 80 cpm; 30915A11211-06

NOTES:

Drilling Contractor: Pennsylvania Drilling
Drilling Equipment : Acker 432
Driller : Ron Connors
Helper : Ted Bais

UK = UNKNOWN
SAA = Same As Above
N/A = Not Applicable

Background = 80 cpm (BG) 1.1 ppm (Cs137)

- Samples collected per ASTM Standard Penetration Test.
- * All colors identified by the Munsell Color Chart.

FERNALD
RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 90-03-24	PROJECT NAME: OU5: Glacial Till Vadose Zone Sampling	
BORING NUMBER: 11211	COORDINATES: —	DATE: 09-15-93
ELEVATION: —	GWL: Depth — Date/Time —	DATE STARTED: 09-15-93
ENGINEER/GEOLOGIST: Terry Konkin	Depth — Date/Time —	DATE COMPLETED: 09-16-93
DRILLING METHODS: HSA		PAGE 2 OF 5

DEPTH (FEET)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 INCH	RECOVERY (INCH)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
5.0	9-15-93 1030 -07	2	6	Stiff ~~[illegible]~~ (10YR 4/1) mottled ~~[illegible]~~ brown, silty CLAY, very moist	CL	2.0	SEE PREVIOUS PAGE 30915A11211 ~~-08~~ 07
5.5	9-15-93 1032	5	0	no recovery	N/A	~~2.0~~ N/A	~~30915A11211-09~~ NA
6.0	9-15-93 1038 -08	1	6	SAA	CL	2.0	MICROTIP = 1.5 PPM BY = 80 CPM 30915A11211-08
6.5	9-15-93 1038	2	0	~~[illegible]~~ No Recovery	N/A	N/A	~~30915-11211-11~~ NA
7.0	9-15-93 1038	5	0	~~[illegible]~~ No Recovery	N/A	N/A	~~30915-11211-12~~ NA
7.5	9-15-93 1050 -09	4	6	very stiff, SAA	CL	2.5	MICROTIP = 0.8 (0.8) PPM BY = 80 CPM 30915A11211 ~~-13~~ 09
8.0	9-15-93 1050 -10	2	6	SAA	CL	2.5	30915-11211-~~14~~ 10
8.5	9-15-93 1050 -11	5	6	SAA, some fine sand	CL	2.5	30915-11211-~~15~~ 11
9.0	9-15-93 1105 -12	1	3 6	SAA, silty (10YR 5/4) YELLOWISH BROWN	CL	2.5	MICROTIP = 0.2 (0.8) PPM BY = 80 CPM 30915-11211-12
9.5			1	loose, ~~[illegible]~~ SAND, fine-coarse, ~~[illegible]~~ sorted, wet some layered areas	SP	N/A	
10.0	9-15-93 1105 -13	3	6	SAA	SP	N/A	30915A11211-13

NOTES

Drilling Contractor: Pennsylvania Drilling
Drilling Equipment: Acker 432
Driller: Ron Cannons
Helper: Ted Bais

UK = UNKNOWN
SAA = Same As Above
N/A = Not Applicable

Background = 80 cpm (BY)
1.5 ppm (MT)

- Samples collected per ASTM Standard Penetration Test.
- All colors identified by the Munsell Color Chart.

000534

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 00-0324	PROJECT NAME: OU5: Glacial Till Vadose Zone Sampling	
BORING NUMBER: 11211	COORDINATES: —	DATE: 09-15-93
ELEVATION: —	GWL: Depth — Date/Time —	DATE STARTED: 09-15-93
ENGINEER/GEOLOGIST Tony Ko-Kin	Depth — Date/Time —	DATE COMPLETED: 09-16-93
DRILLING METHODS: HSA		PAGE 3 OF 7

DEPTH (FEET)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 (INCH)	RECOVERY (INCH)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
10.0	9-15-93 1105 -14	5	6	Stiff ~~dark~~ brown (10YR 3/3), silty CLAY, med plastic, moist	CL	2.0	SEE PREVIOUS PAGE 30915-11211-14
11.0	9-15-93 1130 -15	9	6	med dense, ~~med~~ brown (10YR 4/3) SAND, fine-coarse, poorly sorted, wet	SP	N/A	MICROTIP = 1.0 ppm BG = 80 cpm 30915-11211-15
11.5	9-15-93 1130 -16	10	6	~~Soft~~ SAA	SP	N/A	30915A11211-16
12.0	9-15-93 1130 -17	15	6	SAA	SP	N/A	30915A11211-17
12.5	9-15-93 1140 -18	4	6	soft, med dark gray (5GY 4/1) ~~OLIVE~~ silty CLAY, med plast, very moist	CL	0.5	MICROTIP = 1.0 ppm BG = 80 cpm 30915-11211-18
13.0	9-15-93 1140 -19	2	6	loose ~~med~~ yellowish brown (10YR 5/4) SAND, some silt, fine-coarse, some gravel, poorly sorted, wet	SP	N/A	30915A11211-19
13.5	9-15-93 1140 -20	6	6	SAA	SP	N/A	30915A11211-20
14.0	9-15-93 1150 -21	11	6	SAA	SP	N/A	MICROTIP = 1.0 ppm BG = 60 (60) cpm 30915A11211-21
14.5	9-15-93 1150 -22	12	6	SAA, clayey	SP	N/A	30915-11211-22
15.0	9-15-93 1150 -23	12	6	SAA	SP	N/A	30915A11211-23

NOTES

Drilling Contractor: Pennsylvania Drilling
Drilling Equipment : Acker 432
Driller : Ron Connors
Helper : Ted Bais

UK = UNKNOWN
SAA = Same As Above
N/A = Not Applicable

Background = 80 cpm (BG)
1.0 ppm (MT)

* Samples collected per ASTM Standard Penetration Test.
* All colors identified by the Munsell Color Chart.

000535

1794

FERNALD
RI/FS

1507

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 20-03-24	PROJECT NAME: OU5: Glacial T.A Vadose Zone Sampling		
BORING NUMBER: 11211	COORDINATES: —	DATE: 09-15-93	
ELEVATION: —	GWL: Depth — Date/Time —	DATE STARTED: 09-15-93	
ENGINEER/GEOLOGIST: Tony Kinkin	Depth — Date/Time —	DATE COMPLETED: 9-16-93	
DRILLING METHODS: HSA		PAGE 4 OF 57	

DEPTH (FEET)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 (INCH)	RECOVERY (INCH)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15.0	9-15-93 1155 -24	6	6	medium dense, ~~moist~~ yellowish brown (10YR 5/4) GRAVEL, some clay, med grained, fairly well sorted, some clay/silt, wet	GC	N/A	MICROTIP = 1.0 ppm; BG = 100 cpm; 30915-11211-24
15.5	9-15-93 1155 -25	5	6	SAA	GC	N/A	30915A11211-25
16.0	9-15-93 1455 -26	12	6	medium dense, ~~moist~~ yellowish brown (10YR 5/4) SAND, fine/coarse grained, poorly sorted, some clay, little silt, wet	SP	N/A	30915-11211-26
16.5	9-15-93 1630 -27	14	6	SAA, no clay	SP	N/A	MICROTIP = 1.0 ppm; BG = 80 cpm; 30915A11211-27
17.0	9-15-93 1630 -28	15	6	SAA	SP	N/A	30915A11211-28
17.5	9-15-93 1630 -29	15	6	SAA	SP	N/A	30915A11211-29
18.0	9-15-93 1642 -30	4	6	SAA	SP	N/A	MICROTIP = 1.0 ppm; BG = 100 cpm; 30915A11211-30
18.5	9-15-93 1642 -31	7	6	SAA	SP	N/A	30915A11211-31
19.0	9-15-93 1642 -32	11	6	SAA	SP	N/A	30915A11211-32
19.5	9-15-93 1650 -33	4	6	SAA	SP	N/A	MICROTIP = 1.0 ppm; BG = 100 cpm; 30915A11211-33
20.0							

NOTES:

Drilling Contractor: Pennsylvania Drilling
Drilling Equipment : Acker 432
Driller : Ron Gongers
Helper : Ted Bais

UK = UNKNOWN
SAA = Same As Above
N/A = Not Applicable

Background = 80 cpm (BG)
1.0 ppm (MT)

* Samples collected per ASTM Standard Penetration Test.
* All colors identified by the Munsell Color Chart.

000536

1795

FERNALD
RI/FS

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 580-03-24.	PROJECT NAME: OU5: Glacial Till Vadose Zone Sampling	
BORING NUMBER: 11211	COORDINATES: —	DATE: 09-15-93
ELEVATION: —	GWL: Depth — Date/Time —	DATE STARTED: 09-15-93
ENGINEER/GEOLOGIST: Terry Kowkin	Depth — Date/Time —	DATE COMPLETED: 09-15-93
DRILLING METHODS: HSA		PAGE 5 OF 5

DEPTH (FEET)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6 INCH	RECOVERY (INCH)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
20	9-15-93 1450 -34	10	6	med dense, ~~med~~ brown (10YR 5/4) SAND, fine-coarse, poorly sorted, little silt, wet	SP	N/A	SEE PREVIOUS PAGE 30915-11211-34
20.5	9-15-93 1650 -35	10	6	stiff, ~~[illegible]~~ brown (2.5Y 5/2) silty CLAY, ~~trace~~ some fine-med sand, med plast, moist	CL	2.0	30915-11211-35
21.0	9-15-93 1710 -36	UK	6	gray silt, trace coarse (25Y 5/1) gravel, very moist, clayey	ML	N/A	MICROTIP = 1.0 PPM BY = 80 CPM 30915-11211-36
21.5	9-15-93 1710 ~~-37~~	UK	0	NR No Recovery	N/A	N/A	NA
22.0	9-15-93 1710	UK	0	NR No Recovery	N/A	N/A	NA
22.5	9-15-93 1720 -37	10	6	med dense, ~~[illegible]~~ brown (10YR 5/4) SAND, fine-coarse, poorly sorted, some silt, wet	SP	N/A	MICROTIP = 1.0 PPM BY = 80 CPM 30915-11211-37
23.0	9-15-93 1720 -38	38	6	SAA			
23.5				stiff, med gray (2.5Y 5/1) silty CLAY, trace gravel, med plast, moist	CL	2.0	30915-11211-38
24.0	9-15-93 1720 -39	35	6	SAA	~~2.0~~ CL	2.0	30915A11211-39
				TD = 24.0'			MICROTIP = PPM BY = CPM

NOTES

Drilling Contractor: Pennsylvania Drilling
Drilling Equipment: Acker 432
Driller: Ben Connors
Helper: Ted Bair

UK = UNKNOWN
SAA = Same As Above
N/A = Not Applicable

Background = 80 cpm (BY)
1.0 ppm (MT)

* Samples collected per ASTM Standard Penetration Test.
* All colors identified by the Munsell Color Chart.

000537

APPENDIX D

TABLE D-1
Summary of Boring Locations and Elevations
Operable Unit 3
Former Plant Area

FEMP ID	Boring ID	Easting Coordinate	Northing Coordinate	Elevation (ft MSL)	Reference
12266	G3-001	1350367.2	481935.0	588.7	PO-177
12267	G3-002	1348876.8	481728.7	587.8	PO-177
12268	G3-003	1345917.5	481488.5	ND1	PO-177
12269	G3-004	1348835.9	480832.0	579.6	PO-177
12270	G3-005	1348629.6	480668.2	579.1	PO-177
12271	G3-006	1349048.4	480833.8	580.7	PO-177
12272	G3-007	1348559.9	480276.3	ND2	PO-177
12273	G3-008	1348911.5	480383.7	579.5	PO-177
12274	G3-009	1350356.3	480499.6	579.3	PO-177
12275	G3-010	1348517.2	479760.8	577.9	PO-177

Notes:

1. Coordinates are NAD83
2. ND1 No Data - Could not be obtained due to Boiler Plant Demolition (coordinates are estimates).

   ND2 No Data - Area was covered with gravel and location could not be determined (coordinates are estimates).

APPENDIX E

This appendix presents typical grain-size curves for the soils encountered in the PO-177 study. Table E-1 below is a list of the selected typical soil samples representing the various soils encountered. The typical soils were selected by visually determining the approximate median sample for a given USCS classification. The typical grain-size curves are included in this Appendix.

Table E-1 - Representative Grain-Size Curves

USCS Description	USCS Symbol	Boring ID	Sample Number	Sample Depth (ft)
Lean Clay	CL	12275	412443	11.0-13.0
Sandy Lean Clay	CL	12269	412398	21.0-23.0
Sandy Silty Clay	CL-ML	1244	50654, 50655	12.5-13.5
Sandy Silt	ML	12273	412336	9.0-11.0
Silty Sand	SM	12271	412377	17.0-19.0
Clayey Sand with Gravel	SC	1293	19033	9.0-9.5
Silty, Clayey Sand	SC-SM	12269	412392	13.0-29.0
Well-Graded Sand with Gravel	SW	11112	30920A11112-03-05	5.5-8.0
Well-Graded Sand with Silt and Gravel	SW-SM	11112	30920A11112-10-11-12-13	10.0-12.0
Poorly-Graded Sand with Gravel	SP-SM	11115	30915A11115-17-18-20-21	12.0-14.5

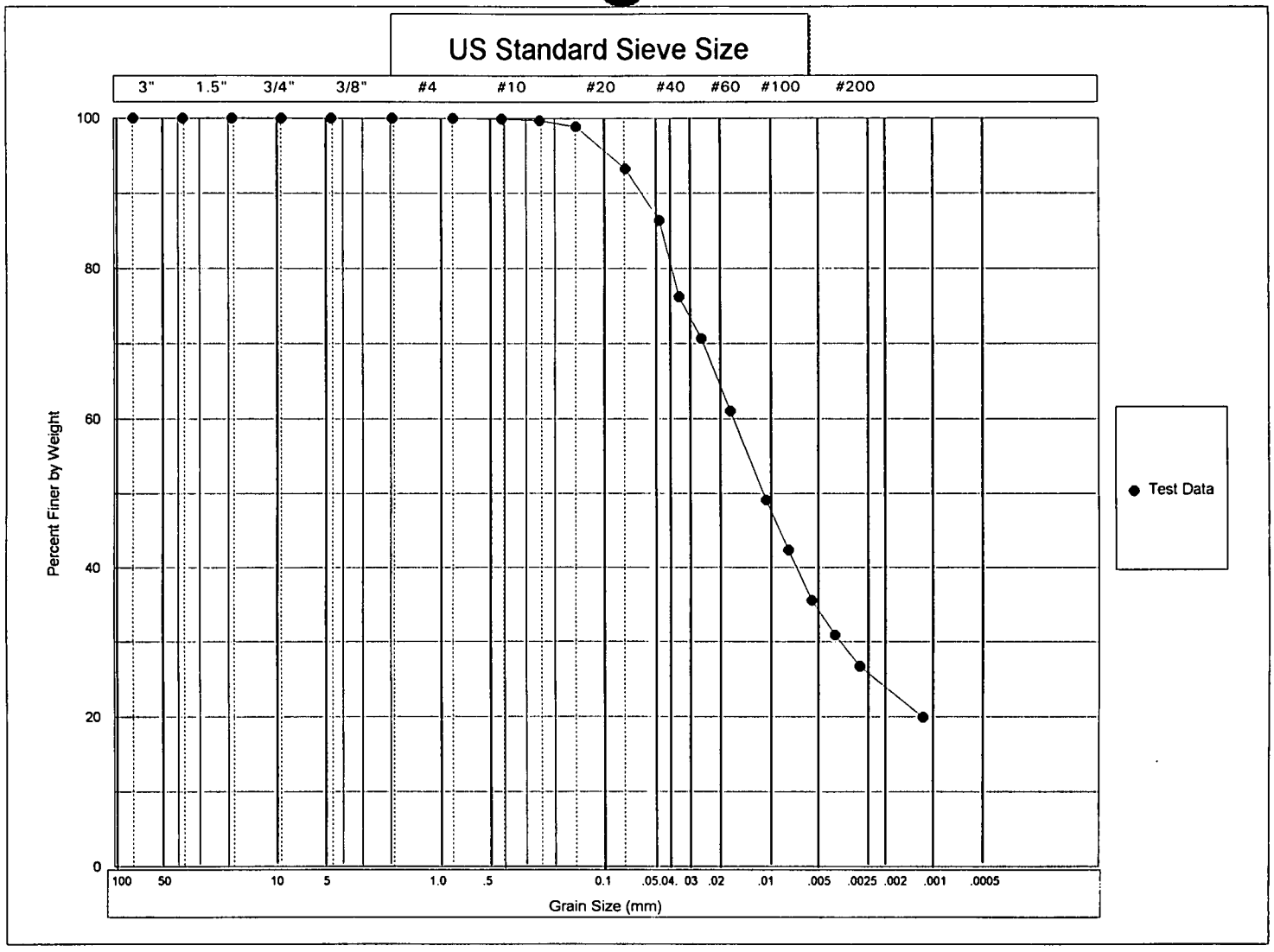
Note: Sample 412392 is a bulk sample and may include several different types of soils mixed together.

The typical grain-size curves from PO-177 were compared to data from PARSONS 1959, PO-132. The soils encountered in PO-177 were generally within the range of grain-size curves for similar soils from the area immediately to the east of the FPA (PO-132). The plots of grain-size curve ranges for the Brown and Gray Till from PO-132 are also included in this Appendix for reference.

All the PO-177 grain-size data are presented in SAIC 1997.

Typical Range of Grain-Size Curves

for Fine and Coarse-Grained Samples
(Source PO-132)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	CRS	MEDIUM	FINE	

USCS

COBBLES TO BOULDERS	PEBBLE GRAVEL				SAND			SILT	CLAY
	COARSE	MED	FINE	GRAN	COARSE	MED	FINE		

WENTWORTH

Client: SAIC / Parsons PO177 Boring No.: G3-010, 12275 Sample No.: 412443

Depth: 11.0-13.0' Job Number: 2059-19

Classification: Lean Clay (CL)

Advanced Terra Testing, Inc.

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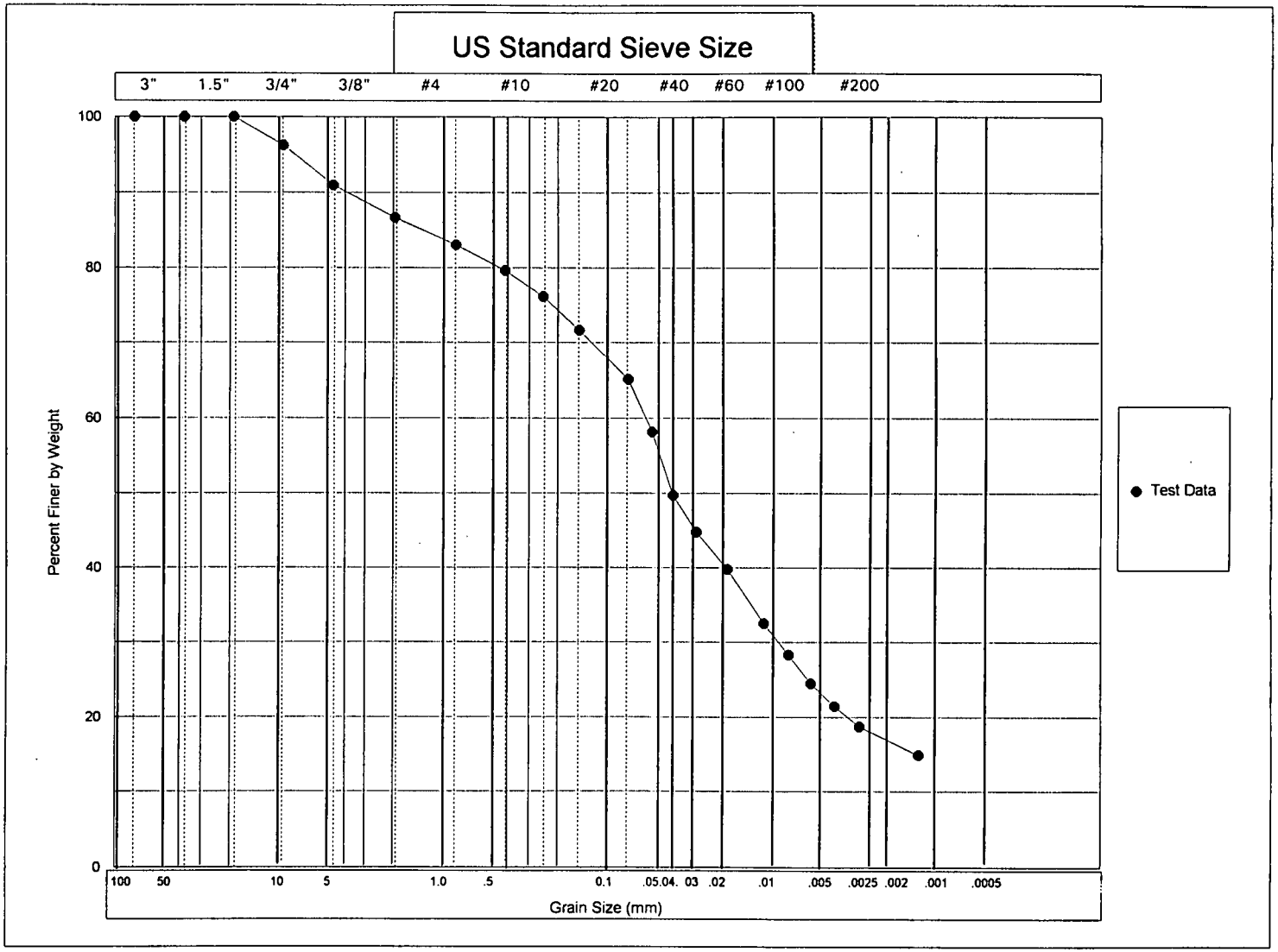


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	CRS	MEDIUM	FINE	

USCS

COBBLES TO BOULDERS	PEBBLE GRAVEL				SAND			SILT	CLAY
	COARSE	MED	FINE	GRAN	COARSE	MED	FINE		

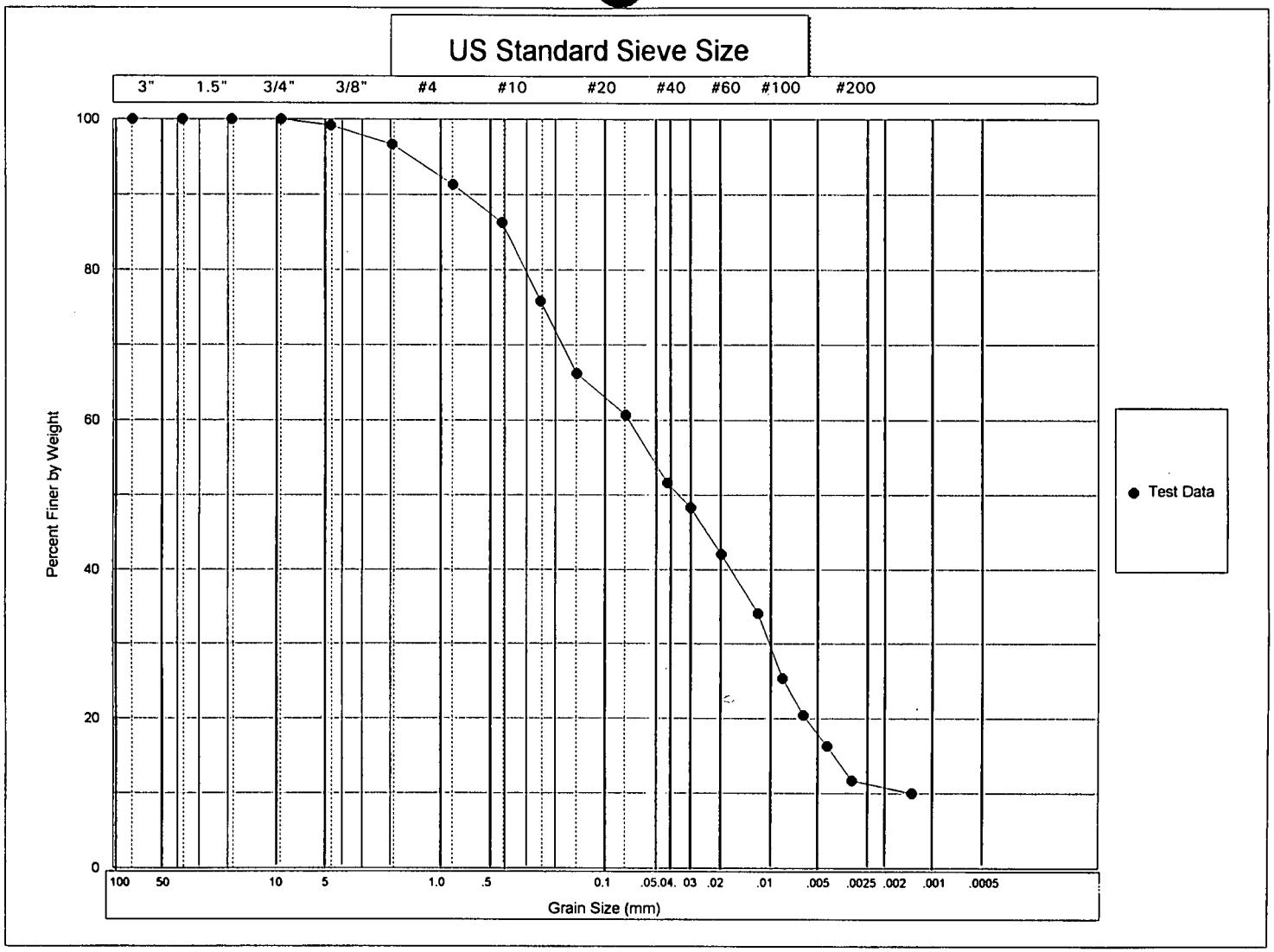
WENTWORTH

Client: SAIC / Parsons PO177 Boring No.: G3-004, 12269 Sample No.: 412398

Depth: 21.0-23.0' Job Number: 2059-19

Classification: Sandy Lean Clay (CL)

Advanced Terra Testing, Inc.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	CRS	MEDIUM	FINE	

USCS

COBBLES TO BOULDERS	PEBBLE GRAVEL				SAND			SILT	CLAY
	COARSE	MED	FINE	GRAN	COARSE	MED	FINE		

WENTWORTH

Client: SAIC / Parsons PO177 Boring No.: 1244 Sample No.: 50654,50655

Depth: 12.5-13.5' Job Number: 2059-19

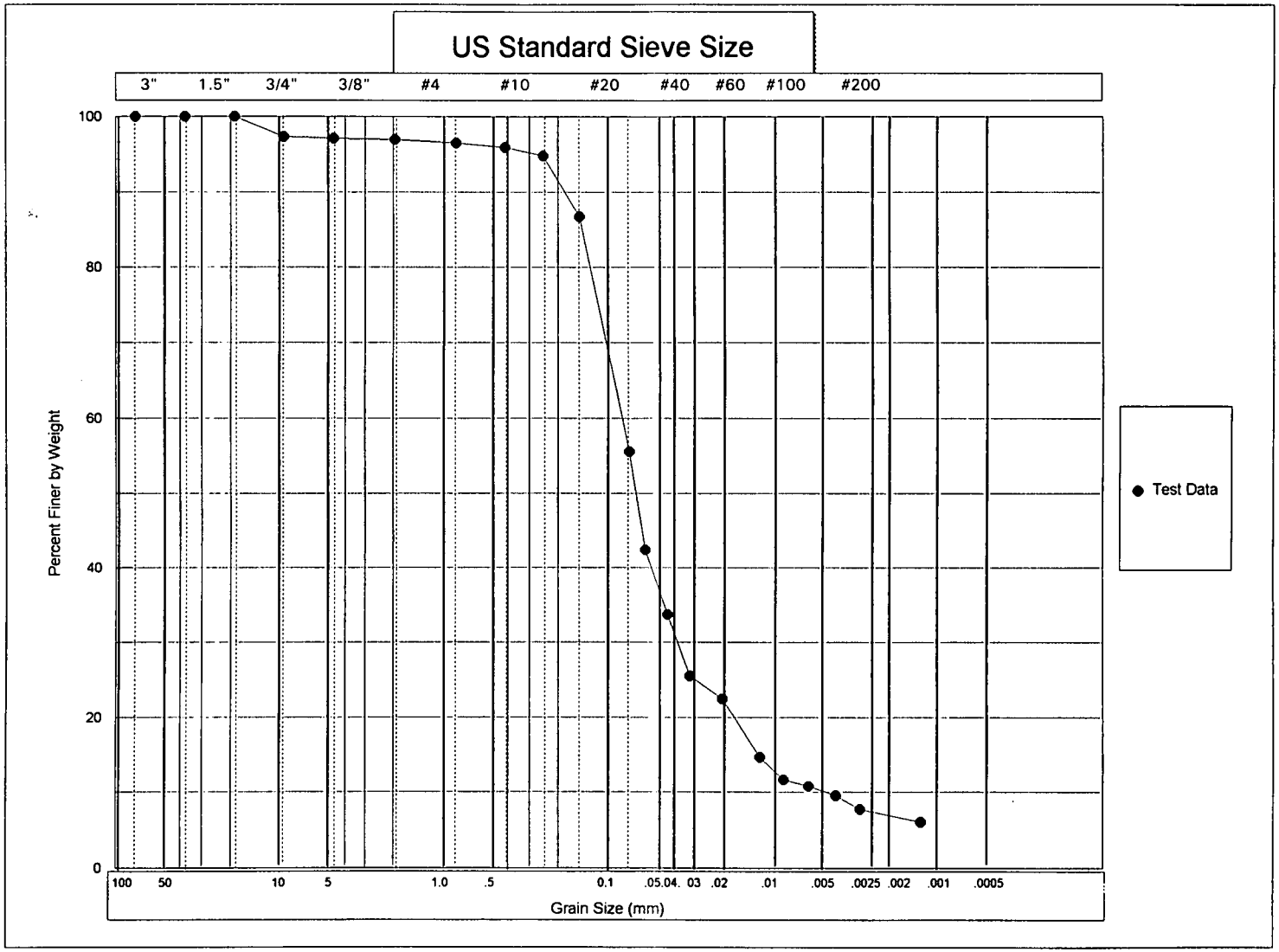
Classification: Sandy Silty Clay (CL-ML)

Advanced Terra Testing, Inc.

000543

L-1502

000511



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	CRS	MEDIUM	FINE	

USCS

COBBLES TO BOULDERS	PEBBLE GRAVEL				SAND			SILT	CLAY
	COARSE	MED	FINE	GRAN	COARSE	MED	FINE		

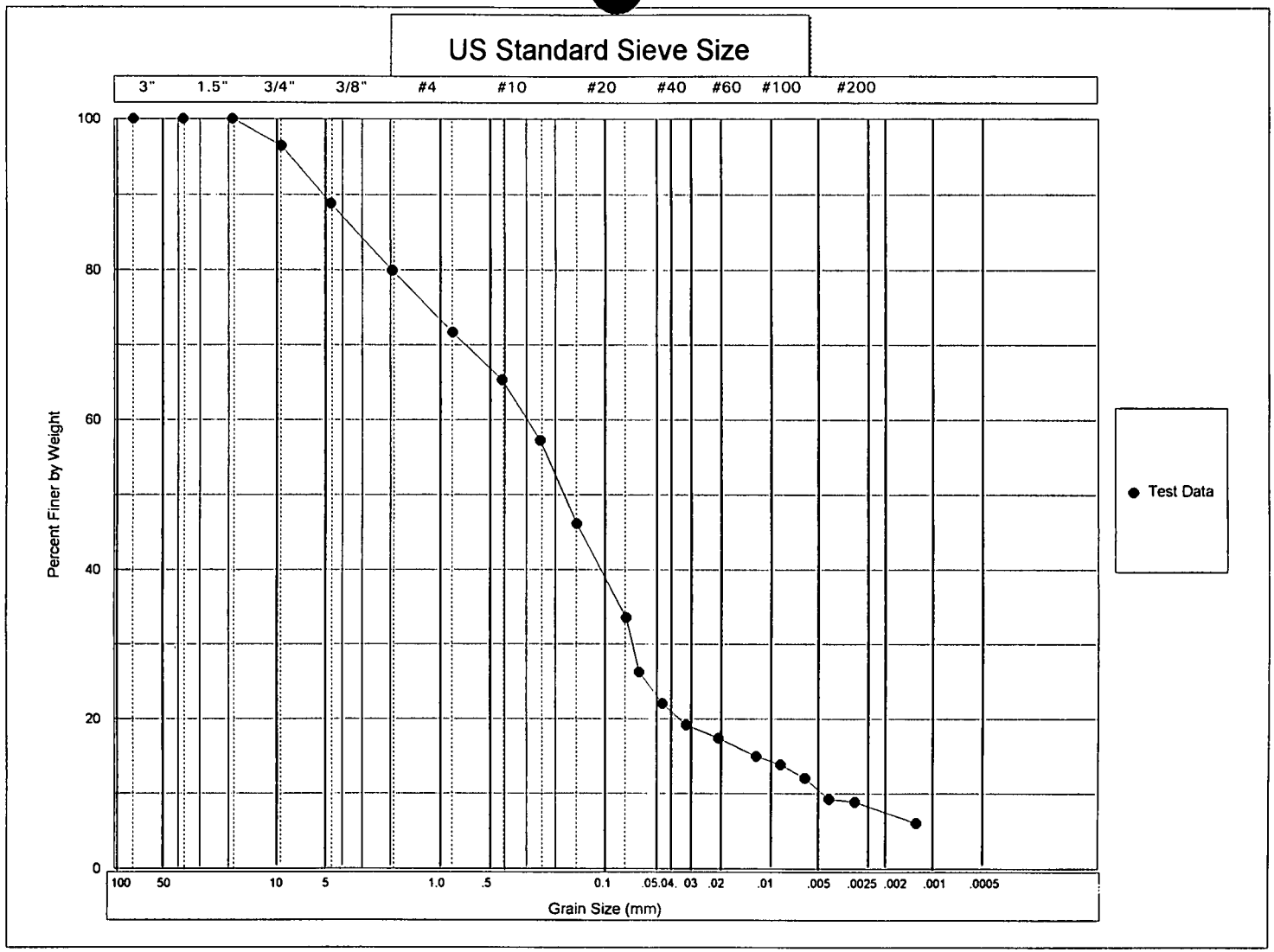
WENTWORTH

Client: SAIC / Parsons PO177 Boring No.: G3-008, 12273 Sample No.: 412336

Depth: 9.0-11.0' Job Number: 2059-19

Classification: Sandy Silt (ML)

Advanced Terra Testing, Inc.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	CRS	MEDIUM	FINE	

USCS

COBBLES TO BOULDERS	PEBBLE GRAVEL				SAND			SILT	CLAY
	COARSE	MED	FINE	GRAN	COARSE	MED	FINE		

WENTWORTH

Client: SAIC / Parsons PO177 Boring No.: G3-006, 12271 Sample No.: 412377

Depth: 17.0-19.0' Job Number: 2059-19

Classification: Silty Sand (SM)

Advanced Terra Testing, Inc.

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1502

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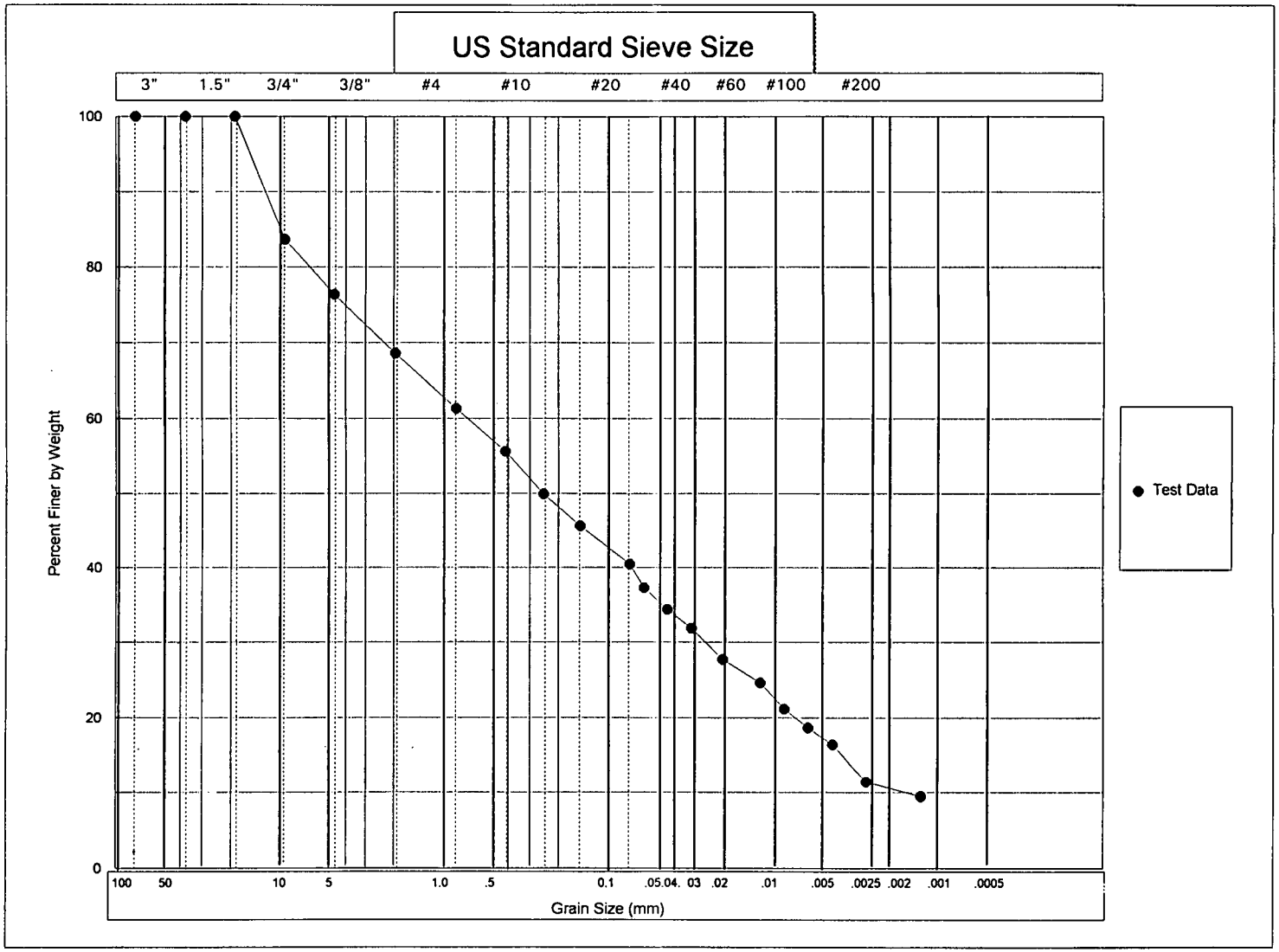


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	CRS	MEDIUM	FINE	

USCS

COBBLES TO BOULDERS	PEBBLE GRAVEL				SAND			SILT	CLAY
	COARSE	MED	FINE	GRAN	COARSE	MED	FINE		

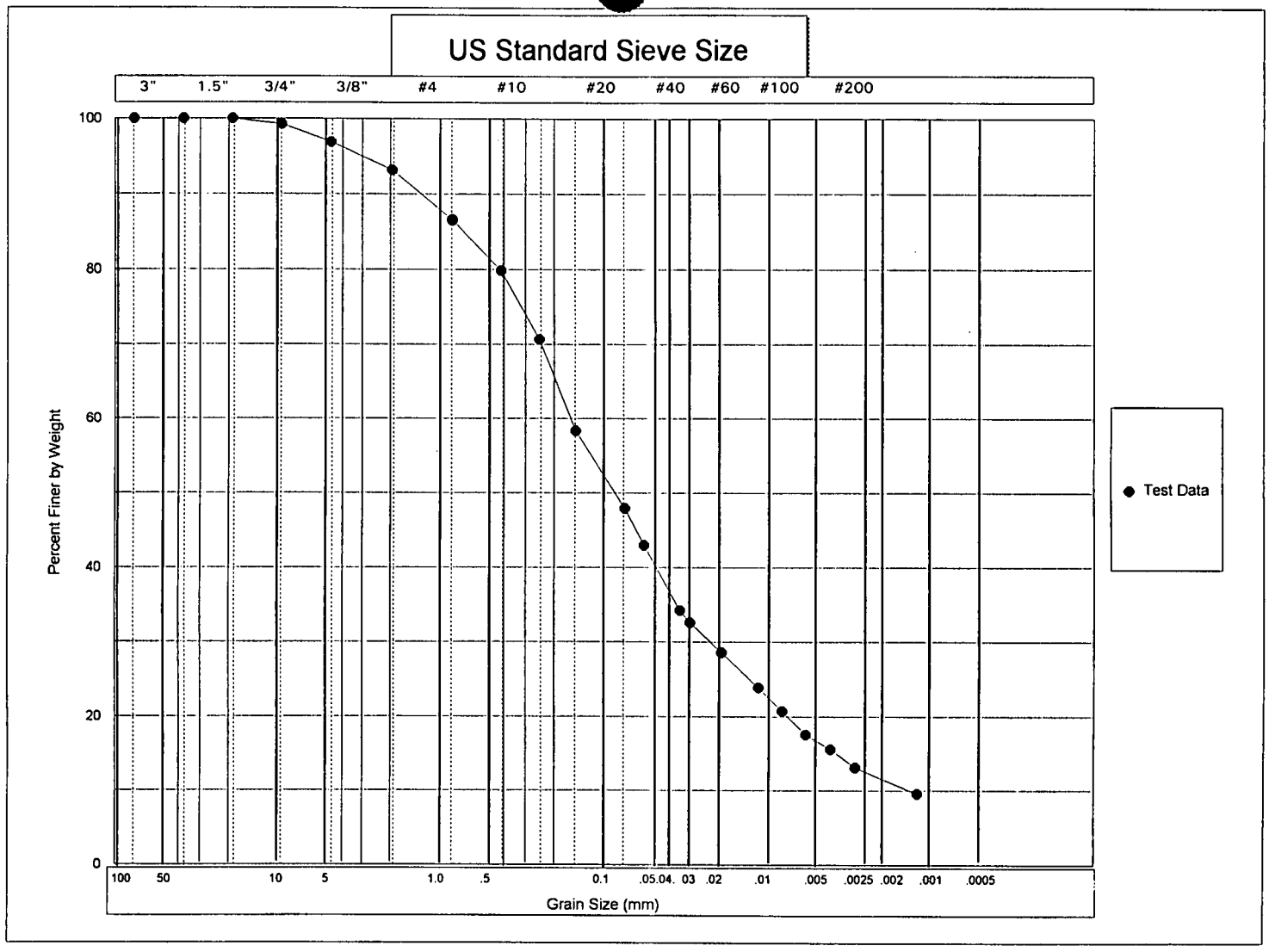
WENTWORTH

Client: SAIC / Parsons PO177 Boring No.: 1293 Sample No.: 19033

Depth: 9.0-9.5' Job Number: 2059-19

Classification: Clayey Sand with Gravel (SC)

Advanced Terra Testing, Inc.



COBBLES	GRAVEL		SAND			SILT OR CLAY	USCS
	COARSE	FINE	CRS	MEDIUM	FINE		

COBBLES TO BOULDERS	PEBBLE GRAVEL				SAND			SILT	CLAY	WENTWORTH
	COARSE	MED	FINE	GRAN	COARSE	MED	FINE			

Client: SAIC / Parsons PO177 Boring No.: G3-004, 12269 Sample No.: 412392
Depth: 13.0-29.0' Job Number: 2059-19
Classification: Silty, Clayey Sand (SC-SM)

Advanced Terra Testing, Inc.

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1502

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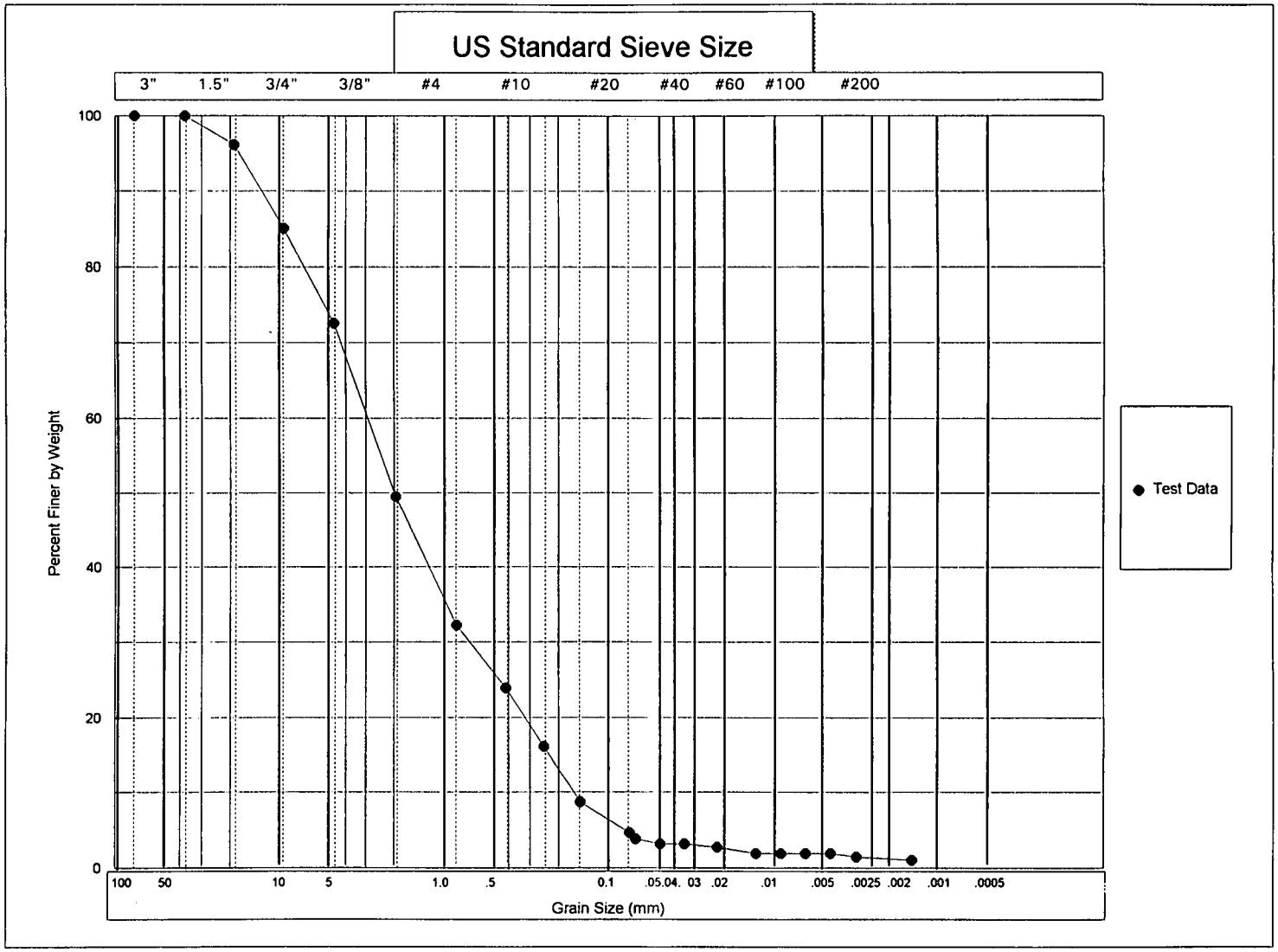


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	CRS	MEDIUM	FINE	

USCS

COBBLES TO BOULDERS	PEBBLE GRAVEL				SAND			SILT	CLAY
	COARSE	MED	FINE	GRAN	COARSE	MED	FINE		

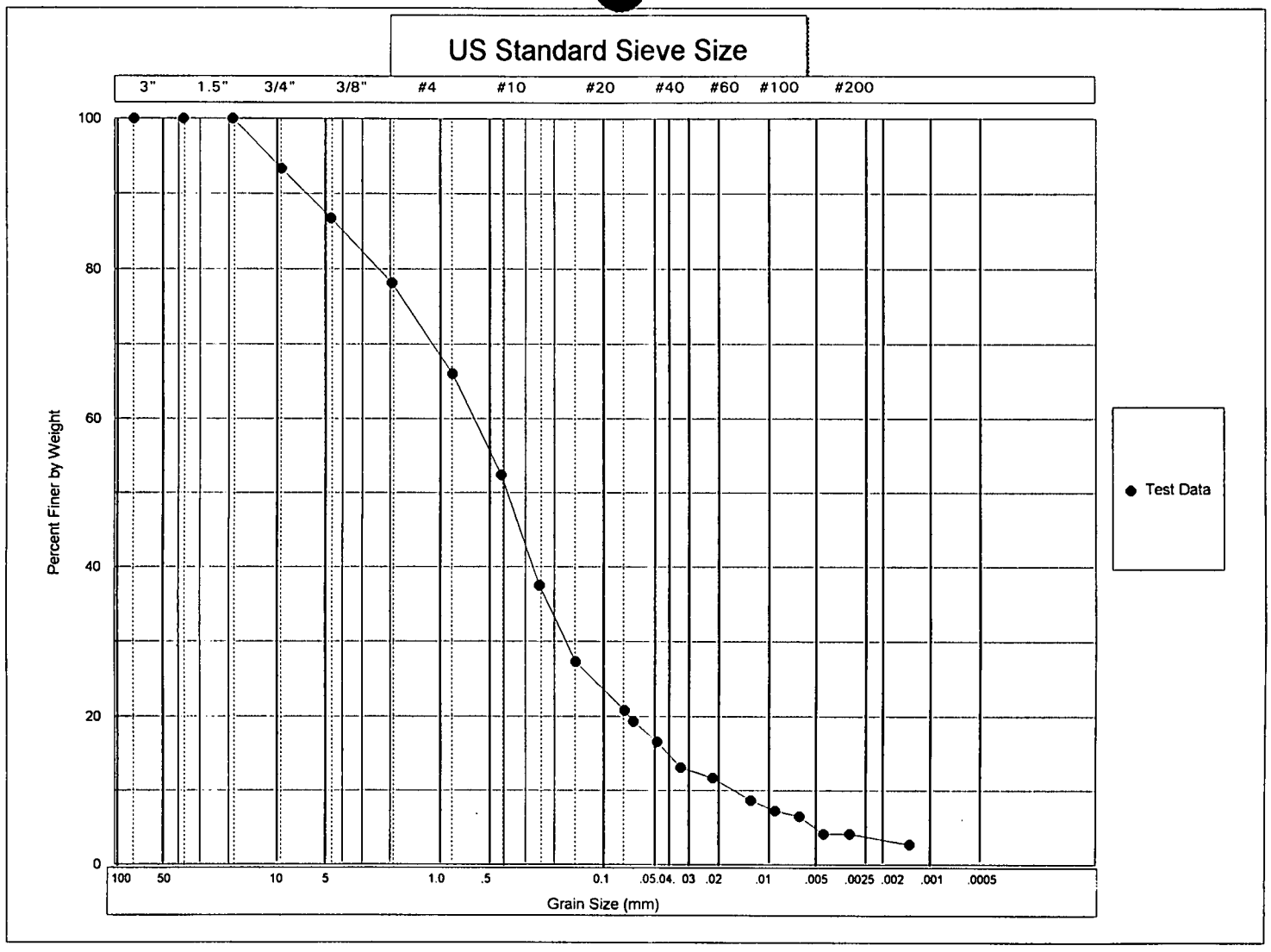
WENTWORTH

Client: SAIC / Parsons PO177 Boring No.: 11112 Sample No.: 30920A11112-05, -03

Depth: 5.5-6.0', 7.5-8.0' Job Number: 2059-19

Classification: Well Graded Sand with Gravel (SW)

Advanced Terra Testing, Inc.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	CRS	MEDIUM	FINE	

USCS

COBBLES TO BOULDERS	PEBBLE GRAVEL				SAND			SILT	CLAY
	COARSE	MED	FINE	GRAN	COARSE	MED	FINE		

WENTWORTH

Client: SAIC / Parsons PO177 Boring No.: 11211 Sample No.: 30915A11211-13,-16,-17,-19

Depth: 9.5-10.0,11.0-12.0,12.5-13.0' Job Number: 2059-19

Classification: Well Graded Sand with Silt and Gravel (SW-SM)

Advanced Terra Testing, Inc.

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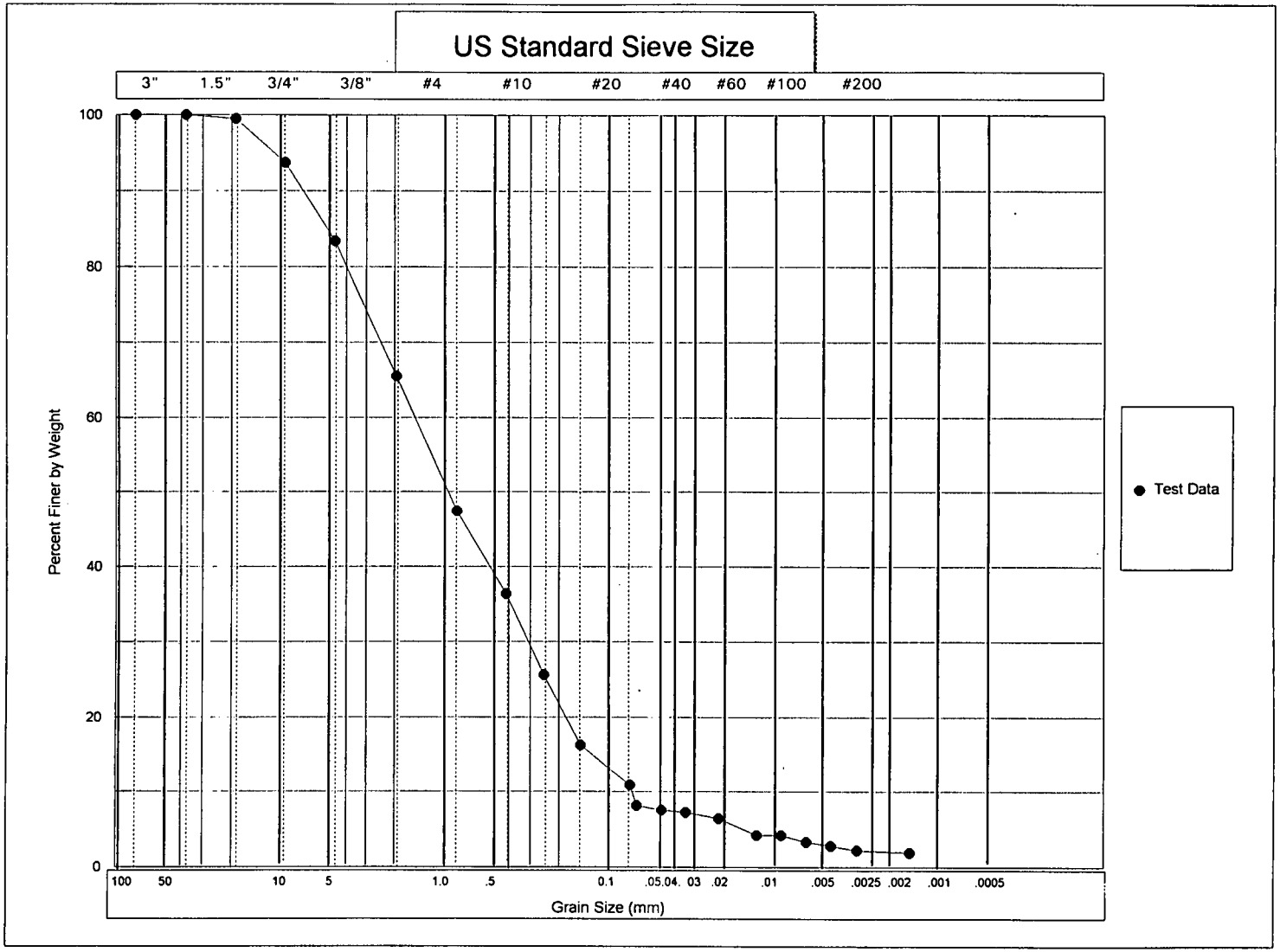


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	CRS	MEDIUM	FINE	

USCS

COBBLES TO BOULDERS	PEBBLE GRAVEL				SAND			SILT	CLAY
	COARSE	MED	FINE	GRAN	COARSE	MED	FINE		

WENTWORTH

Client: SAIC / Parsons PO177 Boring No.: 11115 Sample No.: 30915A11115-17,-18,-20,-21

Depth: 12.0-13.0', 13.5-14.5' Job Number: 2059-19

Classification: Poorly Graded Sand with Silt and Gravel (SP-SM)

Advanced Terra Testing, Inc.

Typical Grain-Size Curves

from PO-177 Investigation

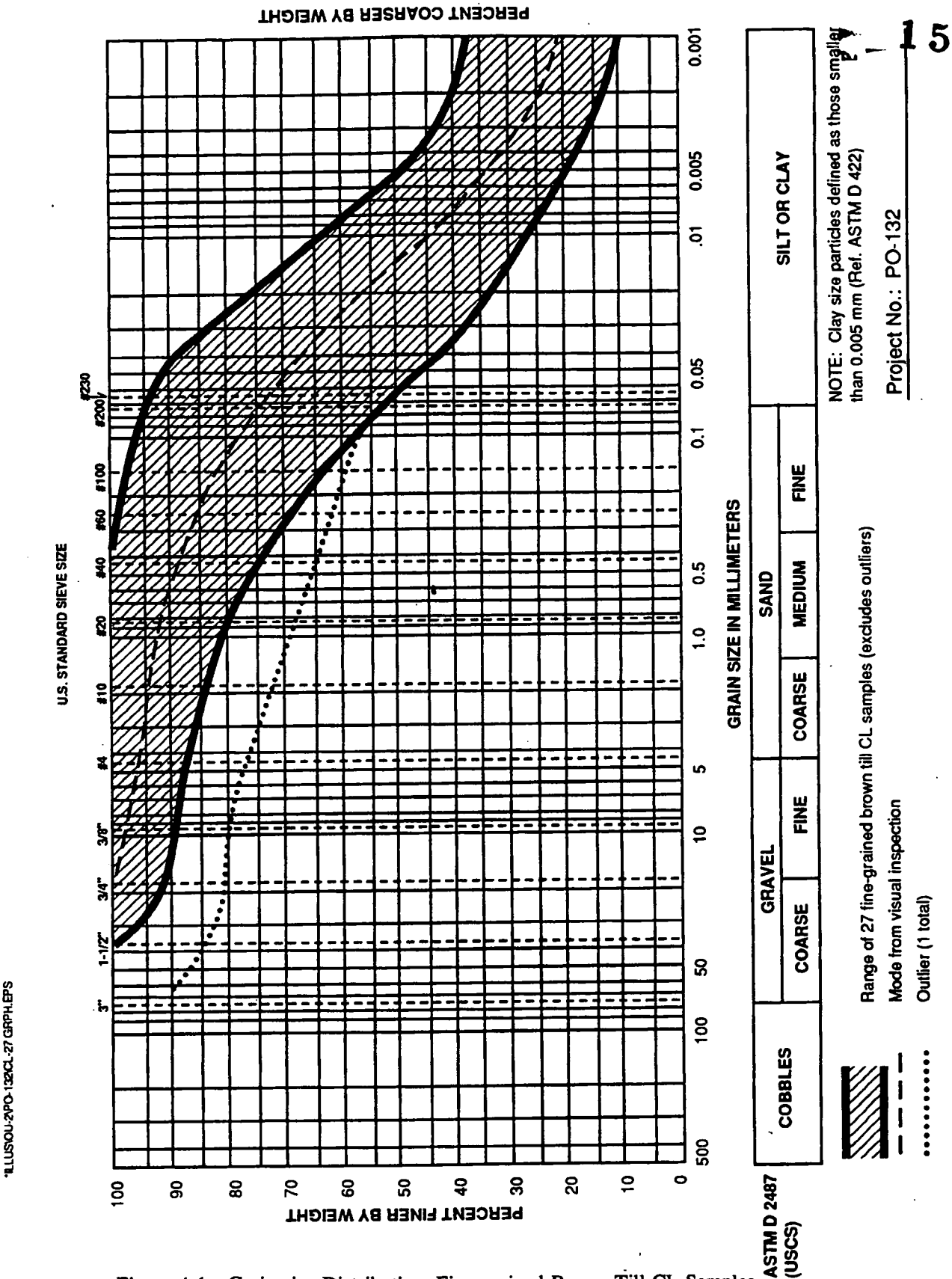


Figure 4-1 - Grain-size Distribution, Fine-grained Brown Till CL Samples

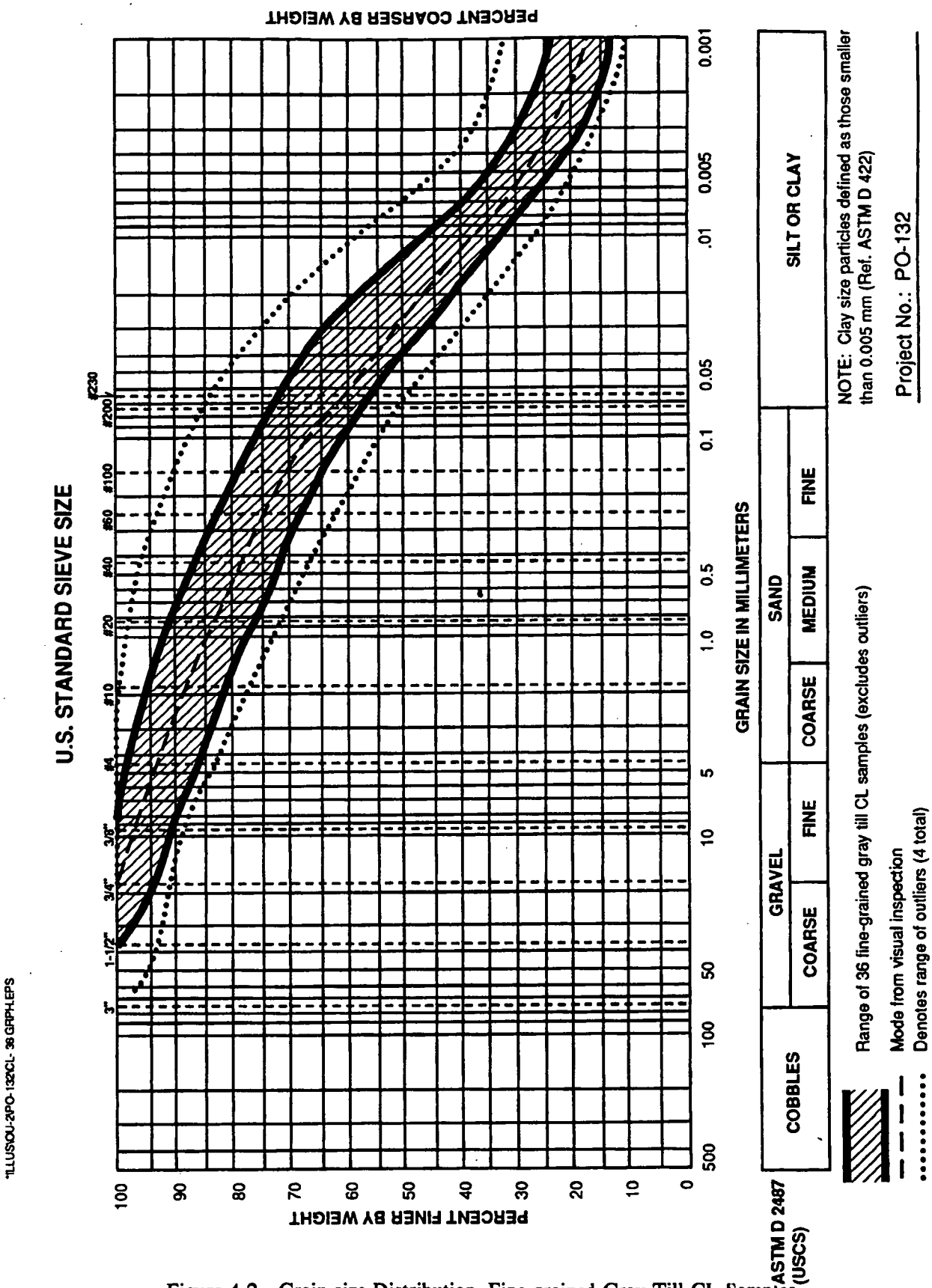


Figure 4-2 - Grain-size Distribution, Fine-grained Gray Till CL Samples

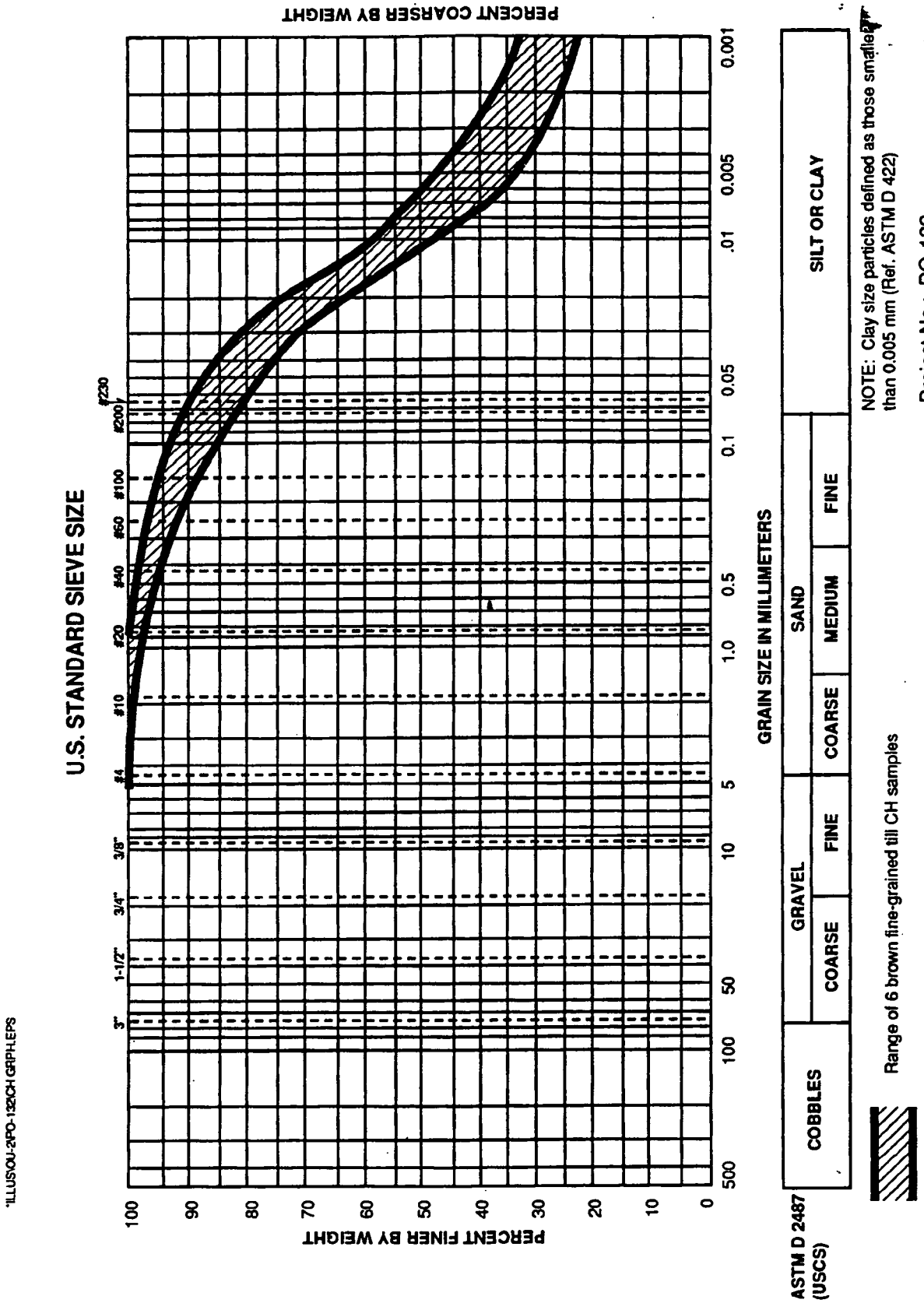


Figure 4-3 - Grain-size Distribution, Fine-grained Brown Till CH Samples

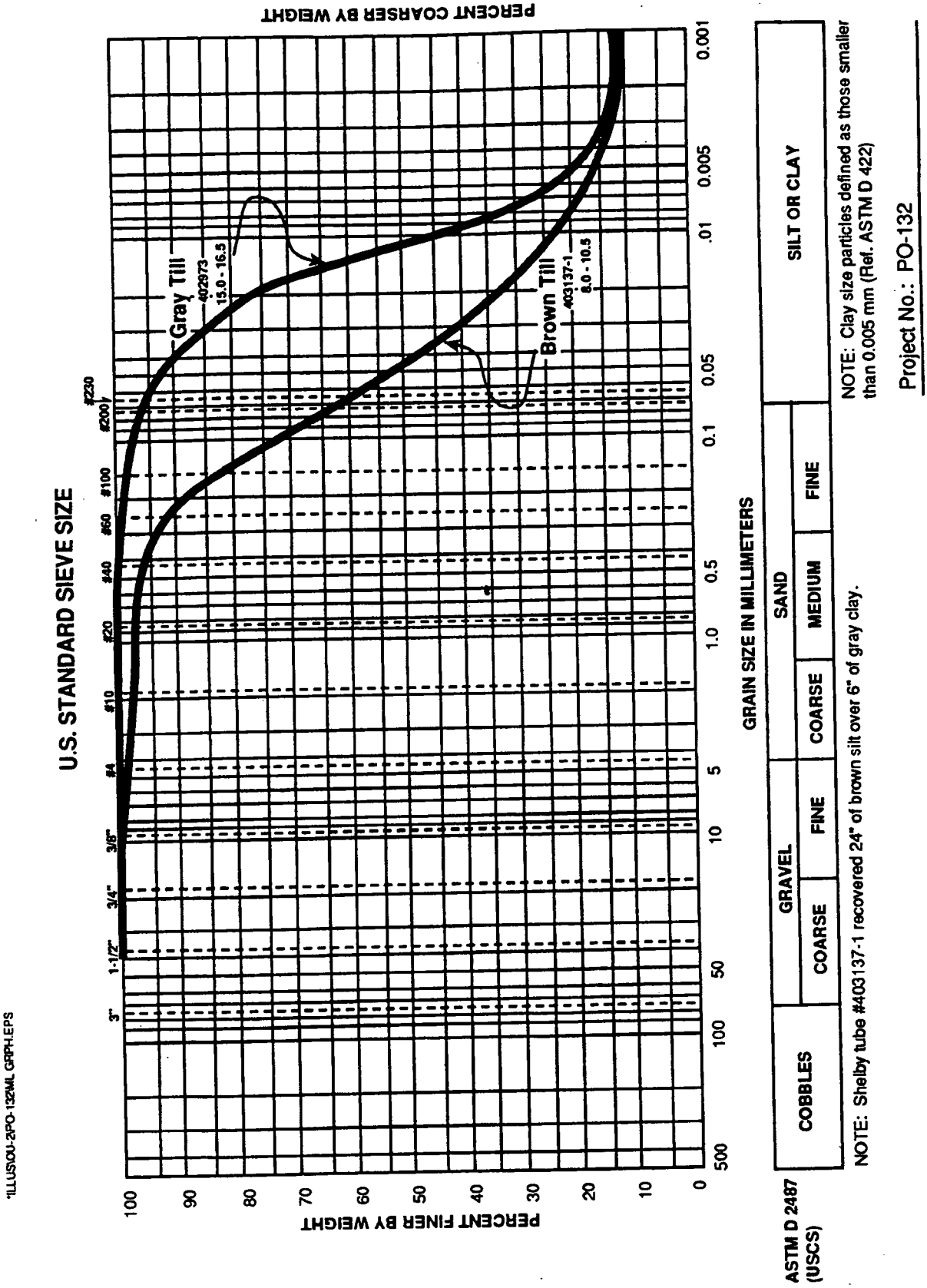
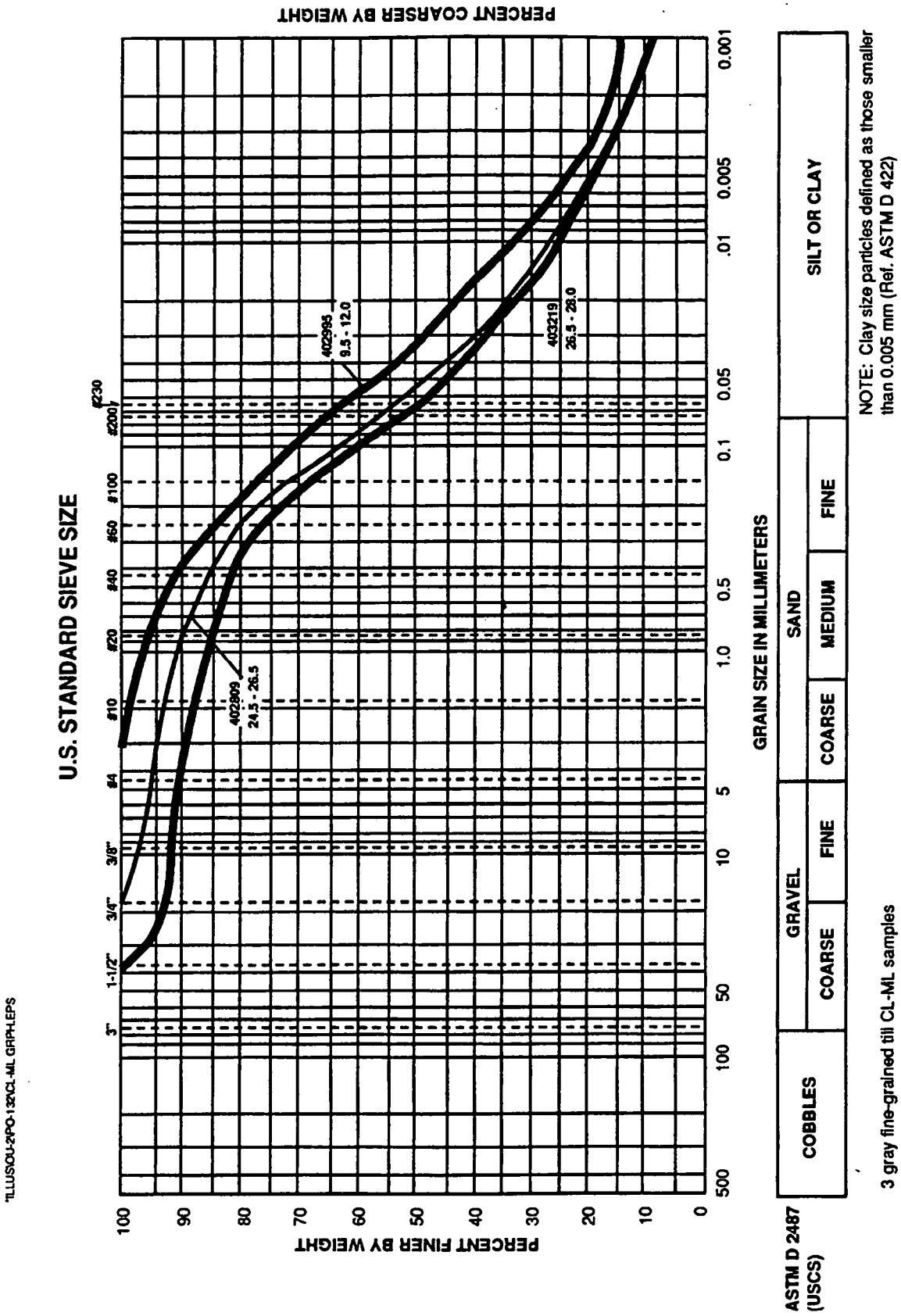


Figure 4-4 - Grain-size Distribution, Fine-grained Brown Till ML Samples



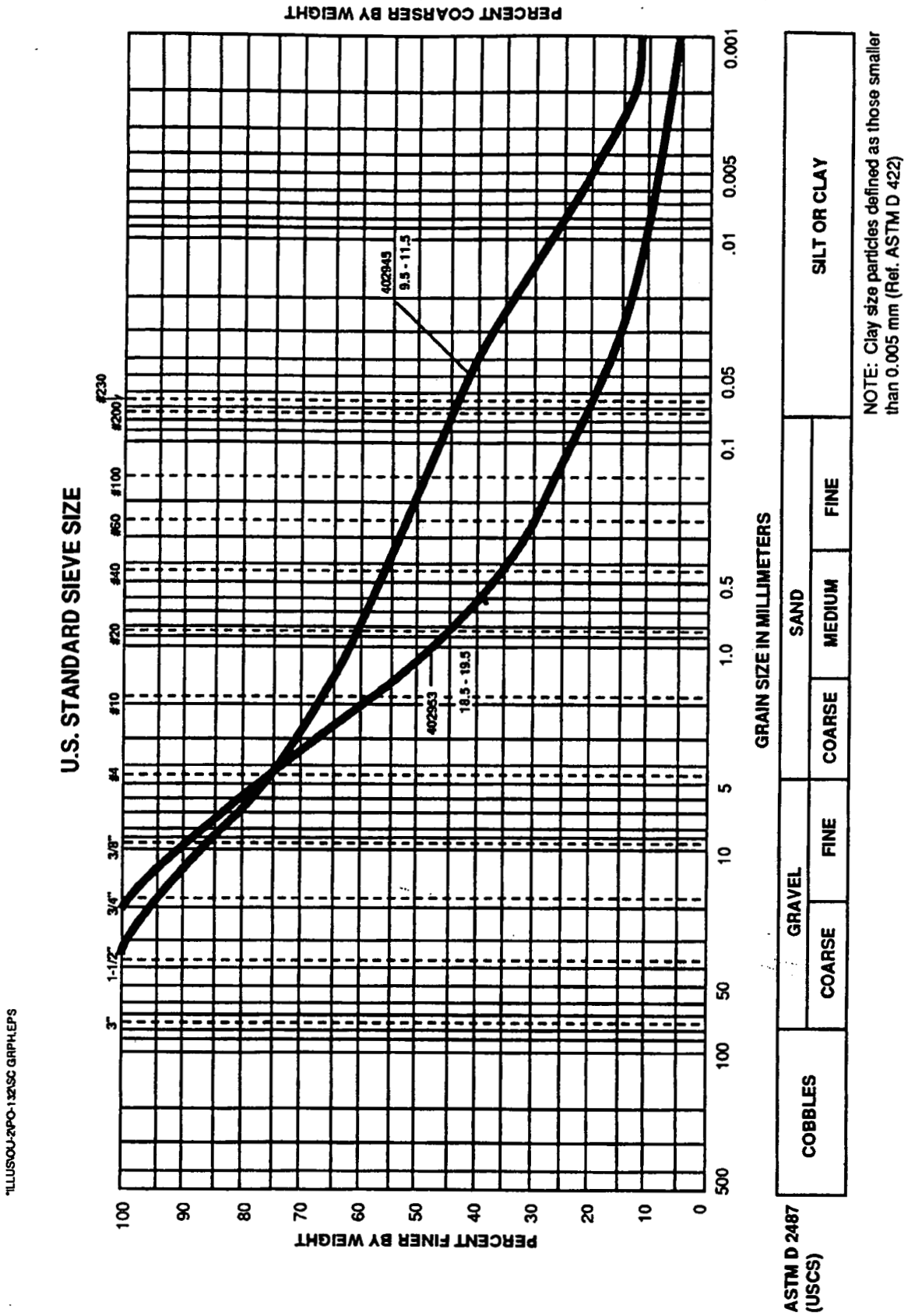
NOTE: Clay size particles defined as those smaller than 0.005 mm (Ref. ASTM D 422)

