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Firestone

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November 19, 1990

Ms. Debra Rossi
Remedial Project Manager
U.S. Environmental Protection Agency
Region III
841 Chestnut Building
Philadelphia, PA 19107

Re: Submittal: Phase II Report and Phase III Work Plan Revisions
Woodlawn Landfill RI/FS, Cecil County, Maryland

Dear Ms. Rossi:

Enclosed are three (3) copies of each of the subject documents which are being submitted in accordance with the project Consent Order (U.S. EPA Docket No. III-89-05-DC, December 28, 1988). These documents (Revision 01) completely replace the original documents (Revision 0).

H47ITC---9011190051

(1) Report (Revision 01)
Phase II - Site Characterization
Dated June 5, 1990 (Revision 0); Revised November 19, 1990

(2) Detailed Work Plan (Revision 01)
Phase III - Groundwater Evaluation
Dated June 5, 1990 (Revision 0); Revised November 19, 1990

The revisions in the subject documents have been approved as per your letter of October 18, 1990. These revisions were made on the basis of the:

- Document: Responses to Agency Comments and Revisions to Phase II Report and Phase III Detailed Work Plan, dated October 5, 1990
- Review of additional comments in your October 18th letter and resulting modifications to the documents
- Review of comments from the state of Maryland dated October 23 and faxed to us by the U.S. EPA on October 29, and resulting modifications to the documents

AR301156

Please advise us if you have any questions or comments.

Sincerely yours,

George B. Markert

George B. Markert
Senior Environmental Consultant
Corporate Environmental Affairs

GBM:AMJ:jar
Enclosures

cc: Mr. Peter Ludzia, U.S. EPA - III (no enclosures)
Ms. Patricia Hilsinger, U.S. EPA (no enclosures)
Mr. Milton Marder, MDE (one copy of each enclosure)
Ms. Pamela Marks, Maryland Office of Attorney General (no enclosures)
Mr. Barry Belford, Cecil County (one copy of each enclosure)
Mr. Mark Grummer, Kirkland & Ellis (one copy of each enclosure)
Mr. Kevin Gaynor, Counsel to Cecil County (no enclosures)
Mr. Joseph Lewandowski, ERM (one copy of each enclosure)
Dr. Alan M. Jacobs, IT Corporation (no enclosures)

REPORT
PHASE II - SITE CHARACTERIZATION
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
WOODLAWN LANDFILL
CECIL COUNTY, MARYLAND

PREPARED BY:

IT CORPORATION
MONROEVILLE, PENNSYLVANIA

JUNE 5, 1990 (REVISION 0)
NOVEMBER 19, 1990 (REVISION 01)
PROJECT NO. 303486

Prepared by:		Approved by:	
Mark J. Hardner	Date 11/16/90	Alan M. Jacobs IT Project Manager	Date 11/16/90
		Lawrence J. Hosen IT Project Director	Date 11/16/90
		Robert C. Streeter IT Quality Assurance Officer	Date 11/16/90
		George B. Marlbeart Client Representative	Date 11/16/90

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EXECUTIVE SUMMARY

In accordance with the project Consent Order (III-89-05-DC) and the approved Scope of Work, respondents are conducting a Remedial Investigation/ Feasibility Study (RI/FS) for the Woodlawn Landfill, Cecil County, Maryland. The RI/FS is a phased study comprising:

- Quality Assurance Project Plan (QAPP)
- Health and Safety Plan
- Phase I - Preliminary Investigations
- Phase II - Site Characterization
- Phase III - Groundwater Evaluation
- Phase IV - Additional Field Work
- RI and Preliminary FS Reports
- Final FS Report

The Woodlawn Landfill site (Site), originally a sand and gravel pit, received wastes containing hazardous constituents from numerous parties during the period from the 1960s to the early 1980s. In the early 1980s, waste placement on the Site ceased. To IT Corporation's (IT) knowledge, no solid wastes are being placed at the Woodlawn Landfill. The landfill proper remains closed to activities other than RI/FS work. Still in operation is the Cecil County Transfer Station adjacent to the Site, which compacts mostly residential waste and loads it for shipment to another landfill. During the course of Phase II investigations, it was noted that liquid wastes resulting from trash compaction were discharging onto the Site southwest of the Transfer Station. A one-time sampling of the contents of the septic tank indicated high concentrations of volatile organic compounds (e.g., toluene, xylenes, benzene, and acetone).

Since June 1989, IT has conducted field work beginning with Phase I. The Phase I reports have been approved by the U.S. EPA together with work plans for Phases II, IV, and RI/FS Methodologies. This report presents the results and findings of Phase II tasks. The report is accompanied by a Detailed Work Plan for Phase III as a separate volume.

As approved by the U.S. EPA, Phase II tasks included:

- Data management
- Installation of 5 bedrock, 3 soil, and 3 perched monitoring wells

- Installation of 6 piezometers
- Rock-coring of one bedrock well
- Land surveying
- Water-level measurements and construction of groundwater contour maps
- One round of groundwater sampling of modified TCL and modified TAL chemicals using CLP protocol for 10 new monitoring wells, 19 existing monitoring wells, and 11 domestic wells
- Borehole geophysical investigation (spontaneous potential, EM induction, full-wave sonic, and borehole television logging) of 4 wells
- Rising head slug tests on 11 wells
- Borehole television inspections on 4 previously installed monitoring wells (installed by the state and county prior to Phase I) that were suspected of being damaged--three of which were subsequently considered usable for further analyses
- Incorporation of domestic wells and usable monitoring wells into the monitoring network and upgrading of monitoring wells by the installation of protective casing with locking caps

All the foregoing tasks were performed according to the approved Detailed Work Plan (DWP-II), the Quality Assurance Project Plan (QAPP), and the project Health and Safety Plan.

Phase II results were used to further characterize the hydrogeology, groundwater chemistry, groundwater flow, and solute migration at the Site. These characteristics will be discussed under the headings Hydrogeology and Groundwater Chemistry. Several data needs were identified, which indicated the need to collect additional data at specific Site locations as part of Phase IV - Additional Field Work and to modify the analytical program for Phase III. The Phase IV Detailed Work Plan (DWP-IV) will be revised and submitted after approval of the Phase II Report and in time to satisfactorily complete Phase IV according to the approved Schedule of Work. These data, in addition to the proposed work for Phase III and completed and future work for Phase IV, are generally sufficient to finalize the remedial investigation (including the risk assessment) and to perform a feasibility study.

Phase II - Site Characterization findings are summarized as follows:

Hydrogeology

- Soils

  - The soils encountered in the borings overlying bedrock consist of a thick granular residual soil (saprolite), that is in turn overlain by alluvial sands and gravels with some fine sediments. In places, the sands and gravels are mixed with hillwash (colluvium), fill, and municipal and industrial wastes. The materials above the bedrock are approximately 100 feet thick at the northern landfill boundary, and thin to about 20 feet thick at the southern boundary. Knowledge of the stratigraphic framework is necessary for planning future drilling, estimating volumes of soil and waste, and extrapolating hydraulic parameters laterally across the site.

- Bedrock

  - The bedrock consists of gneissic granite and metadiorite. The mineral composition and weathering characteristics of the gneissic granite and metadiorite may contribute to the high concentrations of iron and manganese in the groundwater. The high conductivity that these metals produce in the groundwater probably accounts for some of the geophysical anomalies (EM) that were mapped as part of Phase I. These conductivity anomalies can be used to estimate groundwater flow directions (i.e., in the direction of plume elongation).

  - The bedrock encountered in the borings is fractured, with more abundant and more irregular fractures in the metadiorite. Water yields are higher at fracture zones. Remediation alternatives involving pumping of groundwater from the bedrock would rely on placement of wells at these fracture zones.

  - The topography of the buried bedrock surface as estimated from the boring data generally follows the surface topography. Irregular topographic relief of the bedrock surface indicates possible structural discontinuities (interruptions in the bedrock surface caused by the presence of faults, joints, or lineaments) with resultant preferred groundwater flow paths in the bedrock in the west-central part of the site.

- Aquifers

  - The soil and bedrock aquifers are unconfined (nonartesian). Groundwater levels and flow "directions" are similar in these two aquifers. Contaminant migration directions should be similar in the two aquifers. Of the two aquifers, the bedrock aquifer is more commonly utilized for water supply in the surrounding area. We know of only one domestic well in the area (Craft) that may derive water from the soil aquifer.

  - The water table (approximately the upper surface of the saturated zone) is in the weathered soil above the bedrock in most of the Site (as determined by static water levels in the wells). In the southwestern part of the Site, the water table is beneath the bedrock surface, resulting in a completely unsaturated soil in this area. As a result, wells should not be planned in the soil in the southwest part of the Site.

  - The regional groundwater flow as interpolated from the well measurements is west-southwest (towards the Susquehanna River). Local groundwater flow directions are similar to the regional pattern. In the northeast part of the Site along a line extending west-southwest from the Transfer Station to the central part of the landfill there is a groundwater divide between westerly and southwesterly flow in the soil aquifer.

  - An impermeable layer was not encountered in the borings at the buried bedrock surface, allowing hydraulic communication between the bedrock aquifer and the soil aquifer above. Testing and remediation alternatives involving pumping groundwater from the bedrock must take into consideration the danger in drawing contaminants downward from the soil aquifer.

  - Perched water zones resulting from impermeable clay layers above the water table are present in wells south of Cells B/C and immediately off the west-central landfill boundary. The perched water zones cause seeps to occur where the clay layers intersect the ground surface. For Site remediation, seeps of contaminated water would need to be collected and treated.

- Ranges of hydraulic conductivity in each aquifer are 2.7×10^{-5} to 1.4×10^{-2} centimeters per second (cm/s) (bedrock aquifer); 8.6×10^{-5} to 2.8×10^{-4} cm/s (soil aquifer); 2.1×10^{-4} to 2.5×10^{-4} cm/s (perched aquifer). These values can be used in the Site area as guidelines for modeling input parameters.

- Hydraulic gradients range from 0.005 to 0.330 in the soil aquifer and from 0.02 to 0.125 in the bedrock aquifer.

Groundwater Chemistry

Chemical analyses were performed using a modified Target Compound List (TCL) and a modified Target Analyte List (TAL) within the CLP protocol for one round of groundwater sampling. Wells sampled during this initial round included the previously existing monitoring wells, IT-installed monitoring wells, and selected domestic wells. Analytical data will be further evaluated in Phase III in accordance with the approved Scope of Work. Analyses indicate that:

- The main analytes exceeding potential ARARs in the monitoring wells include vinyl chloride (7J-520 ppb), bis(2-ethylhexyl)phthalate (4J-140 ppb), and manganese (5,850-13,800 ppb). Other analytes detected sporadically in a few monitoring wells exceeding potential ARARs include benzene (5-39 ppb), barium (1,170 ppb), and lead (278 ppb).

- The organic analytes detected in domestic wells were acetone (7J-10 ug/l), di-n-butylphthalate (2J-3J ug/l), and diethylphthalate (4J ug/l). The inorganic analytes detected in domestic wells are listed in the tables of the report. Although none of the organic and inorganic concentrations were above chemical-specific potential ARARs, two of the metals have concentrations above secondary Maximum Contaminant Levels (secondary MCLs). These metals are manganese and iron. Manganese concentrations from unfiltered domestic samples ranged from 123 to 3,060 ug/l in the Craft, Odom, and Hess wells and concentrations from filtered samples ranged from 115 to 1,400 ug/l in the Craft and Odom wells. The iron concentration from unfiltered samples ranged from 965 to 29,200 ug/l in the Craft, Odom, and Hess wells; from the filtered samples the concentration was 351 ug/l (Odom well). Each analyte detected in the domestic wells was found in no more than three of the eleven wells and, in all cases, analyte concentrations are below potential chemical-specific ARARs for groundwater.

- No PCBs were detected in any of the analyses.

- Pesticides (alpha-BHC, DDT, Heptachlor, and Endosulfan I) were detected in only 8 of the 29 monitoring wells. These eight wells are at random locations.

- Concentrations of the main analytes are generally higher in monitoring wells around Cell B/C and the presumed location around Cell A. The vinyl chloride plume in the groundwater tested is restricted to the areas around the cells. Phthalates are present in monitoring wells in both cell and noncell areas. The cell areas may be considered for source treatment of these chemicals.

- Vinyl chloride has been detected in some of the monitoring wells in the soil aquifer and perched water in the cell areas only (F-Series wells). Vinyl chloride was detected in the bedrock aquifer only in Monitoring Well ITB-1 (at the northeast boundary of the landfill). No vinyl chloride was detected in any of the domestic wells tested.

- Bis(2-ethylhexyl)phthalate has been detected in some of the monitoring wells in the soil, perched and bedrock aquifers, in the cell areas, and in areas at the northwest and west-central boundaries of the Site.

- With current RI data and prior to formal feasibility analyses, cleanup strategies center around the presence of vinyl chloride from the cell areas and from other areas on the Site. The significance of the presence of phthalates at the concentrations reported is still being evaluated.

Data Needs

The following information still needs to be collected (in addition to tasks in currently approved work plans):

- Lateral extent of vinyl chloride contamination north of Monitoring Well ITB-1

- Vertical extent of vinyl chloride contamination in the bedrock near Monitoring Well ITB-1

- Lateral extent of bis(2-ethylhexyl)phthalate contamination west of Monitoring Well ITB-3

- Vertical extent of bis(2-ethylhexyl)phthalate contamination in the bedrock near Monitoring Well ITB-3

The impact of the discharges on the Site from the Transfer Station has yet to be determined. Cecil County has been queried as to the quantities and types of chemicals handled and possibly discharged by the Station.

1.0 INTRODUCTION

In accordance with the Consent Order entered into on December 28, 1988 among Bridgestone/Firestone, Inc. (formerly The Firestone Tire & Rubber Company [Firestone]), Cecil County, Maryland, and the U.S. Environmental Protection Agency (U.S. EPA), IT Corporation (IT) is submitting a report for Phase II of the Remedial Investigation and Feasibility Study (RI/FS) for the Woodlawn Landfill, Cecil County, Maryland. This report follows the latest revision of the U.S. EPA-approved Detailed Work Plan for Phase II (Revision 01), dated November 30, 1989 (DWP-II) and U.S. EPA-approved modifications. The report satisfies data and reporting requirements consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA); relevant agency guidances; and project Consent Order (U.S. EPA Docket No. III-89-05-DC, dated December 28, 1988), including the approved Scope of Work and the Detailed Work Plan.

1.1 OBJECTIVES OF PHASE II WORK

The RI/FS, as outlined in the Scope of Work (IT, September 30, 1988; Revision 01, November 2, 1988), is a phased study, with Phase II comprising the Site Characterization. The objectives of the Phase II work are to:

- Further (subsequent to Phase I - Preliminary Investigations) characterize the hydrogeology, groundwater chemistry, groundwater flow, and solute migration at the Woodlawn Landfill Site and environs
- Identify additional data needs

1.2 SITE BACKGROUND

The Site background consists of the description of the Site, a brief history of the Site, and a description of previous investigations pertinent to Phase II work.

1.2.1 Site Description

The Site is located in northwestern Cecil County, Maryland (Figure 1).

The Site is herein defined as the approximately 38-acre property of the former Woodlawn County Landfill. Working access to the Site is achieved through the entrance road to the Woodlawn County Transfer Station at the intersection of Firetower and Waibel Roads. The Transfer Station houses the temporary Site office used during this study phase. The Contamination Reduction Zone (CRZ) is located west of the Transfer Station. Beyond the CRZ is the Exclusion Zone (EZ), which comprises the principal data gathering area for the project.

The Site comprises rugged terrain that slopes southward towards a westward flowing creek (Figure 1). Approximately 50 percent of the Site area contains dense tree cover. The land surface is relatively free of thick vegetative cover in the north-central area where most recent landfill operations took place. Tree cover is densest in the southern and eastern part of the site. The western edge of the site is also tree covered and slopes steeply to the west. The central part of the Site contains few trees and is covered with grasses and shrubs. In the southern part of the central area there is a settling basin that was designed to collect runoff during precipitation events.

Vehicular traffic has access to the Site area via Waibel and Firetower Roads. Waibel Road borders the southeast and eastern landfill property boundary. The entrance to the Transfer Station is at the intersection of Waibel Road and Firetower Road near the northeastern corner of the Site. Also near this intersection is the junction of a former road, now a jeep trail, which traverses the northern edge of the landfill property. No fencing exists around the landfill perimeter to inhibit access. An unlocked gate, kept closed, is in place at the former main landfill entrance just west of the Transfer Station.

Bedrock that underlies the Site consists of gneissic granite and metadiorite. It is overlain by a residual soil (saprolite) developed by in situ weathering of the bedrock. Overlying the saprolite are terrace deposits of sand and gravel. Sand and gravel were excavated prior to the development of the landfill. The landfill operations included excavation of surface soils and placement of waste fill, as discussed below.

1.2.2 Site History

The Woodlawn Landfill was originally a sand and gravel pit. It received wastes containing hazardous constituents from numerous parties during the period from the 1960s to the early 1980s. These wastes were placed wherever active landfilling operations were taking place at the time as well as elsewhere on the Site. From 1979 to late 1980, polyvinyl chloride (PVC) sludge was placed in each of three cells (A, B, and C). Cell A was formed by the excavation for fill used to cover wastes at the active face of the landfill (Figure 1). Cell C overlies Cell B and comprises waste that was placed over the area of Cell B (Figure 1). This sludge was also placed in other sections of the Site.

Several monitoring wells were installed on site during the early 1980s by the state of Maryland, Cecil County, and Firestone. The state of Maryland wells (B-series) were constructed in June/July 1982 and the Cecil County wells (OW- and SW-series) in March 1982. Firestone installed a total of ten monitoring wells (F-series) in 1980 and 1982. Monitoring Wells F-1, 2, and 3 were constructed in the Fall 1980 and the remaining seven were constructed in the Winter 1982.

All of the aforementioned wells were completed in the soil aquifer above the top of bedrock. The bedrock well (TSTA-1) serving the Transfer Station was installed by Cecil County in September 1977.

Cecil County continues to operate the Transfer Station, adjacent to the Site, including unloading of refuse from resident and commercial vehicles, trash compaction, and reloading of compacted trash onto county vehicles (for transfer to another landfill). Two aboveground tanks outside the Transfer Station are utilized for public waste-oil disposal. The Transfer Station also houses a dog pound. To IT's knowledge, no solid wastes are being placed at the Site; the landfill remains closed to activities other than RI/FS work.

Since June 5, 1989, IT has conducted field work beginning with Phase I investigations as described in the Phase I reports (Section 1.2.3). This work was "noninvasive" in that there was no drilling or excavation of material. Phase II investigations began on December 5, 1989, marking the start of "invasive" work. During the course of Phase II work, IT observed the Transfer Station septic system. It was found that sewage lines, compaction fluid lines, and floor drains all connect into one underground system outside the Transfer Station. The system consists of an underground septic tank and drain field (leach field) which lies to the southwest in successive downgrade positions from the Transfer Station. IT observed waste fluid discharging to the ground surface from the cleanout manhole at the head of the drain field. The waste fluid discharged onto the Site.

1.2.3 Previous Investigations

Investigations prior to IT's involvement are documented in Appendix D (Existing Data) of the DWP-I. The documents include reports, boring logs and well completion data, analytical results, aerial photographs, and maps. Previous investigations by IT are documented in the Phase I (Preliminary Investigations) and Phase I (Addendum) Reports. Phase I work consisted of surface geophysical surveys, a topographic survey, aerial photograph interpretation, existing well evaluation, and the soil-gas survey (documented in the Phase I Addendum Report). In summary, previous documents include:

- Reports by Spotts, Stevens, and McCoy (1979, 1980)--concerning investigations pertaining to proposed sludge disposal.
- Reports by Woodward-Clyde Consultants (1982a, 1982b)--concerning preliminary hydrogeological investigations pertaining to Cells C and A, respectively. This report described the F-series wells which are situated around the cell areas of A and B/C.
- Analytical Results for Water Samples -- these include systematic sampling of F-Series wells (installed by Firestone), B-Series wells (installed by the State of Maryland), OW- and SW-Series wells (installed by Cecil County), and selected domestic wells on properties adjacent to the Site.
- Aerial Photographs--these include paired and series of photographs taken by the federal government and private companies during the period from 1964 to 1986.
- Report by the U.S. EPA (EMSL) (1988) providing a Site analysis using available aerial photographs.
- A topographic map by the U.S. Army Corps of Engineers (1988) (for U.S. EPA by Surdex Corporation).

- Other documents included in Appendix D, Detailed Work Plan--Phase I (DWP-I).
- Phase I Report, Preliminary Investigations by IT (September 5, 1989; Revision 01, November 30, 1989)
- Addendum Report, Phase I, Preliminary Investigations by IT (October 10, 1989)

1.3 QUALITY ASSURANCE

Phase II work was performed in accordance with the latest version of the Quality Assurance Project Plan (QAPP) for the Woodlawn Landfill RI/FS, dated November 30, 1989 (Revision 05). As part of the QAPP, a Quality Assurance (QA) field audit was performed as described in the April 16, 1990 Memorandum (Appendix A, this report) by the QA officer.

1.4 REPORT ORGANIZATION

This report is organized as follows:

- The Introduction (Chapter 1.0) presents the objectives, the site background, and the report organization.
- The Site Characterization Objectives, Methods, and Results (Chapter 2.0) include the description of Phase II Tasks (data management, access permission, monitoring well installation, land survey, construction of groundwater contour maps, groundwater sampling and analysis, borehole geophysics, rising head slug tests, pumping tests [not performed, refer to Section 2.9 of the text], and piezometers). Each task, with the exception of data management, is described using the subheading format: Objectives, Methodology, and Results.
- The Site Characterization Findings (Chapter 3.0) present the results of the site characterization under the headings: Hydrogeology (3.1), Groundwater Chemical Analysis (3.2), and Additional Data Needs (3.3).

1.5 PHASE IV - ADDITIONAL FIELD WORK

Although Phase IV work is ongoing in accordance with the Phase IV Detailed Work Plan (DWP-IV), none of the results are presented herein. Additional data needs (Section 3.3 of this report) suggest revisions that are to be made to the DWP-IV to satisfy these needs.

2.0 SITE CHARACTERIZATION

Phase II consists of the following tasks (as per the DWP-II):

- Data Management
- Access Permission
- Monitoring Well Installation
- Land Survey
- Construction of Groundwater Contour Maps
- Groundwater Sampling and Analysis
- Borehole Geophysics
- Rising Head Slug Tests
- Pumping Tests
- Piezometers

Each task, with the exception of Data Management, is described using the subheading format: Objective, Methodology, and Results.

2.1 DATA MANAGEMENT

The data management process, developed for the project and described in the Scope of Work (Revision 01, November 2, 1988), and further discussed in the Phase I Report, was continued through Phase II work. The objectives and the procedures remained the same for Phase II work.

2.1.1 Records Management System

The documents generated by the project have been separated into the categories required for filing into the Records Management/Document Control (RMDC) facility. This process was detailed in the Phase I Report.

2.1.2 Analytical and Field System

The Analytical and Field System (AFS) stores on computer all analytical and field data from Phase II tasks as described in the subsections below. In addition, hard copies of all data are stored in the project files.

2.1.2.1 Boring Logs and Well/Piezometer Diagrams

Boring logs were processed and stored using the Rockware software package specially designed with the IT format. Well/piezometer diagrams were processed and stored using AutoCAD.

2.1.2.2 Land Survey Data

Land survey data were stored on diskette on IT's AutoCAD system containing the site base map.

2.1.2.3 Water Level Data

Groundwater level data were tabulated using Lotus software. Surfer software was used to contour groundwater elevations.

2.1.2.4 Borehole Geophysical Data

Borehole geophysical data including SP, EM induction, and acoustic logs were stored via hard copy in the project files. Borehole television inspections were stored on videotape (VHS format).

2.1.2.5 Slug Test Data

Slug test data were transformed directly from the Hermit Data Logger to diskette via portable computer at the time of testing. TimeLag-1 software was used to process the data.

2.1.2.6 Chemical Analytical Data

Chemical analytical data were tabled and stored using dBase IV software.

2.2 ACCESS PERMISSION FOR PROPOSED MONITORING WELL LOCATIONS

The process for obtaining access to land on or adjacent to the Site for the purpose of conducting Phase II tasks in the field followed requirements in the Consent Order. This process is summarized in the subsections to follow.

2.2.1 Objectives

The objectives of this task were to:

- Gain legal access to properties where data or samples were collected with a minimum of interference

- Maintain favorable community relations with local residents

2.2.2 Methodology

The process for obtaining access permission to land on or adjacent to the Site was begun by contacting Mr. Brian Bollender of the Cecil County Maryland Department of Public Works. Mr. Bollender sent letters to all landowners listed by IT requesting permission to access their property for the purpose of installing and/or sampling groundwater wells. Once permission was granted by the landowners, IT personnel contacted them by phone just prior to entering their property to collect data or samples.

During the course of Phase II work, it was necessary to enter private properties with vehicles, drill rigs, and equipment. Repairs on the property of one resident to alleviate "ruts" left by crossing the land were made by "back dragging" with a bulldozer and by placing crushed stone on the driveway.

2.2.3 Results

As a result of following through with the carefully planned property access procedure, the objectives of this task were fully met. Monitoring wells were installed and sampled on the Site and on the private properties surrounding it as planned. All landowners were satisfied with IT's operations during monitoring well installation and sampling and domestic well sampling.

2.3 MONITORING WELL INSTALLATION

2.3.1 Objective

The objective of this task was to install monitoring wells in locations and with screened intervals to adequately characterize the hydrostratigraphy, water levels, groundwater quality, and hydrologic properties of the site aquifers. In addition, the following subsurface geological information was determined as the borings were advanced for installation of monitoring wells:

- Thickness and character of soils and fill material (overburden) above the bedrock
- Character of bedrock including rock type and fracture zones
- Depth to bedrock

2.3.2 Methodology

Phase II monitoring wells were located to augment the existing monitoring well network. These wells were placed, as specified in the Phase II Detailed Work Plan (DWP-II), to monitor possible contaminant plumes. Soil gas, geophysical, and site historical information gathered during Phase I investigations were used to determine the well locations. The soil-gas survey aided the strategic positioning of monitoring wells through the detection of volatile organic compounds (VOCs) in the subsurface (vadose zone). The presence of VOCs in the soils indicated the areas and potential migration directions of groundwater contaminant plumes. The geophysical survey was also useful for this purpose by indicating the possible presence of groundwater solutes through the detection of conductive plumes in the subsurface. In addition, the geophysical survey seemed to identify areas underlain by buried objects (drums, tanks, etc.) that would resist drilling penetration or that could contain waste materials. Site historical information used for locating monitoring well positions included historical aerial photographs, previous chemical analyses of existing monitoring wells (prior to Phase II installations) and disposal records.

The monitoring wells were sited in a downgradient position to the plumes and source areas defined in Phase I. In two cases, locations for soil and bedrock monitoring well pairings were determined based on water level information obtained following installation of soil piezometer groups. Final locations of monitoring wells are shown in Figure 1.

Monitoring wells for Phase II work were grouped into three different types (with numbering scheme in parenthesis):

- Perched Water Monitoring Wells (ITP-1, ITP-2, and ITP-3)
- Saturated Soil Monitoring Wells (ITS-1, ITS-2, and ITS-3)
- Bedrock Monitoring Wells (ITB-1, ITB-2, ITB-3, ITB-4, and ITB-5)

All monitoring wells were drilled and installed according to procedures in accordance with U.S. EPA-recommended practices as well as Maryland state regulations (Maryland Well Construction Regulations, COMAR 26.04.04).[1] These monitoring wells were drilled and installed by Hydro-Group, Inc., under the direct supervision of an IT project geologist. This subcontractor was preapproved and is registered in the state of Maryland.

The following sections provide details regarding the installation, completion, soil sample collection, and equipment decontamination for each type of monitoring well.

2.3.2.1 Perched Water Monitoring Wells

Two perched water monitoring wells (ITP-1 and ITP-2) were installed to study the quantity and quality of groundwater present in the two areas of perched water identified on site (Figure 1). These wells are located upgradient of the observed seepage areas where perched water is discharging to the surface.

An additional perched water monitoring well (ITP-3) that was not proposed in the DWP-II, but approved by the U.S. EPA during Phase II investigations, was installed to the west of the landfill boundary (Figure 1). This well was completed in a shallow, water-bearing sand and gravel zone identified during the installation of Soil Monitoring Well ITS-3. The purpose of this well was to sample groundwater in the soil that was not entering the nearby Monitoring Well ITS-3 because of a confining clay layer above the planned screen interval of that well.

Borings for perched water monitoring wells were advanced using 6-1/4-inch-inside-diameter (I.D.) hollow-stem augers. Continuous split-spoon samples were collected according to the American Society for Testing and Materials (ASTM) Method 1586[2] during the drilling of Monitoring Wells ITP-1 and ITP-2. Auger cuttings were logged but not sampled during the drilling of Monitoring Well ITP-3 because samples were collected previously from the nearby Soil Monitoring Well ITS-3.

Drilling and installation of perched water monitoring wells were supervised by the IT project geologist on site. Information obtained during drilling operations was recorded on the IT soil boring log forms as specified in Section 6.3.3.1 of the QAPP. Soils were visually classified according to the Unified Soil Classification System (USCS). The locations of the perched water monitoring wells are shown in Figure 1. Boring logs for these wells are presented in Appendix B.

