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OPERABLE UNIT 1 REMEDIAL DESIGN PRE-FINAL DESIGN PACKAGE II
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DESIGN

Operable Unit 1 Remedial Design
Pre-Final Design Package II

Volume 1 of 1

Fernald Environmental Management Project
Fernald, Ohio
Fernald Area Office

March 1996

United States Department of Energy

Operable Unit 1 Remedial Design
Pre-Final Design Package II

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United States Department of Energy

EXCAVATION PLAN

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Waste Excavation Plan for the Operable Unit 1 Remediation System Design

Operable Unit 1
Project Order 145

March 1996
Revision F

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

PARSONS

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Waste Excavation Plan for the Operable Unit 1 Remediation System Design

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LIST OF ACRONYMS AND ABBREVIATIONS

ALTER	Accelerated Life Testing and Environmental Research
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPT	Core Penetrometer Test
DAC	Derived Air Concentration
DEEP	Dewatering and Excavation Evaluation Program
EPDM	Ethylene Propylene Diene Monomer
FID	Flame Ionization Detector
FEMP	Fernald Environmental Management Project
MDD	Maximum Dry Density
mrem	millirem
OMC	Optimum Moisture Content
OSDF	On-Site Disposal Facility
OU	Operable Unit
PID	Photoionization Detector
PSMS	Pit Stormwater Management System
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SPT	Standard Penetration Test
tph	tons per hour
WAC	Waste Acceptance Criteria
WPRAP	Waste Pit Remedial Action Project
VOC	Volatile Organic Compound

SECTION 1

INTRODUCTION

This report reviews the excavation method and presents the waste excavation plan proposed for Operable Unit 1 (OU1). OU1 consists of six waste pits, a Burn Pit, and a Clearwell. The six waste storage pits constructed at the Fernald Environmental Management Project (FEMP) are referred to as "wet" or "dry" pits, depending on the state of the material at the time it was placed in the pit. A pit that received slurries is classified as a "wet" pit, while a pit that received dry solids is classified as a "dry" pit. Waste Pits 1, 2, 4, and Burn Pit are "dry" pits; Waste Pits 3, 5, and 6 are "wet" pits.

1.1 Excavation Methods

The review focuses on a top and bottom excavation method wherein one set of equipment is located on top of the pit cap (i.e., on top of the soil cover overlying the pit waste) to strip the cap and waste, and a second operation simultaneously completes waste removal from the pit bottom. Equipment operations are not planned or anticipated to occur directly on pit wastes. Operations will be from on top of pit caps, on the pit bottoms, on existing berms or on constructed ramps. This approach was devised to eliminate the need for the operators to drive directly on waste of unknown strength (see Subsection 5.2 for clarification of excavation approach).

For the preferred top and bottom approach, contingency measures are presented that respond to or accommodate unexpected waste or stability conditions. Also, various aspects of the operation, such as the most efficient equipment types are presented to optimize the overall approach.

WPRAP is currently planning on performing the excavation of all waste pits by the use of mechanical excavation equipment. As a contingency, excavation of the waste pits by the use of slurrying equipment (hydraulic excavation) is being designed and procured. By designing and preparing for both excavation techniques, if pit wastes are encountered that cannot be readily excavated, slurrying of these wastes can commence with minimal downtime.

1.2 Review Methodology

The waste excavation plan is a review and conceptualization of the top and bottom excavation approach. The review uses data from Pits 3 and 5 since these pits are the deepest and have the most difficult wastes to excavate and handle. Excavation in Pits 1, 2, 4, and in the Burn Pit will be similar to Pit 3. Excavation in Pit 6 and Clearwell will be similar to that of Pit 5.

Both Pit 3 and Pit 5 (and possibly most of the other pits) are expected to contain some flowable wastes. However, for better efficiency in subsequent water removal steps, mechanical excavation is preferred and is the planned excavation method. (If there are any wastes that cannot be excavated mechanically, hydraulic excavation is retained as a contingency method. For waste volumes that need to be hydraulically excavated, pumping will be done without the addition of slurrying water.) Therefore, mechanical excavation is the focus of this study. To the extent possible (and the most cost effective), water removal is maximized in the pit area either prior to and/or in conjunction with the waste excavation.

Pits 4 and 5 have been identified as a hazardous waste management units. This is not expected to change the basic excavation methodology presented in this plan. Since the RI final issue, analytical results of sampling indicate there is no listed waste. Those pits will be blended with other pit materials. RCRA testing will be performed on the final combined waste streams, after processing, at the time material is loaded into railcars.

1.3 Status with Respect to DEEP Information

Based on the Dewatering and Excavation Evaluation Program (DEEP) information available on the waste strengths, a review of the top and bottom excavation method has been made. Review and analysis of waste strength test data from Pits 1, 2, and 3 indicates that, although the waste strengths are very low, the excavation faces will maintain minimum slopes of approximately 3H:1V without the need or further benefit of dewatering.

Trial field excavations also included as part of the DEEP testing have also confirmed the very low strengths of most of the pit wastes. The trial excavations also confirmed the need to maintain waste excavation slopes of 3H:1V to ensure stable excavation faces. Furthermore, caution is warranted when estimating and predicting the waste strength properties because of the practical limitations on the number of test points and the wide variation evident in the existing waste properties.

While the overlying soil cap materials act as a load-distributing layer, and the cap materials normally have higher strengths than the wastes, as the excavation faces are opened, the overall stability of the slope depends on the strength of the underlying waste.

The DEEP information, data, and status is presented in the accompanying DEEP report, "Technical Summary of DEEP Test Data, Rev B," (PARSONS 1996b).

1.4 Waste Pit Descriptions

This section provides a general description of the configuration and origin of the contents of each of the waste pits. Narratives for this section were obtained from the OU1 Waste Pit Content Study Report (Rev. 0, PARSONS 1993). The purpose of this section is to provide basic information about the construction and operation of Waste Pits 1 through 6, the Clearwell, and the Burn Pit. For additional detail, reference the above mentioned report. See Figure 1-1 at the end of this section for a plan view of the waste pits and the proposed waste processing facilities.

1.4.1 Waste Pit 1

The waste pit footprint is oval, and the pit is approximately 165 feet wide by 350 feet long by 29 feet deep. The bottom of Waste Pit 1 slopes approximately 1 foot from the east to the west side. Four feet of low permeability materials was placed in the southeast corner of Waste Pit 1. A sump area, lined with approximately 6 feet of low permeability material, was constructed in the southwest corner of Waste Pit 1. A trench that is 11-12 feet wide and 10 feet deep was excavated around the bottom of the waste pit and backfilled with low permeability material. The low permeability material used in the construction of Waste Pit 1 was obtained from excavating clay from the area which would later become the Burn Pit.

The majority of the materials placed in Waste Pit 1 were dry solids including neutralized waste filter cakes, production plant sump cakes, depleted slag (magnesium fluoride), scrap graphite, contaminated brick, and sump liquor. The following materials were routinely dumped into Waste Pits 1, 2, or 3: trailer cake from Plant 8, neutralized filtrate from uranyl ammonium phosphate cake from Plant 8 (including sump liquor), General Sump slurry from the Ore Refinery (including neutralized raffinates), broken graphite molds from Plant 5, chemical feed sump residues from the Water and Boiler Plants, hand cleaned and moistened residues by the residue crew, and cooling water from heat treating operations in Plant 6. The feed sump residues from the Water and Boiler Plants and cooling water from the heat treating operation were disposed of using a tank truck. The hand cleaned and monitored residues were disposed of with the use of a truck. Rainwater from the pipe trench in the K-65 area was pumped into the south end of Waste Pit 1 through an existing pump. Waste acid filter cake from Plant 8, depleted C-liner from the Storage Pad and Plant 5, and sump cake from Plant 7 were disposed of in Waste Pit 1.

1.4.2 Waste Pit 2

The Waste Pit 2 footprint resembles a six-sided polygon, and the pit is approximately 190 feet wide by 270 feet long by 23 feet deep. In the southern portion of the waste pit, a small, spring fed pond existed with a typical water elevation of approximately 574 feet. The pond was drained and the pit was constructed by excavating a basin into the existing native clay. At the north end of the pit, trees, stumps, and roots were removed from the bottom of the pit and the area was backfilled with clay to construct an

impervious pit. The pit was lined with a compacted, on-site native clay layer. The pit bottom and interior side slopes were lined with 4.5 feet of low permeability material. The low permeability material used in the construction of Waste Pit 2 was obtained by excavating material from the location of the future Burn Pit.

Waste Pit 2 was primarily used as a dry pit, but some wet materials were placed in the pit before Waste Pit 3 was constructed. Waste Pit 2 was filled with semi-liquid, filter cakes, sump liquor, and other aqueous liquids. Waste Pit 2 received dry solids mainly consisting of neutralized waste filter cakes from the production plants, depleted slag, scrap graphite, contaminated brick, and sump liquor.

1.4.3 Waste Pit 3

The pit resembles an irregular oval and is approximately 450 feet wide by 720 feet long by 42 feet deep. Waste Pit 3 was constructed by excavating into an existing low permeability material to an approximate elevation of 548 feet. The west berm was constructed approximately 20 feet above the 1958 ground surface. The north side of Waste Pit 3 had no berm. The east side was formed from the west sides of Waste Pits 1 and 2. The sides of Waste Pit 3 were constructed with a 1.5H:1V interior slope and lined with 12 inches of clay. Some of the excavated soil was used to form the west wall of the pit. Layers of 6- to 8-inches were placed on the sides and compacted with a sheepsfoot roller. A natural layer of low permeability material forms the bottom of the pit. Additional clay material was not placed in the bottom of the pit. Spoil areas for the construction of Waste Pit 3 were located due north of the pit and west of the pit; topsoil was placed further north of the pit. The spoil area due north was graded to an approximate elevation of 575 feet.

From 1959 to 1968, Waste Pit 3 was operated as a wet pit for use as a settling basin. Waste Pit 3 was divided into three sections. In August 1959, only one third had been designated for use. This portion of Waste Pit 3 was designated to receive slurries from the Ore Refinery and the Recovery Plant. Material was not to be dumped here until Waste Pit 2 was filled. The majority of the wet material Waste Pit 3 received was lime-neutralized radioactive raffinate concentrate from Plant 8 and the General Sump. The neutralized waste slurry was received through an inlet pipe at the north end of the pit. The solids settled in the pit, while the supernatant liquid flowed through weirs at the south end of the pit into the Clearwell. Contaminated rainwater from the Burn Pit area was pumped into the north end of Waste Pit 3 with the use of a portable pump. The slurries from the Ore Refinery (Plant 2/3) and the Recovery Plant were pumped to Waste Pit 3. The solids settled out while the clear liquid passed over a weir to the Clearwell. In the late 1960s, an area was dug in the north end of the pit and wooden pallets were placed in this area and then crushed with the bulldozer.

1.4.4 Waste Pit 4

The footprint of Waste Pit 4 resembles a trapezoid, and the pit is approximately 380 feet wide by 310 feet long by 32 feet deep. Waste Pit 4 was constructed with interior side slopes of 2H:1V. Waste Pit 4 was lined with 1 to 2 feet of low permeability material.

Depleted uranium residues, low grade thorium residues, contaminated ceramics, and general refuse were discarded without treatment into Waste Pit 4. The depleted uranium residues (0.142 - 0.40 percent U-235) were either not suitable for remelt or it was not economically feasible to recover the uranium. Thorium residues were placed in the pit when it was not economically feasible to reprocess the residues. The ceramics were from production electric furnaces. From 1975 until 1984 the majority of the filter cakes from Plant 8, resulting from the filtration of neutralized raffinates and sludges accumulated in the General Sump tanks, and recycled slurries from Waste Pit 5 were classified as dry waste and deposited into Waste Pit 4. Waste Pit 4 also received process residues, trailer cakes, slurries, raffinates, graphite, non-combustible trash, and asbestos. Waste Pit 4 received construction rubble, crucibles, and contaminated asbestos. Trash, cans, drums, graphite, graphite crucible molds (13 inches in diameter and 3 feet tall), solid abrasive materials, uranium metal, magnesium fluoride, concrete, ceramics, drummed residues of uranium materials, pyrophoric chips and fines, concrete, thorium, and asbestos were deposited in Waste Pit 4. At least 100 drums were deposited on the west side of Waste Pit 4. From 1980 to 1983 barium chloride was disposed of in Waste Pit 4. Between May 1981 and April 1983 Waste Pit 4 received approximately 23,500 pounds of low-level radioactive waste containing barium chloride heat treatment salt.

1.4.5 Waste Pit 5

The footprint of Waste Pit 5 is rectangular, and the pit is approximately 820 feet long by 240 feet wide by 30 feet deep. The pit extends about 15 feet above the original grade on the south side and 14 to 20 feet above grade on the north side. The pit was lined with a 60-mil thick Royal-Seal ethylene propylene diene monomer (EPDM) Elastomeric Membrane. Seepage was encountered during excavation of the pit. The areas where seepage occurred were over excavated and filled with clay prior to installing the liner.

The bottom elevation of Waste Pit 5 is 560 feet at the east side and 558.5 feet at the west side. Waste Pit 5 was constructed with interior side slopes of 2.5H:1V. The top of the waste elevation is approximately 588 feet. Hence, the maximum depth of waste is approximately 30 feet deep.

Waste Pit 5 was placed in service on October 21, 1968. Liquid wastes from all of the plants were pretreated and then sent to the General Sump. At the General Sump, thorium wastes were co-precipitated with barium carbonate and aluminum sulfate to reduce the activity of the Ra-228, and then pumped to Waste Pit 5. Uranium wastes were treated at the General Sump with CaO to adjust the pH to obtain a

maximum precipitation of the radioactive material, and then pumped to Waste Pit 5. Until 1984 sludges which settled in the General Sump were sampled and, if the total content of radioactive materials was within pre-set allowable discard limits, the sludges were sent to Waste Pit 5. All of the liquid waste entered Waste Pit 5 through a pipe in the eastern end of the basin. The uranium and thorium containing solids settled out and remained in the pit while the supernatant liquor overflowed through an effluent tower in the southwest end of the pit where it subsequently flowed to the Clearwell. Waste Pit 5 also received neutralized raffinate settled solids, slag leach slurry, sump slurries, and lime sludge from Plant 2/3 and Plant 8.

1.4.6 Waste Pit 6

Waste Pit 6 is square with each side approximately 210 feet long. It is approximately 24 feet deep. Waste Pit 6 was constructed in the same manner as Waste Pit 5 and was also lined with a 60-mil EPDM liner. The bottom elevation of Waste Pit 6 is 560 feet, and the elevation of the top of the waste is approximately 580 feet. Therefore, the depth of the waste material is approximately 20 feet.

Waste Pit 6 received non-coarse, non-pyrophoric solid wastes including depleted slag, green salt, filter cakes, and process residues. Excess rainwater that collected in Waste Pit 6 was pumped to Waste Pit 5 and then discharged to the Clearwell. Material was bulldozed or clam-shelled into the waste pit. Depleted sump filter cake from all of the plants, fine depleted slags, decladding "blue" water, and heat treated quench water were deposited into Waste Pit 6.

1.4.7 Burn Pit

The Burn Pit was used to burn materials such as laboratory chemicals, combustible materials (including pyrophoric and reactive chemicals), oils, and low-level contaminated combustible material. The Burn Pit was also used to burn cafeteria debris, cans, napkins, and skids when the Sewage Treatment Plant incinerator was inoperable.

1.4.8 Clearwell

The footprint of the Clearwell resembles a trapezoid, and the pit is approximately 200 feet long by 180 feet wide by 27 feet deep. The east, west, and south side of the Clearwell were constructed with a 1.5H:1V interior slope; while the north side was constructed with a 2H:1V interior slope. All of the sides were lined with 12 inches of clay.

The west berm was constructed approximately 20 feet above the 1958 ground surface. The north side is adjacent to the south side of Waste Pit 3. The east side was formed from the west side of Waste Pit 1.

The Clearwell was constructed by excavating into an existing low permeability material to an approximate elevation of 548 feet. Additional clay material was not placed in the bottom of the Clearwell. There is approximately 11 feet of decant solid waste in the bottom of the Clearwell.

The Clearwell received surface water runoff from all of the pits and liquid from Waste Pits 3 and 5. The Clearwell was used as the final settling basing before water discharged to the Great Miami River.

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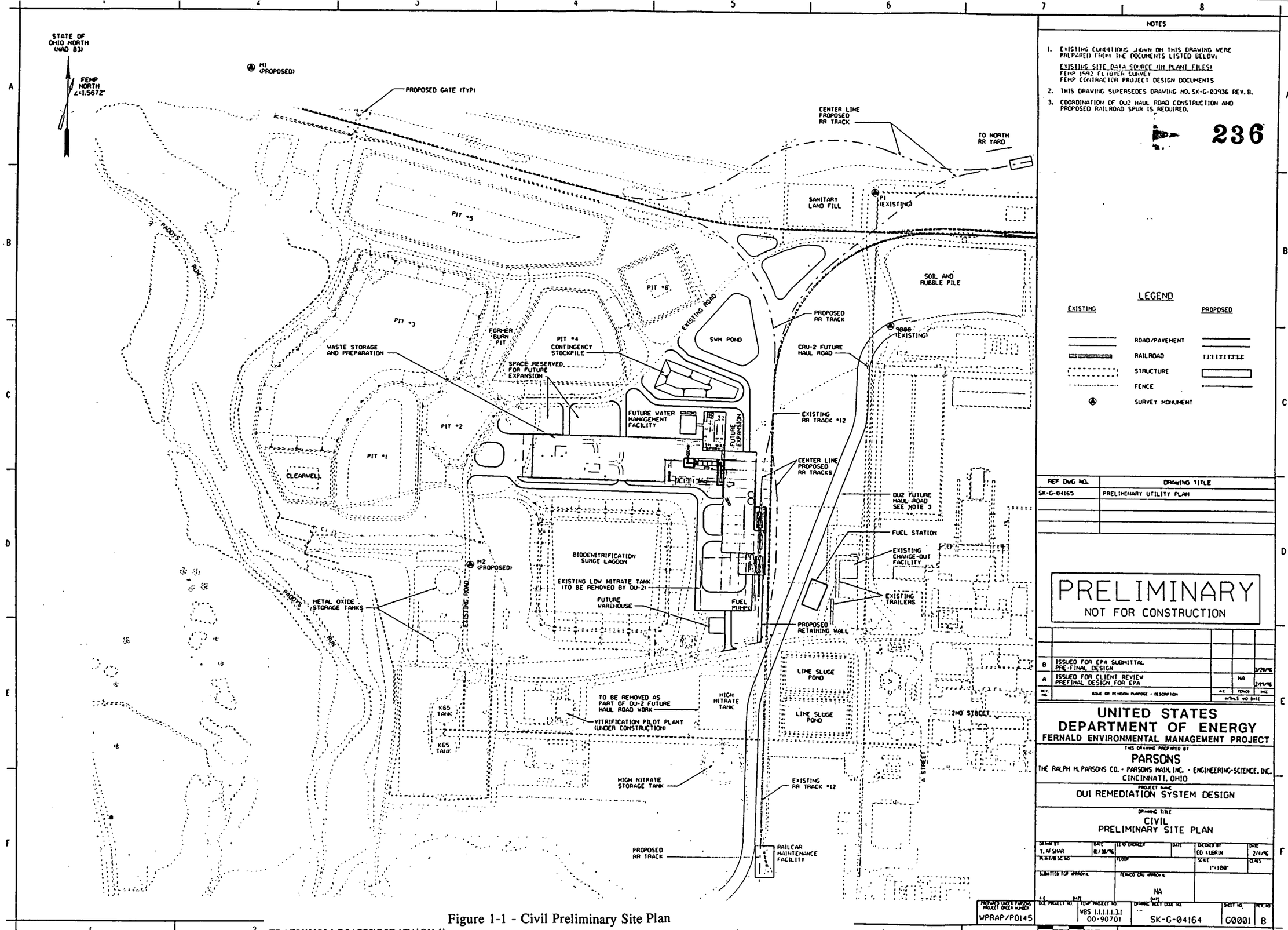

Figure 1-1 - Civil Preliminary Site Plan

SECTION 2

CRITERIA AND ASSUMPTIONS

2.1 Criteria

The following criteria were considered in the evaluation.

1) Operator Safety - Variation in waste composition and soil conditions make excavation operations less predictable. Personnel and equipment maintain a safe distance from excavated slopes in the pit cap and pit bottom.

2) Segregation - To process waste in an orderly fashion, segregation of waste types (i.e., debris, excessively wet material, dry materials) start at the excavation.

3) Stormwater - Existing perimeter stormwater controls are kept intact. With these controls, stormwater runoff from the waste pit area now flows either to the Clearwell or to Sump 18-N adjacent to the Clearwell. Separate pumping systems transfer this stormwater to the Biodenitrification Surge Lagoon.

   Runon into excavation areas is minimized to reduce the volume of contaminated water sent to treatment. Stormwater and water freely draining from the waste in the excavations is collected. Suspended solids are removed. Additional methods of pretreatment could be necessary and are being investigated. Storm and waste drainage water are transferred to the Clearwell and/or Sump 18-N. From the Clearwell and Sump 18-N, water is transferred to the Biodenitrification Surge Lagoon and then conveyed to the FEMP wastewater treatment system for final treatment prior to discharge.

   Note: Stormwater associated with the 11 acres for the new processing facilities is handled separately from the waste pit area system.

4) Process - The excavation process is designed to provide a steady stream of waste that is readily adaptable to variable drying and mixing rates. The drier the excavated material, the better the efficiency of operation.

5) Reclamation - The pits are remediated in a logical sequence that permits phased reclamation to natural drainage.

6) Infiltration - Infiltration of contaminated water from the waste to surrounding soils is minimized.

7) Airborne Emissions - The release of fugitive dust is minimized.

2.2 Assumptions

During the evaluation of the top and bottom excavation approach, the following assumptions are made. Various ongoing programs (i.e., DEEP) have been performed to confirm the validity of these assumptions where necessary.

1) Many of the waste types particularly those encountered in Pits 3 and 5 have very low strengths and high moisture contents. It is assumed that the waste throughout the pit (and for the other pits with overlying soil caps) has sufficient strength to maintain a workable and stable slope and that pit caps can support excavation equipment. DEEP strength data indicate undewatered wastes have adequate strength to maintain workable excavation slopes. However, recommendations for slope adjustments in the field are made at the discretion of, and are to be the responsibility of, a qualified and competent field geotechnical engineer.

2) The potential for gas and particulate airborne emissions at the pits is assumed to exist. It is also assumed that these emissions are manageable and controllable to acceptable levels with readily available measures. Additional study during future stages of plan development will determine the validity of these assumptions.

3) It is assumed that blending (for material characteristics) of waste, as a part of the excavation operations, commences at the excavation. As necessary, this blending and mixing will be achieved by excavating in two or more areas with the desired different material characteristics. By alternately transferring truckloads of waste to the processing facilities, the blending continues through the various waste processing steps.

4) Equipment support system control for the operator (such as air supplied enclosed cab) and/or personal protective equipment requirements are assumed to be the same at the top and at the bottom of the pits.

5) The FEMP wastewater treatment system is assumed to be able to handle the quantity of storm and wastewater from the OU1 construction area and operating facility. (The quantity of water will be determined as the design progresses). Temporary storage of storm and wastewater may be required and will be based on the 25-year, 24-hour storm. Waste Pit area storm and wastewater is managed separately from storm and wastewater in the waste processing area. Both streams ultimately enter the Biodenitrification Surge Lagoon for treatment by the FEMP wastewater treatment system. (See the OU1 Remedial Facilities Process Description for additional clarification.)

SECTION 3

PIT EXCAVATION SEQUENCE

The proposed excavation sequence is as follows: Waste Pits 1, 5, 3, 2, and 4; the Burn Pit; Waste Pit 6; and the Clearwell (see Figure 3-1). Overlapping or simultaneous excavation of various pits provides the necessary waste mixing from a radiological and moisture control standpoint. Once opened, each waste area is excavated and reclaimed as soon as is practical.

For a given pit or group of pits (such as Pits 1, 2, and 3), the excavation will proceed through a series of phases. Thus Phase 2 of the excavation of the Pits 1 - 3 group might occur at the same time as Phase 1 of the Pit 5 excavation.

1) Waste Pits 1 and 3 are excavated simultaneously. This is the logical area to initiate the excavation. The heterogenous nature of Pit 3's waste provides an initial representative process stream to the dryer. This allows for a realistic assessment of the facility's performance and can determine future needs or facility deficiencies at an early phase in the remediation. Pit 3 is adjacent to Paddys Run and permits an orderly sequence for reclamation. Waste Pit 1 provides an area to egress into Pit 3's bottom. Hence, the pits are excavated as a unit so that reclamation grading can direct uncontaminated runoff toward the natural drainage at Paddys Run (see Drawing 91X-5900-G-00133 Appendix B) and Subsection 5.2.1 for additional detail.

2) During progress of Pits 1 and 3 operation and excavation, Pit 2 becomes accessible and is available for excavation. Material in Pit 2 is mixed with Pit 1 and 3 waste to meet the WAC requirements. The majority of Pit 2 is excavated from the top. A limited amount of waste will be removed from bottom operations. Access into the bottom of Pit 2 is obtained through the common berm from the bottom of Pit 1.

   The mixing of pit wastes is achieved by controlling the excavation and transfer sequence from the pits as necessary. For instance, if from existing waste pit sample information, one part of Pit 2 waste and two parts of Pit 3 waste were required to reduce to the WAC level, then excavation and transfer, trucked by truck, would proceed in that fashion. Actual mixing would begin to occur as the truck loads were emptied into the bunkers in the waste preparation area.

3) Pit 4 is excavated next. Pit 4 excavation must precede the Burn Pit excavation to maintain berm stability. The Burn Pit's limits and confines are unknown; however, they are very close to those of Pit 4. It is, therefore, important to excavate Pit 4 first and not risk breaching its berm in searching for the Burn Pit's boundary. In this way the Burn Pit's excavation is free to follow a definable site. Pit 4 waste also requires mixing to meet WAC requirements. Pit 3 and Burn

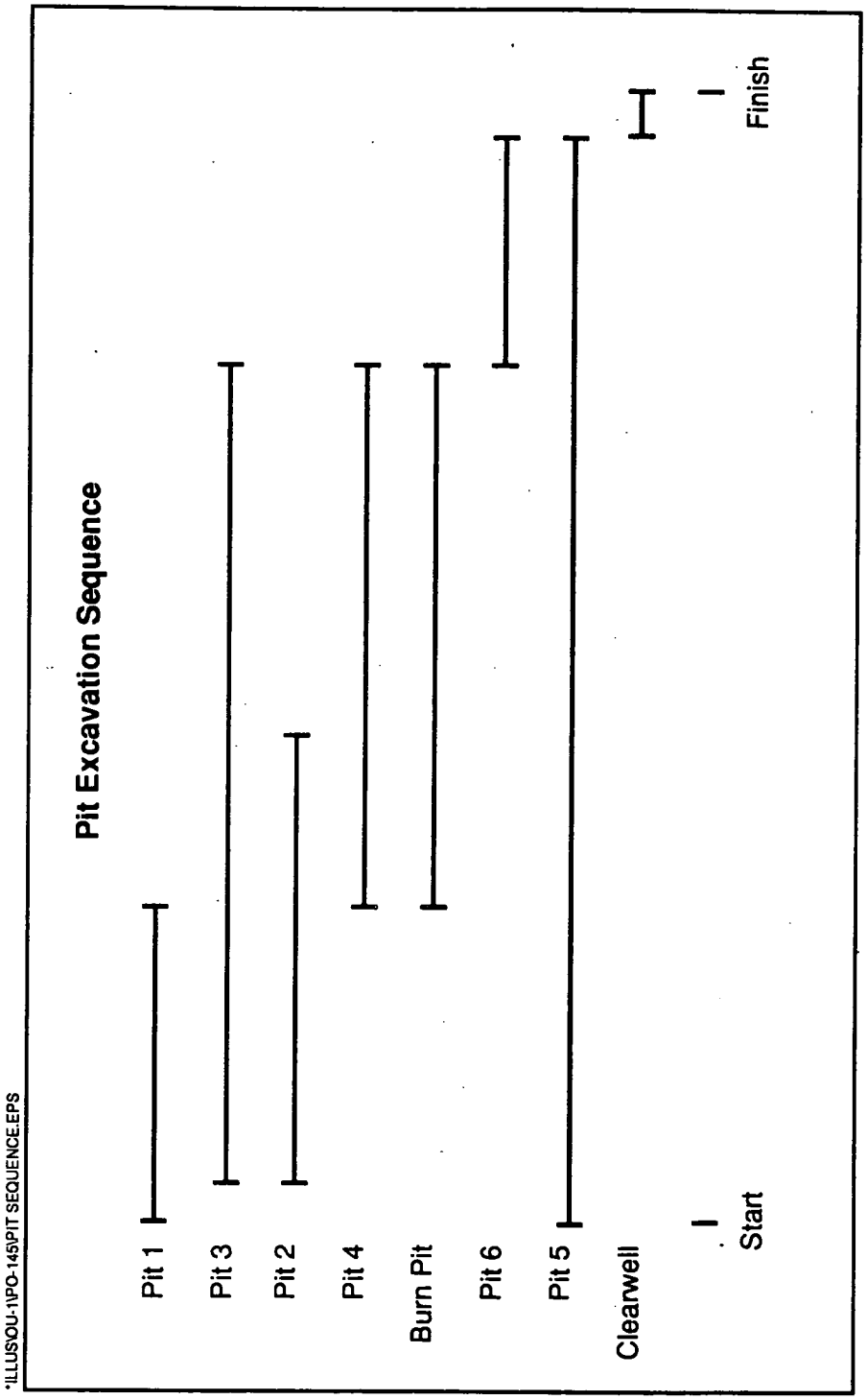

Figure 3-1 - Pit Excavation Sequence

Pit waste is available for this. The 6 foot earthen cap on Pit 4 also provides drier material for blending with wet pit wastes.

4) Waste Pit 6 is excavated after the Burn Pit followed by completion of Waste Pit 5 excavation. Excavation within Waste Pit 5 commences early in the operation but is not completed until the other areas have been reclaimed. Pit 5's surface face is cut to allow water to drain from the waste. The wastewater is conveyed by sump and pump to the Pit 5 effluent tower. Waste Pit 5's operation is extended to permit maximum wastewater drainage before excavation. Also, as quantities of drier waste (including other pit caps and underlying pit soils) become available, they are mixed with the Pit 5 wastes to keep production levels of waste product high while processing the very wet materials in Pit 5. See Drawing 91X-5900-G-00154 Appendix B and Subsection 5.2.2 for additional detail.

5) The Clearwell is used as part of the stormwater management plan throughout the project; therefore, its reclamation is last. The Clearwell is hydraulically pumped periodically to remove accumulated sediments.

Actual excavation rates (and hence, time frames) for completing each pit are tied to the capacity of the waste processing facilities and, in particular, the dryer. See Table 3-1 for in situ waste volumes. The volumes of contaminated liner and soils below the pits are unknown. The basis for WPRAP's estimated treatment volume assumes liners and 1.5 feet of soils below go to the off site disposal facility, and an additional 1.5 feet below this go to the on-site disposal facility. It is assumed for this estimate that the remaining soils meet the final remediation levels. The observational approach will be used to guide the excavation and establish the actual depths and resultant material volumes.

Excavation rates are designed to meet this demand (over one shift) and be readily adaptable to increased rates if the treatment capacity is later increased. Provisions are made for stockpiling dry cap material in the waste pit area and for a exterior waste stockpile at the facility. This will provide flexibility in management of overall waste processing activities. The exterior stockpile will normally be used for stockpiling wetter wastes that will drain over time. While providing a contingency supply, the stockpile could be periodically retrieved (for processing) and replaced after sufficient drainage had occurred.

Once soil remediation progresses to the point where the contamination levels of the remaining soils are below the final remediation levels identified in Table A-1 of Appendix A, reclamation of the pits begins. Although specifics of these reclamation activities are developed as part of the OU5 design process, it is anticipated that any existing berms that meet the final remediation levels are used as backfill to minimize the use of borrow materials from other areas. It is assumed that the berm areas contain some areas of contamination. Accordingly, prior to use of the berm areas for reclamation, these areas (and other surface soil areas within the OU1 boundary) will need to be excavated until the remaining soils are below the final remediation levels identified in Table A-1 (obtained from the OU1 and OU5 RODs).

Table 3-1 - Waste Pit Volumes[1]

Pit	Waste Volume[2] (yd^3)	Cover Volume (yd^3)	1.5 Feet Below[3] Waste (yd^3)	1.5 - 3.0 Feet Below[4] Waste (yd^3)	Total
1	66,700	1,700	5,200	5,200	78,800
2	33,200	4,200	2,600	2,600	42,600
3	213,800	93,700	13,700	13,700	334,900
4	58,200	14,600	4,700	4,700	82,200
5	97,900	NA	9,600	9,600	117,100
6	9,600	NA	1,900	1,900	13,400
Burn Pit	30,300	NA	2,200	2,200	34,700
Clearwell	4,300	NA	1,900	1,900	8,100
Total	514,000	114,200	41,800	41,800	711,800

(1) Per CRU-1 Waste Pit Data dated September 18, 1995.

(2) Includes waste and low permeability soils serving as pit liners.

(3) Approximate volume to be disposed of with the waste at the permitted commercial disposal facility.

(4) Approximate volume to be disposed of at the On-Site Disposal Facility (OSDF).

The final reclamation plan for the waste pit area is an integral part of the overall FEMP site reclamation plan developed as a part of the Soil Remediation Project design. This excavation plan only covers interim grading for free release of storm runoff to follow a general westerly flow to Paddys Run over a vegetated cover.

SECTION 4

MATERIAL CHARACTERISTICS

As part of the DEEP Program and previous geotechnical investigations at OU1, geotechnical data have been collected to provide for engineering assessment of excavation techniques best suited to remediation objectives. The following DEEP program activities and associated data have been incorporated into or considered in this evaluation:

1) Physical properties laboratory test results from Pits 1, 2, and 3 waste materials, including consolidated, undrained triaxial shear strength tests, unit weight, moisture content, other index properties, and compaction test results.

2) Physical properties laboratory test results from Pits 5 and 6 waste materials including undrained triaxial shear strength tests one-dimensional consolidation tests, unit weight, moisture content, other index properties, and compaction test results.

3) Wet excavation/slurry test data, including compaction and bearing tests.

4) Waste dewatering testing.

5) Dry excavation test data and evaluation. (Note: Although termed "dry," dewatering effects were limited.)

A DEEP report (PARSONS 1996b) is included as part of this Pre-Final design package.

4.1 Waste/Soil Characteristics for Excavation and Handling

This section provides a general description of the waste materials found in the OU1 waste pits, primarily in terms of soil material classifications. The data were primarily obtained from the OU1 Remedial Investigation/Feasibility Study (RI/FS) and University of Cincinnati Accelerated Life Testing and Environmental Research (ALTER) testing of materials obtained from small diameter samplers (split-spoon, Vibra Core, and Shelby Tube), and bulk archived sample material from auger boring and grab sampling.

The mixed waste in clay lined pits at the FEMP is, in general, a fine grained physically soil-like material. Typically each waste pit is heterogeneous, and often locally stratified. In general, the mixed waste in the pits is similar in its grain size distribution. It is composed predominantly of silt size particles. Moisture contents and limits, however, vary widely indicating that the contributing factors to plasticity and moisture holding capacity are not similar between pits. It has been found that the properties of the waste in several of the pits are affected by amorphous materials (ALTER 1994).

The pits, especially the covered pits, also contain debris of various sizes. Various debris, including large pieces of concrete rubble, coarse gravel, planks of lumber, sheet metal, metal bands, and metal wire, were encountered during DEEP wet trenching with a track hoe at various locations at Pits 1, 2, and 3.

The subsections below provides a general description of waste materials from each pit. These descriptions are generally based on data from four reports:

1) *Characterization Investigation Study, Geotechnical Evaluation of Waste Pit Material Properties, and Boring Logs* (WESTON 1988)

2) *Final Remedial Investigation Report for Operable Unit 1* (DOE 1994a)

3) *Cooperative Remedy Screenings Program*, Final Report (ALTER 1994)

4) *CRU1 Dewatering, Excavation Evaluation Program Waste Pits 1, 2, 3*, Final Report (ALTER 1995b)

5) *CRU1 Dewatering, Excavation Evaluation Program Waste Pits 5 and 6*, Final Report (ALTER 1995c).

6) PO19 Data Report, Draft Final Report (SAIC 1996)

The descriptions below for Pits 1, 2, and 3 have been updated to include data from the final ALTER Report. The DEEP report in this pre-final design package summarizes data from these and other laboratory testing. Table 4-1 reports the average initial moisture contents and initial density values along with waste volumes and total weights.

Table 4-1 - WPRAP Waste Pit Density and Moisture Content Summary

Pit	Pit Volume (yd_3)	Waste Wet Density Initial (pcf)	Waste Dry Density[2] Initial (pcf)	Initial Moisture Content (%)[1]	Initial Moisture Content (%)[4]	Wet Total Weight Waste (tons)	Dry Total Weight Waste (tons)
1	68,400	114.5	78.4	46.0	31.5	105,729	72,417
2	37,400	82.7	32.2	156.9	61.1	41,755	16,253
3	307,500	80.0	28.2	183.5	64.7	332,100	117,143
4	72,800	131.7	102.0	29.1	22.5	129,435	100,254
5	97,700	71.8	14.6	393.4	79.7	94,804	19,223
6	9,600	148.3	125.3	18.4	15.5	19,220	16,233
BP	30,300	122.0	93.4	30.6	23.4	49,904	38,211
CW[3]	4,300	104.0	65.5	58.8	37.0	6,037	3,802

Notes: 1 Moisture contents reported on dry weight basis.

2 Dry density calculated from wet density and moisture content, assuming constant volume and complete saturation.

3 Assumes same wet density and moisture content as Pit 5 due to insufficient data

4 Moisture contents reported on wet weight basis.

4.1.1 Waste Pit 1

In general, Pit 1 waste materials behave like nonplastic silts (ML) with little cohesion and low dry strength. Some coarse-grained silty sand (SM) (with nonplastic silts) and sandy elastic silt (MH) are also present. The moisture contents range from about 16 to 67 percent (by dry weight).

Petroleum odor was observed for some Pit 1 samples. This indicates that petroleum products may have an impact, aiding in its nonplastic nature and causing dried Pit 1 waste to repel water (ALTER 1994). According to another geotechnical laboratory (SAIC 1996), the dried waste materials repelled water initially, but combined with the water after extensive mixing. Observations made during the ramp and pad excavations also determined that the waste repels water.

A composite sample of nonplastic silt was formed from low-water-content, nonplastic materials (NP1) from Waste Pits 1 and 4. A standard compaction test of the NP1 material resulted in an optimum moisture content (OMC) of 13.4 percent and a maximum dry density (MDD) of 116.6 pounds per cubic foot (pcf), which compares to values for ordinary soils. A direct shear test of the remolded NP1 material resulted in a consolidated drained friction angle (ϕ_{cd}) of 40 degrees at 96 percent MDD, which is slightly less than that expected for dense sand (ALTER 1994).

Compaction tests were also performed on three other bulk samples of materials from Waste Pit 1 using either standard compaction methods or a Harvard miniature compactor (ALTER 1995b and WESTON 1988). The compaction tests resulted in MDD values of 109.4 to 117.5 pcf and OMC values of 15.6 to 20.3 percent. These values also compare to values for ordinary soils.

From nine unit weight tests of undisturbed DEEP Shelby tube samples, wet unit weight ranged from 136.8 to 83.6 pcf, and the corresponding dry unit weight ranged from 36.1 to 115.4 pcf (ALTER 1995b and SAIC 1996). Shear strength parameters were measured for two samples in Pit 1, resulting in ϕ_u values of 19 to 23.2 degrees, ϕ_d values of 30.2 to 39.0 degrees, c_u values of 4.9 to 6.7 psi, and c_d values of 0 to 3.3 psi. Slopes of 2H/1V can be maintained during Pit excavation provided drain conditions exist. Under undrained conditions a slope of 2.5H/1V can be maintained.

4.1.2 Waste Pit 2

In general, Pit 2 waste materials range in behavior from nonplastic silts and sands (silt with sand, sandy silt, silty sand) to highly plastic silts (elastic silt, elastic silt with sand, sandy elastic silt). Some lean clays and clayey sands with gravel are also present. Moisture contents range from about 17 percent (lean clay with sand) to 320 percent (nonplastic silt with sand). Moisture content of the elastic silt materials ranges from about 70 to 230 percent.

A composite sample of elastic silt (MH2) was formed to represent MH materials with lower liquid and plastic limits (typical of Pits 2 and 3). The material for this composite sample came from Pits 2 and 3. A standard compaction test resulted in an OMC of 35.4 percent and MDD of 77.8 pcf. This density is low for MH soil. A remolded, unconfined compressive strength test at 96 percent MDD and +2 percent OMC resulted in an undrained cohesion (c_u) of 1,468 psf with a brittle failure mode. A direct shear test of the remolded MH2 material resulted in ϕ_{cd} of 29 degrees at 97 percent MDD (ALTER 1994).

Additional compaction tests were performed on bulk samples from Waste Pit 2. One sample was a composite sample of silty sand (SM) from Waste Pit 2 and the Clearwell, which resulted in a MDD of 102.3 pcf and an OMC of 20.1 percent. In addition, a direct shear test was performed on the SM sample, resulting in a consolidated drained friction angle (ϕ_{cd}) of 29 degrees and a consolidated undrained cohesion value of 7.6 pounds per square inch (psi) at 97 percent MDD. The cohesion value is higher than what would normally be expected for a silty sand and may be due to using too high a strain rate during the test (ALTER 1994).

A second sample was a lean clay (CL) sample from Pit 2 resulting in a MDD of 118.7 pcf and an OMC of 14.2 percent (DEEP 1995a). The final sample was an elastic silt (MH), which resulted in a MDD of 86.3 pcf and an OMC of 17.5 percent (WESTON 1988). The results from the lean clay and the silty sand samples are consistent for these types of soils. The MDD from the elastic silt is low for MH type soils.

From six unit weight tests of undisturbed DEEP Shelby tube samples, wet unit weight ranged from 82.7 to 131.2 pcf, and the corresponding dry unit weight ranged from 31.1 to 105.7 pcf (ALTER 1995b and SAIC 1996). Shear strength parameters were measured for one sample in Pit 2. The resulting ϕ_u, c_u, ϕ_d, and c_d values were 18.0 degrees, 1.7 psi, 36.0 degrees, and 0.9 psi, respectively. Slopes of 2H/1V can be maintained during Pit excavation provided drain conditions exist. Under undrained conditions a slope of 2.5H/1V can be maintained.

4.1.3 Waste Pit 3

In general, Pit 3 waste materials range in behavior from low plasticity and nonplastic silts and sands (silt with sand, sandy silt and silty sand) to highly plastic silts (sandy elastic silt, elastic silt with sand). Some lean clays are also present. Moisture contents range from about 25 percent (silt with sand) to 270 percent. Moisture content of the sandy elastic silt material ranges from about 55 percent to 366 percent.

From 36 unit weight tests of undisturbed DEEP Shelby tube samples, wet unit weight ranged from 71.4 to 129.7 pcf, and the corresponding dry unit weight ranged from 15.3 pcf to 110.0 pcf (ALTER 1995b and SAIC 1996).

In-place strength of Pit 3 waste from the DEEP CPT probes and SPT tests indicates very low strengths over much of the Pit area (below the cap materials). Low strengths are expected to result in waste collapse at low natural slopes, which may present safety concerns and excavation inefficiencies due to flat slopes. DEEP results of 11 consolidated, undrained triaxial shear strength tests had the following results: undrained friction angle (ϕ_u) ranged from 13 degrees to 24 degrees with cohesion intercept of 0 psi to 2.4 psi, drained friction angle (ϕ_d) ranged from 28 degrees to 40 degrees, with cohesion intercept between 0 and 1.6 psi (ALTER 1995b and SAIC 1996). In addition, existing data also indicate that the moisture content for much of the waste (in situ conditions) is above the liquid limit, indicating the material could behave similarly to a fluid. This was observed during the ramp excavation. To accommodate these conditions, excavation from the top of the pit cap will allow equipment to operate on a firm foundation. Once all excavating from the cap is complete, excavating the second bench from the bottom of the Pit will allow equipment to operate on a firmer footing. Slopes of 3H/1V can be maintained during excavation of the Pit provided.

4.1.4 Waste Pit 4

In general, most of the materials sampled from Waste Pit 4 behave as either nonplastic silts (ML[NP]) or lean clays (CL). The moisture contents of the samples ranged between 10.1 and 61.5 percent (WESTON 1988 and DOE 1994). No DEEP samples were removed from Waste Pit 4, since Waste Pit 4 is currently covered with a RCRA cap composed of geotextiles.

A composite sample of nonplastic silt was formed from low-water-content, nonplastic materials (NP1) from Waste Pits 1 and 4. Compaction test and remolded physical properties of the composite sample are reported in Subsection 5.1 of this report.

Compaction tests were also performed on two other samples from Waste Pit 4. The material types of the two samples were nonplastic silt (ML[NP]) and lean clay (CL) having corresponding maximum dry densities and optimum moisture contents of 120.6 pcf and 18.2 percent and 118.4 pcf and 18.7 percent, respectively. These values are normal to high for soils with similar USCS classifications, which may be attributed to the high specific gravities (3.02 to 3.33) reported for the compaction samples form Waste Pit 4.

From unit weight tests performed on undisturbed samples from previous studies, wet unit weights varied from 110.7 to 137.7 pcf, and the moisture content varied from 15.9 to 61.5 percent (WESTON 1988 and DOE 1994).

4.1.5 Waste Pit 5

The majority of the solids portion of the Waste Pit 5 materials behave similar to elastic silts (MH). Also within Waste Pit 5 there are some silts (ML) and some nonplastic silts (ML[NP]). Initially the waste materials were placed in Waste Pit 5 in slurry form (PARSONS 1993). The Waste Pit 5 materials generally remain sludge-like, which is evident since the majority of the sample moisture contents are greater than the liquid limits reported. Water contents of the sampled Waste Pit 5 materials range from 73.4 to 1141.2 percent.

A composite sample of nonplastic silt was formed from high-water-content, nonplastic materials (NP2) from Waste Pits 5 and 6. A Standard Proctor compaction test performed on the NP2 material resulted in an OMC of 36.2 percent and a MDD of 76.9 pcf. The MDD is low and the OMC is high for soils having similar USCS classification. A direct shear test was performed on a remolded sample of NP2 material resulting in a consolidated, drained friction angle (ϕ_{cd}) of 31 degrees and a consolidated, drained cohesion value (c_{cd}) of 6.3 psi at 100 percent MDD, which is low for low-clay-content silt (ALTER 1994).

Another composite sample of elastic silt was formed from high-liquid-limit, high-plastic-limit, and high-moisture-content materials (MH1) from Waste Pit 5. A one-point Standard Proctor compaction test was performed on a sample of MH1 material resulting in a MDD value of 64.5 pcf and an OMC value of 56.0 percent (Lutz 1994). The one-point method was necessary since the results from the Standard Proctor test were determined to be erroneous. The MDD value is very low and the OMC value is very high for typical soils having a USCS classification of MH. A direct shear test was performed on a remolded sample of MH1 material, resulting in a consolidated drained friction angle (ϕ_{cd}) of 33 degrees and a consolidated, drained cohesion value (c_{cd}) of 1.2 psi at 98 percent MDD, which is average for dense

silt. In addition, an unconfined compression test was performed on a sample of the MH1 material compacted to 98 percent MDD, resulting in an unconfined compressive strength (q_u) of 2,425 pounds per square foot (psf) or an unconfined cohesion value (c_u) of 1,212 psf. The unconfined compression failure mode of the MH1 sample was brittle (ALTER 1994).

Compaction tests were also performed on four other samples of waste material from Waste Pit 5. Three of the compaction samples were classified as elastic silts (MH), and insufficient data were available to determine the classification of the fourth sample. The compaction tests performed on the MH materials resulted in MDD values ranging from to 62.5 to 65.8 pcf and OMC values ranging from 50.4 to 60.8 percent (WESTON 1988 and ALTER 1995c). The MH materials' MDD values are low and the OMC values are high for typical soils having similar classification. The fourth compaction test performed on the unclassified Waste Pit 5 sample resulted in a MDD value of 97.9 pcf and an OMC value of 26.7 percent (ALTER 1995c).

Unit weight tests performed on DEEP undisturbed-Vibracore samples resulted in wet density values ranging from 64.7 to 100.1 pcf (ALTER 1995c and SAIC 1996). Corresponding dry densities cannot be accurately determined due to the slurry nature of the Waste Pit 5 material. Upon drying, the samples would lose considerable volume due to the large volume of water present in the samples.

Shear strength parameters were measured on one vibracore sample from Boring WP5-5A. The resulting ϕ_u, c_u, ϕ_d, and c_d values were 15 degrees, 1.0 psi, 32 degrees, and 0.7 psi, respectively (SAIC 1996).

Consolidation tests were performed on three vibracore samples. The compression index values ranged from 2.7 to 3.9, which indicates the waste is very soft and compressible. The recompression index values range from 0.04 to 0.09, which is in the normal range for clay (Das 1990a). The initial void ratios range between 9.91 and 16.66, which also indicates a high potential for compressibility.

4.1.6 Waste Pit 6

The majority of the sampled materials from Waste Pit 6 behave as either nonplastic silts (ML[NP]) or silty sands (SM). In addition, one sample was classified as a silt (ML) and one sample was classified as an elastic silt (MH). Moisture contents of all the samples varied greatly from 11.2 to 425.6 percent.

A composite sample of high-moisture-content nonplastic silt material (NP2) from Waste Pits 5 and 6 was tested for compaction characteristics and physical properties on remolded samples. Results of the tests performed on NP2 were reported in Subsection 5.5 of this report.

Another composite sample of silt material (ML) was formed from Waste Pit 6 and the Burn Pit. A Standard Proctor compaction test was performed on the ML sample, which resulted in a MDD value of 99.0 pcf and an OMC value of 19.9 percent. These values are typical for soils with an ML classification.

A direct shear test was performed on a ML sample recompacted to 96 percent MDD, resulting in a consolidated drained friction angle (ϕ_{cd}) of 37 degrees, which is higher than expected values for a dense silt (ALTER 1994).

Compaction tests were also performed on four silty sand (SM) samples, one nonplastic silt (ML[NP]) sample, and one sample that had insufficient classification data. The nonplastic silt resulted in a MDD value of 101.2 pcf and an OMC of 23.0 percent, which is typical for a nonplastic silt soil. Compaction tests on the silty sand samples resulted in MDD values between 129.7 and 149.5 pcf and OMC values between 9.2 and 14.6 percent. The silty sand values are higher than expected values for silty sand, which is probably due to the higher than normal values of specific gravity (3.24 to 3.42) for soils. The unclassified sample resulted in a MDD value of 139.9 pcf and an OMC value of 11.7 percent, which is similar to the SM values from Waste Pit 6.

Unit weight tests were performed on 13 DEEP undisturbed-Vibracore samples. The resulting wet densities ranged from 83.4 to 170.2 pcf with respective dry densities of 35.4 to 148.5 pcf (ALTER 1995c). The reported values are high; the high densities may be attributed to either a combination of the high specific gravities or compaction of the samples as a result of the vibratory sampling method.

4.1.7 Burn Pit

The majority of the materials sampled from the Burn Pit behaved similarly to either silts (ML) or silty sands (SM). One sample from the Burn Pit classified as a lean clay (CL). The Burn Pit was used to burn flammable liquid and solid wastes; therefore, the silts and silty sands are, more than likely, ashes and cinders from incinerated materials. The moisture contents of the Burn Pit materials varied from 25.5 to 43.3 percent (WESTON 1988 and DOE 1994).

Compaction tests were performed on two bulk samples from the Burn Pit. The first sample was a composite sample of silt (ML) from the Burn Pit and Waste Pit 6. The Standard Proctor test resulted in a MDD of 99.0 pcf and an OMC of 19.9 percent (ALTER 1994). Results of the physical property tests performed on the composite sample are reported in Subsection 5.6 of this report.

The second sample was a silty sand (SM) bulk sample from the Burn Pit. The compaction test resulted in a MDD of 81.2 pcf and an OMC of 9.5 percent (WESTON 1988). The MDD value is low for soils with similar classification, which is probably due to the low specific gravity of the solids in the sample (2.35). Silty sand soils generally have specific gravities between 2.65 and 2.67.

A unit weight test performed on one undisturbed sample of silty sand material resulted in a wet unit weight of 101.4 pcf, a corresponding dry unit weight of 70.8 pcf, and a moisture content of 43.3 percent. Due to the large moisture content, the wet and dry unit weights were less than typical in situ densities for similar soil materials (dry densities usually vary between 87 and 127 pcf [Holtz and Kovacs 1981]).

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4.1.8 Clearwell

One-half (four) of the bulk samples removed from the Clearwell were classified as elastic silts (MH) with varying amounts of sand. The other half (four) of the samples from the Clearwell were evenly divided between either silty sands (SM) or lean clays (CL). The moisture contents of the samples varied from 35.4 to 73.9 percent (ALTER 1994). The moisture content tests were performed on archived bulk samples from the Remedial Investigation testing. The samples had been stored for at least 2 years, and the water had partially separated from the waste material (Lutz 1994), which may have caused the reported moisture contents to be low.

One compaction test was performed on a composite sample made of silty sand (SM) materials from Waste Pit 2 and the Clearwell. The compaction test resulted in a MDD of 102.3 pcf and an OMC of 20.1 percent (ALTER 1994). Results of physical property tests performed on remolded samples of the composite material is reported in Subsection 5.2 of this report.

No undisturbed samples have been removed from the Clearwell. The Clearwell was used to store liquid from Waste Pits 3 and 5 and surface runoff water from all of the Pits before pumping the effluent to the Great Miami River (PARSONS 1993). As a result of the Clearwell's use, unit weight values from either Waste Pit 3 or 5 may be an adequate estimate of Clearwell material unit weights.

Samples were collected in the north berm of the Clearwell during DEEP. Moisture content data from Boring 11574 range from 13.9 to 28.4 percent. All of the samples collected were classified as sandy lean clays or lean clays with sand (CL).

Measured wet densities, from two berm Shelby tube samples, were between 121.3 and 137.4 pcf. The corresponding dry densities ranged between 94.5 and 120.1 pcf (SAIC 1996). Shear strength parameters were measured on two Shelby tube samples using the consolidated undrained triaxial compression test, resulting in ϕ_u values of 16.0 and 22.0 degrees, c_u values of 3.5 psi, ϕ_d values of 29.0 and 28.0 degrees, and c_d values of 3.1 psi.

4.2 Potential Waste Dewatering

DEEP dewatering tests using wells and wellpoints have been conducted in Waste Pits 1 and 3 to evaluate the effectiveness of this technique to increase the strength and bearing capacity of wet pit materials prior to excavation. Trenching or ramping in the pit materials has been conducted to evaluate the degree of success of the excavation program. The results provide the bearing capacity, angle of repose, and safe, maintainable slopes.

Initial strength test data indicate, however, that dewatering is not required to excavate with reasonable efficiency and safety for the top and bottom excavation approach. If trenching/ramping tests confirm that dewatering is not necessary to achieve safe bearing capacities and slopes, then a major rationale for the use of dewatering is removed.

However, the dewatering testing did indicate that water can be removed from some waste areas through the use of wells and wellpoints. Given assumptions regarding sustainable yields and the percentage of total waste volume that can be removed as free water, the number of wells needed to achieve the greatest possible reduction in drying time has been calculated. With some conceptual planning of a dewatering system, the cost effectiveness of using this number of wells to reduce drying times could be determined. Additional savings from dewatering may result from the potential elimination of a second dryer to meet future increased production levels.

To summarize, it appears that dewatering should not be pursued as a means of enhancing soil strength and stability, but may be of value in reducing processing times. If full-scale dewatering is not found to be cost effective, other dewatering techniques (such as using wick drains, compression through surcharging or preloading the surface, gravity drainage through trenching, French drains, or other interceptor drains and sumps) may be considered.

SECTION 5

OPERATION SEQUENCE

5.1 Water Management

A key element of maintaining a workable site and reducing waste migration is water management. Wastewater is removed for treatment and stormwater is restricted to the extent possible from contacting waste. Wastewater is considered either the water currently within the waste, perched water that travels through the waste, or stormwater that has been allowed to come in contact with exposed waste. Retention, collection, and removal of water draining from the waste is expected to be difficult.

The existing Pit Stormwater Management System (PSMS), including the Clearwell, continues to be used throughout the excavation. The PSMS consists of routing stormwater and wastewater to the Clearwell and Building 18N (the Special Products Plant), then to the Biodenitrification Surge Lagoon and, finally, to treatment at the FEMP wastewater treatment system. However, due to the denuded state created by the excavation, selected water management features will probably need to be built, improved, and maintained. Approximately 15 to 20 tons/acre/year of sediment from the denuded surfaces could enter the water management system. Additional water management work includes temporary stormwater diversion berms, construction dewatering, treatment pools, and possible other dewatering/drainage techniques as noted in Subsection 4.2. Water management practices are maintained so that the water treatment facilities are not overloaded.

Temporary diversion berms are constructed before excavation begins so that stormwater is intercepted before entering uncovered waste areas. These berms are installed, removed, and relocated, as necessary, as excavation progresses. See Drawing No. 91K-5900-G-00133 for concept.

Construction dewatering is accomplished using sumps and pumps. Sump location and number is field determined. The sumps and wells are pumped into the PSMS.

It is important that the sediment is controlled so that the water treatment facilities are not overloaded. Temporary settling pools with liners with other sediment control measures (e.g., flocculate, polishers, etc.) will potentially be used to reduce solids loading. Baffles are helpful by increasing detention time, allowing more suspended solids to settle. The settling pools' purpose is twofold. First, they reduce the frequency with which the Clearwell requires maintenance and removal of the settled soils, and second, they reduce the solids entering the wastewater treatment facilities (Biodenitrification Surge Lagoon and, subsequently, the FEMP wastewater treatment system).

5.2 Excavation Approach

The excavation approach for Waste Pit 3 is described in Subsection 5.2.1 to illustrate the general excavation approach for most of the other waste areas except Pit 5, Pit 6, and the Clearwell. Pit 5 is expected to be the wettest waste area; therefore, additional waste drainage measures are warranted. As described in Subsection 5.2.2 Pit 6 excavation is similar to that of Pit 5, as is the final excavation of the Clearwell wastes.

In general, lightweight, low-ground-pressure equipment is used to excavate from on top of the cap to a safe, maximum possible depth with safe side slopes. This initial operation strips 15 to 20 feet (more, if possible) of the cap and waste, and is staged to move ahead of the second operation, taking place from the bottom of the pit (the bottom of the waste). Articulated dump trucks (approximate 20-ton capacity) haul the waste to the processing area. Low points are graded in the pit to create sumps for wastewater collection. Caution is warranted near the bottom of the waste so that sumps are not excavated into the top of the Great Miami Aquifer. Excavated dry materials are segregated and transferred to the process area.

The excavation operations allow for separate handling and transfer (to the waste processing facilities) for drier wastes and soils and also for debris encountered in the pits. At the waste preparation area of the facility, the drier materials are mixed with the wetter waste to improve handleability. Debris management starts with initial excavation and is more fully described in Appendix A and the overall Process Description for the Remediation System Design (PARSONS 1996a).

During excavation of dry materials, water sprays are used as necessary to minimize escape of fugitive radioactive contaminants to the atmosphere. These dry materials are excavated and transferred separately to the waste processing area. Dry waste, such as cap and contaminated berm material, is excavated on an as needed basis and is used for blending with wet waste.

Exposed areas, other than the working face, that are not reclaimed in a timely manner are covered with spray membranes, herculite plastic, or other suitable protection to reduce erosion and waste migration. These and other stormwater control measures are maintained throughout the excavation.

While the following subsections depict fairly definitive phases of excavation, additional phases and plans will be prepared for the other less difficult pits (Waste Pits 4 and 6, the Burn Pit, and the Clearwell). A large degree of flexibility needs to be maintained in the excavation plans.

Due to the heterogeneity of the waste pits and the lessons learned during the performance of the DEEP project, a precise mining plan would be difficult to implement during changing field conditions. Excavation face stability and angle of repose of the wastes will determine the exact method and sequence of the pit excavations, and field adjustments to the plan should be anticipated.

5.2.1 Waste Pits 1 and 3

As discussed above, the 40 foot deep excavation of Pit 3 uses a top and bottom approach that operates from stable edges (i.e., cover, bottom, or berms). An approximately 15 to 20 foot depth of material is removed from the top. The remaining waste is excavated from the bottom. A benched working face, is used throughout the operations to maintain a safe separation between top and bottom excavations and to minimize slope heights. Slopes are to maintain a 3H:1V minimum steepness. Access to the bottom of Pit 3 is obtained through Pit 1. The sequence for this entry occurs as follows:

1) Excavate waste at south and west sides of Pit 1 to approximate bottom elevation 562. Maintain stable slopes, at least 3H:1V. Maintain previously existing 3H:1V slope at east side of Clearwell (Phase 1 on drawing 91X-5900-G-00133).

2) Remove top 15 to 20 feet of waste from Pit 3 at its southeast corner. Maintain a 20-foot clearance from top of dike at Clearwell. These first two operations expose the pit berm shared by Pits 1 and 3. The actual location and configuration of this berm must be known prior to ramp construction and subsequent entry into the bottom of both pits (Phase 2 on drawing 91X-5900-G-00133).

3) Construct a cut and fill ramp in the south berm of Pit 1 to the bottom at approximately elevation 562. Ramp grades are flexible but should be kept uniform and should not exceed 8 percent. Construct a road into the Pit 1 bottom liner to the edge of the common Pit 1-3 berm. Simultaneously excavate the top 20 feet of the common berm at the point of planned entry into Pit 3. Point of planned entry needs to be established at a reasonable distance (approximately 120 feet) north of the Clearwell to permit construction of slopes and road without endangering Clearwell. All roads are established through berms or pit bottoms and not in wastes (Phase 3 on drawing 91X-5900-G-00133).

4) Excavate through the bottom portion of the Pit 1-3 common berm to begin operations from bottom of Pit 3 at approximately elevation 548 (Phase 4 on drawing 91X-5900-G-00133).

See Drawing 91X-5900-G-00133 for the plan view of the above sequence and for a section of Pit 1 ramp construction and Pit 3 benched excavation.

The areas need to be maintained and drained. Roads are crowned or pitched. Sufficient space is provided for ditches and sumps. Road surfaces consist of at least a layer of geotextile and gravel. Consideration should be given to interlocking wood mats at locations with more difficult soil conditions or high traffic areas.

The waste conditions are quite varied and will be unpredictable. Operations will need to maintain stable slopes and setback distances. See Subsection 5.6 for further discussion.

5.2.2 Waste Pit 5

In addition to the foot or more of water over the waste, Waste Pit 5 is reported as having a significant amount of liquid waste. Therefore, this pit is opened early and remains open for an extended period to allow drainage. The waste at the pit's southern boundary is trenched first. The open face is expected to release wastewater. This wastewater is conveyed to the Clearwell via an existing effluent tower and pipe. Sump pumps and pipe will be used to keep trenched excavations dry and to convey wastewater to the effluent tower. After the pit has drained as much as is practical, waste excavation is anticipated to follow similarly to the other areas. Approximately 11,000 cubic yards of berm material needs to be excavated to provide a work area so that the backhoe can reach to the bottom of Waste Pit 5. See Drawing 91X-5900-G-00154 for plan and Drawing 91X-5900-G-00134 for accompanying sections.

The sequence for waste excavation is planned as follows:

1) Widen the Pit 5 berm from 10 feet to 20 feet to permit access for excavation equipment. See Section A on Drawing 91X-5900-G-00134 for detail.

2) Excavate waste around perimeter of pit from berm using a long reach excavator. Operator needs to exercise caution near 2.5H:1V berm slopes. Water will be drained from top of waste prior to excavation and excavations will be pumped and kept dry as possible throughout construction sequence.

3) Construct a cut and fill ramp and bench at mid-height in existing 2.5H:1V berm slope around pit perimeter. Excavation of waste will occur concurrently with this operation. The integrity and function of the effluent tower needs to be maintained. Hence, bench construction will not occur at this vicinity. The excavator will cast material from the pit to the top berm. A front end loader will be used to load trucks from here. This method of operation will minimize truck traffic on the narrow bench in the berm.

4) At the end of the above operation, a mound of waste will be left in the bottom of Pit 5. The natural repose angle of Pit 5 waste is expected to be low. Hence, the resulting mound will probably be less than 10 feet in height. A ramp will be constructed on the east side of the pit to egress the bottom. Excavation will proceed from this ramp and progress west through the bottom of the pit to complete the waste's removal. It is expected that whatever is left of the Pit 5 EDPM liner will also be removed at this time.

The existing water cover at Pit 5 controls radon release from the pit waste. Additional monitoring and surveillance at the time of dewatering will determine if any radon abatement measures are required for the waste.

5.2.3 Excavation of Soils Underlying the Pits

For this Waste Excavation plan, it is assumed that upper parts of the pit liners and some areas soil below the liners must be treated and disposed of with the pit waste. Visual observation of material characteristics during the excavation operations are initially used to determine when the apparent depth of contamination is reached (i.e., limit of waste). However, following the initial cut, and at some actual deeper field-determined depth, the contamination lessens to a level at which the soil can be disposed of in the planned OSDF. This delineation of contamination level and depth (and excavation as necessary) is initially accomplished with the use of real-time field scanning equipment. Additional characterization of the incrementally excavated soil will likely be necessary to assure confidence in meeting the OSDF Waste Acceptance Criteria (WAC) or designating the soil for off-site disposal.

Similarly, at some greater depth, the soil contamination level will further lessen to the point at which it is below the final soil remediation levels identified for OU1 and OU5 and can therefore be left in place. Cleanup level confirmation sampling and site restoration is determined in a site-wide design package submitted pursuant to the OU5 remedial design process. Additional detail of this soil excavation process as described in the Draft OU5 Record of Decision is presented in Section A4.1 of Appendix A of this plan.

For purposes of preparing this excavation plan, and for developing overall project waste and soils mass balances, assumptions are made for these contaminated soil depths. The first 1.5 feet of soil below the pit liners is assumed to be treated with the waste (and disposed of off-site) and the next 1.5 feet of soil is assumed suitable for disposal in the OSDF. Below the 3-foot limit, it is assumed the soil is acceptable to be left in place.

5.3 Waste Transport

As described in Subsection 5.2, waste pits are excavated using conventional earth moving equipment such as extended reach hydraulic excavators and front end loaders. Approach ramps are excavated as required for equipment deployment and for transporting waste from the pits. During excavation, large debris is segregated from the waste based on visual observations. Waste along with some debris (that is not visually apparent) is loaded into trucks (all wheel drive articulating rear dumps) for transport to the debris management area located in the waste preparation facility.

Large debris found during excavation is loaded into trucks and transported or possibly moved by skid to a pad at the pit side. Debris segregation and processing is also discussed in Section 2.2 of Process Description and in Appendix A of this report.

All waste and debris is transported by all wheel drive articulating rear dump trucks. As necessitated by field conditions, trucks are covered with tarp during transportation of dry materials to minimize fugitive emissions to the atmosphere.

5.4 Equipment Selection Parameters

Conventional earth moving equipment such as front end loaders, hydraulic excavators, and all wheel drive articulating rear dump trucks are used for excavation and transport of waste and debris. As the excavation proceeds, excavation conditions change depending on the waste characteristics. The cap material is relatively dry and is easily excavated. However, as the excavation proceeds deeper in some of the pits, liquid waste may be encountered. For ALARA purposes equipment will have enclosed cabs with filtered intakes.

Because of the varying conditions in the pits, equipment selection takes into consideration the following parameters.

5.4.1 Debris Excavation

Some of the pits (Pits 1, 2, 4, and the Burn Pit) contain waste that has a high solids content. During excavation of these pits (and excavation of some areas of other pits), excavation equipment such as front end loaders and hydraulic excavators is used to excavate and segregate debris from the waste. If waste is deemed to be debris free it is loaded directly into trucks. However, if debris (wood pallets, concrete blocks, structural steel etc.) is encountered, it is segregated before transport to the feed preparation facility.

5.4.2 Low Ground Pressure

In Pit 3, soft footing conditions will be encountered as excavation proceeds deeper into the pits. In those conditions "swamp equipment," (i.e., equipment with wide tracks suitable for low ground pressure) is employed. The approach ramps, as well as areas being excavated, may require interlocking wooden mats, as field conditions warrant, for transport of waste out of the pits by all wheel drive articulating rear dump trucks. Trucks are equipped with flotation tires suitable for low ground pressure operations.

5.4.3 Waste Excavation and Transfer Rates

Pit waste excavation and transfer rates vary depending upon the moisture content of the waste. This is because the dryer has a maximum water evaporation capacity of 4.2 tons per hour (tph). To support dryer operations, excavation rates are lower for the wet pits and higher for the dry pits.

The highest excavation rates will be for Pits 1, 4, and 6, because when free water has drained, the contents of these pits yield the maximum dryer throughput. A maximum of approximately 4,100 tons of waste per week will be excavated for Pits 1, 4, and 6. Excavation operations are planned for 5 days per week, 8 hours per day. However, excavating operators and equipment are effective only 6 hours per day. The equipment and operator fleet is, therefore, selected to support an excavation rate of 140 tph. Excavation rates for the other pits are expected to be less.

5.4.4 Equipment Retrieval Capabilities

There is a possibility of equipment getting stuck in areas where soft footing conditions are encountered. Excavation operations will be planned so that excess equipment is available to pull equipment out of the waste. Trucks, dozers, winches, and steel cables are made available for equipment retrieval. All excavation equipment will have features so that steel cables can be easily attached in case it has to be pulled by a truck or a dozer.

5.4.5 Liquid Waste Retrieval

Some areas of the pits are extremely wet and pumping waste is a reasonable alternative for waste retrieval. A slewing/luffing crane with long reach may be needed if it is necessary to reslurry the waste.

5.4.6 Stormwater Collection

As described earlier, stormwater is collected from excavation areas and pumped to the Clearwell for settling. Also, temporary settling pools are employed prior to pumping the water to the Clearwell. If field conditions dictate, a crane may be required for deployment of the stormwater pumps. In some instances it is possible to manually deploy the pump without a crane. In that case steel cables are attached to the pump for ease of handling.

5.5 Minimization of Aquifer Infiltration

Water that percolates or travels over the waste to the pit bottom could infiltrate to the coarse sands and gravels of the Great Miami Aquifer. Pits 1, 2, 4, 5, and 6 bottoms are located approximately 10 feet above the Great Miami Aquifer materials. The top of the aquifer materials is approximately 547 feet

mean sea level elevation. Water levels in the aquifer are approximately 25 feet lower. If the pits are kept drained, no deep holes are excavated in the pit bottoms, and pit liners maintained intact as much as possible, the potential for infiltration is minimal and manageable. The actual depth and limits of the Burn Pit are not known. Pit 3 and the Clearwell have areas with 1 foot or less of separation between the waste and the Great Miami Aquifer. Some of the aquifer's sands may be contaminated. The extent and depth of contamination is not known, but will be determined during sampling and analysis after waste excavation (see Subsections 1.4 and 5.2.3).

Construction will take measures to limit and minimize infiltration, especially at Pit 3 and the Clearwell. As mentioned previously, stormwater diversion is important because it lessens the volume of water to handle or possible infiltration into the Great Miami Aquifer. Covering on inactive excavation face areas lessens water contact with waste. The sump and pumps in the bottoms of the excavation are to be kept functional and maintained. A diligent and dedicated effort to remove standing water will be followed. Exposed sand in the pit bottoms presents the most difficult condition. Based on the site and distance from the working face, various techniques can be used, such as:

1) Blend in agricultural lime, cement, or bentonite with sand to form a less permeable surface.

2) Install perforated drain lines to intercept seepage.

3) Geomembranes or sprayed membranes can be applied to pit bottoms that will remain inactive for a long period.

4) Common clayey soil can be placed. Soil may be from above pit caps, to minimize creation of new or additional waste.

Combinations of these techniques (such as combining a geomembrane with a foot of common soil) could prove effective. Use of additives and drains is more effective at or near the working face. Additives, which are especially useful in absorbing free liquids, can be broadcast and tilled in later. Care is to be exercised when using lime or cement, due to their acidic and alkaline natures. Bentonite, while more costly, is a more effective additive.

Additional study in the later stages of design will determine the most cost-effective choices. At this time, sprayed membranes appear attractive from the standpoint of easy application, minimal additional waste, and anticipated effectiveness. However, having a selection of options is probably best suited to the range of conditions that may be encountered.

5.6 Field Conditions

5.6.1 Flexibility of Operations

A wide array of field conditions will be encountered through a multitude of waste types. The waste includes wooden pallets, concrete debris, cinders, clay, sands, wet tailings, sludge, drums, metals, slag, graphite, process wastes, and perched water. Thickness of waste types varies drastically from several feet to 30 feet. Pit 5, Pit 6, and the Clearwell waste is mostly a wet consistent tailing, sludge, or sediment. Pit 1 is mostly non-plastic solids and debris. Pit 3 is the largest and most varied, and is expected to have the most difficult and uncertain conditions. The middle half or more of this pit contains a wet sludge or tailings ranging in thickness from 20 to 30 feet. Recent CPT and SPT test data show this area to have very little strength; however, results indicate sufficient material strengths for the planned excavation operations.

Operations and equipment will adapt to this wide array of wastes. Backhoes are readily adaptable to interchanging attachments. Buckets with "thumb," grapples, and hydraulic hammer attachments are considered standard standby equipment at the site. The majority of the pit wastes were end-dumped or pumped in. Hence, operations occur from pit caps, pit bottoms, and pit berms at reasonable setback distances from all open slopes.

5.6.2 Slope Stability

Waste materials need to be able to hold a stable slope to allow the safe operation of equipment during mechanical excavation. If it becomes necessary to improve strength and bearing capacity of the material, dewatering techniques using wells, drains, or other methods may be implemented.

Stable slopes for the different soil and waste material encountered will be determined and adhered to. Guidelines for determining slope stability for the various conditions will be addressed in the design and in the construction work plan. Continual observation is needed due to the multitude of waste types and conditions encountered. Qualified field personnel, knowledgeable about soil analysis and predictable hazards in excavation work, ultimately will determine the safe setback distance and stable slope to maintain. As with any excavation operation, the rules and regulations of OSHA 29 CFR, Part 1926, Subpart P, "Excavations," will be adhered to and followed.

Excavation operations from the cover will consider transitional and rotational slide failures. The cap material is composed mostly of earthen materials at a reasonable moisture and is approximately 10-feet thick at Pit 3. Excavation activities to this depth present only limited problems. Once excavation proceeds deeper than the thickness of the cap, the waste becomes exposed. In the middle of Pit 3, the waste has limited strength. Hence, toe conditions could become unstable, resulting in various degrees

and types of slide failures. Field operations will inspect toe conditions and adjust slopes of excavation, or depth as necessary. Conditions at the top of the slope, such as undercutting that leaves a ledge or tension cracks in the soil, will be monitored. Equipment will not proceed into areas with these features.

Pumping subgrade and other undesirable characteristics associated with soft and wet field conditions are expected in the pit bottoms. Equipment is to operate from an aggregate road with geosynthetics or equivalent platforms to reduce the risk of sinking and tracking waste. Truck traffic and egress from the pit bottoms is not allowed to leave a dedicated and maintained road. Use of interlocking wood mats should be considered on difficult areas (i.e., pumping subgrade).

5.6.3 Airborne Emissions

The waste pit area excavation approach and methods uses conventional soils excavation equipment, similar to many other common earthwork and earth-moving operations. In these operations, dry soil or waste particles become airborne from moving vehicles or operating excavation equipment. Activities such as dumping from a front-end loader, dropping from a backhoe or hydraulic excavator, and blending with a front-end loader all create airborne particles. As natural wind speeds increase, the dust problem increases. If wind speeds are high enough, they cause particle suspension and dispersion.

A number of dust control/suppression measures are available. Because the wastes exist in a saturated condition, dust control measures are not expected to be required on a normal basis in the waste pit area. Normally the wastes remain wet throughout their excavation and transfer to the waste preparation area.

However, for the waste haul roads, pit areas that are open but inactive, or any areas where dusting becomes or has the potential to be a problem, the following types of dust control measures will be employed.

1) Operating controls, such as truck haul speed limits and truck bed covers, are established by field conditions.

2) Water spraying outside of the pits, using recycle wastewater wherever possible, is used.

3) Chemical binders or moisture attractors are applied. The choice of chemical depends on whether there might be travel on the surface, whether it is an inactive area, and the required time for stabilization.

5.6.4 Special Features

Wastewater from Pit 5 is conveyed to the Clearwell via a 12-inch diameter pipe located along Pit 3's western berm. This pipe system must be relocated before this berm is used as backfill in reclamation.

SECTION 6

MONITORING

This section covers Air and Worker Safety Monitoring that will be conducted during waste pit area excavation operations. Ground and surface water monitoring will be implemented as part of the Aquifer Restoration Project monitoring operations.

6.1 Air Monitoring Program

Two existing air emissions monitoring programs support the OU1 remedial action; they are the Fernald Site Environmental Monitoring Program and the Occupational Air Monitoring Program. Both programs will continue to be implemented throughout the OU1 remedial action. In addition to these programs, air monitoring specific to OU1 emissions requirements will also be identified in subsequent more detailed versions of the Excavation Plan and the accompanying equipment specifications will address those requirements. The remedial action deliverables associated with the actual air monitoring operations will be identified in the Remedial Action Work Plan.

Radiological Environmental Monitoring continues under the Fernald Site Environmental Monitoring Program on a weekly basis. Data is collected during the implementation of the remedial action from air monitoring stations located on site (including four environmental air monitors in the vicinity of the waste pits), near the fenceline, and at several locations in nearby communities. The monitoring program has been developed in response to United States Department of Energy Orders 5400.1 and 5400.5 and 10 CFR 835 and is presented in the Fernald Site Environmental Monitoring Plan, PL-1002.

Additional project specific monitoring may be required based on an environmental assessment for supplemental air monitoring conducted during the remediation. During the design process computer modeling is done to derive a maximum release estimate and off-site exposures during OU1 remedial activities at the waste pits., For this modeling and release estimation, natural catastrophes (such as earthquakes) are not considered. If modeling indicates that the maximum off-site inhalation exposure due to excavation and drying of the wastes is at least 0.1 millirem (mrem)/yr., then supplemental environmental ambient air monitoring is required during remedial activities.

Air monitoring is not required if modeling indicates the maximum potential off-site inhalation exposure due to the excavation and drying of the wastes is less than 0.1 mrem/yr. However, monitoring may still be performed during these activities to provide data on the effectiveness of engineering controls or to address public concerns.

Once a decision is made to monitor the remediation activities for OU1, a project specific air monitoring program is developed. The monitoring locations, frequency of filter collection and analysis, specific analytes, etc. is determined. The following elements are evaluated to develop a project-specific, supplemental air monitoring program:

1) Project specific phases and activities that have the potential for radiological air emissions, and the type of monitoring (continuous versus grab) that should be performed. Continuous sampling is desirable if airborne radionuclide concentrations have the potential to fluctuate widely.

2) The need for pre- and post-project monitoring. This data is necessary for comparing data that is obtained during each project. Such data are also used to verify the effectiveness of control measures.

3) The potential hazard of the materials available for release, considering both the expected quantities and relative radiotoxicities. The review of previously obtained characterization data of radionuclides in a particular component, including ratios to other non-measurable radionuclides, is necessary since the control of radionuclide releases depends on the source available and any treatment system used.

4) The expected dispersion of airborne releases, including predominant wind directions and the degree to which the radionuclides of concern is diluted or reconcentrated in the biosphere. Air monitors generally concentrate downwind of the monitored area, but monitors in all directions are desirable.

5) The length of time required to complete each activity that has the potential to cause fugitive emissions.

6) Representativeness. Measurements should be made at the points/areas at which the data best represent what is being released to uncontrolled areas. These measurement points are based on the previously discussed modeling efforts and take into consideration maximum release estimates for optimal placement of the air monitors.

7) Other remedial activities being performed at the same time. More than one project may be occurring simultaneously. Project-specific monitoring with results that can be attributed solely to one project may not be possible.

8) The radionuclides or analytes to be measured. Gross radioactivity measurements will probably be inadequate, except under the following circumstances: when gross radioactivity releases are a small fraction of the off-site Derived Concentration Guide values for "unidentified" mixtures; when ratios of specific radionuclides are sufficiently known (and constant) for which gross

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activity measurements are truly indicative; and when radionuclide concentrations are so low as to preclude specific nuclide measurements.

9) Accessibility to the air monitoring station for maintenance, filter exchange, and calibration.

In addition to the air monitoring network described here, Radiological Environmental Monitoring is also conducting environmental monitoring and surveillance of radon. This program has been previously documented and discussed in the CRU1 Dewatering, Excavation, Evaluation Program. The radon monitoring program currently has several continuous radon instruments in the waste pit area. Additional monitors may be deemed necessary once project plans have been finalized.

6.2 Occupational Air Monitoring, Chemical (Volatile Organics and Heavy Metals)

Personnel monitoring for workers conducting activities associated with OU1 remedial activities is conducted to access exposure to volatile organic compounds (VOCs) and heavy metals. The VOCs and metals sampled for are based on air monitoring data collected during the DEEP.

The amount of sampling conducted is based on the task being conducted and the potential for exposure. This information is further defined as the remediation design is completed.

For personnel VOC sampling, it is anticipated that personal Photoionization Detector (PID) units with alarming features will be used along with long term sampling equipment.

For personnel heavy metal sampling, it is anticipated the personal sampling pumps with particulate filters will be used.

In addition to the personnel monitoring, area monitoring for VOCs is conducted. The VOCs are monitored using PID, FID, or other direct reading portable equipment and sorbet tubes.

At this time, the use of respiratory protection along with protective coveralls (anti-c's) is anticipated for some workers on a temporary basis. Specific personnel protective equipment requirements will be determined when the excavation plan is completed.

All Radiological Control air sampling that is to be performed during the excavations of the waste pits is intended to supply information to Radiological Engineering and Radiological Assessment (field support) for implementation of worker protection requirements. Radiological surveys (radiation and contamination) are performed to assess conditions in the work areas and are used in conjunction with the air sample data to determine personal protective requirements.

The isotope of concern for the Radiological area that isolates Waste Pits 1-4, the Burn Pit, the Clearwell, and the Pit 5 Contamination Area is Thorium-230. The Derived Air Concentration (DAC) for Th-230 is 3E-12 μCi/ml. The DAC for Radon-222 (in the Uranium-238 decay chain) progeny is 0.33 Working Levels.

6.3 Radiological Control Air Monitoring to be Performed During OU1 Waste Pit Excavations

1) All personnel entering the contamination area that isolates Waste Pits 1-4, the Burn Pit, and the Clearwell are required to wear Personal or Breathing Zone Air Samplers (Lapel Air Samplers). This is required for all thorium areas and the information is used for internal dosimetry purposes.

2) High or low volume general area air sampling (for particulates) is performed at the excavation sites and at the boundaries of the Radiological Areas. This data also aids Radiological Control in determining necessary posting requirements and ensuring proper radiological controls and personal protective measures for work activities.

3) Radon grab sampling is performed in and around the excavation and at the boundaries of Radiological Areas. The samples are taken periodically during excavation to determine radon levels in worker occupied spaces and aids Radiological Control in determining necessary posting requirements and ensuring proper radiological controls and personal protective measures for work activities.

SECTION 7

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Materials Management

APPENDIX A

MATERIALS MANAGEMENT

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MATERIALS MANAGEMENT

A.1 Introduction

A key aspect of the remediation activities for Operable Unit 1 (OU1) relates to the handling of materials excavated from the pit areas during the remedial action. The purpose of this appendix is to discuss the various forms of materials which can be expected to be generated through the OU1 excavation activities and then discuss how these materials will best be handled, with a focus on special waste handling needs. This appendix does not include materials management associated with the Decontamination and Decommissioning (D&D) activities; rather, this will be addressed through facilities D&D remedial planning documents.

For discussion purposes, this appendix presents the OU1 materials management strategy reflective of currently delineated organizational responsibilities. The organizational responsibilities generally fall within one of five Fernald Environmental Management Project remediation project designations, which, with the exception of soils remediation, are essentially aligned with the operable unit definitions contained in the United States Department of Energy's (DOE's) Amended Consent Agreement with the United States Environmental Protection Agency (US EPA). These remediation projects, as currently defined, are as follows:

1) Waste Pits Remedial Action Project - Includes the scope of activities identified in the OU1 Record of Decision (ROD).

2) Soil Remediation Project - Includes the scope of activities identified in the OU2 ROD, including the removal of source units within the OU, and all aspects of design and operation of the On-Site Disposal Facility (OSDF). In addition, the Soil Remediation Project includes the various components of the OU5 ROD associated with the sitewide excavation of contaminated soils, disposition of those soils, and sitewide restoration activities.

3) Facilities Decontamination and Dismantlement (D&D) Project - Includes the scope of activities identified in the proposed alternative for OU3.

4) Fernald Residues Vitrification Plant Project - Includes the scope of activities identified in the OU-4 ROD.

5) Aquifer Restoration Project - Includes the scope of activities identified in the OU5 ROD, except for the soil remediation activities which are part of the Soil Remediation Project.

Although responsibilities may change over time, this should have no direct relationship to the concepts presented herein.

A.2 OU1 Waste Streams

Based on process knowledge and excavation activities which have taken place through the Dewatering Excavation and Evaluation Program, various types of materials are expected to be encountered during OU1 excavation activities. These materials can be separated into two categories - OU1 Processable Waste Streams and OU1 Special Case Waste Streams. OU1 Processable Waste Streams reflect various materials which are routinely processed through the OU1 waste processing facilities, while OU1 Special Case Waste Streams reflect wastes which, by their nature, require some special handling. This includes nonprocessable wastes and other special wastes that may be processed in the OU1 remediation facility after pre-treatment, such as size reduction. The materials identified as being a part of each of these waste streams are as follows:

1) <u>OU1 Processable Waste Streams</u> - General sump sludge; neutralized raffinate; magnesium fluoride; water treatment sludge; graphite and ceramics; uranyl ammonium phosphate filtrate; ash; flyash; thorium wastes; and depleted residues, including: contaminated rags, paper, and polyethylene; dust collector bags; scrap salts (high in fluoride), including floor sweepings; contaminated soil, rocks, sand, brick, and ceramics; pit liners; furnace salt (solidified, nonchloride); dust collector residues (high fluoride, pyrophoric); dry crushed slag from furnace pot blowouts; partially oxidized metal (containing no metal-x fire retardant); bad reductions (no derbies); unrecycled slag (ball mill product); dirty prill (magnesium metal, high uranium content); reject UO_3; drum decontamination residues; magnesium oxide and magnesium zirconate from crucible cleanout; sludges (oily, high free metal); sludges (salt, soft, chloride); sludges (nonoily, low or high free metal); wet sump of filter cake (with and without oil); scrap uranium oxide U_3O_8; chips and turnings; scrap wood/wood pallets; concrete with rebar; personal protective equipment; and solid metal (other than cores) U_3O_8.

2) <u>OU1 Special Case Waste Streams</u> - Intact drums; oversized concrete with rebar; heavy gage metals; derbies; heavy equipment metals; asbestos; and transformers.

This categorization of materials provides the basis for the remainder of the discussions in this appendix. It is not the intent of this appendix to discuss routine materials management activities, but rather to focus the discussion on special handling requirements for OU1 materials. This appendix, therefore, focuses on the OU1 Special Case Waste Streams which, by their definition, require special handling. In addition, this appendix focuses on the handling of soils, which can differ from that of the other OU1 Processable Waste Stream materials depending on the levels of contamination found therein.

Subsections A.3 and A.4 provide discussion relative to the handling of OU1 Special Case Waste Streams. Subsection A.5 discusses the management of OU1 soils.

A.3 Derbies, Intact Drums, Asbestos, and Transformers

Because of the nature of these materials, or the nature of materials within them, derbies, intact drums, asbestos, and transformers are packaged to prevent possible degradation to the environment (e.g., drums to be overpacked), and transported to the Fernald site's existing and ongoing Waste Management operation where they are handled by others in accordance with existing site procedures for such wastes. This includes such things as the characterization of materials in drums, draining of fluids from transformers, treatment of any wastes from drums, transformers, etc., as necessary, appropriate packaging, and shipment for disposal to Envirocare[1], the United States Department of Energy's Nevada Test Site, etc., as appropriate.

A.4 Oversized Materials

Certain materials identified in Subsection A.2 as waste streams are identified as such primarily because of their size, including oversized concrete with rebar, heavy gage metals, and heavy equipment metals. These "oversized" materials are categorized as such because they are not amenable or readily amendable to processing through the OU1 remediation facilities. These materials are transported to the waste preparation area, or other area, where attempts are made to size reduce this material to meet the size constraints of the treatment process (primarily dictated by the shredder). Any OU1 oversized materials which are otherwise incompatible for processing through the OU1 remediation facilities, are transported to the Blending and Loadout Facility for size reduction to meet the Waste Acceptance Criteria (WAC) for the off-site disposal facility and placement in railcars for shipment to the permitted commercial disposal facility.

A.5 OU1 Soils Management

This section focuses on the extent to which OU1 soils need to be excavated, the disposition of excavated soils, and factors that, therefore, need to be considered relative to soils management.

A.5.1 Final Remediation Levels for Operable Unit 1 Soils

The selected remedy described in the OU1 ROD includes excavation of the surrounding contaminated soils within the OU1 boundary. In support of this, the ROD presents remediation levels established for

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[1] FEMP Waste Management has contracted with Envirocare for this disposal. OU1 has not yet contracted with a permitted commercial disposal facility.

both surface soils and soils beneath the waste areas, for the OU1 constituents of concern. (These levels are also presented in Tables 3-1 and 3-2 of the OU1 Remedial Design Work Plan.) These levels are protective of human health and the environment, assuming continued Federal ownership of the site as provided in the selected OU1 remedy.

The OU1 ROD states that the OU1 remediation levels discussed above will be re-examined upon finalization of the OU5 remedy decision process. Specifically, where the final remediation level for a constituent established through the OU5 remedy decision process is more restrictive (i.e., lower) than that defined in the OU1 ROD, the final OU5 remediation level will serve as the soil cleanup criteria. Table A-1 presents the OU1 final remediation levels for soils based on a re-examination against the on-property soil remediation levels identified in Table 9-3 of the Final OU5 ROD.

As is evidenced by Table A-1, the OU5 levels are more restrictive in their entirety than the OU1 surface soil levels and, therefore, are used for all OU1 surface soil excavation. The OU5 remediation levels are also used for OU1 subsurface soils, with the following exceptions:

1) OU1 levels established for technetium-99 for subsurface soils are more restrictive (i.e., lower), in every case, than the OU5 soil remediation level for technetium-99 and are, therefore, used.

2) The polychlorinated biphenyl (PCB) level established for Waste Pit 1 subsurface soils is used in conjunction with the Aroclor-specific OU5 levels. Specifically, in addition to remediating to the individual levels for Aroclor-1254 and -1260, remediation also proceeds to the extent that the level for all PCBs is below .78 ppm.

Table A-1 includes only the level of 82 ppm for less leachable forms of uranium (i.e., it does not contain the 20 ppm level for the more leachable forms of uranium). The reason for this is that according to the Final OU5 ROD, the more leachable forms of uranium are associated with soils within the former production area beneath the retired processing buildings. For soil exhibiting these less leachable forms of uranium, however, the Final OU5 ROD goes on to state that the selected remedy has adopted an As Low As Reasonably Achievable (ALARA) goal of 50 ppm of total uranium in soil.

Table A-1 - Final Remediation Levels for OU1 Soils[c]

Constituent	Final OU1 Remediation Level	Constituent	Final OU1 Remediation Level
Radionuclides (pCi/g)		**Chemicals (mg/kg) (Cont'd)**	
Cesium-137 + 1d	1.4×10^{0}	Bromomethane	8.2×10^{3}
Neptunium-237 + 1d	3.2×10^{0}	Cadmium	8.2×10^{1}
Lead-210 + 2d	3.8×10^{1}	Carbazole	1.2×10^{1}
Plutonium-238	7.8×10^{1}	Carbon disulfide	5.0×10^{3}
Plutonium-239/240	7.7×10^{1}	Carbon tetrachloride	2.1×10^{0}
Radium-226 + 8d	1.7×10^{0}	Chlordane	1.9×10^{-1}
Radium-228 + 1d	1.8×10^{0}	Chlorobenzene	3.4×10^{2}
Strontium-90 + 1d	1.4×10^{1}	Chloroform	4.5×10^{1}
Technetium-99[a]	3.0×10^{1}	Chromium VI	3.0×10^{2}
Thorium-228 + 7d	1.7×10^{0}	Chrysene	2.0×10^{3}
Thorium-230	2.8×10^{2}	Cobalt	7.4×10^{2}
Thorium-232 + 10d	1.5×10^{0}	Copper	2.2×10^{5}
Uranium, total (ppm)	8.2×10^{1}	Cyanide	1.2×10^{5}
		Dibenzo(a,h)anthracene	2.0×10^{0}
Chemicals (mg/kg)		3,3-Dichlorobenzidine	5.5×10^{-1}
Acetone	4.3×10^{4}	1,2-Dichloroethane	1.6×10^{-1}
Antimony	9.6×10^{1}	1,1-Dichloroethene	4.1×10^{-1}
Aroclor-1254[b]	1.3×10^{-1}	Dieldrin	1.5×10^{-2}
Aroclor-1260[b]	1.3×10^{-1}	Di-n-octylphthalate	1.1×10^{3}
Arsenic	1.2×10^{1}	Ethylbenzene	5.1×10^{3}
Barium	6.8×10^{4}	Fluoride	7.8×10^{4}
Benzene	8.5×10^{2}	Heptachlorodibenzofuran	8.8×10^{-4}
Benzo(a)anthracene	2.0×10^{1}	Heptachlorodibenzo-p-dioxin	8.8×10^{-4}
Benzo(a)pyrene	2.0×10^{0}	Indeno(1,2,3-cd)pyrene	2.0×10^{1}
Benzo(b)fluoranthene	2.0×10^{1}	Lead	4.0×10^{2}
Benzo(k)fluoranthene	2.0×10^{2}	Manganese	4.6×10^{3}
Beryllium	1.5×10^{0}	Mercury	7.5×10^{0}

Table A-1 - Final Remediation Levels for OU-1 Soils[c] (Continued)

Constituent	Final OU1 Remediation Level	Constituent	Final OU1 Remediation Level
Chemicals (mg/kg)		**Chemicals (mg/kg) (Cont'd)**	
Bis(2-chloroisopropyl)ether	4.2×10^{2}	Methyl-2-pentanone	2.5×10^{3}
Bis(2-ethylhexyl)phthalate	8.2×10^{2}	Methylene chloride	3.7×10^{1}
Boron	7.4×10^{3}	4-Methylphenol	2.5×10^{2}
Bromodichloromethane	4.0×10^{0}	Molybdenum	2.9×10^{3}
Bromoform	3.1×10^{1}	Nickel	1.5×10^{4}
4-Nitroanaline	1.5×10^{2}	Thallium	9.1×10^{1}
N-nitrosodiphenylamine	5.1×10^{1}	Toluene	1.0×10^{5}
N-nitrosodipropylamine	2.0×10^{-1}	Tributyl phosphate	2.5×10^{2}
Octachlorodibenzofuran	8.8×10^{-3}	1,1,2-Trichloroethane	4.3×10^{0}
Octachlorodibenzo-p-dioxin	8.8×10^{-3}	Trichloroethene	2.5×10^{1}
Pentachlorophenol	2.3×10^{0}	Vanadium	5.1×10^{3}
Selenium	5.4×10^{3}	Vinyl chloride	1.3×10^{-1}
Silver	2.9×10^{4}	Xylenes, total	9.2×10^{5}
Tetrachloroethene	3.6×10^{0}	Zinc	1.2×10^{5}

[a] The soil remediation levels for technetium-99 for the following OU1 areas (as identified in the OU1 ROD) are more restrictive than the level identified in this table, and will, therefore, serve as the final remediation level for technetium-99 for the respective area:

Waste Pit 2 Subsurface Soils - 5.5×10^{0} pCi/g
Waste Pit 3 Subsurface Soils - 7.5×10^{-1} pCi/g
Waste Pit 4 Subsurface Soils - 2.6×10^{-1} pCi/g
Waste Pit 5 Subsurface Soils - 1.4×10^{0} pCi/g
Waste Pit 6 Subsurface Soils - 7.3×10^{0} pCi/g
Burn Pit Subsurface Soils - 1.4×10^{1} pCi/g
Clearwell Subsurface Soils - 9.9×10^{0} pCi/g

[b] The PCB level established for Waste Pit 1 subsurface soils will be used in conjunction with these Aroclor-specific levels. Specifically, in addition to remediating to the individual levels for Aroclor-1254 and -1260, remediation will also proceed to the extent that the level for total PCBs is below 0.78 ppm.

[c] Based on integration with Final OU5 ROD remediation levels

The Fernald site will apply available hand-held instrumentation to help guide excavation and assist in identifying any isolated areas of higher contamination to help attain this ALARA goal.

A.5.2 Soils Disposition

Another key component of the selected remedy described in the OU1 ROD is that residual contaminated soils are dispositioned consistent with the selected remedies for contaminated process area soils documented in the Final OU5 ROD. The OU1 ROD further states that any materials not amenable to the OU5 remedy will be disposed as waste materials (i.e., shipped off site). This section addresses this component by first presenting the selected remedy for OU5 with respect to soils remediation, and then discussing how this soils remediation strategy will be implemented in terms of OU1 remediation activities.

A.5.2.1 OU5 Selected Remedy

The selected remedy described in the Final OU5 ROD consists of several key components associated with soil (and sediment) remediation.

There are several key elements of the selected remedy in the August 1995 Draft OU5 ROD which relate to excavation. Specifically, excavation includes verification sampling to establish excavation boundaries, excavation of soils to the extent necessary to attain the final remediation levels, and performance of a certification sampling program following excavation activities to demonstrate that the final remediation levels have been attained.

In terms of the disposal of soils, the two key elements identified in the Final OU5 ROD are the transportation and on-property disposal of excavated material attaining the OSDF WAC, and the transportation and off-site disposal of excavated material exceeding the OSDF WAC. As can be seen here, the key to this disposition strategy is the ability to meet the WAC for the OSDF for OU5 materials. Table A-2 presents the OU5 OSDF WAC, as identified in Table 9-7 of the Final OU5 ROD.

Table A-2 - Operable Unit 5 On-Site Disposal Facility Waste Acceptance Criteria

Constituent of Concern	Maximum Concentration	Constituent of Concern	Maximum Concentration
Radionuclides (pCi/g)		**Organic (mg/kg) (Cont'd)**	
Neptunium-237	3.12×10^{9}	Heptachlor epoxide[a]	*
Strontium-90	5.67×10^{9}	Hexachlorobutadiene[a]	*
Technetium-99	2.91×10^{1}	Methoxychlor[a]	*
Uranium, total (mg/kg)	1.03×10^{3}	Methylene chloride[a]	*
Organics (mg/kg)		Methyl ethyl ketone[a]	*
Acetone[a]	*	Methyl isobutyl ketone[a]	*
Alpha-chlordane	2.89×10^{0}	4-Nitroaniline	4.42×10^{-2}
Benzene[a]	*	Tetrachloroethene[a]	1.28×10^{2}
Bis(2-chloroisopropyl)ether	2.44×10^{-2}	Toluene[a]	*
Bromodichloromethane	9.03×10^{-1}	Toxaphene[a]	1.06×10^{5}
Carbazole	7.27×10^{4}	1,1,1-Trichloroethane[a]	*
Carbon tetrachloride[a]	*	Trichloroethene[a]	1.28×10^{2}
Chloroethane[a]	3.92×10^{5}	Vinyl chloride	1.51×10^{0}
Chloroform[a]	*	Xylenes[a]	*
Chloromethane[a]	*	**Inorganics (mg/kg)**	
1,1-Dichloroethane	*	Barium[a]	*
1,2-Dichloroethane[a]	*	Boron	1.04×10^{3}
1,1-Dichloroethene[a]	1.14×10^{1}	Chromium VI[a]	*
1,2-Dichloroethene[a]	1.14×10^{1}	Lead[a]	*
Endrin[a]	*	Mercury[a]	5.66×10^{4}
Ethylbenzine[a]	*	Silver[a]	*
Heptachlor[a]	*		

[a] RCRA-based constituent of concern.

* Denotes compounds that will not exceed designated Great Miami Aquifer action level within the 1,000-year performance period, regardless of starting concentration in the disposal facility.

Several of the Resource Conservation and Recovery Act (RCRA) constituents shown in Table A-2, including a number of the RCRA organic solvents, do not have a calculated WAC value because the OU5 modeling simulations show that these constituents do not have the capability to exceed designated Great Miami Aquifer action levels within the 1,000-year simulation period, regardless of the starting concentrations for these constituents in the disposal facility. However, the mass balance approach applied in the modeling does not consider the potential deleterious effect that full-strength solvents can have on the earthen material comprising the disposal facility liners or the underlying native clays. Full strength solvents have been proven to cause shrinking of clays with a resulting potential for increases in clay liner permeability. As a best management practice for these compounds, the Fernald site acknowledges that it cannot place any RCRA Constituents of Concern into the disposal facility at concentrations that are incompatible with the clay liners or the underlying native clays beneath the liners. To track these concentrations during the excavation control surveys, field screening methods will be relied on to identify the soil that is contaminated with RCRA organics. This soil will be segregated for treatment before placement in the OSDF or shipped for off-site disposal.

In addition, through the identification of specific geographical areas in the Final OU5 ROD, where efforts will be made to identify and segregate for treatment (as needed) the soil that qualifies as RCRA characteristic waste, it is envisioned that no significant quantity of RCRA characteristic materials will be placed in the OSDF.

Key elements of the OU5 selected remedy, which relate to the treatment of soils, include the application of cost-effective treatment (e.g., thermal desorption) for soil that exceeds the WAC due to the presence of nonradiological constituents. Additionally, continuation of efforts to examine and apply, where practical, emerging technologies pertaining to treatment of soil and sediment occurs.

A final element of the OU5 selected remedy relates to the implementation of the remedy, and hence, is a focal point of the discussions which follow. Specifically, the Final OU5 ROD states that soil excavation and interim storage will be conducted consistent with the requirements of the US EPA-approved Removal Action (RA) 17 Work Plan (Improved Storage of Soil and Debris) until such time as the appropriate OU5 remedial design is approved by the US EPA. The OU5 remedial design deliverable addressing soil management practices during the remedial action will contain the final strategy for excavation and interim storage/staging of contaminated materials originating from OU5. At this point, RA 17 will be terminated, and soil and sediment excavation activities will be conducted in accordance with the approved remedial design plan.

A.5.2.2 Overall OU1 Soils Disposition Strategy

This section discusses how the selected remedy for OU5 soils, as discussed in Subsection A.5.2.1 is implemented in terms of OU1 remediation activities. Specifically, the discussion focuses on the overall concept for OU1 soils management based on the elements discussed above.

Soils Generated Prior to Opening of the OSDF

Under this scenario (i.e., prior to the opening of the OSDF), the only soils that are assumed to be generated by OU1 are soils removed during initial site preparation activities.

As is indicated in Subsection A.5.2.1, until such time as the appropriate OU-5 remedial design is approved, soils management is conducted consistent with the requirements of the US EPA-approved RA 17 Work Plan. Rev. 3 of the RA 17 Work Plan provides a strategy based on approved RODs or anticipated remedies, such as the selected remedy in the Final OU5 ROD. In terms of soils management, one of the goals of Rev. 3 of RA 17 is to minimize the total number of soil staging areas for the Fernald site by providing an integrated implementation strategy (which can be achieved through the application of soil staging criteria). In general, therefore, the following storage/staging strategy will be applied to OU1 soils generated prior to the opening of the OSDF:

1) Soils which meet the WAC for the OSDF could be managed with soils from other projects destined for on-site disposal, including potential management in a single central storage area.

2) Soils which do not meet the WAC for the OSDF because they contain organic matter in excess volumes could be managed with like soils from other projects, including potential management in a single central staging area, until such treatment can be applied.

3) OU1 soils destined for eventual treatment in the OU1 remediation facility (for disposal off site), including those which do not meet the on-site WAC, will be stored and appropriately managed (e.g., appropriate fugitive emissions controls) within the OU1 boundary.

It should be noted that construction rubble could also be generated during site preparation activities. Because this rubble is destined for eventual treatment in the OU1 remediation facility (in accordance with Section A.4), it will also be stored and appropriately managed within the OU1 boundary.

Soils Generated After the OSDF is Open

Prior to the opening of the OSDF, the Soil Remediation Project will be developing remedial planning documents for approval, which will provide details associated with the management of soils destined for

placement in the OSDF. Once the Soil Remediation Project remedial planning documents are approved relative to material handling for the OSDF, any subsequent OU1 activities which result in the generation of materials which can be placed into the OSDF will be performed in a coordinated sitewide manner in accordance with these documents.

Within the OU1 remedial facilities, storage areas have been identified for soils, with these areas generally representing feed piles leading into treatment, and storage in preparation for loading, primarily for shipment for off-site disposal. Those OU1 soils destined for the OSDF will be segregated and managed in one of these areas, as necessary, to effect a coordinated transfer of these materials to the Soil Remediation Project for placement in the OSDF.

A.5.2.3 Disposition of OU1 Waste Pit Soil Cover

An exception to the strategy presented in Subsection A.5.2.2, is that the waste pit cover soils are stockpiled during excavation, for possible blending with other OU1 wastes. Processed wastes that are characterized and determined to exceed the WAC of the permitted commercial disposal facility are loaded into railcars and mixed with the cover soil in a proportion determined to meet the permitted commercial disposal facility WAC, thereby minimizing the quantity of wastes requiring shipment and costly disposal at the Nevada Test Site. Any cover soils remaining after remediation of the waste pits are treated and characterized for placement in the OSDF, maximizing the quantity of waste pit cover soils disposal in the OSDF.

A.6 Summary

Figure A-1 provides a summary of the various materials management strategies presented in this appendix. Figure A-1 reflects management for placement of any materials in the OSDF by the Soil Remediation Project.

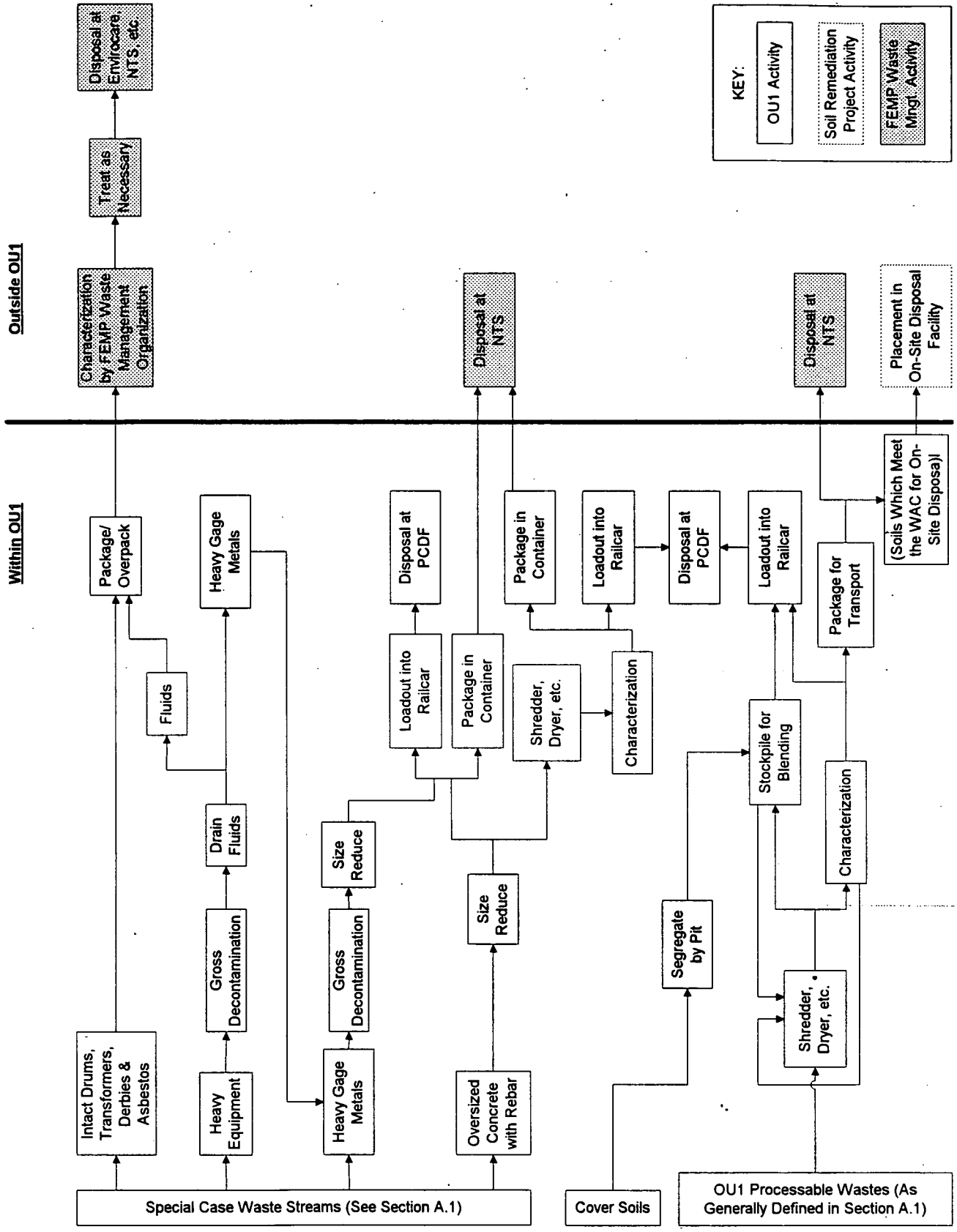

Figure A-1 - OU-1 Materials Management

Conceptual Drawings

APPENDIX B

CONCEPTUAL DRAWINGS

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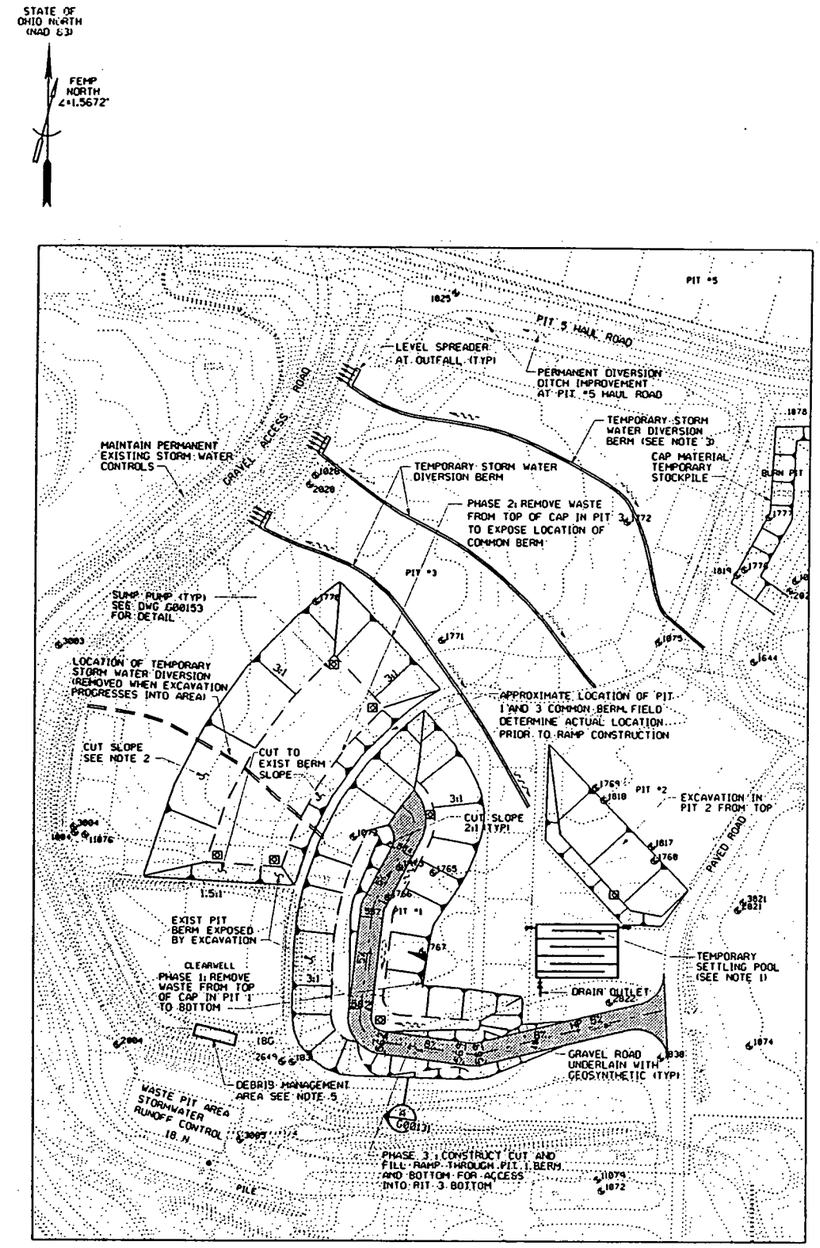
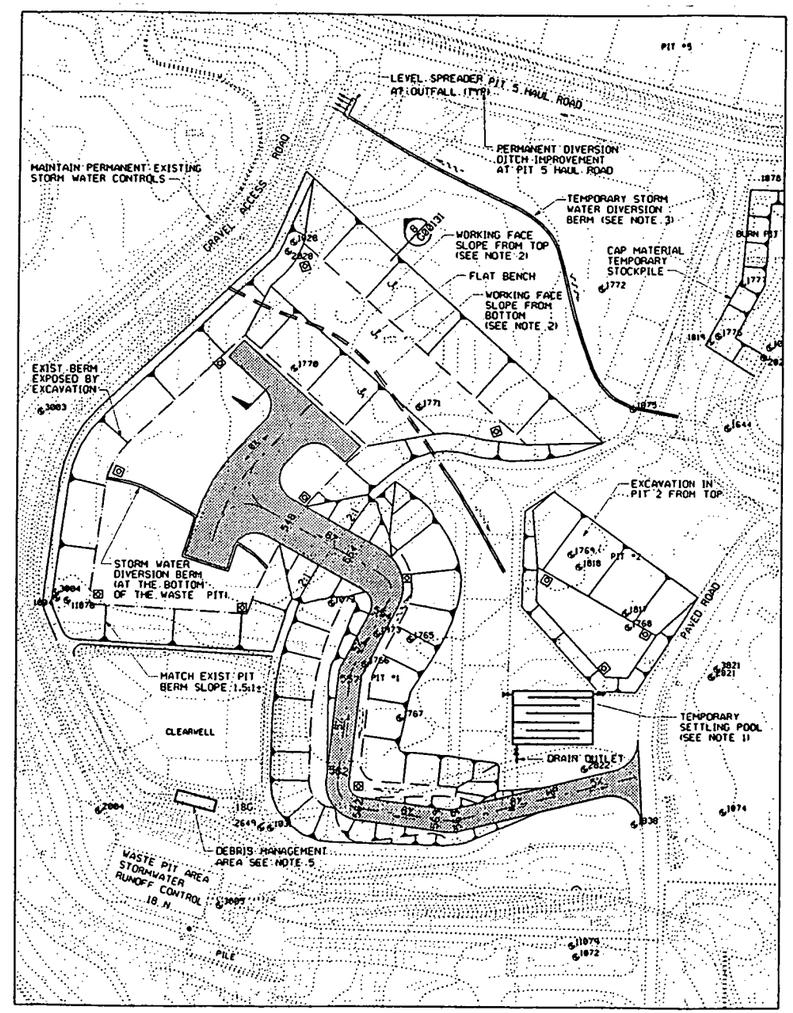


PLAN PHASE 1, 2, & 3



PLAN PHASE 4

NOTES

1. TEMPORARY SETTLING POOL WILL RECEIVE STORM WATER PUMPED FROM PIT BOTTOMS. PRIMARY PURPOSE IS FIRST STAGE SETTLING OF SUSPENDED SOLIDS TO REDUCE LOAD OF SEDIMENT AT CLEARWELL. POOL COULD BE A 3' HIGH FREESTANDING STRUCTURE WITH LINER. BAFFLES ARE OPTIONAL, BUT WOULD INCREASE DETENTION TIME NEEDED TO SETTLE SOLIDS. LOCATION TO BE FIELD DETERMINED AND WILL CHANGE AS EXCAVATION PROGRESSES.
2. 3H:1V SLOPE IS SHOWN. ACTUAL SLOPE ANGLE WILL BE FIELD DETERMINED BY QUALIFIED PERSONNEL BASED ON FIELD CONDITIONS ENCOUNTERED.
3. TEMPORARY STORM WATER DIVERSION BERM TO BE INSTALLED AT START OF CONSTRUCTION AND RELOCATED AS NECESSARY.
4. SUMP PUMP PITS SHALL BE FIELD LOCATED AT EDGE OF MUCK OR WET AREA AND MAINTAINED AS NEEDED.
5. DEBRIS MANAGEMENT AREA IS A CONCRETE PAD WHICH DRAINS TO THE CLEARWELL.

LEGEND

EXISTING		PROPOSED
	CONTOUR	565
	ROAD	
	STRUCTURE	
	FENCE	
1644	MONITORING WELL	
	SLOPE	
	SWALE	
	SUMP PUMP PIT	

REF DWG NO.	DRAWING TITLE
91X-5900-G-00131	PIT 1 AND 3 - EXCAVATION SECTIONS
91X-5900-G-00153	DETAILS

000062

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
C	ISSUED FOR EPA SUBMITTAL PRE FINAL DESIGN		NA	03/28/96
B	ISSUED FOR 90% DESIGN REVIEW		NA	11/29/95
A	ISSUED FOR 60% DESIGN REVIEW		NA	

DETAILS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
OU1 REMEDIATION SYSTEM DESIGN
WASTE EXCAVATION PLAN

DRAWING TITLE
CIVIL
PIT 1, 2, AND 3 EXCAVATION PLAN

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
M. LIU	09/22/95			K. GERARD	09/25/95

R.W.P./FIELD NO.	FLOOR	SCALE	CLASS
		1"=60'	

SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL
A-E DATE	NA DATE
	NA

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
WPRAP/P0145		WSB 1.1.1.1.1.3.1 00-90701	91X-5900-G-00133	G0001	C

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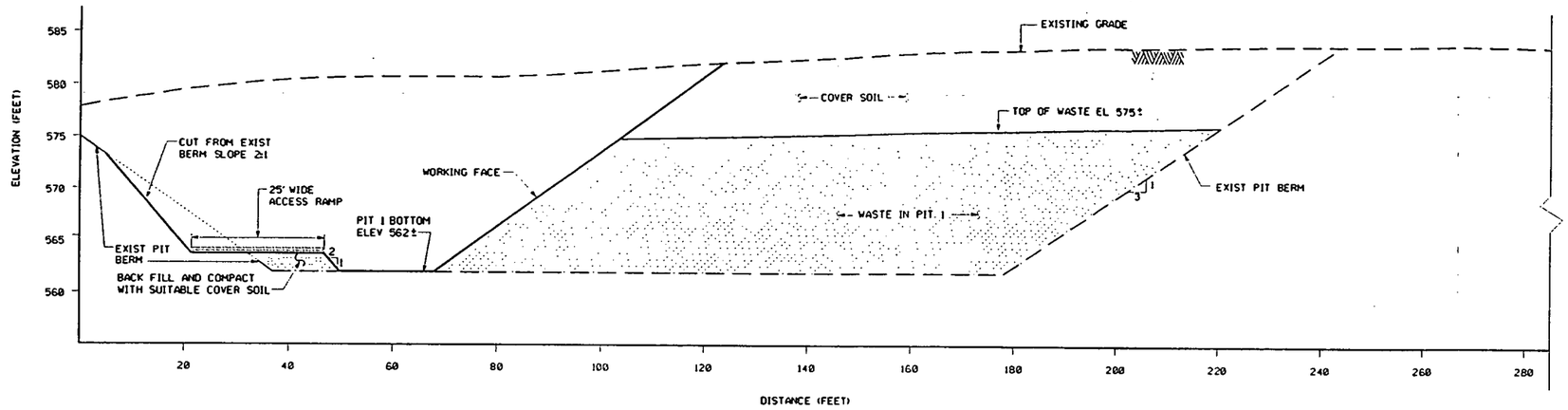

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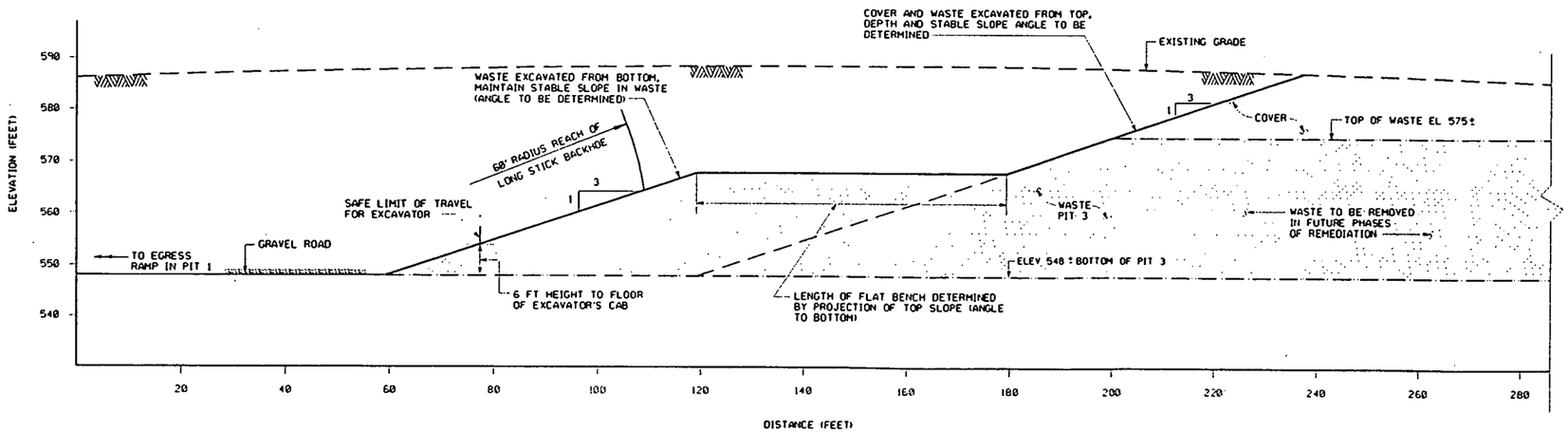
V : 1"=5'



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NOTES

236

REF DWG NO.	DRAWING TITLE
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000063

PRELIMINARY
NOT FOR CONSTRUCTION

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B	ISSUED FOR 90% DESIGN REVIEW		NA	8/23/95
A	ISSUED FOR 60% DESIGN REVIEW		NA	

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PROJECT NAME
OU1 REMEDIATION SYSTEM DESIGN
WASTE EXCAVATION PLAN

DRAWING TITLE
CIVIL
PIT 1 AND 3
EXCAVATION SECTIONS

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
W. LIU	9/23/95			K. GERARD	9/25/95

PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		AS SHOWN	

SUBMITTED FOR APPROVAL	TERMCO CRU APPROVAL
A-E DATE	NA DATE NA

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	A-E PROJECT NO.	TEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
WPRAP/P0145		VBS 1.1.1.1.1.31 00-90701	91X-5900-G-00131	G0002	C

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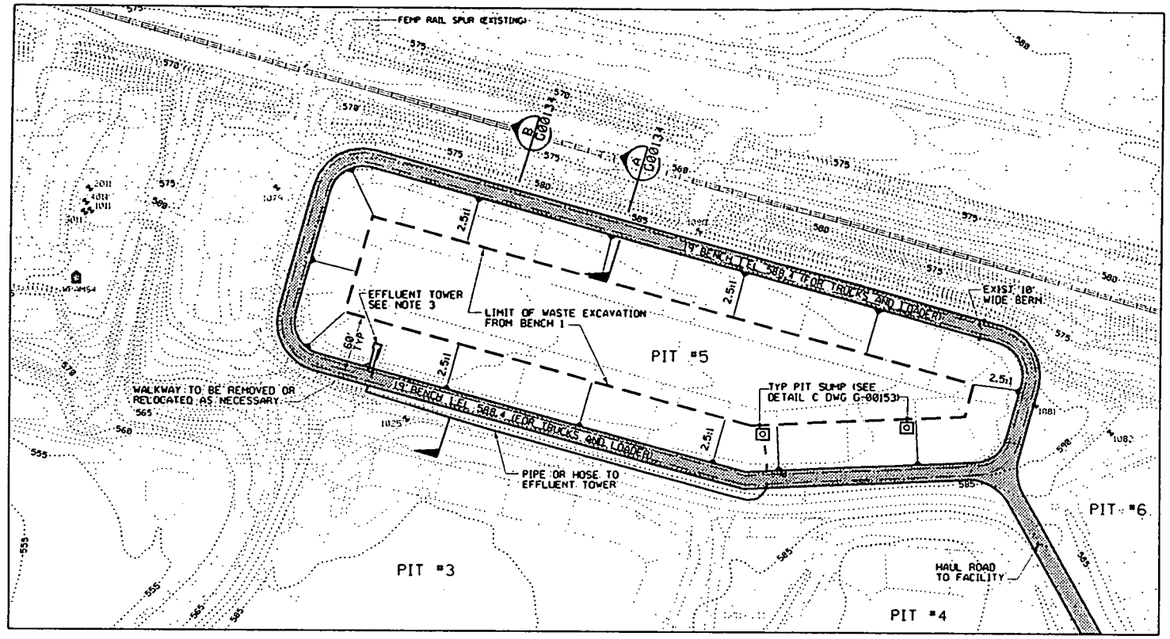
STATE OF OHIO NORTH (NAD 83)

FEMP NORTH ∠+1.5672°



PHASE 1 EXCAVATION PLAN

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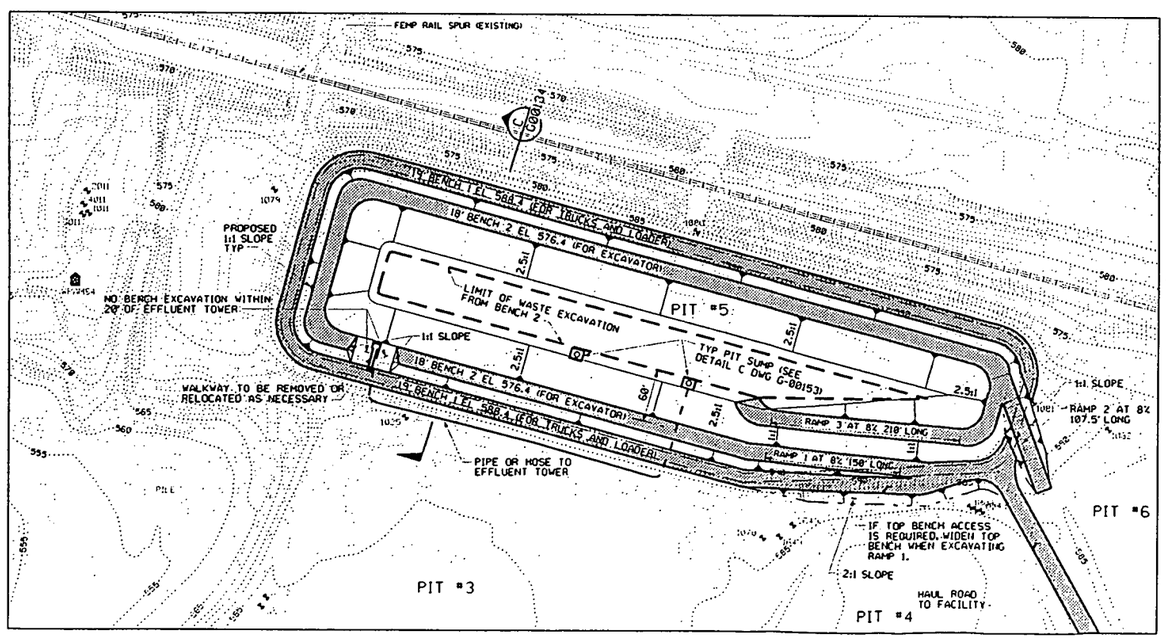

PHASE 2 EXCAVATION PLAN

SCALE : 1"=60'

NOTES

1. EXISTING CONDITIONS SHOWN ON THIS DRAWING WERE PREPARED FROM FEMP SITE PROVIDED DATA FROM THE DOCUMENTS LISTED BELOW.

   EXISTING SITE DATA SOURCE (IN PLANT FILES)
   FEMP CADD GRID/UTILITY DRAWINGS
   FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS

2. DESCRIPTION OF LONG REACH EXCAVATOR OPERATION:

   EXCAVATE EXISTING TOP OF BERM 2.0' DEEP MAKE THE BENCH 1 FROM 10' TO 19' WIDE FOR LONG REACH EXCAVATOR SPACE REQUIRED.

   LONG REACH EXCAVATOR WITH MINIMUM 60' ARM AND 38' DUMPING HEIGHT TO REMOVE WASTE AND LOAD INTO TRUCKS FOR TRANSPORT TO DISPOSAL AREA.

   EXCAVATE 150 FEET RAMP 1 AND 107.5 FEET RAMP 2 AT 8% SLOPE TO THE 18 FEET WIDE BENCH 2 TO ALLOW LONG REACH EXCAVATOR FOR SECOND REMOVAL.

   EXCAVATE 210 FEET RAMP 3 AT 8% SLOPE TO THE BOTTOM OF THE PIT FOR THE FINAL REMOVAL.

   MAINTAIN SPACING OF OPERATION SEQUENCES ALONG THE BENCHES AND RAMPS UNTIL EXCAVATION IS COMPLETED.

3. POND IS TO BE DRAINED AND MAINTAINED IN A DRAINED STATE. POOL LEVEL CONTROLLED AT EFFLUENT TOWER IS TO BE LOWERED TWO FEET BEFORE BERM IS WIDENED AND PROGRESSIVELY LOWERED DURING CONSTRUCTION.

LEGEND

EXISTING		PROPOSED
	CONTOUR	565
	ROAD	
	RAIL ROAD	
	STRUCTURE	
	FENCE	
	MONITORING WELL	
	SLOPE	

REF DWG NO.	DRAWING TITLE
91X-5900-G-00134	PIT 5 EXCAVATION SECTIONS
91X -5900-G-0015	DETAILS

000064

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FEMPCO	DATE
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B	ISSUED FOR 90% DESIGN REVIEW		NA	10/21/95
A	ISSUED FOR 60% DESIGN REVIEW		NA	

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
OU1 REMEDIATION SYSTEM DESIGN
WASTE EXCAVATION PLAN

DRAWING TITLE
CIVIL
PIT 5
EXCAVATION PLAN

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
K. TANG / W. LIU	08/14/95			E. KUBRIN	08/18/95

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1"=60'	

SUBMITTED FOR APPROVAL	FEMPCO CRU APPROVAL
NA	NA

A-E DOE PROJECT NO.	DATE	FEMP PROJECT NO.	DATE	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
		VS8 1.1.1.1.1.3.1 00-90701		91X-5900-G-00154	G0003	C

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
WPRAP/P0145

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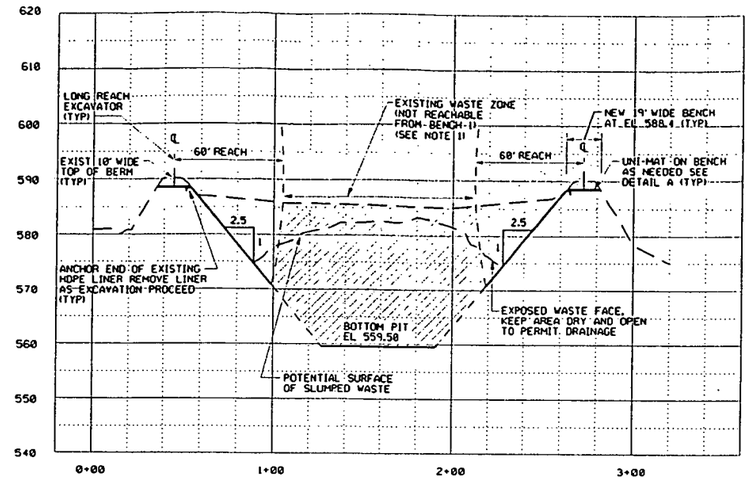

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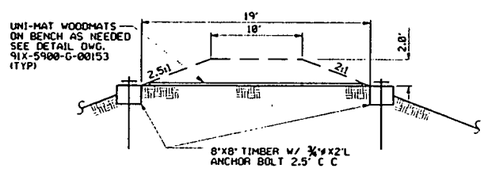
VERT 1" = 10'



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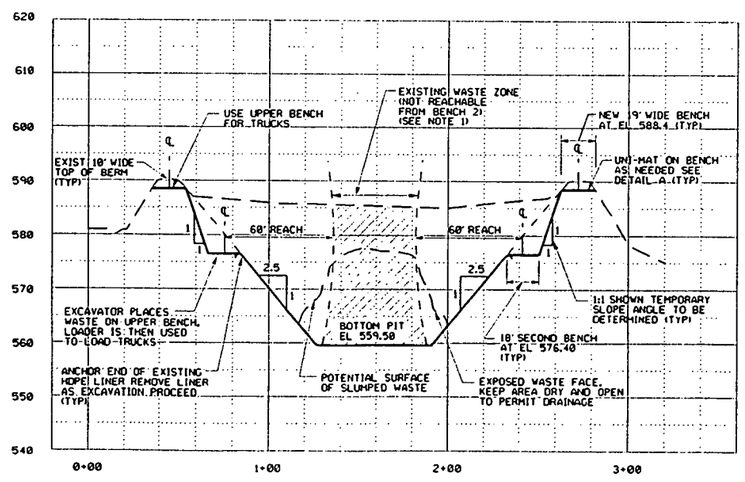

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HOR 1" = 30'
VERT 1" = 10'

NOTES

1. WASTE IS EXPECTED TO SLUMP TO A LOWER ANGLE. REPOSE SLOPE ANGLE TO BE DETERMINED.

236

REF DWG NO.	DRAWING TITLE
91X-5900-G-00154	PIT 5 EXCAVATION PLAN

000085

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
C	ISSUED FOR EPA SUBMITTAL PRE FINAL DESIGN		NA	11/28/95
B	ISSUED FOR 90% DESIGN REVIEW		NA	10/23/95
A	ISSUED FOR 60% DESIGN REVIEW		NA	

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
OU1 REMEDIATION SYSTEM DESIGN
WASTE EXCAVATION PLAN

DRAWING TITLE
CIVIL
PIT 5
EXCAVATION SECTIONS

DRAWN BY	DATE	LEAD DRAFTER	DATE	CHECKED BY	DATE
K. TANG / V. LIU	8/16/95			D. REED	8/17/95

PLANT/BLDG. NO	FLOOR	SCALE	CLASS
		AS SHOWN	

SUBMITTED FOR APPROVAL	FERNCO CAU APPROVAL	
	NA	NA

A-E LEAD PROJECT NO	DATE	TEAM PROJECT NO	DATE	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO
		VBS 1.1.1.1.3.1 00-90701		91X-5900-G-00134	G0004	C

PREPARED UNDER PARSONS PROJECT UNDER NUMBER WPRAP/P0145

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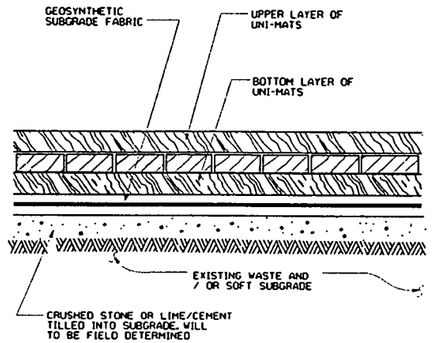
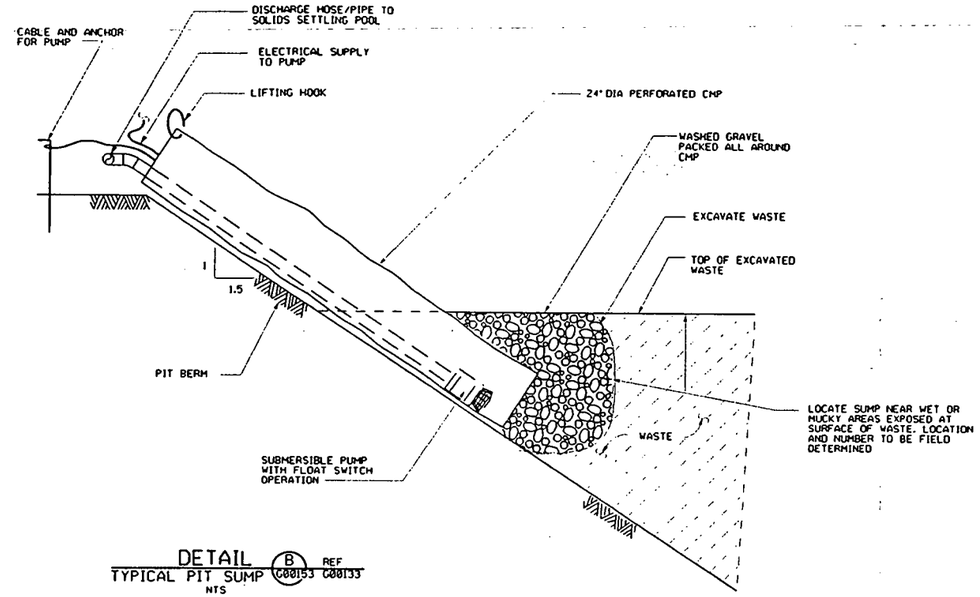


DETAIL (A) REF C00153 C00133
TYPICAL UNI-MAT ROAD
NTS



DETAIL (B) REF C00153 C00133
TYPICAL PIT SUMP
NTS

NOTES

236

REF DWG NO.	DRAWING TITLE
91X-5900-G-00133	PIT 1 AND 3 EXCAVATION PLAN
91X-5900-G-00154	PIT 5 EXCAVATION PLAN

000086

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
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B	ISSUED FOR 90% DESIGN REVIEW		NA	10/23/95
A	ISSUED FOR 60% DESIGN REVIEW		NA	

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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PARSONS
THE RALPH M. PARSONS CO. - PARSONS MAIN, INC. - ENGINEERING-SCIENCE, INC.
CINCINNATI, OHIO

PROJECT NAME
OU1 REMEDIATION SYSTEM DESIGN
WASTE EXCAVATION PLAN

DRAWING TITLE
CIVIL
DETAILS

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
K. TANG	8/18/-95			D. REED	8/18/95

PL.MNT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	

SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL	
	NA	NA

A-E	DATE		DATE			
DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING SHEET CODE NO.		SHEET NO.	REV. NO.
	VBS 1.1.1.1.3.1 00-90701	91X-5900-G-00153		G0005	C

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
WPRAP/P0145

TECHNICAL SUMMARY OF DEEP
TEST DATA

236

Technical Summary of DEEP Test Data

Operable Unit 1
Project Order 145
March 1996
Revision 0

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

PARSONS

25 Merchant Street
Cincinnati, Ohio 45246

000007

Technical Summary of DEEP Test Data

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LIST OF ACRONYMS AND ABBREVIATIONS

ALTER	Accelerated Life Testing and Environmental Research
ARA	Applied Research Associates, Inc.
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CPT	Cone Penetrometer Test
DEEP	Dewatering and Excavation Evaluation Program
DOE	United States Department of Energy
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
ft	foot (feet)
GIS	Geographical Information System
GMA	Great Miami Aquifer
gpm	gallons per minute
MDD	Maximum Dry Density
OMC	Optimum Moisture Content
OU	Operable Unit
pcf	pounds per cubic foot
psf	pounds per square foot
RCRA	Resource Conservation and Recovery Act
sec	second
SPT	Standard Penetration Test
3-D	three-dimensional
WPRAP	Waste Pits Remedial Action Project

SECTION 1

INTRODUCTION

This document presents geotechnical interpretations, analyses, and evaluations based on field and geotechnical laboratory data collected in the Operable Unit 1 (OU1) area at the Fernald Environmental Management Project (FEMP) as part of the Dewatering and Excavation Evaluation Program (DEEP). These geotechnical data include results of slug tests, cone penetrometer tests (CPTs), Standard Penetration Tests (SPTs), visual logging of test borings, wet trenching, test dewatering, and ramp and pad excavations at Pits 1, 2, 3, 5, and 6. Geotechnical soil sampling was performed in conjunction with the test borings at Pits 1, 2, 3, 5, and 6. This report summarizes the final results of geotechnical laboratory tests on samples from test borings at Pits 1, 2, and 3 test borings completed in October 1994. Data included in this report is from the Burn Pit, Clearwell, and Pit 4 were collected during the RI/FS.