Project No.: PO-132

3 gray fine-grained till CL-ML samples

"LLUS\OU-2\PO-132\CL-ML GRPH.EPS

Figure 4-5 - Grain-size Distribution, Fine-grained Gray Till CL-ML Samples

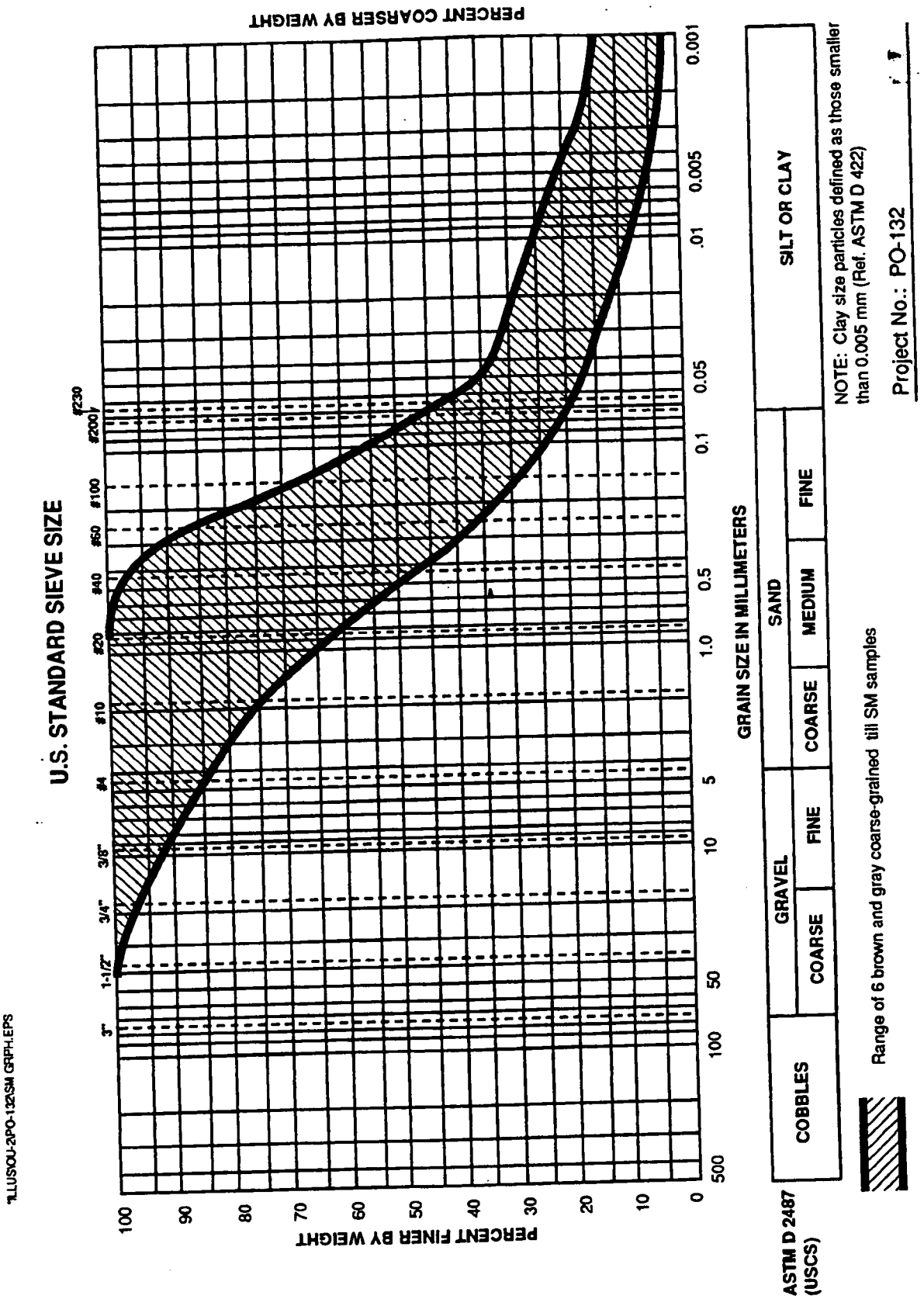


NOTE: Clay size particles defined as those smaller than 0.005 mm (Ref. ASTM D 422)

Project No.: PO-132

"ILLUS\OU-2\PO-132\SC GRPH.EPS

Figure 4-6 - Grain-size Distribution, Coarse-grained Brown Till SC Samples



"LLUSOU-2\PO-132\SM GRPH.EPS

Figure 4-7 - Grain-size Distribution, Coarse-grained Brown and Gray SM Samples

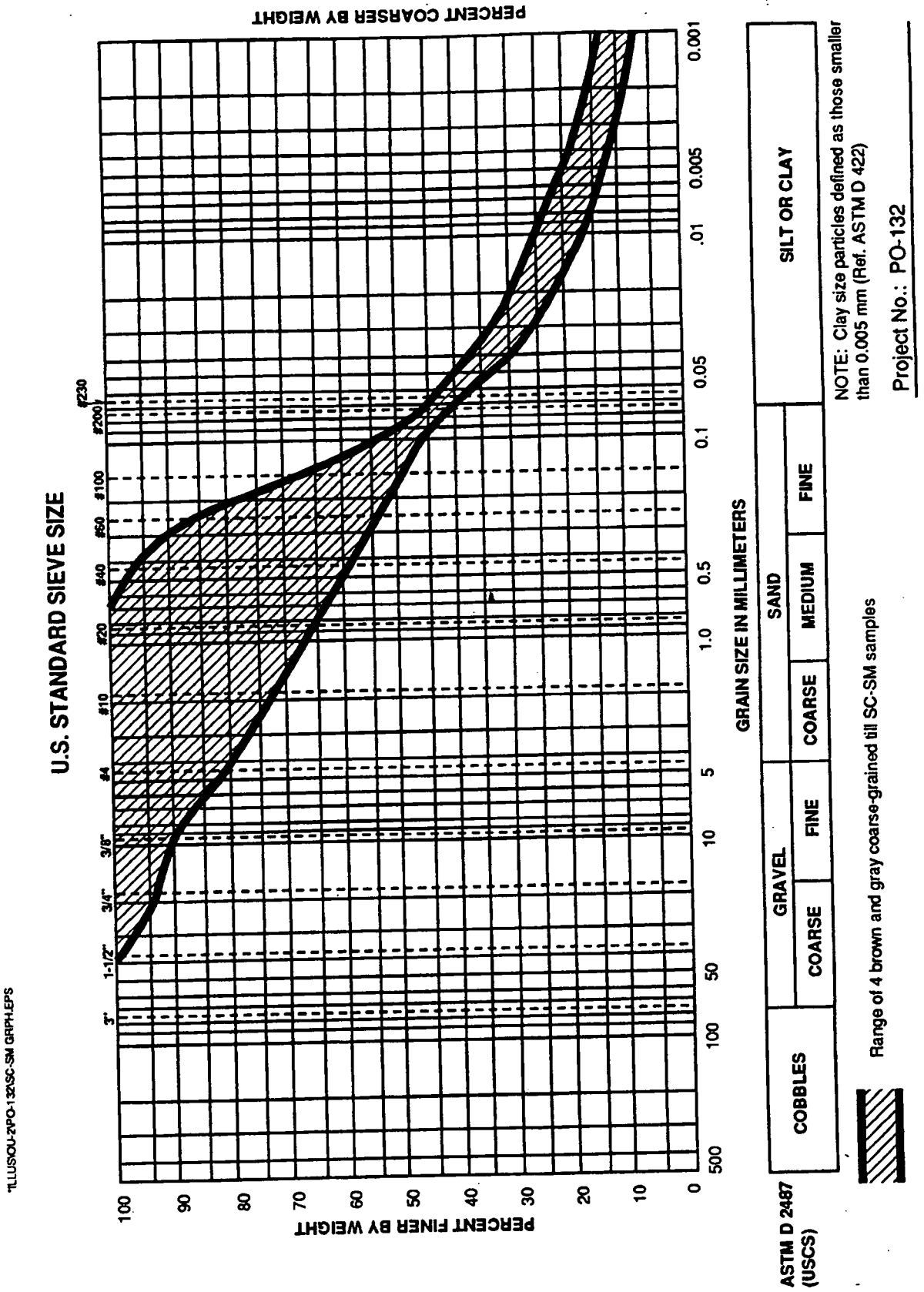


Figure 4-8 - Grain-size Distribution, Coarse-grained Brown and Gray SC-SM Samples

APPENDIX F

APPENDIX F

SUMMARY TABLES - GEOTECHNICAL LABORATORY TEST DATA FROM PO-177 GEOTECHNICAL INVESTIGATION

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TABLE F-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
NE	12266	G3-001	412462	SS	3.5	5.0	25.9	PO-177
NE	12266	G3-001	412463	ST	5.0	7.0	25.0	PO-177
NE	12266	G3-001	412464	SS	7.0	9.0	20.2	PO-177
NE	12266	G3-001	412465	SS	9.0	11.0	21.7	PO-177
NE	12266	G3-001	412466	ST	11.0	13.0	26.0	PO-177
NE	12266	G3-001	412468	SS	13.0	15.0	16.2	PO-177
NE	12266	G3-001	412469	SS	15.0	17.0	12.0	PO-177
NE	12266	G3-001	412470	SS	17.0	19.0	17.2	PO-177
NE	12266	G3-001	412471	SS	19.0	21.0	13.5	PO-177
NE	12266	G3-001	412472	SS	21.0	22.5	17.3	PO-177
NE	12266	G3-001	412473	SS	22.5	24.0	17.1	PO-177
NE	12266	G3-001	412474	ST	24.0	26.0	16.2	PO-177
NW	12267	G3-002	412349	SS	1.0	3.0	17.7	PO-177
NW	12267	G3-002	412351	SS	3.0	5.0	23.5	PO-177
NW	12267	G3-002	412352	SS	5.0	7.0	14.1	PO-177
NW	12267	G3-002	412353	SS	7.0	9.0	16.9	PO-177
NW	12267	G3-002	412354	ST	9.0	11.0	17.6	PO-177
NW	12267	G3-002	412355	SS	11.0	13.0	17.3	PO-177
NW	12267	G3-002	412357	SS	13.0	15.0	13.7	PO-177
NW	12267	G3-002	412358	DM	15.0	17.0	15.0	PO-177
NW	12267	G3-002	412360	SS	19.5	21.0	15.0	PO-177
NW	12267	G3-002	412361	ST	21.0	23.0	12.0	PO-177
NW	12267	G3-002	412362	SS	23.0	25.0	2.0	PO-177
NE	12268	G3-003	412301	SS	1.0	3.0	10.2	PO-177
NE	12268	G3-003	412302	SS	3.0	5.0	12.6	PO-177
NE	12268	G3-003	412303	ST	5.0	7.0	14.4	PO-177
NE	12268	G3-003	412304	SS	7.0	9.0	12.0	PO-177
NE	12268	G3-003	412305	D	9.0	11.0	6.7	PO-177
NE	12268	G3-003	412306	SS	11.0	13.0	10.8	PO-177
NE	12268	G3-003	412307	D	13.0	15.0	8.3	PO-177
NE	12268	G3-003	412308	SS	17.0	19.0	13.1	PO-177
NE	12268	G3-003	412309	SS	19.0	21.0	8.5	PO-177
NE	12268	G3-003	412310	D	21.0	23.0	6.3	PO-177
NE	12268	G3-003	412311	SS	23.0	25.0	14.5	PO-177
NW	12269	G3-004	412383	SS	1.0	3.0	13.2	PO-177
NW	12269	G3-004	412384	SS	3.0	5.0	21.8	PO-177
NW	12269	G3-004	412385	ST	5.0	7.0	26.1	PO-177
NW	12269	G3-004	412386	SS	7.0	9.0	1.9	PO-177
NW	12269	G3-004	412387	SS	9.0	11.0	22.8	PO-177
NW	12269	G3-004	412389	SS	13.0	15.0	20.6	PO-177
NW	12269	G3-004	412393	SS	17.0	19.0	22.1	PO-177
NW	12269	G3-004	412395	SS	19.0	21.0	23.4	PO-177
NW	12269	G3-004	412398	SS	21.0	23.0	15.4	PO-177
NW	12269	G3-004	412400	DM	26.0	27.5	9.8	PO-177
NW	12269	G3-004	412402	DM	27.5	29.0	10.0	PO-177
SW	12270	G3-005	412419	SS	1.0	3.0	11.8	PO-177
SW	12270	G3-005	412420	DM	3.0	5.0	18.0	PO-177
SW	12270	G3-005	412422	SS	5.0	7.0	23.2	PO-177
SW	12270	G3-005	412423	SS	7.0	9.0	8.1	PO-177
SW	12270	G3-005	412424	SS	9.0	10.5	19.8	PO-177
SW	12270	G3-005	412425	SS	12.0	13.5	17.0	PO-177
SW	12270	G3-005	412428	SS	15.5	17.0	16.4	PO-177
SW	12270	G3-005	412429	SS	17.0	19.0	15.6	PO-177
SW	12270	G3-005	412430	SS	19.0	21.0	2.1	PO-177
SW	12270	G3-005	412431	SS	21.0	23.0	19.7	PO-177
SW	12270	G3-005	412433	SS	25.0	27.0	13.2	PO-177
SW	12270	G3-005	412434	3"SS	27.0	29.0	10.3	PO-177
SW	12271	G3-006	412365	SS	1.0	3.0	2.2	PO-177
SW	12271	G3-006	412368	SS	5.0	7.0	22.1	PO-177
SW	12271	G3-006	412369	ST	7.0	9.0	25.0	PO-177
SW	12271	G3-006	412370	SS	9.0	11.0	25.8	PO-177
SW	12271	G3-006	412371	SS	11.0	13.0	20.2	PO-177
SW	12271	G3-006	412375	DM	15.0	17.0	11.1	PO-177
SW	12271	G3-006	412377	SS	17.0	19.0	11.0	PO-177

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TABLE F-1
Summary of Moisture Content
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Sample Moisture Content (%)	Reference
SW	12271	G3-006	412378	SS	19.0	21.0	5.9	PO-177
SW	12271	G3-006	412379	SS	21.0	23.0	13.9	PO-177
SW	12271	G3-006	412380	ST	23.0	25.0	13.0	PO-177
SW	12271	G3-006	412381	ST	25.0	27.0	9.5	PO-177
SW	12272	G3-007	412312	SS	1.0	3.0	15.8	PO-177
SW	12272	G3-007	412313	SS	3.0	5.0	24.2	PO-177
SW	12272	G3-007	412314	SS	5.0	7.0	21.3	PO-177
SW	12272	G3-007	412315	SS	9.0	11.0	24.1	PO-177
SW	12272	G3-007	412316	SS	11.0	13.0	20.9	PO-177
SW	12272	G3-007	412317	SS	13.0	15.0	18.1	PO-177
SW	12272	G3-007	412318	D	15.0	17.0	17.6	PO-177
SW	12272	G3-007	412319	DM	17.0	19.0	11.5	PO-177
SW	12272	G3-007	412321	ST	19.0	21.0	15.7	PO-177
SW	12272	G3-007	412322	SS	21.0	22.5	13.7	PO-177
SW	12272	G3-007	412324	ST	23.0	25.0	11.0	PO-177
SW	12272	G3-007	412325	SS	25.0	26.5	11.2	PO-177
SW	12272	G3-007	412326	ST	26.5	28.0	13.8	PO-177
SW	12273	G3-008	412331	SS	3.0	5.0	7.5	PO-177
SW	12273	G3-008	412332	ST	5.0	7.0	19.4	PO-177
SW	12273	G3-008	412333	SS	7.0	9.0	18.7	PO-177
SW	12273	G3-008	412336	SS	9.0	11.0	21.4	PO-177
SW	12273	G3-008	412338	SS	11.0	13.0	21.3	PO-177
SW	12273	G3-008	412339	SS	13.0	15.0	21.7	PO-177
SW	12273	G3-008	412340	SS	15.0	17.0	22.4	PO-177
SW	12273	G3-008	412341	ST	17.0	19.0	16.5	PO-177
SW	12273	G3-008	412343	SS	19.0	21.0	2.2	PO-177
SW	12273	G3-008	412345	SS	23.0	25.0	12.4	PO-177
SE	12274	G3-009	412407	SS	1.0	3.0	8.8	PO-177
SE	12274	G3-009	412408	SS	3.0	5.0	22.9	PO-177
SE	12274	G3-009	412409	ST	5.0	7.0	24.0	PO-177
SE	12274	G3-009	412410	ST	7.0	9.0	11.4	PO-177
SE	12274	G3-009	412411	SS	9.0	11.0	9.2	PO-177
SE	12274	G3-009	412413	DM	11.0	12.5	4.2	PO-177
SE	12274	G3-009	412414	DM	13.0	14.5	12.9	PO-177
SE	12274	G3-009	412416	D	17.0	19.0	11.0	PO-177
SW	12275	G3-010	412437	SS	1.0	3.0	19.0	PO-177
SW	12275	G3-010	412438	SS	3.0	5.0	17.6	PO-177
SW	12275	G3-010	412439	ST	5.0	7.0	23.3	PO-177
SW	12275	G3-010	412440	SS	7.0	9.0	21.7	PO-177
SW	12275	G3-010	412442	SS	9.0	11.0	21.7	PO-177
SW	12275	G3-010	412443	ST	11.0	13.0	22.2	PO-177
SW	12275	G3-010	412444	SS	13.0	15.0	23.0	PO-177
SW	12275	G3-010	412445	SS	15.0	17.0	23.5	PO-177
SW	12275	G3-010	412446	SS	17.0	19.0	24.0	PO-177
SW	12275	G3-010	412447	ST	19.0	21.0	9.7	PO-177

Notes:

1. Area:
   - NE Northeast Quadrant of Former Plant Area
   - NW Northwest Quadrant of Former Plant Area
   - SE Southeast Quadrant of Former Plant Area
   - SW Southwest Quadrant of Former Plant Area
2. Sample Type:
   - D Denison Sampler
   - DM Dames and Moore Sampler
   - SS Split Spoon
   - 3" SS 3" Split Spoon
   - ST Shelby Tube
3. Reference:
   - PO177 Former Plant Area Geotechnical Investigation, Geotechnical Laboratory Data Report, PARSONS PO177, September 1997

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TABLE F-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color (3)	General Stratum	USCS Name (4)	USCS Symbol (4)	Sample Moisture Content (%)	Atterberg Limits LL (5)	PL (5)	PI (5)	Grain Size Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	D10 (6)	D30	D60	Specific Gravity (7)	Reference
NE	12266	G3-001	412463	ST	5.0	7.0	Olive Brown	Brown Clay	Lean Clay with Sand	CL	25.0	29.2	17.4	11.8	0.2	15.7	84.1	20.0		0.006	0.022	2.78	PO-177
NE	12266	G3-001	412465	SS	9.0	11.0	Greenish Gray	Lacustrine	Lean Clay	CL	21.7	22.5	14.2	8.3	0.0	13.4	86.6	20.0		0.006	0.04	2.74	PO-177
NE	12266	G3-001	412466	ST	11.0	13.0	Dark Greenish Gray	Gray Till	Lean Clay with Sand	CL	26.0	24.6	15.2	9.4	5.8	20.0	74.2	21.5		0.0048	0.035	2.78	PO-177
NE	12266	G3-001	412469	SS	15.0	17.0	Dark Greenish Gray	Gray Till	Lean Clay with Sand (V)	CL (V)	12.0												PO-177
NE	12266	G3-001	412470	SS	17.0	19.0	Dark Greenish Gray	Muddy Stream	Silty Sand	SM	17.2	NP	NP	NP	3.3	75.5	21.2	3.0	0.044	0.16	0.37	2.79	PO-177
NE	12266	G3-001	412471	SS	19.0	21.0	Dark Greenish Gray	Lacustrine	Well-graded Sand with Clay (V)	SW-SC (V)	13.5												PO-177
NE	12266	G3-001	412474	ST	24.0	26.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay with Gravel	CL	16.2	27.9	15.3	12.6	19.2	22.0	58.8	20.5		0.006	0.1	2.81	PO-177
NW	12267	G3-002	412351	SS	3.0	5.0	Dark Yellowish Brown	Brown Clay	Lean Clay with Sand	CL	23.5	45.9	14.2	31.7	5.7	15.2	79.2	28.5		0.0035	0.025	2.76	PO-177
NW	12267	G3-002	412352	SS	5.0	7.0	Olive Yellow	Brown Clay	Lean Clay with Sand	CL	14.1	27.0	15.0	12.0	4.0	16.7	79.3	21.5		0.006	0.025	2.76	PO-177
NW	12267	G3-002	412353	SS	7.0	9.0	Light Olive Brown	Brown Clay	Lean Clay with Sand	CL	16.9	25.3	15.2	10.1	3.2	12.3	84.5	28.2		0.0075	0.024	2.81	PO-177
NW	12267	G3-002	412354	ST	9.0	11.0	Light Olive Brown	Brown Clay	Lean Clay	CL	17.6	24.9	17.6	7.3	6.8	7.2	86.0	12.5	0.0013	0.0075	0.02	2.78	PO-177
NW	12267	G3-002	412357	SS	13.0	15.0	Dark Greenish Gray	Gray Till	Lean Clay with Sand	CL	13.7	23.2	13.3	9.9	7.5	20.4	72.1	18.0		0.008	0.05	2.78	PO-177
NW	12267	G3-002	412358	DM	15.0	17.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	15.0	26.3	13.3	13.0	8.2	22.4	69.4	22.0		0.0045	0.043	2.77	PO-177
NW	12267	G3-002	412361	ST	21.0	23.0	Greenish Gray	Gray Till	Sandy Lean Clay	CL	12.0	22.3	12.9	9.4	12.9	30.6	56.5	16.0		0.0095	0.12	2.76	PO-177
NW	12267	G3-002	412362	SS	23.0	25.0	Greenish Gray	Gray Till	Sandy Lean Clay (V)	CL (V)	2.0												PO-177
NE	12268	G3-003	412303	ST	5.0	7.0	Light Olive Brown	Brown Clay	Sandy Lean Clay	CL	14.4	26.4	14.9	11.5	4.3	26.1	69.6	21.0		0.0055	0.044	2.81	PO-177
NE	12268	G3-003	412305	D	9.0	11.0	Dark Greenish Gray	Gray Till	Clayey Sand with Gravel	SC	6.7	19.1	11.8	7.3	16.3	43.5	40.2	11.5	0.0014	0.033	0.42	2.78	PO-177
NE	12268	G3-003	412307	D	13.0	15.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	8.3	19.9	12.2	7.7	3.9	45.5	50.6	13.2		0.013	0.22	2.80	PO-177
NE	12268	G3-003	412310	D	21.0	23.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	6.3	21.7	13.4	8.3	13.7	35.7	50.6	14.5		0.011	0.25	2.82	PO-177
NW	12269	G3-004	412385	ST	5.0	7.0	Dark Greenish Gray/LOB	Brown Clay	Fat Clay	CH	26.1	57.0	18.1	38.9	0.0	1.2	98.8	42.0			0.0056	2.75	PO-177
NW	12269	G3-004	412389	SS	13.0	15.0	Light Olive Brown/Greenish Gray	Brown Clay/Gray Till	Lean Clay	CL	20.6	23.8	14.7	9.1	0.2	6.6	93.2	20.5		0.0065	0.19	2.73	PO-177
NW	12269	G3-004	412391	SS	15.0	17.0	Dark Yellowish Brown	Muddy Stream	Poorly Graded Sand with Silt	SP-SM		NP	NP	NP	0.3	93.2	6.5	1.8	0.1	0.26	0.515	2.75	PO-177
NW	12269	G3-004	412392	BULK	13.0	29.0	Brown/Gray	Muddy Stream/Gray Till	Silty, Clayey Sand	SC-SM		17.5	11.6	5.9	3.1	49.0	47.9	11.0	0.0013	0.023	0.16	2.81	PO-177
NW	12269	G3-004	412393	SS	17.0	19.0	Dark Yellowish Brown	Muddy Stream	Silty Sand	SM	22.1	NP	NP	NP	0.4	83.3	16.3	3.5	0.055	0.13	0.25	2.74	PO-177
NW	12269	G3-004	412395	SS	19.0	21.0	Dark Yellowish Brown	Muddy Stream	Silty Sand	SM	23.4	NP	NP	NP	0.5	85.1	14.1	3.0	0.065	0.12	0.21	2.73	PO-177
NW	12269	G3-004	412398	SS	21.0	23.0	Gray	Gray Till	Sandy Lean Clay	CL	15.4	20.6	12.5	8.1	9.0	25.8	65.2	17.0		0.009	0.06	2.76	PO-177
NW	12269	G3-004	412400	DM	26.0	27.5	Gray	Gray Till	Sandy Lean Clay	CL	9.8	24.3	13.7	10.6	11.1	30.6	58.3	16.5		0.0095	0.08	2.75	PO-177
NW	12269	G3-004	412402	DM	27.5	29.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	10.0	24.1	13.1	11.0	6.3	31.2	62.5	19.0		0.007	0.06	2.73	PO-177
SW	12270	G3-005	412420	DM	3.0	5.0	Light Olive Brown	Brown Clay	Lean Clay with Sand	CL	18.0	35.9	18.0	17.9	4.3	20.0	75.7	26.5		0.0035	0.03	2.76	PO-177
SW	12270	G3-005	412424	SS	9.0	10.5	Light Olive Brown	Lacustrine	Lean Clay	CL	19.8	26.5	15.8	10.7	0.0	4.9	95.1	22.3		0.0045	0.017	2.76	PO-177
SW	12270	G3-005	412426	SS	13.5	15.5	Brown/Gray	Muddy Stream	Silty Sand	SM		NP	NP	NP	8.3	63.0	28.7	3.1	0.018	0.078	0.32	2.74	PO-177
SW	12270	G3-005	412429	SS	17.0	19.0	Greenish Gray	Lacustrine	Sandy Silt	ML	15.6	NP	NP	NP	8.2	37.1	54.7	5.0	0.011	0.033	0.09	2.56	PO-177
SW	12270	G3-005	412431	SS	21.0	23.0	Dark Greenish Gray	Lacustrine	Silty Sand	SM	19.7	NP	NP	NP	4.8	47.8	47.4	2.5	0.021	0.055	0.1	2.78	PO-177
SW	12270	G3-005	412434	3"SS	27.0	29.0	Greenish Gray	Muddy Stream/Gray Till	Sandy Lean Clay	CL	10.3	22.0	12.4	9.6	10.8	33.1	56.1	16.5		0.012	0.011	2.73	PO-177
SW	12271	G3-006	412369	ST	7.0	9.0	Greenish Gray	Brown Clay	Fat Clay	CH	25.0	51.7	20.6	31.1	0.0	2.4	97.6	39.0			0.009	2.72	PO-177
SW	12271	G3-006	412371	SS	11.0	13.0	Light Olive Brown	Brown Till?	Sandy Lean Clay	CL	20.2	30.7	15.0	15.7	12.1	19.4	68.5	23.5		0.004	0.032	2.75	PO-177
SW	12271	G3-006	412374	SS	13.0	15.0	Olive Brown	Muddy Stream	Clayey Sand (V)	SC (V)													PO-177
SW	12271	G3-006	412375	DM	15.0	17.0	Olive Brown	Muddy Stream	Clayey Sand	SC	11.1	20.7	12.0	8.7	13.3	40.3	46.4	16.0		0.011	0.22	2.71	PO-177
SW	12271	G3-006	412376	DM	15.0	17.0	Olive Brown	Muddy Stream	Clayey Sand (V)	SC (V)													PO-177
SW	12271	G3-006	412377	SS	17.0	19.0	Olive Brown	Muddy Stream	Silty Sand	SM	11.0	12.6	11.5	1.1	11.2	55.3	33.5	7.5	0.0045	0.065	0.3	2.74	PO-177
SW	12271	G3-006	412381	ST	25.0	27.0	Greenish Gray	Gray Till	Sandy Lean Clay	CL	9.5	23.2	13.0	10.2	11.1	31.0	57.9	15.2		0.011	0.09	2.77	PO-177
SW	12272	G3-007	412315	SS	9.0	11.0	Light Olive Brown	Brown Clay	Lean Clay	CL	24.1	29.1	16.5	12.6	0.0	6.6	93.4	23.5		0.0045	0.021	2.73	PO-177
SW	12272	G3-007	412316	SS	11.0	13.0	Light Olive Brown	Lacustrine	Silt with Sand	ML	20.9	NP	NP	NP	0.0	25.7	74.3	10.0	0.002	0.02	0.055	2.75	PO-177
SW	12272	G3-007	412318	D	15.0	17.0	Greenish Gray	Muddy Stream	Silty Sand	SM	17.6	NP	NP	NP	0.0	79.5	20.5	2.0	0.06	0.09	0.18	2.68	PO-177
SW	12272	G3-007	412321	ST	19.0	21.0	Dark Greenish Gray	Muddy Stream/Gray Till	Sandy Lean Clay	CL	15.7	24.6	12.6	12.0	11.8	31.9	56.3	18.5		0.007	0.1	2.77	PO-177
SW	12272	G3-007	412324	ST	23.0	25.0	Gray	Gray Till	Sandy Lean Clay	CL	11.0	24.3	14.0	10.3	5.4	31.0	63.6	18.3		0.0075	0.065	2.77	PO-177
SW	12273	G3-008	412332	ST	5.0	7.0	Brownish Yellow	Brown Clay	Lean Clay	CL	19.4	33.4	17.6	15.8	0.0	1.8	98.2	27.0		0.003	0.013	2.77	PO-177
SW	12273	G3-008	412334	SS	7.0	9.0	Light Olive Brown	Muddy Stream	Silty Sand	SM		NP	NP	NP	0.0	57.2	42.8	9.0	0.003	0.06	0.1	2.75	PO-177
SW	12273	G3-008	412336	SS	9.0	11.0	Light Olive Brown	Muddy Stream	Sandy Silt	ML	21.4	NP	NP	NP	2.9	41.6	55.5	7.0	0.005	0.038	0.08	2.76	PO-177
SW	12273	G3-008	412341	ST	17.0	19.0	Dark Grayish Brown	Muddy Stream	Sandy Silt	ML	16.5	NP	NP	NP	0.3	33.9	65.8	8.8	0.003	0.012	0.065	2.80	PO-177
SW	12273	G3-008	412342	BULK	17.0	19.0	Dark Grayish Brown	Muddy Stream	Lean Clay	CL		28.9	16.1	12.8	2.4	7.8	89.8	27.0		0.003	0.014	2.76	PO-177
SE	12274	G3-009	412409	ST	5.0	7.0	Light Olive Brown	Brown Clay	Lean Clay	CL	24.0	41.3	20.1	21.2	0.0	2.1	97.9	33.5		0.0014	0.0075	2.73	PO-177
SE	12274	G3-009	412410	ST	7.0	9.0	Light Olive Brown	Brown Clay	Sandy Lean Clay	CL	11.4	30.6	16.7	13.9	5.7	25.5	68.8	21.2		0.0055	0.048	2.74	PO-177
SE	12274	G3-009	412414	DM	13.0	14.5	Dark Greenish Gray	Gray Till	Gravelly Lean Clay with Sand	CL	12.9	27.0	14.1	12.9	21.7	17.7	60.6	19.0		0.006	0.007	2.77	PO-177
SW	12275	G3-010	412439	ST	5.0	7.0	Light Olive Brown	Brown Clay	Lean Clay with Sand	CL	23.3	45.4	17.6	27.8	0.0	18.4	81.6	29.5		0.0022	0.018	2.68	PO-177

TABLE F-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color (3)	General Stratum	USCS Name (4)	USCS Symbol (4)	Sample Moisture Content (%)	Atterberg Limits LL (5)	PL (5)	PI (5)	Grain Size Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	D10 (6)	D30	D60	Specific Gravity (7)	Reference
SW	12275	G3-010	412443	ST	11.0	13.0	Light Olive Brown	Brown Clay	Lean Clay	CL	22.2	26.5	15.3	11.2	0.0	6.8	93.2	24.0		0.0035	0.017	2.75	PO-177
SW	12275	G3-010	412444	SS	13.0	15.0	Light Olive Brown	Brown Clay	Silty Clay	CL-ML	23.0	22.8	17.4	5.4	0.5	4.0	95.5	16.0		0.0085	0.022	2.77	PO-177
SW	12275	G3-010	412445	SS	15.0	17.0	Light Olive Brown	Lacustrine	Lean Clay	CL	23.5	23.3	16.2	7.1	0.7	2.7	96.6	19.0		0.006	0.018	2.79	PO-177
SW	12275	G3-010	412446	SS	17.0	19.0	Light Olive Brown	Lacustrine	Lean Clay	CL	24.0	29.1	16.9	12.2	0.7	2.0	97.3	31.0		0.0019	0.0075	2.79	PO-177
SW	12275	G3-010	412447	ST	19.0	21.0	Light Olive Brown	Lacustrine	Silty Sand with Gravel	SM	9.7	15.5	12.4	3.1	23.0	35.3	41.7	8.3	0.0032	0.036	0.45	2.76	PO-177
SW	12275	G3-010	412449	BULK	13.0	19.0	Light Olive Brown	Brown Clay/Lacustrine	Lean Clay	CL		28.0	17.2	10.8	0.0	3.9	96.1	26.0		0.003	0.009	2.80	PO-177
NW	11112		30920A11112-03,-05	SS(M)	5.5	8.0	Light Olive Brown	Muddy Stream	Well-graded Sand with Gravel	SW					27.4	68.0	4.6	1.5	0.16	0.7	2.9	2.76	PO-177 (RI/FS Archive)
NW	11112		30920A11112-06,-08,-09	SS(M)	8.0	10.0	Light Olive Brown	Muddy Stream	Well-graded Sand with Gravel	SW					43.8	52.6	3.6	0.5	0.35	1.5	5.5	2.78	PO-177 (RI/FS Archive)
NW	11112		30920A11112-10-11-12-13	SS(M)	10.0	12.0	Light Olive Brown	Muddy Stream	Well-graded Sand with Silt and Gravel (V)	SW-SM (V)					27.4	65.7	6.9	1.5	0.15	0.9	2.8	2.77	PO-177 (RI/FS Archive)
NW	11112		30920A11112-14-15-16-17	SS(M)	12.0	14.0	Light Olive Brown	Muddy Stream	Poorly-graded Sand with Silt and Gravel (V)	SP-SM (V)					26.5	62.7	10.8	2.5	0.07	0.37	2.35	2.72	PO-177 (RI/FS Archive)
NW	11115		30915A11115-08,-10	SS(M)	6.0	8.0	Light Olive Brown	Muddy Stream	Poorly-graded Sand with Silt and Gravel	SP-SM		NP	NP	NP	32.5	58.0	9.5	1.3	0.075	0.45	2.8	2.70	PO-177 (RI/FS Archive)
NW	11115		30915A11115-13,-14,-15	SS(M)	9.0	10.5	Light Olive Brown	Muddy Stream	Well-graded Sand with Silt and Gravel (V)	SW-SM (V)					33.8	57.1	9.1	1.8	0.09	0.7	3.4	2.68	PO-177 (RI/FS Archive)
NW	11115		30915A11115-17,-18,-20-21	SS(M)	12.0	14.5	Light Olive Brown	Muddy Stream	Poorly-graded Sand with Silt and Gravel	SP-SM		NP	NP	NP	16.5	72.7	10.8	2.0	0.07	0.31	1.6	2.75	PO-177 (RI/FS Archive)
NW	11208		30909A11208-15,-16	SS	9.0	10.0	Yellowish Brown	Muddy Stream	Well-graded Sand with Silt and Gravel (V)	SW-SM (V)					37.2	51.3	11.5	2.7	0.06	0.5	4	2.75	PO-177 (RI/FS Archive)
NW	11208		30909A11208-21	SS	12.0	12.5	Yellowish Brown	Muddy Stream	Poorly-graded Sand with Silt and Gravel (V)	SP-SM (V)		NP	NP	NP									PO-177 (RI/FS Archive)
NW	11208		30909A11208-9,-10,-11	SS(M)	6.0	7.5	Yellowish Brown	Muddy Stream	Silty Sand with Gravel	SM					20.3	66.3	13.4	3.5	0.05	0.31	1.9	2.75	PO-177 (RI/FS Archive)
NW	11211		30915A11211-13,-16,-17-19	SS(M)	9.5	13.0	Yellowish Brown/DYB/Gray/Brown	Muddy Stream	Silty Sand	SM		NP	NP	NP	13.3	65.9	20.8	3.5	0.017	0.165	0.7	2.70	PO-177 (RI/FS Archive)
SW	1134		50650	SS	11.5	12.0	Brownish Yellow	Muddy Stream	Silty Sand	SM		NP	NP	NP	0.0	80.9	19.1	1.0	0.042	0.09	0.17	2.67	PO-177 (RI/FS Archive)
SE	1149		51420	SS	14.0	14.5	Brown	Lacustrine	Sandy Lean Clay	CL		19.8	12.2	7.6	3.7	43.1	53.2	13.0	0.0013	0.014	0.12	2.72	PO-177 (RI/FS Archive)
SE	1153		016063	SS	9.0	9.5	Brownish Yellow	Lacustrine	Silty Sand (V)	SM (V)					4.9	64.7	30.4	3.0	0.012	0.07	0.2	2.78	PO-177 (RI/FS Archive)
SW	1177		115628,115629,115630	SS(M)	17.5	19.0	Brown and Grayish Brown	Muddy Stream	Silty Sand (V)	SM (V)					9.0	76.4	14.6	2.0	0.055	0.23	0.75	2.74	PO-177 (RI/FS Archive)
SW	1177		51615,51617	SS(M)	11.0	12.5	Brown	Muddy Stream	Well-graded Sand with Silt (V)	SW-SM (V)					1.6	87.6	10.8	1.0	0.06	0.26	0.5	2.75	PO-177 (RI/FS Archive)
SW	1177		51618,51619,51620	SS(M)	12.5	14.0	Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					15.4	66.8	17.8	2.5	0.034	0.17	0.6	2.69	PO-177 (RI/FS Archive)
SW	1177		51624,51625,51626,51627	SS(M)	15.5	17.5	Brown	Muddy Stream	Well-graded Sand with Silt (V)	SW-SM (V)					13.9	75.0	11.1	2.0	0.07	0.26	0.6	2.77	PO-177 (RI/FS Archive)
SW	1183		51741,51742,51743	SS(M)	13.0	14.5	OliveGray,Yellowish Brown, LOB,OB	Lacustrine	Sandy Silty Clay	CL-ML		19.8	13.6	6.2	3.6	44.4	52.0	9.5	0.0022	0.015	0.19	2.76	PO-177 (RI/FS Archive)
SW	1185		51784,51785,51786,51787	SS(M)	15.5	17.5	Olive Gray	Lacustrine	Silty Sand	SM		NP	NP	NP	2.0	76.7	21.3	3.0	0.035	0.11	0.29	2.75	PO-177 (RI/FS Archive)
SW	1186		51800,51799	SS(M)	13.0	14.0	LOB and Dark Grayish Brown	Lacustrine	Silty Sand (V)	SM/SP (V)		NP	NP	NP									PO-177 (RI/FS Archive)
SW	1188		51847,51848	SS	18.0	19.0	Olive Brown	Lacustrine	Poorly-graded Sand with Silt	SP-SM		NP	NP	NP	4.2	88.1	7.7	1.0	0.085	0.22	0.5	2.74	PO-177 (RI/FS Archive)
SW	1193		51935,36,37,38,39	SS(M)	12.0	14.5	Yellowish Brown to Olive	Lacustrine	Silty Clay with Sand	CL-ML		21.4	15.1	6.3	0.4	23.4	76.2	12.0		0.008	0.034	2.80	PO-177 (RI/FS Archive)
SW	1196		16900,16901,16902	SS	10.5	12.0	Light Olive Brown	Lacustrine	Clayey Silt (V)	ML/CL (V)		37.9	18.8	19.1									PO-177 (RI/FS Archive)
SW	1196		51995,51996,51997	SS	12.0	13.5	Light Olive Brown	Lacustrine	Clayey Silt (V)	ML/CL (V)		27.0	16.0	11.0									PO-177 (RI/FS Archive)
SW	1198		52037,52038	SS	12.0	13.0	Dark Grayish Brown/Olive	Lacustrine	Sandy Clay	CL/SC (V)		29.6	14.9	14.7									PO-177 (RI/FS Archive)
SW	1205		52157,52158,52159	SS	12.0	13.5	Brownish Yellow	Muddy Stream	Silty Sand	SM		NP	NP	NP	0.5	74.0	25.5	4.0	0.009	0.075	0.22	2.64	PO-177 (RI/FS Archive)
SW	1208		52206,52207,52208,52209	SS(M)	16.5	18.5	Dark Grayish Brown	Muddy Stream	Silty Sand	SM		NP	NP	NP	0.5	82.8	16.7	1.5	0.055	0.12	0.22	2.73	PO-177 (RI/FS Archive)
SW	1210		17205,17206	SS	8.0	9.0	Dark Yellowish Brown	Lacustrine	Silty Sand (V)	SM (V)		NP	NP	NP									PO-177 (RI/FS Archive)
SW	1212		17250,17253,52235	SS(M)	9.5	12.5	Brown	Stratifed Sediment	Sandy Silt	ML		NP	NP	NP	2.0	44.4	53.6	2.5	0.014	0.04	0.08	2.88	PO-177 (RI/FS Archive)
SW	1214		17298	SS	11.5	12.0	Light Olive Brown	Stratifed Sediment	Clayey Silt (V)	ML/CL (V)		35.5	18.2	17.3									PO-177 (RI/FS Archive)
SW	1214		52275	SS	12.0	12.5	Light Olive Brown	Stratifed Sediment	Clayey Silt (V)	ML/CL (V)		32.2	16.5	15.7									PO-177 (RI/FS Archive)
SW	1214		52276,52277	SS	12.5	13.5	Olive Gray	Stratifed Sediment	Clayey Silt (V)	ML/CL (V)		32.0	16.5	15.5									PO-177 (RI/FS Archive)
SW	1216		52318	SS	13.5	14.0	Olive	Stratifed Sediment	Silty Sand	SM		NP	NP	NP	1.1	59.2	39.7	6.0	0.0065	0.05	0.12	2.72	PO-177 (RI/FS Archive)
SW	1217		52335,52336	SS	11.0	12.0	Light Olive Brown	Lacustrine	Silty Clay with Sand	CL-ML		20.3	14.7	5.6	0.0	15.7	84.3	11.5	0.0015	0.008	0.025	2.79	PO-177 (RI/FS Archive)
SW	1220		52370	SS	18.5	19.0	Brownish Yellow	Sratified Sediment	Well-graded Sand with Silt and Gravel (V)	SW-SM (V)					25.3	69.2	5.5	1.0	0.27	1.05	2.9	2.67	PO-177 (RI/FS Archive)
SW	1224		50803,50804	SS	16.5	17.5	Gray	Sratified Sediment	Silty Sand	SM		NP	NP	NP	10.8	53.1	36.1	4.0	0.0075	0.06	0.22	2.73	PO-177 (RI/FS Archive)
SW	1224		50805,50806,50807	SS(M)	17.5	19.0	Gray	Sratified Sediment	Silty Sand	SM		NP	NP	NP	9.4	51.7	38.9	6.0	0.0045	0.05	0.17	2.62	PO-177 (RI/FS Archive)
SW	1225		52436,52437	SS	12.5	13.5	Light Olive Brown	Lacustrine	Silty Clay with Sand	CL-ML		20.6	16.6	4.0	3.1	13.1	83.8	7.5	0.035	0.012	0.03	2.65	PO-177 (RI/FS Archive)
SW	1227		17581,17582	SS	9.0	10.0	Brownish Yellow	Lacustrine	Sandy Silt	ML		17.8	15.4	2.4	1.3	48.5	50.2	8.5	0.03	0.032	0.09	2.89	PO-177 (RI/FS Archive)
SW	1230		50724,50725,50726	SS(M)	11.0	12.5	Yellowish Brown/Grayish Brown	Muddy Stream	Silty Clay with Sand	CL-ML		19.8	14.7	5.1	0.0	18.5	81.5	12.5		0.015	0.042	2.71	PO-177 (RI/FS Archive)
SW	1230		50727,50728,50729	SS(M)	12.5	14.0	Grayish Brown	Muddy Stream	Silt (V)	ML (V)		NP	NP	NP									PO-177 (RI/FS Archive)
SW	1230		50730	SS	14.0	14.5	Grayish Brown	Muddy Stream	Silty Sand/Poorly-graded Sand (V)	SM/SP (V)		NP	NP	NP									PO-177 (RI/FS Archive)
SW	1230		50733,50731	SS(M)	14.5	16.0	Grayish Brown	Muddy Stream	Silty,Clayey Sand (V)	SC-SM (V)		18.2	12.6	5.6									PO-177 (RI/FS Archive)
SW	1230		50734,50735	SS(M)	16.0	17.0	Grayish Brown	Muddy Stream	Clayey Sand	SC		18.2	10.8	7.4	9.3	41.2	49.5	10.0	0.002	0.021	0.18	2.73	PO-177 (RI/FS Archive)
SW	1230		50736,50737,50738	SS(M)	17.0	18.5	Grayish Brown	Muddy Stream	Sandy Silt (V)	ML (V)		NP	NP	NP									PO-177 (RI/FS Archive)
SW	1233		17713,17714	SS	9.0	10.0	Brownish Yellow	Muddy Stream	Silty Sand	SM		NP	NP	NP	4.7	52.2	43.1	9.0	0.0025	0.042	0.15	2.71	PO-177 (RI/FS Archive)
SW	1233		42546,42547,42548	SS	16.5	18.0	Gray	Lacustrine	Well-graded Sand with Silt (V)	SW-SM (V)					12.5	79.2	8.3	2.5	0.11	0.46	1.3	2.67	PO-177 (RI/FS Archive)
SW	1233		52536	SS	11.5	12.0	Brownish Yellow	Lacustrine	Silty Sand	SM		NP	NP	NP	4.6	65.0	30.4	9.0	0.003	0.075	0.23	2.73	PO-177 (RI/FS Archive)

TABLE F-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color (3)	General Stratum	USCS Name (4)	USCS Symbol (4)	Sample Moisture Content (%)	Atterberg Limits LL (5)	PL (5)	PI (5)	Grain Size Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	D10 (6)	D30	D60	Specific Gravity (7)	Reference
SW	1233		52537	SS	12.0	12.5	Brownish Yellow	Lacustrine	Lean Clay	CL (V)		26.4	13.6	12.8									PO-177 (RI/FS Archive)
SW	1233		52538,52539	SS	12.5	13.5	Brownish Yellow	Lacustrine	Silty Sand (V)	SM (V)		NP	NP	NP									PO-177 (RI/FS Archive)
SW	1233		52540,52541,52542	SS	13.5	15.0	Brownish Yellow	Lacustrine	Silty Sand	SM		NP	NP	NP	4.1	83.3	12.6	3.0	0.05	0.19	0.4	2.79	PO-177 (RI/FS Archive)
SW	1233		52544,52545	SS	15.5	16.5	Brownish Yellow to Gray	Lacustrine	Clayey Sand/Silty Sand (V)	SC/SM (V)		20.6	12.3	8.3									PO-177 (RI/FS Archive)
SW	1233		52549,52550	SS	18.0	19.0	Gray	Lacustrine	Poorly-graded Sand with Silt (V)	SP-SM (V)					0.2	94.5	5.3	1.5	0.16	0.34	0.75	2.76	PO-177 (RI/FS Archive)
SW	1236		17776	SS	7.5	8.0	Brownish Yellow	Lacustrine	Clayey Gravel (V)	GC (V)		34.5	16.3	18.2									PO-177 (RI/FS Archive)
SW	1236		17776,17777,17779,17780	SS(M)	7.5	10.0	Brownish Yellow	Lacustrine	Sandy Silty Clay (V)	CL-ML (V)					11.8	29.0	59.2	13.5		0.012	0.08	2.76	PO-177 (RI/FS Archive)
SW	1236		17777,17779,17780	SS(M)	8.0	10.0	Brownish Yellow	Lacustrine	Sandy Silty Clay (V)	CL-ML (V)		18.7	12.4	6.3									PO-177 (RI/FS Archive)
SW	1240		50695,50696	SS	11.0	12.0	Yellowish Brown/Gray	Lacustrine	Silt (V)	ML (V)		17.8	15.9	1.9									PO-177 (RI/FS Archive)
SW	1241		17889,17890,17892	SS(M)	9.0	11.0	Brownish Yellow	Lacustrine	Silty Clay with Sand	CL-ML		20.0	14.0	6.0	1.5	20.3	78.2	16.0		0.013	0.034	2.74	PO-177 (RI/FS Archive)
SW	1242		50690,50691	SS	12.5	13.5	Brownish Yellow	Lacustrine	Silty Sand (V)	SM (V)		NP	NP	NP									PO-177 (RI/FS Archive)
SW	1244		50654,50655	SS	12.5	13.5	Brownish Yellow	Lacustrine	Sandy Silty Clay	CL-ML		19.9	14.0	5.9	0.8	38.6	60.6	11.0	0.0014	0.01	0.075	2.74	PO-177 (RI/FS Archive)
SW	1245		52598,599,600,601,602	SS(M)	12.5	15.0	Dark Yellowish Brown/Gray	Lacustrine	Silty Clay with Sand	CL-ML		21.9	16.0	5.9	0.6	16.3	83.1	16.0		0.013	0.038	2.65	PO-177 (RI/FS Archive)
SW	1247		18024	SS	12.0	12.5	Yellowish Brown	Lacustrine	Silty Sand (V)	SM (V)					1.0	79.0	20.0	3.5	0.014	0.27	0.6	2.74	PO-177 (RI/FS Archive)
SW	1250		52699,700,701,702	SS(M)	12.0	14.0	Dark Yellowish Brown	Lacustrine	Sandy Silty Clay	CL-ML		19.5	14.6	4.9	2.7	46.7	50.6	7.0	0.0045	0.034	0.12	2.73	PO-177 (RI/FS Archive)
SW	1250		52703,04,06,07,08,09	SS(M)	14.0	17.5	Dark Gray/Light Olive Brown	Lacustrine	Silty Clay with Sand	CL-ML		21.3	14.9	6.4	5.0	14.7	80.3	15.0		0.012	0.039	2.75	PO-177 (RI/FS Archive)
SW	1267		53036,53038	SS(M)	11.5	13.0	Grayish Brown/Gray	Muddy Stream	Silt	ML		NP	NP	NP	0.1	6.7	93.2	7.5	0.004	0.011	0.026	2.78	PO-177 (RI/FS Archive)
NE	1274		53182	SS	14.5	15.0	Gray	Muddy Stream	Silty Sand	SM		NP	NP	NP	10.4	61.4	28.2	3.5	0.024	0.08	0.32	2.75	PO-177 (RI/FS Archive)
NE	1287		18900,01,02,03,04	SS	7.5	10.0	Brown to Yellowish Brown	Muddy Stream	Sillty Sand (V)	SM (V)					8.2	76.4	15.4	1.0	0.05	0.16	0.32	2.74	PO-177 (RI/FS Archive)
NE	1293		19033	SS	9.0	9.5	Yellowish Brown	Muddy Stream	Clayey Sand with Gravel	SC		24.2	12.8	11.4	23.6	36.0	40.4	11.0	0.0017	0.026	0.75	2.64	PO-177 (RI/FS Archive)
NW	1336		19982,54415,54416,54417	SS(M)	10.5	12.5	Brown	Muddy Stream	Silty Sand (V)	SM (V)		NP	NP	NP									PO-177 (RI/FS Archive)
NW	1336		54418,54421,54422	SS(M)	12.5	15.0	Gray and Brown	Muddy Stream	Silty Sand (V)	SM (V)					11.4	70.0	18.6	3.0	0.035	0.13	0.48	2.74	PO-177 (RI/FS Archive)
NW	1336		54426,54427	SS(M)	16.5	17.5	Gray	Muddy Stream	Silty Sand (V)	SM (V)		NP	NP	NP									PO-177 (RI/FS Archive)
NW	1338		50018,50020,50021	SS(M)	6.5	8.5	Dark Brown to Brown	Muddy Stream	Clayey Sand (V)	SC (V)					10.2	58.3	31.5	10.0	0.002	0.065	0.45	2.76	PO-177 (RI/FS Archive)
NW	1339		50037,38,40,41,42,43,44	SS(M)	6.0	10.0	Yellowish Brown to DYB to Brown	Muddy Stream	Silty Sand with Gravel	SM		NP	NP	NP	19.7	66.1	14.2	1.5	0.05	0.26	1.3	2.97	PO-177 (RI/FS Archive)
NW	1346		54627,54628	SS	17.0	18.0	Light Olive Brown	Muddy Stream	Sandy Silty Clay	CL-ML		16.9	12.1	4.8	5.7	40.8	53.5	9.0	0.0028	0.024	0.12	2.72	PO-177 (RI/FS Archive)
NW	1346		54629	SS	18.0	18.5	Light Olive Brown	Muddy Stream	Sandy Silty Clay (V)	CL-ML (V)		19.5	12.9	6.6									PO-177 (RI/FS Archive)
SW	1347		54648,54650	SS	17.5	19.0	Gray	Lacustrine	Clayey Silt (V)	ML/CL (V)		38.7	18.0	20.7									PO-177 (RI/FS Archive)
NW	1348		54667,54668	SS(M)	17.5	18.5	Brown	Muddy Stream	Clayey Sand with Gravel	SC		22.2	12.2	10.0	24.3	49.3	26.4	9.0	0.0045	0.12	1.3	2.71	PO-177 (RI/FS Archive)
NW	1349		54681,54682	SS(M)	14.0	15.0	Brown	Lacustrine	Silt	ML		22.8	18.9	3.9	0.0	0.9	99.1	13.0		0.0065	0.013	2.73	PO-177 (RI/FS Archive)
NW	1351		54724,25,26,27,28,29,30	SS(M)	15.5	19.0	Gray and Brown	Muddy Stream	Silty Clay	CL-ML		20.8	15.6	5.2	0.0	9.2	90.8	14.5		0.013	0.033	2.67	PO-177 (RI/FS Archive)
NW	1352		54739	SS	13.0	13.5	Dark Yellowish Brown	Muddy Stream	Silty Sand	SM		NP	NP	NP	0.1	59.1	40.8	4.5	0.017	0.055	0.15	2.74	PO-177 (RI/FS Archive)
NW	1354		54787,54789	SS(M)	17.0	18.5	Brown and Olive Brown	Muddy Stream	Silty Sand with Gravel (V)	SM (V)					22.0	62.2	15.8	3.0	0.05	0.15	1.1	2.72	PO-177 (RI/FS Archive)
NW	1356		54820	SS	13.5	14.0	Brown	Muddy Stream	Silty Sand (V)	SM (V)		NP	NP	NP									PO-177 (RI/FS Archive)
NW	1356		54821,54822	SS	14.0	15.0	Brown	Muddy Stream	Silty Sand	SM		NP	NP	NP	1.5	80.8	17.7	4.0	0.02	0.2	0.36	2.72	PO-177 (RI/FS Archive)
NW	1356		54827,54826	SS	16.5	17.5	Brown	Muddy Stream	Well-graded Sand with Silt (V)	SW-SM (V)					6.4	84.0	9.6	1.5	0.06	0.22	0.48	2.76	PO-177 (RI/FS Archive)
NW	1359		54876	SS	11.5	12.0	Yellowish Brown	Muddy Stream	Clayey Sand (V)	SC (V)		26.9	15.2	11.7									PO-177 (RI/FS Archive)
NW	1360		54900,54901	SS	13.5	14.5	Dark Yellowish Brown	Muddy Stream	Silt with Sand	ML		NP	NP	NP	0.5	21.0	78.5	4.5	0.0075	0.019	0.035	2.86	PO-177 (RI/FS Archive)
SW	1420		15537,8,51135,6,7,8	SS(M)	11.0	14.0	Light Olive Brown and OB	Muddy Stream	Lean Clay	CL		31.0	15.1	15.9	0.0	2.5	97.5	31.5		0.0017	0.012	2.61	PO-177 (RI/FS Archive)
SW	1420		51140	SS	14.5	15.0	Olive	Muddy Stream	Silty, Clayey Sand	SC-SM		16.4	12.4	4.0	7.7	47.7	44.6	9.0	0.003	0.042	0.19	2.75	PO-177 (RI/FS Archive)
SW	1420		51143,44,45,46	SS(M)	16.0	18.0	Olive Brown	Muddy Stream	Well-graded Sand with Silt (V)	SW-SM (V)					14.4	77.2	8.4	1.0	0.095	0.33	1	2.73	PO-177 (RI/FS Archive)
SW	1420		51147,48,49,50	SS	18.0	20.0	Olive Brown	Muddy Stream	Well-graded Sand with Silt (V)	SW-SM (V)					3.2	87.6	9.2	2.2	0.07	0.26	0.42	2.76	PO-177 (RI/FS Archive)
NOU1	1501		51127	SS	17.0	17.5	Gray	Gray Till	Sandy Silt (V)	ML (V)					4.9	29.1	66.0	21.5		0.0045	0.045	2.73	PO-177 (RI/FS Archive)
SW	1503		00722,00724,00725,00726	SS(M)	17.0	19.5	Brown to Yellow Brown/Dark Brown	Stratified Sediiment	Poorly-graded Sand with Silt (V)	SP-SM (V)					7.4	82.0	10.6	3.0	0.07	0.21	0.4	2.73	PO-177 (RI/FS Archive)

TABLE F-2
Summary of Index Properties
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth	Bottom Depth	Color (3)	General Stratum	USCS Name (4)	USCS Symbol (4)	Sample Moisture Content (%)	Atterberg Limits LL (5)	Atterberg Limits PL (5)	Atterberg Limits PI (5)	Grain Size Gravel (%)	Grain Size Sand (%)	Grain Size Silt and Clay (%)	Grain Size Clay 0.002 mm (%)	Grain Size D10 (6)	Grain Size D30	Grain Size D60	Specific Gravity (7)	Reference

Notes:

1. Area:
   - NE Northeast Quadrant of Former Plant Area
   - NW Northwest Quadrant of Former Plant Area
   - SE Southeast Quadrant of Former Plant Area
   - SW Southwest Quadrant of Former Plant Area
2. Sample Type:
   - BULK Bulk Sample
   - D Denison Sampler
   - DM Dames and Moore Sampler
   - SS Split Spoon Sample
   - SS (M) Multiple Split Spoon - Composite Sample
   - 3" SS 3" O.D. Split Spoon Sample
   - ST Shelby Tube
3. Color:
   - DYB Dark Yellowish Brown
   - LOB Light Olive Brown
   - OB Olive Brown
4. (V) - Partially or completely visually classified (ASTM D2488)
5. NP - Reported as non-plastic from laboratory plasticity test (ASTM D4318)
6. No value for D10 indicates that no extrapolation was performed when D30 and D60 are reported.
7. Specific gravity is for minus No. 10 sieve potion of the sample.
8. Reference: PO177 Former Plant Area Geotechnical Investigation, Geotechnical Laboratory Data Report, PARSONS PO177, September 1997
9. General Stratum:
   - Brown Clay/Gray Till — Sample is a combination of Brown Clay and Gray Till
   - Muddy Stream/Gray Till — Sample is a combination of Muddy Stream and Gray Till
   - Brown Clay/Lacustrine — Sample is a combination of Brown Clay and Lacustrine deposits

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TABLE F-3
Summary of Unit Weight and Percent Saturation
Operable Unit 3
Former Plant Area

AREA	FEMP ID	Other ID	Sample Number	Sample Type	Specimen ID	Top Depth (ft)	Bottom Depth (ft)	Color	General Stratum	USCS Name	USCS Symbol	Test Type	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Percent Saturation (%)	SG	Reference
NE	12266	G3-001	412463	ST		5.0	7.0	Olive Brown	Brown Clay	Lean Clay with Sand	CL	UCS	25.0	127.4	101.9	98.9	2.78	PO-177
NE	12266	G3-001	412466	ST	A	11.0	13.0	Dark Greenish Gray	Gray Till	Lean Clay with Sand	CL	CUpp	12.9	144.7	128.2	100.0	2.78	PO-177
NE	12266	G3-001	412466	ST	B	11.0	13.0	Dark Greenish Gray	Gray Till	Lean Clay with Sand	CL	CUpp	15.3	142.4	123.5	100.0	2.78	PO-177
NE	12266	G3-001	412466	ST	C	11.0	13.0	Dark Greenish Gray	Gray Till	Lean Clay with Sand	CL	CUpp	26.0	128.2	101.7	100.0	2.78	PO-177
NE	12266	G3-001	412474	ST		24.0	26.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay with Gravel	CL	UCS	16.2	141.0	121.4	100.0	2.81	PO-177
NW	12267	G3-002	412358	DM		15.0	17.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	UCS	15.0	142.3	123.8	100.0	2.77	PO-177
NW	12267	G3-002	412361	ST		21.0	23.0	Greenish Gray	Gray Till	Sandy Lean Clay	CL	UCS	12.0	145.7	130.1	100.0	2.76	PO-177
NE	12268	G3-003	412305	D		9.0	11.0	Dark Greenish Gray	Gray Till	Clayey Sand with Gravel	SC	UCS	6.7	149.5	140.1	78.2	2.78	PO-177
NE	12268	G3-003	412307	D	A	13.0	15.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	CUpp	8.3	145.3	134.1	76.9	2.80	PO-177
NE	12268	G3-003	412307	D	B	13.0	15.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	CUpp	8.3	144.1	133.1	73.8	2.80	PO-177
NE	12268	G3-003	412307	D	C	13.0	15.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	CUpp	8.2	145.6	134.6	76.8	2.80	PO-177
NE	12268	G3-003	412310	D		21.0	23.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	UCS	6.3	156.0	146.8	88.7	2.82	PO-177
NW	12269	G3-004	412385	ST		5.0	7.0	Dark Greenish Gray/LOB	Brown Clay	Fat Clay	CH	UCS	26.1	124.2	98.5	96.6	2.75	PO-177
NW	12269	G3-004	412400	DM	Stage 1	26.0	27.5	Gray	Gray Till	Sandy Lean Clay	CL	CUpps	9.8	148.9	135.7	100.0	2.75	PO-177
NW	12269	G3-004	412402	DM		27.5	29.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	UCS	10.0	147.0	133.6	99.3	2.73	PO-177
SW	12270	G3-005	412420	DM		3.0	5.0	Light Olive Brown	Brown Clay	Lean Clay with Sand	CL	UCS	18.0	133.4	113.0	94.7	2.76	PO-177
SW	12271	G3-006	412369	ST		7.0	9.0	Greenish Gray	Brown Clay	Fat Clay	CH	UCS	25.0	125.3	100.2	98.1	2.72	PO-177
SW	12271	G3-006	412375	DM		15.0	17.0	Olive Brown	Muddy Stream	Clayey Sand	SC	CD	11.1	141.3	127.2	93.4	2.71	PO-177
SW	12271	G3-006	412375	DM		15.0	17.0	Olive Brown	Muddy Stream	Clayey Sand	SC	Pbp	11.1	147.9	133.2	100.0	2.71	PO-177
SW	12271	G3-006	412375	DM	A	15.0	17.0	Olive Brown	Muddy Stream	Clayey Sand	SC	DS	11.1	144.6	130.1	100.0	2.71	PO-177
SW	12271	G3-006	412375	DM	B	15.0	17.0	Olive Brown	Muddy Stream	Clayey Sand	SC	DS	11.1	146.7	132.1	100.0	2.71	PO-177
SW	12271	G3-006	412375	DM	C	15.0	17.0	Olive Brown	Muddy Stream	Clayey Sand	SC	DS	11.1	147.0	132.3	100.0	2.71	PO-177
SW	12271	G3-006	412381	ST		25.0	27.0	Greenish Gray	Gray Till	Sandy Lean Clay	CL	UCS	9.5	147.2	134.4	92.3	2.77	PO-177
SW	12272	G3-007	412324	ST	A	23.0	25.0	Gray	Gray Till	Sandy Lean Clay	CL	CUpp	11.0	143.4	129.2	89.7	2.77	PO-177
SW	12272	G3-007	412324	ST	B	23.0	25.0	Gray	Gray Till	Sandy Lean Clay	CL	CUpp	12.6	142.5	126.5	95.6	2.77	PO-177
SW	12272	G3-007	412324	ST	C	23.0	25.0	Gray	Gray Till	Sandy Lean Clay	CL	CUpp	11.4	142.1	127.5	88.6	2.77	PO-177
SW	12273	G3-008	412332	ST		5.0	7.0	Brownish Yellow	Brown Clay	Lean Clay	CL	UCS	19.4	134.7	112.8	100.0	2.77	PO-177
SW	12273	G3-008	412341	ST		17.0	19.0	Dark Grayish Brown	Muddy Stream	Sandy Silt	ML	TX CD	18.2	133.1	112.7	92.1	2.80	PO-177
SW	12273	G3-008	412341	ST		17.0	19.0	Dark Grayish Brown	Muddy Stream	Sandy Silt	ML	Pbp	22.7	129.5	105.6	97.1	2.80	PO-177
SW	12273	G3-008	412341	ST		17.0	19.0	Dark Grayish Brown	Muddy Stream	Sandy Silt	ML	UCS	16.5	134.7	115.6	90.2	2.80	PO-177
SW	12273	G3-008	412341	ST	A	17.0	19.0	Dark Grayish Brown	Muddy Stream	Sandy Silt	ML	DS	20.0	133.8	111.5	98.5	2.80	PO-177
SW	12273	G3-008	412341	ST	B	17.0	19.0	Dark Grayish Brown	Muddy Stream	Sandy Silt	ML	DS	19.2	136.1	114.1	100.0	2.80	PO-177
SW	12273	G3-008	412341	ST	C	17.0	19.0	Dark Grayish Brown	Muddy Stream	Sandy Silt	ML	DS	21.9	132.7	108.9	100.0	2.80	PO-177
SE	12274	G3-009	412409	ST		5.0	7.0	Light Olive Brown	Brown Clay	Lean Clay	CL	UCS	24.0	126.6	102.0	97.9	2.73	PO-177
SE	12274	G3-009	412410	ST	A	7.0	9.0	Light Olive Brown	Brown Clay	Sandy Lean Clay	CL	CUpp	11.4	142.7	128.0	93.3	2.74	PO-177
SE	12274	G3-009	412410	ST	B	7.0	9.0	Light Olive Brown	Brown Clay	Sandy Lean Clay	CL	CUpp	19.7	133.4	111.4	100.0	2.74	PO-177
SE	12274	G3-009	412410	ST	C	7.0	9.0	Light Olive Brown	Brown Clay	Sandy Lean Clay	CL	CUpp	25.7	126.4	100.6	100.0	2.74	PO-177
SE	12274	G3-009	412414	DM		13.0	14.5	Dark Greenish Gray	Gray Till	Gravelly Lean Clay with Sand	CL	UCS	12.9	141.9	125.8	94.9	2.77	PO-177
SW	12275	G3-010	412439	ST		5.0	7.0	Light Olive Brown	Brown Clay	Lean Clay with Sand	CL	UCS	23.3	122.5	99.3	91.7	2.68	PO-177
SW	12275	G3-010	412443	ST	A	11.0	13.0	Light Olive Brown	Brown Clay	Lean Clay	CL	CUpp	22.2	131.5	107.6	100.0	2.75	PO-177
SW	12275	G3-010	412443	ST	B	11.0	13.0	Light Olive Brown	Brown Clay	Lean Clay	CL	CUpp	23.2	126.4	102.7	94.7	2.75	PO-177
SW	12275	G3-010	412443	ST	C	11.0	13.0	Light Olive Brown	Brown Clay	Lean Clay	CL	CUpp	23.6	128.8	104.2	100.0	2.75	PO-177
SW	12275	G3-010	412447	ST		19.0	21.0	Light Olive Brown	Lacustrine	Silty Sand with Gravel	SM	UCS	9.7	152.1	138.6	100.0	2.76	PO-177

TABLE F-3
Summary of Unit Weight and Percent Saturation
Operable Unit 3
Former Plant Area

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AREA	FEMP ID	Other ID	Sample Number	Sample Type	Specimen ID	Top Depth (ft)	Bottom Depth (ft)	Color	General Stratum	USCS Name	USCS Symbol	Test Type	Moisture Content (%)	Wet Density (pcf)	Dry Density (pcf)	Percent Saturation (%)	SG	Reference

Notes:

1. Area:
   - NE Northeast Quadrant of Former Plant Area
   - NW Northwest Quadrant of Former Plant Area
   - SE Southeast Quadrant of Former Plant Area
   - SW Southwest Quadrant of Former Plant Area
2. Sample Type:
   - D Denison Sampler
   - DM Dames and Moore Sampler
   - ST Shelby Tube
3. Test Type:
   - CD Triaxial Shear, Consolidated Drained (Modified ASTM D4767)
   - CUpp Triaxial Shear, Consolidated Undrained with Pore Pressure Measurements (ASTM D4767)
   - CUpps Triaxial Shear, Consolidated Undrained with Pore Pressure Measurements, Staged Test (ASTM D4767)
   - DS Direct Shear (ASTM D3080
   - Pbp Triaxial, Back Pressure Permeability (ASTM D5084)
   - UCS Unconfined Compressive Strength (ASTM D2166)
4. Reference: PO177 Former Plant Area Geotechnical Investigation, Geotechnical Laboratory Data Report, PARSONS PO177, September 1997

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TABLE F-4
Summary of Unconfined Compressive Strength Tests
Operable Unit 3
Former Plant Area

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Color	General Stratum	USCS Name	USCS Symbol	Test Type	Test Method	Pre-Test Moisture Content (%)	Pre-Test Dry Density (pcf)	Axial Strain (%)	Unconfined Compressive Strength (psf)	Reference
NE	12266	G3-001	412463	ST	5.0	7.0	Olive Brown	Brown Clay	Lean Clay with Sand	CL	UCS	ASTM D 2166	25.0	101.9	7.18	1914	PO-177
NE	12266	G3-001	412474	ST	24.0	26.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay with Gravel	CL	UCS	ASTM D 2166	16.2	121.4	13.94	1127	PO-177
NW	12267	G3-002	412358	DM	15.0	17.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	UCS	ASTM D 2166	15.0	123.8	14.95	2621	PO-177
NW	12267	G3-002	412361	ST	21.0	23.0	Greenish Gray	Gray Till	Sandy Lean Clay	CL	UCS	ASTM D 2166	12.0	130.1	15.61	2740	PO-177
NE	12268	G3-003	412305	D	9.0	11.0	Dark Greenish Gray	Gray Till	Clayey Sand with Gravel	SC	UCS	ASTM D 2166	6.7	140.1	1.78	18643	PO-177
NE	12268	G3-003	412310	D	21.0	23.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	UCS	ASTM D 2166	6.3	146.8	1.72	4130	PO-177
NW	12269	G3-004	412385	ST	5.0	7.0	Dark Greenish Gray/LOB	Brown Clay	Fat Clay	CH	UCS	ASTM D 2166	26.1	98.5	13.91	4293	PO-177
NW	12269	G3-004	412402	DM	27.5	29.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	UCS	ASTM D 2166	10.0	133.6	10.81	7996	PO-177
SW	12270	G3-005	412420	DM	3.0	5.0	Light Olive Brown	Brown Clay	Lean Clay with Sand	CL	UCS	ASTM D 2166	18.0	113.0	13.26	4514	PO-177
SW	12271	G3-006	412369	ST	7.0	9.0	Greenish Gray	Brown Clay	Fat Clay	CH	UCS	ASTM D 2166	25.0	100.2	7.82	4299	PO-177
SW	12271	G3-006	412381	ST	25.0	27.0	Greenish Gray	Gray Till	Sandy Lean Clay	CL	UCS	ASTM D 2166	9.5	134.4	8.46	17803	PO-177
SW	12273	G3-008	412332	ST	5.0	7.0	Brownish Yellow	Brown Clay	Lean Clay	CL	UCS	ASTM D 2166	19.4	112.8	7.50	4160	PO-177
SW	12273	G3-008	412341	ST	17.0	19.0	Dark Grayish Brown	Muddy Stream	Sandy Silt	ML	UCS	ASTM D 2166	16.5	115.6	2.43	541	PO-177
SE	12274	G3-009	412409	ST	5.0	7.0	Light Olive Brown	Brown Clay	Lean Clay	CL	UCS	ASTM D 2166	24.0	102.0	5.06	4865	PO-177
SE	12274	G3-009	412414	DM	13.0	14.5	Dark Greenish Gray	Gray Till	Gravelly Lean Clay with Sand	CL	UCS	ASTM D 2166	12.9	125.8	7.09	4039	PO-177
SW	12275	G3-010	412439	ST	5.0	7.0	Light Olive Brown	Brown Clay	Lean Clay with Sand	CL	UCS	ASTM D 2166	23.3	99.3	3.13	1499	PO-177
SW	12275	G3-010	412447	ST	19.0	21.0	Light Olive Brown	Lacustrine	Silty Sand with Gravel	SM	UCS	ASTM D 2166	9.7	138.6	4.67	3419	PO-177

Notes:

1. Area:
   - NE Northeast Quadrant of Former Plant Area
   - NW Northwest Quadrant of Former Plant Area
   - SE Southeast Quadrant of Former Plant Area
   - SW Southwest Quadrant of Former Plant Area
2. Sample Type:
   - D Denison Sampler
   - DM Dames and Moore Sampler
   - ST Shelby Tube
3. Test Type: UCS Unconfined Compressive Strength (ASTM D2166)
4. Reference: PO177 Former Plant Area Geotechnical Investigation, Geotechnical Laboratory Data Report, PARSONS PO177, September 1997

TABLE F-5
Summary of Consolidated Undrained Traixial Compression Tests
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Boring ID	Sample Number	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Color	General Stratum	USCS Name	USCS Symbol	Test Type	Average Pre-Test Moisture (%)	Average Pre-Test Dry Density (pcf)	Effective Stress		Total Stress		Testing Condition	Reference
														Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)		
NE	12266	G3-001	412466	ST	11.0	13.0	Dark Greenish Gray	Gray Till	Lean Clay with Sand	CL	CUpp	18.1	117.8	105	31.0	275	21.0	Saturated	PO-177
NE	12268	G3-003	412307	D	13.0	15.0	Dark Greenish Gray	Gray Till	Sandy Lean Clay	CL	CUpp	8.3	133.9	280	32.4	910	30.2	Saturated	PO-177
NW	12269	G3-004	412400	DM	26.0	27.5	Gray	Gray Till	Sandy Lean Clay	CL	CUpps	9.8	135.7	490	30.8	554	29.8	Saturated	PO-177
SW	12272	G3-007	412324	ST	23.0	25.0	Gray	Gray Till	Sandy Lean Clay	CL	CUpp	11.7	127.7	338	31.4	760	37.7	Saturated	PO-177
SE	12274	G3-009	412410	ST	7.0	9.0	Light Olive Brown	Brown Clay	Sandy Lean Clay	CL	CUpp	18.9	113.3	23	35.3	0	34.5	Saturated	PO-177
SW	12275	G3-010	412443	ST	11.0	13.0	Light Olive Brown	Brown Clay	Lean Clay	CL	CUpp	23.0	104.8	210	34.5	357	36.5	Saturated	PO-177

Notes:

1. Area:
   - NE Northeast Quadrant of Former Plant Area
   - NW Northwest Quadrant of Former Plant Area
   - SE Southeast Quadrant of Former Plant Area
   - SW Southwest Quadrant of Former Plant Area
2. Sample Type:
   - D Denison Sampler
   - DM Dames and Moore Sampler
   - ST Shelby Tube
3. Test Type:
   - CUpp Triaxial Shear, Consolidated, Undrained with Pore Pressure Measurements (ASTM D4767), 3 point test
   - CUpps Triaxial Shear, Consolidated, Undrained with Pore Pressure Measurements (ASTM D4767), staged test
4. Average pre-test moisture and dry density reported for sample 412400 is for first stage only.
5. Reference: PO177 Former Plant Area Geotechnical Investigation, Geotechnical Laboratory Data Report, PARSONS PO177, September 1997

000570

TABLE F-6
Summary of Consolidated-Drained Triaxial Compression and Direct Shear Tests
Operable Unit 3
Former Plant Area

Area	FEMP ID	Other ID	Sample Number	Sample Type	Top Depth (feet)	Bottom Depth (feet)	General Stratum	USCS Name	USCS Symbol	Test Type	Test Method	Average Pre-Test Moisture (%)	Average Pre-Test Dry Density (pcf)	Cohesion (psf)	Friction Angle (degrees)	Reference
SW	12271	G3-006	412374	SS	13.0	15.0	Muddy Stream	Clayey Sand (V)	SC (V)	CD	ASTM D 4767	11.6	126.6	0.0	32.0	PO-177
SW	12271	G3-006	412375	DM	15.0	17.0	Muddy Stream	Clayey Sand	SC	DS	ASTM D 3080	11.1	131.5	629.0	29.5	PO-177
SW	12273	G3-008	412341	ST	17.0	19.0	Muddy Stream	Sandy Silt	ML	CD	ASTM D 4767	18.2	112.7	0.0	38.0	PO-177
SW	12273	G3-008	412341	ST	17.0	19.0	Muddy Stream	Sandy Silt	ML	DS	ASTM D 3080	20.4	111.5	218.0	31.0	PO-177

Notes:

1. Area:
   - NE Northeast Quadrant of Former Plant Area
   - NW Northwest Quadrant of Former Plant Area
   - SE Southeast Quadrant of Former Plant Area
   - SW Southwest Quadrant of Former Plant Area
2. Sample Type:
   - DM Dames and Moore Sampler
   - ST Shelby Tube
   - SS Split Spoon (Tested Sample Remolded)
3. Sample 412374 was remolded with slough obtained from Dames and Moore sample 412376. Target density based on the undisturbed portion of the Dames and Moore sample 412375 used in the direct shear test.
4. Classification of sample 412374 is a visual classification.
5. Test Type:
   - DS 3 Point Direct Shear - Normal Pressures of 4.86, 9.72, and 25 psi - ASTM D3080
   - CD 1 Point Consolidated-Drained Triaxial Compression Test - Confining Pressure = 10 psi - Modified ASTM D4767
6. Data Source: PO177 Former Plant Area Geotechnical Investigation, Geotechnical Laboratory Data Report, PARSONS PO177, September 1997