After perched monitoring well borings were drilled to the appropriate depths, the monitoring wells were installed. Prior to installation, well screens and risers were steam cleaned. All monitoring wells were constructed of 4-inch-I.D. Schedule 40 polyvinyl chloride (PVC) flush-threaded (nonglued) riser pipes and machine-slotted well screens with 0.020-inch slot size. A 10-foot-long section of screen with a tight fitting, threaded bottom cap and a sufficient length of riser pipe was lowered into the monitoring well boring inside the hollow-stem augers. Perched Monitoring Well ITP-3 was equipped with a five-foot-long section of screen because of its shallow (nine feet) depth. The top of the riser pipe was fitted with a slip-on cap. As the augers were withdrawn from the hole, the annular space around the screen was backfilled with a coarse quartz sand filter pack to a minimum height of two feet above the well screen. Depths of well construction materials were measured during installation using a weighted measuring tape lowered into the annular space around the casing. Filter pack material was placed slowly into the well from the surface and measurements were taken frequently to reduce the possibility of "bridging" of the filter pack or bentonite seal. A one-foot layer of fine quartz sand was placed above the screen filter pack followed by a two-foot bentonite seal using bentonite pellets. After placement of the bentonite, approximately five gallons of distilled water were poured into the hole to initiate the expansion of the bentonite. This procedure was necessary for these shallow installations because the bentonite was not in contact with sufficient groundwater to saturate the bentonite. After allowing approximately two hours for the bentonite seal to become saturated, the remainder of the annular space was tremie grouted to the surface.

with cement/bentonite grout mixture using 95 percent cement and 5 percent bentonite by weight.

Each monitoring well installation was equipped with a six-inch-diameter protective steel casing with a hinged locking cap. All protective casings were painted with high-visibility paint and labeled with the appropriate well number. State of Maryland monitoring well permit tags were bonded with stainless steel to the outside of each protective casing. An 18-by-18-by-6-inch-thick concrete pad was constructed around the base of each well after completion. Concrete pads were sloped away from the monitoring well to drain surface water away from the well installation. No guard posts were required for perched monitoring wells. Monitoring well installation diagrams are presented in Appendix C.

2.3.2.2 Saturated Soil Monitoring Wells

A total of three saturated soil monitoring wells were installed to supplement the existing monitoring well network (Figure 1). These wells were located where additional information was needed to satisfy the objectives of the Phase II Site Characterization study. One proposed soil monitoring well, ITS-4, was not drilled because all the soil was observed to be dry while drilling for the installation of Monitoring Well ITB-4.

The location of the monitoring wells north of State of Maryland Monitoring Well B-1 (Wells ITB-1 and ITS-1) and west of State of Maryland Monitoring Well B-4 (Wells ITB-3 and ITS-3) were based on the results of piezometer measurements from three new piezometers at each location. The piezometers at each location were placed at corners of a triangle to estimate the plane of the potentiometric surface in the saturated soil. The dip of these planes approximated the groundwater flow directions and were used to determine the placement of the saturated soil wells (downgradient from Cell A and areas of soil-gas anomalies). Companion Bedrock Wells ITB-1 and ITB-3 were placed adjacent to the saturated Soil Wells ITS-1 and ITS-3, respectively (Figure 1).

Piezometer installation followed the procedures detailed in Section 2.10. Approximately two days after installation, water level readings of piezometers were used to site the monitoring wells at each location as described.

Borings for saturated soil monitoring wells were advanced using 6-1/4-inch-I.D. hollow-stem augers. Split-spoon samples were collected at 5-foot intervals using a 1-3/8-inch-I.D. split-spoon sampler following the procedures in ASTM Method 1586. This drilling and sampling method was continued until bedrock refusal was encountered.

As discussed in Section 2.3.2.1, drilling activities were supervised and all appropriate information was recorded by the on-site IT geologist on the soil boring log forms (Appendix B).

After saturated soil monitoring well borings were drilled to the appropriate depth, the monitoring wells were installed as per the approved DWP-II. Prior to installation, well screens and risers were steam cleaned. All monitoring wells were constructed of 4-inch-I.D. Schedule 40 polyvinyl chloride (PVC) flush-threaded (nonglued) riser pipes and machine-slotted well screens with 0.020-inch slots. A section of well screen with a bottom cap and a sufficient length of riser pipe was lowered into monitoring well borings inside the hollow-stem augers. Screen lengths were placed from the bottom of the saturated soil aquifer to five feet above the water table. The screened section, with a tight-fitting threaded bottom cap, was lowered into the monitoring well boring inside the hollow-stem augers. The top of the riser pipe was extended approximately 2.5 feet above the ground surface and fitted with a slip-on cap. As the augers were withdrawn from the hole, the annular space around the screen was backfilled with a coarse quartz sand filter pack to a minimum height of two feet above the well screen. Depths of well materials were measured using a weighted measuring tape lowered into the annular space around the casing. Filter pack material was placed slowly into the well from the surface and measurements were taken frequently to reduce the possibility of "bridging" of the filter pack or bentonite seal. A one-foot layer of fine quartz sand was placed above the screen filter pack followed by a two-foot bentonite seal using bentonite pellets. After placement of the bentonite, approximately five gallons of distilled water was poured into the hole to initiate the expansion of the bentonite. This procedure was necessary for these shallow installations because the bentonite was not in contact with sufficient groundwater to saturate the bentonite. After allowing approximately two hours for the bentonite seal to become saturated, the remainder of the annular space was tremie grouted to the surface with bentonite/cement grout mixture using 95 percent cement and 5 percent bentonite by weight. Monitoring well installation diagrams are presented in Appendix C.

Each monitoring well installation was equipped with a six-inch-diameter protective steel casing with a hinged locking cap. All protective casings were painted with high-visibility paint and labeled with the appropriate well number. State of Maryland monitoring well permit tags were bonded with stainless steel to the outside of each protective casing. An 18-by-18-by-6-inch-thick concrete pad was constructed around the base of each well after completion. Each pad was sloped away from the monitoring well to drain surface water away from the well installation. No guard posts were required for saturated soil monitoring wells.

2.3.2.3 Bedrock Monitoring Wells

Bedrock aquifer monitoring wells were installed as per the approved DWP-II at five locations (Figure 1) to obtain information such as groundwater flow rates and directions, quality of the bedrock aquifer groundwater, and bedrock characteristics. The depths of bedrock monitoring wells were controlled by the quantity of groundwater entering the monitoring well. Compared to well yields of bedrock wells in the local area (Appendix D from DWP-I), a cumulative flow rate of one gallon per minute into the monitoring well was established as a minimum monitoring well yield. Bedrock monitoring wells were drilled to a depth so as to produce a minimum of one-half gallon per minute flow into the borehole. This flow rate was determined by timed measurements of the water level in the well during drilling activities.

As shown in Figure 1, all bedrock monitoring wells were located in close proximity to saturated soil monitoring wells, with the exception of Well ITB-4. No soil monitoring well was installed in this vicinity due to the lack of moisture in the soil. Bedrock monitoring wells were installed using an air rotary drilling method. This method was selected because a temporary surface casing was required to seal off the saturated soil aquifer from the bedrock aquifer and to facilitate penetration of the bedrock.

Bedrock monitoring well pilot borings were advanced through the soil using a ten-inch-diameter air hammer. The borings were then enlarged with a 13-1/4-inch-diameter air hammer. Temporary casing with a ten-inch-diameter was driven to seal off the soil aquifer and to prevent caving of soil into the boring. Borings were advanced a minimum of five feet into bedrock using an undersized air roller bit. An eight-inch-I.D. steel surface casing was installed in the boring and pressure grouted in place. The ten-inch-diameter temporary casing was back driven from the hole concurrent with pressure grouting of the steel surface casing. Grout consisted of a cement/bentonite mixture with 95 percent cement and 5 percent bentonite by weight. Drilling operations were discontinued for a minimum of 24 hours after completion of grouting activities to allow the grout to cure.

The wells were completed in the bedrock aquifer using air rotary drilling methods, drilling a 7-7/8-inch-diameter hole. Periodic water level measurements were taken using an electronic water level meter to determine when sufficient water flowed into the well to stop drilling. Bedrock wells were drilled into the bedrock aquifer a minimum of 30 feet. This enabled the installation of the bentonite seal at least 15 feet below the top of the bedrock surface.

After the required depth of the bedrock monitoring well was reached, a ten-foot-long section of four-inch-I.D. Schedule 40 polyvinyl chloride (PVC) machine-slotted well screen with a bottom cap and a sufficient length of four-inch-I.D. Schedule 40 PVC flush-threaded (nonglued) riser pipe was lowered into the monitoring well boring inside the hollow-stem augers. The well was completed using procedures similar to those described for completing other on-site monitoring wells. Guard posts were installed around bedrock Monitoring Well ITB-1. These posts were grouted in place and painted with high-visibility paint. Monitoring well installation diagrams are presented in Appendix C. All variances to specified well drilling or installation procedures were documented and are presented in Appendix A.

In the case of the Bedrock Well ITB-5 (near the previously existing F-3 saturated soil monitoring well), the bedrock was cored in accordance with the approved DWP-II prior to reaming out the hole to the appropriate diameter and prior to installing the monitoring well.

Rock coring was accomplished using a soil boring drill rig equipped with an NX double-walled core barrel with a diamond bit. Core runs were ten feet in length and all core removed from the boring was placed in core boxes for inspection by the IT geologist. After completion of coring operations, the boring was reamed out to a diameter of 7-7/8 inches and the monitoring well was installed as previously described. Rock core descriptions for bedrock Monitoring Well ITB-5 are included with the boring logs in Appendix B.

A visual description of the bedrock materials encountered was made by the IT geologist based on visual observations of the cuttings from air rotary drilling methods and/or rock core samples. Information obtained during drilling operations including depths to fracture zones was recorded on a Visual Classification of Rock Boring Log as specified in Section 6.3.3.1 of the QAPP and shown in Figure 6-5 of the QAPP. Boring logs for bedrock monitoring wells are presented in Appendix B.

2.3.2.4 Well Development

New monitoring well installations were developed as per the approved DWP-II after completion for approximately eight hours or until the water produced had a measured turbidity of 10 Nephelometric turbidity units (NTUs) or less, whichever occurred first. This procedure ensured that a satisfactory hydraulic connection was established between the well and the aquifer being monitored. Well development consisted of mechanical and/or air surging techniques, bailing, and pumping to remove any fine material remaining in the well or filter pack. Perched water and saturated soil monitoring wells were developed using surge blocks and bailing. Surge blocks were used to help flush fine materials from the surrounding filter pack. After the wells were surged, the water in the well was bailed out with PVC bailers. The bailing method was used in place of the pumping method on perched water and saturated soil wells because of the presence of sandy material. On more than one occasion, pumps became clogged shortly after pumping was initiated. In the case of perched water and saturated soil monitoring wells, the 10 NTU criterion was generally not met, and as a result, these wells were each developed for approximately eight hours.

The wells not meeting the 10 NTU criterion (with NTU reading in parenthesis) were:

- ITS - 1 (>100 NTUs)
- ITS - 2 (>100 NTUs)
- ITP - 1 (80 NTUs)
- ITP - 2 (>100 NTUs)

Bedrock monitoring wells were developed using only a four-inch submersible stainless steel pump. This method was sufficient for purposes of well development because the 10 NTU requirement was generally reached within a period of less than one-half hour of pumping. Following development, each well was slug tested to estimate hydraulic conductivity of the aquifers. Pumping tests were not performed on the wells as discussed in Section 2.9.

Sample purging rates were kept below well development rates in all cases. Similar pump systems were used for well development and sample purging to preclude the possibility of exceeding development pumping rates during sample purging.

Waste groundwater generated during well development was stored on site in 55-gallon drums. These drums were labeled according to well number, date, and contents (development water) and placed on wooden pallets in the area designated for wastewater storage. These drums remain on site while various management options for removal/disposal are being evaluated.

2.3.2.5 Soil Sample Collection

As previously described, soil samples were collected as per the approved DWP-II at five-foot intervals while advancing the borings for saturated soil monitoring well installations. After collection, split-spoon soil samples were screened for volatile organic compounds (VOC) using a VOC photoionization detector (PID). A 10.2 eV lamp was contained within the PID instrument used for screening soil samples. This lamp is capable of detecting the volatile organic compounds identified in Table 2.1 of the QAPP. After soil samples were visually inspected, they were then removed from the split-spoon sampler and placed in 500 ml glass jars and covered with aluminum foil. On the same day of drilling, samples were then permitted to sit in an area kept at room temperature (approximately 68 degrees Fahrenheit) for a minimum of 30 minutes to allow any volatile organic vapors to volatilize into the head space of the glass sample jar. After the 30-minute waiting period the tip of the PID probe was inserted into the head space of the glass jar by puncturing the aluminum foil cover. Results of the PID screenings were recorded on boring logs (Appendix B). Waste soil material brought to the surface during the drilling activities was held on site in 55-gallon drums placed on wooden pallets. These drums were labeled according to well number, date, and contents (soil) and placed in the area designated for waste soil storage. Waste soil drums remain on site while various management options for removal/disposal are being evaluated.

The decontamination procedure for soil sampling followed the procedure identified in Section 6.3.6 of the QAPP. The description of this procedure is included in the subsection to follow.

2.3.2.6 Equipment Decontamination

To prevent the possibility of cross contamination between monitoring well locations, drilling equipment was decontaminated as per the approved DWP-II directly after completing each monitoring well. This approved decontamination procedure consisted of steam cleaning all augers, drill bits, drill rods, and other drilling equipment with a high pressure steam cleaner at the designated site decontamination area. Water generated during decontamination activities was held on site in 55-gallon drums placed on wooden pallets. These barrels were labeled according to contents (decontamination water) and date. Barrels were placed in the area designated for wastewater storage.

In addition, equipment used for collection of soil samples (split-spoon samplers, hand trowels, sample pans, etc.) was decontaminated between collection of each split-spoon sample. The decontamination procedure for soil sampling followed the procedure identified in Section 6.3.6 of the QAPP. This procedure consisted of the following sequence:

- Detergent wash
- Tap water wash
- DI water rinse
- Methanol rinse
- Allow equipment time to air dry
- Final DI water rinse

Sampling equipment was allowed sufficient time to air dry after decontamination before reuse. During drilling activities, split-spoon samplers were decontaminated after collection of each soil sample. After spoons were decontaminated, they were placed on clean polyethylene sheeting until required for collecting additional samples. Bailers were decontaminated after each use at a well location. After decontamination, bailers were wrapped in polyethylene until used at the next sampling location.

2.3.3 Results

A total of 11 new monitoring wells were installed during Phase II to supplement the existing monitoring well network (Figure 1). Two approved changes were made in the well program during the course of Phase II field work as described in the remainder of this paragraph. An additional perched water monitoring well, ITP-3, was installed close to soil Monitoring Well ITS-3. This well was installed to monitor groundwater in the perched sand and gravel zone identified while drilling Well ITS-3. Monitoring Well ITS-3 was found to be dry shortly after its installation and has remained so as of the measurement taken on April 10, 1990. Another change to the well program, as modified and approved by the U.S. EPA, involved the omission of the soil companion well to bedrock Monitoring Well ITB-4. The decision to omit this well from the program was based on the soil overlying the bedrock being dry in the Well ITB-4 boring. In addition, the closest existing soil monitoring wells, OW-3 and OW-4, were also dry at this time.

The stratigraphy of soil, fill, and bedrock types encountered during drilling is presented on boring logs in Appendix B. Boring logs include the nature and thickness of overburden material and the nature of bedrock. Bedrock elevation contours representing the top of the bedrock surface are depicted in Figure 2. These contours were based on surface geophysical data collected during Phase I investigations and on boring log data collected during Phase II.

Details of each monitoring well installation are shown in the diagrams found in Appendix C.

All monitoring wells (including piezometers) installed during Phase II were permitted by the state of Maryland prior to the start of drilling operations. Table 1 summarizes pertinent information regarding monitoring wells (and piezometers), including permit number, ground surface elevation, well depth, aquifer designation, and screen interval.

Water level measurements for newly installed (Phase II) monitoring wells and previously existing monitoring wells are presented in Table 2.

In addition to the installation and completion of the Phase II monitoring wells as described above, IT made repairs where needed and provided additional protection to the following state and county wells: OW-1, OW-4, B-2, B-3, B-4, B-5, and B-6. PVC riser pipe extensions of like diameter were connected to the existing pipes with a coupler after uneven damaged portions were removed. The riser pipes were extended to a level approximately 2.5 feet above the ground surface. These wells were fitted with steel protective casings and with concrete bases as for the monitoring wells installed by IT.

Monitoring Well B-1 was determined by borehole television inspection to be blocked at a level 32 feet below ground surface. An attempt was made to salvage this well by drilling through the plug. However, during this operation, the PVC collapsed several feet below the ground surface. IT classified this well as unreliable for data collection (groundwater chemical samples and water levels) because of possible screen damage. The state of Maryland (Maryland Department of the Environment) was notified on February 26, 1990 concerning the condition of Well B-1. This well presently awaits decommissioning.

2.4 LAND SURVEY

2.4.1 Objective

The objective of surveying the locations and elevations of monitoring wells and piezometers was to accurately locate the wells so that representative site maps, including stratigraphic cross sections and contour maps, were accurately drawn.

2.4.2 Methodology

Land surveying of monitoring wells, domestic wells, and piezometers was performed in accordance with the approved DWP-II by Ludgate Engineering Corporation, approved professional land surveyors with registry in the state of Maryland. All Ludgate personnel entering the site were certified with 40-hour OSHA waste site worker training prior to entering the Site. Surveying operations were supervised by the IT Site Manager. Location coordinates were based on the Maryland State Plane Coordinate System previously established on the site base map (during Phase I). Well elevations were tied to the existing bench mark located northeast of the Transfer Station and based on the 1927 North American Datum. Elevations of each well were recorded at the ground surface, top of the inside casing, and top of the outside casing and referenced in feet above mean sea level. Elevation measurements were made to within an accuracy of 0.01 foot. Location coordinates and elevations were surveyed with reference points as described above utilizing the closed traverse survey method. This method provided accuracy checks during its performance by closing the traverse to the initial survey point. This task included the marking of each well's inside casing with a v-notch to indicate the reference datum for all water level measurements.

In addition to newly installed monitoring wells, domestic wells, and piezometers, all existing state and county wells upgraded with PVC extensions and steel protective casings were resurveyed.

2.4.3 Results

Survey data for all monitoring wells are summarized in Table 2. Survey data for domestic wells are summarized in Table 3. Ludgate Engineering provided IT with data stored on a diskette compatible with the IT AutoCAD system. Well coordinates were directly input to AutoCAD via diskette.

2.5 CONSTRUCTION OF GROUNDWATER CONTOUR MAPS

2.5.1 Objectives

The objectives of constructing groundwater contour maps were to determine Site area groundwater flow directions and gradients in the saturated soil aquifer and in the bedrock aquifer.

2.5.2 Methodology

To meet these objectives, groundwater level (potentiometric surface) measurements were obtained from the bedrock aquifer wells and from the saturated soil aquifer wells as per the approved DWP-II. The instruments used were an electronic measuring device (M-Scope) for Site monitoring wells and piezometers and an acoustic sounding device for domestic wells. Both instruments were calibrated and cross checked to assure reliability. Water level measurements were converted to elevations above mean sea level using the land survey elevations.

The contour map of the potentiometric surface of the soil aquifer was constructed using Surfer software. Inputs included the scale (adjusted to match the site base map), site and well location coordinates, and groundwater elevations for each soil well. The elevation inputs were based on water levels measured during a single sampling event. Water levels were compared to a sampling event repeated approximately one month later to confirm results. The Surfer contour map was supplemented by hand drawing to refine the contour representations. A variable contour interval was chosen in the northeast part of the Site where the potentiometric surface is relatively flat.

The contour map of the potentiometric surface of the bedrock aquifer was constructed by plotting the derived elevations on the map at the corresponding bedrock monitoring or domestic well. Elevations were interpolated to produce a contour interval of ten feet. This contour interval was selected based on the map scale and available data.

2.5.3 Results

Contour maps for the soil aquifer and the bedrock aquifer are shown in Figures 3 and 4, respectively. Arrows point towards the general direction of groundwater flow on these maps. Gradients vary within the range of 0.005 to 0.330 for the soil aquifer and within the range of 0.020 to 0.125 for the bedrock aquifer.

Table 2 summarizes groundwater elevations for all existing site monitoring wells. Domestic well groundwater elevations are presented in Table 3.

2.6 GROUNDWATER SAMPLING AND ANALYSIS

2.6.1 Objective

The objective of this task was to characterize contaminants in the perched, soil, and bedrock aquifers by sampling previously existing monitoring wells, IT-installed (Phase II) monitoring wells, and selected domestic wells.

2.6.2 Methodology

The IT Analytical Services (ITAS) Laboratory in Export, Pennsylvania was used for all analyses. The U.S. EPA was provided with the credentials of the ITAS laboratory, including their Contract Laboratory Program (CLP) certification. The U.S. EPA approved the use of ITAS for analytical work on the Woodlawn Landfill RI/FS.

The U.S. EPA-approved analytical program established for the initial sampling of all groundwater samples included:

- VOCs on the Target Compound List (TCL) plus acrolein, acrylonitrile, and 2-chloroethyl vinyl ether
- Base neutral/acid extractable organic compounds (BNAs) on the TCL
- Chlorinated pesticides plus PCBs
- Inorganic analytes on the Target Analyte List (TAL) minus selenium and antimony

The U.S. EPA- and the state of Maryland-approved modifications (addition of acrolein, acrylonitrile and 2-chloroethyl vinyl ether and deletion of selenium and antimony) were based on a review of the compounds listed in the Consent Order, compounds found on site in previous water analyses, and compounds on Maryland's laboratory report list. Analytical results obtained prior to IT involvement are contained in Appendix D of the Detailed Work Plan for Phase I.

The complete list of analytes is presented in the data tables in Appendix D. These analyses were completed using the U.S. EPA Contract Laboratory Program (CLP) protocols. The IT QA/QC laboratory procedures are specified in the project-specific QAPP. The appropriate number of field blanks, trip blanks and field duplicate samples were collected to meet the requirements established in the QAPP. Duplicate samples were each given an individual sample number or name and sent to the laboratory as "blind" samples. This was to ensure that no special treatment would be given to QA/QC samples in the laboratory. Samples and blanks were analyzed according to the analytical methods identified in Tables 2.1 and 2.2 of the QAPP.

Sampling methods for the collection of monitoring well and domestic well samples are described in the subsections below.

2.6.2.1 Monitoring Well Sampling

Monitoring wells were sampled using a Teflon bailer in all cases. Temperature, conductivity, and pH measurements were taken at regular intervals on wells that required the purging of "large" volumes of water and could not be drawn down to dryness or near dryness. Monitoring Wells ITB-2 and ITB-5 recovered very rapidly (concurrent with pumping). Readings were taken at intervals of approximately 20 gallons of purged water until the temperature, conductivity, and pH were stabilized. For wells that could be purged or bailed to dryness, the well was evacuated a minimum of two casing volumes and allowed to recover prior to sample withdrawal. Except for those monitoring wells that were pumped or bailed to dryness, a minimum of three casing volumes was purged prior to sampling. The wells were purged according to the procedure established in Section 6.3.1

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of the QAPP. Water removed during purging and sampling activities is being held on site pending evaluation of specific management options for removal/disposal.

After purging, monitoring well groundwater samples were collected according to the procedures identified in Section 6.3 of the QAPP by pouring from the bailer directly into the appropriate sample bottles. Samples designated for inorganic analyses were poured directly from the bailer into the filtering apparatus and filtered with a 0.45 micron filter prior to preparation for shipment to the laboratory. Each groundwater sample collected was measured in the field for pH, specific conductance, and temperature (Table 4). These field tests were completed with properly calibrated equipment as per Section 6.5.1 of the QAPP. Each set of samples was labeled at the time of collection and stored in a cooler with ice to maintain a temperature of approximately 4 degrees Celsius until final packaging was completed for shipment of samples to the laboratory.

Sampling pumps and bailers were decontaminated after collection of groundwater samples at each monitoring well location. The decontamination procedure consisted of pumping a minimum of five gallons of clean tap water through the pump and discharge line and rinsing the outside of the pump and discharge line with clean tap water. This step was followed by a final rinse with deionized water of the outside of the pump and discharge hose and pumping a minimum of five gallons of deionized water through the pump. Bailers were decontaminated by steam cleaning and washing with a nonphosphate detergent and water followed by a tap water rinse, deionized water rinse, methanol, total air drying, and a final deionized water rinse. Field test equipment probes (pH, specific conductance, and temperature) were decontaminated with deionized water after each use.

Groundwater samples collected were maintained by IT chain-of-custody protocol as specified in the QAPP from the time of collection to disposal of the samples after laboratory analyses were completed. These procedures required that each sample be recorded on a Chain-of-Custody form. This completed form accompanied the samples after collection to the laboratory. In addition, each sample was recorded on a Request for Analysis form which identified the analytical program to be completed for each sample collected. A sample collection log was completed for each sample collected. These logs were used to record specific sample collection information (including water level readings). Sample collection logs are maintained in the project files.

2.6.2.2 Domestic Well Sampling

Domestic well samples were collected from the faucet or valve closest to the well discharge point. Samples were collected prior to the water going through any filtering systems. The exact locations of domestic well samples and features of the domestic water supply systems (including holding tanks and filtration systems) are presented in Table 19 of the revised report. Before samples from domestic wells were collected the pumps were run a minimum of 15 minutes to ensure that fresh groundwater samples were collected. Field parameters (pH, specific conductance, and temperature) were measured on all domestic wells (Table 4). Samples were placed in the appropriately labeled sample jars and stored in a cooler with ice until packaged for final shipment to the laboratory as prescribed in the approved project QAPP. Chain-of-Custody forms, Request for Analysis forms, and sample collection logs were filled out as described in the previous subsection (Monitoring Well Sampling). Field test equipment probes were decontaminated with deionized water following each usage.

Domestic water well levels were measured using an acoustic sounding device. The acoustic sounding device was chosen to measure water levels in the domestic wells because it requires no placement of probes into the well. Prior to using the acoustic sounding device on each day of work, the acoustic sounding device was checked for calibration by measuring the water level on the Transfer Station monitoring well using both the acoustic sounder and a calibrated M-Scope (a graduated, electronic measuring tape). After results of the two devices compared favorably, the acoustic device was used for measurement on domestic wells.

2.6.3 Results

Results of groundwater chemical analyses of monitoring wells are summarized in Tables 5, 6, and 7. Results of domestic well analyses are summarized in Table 8. These tables contain all detected analytes validated according to the guidelines referenced in the second paragraph of Section 2.6.3. Figure 5 shows the domestic wells sampled in terms of groundwater chemical analyses and/or water level measurements. Three-dimensional plots of contaminant concentrations for vinyl chloride, total phthalates and BTEX are shown in Figures 6, 7, and 8, respectively. These figures were created using Surfer software. Figure 9 shows concentration isopleths for total metals (iron and manganese). This figure was created by Surfer software and overlaid on the AutoCAD site base map.

The data validation procedure for vinyl chloride and bis(2-ethylhexyl)phthalate analyses from monitoring and domestic wells is summarized in Tables 15 and 16, respectively.

Chemical analytical data were validated according to U.S. EPA's "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses"[3] and "Functional Guidelines for Evaluating Inorganic Analyses."[4] The "ten times" rule has been applied to common laboratory contaminants including acetone, 2-butanone, methylene chloride, toluene, and phthalate esters. The "five times" rule has been applied to other TCL compounds when found in associated blanks. Refer to Table 9 for a summary of data qualifier (B, J, E, etc.) definitions. Average precision and accuracy were calculated according to the methods detailed in Chapter 12.0 of the QAPP. Tables 10, 11, 12, and 13 summarize the precision and accuracy data for volatile organics, semivolatile organics, pesticide/PCBs, and metals analyses, respectively. These tables identify the samples analyzed in each group, associated QC samples, number of parameters analyzed, and out-of-control precision and accuracy values. Evaluation of these results will be made during Phase III work (Data Evaluation). A summary of Quality Assurance/Quality Control (QA/QC) data is presented in Table 14. The purpose of Table 14 is to give an initial overview of the QA/QC results for groundwater sampling.

Table 17 provides the summary of data completeness for vinyl chloride and bis(2-ethylhexyl)phthalate including the percentage of total usable data points out of the set of total data points collected and analyzed and available. The data were evaluated against holding times, QC Sample Criteria, ability to reanalyze the samples, and lost or broken sample containers (as specified in Chapter 12.0 of the QAPP).

Data comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. This parameter was evaluated and it was determined that the data sets were comparable based on the implementation of standard collection procedures (i.e., bailers used to collect all samples) and analysis techniques (CLP protocol). In addition, all analytical results were reported alike in appropriate units. Precision and accuracy data for all the groundwater samples were acceptable (above 90 percent usable) and, therefore, the data sets of the first round of sampling can be compared with confidence.

2.7 BOREHOLE GEOPHYSICS

2.7.1 Objectives

The objectives of the borehole geophysical survey were to further characterize the hydrogeologic and physical site conditions and to correlate with the results of the surface geophysical studies, where applicable.

2.7.2 Methodology

Borehole geophysical methods in accordance with the approved DWP-II include borehole geophysical surveys and borehole television inspections. Each of these methods is detailed in the subsections below.

2.7.2.1 Borehole Geophysical Surveys

The geophysical methods consisted of using a borehole probe and a surface console to monitor specific subsurface conditions. The probe traversed the borehole transmitting and/or receiving the appropriate data, while the surface unit controlled the signal parameters and recorded the resulting responses.

Borehole geophysical surveying included Spontaneous Potential (SP) logging, velocity (sonic) logging, and electromagnetic (EM) induction logging. Borehole television inspections were also performed (Section 2.7.2.2). The SP devices measured the electric potential difference between a fixed surface electrode and an electrode on the probe. The electric potential between the two electrodes changes as the probe electrode moves from one lithologic unit to another. The interface is indicated by the inflection point on the log curve. SP provided supporting information regarding the permeability of surrounding material.

Sonic logs were developed by measuring the "internal transit time" for an acoustic wave to travel within geologic formations. The capacity of geologic formations to transmit sound waves varies with lithology and with rock texture, notably porosity. The sonic logs provided stratigraphic and porosity information regarding the surrounding formation. Interfaces within natural soils and between the soils and bedrock were identified. To some extent, the sonic logs were also helpful in identifying fractures and fractured zones, which can represent pathways for groundwater flow. These data were correlated with the results of surface (including seismic refraction) and subsurface studies (Section 2.7.3.1).