Seven additional test borings were conducted in Pits 1, 2, and 3, and the Clearwell berm in August 1995, and a crane-mounted VibraCore sampler collected samples at 40 locations in Pits 5 and 6. Results of geotechnical laboratory testing of samples collected during the 1995 field activities are presented in this report. Samples were also collected for geotechnical testing during trenching activities.

There are numerous reasons for collecting the DEEP data, as can be found in the DEEP Data Quality Objectives (DQOs). However, these can be combined into three general purposes:

1) To provide engineering input to an assessment of excavation techniques best suited to remediation objectives

2) To develop a data base for assessing laboratory test results as they relate and can be extrapolated to actual physical conditions, and correlation to CPT and SPT data.

3) To provide material property parameters for waste process design

The data received by PARSONS to date from the DEEP for Pits 1, 2, 3, 5, and 6 were used for preliminary analyses and evaluation of in situ dewatering and mechanical excavation of these Pit wastes. The preliminary analyses, described in Section 4, consider the slope stability and bearing capacity of Pit 3 waste material during mechanical excavation. This section also summarizes preliminary evaluation of well or well point systems for use in waste dewatering prior to and during excavation. Section 2 described the DEEP testing program as performed.

Section 3 summarizes index properties, including moisture content, density, and plasticity. These properties provide data that can be used to establish a basis for process design, which includes drying the waste. Index property data from geotechnical testing conducted prior to the DEEP Project were used to supplement the DEEP index properties data base. Section 3 also includes available physical in situ properties of the waste materials currently consisting of shear strength parameters only. Finally, compaction characteristics and remolded physical properties of various bulk samples from all the Waste Pits are presented in Section 3.

Based on the preliminary analyses described in Section 4 and the current design data needs, recommendations for additional testing are provided in Section 5.

SECTION 2

TESTING PROGRAM

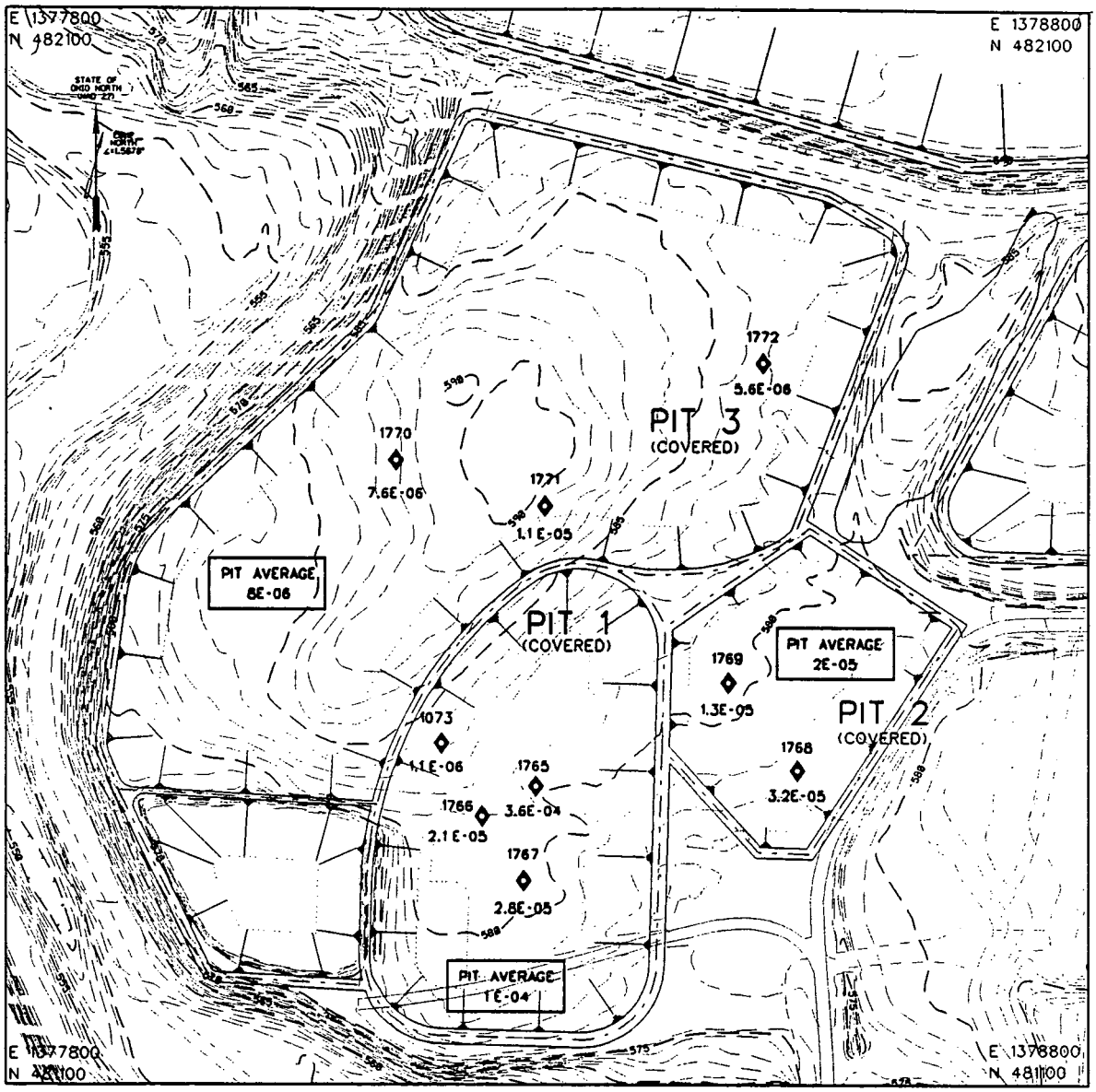
Fernald Environmental Restoration Management Corporation (FERMCO) conducted a treatability study to evaluate dewatering and mechanical excavation of waste materials in three covered Waste Pits and two open Pits in the OU1 area at the FEMP site. *Operable Unit 1 Dewatering Excavation Evaluation Program Treatability Study Work Plan* (DOE 1994a), prepared and amended by FERMCO Comprehensive Environmental Response, Compensation, and Liability Act/Resource Conservation and Recovery Act (CERCLA/RCRA) Unit 1, describes the objectives and activities of the treatability study. As part of the treatability study, geotechnical data collection activities at Waste Pits 1, 2, 3, 5, 6, Burn Pit, and Clearwell have been conducted. Field slug tests were performed at nine existing monitoring wells in covered Pits 1, 2, and 3. Geotechnical test borings and cone penetrometer tests in Pits 1, 2, and 3 were conducted to provide data regarding physical properties of the waste in existing "wet" conditions. Geotechnical samples have also been removed from test borings in Pits 5 and 6 using a vibratory sampler. Geotechnical samples taken from the test borings have been transferred to two different geotechnical testing laboratories. Final geotechnical laboratory test results are available for Pits 1, 2, 3, 4, 5, 6, Burn Pit, and Clearwell and are located in Appendix F. Trenching was conducted under wet conditions using a tracked excavator at a total of seven locations in Pits 1, 2, and 3. The first phase of test dewatering was performed in Pits 1 and 3. Ramp and pad excavations were performed in Pits 1 and 3.

The following subsections summarize the DEEP field activities conducted. Section 3 summarizes the final results of geotechnical laboratory testing.

2.1 Slug Tests

As part of the DEEP, to evaluate dewatering and excavation conditions within Waste Pits 1, 2, and 3, during March and April, 1994 (see Figure 2-1),FERMCO performed field slug tests on nine existing monitoring wells located in the Waste Pits, and forwarded the data to PARSONS for analysis (PARSONS 1994). Wells 1073, 1765, 1766, and 1767 are located in Pit 1. It should be noted that, judging from the boring log, Well 1073 appears to have been drilled in the berm of the Pit and, therefore, is screened largely in materials not representative of waste materials. Wells 1768 and 1769 are located in Pit 2; wells 1770, 1771, and 1772 are located in Pit 3.

In general, falling head field tests were performed by initially measuring undisturbed water levels by hand, then inserting a slug to perturb the water level and digitally capture water level versus time data as the well water level returned to near initial conditions. Rising head field tests were similarly performed by withdrawing the slug and digitally logging water level recovery.



NOTE: ALL HYDRAULIC CONDUCTIVITIES ARE STATISTICAL MATCH RISING HEAD VALUES.

0 100 200 FT
SCALE

1772 ◆ 5.6E-06 MONITORING WELL SHOWING WELL NUMBER AND HYDRAULIC CONDUCTIVITY IN (cm/sec)

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Figure 2-1 - Slug Test Locations and Results

The objective of the slug tests in existing wells was to develop an approximate sense of the range of hydraulic conductivity values that can be anticipated for Pit Waste materials in the vicinity of the well screens. Figure 2-1 presents a Waste Pit area well site map that includes rising head hydraulic conductivities for each well, and conductivity averages for each Pit.

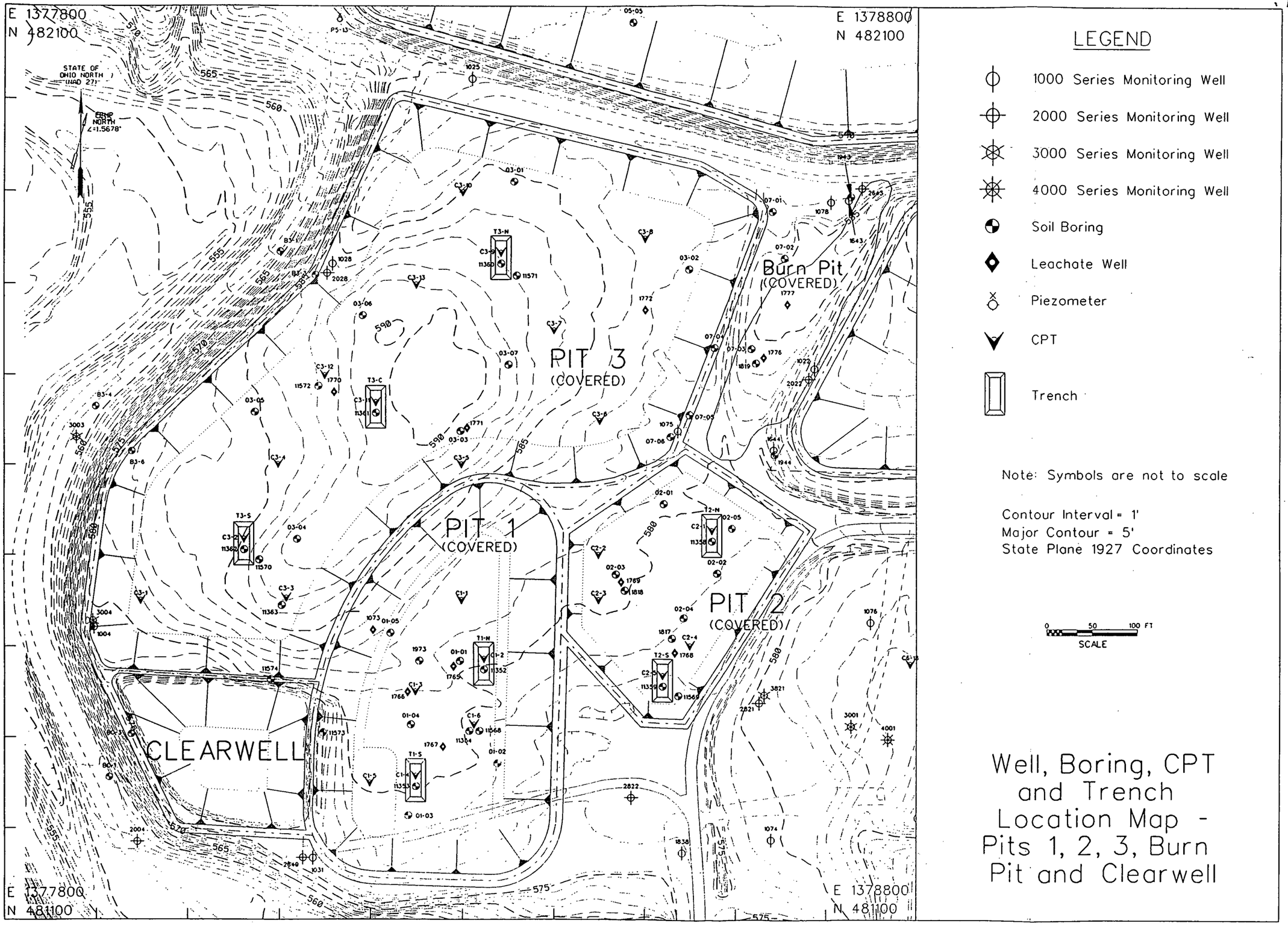
From the slug tests, some general observations can be made regarding the permeability characteristics of the wastes. Pit 1 wastes show slightly higher hydraulic conductivities than Pit 2 wastes, which show slightly higher conductivities than Pit 3 wastes (see Figure 2-1). Although the hydraulic conductivity ranges vary slightly, it can be concluded that the waste materials in Pits 1 and 2 typically show modal conductivities on the order of 10^{-5} cm/sec, whereas Pit 3 waste materials show hydraulic conductivities on the order of 10^{-6} cm/sec. No general trends within each Pit were noted.

2.2 Cone Penetrometer Testing

Applied Research Associates, Inc. (ARA) conducted Piezo-electric CPTs at Waste Pits 1, 2, and 3 from August 23, 1994, to September 2, 1994. The tests were conducted with a penetrometer truck having an overall push capacity of 45,000 pounds. Twenty-three CPT probings were conducted at Waste Pits 1, 2, and 3: six at Waste Pit 1, five at Waste Pit 2, and 12 at Waste Pit 3. Figure 2-2 shows the CPT locations. Data from these tests represent existing water conditions.

A penetrometer probe of standard dimensions was used and advanced at a constant rate. Inside the probe, load cells independently measure the vertical resistance against the conical tip and the side friction along the sleeve. Forces are sensed by the load cells and the data are transmitted from the probe assembly via a cable within the push tubes. A pressure transducer located behind the tip in the lower end of the probe measures penetration probe pressure. Typically a set of data is recorded each second, for a minimum resolution of one data point every 0.8 inch. The depth of penetration is measured using a string potentiometer mounted on the push frame.

Electronic data acquisition equipment for the cone penetrometer consists of a computer with a graphics monitor and a rack of eight signal conditioners. Analog signals transmitted from the probe are amplified, filtered, and digitized. The digital data are then read into memory and written to an internal hard disk for future processing. Upon completion of the test, raw data are translated via a soil-specific algorithm and plotted. Floppy disks containing data are brought to ARA for analysis and preparation of reports. Following these tests, PARSONS was also provided copies of the floppy disks. PARSONS developed CPT logs for Waste Pits 1, 2, and 3 from the ARA digital data. Appendix A contains these preliminary CPT logs.



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OU-1\PO-145\JAN1996\DEEPRPT

Figure 2-2 - Well, Boring, CPT, and Trench Location Map - Pits 1, 2, and 3, Burn Pit, and Clearwell

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2.3 Test Borings

Standard Penetration Tests (SPT) (ASTM D 1596) were performed in conjunction with geotechnical sampling at Waste Pits 1, 2, and 3 from October 4 to 11, 1994. Nine borings were completed: three in Waste Pit 1 (11352, 11353 and 11354), two in Waste Pit 2 (11358 and 11359), and four in Waste Pit 3 (11360 through 11363). Figure 2-2 shows the locations of the test borings. Data from these borings represent existing water conditions. Hollow stem auger drilling methods were used to advance the test borings. SPTs were performed in each test boring at planned depth intervals. A FERMCO field geologist visually logged split-barrel samples. Thin-walled samples (Shelby Tubes) (ASTM D 1587) were collected in undisturbed material in advance of the auger at planned depth intervals. Selected geotechnical samples were sent to an on-site geotechnical laboratory for testing. At the completion of sampling, all borings were backfilled with Volclay grout. Geotechnical testing results of samples collected from these test borings are available (ALTER 1995a).

To provide correlation data for the CPT probes, these nine borings in Waste Pits 1, 2, and 3 were located within about 10 feet of a CPT location. Section 4 contains additional discussion of SPT/CPT correlation.

Seven additional geotechnical test borings were completed at Waste Pits 1, 2 and 3 from August 7 through 16, 1995: one in Pit 1 (11568), one in Pit 2 (11569), three in Pit 3 (11570, 11571, and 11572), and two in the Clearwell berm bordering Pits 1 and 3 (11573 and 11574). Figure 2-2 shows the test boring locations. Boring 11573 did not intercept the clay berm at the anticipated depth and was terminated in cover waste material at 16.5 feet. Boring 11574 intercepted the berm at about 15 feet and was terminated at 35 feet. Shelby Tube sampling was conducted as described above to provide additional samples for strength tests to support slope stability analyses. The test borings in the Pits were located near the locations of the borings completed in October 1994 to allow for comparison of test results. Selected geotechnical samples were sent to a geotechnical laboratory for testing. The geotechnical laboratory data are available (SAIC 1996).

In addition to the above-mentioned geotechnical test borings, Figure 2-2 also includes locations of test borings from the following geotechnical studies:

1) *Characterization Investigation Study, Geotechnical Evaluation of Waste Pit Material Properties, and Boring Logs* (WESTON 1988)

2) *Final Remedial Investigation Report for Operable Unit 1* (DOE 1994)

3) *Waste Pits 3 and 5 and Clearwell Dikes Stability Analysis Report* (PARSONS 1992)

Forty vibracore test borings were conducted at Waste Pits 5 and 6 during July 1995: 28 (WP5-1 through WP5-14 and WP5-1A through WP5-14A) in Pit 5 and 12 (WP6-1 through WP6-7 and WP6-1A through WP6-5A) in Pit 6. Figure 2-3 shows the vibracore test boring locations along with test borings from previous geotechnical studies, including:

1) *Characterization Investigation Study, Geotechnical Evaluation of Waste Pit Material Properties, and Boring Logs* (WESTON 1988)

2) *Final Remedial Investigation Report for Operable Unit 1* (DOE 1994)

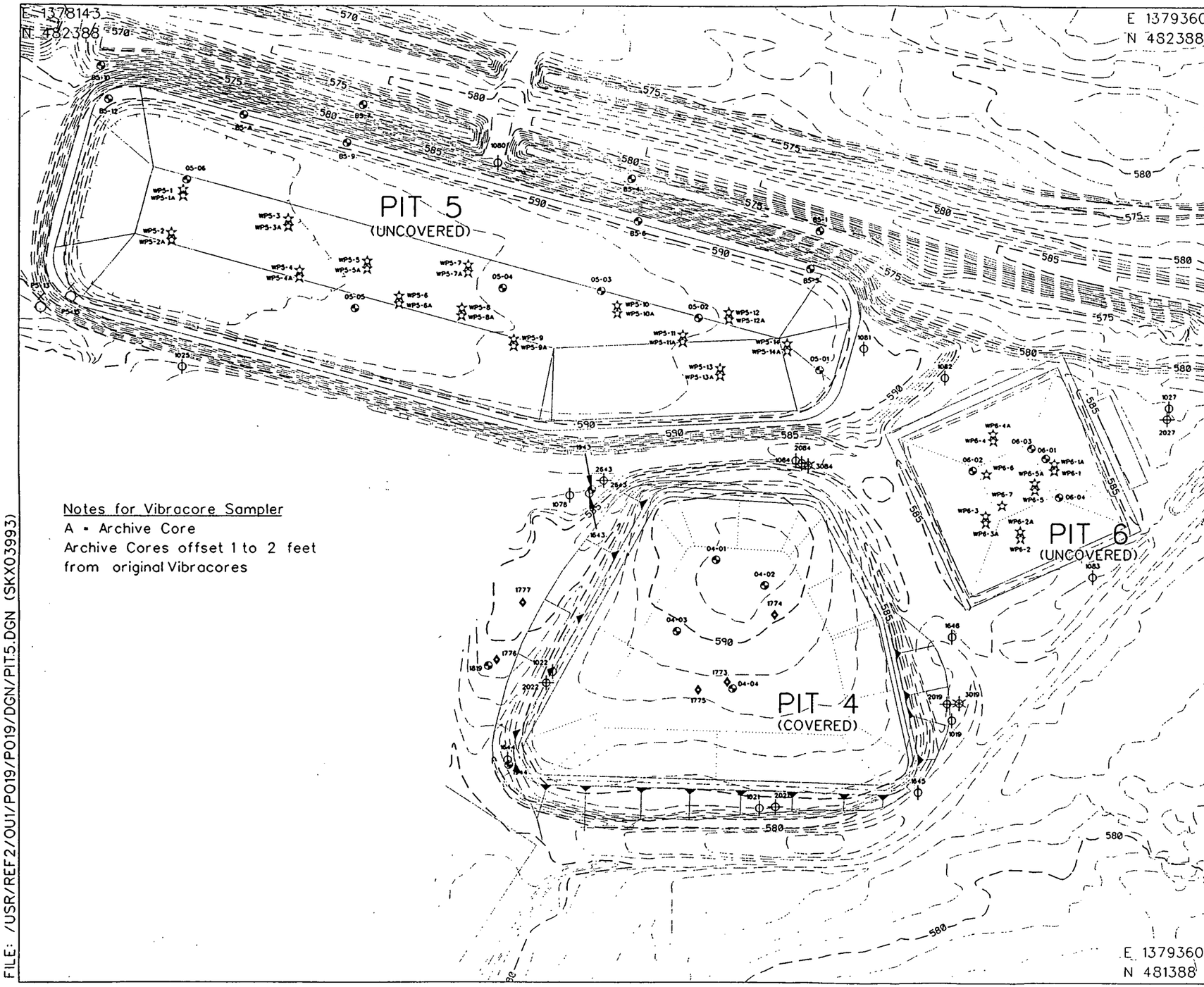
3) *Waste Pits 3 and 5 and Clearwell Dikes Stability Analysis Report* (PARSONS 1992)

Selected geotechnical samples were sent to two different geotechnical laboratories. Table 2-1 is a cross-reference of the geotechnical test borings or wells and the studies in which they were performed.

Table 2-1 - Geotechnical Test Boring and Well Cross-Reference for OU1 Waste Pits

Type	Identification	Reference Report
Monitoring Wells	1000 series	(DOE 1994)
Leachate Well	1000 series	(DOE 1994)
Geotechnical Test Boring	1000 series	(DOE 1994)
Monitoring Wells	2000 series	(DOE 1994)
Monitoring Wells	3000 series	(DOE 1994)
Monitoring Wells	4000 series	(DOE 1994)
Geotechnical Test Boring	01-01 through 06-04	(WESTON 1988)
Geotechnical Test Boring	B3-1 through B3-6	(PARSONS 1992)
Geotechnical Test Boring	BC-1 and BC-3	(PARSONS 1992)
Geotechnical Test Boring	B5-1 through B5-12	(PARSONS 1992)
Piezometer	P5-13 and P5-15	(PARSONS 1992)
Vibracore Test Boring	WP5-1 through WP6-7 and WP5-1A through WP6-5A	*
Geotechnical Test Boring	11352 through 11361	*
Geotechnical Test Boring	11568 through 11574	*

* - indicates that results of data are first presented in this report



Notes for Vibracore Sampler
A - Archive Core
Archive Cores offset 1 to 2 feet from original Vibracores

LEGEND

- 1000 Series Monitoring Well
- 2000 Series Monitoring Well
- 3000 Series Monitoring Well
- Soil Boring
- Leachate Well
- Vibracore Sampler
- Piezometer

Note: Symbols are not to scale

Contour Interval = 1'
Major Contour = 5'
State Plane 1927 Coordinates

0 50 100 FT
SCALE

Well and Boring Location Map - Pits 4,5 and 6

2-7

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Figure 2-3 - Well and Boring Location Map - Pits 4, 5, and 6

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Appendix B contains draft logs for the test borings from the July 1995 and August 1995 DEEP geotechnical investigations.

2.4 Wet Trenching

A total of seven wet (not dewatered prior to excavation) trenches were excavated in Pits 1, 2 and 3 as part of DEEP for the purpose of evaluating conditions of the waste, and to provide information about dewatering and/or excavating a wet waste. A John Deere 690D LC tracked excavator (track hoe) was used to perform test excavations at seven locations at Pits 1, 2 and 3 (see Figure 2-2). FERMCO conducted the trenching from February 1 through March 14, 1995.

The trenches were conducted, using the track hoe, at seven locations that had a prior CPT sounding and a geotechnical test boring. The excavation site was prepared for spoil piles prior to the excavation. Plastic sheets were placed on the ground surface in the vicinity of the location to collect and direct drainage from the spoil pile back to the trench. A temporary berm around the perimeter of the spoil pile areas was formed using hay bails and plastic sheets. The trench was dug between two spoil pile areas. One spoil pile was for the cover material and the other for the waste. Tanks (3,000 - 8,000 gallon capacity) at each trench location collected water that was pumped from the trench during excavation.

Excavation proceeded by creating a rectangular trench about two bucket widths wide (30 inches wide, 0.79 cy heaped bucket), resulting in a planned width of 5 feet total. The length of the trenches was about 20 to 25 feet. The long axis trended along a north-south line, with the track hoe positioned at the north end of the trench. Excavation was performed so the trench wall slope remained as steep as possible, permitting observation of trench sidewall failure. The backhoe's full reach allowed for an excavated depth of 15 feet. As the trench wall material collapsed into the trench, it was excavated from the Pit and placed on the spoil pile. The final width of the trench at ground surface varied from 5 to 30 feet, depending on the amount of sidewall failure. A field engineer recorded observations during the excavation.

During the trenching, a FERMCO sampling technician collected samples bucket of the waste materials directly from the track hoe, the materials as they were taken from various depths within the trench. Excavated materials were then placed in the prepared spoil pile areas. Additional material samples were collected from the waste spoil pile prior to backfilling the trench. A 5-gallon plastic bucket of waste material was collected from each trench. Only compaction tests were reported for these samples. Moisture content, classification, and bearing ratio data were not reported by the laboratory. Additionally, waste material from each of the trenches was archived in white steel boxes for future testing by FERMCO.

FERMCO videotaped excavation operations at each location. The videographer was positioned above the trench location with a four-wheel drive man-lift.

Appendix C summarizes field observation notes completed by the field engineers during trenching operations.

2.5 Dewatering

B&B Drilling, Inc. performed the first of three phases of a dewatering test program for Pits 1 and 3 from July 27 to August 19, 1995. The primary objective of Phase I was to determine whether groundwater could be extracted from Pit 1 and 3 sludges. If extraction was judged feasible, further objectives were to determine optimum well installation technique and well yield. Phase II of the study was to determine sludge hydrology, well spacing, and the effect of certain enhancements to well efficiencies. Phase III presented a plan to perform pilot-scale dewatering operations in Pits 1 and 3.

Starting on July 27, 1995, a linear array of wells, wellpoints, and instruments were installed in Pit 1 using various combinations of drilling techniques. Figure 2-4 shows a plan view of the array. Both wells had screen and riser diameters of 4 inches, while both wellpoints had screen and riser diameters of 1.5 inches. All wells and wellpoints were screened from 7 to 12 feet of depth. The pore pressure piezometer was screened by a canvas bag over an interval of 10 to 12 feet of depth, and the tensiometer tip was installed at a depth of 6.5 feet. Figure 2-5 shows the location of the array within Pit 1.

The well designated as DW1-1 on Figure 2-4 was installed using direct rotary techniques with water only. Well DW2-1 was installed in a similar fashion, except that the borehole was flushed with fresh water after drilling. Wellpoints WP1-1 and WP2-1 were both installed by the jet method, the difference being that WP2-1 was flushed with fresh water after drilling. The Pit 1 array installation was completed on August 8, 1995.

A similar linear array was installed in Pit 3 beginning on August 9, 1995. Figure 2-6 shows that the arrangement of the test array for Pit 3 differs from that of Pit 1 only in the inter-element spacing. Screen and riser diameters were 4 inches and 1.5 inches for the wells and wellpoints, respectively. All wells and wellpoints were screened from 10 to 30 feet of depth except DW1-3, which was screened from 9 to 29 feet. The pore pressure piezometer was screened by a canvas bag over the 27-to-29 foot interval whereas the tensiometer tip was installed at 9 feet. Figure 2-5 depicts the location of the array within Pit 3.

Both wells were drilled using direct rotary techniques with water only, and both wellpoints were installed by the jet method. Array installation was completed on August 14, 1995 for Pit 3.

Four preliminary tests for Pit 1 commenced on August 17, 1995 and involved, for each of the four wells and wellpoints, 1 hour of pumping followed by measurement of post-pumping recovery. For the two

PHASE I - TEST WELL AS-BUILT LOCATION PLAN(PIT #1)
NTS

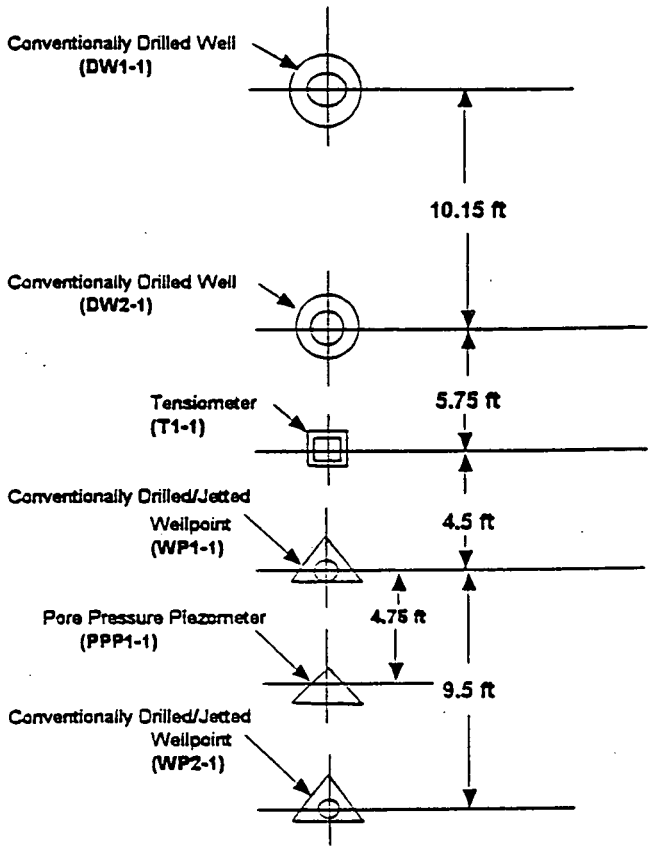
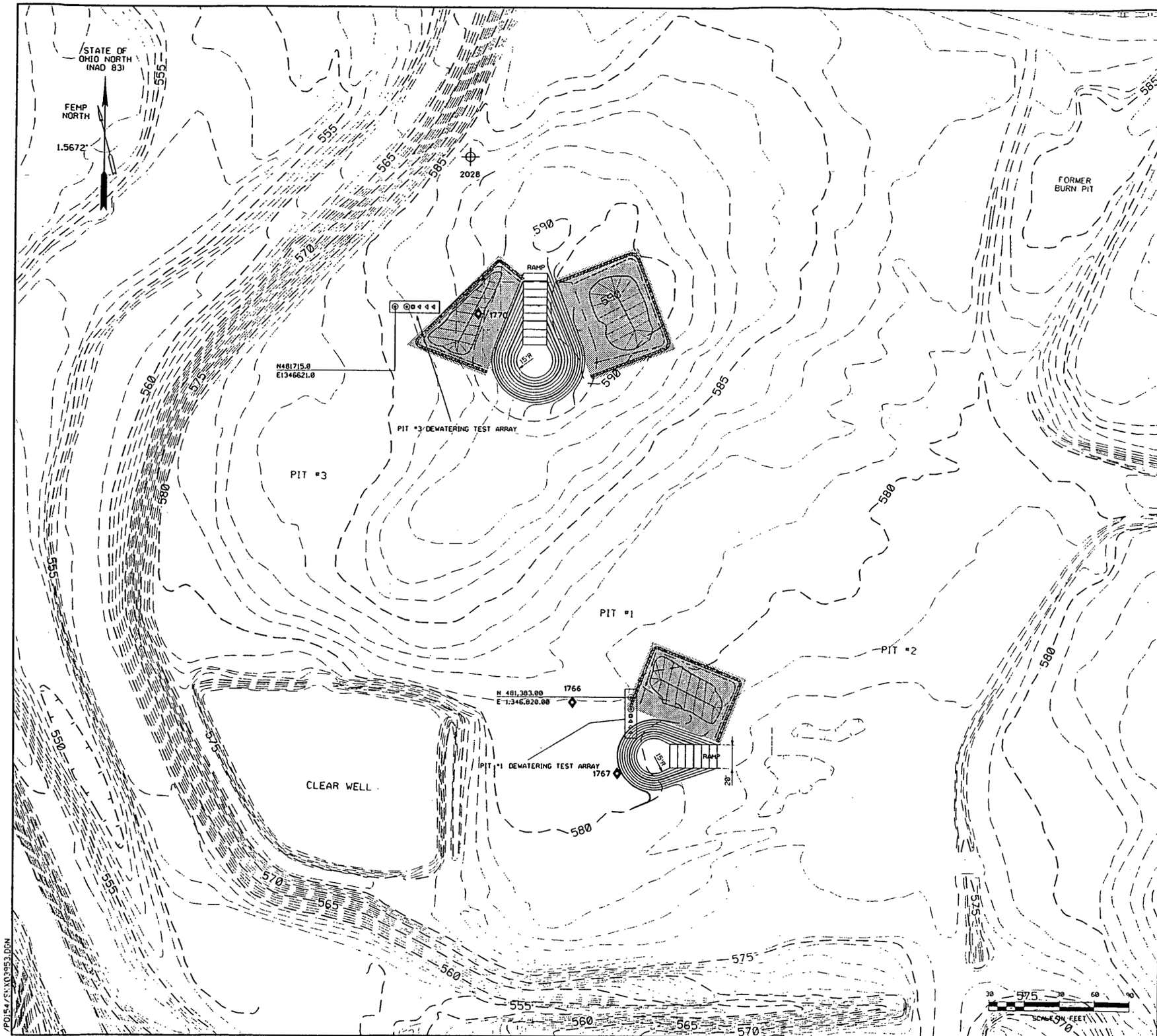


Figure 2-4 - Pit 1 Test Array Plan View (B&B 1995)



LEGEND

- CONVENTIONALLY DRILLED WELL
- TENSIOMETER
- CONVENTIONALLY DRILLED/JETTED WELLPOINT
- PORE PRESSURE PIEZOMETER
- MONITORING WELL
- LEACHATE WELL

FIGURE 2-5
LOCATION MAP
DEWATERING TEST ARRAYS
AND APPROXIMATE
RAMP EXCAVATION
LOCATIONS

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/P0154/SKX03953.DGN

ERAFS1\VOL1:RSAPPS\RSDATA\
OU-1\PO-145\JAN1996\DEEPRPT

Figure 2-5 - Location Map for Dewatering Test Arrays and Approximate Ramp Excavation Locations

FILE: /USR/REF2/OU1/PO19/PO19/DGN/SKX04083.DGN
3/6/96, 11:58am, Rev. No. 0

D.E.E.P. DEWATERING TREATABILITY STUDY

PHASE I - TEST WELL AS-BUILT LOCATION PLAN(PIT #3)

NTS

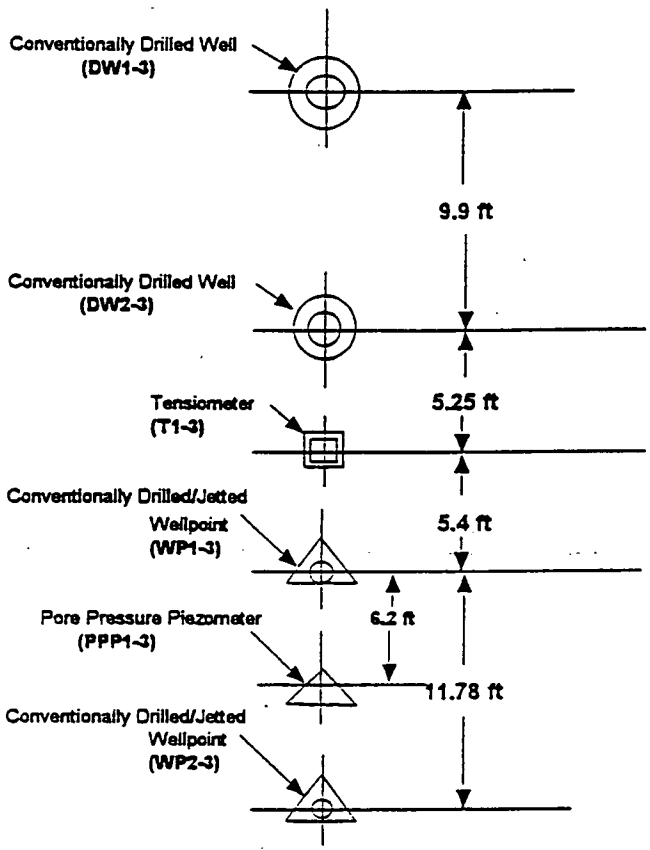

Figure 2-6 - Pit 3 Test Array Plan View (B&B 1995)

wells, the 1 hour pumping periods consisted of 1/2 hour of pumping under gravity followed by 1/2 hour of pumping with applied vacuum of 23 inches of water. The wellpoints were pumped with a vacuum of 20 to 25 inches of water for the entire hour.

Wellpoint WP2-1 demonstrated the highest yield in the preliminary tests (approximately 1.3 gallons per minute [gpm]) and was then pumped for 4 hours, after which recovery was measured. Figure 2-7 shows the time history of well yield during this 4 hour test. The plot shows a fluctuating yield with an average over the 4 hours of 1.15 gpm. Pit 1 testing was completed on August 18, 1995.

Testing in Pit 3 began on August 18, 1995. The preliminary test procedure for Pit 3 was identical to that for Pit 1. Vacuum for the second 1/2 hour of the well pumping tests was 22 inches of water for DW1-3 and 27 to 28 inches for DW2-3. Vacuum was 24 to 27 inches for WP1-3 and 25 to 26 inches for WP2-3 for the entire hour of pumping.

Well DW2-3, which demonstrated a preliminary test average yield of .4 gpm (.65 gpm with vacuum), was selected for the 4 hour pump test. Figure 2-8 shows the time history of well yield during this 4-hour test. The plot shows a consistently decreasing yield with a final yield of .26 gpm at the end of 4 hours. Pit 3 testing was completed on August 19, 1995.

Appendix D summarizes B&B Drilling, Inc.'s findings and recommendations and uses Phase I results to evaluate the impact of dewatering on Pit remediation activities and schedules.

2.6 Ramp and Pad Excavations

The DEEP test ramps and pads were excavated to determine at what slopes the Pit materials from Waste Pits 1 and 3 would remain stable. Secondly, the ramp excavations would provide information on allowable bearing capacity for equipment, and the field bearing capacity results could then be compared to the calculations, which were based on limited geotechnical data. Finally, the ramp excavation would provide insight into the depth at which water will be encountered within the Waste Pits and the rate at which the groundwater will enter the excavations as final excavation of the Pit materials begins. Figure 2-5 shows the approximate locations ramps and pads excavations in Waste Pits 1 and 3.

A ramp and pad excavation was performed in Waste Pit 1 between October 17 and October 24, 1995. The ramp excavation in Waste Pit 1 contained an east-west trending ramp having a slope of approximately 15 percent. A horizontal pad was excavated at the bottom of the ramp (approximately 8.5 feet below the existing ground surface), having a diameter of approximately 30 feet. The side slopes along the ramp were cut to 1H/1V at the top of the ramp and gradually became 1.5H/1V at the bottom of the ramp. Slopes surrounding the pad varied between 1.5H/1V and 2H/1V.

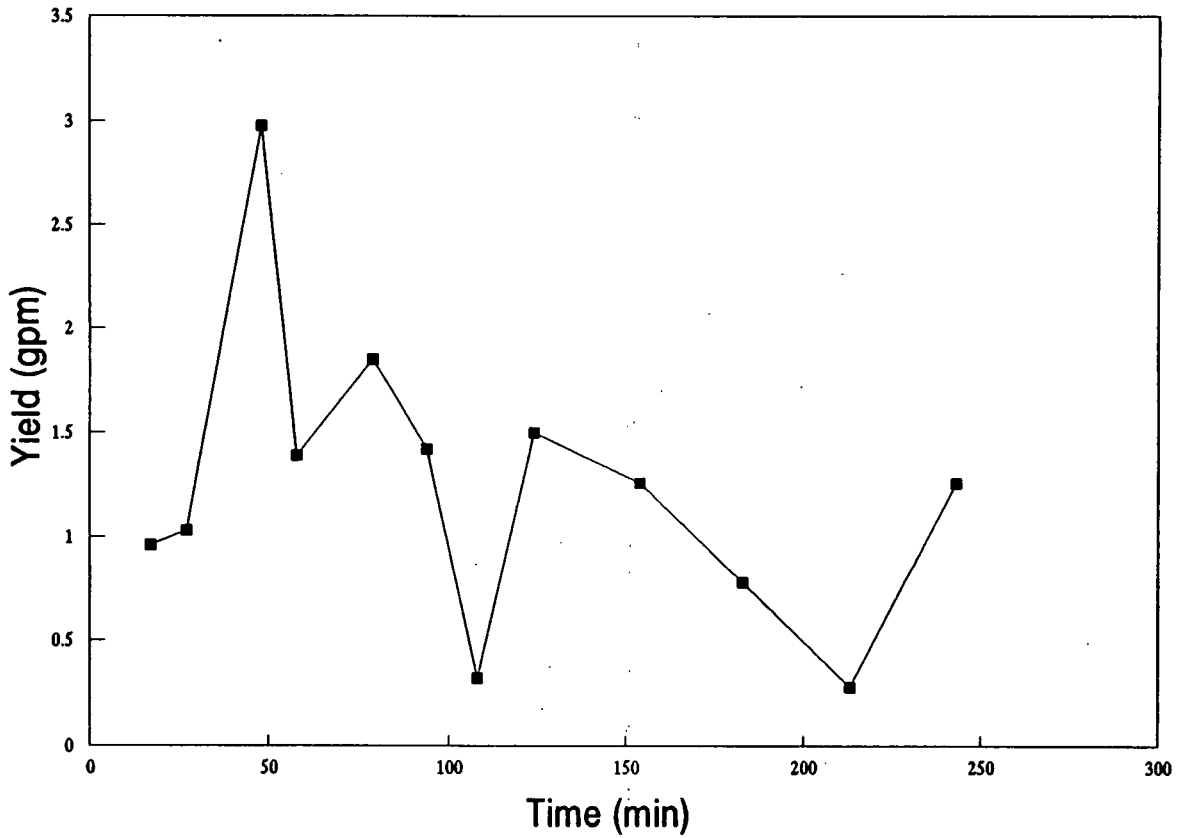

Figure 2-7 - Wellpoint Yield vs. Time for Pit 1, 4-Hour Pumping Test

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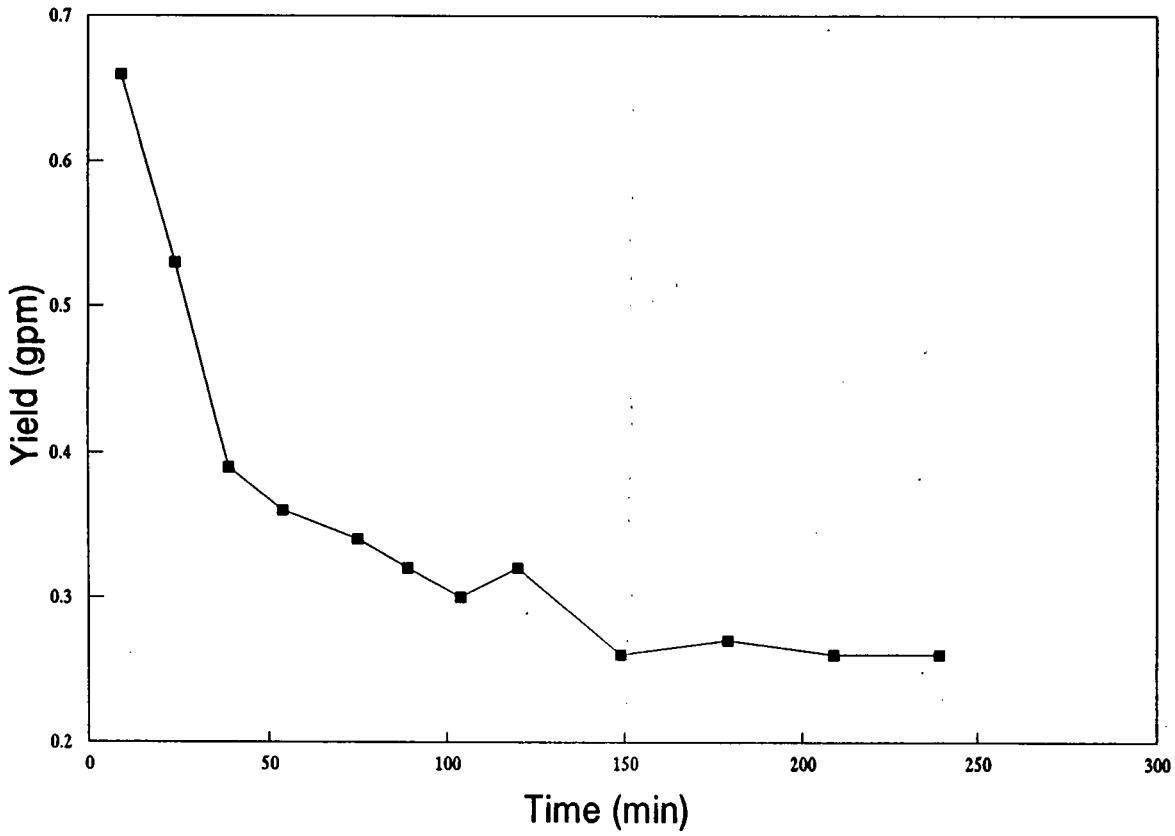

Figure 2-8 - Well Yield vs. Time for Pit 3, 4-Hour Pumping Test

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The ramp and pad excavation was performed using a John Deere 690D-LC track hoe working from the existing ground surface. The excavated material was then stockpiled using a track loader. The stockpiles of Waste Pit 1 materials maintained angles of repose between 30 and 35 degrees.

Upon completion of the ramp and pad excavation, approximately 0.5 to 1.0 feet of water covered approximately one-fifth of the west pad area. The origin of the water was difficult to determine. It appeared that a small portion of the water was coming from the south slope approximately 6 feet below the existing ground surface while the remaining water appeared to be infiltrating from the bottom of the excavation on the west side of the pad area.

Once the ramp and pad excavation was finished, a John Deere 555G WT Series IV track loader was driven down the ramp and onto the pad area. The track loader made several laps around and across the pad. The surface material of the pad appeared to compact under the weight of the tracks except on the west side of the pad, where the water had ponded. In the area of the pad where the water had ponded, the track loader caused ruts to form, but the wet Pit material did not noticeably hinder the movement of the track loader.

At the bottom of the ramp in the pad area, an additional excavation (10 feet wide by 17 feet long by approximately 5 feet deep) was performed. The purpose of the excavation was to determine the groundwater level in Waste Pit 1.

At approximately 13 feet below the existing ground surface, groundwater was observed flowing rapidly into the excavation. The seepage forces of the inflowing groundwater were sufficient to cause sloughing of the excavation side walls, which were approximately vertical. After approximately ½ hour after seepage began the water level in the additional excavation appeared to remain constant at approximately 11 feet below the existing ground surface.

After the excavation had remained open for three days, the water level in the bottom was approximately 7.5 feet below the existing ground surface. All of the side slopes in the ramp and pad excavation remained stable throughout the duration of the excavation.

A second ramp and pad excavation was performed in Waste Pit 3 between October 25 and October 31, 1995. The ramp excavation in Waste Pit 3 was to have a north-south trending ramp with a slope of approximately 15 percent. A horizontal pad was to be excavated at the bottom of the ramp (approximately 12 feet below the existing ground surface), having a diameter of approximately 30 feet. The side slopes along the ramp were to be cut at 2H/1V at the top of the ramp and gradually become 2.5H/1V at the bottom of the ramp. Slopes surrounding the pad were to be 2.5H/1V.

Before excavation of the ramp and pad were started in Waste Pit 3, the center of the proposed pad area was moved 54 feet to the southeast to avoid damaging a monitoring well. The center of the pad was 177

feet from well 2028 and 60 feet from well 1770; the distances were estimated by pacing. The excavation was started on October 25, 1995, and completed on October 31, 1995. Due to the soft materials encountered in Waste Pit 3, the proposed ramp was not excavated. However, most of the material in the pad area was excavated before a slope failure preciPitated the halt of excavation.

The depth of the pad excavation was approximately 13 feet below the existing ground surface. The majority of the final excavation side slopes varied between 1H/1V to 2H/1V. The final north slope of the excavation was nearly vertical when excavation was halted.

The excavation in Waste Pit 3 was performed using the same equipment and methods used in the ramp and pad excavation in Waste Pit 1. The cover and waste materials excavated from Waste Pit 3 were separated and stockpiled. The cover material stockpile and the waste stockpile containing mostly fly ash and bottom ash sustained angles of repose between 35 and 40 degrees. The waste stockpile containing an orange colored, soft, semi-cohesive material maintained an angle of repose of approximately 30 degrees.

On the second day of excavation in Waste Pit 3, an orange layer of soft, saturated, poor-draining, semi-cohesive waste material was encountered. The upper surface of the orange layer sloped from 4 feet below the existing ground surface on the east side of the excavation to approximately 9 feet below the existing ground surface on the west side of the excavation. Overlying the orange material was a black, fly ash and bottom ash, granular, free-draining, cohesionless material overlain by 1 to 1.5 feet of brown, silty clay.

On the west side of the excavation, the orange material was excavated to a depth of approximately 13 feet below the existing ground surface by the end of the second day of excavation. Upon reaching the 13-foot depth, the surrounding orange material began to flow into the resulting excavation. As a result of the flowing orange material, the black material that the track hoe was resting upon was undercut (a horizontal void was formed between the black material and the orange material). Vertical tension cracks formed in the cohesionless black material beneath the tracks of the track hoe. The unsupported black material then broke away at the tension crack into the existing excavation. Immediately before the black material failed, the track hoe operator backed the track hoe off the portion of the black material that failed.

At the beginning of work on the third day of excavation in Waste Pit 3, water had ponded in the bottom of the excavation. The surface of the ponded water was approximately 10 feet below the existing ground surface. The depth of the water varied between 3 feet on the west side of the excavation to approximately 1 foot on the south and east sides of the excavation. It appeared that the water was originating from the northwest side slope of the excavation starting at a depth of approximately 3 feet. A majority of the side slopes steeper than 1H/1V sloughed into the bottom of the excavation. A few of the 1.5H/1V slopes sloughed in isolated areas.

On the third day of Waste Pit 3 excavation, the track hoe operator attempted to drive onto the stockpile of orange waste material. Due to the consistency of the material, the track hoe simply drove through the stockpile.

Additionally, on the third day of Waste Pit 3 excavation, FERMCO decided to discontinue the excavation. It was decided that the material was too soft to drive the track hoe on, and further excavation was not warranted. The filling of the excavation was started on the afternoon of October 30, 1995 and finished on October 31, 1995.

Appendix E presents a more detailed discussion of the ramp and pad excavations.

SECTION 3

SUMMARY OF LABORATORY TESTING PROGRAM

Selected disturbed samples (from split-barrel samplers) and undisturbed samples (Shelby Tube and Vibracore samples) were transferred to two different on-site geotechnical laboratories for testing. The testing plan for these samples includes index properties testing and physical properties testing. Index properties testing includes grain size analyses, specific gravity tests, moisture content tests, and Atterberg limits tests. Physical properties testing on waste material from Waste Pits 1, 2, 3, and 5 includes consolidated, undrained triaxial shear strength tests, consolidation test, and unit weight test data.

Tests on some of the samples from Borings 11352 through 11363 were performed about 6 to 8 months after sampling was complete. As a result, some drying of the samples or segregation of moisture and solids may have occurred in the samples, which may have affected the moisture content and physical test results.

3.1 Index Properties

Index properties are reported for the OU1 waste. Index properties for the DEEP are reported in *CRU-1 Dewatering, Excavation, Evaluation Program Waste Pits 1, 2, 3,* Final Report (ALTER 1995a); *CRU-1 Dewatering, Excavation, Evaluation Program - Waste Pits 5 and 6*, Final Report (ALTER 1995a); and *Draft Final Test Results, PO-19* (SAIC 1996). Additional data are reported from the following sources:

1) *Characterization Investigation Study, Geotechnical Evaluation of Waste Pit Material Properties, and Boring Logs* (WESTON 1988)

2) *Final Remedial Investigation Report for Operable Unit 1* (DOE 1994)

3) *Cooperative Remedy Screenings Program,* Final Report (ALTER 1994)

Table 3-1 is a summary of the index properties of materials sampled from the OU1 Waste Pits. It is organized by the primary Unified Soils Classification System (USCS) group names found in each Waste Pit.

Table 3-2 is a summary of average moisture contents and unit weights for the OU1 Waste Pits arranged by USCS group name. For Pit 1, the majority of the material sampled was a nonplastic silt (ML[NP]). In Pit 2 the majority of the sampled material was an elastic silt (MH) with some lean clay (CL), clayey sand (SC) and silty sand (SM). In Pit 3 the majority of the sampled material classifies as either a silt (ML) or an elastic silt (MH) with some lean clay (CL) and silty sand (SM).

Table 3-1 - Summary of Index Properties

Pit No.	USCS Group Name	Moisture Content (%)	Specific Gravity	Grain Size Analysis				Atterberg Limits			Dry Unit Weight (pcf)	Wet Unit Weight (pcf)
				Gravel (%)	Sand (%)	Silt and Clay (%)	Clay Fraction (%)	LL	PL	PI		
1	ML(NP)	15.9 - 39.1 [25]	2.92 - 3.15	0 - 19	4 - 38	53 - 96	0 - 13	NP	NP	NP	109.4 - 120.4[6]	135.7 - 145.6[6]
	SM	44.8 - 132.0 [5]	2.80 - 3.05	2 - 6	49 - 50	46 - 48	4 - 7	NP	NP	NP	36.1 - 74.9[3]	83.6 - 108.5[3]
	MH	50.4 - 67.0[4]	2.77	1	46	53	13	66.3	57.8	8.4	59.9 - 69.3[3]	100.1 - 105.1[3]
2	CL	16.7 - 38.3[2]	2.72	4 - 8	22 - 26	66 - 74	22	42.3 - 44.1	16.2 - 23.1	19.2 - 27.9	-	-
	MH	31.9 - 231.2[12]	2.59 - 3.02	0 - 20	1 - 40	58 - 99	2 - 22	53.0 - 181.0	32.0 - 109.0	10.2 - 72.0	23.7 - 45.6[6]	78.5 - 90.2[6]
	SC	21.4 - 24.1[2]	2.20 - 2.69	18 - 22	32 - 67	15 - 46	8 - 11	24.0 - 33.4	14.0 - 20.3	10.0 - 13.2	105.7[1]	131.2[1]
	SM	32.7 - 35.4[2]	2.65	1 - 25	46 - 55	29 - 44	8	33.1 - 36.0	23.2 - 28.0	8.0 - 9.9	84.8[1]	112.5[1]
3	CL	17.9 - 36.1[3]	2.69	4 - 6	20 - 25	72 - 74	25	26.3 - 44.1	16.2 - 25.2	10.1 - 18.9	110.0[1]	129.7[1]
	MH	55.1 - 365.5[31]	1.99 - 2.88	0 - 4	4 - 49	50 - 96	2 - 16	52.0 - 119.0	32.0 - 74.6	16.0 - 71.0	15.3 - 33.7[19]	73.7 - 83.8[19]
	ML	25.3 219.6[11]	2.45 - 2.96	0 - 7	4 - 46	53 - 96	3 - 23	30.0 - 46.9	24.8 - 33.9	4.6 - 18.7	31.8 - 55.5[2]	75.1 - 84.5[4]
	ML (NP)	44.6 - 84.6[5]	2.39	1 - 7	31 - 46	53 - 67	7 - 8	NP	NP	NP	64.3[1]	93.0[1]
	SM	63.7 - 268.7[12]	2.20 - 2.88	0 - 3	48 - 56	43 - 50	6 - 8	73.2 - 116.0	55.0 - 56.2	17.0 - 61.0	20.6 - 49.7[11]	75.2 - 90.1[11]
4	CL	10.1 - 25.4[5]	2.62 - 3.63	1-13	23 - 42	55 - 77	7 - 20	28.4 - 34.1	8.0 - 17.2	8.0 - 17.2	95.5 - 122.2[2]	110.7 - 148.4[2]
	ML (NP)	17.6 - 29.3[6]	2.75 - 3.33	0-7	6 - 38	55 - 94	6 - 11	NP	NP	NP	117.1[1]	137.7[1]
5	MH	120.4 - 1141.2 [33]	2.43 - 2.98	0	0 - 62	68 - 100	0 - 19	50.4 - 112.3	40.0 - 88.0	3.5 - 44.2	5.2 - 38.8[30]	64.7 - 85.6[30]
	ML	73.4 - 360.7[6]	2.91 - 2.92	0	13	87	6 - 10	45.7 - 48.7	38.7 - 46.5	1.2 - 10.1	15.6 - 57.7[6]	68.6 - 100.1[6]
	ML (NP)	109.3 - 114.5[2]	2.71	0	6	94 - 95	9	NP	NP	NP	-	-

Table 3-1 - Summary of Index Properties (Continued)

Pit No.	USCS Group Name	Moisture Content (%)	Specific Gravity	Grain Size Analysis				Atterberg Limits			Dry Unit Weight (pcf)	Wet Unit Weight (pcf)
				Gravel (%)	Sand (%)	Silt and Clay (%)	Clay Fraction (%)	LL	PL	PI		
6	ML (NP)	26.8 - 425.1[5]	2.87 - 3.25	0 - 10	4 - 35	54 - 96	4 - 10	NP	NP	NP	35.4[1]	83.4[1]
	SM	11.2 - 117.6[13]	3.24 - 3.42	0 - 5	48 - 54	46 - 49	5	NP	NP	NP	90.8 - 148.5[12]	123.6 - 170.2[12]
CW	CL	35.4 - 53.4[2]	2.69	0 - 3	31 - 40	61 - 66	22	35.1 - 43.9	18.0 - 25.6	17.1 - 18.3	-	-
	MH	65.1 - 73.9[4]	2.78	1 - 11	23 - 36	53 - 77	24	50.6 - 54.7	32.5 - 40.2	13.1 - 18.1	-	-
	SM	40.2 - 61.9[2]	-	0 - 9	47 - 52	45 - 49	-	39.3 - 45.0	24.9 - 28.0	14.4 - 17.0	-	-
BP	ML	25.6 - 30.2[3]	2.50	4 - 13	30 - 38	53 - 59	15	35.1 - 37.8	26.7 - 34.0	2.0 - 11.1	-	-
	SM	29.2 - 43.3 [3]	2.35 - 3.74	7 - 13	46 - 54	36 - 47	4 - 9	NP	NP	NP	70.8[1]	101.4[1]

Notes: Superscript number in parentheses is the number of samples.

% Gravel: Portion retained on #4 sieve up to 3 inches in diameter.

% Sand: Portion passing #4 sieve but retained on #200 sieve

%Silt and Clay: Portion passing the #200 sieve. Distinction between clay and silt is determined by the hydrometer analysis.

CW: Clearwell

BP: Burn Pit

NP: Non Plastic

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Table 3-2 - Summary of Average Moisture Contents and Unit Weights

Pit Number	USCS Group Name	Average Moisture Content(s)	Average Dry Unit Weight (pcf)	Average Wet Unit Weight (pcf)
1	ML(NP)	22.9(25)	114.1(6)	138.5(6)
	SM	67.4(5)	64.7(3)	91.9(3)
	MH	57.5(4)	64.1(3)	102.3(3)
2	CL	27.5(2)	ND	ND
	MH	127.1(12)	35.1(6)	85.0(6)
	SC	22.8(2)	105.7(1)	131.2(1)
	SM	34.1(2)	84.8(1)	112.5(1)
3	CL	24.0(3)	110.0(1)	129.7(1)
	MH	192.6(31)	24.7(19)	76.9(19)
	ML	85.5(11)	43.6(2)	79.4(2)
	ML(NP)	58.8(5)	64.3(1)	93.0(1)
	SM	179.5(12)	29.2(11)	79.7(11)
4	CL	18.2(2)	108.9(2)	129.6(2)
	ML (NP)	24.7(6)	117.1(1)	137.7(1)
5	MH	463.3(33)	15.4(30)	72.5(30)
	ML	224.8(6)	27.0(6)	76.8(6)
	ML (NP)	111.9(2)	ND	ND
6	ML (NP)	139.7(5)	35.4(1)	83.4(1)
	SM	26.0(13)	129.8(12)	152.2(12)
Clearwell	MH	69.8(4)	ND	ND
	CL	44.4(2)	ND	ND
Clearwell Berm	CL	18.0(5)	110.6(2)	131.8(2)
Burn Pit	SM	51.1(2)	ND	ND

Notes: ND = No data available

Number in parentheses is number of samples average is based upon.

In Pit 4 the sampled materials were evenly divided between lean clay (CL) and nonplastic silts (ML[NP]). The predominant material sampled from Pit 5 was elastic silt (MH) with some inelastic silt (ML) and nonplastic silt (ML[NP]). Sampled materials from Pit 6 were evenly divided between nonplastic silt (ML[NP]) and silty sand (SM). The most predominant material sampled from the Clearwell was elastic silt (MH) with some lean clay (CL) and silty sand (SM). In the Burn Pit the sampled materials were evenly divided between nonplastic silt (ML) and silty sand (SM).

Figures 3-1 through 3-8 present the distribution of grain-size curves for materials sampled from the OU1 Waste Pits. Pits 3, 4, 5, and 6 were very poorly graded, which was also true of the Burn Pit. Pits 1 and 2 exhibited more uniform gradation characteristics. Most the the material from teh Waste Pits was measured in the silt region of the grain-size curver, with the exception of the Burn Pit which had more sand than silt.

Figure 3-1 is the grain-size distribution for Waste Pit 1. The lower left, flatter curves represent the samples classified as silty sands and one sample classified as a clayey gravel. The upper right curves that have more curvature represent the samples classified as nonplastic silts. Overall, the band of grain-size distribution for the Waste Pit 1 samples is somewhat narrow for the variety of different materials encountered.

Figure 3-2 is the grain-size distribution for Waste Pit 2. The lower five curves represent the samples classified as clayey or silty sands, while the remaining upper curves represent the samples classified as silts. Waste Pit 2 has a wide band of grain-size distribution and has the widest band of all the Waste Pits.

Figure 3-3 is the grain-size distribution for Waste Pit 3. There appear to be no distinguishable trends in the grain-size distribution between the different material types. In general, the band of grain-size distribution is very narrow for the large number of samples analyzed for grain-size.

Figure 3-4 is the grain-size distribution for Waste Pit 4. The upper three more curving grain-size curves represent nonplastic silts. The remaining lower and flatter grain-size curves represent both nonplastic silts and clays sampled from Waste Pit 4. Overall, the band of grain-size curves is very narrow for the sampled materials from Waste Pit 4, and all the sampled materials were classified as fine-grained (silts or clays).

Figure 3-5 is the grain-size distribution for Waste Pit 5. There is no distinguishable pattern between the nonplastic silts and elastic silts sampled in Pit 5. Considering the number of grain-size analyses performed, the band of grain-size curves is extremely narrow.

Figure 3-6 is the grain-size distribution for Waste Pit 6. All the grain-size curves shown represent materials classified as nonplastic silts. The band of grain-size curves is narrow.

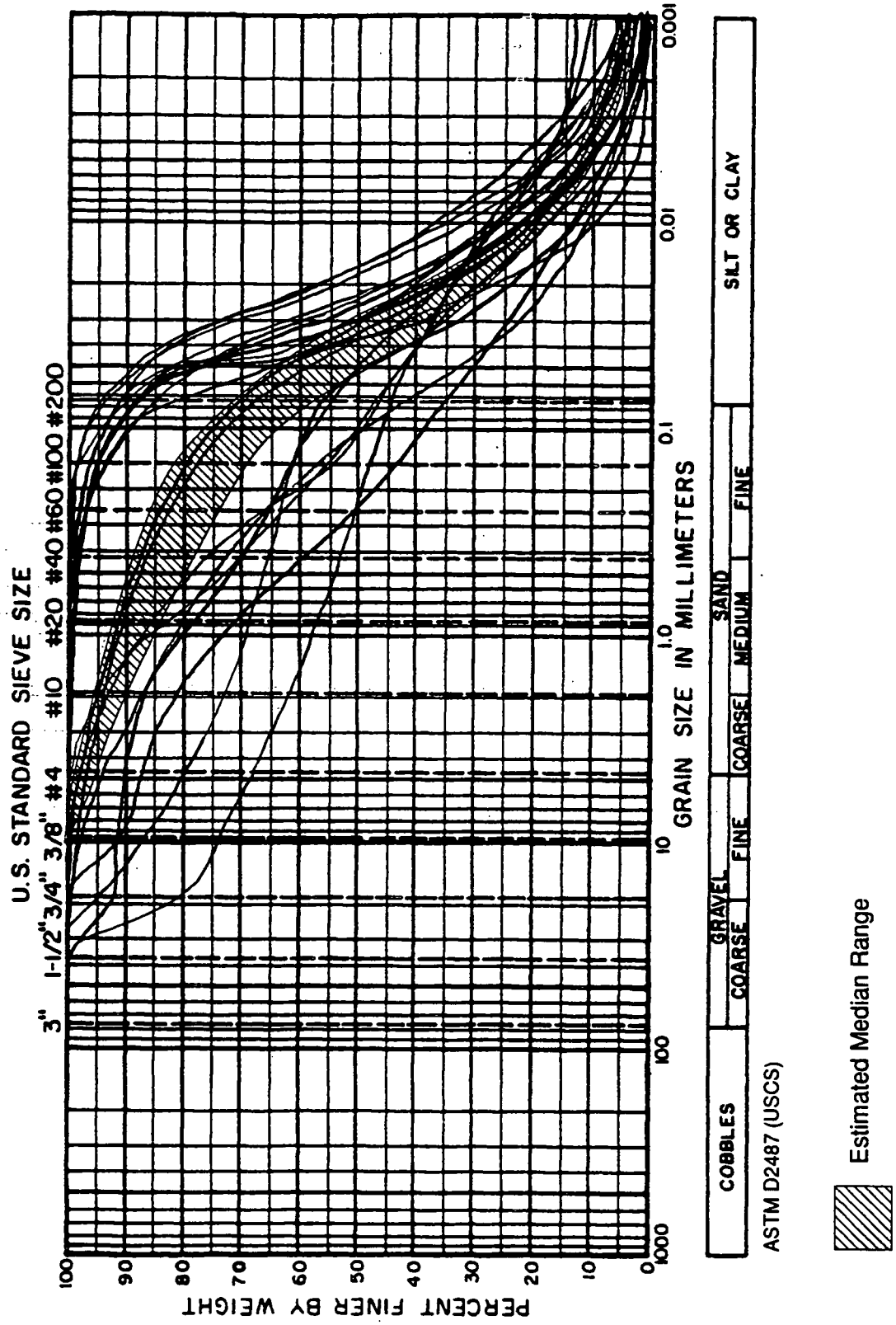

Figure 3-1 - Grain-Size Distribution for OU1 Waste Pit 1 Materials

"ILLUS\OU-1\PO-19\SIEVE-1.EPS

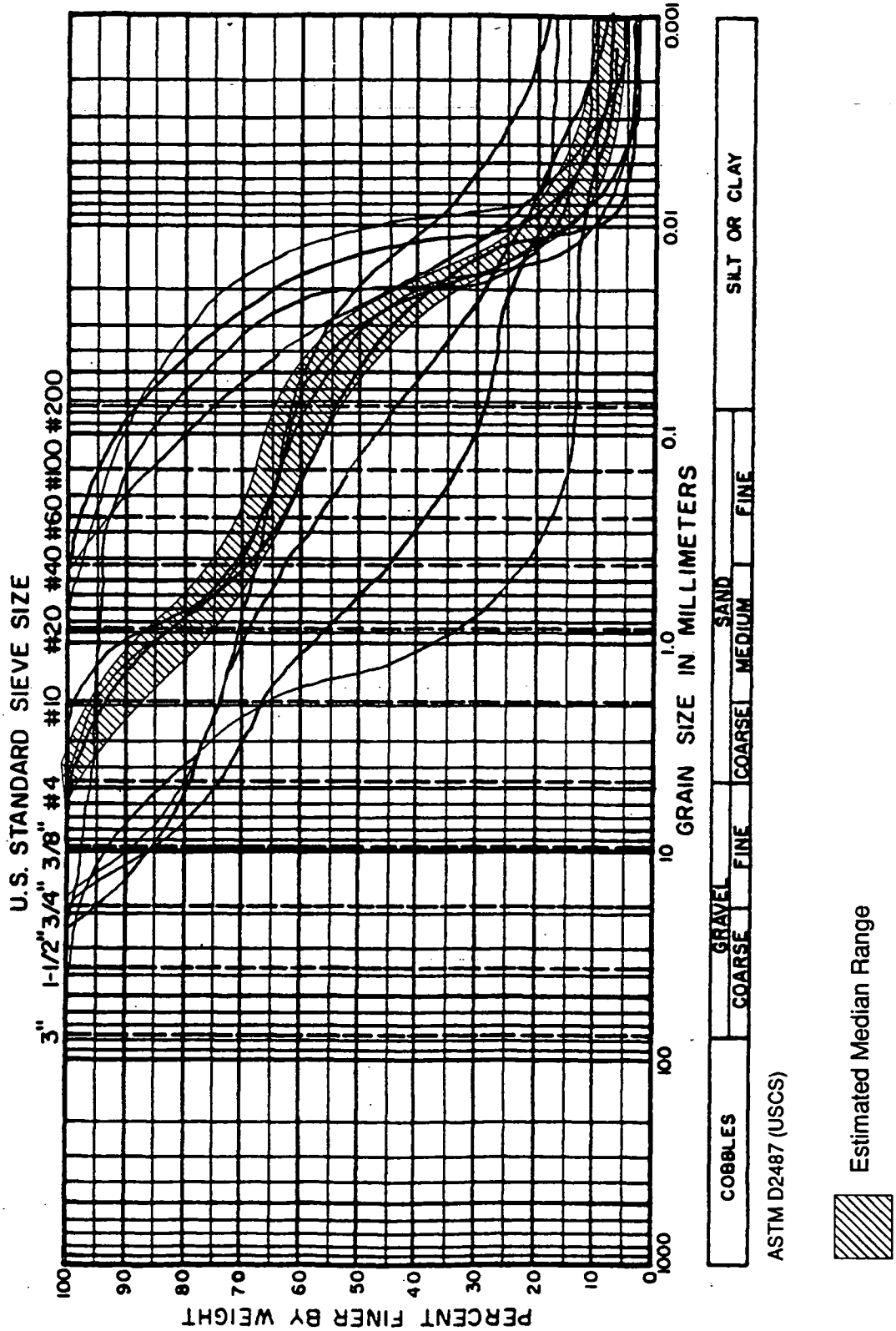

Figure 3-2 - Grain-Size Distribution for OU1 Waste Pit 2 Materials

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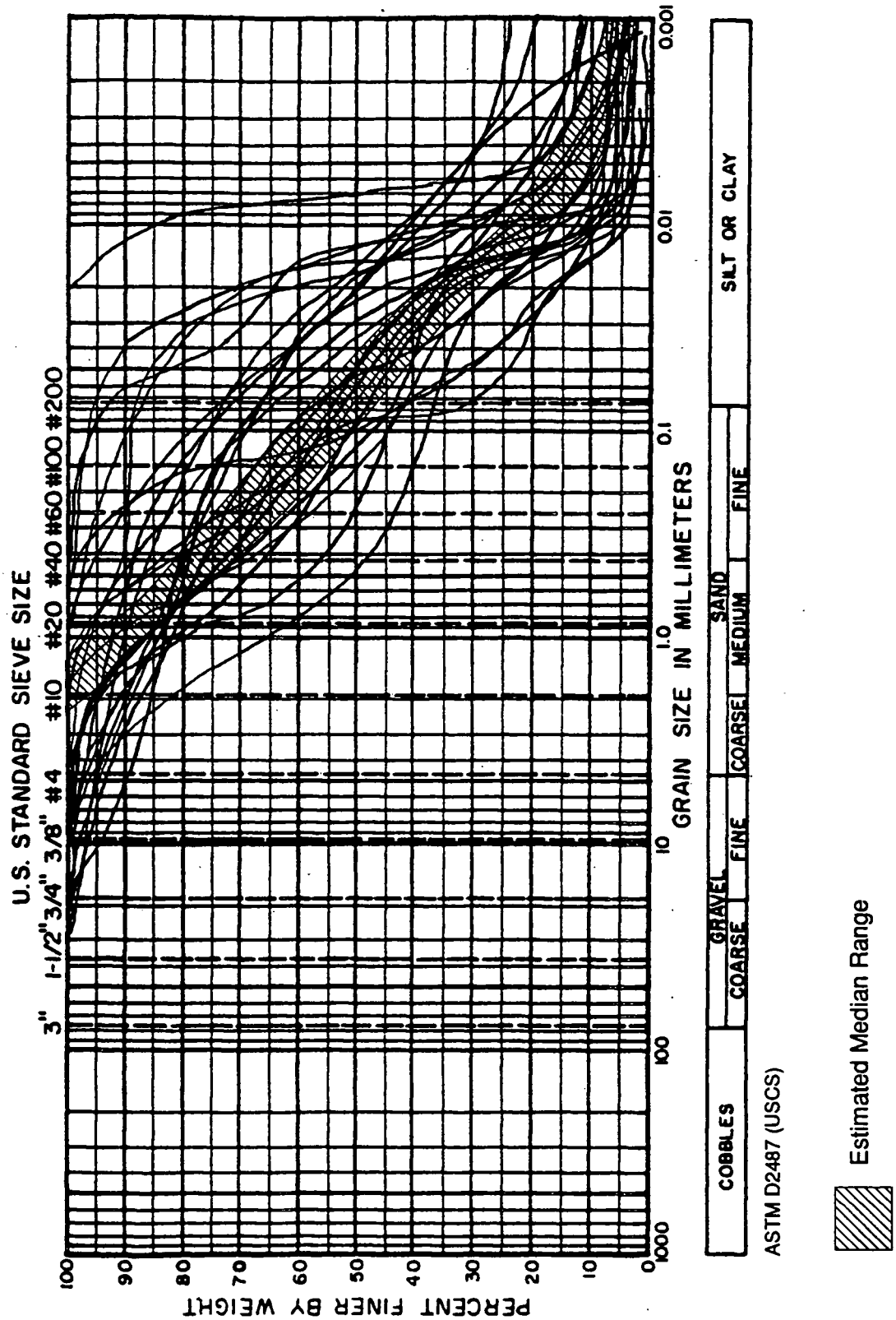

Figure 3-3 - Grain-Size Distribution for OU1 Waste Pit 3 Materials

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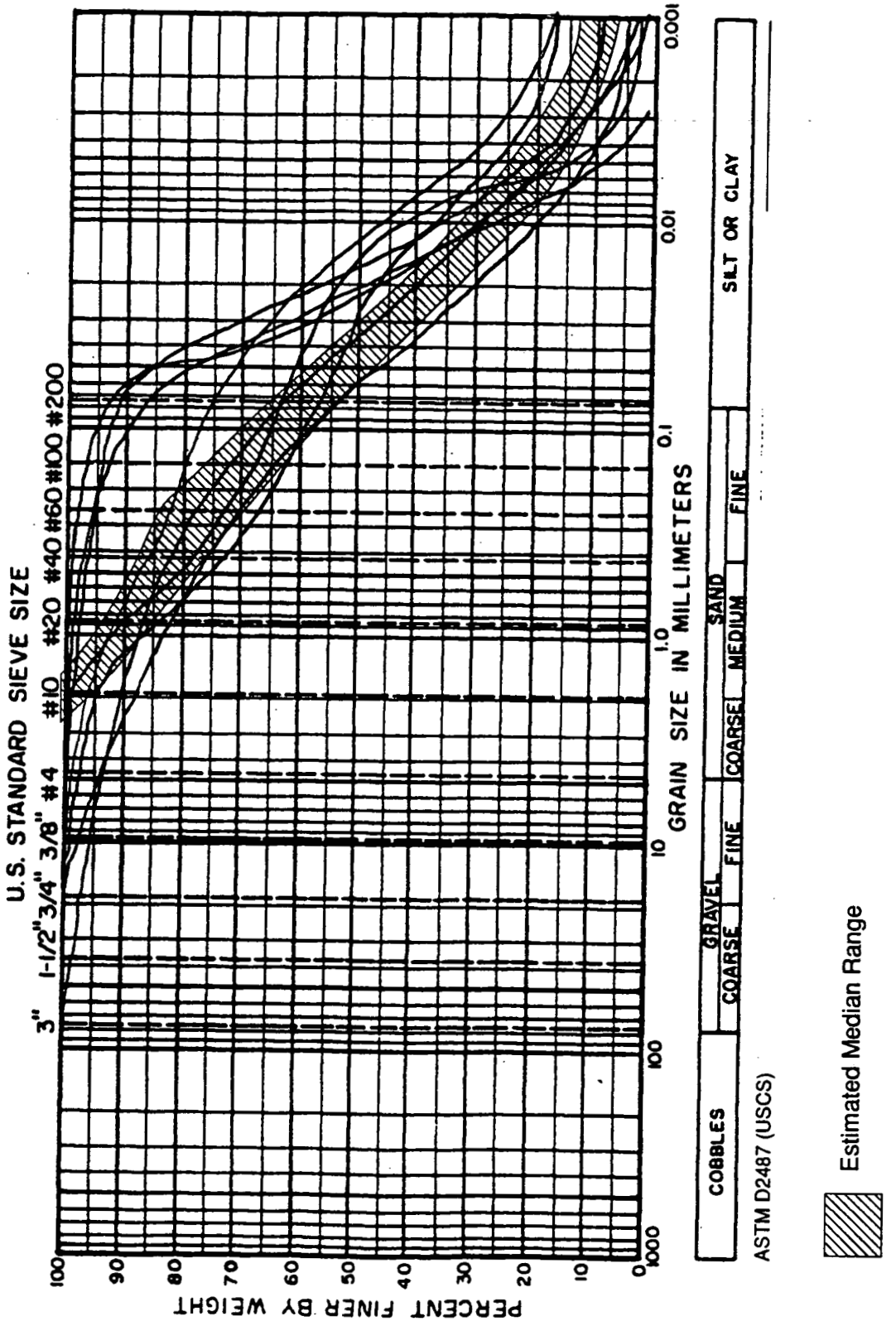

Figure 3-4 - Grain-Size Distribution for OU1 Waste Pit 4 Materials

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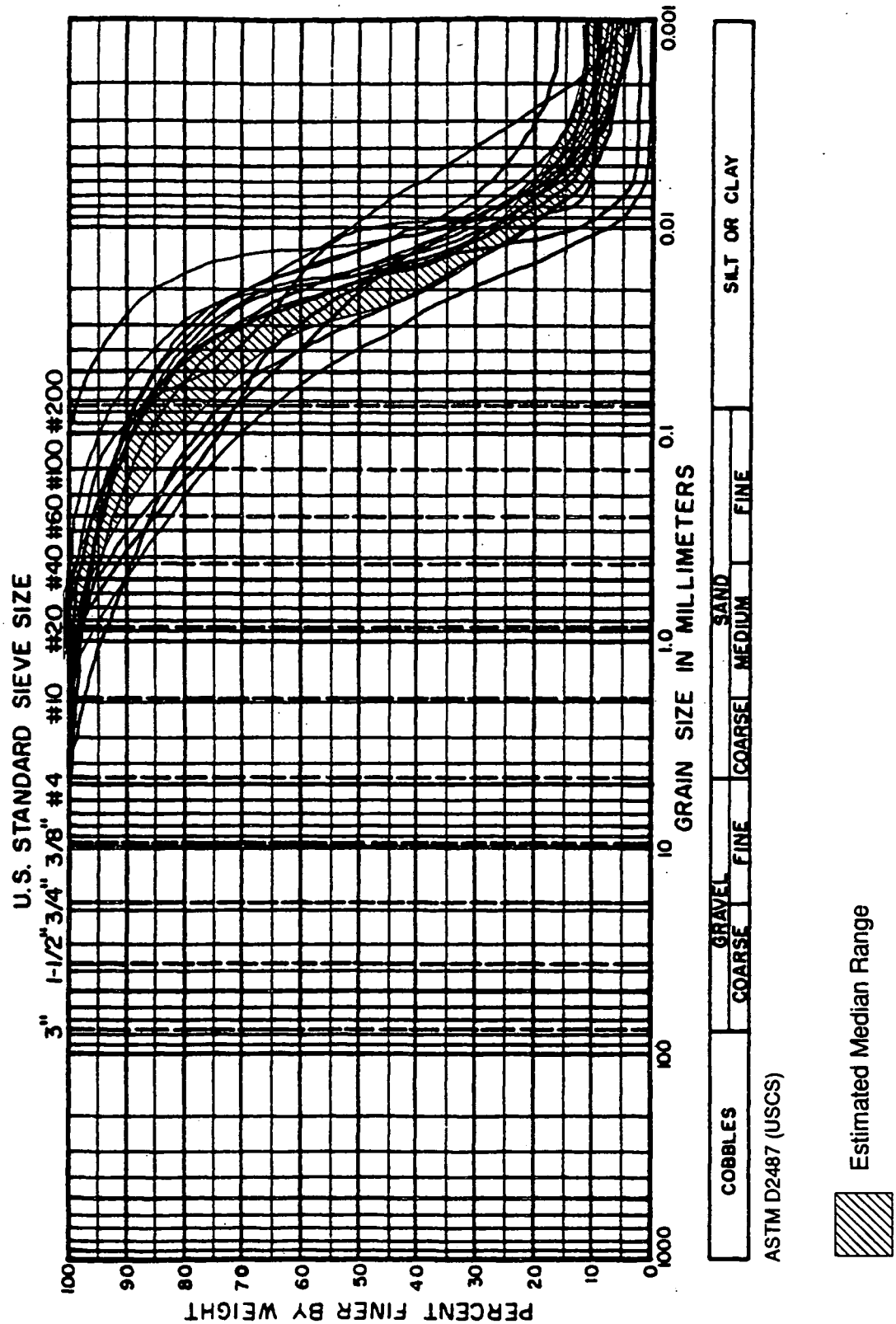


Figure 3-5 - Grain-Size Distri[illegible]n for OU1 Waste Pit 5 Materials

*ILLUS\OU-1\PO-19\SIEVE-5.EPS

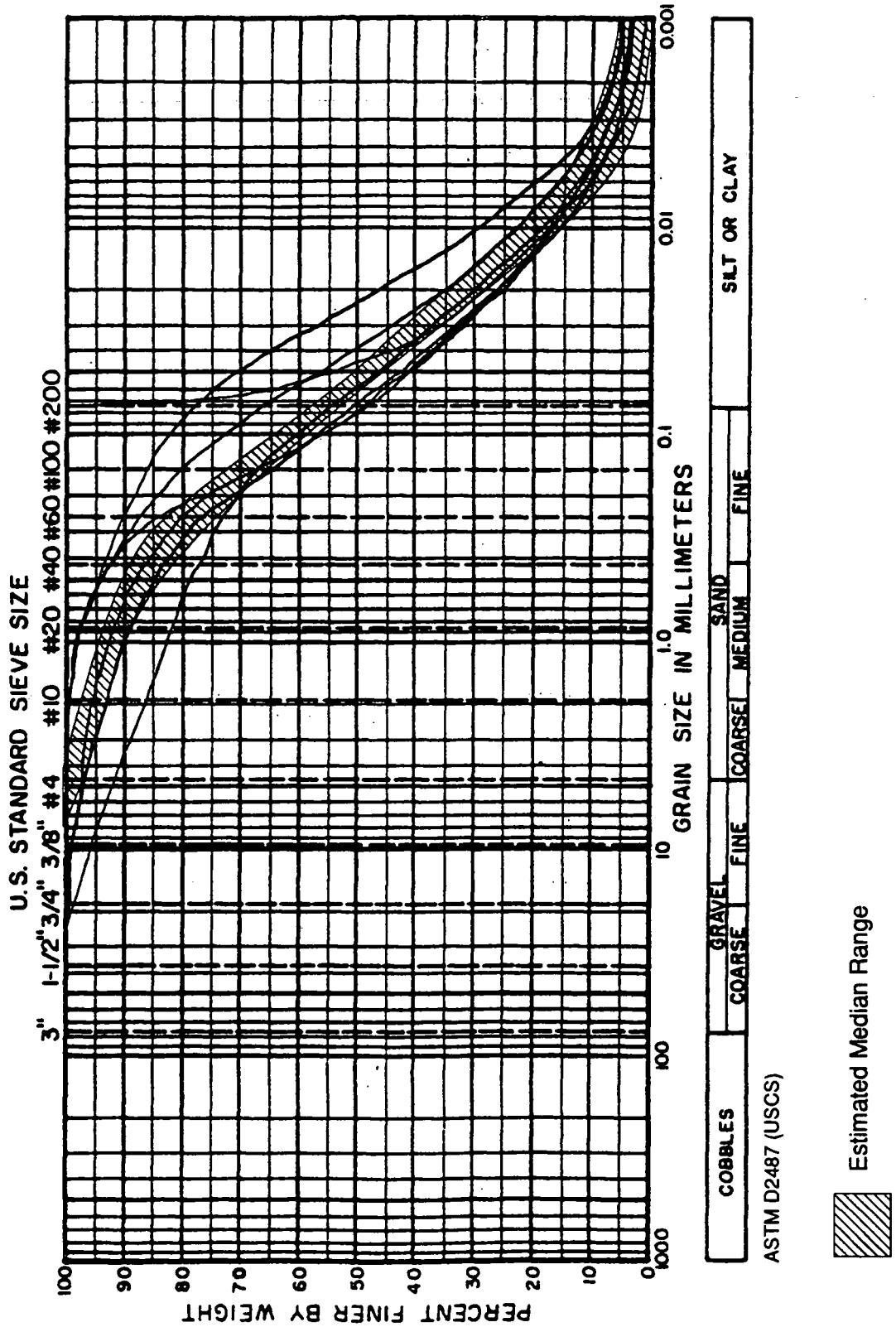


Figure 3-6 - Grain-Size Distribution for OU1 Waste Pit 6 Materials

"ILLUS\OU-1\PO-19\SIEVE-6.EPS

Figure 3-7 is the grain-size distribution for the Burn Pit, representing materials classified as either silt or sand. The band of the grain-size curves is narrow with the exception of the uppermost curve. This grain-size curve represents a silt (ML) and appears to be an outlier for the Burn Pit.

Figure 3-8 is the estimated grain-size distribution for the Clearwell. The grain-size curves shown were estimated from reported ALTER 1994 percentages of gravel, sand, silt, and clay as no grain-size curves were presented. According to the estimated grain-size curves, most of the materials from the Clearwell are silts, and the band of grain-size curves is narrow.

Overall, the band of grain-size curves were in the silt region, considering the number of and classification variety of OU1 Waste Pit samples. In general Pits 4, 5, and 6 and the clearwell contain the finer grained materials, and Waste Pits 1, 2, 3 contain a combination of both fine grained and coarse grained materials. The Burn Pit is the only Pit in which the majority of samples were classified as coarse grained. In general, Pits 3, 4, 5, and 6 were poorly graded, while Pits 1 and 2 were more uniform in grading.

Appendix E includes tables of all the geotechnical properties for OU1 Waste Pits 1 through 6 and Burn Pit and Clearwell.

As shown in Figure 3-9 and in Appendix E, the fine-grained materials from Waste Pits 1 and 6 are nonplastic silts while the materials from Waste Pits 2, 3, and 5 are low plasticity and high plasticity silts. The material from Pits 1 and 4 tends to be much drier and more dense than the materials from Waste Pits 2, 3, and 5.

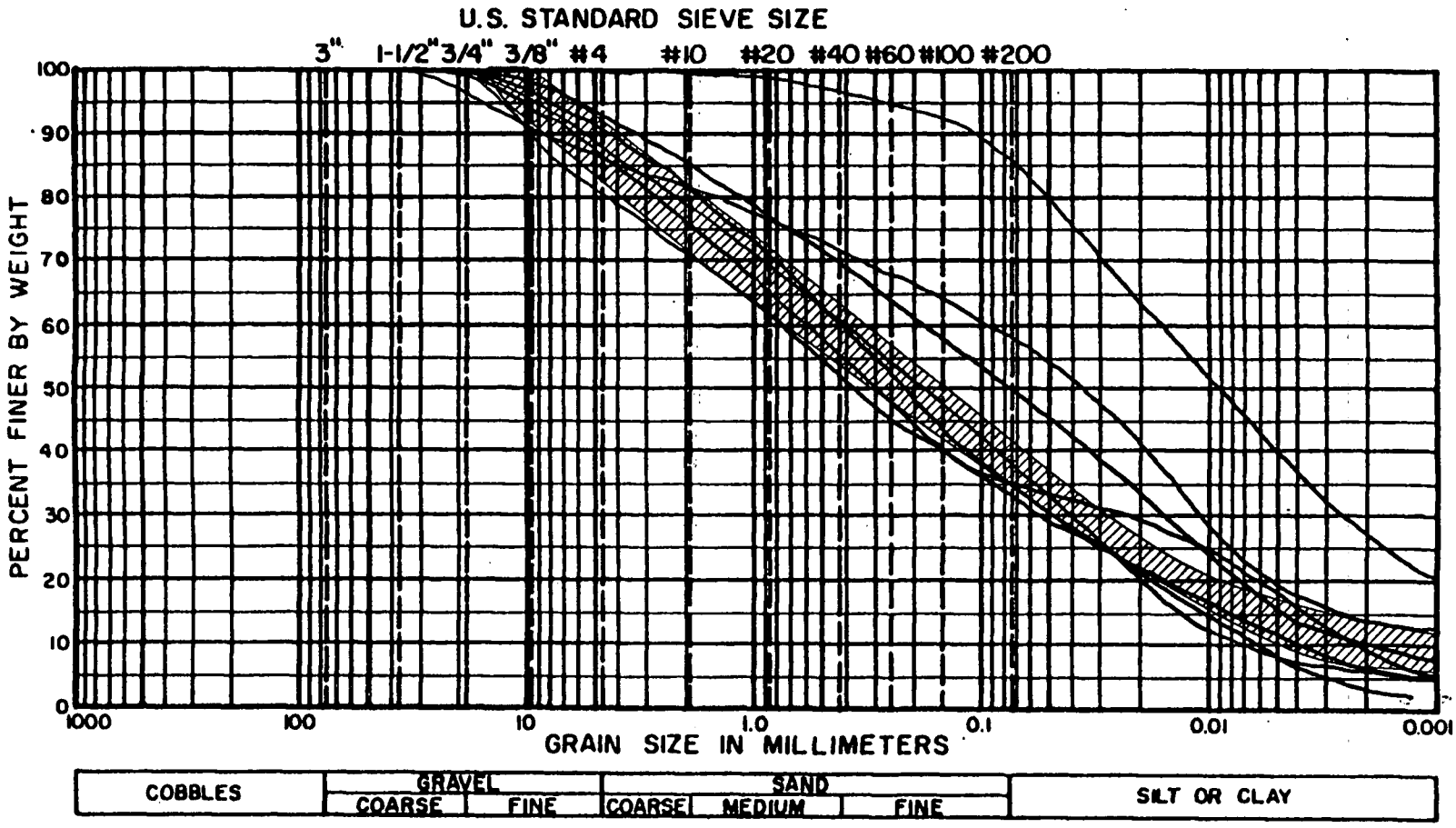
3.2 Physical Properties (In Situ and Remolded)

The physical properties of Pits 1, 2 and 3 are divided into in situ and remolded physical properties. The in situ physical property source is ALTER 1995a and SAIC 1996, and the remolded physical property source is ALTER 1994.

3.3 Undisturbed Physical Properties

The only in situ physical property reported in ALTER 1995a is the consolidated, undrained CU triaxial shear results from Waste Pits 1 and 3. SAIC 1996 reports shear results from Waste Pits 1, 2, 3, and 5. Table 3-3 summarizes Waste Pits 1, 2, 3, and 5 CU triaxial results. The reported undrained ϕ_u values range between 13 degrees and 23 degrees and undrained cohesion values between 0 and 4.9 psi. The reported drained ϕ_d values range between 28 degrees and 39 degrees and the drained cohesion values were between 0 and 3.1 psi. SAIC 1996 reported consolidation data for Waste Pit 5. The results of the consolidation tests are reported in Table 3-4.

*ILLUS\OU-1\PO-19\SIEVE-BPIT.EPS



ASTM D2487 (USCS)

Estimated Median Range

Figure 3-7 - Grain-Size Distribution for OU1 Burn Pit Materials

*ILLUS\OU-1\PO-19\SIEVE-CLWL.EPS

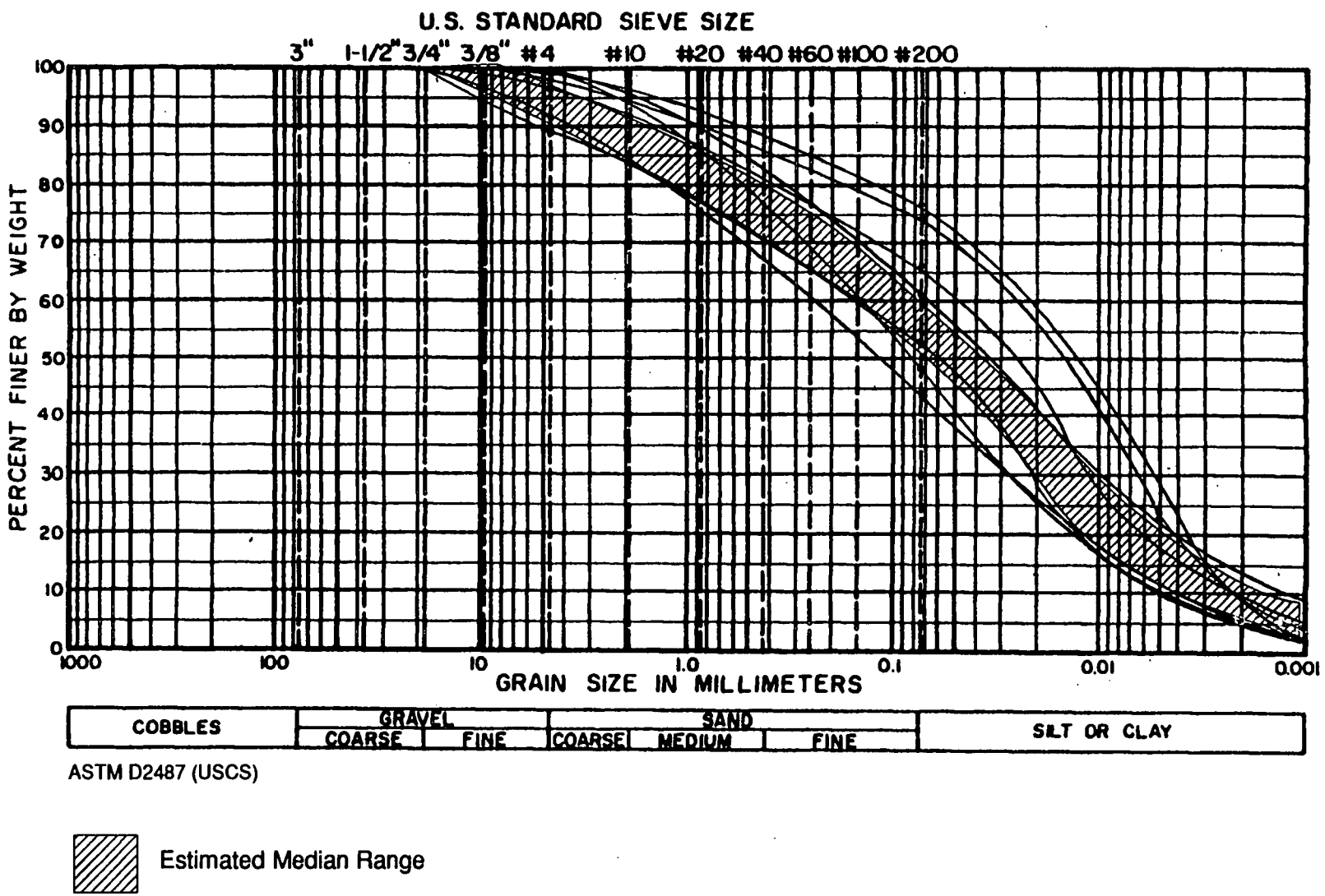


Figure 3-8 - Grain Size Distribution for OU1 Clearwell Material

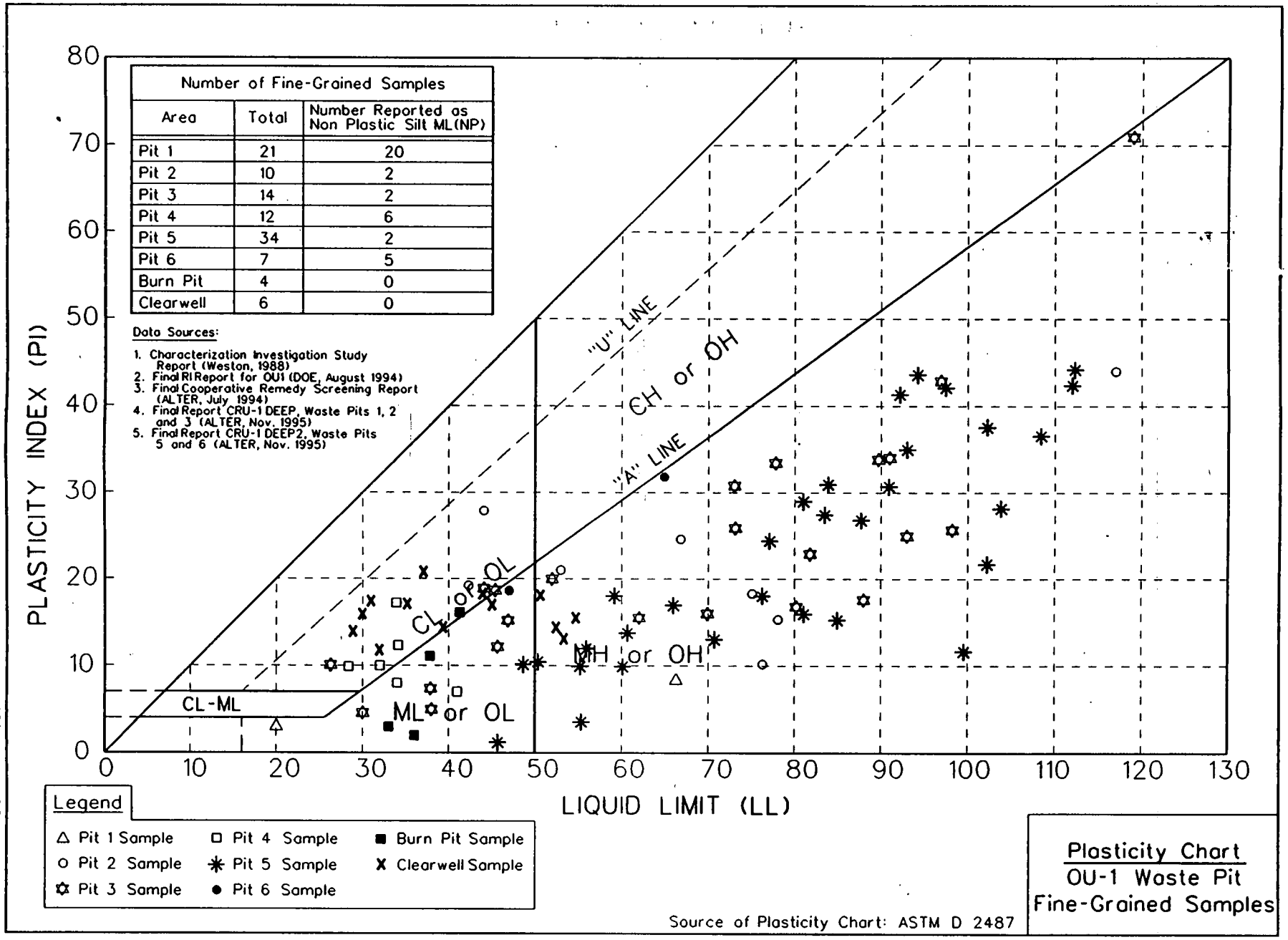


Figure 3-9 - Plasticity Chart

Table 3-3 - Summary of In Situ Physical Properties

Boring Number	Sample Number	Depth Range (ft)	Pit Number	ϕ_u	c_u (psi)	ϕ_d	c_d (psi)	Source
11354	400030	12.5 - 13.5	1	23.2°	4.9	30.2°	0	ALTER
11568	405653	10.5 - 13.0	1	19.0°	6.7	39.0°	3.3	SAIC
11569	405655	7.5 - 10.0	2	18.0°	1.7	36.0°	0.9	SAIC
11361	400039	21.0 - 22.5	3	23.9°	0	33.7°	0	ALTER
11361	400040	30.0 - 31.5	3	17.5°	0	29.5°	0	ALTER
11362	400041	19.0 - 20.5	3	15.0°	1.5	39.0°	0	ALTER
11362	400042	23.0 - 25.0	3	16.0°	0.7	32.9°	0	ALTER
11570	405657	10.5 - 13.0	3	14.8°	2.0	34.0°	1.0	SAIC
11570	405658	15.5 - 18.0	3	14.0°	1.7	28.0°	1.5	SAIC
11571	405663	17.5 - 20.0	3	13.0°	1.7	30.0°	1.5	SAIC
11571	405687	32.5 - 35.0	3	15.0°	2.1	36.0°	1.3	SAIC
11572	405669	15.0 - 17.5	3	17.0°	0.4	40.0°	0.2	SAIC
11572	405672	22.5 - 25.0	3	19.0°	0	37.0°	0	SAIC
11572	405675	30.0 - 32.5	3	18.0°	2.4	35.0°	1.6	SAIC
WP5-5A	405325	20.0 - 25.0	5	15.0°	1.0	32.0°	0.7	SAIC
11574	405678	7.5 - 10.0	Clearwell (berm)	16.0°	3.5	29.0°	3.1	SAIC
11574	405684	22.5 - 25.0	Clearwell (berm)	22.0°	3.5	28.0°	3.1	SAIC

Table 3-4 - Summary of In Situ Consolidation Parameters

Boring No.	Sample No.	Depth Range (ft)	Pit No.	Initial Void Ratio	C_c	C_r	Coefficient of Consolidation, C_v			
							400 psf load	800 psf load	1600 psf load	3200 psf load
WP5-5A	405325	15.0-20.0	5	16.660	3.850	0.094	0.207	0.528	0.041	0.119
WP5-5A	405325	20.0-25.0	5	14.657	3.750	0.089	0.145	0.035	0.194	0.063
WP5-11A	405337	12.5-17.5	5	9.910	2.696	0.035	0.067	0.047	0.040	0.029

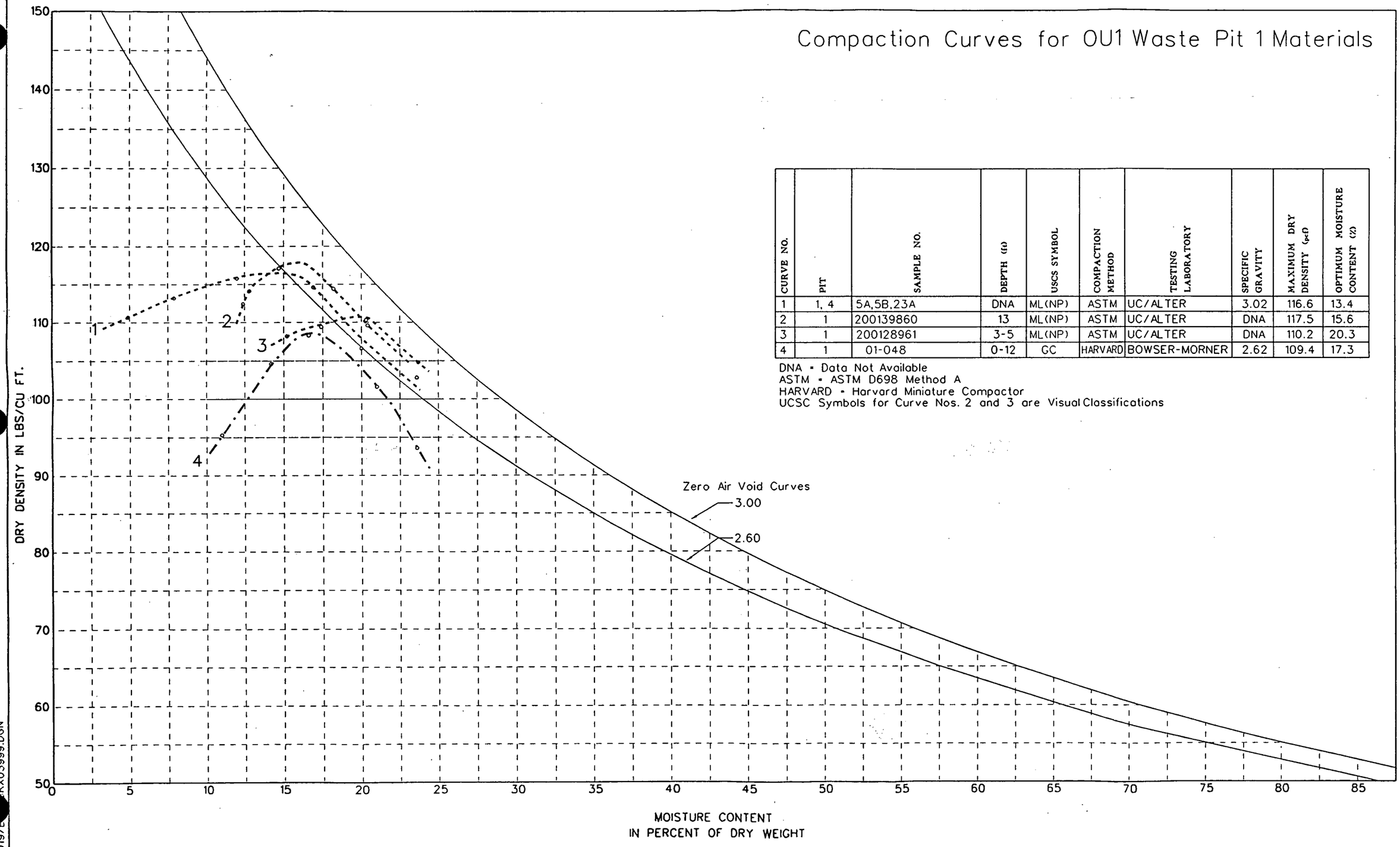
3.4 Remolded Physical Properties

Physical property tests were performed on remolded samples composited from several different sample intervals and combinations of different Waste Pits (ALTER 1994). Table 3-5 summarizes the results of the physical property tests performed on the composited samples.

In addition, moisture-density relationships were determined using bulk samples of materials in the Waste Pits using either the Standard Proctor method (ASTM D698, method A) or the Harvard miniature compactor in ALTER 1995a, ALTER 1995b, ALTER 1994, and WESTON 1988. Figures 3-10 to 3-17 present the various compaction curves by individual Waste Pit presented in the above-mentioned reports.

WESTON 1988 used a Harvard miniature compactor to determine the moisture-density relationships of composite waste samples from all of the OU1 Waste Pits as a result of inadequate sample volume to perform a Standard Proctor on the samples. In WESTON 1988, a correlation study was performed between the Harvard miniature compactor and the Standard Proctor compaction methods to determine the compaction sequence and compaction effort required for the Harvard miniature compactor to produce results similar to the Standard Proctor. Figure 3-18 shows the results of the compaction correlation study. As a result of the correlation study, it was determined that using the Harvard miniature compactor with 3 lifts and 25 rods per lift produced the results nearest to the Standard Proctor.

The bulk samples tested for moisture-density relationships vary in depth between 0 and 30 feet below grade at Pits 1, 2, 3, 4, and the Burn Pit. The bulk samples at Pits 5 and 6, and the Clearwell were collected from 1 to 40 feet below the standing water level. The maximum dry densities of the compaction tests vary between 60.4 and 149.5 pounds per cubic foot, and the optimum moisture contents vary between 9.2 and 62.8 percent by dry weight basis. The specific gravities of the materials tested varied from 2.35 to 3.42. Depth and specific gravity data were unavailable for several of the samples used in the reported compaction tests.

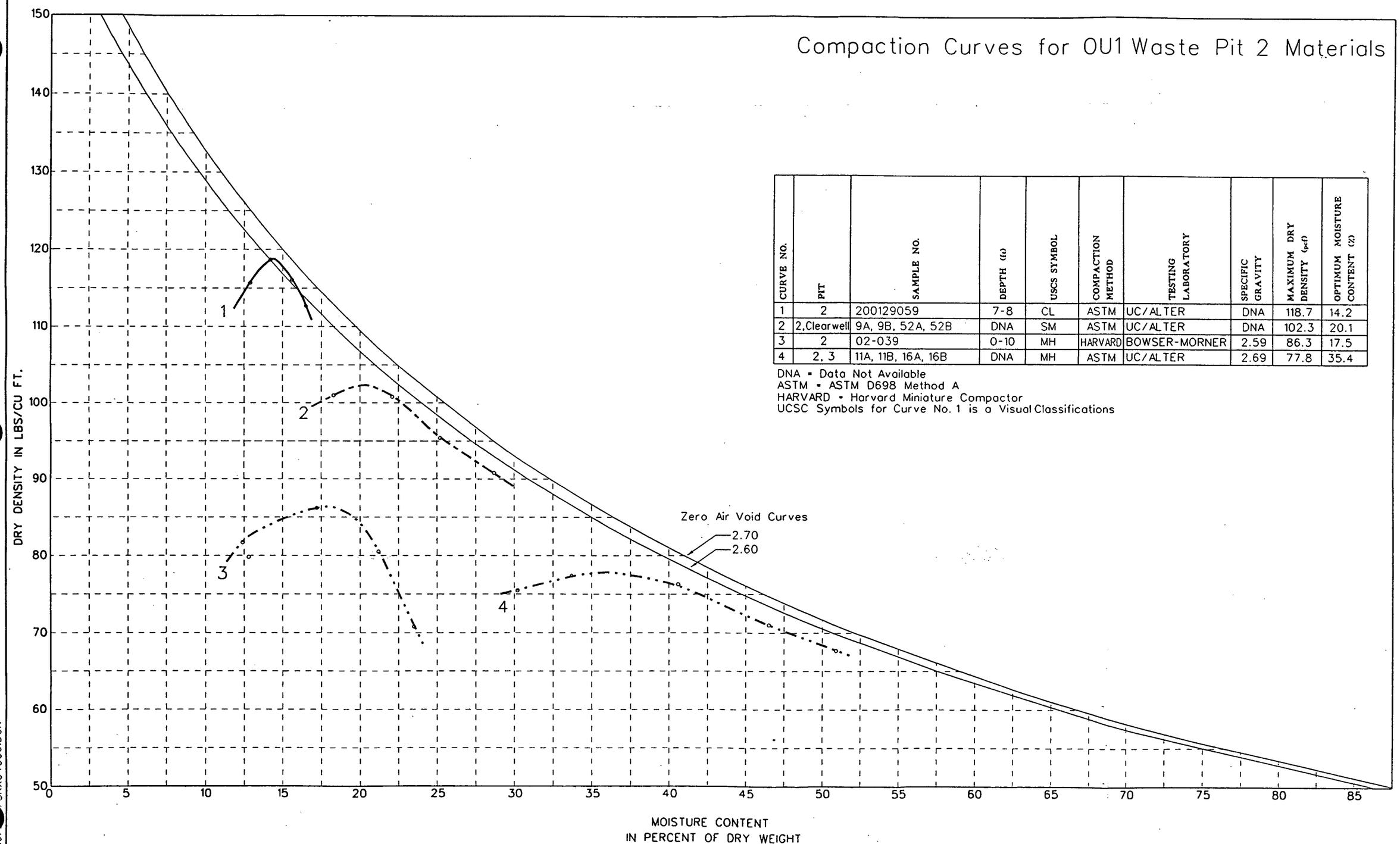


CURVE NO.	PIT	SAMPLE NO.	DEPTH (ft)	USCS SYMBOL	COMPACTION METHOD	TESTING LABORATORY	SPECIFIC GRAVITY	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
1	1, 4	5A,5B,23A	DNA	ML(NP)	ASTM	UC/ALTER	3.02	116.6	13.4
2	1	200139860	13	ML(NP)	ASTM	UC/ALTER	DNA	117.5	15.6
3	1	200128961	3-5	ML(NP)	ASTM	UC/ALTER	DNA	110.2	20.3
4	1	01-048	0-12	GC	HARVARD	BOWSER-MORNER	2.62	109.4	17.3

DNA - Data Not Available
ASTM - ASTM D698 Method A
HARVARD - Harvard Miniature Compactor
UCSC Symbols for Curve Nos. 2 and 3 are Visual Classifications

Figure 3-10 - Compaction Curves for OU1 Waste Pit 1 Materials

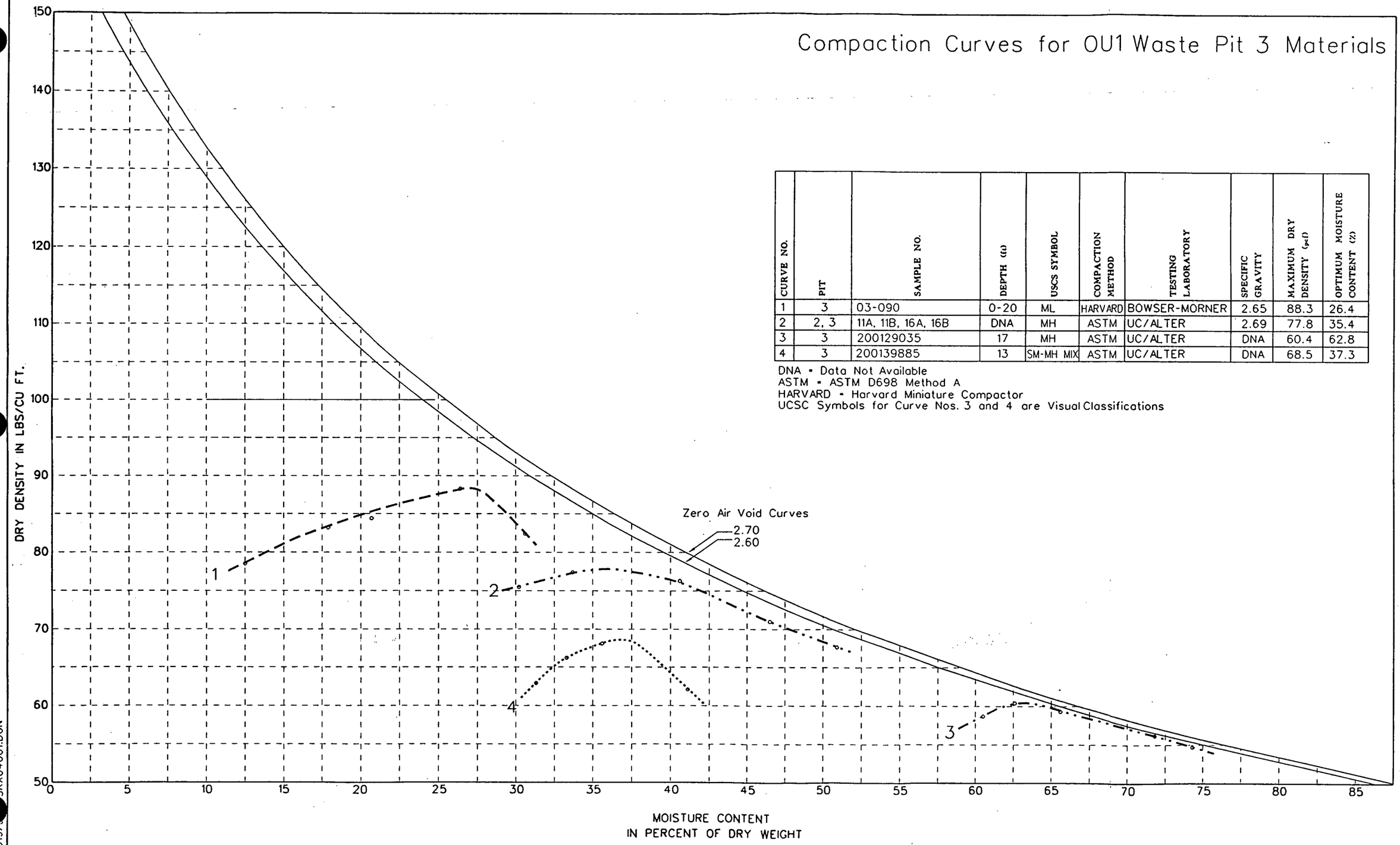
PO19/E KX03999.DGN



CURVE NO.	PIT	SAMPLE NO.	DEPTH (ft)	USCS SYMBOL	COMPACTION METHOD	TESTING LABORATORY	SPECIFIC GRAVITY	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
1	2	200129059	7-8	CL	ASTM	UC/ALTER	DNA	118.7	14.2
2	2,Clearwell	9A, 9B, 52A, 52B	DNA	SM	ASTM	UC/ALTER	DNA	102.3	20.1
3	2	02-039	0-10	MH	HARVARD	BOWSER-MORNER	2.59	86.3	17.5
4	2, 3	11A, 11B, 16A, 16B	DNA	MH	ASTM	UC/ALTER	2.69	77.8	35.4

DNA = Data Not Available
ASTM = ASTM D698 Method A
HARVARD = Harvard Miniature Compactor
UCSC Symbols for Curve No. 1 is a Visual Classifications

Figure 3-11 - Compaction Curves for OU1 Waste Pit 2 Materials



CURVE NO.	PIT	SAMPLE NO.	DEPTH (ft)	USCS SYMBOL	COMPACTION METHOD	TESTING LABORATORY	SPECIFIC GRAVITY	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
1	3	03-090	0-20	ML	HARVARD	BOWSER-MORNER	2.65	88.3	26.4
2	2, 3	11A, 11B, 16A, 16B	DNA	MH	ASTM	UC/ALTER	2.69	77.8	35.4
3	3	200129035	17	MH	ASTM	UC/ALTER	DNA	60.4	62.8
4	3	200139885	13	SM-MH MIX	ASTM	UC/ALTER	DNA	68.5	37.3

DNA - Data Not Available
ASTM - ASTM D698 Method A
HARVARD - Harvard Miniature Compactor
UCSC Symbols for Curve Nos. 3 and 4 are Visual Classifications

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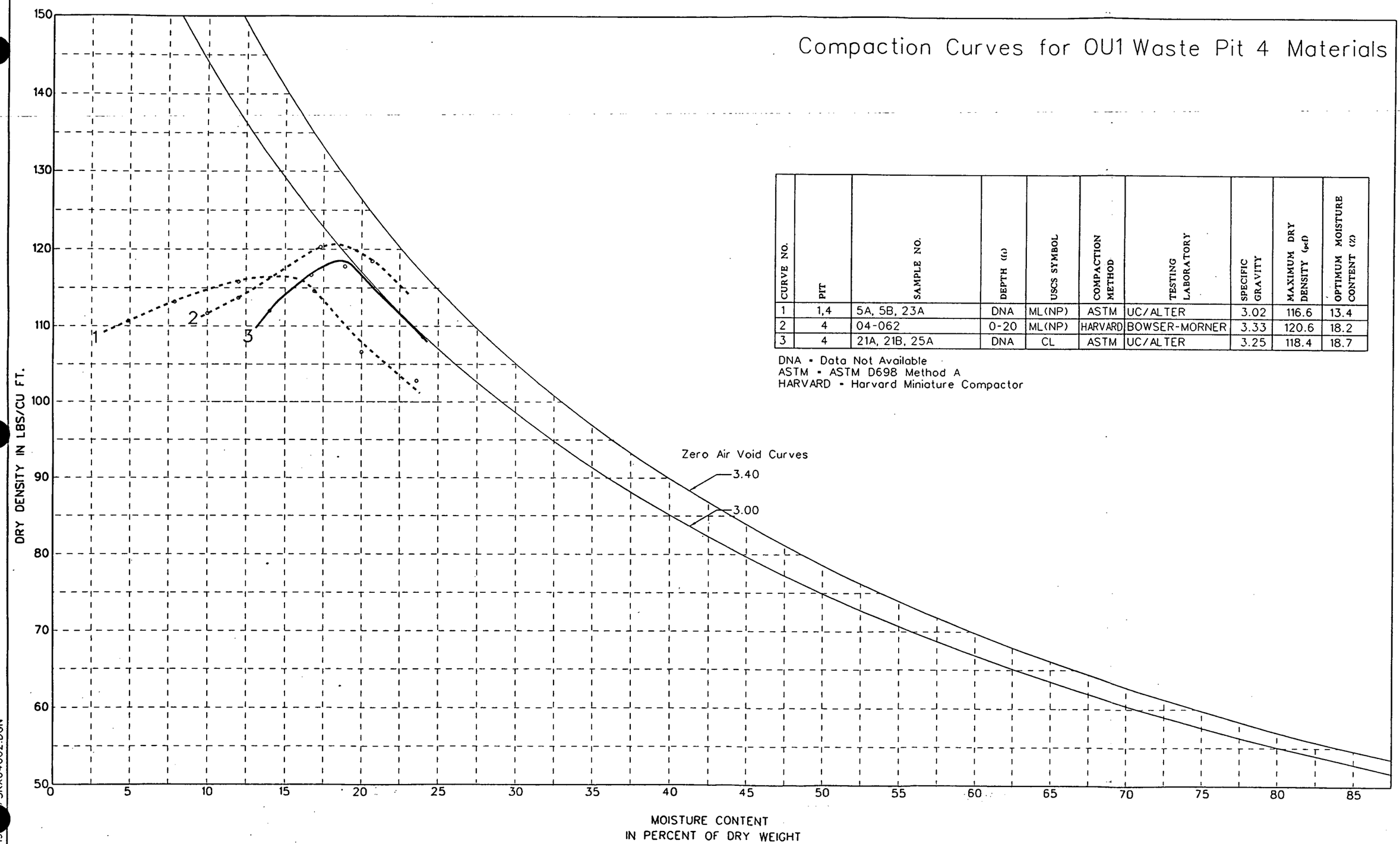
Figure 3-12 - Compaction Curves for OU1 Waste Pit 3 Materials

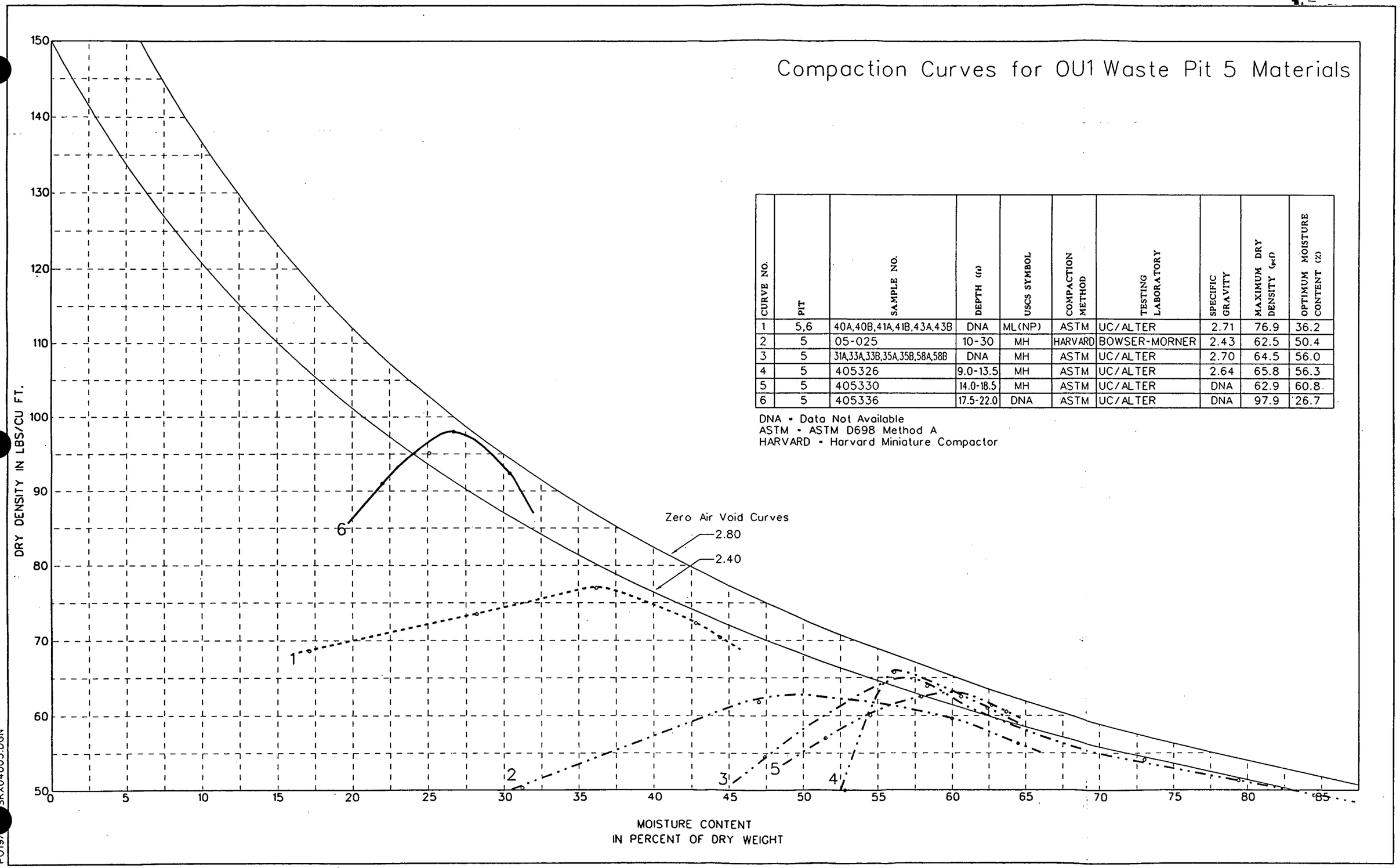
000112



CURVE NO.	PIT	SAMPLE NO.	DEPTH (ft)	USCS SYMBOL	COMPACTION METHOD	TESTING LABORATORY	SPECIFIC GRAVITY	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
1	1,4	5A, 5B, 23A	DNA	ML(NP)	ASTM	UC/ALTER	3.02	116.6	13.4
2	4	04-062	0-20	ML(NP)	HARVARD	BOWSER-MORNER	3.33	120.6	18.2
3	4	21A, 21B, 25A	DNA	CL	ASTM	UC/ALTER	3.25	118.4	18.7

DNA - Data Not Available
ASTM - ASTM D698 Method A
HARVARD - Harvard Miniature Compactor

Figure 3-13 - Compaction Curves for OU1 Waste Pit 4 Materials



CURVE NO.	PIT	SAMPLE NO.	DEPTH (ft)	USCS SYMBOL	COMPACTION METHOD	TESTING LABORATORY	SPECIFIC GRAVITY	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
1	5,6	40A,40B,41A,41B,43A,43B	DNA	ML(NP)	ASTM	UC/ALTER	2.71	76.9	36.2
2	5	05-025	10-30	MH	HARVARD	BOWSER-MORNER	2.43	62.5	50.4
3	5	31A,33A,33B,35A,35B,58A,58B	DNA	MH	ASTM	UC/ALTER	2.70	64.5	56.0
4	5	405326	9.0-13.5	MH	ASTM	UC/ALTER	2.64	65.8	56.3
5	5	405330	14.0-18.5	MH	ASTM	UC/ALTER	DNA	62.9	60.8
6	5	405336	17.5-22.0	DNA	ASTM	UC/ALTER	DNA	97.9	26.7

DNA - Data Not Available
ASTM - ASTM D698 Method A
HARVARD - Harvard Miniature Compactor

3-22

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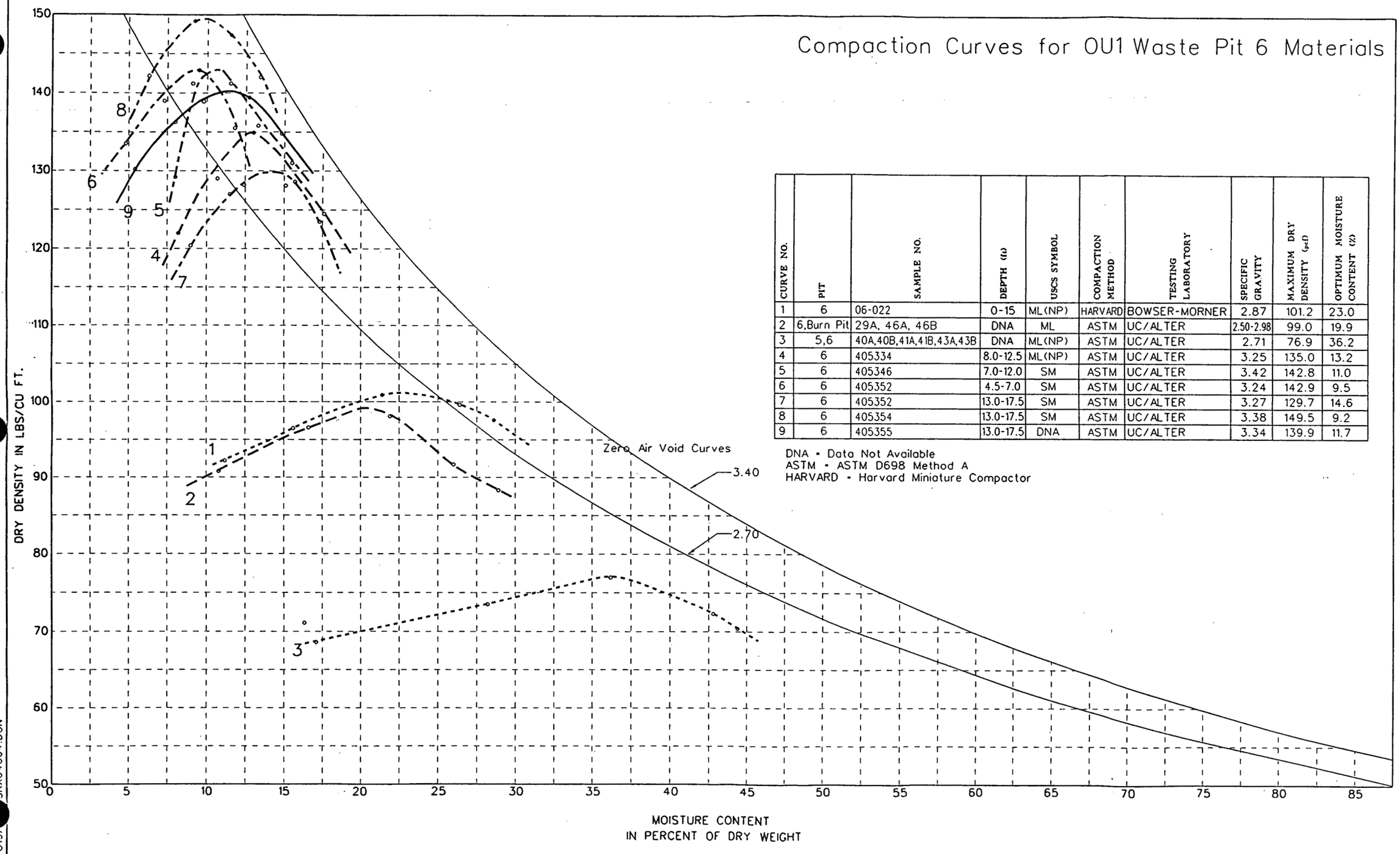
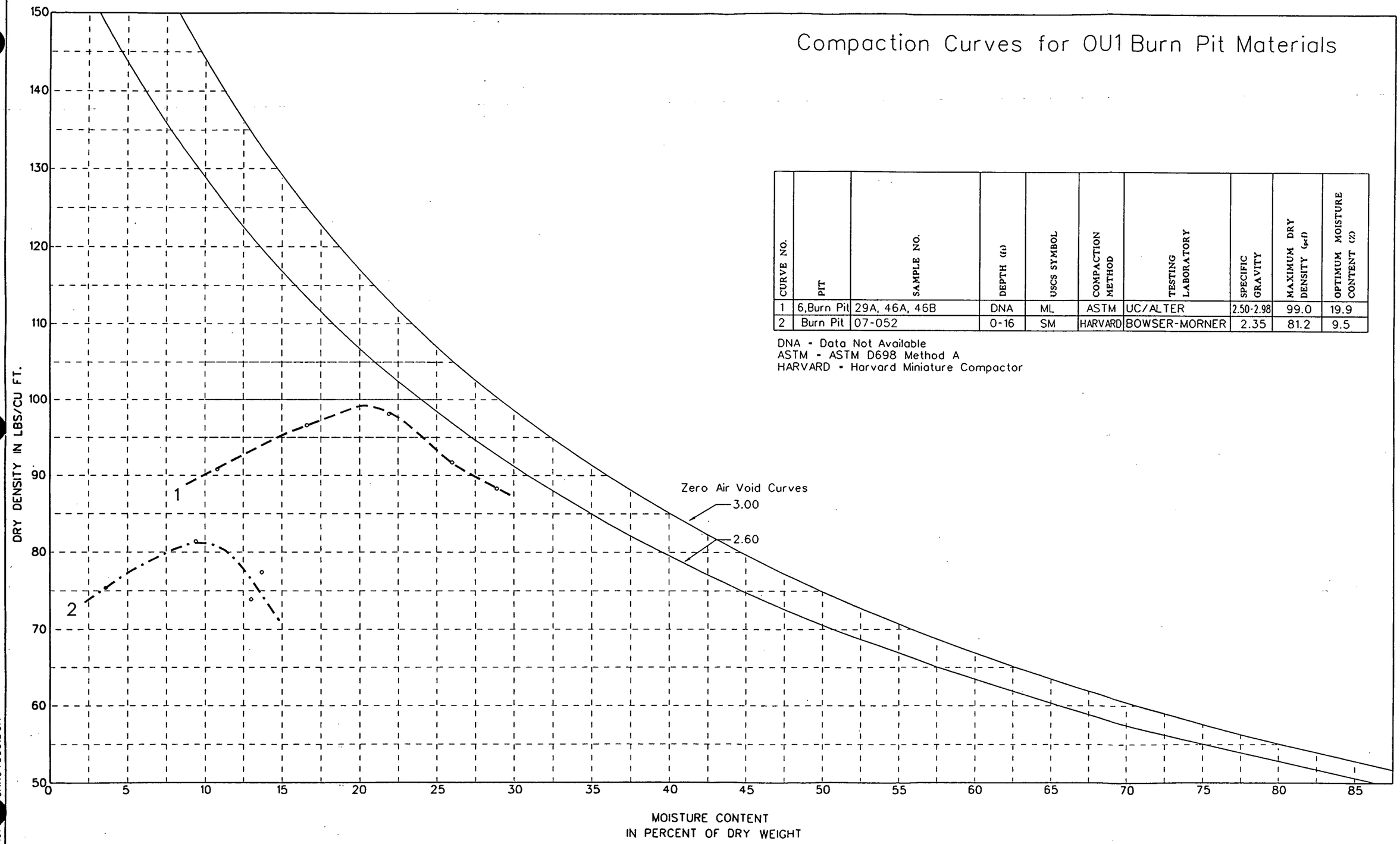
Figure 3-14 - Compaction Curves for OU1 Waste Pit 5 Materials

000114



CURVE NO.	PIT	SAMPLE NO.	DEPTH (ft)	USCS SYMBOL	COMPACTION METHOD	TESTING LABORATORY	SPECIFIC GRAVITY	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
1	6	06-022	0-15	ML(NP)	HARVARD	BOWSER-MORNER	2.87	101.2	23.0
2	6,Burn Pit	29A, 46A, 46B	DNA	ML	ASTM	UC/ALTER	2.50-2.98	99.0	19.9
3	5,6	40A,40B,41A,41B,43A,43B	DNA	ML(NP)	ASTM	UC/ALTER	2.71	76.9	36.2
4	6	405334	8.0-12.5	ML(NP)	ASTM	UC/ALTER	3.25	135.0	13.2
5	6	405346	7.0-12.0	SM	ASTM	UC/ALTER	3.42	142.8	11.0
6	6	405352	4.5-7.0	SM	ASTM	UC/ALTER	3.24	142.9	9.5
7	6	405352	13.0-17.5	SM	ASTM	UC/ALTER	3.27	129.7	14.6
8	6	405354	13.0-17.5	SM	ASTM	UC/ALTER	3.38	149.5	9.2
9	6	405355	13.0-17.5	DNA	ASTM	UC/ALTER	3.34	139.9	11.7

Figure 3-15 - Compaction Curves for OU1 Waste Pit 6 Materials

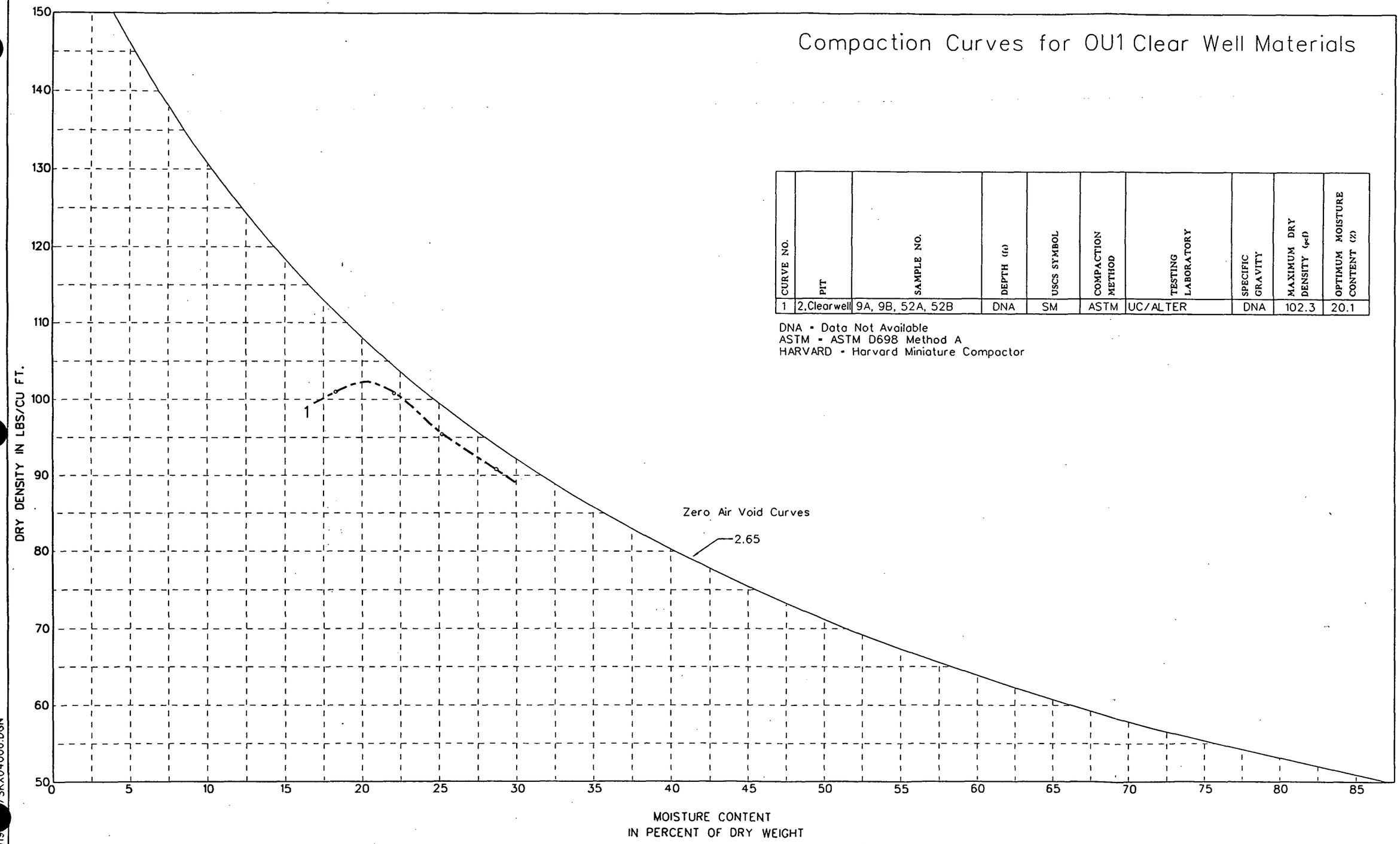


CURVE NO.	PIT	SAMPLE NO.	DEPTH (ft)	USCS SYMBOL	COMPACTION METHOD	TESTING LABORATORY	SPECIFIC GRAVITY	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
1	6,Burn Pit	29A, 46A, 46B	DNA	ML	ASTM	UC/ALTER	2.50-2.98	99.0	19.9
2	Burn Pit	07-052	0-16	SM	HARVARD	BOWSER-MORNER	2.35	81.2	9.5

DNA - Data Not Available
ASTM - ASTM D698 Method A
HARVARD - Harvard Miniature Compactor

Figure 3-16 - Compaction Curves for OU1 Burn Pit Materials

PO19/SKX04005.DGN



CURVE NO.	PIT	SAMPLE NO.	DEPTH (ft)	USCS SYMBOL	COMPACTION METHOD	TESTING LABORATORY	SPECIFIC GRAVITY	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
1	2,Clearwell	9A, 9B, 52A, 52B	DNA	SM	ASTM	UC/ALTER	DNA	102.3	20.1

DNA - Data Not Available
ASTM - ASTM D698 Method A
HARVARD - Harvard Miniature Compactor

Figure 3-17 - Compaction Curves for OU1 Clearwell Materials

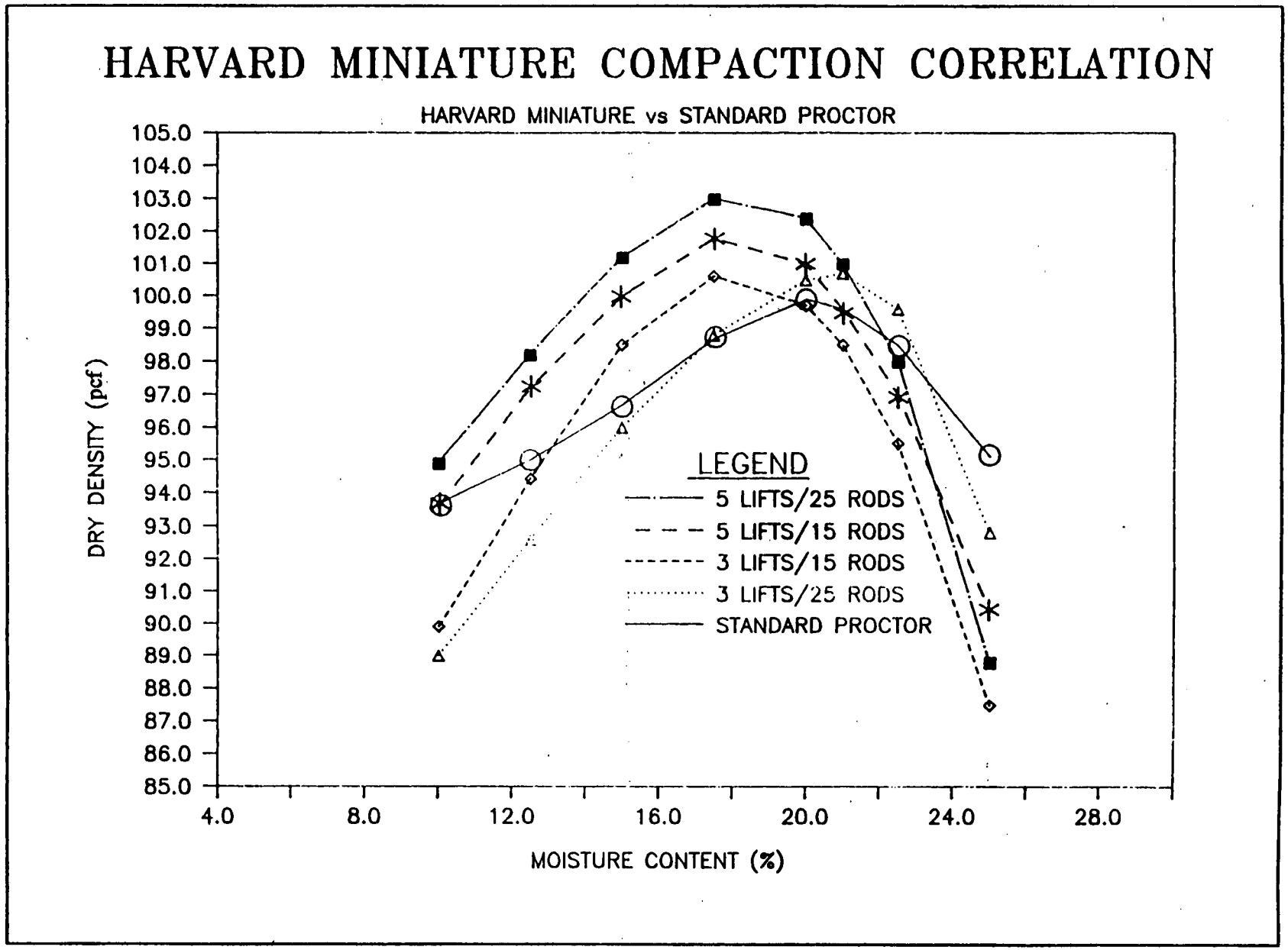


Figure 3-18 - Comparison of Different Compaction Efforts for Miniature Harvard Compactor to Standard Proctor Effort (WESTON 1988)

Table 3-5 - Summary of Remolded Physical Properties

Sample Group	Source of Material for Composite Sample	Liquid Limit %	Plastic Limit %	Optimum Moisture %	Std. Proctor Max. Dry Density (lb/ft^3)	UCS*		Direct Shear		Permeability* (cm/s)
						q_u (psf)	c_u (psf)	c_{cd} (psi)	ϕ_{cd} (° ∠)	
NP1	Pits 1 and 4	21.3	NP	13.4	116.6	N/A	N/A	0.0	40	4.3×10^{-6}
NP2	Pits 5 and 6	48.9	NP	36.2	76.9	N/A	N/A	6.3	31	N/A
MH1	Pit 5	89.3	56.9	56**	65**	2425	1212	1.7	33	1.2×10^{-7}***
MH2	Pits 2 and CW	59.8	40.1	35.4	77.8	2936	1468	7.6	2.9	6.6×10^{-8}*
ML	Pit 6 and Burn Pit	36.8	27.8	19.9	99.0	5744	2872	2.6	37	5.9×10^{-7}
CL	Pit 4	28.2	19.4	18.7	118.4	2962	1481	2.4	32	2.6×10^{-7}
SM	Pits 2 and 3	32.2	23.8	20.1	102.3	2962	1481	2.4	32	2.6×10^{-7}

* at approximately 95 percent Standard Proctor maximum dry density

** estimated (Lutz 1994)

*** at approximately 89 percent Standard Proctor maximum dry density

Source: (ALTER 1994)

000219

2396

3.4.1 Pit 1

The maximum dry densities and optimum moisture contents for Waste Pit 1 materials vary between 109.4 and 117.5 pcf and 13.4 and 20.3 percent, respectively. The depths of the test materials range from 0 to 13 feet below the existing ground surface. The different USCS classifications of the Waste Pit 1 materials were nonplastic silt (ML[NP]) and clayey gravel (GC), and the specific gravities vary between 2.62 and 3.02.