TABLE F-7
Summary of Permeability Tests
Operable Unit 3
Former Plant Area

1507

Area	FEMP ID	Other ID	Sample Number	Sample Type	Top Depth (feet)	Bottom Depth (feet)	General Stratum	USCS Name	USCS Symbol	Target Dry Density (pcf)	Test Type	Test Method	Confining Pressure (psf)	Pretest Moisture (%)	Pretest Dry Density (pcf)	Average Permeability (cm/sec)	Reference
NW	12269	G3-004	412391	SS	15.0	17.0	Muddy Stream	Poorly Graded Sand with Silt	SP-SM	110.0	Pr	ASTM D 5084	2160	18.1	108.0	4.43E-04	PO-177
SW	12270	G3-005	412426	SS	13.5	15.5	Muddy Stream	Silty Sand	SM	112.0	Pr	ASTM D 5084	2016	14.1	110.1	1.38E-05	PO-177
SW	12271	G3-006	412375	DM	15.0	17.0	Muddy Stream	Clayey Sand	SC		Pbp	ASTM D 5084	720	11.1	133.2	1.18E-07	PO-177
SW	12273	G3-008	412341	ST	17.0	19.0	Muddy Stream	Sandy Silt	ML		Pbp	ASTM D 5084	720	22.7	105.6	2.90E-07	PO-177

Notes:

1. Area: NW Northwest Quadrant of Former Plant Area
   SW Southwest Quadrant of Former Plant Area
2. Sample Type: DM Dames and Moore Sampler
   SS Split Spoon (Remolded)
   ST Shelby Tube
3. Test Type: Pbp Triaxial, Back-Pressure Permeability Test (ASTM D5084)
   Pr Triaxial, Remolded, Back-Pressure Permeability Test (ASTM D5084)
4. Avg. Permeability: Average of the last four determinations from the test.
5. Reference: PO177 Former Plant Area Geotechnical Investigation, Geotechnical Laboratory Data Report, PARSONS PO177, September 1997

000572

TABLE F-8
Summary of Standard Compaction Tests
Operable Unit 3
Former Plant Area

Area	FEMP ID	Other ID	Sample Number	Sample Type	Top Depth (feet)	Bottom Depth (feet)	General Stratum	USCS Name	USCS Symbol	LL	PL	PI	Gravel (%)	Sand (%)	Silt and Clay (%)	Clay 0.002 mm (%)	SG	Test Type	Test Method	Optimum Moisture Content (%)	Maximum Dry Density (pcf)	Reference
NW	12269	G3-004	412392	BULK	13.0	29.0	Muddy Stream/Gray Till	Silty, Clayey Sand	SC-SM	17.5	11.6	5.9	3.1	49.0	47.9	11.0	2.81	SP	ASTM D 698	8.8	131.2	PO-177
SW	12273	G3-008	412342	BULK	17.0	19.0	Muddy Stream	Lean Clay	CL	28.9	16.1	12.8	2.4	7.8	89.8	27.0	2.76	SP	ASTM D 698	14.3	118.3	PO-177
SW	12275	G3-010	412449	BULK	13.0	19.0	Brown Clay/Lacustrine	Lean Clay	CL	28.0	17.2	10.8	0.0	3.9	96.1	26.0	2.80	SP	ASTM D 698	14.1	118.6	PO-177

Notes:

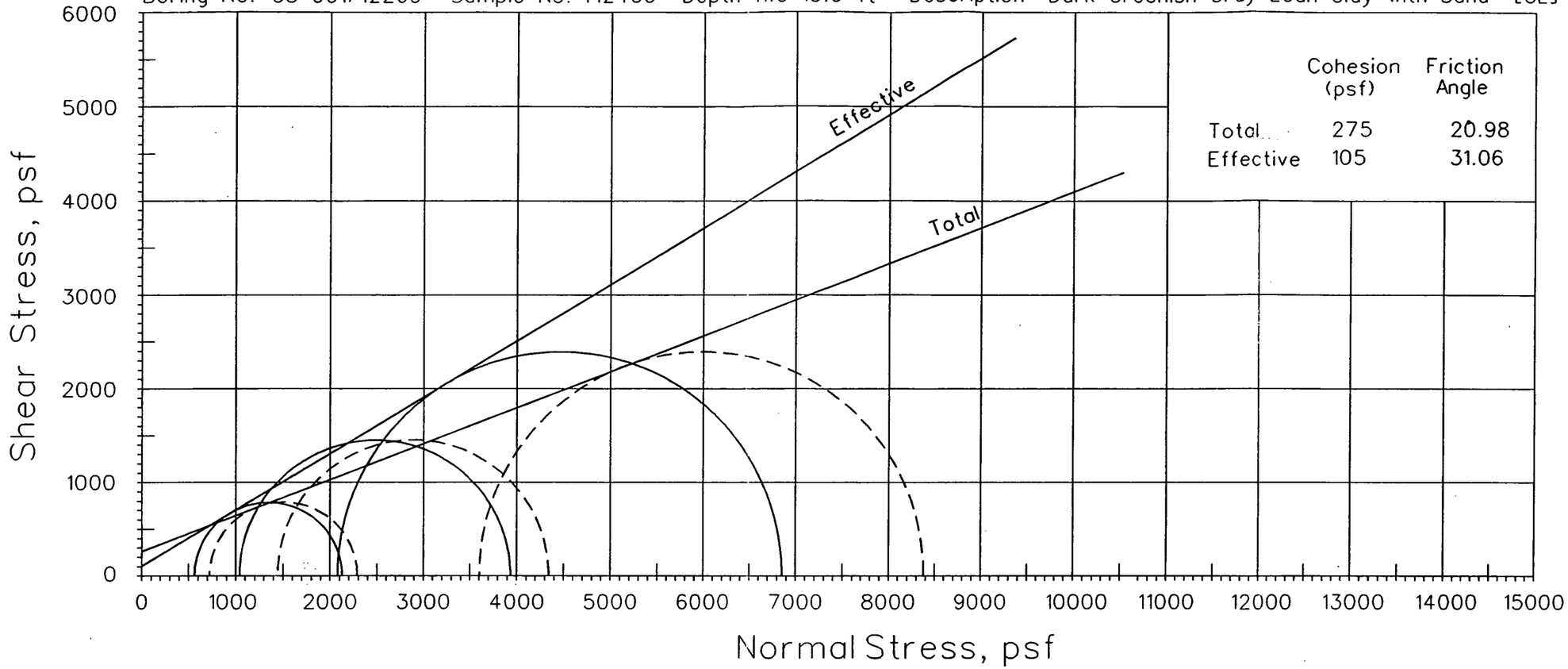
1. Area:
   - NE Northeast Quadrant of Former Plant Area
   - NW Northwest Quadrant of Former Plant Area
   - SE Southeast Quadrant of Former Plant Area
   - SW Southwest Quadrant of Former Plant Area
2. Sample Type: BULK Bulk Sample
3. Test Type: SP Standard Proctor Compactive Effort (ASTM D 698 Method A)
4. Data Source: PO177 Former Plant Area Geotechnical Investigation, Geotechnical Laboratory Data Report, PARSONS PO177, September 1997

APPENDIX G

R412466mo.m po177erma@ws415. Fri Feb 27 16:21:35 CST 1998

Triaxial Compression Test Report

Boring No. G3-001/12266 Sample No. 412466 Depth 11.0-13.0 ft Description -Dark Greenish Gray Lean Clay with Sand [CL]



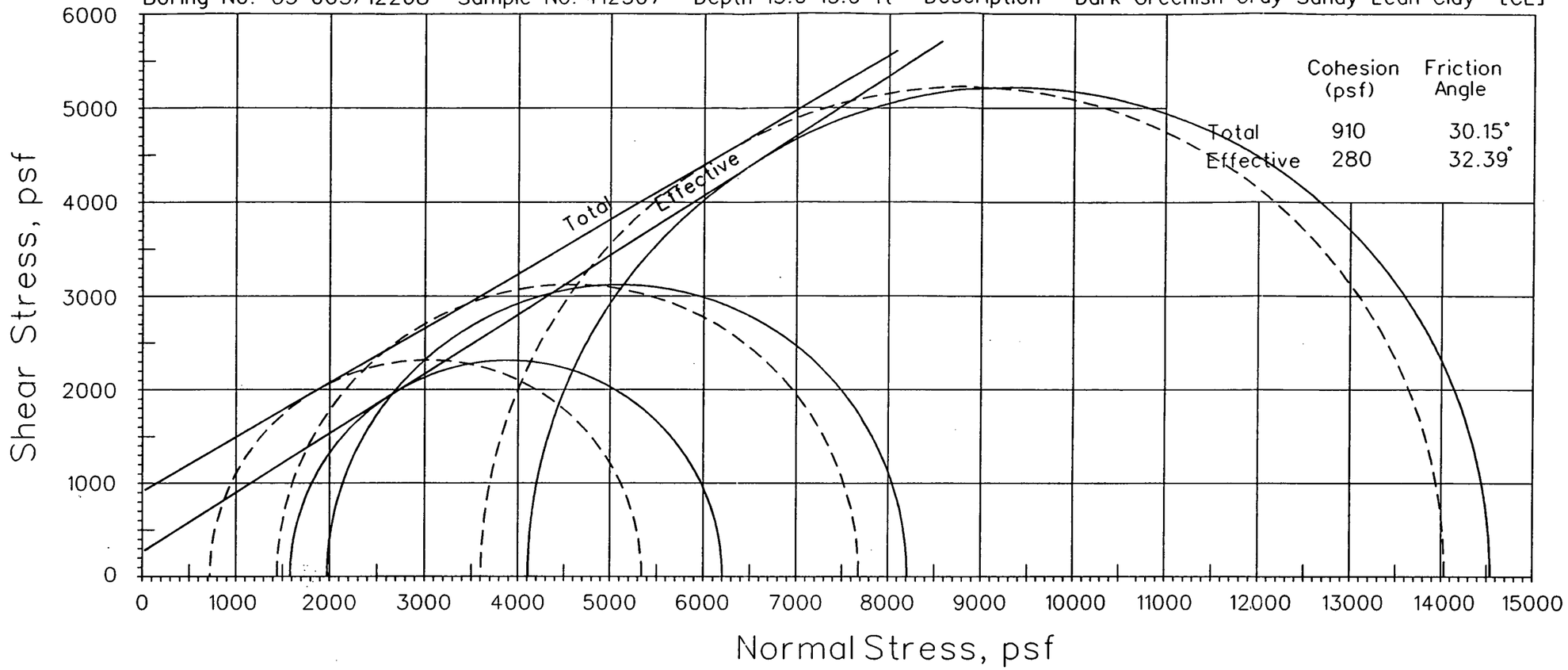
Type of Test: Triax CU Sample Type: In Situ Failure Criteria: Maximum Deviator Stress

Boring No.	Depth (feet)	Spec. No.	Moisture Content (%)		Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Axial Strain (%)	Deviator Stress (psf)	Delta Pore Pressure (psf)	Effective Minor Principal Stress ($sigma_3$) (psf)	Effective Major Principal Stress ($sigma_1$) (psf)	Principal Stress Ratio
			Initial	Final								
G3-001/12266	11.0-13.0	412466A	12.9	11.4	144.7	128.2	12.03	4781	1526	2074	6855	3.31
		412466B	15.3	13.7	142.4	123.5	11.04	2898	403	1037	3935	3.80
		412466C	26.0	24.1	128.2	101.7	14.14	1568	158	562	2129	3.79

CAD FILE: /USR/REF3/FPA/FPA/DGN/412466MO.DGN

Triaxial Compression Test Report

Boring No. G3-003/12268 Sample No. 412307 Depth 13.0-15.0 ft Description - Dark Greenish Gray Sandy Lean Clay [CL]



Type of Test: Triax CU Sample Type: In Situ Failure Criteria: Maximum Deviator Stress Limited by 15% Strain

Boring No.	Depth (feet)	Spec. No.	Moisture Content (%)		Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Axial Strain (%)	Deviator Stress (psf)	Delta Pore Pressure (psf)	Effective Minor Principal Stress ($sigma_3$) (psf)	Effective Major Principal Stress ($sigma_1$) (psf)	Principal Stress Ratio
			Initial	Final								
G3-003/12268	13.0-15.0	412307A	8.3	9.4	145.3	134.1	13.84	10436	-504	4104	14540	3.54
		412307B	8.3	10.0	144.1	133.1	13.62	6239	-533	1973	8211	4.16
		412307C	8.2	10.1	145.6	134.6	14.03	4621	-864	1584	6205	3.92

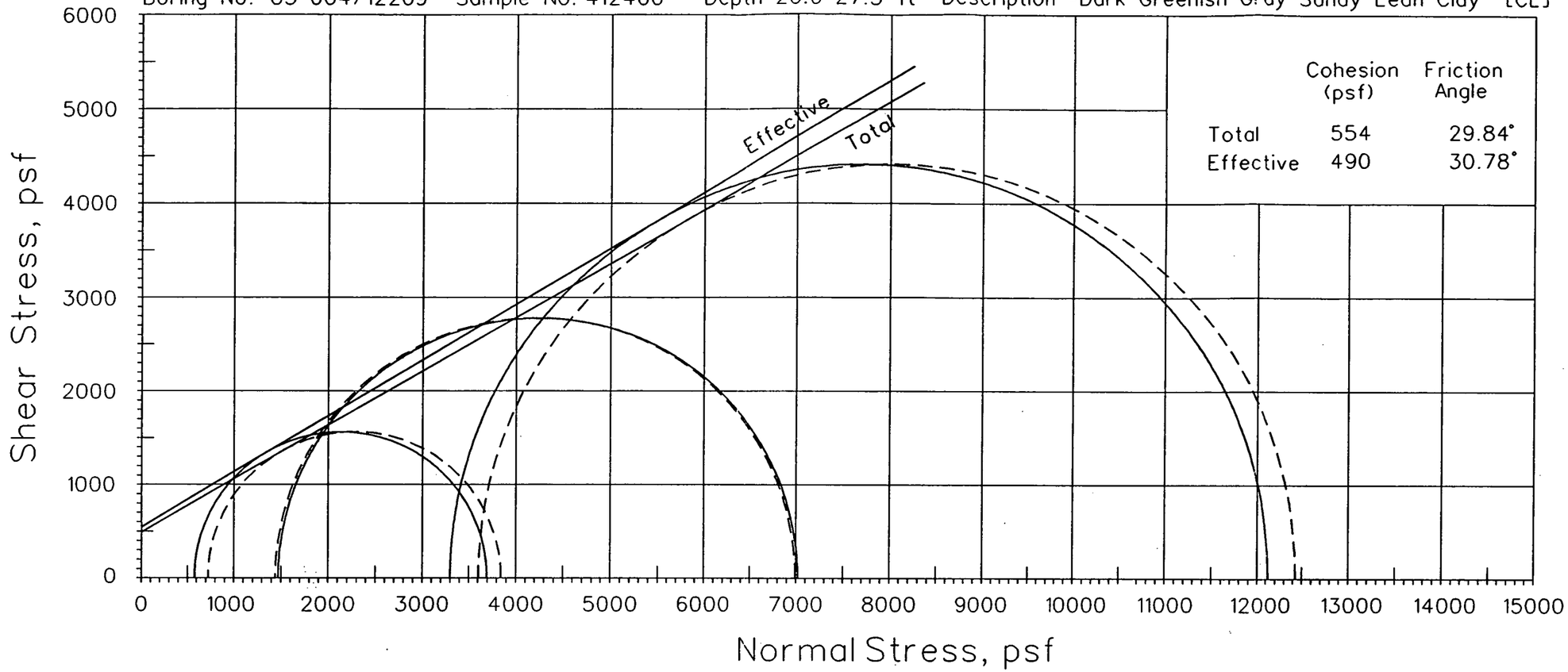
CAD FILE: /USR/REF3/FPA/FPA/DGN/412307MO.DGN

R412307mo.m po177erma@ws415. Fri Feb 27 16:22:11 CST 1998

R412400mo.m po177erma@ws415. Fri Feb 27 16:23:16 CST 1998

Triaxial Compression Test Report

Boring No. G3-004/12269 Sample No. 412400 Depth 26.0-27.5 ft Description -Dark Greenish Gray Sandy Lean Clay [CL]



Type of Test: Triax CU Sample Type: In Situ Failure Criteria: Maximum Principal Stress Ratio

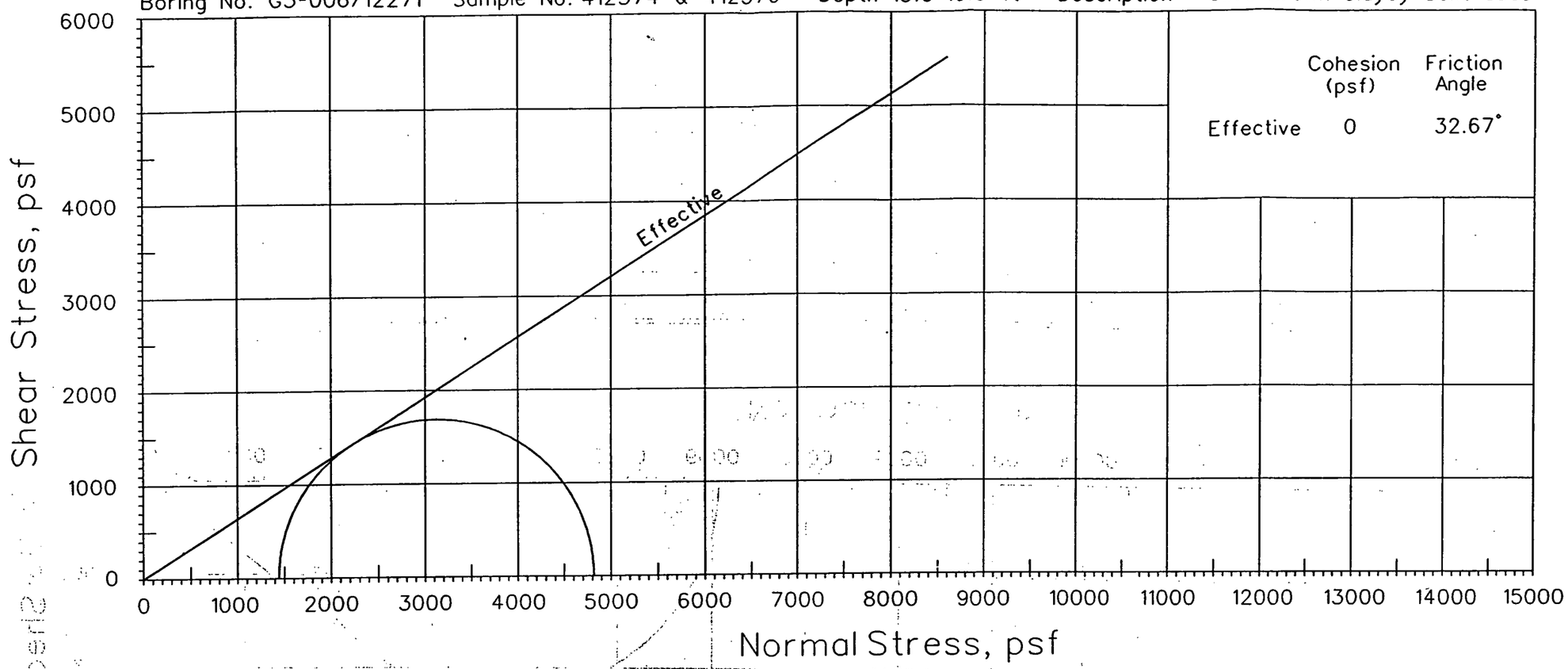
Boring No.	Depth (feet)	Spec. No.	Moisture Content (%)		Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Axial Strain (%)	Deviator Stress (psf)	Delta Pore Pressure (psf)	Effective Minor Principal Stress ($sigma_3$) (psf)	Effective Major Principal Stress ($sigma_1$) (psf)	Principal Stress Ratio
			Initial	Final								
G3-004/12269	26.0-27.5	412400-1	9.8	N/A	148.9	N/A	1.40	3121	144	576	3697	6.42
		412400-2	N/A	N/A	N/A	N/A	0.73	5551	-29	1469	7019	4.78
		412400-3	N/A	10.8	N/A	138.2	0.80	8827	302	3298	12124	3.68

CAD FILE: /USR/REF3/FPA/FPA/DGN/412400MO.DGN

R412374_76.m po177erma@ws415. Fri Feb 27 16:25:27 CST 1998

Triaxial Compression Test Report

Boring No. G3-006/12271 Sample No. 412374 & 412376 Depth 13.0-16.5 ft Description - Olive Brown Clayey Sand [SC]



Type of Test: Triax CD Sample Type: In Situ Failure Criteria: Maximum Effective Stress Ratio

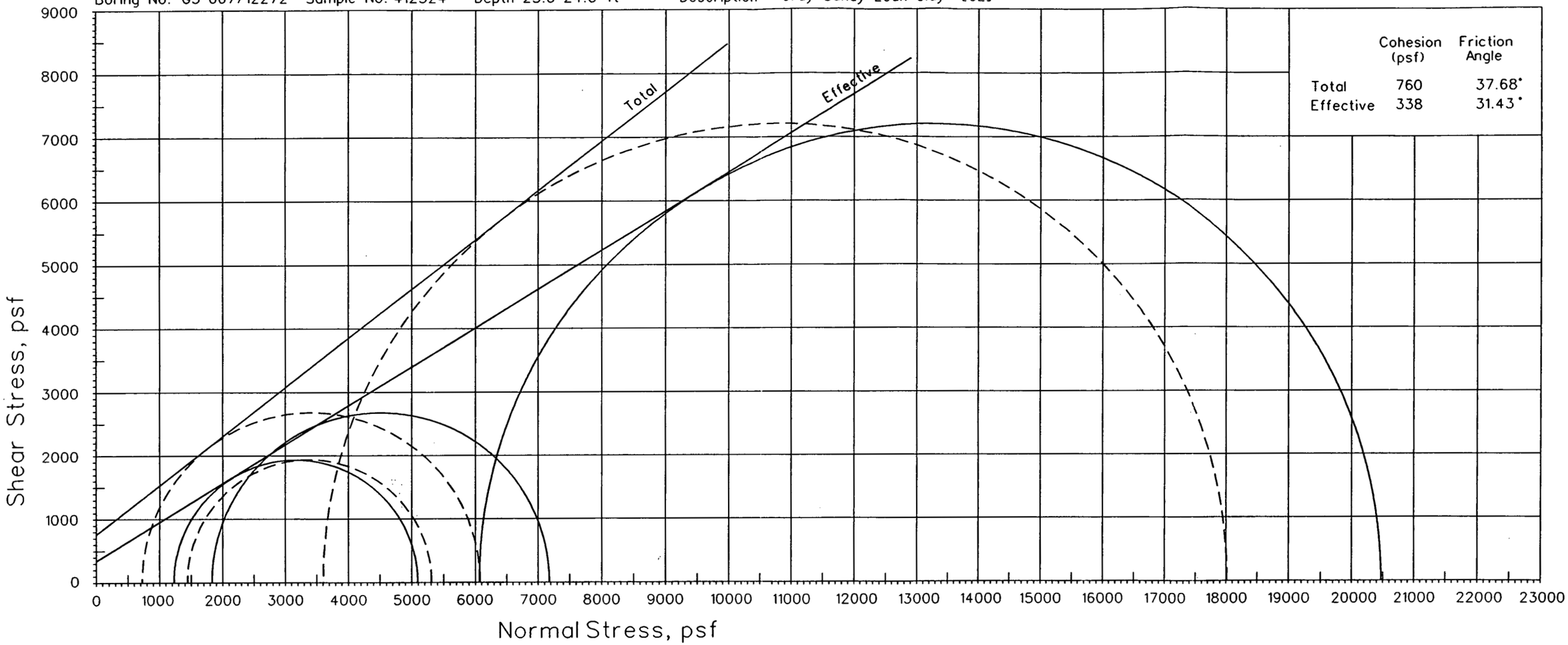
Boring No.	Depth (feet)	Spec. No.	Moisture Content (%)		Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Axial Strain (%)	Deviator Stress (psf)	Delta Pore Pressure (psf)	Effective Minor Principal Stress ($sigma_3$) (psf)	Effective Major Principal Stress ($sigma_1$) (psf)	Effective Stress Ratio
			Initial	Final								
G3-006/12271	13.0-15.0	412374 412376	11.6	10.6	141.3	126.6	20.15	N/A	N/A	1440	4817	3.35
	15.0-16.5											

CAD FILE: /USR/REF3/FPA/FPA/DGN/412374_76.DGN

R412324mo.p 177erma@ws415. Fri Feb 27 16:24:21 CST 1998

Triaxial Compression Test Report

Boring No. G3-007/12272 Sample No. 412324 Depth 23.0-24.0 ft Description - Gray Sandy Lean Clay [CL]



Type of Test: Triax CU Sample Type: In Situ Failure Criteria: 15% Axial Strain

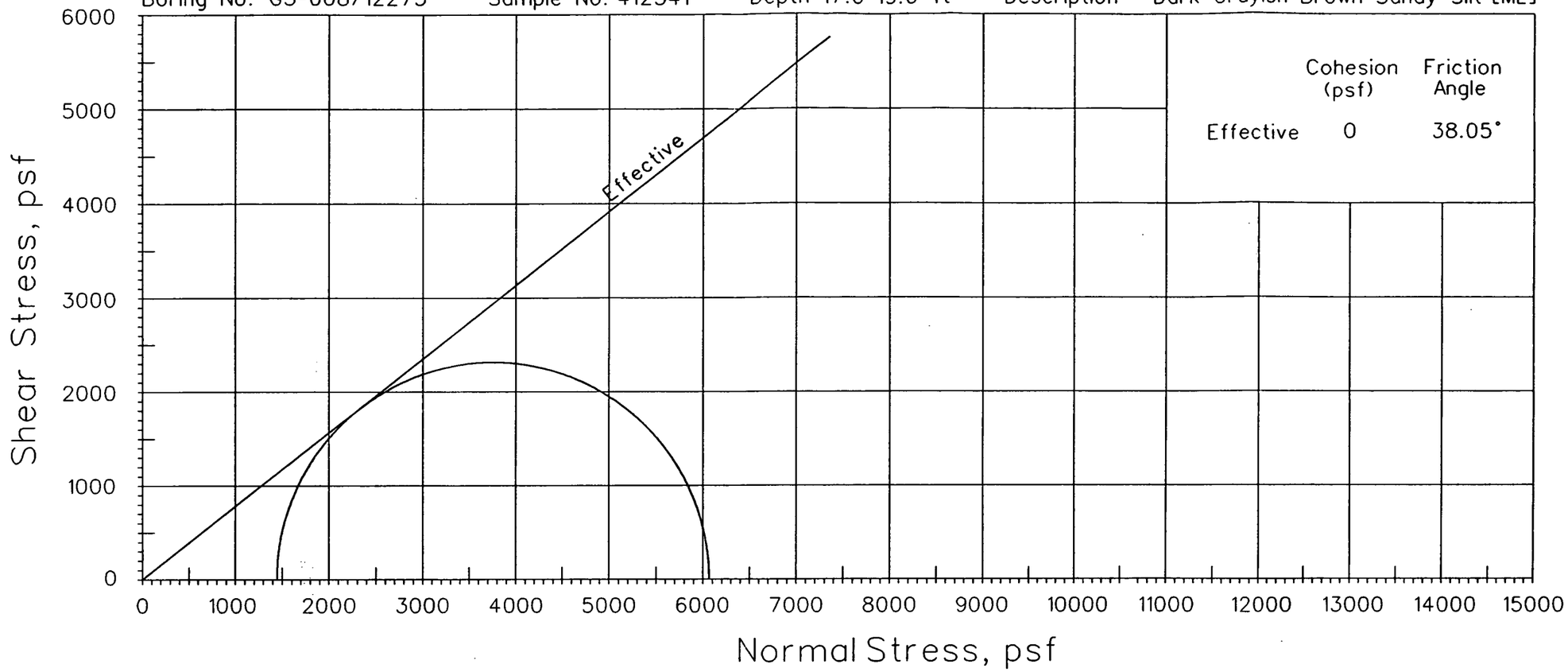
Boring No.	Depth (feet)	Spec. No.	Moisture Content (%)		Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Axial Strain (%)	Deviator Stress (psf)	Delta Pore Pressure (psf)	Effective Minor Principal Stress ($sigma_3$) (psf)	Effective Major Principal Stress ($sigma_1$) (psf)	Principal Stress Ratio
			Initial	Final								
G3-007/12272	23.0-24.0	412324A	11.0	11.9	143.4	129.2	15.03	14411	-2462	6062	20473	3.38
		412324B	12.6	13.5	142.5	126.5	10.07	3866	216	1224	5090	4.16
		412324C	11.4	13.6	142.1	127.5	14.06	5352	-1109	1829	7181	3.93

CAD FILE: /USR/REF3/FPA/FPA/DGN/412324MO.DGN

R412341mo.m po177erma@ws415. Fri Feb 27 16:29:49 CST 1998

Triaxial Compression Test Report

Boring No. G3-008/12273 Sample No. 412341 Depth 17.0-19.0 ft Description - Dark Grayish Brown Sandy Silt [ML]



Type of Test: Triax CD Sample Type: In Situ Failure Criteria: Maximum Effective Stress Ratio

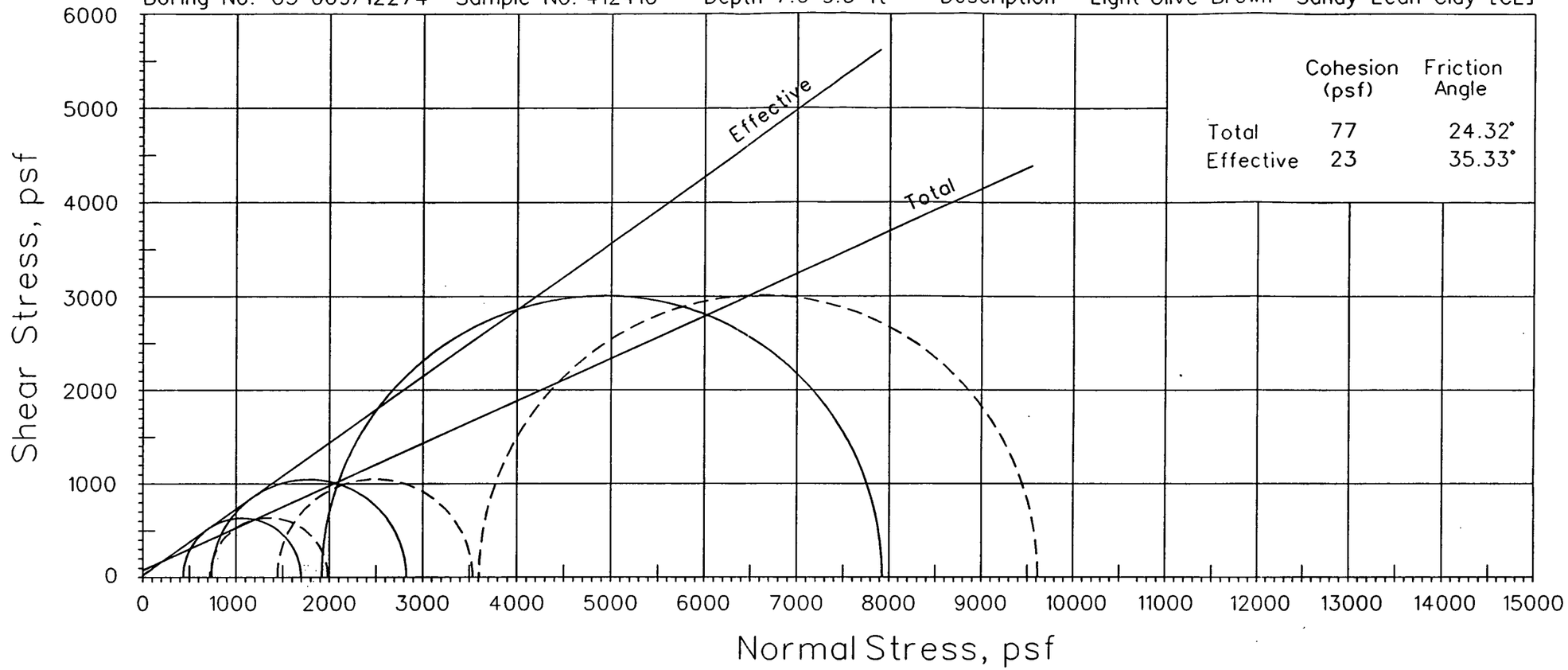
Boring No.	Depth (feet)	Spec. No.	Moisture Content (%)		Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Axial Strain (%)	Deviator Stress (psf)	Delta Pore Pressure (psf)	Effective Minor Principal Stress ($sigma_3$) (psf)	Effective Major Principal Stress ($sigma_1$) (psf)	Effective Stress Ratio
			Initial	Final								
G3-008/12273	17.0-19.0	412341	18.2	18.4	133.1	112.7	4.53	N/A	N/A	1440	6065	4.21

CAD FILE: /USR/REF3/FPA/FPA/DGN/412341MO.DGN

R412410a_mo.m po177erma@ws415. Fri Feb 27 16:23:49 CST 1998

Triaxial Compression Test Report

Boring No. G3-009/12274 Sample No. 412410 Depth 7.0-9.0 ft Description - Light Olive Brown Sandy Lean Clay [CL]



Type of Test: Triax CU Sample Type: In Situ Failure Criteria: Maximum Principal Stress Ratio

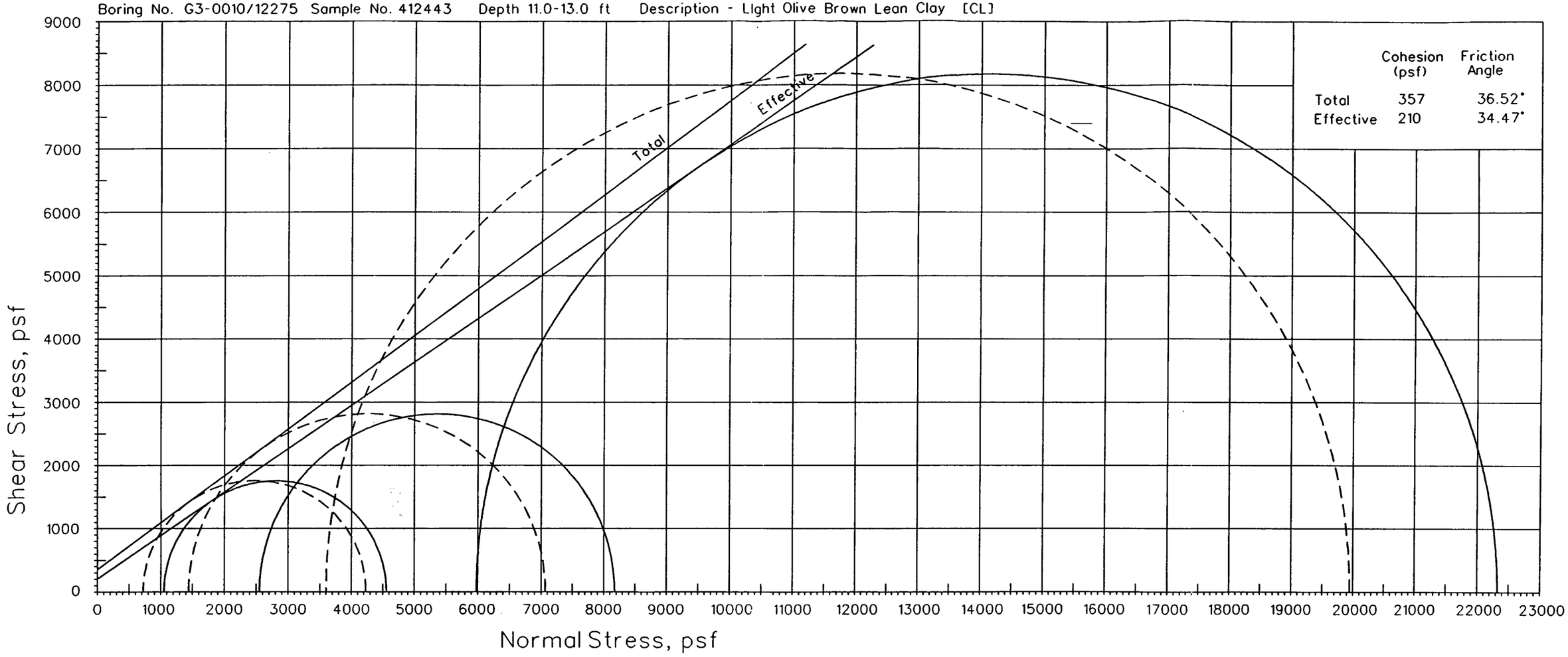
Boring No.	Depth (feet)	Spec. No.	Moisture Content (%)		Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Axial Strain (%)	Deviator Stress (psf)	Delta Pore Pressure (psf)	Effective Minor Principal Stress ($sigma_3$) (psf)	Effective Major Principal Stress ($sigma_1$) (psf)	Principal Stress Ratio
			Initial	Final								
G3-009/12274	7.0-9.0	412410A	11.4	11.8	142.7	128.0	5.52	6013	1685	1915	7928	4.14
		412410B	19.7	18.2	133.4	111.4	5.52	2091	706	734	2826	3.85
		412410C	25.7	26.0	126.4	100.6	5.01	1264	288	432	1696	3.93

CAD FILE: /USR/REF3/FPA/FPA/DGN/412410A_MO.DGN

R412443mo.[illegible]177erma@ws415. Fri Feb 27 16:24:54 CST 1998

Triaxial Compression Test Report

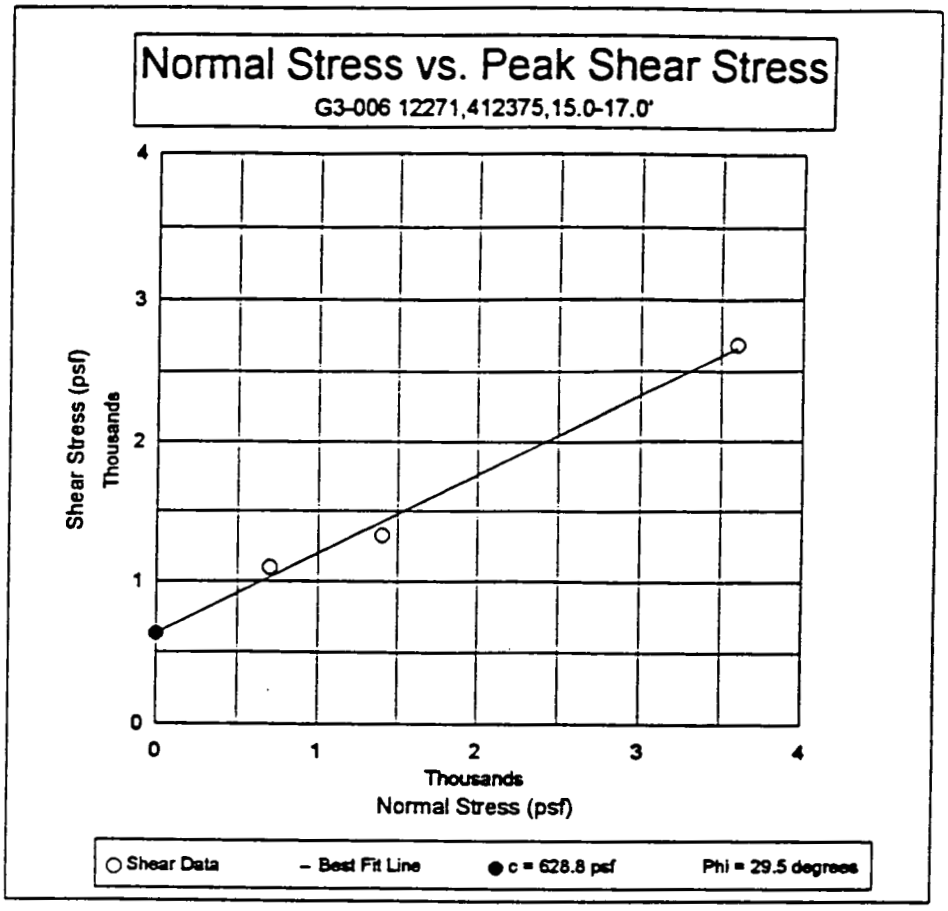
Boring No. G3-0010/12275 Sample No. 412443 Depth 11.0-13.0 ft Description - Light Olive Brown Lean Clay [CL]

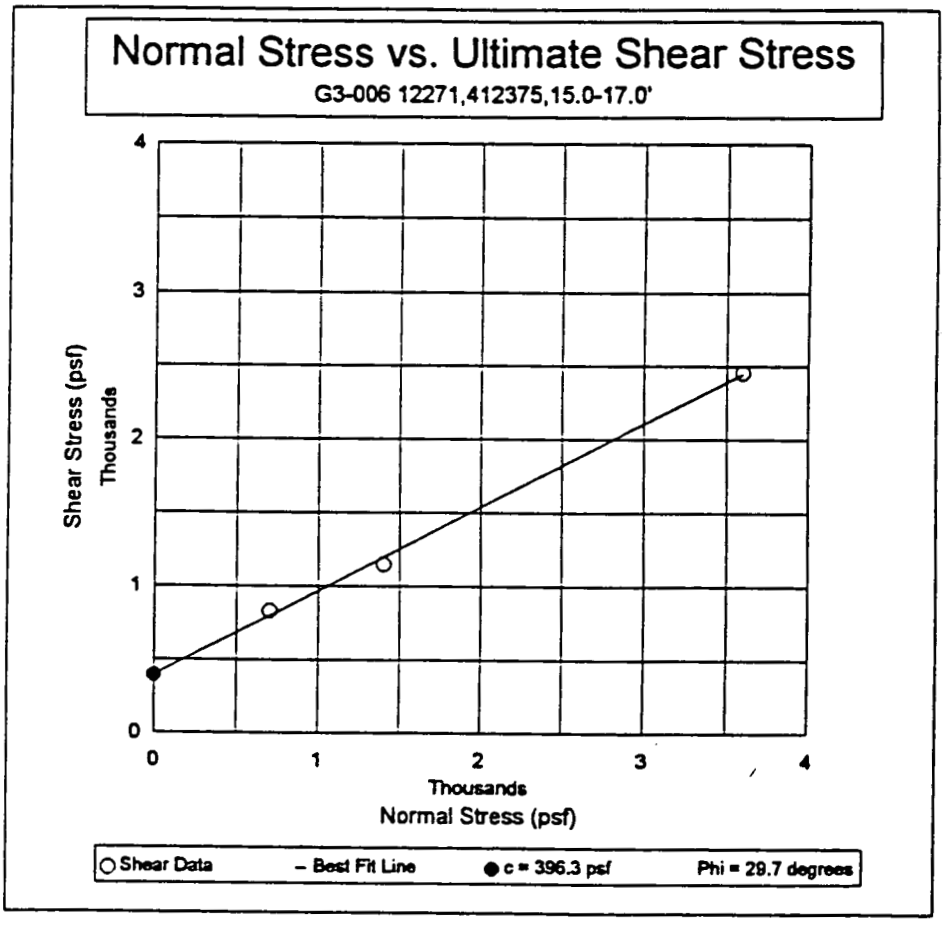


Type of Test: Triax CU Sample Type: In Situ Failure Criteria: Maximum Deviator Stress

Boring No.	Depth (feet)	Spec. No.	Moisture Content (%)		Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Axial Strain (%)	Deviator Stress (psf)	Delta Pore Pressure (psf)	Effective Minor Principal Stress ($sigma_3$) (psf)	Effective Major Principal Stress ($sigma_1$) (psf)	Principal Stress Ratio
			Initial	Final								
G3-010/12275	11.0-13.0	412443A	22.2	21.5	131.5	107.6	12.00	16350	-2376	5976	22326	3.74
		412443B	23.2	22.9	126.4	102.7	15.00	5625	-1109	2549	8174	3.21
		412443C	23.6	24.1	128.8	104.2	8.01	3509	-331	1051	4560	4.34

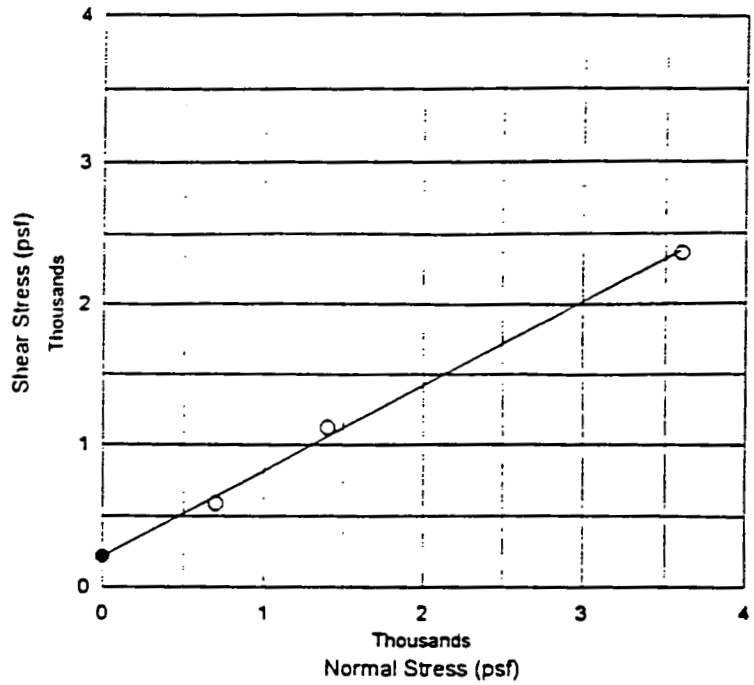
CAD FILE: /USR/REF3/FPA/FPA/DGN/412443MO.DGN


Normal Stress vs. Peak Shear Stress
G3-006 12271,412375,15.0-17.0'
Shear Stress (psf)
Thousands
0
1
2
3
4
Thousands
Normal Stress (psf)
Shear Data
Best Fit Line
c = 628.8 psf
Phi = 29.5 degrees


Normal Stress vs. Ultimate Shear Stress
G3-006 12271,412375,15.0-17.0'
Shear Stress (psf)
Thousands
0
1
2
3
4
Thousands
Normal Stress (psf)
Shear Data
Best Fit Line
c = 396.3 psf
Phi = 29.7 degrees

Normal Stress vs. Peak Shear Stress

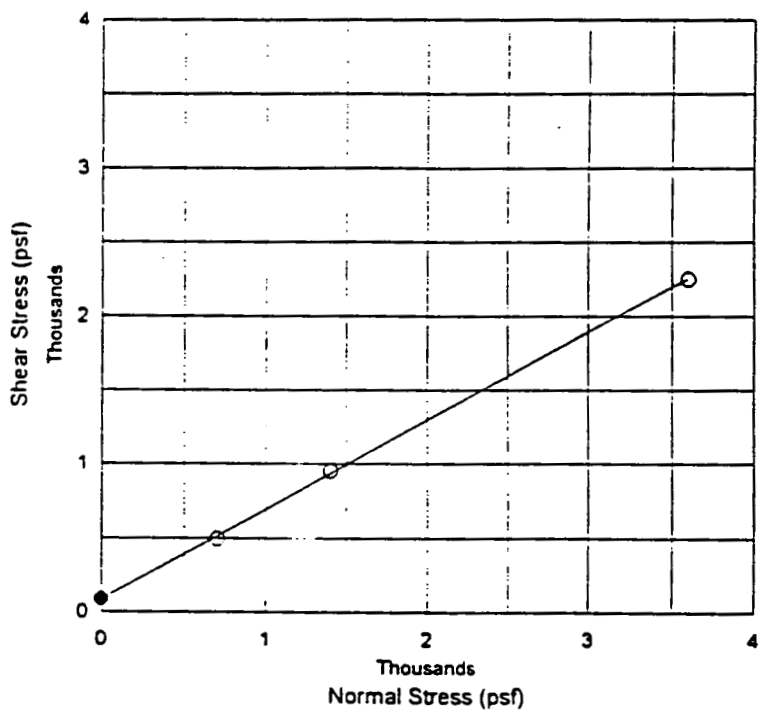
G3-008, 12273,412341, A,17.0-19.0'



○ Shear Data – Best Fit Line ● c = 218.2 psf Phi = 31.0 degrees

Normal Stress vs. Ultimate Shear Stress

G3-008, 12273,412341, A,17.0-19.0'



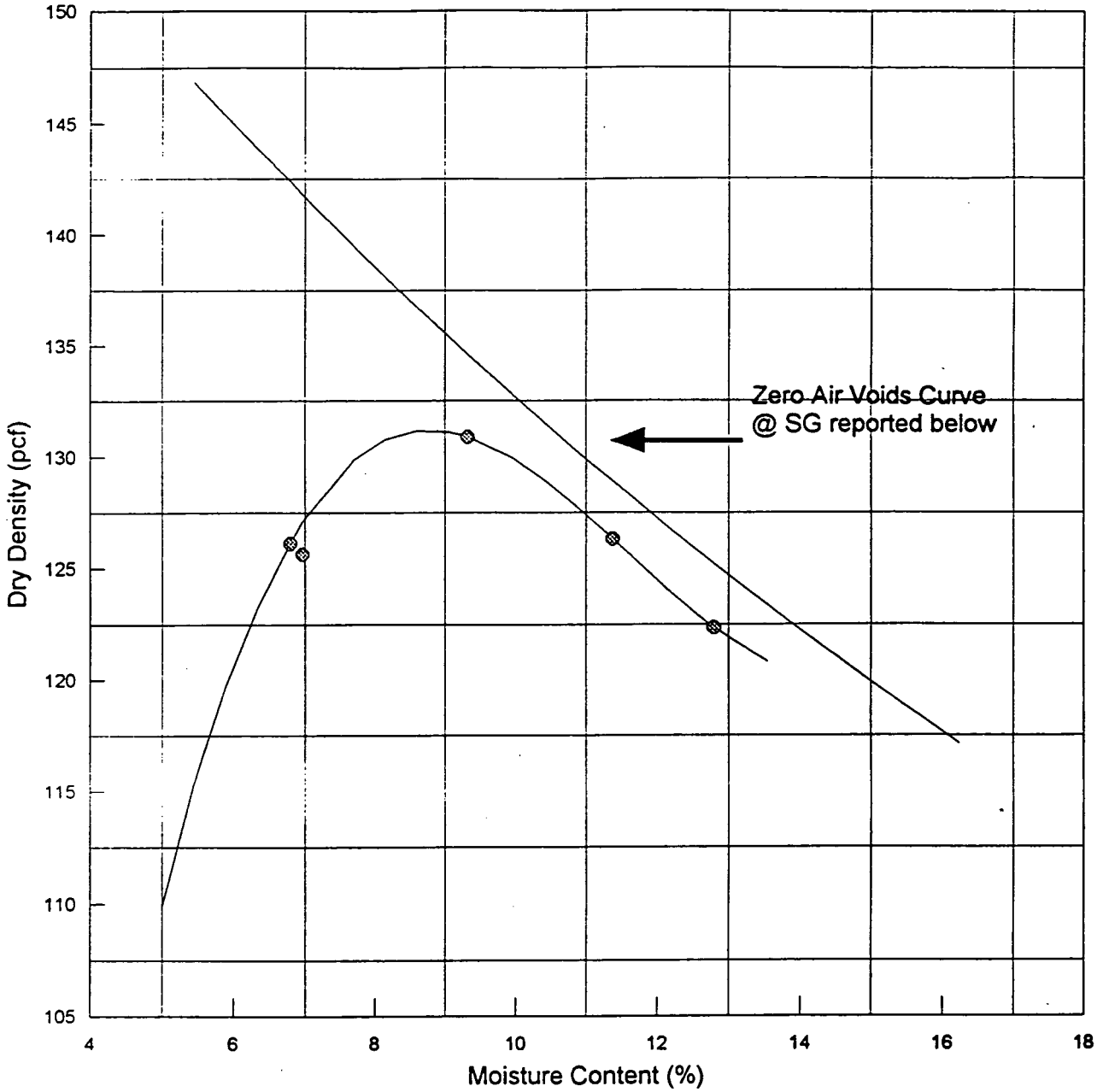
○ Shear Data – Best Fit Line ● c = 87.3 psf Phi = 31.1 degrees

APPENDIX H

Compaction Curves from PO-177 Tests

Proctor Compaction Test

G3-004, 12269, 13.0-29.0', 412392



– Best Fit Curve ⊗ Actual Data

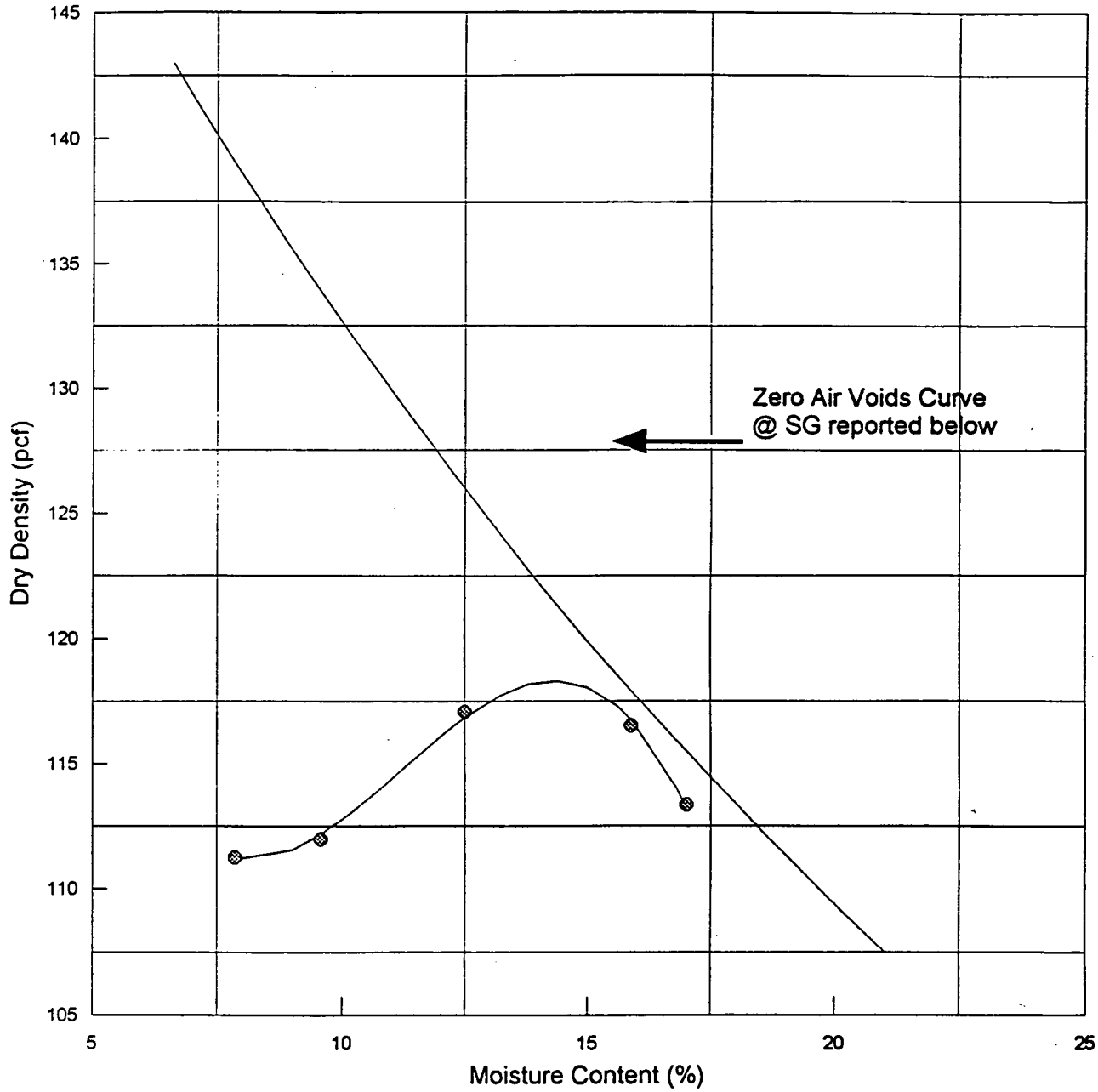
– Zero Air VoidsCurve @ SG = 2.70

OPTIMUM MOISTURE CONTENT = 8.8 MAXIMUM DRY DENSITY = 131.2
ASTM D 698 A, Rock correction applied? N

ADVANCED TERRA TESTING, INC.

Proctor Compaction Test

G3-008, 12273, 17.0-19.0', 412342



– Best Fit Curve ⊗ Actual Data

– Zero Air VoidsCurve @ SG = 2.70

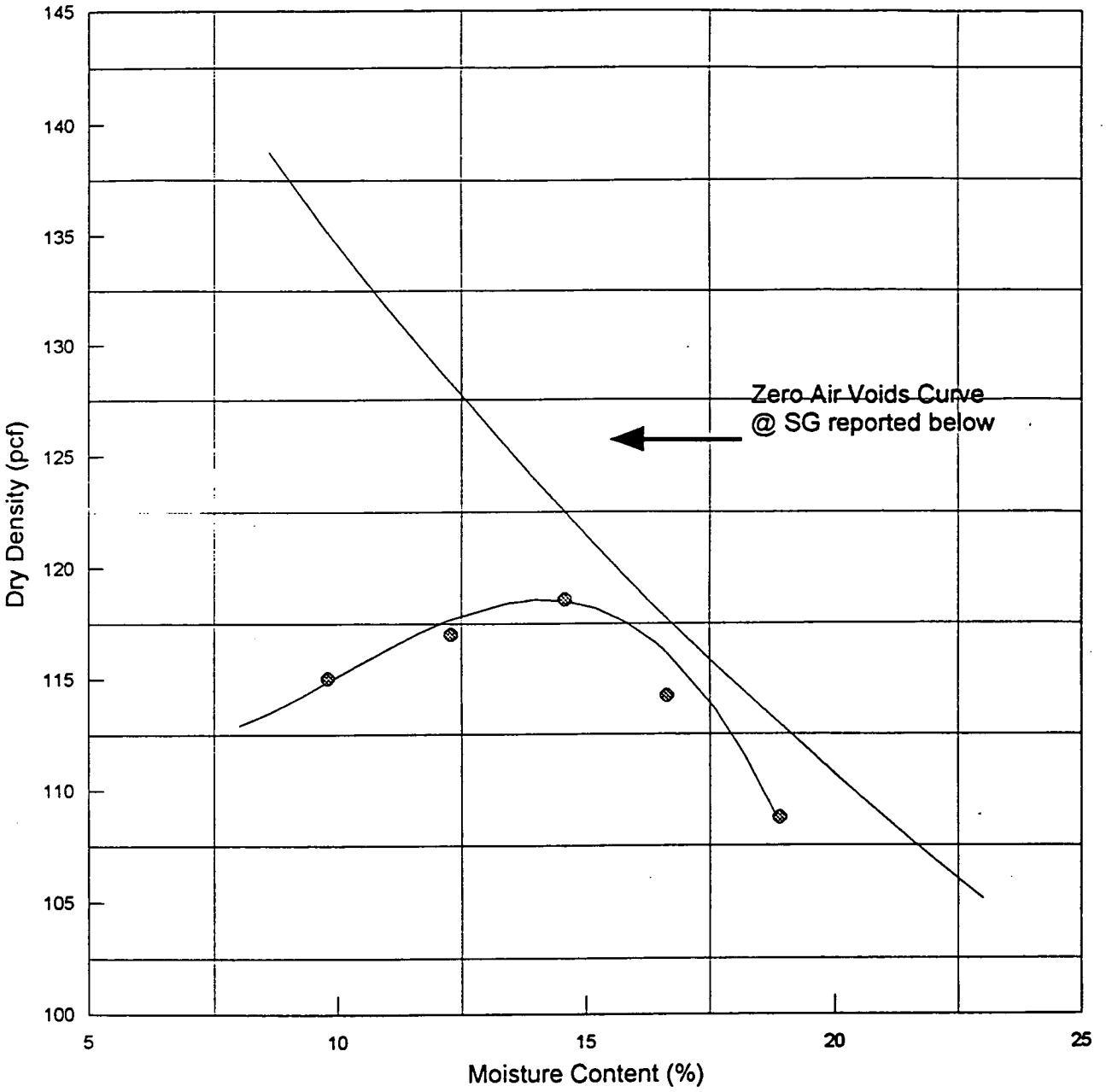
OPTIMUM MOISTURE CONTENT = 14.3 MAXIMUM DRY DENSITY = 118.3
ASTM D 698 A, Rock correction applied? N

ADVANCED TERRA TESTING, INC.

000586

Proctor Compaction Test

G3-010,12275, 13.0-19.0', 412449



- Best Fit Curve
- Actual Data
- Zero Air VoidsCurve @ SG = 2.75

OPTIMUM MOISTURE CONTENT = 14.1 MAXIMUM DRY DENSITY = 118.6
ASTM D 698 A, Rock correction applied? N

ADVANCED TERRA TESTING, INC.

Compaction Curves from PO-140 Report

(OSDF Area East of FPA)

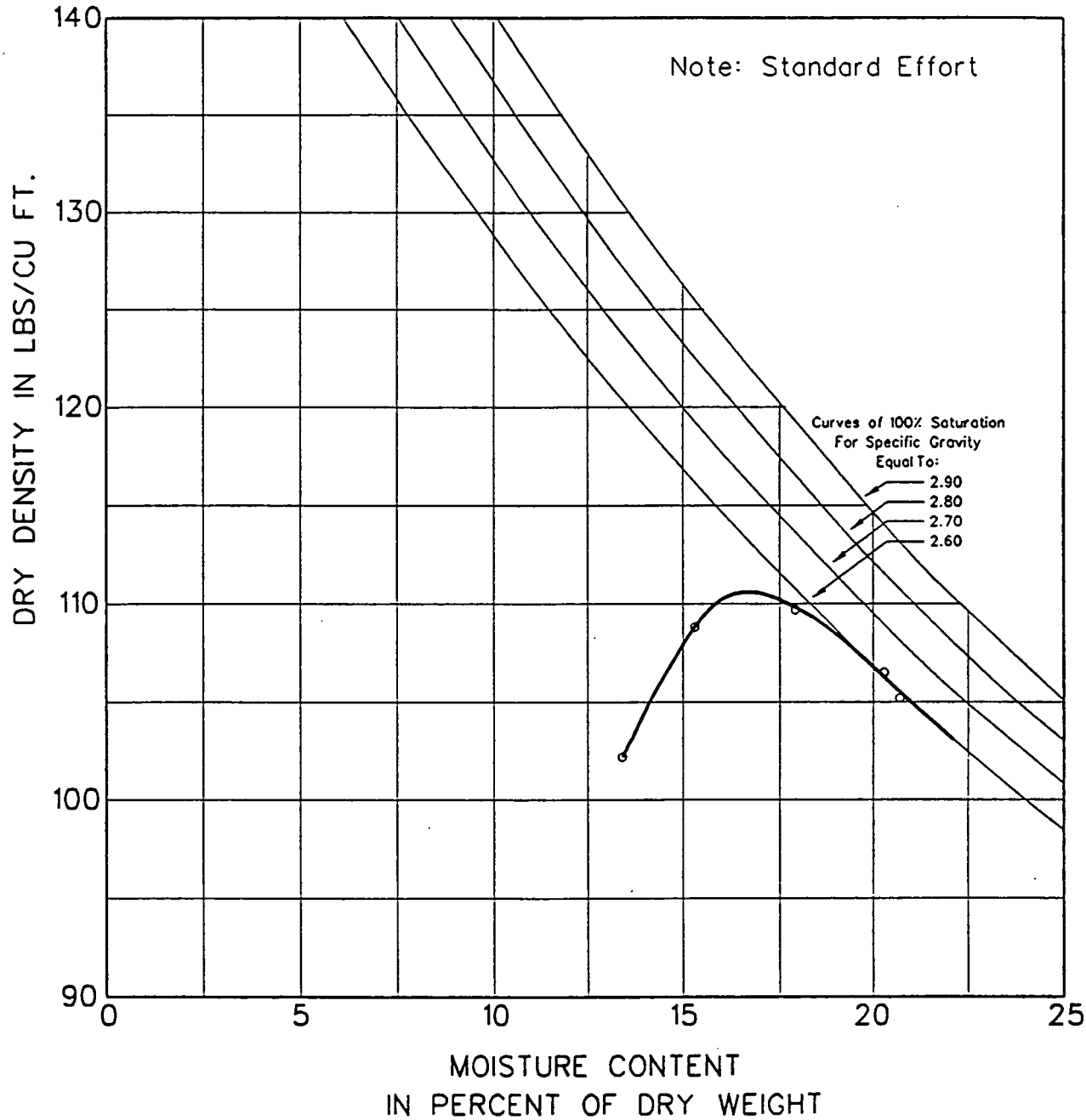
Boring: 11468 Sample Number: 403103 Depth: 2.0-6.5 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 16.7% Maximum Dry Density: 110.5 lbs/ft^3

Specific Gravity: 2.75 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/03/95



ILENAME: SKX03656.DGN

R403103c.m(2473.ws415) po140@ws415. Tue Oct 31 13:00:59 CST 1995

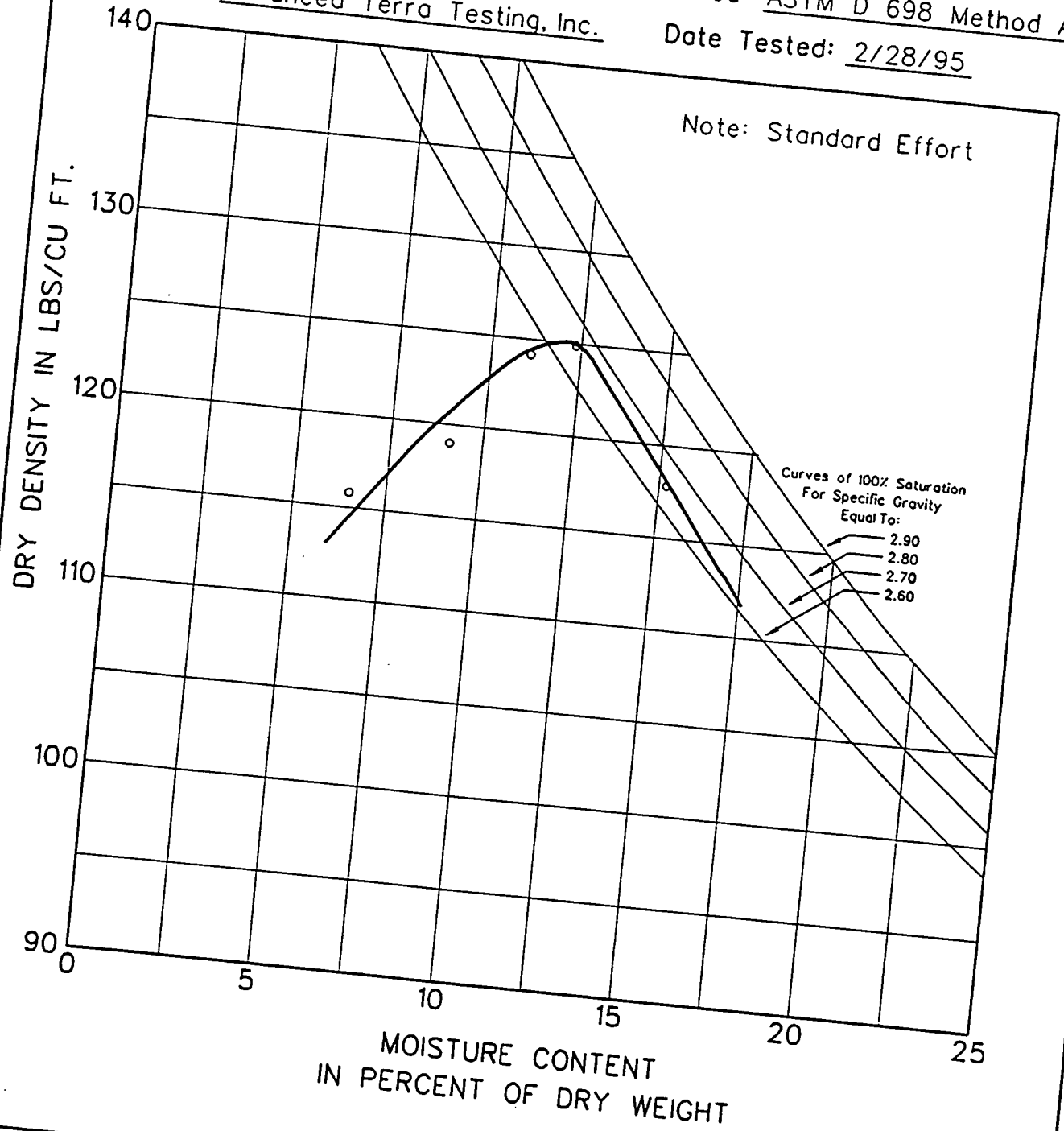
Boring: 11468 Sample Number: 403104 Depth: 9.0-13.0 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 11.6% Maximum Dry Density: 125.0 lbs/ft^3

Specific Gravity: 2.78 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 2/28/95



3104c.m(2456.ws415) po140@ws415. Tue Oct 31 12:47:13 CST 1995

000590

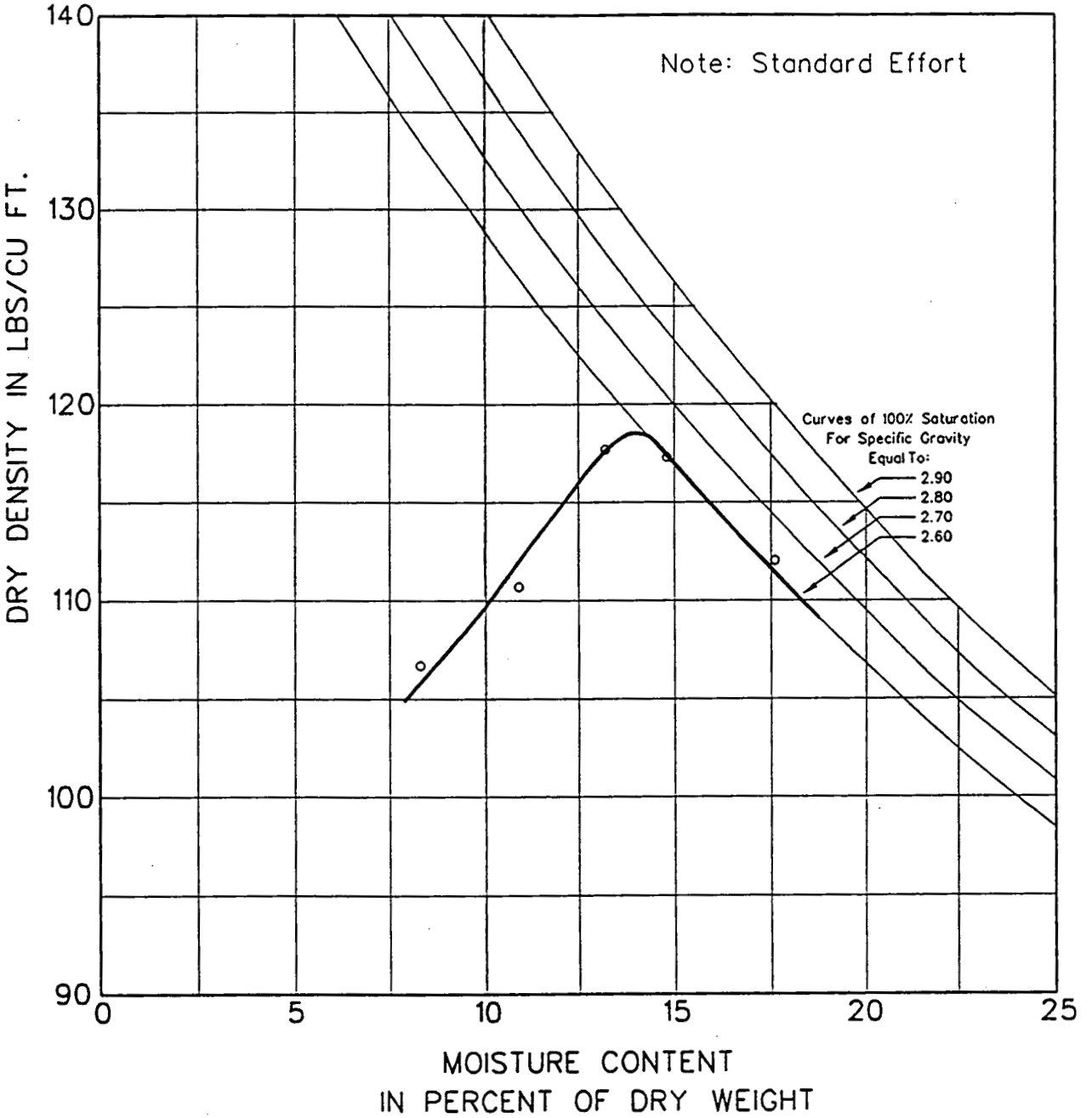
Boring: 11469 Sample Number: 402824 Depth: 3.0-7.5 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 13.9% Maximum Dry Density: 118.5 lbs/ft^3

Specific Gravity: 2.70 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/14/95



FILENAME: SKX03655.DGN

R402824c.m(2472.ws415) po140@ws415. Tue Oct 31 13:00:32 CST 1995

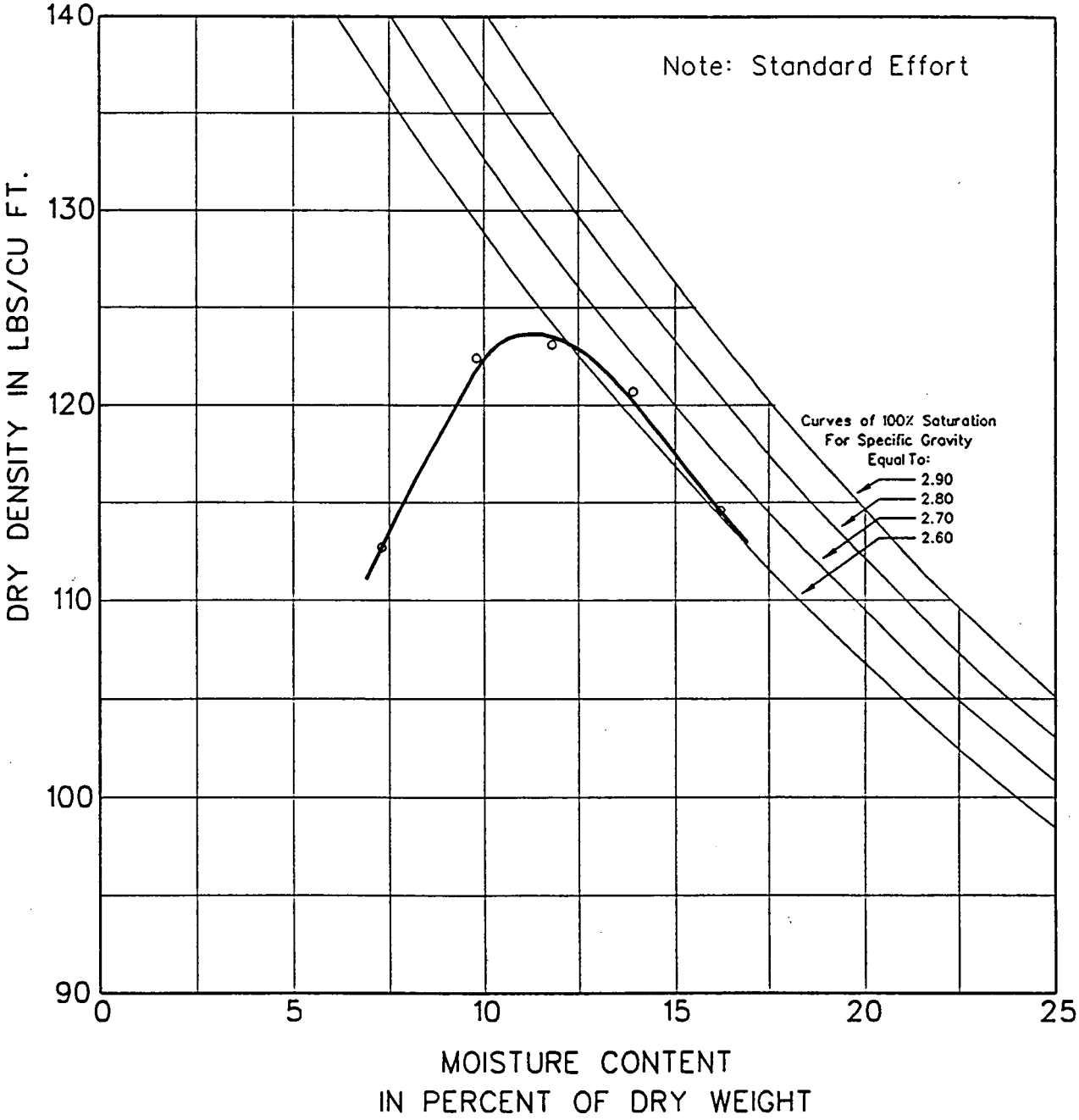
Boring: 11469 Sample Number: 402828 Depth: 7.5-12.0 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 11.3% Maximum Dry Density: 123.7 lbs/ft^3

Specific Gravity: 2.69 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/15/95