EM induction devices generate a primary electromagnetic field at a transmitter coil. The primary field induces electric currents in the surrounding material, where they are detected by their effects on a receiving coil. Strength and phase comparisons between the primary and secondary fields indicate the conductivity of the surrounding material. EM induction measured the electrical conductivity of the surrounding material. These data indicated the absence or presence of electrolytes (i.e., solute plumes) and were correlated with surface EM survey data (Section 2.7.3.1).

Bedrock Monitoring Wells ITB-2 and ITB-5 and Soil Monitoring Wells ITS-2 and SW-1 were surveyed using the methods described above.

2.7.2.2 <u>Borehole Television Inspections</u>

Borehole television inspection was performed by lowering a waterproof television camera with integral lighted attachments down the well bore and viewing the side of the hole with axial (downhole) and radial (sidehole) lenses. Each view was titled and videotaped. The method used a Westinghouse ETV-1252 black and white television inspection system.

Borehole television inspection was used to evaluate the integrity of wells, to identify bedrock fractures, and to observe water movement at fracture zones. The latter was accomplished by watching sediment particles in the groundwater as they drifted by fracture apertures. The displacement of particles indicates turbulent groundwater flow into or out of the borehole from the surrounding strata through the fracture. If particulates are not displaced, this may indicate that these fractures may not produce much water or the water flow is more laminar than turbulent.

Borehole television inspection was performed in pre-Phase II Monitoring Wells B-1, B-2, B-3, OW-1, and OW-2 for integrity evaluation and to observe flow of water at the well screens. Unprotected PVC riser pipes were damaged at the ground surface in these wells prior to Phase I work.

Borehole television inspections were also performed on IT Wells ITB-2 and ITB-5. Inspections performed on these wells were for the evaluation of fractures and groundwater flow in bedrock and to observe the character of the bedrock. Final completion of the bedrock borings with PVC well screens and riser pipes were delayed to accommodate borehole television inspection. These boreholes were cased to the top of the rock before inspections were performed.

2.7.3 <u>Results</u>

The results of borehole geophysical surveys and television inspections are presented in the subsections below.

2.7.3.1 <u>Borehole Geophysical Surveys</u>

Geophysical survey results were presented on hardcopy as individual logs for each method run. Interpretation of results was based on the entire suite of logs run for a particular well. No single method stood alone as an interpretive tool.

Geophysical results from all methods were correlated with other subsurface studies (boring log, borehole camera, seismic refraction, and surface EM survey information) to confirm depths of lithologic units, fractures, and presence of electrolytes.

Saturated Soil Monitoring Well SW-1 (installed by Cecil County) was logged to a depth of 35.0 feet below ground surface. The water level was recorded at 21.0 feet below ground surface. The EM induction log showed a significant increase in conductivity at the water table depth. This was apparently due to the presence of metals (Fe and Mn) in the groundwater confirmed by the chemical analysis for this well (Table 7). This was also supported by the relatively high conductivity value for this well taken during water sampling (Table 4). No indication of buried metals was exhibited by the EM log. The EM induction method is capable of detecting the presence of buried metals, i.e., drums within a radius of approximately two meters from the well (or borehole).

Bedrock Monitoring Well ITB-5 was logged to a depth of 66.0 feet below ground surface. The water level was recorded at 20.0 ft. below ground surface. The bottom of the steel casing was logged at 44.0 feet below ground surface. The SP log showed a gradual drop in electronegativity indicating increasing permeability (i.e., fractures) in bedrock towards the bottom of the boring. The sonic log indicated the presence of fractures at depths of 45, 48, and 62 feet. It also displayed the homogeneity of the gneissic granite bedrock. EM induction logging showed a significant increase in conductivity at a depth of 62 feet. This was likely due to the presence of metals in the groundwater, as in Monitoring Well SW-1. Refer to Table 4 for the concentrations of iron and manganese in the groundwater for Monitoring Well ITB-5. The EM log showed no indication of buried metals nearby the well. No anomaly was defined by Phase I surface geophysical methods at the location of either of these wells.

Saturated Soil Monitoring Well ITS-2 was logged to a depth of 61.0 feet below ground surface. The water level was recorded at 48.0 feet below ground surface. The EM induction log showed no significant changes in conductivity in the well. No indication of buried metal sources was exhibited by the EM log.

Monitoring Well ITB-2 was logged to a depth of 102.0 feet below ground surface. The water level was recorded at a depth of 47.0 feet below ground surface. The bottom of the steel casing was logged at 70.0 feet below ground surface. The SP log showed a gradual drop in electronegativity indicating increasing permeability (i.e., fractures) in the bedrock towards the bottom of the boring. The sonic log indicated the presence of fractures at depths of 76, 82, 91, and 100 feet. The EM induction log showed no sign of buried metals around the well nor any increase in conductivity to indicate the presence of contaminants in the groundwater.

2.7.3.2 Borehole Television Inspections

Borehole television inspections were recorded on videotape (VHS format) with back-up copies made and stored in the project files. The description of each well in the following paragraphs highlights the relevant findings contained within the videotapes. Saturated Soil Monitoring Well B-1, installed by the state of Maryland, was found to be plugged at a depth of 32.0 feet below ground surface. Debris including soil, leaves, and PVC shards was contained in the plug. An attempt to free the blockage using a 1.0-inch-I.D. PVC riser pipe placed inside the existing riser pipe was not successful.

Saturated Soil Monitoring Well B-2, installed by the state of Maryland, was logged showing a total depth at 73.0 feet below ground surface, with the water level at 45.0 feet below ground surface. Screen slots began at a depth of 69.0 feet below ground surface down to the well bottom. Screen slots on one side appeared particularly clogged with debris (possibly algal growth). Tree leaves were observed within the water and on the side of the casing above the water level.

Saturated Soil Monitoring Well OW-1, installed by Cecil County, was logged as having a total depth of 51.0 feet below ground surface. The water level was recorded at 41.0 feet below ground surface. Screen slots began at a depth of 46.0 feet below ground surface and extended to the well bottom. Eighteen sets of twelve slots each were noted over this interval. Solidified lobes of adhesive extending from casing joints down across screen slots were observed. These lobes were thought to be glue used in the connection of PVC riser pipe and screen during the well installation.

Saturated Soil Monitoring Well OW-2, installed by Cecil County, was logged having a depth of 70.0 feet below ground surface. Screen slots began at 63.0 feet down to the well bottom. The water level was recorded at 46.0 feet below ground surface. As in Monitoring Well OW-1, solidified adhesive lobes were observed at and extending down from casing joints across the screen slots.

Monitoring Well ITB-2 was inspected from the bottom of the steel casing at 70.5 feet below ground surface to the well bottom at 101.5 feet below ground surface. The water level was recorded at 46.0 feet below ground surface. The bedrock type observed was predominantly metadiorite with minor, coarser crystalline variations at the top of bedrock resembling the gneissic granite. Fractures were observed at depths of 82, 86, 91, 99, and 101 feet. Fractures were generally irregular, wedge-shaped widening to various sizes. The most significant fracture, observed at a depth of 101 feet, widened to approximately one inch at the well bottom.

Monitoring Well ITB-5 was inspected from the bottom of the steel casing at 44.0 feet to the well bottom at 68.0 feet below ground surface. The water level was recorded at a depth of 20.0 feet below ground surface. Gneissic granite was observed throughout the extent of the viewed boring with occasional local variations in mineralization. A one-foot-long vertical inclusion containing darker, fine grained minerals was observed at 48.0 feet. Fractures were noted at depths of 55, 58, 65, and 68 feet. Fracture orientation were high angle to near vertical and near horizontal. Fracture widths ranged in size but were less than one inch as observed at the well bottom.

2.8 RISING HEAD SLUG TESTS

2.8.1 Objectives

The purpose of performing rising head slug tests was to estimate the hydraulic conductivity of the soil and bedrock aquifers and perched water zones.

2.8.2 Methodology

Rising head slug tests as per the approved DWP-II were performed in each of the following wells installed by IT: ITP-1, ITP-2, ITS-1, ITS-2, ITB-1, ITB-2, ITB-3, ITB-4, and ITB-5. In addition, two pre-Phase II wells were slug tested, namely Soil Monitoring Wells SW-1 and F-7.

Rising head slug tests were performed using a Hermit Data Logger, Model 2000 (HDL). The HDL consisted of a portable, electronic console unit and a pressure sensitive probe (transducer). It was programmed to record the water level changes over time during the test. A three-inch-outside-diameter (O.D.) PVC cylinder, a slug, with a length of ten feet was used to displace water in the majority of the monitoring wells. A five-foot-long slug was used for perched wells which contained a lesser standing water column. A one-inch-diameter stainless steel slug was used to accommodate the riser diameter (two-inch I.D.) of Monitoring Well F-7.

Prior to initiating the rising head slug test, the groundwater level in each well was recorded using an M-scope (a graduated, electronic measuring tape). The actual rising head slug test started with complete removal of the slug from below the water. The resulting drop in groundwater elevation was recorded by the transducer marking the actual starting time of the test. The gradual rise in the water level in the well was recorded periodically to the nearest 0.01 foot, at time intervals established prior to testing. Depth-time measurements were recorded until the water level reached equilibrium or a sufficient number of readings clearly indicated a trend on a semilog plot of time versus depth. The time required for slug test completion was dependent on the slug volume and the formation hydraulic conductivity.

All data measured during slug tests were electronically transferred ("dumped") to a portable computer at the earliest convenient time during the same day of testing. Backup copies of data were stored on diskettes created at the end of each testing day. Diskettes containing the raw slug test data as well as hard copies of the data are stored in the project files.

As per the approved DWP-II, precautions were taken so that the wells were not contaminated by materials introduced during the tests. These testing materials, including the transducer, slug, and water level probe, were decontaminated prior to and after each slug test. The slug was fitted with new nylon rope for the testing of each well.

2.8.3 Results

The hydraulic conductivity estimates are summarized in Table 18. These estimates were computed using TimeLag-1 Software. TimeLag-1 is a microcomputer program which utilizes the methods of Hvorslev[5] and Bouwer and Rice[6] to determine these estimates.

The hydraulic conductivities for bedrock aquifer wells ranged from 2.7 x 10^{-5} centimeters per second (cm/s) to 1.4 x 10^{-2} cm/s. The hydraulic conductivities from the soil aquifer wells ranged from 8.6 x 10^{-5} cm/s to 2.8 x 10^{-4} cm/s. The hydraulic conductivities from the perched wells ranged from 2.1 x 10^{-4} cm/s to 2.5 x 10^{-4} cm/s. With the exception of bedrock Monitoring Well ITB-2, hydraulic conductivities of the soil and bedrock aquifers lie within a similar range. The similar conductivity values are likely due to the hydraulic connection between the two aquifers and the range in yields from the fractures in the bedrock aquifer from well to well.

The hydraulic conductivity in the bedrock aquifer across the site depends on the specific characteristics of the bedrock fractures. These characteristics include the number, size, shape, and distribution of the fractures or fracture systems in the rocks. Openings in the rock form either at the same time as the formation of the rock matrix (primary porosity) or at a later time (secondary porosity). Crystalline rocks such as the ones found in the bedrock beneath the site rarely exhibit significant primary porosity. Secondary porosity occurs either as the result of dynamic earth movements (faulting) or by weathering. Different rock types such as gneissic granite and metadiorite respond differently to faulting and weathering and therefore different characteristic fracturing results. The difference in hydraulic conductivity of the bedrock across the site depends on the resultant fracturing from a combination of the above characteristics and processes.

Variations in the hydraulic conductivity across the site in the soil aquifer depend primarily on differences in clay content in the saprolite. Variations could also occur according to the degree to which the soils have been reworked and reconstituted by landfill operations.

2.9 PUMPING TESTS

2.9.1 Objective

The objective of pumping tests was to evaluate aquifer characteristics and parameters such as hydraulic conductivity. However, no pumping tests were performed during Phase II to preclude cross contamination of soil and bedrock aquifers. This U.S. EPA-approved decision was documented in correspondence dated March 6, 1990. Rising head slug tests were used, as described in the previous section, to estimate characteristics of soil and bedrock aquifers and perched water zones. As a result, no soil or bedrock piezometers were installed to serve as pumping test observation wells.

2.10 PIEZOMETER INSTALLATION

2.10.1 Objective

The objective of piezometer installation was to better locate soil and bedrock monitoring wells downgradient of suspected site sources of contamination.

2.10.2 Methodology

The location of the monitoring wells north of state of Maryland Monitoring Well B-1 (Wells ITS-1 and ITB-1) and west of state of Maryland Monitoring Well B-4 (Wells ITS-3 and ITB-3) were determined as per the approved DWP-II by the results of piezometer measurements from three new piezometers installed at each location (Figure 1). The piezometers at each location were positioned at corners of a triangle used to determine the plane of the potentiometric surface of the saturated soil aquifer. The dip directions of these planes were used to approximate the groundwater flow directions and thus determine the placement of the saturated soil wells downgradient from areas of suspected site contamination (i.e., downgradient from areas with soil-gas anomalies). Companion bedrock wells were placed adjacent to these saturated soil wells (Figure 1).

Piezometer installation followed the procedure detailed in the subsection below.

2.10.2.1 Soil Piezometer Installation

Piezometers were installed in soil using 3-1/2-inch-I.D. hollow-stem augers. The borings were located within approximately 50 feet of the proposed monitoring wells and drilled to auger-refusal depth. After the well was advanced to this depth, a section of screen and attached riser pipe was assembled. The screen was a one-inch-I.D. slotted PVC screen with length extending from the bottom of the boring to five feet above the soil aquifer potentiometric surface. The screen and riser pipe were placed in the borehole. As the augers were withdrawn, the annular space around the screen was backfilled with a coarse sand filter pack to a minimum elevation of two feet above the groundwater table in the soil. The piezometers were completed in the same manner as the monitoring wells.

Piezometers were developed for approximately eight hours using air injection and mechanical surging techniques. Wastewater generated during development was poured into drums and stored in the area designated for wastewater storage pending evaluation of specific management options for removal/disposal.

Boring logs documenting auger cuttings, moisture, air monitoring readings, and auger-refusal points were completed for the soil piezometers. State of Maryland monitoring well permits were acquired for all piezometers prior to drilling operations. Permit tags were bonded to the protective casings upon completion. Steel guard posts were placed around Piezometers ITZ-1, ITZ-2, and ITZ-3 according to specifications of the Detailed Work Plan for Phase II work.

2.10.3 Results

The installation of soil piezometers provided a method to better locate soil and bedrock monitoring well pairings downgradient of suspected site sources of contamination. Locations of these piezometers are shown on the site base map (Figure 1). Pertinent details including permit numbers, ground surface elevations, well depths, aquifer designations, and screened intervals are summarized in Table 1. Soil Piezometer ITZ-7 was installed as a replacement for ITZ-6, which was not completed. The borehole for

Piezometer ITZ-6 remained dry after reaching its auger-refusal point. The borehole was allowed to stand open for several hours before the decision was made to grout it to surface. A cement/bentonite slurry mixture was used to grout the borehole.

3.0 SITE CHARACTERIZATION FINDINGS

3.1 HYDROGEOLOGY

From the results of the site characterization tasks (Phase II) as described in Chapter 2.0, the hydrogeology of the Site has been further characterized. Hydrogeology combines the studies of geology and hydrology. The hydrogeologic features of the Site influence the groundwater flow and solute transport (as discussed further in Sections 3.1.2 and 3.1.3, respectively). These features include:

- Soil (stratigraphic sequence, thickness of layers, continuity of layers, porosity, compactness, mineral composition)
- Bedrock (rock type, fracture zones, slope and depth of the bedrock/soil interface (bedrock surface), mineral composition)
- Groundwater (perched zones, hydraulic conductivity, confining layers, potentiometric surfaces, unconfined and confined aquifers, pumping yields, direction of groundwater flow, hydraulic communication between aquifers)

The soil layers overlie the bedrock in all parts of the Site. The groundwater is found in the soil and/or the bedrock. Specific relationships of soil, bedrock, and groundwater are described in the following sections.

3.1.1 Soils (including fill material)

All unconsolidated materials lying above the bedrock are classified here as soils. The stratigraphy of the soils in the borings from bottom to top can be generalized as follows:

- Residual soils derived from weathering of the bedrock (saprolite)
- Transported soils including stream derived sands and gravels (alluvium) and hillwash (colluvium)
- Material such as waste and reworked natural soils (fill)

Knowledge of the stratigraphic framework is necessary for planning future drilling, estimating volumes of soil, and extrapolating hydraulic parameters across the Site.

3.1.1.1 Saprolite

From boring data, a thick residual soil overlies the bedrock throughout the Site. This soil is also referred to as saprolite. A saprolite in the Piedmont Province of the Appalachian region refers to a highly weathered residual soil that retains the textural features of the rock from which it was derived. In most cases, the saprolite can be identified as to its derivation (gneissic granite or metadiorite).

The thickness of the saprolite varies from 90 feet in the northern part of the site to 15 feet in the southwestern part of the site.

Knowledge of the properties and thickness of the saprolite will be used to define the soil aquifer in the groundwater modeling task (Phase III). In most of the Site (except for the southwest area), the water table is located in the saprolite. All "saturated soil monitoring" wells (excluding perched zone wells) are screened in this stratum.

3.1.1.2 Alluvium and Colluvium

Lying above the saprolite in many borings are deposits of alluvium and colluvium. These deposits were the source materials for the sand and gravel operation that predated the landfill.

These are transported soils, in contrast to the saprolite that was formed in place. The transporting media for the alluvium were streams during ancestral stages of the Susquehanna River network. The alluvium consists of well sorted (poorly graded) sands and gravels, with a small amount of fines (silts and clays).

In addition to the alluvium, there are also naturally reworked soils that were eroded and deposited by overland runoff and small gullies. These soils are called colluvium. They lack the higher degree of sorting (contain more fines and are more heterogeneous) of the alluvium.

The alluvium and colluvium in places on the Site contain layers (semicontinuous and discontinuous) of silty clay and clay. These clay layers form confining layers and inhibit groundwater flow vertically through the soil column. In places they form perched-water zones and channel the perched water to the ground surface (forming seeps).

The thickness of the alluvium and colluvium varies from 10 feet in the northern part of the site to 50 feet in the western part of the site.

Knowledge of the stratigraphy of the alluvium and colluvium permit extrapolation of hydraulic parameters between testing points. Pertinent hydraulic parameters are used in defining layers in the computer modeling of Phase III.

3.1.1.3 Fill

The fill material that was sampled results from the cut and fill activities of the sand and gravel operation and the landfill operation. Sand and gravel was removed in places leaving irregular pits, mounds and some ridges (highwalls). The landfill operation also modified the topography and rearranged some of the alluvium, colluvium and mounds of reworked sand and gravel. Interpretive maps made from historical aerial photographs (Phase I Report) describe the changing topography and site features during pit and landfill activities.

Phase IV drilling (borings in waste) will be described in a subsequent report. Drilling conducted to install monitoring wells and piezometers avoided major areas of waste, so the fill was not penetrated and described in Phase II work.

Knowledge of the fill distribution and depth, especially fill containing waste materials, is significant to estimating volumes of materials present for source treatment of contaminated soil. Phase IV will characterize the waste and overlying/ underlying fill materials.

3.1.2 Bedrock

There are two bedrock formations beneath the Site: a gneissic granite and a metadiorite. Knowledge of the composition and properties of the bedrock can be used to:

- In part, explain the presence of compounds in the groundwater (especially metallic) that result from natural causes (exclusive of landfill operations)
- Aid in design of well placement to take advantage of higher yields of groundwater along fracture zones
- Determine input parameters for groundwater modeling tasks

3.1.2.1 Gneissic Granite

The gneissic granite is a pink, coarsely crystalline rock with a weak foliation. The rock is like a granite (in mineral composition) that underwent mild metamorphism (giving it a gneiss-like foliation). A pure gneiss would have a stronger foliation. Foliations result when planar and elongate minerals line up in the rock matrix causing obvious planar surfaces. Foliations can form planes of weakness in the rock and may encourage fracture development along these planes.

This description identifies this rock as a part of a formation called the Port Deposit Gneiss. The Port Deposit Gneiss crops out along the bluffs of the Susquehanna River at Port Deposit, Maryland. The gneissic granite under the Site differs from the type Port Deposit Gneiss in that it is less foliated.

The gneissic granite contains interlocking crystals of feldspar, quartz, hornblende, mica, and accessory minerals. All these minerals are complex silicates (containing silica, iron, aluminum, manganese, calcium, sodium, potassium, and trace elements). Upon weathering, this rock breaks down into clay minerals, silica, and oxides of iron and manganese. The iron and manganese oxides stain the soils and can be transported by the groundwater. This natural source can, in part, account for the presence of iron and manganese in the groundwater. (Landfill waste may be an additional source of these metals.)

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Based on boring log information, the gneissic granite underlies the saprolite at the soil/rock interface in all areas of the site with the exception of the northwestern area. The uppermost rock unit in this area is metadiorite. The gneissic granite was observed over the entire interval penetrated in Monitoring Wells ITB-4 and ITB-5. The gneissic granite was found to overlie metadiorite in Wells ITB-1 and ITB-3. This indicates the presence of a contact between the gneissic granite and the metadiorite, possibly along the photo-lineament identified during Phase I investigations. This lineament extends in the northern part of the site approximately along an east-to-west trend. Thicknesses of the gneissic granite were 36 feet in Well ITB-1 and 13 feet in Well ITB-3.

Planar, smooth walled fracture zones are common in the rock observed. They are near-vertical and near-horizontal with apertures of less than one inch.

3.1.2.2 Metadiorite

The metadiorite is a black and white, finely crystalline rock with a pronounced schistosity. The rock is like a diorite (in mineral composition) that underwent metamorphism (giving it its schistose texture). Schistosity is a type of foliation that is dominated by mica accumulations in the foliation planes. These planes are weak layers that cause the rock to break apart or crumble during drilling.

The metadiorite is similar in composition and texture to another rock found in the Site region, described as a metagabbro. A metagabbro differs slightly from a metadiorite in mineral composition (no quartz and no hornblende).

The metadiorite contains interlocking crystals of feldspar, some quartz, hornblende and augite, mica, and accessory minerals. These minerals are complex silicates (containing silica, iron, aluminum, manganese, calcium, sodium, potassium, and trace elements). As compared to the gneissic granite, the metadiorite contains less quartz, more sodium, and less potassium. Augite is similar in composition to hornblende. Weathering by-products are similar to those of the gneissic granite. Because of compositional differences and the crumbly nature of the metadiorite, weathering can occur faster than in the gneissic granite.

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As a result, iron- and manganese-rich oxides can enter the environment more easily than from the gneissic granite.

The metadiorite is the uppermost rock unit encountered in the borings at the northwest part of the site. It was encountered in the drilling for Monitoring Wells ITB-1, ITB-2, and ITB-3.

Although this rock was not cored, the borehole television logging revealed the nature of the fractures. Fractures are more abundant and more irregular in the metadiorite observed than in the gneissic granite. This results from the schistose texture of the metadiorite.

3.1.2.3 Bedrock Surface

The bedrock surface is the interface between the soil and the rock beneath. It is the contact between:

- Relatively unconsolidated materials (soil) that can be penetrated by augers or by a standard split-spoon sampler and hammer (140-pound hammer, 2-inch-O.D. split-spoon, <50 blows/6-inch penetration)
- Hard rock that must be bored by rock-drilling methods

The topography of the bedrock surface is currently buried by the overlying soils. Subsurface data have been used to map this surface (Figure 2). The buried topography is similar to the present-day surface topography. Thicker soils on the divide areas make the overall slope of the present-day surface steeper than that of the buried surface.

Phase II drilling and borehole geophysics indicate that the contact between soil and bedrock is abrupt. A thick layer of residual soil (saprolite) overlies the bedrock. The residual soil is very granular. There is no evidence of a layer that might restrict groundwater flow between the soil and bedrock (such as a residual layer of clayey soil). Fractures in the bedrock that intersect this surface provide additional conduits for groundwater flow across the contact. These conditions apply to the bedrock surface with respect to both the gneissic granite and the metadiorite.

Along the west-central boundary of the landfill, near well ITB-3, there is an irregular bedrock surface as interpreted from differences in depths to bedrock from nearby borings. This appears to be in or near the area of the contact between the gneissic granite and the metadiorite and a photolinear (east-west orientation). South of this area the soil (except for perched water zones) is unsaturated. These factors suggest that this contact zone may be a path for groundwater flow beneath the bedrock surface.

Knowledge of the bedrock surface can be used to:

- Design future drilling programs, including those for groundwater recovery systems
- Define input parameters for the groundwater modeling during Phase III

3.1.3 Groundwater

Phase II studies have further defined the Site aquifers. An aquifer is technically a body of rock or soil that contains sufficient saturated permeable material to conduct significant quantities of groundwater under ordinary hydraulic gradients. An aquitard is a rock or soil unit that tends to inhibit the movement of groundwater.

There are three main aquifers. These are the bedrock aquifer (including the gneissic granite and the metadiorite), the saturated soil aquifer (including the saprolite and alluvium/colluvium), and the perched aquifer.

Based on water-level elevation measurements and stratigraphic information, all the aquifers are unconfined. Unconfined aquifers have no impermeable layer above them causing the fully saturated aquifer to build up artesian pressure. Well Clusters ITS-1/ITB-1 and ITS-2/ITB-2, each monitoring water-level in the soil and bedrock aquifers, indicate by their similar water-level elevations that the soil aquifer is in communication with the bedrock aquifer. If either aquifer is pumped for a sufficiently long time, water flow may occur between the aquifers. Hydraulic communication between these aquifers is also indicated by the absence of a confining clay layer at the bedrock/soil interface and the presence of fractures in the bedrock near this surface.

There is one principal aquitard. Clay layers (semicontinuous or discontinuous) within the alluvium/colluvium aquifer in the unsaturated zone inhibit vertical flow downward. Clay layers intercept infiltration water and redirect it laterally to seeps. The aquitard does not confine the soil aquifer below because unsaturated soil is present beneath it.

Knowledge of the aquifers and aquitards help to:

- Predict movement of groundwater and solute plumes over the site area.
- Define input parameters for computer modeling.
- Aid in design and installation of monitoring and recovery wells and piezometers.
- Design waste treatment, removal, and isolation strategies.
- Determine groundwater yields, flow rates, solute concentrations, flow directions, etc.
- Determine baseline risks and remediation risks for groundwater receptors; determine source concentrations, pathways, and potential receptors of contaminated groundwater.

3.1.3.1 Bedrock Aquifer

The bedrock aquifer includes the body of rock defined as gneissic granite and metadiorite. It conducts ground water in fractures. There is no significant intergranular movement of groundwater in the body of the rock exclusive of the fractures.

The gradient of the potentiometric surface of the bedrock aquifer (Figure 4) is to the west-southwest. This indicates that groundwater flow in the bedrock is regionally in this direction. On a local scale (tens to hundreds of feet), the groundwater should follow fracture zones. The groundwater would travel along a fracture plane in the general direction of the regional flow. Based on water level data compiled in "Hydrologic Data for Cecil County, Maryland, Basic Data Report No. 16, 1987," [7] the regional groundwater flow direction is toward the Susquehanna River to the west-southwest. At fracture intersections, it would adjust its pathway to maintain as an average the regional flow pattern.

The metadiorite has a crumbly texture and its fractures are more irregular than the gneissic granite. As a result, the local groundwater flow in the metadiorite should better approximate the regional groundwater flow direction than in the gneissic granite.

3.1.3.2 Saturated Soil Aquifer

The saturated soil aquifer includes the body of saturated soil defined as saprolite and, in places, the alluvium/ colluvium. It conducts groundwater through the pore spaces of the soil matrix.

The gradient of the potentiometric surface of the soil aquifer (Figure 3) is westward and southwestward from the groundwater divide along a line extending from near the Transfer Station west-southwest to the central part of the landfill. The potentiometric surface is generally in the saprolite in the northern and southeastern part of the Site. In the southwestern part of the Site, the soil is unsaturated causing the potentiometric surface to be below the level of the bedrock surface.

3.1.3.3 Perched Aquifer

The perched aquifer includes isolated parts of the alluvium/colluvium and fill material. This aquifer lies above a clay layer (an aquitard). Infiltration water percolates downward through the alluvium/colluvium and fill (including waste and reworked soil) until it meets the buried clay layer. Then the water flows laterally on the surface of the layer in the direction of the dip. Where the layer intersects the ground surface, the water surfaces at a seep.

The perched aquifer was found in two areas of the Site. These areas are not connected; the aquitard is not continuous between these areas. The areas include:

- The central part of the landfill including Cell B/C
- The area at the west-central boundary of the landfill

The slope of the buried clay layer in the central part of the landfill causes seeps to occur to the south of the central area in the sampling areas of LS-1 and LS-3 (Phase IV).

From knowledge of construction details of Cell B (Spotts, Stevens and McCoy, "Sludge Disposal Report," September 4, 1979, Revised March 1980), standing water was found during construction-excavation. This standing water was probably water from the perched aquifer. Additional trenching caused this water to drain. Apparently the clay layer was breached and the water could percolate downward through the unsaturated soil below. In effect, a natural clay liner was punctured.

3.1.3.4 Groundwater Yields

The following average sustained yields were estimated from Phase II testing:

- Bedrock Wells - 20.0 gallons per minute (gpm)
- Soil Wells - 0.65 gpm
- Perched Wells - 0.10 gpm

These yields were estimated using the hydraulic conductivities generated in this report (Table 18) and standard methods (Jacob's equation)[8] for determining well hydraulic parameters. Yields in the bedrock and soil aquifers are influenced by movement of groundwater between these aquifers.