3.4.2 Pit 2

For Waste Pit 2 the maximum dry densities and optimum moisture contents ranged between 77.8 and 118.7 pcf and 14.2 and 35.4 percent, respectively. The depths of the test materials range from 0 to 10 feet below the existing ground surface. The different USCS classifications of the Waste Pit 2 materials were lean clay (CL), silty sand (SM) and elastic silt (MH). The specific gravities of the elastic silts range from 2.62 to 3.02, and the specific gravities were not reported for the lean clay and the silty sand samples.

3.4.3 Pit 3

The maximum dry densities and optimum moisture contents for Waste Pit 3 materials varied between 60.4 and 88.3 pcf and 26.4 and 62.8 percent, respectively. The depths of the test materials range from 0 to 20 feet below the existing ground surface. The different USCS classifications of the Waste Pit 2 materials were silt (ML), elastic silt (MH), and a mix of elastic silt and silty sand. The mix of silty sand and elastic silt was determined from the field log of the trench excavation from Waste Pit 3, not from laboratory classification. The specific gravities of the materials range from 2.65 to 2.69.

3.4.4 Pit 4

For Waste Pit 4 the maximum dry densities and optimum moisture contents ranged between 116.6 and 120.6 pcf and 13.4 and 18.7 percent, respectively. The depths of the test materials range from 0 to 20 feet below the existing ground surface. The different USCS classifications of the Waste Pit 2 materials were lean clay (CL), nonplastic silt (ML[NP]) and silt (ML). The specific gravities of the elastic silts range from 3.02 to 3.33, and the specific gravities were not reported for the lean clay and the silty sand samples.

3.4.5 Pit 5

The maximum dry densities and optimum moisture contents for Waste Pit 5 materials varied between 62.9 and 97.9 pcf and 26.7 and 60.8 percent, respectively. The depths of the test materials range from 6.9 to 30 feet below the existing ground surface. The different USCS classifications of the Waste Pit 2 materials were nonplastic silt (ML[NP]) and elastic silt (MH). The specific gravities of the materials range from 2.43 to 2.71.

3.4.6 Pit 6

For Waste Pit 6 the maximum dry densities and optimum moisture contents ranged between 76.9 and 149.5 pcf and 9.2 and 36.2 percent, respectively. The depths of the test materials range from 0 to 17.5 feet below the existing ground surface. The different USCS classifications of the Waste Pit 2 materials were silty sand (SM), nonplastic silt (ML[NP]) and silt (ML). The specific gravities of the elastic silts range from 2.50 to 3.42.

3.4.7 Burn Pit

The maximum dry densities and optimum moisture contents for the Burn Pit materials varied between 81.2 and 99.0 pcf and 9.5 and 19.9 percent, respectively. The depths of the test materials range from 0 to 16 feet below the existing ground surface. The different USCS classifications of the Waste Pit 2 materials were silt (ML) and silty sand (SM). The specific gravities of the materials range from 2.35 to 2.98.

3.4.8 Clearwell

In the Clearwell, one sample was tested for compaction characteristics. The sample tested was a combination of silty sand material from the Clearwell and Waste Pit 2. The maximum dry density and the optimum moisture content were 102.3 pcf and 20.1 percent, respectively. Specific gravity data were not reported for the sample.

3.4.9 Conclusion

Compared to material from Pits 2, 3, 5, 6, the Burn Pit, and the Clearwell, the waste materials from Pits 1 and 4 are closer to optimum moisture due to their more free-draining nature and original dry placement. As a result, it is possible for the materials in Pits 1 and 4 to have in situ densities near maximum dry density, whereas the material from the other Pits is too wet to obtain in situ densities near maximum dry density.

These data suggest that the material in Pits 2 and 3 will have to be densified before ramps, roads or other access structures can be built in the Pits for removal of the waste material, assuming equipment will bear directly on the waste material. Materials from Pits 5, 6, and the Clearwell will have to be dewatered and possibly densified before ramps, roads, or other access structures can be built in these Pits for removal of the waste material. Except for working atop the soil cap, there is no plan to work on the waste.

Appendix I summarizes recommendations for density and moisture to be used for process design. Additionally, the geotechnical laboratory data are expected to allow for calibration of the CPT data from Waste Pits 1, 2, and 3, thus enhancing confidence in extrapolation of expected material properties to areas where only CPT data exist. Water levels and geotechnical data corresponding to geotechnical borings in the near vicinity of the CPTs have been sent to the CPT contractor. Updated CPT data considering the water levels and geotechnical data have not been received and are planned for inclusion included in the final report.

SECTION 4

ANALYSIS AND RESULTS

This section presents an evaluation of the Waste Pits' subsurface conditions, and analyses of slope stability and bearing capacity of materials at Pit 3. The results from these analyses are important with respect to evaluating and establishing the appropriate approach to safe mechanical excavation of the materials at OU1/WPRAP. The analyses evaluate conditions in covered Pit 3, which is the largest and deepest, and, potentially, poses the most challenging excavation sequence. A three-dimensional (3-D) interpretation of CPT data is presented, and preliminary correlations of CPT and SPT data are discussed. A 3-D excavation sequence is modeled and presented in Appendix H.

Considerable benefit has been realized in terms of correlating CPT/SPT data as it relates to necessary design parameters and interpretation of subsurface conditions. By integrating data from the CPT probings with data from the boring logs, it is possible to view the suite of results on a single graphic (see Figure 4-1). This capability greatly enhances understanding of the interactions of the various parameters, and lends confidence to conclusions made from the data. Subsection 4.5 provides a discussion of specific parameters as they relate to one another, to the boring log classifications, and ultimately to laboratory test results.

4.1 Subsurface Conditions

The following discussion summarizes findings from the SPT borings and vibracore borings drilled in the areas of Waste Pits 1, 2, 3, 4, 5, 6, Burn Pit, and Clearwell and trenching activities in Waste Pits 1, 2, and 3.

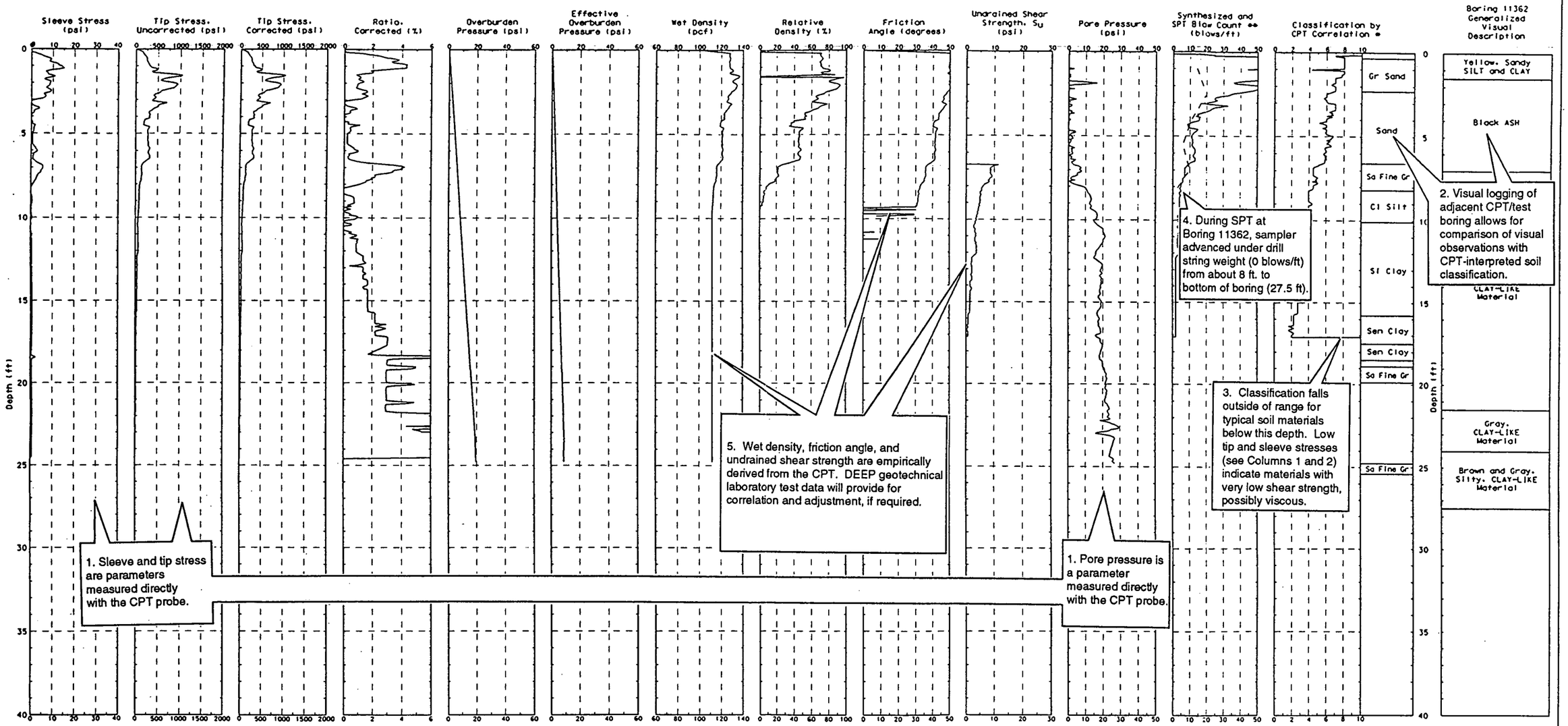
The waste in clay-lined Pits at the FEMP is, in general, a fine-grained, physically soil-like material. Typically each Waste Pit is heterogeneous, and often locally stratified but not stratified over the areal extents of each Pit. In general, the waste in the Pits is similar in its grain size distribution. It is composed predominantly of silt size particles. Moisture contents and limits, however, vary widely, indicating that the factors contributing to plasticity and moisture holding capacity are not similar between Pits. It has been found that the properties of the waste in several of the Pits are affected by amorphous materials (ALTER 1994).

Although samples recovered from borings tend to show locally stratified conditions within the boring excavation, it is worth noting that any reasonable attempt at stratigraphic correlation between and among borings or trenches more than a few feet apart results in nearly all identified units displaying discontinuity. This is understandable in light of the method of deposition. The materials were literally dumped at various locations around the Pits at irregular (spatially and temporal) intervals, were of

PIT: 3

CPT ID: C3-2

DATE TEST PERFORMED: 9/1/94



LOCATION

ID	Coordinates (NAD 1983) Northing	Coordinates (NAD 1983) Easting	Ground Surface Elevation - feet (NAVD 1927)
C3-2	481536	1346593	584.8
11362	481546	1346593	584.5

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11362

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S01S402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

CPT ID: C3-2

CAD FILE: P019/SKX03462.DGN

Figure 4-1 - Annotated Log of CPT Data and Adjacent Test Boring Selected Data

inconsistent composition, and were periodically reworked as it became necessary to spread dumped materials farther into the Pit as the active area of deposition along Pit margins became full. Consequently, prediction of what specific material might be encountered at what depth or in what areal configuration is impossible with any reasonable certainty. However, based on review of boring logs and attendant laboratory test results, some generalizations pertinent to design of remediation activities can be made.

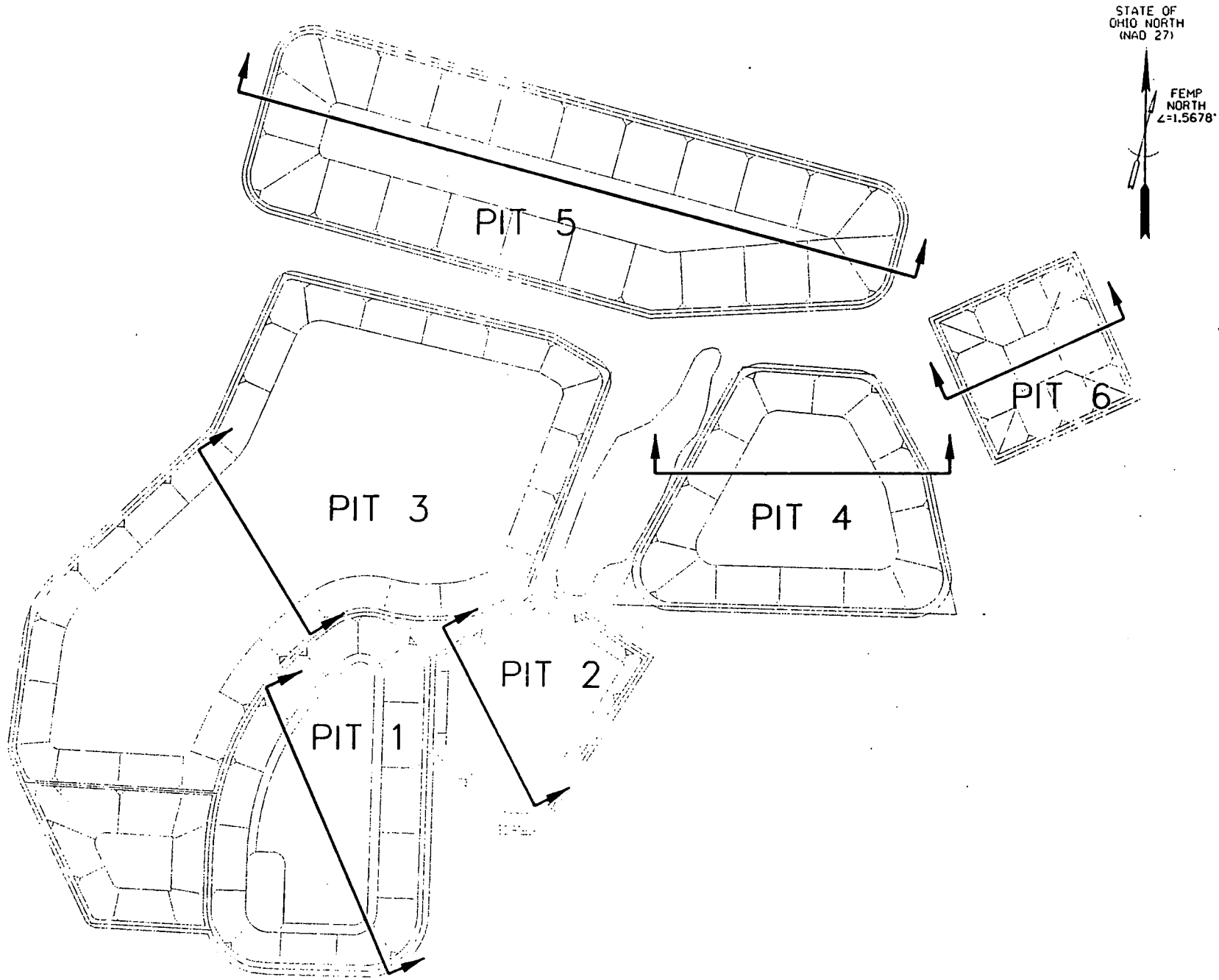
Materials used to cover the process waste within Pits 1, 2, 3, and 4 range in composition from fly ash to silt/clay mixtures. No attempt was made to provide detailed evaluation of cap thickness on a Pit-by-Pit basis, but suffice it to say that the thickness where observed in borings and trenches ranges from less than a foot to several feet. Consistency of the covering materials varies from very stiff to medium dense.

In general, visual classifications as presented on boring logs tend to identify materials and units within the Pits as finer grained than they are demonstrated to be in the laboratory; most materials visually logged and classified as clay are found to be silts when subjected to laboratory analysis. This is in large part demonstrated and confirmed by the wet-trenching operations wherein it was clear that materials did not stick to the backhoe bucket as would be anticipated if the materials were indeed clay. Also, the materials displayed a tendency to be "blocky" when saturated and first excavated, but readily dissipated into a "lump" when disturbed by the process of excavation and placement on the spoil pile - behavior typical of silts. Field identification of the materials as clay or clay-like is understandable due to the generally shiny and smooth appearance, as well as the tendency to retain a substantial amount of water and behave in a plastic manner, all characteristics typically attributable to clays.

Figure 4-2 shows the location of cross sections presented on Figures 4-3 and 4-4. Figure 4-3 presents diagrammatic cross sections of Pits 1, 2, and 3, and provides for graphic comparison of visual log classification with laboratory classification. The cross sections show visual classification along the left side of the boring line with the appropriate Unified Soil Classification System designator in parentheses, and laboratory classification (where samples were collected for testing) along the right side of the boring line in bold print. It should be noted that most of the borings are projected into the section line. Figure 4-4 presents diagrammatic cross sections of Pits 4, 5, and 6 for comparison of visual log classification with laboratory classification of subsurface materials.

For purposes of generalizing the subsurface material types into units that can be readily recognized between borings and Pits, boring materials are presented in four major categories based on evaluation of boring logs and analysis of laboratory test results: Silty sand and sand (SM), low plasticity silt (ML), high plasticity silt (MH), low plasticity clay (CL). There are also locations where clayey sand (SC) is identified, but they are rare compared to the other major material types.

Although debris is not considered as a "material type," any discussion of the Pits without mention of debris would be incomplete. Unfortunately, only the largest of generalizations can be made regarding



0 100 200 FT
SCALE

LOCATION OF DIAGRAMMATIC
CROSS SECTIONS

Figure 4-2 - Location of Diagrammatic Cross Sections

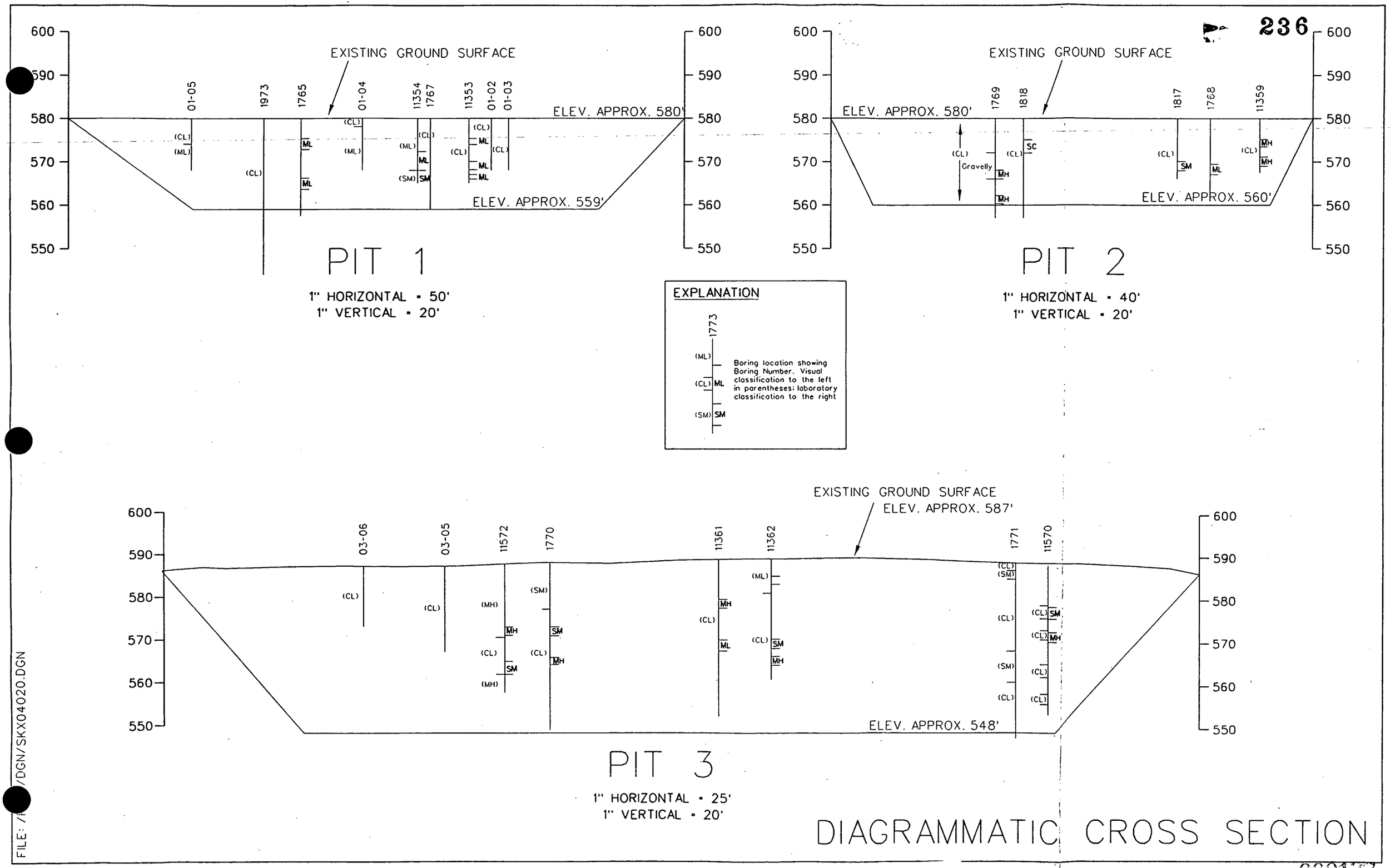
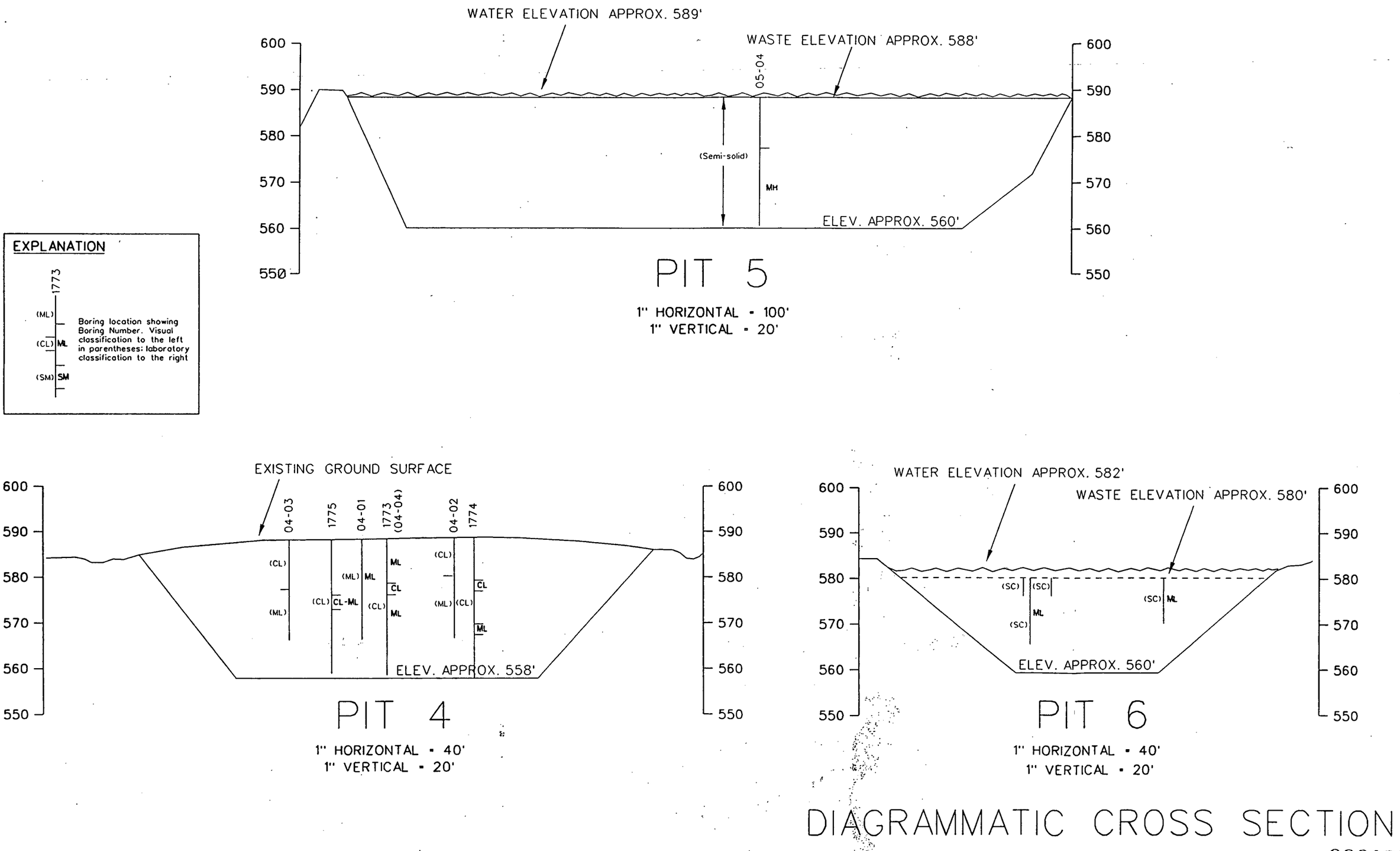


Figure 4-3 - Diagrammatic Cross Section for Waste Pits 1, 2, and 3



FILE: /P DGN/SKX04020.DGN

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OU-1\PO-145\JAN1996\DEEPRPT

Figure 4-4 - Diagrammatic Cross Section for Waste Pit 4, 5, and 6

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the nature and extent of the numerous types of debris in the various Pits. Types of debris encountered during DEEP wet trenching and ramp excavations with a track hoe at various locations in Pits 1, 2, and 3 included large pieces of concrete rubble, coarse gravel, planks of lumber, sheet metal, metal bands, metal drums, metal buckets, and metal wire. In general, debris can be expected more typically around the margins of the Pits and extending an estimated one-third the distance into the center of each Pit. Beyond that, no prediction is made with any confidence.

Visual inspection of the various diagrammatic cross sections demonstrates some recognizable correlations with various material types as they relate to the various Pits. The following sections discuss these correlations on a Pit-by-Pit basis.

Based on preliminary review of DEEP wet trenching and ramp excavation activities in Pits 1, 2, and 3, groundwater may be present as freestanding or pore water in the waste materials and perched at the cap/waste interface, which may present problems during excavation. Other sources of perched groundwater may be encountered at the excavation face at the Pit perimeters. A detailed description summarizing the field observations from wet trenching and ramp and pad excavations in Pits 1, 2, and 3 can be found in Appendix C and Appendix E, respectively.

4.1.1 Classification of Waste Pit 1 Material

The waste contents in Pit 1 are predominantly composed of materials that respond to laboratory testing similarly to nonplastic silts. Up to about 3 feet of coarser-grained material (silty sand [SM]) was identified by laboratory test on a sample from about 12 to 15 feet in boring 11354. Visual logging indicated that at depth, materials were generally classified as silt/sand mixtures (SM) in the more central area of the Pit. For purposes of this discussion, the central area is that area in the middle third of the Pit when measured from side to side.

Boring 11352 indicates a stiff to very stiff silt/clay mixture comprising a cap of about 6 inches in thickness. Below a depth of about 5 feet to the total drilled depth of 15.5 feet, the materials become paste-like, wet, and soft. Boring 11353 indicates a cap thickness of about 2 feet that is composed of very stiff, sandy clay. At a depth of about 3 feet, to the total drilled depth of 15.5 feet, the materials become soft, wet, and loose. The upper 10 feet of boring 11354 is composed of very stiff silt/clay mixtures. Below 10 feet, the materials become wet to the total depth of 15.5 feet. Materials in Pit 1 have been classified visually as predominantly clay (CL); however, examination of Figure 4-3 shows that in most places classified visually as clay (CL), the materials are classified according to laboratory test results as low plasticity silt, ML.

General conclusions from observing wet trenching can be found in Subsection 5.11. General conclusions from observing Pit 1 ramp excavations can be found in Subsection 5.12.

4.1.2 Classification of Waste Pit 2 Material

Similar to Waste Pit 1, materials in Waste Pit 2 were visually logged as clay (CL), and laboratory tests on the materials result in classifications of predominantly high plasticity silt, MH, as well as some low plasticity silt, ML, and some minor amounts of sand/silt/clay mixtures. It is also worth noting that some coarse-grained materials (clayey sand, SC, and silty sand, SM) were found in the middle one-third of Pit 2 just as in Pit 1. The most notable difference is that in Pit 2 the majority of materials respond to laboratory testing as high plasticity silt, MH, rather that the low plasticity silt, ML, of Pit 1. See Subsection 5.11 for general conclusions from observations during Pit 2 wet trenching.

4.1.3 Classification of Waste Pit 3 Material

Although predominantly logged as clay (CL) visually, most of the samples of materials from Pit 3 have been laboratory classified as high plasticity silt, MH. Scattered throughout the Pit in layers up to about 10 feet locally (boring 1770), visual classifications have identified sand/silt (SM) layers. Laboratory tests on samples from throughout the Pit have also identified sand/silt mixtures at depths ranging from 4 feet to 23 feet. Typically these mixtures are observed in samples about 24 inches long. It is interesting to note, however, that with only one exception, laboratory samples that classified as SM were retrieved from areas within a boring that were visually classified as (CL) the same characteristic as observed in Pits 1 and 2; the visual classification tended to be finer grained than the laboratory classification.

See Subsection 5.11 for results drawn from observations made during the Pit 3 wet trenching. Subsection 5.12 includes results made as a result of observations made during the Pit 3 ramp and pad excavation.

4.1.4 Classification of Waste Pit 4 Material

Materials visually logged and classified, as well as laboratory classifications of material samples, uniformly provided descriptions of fine-grained materials, CL and ML. However, it is expected that considerable trash is scattered throughout the Pit.

4.1.5 Classification of Waste Pit 5 Material

For purposes of discussion, only boring 05-04 was plotted on the diagrammatic cross section because all borings seemed to provide material descriptions of "semi-solid" without any attempt to necessarily relate the material to a standard soil classification. Also, boring 05-04 had laboratory test results from a composite sample taken of the interval 10 feet to 29 feet. Testing of that sample resulted in a material that behaves generally like a high plasticity or elastic silt MH. Boring logs as well as laboratory data mention a grittiness, or slightly granular nature of some of the materials. Commonly the waste materials are brightly colored and highly variegated, displaying some indication of correlative "stratigraphy"

between borings. However, with some water contents in excess of 600 percent, it is understandable that sample recovery with standard soil sampling techniques is difficult at best, and consequently the ability to determine specific engineering parameters for specific "layers" is moot.

4.1.6 Classification of Waste Pit 6 Material

Borings used for interpretation of subsurface material type, nature, and extent all resulted in visual classifications correlative to coarse-grained materials (i.e., silt/sand mixtures with some clay [SC]). Laboratory classification of the same materials resulted in classification of ML-sandy silt, silt with sand, and silty sand SM. This is the only instance regarding logging and testing of Waste Pit materials wherein visual logging resulted in classifications of the materials being more coarse grained than laboratory classification of the same materials. It is important to recognize, however, that the difference is slight, inasmuch as the visual log provides descriptions of sand/silt mixtures with some clay, and the laboratory results yield silt with sand, and silty sand. Regardless, the materials are nonplastic and appear to come closer to being predictably stratified than in Pits 1 through 4. This is reasonable considering the "settlement pond" nature of the Pit and the somewhat more consistent process used to deposit waste materials.

4.1.7 Classification of Burn Pit Material

Samples taken from the Burn Pit as composites of materials from 10 feet to 16 feet are classified as silty sand, SM; sandy silt, ML; and lean clay with sand, CL, based on laboratory results. This compares favorably with the visual field classifications which also describe layers of sand/silt mixtures with some clay locally.

4.1.8 Classification of Clearwell Material

Samples from the Clearwell indicated constituents representative of the broad spectrum of materials present in Pits 1 through 6 and the Burn Pit. This is reasonable because the Clearwell was used to handle overflow as well as stormwater drainage. The materials are predominantly fine-grained and seem to be silts.

4.2 Stability Analysis

This section discusses slope stability analyses of Waste Pit 3 materials. The discussion is divided into technical approach, analysis cross section, material properties, and results.

4.2.1 Technical Approach

The stability of the proposed Pit 3 excavation access ramps and subgrade soils was analyzed for the following six unique scenarios:

1) 2.5 Horizontal to 1 Vertical Slope, Undrained Condition
2) 3 Horizontal to 1 Vertical Slope, Undrained Condition
3) 4 Horizontal to 1 Vertical Slope, Undrained Condition
4) 2.5 Horizontal to 1 Vertical Slope, Drained Condition
5) 3 Horizontal to 1 Vertical Slope, Drained Condition
6) 4 Horizontal to 1 Vertical Slope, Drained Condition

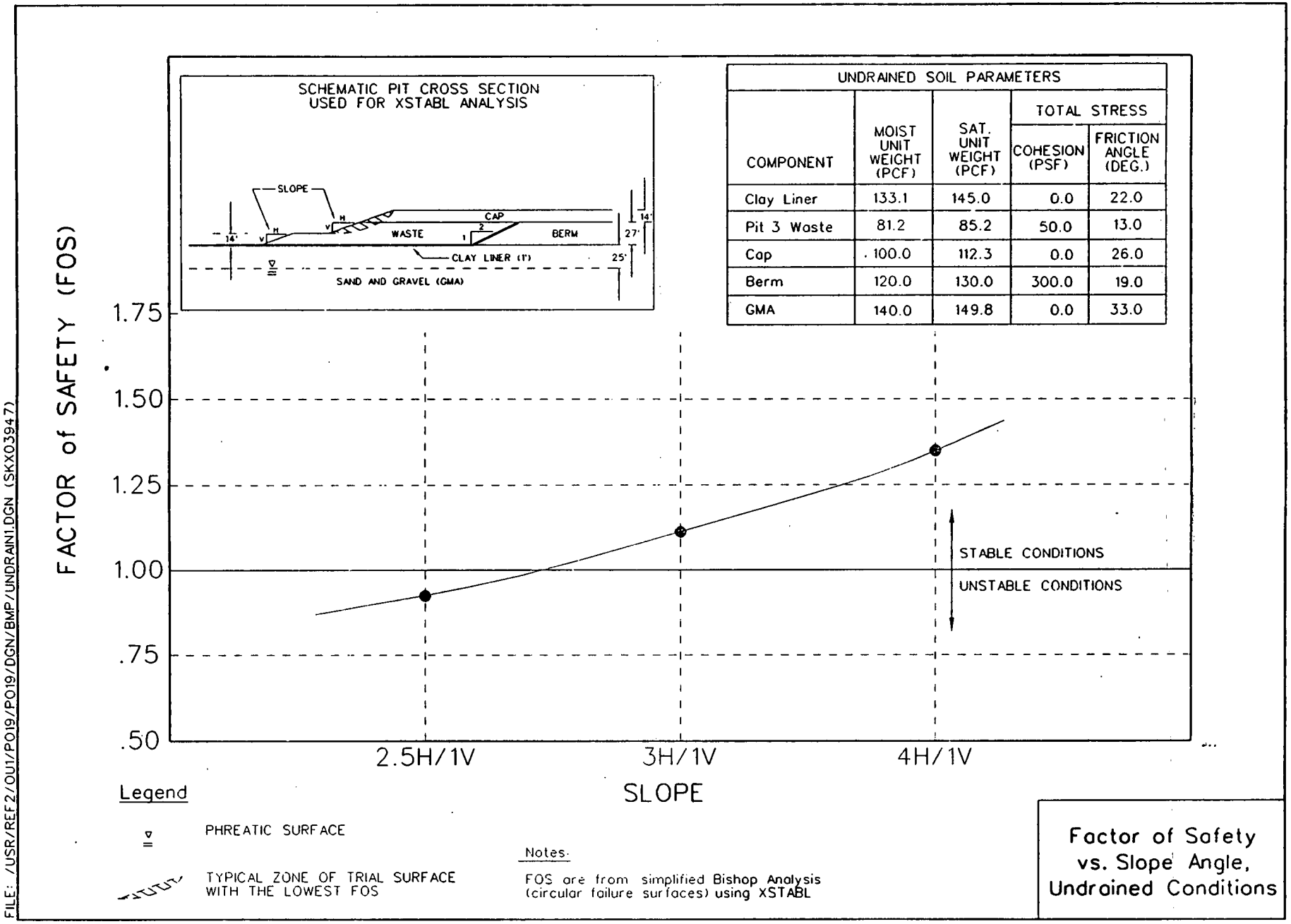
Undrained conditions consider total stress parameters determined for the waste while drained conditions assume effective stress parameters and incorporate a lowered phreatic water surface to account for partial Pit dewatering from wells, wick drains, trenching, etc.

The analyses were performed using the XSTABL slope stability computer model, developed by Interactive Software Designs, Moscow, Idaho. This model performs two-dimensional limit equilibrium analyses and incorporates a random surface generator for searching out the critical failure surface for a given slope. All analysis performed assumed static conditions and utilized the Bishop's Simplified Method.

4.2.2 Analyses Cross Section

Each cross section consists of five soil layers including the cap, waste, berm, one foot clay liner, and Great Miami Aquifer. Three distinct geometries are assumed based on slopes of 2.5 to 1, 3 to 1, and 4 to 1. The geometry is determined by descending through the cap and waste at the appropriate slope to a point midway through the waste depth. A horizontal bench extends from this point to a location determined by extending the first ramp to the bottom of the Pit and drawing a vertical line to intersect. The second ramp proceeds from this intersection point at the appropriate slope to the bottom of the Pit. Figures 4-5 and 4-6 show the safety factors for each slope angle analyzed, and the undrained and drained conditions, respectively. Embankment heights are also shown in these figures.

Both drained and undrained cases incorporate a horizontal phreatic water surface representing the water table at 522.0 ft above mean sea level. However, the drained scenarios assume a second water surface to account for partial dewatering. This surface is bordered by the bottom of the waste, the lower ramp, and the extension of the horizontal bench to the Pit berm (See Appendix F).



UNDRAINED SOIL PARAMETERS				
			TOTAL STRESS	
COMPONENT	MOIST UNIT WEIGHT (PCF)	SAT. UNIT WEIGHT (PCF)	COHESION (PSF)	FRICTION ANGLE (DEG.)
Clay Liner	133.1	145.0	0.0	22.0
Pit 3 Waste	81.2	85.2	50.0	13.0
Cap	100.0	112.3	0.0	26.0
Berm	120.0	130.0	300.0	19.0
GMA	140.0	149.8	0.0	33.0

FILE: /USR/REF2/OU1/PO19/PO19/DGN/BMP/UNDRAIN1.DGN (SKX03947)

Figure 4-5 - Factor of Safety vs. Slope Angle, Undrained Conditions

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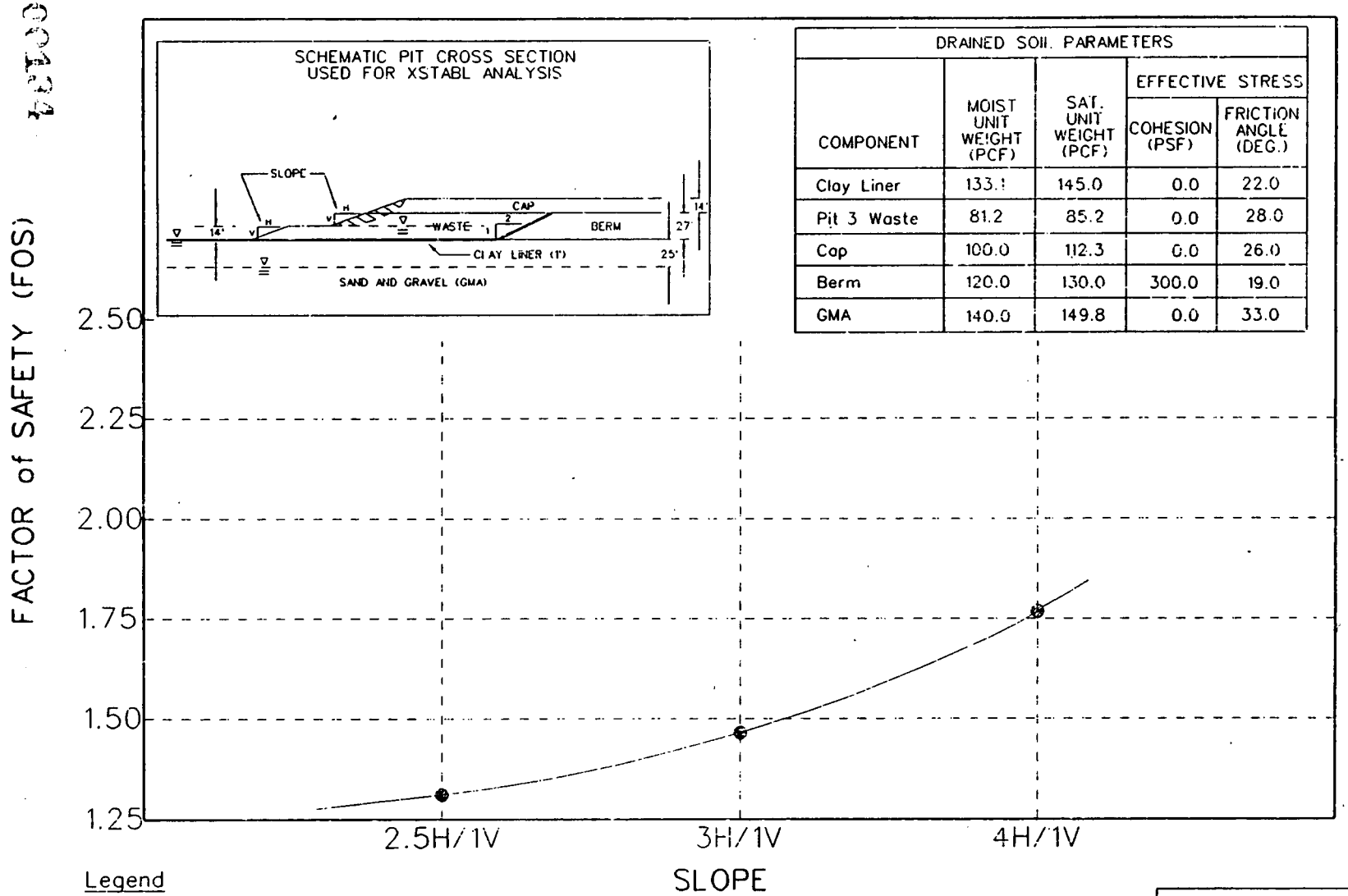


DRAINED SOIL PARAMETERS				
			EFFECTIVE STRESS	
COMPONENT	MOIST UNIT WEIGHT (PCF)	SAT. UNIT WEIGHT (PCF)	COHESION (PSF)	FRICTION ANGLE (DEG.)
Clay Liner	133.1	145.0	0.0	22.0
Pit 3 Waste	81.2	85.2	0.0	28.0
Cap	100.0	112.3	0.0	26.0
Berm	120.0	130.0	300.0	19.0
GMA	140.0	149.8	0.0	33.0

Legend

PHREATIC SURFACE

TYPICAL ZONE OF TRIAL SURFACE WITH THE LOWEST FOS

Notes:

- FOS are from simplified Bishop Analysis (circular failure surfaces) using XSTABL

Factor of Safety vs. Slope Angle, Drained Conditions

FILE: /USR/REF2/OU1/PO19/DGN/BMP/DRAIN1.DGN (SKX03948)

Figure 4-6 - Factor of Safety vs. Slope Angle, Drained Conditions

4.2.3 Material Properties

Material properties used for slope stability modeling were based on laboratory results (ALTER 1995a and SAIC 1996), literature values, and engineering judgement. Properties for drained and undrained simulations for each of the five soil layers are summarized in Appendix F.

4.2.4 Results

Table 4-1 summarizes the results of the stability analysis modeling for each of the six cases examined.

Table 4-1 - Summary of Stability Analyses Results, Pit 3

Scenario	Slope	Condition	FOS
1	2.5 to 1	Undrained	0.92
2	3.0 to 1	Undrained	1.11
3	4.0 to 1	Undrained	1.35
4	2.5 to 1	Drained	1.31
5	3.0 to 1	Drained	1.47
6	4.0 to 1	Drained	1.77

Note: For Drained Case FOS = 1.09 for 2.0 to 1 Slope.

In all cases, the most critical failure surface is located on the upper ramp. Any reduction in the height of the embankment will increase the factors of safety.

Data files detailing geometry, soil layer parameters, phreatic water surfaces, and the 10 most critical failure surfaces are provided in Appendix F.

4.3 Bearing Capacity

This section discusses bearing capacity of materials from Waste Pit 3. Shear strength data were available for Waste Pit 1, but shear strength values were only used from Pit 3 since Pit 3 values were smaller than Pit 1. The smaller values from Pit 3 were used to provide a conservative analysis.

4.3.1 Bearing Capacity of Track Loaders on Waste Material

Track loaders are being considered for use in removing the waste material from the OU1 Waste Pits. As a result, the bearing capacity of the waste material under the load of various track loaders was investigated. The bearing capacity of the waste material was analyzed in the event that equipment would rest on the waste material while excavating adjacent waste material. This is a conservative analysis since the excavation plan calls for working from the capped berms and excavating upward from the ramped entrance into the Pit bottom.

Shear strength values, determined using consolidated-undrained triaxial shear tests, from OU1 Waste Pit 3 were used for evaluation of bearing capacity. The undrained ϕ value was 13 degrees, and the undrained cohesion value was 50 psf. The drained ϕ value was 28 degrees, and the drained cohesion value was 0 psf. These are the lowest measured values and were used to remain conservative.

The width of the tracks were used for the width of the bearing surface, and the contact length of the tracks with the ground surface were used for the length of the bearing surface. Operating loads and track dimensions of two track loaders, a Caterpillar 931 C Series II and a Caterpillar 953B, were determined using published data from the manufacturer.

Both drained and undrained conditions were evaluated for bearing capacity failure. The existing waste material in Waste Pit 3 has moisture contents between 18 percent and 295 percent with the majority of the measurements being greater than 40 percent. As a result, the majority of the waste material is saturated, and any loading of the material would result in undrained conditions. If the waste material was dewatered before excavation was started, loading could result in drained conditions depending upon the degree of the dewatering.

The drained and undrained factors of safety against bearing failure for both types of track loaders are summarized in Table 4-2. Since the removal of the wastes in the Waste Pits is a construction activity, a factor of safety against bearing failure between 1.5 and 2.0 is considered adequate. The Caterpillar 931C Series II track loader results in undrained and drained factors of safety of 0.8 and 1.8, respectively. The Caterpillar 953B track loader results in undrained and drained factors of safety of 0.4 and 0.8, respectively. Due to the low factors of safety in both the undrained and drained cases, the Caterpillar 953B track loader or similar loaders producing loads of similar magnitude are not recommended for the excavation of the waste materials in the OU1 Waste Pits. The waste materials in the OU1 Waste Pits should provide adequate bearing capacity to support the Caterpillar 931C Series II track loader or another track loader producing similar load for drained conditions only.

Table 4-2 - Summary of Bearing Capacity, Pit 3

Loader/Drainage Case	Track Load (psi)	Ult. Bearing Capacity (psi)	Factor of Safety
931C Undrained	4.8	4.0	0.8
931C Drained	4.8	8.5	1.8
953B Undrained	9.1	3.8	0.4
953B Drained	9.1	7.2	0.8

4.3.2 Field Observations of Track Loaders on Waste Material

During the ramp and pad excavations in Waste Pits 1 and 3, attempts at operating a John Deere 555G WT Series IV track loader on the waste materials were made. The contact pressure of the tracks on the ground surface for this track loader is 5.81 psi, according to the owner's manual.

Upon operating the track loader on the waste material within Waste Pit 1, the track loader operated without difficulty. In fact, the loose material left from excavation appeared to compact under the weight of the loader's tracks. At the west end of the pad area where water had ponded, operating the track loader caused significantly deep ruts; but the rutting did not hinder or slow the movement of the track loader. As a result, it appears the actual bearing capacity of the waste material in Waste Pit 1 is equal to or greater than the estimated bearing capacity that was calculated using shear test results.

No attempt was made to operate the track loader on the Pit 3 waste material since it was determined by OU1 personnel that the waste material was too soft to support the track loader. During excavation of the soft waste material, the material would almost immediately collapse into the excavation made by the track hoe bucket. In addition, an attempt was made to drive the track hoe onto the stockpiled waste material from Waste Pit 3. Instead of driving onto the pile, the track hoe drove through the pile with little or no resistance. As a result, no attempt was made at driving the track loader on the waste in the Pit.

As a result of not operating the track loader on the waste in Waste Pit 3, the validity of the bearing capacity calculations using the shear test results could not be determined. Considering the observations made in the field, it is estimated that the bearing capacity by calculation closely estimates the actual bearing capacity of the waste material encountered during the ramp and pad excavation within Waste Pit 3.

4.4 3-D CPT Data Interpretation

In addition to the graphic log representation, the CPT data can readily be entered into a Geographical Information System (GIS) 3-D model to develop interpretations as presented on Figures 4-7 and 4-8.

Figures 4-7 and 4-8 are developed by PARSONS directly from the ARA digital CPT data. The empirical blow count data for the 12 Waste Pit 3 CPT probings were loaded into the GIS platform, and a 3-D voxel model was used to interpolate and extrapolate the data and create various views. Color Figures 4-7 and 4-8 represent a range of blow count, which, in turn, also represents a range of consistencies for the waste materials. For Waste Pit 3, the consistencies of materials were used as described in Table 4-3.

Table 4-3 - Consistency of Cohesive Soils (see Figures 4-5 and 4-6)

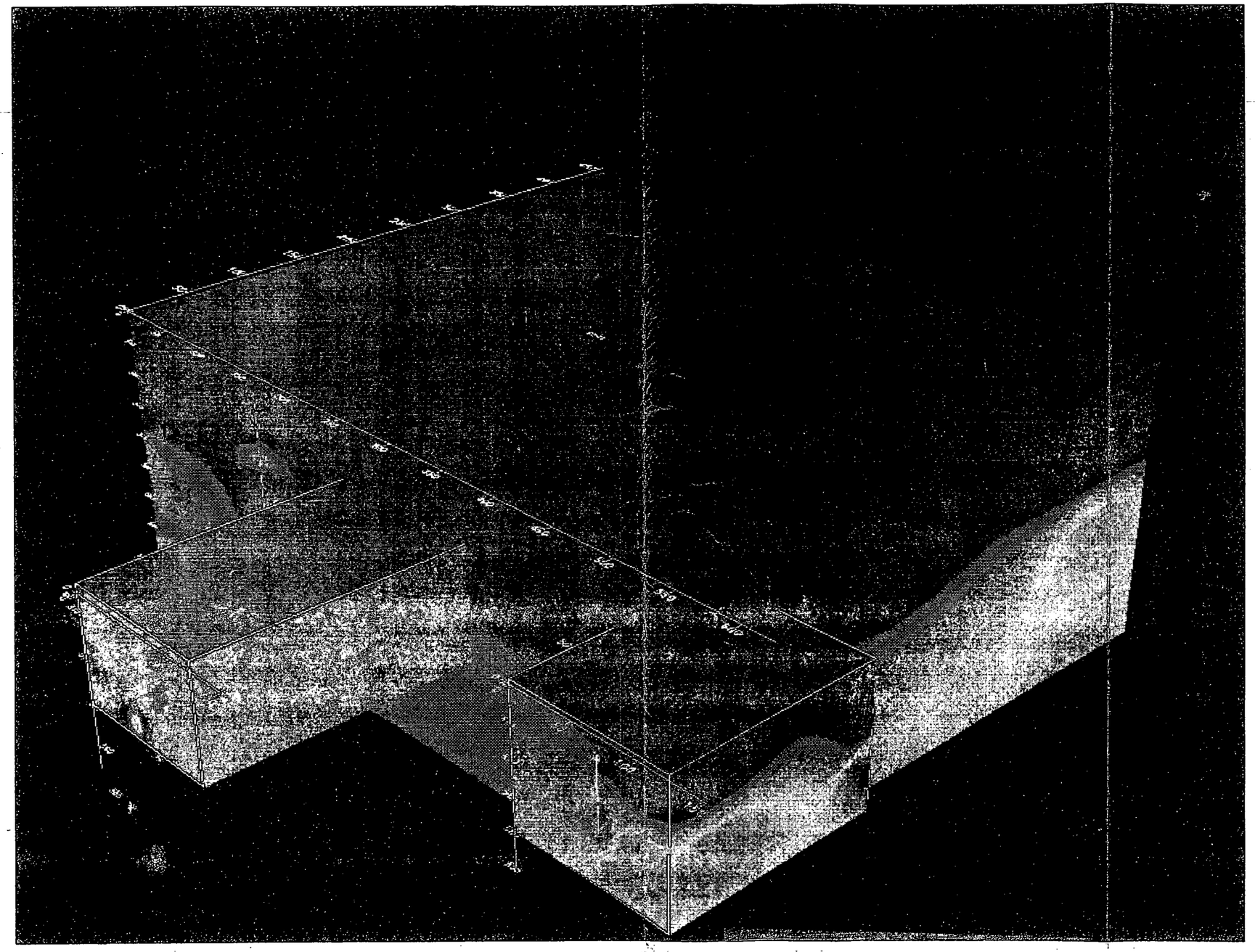
Color	Blow Count	Consistency
Black	0 to 4	very soft to soft
Red	5 to 8	medium stiff
Purple	9 to 15	stiff
Blue	16 to 30	very stiff
Yellow	31 to 50	hard
Green	> 50	very hard

From the graphical presentations for Waste Pit 3, the distribution of the consistencies of the Waste Pit materials can be visualized and areas with potentially low strength characteristics identified for additional evaluation. Figures 4-7 and 4-8 show that potentially unstable, very soft to soft materials exist below about Elevation 565. Stiffer materials overlay the softer materials. These stiffer materials have a greater thickness at the northern end of Waste Pit 3.

Visual inspection of the side-by-side CPT printouts and of the GIS-generated graphics provides a general picture of the more granular cap materials, which are about 10 to 15 feet in thickness, overlying the fine-grained, clay like, soft waste materials below the cap. More recently, trenching activities under present water conditions (part of the DEEP program) have confirmed much of the engineering data derived from the CPT probings and SPT boring activities.

The GIS system has also proven useful in assessing the relationship of material types among the Waste Pits. Figure 4-9 is a 3-D depiction of material types in Waste Pit 3 (the biggest block), Waste Pit 2 (the

000138

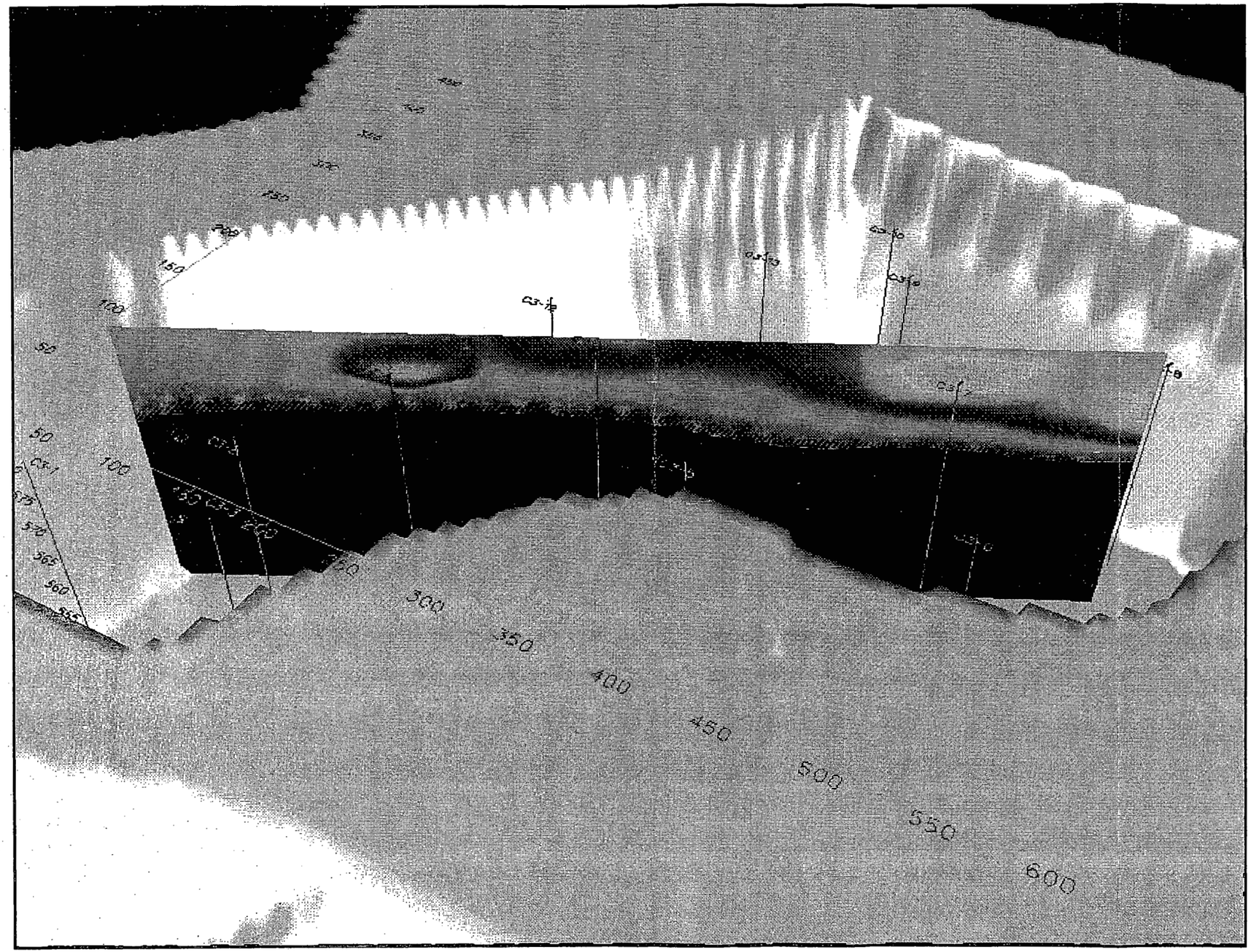


LEGEND

Color Code	SPT Blow Count
	< 4
	4-8
	8-15
	15-30
	30-50
	50-100
	> 100

Note: Small block on left represents Pit 1 imposed on Pit 3, and small block on right represents Pit 2 imposed on Pit 3. North direction is toward the lower right corner.

Figure 4-7 - Three-Dimensional Interpretation of Empirical Blow Count Data at Waste Pits 1, 2, and 3

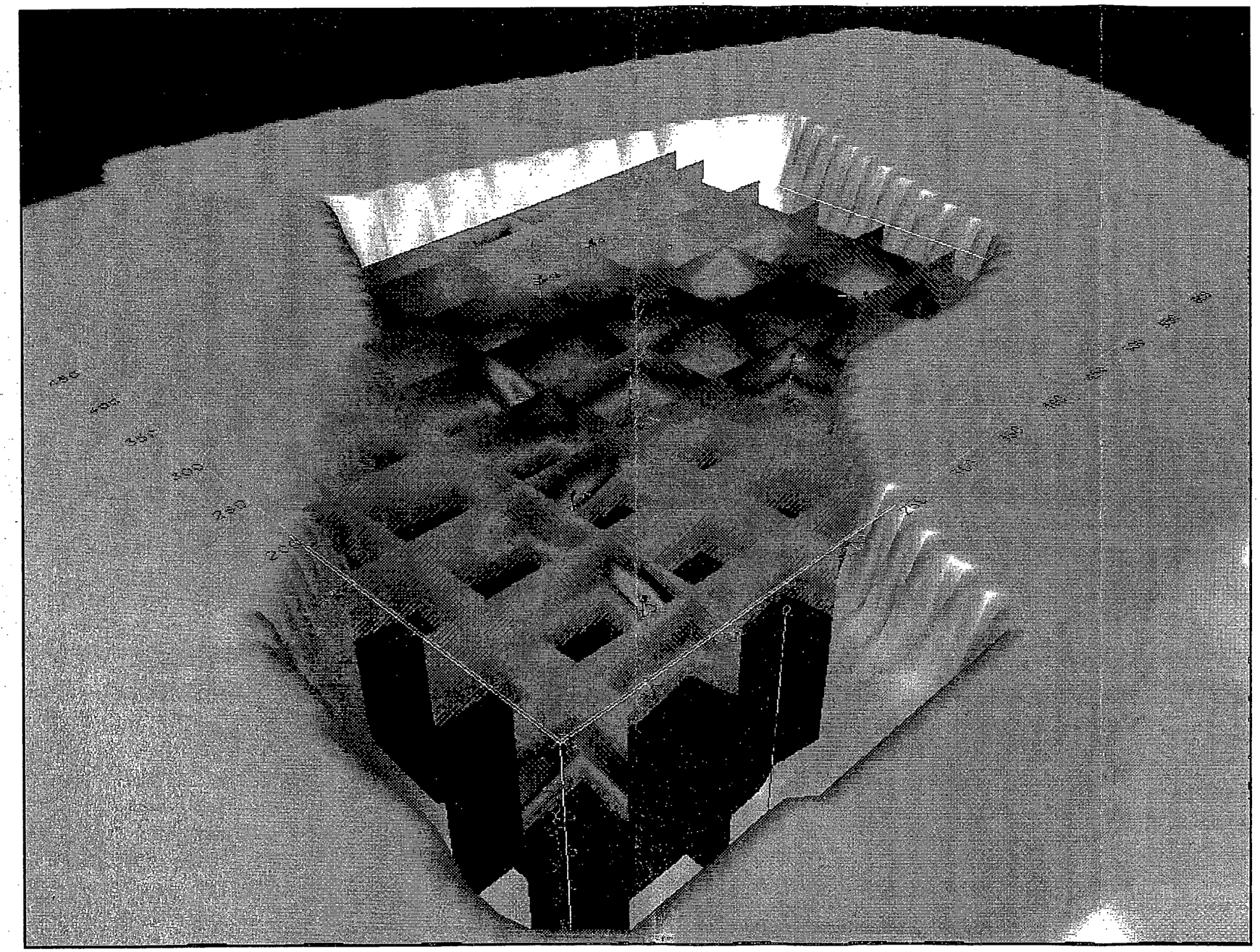


LEGEND

Color Code	SPT Blow Count
	< 4
	4-8
	8-15
	15-30
	30-50
	50-100
	> 100

Note: North Direction is Toward the Upper Right Corner

Figure 4-8 - Cross-Section of Three-Dimensional Interpretation of Empirical Blow Count Data at Waste Pit 3



LEGEND

Color Code	CPT Soil Type
	Below Range
	Sensitive
	Peat
	Soft Clay
	Clay
	Silty Clay
	Clayey Silt
	Silt
	Sandy Silt
	Silty Sand
	Sand
	Gravelly Sand
	Over Consolidated
	Above OC

Figure 4-9 - Three-Dimensional Block Model Interpretation of Material Types at Waste Pits 1, 2, and 3

Note: North Direction is Toward the Lower Right Corner

block intercepting the corner of the big block), and Waste Pit 1 (intersecting the side of the big block). The graphic is generalized, taking into account only material type (i.e., CPT empirical classification) and not necessarily the shape or exact geographical orientation of the three Pits.

In Figure 4-9, the red to pink and purple-red represents fine-grained, soft deposits (i.e., clay). The green to greenish-blue represents sand/silt mixtures, and the light to dark blue represents coarse-grained materials (sand and gravel). From Figure 4-9 it is readily discerned that Waste Pit 3 is generally similar to Waste Pit 2 in grain-size makeup and distribution, whereas Waste Pit 1 is clearly different from either Waste Pit 2 or Waste Pit 3.

4.5 CPT Correlations

As discussed in Section 2, test borings were conducted adjacent to the CPT probes. The purpose of the adjacent placement of test borings and CPT probes was to allow comparison among CPT data and visual observations, SPT blow counts, and material classifications and physical properties obtained from laboratory tests. This comparison is anticipated to allow a site-specific calibration of the CPT for FEMP materials. Figure 4-1 provides an annotated log showing the CPT data from CPT probe C3-2, SPT blow count data from boring 11362, and a generalized visual description profile from the field geologist's log of boring 11362. Assumptions made for preparation of the CPT logs are indicated in the notes on the log.

The following items correspond to the annotated text blocks on Figure 4-1:

1) The three parameters measured directly with the CPT are sleeve stress, tip stress, and pore pressure. Other CPT data from C3-2 are based on empirical correlations for soils. Site-specific laboratory data from the adjacent test boring will assist in calibrating the CPT for the site-specific material, especially necessary because the majority of the OU1 waste materials are not truly soil materials.

2) The visual logging of adjacent test borings allows comparison/correlation of visual observations with empirical CPT classifications.

3) The empirical CPT classification number sometimes falls outside the range of typical soil materials when CPT data for the waste materials are evaluated using empirical correlations for soils. For C3-2, low tip and sleeve stresses indicate waste material with very low shear strength, possibly viscous.

4) During the SPT at test boring 11362, the sampler advanced under the weight of the drill string alone. This occurred from a depth of about 8 feet to the bottom of the test boring (27.5 feet).

The empirical blow count from the CPT correlated very closely with the SPT blow count from the test boring.

5) Empirical CPT correlations such as wet density, friction angle, and undrained shear strength require comparison with results of geotechnical laboratory tests. This will allow for adjustment of CPT parameter plots, if required.

SECTION 5

CONCLUSIONS

This section presents conclusions regarding OU1 Waste Pit material geotechnical characteristics; dewatering and CPT correlations based on the DEEP activities conducted; and geotechnical laboratory test results. Appendix F presents all the geotechnical data in tabular form. Appendix I presents suggested use of data for waste processing design.

5.1 Pit 1

In general, Pit 1 waste materials behave like nonplastic silts (ML) with little cohesion and low dry strength. Some coarse-grained silty sand (SM) (with nonplastic silts) and sandy elastic silt (MH) are also present. The moisture contents range from about 16 to 67 percent (by dry weight).

Petroleum odor was observed for some Pit 1 samples. This indicates that petroleum products may have an impact, aiding in its nonplastic nature and causing dried Pit 1 waste to repel water (ALTER 1994). According to another geotechnical laboratory (SAIC 1996), the dried waste materials repelled water initially, but combined with the water after extensive mixing. Observations made during the ramp and pad excavations also determined that the waste repels water.

A composite sample of nonplastic silt was formed from low-water-content, nonplastic materials (NP1) from Waste Pits 1 and 4. A standard compaction test of the NP1 material resulted in an optimum moisture content (OMC) of 13.4 percent and a maximum dry density (MDD) of 116.6 pounds per cubic foot (pcf), which compares to values for ordinary soils. A direct shear test of the remolded NP1 material resulted in a consolidated drained friction angle (ϕ_{cd}) of 40 degrees at 96 percent MDD, which is slightly less than that expected for dense sand (ALTER 1994).

Compaction tests were also performed on three other bulk samples of materials from Waste Pit 1 using either standard compaction methods or a Harvard miniature compactor (ALTER 1995a and WESTON 1988). The compaction tests resulted in MDD values of 109.4 to 117.5 pcf and OMC values of 15.6 to 20.3 percent. These values also compare to values for ordinary soils.

From nine unit weight tests of undisturbed DEEP Shelby tube samples, wet unit weight ranged from 136.8 to 83.6 pcf, and the corresponding dry unit weight ranged from 115.4 to 36.1 pcf (ALTER 1995a and SAIC 1996). Shear strength parameters were measured for two samples in Pit 1, resulting in ϕ_u values of 19 to 23.2 degrees, ϕ_d values of 30.2 to 39.0 degrees, c_u values of 4.9 to 6.7 psi, and c_d values of 0 to 3.3 psi. Slopes of 2H/1V can be maintained during Pit excavation provided drain conditions exist. Under undrained conditions a slope of 2.5H/1V can be maintained.

5.2 Pit 2

In general, Pit 2 waste materials range in behavior from nonplastic silts and sands (silt with sand, sandy silt, silty sand) to highly plastic silts (elastic silt, elastic silt with sand, sandy elastic silt). Some lean clays and clayey sands with gravel are also present. Moisture contents range from about 17 percent (lean clay with sand) to 320 percent (nonplastic silt with sand). Moisture content of the elastic silt materials ranges from about 70 to 230 percent.

A composite sample of elastic silt (MH2) was formed to represent MH materials with lower liquid and plastic limits (typical of Pits 2 and 3). The material for this composite sample came from Pits 2 and 3. A standard compaction test resulted in an OMC of 35.4 percent and MDD of 77.8 pcf. This density is low for MH soil. A remolded, unconfined compressive strength test at 96 percent MDD and +2 percent OMC resulted in an undrained cohesion (c_u) of 1,468 psf with a brittle failure mode. A direct shear test of the remolded MH2 material resulted in ϕ_{cd} of 29 degrees at 97 percent MDD (ALTER 1994).

Additional compaction tests were performed on bulk samples from Waste Pit 2. One sample was a composite sample of silty sand (SM) from Waste Pit 2 and the Clearwell, which resulted in a MDD of 102.3 pcf and an OMC of 20.1 percent. In addition, a direct shear test was performed on the SM sample, resulting in a consolidated drained friction angle (ϕ_{cd}) of 29 degrees and a consolidated undrained cohesion value of 7.6 pounds per square inch (psi) at 97 percent MDD. The cohesion value is higher than what would normally be expected for a silty sand and may be due to using too high a strain rate during the test (ALTER 1994).

A second sample was a lean clay (CL) sample from Pit 2 resulting in a MDD of 118.7 pcf and an OMC of 14.2 percent (DEEP 1995a). The final sample was an elastic silt (MH), which resulted in a MDD of 86.3 pcf and an OMC of 17.5 percent (WESTON 1988). The results from the lean clay and the silty sand samples are consistent for these types of soils. The MDD from the elastic silt is low for MH type soils.

From six unit weight tests of undisturbed DEEP Shelby tube samples, wet unit weight ranged from 82.7 to 131.2 pcf, and the corresponding dry unit weight ranged from 31.1 to 105.7 pcf (ALTER 1995 and SAIC 1996). Shear strength parameters were measured for one sample in Pit 2. The resulting ϕ_u, c_u, ϕ_d, and c_d values were 18.0 degrees, 1.7 psi, 36.0 degrees, and 0.9 psi, respectively. Slopes of 2H/1V can be maintained during Pit excavation provided drain conditions exist. Under undrained conditions a slope of 2.5H/1V can be maintained.

5.3 Pit 3

In general, Pit 3 waste materials range in behavior from low plasticity and nonplastic silts and sands (silt with sand, sandy silt and silty sand) to highly plastic silts (sandy elastic silt, elastic silt with sand). Some lean clays are also present. Moisture contents range from about 25 percent (silt with sand) to 270 percent. Moisture content of the sandy elastic silt material ranges from about 55 percent to 366 percent.

From 36 unit weight tests of undisturbed DEEP Shelby tube samples, wet unit weight ranged from 71.4 to 129.7 pcf, and the corresponding dry unit weight ranged from 15.3 pcf to 110.0 pcf (ALTER 1995 and SAIC 1996).

In-place strength of Pit 3 waste from the DEEP CPT probes and SPT tests indicates very low strengths over much of the Pit area (below the cap materials). Low strengths are expected to result in waste collapse at low natural slopes, which may present safety concerns and excavation inefficiencies due to flat slopes. DEEP results of 11 consolidated, undrained triaxial shear strength tests had the following results: undrained friction angle (ϕ_u) ranged from 13 degrees to 24 degrees with cohesion intercept of 0 psi to 2.4 psi, drained friction angle (ϕ_d) ranged from 28 degrees to 40 degrees, with cohesion intercept between 0 and 1.6 psi (ALTER 1995 and SAIC 1996). In addition, existing data also indicate that the moisture content for much of the waste (in situ conditions) is above the liquid limit, indicating the material could behave similarly to a fluid. This was observed during the ramp excavation. To accommodate these conditions, excavation from the top of the capped berm will allow equipment to operate on a firm foundation. Once all excavating from the berm is complete, excavating the second bench from the bottom of the Pit will allow equipment to operate on a firmer footing. Slopes of 3H/1V can be maintained during excavation of the Pit provided.

5.4 Pit 4

In general, most of the materials sampled from Waste Pit 4 behave as either nonplastic silts (ML[NP]) or lean clays (CL). The moisture contents of the samples ranged between 10.1 and 61.5 percent (WESTON 1988 and DOE 1994). No DEEP samples were removed from Waste Pit 4, since Waste Pit 4 is currently covered with a RCRA cap composed of geotextiles.

A composite sample of nonplastic silt was formed from low-water-content, nonplastic materials (NP1) from Waste Pits 1 and 4. Compaction test and remolded physical properties of the composite sample are reported in Subsection 5.1 of this report.

Compaction tests were also performed on two other samples from Waste Pit 4. The material types of the two samples were nonplastic silt (ML[NP]) and lean clay (CL) having corresponding maximum dry

densities and optimum moisture contents of 120.6 pcf and 18.2 percent and 118.4 pcf and 18.7 percent, respectively. These values are normal to high for soils with similar USCS classifications, which may be attributed to the high specific gravities (3.02 to 3.33) reported for the compaction samples form Waste Pit 4.

From unit weight tests performed on undisturbed samples from previous studies, wet unit weights varied from 110.7 to 137.7 pcf, and the moisture content varied from 15.9 to 61.5 percent (WESTON 1988 and DOE 1994).

5.5 Pit 5

The majority of the solids portion of the Waste Pit 5 materials behave similar to elastic silts (MH). Also within Waste Pit 5 there are some silts (ML) and some nonplastic silts (ML[NP]). Initially the waste materials were placed in Waste Pit 5 in slurry form (PARSONS 1993). The Waste Pit 5 materials generally remain sludge-like, which is evident since the majority of the sample moisture contents are greater than the liquid limits reported. Water contents of the sampled Waste Pit 5 materials range from 73.4 to 1141.2 percent.

A composite sample of nonplastic silt was formed from high-water-content, nonplastic materials (NP2) from Waste Pits 5 and 6. A Standard Proctor compaction test performed on the NP2 material resulted in an OMC of 36.2 percent and a MDD of 76.9 pcf. The MDD is low and the OMC is high for soils having similar USCS classification. A direct shear test was performed on a remolded sample of NP2 material resulting in a consolidated, drained friction angle (ϕ_{cd}) of 31 degrees and a consolidated, drained cohesion value (c_{cd}) of 6.3 psi at 100 percent MDD, which is low for low-clay-content silt (ALTER 1994).

Another composite sample of elastic silt was formed from high-liquid-limit, high-plastic-limit, and high-moisture-content materials (MH1) from Waste Pit 5. A one-point Standard Proctor compaction test was performed on a sample of MH1 material resulting in a MDD value of 64.5 pcf and an OMC value of 56.0 percent (Lutz 1994). The one-point method was necessary since the results from the Standard Proctor test were determined to be erroneous. The MDD value is very low and the OMC value is very high for typical soils having a USCS classification of MH. A direct shear test was performed on a remolded sample of MH1 material, resulting in a consolidated drained friction angle (ϕ_{cd}) of 33 degrees and a consolidated, drained cohesion value (c_{cd}) of 1.2 psi at 98 percent MDD, which is average for dense silt. In addition, an unconfined compression test was performed on a sample of the MH1 material compacted to 98 percent MDD, resulting in an unconfined compressive strength (q_u) of 2,425 pounds per square foot (psf) or an unconfined cohesion value (c_u) of 1,212 psf. The unconfined compression failure mode of the MH1 sample was brittle (ALTER 1994).

Compaction tests were also performed on four other samples of waste material from Waste Pit 5. Three of the compaction samples were classified as elastic silts (MH), and insufficient data were available to determine the classification of the fourth sample. The compaction tests performed on the MH materials resulted in MDD values ranging from to 62.5 to 65.8 pcf and OMC values ranging from 50.4 to 60.8 percent (WESTON 1988 and ALTER 1995b). The MH materials' MDD values are low and the OMC values are high for typical soils having similar classification. The fourth compaction test performed on the unclassified Waste Pit 5 sample resulted in a MDD value of 97.9 pcf and an OMC value of 26.7 percent (ALTER 1995b).

Unit weight tests performed on DEEP undisturbed-Vibracore samples resulted in wet density values ranging from 64.7 to 100.1 pcf (ALTER 1995b and SAIC 1996). Corresponding dry densities cannot be accurately determined due to the slurry nature of the Waste Pit 5 material. Upon drying, the samples would lose considerable volume due to the large volume of water present in the samples.

Shear strength parameters were measured on one vibracore sample from Boring WP5-5A. The resulting ϕ_u, c_u, ϕ_d, and c_d values were 15 degrees, 1.0 psi, 32 degrees, and 0.7 psi, respectively (SAIC 1996).

Consolidation tests were performed on three vibracore samples. The compression index values ranged from 2.7 to 3.9, which indicates the waste is very soft and compressible. The recompression index values range from 0.04 to 0.09, which is in the normal range for clay (Das 1990a). The initial void ratios range between 9.91 and 16.66, which also indicates a high potential for compressibility.

5.6 Pit 6

The majority of the sampled materials from Waste Pit 6 behave as either nonplastic silts (ML[NP]) or silty sands (SM). In addition, one sample was classified as a silt (ML) and one sample was classified as an elastic silt (MH). Moisture contents of all the samples varied greatly from 11.2 to 425.6 percent.

A composite sample of high-moisture-content nonplastic silt material (NP2) from Waste Pits 5 and 6 was tested for compaction characteristics and physical properties on remolded samples. Results of the tests performed on NP2 were reported in Subsection 5.5 of this report.

Another composite sample of silt material (ML) was formed from Waste Pit 6 and the Burn Pit. A Standard Proctor compaction test was performed on the ML sample, which resulted in a MDD value of 99.0 pcf and an OMC value of 19.9 percent. These values are typical for soils with an ML classification. A direct shear test was performed on a ML sample recompacted to 96 percent MDD, resulting in a consolidated drained friction angle (ϕ_{cd}) of 37 degrees, which is higher than expected values for a dense silt (ALTER 1994).

Compaction tests were also performed on four silty sand (SM) samples, one nonplastic silt (ML[NP]) sample, and one sample that had insufficient classification data. The nonplastic silt resulted in a MDD value of 101.2 pcf and an OMC of 23.0 percent, which is typical for a nonplastic silt soil. Compaction tests on the silty sand samples resulted in MDD values between 129.7 and 149.5 pcf and OMC values between 9.2 and 14.6 percent. The silty sand values are higher than expected values for silty sand, which is probably due to the higher than normal values of specific gravity (3.24 to 3.42) for soils. The unclassified sample resulted in a MDD value of 139.9 pcf and an OMC value of 11.7 percent, which is similar to the SM values from Waste Pit 6.

Unit weight tests were performed on 13 DEEP undisturbed-Vibracore samples. The resulting wet densities ranged from 83.4 to 170.2 pcf with respective dry densities of 35.4 to 148.5 pcf (ALTER 1995b). The reported values are high; the high densities may be attributed to either a combination of the high specific gravities or compaction of the samples as a result of the vibratory sampling method.

5.7 Burn Pit

The majority of the materials sampled from the Burn Pit behaved similarly to either silts (ML) or silty sands (SM). One sample from the Burn Pit classified as a lean clay (CL). The Burn Pit was used to burn flammable liquid and solid wastes; therefore, the silts and silty sands are, more than likely, ashes and cinders from incinerated materials. The moisture contents of the Burn Pit materials varied from 25.5 to 43.3 percent (WESTON 1988 and DOE 1994).

Compaction tests were performed on two bulk samples from the Burn Pit. The first sample was a composite sample of silt (ML) from the Burn Pit and Waste Pit 6. The Standard Proctor test resulted in a MDD of 99.0 pcf and an OMC of 19.9 percent (ALTER 1994). Results of the physical property tests performed on the composite sample are reported in Subsection 5.6 of this report.

The second sample was a silty sand (SM) bulk sample from the Burn Pit. The compaction test resulted in a MDD of 81.2 pcf and an OMC of 9.5 percent (WESTON 1988). The MDD value is low for soils with similar classification, which is probably due to the low specific gravity of the solids in the sample (2.35). Silty sand soils generally have specific gravities between 2.65 and 2.67.

A unit weight test performed on one undisturbed sample of silty sand material resulted in a wet unit weight of 101.4 pcf, a corresponding dry unit weight of 70.8 pcf, and a moisture content of 43.3 percent. Due to the large moisture content, the wet and dry unit weights were less than typical in situ densities for similar soil materials (dry densities usually vary between 87 and 127 pcf [Holtz and Kovacs 1981]).

5.8 Clearwell

One-half (four) of the bulk samples removed from the Clearwell were classified as elastic silts (MH) with varying amounts of sand. The other half (four) of the samples from the Clearwell were evenly divided between either silty sands (SM) or lean clays (CL). The moisture contents of the samples varied from 35.4 to 73.9 percent (ALTER 1994). The moisture content tests were performed on archived bulk samples from the Remedial Investigation testing. The samples had been stored for at least 2 years, and the water had partially separated from the waste material (Lutz 1994), which may have caused the reported moisture contents to be low.

One compaction test was performed on a composite sample made of silty sand (SM) materials from Waste Pit 2 and the Clearwell. The compaction test resulted in a MDD of 102.3 pcf and an OMC of 20.1 percent (ALTER 1994). Results of physical property tests performed on remolded samples of the composite material is reported in Subsection 5.2 of this report.

No undisturbed samples have been removed from the Clearwell. The Clearwell was used to store liquid from Waste Pits 3 and 5 and surface runoff water from all of the Pits before pumping the effluent to the Great Miami River (PARSONS 1993). As a result of the Clearwell's use, unit weight values from either Waste Pit 3 or 5 may be an adequate estimate of Clearwell material unit weights.

Samples were collected in the north berm of the Clearwell during DEEP. Moisture content data from Boring 11574 range from 13.9 to 28.4 percent. All of the samples collected were classified as sandy lean clays or lean clays with sand (CL).

Measured wet densities, from two Shelby tube samples, were between 121.3 and 137.4 pcf. The corresponding dry densities ranged between 94.5 and 120.1 pcf (SAIC 1996). Shear strength parameters were measured on two Shelby tube samples using the consolidated undrained triaxial compression test, resulting in ϕ_u values of 16.0 and 22.0 degrees, c_u values of 3.5 psi, ϕ_d values of 29.0 and 28.0 degrees, and c_d values of 3.1 psi.

5.9 Dewatering

DEEP dewatering tests using wells and wellpoints have been conducted in Waste Pits 1 and 3 to evaluate the effectiveness of this technique to increase the strength and bearing capacity of wet Pit materials prior to excavation. Trenching or ramping in the Pit materials is being conducted to evaluate the degree of success of the excavation program. The results should allow a confirmation of the bearing capacity, angle of repose, and safe, maintainable slopes.

Strength test data indicate that dewatering is not required to excavate with reasonable efficiency and safety for the top and bottom excavation approach. Trenching/ramping tests confirm that dewatering is not necessary to achieve safe slopes.

Dewatering testing indicated that water can be removed from the wastes through the use of wells and wellpoints. Given assumptions regarding sustainable yields and the percentage of total waste volume that can be removed as free water, the number of wells needed to achieve the greatest possible reduction in drying time has been calculated (see Appendix D). With some conceptual planning of a dewatering system, the cost effectiveness of using this number of wells to reduce drying times could be determined. Additional savings from dewatering may result from the potential elimination of a second dryer to meet future increased production levels.

Due to measured drawdown and well efficencies from the Phase 1 Dewatering, it is estimated that dewatering wells would provide dewatered conditions in a very localized area near the wells. As a result, wells would have to be spaced very close to one another to achieve any considerable dewatering of the waste. In addition, the remedial facility dryer would provide more efficient moisture reduction of the waste than the use of dewatering wells for waste processing.

To summarize, it appears that dewatering should not be pursued as a means of enhancing soil strength and stability, but may be of value in reducing processing times.

5.10 CPT Correlations

Inclusion of the laboratory test results will provide a basis for calibration of the CPTs to direct measurements from test borings, providing further confidence and enhancing specific detail. Currently, a decision is being made whether to incorporate the geotechnical data with the CPT data. Geotechnical data has been incorporated into four sets of CPT data. PARSONS and FERMCO are reviewing the revised CPT data to see if the changes affect the results significantly, and whether further revision is justified.

Application of the integrated CPT/SPT and laboratory test data includes:

1) Allowing efficient data gathering with the CPT in the event that specific data gaps are identified in design.

2) Allowing concise and understandable presentation of a wide range of data to concerned parties.

3) Providing specific data for evaluation of excavation alternatives.

4) Possibly assisting in prioritization of remedial activities.

The geotechnical index property and unit weight data have been provided to the CPT contractor to make adjustments in data files, if required. Further, it is recommended that the shear strength data, be provided to the CPT contractor to make adjustments in data files, if required.

5.11 Wet Trenching

The following conclusions are the results of observation from the wet trenching at Pits 1, 2, and 3:

1) Mechanical excavation of Pit wastes to depths of about 15 to 20 feet using a bucket excavator from the ground surface of the covered Pits was demonstrated.

2) The waste materials encountered to the depths excavated, behaved like earth materials (i.e. did not flow), and were blocky or granular. Material that exhibited gelatinous behavior was also encountered, especially in Pit 1.

3) The cover material for the Waste Pits was general fill: clay, flyash, gravel, and other debris and rubble. The cover thickness in Pits 1 and 2 is from 1 to a few feet, and the cover thickness at Pit 3 is from 10 to 12 feet thick.

4) A laminated to stratified, fine-grained waste underlies the cover material in Pits 2 and 3. This material, composed of various layers of plastic and granular materials, is soft, saturated, highly plastic and holds water. Wastes in Pits 2 and 3, which are laminated to stratified, had thin layers of wet, soupy material. The waste material in Pit 1, is soft, saturated, granular and gelatinous.

5) Standing water was encountered at trenches T1-S, T2-N, and T3-N near ground surface. Trenches T1-N, T2-S, T3-C and T3-S did not have standing water. At the trenches with standing water, large amounts of rubble were also encountered in the cover or shallow waste. This relatively porous rubble creates zones of perched water, often found in the cover material. A large amount of lumber was found in Trench T3-N.

6) Trench wall collapse was observed in the noncohesive materials comprising the cover. At the shallow depths excavated, the more cohesive waste material underlying the cap often held vertical slopes when it was wet. The material, however, is soft and gelatins or "pudding like". The ability of the these materials to hold steep working slopes at an appreciable height is doubtful. Laboratory classification tests show the waste material is non plastic to highly plastic silts. As the exposed working face dries, this material exhibits an uncertain behavior.

7) Based on visual observation, angle of repose of the wet waste placed waste piles was generally about 20 to 30 degrees for Pit 2 and 3 wastes. It should be noted that the waste piles were typically no greater than about 8 feet high.

5.12 Ramp Excavations

The following conclusions are the results of the field observations made during the ramp excavations made in Waste Pits 1 and 3:

1) Mechanical excavation with a bucket excavator (track hoe) from the ground surface to depths of approximately 10 to 13 feet was demonstrated.

2) The materials encountered in Waste Pit 1 behaved similarly to noncohesive silt and sand soils. In addition, the Waste Pit 1 materials appeared to have adequate shear strength to maintain slopes of 1.5H/1V and flatter and to support excavation equipment on horizontal surfaces. When wet, however, the material did not support the excavation equipment as well as when the material was only moist. No slope stability calculations were performed on the Waste Pit 1 excavation scenario, but shear strength test results indicate that Waste Pit 1 materials have higher shear strength than Waste Pit 3 materials.

3) The upper materials encountered in Waste Pit 3 behaved similarly to noncohesive, free-draining, sand soils. The material appeared to be a combination of cinders and ash material. The upper material also exhibited adequate shear strength to maintain slopes up to 1.5H/1V and support excavation equipment on horizontal surfaces. The presence of perched water required flatter slopes to remain stable.

4) Lower-lying materials in Pit 3 did not behave similarly to soils. Instead, the materials behaved more like a semi-cohesive sludge. When excavated, the material often slumped or flowed into the void created by the bucket excavator. At one point during the excavation, the flowing material caused a slope failure of the overlying noncohesive material.

5) The cover material in Waste Pit 1 consisted of 1 to 2 feet of clay material. The cover material in Waste Pit 3 consisted of 1 to 2 feet of clay material and several feet of ash and cinder materials.

6) Slow groundwater seepage occurred in both Waste Pits 1 and 3. At approximately 12 to 13 feet below the existing ground surface, a large quantity of groundwater was encountered that infiltrated into the excavation at a rate of approximately 110 to 150 gpm, estimated by using the estimated pit dimensions and the rise in water level per a given period of time. As a result, sumps and pumps will be required at deeper depths in Pit 1, if equipment will be used on the waste material.

7) Stockpiled clay cover material maintained angles of repose between 35 an 40 degrees. Stockpiled noncohesive materials from Waste Pits 1 and 3 maintained angles of repose between 30 and 35

degrees. The stockpiled semi-cohesive sludge-like material from Waste Pit 3 maintained an angle of repose of approximately 25 degrees.

8) The moist materials at the bottom of the excavation in Waste Pit 1 appeared to compact under the weight of the track loader's tracks. The wet material in the bottom of Waste Pit 1 rutted under the weight of the track loader's tracks, but did not hinder the movement of the track loader. Due to the observed rutting of the wet material, dewatering of the waste or using sumps to collect excess water may be necessary if equipment is to be operated directly on the waste in Pit 1.

9) The noncohesive, cinder and ash material in Waste Pit 3 was strong enough to support the weight of the track hoe (bucket excavator). No attempt was made to operate equipment on the semi-cohesive sludge, since it was determined the sludge was too weak to support the weight of equipment.

10) The track loader easily traveled up and down the stockpiled clay and noncohesive materials without affecting the stockpiles' angles of repose. An attempt was made to drive the track hoe on the stockpile of semi-cohesive sludge-like material, which resulted in the track loader driving through, not on, the stockpile.

11) From observations and discussion with workers involved in the ramp excavation, it appears the semi-cohesive sludge-like material loses most, if not all, of its shear strength when disturbed (vibrated, stepped on, etc.). As a result, this material will have to be excavated from the side berms or utilizing some other method that does not require equipment to rest on the waste.

SECTION 6

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000158

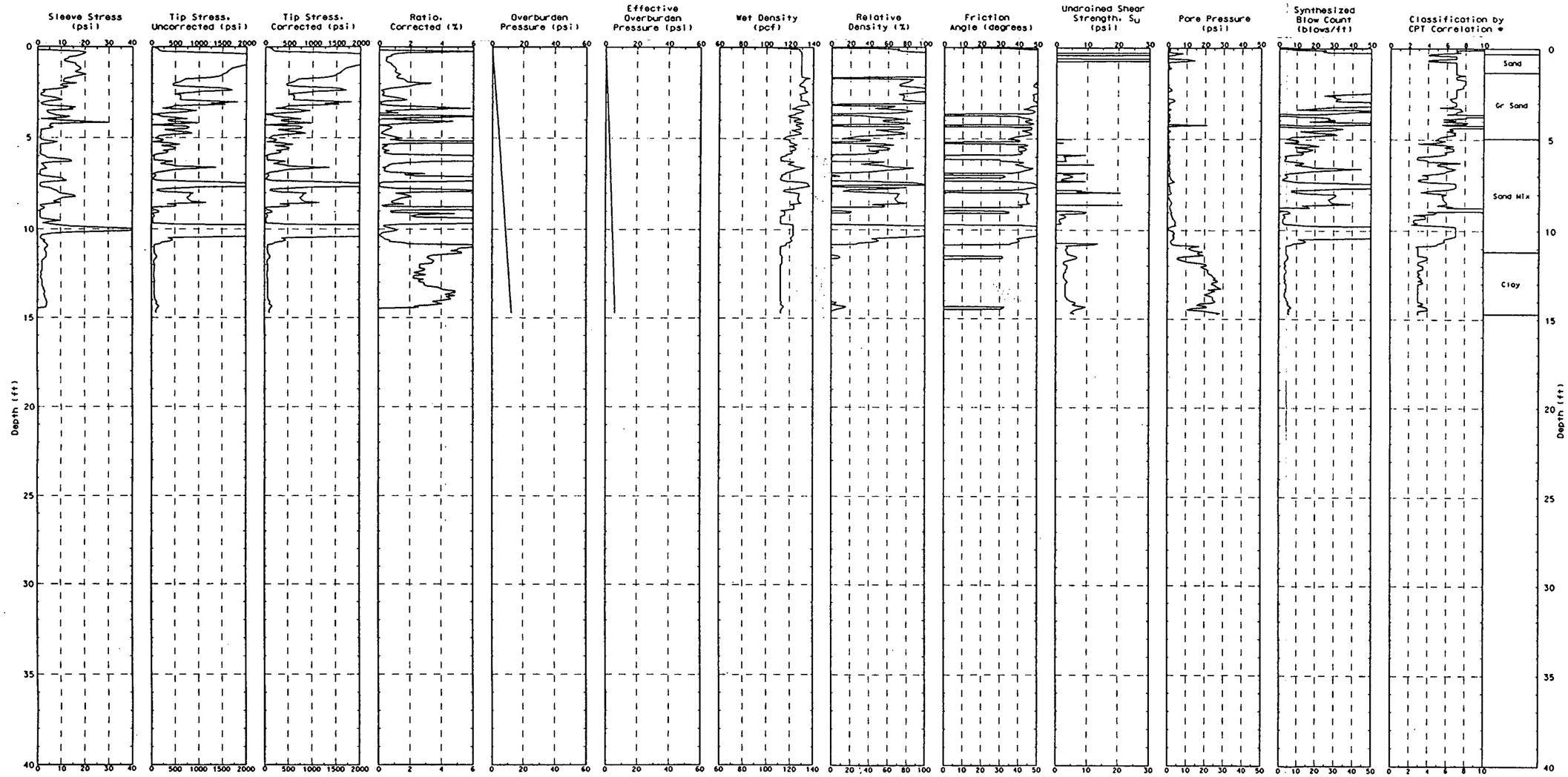
APPENDIX A

PRELIMINARY CPT LOGS

PIT: 1

CPT ID: C1-1

DATE TEST PERFORMED: 8/30/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-1	481480	1346830	581.4

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S30G404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

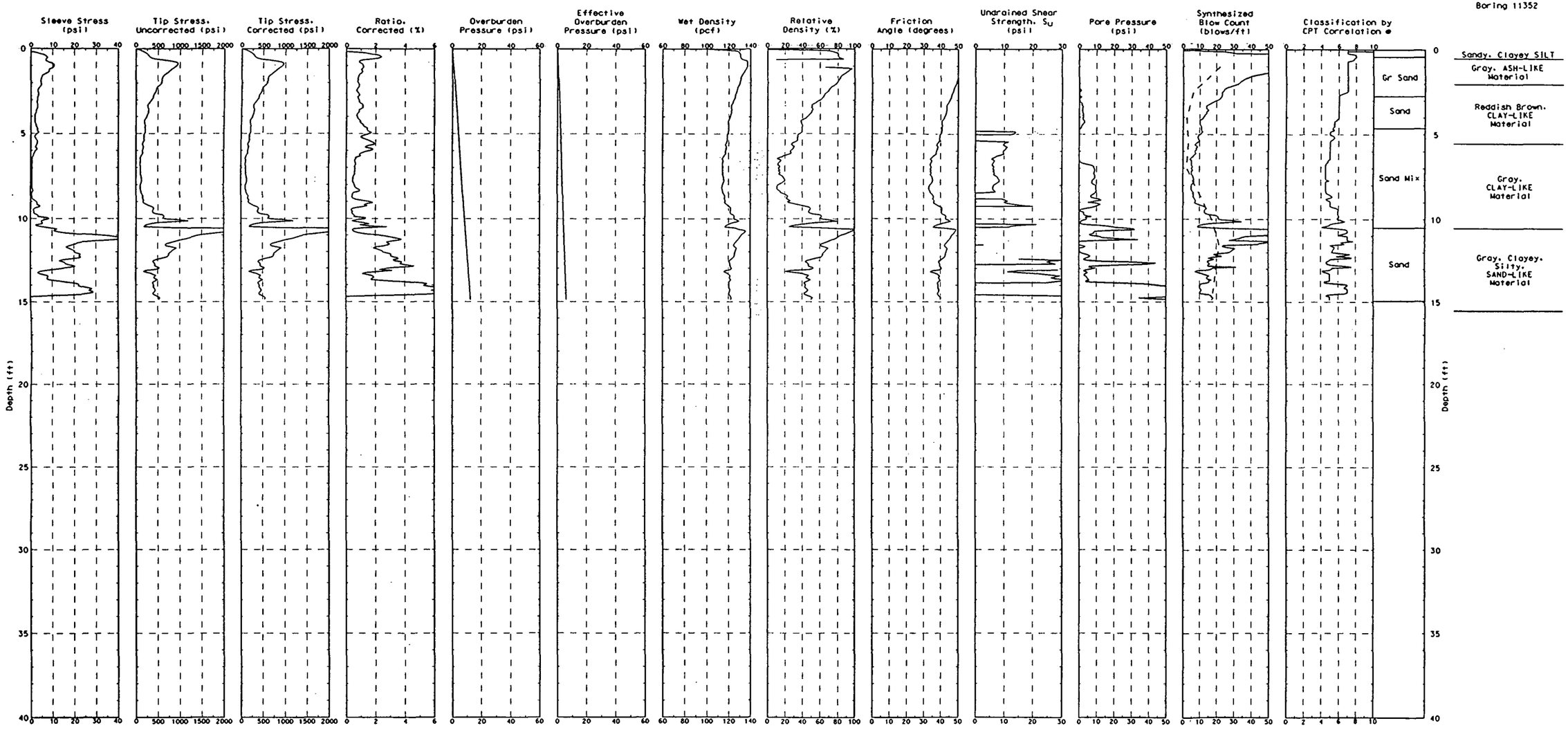
CPT ID: C1-1

CAD FILE: P019/SKX03450.DGN

PIT: 1

CPT ID: C1-2

DATE TEST PERFORMED: 8/30/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-2	481410	1346850	580.1
11352	481405	1346851	579.9

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S30G405
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

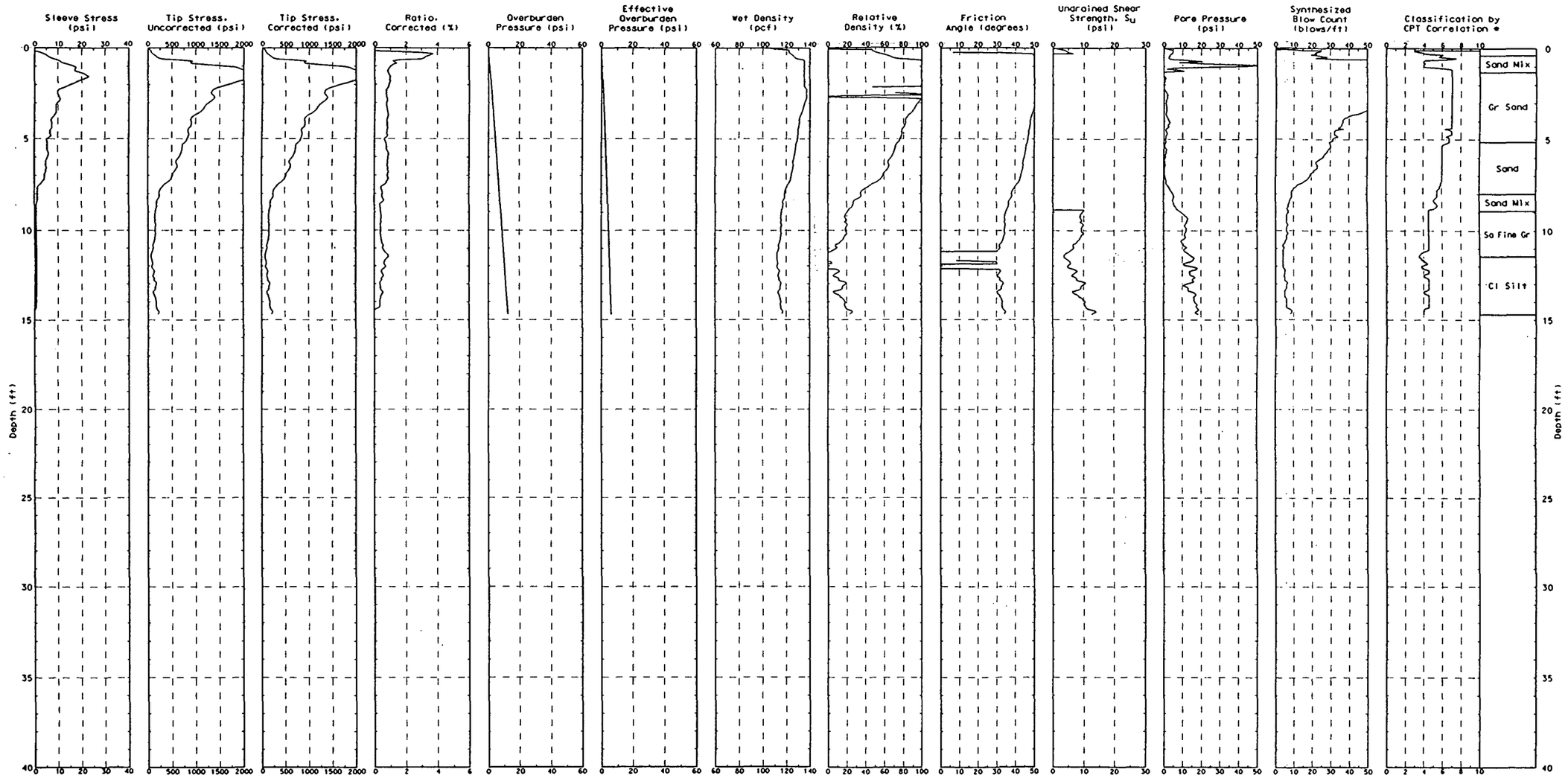
CPT ID: C1-2

CAD FILE: PD19/SKX03451.DGN

PIT: 1

CPT ID: C1-3

DATE TEST PERFORMED: 8/31/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-3	481380	1346780	580.6

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S31G405
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empiricol correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

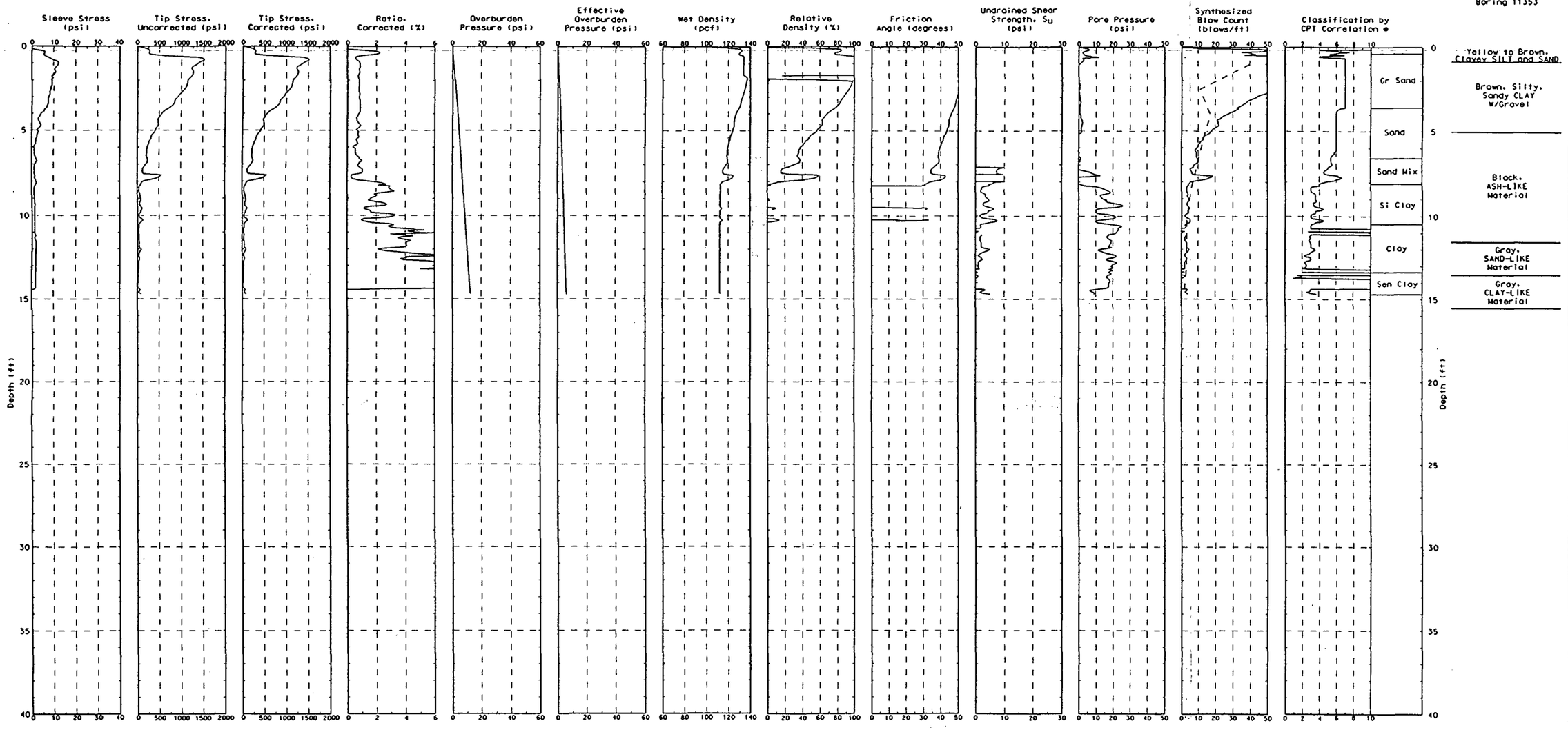
CPT ID: C1-3

CAD FILE: PD19/SKX03452.DGN

PIT: 1

CPT ID: C1-4

DATE TEST PERFORMED: 8/31/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-4	481287	1346780	580.2
11353	481286	1346770	580.2

LEGEND

• Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S31G402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

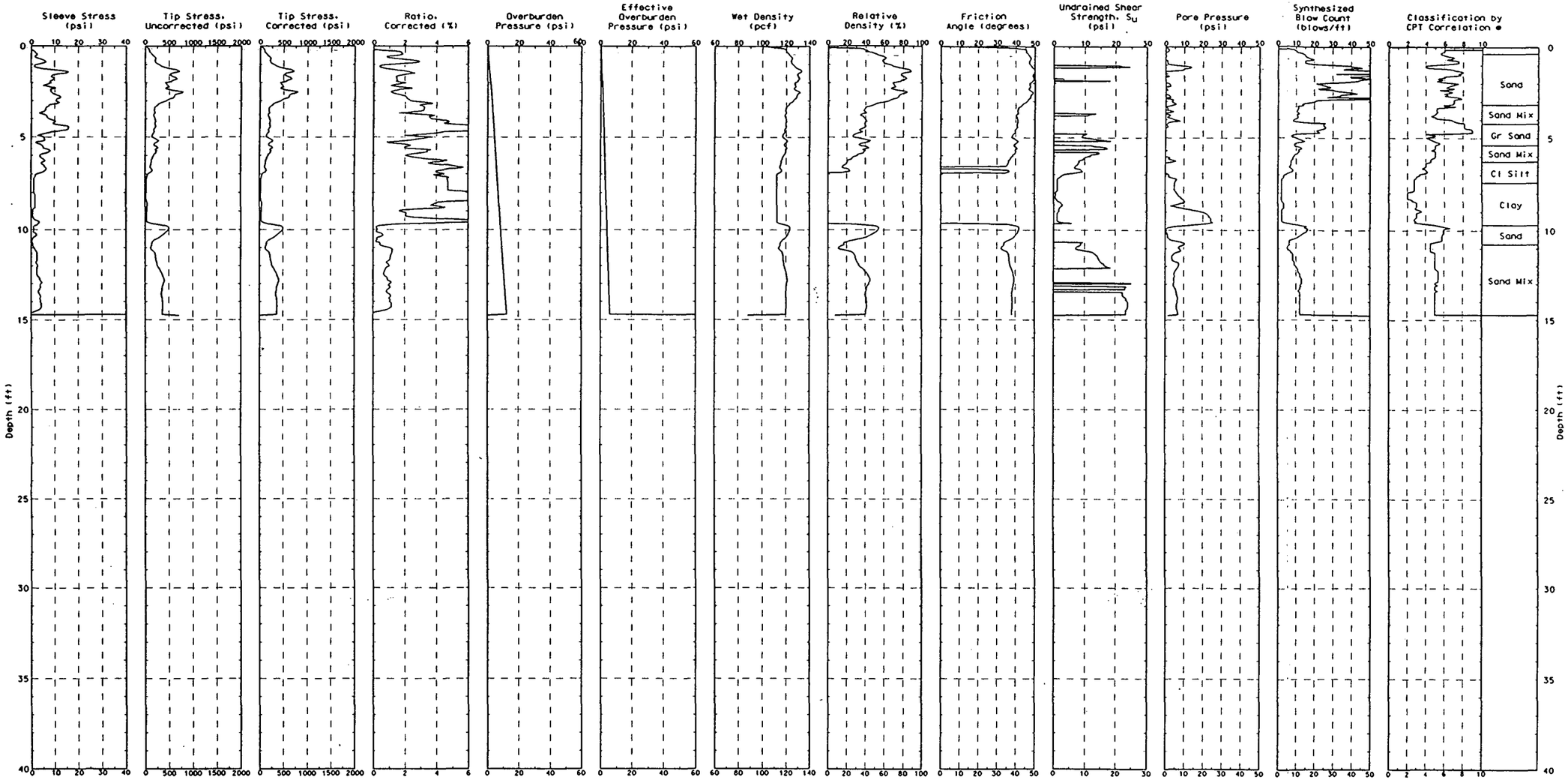
CPT ID: C1-4

CAD FILE: P019/SKX03453.DGN

PIT: 1

CPT ID: C1-5

DATE TEST PERFORMED: 8/31/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-5	481280	1346730	580.1

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S31G404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

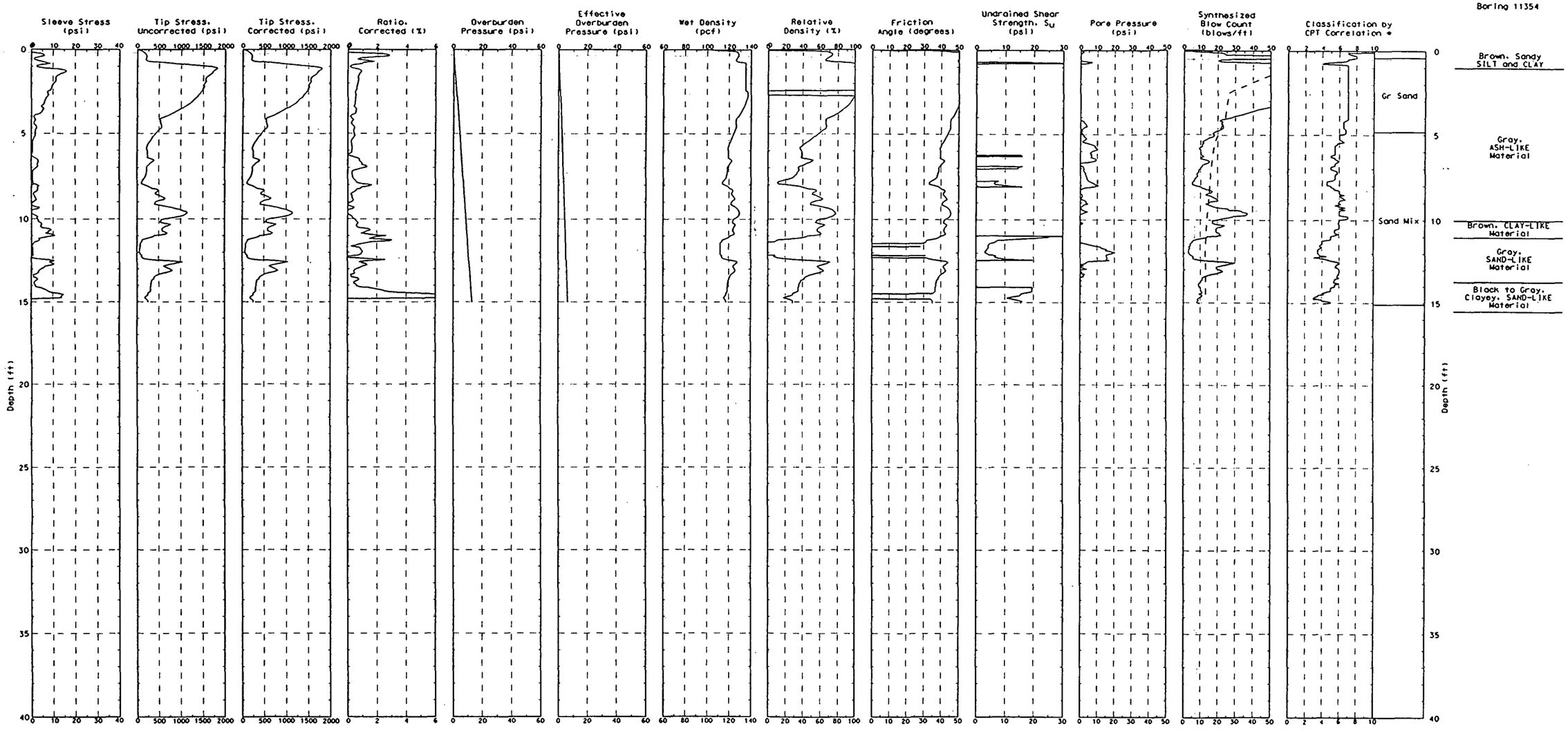
CPT ID: C1-5

CAD FILE: PD19/SKX03454.DGN

PIT: 1

CPT ID: C1-6

DATE TEST PERFORMED: 8/31/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-6	481336	1346838	579.6
11354	481336	1346838	579.6

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S31G403
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

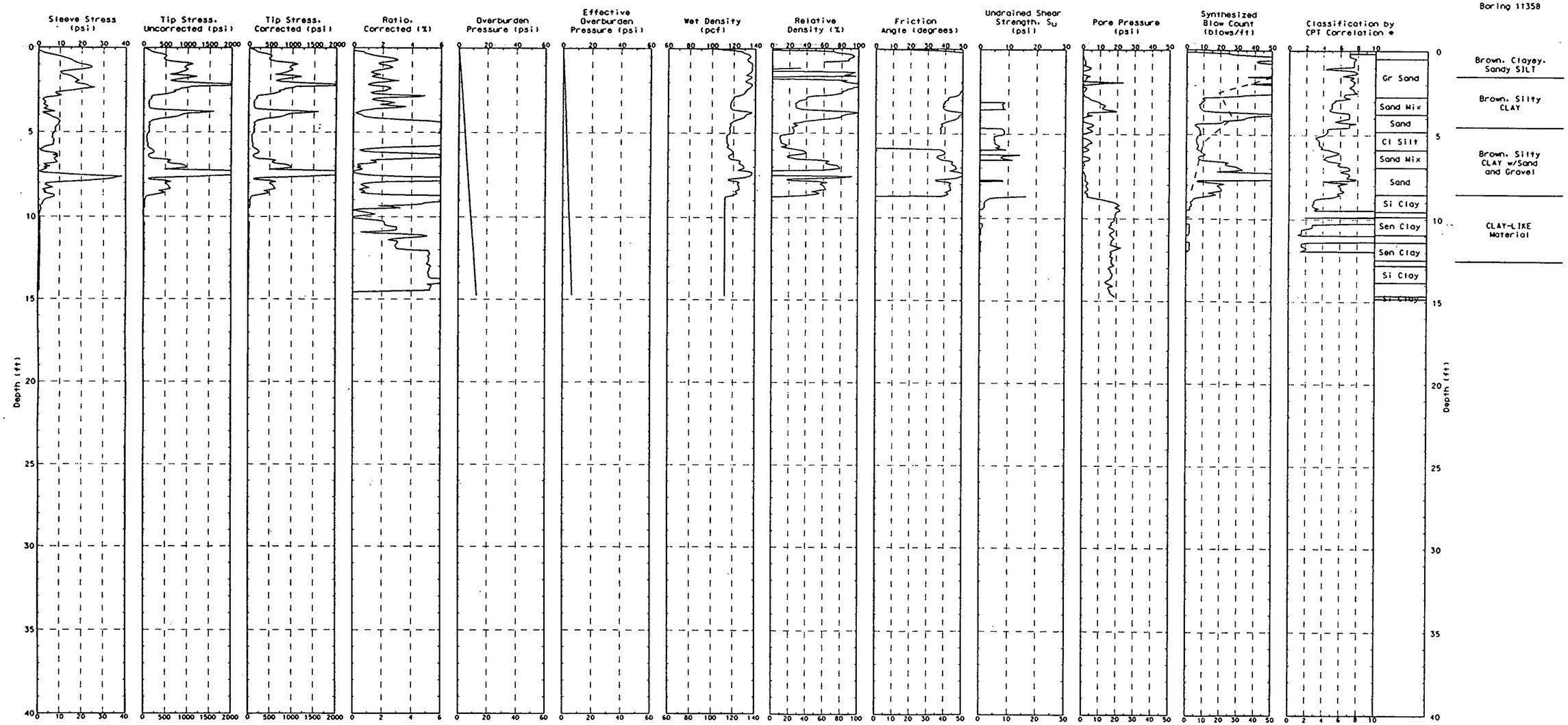
CPT ID: C1-6

CAD FILE: PD19/SKK03455.DGN

PIT: 2

CPT ID: C2-1

DATE TEST PERFORMED: 8/24/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C2-1	481556	1347104	579.4
11358	481551	1347100	579.5

LEGEND

- Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S24G401
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

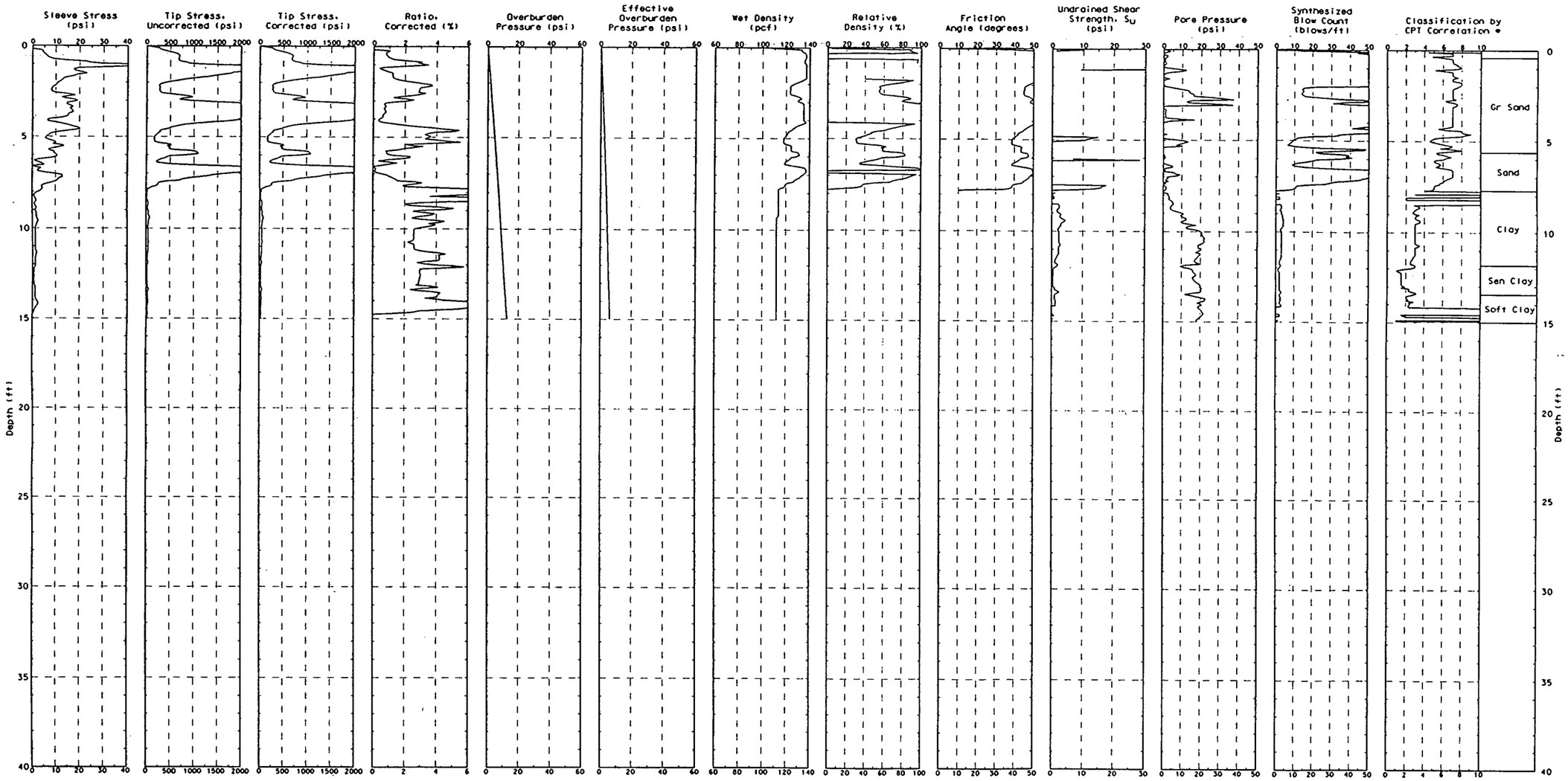
CPT ID: C2-1

CAD FILE: PO19/SKX03456.DGN

PIT: 2

CPT ID: C2-2

DATE TEST PERFORMED: 8/24/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C2-2	481530	1346980	580.8

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: 524G402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

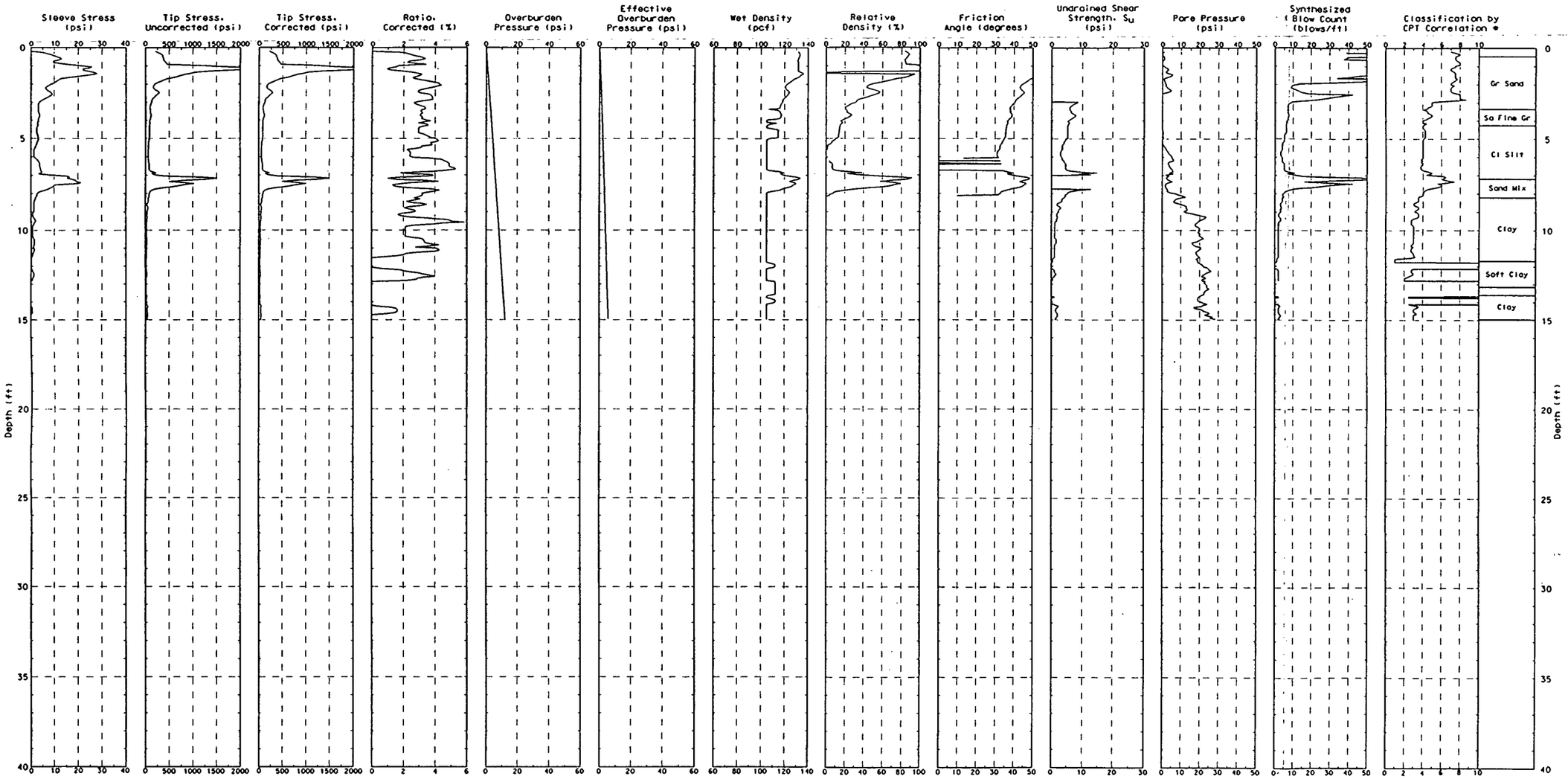
CPT ID: C2-2

CAD FILE: PD19/SKX03457.DGN

PIT: 2

CPT ID: C2-3

DATE TEST PERFORMED: 8/24/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C2-3	481480	1346980	580.1

LEGEND

- Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S24G403
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

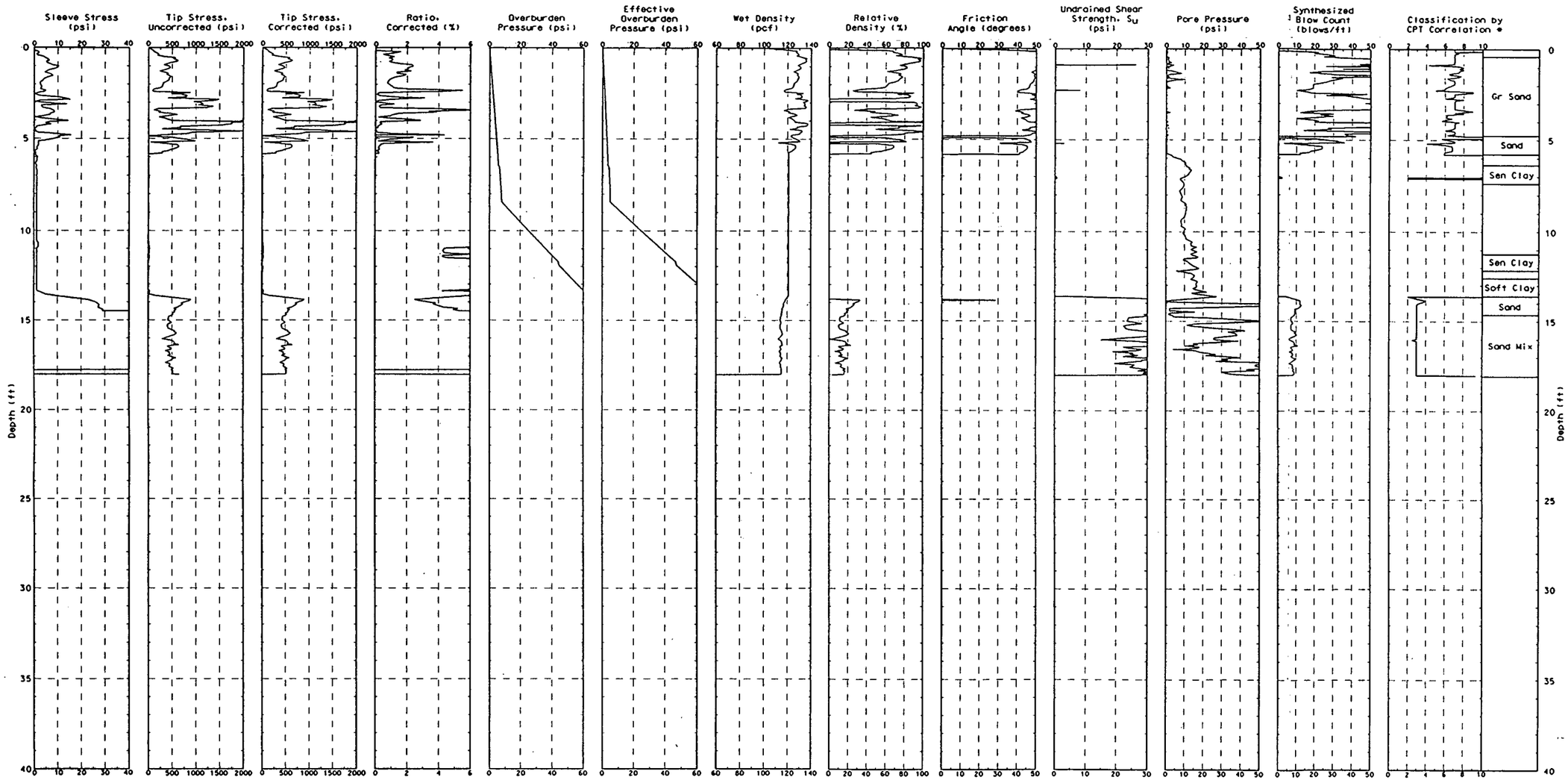
CPT ID: C2-3

CAD FILE: P019/SKX03458.DGN

PIT: 2

CPT ID: C2-4

DATE TEST PERFORMED: 8/23/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C2-4	481430	1347080	578.2

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S23G404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

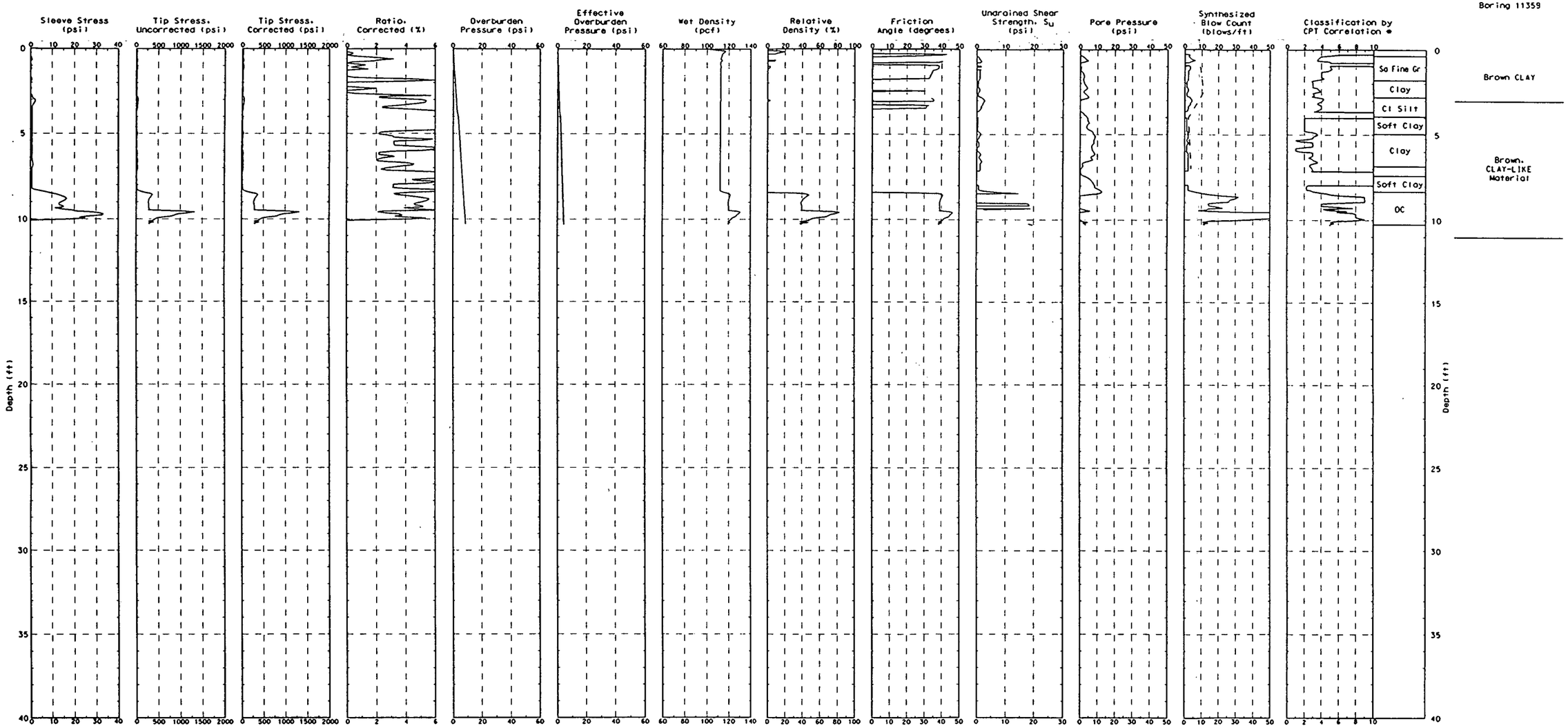
CPT ID: C2-4

CAD FILE: PD19/SKX03459.DGN

PIT: 2

CPT ID: C2-5

DATE TEST PERFORMED: 8/23/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C2-5	481397	1347050	577.7
11359	481396	1347044	577.7

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S23G402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