000592

FILENAME: SKX03657.DGN

R402828c.m(2474.ws415) po140@ws415. Tue Oct 31 13:01:27 CST 1995

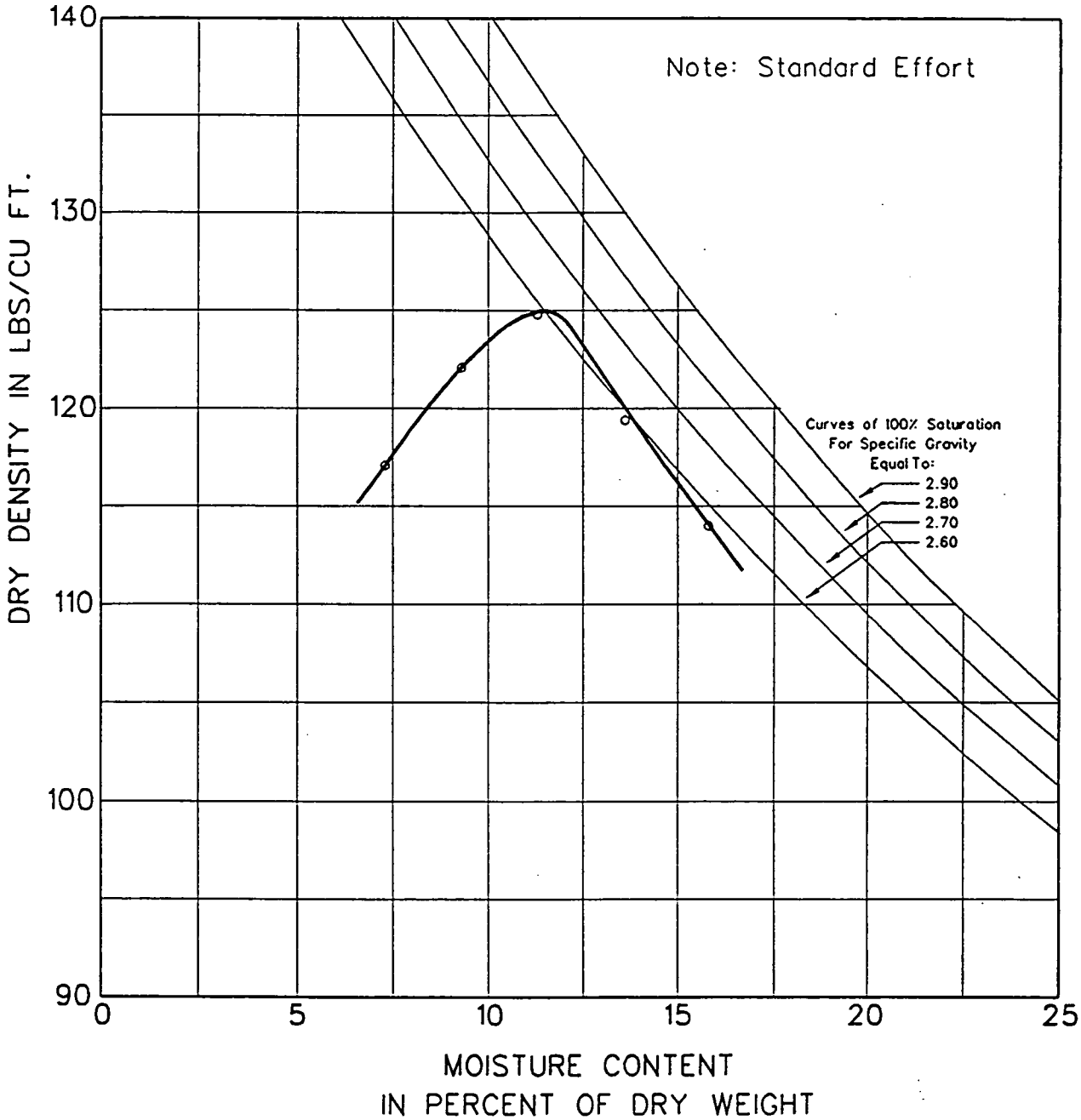
Boring: 11470B Sample Number: 403169-1 Depth: 3.5-7.5 ft

Description: Brown Sandy Silt (ML)

Optimum Moisture Content: 11.1% Maximum Dry Density: 125.0 lbs/ft^3

Specific Gravity: 2.70 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/03/95



LENAME: SKX03638.DGN

R403169c.m(2455.ws415) po140@ws415. Tue Oct 31 12:45:09 CST 1995

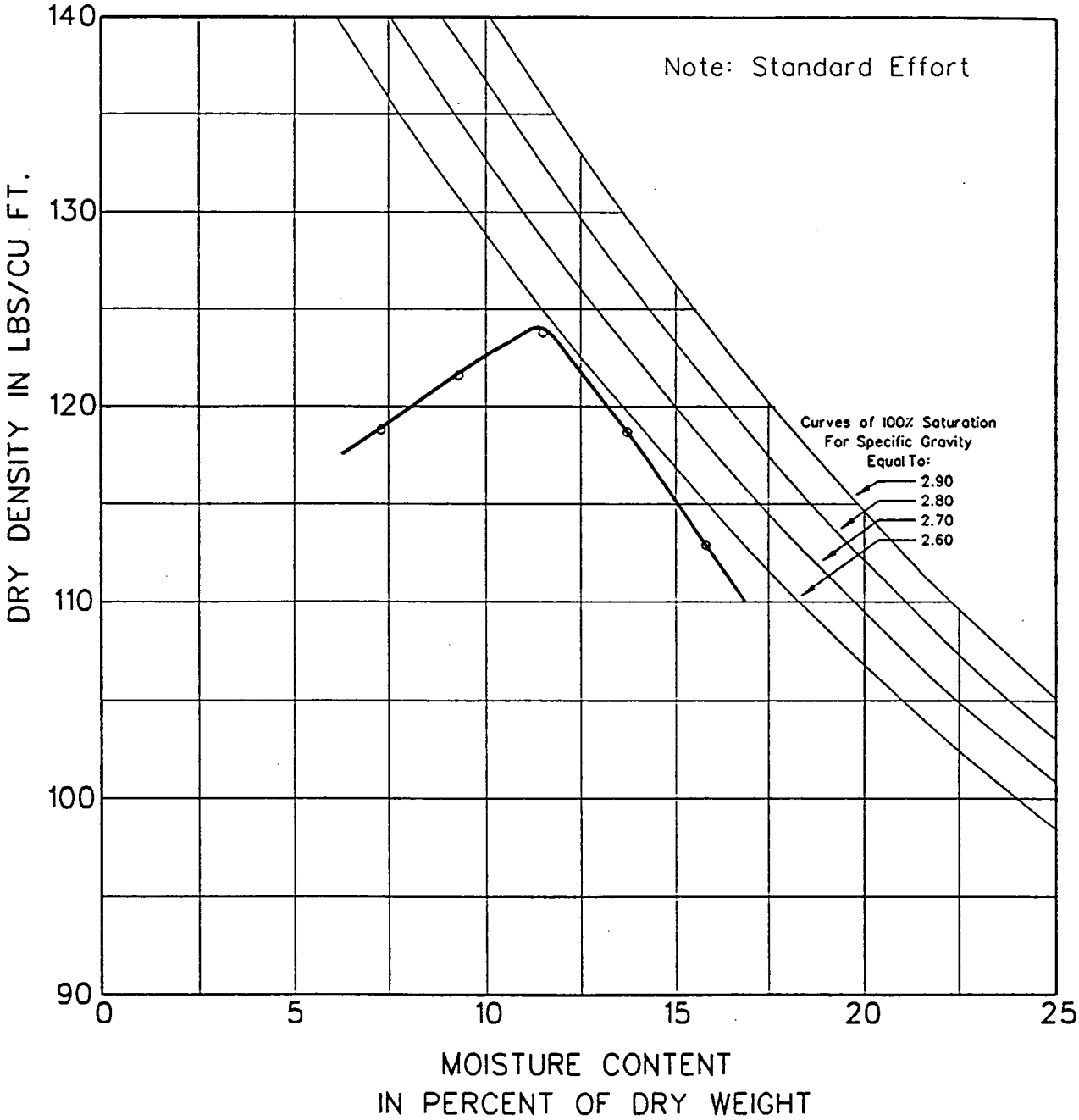
Boring: 11470B Sample Number: 403170-1 Depth: 7.5-12.0 ft

Description: Brown Sandy Silt (ML)

Optimum Moisture Content: 11.4% Maximum Dry Density: 124.0 lbs/ft^3

Specific Gravity: 2.72 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/09/95



FILENAME: SKX03637.DGN

R403170c.m(2454.ws415) po140@ws415. Tue Oct 31 12:44:23 CST 1995

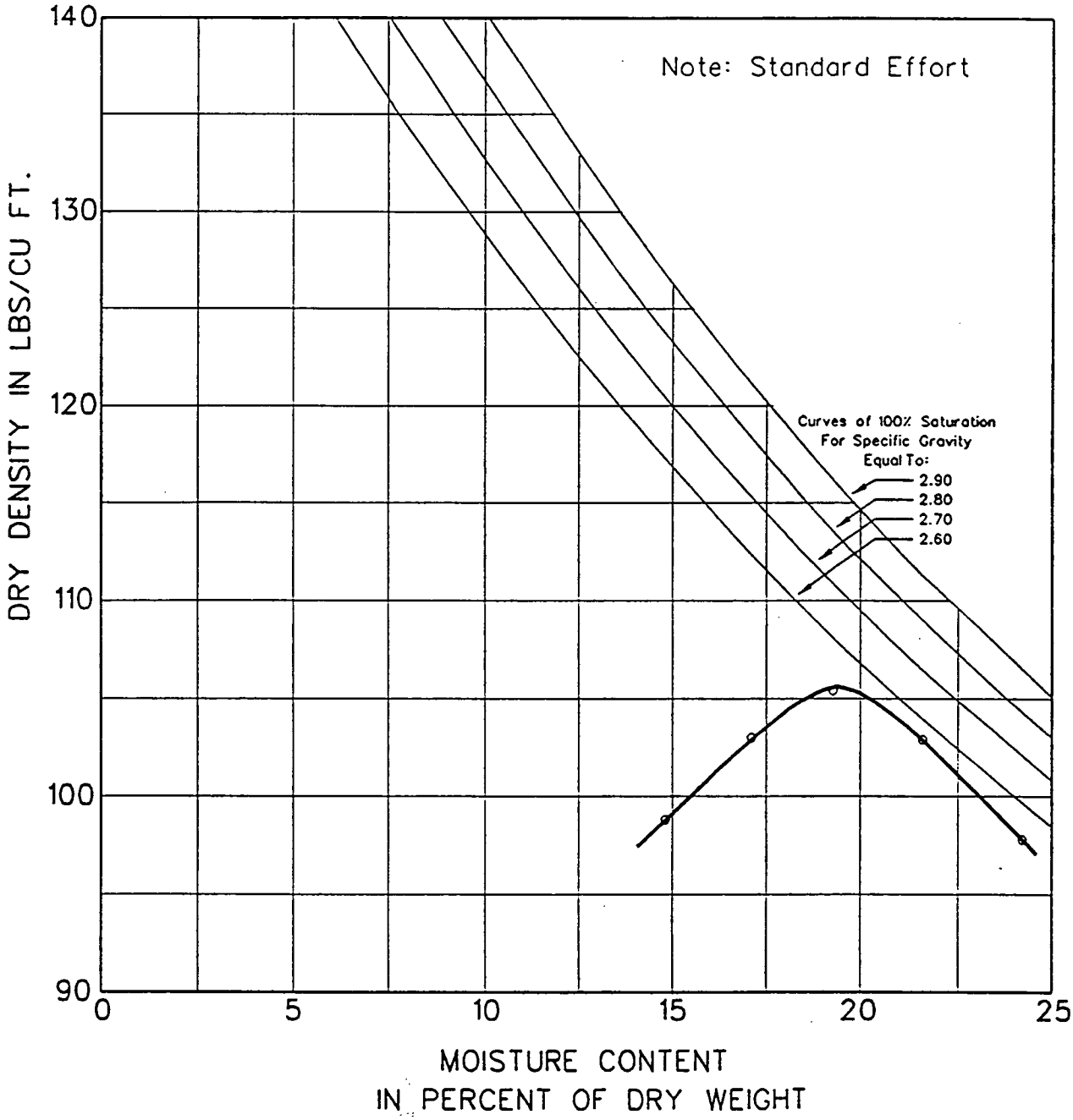
Boring: 11471 Sample Number: 402966 Depth: 3.0-7.5 ft

Description: Brown Fat Clay (CH)

Optimum Moisture Content: 19.3% Maximum Dry Density: 105.6 lbs/ft^3

Specific Gravity: 2.72 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/03/95



_ENAME: SKX03654.DGN

R402966c.m(2471.ws415) po140@ws415. Tue Oct 31 13:00:04 CST 1995

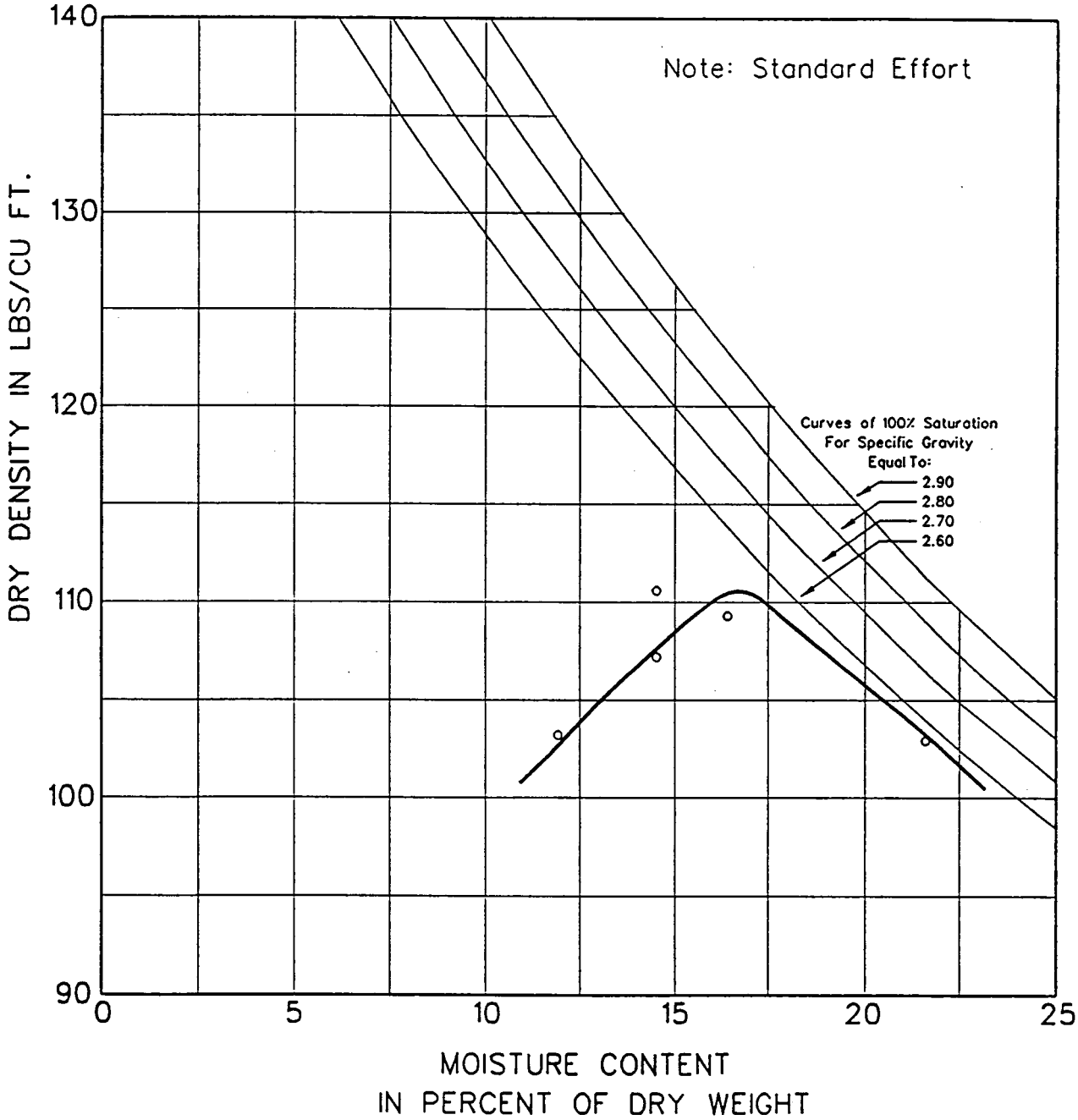
Boring: 11471 Sample Number: 402978 Depth: 7.5-10.5 ft

Description: Brown Lean Clay (CL)

Optimum Moisture Content: 17.4% Maximum Dry Density: 110.6 lbs/ft^3

Specific Gravity: 2.71 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/01/95



FILENAME: SKX03653.DGN

R402978c.m(2470.ws415) po140@ws415. Tue Oct 31 12:59:37 CST 1995

000596

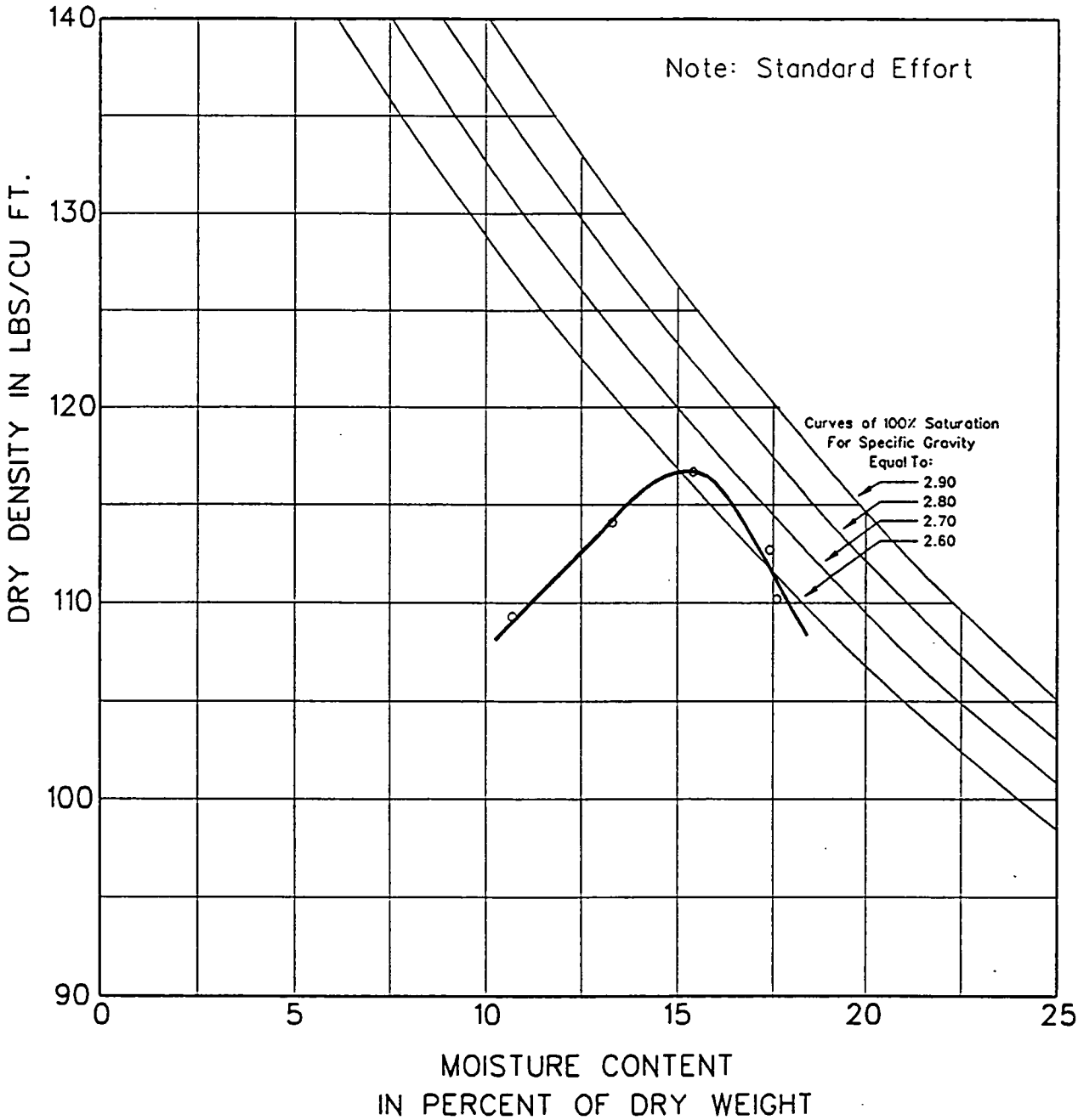
Boring: 11473 Sample Number: 402923 Depth: 3.0-7.5 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 15.1% Maximum Dry Density: 116.7 lbs/ft^3

Specific Gravity: 2.76 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/14/95



ILENAME: SKX03651.DGN

R402923c.m(2468.ws415) po140@ws415. Tue Oct 31 12:58:38 CST 1995

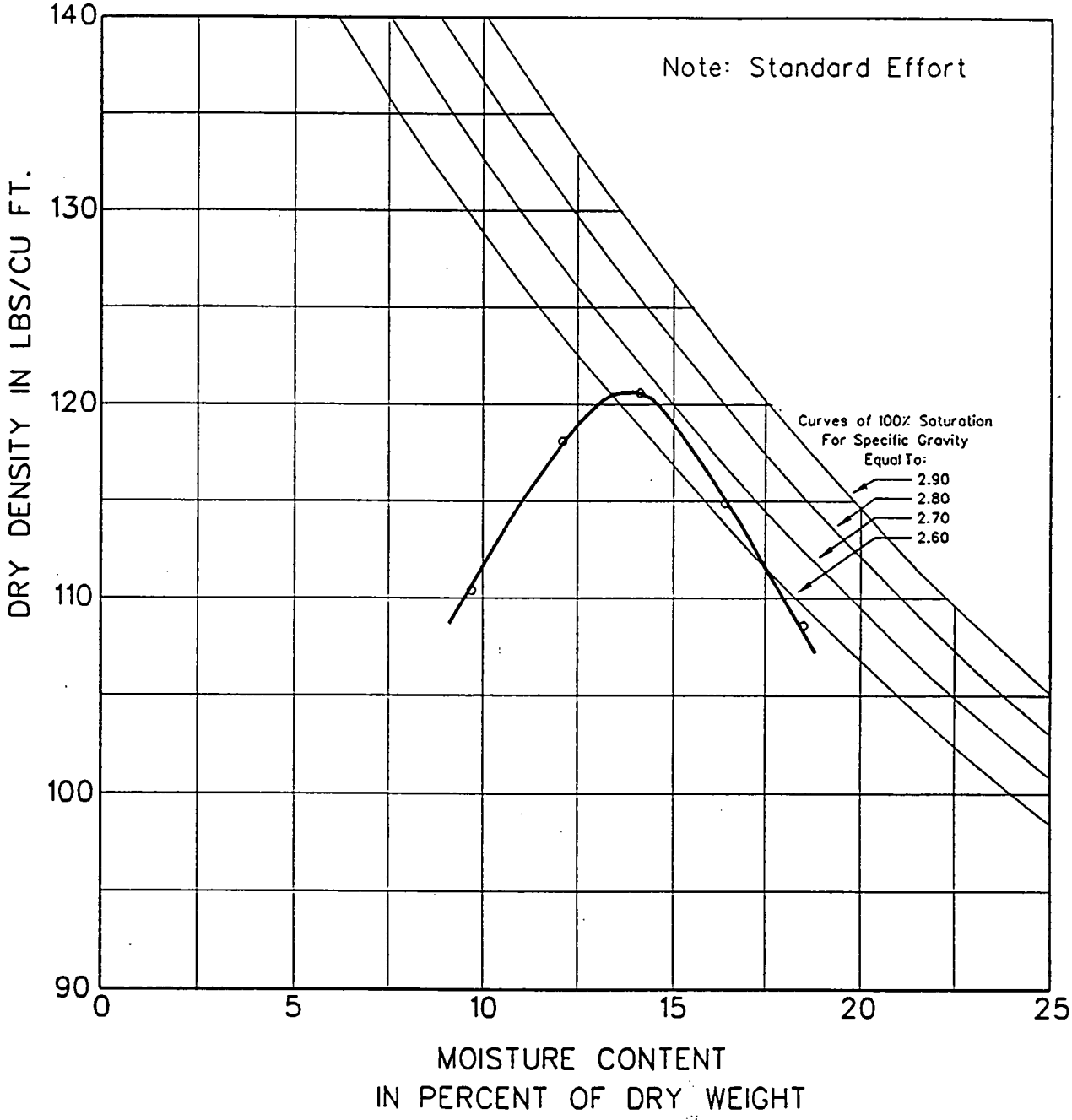
Boring: 11473 Sample Number: 402925 Depth: 7.5-12.0 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 13.7% Maximum Dry Density: 120.6 lbs/ft^3

Specific Gravity: 2.76 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/16/95



FILENAME: SKX03635.DGN

R402925c.m(2452.ws415) po140@ws415. Tue Oct 31 12:42:32 CST 1995

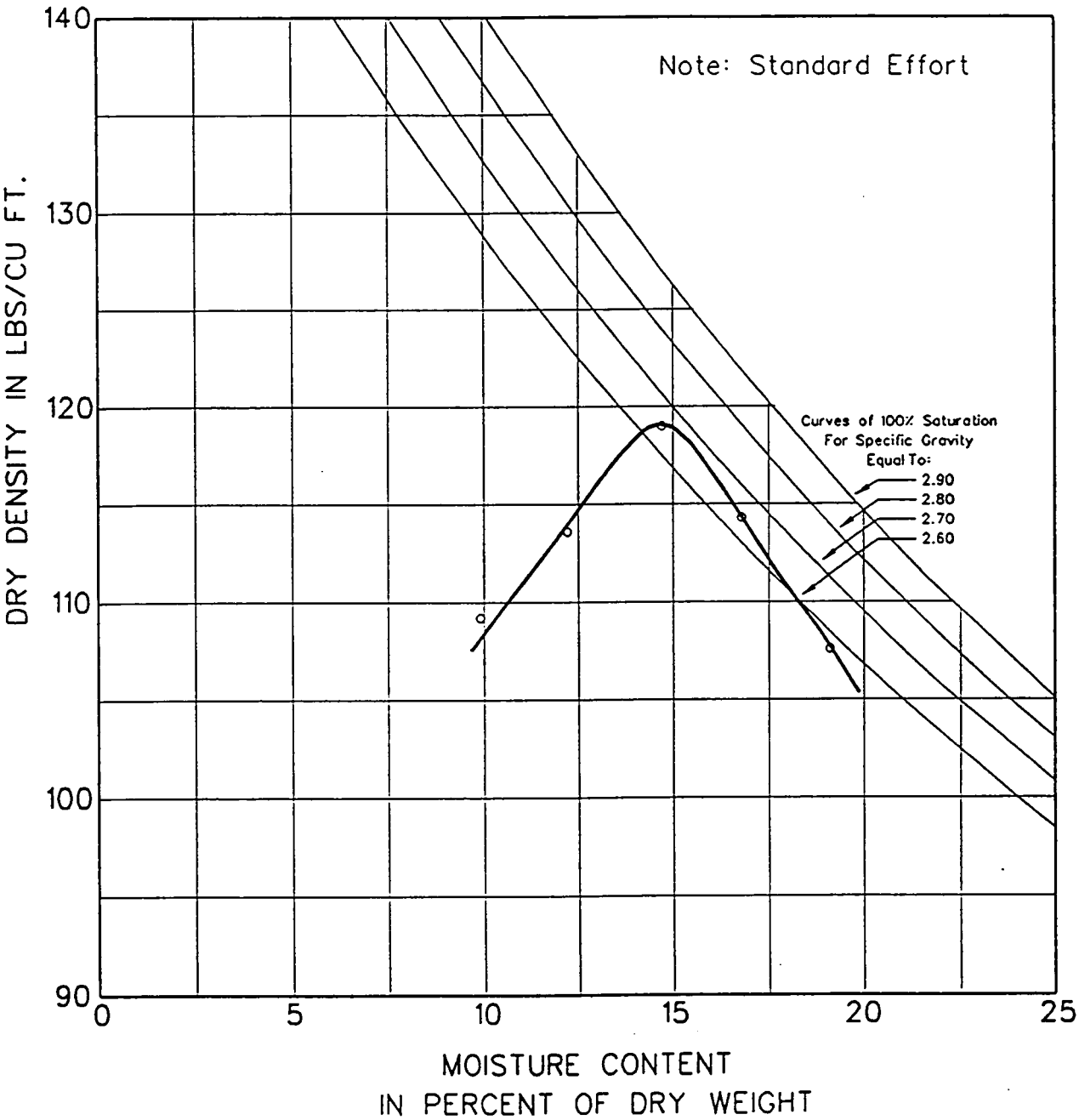
Boring: 11472 Sample Number: 402958 Depth: 3.5-7.5 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 14.4% Maximum Dry Density: 119.0 lbs/ft^3

Specific Gravity: 2.74 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/13/95



FILENAME: SKX03636.DGN

R402958c.m(2453.ws415) po140@ws415. Tue Oct 31 12:42:59 CST 1995

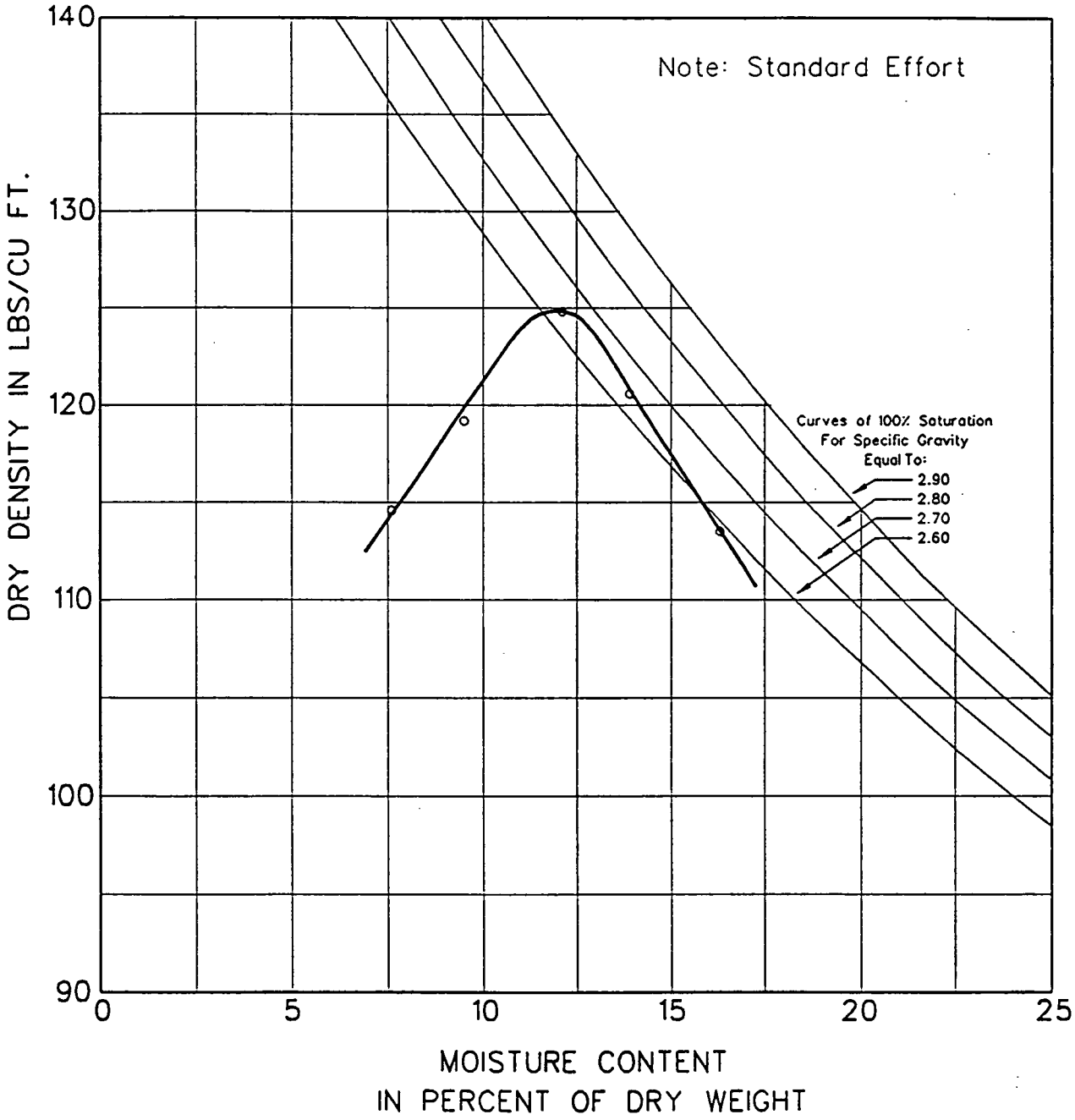
Boring: 11472 Sample Number: 402959 Depth: 9.0-12.0 ft

Description: Brown Sandy Lean Clay (CL)

Optimum Moisture Content: 12.0% Maximum Dry Density: 124.9 lbs/ft^3

Specific Gravity: 2.69 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/18/95



FILENAME: SKX03652.DGN

R402959c.m(2469.ws415) po140@ws415. Tue Oct 31 12:59:08 CST 1995

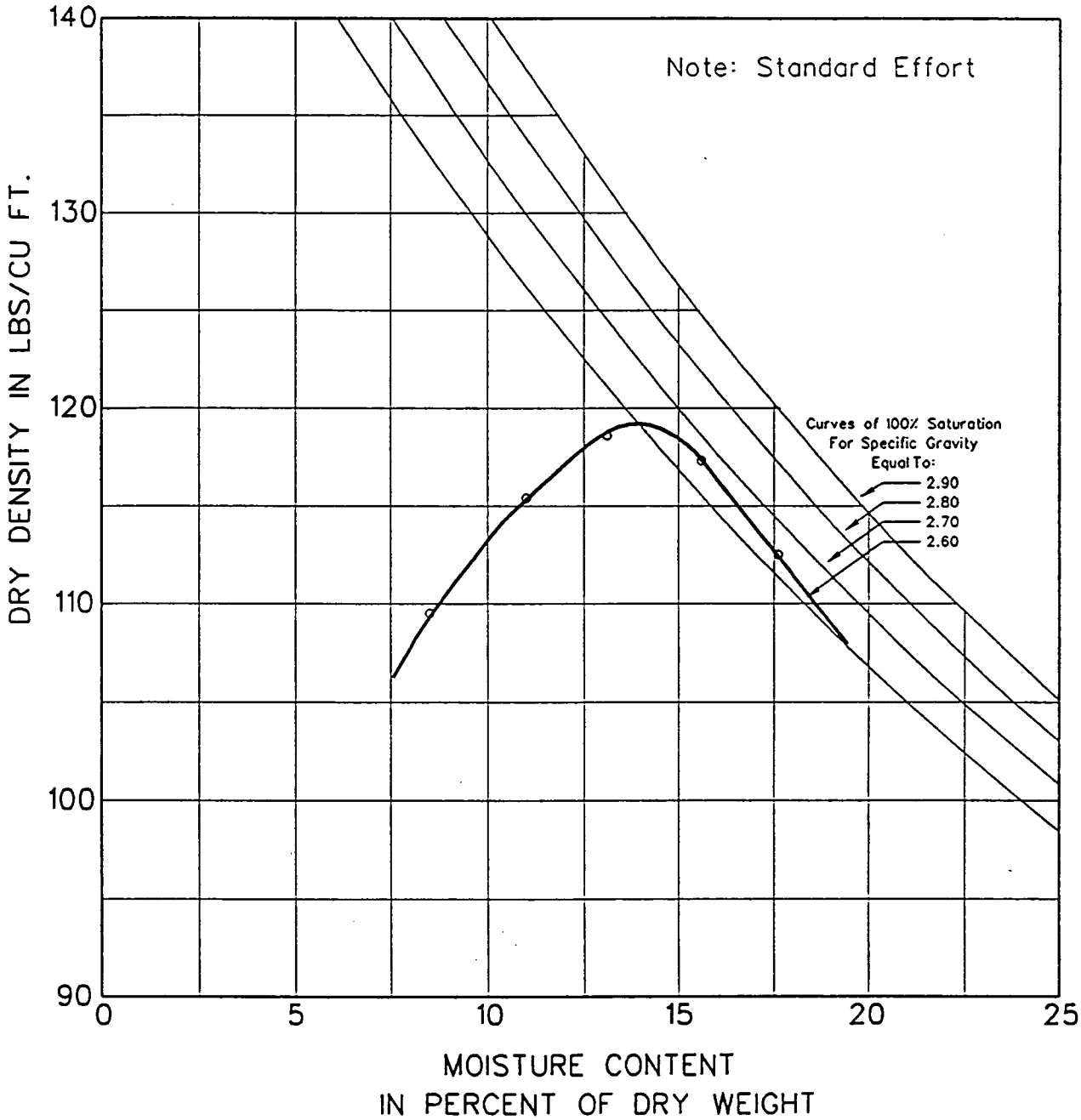
Boring: 11474 Sample Number: 402896 Depth: 3.0-7.5 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 13.7% Maximum Dry Density: 119.2 lbs/ft^3

Specific Gravity: 2.79 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/14/95



_ENAME: SKX03650.DGN

R402896c.m(2467.ws415) po140@ws415. Tue Oct 31 12:52:18 CST 1995

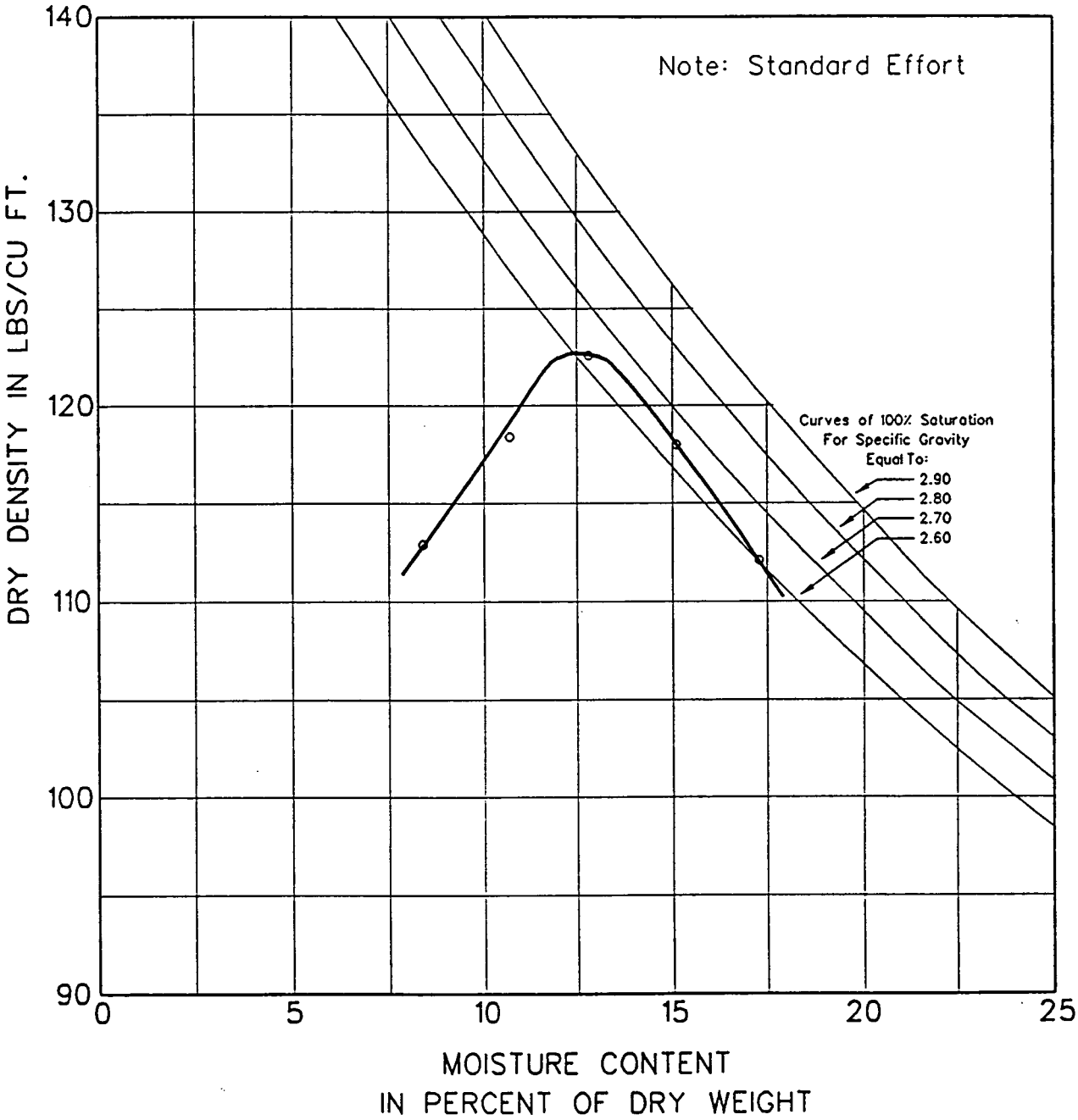
Boring: 11474 Sample Number: 402901 Depth: 9.7.5-12.0 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 12.8% Maximum Dry Density: 122.6 lbs/ft^3

Specific Gravity: 2.76 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/16/95



FILENAME: SKX03649.DGN

R402901c.m(2466.ws415) po140@ws415. Tue Oct 31 12:51:51 CST 1995

000602

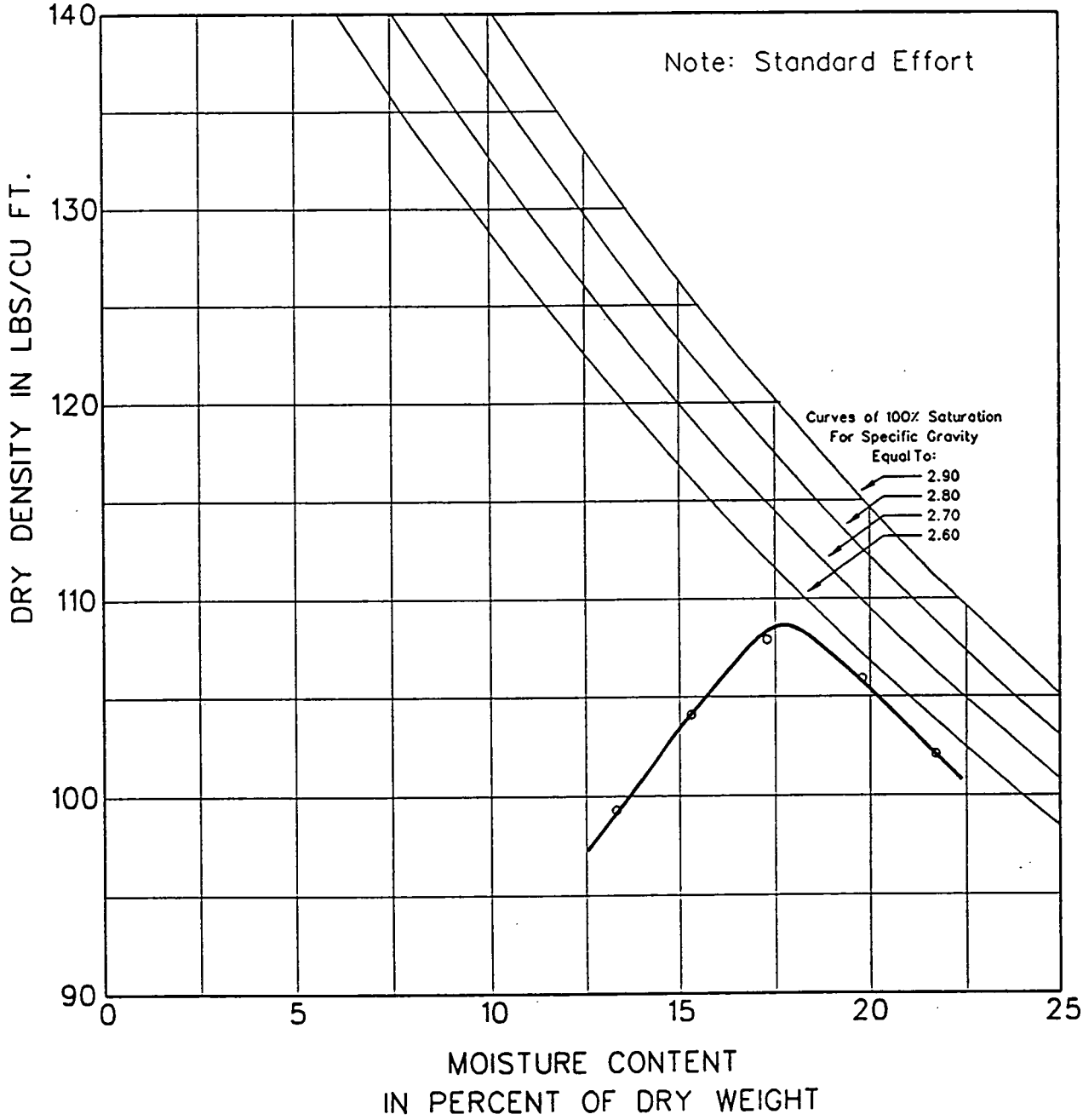
Boring: 11475 Sample Number: 403264 Depth: 4.5-8.5 ft

Description: Brown Lean Clay with Sand (Fill) (CL)

Optimum Moisture Content: 18.1% Maximum Dry Density: 108.3 lbs/ft^3

Specific Gravity: 2.71 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/06/95



.LENAME: SKX03648.DGN

R403264c.m(2465.ws415) po140@ws415. Tue Oct 31 12:51:24 CST 1995

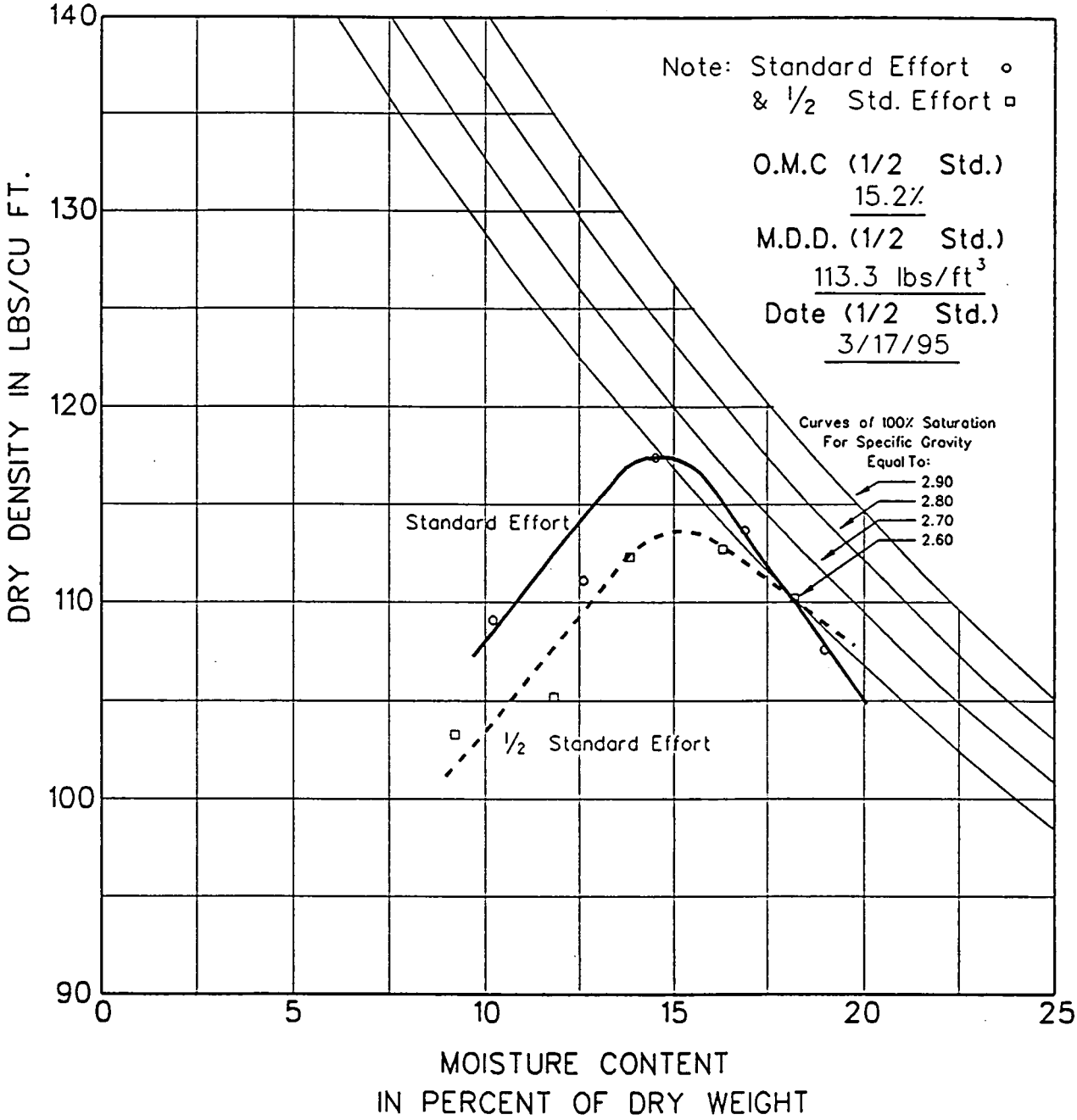
Boring: 11476 Sample Number: 402993 Depth: 3.5-7.5 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 14.6% Maximum Dry Density: 117.4 lbs/ft^3

Specific Gravity: 2.72 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/09/95



FILENAME: SKX03631.DGN

R402993c.m(2448.ws415) po140@ws415. Tue Oct 31 12:37:41 CST 1995

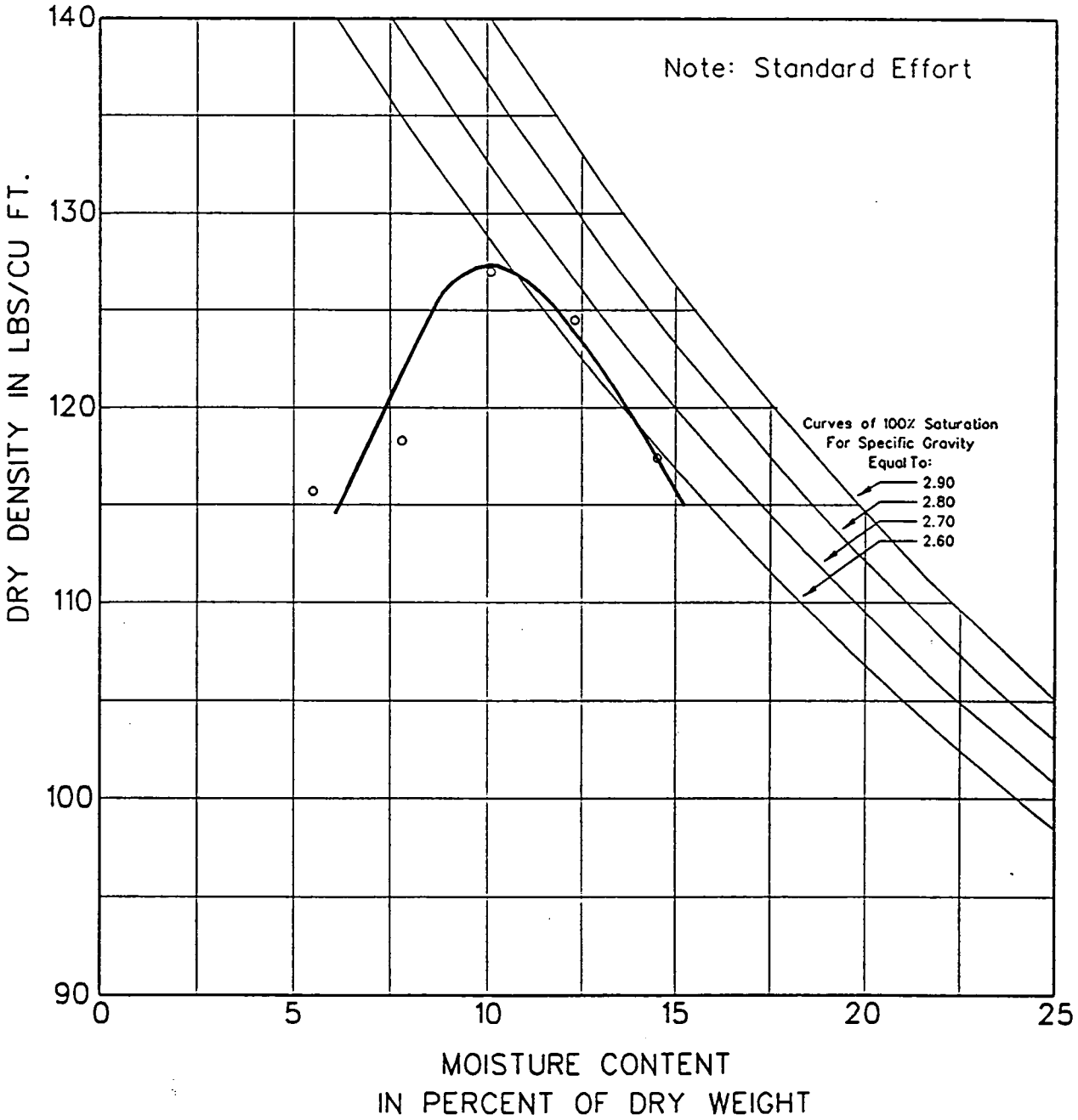
Boring: 11476 Sample Number: 403010 Depth: 12.0-15.0 ft

Description: Gray Lean Clay with Sand (CL)

Optimum Moisture Content: 10.5% Maximum Dry Density: 127.3 lbs/ft^3

Specific Gravity: 2.75 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/09/95



FILENAME: SKX03634.DGN

R403010c.m(2451.ws415) po140@ws415. Tue Oct 31 12:41:43 CST 1995

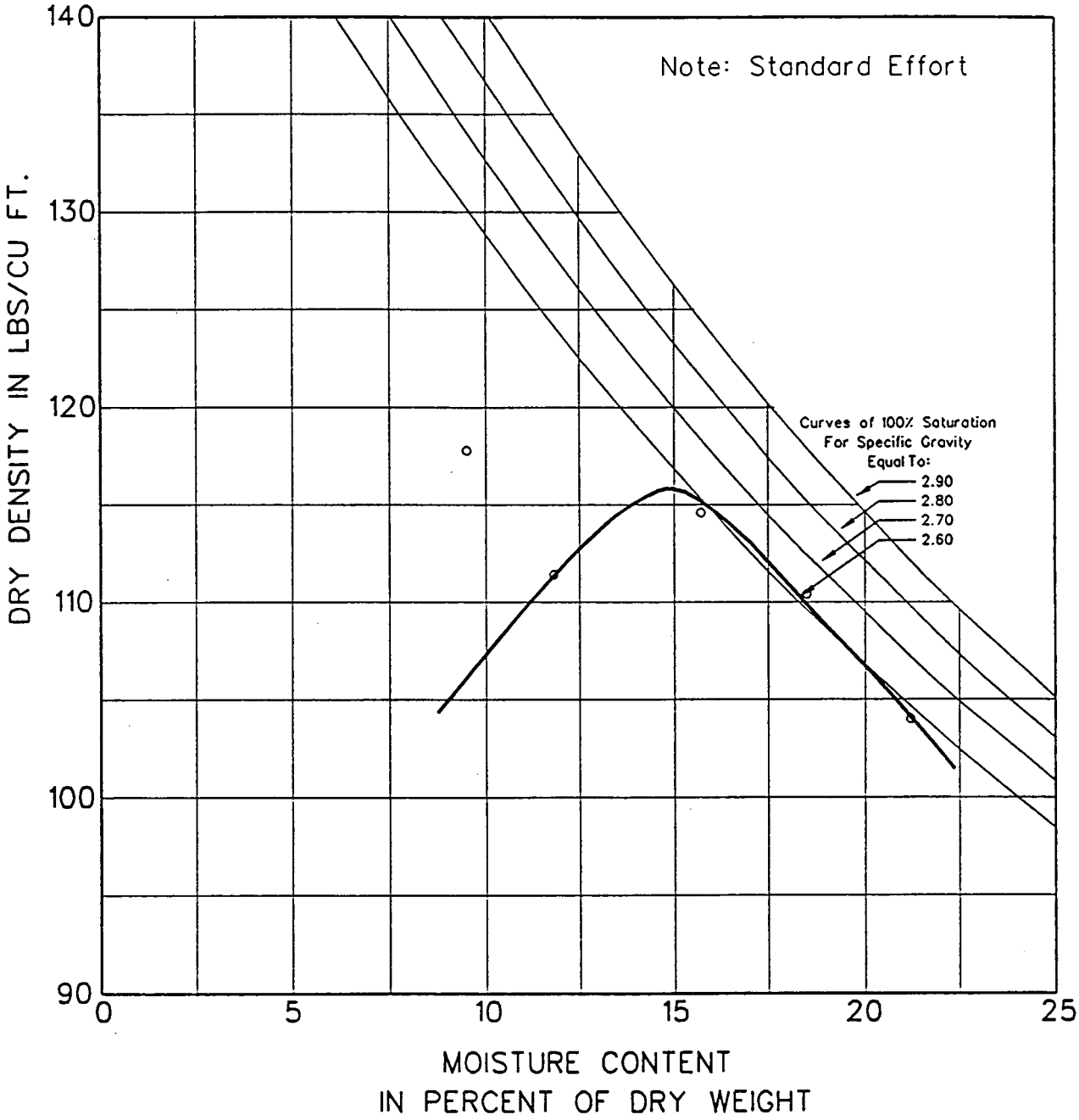
Boring: 11477 Sample Number: 402866 Depth: 3.5-7.5 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 14.6% Maximum Dry Density: 116.0 lbs/ft^3

Specific Gravity: 2.79 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 2/28/95



FILENAME: SKX03632.DGN

R402866c.m(2449.ws415) po140@ws415. Tue Oct 31 12:38:52 CST 1995

000606

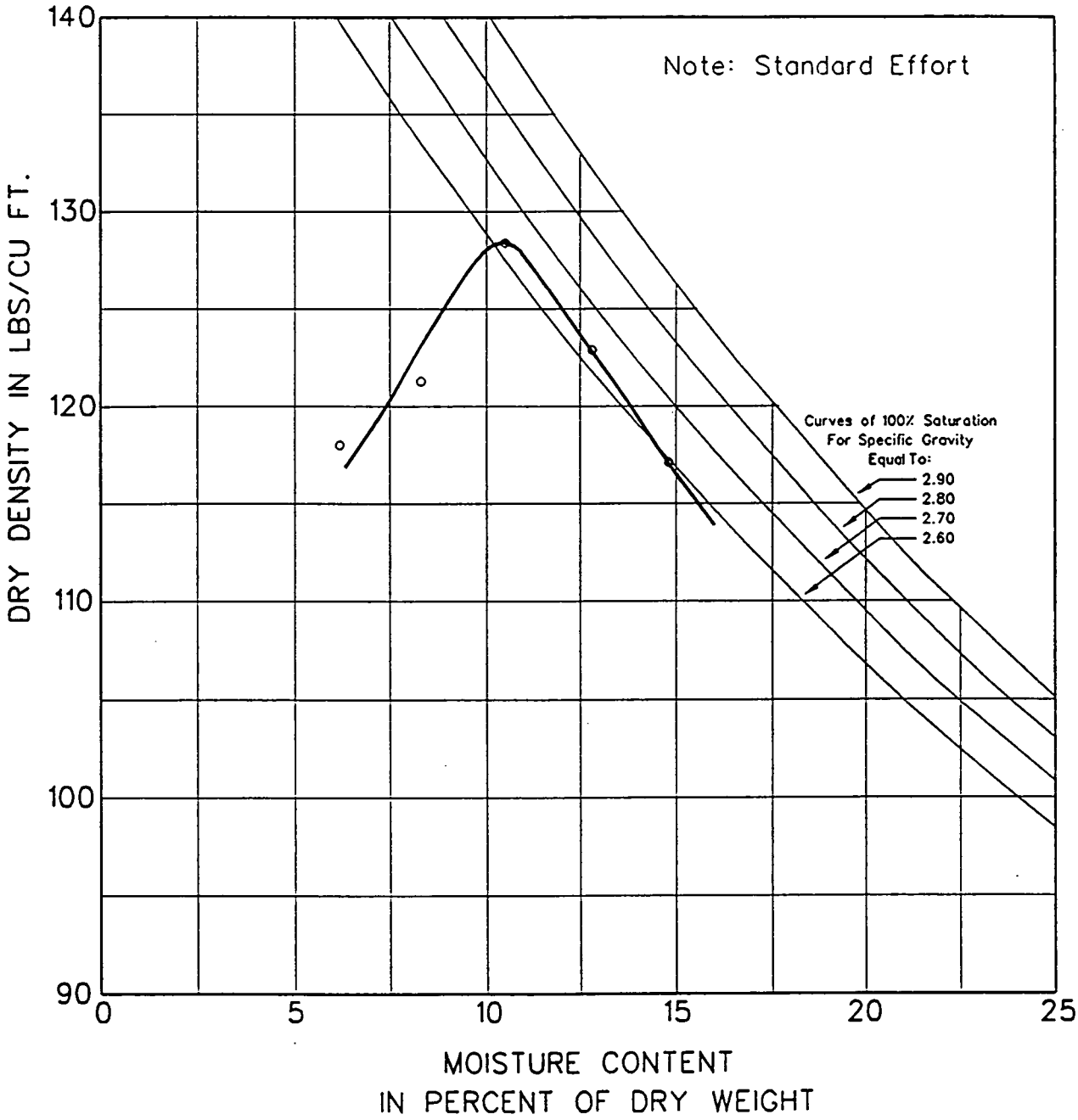
Boring: 11477 Sample Number: 402874 Depth: 14.0-18.0 ft

Description: Gray Sandy Lean Clay (CL)

Optimum Moisture Content: 10.5% Maximum Dry Density: 128.4 lbs/ft^3

Specific Gravity: 2.72 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/14/95



FILENAME: SKX03647.DGN

K402874c.m(2464.ws415) po140@ws415. Tue Oct 31 12:50:57 CST 1995

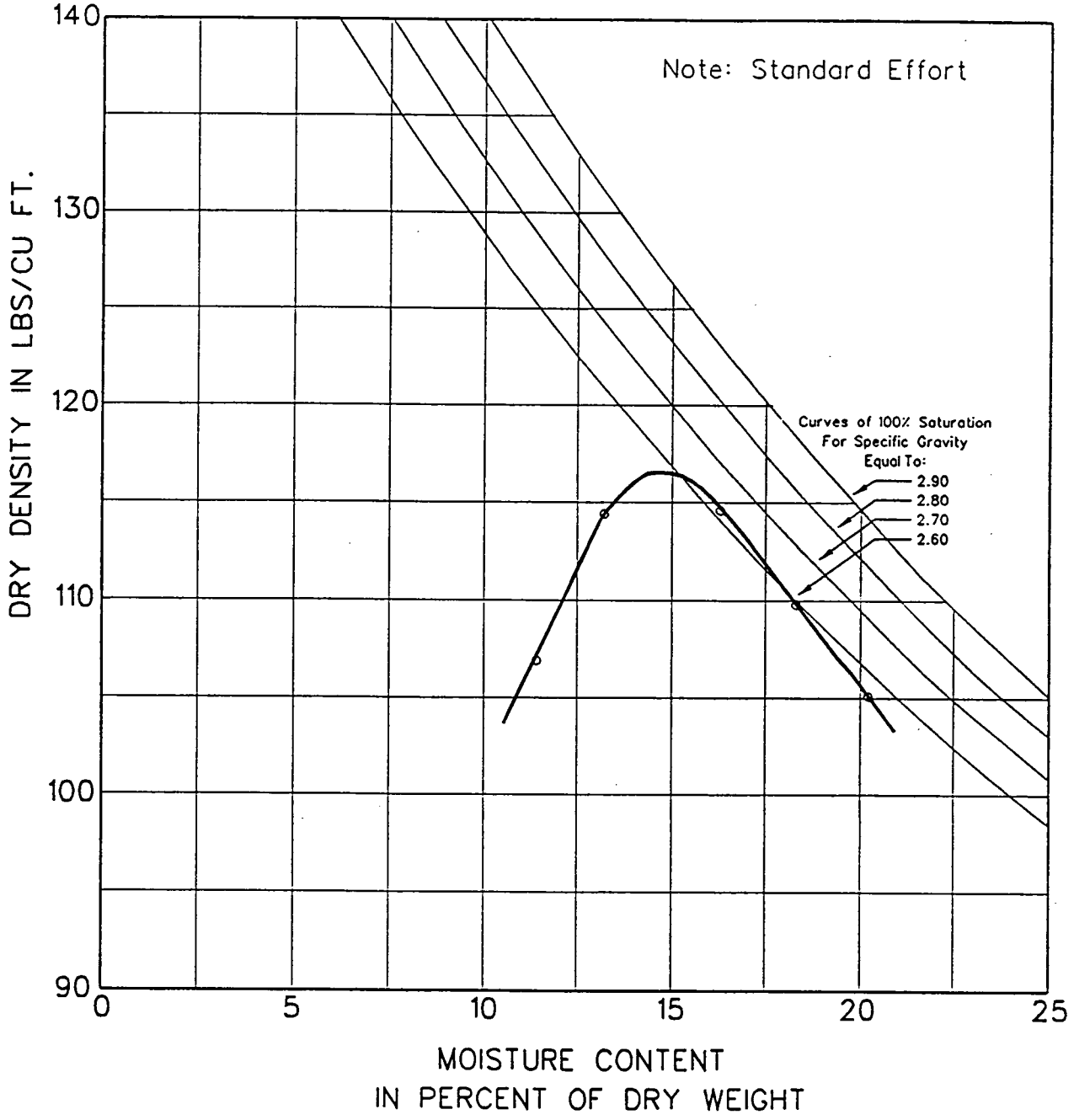
Boring: 11478 Sample Number: 402796 Depth: 3.5-7.5 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 14.7% Maximum Dry Density: 116.5 lbs/ft^3

Specific Gravity: 2.71 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/09/95



FILENAME: SKX03646.DGN

R402796c.m(2463.ws415) po140@ws415. Tue Oct 31 12:50:30 CST 1995

000608

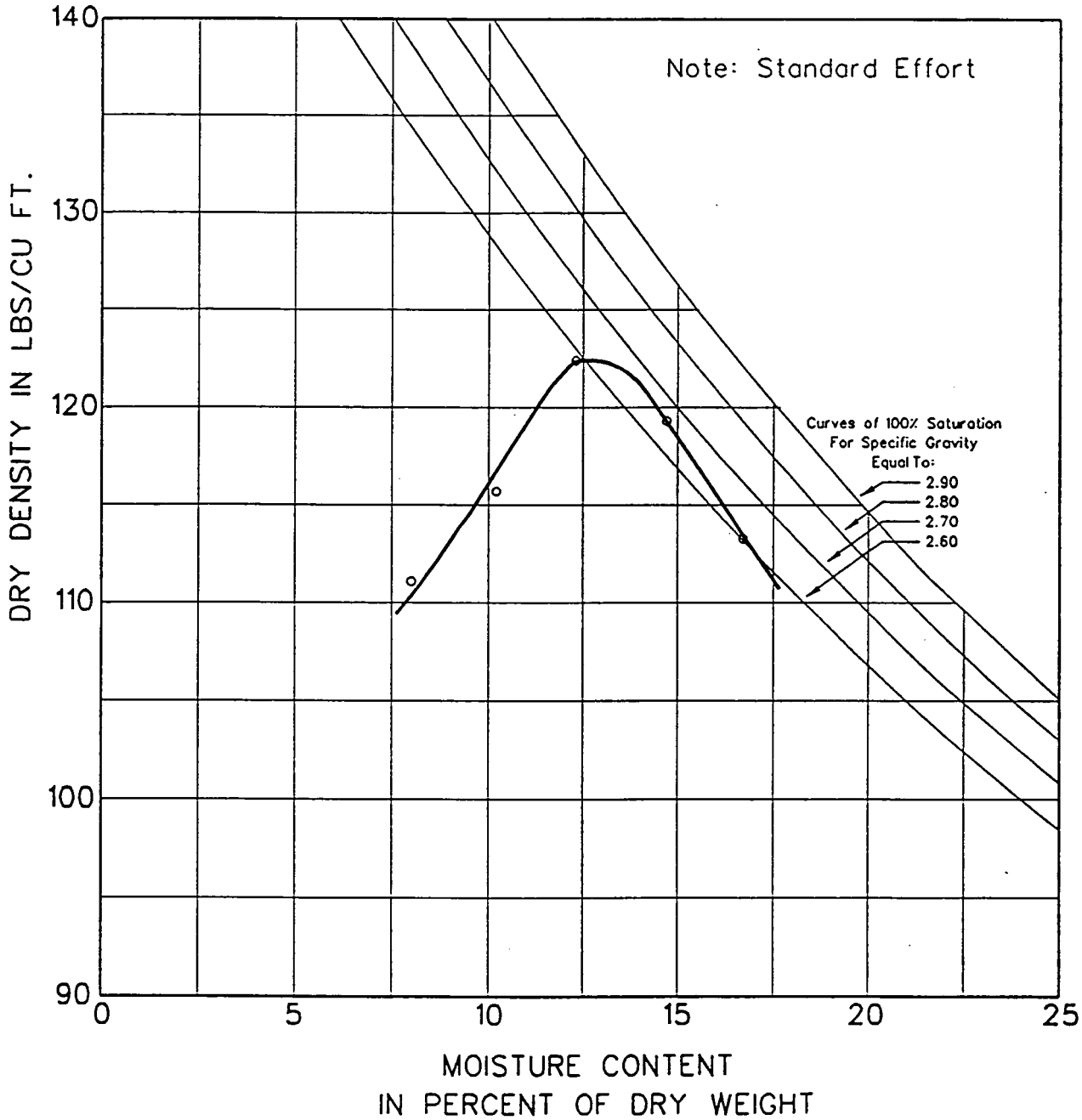
Boring: 11478 Sample Number: 402813 Depth: 7.5-10.0 ft

Description: Brown Sandy Lean Clay (CL)

Optimum Moisture Content: 12.7% Maximum Dry Density: 122.6 lbs/ft^3

Specific Gravity: 2.71 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/16/95



LENAME: SKX03645.DGN

R402813c.m(2462.ws415) po140@ws415. Tue Oct 31 12:50:03 CST 1995

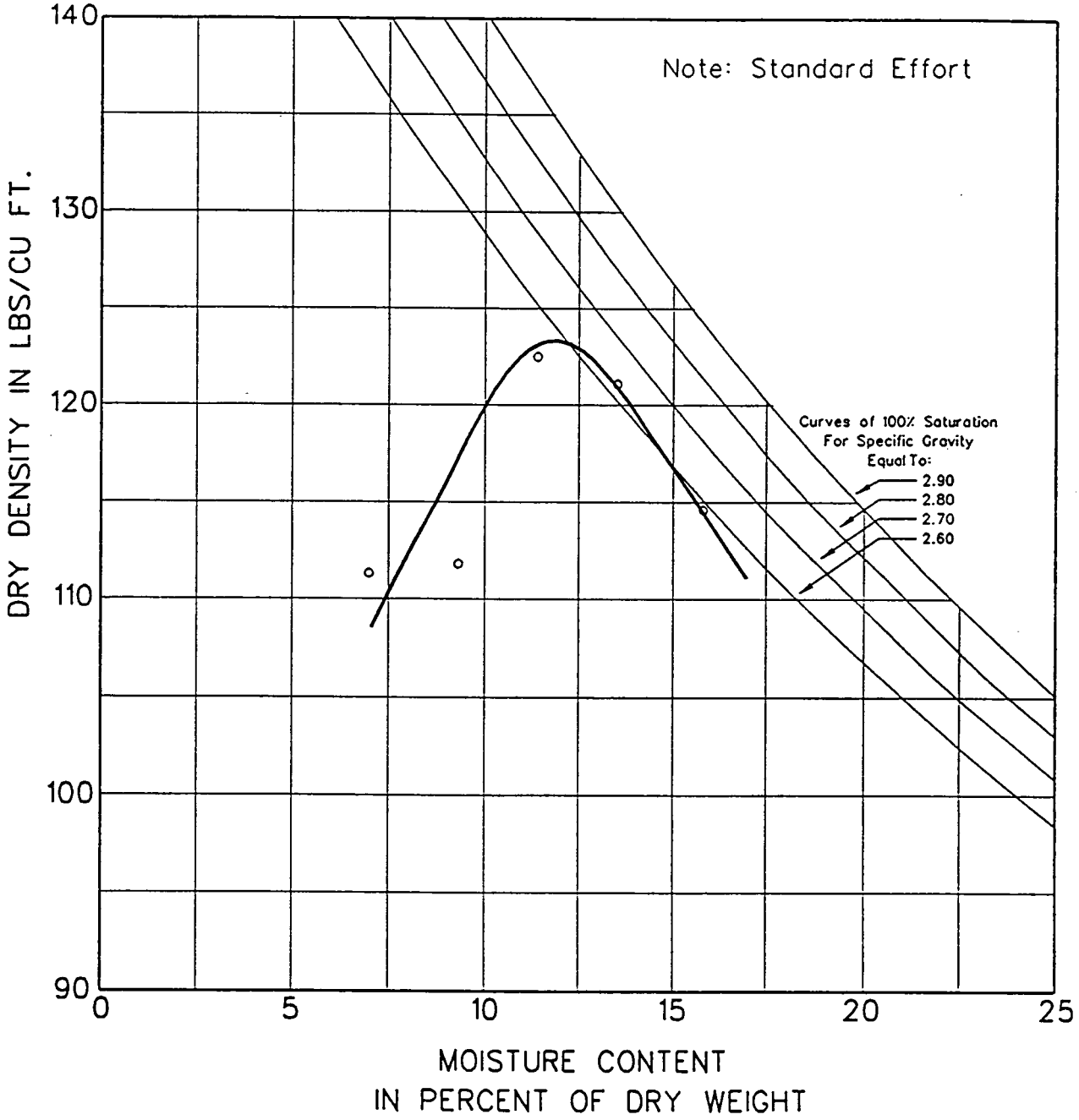
Boring: 11479 Sample Number: 403048 Depth: 3.5-7.5 ft

Description: Brown Sandy Lean Clay (CL)

Optimum Moisture Content: 11.8% Maximum Dry Density: 123.3 lbs/ft^3

Specific Gravity: 2.75 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/06/95



FILENAME: SKX03644.DGN

R403048c.m(2461.ws415) po140@ws415. Tue Oct 31 12:49:36 CST 1995

000610

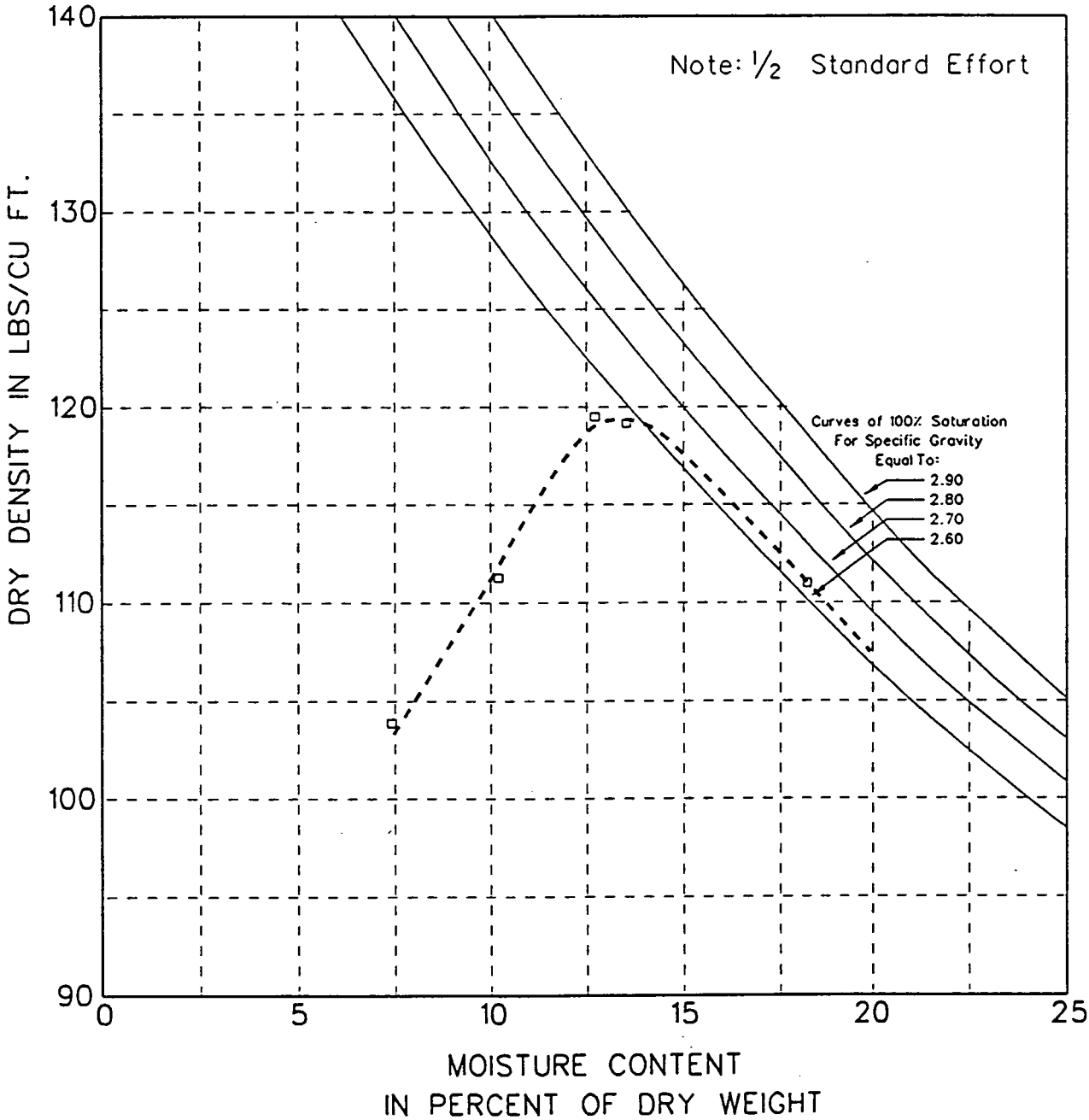
Boring: 11479 Sample Number: 403049 Depth: 7.5-10.5 ft

Description: Brown Sandy Lean Clay (CL)

Optimum Moisture Content: 13.0% Maximum Dry Density: 119.5 lbs/ft^3

Specific Gravity: 2.75 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/27/95