3.1.3.5 Hydraulic Conductivity

The following ranges of hydraulic conductivity were calculated from the slug tests conducted during Phase II:

- Bedrock Aquifer - 2.7×10^{-5} to 1.4×10^{-2} centimeters per second (cm/s)
- Soil Aquifer - 8.6×10^{-5} to 2.8×10^{-4} cm/s
- Perched Aquifer - 2.1×10^{-4} to 2.5×10^{-4} cm/s

3.1.3.6 Direction of Groundwater Flow

The anticipated flow directions of groundwater in the soil and bedrock aquifers are similar because of the communication between these two aquifers. Separate contour maps of the potentiometric surface of the two aquifers have been drawn (Figures 3 and 4) and compared. Flow directions are perpendicular to the contour lines. The flow direction is towards the lower-elevation contour lines.

Measured water-level elevations indicate that the regional groundwater flow is towards the Susquehanna River and Chesapeake Bay (west-southwest). Local groundwater flow directions are in part influenced by local topography (land surface and the buried bedrock surface); flow directions are usually down slope. The local bedrock-surface topography is shown in Figure 2. Local flow directions are also influenced in the bedrock by fracture orientations; groundwater follows the fractures. Individual fractures cannot be mapped across the Site or Site region using available data. Regional groundwater flow directions, however, are more important than local flow directions to the risk assessment or feasibility study. The geometry of contaminant plumes, as discussed in Section 3.2, also confirms these directions of flow.

Groundwater flow directions are based on the contour configurations constructed from water-level elevation data acquired during Phase II. Water-level elevation measurements from additional domestic wells in the area to the north of the site will be acquired during Phase III to better define groundwater flow directions in this area.

3.2 CHEMICAL ANALYSES OF GROUNDWATER

The results of the chemical analyses as presented in Chapter 2.0 have been compiled and preliminary interpretations based on one sampling round have been developed. In accordance with the approved Scope of Work, full-scale data evaluation on Phase II data is to be performed during Phase III (refer to the accompanying document: "Detailed Work Plan, Phase III Groundwater Evaluation"). The concepts presented below are based on initial data validation in terms of average precision and accuracy (Table 9). The data were also validated in terms of the significance of qualified data (e.g., B, J, etc., values) and were reported in accordance with U.S. EPA practices cited in Section 2.6.3 of this report.

The data validation procedure for vinyl chloride and bis(2-ethylhexyl)phthalate analyses from monitoring and domestic wells is summarized in Tables 11 and 12, respectively.

3.2.1 Summary of Results

The main analytes detected in the monitoring wells are vinyl chloride, bis(2-ethylhexyl)phthalate, iron and manganese. In only a few monitoring wells there are other volatile organic compounds (VOCs) that were detected at lower concentrations. These other VOCs include chlorobenzene, ethylbenzene, benzene, total xylenes, and toluene (Tables 5 through 7).

The organic analytes detected in domestic wells were acetone, di-n-butylphthalate, and diethylphthalate. Acetone (7J-10 ug/l) and di-n-butylphthalate (2J-3J ug/l) were detected in three of the eleven domestic wells sampled and diethylphthalate (4J) was detected in one of those wells (Table 8). These concentrations are below potential chemical-specific ARARs for groundwater (Table 20).

The inorganic analytes detected in domestic wells are listed in Table 8. The list presents the results of all TAL elements analyzed for. All concentrations; however, are below chemical-specific potential ARARs. Although below ARARs, two inorganic analytes were detected above secondary Maximum Contaminant Levels (secondary MCLs) in domestic wells. These metals were iron and manganese. The secondary MCL for manganese (50 ug/l) was exceeded in three of the unfiltered domestic well samples (123 to 3,060 ug/l) in the Craft, Odom, and Hess wells and two of the filtered domestic well samples (115 and 1,400 ug/l) in the Craft, and Odom wells. The secondary MCL for iron (300 ug/l) was exceeded in three of the unfiltered domestic well samples (965 to 29,200 ug/l) in the Craft, Odom, and Hess wells and one of the filtered samples (351 ug/l in the Odom well).

No PCBs were detected in any of the 29 monitoring wells or the 11 domestic wells sampled.

Pesticides detected in 8 of the 29 monitoring wells included Alpha-BHC (4 wells), DDT (1 well), Heptachlor (1 well), and Endosulfan I (2 wells). No pesticides were detected in the domestic wells that were sampled.

3.2.2 Definition of Solute Plumes

For purposes of discussion the Site is divided into regions of groundwater quality. These regions include:

- Cell Area B/C and adjacent area to the south--includes wells F-5, F-6, F-2, F-7, ITP-2, ITP-1
- Northeast area--includes wells F-1, F-8, F-10, F-9, OW-1, ITB-1, ITS-1, Transfer Station (TSTA)
- Northwest area--includes wells B-2, OW-2, B-3, ITS-2, ITB-2
- West-central area--includes wells B-4, ITP-3, ITB-3
- Southeast area--includes wells F-3, ITB-5, SW-1
- Southern area--includes wells B-6, B-5, ITB-4, OW-4

Monitoring Wells F-1 and TSTA-1 were chosen as the preliminary site background monitoring wells based on their upgradient positions.

The areas of highest concentrations of vinyl chloride are the on-site Cell Area B/C and the on-site Northeast area. The area of highest concentration of bis(2-ethylhexyl)phthalate is in the northwest part of the Site. It is possible that the on-site Northwest and West-central areas are secondary areas of plume origination (additional source areas). Phase IV results will be used to define the nature and extent of source areas of waste.

From these source areas the plumes extend outward in the down gradient directions as indicated by Section 3.1.3 (Groundwater). From the Cell Area B/C this means south and west of Cell B/C. From the Northeast area this means west-southwest of the expected location of Cell A. From the Northwest and West-Central areas the direction of plume elongation is to the west.

From initial results, the migration of vinyl chloride in the groundwater remains within the vicinity of Cell B/C. Phthalate esters, however, are present in the cell areas and in the Northwest and West-Central areas. The extent of migration of vinyl chloride at the north end of the Site and phthalate esters at the West-Central part of the Site has yet to be determined.

Total iron and manganese concentrations are represented in Figure 9. The maximum total concentration is shown to be 50,000 parts per billion (ppb) in the area surrounding Monitoring Well ITP-1, just southwest of Cell B/C. The total concentrations decrease in all directions away from this area. Chemical analyses from background Monitoring Wells F-1 and TSTA-1 (Transfer Station) showed only a detection of manganese (51.7 ppb) in Monitoring Well F-1 and a detection of 2 "J" of 1,2-dichloroethene in the Transfer Station well. No metals were detected in upgradient domestic wells (to the north and west). Although native materials (soil and rock) could contribute to the elevated levels of iron and manganese, it appears that the source of the metals is apparently on the Site in the region of Cell B/C.

3.2.3 Significance of the Chemical Analyses

From the results of analyses, the chemicals that may pose the most significant health risk are vinyl chloride and bis(2-ethylhexyl)phthalate. Vinyl chloride is a Group A carcinogen and concentration levels of vinyl chloride that are greater than 2 ug/l in drinking water are above the MCL. Bis(2-ethylhexyl) phthalate is a Group B2 carcinogen and levels greater than 4 ug/l in drinking water are above the proposed MCL.

3.2.3.1 Vinyl Chloride Monomer

Vinyl chloride (monomer) is suspected to be present in the PVC sludge (as an ingredient in plastics manufacturing) and in municipal wastes (as a biodegradation by-product of other chlorinated hydrocarbons). [9, 10, 11, 12, 13, 14, 15]

The vinyl chloride plume is not detected in the groundwater far from the potential source areas of this compound (the furthest extent of vinyl chloride to the north is undetermined). It is possible that the compound:

- Becomes diluted
- Biodegrades
- Degasses out of the groundwater into the vadose zone

Soil-gas results from Phase I showed that vinyl chloride was detected in the vadose zone in the western and southwestern part of the landfill, where it was not detected in the groundwater. This may result from the above bulleted items or from the possibility that there are additional sources of vinyl chloride that have not migrated to the groundwater below.

3.2.3.2 Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate is suspected to be present in the PVC sludge (as an ingredient in plastics manufacturing) and in municipal wastes (found in plastic containers).

Bis(2-ethylhexyl)phthalate is a semivolatile organic compound. This compound is associated with plastics manufacturing; however, it can be found in municipal waste and as a laboratory contaminant. It is not as volatile as vinyl chloride and, therefore, tends to persist in the environment longer than vinyl chloride.

3.3 ADDITIONAL DATA NEEDS

3.3.1 Area of Monitoring Well ITB-1

Groundwater flow direction north of Piezometer ITZ-2 should be established to determine the northward extent of vinyl chloride contamination detected in Monitoring Well ITB-1. (Current data indicate that the flow direction at Monitoring Well ITB-1 is westward). This can be accomplished by measuring approximately six additional water level elevations in domestic wells to the north of ITB-1: three on Colora Road from Firetower Road to a point at the extension of the western boundary of the site; and approximately three on Firetower Road between the Transfer Station and Colora Road. Then depending on the results of these data, one additional well cluster (in soil and bedrock aquifers) can be installed north of Piezometer ITZ-2 to confirm the northern extent of vinyl chloride contamination. The exact location of this well cluster will be based on groundwater contours prepared after the water levels in the domestic wells are measured.

The vertical extent (depth) of vinyl chloride contamination should be further evaluated with a deeper bedrock well near Monitoring Well ITB-1. This well should be sampled with a packer unit incrementally during the drilling process.

3.3.2 Area of Monitoring Well ITB-3

The westward extent of phthalate contamination should be further evaluated (beyond Monitoring Well ITB-3) for phthalate contamination by installing an additional well cluster to the west of Monitoring Well ITB-3. If the soil is dry at this location, then only a bedrock well would need to be installed.

The vertical extent (depth) of phthalate contamination should be further evaluated with a deeper bedrock well near Monitoring Well ITB-3. This well should be sampled with a packer unit incrementally during the drilling process.

3.3.3 Analytical Modifications

The "target" compounds of vinyl chloride and bis(2-ethylhexyl)phthalate should be analyzed for in concentrations determined by their health risks. Chemical groups that were not present in significant quantities to be of concern need not be analyzed for in future groundwater analyses. These chemicals include PCBs and pesticides.

3.3.4 Transfer Station

The impact of the Transfer Station on the Site has yet to be determined. Compaction and other liquid wastes from the Station may have been discharging onto the landfill for an extended period of time. The quantities and types of chemicals from the Station that may affect the results of analyses of samples from current or future sampling points should be evaluated. We are requesting from Cecil County a review of operational procedures of the Transfer Station and a determination of the quantity and types of chemicals that were present at the Station that may have been released to the landfill.

3.4 POTENTIAL CHEMICAL-SPECIFIC ARARs AND TBCs

3.4.1 Objectives and Scope of ARARs

As requested by the U.S. EPA following the original submittal of the Phase II Report, chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered materials (TBCs) are presented here in advance of the schedule from the approved Scope of Work. This early submittal is made to achieve the following objectives:

- Facilitate the preparation of the final Remedial Investigation/Feasibility Study report, and
- Reduce the potential for data gaps at the conclusion of the RI.

ARARs and TBCs are defined in the U.S. EPA CERCLA Guidance Document [17] as follows:

> ARAR is an acronym meaning: Applicable or Relevant and Appropriate Requirements. "Applicable requirements" mean those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.
>
> "Relevant and appropriate requirements" mean those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.
>
> TBC materials are nonpromulgated advisories or guidances issued by federal or state government that are not legally binding and do not have the status of potential ARARs. However, in many circumstances, TBCs will be considered along with ARARs as part of the site risk assessment and may be used in determining the necessary level of cleanup for protection of health or the environment.

ARARs and TBCs were identified on the basis of one round of groundwater sampling of the site monitoring wells. Table 20 presents the potential ARARs (MCLs and MCLGs) and TBCs (reference doses and cancer risks) for TCL and TAL analytes. In addition, the

Practical Quantitation Limits (PQLs) are included as potential ARARs because they represent a technical limitation to the determination of acceptable exposure levels. They represent a bottom limit on the value of the ARAR for that particular constituent (in that particular environmental medium). Proposed MCL and MCLG values are also included in this table.

The compilation of Table 20 was achieved in the following manner:

- Summarizing the entire Target Compound List (TCL) for organic analytes and the Target Analyte List (TAL) for inorganic analytes detected in the on-site monitoring wells along with the concentration range and detection frequency.

- Providing a list of potential chemical-specific ARARs (MCLs and MCLGs) and To Be Considered (TBC) materials (reference doses and cancer risks). This list is presented in Table 21 and contains the only potential ARARs and TBC materials that have been identified.

- Providing TCL and TAL analytes (after data validation, detected in greater than 5 percent of monitoring wells or detected in any frequency in the case of Group A carcinogens) for which there are ARARs and TBCs. The state of Maryland potential chemical-specific ARARs for groundwater are the same as the federal regulations and, therefore, not listed separately in Table 20.

The chemical-specific ARARs and TBCs have been tabulated according to the documents presented in the list of References (Nos. 16 through 21).

3.4.2 Modification to Chemical Analytical Program

With the identification of ARARs, it has become necessary to modify the analytical program to detect vinyl chloride at lower concentrations. The currently approved methods for chemical analyses as per the project Consent Order are those required by the U.S. EPA, Contract Laboratory Program (CLP). In comparing the ARARs with the CLP method detection limits, it can be noted that for all chemicals, the ARARs are greater than or equal to the detection limits except for vinyl chloride. To achieve a lower detection limit for vinyl chloride, U.S. EPA Method 502.2 (Volatile Organic Compounds In Water By Purge And Trap Capillary Column Gas Chromatography With Photoionization And

Electrolytic Conductivity Detectors in Series) will be used. This method has a generic detection limit of 0.02 ug/l. However, the actual detection limit for this method is based on the calculated detection limit according to that achievable by individual laboratory instrumentation.

An alternative analytical method to provide lower detection limits was investigated for bis(2-ethylhexyl)phthalate (BEHP) (which has a proposed MCL of 4 ug/l and the 10^{-6} cancer risk concentration of 2.5 ug/l). This method (U.S. EPA Method 625) has the same generic method detection limit (2.5 ug/l) as the CLP generic method detection limit for base neutral acid/extractable compounds (BNAs) in aqueous samples. Therefore, the CLP SOW will be retained as the method for analysis of BEHP because these methods are, in theory, equally sensitive.

3.4.3 Ongoing ARAR Identification

The plan for ARAR identification during subsequent investigations to be undertaken in this project is presented in the following paragraphs.

As a first step, all potentially applicable federal and state of Maryland regulations will be identified, reviewed, and included as appropriate. Primary sources of such guidance include:

- Code of Federal Regulations (CFR)
- Clean Water Act (CWA)
- Safe Drinking Water Act (SDWA)
- Clean Air Act (CAA)
- Solid Waste Disposal Act (SWDA)
- Toxic Substances Control Act (TSCA)
- RCRA regulations as amended by the Hazardous and Solid Waste Amendments (HSWA)
- Federal Register
- Federal Water Pollution Control Act (FWPCA)
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
- Endangered Species Act
- Fish and Wildlife Conservation Act
- Marine Protection and Sanctuaries Act (MPSA)
- Migratory Bird Act Treaty
- Marine Mammals Protection Act

- Coastal Zone Management Act (CZM)
- Code of Maryland Regulations (COMAR)

In the event that any state regulations are identified which are applicable or relevant and appropriate and which are more stringent than corresponding federal regulations, then the state guidance will be followed. Any other pertinent information, including local ordinances, siting criteria, etc., will also be reviewed and included in the list of ARARs, as appropriate. Agency-published documentation will also be researched continually as part of the ongoing identification effort. A list of the documentation consulted thus far was included in the August 8, 1990 submittal of preliminary chemical-specific potential ARARs to the U.S EPA.

Potential chemical-, location-, and action-specific ARARs will be identified and reviewed based on a continuing evaluation of existing site data and future data generated during Phases III and IV of the Remedial Investigation. A preliminary evaluation of potential action-specific ARARs will also be performed relative to any remedial technologies which may emerge as feasible during preliminary feasibility study activities.

The use of automated data bases, such as ENFLEX(TM) and IRIS (Integrated Risk Information System) will also be employed in order to monitor the changes taking place within the regulations which may be potentially applicable to the Woodlawn landfill site. ENFLEX(TM) is updated quarterly and provides easy access to all federal and state regulations and statutes. The IRIS data base will also be utilized to the extent practical; however, the data contained in this system are more relevant to the performance of the Risk Assessment. As a secondary source to the IRIS data base, the Health Effects Assessment Summary Tables (HEAST) manual will be reviewed for any additional pertinent information.

It is recognized that ARAR identification is a dynamic endeavor which requires cooperation among all parties involved in the RI/FS process. Continual identification and review of potentially applicable or relevant and appropriate information will require a joint effort between Bridgestone/Firestone, Cecil County, the U.S. EPA, and the state of Maryland in order to ensure that an effective and comprehensive listing of ARARs is developed.

Throughout the remainder of this process, open and frequent communication must be maintained among these parties to promote the development of acceptable and reasonable ARARs.

REFERENCES

1. Code of Maryland Regulations (COMAR), Title 26 Dept. of the Environment, Subtitle 04 Regulation of Water Supply, Sewage, and Solid Waste, Chapter 0.4 Well Construction, Effective date: November 28, 1980 (7:24 Md.R. 2257).

2. American Society for Testing and Materials (ASTM), "Standard Method for Penetration Test and Split Barrel Sampling of Soils", Method D1586-84, November, 1984.

3. "Laboratory Data Validation - Functional Guidelines for Evaluating Organic Analyses," prepared for the Hazardous Site Evaluation Division, U.S. EPA, February 1, 1988.

4. "Laboratory Data Validation - Functional Guidelines for Evaluating Inorganic Analyses," prepared for the Hazardous Site Evaluation Division, U.S. EPA, July 1, 1988.

5. Hvorslev, J.M., "Time Lag and Soil Permeability in Groundwater Observations," U.S. Army Corps of Engineers, Waterways Exp. Sta., Vicksburg, Mississippi, 1951, Bulletin 36.

6. Bouwer, H. and Rice, R.C., "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells," Water Resources Research, Vol. 12, No. 3, June 1976.

7. Hydrologic Data for Cecil County, Maryland Basic Data Report No. 16, Dept. of Natural Resources, Maryland Geologic Survey, 1987.

8. Fetter, Jr., C.W., 1980, "Applied Hydrogeology", Bell and Howell Company, Columbus, Ohio.

9. Wood, J.A. and M. L. Porter, 1987, "Hazardous Pollutants in Class II Landfills," JAPCA, Volume 37, No. 5, May, 1987.

10. Barrio-Lage, G.A., Parsons, F.Z., Archer, H.E., Narbaitz, R.M., "Enhanced Aerobic and Anaerobic Biotransformation of Vinyl Chloride in Groundwater Environments," Physiochemical and Biological Detoxification of Hazardous Wastes, Technomic, 1989.

11. Barrio-Lage, G.A., Parsons, F.Z., Nassar, R.S., "Kinetics of The Depletion of Trichloroethene," Environ. Sci. Technol., Volume 21, No. 4, 1987.

12. Vogel, T.M. and McCarty, P.L., "Abiotic and Biotic Transformations of 1,1,1-Trichloroethane Under Methanogenic Conditions," Environ. Sci. Technol., Vol. 21, No. 12, 1987.

13. Kleopfer, R.D., et al, Jackson, D.E, Wurrey, C.J., "Anaerobic Degradation of Trichloroethylene in Soil," Environ. Sci. Technol., Vol. 19, No. 3, 1985.

14. McCarty, P.L., Semprini, L., Roberts, P.V., "Methodologies for Evaluating the Feasibility of In Situ Biodegradation of Halogenated Aliphatic Groundwater Contaminants by Methanotrophs," Proceedings of the 1989 A&WMA/EPA International Symposium on Hazardous Waste Treatment: Biosystems for Pollution Control Cincinnati, Ohio, February 1989.

15. "The Landfill Gas Testing Program: A Second report to the California Legislature," State of California Air Resources Board, Stationary Source Division, Sacramento, CA, June, 1989.

16. Annotated Code of Maryland, Health Environment, Title 9 (Sub. 4): 9-407, B1, 1982. (The state of Maryland has decreed that "the State primary drinking water standards may not be more stringent than" established federal requirements for potable groundwater or surface water.)

17. U.S. EPA, CERCLA Compliance with Other Laws Manuals: Interim Final, EPA/540/6-89/006, 1988.

18. U.S. EPA, National Primary and Secondary Drinking Water Regulations: Proposed Rule, Federal Register 54:22062, 1989.

19. U.S. EPA, Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.7-01a, Office of Emergency and Remedial Response, Washington, DC, 1989.

20. U.S. EPA, National Oil and Hazardous Substances Pollution Contingency Plan: Final Rule, Federal Register 55:8836d, 1990.

21. Code of Federal Regulations (40 CFR, Parts 141, 142: July 1, 1989).

TABLES

TABLE 1

SUMMARY OF MONITORING WELL/PIEZOMETER DETAILS
WOODLAWN LANDFILL RI/FS

WELL NO.	MARYLAND STATE PERMIT NO.	GROUND SURFACE ELEVATION (ft)[a]	WELL DEPTH (ft)[b]	AQUIFER	SCREEN INTERVAL (ft)[b]
ITP-1	CE-88-0932	437.79	18.0	Perched	8.0-18.0
ITP-2	CE-88-0933	438.07	20.0	Perched	10.0-20.0
ITP-3	CE-88-1054	422.87	11.0	Perched	4.0-9.0
ITS-1	CE-88-0966	465.34	92.0	Soil	42.0-92.0
ITS-2	CE-88-0934	422.02	66.3	Soil	36.3-66.3
ITS-3	CE-88-0965	422.89	24.5	Soil	14.5-24.5
ITB-1	CE-88-0970	457.64	163.0	Bedrock	133.0-163.0
ITB-2	CE-88-0935	420.22	102.5	Bedrock	92.5-102.5
ITB-3	CE-88-0969	420.24	122.0	Bedrock	102.0-122.0
ITB-4	CE-88-0968	398.04	45.0	Bedrock	35.0-45.0
ITB-5	CE-88-0967	415.59	68.5	Bedrock	58.5-68.5
ITZ-1	CE-88-0937	458.11	84.0	Soil	44.0-84.0
ITZ-2	CE-88-0938	452.76	81.0	Soil	46.0-81.0
ITZ-3	CE-88-0936	448.44	79.0	Soil	39.0-79.0
ITZ-4	CE-88-0973	416.26	39.0	Soil	18.5-38.5
ITZ-5	CE-88-0972	410.61	47.0	Soil	27.0-47.0
ITZ-6[c]	NA[d]	413.78	41.0[e]	NA (Soil dry)	NA
ITZ-7	CE-88-1052	423.50	86.0	Soil	36.0-86.0

[a]Elevation in feet above mean sea level.

[b]Measurements from ground surface.

[c]ITZ-6 not constructed, soil dry, and grouted to surface.

[d]Not applicable.

[e]Depth of borehole.

TABLE 2

SUMMARY OF WATER LEVEL AND SURVEY DATA FOR MONITORING WELLS WOODLAWN LANDFILL RI/FS

WELL NO.	COORDINATES NORTH	COORDINATES EAST	GROUND ELEVATION (ft)[a]	INSIDE PIPE ELEVATION (ft)[a]	OUTSIDE PIPE ELEVATION (ft)[a]	DATE SURVEYED	WATER DEPTH[b] 04/10/90	WATER ELEVATION (ft)[a]
ITZ-1	660,470	1,057,032	458.11	460.61	460.70	01-10-90	51.71	408.90
ITZ-2	660,544	1,056,912	452.76	455.12	455.27	01-10-90	47.72	407.40
ITZ-3	660,450	1,056,828	448.44	450.81	450.95	01-10-90	44.33	406.48
ITZ-4	660,048	1,056,085	416.26	417.67	418.74	01-10-90	23.14	394.53
ITZ-5	659,914	1,055,719	410.61	413.14	413.34	01-10-90	41.40	371.74
ITZ-6[c]	659,690	1,056,017	413.78	NA[d]	NA	01-10-90	NA	NA
ITZ-7	659,864	1,055,887	423.50	425.95	426.29	01-10-90	44.32	381.63
ITP-1	659,756	1,056,769	437.79	440.07	440.43	01-10-90	11.38	428.69
ITP-2	659,798	1,056,968	438.07	440.15	440.43	01-10-90	16.43	423.72
ITP-3	659,884	1,056,071	422.87	425.37	425.54	02-19-90	7.65	417.72
ITS-1	660,392	1,057,023	465.34	467.62	468.00	02-19-90	58.10	409.52
ITS-2	660,512	1,056,051	422.02	424.69	424.80	01-10-90	50.25	374.44
ITS-3	659,889	1,056,072	422.89	425.31	425.38	02-19-90	Dry	Dry
ITB-1	660,482	1,056,960	457.64	460.13	460.18	02-19-90	51.00	409.13
ITB-2	660,488	1,056,054	420.22	422.92	423.11	01-10-90	48.60	374.32
ITB-3	659,788	1,056,042	420.24	422.77	422.97	02-19-90	53.15	369.62
ITB-4	659,277	1,056,421	398.04	400.75	400.95	01-10-90	33.43	367.32
ITB-5	659,513	1,056,914	415.59	418.30	418.50	02-19-90	21.75	396.55
F-1	660,215	1,057,073	473.63	474.28	474.28	07-11-89	64.48	409.80
F-2	659,891	1,057,051	429.74	430.54	430.54	07-11-89	24.68	405.86
F-3	659,568	1,056,958	420.58	420.88	420.88	07-11-89	22.60	398.28
F-5	659,994	1,057,098	445.30	447.06	447.16	07-11-89	39.63	407.43
F-6	659,899	1,056,996	436.00	437.25	437.41	07-11-89	29.90	407.35
F-7	659,858	1,056,909	441.90	443.94	444.08	07-11-89	35.96	407.98
F-8	660,273	1,057,030	471.10	473.47	473.55	07-11-89	63.54	409.93
F-9	660,344	1,057,026	470.20	471.61	471.73	07-11-89	61.87	409.74
F-10	660,297	1,056,981	467.00	468.81	468.90	07-11-89	58.99	409.82
B-1[e]	660,408	1,056,976[f]	459.25	461.49	461.27	02-19-90	NA	NA
B-2	660,522	1,056,516[f]	444.28	446.60	446.82	02-19-90	46.76	399.84
B-3	660,682	1,056,128[f]	425.70	428.24	428.38	02-19-90	53.15	375.69
B-4	659,980	1,056,159[f]	432.66	434.56	434.80	02-19-90	38.15	396.41
B-5	658,891	1,056,444[f]	359.50	360.82	361.18	03-19-90	4.20	356.62
B-6	659,115	1,056,736	394.05	395.78	396.18	02-19-90	24.60	371.18
OW-1	660,389	1,056,844	447.23	449.54	449.76	02-19-90	42.49	407.05
OW-2	660,539	1,056,248[f]	433.75	436.43	436.60	02-19-90	47.04	389.39
OW-3	659,666	1,056,149	393.89	396.14	396.46	03-19-90	Dry	Dry
OW-4	659,468	1,056,321[f]	415.24	417.33	417.58	03-19-90	36.59	380.74
SW-1	659,510	1,056,941[f]	414.79	417.18	417.66	03-19-90	22.00	395.18
TSTA-1[g]	660,182	1,057,321	470.66	467.93	472.05	02-19-90	66.38[h]	405.67

[a]Elevation in feet above mean sea level.

[b]Water depth measured in feet below top of inner casing.

[c]ITZ-6 not constructed, soil dry, grouted to surface.

[d]Not applicable.

[e]B-1 deemed unreliable for data collection, well is pending decommissioning.

[f]Coordinates surveyed on 08/24/90.

[g]Transfer Station well.

[h]Water level measurement taken from top of outside pipe.

TABLE 3

SUMMARY OF WATER LEVEL AND SURVEY DATA FOR DOMESTIC WELLS WOODLAWN LANDFILL RI/FS

WELL NAME	COORDINATES NORTH	COORDINATES EAST	GROUND ELEVATION (ft)[a]	INSIDE PIPE ELEVATION (ft)[a]	OUTSIDE PIPE ELEVATION (ft)[a]	DATE SURVEYED	WATER DEPTH 03/15/90	WATER ELEVATION (ft)[a]
S. Harvey	660,732	1,055,255	446.24	443.59	447.59	03-27-90	73.1	374.44
D. Haywood	661,856	1,057,230	387.72	385.25	388.97	03-27-90	22.7	366.27
Hess	660,401	1,054,940	390.26	NA	391.94	03-27-90	35.72	356.22
E. Jackson	659,836	1,058,326	458.30	455.83	459.18	03-27-90	53.6	405.58
C. Odom	658,495	1,056,989	387.91	385.33	388.76	03-27-90	14.8	373.96
C. Sexton	660,660	1,055,598	425.37	422.72	427.33	01-10-90	55.4	371.93

Note: Groundwater samples only (no water level measurements) were taken from the following domestic wells: Barton, Bullock, Catalina, Craft, Flaherty, and J. Jackson.

[a]Elevation measured in feet above mean sea level.