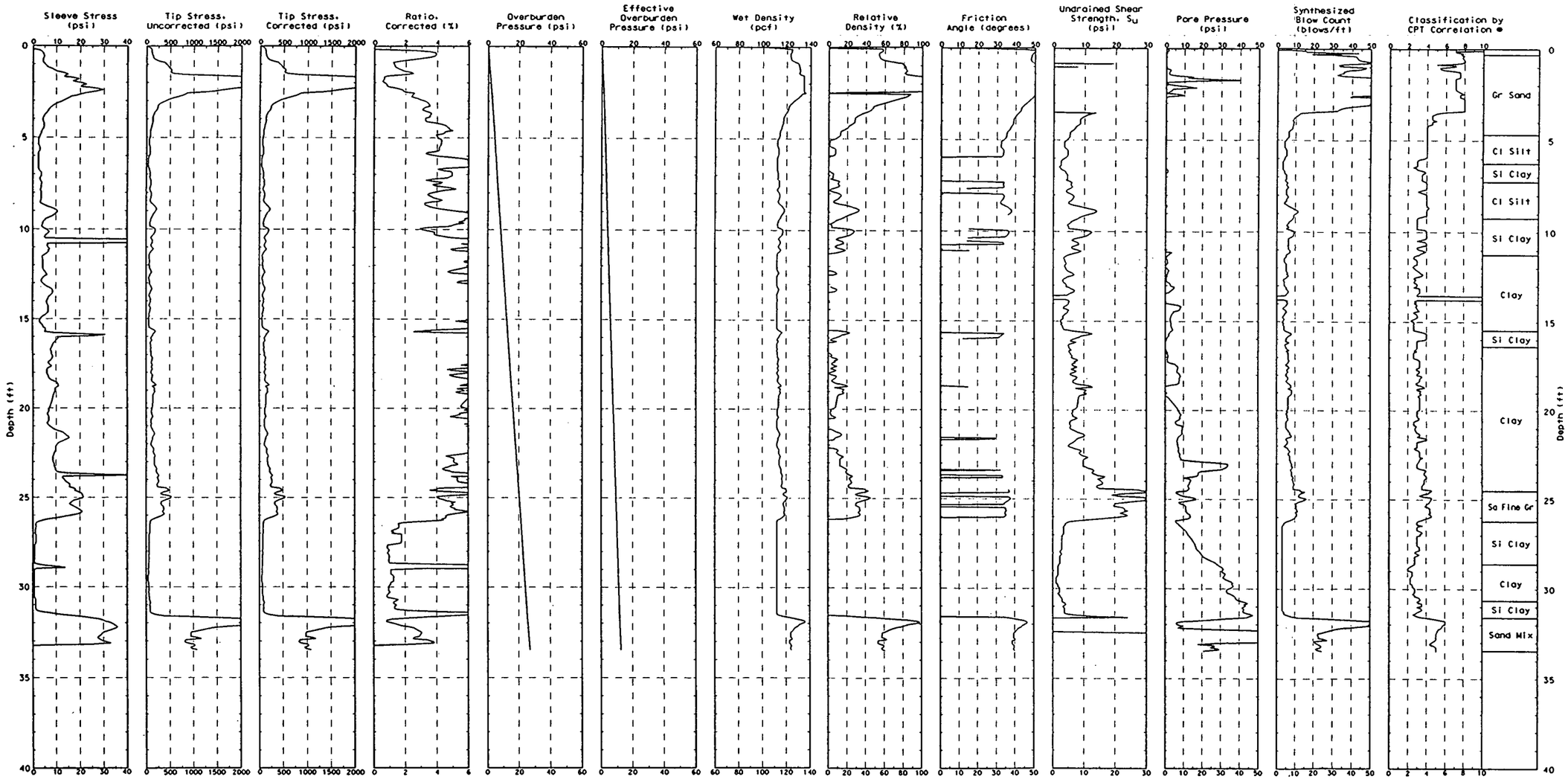
CPT ID: C2-5

CAD FILE: P019/SKX03460.DGN

PIT: 3

CPT ID: C3-1

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-1	481480	1346480	580.2

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S01S403
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

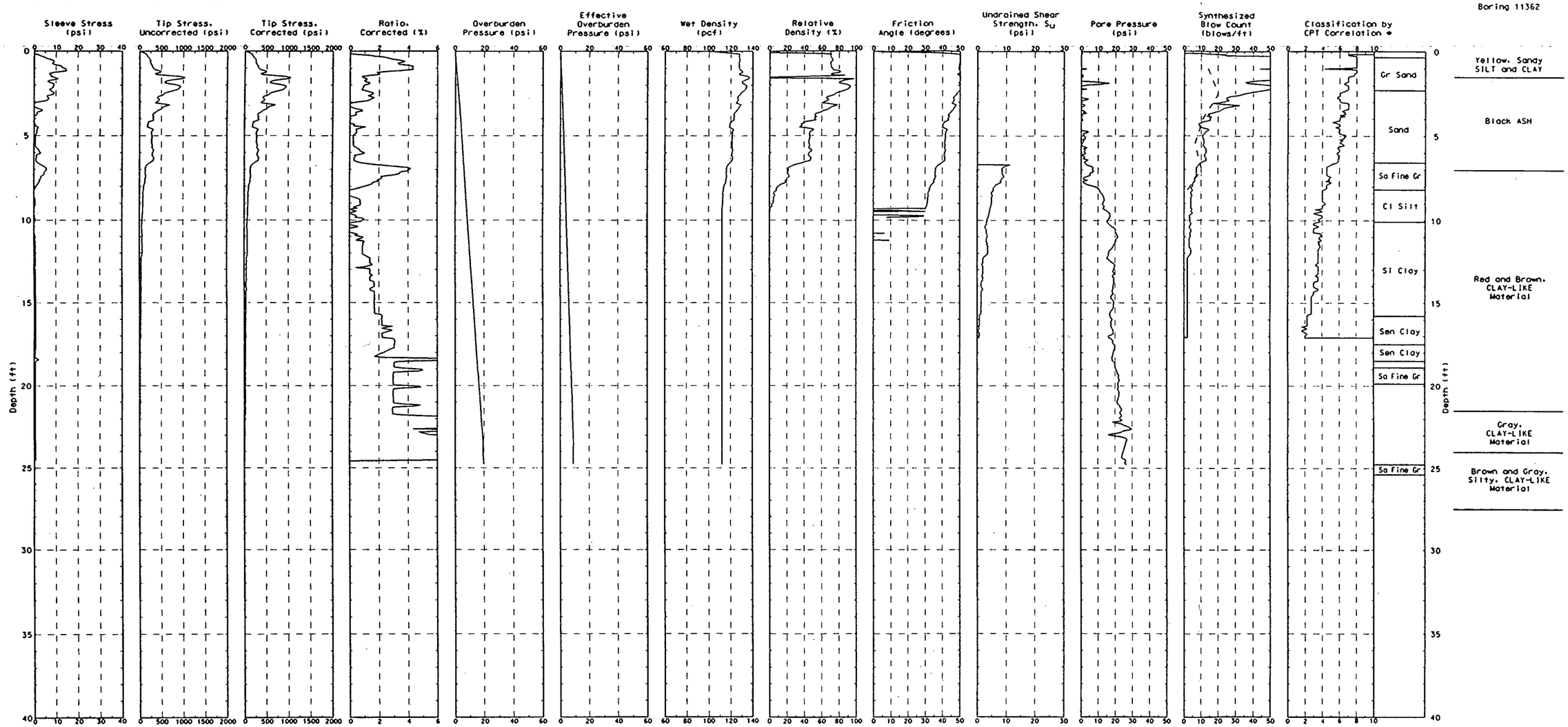
CPT ID: C3-1

CAD FILE: P019/SKX03461.DGN

PIT: 3

CPT ID: C3-2

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-2	481536	1346593	584.8
11362	481546	1346593	584.5

LEGEND

- Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S015402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

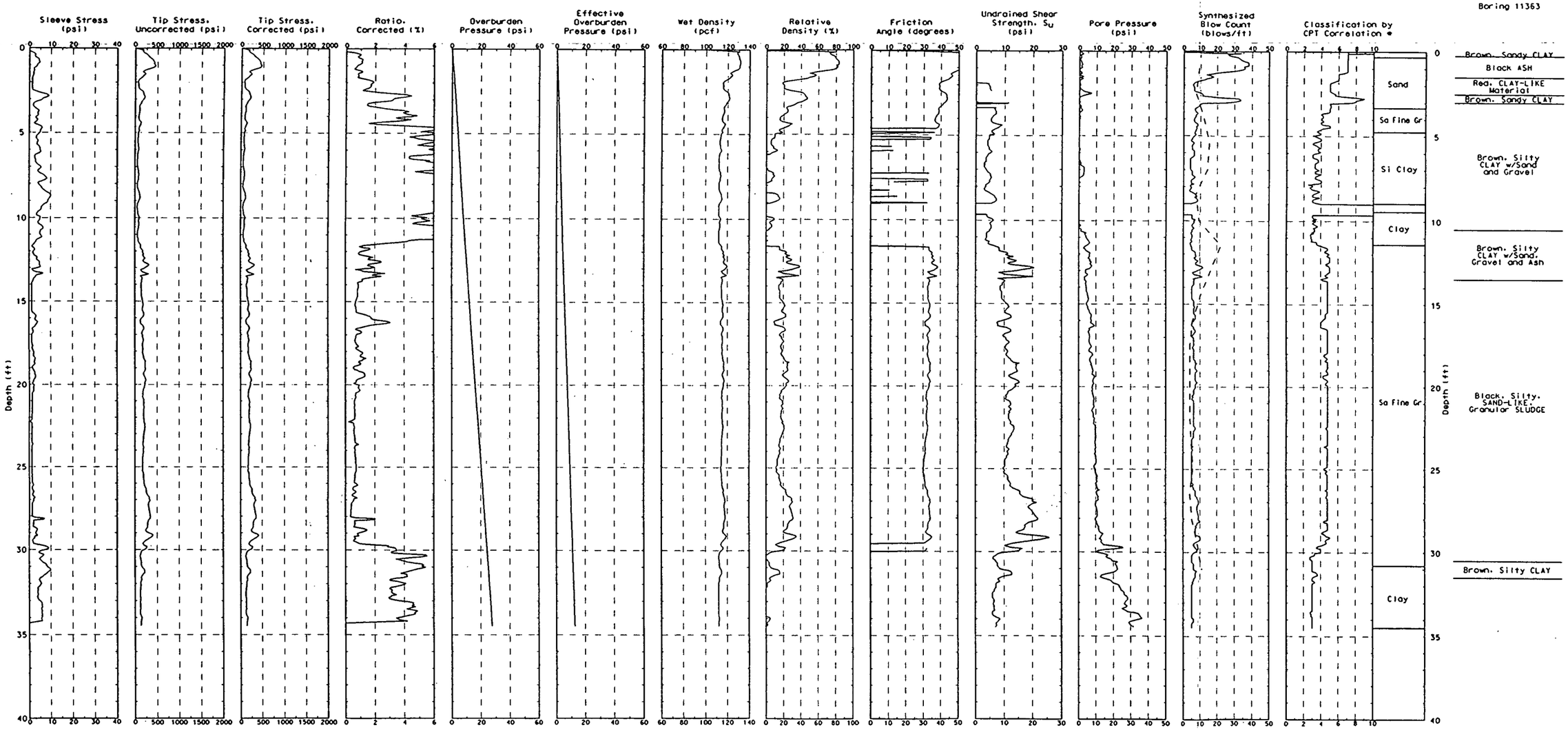
CPT ID: C3-2

CAD FILE: P019/SKX03462.DGN

PIT: 3

CPT ID: C3-3

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-3	481474	1346634	586.0
11363	481474	1346634	586.0

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S01S401
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

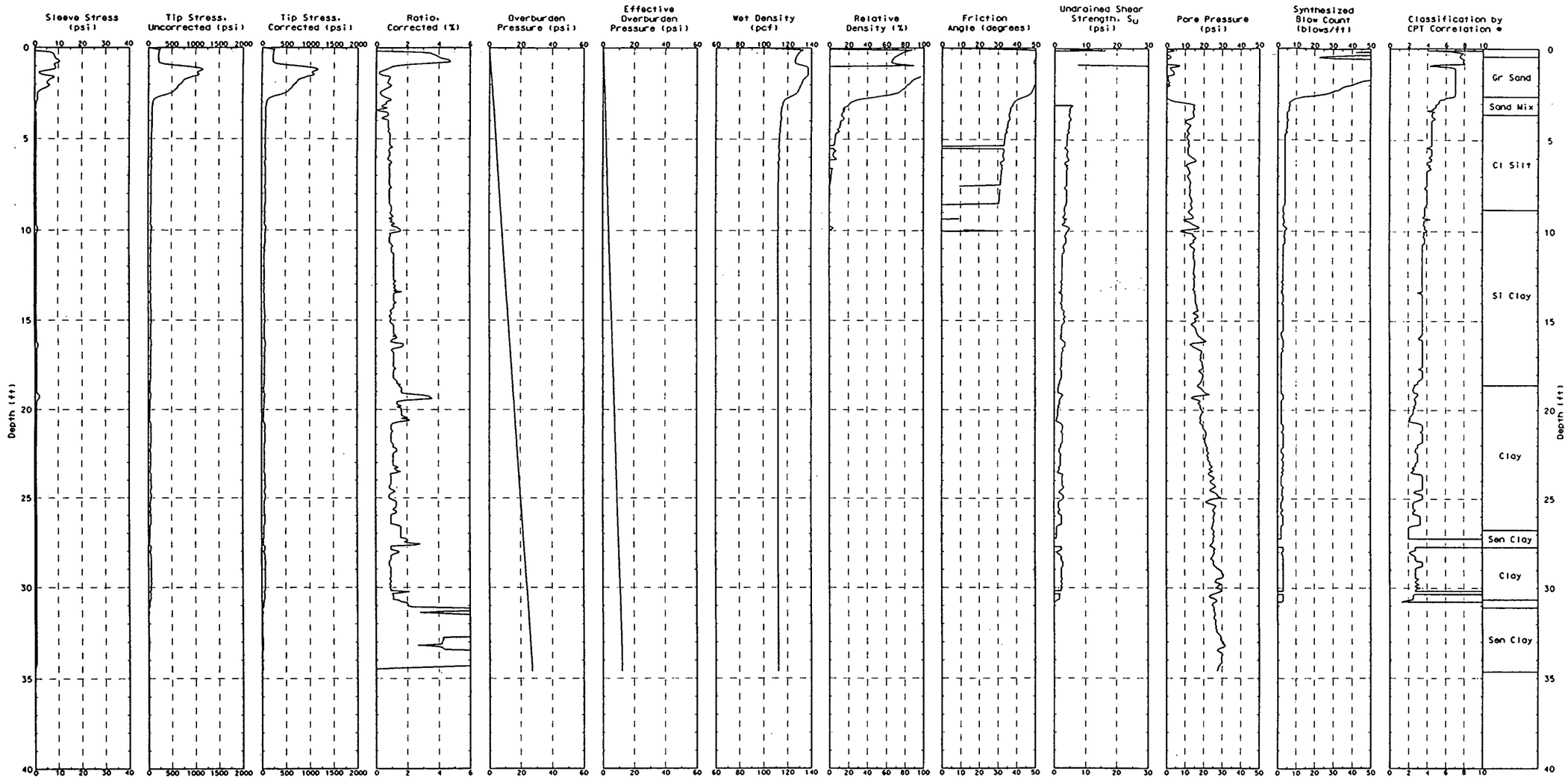
CPT ID: C3-3

CAD FILE: PD19/SKX03463.DGN

PIT: 3

CPT ID: C3-4

DATE TEST PERFORMED: 8/25/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-4	481630	1346630	585.1

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S25G401
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

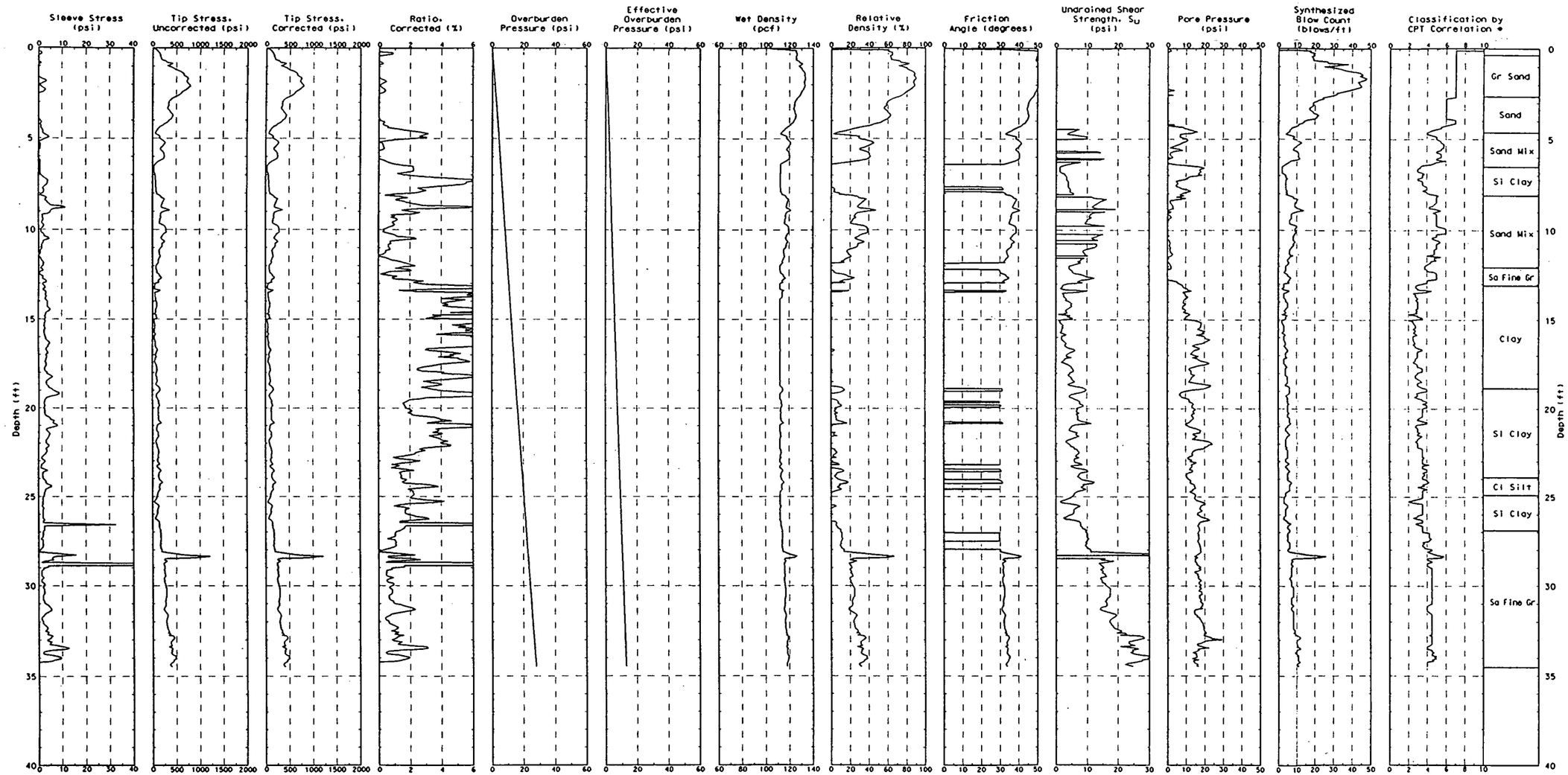
CPT ID: C3-4

CAD FILE: PD19/SKX03464.DGN

PIT: 3

CPT ID: C3-5

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-5	481630	1346830	587.5

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S015404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

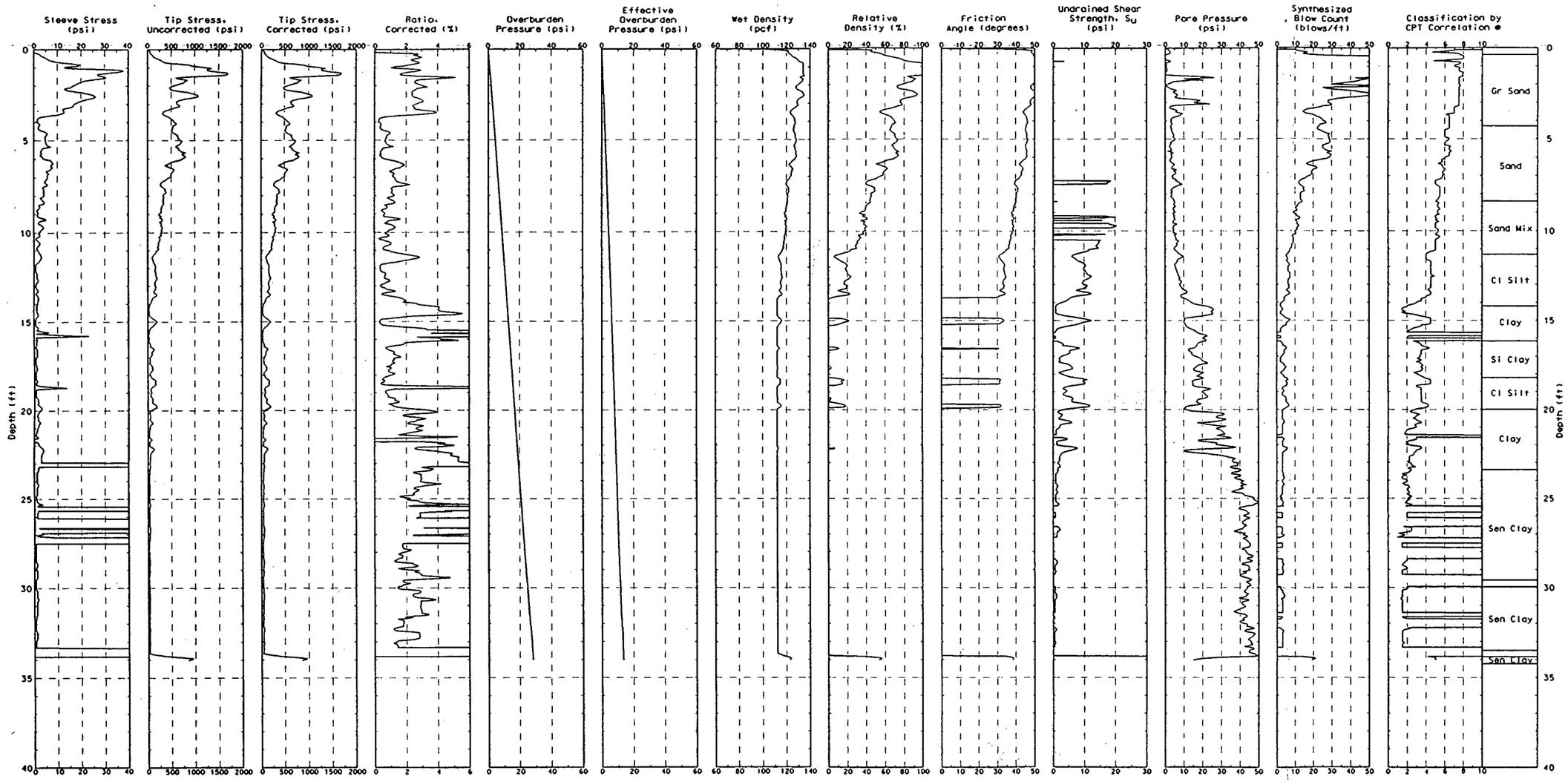
CPT ID: C3-5

CAD FILE: P019/SKX03465.DGN

PIT: 3

CPT ID: C3-6

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-6	481679	1346981	582.6

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S01S405
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

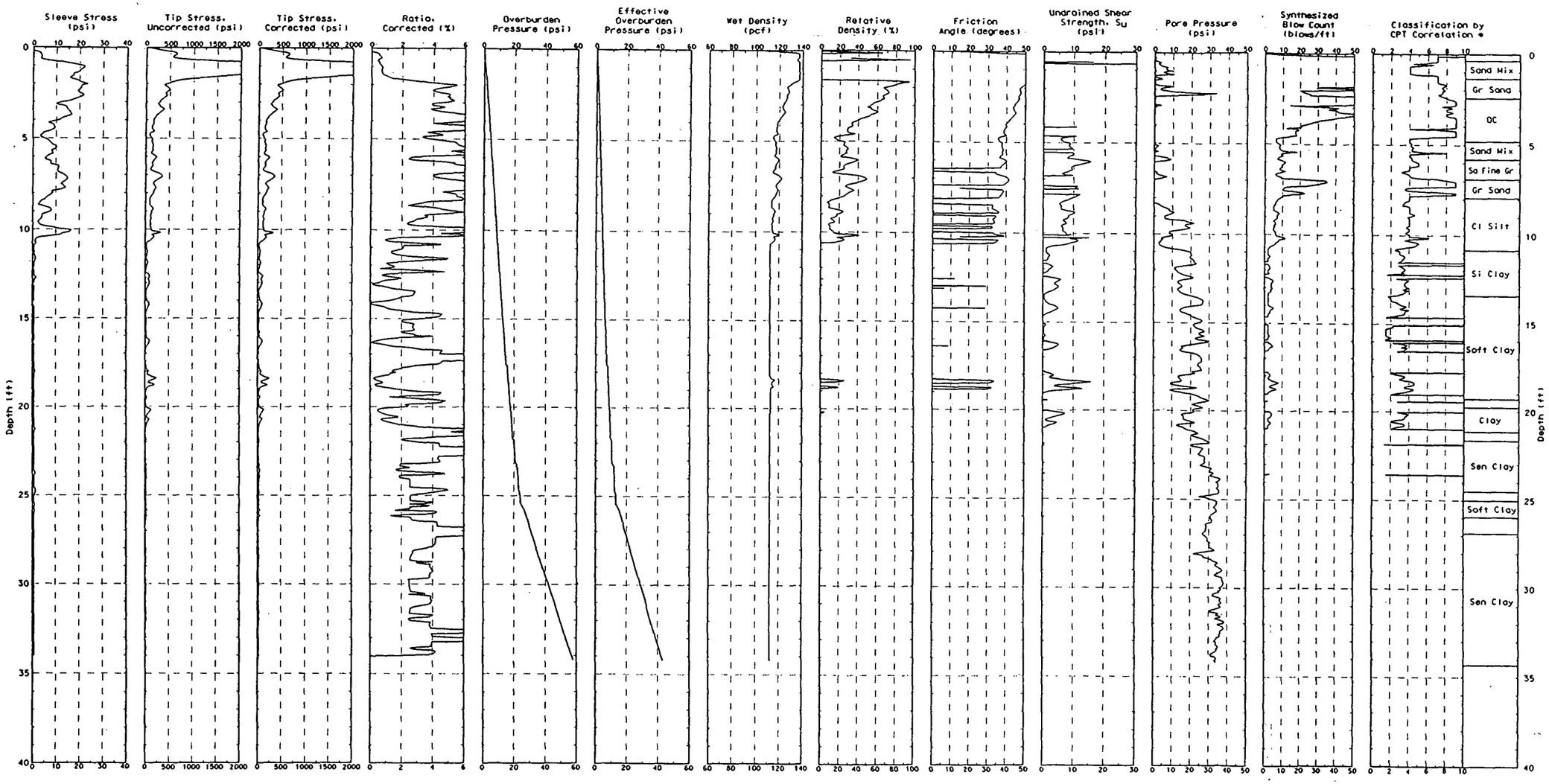
CPT ID: C3-6

CAD FILE: PD19/SKX03466.DGN

PIT: 3

CPT ID: C3-7

DATE TEST PERFORMED: 8/26/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-7	481779	1346931	586.1

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S26G402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

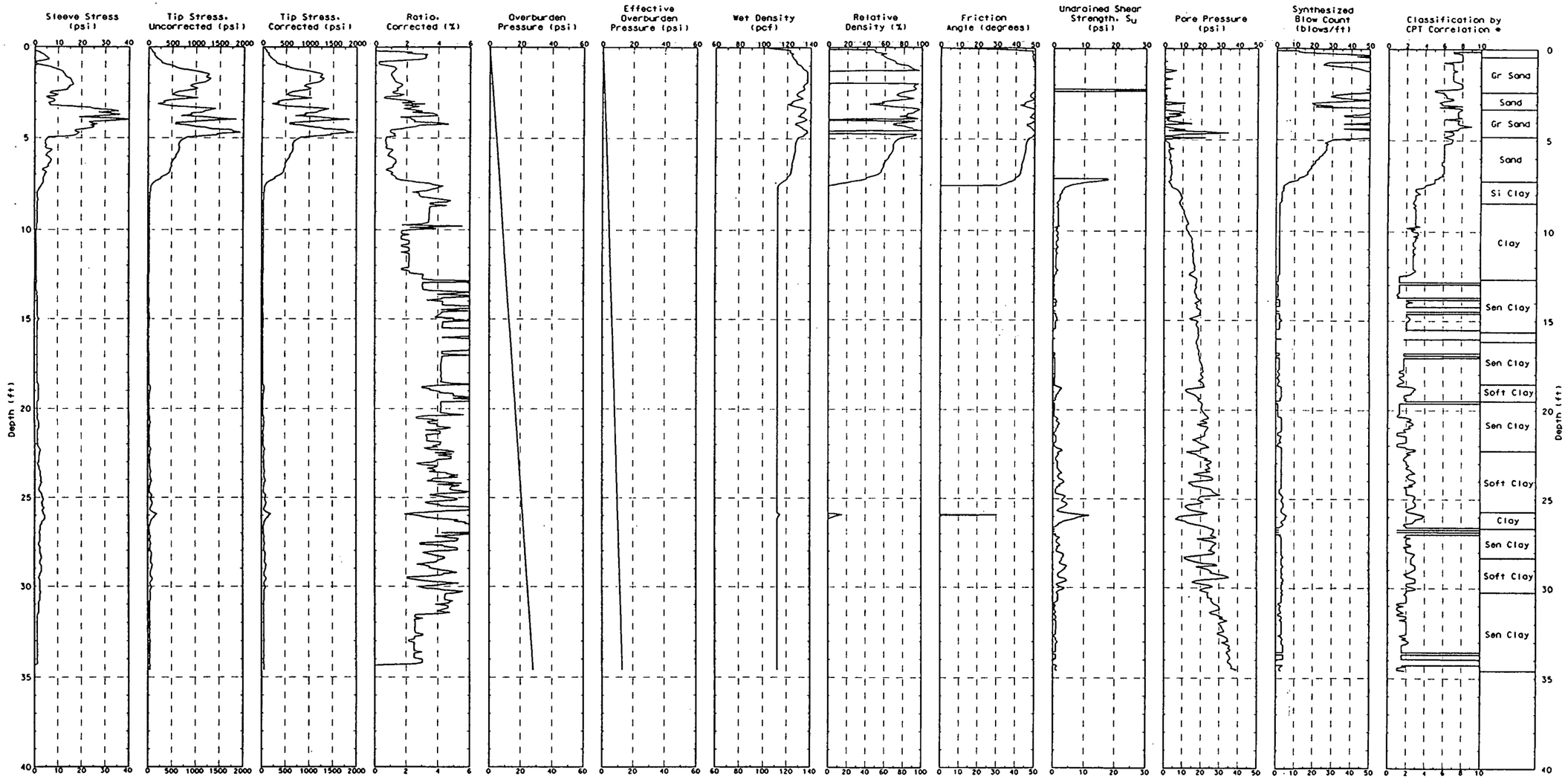
CPT ID: C3-7

CAD FILE: P019/SKX03467.DGN

PIT: 3

CPT ID: C3-8

DATE TEST PERFORMED: 8/30/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-8	481879	1347031	583.3

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S30G401
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

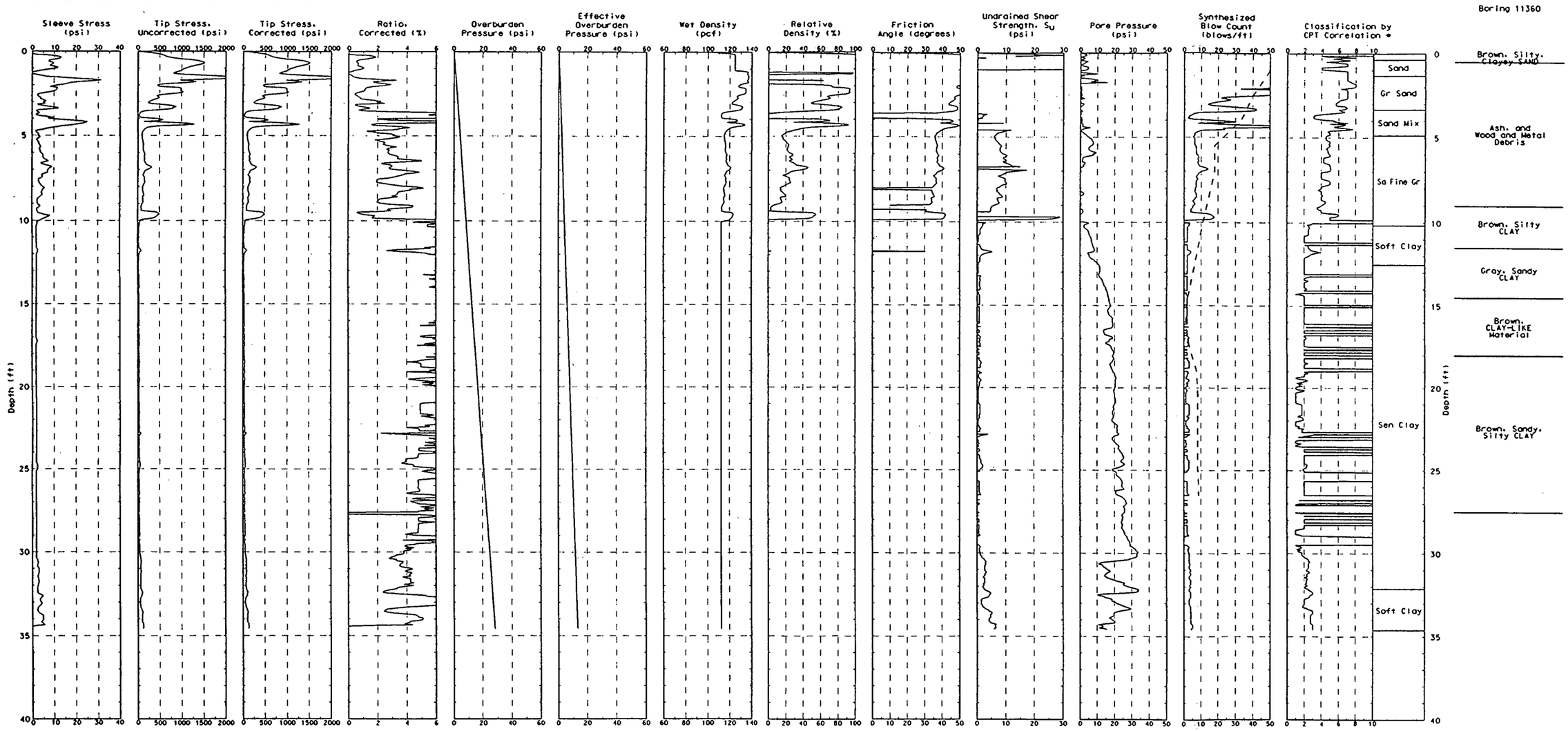
CPT ID: C3-8

CAD FILE: PD19/SKX0346B.DGN

PIT: 3

CPT ID: C3-9

DATE TEST PERFORMED: 8/26/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-9	481865	1346866	586.9
11360	481867	1346863	586.9

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S26G401
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

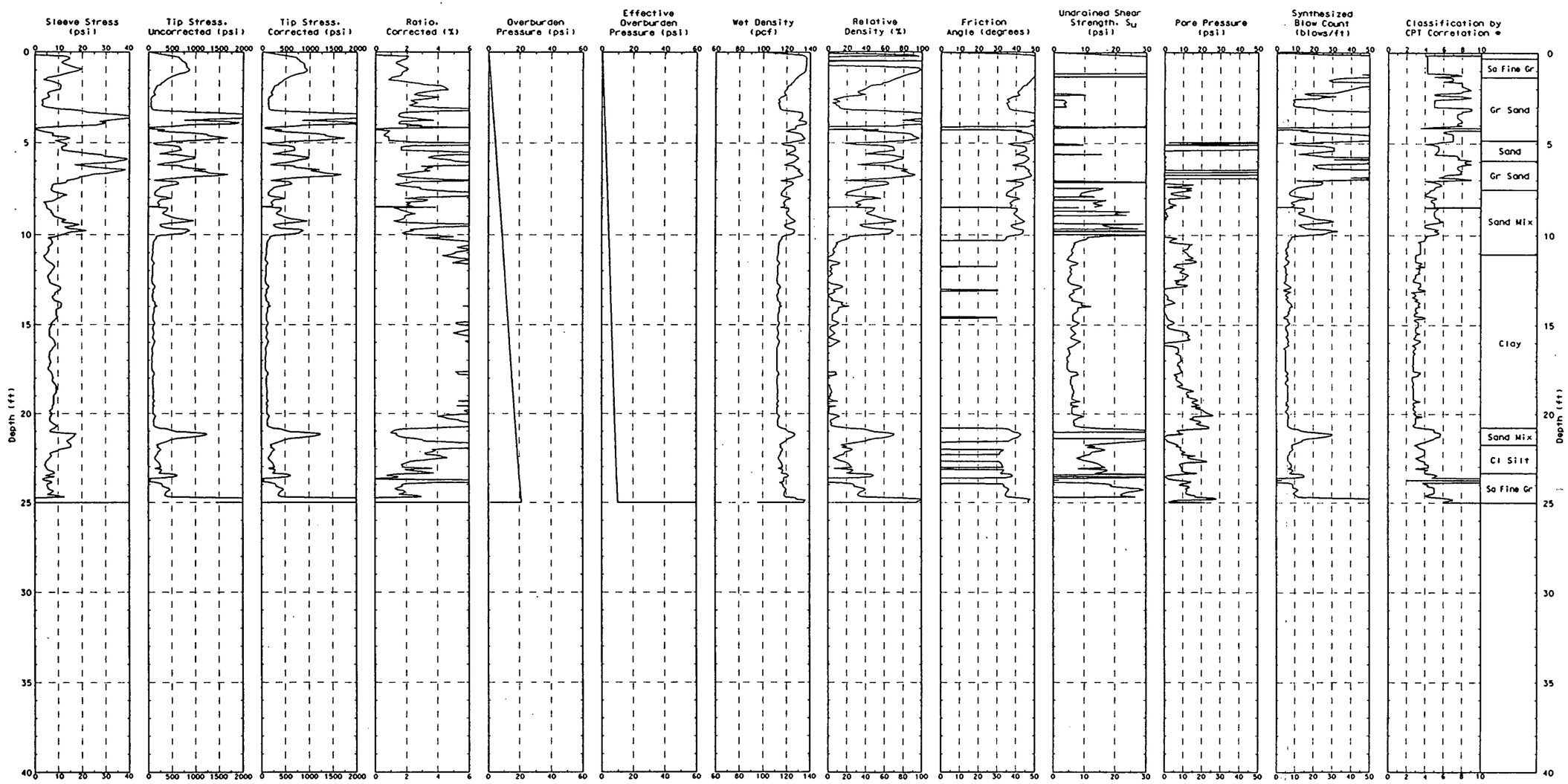
CPT ID: C3-9

CAD FILE: PO19/SKX03469.DGN

PIT: 3

CPT ID: C3-10

DATE TEST PERFORMED: 8/25/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-10	481929	1346831	585.1

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S25G404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

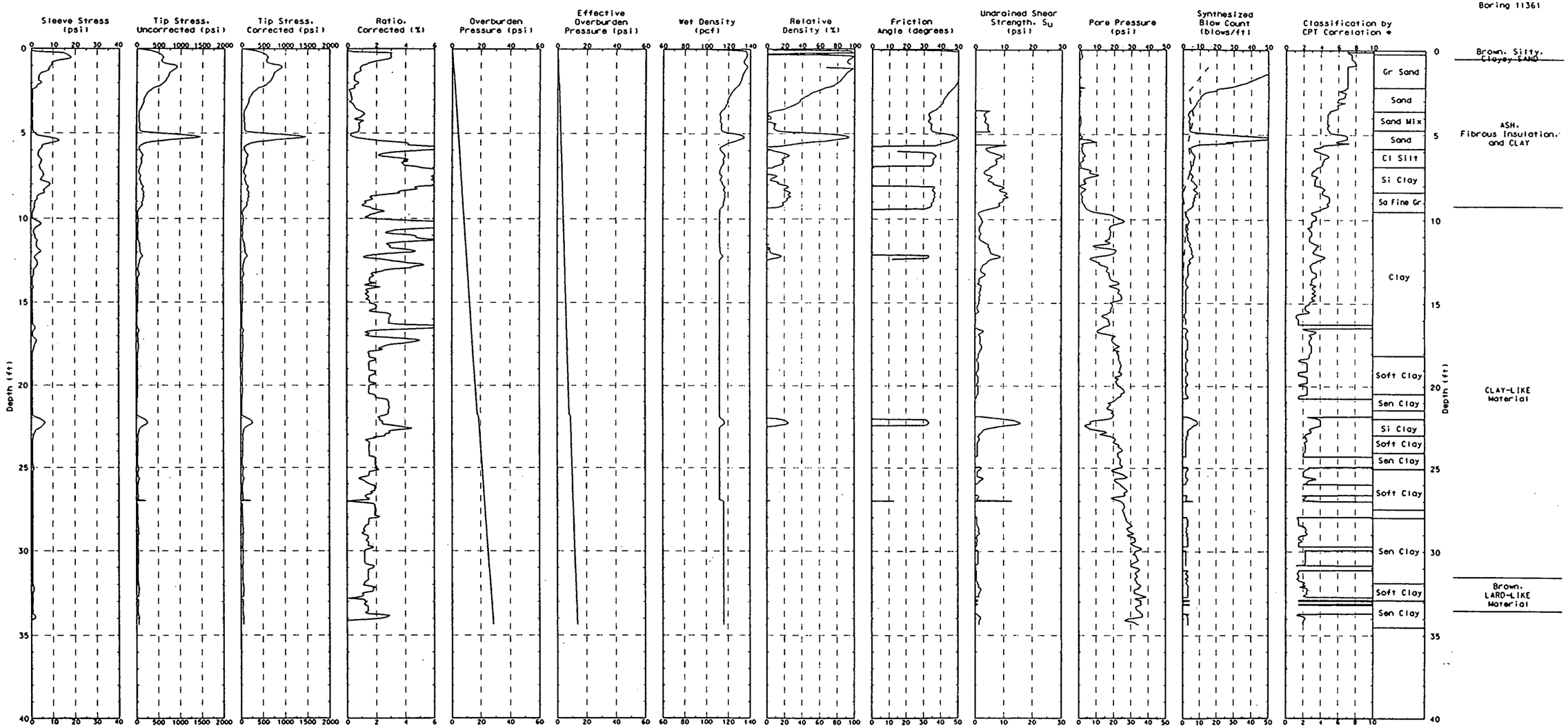
CPT ID: C3-10

CAD FILE: PD19/SKX03470.DGN

PIT: 3

CPT ID: C3-11

DATE TEST PERFORMED: 8/24/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-11	481690	1346737	589.5
11361	481698	1346734	589.5

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S24G404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

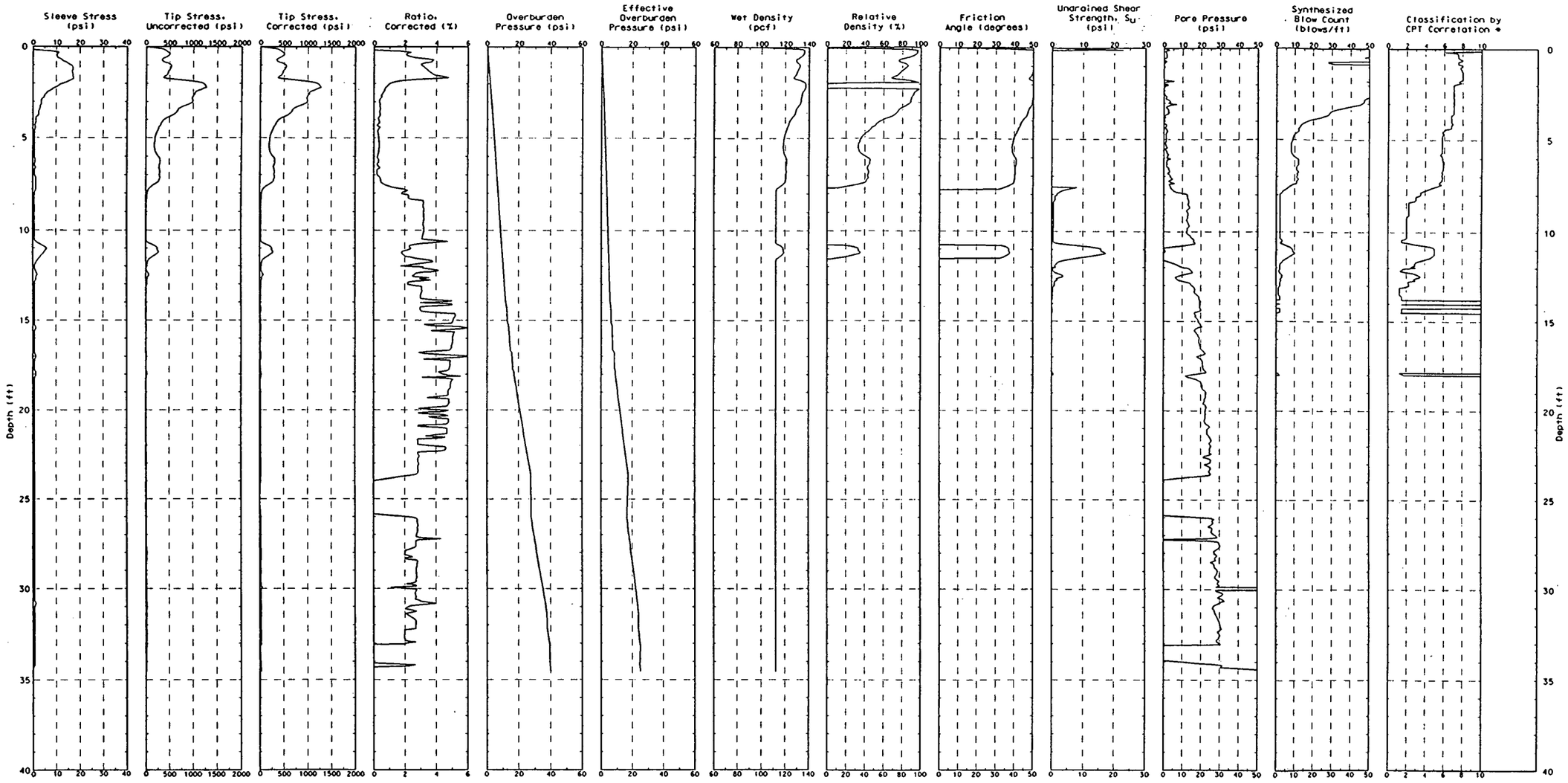
CPT ID: C3-11

CAD FILE: P019/SKX03471.DGN

PIT: 3

CPT ID: C3-12

DATE TEST PERFORMED: 8/25/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-12	481729	1346681	587.0

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S25G402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

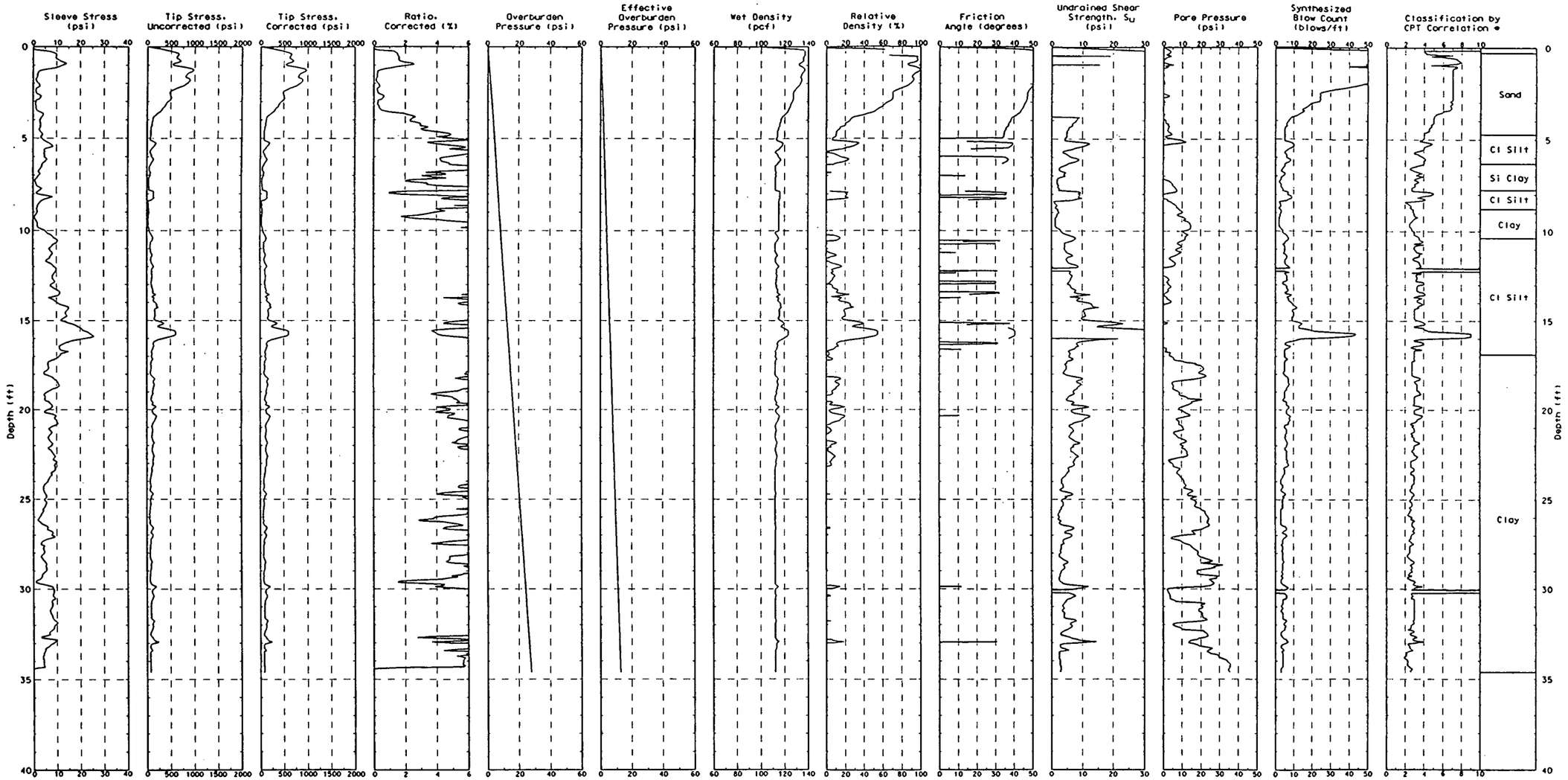
CPT ID: C3-12

CAD FILE: P019/SKX03472.DGN

PIT: 3

CPT ID: C3-13

DATE TEST PERFORMED: 8/25/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-13	481829	1346781	589.3

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S25G403
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

CPT ID: C3-13

CAD FILE: P019/SKX03473.DGN

APPENDIX B

DEEP BORING LOGS

FEMP

LITHOLOGIC LOG

CONTROL NO.: 1003061156 8C16-ØØ4

PROJECT NAME: OU1 Dewatering Excavation Program Geotechnical Investigation	PROJECT NO.: 10.03 06
LOCATION/NUMBER: 11565 (C1-6)	COORDINATES:
DATE STARTED: 8-11-95	DATE COMPLETED: 8-11-95
SURFACE ELEVATION:	GROUNDWATER LEVEL: NA; DATE: NA; TIME: NA
GROUNDWATER LEVEL: NA; DATE: NA; TIME: NA	
GEOLOGIST: Keith Payne	DRILLING CONTRACTOR: Alliance
DRILLING EQUIPMENT: Hollow Stem Auger	DRILLER: Martin Proctor
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
WATER LOST DURING DRILLING: 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
1.0							
2.0							
3.0	0850 8-11-95 405651		24	(2.5Y, 5/1) Gray, Sandy Silt, moist, non-plastic, possibly ash			Bγ = 100 CPM PID = 0 PPM
4.0							
5.0							
6.0							
7.0							

METER	BKGD	DATE	TIME
PID	0 ppm	8-11-95	0845
ALPHA	NA	NA	NA
BETA / GAMMA	30cpm	8-11-95	0845

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: Piston Sampler with Shelby Tube
DIAMETER OF SAMPLER: 3" I.D.
WEIGHTS OF HAMMER: NA

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER: 100306115 68C61-005

PROJECT NAME: OU1 Dewatering Excavation Program Geotech Invest.

PROJECT NUMBER: 10.0306

LOCATION NUMBER: 11568 (C1-6)

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
8.0 9.0	0900 8-11-95 405652		19	(2.5Y, 5/1) Gray, Sandy Silt, moist, non-plastic, possibly ash			βγ=500 cpm PID=0 PPM Bottom two Inches of Shelby tube crushed. Rest of sample is good.
10.0 11.0 12.0	0920 8-11-95 405653		19	(10YR, 5/1) gray, sandy silt with 15-20% white plates. slightly moist, non-plastic			βγ=1,200 cpm PID=1.1 PPM
13.0 14.0 15.0 16.0				Bottom of Boring 13.0'			

METER	BKGD	DATE	TIME
PID	See p. 1		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See p. 1
DIAMETER OF SAMPLER	
WEIGHTS OF HAMMER	

NOTES: water in boring as augers are pulled

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 2

PROJECT NAME: OU1 Dewatering Excavation Evaluation Program Geotech. Invest.	PROJECT NO.: 10.03.06
LOCATION/NUMBER: 11569 (C2-5)	COORDINATES:
DATE STARTED: 8-11-95	DATE COMPLETED: 8-11-95
SURFACE ELEVATION:	GROUNDWATER LEVEL: NA — DATE: NA — TIME: NA
GROUNDWATER LEVEL: NA — DATE: NA — TIME: NA	
GEOLOGIST: Keith Payne	DRILLING CONTRACTOR: Alliance
DRILLING EQUIPMENT: Hollow Stem Auger	DRILLER: Martin Proctor
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
WATER LOST DURING DRILLING: 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
1.0							
2.0							
3.0	0510 8-11-95 405654	NA	25	(2.5Y, 5/4) pale yellow, clayey silt, moist, slight plasticity, pudding like in texture	NA	NA	BG = 4,000 CPM PID = 11.5 PPM
4.0							Shelby Tube with Piston Sampler
5.0							
6.0							
7.0							

METER	BKGD	DATE	TIME
PID	1.0 PPM	8-12-95	0505
ALPHA	NA	NA	NA
BETA / GAMMA	150 CPM	8-12-95	0505

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Piston Sampler Lith Shelby Tube

DIAMETER OF SAMPLER: 3" I D.

WEIGHTS OF HAMMER: NA

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Evaluation Program Geotech. Investigation

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11569 (C2-5)

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
8.0	0520 8-11-95 405655		25	(2.5 Y, 8/4) pale yellow, clayey silt, moist, slight plasticity, with wood fragment possibly from pallet, pudding like in texture			BY = 610 cpm PID = 7.7 PPM
9.0				(7.5 YR, 6/6) reddish yellow, clayey silt, moist, slight plasticity, pudding like in texture			
10.0	0530 8-11-95 405656		24	(5YR, 6/8) reddish yellow, clayey silt, moist, low plasticity, pudding like in texture			BY = 810 cpm PID = 6.9 PPM
11.0							
12.0				12.5' Bottom of Boring			
13.0							
14.0							
15.0							
16.0							

METER	BKGD	DATE	TIME
PID			
ALPHA		See Page 1	
BETA / GAMMA			

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	
DIAMETER OF SAMPLER	See Page 1
WEIGHTS OF HAMMER	

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 4

PROJECT NAME: OU1 Dewatering Excavation Program Geotechnical Investigation	PROJECT NO.: 1003.06
LOCATION/NUMBER: 11570 (C3-2)	COORDINATES:
DATE STARTED: 8-7-95	DATE COMPLETED: 8-8-95
SURFACE ELEVATION:	GROUNDWATER LEVEL: NA — DATE: NA — TIME: NA
GROUNDWATER LEVEL: NA	DATE: NA — TIME: NA
GEOLOGIST: Keith Payne	DRILLING CONTRACTOR: Alliance
DRILLING EQUIPMENT: Hollow Stem Auger	DRILLER: Martin Proctor
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
WATER LOST DURING DRILLING: 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
0.0							
1.0							
2.0							
3.0							
4.0							
5.0							
6.0							
7.0							

METER	BKGD	DATE	TIME
PID	10.0 ppm	8-7-95	0700
ALPHA	0 cpm	8-7-95	0700
BETA / GAMMA	70 cpm	8-7-95	0700

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Piston Sampler with Shelby Tube

DIAMETER OF SAMPLER: 3" I.D.

WEIGHTS OF HAMMER: NA

NOTES: Cuttings from Augers mound up to 8-12 inches high begin to lean to 70° and bottom of mound fails

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Program Geotech Invest.

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11570 (C3-2)

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
7.0							
8.0							
	0710 8-7-95						
9.0		NA	0	No Recovery	NA	NA	No Recovery
10.0							
	0900 8-8-95 405657			(5YR, 4/4) Reddish Brown, clay size particles with pudding like texture, wet, non-plastic			BG = 500 cpm α = 0 cpm PID = 213.5 ppm
11.0		NA	31		NA	NA	
12.0							Shelby Tube with Piston Sampler
13.0							
14.0							
15.0							
	0530 8-8-95 405658	NA	30	Shelby Tube 15.5 - 18.0'	NA	NA	
16.0							

METER	BKGD	DATE	TIME
PID	15-3 ppm See pg. 1	8-8-95	0455
ALPHA	0 cpm	8-8-95	0455
BETA / GAMMA	100 cpm	8-8-95	0455

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: See pg. 1

DIAMETER OF SAMPLER: See pg. 1

WEIGHTS OF HAMMER: See pg. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU1 Dewatering Excavation Program Geotech. Invest.	10.03.06	11570 (C3-2)

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
16.0							
17.0				(5YR, 8/3) pink, clay size particles, pudding like texture, medium plasticity, moist	~~NA~~	~~NA~~ KD NA 8-16-95	PID = 10.3 ppm α = 0.0 cpm βγ = 200 cpm Shelby Tube with Piston Sampler
18.0							
19.0							
20.0							
21.0							
22.0							
23.0	0605 8-8-95 405659	NA	30	(7.5YR, 2.5/3) Very Dark Brown with (7.5YR, 8/3) pink flakes, non-plastic, silty clay, very moist	NA	NA	PID = 91.3 ppm α = 0 cpm βγ = 400 cpm
24.0							
25.0							

METER	BKGD	DATE	TIME
PID	See		
ALPHA		P. 2	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See p. 1
DIAMETER OF SAMPLER: See p. 1
WEIGHTS OF HAMMER: see p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Program Geotech Invest

PROJECT NUMBER: 16.03.06

LOCATION NUMBER: 11570 (2)

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
25.0							See Thin Tube Piston Sampler 23-25.5
26.0							
27.0							
28.0							
29.0							
30.0							
31.0	0630 8-8-95 405660	NA	29	(2.5Y, 7/6) Yellow, Silty Clay, very moist, non-plastic	NA	NA	PID = 50.7 ∝ = 30 BJ = 3,600
32.0							See Thin Tube with Piston Sampler
33.0							
34.0							

METER	BKGD	DATE	TIME
PID	See		
ALPHA		Pg. 2	
BETA / GAMMA			

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See p. 1
DIAMETER OF SAMPLER	See p. 1
WEIGHTS OF HAMMER	See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 5

PROJECT NAME: OU1 Dewatering Excavation Program Geotechnical Investigation	PROJECT NO.: 10 03 06
LOCATION/NUMBER: 11571 (C3-9)	COORDINATES:
DATE STARTED: 8-10-95	DATE COMPLETED: 8-11-95
SURFACE ELEVATION:	GROUNDWATER LEVEL: NA
DATE: NA	TIME: NA
GROUNDWATER LEVEL: NA	DATE: NA
TIME: NA	
GEOLOGIST: Keith Payne	DRILLING CONTRACTOR: Alliance
DRILLING EQUIPMENT: Hollow Stem Auger	DRILLER: Martin Proctor
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
WATER LOST DURING DRILLING: 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
0.0							
1.0							
2.0							
3.0							
4.0							
5.0							
6.0							
7.0							

METER	BKGD	DATE	TIME
PID	10.2 ppm	8-10-95	0800
ALPHA	0 cpm ~~NA~~	8-10-95 ~~NA~~	0800 ~~NA~~
BETA / GAMMA	NA	NA	NA

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: Shelby Tube with Piston Sampler
DIAMETER OF SAMPLER: 3" I.D.
WEIGHTS OF HAMMER: NA

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Program Geotech Invest.

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11571 (C3-[illegible])

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
7.0							
8.0							
9.0							
10.0	0810 8-10-95 405661	NA	11	(5YR, 2.5/1) Black, silty Sand, non-plastic, very moist	NA	NA	α = 0 cpm PID = 9.8 ppm Shelby Tube with Piston Sampler
11.0							
12.0							
13.0	0820 8-10-95 405662	NA	18	(7.5 YR, 5/8) Strong Brown, Clayey Silt, moist non-plastic, pudding like texture	NA	NA	α = 0 cpm PID = 19.4 ppm Shelby Tube with Piston Sampler
14.0							
15.0							
16.0							

METER	BKGD	DATE	TIME
PID	See		
ALPHA		Pg.	
BETA / GAMMA			

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See pg. 1
DIAMETER OF SAMPLER	See pg. 1
WEIGHTS OF HAMMER	See pg. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU1 Dewatering Excavation Program Geotech Invest.	10.03.06	11571 (C3-9)

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
16.0							
17.0							
18.0	0830 8-10-95 405663	NA	24	(7.5YR, 7/6) Reddish yellow, clayey silt, non-plastic, moist, pudding like texture.	NA	NA	PID = 0.0 ppm α = 0 cpm Shelby Tube with piston sampler
19.0							
20.0							
21.0							
22.0							
23.0							
24.0							
25.0							

METER	BKGD	DATE	TIME
PID	See p. 1		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See p 1
DIAMETER OF SAMPLER	See p 1
WEIGHTS OF HAMMER	See p 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP
LITHOLOGIC LOG
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CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Program Geotech Invest.

PROJECT NUMBER: 10.03 06

LOCATION NUMBER: 11571 (c[illegible])

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
25.0							
26.0 27.0	0940 8-10-95 405664	NA	25	(2.5 YR, 7/1) light reddish gray, clayey silt, pudding like texture, moist, non-plastic	NA	NA	PID = Dead Battery α = 0 ppm Sealy Tube with piston sampler
30.0 31.0 32.0 34.0							
32.0	0900 8-10-95 405687	NA	26	(2.5Y, 7/8) pale yellow, clayey silt, with pudding like texture, slightly moist non-plastic.	NA	NA	PID = Dead Battery α = 0 ppm

METER	BKGD	DATE	TIME
PID	See		
ALPHA		p. 1	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See p. 1
DIAMETER OF SAMPLER: See p. 1
WEIGHTS OF HAMMER: See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
cu 1 Dewatering Excavation Program Geotech Invest.	10.03.06	11571 (C3-9)

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
24.0				Shelby Tube with Piston Sampler 32.5 - 35.0'			
35.0				Bottom of Borehole 35.0'			

METER	BKGD	DATE	TIME
PID	See		
ALPHA		p. 1	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See p. 1
DIAMETER OF SAMPLER: See p. 1
WEIGHTS OF HAMMER: See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP

LITHOLOGIC LOG

CONTROL NO.:

PROJECT NAME: OU1 Dewatering Excavation Evaluation Program Geotechnical Invest.	PROJECT NO.: 10.03.06
LOCATION/NUMBER: 11572 (C3-12)	COORDINATES:
DATE STARTED: 8-9-95	DATE COMPLETED: 8-10-95
SURFACE ELEVATION:	GROUNDWATER LEVEL: NA — DATE: NA — TIME: NA
GROUNDWATER LEVEL: NA — DATE: NA — TIME: NA	
GEOLOGIST: Keith Payne	DRILLING CONTRACTOR: Alliance
DRILLING EQUIPMENT: Hollow Stem Auger	DRILLER: Martin Proctor
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
WATER LOST DURING DRILLING: 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
1.0							
2.0							
3.0							
4.0							
5.0	0350 8-9-95 405665	4 3 2	14	(Gley, N2.5/) Black, Sandy silt, moist, non-plastic	NA	NA	PID = 3.5 ppm α = 0 cpm β/γ = 150 cpm split Spoon
6.0							
7.0							

METER	BKGD	DATE	TIME
PID	1.0 ppm	8-9-95	0340
ALPHA	0 cpm	8-9-95	0340
BETA / GAMMA	50 cpm	8-9-95	0340

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Split Spoon / Shelby Tube with Piston Sampler

DIAMETER OF SAMPLER: 2" I.D. / 3" I.D.

WEIGHTS OF HAMMER: 140 lbs / NA

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FE-MP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Evaluation Program Geotechnical Investigation

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11572 (C3-12)

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
7.0							
8.0	0400 8-9-95 405666	NA	24	(5YR, 5/8) Yellowish Red, Silt, moist, non-plastic	NA	NA	PID = 3.5 ppm α = 0 cpm βγ = 1,500 cpm Shelby Tube with Piston Sampler
9.0							
10.0	0410 8-9-95 405667	weight of Rod	18	(5YR, 5/8) Yellowish Red, Silt, moist, non-plastic	NA	NA	PID = 21.5 ppm α = 0 cpm βγ = 700 cpm Split Spoon
11.0							
12.0							
13.0	0420 8-9-95 405668	NA	15	(5YR, 5/8) Yellowish Red, Silt, moist, non-plastic	NA	NA	PID = 15.7 ppm α = 0 cpm βγ = 40 cpm Shelby Tube with Piston Sampler
14.0							
15.0	0715 8-9-95 405669	NA	30	(7.5YR, 4/3) Brown, Clayey Silt, Very moist, non-plastic, mottled with (7.5YR, 7/1) light grey, silty clay very moist non-plastic	NA	NA	PID = 10.1 ppm α = 0 cpm βγ = not working Shelby Tube with Piston Sampler
16.0							

METER	BKGD	DATE	TIME
PID	See		
ALPHA		p. 1	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: see p. 1
DIAMETER OF SAMPLER: see p. 1
WEIGHTS OF HAMMER: see p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dismantling Excavation Evaluation Program Geotechnical Investigation

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11572 (C3-12)

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
16.0				Shelby Tube 15.0-17.5'			
17.0							
18.0	0740 8-9-95 405670	NA	30	(2.5Y, 6/2) light brownish gray, silty clay, moist, slight plasticity	NA	NA	PID = ~~40.0~~ 40.0 ppm KP 8-21-95; α = 0 cpm; βγ = Broken; Shelby Tube with Piston Sampler
19.0							
20.0	0750 8-9-95 405671	weight of Rod	18	(2.5Y, 6/2) light brownish gray, silty clay, moist, slight plasticity, marbled with (2.5Y, 8/1) white pudding like material	NA	NA	PID = 44.5 ppm; α = 0 cpm; βγ = Broken cpm; Split Spoon
21.0							
22.0							
23.0	0815 8-9-95 405672	NA	32	(2.5Y, 4/1) Dark Gray, Silty clay moist, slight plasticity, marbled with (2.5Y, 7/6) yellow, silty clay, moist, slight plasticity	NA	NA	PID = 24.8 ppm; α = 0 cpm; βγ = Broken; Shelby Tube with Piston Sampler
24.0							
25.0							

METER	BKGD	DATE	TIME
PID	See		
ALPHA		p. 1	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See p. 1
DIAMETER OF SAMPLER: See p. 1
WEIGHTS OF HAMMER: See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG
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CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Evaluation Program Geotechnical Investigation

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11572 (C3)

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
24.0	0820 8-9-95 405673	1 0 3	18	Alternating layers of (2.5Y, 4/1) Dark Gray, Silty Clay, moist, slight plasticity and (2.5Y, 7/6) Yellow, Silty clay, moist, slight plasticity	NA	NA	PID = 15.5 ppm α = 0 cpm βγ = not working Split Spoon
26.0							
28.0	0225 8-10-95 405674	NA	18	(10YR, 7/6) Yellow, Clayey Silt, moist, slight plasticity	NA	NA	PID = 76.4 ppm α = 0 cpm βγ = not working Shelby Tube with Piston Sampler
30.0	0245 8-10-95 405675	NA	19	(10YR, 7/6) Yellow, Clayey Silt, moist, slight plasticity	NA	NA	PID = 7.9 ppm α = 0 cpm βγ = not working 11 inches of water on top of sample Shelby Tube with Piston Sampler
32.0	0300 8-10-95 405676	NA	19	(5YR, 4/4) Reddish Brown, Clayey Silt, moist, non-plastic	NA	NA	PID = 7.9 ppm α = 5.5 cpm βγ = not working 9 inches of water on top of sample Shelby Tube with Piston Sampler
34.0							

METER	BKGD	DATE	TIME
PID 9.6 ppm	1.0 ppm ~~not working~~	8-9-95 8-10-95	0340 0220
ALPHA	0 cpm 0 cpm	8-9-95 8-10-95	0340 0220
BETA / GAMMA	50 ppm Not working ~~8-2-95 9.6 ppm~~	8-9-95 8-10-95	0340 0220

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: See p. 1

DIAMETER OF SAMPLER: See p. 1

WEIGHTS OF HAMMER: See p. 1

NOTES:

Late P.M. of 8-9-95 Rainfall Event Occured

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Evaluation Program Geotechnical Investigation

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11572(C3-12)

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
34.0				Shelby Tube 32.5-35.0'			
35.0				Bottom of Boring 35.0'			
36.0							

METER	BKGD	DATE	TIME
~~PID~~ BS 8-21-95	Not Working	8-10-95	—
ALPHA	0cpm	8-10-95	0220
PID ~~BETA/GAMMA~~ FD 8-21-95	9.6p	8-10-95	0220

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See p. 1
DIAMETER OF SAMPLER	See p. 1
WEIGHTS OF HAMMER	See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP

LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: OU1 Dewatering Excavation Evaluation Program Geotechnical Investigation	PROJECT NO.: 10.03.06
LOCATION/NUMBER: 11573 (CB1-1)	COORDINATES:
DATE STARTED: 8-12-95	DATE COMPLETED: 8-12-95
SURFACE ELEVATION:	GROUNDWATER LEVEL: NA; DATE: NA; TIME: NA
GROUNDWATER LEVEL: NA; DATE: NA; TIME: NA	
GEOLOGIST: Keith Payne	DRILLING CONTRACTOR: Alliance
DRILLING EQUIPMENT: Hollow Stem Auger	DRILLER: Martin Proctor
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
WATER LOST DURING DRILLING: 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
1.0							
2.0							
3.0							
4.0							
5.0	0205 8-12-95 405688	3 3 3	10	(2.5Y, 2.5/1) Black, Clayey Silt, Slightly moist, non-plastic			BG = 1,900 cpm PID = 5.0 ppm split spoon
6.0							
7.0							

METER	BKGD	DATE	TIME
PID	10 ppm	8-12-95	0205
ALPHA	NA	NA	NA
BETA / GAMMA	150 CPM	8-12-95	0205

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Split-Spoon / See by Tube

DIAMETER OF SAMPLER: 2" ID / 3" I.D.

WEIGHTS OF HAMMER: 140 lbs / NA

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Program Geotech Investigation

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 1.573 (CB1-

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
8.0	0225 8-12-95 405689	NA	28	Top of Shelby Tube SAA Bottom of Shelby Tube (10YR, 5/1) Gray, Clayey Silt, moist slight plasticity			BX = 2,000 cpm PID = 5.0 ppm possibly ash Shelby Tube
10.0	0230 8-12-95 405690	1 0 1	18	(10YR, 7/2) light gray, clayey silt, moist slight plasticity			BX = 1,300 cpm PID = 5.8 ppm Split Spoon
12.0							
13.0	0240 8-12-95 405691		27	(7.5YR, 5/6) Strong Brown, clayey Silt, moist, non-plastic			BX = 2,900 cpm PID = 548.0 ppm Shelby Tube
15.0	0255 8-12-95 405692	0 0 1	18	(2.5, 6/3) light yellowish brown, clayey silt moist, low plasticity			BX = 4,000 cpm PID = 591 ppm
16.0							

METER	BKGD	DATE	TIME
PID	See Pg. 1		
ALPHA *			
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See pg. 1
DIAMETER OF SAMPLER: See pg. 1
WEIGHTS OF HAMMER: See pg. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG
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CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Evaluation Program Geotech. Invest.

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11573(CB1-1)

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
				see p. 2			split spoon
17.0				Bottom of Boring ~~16.5~~ KP 8-17-95 17.5'			
18.0							

METER	BKGD	DATE	TIME
PID	See pg. 1		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See pg. 1
DIAMETER OF SAMPLER: See pg. 1
WEIGHTS OF HAMMER: See pg. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

PROJECT NAME: OU1 Dewatering Excavation Evaluation Geotechnical Investigation	PROJECT NO.: 10.03.06
LOCATION/NUMBER: 1594 (CB3-1)	COORDINATES:
DATE STARTED: 8-15-95	DATE COMPLETED: 8-16-95
SURFACE ELEVATION:	GROUNDWATER LEVEL: NA / DATE: NA / TIME: NA
GROUNDWATER LEVEL: NA / DATE: NA / TIME: NA	
GEOLOGIST: Keith Payne	DRILLING CONTRACTOR: Alliance
DRILLING EQUIPMENT: Hollow Stem Auger	DRILLER: Martin Proctor
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
WATER LOST DURING DRILLING: 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
1.0							
2.0							
3.0							
4.0							
5.0	0345 8-15-95 405677	2 2 4	9	(2.5Y, 4/4) Olive Brown, Clayey Silt, slightly moist, low plasticity	NA	NA	PID = 39.2 ppm Bγ = 2,600 cpm split spoon
6.0							
7.0							

METER	BKGD	DATE	TIME
PID	34.4 ppm	8-15-95	0340
ALPHA	NA	NA	NA
BETA / GAMMA	50 cpm	8-15-95	0340

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Split Spoon / Shelby Tube
DIAMETER OF SAMPLER	2" I.D. / 3" I.D.
WEIGHTS OF HAMMER	140 lbs / NA

NOTES:

PID readings high due to close proximity to rig

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG
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CONTROL NUMBER:

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU1 Dewatering Excavation Emtration Geotech. Invest.	10.03.06	11574 (CB3-1)

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
7.0							
8.0 9.0	0350 8-15-95 405678	NA	22	(2.5Y, 5/4) light olive brown, clayey silt with trace sand and roots, slightly moist, slight plasticity	NA	NA	PID = 35.7 ppm Bγ = 125 cpm Shelby Tube
10.0 11.0	0355 8-15-95 405679	4 2 4	12	(5Y, 5/2) Olive gray, fine sandy silt, slightly moist, non-plastic	NA	NA	PID = 34.1 ppm Bγ = 250 cpm Split Spoon
12.0							
13.0 14.0	0410 8-15-95 405680	NA	25	(5Y, 5/2) Olive gray, clayey silt, Dry to slightly moist, non-plastic	NA	NA	PID = 34.6 ppm Bγ = 90 cpm Shelby Tube
15.0 16.0	0415 8-15-95 405681	6 10 25	10	(7.5YR, 5/8) Strong Brown, clayey silt, slightly moist, non-plastic, mottled with (7.5YR, 4/1) dark gray, silty clay, moist, non-plastic	NA	NA	PID = ~~50 ppm~~ NA KP 8-16-95 Bγ = 50 cpm

METER	BKGD	DATE	TIME
PID	See		
ALPHA		pg. 1	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See pg. 1
DIAMETER OF SAMPLER: See pg. 1
WEIGHTS OF HAMMER: See pg. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU 1 Dewatering Excavation Evaluation Geotech. Invest.	10.03.06	11574 (CB3-1)

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
16.0							Split Spoon 15.0-16.5'
17.0							
18.0	0200 8-16-95 405682		10	(7.5YR, 5/8) Strong Brown, Clayey Silt, slightly moist, non-plastic, mottled with (7.5YR, 4/1) dark gray, silty clay, moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 90 cpm 22 inches refusal encountered cobble
19.0							
20.0							Shelby Tube
21.0	0215 8-16-95 405683	6 10 11	14	(7.5 YR, 4/1) Dark Gray, Silt with trace sand, slightly moist, non-plastic, mottled with 15% (7.5 YR, 5/8) Strong Brown, clayey silt with trace sand, slightly moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 70 cpm Split Spoon
22.0							
23.0	0230 8-16-95 405684	NA	16	(2.5Y, 4/1) Dark Grey, Clayey Silt with 20 mm × 20mm × 30 mm piece of gravel, low moisture, low plasticity	NA	NA	PID = 0.0 ppm βγ = 50 cpm
24.0							
25.0							Shelby Tube

METER	BKGD	DATE	TIME
PID	0.0 ppm	8-16-95	0150
ALPHA	NA	NA	NA
BETA / GAMMA	70cpm	8-16-95	0150

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See pg. 1
DIAMETER OF SAMPLER: See pg. 1
WEIGHTS OF HAMMER: See pg. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU 1 Dewatering Excavation Evaluation Geotech. Invest.

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11574 (CB[illegible])

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
25.0	0245 8-16-95 405685	7 11 12	12	(2.5Y, 4/1) dark grey, clayey silt with some coarse sand and fine gravel, mottled with (2.5Y, 5/4) light olive brown clayey silt, moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 70 cpm Split Spoon
27.0							
28.0	0300 8-16-95 405686	NA	13	(2.5Y, 4/1) dark grey, clayey silt with some coarse sand and fine gravel, mottled with (2.5Y, 5/4) light olive brown clayey silt, moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 50 cpm 25 inches refusal Shelby Tube
29.0							
30.0	0315 8-16-95 405687	21 28 34	14	(2.5Y, 5/4) light olive brown, sandy clay, slightly moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 100 cpm Split Spoon
31.0							
32.0							
33.0	0335 8-16-95 ~~405688~~ KP 9-24-95	NA	2	(2.5Y, 5/4) light olive brown, sandy clay, slightly moist, non-plastic Did not Keep Shelby Tube	NA	NA	PID = 0.0 ppm βγ = 150 cpm Crushed Tube
34.0							

METER	BKGD	DATE	TIME
PID	See		
ALPHA		R 3	
BETA / GAMMA			

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See p. 1
DIAMETER OF SAMPLER	See p. 1
WEIGHTS OF HAMMER	See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU1 Dewatering Excavation Evaluation Geotech. Invest.	10.03.06	11574 (CB3-1)

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
34.0							
							Shelby Tube 32.5-35.0'
35.0				Bottom of Boring 35.0'			
36.0							
37.0							
38.0							
39.0							
40.0							
41.0							
42.0							
43.0							

METER	BKGD	DATE	TIME
PID	See		
ALPHA		p. 3	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER See p. 1
DIAMETER OF SAMPLER See p. 1
WEIGHTS OF HAMMER See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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

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FEMP

FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.: 10.03.11	PAGE 1 OF 236
[redacted]	BADGE NO.: 8365	DATE: 7/6/95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:	
GeoTech Boring 1 Pit 6	Waste Pit 6	
WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (in Hg):
Cloudy	73°F	30.32

TIME	DESCRIPTION OF ACTIVITY
800	Arrive at Waste Pit 6. Set up for
	Sampling
900	Crane Sets up on Berm of Pit 6
930	Set up Vibra Core
1105	Crane Moves Vibra Core To Pit.
1120	Begin Coring
1125	Place Core on Berm
1135	Pull Archive Core
1150	Place Archive Core on Berm
1210	Dress out and go into Zone
1220	Cut 6" Core From 13.0 - 12.5 Feet. Bottom of
	Core at 13.0 Feet. Sample # 405344
1240	Take Composite Sample From 8.0' - 12.5' # 405344
1250	Archive Core Has 5.0 of Recovery.
	Archive Core Taken To 13.0 Feet Below water
	Level Sample # 405345 8.0 - 13.0 Feet
1305	Clean up Area

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA	—						

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Microtip	960553	KR	7/6/95	930	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	None
NA	NA	Ludlum	89745	

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FS-F-3682 (11-08-94)

G:\WPSC\94-364.DRW

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FEMP

FIELD ACTIVITY LOG

(CONTINUATION PAGE)

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.: 10.03.11	PAGE 2 OF 2
[redacted]	BADGE NO.: 8365	DATE: 7/6/95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:
P.T 6 Boring 1	Waste Pit 6

TIME	DESCRIPTION OF ACTIVITY
1315	Leave Zone

F-3682-1 (11-08-94)

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000210

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FEMP

LITHOLOGIC LOG

CONTROL NO.:	PAGE 1 OF 4

PROJECT NAME:	PROJECT NO.:
Geotechnical Investigation of Waste Pits 5 and 6	10.03.11

BORING NUMBER:	COORDINATES:	DRILLING CONTRACTOR:	DRILLER / HELPER:
1 Waste Pit 6		Wise	NA

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED:
				7/6/95
GEOLOGIST:	**GROUNDWATER LEVEL:**	**DATE:**	**TIME:**	**DATE COMPLETED:**
R Geiger				7/6/95

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	DRILLING EQUIPMENT:
NA GAL	NA GAL	Vibra-Corer

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
	NA	NA	NA	No Recovery	NA	NA	NA
1							
2							
3							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	1.6	7/6/95	930
ALPHA	NA	NA	NA
BETA / GAMMA	50	7/6/95	930

NOTES: Pit covered with water. Depth of water is unknown. Depth on log starts at water surface. Descriptions of material taken at points where Vibra Corer Tube was cut.

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

000211

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TEMP

LITHOLOGIC LOG

CONTROL NO.:

PROJECT NAME: GeoTech Investigation P.T5+6	PROJECT NO.: 10.03.11.
BORING NUMBER: 1 WesTe Pit 6	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7/6/95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7/6/95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra-Corer	

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
4	NA	NA	NA	No Recovery	NA	NA	NA
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	1.6.	7/6/95	930
ALPHA	NA	NA	NA
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 3 OF 4

PROJECT NAME: Geotech Investigation Pits 5 and 6	PROJECT NO.: 10.03.11
BORING NUMBER: 1 Waste Pit 6	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7/6/95	
GEOLOGIST: K. Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7/6/95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Core	

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	NA	NA	NA	No Recovery ↓	NA	NA	NA
8	1240 7/6/95 405344	NA	12	Bright Pea Green with some Dark Green swirls. Liquid material. Material Ran out of End of Tube.	NA	NA	PID = 2.1 Py = 7000 No Munsel Color Matches Material. Composite Sample # 405344 8-12.5 Feet
9			12				
10			12				

INSTRUMENT	BACKGROUND	DATE	TIME
PID	See pg 1		
ALPHA	NA →		
BETA / GAMMA	See pg 1		

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 4 OF 4

PROJECT NAME: GeoTech Investigation Pits 5 and 6			PROJECT NO.: 10.03.11
BORING NUMBER: 1 Pit 6	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7/6/95
GEOLOGIST: K Geiger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7/6/95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Vibra Corer	

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
11			12				
12	1220 7/6/95 405344		12	2.5Y 7/2 Light Gray with 2.5YN/3 very Dark Gray Silty Clay Like material, medium plasticity, very moist	NA	NA	PID = 2.1 $\beta\gamma$ = 7000 6" Core # 405344 12.5-13.0'
13				Bottom of Core 13.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID	See pg 1		
ALPHA	NA →		
BETA / GAMMA	See pg 1		

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

FEMP

FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NAME / NO.: 10.03.11	PAGE 1 OF 1
[redacted]	BADGE NO.: 8365	DATE: 7/6/95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:
Boring 2 Pit 6	Waste Pit 6

WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (in Hg):
Partly Cloudy	73°F	30.32

TIME	DESCRIPTION OF ACTIVITY
1445	Begin To Position Crane at Next Sample Point
1535	Set up Vibra-Corer
1615	Dress out and Enter Zone
1620	Crane places Vibra-Corer Over Pit.
1625	Waiting on Position Fix From Geodometer
1650	Begin Coring
1700	Wise Personnel Begin To Remove Core.
1705	Begin To Sample Core.
1710	Take 6"(inch) Sample From Tip of Core Sample # 405346 11.5-12 Feet
1715	Take 5 Foot Composite Sample # 405346 7-12 Feet
	Sample Core is 12 Feet Deep From Water Surface. ~~Five~~ KG 7/6/95
	Five Feet of Recovery in Core 7-12 Feet
1720	Set up To Take Archive Sample.
1725	Problems with Air Hose on Vibra-Corer
1800	Take Archive Core # 405347 3 ~~7~~ KG 7/6/95 -12 Feet. Archive
	Core is 12 Feet Deep From Water Surface. Core Has
	9 ~~5~~ KG 7/6/95 Feet of Recovery 3 ~~7~~ KG 7/6/95 -12 Feet, # 7-12 405347, 3-7 405347 Time 1810
1830	Clean Up Zone. Frisk out Samples.
1850	Place and Lock Samples in Decon Trailer ~~Trailer~~ KG 7/6/95

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Photovac	16553	KG	7/6/95	930	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	None
NA	NA	Ludlum	99745	

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FS-F-3682 (05-08-95)

G:\WPSC\95-0061.DRW

FEMP*

LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 4

PROJECT NAME: Geotechnical Investigation of Waste Pits 5 and 6

PROJECT NO.: 10.03.11

BORING NUMBER: 2 Pit 6

COORDINATES:

DRILLING CONTRACTOR: Wise

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7/6/95

GEOLOGIST: K Geyer

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7/6/95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Vibro-Corer

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
	NA	NA	NA	No Recovery	NA	NA	NA
1							
2							
3							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	1.6	7/6/95	1615
ALPHA	NA	NA	NA
BETA / GAMMA	50	7/6/95	1615

NOTES: Pit Covered with water, Depth of water is unknown. Depth on Log starts at water surface. Descriptions of material taken at points where Vibra Corer Tube was cut.

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PROJECT NAME: Geo Tech. Investigation Pits 5 and 6	PROJECT NO.: 10.03.11
BORING NUMBER: 2 PIT 6	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7/6/95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7/6/95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra - Corer	

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
	NA	NA	NA	NO Recovery	NA	NA	NA
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1.

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 3 OF 4

PROJECT NAME: GeoTech Investigation Pits Sand 6			PROJECT NO.: 10.03.11
BORING NUMBER: 2 PIT 6	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7/6/95
GEOLOGIST: K Geiger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7/6/95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Vibra Corer

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	1715 7/6/95 405346 7-12	NA	12	5Y 2.5/1 Black Sandy silty material with some yellow and orange spots, Low To No Plasticity, wet	NA	NA	By 7000 cpm PID 2.1 ppm composit Sample 7-12 Feet
8			12				
9			12				
10			12				

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA		Sept 1	
BETA / GAMMA			

NOTES: Sept 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

000013

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LITHOLOGIC LOG

CONTROL NO.:

PROJECT NAME: GeoTech Inves. Pits 5 and 6			PROJECT NO.: 10.03.11
BORING NUMBER: 2 Pit 6	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7/6/95
GEOLOGIST: R Geiger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7/6/95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Vibra Corer

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
11	1710 7/6/95 405246 11.5-12	NA	12	5Y 2.5/1 Black Sandy Silty Material with Some Yellow and orange spots, Low To No Plasticity, wet	NA	NA	Dr = 7000 cpm PID 2.1 ppm 6" Sample
12				Bottom of Boring 12 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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FEMP

FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.: 10.03.11	PAGE 1 OF
[redacted]	BADGE NO.: 8365	DATE: 7/10/95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:
3 Pit 6	Waste Pit 6

WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (in Hg):
Partly Cloudy	70°F	29.94

TIME	DESCRIPTION OF ACTIVITY
800	Arrive at Pit 6 Set up for Sampling
825	Workers Prepare To Move Crane
945	Crane in Position Dress out Enter Zone
1000	Begin To Drive Core.
1010	Remove Core
1015	Sample Core To 14.0 Feet. Take 6" Sample From
	Core Bottom # 405348 13.5 - 14.0 Feet.
1020	Take Composite Sample # 405348 9.0 - 13.5 Feet
1035	Take 6" Sample 8.5 - 9.0 Feet # 405348
1045	Take Composite Sample # 405348 4.0 - 8.5 Feet
1100	Take Archive Sample 9.0 - 14.0 # 405349 PID 5.7
	$\beta\gamma$ = 10,000 cpm
1110	Take Archive Sample # 405349 4.0 - 9.0 Feet PID 5.7
	$\beta\gamma$ = 10,000 cpm Total of 10' of Recovery
1115	Clean up Site - Frisk out Samples
1125	Lock Samples in Decon Trailer.

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
microtip	960553	KR	7/10/95	845	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	NONE
NA	NA	Ludlum	89745	

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 4

PROJECT NAME: Geotechnical Investigation of Waste Pits 5 and 6			PROJECT NO.: 10,03,11
BORING NUMBER: 3 Pit 6	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7/10/95
GEOLOGIST: K Geiger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7/10/95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Vibra-Core

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
0	NA	NA	NA	No Recovery	NA	NA	NA
1							
2							
3							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7/10/95	845
ALPHA	NA	NA	NA
BETA / GAMMA	50	7/10/95	845

NOTES: Pit Covered with water. Depth of water is Unknown. Depth on Log Starts at water Surface. Descriptions of Material Taken at Points where Vibra-Core Tub was Cut.

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G:/WPSC/95-0037.DRW (2-15-95)

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PROJECT NAME: Geotech. Investigation of Waste Pits 5 and 6	PROJECT NO.: 10.03.11
BORING NUMBER: 3 Pit 6	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7/10/95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7/10/95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Core	

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
				No Recovery			
4	1045 7/10/95 405348 4.0-8.5	NA	12	10YR 2/1 Black Silty Sandy Like material no Plasticity, moist	NA	NA	By 20,000 cpm PID 5.7 ppm Composite Sample 4.0-8.5 Feet
5			12				
6			12				
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA			
BETA / GAMMA			

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 3 OF 4

PROJECT NAME: GeoTech Investigation of Waste Pits Sand 6	PROJECT NO.: 10.03.11
BORING NUMBER: 3 Pit 6	COORDINATES:
DRILLING CONTRACTOR: WESE	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7/10/95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7/10/95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: U-Bay - Core	

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			12				
8			12				
	1035 7/10/95 405348 8.5-9.0	NA		10YR 2/1 Black Silty Sandy Lite material with some Small Rounded Gravel No Plasticity, Moist	NA	NA	Bq 20000cpm PID 5.7ppm 6" Sample 8.5-9.0 Feet
9	1020 7/10/95 405348 9.0-13.5	NA	12	SAA	NA	NA	Bq 20,000 cpm PID 3.1ppm Composite 9.0-13.5 Feet
10			12				

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA		See pg 1	
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

CONTROL NO.:

FEMP

LITHOLOGIC LOG

PROJECT NAME: GeoTech Investigation of Waste Pits Sand 6	PROJECT NO.: 10.03.11

BORING NUMBER:	COORDINATES:	DRILLING CONTRACTOR:	DRILLER / HELPER:
3 Pit 6		Wise	NA

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED:
				7/10/95

GEOLOGIST:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED:
K. Gorigal				7/10/95

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	DRILLING EQUIPMENT:
NA GAL	NA GAL	Vibra-Core

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
11			12				
12			12				
13							
14	1015 7/10/95 405348 13.5-14.0	NA	12	10YR 2/1 Black Silty Sandy Like Material, No Plasticity, Moist	NA	NA	Br 20,000cpm PID 3.1 ppm 6" Sample 13.5-14.0 Feet

Bottom of Boring 14.0 Feet

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

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FEMP

FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NAME / NO.: 10.03.14	PAGE 1 OF 1
[redacted]	BADGE NO.: 8365	DATE: 8/14/95

FIELD ACTIVITY SUBJECT: Pit 6 #4	GENERAL LOCATION / FACILITY DESCRIPTION: Waste Pit	
WEATHER CONDITIONS: Partly Cloudy	AIR TEMPERATURE: 81°F	BAROMETRIC PRESSURE (In Hg): 29.91

TIME	DESCRIPTION OF ACTIVITY
715	Arrive AT Pit 6 Set up for Sampling
	Attach Tag line To Crane
720	Take Preliminary Geodimeter Readings.
815	Calibrate RED. Swing Crane into Position.
825	Set up Vibra-Corer
840	Vibra Corer in Position. Advance corer.
905	Take 6" Sample 11-10.5 Feet # 405350
915	Take Composite Sample 6-11 Feet #405350
920	Take Archive Sample # 405351
930	5 Feet of Recovery on Archive 6-11 Feet
940	Clean Sample Area. Bag Samples
1000	Exit Zone

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
MicroTip	960553	BN	8/14/95	815	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME: NA	SERIAL NO.: NA	MFR. NAME: Ludlum	SERIAL NO.: 89745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

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LITHOLOGIC LOG

CONTROL NO.:	PAGE 1 OF
PROJECT NAME: GeoTechnical Investigation at Waste Pits 5 and 6	PROJECT NO.: 10.03.11
BORING NUMBER: #4 Waste P.T 6	COORDINATES:
DRILLING CONTRACTOR: WISE	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME: / DATE STARTED: 7-14-95
GEOLOGIST: K Geigel	GROUNDWATER LEVEL: / DATE: / TIME: / DATE COMPLETED: 7-14-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra-Corer	

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
		NN	NA	NO Recovery	NA	NA	
1							
2							
3							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-14-95	815
ALPHA	NA	NA	NA
BETA / GAMMA	50	7-14-95	815

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 2 OF

PROJECT NAME: GeoTech. Investigation of Waste Pits 5 and 6	PROJECT NO.: 10.03.11

BORING NUMBER:	COORDINATES:	DRILLING CONTRACTOR:	DRILLER / HELPER:
#4 Waste Pit 6		Wise	NA

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED:

GEOLOGIST:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED:
K Geiger				

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	DRILLING EQUIPMENT:
NA GAL	NA GAL	Vibra-Corer

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
4		NA	NA	No Recovery	NA	NA	
5							
6	915 9/14/95 405350	NA	12	10YR 2/1 Black with some Dark Green To 5Y 8/8 Yellow Silty Sandy Clay material very moist No plasticity			Bz 41,000 cpm PID 2.1
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	See pg 1		
ALPHA	NA	NA	NA
BETA / GAMMA	See pg 1		

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 3 OF

PROJECT NAME: GeoTechnical Investigation of Waste Pits Sand 6

PROJECT NO.: 10-03.11

BORING NUMBER: #4 Pit 6

COORDINATES:

DRILLING CONTRACTOR: Wiss

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED:

GEOLOGIST: K Gerdes

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED:

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Vibra-Corer

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
8		NA			NA	NA	
			12				
9				Composite Sample			
			12				
10							
			12				
	900 7-14-95 V05350			10YR 2/1 Black with some Dark Green to 5Y 8/4 Yellow Swirls Silty Sandy Like material No Plasticity Very moist			P405350 RFD 3.1 CPM 15000 B2 6" Sample
11				Bottom of Core 11.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	NA	NA	NA
BETA / GAMMA			

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FIELD ACTIVITY LOG

[redacted]

CONTROL NO.:	PROJECT NAME / NO.: 10.03.11	PAGE 1 OF ___
	BADGE NO.: 8365	DATE: 7-14-95

FIELD ACTIVITY SUBJECT: #5 Pit 6	GENERAL LOCATION / FACILITY DESCRIPTION: Waste Pit	
WEATHER CONDITIONS: Partly Cloudy	AIR TEMPERATURE: 82°F	BAROMETRIC PRESSURE (in Hg): 29.91

TIME	DESCRIPTION OF ACTIVITY
1015	Move Crane into Position, Set up Vibra-Core
1020	Extrude Sample from Core
1030	Take 6" Sample 18.5 - 18.0 Feet # 405352
1035	Take Composite 18.0 - 13.0 Feet # 405352
1040	Take 6" Sample 12.5 - 13.0 Feet # 405352
1045	Take Composite 12.5 - 7.5 Feet # 405352
1050	Take 6" Sample 7.0 - 7.5 Feet # 405352
1100	Take Composite 4.5 - 7.0 Feet # 405352
1110	Take Archive Sample 16.0 - 13.0 # 405353
1115	Take Archive Sample 12.0 - 8.0 # 405353
1120	Take Archive Sample 8 - 3.0 # 405353
1130	Clean up Lease Zone

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
microtip	960553	BN	7-14-95	815	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
NA	NA	Ludlum	89745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED
000009			

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FEMP

LITHOLOGIC LOG

CONTROL NO.:	PAGE 1 OF
PROJECT NAME: 620 Tech. Investigation at Waste Pits 5 and 6	PROJECT NO.: 10.03.11
BORING NUMBER: #5 Pit 6	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-14-95	
GEOLOGIST: R Geegan	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-14-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Corer	

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
0				No Recovery			
1							
2							
3							
4							
4.5	1100 7-14-95 405352			10YR 2/1 Black Silty Material no plasticity very moist			PID = 50,000 PID = 0
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-14-95	815
ALPHA	NA	NA	NA
BETA / GAMMA	50*	7-14-95	815

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:	PAGE ____ OF ____

PROJECT NAME: GeoTech Investigation of Waste Pits Sand 6	PROJECT NO.: 10.03.11

BORING NUMBER: #5 Pit 56 7-14-95	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED:
GEOLOGIST: K Geigen	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED:

WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL	DRILLING EQUIPMENT: Vibra Corer

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	1050 7-14-95 405352			10YR 2/1 Black silty material with some fine Gravel size material, No Plasticity very moist			By = 100,000 cpm PID = 2.1 6" Sample
8	1045 7-14-95 405352			Composite			
9							
10							
11							
12	1040 7-14-95 405352			10YR 2/1 Black with some Yellow Green Swirls silty material with some fine Gravel, No Plasticity very moist			By 25,000 6" Sample PID 0.0
13	1035 7-14-95 405352			10YR 2/1 Black with some Yellow Green Swirls Silty Sandy with Gravel sized material/ No Plasticity, moist to wet			By 6000 cpm PID 0.0 ppm
14							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	NA	NA	NA
BETA / GAMMA			

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP

LITHOLOGIC LOG

CONTROL NO.:	PAGE ____ OF ____
PROJECT NAME: Geotechnical Investigation of Waste Pits 5 and 6	PROJECT NO.: 10.03.11
BORING NUMBER: #5 P.T 6	COORDINATES:
DRILLING CONTRACTOR: W.S.R	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-14-95	
GEOLOGIST: R Gregg	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-14-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Corer	

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							
15				Composite			
16							
17							
18	1030 7-14-95 405352			10YR 2/1 Black with some Yellow Green swirls Silty Soil Like Material with Gravel Size pieces, No Plasticity, very Moist			By 6000 cpm PID 0.0 ppm 6" Sample
18.5				Bottom of Core 18.5 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	NA	NA	NA
BETA / GAMMA			

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NAME / NO.: 10.03.11	PAGE 1 OF 1
[redacted]	BADGE NO.: 8565	DATE: 7-14-95

FIELD ACTIVITY SUBJECT: #6 Pit 6	GENERAL LOCATION / FACILITY DESCRIPTION: Waste Pit	
WEATHER CONDITIONS: Partly Cloudy	AIR TEMPERATURE: 82°F	BAROMETRIC PRESSURE (In Hg): 29.91

TIME	DESCRIPTION OF ACTIVITY
1500	Move Crane into Position
1515	Take 6" Sample 15-17.5 Feet # 405354
1520	Take Composite Sample 13-17.5 Feet # 405354
1530	Take 6" Sample 12.5-13.0 Feet # 405354
1535	Take Composite 12.5-8 Feet # 405354
1540	Take 6" Sample 7.5-8 Feet # 405354
1545	Take Composite 7.5-5.0 Feet # 405354
1555	Clean Up Leave Zone No Archive Taken

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
microtip	960553	BN	7-14-95	815	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME: NA	SERIAL NO.: NA	MFR. NAME: Ludlum	SERIAL NO.: 84745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED
000033			

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 3

PROJECT NAME: Geotechnical Investigation of Waste Pits 5 and 6			PROJECT NO.: 10.03.11
BORING NUMBER: #6 Pit 6	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-14-95
GEOLOGIST: K Geigen	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-14-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Urna-Coard	

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
0		NA	NA	No Recovery	NA	NA	
1							
2							
3							
4							
5	1545 7-14-95 405354	NA	12	10YR 2/1 Black Sandy Silt Like material No to low plasticity very moist	NA	NA	BZ 100,000 PID 0.0
6			12				
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-14-95	815
ALPHA	NA	NA	NA
BETA / GAMMA	50	7-14-95	815

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 2 OF 3

PROJECT NAME: Geotech. Invest. of Pits 5 and 6

PROJECT NO.: 10.03.11

BORING NUMBER: Ex. Pit 6

COORDINATES:

DRILLING CONTRACTOR: W.G.

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-14-95

GEOLOGIST: R. Bligen

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-14-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Vibra Corer

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		NA	6		NA	NA	
	1540 7-14-95 405354	NA	6	10YR 2/1 Black Sandy Silty Like material No to Low Plasticity, Very Moist	NA	NA	By 50000 PID 0.0 Composite
8	1535 7-14-95 405354	NA	12	10YR 2/1 Black Sandy Silt Like Material No to Low Plasticity Very Moist	NA	NA	By 50,000 PID 0.0
9			12				
10			12	Composite			
11			12				
12			6				
	1530 7-14-95 405354	NA	6	10YR 2/1 Black Sandy Silt Like Material No to Low Plasticity Very Moist.	NA	NA	By 10,000 PID = 0.
13	1520 7-14-95 405354	NA	12	10YR 2/1 Black Sandy Silt Like Material No to Low Plasticity Very Moist	NA	NA	By 10,000 PID = 0
14							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See	P9	
BETA / GAMMA			

NOTES: See P9

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotech Inves. of waste Pits 5 and 6

PROJECT NO.: 10-03.11

BORING NUMBER: #6 Pit 6

COORDINATES:

DRILLING CONTRACTOR: WSL

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-14-95

GEOLOGIST: Ken Geisler

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-14-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Vibra-Corer

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
		NA	12		NA	NA	
			12	Composite			
			12				
			6				
	1515 7-14-95 409354	NA	6	10YR 2/1 Black Silty material with some sand no to low plasticity very moist	NA	NA	By 6,000 cpm PID 00 6" Sample
				Bottom of core 15 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
[redacted]A	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FIELD ACTIVITY LOG

CONTROL NO.: [redacted]

PROJECT NAME / NO.: 10.03.11

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BADGE NO.: 8365

DATE: 7-14-95

FIELD ACTIVITY SUBJECT: #7 P.T 6

GENERAL LOCATION / FACILITY DESCRIPTION: Waste P.T

WEATHER CONDITIONS: Partly Cloudy

AIR TEMPERATURE: 95°F

BAROMETRIC PRESSURE (in Hg): 29.92

TIME	DESCRIPTION OF ACTIVITY
1600	Crane in Position
1620	Take 6" Sample 17.5-19 Feet # 405355
1625	Take Composite 13.0-17.5 Feet # 405355
1630	Take 6" Sample 13.0-12.5 Feet # 405355
1640	Take Composite 12.5-8.0 Feet # 405355
1655	Clean up and Leave Zone. NO Archive Taken

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Microtip	96053	BN	7-14-95	815	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME: NA	SERIAL NO.: NA	MFR. NAME: Ludlum	SERIAL NO.: 89745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

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LITHOLOGIC LOG

CONTROL NO.:	PAGE 1 OF 3

PROJECT NAME: Geotechnical Investigation of Waste Pits 5 and 6	PROJECT NO.: 10.03.11

BORING NUMBER: IM P.T 6	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NG

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-14-95
GEOLOGIST: K Geiger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-14-95

WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL	DRILLING EQUIPMENT: Vibra Corer

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
0		NA	NA	NO RECOVERY	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-14-95	815
ALPHA	NA	NA	NA
BETA / GAMMA	50	7-14-95	815

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GeoTech Invest. Pits 5 and 6

PROJECT NO.: 10.03.11

BORING NUMBER: #3 Pit 6

COORDINATES:

DRILLING CONTRACTOR: W. Sel

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-14-95

GEOLOGIST: R Gleigh

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-14-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Vibra-Corer

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
1				↓			
5	1640 7-14-95 405355	NA	12	10YR 2/1 Black Sandy Silt Like Material low to no Plasticity, very moist	NA	NA	BY 150,000 PID 0.0
9			12	Composite			
10			12				
11			12				
12			6				
	1630 7-14-95 405355	NA	6	10YR 2/1 Black Sandy Silt Like material low to no Plasticity very Moist	NA	NA	BY 15,000 PID 0.0 6" Sample
13	1625 7-14-95 405355	NA	12	10YR 2/1 Black Sandy Silt Like material low to no Plasticity very Moist	NA	NA	BY 15,000 PID 0.0
14							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See Pg 1		
BETA / GAMMA			

NOTES: See Pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotech Invest. Pits 5 and 6	PROJECT NO.: 10.03.11
BORING NUMBER: #7 P.T6	COORDINATES:
DRILLING CONTRACTOR:	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-14-95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-14-95	
WATER USED DURING DRILLING: NA GAL.	WATER RECOVERED DURING DRILLING: NA GAL.
DRILLING EQUIPMENT: Vibra-Corer	

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		NA	12	Composite	NA	NA	
15		NA	12				
16		NA	12				
17		NA	6				
18	1440 7-14-95 405355	NA	6	10YR 2/1 Black Sandy Silt Like ~~material~~ material, Low to No Plasticity, Very Moist ~~Cuttings~~	NA	NA	By Geo RED O.C 6" Sample
				Bottom of Core 18.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA			
BETA / GAMMA			

Sol pg 1

NOTES:

Sol pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.: 10.03.3011	PAGE 1 OF 1
[redacted]	BADGE NO.: 8365	DATE: 7-19-95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:	
P.T 5 #5,6 WP5-1 WP5-1A	P.T 5	
WEATHER CONDITIONS: Partly Cloudy	AIR TEMPERATURE: 97°F	BAROMETRIC PRESSURE (in Hg): 29.90

TIME	DESCRIPTION OF ACTIVITY
1415	Crew in Position, Begin Coring
1420	Take Sample 24.5 - 25.0 405316
1425	Take Composite 20.0 - 24.5 405316
1430	Take Sample 19.5 - 20.0 405316
1435	Take Composite 15.0 - 19.5 405316
1440	Take Sample 14.5 - 15.0 405316
1445	Take Composite 11 - 14.5 405316
1450	Take Archive 20-25 405317
1455	Take Archive 15-20 405317
1500	Take Archive 10-15 405317
1505	Clean Up

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Microtip	960553	BN	7-19-95	1200	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
NA	NA	Ludlum	89745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 4

PROJECT NAME: Geotechnical Investigation of Waste Pits 5+6	PROJECT NO.: 10.03.11
BORING NUMBER: PIT 5, WIS-1	COORDINATES:
DRILLING CONTRACTOR: WISE	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-19-95	
GEOLOGIST: K Corrigan	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-19-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Corer	

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
0	NA	NA	NA	No Recovery	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-19-95	1200
ALPHA	NA →		→
BETA / GAMMA	50	7-19-95	1200

NOTES: Depths are Taken from Waste Pit 5 Berm

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 2 OF 4

PROJECT NAME: GeoTech Invest. Pits 5+6	PROJECT NO.: 10.03.11
BORING NUMBER: WA5-1	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-19-95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-19-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Corer	

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
	NA	NA	NA	No Recovery	NA	NA	
	1445 7-19-95 4053.6	NA	12	Composite	NA	NA	B_γ = 39,000 CPM PID = 1.6 ppm
			12				
			12				
			12				

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See 191		
BETA / GAMMA			

NOTES: See 191

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GeoTech Invest. P-79 546

PROJECT NO.: 10.03 11

BORING NUMBER: WP5-1

COORDINATES:

DRILLING CONTRACTOR: Weisel

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-19-95

GEOLOGIST: K Geiger

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-19-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: U. Bra Corer

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				↓			
	1440 7-19-95 405316	NA	6	Bright Lime Green (no Munsell Color Match) with Gray 5Y 5/1 Pudding Like Material No Plasticity, Very Moist	NA	NA	BY = 25,000 cpm PID = 1.0 ppm
15	1435 7-19-95 405316	NA	12	Composite	NA	NA	BY = 25,000 cpm PID = 1.0 ppm
16			12				
17			12				
18			12				
19			6				
20	1430 7-19-95 405316	NA	6	5YR 5/2 Reddish Gray Pudding Like Material No Plasticity, Very Moist	NA	NA	BY = 25,000 cpm PID 1.0 ppm
21	1425 7-19-95 405316	NA	12	Composite	NA	NA	BY = 30,000 PID = 1.0 ppm

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See	191	
BETA / GAMMA			

NOTES: See 191

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 3 OF 4

PROJECT NAME: Geotech Invest. Pits 5+6	PROJECT NO.: 10.03.11

BORING NUMBER:	COORDINATES:	DRILLING CONTRACTOR:	DRILLER / HELPER:
WP5-1		Wise	NA

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED:
				7-19-95

GEOLOGIST:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED:
K Geiger				7-19-95

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	DRILLING EQUIPMENT:
NA GAL	NA GAL	Vibra Core

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
	1420 7-19-95 405316	NA	6	5YR 5/1 Gray Pudding Like material No Plasticity Very moist	NA	NA	BZ 25,000 cpm AZ 0 cpm
				Bottom of core 25.0 FEET			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA			
BETA / GAMMA			

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FIELD ACTIVITY LOG

[redacted]

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.: 10.03.3011	PAGE 1 OF 1
	BADGE NO.: 8365	DATE: 7-19-95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:	
Pit 5 #3,4 WP52 WP5-2A	Pit 5	
WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (in Hg):
Partly Cloudy	87°F	29.90

TIME	DESCRIPTION OF ACTIVITY
1325	Crane in Position, Begin Coring
1330	Take Sample 23.5 - 24.0 405318
1335	Take Composite 19.0 - 23.5 405319
1340	Take Sample 18.5 - 19 405318
1345	Take Composite 14 - 18.5 405319
1350	Take Sample 13.5 - 14.0 405318
1355	Take Composite 9 - 13.5 405318
1358	Take Archive 20 - 25 405319
1400	Take Archive 15 - 20 405319
1405	Take Archive 11 - 15 405319
1410	Clean up Area

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Microtox	960593	BN	7-19-95	830	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
NA	NA	Ludlum	89745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 4

PROJECT NAME: Geotech Investigation Waste Pits 5+6			PROJECT NO.: 10.03 11
BORING NUMBER: WP5-2 PTS 3	COORDINATES:	DRILLING CONTRACTOR: WISE	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-19-95
GEOLOGIST: K Geisen	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-19-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL	DRILLING EQUIPMENT: NA	

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
0	NA	NA	NA	NO RECOVERY	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-19-95	1200
ALPHA	—	NA	—
BETA / GAMMA	50	7-19-95	1200

NOTES: Depths are Taken From Waste Pits Bern

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GeoTech Invest. Pty Ltd	PROJECT NO.: 1003.11
BORING NUMBER: WP5-2	COORDINATES:
DRILLING CONTRACTOR: Wisl	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-19-95	
GEOLOGIST: R Geiser	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-19-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Urbna Corer	

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
	NA	NA	NA	No Recovery	NA	NA	
	1355 7-19-95 4053.8	NA	12	Composite	NA	NA	$\beta\gamma$ = 25,000 cpm ID = 1.0 ppm
			12				
			12				
			12				
			6				
	1330 7-19-95 4053.8	NA	6	2.5Y N4/ Dark Gray Rubbing Life Material No Plasticity Very Moist	NA	NA	$\beta\gamma$ = 25,000 cpm ID = 1.0 ppm

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA		Sep 19	
BETA / GAMMA			

NOTES: Sep 19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotech Invest. P.79 5+6

PROJECT NO.: 10.03.11

BORING NUMBER: WP5-2

COORDINATES:

DRILLING CONTRACTOR: Wisl

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-19-95

GEOLOGIST: K Geyer

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-19-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Vibra Corer

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	1345 7-19-95 405318	NA	12	Composite	NA	NA	By 30,000 cpm PID = 0.0 ppm
15			12				
16			12				
17			12				
18			6				
19	1340 7-19-95 405318	NA	6	5YR 7/3 Pink Pudding Like material No Plasticity Very Moist	NA	NA	PID = 1.0 By = 25,000 cpm
20	1335 7-19-95 405318	NA	12	Composite	NA	NA	By = 25,000 cpm PID 1.0 ppm
21			12				

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GeoTech Invest. Pty 546	PROJECT NO.: 70.03.11
BORING NUMBER: WP5-2	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-19-95	
GEOLOGIST: K Geisen	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-19-95	
WATER USED DURING DRILLING: NA GAL.	WATER RECOVERED DURING DRILLING: NA GAL.
DRILLING EQUIPMENT: V. Big conca	

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
		NA	12		NA	NA	
			12				
			6				
	1330 7-19-95 405318	NA	6	5YR 6/4 Light Reddish Brown Padding like material no plasticity very moist	NA	NA	BT = 25,000 AIA = 0.0
				Bottom of core 24.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.: 10.03.3011	PAGE 1 OF 1
[redacted]	BADGE NO.: 8365	DATE: 7-19-95

FIELD ACTIVITY SUBJECT:	FACILITY DESCRIPTION:
PIT 5 7,8 WP5-3, WP5-3A	PIT 5

WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (in Hg):
Partly Cloudy	87°F	29.90

TIME	DESCRIPTION OF ACTIVITY
1507	Crane in Position, Begin Coring
1510	Take Sample 23.5-24 405320
1515	Take Composite 19-23.5 405320
1520	Take Sample 18.5-19.0 405320
1525	Take Composite 14.0-18.5 405320
1530	Take Sample 13.5-14.0 405320
1535	Take Composite 9.0-13.5 405320
1540	Take Archive 19.5-24.5 405321
1545	Take Archive 14.5-19.5 405321
1550	Take Archive 10.5-14.5 405321
1555	Clean Up

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Microtip	960533	BN	7-19-95	1200	Spec Gas	Isobutylene	100ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
NA	NA	Ludlum	59743	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 4

PROJECT NAME: Geotechnical Investigation of Pits 5 and 6

PROJECT NO.: 1.1.03 11

BORING NUMBER: WP5-73

COORDINATES:

DRILLING CONTRACTOR:

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-19-95

GEOLOGIST: K Geiser

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-19-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Hand Auger

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
0	NA	NA	NA	No Recovery	NA	NA	NA
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-19-95	1200
ALPHA		NA	
BETA / GAMMA	50	7-19-95	1200

NOTES: Depths are taken from waste Pit 5 Berm

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GroTech Invest Pits 5 and 6	PROJECT NO.: 10.03.11
BORING NUMBER: #7 WP5-3	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-19-95	
GEOLOGIST: K Coleman	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-19-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibro Corer	

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
				NO Recovery ↓			
	1535 7-19-95 405320	NA	12	Composite	NA	NA	BY 25,000 CPM PID 0.0 ppm
			12				
			12				
			12				
			6				
	1530 7-19-95 405320	NA	6	5YR 7/3 Pink Pudding like material No Plasticity Very Moist	NA	NA	BY = 25,000 CPM PID = 0.0 ppm

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA			
BETA / GAMMA			

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotech Investigation Pits 5 + 6	PROJECT NO.: 10.03.11
BORING NUMBER: 24 WPS-3	COORDINATES:
DRILLING CONTRACTOR: WSR	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME: / DATE STARTED: 7-19-95
GEOLOGIST: C Gorgon	GROUNDWATER LEVEL: / DATE: / TIME: / DATE COMPLETED: 7-19-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibro Corer	

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	1525 7-19-95 405320	NA	12	composite	NA	NA	BY = 25,000 cpm PID = 0.0 ppm
15			12				
16			12				
17			17				
18			6				
	1520 7-19-95 405320	NA	6	10YR 6/2 Pale Red Pudding like material No Plasticity Very Moist	NA	NA	BY = 30,000 cpm PID = 0.0 ppm
19	~~1525 7-19-95~~ 1515 7-19-95 405320	NA	12	composite	NA	NA	BY = 30,000 cpm PID = 0.0 ppm
20			12				
21							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 4 OF 4

PROJECT NAME: Geotech Investigation Pits 5 + 6	PROJECT NO.: 11.03.11
BORING NUMBER: WP5-3	COORDINATES:
DRILLING CONTRACTOR: Wisl	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-19-95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-19-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Corer	

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
		NA	12		NA	NA	
			12				
			6				
	1510 7-19-95 UCS320	NA	6	5YR 5/1 Gray Pudding like material with some areas crust like in consistency no plasticity very moist	NA	NA	BZ = 25,000 cpm PID = 1.0 ppm
				Bottom of core 24.0 feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	Sur Bgl		
BETA / GAMMA			

NOTES: Sur Bgl

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

S-F-3681 000355

G: / WPSC / 95-0037.DRW (2-15-95)

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FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.: FY 7-19-95 10.03.3811	PAGE 1 OF 1
PRE [redacted]	BADGE NO.: 8365	DATE: 7-19-95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:	
PIT 5 #1,2 WP5-4, WP5-4A	PIT 5	
WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (In Hg):
Partly Cloudy	87°F	29.90

TIME	DESCRIPTION OF ACTIVITY
1230	Crane in Position Begin Coring
1235	Take Sample 24-24.5 405322
1240	Take Composite 19.5-24 405322
1245	Take Sample 19-19.5 405322
1250	Take Composite 14.5-19.0 405322
1255	Take Sample 14-14.5 405322
1300	Take Composite 9.5-14 405322
1305	Take Archive 19.5-24.5 405323
1310	Take Archive 14.5-19.5 405323
1315	Clean Up

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
m-Crotip	960553	BN	7-19-95	1200	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	NONE
NA	NA	Ludlum	99745	

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FS-F-3682 (11-08-94) G:\WPSC\94-364.DRW

FEMP

LITHOLOGIC LOG

CONTROL NO.:	
PAGE 1 OF 4	
PROJECT NAME: Geotechnical Investigation of Pits 5 and 6	PROJECT NO.: 10.03.11
BORING NUMBER: PIT 5 1,2 WP5-4 WP5-4A	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-19-95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-19-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: U. bar Core	

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
0	NA	NA	NA	No Recovery	NA	NA	NA
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-19-95	1200
ALPHA	NA		
BETA / GAMMA	50	7-19-95	1200

NOTES: Depths are Taken From waste Pit 5 Berm.

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 2 OF 4

PROJECT NAME: Geotech Investigation Pits 5 and 6

PROJECT NO.: 10.03.11

BORING NUMBER: WA5-4 WA5-4A

COORDINATES:

DRILLING CONTRACTOR: WSR

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-19-95

GEOLOGIST: K Geigen

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-19-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Vibra Corer

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
	NA	NA	NA	No Recovery	NA	NA	
	1300 7-19-95 405322	NA	6	Composite	NA	NA	Bj = 20,000 cpm PEN = 0.0
			12				
			12				
			12				
			12				

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	Sep 91		
BETA / GAMMA			

NOTES: Sep 91

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:	PAGE 3 of 4

PROJECT NAME: GeoTech Investigation Pits 5 + 6	PROJECT NO.: 10.03.11		
BORING NUMBER: 1, 2 WP5-4 WP5-4A	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-19-95
GEOLOGIST: E Green	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-19-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL	DRILLING EQUIPMENT: Vibra Corer	

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	1255 7/19/95 405322	NA	6	Bright Lime Green (No Munsell Color match) with Gray 5Y 5/1 Pudding Like material Non Plastic Very Moist.	NA	NA	BZ = 25,000 PID = 1.0 ppm
15	1250 7-19-95 405322	NA	6	Composite	NA	NA	BZ = 25,000 PID = 1.0 ppm
			12				
16			12				
17			12				
18			12				
19	1245 7-19-95 405322	NA	6	5YR 5/2 Reddish Gray Puddling Like material, Non Plastic Very Moist	NA	NA	BZ = 25000 PID = 0.0 ppm
20	1240 7-19-95 405322	NA	6	Composite 19.5-24 24 KG 7-19-95	NA	NA	BZ = 25000 PID = 1.0
			12				
21							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotech Investigation Pits 5 and 6	PROJECT NO.: 10.03.11
BORING NUMBER: PIT5 1,2 WP5-4 WP5-4A	COORDINATES:
DRILLING CONTRACTOR: Weiler	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-19-95	
GEOLOGIST: E Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-19-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Corer	

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
1		NA	12		NA	NA	
2			12				
3			12				
4	1235 7-19-95 405322	NA	6	5YR 5/1 Gray Pudding Like Material Non Plastic Very Moist	NA	NA	BZ 30,000 cpm PID 10 ppm
5							
15				Bottom of Boring 24.5 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.:	PAGE 1 OF 1
[redacted]	10.03.11	
	BADGE NO.: 8365	DATE: 7-19-95

FIELD ACTIVITY SUBJECT:	CURRENT LOCATION / FACILITY DESCRIPTION:
P.T 5 9,10 WP5-5, WP5-5A	P.T 5

WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (In Hg):
Partly Cloudy	87°F	29.90

TIME	DESCRIPTION OF ACTIVITY
1600	Crane in ~~Pos. To~~ KG 7-19-95 Position, Begin Coring
1605	Take Sample 25-25.5 405324
1610	Take Composite 20.5-25 405324
1615	Take Sample 20.0-20.5 405324
1620	Take Composite 15.5-20.0 405324
1625	Take Sample 15.0-15.5 405324
1630	Take Composite 10.5-15 405324
1635	Take Archive 20-25 405325
1640	Take Archive 15-20 405325
1645	Take Archive 10-15 405325
1650	Clean up Area

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Microtip	960593	BN	7-19-95	1200	Spec. Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
NA	NA	Ludlum	39745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotechnical Investigation of A-79 Sand 6

PROJECT NO.: 10.03.11

BORING NUMBER: WP5-5 #9

COORDINATES:

DRILLING CONTRACTOR: Wise

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-19-95

GEOLOGIST: K Green

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-19-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Vibra Corer

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
0	NA	NA	NA	NO RECOVERY	NA	NA	NA
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-19-95	1200
ALPHA.	NA	→	→
BETA / GAMMA	50	7-19-95	1200

NOTES: Depths are Taken from Wesix P.T 5 Barrel

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 2 OF 4

PROJECT NAME: Geotech Invest. P.75 Sand 6	PROJECT NO.: 10.03.11
BORING NUMBER: WA5-5 #9	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-19-95	
GEOLOGIST: K Grigar	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-19-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Visra Corer	

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
	NA	NA	NA	No Recovery	NA	NA	
	1630 7-19-95 405324	NA	6	Composite	NA	NA	Bg = 30,000 cpm PID = 1.0 PPM
			12				
			12				
			12				

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA			
BETA / GAMMA			

Std 19 1

NOTES:

Std 19 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotech Invest. P.T. 5 + 6	PROJECT NO.: 10.03.11
BORING NUMBER: WP5-5 #9	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-19-95	
GEOLOGIST: R Origan	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-19-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: U-Bla Corer	

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		NA	12	Composite	NA	NA	
15	1625 7-19-95 405324	NA	6	10YR 6/2 Pale Red Pudding Like material No Plasticity Very Moist	NA	NA	By = 20,000 cpm PID = 1.0 ppm
16	1620 7-19-95 405324	NA	6	Composite	NA	NA	By = 20,000 cpm PID = 1.1 ppm
			12				
17			12				
18			12				
19			12				
20	1615 7-19-95 405324	NA	6	5YR 6/4 Light Reddish Brown Pudding Like material No Plasticity Moist	NA	NA	By = 25,000 cpm PID = 0.0 ppm
21	1610 7-19-95 405324	NA	6	Composite	NA	NA	By = 25,000 cpm PID = 0.0 ppm

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	Sept-19		
BETA / GAMMA			

NOTES:

Sept-19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotech Invest. A-4S 5+6

PROJECT NO.: 10-03.11

BORING NUMBER: WA5-5 #9

COORDINATES:

DRILLING CONTRACTOR: Wise

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-19-95

GEOLOGIST: K Origer

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-19-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Ultra Corer

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
1		NA	12	Composite	NA	NA	
2			12				
3			12				
4			12				
5	1605 7-19-95 405324	NA	6	10YR 2/1 Black Pudding Like material with some Granular Sand Like Material No Plasticity Very Moist	NA	NA	BY = 27,000 ppm ASH = 00 ppm
				Bottom of Core 25.5 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See 19		
BETA / GAMMA			

NOTES: See 19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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FIELD ACTIVITY LOG

[redacted]

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.: 10.03.11	PAGE 1 OF 1
	BADGE NO.: 8365	DATE: 7-24-95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:	
P.T 5 11,12 WP5-6 WP5-6A	P.T 5	
WEATHER CONDITIONS: Partly Cloudy	AIR TEMPERATURE: 80°F	BAROMETRIC PRESSURE (in Hg): 30.01

TIME	DESCRIPTION OF ACTIVITY
835	Set up for Sampling
840	Take Sample 23.5-24.0 405326
845	Take Composite 19.0-23.5 405326
850	Take Sample 18.5-19.0 405326
855	Take Composite 14-18.5 405326
900	Take Sample 13.5-14.0 405326
905	Take Composite 9.0-13.5 405326
910	Take Archive 19-24 405327
915	Take Archive 14-19 405327
920	Take Archive 11-14 405327
925	Clean Up

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
A-Cnot.p	960553	BN	7-24-95	930	Spec Gas	Isobutylene	100ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	None
NA	NA	Cullum	89745	

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FEMP

LITHOLOGIC LOG

CONTROL NO.:	PAGE 1 OF 4
PROJECT NAME: GeoTech Investigation of Pits 5 and 6	PROJECT NO.: 10.07.11

BORING NUMBER:	COORDINATES:	DRILLING CONTRACTOR:	DRILLER / HELPER:
WP5-6 #11		WSR	NA

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED:
				7-24-95

GEOLOGIST:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED:
K Geisler				7-24-95

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	DRILLING EQUIPMENT:
NA GAL	NA GAL	Vibra Corer

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
0	NA	NA	NA	No Recovery	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-24-95	830
ALPHA	NA		
BETA / GAMMA	50	7-24-95	830

NOTES: Depths are Taken from Waste Pit 5 Berm

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

CONTROL NO.:

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LITHOLOGIC LOG

PROJECT NAME: GroTech Invest. Pits 5+6	PROJECT NO.: 10.03.11
BORING NUMBER: WP5-6	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-24-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Wiska Cover	

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
	NA	NA	NA	No Recovery	NA	NA	
	905 7-24-95 405326	NA	12	Composite	NA	NA	By = 25,000 cpm PID = 0.0 ppm
			12				
			12				
			12				
			6				
	900 7-24-95 405326	NA	6	10YR 5/1 white pudding like material no plasticity very moist	NA	NA	By = 25,000 cpm PID 1.0 ppm

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GeoTech Invest. P.79 5+6			PROJECT NO.: 10,C3.11
BORING NUMBER: WP5-6	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: K. Cogia	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Urban Corer

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		NA	12	Composite	NA	NA	By = 21,000 cpm PID 1.0 ppm
15			12				
16			12				
17			12				
18			6				
	950 7-24-95 405326	NA	6	5YR 6/3 Light Reddish Brown Pudding Like Material Non Plastic Very Moist	NA	NA	By = 25,000 cpm PID 0.0 ppm
19	845 7-24-95 405326	NA	12	Composite	NA	NA	By = 26,000 cpm PID 0.0 ppm
20			12				
21							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GeoTech Invest. Pits 5+6			PROJECT NO.: 10.03.11
BORING NUMBER: WP5-6	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: R Geiger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Ultra Corer

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
		NA	12	Composite	NA	NA	
			12				
			6				
	940 7-24-95 405326	NA	6	5Y 4/1 Dark Gray Pudding Like material No Plastic Very moist	NA	NA	BT = 24000 cpm PID = 10 ppm
				Bottom of Core 24.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

000020

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FEMP

FIELD ACTIVITY LOG

[redacted]

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.:	PAGE 1 OF 1
	10.03_11	
	BADGE NO.: 8365	DATE: 7-24-95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:	
Pit 5 13.14 WP5-7 WP5-7A	Pit 5	
WEATHER CONDITIONS: Partly Cloudy	AIR TEMPERATURE: 90°F	BAROMETRIC PRESSURE (in Hg): 30.01

TIME	DESCRIPTION OF ACTIVITY
930	Set up for Sampling
935	Take Sample 23.5-24 405328
940	Take Composite 19.0-23.5 405328
945	Take Sample 18.5-19.0 405328
950	Take Composite 14.0-~~19.0~~ 18.5 405328
955	Take Sample 13.5-14.0 405328
1000	Take Composite 9.0-13.5 405328
1005	Take Archive 19-24 405329
1010	Take Archive 14-19 405329
1020	Clean up Area

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
microtip	960553	BN	7-24-95	830	Brecks	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME: NA	SERIAL NO.: NA	MFR. NAME: Ludlum	SERIAL NO.: 99745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FS-F-3682 (11-08-94)

G:\WPSC\94-364.DRW

FEMP

LITHOLOGIC LOG

CONTROL NO.:	
PAGE 1 OF 4	
PROJECT NAME: GeoTech Investigation P.TS 5+6	PROJECT NO.: 10.C3.11
BORING NUMBER: WP5-7 #13	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	
GEOLOGIST: R Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-24-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Corer	

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
0		NA	NA	NO Recovery	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-24-95	830
ALPHA	NA →		
BETA / GAMMA	50	7-24-95	830

NOTES: Depths Taken From Waste P.T 5 Beam

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 2 OF 4

PROJECT NAME: Geotech Invest. Pit 5+6	PROJECT NO.: 10.03.11

BORING NUMBER:	COORDINATES:	DRILLING CONTRACTOR:	DRILLER / HELPER:
WP5-7		Wise	NA

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED:
				7-24-95

GEOLOGIST:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED:
K Geiger				7-24-95

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	DRILLING EQUIPMENT:
NA GAL	NA GAL	Visqueen-coran

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
		NA	NA	No Recovery	NA	NA	
	1000 7-24-95 405328	NA	12	Composite	NA	NA	BZ 25000cpm PID = 1.0ppm
			12				
			12				
			12				
			6				
	955 7-24-95 405324	NA	6	~~7-24-95~~ ~~2.5Y~~ 5YR 7/3 Pink with 2.5Y 5/4 Reddish Brown swirls Pudding-like material No plasticity Very Moist	NA	NA	BZ = 27,000cpm PID 0.0ppm

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See 19		
BETA / GAMMA			

NOTES: See 19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

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FEMP

LITHOLOGIC LOG

CONTROL NO.:	PAGE 3 OF 4
PROJECT NAME: Geotech Invest, Pits 5+6	PROJECT NO.: 10.c3.11
BORING NUMBER: WP5-7 d13	COORDINATES:
DRILLING CONTRACTOR:	DRILLER / HELPER: N/A
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	GEOLOGIST: K Geiger
GROUNDWATER LEVEL: / DATE: / TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: N/A GAL	WATER RECOVERED DURING DRILLING: N/A GAL
DRILLING EQUIPMENT: Urban Corer	

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	950 7-24-95 405328	NA	12	Composite	NA	NA	Bz 28,000cpm PID = 1.1 ppm
15			12				
16			12				
17			12				
18			6				
19	945 7-24-95 405328	NA	6	5YR 7/3 pink with some 5YR 5/6 yellowish red swirls puddingy like material NO plasticity very moist	NA	NA	Bz 25,000cpm PID = 1.0 ppm
20	940 7-24-95 405328	NA	12	Composite	NA	NA	Bz 26,000cpm PID = 1.0 ppm
21			12				

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

FEMP

LITHOLOGIC LOG

CONTROL NO.:	PAGE 4 OF 4

PROJECT NAME: Geotech Investi. Pits 5+6	PROJECT NO.: 10.03.11

BORING NUMBER: WP5-7	COORDINATES:	DRILLING CONTRACTOR: Wisl	DRILLER / HELPER: NA

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: K Gregen	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95

WATER USED DURING DRILLING: NA GAL.	WATER RECOVERED DURING DRILLING: NA GAL.	DRILLING EQUIPMENT: Vibra Corer

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
		NA	12	composite	NA	NA	
			12				
			6				
	935 7-24-95 405328	NA	6	5Y 3/2 Dark Olive Gray Puddinglike Material No Plasticity Very moist	NA	NA	Br = 25,000CPM PID = 0.0 ppm
				Bottom of Core 24.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See Pg 1		
BETA / GAMMA			

NOTES: See Pg 1

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

S-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

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FEMP

FIELD ACTIVITY LOG

CONTROL NO.: [redacted]

PROJECT NAME / NO.: 10,03,11

PAGE 1 OF 1

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BADGE NO.: 8365

DATE: 9-24-95

FIELD ACTIVITY SUBJECT: P.T 5 15,16 W15-8 W15-8A

GENERAL LOCATION / FACILITY DESCRIPTION: PIT 5

WEATHER CONDITIONS: Partly Cloudy

AIR TEMPERATURE: 85F

BAROMETRIC PRESSURE (in Hg): 30.01

TIME	DESCRIPTION OF ACTIVITY
1025	Set up for Sampling
1030	Take Sample 23.5-24.0 405330
1035	Take Composite 19-23.5 405330
1040	Take Sample 18.5-19.0 405330
1045	Take Composite 14-18.5 405330
1050	Take Sample 13.5-14 405330
1055	Take Composite 9.0-13.5 405330
1100	Take Archive 19-24 405331
1105	Take Archive 14-19 405331
1110	Take Archive 9-14 405331
1115	Clean Area

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Microtip	960353	BN	9-24-95	830	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME: NA	SERIAL NO.: NA	MFR. NAME: Ludlum	SERIAL NO.: 89945	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FS-F-3682 (05-08-95)

G:\WPSC\95-0081.DRW

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FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 4

PROJECT NAME: Geotechnical Investigation of Pits 5 and 6

PROJECT NO.: 10.03.11

BORING NUMBER: WP5-8 # 15

COORDINATES:

DRILLING CONTRACTOR: Wise

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-24-95

GEOLOGIST: K Geiger

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-24-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Urbaq Corer

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
0		NA	NA	No Recovery	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-24-95	830
ALPHA	NA		
BETA / GAMMA	50		830

NOTES: Depths Taken From Bottom of Waste Pit 5

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

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9/10

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PROJECT NAME: GeoTech Invest. PTS 5+6	PROJECT NO.: 10.03.11
BORING NUMBER: WP5-8	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	
GEOLOGIST: K Gergin	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-24-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Corer	

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		NA	NA	No Recovery	NA	NA	
8							
9	1055 7-24-95 405330	NA	12	Composite	NA	NA	Bz = 27,000 ppm PID 1.0 ppm
10			12				
11			12				
12			12				
13			6				
14	1050 7-24-95 405330	NA	6	2.5Y 4/3 Red with 5Y 8/1 white swirls Pudding Like material with some sand size material No plasticity very moist	NA	NA	Bz = 27,000 ppm PID = 1.0 ppm

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA		Sep 19	
BETA / GAMMA			

NOTES: Sep 19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

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FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 3 OF 4

PROJECT NAME: Geo Tech Invest. Ars 540			PROJECT NO.: 10.0311
BORING NUMBER: WA5-8	COORDINATES:	DRILLING CONTRACTOR: Wiel	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: K Geiger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Vibra Corer

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	1045 7-24-95 405330	NA		Composite	NA	NA	By 24,500 cpm PID = 0.0
		42 KG 7-24-95	12				
15		42 KG 7-24-95	12				
16		42 KG 7-24-95	12				
17		42 KG 7-24-95	12				
18		42 KG 7-24-95	6				
	1040 7-24-95 405330	NA KG 7-24-95	6	5YR 6/1 Gray with some 2.5YR 6/4 Light Reddish Brown swirls pudding like material no plasticity very moist	NA	NA	By 30,000 cpm PID = 1.0 ppm
19	1035 7-24-95 405330	NA	12	Composite	NA	NA	By 30,000 cpm PID ~ 1.0 ppm
20			12				
21							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See 19		
BETA / GAMMA			

NOTES: See 19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 4 OF 4

PROJECT NAME: Geotech Invest. Pty 5+6			PROJECT NO.: 10.03.11
BORING NUMBER: WP5-8	COORDINATES:	DRILLING CONTRACTOR: W.G.L.	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: K Geiger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Vibra Corer

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
21		NA	12	Composite	NA	NA	
22			12				
23			6				
	1030 7-24-95 105330	NA	6	5Y 4/2 Olive Gray Pudding Like material NO Plasticity Very moist	NA	NA	Dr 30,000cpm DID = 1.0 µm
24				Bottom of Core 24.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See 19		
BETA / GAMMA			

NOTES: See 19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

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FEMP
FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NAME / NO.:	PAGE 1 OF 1
[redacted]	10.03.11	
	BADGE NO.: 8365	DATE: 7-24-95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:
P.T 5 17,13 WP5-9 WP5-9A 7-24-95	P.T 5
WEATHER CONDITIONS:	AIR TEMPERATURE: 86°F / BAROMETRIC PRESSURE (In Hg): 30.01

TIME	DESCRIPTION OF ACTIVITY
1115	Set up for Sampling
1120	Take Sample 23.5-24.0 405332
1125	Take Composite 19-23.5 405332
1130	Take Sample 18.5-19.0 405332
1135	Take Composite 14-18.5 405332
1140	Take Sample 13.5-14.0 405332
1142	Take Composite 9.0-13.5 405322
1145	Take Archive 19-24 405333
1150	Take Archive 14-19 405333
1152	Take Archive 11-14 405333
1155	Clean Area

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
microtip	960553	BN	7-24-95	830	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME: NA	SERIAL NO.: NA	MFR. NAME: Ludlum	SERIAL NO.: 84945	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FS-F-3682 (05-08-95)

G:\WPSC\95-0061.DRW

CONTROL NO.:

FEMP
LITHOLOGIC LOG

PROJECT NAME: Geotechnical Investigation Pits 5+6			PROJECT NO.: 10.03.11
BORING NUMBER: WPS-9 #17	COORDINATES:	DRILLING CONTRACTOR: W.S.L	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: K Gergen	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Vibra Corer

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
0		NA	NA	No Recovery	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	KG 7-24-95 50 0.0	7-24-95	830
ALPHA	NA	→	
BETA / GAMMA	50	7-24-95	830

NOTES: Depths Taken From Beam of P.T 5

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PROJECT NAME: GeoTech Invest. Pit 5+6	PROJECT NO.: 10-03,11
BORING NUMBER: WP5-9	COORDINATES:
DRILLING CONTRACTOR: W-E	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	
GEOLOGIST: R Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-24-95	
WATER USED DURING DRILLING: NA GAL.	WATER RECOVERED DURING DRILLING: NA GAL.
DRILLING EQUIPMENT: V. Bac Cover	

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		NA	NA	No Recovery	NA	NA	
8							
9							
	1142 7-24-95 405322	NA	12	Composite	NA	NA	BY 2500 ppm PID = 1.0 ppm
10			12				
11			12				
12			12				
13			6				
	1140 7-24-95 405322	NA	6	10YR 8/1 White Pudding Like material No Plasticity very moist	NA	NA	BY 30,000 ppm PID = 0.0 ppm
14							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Crotch Invest. P.Ts 5+6			PROJECT NO.: 10.03.11
BORING NUMBER: WP5-9	COORDINATES:	DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: K Geiger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Vibra Corer

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	1135 7-24-95 405332	NA	12	Composite	NA	NA	By = 30,000 cpm PID = 1.0 ppm
15			12				
16			17				
17			12				
18			6				
	1130 7-24-95 405332	NA	6	5Y 4/1 Dark Gray with 5Y 7/1 Light Gray and 5YR 7/3 Pink Swirls Pudding like material No plasticity Very moist	NA	NA	By = 30,000 cpm PID 1.0 ppm
19	1125 7-24-95 405332	NA	12	Composite	NA	NA	By 30,000 cpm PID 1.1 ppm
20			12				
21							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See	Pg. 1	
BETA / GAMMA			

NOTES: See pg 1

*. SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GeoTech Invest. P.T.S 5+6

PROJECT NO.: 10.03.11

BORING NUMBER: WP5-9

COORDINATES:

DRILLING CONTRACTOR: Wisl

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-24-95

GEOLOGIST: K Geiger

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-24-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: V.Oke Corer

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
21		NA	12	composite	NA	NA	
22			12				
23			6				
	1120 7-24-95 405332	NA	6	2.5Y N8/ white with some 2.5Y N6/ Gray Pudding Like Material Nonplasticity V. moist	NA	NA	13 > 27,500 cpm RTD = 1.1 ppm
24				Bottom of Core 24.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID	See pg 1		
ALPHA			
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

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FEMP

FIELD ACTIVITY LOG

[redacted]

CONTROL NO.:

PROJECT NAME / NO.:

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BADGE NO.: 8365

DATE: 7-24-95

FIELD ACTIVITY SUBJECT: Pit 5 19,20 WP5-10 WP5-10A

GENERAL LOCATION / FACILITY DESCRIPTION: Pit 5

WEATHER CONDITIONS: Partly Cloudy

AIR TEMPERATURE: 86°F

BAROMETRIC PRESSURE (In Hg): 29.92

TIME	DESCRIPTION OF ACTIVITY
1155	Set up for Sampling
1158	Take Sample 23.5-24 405334
1200	Take Composite 19-23.5 405334
1205	Take Sample 18.5-19.0 405334
1210	Take Composite 18.5-14 405334
1215	Take Sample 13.5-14 405334
1220	Take Composite 9.0-13.5 405334
1225	Take Archive 19-24 405335
1230	Take Archive 14-19 405335
1235	Take Archive 10-14 405335
1240	Clean up Area

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Microtip	960553	BN	7-24-95	830	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
NA	NA	Ludlum	84745	None.