FILENAME: SKX03643.DGN

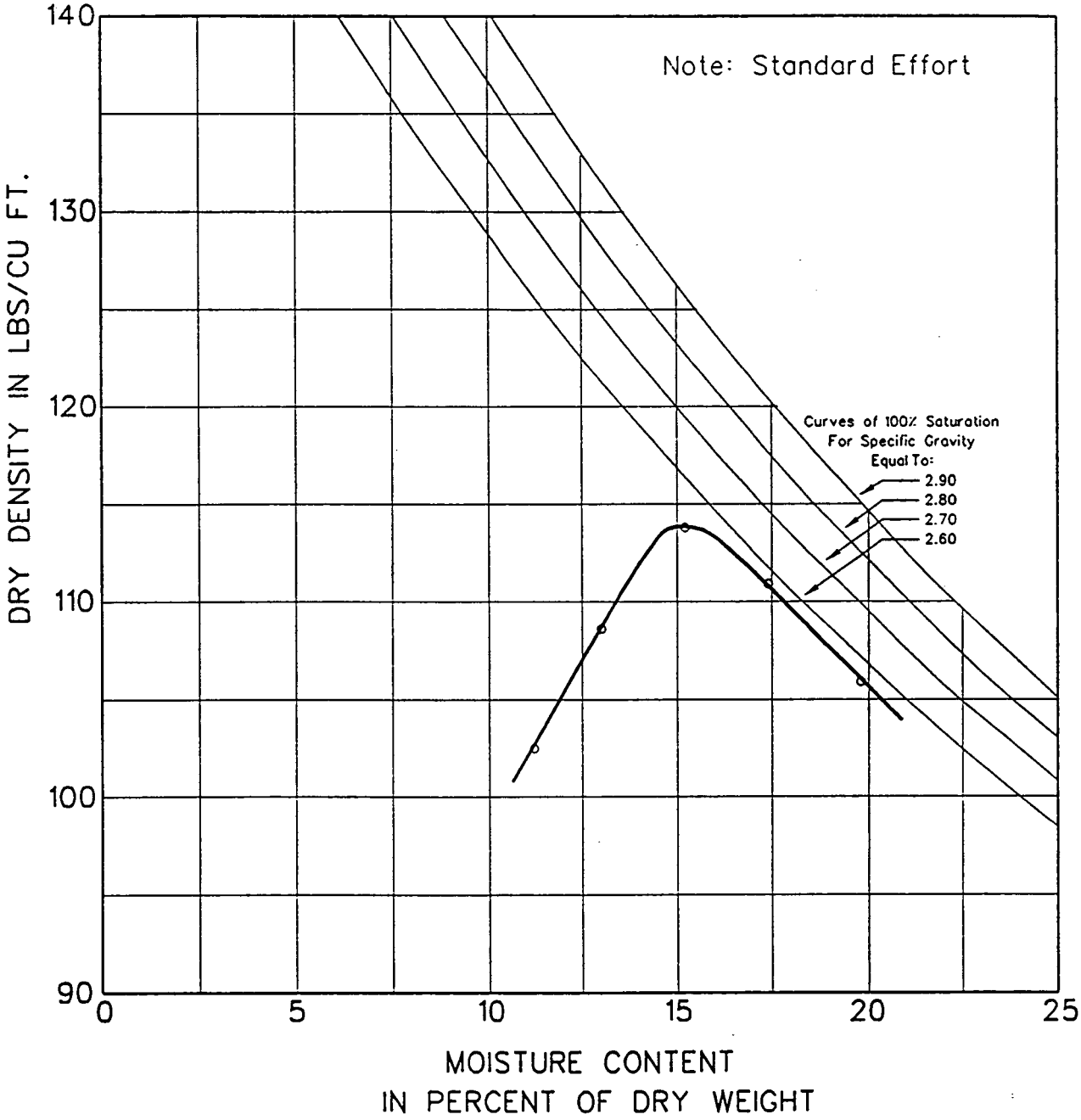
Boring: 11480 Sample Number: 402771 Depth: 3.0-7.5 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 15.2% Maximum Dry Density: 113.8 lbs/ft^3

Specific Gravity: 2.78 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/17/95



FILENAME: SKX03633.DGN

R402771c.m(2450.ws415) po140@ws415. Tue Oct 31 12:39:22 CST 1995

000612

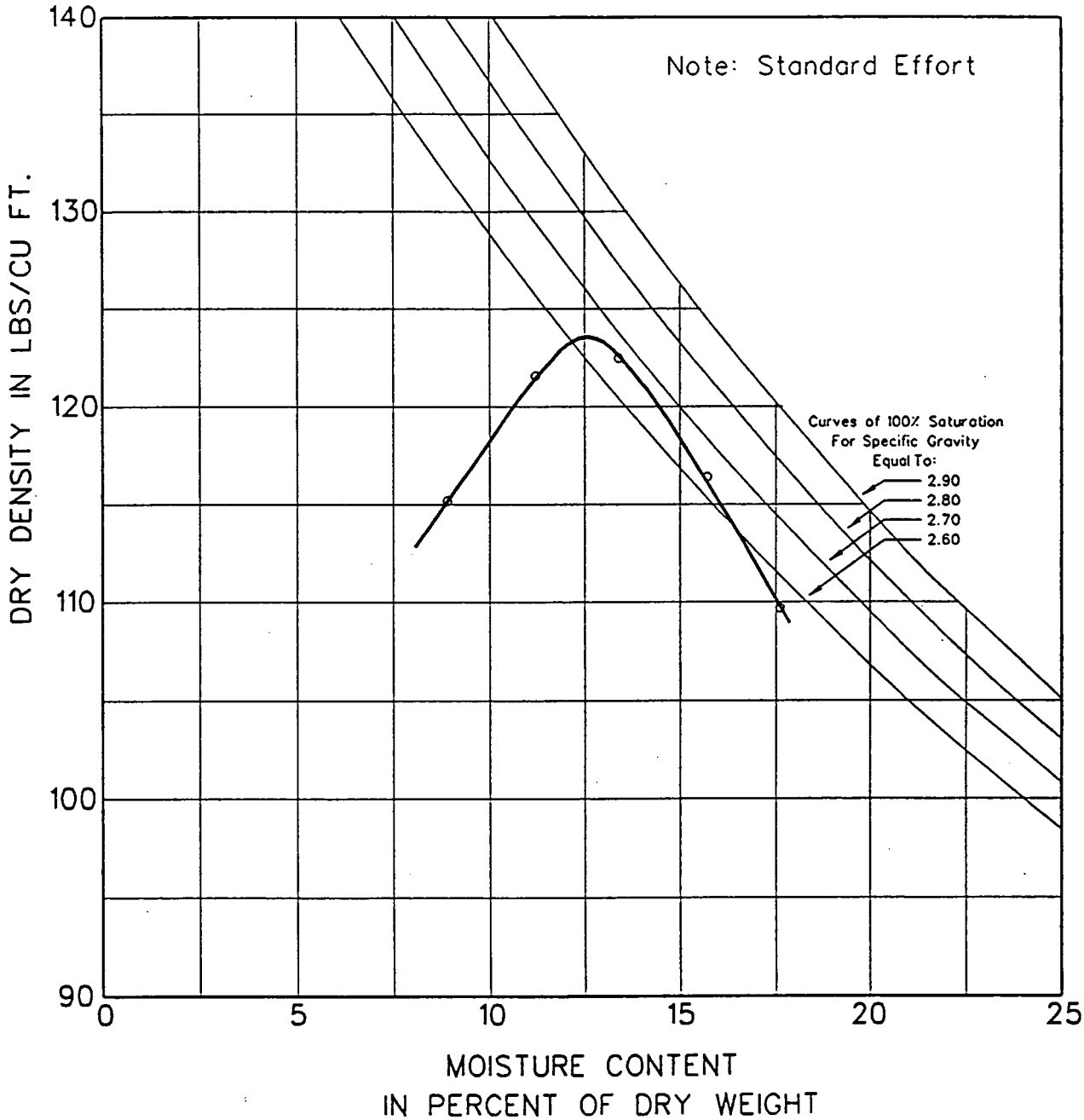
Boring: 11480 Sample Number: 402774 Depth: 7.5-12.0 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 12.5% Maximum Dry Density: 123.5 lbs/ft^3

Specific Gravity: 2.76 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/16/95



ILENAME: SKX03642.DGN

R402774c.m(2459.ws415) po140@ws415. Tue Oct 31 12:48:41 CST 1995

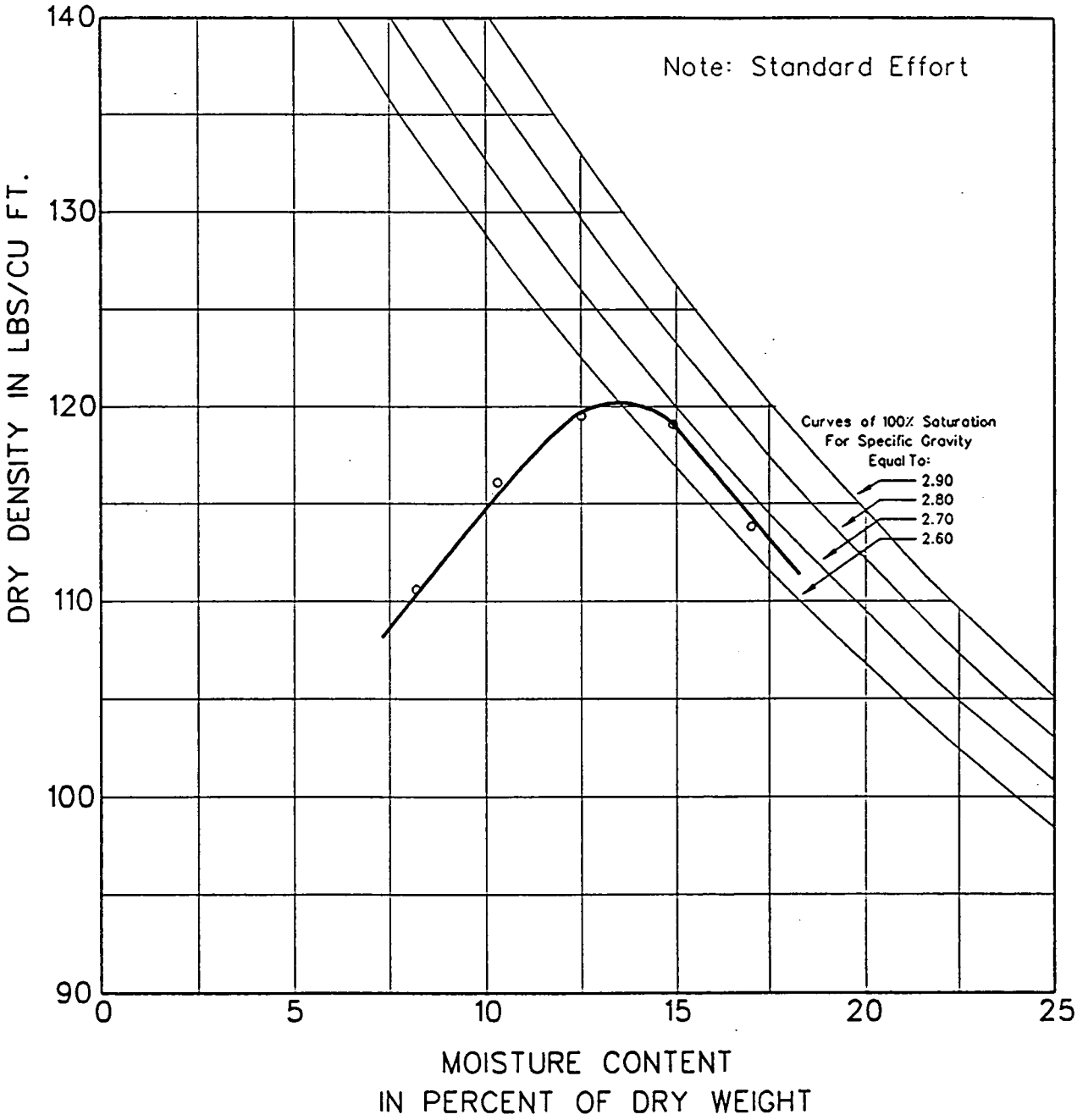
Boring: 11481 Sample Number: 403230 Depth: 3.5-7.5 ft

Description: Brown Sandy Lean Clay with Gravel (CL)

Optimum Moisture Content: 13.4% Maximum Dry Density: 120.2 lbs/ft^3

Specific Gravity: 2.74 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/16/95



FILENAME: SKX03641.DGN

R403230c.m(2458.ws415) po140@ws415. Tue Oct 31 12:48:12 CST 1995

000614

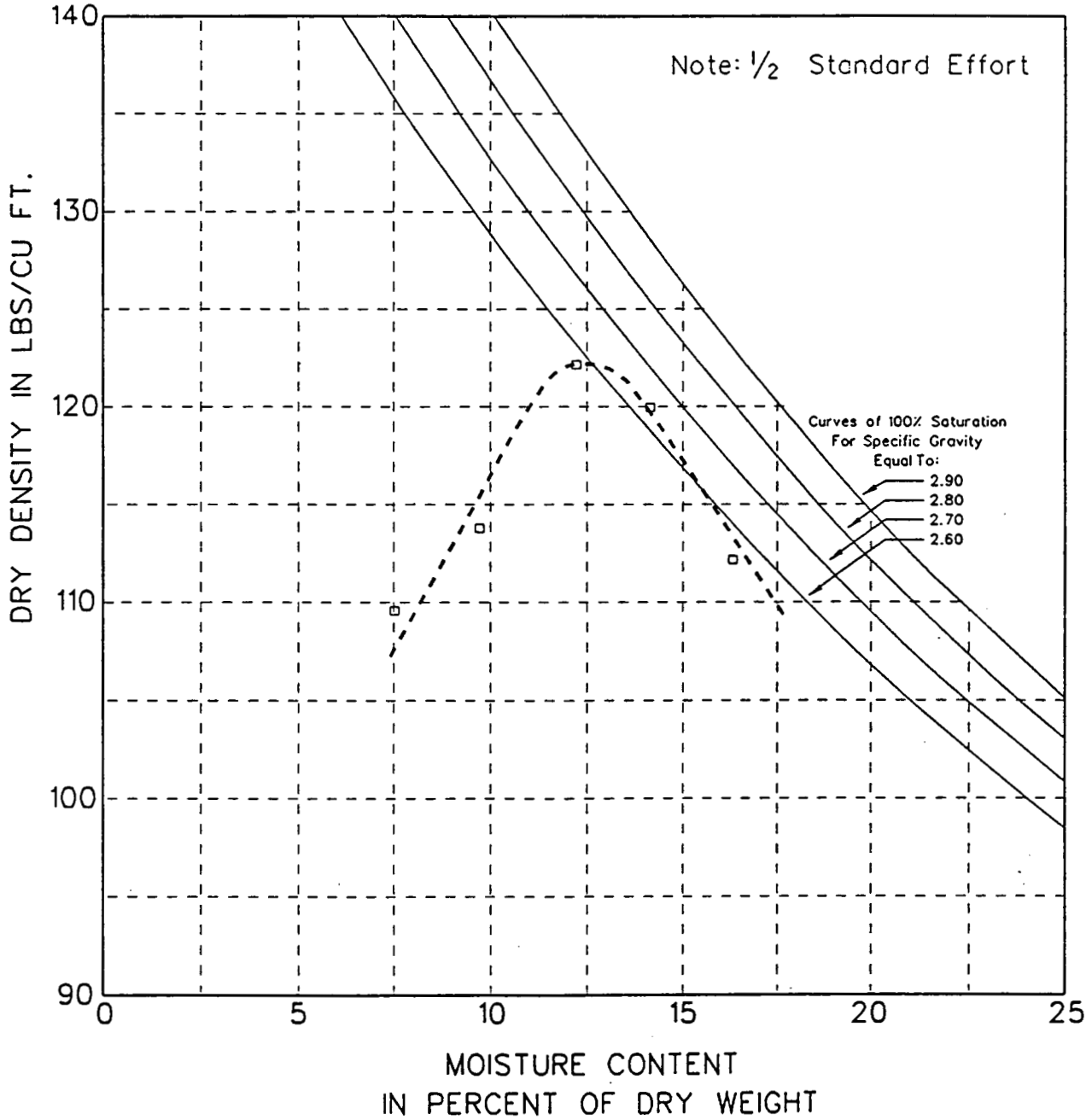
Boring: 11481 Sample Number: 403231 Depth: 13.5-18.5 ft

Description: Gray Lean Clay with Sand (CL)

Optimum Moisture Content: 12.5% Maximum Dry Density: 122.2 lbs/ft^3

Specific Gravity: 2.69 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 3/14/95



.ENAME: SKX03640.DGN

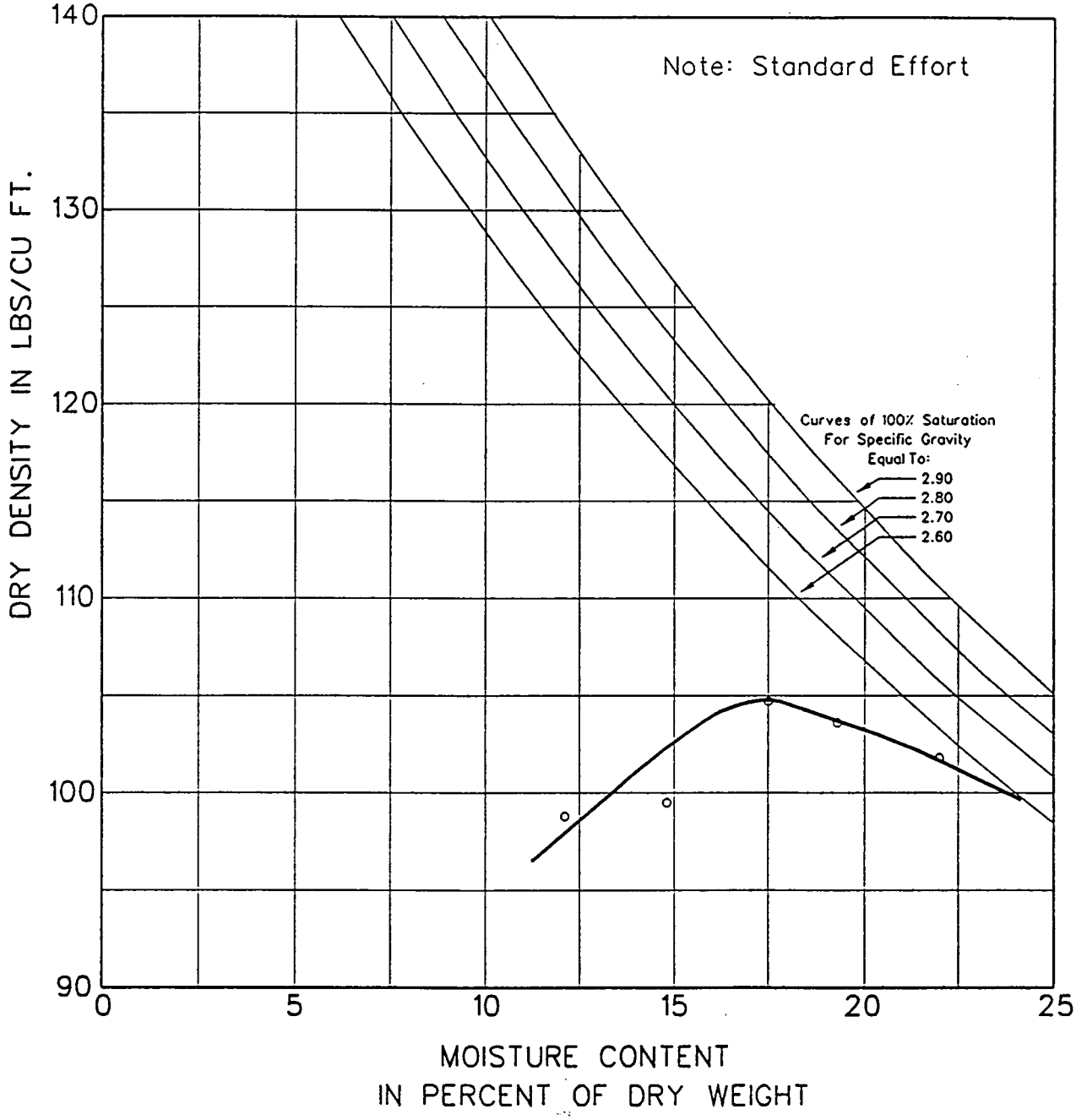
Boring: G2-SB-1 Sample Number: 404608 Depth: 1.5-5.0 ft

Description: Brown Lean Clay (CL)

Optimum Moisture Content: 17.5% Maximum Dry Density: 104.8 lbs/ft^3

Specific Gravity: 2.73 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 5/18/95



FILENAME: SKX03761.DGN

000616

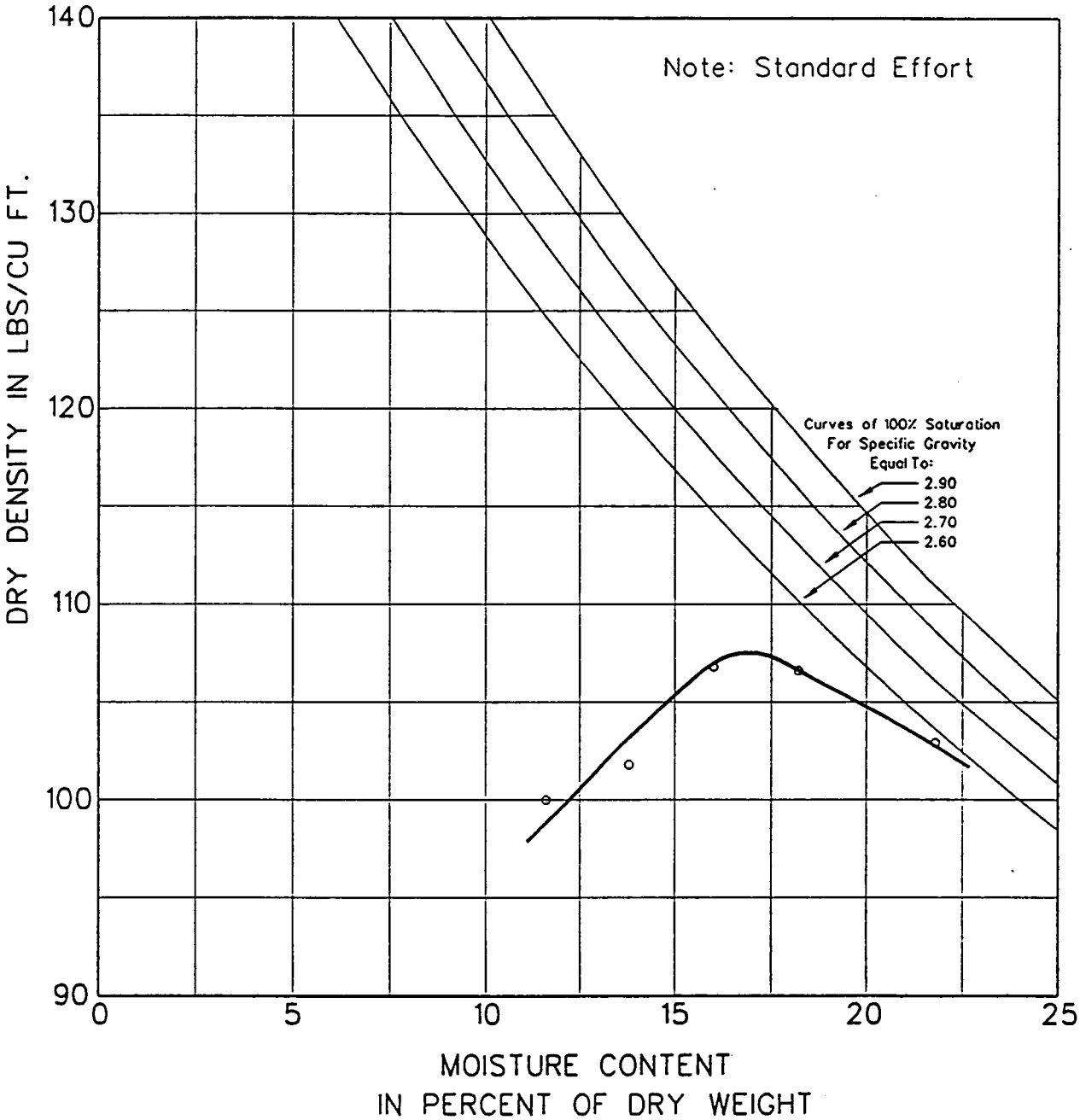
Boring: G2-SB-2 Sample Number: 404603 Depth: 1.5-5.0 ft

Description: Brown Lean Clay (CL)

Optimum Moisture Content: 17.0% Maximum Dry Density: 107.5 lbs/ft^3

Specific Gravity: 2.69 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 5/23/95



LENAME: SKX03762.DGN

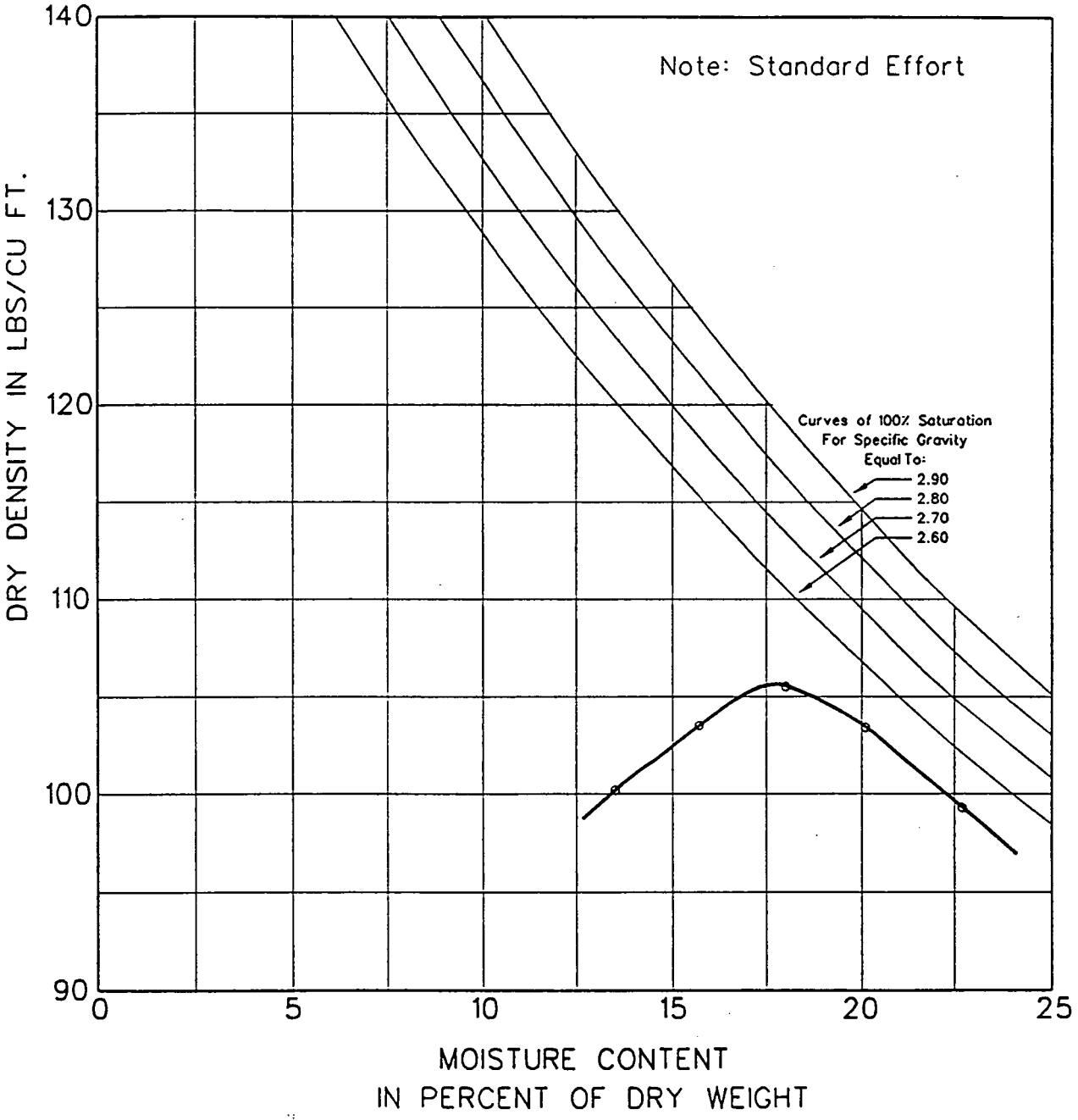
Boring: G2-SB-2, 3,4,6 Sample Number: 404617 Depth: 0-1.5 ft

Description: Top Soil

Optimum Moisture Content: 17.7% Maximum Dry Density: 105.6 lbs/ft^3

Specific Gravity: 2.61 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 6/02/95



FILENAME: SKX03763.DGN

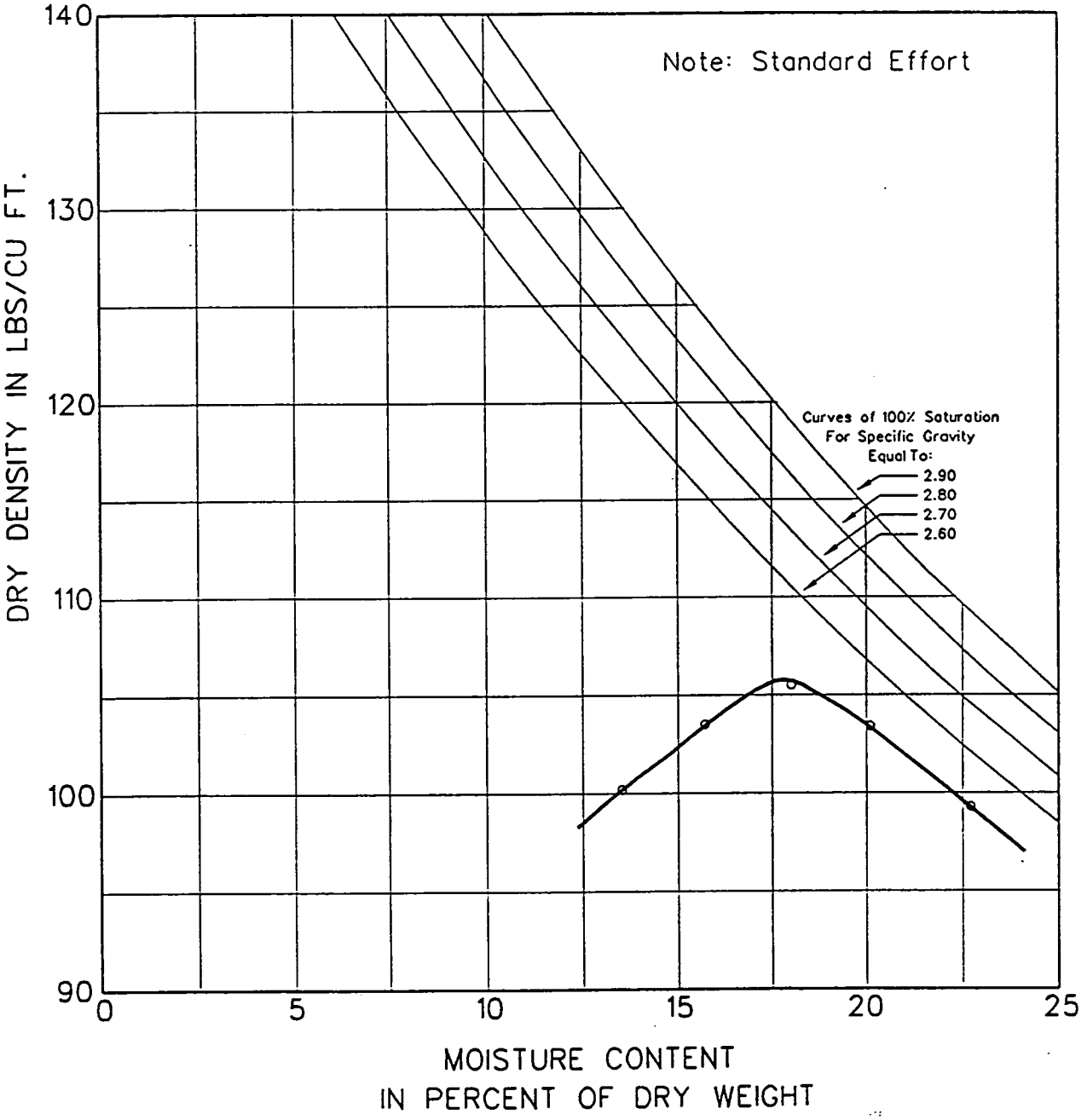
Boring: G2-SB-3 Sample Number: 404591 Depth: 1.5-5.0 ft

Description: Brown Lean Clay (CL)

Optimum Moisture Content: 17.8% Maximum Dry Density: 105.8 lbs/ft^3

Specific Gravity: 2.67 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 5/25/95



ENAME: SKX03764.DGN

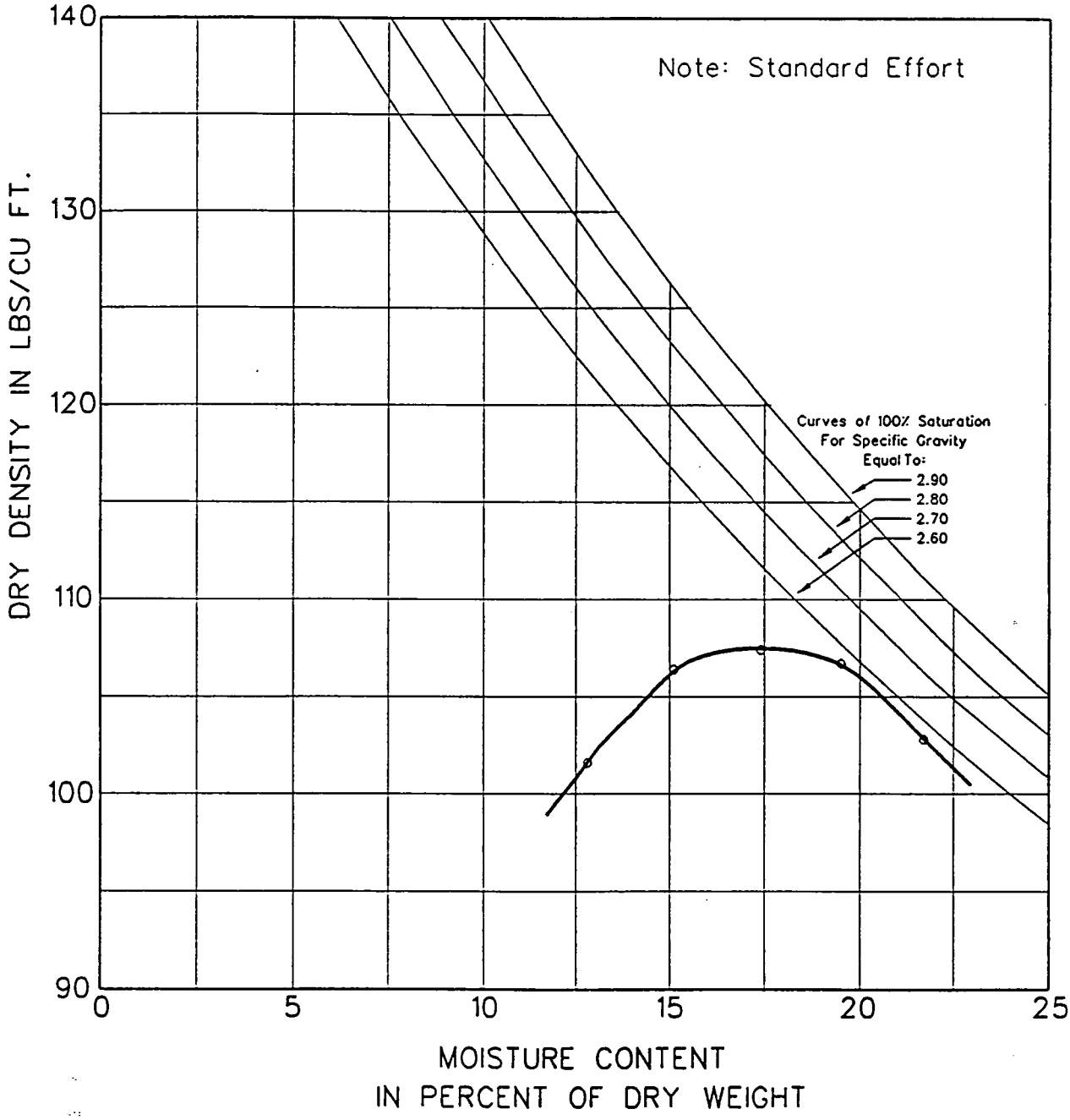
Boring: G2-SB-4 Sample Number: 404615 Depth: 1.5-5.0 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 17.2% Maximum Dry Density: 107.5 lbs/ft^3

Specific Gravity: 2.70 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 5/18/95



FILENAME: SKX03765.DGN

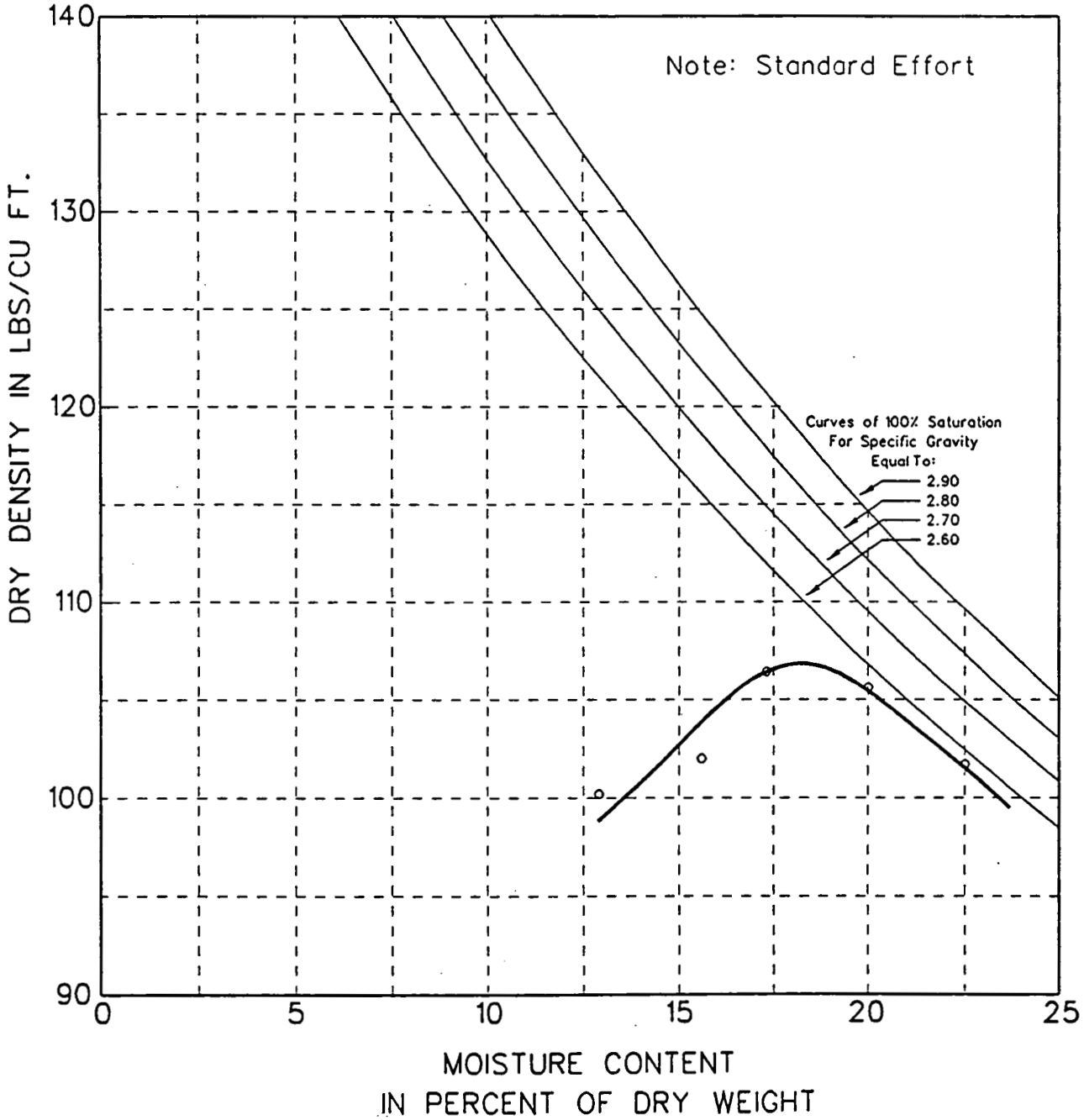
Boring: G2-SB-5 Sample Number: 404627 Depth: 1.5-5.0 ft

Description: Brown Lean Clay (CL)

Optimum Moisture Content: 18.2% Maximum Dry Density: 106.8 lbs/ft^3

Specific Gravity: 2.71 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 5/28/95



ENAME: SKX03767.DGN

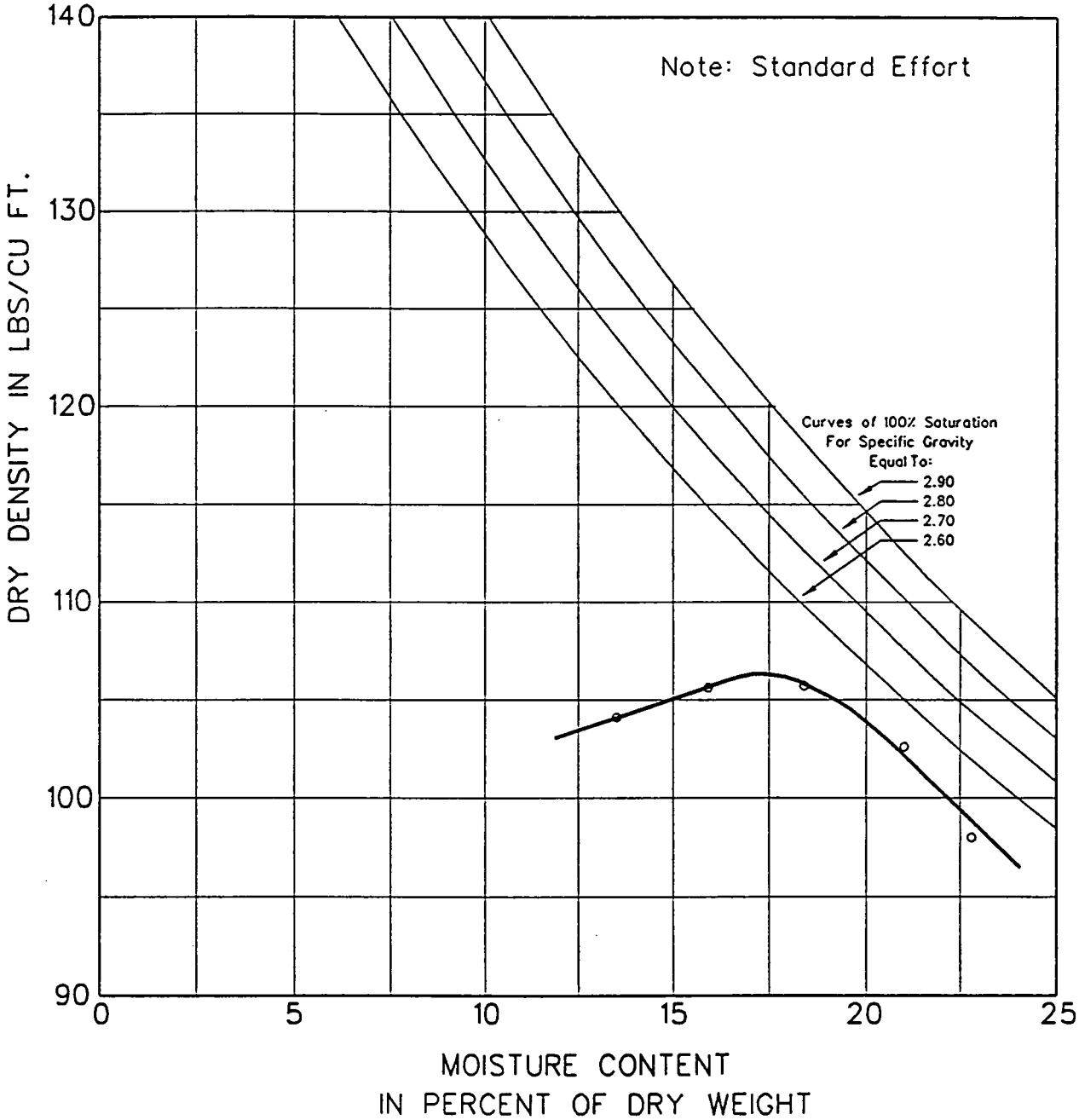
Boring: G2-SB-6 Sample Number: 404595 Depth: 1.5-5.0 ft

Description: Brown Lean Clay (CL)

Optimum Moisture Content: 17.3% Maximum Dry Density: 106.3 lbs/ft^3

Specific Gravity: 2.66 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 5/31/95



FILENAME: SKX03768.DGN

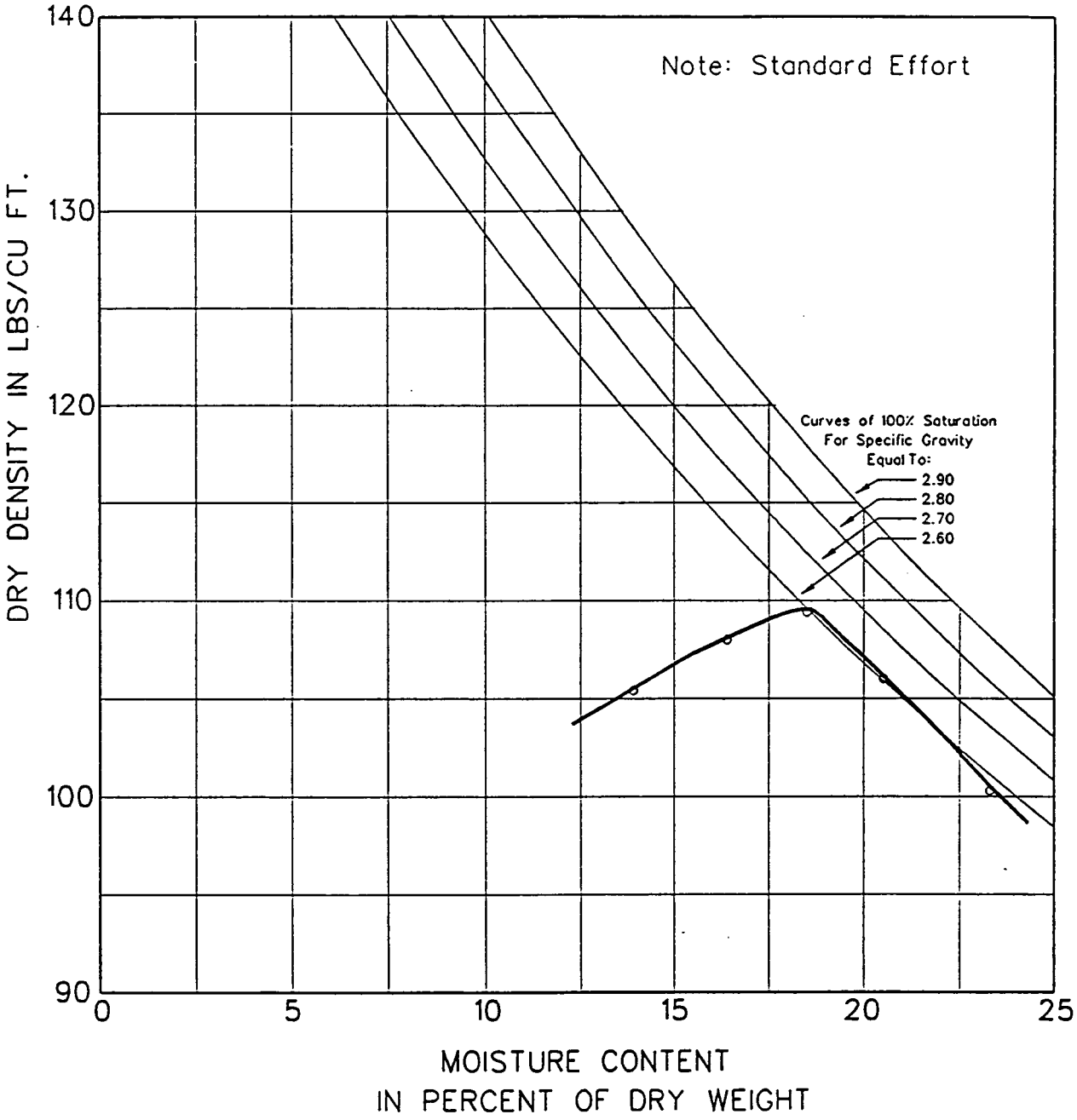
Boring: G2-SB-7 Sample Number: 404632 Depth: 1.5-5.0 ft

Description: Brown Lean Clay (CL)

Optimum Moisture Content: 18.5% Maximum Dry Density: 109.6 lbs/ft^3

Specific Gravity: 2.72 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 5/18/95



FILENAME: SKX03769.DGN

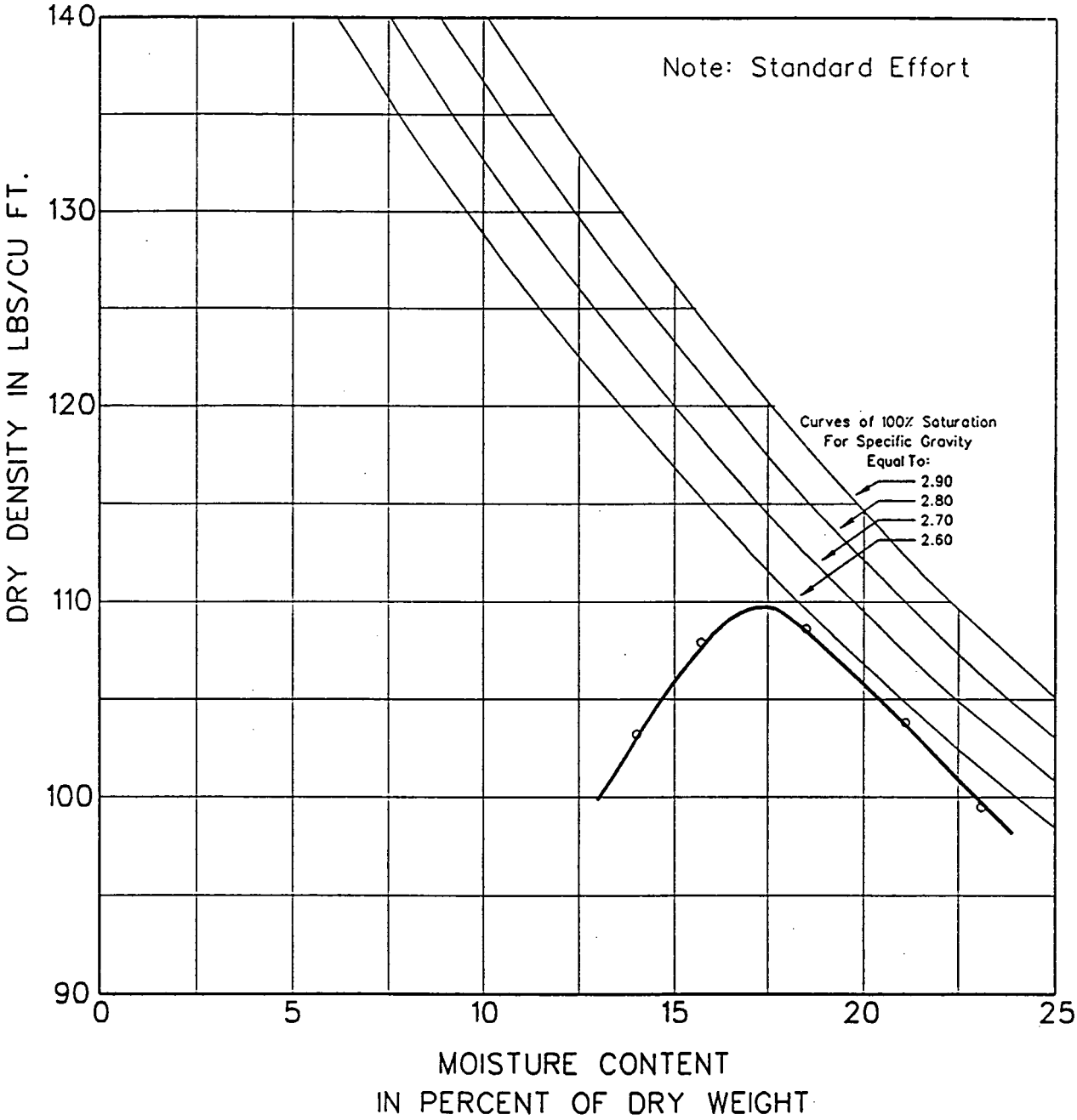
Boring: G2-SB-8 Sample Number: 404621 Depth: 1.5-5.0 ft

Description: Brown Lean Clay (CL)

Optimum Moisture Content: 17.5% Maximum Dry Density: 109.7 lbs/ft^3

Specific Gravity: 2.74 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 5/31/95



FILENAME: SKX03770.DGN

000621

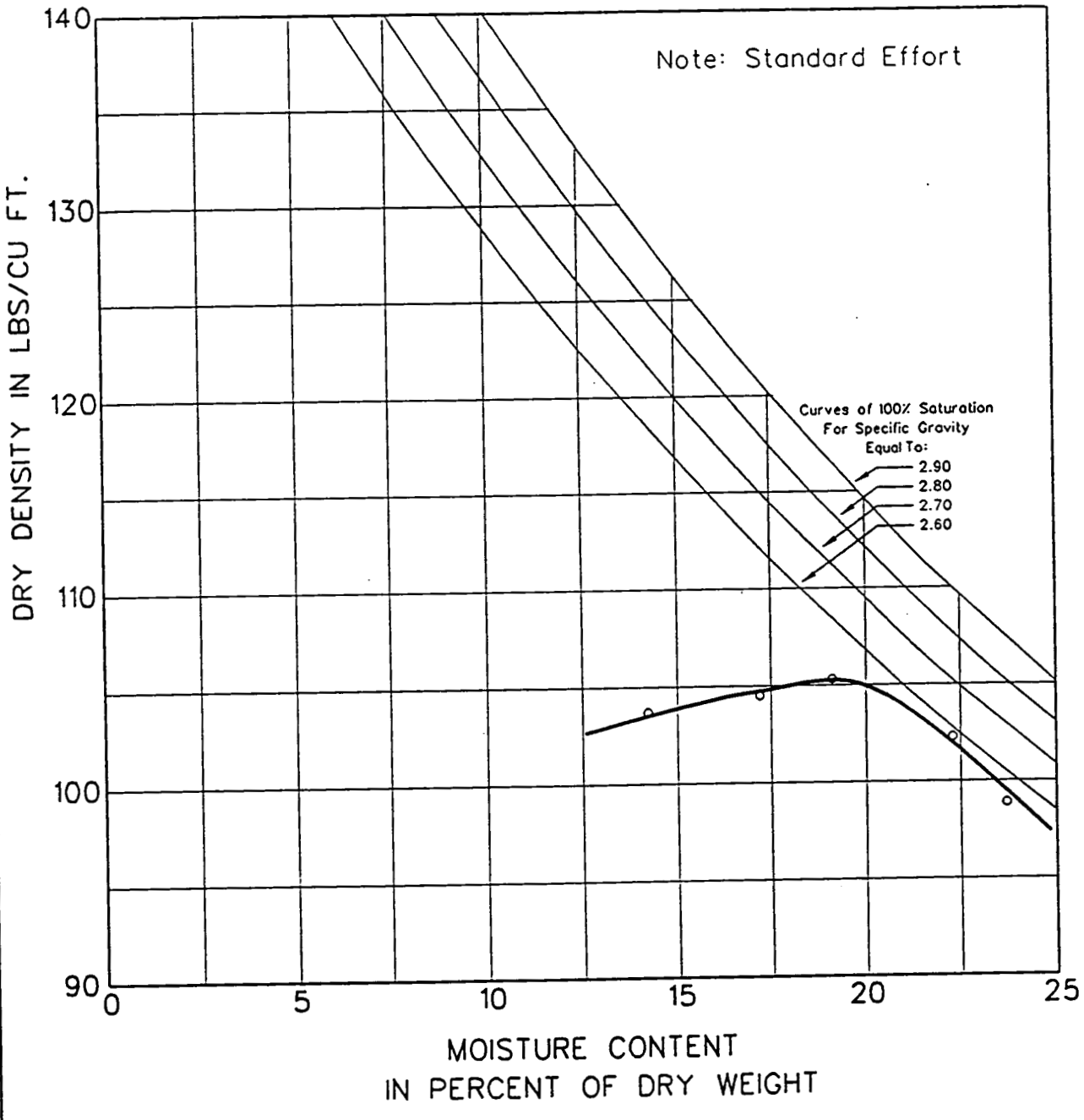
Boring: G2-SB-8, 9,10,11 Sample Number: 404644 Depth: 0-1.5 ft

Description: Topsoil

Optimum Moisture Content: 19.3% Maximum Dry Density: 105.3 lbs/ft^3

Specific Gravity: 2.67 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 6/07/95



LENAME: SKX03771.DGN

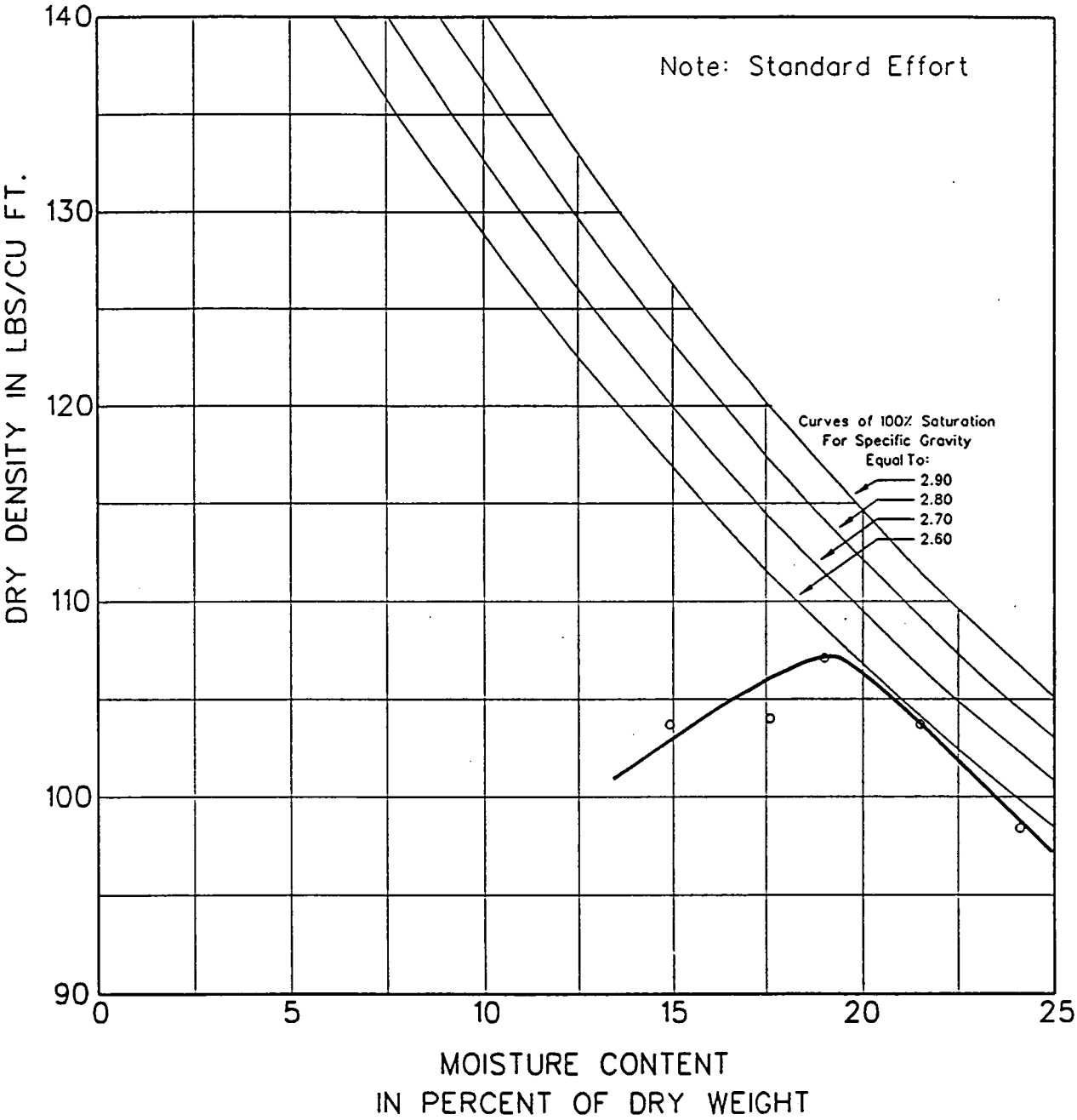
Boring: G2-SB-9 Sample Number: 404587 Depth: 1.5-5.0 ft

Description: Brown Lean Clay (CL)

Optimum Moisture Content: 19.2% Maximum Dry Density: 107.2 lbs/ft^3

Specific Gravity: 2.69 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 5/31/95



FILENAME: SKX03772.DGN

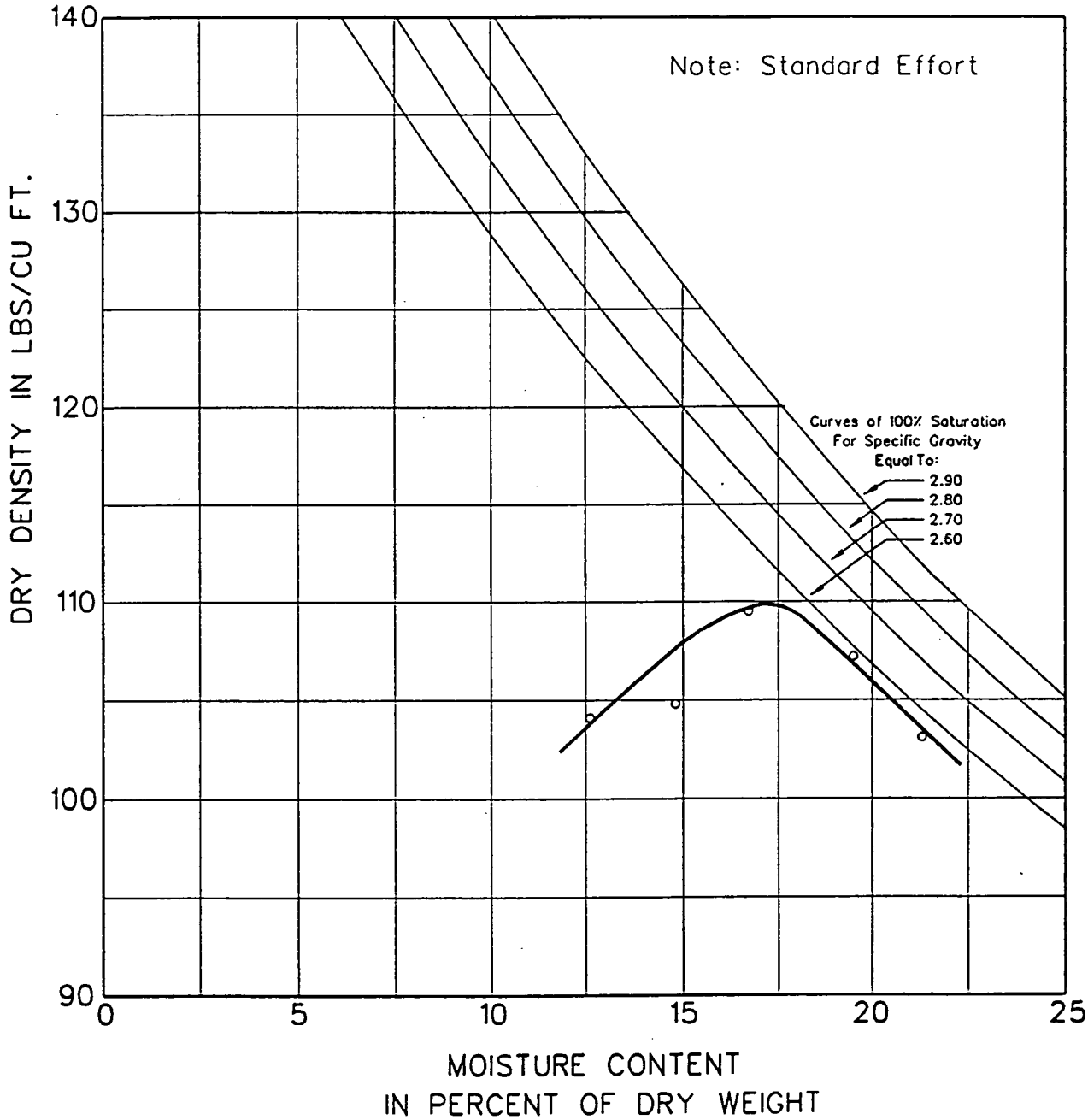
Boring: G2-SB-10 Sample Number: 404637 Depth: 1.5-5.0 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 17.1% Maximum Dry Density: 109.9 lbs/ft^3

Specific Gravity: 2.77 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 6/02/95



FILENAME: SKX03773.DGN

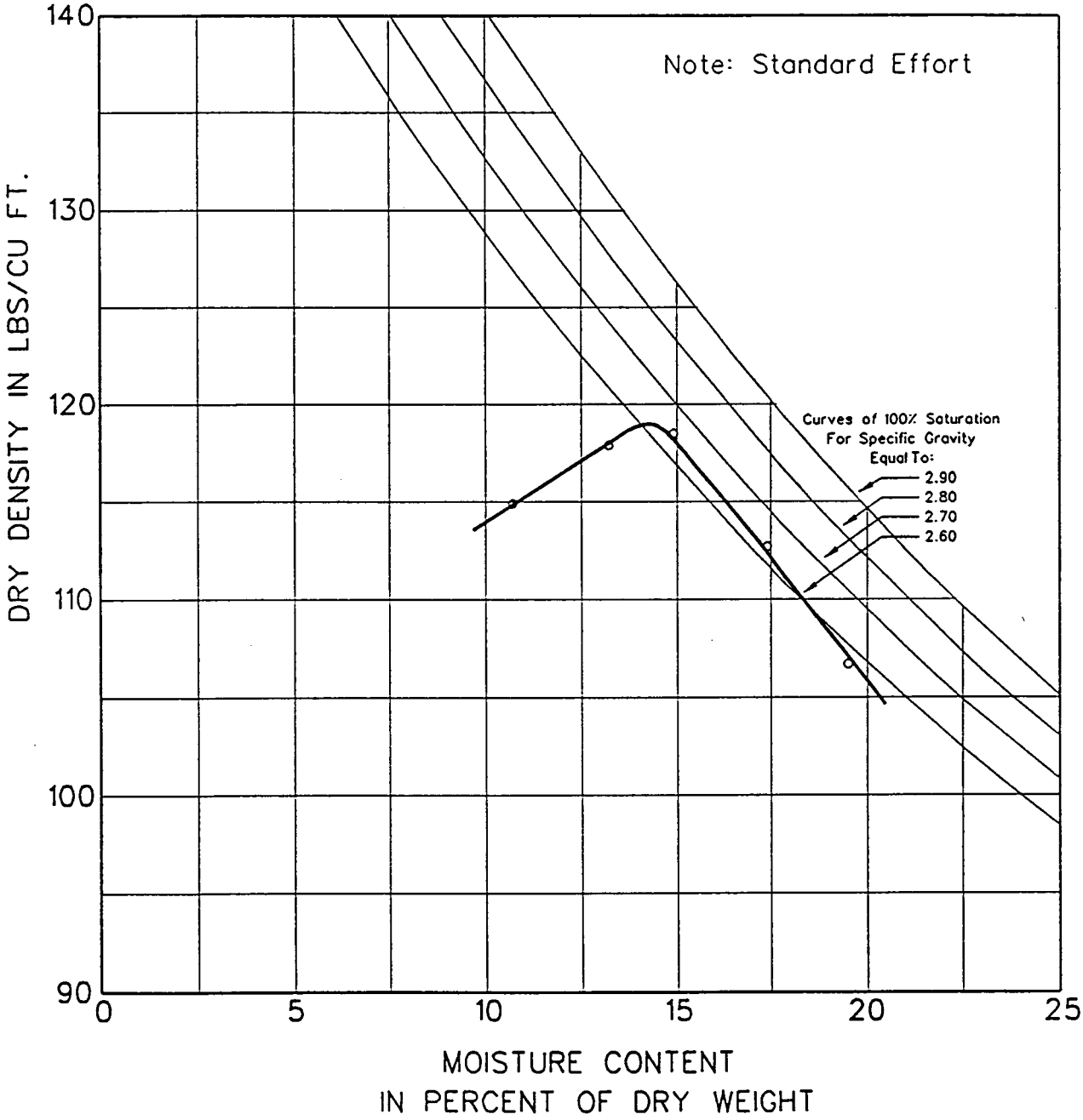
Boring: G2-SB-11 Sample Number: 404642 Depth: 1.5-5.0 ft

Description: Brown Lean Clay with Sand (CL)

Optimum Moisture Content: 14.3% Maximum Dry Density: 119.0 lbs/ft^3

Specific Gravity: 2.77 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 5/25/95



FILENAME: SKX03774.DGN

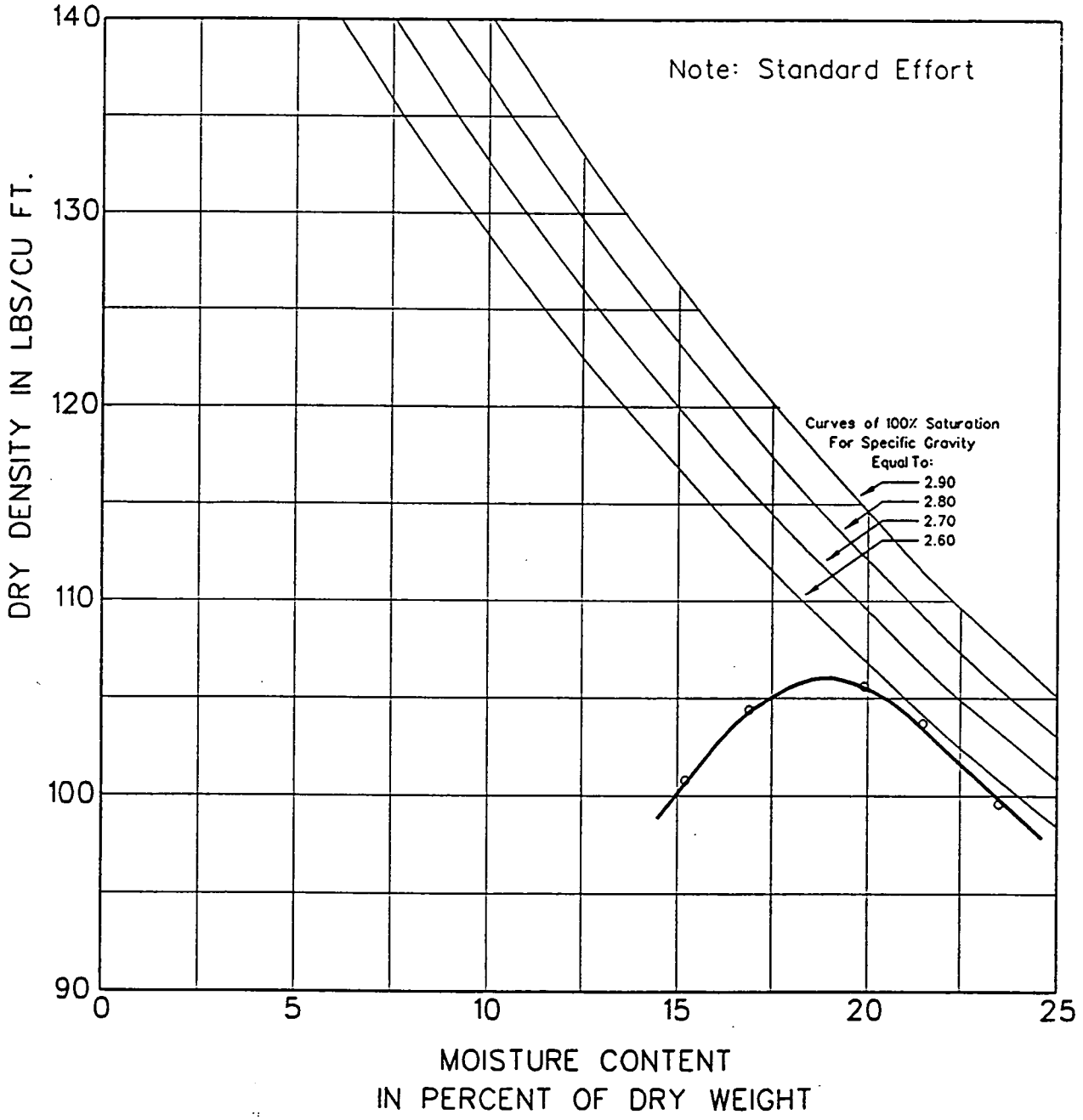
Boring: G2-SB-12 Sample Number: 404599 Depth: 1.5-4.2 ft

Description: Brown Fat Clay (CH)

Optimum Moisture Content: 18.1% Maximum Dry Density: 106.1 lbs/ft^3

Specific Gravity: 2.73 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 6/08/95



.ENAME: SKX03775.DGN

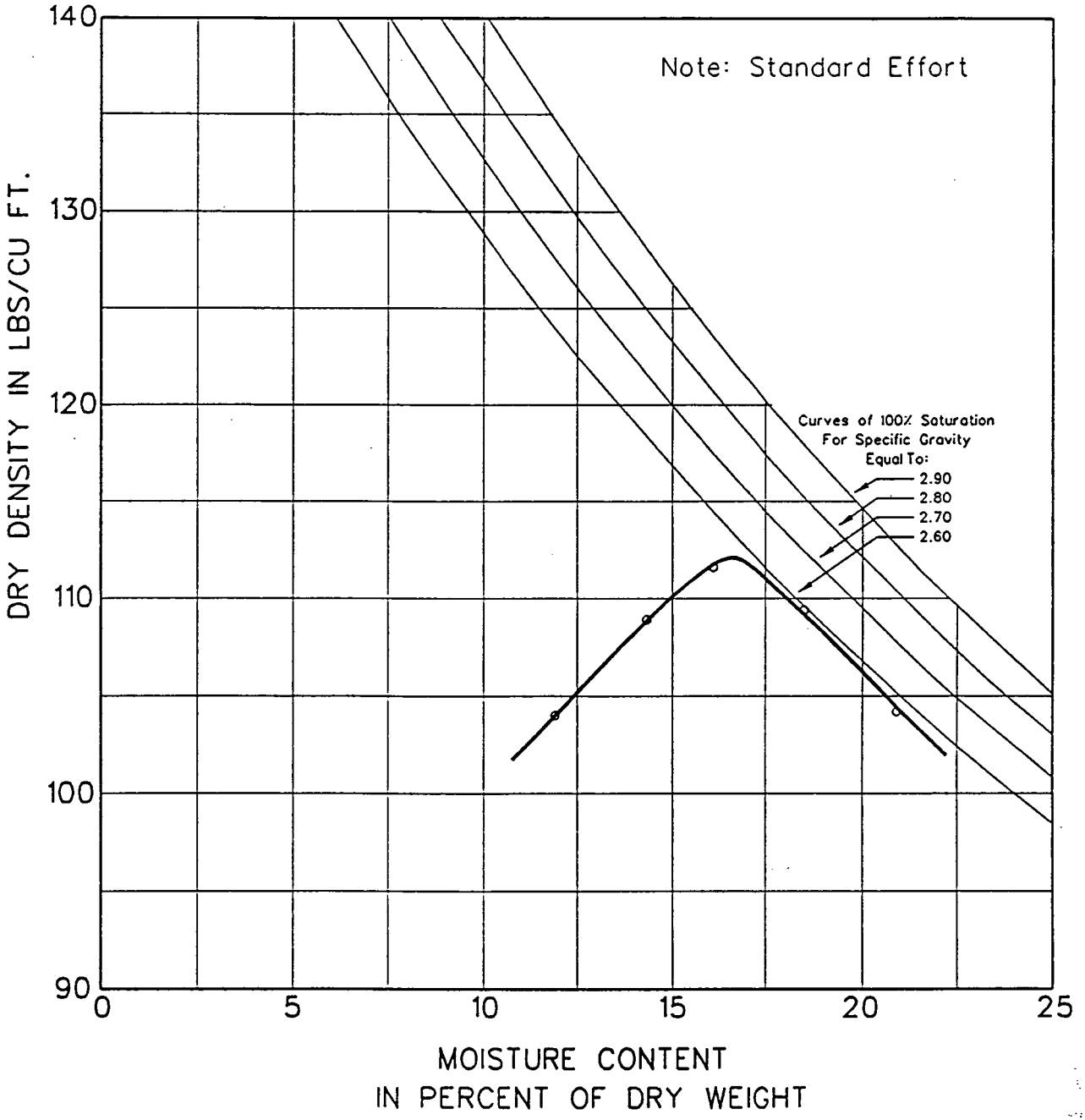
Boring: G2-SB-13 Sample Number: 404583 Depth: 1.5-5.0 ft

Description: Brown Lean Clay (CL)

Optimum Moisture Content: 16.6% Maximum Dry Density: 112.1 lbs/ft^3

Specific Gravity: 2.68 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 6/02/95



FILENAME: SKX03776.DGN

000630

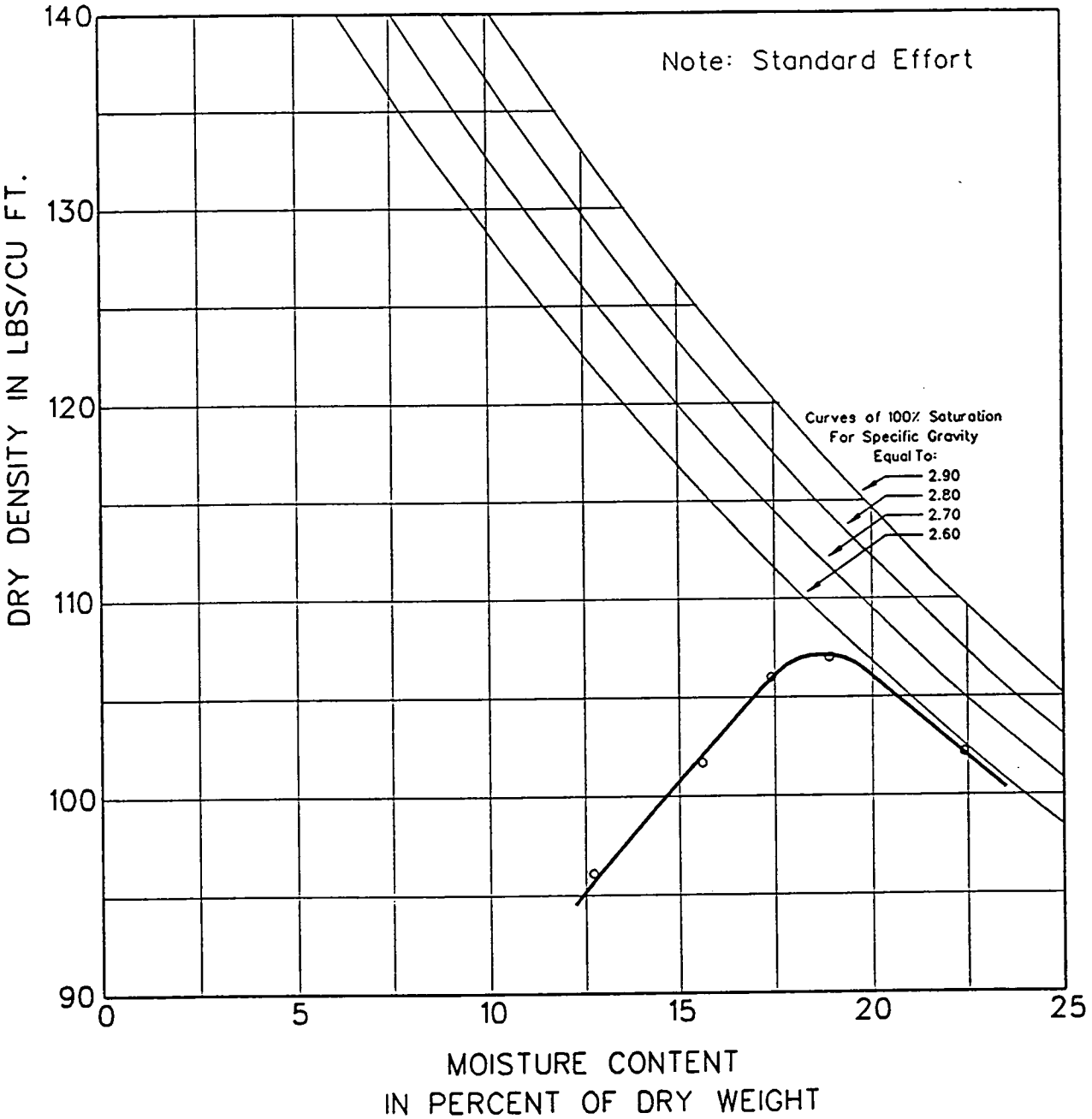
Boring: G2-SB-14 Sample Number: 404578 Depth: 1.5-5.0 ft