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TABLE 4

SUMMARY OF FIELD PARAMETER MEASUREMENTS
MONITORING AND DOMESTIC WELLS
WOODLAWN LANDFILL RI/FS

WELL ID	pH	SPECIFIC CONDUCTANCE (uS/cm)[a]	TEMPERATURE ^{0}C	DATE OF MEASUREMENT
ITP-1	6.8	1.680	13.4	3/09/90
ITP-2	8.0	0.561	12.4	3/08/90
ITP-3	6.0	0.158	8.4	3/08/90
ITS-1	6.5	0.078	14.4	3/12/90
ITS-2	6.4	0.231	15.9	3/12/90
ITB-1	6.5	0.411	17.3	3/14/90
ITB-2	6.3	0.397	13.1	3/12/90
ITB-3	6.0	0.300	13.4	3/08/90
ITB-4	6.1	0.695	17.1	3/14/90
ITB-5	6.2	0.548	13.4	3/15/90
F-1	6.5	0.036	17.6	3/13/90
F-2	5.3	0.245	15.6	3/14/90
F-3	6.4	0.810	18.0	3/13/90
F-5	6.7	0.055	16.6	3/14/90
F-6	6.0	0.318	15.3	3/14/90
F-7	6.9	0.600	17.9	3/13/90
F-8	6.0	0.146	16.0	3/13/90
F-9	6.0	0.147	15.1	3/12/90
F-10	6.0	0.110	15.0	3/12/90
B-2	6.8	0.074	12.0	3/09/90
B-3	5.5	0.090	8.3	3/07/90
B-4	5.5	0.982	15.6	3/15/90
B-5	6.5	0.088	14.1	3/15/90
B-6	6.0	0.368	15.9	3/15/90
OW-1	6.4	0.055	12.0	3/09/90
OW-2	7.0	0.366	10.1	3/07/90
OW-4	6.3	1.107	16.9	3/14/90
SW-1	6.1	0.850	18.0	3/13/90
TSTA-1[b]	6.0	0.076	12.8	3/08/90
W. Barton	5.7	0.082	18.0	3/14/90
H. Bullock	5.7	0.114	16.6	3/14/90
S. Harvey	5.9	0.082	14.6	3/14/90
D. Haywood	5.9	0.099	15.1	3/14/90
J. Jackson	5.5	0.045	17.6	3/14/90
C. Sexton	7.5	0.134	12.6	3/09/90
J. Craft	6.1	0.153	14.5	3/15/90
J. Flaharty	6.5	0.053	14.4	3/15/90
C. Odom	6.1	0.110	17.1	3/14/90
Catalina	8.3	0.880	17.2	4/09/90
Hess	6.9	0.990	21.1	4/09/90

[a]Units of Specific Conductance in microSiemens per centimeter (uS/cm).

[b]Transfer Station well.

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TABLE 5
SUMMARY OF ANALYTICAL DATA
IT MONITORING WELL SAMPLES[a]
WOODLAWN LANDFILL RI/FS
(units ug/l[b])

DETECTED PARAMETERS[c]	ANALYTICAL METHOD[d]	WELL ID/AQUIFER COMPLETED IN											CRQL[e]
		ITB1	ITB2	ITB3	ITB4	ITB5	ITS1	ITS2	ITP1	ITP2	ITP2DLRE[f]	ITP3	
		BEDROCK AQUIFER					SOIL AQUIFER		PERCHED AQUIFER				
Volatile Organics													
Vinyl Chloride	CLP	76	-[g]	-	-/-[h]	-	-	-	-	7J	-	-	10
Chloroethane	CLP	-	-	-	-/-	-	-	-	-	6J	-	-	10
1,1-Dichloroethane	CLP	6	-	-	-/-	-	-	-	-	1J	-	-	5
1,2-Dichloroethane	CLP	-	-	-	-/-	-	-	-	-	-	15J	-	5
1,2-Dichloroethene	CLP	-	-	-	-/-	-	-	-	-	6	-	-	5
2-Butanone	CLP	-	-	-	-/-	-	-	-	-	1,100E	1,900	-	10
1,2-Dichloropropane	CLP	-	-	-	-/-	-	-	-	-	2J	-	-	5
Trichloroethene	CLP	3J	-	-	-/-	-	-	-	-	2J	-	-	5
Benzene	CLP	2J	-	-	-/-	-	-	-	5	39	55	-	5
4-Methyl-2-Pentanone	CLP	-	-	-	-/-	-	-	-	-	270E	300	-	10
2-Hexanone	CLP	-	-	-	-/-	-	-	-	-	130	210	-	10
Toluene	CLP	9	-	-	-/-	-	-	-	5	1,400E	930	-	5
Chlorobenzene	CLP	2J	-	-	2J/5	-	-	2J	27	2J	-	-	5
Ethylbenzene	CLP	3J	-	-	-/-	-	-	-	33	48	39J	-	5
Total Xylenes	CLP	11	-	-	-/-	-	-	-	75	290E	280	-	5
Tetrachloroethene	CLP	3J	-	-	-/-	-	-	-	-	-	-	-	5
Semivolatile Organics											ITP2DL[i]		
Benzyl Alcohol	CLP	-	-	-	-/-	-	-	-	9J	-	-	-	10
4-Methylphenol	CLP	-	-	-	-/-	-	-	-	14	-	-	-	10
Benzoic Acid	CLP	5J	-	-	3J/19J	-	-	-	-	-	-	-	50
Naphthalene	CLP	-	-	-	-/-	-	-	-	10	11	-	-	10
2-Methylnaphthalene	CLP	-	-	-	-/-	-	-	-	2J	-	-	-	10

See footnotes at end of Table.

TABLE 5
(Continued)

DETECTED PARAMETERS[c]	ANALYTICAL METHOD[d]	WELL ID/AQUIFER COMPLETED IN											CRQL[e]
		BEDROCK AQUIFER					SOIL AQUIFER		PERCHED AQUIFER				
		ITB1	ITB2	ITB3	ITB4	ITB5	ITS1	ITS2	ITP1	ITP2	ITP2DL[1]	ITP3	
Semivolatile Organics (Cont.)													
Diethylphthalate	CLP	-	-	-	-/-	-	-	-	2J	410E	420	-	10
N-Nitrosodiphenylamine	CLP	-	-	-	-/3J	-	-	-	2J	-	-	-	10
Phenanthrene	CLP	-	-	-	-/-	-	-	-	2J	-	-	-	10
Di-n-Butylphthalate	CLP	-	3J	-	-/-	3J	3J	2J	-	5J	6J	3J	10
Bis(2-ethylhexyl)phthalate	CLP	-	9J	59	-/-	5J	2J	-	20	93	88	15	10
Di-n-octylphthalate	CLP	-	-	-	-/2J	-	-	-	4J	8J	-	-	10
4-Chloro-3-Methyphenol	CLP	-	-	-	-/-	-	-	-	14J	-	-	-	10
Pentachlorophenol	CLP	-	-	-	-/4J	-	-	-	-	-	-	-	50
Fluoranthene	CLP	-	-	-	-/2J	-	-	-	-	-	-	-	10
Pyrene	CLP	-	-	-	-/2J	-	-	-	-	-	-	-	10
Butylbenzylphthalate	CLP	-	-	-	-/2J	-	-	-	-	-	-	-	10
Benzo(a)anthracene	CLP	-	-	-	-/3J	-	-	-	-	-	-	-	10
Chrysene	CLP	-	-	-	-/3J	-	-	-	-	-	-	-	10
Benzo(k)fluoranthene	CLP	-	-	-	-/2J	-	-	-	-	-	-	-	10
1,4-Dichlorobenzene	CLP	-	-	-	-/4J	-	-	-	-	-	-	-	10

See footnotes at end of Table.

TABLE 5
(Continued)

DETECTED PARAMETERS[c]	ANALYTICAL METHOD[d]	WELL ID/AQUIFER COMPLETED IN										CRQL[e]
		BEDROCK AQUIFER					SOIL AQUIFER		PERCHED AQUIFER			
		ITB1	ITB2	ITB3	ITB4	ITB5	ITS1	ITS2	ITP1	ITP2	ITP3	
Pesticides/PCBs												
Alpha-BHC	CLP	-	-	-	-/-	0.11	-	-	-	-	-	0.05
4',4'-DDT	CLP	-	-	-	-/-	-	-	-	-	0.16	-	0.10
TAL Metals (Filtered Sample)												CRDL[f]
Aluminum	CLP	-	100B	-	-/-	24.7B	133B	1,230	132B	-	136B	200
Arsenic	CLP	-	-	-	-/-	-	-	-	3.0B	-	-	10
Barium	CLP	64.6B	6.4B	12.5B	146B/-143B	50.1B	31.4B	14.6B	1,170	956	179B	200
Cadmium	CLP	-	-	-	-/-	-	-	-	8.7	2.0B	-	5
Calcium	CLP	48,500	27,800	27,000	68,600/66,500	31,800	5,870	18,300	197,000	90,200	8,870	5,000
Chromium	CLP	-	-	9.2B	-/-	-	-	6.0B	22.4	10.4	-	10
Cobalt	CLP	-	-	-	44.6B/43.5B	-	3.5	3.6B	27.1B	16.0B	9.5B	50
Copper	CLP	-	-	-	-/-	-	-	-	-	-	-	25
Iron	CLP	180	306	54.3B	6,950/6,820	48.3B	225	1,880	52,300	48,700	515	100
Lead	CLP	-	2.0B	-	-/-	-	-	-	-	-	12.4	3
Magnesium	CLP	10,900	16,600	7,180	25,200/24,500	8,760	1,480B	8,420	176,000	41,000	3,870B	5,000
Manganese	CLP	1,960	18.3	38.1	10,500/10,100	817	1,070	297	1940	466	681	15
Nickel	CLP	-	-	-	-/-	7.8B	-	5.5B	68.7	25.5B	6.9B	40
Potassium	CLP	2,960BE	3,130BE	4,830BE	5,790E/5,450E	2,750B	2,010BE	1,310BE	151,000E	36,100E	5,720E	5,000
Sodium	CLP	15,500	11,700	13,900	31,000/30,300	17,700	3,690B	9,300	355,000	41,200	7,620	5,000
Vanadium	CLP	-	4.0B	2.5B	-/-	2.4B	-	6.8B	24.2B	9.1B	-	50
Zinc	CLP	96.7	116	-	87.6/76.4	99.4	-	-	294	280	-	20

[a]For monitoring well locations, refer to Figure 1.
[b]Micrograms per liter or parts per billion.
[c]Parameters detected are included in the table. For analytical results, refer to data tables in Appendix D.

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TABLE 5
(Continued)

FOOTNOTES (Cont.)

[d]U.S. EPA Contract Laboratory Program, Statement of Work (SOW). For Organic Analyses, multi-media, multi-concentration SOW 2/88, and SOW for Inorganic Analyses, multi-media, multi-concentration SOW 788.
[e]CRQL - Contract Required Quantitation Limits. U.S. EPA CLP, SOW 2/88 (Reference d).
[f]ITP2DLRE - Indicates the sample was reanalyzed after dilution.
[g]Indicates parameter not detected. For detection limits, refer to data tables in Appendix D.
[h]Indicates the samples were analyzed in duplicate; a "blind" sample, named F-11, was collected as a duplicate of Montitoring Well ITB-4.
[i]ITP2DL - Indicates the sample was reanalyzed.
[j]CDRL - Contract Required Detection Limit. U.S. EPA CLP, SOW 788 (Reference d).

NOTE: For data qualifiers B, J, etc., refer to Table 8.

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TABLE 6

SUMMARY OF ANALYTICAL DATA
F-SERIES MONITORING WELLS[a]
WOODLAWN LANDFILL RI/FS
(units ug/l[b])

DETECTED PARAMETERS[c]	ANALYTICAL METHOD[d]	WELL ID/AQUIFER COMPLETED IN									CRQL[e]
		F1	F2	F3	F5	F6	F7	F8	F9	F10	
		SOIL AQUIFER									
Volatile Organics											
Vinyl Chloride	CLP	-[f]	100	-	110	520	57	20	-	27	10
Acetone	CLP	-	-	-	7J	-	-	-	-	-	10
1,1-Dichloroethane	CLP	-	2J	-	-	-	1J	-	3J	2J	5
1,2-Dichloroethene	CLP	-	-	-	-	-	-	-	-	3J	5
2-Butanone	CLP	-	-	-	-	63	-	-	-	-	10
Trichloroethene	CLP	-	4J	-	-	-	-	-	-	4J	5
Benzene	CLP	-	2J	2J	-	-	3J	-	-	1J	5
Toluene	CLP	-	-	-	-	-	4J	-	-	4J	5
Chlorobenzene	CLP	-	-	12	-	-	-	-	-	-	5
Ethylbenzene	CLP	-	-	-	-	-	2J	-	-	-	5
Total Xylenes	CLP	-	-	-	-	8J	6	-	-	1J	5
Tetrachloroethene	CLP	-	1J	-	-	-	-	-	-	2J	5
Semivolatile Organics											
Benzoic Acid	CLP	-	-	-	-	-	100	-	-	-	50
Di-n-Butylphthalate	CLP	-	3J	-	-	-	-	3J	2J	3J	10
Bis(2-ethylhexyl)phthalate	CLP	-	-	-	-	-	14	21	11	22	10
Pesticides/PCBs											
Alpha-BHC	CLP	-	-	-	-	-	0.063X	-	-	-	0.05
Endosulfan I	CLP	-	-	-	-	-	-	-	-	0.17X	0.05
TAL Metals (Filtered Sample)											CRDL[g]
Aluminum	CLP	-	-	-	286	-	-	-	-	-	200
Barium	CLP	11.7B	41.4B	111B	17.1B	189B	39.4B	31.8B	21.2B	73.5B	200
Cadmium	CLP	-	-	-	-	-	-	-	-	-	5
Calcium	CLP	1,080B	18,400	57,400	2,620B	27,000	80,800	6,470	6,530	8,510	5,000
Chromium	CLP	-	-	-	-	-	-	-	-	-	10

See footnotes at end of Table.

TABLE 6
(Continued)

ETECTED ARAMETERS[c]	ANALYTICAL METHOD[d]	F1	F2	F3	F5	F6	F7	F8	F9	F10	CRDL[g]
		WELL ID/AQUIFER COMPLETED IN — SOIL AQUIFER									
AL Metals (Continued)											
obalt	CLP	-	-	-	-	26.5B	-	41.1B	42B	29.4B	50
opper	CLP	-	-	-	-	-	-	-	-	-	25
on	CLP	29.8B	7,690	37,000	628	424	13,100	5,310	11,100	2,020	100
ead	CLP	15.6	-	-	-	2.7BW	-	-	-	-	3
fagnesium	CLP	418B	5,680	19,300	929B	8,010	11,400	2,330B	2,730B	2,440B	5,000
fanganese	CLP	51.7	10,900	5,970	112	1,840	9,620	8,760	13,800	2,310	15
fercury	CLP	-	-	-	0.22	1.9	-	-	-	-	0.2
lickel	CLP	-	-	-	-	-	-	-	-	-	40
otassium	CLP	-	938BE	2,170BE	1,260BE	1,750BE	2,400BE	1,430BE	968BE	2,360BE	5,000
odium	CLP	1,740B	6,120	40,100	3,230B	8,790	8,960	3,580B	3,000B	3,360B	5,000
anadium	CLP	-	-	-	-	-	-	-	-	-	50
inc	CLP	-	-	-	-	-	-	-	-	-	20

'or monitoring well locations, refer to Figure 1.
licrograms per liter or parts per billion.
'arameters detected are included in this table. For analytical results, refer to data tables in Appendix D.
J.S. EPA Contract Laboratory Program, Statement of Work (SOW). For organic analyses, multimedia, multi-concentration SOW 2/88, and SOW for Inorganic Ana77lyses, multimedia, multi-concentration SOW 788.
RQL - Contract Required Quantitation Limits. U.S. EPA CLP SOW 2/88 (Reference d).
ndicates parameter not detected. For detection limits, refer to data tables in Appendix D.
RDL - Contract Required Detection Limit. U.S. EPA CLP, SOW 788 (Reference d).

OTE: For data qualifiers B, J, etc., refer to Table 8.

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TABLE 7

SUMMARY OF ANALYTICAL DATA STATE AND COUNTY AND OTHER MONITORING WELL SAMPLES[a] WOODLAWN LANDFILL RI/FS (units ug/l[b])

ANALYTICAL PARAMETERS[c]	ANALYTICAL METHOD[d]	WELL ID/AQUIFER COMPLETED IN										CRQL[e]
				STATE WELLS				COUNTY WELLS			OTHER WELL	
		B2	B3	B4	B5	B6	OW1	OW2	OW4	SW1	TSTA-1[f]	
		SOIL AQUIFER					SOIL AQUIFER				BEDROCK AQUIFER	
Volatile Organics												
Chloroethane	CLP	J	-	-	-	-	-	-	4J	-	-	10
Vinyl Chloride	CLP	-	-	-	-	-	-	-	-	-	-	10
1,2-Dichloroethene	CLP	-	-	-	-	-	-	-	-	-	2J	5
Toluene	CLP	-	-	4J	-	1J	-	-	-	-	-	5
Chlorobenzene	CLP	-	-	-	-	2J	-	10	14	13	-	5
Benzene	CLP	-	-	-	-	-	-	1J	2J	1J	-	5
Semivolatile Organics												
Benzoic Acid	CLP	-	-	-	-	-	-	73	12J	-	-	50
Diethylphthalate	CLP	-	-	8J	-	-	-	-	-	-	-	10
Pentachlorophenol	CLP	-	-	7J	-	-	-	-	-	-	-	50
Di-n-butylphthlate	CLP	-	4BJ	-	-	3J	3J	4J	-	-	-	10
Pyrene	CLP	-	-	5J	-	-	-	-	-	-	-	10
Bis(2-ethylhexyl)phthalate	CLP	3J	10	33	10	4J	25	140	-	-	-	10
Pesticides/PCBs												
Alpha-BHC	CLP	-	-	0.19	-	-	-	-	-	0.064X	-	0.05
Heptachlor	CLP	-	-	-	-	0.082	-	-	-	-	-	0.05
Endosulfan I	CLP	-	-	-	-	-	0.24	-	-	-	-	0.05
TAL Metals (Filtered Sample)												CRDL[h]
Aluminum	CLP	385	-	38.1B	67.1B	18.9B	240	81.8B	191B	156B	-	200
Arsenic	CLP	-	-	3.0B	-	-	-	-	3.0B	6.0B	-	10
Barium	CLP	19.3B	2.9B	183B	15.3B	29.6B	21.1B	10.3B	439	111B	8.6B	200
Cadmium	CLP	-	-	-	-	-	-	-	-	-	-	5
Calcium	CLP	6,840	8,120	70,300	6,510	39,300	3,620B	38,800	106,000	84,500	5,090	5,000
Chromium	CLP	-	-	-	-	-	-	-	-	-	-	10

See footnotes at end of Table.

TABLE 7
(Continued)

ANALYTICAL PARAMETERS[a]	ANALYTICAL METHOD[d]	WELL ID/AQUIFER COMPLETED IN										CRDL[h]
		STATE WELLS					COUNTY WELLS				OTHER WELL	
		B2	B3	B4	B5	B6	OW1	OW2	OW4	SW1	TSTA-1[f]	
		SOIL AQUIFER					SOIL AQUIFER				BEDROCK AQUIFER	
TAL Metals (Continued)												
Cobalt	CLP	-	-	121	-	-	-	8.3B	23B	48.2B	-	50
Copper	CLP	-	-	-	-	-	-	-	10.4B	-	68.1	25
Iron	CLP	452	61.2B	9,910	79.3B	-	518	3,900	25,900	17,200	30.5B	100
Lead	CLP	4.8	4.7	-	-	-	22.1	10.4	-	278S	-	3
Magnesium	CLP	1,340B	3,910B	13,200	1,960B	10,800	1,280B	17,800	30,300	22,500	1,110B	5,000
Manganese	CLP	112	3.5B	5,850	15.7	216	70.1	1,380	8,510	10,500	6.4B	15
Mercury	CLP	-	-	-	-	0.31N	-	-	-	-	-	0.2
Nickel	CLP	-	-	23.5B	-	-	-	7.4B	15B	-	-	40
Potassium	CLP	824BE	-	3,150B	997B	1,470B	1,540BE	3,510BE	4,880B	3,220BE	938BE	5,000
Silver	CLP	-	-	-	-	-	-	-	-	-	-	10
Sodium	CLP	5,630	5,560	78,300	6,690	15,200	3,760B	18,300	52,000	34,600	5,670	5,000
Vanadium	CLP	-	-	5.9B	-	3.5B	-	5.4B	10.7B	-	-	50
Zinc	CLP	-	-	49.2	12.0B	11.9B	-	-	34.6	39.8	-	20

[a]For monitoring well locations, refer to Figure 1.
[b]Micrograms per liter or parts per billion.
[c]Parameters detected are included in this table. For analytical results, refer to data tables in Appendix D.
[d]U.S. EPA Contract Laboratory Program, Statement of Work (SOW). For organic analyses, multimedia, multi-concentration SOW 2/88, and SOW for inorganic analyses, multimedia, multi-concentration SOW 788.
[e]CRQL - Contract Required Quantitation Limit - U.S. EPA CLP, SOW 2/88 (Reference d).
[f]Transfer Station tap sample.
[g]Indicates parameter not detected. For detection limit, refer to data tables in Appendix D.
[h]CRDL - Contract Required Document, U.S. EPA CLP, SOW 788 (Reference d).

NOTE: For data qualifiers J and B, etc., refer to Table 8.

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TABLE 8
SUMMARY OF ANALYTICAL DATA
DOMESTIC WELL[a] SAMPLES
WOODLAWN LANDFILL RI/FS
(units ug/l[b])

DETECTED PARAMETERS[c] (AQUIFER TAPPED)	ANALYTICAL METHODS[d]	W. BARTON 408 FIRETOWER ROAD (BEDROCK)		H. BULLOCK 430 FIRETOWER ROAD (BEDROCK)		S. HARVEY 2036 COLORA ROAD (BEDROCK)		D. HAYWOOD 2239 COLORA ROAD (BEDROCK)		J. JACKSON 140 FIRETOWER ROAD (BEDROCK)		C. SEXTON 2088 COLORA ROAD (BEDROCK)		CRQL[f]
Volatile Organics														
Acetone	CLP	10		7 J		– g		9 J		–		–		10
Semivolatile Organics														
Diethylphthalate	CLP	–		–		–		–		4 J		–		10
Di-N-butylphthalate	CLP	–		3 J		–		–		–		–		10
Pesticides/PCBs	CLP	–		–		–		–		–		–		–
TAL Metals		F	NF	F	NF	F	NF	F	NF	F	NF	F	NF	CRDL[h]
Aluminum	CLP	–	–	–	–	–	–	–	–	–	–	–	–	200
Barium	CLP	15.3 B	14.4 B	27.7 B	29.4 B	58.7 B	58.7 B	6.6 B	9.1 B	–	4.6 B	26.4 B	26.6 B	200
Beryllium	CLP	–	–	–	–	–	–	–	–	–	–	–	–	5
Cadmium	CLP	–	–	–	–	–	–	–	–	–	–	–	–	5
Calcium	CLP	7,070	7,030	9,850	10,000	8,930	9,110	9,970	10,000	3,190 B	3,020 B	10,400	10,500	5,000
Chromium	CLP	–	–	–	–	–	–	–	–	–	–	–	–	10
Cobalt	CLP	–	–	–	–	–	–	–	–	–	–	–	–	50
Copper	CLP	112	62.1	–	83.9	–	64	–	125	254	100	–	–	25
Iron	CLP	–	–	–	31.1 B	–	–	–	–	–	105	–	206	100
Lead	CLP	2.9 BW	–	–	–	–	3.8	–	–	2.1 B	4.2	2.5 B	5.6	3
Magnesium	CLP	1,690 B	1,640 B	3,210 B	3,240 B	2,510 B	2,620 B	3,010 B	3,030 B	451 B	412 B	3,470 B	3,550 B	5,000
Manganese	CLP	3.1 B	–	3.1 B	3.1 B	2.5 B	3.4 B	–	2.4 B	2.5 B	–	8.2 B	9.9 B	15
Nickel	CLP	–	–	–	–	–	–	–	–	–	–	–	–	40
Potassium	CLP	1,190 BE	1,100 B	1,370 BE	1,250 B	1,440 BE	1,360 B	1,000 BE	943 B	840 BE	736 B	1,070 E	1,090 B	5,000
Silver	CLP	–	–	–	–	–	–	–	–	–	–	–	–	10
Sodium	CLP	6,840	6,870	8,010	8,130	5,780	5,840	6,520	6,580	6,060	5,810	6,060	6,190	5,000
Vanadium	CLP	–	–	–	2.3 B	–	2.8 B	–	2.2 B	–	–	–	2.6 B	50
Zinc	CLP	–	–	–	–	–	–	–	–	–	29.1	–	61.3	20

a For domestic well locations refer to Figure 5.
b Micrograms per liter or parts per billion.
c Parameters detected are included in this table; for analytical results, refer to data tables in Appendix D.
d U.S. EPA Contract Laboratory Program, Statement of Work (SOW). For organic analyses, multimedia, multi-concentration SOW 2/88 and SOW for inorganic analyses, multimedia, multi-concentration SOW 788.
e Johnson sample is a duplicate sample taken at the Craft Well and sent to the laboratory under this name as a "blind" sample.
f CRQL – Contract Required Quantitation Limit, U.S. EPA CLP SOW 2/88 (Reference d).
g Indicates parameter not detected; for detection limit, refer to data tables in Appendix D.
h CRDL – Contract Required Detection Limit, U.S. EPA CL SOW 788 (Reference d).

Note:

1. For data qualifiers J, B, etc., refer to Table 8.
2. F – Filtered Sample
   NF – Unfiltered Sample
3. NA – Not [illegible]ple

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TABLE 8 (Continued)
SUMMARY OF ANALYTICAL DATA
DOMESTIC WELL[a] SAMPLES
WOODLAWN LANDFILL RI/FS
(units ug/l[b])

DETECTED PARAMETERS[c] (AQUIFER TAPPED)	ANALYTICAL METHODS[d]	J. CRAFT 452 WAIBEL ROAD (UNKNOWN)		M. JOHNSON[e] (NA)		J. FLAHARTY 248 FIRETOWER ROAD (BEDROCK)		C. ODOM 456 WAIBEL ROAD (BEDROCK)		CATALINA 2040 COLORA ROAD (BEDROCK)		HESS 2040 COLORA ROAD (BEDROCK)		CRQL[f]
Volatile Organics														
Acetone	CLP	–		–		–		–		–		–		10
Semivolatile Organics														
Diethylphthalate	CLP	–		–		–		–		–		–		10
Di-N-butylphthalate	CLP	3 J		2 J		–		–		–		–		10
Pesticides/PCBs	CLP	–		–		–		–		–		–		–
TAL Metals		F	NF	F	NF	F	NF	F	NF	F	NF	F	NF	CRDL[h]
Aluminum	CLP	13.3 B	–	11.4 B	–	–	–	–	–	–	–	–	963	200
Barium	CLP	16.7 B	18.8 B	16.5 B	18.5 B	11.1 B	11.0 B	–	8.9 B	7.1 B	9.1 B	19.2 B	35.7 B	200
Beryllium	CLP	–	–	–	–	–	–	–	–	2.2 B	2.2 B	–	2.2 B	5
Cadmium	CLP	–	–	–	–	–	–	–	–	–	–	–	–	5
Calcium	CLP	18,200	21,100	17,800	20,900	5,680	5,480	13,200	12,900	21,700	23,300	23,800	24,500	5,000
Chromium	CLP	–	–	–	–	–	–	–	–	–	–	–	–	10
Cobalt	CLP	–	–	–	–	–	–	–	–	5.8 B	4.8 B	–	9.7 B	50
Copper	CLP	62.6	284	53.6	227	20.1 B	–	9.0 B	–	–	–	–	–	25
Iron	CLP	82.7 B	965	106	884	–	29.0 B	351	1,410	–	–	–	29,200	100
Lead	CLP	–	12.7	–	5.0	–	–	–	–	–	–	–	4.0	3
Magnesium	CLP	5,050	6,150	4,960 B	6,080	1,670 B	1,640 B	3,860 B	3,750 B	5,130	5,600	5,070	5,710	5,000
Manganese	CLP	1,400	3,060	1,370	3,040	2.4 B	2.3 B	115	133	9.3 B	10.9 B	12.6 B	123	15
Nickel	CLP	–	–	–	–	–	–	–	–	–	–	–	–	40
Potassium	CLP	1,750 B	1,850 B	1,810 B	1,850 B	914 B	786 B	2,040 B	1,940 B	2,460 B	2,660 B	1,980 B	2,360 B	5,000
Silver	CLP	–	–	–	–	–	–	–	–	–	–	–	–	10
Sodium	CLP	7,840	7,730	7,790	7,670	4,760 B	4,290 B	6,690	6,390	11,000 E	9,280 E	7,410 E	7,550 E	5,000
Vanadium	CLP	2.3 B	3.2 B	2.3 B	3.2 B	2.3 B	–	–	2.6 B	–	–	–	10.1 B	50
Zinc	CLP	26.8	77.8	21.3	42.4	17.3 B	–	11.6 B	–	–	–	–	–	20

a For domestic well locations refer to Figure 5.
b Micrograms per liter or parts per billion.
c Parameters detected are included in this table; for analytical results, refer to data tables in Appendix D.
d U.S. EPA Contract Laboratory Program, Statement of Work (SOW). For organic analysis, multimedia, multi-concentration SOW 2/88 and SOW for inorganic analyses, multimedia, multi-concentration SOW 788.
e Johnson sample is a duplicate sample taken at the Craft Well and sent to the laboratory under this name as a "blind" sample.
f CRQL – Contract Required Quantitation Limit, U.S. EPA CLP SOW 2/88 (Reference d).
g Indicates parameter not detected; for detection limit, refer to data tables in Appendix D.
h CRDL – Contract Required Detection Limit, U.S. EPA CL SOW 788 (Reference d).

Note:

1. For data qualifiers J, B, etc., refer to Table 8.
2. F – Filtered Sample
   NF – Unfiltered Sample
3. NA – Not Applicable

TABLE 9

DATA QUALIFIER DEFINITIONS AND EXPLANATIONS[a] MONITORING AND DOMESTIC WELL SAMPLES WOODLAWN LANDFILL RI/FS

DATA QUALIFIER	DEFINITION	EXPLANATION
J (Organics)	The value is an estimate. The identification criteria is met but the value is below contract-required quantitation limits (CRQL).	The value indicates the chemical is present but the actual numeric value may be higher or lower than indicated.
J (Inorganics)	The value is an estimate. The values is less than contract-required detection limit (CRDL) but greater than instrument detection limit (IDL)	The indicated chemical is present but actual numeric value may be higher or lower than indicated.
B	The analyte found in associated blank as well as in the sample.	The value indicates possible/probable blank contamination. The value should be evaluated with proper precaution.
U	The constituent was analyzed for but was not detected. The associated numerical value is the sample quantitation/detection limit.	The value indicates the parameter was not found at the indicated detection/quantitation limits.