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotechnical Investigation Pits 5+6

PROJECT NO.: 10.03.11

BORING NUMBER: WPS-10 #19

COORDINATES:

DRILLING CONTRACTOR:

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-24-95

GEOLOGIST: K Geiger

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-24-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Vibra-Corer

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
0		NA	NA	NO Recovery	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-24-95	830
ALPHA	NA →		
BETA / GAMMA	50	7-24-95	830

NOTES: Depths Taken From Beam at Pit 5

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotech Invest Pits 5+6	PROJECT NO.: 10.03.11
BORING NUMBER: WP5-10	COORDINATES:
DRILLING CONTRACTOR: Weser	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	GEOLOGIST: K. Geiger
GROUNDWATER LEVEL: / DATE: / TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra-Corer	

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		NA	NA	No Recovery	NA	NA	
8							
9	1220 7-24-95 405334	NA	12	Composite	NA	NA	Bz = 30,000 cpm PID = 1.1 ppm
10			12				
11			12				
12			12				
13			6				
13.5	1215 7-24-95 405334	NA	6	Light Grayish (Teal) Gray (no Munsell match) with some 10YR 5/1 Gray Pudding Like material / No Plasticity Gray Moist	NA	NA	Bz 30,000 cpm PID = 1.1 ppm
14							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See 19		
BETA / GAMMA			

NOTES: See 19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GeoTech Invest. Pits 5+6

PROJECT NO.: 10.03

BORING NUMBER: WPS-10

COORDINATES:

DRILLING CONTRACTOR: Wise

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-24-95

GEOLOGIST: K. Geiger

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-24-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Ubra Corer

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	1210 7-24-95 405334	NA	12	Composite	NA	NA	BY 30,000cpm PID=1.1 ppm
15			12				
16			12				
17			12				
18			6				
	1205 7-24-95 405334	NA	6	2.5Y 4/2 Dark Grayish Brown Pudding Like material NO Plasticity Very moist	NA	NA	BY = 30,000cpm PID = 1.0 ppm
19	1200 7-24-95 405334		12	Composite	NA	NA	BY = 30,000cpm PID = 1.0 ppm
20			12				
21							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See 191		
BETA / GAMMA			

NOTES: See 191

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GeoTech Invest. Pits 5+6	PROJECT NO.: 70.03.11

BORING NUMBER: WP5-10	COORDINATES:	DRILLING CONTRACTOR: Wiser	DRILLER / HELPER: NA

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: K Geisen	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95

WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL	DRILLING EQUIPMENT: Vibra Corer

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
		NA	12		NA	NA	BZ 30,000CPM PID = 1.1ppm
			12				
			6				
	1158 7-24-95 405331	NA	6	5YR 3/1 Very Dark Gray Pudding like material no plasticity Very Moist	NA	NA	BZ 30,000CPM PID = 1.1ppm
				Bottom of Core 29.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	Std 19		
BETA / GAMMA			

NOTES: Std 19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FIELD ACTIVITY LOG

[redacted]

CONTROL NO.:	PROJECT NAME/NO.: 10.03.11	PAGE 1 OF 1
	BADGE NO.: 8365	DATE: 7-24-95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:
P.T 5 #22,23 WA5-11A, WA5-11	P.T 5

WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (in Hg):
	87°F	29.91

TIME	DESCRIPTION OF ACTIVITY
1300	Crane in Position.
1305	Take Sample 22.0-22.5 405336
1310	Take Composite 17.5-22.0 405336
1315	Take Sample 17.0-17.5 405336
1320	Take Composite 12.5-17.0 405336
1325	Take Sample 12.0-12.5 405336
1330	Take Composite 9.5-12.0 405336
1332	Take Archive 23.0-18.0 405337
1335	Take Archive 13.0-18.0 405337
7-24-95 1340	Take Archive 8-13 405337
1345	Clean Up Zone

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
microtip	940553	BN	7-24-95	830	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
NA	NA	Ludlum	59745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 4

PROJECT NAME: Geotechnical Investigation of Waste Pits 5+6

PROJECT NO.: 10.03.11

BORING NUMBER: WP5-11 ≈ 22

COORDINATES:

DRILLING CONTRACTOR: Wise

DRILLER / HELPER:

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-24-95

GEOLOGIST: K Geiger

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-24-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: U. bag-Corer

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
0		NA	NA	No Recovery	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	3.0	7-24-95	830
ALPHA	NA	→	→
BETA / GAMMA	50	7-24-95	830

NOTES: Depths Taken From Bottom of Pit 5

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 2 OF 4

PROJECT NAME: Geo Tech Invest. P.Tg 5+6			PROJECT NO.: 10.03.11
BORING NUMBER: WP5-11 #13	COORDINATES:	DRILLING CONTRACTOR: WISE	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: K Gerger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Ubra Corer

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
1		NA	NA	NO Recovery	NA	NA	
5							
7							
9.5	1330 7-24-95 405336	NA	6	Composite	NA	NA	By 25,000 cpm PID = 0.0 ppm
10			12				
11			12				
12	1325 7-24-95 405334	NA	6	5YR 8/4 Pink with 5YR 6/1 Light Gray swirls Pudding like material NO Plasticity very moist	NA	NA	By 25,000 PID = 0.0 ppm
	1320 7-24-95 405336	NA	6	Composite	NA	NA	By = 25000 PID = 0.0 ppm
13			12				
14							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotech Invest. 1.TS 5+6	PROJECT NO.: 10.03.11
BORING NUMBER: WP5-11	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: DATE: TIME:
DATE STARTED: 7-24-95	
GEOLOGIST: K Geisin	GROUNDWATER LEVEL: DATE: TIME:
DATE COMPLETED: 7-24-95	
WATER USED DURING DRILLING: N.A GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT:	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (Inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (T&F)	REMARKS
14		NA	12	Composite	NA	NA	
15			12				
16			12				
17	1315 7-24-95 405336	NA 6 blows	6	5YR 4/2 Dark Reddish Gray Pudding Like Material NO Plasticity Very moist	NA	NA	Bz = 20,000cpm PID = 1.1 ppm
18	1310 7-24-95 405334	NA	6	Composite	NA	NA	Bz = 27,000cpm PID = 1.0ppm
			12				
19			12				
20			12				
21							

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GroTech Invest. Pits 5+6	PROJECT NO.: 10.03.11
BORING NUMBER: WP5-11	COORDINATES:
DRILLING CONTRACTOR: Weisel	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	
GEOLOGIST: K Gilgin	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-24-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Core	

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
1		NA	12	Composite	NA	NA	
2	1305 7-24-95 405736	NA	6	10YR 3/1 Very Dark Gray pudding like material NO Plasticity, Very moist	NA	NA	BZ = 29,000cpm BIO = 1.0ppm
22.5				Bottom of Core 22.5 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	Sep 19		
BETA / GAMMA			

NOTES: Sep 19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.:	PAGE 1 OF 236
[redacted]	10.03.11	
	BADGE NO.: 8365	DATE: 7-24-95

FIELD ACTIVITY SUBJECT:	TION / FACILITY DESCRIPTION:
P.T5 24,25 WP5-12 WP5-12A	P.T5

WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (in Hg):
Partly Cloudy	87°F	29.41

TIME	DESCRIPTION OF ACTIVITY
1350	Begin To Set up for Sampling
1355	Take Sample 15.5-16 405338
1358	Take Composite 11-15.5 405338
1400	Take Sample 10.5-11.0 405338
1405	Take Composite 8.0-10.5 405338
1410	Take Archive 13.0-18.0 405339
1415	Take Archive 8.0-13.0 405339
1420	Clean Up Area

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Microtip	960553	BN	830	7-24-95	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
NA	NA	Ludlum	89745	NONE

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FS-F-3682 (11-08-94)

G:\WPSC\94-364.DRW

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 3

PROJECT NAME: Geotechnical Investigation of Pits 5 & 6	PROJECT NO.: 10.03.11
BORING NUMBER: WP5-12 #35	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-24-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: U.Sag Corer	

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
0		NA	NA	No Recovery	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-24-95	830
ALPHA	NA →		
BETA / GAMMA	50	7-24-95	830

NOTES: Depths are from the Base of waste P.T 5

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

PROJECT NAME: GeoTech Invest. Pits 5+6	PROJECT NO.: 10.03.11
BORING NUMBER: WP5-12	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	GEOLOGIST: K Geiger
GROUNDWATER LEVEL: / DATE: / TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Urba Corer	

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
		NA	NA	No Recovery	NA	NA	
	1405 7-24-95 405338	NA	12	Composite	NA	NA	By=29,000 cpm PID=1.1 ppm
			12				
			6				
	1400 7-24-95 405338	NA	6	Dk Gray Pudding like material No Plasticity Very Moist	NA	NA	By 30,000 cpm PID 1.0 ppm
	1358 7-24-95 405338	NA	12	Composite	NA	NA	By 25,000 cpm PID = 0.0 ppm
			12				
			12				

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See p91		
BETA / GAMMA			

NOTES: See p91

SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: Geotech Invest. PTS 546	PROJECT NO.: 10.03.11
BORING NUMBER: WP5-12	COORDINATES:
DRILLING CONTRACTOR: Wilde	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	
GEOLOGIST: K. Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-24-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Urban-Corer	

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		NA	12	Composite	NA	NA	
15			6				
16	1355 7-24-95 405338		6	10YR 3/1 Very Dark Gray Pudding Like Material, No Plasticity, Very Moist	NA	NA	BY 30,000 PID = 0.0
				Bottom of Core 16.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See 19		
BETA / GAMMA			

NOTES: See 19

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NO. / RI/FS WBS NO.:	PAGE 1 OF 1
[redacted]	10.03.11	
	BADGE NO.: 8365	DATE: 7/24-95

FIELD ACTIVITY SUBJECT:	LOCATION / FACILITY DESCRIPTION:
P.T 5 26,27 WP5-13A, WP5-13	P.T 5

WEATHER CONDITIONS:	AIR TEMPERATURE:	BAROMETRIC PRESSURE (in Hg):
Partly Cloudy	87.F	29.91

TIME	DESCRIPTION OF ACTIVITY
1425	Set up for Sampling
1430	Take Sample 13.5-14.0 405340
1435	Take Composite 9-13.5 405340
1440	Take Archive 9-14 405341
1445	Take Archive 6-9 405341
1450	Clean Up Area

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
microtip	960553	BN	8-30	7-24-95	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
NA	NA	Ludlum	87745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 2

PROJECT NAME: Geotechnical Investigation Waste Pits 5+6			PROJECT NO.: 10.03.11
BORING NUMBER: WP5-13	COORDINATES:	DRILLING CONTRACTOR: Weiser	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: K Geiger	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Vibra-Corer

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
0		NA	NA	NO Recovery	NA	NA	
1							
2							
3							
4							
5							
6							
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-24-95	830
ALPHA	NA →		
BETA / GAMMA	50	7-24-95	830

NOTES: Depths Taken From Bottom of Pit 5

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME: GeoTech Invest: P.T 5+6

PROJECT NO.: 16.03.11

BORING NUMBER: ~~WP~~ WP5-13 a24

COORDINATES:

DRILLING CONTRACTOR: Wise

DRILLER / HELPER: NA

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME:

DATE STARTED: 7-24-95

GEOLOGIST: K Corigan

GROUNDWATER LEVEL: DATE: TIME:

DATE COMPLETED: 7-24-95

WATER USED DURING DRILLING: NA GAL

WATER RECOVERED DURING DRILLING: NA GAL

DRILLING EQUIPMENT: Vibra Corer

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
				No Recovery			
	1435 7-24-95 405340	NA	12	Composite	NA	NA	BY = 30,000 cpm PID = 0.0 ppm
			12				
			12				
			12				
			6				
	1430 7-24-95 405340	NA	6	5Y 4/1 Dark Gray with white + tan mottling pudding like material, no plasticity, fully moist	NA	NA	BY 25000 cpm PID = 1.1 ppm

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See pg 1		
BETA / GAMMA			

NOTES: Bottom of Core 14.0 Feet

See pg 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

000302

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FIELD ACTIVITY LOG

CONTROL NO.:	PROJECT NO. / RI/ S WBS NO.:	PAGE 1 OF 1
[redacted]	10.03.11	
	BADGE NO.: 8365	DATE: 7-24-95

FIELD ACTIVITY SUBJECT:	GENERAL LOCATION / FACILITY DESCRIPTION:	
Pit 5 28,24 WP5-14A, WP5-14	Pit 5	
WEATHER CONDITIONS: Partly Cloudy	AIR TEMPERATURE: 87°F	BAROMETRIC PRESSURE (in Hg): 29.91

TIME	DESCRIPTION OF ACTIVITY
1500	Set up for Sampling
1505	Take Sample 15.5-16 405342
1510	Take Composite 11-15.5 405342
1515	Take Sample 10.5-11.0 405342
1520	Take Composite 6-10.5 405342
1525	Take Archive 12-17 405343
1530	Take Archive 8-12 405343
1540	Clean up Area

METER CALIBRATION

WATER QUALITY METER

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	STD. SOLN. MFR.:	STD. SOLN. LOT NO.:	STD. SOLN. EXP. DATE:
NA							

PHOTOIONIZATION DETECTOR

MFR. NAME:	SERIAL NO.:	INITIALS:	DATE:	TIME:	CAL. GAS MFR.:	CAL. GAS TYPE:	CAL. GAS CONC.:	ppm:	PROBE eV:
Photovac	960553	BN	7-24-95	830	Spec Gas	Isobutylene	100 ppm	100	10.2

ALPHA METER		BETA GAMMA METER		CALIBRATION PROBLEMS:
MFR. NAME:	SERIAL NO.:	MFR. NAME:	SERIAL NO.:	
NA	NA	Ludlum	84745	None

VISITORS		TIME	
NAME(S)	ORGANIZATION(S)	ARRIVED	DEPARTED

FS-F-3682 (11-08-94)

G:\WPSC\94-364.DRW

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FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 OF 3

PROJECT NAME: Geotechnical Investigation of Pits 5+6	PROJECT NO.: 10.03.11
BORING NUMBER: WP5-14 #79	COORDINATES:
DRILLING CONTRACTOR: Wise	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	
GEOLOGIST: K Colegrove	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-24-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Urna-Corm	

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
0		NA	NA	No Recovery	NA	NA	
1							
2							
3							
4							
5							
6	1520 7-24-95 405342	NA	12	Composite	NA	NA	BZ 30,000 PID = 0.0
7							

INSTRUMENT	BACKGROUND	DATE	TIME
PID	0.0	7-24-95	830
ALPHA	NA	→	→
BETA / GAMMA	50	7-24-95	830

NOTES: Drilling Taken from Berm at Pit 5

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

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LITHOLOGIC LOG

CONTROL NO.:

PAGE 2 OF 3

PROJECT NAME: GeoTech Invest, Lots 5 + 6	PROJECT NO.: 10.03.11
BORING NUMBER: WPS-14	COORDINATES:
DRILLING CONTRACTOR: Wizl	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL: / DATE: / TIME:
DATE STARTED: 7-24-95	
GEOLOGIST: K Geiger	GROUNDWATER LEVEL: / DATE: / TIME:
DATE COMPLETED: 7-24-95	
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
DRILLING EQUIPMENT: Vibra Corer	

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
		NA	12	Composite	NA	NA	
			12				
			12				
			6				
	1515 7-24-95 405342	NA	6	5Y 5/1 Gray with 2.5YR 4/6 Red Swirls with some sand size material, Mudding like material No Plasticity, Very moist	NA	NA	BZ = 25,000 cpm PID = 1.0 ppm
	1510 7-24-95 405342	NA	12	Composite	NA	NA	BZ = 27,000 cpm PID = 0.0 ppm
			12				
			12				

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See 191		
BETA / GAMMA			

NOTES: See 191

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

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FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 3 OF 3

PROJECT NAME: Geotech Invest. Pits 5+6			PROJECT NO.: 10.03.11
BORING NUMBER: WPS-14	COORDINATES:	DRILLING CONTRACTOR:	DRILLER / HELPER: NA
SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED: 7-24-95
GEOLOGIST: K Gilgan	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED: 7-24-95
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL		DRILLING EQUIPMENT: Vibra Corer

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		NA	12	composite	NA	NA	
15			6				
	1505 7-24-95 405342	NA	6	5Y 3/2 Dark Olive Gray with 5Y 8/1 white swirls pudding like material No plasticity Very moist	NA	NA	BY 25,000 ppm PID = 0.0
16				Bottom of core 16.0 Feet			

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA	See 19 1		
BETA / GAMMA			

NOTES: See 19 1

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

APPENDIX C

SUMMARY OF FIELD OBSERVATIONS FROM WET TRENCHING

APPENDIX C
SUMMARY OF FIELD OBSERVATIONS FROM WET TRENCHING

C.1 INTRODUCTION

A total of seven wet (not dewatered prior to excavation) trenches have been excavated in Pits 1, 2 and 3 as part of DEEP for the purpose of evaluating conditions of the waste, and to provide information about dewatering and/or excavating a wet waste. A John Deere 690D LC tracked excavator (track hoe) was used to perform test excavations at seven locations at Pits 1, 2 and 3 (see Figure 2-2). FERMCO conducted the trenching from February 1 through March 14, 1995.

C.2 GENERAL

The trenches were conducted, using the track hoe, at seven locations that had a prior CPT sounding and a geotechnical test boring. The excavation site was prepared for spoil piles prior to the excavation. Plastic sheets were placed on the ground surface in the vicinity of the location to collect and direct drainage from the spoil pile back to the trench. A temporary berm around the perimeter of the spoil pile areas was formed using hay bails and plastic sheets. The trench was dug between two spoil pile areas. One spoil pile was for the cover material and the other for the waste. Water tanks (3,000 - 8,000 gallon capacity) at the excavation location collected water that was pumped from the trench with portable dewatering pumps.

Excavation proceeded by creating a rectangular trench about 30 inches wide, 0.79 cy heaped bucket, and 5 feet total. The length of the trenches was about 20 to 25 feet. The long axis of the trench ran along a general north-south line, with the track hoe positioned at the north end of the trench. Excavation was done so the trench wall slope remained as steep as possible, permitting observation of trench sidewall failure. The backhoe achieved its full reach (excavated depth of 15 feet). As the trench wall material collapsed into the trench, it was excavated from the Pit and placed on the spoil pile. The final width of the trench at ground surface varied from location to location, depending on the amount of sidewall failure. A field engineer recorded observations during the excavation.

During the trenching, a FERMCO sampling technician collected samples of the waste materials, taken at various depths from each trench, directly from the track hoe bucket, prior to its placement on the spoil pile. Additional material samples were collected from the waste spoil pile prior to backfilling the material into the trench. A 5-gallon plastic bucket of waste material was collected from each trench. The samples were transferred to an on-site geotechnical laboratory for moisture content tests, classification, compaction, and bearing ratio tests. The geotechnical laboratory only reported compaction test results. The results of these geotechnical tests are not available. Additionally, waste material from each of the trenches was archived in white steel boxes for future testing by FERMCO.

FERMCO videotaped excavation operations at each location. The cameraman was positioned above the trench location with a four-wheel drive man-lift.

When the trench was completed, material from the waste spoil pile was backfilled into the trench and covered with material from the cover spoil pile.

The following subsections summarize field observation notes completed by the field engineers during trenching operations.

C.3 Pit 1 Trenches

Trench ID: T1-N

Location: North end of Pit 1, at stake #11352

Field Engineer: K. Ernst

Long Axis of Trench: North-South

Corresponding CPT and Test Boring:

CPT ID:	C1-2
Test Boring ID:	11352

Corresponding Video Number: Trench #2

Date/Time of Trenching:

February 13, 1995	
Excavation start time:	1416
Excavation end time:	1509
Backfill start time:	1510
Backfill end time:	1545

Weather Conditions:

At 1002: Cold, Temperature approx. 10 degrees F, sunny and clear. Ground surface is frozen, with about 2 - 4" of snow cover.

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the track hoe stick.

Depth (feet)	Description
0 -1	yellow-brown clay (cover)
1	gray material encountered (waste)
1 - 3	gray and reddish earthen material, dry
3 - 4	reddish gray, coarse, sand-like material; reddish, gray and some black clayey sand. The gray coarse granular material was "jelly-like", but runny (flowable). The reddish granular material was wet. Black material was sandy, drier.
4	reddish gray, with some black material, dry to moist. Track hoe bucket makes vertical sides of trench smooth, slickensided. (Note: At the end of the excavation, the east trench wall collapsed creating a bowl that undercut the 1 foot thick clay cap, exposing alternating layers of gray, brown, black, and red material varying from about 2" to 1 foot thick directly beneath the cover. The layers dipped to the north at an angle of about 30 degrees.)
5	spots of white material in waste
6 - 7	red and gray material which is somewhat "ice-cream" like in appearance. The gray material is clay-like and behaves like jelly when troweled in the plastic sample bucket. Some sand is present. Water comes to top of bucket when agitated.

7.5	red, gray clay-like, "ice-cream like material. Material transported in track hoe bucket bounces in jelly-like fashion.
9 - 10	Mostly red, clay-like material, pockets of green granular material, wet. Green grains look like coarse subangular sand, 1/16" to 1/8" max. Brown clay-like material is present. White, soupy, granule, non plastic material also present. Some of the white material was "jelly-like".
10 - 11	White, grayish sludge pockets encountered in the mostly red, clay-like material. Gray, runny, soupy, sludge-like material, wet. Some, black, green yellow and gray material. Yellow material was flakes, sandy and wet. Black material was sandy.
12 - 14	Sandy material, primarily brownish gray sandy material. Sand is coarse grained, moist, with tints of pink color. Sand is surrounded by clay-like material. Some orange clay-like material, and some greenish yellow material.

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
1418	1	Track hoe operator digging off cover material, creating trench about 2 bucket widths wide
1420	1 - 3	Reddish gray material angle of repose on waste spoil pile 35 - 40 degrees
1425		Trench is "dry" (no standing water)
1428	4	Trench side slopes vertical, track hoe bucket makes sides of trenches smooth, slickensided
1432	5	Angle of repose of waste spoil pile 35 -40 degrees. Operator in the man-lift observed a soft pocket zone in the trench from depth of about 3 to 6.5 ft below land surface that was slowly caving in while digging.
1444	8	Trench slopes still vertical. Material in track hoe bucket bounces as if "jelly-like"

1455	11-12	Collapse of north and east trench walls, creating a bowl that undercuts the overlying material. Top of the undercut is at 5 feet
1507	13-14	Trench walls of waste material rapidly slough into the trench, creating a large bowl that undercuts overlying materials on the east and west sides of the trench. The zone of undercut extends horizontally about 3 feet from the plane of previously near vertical face at each side of the trench. The waste material that caved from the trench walls broke cleanly from the (frozen) clay cover along the cover/waste interface, leaving a 1 foot shelf of frozen ground.
1510	13-14	The maximum depth before the cave-in at 1507 was about 13 - 14 feet. No standing water was observed in the trench. The size of the trench at the ground surface before the cave-in was about 6 feet wide by 25 feet long. After the cave-in, the northern portion of the trench had a width at ground surface of about 12 feet
1535		During backfilling: the backfilled material behaves (jiggles) like jello when the track hoe operator smoothes the waste material filled into the trench at waste final grade
1541		At completion of backfilling: after the (clay) cover material is placed over the waste in the backfilled trench, the ground surface behaves (jiggles) like jello when tamped with the hoe bucket

Trench ID: T1-S

Location: South end of Pit 1

Field Engineer: B. Catanach

Corresponding CPT and Test Boring:

CPT ID: C1-4
Test Boring ID: 11353

Corresponding Video Number: Trench #6

Date/Time of Trenching:

March 15, 1995
Excavation start time: 0905
Excavation end time: 1045

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the track hoe stick.

Depth (feet)	Description
0 - 1	brown and gray cover material. Small amounts of wood and metal debris
2 -3	same as above, more metal debris
4	brown silt material with concrete and steel debris
5	gray material, light brown material, plastic. No more construction debris. (Water begins to seep rapidly into the trench)
6	black sludge material
7-8	dark gray material, plastic, jello consistency (Water level in trench at 5 ft depth)
9	same as above
11-12	gray material with some light blue, dry looking material (Water pumped down to 10 ft depth)
14	same above
15	light brown plastic material, and light gray material

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
0905		Start trenching
0925	5	Water starts to rapidly seep in
0934	7-8	Standing water level in trench at 5 feet depth, right face of trench sloughs into trench
0940	9	Right face of trench collapses again
0950	9	Started pumping water, stopped excavating
0955	9	Filled 1800 gallons into a 2,500 gallon tank
0958	10	Restarted excavating, right face collapse again. Trench width about 9 feet at ground surface
1008	11 - 12	Left face still holding, only minor sloughing. Water level pumped down to 10 feet
1020	12 - 13	Stopped pumping. 8000 gallons pumped, water level in trench 10 feet

C.4 Pit 2 Trenches

Trench ID: T2-N

Location: North end of Pit 2, at stake #11358

Field Engineer: K. Ernst

Long Axis of Trench: North-South

Corresponding CPT and Test Boring:

CPT ID:	C2-1
Test Boring ID:	11358

Corresponding Video Number: Trench #1

Date/Time of Trenching:

February 1 - 2, 1995

Excavation start time:	1405 (February 1)
Excavation end time:	1541 (February 1)
Backfill start time:	1100 (February 2)
Backfill end time:	1715 (February 2)

Weather Conditions:

February 1 at 1245: Sunny with some clouds, temperature about 38 degrees F, snow on ground

February 2 at 1740: Overcast, temperature about 36 degrees F, ground partially covered with snow, snow melting, slush and puddles on ground, ground extremely wet.

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the track hoe stick.

Depth (feet)	Description
0 - 1.5	brown to yellow brown silt and clay, grass and roots, dry to moist. (Water beginnings to seep in to the trench at depth 1.5 feet)
1.5 - 2	grayish brown soil
2 - 2.5	encounter concrete rubble
2.5 - 3	"brick-red," white and black material

3 - 6	red clay-like material, wire (2 to 5' long typical), porous slag (3 to 4" pieces, black, lava-like, 1/16 to 1/8" pores; typical; floating on water surface), black siding material, metal straps, metal buckets (10-gal typical), construction debris, concrete rubble
6 - 8	clay, brown with gray streaks, with brown, grayish brown and gray sand and gravel, very wet. Gravel is round (larger gravel) to subangular (smaller gravel), size is 1/8" to about 2.5", red and black gravel also present. Rock (3 to 5" diameter), possibly concrete rubble. Some metal, flat 1" wide by 10" long, typical. 3' x 3' x 1' piece of flat concrete excavated (water surface at depth 6 - 7 feet)
8 - 11	brown, with "brick-red" and black clay like material, wet to very wet. Track hoe bucket scraping sound at 11 feet while excavating south end of trench, possibly large piece of concrete rubble. Gray clayey gravel-like material, 1 to 2", rounded.
11 - 13	stratified white, light greenish gray, reddish brown and tan fine-grained material, some rust colored material, low to medium plasticity, moist. Material is putty- or paste-like, very spreadable. Some material possibly lime sludge (water surface at depth 7 - 8 feet)
13 - 17	same as above, some black and burnt orange material, moist. Reddish brown material is very fine-grained, appears paste-, putty-like, and breaks into chunks along discrete lines. Lard-like white to light green tinted material. Also contains brown coarse sand to fine gravel (1/8" typical), round to subangular. Burnt orange material, approx 2" x 2" porous, friable. 18" x 18" x 1/4" to 1/8" black, hard tar-like sheet.

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
1405	(Feb 1)	Start trenching
1412		Track hoe operator excavating cover materials to start a rectangular trench, about 15 - 17 feet long, and two bucket widths (about 5 - 6 feet) wide

1413	1.5	Water begins to seep in at east side of trench at 1.5 feet
1415	3	Water also observed seeping into trench from a level of about 3 feet
1419	4	Predominantly red clay-like material is excavated. Excavated materials in the hoe buckets come from the trench as pieces, or blocks of earthen-like materials
1422	5	Length of trench (north - south) at surface 15 - 20 feet; width 5 feet; side slopes (east and west) are vertical
1425	5 - 6	water seeping into trench from above
1430	6 - 7	angle of repose of waste pile about 35 degrees
1434	7 - 8	waste material in bucket slides easily from hoe bucket into white metal box
1435	7 - 8	Water surface in trench at about 6 foot depth, trench walls vertical
1454	7 - 8	Waste material placed on the spoil pile is very wet, causes pile to slump to about 30 degree angle of repose. Water level in trench is relatively constant at 6 - 7 foot depth
1510	11 - 13	Stratified waste material appears chalky and blocked in hoe bucket; material heaped high (2 feet) in bucket excavated from below water surface in trench. Material sticks slightly to hoe bucket, as operator has to move bucket up and down to remove material.
1525	13 - 17	Stratified waste material breaks from hoe bucket in blocks.
1541	17	Stopped digging trench
1553		Condition of trench: Length 26 - 27 feet, width about 5 feet at ground surface, about 17 feet deep. Standing

	water in trench at about 6 feet below land surface. Water in the trench is brown and murky. Trench walls (that are visible above the standing water level) are vertical, and generally composed of brown to grayish brown clay. Just above the water surface there appeared to be some undercutting, but the extent could not be determined due to murky, brown water. Conditions of the trench below the water level can not be seen.
1623	Other observations: little water drained from the waste material after it was piled on the spoil pile. (Note: standing water in the hoe bucket was drained into the trench prior to placing the bucket load on the pile.) Some water puddled on the plastic sheet in the vicinity of where the waste was piled, but there was no flow or streams of water back into the open trench. Wetter waste material from depths of about 12 - 15 feet slumped more when placed on the top of the waste pile (est. angle of repose of the waste pile: 20 degrees)
1000 (Feb 2)	Condition of trench: Water level in trench about 0.5 to 1 foot below land surface. Surface water runoff from snow melt into the trench (which is located along a drainage swale) contributes to the standing water in the trench
1115	Started pumping water from trench to tank
1125	500 gallons of water in tank (pumping rate approx. 50 gpm)
1129	Water level in trench about 1.3' below land surface; 750 gallons of water in tank
1135	1000 gallons of water in tank (pumping rate approx 50 gpm)
1139	Water level in trench 1.8' below land surface; 1250 gallons of water in tank

1144	Water level in trench 2.1' below land surface; 1500 gallons in tank
1149	Water level in trench 2.5' below land surface; 1750 gallons of water in tank
1155	Water level in trench 2.8' below land surface; 2000 gallons of water in tank
1205	Stopped pumping, tank near capacity. Water level in trench about 3' below land surface; 2600 gallons of water in tank
1213	Track hoe operator backfilling trench
1220	About 1/2 of the waste spoil pile backfilled into trench. Water in trench displaced; water level 0.25 to 0.5 feet below land surface
1618	Construction personnel position an additional 2500 gallon capacity tank near the trench
1619	Trench condition: water level at or near land surface. Pieces of porous slag floating on the water surface cover about 50 percent of the water surface area of the trench
1620	Pump started, pumping to tank. Trench collecting surface water runoff from snow melting. Drainage is entering the trench from the northwest. Hoe operator builds berm at the north end of the trench to minimize in flow.
1630	Track hoe operator backfilling during pumping
1650	Approximately 1500 gallons in tank
1704	Pump stopped. Approximately 2200 gallons pumped to tank (Total pumped from trench to two tanks: approximately 4800 gallons)

1708	Backfilling complete, operator grading surface with hoe bucket

Trench ID: T2-S

Location: South end of Pit 2

Field Engineer: B. Catanach

Corresponding CPT and Test Boring:

CPT ID: C2-5
Test Boring ID: 11359

Corresponding Video Number: Trench #7

Date/Time of Trenching:

March 16, 1995
Excavation start time: 1018
Excavation end time: 1152
Backfill start time: 1152
Backfill end time: 1230

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the track hoe stick.

Depth (feet)	Description
0 - 1	brown to light brown clayey silt
1 - 2	mainly brown material, some plasticity

2 - 3	mainly light brown/red material, plastic small amounts of gray powdery material. Excavated two round crucibles that could not be crushed with hoe bucket.
3 - 4	light red clay-like material, very plastic. Small amounts of white material mixed in. A lot of cast iron crucibles.
4 - 7	light red and tan material, very plastic (no water infiltration into trench)
7 - 9	same as above
9 - 11	light tan and red material, very plastic, "pudding-like (no water infiltration into trench)
11 - 14	same as above (small amount of water trickling into trench from 4 - 5 feet below land surface)
14 - 16	dark brown material

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
1018		Start excavation
1028	3	Trench walls holding vertical
1033	4	Trench walls holding vertical
1055	6 - 7	Trench walls holding vertical. No water infiltration
1102	8 - 9	Trench walls vertical.
1109	10 - 11	Trench walls vertical. No water infiltration
1125	13	Major collapse of right trench face
1140	14	Small amount of water trickling in at 4 - 5' depth below ground level

1143	15 -16	Left face of trench cave in
1152		Started backfilling
1230		Backfilling complete

C.5 Pit 3 Trenches

Trench ID: T3-N

Location: North end of Pit 3, between stakes #11360 and C3-9

Field Engineer: K. Ernst

Long Axis of Trench: North-South

Corresponding CPT and Test Boring:

CPT ID: C3-9
Test Boring ID: 11360

Corresponding Video Number: Trench #3

Date/Time of Trenching:

February 16, 1995
Excavation start time: 1034
Excavation end time: 1208
Backfill start time: 1450
Backfill end time: 1525

Weather Conditions:

At 1000: Overcast, temperature about 35 degrees F, puddles and some patches of snow on the ground

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the track hoe stick.

Depth (feet)	Description
0 - 1	yellow brown clay, 2" x 8" X 5' piece of lumber
1 - 3	black ash, dry to moist; many wood (lumber) debris, 1/2" to 3/4" thick, up to a few feet long, wood pallet debris (water level encountered 2 to 3' below land surface)
3 - 5	black or gray ash-like material with wood and metal debris; wood is lumber ranging in a few inches to several feet in length; typical thickness of lumber: 1" to 4 - 6".
5 - 6	brown clay with coarse sand and fine to coarse gravel (2 - 3" max.). Ash and wood debris. The east side of the trench (observed to about 6 ft depth) generally had alternating layers of clay and ash dipping to the south. The west side of the trench had crossed lumber stacked, and protruding at the trench wall.
6 - 10	brown gravelly, sandy clay, medium plasticity, wet. Gravel is fine to coarse (2 - 3" max.), subround to round, sand is fine to coarse. (water surface in trench at 4.5 feet below land surface)
10 - 13	Stratified "rust"-red, orange, white fine-grained material, some light to dark gray material. White material has a yellowish or greenish tint
13 - 15	same as above
15 - 17	same as above, red material layers are plastic, clay-like; gray layers are "jelly"-like.
17 - 18	same as above, white material is paste-like

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
1034		Start excavation
1038	2 - 3	Encountered groundwater level, trench side slopes are stable
1041	3	Standing water in trench, water black and murky
1044	4	West side of cover material falls into trench while digging; east side of trench vertical
1050	5	Water draining from waste pile (containing ash and lumber) back into trench
1103	6	Water level in trench about 3' below land surface
1130	10	Started pumping water from trench to tank (approx 8000 gal. capacity). Water level in trench about 4.5 feet below land surface
1137	15	Tank approx. 1/2 full (approx. 4000 gallons). Water level in trench at about 6 feet below land surface.
1159	17	Stratified waste material is "blocky", i.e. breaks into blocks when placed with the hoe bucket on the spoil pile. A block sitting on the pile was observed to break apart under it's own weight
1207	18	Stopped pumping from trench. Tank approx 5/8 full (approx 5000 gal). (Note: pumping was stopped from about 1140 to 1202 to clear clogged strainer valve). Standing water in trench at about 6 feet below land surface. Trench, at ground level is about 18 feet long, and 6 feet wide at south end; 9 - 10 feet wide at north end.

1440	Water level in trench about 4 feet below land surface. Pumping to tank started.
1450	Water level in trench at about 6.5 feet below land surface. Water observed pouring into the trench along a horizonal line along the north trench face at depth 5.5 feet. Bowled cave in at about depth 4 feet along east and south face of trench at south end. Bowled area is in black ash material, and extends below the water surface.
1456	Stopped pumping, tank full (appox. 7500 gal.) Water level in trench is about 6.5 feet
1457	Start backfilling trench
1525	Water level in trench at about depth 4 feet due to backfilling. Stopped backfilling.
1525	Started gravity drain of tank into trench
1528	Stopped gravity drain
1535	Started pumping water from tank into trench
1545	Water level in tank about 1/2 full (about 3500 gallons of water pumped). Water surface in trench is steady, about 3 - 4 feet below land surface.
1614	Pump looses suction. About 6700 gallons, total pumped into trench. Water level in trench about 3 - 4 feet below land surface. Recommence backfilling trench.
1622	Backfilling complete.

Trench ID: T3-C

Location: Central part of Pit 3

Field Engineer: B. Catanach

Corresponding CPT and Test Boring:

CPT ID: C3-11
Test Boring ID: 11361

Corresponding Video Number: Trench #5

Date/Time of Trenching:

March 14, 1995
Excavation start time: 0925
Excavation end time: 1045
Backfill start time: 1055
Backfill end time: 1125

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the track hoe stick.

Depth (feet)	Description
0 - 1	brown clayey silt with small amounts of black ash
1 - 3	black ash
3 - 4	mostly black ash, small amounts of olive brown silt
4 - 9	mostly black ash
9 - 11	black ash, small amounts of red pudding-like material
11 - 13	black ash, pudding like, with coarse consistency, saturated, with free liquids
13 - 15	red pudding-like material

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
0925		Start excavation
0935	4	Ash material is sloughing in off trench sidewalls. Waste (ash) stockpile angle of repose 1 to 1.
0945	5	Trench sidewalls sloughing off, left face sloughs into trench
0950	6	Right face of excavation sloughed into trench. Trench about 9 feet wide at top
1005	11	Trench at surface about 9 feet wide, trench sidewall holding
1010	13	Both trench sidewalls cave in, the excavation is 15 feet wide at ground surface. Black ash is saturated with free liquids
1055		Start backfilling trench
1125		Complete backfilling trench

Trench ID: T3-S

Location: South end of Pit 3, at stake C3-2

Field Engineer: K. Ernst

Long Axis of Trench: North, North-East

Corresponding CPT and Test Boring:

CPT ID: C3-2
Test Boring ID: 11362

Corresponding Video Number: Trench #4

Date/Time of Trenching:

February 22, 1995
Excavation start time: 1006
Excavation end time: 1111
Backfill start time: 1136
Backfill end time: 1215

Weather Conditions:

At 0907: Sunny, temperature about 31 degrees F, ground is free of snow cover,

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the track hoe stick.

Depth (feet)	Description
0 - 1.5	yellowish brown clay, moist
1.5 -2	black ash, moist
2 - 3	black ash and brown clay, moist. Some "brick"-red clay-like material
3 - 5	brown and gray sandy clay material with black sandy ash, moist to wet
5 - 6	grayish brown sandy clay and sandy ash, wet
6 - 7	gray and brown sandy clay, wet
7 - 7.5	same as above, with some black ash
7.5 - 8	black ash

8 - 9.5	brown sandy clay, moist to wet
9.5 - 14	red, tan, white, gray, brown, black stratified material. Materials, except white and black materials are paste-like. White and black material are granular (fine to medium sand)
14 - 18	same as above. "Brick"-red material is soft, fine-grained, paste-like and wet. Bright white material is granular (fine to medium sand). Tan-white material is more paste-like, moist. Material is generally stratified (layer thickness 1 inch typical), however layers thinner than 1/4" are present (1/8", 1/16" typical, often the black granular material)

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
1006		Start excavation
1009	1	Angle of repose of cover material (clay, moist) spoil pile approx. 40 degrees
1015	5	Angle of repose waste spoil pile material (sandy clay and ash, wet) approx. 25 degrees
1022	6	Grayish brown sandy clay and sandy ash sticks somewhat to hoe bucket
1035	11	Cave in of west trench wall, west side wall vertical, creating "D" shaped trench perimeter at the ground surface. Exposed face of east trench shows stratigraphy of clay and ash cover: alternating layers of clay and ash.
1044	13	Upper part (cover material) of the west trench wall falls into the trench, creating an approximately oval shaped trench perimeter at ground surface (about 18' x 10'). Some areas of the clay at the ground surface are undercut by the collapsed material.
1048	14	ash and clay caving from trench walls into trench

1057	14	excavated stratified waste material sticks somewhat to hoe bucket
1059	15	excavated stratified waste material is very soft, highly plastic when worked with the hoe bucket while placing in white metal box
1103	16 - 17	stratified waste material shows signs of dilatancy when a plastic bucket of the material is tapped with a trowel
1104	16 - 17	waste material is soft when tamped with the hoe bucket while placing in white metal box
1107	17	Angle of repose of red clay-like material on top of the waste spoil pile is approx. 20 degrees
1111	19	Track hoe boom at full extension, can dig no deeper. No standing water in trench. No drainage of water from spoil piles.
1114		Angle of repose of waste spoil pile approx. 20 - 30 degrees
1115		East edge of upper part of trench caves some more
1126		Condition of trench: cover material is layered brown; grayish brown sandy clay and black ash. The cover materials have sloughed into the trench creating an oval shaped depression about 9 to 10 feet deep to the top of the sloughed material in the trench. The side wall angles are estimated to be about 50 to 60 degrees.
1127		Hoe operator excavates the sloughed material from the trench, and creates vertical faces (i.e and notch) in the red clay-like material. Vertical faces extend from about 10 to 15 feet depths, and appear "greasy" or slickensided due to the excavator bucket. There was no standing water or seepage. After excavating to about 15 depth, the overlying sandy clay and ash material caved suddenly into the trench, filling the notch.
1136		Started backfilling trench

1137	Final dimensions of trench prior to backfilling: oval shaped, approx. 20 feet by 15 feet wide at ground surface
1145	Waste dropped into the trench while backfilling was heavy and pudding-like
1215	Completed backfilling

C.6 Analysis of Wet Trench Data for Groundwater Flux Into Trench

Rough estimates of the volumetric flux of water produced in a trench may be made from data taken during wet trenching tests. The calculated flux may be used to size dewatering pumps and requires the following input data: (1) width of trench, (2) length of trench, (3) depth of water in trench at the beginning of pumping, (4) volume of water pumped for a fixed time period, (5) length of pumping period, (6) depth of water in trench at end of pumping, and (7) estimated saturated thickness of productive (highly permeable) zone.

The following assumptions must be made to estimate the volumetric flux of water produced by the productive zone:

1) The rate of pumping is constant.

2) The trench is a rectangular box.

3) The flux of water produced is constant.

4) The supply of water in the productive zone is very large compared to the volume of water removed during trench tests.

5) The trenching takes place in soil layers (including productive and less permeable layers) of uniform thickness.

6) The entire face of the productive zone is completely exposed by the time pumping starts. If this is not the case, the saturated thickness of the zone can be decreased to reflect a more accurate time-average.

7) The only source of water into the trench is seepage from the productive zone and the only sink of water out of the trench is that which is pumped out.

The calculation proceeds from a conservation of free water mass in which the rate of water produced (volume/time) minus the rate of water pumped out of the trench equals the rate of change of water volume in the Pit:

$$Q_i - Q_o = \frac{dV}{dt}$$

where

$$Q_i = .2674qT(L+W)$$

$$Q_o = \frac{.1337P}{t}$$

$$\frac{dV}{dt} = \frac{LW(D_e - D_b)}{t}$$

and

Q_i = volume flow into trench (ft^3/min)
Q_o = volume flow out of trench (ft^3/min)
V = volume of water in trench (ft^3)
q = volumetric flux of water produced (gpm/ft^2)
T = saturated thickness of productive zone (ft)
L = length of trench (ft)
W = width of trench (ft)
P = volume of water pumped in time period t (g)
t = time period for pumping (min)
D_e = depth of water in trench at end of time period t (ft)
D_b = depth of water in trench at beginning of time period t (ft)

Making substitutions and solving for q, there results

$$q = \frac{LW(D_e - D_b) + .1337P}{.2674Tt(L+W)}$$

Table 1 contains the results of the estimated groundwater flux for T1-S located in the south end of Pit 1.

000333

Table 1 - Estimate of Groundwater Influx at Trench T1-S

Trench #	Time Period	Length (ft)	Width (ft)	Beginning Water Depth (ft)	Ending Water Depth (ft)	Volume Pumped (gal)	Pumping Period (min)	Productive Zone Thickness (ft)	Flux Into Trench (gpm/sq ft)
T1-S	0950-1020	20.0	5.0	4.0	2.0	8000	30	2.0	2.17

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APPENDIX D

DEWATERING EVALUATION

APPENDIX D
DEWATERING EVALUATION

D.1 Introduction

FERMCO awarded a contract to B&B Drilling, Inc. on March 3, 1995, to perform a dewatering feasibility study at OU1 Waste Pits 1 and 3. On completion of the first of three phases of the study, B&B submitted a report to FERMCO dated August 1995 (B&B 1995). This evaluation summarizes the major findings of Phase I and evaluates the impact of these findings on the activities and schedule for remediation of Pits 1 and 3.

The primary objective of Phase I was to determine whether groundwater can be extracted from Pit 1 and 3 sludges. If extraction was judged feasible, further objectives were to determine optimum well installation technique and well yield. Phase II of the study was to determine sludge hydrology, well spacing, and the effect of certain enhancements to well efficiencies. Phase III was to perform pilot-scale dewatering operations in Pits 1 and 3. Phase II and III were cancelled due to results of Phase I.

D-1.1 Test Configurations and Installation Techniques

Pit 1 - A linear array of wells, wellpoints, and instruments were installed in Pit 1 using various combinations of drilling techniques. Figure D-1 depicts a plan view of the array. Both wells had screen and riser diameters of 4 inches, while both wellpoints had screen and riser diameters of 1.5 inches. All wells and wellpoints were screened from 7 to 12 feet of depth. The pore pressure piezometer was screened by a canvas bag over an interval of 10 to 12 feet of depth, and the tensiometer tip was installed at a depth of 6.5 feet. Figure D-2 shows the precise location of the array within Pit 1.

The well designated as DW1-1 on Figure D-1 was installed using direct rotary techniques with water only. Well DW2-1 was installed in a similar fashion, except that the borehole was flushed with fresh water after drilling. Wellpoints WP1-1 and WP2-1 were both installed by the jet method, the difference being that WP2-1 was flushed with fresh water after drilling.

Pit 3 - Figure D-3 shows that the test array for Pit 3 had an arrangement similar to the Pit 1 array but with different spacings. Screen and riser diameters were 4 inches and 1.5 inches for the wells and wellpoints, respectively. All wells and wellpoints were screened from 10 to 30 feet of depth except DW1-3, which was screened from 9 to 29 feet. The pore pressure piezometer was screened by a canvas bag over the 27- to 29-foot interval while the tensiometer tip was installed at 9 feet. Figure D-2 shows the location of the array within Pit 3.

D.E.E.P. DEWATERING TREATABILITY STUDY

PHASE I - TEST WELL AS-BUILT LOCATION PLAN(PIT #1)

NTS

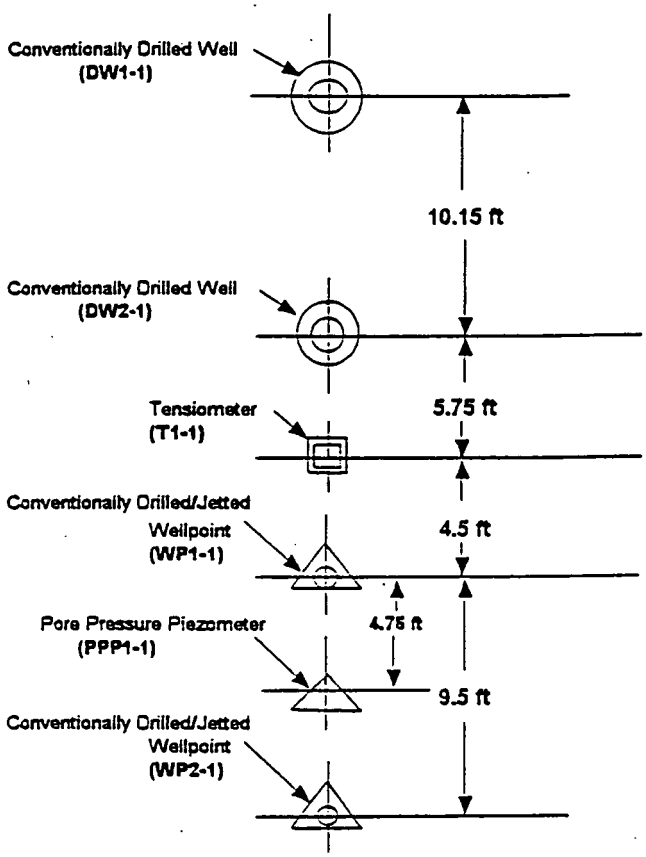
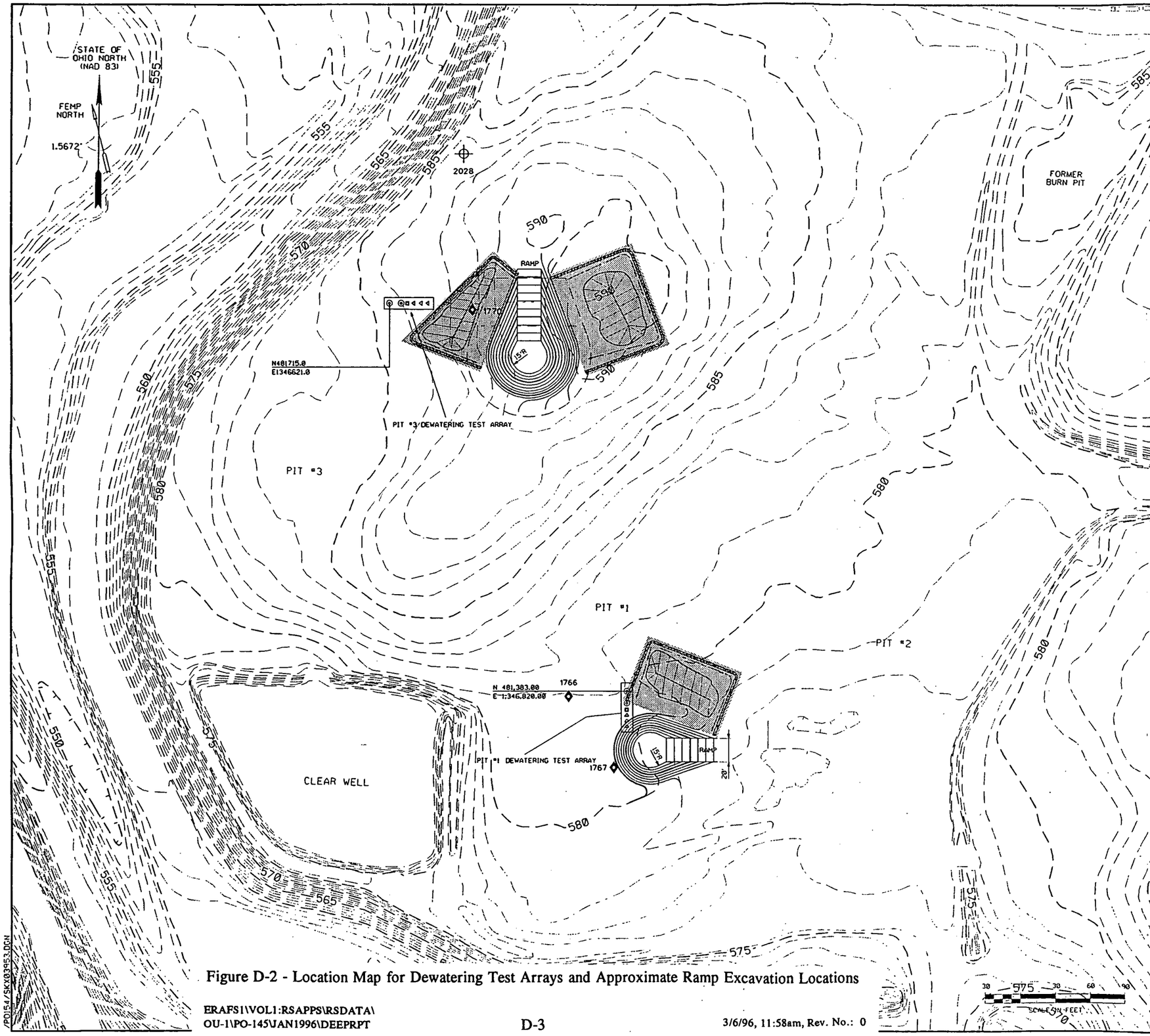


Figure D-1 - Pit 1 Test Array Plan View



LEGEND

- CONVENTIONALLY DRILLED WELL
- TENSIOMETER
- CONVENTIONALLY DRILLED/JETTED WELLPOINT
- PORE PRESSURE PIEZOMETER
- MONITORING WELL
- LEACHATE WELL

FIGURE D-2
LOCATION MAP
DEWATERING TEST ARRAYS
AND APPROXIMATE
RAMP EXCAVATION
LOCATIONS

Figure D-2 - Location Map for Dewatering Test Arrays and Approximate Ramp Excavation Locations

/PO154/SKX03953.DGN

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D.E.E.P. DEWATERING TREATABILITY STUDY

PHASE I - TEST WELL AS-BUILT LOCATION PLAN(PIT #3)

NTS

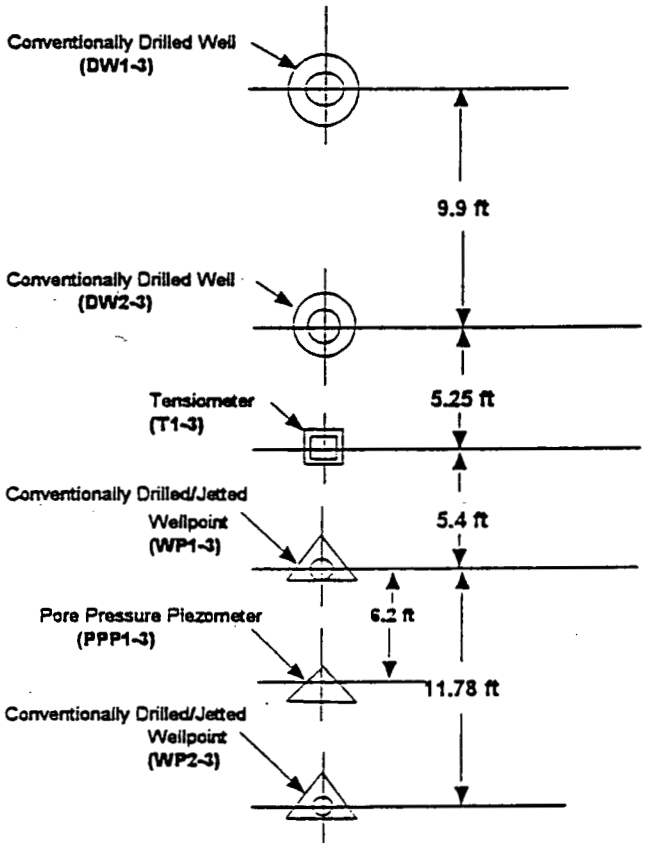

Figure D-3 - Pit 3 Test Array Plan View

Both wells were drilled using direct rotary techniques with water only, and both wellpoints were installed by the jet method.

D-1.2 Test Procedure and Results

Pit 1 - The preliminary test procedure for Pit 1 involved 1 hour of pumping, followed by measurement of post-pumping recovery. Each of the four wells and wellpoints were pumped in this manner for a total of four preliminary tests. For the two wells, the 1 hour pumping periods consisted of a 1/2 hour of pumping under gravity flow followed by a 1/2 hour of pumping with applied vacuum of 23 inches of water. The wellpoints were pumped with vacuum of 20- to 25-inches of water for the entire hour.

Wellpoint WP2-1 demonstrated the highest yield in the preliminary tests (approximately 1.3 gpm) and was then pumped for 4 hours, after which recovery was measured. Figure D-4 shows the time history of well yield during this 4 hour test. The plot shows a fluctuating yield with an average of 1.15 gpm over the 4 hours.

Pit 3 - The preliminary test procedure for Pit 3 was identical to that for Pit 1. Vacuum for the second 1/2 hour of the well pumping tests was 22 inches of water for DW1-3 and 27 to 28 inches for DW2-3. Vacuum was 24 to 27 inches for WP1-3 and 25 to 26 inches for WP2-3 for the entire hour of pumping.

Well DW2-3, which demonstrated a preliminary test average yield of .4 gpm (.65 gpm with vacuum), was selected for the 4 hour pump test. Figure D-5 shows the time history of well yield during this 4 hour test. The plot shows an almost monotonically decreasing yield with a final yield of .26 gpm at the end of 4 hours.

D.2 B&B'S Conclusions and Recommendations

From the test results presented above (and more detailed results contained in the B&B report), B&B concluded that sufficient amounts of free water exist in Pits 1 and 3 to allow sustainable yields with conventional dewatering equipment. In particular, B&B recommends 1.5-inch-diameter PVC wellpoints in Pit 1 (where suction lift is less than 18 feet) and 4-inch-diameter PVC wells for the deeper wastes of Pit 3. Installation of wellpoints and wells should be done via the jetting and drilling techniques described in the Phase I report. In all cases, flushing the borehole with fresh water immediately preceding well and filter installation is recommended. Vacuum enhancement is recommended for both wells and wellpoints, as is incorporation of ejectors in each Pit 3 well. Further advanced enhancement techniques, such as electroosmosis, are not recommended.

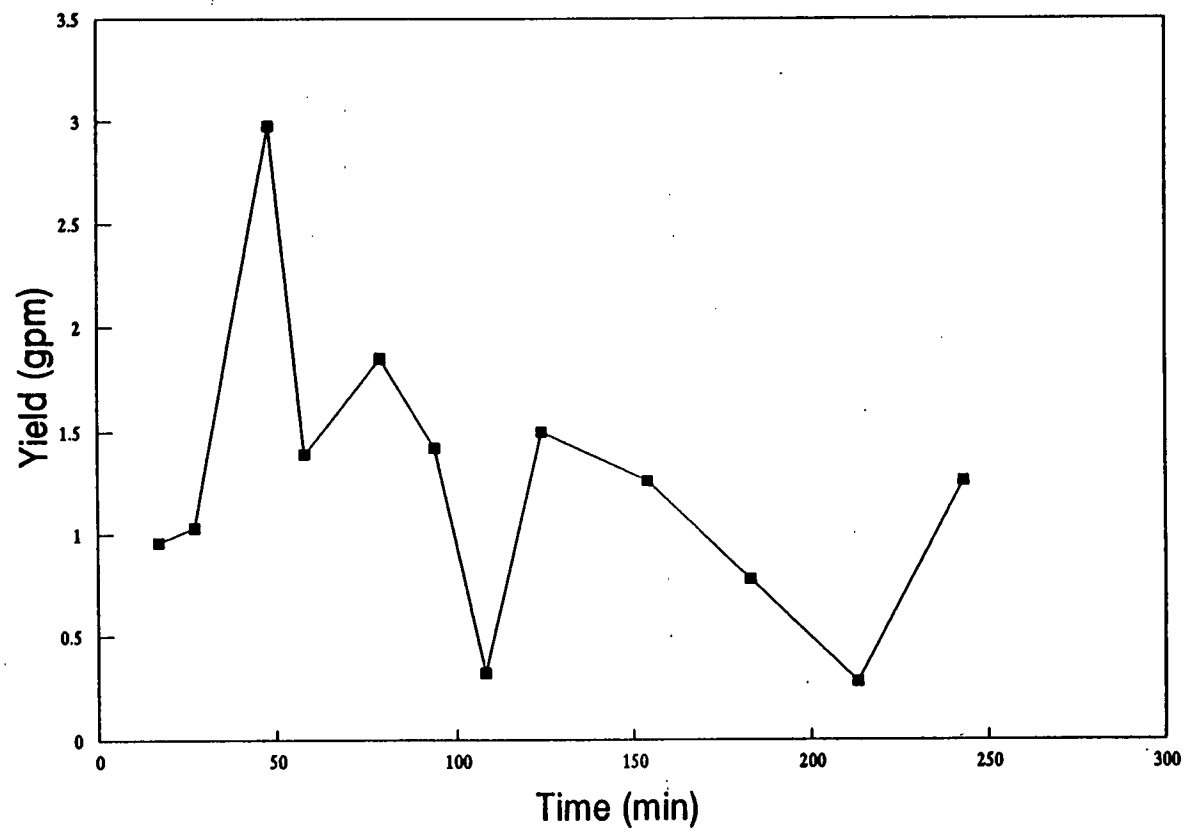

Figure D-4 - Wellpoint Yield vs. Time for Pit 1, 4-Hour Pumping Test

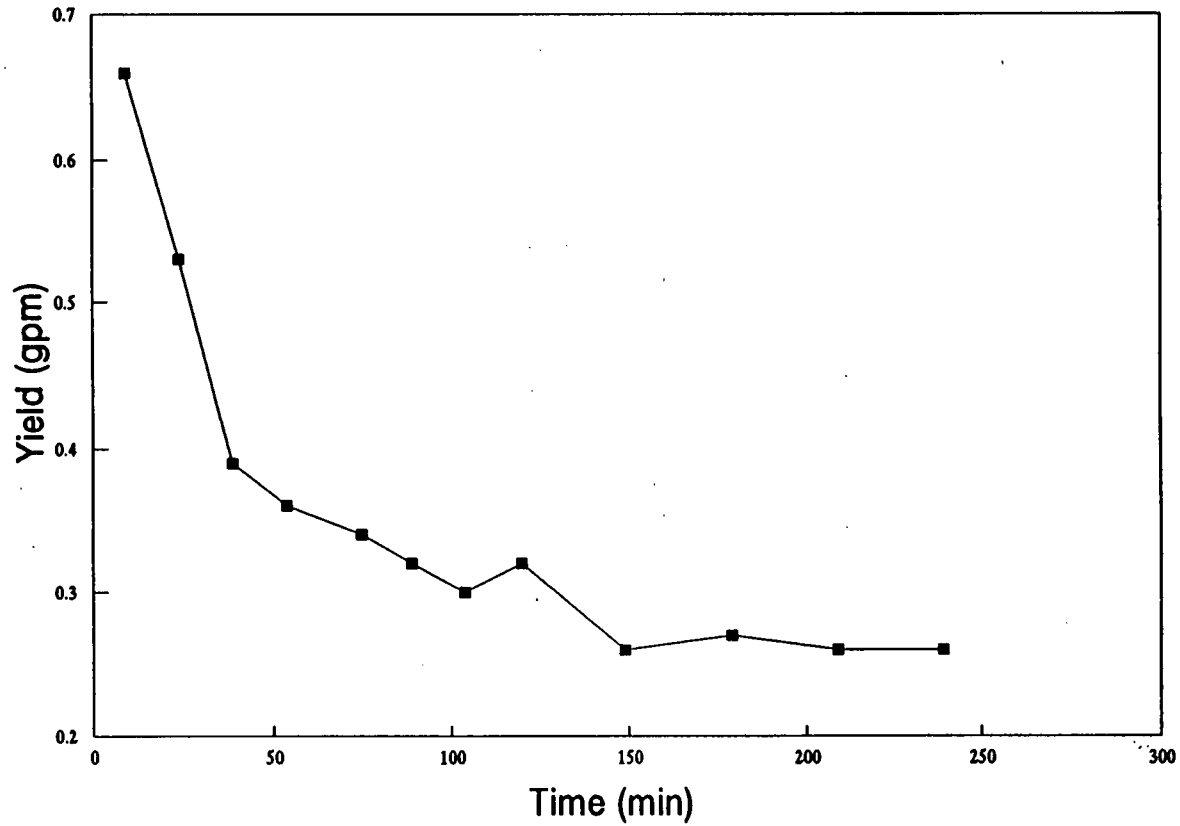

Figure D-5 - Well Yield vs. Time for Pit 3, 4-Hour Pumping Test

D.3 Evaluation

The primary benefits anticipated from Pit dewatering are increased soil stability and reduction in soil water content. More stable soils will alleviate handling problems and result in a quicker, more efficient, and safer excavation process. Reduction in soil water content will shorten processing times and lower energy costs associated with soil drying.

D-3.1 Soil Stability Enhancement

Ramping activities in the sections of the Pits treated in Phase I determined the degree of improvement in soil stability. The results allowed comparison of bearing capacities and angles of repose for pre- and post-Phase I soils. However, data from pre-dewatering strength tests indicate that Pit soils are sufficiently stable for safe and efficient excavation without the use of dewatering.

D-3.2 Reduction in Soil Water Content

To evaluate the impact of dewatering on soil processing activities and schedules, the following assumptions were made:

1) Sustainable yields of 1.15 and .26 gpm can be achieved for Pits 1 and 3, respectively.

2) The above yields are reliable averages for the entire areal extent of the respective Pits.

3) The volume of free water drainable from the Pits equals the soil effective porosity times the total saturated Pit volume. An effective porosity of .15 is assumed for both Pit 1 and 3.

4) Infiltration is negligible with respect to pumping. It is assumed that runon from heavy preciPitation and perched water sources will be controlled by use of conventional devices such as sumps and drains.

5) Minimizing the duration of remediation will minimize the total cost of remediation.

6) In the absence of dewatering, the remediation duration is constrained by the rate at which the soil can be dried.

The first and most important of these assumptions deals with the sustainable yields of wells and wellpoints used in the dewatering of Pits 1 and 3. The declining yield through time depicted in Figure D-5 is a major concern. Tests longer than 4 hours in duration would be valuable in determining whether a significant sustainable yield exists, and, if so, what that yield is. If longer duration tests indicate a

negligible sustainable yield, advantage can be gained by attempting to dewater the Waste Pits. It should be kept in mind throughout the following evaluation that assumptions of long-term yields based on short duration tests may be suspect.

The assumption that test results from a small area of a Pit are applicable to the entire Pit may also be suspect. Sustainable yield data available from several locations within a Pit is preferred for calculating a more reliable overall average.

The majority of materials in Waste Pits 1 and 3 are classified as silts (USCS classes ML and MH) (ALTER 1995a). An effective porosity value of .15 is generally prescribed for these classes of soils (Maidment 1993). A depth to water level of 4 feet (ALTER 1995a) will be used to calculate the saturated volume of soil.

The assumption of negligible infiltration implies that an equilibrium drawdown distribution will not be reached. The dewatering wells will simply remove the volume of free water initially present in the soils.

The final two assumptions dictate that the remediation duration and cost will be minimized if the time required to dewater equals the time required to dry the soils to the optimum moisture content. Because the amounts of water that will be removed by dewatering and drying are both fixed, the drying time is likewise fixed. The optimum number of wells is the number that can dewater a Pit in this fixed drying time; more wells will cost more without shortening remediation, and fewer wells will make the dewatering process the time constraint.

Given the above, the following equation expressing the equality of drying and dewatering times can be solved for the number of dewatering wells:

$$\frac{M-\rho nFV}{r} = \frac{nFV}{Nq} \qquad \text{(D-1)}$$

$$N = \frac{rnFV}{q(M-\rho nFV)} \qquad \text{(D-2)}$$

where M = mass of water evaporated without dewatering (t)
ρ = water density (t/yd^3)
n = effective porosity of soil
F = saturated fraction of soil volume
V = total volume of soil in Pit (yd^3)
r = dryer evaporation rate (t/d)
q = yield of each dewatering well (yd^3/d)
N = number of dewatering wells

Because an integral number of wells must be used, drying and dewatering times will vary slightly. The expression on the left side of equation D-1 represents drying time, while the right side (with the appropriate number of wells substituted) represents dewatering time.

Table D-1 lists values of the above variables, number of dewatering wells required, and treatment times with and without dewatering for Pits 1 and 3. Values for mass of water evaporated without dewatering, total volume of soil, dryer evaporation rate, and treatment time without dewatering were obtained from a FERMCO waste processing analysis (FERMCO 1995).

Table D-1 shows that 36 wells are required to dewater Pit 1 and 20 wells are required to dewater Pit 3. These figures reflect the minimum numbers of wells that should be pumping at all times during excavation to keep up with the drying rate. In actuality, an array of wells greater in number than the minimum should be installed over a limited area; as excavation proceeds, the front row of this array can be shut down and a new row at the back of the array can be turned on. This "leapfrogging" technique allows wells to be reused or disposed of in place while maintaining a core array composed of the minimum number of operating wells.

Table D-1 also gives an estimate of processing time reductions due to dewatering. Dewatering results in savings of 66 days for Pit 1 and 334 days for Pit 3. These estimates are only as reliable as the assumptions used to derive them.

Table D-1 - Calculation of Number of Dewatering Wells Required to Minimize Processing Times and Reduction in Processing Times for Pits 1 and 3

Input Data	Pit 1	Pit 3
Dryer Evaporation Rate (ton/d)	100	100
Effective Porosity of Soil	0.15	0.15
Pit Depth (ft)	17	37
Depth to Water Level (ft)	4	4
Total Volume of Soil in Pit (yd^3)	68400	307500
Yield of each Dewatering Well (gpm)	1.15	0.26
Mass of Water Evaporated without Dewatering (ton)	9245	145494
Water Density (ton/yd^3)	0.843	0.843
Treatment Time without Dewatering (d)	92	1442
Results		
Saturated Fraction of Soil Volume	0.765	0.892
Volume of Water Removed by Dewatering (yd^3)	7846	41139
Mass of Water Removed by Dewatering (ton)	6614	34680
Mass of Water Evaporated after Dewatering (ton)	2631	110814
Treatment Time with Dewatering (d)	26	1108
Required Number of Dewatering Wells	36	20
Time Saved by Dewatering (d)	66	334

APPENDIX E

SUMMARY OF FIELD OBSERVATIONS FROM RAMP AND PAD EXCAVATIONS

E.1 Introduction

Between October 17 and October 31, 1995, FERMCO performed ramped excavations within Waste Pits 1 and 3 in conjunction with the DEEP (Dewatering, Excavation, Evaluation Program) project. The intent of the ramp excavations was to provide information for the excavation methods, equipment operation and material handling of the waste materials within the Waste Pits 1 and 3.

The planned ramp excavations consisted of a circular excavation (pad area) having 1.5H/1V side slopes and a ramp extending from the bottom of the excavation to the ground surface having a grade of approximately 15 percent. The depth of the excavations were dependent upon the Pit in which the excavation was being performed. The planned excavation depth in Pit 1 was eight feet below the existing ground surface, and the planned excavation depth in Pit 3 was twelve feet below the existing ground surface. Approximate locations of the ramp excavations are shown in Figure 2-9.

A PARSONS engineer was present during the ramp excavations to observe the stability of the excavated slopes within the different waste material types. In addition, the engineer noted the depths at which water was encountered in each Pit and approximated the infiltration rate of groundwater flowing into each excavation.

E.2 Ramp Excavations

The ramp excavation in Waste Pit 1 was performed first. The ramp excavation in Pit 3 was performed after the excavation in Pit 1 was completed and filled with the stockpiled waste materials. Therefore, this report will first discuss the ramp excavation in Pit 1 and then the excavation in Pit 3.

Both ramp excavations were performed using a John Deere 690D-LC track hoe. The material excavated by the track loader was then stockpiled using a John Deere 555G WT Series IV track loader.

Waste Pit 1

Ramp excavation in Waste Pit 1 began on October 17, 1995. The ground surface was dry and was covered with vegetation (grass). The ramp excavation was located immediately southeast of the southern most well in the line of dewatering test array installed during the dewatering test phase of the DEEP project. The center of the pad portion of the excavation was located about 82 feet to the southeast of Well #1766 and 40 feet northeast of Well #1767. The ramp was planned to start on the east side of the bottom of the rounded excavation and rise to the ground surface east of the rounded excavation.

The top 1 to 1.5 feet of excavated material consisted of a lean, yellowish-brown to dark yellowish brown, moist clay material. Upon stock piling the lean clay material, the material had an angle of repose of approximately 40 degrees.

Once the lean clay material was removed, the pad and ramp were excavated from west to the east. Underlying the lean clay material was a medium to dark gray, moist, silty to sandy material. The gray material had little to no cohesion. On the west side of the pad excavation beginning at a depth of approximately 3 feet below the ground surface, the material became reddish gray mixed with occasional green. The reddish gray and the green material also appeared to have little to no cohesion and were also moist and silty to sandy in nature. At approximately 6 feet below the ground surface the material became brownish-gray and remained that color to the bottom of the excavation, approximately 8.5 feet. The brownish-gray material was again moist, silty to sandy in nature and exhibited little to no cohesion. The east half of the pad excavation remained medium to dark gray immediately below the lean clay to the bottom of the excavation, approximately 8 feet below the ground surface. Traces of wire, metal banding, brick, plastic sheeting, lumber and one 55 gallon drum were encountered throughout the gray and reddish gray material.

At the end of the first day of excavation, all of the lean clay material was removed and stockpiled. In addition the west half of the pad excavation was excavated to approximately 6 feet. The side slopes were graded to approximately 1.5H/1V to 2H/1V. Portions of the north and south areas of the pad excavations were excavated to a depth of approximately 5 feet. Due to the manner of excavation, the track hoe was excavating from a peninsula within the pad and ramp excavation areas. The slopes around the peninsula were approximately 1H/1V. The track hoe moved off of the peninsula at the end of the first day and was parked to the northeast of the ramp and pad area. The stockpiled gray and reddish gray material had an angle of repose of approximately 30 degrees.

Upon starting excavation on October 18, 1995, all of the slopes left open overnight along the excavation perimeter and peninsula remained intact with no visible failures. The stockpiles of lean clay and the silty to sandy material maintained their angle of repose overnight. In addition, there was approximately one foot of water in the bottom of the excavation along the bottom of the west side slope. The water was entering the excavation slowly from along the southwest slope at a depth of approximately 5.5 to 6 feet. In addition, there was very slight bubbling occurring in the water near the base of the west perimeter slope, which may have been water entering the excavation from the bottom of the excavation.

The track hoe operator attempted to absorb the water in the bottom of the excavation using the dry gray material that was excavated during the previous day. The material did not appear to absorb any of the water. The resulting wet material had no cohesion. Once the operator realized the material was not absorbing the water, he excavated a sump along the base of the west side slope that had a bottom depth of approximately 8.5 feet. The sump easily contained all of the water, and the operator then continued the remainder of the excavation.

During the course of work on October 18, the track loader operator drove the track loader up onto the stockpile of gray and reddish gray material in order to increase the height of the stockpile. The stockpile supported the track loader with little to no rutting. The first time the track loader drove up the stockpile, the tracks sank into the pile slightly. By the third or fourth time, the tracks did not rut the pile. The slopes on the stockpile remained approximately 35 degrees after the track loader operated on the pile.

At the end of work on October 18, the ramp and pad excavations were complete. The perimeter side slopes of the pad excavation varied between 1.5H/1V and 2H/1V. The side slopes along the ramp varied from 1H/1V to 1.5H/1V. The water level in the bottom of the excavation did not appear to increase over the course of the day.

Before the operators left the area, the track loader drove down the ramp onto the pad area. The moist gray material at the bottom of the excavation compacted under the tracks of the track loader and did not appear to pump. At the western most edge of the pad area where the water was ponded, the material was rutted by the track loader but did not hinder or slow the movement of the track loader.

The finished pad had a diameter of approximately 30 feet at the toe of the perimeter slopes. The diameter of the pad area at the top of the perimeter slopes was approximately 60 feet. The length of the ramp was between 45 and 50 feet long. The depth of the pad area sloped from approximately 9 feet on the west side (excluding the excavated sump) to approximately 7.5 feet on the east side at the base of the ramp.

Upon returning to the excavation on October 19, all of the perimeter side slopes of the pad and ramp excavation remained intact and stable. The stockpiles' angles of repose remained constant overnight. In addition, the pad portion of the excavation was completely under water except for an approximately 10-foot wide section on the east side of the pad at the base of the ramp. The depth of the water was approximately 1.5 to 2 feet deep on the west side of the pad. There was a slight trickle of water originating from the southwest perimeter slope, but was not enough flow to cause the water that was visible in the bottom of the excavation. In addition, the bubbling was no longer visible along the toe of the west perimeter slope.

FERMCO decided to continue excavation to determine at what depth water would be encountered. The track hoe operator excavated a deeper sump along the toe of the west perimeter slope to collect the water lying on the pad area. Once the water was transferred to the sump, the track hoe operator started a continued excavation in the eastern half of the pad area. The continued excavation had a width of approximately 10 feet and a length of approximately 17 feet. The depth of the continued excavation was approximately 6 feet below the existing pad elevation (approximately 13 to 14 feet below the existing ground surface).

In the continued excavation at a depth of approximately 9 feet below the ground surface, a moist, cohesionless, black granular material was encountered. At 10 feet below the ground surface, a moist,

low cohesion, light gray to white, silty to sandy material was encountered. At a depth of approximately 11 feet below the ground surface, a moist to wet, cohesionless, medium to dark gray granular material was encountered. The medium to dark gray material continued to the bottom of the continued excavation.

At a depth of approximately 13 feet below the ground surface, water was encountered. The water was flowing heavily from the east face of the continued excavation. The seepage force of the infiltrating water on the east face caused sloughing of the east face of the continued excavation. In addition, small quantities of water were infiltrating into the continued excavation at the interface of the pale gray and dark gray materials, which caused minor sloughing of the other vertical faces of the continued excavation.

After approximately 10 minutes the bottom one foot of the continued excavation was under water (corresponding to a flow rate of about 110 to 150 gpm). In the following ten minutes the water level rose another foot to a depth of approximately 12 feet below the ground surface. Over the next twenty minutes, the water level in the continued excavation did not change noticeably. Once the water level quit rising in the continued excavation, the excavation activities were stopped for the day. The excavation was left open for the weekend to see how much water would accumulate in the excavation and see if any slope failures would occur.

Upon returning to the excavation on October 23, there was approximately 2.5 feet of water in the bottom of the excavation. The top surface of the water covered the bottom 1 or 2 feet of the ramp. The water was due to a combination of groundwater flow and rainwater. A shadow could be seen were the continued excavation was located under the water, but the condition of the side faces of the excavation could not be determined.

The perimeter slopes of pad and ramp excavation were intact, and no apparent failures had occurred. The slopes of the stockpile also appeared intact, the angles of repose did not change on either the lean clay or gray material stockpiles. The ramp and pad excavation was then reclaimed using the excavated material for backfill. The reclamation was completed by the end of work on October 24.

Waste Pit 3

At the beginning of work on October 25, the entire ramp and pad excavation location within Waste Pit 3 was moved 54 feet to the southeast. The relocation was performed in order to avoid disturbing a 35 ft deep monitoring well (Well #1770). After relocation the center of the pad excavation was located about 60 feet south by southeast of Well #1770 and 177 feet south by southeast of Well #2028. The ramp and pad excavation was oriented so that the northwest corner of the ramp was located almost due east of the eastern most dewatering well in the dewatering test array remaining from the previous dewatering study. The lengthwise axis of the ramp ran from the northwest at the ground surface to the southeast at the proposed finished elevation of the pad excavation.

The ground surface of the excavation area was mostly not covered with vegetation (bare soil), with the exception of the eastern edge of the excavation area that was covered with vegetation (grass). The bare ground surface was moist and gently sloped downward toward the southwest. Running southwest through the approximate center of the pad excavation area was an erosional channel, resulting from surface water runoff. The channel varied between 2 and 4 feet wide and between 2 and 6 inches deep.

Excavation of the ramp and pad area began the afternoon of October 25. The first type of material encountered during the excavation was a dark yellowish-brown to yellowish-brown, moist, lean clay fill. The depth of the lean clay fill varied from approximately 1 ft at the southern extent of the excavation to approximately 3 ft at the northern extent of the excavation. Occasionally there were small pieces of wire mixed with the lean clay fill on the north side of the excavation. Underlying the lean clay fill was a black, moist, cohesionless, silty sand (similar to the fly ash or bottom ash material in the active and inactive flyash piles of OU2). Occasional wire, metal banding, brick, clay tile, and paint lids were mixed with the black material.

At the end of work on October 25, all the clay fill material along with small amounts of black material had been removed from the excavation area. The resulting stockpile of lean clay fill mixed with some black material had an angle of repose of 35 degrees to 40 degrees.

On October 26 excavation began in the black silty sand material. In the southeast pad area, small patches of reddish-orange, moist, semi-cohesive, fine grained material clumps mixed with the black material at approximately 2.5 feet below the ground surface. Along the south and southwest edges of the pad excavation area, olive brown, moist, cohesional, fine grained material clumps mixed with the black material at approximately 4 to 4.5 feet below the ground surface. Also occasionally mixed with the black material is wire, cable, brick, wood and metal banding. The black material became wet along the west and northwest edges of the pad excavation area at a depth of approximately 3 feet below the ground surface.

At approximately 4 feet below the ground surface in the southeast area of the pad area, the reddish-orange material became continuous. The reddish-orange material was moist to wet, soft to very soft, cohesional and fine grained. The top surface of the reddish-orange material dipped downward as the excavation was continued to the west and northwest. The top surface of the reddish-orange material was approximately 8 to 9 feet below the ground surface on the west and northwest edges of the excavation. The color of the reddish-orange material became a brilliant orange on the west side of the pad excavation area. As the reddish-orange material was excavated deeper, it became softer.

The track hoe operator excavated the southeast, south, southwest, west and northwest portions of the pad area first. As a result, the track hoe was resting on a peninsula of black silty sand material located in the approximate center of pad excavation. The side slopes of the peninsula were approximately 1H/1V.

The black material was stockpiled in a separate stockpile from the lean clay fill. The stockpile of black material had an angle of repose of approximately 30 degrees. The perimeter slopes of the pad excavation were graded to approximately 1.5H/1V. When the operator stopped for lunch, the slopes on the northwest side of the pad excavation area in the black material were left near vertical. In addition, the top surface of the orange material was completely uncovered, and some of the orange material was excavated from the southeast and south edges of the excavation.

After returning to the excavation in the afternoon, the vertical faces on the northwest perimeter of the pad excavation were noticeably wet and had sloughed slightly. All of the 1.5H/1V slopes remained intact and did not fail over the lunch break.

During lunch, the operator of the back hoe was instructed to make a stockpile of the orange material so a group of visiting engineers could see the material from the roadway. As a result, the operator immediately started to excavate the reddish-orange to orange material while sitting on the peninsula in the center of the pad area. When the operator would remove a bucket full of the material, the resulting trench would only remain open momentarily. After a few seconds, the vertical side walls of the trench would slough or collapse.

On the west side of the pad excavation area, the track hoe began to remove the orange material from the toe of the perimeter side slope. After removing approximately 3 buckets of material, the orange material began to flow into the void made by the removal of the material. At approximately the same time a vertical tension crack developed in the peninsula the track hoe was resting on, approximately under the center of the tracks. The track hoe operator immediately backed the track hoe off of the peninsula, at which time the peninsula sloughed into the excavation. The track hoe operator managed to move the track hoe to stable ground before the failure occurred.

The failure appeared to be initiated by the sliding of flowing of the orange material in the bottom of the excavation. Apparently the displacement of the orange material undermined the peninsula of black material on which the track hoe was sitting. Once undermined, there was no support for the overlying black material. The unsupported black material then sloughed into the pad excavation.

One of the laborers said he stepped on a piece of the orange material while setting up silt fences around the stockpiles. He said the material did not stick to his boot or was it displaced by his boot. Instead, he said the piece that first appeared solid turned into a puddle of thick liquid.

After the failure occurred in the peninsula, the track hoe operator began to remove some of the sloughed black material from the excavation while sitting on what was remaining of the former peninsula. Before leaving the excavation at the end of work, the track hoe operator dressed the slopes on the south and southwest sides of the pad excavation from 1.5H/1V to 2H/1V. The angle of repose of the orange material stockpile was approximately 25 degrees. The depth of the excavation varied from approximately

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9 feet on the southeast and south sides of the excavation to approximately 10.5 feet on the west and northwest sides of the excavation. In the center of the excavation was a large pile of loose black silty sand material left from the failure. The bottom of the excavation contained no standing water.

Once the operators and the crew had left the contaminated area, the possibility of operating equipment on the soft orange material was discussed between the engineers and the operators. It was determined that the material was too soft to support excavation equipment. As a result, the track loader would not enter the excavation once the pad and ramp excavation was completed.

Upon returning to the FEMP on October 30, FERMCO had decided to discontinue the ramp and pad excavation in Waste Pit 3. The desired information from the Pit excavation had been obtained and no further excavation was necessary.

After inspecting the excavation, there was water between 1 and 3 feet deep in the bottom of the excavation (the water was deeper on the west side of the excavation than on the east side). The water was greenish-black in color and had a film on the surface near the edges of the excavation. The film appeared to be similar to oil or some other type of petroleum product. The water in the bottom of the excavation formed a moat around the island of sloughed black material in the center of the excavation. The ponded water was from a combination of seeping groundwater and rainwater.

All of the slopes that were graded to 1.5H/1V or flatter remained intact over the weekend with no apparent failures. Any slopes generally steeper than 1.5H/1V sloughed. The vertical slopes on the northwest side of the excavation were wet and had sloughed badly. The resulting slopes along the northwest edge were between vertical and 1H/1V. In the vertical faces, there were concave depressions eroded into the faces from the seeping groundwater. In addition to the sloughing, it appeared some block type failures had also occurred. The blocks did not fall into the excavation, but instead remained intact along the edge of the excavation.

The material that was brilliant orange on October 26 turned orange-brown (color of clay drainage tile). This color change may have been due to the material being exposed to air or water.

The final excavation was approximately circular in shape. The diameter at the top of the perimeter slopes was approximately 70 feet. The diameter at the toe of the perimeter slopes was approximately 37 feet but could not be determined exactly due to the water in the bottom of the excavation. The slopes along the east, south and west sides of the excavation varied between 1.5H/1V and 2H/1V. The slopes along the north side of the excavation varied between vertical and 1H/1V. The east-west dimension of the pile of loose black material in the bottom of the excavation was approximately 28 feet and the north-south dimension was approximately 32 feet. The plan view shape of the pile was trapezoidal. The base of the trapezoid intersected the north and southeast bottom portions of the excavation at the toe of the side

slopes. The top of the trapezoid was approximately parallel to the base and near the center of the excavation.

The track hoe operator attempted to drive the track hoe onto the stockpile of orange material. The track hoe drove through the pile instead onto the pile. The material provided little resistance and did not slow the track hoe. In addition, the track hoe remained level while attempting to drive on the pile, indicating the material was too weak to even partially support the track hoe.

The excavation was reclaimed starting the afternoon of October 30. The reclamation process involved filling the excavation with the previously excavated materials from Waste Pit 3.

APPENDIX F

GEOTECHNICAL DATA

Geotechnical Data Table Explanation

The presented table of available geotechnical data is divided into five subtables, which are labelled Tables 1 through 5. Each subtable is further divided by OU1 Waste Pit number or designation; as a result, there are eight pages for each table number (one for each OU1 Waste Pit). Each page of the subtables includes sample identification data (Pit number or designation, boring number, sample number, sample type, sample top depth, sample bottom depth, and the data source number which corresponds to the data sources on the cover page) so that the geotechnical data can be associated with the respective sample.

The cover page of the geotechnical data table contains the sources of data and any applicable notes. Table 1, titled *Boring and Sample Index*, reports the location of the boring from which the sample was taken, the ground surface elevation of the boring, the general stratum from which the sample was taken, and the consistency of the sample, if reported. Table 2, titled *Boring Log Visual Description*, reports the visual description from the field log or laboratory log when available and a corresponding SPT N-value when applicable. Table 3, titled *Index Properties Data*, includes the results of index property tests performed on the samples, USCS group symbol, and USCS group name. Table 4, titled *In Situ Physical Properties*, includes results of physical property tests (unit weight data, shear strength data, permeability data, and consolidation data) performed on undisturbed samples from the Waste Pits. Table 5, titled *Remolded Physical Properties*, includes results from physical property tests (compaction data, unit weight of samples, unconfined compressive strength (UCS), direct shear, permeability data, and consolidation data) performed on remolded samples from the Waste Pits.

OU-1 Waste Pits Geotechnical Data Summary

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Data Source:

1. Remdial Investigation Report for OU1 (Final), August 1994, Volume 1 and Appendix A
2. CRU1 Dewatering, Excavation, Evaluation Program Waste Pits 1, 2, and 3 (UC Doc. #30-FO-17, November 1995), ALTER, Final Report.
3. Cooperative Screening Program Final Report, ALTER, U.C., July 1994
4. Characterization Investigation Study, Geotechnical Evaluation of Waste Pit Material Properties and Boring Logs (CIS, Weston March 1988).
5. CRU1 Dewatering, Excavation, Evaluation Program Waste Pits 5 and 6 (UC Doc. #30-FO-19, November 1995), ALTER, Final Report.
6. Draft Final Data Report from Science Applications International Corporation, PARSONS Subcontract No. 76663S0018, January 29, 1996

Notes:

% Gravel = % by wgt. retained on No. 4 sieve (4.75 mm)
% Sand = % by wgt. passing No. 4 Sieve and retained on No. 200 sieve (0.75mm)
% Silt or Clay = percent by weight passing No. 200 sieve
Clay Fraction = percent by weight finer than 0.002 mm

Shaded data indicates preliminary-unchecked data. Data will be finalized when final report is received from laboratory contractor

(1)	Incomplete or questionable data in RI Report
(2)	Average of two tests: 106.6 pcf, 24.6% ; 114.1 pcf, 22.1%
(3)	Listed as "remolded unit weight"; assumed to be wet density
(4)	Listed as "unit weight"; assumed to be wet density
(5)	Pit 5, Pit 6, and Clear Well boring or grab sample locations unavailable from data source reference
(6)	Harvard Miniature Compaction Test
(7)	At approx 95% Standard Proctor maximum dry density (MDD)
(8)	Estimated by the University of Cincinnati
(9)	At 89% Standard Proctor MDD and 11 % wet of OMC
(10)	These samples collected using Vibracore - Samples may be densified
(11)	Identical values assumed due to testing on combined samples
(12)	Average of measured results from triaxial shear tests plus individual density or moisture data
(13)	Average of values from the top and bottom of the sample
(14)	Average of measured results from consolidation test and individual density or moisture data
(15)	Average of measured results from triaxial shear tests and consolidation test plus any individual density or moisture data
(16)	Wet trench location
(17)	Approximate mid-depth of sample, from field notes
(18)	Reported in preliminary data, but not reported with final data

SS	Split Spoon Sample
ST	Shelby Tube Sample
CAN COMP	Composite Sample of Decanted Archive Material
CAN	One Gallon Can Sample of Decanted Archive Material
COMP	Composite Sample
JAR	Jar Bulk Sample
VC	Vibracore Sample

Group 1	Sample Numbers: 5A, 5B, 23A
Group 2	Sample Numbers: 40A, 40B, 41A, 41B, 43A, 43B
Group 3	Sample Numbers: 31A, 33A, 33B, 35A, 35B, 58A, 58B
Group 4	Sample Numbers: 11A, 11B, 16A, 16B
Group 5	Sample Numbers: 29A, 46A, 46B
Group 6	Sample Numbers: 21A, 21B, 25A
Group 7	Sample Numbers: 9A, 9B, 52A, 52B

TABLE 1 – BORING AND SAMPLE INDEX

Sample Indentification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(If reported)
1	1765	63089	ST	4.5	7	1	481377.70	1378289.96	580.77	Waste	Sludge
1	1765	63101	ST	14.0	16.5	1	481377.70	1378289.96	580.77	Waste	Sludge
1	1766	63050	ST	4.5	7	1	481349.56	1378240.51	581.21	Waste	Sludge
1	1766	63054	ST	8.5	11.0	1	481349.56	1378240.51	581.21	Waste	Sludge
1	1766	63062	ST	14.0	16.5	1	481349.56	1378240.51	581.21	Waste	Sludge
1	1767	63008	ST	3.5	6.0	1	481289.27	1378278.74	580.70	Waste	Sludge
1	11352	400053	SS	2.0	3.0	2	481376.02	1378320.29	579.94	Waste	
1	11352	400054	SS	5.5	6.0	2	481376.02	1378320.29	579.94	Waste	
1	11352	400025	ST	7.5	10.0	2	481376.02	1378320.29	579.94	Waste	
1	11352	400026	ST	11.5	14.0	2	481376.02	1378320.29	579.94	Waste	
1	11353	400047	SS	4.5	5.5	2	481256.98	1378238.46	580.23	Waste	
1	11353	400028	ST	10.0	12.5	2	481256.98	1378238.46	580.23	Waste	
1	11353	400051	SS	13.5	14.0	2	481256.98	1378238.46	580.23	Waste	
1	11354	400029	ST	7.5	10.0	2	481306.30	1378307.20	579.57	Waste	
1	11354	400030	ST	11.5	14.0	2	481306.30	1378307.20	579.57	Waste	
1	1765	1A	CAN			3	481377.70	1378289.96	580.77		
1	1765	2A	CAN			3	481377.70	1378289.96	580.77		
1	1765	3A	CAN			3	481377.70	1378289.96	580.77		
1	1766	4A	CAN			3	481349.56	1378240.51	581.21		
1	1766	5A	CAN			3	481349.56	1378240.51	581.21		
1	1766	6A	CAN			3	481349.56	1378240.51	581.21		
1	1766	7A	CAN			3	481349.56	1378240.51	581.21		
1	1767	8A	CAN			3	481289.27	1378278.74	580.70		
1		1-48	COMP	0.0	12.0	4					Clayey
1	T1-S[16]	200139860	COMP	13.0 [17]		2					
1	T1-N[16]	200128961	COMP	3.0	5.0	2					
1	11568	405653	ST	10.5	13.0	6	481313.92	1378312.28		Waste	

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TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(If reported)
2	1768	63619	ST	11.0 [1]	13.0 [1]	1	481392.56	1378532.54	578.71	Waste	
2	1768	63619dup	ST	11.0 [1]	13.0 [1]	1	481392.56	1378532.54	578.71	Waste	
2	1769	63521	ST	12.0	14.0	1	481474.32	1378468.56	580.62	Waste	Sludge
2	1769	63530	ST	18.0	20.0	1	481474.32	1378468.56	580.62	Waste	Sludge
2	1817	63875	ST	10.5	12.5	1	481408.18	1378529.35	578.80	Fill	
2	1818	63865	ST	5.0	7.5	1	481460.40	1378477.46	580.00	Waste	
2	11358	400031	ST	6.0	8.5	2	481521.67	1378568.47	579.46	Waste	
2	11358	400062	SS	8.5	10.0	2	481521.67	1378568.47	579.46	Waste	
2	11359	400033	ST	4.5	7.0	2	481366.84	1378512.99	577.72	Waste	
2	11359	400034	ST	8.5	11.0	2	481366.84	1378512.99	577.72	Waste	
2	1768	9A	CAN			3	481392.56	1378532.54	578.71		
2	1769	10A	CAN			3	481474.32	1378468.56	580.62		
2	1818	11A	CAN			3	481460.40	1378477.46	580.00		
2	1817	12A	CAN			3	481408.18	1378529.35	578.80		
2	02-05	2-39	COMP	0.0	10.0	4	481529.03	1378595.00			Clayey
2	T2-N [1]	200129059	COMP	7.0	8.0	2					
2	11569	405655	ST	7.5	10.0	6	481367.62	1378518.93		Waste	

TABLE 1 – BORING AND SAMPLE INDEX

Sample Indentification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(If reported)
3	1770	63328	ST	4.0	6.0	1	481680.61	1378159.99	587.67	Cover	Sludge
3	1770	63357	ST	20.0	22.0	1	481680.61	1378159.99	587.67	Waste	Sludge
3	1770	63370	ST	28.0	30.0	1	481680.61	1378159.99	587.67	Waste	Sludge
3	1771	63458	ST	32.0	34.0	1	481638.22	1378298.05	589.62	Waste	Sludge
3	1772	63278	ST	19.5	22.0	1	481771.63	1378500.36	583.43	Waste	Sludge
3	11360	400097	SS	13.0	13.5	2	481837.28	1378331.84	586.94	Waste	
3	11360	400100	SS	13.5	14.0	2	481837.28	1378331.84	586.94	Waste	
3	11360	400035	ST	20.5	23.0	2	481837.28	1378331.84	586.94	Waste	
3	11361	400038	ST	10.5	13.0	2	481668.80	1378202.98	589.49	Waste	
3	11361	400039	ST	21.0	22.5	2	481668.80	1378202.98	589.49		
3	11361	400040	ST	29.0	31.5	2	481668.80	1378202.98	589.49	Waste	
3	11362	400076	SS	6.0	6.5	2	481516.62	1378062.08	584.53	Waste	
3	11362	400077	SS	6.5	7.0	2	481516.62	1378062.08	584.53	Waste	
3	11362	400041	ST	19.0	21.5	2	481516.62	1378062.08	584.53	Waste	
3	11362	400042	ST	23.0	25.5	2	481516.62	1378062.08	584.53	Waste	
3	11363	400044	ST	12.0	14.5	2	481444.31	1378102.59	585.98	Waste	
3	11363	400045	ST	19.0	21.5	2	481444.31	1378102.59	585.98	Waste	
3	1770	13A	CAN			3	481680.61	1378159.99	587.67		
3	1770	14A	CAN			3	481680.61	1378159.99	587.67		
3	1770	15A	CAN			3	481680.61	1378159.99	587.67		
3	1771	16A	CAN			3	481638.22	1378298.05	589.62		
3	1771	17A	CAN			3	481638.22	1378298.05	589.62		
3	1772	18A	CAN			3	481771.63	1378500.36	583.43		
3	1772	19A	CAN			3	481771.63	1378500.36	583.43		
3	03-05	3-52	COMP	0.0	20.0	4	481658.38	1378073.25			Sludge
3	03-05	3-52 Redue	COMP	0.0	20.0	4	481658.38	1378073.25			Sludge
3	03-02	3-90	COMP	0.0	20.0	4	481815.44	13785447.75			Sludge
3	03-02	3-90 Redue	COMP	0.0	20.0	4	481815.44	13785447.75			Sludge
3	T3-N[16]	200129035	COMP	17.0 [17]							
3	T3-C[16]	200139885	COMP	13.0 [17]							
3	11570	405657	ST	10.5	13.0	6	481506.61	1378061.91		Waste	
3	11570	405658	ST	15.5	18.0	6	481506.61	1378061.91		Waste	
3	11571	405663	ST	17.5	20.0	6	481828.14	1378342.05		Waste	
3	11571	405687	ST	32.5	35.0	6	481828.14	1378342.05		Waste	
3	11572	405669	ST	15.0	17.5	6	481687.17	1378142.80		Waste	
3	11572	405672	ST	22.5	25.0	6	481687.17	1378142.80		Waste	
3	11572	405675	ST	30.0	32.5	6	481687.17	1378142.80		Waste	

TABLE 1 – BORING AND SAMPLE INDEX

Sample Indentification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(if reported)
4	1773	63747	ST	11.0	13.0	1	481696.36	1378864.51	588.80	Waste	
4	1774	63670	ST	10.0	12.0	1	481765.34	1378912.61	590.50	Waste	
4	1774	63687	ST	20.0	22.0	1	481765.34	1378912.61	590.50	Waste	
4	1775	63826	ST	15.0	17.0	1	481688.37	1378835.02	588.40	Waste	
4	1773	21A	CAN			3	481696.36	1378864.51	588.80		
4	1773	22A	CAN			3	481696.36	1378864.51	588.80		
4	1773	23A	CAN			3	481696.36	1378864.51	588.80		
4	1775	24A	CAN			3	481688.37	1378835.02	588.40		
4	1775	25A	CAN			3	481688.37	1378835.02	588.40		
4	1775	26A	CAN			3	481688.37	1378835.02	588.40		
4	04-01	4-02	COMP	0.0	20.0	4	481822.09	1378853.13			Clayey
4	04-04	4-62	COMP	0.0	20.0	4	481696.72	1378864.63			Clayey
4	04-04	4-62 Redue	COMP	0.0	20.0	4	481696.72	1378864.63			Clayey

TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(If reported)
5	(3)	30A	CAN			3					
5	(3)	31A	CAN			3					
5	(3)	32A	CAN			3					
5	(3)	33A	CAN			3					
5	(3)	34A	CAN			3					
5	(3)	35A	CAN			3					
5	(3)	36A	CAN			3					
5	(3)	37A	CAN			3					
5	(3)	38A	CAN			3					
5	(3)	39A	CAN			3					
5	(3)	40A	CAN			3					
5	(3)	41A	CAN			3					
5	(3)	57A	CAN			3					
5	(3)	58A	CAN			3					
5	05-04	5-25	COMP	10.0	29.0	4	482103.13	1378635.75			Clayey
5	WP5-1	405316	VC	14.5	15.0	5	482202.36	1378309.97			
5	WP5-1	405316	VC	19.5	20.0	5	482202.36	1378309.97			
5	WP5-1	405316	VC	24.5	25.0	5	482202.36	1378309.97			
5	WP5-2	405318	VC	9.0	14.0	5	482158.95	1378298.31			
5	WP5-2	405318	VC	19.0	24.0	5	482158.95	1378298.31			
5	WP5-3	405320	VC	13.5	19.0	5	482172.61	1378416.80			
5	WP5-3	405320	VC	19.0	24.0	5	482172.61	1378416.80			
5	WP5-4	405322	VC	9.5	14.5	5	482121.15	1378428.45			
5	WP5-4	405322	VC	19.0	19.5	5	482121.15	1378428.45			
5	WP5-5	405324	VC	10.5	15.5	5	482130.40	1378497.55			
5	WP5-5	405324	VC	15.5	20.5	5	482130.40	1378497.55			
5	WP5-5	405324	VC	25.0	25.5	5	482130.40	1378497.55			
5	WP5-6	405326	VC	9.0	14.0	5	482095.08	1378530.25			
5	WP5-6	405326	VC	14.0	19.0	5	482095.08	1378530.25			
5	WP5-6	405326	VC	23.5	24.0	5	482095.08	1378530.25			
5	WP5-7	405328	VC	13.5	18.5	5	482126.85	1378600.72			
5	WP5-7	405328	VC	18.5	24.0	5	482126.85	1378600.72			
5	WP5-8	405330	VC	9.0	14.0	5	482083.10	1378594.38			
5	WP5-8	405330	VC	14.0	18.5	5	482083.10	1378594.38			
5	WP5-8	405330	VC	18.5	24.0	5	482083.10	1378594.38			
5	WP5-9	405332	VC	13.5	14.0	5	482051.15	1378647.34			
5	WP5-9	405332	VC	18.5	19.0	5	482051.15	1378647.34			
5	WP5-9	405332	VC	23.5	24.0	5	482051.15	1378647.34			
5	WP5-10	405334	VC	9.0	14.0	5	482085.83	1378751.96			
5	WP5-10	405334	VC	18.5	24.0	5	482085.83	1378751.96			
5	WP5-11	405336	VC	12.0	12.5	5	482055.52	1378819.20			
5	WP5-11	405336	VC	17.0	17.5	5	482055.52	1378819.20			
5	WP5-11	405336	VC	22.0	22.5	5	482055.52	1378819.20			
5	WP5-12	405338	VC	15.5	16.0	5	482078.90	1378865.70			
5	WP5-13	405340	VC	13.5	14.0	5	482021.10	1378857.08			
5	WP5-14	405342	VC	10.5	16.0	5	482046.61	1378925.25			
5	1 (1)	*****	VC	24.5	25.0	5					
5	***** (1)	*****	VC	***	***	5					
5	WP5-5A	405325	VC	15.0	20.0	6	482130.42	1378497.55		Waste	
5	WP5-5A	405325	VC	20.0	25.0	6	482130.42	1378497.55		Waste	
5	WP5-11A	405337	VC	12.5	17.5	6	482057.85	1378819.20		Waste	

TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(If reported)
6	WP6-1	405344	VC	8.0	13.0	5	481922.58	1379200.12			
6	WP6-2	405346	VC	7.0	12.0	5	481848.66	1379158.40			
6	WP6-3	405348	VC	8.5	9.0	5	481864.08	1379126.79			
6	WP6-3	405348	VC	13.5	14.0	5	481864.08	1379126.79			
6	WP6-4	405350	VC	10.5	11.0	5	481946.08	1379137.02			
6	WP6-5	405352	VC	4.5	7.5	5	481898.62	1379180.74			
6	WP6-5	405352	VC	12.5	18.5	5	481898.62	1379180.74			
6	WP6-6	405354	VC	7.5	8.0	5	481911.47	1379130.15			
6	WP6-6	405354	VC	12.5	18.0	5	481911.47	1379130.15			
6	WP6-7	405355	VC	12.5	18.0	5	481878.92	1379146.28			
6	(3)	43A	CAN			3					
6	(3)	45A	CAN			3					
6	(3)	45C	CAN			3					
6	(3)	46A	CAN			3					
6	(3)	47A	CAN			3					
6	06-04	6-10	COMP	0.0	10.0	4	481887.47	1379205.00			Sludge
6	06-03	6-22	COMP	0.0	15.0	4	481938.28	1379176.38			Sludge

TABLE 1 – BORING AND SAMPLE INDEX

Sample Indentification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(If reported)
CW	(3)	49A	CAN			3					
CW	(3)	50A	CAN			3					
CW	(3)	51A	CAN			3					
CW	(3)	52A	CAN			3					
CW	(3)	53A	CAN			3					
CW	(3)	54A	CAN			3					
CW	(3)	55A	CAN			3					
CW	(3)	56A	CAN			3					
CW	11574	405678	ST	7.5	10	6	481363.73	1378090.31		Berm	
CW	11574	405679	JAR	10	11.5	6	481363.73	1378090.31		Berm	
CW	11574	405683	JAR	20	21.5	6	481363.73	1378090.31		Berm	
CW	11574	405684	ST	23	25	6	481363.73	1378090.31		Berm	
CW	11574	405685	JAR	25.0	26.5	6	481363.73	1378090.31		Berm	

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TABLE 1 – BORING AND SAMPLE INDEX

Sample Indentification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(If reported)
BP	1776	63176	ST	4.5	6.0	1	481718.86	1378630.15	584.80		
BP	1776	27A	CAN			3					
BP	1777	28A	CAN			3					
BP	1819	29A	CAN			3					
BP	07-01	7-02	COMP	0.0	10.0	4	481887.94	1378639.50			Sludge
BP	07-04	7-34	COMP	0.0	16.0	4	481729.66	1378575.50			Sludge
BP	07-04	7-34 Redue	COMP	0.0	16.0	4	481729.66	1378575.50			Sludge
BP	07-06	7-52	COMP	0.0	16.0	4	481630.91	1378527.75			Sludge

TABLE 1 – BORING AND SAMPLE INDEX

Sample Indentification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(if reported)
1, 4	1766, 1773	Group 1	CAN COMP			3					
5, 6	(3)	Group 2	CAN COMP			3					
5	(3)	Group 3	CAN COMP			3					
2, 3	1818, 1771	Group 4	CAN COMP			3					
6, BP	1819(3)	Group 5	CAN COMP			3					
4	1773, 1775	Group 6	CAN COMP			3					
2, CW	1768(3)	Group 7	CAN COMP			3					

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Indentification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends, underlying split spoon (SS) sample, or laboratory log and description	SPT N Value
1	1765	63089	ST	4.5	7	1	7–7.5 ft SS = Loose(10YR4/1)dk gray mottled with(2.5Y4/4)reddish brown clay–like material, moderate cohesion and plasticity, very moist	
1	1765	63101	ST	14.0	16.5	1	16.5–17 ft SS= Very loose(10YR4/1)dark gray silty clay like material,gelatinous in nature,good plasticity,poor cohesion,very moist	
1	1766	63050	ST	4.5	7	1	7–7.5 ft SS=Medium dense(2.5Y N4) gray claylike material, low plasticity, slight cohesion, moderately moist	
1	1766	63054	ST	8.5	11.0	1	11–11.5 ft SS=Firm (2.5Y N3/) very dark gray silty clay like, moderate cohesion,moderate plasticity, moist	
1	1766	63062	ST	14.0	16.5	1	16.5–17 ft SS=Soft(2.5Y N3) very dark gray clay–sized particles, consitency similar to gelatin, low plasticity, very moist	
1	1767	63008	ST	3.5	6.0	1	Bot ST = ash like powdery material with a waxy consistency, color was mottled gray, white, black, and yellow, moist.	
1	11352	400053	SS	2.0	3.0	2	Stiff, (2.5 YR 5/4) reddish brown, silt or ash–like to clay–like material, low to medium plasticity, lightweight, moist	6
1	11352	400054	SS	5.5	6.0	2	V. soft, (2.5 YR N/5) gray, clay size particle, paste–like material, cohesive, moist to wet	3
1	11352	400025	ST	7.5	10.0	2	Top ST= (2.5YR5/4) rdish brn silt– or ash–like to clay–like, moist to wet;Bot ST= hard (2.5YN/8) wht clay–silt matrix, f to m coarse grains, moist	
1	11352	400026	ST	11.5	14.0	2	Bot ST= very stiff, (2.5Y N/5) gray silty clay–like material, moist	
1	11353	400047	SS	4.5	5.5	2	Strat matl: stf (2.5Y4/4) olv brn sl clay w/gv, moist (4"); green granules, wet (2"), med stiff, (2.5Y4/4) olv brn sl clay w/ blk jelly, wet(2")	13
1	11353	400028	ST	10.0	12.5	2	Bot ST= (2.5Y N/5) gray fine to med sand–like matl, metal–like, silvery, moist (some particles dryed to white–gray powder)	
1	11353	400051	SS	13.5	14.0	2	Very soft, (2.5 Y N/7) lt gray, pudding– to "cake icing–" like material, smooth to granular, very light weight, wet	3
1	11354	400029	ST	7.5	10.0	2	Bot ST = (2.5 Y N/7) lt gray powdery, waxy material, slightly cohesive, very light weight, moist (drys to a white very fine powder)	
1	11354	400030	ST	11.5	14.0	2	14–14.5 ft SS= Soft, (2.5 Y N/2), black sandy clay–like material, med grains, pockets of white waxy material, some cly sand matl, moist to wet	
1	1765	1A	CAN			3		
1	1765	2A	CAN			3		
1	1765	3A	CAN			3		
1	1766	4A	CAN			3		
1	1766	5A	CAN			3		
1	1766	6A	CAN			3		
1	1766	7A	CAN			3		
1	1767	8A	CAN			3		
1		1–48	COMP	0.0	12.0	4		
1	T1–S[16]	200139860	COMP	13.0 [17]		2	Gray with some light blue dry material	
1	T1–N[16]	200128961	COMP	3.0	5.0	2	Reddish–gray coarse sand like material with some black material beginning at 4.0 ft	
1	11568	405653	ST	10.5	13.0	6	Bot ST = (10 YR 5/1) gray, sandy silt with 15–20% white plates, slightly moist, non–plastic	

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Indentification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends, underlying split spoon (SS) sample, or laboratory log and description	SPT N Value
2	1768	63619	ST	11.0 [1]	13.0 [1]	1	13–13.5 ft SS=Very soft (2.5Y N7) light gray clay size material interspersed with white granular material, wet pasty consistency	
2	1768	63619dup	ST	11.0 [1]	13.0 [1]	1	13–13.5 ft SS=Very soft (2.5Y N7) light gray clay size material interspersed with white granular material, wet pasty consistency	
2	1769	63521	ST	12.0	14.0	1	14–14.5 ft SS= Very loose (5Y 6/3) pale olive, clay–like material, pasty consistency, wet	
2	1769	63530	ST	18.0	20.0	1	20–20.5 ft SS= Very soft (5Y 8/1) white clay size material with some black streaking, pasty consistency, wet	
2	1817	63875	ST	10.5	12.5	1	13–13.5 ft SS= Very soft (10YR, 8/2) white clay material streaked with black, pasty consistency, very moist	
2	1818	63865	ST	5.0	7.5	1	7.5–8.0 ft SS= Very dense (10YR, 3/3) dark brown silty clay, fragments of brick, very wet	
2	11358	400031	ST	6.0	8.5	2	8.5–9.0 SS= V. soft (10 YR 6/8) brnish yel, lt wt matl, vesicular appearance of "ice cream", somewhat clay–like, low to med plas, v. moist	
2	11358	400062	SS	8.5	10.0	2	V. soft (10 YR 6/8) brnish yel, lt wt matl, vesicular appearance of "ice cream", somewhat clay–like, low to med plas, v. moist	0
2	11359	400033	ST	4.5	7.0	2	Bot of ST: Very soft, (7.5 YR 5/8) stong brown "clay–like" material, high plasticity, very moist	
2	11359	400034	ST	8.5	11.0	2	Bot of ST: Very soft, (7.5 YR 5/8) stong brown "clay–like" material, high plasticity, very moist	
2	1768	9A	CAN			3		
2	1769	10A	CAN			3		
2	1818	11A	CAN			3		
2	1817	12A	CAN			3		
2	02–05	2–39	COMP	0.0	10.0	4		
2	T2–N[1a]	200129059	COMP	7.0	8.0	2	Red clay like material	
2	11569	405655	ST	7.5	10.0	6	Bot ST = (5YR 6/8) reddish–yellow, clayey silty, moist, low plasticity, pudding like texture	

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Indentification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends, underlying split spoon (SS) sample, or laboratory log and description	SPT N Value
3	1770	63326	ST	4.0	6.0	1	6–6.5 ft SS= Loose (10YR 2/1) black medium sand with sparse angular gravel poor cohesion, very wet	
3	1770	63357	ST	20.0	22.0	1	22–22.5 ft SS= Very loose (2.5Y 4/8) red clay–like material pudding consistency, very moist	
3	1770	63370	ST	28.0	30.0	1	30–30.5 ft SS= Very loose (2.5Y 4/6) red clay–like material, pasty consistency, very moist	
3	1771	63456	ST	32.0	34.0	1	34–34.5 ft SS=Very loose(2.5YR4/8) red clay like mat. streaked w black & sparse(5Y8/4) pale yellow material, pasty consistency, very moist	
3	1772	63278	ST	19.5	22.0	1	22–22.5 ft SS= Loose (5Y 2.5/1) black fine to medium sand, poor cohesion, wet	
3	11360	400097	SS	13.0	13.5	2	Strat matl: v soft gray gvly clay w/sd, fiberous roots, wet(1"); stf, lt olive brn sandy clay, mst (2"); v. soft ylsh red & brn "pudding–like" matl, wet	4
3	11360	400100	SS	13.5	14.0	2	V soft, (10 YR 3/1) very dark gray sandy (fine sand) clay with silt, wet	4
3	11360	400035	ST	20.5	23.0	2	Bot ST = Very stiff (2.5Y 4/2) dark grayish brown sandy, silty clay with fine to coarse sand, high plasticity, very moist	
3	11361	400038	ST	10.5	13.0	2	9.0–10.5 ft SS= Very soft (10R 5/8) red clay–like, high plasticity, moist to wet	
3	11361	400039	ST	21.0	22.5	2	Very soft (10R 5/8) red clay–like, high plasticity, moist to wet	
3	11361	400040	ST	29.0	31.5	2	28.0–29.0 ft SS= Very soft (7.5YR 3/4) brown pudding–like w/some red clay–like material, blk flyash and brnish yellow paste–like material mixed, wet	
3	11362	400076	SS	6.0	6.5	2	Loose, (2.5 Y N2) black, silty–like coal ash, metallic luster or sheen, wet	10
3	11362	400077	SS	6.5	7.0	2	Loose, (2.5 Y N2) black, silty–like coal ash, metallic luster or sheen, wet	10
3	11362	400041	ST	19.0	21.5	2	Bot ST: Very soft, (2.5YR 4/8) red "pudding–like" and (10 YR 6/3) pale brown "dough–like" material, swirled together, wet	
3	11362	400042	ST	23.0	25.5	2	Bot ST: (2.5 Y 5/4) olive brown silty "clay–like" waxy material, light weight, moist	
3	11363	400044	ST	12.0	14.5	2	Top ST: v soft (2.5 Y 4/2) dk grayish brown si clay, some f to c sand, trace flyash and yel part, high plast, v moist; Bot ST: blk granular sludge, wet	
3	11363	400045	ST	19.0	21.5	2	Loose, (2.5 N/2) black granular sludge, fine to coarse, wet	
3	1770	13A	CAN			3		
3	1770	14A	CAN			3		
3	1770	15A	CAN			3		
3	1771	16A	CAN			3		
3	1771	17A	CAN			3		
3	1772	18A	CAN			3		
3	1772	19A	CAN			3		
3	03–05	3–52	COMP	0.0	20.0	4		
3	03–05	3–52 Redue	COMP	0.0	20.0	4		
3	03–02	3–90	COMP	0.0	20.0	4		
3	03–02	3–90 Redue	COMP	0.0	20.0	4		
3	T3–N[16]	200129035	COMP	17.0 [17]			Red, gray, orange, and white clay like material	
3	T3–C[16]	200139885	COMP	13.0 [17]			Black ash with trace of red pudding like material	
3	11570	405657	ST	10.5	13.0	6	Bot ST= (5YR 4/4) reddish–brown, clay size particles, wet, non–plastic, pudding like texture	
3	11570	405658	ST	15.5	18.0	6	Bot ST= (5YR 5/3) pink, clay size particles, medium plasticity, moist, pudding like texture	
3	11571	405663	ST	17.5	20.0	6	Bot ST= (7.5YR 7/6) reddish–yellow, clayey silt, non–plastic, moist, pudding like texture	
3	11571	405667	ST	32.5	35.0	6	Bot ST= (2.5Y 7/3) pale yellow, clayey silt, slightly moist, non–plastic, pudding like texture	
3	11572	405669	ST	15.0	17.5	6	Bot ST= (7.5YR 4/3) brown with (7.5YR 7/1) light gray, clay, very moist, non–plastic	
3	11572	405672	ST	22.5	25.0	6	Bot ST= (2.5Y 4/1) dark gray marbled with (2.5Y 7/6) yellow, silty clay, moist, slight plasticity	
3	11572	405675	ST	30.0	32.5	6	Bot ST= (2.5Y 4/1) dark gray marbled with (2.5Y 7/6) yellow, silty clay, moist, slight plasticity	

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Indentification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends, underlying split spoon (SS) sample, or laboratory log and description	SPT N Value
4	1773	63747	ST	11.0	13.0	1	13.0–13.5 ft SS = Dense (2.5 Y N2/) black, clayey, sludgy matl. w/flecks of purple, yellow, green matl., very wet, used motor oil consistency, flows like mud, some large chunks of material	
4	1774	63670	ST	10.0	12.0	1	12.0–12.5 ft SS = Medium dense (2.5 Y N3/) very dark gray silty clayey material, very moist to wet, jello like consistency (rubbery), waxy appearance	
4	1774	63687	ST	20.0	22.0	1	22.0–22.5 ft SS = Dense (2.5, N3/) clay–like material consistent throughout, uniformly moist, greasy consistency	
4	1775	63826	ST	15.0	17.0	1	17.0–17.5 ft SS = loose, very soft (2.5 Y, N3/) very dark gray clay–like material with streaks of yellowish material, wet, flowing, jello–like	
4	1773	21A	CAN			3		
4	1773	22A	CAN			3		
4	1773	23A	CAN			3		
4	1775	24A	CAN			3		
4	1775	25A	CAN			3		
4	1775	26A	CAN			3		
4	04–01	4–02	COMP	0.0	20.0	4		
4	04–04	4–62	COMP	0.0	20.0	4		
4	04–04	4–62 Redue	COMP	0.0	20.0	4		

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Sample Indentification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends, underlying split spoon (SS) sample, or laboratory log and description	SPT N Value
5	(3)	30A	CAN			3		
5	(3)	31A	CAN			3		
5	(3)	32A	CAN			3		
5	(3)	33A	CAN			3		
5	(3)	34A	CAN			3		
5	(3)	35A	CAN			3		
5	(3)	36A	CAN			3		
5	(3)	37A	CAN			3		
5	(3)	38A	CAN			3		
5	(3)	39A	CAN			3		
5	(3)	40A	CAN			3		
5	(3)	41A	CAN			3		
5	(3)	57A	CAN			3		
5	(3)	58A	CAN			3		
5	05-04	5-25	COMP	10.0	29.0	4		
5	WP5-1	405316	VC	14.5	15.0	5	dark brown with black streaks and patches, very soft, wet clay like material, light gray material intermittently dispersed throughout sample	
5	WP5-1	405316	VC	19.5	20.0	5	salmon red mottled with gray and white, very soft, very wet clay material	
5	WP5-1	405316	VC	24.5	25.0	5	fleshy peach and gray, very soft, some cohesion, wet material with pudding cosistency	
5	WP5-2	405318	VC	9.0	14.0	5	Top =brown and gray with black streaks, very wet, very soft material Bot=gray, soft, wet material	
5	WP5-2	405318	VC	19.0	24.0	5	light gray to dark salmon red, very soft, wet clay material	
5	WP5-3	405320	VC	13.5	19.0	5	light to medium gray with streaks of white, salmon, and light brown, soft, wet material	
5	WP5-3	405320	VC	19.0	24.0	5	Top and Bot=dark brown, soft, wet clay Middle=white with brown and orange streaks, soft, wet material	
5	WP5-4	405322	VC	9.5	14.5	5	Top=white, stiff, greasy material Bot=gray, very soft material	
5	WP5-4	405322	VC	19.0	19.5	5	Top=gray mottled with peach and white, very soft material Bot=dark peach, very moist, stiffer than top portion	
5	WP5-5	405324	VC	10.5	15.5	5	orange-peach with gray and white streaks, soft clay-like material	
5	WP5-5	405324	VC	15.5	20.5	5	peach-salmon red with intermittent white globs and light brown patches, soft, wet, clay material	
5	WP5-5	405324	VC	25.0	25.5	5	dark brown with light brown and white streaks, very moist, soft clay material	
5	WP5-6	405326	VC	9.0	14.0	5	layered coco brown, white with golden grown patches, red, light brown-cream, very soft to stiff, moist to wet clay material	
5	WP5-6	405326	VC	14.0	19.0	5	salmon with layers of white and gray and mottled with tan and light brown, soft, very wet clay material	
5	WP5-6	405326	VC	23.5	24.0	5	medium-dark to light brown mixed with dark brown, brick red and striations of white, soft to med. stiff, moist to wet clay material	
5	WP5-7	405328	VC	13.5	18.5	5	light brown with fleshy-peach to brown to red brown, very soft, wet clay	
5	WP5-7	405328	VC	18.5	24.0	5	salmon to light brown, very soft, wet clay material	
5	WP5-8	405330	VC	9.0	14.0	5	salmon mottled with brown and white, extremely soft and wet clay material	
5	WP5-8	405330	VC	14.0	18.5	5	Top =2.5Y 4/8 Red with 5Y8/1 White Bottom=5YR 6/1 Gray with some 2.5YR 6/4 Light Reddish Brown, pudding like, no plasticity, very moist	
5	WP5-8	405330	VC	18.5	24.0	5	light brown mottled with gray, white and salmon, soft, very moist clay material	
5	WP5-9	405332	VC	13.5	14.0	5	dark gray mottled with white, light gray and yellow material	
5	WP5-9	405332	VC	18.5	19.0	5	dark brown with interior pockets of light brown and red, soft, moist material; exterior streaked with light brown and tan	
5	WP5-9	405332	VC	23.5	24.0	5	dark brown to tan mottled with light gray, light yellow and white, soft, wet clay material	
5	WP5-10	405334	VC	9.0	14.0	5	coco brown, very soft, wet clay material; interior blueish-gray with streaks of rust colored clay material	
5	WP5-10	405334	VC	18.5	24.0	5	dark brown with intermittence of salmon and gray, layers of gray and salmon, very wet and soft clay material	
5	WP5-11	405336	VC	12.0	12.5	5	brown becoming mixed with light gray mottled with pink, soft, wet, clay material	
5	WP5-11	405336	VC	17.0	17.5	5	brown mottled with gray and light brown, soft, moist clay	
5	WP5-11	405336	VC	22.0	22.5	5	dark brown to black clay mottled with white and dark gray clay material	
5	WP5-12	405338	VC	15.5	16.0	5	light gray, light brown, peach and gray-brown vertically striated, soft, wet clay material	
5	WP5-13	405340	VC	13.5	14.0	5	gray mottled with white, brown and black, soft, wet clay	
5	WP5-14	405342	VC	10.5	16.0	5	dark brown with brick red and light brown streaks and gray, soft to medium stiff, moist to wet clay	
5	1 (18)	*****	VC	24.5	25.0	5	Top=brown, medium stiff clay Bot=marbled with brown, gray, brick red, white, very soft, wet, clay	
5	***** (18)	*****	VC	***	***	5	brown, gray and white, very soft and wet clay mixture; gray portion is greasy	
5	WP5-5A	405325	VC	15.0	20.0	6	Top =10YR 6/2 Pale Red Botttom=5YR 6/4 Light Reddish Brown, pudding like material, no plasticity, very moist	
5	WP5-5A	405325	VC	20.0	25.0	6	Top =5YR 6/4 Light Reddish Brown Bottom=10YR 2/1 Black, pudding like material, no plasticity, moist to very moist	
5	WP5-11A	405337	VC	12.5	17.5	6	Top =5YR 8/4 Pink with 5YR 6/1 Light Gray Bottom=5YR 4/2 Dark Reddish Gray, pudding like material, no plasticity, very moist	

TABLE 2 – BORING LOG VISUAL DESCRIPTION

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Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends, underlying split spoon (SS) sample, or laboratory log and description	SPT N Value
6	WP6-1	405344	VC	8.0	13.0	5	top= black with yellow and gray, soft, sticky, very moist material Bot=white-gray, soft, sticky, very moist material	
6	WP6-2	405346	VC	7.0	12.0	5	black coal-like, medium stiff, granular material with yellow clay-like mottles	
6	WP6-3	405348	VC	6.5	9.0	5	black, medium stiff, very wet silt	
6	WP6-3	405348	VC	13.5	14.0	5	black, uniform, granular material	
6	WP6-4	405350	VC	10.5	11.0	5	black to dark gray, very soft material	
6	WP6-5	405352	VC	4.5	7.5	5	top= black soft material bot= black outside with green and yellow granular interior	
6	WP6-5	405352	VC	12.5	18.5	5	black, soft, wet silt-like material	
6	WP6-6	405354	VC	7.5	8.0	5	black, medium stiff, moist, sandy, clayey silt	
6	WP6-6	405354	VC	12.5	18.0	5	black, medium stiff to loose, dry to moist clay-like material	
6	WP6-7	405355	VC	12.5	18.0	5	black, loose to med. stiff, dry to wet clay-like material	
6	(3)	43A	CAN			3		
6	(3)	45A	CAN			3		
6	(3)	45C	CAN			3		
6	(3)	46A	CAN			3		
6	(3)	47A	CAN			3		
6	06-04	6-10	COMP	0.0	10.0	4		
6	06-03	6-22	COMP	0.0	15.0	4		

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TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Indentification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends, underlying split spoon (SS) sample, or laboratory log and description	SPT N Value
CW	(3)	49A	CAN			3		
CW	(3)	50A	CAN			3		
CW	(3)	51A	CAN			3		
CW	(3)	52A	CAN			3		
CW	(3)	53A	CAN			3		
CW	(3)	54A	CAN			3		
CW	(3)	55A	CAN			3		
CW	(3)	56A	CAN			3		
CW	11574	405678	ST	7.5	10	6	(2.5Y 5/4) light olive brown, moist, slight plasticity clayey silt with trace sand and roots	
CW	11574	405679	JAR	10	11.5	6	(5Y 5/2) olive gray, slightly moist, non–plastic, fine sandy silt	
CW	11574	405683	JAR	20	21.5	6	(7.5YR 4/1) dark gray, slight moist, non–plastic silt with trace sand mottled with 15% (7.5YR 5/8) strong brown, slightly moist, non–plastic, clayey silt with trace sand	
CW	11574	405684	ST	23	25	6	(2.5Y 4/1) dark gray, low moisture, low plasticity, clayey silt	
CW	11574	405685	JAR	25.0	26.5	6	(2.5Y 5/1) dark gray clayey silt with some coarse sand and fine gravel, mottled with (2.5Y 5/4) light olive brown, moist, non–plastic clayey silt	

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Sample Indentification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends, underlying split spoon (SS) sample, or laboratory log and description	SPT N Value
BP	1776	63176	ST	4.5	6.0	1	6.0–6.5 ft SS = Loose (2.5 Y 4/2) dark grayish brown silty clay, moderate cohesion and plasticity, wet	
BP	1776	27A	CAN			3		
BP	1777	28A	CAN			3		
BP	1819	29A	CAN			3		
BP	07-01	7-02	COMP	0.0	10.0	4		
BP	07-04	7-34	COMP	0.0	16.0	4		
BP	07-04	7-34 Redue	COMP	0.0	16.0	4		
BP	07-08	7-52	COMP	0.0	16.0	4		

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Sample Indentification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends, underlying split spoon (SS) sample, or laboratory log and description	SPT N Value
1, 4	1766, 1773	Group 1	CAN COMP			3		
5, 6	[2]	Group 2	CAN COMP			3		
5	[2]	Group 3	CAN COMP			3		
2, 3	1818, 1771	Group 4	CAN COMP			3		
6, BP	1819[2]	Group 5	CAN COMP			3		
4	1773, 1775	Group 6	CAN COMP			3		
2, CW	1768[2]	Group 7	CAN COMP			3		

TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
1	1765	63089	ST	4.5	7	1	23.6	3.0327	0.1	9.6	90.3	4	NP	NP	NP	ML (NP)	Silt (NP)
1	1765	63101	ST	14.0	16.5	1	20.9	2.92	0.0	8.3	91.7	10.0	NP	NP	NP	ML (NP)	Silt (NP)
1	1766	63050	ST	4.5	7	1	19.3	3.0342	0.2	8.6	91.2	8	20	17	3	ML	Silt
1	1766	63054	ST	8.5	11.0	1	15.9	3.15	0.0	10.0	90.0	4.0	NP	NP	NP	ML (NP)	Silt (NP)
1	1766	63062	ST	14.0	16.5	1	21.8	3.03	0.0	10.2	89.8	5.0	NP	NP	NP	ML (NP)	Silt (NP)
1	1767	63008	ST	3.5	6.0	1	23.3	3.07	3.1	25.8	71.1	3.0	NP	NP	NP	ML (NP)	Silt (NP) with Sand
1	11352	400053	SS	2.0	3.0	2	33.9		0.0	4.0	96.0	10.0	24.9	26.4		ML (NP)	Silt (NP)
1	11352	400054	SS	5.5	6.0	2	27.7		0.0	6.0	94.0	5.5	20.2	22.3		ML (NP)	Silt (NP)
1	11352	400025	ST	7.5	10.0	2	19.6	3.09	0.7	10.3	89.0	7.5	19.1	22.8		ML (NP)	Silt (NP)
1	11352	400026	ST	11.5	14.0	2	44.8	3.05	5.5	48.5	46.0	3.5	42.1	42.5		SM	Silty Sand
1	11353	400047	SS	4.5	5.5	2	19.3		19.0	28.0	53.0	13.0				ML (NP)	Sandy Silt (NP) with Gravel
1	11353	400028	ST	10.0	12.5	2	18.3	3.05	1.0	15.5	83.5	6.5	19.9	20.8		ML (NP)	Silt (NP) with Sand
1	11353	400051	SS	13.5	14.0	2	30.9		3.0	28.3	68.7	1.3				ML (NP)	Sandy Silt (NP)
1	11354	400029	ST	7.5	10.0	2	23.1	3.11	0.1	3.9	96.0	7.3	18.9	22.9		ML (NP)	Silt (NP)
1	11354	400030	ST	11.5	14.0	2	47.3	2.80	2.0	50.0	48.0	6.7	67.7	68.2		SM	Silty Sand
1	1765	1A	CAN			3	20.3		0.0	14.2	85.5		NP	NP	NP	ML (NP)	Silt (NP)
1	1765	2A	CAN			3	24.7		0.0	13.2	86.8		NP	NP	NP	ML (NP)	Silt (NP)
1	1765	3A	CAN			3	39.1		2.9	26.8	70.3		NP	NP	NP	ML (NP)	Silt (NP) with Sand
1	1766	4A	CAN			3	18.0		0.0	9.0	91.0		NP	NP	NP	ML (NP)	Silt (NP)
1	1766	5A	CAN			3	20.7	3.02	0.4	10.8	88.8	0.0	NP	NP	NP	ML (NP)	Silt (NP)
1	1766	6A	CAN			3	21.1		0.0	9.0	91.0		NP	NP	NP	ML (NP)	Silt (NP)
1	1766	7A	CAN			3	20.7		1.1	9.8	89.1		NP	NP	NP	ML (NP)	Silt (NP)
1	1767	8A	CAN			3	22.7		3.9	37.6	58.5		NP	NP	NP	ML (NP)	Silt (NP)
1		1-48	COMP	0.0	12.0	4	17.2	2.62	32.5	24.5	43.0	14.0	34.0	23.0	11.0	GC	Clayey Gravel with Sand
1	T1-S[1]	200139860	COMP	13.0[1]		2											
1	T1-N[1]	200128961	COMP	3.0	5.0	2											
1	11568	405653	ST	10.5	13.0	6	50.4	2.77	0.8	46.5	52.7	13.3	66.3	57.8	8.4	MH	Sandy Elastic Silt

TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	Atterberg Limits LL	PL	PI	USCS Group Symbol	Group Name
2	1768	63619	ST	11.0 (1)	13.0 (1)	1	290.0	2.80	0.0	39.0	61.0	5.0	NP	NP	NP	ML (NP)	Sandy Silt (NP)
2	1768	63619dup	ST	11.0 (1)	13.0 (1)	1	316.6	2.79	0.0	28.5	71.5	3.0	NP	NP	NP	ML (NP)	Silt (NP) with Sand
2	1769	63521	ST	12.0	14.0	1	231.2	2.64	0.3	40.2	59.5	4.0	117.0	73.0	44.0	MH	Sandy Elastic Silt
2	1769	63530	ST	18.0	20.0	1	169.8	2.64	1.8	40.1	58.1	4.0	181.0	109.0	72.0	MH	Sandy Elastic Silt
2	1817	63875	ST	10.5	12.5	1	32.7	2.65	25.4	45.5	29.1	8.0	36.0	28.0	8.0	SM	Silty Sand with Gravel
2	1818	63865	ST	5.0	7.5	1	21.4	2.20	18.1	67.3 (1)	14.6 (1)	8.0	24.0	14.0	10.0	SC	Clayey Sand with Gravel
2	11358	400031	ST	6.0	8.5	2	24.1	2.69	21.5	32.2	46.3	11.0	33.4	20.3	13.2	SC	Clayey Sand with Gravel
2	11358	400062	SS	8.5	10.0	2	245.7		0.0	0.0	100.0	8.6					
2	11359	400033	ST	4.5	7.0	2	109.6	3.02	0.0	1.3	98.7	8.0	78.1	64.0	15.3	MH	Elastic Silt
2	11359	400034	ST	8.5	11.0	2	98.2	2.86	4.7	14.0	81.3	1.8	76.3	66.2	10.2	MH	Elastic Silt with Sand
2	1768	9A	CAN			3	35.4		1.0	55.1	43.9		33.1	23.2	9.9	SM	Silty Sand
2	1769	10A	CAN			3	38.3	2.72	7.6	26.1	66.3	22.2	42.3	23.1	19.2	CL	Sandy Lean Clay
2	1818	11A	CAN			3	70.5	2.67	5.5	27.8	66.7	11.7	66.8	42.2	24.6	MH	Sandy Elastic Silt
2	1817	12A	CAN			3	16.7		4.2	22.3	73.5		44.1	16.2	27.9	CL	Lean Clay with Sand
2	02-05	2-39	COMP	0.0	10.0	4	31.9	2.59	20.0	19.0	61.0	22.0	53.0	32.0	21.0	MH	Gravelly Elastic Silt with Sand
2	T2-N(1)	200129059	COMP	7.0	8.0	2											
2	11569	405655	ST	7.5	10.0	6	139.0	2.98	0.0	9.3	90.7	17.7	75.1	56.8	18.3	MH	Elastic Silt

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Sample Indentification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	Atterberg Limits LL	PL	PI	USCS Group Symbol	Group Name
3	1770	63328	ST	4.0	6.0	1	63.7	2.20	0.5	56.0	43.5	8.0	NP	NP	NP	SM	Silty Sand
3	1770	63357	ST	20.0	22.0	1	138.7	2.84	0.2	56.4	43.4	6.0	116.0	55.0	61.0	SM	Silty Sand
3	1770	63370	ST	28.0	30.0	1	131.1	2.77	1.1	48.6	50.3	4.0	119.0	48.0	71.0	MH	Sandy Elastic Silt
3	1771	63458	ST	32.0	34.0	1	55.1	2.84	0.2	37.1	62.7	3.0	93.0	68.0	25.0	MH	Sandy Elastic Silt
3	1772	63278	ST	19.5	22.0	1	35.4	2.45	1.3	45.8	52.9	15[1]	NP	NP	NP	ML(NP)	Sandy Silt
3	11360	400097	SS	13.0	13.5	2	54.3		0.8	11.2	88.0	10.0	45.4	28.1	18.7	ML	Silt
3	11360	400100	SS	13.5	14.0	2	54.3[1]		0.8[1]	11.2[1]	88.0[1]	10.0[1]	45.4[1]	28.1[1]			
3	11360	400035	ST	20.5	23.0	2	18.0	2.69	4.0	24.5	71.5	25.3	26.3	16.2	10.1	CL	Lean Clay with Sand
3	11361	400038	ST	10.5	13.0	2	196.9	2.88	0.0	0.0	100.0	17.0	92.2	74.6	18.6	MH	
3	11361	400039	ST	21.0	22.5	2											
3	11361	400040	ST	29.0	31.5	2	102.8	2.96	0.0	4.0	96.0	7.3	45.7	33.9	12.2	ML	Silt
3	11362	400076	SS	6.0	6.5	2	84.6[1]		7.0[1]	32.7[1]	60.3[1]	6.3[1]	51.0[1]	57.8[1]		ML (NP)	
3	11362	400077	SS	6.5	7.0	2	84.6		7.0	32.7	60.3	6.3	51.0	57.8		ML (NP)	Sandy Silt (NP)
3	11362	400041	ST	19.0	21.5	2	87.5	2.88	2.5	47.8	49.7		73.2	56.2	17.0	SM	Silty Sand
3	11362	400042	ST	23.0	25.5	2	173.6	2.60	0.6	42.9	56.5		91.0	56.9	34.1	MH	Sandy Elastic Silt
3	11363	400044	ST	12.0	14.5	2	25.3	2.79	5.3	22.4	72.3	23.0	30.0	24.8	4.6	ML	Silt with Sand
3	11363	400045	ST	19.0	21.5	2	44.7	2.39	2.4	30.7	66.9	7.3	45.7	53.7		ML (NP)	Sandy Silt (NP)
3	1770	13A	CAN			3	145.4		3.2	33.7	63.1		89.7	55.8	33.9	MH	Sandy Elastic Silt
3	1770	14A	CAN			3	152.7		3.5	23.8	72.7		81.8	58.9	22.9	MH	Elastic Silt with Sand
3	1770	15A	CAN			3	42.2	2.69	6.5	25.8	67.7	3.1	46.9	31.7	15.2	ML	Sandy Silt
3	1771	16A	CAN			3	96.8	2.72	3.3	27.0	69.7	15.7	77.8	44.3	33.5	MH	Sandy Elastic Silt
3	1771	17A	CAN			3	142.0		1.0	15.3	83.7		69.9	53.9	16.0	MH	Elastic Silt with Sand
3	1772	18A	CAN			3	41.9		2.5	40.9	56.6		37.9	30.5	7.4	ML	Sandy Silt
3	1772	19A	CAN			3	36.1		6.0	19.9	74.1		44.1	25.2	18.9	CL	Lean Clay with Sand
3	03-05	3-52	COMP	0.0	20.0	4	55.9	2.54			67.0	10.0	52.0	32.0	20.0	MH	Sandy Elastic Silt
3	03-05	3-52 Redue	COMP	0.0	20.0	4	57.0		9.0	25.0	66.0	13.0					
3	03-02	3-90	COMP	0.0	20.0	4	43.3				68.0	11.0	38.0	33.0	5.0	ML	Sandy Silt
3	03-02	3-90 Redue	COMP	0.0	20.0	4	41.6	2.65	5.0	29.0	66.0	15.0					
3	T3-N[1]	200129035	COMP	17.0[17]													
3	T3-C[1]	200139885	COMP	13.0[17]													
3	11570	405657	ST	10.5	13.0	6	268.7	2.83	0.0	52.1	47.9	1.9	96.9	53.9	42.9	SM	Silty Sand
3	11570	405658	ST	15.5	18.0	6	295.3	1.99	0.0	46.2	53.8	3.4	73.0	42.2	30.8	MH	Sandy Elastic Silt
3	11571	405663	ST	17.5	20.0	6	217.2	2.78	0.0	14.4	85.6	5.9	80.2	63.4	16.8	MH	Elastic Silt
3	11571	405687	ST	32.5	35.0	6	205.5	2.82	0.0	4.0	96.0	2.1	88.0	70.5	17.6	MH	Elastic Silt
3	11572	405669	ST	15.0	17.5	6	186.1	2.77	0.0	36.8	63.2	5.8	73.1	47.2	25.9	MH	Sandy Elastic Silt
3	11572	405672	ST	22.5	25.0	6	194.3	2.76	0.0	59.4	40.6	5.7	62.0	46.5	15.5	SM	Silty Sand
3	11572	405675	ST	30.0	32.5	6		2.67	0.0	25.7	74.3	7.8	98.2	72.5	25.7	MH	Elastic Silt with Sand