Description: Brown Fat Clay (CH)

Optimum Moisture Content: 18.7% Maximum Dry Density: 107.1 lbs/ft^3

Specific Gravity: 2.78 Compaction Method: ASTM D 698 Method A

Lab: Advanced Terra Testing, Inc. Date Tested: 6/07/95



ENAME: SKX03766.DGN

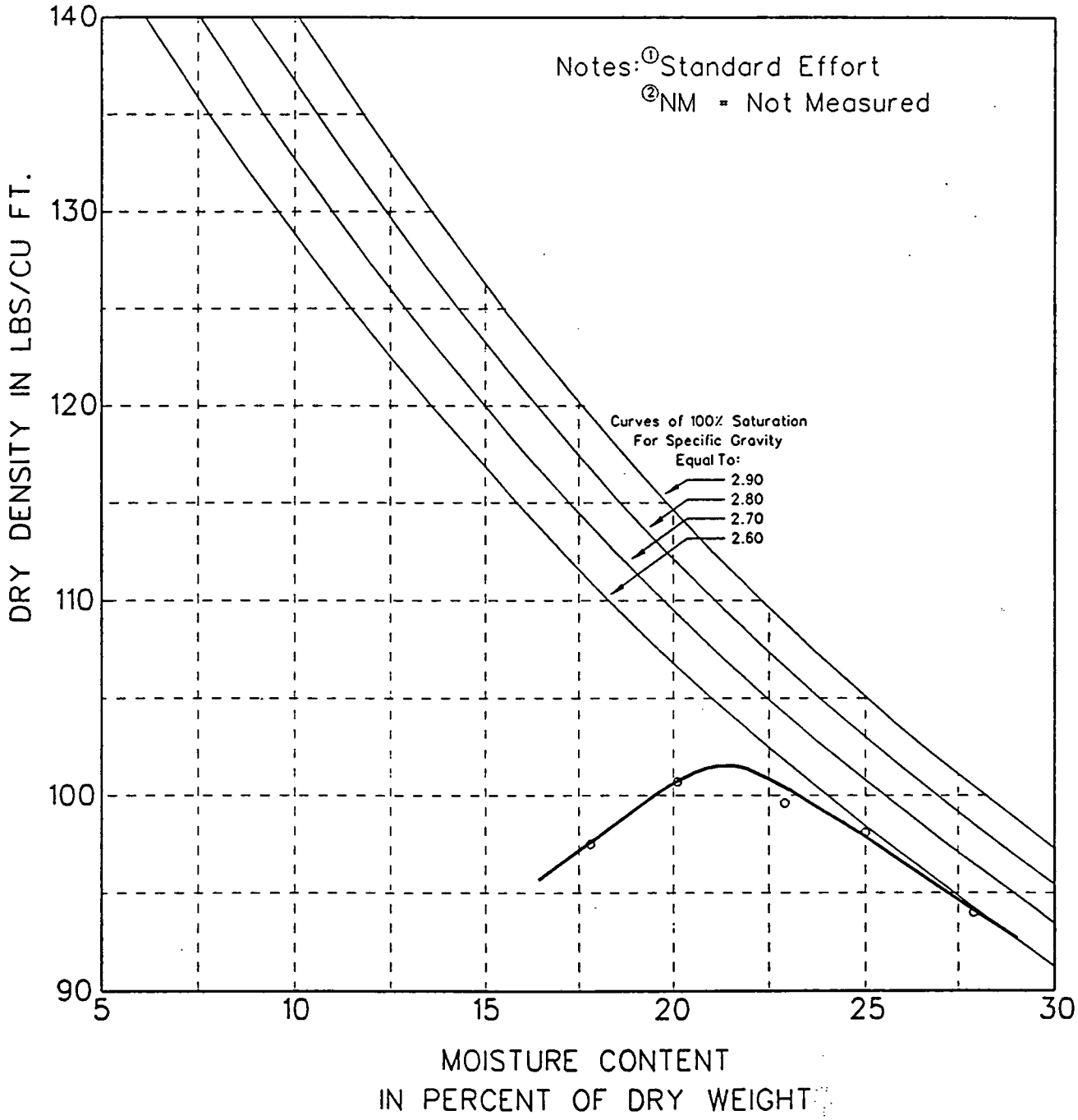
Boring: G2-SB-15 Sample Number: 404649 Depth: 1.0-2.0 ft

Description: Brown Lean Clay with trace Sand (Visual Description)

Optimum Moisture Content: 21.4% Maximum Dry Density: 101.0 lbs/ft^3

Specific Gravity: NM② Compaction Method: ASTM D 698 Method A①

Lab: Advanced Terra Testing, Inc. Date Tested: 6/30/95



FILENAME: SKX03759.DGN

000632

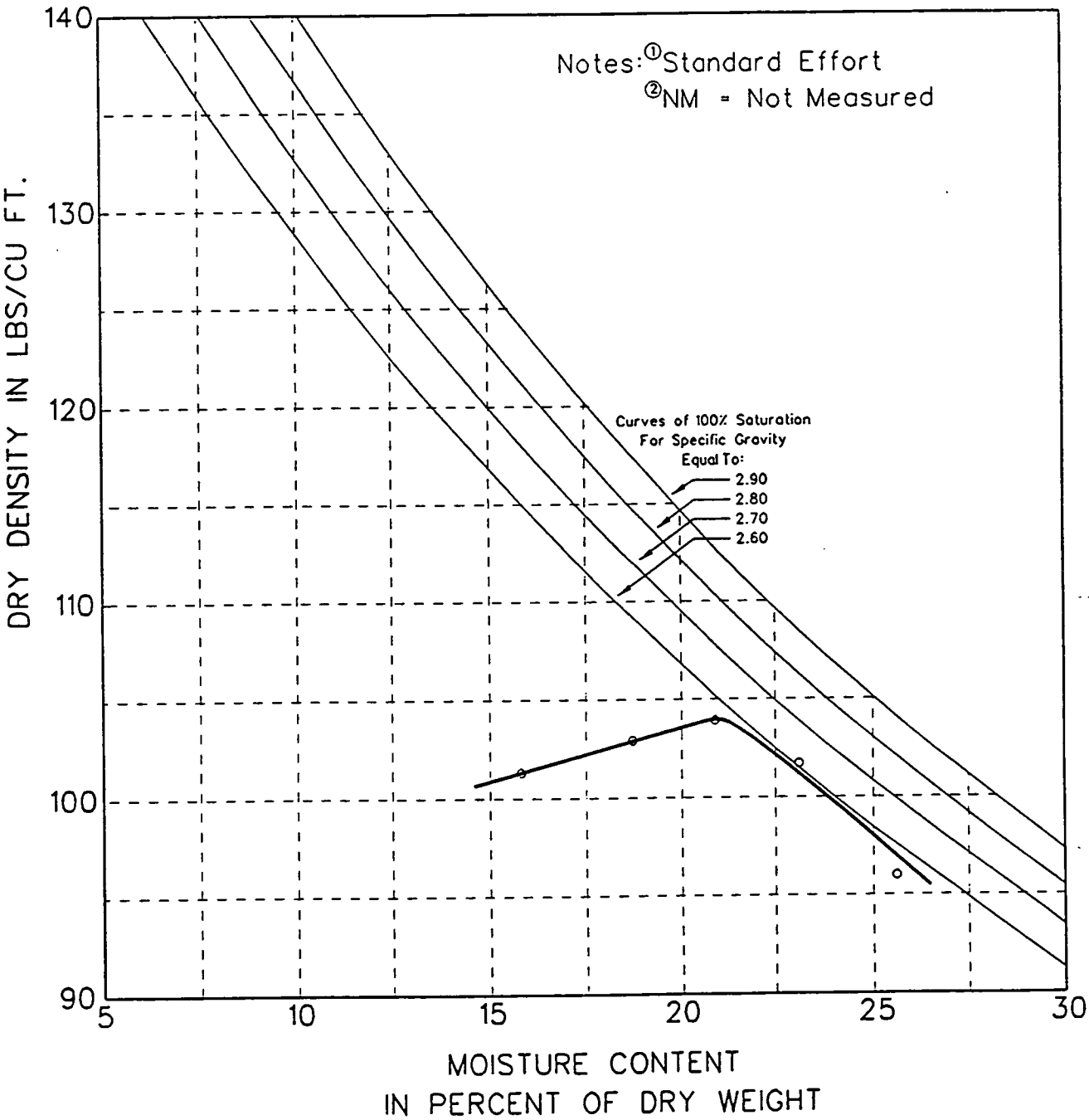
Boring: G2-SB-16 Sample Number: 404650 Depth: 1.0-2.0 ft

Description: Brown Lean Clay (Visual Description)

Optimum Moisture Content: 20.9% Maximum Dry Density: 103.9 lbs/ft^3

Specific Gravity: NM② Compaction Method: ASTM D 698 Method A①

Lab: Advanced Terra Testing, Inc. Date Tested: 6/29/95



NAME: SKX03758.DGN

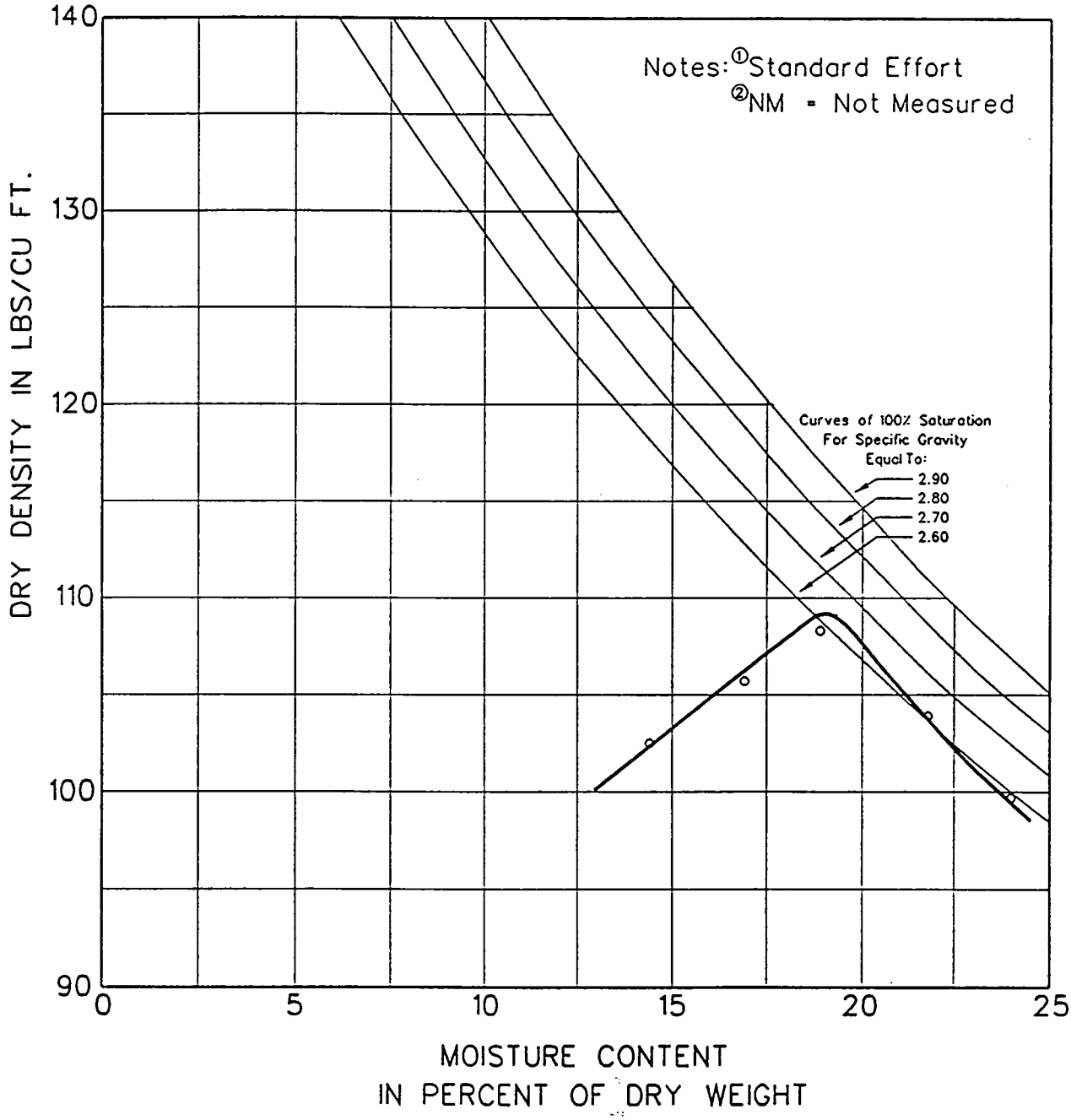
Boring: G2-SB-17 Sample Number: 405366 Depth: 1.0-2.0 ft

Description: Clayey Silt (Visual Description)

Optimum Moisture Content: 19.3% Maximum Dry Density: 109.1 lbs/ft^3

Specific Gravity: NM② Compaction Method: ASTM D 698 Method A①

Lab: Advanced Terra Testing, Inc. Date Tested: 6/29/95



FILENAME: SKX03757.DGN

Sample No. G2-201-204 Depth 0 - 24.5 Elevation _____

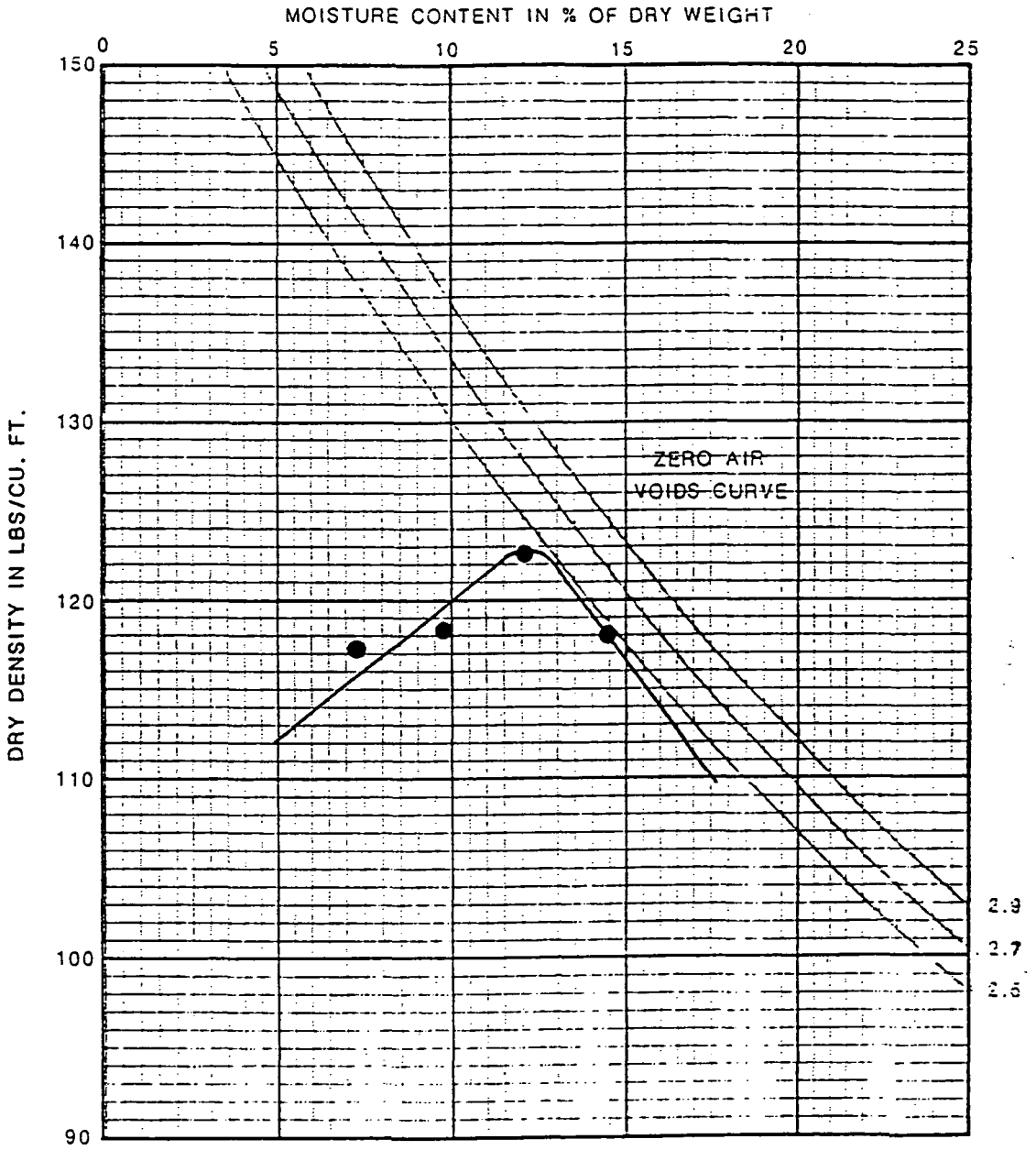
Soil Composite 201, 202, 203, 204

Location Proposed On-Site Disposal Cell (PO-101)

Optimum Moisture Content 12.0%

Maximum Dry Density 122.7 pcf

Method of Compaction ASTM D 698, Method A



File _____

COMPACTION TEST DATA

ADVANCED TERRA TESTING

Sample No. G2-205-208 Depth 0 - 24.5 Elevation _____

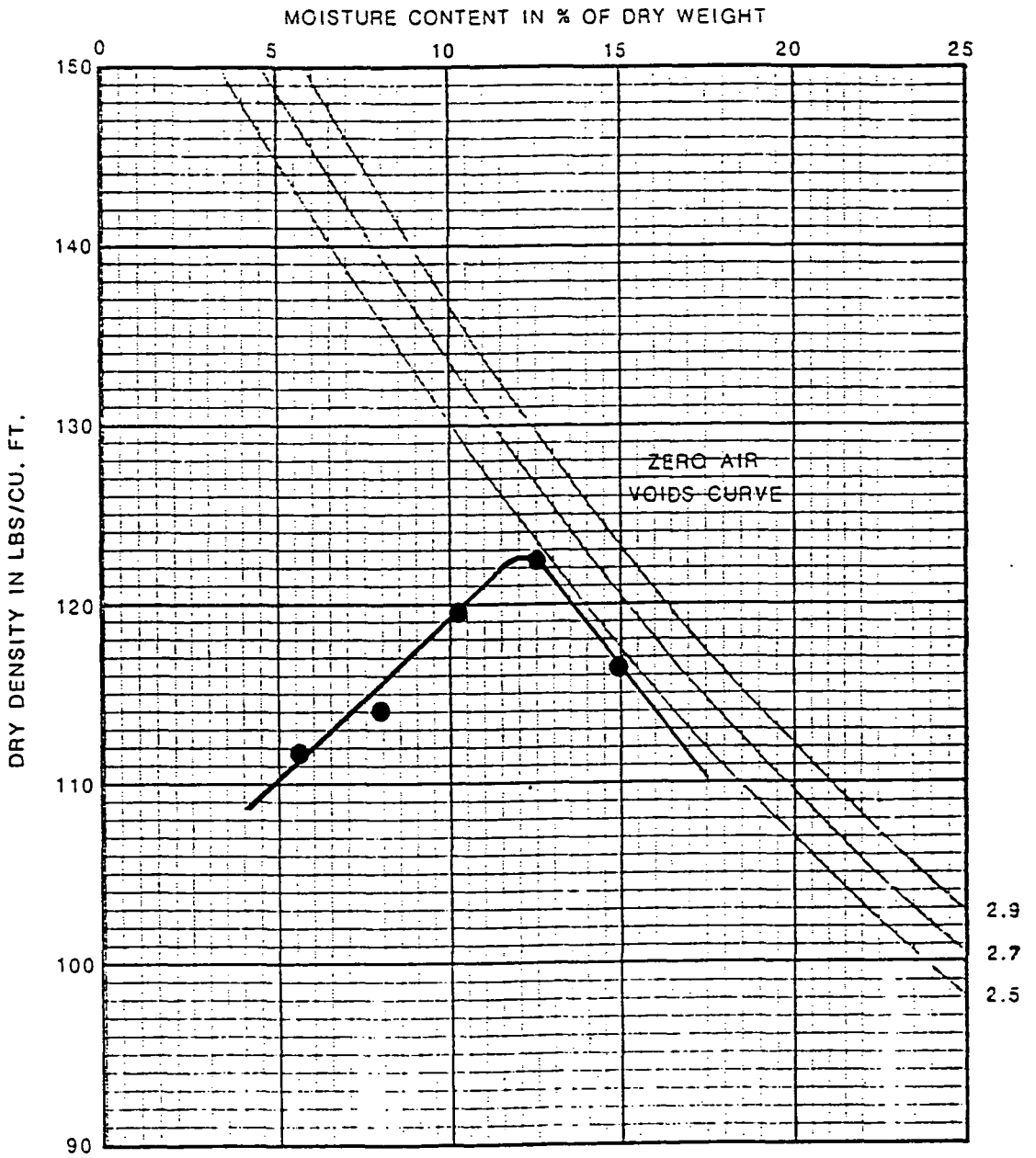
Soil Composite 205, 206, 207, 208

Location Proposed On-Site Disposal Cell (PO-101)

Optimum Moisture Content 12.3%

Maximum Dry Density 122.5 pcf

Method of Compaction ASTM D 698, Method A



File _____

COMPACTION TEST DATA

000636

ADVANCED TERRA TESTING

Sample No. G2-209 Depth 0 - 25 Elevation

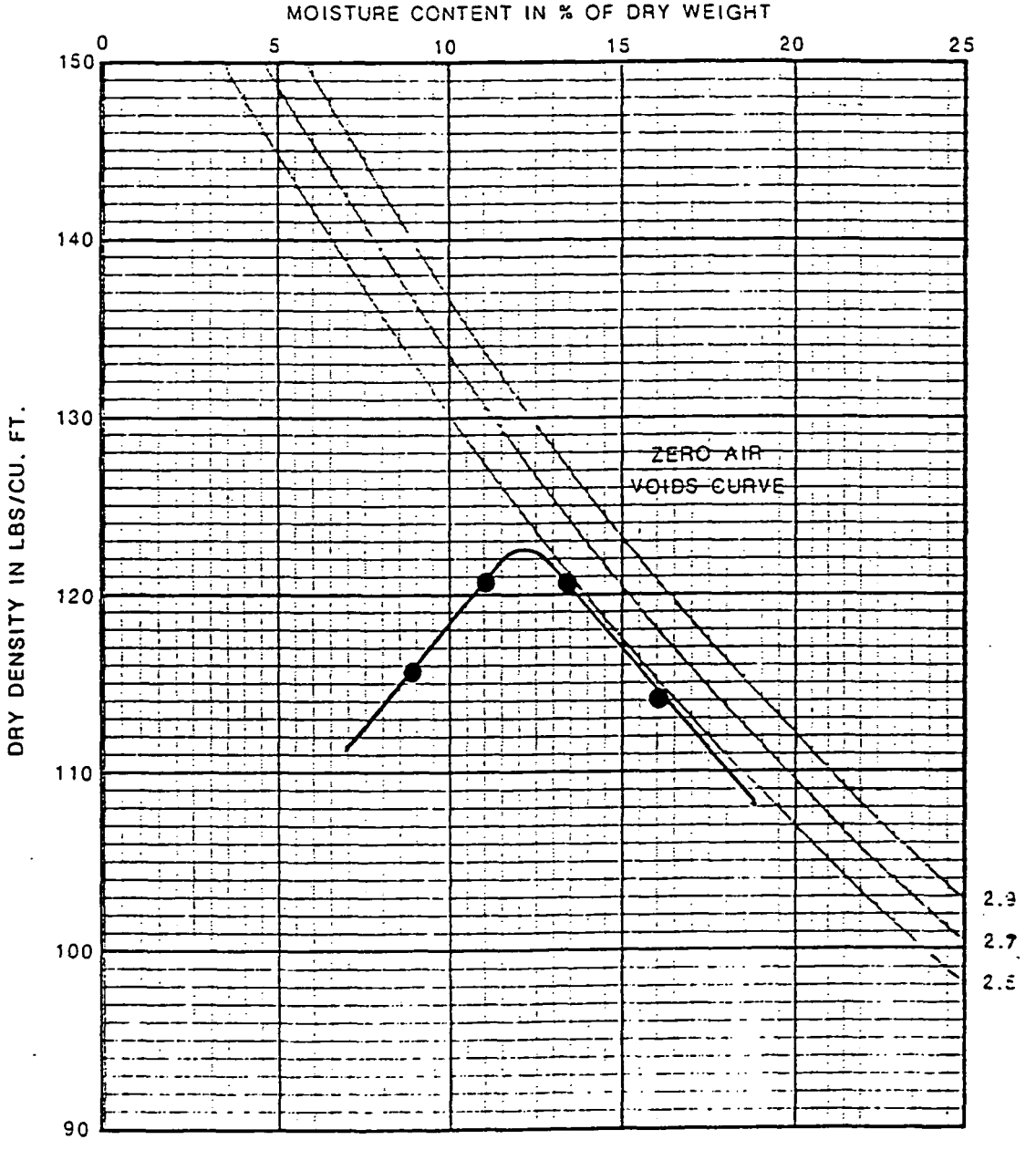
Soil Brown and Gray Sandy Lean Clay (CL)

Location Proposed On-Site Disposal Cell (PO-101)

Optimum Moisture Content 12.3%

Maximum Dry Density 122.3 pcf

Method of Compaction ASTM D 698, Method A



File

COMPACTION TEST DATA

ADVANCED TERRA TESTING

Sample No. 62-209 Depth 0-24.5' Elevation _____

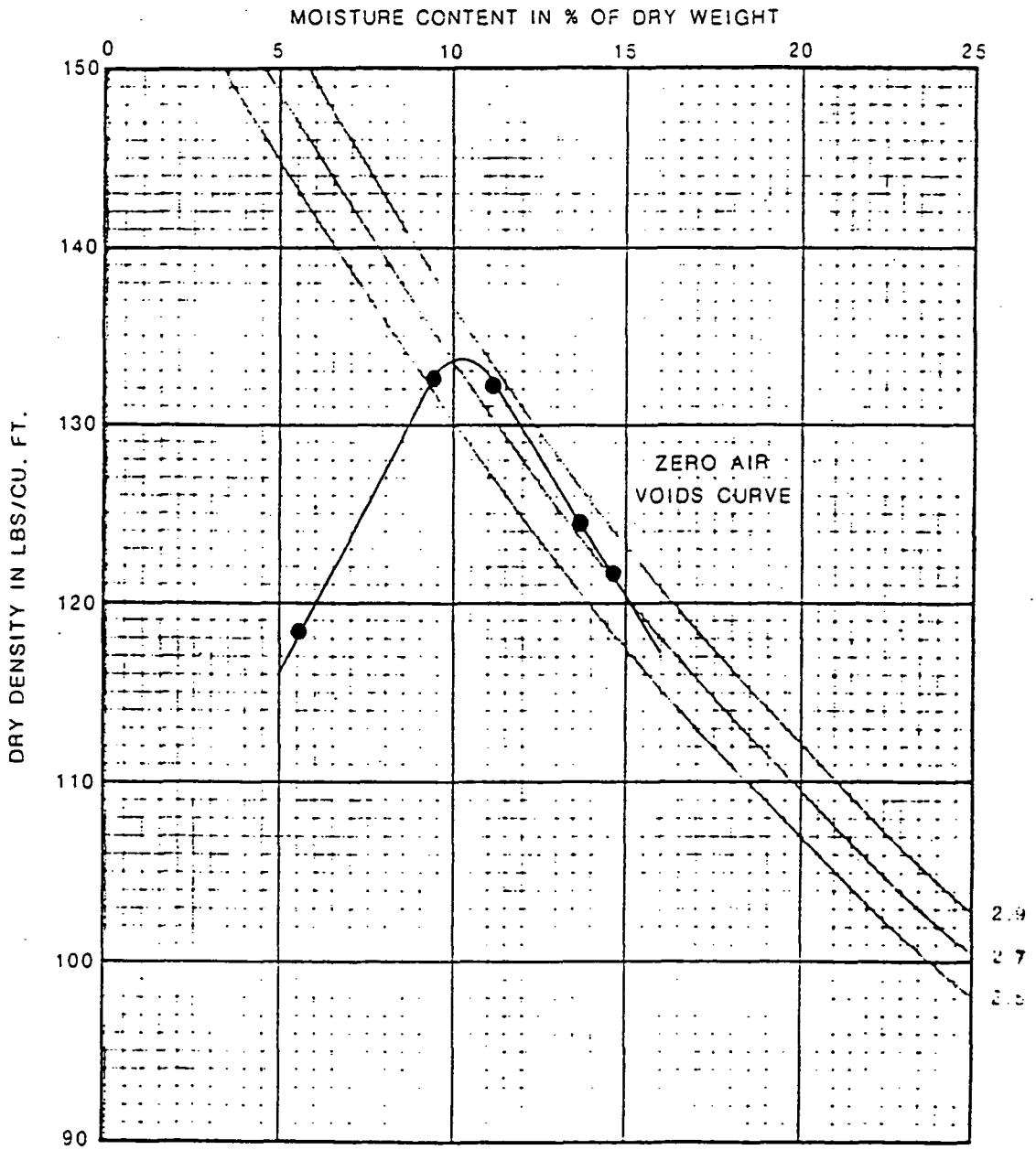
Soil Bulk

Location Onsite Waste Disposal Cell

Optimum Moisture Content 10.3 %

Maximum Dry Density 133.6 pcf

Method of Compaction ASTM D 1557 A



File Parsons PO 101
2059-10

COMPACTION TEST DATA

000638

ADVANCED TERRA TESTING

Sample No. G2-210 Depth 0 - 25 Elevation

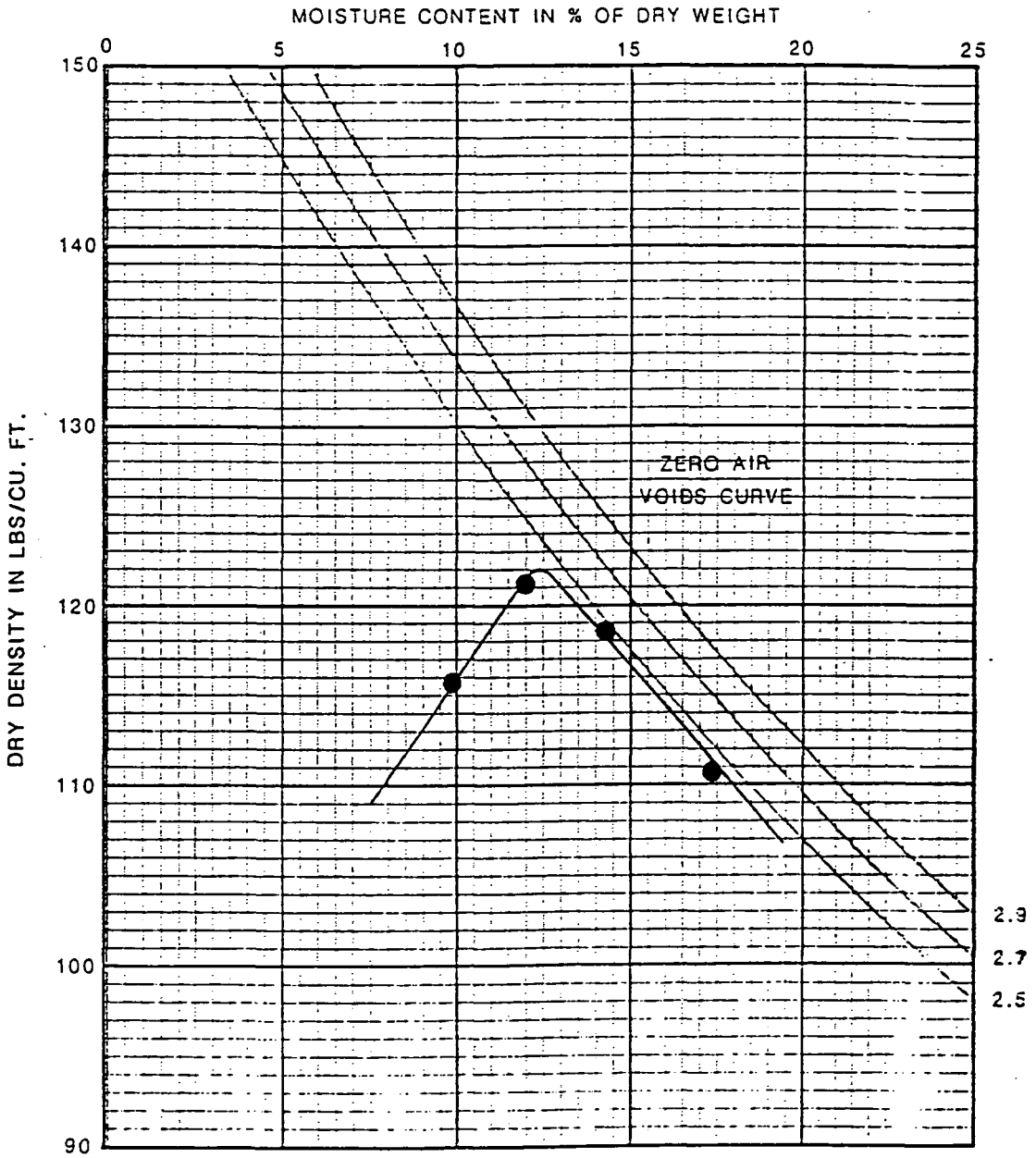
Soil Brown and Gray Lean Clay with Sand (CL)

Location Proposed On-Site Disposal Cell (PO-101)

Optimum Moisture Content 12.4%

Maximum Dry Density 122.3 pcf

Method of Compaction ASTM D 698, Method A



File

COMPACTION TEST DATA

000639

ADVANCED TERRA TESTING

APPENDIX I

EXPLANATION FOR APPENDIX I

Hydraulic conductivity estimates were performed for the PO-177 RI/FS archive samples and recent granular PO-177 samples, which recently had grain-size analyses performed on them. The hydraulic conductivity was estimated using grain-size data and an empirical equation recommended in Frink 1995, due to its applicability for medium grained sands. According to Vuković and Soro 1992, the Krüger formula is:

$$K = 240\, n/(1-n)^2 d_e^2 \qquad \text{(m/day)} \qquad (1)$$

Where:

n = porosity
d_e = effective diameter (mm)
K = hydraulic conductivity (m/day) at temperature t = 0°C

The effective grain diameter of the Krüger formula considers all fractions of the sample. This is different than several other commonly used empirical equations that typical use a single value from the grain-size data (i.e., d_{10}). The equation for the Krüger effective diameter is:

$$1/d_e = \sum_{i=1}^{i=j} \Delta g_i/d_i = \sum_{i=1}^{i=j} \Delta g_i\, 2/(d_i^g + d_i^d) \qquad (2)$$

Where:

Δg_i = weight content of certain fractions of the material
d_i = mean grain diameter of the corresponding fraction
d_i^g = maximum grain diameter of the corresponding fraction
d_i^d = minimum grain diameter of the corresponding fraction
j = the number of fractions used to determine grain size distribution

The other factor that effects the Krüger formula is porosity. Porosity is either measured in the laboratory or estimated using other characteristics of the tested material. Since it is commonly accepted that the uniformity coefficient (C_u) has the greatest effect on the porosity of natural materials this relationship was used to calculate an estimated porosity for each grain-size distribution Frink 1995. An equation that estimates the porosity based upon C_u is:

$$n = 0.255(1+0.83^{C_u}) \qquad (3)$$

Where:

C_u = Uniformity Coefficient = d_{60} / d_{10}

For the estimate of hydraulic conductivity using the Krüger formula, seven points along the grain size distribution, defining the basic shape of the grain size curve, were chosen. These seven points were then used to calculate the effective grain diameters using equation (2). The uniformity coefficients were then used to estimate the porosity of the samples using equation (3). Finally the estimated hydraulic conductivities were calculated using equation (1). The results are reported in Table I-1.

For comparison with the estimated hydraulic conductivities, measured hydraulic conductivities from slug tests and pump tests are reported in Table I-1. The slug test and pump test measurements are from *FEMP Glacial Till/Vadose Zone Hydraulic Investigation Report*.

The hydraulic conductivity estimates were performed on samples classified as silts and sands. A chart in Frink 1995 can be used to compare hydraulic conductivity estimates determined by the Krüger method with other methods that use grain-size diameters to estimate hydraulic conductivity.

TABLE I-1 Hydraulic Conductivity Estimates, Former Plant Area

FEMP ID	Sample Number	Top Depth (ft)	Bottom Depth (ft)	USCS Name	USCS Symbol	D60 (mm)	D50 (mm)	D30 (mm)	D10 (mm)	Gravel (%)	Sand (%)	Silt and Clay -200 (%)	Clay 0.002 mm (%)	LL	PL	Cu	By Grain Size-Kruger Method				Slug Test	Pump Test	Screened Interval	
																	Porosity(%)	K_{32} (cm/sec)	K_{32} (ft/day)	K_{55} (ft/day)	k (ft/day)	k (ft/day)	top (ft)	bottom (ft)
11112	30920A11112-03,-05	5.5	8	Well-graded Sand with Gravel	SW	2.9	2	0.7	0.16	27.4	68	4.6	1.5			18.1	26.4	3.96E-02	112.25	171.80				
11112	30920A11112-06,-08,-09	8	10	Well-graded Sand with Gravel	SW	5.5	3.6	1.5	0.35	43.8	52.6	3.6	0.5			15.7	26.9	2.68E-02	75.97	116.27				
11112	30920A11112-10-11-12-13	10	12	Well-graded Sand with Silt and Gravel	SW-SM	2.8	1.8	0.9	0.15	27.4	65.7	6.9	1.5			18.7	26.3	2.73E-02	77.39	118.44				
11112	30920A11112-14-15-16-17	12	14	Poorly-graded Sand with Silt and Gravel	SP-SM	2.35	1.3	0.37	0.07	26.5	62.7	10.8	2.5			33.6	25.5	9.95E-03	28.20	43.17				
11115	30915A11115-08,-10	6	8	Poorly-graded Sand with Silt and Gravel	SP-SM	2.8	1.6	0.45	0.075	32.5	58	9.5	1.3	NP	NP	37.3	25.5	1.12E-03	3.17	4.86				
11115	30915A11115-13,-14,-15	9	10.5	Well-graded Sand with Silt and Gravel	SW-SM	3.4	2.1	0.7	0.09	33.8	57.1	9.1	1.8			37.8	25.5	1.04E-02	29.48	45.12				
11115	30915A11115-17,-18,-20-21	12	14.5	Poorly-graded Sand with Silt and Gravel	SP-SM	1.6	0.9	0.31	0.07	16.5	72.7	10.8	2	NP	NP	22.9	25.9	2.96E-03	8.39	12.84				
11208	30909A11208-9,-10,-11	6	7.5	Silty Sand with Gravel	SM	1.9	1.05	0.31	0.05	20.3	66.3	13.4	3.5			38.0	25.5	9.95E-03	28.20	43.17				
11208	30909A11208-15,-16	9	10	Well-graded Sand with Silt and Gravel	SW-SM	4	2.2	0.5	0.06	37.2	51.3	11.5	2.7			66.7	25.5	3.52E-03	9.98	15.27				
11211	30915A11211-13,-16,-17-19	9.5	13	Silty Sand	SM	0.7	0.39	0.165	0.017	13.3	65.9	20.8	3.5	NP	NP	41.2	25.5	9.79E-04	2.78	4.25		27.5	10.5	23.0
1134	50650	11.5	12	Silty Sand	SM	0.17	0.13	0.09	0.042	0	80.9	19.1	1	NP	NP	4.0	37.6	1.33E-03	3.77	5.77	0.264		10.0	15.8
1149	51420	14	14.5	Sandy Lean Clay	CL	0.12	0.07	0.014	0.0013	3.7	43.1	53.2	13	19.8	12.2	92.3	25.5	1.16E-04	0.33	0.50	1.07		10.0	14.6
1153	016063	9	9.5	Silty Sand	SM	0.2	0.13	0.07	0.012	4.9	64.7	30.4	3			16.7	26.6	5.57E-04	1.58	2.42	0.485		5.8	10.6
1177	51615,51617	11	12.5	Well-graded Sand with Silt	SW-SM	0.5	0.38	0.26	0.06	1.6	87.6	10.8	1			8.3	30.9	6.26E-03	17.74	27.16				
1177	51618,51619,51620	12.5	14	Silty Sand with Gravel	SM	0.6	0.38	0.17	0.034	15.4	66.8	17.8	2.5			17.6	26.4	3.67E-03	10.40	15.92				
1177	51624,51625,51626,51627	15.5	17.5	Well-graded Sand with Silt	SW-SM	0.6	0.5	0.26	0.07	13.9	75	11.1	2			8.6	30.6	8.79E-03	24.92	38.13	41.9		9.6	24.6
1177	115628,115629,115630	17.5	19	Silty Sand	SM	0.75	0.5	0.23	0.055	9	76.4	14.6	2			13.6	27.5	4.79E-03	13.58	20.78				
1183	51741,51742,51743	13	14.5	Sandy Silty Clay	CL-ML	0.19	0.07	0.015	0.0022	3.6	44.4	52	9.5	19.8	13.6	86.4	25.5	1.68E-04	0.48	0.73				
1185	51784,51785,51786,51787	15.5	17.5	Silty Sand	SM	0.29	0.21	0.11	0.035	2	76.7	21.3	3	NP	NP	8.3	30.9	1.58E-03	4.48	6.85				
1188	51847,51848	18	19	Poorly-graded Sand with Silt	SP-SM	0.5	0.38	0.22	0.085	4.2	88.1	7.7	1	NP	NP	5.9	34.0	7.33E-02	207.78	318.00				
1205	52157,52158,52159	12	13.5	Silty Sand	SM	0.22	0.18	0.075	0.009	0.5	74	25.5	4	NP	NP	24.4	25.8	1.90E-03	5.39	8.24				
1208	52206,52207,52208,52209	16.5	18.5	Silty Sand	SM	0.22	0.19	0.12	0.055	0.5	82.8	16.7	1.5	NP	NP	4.0	37.6	5.37E-03	15.22	23.30				
1212	17250,17253,52235	9.5	12.5	Sandy Silt	ML	0.08	0.06	0.04	0.014	2	44.4	53.6	2.5	NP	NP	5.7	34.3	2.77E-04	0.79	1.20				
1216	52318	13.5	14	Silty Sand	SM	0.12	0.1	0.05	0.0065	1.1	59.2	39.7	6	NP	NP	18.5	26.3	3.60E-04	1.02	1.56				
1217	52335,52336	11	12	Silty Clay with Sand	CL-ML	0.025	0.019	0.008	0.0015	0	15.7	84.3	11.5	20.3	14.7	16.7	26.6	3.02E-05	0.09	0.13				
1220	52370	18.5	19	Well-graded Sand with Silt and Gravel	SW-SM	2.9	2.1	1.05	0.27	25.3	69.2	5.5	1			10.7	29.0	6.20E-05	0.18	0.27				
1224	50803,50804	16.5	17.5	Silty Sand	SM	0.22	0.15	0.06	0.0075	10.8	53.1	36.1	4	NP	NP	29.3	25.6	4.12E-04	1.17	1.79				
1224	50805,50806,50807	17.5	19	Silty Sand	SM	0.17	0.13	0.05	0.0045	9.4	51.7	38.9	6	NP	NP	37.8	25.5	2.31E-04	0.65	1.00				
1225	52436,52437	12.5	13.5	Silty Clay with Sand	CL-ML	0.03	0.021	0.012	0.035	3.1	13.1	83.8	7.5	20.6	16.6	0.9	47.1	1.50E-04	0.43	0.65				
1227	17581,17582	9	10	Sandy Silt	ML	0.09	0.075	0.032	0.03	1.3	48.5	50.2	8.5	17.8	15.4	3.0	40.1	2.42E-05	0.07	0.10	59.8		6.8	11.6
1230	50734,50735	16	17	Clayey Sand	SC	0.18	0.075	0.021	0.002	9.3	41.2	49.5	10	18.2	10.8	90.0	25.5	1.10E-04	0.31	0.48				
1233	17713,17714	9	10	Silty Sand	SM	0.15	0.1	0.042	0.0025	4.7	52.2	43.1	9	NP	NP	60.0	25.5	2.60E-04	0.74	1.13				
1233	52536	11.5	12	Silty Sand	SM	0.23	0.18	0.075	0.003	4.6	65	30.4	9	NP	NP	76.7	25.5	3.04E-04	0.86	1.32				
1233	52540,52541,52542	13.5	15	Silty Sand	SM	0.4	0.035	0.19	0.05	4.1	83.3	12.6	3	NP	NP	8.0	31.2	2.54E-03	7.20	11.02				
1233	42546,42547,42548	16.5	18	Well-graded Sand with Silt	SW-SM	1.3	1	0.46	0.11	12.5	79.2	8.3	2.5			11.8	28.3	6.03E-03	17.09	26.16				
1233	52549,52550	18	19	Poorly-graded Sand with Silt	SP-SM	0.75	0.55	0.34	0.16	0.2	94.5	5.3	1.5			4.7	36.1	9.48E-03	26.87	41.13				
1241	17889,17890,17892	9	11	Silty Clay with Sand	CL-ML	0.034	0.03	0.013		1.5	20.3	78.2	16	20	14						0.298		10.3	15.1
1244	50654,50655	12.5	13.5	Sandy Silty Clay	CL-ML	0.075	0.037	0.01	0.0014	0.8	38.6	60.6	11	19.9	14	53.6	25.5	5.20E-05	0.15	0.23				
1247	18024	12	12.5	Silty Sand (V)	SM (V)	0.6	0.45	0.27	0.014	1	79	20	3.5			42.9	25.5	1.27E-03	3.60	5.51				
1250	52,699,700,701,702	12	14	Sandy Silty Clay	CL-ML	0.12	0.07	0.034	0.0045	2.7	46.7	50.6	7	19.5	14.6	26.7	25.7	2.95E-04	0.84	1.28				
1267	53036,53038	11.5	13	Silt	ML	0.026	0.02	0.011	0.004	0.1	6.7	93.2	7.5	NP	NP	6.5	33.1	5.16E-05	0.15	0.22				
1274	53182	14.5	15	Silty Sand	SM	0.32	0.19	0.08	0.024	10.4	61.4	28.2	3.5	NP	NP	13.3	27.6	1.06E-03	3.00	4.60				
1287	18900,01,02,03,04	7.5	10	Silty Sand (V)	SM (V)	0.32	0.25	0.16	0.05	8.2	76.4	15.4	1			6.4	33.2	2.48E-03	7.03	10.76				
1293	19033	9	9.5	Clayey Sand with Gravel	SC	0.75	0.25	0.026	0.0017	23.6	36	40.4	11	24.2	12.8	441.2	25.5	1.15E-04	0.33	0.50	0.163		7.0	12.0
1336	54418,54421,54422	12.5	15	Silty Sand	SM	0.48	0.3	0.13	0.035	11.4	70	18.6	3			13.7	27.5	1.36E-03	3.86	5.90	67.2		7.7	20.7
1338	50018,50020,50021	6.5	8.5	Clayey Sand (V)	SC (V)	0.45	0.28	0.065	0.002	10.2	58.3	31.5	10			225.0	25.5	4.20E-04	1.19	1.82	3.61		5.0	10.0
1339	50037,38,40,41,42,43,44	6	10	Silty Sand with Gravel	SM	1.3	0.6	0.26	0.05	19.7	66.1	14.2	1.5	NP	NP	26.0	25.7	2.11E-03	5.98	9.15		38.6	7.0	12.0
1346	54627,54628	17	18	Sandy Silty Clay	CL-ML	0.12	0.06	0.024	0.0028	5.7	40.8	53.5	9	16.9	12.1	42.9	25.5	1.03E-04	0.29	0.45	0.623		14.9	19.6
1348	54667,54668	17.5	18.5	Clayey Sand with Gravel	SC	1.3	0.45	0.12	0.0045	24.3	49.3	26.4	9	22.2	12.2	288.9	25.5	4.89E-04	1.39	2.12				
1351	54724,25,26,27,28,29,30	15.5	19	Silty Clay	CL-ML	0.033	0.025	0.013		0	9.2	90.8	14.5	20.8	15.6						32.2		13.0	20.0
1352	54739	13	13.5	Silty Sand	SM	0.15	0.1	0.055	0.017	0.1	59.1	40.8	4.5	NP	NP	8.8	30.4	5.62E-04	1.59	2.44				
1354	54787,54789	17	18.5	Silty Sand with Gravel	SM	1.1	0.48	0.15	0.05	22	62.2	15.8	3			22.0	25.9	2.75E-03	7.80	11.93				
1356	54821,54822	14	15	Silty Sand	SM	0.36	0.32	0.2	0.02	1.5	80.8	17.7	4	NP	NP	18.0	26.4	2.94E-04	0.83	1.28				
1356	54827,54826	16.5	17.5	Well-graded Sand with Silt	SW-SM	0.48	0.35	0.22	0.06	6.4	84	9.6	1.5			8.0	31.2	2.22E-03	6.29	9.63				
1360	54900,54901	13.5	14.5	Silt with Sand	ML	0.035	0.3	0.019	0.0075	0.5	21	78.5	4.5	NP	NP	4.7	36.1	1.49E-04	0.42	0.65				
1420	51140	14.5	15	Silty, Clayey Sand	SC-SM	0.19	0.1	0.042	0.003	7.7	47.7	44.6	9	16.4	12.4	63.3	25.5	2.98E-04	0.84	1.29				
1420	51143,44,45,46	16	18	Well-graded Sand with Silt	SW-SM	1	0.65	0.33	0.095	14.4	77.2	8.4	1			10.5	29.1	6.80E-03	19.28	29.50	30.2		9.9	19.6

TABLE I-1 Hydraulic Conductivity Estimates, Former Plant Area

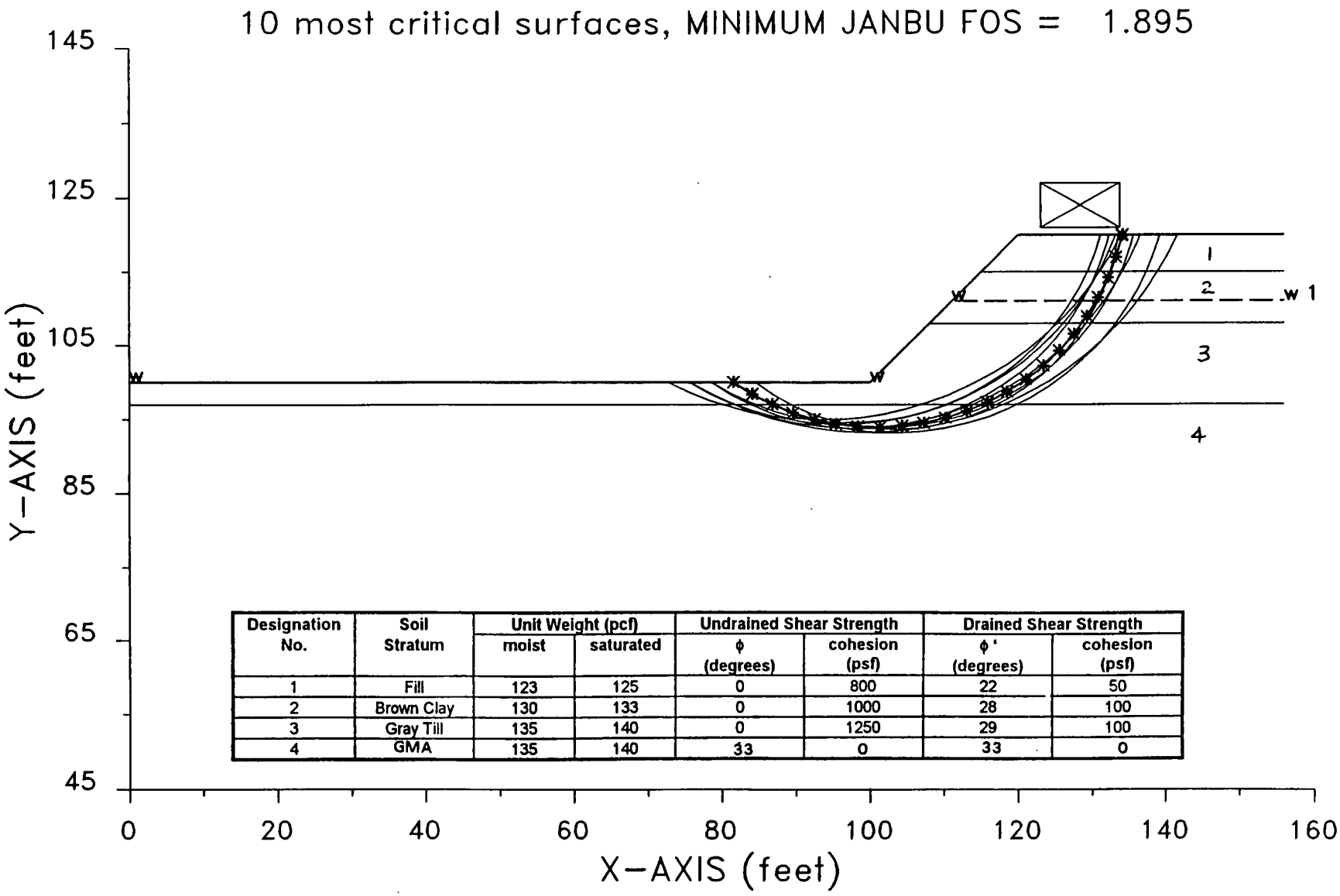
FEMP ID	Sample Number	Top Depth (ft)	Bottom Depth (ft)	USCS Name	USCS Symbol	D60 (mm)	D50 (mm)	D30 (mm)	D10 (mm)	Gravel (%)	Sand (%)	Silt and Clay -200 (%)	Clay 0.002 mm (%)	LL	PL	Cu	By Grain Size-Kruger Method				Slug Test	Pump Test	Screened Interval	
																	Porosity(%)	K_{32} (cm/sec)	K_{32} (ft/day)	K_{55} (ft/day)	k (ft/day)	k (ft/day)	top (ft)	bottom (ft)
1420	51147,48,49,50	18	20	Well-graded Sand with Silt	SW-SM	0.42	0.37	0.26	0.07	3.2	87.6	9.2	2.2			6.0	33.8	1.13E-02	32.03	49.02				
1503	00722,00724,00725,00726	17	19.5	Poorly-graded Sand with Silt	SP-SM	0.4	0.35	0.21	0.07	7.4	82	10.6	3			5.7	34.3	9.55E-03	27.07	41.43				
12266	412470	17	19	Silty Sand	SM	0.37		0.16	0.044	3.3	75.5	21.2	3	NP	NP	8.4	30.8	2.06E-03	5.84	8.94				
12269	412393	17	19	Silty Sand	SM	0.25		0.13	0.055	0.4	83.3	16.3	3.5	NP	NP	4.5	36.4	3.48E-03	9.86	15.10				
12269	412395	19	21	Silty Sand	SM	0.21		0.12	0.065	0.5	85.1	14.1	3	NP	NP	3.2	39.5	6.05E-03	17.15	26.25				
12270	412429	17	19	Sandy Silt	ML	0.09		0.033	0.011	8.2	37.1	54.7	5	NP	NP	8.2	31.1	3.91E-04	1.11	1.70				
12270	412431	21	23	Silty Sand	SM	0.1		0.055	0.021	4.8	47.8	47.4	2.5	NP	NP	4.8	36.0	7.30E-04	2.07	3.17				
12271	412375	15	17	Clayey Sand	SC	0.22		0.011	0.0008	13.3	40.3	46.4	16	20.7	12	275.0	25.5	1.02E-04	0.29	0.44				
12271	412377	17	19	Silty Sand	SM	0.3		0.065	0.0045	11.2	55.3	33.5	7.5	12.6	11.5	66.7	25.5	3.69E-04	1.05	1.60				
12272	412316	11	13	Silt with Sand	ML	0.055		0.02	0.002	0	25.7	74.3	10	NP	NP	27.5	25.7	2.18E-04	0.62	0.95				
12272	412318	15	17	Silty Sand	SM	0.18		0.09	0.06	0	79.5	20.5	2	NP	NP	3.0	40.1	3.65E-03	10.35	15.83				
12273	412334	7	9	Silty Sand	SM	0.1		0.06	0.003	0	57.2	42.8	9	NP	NP	33.3	25.6	1.65E-04	0.47	0.72				
12273	412336	9	11	Sandy Silt	ML	0.08		0.038	0.005	2.9	41.6	55.5	7	NP	NP	16.0	26.8	2.05E-04	0.58	0.89				
12273	412341	17	19	Sandy Silt	ML	0.065		0.012	0.003	0.3	33.9	65.8	8.8	NP	NP	21.7	26.0	5.56E-05	0.16	0.24				
12275	412447	19	21	Silty Sand with Gravel	SM	0.45		0.036	0.0032	23	35.3	41.7	8.3	15.5	12.4	140.6	25.5	1.67E-04	0.47	0.72				

Data Sources: SAIC, Inc, Former Plant Area Geotechnical Investigation Laboratory Data Report, September 1997
Parsons, FEMP Glacial Till/Vadose Zone Hydraulic Investigatins Report, OU5, PO 37, Vol. I and II, Rev. 0, May 1994

Notes:

1. (V) in USCS Name and Symbol is a visual classification only
2. Hydraulic Conductivity from grain-size analyses based on Kruger Method
3. Slug Test and Pump Test data from PARSONS PO 37
4. NP reported as non plastic by the laboratory
5. K_{32} is hydraulic conductivity at 32 degrees F and K_{55} is hydraulic conductivity at 55 degrees F (approximate constant subsurface temperature)

APPENDIX J



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Fill	123	125	0	800	22	50
2	Brown Clay	130	133	0	1000	28	100
3	Gray Till	135	140	0	1250	29	100
4	GMA	135	140	33	0	33	0

Figure J-1 - Recommended 1H:1V Short-Term Slope Configuration with Equipment Load for Excavation Site NE-B

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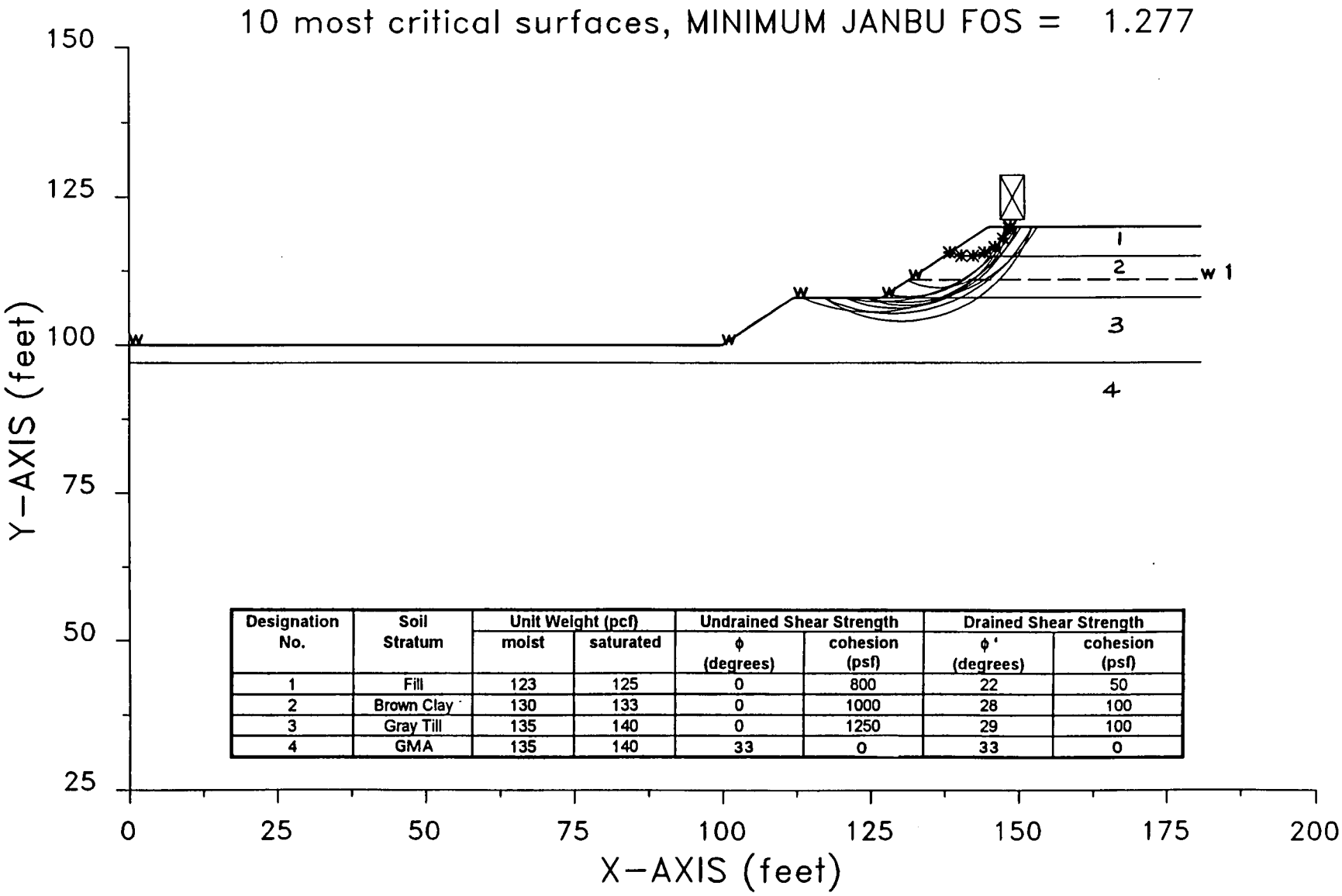
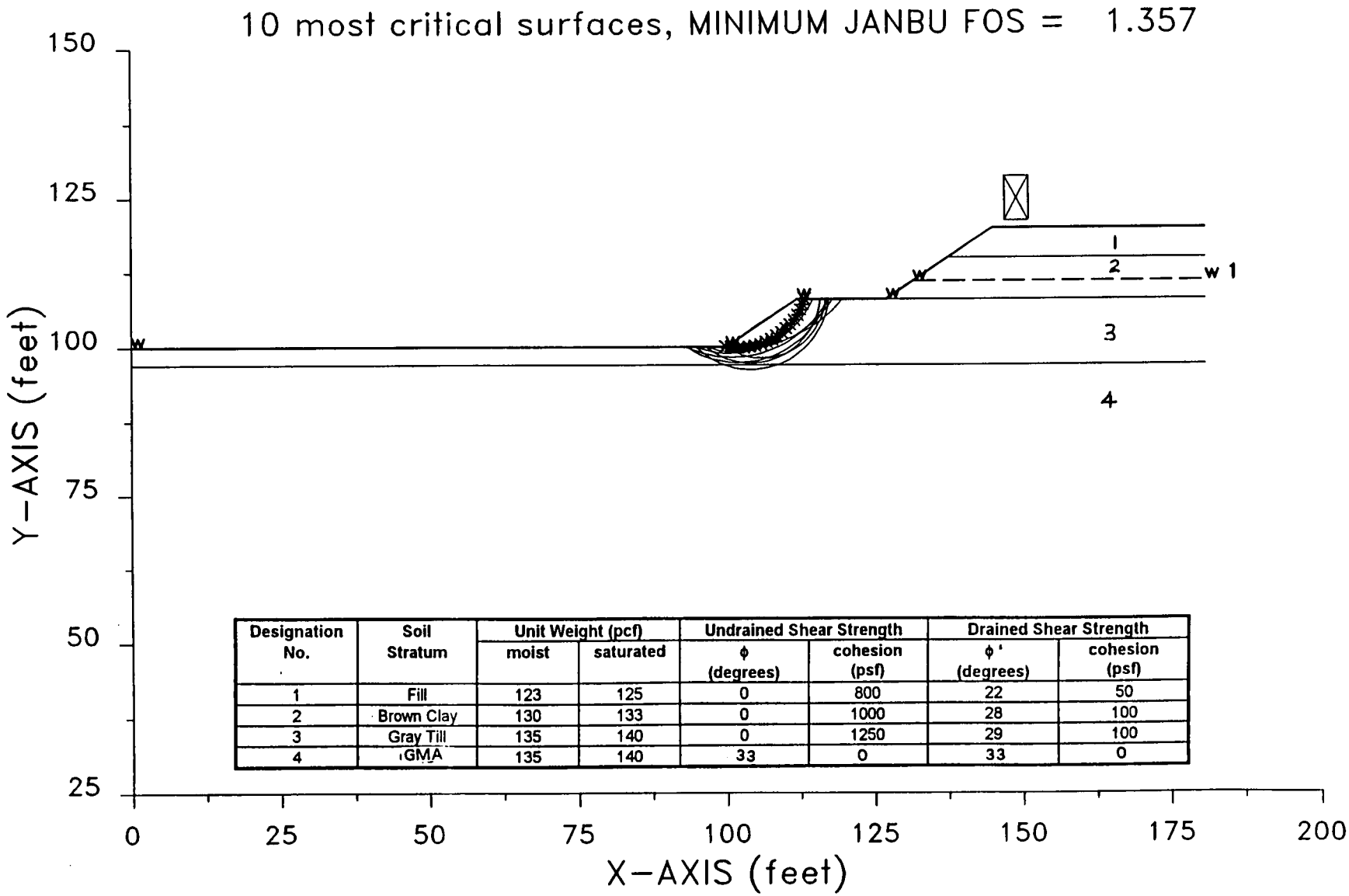


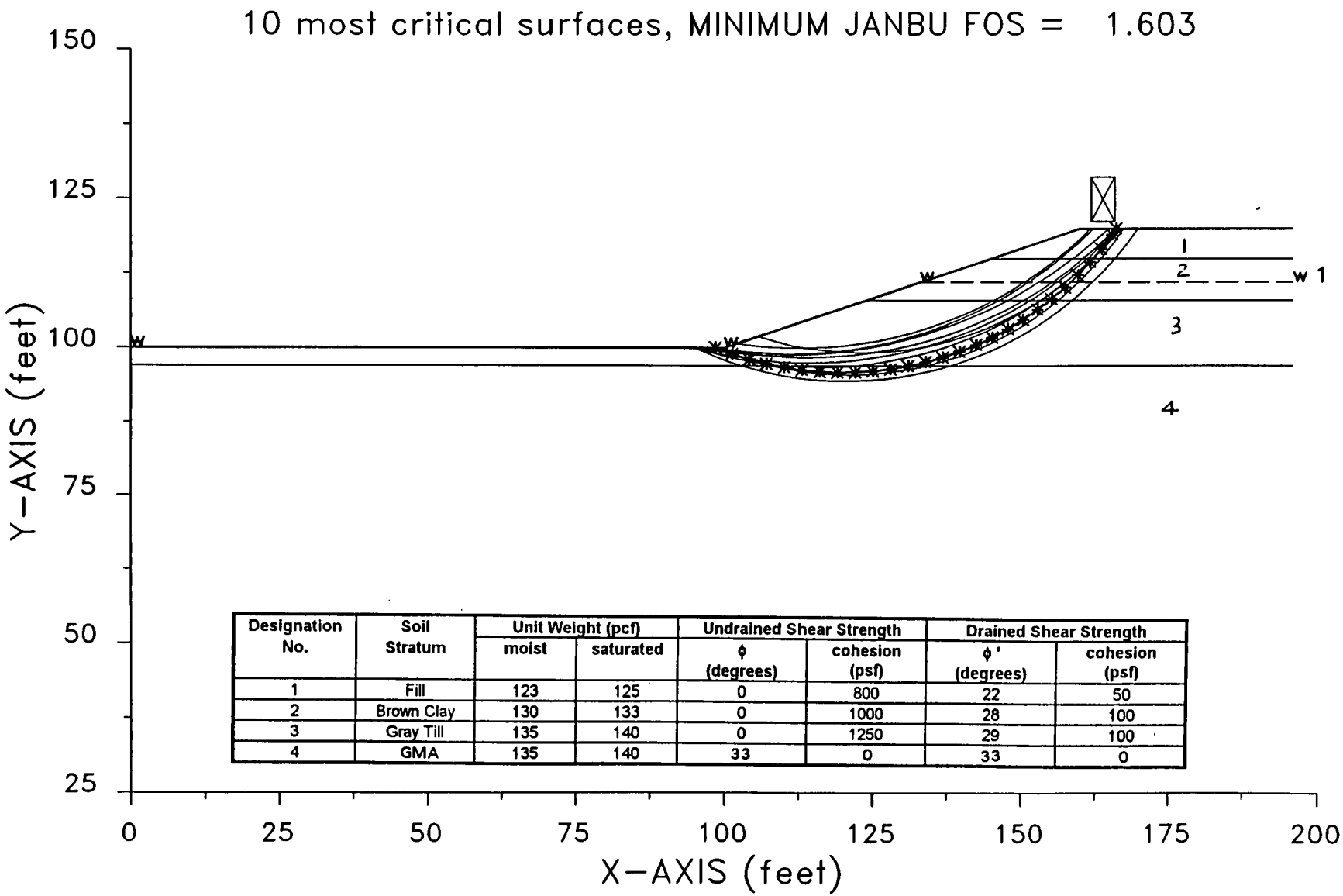
Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Fill	123	125	0	800	22	50
2	Brown Clay	130	133	0	1000	28	100
3	Gray Till	135	140	0	1250	29	100
4	GMA	135	140	33	0	33	0

Figure J-2 - Recommended 1.5H:1V Interim Long-Term Slope Configuration with Berm Load for Excavation Site NE-B, Upper Slope. (Maximum slope height is 10 feet with 15 feet wide bench)



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Fill	123	125	0	800	22	50
2	Brown Clay	130	133	0	1000	28	100
3	Gray Till	135	140	0	1250	29	100
4	GMA	135	140	33	0	33	0

Figure J-3 - Recommended 1.5H:1V Interim Long-Term Slope Configuration with Berm Load for Excavation Site NE-B, Lower Slope. (Maximum slope height is 10 feet with 15 feet wide bench)



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	φ (degrees)	cohesion (psf)	φ' (degrees)	cohesion (psf)
1	Fill	123	125	0	800	22	50
2	Brown Clay	130	133	0	1000	28	100
3	Gray Till	135	140	0	1250	29	100
4	GMA	135	140	33	0	33	0

Figure J-4 - Recommended 3H:1V Permanent Long-Term Slope Configuration with Berm Load for Excavation Site NE-B.

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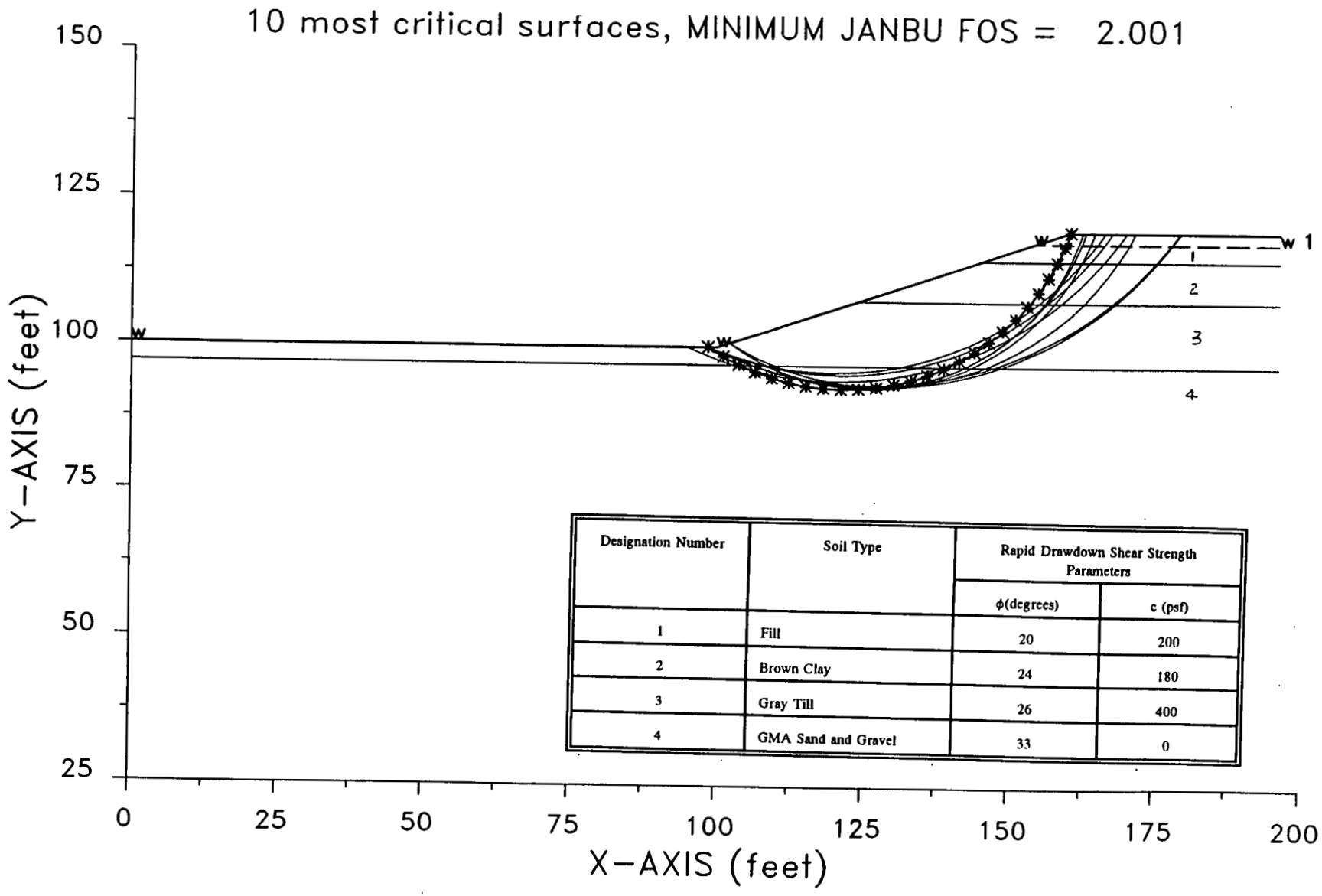
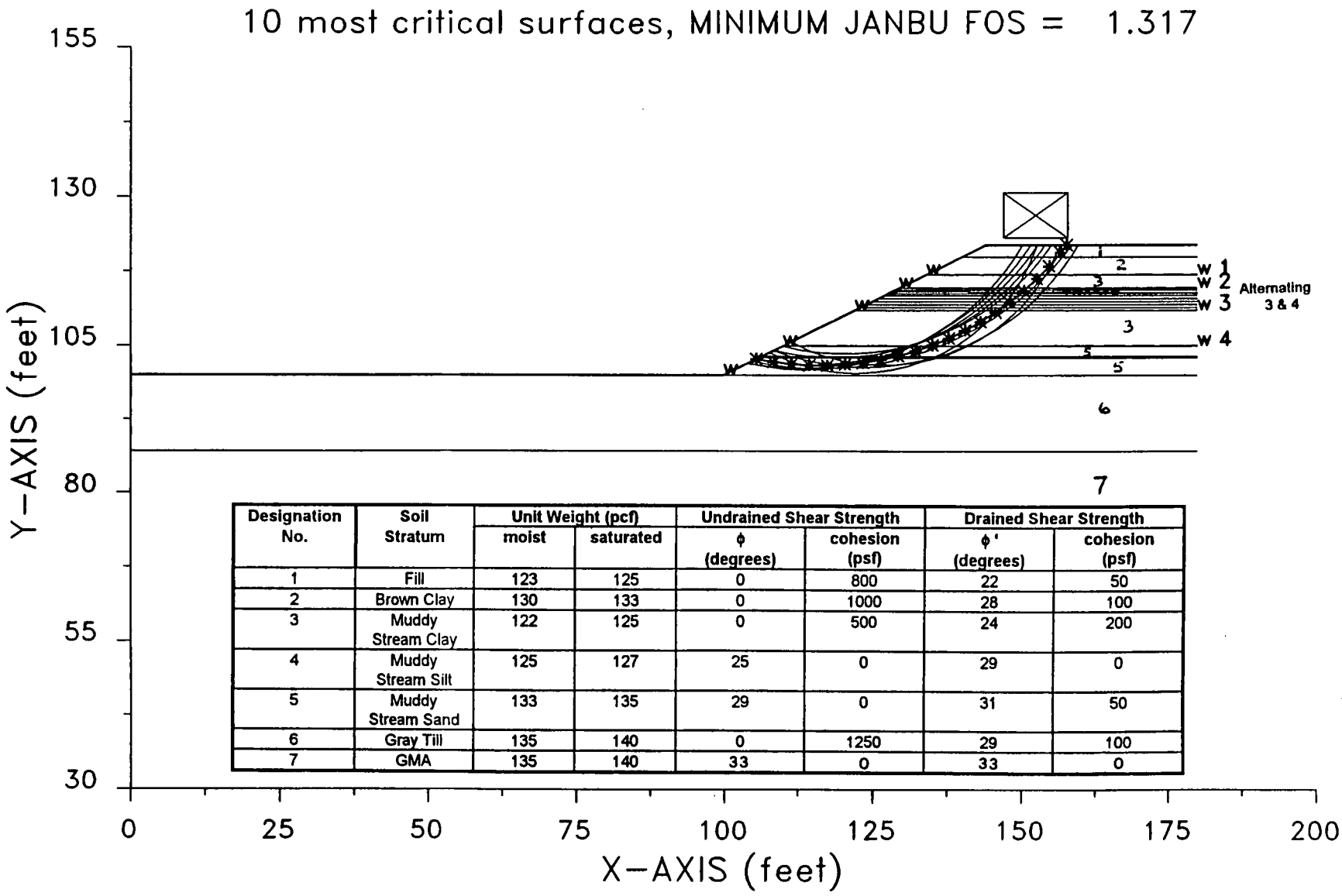


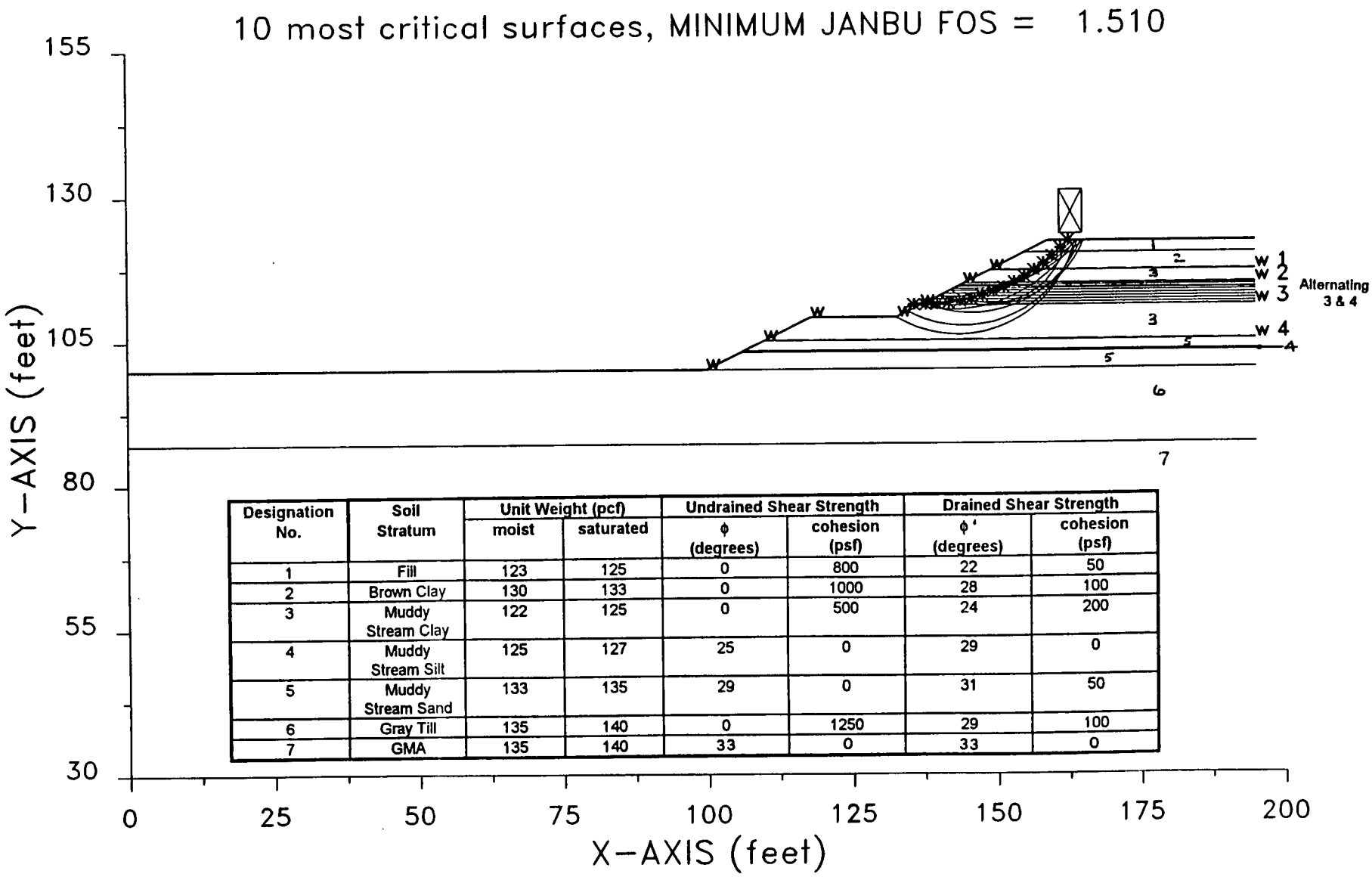
Designation Number	Soil Type	Rapid Drawdown Shear Strength Parameters	
		ϕ(degrees)	c (psf)
1	Fill	20	200
2	Brown Clay	24	180
3	Gray Till	26	400
4	GMA Sand and Gravel	33	0

Figure J-5 - Recommended 3H:1V Permanent Slope Configuration, Rapid Drawdown Analysis for Excavation Site NE-B.