See footnote at the end of the table.

TABLE 9
(Continued)

LABORATORY QUALIFIER	DEFINITION	EXPLANATION
E (Organics)	The concentration exceeds calibration range of GC/MS instrument.	The indicated value exceeded the instrument calibration range. The actual value may be higher than indicated.
E (Inorganics)	The reported value is an estimate because of presence of interference.	The value may be higher or lower than the actual value due to interference.
S (Metals)	The reported value has been determined by method of standard addition (MSA).	The reported value is correct and has been determined by regression analysis of absorbance plots of four different aliquot spike concentrations.
W (Metals)	Post digestion spike for furnace AA analysis is out of control limits.	The actual value may be higher or lower because after the sample digestion the spike analysis for the analyte was out of control limits.
X	Specific flag and footnote to define results properly. If used, must be fully described and description attached to summary data package and case narrative.	The "X" footnote used for pesticide analyses indicates the manual computation of the parameter concentration.

[a]Definitions applicable for Tables 5 through 17. We have attempted to provide layman's definitions of the U.S. EPA qualifier codes. However, development of these definitions may be the function of the Agency.

TABLE 10

SUMMARY OF PRECISION AND ACCURACY[a] VOLATILE ORGANIC ANALYSES MONITORING/DOMESTIC WELL SAMPLES WOODLAWN LANDFILL RI/FS

SAMPLE ID	CORRESPONDING QC SAMPLE ID	PRECISION		ACCURACY	
		PARAMETER ANALYZED	OUT OF CONTROL	PARAMETER ANALYZED	OUT OF CONTROL
F-1, F-2, F-3, F-5, F-6, F-7, F-8, F-10, F-11, ITB-1, ITB-4, SW-1, Barton, Bullock, Harvey, Haywood, Jackson	ITB-1	5	0	10	0
B-2, B-3, F-9, ITB-2, ITB-3, ITP-1, ITP-2, ITP-3, ITS-1, ITS-2, OW-1, OW-2, Sexton, TSTA-1	F-9	5	0	10	0
B-4, B-5, B-6, ITB-5, Odom, OW-4, Craft, Flaharty, Johnson	Flaharty	5	2	10	0
Hess and Catalina	Catalina	5	0	10	0
Total 42	4	20	2	40	0

[a]Precision and accuracy data were determined using matrix spike and matrix spike duplicate analysis.

NOTE: ITP-2DLRE was analyzed with F-9 QC sample.

TABLE 11

SUMMARY OF PRECISION AND ACCURACY[a] SEMIVOLATILE ORGANIC ANALYSES MONITORING/DOMESTIC WELL SAMPLES WOODLAWN LANDFILL RI/FS

SAMPLE ID	CORRESPONDING QC SAMPLE ID	PRECISION		ACCURACY	
		PARAMETER ANALYZED	OUT OF CONTROL	PARAMETER ANALYZED	OUT OF CONTROL
F-1, F-2, F-3, F-5, F-6, F-7, F-8, F-10, F-11, ITB-1, ITB-4, SW-1, Barton, Bullock, Harvey, Haywood, Jackson	ITB-1	11	4	22	3
B-2, B-3, F-9, ITB-2, ITB-3, ITP-1, ITP-2, ITP-3, ITS-1, ITS-2, OW-1, OW-2, Sexton, TSTA-1	F-9	11	0	22	9
B-4, B-5, B-6, ITB-5, Odom, OW-4, Craft, Flaharty, Johnson	Flaharty	11	0	22	3
Hess and Catalina	Catalina	11	0	22	0
Total 42	4	44	4	88	15

[a]Precision and accuracy data were determined using matrix spike and matrix spike duplicate analysis.

NOTE: ITP-2DL was analyzed with F-9 QC sample.

TABLE 12

SUMMARY OF PRECISION AND ACCURACY[a]
PESTICIDE/PCB ANALYSES
MONITORING/DOMESTIC WELL SAMPLES
WOODLAWN LANDFILL RI/FS

SAMPLE ID	CORRESPONDING QC SAMPLE ID	PRECISION		ACCURACY	
		PARAMETER ANALYZED	OUT OF CONTROL	PARAMETER ANALYZED	OUT OF CONTROL
F-1, F-2, F-3, F-5, F-6, F-7, F-8, F-10, F-11, ITB-1, ITB-4, SW-1, Barton, Bullock, Harvey, Haywood, Jackson	ITB-1	6	0	12	1
B-2, B-3, F-9, ITB-2, ITB-3, 'TP-1, ITP-2, ITP-3, ,TS-1, ITS-2, OW-1, OW-2, Sexton, TSTA-1	F-9	6	0	12	0
B-4, B-5, B-6, ITB-5, Odom, OW-4, Craft, Flaharty, Johnson	Flaharty	6	1	12	0
Hess and Catalina	Catalina	6	0	12	0
Total 42	4	24	1	48	1

[a]Precision and accuracy data were determined using matrix spike and matrix spike dupicate analyses.

TABLE 13

SUMMARY OF PRECISION AND ACCURACY[a]
TAL-METAL ANALYSES
MONITORING/DOMESTIC WELL SAMPLES
WOODLAWN LANDFILL RI/FS

SAMPLE ID	CORRESPONDING QC SAMPLE ID	PRECISION		ACCURACY	
		PARAMETER ANALYZED	OUT OF CONTROL	PARAMETER ANALYZED	OUT OF CONTROL
Filtered Samples					
F-1, F-2, F-3, F-5, F-6, F-7, F-8, F-10, F-11, ITB-1, ITB-4, SW-1, Barton, Bullock, Harvey, Haywood, Jackson	ITB-1	15	0	17	1
B-2, B-3, F-9, ITB-2, ITB-3, ITP-1, ITP-2, ITP-3, ~TS-1, ITS-2, OW-1, W-2, Sexton, TSTA	F-9	10	1	17	2
B-4, B-5, B-6, ITB-5, Odom, OW-4, Craft, Flaharty, Johnson	Flaharty	9	1	17	2
Hess and Catalina and (NF Catalina)[b]	Catalina	16	1	17	2
Unfiltered Samples					
NF Barton, NF Bullock, NF Craft, NF Flaharty, NF Harvey, NF Haywood, NF Jackson, NF Johnson, NF Odom, NF Sexton	NF Flah	12	3	17	0
Total 53	5	62	6	85	5

[a] recision and accuracy data were determined from duplicate and spike sample analyses.

[b]NF Catalina has been included with Filtered Catalina QA sample.

TABLE 14

SUMMARY OF QA/QC DATA[a] MONITORING AND DOMESTIC WELL SAMPLES WOODLAWN LANDFILL RI/FS

SAMPLE[b] ID	PARAMETER	AVERAGE PRECISION[c] % RPD	AVERAGE ACCURACY[c] (% RECOVERY)	QC LIMITS[d] % RPD	QC LIMITS[d] % RECOVERY
F-9	Volatile organics	2.6	102-99.6	11-14	61-145
	Acid extractables	30.2	23.2-17.4	40-50	9-123
	Base neutrals	-5.7	40.5-42.7	28-38	24-127
	Pesticides/PCBs	-2.3	92.7-95	15-27	38-131
	Metals[e]	6.6	98.2	20	75-125
ITB1	Volatile organics	4.6	112.2-107.4	11-14	61-145
	Acid extractables	-71.4	26.6-47.6	40-50	9-123
	Base neutrals	-5.8	83.2-88.5	28-38	24-127
	Pesticides/PCBs	-2.3	98.2-100.5	15-27	38-131
	Metals[e]	3.2	100.8	20	75-125
Flaharty	Volatile organics	11.6	99.8-89	11-14	61-145
	Acid extractables	-17.4	63.8-74.2	40-50	9-123
	Base neutrals	2	78.8-81.5	28-38	24-127
	Pesticides/PCBs	12.2	102.7-91.8	15-27	38-131
	Metals[e]	26.6	103.4	20	75-125
Catalina	Volatile organics	0.6	99.8-99.2	11-14	61-145
	Acid extractables	1.8	63.4-62.4	40-50	9-123
	Base neutrals	20.5	65.3-80.3	28-38	24-127
	Pesticides/PCBs	2.7	101-98.3	15-27	38-131
	Metals[e]	5.7	101.4	20	75-125

[a]QA/QC data are generated pursuant to U.S. EPA CLP protocol. The data package is stored at IT's Monroeville, Pennsylvania office.

[b]Indicates samples were included in the QA/QC Program.

[c]Average precision (% RPD) and average accuracy (% recovery) data were calculated using matrix spike and matrix spike duplicate data.

[d]QC limits are taken from U.S. EPA CLP, SOW, February 1988.

[e]QC limits for metals are from U.S. EPA CLP, SOW, September 1988.

TABLE 15

DATA VALIDATION - VINYL CHLORIDE MONITORING AND DOMESTIC WELL SAMPLES[a] WOODLAWN LANDFILL RI/FS (unit ug/l)[b]

SAMPLE ID	REPORTED CONCENTRATION	CRQL[c]	BLANK VALUE FROM CORRESPONDING SAMPLE	CORRESPONDING % RPD[d]	CORRESPONDING % RECOVERY[d]	COMMENTS[e]
IT Monitoring Wells						
ITP2	7J	10	U[f]	2.6	99.6-102	Data acceptable
ITB1	76	10	U	4.6	107.4-112.2	Data acceptable
ITB5	1J	10	U	11.6	89-99.8	Reject based on % RPD
F-Series Wells						
F2	100	10	U	4.6	107.4-112.2	Data acceptable
F5	110	10	U	4.6	107.4-112.2	Data acceptable
F6	520	10	U	4.6	107.4-112.2	Data acceptable
F7	57	10	U	4.6	107.4-112.2	Data acceptable
F8	20	10	U	4.6	107.4-112.2	Data acceptable
F10	27	10	U	4.6	107.4-112.2	Data acceptable
State/County Wells						
B6	4J	10	U	11.6	89-99.8	Reject based on % RPD
Domestic Wells	U	10	-	-	-	-

[a]For sample results, refer to Tables 5 through 8.

[b]ug/l = Micrograms per liter or parts per billion.

[c]CRQL = Contract-Required Quantitation Limits (U.S. EPA CLP, SOW, February 1988).

[d]For % RPD and % Recovery, refer to Table 14.

[e]Data validation based on the blanks, % RPD, and recovery values.

[f]Indicates parameter not detected at detection limit; for detection limits, refer to tables in Appendix D.

Note: Samples with positive detects are included in this table. For data qualifiers, refer to Table 8.

Data validated according to U.S. EPA guidelines; refer to text (Section 2.6.3) for details.

TABLE 16

DATA VALIDATION - E ETHYLHEXYL)PHTHALATE MONITORING AND DOMESTIC WELL SAMPLES[a] WOODLAWN LANDFILL RI/FS (unit ug/l)[b]

SAMPLE ID	REPORTED CONCENTRATION	CRQL[c]	BLANK VALUE FROM CORRESPONDING SAMPLE	CORRESPONDING % RPD[d]	CORRESPONDING % RECOVERY[d]	COMMENTS[e]
IT Monitoring Wells						
ITS1	2J	10	U[f]	-5.7	40.5-42.7	Data acceptable
ITP1	20	10	3J	-5.7	40.5-42.7	Data acceptable
ITP2	93	10	U	-5.7	40.5-42.7	Data acceptable
ITP3	15	10	U	-5.7	40.5-42.7	Data acceptable
ITB1	3B	10	5J	-5.8	83.2-88.5	Reject based on blank
ITB2	9J	10	U	-5.7	40.5-42.7	Data acceptable
ITB3	59	10	U	-5.7	40.5-42.7	Data acceptable
ITB4	2BJ	10	5J	-5.8	83.2-88.5	Data acceptable
ITB5	5J	10	U	2.0	78.8-81.5	Data acceptable
F-Series Wells						
F5	12B	10	5J	-5.8	83.2-88.5	Reject based on blank
F6	13B	10	5J	-5.8	83.2-88.5	Reject based on blank
F7	14	10	U	-5.8	83.2-88.5	Data acceptable
F8	21	10	U	5.8	83.2-88.5	Data acceptable
F9	11	10	U	-5.7	40.5-42.7	Data acceptable
F10	22	10	U	-5.7	83.2-88.5	Data acceptable
State/County Wells						
B2	3J	10	U	-5.7	40.5-42.7	Data acceptable
B3	10	10	U	-5.7	40.5-42.7	Data acceptable
B4	33	10	U	2.0	78.8-81.5	Data acceptable
B5	10	10	U	2.0	78.8-81.5	Data acceptable
B6	4J	10	U	2.0	78.8-81.5	Data acceptable
OW1	25	10	U	-5.7	40.5-42.7	Data acceptable
OW2	140	10	U	-5.7	40.5-42.7	Data acceptable
Domestic Wells	U	10	-	-	-	-

[a]For sample results, refer to Tables 5 through 8.

[b]ug/l = Micrograms per liter or parts per billion.

[c]CRQL = Contract-Required Quantitation Limits (U.S. EPA CLP, SOW, February 1988).

[d]For % RPD and % Recovery, refer to Table 14.

[e]Data validation based on the blanks, % RPD, and recovery values.

[f]Indicates parameter not detected at detection limit; for detection limits, refer to tables in Appendix D.

Note: Samples with positive detects are included in this table. For data qualifiers, refer to Table 8.

Data vali[illegible] according to U.S. EPA guidelines; refer to text (Section 2.6.3) fo[illegible]s.

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TABLE 17

SUMMARY OF COMPLETENESS OF DATA MONITORING AND DOMESTIC WELL SAMPLES WOODLAWN LANDFILL RI/FS

PARAMETER	NO. OF SAMPLE COLLECTED/NO. OF DATA POINTS	NO. OF SAMPLES EXCEEDING HOLDING TIMES[b]	NO. OF SAMPLES LOST DUE TO BROKEN CONTAINERS	NO. OF SAMPLES FAILING QC CRITERIA	NO. OF USABLE DATA POINTS TOTAL	PERCENT
Vinyl Chloride	42[a]	0	0	2[b]	40	95[c]
Bis(2-ethylhexyl) phthalate	42[a]	0	0	3[b]	39	93

[a]Include duplicate samples.
[b]Refer to Table 15 and 16 for information on rejected data.
[c]Present usable data point = No. of usuable data x 100/Total data point.

NOTE: Completeness of data was evaluated for main analyte vinyl chloride and bis(2-ethylhexyl)phthalate.

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TABLE 18

SUMMARY OF HYDRAULIC CONDUCTIVITY ESTIMATES
WOODLAWN LANDFILL RI/FS

WELL	HYDRAULIC CONDUCTIVITY[a]
ITB-1	2.7×10^{-5} (0.08)
ITB-2	1.4×10^{-2} (39.4)
ITB-3	2.8×10^{-4} (0.79)
ITB-4	1.4×10^{-4} (0.40)
ITB-5	1.5×10^{-3} (4.30)
ITP-1	2.1×10^{-4} (0.60)
ITP-2	2.5×10^{-4} (0.71)
ITS-1	8.6×10^{-5} (0.24)
ITS-2	1.4×10^{-4} (0.40)
SW-1	2.8×10^{-4} (0.79)
F-7	7.7×10^{-5} (0.22)

[a]Hydraulic conductivity units in centimeters per second with feet per day in parenthesis.

TABLE 19

LOCATION OF DOMESTIC WELL SAMPLES AND FEATURES OF DOMESTIC WATER SUPPLY SYSTEMS WOODLAWN LANDFILL RI/FS

DOMESTIC WELL ID	EXACT SAMPLE LOCATION	FEATURES OF WATER SUPPLY SYSTEM
W. Barton	Back spigot East side of house	~ 25-50 gallon holding tank. No filtration system.
H. Bullock	Kitchen tap	~ 10 gallon holding tank. No filtration system.
S. Harvey	Side spigot West side of house	~ 25 gallon holding tank. No filtration system.
D. Haywood	Back spigot North side of house	NR
J. Jackson	Side spigot Northwest side of house	~ 25 gallon holding tank. No filtration system
C. Sexton	Back spigot South side of house	No holding tank. No filtration system.
J. Craft	Back spigot South side of house	NR
J. Flaharty	Back spigot Northeast side of house	~ 20-30 gallon holding tank. No filtration system.
C. Odom	Front spigot North side of house	~ 40 gallon holding tank. No filtration system.
Catalina	Kitchen tap	~ 30 gallon holding tank. Filtration system, iron conditioner (by-passed during sampling).
Hess	Well in yard North of main structure	NA

NOTES:

NA = Not applicable.
NR = Not recorded.
Information on this table obtained through telephone correspondence.

TABLE 20*

CHEMICAL-SPECIFIC POTENTIAL ARARs AND TBCs RELATIVE TO GROUNDWATER AT THE WOODLAWN LANDFILL SITE

	POTENTIAL ARARs		ARARs TO BE CONSIDERED (TBC)		
	FEDERAL MAXIMUM CONTAMINANT LEVEL (MCL) (ug/l)[a]	NONZERO FEDERAL MAXIMUM CONTAMINANT LEVEL GOALS (MCLGs) (ug/l)	CONCENTRATION AT REFERENCE DOSE LEVELS[b] (ug/l)	CONCENTRATION AT 10^{-4} - 10^{-6} CANCER RISK LEVEL[c] (ug/l)	CRQL[d] (ug/l)
Organic Compounds					
Vinyl Chloride(A)	2.0	-[e]	-	-	10
1,1-Dichloroethane(C)[f]	-	-	3,500	-[f]	5
1,2-Dichloroethane(B2)	5.0	-	-	-	5
Cis-1,2-Dichloroethene	70	70	350	-	5
2-Butanone	-	-	1,750	-	10
Trichloroethene(B2)	5.0	-	-	-	5
Benzene(A)	5.0	-	-	-	5
Toluene	2,000 (proposed)	2,000 (proposed)	7,000	-	5
Chlorobenzene	100 (proposed)	100 (proposed)	700	-	5
Ethylbenzene	700 (proposed)	700 (proposed)	3,500	-	5
Xylenes (total)	10,000 (proposed)	10,000 (proposed)	70,000	-	5
Tetrachloroethene(B2)	5 (proposed)	-	-	69 - 0.69	5
Benzoic Acid	-	-	140,000	-	50
Naphthalene	-	-	140	-	10
Di-ethyl phthalate	-	-	28,000	-	10
Di-n-butyl phthalate	-	-	3,500	-	10
Bis(2-ethylhexyl)phthalate(B2)	4 (proposed)	-	-	250 - 2.5	10
Pentachlorophenol	-	220 (proposed)	1,050	-	50
Pyrene	-	-	1,050	-	10
Alpha-BHC(B2)	-	-	-	0.56 - 0.0056	0.05
Endosulfan I	-	-	1.75	-	0.05

Footnotes at the end of the table.

*Revision 01 - 8/30/90

TABLE 20
(Continued)

Inorganic Compounds	POTENTIAL ARARs: FEDERAL MAXIMUM CONTAMINANT LEVEL (MCL) (ug/l)[a]	POTENTIAL ARARs: NONZERO FEDERAL MAXIMUM CONTAMINANT LEVEL GOALS (MCLGs) (ug/l)	ARARs TO BE CONSIDERED (TBC): CONCENTRATION AT REFERENCE DOSE LEVELS[b] (ug/l)	ARARs TO BE CONSIDERED (TBC): CONCENTRATION AT 10^{-4} - 10^{-6} CANCER RISK LEVEL[c] (ug/l)	CRDL[g] (ug/l)
Arsenic(A)	50[h]	-	-	-	10
Barium	1,000/5,000 (proposed)	5,000 (proposed)	-	-	200
Cadmium	10/5 (proposed)	5 (proposed)	-	-	5
Chromium (total)	50/100 (proposed)	100 (proposed)	-	-	10
Copper	1,300[i] (proposed)	1,300 (proposed)	1,300	-	25
Lead	50[h]	20 (proposed)	-	-	3
Manganese	-	-	3,500	-	15
Mercury	2.0	-	-	-	0.2
Nickel	100 (proposed)	100 (proposed)	700	-	40
Vanadium	-	-	245	-	50
Zinc	-	-	7,000	-	20

NOTE:
The above listed chemicals were detected in more than one well for one round of groundwater sampling. All Group A carcinogens detected were listed regardless of frequency. The symbols in parentheses following the compound name denote the carcinogen group.

[a] ug/l = micrograms per liter or parts per billion.

[b] This is the concentration of a systemic toxicant in water ingested by a 70-kg adult that is not expected to pose adverse health effects. An assumption of 2 liters per day consumption of contaminated water is made in the calculation.

[c] This is the concentration of a carcinogen in water that corresponds to an excess cancer risk of 1×10^{-4} to 1×10^{-6}. An assumption is made that a 70-kg adult will drink 2 liters of water per day over a 70-year period. Values are listed for those compounds only when MCLs are either proposed or not established.

[d] Contract required quantitation limits (CRQL); U.S. EPA, SOW for Organic Analyses, Multimedia Multiconcentration 2/88.

[e] "-" = not indicated.

[f] Proposal to omit 1,1-dichloroethane from the list of carcinogens of concern until such date that a reliable, peer-reviewed slope factor has been determined.

[g] Contract required detection limits (CRDL), U.S. EPA, SOW for Inorganic Analyses, Multimedia Multiconcentration SOW No. 788.

[h] National Interim Primary Drinking Water Regulation (NIPDWR) (40CFR, July 1, 1989) that is enforceable under the Safe Drinking Water Act. This chemical concentration is considered as being "protective of public health to the extent feasible."

[i] Current proposed drinking water MCL; drinking water criteria document concluded toxicity data were inadequate for calculation of an RfD for copper.

TABLE 21

POTENTIAL ARARs AND TBCs FOR GROUNDWATER AT THE WOODLAWN LANDFILL SITE

CHEMICAL-SPECIFIC ARARS

	REQUIREMENTS	APPLICATION TO THE WOODLAWN LANDFILL SITE
I.	Resource Conservation and Recovery Act (RCRA) as amended by Hazardous and Solid Waste Amendments (HSWA) (42 USCA 7401-7642) (40CFR260-280)	RCRA-related regulations are generally action specific. However, RCRA provides MCLs as part of groundwater protection standards (40CFR264.94). Table 6 lists chemicals and RCRA MCLs where available. (RELEVANT AND APPROPRIATE)
II.	Safe Drinking Water Act (SDWA) [42 USCA 3000(f)] (40 CFR Parts 141-149) (54FR22064, Federal Register, May 22, 1989)	(A) Establishes MCLs which are enforceable standards for chemicals in public drinking water supplies. They not only consider health factors, but also economic and technical feasibility of removing a chemical from a water supply system. (APPLICABLE)
		(B) Establishes MCLGs which are nonenforceable health goals for public water systems. MCLGs are set at levels that would result in no known or anticipated adverse health efforts with an adequate margin of safety. (RELEVANT AND APPROPRIATE)

TO BE CONSIDERED MATERIALS

	REQUIREMENTS	APPLICATION TO THE WOODLAWN LANDFILL SITE
I.	National Contingency Plan (NCP) (55 FR 8666, Federal Register, March 8, 1990) (40CFR300)	Baseline Risk Assessment (BLRA) will determine safe levels for those chemicals without Maximum Concentration Levels (MCLs), and will judge whether MCLs are sufficiently health-protective. The BLRA utilizes Reference Doses (RfDs) and cancer risks as a measure of safe levels.
II.	Groundwater Protection Strategy of U.S. EPA (40CFR264.94)	While not potential ARARs, the groundwater classification guidelines are considered in the Baseline Risk Assessment and Feasibility Study.

AR301264

AR301264

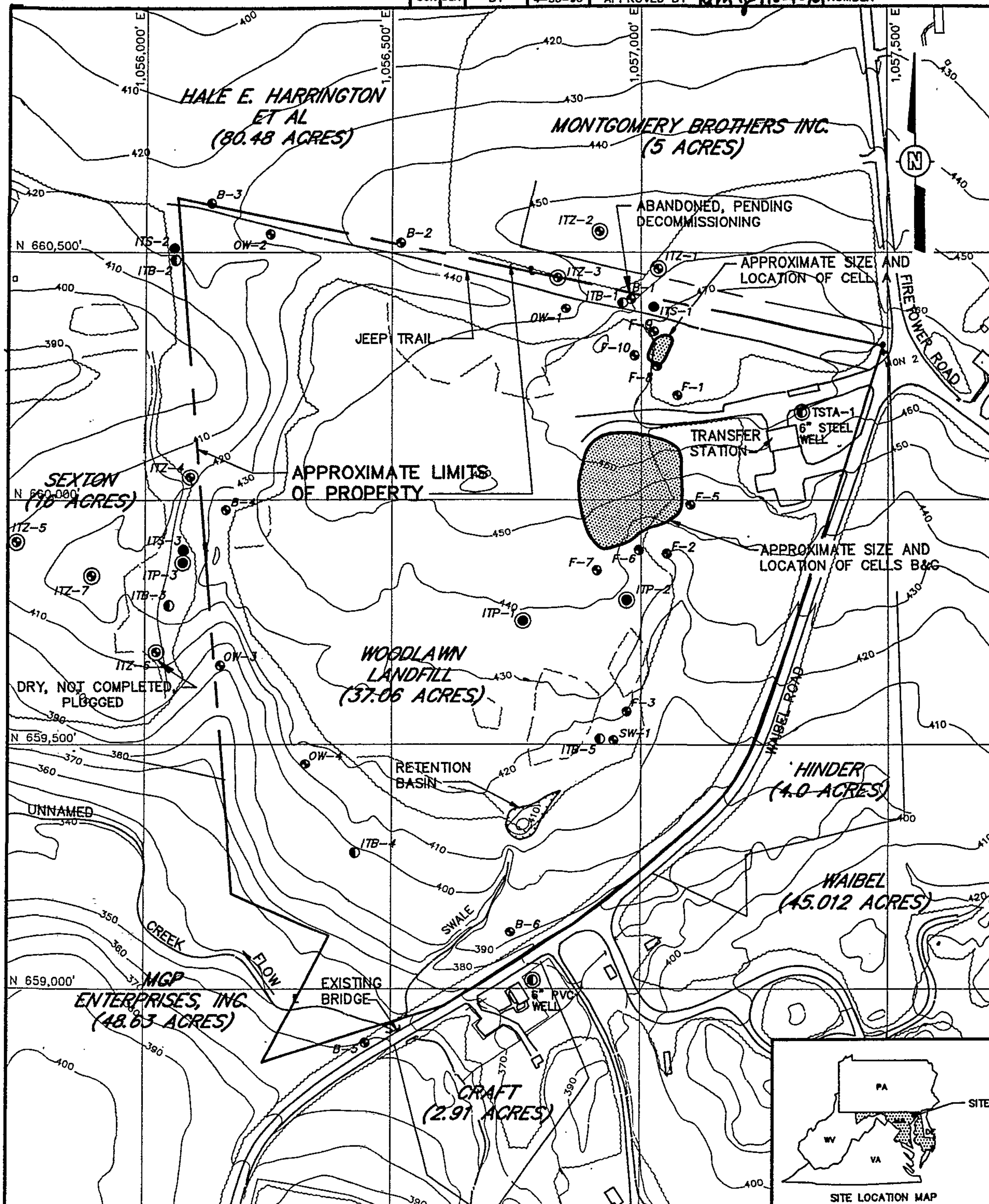
TABLE 21
(Continued)

TO BE CONSIDERED MATERIALS

REQUIREMENTS	APPLICATION TO THE WOODLAWN LANDFILL SITE
	Establishes three categories of groundwater protection standards: background, RCRA MCLs and Alternate Concentration Limit (ACLs). CERCLA Sec. 121(d)(2)(B)(ii) list three additional conditions limiting use of ACLs at Superfund sites.