TABLE 3 – INDEX PROPERTIES DATA

Sample Indentification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
4	1773	63747	ST	11.0	13.0	1	21.4	2.62	2.1	41.4	56.5	19.0	34.0	26.0	8.0	CL	Sandy Lean Clay
4	1774	63670	ST	10.0	12.0	1	15.9	2.79	0.8	22.6	76.6	20.0	32.0	22.0	10.0	CL	Lean Clay with Sand
4	1774	63687	ST	20.0	22.0	1	17.6	3.10	0.3	7.6	92.1	11.0	NP	NP	NP	ML (NP)	Silt (NP)
4	1775	63826	ST	15.0	17.0	1	61.5	3.59	0.1	36.0	63.9	4.0	41.0	34.0	7.0	CL-ML	Sandy Silty Clay
4	1773	21A	CAN			3	18.0	3.25	6.4	29.5	64.1	6.6	28.4	18.5	9.9	CL	Sandy Lean Clay
4	1773	22A	CAN			3	23.3		0.0	12.0	88.0		NP	NP	NP	ML (NP)	Silt (NP)
4	1773	23A	CAN			3	22.2	3.02	0.8	15.2	84.0	8.4	NP	NP	NP	ML (NP)	Silt (NP) with Sand
4	1775	24A	CAN			3	10.1		13.4	24.7	61.9		33.9	16.7	17.2	CL	Sandy Lean Clay
4	1775	25A	CAN			3	25.4		1.2	34.7	64.1		34.1	21.8	12.3	CL	Sandy Lean Clay
4	1775	26A	CAN			3	29.3		1.2	18.0	80.8		NP	NP	NP	ML (NP)	Silt (NP) with Sand
4	04-01	4-02	COMP	0.0	20.0	4	27.0	2.75	0.0	6.0	94.0	6.0	NP	NP	NP	ML (NP)	Silt (NP)
4	04-04	4-62	COMP	0.0	20.0	4	28.6	3.33	7.0	38.0	55.0	6.0	NP	NP	NP	ML (NP)	Sandy Silt (NP)
4	04-04	4-62 Redue	COMP	0.0	20.0	4		3.63									

TABLE 3. – INDEX PROPERTIES DATA

Sample Indentification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
5	(3)	30A	CAN			3	173.0		0.0	5.0	95.0		70.7	57.7	13.0	MH	Elastic Silt
5	(3)	31A	CAN			3	497.5		0.0	5.2	94.8		94.2	50.6	43.6	MH	Elastic Silt
5	(3)	32A	CAN			3	483.0		0.0	3.4	96.6		102.2	80.5	21.7	MH	Elastic Silt
5	(3)	33A	CAN			3	507.3		0.0	1.3	98.7		108.4	71.8	36.6	MH	Elastic Silt
5	(3)	34A	CAN			3	451.7		0.0	1.9	98.1		102.2	64.4	37.6	MH	Elastic Silt
5	(3)	35A	CAN			3	161.1	2.70	0.0	11.9	88.1	14.5	90.9	60.2	30.7	MH	Elastic Silt
5	(3)	36A	CAN			3	342.4		0.0	8.1	91.9		103.8	75.6	28.2	MH	Elastic Silt
5	(3)	37A	CAN			3	620.0		0.0	0.2	99.8		93.0	58.0	35.0	MH	Elastic Silt
5	(3)	38A	CAN			3	495.7	2.74	0.0	2.7	97.3		112.3	68.1	44.2	MH	Elastic Silt
5	(3)	39A	CAN			3	448.5		0.0	5.9	94.1		112.0	69.6	42.4	MH	Elastic Silt
5	(3)	40A	CAN			3	114.5		0.0	5.5	94.5		NP	NP	NP	ML (NP)	Silt (NP)
5	(3)	41A	CAN			3	109.3	2.71	0.0	6.0	94.0	8.9	NP	NP	NP	ML (NP)	Silt (NP)
5	(3)	57A	CAN			3	242.3		0.0	14.6	85.4		87.7	60.9	26.8	MH	Elastic Silt
5	(3)	58A	CAN			3	295.7	2.70	0.0	10.4	89.6	10.2	77.1	52.7	24.4	MH	Elastic Silt
5	05-04	5-25	COMP	10.0	29.0	4	189.5	2.43	0.0	30.0	70.0	2.0	81.0	52.0	29.0	MH	Sandy Elastic Silt
5	WP5-1	405316	VC	14.5	15.0	5											
5	WP5-1	405316	VC	19.5	20.0	5											
5	WP5-1	405316	VC	24.5	25.0	5											
5	WP5-2	405318	VC	9.0	14.0	5	302.8	2.71	0.0	3.4	96.6	5.0	59.2	41.2	18.0	MH	Elastic Silt
5	WP5-2	405318	VC	19.0	24.0	5	566.0	2.98	0.0	5.4	94.6		92.2	50.9	41.3	MH	Elastic Silt
5	WP5-3	405320	VC	13.5	19.0	5	551.0	2.94	0.0				80.5	44.8	35.7		
5	WP5-3	405320	VC	19.0	24.0	5	295.0	2.74	0.1	20.3	79.6		85.0	69.8	15.2	MH	Elastic Silt with Sand
5	WP5-4	405322	VC	9.5	14.5	5	1141.2	2.81	0.0	13.3	86.7	10.3	60.7	47.0	13.7	MH	Elastic Silt
5	WP5-4	405322	VC	19.0	19.5	5											
5	WP5-5	405324	VC	10.5	15.5	5	448.4	2.94	0.0	9.8	90.2		66.0	49.1	16.9	MH	Elastic Silt
5	WP5-5	405324	VC	15.5	20.5	5	418.8	2.98	0.0	0.3	99.7	11.1	81.1	65.2	15.9	MH	Elastic Silt
5	WP5-5	405324	VC	25.0	25.5	5											
5	WP5-6	405326	VC	9.0	14.0	5	931.6	2.64	0.1	3.6	96.3	8.9	60.1	50.2	9.9	MH	Elastic Silt
5	WP5-6	405326	VC	14.0	19.0	5	576.7	2.84	0.0	10.0	90.0	9.5	83.5	56.1	27.4	MH	Elastic Silt
5	WP5-6	405326	VC	23.5	24.0	5											
5	WP5-7	405328	VC	13.5	18.5	5	576.2	2.88	0.0	10.5	89.5	4.2	76.3	58.3	18.0	MH	Elastic Silt
5	WP5-7	405328	VC	18.5	24.0	5	185.5	2.80	0.0	8.1	91.9	4.8	55.2	45.3	9.9	MH	Elastic Silt
5	WP5-8	405330	VC	9.0	14.0	5	537.1	2.77	0.1	10.1	89.8	19.0	55.4	51.9	3.5	MH	Elastic Silt
5	WP5-8	405330	VC	14.0	18.5	5											
5	WP5-8	405330	VC	18.5	24.0	5	120.4	2.91	0.0	25.5	74.5	4.8	50.4	40.0	10.4	MH	Elastic Silt with Sand
5	WP5-9	405332	VC	13.5	14.0	5											
5	WP5-9	405332	VC	18.5	19.0	5											
5	WP5-9	405332	VC	23.5	24.0	5											
5	WP5-10	405334	VC	9.0	14.0	5	351.1	2.78	0.0	13.1	86.9	5.1	56.0	44.1	11.9	MH	Elastic Silt
5	WP5-10	405334	VC	18.5	24.0	5	73.4	2.92	0.0	13.4	86.6	5.9	48.7	38.7	10.1	ML	Silt
5	WP5-11	405336	VC	12.0	12.5	5											
5	WP5-11	405336	VC	17.0	17.5	5											
5	WP5-11	405336	VC	22.0	22.5	5											
5	WP5-12	405338	VC	15.5	16.0	5											
5	WP5-13	405340	VC	13.5	14.0	5											
5	WP5-14	405342	VC	10.5	16.0	5	195.9	2.91	0.0	12.9	87.2	9.7	45.7	46.5	1.2	ML	Silt
5	1 (1)	*****	VC	24.5	25.0	5											
5	***** (1)	*****	VC	***	***	5											
5	WP5-5A	405325	VC	15.0	20.0	6	509.2	2.66	0.0	10.3	89.7	10.3	83.9	53.1	30.9	MH	Elastic Silt
5	WP5-5A	405325	VC	20.0	25.0	6	497.3	2.93	0.0	31.5	68.5	13.4	97.5	55.5	42.1	MH	Sandy Elastic Silt
5	WP5-11A	405337	VC	12.5	17.5	6	306.7	2.71	0.0	62.4	67.6	0.0	99.6	88.0	11.6	MH	Sandy Elastic Silt

TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
6	WP6-1	405344	VC	8.0	13.0	5	135.8	3.25	10.3	35.3	54.4	4.0	NP	NP	NP	ML (NP)	Sandy Silt (NP)
6	WP6-2	405346	VC	7.0	12.0	5	23.4	3.42	3.0	49.6	47.4	4.7	NP	NP	NP	SM	Silty Sand
6	WP6-3	405348	VC	8.5	9.0	5											
6	WP6-3	405348	VC	13.5	14.0	5											
6	WP6-4	405350	VC	10.5	11.0	5											
6	WP6-5	405352	VC	4.5	7.5	5	15.9	3.24	0.0	54.0	46.0	4.7	NP	NP	NP	SM	Silty Sand
6	WP6-5	405352	VC	12.5	18.5	5	33.6	3.27	4.7	48.8	46.5		NP	NP	NP	SM	Silty Sand
6	WP6-6	405354	VC	7.5	8.0	5											
6	WP6-6	405354	VC	12.5	18.0	5	14.6	3.38	4.2	47.7	48.1	5.4	NP	NP	NP	SM	Silty Sand
6	WP6-7	405355	VC	12.5	18.0	5	13.4	3.34				4.8	NP	NP	NP		
6	(3)	43A	CAN			3	425.1		0.0	3.7	96.3		NP	NP	NP	ML (NP)	Silt (NP)
6	(3)	45A	CAN			3	26.8	3.21	0.0	27.6	72.4	9.6	NP	NP	NP	ML (NP)	Silt (NP) with Sand
6	(3)	45C	CAN			3	117.6		0.0	51.3	48.7		NP	NP	NP	SM	Silty Sand
6	(3)	46A	CAN			3	107.4	2.98	0.0	13.8	86.2	27.9	47.0	28.4	18.6	ML	Silt
6	(3)	47A	CAN			3	111.4	2.85	0.0	9.8	90.2	35.2	64.9	33.1	31.8	MH	Elastic Silt
6	06-04	6-10	COMP	0.0	10.0	4	60.4	2.87	0.0	21.0	79.0	7.0	NP	NP	NP	ML (NP)	Silt (NP) with Sand
6	06-03	6-22	COMP	0.0	15.0	4	50.5		0.0	32.0	68.0	8.0	NP	NP	NP	ML (NP)	Sandy Silt (NP)

TABLE 3 – INDEX PROPERTIES DATA

Sample Indentification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
CW	(3)	49A	CAN			3	53.4		3.3	31.1	65.6		43.9	25.6	18.3	CL	Sandy Lean Clay
CW	(3)	50A	CAN			3	65.1		10.9	36.4	52.7		50.6	32.5	18.1	MH	Sandy Elastic Silt
CW	(3)	51A	CAN			3	61.9		0.0	51.5	48.5		45.0	28.0	17.0	SM	Silty Sand
CW	(3)	52A	CAN			3	40.2		8.5	47.0	44.5		39.3	24.9	14.4	SM	Silty Sand
CW	(3)	53A	CAN			3	35.4	2.69	0.0	39.4	60.6	22.3	35.1	18.0	17.1	CL	Sandy Lean Clay
CW	(3)	54A	CAN			3	73.9		0.5	22.5	77.0		54.7	39.2	15.5	MH	Elastic Silt with Sand
CW	(3)	55A	CAN			3	71.7	2.78	1.8	23.7	74.5	23.8	52.4	38.0	14.4	MH	Elastic Silt with Sand
CW	(3)	56A	CAN			3	68.5		3.3	31.3	65.4		53.3	40.2	13.1	MH	Sandy Elastic Silt
CW	11574	405678	ST	7.5	10	6		2.72	5.7	21.7	72.6	21.7	28.8	14.9	13.9	CL	Lean Clay with Sand
CW	11574	405679	JAR	10	11.5	6	16.9	2.66	6.2	36.0	57.8	14.6	31.9	20.2	11.8	CL	Sandy Lean Clay
CW	11574	405683	JAR	20	21.5	6	13.9	2.73	8.1	24.1	67.8	22.6	30.9	13.5	17.4	CL	Sandy Lean Clay
CW	11574	405684	ST	23	25	6		2.72	3.6	25.7	70.7	27.4	37.0	16.1	20.8	CL	Lean Clay with Sand
CW	11574	405685	JAR	25.0	26.5	6	19.5	2.73	4.7	24.4	70.9	23.4	29.9	14.0	15.9	CL	Lean Clay with Sand

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TABLE 3 – INDEX PROPERTIES DATA

Sample Indentification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
BP	1776	63176	ST	4.5	6.0	1	43.3	3.74	6.9	46.0	47.1	9.0	NP	NP	NP	SM	Silty Sand
BP	1776	27A	CAN			3	25.5		2.6	26.2	71.2		41.3	24.7	16.6	CL	Lean Clay with Sand
BP	1777	28A	CAN			3	25.6		4.4	37.0	58.6		35.1	31.0	4.1	ML	Sandy Silt
BP	1819	29A	CAN			3	30.0	2.50	8.5	38.2	53.3	15.0	37.8	26.7	11.1	ML	Sandy Silt
BP	07-01	7-02	COMP	0.0	10.0	4	30.1	2.46	10.0	54.0	36.0	4.0	NP	NP	NP	SM	Silty Sand
BP	07-04	7-34	COMP	0.0	16.0	4	30.2		13.0	30.0	57.0	15.0	36.0	34.0	2.0	ML	Sandy Silt
BP	07-04	7-34 Redue	COMP	0.0	16.0	4							33.0	30.0	3.0		
BP	07-06	7-52	COMP	0.0	16.0	4	29.2	2.35	13.0	47.0	40.0	6.0	NP	NP	NP	SM	Silty Sand

TABLE 3 – INDEX PROPERTIES DATA

Sample Indentification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
1, 4	1766, 1773	Group 1	CAN COMP			3							21.3	NP	NP	ML (NP1)	Non-plastic Silt 1
5, 6	(3)	Group 2	CAN COMP			3							48.9	NP	NP	ML (NP2)	Non-plastic Silt 2
5	(3)	Group 3	CAN COMP			3							89.3	56.9	32.4	MH1	Elastic Silt 1
2, 3	1818, 1771	Group 4	CAN COMP			3							59.8	40.1	19.7	MH2	Elastic Silt 2
6, BP	1819(3)	Group 5	CAN COMP			3							36.6	27.8	9.0	ML	Silt
4	1773, 1775	Group 6	CAN COMP			3							28.2	19.4	8.8	CL	Clay
2, CW	1768(3)	Group 7	CAN COMP			3							32.2	23.8	8.4	SM	Silty Sand

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Indentification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_u$ (deg)	c_u (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
1	1765	63089	ST	4.5	7	1	110.4 [2]	23.4 [2]	136.2												
1	1765	63101	ST	14.0	16.5	1	120.5	20.9	145.6	85.0	132.4	47.4	15.0								
1	1766	63050	ST	4.5	7	1	114.9	19.5	137.3												
1	1766	63054	ST	8.5	11.0	1	117.9	18.7	139.9									1.20E-05	0.08	0.01	0.13
1	1766	63062	ST	14.0	16.5	1															
1	1767	63008	ST	3.5	6.0	1															
1	11352	400053	SS	2.0	3.0	2															
1	11352	400054	SS	5.5	6.0	2															
1	11352	400025	ST	7.5	10.0	2	115.4	19.7	138.1												
1	11352	400028	ST	11.5	14.0	2	74.9	44.9	108.5												
1	11353	400047	SS	4.5	5.5	2															
1	11353	400028	ST	10.0	12.5	2	109.4	24.0	135.7												
1	11353	400051	SS	13.5	14.0	2															
1	11354	400029	ST	7.5	10.0	2	111.2	23.0	136.8					23.2	4.9	30.2	0.0				
1	11354	400030	ST	11.5	14.0	2	43.6 [12]	90.9 [12]	83.7 [12]												
1	1765	1A	CAN			3															
1	1765	2A	CAN			3															
1	1765	3A	CAN			3															
1	1766	4A	CAN			3															
1	1766	5A	CAN			3															
1	1766	6A	CAN			3															
1	1766	7A	CAN			3															
1	1767	8A	CAN			3															
1		1-48	COMP	0.0	12.0	4															
1	T1-S[16]	200139860	COMP	13.0 [17]		2															
1	T1-N[16]	200128861	COMP	3.0	5.0	2															
1	11568	405653	ST	10.5	13.0	6	64.1 [12]	57.5 [12]	67.0 [12]					19.0	6.7	39.0	3.3				

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Indentification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_u$ (deg)	c_u (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
2	1768	63619	ST	11.0 (1)	13.0 (1)	1	19.9 (1)	290.0	77.5												
2	1768	63619dup	ST	11.0 (1)	13.0 (1)	1	18.2 (1)	316.6	75.6												
2	1769	63521	ST	12.0	14.0	1	23.7	231.2	78.5 (4)									1.30E-07	2.20	0.10	6.00
2	1769	63530	ST	18.0	20.0	1															
2	1817	63875	ST	10.5	12.5	1	84.8	32.7	112.5 (4)										0.40	0.02	0.96
2	1818	63865	ST	5.0	7.5	1															
2	11358	400031	ST	6.0	8.5	2	105.7	24.1	131.2												
2	11358	400062	SS	8.5	10.0	2															
2	11359	400033	ST	4.5	7.0	2	42.9	109.8	90.0												
2	11359	400034	ST	8.5	11.0	2	45.6	97.7	90.2												
2	1768	9A	CAN			3															
2	1769	10A	CAN			3															
2	1818	11A	CAN			3															
2	1817	12A	CAN			3															
2	02-05	2-39	COMP	0.0	10.0	4															
2	T2-N(14)	200129059	COMP	7.0	8.0	2															
2	11569	405655	ST	7.5	10.0	6	32.8 (12)	151.5 (12)	83.8 (12)					18.0	1.7	36.0	0.9				

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Indentification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_u$ (deg)	c_u (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
3	1770	63328	ST	4.0	6.0	1	49.7	63.7	81.3 [4]	90.0	131.8	41.8	15.0								
3	1770	63357	ST	20.0	22.0	1	37.7	138.7	90.1 [4]									7.60E-07	1.20	0.05	3.75
3	1770	63370	ST	26.0	30.0	1															
3	1771	63458	ST	32.0	34.0	1												3.80E-07			
3	1772	63276	ST	19.5	22.0	1	55.5	35.4	75.1 [4]										0.40	0.05	1.75
3	11360	400097	SS	13.0	13.5	2															
3	11360	400100	SS	13.5	14.0	2															
3	11360	400035	ST	20.5	23.0	2	110.0	17.9	129.7												
3	11361	400038	ST	10.5	13.0	2	25.5	196.9	75.7												
3	11361	400039	ST	21.0	22.5	2	49.1 [12]	95.0 [12]	95.8 [12]					23.9	0.0	33.7	0.0				
3	11361	400040	ST	29.0	31.5	2	31.8 [12]	163.3 [12]	83.8 [12]					17.5	0.0	29.5	0.0				
3	11362	400076	SS	6.0	6.5	2															
3	11362	400077	SS	6.5	7.0	2															
3	11362	400041	ST	19.0	21.5	2	31.4 [12]	158.1 [12]	81.0 [12]					15.0	1.5	39.0	0.0				
3	11362	400042	ST	23.0	25.5	2	27.1 [12]	183.7 [12]	77.9 [12]					16.0	0.7	32.9	0.0				
3	11363	400044	ST	12.0	14.5	2															
3	11363	400045	ST	19.0	21.5	2	64.3	44.6	93.0												
3	1770	13A	CAN			3															
3	1770	14A	CAN			3															
3	1770	15A	CAN			3															
3	1771	16A	CAN			3															
3	1771	17A	CAN			3															
3	1772	18A	CAN			3															
3	1772	19A	CAN			3															
3	03-05	3-52	COMP	0.0	20.0	4															
3	03-05	3-52 Reduc	COMP	0.0	20.0	4															
3	03-02	3-90	COMP	0.0	20.0	4															
3	03-02	3-90 Reduc	COMP	0.0	20.0	4															
3	T3-N[14]	200129035	COMP	17.0 [17]																	
3	T3-C[14]	200139885	COMP	13.0 [17]																	
3	11570	405657	ST	10.5	13.0	6	25.0 [12]	230.3 [12]	78.0 [12]					13.0	2.3	34.0	1.0				
3	11570	405658	ST	15.5	18.0	6	25.2 [12]	242.4 [12]	78.5 [12]					14.0	1.7	28.0	1.5				
3	11571	405663	ST	17.5	20.0	6	25.9 [12]	208.8 [12]	78.9 [12]					13.0	1.7	30.0	1.5				
3	11571	405667	ST	32.5	35.0	6	26.2 [12]	199.6 [12]	77.8 [12]					15.0	2.1	36.0	1.3				
3	11572	405669	ST	15.0	17.5	6	21.9 [12]	238.9 [12]	73.9 [12]					17.0	0.4	40.0	0.2				
3	11572	405672	ST	22.5	25.0	6	24.3 [12]	215.5 [12]	76.0 [12]					19.0	0.0	37.0	0.0				
3	11572	405675	ST	30.0	32.5	6	21.4 [12]	250.3 [12]	74.6 [12]					18.0	2.4	35.0	1.6				

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Indentification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_s$ (deg)	c_s (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
4	1773	63747	ST	11.0	13.0	1	122.2	21.4	148.4 (1)												
4	1774	63670	ST	10.0	12.0	1	95.5	15.9	110.7 (1)	90.0	155.8	65.8	15.0								
4	1774	63687	ST	20.0	22.0	1	117.1	17.6	137.7									4.80E-06	0.09	0.02	0.41
4	1775	63826	ST	15.0	17.0	1	66.5	61.5	110.7 (1)												
4	1773	21A	CAN			3															
4	1773	22A	CAN			3															
4	1773	23A	CAN			3															
4	1775	24A	CAN			3															
4	1775	25A	CAN			3															
4	1775	26A	CAN			3															
4	04-01	4-02	COMP	0.0	20.0	4															
4	04-04	4-62	COMP	0.0	20.0	4															
4	04-04	4-62 Reduce	COMP	0.0	20.0	4															

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Indentification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_u$ (deg)	c_u (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
5	[5]	30A	CAN			3															
5	[5]	31A	CAN			3															
5	[5]	32A	CAN			3															
5	[5]	33A	CAN			3															
5	[5]	34A	CAN			3															
5	[5]	35A	CAN			3															
5	[5]	36A	CAN			3															
5	[5]	37A	CAN			3															
5	[5]	38A	CAN			3															
5	[5]	39A	CAN			3															
5	[5]	40A	CAN			3															
5	[5]	41A	CAN			3															
5	[5]	57A	CAN			3															
5	[5]	58A	CAN			3															
5	05-04	5-25	COMP	10.0	29.0	4															
5	WP5-1	405316	VC	14.5	15.0	5	18.4 [10]	293.2	72.3 [10]												
5	WP5-1	405316	VC	19.5	20.0	5	10.8 [10]	523.2	67.0 [10]												
5	WP5-1	405316	VC	24.5	25.0	5	12.1 [10]	500.8	72.4 [10]												
5	WP5-2	405318	VC	9.0	14.0	5	19.5 [10]	302.8	78.6 [10]												
5	WP5-2	405318	VC	19.0	24.0	5	10.8 [13]	510.3 [13]	69.3 [13]												
5	WP5-3	405320	VC	13.5	19.0	5	11.1 [13]	499.4 [13]	68.9 [13]												
5	WP5-3	405320	VC	19.0	24.0	5	18.2 [10]	295.0	71.7 [10]												
5	WP5-4	405322	VC	9.5	14.5	5	5.2 [10]	1141.2	64.7 [10]												
5	WP5-4	405322	VC	19.0	19.5	5	11.0 [10]	529.1	69.0 [10]												
5	WP5-5	405324	VC	10.5	15.5	5	12.6 [10]	448.4	69.1 [10]												
5	WP5-5	405324	VC	15.5	20.5	5	13.5 [10]	418.8	70.2 [10]												
5	WP5-5	405324	VC	25.0	25.5	5	15.1 [10]	372.1	71.1 [10]												
5	WP5-6	405326	VC	9.0	14.0	5	6.5 [10]	931.6	67.4 [10]												
5	WP5-6	405326	VC	14.0	19.0	5	10.2 [10]	576.7	69.0 [10]												
5	WP5-6	405326	VC	23.5	24.0	5	28.9 [10]	182.9	81.7 [10]												
5	WP5-7	405328	VC	13.5	18.5	5	11.1 [10]	525.6	69.4 [10]												
5	WP5-7	405328	VC	18.5	24.0	5	21.7 [13]	380.9 [13]	74.1 [13]												
5	WP5-8	405330	VC	9.0	14.0	5	10.8 [10]	537.1	68.8 [10]												
5	WP5-8	405330	VC	14.0	18.5	5															
5	WP5-8	405330	VC	18.5	24.0	5	29.5 [13]	288.8 [13]	78.3 [13]												
5	WP5-9	405332	VC	13.5	14.0	5	6.9 [10]	670.8	66.7 [10]												
5	WP5-9	405332	VC	18.5	19.0	5	11.5 [10]	505.5	69.9 [10]												
5	WP5-9	405332	VC	23.5	24.0	5	31.6 [10]	162.8	83.1 [10]												
5	WP5-10	405334	VC	9.0	14.0	5	16.6 [10]	351.1	74.7 [10]												
5	WP5-10	405334	VC	18.5	24.0	5	44.6 [13]	177.5 [13]	87.2 [13]												
5	WP5-11	405336	VC	12.0	12.5	5	23.7 [10]	197.2	70.5 [10]												
5	WP5-11	405336	VC	17.0	17.5	5	33.5 [10]	107.0	69.3 [10]												
5	WP5-11	405336	VC	22.0	22.5	5	51.6 [10]	77.9	92.2 [10]												
5	WP5-12	405338	VC	15.5	16.0	5	27.4 [10]	159.2	70.9 [10]												
5	WP5-13	405340	VC	13.5	14.0	5	32.1 [10]	124.6	72.0 [10]												
5	WP5-14	405342	VC	10.5	16.0	5	24.9 [13]	196.0 [13]	72.8 [13]												
5	1 [18]	*****	VC	24.5	25.0	5	15.6 [10]	360.7	72.0 [10]												
5	***** [18]	*****	VC	***	***	5	20.1 [10]	241.0	66.6 [10]												
5	WP5-5A	405325	VC	15.0	20.0	6	9.4 [10]	615.8 [14]	70.7 [10]										3.850	0.094	16.660
5	WP5-5A	405325	VC	20.0	25.0	6	18.1 [10]	502.3 [13]	76.4 [10]					15.0	1.0	32.0	0.7		3.750	0.089	14.657
5	WP5-11A	405337	VC	12.5	17.5	6	15.5 [10]	340.8 [14]	73.6 [10]										2.696	0.035	9.910

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Indentification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_u$ (deg)	c_u (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
6	WP6-1	405344	VC	8.0	13.0	5	35.4 (10)	135.8	83.4 (10)												
6	WP6-2	405346	VC	7.0	12.0	5	108.3 (10)	23.4	133.6 (10)												
6	WP6-3	405348	VC	8.5	9.0	5	137.7 (10)	14.7	157.9 (10)												
6	WP6-3	405348	VC	13.5	14.0	5	138.2 (10)	13.1	156.3 (10)												
6	WP6-4	405350	VC	10.5	11.0	5	90.6 (10)	36.1	123.6 (10)												
6	WP6-5	405352	VC	4.5	7.5	5	130.2 (10)	15.9	150.9 (10)												
6	WP6-5	405352	VC	12.5	18.5	5	107.5 (13)	24.4 (13)	147.0 (13)												
6	WP6-6	405354	VC	7.5	8.0	5	139.7 (10)	11.2	155.4 (10)												
6	WP6-6	405354	VC	12.5	18.0	5	147.2 (13)	13.5 (13)	165.5 (13)												
6	WP6-7	405355	VC	12.5	18.0	5	141.6 (13)	15.3 (13)	162.1 (13)												
6	(3)	43A	CAN			3															
6	(3)	45A	CAN			3															
6	(3)	45C	CAN			3															
6	(3)	46A	CAN			3															
6	(3)	47A	CAN			3															
6	06-04	6-10	COMP	0.0	10.0	4															
6	06-03	6-22	COMP	0.0	15.0	4															

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Indentification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_u$ (deg)	c_u (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
CW	(5)	49A	CAN			3															
CW	(5)	50A	CAN			3															
CW	(5)	51A	CAN			3															
CW	(5)	52A	CAN			3															
CW	(5)	53A	CAN			3															
CW	(5)	54A	CAN			3															
CW	(5)	55A	CAN			3															
CW	(5)	56A	CAN			3															
CW	11574	405678	ST	7.5	10	6	103.4 (12)	23.8 (12)	127.4 (12)					16.0	3.5	29.0	3.1				
CW	11574	405679	JAR	10	11.5	6		16.9													
CW	11574	405683	JAR	20	21.5	6		13.9													
CW	11574	405684	ST	23	25	6	117.7 (12)	15.8 (12)	136.2 (12)					22.0	3.5	26.0	3.1				
CW	11574	405685	JAR	25.0	26.5	6		19.5													

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Indentification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_s$ (deg)	c_s (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
BP	1776	63176	ST	4.5	6.0	1	70.8	43.3	101.4 (4)									5.20E-07	0.20	0.02	1.35
BP	1776	27A	CAN			3															
BP	1777	28A	CAN			3															
BP	1819	29A	CAN			3															
BP	07-01	7-02	COMP	0.0	10.0	4															
BP	07-04	7-34	COMP	0.0	16.0	4															
BP	07-04	7-34 Reduo	COMP	0.0	16.0	4															
BP	07-08	7-52	COMP	0.0	16.0	4															

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TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Indentification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
PR No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_s$ (deg)	c_s (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
1, 4	1766, 1773	Group 1	CAN COMP			3															
5, 6	(3)	Group 2	CAN COMP			3															
5	(3)	Group 3	CAN COMP			3															
2, 3	1818, 1771	Group 4	CAN COMP			3															
6, BP	1818(3)	Group 5	CAN COMP			3															
4	1773, 1775	Group 6	CAN COMP			3															
2, CW	1768(3)	Group 7	CAN COMP			3															

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Indentification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consilidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ed} (psf)	ϕ_{ed} (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Intial Void Ratio	Percent Compact.
1	1765	63089	ST	4.5	7	1														
1	1765	63101	ST	14.0	16.5	1														
1	1766	63050	ST	4.5	7	1														
1	1766	63054	ST	8.5	11.0	1														
1	1766	63062	ST	14.0	16.5	1														
1	1767	63008	ST	3.5	6.0	1														
1	11352	400053	SS	2.0	3.0	2														
1	11352	400054	SS	5.5	6.0	2														
1	11352	400025	ST	7.5	10.0	2														
1	11352	400026	ST	11.5	14.0	2														
1	11353	400047	SS	4.5	5.5	2														
1	11353	400028	ST	10.0	12.5	2														
1	11353	400051	SS	13.5	14.0	2														
1	11354	400029	ST	7.5	10.0	2														
1	11354	400030	ST	11.5	14.0	2														
1	1765	1A	CAN			3														
1	1765	2A	CAN			3														
1	1765	3A	CAN			3														
1	1766	4A	CAN			3														
1	1766	5A	CAN			3														
1	1766	6A	CAN			3														
1	1766	7A	CAN			3														
1	1767	8A	CAN			3														
1		1-48	COMP	0.0	12.0	4		17.3 (6)	109.4 (6)						103.6	20.0	1.8E-03	0.138	0.58	94.7
1	T1-S(16)	200139860	COMP	13.0 (17)		2		15.6	117.5											
1	T1-N(16)	200128981	COMP	3.0	5.0	2		20.3	110.2											
1	11568	405653	ST	10.5	13.0	6														

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Indentification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consolidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ed} (psf)	$\varnothing_{ed}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Intial Void Ratio	Percent Compact.
2	1768	63619	ST	11.0 (1)	13.0 (1)	1														
2	1768	63619dup	ST	11.0 (1)	13.0 (1)	1														
2	1769	63521	ST	12.0	14.0	1														
2	1769	63530	ST	18.0	20.0	1	118.6 (3)													
2	1817	63875	ST	10.5	12.5	1														
2	1818	63865	ST	5.0	7.5	1	145.7 (3)													
2	11358	400031	ST	6.0	8.5	2														
2	11358	400062	SS	8.5	10.0	2														
2	11359	400033	ST	4.5	7.0	2														
2	11359	400034	ST	8.5	11.0	2														
2	1768	9A	CAN			3														
2	1769	10A	CAN			3														
2	1818	11A	CAN			3														
2	1817	12A	CAN			3														
2	02-05	2-39	COMP	0.0	10.0	4		17.5 (6)	86.3 (6)						81.8	20.3	5.8E-03	0.244	0.98	94.8
2	T2-N(15)	200129059	COMP	7.0	8.0	2		14.2	118.7											
2	11569	405655	ST	7.5	10.0	6														

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Indentification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consolidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ad} (psf)	ϕ_{ad} (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Initial Void Ratio	Percent Compact.
3	1770	63328	ST	4.0	6.0	1														
3	1770	63357	ST	20.0	22.0	1														
3	1770	63370	ST	28.0	30.0	1														
3	1771	63458	ST	32.0	34.0	1	118.3 [3]													
3	1772	63278	ST	19.5	22.0	1	118.3 [3]													
3	11360	400097	SS	13.0	13.5	2														
3	11360	400100	SS	13.5	14.0	2														
3	11360	400035	ST	20.5	23.0	2														
3	11361	400038	ST	10.5	13.0	2														
3	11361	400039	ST	21.0	22.5	2														
3	11361	400040	ST	29.0	31.5	2														
3	11362	400076	SS	6.0	6.5	2														
3	11362	400077	SS	6.5	7.0	2														
3	11362	400041	ST	19.0	21.5	2														
3	11362	400042	ST	23.0	25.5	2														
3	11363	400044	ST	12.0	14.5	2														
3	11363	400045	ST	19.0	21.5	2														
3	1770	13A	CAN			3														
3	1770	14A	CAN			3														
3	1770	15A	CAN			3														
3	1771	16A	CAN			3														
3	1771	17A	CAN			3														
3	1772	18A	CAN			3														
3	1772	19A	CAN			3														
3	03-05	3-52	COMP	0.0	20.0	4														
3	03-05	3-52 Redue	COMP	0.0	20.0	4														
3	03-02	3-90	COMP	0.0	20.0	4		26.4 [6]	88.3 [6]						63.0	30.1	1.6E-02	0.135	0.91	94.0
3	03-02	3-90 Redue	COMP	0.0	20.0	4														
3	T3-N[16]	200129035	COMP	17.0 [17]				62.8	60.4											
3	T3-C[16]	200139885	COMP	13.0 [17]				37.3	68.5											
3	11570	405657	ST	10.5	13.0	6														
3	11570	405658	ST	15.5	18.0	6														
3	11571	405683	ST	17.5	20.0	6														
3	11571	405687	ST	32.5	35.0	6														
3	11572	405669	ST	15.0	17.5	6														
3	11572	405672	ST	22.5	25.0	6														
3	11572	405675	ST	30.0	32.5	6														

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Indentification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consolidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{cd} (psf)	ϕ_{cd} (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Initial Void Ratio	Percent Compact.
4	1773	63747	ST	11.0	13.0	1														
4	1774	63670	ST	10.0	12.0	1														
4	1774	63687	ST	20.0	22.0	1														
4	1775	63828	ST	15.0	17.0	1														
4	1773	21A	CAN			3														
4	1773	22A	CAN			3														
4	1773	23A	CAN			3														
4	1775	24A	CAN			3														
4	1775	25A	CAN			3														
4	1775	26A	CAN			3														
4	04-01	4-02	COMP	0.0	20.0	4														
4	04-04	4-62	COMP	0.0	20.0	4		16.2 (6)	120.6 (6)						114.3	22.4	1.6E-02	0.159	0.98	94.8
4	04-04	4-62 Reduo	COMP	0.0	20.0	4														

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Indentification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consilidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ed} (psf)	$Ø_{ed}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Intial Void Ratio	Percent Compact.
5	(3)	30A	CAN			3														
5	(3)	31A	CAN			3														
5	(3)	32A	CAN			3														
5	(3)	33A	CAN			3														
5	(3)	34A	CAN			3														
5	(3)	35A	CAN			3														
5	(3)	36A	CAN			3														
5	(3)	37A	CAN			3														
5	(3)	38A	CAN			3														
5	(3)	39A	CAN			3														
5	(3)	40A	CAN			3														
5	(3)	41A	CAN			3														
5	(3)	57A	CAN			3														
5	(3)	58A	CAN			3														
5	05-04	5-25	COMP	10.0	29.0	4		50.4 (6)	82.5 (6)						59.8	54.7	1.7E-02	0.425	1.54	95.7
5	WP5-1	405316	VC	14.5	15.0	5														
5	WP5-1	405316	VC	19.5	20.0	5														
5	WP5-1	405316	VC	24.5	25.0	5														
5	WP5-2	405318	VC	9.0	14.0	5														
5	WP5-2	405318	VC	19.0	24.0	5														
5	WP5-3	405320	VC	13.5	19.0	5														
5	WP5-3	405320	VC	19.0	24.0	5														
5	WP5-4	405322	VC	9.5	14.5	5														
5	WP5-4	405322	VC	19.0	19.5	5														
5	WP5-5	405324	VC	10.5	15.5	5														
5	WP5-5	405324	VC	15.5	20.5	5														
5	WP5-5	405324	VC	25.0	25.5	5														
5	WP5-6	405326	VC	9.0	14.0	5		56.3	65.8											
5	WP5-6	405326	VC	14.0	19.0	5														
5	WP5-6	405326	VC	23.5	24.0	5														
5	WP5-7	405328	VC	13.5	18.5	5														
5	WP5-7	405328	VC	18.5	24.0	5														
5	WP5-8	405330	VC	9.0	14.0	5														
5	WP5-8	405330	VC	14.0	18.5	5		60.8	62.9											
5	WP5-8	405330	VC	18.5	24.0	5														
5	WP5-9	405332	VC	13.5	14.0	5														
5	WP5-9	405332	VC	18.5	19.0	5														
5	WP5-9	405332	VC	23.5	24.0	5														
5	WP5-10	405334	VC	9.0	14.0	5														
5	WP5-10	405334	VC	18.5	24.0	5														
5	WP5-11	405336	VC	12.0	12.5	5														
5	WP5-11	405336	VC	17.0	17.5	5		26.7	97.9											
5	WP5-11	405336	VC	22.0	22.5	5														
5	WP5-12	405338	VC	15.5	16.0	5														
5	WP5-13	405340	VC	13.5	14.0	5														
5	WP5-14	405342	VC	10.5	16.0	5														
5	1 (18)	*****	VC	24.5	25.0	5														
5	***** (18)	*****	VC	***	***	5														
5	WP5-5A	405325	VC	15.0	20.0	6														
5	WP5-5A	405325	VC	20.0	25.0	6														
5	WP5-11A	405337	VC	12.5	17.5	6														

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TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Identification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consolidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{cd} (psf)	$\varnothing_{cd}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Initial Void Ratio	Percent Compact.
6	WP6-1	405344	VC	8.0	13.0	5		13.2	135.0											
6	WP6-2	405346	VC	7.0	12.0	5		11.0	142.8											
6	WP6-3	405348	VC	6.5	9.0	5														
6	WP6-3	405348	VC	13.5	14.0	5														
6	WP6-4	405350	VC	10.5	11.0	5														
6	WP6-5	405352	VC	4.5	7.5	5		9.5	142.9											
6	WP6-5	405352	VC	12.5	18.5	5		14.6	129.7											
6	WP6-6	405354	VC	7.5	8.0	5														
6	WP6-6	405354	VC	12.5	16.0	5		9.2	149.5											
6	WP6-7	405355	VC	12.5	16.0	5		11.7	139.9											
6	(3)	43A	CAN			3														
6	(3)	45A	CAN			3														
6	(3)	45C	CAN			3														
6	(3)	46A	CAN			3														
6	(3)	47A	CAN			3														
6	06-04	6-10	COMP	0.0	10.0	4														
6	06-03	6-22	COMP	0.0	15.0	4		23.0 (6)	101.2 (6)						96.6	25.4	5.7E-03	0.242	0.66	95.4

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Indentification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consilidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{cd} (psf)	$\emptyset_{cd}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Intial Void Ratio	Percent Compact.
CW	(5)	49A	CAN			3														
CW	(5)	50A	CAN			3														
CW	(5)	51A	CAN			3														
CW	(5)	52A	CAN			3														
CW	(5)	53A	CAN			3														
CW	(5)	54A	CAN			3														
CW	(5)	55A	CAN			3														
CW	(5)	56A	CAN			3														
CW	11574	405678	ST	7.5	10	6														
CW	11574	405679	JAR	10	11.5	6														
CW	11574	405683	JAR	20	21.5	6														
CW	11574	405684	ST	23	25	6														
CW	11574	405685	JAR	25.0	26.5	6														

000400

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TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Indentification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consilidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{cd} (psf)	$\varnothing_{cd}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Initial Void Ratio	Percent Compact.
BP	1776	63176	ST	4.5	6.0	1														
BP	1776	27A	CAN			3														
BP	1777	28A	CAN			3														
BP	1819	29A	CAN			3														
BP	07-01	7-02	COMP	0.0	10.0	4														
BP	07-04	7-34	COMP	0.0	16.0	4														
BP	07-04	7-34 Redue	COMP	0.0	16.0	4														
BP	07-06	7-52	COMP	0.0	16.0	4		9.5 (6)	81.2 (6)											

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Indentification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consilidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ed} (psf)	$\varnothing_{ed}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Initial Void Ratio	Percent Compact.
1, 4	1766, 1773	Group 1	CAN COMP			3		13.4	116.6			0.0 (7)	40 (7)	4.3E-06 (7)						
5, 6	(3)	Group 2	CAN COMP			3		36.2	76.9			6.3 (7)	31 (7)	NA						
5	(3)	Group 3	CAN COMP			3		56.0 (8)	65.0 (8)	2425 (7)	1212 (7)	1.7 (7)	33 (7)	1.2E-07 (7)(9)						
2, 3	1818, 1771	Group 4	CAN COMP			3		35.4	77.8	2936 (7)	1466 (7)	7.6 (7)	29 (7)	6.6E-06 (7)						
6, BP	1819(3)	Group 5	CAN COMP			3		19.9	99.0	5744 (7)	2872 (7)	2.6 (7)	37 (7)	5.9E-07 (7)						
4	1773, 1775	Group 6	CAN COMP			3		18.7	118.4	3014 (7)	1507 (7)	0.0 (7)	36 (7)	2.3E-07 (7)						
2, CW	1768(3)	Group 7	CAN COMP			3		20.1	102.3	2962 (7)	1481 (7)	2.4 (7)	32 (7)	2.6E-07 (7)						

000402

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APPENDIX G

SLOPE STABILITY DATA FILES

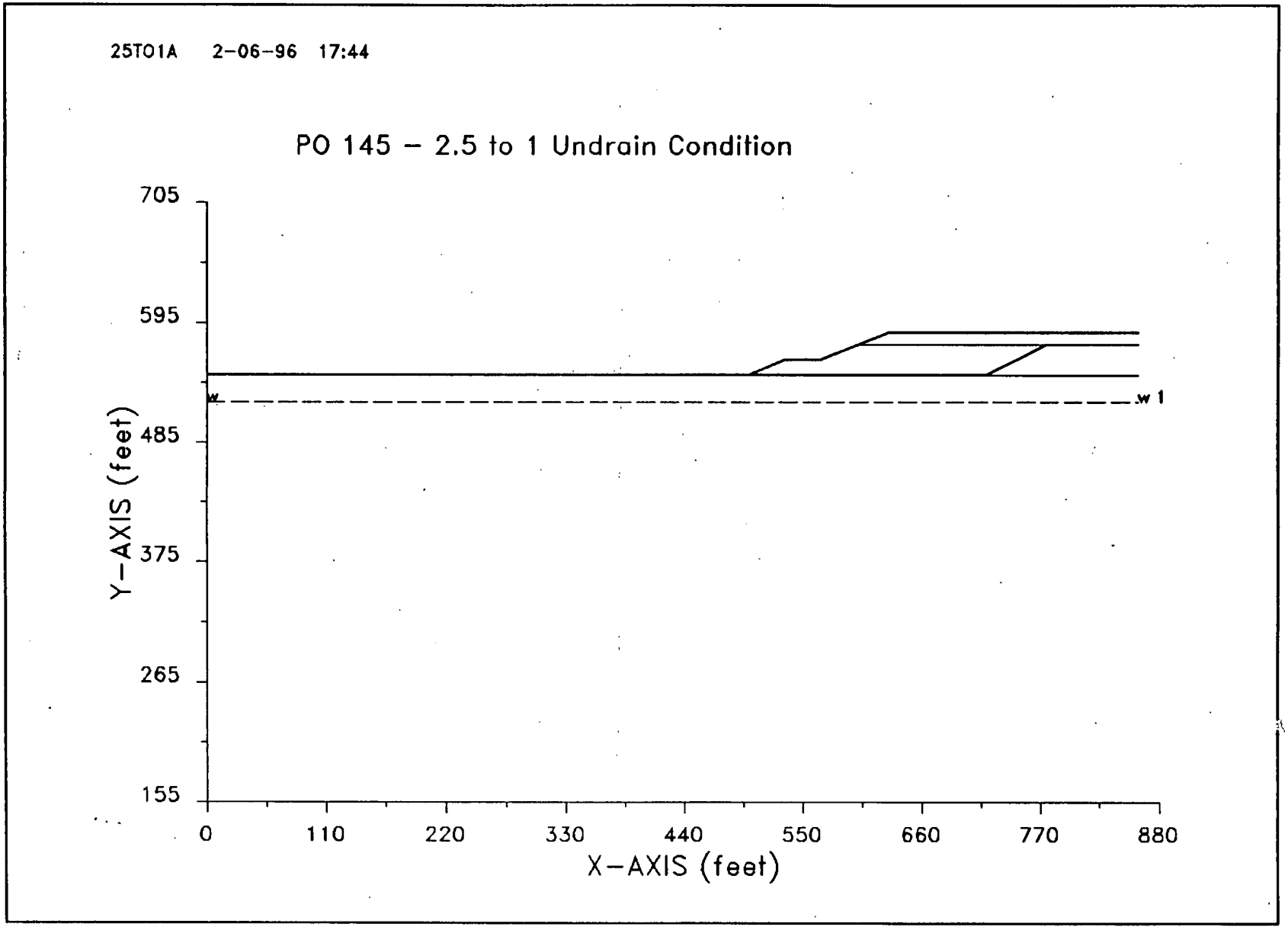
Table G1 - Soil Parameters for Drained and Undrained Conditions

Soil Parameters							
				Total Stress		Effective Stress	
Soil Layer Number	Soil Type	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)
1	Clay Liner	133.1	145.0	0.0	22.0	0.0	22.0
2	Pit 3 Waste	81.2	85.2	50.0	13.0	0.0	28.0
3	Cap	100.0	112.3	0.0	26.0	0.0	26.0
4	Berm	120.0	130.0	300.0	19.0	300.0	19.0
5	GMA	140.0	149.8	0.0	33.0	0.0	33.0

000404

Table G2 - Summary of Most Critical Failure Surface Data

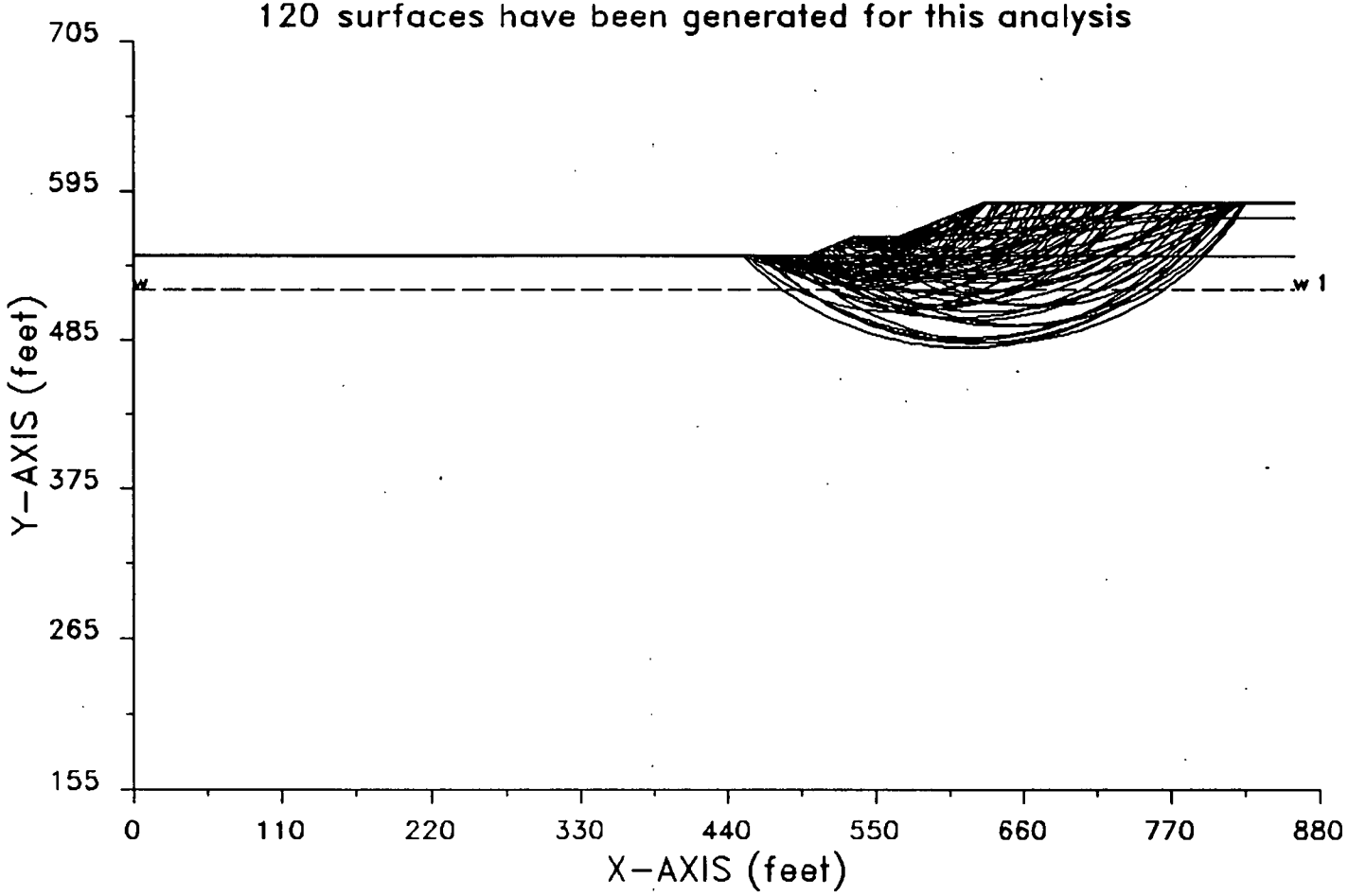
Data for the Most Critical Failure Surface				
Case Description	Radius (ft)	Center of Curve		FOS
		X (ft)	Y (ft)	W/O Seismic Loads
2.5 to 1 - Undrained Condition	57.56	584.44	619.75	0.924
3 to 1 - Undrained Condition	57.2	583.11	621.99	1.112
4 to 1 - Undrained Condition	75.59	558.81	634.1	1.350
2.5 to 1 - Drained Condition	75.34	567.26	628.77	1.311
3 to 1 - Drained Condition	73.53	563.29	627.13	1.469
4 to 1 - Drained Condition	148.63	538.36	696.25	1.768


25T01A 2-06-96 17:44
PO 145 – 2.5 to 1 Undrain Condition
705
595
485
375
265
155
Y-AXIS (feet)
w
w 1
0
110
220
330
440
550
660
770
880
X-AXIS (feet)

000406

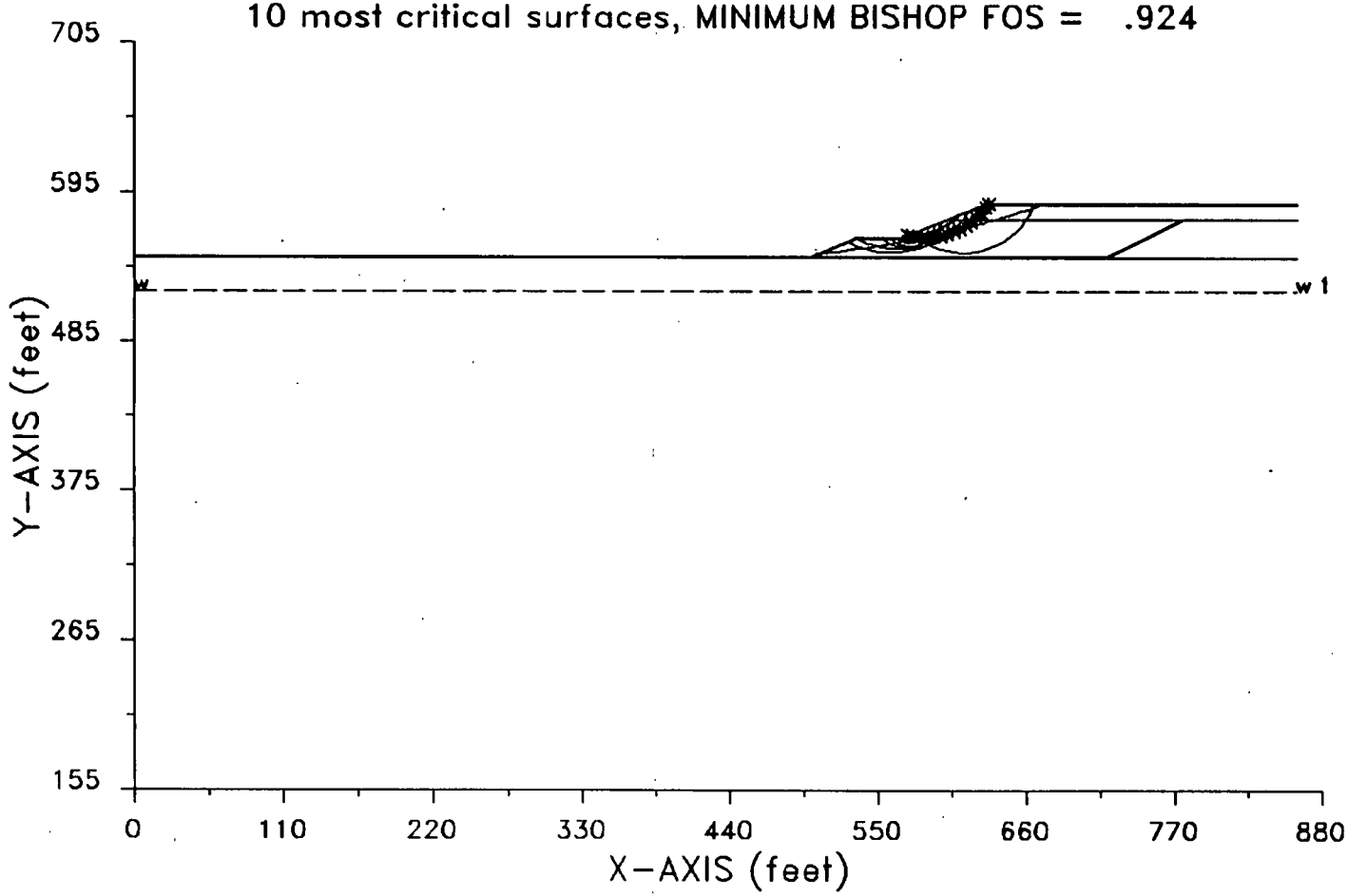
25T01A 2-06-96 17:44

PO 145 – 2.5 to 1 Undrain Condition
120 surfaces have been generated for this analysis



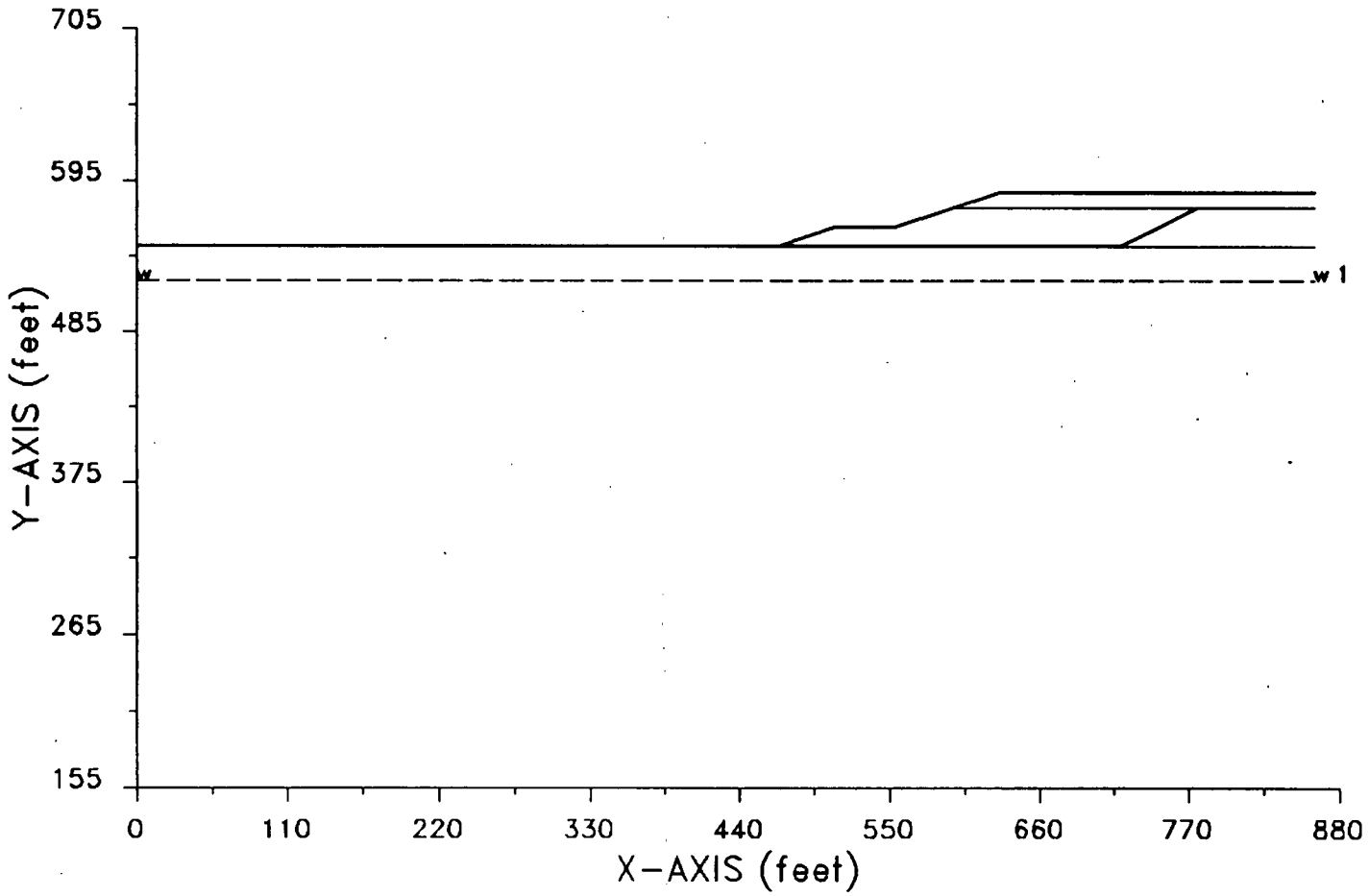
25T01A 2-06-96 17:44

PO 145 – 2.5 to 1 Undrain Condition
10 most critical surfaces, MINIMUM BISHOP FOS = .924



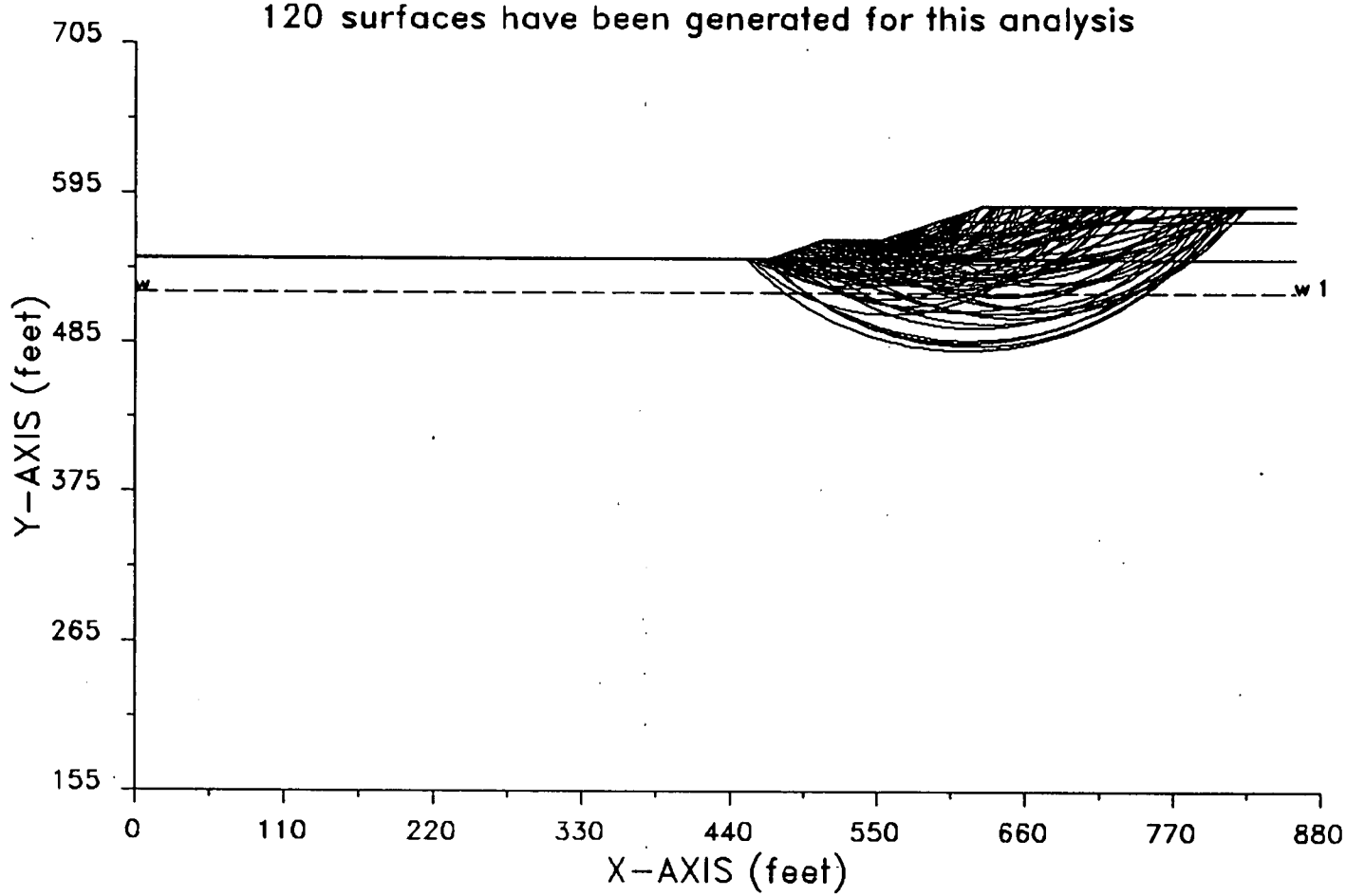
3T01A 2-06-96 17:41

PO 145 – 3 to 1 Undrain Condition



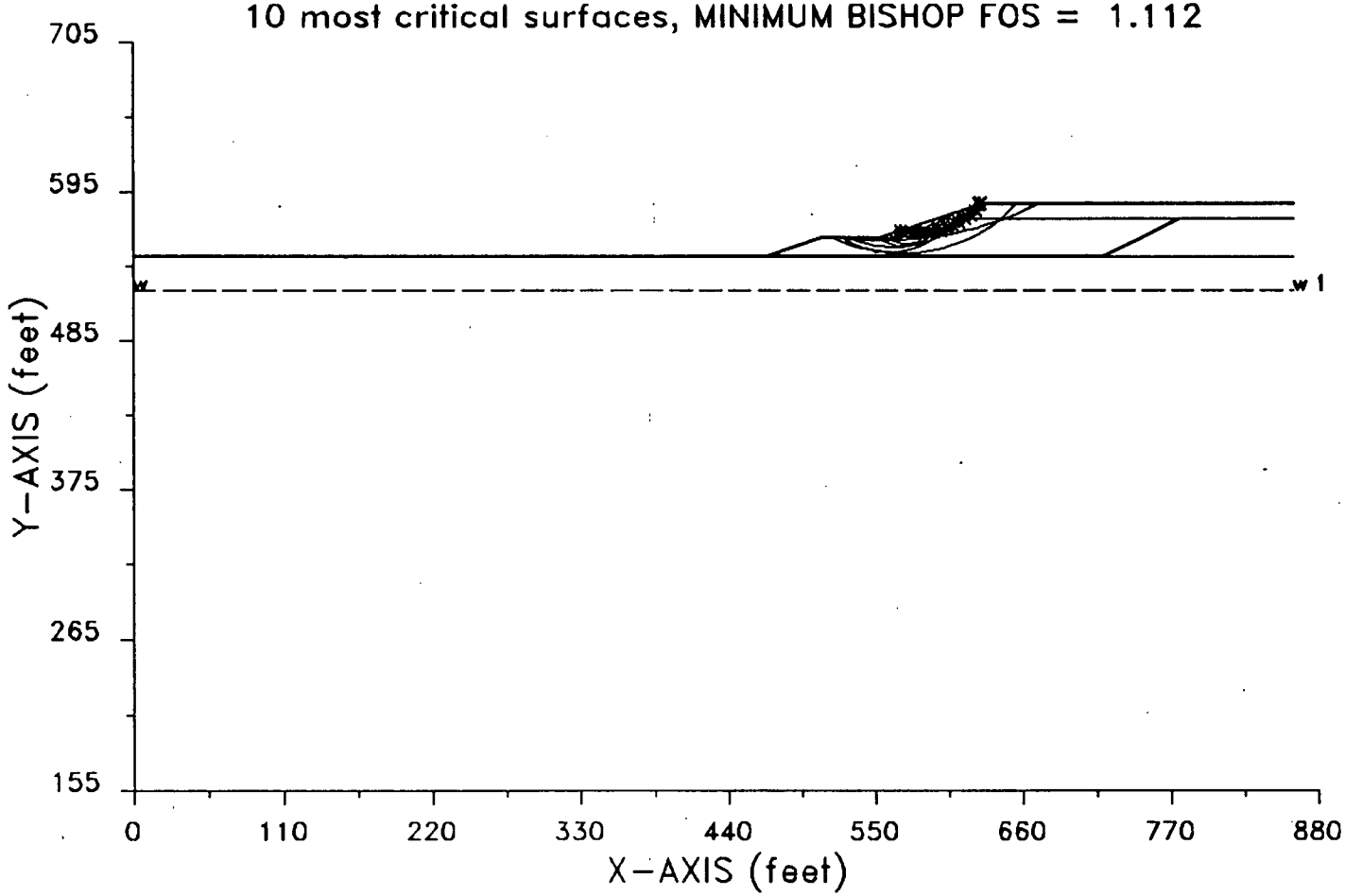
3T01A 2-06-96 17:41

PO 145 – 3 to 1 Undrain Condition
120 surfaces have been generated for this analysis



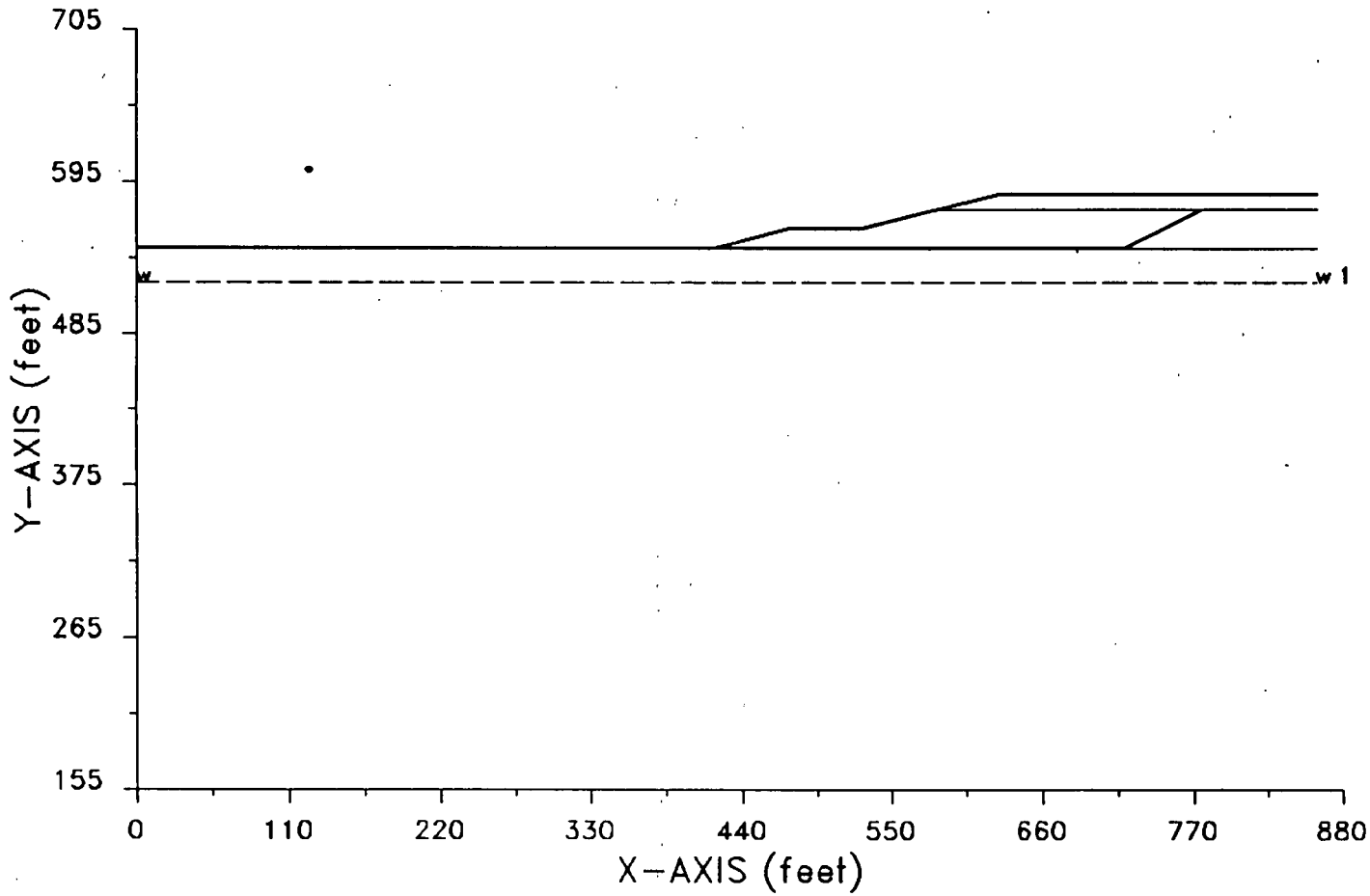
3T01A 2-06-96 17:41

PO 145 – 3 to 1 Undrain Condition
10 most critical surfaces, MINIMUM BISHOP FOS = 1.112



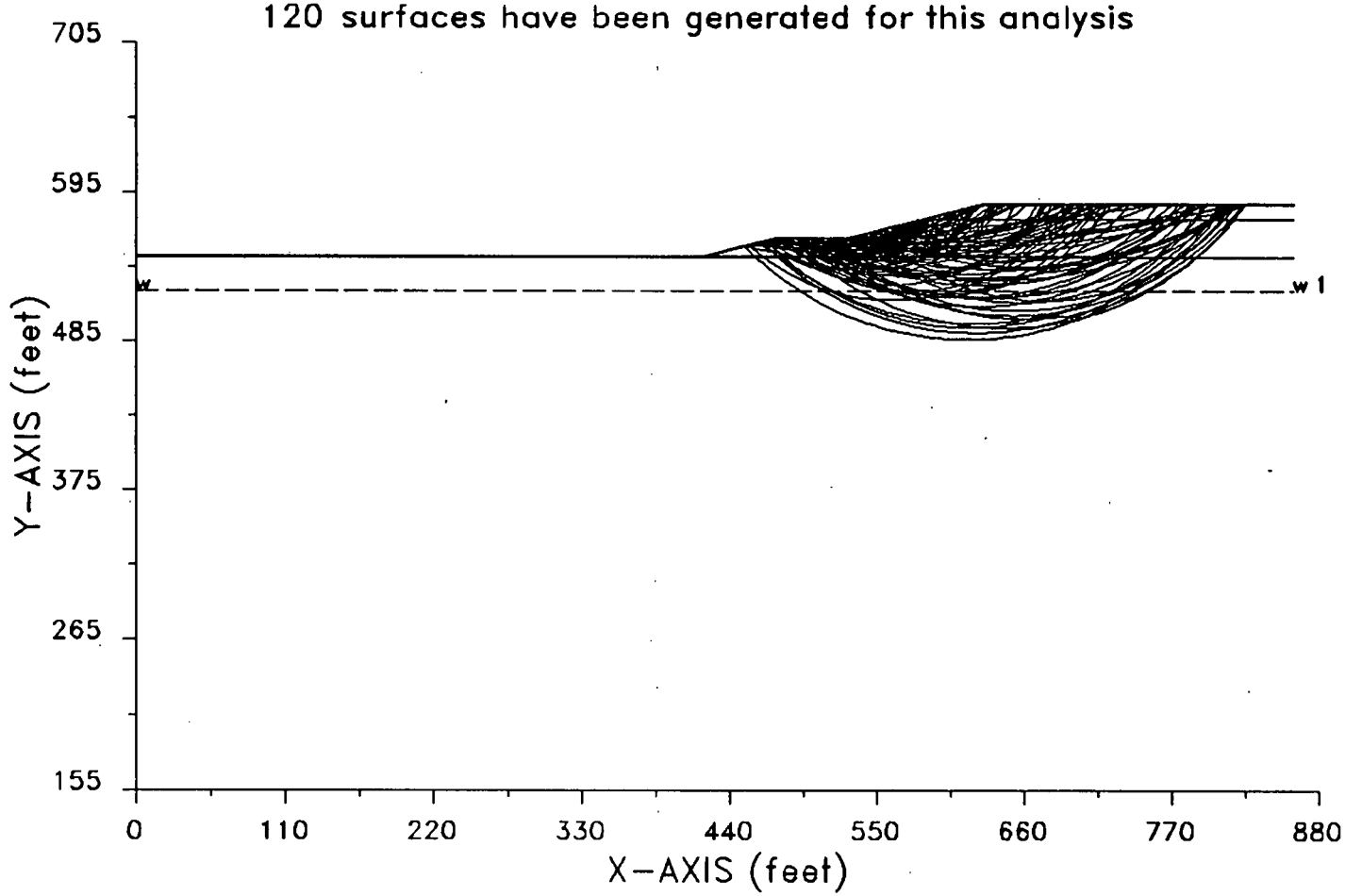
4T01A 2-06-96 17:42

PO 145 – 4 to 1 Undrain Condition



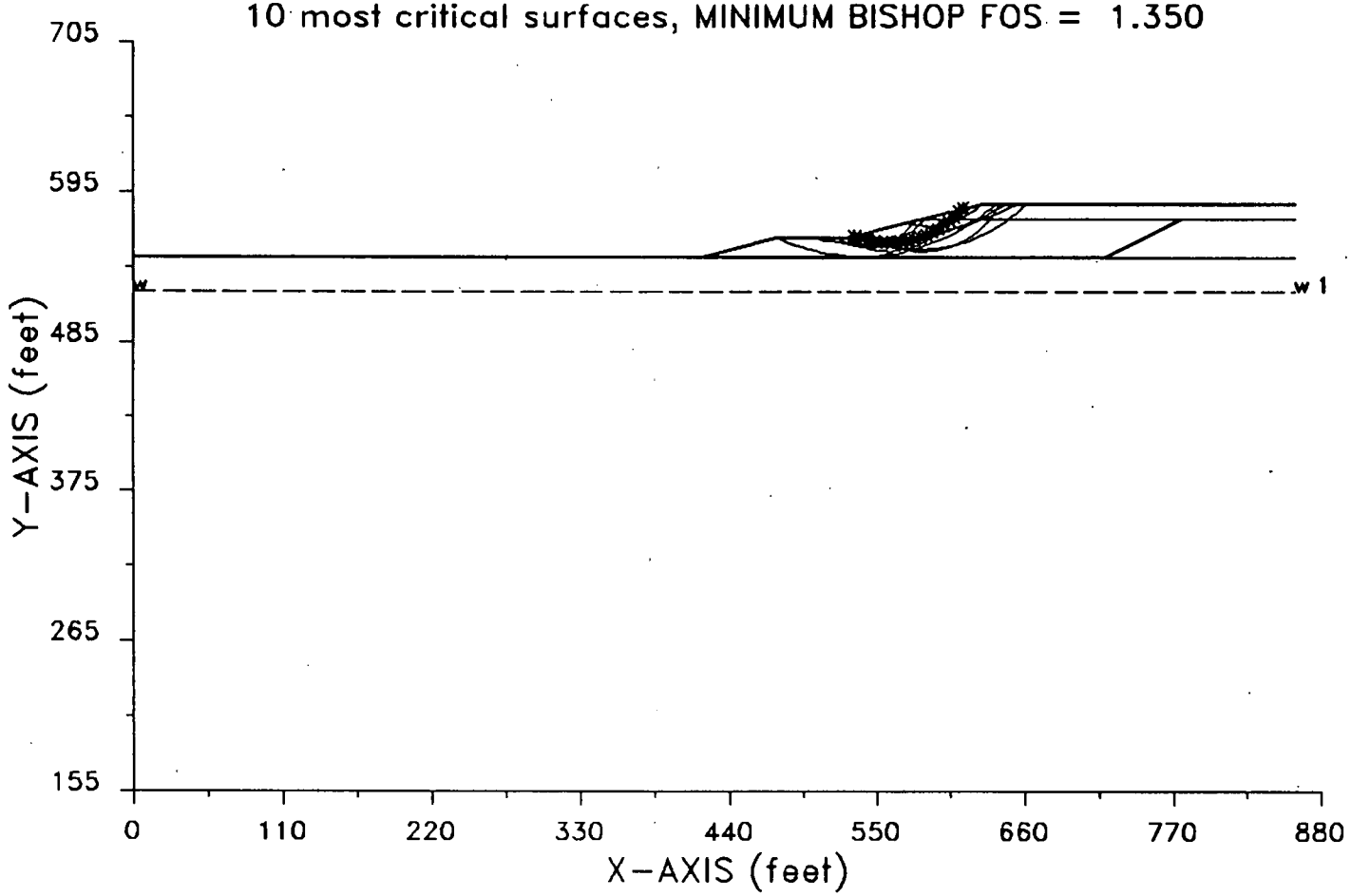
4T01A 2-06-96 17:42

PO 145 – 4 to 1 Undrain Condition
120 surfaces have been generated for this analysis



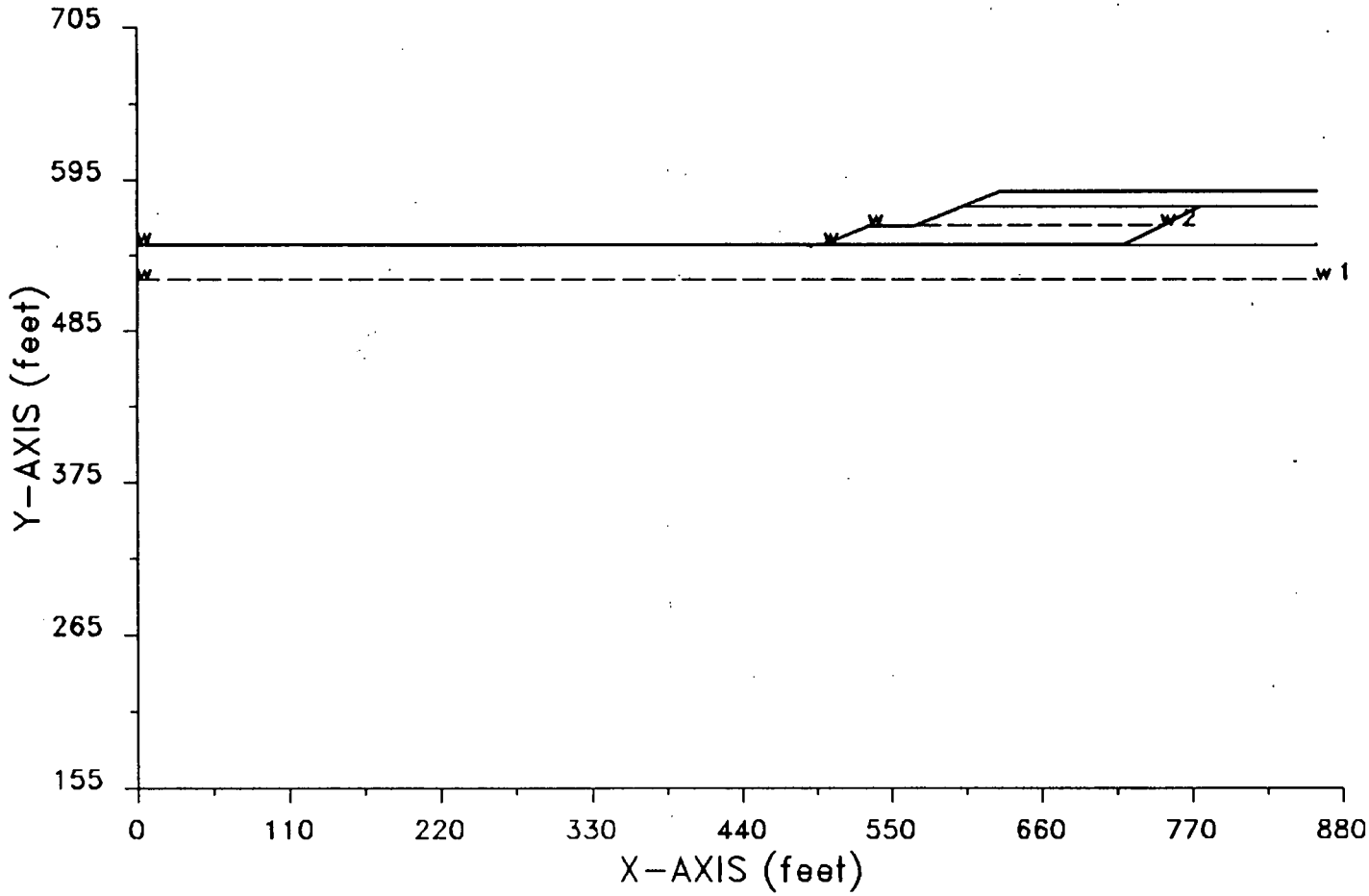
4T01A 2-06-96 17:42

PO 145 – 4 to 1 Undrain Condition
10 most critical surfaces, MINIMUM BISHOP FOS = 1.350



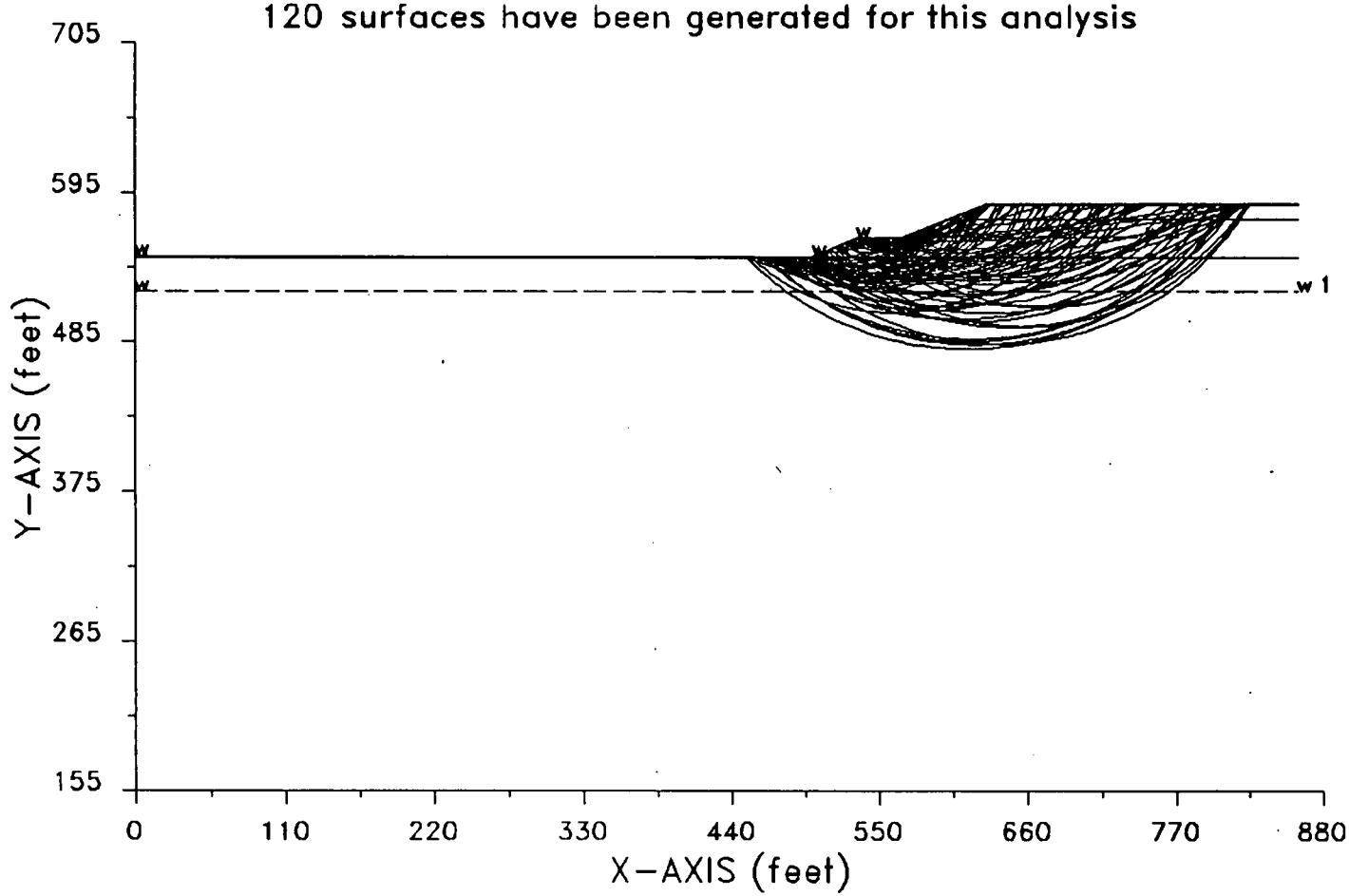
25T01DA 2-06-96 17:45

PO 145 – 2.5 to 1 Drained Condition



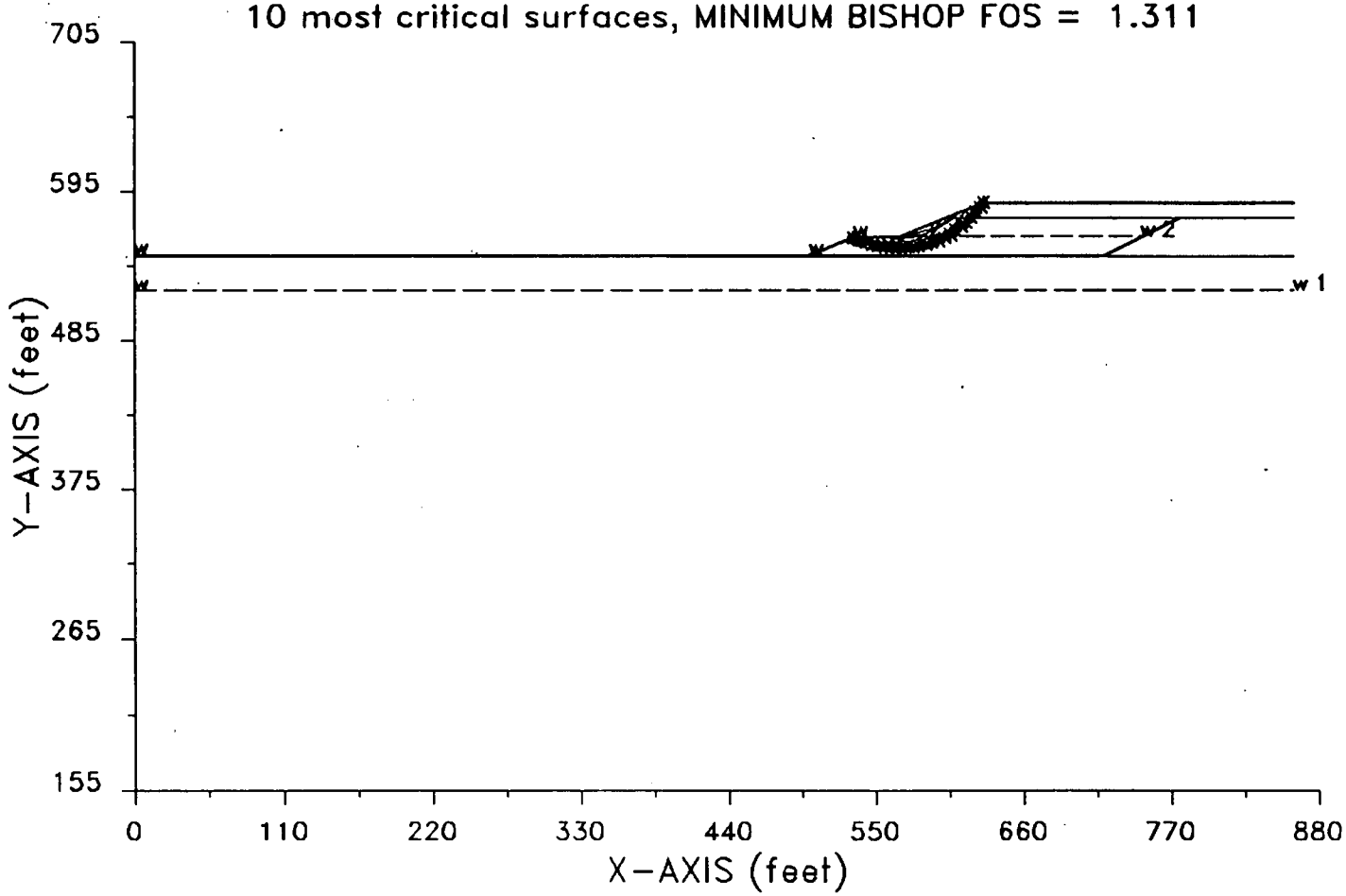
25T01DA 2-06-96 17:45

PO 145 – 2.5 to 1 Drained Condition
120 surfaces have been generated for this analysis



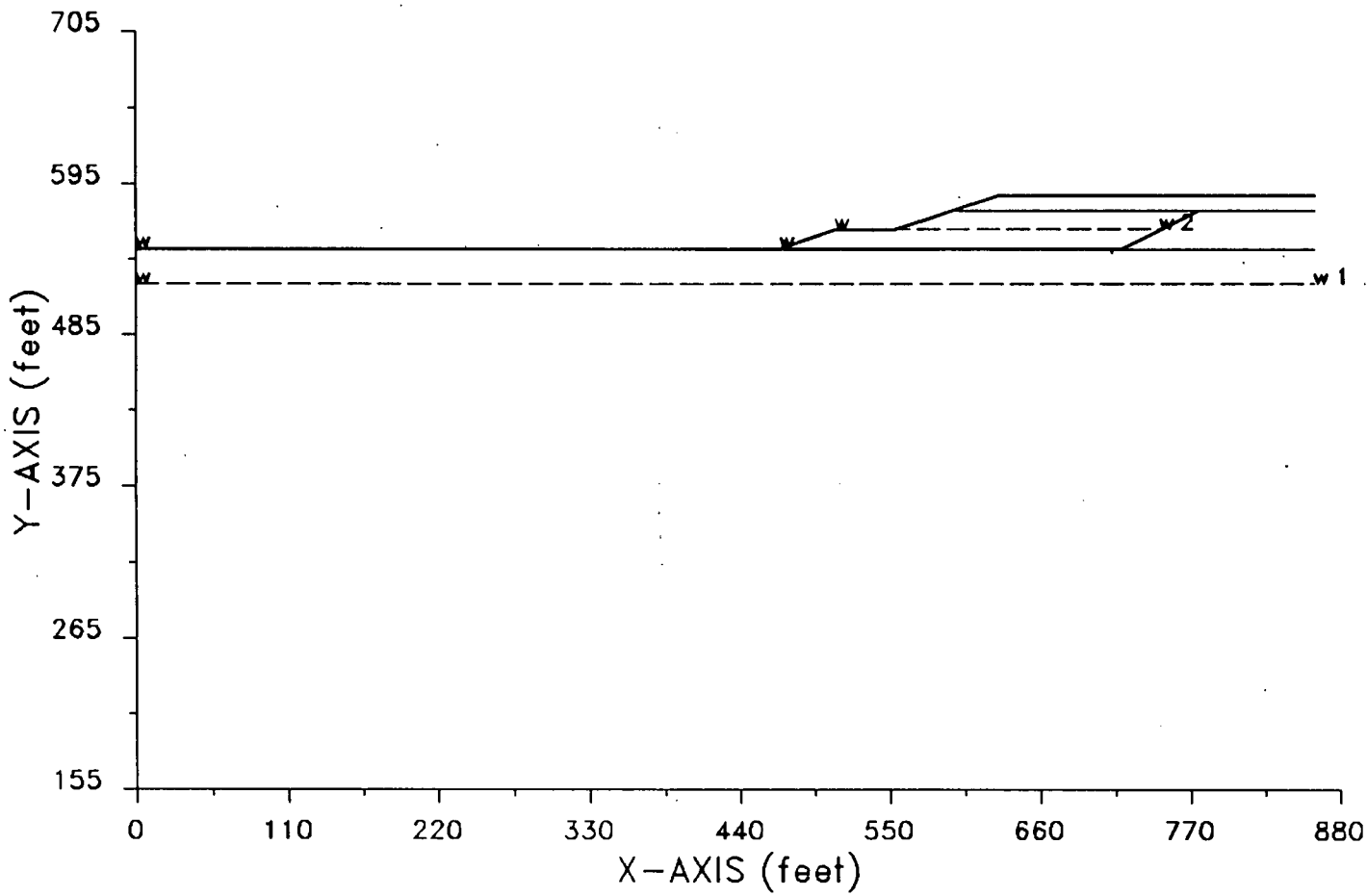
25T01DA 2-06-96 17:45

PO 145 – 2.5 to 1 Drained Condition
10 most critical surfaces, MINIMUM BISHOP FOS = 1.311



3T01DA 2-06-96 17:47

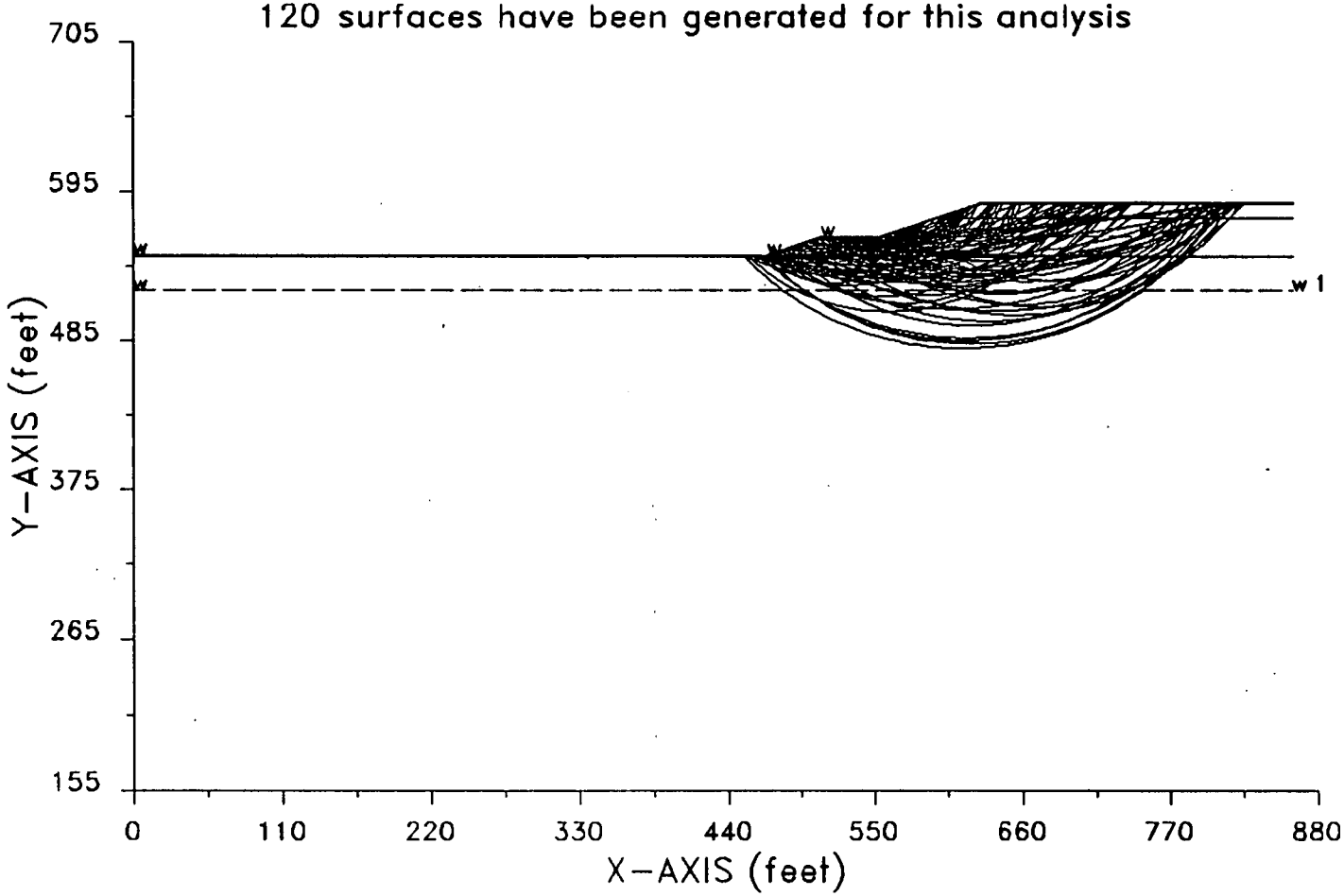
PO 145 – 3 to 1 Drained Condition



000148

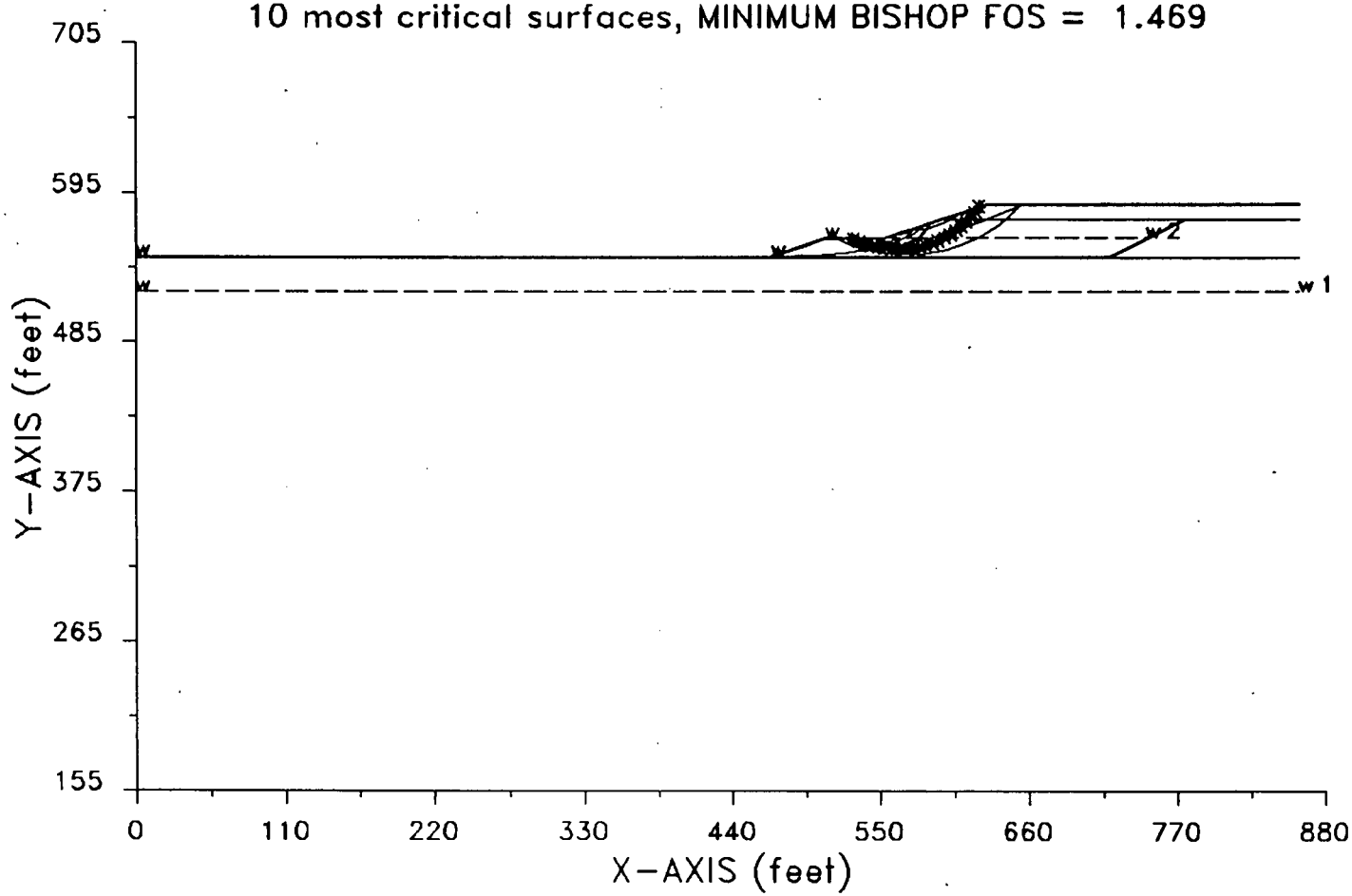
3T01DA 2-06-96 17:47

PO 145 – 3 to 1 Drained Condition
120 surfaces have been generated for this analysis



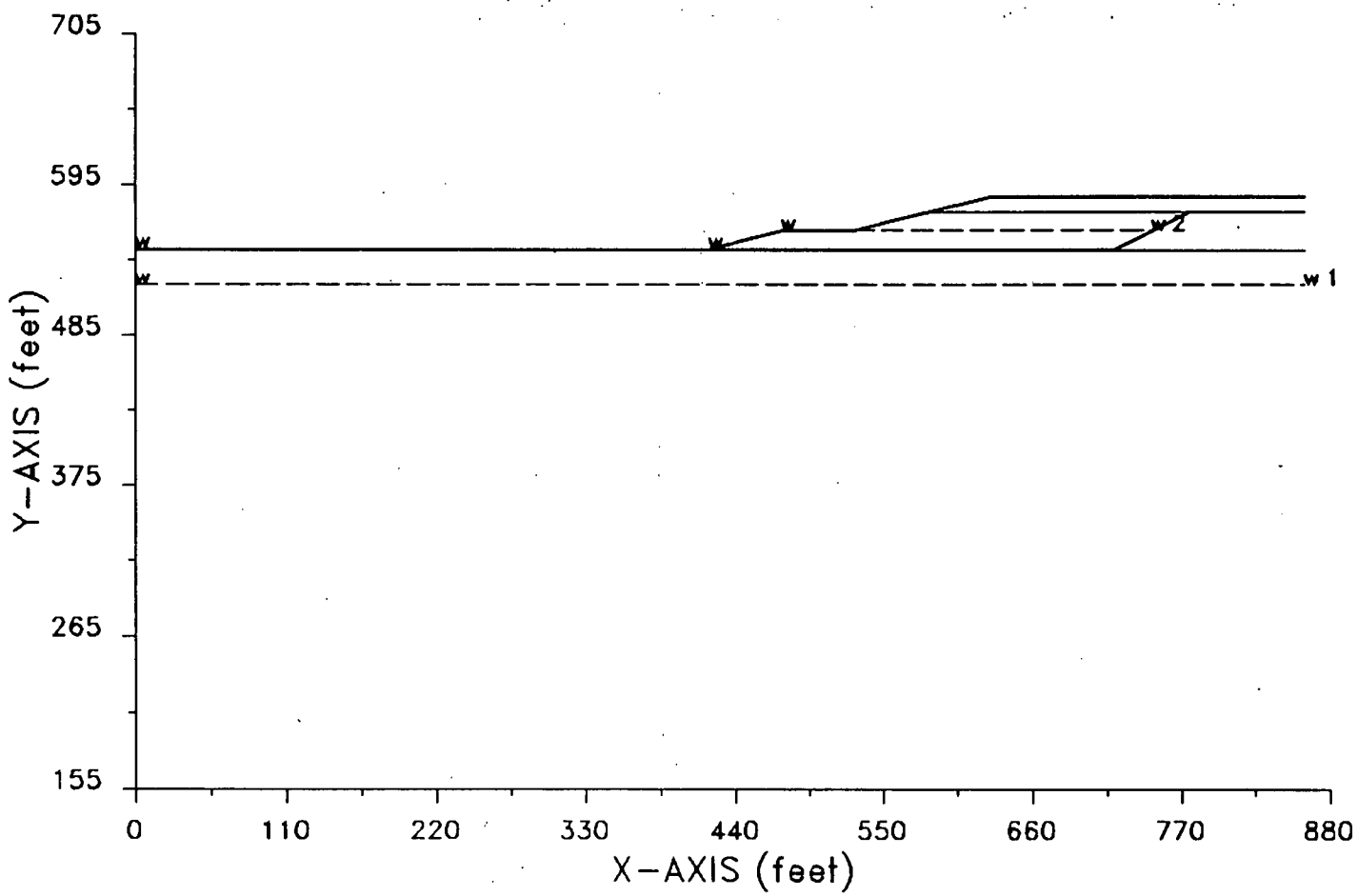
3T01DA 2-06-96 17:47

PO 145 – 3 to 1 Drained Condition
10 most critical surfaces, MINIMUM BISHOP FOS = 1.469



4T01DA 2-06-96 17:49

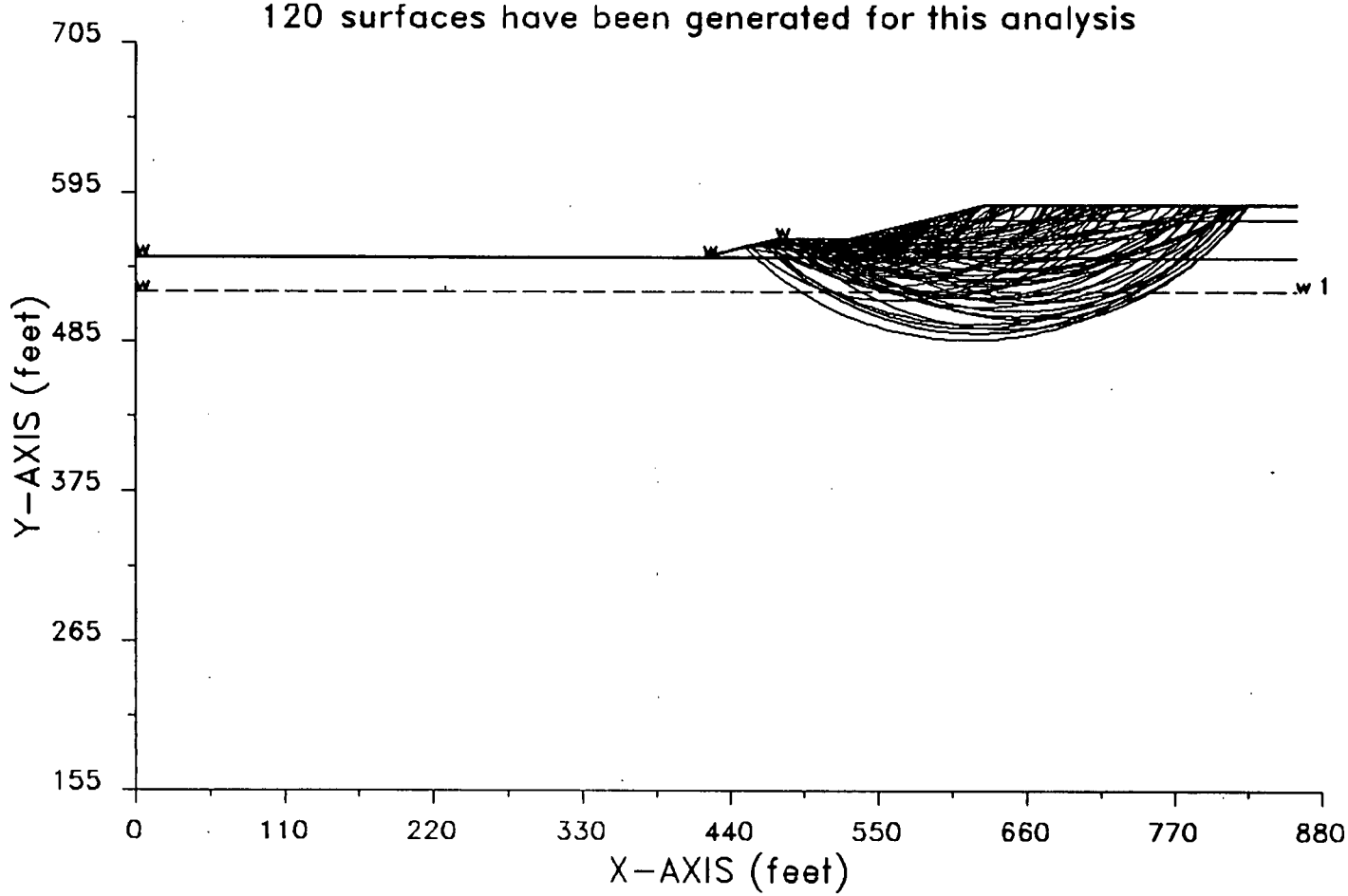
PO 145 – 4 to 1 Drained Condition



4T01DA 2-06-96 17:49

PO 145 – 4 to 1 Drained Condition

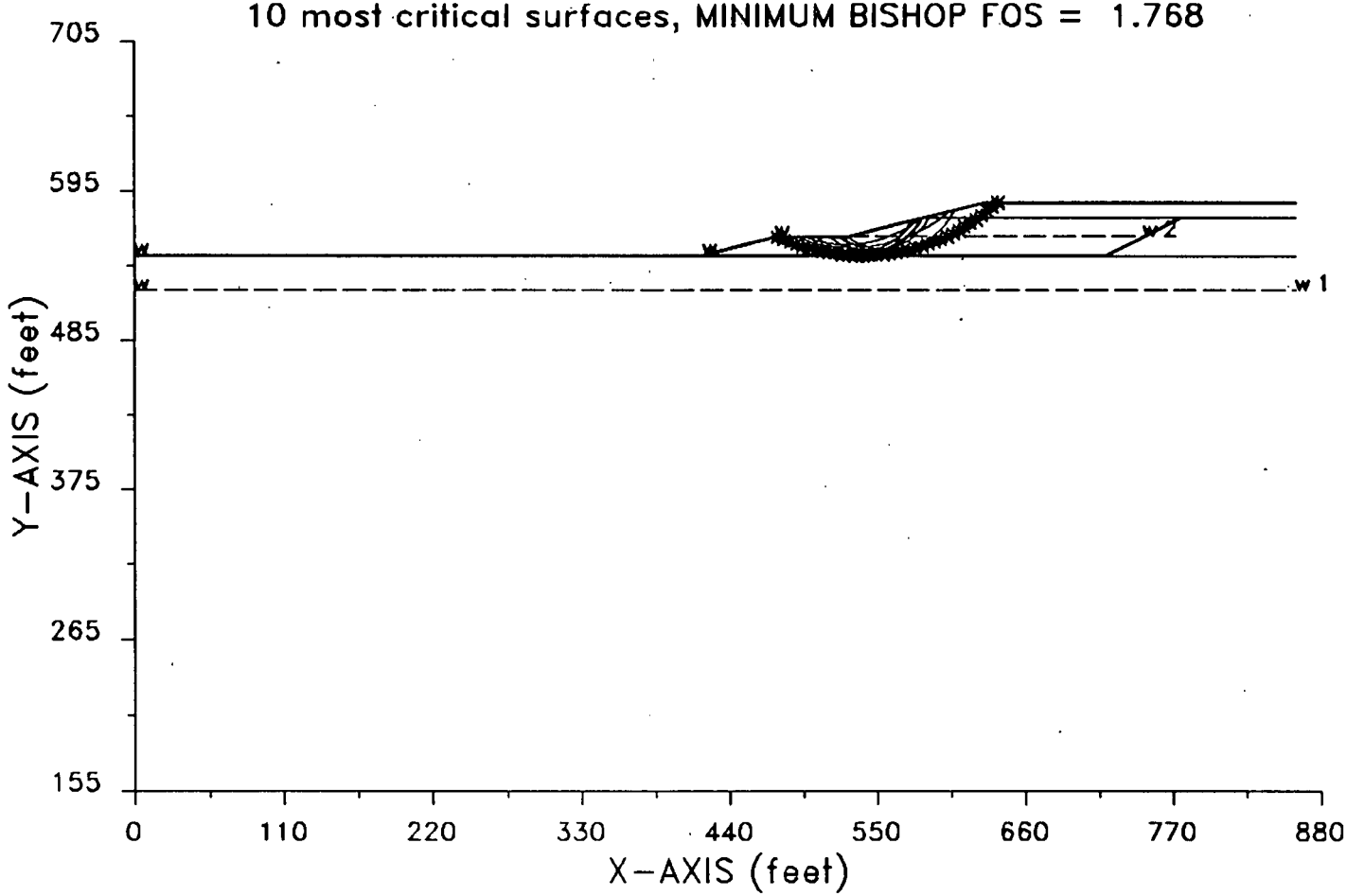
120 surfaces have been generated for this analysis



000422

4T01DA 2-06-96 17:49

PO 145 – 4 to 1 Drained Condition
10 most critical surfaces, MINIMUM BISHOP FOS = 1.768



XSTABL File: 25TO1A 2-06-96 17:44

```
*****************************************
*          X S T A B L                  *
*                                       *
*     Slope Stability Analysis          *
*          using the                    *
*        Method of Slices               *
*                                       *
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*****************************************
```

Problem Description : PO 145 - 2.5 to 1 Undrain Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	500.0	548.0	1
2	500.0	548.0	533.3	561.5	2
3	533.3	561.5	566.6	561.5	2
4	566.6	561.5	600.0	575.0	2
5	600.0	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	500.0	548.0	1
2	500.0	548.0	533.3	561.5	2
3	533.3	561.5	566.6	561.5	2
4	566.6	561.5	600.0	575.0	2
5	600.0	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	500.0	548.0	1

9	500.0	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4
15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	0
2	81.2	85.2	50.0	13.00	.000	.0	0
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit : = -45.0 degrees
Upper angular limit : = (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	571.80	563.60
2	576.72	562.72
3	581.70	562.26
4	586.70	562.24
5	591.68	562.65
6	596.61	563.50
7	601.44	564.76
8	606.15	566.45
9	610.70	568.53
10	615.04	571.00
11	619.16	573.84
12	623.01	577.02
13	626.58	580.53

14	629.82	584.33
15	631.72	587.00

**** Simplified BISHOP FOS = .924 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 2.5 to 1 Undrain Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft-lb)	Resisting Moment
1.	.924	584.44	619.75	57.56	571.80	631.72	7.361E+05
2.	1.143	567.26	628.77	75.34	533.33	629.89	1.743E+06
3.	1.166	566.84	622.30	61.80	555.77	611.58	4.016E+05
4.	1.205	570.86	621.02	57.42	571.80	609.98	2.209E+05
5.	1.347	573.43	579.44	21.17	562.18	593.19	1.031E+05
6.	1.391	574.79	578.80	23.44	558.97	597.70	1.957E+05
7.	1.453	612.79	606.86	56.47	575.00	665.67	2.785E+06
8.	1.455	559.55	620.78	69.94	526.92	617.90	1.553E+06
9.	1.509	426.69	1311.23	765.38	504.49	674.28	2.757E+07
10.	1.515	570.71	582.11	27.46	552.56	596.77	2.471E+05

*** END OF FILE ***

XSTABL File: 3TO1A 2-06-96 17:41

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*****************************************
*          X S T A B L                  *
*                                       *
*      Slope Stability Analysis         *
*            using the                  *
*          Method of Slices             *
*                                       *
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*****************************************
```

Problem Description : PO 145 - 3 to 1 Undrain Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	469.1	548.0	1
2	469.1	548.0	509.6	561.5	2
3	509.6	561.5	553.1	561.5	2
4	553.1	561.5	593.6	575.0	2
5	593.6	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	469.1	548.0	1
2	469.1	548.0	509.6	561.5	2
3	509.6	561.5	553.1	561.5	2
4	553.1	561.5	593.6	575.0	2
5	593.6	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	469.1	548.0	1

9	469.1	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4
15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	0
2	81.2	85.2	50.0	13.00	.000	.0	0
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced
along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined
within the angular range defined by :

Lower angular limit : = -45.0 degrees
Upper angular limit : = (slope angle - 5.0) degrees

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter. In such
cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface
is specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	568.59	566.66
2	573.48	565.61
3	578.44	564.98
4	583.43	564.79
5	588.43	565.04
6	593.38	565.72
7	598.26	566.84
8	603.01	568.37
9	607.62	570.32
10	612.04	572.66
11	616.24	575.37
12	620.18	578.45
13	623.84	581.85
14	627.19	585.57
15	627.82	586.41

**** Simplified BISHOP FOS = 1.112 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 3 to 1 Undrain Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.112	583.11	621.99	57.20	568.59	627.82	6.601E+05
2.	1.192	563.29	627.13	73.53	530.13	623.49	1.719E+06
3.	1.205	562.72	618.12	57.53	552.56	604.47	4.238E+05
4.	1.231	569.68	665.30	116.27	517.31	655.56	5.992E+06
5.	1.361	573.81	586.26	29.92	555.77	602.46	3.533E+05
6.	1.385	569.63	591.14	29.66	558.97	594.68	1.563E+05
7.	1.407	559.64	613.04	62.82	523.72	614.14	1.591E+06
8.	1.431	555.80	819.68	260.58	520.51	673.10	9.920E+06
9.	1.440	573.87	624.30	56.61	571.80	609.42	2.069E+05
10.	1.445	571.09	582.63	28.10	552.56	598.41	3.466E+05

*** END OF FILE ***

XSTABL File: 4TO1A 2-06-96 17:42

```
*****************************************
*          X S T A B L                  *
*                                       *
*     Slope Stability Analysis          *
*          using the                    *
*       Method of Slices                *
*                                       *
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*                                       *
* Ver. 5.101a          95 — 1316        *
*****************************************
```

Problem Description : PO 145 - 4 to 1 Undrain Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	419.6	548.0	1
2	419.6	548.0	473.6	561.5	2
3	473.6	561.5	527.6	561.5	2
4	527.6	561.5	581.6	575.0	2
5	581.6	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	419.6	548.0	1
2	419.6	548.0	473.6	561.5	2
3	473.6	561.5	527.6	561.5	2
4	527.6	561.5	581.6	575.0	2
5	581.6	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	419.6	548.0	1

9	419.6	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4
15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	0
2	81.2	85.2	50.0	13.00	.000	.0	0
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit : = -45.0 degrees
Upper angular limit : = (slope angle - 5.0) degrees

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	533.33	562.93
2	538.09	561.40
3	542.95	560.19
4	547.87	559.31
5	552.83	558.75
6	557.83	558.52
7	562.83	558.62
8	567.81	559.05
9	572.75	559.81
10	577.63	560.90
11	582.43	562.30
12	587.13	564.02
13	591.70	566.05
14	596.12	568.37
15	600.39	570.99
16	604.47	573.88
17	608.35	577.03
18	612.01	580.43
19	614.70	583.27

**** Simplified BISHOP FOS = 1.350 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 4 to 1 Undrain Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.350	558.81	634.10	75.59	533.33	614.70	1.414E+06
2.	1.419	543.75	747.35	190.64	501.28	646.86	6.974E+06
3.	1.463	582.92	661.00	107.76	536.54	661.21	5.585E+06
4.	1.464	583.54	617.55	66.13	542.95	642.20	2.944E+06
5.	1.477	558.71	606.56	55.14	526.92	607.87	1.474E+06
6.	1.486	545.84	796.60	236.46	520.51	655.32	7.836E+06
7.	1.539	588.53	626.60	56.58	571.80	628.66	6.150E+05
8.	1.666	538.36	696.25	148.63	475.64	639.14	8.814E+06
9.	1.673	556.27	596.50	35.99	539.74	585.76	2.934E+05
10.	1.716	543.55	593.24	39.22	520.51	577.66	5.055E+05

*** END OF FILE ***

XSTABL File: 25TO1DA 2-06-96 17:45

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*****************************************
*          X S T A B L                  *
*                                       *
*     Slope Stability Analysis          *
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*        Method of Slices               *
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*****************************************
```

Problem Description : PO 145 - 2.5 to 1 Drained Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	500.0	548.0	1
2	500.0	548.0	533.3	561.5	2
3	533.3	561.5	566.6	561.5	2
4	566.6	561.5	600.0	575.0	2
5	600.0	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	500.0	548.0	1
2	500.0	548.0	533.3	561.5	2
3	533.3	561.5	566.6	561.5	2
4	566.6	561.5	600.0	575.0	2
5	600.0	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	500.0	548.0	1

9	500.0	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4
15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	2
2	81.2	85.2	.0	28.00	.000	.0	2
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

2 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

Water Surface No. 2 specified by 4 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)

1	.00	548.00
2	500.00	548.00
3	533.30	561.50
4	746.60	561.50

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit : = -45.0 degrees
Upper angular limit : = (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 23 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	533.33	561.50
2	537.87	559.40
3	542.54	557.60
4	547.31	556.12
5	552.17	554.96
6	557.10	554.12
7	562.08	553.61
8	567.07	553.43
9	572.07	553.59
10	577.05	554.07
11	581.98	554.89
12	586.85	556.03
13	591.63	557.49
14	596.31	559.27
15	600.85	561.35
16	605.25	563.73
17	609.48	566.39
18	613.52	569.33
19	617.36	572.54
20	620.98	575.99
21	624.36	579.67
22	627.49	583.57
23	629.89	587.00

**** Simplified BISHOP FOS = 1.311 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 2.5 to 1 Drained Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.311	567.26	628.77	75.34	533.33	629.89	1.999E+06
2.	1.371	570.86	621.02	57.42	571.80	609.98	2.513E+05
3.	1.376	566.84	622.30	61.80	555.77	611.58	4.739E+05
4.	1.381	567.02	577.00	17.47	558.97	581.60	2.489E+04
5.	1.399	559.55	620.78	69.94	526.92	617.90	1.496E+06
6.	1.420	570.71	582.11	27.46	552.56	596.77	2.316E+05
7.	1.443	573.43	579.44	21.17	562.18	593.19	1.105E+05
8.	1.443	575.22	574.31	9.42	575.00	581.92	1.005E+03
9.	1.464	584.44	619.75	57.56	571.80	631.72	1.166E+06
10.	1.469	574.79	578.80	23.44	558.97	597.70	2.067E+05

*** END OF FILE ***

XSTABL File: 3TO1DA 2-06-96 17:47

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```

Problem Description : PO 145 - 3 to 1 Drained Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	469.1	548.0	1
2	469.1	548.0	509.6	561.5	2
3	509.6	561.5	553.1	561.5	2
4	553.1	561.5	593.6	575.0	2
5	593.6	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	469.1	548.0	1
2	469.1	548.0	509.6	561.5	2
3	509.6	561.5	553.1	561.5	2
4	553.1	561.5	593.6	575.0	2
5	593.6	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	469.1	548.0	1

9	469.1	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4
15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	2
2	81.2	85.2	.0	28.00	.000	.0	2
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

2 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

Water Surface No. 2 specified by 4 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)

1	.00	548.00
2	469.10	548.00
3	509.60	561.50
4	746.60	561.50

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit : = -45.0 degrees
Upper angular limit : = (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 22 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	530.13	561.50
2	534.66	559.40
3	539.33	557.61
4	544.11	556.14
5	548.98	555.00
6	553.92	554.20
7	558.90	553.73
8	563.89	553.60
9	568.89	553.81
10	573.86	554.36
11	578.78	555.25
12	583.63	556.47
13	588.38	558.02
14	593.02	559.89
15	597.52	562.07
16	601.86	564.54
17	606.03	567.31
18	609.99	570.36
19	613.74	573.67
20	617.26	577.22
21	620.52	581.01
22	623.49	584.96

**** Simplified BISHOP FOS = 1.469 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 3 to 1 Drained Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft-lb)	Resisting Moment
1.	1.469	563.29	627.13	73.53	530.13	623.49	2.120E+06
2.	1.504	559.64	613.04	62.82	523.72	614.14	1.701E+06
3.	1.540	556.60	592.55	36.97	536.54	587.98	3.041E+05
4.	1.543	557.29	579.54	21.20	546.15	575.55	6.758E+04
5.	1.576	478.37	976.54	428.59	469.23	657.14	2.061E+07
6.	1.579	557.40	592.36	32.84	546.15	582.59	1.332E+05
7.	1.615	573.87	624.30	56.61	571.80	609.42	2.320E+05
8.	1.624	550.57	630.81	67.87	558.97	584.06	6.342E+04
9.	1.627	562.79	579.63	24.61	546.15	586.34	2.137E+05
10.	1.630	569.68	665.30	116.27	517.31	655.56	7.934E+06