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Fill	123	125	0	800	22	50
2	Brown Clay	130	133	0	1000	28	100
3	Muddy Stream Clay	122	125	0	500	24	200
4	Muddy Stream Silt	125	127	25	0	29	0
5	Muddy Stream Sand	133	135	29	0	31	50
6	Gray Till	135	140	0	1250	29	100
7	GMA	135	140	33	0	33	0

Figure J-6 - Recommended 2H:1V Short-Term Slope Configuration with Equipment Load for Excavation Site NE-A.



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ ' (degrees)	cohesion (psf)
1	Fill	123	125	0	800	22	50
2	Brown Clay	130	133	0	1000	28	100
3	Muddy Stream Clay	122	125	0	500	24	200
4	Muddy Stream Silt	125	127	25	0	29	0
5	Muddy Stream Sand	133	135	29	0	31	50
6	Gray Till	135	140	0	1250	29	100
7	GMA	135	140	33	0	33	0

Figure J-7 - Recommended 2H:1V Interim Long-Term Slope Configuration with Berm Load for Excavation Site NE-A, Upper Slope. (Maximum slope height is 13 feet with 15 feet wide bench)

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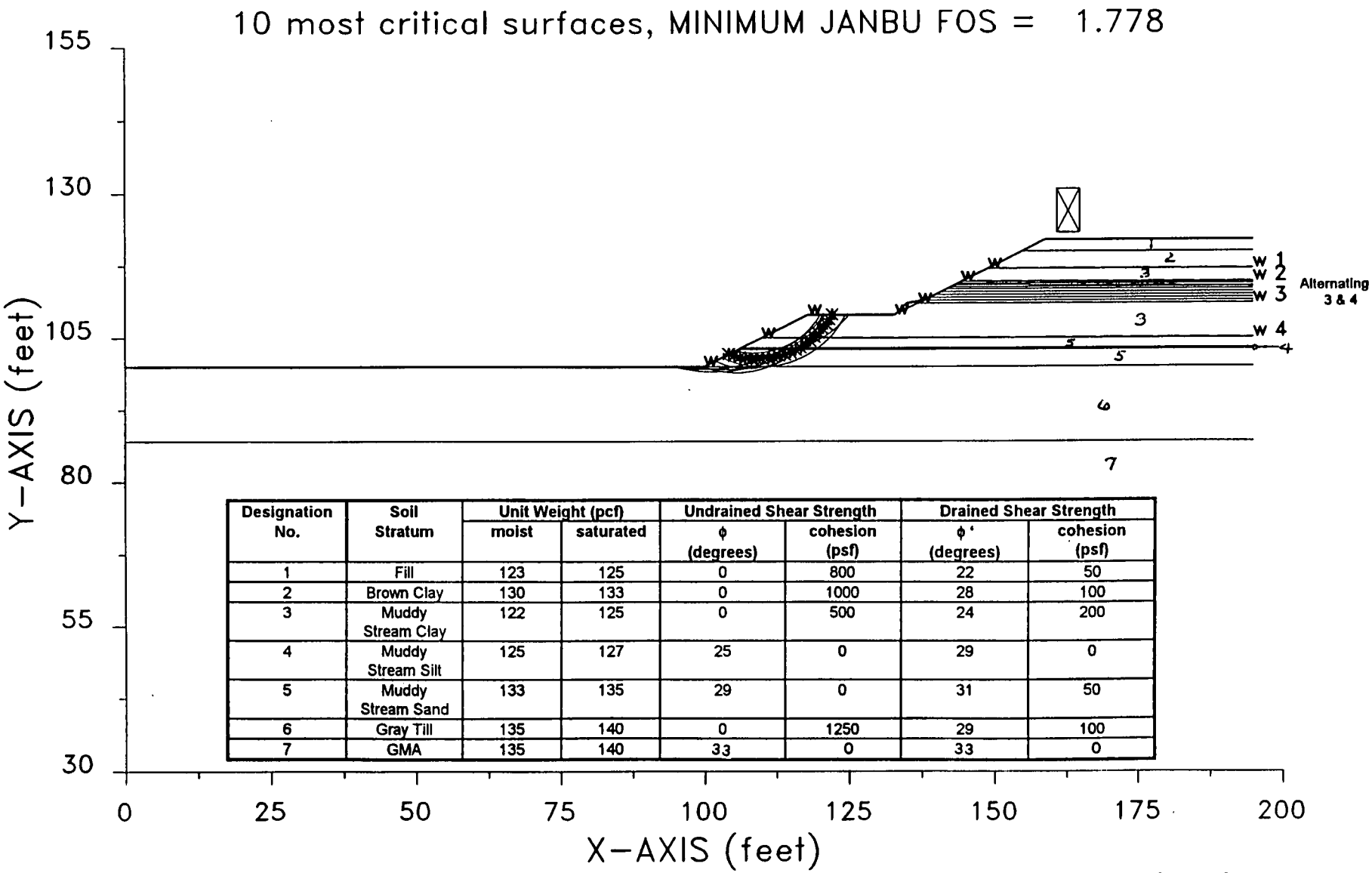
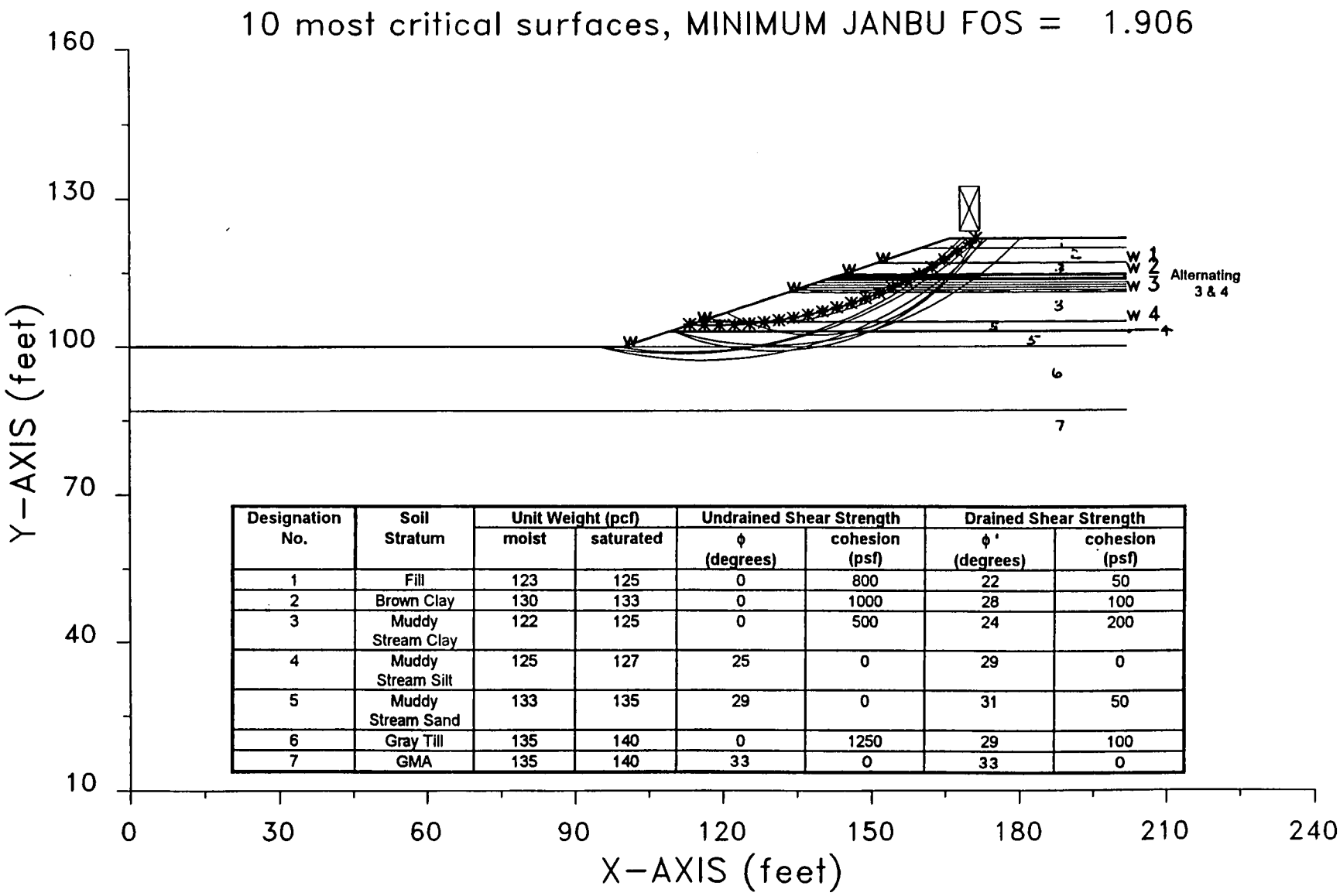


Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Fill	123	125	0	800	22	50
2	Brown Clay	130	133	0	1000	28	100
3	Muddy Stream Clay	122	125	0	500	24	200
4	Muddy Stream Silt	125	127	25	0	29	0
5	Muddy Stream Sand	133	135	29	0	31	50
6	Gray Till	135	140	0	1250	29	100
7	GMA	135	140	33	0	33	0

Figure J-8 - Recommended 2H:1V Interim Long-Term Slope Configuration with Berm Load for Excavation Site NE-A, Lower Slope. (Maximum slope height is 13 feet with 15 feet wide bench)

000551

15027



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Fill	123	125	0	800	22	50
2	Brown Clay	130	133	0	1000	28	100
3	Muddy Stream Clay	122	125	0	500	24	200
4	Muddy Stream Silt	125	127	25	0	29	0
5	Muddy Stream Sand	133	135	29	0	31	50
6	Gray Till	135	140	0	1250	29	100
7	GMA	135	140	33	0	33	0

Figure J-9 - Recommended 3H:1V Permanent Long-Term Slope Configuration with Berm Load for Excavation Site NE-A.

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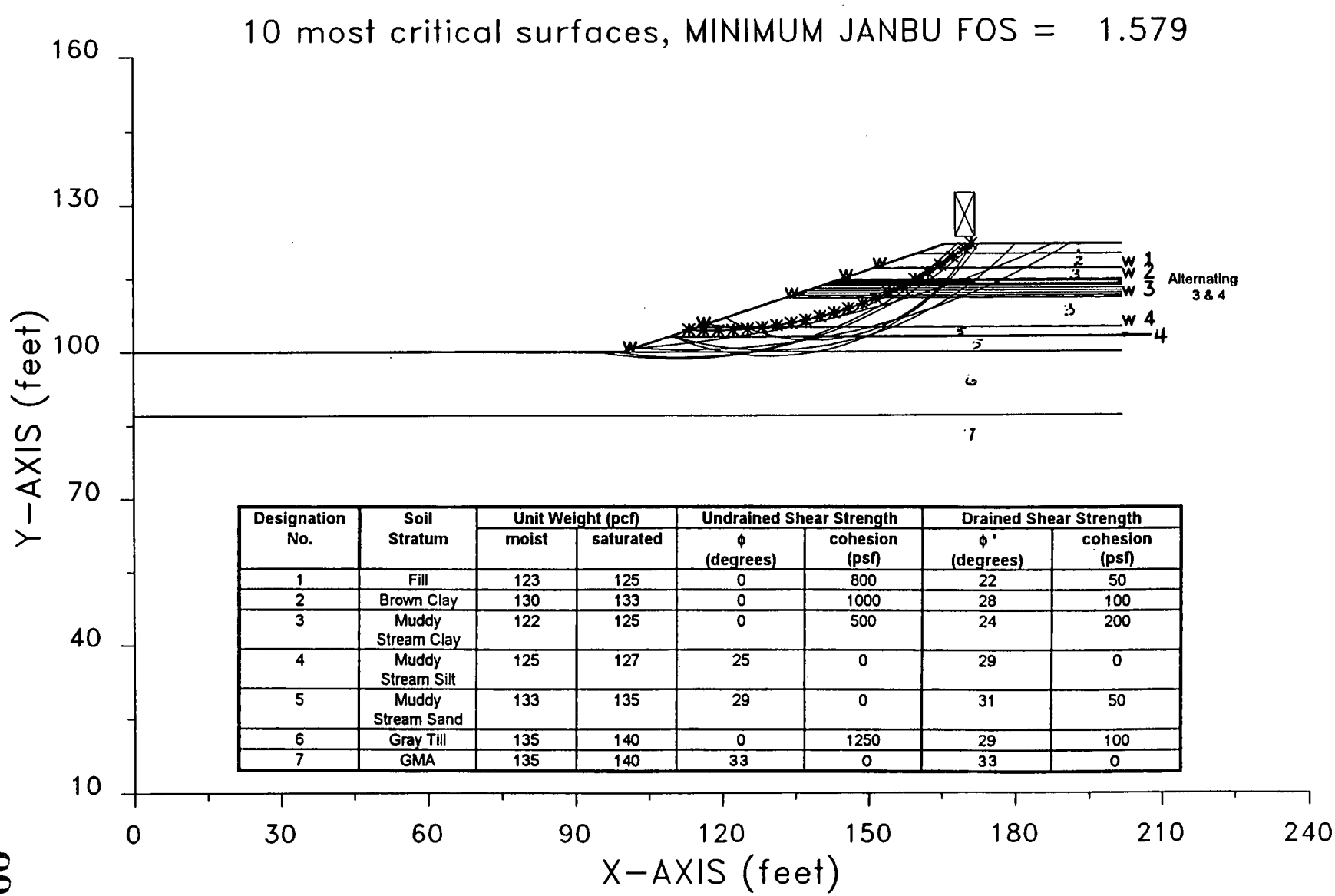
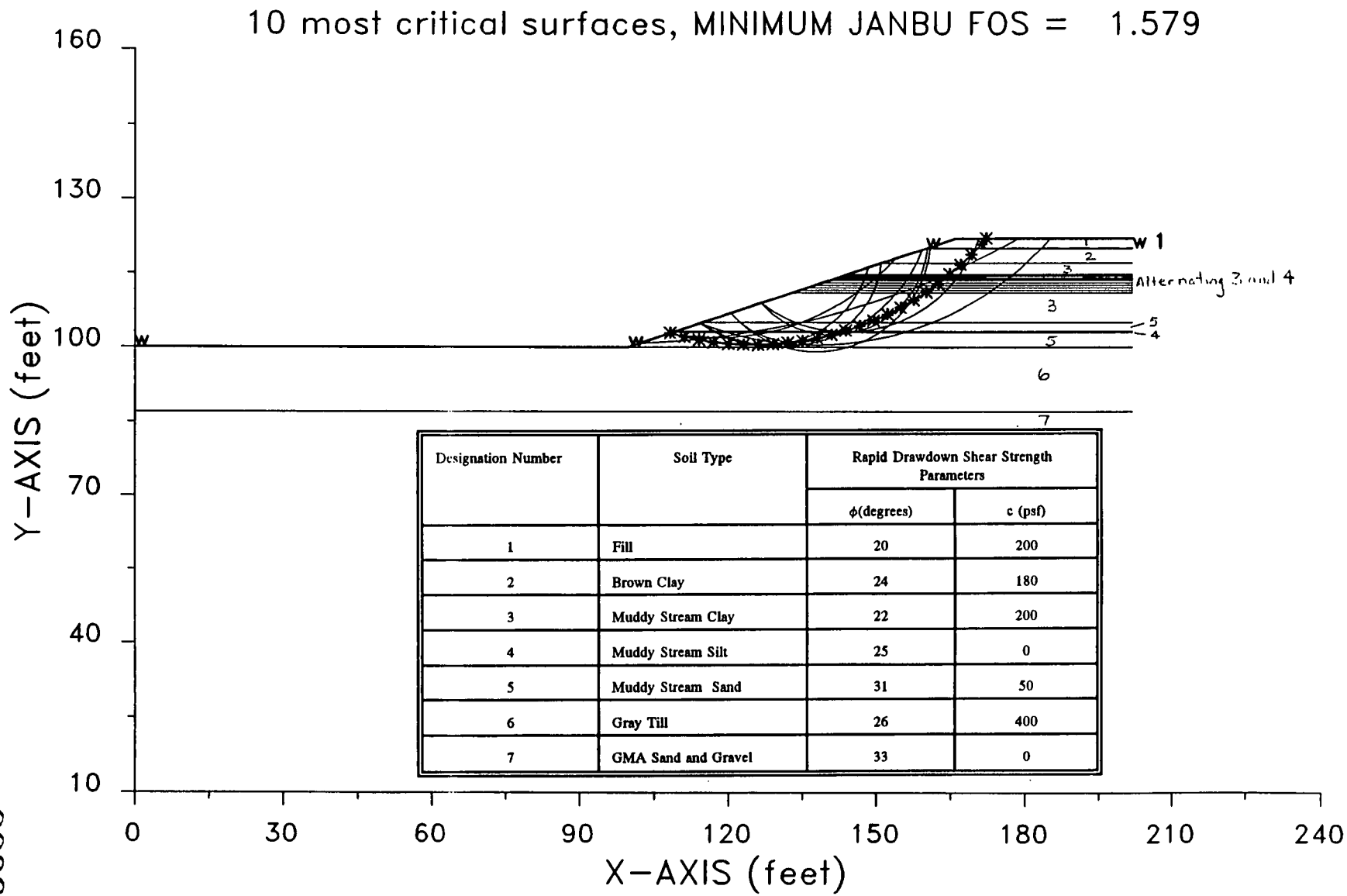
15 07



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Fill	123	125	0	800	22	50
2	Brown Clay	130	133	0	1000	28	100
3	Muddy Stream Clay	122	125	0	500	24	200
4	Muddy Stream Silt	125	127	25	0	29	0
5	Muddy Stream Sand	133	135	29	0	31	50
6	Gray Till	135	140	0	1250	29	100
7	GMA	135	140	33	0	33	0

Figure J-10 - Recommended 3H:1V Permanent Long-Term Slope Configuration with Berm and Earthquake Load for Excavation Site NE-A.



Designation Number	Soil Type	Rapid Drawdown Shear Strength Parameters	
		ϕ(degrees)	c (psf)
1	Fill	20	200
2	Brown Clay	24	180
3	Muddy Stream Clay	22	200
4	Muddy Stream Silt	25	0
5	Muddy Stream Sand	31	50
6	Gray Till	26	400
7	GMA Sand and Gravel	33	0

Figure J-11 - Recommended 3H:1V Permanent Slope Configuration, Rapid Drawdown Analysis for Excavation Site NE-A (with 50 psf cohesion in Muddy Stream Sand Soils).

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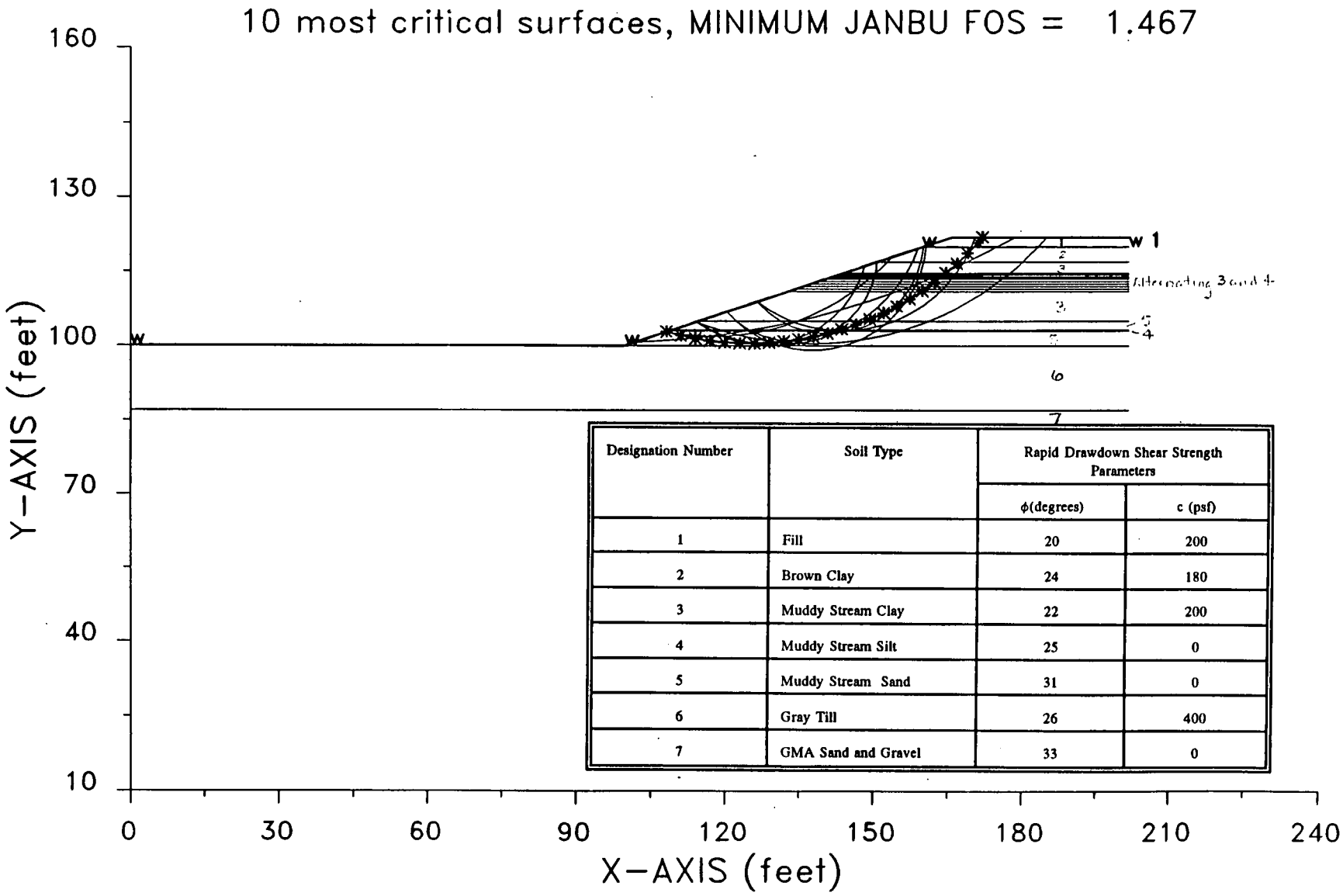
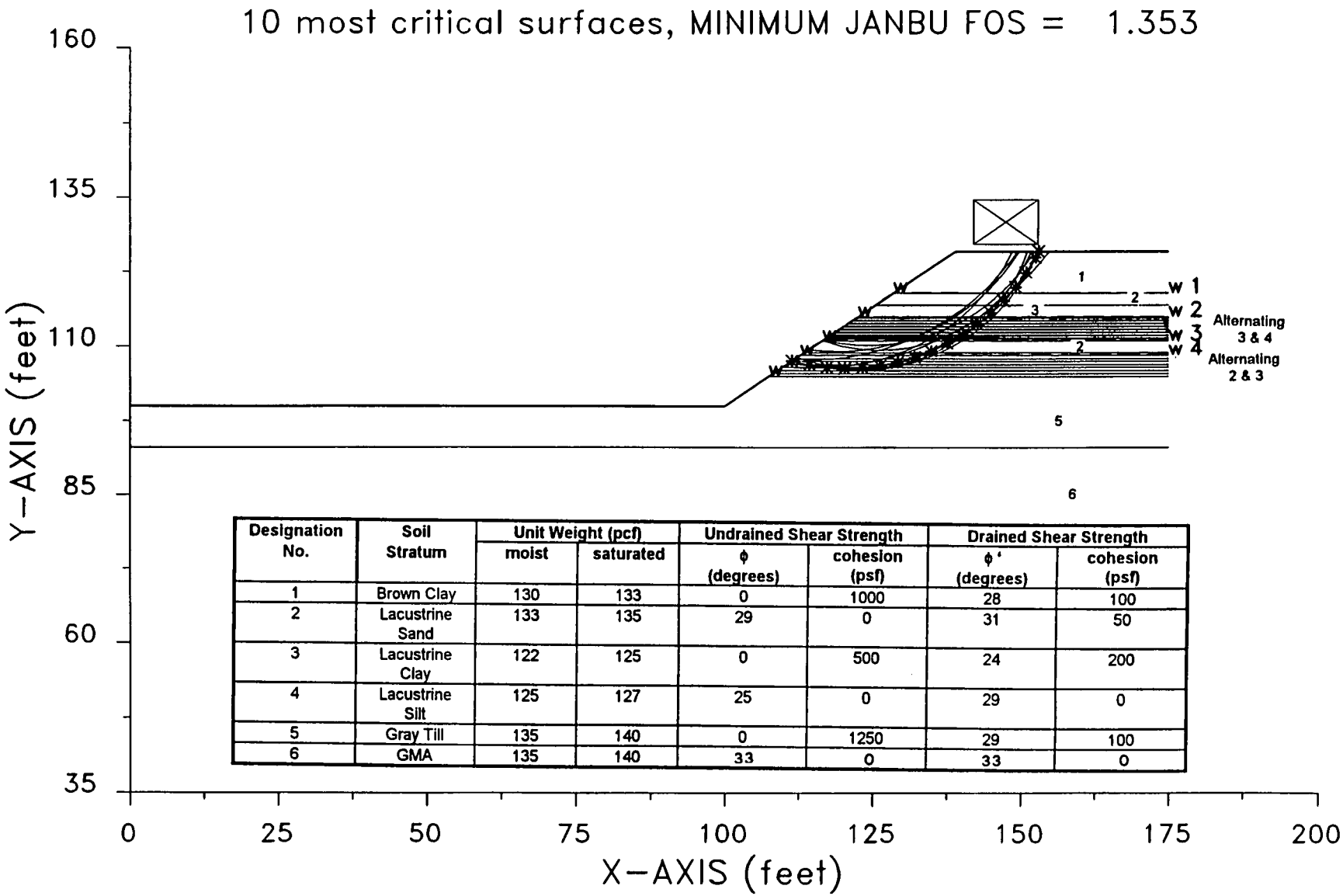


Designation Number	Soil Type	Rapid Drawdown Shear Strength Parameters	
		ϕ(degrees)	c (psf)
1	Fill	20	200
2	Brown Clay	24	180
3	Muddy Stream Clay	22	200
4	Muddy Stream Silt	25	0
5	Muddy Stream Sand	31	0
6	Gray Till	26	400
7	GMA Sand and Gravel	33	0

Figure J-12 - Recommended 3H:1V Permanent Slope Configuration, Rapid Drawdown Analysis for Excavation Site NE-A (with 0 psf cohesion in Muddy Stream Sand Soils).



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Lacustrine Sand	133	135	29	0	31	50
3	Lacustrine Clay	122	125	0	500	24	200
4	Lacustrine Silt	125	127	25	0	29	0
5	Gray Till	135	140	0	1250	29	100
6	GMA	135	140	33	0	33	0

Figure J-13 - Recommended 1.5H:1V Short-Term Slope Configuration with Equipment Load for Excavation Site SW-A Boring 12272.

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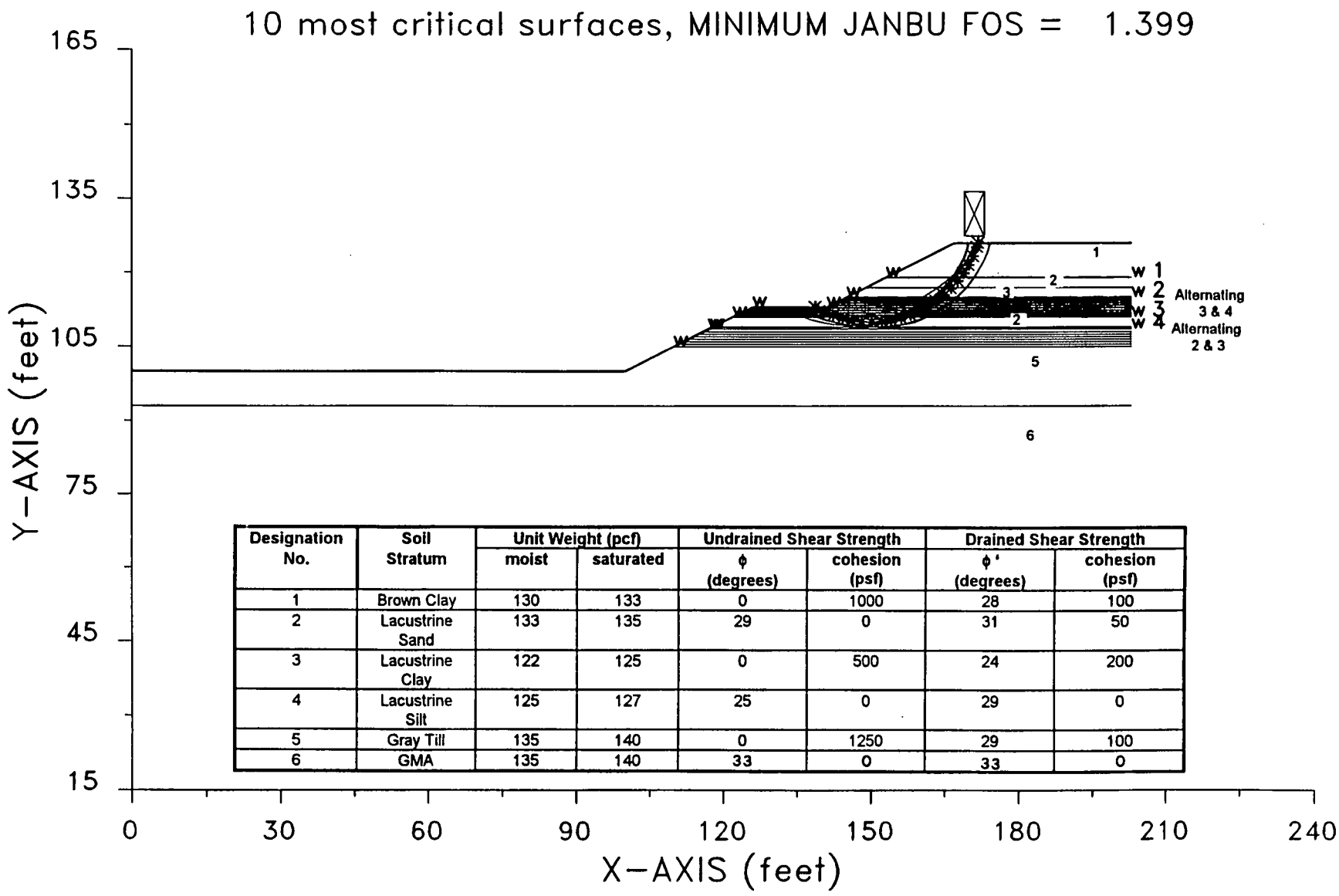

Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Lacustrine Sand	133	135	29	0	31	50
3	Lacustrine Clay	122	125	0	500	24	200
4	Lacustrine Silt	125	127	25	0	29	0
5	Gray Till	135	140	0	1250	29	100
6	GMA	135	140	33	0	33	0

Figure J-14 - Recommended 2H:1V Interim Long-Term Slope Configuration with Berm Load for Excavation Site SW-A Boring 12272, Upper Slope. (Maximum slope height is 13 feet with 15 feet wide bench)

000657

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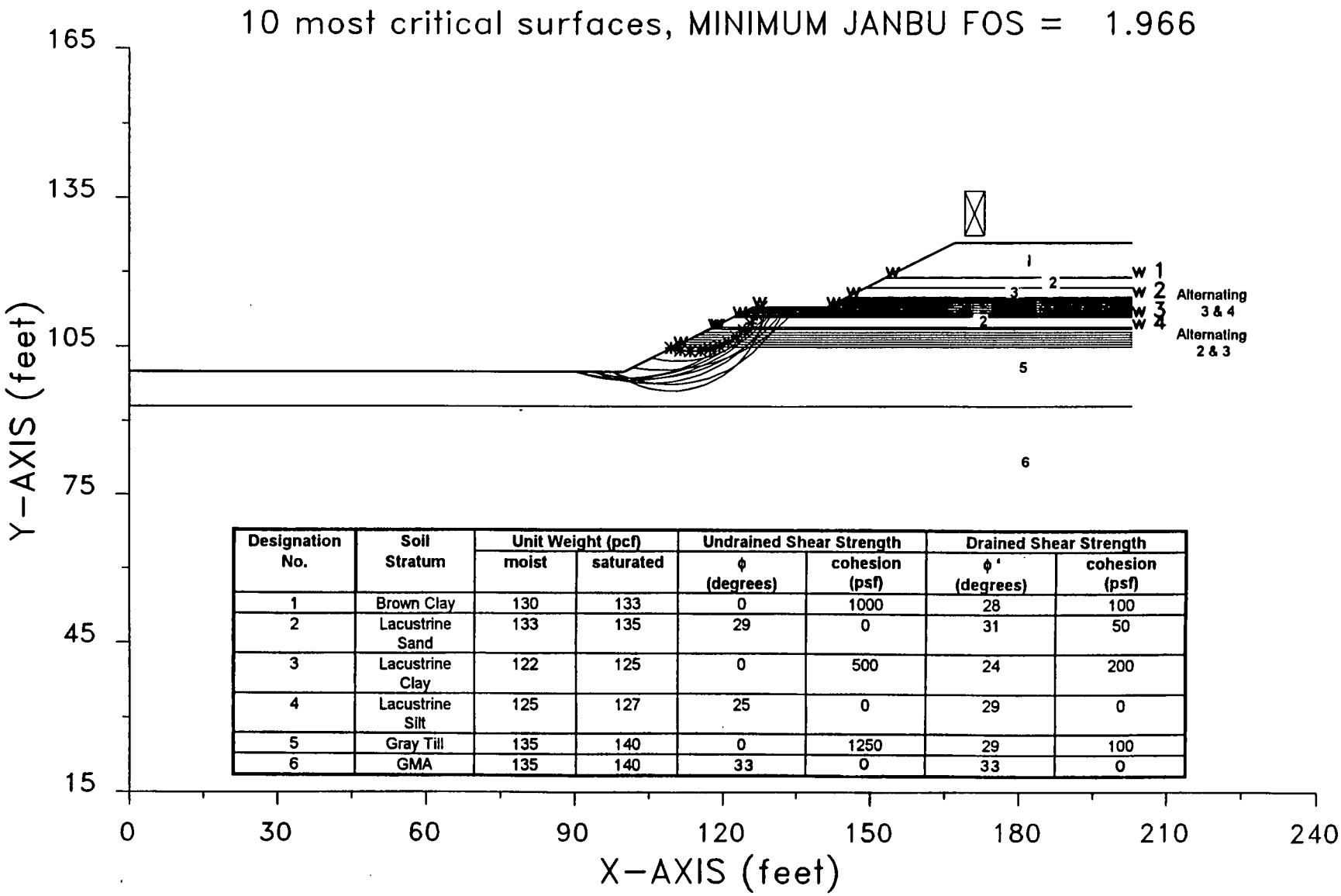
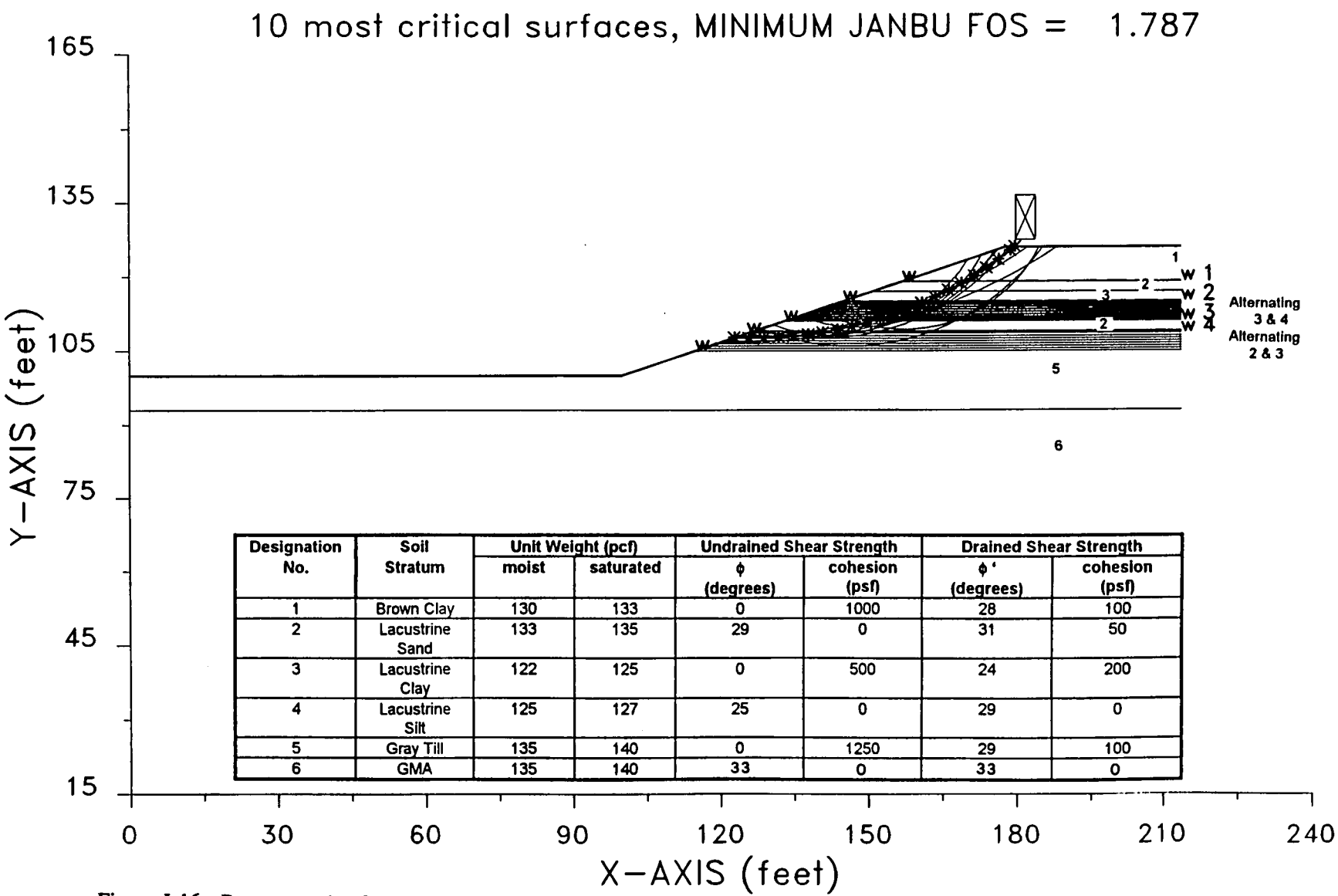


Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Lacustrine Sand	133	135	29	0	31	50
3	Lacustrine Clay	122	125	0	500	24	200
4	Lacustrine Silt	125	127	25	0	29	0
5	Gray Till	135	140	0	1250	29	100
6	GMA	135	140	33	0	33	0

Figure J-15 - Recommended 2H:1V Interim Long-Term Slope Configuration with Berm Load for Excavation Site SW-ABoring 12272, Lower Slope. (Maximum slope height is 13 feet with 15 feet wide bench)

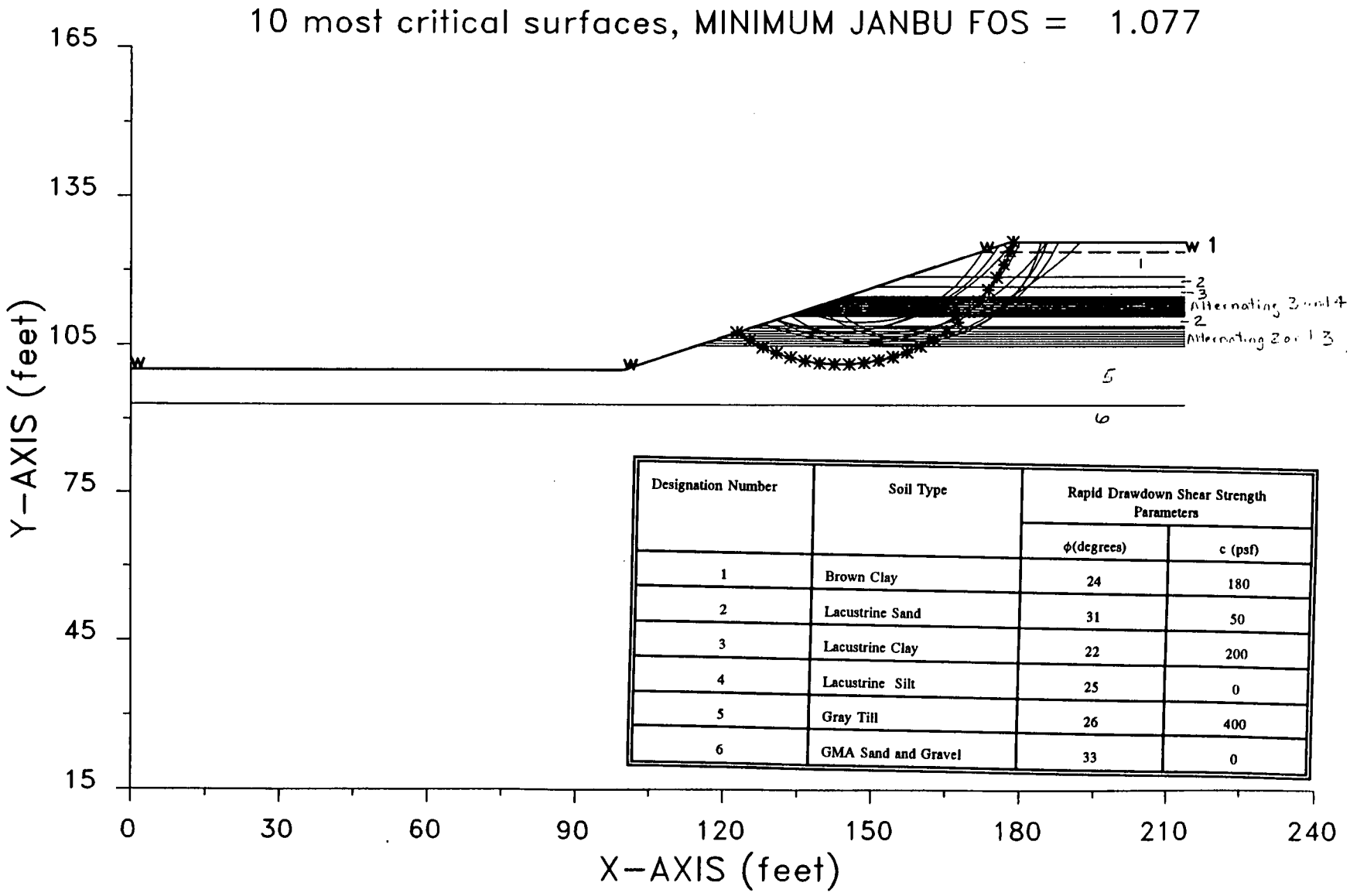
000658

2 0 1 5 0



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Lacustrine Sand	133	135	29	0	31	50
3	Lacustrine Clay	122	125	0	500	24	200
4	Lacustrine Silt	125	127	25	0	29	0
5	Gray Till	135	140	0	1250	29	100
6	GMA	135	140	33	0	33	0

Figure J-16 - Recommended 3H:1V Permanent Long-Term Slope Configuration with Berm Load for Excavation Site SW-A Boring 12272.

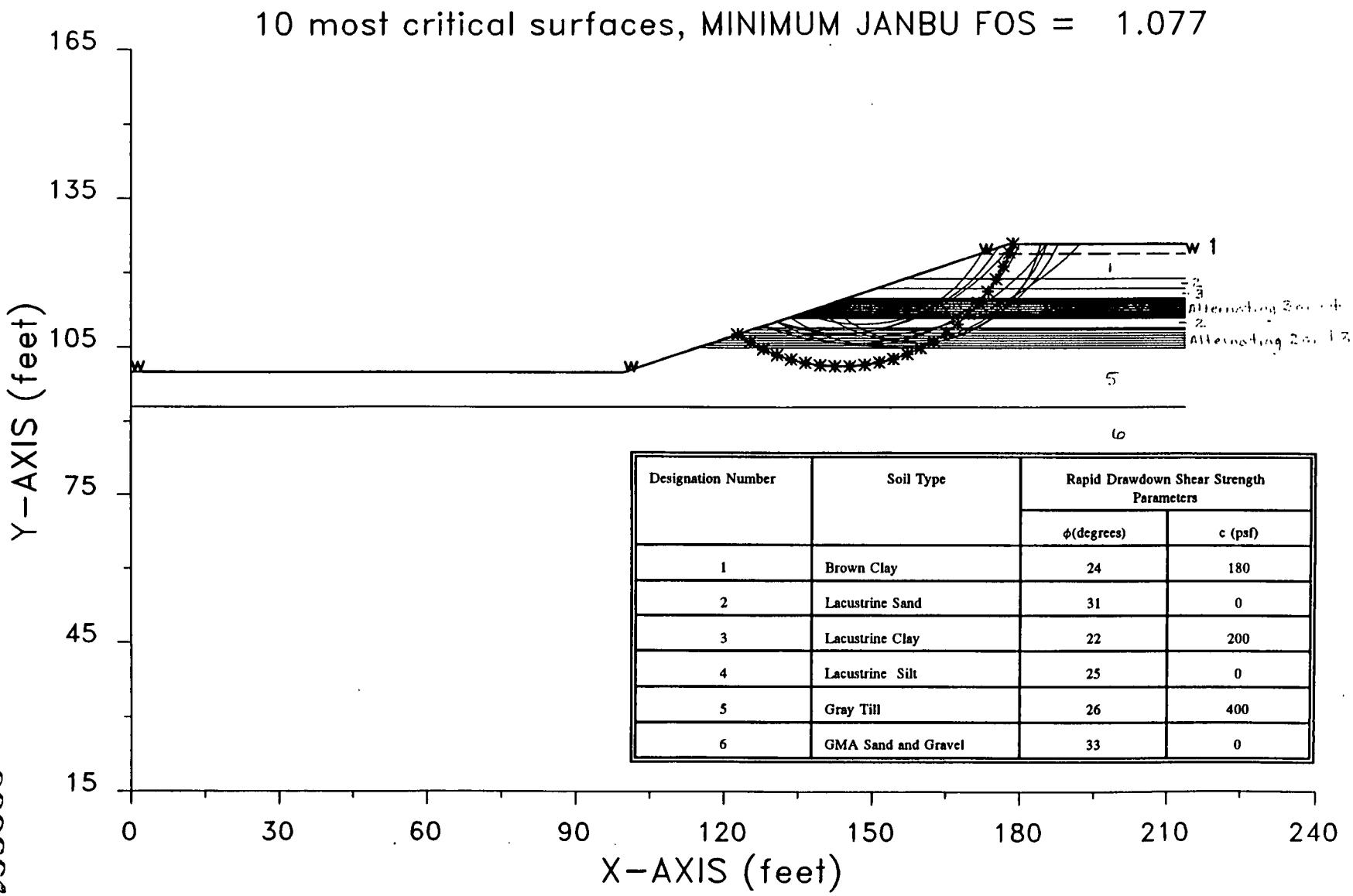


Designation Number	Soil Type	Rapid Drawdown Shear Strength Parameters	
		ϕ(degrees)	c (psf)
1	Brown Clay	24	180
2	Lacustrine Sand	31	50
3	Lacustrine Clay	22	200
4	Lacustrine Silt	25	0
5	Gray Till	26	400
6	GMA Sand and Gravel	33	0

Figure J-17 - Recommended 3H:1V Permanent Slope Configuration, Rapid Drawdown Analysis for Excavation Site SW-A Boring 12272 (with 50 psf cohesion in Lacustrine Sand Soils).

009660

1507

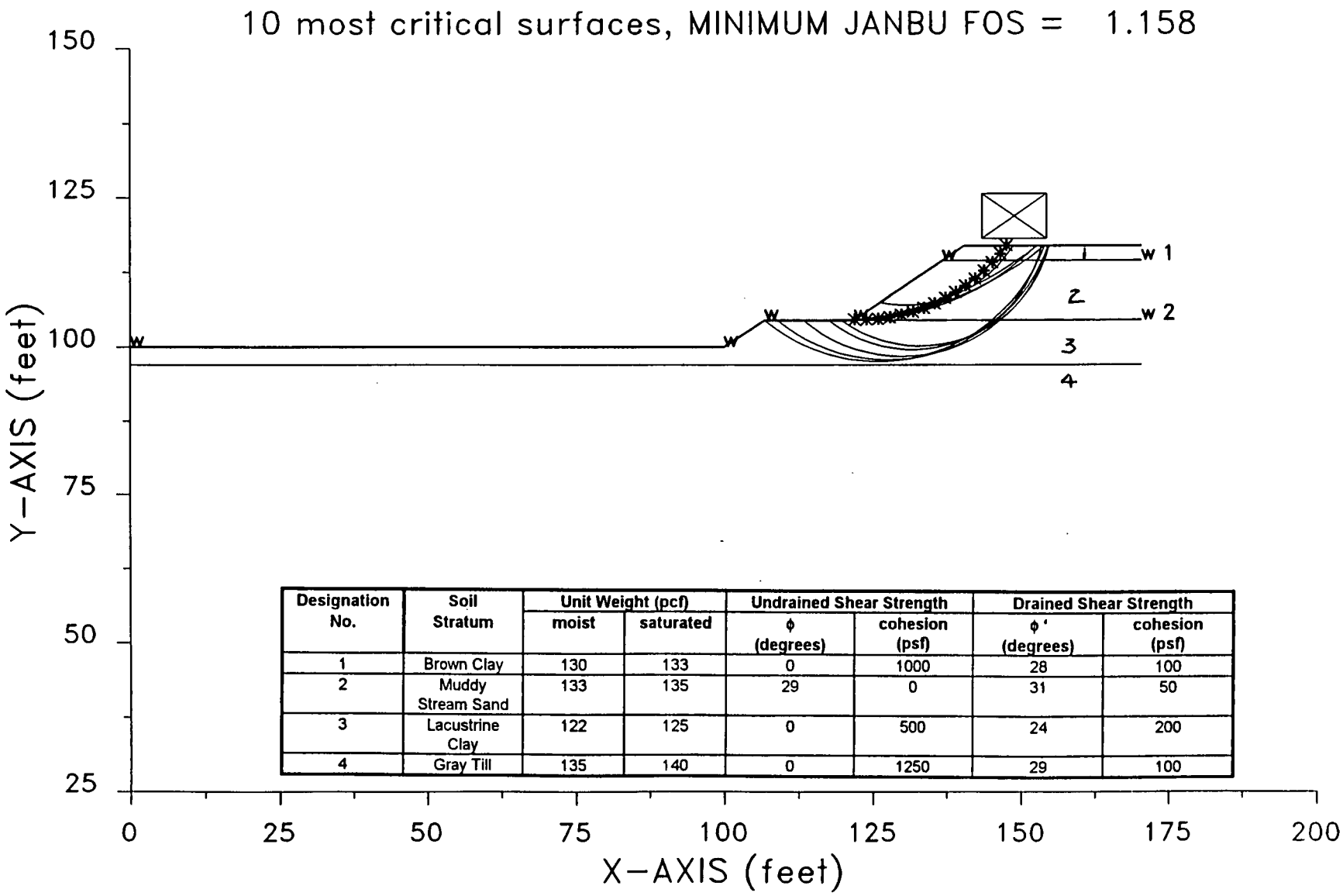


Designation Number	Soil Type	Rapid Drawdown Shear Strength Parameters	
		ϕ(degrees)	c (psf)
1	Brown Clay	24	180
2	Lacustrine Sand	31	0
3	Lacustrine Clay	22	200
4	Lacustrine Silt	25	0
5	Gray Till	26	400
6	GMA Sand and Gravel	33	0

Figure J-18 - Recommended 3H:1V Permanent Slope Configuration, Rapid Drawdown Analysis for Excavation Site SW-A Boring 12272 (with 0 psf cohesion in Lacustrine Sand Soils).

000661

1507



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Muddy Stream Sand	133	135	29	0	31	50
3	Lacustrine Clay	122	125	0	500	24	200
4	Gray Till	135	140	0	1250	29	100

Figure J-19 - Recommended 1.5H:1V Short-Term Slope Configuration with Equipment Load for Excavation Site SW-A Boring 1236, Upper Slope. (Maximum slope height is 12.5 feet with 15 feet wide bench)

299000

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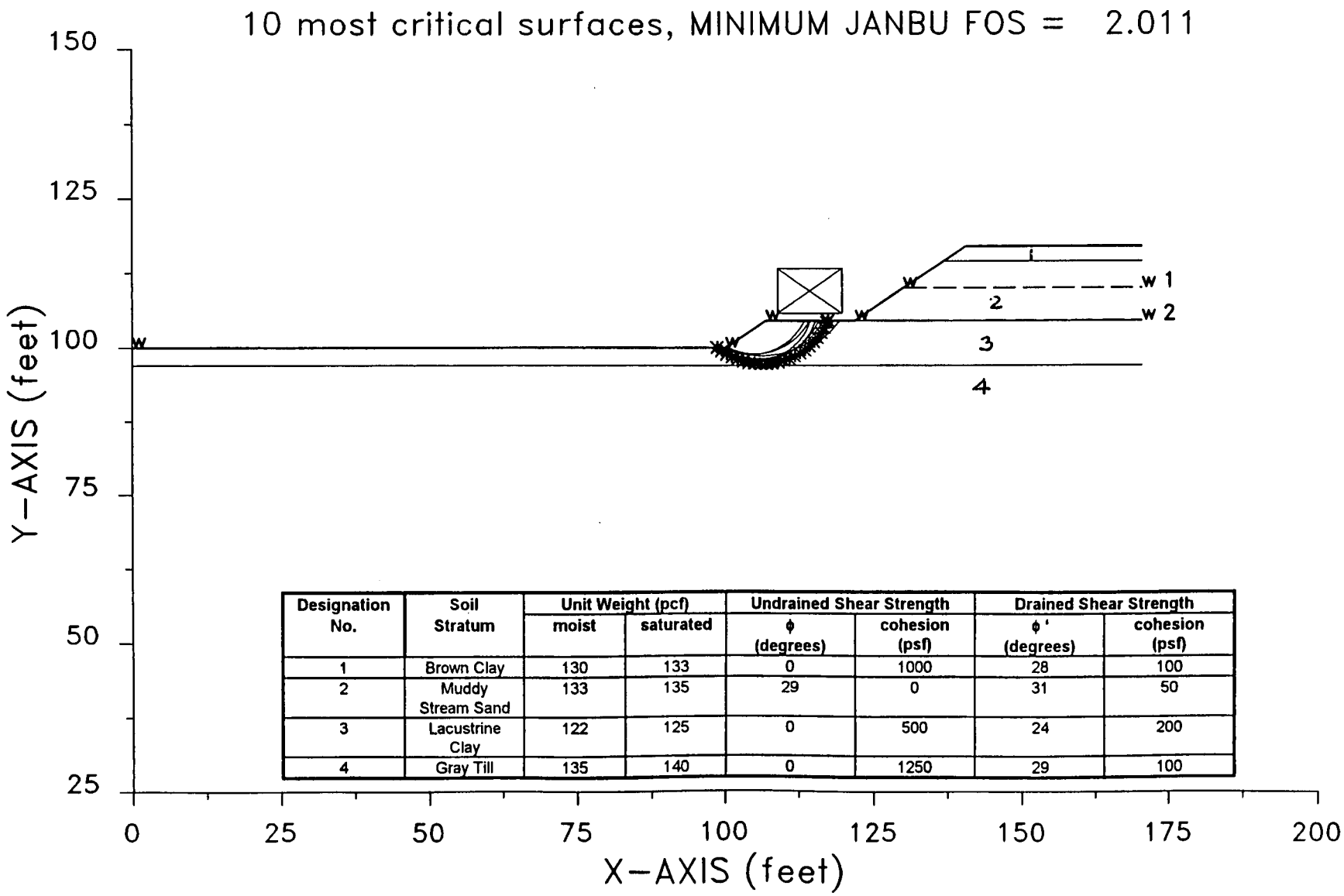
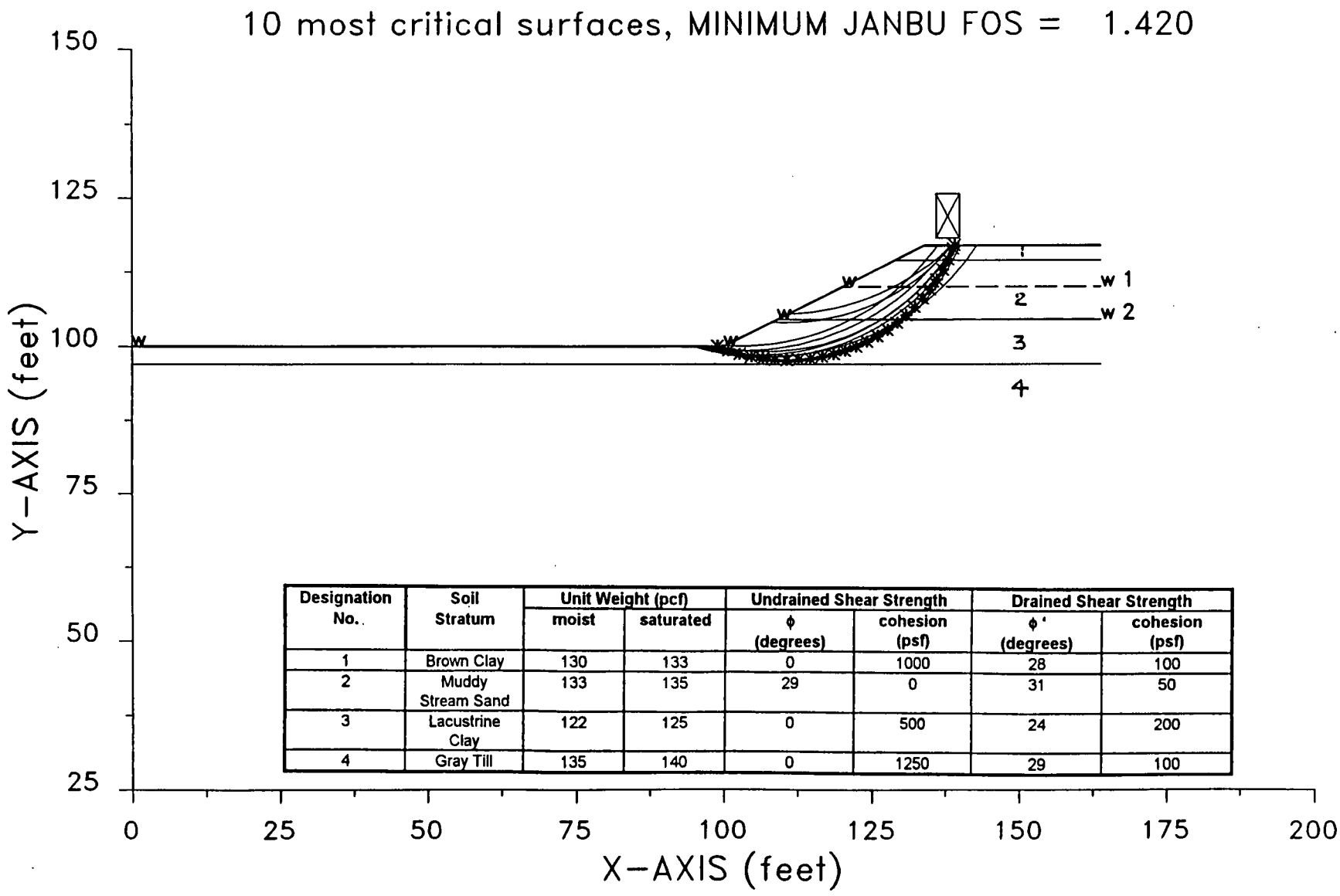


Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Muddy Stream Sand	133	135	29	0	31	50
3	Lacustrine Clay	122	125	0	500	24	200
4	Gray Till	135	140	0	1250	29	100

Figure J-20 - Recommended 1.5H:1V Short-Term Slope Configuration with Equipment Load for Excavation Site SW-A Boring 1236, Lower Slope. (Maximum slope height is 12.5 feet with 15 feet wide bench)

000663

1502



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Muddy Stream Sand	133	135	29	0	31	50
3	Lacustrine Clay	122	125	0	500	24	200
4	Gray Till	135	140	0	1250	29	100

Figure J-21 - Recommended 2H:1V Interim Long-Term Slope Configuration with Berm Load for Excavation Site SW-A Boring 1236.

000664

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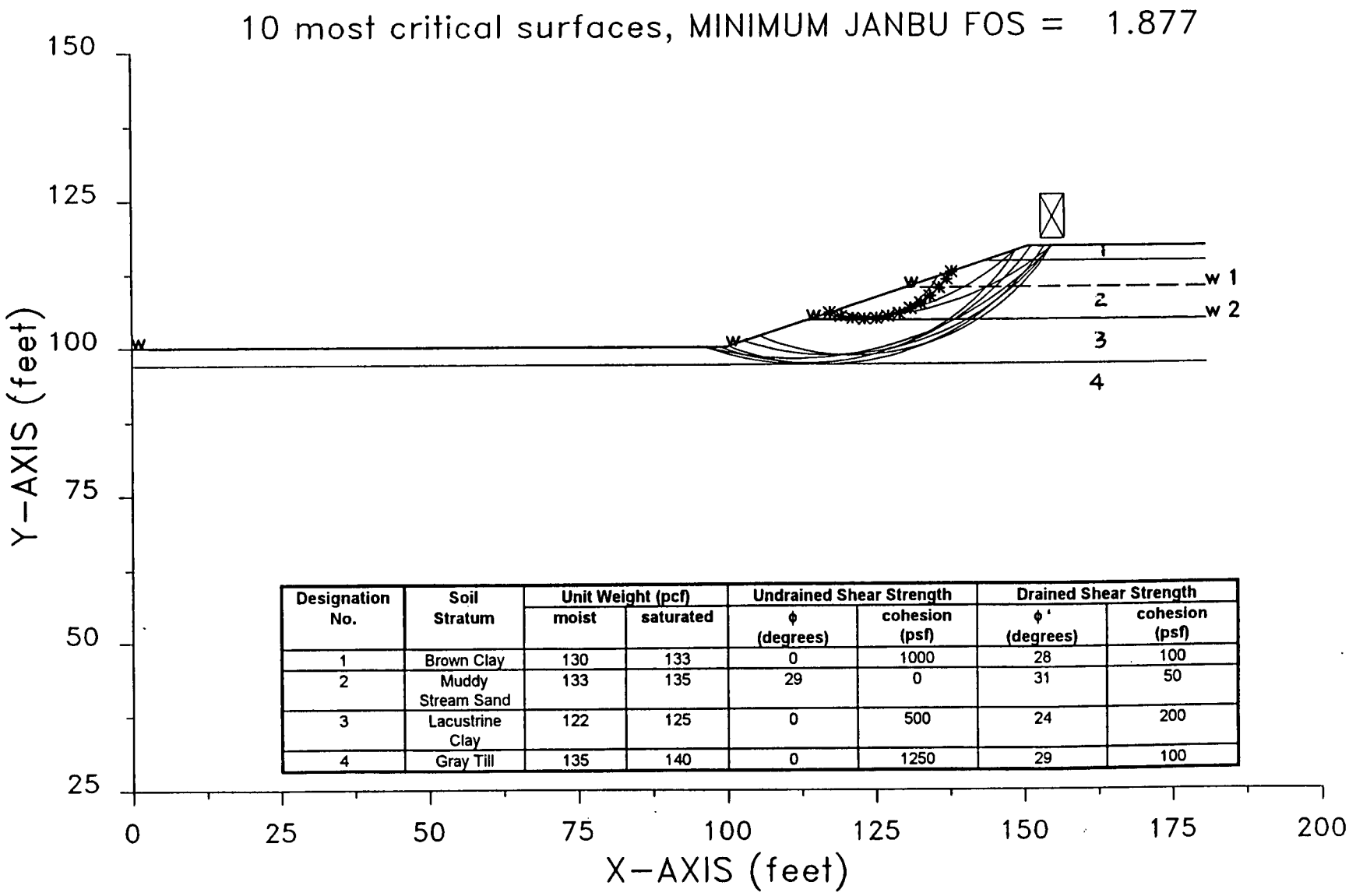
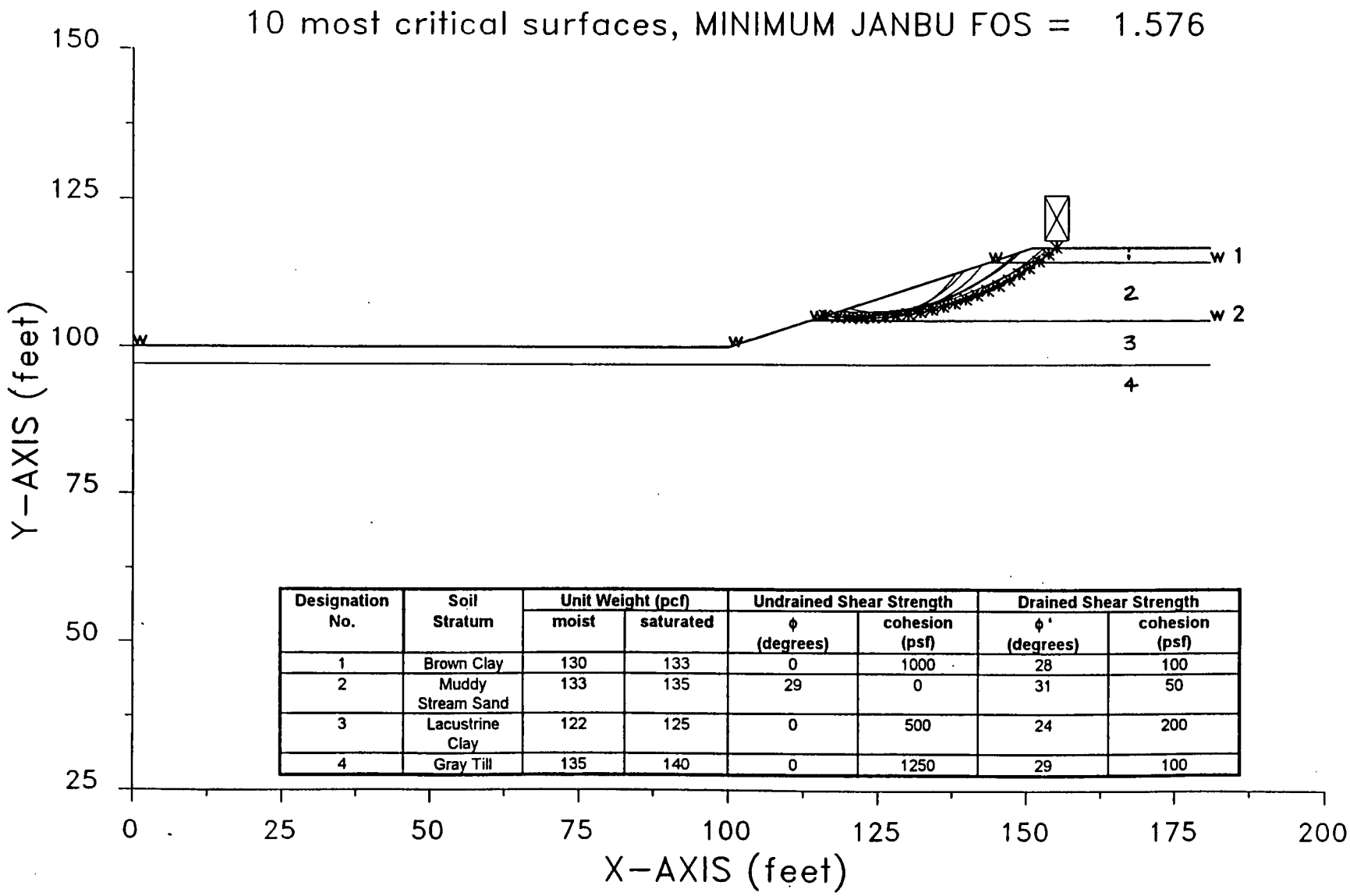


Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Muddy Stream Sand	133	135	29	0	31	50
3	Lacustrine Clay	122	125	0	500	24	200
4	Gray Till	135	140	0	1250	29	100

Figure J-22 - Recommended 3H:1V Permanent Long-Term Slope Configuration with Berm Load for Excavation Site SW-A Boring 1236.

000565

2051

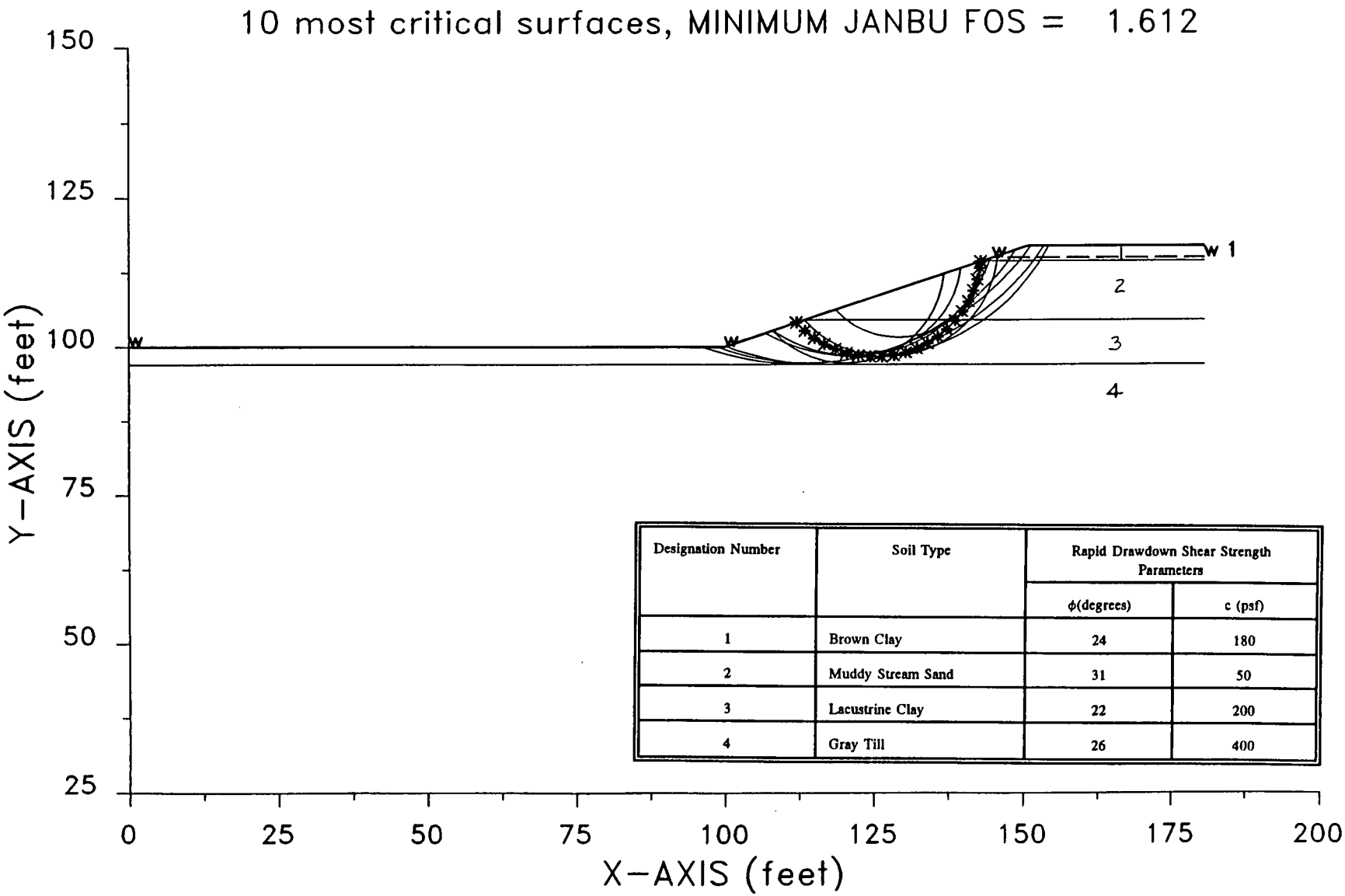


Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Muddy Stream Sand	133	135	29	0	31	50
3	Lacustrine Clay	122	125	0	500	24	200
4	Gray Till	135	140	0	1250	29	100

Figure J-23 - Recommended 3H:1V Permanent Long-Term Slope Configuration with Berm Load for Excavation Site SW-A Boring 1236, High Water Table.

000666

1507



Designation Number	Soil Type	Rapid Drawdown Shear Strength Parameters	
		ϕ(degrees)	c (psf)
1	Brown Clay	24	180
2	Muddy Stream Sand	31	50
3	Lacustrine Clay	22	200
4	Gray Till	26	400

Figure J-24 - Recommended 3H:1V Permanent Slope Configuration, Rapid Drawdown Analysis for Excavation Site SW-A Boring 1236 (with 50 psf cohesion in Muddy Stream Sand Soils).