FIGURES

BB	88	DRAWN BY	R. Weible	CHECKED BY	HJH	10-4-90	DRAWING NUMBER	303486-B60
50%	BLK		4-30-90	APPROVED BY		10-4-90		



LEGEND

- F-2 SOIL MONITORING WELL INSTALLED BY FIRESTONE
- OW-4 SW-1 SOIL MONITORING WELL INSTALLED BY CECIL COUNTY
- B-6 SOIL MONITORING WELL INSTALLED BY THE STATE OF MARYLAND
- BEDROCK WELL (TSTA-1 INSTALLED BY CECIL COUNTY)
- ITB BEDROCK WELL INSTALLED BY IT CORPORATION
- ITS SOIL WELL INSTALLED BY IT CORPORATION
- ITP PERCHED WATER WELL INSTALLED BY IT CORPORATION
- ITZ SOIL PIEZOMETER INSTALLED BY IT CORPORATION

SCALE 0 200 400 FEET

FIGURE 1

SITE BASE MAP

PREPARED FOR

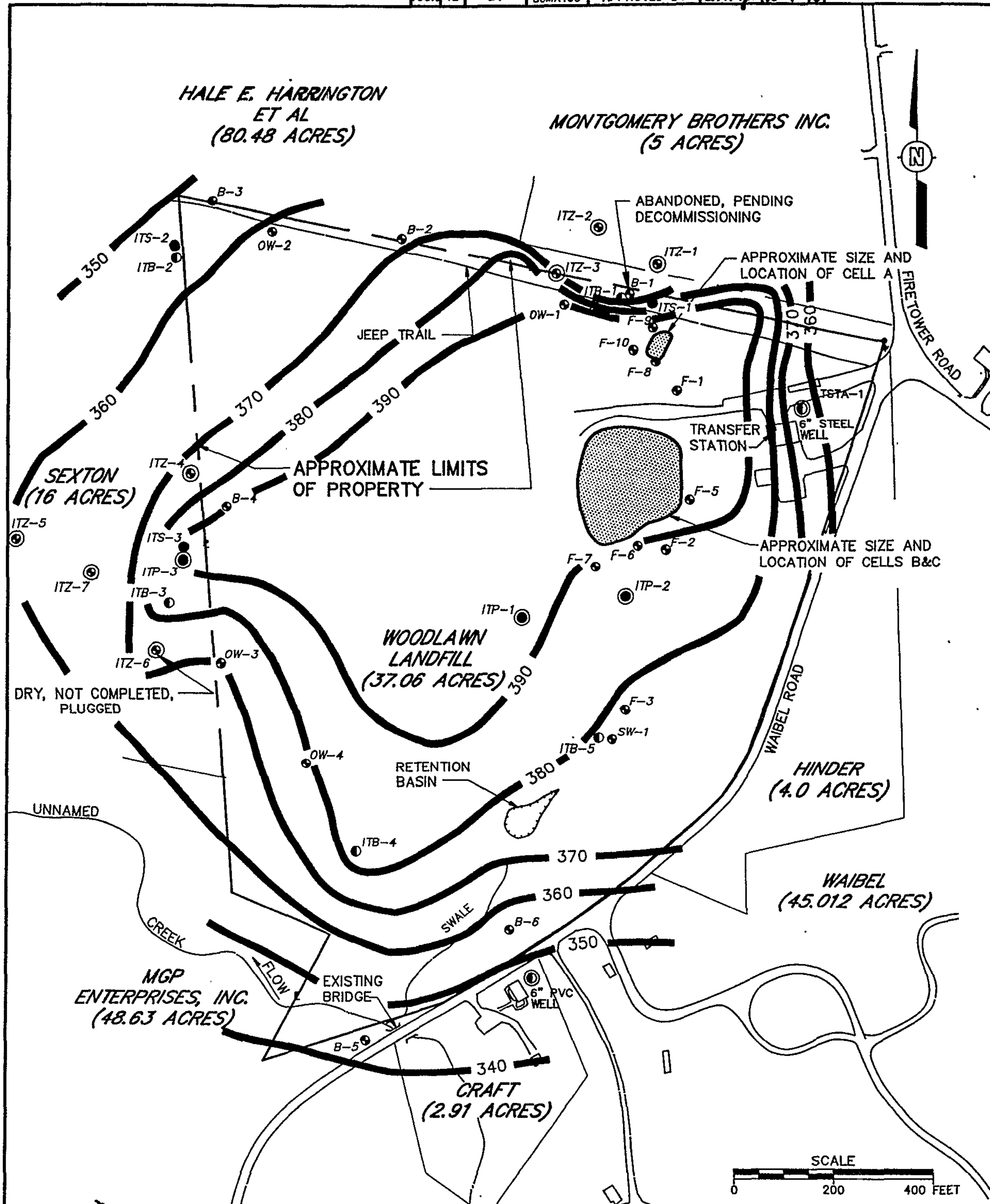
WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

AR301267

132298

BLK. 1B	DRAWN BY	B.A.KUMPF 30MAY90	CHECKED BY	MJH	10-4-90	DRAWING NUMBER	303486-B64
100% 1B			APPROVED BY	QMA	10-4-90		



LEGEND

Symbol	Description
B-2	SOIL MONITORING WELL INSTALLED BY FIRESTONE
OW-4, SW-1	SOIL MONITORING WELL INSTALLED BY CECIL COUNTY
B-6	SOIL MONITORING WELL INSTALLED BY THE STATE OF MARYLAND
	BEDROCK WELL (TSTA-1 INSTALLED BY CECIL COUNTY)
ITB-1	BEDROCK WELL INSTALLED BY IT CORPORATION
ITS-1	SOIL WELL INSTALLED BY IT CORPORATION
ITP-1	PERCHED WATER WELL INSTALLED BY IT CORPORATION
ITZ-1	SOIL PIEZOMETER INSTALLED BY IT CORPORATION

350 — INTERPOLATED TOP OF BEDROCK ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL

NOTE: REFER TO APPENDIX B THIS REPORT, FIGURES 9-13 OF PHASE I REPORT, AND APPENDIX D OF PHASE I WORK PLAN FOR DATA USED TO CREATE THIS FIGURE.

FIGURE 2

TOP OF BEDROCK ELEVATION CONTOURS

PREPARED FOR

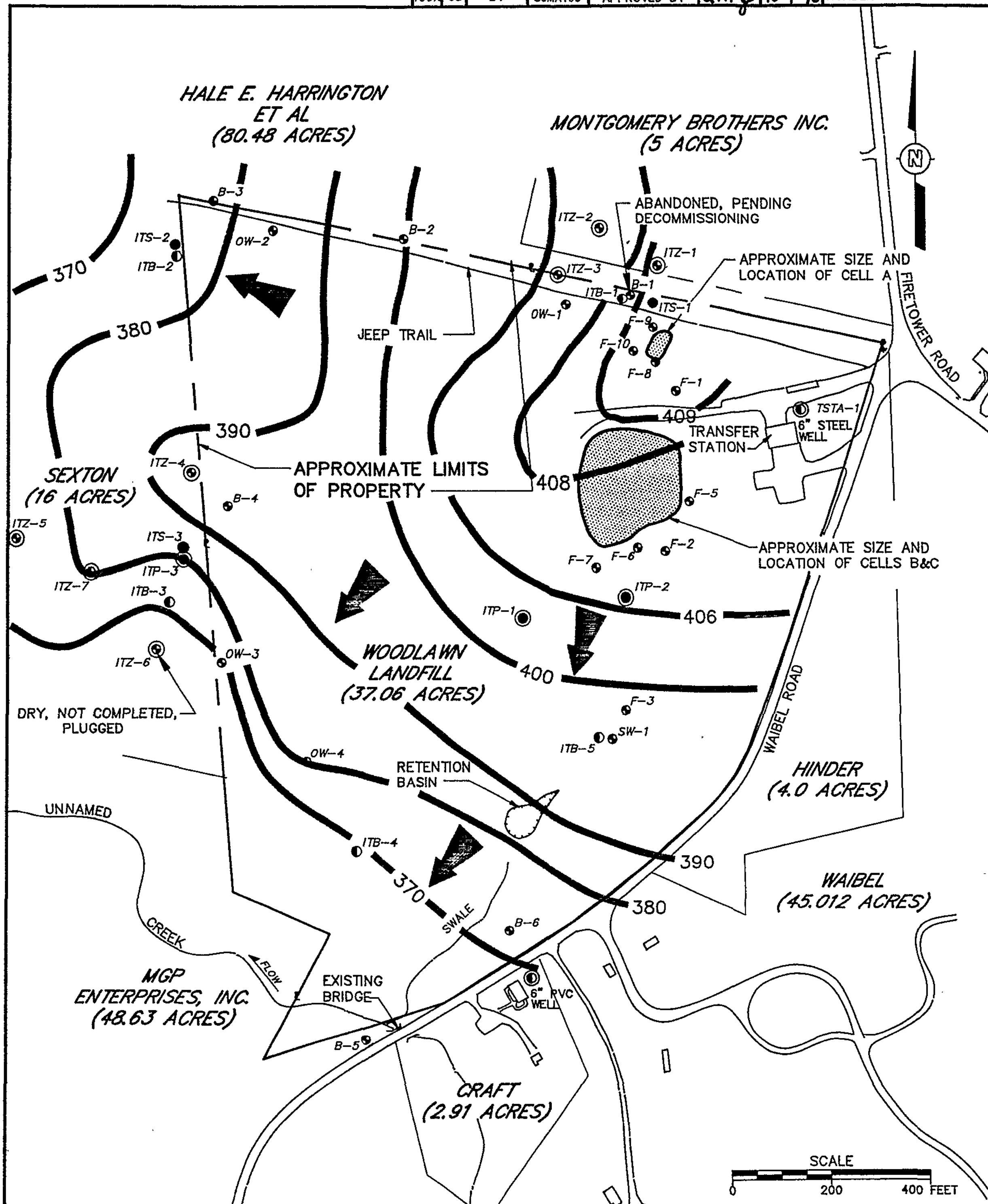
WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

132288

8921086

BLU	9B	DRAWN BY	B.A.KUMPF	CHECKED BY	MJH	10-4-90	DRAWING NUMBER	303486–B65
100%	9B		30MAY90	APPROVED BY	QM	10-4-90		



LEGEND

- F-2 — SOIL MONITORING WELL INSTALLED BY FIRESTONE
- OW-4, SW-1 — SOIL MONITORING WELL INSTALLED BY CECIL COUNTY
- B-6 — SOIL MONITORING WELL INSTALLED BY THE STATE OF MARYLAND
- BEDROCK WELL (TSTA-1 INSTALLED BY CECIL COUNTY)
- ITB-1 — BEDROCK WELL INSTALLED BY IT CORPORATION
- ITS-1 — SOIL WELL INSTALLED BY IT CORPORATION
- ITP-1 — PERCHED WATER WELL INSTALLED BY IT CORPORATION
- ITZ-1 — SOIL PIEZOMETER INSTALLED BY IT CORPORATION
- 370 — INTERPOLATED CONTOUR LINES IN FEET ABOVE MEAN SEA LEVEL
- APPARENT DIRECTION OF GROUNDWATER FLOW

NOTE:
REFER TO TABLE 2 THIS REPORT FOR WATER LEVEL DATA FOR THE WELLS SHOWN

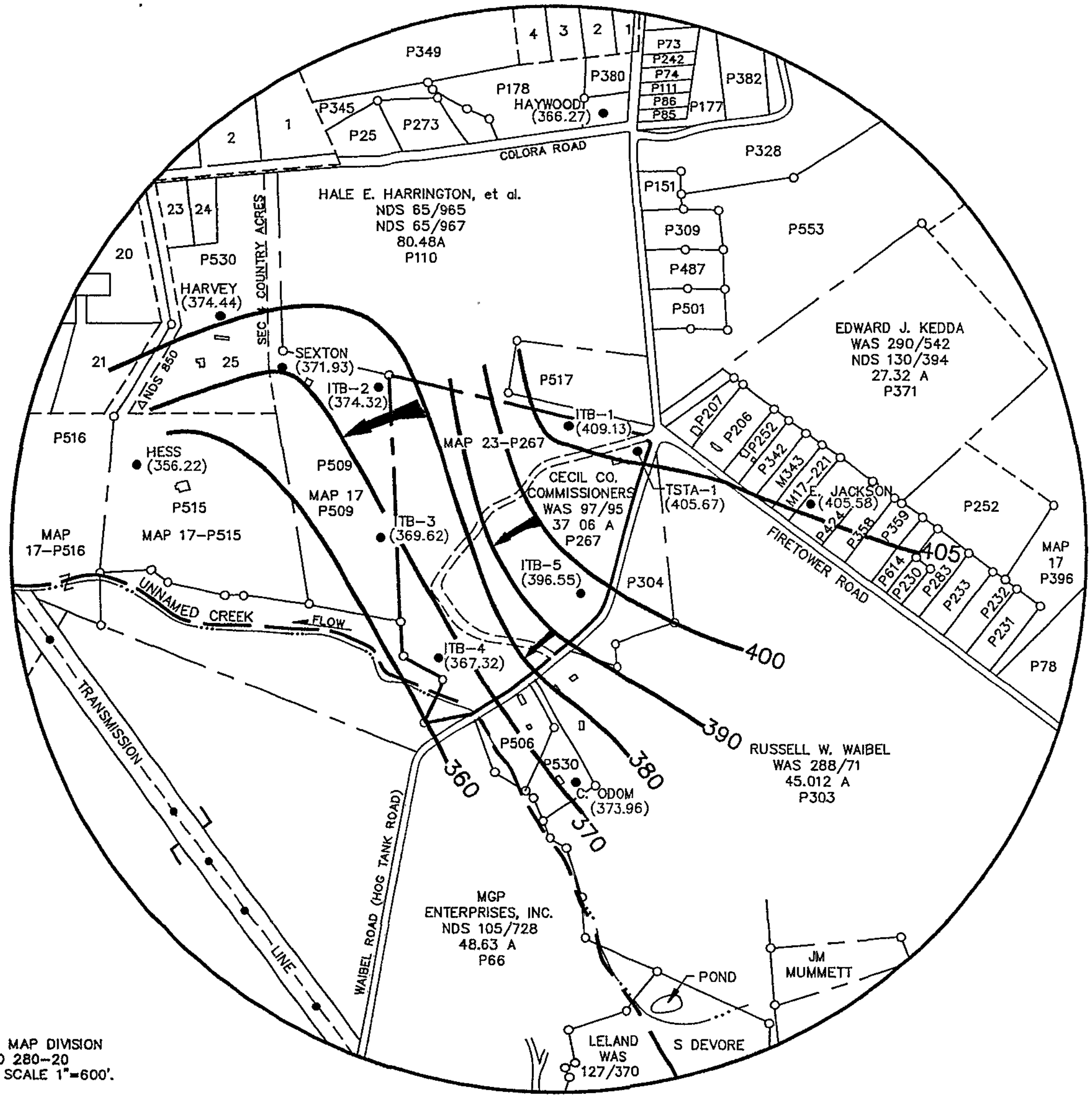
FIGURE 3

POTENTIOMETRIC SURFACE SOIL AQUIFER

PREPARED FOR

WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION



LEGEND:

- ITB–1 (409.13) — BEDROCK MONITORING WELL GROUNDWATER ELEVATION
- APPARENT GROUNDWATER FLOW DIRECTION
- –405– INTERPOLATED CONTOUR LINES IN FEET ABOVE MEAN SEA LEVEL

SCALE

0 600 1200FEET

FIGURE 4

POTENTIOMETRIC SURFACE
BEDROCK AQUIFER

PREPARED FOR

WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

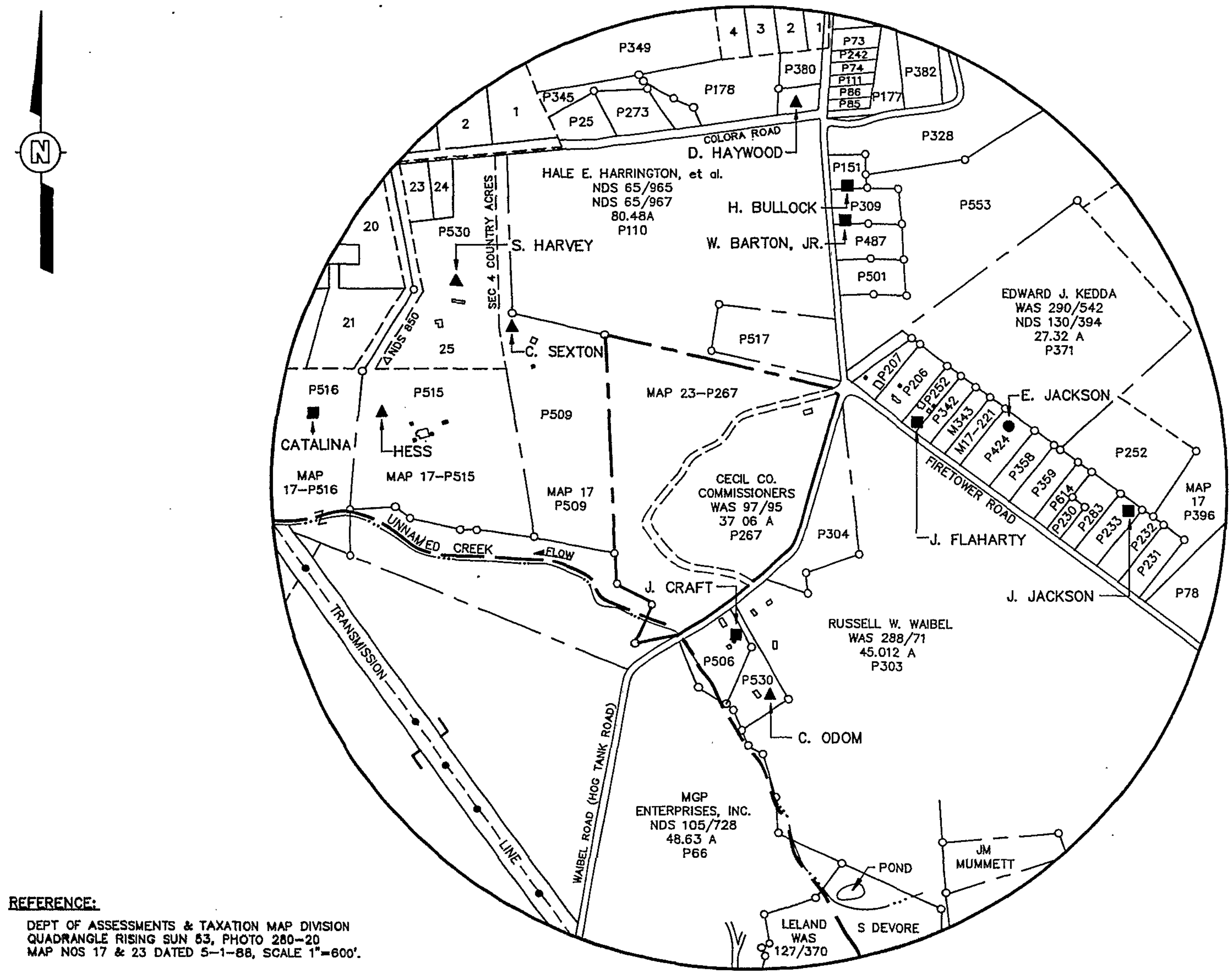
REFERENCE:

DEPT OF ASSESSMENTS & TAXATION MAP DIVISION
QUADRANGLE RISING SUN 53, PHOTO 280–20
MAP NOS 17 & 23 DATED 5–1–88, SCALE 1"=600'.

11B BLU	11B 100%	DRAWN BY	NAM 24SEPT90	CHECKED BY / APPROVED BY	MTH / amj	10-9-90 / 10-9-90	DRAWING NUMBER	303486–B72

132298

DRAWN BY	NAM 24SEPT90	CHECKED BY / APPROVED BY	MJH / amf	10-4-90 / 10-4-90	DRAWING NUMBER	303486-B73



LEGEND:

- ■ DOMESTIC WELL GROUNDWATER SAMPLE
- ● DOMESTIC WELL WATER LEVEL MEASUREMENT
- ▲ DOMESTIC WELL GROUNDWATER SAMPLE AND WATER LEVEL MEASUREMENT

SCALE

0 600 1200FEET

FIGURE 5

LOCATION OF DOMESTIC WELLS

PREPARED FOR

WOODLAWN LANDFILL RI/FS

IT INTERNATIONAL TECHNOLOGY CORPORATION

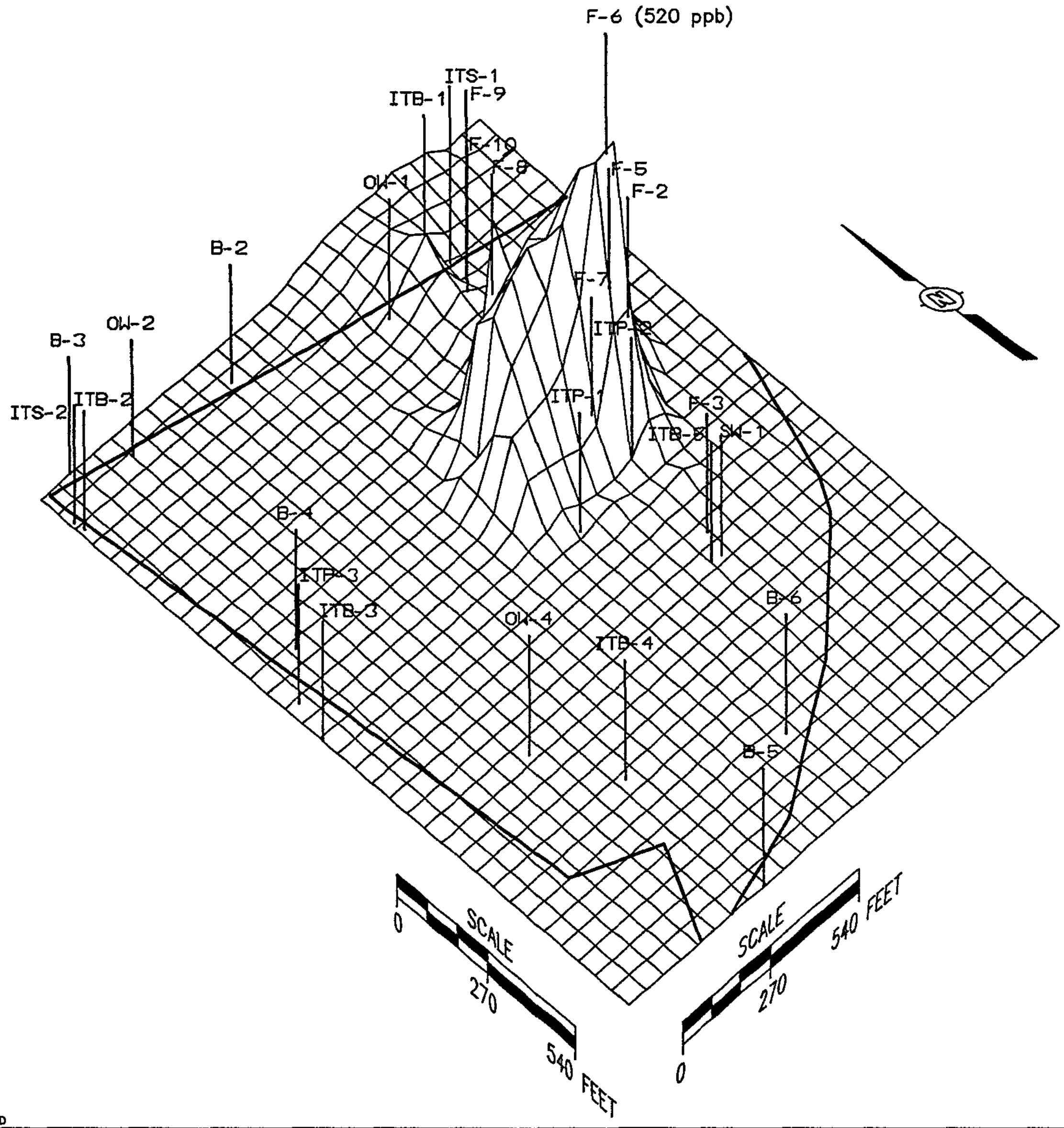
REFERENCE:

DEPT OF ASSESSMENTS & TAXATION MAP DIVISION
QUADRANGLE RISING SUN 63, PHOTO 280-20
MAP NOS 17 & 23 DATED 5-1-88, SCALE 1"=600'.

132298

AR301271

DRAWN BY	D.E.S.	CHECKED BY	MJH	6/1/90	DRAWING NUMBER	303486-B66
	5/30/90	APPROVED BY	amj	6/1/90		



LEGEND:

B-6 — LOCATION OF MONITORING WELL

HEIGHT REPRESENTS RELATIVE CONCENTRATION

NOTE:

BACKGROUND WELLS F-1 AND TSTA-1 NOT SHOWN.

FIGURE 6

GROUNDWATER CHEMICAL 3-D PLOT RELATIVE CONCENTRATION OF VINYL CHLORIDE

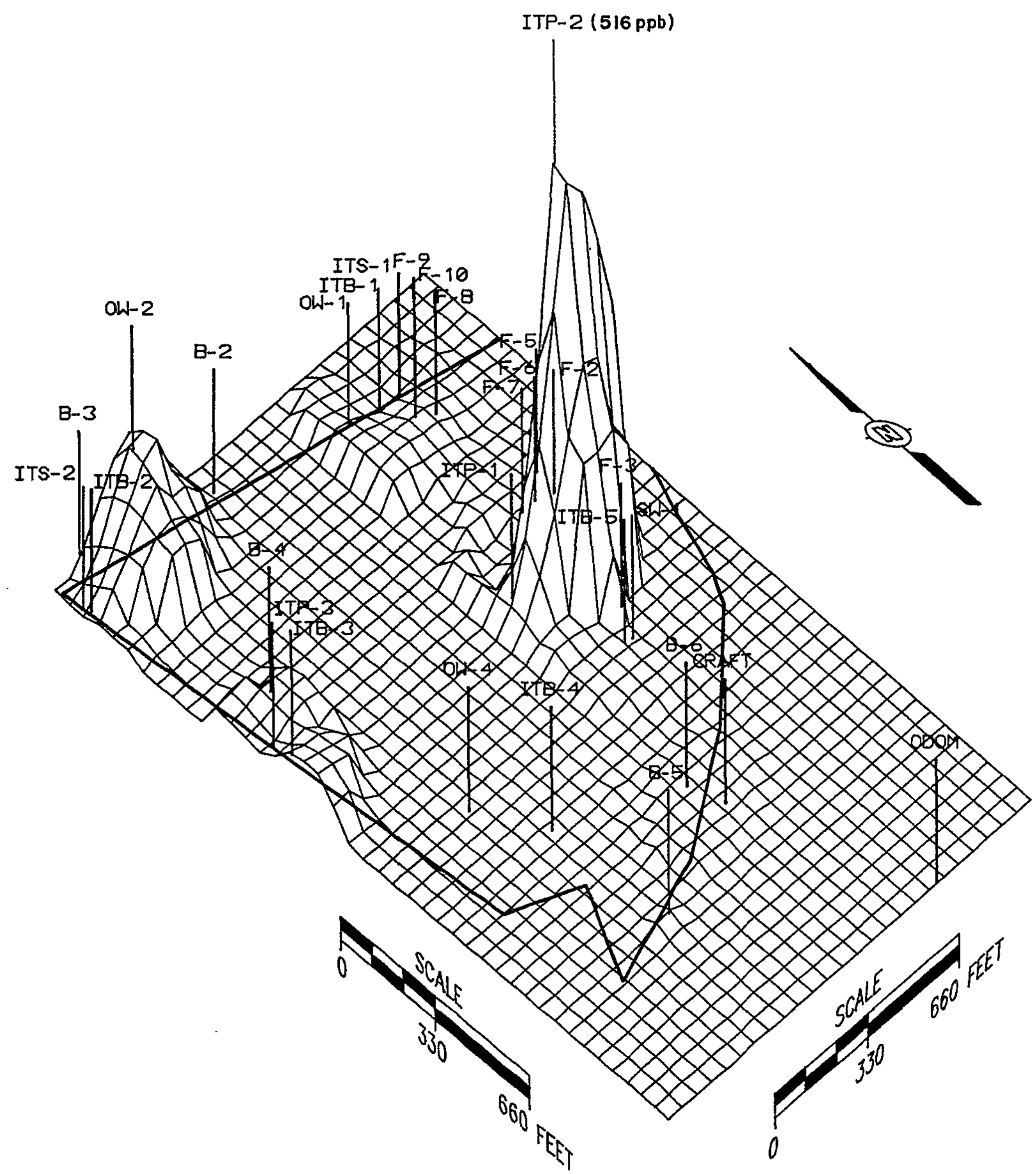
PREPARED FOR

WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

132298

DRAWN BY	D.E.S. 5/30/90	CHECKED BY / APPROVED BY	DRAWING NUMBER 303486-B67



LEGEND:

B-6

LOCATION OF MONITORING WELL

HEIGHT REPRESENTS RELATIVE CONCENTRATION

NOTE:

BACKGROUND WELLS F-1 AND TSTA-1 NOT SHOWN.

FIGURE 7

GROUNDWATER CHEMICAL 3-D PLOT RELATIVE CONCENTRATION OF TOTAL PHTHALATES

PREPARED FOR

WOODLAWN LANDFILL RI/FS

IT INTERNATIONAL TECHNOLOGY CORPORATION

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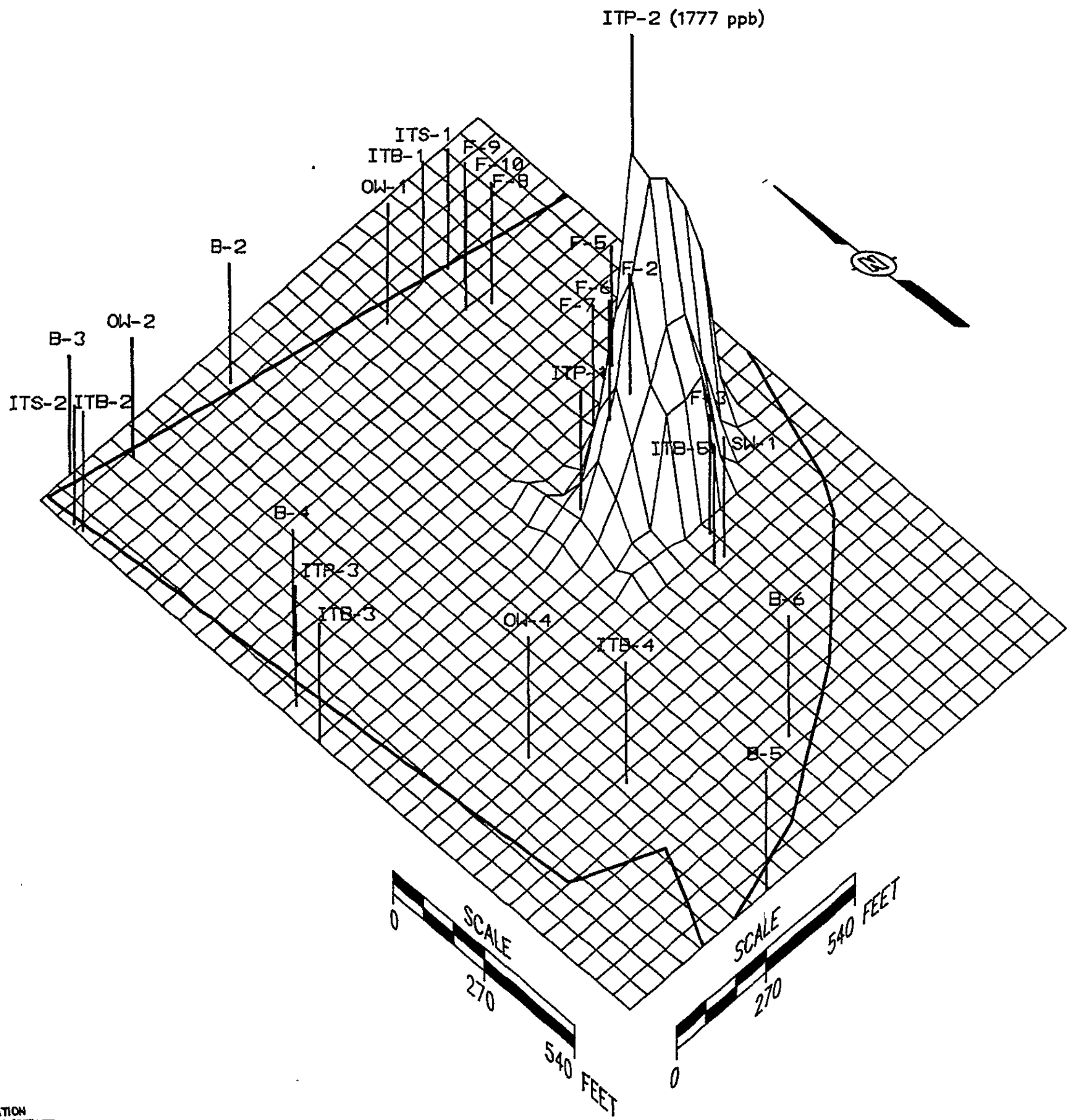
DRAWN BY	D.E.S. 5/30/90	CHECKED BY / APPROVED BY	MJH 6/1/90 / amj 6/1/90	DRAWING NUMBER	303486-B68



LEGEND:

B-6

LOCATION OF MONITORING WELL

HEIGHT REPRESENTS RELATIVE CONCENTRATION

NOTE:

BACKGROUND WELLS F-1 AND TSTA-1 NOT SHOWN.