*** END OF FILE ***

XSTABL File: 4TO1DA 2-06-96 17:49

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*****************************************
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*****************************************
```

Problem Description : PO 145 - 4 to 1 Drained Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	419.6	548.0	1
2	419.6	548.0	473.6	561.5	2
3	473.6	561.5	527.6	561.5	2
4	527.6	561.5	581.6	575.0	2
5	581.6	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	419.6	548.0	1
2	419.6	548.0	473.6	561.5	2
3	473.6	561.5	527.6	561.5	2
4	527.6	561.5	581.6	575.0	2
5	581.6	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	419.6	548.0	1

9	419.6	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4
15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	2
2	81.2	85.2	.0	28.00	.000	.0	2
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

2 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

Water Surface No. 2 specified by 4 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)

1	.00	548.00
2	419.60	548.00
3	473.60	561.50
4	746.60	561.50

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit : = -45.0 degrees
Upper angular limit : = (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 37 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	475.64	561.50
2	480.21	559.47
3	484.84	557.59
4	489.54	555.87
5	494.29	554.30
6	499.09	552.90
7	503.93	551.66
8	508.81	550.58
9	513.73	549.67
10	518.67	548.93
11	523.64	548.35
12	528.62	547.94
13	533.62	547.69
14	538.62	547.62
15	543.61	547.71
16	548.61	547.97
17	553.59	548.40
18	558.55	548.99
19	563.50	549.76
20	568.41	550.68
21	573.29	551.78
22	578.13	553.03
23	582.92	554.45
24	587.67	556.03
25	592.35	557.77
26	596.98	559.66
27	601.54	561.71
28	606.03	563.91
29	610.45	566.26
30	614.78	568.76
31	619.02	571.40
32	623.18	574.18
33	627.23	577.10
34	631.19	580.16
35	635.04	583.35
36	638.79	586.66
37	639.14	587.00

**** Simplified BISHOP FOS = 1.768 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 4 to 1 Drained Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft-lb)	Resisting Moment
1.	1.768	538.36	696.25	148.63	475.64	639.14	9.351E+06

2.	1.827	540.54	604.89	56.42	504.49	589.51	1.438E+06
3.	1.843	538.37	602.03	52.83	504.49	584.05	1.140E+06
4.	1.855	540.27	590.20	38.84	514.10	575.17	5.924E+05
5.	1.880	543.55	593.24	39.22	520.51	577.66	5.539E+05
6.	1.890	530.59	666.04	112.71	488.46	604.08	2.912E+06
7.	1.894	534.60	604.80	56.65	498.08	582.93	1.258E+06
8.	1.978	558.71	606.56	55.14	526.92	607.87	1.974E+06
9.	1.987	526.82	645.15	89.54	494.87	582.77	1.166E+06
10.	2.032	548.50	586.25	35.02	523.72	581.63	6.715E+05

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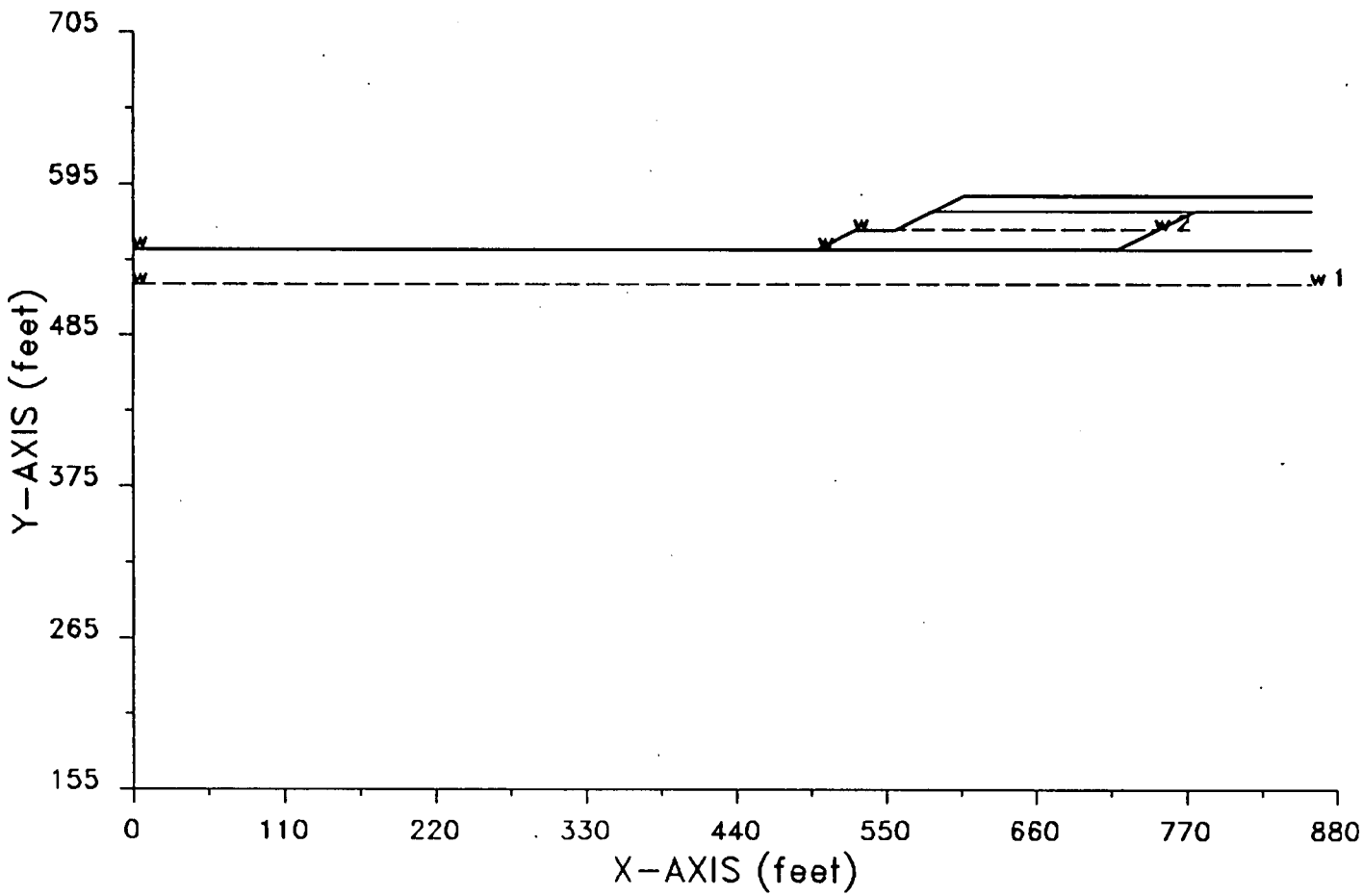
2T01DA 3-01-96 8:16

PO 145 – 2.0 to 1 Drained Condition



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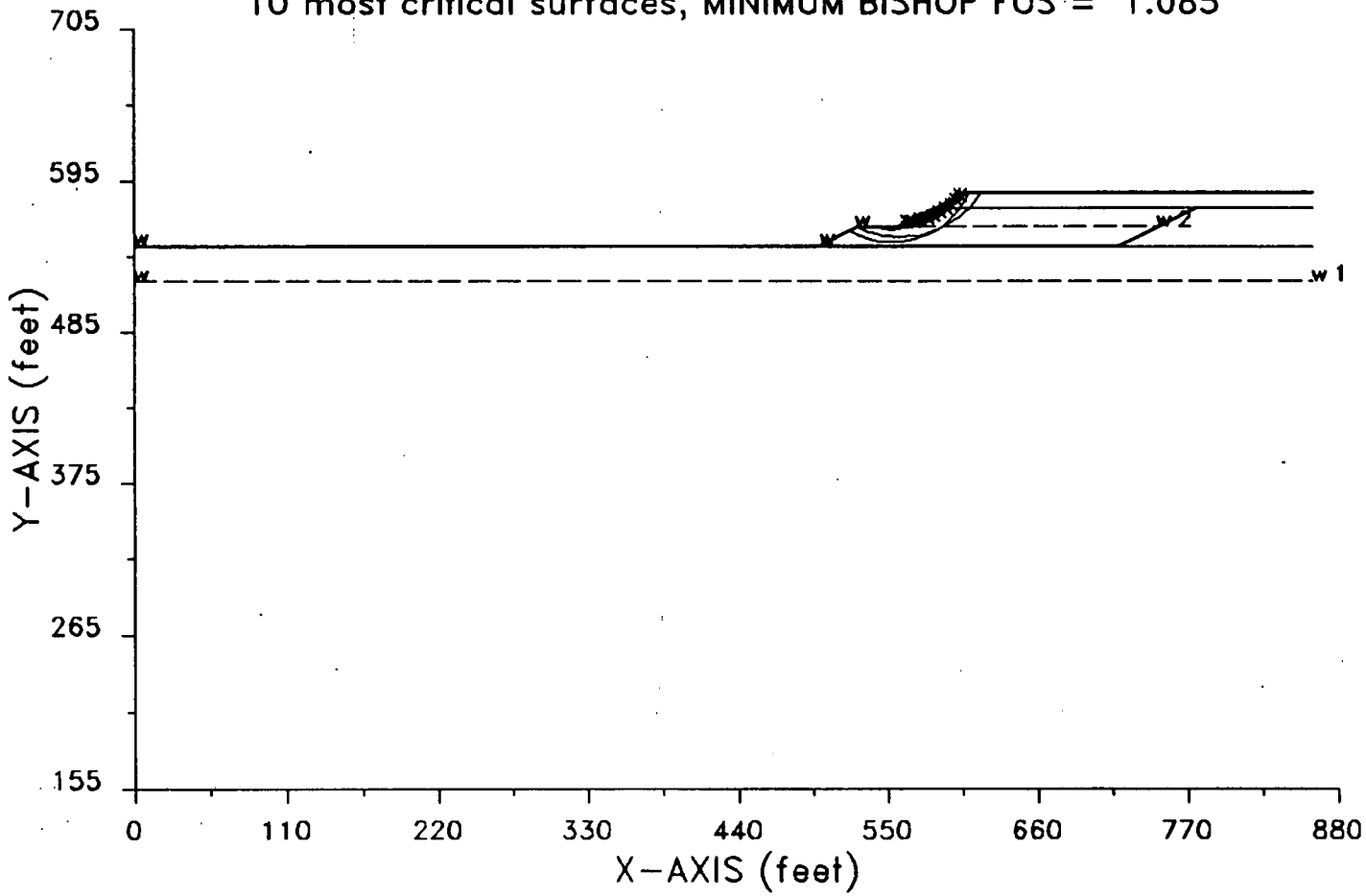
PO 145 – 2.0 to 1 Drained Condition
10 most critical surfaces, MINIMUM BISHOP FOS = 1.085



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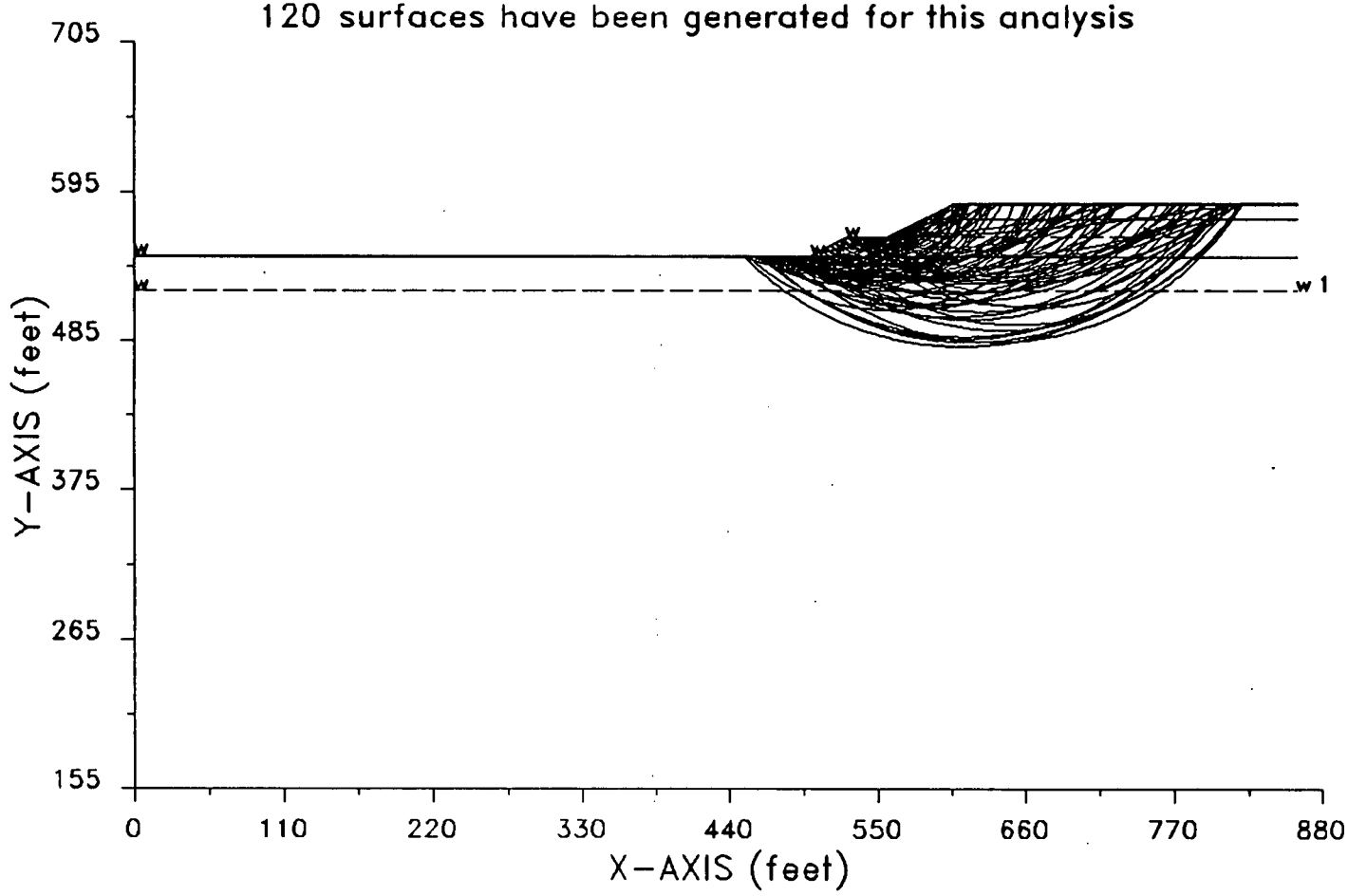
PO 145 – 2.0 to 1 Drained Condition
120 surfaces have been generated for this analysis



154000

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```

Problem Description : PO 145 - 2.0 to 1 Drained Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	500.0	548.0	1
2	500.0	548.0	526.0	561.5	2
3	526.0	561.5	556.0	561.5	2
4	556.0	561.5	583.0	575.0	2
5	583.0	575.0	607.0	587.0	3
6	607.0	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	500.0	548.0	1
2	500.0	548.0	526.0	561.5	2
3	526.0	561.5	556.0	561.5	2
4	556.0	561.5	583.0	575.0	2

5	583.0	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	500.0	548.0	1
9	500.0	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4
15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	2
2	81.2	85.2	.0	28.00	.000	.0	2
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

2 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

Water Surface No. 2 specified by 4 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	548.00
2	500.00	548.00
3	526.00	561.50
4	746.60	561.50

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 570.0 ft

Each surface terminates between x = 570.0 ft
and x = 820.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit : = -45.0 degrees
Upper angular limit : = (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

• • • • • SIMPLIFIED BISHOP METHOD • • • • •

The most critical circular failure surface
is specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	563.85	565.42
2	568.81	566.03
3	573.70	567.07
4	578.48	568.52
5	583.12	570.39
6	587.58	572.65
7	591.83	575.29
8	595.83	578.29
9	599.56	581.62
10	602.51	584.75

**** Simplified BISHOP FOS = 1.085 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 2.0 to 1 Drained Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.085	559.32	622.89	57.64	563.85	602.51	2.938E+05
2.	1.097	548.86	601.47	40.11	557.69	574.70	2.182E+04
3.	1.145	562.37	577.79	12.45	563.85	571.37	1.480E+03
4.	1.146	572.92	606.84	38.45	570.00	605.23	2.443E+05
5.	1.147	558.27	615.52	54.90	548.46	604.32	6.493E+05
6.	1.179	552.95	612.00	62.19	520.77	609.86	1.834E+06
7.	1.188	555.23	586.26	25.67	548.46	576.18	5.149E+04
8.	1.202	558.87	624.49	70.63	526.92	618.74	2.322E+06
9.	1.211	553.15	590.90	31.33	542.31	578.68	8.898E+04
10.	1.222	571.22	594.99	28.36	566.92	596.21	1.393E+05

* * * END OF FILE * * *

APPENDIX H

EXCAVATION SEQUENCING

Figure H-1: Pre-excavation Topographical Surface

The 1992 Flyover data was used to develop a topographical grid for the Waste Pit pre-excavation surface. Geographic reference points include the primary and secondary roads, Waste Pit boundaries, and surface water areas. The purpose of this Figure is to depict the present surface and is to be used as a reference for the following excavation figures.

Figure H-2: Pit 1 - Phase I Excavation

Excavation of Pit 1 will be accomplished by the removal of material from the edges of the Pit, using backhoes and other necessary equipment. The depth of excavation and volume of excavation material removed during Phase I will be constrained by the equipment's capabilities. This Figure is an MGE Terrain Model (MSM) grid surface depiction.

Figure H-3: Pit 1 - Phase II Excavation

After Phase I, the center of Pit 1 will be excavated to an approximate surface elevation of 554 feet. An access ramp, central to the excavation, will be developed for the subsequent breaching and excavation of the berm between Pits 1 and 3. This figure is a MSM grid surface depiction.

Figure H-4: Pit 3 - Phase III Excavation

Excavation of Pit 3 will be accomplished by first excavating the clay and ash materials to a maximum depth (to be determined) from the ground surface. MSM grid surface depiction.

Figure H-5: Pit 3 - Phase IV Excavation

Pit 3 will be excavated to a surface elevation of approximately 554 feet and the common berm between Pits 1 and 3 will be broken. Waste material will be removed from Pit 3 to an elevation equivalent to that of Pit 1. MSM grid surface depiction.

Figure H-6: Pit 5 - Final Excavation

Depicts Pit 5 after excavation is complete.

Figure H-1 - Pre-excavation Topographical Surface

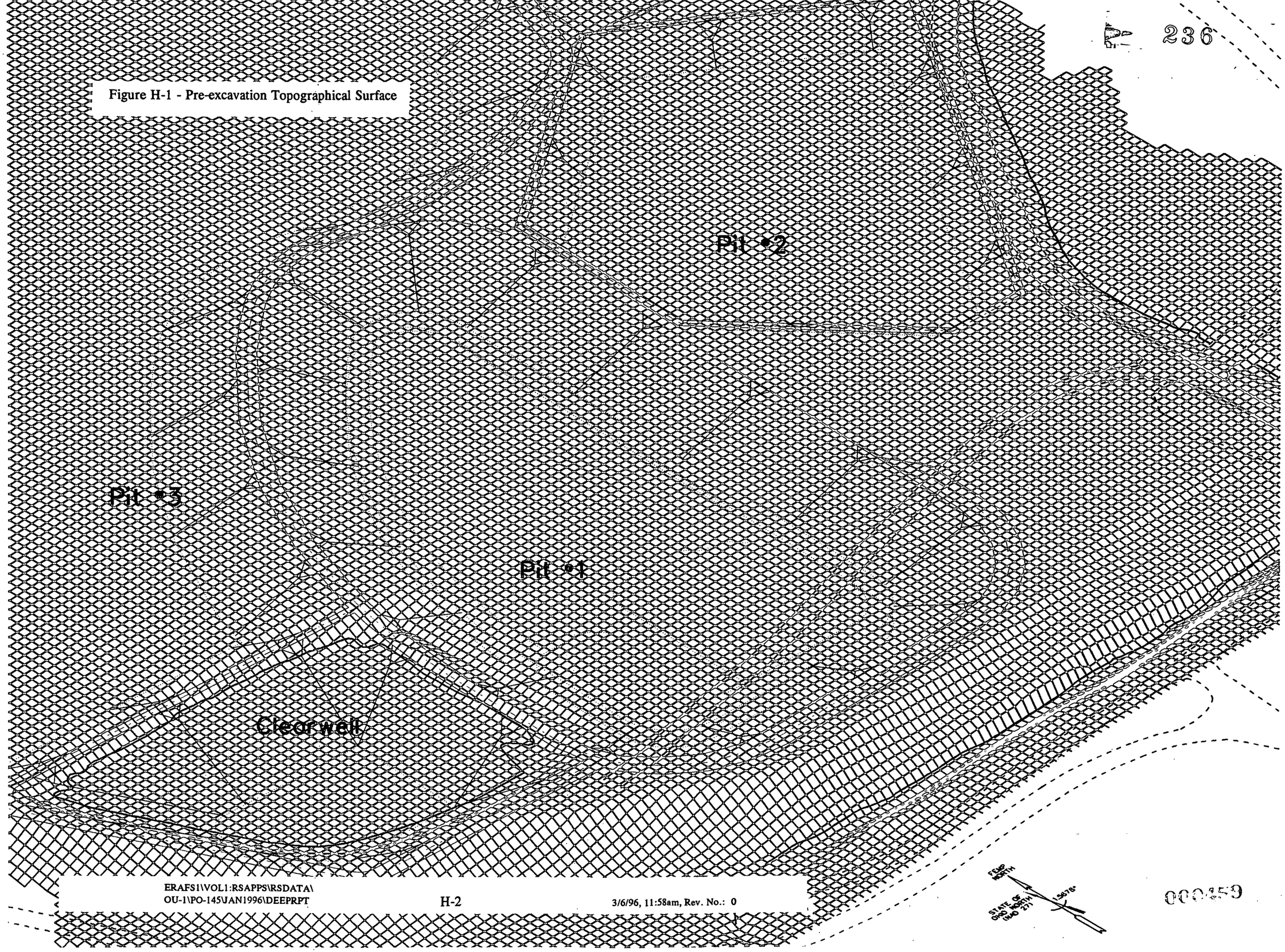

Figure H-2 - Pit 1 - Phase I Excavation

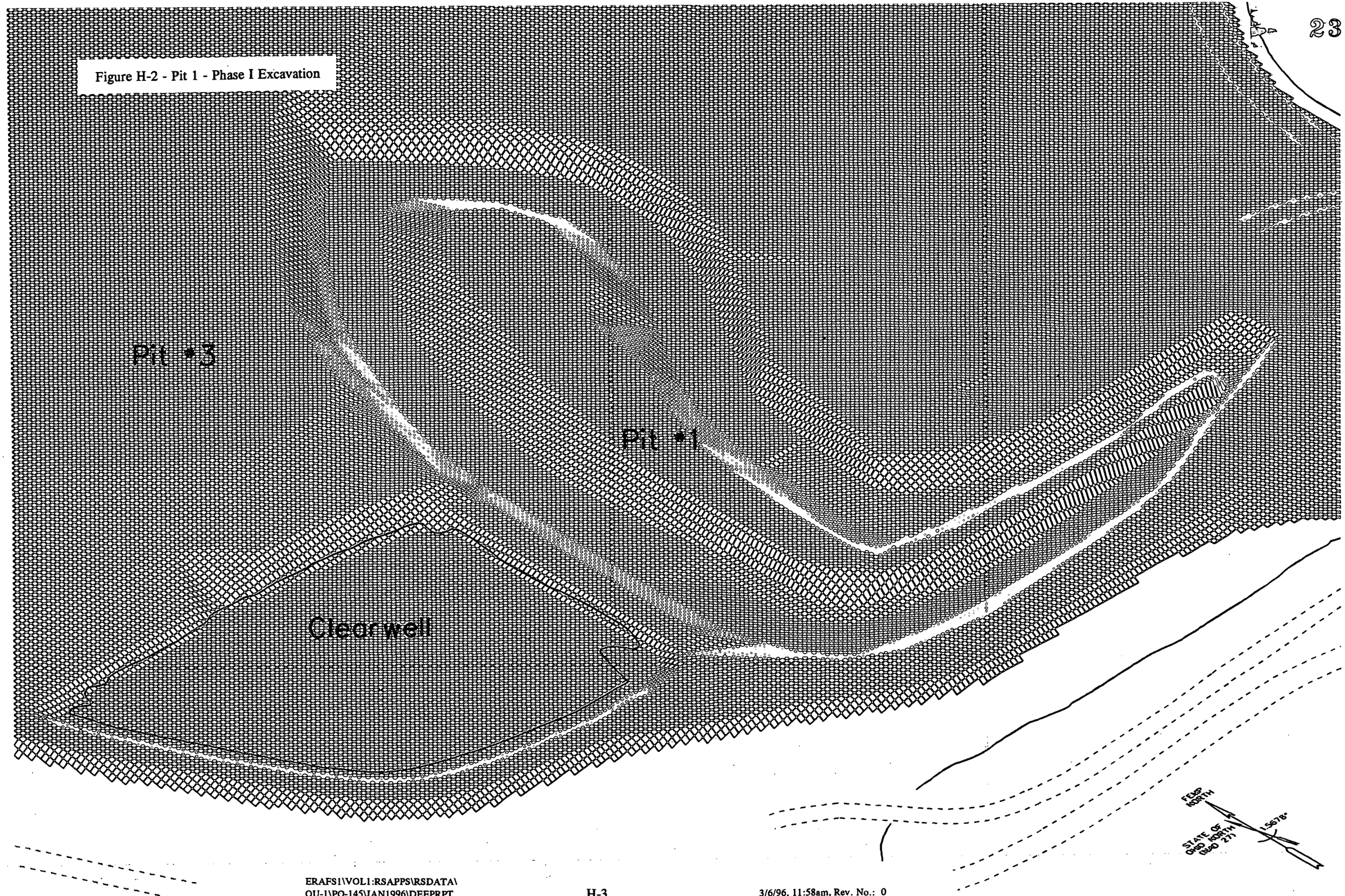

Figure H-3 - Pit 1 - Phase II Excavation

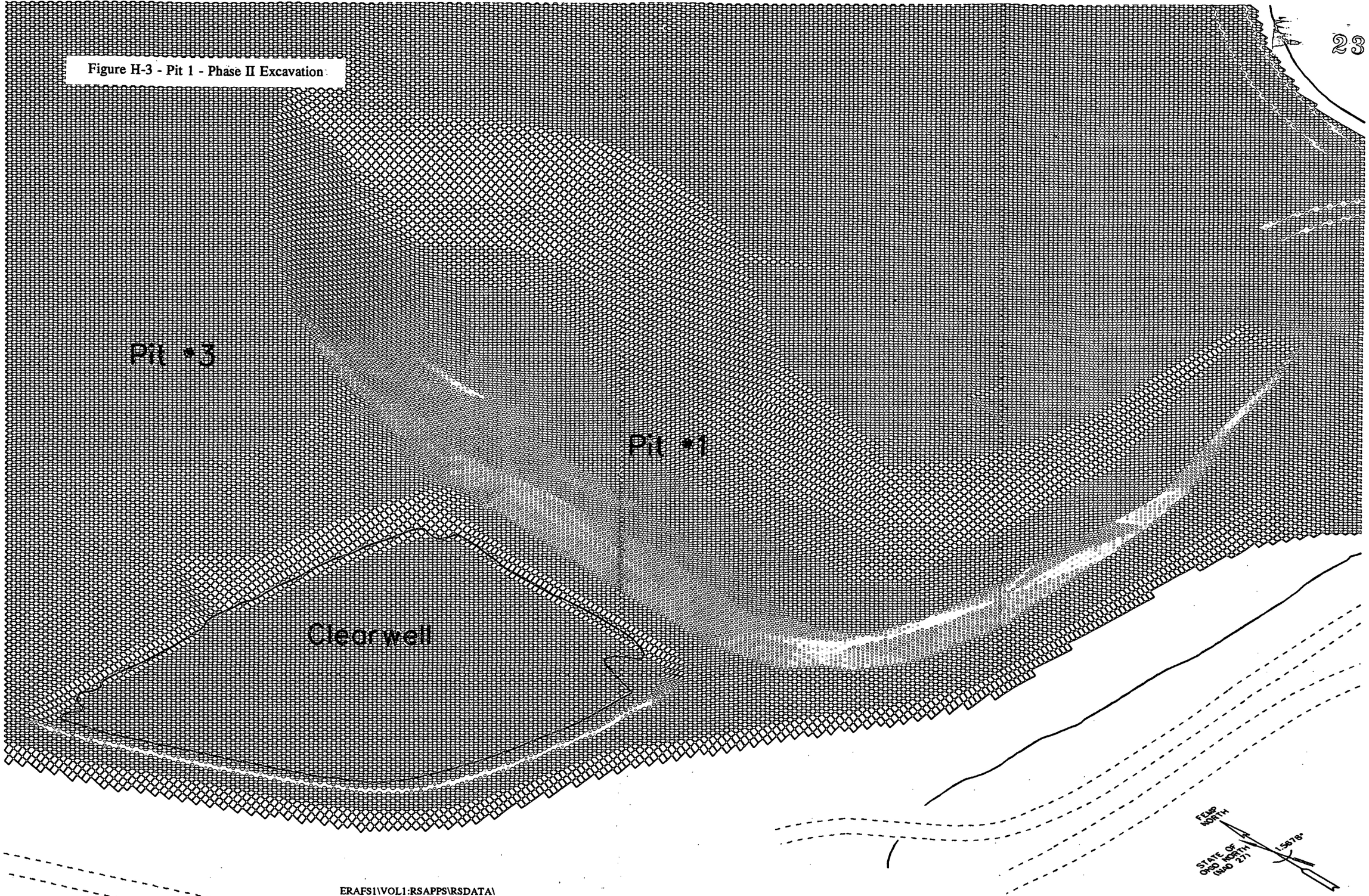

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Figure H-4 - Pit 3 - Phase III Excavation

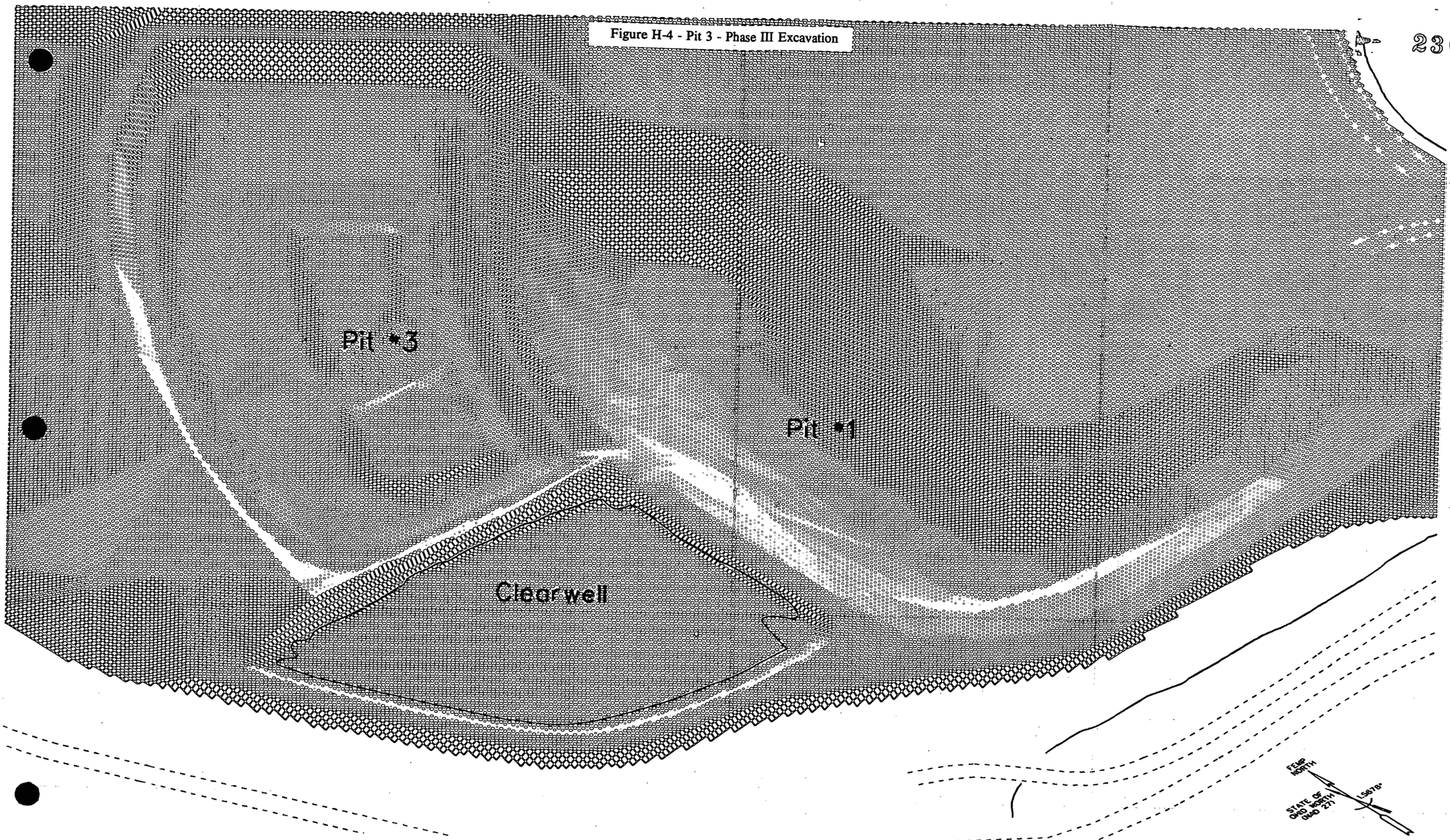


Figure H-5 - Pit 3 - Phase IV Excavation

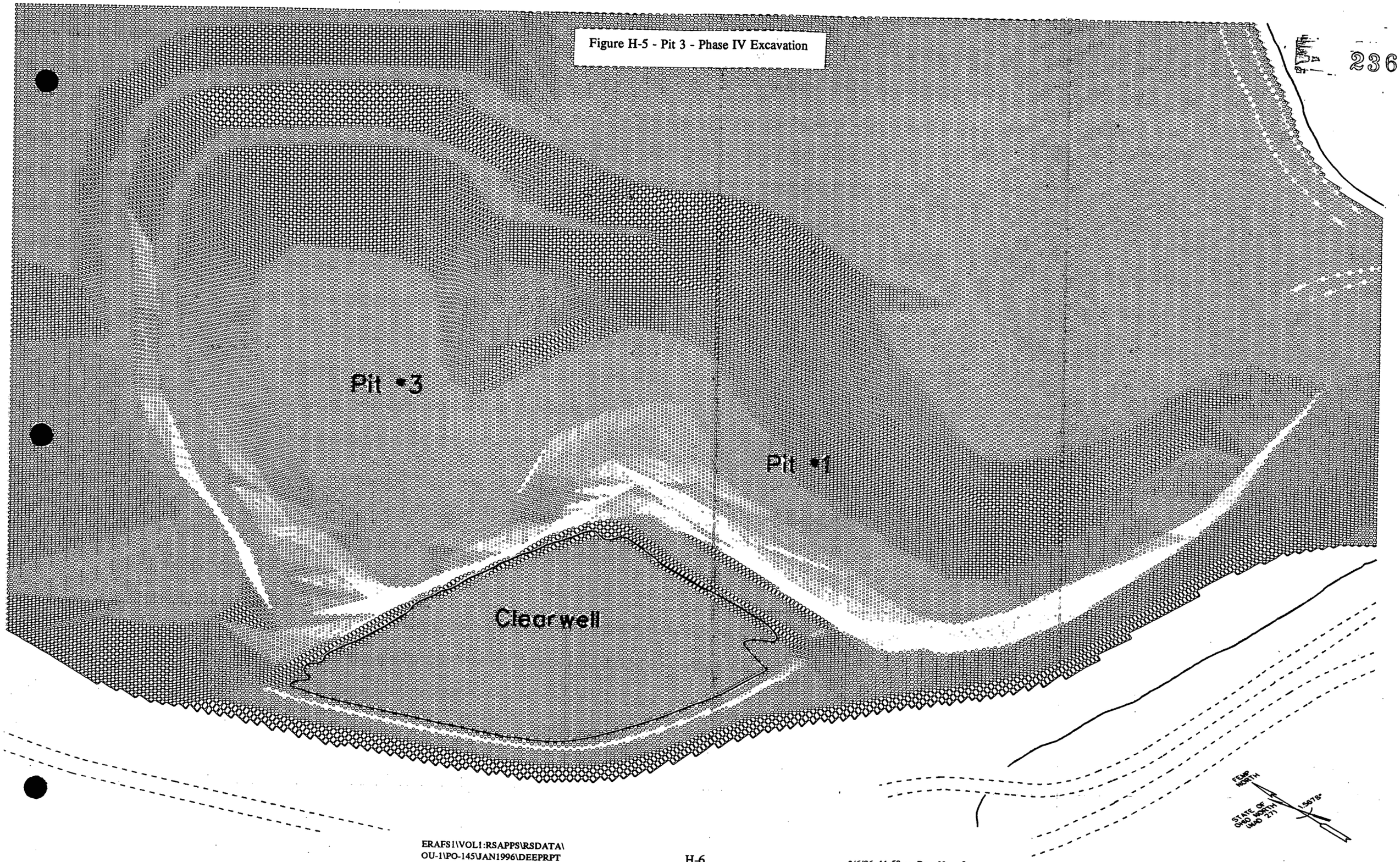
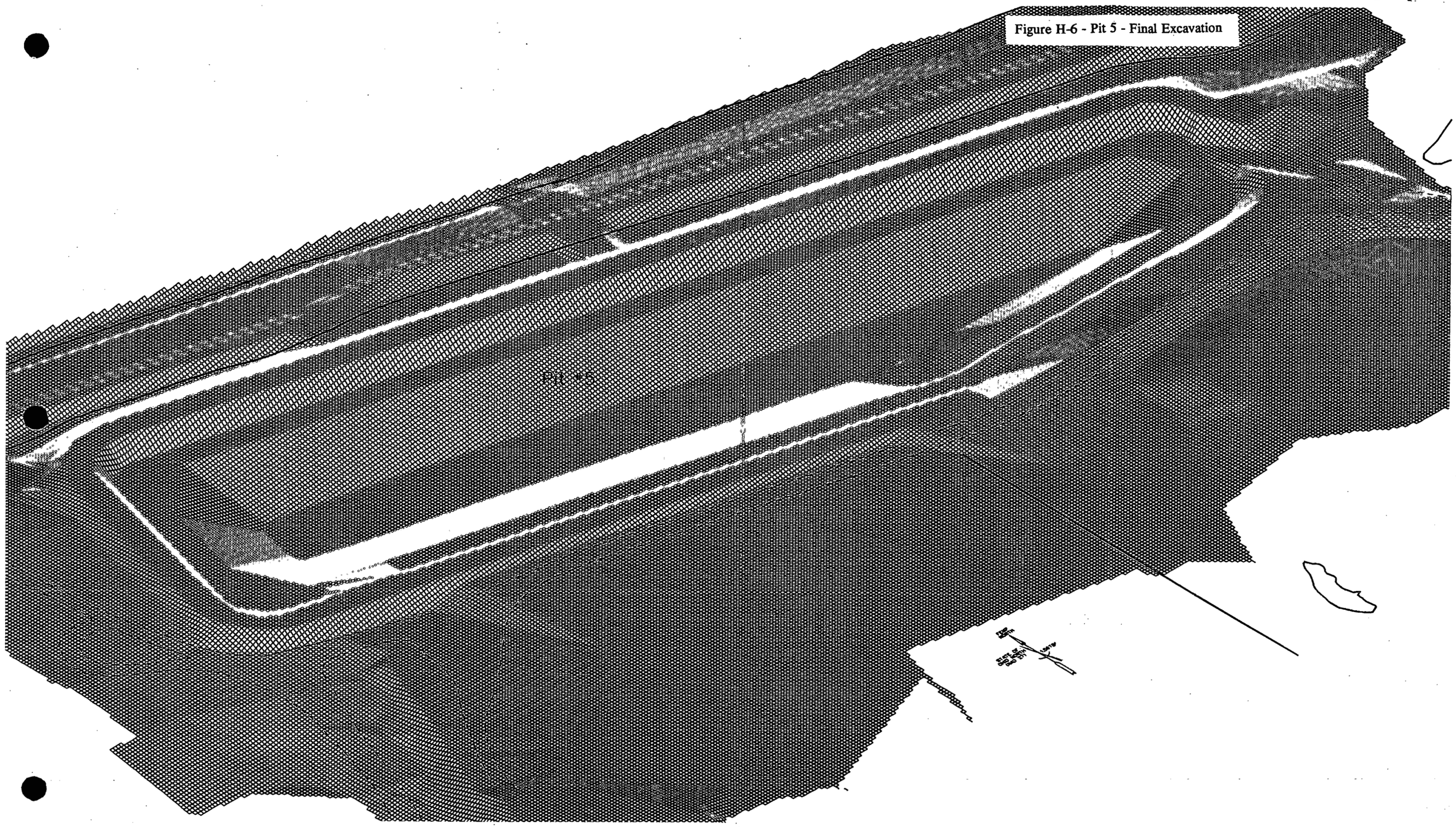


Figure H-6 - Pit 5 - Final Excavation



APPENDIX I

WASTE PROPERTIES FOR PROCESSING

Introduction

To design the waste processing system for the waste pits, it has been determined by PARSONS and FERMCO that a single unit weight and moisture content, for the purpose of data handling simplification, should be used for each individual waste pit. Due to the variability of the waste materials within each Pit, the ideal method, for the purpose of accuracy, would be to use the actual density and moisture data for each different type of waste. On the other hand, the heterogeneous nature of the waste materials makes using different values for different waste material types impractical.

In addition, the process designers need the bulk densities of the waste stream from the Waste Pits at three stages:

1) After excavation of the waste from the Pits
2) Before the waste is placed in the dryer unit
3) After the waste is removed from the dryer unit

This Appendix provides waste wet density and moisture content values for each waste pit and describes the methodology used to derive those values. In addition, this Appendix provides estimates for the average bulk density of the waste stream at the above mentioned stages of the proposed waste processing operation.

Waste Wet Density and Moisture Content by Pit

An attempt was made to use the average wet density data and moisture content data for each waste pit as the value of wet density and moisture content for each pit. Upon back calculating the specific gravity from the measured moisture content and wet density data, it was discovered that most of the calculated specific gravities did not match the measured specific gravities (See Table I-1). Possible reasons for the disagreement may have been sample disturbance or the long times between sampling and testing of several samples. As a result of the discrepancy, it was determined that using the average moisture content data and average specific gravity data to back calculate the wet density for each Pit would provide a more realistic value of wet density.

The average moisture content and average specific gravity data are found in Table I-1. The back calculated values of wet density for each Pit are reported in Table I-2.

Free-Draining Water within the Waste Materials

The amount of free-draining water present in the waste streams of each pit is unavailable. As a result, the effective porosities of the waste materials were assumed using published values of effective porosity according to USCS classification symbol. Using waste pit volumes and water levels in the waste pits

published in the *Waste Pit Content Study Report* (PARSONS 1993) and the assumed water levels in Pits 5 and 6, the free-draining water was estimated in the waste material by pit. Additionally, it was assumed that 90% of the drainable water would drain from the waste upon excavation. Finally, it was assumed that the remaining 10% of the free water not trapped in the pore space would drain from the waste while the waste is stockpiled before entering the dryer. Table I-3 reports the volume and weight of free-draining water calculated for each waste pit.

Bulk Densities

Using the average moisture content, back calculated wet density, free-draining water, available compaction data, and assumed bulking factors, the bulk densities were estimated at each of the previously mentioned stages of the waste processing operation. Table I-4 reports the data used to estimate the bulk densities and the estimated values of bulk density.

Conclusion

Table I-5 is a summary of the estimated waste parameters for use in the waste processing design. The estimates presented in Table I-5, with the exception of wet density and moisture content, were derived using numerous assumptions. Therefore, caution should be practiced when using these estimates.

Further testing is necessary in order to determine the free-draining water and bulking factors for the waste materials. Basic bench scale testing of waste pit materials would eliminate the uncertainty of the bulk density and free water estimates. Determining free-draining water and bulking factors would provide better volume estimates and weight of waste to be shipped off-site, the number of rail cars needed and other engineering and operations concerns relating to the volume, mass, and moisture content of the waste form after handling outside the pits. Therefore, this testing should be performed.

TABLE 1 -- Statistical Summary of Density and Moisture Data

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Sample Identification							USCS Classification		Unit Weight Data			Specific Gravity	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	USCS Group Symbol	Group Name	Moisture Content (% dry wgt)	Wet Density (pcf)	Dry Density (pcf)	Calc'd Specific Gravity	Meas'd Specific Gravity
1	1765	63089	ST	4.5	7.0	1	ML (NP)	Silt (NP)	23.4	136.2	110.4	3.02	3.03
1	1765	63101	ST	14.0	16.5	1	ML (NP)	Silt (NP)	20.9	145.6	120.4	3.23	2.92
1	1766	63050	ST	4.5	7.0	1	ML	Silt	19.5	137.3	114.9	2.87	3.03
1	1766	63054	ST	8.5	11.0	1	ML (NP)	Silt (NP)	17.3	138.3	117.9	2.81	3.15
1	1766	63062	ST	14.0	16.5	1	ML (NP)	Silt (NP)					3.03
1	1767	63008	ST	3.5	6.0	1	ML (NP)	Silt (NP) with Sand					3.07
1	11352	400053	SS	2.0	3.0	2	ML (NP)	Silt (NP)					
1	11352	400054	SS	5.5	6.0	2	ML (NP)	Silt (NP)					
1	11352	400025	ST	7.5	10.0	2	ML (NP)	Silt (NP)	19.7	138.1	115.4	2.91	3.09
1	11352	400026	ST	11.5	14.0	2	SM	Silty Sand	44.9	108.5	74.9	2.60	3.05
1	11353	400047	SS	4.5	5.5	2	ML (NP)	Sandy Silt (NP) with Gravel					
1	11353	400028	ST	10.0	12.5	2	ML (NP)	Silt (NP) with Sand	24.0	135.7	109.4	3.03	3.05
1	11353	400051	SS	13.5	14.0	2	ML (NP)	Sandy Silt (NP)					
1	11354	400029	ST	7.5	10.0	2	ML (NP)	Silt (NP)	23.0	136.8	111.2	3.02	3.11
1	11354	400030	ST	11.5	14.0	2	SM	Silty Sand	93.3	83.6	43.2	1.96	2.80
									132.0	83.7	36.1	2.44	
1	1765	1A	CAN			3	ML (NP)	Silt (NP)					
1	1765	2A	CAN			3	ML (NP)	Silt (NP)					
1	1765	3A	CAN			3	ML (NP)	Silt (NP) with Sand					
1	1766	4A	CAN			3	ML (NP)	Silt (NP)					
1	1766	5A	CAN			3	ML (NP)	Silt (NP)					3.02
1	1766	6A	CAN			3	ML (NP)	Silt (NP)					
1	1766	7A	CAN			3	ML (NP)	Silt (NP)					
1	1767	8A	CAN			3	ML (NP)	Silt (NP)					
1		1-48	COMP	0.0	12.0	4	GC	Clayey Gravel with Sand					2.62
1	11568	405653	ST	10.5	13.0	6	MH	Sandy Elastic Silt	67.0	100.1	59.9	2.70	2.77
									51.6	105.1	69.3	2.60	
									60.9	101.6	63.1	2.64	

17.3	83.6	Minimum	2.62
132.0	145.6	Maximum	3.15
46.0	119.3	Average	2.98
35.0	22.6	Standard Deviation	0.15

Table I-1 - Average Density, Moisture Content, Specific Gravity, and Back Calculated Specific Gravity of the Waste Pit Materials

TABLE 1 – Statistical Summary of Density and Moisture Data

K:\PO19\STATS.WK3

Sample Identification							USCS Classification		Unit Weight Data			Specific Gravity	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	USCS Group Symbol	Group Name	Moisture Content (% dry wgt)	Wet Density (pcf)	Dry Density (pcf)	Calc'd Specific Gravity	Meas'd Specific Gravity
2	1768	63619	ST	11.0	13.0	1	ML (NP)	Sandy Silt (NP)	290.0	77.5	19.9	4.13	2.80
2	1768	63619dup	ST	11.0	13.0	1	ML (NP)	Silt (NP) with Sand	316.6	75.6	18.2	3.68	2.79
2	1769	63521	ST	12.0	14.0	1	MH	Sandy Elastic Silt	231.2	78.5	23.7	3.12	2.64
2	1769	63530	ST	18.0	20.0	1	MH	Sandy Elastic Silt					2.64
2	1817	63875	ST	10.5	12.5	1	SM	Silty Sand with Gravel	32.7	112.5	84.8	2.44	2.65
2	1818	63865	ST	5.0	7.5	1	SC	Clayey Sand with Gravel					2.20
2	11358	400031	ST	6.0	8.5	2	SC	Clayey Sand with Gravel	24.1	131.2	105.7	2.86	2.69
2	11358	400062	SS	8.5	9.0	2							
2	11359	400033	ST	4.5	7.0	2	MH	Elastic Silt	109.8	90.0	42.9	2.80	3.02
2	11359	400034	ST	8.5	11.0	2	MH	Elastic Silt with Sand	97.7	90.2	45.6	2.56	2.86
2	1768	9A	CAN			3	SM	Silty Sand					
2	1769	10A	CAN			3	CL	Sandy Lean Clay					2.72
2	1818	11A	CAN			3	MH	Sandy Elastic Silt					2.67
2	1817	12A	CAN			3	CL	Lean Clay with Sand					
2	02-05	2-39	COMP	0.0	10.0	4	MH	Gravelly Elastic Silt with Sand					2.59
2	11569	405655	ST	7.5	10.0	6	MH	Elastic Silt	161.9	84.9	32.4	3.27	2.98
									139.2	83.7	35.0	2.56	
									166.0	82.7	31.1	2.88	

24.1	75.6	Minimum	2.20
316.6	131.2	Maximum	3.02
156.9	90.7	Average	2.71
98.8	17.7	Standard Deviation	0.20

Table I-1 - Average Density, Moisture Content, Specific Gravity, and Back Calculated Specific Gravity of the Waste Pit Materials (Continued)

TABLE 1 – Statistical Summary of Density and Moisture Data

K:\PO19\STATS.WK3

Sample Identification							USCS Classification		Unit Weight Data			Specific Gravity	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	USCS Group Symbol	Group Name	Moisture Content (% dry wgt)	Wet Density (pcf)	Dry Density (pcf)	Calc'd Specific Gravity	Meas'd Specific Gravity
3	1770	63328	ST	4.0	6.0	1	SM	Silty Sand	63.7	81.3	49.7	1.61	2.20
3	1770	63357	ST	20.0	22.0	1	SM	Silty Sand	138.7	90.1	37.7	3.76	2.84
3	1770	63370	ST	28.0	30.0	1	MH	Sandy Elastic Silt					2.77
3	1771	63458	ST	32.0	34.0	1	MH	Sandy Elastic Silt					2.84
3	1772	63278	ST	19.5	22.0	1	ML	Sandy Silt	35.4	75.1	55.5	1.30	2.45
3	11360	400097	SS	13.0	13.5	2	ML	Silt					
3	11360	400100	SS	13.5	14.0	2							
3	11360	400035	ST	20.5	23.0	2	CL	Lean Clay with Sand	17.9	129.7	110.0	2.58	2.69
3	11361	400038	ST	10.5	13.0	2	MH		196.9	75.7	25.5	2.09	2.88
3	11361	400039	ST	21.0	22.5	2			137.6	84.9	35.7	2.70	
									100.9	95.9	47.7	3.35	
									46.6	106.7	72.8	2.56	
3	11361	400040	ST	29.0	31.5	2	ML	Silt	219.6	80.7	25.3	3.63	2.96
									206.4	79.1	25.8	2.83	
									124.3	84.5	37.7	2.42	
3	11362	400076	SS	6.0	6.5	2	ML (NP)						
3	11362	400077	SS	6.5	7.0	2	ML (NP)	Sandy Silt (NP)					
3	11362	400041	ST	19.0	21.5	2	SM	Silty Sand	190.0	80.9	27.9	2.97	2.88
									182.2	81.3	28.8	2.91	
									172.8	80.7	29.6	2.62	
3	11362	400042	ST	23.0	25.5	2	MH	Sandy Elastic Silt	178.5	79.1	28.4	2.43	2.60
									185.0	79.0	27.7	2.49	
									197.6	75.5	25.4	2.07	
3	11363	400044	ST	12.0	14.5	2	ML	Silt with Sand					2.79
3	11363	400045	ST	19.0	21.5	2	ML (NP)	Sandy Silt (NP)	44.6	93.0	64.3	1.91	2.39
3	1770	13A	CAN			3	MH	Sandy Elastic Silt					
3	1770	14A	CAN			3	MH	Elastic Silt with Sand					
3	1770	15A	CAN			3	ML	Sandy Silt					2.69
3	1771	16A	CAN			3	MH	Sandy Elastic Silt					2.72
3	1771	17A	CAN			3	MH	Elastic Silt with Sand					
3	1772	18A	CAN			3	ML	Sandy Silt					
3	1772	19A	CAN			3	CL	Lean Clay with Sand					
3	03-05	3-52	COMP	0.0	20.0	4	MH	Sandy Elastic Silt					2.54
3	03-05	3-52 Redue	COMP	0.0	20.0	4							
3	03-02	3-90	COMP	0.0	20.0	4	ML	Sandy Silt					
3	03-02	3-90 Redue	COMP	0.0	20.0	4							2.65
3	11570	405657	ST	10.5	13.0	6	SM	Silty Sand	254.5	75.6	21.3	2.62	2.83
									167.5	81.5	30.5	2.68	
									230.4	76.8	23.2	2.63	
3	11570	405658	ST	15.5	18.0	6	MH	Sandy Elastic Silt	253.7	75.4	21.3	2.56	1.99
									148.9	83.8	33.7	2.74	
									271.6	76.2	20.5	3.06	
3	11571	405663	ST	17.5	20.0	6	MH	Elastic Silt	193.5	80.5	27.4	2.94	2.78
									196.2	79.5	26.8	2.76	
									228.3	76.7	23.4	2.58	
3	11571	405687	ST	32.5	35.0	6	MH	Elastic Silt	194.4	76.7	26.1	2.22	2.82
									185.3	80.5	28.2	2.79	
									213.1	76.2	24.3	2.31	
3	11572	405669	ST	15.0	17.5	6	MH	Sandy Elastic Silt	365.5	71.4	15.3	2.42	2.77
									237.5	76.5	22.7	2.65	
									166.5	73.7	27.7	1.69	
3	11572	405672	ST	22.5	25.0	6	SM	Silty Sand	268.7	75.9	20.6	2.91	2.76
									246.2	75.2	21.7	2.43	
									152.6	77.0	30.5	1.92	
3	11572	405675	ST	30.0	32.5	6	MH	Sandy Elastic Silt	282.5	74.2	19.4	2.55	2.67
									238.3	75.8	22.4	2.49	
									230.0	74.4	22.5	2.14	

17.9	71.4	Minimum	1.99
365.5	129.7	Maximum	2.96
183.5	81.2	Average	2.66
73.7	10.4	Standard Deviation	0.23

Table I-1 - Average Density, Moisture Content, Specific Gravity, and Back Calculated Specific Gravity of the Waste Pit Materials (Continued)

TABLE 1 – Statistical Summary of Density and Moisture Data

K:\PO19\STATS.WK3

Sample Identification							USCS Classification		Unit Weight Data			Specific Gravity	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	USCS Group Symbol	Group Name	Moisture Content (% dry wgt)	Wet Density (pcf)	Dry Density (pcf)	Calc'd Specific Gravity	Meas'd Specific Gravity
4	1773	63747	ST	11.0	13.0	1	CL	Sandy Lean Clay	21.4	148.4	122.2	3.37	2.62
4	1774	63670	ST	10.0	12.0	1	CL	Lean Clay with Sand	15.9	110.7	95.5	2.02	2.79
4	1774	63687	ST	20.0	22.0	1	ML (NP)	Silt (NP)	17.6	137.7	117.1	2.80	3.10
4	1775	63826	ST	15.0	17.0	1	CL-ML	Sandy Silty Clay	61.5	110.7	68.5	3.39	3.59
4	1773	21A	CAN			3	CL	Sandy Lean Clay					3.25
4	1773	22A	CAN			3	ML (NP)	Silt (NP)					
4	1773	23A	CAN			3	ML (NP)	Silt (NP) with Sand					3.02
4	1775	24A	CAN			3	CL	Sandy Lean Clay					
4	1775	25A	CAN			3	CL	Sandy Lean Clay					
4	1775	26A	CAN			3	ML (NP)	Silt (NP) with Sand					
4	04-01	4-02	COMP	0.0	20.0	4	ML (NP)	Silt (NP)					2.75
4	04-04	4-62	COMP	0.0	20.0	4	ML (NP)	Sandy Silt (NP)					3.33
4	04-04	4-62 Redue	COMP	0.0	20.0	4							3.63

15.9	110.7	Minimum	2.62
61.5	148.4	Maximum	3.63
29.1	126.9	Average	3.12
21.7	19.2	Standard Deviation	0.36

Table I-1 - Average Density, Moisture Content, Specific Gravity, and Back Calculated Specific Gravity of the Waste Pit Materials (Continued)

TABLE 1 – Statistical Summary of Density and Moisture Data

K:\PO19\STATS.WK3

Sample Identification							USCS Classification		Unit Weight Data			Specific Gravity	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	USCS Group Symbol	Group Name	Moisture Content (% dry wgt)	Wet Density (pcf)	Dry Density (pcf)	Calc'd Specific Gravity	Meas'd Specific Gravity
5		30A	CAN			3.0	MH	Elastic Silt					
5		31A	CAN			3.0	MH	Elastic Silt					
5		32A	CAN			3.0	MH	Elastic Silt					
5		33A	CAN			3.0	MH	Elastic Silt					
5		34A	CAN			3.0	MH	Elastic Silt					
5		35A	CAN			3.0	MH	Elastic Silt					2.70
5		36A	CAN			3.0	MH	Elastic Silt					
5		37A	CAN			3.0	MH	Elastic Silt					
5		38A	CAN			3.0	MH	Elastic Silt					2.74
5		39A	CAN			3.0	MH	Elastic Silt					
5		40A	CAN			3.0	ML (NP)	Silt (NP)					
5		41A	CAN			3.0	ML (NP)	Silt (NP)					2.71
5		57A	CAN			3.0	MH	Elastic Silt					
5		58A	CAN			3.0	MH	Elastic Silt					2.70
5	05-04	5-25	COMP	10.0	29.0	4.0	MH	Sandy Elastic Silt					2.43
5	WP5-1	405316	VC	14.5	15.0	5.0			293.2	72.3	18.4	2.17	
5	WP5-1	405316	VC	19.5	20.0	5.0			523.2	67.0	10.8	1.75	
5	WP5-1	405316	VC	24.5	25.0	5.0			500.8	72.4	12.1	5.88	
5	WP5-2	405318	VC	9.0	14.0	5.0	MH	Elastic Silt	302.8	78.6	19.5	5.89	2.71
5	WP5-2	405318	VC	19.0	24.0	5.0	MH	Elastic Silt	454.6	69.8	12.6	2.43	2.98
									566.0	68.7	10.3	2.57	
5	WP5-3	405320	VC	13.5	19.0	5.0			447.8	68.1	12.4	1.85	2.94
									551.0	69.6	10.7	3.06	
5	WP5-3	405320	VC	19.0	24.0	5.0	MH	Elastic Silt with Sand	295.0	71.7	18.2	2.05	2.74
5	WP5-4	405322	VC	9.5	14.5	5.0	MH	Elastic Silt	1141.2	64.7	5.2	1.79	2.81
5	WP5-4	405322	VC	19.0	19.5	5.0			529.1	69.0	11.0	2.51	
5	WP5-5	405324	VC	10.5	15.5	5.0	MH	Elastic Silt	448.4	69.1	12.6	2.14	2.94
5	WP5-5	405324	VC	15.5	20.5	5.0	MH	Elastic Silt	418.8	70.2	13.5	2.36	2.98
5	WP5-5	405324	VC	25.0	25.5	5.0			372.1	71.1	15.1	2.37	
5	WP5-6	405326	VC	9.0	14.0	5.0	MH	Elastic Silt	931.6	67.4	6.5	4.26	2.64
5	WP5-6	405326	VC	14.0	19.0	5.0	MH	Elastic Silt	576.7	69.0	10.2	2.84	2.84
5	WP5-6	405326	VC	23.5	24.0	5.0			182.9	81.7	28.9	3.01	
5	WP5-7	405328	VC	13.5	18.5	5.0	MH	Elastic Silt	525.6	69.4	11.1	2.71	2.88
5	WP5-7	405328	VC	18.5	24.0	5.0	MH	Elastic Silt	576.2	68.0	10.1	2.26	2.80
									185.5	80.1	28.1	2.71	
5	WP5-8	405330	VC	9.0	14.0	5.0	MH	Elastic Silt	537.1	68.8	10.8	2.45	2.77
5	WP5-8	405330	VC	14.0	18.5	5.0							
5	WP5-8	405330	VC	18.5	24.0	5.0	MH	Elastic Silt with Sand	457.1	70.9	12.7	3.01	2.91
									120.4	85.6	38.8	2.48	
5	WP5-9	405332	VC	13.5	14.0	5.0			870.8	66.7	6.9	2.67	
5	WP5-9	405332	VC	18.5	19.0	5.0			505.5	69.9	11.5	2.85	
5	WP5-9	405332	VC	23.5	24.0	5.0			162.8	83.1	31.6	2.90	
5	WP5-10	405334	VC	9.0	14.0	5.0	MH	Elastic Silt	351.1	74.7	16.6	3.89	2.78
5	WP5-10	405334	VC	18.5	24.0	5.0	ML	Silt	281.5	74.3	19.5	2.57	2.92
									73.4	100.1	57.7	2.88	
5	WP5-11	405336	VC	12.0	12.5	5.0			197.2	70.5	23.7	1.52	
5	WP5-11	405336	VC	17.0	17.5	5.0			107.0	69.3	33.5	1.26	
5	WP5-11	405336	VC	22.0	22.5	5.0			77.9	92.2	51.8	2.35	
5	WP5-12	405338	VC	15.5	16.0	5.0			159.2	70.9	27.4	1.45	
5	WP5-13	405340	VC	13.5	14.0	5.0			124.6	72.0	32.1	1.43	
5	WP5-14	405342	VC	10.5	16.0	5.0	ML	Silt	196.1	70.9	23.9	1.55	2.91
									195.9	74.6	25.2	1.94	
5	1	*****		24.5	25.0	5.0			360.7	72.0	15.6	2.59	
5	*****	*****		***	***	5.0			241.0	68.6	20.1	1.45	
5	WP5-5A	405325		15.0	20.0	6.0	MH	Elastic Silt	580.3	70.7	10.4	4.97	2.66
5	WP5-5A	405325		20.0	25.0	6.0	MH	Sandy Elastic Silt	544.0	75.2	11.7	-10.40	2.93
									521.6	70.9	11.4	3.92	
									235.8	78.9	23.5	3.36	
									210.3	80.4	25.9	3.28	
5	Pit 5-11A	405337		12.5	17.5	6.0	MH	Sandy Elastic Silt	374.8	73.6	15.5	3.60	2.71

73.4	64.7	Minimum	2.43
1141.2	100.1	Maximum	2.98
393.4	73.2	Average	2.80
228.9	6.9	Standard Deviation	0.13

Table I-1 - Average Density, Moisture Content, Specific Gravity, and Back Calculated Specific Gravity of the Waste Pit Materials (Continued)

TABLE 1 – Statistical Summary of Density and Moisture Data

K:\PO19\STATS.WK3

Sample Identification							USCS Classification		Unit Weight Data			Specific Gravity	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	USCS Group Symbol	Group Name	Moisture Content (% dry wgt)	Wet Density (pcf)	Dry Density (pcf)	Calc'd Specific Gravity	Meas'd Specific Gravity
6	WP6-1	405344		8.0	13.0	5.0	ML (NP)	Sandy Silt (NP)					3.25
6	WP6-2	405346		7.0	12.0	5.0	SM	Silty Sand	23.4	133.6	108.3	2.92	3.42
6	WP6-3	405348		8.5	9.0	5.0			14.7	157.9	137.7	3.26	
6	WP6-3	405348		13.5	14.0	5.0			13.1	156.3	138.2	3.12	
6	WP6-4	405350		10.5	11.0	5.0			36.1	123.6	90.8	3.07	
6	WP6-5	405352		4.5	7.5	5.0	SM	Silty Sand	15.9	150.9	130.2	3.12	3.24
6	WP6-5	405352		12.5	18.5	5.0	SM	Silty Sand	15.2	164.6	142.9	3.51	3.27
									33.6	129.3	96.8	3.24	
6	WP6-6	405354		7.5	8.0	5.0			11.2	155.4	139.7	2.99	
6	WP6-6	405354		12.5	18.0	5.0	SM	Silty Sand	12.3	160.8	143.2	3.20	3.38
									14.6	170.2	148.5	3.65	
6	WP6-7	405355		12.5	18.0	5.0			17.1	162.4	138.7	3.58	3.34
									13.4	161.7	142.6	3.29	
6		43A	CAN			3.0	ML (NP)	Silt (NP)					
6		45A	CAN			3.0	ML (NP)	Silt (NP) with Sand					3.21
6		45C	CAN			3.0	SM	Silty Sand					
6		46A	CAN			3.0	ML	Silt					2.98
6		47A	CAN			3.0	MH	Elastic Silt					2.85
6	06-04	6-10	COMP	0.0	10.0	4.0	ML (NP)	Silt (NP) with Sand					2.87
6	06-03	6-22	COMP	0.0	15.0	4.0	ML (NP)	Sandy Silt (NP)					

11.2	123.6	Minimum	2.85
36.1	170.2	Maximum	3.42
18.4	152.2	Average	3.18
8.3	15.1	Standard Deviation	0.21

Table I-1 - Average Density, Moisture Content, Specific Gravity, and Back Calculated Specific Gravity of the Waste Pit Materials (Continued)

TABLE 1 – Statistical Summary of Density and Moisture Data

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Sample Identification							USCS Classification		Unit Weight Data			Specific Gravity	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	USCS Group Symbol	Group Name	Moisture Content (% dry wgt)	Wet Density (pcf)	Dry Density (pcf)	Calc'd Specific Gravity	Meas'd Specific Gravity
CW		49A	CAN			3.0	CL	Sandy Lean Clay	53.4				
CW		50A	CAN			3.0	MH	Sandy Elastic Silt	65.1				
CW		51A	CAN			3.0	SM	Silty Sand	61.9				
CW		52A	CAN			3.0	SM	Silty Sand	40.2				
CW		53A	CAN			3.0	CL	Sandy Lean Clay	35.4				2.69
CW		54A	CAN			3.0	MH	Elastic Silt with Sand	73.9				
CW		55A	CAN			3.0	MH	Elastic Silt with Sand	71.7				2.78
CW		56A	CAN			3.0	MH	Sandy Elastic Silt	68.5				
CW	11573	405678	ST	7.5	10.0	6.0	CL	Lean Clay with Sand	18.3	133.9	113.2	2.72	2.72
									23.6	127.1	102.8	2.70	2.72
									28.4	121.3	94.5	2.66	2.72
CW	11573	405679	JAR	10.0	11.5	6.0	CL	Sandy Lean Clay					
CW	11573	405683	JAR	20.0	21.5	6.0	CL	Sandy Lean Clay					
CW	11573	405684	ST	22.5	25.0	6.0	CL	Lean Clay with Sand	17.2	134.9	115.1	2.70	2.72
									14.4	137.4	120.1	2.66	2.72
CW	11573	405685	JAR	25.0	26.5	6.0	CL	Lean Clay with Sand					

35.4	Min (Waste Materials)	2.69
73.9	Max (Waste Materials)	2.78
58.8	Avg (Waste Materials)	2.74
14.4	Std Dev (Waste Matls)	0.06

14.4	121.3 Minimum (Berm Materials)
28.4	137.4 Maximum (Berm Materials)
20.4	130.9 Average (Berm Materials)
5.6	6.6 Standard Deviation (Berm Materials)

Table I-1 - Average Density, Moisture Content, Specific Gravity, and Back Calculated Specific Gravity of the Waste Pit Materials (Continued)

TABLE 1 – Statistical Summary of Density and Moisture Data

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Sample Identification							USCS Classification		Unit Weight Data			Specific Gravity	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	USCS Group Symbol	Group Name	Moisture Content (% dry wgt)	Wet Density (pcf)	Dry Density (pcf)	Calc'd Specific Gravity	Meas'd Specific Gravity
BP	1776	63176	ST	4.5	6.0	1.0	SM	Silty Sand	43.3	101.4	70.8	2.23	3.74
BP	1776	27A	CAN			3.0	CL	Lean Clay with Sand	25.5				
BP	1777	28A	CAN			3.0	ML	Sandy Silt	25.6				
BP	1819	29A	CAN			3.0	ML	Sandy Silt	30.0				2.50
BP	07-01	7-02	COMP	0.0	10.0	4.0	SM	Silty Sand	30.1				2.46
BP	07-04	7-34	COMP	0.0	16.0	4.0	ML	Sandy Silt	30.2				
BP	07-04	7-34 Redue	COMP	0.0	16.0	4.0							
BP	07-06	7-52	COMP	0.0	16.0	4.0	SM	Silty Sand	29.2				2.35

25.5	101.4	Minimum	2.35
43.3	101.4	Maximum	3.74
30.6	101.4	Average	2.76
6.0		Standard Deviation	0.66

Table I-1 - Average Density, Moisture Content, Specific Gravity, and Back Calculated Specific Gravity of the Waste Pit Materials (Continued)

Pit	Avg. Wet Density (pcf)	Avg. Moisture Content(1)	Dry Density (pcf)	Pit Volume(2) (yd^3)	Percent of Total Waste	Weight of Water (lbs)	Volume of Water (ft^3)	Volume of Solids (ft^3)	Average Specific Gravity(3)
Pit 1	114.5	46.0%	78.5	68,400	10.2%	66647217	1068064	778736	2.98
Pit 2	82.7	156.9%	32.2	37,400	5.6%	51009636	817462	192338	2.71
Pit 3	80.0	183.5%	28.2	307,500	45.9%	429968025	6890513	1411987	2.66
Pit 4	131.7	29.1%	102.0	72,800	10.9%	58368637	935395	1030205	3.12
Pit 5	71.8	393.4%	14.5	97,900	14.6%	151218029	2423366	219934	2.80
Pit 6	148.3	18.4%	125.2	9,600	1.4%	5971670	95700	163500	3.18
Burn Pit	122.0	30.6%	93.4	30,300	4.5%	23385382	374766	443334	2.76
Clearwell	104.0	58.8%	65.5	4,300	0.6%	4470874	71649	44451	2.74
Liner(4)	136.0	16.0%	117.2	41,800	6.2%	21170979	339279	789321	2.69
				Total 670000			13016193	5073807	

Notes:
(1) Average Moisture Content is From Table I-1
(2) Source: (PARSONS 1993). Project Order 10, Waste Pit Content Study Report.
(3) Average Specific Gravity is From Table I-1
(4) Source: PARSONS, Project Order 140, Geotechnical Investigation On-Site Disposal Facility, December 1995

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Table I-2 - Back Calculated Values of Wet Density From Average Specific Gravity and Moisture Content for the Waste Pit Materials

Table 1 – Volume of Free Water by Pit Based on Pit Construction Data Using Effective Porosities of Predominant Materials

		Average Thickness [1]			Percent of Layer Saturated			Total Volume [1]			Effective Porosity [3]			Volume of Subsurface Free Water					
Pit	Depth [2] to Water ft	Cover ft	Waste ft	Liner ft	Cover	Waste	Liner	Cover yd^3	Waste yd^3	Liner yd^3	Cover	Waste	Liner	Cover ft^3	Waste ft^3	Liner ft^3	Cover gal	Waste gal	Liner gal
Waste Pit 1	3.24	0.5	18.0	11.0	0.0	84.8	100.0	1,700	48,500	18,200	0.15	0.20	0.01	0	222,082	4,914	0	1,661,170	36,757
Waste Pit 2	1.39	2.5	15.0	4.5	44.4	100.0	100.0	4,200	24,200	9,000	0.15	0.20	0.01	7,552	130,680	2,430	56,492	977,486	18,176
Waste Pit 3	3.67	14.0	27.0	1.0	73.8	100.0	100.0	93,700	204,100	9,700	0.15	0.20	0.01	280,096	1,102,140	2,619	2,095,119	8,244,007	19,590
Waste Pit 4	9.50	6.0	25.0	1.0	0.0	86.0	100.0	14,600	55,100	3,100	0.10	0.20	0.01	0	255,924	837	0	1,914,312	6,261
Waste Pit 5	0.00	DA	28.0	DA	100.0	100.0	100.0	DA	97,900	DA	DA	0.20	DA	0	528,660	0	0	3,954,377	0
Waste Pit 6	0.00	DA	20.0	DA	100.0	100.0	100.0	DA	9,600	DA	DA	0.20	DA	0	51,840	0	0	387,763	0
Burn Pit	3.16	DA	26.0	DA	0.0	87.8	100.0	DA	30,300	DA	DA	0.20	DA	0	143,734	0	0	1,075,129	0
Clear Well	0.00	DA	11.0	1.0	100.0	100.0	100.0	DA	3,700	600	DA	0.20	0.01	0	19,980	162	0	149,450	1,212

Notes:

DA Does not apply

(1) Waste Pit contents Study Report, September 10, 1993, Revision 0, Final Issue

(2) Remedial Investigation Report for Operable Unit 1, October 1993, Draft

(3) *Handbook of Hydrology*, Table 16.2.1 – Representative Values for Effective Porosity, p. 16.4, © 1993

(4) Total water estimation does not include water contained in the liner material

(5) Standing water for the Clear Well is assumed to be eight feet deep.

Conversions:

For H_2O 62.4 lb_m/ft^3
7.48 gal/ft^3

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Table I-3 - Drainable Water Estimate of the Waste Pit Materials

Table 1 – Volume of Free Water by Pit Based on Pit Construction Data Using Effective Porosities of Predominant Materials (cont.)

Pit	Weight of Subsurface Free Water			Surface Water					Total Free Water			Total Free Water [4] (Excluding Liner Layer)		
	Cover	Waste	Liner	Standing Water [1] [5]	Pit Area [1]	Surface Water	Surface Water	Surface Water						
	lb	lb	lb	ft	ft^2	ft^3	gal	lb	ft^3	gal	lb	ft^3	gal	lb
Waste Pit 1	0	13,857,886	306,634	DA	93,804	0	0	0	226,996	1,697,926	14,164,519	222,082	1,661,170	13,857,886
Waste Pit 2	471,272	8,154,432	151,632	DA	46,645	0	0	0	140,662	1,052,155	8,777,336	138,232	1,033,979	8,625,704
Waste Pit 3	17,477,995	68,773,536	163,426	DA	246,632	0	0	0	1,384,855	10,358,716	86,414,956	1,382,236	10,339,126	86,251,531
Waste Pit 4	0	15,969,662	52,229	DA	85,251	0	0	0	256,761	1,920,573	16,021,891	255,924	1,914,312	15,969,662
Waste Pit 5	0	32,988,384	0	1.0	162,916	162,916	1,218,612	10,165,958	691,576	5,172,988	43,154,342	691,576	5,172,988	43,154,342
Waste Pit 6	0	3,234,816	0	2.0	32,397	64,794	484,659	4,043,146	116,634	872,422	7,277,962	116,634	872,422	7,277,962
Burn Pit	0	8,968,994	0	DA	39,773	0	0	0	143,734	1,075,129	8,968,994	143,734	1,075,129	8,968,994
Clear Well	0	1,246,752	10,109	6.0	28,921	231,368	1,730,633	14,437,363	251,510	1,881,295	15,694,224	251,348	1,880,083	15,684,115

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Table I-3 - Drainable Water Estimate of the Waste Pit Materials (Continued)

Pit	Pit Volume (yd^3)	Pit Volume (ft^3)	Percent Total Volume	Waste Wet Density Initial (pcf)	Initial Moisture Content (%)[1]	Wet Total Weight Waste (tons)	Dry Total Weight Waste (tons)	AFTER LOSING 90% FREE WATER							AFTER LOSING 100% FREE WATER							AFTER PROCESSING BY THE DRYER					
								Water Weight[5] (tons)	Pit Waste Volume (ft^3)	Wet Density (pcf)	Bulking Factors (%)[6]	Bulk Wet Density (pcf)[7]	Portion of Total Bulk Density (pcf)	Moisture Content (%)[1]	Water Weight (tons)	Pit Waste Volume (ft^3)	Wet Density (pcf)	Bulking Factors (%)[6]	Bulk Wet Density (pcf)[7]	Portion of Total Bulk Density (pcf)	Moisture Content (%)[1]	Optimum Moisture (%)[9,1]	Maximum Dry Density (pcf)	Wet Density (pcf)	Bulking Factor (%)[8]	Bulk Wet Density (pcf)[7]	Portion of Total Bulk Density (pcf)
1	68400	1846800	10.21%	114.5	46.0	1.06E+05	7.24E+04	6374	1846800 [2]	107.6	15%	93.6	9.6	37.2	7082	1846800 [2]	106.8	15%	92.9	9.5	36.2	15.60%	117.5	135.8	15%	118.1	12.1
2	37400	1009800	5.58%	82.7	156.9	4.18E+04	1.63E+04	3950	1009800 [2]	74.9	15%	65.1	3.6	132.6	4389	1009800 [2]	74.0	15%	64.4	3.6	129.9	17.50%	86.3	101.4	15%	88.2	4.9
3	307500	8302500	45.90%	80.0	183.5	3.32E+05	1.17E+05	38887	8302500 [2]	70.6	12%	63.1	28.9	150.3	43207	8302500 [2]	69.6	12%	62.1	28.5	146.6	62.80%	60.4	98.3	15%	85.5	39.2
4	72800	1965600	10.87%	131.7	29.1	1.29E+05	1.00E+05	7210	1965600 [2]	124.4	15%	108.1	11.8	21.9	8011	1965600 [2]	123.5	15%	107.4	11.7	21.1	13.40%	116.6	132.2	15%	115.0	12.5
5	97900	2643300	14.61%	71.8	393.4	9.49E+04	1.92E+04	14845 [4]	2167506 [3]	73.9	NA[8]	73.9	10.8	316.2	16494 [4]	2114640 [3]	74.2	NA[8]	74.2	10.8	307.6	56.00%	64.5	100.6	15%	87.5	12.8
6	9600	259200	1.43%	148.3	18.4	1.92E+04	1.62E+04	1456	259200 [2]	137.1	12%	122.4	1.8	9.4	1617	259200 [2]	135.8	12%	121.3	1.7	8.4	9.50%	142.9	156.5	12%	139.7	2.0
BP	30300	818100	4.52%	122.0	30.6	4.99E+04	3.82E+04	4036	818100 [2]	112.1	20%	93.4	4.2	20.0	4484	818100 [2]	111.0	20%	92.5	4.2	18.9	9.50%	81.2	88.9	12%	79.4	3.6
CW	4300	116100	0.64%	104.0	58.8	6.04E+03	3.80E+03	561	116100 [2]	94.3	12%	84.2	0.5	44.0	623	116100 [2]	93.3	12%	83.3	0.5	42.4	20.10%	102.3	122.9	15%	106.8	0.7
Liner	41800	1128600	6.24%	136.0	16.0	7.67E+04	6.62E+04	3078	1128600 [2]	130.5	25%	104.4	6.5	11.3	3420	1128600 [2]	129.9	25%	104.0	6.5	10.8	12.60% [10]	123.0 [10]	138.5	25%	110.8	6.9
Totals	670000	18090000	100%			7.79E+05	3.84E+05	77318	16485606				77.7		85909	16432740				77.0							94.7

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Notes:
1. Moisture contents reported based on dry weight basis
2. Based on constant volume, waste is a solid, water, and air matrix
3. Based on slurry volume change once free water is lost using water density = 62.4 lb/ft^3, waste is a slurry
4. Weight based on 20% **(Assumed)** effective porosity
5. Based on subsurface free water weights from Table I-3 *(Free Water Table)*
6. Bulking Factors **Assumed**
7. Based on **Assumed** Bulking Factors
8. Not Applicable because of slurry nature of waste
9. Assumed to be moisture content of waste upon leaving dryer
10. Source: PARSONS, 1995. Project Order 140, Geotechnical Investigation On-Site Disposal Facility.

Table I-4 - Bulk Density Estimates of the Waste Pit Materials at Three Stages in the Waste Processing Operation

Pit	Pit Volume (yd^3)	Waste Wet Density Initial (pcf)	Waste Dry Density[2] Initial (pcf)	Initial Moisture Content (%)[1]	Initial Moisture Content (%)[3]	Wet Total Weight Waste (tons)	Dry Total Weight Waste (tons)	Waste Wet Bulk Density After Excavation (pcf)	Waste Wet Bulk Density Before Dryer (pcf)	Waste Wet Bulk Density After Dryer (pcf)
1	68400	114.5	78.4	46.0	31.5	105729	72417			
2	37400	82.7	32.2	156.9	61.1	41755	16253			
3	307500	80.0	28.2	183.5	64.7	332100	117143			
4	72800	131.7	102.0	29.1	22.5	129435	100259			
5	97900	71.8	14.6	393.4	79.7	94894	19233			
6	9600	148.3	125.3	18.4	15.5	19220	16233			
BP	30300	122.0	93.4	30.6	23.4	49904	38211			
CW	4300	104.0	65.5	58.8	37.0	6037	3802			
Totals	628200					779075	383552	77.7	77.0	94.7

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Notes:
1. Moisture contents reported on dry weight basis
2. Dry Density calculated from wet density and moisture content, assuming constant volume and complete saturation
3. Moisture contents reported on wet weight basis

Table I-5 - Summary of Wet Density, Moisture Content, and Estimated Bulk Density of the Waste Pit Materials

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TRANSPORTATION AND DISPOSAL PLAN

Transportation And Disposal Plan

March 1996
Revision F

Prepared for:

The United States Department of Energy
Fernald Field Office
Fernald, Ohio

Prepared by:

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LIST OF ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSXT	CSX Transportation, Inc.
DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy-Headquarters
DOE-FN	U.S. Department of Energy-Fernald Area Office
DOE-NV	U.S. Department of Energy-Nevada
DOT	U.S. Department of Transportation
EOC	FEMP Emergency Operations Center
EM	Environmental Management
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Corporation
FR	Federal Register
FRA	Federal Railroad Administration
FRMAC	Federal Radiological Monitoring and Assessment Center
HAZMAT	(DOT) Hazardous Material
IAFF	International Association of Firefighters
LLRW	Low Level Radioactive Waste
LSA	Low Specific Activity
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
PCB	Polychlorinated biphenyl
PCDF	Permitted Commercial Disposal Facility
RPCDF	Representative Commercial Disposal Facility
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
SNM	Special Nuclear Material
TLD	Thermoluminescent Dosimeter
UPRR	Union Pacific Railroad Company
WAC	Waste Acceptance Criteria
WPRAP	Waste Project Removal Action Plan

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EXECUTIVE SUMMARY

Purpose

The United States Department of Energy (DOE) has developed this Transportation and Disposal Plan to facilitate the remediation of the waste pits comprising Operable Unit 1 (WPRAP), from the DOE's Fernald Environmental Management Project (FEMP), located near Fernald, Ohio. This document is the third element (of three elements) of Package II of the Remedial Design Project Documentation and Deliverables. The other two elements in Package II are the Excavation Plan. The five elements of the Package I are the Plant Facilities Design Criteria Package, Plant Facilities Engineering, Equipment Specifications, Description of On-Site Rail Improvements, and Construction Plan.

The primary objective is to refine the remedial alternative as presented in the *Final Feasibility Study for Operable Unit 1* (DOE 1994b) and in the *Final Proposed Plan for Operable Unit 1* (DOE 1994c), and as selected in the *Record of Decision For Remedial Actions at Operable Unit 1* (DOE 1995a), by describing the logistics of rail transportation, and providing objectives and criteria to be implemented in the detailed design phase. This plan highlights operational aspects of waste transportation sufficiently to demonstrate that wastes can be transported safely in accordance with all applicable regulations. The document serves as a transition between conceptualization (*i.e.*, the feasibility study) and implementation (*i.e.*, remedial action).

At this time, services for disposal have not been procured, the Tender with the railroads has not been negotiated, and the designs of the on-site WPRAP waste treatment and waste loading facilities have not been finalized. In addition, many aspects of this Transportation and Disposal Plan interface with design features described in the other elements of the Remedial Design Project Documentation and Deliverables. Therefore, some aspects of this plan are preliminary or conceptual in nature, and the details remain to be developed. Actions or activities to be completed are identified in this plan.

This document also supports the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) community involvement process by identifying and evaluating anticipated transportation issues and providing recommended resolutions for presentation in public meetings and incorporation in the detailed design effort.

WPRAP Waste Characterization

Operable Unit 1 consists of eight WPRAP subunits, Waste Pits 1 through 6, the Clearwell, and the Burn Pit. The waste materials contained in these units were generated by chemical and metallurgical processes associated with the uranium purification mission of the former Feed Materials Production Center. The wastes consist of a variety of heterogeneous process waste residues including slags, sludges, precipitates,

and filter cakes. Some pits were covered with soil after being taken out of active service. In addition, building debris was disposed in the waste pits. (DOE 1994a)

Analytical data indicate that WPRAP waste will meet the criteria for Low Specific Activity (LSA) material under criteria in 49 CFR 173 (See Appendix A, Attachment 1 of this report). LSA material is the lowest hazard transportation category of radioactive material. Transport requirements for LSA material are defined in 49 CFR 173.425, and described in Appendix B of the main report.

Operable Unit 1 Remedial Plan

As described in the *Operable Unit 1 Record of Decision* (DOE 1995a), the selected remedy consists of the following items:

1) Excavation of wastes from WPRAP's six waste pits, Clearwell, Burn Pit, and soils with in the WPRAP boundary, liners, *etc.*
2) Pretreatment (*e.g.*, sorting, crushing, shredding)
3) Treatment by thermal drying
4) Off-site disposal at a permitted commercial disposal facility (PCDF)

The untreated waste pit material has a high moisture content and is heterogeneous in nature, physically and radiologically. The excavated WPRAP material will be treated to meet the PCDF's waste acceptance criteria (WAC) for a relatively homogeneous waste product with low activity. These processing operations will generate approximately 724,000 tons (670,000 cubic yards) of soil-like materials and debris, which will be loaded into railcars and transported to disposal facilities over a seven-year period, projected to start in 1998.

For design purposes, it is estimated that 100 per cent of the treated wastes will be disposed at a representative PCDF (RPCDF). For planning purposes, a facility located near Clive, Utah, is used as the RPCDF. As a contingency, waste that does not meet the acceptance criteria of the RPCDF can be shipped to the Nevada Test Site (NTS).

Community Involvement

To facilitate community involvement, the FEMP organized four transportation meetings. Based on these four meetings, the public's primary concerns included the following items:

1) The condition of the CSX Transportation (CSXT) Branch Line from the FEMP to Cottage Grove, Indiana
2) Staging of loaded cars at the Shandon Yard switchyard near the FEMP
3) Time that trains would be delayed at Cottage Grove waiting for clearance onto the main line.

This Transportation and Disposal Plan addresses these concerns in the following manner:

1) The track and other infrastructure on the branch line will be inspected and repaired (as needed) before initiation of rail traffic associated with this project.
2) As a result of the WPRAP Record of Decision and a recently-completed study, the DOE will not use the Shandon Yard switchyard to store loaded and unloaded cars.
3) CSXT has committed to exert all efforts to keep delays at Cottage Grove to less than one hour.

The DOE will continue to offer opportunities for public involvement beyond those required by the CERCLA regulations and U.S. Environmental Protection Agency (EPA) guidance, during the Remedial Design (RD) and Remedial Action (RA) phases of the remediation. As details of the transportation plans are finalized, interested stakeholders will be informed. Further information regarding FEMP initiatives is presented in Section 8.

Selection Of Transportation Mode

For planning purposes, the principal disposal site is assumed to be the RPCDF which is located in Clive, Utah. This facility has direct rail access and "roll-over" equipment for unloading gondola railcars. A NEPA Impact Analysis was performed as part of the *Feasibility Study Report for Operable Unit 1*. A cost-benefit study of various shipment options indicated that direct rail transport to the RPCDF is the most economical mode and is also most acceptable to the public (FERMCO 1995d). Cost factors, evaluated in the study, included: (1) railcar and container pricing and maintenance, (2) cover and liner, (3) transportation, (4) on/off-site rail upgrades, (5) on-site structures, and (5) acquisition and operation cost of site locomotive.

The optimal rail configuration is a unit train, consisting of gondola cars where the load is contained by a disposable liner and a hard cover.

The most direct rail route between the FEMP and the RPCDF involves only two railroads, CSX Transportation (CSXT) and Union Pacific Railroad (UPRR). A brief profile of these two railroads is provided in Section 2.1 of the main report. Both CSXT and UPRR are among the three largest railroads in the United States and have ample capacity to handle the anticipated WPRAP traffic.

A unit train is a train that makes a direct run between the point of origin and the destination point. The unit train receives priority right-of-way and expedited switching, and stays intact along the whole route, (*i.e.*, it does not receive additional freight, nor drop any freight). The gondola railcar was selected as the most cost-effective means of transporting bulk quantities of material. The DOE has committed that railcars with WPRAP material will be lined with a disposable synthetic material liner and covered with a secured hard cover (See Figure 2-1). For further information on the train configuration, see Section 2 of this report.

Railcar Logistics at the FEMP

To support rail transportation operations, a major upgrade of facilities at the FEMP will be required. Site improvements include construction of the waste loading facility, and installation of fencing around all tracks. The proposed upgrade program of the FEMP railroad infrastructure is shown in Figure 3-2. For details on the facilities, see Section 3 of the main report.

Two refurbished switchyard locomotives, and the FEMP Trackmobile®, will move the cars around the FEMP. The Trackmobile® will be used in the loading building. After loading in the waste loading facility, cars will be decontaminated (if necessary) and radiologically surveyed before being placed in a holding area. Cars will be held in storage until analytical results indicate it is acceptable to release the cars. Details of the waste loading process are provided in the *Description of On-Site Rail Improvements*.

Prior to releasing the unit train from the FEMP, the train will be radiologically surveyed, and inspected for mechanical safety (*e.g.*, brakes). In addition, shipping papers will be prepared for the railroad and the disposal facility. The disposal facility will require certification that the waste has been analyzed and meets the disposal facilityś WAC.

Logistics of Rail Transport to the RPCDF

CSXT will move the loaded unit trains from the FEMP through Cincinnati, Ohio, to East St. Louis. UPRR will move the unit train from East St. Louis to the RPCDF.

On the basis of the design load and rating, CSXT indicates that the following three trestles are not satisfactory for the rail traffic associated with this project. These three trestles are located on the Branch Line from the FEMP to Cottage Grove:

1) Camp Run
2) South Wynn Road
3) Bucks Run and Road (Okeana Trestle)

CSXT believes these trestles need to be rebuilt prior to commencement of rail traffic associated with this project. These efforts can be effected with nominal disruption of the current rail traffic. The DOE is committed to upgrading these structures before waste shipment.

The away-from-site round-trip cycle for a unit train is 16 calendar days which includes: one day for en-route delays, and five days at the disposal facility. With the addition of two days (one at the start and one at the conclusion of the trip) for assembling and breaking-down the unit train at the FEMP, the total cycle time used for planning purposes is 18 calendar days. After production operations with one waste dryer have stabilized in FY 1999, on the average a unit train will depart every 14 days with 42 loaded

cars. Two unit trains will be used. In FY 2001, when two treatment systems are operable, a unit train could depart every 8 days with 53 loaded cars. This effort would require three unit trains. for further details on the train schedule, see Section 4.2 of this report.

Tracking the location of railcars is standard practice with all major railroad companies. Tracking data are received from railroad transponders located at main switches along the tracks. With this system, the location of each car can be determined based on the last transmission. At any time, WPRAP's traffic management organization can access the system to determine the locations of the trains/cars. If cars are stopped due to a transportation incident, the FEMP would be immediately notified by railroads' control centers.

Permitted Commercial Disposal Facility

The RPCDF is licensed to accept for disposal: (a) specific low concentrations of radionuclides within the low-level radioactive waste (LLRW) classification (b) Naturally Occurring Radioactive Material (NORM), (c) mixed waste, and (d) 11e.(2) by-product materials (uranium and thorium mill tailings). The disposal facility of approximately 540 acres is next to a DOE mill tailings disposal site (100 acres). The facility is located near Clive, Utah, about 75 miles west (65 miles by air) (NRC 1993) of Salt Lake City, Utah. The disposal facility has been successful in working with their regulators to obtain additional licenses and processing amendments to its existing licenses and has ample disposal capacity to accept WPRAP material.

The disposal site is located one mile south of the main line of UPRR and is connected by a rail spur. It has facilities to accommodate 300 railcars at one time. Gondola cars are unloaded with the roll-over device shown on Figure 5-2.

The FEMP will make every effort to ensure that all waste material shipped to the disposal facility meets its WAC. The FEMP will perform confirmatory analysis prior to its shipment to the RPCDF. In the unlikely event that any waste arriving at the disposal facility does not conform to the accepted waste profile, based on the facility's sampling and analysis of the waste shipment, then the waste material will not be unloaded. The FEMP would be notified immediately, and the material would be resampled and analyzed.

The disposal facility is able to process some non-conforming waste, such as waste with free liquids, into an acceptable form, and then accept the waste for disposal. However, if the waste exceeds the chemical/radiological acceptance criteria, the waste will be returned to the FEMP. Due to the waste acceptance procedure of the NTS, transshipment from the RPCDF is not currently believed to be feasible. After the railcar returns to the FEMP, material will be removed. If the FEMP's evaluation confirms that the rejected material, after reprocessing, could not be accepted by the RPCDF, then the waste would be re-packaged for transportation and disposal at the NTS unless analysis indicates that the waste exceeds

the Land Disposal Restrictions. The latter event is not believed likely. For further information on the disposal operations at the RPCDF, see Section 5 of the main report.

Transport and Disposal at the NTS

The NTS is located in Nye County, Nevada, about 65 miles northwest of Las Vegas. The NTS encompasses about 1350 square miles and has been the primary location for testing the nation's nuclear weapons since January 1951. Since 1978, the NTS has also served as a major LLRW disposal facility for several DOE sites.

Material that cannot be treated to meet the RPCDF's WAC will be disposed of at the NTS. Before any waste material leaves the FEMP, the waste will be analyzed to ensure compliance with the NTS WAC (DOE *et al.* 1992). Prior to shipment of WPRAP material to the NTS, the FEMP will submit the appropriate application for DOE approval.

Current FEMP procedures for shipment of LLRW to the NTS specify the use of disposable metal containers transported by truck. For disposal of limited quantities of material, use of disposable containers is practical. However, for bulk quantities of material, the metal containers would be emptied at the disposal cell and returned for repeated use. Transport to the NTS is by truck, along existing routes, in accordance with existing procedures. The FEMP has been shipping LLRW to the NTS since 1986. For further information on the NTS, see Section 6 of the main report.

Emergency Response Planning And Training

Federal regulations and DOE orders require the FEMP (as shipper), the DOE, and the carriers to have emergency plans and procedures in place to respond to transportation accidents. Currently, the FEMP has a *Transportation Emergency Plan* (FERMCO 1995a) and associated emergency preparedness procedures that cover only truck transport incidents. Before initiation of WPRAP shipments, the existing plan and procedures will be revised to include rail transport accidents. In addition, the DOE will offer emergency training to first responders in the nearby communities and will participate, as requested, in periodic training programs sponsored by the railroad and other organizations responsible for emergency planning (DOE 1995a). As part of emergency response preparations, the DOE is committed to contact and work with representatives from Ohio, Utah, and transited states prior to the first waste shipment to brief them on shipment plans.

On July 18, 1995, the FEMP and the DOE took a significant step toward honoring their commitments with respects to emergency planning, training, and assistance to local communities. The FEMP awarded a $1 million contract to the International Association of Fire Fighters to develop a custom-tailored emergency response training program for first responders. The program will specifically include all waste shipments from the FEMP, including WPRAP material.

In the event of an emergency, there are at least six different generic organizations involved in responding, as shown on Figure 7-1. The functions of the six organizations are identified below.

1) Train crews are trained to make an initial notification and assessment of the emergency.

2) Railroad companies have contingency plans, technical and communications personnel, and remediation contractors in place to respond to transportation incidents.

3) Local authorities at the scene of the accident serve as the on-scene incident commander. All other parties support the on-scene commander.

4) States have emergency response organizations and personnel for monitoring and administrative functions. These may include state police and national guard, state departments of transportation, health (State Radiation Control Programs), and environmental protection.

5) The DOE has a network of regional Radiological Assistance Teams that can respond to support local response agencies.

6) The FEMP's existing emergency response program will be revised to support the management of off-site rail emergencies, and to support the railroad and on-scene commander with both technical and communication personnel.

Further details regarding emergency preparedness are provided in Section 7 of the main report.

Training and emergency response initiatives will be developed as appropriate in response to all applicable future rules and regulations, such as those in Docket No. HM-169A (60 FR 50292; September 28, 1995).

Pre-Shipment Notification

Under Department of Transportation (DOT) regulations, LLRW, such as the WPRAP remediation wastes, are regulated and shipped as hazardous materials. For rail shipments to the RPCDF, the states of Ohio, Utah, and transited states do not require prior formal notification of LLRW and there are no known corresponding local requirements. The DOT and the Nuclear Regulatory Commission, through their rule making process and related studies, have determined that prior notification is not required for LLRW. State and local provisions requiring pre-notification, which are inconsistent with federal regulations, have been determined to be incompatible with the national need for uniform transport regulations; consequently, these state and local regulations are preempted.

Currently, the FEMP does not provide advance notification of specific truck shipments to stakeholders. However, reports that address aggregate projected and completed shipments are prepared and distributed to stakeholders. Recognizing the interest of Fernald stakeholders in rail transportation issues, the FEMP will periodically present plans prior to shipment for waste shipment by rail to interested members of the public or interested stakeholders during routine public briefings. These plans will include the following information:

1) Time frames over which waste shipment will occur
2) The number of shipments anticipated
3) Quantities and types of waste planned

The FEMP intends to continue to work with interested stakeholders. Public information sessions will be held to address concerns regarding shipment and staging of these wastes prior to transport. Feedback will be incorporated in the development of detailed transportation plans. Any public notification given for rail shipments leaving the FEMP would be coordinated with the rail carrier.

The FEMP will contact representatives from Ohio, Utah, Nevada, and transited states, prior to the first waste shipment, to brief them on overall shipment plans. This information will allow states to prepare, as necessary, for any potential emergency response activities involving FEMP wastes and ensure that potential first responders are aware of the transport of these wastes.

Ongoing Compliance Initiative

It may be expected that regulatory, and other, requirements/conditions will change during implementation of WPRAP's remedial alternative. Thus, revisions to planning and execution documents/procedures will be periodically necessary.

For example, this document was prepared during a transition time involving the September 28, 1995 promulgation of amended DOT regulations (60 FR 50292). An initial review of the regulations, which will become effective on April 1, 1996, indicates that WPRAP's planned transportation activities will not be substantially impacted. The Transportation and Disposal Plan does not address complete compliance with these regulations as they are not yet finalized.

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SECTION 1

INTRODUCTION

1.1 Purpose

The United States Department of Energy (DOE) has developed this Transportation and Disposal Plan to facilitate the remediation of the waste pits comprising Operable Unit 1 (WPRAP), from the DOE's Fernald Environmental Management Project (FEMP), located near Fernald, Ohio. This document is the third element (of three elements) of Package II of the Remedial Design Project Documentation and Deliverables. The other two elements in Package II are the Excavation Plan and the Site Restoration Plan. The five elements of the Package I are the Plant Facilities Design Criteria Package, Plant Facilities Engineering, Equipment Specifications, Site Improvement Plan, and Construction Plan.

The primary objective is to refine the remedial alternative as presented in the *Final Feasibility Study for Operable Unit 1* (DOE 1994b) and in the *Final Proposed Plan for Operable Unit 1* (DOE 1994c), and as selected in the *Record of Decision For Remedial Actions at Operable Unit 1* (DOE 1995a), by describing the logistics of rail transportation, and providing objectives and criteria to be implemented in the detailed design phase. This plan highlights operational aspects of waste transportation sufficiently to demonstrate that wastes can be transported safely in accordance with all applicable regulations. The document serves as a transition between conceptualization (*i.e.*, the feasibility study) and implementation (*i.e.*, remedial action).

At this time, services for disposal have not been procured, the contract with the railroads has not been negotiated, and the designs of the on-site WPRAP waste treatment and waste loading facilities have not been finalized. In addition, many aspects of this Transportation and Disposal Plan interface with design features described in the other elements of the Remedial Design Project Documentation and Deliverables. Therefore, some aspects of this plan are preliminary or conceptual in nature and the details remain to be developed. Actions or activities to be completed are identified in this plan.

This document also supports the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) community involvement process by identifying and evaluating anticipated transportation issues and providing recommended resolutions for presentation in public meetings and incorporation in the detailed design effort.

1.2 WPRAP Waste Characterization

In general, eight WPRAP subunits, Waste Pits 1 through 6, the Clearwell, and the Burn Pit, were excavated into clay lens(es). In certain instances, additional clay and/or synthetic materials were then installed to form liners and the wastes were subsequently emplaced. The waste materials contained in these units were generated by chemical and metallurgical processes associated with the uranium purification mission of the former Feed Materials Production Center. The wastes consist of a variety of heterogeneous process waste residues including slags, sludges, precipitates, and filter cakes. Some pits were covered with soil after being taken out of active service. In addition, building debris was disposed in the waste pits. (DOE 1994a)

Materials excavated from the pits will be pretreated (*e.g.*, sorted, crushed) and dried (as required to meet the waste acceptance criteria (WAC) of the disposal facility), before transportation to a waste disposal site. Waste samples will be analyzed to ensure that wastes meet physical, chemical, and radiological acceptance criteria for disposal. Data from the *Final Remedial Investigation for Operable Unit 1* (DOE 1994a) indicate the waste pits are contaminated with uranium, thorium, and other heavy metals, as well as with organic compounds. However, very little, if any, WPRAP waste will be hazardous under federal and state regulations. The regulatory analysis (Table J.6-3) in the WPRAP Feasibility Study (DOE 1994b) determined that "WPRAP does not contain any listed RCRA [Resource Conservation and Recovery Act] wastes. Post-treated wastes are not expected to exhibit any hazardous characteristics." Additional testing will be performed on the processed materials for routine quality assurance and quality control purposes.

Analytical data indicate that WPRAP waste will meet the criteria for Low Specific Activity (LSA) material under criteria in 49 CFR 173 (See Appendix A). Transport requirements for LSA material are defined in 49 CFR 173.427, and described in Appendix A, Attachment 3.

1.3 Operable Unit 1 Remedial Plan

As described in the *Operable Unit 1 Record of Decision* (DOE 1995a), the selected remedy consists of the following items:

1) Excavation of wastes from WPRAP's six waste pits, Clearwell, Burn Pit, and soils with in the WPRAP boundary, liners, *etc.*
2) Pretreatment (*e.g.*, sorting, crushing, shredding)
3) Treatment by thermal drying
4) Off-site disposal at a permitted commercial disposal facility (RPCDF)

The untreated waste pit material has a high moisture content and is heterogeneous in nature, physically and radiologically. The excavated WPRAP material will be treated to meet the RPCDF's WAC for a

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relatively homogeneous waste product with low activity. These processing operations will generate approximately 724,000 tons (670,000 cubic yards) of soil-like materials and debris, which will be loaded into railcars and transported to disposal facilities over a seven-year period, projected to start in 1998.

For design purposes, it is estimated that 100 per cent of the treated wastes will be disposed at a RPCDF. For planning purposes, a facility located near Clive, Utah, is used as the RPCDF. As a contingency, waste that does not meet the acceptance criteria of the RPCDF can be shipped to the Nevada Test Site (NTS).

1.4 Selection Of Transportation Mode

A cost-benefit study of several transportation modes (FERMCO 1995d) determined that bulk rail transport directly to the RPCDF is the most economical and safest mode. The optimal configuration is a unit train, consisting of gondola cars, where the load is contained by a disposable liner and a hard railcar cover (See Section 4). Since the NTS does not have rail access, waste must be shipped in containers to the NTS and delivered by truck.

Rail shipment was selected as the transportation mode to the RPCDF for the following primary reasons:

1) Safety: Rail transportation is safer than transportation by truck and provides less overall potential for exposure to the public.

2) Regulatory Compliance: Rail shipment can be implemented in full conformance with all federal and state requirements for transportation and waste management. (See Appendix A for a description of the transportation regulatory drivers.)

3) Availability: The RPCDF has direct rail access and bulk railcar unloading facilities.

4) Cost: Rail transportation is generally less expensive than shipment by truck.

1.5 Community Involvement

To facilitate community involvement in the WPRAP remedy selection process, three transportation meetings were held: Transportation Workshop (August 9, 1994), CSX Transportation Availability Session (August 16, 1994), and the WPRAP Public Meeting (August 23, 1994). Additionally, a combined Operable Unit 1 and Operable Unit 4 transportation meeting was held as part of the remedial design process on June 29, 1995. Based on these four meetings, the public's primary concerns included the following items:

1) The condition of the CSX Transportation (CSXT) Branch Line from the FEMP to Cottage Grove, Indiana
2) Staging of loaded cars at the Shandon Yard switchyard near the FEMP
3) Time that trains would be delayed at Cottage Grove waiting for clearance onto the main line.

This document addresses these concerns in the following manner:

1) The track and other infrastructure on the branch line will be inspected and repaired (as needed) before initiation of rail traffic associated with this project.
2) As a result of the WPRAP Record of Decision and a recently-completed study, the DOE will not use the Shandon Yard switchyard to store loaded and unloaded cars.
3) All efforts will be made to keep delays at Cottage Grove to less than one hour.

The DOE will continue to offer opportunities for public involvement beyond those required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations and U.S. Environmental Protection Agency (EPA) guidance, during the Remedial Design (RD) and Remedial Action (RA) phases of the remediation. As details of the transportation plans are finalized, interested stakeholders will be informed. Further information regarding FEMP initiatives is presented in Section 8.2.

1.6 Organization

The report is divided into eight sections, as shown below:

1) Introduction and background information
2) Transportation Modes From the FEMP to the waste disposal facilities
3) Railcar handling and waste loading at the FEMP
4) Logistics of Rail Transportation from the FEMP to the RPCDF
5) RPCDF operation and logistics
6) NTS disposal operation and logistics
7) Emergency Response Planning and Training
8) Pre-shipment Notification

References and appendices are presented at the end of the report.

SECTION 2

DESCRIPTION OF TRANSPORTATION MODE

This section describes the principal transportation mode to move WPRAP waste off site to the disposal site. For the purposes of transportation planning, the principal disposal site is assumed to be a RPCDF, which has railcar unloading facilities, and is located in Clive, Utah. A cost-benefit study of various transportation mode options indicated that direct rail transport to the disposal site is the most economical and the safest mode (FERMCO 1995d). The optimal rail configuration is a unit train, consisting of gondola cars where the load is contained by a disposable liner and a hard cover. As a contingency, any waste unable to meet the WAC of the RPCDF will be disposed at the NTS. The assumed mode of transportation for NTS waste is truck, the current mode of operation.

The DOE is committed to specify in its contract with the railroads that they comply with all applicable regulations regarding the integrity and safety of the railroad line. The DOE will require the railroads to document their compliance with the regulations and laws before shipment, and will require that the railroad document their continuing compliance. In this manner, the DOE will be assured that the tracks and associated rail structures, such as culverts and crossings, are in a safe condition before shipment. In addition, the DOE will require the railroads comply with applicable Ohio transportation regulations, as well as with regulations of states through which the waste may be routed. (DOE 1995a)

2.1 Railroad Companies

The only rail carrier serving the FEMP is CSXT. The main rail carrier serving the RPCDF is Union Pacific Railroad Company (UPRR). The most direct rail route between the FEMP and the RPCDF involves only these two railroads, CSXT and UPRR. A brief profile of these two railroads is provided below. A switching railroad may be used as a subcontractor for the transfer of the trains from CSXT to UPRR (westbound) and from UPRR to CSXT (eastbound).

Both CSXT and UPRR are considered Class I railroads, the highest classification of railroads. The Interstate Commerce Commission classifies railroads based on their annual operating revenue. There are only twelve railroads in the United States that have the Class I designation. Based on 1992 data, UPRR is the number one railroad in terms of operating revenue, while CSXT is number three.

Rail transport of WPRAP waste material from the FEMP originates on the CSXT line. As the originating railroad, CSXT is the point of contact between the FEMP and both railroads. The rail routes are described in Section 4.1.

2.1.1 CSX Transportation Inc.

CSXT, with headquarters in Jacksonville Florida, is part of the CSX Corporation. This corporation is composed of several international transportation companies, offering rail, intermodal shipping (*e.g.*, rail/truck, using containers or trailers), barging, trucking and related services. CSXT's rail transportation and distribution services accounted for 49 percent of CSX's 1993 total operating revenue of $8.9 billion and 74 percent of CSX's total operating income of $913 million (CSX 1994).

Rail traffic is controlled from a single dispatching and switching center in a weather-proof facility in Jacksonville. This facility displays a schematic diagram of the entire rail system (including the FEMP-Cottage Grove Branch Line), showing the real-time position of each train. Its dispatchers are in instantaneous voice and data link with each locomotive. See Section 4.3 for further details on this tracking system.

Based on 1993 data, CSXT has the following statistical profile:

States/Provinces served	21 plus the District of Columbia
Miles of track owned	18,779
Traffic	
Average trains per day	1,300
Average carloads per day	15,000
Total 1993 carloads	4,203,000
Equipment	
Locomotives	2,810
Freight cars	105,136
Average employment	29,000

(CSX 1995c)

CSXT has extensive experience transporting radioactive materials, as a result of its status as the exclusive rail carrier for the DOE's Savannah River Site. Most recently, CSXT transported foreign spent nuclear reactor fuel to the Savannah River Site.

2.1.2 Union Pacific Railroad Company

UPRR, with headquarters in Omaha, Nebraska, is part of the Union Pacific Corporation. This corporation is involved in rail and truck transportation services, and hydrocarbon and minerals operations. UPRR's rail transportation and distribution services accounted for 66 percent of UPRR's 1993 total operating revenue of $7.6 billion (UP 1994). (On August 3, 1995, Union Pacific and Southern Pacific

representatives agreed to a merger of the two companies; the proposed merger is under review by the U.S. Department of Justice.)

Similar to CSXT, UPRR's rail traffic is controlled from a single dispatching and switching center in a weather-proof facility in Omaha. See Section 4.3 for further details on the UPRR tracking system.

Based on 1993 data, UPRR has the following statistical profile:

States/Provinces served	19
Miles of track owned	17,835
Traffic	
Average trains per day	750
Average carloads per day	12,603
Total 1993 carloads	4,600,000
Equipment	
Locomotives	3,121
Freight cars	66,813
Average employment	29,000

UPRR has extensive experience transporting radioactive materials because of its status as the exclusive rail carrier for the DOE's Idaho National Engineering Laboratory at Idaho Falls, Idaho. This experience includes shipments of spent nuclear fuel from U.S. Navy ships, nuclear fuel debris from the Three Mile Island accident, transuranic waste from several DOE facilities, uranium mill tailings from Salt Lake City, contaminated soils originating from many states (*e.g.*, Colorado, Illinois, and New Jersey) and radium export shipments.

2.2 Anticipated FEMP Rail Traffic

The anticipated rail traffic, resulting from the off-site shipment of WPRAP waste, is insignificant in comparison to the existing rail traffic of CSXT and UPRR. This section illustrates this finding with a statistical comparison.

After production with a single waste treatment unit has stabilized in FY 1999, two unit trains, composed of about 50 to 60 loaded gondola cars are planned. In this scenario, each train departs the FEMP at an average interval of 16 calendar days. An average of 8 cars are loaded per calendar day. Depending on the frequency of shipments, between 130 and 190 gondola cars are dedicated for WPRAP waste shipments.

In contrast, based on the statistical profiles presented in Section 2.1, CSXT and UPRR average about 1000 trains per day and transport over 12,000 railcars per day. The anticipated average FEMP rail traffic is approximately 0.1 trains per day, or about three to seven railcars per day.

From a national perspective, approximately 1,400 million tons of freight are transported by rail annually (1992). In contrast, WPRAP is expected to ship less than 0.1 million tons of waste per year for about seven years.

CSXT transports about 209 billion ton-miles of freight each year (1992), and UPRR transports about 147 billion ton-miles per year (1992). WPRAP waste is equivalent about 0.4 billion ton-miles per year.

The UPRR main line west of Salt Lake City, Utah, current traffic averages 20 trains per day (NRC 1993). At peak operation, the WPRAP unit train is an incremental addition of one train every eight days.

There are more than 1.1 million freight cars in service nationally, including more than 140,000 gondola cars. The number of new gondola cars, to be procured by the FEMP from manufacturers or leasing entities, for transporting WPRAP waste represents an increase of about 0.1 percent of the national fleet of gondola cars.

In summary, comparison of the anticipated magnitude of WPRAP rail traffic to the current magnitude of rail traffic for the designated rail carriers, shows that the designated carriers have sufficient transport capacity to satisfy the project requirements. Similarly, the number of gondola cars required for this project is insignificant in comparison to the number of railcars in service in the national fleet. In conclusion, CSXT and UPRR can easily accommodate this additional WPRAP traffic.

2.3 Rail Transportation Configuration

The optimal rail transportation configuration for transporting WPRAP waste to a RPCDF, with direct rail access and a rotary railcar unloader, was determined by a detailed cost-benefit study (FERMCO 1995d). This configuration is a unit train consisting of DOE-controlled (*i.e.*, owned or leased) gondola cars where the load is contained by a disposable liner and a hard railcar cover. A detailed description is provided below.

2.3.1 Unit Train

A unit train is a train that makes a direct run between the point of origin and the destination point. The unit train receives priority right-of-way and expedited switching, and stays intact along the whole route, (*i.e.*, it does not receive additional freight, nor drop any freight). Thus, the use of unit train service

affords compliance with Department of Transportation (DOT) regulations (49 CFR 174.14) which require expeditious handling of railcars moving radioactive materials.

The unit train concept offers several key advantages over regular freight service:

1) Lower transportation cost (volume discount)
2) Shorter transit time, which increases the utilization of the railcar fleet
3) Improved train safety by minimizing idle time on rail sidings and eliminating individual railcar switching/handling
4) Improved railcar security and tracking
5) Immediate return of all empty railcars, which cannot be easily accomplished under regular freight service
6) Reduced maintenance costs

Unit train status is achieved when there are at least forty freight cars in a train. With less than forty cars, the transportation cost is raised significantly for the same degree of service. Consequently, there is a strong economic incentive to use the unit train concept.

DOT regulations (49 CFR 174.85 (b)) specify that a car placarded "RADIOACTIVE" cannot be placed next to a locomotive or an occupied caboose[1]. Therefore, a unit train of radioactive material must have a "buffer" railcar inserted between the locomotive(s) and the RADIOACTIVE-placarded gondola cars. This car can be either supplied by the railroad or the FEMP. However, to ensure its stability, the car must be loaded with any non-radioactive material (as defined by DOT).

Radiation exposure of the rail crew is limited under DOT regulation (49 CFR 174.700(g)(3)), which sets the maximum allowable radiation level to 2 millirem per hour for any normally occupied position in the train or adjacent railcar.

2.3.2 Gondola Railcar

Although there are several types, most gondola railcars are long, low cars, loaded and unloaded from the top. They can be unloaded by means of a car roll-over unit. The design specifications of the representative gondola car, for purposes of this plan, are shown below (Grnbr 1994):

Inside length	52' 6"
Inside width	9' 7.5"
Inside height	5' 6" (one foot higher than "standard")
Cargo capacity	107 tons/ 103 cubic yards

[1] Cabooses are no longer commonly used by the railroads.

Empty weight	36 tons
Outside length	57' 1.5" (coupler-to-coupler)
Turning radius	209 feet (when coupled)

A gondola car is expected to contain about 90 tons of WPRAP material, when loaded to about one foot below the top of the car (*i.e.*, one foot "freeboard"). The treated waste material is assumed to have an estimated density of 80 pounds per cubic foot or 1.08 tons per cubic yard.

The gondola railcar was selected as the most cost-effective means of transporting bulk material. This car offers the minimum logistical and space requirements. The implementability of this rail mode is enhanced since the RPCDF has a roll-over unloading facility and is experienced in its use. Another alternative, top-loading and bottom-unloading hopper car, is prohibited by federal regulations (49 CFR 174.700(e)).

2.3.3 Liners and Hard Cover

To address public concerns documented in the Responsiveness Summary to the Record of Decision (DOE 1995a), the DOE has committed that railcars with WPRAP material will be lined with a synthetic material liner and covered with a secured hard cover (See Figure 2-1). Liners cannot be used with high wall gondola cars, due to interference with the internal cross bracing.

The purposes of the disposal liner are to prevent external contamination of the railcar during loading (when the flaps are folded over the outside of the car), prevent release of material during transport, prevent infiltration of water into the dried material during shipment, minimize contamination of the inside surface of the railcar, and facilitate the release of frozen cargo from the car. The hard cover is designed to prevent human intrusion, infiltration of precipitation, and inadvertent release of the WPRAP material.

The design requirements for the liner and hard cover will satisfy DOT regulations (49 CFR 173.427 and 174.700(g)(1)), which specify that LSA material be transported in a "strong tight package" in a closed transportation vehicle, under exclusive use conditions. A strong, tight package is a package that will prevent the release of any radioactive material under normal transport conditions. For shipments of hazardous waste, the liner must be compatible with the waste.

2.4 Options Planning

A number of options to the baseline rail transportation scenario for shipment to the RPCDF are described below. Contingency planning for wastes rejected by the RPCDF is addressed by Section 5.

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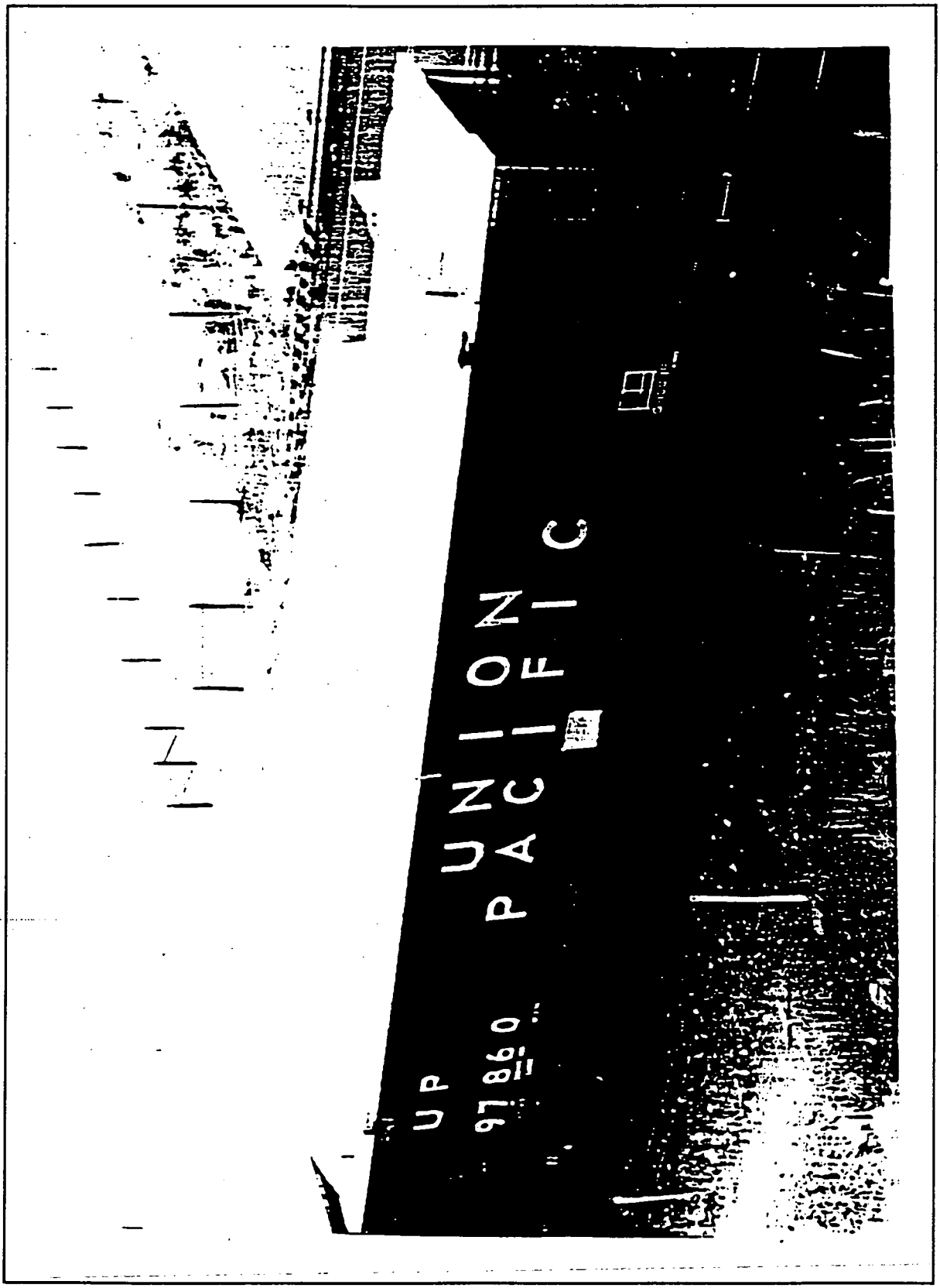

Figure 2-1 - Gondola Car with Hard Cover

2.4.1 Small Volume Shipments to the NTS

The objective of the WPRAP waste treatment unit is to process all pit waste, such that the waste will satisfy the WAC at the RPCDF. As a contingency, small volumes of material that do not meet the WAC of the RPCDF will be shipped to the NTS by truck. For the purpose of this document, it is assumed such material will satisfy the WAC of the NTS. The FEMP has extensive experience in shipping low level radioactive waste (LLRW) to the NTS by truck, and has procedures in place that ensure compliance with all transportation requirements.

Current NTS procedures for shipment of waste (to the NTS) specify the use of disposable metal containers transported by truck. The standard metal containers at NTS are steel drums (7.5 cubic feet) and "white metal boxes" (100 cubic feet). Use of loaded containers weighing over 9000 lb require explicit prior notification of and approval by the NTS. (See Section 8 for further details.)

2.4.2 Flexibility in Loadout Configuration

The baseline loadout configuration is shipment of WPRAP material in a lined gondola car with a hard cover.

Alternatively, the WPRAP waste material can be loaded in returnable bulk metal containers. The maximum weight for truck transport (without obtaining an overweight permit) is 20 tons. Several (three to four) of these standard 20-ton containers could also be placed on a flatbed railcar for transport to the RPCDF. The "Intermodal" concept of using standard 20-ton containers for both truck and rail transport to the disposal facility is discussed below.

2.4.3 Intermodal Shipment

In the event that the baseline rail transportation scenario cannot be implemented, intermodal shipment provides a contingent means to transport the WPRAP material off site. The key feature of intermodal transport is its inherent flexibility to utilize both road and rail transport.

The intermodal transport scenario consists of the following segments:

1) Load the WPRAP material into lined 20-ton intermodal containers

2) Employ short-haul trucking to transport the containers to a rail terminal

3) Long distance rail transport to either the disposal site, or a transfer terminal near the disposal site, for the final short-haul truck transport to the disposal site

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4) Return of the empty containers to the FEMP

Alternatively, the containers from the FEMP could be transported directly by rail to the disposal site or a nearby transfer terminal for short-haul transport.

DOT regulations (49 CFR 173.427(a)(6) and (c)(1)) governing exclusive-use shipment of LSA material in strong and tight containers) require that the loading and the unloading of containers be performed under the supervision of the shipper (Fernald Environmental Management Corporation (FERMCO)) or the consignee (disposal facility). Thus, only trained radiological personnel are permitted to handle or move LSA containers. Otherwise, transport must be performed with certified, Type A containers instead of LSA containers.

A description of container handling at the disposal facility is presented in Section 5.2.2.

SECTION 3

RAILROAD CAR HANDLING AT THE FEMP

This section addresses management of railcars and processed waste materials at the site, including the preparation of unit trains, before departure from the site. The section discusses waste handling, rail facilities, the inspection/maintenance facility, and transportation documentation. The design of the FEMP loading process is in the preliminary design phase; refer to the *Description of On-Site Rail Improvements* for details.

The FEMP will use the "staggered" unit train concept to ship waste off site. This scheduling concept, allows time between the departure of one loaded train and the arrival of the inbound train of empty cars.

3.1 Rail Facilities

3.1.1 Current Facilities

The existing railroad track system at the FEMP is shown on Figure 3-1. The rail system was most recently used to move coal to the site and to remove selected wastes from the site.

From the CSXT Branch Line, the FEMP spur, a single line of DOE-owned track, extends east, crosses Paddy's Run Road, runs north of the WPRAP area. The FEMP spur extends east into the former process area, and divides into two parallel tracks (Tracks 1 and 2), with crossovers. This trackage supports five "trailing point" curving yard spurs that allow cars to be pushed south into the former processing area. The crossovers function as "double-ended" sidings to allow an engine to be cut off and move to the other end of a string of cars to push them onto the single "facing-point" siding (Track 12), which curves around the west side of the site.

The FEMP spur and Track 12 were constructed with heavy rail (131 pounds per linear yard), which has sufficient structural capacity for the projected rail traffic. Certain FEMP trackage (*e.g.*, Track 12) was constructed with used rail. However, Tracks 1 and 2 are constructed with 80-pound rail and will be used only to store empty cars.

3.1.2 Proposed Facilities

To support rail transportation operations, a major phased upgrade of facilities at the FEMP will be required. Site improvements include installing new tracks, installing of fencing around all tracks, and constructing the waste loading facility. Phase I of the proposed upgrade is shown in Figure 3-2, and is composed of the following trackage elements:

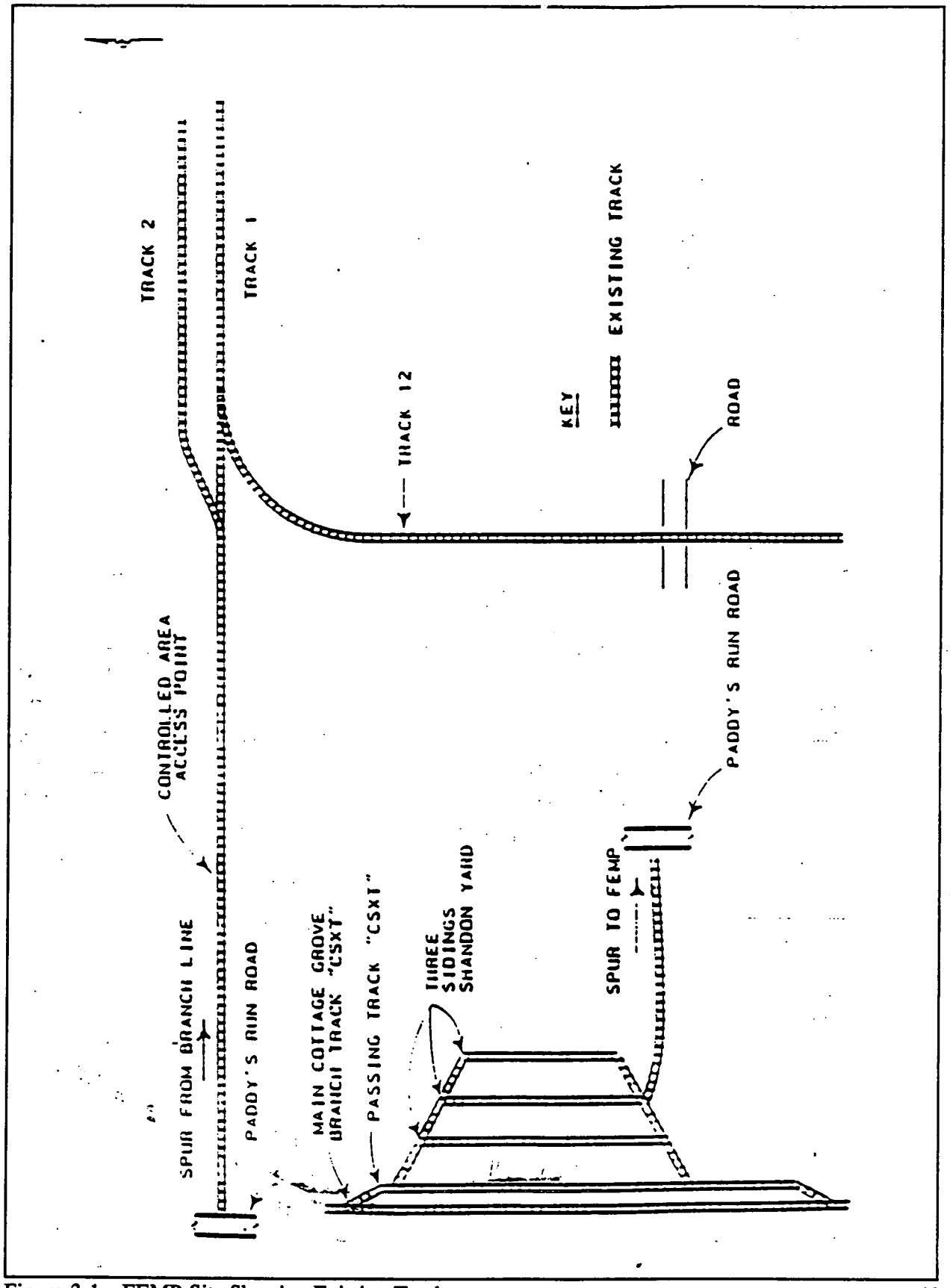

Figure 3-1 - FEMP Site Showing Existing Trackage

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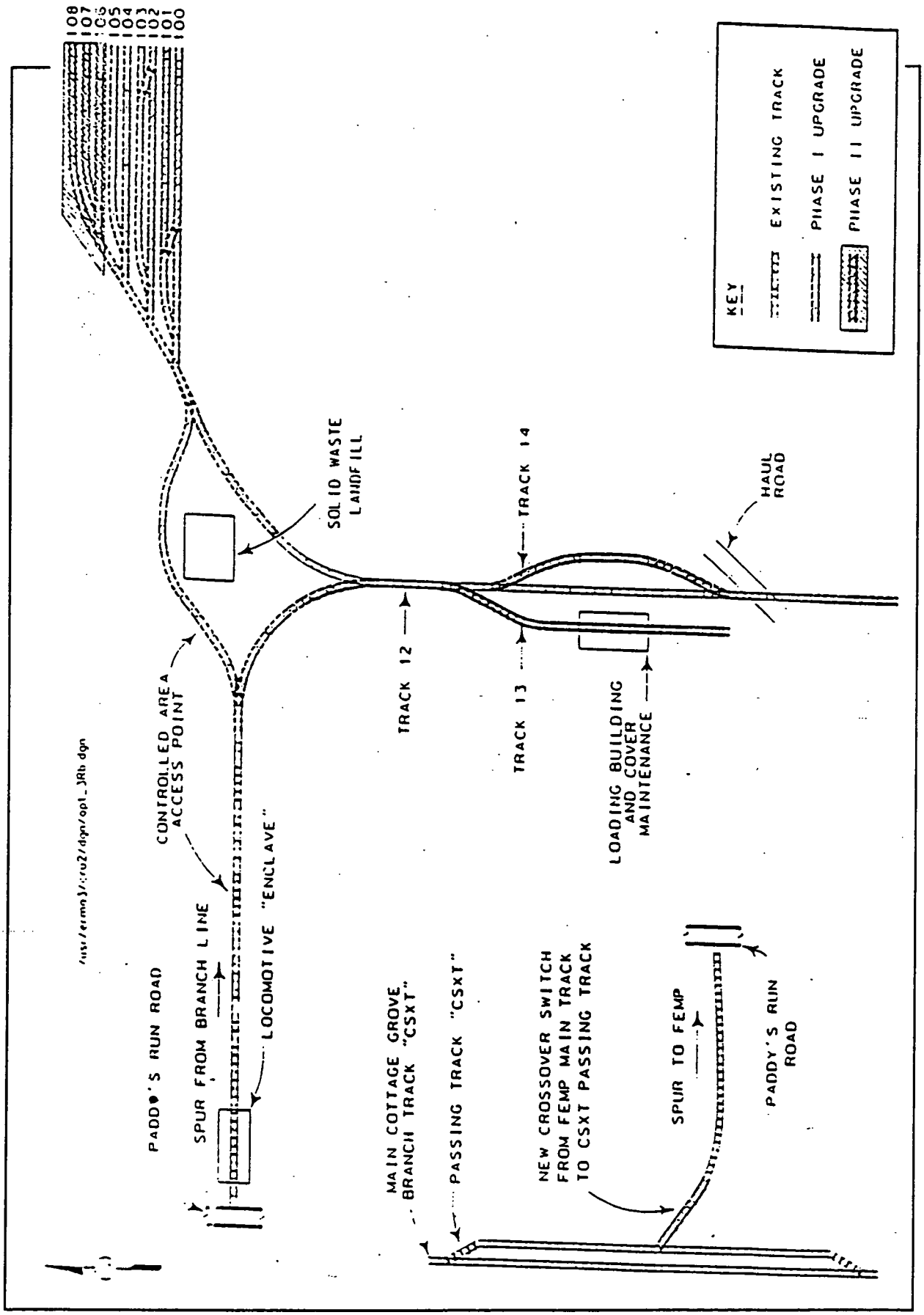

Figure 3-2 - Proposed FEMP Railroad Facilities

- "Upfront cost" (to be credited) for rebuilding CSXT Shandon Yard switches.
- Inspection of the Main FEMP Spur and the FEMP trestle (upgrading, if necessary).
- Inspection, upgrading, and east extension of Tracks 1 and 2 for staging empty railcars.
- Construction of:

    - New curve to connect the Main FEMP Spur with Track 12.
    - Tracks 100-105

Phase II involves the construction of Tracks 106-108.

3.2 Waste Handling

The proposed location for the waste loading facility is adjacent to Track 13, as shown in Figure 3-2.

Two site locomotives will be used to move railcars to and from the loading facility, and to assemble unit trains.

Processed waste will be stored only in sealed and covered railcars, or in the process facility. If empty railcars are not available and no option exists for off-site shipment due to an unforeseen scheduling difficulty, the FEMP will adjust the waste treatment rate to prevent an accumulation of processed waste.

3.2.1 Loading Process

The FEMP Trackmobile®, not the two site locomotives, will move cars through the waste loading facility. In general, the hard fiberglass cover is removed and the liner will be installed. The liner, made of a disposable reinforced synthetic material, is draped over the sides to avoid contamination of the car. The liner is inspected to ensure containment integrity. Then, the waste material is loaded into the gondola railcars; cars are considered full when loaded to a 1-foot freeboard, or the weight capacity of the car (including the liner and the lid) is reached. Final samples for waste acceptance testing and certification are collected at this time. After loading is complete, the lap-over top of the liner is sealed (either tape or heat seal) over the load. Finally, the hard cover is placed on the loaded car. The hard cover is secured by four heavy metal clamps; one clamp per car is secured with a tamper proof seal.

After remediation starts, operations will support loading at a rate ranging from 4 to 8 cars per day. Details of the waste loading process are provided in the *Description of On-Site Rail Improvements*.

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3.2.2 FEMP Waste Sampling and Quality Control

Most excavated WPRAP material must be treated to meet the RPCDF's WAC. The DOE is committed to ensuring that the waste will meet the WAC for the receiving facility before the loaded railcars or containers depart the FEMP. (DOE 1995a) Before shipment, all loads are sampled and analyzed to enable the shipper (*i.e.*, FERMCO) to certify that the waste satisfies the WAC of the disposal facility. Specific sampling and analysis activities will be addressed in the *Sampling and Analysis Plan*, which will be developed and submitted in accordance with the WPRAP Remedial Action Work Plan. The *Sampling and Analysis Plan* will include applicable requirements of the disposal facility. All analyses will be conducted in accordance the *Sitewide CERCLA Quality Assurance Project Plan* (WEMCO 1992).

Confirmatory samples collected for RPCDF waste acceptance testing taken directly from the railcars, will require a 24-hour analytical turnaround period. If a railcar fails the WAC, a scheduling delay may occur, particularly if the last cars making up a unit train do not produce acceptable results. Accordingly, a reserve of loaded cars will be maintained.

If the analytical results indicate the loaded railcar contains hazardous waste, FEMP personnel will confirm that the RPCDF can accept the material for treatment and disposal. If so, the railcar is placarded and manifested for shipment as hazardous waste.

3.2.3 Exterior Decontamination of Loaded Railcars/Containers

Following waste loading, each railcar will enter an enclosed area for decontamination (if needed). The hard cover and the decontamination process will be designed to avoid introducing water into the sealed cargo. The gondola cars are then transferred to a heavy rail, access-controlled storage spur, and held until results of the various analyses are determined.

3.2.4 Radiological Monitoring Requirements and Quality Control For Railcar Release

Before release of the loaded railcars from the site, each railcar will be externally surveyed for external contamination and acceptable radiation levels, in accordance with the *Sitewide CERCLA Quality Assurance Project Plan* and existing FEMP survey procedures. Specific criteria for the transportation of radioactive material are listed in 49 CFR 173.

Two types of radiation surveys will be conducted on each railcar. Both surveys are expected to be performed in less than one hour. The first survey measures direct radiation per 49 CFR 173.441; results are available immediately. The second survey measures removable external contamination per 173.443(b), using a wipe test or using a roller with an adhesive surface; results are available overnight.

In addition to the radiation surveys, as appropriate, thermoluminescent dosimeters (TLDs) may be attached to the exteriors of several gondola cars or attached to the shipping papers, pursuant to agreements to be negotiated with the railroads. TLDs are monitored as necessary to track the external radiation fields.

In general, the radioactivity limits for loaded railroad cars are based upon the isotopic and radioactivity concentrations of the involved materials. Assuming that concentrations measured in the WPRAP Remedial Investigation (DOE 1994a) are representative of the wastes to be transported to the RPCDF, the following maximum limits are applicable:

1) 200 millirem per hour reading on any external surface
2) 10 millirem per hour at any point 2 meters from the outer surface
3) 2 millirem per hour in any normally occupied space, such as cab of the train

The WPRAP material is expected to exhibit much lower radiation levels, so that compliance with this requirement is not expected to be a problem.

Pursuant to 49 CFR 174.715(b), if the interior surface of the unloaded railcar, yields a radiation dose that exceeds 10 millirem per hour or 2 millirem at 1 meter (3 feet), the car must be conspicuously stenciled with the words: "FOR RADIOACTIVE MATERIALS USE ONLY" in lettering at least 8 cm (3 inches) high on both sides of car. The car must be kept closed to prevent inadvertent access, except for loading and unloading operations. It is recommended that the cars be factory-painted with the stencil which could be covered if it is determined that the above-noted criteria can be achieved.

3.3 Inspection/Maintenance Area

A maintenance area will be constructed at the FEMP to perform routine maintenance on the locomotives. Major service and repairs will be performed off site. The location of the FEMP facility is at the southern end of Track 12. See the *Description of On-Site Rail Improvements* for details of the facility.

In addition, the area would allow certified outside contract personnel to provide routine/preventive maintenance of FEMP-owned/leased cars. This maintenance area eliminates the need to decontaminate railcars and lose their availability for extended time periods. However, major service and repairs of the rolling stock will be performed off site by commercial railroad-approved maintenance shop(s). Railroads have repair facilities to correct maintenance problems developed *en route*, but this is disruptive of unit train service and must be avoided. The lease/purchase of new cars will minimize this problem. The mechanisms for performing routine and *en route* repairs will be documented in contracts with the railroads and the railcar manufacturer or leasing firm.

To minimize the need for unscheduled off-site maintenance, the railcar owner (i.e., the FEMP or the leasing company) will develop a rigorous railcar inspection and preventive maintenance program.

3.4 Rail Shipment Documentation

Disposal facilities require load-specific documentation, including a 72-hour shipment notification and a Radioactive Waste Shipment & Disposal Record to ship waste. Loads, if any, of hazardous waste will be transported under a hazardous waste manifest.

To support preparation of waste-specific shipment documentation, the following systems are planned:

1) Automated shipping document generation: The generation of the documentation necessary to ship waste from the FEMP takes several (*i.e.*, two to six) days after car loading due to the laboratory turn-around time. A lengthy delay to generate the documentation could cause an accumulation of loaded railcars. To minimize this possibility, all documents necessary for each car/container are computer-generated from an integrated database. This system integrates the data from the loading equipment, car register, and analytical data base. The necessary documents for each car/container are generated for each loaded car as it is released from the storage area.

   During this process, the hazardous materials shipping documentation for each car is verified to ensure that the description of the contents of the loaded car reflects the analytical results from the waste characterization. Also, these analytical results are reviewed to ensure that all required transportation placarding is posted. These reviews are performed by an individual who has DOT HM-126F training.

   The computer system will compare the analytical results for the material to be shipped, obtained by testing pursuant to the Sampling and Analysis Plan which will be developed, with the RPCDF's WAC to ensure the criteria are satisfied. This would prevent shipping papers from being prepared for waste which had not cleared the FEMP's Quality Assurance process. In the event that the PCDF were to reject a carload, this data would be the first point of reference in addressing the problem.

2) Automatic scale at loading station: The scale weighs the car as it is loaded and assists in the loading process. The scale provides important information for shipping documentation, since the railroads are typically paid by weight shipped. Railroads will accept a customer's weight representation, but periodically spot-check cars.

This documentation is the basis for preparation of a Consist Report. A typical CSXT Consist Report shows the following information for each railcar:

1) Identification number
2) Position within the train
3) Status (empty/full)
4) Weight
5) Contents and related emergency instructions

The Consist contains critical information in the event of an emergency (See Section 9).

At East St. Louis, Illinois, CSXT crew provides the UPRR crew with this documentation which travels with the train until arrival at its ultimate destination.

The above-noted hard-copy "paper trail" for the shipment in progress is supplemented by the railroads' real-time car-tracing data bases as described in Section 4.3.

Placarding of railcars by FEMP personnel is required. The specific placard will be determined by the specific nature of the waste. Based on the WPRAP Remedial Investigation (DOE 1994a), a "RADIOACTIVE" placard is required for planned waste shipments (See Section 2.3.1).

In addition, to have a record of the radiation field in the occupied portion of the locomotive, a TLD may be attached to the official shipping papers carried by the train crew. Upon arrival at the RPCDF, this TLD is removed and mailed to the FEMP or a measurement laboratory by the disposal facility personnel. Details of this procedure have not been finalized.

CSXT connects to the loaded unit train at the FEMP gate; consequently, the CSXT locomotive is not surveyed. If the CSXT train crew enters the FEMP to inspect the train, crew members will be monitored (with TLDs). Current plans assume that CSXT will perform their inspection outside the FEMP boundary. A work procedure will be developed to detail the activities involved with the train inspection and turnover to CSXT.

3.5 Unit Train Transfer

The unit train is assembled one to two days before its scheduled departure. At this time, a final radiation survey is contemplated as the cars may collect dust due to being stored on tracks near areas where remediation activities will be in progress. The need for such testing will be evaluated further. After the unit train has been assembled, an initial stationary brake test and final radiation survey (for site release) is conducted on site by FEMP personnel. When the CSXT locomotive arrives, the train is pulled out to the Branch Line. The entire train is inspected again by CSXT prior to acceptance and movement from the FEMP to confirm that the cars are mechanically fit and all safety equipment is present and operable.

SECTION 4

LOGISTICS OF RAIL TRANSPORT TO THE REPRESENTATIVE PERMITTED COMMERCIAL DISPOSAL FACILITY

This section details the plans and logistics associated with the rail transport from the FEMP to the RPCDF, including the route, schedule, and tracking of unit trains. Only the primary routes proposed by the railroads are identified below.

4.1 Route

For planning purposes, a RPCDF is used as the basis for this analysis. Although the entire route to Clive, Utah is reviewed in this section, attention is focused on the portion of the route where the traffic associated with this project would cause a major rail traffic increase (*i.e.*, the Branch Line between the Shandon Yard and its junction with CSXT's main line at the Cottage Grove, Indiana yard).

4.1.1 CSX Transportation (Fernald to East St. Louis, Illinois)

CSXT will transport the WPRAP waste from the FEMP to East St. Louis, Illinois, CSXT's western terminal yard.

4.1.1.1 Fernald to Cottage Grove

Unit trains will transit the 24-mile long branch line between the FEMP and the Cottage Grove yard on a regular basis. Trains move at a maximum speed of 25 miles per hour along the route, shown in Figure 4-1. CSXT's current traffic on this line is three local freight trains per week; once FEMP begins rail shipments, this rate will increase.

4.1.1.1.1 Shandon Yard

This switch yard parallels CSXT's line at the junction of the FEMP spur and consists of three parallel tracks. Shandon Yard will not be used as a staging area for unit trains.

A switch will be constructed to connect the FEMP spur directly to the CSXT Branch Line.

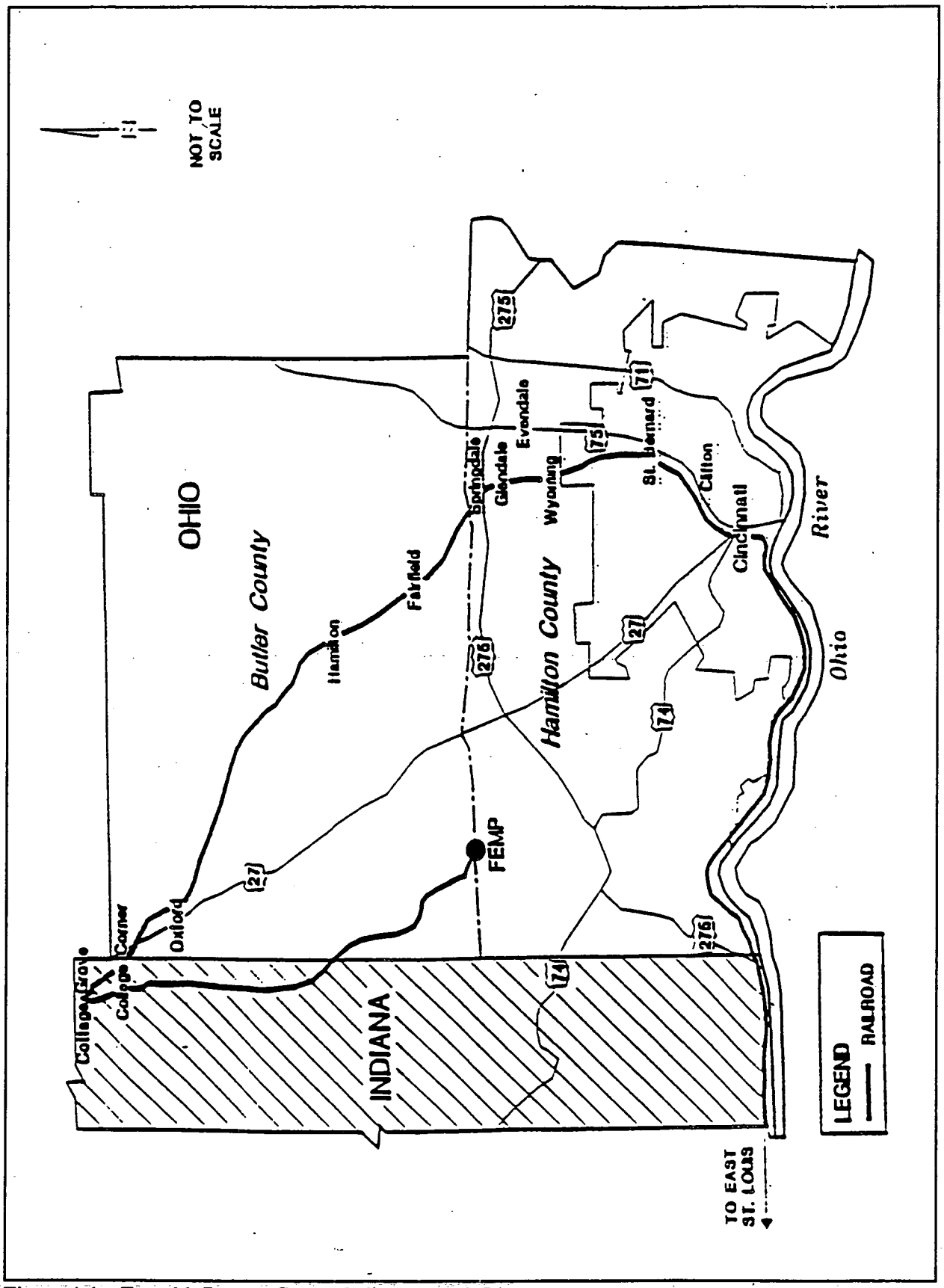

Figure 4-1 - Fernald-Cottage Grove, Indiana Branch Line

4.1.1.1.2 Cottage Grove Yard

Located in the town of Cottage Grove, Indiana, this yard has ample capacity for unit trains, but the trains might have to wait a maximum time of approximately one hour for clearance onto the main line. The FEMP will make arrangements with CSXT to minimize the holding time at Cottage Grove by obtaining clearance prior to departure from the FEMP.

4.1.1.1.3 Track Condition

The Branch Line between the Shandon and Cottage Grove yards is a Class 2 track, as defined by 49 CFR 213.9, which establishes a 25 mph speed limit. Other tracks for the balance of the trip to Clive, Utah are equal or higher in class. All track is inspected as required by 49 CFR 213, Federal Railroad Administration (FRA) Regulations, to determine the condition of the following:

1) Rails
2) Rail joints
3) Crossties
4) Switches/crossovers
5) Crossings (track and grade)
6) Ballast
7) Tieplates
8) Rail Fastenings

Before initiation of rail shipments, the FEMP will request that CSXT perform a track inspection of the Branch Line between the FEMP and Cottage Grove, and certify that all required project-specific maintenance and upgrades needed to support the WPRAP rail shipments have been performed. This FRA certification will document that this work was completed.

Public comments on the condition on rail track and associated property from the FEMP to Cottage Grove should be directed to CSXT Louisville District Office at (812) 288-1844.

4.1.1.1.4 Bridge and Trestle Upgrades

Based on information provided by CSXT, trains, *en route* from the FEMP to Cottage Grove, cross several bridges/trestles of wood or wood and steel construction and of various ages. These structures have received substantial maintenance since the time of construction and, reportedly, are adequate for current rail traffic.

The trestles are routinely inspected for the following items:

1) Track Condition
2) Superstructure
3) Substructure
4) Waterway obstructions (if applicable)

On the basis of the design load and rating, CSXT indicates that three of the bridges or trestles are not satisfactory for the unit train rail traffic associated with this project. These three trestles span:

1) Camp Run
2) South Wynn Road
3) Bucks Run (Okeana Trestle)

CSXT believes these trestles need to be replaced or rebuilt prior to commencement of rail traffic associated with this project. Specifically, CSXT has advised the FEMP that the use of the branch line to support the proposed additional train traffic requires that the trestles identified above be strengthened. These efforts can be effected with nominal disruption of the current rail traffic. The structure of primary concern is the 846 foot long and 65 foot high "Okeana Trestle" at Bucks Run Road, of which 646 linear feet is timber construction. The DOE is committed to upgrading these structures before waste shipment. (DOE 1995a) The *Off-Site Rail Upgrades*, another design deliverable submitted with the WPRAP Remedial Design package, contains the details, engineering work, and schedule of three planned trestle upgrades.

4.1.1.1.5 Grade Crossings

FEMP personnel have identified 24 "at grade" road crossings (*i.e.*, without a bridge or a overpass) located on the route shown by Figure 4-1. All crossings have the "crossbuck" signs as required by federal regulations. None has crossing gates; most do not have flashing lights. Installation of gates and/or flashing lights at these crossings is the responsibility of the Ohio and Indiana Departments of Transportation on the basis of analysis of vehicular and rail traffic. At present, the DOE has no plans to install such equipment as part of this project.

4.1.1.2 Cottage Grove to East St. Louis

Trains join main line traffic between Cincinnati, and Indianapolis, at Cottage Grove, Indiana.

As shown on Figure 4-1, rail traffic from the FEMP travels north to Cottage Grove, then east and south to the Cincinnati terminal. From Cincinnati, trains head west through Mitchell, Indiana, and Vincennes, Indiana (See Figure 4-2). CSXT service terminates in East St. Louis, Illinois.

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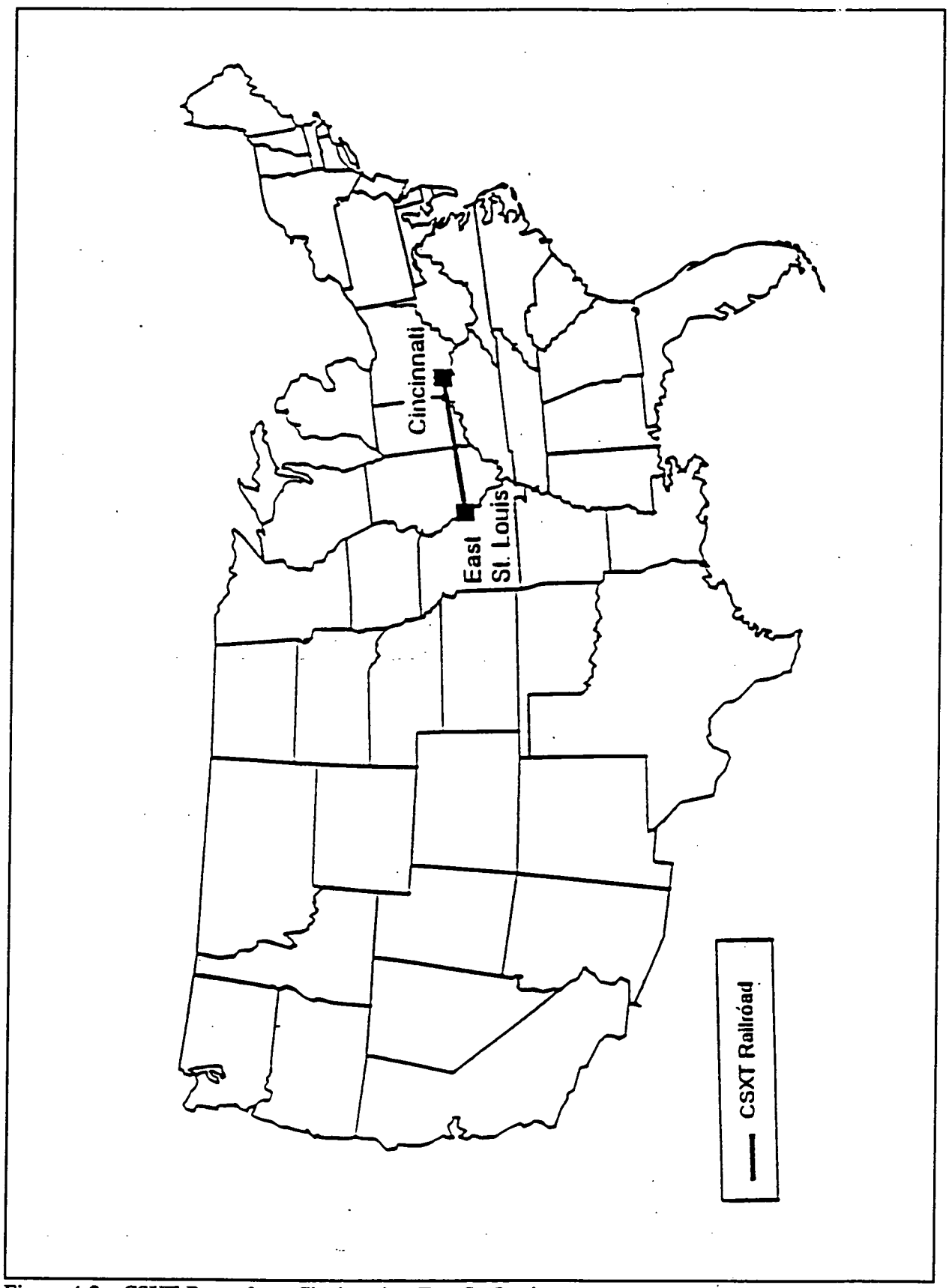

Figure 4-2 - CSXT Route from Cincinnati to East St. Louis

This portion of the route is over main line track that receives constant surveillance and maintenance attention. No non-routine infrastructure upgrades are required.

4.1.2 Union Pacific (East St. Louis, Illinois to Clive, Utah)

In East St. Louis, an inter-terminal switch occurs between CSXT's Cone Yard and UPRR's Valley Junction Yard, and the CSXT crew is replaced by UPRR personnel (See Figure 4-3). A switching railroad company may be used to transfer the unit train from CSXT to UPRR; if so, it will be considered a subcontractor to CSXT or UPRR and will be subject to the terms of the transportation agreement to be negotiated among FERMCO, the DOE, CSXT, and UPRR. Depending upon the arrangements between the railroads, the locomotives may be changed from CSXT equipment to UPRR equipment.

As shown in Figure 4-4, unit trains, under UPRR control, move westward to the Clive, Utah yard through the following major metropolitan areas:

1) St. Louis, Missouri
2) Kansas City, Missouri
3) Topeka, Kansas
4) Cheyenne, Wyoming
5) Ogden, Utah
6) Salt Lake City, Utah

The route traverses Missouri, the northeast corner of Kansas, most of Nebraska, a small part of northeast Colorado, the length of Wyoming, and across northern Utah. The final leg is from Salt Lake City west to Clive, Utah. The need for UPRR's Wendover Utah/Nevada yard to turn-around the unit train is being determined. All trackage is main line, and no non-routine upgrades are necessary for this project.

Car inspections are performed by the receiving company at the transfer between:

1) the FEMP and CSXT
2) CSXT and UPRR
3) the RPCDF and UPRR

Additional inspections are performed by train crews, while *en route* to the RPCDF. In accordance with standard railroad procedures, train inspections are typically performed with each change in crew, with each train refueling, every 1000 miles, and at major rail terminals.

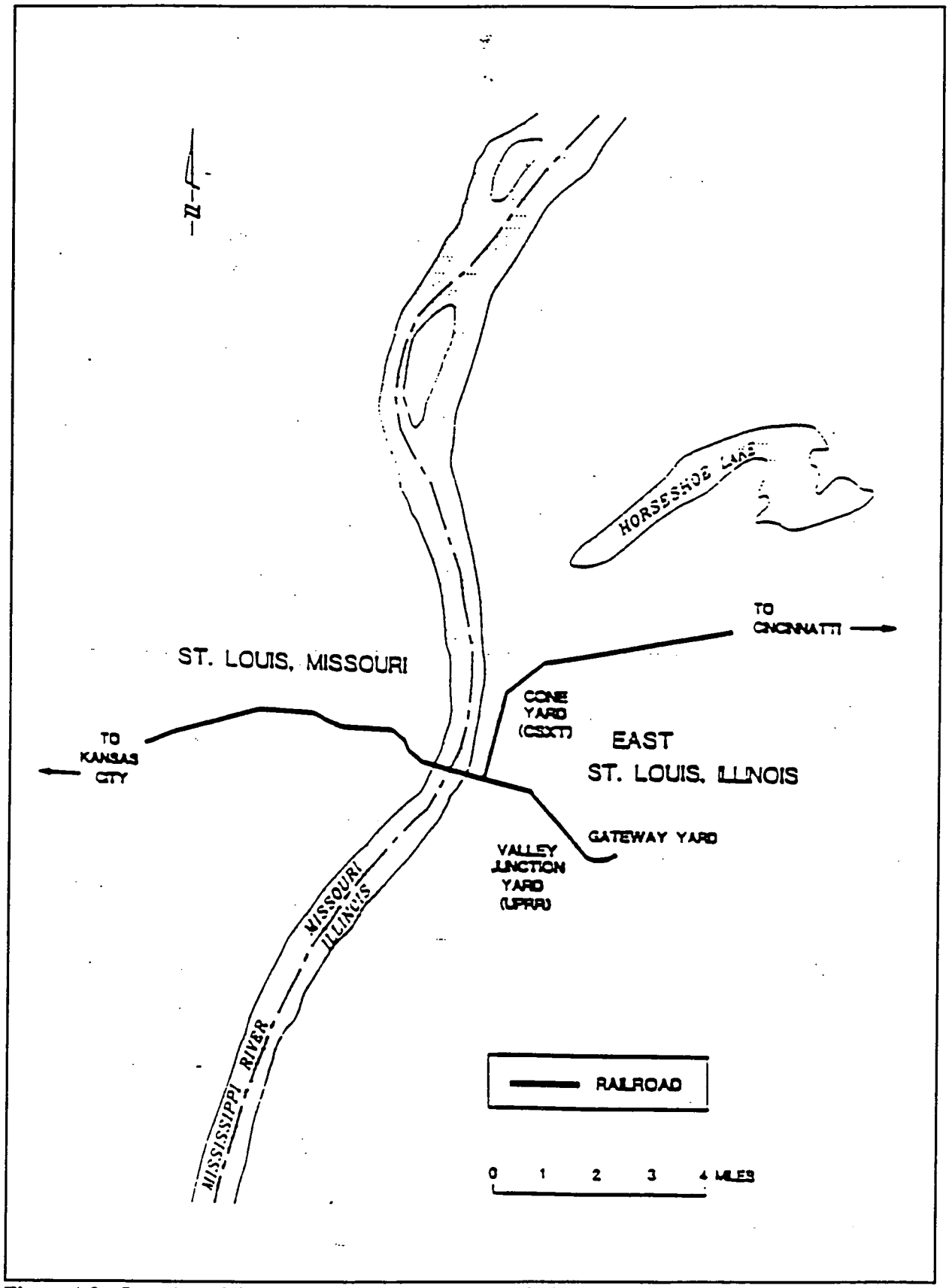

Figure 4-3 - Location of Cone Yard and Valley Junction Switch Yard

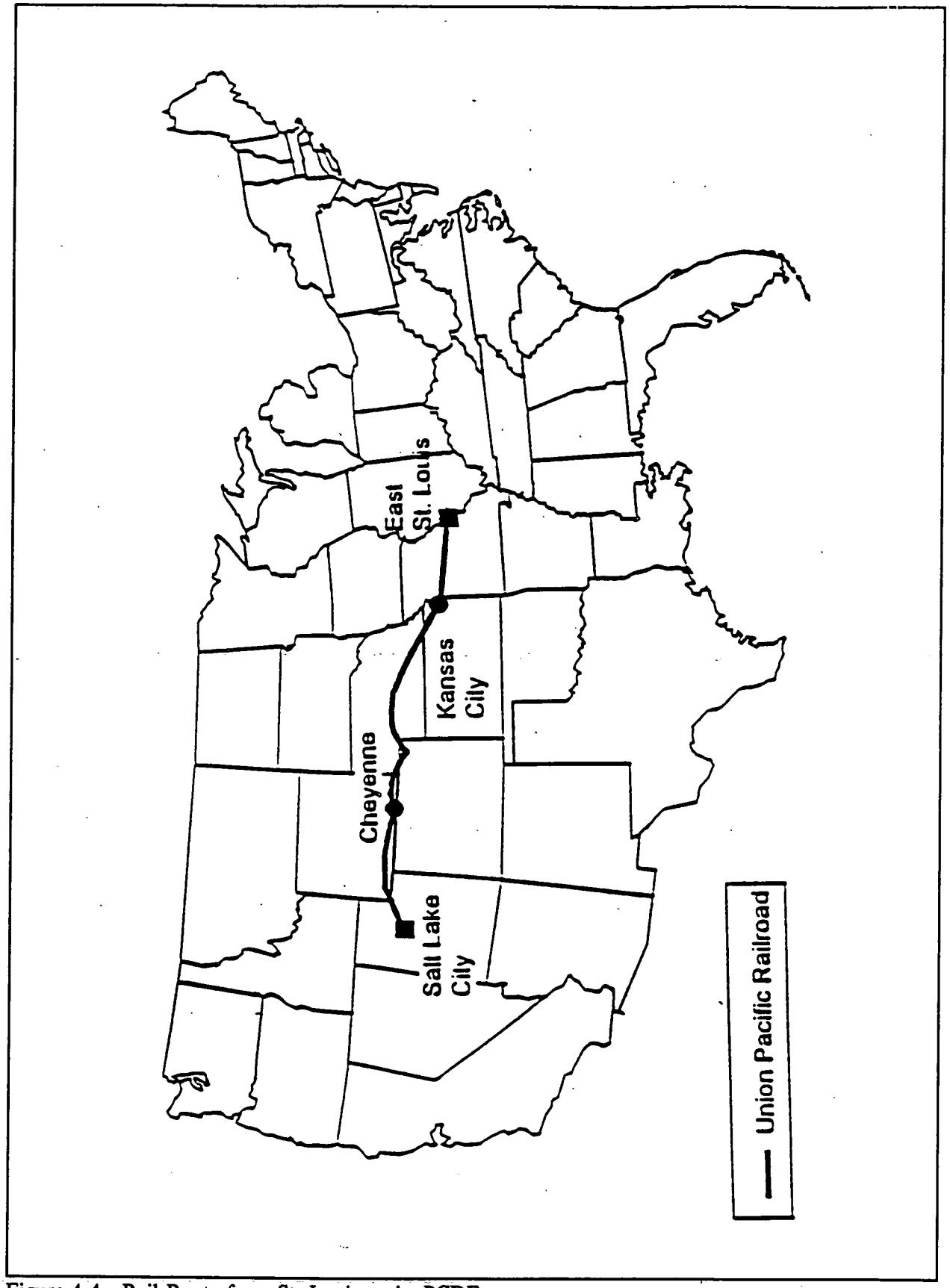

Figure 4-4 - Rail Route from St. Louis to the PCDF

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4.2 Unit Train Schedule

As shown in Table 4-1, the total round trip cycle time for a unit train is 15 calendar days, assuming one day for delays. A 16-day trip cycle is used for planning purposes, including 1 day for train disassembly. This estimate includes a 5 day turnaround time at the disposal facility.

Table 4-1 - Unit Train Schedule for Unit Train

Railroad	From	To	Days	
			FEMP	In-Transit
N/A	FEMP train makeup		1	
CSXT	FEMP	East St. Louis, IL		1
UPRR	East St. Louis, IL	Clive, UT		4
N/A	RPCDF			5
UPRR	Clive, UT	East St. Louis, IL		4
CSXT	East St. Louis, IL	FEMP		1
N/A	FEMP train disassembly		1	
Delays	N/A	N/A		1
TOTAL			2	16

Initially, when only one waste dryer is available, two unit trains with a 14-day loading cycle, are sufficient to meet transportation needs. The 14-day cycle is based on the expected waste processing rate; assuming 24-hour operation and 75% availability, the FEMP can process (and consequently load) 3.2 railcars per day. At this rate, the site can prepare one unit train (40 loaded cars) every 12 days. Later, if and when two treatment systems are placed into operation, three unit trains, with an 8-day loading cycle, are required to meet all transportation needs. In addition, several spare cars are required to meet various operational contingencies (*e.g.*, replacement cars, empty cars to use as buffers, loaded cars waiting for analytical results, cars in the loading facility).