000667

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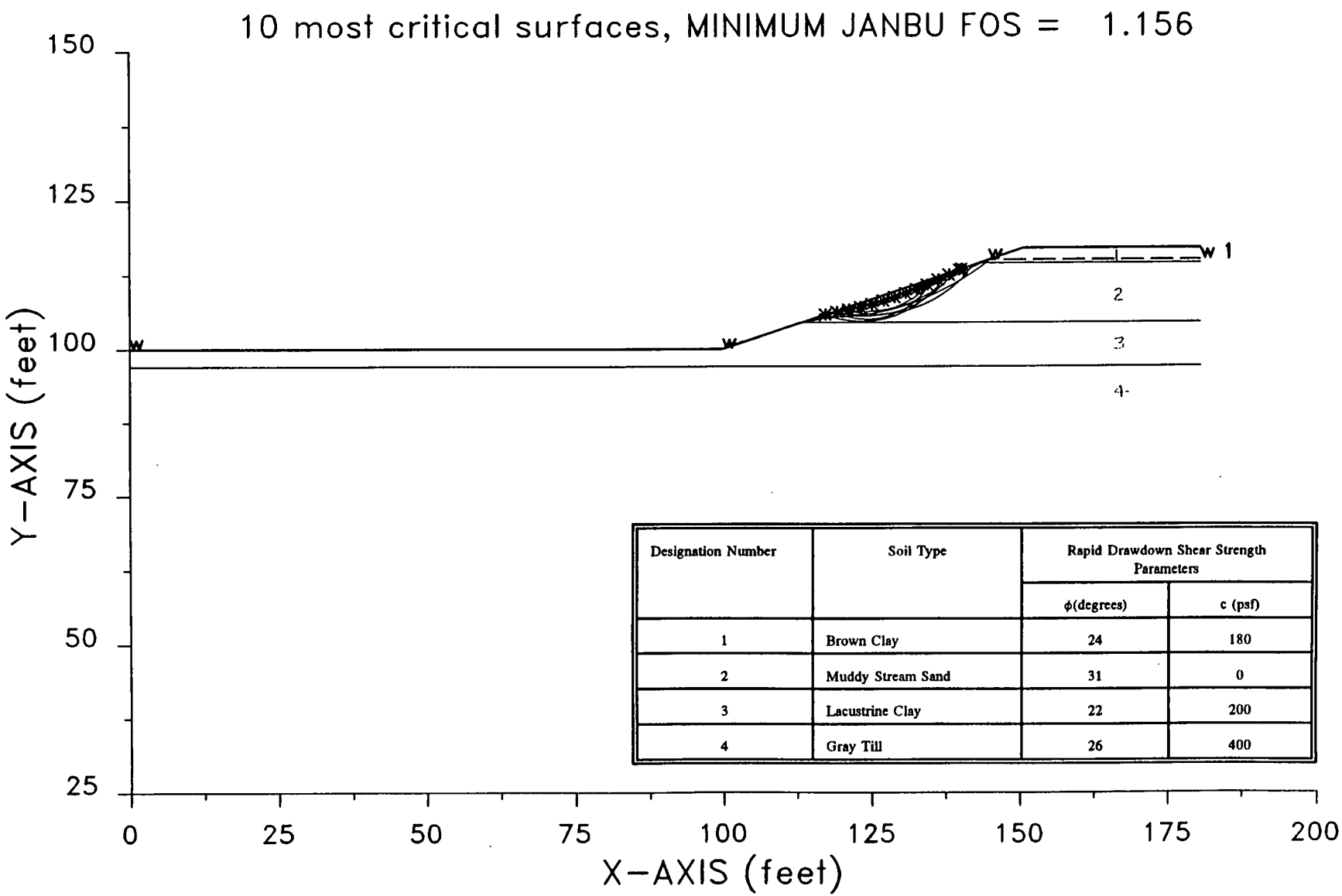
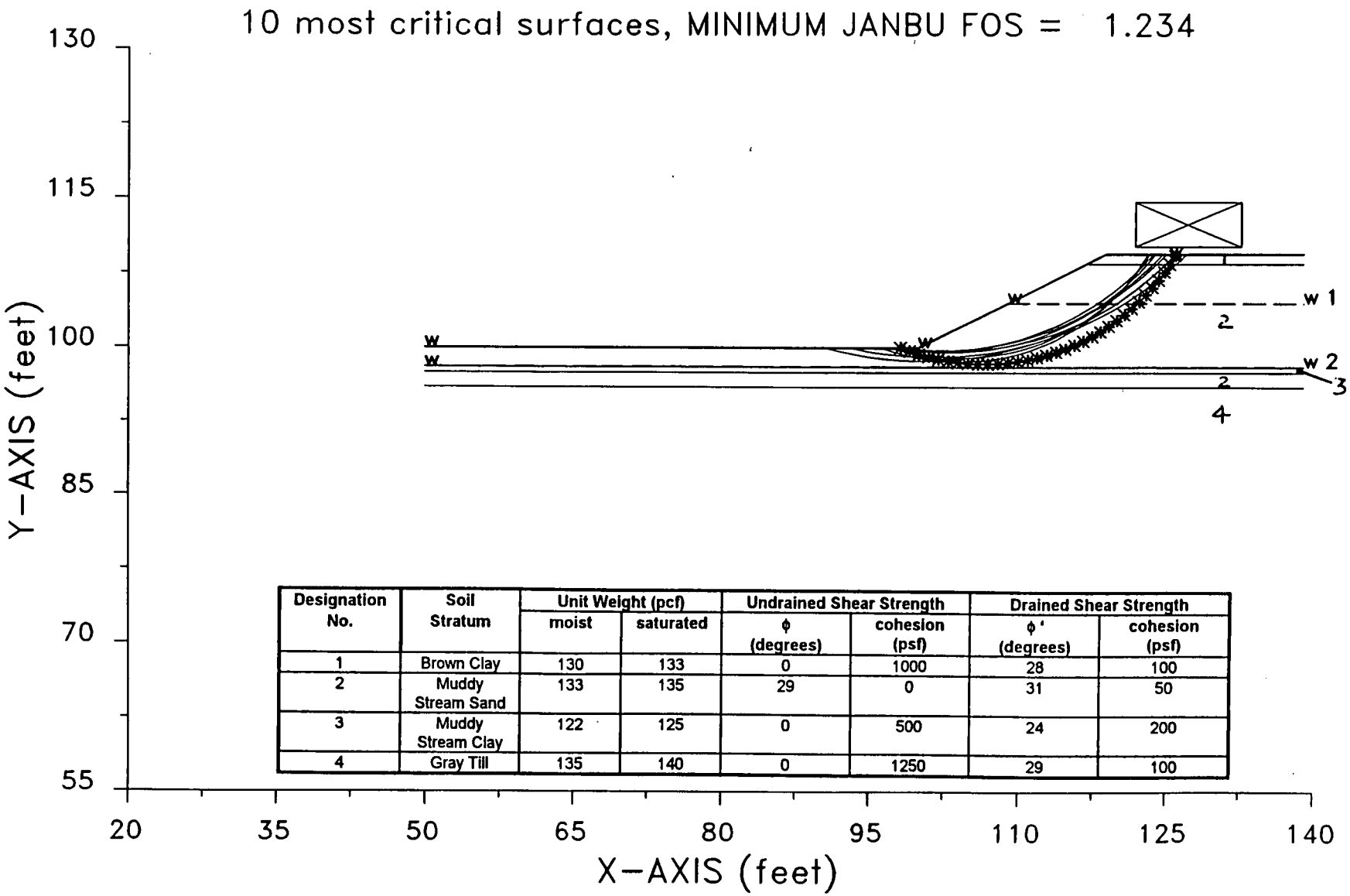


Designation Number	Soil Type	Rapid Drawdown Shear Strength Parameters	
		ϕ(degrees)	c (psf)
1	Brown Clay	24	180
2	Muddy Stream Sand	31	0
3	Lacustrine Clay	22	200
4	Gray Till	26	400

Figure J-25 - Recommended 3H:1V Permanent Slope Configuration, Rapid Drawdown Analysis for Excavation Site SW-A Boring 1236 (with 0 psf cohesion in Muddy Stream Sand Soils).

000368

F 1502



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Muddy Stream Sand	133	135	29	0	31	50
3	Muddy Stream Clay	122	125	0	500	24	200
4	Gray Till	135	140	0	1250	29	100

Figure J-26 - Recommended 2H:1V Short-Term Slope Configuration with Equipment Load for Excavation Site NW-A.

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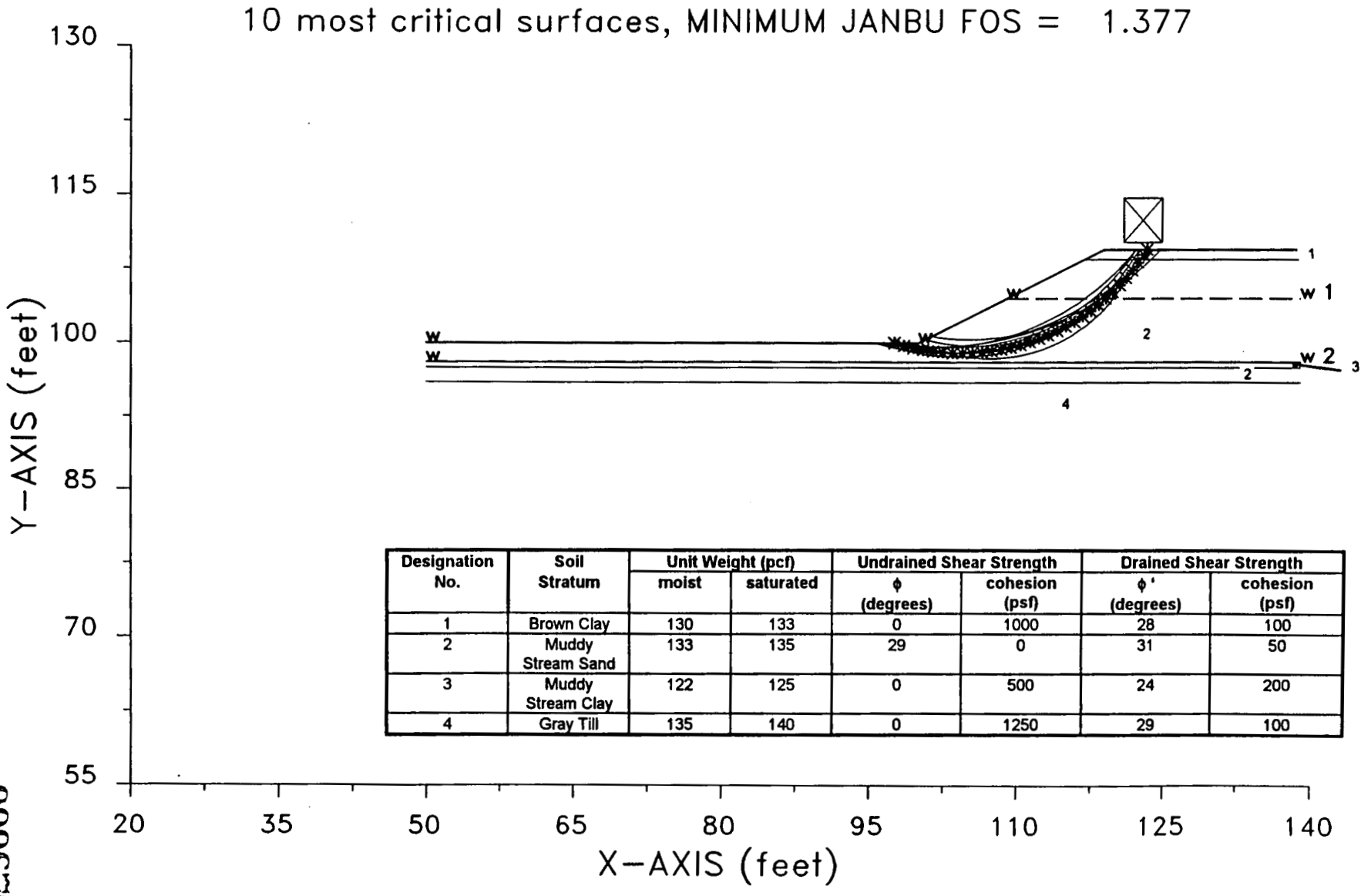
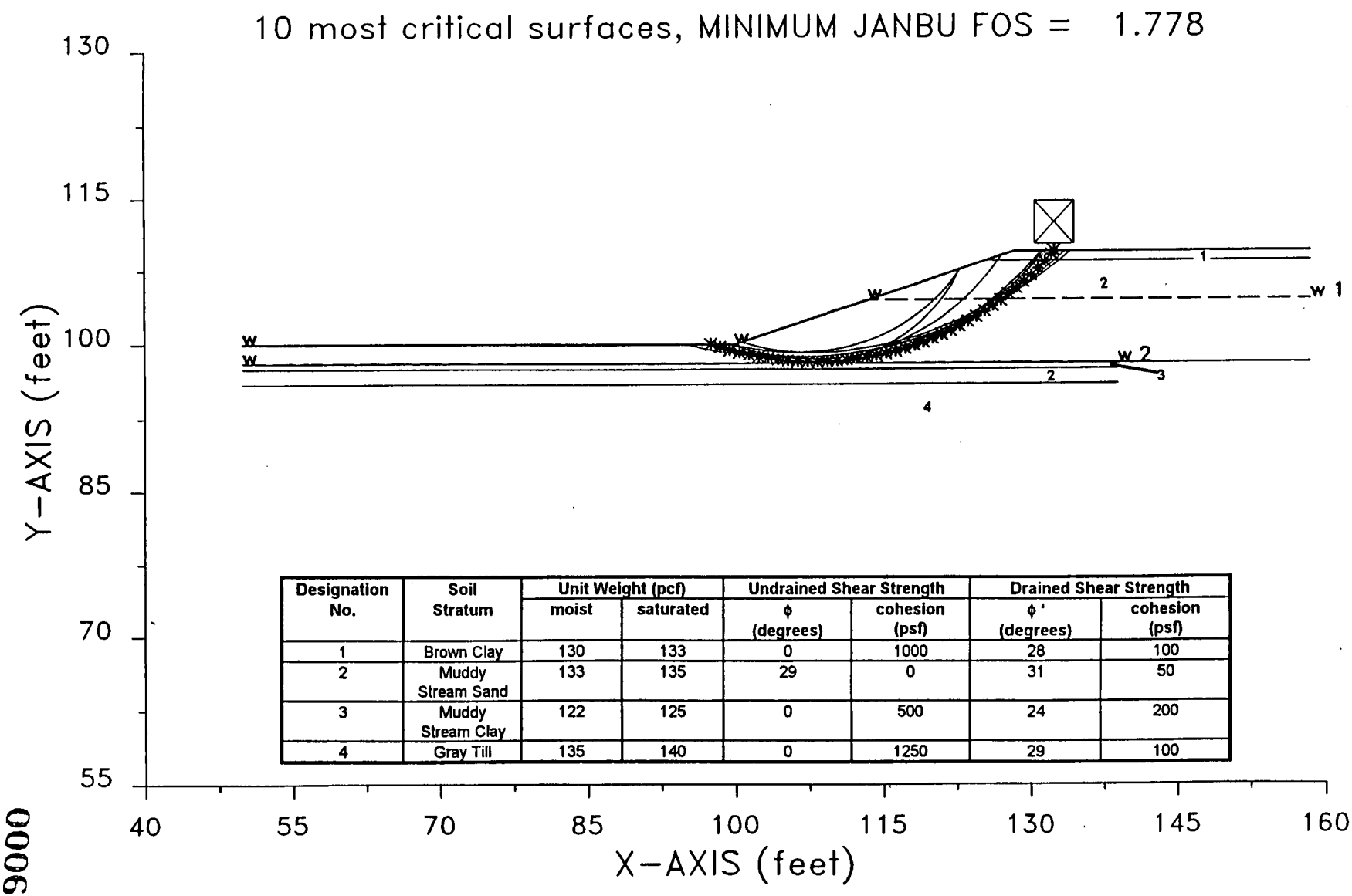


Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Muddy Stream Sand	133	135	29	0	31	50
3	Muddy Stream Clay	122	125	0	500	24	200
4	Gray Till	135	140	0	1250	29	100

Figure J-27 - Recommended 2H:1V Interim Long-Term Slope Configuration with Berm Load for Excavation Site NW-A.



Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Muddy Stream Sand	133	135	29	0	31	50
3	Muddy Stream Clay	122	125	0	500	24	200
4	Gray Till	135	140	0	1250	29	100

Figure J-28 - Recommended 3H:1V Permanent Long-Term Slope Configuration with Berm Load for Excavation Site NW-A.

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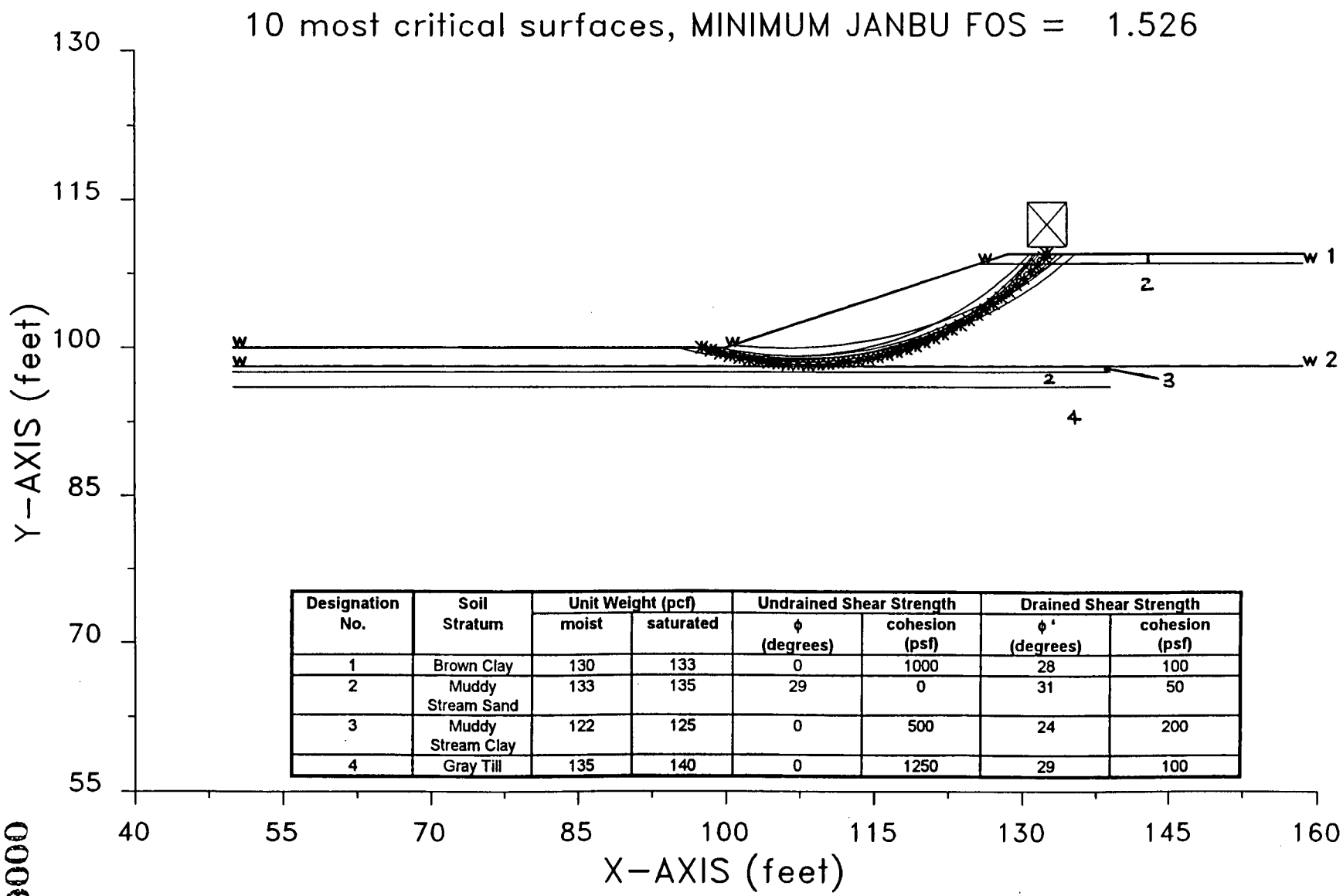

Designation No.	Soil Stratum	Unit Weight (pcf)		Undrained Shear Strength		Drained Shear Strength	
		moist	saturated	ϕ (degrees)	cohesion (psf)	ϕ' (degrees)	cohesion (psf)
1	Brown Clay	130	133	0	1000	28	100
2	Muddy Stream Sand	133	135	29	0	31	50
3	Muddy Stream Clay	122	125	0	500	24	200
4	Gray Till	135	140	0	1250	29	100

Figure J-29 - Recommended 3H:1V Permanent Long-Term Slope Configuration with Berm Load for Excavation Site NW-A, High Water Table.

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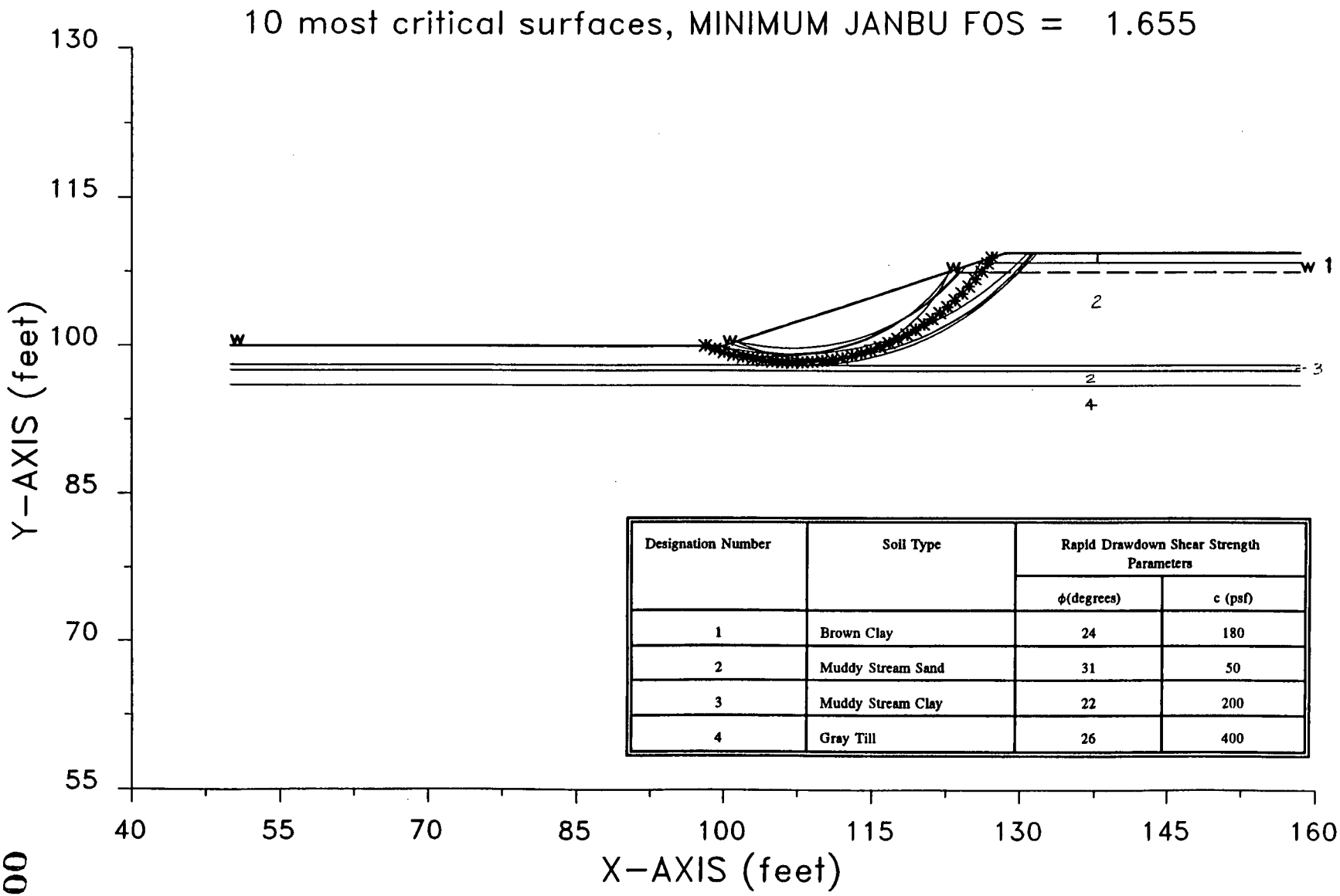
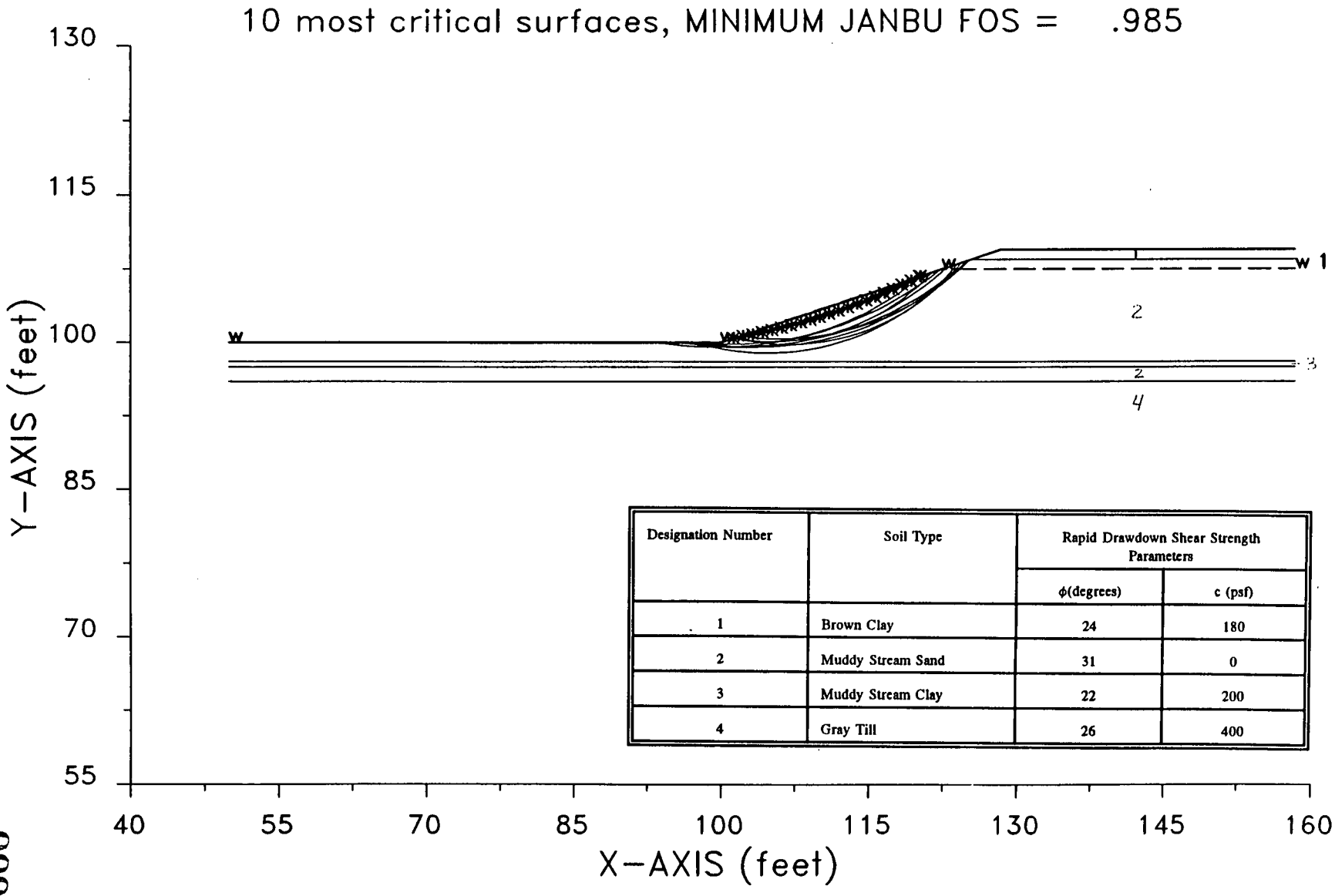


Designation Number	Soil Type	Rapid Drawdown Shear Strength Parameters	
		ϕ(degrees)	c (psf)
1	Brown Clay	24	180
2	Muddy Stream Sand	31	50
3	Muddy Stream Clay	22	200
4	Gray Till	26	400

Figure J-30 - Recommended 3H:1V Permanent Slope Configuration, Rapid Drawdown Analysis for Excavation Site NW-A (with 50 psf cohesion in Muddy Stream Sand Soils).



Designation Number	Soil Type	Rapid Drawdown Shear Strength Parameters	
		ϕ(degrees)	c (psf)
1	Brown Clay	24	180
2	Muddy Stream Sand	31	0
3	Muddy Stream Clay	22	200
4	Gray Till	26	400

Figure J-31 - Recommended 3H:1V Permanent Slope Configuration, Rapid Drawdown Analysis for Excavation Site NW-A (with 0 psf cohesion in Muddy Stream Sand Soils).

APPENDIX K

TABLE OF CONTENTS

TABLE	TITLE
K-1	Summary of Geotechnical Parameters by General Stratum and USCS Soil Group (PO-177 data only)
K-2	Summary of Geotechnical Parameters by General Stratum and USCS Soil Group (PO-177 and prior data)

General Stratum	USCS Group Symbol	Moisture Content (% dry weight)		Dry Density (pcf)	Liquid Limit	Plasticity Index	Percent Gravel	Percent Sand	Percent Silt and Clay	Percent Clay	Specific Gravity		Permeability (cm/sec) Laboratory	Strength Parameters (CU Tests)				Strength Parameters (DS and CD Tests)		Strength Parameters (UCS andUU Tests)	
														Total Friction (degrees)	Total Cohesion (psf)	Effective Friction (degrees)	Effective Cohesion (psf)	Effective Friction (degrees)	Apparent Cohesion (psf)	Total Friction (degrees)	Total Cohesion (psf)
		range	average	range	range	range	range	range	range	range	range	average	range	range	range	range	range	range	range	range	range
Topsoil		15-27	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Brown Clay	CH	18-27	24	96-103	50-59	24-39	0	1 - 10	90-99	38-44	2.68-2.75	2.71	—	—	—	—	—	—	—	0	2440-4299
Brown Clay	CL	1-34	19	94-128	17-48	7-32	0-22	0-47	50-100	13-45	2.65-2.83	2.83	$3.8x10^{-8}$ - $8x10^{-5}$	34-37	0-357	23-35	0-800	—	—	0	925-14760
Brown Clay	CL-ML	11-27	17	98-133	19-23	4-7	0-16	1-50	50-99	10-24	2.72-2.88	2.78	—	—	—	22-32	0-1940	—	—	0	800-7400
Brown Clay	ML	20-24	22	107-108	NP-21	0-2	0-1	25-27	72-75	8-13	2.75	2.75	—	—	—	—	—	—	—	0	921-2580
Fill	CL	19-27	23	95-105	29-49	8-29	0-14	4-27	65-96	18-38	2.64-2.76	2.72	—	—	—	—	—	—	—	0	360-13100
Fill	ML	—	—	—	—	—	4-6	21-25	71-73	—	—	—	—	—	—	—	—	—	—	—	—
Fill	SM	—	—	—	—	—	0-34	35-77	23-44	—	—	—	—	—	—	—	—	—	—	—	—
GMA	Varies	1-21	5	—	NP	0	0-47	2-94	5-98	0-15	—	—	—	—	—	—	—	—	—	—	—
Gray Till	CL	2-26	14	98-147	20-38	8-19	0-23	0-46	51-100	10-43	2.61-2.82	2.76	$2.8x10^{-8}$	21-38	275-916	31-32	105-490	—	—	0	1127-17803
Gray Till	CL-ML	8-25	12	101-132	18-28	4-7	0-18	5-37	53-95	8-27	2.77-2.82	2.79	—	—	—	—	—	—	—	0	2900-9940
Gray Till	ML	10-19	14	—	13-18	2-3	0-10	10-35	55-90	12-22	2.73-2.76	2.75	—	—	—	—	—	—	—	—	—
Gray Till	SC/SM	7-11	9.5	—	NP-16	0-7	0-29	27-95	5-48	10-18	2.78-2.82	2.79	—	—	—	—	—	—	—	—	—
Muddy Stream	CL	10-23	18	99-125	21-41	8-24	0-12	0-42	54-100	15-37	2.61-2.84	2.77	—	28	200	17-34	160-220	—	—	—	—
Muddy Stream	CL-ML	12-17	16	113-123	17-22	4-7	0-6	9-41	54-91	9-22	2.67-2.81	2.78	—	—	—	—	—	—	—	0	1280-3906
Muddy Stream	ML	17-21	18	106-116	NP-18	0-2	0-8	5-42	56-95	5-24	2.75-2.86	2.80	$2.9x10^{-7}$	—	—	—	—	31-38	0-218	0	541
Muddy Stream	SC	8-23	14	104-133	16-30	4-17	0-24	36-61	26-50	9-22	2.64-2.76	2.72	$1.2x10^{-7}$	29-32	—	—	—	29-32	0-629	0	881
Muddy Stream	SM	11-23	18	—	NP-12	0-1	0-35	38-87	10-46	0-9	2.64-2.97	2.74	$1.3x10^{-5}$	—	—	—	—	—	—	—	—
Muddy Stream	SP	4-19	12	—	NP	0	0-42	7-93	4-93	1-7	2.70-2.75	2.72	—	—	—	—	—	—	—	—	—
Muddy Stream	SW	9	9	—	NP	0	0-44	51-94	4-12	0-3	2.68-2.78	2.75	$4.4x10^{-4}$	—	—	—	—	—	—	—	—
Lacustrine	CL	12-24	21	103-124	20-34	7-15	0-4	2-43	53-97	13-31	2.72-2.79	2.76	—	—	—	—	—	—	—	0	2240-8400
Lacustrine	CL-ML	14-20	17	117-122	19-22	4-6	0-12	13-47	51-84	7-16	2.65-2.80	2.74	—	—	—	—	—	—	—	0	3800-4440
Lacustrine	ML	13-21	16	119	NP-18	0-4	0-8	1-49	50-99	5-13	2.56-2.89	2.73	—	—	—	—	—	—	—	—	—
Lacustrine	SM	10-20	15	139	NP-16	0-8	0-23	35-95	5-47	1-9	2.67-2.79	2.75	—	—	—	—	—	—	—	0	3419

Notes:

1. Percent Clay defined as those particles finer than 0.002 mm
2. NP is non plastic

Table K-1 - Summary of Geotechnical Parameters by General Stratum and USCS Soil Group
(PO-177 data only)

000676

General Stratum	USCS Group Symbol	Moisture Content (% dry weight)		Dry Density (pcf)	Liquid Limit	Plasticity Index	Percent Gravel	Percent Sand	Percent Silt and Clay	Percent Clay	Specific Gravity		Permeability (cm/sec) ASTM D 5084	Strength Parameters (CU Tests)				Strength Parameters (DS and CD Tests)		Strength Parameters (UCS andUU Tests)	
														Total Friction (degrees)	Total Cohesion (psf)	Effective Friction (degrees)	Effective Cohesion (psf)	Effective Friction (degrees)	Apparent Cohesion (psf)	Total Friction (degrees)	Total Cohesion (psf)
		range	average	range	range	range	range	range	range	range	range	average	range	range	range	range	range	range	range	range	range
Brown Clay	CH	25-26	26	99-100	52-57	31-39	0	1-2	98-99	39-42	2.72-2.75	2.74	—	—	—	—	—	—	—	0	4293-4299
Brown Clay	CL	11-25	19	94-128	24-46	7-32	0-12	2-26	69-98	13-34	2.68-2.81	2.76	—	34.5-36.5	0-357	34-35	23-210	—	—	0	925-14760
Brown Clay	CL-ML	—	23	—	17	5	1	4	95	16	—	277	—	—	—	—	—	—	—	—	—
Gray Till	CL	2-26	13	102-147	20-28	8-13	4-22	18-46	51-74	13-22	2.73-2.82	2.77	—	21-38	275-910	31-32	105-490	—	—	0	1127-17803
Gray Till	ML	—	—	—	—	—	5	29	66	22	—	2.73	—	—	—	—	—	—	—	—	—
Gray Till	SC	—	7	140	19	7	16	44	40	12	—	2.78	—	—	—	—	—	—	—	0	18643
Muddy Stream	CL	—	—	—	29-31	13-16	0-2	3-8	90-98	27-32	2.61-2.76	2.69	—	—	—	—	—	—	—	—	—
Muddy Stream	CL-ML	—	—	113-123	17-21	5-7	0-6	9-41	54-91	9-15	2.67-2.72	2.70	—	—	—	—	—	—	—	—	—
Muddy Stream	ML	17-21	17	106-116	NP	0	0-3	7-42	56-93	5-9	2.76-2.86	2.80	$2.9x10^{-7}$	—	—	—	—	31-38	0-218	0	541
Muddy Stream	SC	—	11	104-133	16-27	4-12	8-24	36-58	26-50	9-16	2.64-2.76	2.71	$1.2x10^{-7}$	—	—	—	—	29-32	0-629	—	—
Muddy Stream	SM	11-23	18	—	NP-12	0-1	0-22	52-85	13-43	1-9	2.64-2.97	2.74	$1.3x10^{-6}$	—	—	—	—	—	—	—	—
Muddy Stream	SP-SM	—	—	—	NP	0	17-33	58-73	10-11	1-3	2.70-2.75	2.72	—	—	—	—	—	—	—	—	—
Muddy Stream	SW-SM	—	—	—	—	—	2-44	51-88	4-12	1-3	2.68-2.78	2.75	$4.4x10^{-4}$	—	—	—	—	—	—	—	—
Lacustrine	CL	20-24	22	103-124	20-29	7-13	0-4	2-43	53-97	13-31	2.72-2.79	2.76	—	—	—	—	—	—	—	—	—
Lacustrine	CL-ML	—	—	117-122	19-22	4-6	0-12	13-47	51-84	7-16	2.65-2.80	2.74	—	—	—	—	—	—	—	—	—
Lacustrine	ML	16-21	18	—	NP-18	0-4	0-8	1-49	50-99	5-13	2.56-2.89	2.73	—	—	—	—	—	—	—	—	—
Lacustrine	SM	10-20	15	139	NP-16	0-8	0-23	35-95	5-47	1-9	2.67-2.79	2.75	—	—	—	—	—	—	—	0	3419

Notes:

1. Percent Clay defined as those particles finer than 0.002 mm
2. NP is non plastic

Table K-2 - Summary of Geotechnical Parameters by General Stratum and USCS Soil Group
(PO-177 and prior data)

APPENDIX L

APPENDIX M

Summary of Hydrogeologic Parameters, FPA

General Stratum	USCS Group Symbol	Porosity Laboratory Tests (%)		Porosity Estimated from Grain Size (%)		Hydraulic Conductivity (ft/day) Laboratory	Hydraulic Conductivity (ft/day) Slug Test	Hydraulic Conductivity (ft/day) Pump Test	Storativity (unitless) Pump Test	Hydraulic Conductivity (ft/day) Estimated from Grain Size
		range	average	range	average	range	range	range	range	range
Brown Clay	CL	25.1-43.5	35.9	---	---	$1.1x10^{-4}$ - $2.3x10^{-4}$	$3.5x10^{-2}$-0.24	---	---	---
Gray Till	CL	16.6-41.4	27.0	---	---	$7.9x10^{-5}$	$2.1x10^{-2}$-6.28	---	---	---
Muddy Stream	CL-ML	15.9-35.8	28.5	25.5	25.5	$6.8x10^{-6}$ - $5.4x10^{-5}$	$1.3x10^{-3}$-0.62	---	---	0.45
Muddy Stream	ML	33.8-39.6	36.2	26.0-36.1	31.3	$8.2x10^{-4}$	$1.3x10^{-3}$-4.86	---	---	0.22-1.20
Muddy Stream	SC	21.2-39.2	27.1	25.5	25.5	$3.4x10^{-4}$	0.16-3.61	---	---	0.44-2.12
Muddy Stream	SM	---	---	25.5-40.1	29.3	$3.7x10^{-2}$	0.26-67.20	11.7-33.4	$1.0x10^{-3}$-$1.6x10^{-2}$	0.72-43.17
Muddy Stream	SP-SM	---	---	25.5-34.3	27.8	---	---	---	---	4.86-43.17
Muddy Stream	SW/SW-SM	---	---	25.5-33.8	28.7	1.2	30.20-41.90	---	---	0.27-171.80
Muddy Stream	GM						45.6-216			
Lacustrine	CL	---	---	25.5	25.5	---	0.275-0.81	---	---	0.50
Lacustrine	CL-ML	---	---	25.5-47.1	30.1	---	$9.2x10^{-2}$-0.30	---	---	0.13-1.28
Lacustrine	ML	---	---	25.7-40.1	32.3	---	0.54-1.07	---	---	0.10-1.70
Lacustrine	SM	19.5	19.5	25.5-36.0	28.7	---	0.49-41.9	---	---	0.72-11.02
Lacustrine	SP-SM	---	---	34.0-36.1	35.1	---	59.8	18.2-27.5	$3.7x10^{-3}$-$8.5x10^{-3}$	41.13-318.00
Lacustrine	GM	---	---	---	---	---	66.8	---	---	---

Notes:

1. Laboratory porosities based on undisturbed laboratory tests performed on samples from PO-177, various SM&E reports, H.C. Nutting report, ATEC report,. (See Appendices A and F) and FEMP Glacial Till Vadose Zone Report (Appendix B).
2. Porosity estimated from grain-size is based on equation from Vucovic and Soro 1992 and grain-size data is from PO-177 testing.
3. Hydraulic conductivity based on grain-size is based upon equations in Vukovic and Soro 1992. Grain-size data is from PO 177 testing.
4. Slug test data from PARSONS ERA Project, May 1994, FEMP Glacial Till/Vadose Zone Hydraulic Investigations Report, Operable Unit 5, PO 37, PARSONS ERA Project: Fairfield, Ohio and United States Department of Energy, March 1995, Remedial Investigation Report for Operable Unit 5, DOE Fernald Area Office: Fernald, Ohio

Explanation:

Soil Boring, Previous Investigation

Soil Boring, PO-177

Geologic Cross-Section Line

Boundary

Mapped Silts, Sands & Gravels

Modeled Coarse-Grained

Interpreted Lacustrine & Muddy Stream Deposits; Queried Where Uncertain or Approximate (Modeled Coarse-Grained Deposits - Shaded; Mapped Silts, Sands and Gravels - Hatched)

0 200 400 FT

SCALE

Silt, Sand, Gravel

Mapped Sediment Type

CL, ND

CL = Clay Entire Boring Profile;
ND = Boring Not Deep Enough to Establish Nature of Deposit

File: /usr/ref3/fpa/fpa/fpa_silt6.dgn

000027

Figure 1-6 - Location and Extent of Interpreted Deposits At or Near the Brown/Gray Glacial Overburden Interface, FPA

24683_1

Explanation:

1520 — Soil Boring, Previous Investigation

G3-010 — Soil Boring, PO-177

B — B' — Geologic Cross-Section Line

0 250 500 FT
SCALE

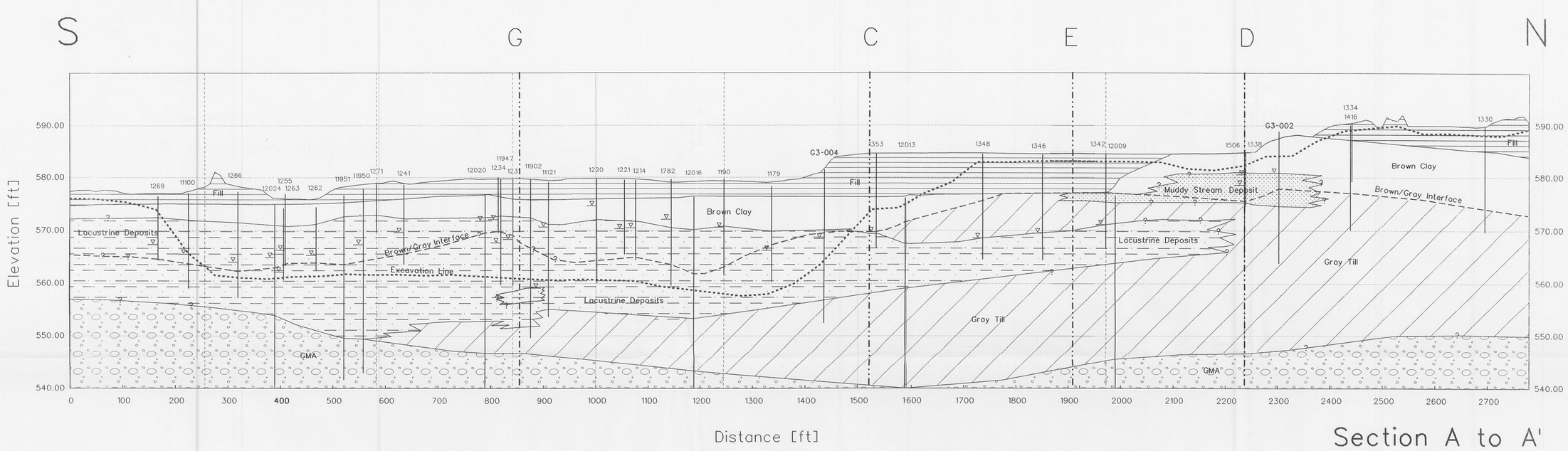
File: /usr/ref3/fpa/fpa/fpa_bore.dgn

000035

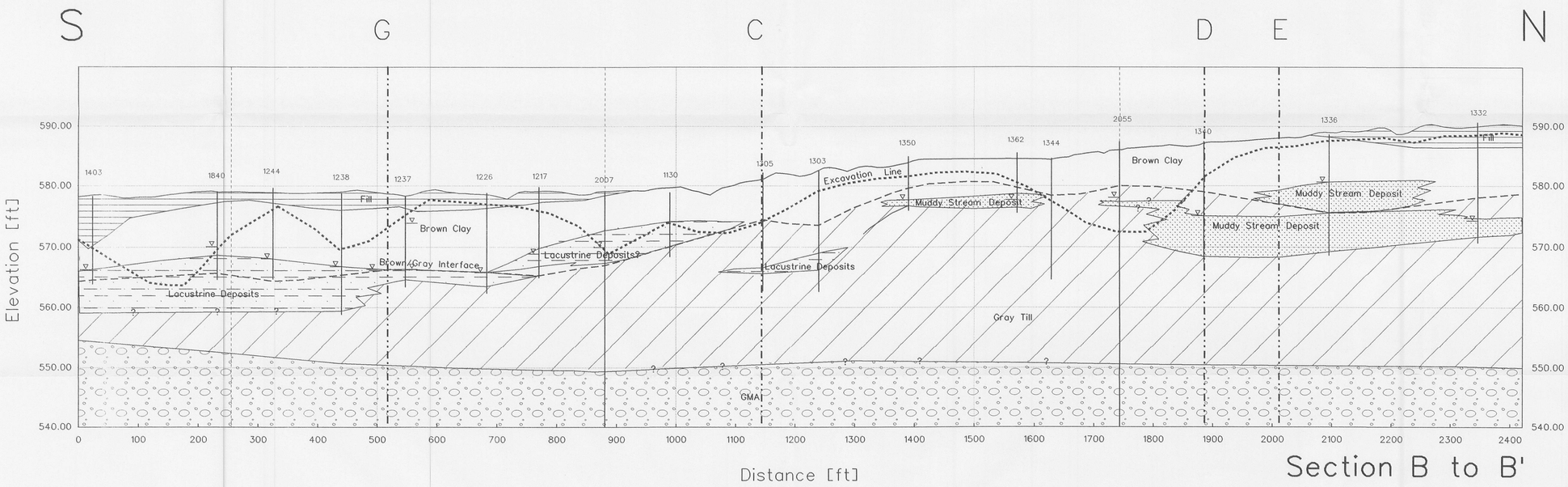
Figure 2-1 - Boring Location Map, FPA

fpa_bore.m po177erma@ws415. Tue Nov 4 11:58:57 CST 1997

246483-2



Section A to A'



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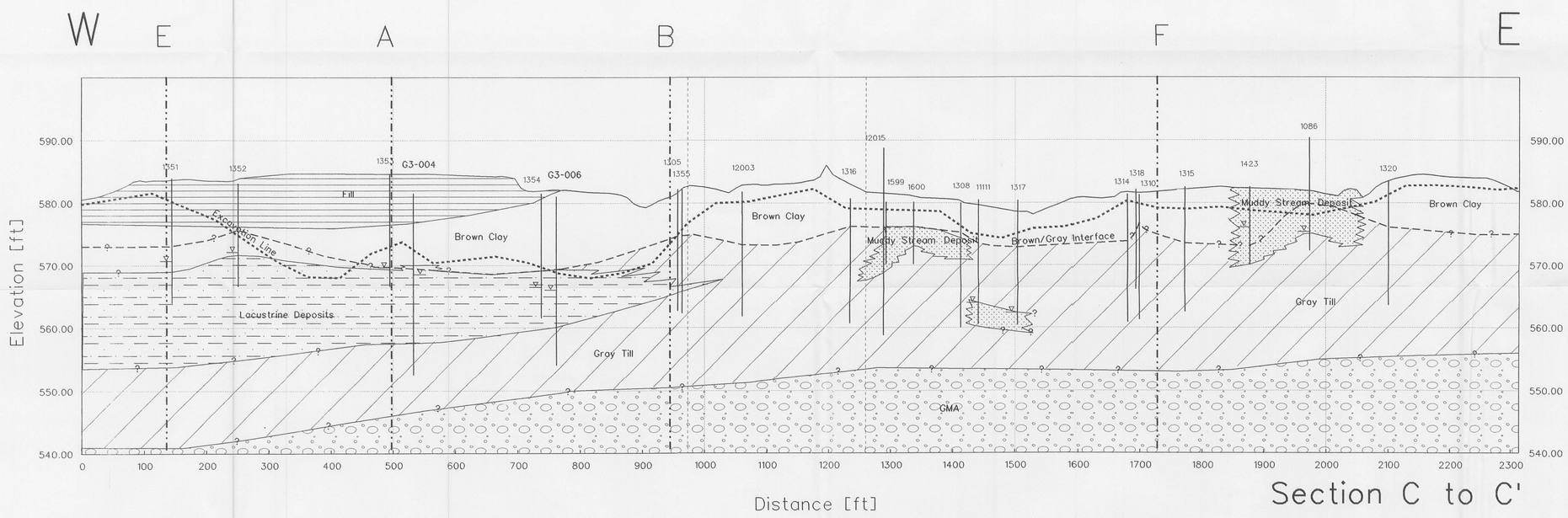

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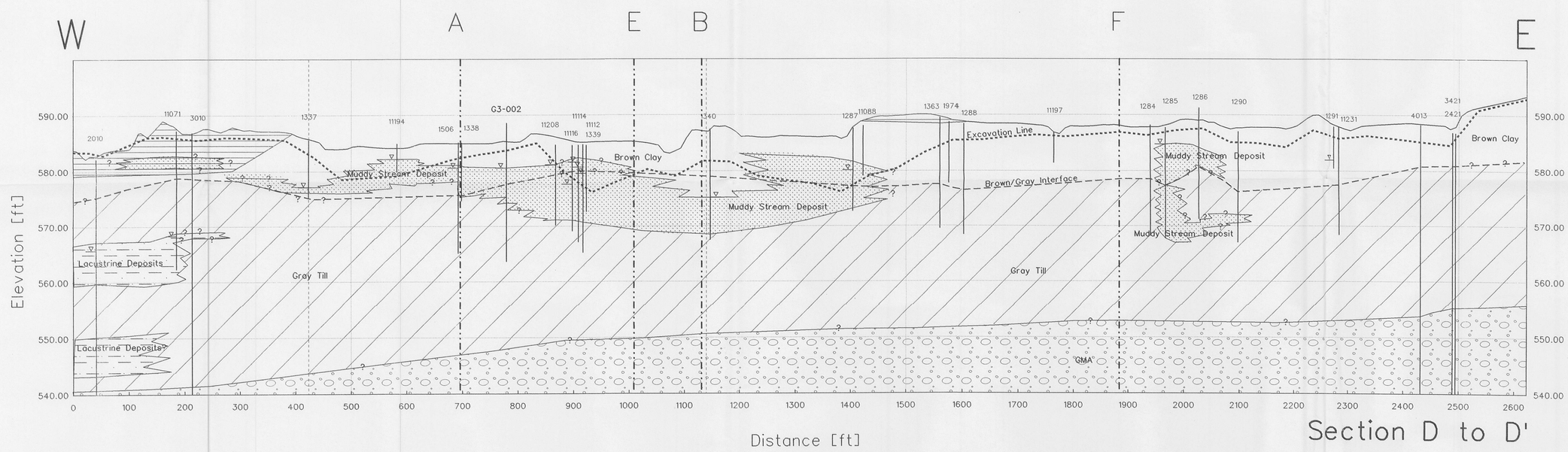


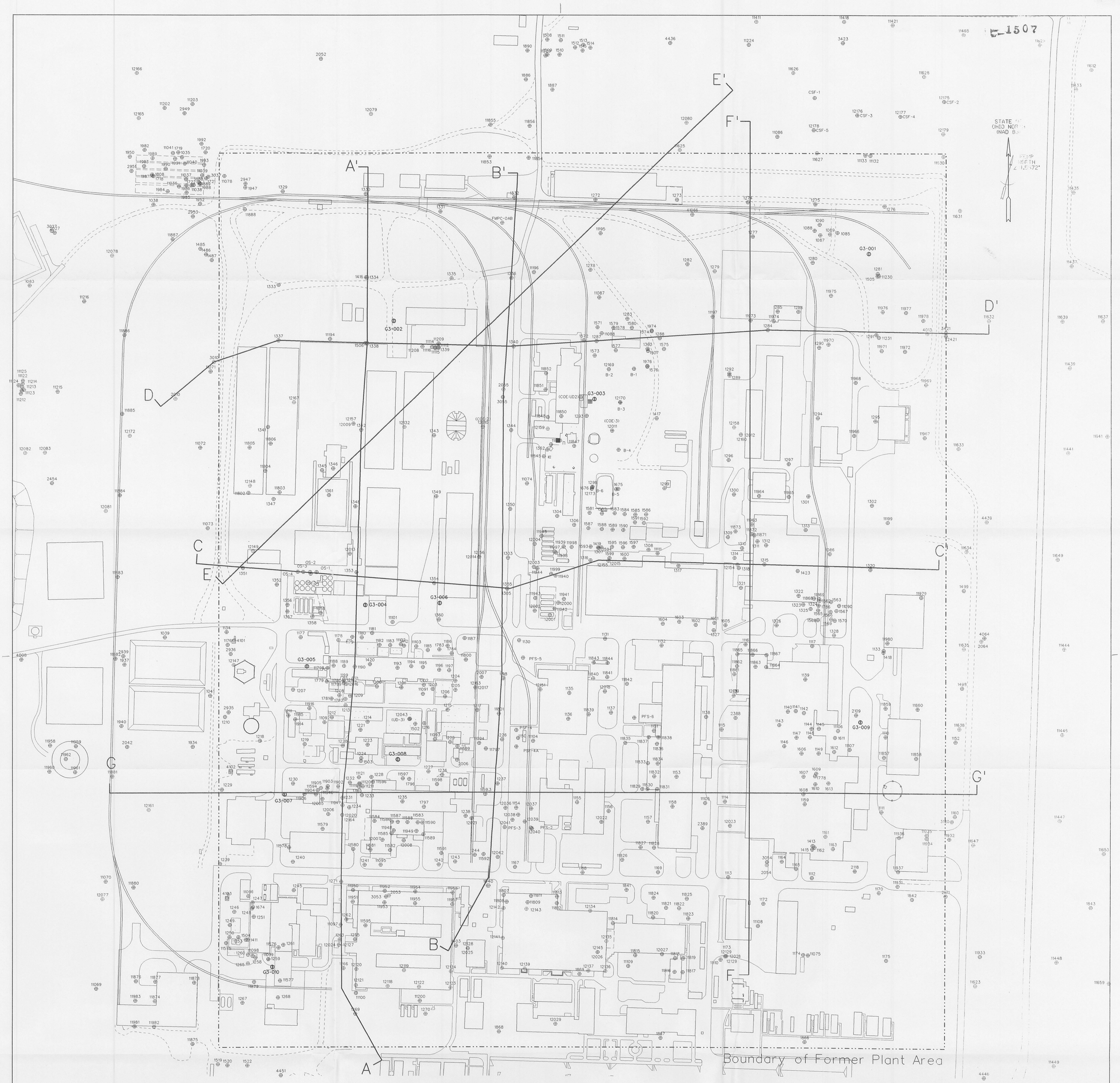
Section D to D'

000088

Vertical Exaggeration 10X

Figure 5-2 - Geologic Cross-Sections A-A' through D-D'

246483_8



Explanation:

1520 — Soil Boring, Previous Investigation

G3-010 — Soil Boring, PO-177

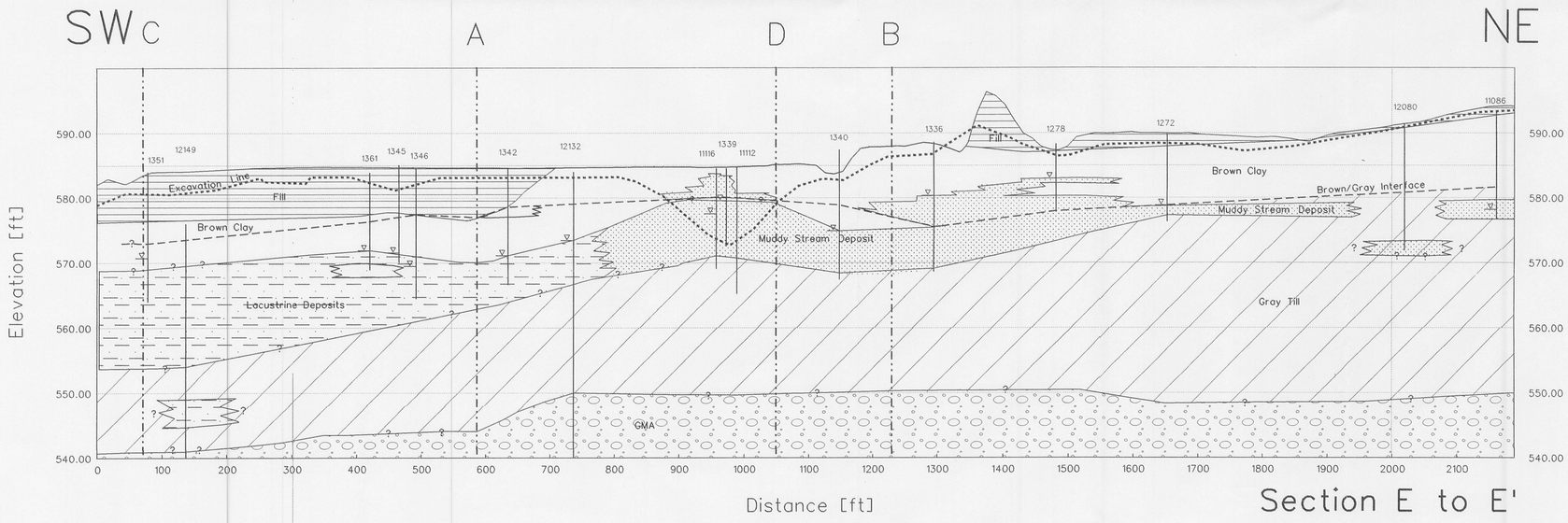
B — B' — Geologic Cross-Section Line

File: /usr/ref3/fpa/fpa/fpa_sect.dgn

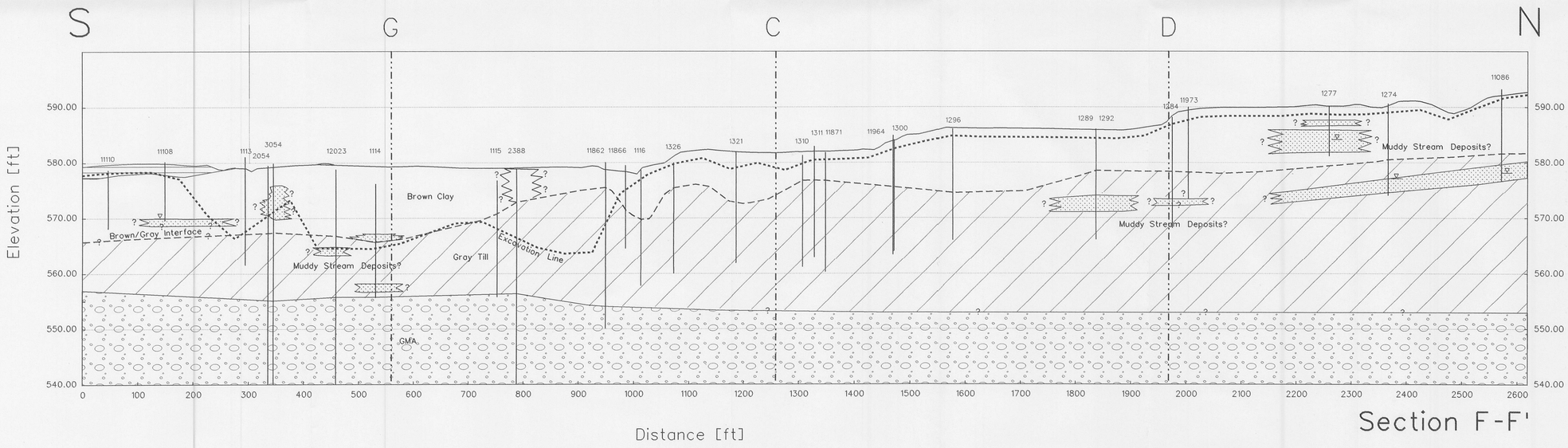
000089

Figure 5-1 - Boring and Line of Section Map, FPA

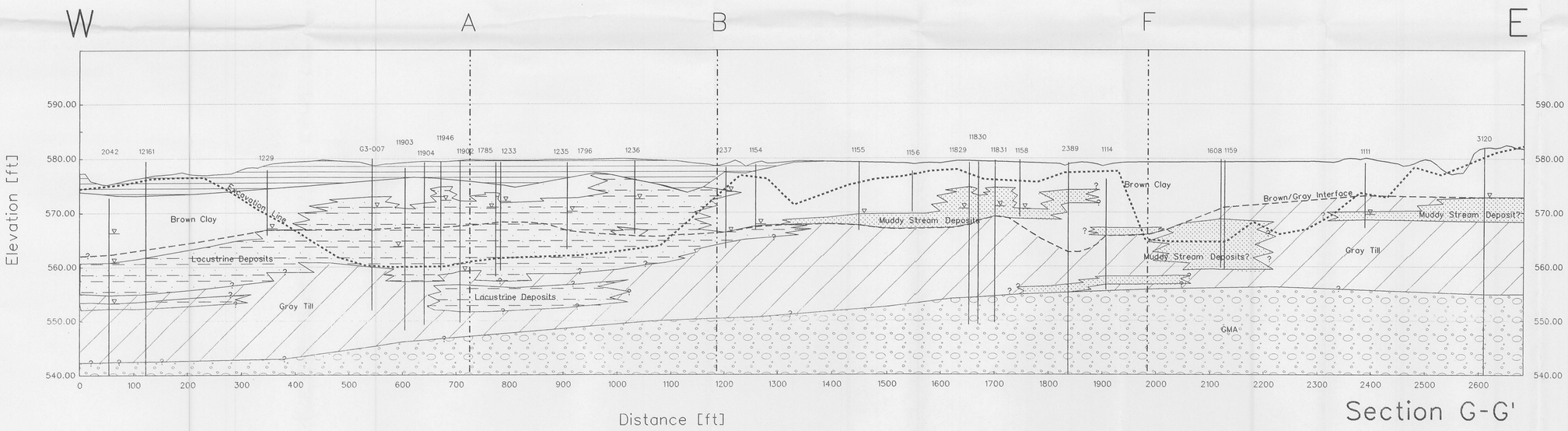
246483_4



Section E to E'



Section F-F'



Section G-G'

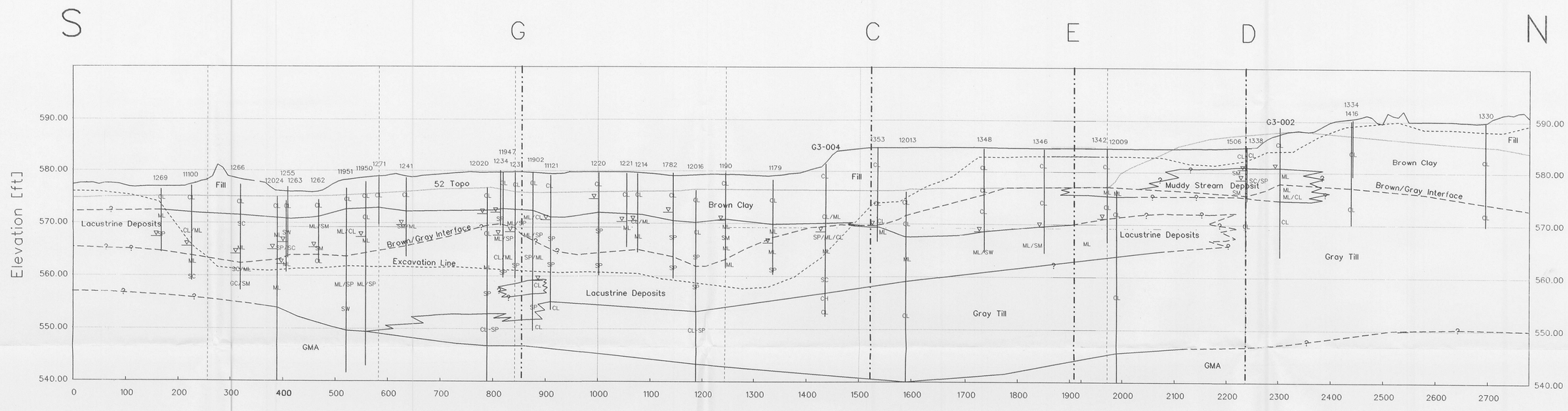
Vertical Exaggeration 10X

000090

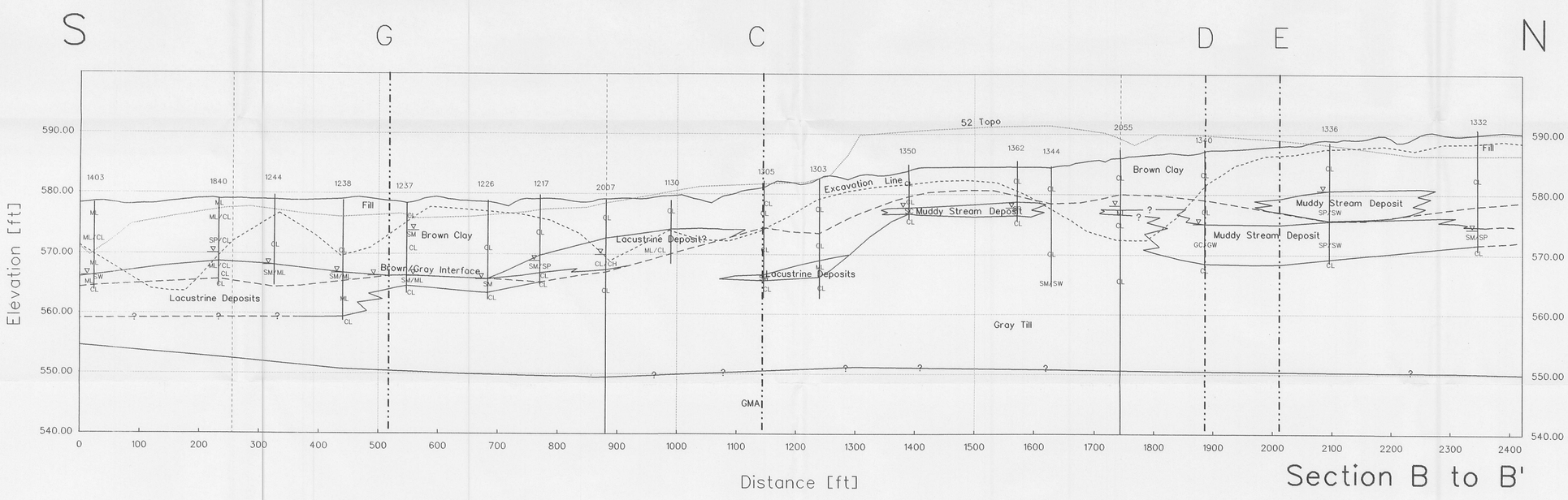
Figure 5-3 - Geologic Cross-Sections E-E' through G-G'

24683_5

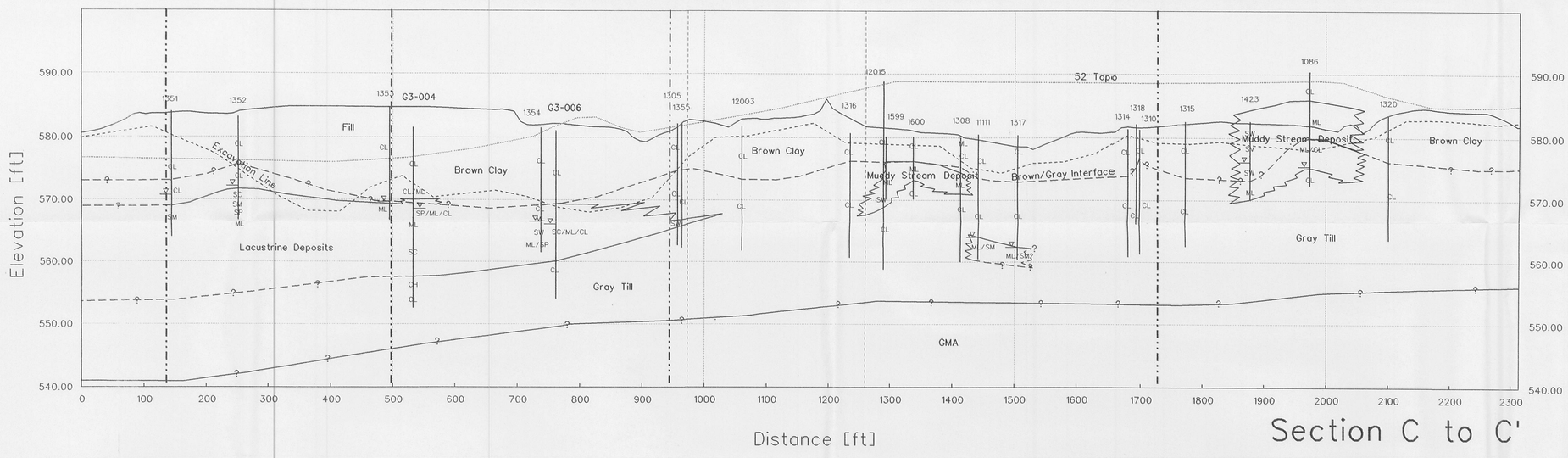
1507



Section A to A'



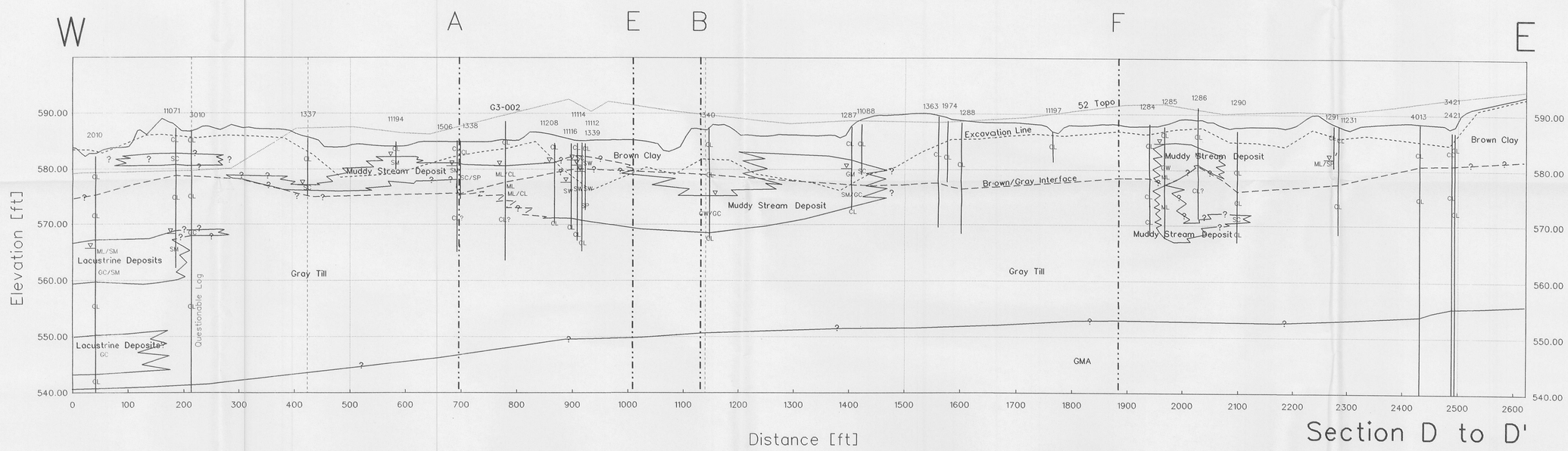
Section B to B'



Section C to C'

Symbols:

CL ML SP	USCS Classification Symbols Shown are from Visual Classification from Field Logs
	1952 Ground Surface
	1992 Ground Surface
	Brown/Gray Interface
	Geologic Contact Approximately Located, Dashed and/or Queried Where Location Uncertain
	Modeled Excavation Line
E	Intersection of Cross-Section
▽	Water Level from Boring Log
12080	Boring Location and Designation



Section D to D'

000679

Vertical Exaggeration 10X

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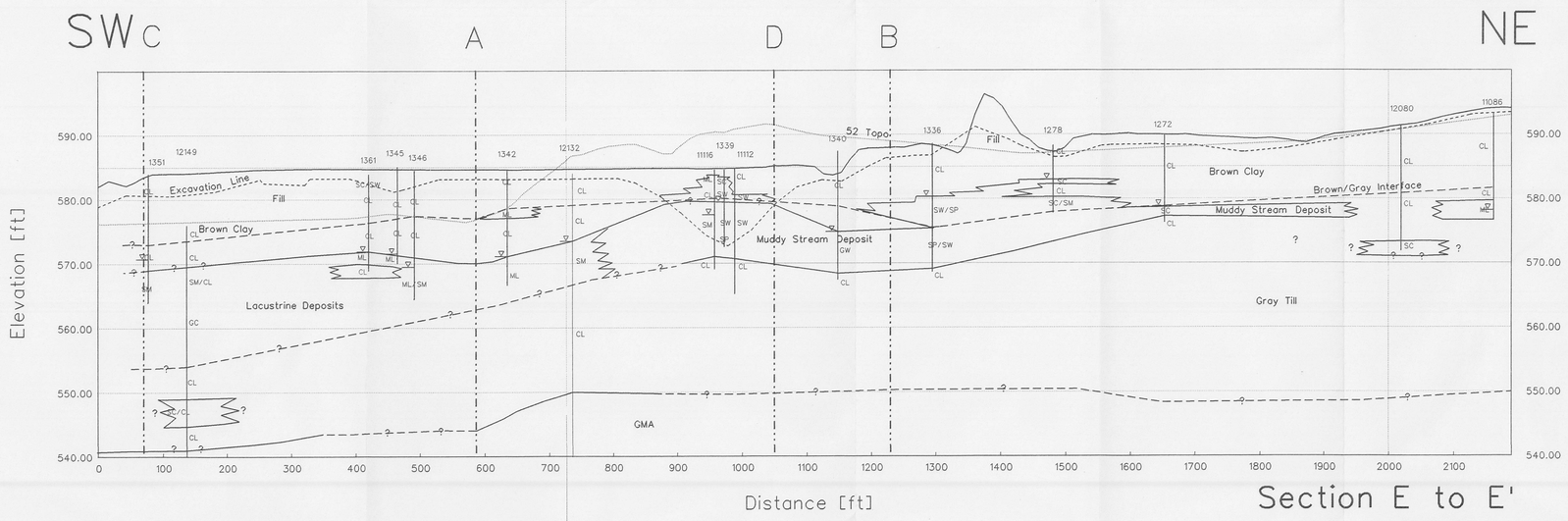
Geologic Cross-Sections A-A' through D-D'

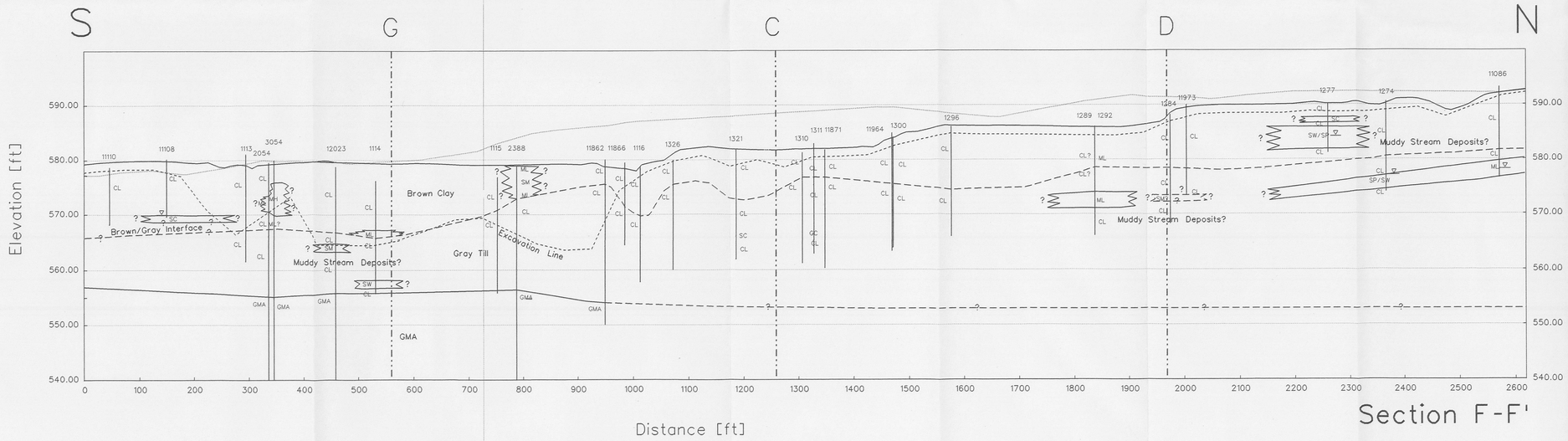
246913-6



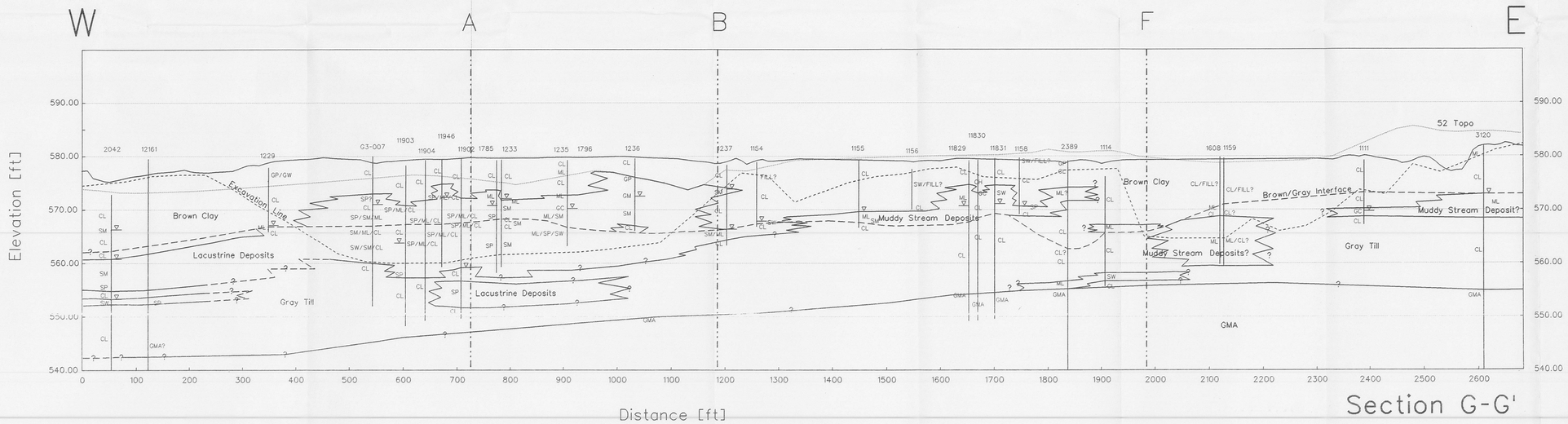
Section E to E'

Symbols:

CL ML SP	USCS Classification Symbols Shown are from Visual Classification from Field Logs
	1952 Ground Surface
	1992 Ground Surface
	Brown/Gray Interface
	Geologic Contact Approximately Located, Dashed and/or Queried Where Location Uncertain
	Modeled Excavation Line
E	Intersection of Cross-Section
	Water Level from Boring Log
12080	Boring Location and Designation



Section F-F'



Section G-G'

000680

Vertical Exaggeration 10X

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