Unit trains are normally scheduled with a seven day notice. For the first year of shipments, CSXT has agreed to allow some scheduling flexibility (with 48 hour verification) to accommodate startup problems.

The schedule of the returning empty unit train does not interfere with the assembly of the outbound unit train, which will require one to two days.

4.3 Location And Status Tracking

Tracking the location of railcars is standard practice with all major railroad companies. CSXT offers this service as an optional computer-accessible package called MERCURY®. UPRR's system is TELE-TRANS®. Tracking data are received from railroad car interrogators/transponders located at main switches along the tracks. With this system, the location of each car can be determined based on the last transponder. These units are separated by various distances, typically ranging from a few miles to about 20 miles. At any time, the FEMP can access the system to determine the locations of the trains/cars.

If cars are stopped due to a transportation incident, the FEMP would be immediately notified by railroads' control centers. The system provides automatic notification if one of the cars is delayed for non-routine safety-related reasons or mechanical repairs. In addition, the train locomotive is capable of voice communication with the railroad's control center. (See Section 7 for a discussion of emergency response.)

SECTION 5

PERMITTED COMMERCIAL DISPOSAL FACILITY

For planning purposes, a RPCDF located in western Utah, is under consideration as a potential bidder for disposal of LSA radioactive waste generated from the remediation of WPRAP and has been and will be used as the disposal facility for planning purposes, until the final disposal site is selected. This RPCDF was used as the RPCDF in the WPRAP Feasibility Study/Proposed Plan (DOE 1994b).

To comply with Off-site Rule for CERCLA waste (40 CFR 300.440), the DOE will audit the RPCDF before shipping WPRAP material to confirm the facility's status and compliance history. The review will be conducted annually throughout the term of the remediation project. In the event the compliance status of the RPCDF changes, the DOE will suspend waste shipments until the actions/requirements for regaining acceptability status are implemented and the facility becomes acceptable.

5.1 Facility Overview

The RPCDF is licensed to accept for disposal: (a) specific low concentrations of radionuclides within the classification LLRW (b) Naturally Occurring Radioactive Material (NORM), (c) mixed waste, and (d) 11e.(2) by-product materials (uranium and thorium mill tailings). The RPCDF of approximately 540 acres is next to a DOE mill tailings disposal site (100 acres). The facility is located in the Great Salt Lake Desert, near Clive Utah, about 75 miles west (65 miles by air) (NRC 1993) of Salt Lake City, Utah. The site is located within the ten square mile industrial area designated by Tooele County exclusively for commercial hazardous waste treatment, storage, and disposal facilities. (This zoning designation will prevent future residential development near the RPCDF.) The RPCDF has been successful in working with their regulators in obtaining additional licenses and processing amendments to its existing licenses.

5.1.1 Disposal Capacity

The facility has a total disposal capacity of 14 million cubic yards of waste. The currently-developed portion of the site with constructed disposal cells has the following disposal capacities:

1) 1.5 million cubic yards for LLRW
2) 1.0 million cubic yards for NORM
3) 1.0 million cubic yards for mixed waste
4) 3 million cubic yards for mill tailings

WPRAP waste is designated for disposal in the LLRW cell, which has ample capacity at this time.

5.1.2 RPCDF Waste Analysis and Acceptance

The RPCDF's Waste Characterization Plan describes the procedures that the waste generator and the RPCDF must follow to characterize the waste and to verify acceptability of the waste at the facility (See Figure 5-1). A partial list of the conditions in the facility's Radioactive Material License, which may affect acceptance of WPRAP material, is presented on Table 5-1. (Note: Table 5-1 is not all inclusive. Refer to the actual license for a complete list of conditions.) The RPCDF is in the process of amending its disposal limits for specific radioisotopes.

As part of the RPCDF's pre-shipment waste acceptance process, the RPCDF requires submittal of a waste profile, (including laboratory analyses and completed forms) with five 2-pound or 1-liter analytic samples The (intended to represent the range of expected concentrations of radionuclides) and one large (50 lb) physical sample to establish acceptance parameters for future shipments. The physical sample is used to determine compaction ratios (Standard Proctor Test). The five analytic samples will be analyzed at the RPCDF's on-site laboratory. Ideally, the collection should include two high concentration samples, two low concentration samples, and one intermediate concentration. Analytical results will be compared to the submitted waste profile for consistency.

Subsequently, waste shipments will be sampled upon receipt and fingerprint analyses will be performed to confirm that the received waste is within the range established by the preshipment sampling and analysis. As-received peak radiological test values are permitted to be ten times the bulk average values. If the RPCDF's analytical results for a shipment exceed the pre-shipment tolerance range, the shipment may be returned. Additional characterization may be required before the waste can be accepted. However, acceptance of waste shipments may be delayed if additional samples, analytical results and/or written confirmation are needed to correct discrepancies between the FEMP's Quality Assurance tests and the RPCDF's post-shipment waste acceptance analyses.

About six months are expected to be required to gain initial acceptance for a waste stream, *i.e.*, to perform the analytical tests and to verify consistency with the facility's license conditions.

As the FEMP proceeds through the cleanup process, it is possible that sampling activities will detect material(s) differing from, or exceeding the tolerances of, the pre-shipment samples. If this occurs, it is necessary for the FEMP to contact the RPCDF concerning the need for additional samples of the material (as above-noted) to establish new acceptance parameters. This will help avoid rejected shipments of the new/different material.

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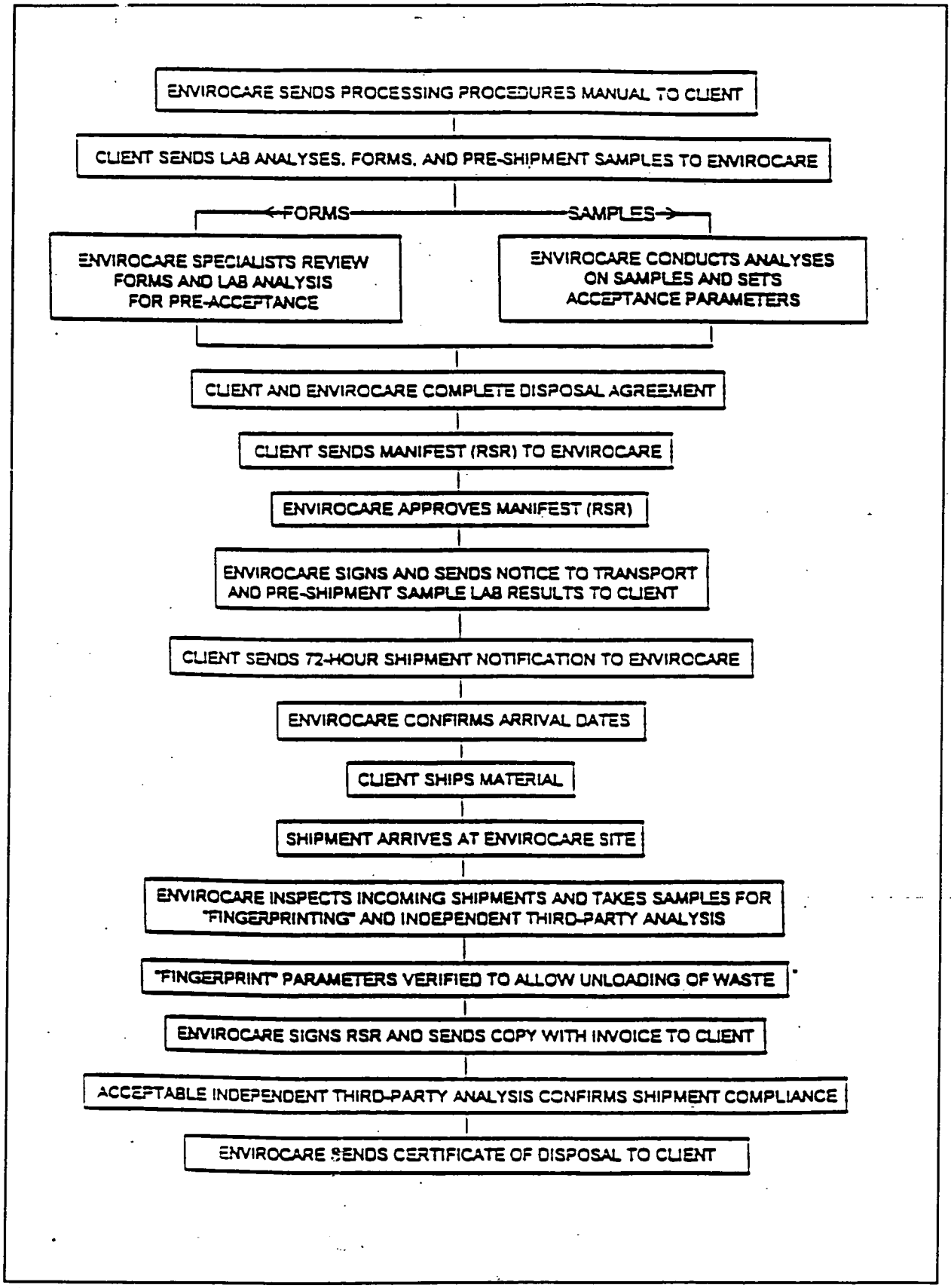

Figure 5-1 - Acceptance and Shipment Process

Table 5-1 - Excerpts from the RPCDF's Radioactive Material License

9. AUTHORIZED USE. . . The licensee shall not accept low-level radioactive waste generated outside the region...unless the provisions of Articles IV and V of the Compact are met. Before receipt of any such shipments, the licensee shall submit to the Utah Division of Radiation Control documentation evidencing compliance . . .

13. The maximum quantity of special nuclear material [enriched or fissile material] which the licensee may possess, undisposed of, at any one time shall not exceed: 350 grams of U-235, 200 grams of U-233, and 200 grams of Pu, or any combination of them . . .

14. License material . . . shall not be placed in a disposal cell unless it has be determined that the concentrations of radionuclides is approximately homogeneous within the physical form of the waste . . .

18. Radioactive waste containing free liquid shall not be accepted for disposal . . .

38. For the purpose of this license, debris is defined as any radioactive waste for disposal other than soils. Compactible debris is defined as: (A) having a gradation that will pass through a four inch (4") grizzly and; (B) as having a density greater (sic) than seventy pounds per cubic foot . . . Contaminated materials, other than soil, not meeting either of these criteria are defined as noncompactible debris.

40. In-place bulk radioactive waste shall be compacted at a moisture content up to three percent (3%) above optimum as determined by the Standard Proctor Method ASTM D-698.

41. The licensee shall compact each lift to not less than ninety percent (90%) of optimum density...

42. All debris shall be less than ten inches (10") in at least one (1) dimension, and no longer than eight feet (8) in any dimension.

43. A lift or any portion of a lift shall be limited to less than ten percent (10%) by volume of debris and the debris shall be uniformly distributed throughout the lift. However, noncompactible debris in the form of concrete, stone or metal may be placed in the lift up to twenty-five percent (25%) by volume, of the total lift, uniformly distributed throughout . . .

52B. Waste containing more than 0.1% chelating agents by weight must be identified . . .

53. The licensee shall not accept radioactive waste for storage and disposal unless the licensee has received a complete "Radioactive Waste Shipment and Disposal Record," (Form #E-100) from the shipper.

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5.1.3 Debris Content and Limitation

The RPCDF's Radioactive Material License with the State of Utah defines the term, "debris" as anything other than soil (see Table 5-1, conditions 38, 42, and 43). In addition, on a case-by-case basis, debris shall not exceed ten percent of the volume of the waste material, and no single piece shall be larger than eight feet by eight feet by ten inches.

In accordance with its license, debris that does not meet the above specification is not acceptable for disposal at the RPCDF. If any such debris is received by the RPCDF, it can either return the debris to the shipper or process the debris to meet its license conditions at an additional cost.

5.1.4 Moisture Content and Limitation

The RPCDF imposes a:

1) Minimum moisture content to minimize dust generation problems at the RPCDF.
2) Upper-bound constraint of no free liquids.

The maximum acceptable moisture content, at the point of landfilling (Table 5-1, condition 40), is three percent above optimum, as determined by the Standard Proctor test.

To reduce the possibility of the WPRAP material becoming frozen in-place in the railcar during the winter, the WPRAP waste treatment unit may need to produce a drier product during in the winter season. This change means a reduced waste processing rate during a time (between December 1 and March 1) when the RPCDF also experiences reduced productivity because of the climate.

5.1.5 Other Limitations

There are no known or anticipated regulatory limitations by the State of Utah that may impact the acceptance of WPRAP material, *i.e.*, there are no volumetric nor physical nor chemical limitations. Radiological analyses performed to date show that homogenized, processed WPRAP material will meet the maximum permitted average concentration for all radionuclides.

The RPCDF also prohibits the disposal of LLRW containing pathogens, infectious wastes, or other etiologic agents. The Feasibility Study (DOE 1994b) regulatory analysis (Appendix J, Table J.6-3) previously determined that this requirement does not apply to WPRAP wastes because the wastes do not contain pathogens or infectious wastes.

Under the RPCDF's mixed waste license, waste regulated as asbestos may not be accepted by the facility. However, this requirement does not prohibit the facility from accepting radioactive waste with some

asbestos contamination. Such waste may be accepted on a case by case basis. The Feasibility Study regulatory analysis (Appendix J, Table J.6-4) previously determined that, "None of the waste in WPRAP is regulated as asbestos waste. Although a small portion of WPRAP waste may contain asbestos, the total is less than 1%, which is the regulatory threshold."

In addition, under the RPCDF's mixed waste license, polychlorinated biphenyl (PCB)-contaminated waste will not be accepted unless the PCB concentrations meet municipal solid waste disposal levels. The Feasibility Study regulatory analysis (Appendix J, Table J.6-4) previously determined that this requirement does "not apply to WPRAP wastes because the RI [Remedial Investigation] has documented that PCBs in the waste pits does not exceed . . . 50 ppm [parts per million] (regulatory threshold)."

5.2 Logistics

The RPCDF has excellent transportation access. The disposal site is located 1-mile south of the main line of the UPRR and is connected by a rail spur. The site is also connected to I-80 by a 2.7-mile four-lane divided highway. This highway facilitates a high volume of truck traffic to the disposal site.

5.2.1 Railroad Traffic

The RPCDF has two 1-mile and one 1.75-mile spurs on its property. Railroad cars are delivered from UPRR's main line, and then "spotted" for staging or unloading by the facility's two locomotives. The facility operator notes that unit trains arrive at the site on a more dependable schedule than blocks of regularly-scheduled freight cars. Representatives of the RPCDF indicate the facility can accommodate the anticipated WPRAP traffic.

The RPCDF has represented that it can easily accommodate the anticipated type of gondola car and traffic thereof. The current three parallel facility spurs limit the number of railcars that can be on site at once to a maximum of 300 cars. The facility's infrastructure has the following capabilities:

1) Handling 120-ton (gross weight) 57-foot gondola cars
2) Turning around a unit train within a four calendar day period under normal weather conditions
3) Providing security for storage of loaded cars in an off-site yard or siding

In current operations, most bulk materials arrive in open top gondola cars, which are pushed, one at a time, through the facility's permitted railcar roll-over device (See Figure 5-2). This unit straddles the spur and effects a controlled "drop" of the waste material into an adjacent concrete pit. The unloading operation can be sprayed with water to reduce the amount of airborne dust. The material is then loaded into dump trucks, transported to the disposal cell, placed in one-foot "lifts" (or levels), compacted, and covered. The empty railcars continue along the spur. When the capacity of the spur behind the roll-over device is reached (about ten cars), the empty cars are removed for decontamination and interim storage.

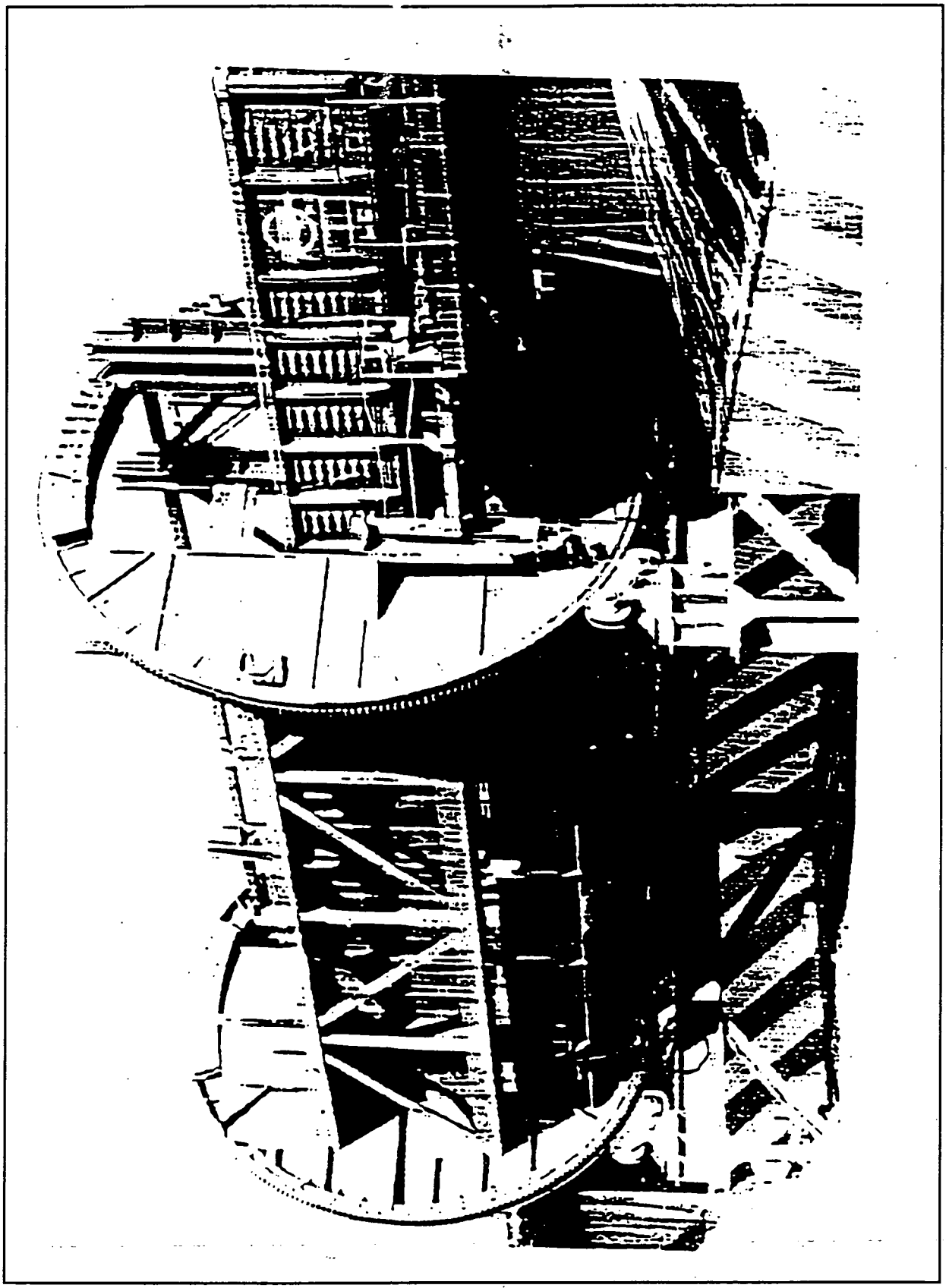

Figure 5-2 - Gondola Car Roll-Over Facility

Daily railroad car unloading capacity of the facility's roll-over device varies from 10 in winter, when frozen loads in railcars have to be hydraulically "jackhammered" to facilitate unloading, to 150 in a 24-hour period campaign during favorable weather. The RPCDF adds a ten percent surcharge for deliveries between December 1 and March 1. The FEMP is considering measures that would avoid the need to "jackhammer" the railcar to unload it (*e.g.*, drier waste material).

During times of inclement weather, such as precipitation or high winds, disposal operations are not performed.

The facility operator recommends bulk transport in membrane-lined gondola cars with hard covers. However, the operator has reported experiencing operational difficulties in handling certain types of liners and metal covers. Thus, during the selection process for the liner and hard cover for the gondola cars, operational experience of the RPCDF operator will be considered. A fiberglass cover manufactured and maintained by EcoFab is recommended by the RPCDF operator.

5.2.2 Container Traffic

The RPCDF is capable of receiving waste *via* intermodal containers on flatbed railcars. About one percent of the facility's waste is currently received in intermodal containers. If intermodal containers were the selected mode of transport (see Section 2.4.3) for WPRAP material, a new handling facility could be readily constructed to handle high-volume WPRAP waste shipments. The container handling activities at the RPCDF could follow either of the following two scenarios.

Scenario 1 - Containers Moved Directly to Disposal Cell

An unloading/loading pad would be constructed next to the existing rail spur to permit a "piggypacker" (large container forklift) to access two flatcars at a time. The pad would serve as an interim container storage/sampling location, if necessary. The containers would be successively placed directly onto trucks which would proceed to the disposal cell and unloaded using the containers' end gates. After decontamination, the closed containers will be returned to the unloading pad, removed from the trucks and placed back on the flatbed railcars.

Scenario 2 - Containers Staged Before Disposal

Using the above-noted pad, a less schedule-intensive method of handling containers would be for the piggypacker to unload full containers and immediately replace them with empty containers. Although this "decouples" waste disposal and train loading/unloading activities, an extra set of containers is required.

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5.2.3 Decontamination

The exterior of all gondola cars is currently decontaminated with high pressure brackish water spray hoses by facility personnel. This method is effective in their current operations.

Federal regulations (49 CFR 174.715(b)) specify that the interior of a gondola car need not be decontaminated after each use as long as the car is used exclusively for radioactive materials and is kept closed at all times (except for loading and unloading) and if a survey shows that the radiation dose does not exceed 10 millirem per hour at the interior surface or 2 millirem per hour at 3 feet from any interior surface. If internal contamination exceeds these levels, then the interior of the car must be decontaminated to be considered an empty unplacarded railcar.

5.2.4 Radiological Monitoring Requirements and Quality Assurance

Radiological monitoring and quality assurance verification are performed to ensure that the exterior of each railcar and/or container used for transporting radioactive waste is not externally contaminated prior to its release from the RPCDF. The facility's License Condition #28 mandates that each transport vehicle be radiological surveyed prior to leaving the facility and that appropriate records of this survey be kept. The license specifies the limits for average and maximum radiation levels to be 0.2 and 1.0 millirad/hour, respectively. Further, the maximum allowable removable surface contamination may not exceed the limits set in Table 10 of 49 CFR 173.443(a). If any of these limits are exceeded, the vehicle must be decontaminated until it passes these release limits for external contamination.

5.3 Noncomplying Waste

The FEMP will make every effort to ensure that all waste material shipped to the RPCDF meets its WAC. The FEMP will perform confirmatory analysis prior to its shipment to the RPCDF (see Sampling and Analysis Plan). In the unlikely event that any waste arriving at the RPCDF does not conform to the accepted waste profile based on the facility's sampling of the waste shipment, then the waste material will not be unloaded. The FEMP is notified, and the following Contingency Plan for Non-Conforming Results is implemented.

The RPCDF is able to process some Non-Conforming waste, such as waste with free liquids, into an acceptable form, and then accept the waste for disposal. However, if the waste exceeds the chemical/radiological acceptance criteria, the waste may be treated by the RPCDF or returned to the FEMP. Returned material will be removed in the loading building. If the FEMP's evaluation confirms that the rejected material after re-processing could not be accepted by the RPCDF, then the waste would be re-packaged for transportation and disposal at the NTS, if within the limits of its WAC.

Normal procedure at the RPCDF is to wait for the confirmatory analysis before disposal. However, if after the waste is disposed and the results from a state-approved laboratory or from the deferred chemical screening parameters analysis show that the waste is beyond the limits of the license, the facility operator must follow the procedure below:

1) Within 24 hours of discovering that non-conforming material had been disposed, the RPCDF must notify the Utah Division of Radiation Control of the situation. Non-conforming waste is material that:
   (1) The waste exceeds the limits of the radioactive material disposal license.
   (2) The waste exhibits hazardous waste characteristics that exceed land disposal restrictions and has not been granted a case-by-case variance from the Utah Division of Water Quality.

2) Within seven calendar days of the notice, the RPCDF must provide the Utah Division of Radiation Control with a written description of the situation. The following information must be included in the written description:
   (1) Name of Generator
   (2) Name of Non-Conforming Waste Stream
   (3) Amount of Non-Conforming Disposed Waste
   (4) Location of Non-Conforming Waste in the Disposal Cell
   (5) Date Non-Conforming Waste was Accepted
   (6) Date Non-Conforming Waste was Placed in Disposal Cell
   (7) Description of Waste Placed on and Around Non-Conforming Waste
   (8) Plan of Action for Resolving Non-Conformance
   (9) Compliance Schedule

The finding of noncomplying waste by the RPCDF resulting from a radiological analysis has a number of possible causes: (a) waste shipment as a whole was complying, but the random sample taken by the RPCDF was not representative (*e.g.*, statistical "hot spot" due to waste not being sufficiently homogenized/processed by the FEMP), (b) waste shipment was complying, but the RPCDF analysis was faulty (*i.e.*, not the FEMP's fault), and (c) waste shipment was noncomplying, but passed through FEMP screening and sampling program (*i.e.*, inadequate waste: homogenization [a statistical "cold spot" was sampled], screening and analysis at the FEMP).

To avoid the shipment of non-acceptable waste material, the FEMP will address this problem in the sampling program and in the waste treatment process. First, the FEMP has made it a high priority to develop and institute a systematic and representative statistical sampling and screening program for the processed waste material (see *Sampling and Analysis Plan*). Second, to assure that the analytical results at FEMP and the disposal site are reasonably representative and consistent, the waste material will be blended. The WPRAP waste treatment system is being design with this key objective in mind. A

number of quality control features will be incorporated into the design to assure the production of a reasonably homogeneous product. (See *Plant Facilities Engineering*.)

Before any off-site waste shipment, the waste material will have been screened, sampled and analyzed, and compared to the submitted waste profile. If the analytical results are not consistent with the submitted waste profile, the waste profile may be revised by notifying the disposal site, as long as the revised profile does not exceed the license conditions or WAC. The contract with the RPCDF will include:

1) A dispute resolution procedure to resolve analytical discrepancies.
2) Charges and procedures for handling non-complying wastes, ranging from treatment options to the return of loaded cars.

Waste exceeding the RPCDF's WAC will be either recycled for further processing or sent directly to the NTS, depending on the extent and nature of the deviation. At this time, it is expected that the RPCDF and the Nevada Test Site can accept waste generated by WPRAP's waste pit remedial action project.

SECTION 6

TRANSPORT AND DISPOSAL AT THE NEVADA TEST SITE

6.1 Facility Overview

The NTS is located in Nye County, Nevada, about 65 miles northwest of Las Vegas. The NTS encompasses about 1350 square miles and is surrounded on three sides by public access exclusion areas. NTS has been the primary location for testing the nation's nuclear weapons since January 1951. Since 1978, NTS has also served as a major LLRW disposal facility for several DOE sites. Off-site waste from other DOE sites must be packaged to meet NTS criteria (DOE *et al.* 1992).

6.2 NTS Waste Acceptance Criteria

Material that cannot be treated to meet the RPCDF's WAC will be disposed of at the NTS. Before any waste material leaves the FEMP, the waste will be analyzed to ensure compliance with the NTS WAC (NVO-325)(DOE *et al.* 1992). A partial list of NTS WAC is presented in Table 6-1. (Note: The criteria presented in Table 6-1 are not all inclusive. Refer to NVO-325 for the complete list of criteria.) Prior to shipment of WPRAP material to the NTS, the FEMP will submit the appropriate application for DOE approval.

The NTS process for application approval, waste characterization, waste certification, exemption requests, and waste transfer, is thoroughly explained in its document, NTS Defense Waste Acceptance Criteria, Certification and Transfer, NVO-325 (Rev. 1). This document states that bulk waste containers must be approved by the Department of Energy-Nevada (DOE-NV). Further, bulk waste containers being returned to the shipper must be decontaminated sufficiently to meet NTS' off-site release limits.

To comply with the Off-site Rule for CERCLA waste (40 CFR 300.440), the DOE will conduct an audit of the disposal facility prior to shipping waste to confirm the facility's status and compliance history. The review will be conducted annually throughout the term of the remediation project. In the event the compliance status of the disposal facility changes, the DOE will suspend waste shipments until the actions/requirements for regaining acceptability status under the policy are implemented and the facility is designated as acceptable.

6.3 Truck Transport

Current FEMP procedures for shipment of LLRW to the NTS specify the use of disposable metal containers transported by truck. For disposal of small limited quantities of material, use of disposable

Table 6-1 - Excerpts for NTS Waste Acceptance Criteria

Packaging for radioactive waste must meet DOT (49 CFR 173) and NRC (10 CFR 71) requirements for LSA, Type A, and Type B packages.

Only low activity LLRW will be accepted in bulk. Bulk waste will be contained such that personnel can unload waste without contaminating personnel and equipment. Bulk waste must meet the requirements of 49 CFR 173.425. Bulk waste containers may be returned to the waste generator.

The quantity of radioactive material in a package shall be limited to the extent that the effects of nuclear decay heat will not adversely affect the physical integrity of a package or (its contents) . . . (49 CFR 173.442)

The package closure shall not be breached under normal handling conditions and shall not be the weakest structural element in the package.

Packages shall be capable of supporting a uniform distributed load of 4,000 psf on any of the surfaces. (Sea/land containers, steel drums and bulk waste are exempt.)

All waste packages shall be provided with permanently attached . . . auxiliary lifting devices to allow handling by means of forklifts, cranes, or similar equipment. . . . lifting devices on the package must not inhibit stacking of the packages. Lifting devices must have a 5:1 safety factor . . .

DOE-NV recommends that 4 ft by 4 ft by 7 ft or 4 ft by 2 ft 7 ft (width, height, length) boxes or 55-gallon steel drums be used. Other size containers are acceptable with approval of DOE-NV.

NTS imposes limits of 9,000 lbs. per box and 1,200 lbs. per drum. Packages exceeding these limits . . . (need approval) and must be shipped in . . .(certain types of) trailers.

Waste packages shall utilize package volume in such a fashion . . . (to maximize packing) efficiency.

Use of Type A packaging not evaluated under the DOE Type A Package Certification Program will not be permitted.

Radioactive gases shall be . . . so that pressure does not exceed 1.5 atmosphere at 20 degrees C. Compressed gases (49 CFR 173.300) will not be accepted.

The external radiation levels for packages shall not exceed 200 mrem/hour on contact (49 CFR 173.441). DOT regulatory exceptions will be acceptable on a case by case basis. Type B containers that require remote handling will be addressed on a case by case basis.

All packages shall be marked with a unique package identifier. Bar coding denoting shipment, package, and waste stream identification is required. Bulk waste shipments must be accompanied by appropriate waste identification documentation.

Fine particulate waste shall be immobilized so that the package contains no more than 1 per cent (by weight) of less than 10-micron diameter particles or 15 percent (by weight) of less than 200-micron diameter particles. When immobilization is impractical, the package shall include a sealed liner and be over-packed.

Table 6-1 - Excerpts for NTS Waste Acceptance Criteria (Continued)

Radioactive-contaminated asbestos capable of giving off friable asbestos dust must be wetted with water and surfactant and stored in double plastic bags having a combined wall thickness of at least 6 mil . . . must be overpacked in leak-resistant metal or wood containers. Sea/land containers containing radioactive asbestos will be considered on a case by case basis. Any regulated asbestos waste must be segregated into a separate stream.

Each waste package shall be prepared for shipment so as to minimize damage during transit. Preshipment storage shall be controlled to avoid adverse effects of weather . . . The accumulation of moisture on or in the packages . . . shall be avoided. Each waste container shall be provided with tamper indication devices once all certification actions have been taken.

Minor liquid residue . . . (is) acceptable. In no case shall free liquid content exceed 0.5 percent (by volume). May use Method 9095 (Paint Filter Test) to demonstrate compliance.

LLRW containing pathogens, infectious wastes, or other etiologic agents (49 CFR 173.386) will not be accepted.

LLRW containing chelating or complexing agents at concentrations greater than 1 percent (by weight) will not be accepted.

containers is practical. However, for bulk quantities of material, the metal containers would be emptied at the disposal cell and returned for repeated use. Transport to the NTS is by truck, along existing routes, in accordance with existing procedures. The maximum net cargo weight for truck load is about 20 tons. Therefore, for terms of economy, large 20-ton containers are assumed.

Currently, NTS does not accept bulk waste from off-site generators. However, NTS does dispose of bulk waste generated internally. In recent discussions, NTS has indicated a willingness to accept bulk waste from the FEMP for disposal at NTS Area 3 following approval of an application from the shipper. Before selection of the specific bulk container, NTS personnel will be consulted regarding their logistical requirements and handling capabilities.

The logistics of loading large bulk containers at the FEMP are under development. It is assumed no road upgrades are necessary along the FEMP access roads to support a single loaded truck. However, if there is a substantial amount of truck traffic, road upgrades would be necessary. At this time, no road improvements are considered necessary to support the anticipated level of truck traffic, an occasional truck.

The FEMP process for shipments to the NTS is well-established and documented in the FEMP procedures. The FEMP has been shipping LLRW to the NTS since 1986. The FEMP's long and excellent record of full compliance with NTS shipping procedures has been cited by the NTS as a model for others to follow. Truck routes are planned in accordance with normal FEMP procedures.

An intermodal option is being evaluated. This would involve originating rail shipments of containers on flat cars at the FEMP, and transhipping the containers to trucks at an intermodal facility to be located.

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Table 6-1 - Excerpts from the NTS Waste Acceptance Criteria

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The package closure shall not be breached under normal handling conditions and shall not be the weakest structural element in the package.

Packages shall be capable of supporting a uniform distributed load of 4,000 psf on any of the surfaces. (Sea/land containers, steel drums and bulk waste are exempt.)

All waste packages shall be provided with permanently attached . . . . auxiliary lifting devices to allow handling by means of forklifts, cranes, or similar equipment. . . . lifting devices on the package must not inhibit stacking of the packages. Lifting devices must have a 5:1 safety factor . . .

DOE-NV recommends that 4 ft by 4 ft by 7 ft or 4 ft by 2 ft 7 ft (width, height, length) boxes or 55-gallon steel drums be used. Other size containers are acceptable with approval of DOE-NV.

NTS imposes limits of 9,000 lbs. per box and 1,200 lbs. per drum. Packages exceeding these limits . . . (need approval) and must be shipped in . . .(certain types of) trailers.

Waste packages shall utilize package volume in such a fashion . . . (to maximize packing) efficiency.

Use of Type A packaging not evaluated under the DOE Type A Package Certification Program will not be permitted.

Radioactive gases shall be . . . so that pressure does not exceed 1.5 atmosphere at 20 degrees C. Compressed gases (49 CFR 173.300) will not be accepted.

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All packages shall be marked with a unique package identifier. Bar coding denoting shipment, package, and waste stream identification is required. Bulk waste shipments must be accompanied by appropriate waste identification documentation.

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Table 6-1 - Excerpts from the NTS Waste Acceptance Criteria (Continued)

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Minor liquid residue . . . (is) acceptable. In no case shall free liquid content exceed 0.5 percent (by volume). May use Method 9095 (Paint Filter Test) to demonstrate compliance.

LLRW containing pathogens, infectious wastes, or other etiologic agents (49 CFR 173.386) will not be accepted.

LLRW containing chelating or complexing agents at concentrations greater than 1 percent (by weight) will not be accepted.

SECTION 7

EMERGENCY RESPONSE PLANNING AND TRAINING

This section describes the existing emergency response infrastructure to provide assistance to any rail transportation incident, except for the FEMP plans, which are under development.

7.1 Process For Plan Development

Federal regulations and DOE orders require the FEMP (as shipper), the DOE, and the carriers to have emergency plans and procedures in place to respond to transportation accidents. Existing emergency plans and procedures must be reviewed and revised, as necessary, or new plans and procedures must be created to provide a quick response to any emergency or non-routine condition that could arise from these rail shipments. Abnormal rail incidents, that could occur either on-site or off-site, could include the following:

1) Removal of a single railcar for unplanned maintenance to correct a safety or mechanical problem from the unit train
2) Derailment of one or more intact and upright railcars
3) Finding external contamination on a railcar while on a siding
4) One or more overturned cars, with a partial or complete loss of contents on land
5) Release of material into a public water supply

Currently, the FEMP has a *Transportation Emergency Plan* (FERMCO 1995a) and associated emergency preparedness procedures that cover only truck transport incidents. Before initiation of WPRAP shipments, the existing plan and procedures will be revised to include rail transport accidents. In addition, the DOE will offer emergency training to first responders in the nearby communities and will participate, as requested, in periodic training programs sponsored by the railroad and other organizations responsible for emergency planning (DOE 1995a). As part of emergency response preparations, the DOE is committed to contact and work with representatives from Ohio, Utah, and transited states prior to the first waste shipment to brief them on shipment plans.

7.2 Overview Of Involved Organizations

In the event of an emergency, there are at least six different generic organizations involved in responding, as shown on Figure 7-1. All the organizations are prepared and trained to provide support and assistance to the On-Scene Commander, as requested. Briefly, the functions of the six organizations are identified below and are further elaborated upon in the following sections:

1) Train crews are trained to make an initial notification and assessment of the emergency.

2) Railroad companies have contingency plans, technical and communications personnel, and remediation contractors in place to respond to transportation incidents. The carriers will develop and maintain a radiation protection program as prescribed in 49 CFR 172, Subpart I, and 174.705.

3) Local authorities at the scene of the accident serve as the on-scene incident commander. All other parties support the on-scene commander.

4) States have emergency response organizations and personnel for monitoring and administrative functions. These may include state police and national guard, state departments of transportation, health (State Radiation Control Programs), and environmental protection.

5) The DOE has a network of regional Radiological Assistance Teams that can respond to support local response agencies.

6) The FEMP's existing emergency response program will be revised to support the management of off-site rail emergencies, and to support the railroad and on-scene commander with both technical and communication personnel.

Depending on the actual location of the radiological accident, specific organizations will respond. The responsibility matrix presented on Figure 7-2, illustrates the various organizations that will respond as a function of the location of the emergency, depending on the particular state and the railroad involved. Additionally, two other resources, independent of location of the emergency, are available: the FEMP and the DOE-Headquarters (DOE-HQ).

7.3 Train Crew

DOT regulations (49 CFR 172) require classroom training for transportation personnel, who are subsequently tested on their knowledge of regulations and emergency procedures. Thus, considerable operational training is imparted to train crews, which typically consist of an engineer, who operates the

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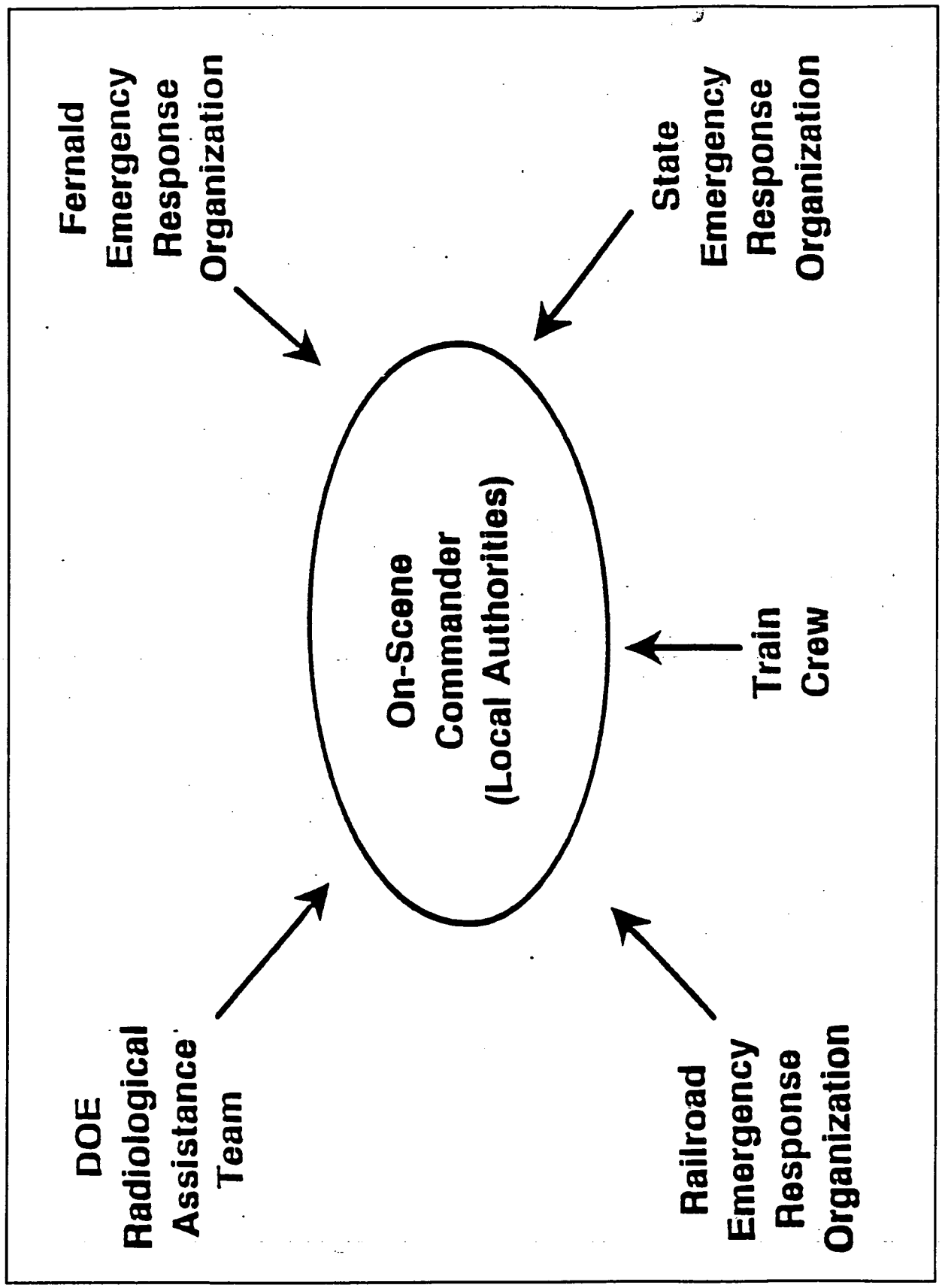

Figure 7-1 - Organizations Responding to a Transportation Incident

RAIL TRANSPORTATION INCIDENT RESPONSIBILITY MATRIX/COVERAGE

FERNALD TO ENVIROCARE

STATE:	OHIO	INDIANA	ILLINOIS	MISSOURI	KANSAS	NEBRESKA	WYOMING	UTAH
State Agencies:	Emergency Management Agency Department of Health	Emergency Management Agency Board of Health	Emergency Management Agency Department of Nuclear Safety	Emergency Management Agency Bureau of Radiological Health	Emergency Management Agency Department of Health and the Environment	Emergency Management Agency Department of Health	Highway Patrol Office	Public Safety Department
Railroad:	CSX Transportation, Inc. Jacksonville, FL		Union Pacific Railroad Company Omaha, NE					
Railroad Regional Emergency Response Offices:	Cincinnati		St. Louis		Kansas City, MO	North Platte	Cheyenne	
Possible Railroad Remediation Contractors:	OHM Remedial Services		OHM Remedial Services				Flint Eng'g & Construction	
Fernald	FERMCO & DOE - FN							
DOE Regional Coordinating Head Office:	Chicago			Oak Ridge	Albuquerque	Chicago	Idaho	
DOE Headquarters:	Env. Restoration & Waste Management/Technology Development (Transportation & Emergency Management Programs)							
USEPA Region/Location:	5 (Chicago)			7 (Kansas City)			8 (Denver)	
Possible USEPA Emergency Response Cleanup Contractors:	OHM Remedial Services			REIDEL Environmental Services				

Note: EPA is not the lead federal agency for radioactive materials accidents.

Figure 7-2 - Rail Transportation Incident Responsibility Matrix/Coverage

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train, and a conductor, who is in charge. For each train, the following information is supplied to the conductor:

1) Special Instructions
2) Train Switchlist and Consist
3) Emergency Handling Precautions
4) Notice of Cars Containing Explosives A and/or poison gas (not applicable)
5) Waybills

The Special Instructions printout lists the complete DOT shipping descriptions for each hazardous material (such as radioactive material) on the train, and the relative position of the car from the engine. The Consist identifies each car on the train by position, cargo and provides basic emergency response information. It includes the train schedule and telephone numbers for incident notification. The hard copy is carried on the train and the file is remotely available on the railroads' computer systems.

The train crew is provided with emergency handling precautions for each hazardous material on the train. In addition, the crew has Waybills that include the following information for each car in the train:

1) Car initial and number

2) Shipper's name and address

3) Consignee's name and address

4) Commodity shipping description, which for a hazardous material includes the proper DOT shipping name, hazard class, four-digit UN or NA identification number, placard notation, and the total weight of the commodity

5) Placard endorsement in the upper left hand corner (for most, but not all, hazardous materials)

6) Emergency Response Telephone Number

Furthermore, the railcar's hazardous material contents can be identified by DOT required placards displayed on each side and each end of the railroad cars or containers. Placement of these "RADIOACTIVE" and other placards and labels, as appropriate, on each railcar is the responsibility of the shipper (the FEMP), not the carrier (49 CFR 172.508);(49 CFR 173.415(b) and (c)), although packages of LSA material are exempt from labeling requirements (49 CFR 173.427.

Railroad crews use the DOT *1993 Emergency Response Guidebook* (DOT 1993) for first responders, which details the safe handling of released hazardous materials and the proper response to an incident.

The crews primary responsibility is to notify their railroad of the accident, and to make an initial assessment of the extent of the accident and to report on their findings. It should be noted that the train crews do not require detailed radiological training as they function only as observers and reporters at the initial stage of the incident.

7.4 Railroad Emergency Response Personnel

CSXT and UPRR have an established emergency response infrastructure to respond rapidly to hazardous materials incidents. After receiving an accident notification, the rail carrier will make other required notifications (to the FEMP, the DOE, state agencies) and initiate immediate response. On call around the clock, professional railroad staff members are strategically located throughout the rail system to provide prompt and effective response to incidents involving hazardous materials or environmentally sensitive chemicals. Those on call would have the authority to authorize the mobilization and response of clean-up firms (see Figure 7-3), which are experts in spill response and cleanup. The railroad's HAZMAT personnel would report to the scene of the accident to support cleanup efforts as required. CSXT, for example, has an emergency response person assigned to Cincinnati. After an emergency is considered contained by the on-scene commander in accordance with guidance in the Emergency Response Guidebook, the rail carrier is responsible for subsequent cleanup activities.

The CSXT emergency response hotline is (800) 593-6188.

The UPRR emergency response hotline is (800) 726-1099.

Railroads frequently present hazardous materials training programs to emergency response groups along their rail systems and to state/federal agencies and private industry groups. The railroads' professional staff has training in hazardous materials and draws upon strong backgrounds in chemistry, environmental engineering, biology, geology and industrial hygiene. In the event of a hazardous materials incident (regardless of severity), the hazardous materials group will notify all state and federal agencies as required/planned.

The railroad and its remediation contractors have primary responsibility for cleaning up the accident scene and restoring the rail line to a safe and functioning condition. The accident site would be independently inspected and verified by state officials when remediated.

7.5 Local Authorities

Initially, the local fire or police authority will assume the role of on-scene incident commander. Every state has an organization and procedures in place to respond to transportation emergencies. All other

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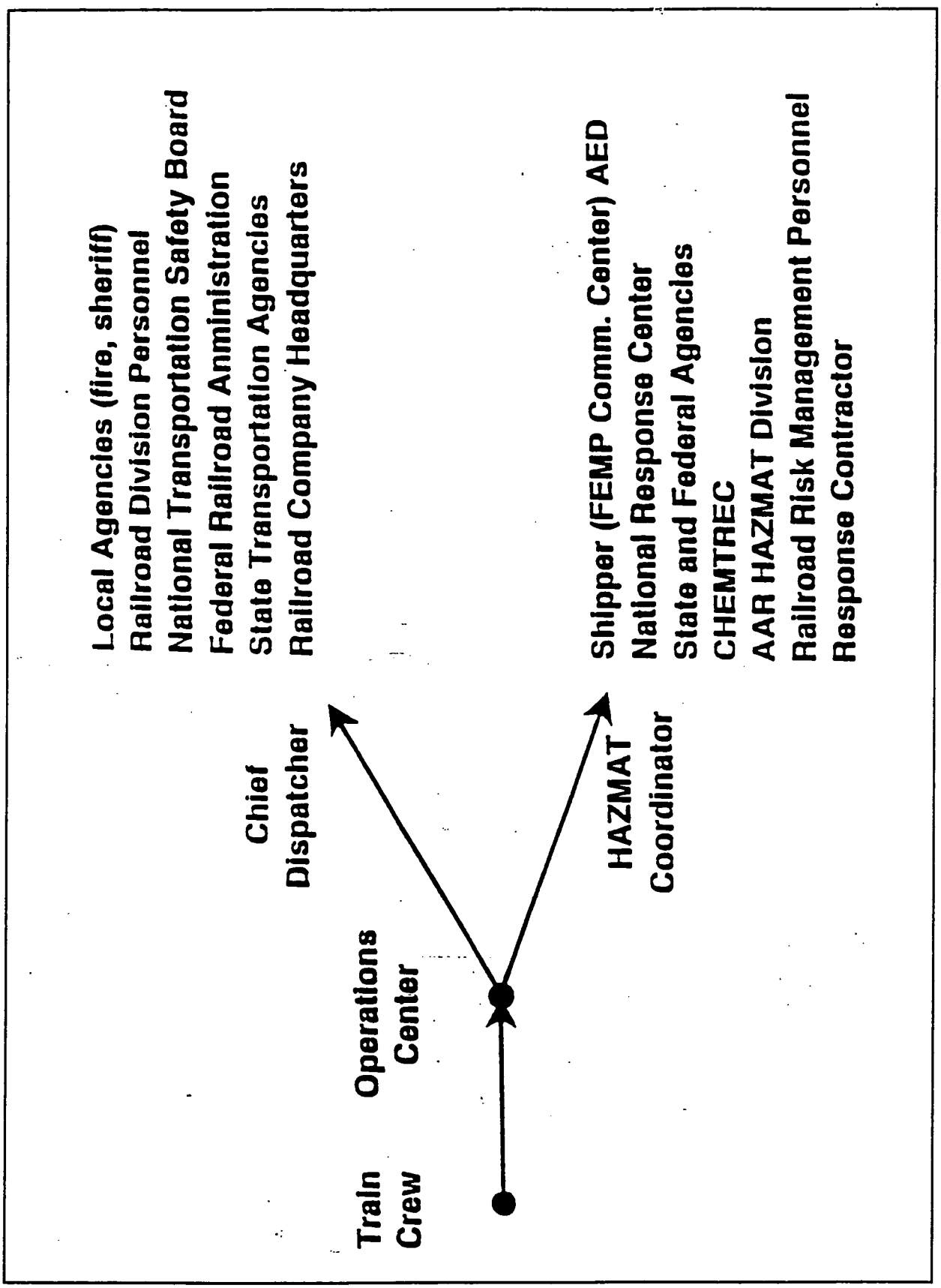


Figure 7-3 - Emergency Notification of FEMP

organizations support the efforts of local emergency officials to mitigate the immediate consequences of an emergency and monitor cleanup efforts conducted by railroad contractors.

The local authorities should coordinate its local emergency plan to be compatible with the states plan. The local emergency plan should specify the respective roles and responsibilities of federal, state, local and private organizations. The local authorities, probably its law enforcement or fire fighting department, will most likely be the first responder. Its primary responsibilities are as follows:

1) Administer emergency measures to save lives and attend to the injured.
2) Determine if radioactive or other hazardous materials are present and obtain information regarding its potential hazards.
3) Notify appropriate authorities to obtain radiological expertise (state, federal, shipper).
4) Determine the action required to prevent further damage to life or property.

(FEMA 1992)

Before initiation of WPRAP rail shipments, the FEMP will offer first responders in nearby communities to opportunity participate in emergency preparedness training, specifically involving the transport of FEMP materials. This topic is discussed further in Section 7.8.

7.6 State Agencies

State or county emergency management agencies and local emergency planning committees have the primary responsibility to protect the public health and welfare in the event of a transportation accident. The state emergency plan should coordinate the activities of all state, county or local agencies for emergency response within each community, assisted by FERMCO, the DOE, or the railroad carrier as necessary. The state has the primary responsibility of protecting its citizens from any unwarranted radiation exposure and thus for managing the containment and control of the potential hazards resulting from an accident. In particular, the state emergency plan should complete the following actions:

1) Take responsibility for developing a radiological response plan, assigning responsibilities to various agencies, and identifying resources
2) Officially designate an emergency radiological response team
3) Coordinate a communications system of federal, state, and local involved agencies
4) Negotiate agreements with contiguous states addressing responses to incidents in close proximity to a common border and a mutual assistance pact
5) Prepare and assist other agencies in the development, distribution and implementation of procedures for the supporting agencies to use to carry out their assigned responsibilities
6) Sponsor periodic drills and exercises to test and "fine-tune" the emergency response system

(FEMA 1992)

Each state has a radiological health agency responsible for the assessment of radiological events within the state and for taking the appropriate actions to protect the public health and safety upon notification of an incident. Appendix C presents a list of State Radiation Control contacts. In most situations, state radiation control programs can provide the most prompt radiological assistance at the scene of an accident, and they are prepared to assess all types of radioactivity. In most states, the radiation control program is responsible for, at a minimum, the initial radiological assessment of transportation accident.

7.7 DOE

The DOE is the lead federal agency for responding to a transportation radiological accident, if it is requested to so by state or local authorities. The DOE's mechanism for providing assistance is through the network of regional radiological assistance teams, which offers technical guidance, communications assistance, and radiological assessment to the on-scene commander.

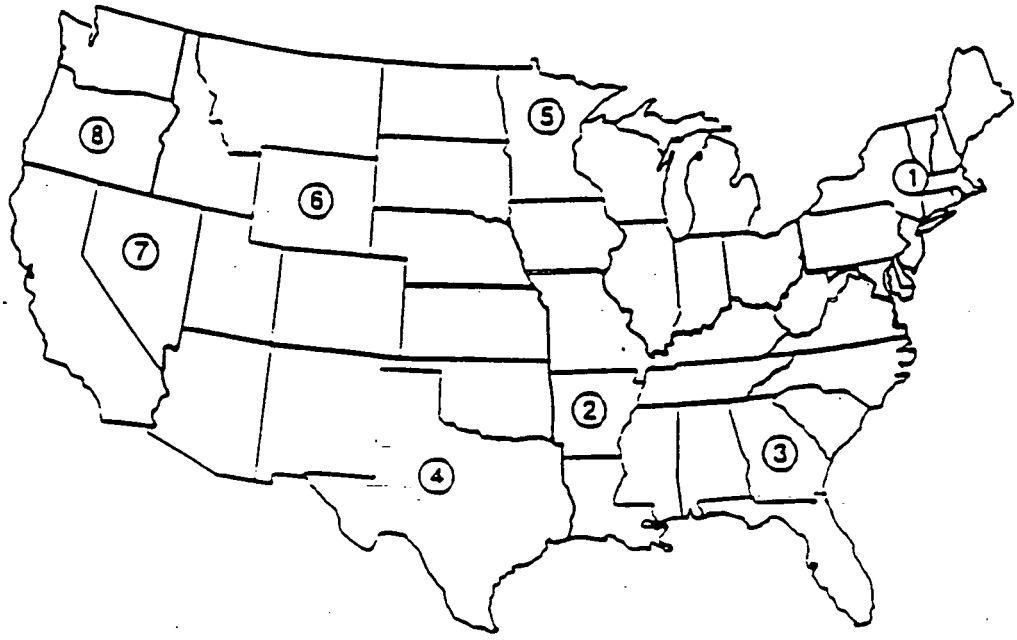
7.7.1 Regional

To assist in mitigating radiological incidents, The DOE provides assistance to state and local agencies through a nationwide network of regional Radiological Assistance Teams, as shown on Figure 7-4 with their telephone numbers. Regional DOE Radiological Assistance Teams provide radiological monitoring, communications, and information coordination during an emergency. An additional mission is to coordinate all efforts for the restoration of public services and expedite recovery following an incident. These teams are made up of DOE and contractor personnel with expertise in health physics, public information and communications. A DOE employee serves as the response coordinator and ensures communications back to the regional office.

When deployed, these teams support field responders and are not intended to direct actions at the incident scene. As with other responders, the DOE response coordinator reports to the local incident commander. (Note: Only in an incident involving a nuclear weapon or Special Nuclear Material does the DOE have authority to take direct command and control.)

7.7.2 DOE Headquarters

At DOE-HQ, the Director of the Office of Environmental Management (EM) is responsible for DOE-HQ emergency response for EM facilities, operations, or activities, including related transportation operations. The Fernald Area Office (FN) reports directly to EM. The DOE-Ohio Field Office receives notification of the event. The DOE-HQ is still the primary contact point for emergency events and still coordinates federal response efforts.



(Region or Regional Coordinating Office)	(1) Brookhaven Area Office	(2) Oak Ridge Field Office	(3) Savannah River Fld. Office	(4) Albuquerque Field Office	(5) Chicago Field Office	(6) Idaho Field Office	(7) San Francisco Field Office	(8) Richland Field Office
Field Office Address	Upton, L.I. New York 11973	P.O. Box 2001 Oak Ridge, TN 37831	P.O. Box A Aiken, S.C. 29808	P.O. Box 5400 Albuquerque NM 87115	9800 S. Cass Ave. Argonne, IL 60439	785 DOE Place Idaho Falls, ID 83402	1333 Broadway Oakland, CA 94612	825 Jadwin Ave. Richland, WA 99352
Telephone for Assistance	(516 282-2369	(615 576-1005	(803 725-3333	(505 845-4857	Duty Hrs: (708) 252-4800 Off Hrs. (708) 252-5721	(208 526-1515	(510 273-4237	(509 373-3600

Figure 7-4 - Regional Coordinating Offices for Radiological Assistance

EM's Operational Emergency Management Teams can be activated to perform the following functions:

1) Monitor and support the FEMP response to an emergency
2) Provide overall management and direction of the DOE emergency response
3) Inform and keep DOE-HQ senior management updated on emergency status
4) Notify and coordinate with other DOE elements and federal agencies
5) Coordinate and authorize deployment of DOE emergency response assets outside the area of responsibility of the FEMP
6) Coordinate response on a federal level

In the event of an accident involving WPRAP material, the DOE will ensure that any material released while in transit from the FEMP to the disposal site is cleaned up to background levels. To ensure achieving such a cleanup standard, the DOE is committed to preparing a contingency plan for additional remedial activities at the accident site. (DOE 1995a) This contingency plan will be developed in accordance with the Remedial Action Work Plan.

In the unlikely event of a major disaster requiring the full resources of the federal government (*i.e.*, exceeding the capability of the DOE Radiological Assistance Teams), the state Radiation Control Program Director has the authority to call the Federal Radiological Monitoring and Assessment Center (FRMAC) for assistance. The FRMAC is a federal interagency group formed specifically to manage and coordinate the vast resources of many federal agencies in case of a major radiological event. (FRMAC was organized as a direct result of the lessons learned from the Three Mile Island experience.)

The U.S. Nuclear Regulatory Commission (NRC) will provide technical advice, assistance with communications, and a radiological assessment team if requested by the principal state or local responder. While, the NRC has the principal federal responsibility for regulating commercial nuclear power and for those radioactive materials licensed by the NRC, the NRC is not a primary responder nor primary resource for radiological assessment of transportation accidents. In case of a major accident where the services of NRC personnel were required, it would be managed and coordinated through the FRMAC.

7.8 FEMP

As shipper of the material leaving the FEMP, FERMCO is required by DOT regulations (49 CFR 172.604) to provide a 24-hour emergency response telephone number on all shipping papers, to have information available regarding the nature of material being transported, and to have back-up personnel available to support the railroad at the accident scene. In addition, DOE Order 5500.3A requires the FEMP to perform, prior to shipment, a hazard assessment analyzing the full spectrum of transportation accident scenarios. The FEMP's emergency plan will be revised to meet these requirements before initiation of rail shipments. Its emergency phone number (513 648-4444) is answered by the Fernald Communications Center, which is staffed 24 hours per day, in the event of a

transportation incident. The FEMP's Emergency Operations Center (EOC) is activated, if determined to be appropriate, to provide information and technical/communications personnel to the scene of the accident as required. The shipment-specific technical information may include source terms, hazard and consequence assessment, health and safety impacts, and recommended protective actions. The FEMP personnel and the DOE would participate in an advisory function in the mitigation of accident conditions and any subsequent cleanup required. The DOE-FN has the authority to activate the DOE regional Radiological Response Team to provide requested assist at the accident scene. The FEMP, as shipper shares responsibility with the railroad for coordinating, arranging, and ensuring cleanup and site restoration of the accident site involving FEMP waste. (FERMCO 1995a) In revising the existing FEMP Transportation Emergency Plan to include rail accidents, the FEMP will coordinate revisions with the railroads.

FEMP emergency preparedness procedures require a transportation hazard assessment before off-site shipments. The assessment will examine various accident scenarios and analyze the resulting potential health impacts to workers and members of the public. A result of the analysis is to recommend measures to mitigate the consequences of the accident and/or reduce the probability of accidents. Another benefit of this hazard assessment is that documentation of the hazards involved is on file and readily available to the FEMP emergency personnel to relay timely and critical information to the accident scene. Hazard assessments, performed in accordance with DOE Orders 5481.1B, 5630.11 and 5500.3A, provide the technical basis for emergency management programs.

The FEMP Transportation Emergency Plan specifies that Butler and Hamilton Counties, the State of Ohio, the DOE-HQ EOC, and the DOE-FN Duty Officer must be notified within 15 minutes of declaring an on-site or near-site emergency. When the EOC is operational, responsibility for assuring proper notifications are made is transferred to the Deputy Emergency Director and the response management group in the EOC. The response management group is lead by the Deputy Emergency Director, who may assign specific notification responsibilities to the members of the support group. Whenever a categorization/classification level is escalated or de-escalated, all parties originally notified must be re-notified. The local communities would mobilize their emergency response personnel based on these notifications. In the event of a distant transportation accident, the primary responsibility of the FEMP is to provide specific technical information regarding the contents of the shipment and the associated worker and public hazards pertaining to its clean-up.

On July 18, 1995, the FEMP took a significant step toward honoring the DOE commitment with respect to emergency planning, training, and assistance the local communities. The FEMP awarded a $1 million contract to the International Association Fire Fighters (IAFF) for its assistance as experts in the field of "Hazardous Material Emergency Response Training." The scope of work entails development of a custom-tailored hazardous material (including radioactive materials) emergency response training program, specifically based on the hazardous materials from the FEMP (including WPRAP waste), Mound, and West Valley. The program is directed toward first responders located near these DOE

facilities and along the transportation routes to be traveled by their waste shipments. This two-year contract involves development of a fully accredited Hazardous Material Emergency Response Training Program, including development of site-specific lesson plans, student work books, reference manuals, audio-visual teaching aids, tests and answer keys. This training program will include consideration of WPRAP's shipping campaign. The IAFF will conduct "Train the Trainer" training sessions, where the trainees learn to become the trainers for future courses. (FERMCO 1995c)

7.9 Incident Scenario

The scenario of how the emergency preparedness organizations would respond to a major transportation incident (*e.g.*, railcar derailment) is outlined below. Note that, due to the nature of WPRAP's waste material (it is neither explosive nor flammable) and the isolation from other hazardous substances afforded by the unit train concept, a railcar derailment (and loss of contents) would not initiate an immediate "acute" threat (*i.e.*, fire or explosion) resulting from the WPRAP material, itself. The WPRAP material is classified as Low Specific Activity material, which is the least hazardous classification for radioactive materials, *i.e.*, a minimal hazard. Thus, containment and cleanup operations could begin immediately as personnel and equipment arrive on the scene.

7.9.1 Evaluation and Notification

The crew's first indication of a major non-collision incident would be activation of the automatic air brakes. The crew's first step is immediate radio notification of the railroad dispatcher, so that oncoming trains are re-routed or stopped. Then, the crew's responsibilities are to walk the length of the train, conduct an inspection (cognizant of their own safety), and notify their dispatcher. This second notification would note what cars are involved using the train Consist. At the end of this process, the railroad's Operations Center and its Hazardous Materials Department will be provided the following information:

1) Exact location of incident

2) Time incident occurred

3) Car numbers and types

4) Commodities involved

5) Status of cars (loaded/empty)

6) Disposition of cars, including damage to car, evidence of leakage (*e.g.*, spill on car or ground), location of leakage (*e.g.*, bottom, dome), and estimate rate of leakage (*e.g.* one pound per minute, car only leaks when moved, *etc.*)

7) Environmental concerns, such as threatened waterways, culverts, drainage ditches

8) Prevailing weather conditions (rain, hail, wind direct or speed, etc.)

9) Public exposure potential (nearest habitation)

10) Nature and extent of any injuries

11) Action taken (leaking car isolated, *etc.*)

12) Name, title, and call back number of the person making the report

When the first response personnel arrive at the scene, the train crew provides the first responders the Consist and shipping papers that identify suggested responses and precautions for the surrounding community. In addition, the responders will be in contact with the railroads' headquarters emergency response personnel and the shipper (FEMP).

The emergency notification sequence from the train crew to the FEMP is illustrated on Figure 7-3. The current emergency notification sequence through the FEMP emergency preparedness organization to the local stakeholders and public is shown on Figure 7-5. The typical sequence of notification within the railroad is: Dispatcher, Division Chief Dispatcher, railroad Operations Center, local railroad office (trainmaster and roadmaster), railroad emergency response, local and county, and state officials and other federal emergency organizations such as the National Response Center, the National Transportation Safety Board and the Federal Railroad Administration. The determination of the appropriate local/county authority to notify would be based on the location of the nearest track milepost to the accident scene. The Division Chief Dispatcher's Office maintains a comprehensive list of agencies and 24-hour telephone numbers for each community within the Division's geographical area of responsibility. A parallel notification would be provided to the Fernald Communications Center, which, in turn, would notify designated DOE-FN, DOE-HQ, and FEMP personnel.

The railroads would expect the availability of a representative of FEMP management (FERMCO and/or the DOE) and a FEMP emergency response professional as on-scene advisor to the railroads' cleanup contractor(s) in performing the remediation. The FEMP is preparing plans to provide FERMCO and DOE representatives at off-site incidents.

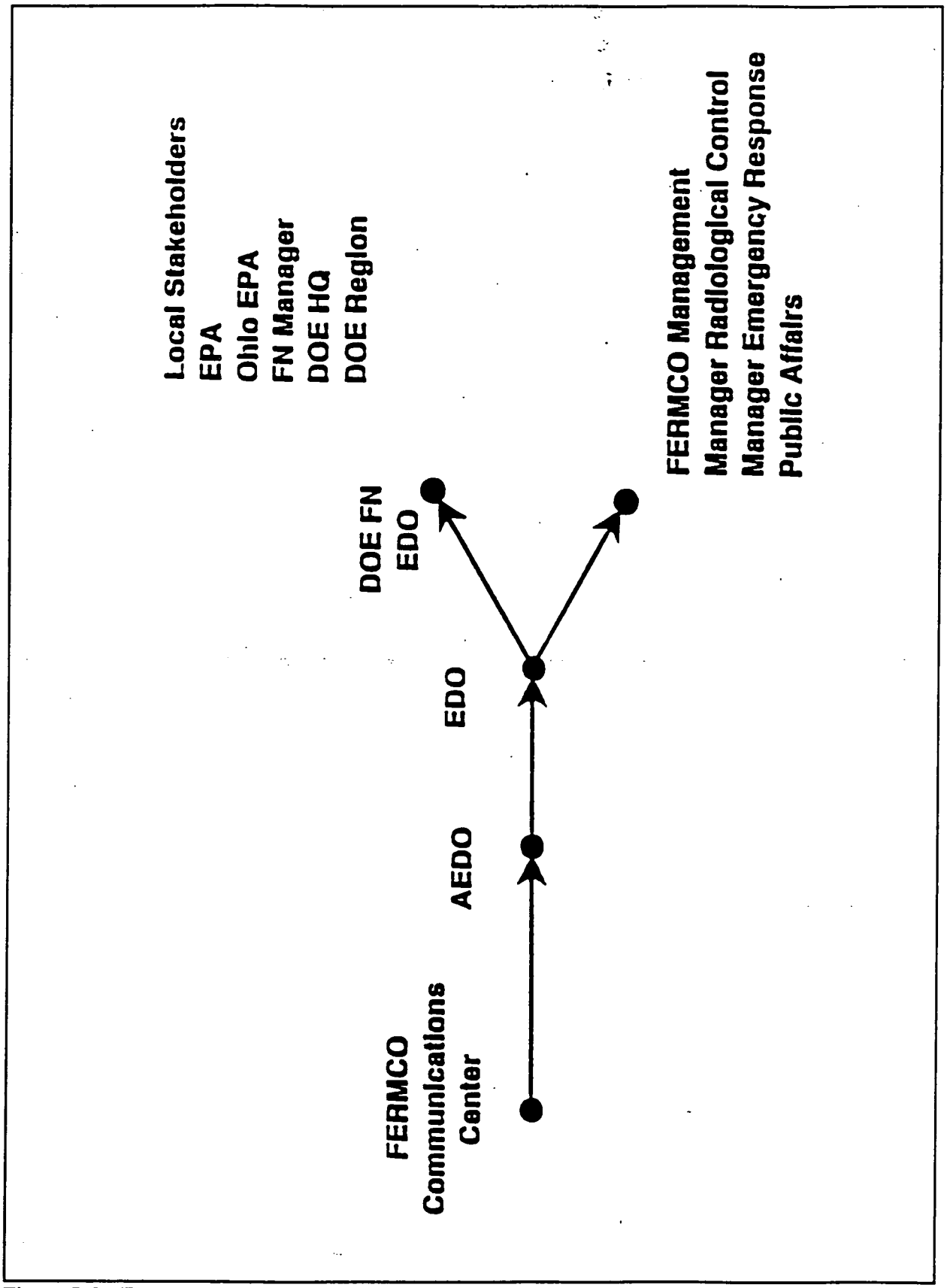


Figure 7-5 - Emergency Notification (Pathway Within the FEMP)

7.9.2 Overview

The DOT *1993 Emergency Response Guidebook*, Guide 62, provides the appropriate actions by firefighters, police, and other emergency services personnel who may be the first responders to a transportation accident involving LSA material (See Figure 7-6). The primary concern of the first responder arriving at the site of a railroad accident is safety of those persons involved. The following immediate actions at an accident would be undertaken if necessary and safe:

1) Rescue the injured
2) Provide initial medical attention
3) Evacuate threatened personnel
4) Secure the perimeter to prevent unauthorized access
5) Set up an incident command post
6) Extinguish fires
7) Take steps to limit the spread of contamination without waiting for a radiological survey
8) Promptly provide additional reports to other agencies involved

The on-scene commander will direct and coordinate the activities of involved local, state and federal agencies to evaluate, monitor, control and administratively stabilize the situation. The radiological assessment group(s) would survey the accident scene and would delineate the extent of the contamination. The On-Scene Commander will determine the need to take protective action by the public, but it is not expected due to the inherently low hazardous nature of the WPRAP material. Then, the railroad's cleanup contractor and railroad emergency response personnel, with advice from the DOE and FEMP personnel, will commence to contain and remove the waste material and complete cleanup of the accident site and the affected environment. The need for subsequent monitoring and remediation will be determined by the appropriate agencies.

000357

GUIDE 62 ERG93

POTENTIAL HAZARDS

HEALTH HAZARDS
Radiation presents minimal risk to lives of persons during transportation accidents.
Low radiation hazard when material is inside container. If material is released from package or bulk container, hazard will vary from little to moderate, depending on the type and amount of radioactivity,the kind of material it is in, and/or the surface it is on.
Full-load shipments and packages often do not have "RADIOACTIVE" labels.
Occasionally, packages may have a "RADIOACTIVE" label and a second hazard label; usually the second hazard is greater than the radiation hazard.
Some radioactive materials cannot be detected by commonly available instruments.
Spilled radioactive materials usually will be visible if packaging fails.
Runoff from control of cargo fire may cause low-level pollution.
FIRE OR EXPLOSION
Some of these materials may burn, but most do not ignite readily.
Radioactivity does not change flammability or other properties of the materials.

EMERGENCY ACTION

Priority response actions may be performed before taking radiation measurements.
Priorities are life saving, control of fire and other hazards, and first aid.
Isolate hazard area and deny entry. Notify Radiation Authority of accident conditions.
Keep unnecessary people at least 150 feet upwind of spill; greater distances may be necessary for people downwind, or if advised by Radiation Authority.
Uninjured persons or equipment with suspected contamination should be detained or isolated; delay cleanup until instructions are received from Radiation Authority.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection.
CALL EMERGENCY Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300.
If water pollution occurs, notify the appropriate authorities.
FIRE
Do not move damaged packages; move undamaged packages out of fire zone.
Small Fires: Dry chemical, CO_2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
SPILL OR LEAK
Do not touch damaged containers or spilled material.
Small Liquid Spills: Cover with sand, earth or other noncombustible absorbent material.
Dike to collect large liquid spills or cargo fire control water.
Cover powder spill with plastic sheet or tarp to minimize spreading.
FIRST AID
Use first aid treatment according to the nature of the injury.
If persons have contacted released material, use standard hazmat procedures for care of contaminated persons, for transport of the injured, and for notifications to authorities.

Figure 7-6 - Initial Emergency Response Actions For LSA Material

SECTION 8

PRE-SHIPMENT NOTIFICATION

This section addresses the federal, FEMP, and state pre-shipment notification requirements.

8.1 Requirements

Under DOT regulations, LLRW, such as the WPRAP remediation wastes, are regulated and shipped as hazardous materials. Packaging and shipment of radioactive wastes is also regulated by the NRC. These federal agencies do not require prior notification of intent to ship LLRW. For shipments to the RPCDF, the states of Ohio, Utah, and transited states do not require prior notification and there are no known corresponding local requirements.

The DOT and the NRC, through their rule making process and related studies, have determined what prenotification (including information, documentation and certification) requirements are necessary for the safe transportation of radioactive materials. These agencies have determined prenotification to affected states is only required for the transport of radioactive materials shipped in highway route controlled quantities, such as spent nuclear fuel and high level radioactive waste (10 CFR 71.97; 49 CFR 173.22). Prior notification is not required for LLRW. State and local provisions requiring prenotification, which are inconsistent with federal regulations, have been determined to be incompatible with the national need for uniform transport regulations; consequently, these state and local regulations are preempted (50 FR 20872; 52 FR 13000; 55 FR 36736).

DOE Order 1540.1A, "Materials Transportation and Traffic Management," requires that a shipment plan be submitted to the DOE-HQ (EM-561) for all shipping campaigns 45 days in advance of such shipment.

8.2 FEMP Initiatives

Currently, the FEMP does not provide advance notification of specific truck shipments to stakeholders. However, reports that address aggregate projected and completed shipments are prepared and distributed to stakeholders. Recognizing the interest of Fernald stakeholders in rail transportation issues, the FEMP will present plans prior to shipment for waste shipment by rail to interested members of the public or interested stakeholders. These plans will include the following information:

1) Time frames over which waste shipment will occur
2) The number of shipments anticipated
3) Quantities and types of waste planned

The FEMP intends to continue to work with interested stakeholders. Public information sessions will be held to address concerns regarding shipment and staging of these wastes prior to transport. Feedback will be incorporated in the development of detailed transportation plans. Any public notification given for rail shipments leaving the FEMP would be coordinated with the rail carrier.

The FEMP will contact representatives from Ohio, Utah, Nevada, and transited states, prior to the first waste shipment, to brief them on overall shipment plans. This information will allow states to prepare, as necessary, for any potential emergency response activities involving FEMP wastes and ensure that potential first responders are aware of the transport of these wastes.

8.3 States

WPRAP wastes, *en route* from Ohio to disposal sites in Nevada or Utah, will transit a number of states that have authority to regulate the following:

1) Certain safety aspects of transportation (*e.g.*, vehicle weight on certain state roadways).

2) Transportation of radioactive materials within their borders as an additional level of regulation without preempting federal regulations or interfere with interstate commerce. Most state requirements apply to truck shipments of high level and route-restricted quantities of radioactive materials. However, certain states address low-level radioactive materials.

The following is the current status of pre-notification requirements for truck and rail shipments.

8.3.1 Colorado

Notification is not required nor requested by Colorado for rail shipment of LLRW. A hazardous materials permit is required for placarded loads transported by truck.

8.3.2 Illinois

Notification is not required nor requested by Illinois.

8.3.3 Indiana

Notification is not required nor requested by Indiana.

8.3.4 Kansas

Notification is not required nor requested by Kansas.

8.3.5 Missouri

Notification is not required nor requested by Missouri.

8.3.6 Nebraska

The state of Nebraska requests a courtesy notification to the Hazardous Materials Coordinator, Nebraska State Patrol, before truck shipments enter the state.

8.3.7 Nevada

Nevada requires a Hazardous Material Permit from the Nevada Highway Patrol for truck shipments. Nevada also requires that vehicles transporting radioactive materials be inspected. A minimum of 4 hours and a maximum of 72 hours advance notification is required before entering the State with radioactive materials. DOE's subcontractor at the NTS must also be notified of incoming shipments prior to arrival.

However, Nevada's rules governing radioactive waste transportation are under revision; this issue must be reviewed before shipment of LLRW to the NTS.

Notification is not required nor requested for shipments of LLRW by rail.

8.3.8 Ohio

The State of Ohio requires highway transporters of radioactive waste to register with the Ohio Public Utilities Commission prior to transport.

8.3.9 Utah

Notification is not required nor requested by Utah.

8.3.10 Wyoming

Wyoming requires a permit to be obtained from the Wyoming Department of Transportation as well as the payment of an emergency response fee for shipment of radioactive materials by truck. There is no equivalent permit for rail.

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APPENDIX A

DOT REQUIREMENTS AND TRANSPORTATION DRIVERS FOR SHIPMENT OF WPRAP WASTE *via* RAIL

ATTACHMENT 1

49 CFR 173.403

Low Specific Activity (LSA) material means Class 7 (radioactive) material with limited specific activity which satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups:

(1) LSA-I.

- (I) Ores containing only naturally occurring radionuclides (e.g., uranium, thorium) and uranium or thorium concentrates of such ores; or
- (ii) Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures; or
- (iii) Class 7 (radioactive) material, other than fissile material, for which the A2 value is unlimited; or
- (iv) Mill tailings, contaminated earth, concrete, rubble, other debris, and activated material in which the Class 7 (radioactive) material is essentially uniformly distributed and the average specific activity does not exceed 10^{-6} A2/g.

(2) LSA-II.

- (I) Water with tritium concentration up to 0.8 TBq/liter (20.0 Ci/liter); or
- (ii) Material in which the Class 7 (radioactive) material is essentially uniformly distributed and the average specific activity does not exceed 10^{-4} A2/g for solids and gases, and 10^{-5} A2/g for liquids.

(3) LSA-III. Solids (e.g., consolidated wastes, activated materials) that meet the requirements of Sec. 173.468 and which:

- (I) The Class 7 (radioactive) material is essentially uniformly distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent (such as concrete, bitumen, ceramic, etc.); and
- (ii) The Class 7 (radioactive) material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that, even under loss of packaging, the loss of Class 7 (radioactive) material per package by leaching when placed in water for seven days would not exceed 0.1 A2; and
- (iii) The average specific activity of the solid does not exceed 2×10^{-3} A2/g.

WASTE PIT 1

LSA-I	1	2	3	4	5	6	7
ISOTOPE	Avg Hit (pCi/g)	Avg Hit (Ci/g)	f(i)	A2 Limit (Ci)	1/ sum (f(i)/A2(i))	A2 x 10-6	Fraction of LSA Limit
Cesium-137	4.300E-01	4.300E-13	4.826E-05	1.350E+01	3.575E-06	1.181E-08	3.641E-05
Neptunium-237	0.000E+00	0.000E+00	0.000E+00	5.410E-03	0.000E+00	1.181E-08	0.000E+00
Plutonium-238	0.000E+00	0.000E+00	0.000E+00	5.410E-03	0.000E+00	1.181E-08	0.000E+00
Plutonium-239/40	0.000E+00	0.000E+00	0.000E+00	5.410E-03	0.000E+00	1.181E-08	0.000E+00
Radium-226	5.100E+01	5.100E-11	5.724E-03	5.410E-01	1.058E-02	1.181E-08	4.318E-03
Radium-228	2.000E+01	2.000E-11	2.245E-03	1.080E+00	2.078E-03	1.181E-08	1.693E-03
Ruthenium-106	0.000E+00	0.000E+00	0.000E+00	5.410E+00	0.000E+00	1.181E-08	0.000E+00
Strontium-90	5.000E-01	5.000E-13	5.611E-05	2.700E+00	2.078E-05	1.181E-08	4.234E-05
Technetium-99	3.600E+00	3.600E-12	4.040E-04	2.430E+01	1.663E-05	1.181E-08	3.048E-04
Thorium-228	3.000E+02	3.000E-10	3.367E-02	1.080E-02	3.117E+00	1.181E-08	2.540E-02
Thorium-230	3.800E+03	3.800E-09	4.265E-01	5.410E-03	7.883E+01	1.181E-08	3.218E-01
Thorium-232	1.800E+02	1.800E-10	2.020E-02	unlimited			
Uranium-234	5.700E+02	5.700E-10	6.397E-02	2.700E-02	2.369E+00	1.181E-08	4.826E-02
Uranium-235	8.500E+01	8.500E-11	9.539E-03	2.700E-02	3.533E-01	1.181E-08	7.197E-03
Uranium-238	3.900E+03	3.900E-09	4.377E-01	unlimited			
		8.911E-09			1.181E-02		4.090E-01

1 Average concentration, OU1 RI Report, Section 4, pp. 4-158 to 4-173
2 Average concentration in Ci/g
3 Fraction of activity from specified nuclide
4 A2 value for specified nuclide
5 Column Total = A2 value for mixture of radionuclides
6 A2 value multiplied by LSA I/II constant
7 Column Total = sum of the fractions

WASTE PIT 2

LSA-I	1	2	3	4	5	6	7
ISOTOPE	Avg Hit (pCi/g)	Avg Hit (Ci/g)	f(i)	A2 Limit (Ci)	1/ sum (f(i)/A2(i))	A2 x 10-6	Fraction of LSA Limit
Cesium-137	1.150E+00	1.150E-12	4.992E-05	1.350E+01	3.698E-06	9.988E-09	1.151E-04
Neptunium-237	0.000E+00	0.000E+00	0.000E+00	5.410E-03	0.000E+00	9.988E-09	0.000E+00
Plutonium-238	1.000E-01	1.000E-13	4.341E-06	5.410E-03	8.024E-04	9.988E-09	1.001E-05
Plutonium-239/40	1.600E-01	1.600E-13	6.945E-06	5.410E-03	1.284E-03	9.988E-09	1.602E-05
Radium-226	4.400E+02	4.400E-10	1.910E-02	5.410E-01	3.530E-02	9.988E-09	4.405E-02
Radium-228	1.800E+02	1.800E-10	7.813E-03	1.080E+00	7.235E-03	9.988E-09	1.802E-02
Ruthenium-106	3.300E+00	3.300E-12	1.432E-04	5.410E+00	2.648E-05	9.988E-09	3.304E-04
Strontium-90	2.600E+00	2.600E-12	1.129E-04	2.700E+00	4.180E-05	9.988E-09	2.603E-04
Technetium-99	1.300E+02	1.300E-10	5.643E-03	2.430E+01	2.322E-04	9.988E-09	1.302E-02
Thorium-228	6.600E+02	6.600E-10	2.865E-02	1.080E-02	2.653E+00	9.988E-09	6.608E-02
Thorium-230	1.100E+04	1.100E-08	4.775E-01	5.410E-03	8.826E+01	9.988E-09	1.101E+00
Thorium-232	2.200E+02	2.200E-10	9.550E-03	unlimited			
Uranium-234	3.900E+03	3.900E-09	1.693E-01	2.700E-02	6.270E+00	9.988E-09	3.905E-01
Uranium-235	1.800E+03	1.800E-09	7.813E-02	2.700E-02	2.894E+00	9.988E-09	1.802E-01
Uranium-238	4.700E+03	4.700E-09	2.040E-01	unlimited			
		2.304E-08			9.988E-03		1.814E+00

1 Average concentration, OU1 RI Report, Section 4, pp. 4-158 to 4-173
2 Average concentration in Ci/g
3 Fraction of activity from specified nuclide
4 A2 value for specified nuclide
5 Column Total = A2 value for mixture of radionuclides
6 A2 value multiplied by LSA I/II constant
7 Column Total = sum of the fractions

WASTE PIT 3

LSA-I	1	2	3	4	5	6	7
ISOTOPE	Avg Hit (pCi/g)	Avg Hit (Ci/g)	f(i)	A2 Limit (Ci)	1/ sum (f(i)/A2(i))	A2 x 10-6	Fraction of LSA Limit
Cesium-137	0.000E+00	0.000E+00	0.000E+00	1.350E+01	0.000E+00	7.856E-09	0.000E+00
Neptunium-237	5.300E-01	5.300E-13	7.000E-05	5.410E-03	1.294E-02	7.856E-09	6.746E-05
Plutonium-238	4.400E-01	4.400E-13	5.811E-05	5.410E-03	1.074E-02	7.856E-09	5.601E-05
Plutonium-239/40	2.200E+00	2.200E-12	2.906E-04	5.410E-03	5.371E-02	7.856E-09	2.800E-04
Radium-226	1.700E+02	1.700E-10	2.245E-02	5.410E-01	4.150E-02	7.856E-09	2.164E-02
Radium-228	1.200E+02	1.200E-10	1.585E-02	1.080E+00	1.467E-02	7.856E-09	1.527E-02
Ruthenium-106	0.000E+00	0.000E+00	0.000E+00	5.410E+00	0.000E+00	7.856E-09	0.000E+00
Strontium-90	1.320E+00	1.320E-12	1.743E-04	2.700E+00	6.457E-05	7.856E-09	1.680E-04
Technetium-99	2.300E+02	2.300E-10	3.038E-02	2.430E+01	1.250E-03	7.856E-09	2.928E-02
Thorium-228	2.800E+02	2.800E-10	3.698E-02	1.080E-02	3.424E+00	7.856E-09	3.564E-02
Thorium-230	4.930E+03	4.930E-09	6.511E-01	5.410E-03	1.204E+02	7.856E-09	6.275E-01
Thorium-232	1.700E+02	1.700E-10	2.245E-02	unlimited			
Uranium-234	6.400E+02	6.400E-10	8.453E-02	2.700E-02	3.131E+00	7.856E-09	8.147E-02
Uranium-235	4.900E+01	4.900E-11	6.472E-03	2.700E-02	2.397E-01	7.856E-09	6.237E-03
Uranium-238	9.780E+02	9.780E-10	1.292E-01	unlimited			
		7.571E-09			7.856E-03		8.177E-01

1 Average concentration, OU1 RI Report, Section 4, pp. 4-158 to 4-173
2 Average concentration in Ci/g
3 Fraction of activity from specified nuclide
4 A2 value for specified nuclide
5 Column Total = A2 value for mixture of radionuclides
6 A2 value multiplied by LSA I/II constant
7 Column Total = sum of the fractions

WASTE PIT 4

LSA-I	1	2	3	4	5	6	7
ISOTOPE	Avg Hit (pCi/g)	Avg Hit (Ci/g)	f(i)	A2 Limit (Ci)	1/ sum (f(i)/A2(i))	A2 x 10-6	Fraction of LSA Limit
Cesium-137	0.000E+00	0.000E+00	0.000E+00	1.350E+01	0.000E+00	6.320E-08	0.000E+00
Neptunium-237	1.800E-01	1.800E-13	7.357E-06	5.410E-03	1.360E-03	6.320E-08	2.848E-06
Plutonium-238	2.500E-01	2.500E-13	1.022E-05	5.410E-03	1.889E-03	6.320E-08	3.956E-06
Plutonium-239/40	1.500E-01	1.500E-13	6.131E-06	5.410E-03	1.133E-03	6.320E-08	2.373E-06
Radium-226	2.300E+01	2.300E-11	9.401E-04	5.410E-01	1.738E-03	6.320E-08	3.639E-04
Radium-228	5.900E+01	5.900E-11	2.411E-03	1.080E+00	2.233E-03	6.320E-08	9.335E-04
Ruthenium-106	0.000E+00	0.000E+00	0.000E+00	5.410E+00	0.000E+00	6.320E-08	0.000E+00
Strontium-90	4.400E+01	4.400E-11	1.798E-03	2.700E+00	6.661E-04	6.320E-08	6.962E-04
Technetium-99	8.000E+01	8.000E-11	3.270E-03	2.430E+01	1.346E-04	6.320E-08	1.266E-03
Thorium-228	9.500E+02	9.500E-10	3.883E-02	1.080E-02	3.595E+00	6.320E-08	1.503E-02
Thorium-230	1.000E+03	1.000E-09	4.087E-02	5.410E-03	7.555E+00	6.320E-08	1.582E-02
Thorium-232	2.300E+02	2.300E-10	9.401E-03	unlimited			
Uranium-234	2.700E+03	2.700E-09	1.104E-01	2.700E-02	4.087E+00	6.320E-08	4.272E-02
Uranium-235	3.800E+02	3.800E-10	1.553E-02	2.700E-02	5.752E-01	6.320E-08	6.013E-03
Uranium-238	1.900E+04	1.900E-08	7.766E-01	unlimited			
		2.447E-08			6.320E-02		8.286E-02

1 Average concentration, OU1 RI Report, Section 4, pp. 4-158 to 4-173
2 Average concentration in Ci/g
3 Fraction of activity from specified nuclide
4 A2 value for specified nuclide
5 Column Total = A2 value for mixture of radionuclides
6 A2 value multiplied by LSA I/II constant
7 Column Total = sum of the fractions

WASTE PIT 5

LSA-I	1	2	3	4	5	6	7
ISOTOPE	Avg Hit (pCi/g)	Avg Hit (Ci/g)	f(i)	A2 Limit (Ci)	1/ sum (f(i)/A2(i))	A2 x 10-6	Fraction of LSA Limit
Cesium-137	2.400E+01	2.400E-11	3.100E-03	1.350E+01	2.296E-04	8.913E-09	2.693E-03
Neptunium-237	4.000E+01	4.000E-11	5.167E-03	5.410E-03	9.551E-01	8.913E-09	4.488E-03
Plutonium-238	2.000E+00	2.000E-12	2.583E-04	5.410E-03	4.775E-02	8.913E-09	2.244E-04
Plutonium-239/40	5.000E+00	5.000E-12	6.459E-04	5.410E-03	1.194E-01	8.913E-09	5.610E-04
Radium-226	9.300E+01	9.300E-11	1.201E-02	5.410E-01	2.221E-02	8.913E-09	1.043E-02
Radium-228	2.230E+01	2.230E-11	2.881E-03	1.080E+00	2.667E-03	8.913E-09	2.502E-03
Ruthenium-106	1.200E+00	1.200E-12	1.550E-04	5.410E+00	2.865E-05	8.913E-09	1.346E-04
Strontium-90	1.000E+01	1.000E-11	1.292E-03	2.700E+00	4.784E-04	8.913E-09	1.122E-03
Technetium-99	1.500E+03	1.500E-09	1.938E-01	2.430E+01	7.974E-03	8.913E-09	1.683E-01
Thorium-228	3.100E+01	3.100E-11	4.004E-03	1.080E-02	3.708E-01	8.913E-09	3.478E-03
Thorium-230	4.500E+03	4.500E-09	5.813E-01	5.410E-03	1.074E+02	8.913E-09	5.049E-01
Thorium-232	3.000E+01	3.000E-11	3.875E-03	unlimited			
Uranium-234	6.400E+02	6.400E-10	8.267E-02	2.700E-02	3.062E+00	8.913E-09	7.181E-02
Uranium-235	3.400E+01	3.400E-11	4.392E-03	2.700E-02	1.627E-01	8.913E-09	3.815E-03
Uranium-238	8.090E+02	8.090E-10	1.045E-01	unlimited			
		7.742E-09			8.913E-03		7.744E-01

1 Average concentration, OU1 RI Report, Section 4, pp. 4-158 to 4-173
2 Average concentration in Ci/g
3 Fraction of activity from specified nuclide
4 A2 value for specified nuclide
5 Column Total = A2 value for mixture of radionuclides
6 A2 value multiplied by LSA I/II constant
7 Column Total = sum of the fractions

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WASTE PIT 6

LSA-I	1	2	3	4	5	6	7
ISOTOPE	Avg Hit (pCi/g)	Avg Hit (Ci/g)	f(i)	A2 Limit (Ci)	1/ sum (f(i)/A2(i))	A2 x 10-6	Fraction of LSA Limit
Cesium-137	1.700E+01	1.700E-11	7.851E-04	1.350E+01	5.815E-05	1.265E-07	1.344E-04
Neptunium-237	2.000E+00	2.000E-12	9.236E-05	5.410E-03	1.707E-02	1.265E-07	1.581E-05
Plutonium-238	7.800E-01	7.800E-13	3.602E-05	5.410E-03	6.658E-03	1.265E-07	6.166E-06
Plutonium-239/40	8.700E+00	8.700E-12	4.018E-04	5.410E-03	7.426E-02	1.265E-07	6.877E-05
Radium-226	3.900E+00	3.900E-12	1.801E-04	5.410E-01	3.329E-04	1.265E-07	3.083E-05
Radium-228	5.400E+01	5.400E-11	2.494E-03	1.080E+00	2.309E-03	1.265E-07	4.269E-04
Ruthenium-106	0.000E+00	0.000E+00	0.000E+00	5.410E+00	0.000E+00	1.265E-07	0.000E+00
Strontium-90	4.100E+00	4.100E-12	1.893E-04	2.700E+00	7.013E-05	1.265E-07	3.241E-05
Technetium-99	1.300E+02	1.300E-10	6.003E-03	2.430E+01	2.471E-04	1.265E-07	1.028E-03
Thorium-228	1.200E+00	1.200E-12	5.542E-05	1.080E-02	5.131E-03	1.265E-07	9.486E-06
Thorium-230	3.200E+01	3.200E-11	1.478E-03	5.410E-03	2.732E-01	1.265E-07	2.530E-04
Thorium-232	5.300E-01	5.300E-13	2.448E-05	unlimited			
Uranium-234	3.400E+03	3.400E-09	1.570E-01	2.700E-02	5.815E+00	1.265E-07	2.688E-02
Uranium-235	1.000E+03	1.000E-09	4.618E-02	2.700E-02	1.710E+00	1.265E-07	7.905E-03
Uranium-238	1.700E+04	1.700E-08	7.851E-01	unlimited			
		2.165E-08			1.265E-01		3.679E-02

1 Average concentration, OU1 RI Report, Section 4, pp. 4-158 to 4-173
2 Average concentration in Ci/g
3 Fraction of activity from specified nuclide
4 A2 value for specified nuclide
5 Column Total = A2 value for mixture of radionuclides
6 A2 value multiplied by LSA I/II constant
7 Column Total = sum of the fractions

Burn Pit

LSA-I	1	2	3	4	5	6	7
ISOTOPE	Avg Hit (pCi/g)	Avg Hit (Ci/g)	f(i)	A2 Limit (Ci)	1/ sum (f(i)/A2(i))	A2 x 10-6	Fraction of LSA Limit
Cesium-137	0.000E+00	0.000E+00	0.000E+00	1.350E+01	0.000E+00	1.175E-08	0.000E+00
Neptunium-237	2.700E-01	2.700E-13	8.907E-05	5.410E-03	1.646E-02	1.175E-08	2.298E-05
Plutonium-238	1.200E-01	1.200E-13	3.959E-05	5.410E-03	7.317E-03	1.175E-08	1.021E-05
Plutonium-239/40	1.200E-01	1.200E-13	3.959E-05	5.410E-03	7.317E-03	1.175E-08	1.021E-05
Radium-226	1.500E+01	1.500E-11	4.948E-03	5.410E-01	9.146E-03	1.175E-08	1.277E-03
Radium-228	6.600E+00	6.600E-12	2.177E-03	1.080E+00	2.016E-03	1.175E-08	5.617E-04
Ruthenium-106	0.000E+00	0.000E+00	0.000E+00	5.410E+00	0.000E+00	1.175E-08	0.000E+00
Strontium-90	3.100E-01	3.100E-13	1.023E-04	2.700E+00	3.787E-05	1.175E-08	2.638E-05
Technetium-99	2.900E+01	2.900E-11	9.566E-03	2.430E+01	3.937E-04	1.175E-08	2.468E-03
Thorium-228	1.200E+02	1.200E-10	3.959E-02	1.080E-02	3.665E+00	1.175E-08	1.021E-02
Thorium-230	1.180E+03	1.180E-09	3.893E-01	5.410E-03	7.195E+01	1.175E-08	1.004E-01
Thorium-232	5.700E+01	5.700E-11	1.880E-02	unlimited			
Uranium-234	7.200E+02	7.200E-10	2.375E-01	2.700E-02	8.797E+00	1.175E-08	6.128E-02
Uranium-235	5.300E+01	5.300E-11	1.748E-02	2.700E-02	6.475E-01	1.175E-08	4.511E-03
Uranium-238	8.500E+02	8.500E-10	2.804E-01	unlimited			
		3.031E-09			1.175E-02		1.808E-01

1 Average concentration, OU1 RI Report, Section 4, pp. 4-158 to 4-173
2 Average concentration in Ci/g
3 Fraction of activity from specified nuclide
4 A2 value for specified nuclide
5 Column Total = A2 value for mixture of radionuclides
6 A2 value multiplied by LSA I/II constant
7 Column Total = sum of the fractions

Clearwell

LSA-I	1	2	3	4	5	6	7
ISOTOPE	Avg Hit (pCi/g)	Avg Hit (Ci/g)	f(i)	A2 Limit (Ci)	1/ sum (f(i)/A2(i))	A2 x 10-6	Fraction of LSA Limit
Cesium-137	1.900E+02	1.900E-10	4.940E-02	1.350E+01	3.659E-03	1.137E-08	1.671E-02
Neptunium-237	1.000E+00	1.000E-12	2.600E-04	5.410E-03	4.806E-02	1.137E-08	8.795E-05
Plutonium-238	2.500E-01	2.500E-13	6.500E-05	5.410E-03	1.201E-02	1.137E-08	2.199E-05
Plutonium-239/40	2.800E-01	2.800E-13	7.280E-05	5.410E-03	1.346E-02	1.137E-08	2.463E-05
Radium-226	7.400E+01	7.400E-11	1.924E-02	5.410E-01	3.556E-02	1.137E-08	6.508E-03
Radium-228	1.800E+01	1.800E-11	4.680E-03	1.080E+00	4.333E-03	1.137E-08	1.583E-03
Ruthenium-106	1.100E+00	1.100E-12	2.860E-04	5.410E+00	5.287E-05	1.137E-08	9.675E-05
Strontium-90	8.500E+00	8.500E-12	2.210E-03	2.700E+00	8.185E-04	1.137E-08	7.476E-04
Technetium-99	3.600E+02	3.600E-10	9.360E-02	2.430E+01	3.852E-03	1.137E-08	3.166E-02
Thorium-228	3.700E+01	3.700E-11	9.620E-03	1.080E-02	8.907E-01	1.137E-08	3.254E-03
Thorium-230	1.680E+03	1.680E-09	4.368E-01	5.410E-03	8.074E+01	1.137E-08	1.478E-01
Thorium-232	1.900E+01	1.900E-11	4.940E-03	unlimited			
Uranium-234	4.570E+02	4.570E-10	1.188E-01	2.700E-02	4.401E+00	1.137E-08	4.019E-02
Uranium-235	1.900E+02	1.900E-10	4.940E-02	2.700E-02	1.830E+00	1.137E-08	1.671E-02
Uranium-238	8.100E+02	8.100E-10	2.106E-01	unlimited			
		3.846E-09			1.137E-02		2.654E-01

1 Average concentration, OU1 RI Report, Section 4, pp. 4-158 to 4-173
2 Average concentration in Ci/g
3 Fraction of activity from specified nuclide
4 A2 value for specified nuclide
5 Column Total = A2 value for mixture of radionuclides
6 A2 value multiplied by LSA I/II constant
7 Column Total = sum of the fractions

Isotope	Avg - Pit 1 (pCi/g)	Avg - Pit 2 (pCi/g)	Pit 1 Avg * Total Pit Vol (Adjusted)	Pit 2 Avg * Total Pit Vol (Adjusted)	Avg Conc. Pits 1 and 2 (pCi/g)	Avg Hit (Ci/g)	f(i)	A2 Limit (Ci)	1/ sum f(i)/A2	A2 x 10 6	Fraction of LSA Limit
Cesium-137	4 300E-01	1 150E+00	2 869E-01	3 828E-01	6 697E-01	6 697E-13	4 919E-05	1 350E+01	3 644E-06	1 175E-08	5 699E-05
Neptunium-237	0 000E+00	0 000E+00	0 000E+00	0 000E+00	0 000E+00	0 000E+00	0 000E+00	5 410E-03	0 000E+00	1 175E-08	0 000E+00
Plutonium-238	0 000E+00	1.000E-01	0 000E+00	3 329E-02	3 329E-02	3 329E-14	2 445E-06	5 410E-03	4 520E-04	1 175E-08	2 833E-06
Plutonium-239/240	0 000E+00	1 600E-01	0 000E+00	5 326E-02	5 326E-02	5 326E-14	3 912E-06	5 410E-03	7 232E-04	1 175E-08	4 533E-06
Radium-226	5 100E+01	4 400E+02	3 402E+01	1 465E+02	1 805E+02	1 805E-10	1 326E-02	5 410E-01	2 451E-02	1 175E-08	1 538E-02
Radium-228	2 000E+01	1 800E+02	1 334E+01	5 992E+01	7 326E+01	7 326E-11	5 382E-03	1 080E+00	4 983E-03	1 175E-08	6 235E 03
Ruthenium-106	0 000E+00	3 300E+00	0 000E+00	1 098E+00	1 098E+00	1 098E-12	8 069E-05	5 410E+00	1 492E-05	1 175E-08	9 349E-05
Strontium-90	5 000E-01	2 600E+00	3 336E-01	8 655E-01	1 199E+00	1 199E-12	8 808E-05	2 700E+00	3 262E-05	1 175E 08	1 020E 04
Technetium-99	3 800E+00	1 300E+02	2 402E+00	4 327E+01	4 567E+01	4 567E-11	3 355E-03	2 430E+01	1 381E-04	1 175E 08	3 887E 03
Thorium-228	3 000E+02	6 600E+02	2 001E+02	2 197E+02	4 198E+02	4 198E-10	3 084E-02	1 080E-02	2 856E+00	1 175E 08	3 573E 02
Thorium-230	3 800E+03	1.100E+04	2 535E+03	3 662E+03	6 197E+03	6 197E-09	4 552E-01	5 410E-03	8 414E+01	1 175E-08	5 274E 01
Thorium-232	1 800E+02	2 200E+02	1 201E+02	7 323E+01	1 933E+02	1 933E-10	1 420E-02	unlimited			
Uranium-234	5 700E+02	3 900E+03	3 803E+02	1 298E+03	1 678E+03	1 678E-09	1 233E-01	2 700E-02	4 567E+00	1 175E-08	1 428E-01
Uranium-235	8 500E+01	1 800E+03	5 671E+01	5 992E+02	6 559E+02	6 559E-10	4 818E-02	2 700E-02	1.784E+00	1 175E-08	5 582E-02
Uranium-238	3 900E+03	4 700E+03	2 602E+03	1 564E+03	4 166E+03	4 166E-09	3 061E-01	unlimited			
						1 361E-08			1.071E-02		7 875E-01

Pit 1 Volume = 3 708E+04
Pit 2 Volume = 1 850E+04
Total Adjusted Pit 1 Volume = 6 671E-01
Total Adjusted Pit 1 Volume = 3.329E-01

ATTACHMENT 2

49 CFR 173.411 Industrial packagings.

(a) General. Each industrial packaging must comply with the requirements of this section which specifies packaging tests, and record retention applicable to Industrial Packaging Type 1 (IP-1), Industrial Packaging Type 2 (IP-2), and Industrial Packaging Type 3 (IP-3)

(b) Industrial packaging certification and tests.
  (1) Each IP-1 must meet the general design requirements prescribed in Sec. 173.410.

49 CFR 173.410 General design requirements.

In addition to the requirements of subparts A and B of this part, each package used for the shipment of Class 7 (radioactive) materials must be designed so that--

(a) The package can be easily handled and properly secured in or on a conveyance during transport.

(b) Each lifting attachment that is a structural part of the package must be designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner, and it must be designed so that failure of any lifting attachment under excessive load would not impair the ability of the package to meet other requirements of this subpart. Any other structural part of the package which could be used to lift the package must be capable of being rendered inoperable for lifting the package during transport or must be designed with strength equivalent to that required for lifting attachments.

(c) The external surface, as far as practicable, will be free from protruding features and will be easily decontaminated.

(d) The outer layer of packaging will avoid, as far as practicable, pockets or crevices where water might collect.

(e) Each feature that is added to the package will not reduce the safety of the package.

(f) The package will be capable of withstanding the effects of any acceleration, vibration or vibration resonance (see Sec. 178.608 of this subchapter) that may arise under normal conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use (see Secs. 173.24 and 173.24a).

(g) The materials of construction of the packaging and any components or structure will be physically and chemically compatible with each other and with the package contents. The behavior of the packaging and the package contents under irradiation will be taken into account.

(h) All valves through which the package contents could escape will be protected against unauthorized operation;

(i) For transport by air--
  (1) The temperature of the accessible surfaces of the package will not exceed 50 deg.C (122 deg.F) at an ambient temperature of 38 deg.C (100 deg.F) with no account taken for insulation;
  (2) The integrity of containment will not be impaired if the package is exposed to ambient temperatures ranging from -40 deg.C (-40 deg.F) to +55 deg.C (131 deg.F); and
  (3) Packages containing liquid contents will be capable of withstanding, without leakage, an internal pressure that produces a pressure differential of not less than 95 kPa (13.8 lb/in/2/).

Attachment 3

Sec. 173.427 Transport requirements for low specific activity (LSA) Class 7 (radioactive) materials and surface contaminated objects (SCO).

(a) In addition to other applicable requirements specified in this subchapter, low specific activity (LSA) materials and surface contaminated objects (SCO), unless excepted by paragraph (d) of this section, must be packaged in accordance with paragraph (b) or (c) of this section and must be transported in accordance with the following conditions:

(1) The external dose rate must not exceed an external radiation level of 10 mSv/h (1 rem/h) at 3 meters from the unshielded material;

(2) The quantity of LSA and SCO material in any single conveyance must not exceed the limits specified in Table 9;

(3) LSA material and SCO that are or contain fissile material must meet the applicable requirements of Sec. 173.451;

(4) Packages must meet the contamination control limits specified in Sec. 173.443;

(5) External radiation levels must comply with Sec. 173.441; and

(6) For LSA material and SCO required by this section to be consigned as exclusive use:

(i) Shipments must be loaded by the consignor and unloaded by the consignee from the conveyance or freight container in which originally loaded;

(ii) There must be no loose Class 7 (radioactive) material in the conveyance, however, when the conveyance is the packaging there must be no leakage of Class 7 (radioactive) material from the conveyance;

(iii) Packages must be braced so as to prevent shifting of lading under conditions normally incident to transportation;

(iv) Specific instructions for maintenance of exclusive use shipment controls must be provided by the offeror to the carrier. Such instructions must be included with the shipping paper information;

(v) Except for shipments of unconcentrated uranium or thorium ores, the transport vehicle must be placarded in accordance with subpart F of Part 172 of this subchapter;

(vi) For domestic transportation only, packages are excepted from the marking and labeling requirements of this subchapter. However, the exterior of each nonbulk package must be stenciled or otherwise marked "Radioactive--LSA" or "Radioactive--SCO", as appropriate, and nonbulk packages that contain a hazardous substance must also be stenciled or otherwise marked with the letters "RQ" in association with the above description; and

(vii) Except when transported in an industrial package in accordance with Table 8, transportation by aircraft is prohibited.

(b) Except as provided in paragraph (c) of this section, LSA material and SCO must be packaged as follows:

(1) In an industrial package (IP-1, IP-2 or IP-3; Sec. 173.411), subject to the limitations of Table 8;

(2) For domestic transportation only, in a DOT Specification 7A (Sec. 178.350 of this subchapter) Type A package. The requirements of Sec. 173.412 (a), (b), (c) and (k) do not apply; or

(3) For domestic transportation only, in a strong, tight package that prevents leakage of the radioactive content under normal conditions of transport. In addition to the requirements of paragraph (a) of this section, the following requirements must be met:

(i) The shipment must be exclusive use;

(ii) The quantity of Class 7 (radioactive) material in each packaging may not exceed an A2 quantity.

(c) LSA-I and SCO-I (see Sec. 173.403), unless packaged in accordance with paragraph (b) of this section, must be packaged in bulk packagings in accordance with this paragraph. The shipment must be, in addition to complying with the applicable requirements of paragraph (a) of this section, exclusive use:

(1) Solids. Packages must be strong tight packagings, meeting the requirements of subpart B of this Part, transported in a closed transport vehicle. The requirements of Sec. 173.410 do not apply.

(2) Liquids. Liquids must be transported in the following packagings:

(I) Specification 103CW, 111A60W7 (Secs. 179.200, 179.201, 179.202 of this subchapter) tank cars. Bottom openings in tanks are prohibited; or

(ii) Specification MC 310, MC 311, MC 312, MC 331 or DOT 412 (Sec. 178.348 or Sec. 178.337 of this subchapter) cargo tank motor vehicles. Bottom outlets are not authorized. Trailer-on-flat-car service is not authorized.

(d) Except for transportation by aircraft, LSA material and SCO that conform to the provisions specified in 10 CFR 20.2005 are excepted from all requirements of this subchapter pertaining to Class 7 (radioactive) materials when offered for transportation for disposal or recovery. A material which meets the definition of another hazard class is subject to the provisions of this subchapter relating to that hazard class.

(e) LSA and SCO that exceed the packaging limits in this section must be packaged in accordance with 10 CFR part 71.

(f) Tables 8 and 9 are as follows:

Table 8.--Industrial Package Integrity Requirements for LSA Material and SCO

Contents	Industrial Packaging Type: Exclusive use shipment	Industrial Packaging Type: Nonexclusive use shipment
LSA-I:		
Solid	IP-1	IP-1
Liquid	IP-1	IP-2
LSA-II:		
Solid	IP-2	IP-2
Liquid and gas	IP-2	IP-3
LSA-III	IP-2	IP-3
SCO-I	IP-1	IP-1
SCO-II	IP-2	IP-2

TABLE 9--Conveyance Activity Limits for LSA Material and SCO

Nature of material	Activity Limit for Conveyances
LSA-I	No limit.
LSA-II and LSA-III; noncombustible solids	No limit.
LSA-II and LSA-III; Combustible solids and all liquids and gases	100 A2
SCO	100 A2

ATTACHMENT 4

49 CFR 171.8 ----------

Transport vehicle means a cargo-carrying vehicle such as an automobile, van, tractor, truck, semitrailer, tank car or rail care used for the tranpsortation of cargo by any mode. Each cargo-carrying body (trailer, rail car, etc.) Is a separate transport vehicle.

Bulk packaging means a packaging, other than a vessel or a barge, including a transport vehicle or freight container, in which hazarous materials are loaded with no intermediate form of containment and which has: (1) A maximum capacity greater than 450 L (119 gallons) as a receptacle for a liquid; (2) A maximum net mass greater than 400 kg (882 pounds) and a maximum capacity greater than 450 L (119 gallons) as a receptacle for a solid; or (3) A water capacity greater than 454 kg (1000 pounds) as a receptacle for a gas as defined in 49 CFR 173,115.

49 CFR 173.403 ----------

A2 means the maximum activity of Class 7 (radioactive) material, other than special form, LSA or SCO, permitted in a Type A package. These values are either listed in Sec. 173.435 or derived in accordance with the procedure prescribed in Sec. 173.433.

Closed transport vehicle means a transport vehicle or conveyance equipped with a securely attached exterior enclosure that during normal transportation restricts the access of unauthorized persons to the cargo space containing the Class 7 (radioactive) materials. The enclosure may be either temporary or permanent, and in the case of packaged materials may be of the "see-through" type, and must limit access from top, sides, and bottom.

Conveyance means (1) For transport by public highway or rail; any transport vehicle or large freight container; (2) For transport by water; any vessel, or any hold, compartment, or defined deck area of a vessel including any transport vehicle on board the vessel; and (3) For transport by aircraft; any aircraft.

Exclusive use (also referred to in other regulations as "sole use" or "full load") means sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The consignor must issue specific instructions in writing, for maintenance of exclusive use shipment controls, and include them with the shipping paper information provided to the carrier by the consignor.

Packaging means for Class 7 (radioactive) materials, the assembly of components necessary to ensure compliance with the packaging requirements of this subpart [49 CFR 171]. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, service equipment for filling, emptying, venting, and pressure relief, and devices for cooling or absorbing mechanical shocks. The conveyance, tie-down system, and auxilliary equipment may sometimes be designated as part of the packaging.

Surface Contaminated Object (SCO) means a solid object which is not itself radioactive but which has Class 7 (radioactive) material distributed on any of its surfaces. SCO must be in one of two groups with surface activity not exceeding the following limits:

Attachment 5

PART 173—SHIPPERS—GENERAL REQUIREMENTS FOR SHIPMENTS AND PACKAGINGS

Subpart A—General

Sec.

173.1 Purpose and scope.
173.2 Hazardous materials classes and index to hazard class definitions.
173.2A Classification of a material having more than one hazard.
173.3 Packaging and exceptions.
173.3a Packaging: special requirements for certain poisonous materials.
173.4 Exceptions for small quantities.
173.5 Agricultural operations:
173.5a Oilfield service vehicles.
173.6 [Removed]
173.7 U.S. Government material.
173.9 Cars, truck bodies, freight containers or trailers containing lading which has been fumigated or treated with Class 3, Division 2.1, 2.3, or 6.1 materials.
173.10 Tank car shipments.
173.11 Shipper's registration statement; flammable cryogenic liquids.
173.12 Exceptions for shipment of waste material.

Subpart B—Preparation of Hazardous Materials for Transportation

173.21 Forbidden materials and packages.
173.22 Shipper's responsibility.
173.22a Use of packagings authorized under exemptions.
173.23 Previously authorized packaging.
173.24 General requirements for packagings and packages.
173.24a Additional general requirements for non-bulk packagings and packages.
173.24b Additional general requirements for bulk packagings.
173.25 Authorized packages and overpacks.
173.26 Quantity limitations.
173.27 General requirements for transportation by aircraft.
173.28 Reuse reconditioning and remanufacture of packagings.
173.29 Empty packagings.
173.30 Loading and unloading of transport vehicles.
173.31 Qualification, maintenance, and use of tank cars.
173.32 Qualification, maintenance and use of portable tanks.
173.32a Approval of Specification IM portable tanks.
173.32b Periodic testing and inspection of Specification IM portable tanks.
173.32c Use of Specification IM portable tanks.
173.32d Removed
173.33 Hazardous materials in cargo tank motor vehicles.
173.35 Hazardous materials in intermediate bulk containers.
173.34 Qualification, maintenance, and use of cylinders.
173.40 General packaging requirements for poisonous materials required to be packaged in cylinders.

Subpart C—Definitions, Classification and Packaging for Class 1

173.50 Class 1—definitions.
173.51 Authorization to offer and transport explosives.
173.52 Classification codes and compatibility groups of explosives.
173.53 Provisions for using old classifications of explosives.
173.54 Forbidden explosives.
173.55 [Reserved].
173.56 New explosives—definition and procedures for classification and approval.
173.57 Acceptance criteria for new explosives.
173.58 Assignment of class and division for new explosives.
173.59 Description of terms for explosives.
173.60 General packaging requirements for explosives.
173.61 Mixed packaging requirements.

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APPENDIX B

STATE RADIATION CONTROL PROGRAMS

STATE RADIATION CONTROL PROGRAM ASSISTANCE FOR INCIDENTS INVOLVING RADIOACTIVE MATERIALS

CRCPD Notes of February 1995

State	State Radiation Control Program: Emerg. Response Section Leader	Voice Phone	Telefax	24-Hour or After Hours[A]: Voice Phone	Agency	Assistance at Rad. Control or (*) only at the 24-Hr. Phone: Locate Shipper	Locate Experts	Conf. Calls	Tech. Info.	Radiol. Survey	Federal Region: DOE	NRC	Date of This Info.
ALABAMA■	Bernis Hannah	**205/613-5391**	205/613-5387	205/242-4378	SP	Yes	Yes	Yes	Yes	Yes	III	II	14 Feb.'95
ALASKA	(none)			907/465-4000	SP	Yes	Yes	Yes	No	No	VIII	IV	13 Feb.'95
ARIZONA■	John Lutton	602/255-4845	602/437-0705	602/223-2212[A]	SP	Yes	Yes	Yes	Yes	Yes	IV	IV	9 Feb.'95
ARKANSAS■	Bernard Bevill	**501/661-2301**	501/661-2468	501/661-2136	RCP	Yes	Yes	Yes	Yes	Yes	II	IV	13 Feb.'95
CALIFORNIA■	Donald Bunn	**916/323-2756**	916/324-3610	**916/262-1621**	EM	Yes	*Yes	Yes	Yes	Yes	VII	IV	14 Feb.'95
COLORADO■	Martin Hanrahan	303/692-3030	303/782-5083	303/756-4455[A]	EM	Yes	Yes	Yes	Yes	Yes	VI	IV	13 Feb.'95
CONNECTICUT	Denny Galloway	**203/424-3029**	203/566-6032	203/566-3333	RCP	Yes	Yes	Yes	Yes	Yes	I	I	14 Feb.'95
DELAWARE	Al Tapert	**302/739-3787**	302/739-3839	**302/834-4531**	EM	Yes	Yes	*Yes	Yes	No	I	I	14 Feb.'95
D.C.	Philip Sumner	**202/727-7218**	202/727-7780	**202/727-6161**	EM	No	No	*Yes	No	No	VII	I	10 Feb.'95
FLORIDA■	Harlan Keaton	**407/297-2095**	407/297-2085	904/413-9911	EM	Yes	Yes	*Yes	Yes	Yes	III	II	9 Feb.'95
GEORGIA■	James Hardeman	404/362-2675	404/362-2653	800/241-4113[A]	RCP	Yes	Yes	Yes	Yes	Yes	III	II	13 Feb.'95
HAWAII	Russell Takata	808/586-4700	808/586-4729	808/734-2161	EM	Yes	Yes	Yes	Yes	Yes	VII	IV	9 Feb.'95
IDAHO	Steven Oberg	208/334-0436	208/334-0429 In-state ->	208/334-4570 800/632-8000	EM	No	Yes	Yes	Yes	Yes	VI	IV	9 Feb.'95
ILLINOIS■	Tim Runyon	**217/785-0600**[24]	217/786-7223	217/785-0600	RCP	Yes	Yes	Yes	Yes	Yes	V	III	14 Feb.'95
INDIANA	Rex Bowser	317/383-6150	317/383-6154	317/383-6144[A]	RCP	No	Yes	Yes	Yes	Yes	V	III	14 Feb.'95
IOWA■	Don Flater	515/281-3478	515/242-6284	515/281-3231	EM	Yes	Yes	Yes	Yes	Yes	V	III	9 Feb.'95
KANSAS■	Harold Spiker	913/296-1561	913/296-0984	913/296-3176	EM	Yes	Yes	Yes	Yes	Yes	IV	IV	9 Feb.'95
KENTUCKY■	John Volpe	502/564-3700	502/564-6533	502/564-7815[A]	RCP	Yes	Yes	*Yes	Yes	Yes	II	II	14 Feb.'95
LOUISIANA■	Stan Shaw	504/765-0140	504/926-1903	504/765-0160	RCP	Yes	Yes	Yes	Yes	Yes	II	IV	13 Feb.'95
MAINE■	Jay Hyland	**207/287-5676**	207/287-4172	207/624-7000 Page Health Eng.	SP	Yes	Yes	Yes	Yes	Yes	I	I	14 Feb.'95
MARYLAND■	Carl Trump	410/631-3300	410/631-3198	410/243-8700[A]	RCP	Yes	Yes	Yes	Yes	Yes	I	I	13 Feb.'95
MASSACHUSETTS	Bob Halliday	**617/727-6214**	617/727-2098	**617/727-9710**	RCP	Yes	Yes	Yes	Yes	Yes	I	I	14 Feb.'95
MICHIGAN	Dennis Hahn	517/335-8200	517/335-8706	517/336-6100[A]	SP	Yes	Yes	Yes	Yes	Yes	V	III	10 Feb.'95
MINNESOTA	Alice Dolezal-Hennigan	612/627-5071	In-state -> 612/627-5075	800/422-0798 612/649-5451	EM	Yes	Yes	Yes	Yes	Yes	V	III	9 Feb.'95
MISSISSIPPI■	Bob Bell	601/354-6657	601/354-6167	601/352-9100	EM	Yes	Yes	Yes	Yes	Yes	II	II	9 Feb.'95

■ NRC Agreement State. **Bold Phone preferred for first report.** [24] a 24-Hr. phone [A] After hours only * Service available only from the 24-Hr. phone.

Agency for after hours or 24-hour calls: EM = Emergency management, SP = State police, RCP = Radiation control program, usually the main department switchboard.

Locate Shipper / Expert means that staff will undertake to identify and notify the shipper / enlist experts on the cargo. Technical information refers here only to radioactive materials.

Conference Call means, here, the capability to dial and connect together three or more numbers e.g. shipper, expert and fire fighters at the accident.

Radiological Survey means staff and equipment for evaluation of all types of ionizing radiation as well as airborne radioactivity at an accident scene.

STATE RADIATION CONTROL PROGRAM ASSISTANCE FOR INCIDENTS INVOLVING RADIOACTIVE MATERIALS

CRCPD Notes of February 1995

State	State Radiation Control Program: Emerg. Response Section Leader	Voice Phone	Telefax	24-Hour or After Hours[A]: Voice Phone	Agency	Assistance at Rad. Control or (*) only at the 24-Hr. Phone: Locate Shipper	Locate Experts	Conf. Calls	Tech. Info.	Radiol. Survey	Federal Region: DOE	NRC	Date of This Info.
MISSOURI	Gary McNutt	314/751-6160	314/526-6946	314/751-2748[A]	EM	Yes	Yes	Yes	Yes	Yes	II	III	14 Feb.'95
MONTANA	Adrian Howe	406/444-3671	406/444-5275	406/444-6965	EM	No	*Yes	No	Yes	Yes	VI	IV	14 Feb.'95
NEBRASKA■	Harold Borchert	402/471-2168	402/471-0169	402/471-4545	SP	Yes	Yes	Yes	Yes	Yes	V	IV	13 Feb.'95
NEVADA■	Stan Marshall	702/687-5394	702/687-5751	702/687-5300	SP	Yes	Yes	Yes	Yes	Yes	VII	IV	13 Feb.'95
NEW HAMPSHIRE■	Diane Tafft	603/271-4588	603/225-2325	603/271-3636[A]	SP	Yes	Yes	*Yes	Yes	Yes	I	I	10 Feb.'95
NEW JERSEY	John Feeney	609/987-6365	609/987-6390	609/292-7172	RCP	Yes	Yes	*Yes	Yes	Yes	I	I	14 Feb.'95
NEW MEXICO■	William Floyd	505/827-4358	505/827-4361	505/827-9329	RCP	Yes	*Yes	*Yes	Yes	Yes	IV	IV	9 Feb.'95
NEW YORK■	Adela Salame-Allie	518/458-6451	518/458-6434	518/457-2200	EM	Yes	Yes	*Yes	Yes	Yes	I	I	10 Feb.'95
NEW YORK CITY■	Richard Borri	718/643-7967	718/643-4616	212/340-4494[A]	RCP	Yes	Yes	No	Yes	Yes	I	I	10 Feb.'95
NORTH CAROLINA■	Johnny James	919/571-4141	919/571-4148	919/733-3861	SP	Yes	Yes	Yes	Yes	Yes	III	II	14 Feb.'95
NORTH DAKOTA■	Ken Wangler	701/328-5188	701/328-5200	701/328-2121	SP	Yes	Yes	No	Yes	Yes	V	IV	9 Feb.'95
OHIO	Robert Owen	614/644-2727[24]	614/644-1909	614/644-2727	RCP	Yes	Yes	Yes	Yes	Yes	V	III	14 Feb.'95
OKLAHOMA	Mike Broderick	405/271-5338	405/271-8425	800/522-0206[A]	RCP	Yes	Yes	Yes	Yes	Yes	IV	IV	10 Feb.'95
OREGON■	Nick Goevelinger	503/731-4014[24]	503/731-4081	503/731-4014	RCP	Yes	Yes	Yes	Yes	Yes	VIII	IV	14 Feb.'95
PENNSYLVANIA	Barbara Conrad	717/787-2480	717/783-8965	717/783-8150	EM	Yes	Yes	Yes	Yes	Yes	I	I	14 Feb.'95
RHODE ISLAND■	(none)	401/277-2438	401/277-6953	401/421-7333	EM	*Yes	No	*Yes	No	No	I	I	13 Feb.'95
SOUTH CAROLINA■	Sandra Threatt	803/896-4095	803/896-4110	803/253-6489[A]	RCP	Yes	Yes	Yes	Yes	Yes	III	II	14 Feb.'95
SOUTH DAKOTA	Mike Pochop	605/773-3351	605/773-4068	605/773-3231	EM	Yes	Yes	*Yes	Yes	Yes	V	IV	10 Feb.'95
TENNESSEE■	Elizabeth Flanagan	615/532-0360	615/532-7938	615/741-0001	EM	No	Yes	*Yes	Yes	Yes	II	II	9 Feb.'95
TEXAS■	Brad Caskey	512/834-6688	512/834-6690	512/458-7460	RCP	Yes	Yes	Yes	Yes	Yes	IV	IV	13 Feb.'95
UTAH■	Dane Finerfrock	801/536-4250	801/533-4097	801/536-4123	RCP	Yes	Yes	Yes	Yes	Yes	VI	IV	14 Feb.'95
VERMONT	Paul Clemons	802/865-7730	802/865-7745	802/244-8727	SP	Yes	Yes	Yes	Yes	Yes	I	I	13 Feb.'95
VIRGINIA	Leslie Foldesi	804/786-5932	804/786-6979	804/674-2400	EM	Yes	Yes	No	Yes	Yes	II	II	10 Feb.'95
WASHINGTON■	Robert Mooney	206/464-7274	206/464-7081	206/NUCLEAR	RCP	Yes	Yes	Yes	Yes	Yes	VIII	IV	9 Feb.'93
WEST VIRGINIA	Beattie DeBord	304/558-0696	304/558-0691	304/558-5380	EM	Yes	Yes	Yes	Yes	Yes	II	II	14 Feb.'95
WISCONSIN	Paul Schmidt	608/267-4792	608/267-4799	800/943-0003	EM	Yes	Yes	Yes	Yes	Yes	V	III	13 Feb.'95
WYOMING	Chuck Fraley (EM)	307/777-7197	307/635-6017	307/777-4321	SP	*Yes	No	*Yes	No	No	VI	IV	13 Feb.'95

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