*BTEX INCLUDES BENZENE, TOLUENE, ETHYLBENZENE AND XYLENE.

FIGURE 8

GROUNDWATER CHEMICAL 3-D PLOT RELATIVE CONCENTRATION OF BTEX*

PREPARED FOR

WOODLAWN LANDFILL RI/FS

IT INTERNATIONAL TECHNOLOGY CORPORATION

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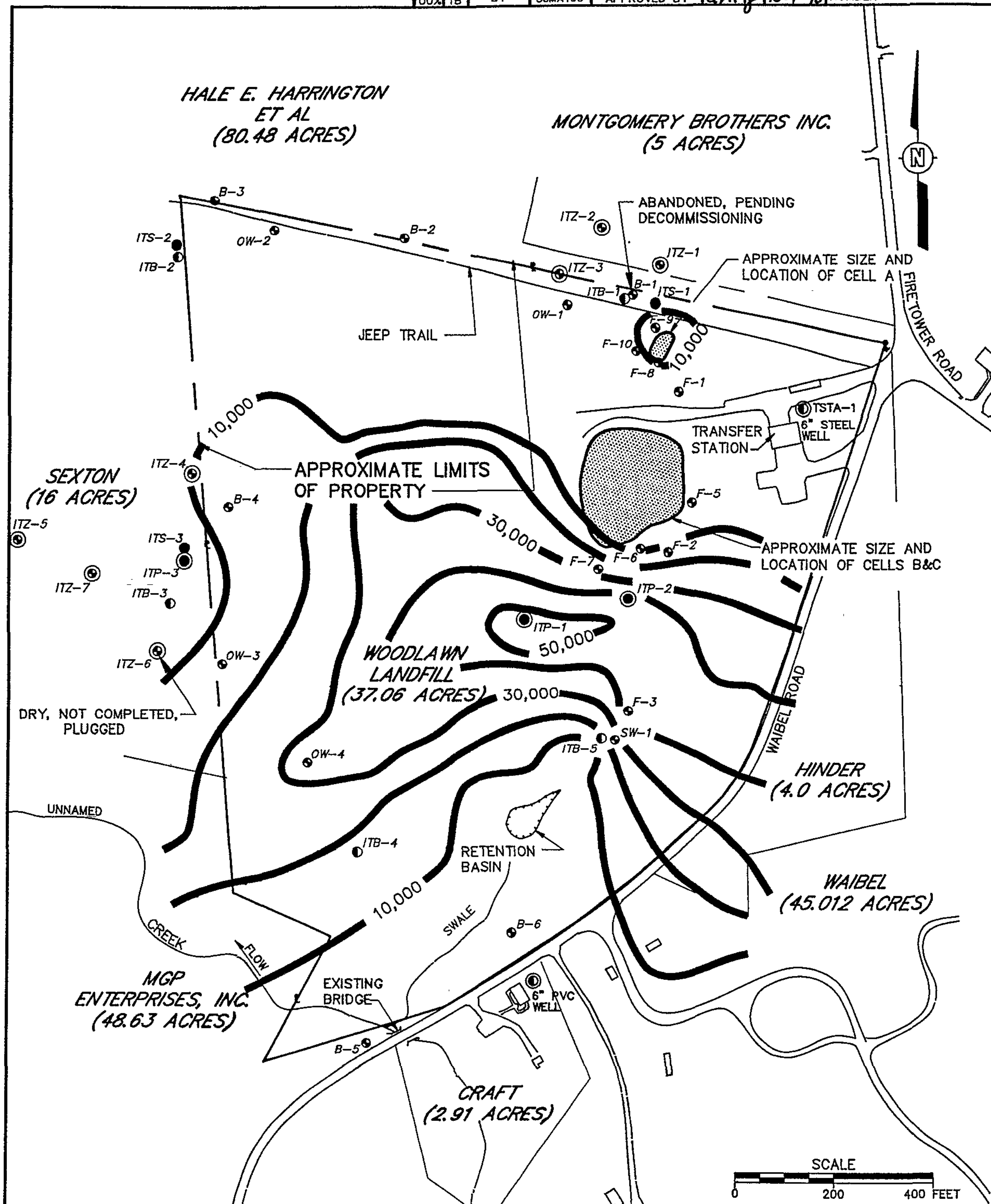
ORG 1B	DRAWN BY	B.A.KUMPF	CHECKED BY	MJM	10-4-90	DRAWING NUMBER	303486-B69
00% 1B		30MAY90	APPROVED BY	amg	10-4-90		



LEGEND

- F-2 — SOIL MONITORING WELL INSTALLED BY FIRESTONE
- OW-4, SW-1 — SOIL MONITORING WELL INSTALLED BY CECIL COUNTY
- B-6 — SOIL MONITORING WELL INSTALLED BY THE STATE OF MARYLAND
- BEDROCK WELL (TSTA-1 INSTALLED BY CECIL COUNTY)
- ITB-1 — BEDROCK WELL INSTALLED BY IT CORPORATION
- ITS-1 — SOIL WELL INSTALLED BY IT CORPORATION
- ITP-1 — PERCHED WATER WELL INSTALLED BY IT CORPORATION
- ITZ-1 — SOIL PIEZOMETER INSTALLED BY IT CORPORATION

10,000 — INTERPOLATED GROUNDWATER CHEMICAL CONTOUR

NOTE:
CONTOUR INTERVAL IS 10,000 PARTS PER BILLION.

FIGURE 9

GROUNDWATER CHEMICAL ISOPLETHS TOTAL IRON AND MANGANESE

PREPARED FOR

WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

132298

AR301275

AR301275

APPENDIX A
QUALITY ASSURANCE AUDIT

INTERNATIONAL TECHNOLOGY CORPORATION

Memorandum

To: N. Allen, D. Troxell, D. Brunner

Date: April 16, 1990

From: A. M. Jacobs/M. J. Hardner AMJ 4/16 MJH 4/16

Project No. 303486

Subject: **QUALITY ASSURANCE FIELD/AUDIT AND RESPONSES COMPLIANCE DOCUMENTATION BRIDGESTONE/FIRESTONE - WOODLAWN LANDFILL RI/FS PHASE II FIELD WORK**

As per the requirements of the subject field audit conducted on February 15 and 16, 1990 by Dennis Brunner, we are documenting actions taken as prescribed in these documents. Attached herewith are:

- Field Audit Report (March 5, 1990)
- Responses to the Field Audit Report (March 16, 1990)
- Variance logs

AMJ:MJH:jit
Enclosures

Distribution:
N. Allen
J. Broscious
D. Brunner
L. Haser
M. Jordan
T. Sole

INTERNATIONAL TECHNOLOGY CORPORATION

Memorandum

To: Alan M. Jacobs

Date: March 5, 1990

From: Dennis E. Brunner

Subject: QUALITY ASSURANCE FIELD AUDIT, BRIDGESTONE/FIRESTONE - WOODLAWN LANDFILL PHASE II AUDIT REPORT: REVISION 00

DATE AND LOCATION

The Quality Assurance (QA) field audit of the Phase II work for Bridgestone/Firestone Woodlawn landfill project was conducted on February 15 and 16, 1990 at the project field site in Cecil County, Maryland. An opening meeting was held with Michael Jordon (Site Manager) on February 15, 1990 at the field site to discuss the objectives and procedures required for conducting the audit.

AUDIT PARTICIPANTS

ENGINEERING OPERATIONS

	Auditor
Alan M. Jacobs Michael K. Jordan Robert Nies Neville F. Allen	Dennis E. Brunner

Activities Audited

The audit was based on the requirements of the IT Engineering Operation (ITEO) QA Manual, Revision No. 1; QA Project Plan (QAPP), Remedial Investigation/Feasibility Study, Woodlawn Landfill, Revision No. 05 dated November 30, 1989; Health and Safety (H&S) Plan, Revision No. 5 dated November 30, 1989; Phase II Site Characterization Detailed Work Plan, Revision No. 2 dated November 30, 1989 and the Phase IV Additional Field Work Detailed Work Plan, Revision No. 02, dated November 30, 1989.

The QAPP is the controlling document for the Bridgestone/Firestone - Woodlawn project activities. Other project documents supplement the QAPP. The project activities and quality practices audited included:

- Project Procedures
- Field Investigation Documentation
- Field Equipment Calibration and Control
- Variance Logs

AR301278

This audit was conducted before all Phase II field activities had been completed. All field documentation was not available at the time of the audit.

AUDIT RESULTS

The results of this audit indicate the Firestone Project Team is applying the provisions of the QAPP and Detailed Work Plan in an acceptable manner.

Findings and observations along with the recommended corrective actions are described below.

PROJECT PROCEDURES

Finding No. 1 - Failure to Document Notification to Regulatory Agencies of of Relocation of Piezometers ITZ 1, 2, and 3 and Perched Monitoring Wells ITP 1 and 2 (Phase II Detailed Work Plan, Section 2.3.1, Page 2-4).

No written documentation was found on site to verify that regulatory agencies had been informed of well and/or piezometer location changes.

Corrective Action: It is not specified in the Detailed Work Plan when the agencies should be notified but it is implied that this would be completed prior to installation of the wells. Formal documentation should be obtained which indicates to the agencies that these well locations have been changed and show the new locations in the appropriate figure and/or drawing of the site.

Finding No. 2 - Failure to obtain approval from State of Maryland representative for variances from the State of Maryland Monitoring Well Specifications (Phase II Detailed Work Plan, Section 2.3.2, Page 2-4).

Several variances from the above referenced State of Maryland Monitoring Well Specifications were identified. The variances are referenced to the paragraphs as numbered in the referenced specifications.

PARAGRAPH NO.	VARIANCE IDENTIFIED
3.	Several wells have screen length greater than 10 feet in length
5.	Centralizers were not used in all monitoring well installations
6.	ITP 1 and 2 were not constructed with a fine sand installed above the well screen sand pack
9.	Soil wells did not meet the 10 NTU requirement for well development
10.	One hour pump tests have not been completed on monitoring well installations to determine yield
13.	Well completion reports have not been completed by the well driller within the 30 day requirement
19.	Well ITB-4 does not have a companion soil well in near proximity

Corrective Action: The State of Maryland representative should be notified in writing of the variances in well construction and/or well development procedures. This letter should contain the justification for the variances. In the case of No. 10 it should be explained why slug tests will be substituted for the required pump test.

As for the completion of Well Completion Reports by the driller, these reports should be completed as soon as possible and the State of Maryland notified as to the schedule for completion of the forms.

Finding No. 3 - Changes in well development methods (Phase II Detailed Work Plan, Section 2.3.2.4, Page 2-13).

Several wells were developed using surging and bailing instead of pumping as specified in the referenced section of the Detailed Work Plan.

Corrective Action: This change in development methodology requires the issuance of a variance log to document the change. Justification for the variance must be included on the variance log form.

Finding No. 4 - Changes to waste groundwater storage facilities (Phase II Detailed Work Plan, Section 2.3.2.4, Page 2-14).

Waste groundwater from drilling, well development, and decontamination activities is being stored on site in 55-gallon closed top drums. The above-referenced section of the Detailed Work Plan specified an aboveground storage tank.

Corrective Action: A variance to the work plan must be documented. Included in the variance log should be justification for the referenced change. This change also requires a variance for the prepared sampling procedure for this water. The new prepared sampling methodology for waste groundwater must be described in the variance log documentation.

FIELD INVESTIGATION DOCUMENTATION

The documentation for all Phase II field activities was not complete because certain Phase II field activities are still ongoing. The following forms were reviewed for completeness:

- Driller's Equipment Log
- Field Activity Daily Logs (FADL's) (12/4/89 through 1/19/90)
- Tailgate Safety Meeting (12/7/89 through 1/19/90)
- Telephone Conversation Logs
- Soil Boring Logs (IT2-1 through 7, ITP-1, ITS-2, and ITB-4)
- Rock Boring Logs (ITB-4)
- Well Completion Diagrams (for wells/piezometers specified above)
- Chain of Custody
- Request for Analysis

- Sample Collection Logs
- Piezometer Data Sheets

Finding No. 5 - In general field documentation has been completed according to the QAPP and associated documents. In some cases information is missing from the field forms. The type of form and information to be completed are described below:

- Driller's Equipment Log - Two drill rigs were mobilized to the site but only one Driller's Equipment Log was in the field files.
- FADL's, Tailgate Safety Meeting Forms - All forms inspected were complete.
- Telephone Conversation Logs - Three logs inspected were not on the proper form. It is suspected that more than three phone calls have been made during the field program. Additional telephone logs were not available.
- Soil and Rock Boring Logs - One or more of the logs inspected were missing the following pieces of information:

  - USCS symbols
  - Water levels, dates, and times
  - Auger sizes
  - Completion dates for borings
  - Strata separations

- Well Completion and Piezometer Installation Sheets - One or more of the forms inspected were missing the following pieces of information:

  - Groundwater levels after installation
  - Installation sheets not checked
  - No note documenting the use and/or quantity of potable water used to hydrate the bentonite pellet seal

- Chain of Custody, Request for Analysis, and Sample Collection Logs - None of these forms were available for review.

- Piezometer Data Sheet - No documentation existed indicating the reference used for measuring water depths. No surveyed elevations for well casings are recorded.

Corrective Action: In most cases field forms can be completed by project personnel by reviewing existing field documentation forms and filling in the missing information. In the case of telephone logs, information with regard to telephone calls is usually documented on FADL's. This should be transferred to the appropriate telephone record log forms.

If groundwater information after installation of monitoring wells or piezometers is not available, a variance must be completed including justification for not including this information on the piezometer installation sheet.

Observation No. 1

On-site personnel all carried metal clip boards containing several days of FADL's and boring log information. All field documentation should be transferred from field personnel to on-site files at the earliest possible date to prevent the possibility of losing field information.

FADL's are prepared by each on-site field team member independently. This can cause problems when numbering FADL's and keeping track of each days activities. It is suggested that one person be responsible for completion and signing of FADL's. If individuals prepare specific sections of FADL's this is acceptable but only one person should be responsible for preparing one complete FADL for each day's activities.

FIELD EQUIPMENT CALIBRATION AND CONTROL

Findings - None. All equipment calibration forms reviewed (12/4/89 to 1/19/90) was complete.

Corrective Action: None.

VARIANCE LOGS

Findings - No variance logs have been prepared for field activities completed to date, although several variances have been recognized by project personnel.

Corrective Action: Variance logs must be completed for all variances recognized by project personnel and identified in this report at the earliest date. Variance log reports should contain justification for each variance and the proper signatures of the appropriate project personnel. After completion, variance reports should be reviewed by the project QA representative.

SUMMARY

The results of this project field audit indicate the Firestone Project Team is generally complying with the ITEO QA Program, QAPP, H&S Plan, and Phase II and PHASE IV Detailed Work Plans. The project team has adhered to sound QA practices with the exception of the instances noted above.

The Firestone Project Team is commended on their compliance with ITEO QA Program and other related documents while completing a large and difficult field sampling program. They are encouraged to continue their outstanding performance for the remaining tasks required to complete this project.

DATES FOR COMPLETION

A written response to this report by the project manager should be submitted to N. Allen by March 16, 1990. This response must address the recommended corrective actions suggested herein or alternative corrective measures prepared by the Firestone Project Team. This response should also include a schedule for all prepared corrective measures.

DISTRIBUTION

N. Allen, Pittsburgh
J. Broscious, Pittsburgh
D. Brunner, Pittsburgh
L. Haser, Pittsburgh
M. Jordon, Pittsburgh
T. Sole, Pittsburgh

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INTERNATIONAL TECHNOLOGY CORPORATION

Memorandum

To: N. Allen, D. Troxell, D. Brunner

Date: March 16, 1990

From: A. M. Jacobs/M. K. Jordan

Project No. 303486

Subject: **QUALITY ASSURANCE FIELD AUDIT**
BRIDGESTONE/FIRESTONE - WOODLAWN LANDFILL RI/FS
RESPONSE TO PHASE II AUDIT REPORT

This memorandum is in response to the Findings of the Phase II Audit Report Revision 00 dated March 5, 1990, a copy of which is attached.

SUBJECT ACTIVITY: PROJECT PROCEDURES

Response to Finding No. 1:

Failure to Document Notification to Regulatory Agencies of the Relocation of Wells

Piezometers ITZ - 1, 2, and 3 and Perched Monitoring Wells ITP-1 and 2 were located more than 20 feet from positions indicated in the Phase II Detailed Work Plan (DWP-II). These changes were made to better characterize water levels (piezometers) and to intersect perched groundwater zones that were producing seeps downgradient (perched monitoring wells). Relative to other wells and site landmarks, these changes were minor, and did not compromise other well/piezometer installation objectives. As per Section 2.3.1 of the DWP-II, regulatory agencies were informed from the field of these minor well and piezometer location changes and had given their verbal approval. These communications were not documented in writing.

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In the future, notifications to agencies of minor changes in well locations that may deviate from project work plans will be noted on the appropriate Field Activity Daily Logs (FADL) or Telephone Record. Final locations of all wells and piezometers will be given to agencies in the Phase II Report.

Response to Finding No. 2:
<u>Failure to Obtain State of Maryland Approval for Variances from the State of Maryland Monitoring Well Installation Specifications</u>

Several variances from the State of Maryland "Specifications for Design and Installation of Groundwater Monitoring Wells at Solid Waste Disposal Facilities, May 1989" were noted (e.g., screen length greater than 10 feet, substitution of rising head aquifer tests for pump tests, etc.).

The State of Maryland representative will be notified in writing of the variances in well construction and the justification for these variances. The drilling contractor, Hydro-Group, has been notified that the Well Completion Reports should be completed as soon as possible. The IT project staff will assist the drilling contractor as necessary to facilitate the prompt completion of the Well Completion Report to the State of Maryland.

Response to Finding No. 3:
<u>Justification of Changes in Well Development Methods</u>

A variance log will be issued to document and justify the bailing of wells instead of pumping as specified in the Phase II Detailed Work Plan.

Response to Finding No. 4:
Justification of Changes in Waste Groundwater Storage Facilities

A variance log will be issued to document and justify the storage of waste groundwater in 55-gallon drums instead of an aboveground storage tank as specified in the Phase II Detailed Work Plan. The procedures for disposal of waste groundwater will also be specified in this variance log.

SUBJECT ACTIVITY: FIELD INVESTIGATION DOCUMENTATION
Response to Finding No. 5:
Failure to Complete Field Forms

In general, field documentation has been completed according to the QAPP and associated documents. In some instances field forms are incomplete and information is missing. In these instances, field forms will be completed to the highest degree possible. In the case of Telephone Records, it is felt that the telephone documentation provided on FADLS is sufficient.

Response to Observation No. 1
Changes in the Completion and Signing of FADLs

During future phases of work, one person should be responsible for the collection, completion and signing of FADLs to document site work. This would eliminate possible problems in the maintaining of documentation of site activities.

SUBJECT ACTIVITY: VARIANCE LOGS

Response to Findings No. 6:

Failure to Complete Variance Logs

Variance logs and justification for variances will be completed and submitted for review by the QA officer or QA project representative.

Recommended actions for Findings and Observations prescribed above will be taken by April 16, 1990, and documented in project files.

On behalf of the members of the project staff, I wish to express my appreciation for the helpful work of the quality assurance team. Their work has improved the quality and safety of this project.

Distribution:

N. Allen
J. Broscious
D. Brunner
L. Haser
M. Jordan
T. Sole

IT CORPORATION

VARIANCE LOG

PROJECT NUMBER 303486 PAGE 1 OF 10

PROJECT NAME Firestone (BFS)

DATE	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
9/13/90	Variance: Wells with screen length greater than ten feet.	
	This is not a true variance according to the Detailed Work Plan for Phase II Site Characterization, but was treated as such by IT site personnel.	
	The screen length in two bedrock wells, ITB-1 and ITB-3, was extended so that an appreciable amount of groundwater inflowed into the wells. During drilling several low-yield zones were penetrated over an interval greater than ten feet. Paragraph three of Section 2.3.1 Methodology (for Monitoring Well Installations) on page 2-3 of the DWP for Phase II (Revision 02, 11/30/89) states that "if it appears from the drilling (in-hole water levels and moisture content of the soils) that these conditions (sufficient water for sampling and water level to reach equilibrium quickly) are not met, then the planned screened interval will be adjusted." (cont. on next page)	

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VARIANCE LOG

PROJECT NUMBER 303486

PROJECT NAME Firestone (BFS)

DATE	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
4/13/90	(cont. from previous page)	
	In each case Dr. Mark Noll of the U.S. E.P.A. was notified for prior approval. Dr. Noll was contacted by telephone on February 7, 1990 to aquire approval for additional screen length for ITB-1. This correspondence is documented on a Record of Telephone Calls form and ~~is~~ ~~these~~ can be found in the Firestone files.	
	Dr. Noll was on-site during the installation of bedrock well ITB3. At this time (February 12, 1990) Dr. Noll approved an additional 10-feet of well screen. Dr. Noll's presence on-site is documented on a Field Activity Daily Log and can be found in the Firestone files.	

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VARIANCE LOG

PROJECT NUMBER 303486 PAGE 3 OF 10

PROJECT NAME Firestone (BFS)

DATE	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
4/13/90	Variance: Centralizers were not used in well installations.	
	Centralizers were not provided by the drilling company at the start of Phase II operations. IT project personnel decided against using the centralizers at this time for the following reasons:	
	(1) All wells were to be completed at shallow depth.	
	(2) All risers were to be held manually at the center of the boring during placement of artificial packing, bentonite seals, and cement/bentonite grout.	
	(3) Centralizers ~~are~~ often cause bridging of artificial packing materials. This requires the addition of water to free the bridged material. IT project personnel refrained from adding water to monitoring wells during or after installation so that native groundwater chemistry would not be altered in any manner. This policy was adapted to insure accurate groundwater analysis results.	

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VARIANCE LOG

PROJECT NUMBER 303486 PAGE 4 OF 10

PROJECT NAME Firestone (BFS)

DATE	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
1/13/90	Variance: Wells ITP-1 and ITP-2 were not constructed with a fine sand placed above the well screen sand pack.	
	Shallow, perched wells ITP-1 and ITP-2, 18 feet and 20 feet, deep respectively, were installed without fine sand placed above the well screen sandpack. The decision was made to forego the fine sand since the wells were to be shallow with 10-foot screen lengths. This allowed for a greater thickness of cement/bentonite grout seal. The additional thickness of grout prevents surface contamination of the perched aquifer.	

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VARIANCE LOG

PROJECT NUMBER 303486 PAGE 5 OF 10

PROJECT NAME Firestone (BFS)

DATE	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
4/13/90	Variance: Soil wells did not	
	meet the 10 NTU requirement	
	for well development.	
	This is not a variance. The	
	DWP Phase II (Rev 02, 11/30/89)	
	states that "new monitoring well	
	installations will be developed for	
	approximately 8 hours or until	
	the water produced has a	
	measured turbidity of 10 NTUs	
	or less, whichever occurs first.	

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IT

IT CORPORATION

VARIANCE LOG

PROJECT NUMBER 303486 PAGE 6 OF 10

PROJECT NAME Firestone (BFS)

DATE	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
4/13/90	Variance: One hour pump tests have not been completed on monitoring well installations to determine yield.	
	Rising head aquifer tests were substituted for pump tests for the following two reasons:	
	(a) To eliminate the possibility of cross-contaminating soil and bedrock aquifers suspected to be in communication	
	(b.) To avoid the possibility of transporting potentially contaminated groundwater from the site towards domestic resources.	
	Verbal approval for slug tests was given by Dr. Mark Noll of the U.S. E.P.A. on February 22, 1990. This change from DWP-II was documented in a letter to the U.S. EPA on March 6, 1990 with notification given to the State of Maryland.	

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VARIANCE LOG

PROJECT NUMBER 303486 PAGE 7 OF 10

PROJECT NAME Firestone (BFS)

DATE	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
4/13/90	Variance: Well completion reports have not been completed by the well driller within the 30 day requirement.	
	The well completion reports were reforwarded to the drilling company on 4/13/90 following a thorough check for accuracy and completion. IT Corp received the full set of reports on 4/10/90. All reports required boring log stratigraphy information, some corrections on depths, and additional information. The drilling company was contacted on the day that the reports were reforwarded (4/13/90) to insure prompt delivery to the state of Maryland. This telecommunication has been documented and placed into Firestone project files.	

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VARIANCE LOG

PROJECT NUMBER 303486 PAGE 8 OF 10

PROJECT NAME Firestone (BFS)

DATE	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
4/13/90	Variance: Well ITB-4 does not have a companion soil well in near proximity. A companion soil well to bedrock well ITB-4 was not installed because the soil horizons remained completely dry while drilling well ITB-4. In fact, the closest existing soil well, OW-4, was also dry at this time. OW-4 was measured four days after the installation of ITB-4 on December 29, 1989. The decision not to drill the companion well, ITS-4 is carefully documented on the Field Activity Daily Log. (See Mr. Jordan's FADL, 1/3/90).	

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IT CORPORATION

VARIANCE LOG

PROJECT NUMBER 303486 PAGE 9 OF 10

PROJECT NAME Firestone (BFS)

DATE	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
9/13/90	Variance: Changes in well development methods, ie bailing along with surging instead of pumping along w/ surging.	
	Bailing was substituted for pumping during well development of soil monitoring wells. This substitution was made to avoid additional time loss due to pump failure during development. Along with clay the soil consisted of silt and fine sand which clogged the pump shortly after initialization. Based on this occurrence the bailing method provided a more efficient means to develop the hydraulic communication between the aquifer and the well.	

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IT
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VARIANCE LOG

PROJECT NUMBER 303486
PAGE 10 OF 10
PROJECT NAME Firestone (BFS)

DATE	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
4/13/90	Variance: Changes to waste groundwater storage facilities, ie, into 55-gallon drums instead of a single above ground storage tank.	
	Fifty-five-gallon drums were substituted for a single storage tank to store waste groundwater on-site. This substitution was made to eliminate the possible need for disposing of a large quantity of potential hazardous waste. By using a single storage vessel, a large quantity of waste groundwater could be contaminated by a single contaminated boring/well.	

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APPENDIX B
BORING LOGS

GENERAL NOTES AND LEGEND

Symbols to be used for designation of subsurface materials on all boring logs and subsurface sections

SLAG	GRAVEL	LIMESTONE	DOLOMITE
FILL	SAND	SILTSTONE	CONGLOMERATE
CONCRETE	SILT	SANDSTONE	ROCK FRAGMENTS
VOID (INDICATES SIZE OF VOID)	CLAY	MASSIVE MUDSTONE OR CLAYSTONE	ASPHALT
WATER	METADIORITE	SHALE	SAPROLITE
APPROXIMATE EXISTING GROUND	GRANITE	COAL	TOPSOIL
APPROXIMATE TOP OF ROCK			

S / 3 — SPLIT BARREL SAMPLE

STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2 INCH O.D. SPLIT BARREL SAMPLER 12 INCHES USING A 140 POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER WAS DRIVEN 18 INCHES AND THE NUMBER OF BLOWS RECORDED FOR EACH 6 INCH INTERVAL.

75/0.5' — PENETRATION REFUSAL RESISTANCE AND FRACTIONAL INCREMENT DRIVEN IN FEET

1-8-81 — GROUND WATER LEVEL AND DATE

U.S.C.S. — UNIFIED SOIL CLASSIFICATION SYSTEM
CAPITAL LETTERS INDICATE LAB TEST CLASSIFICATION.
LOWER CASE LETTERS INDICATE VISUAL FIELD CLASSIFICATION

(60) — RQD (ROCK QUALITY DESIGNATION PERCENT) (LENGTH OF NUMBER OF PIECES GREATER THAN 4 INCHES DIVIDED BY THE LENGTH OF THE CORE RUN)

90 — INDICATES PERCENT OF CORE RECOVERED (LENGTH OF CORE RECOVERED DIVIDED BY LENGTH OF CORE RUN)

THE BORING LOGS AND RELATED INFORMATION DEPICT SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED. SOIL CONDITIONS AND WATER LEVELS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THESE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THESE BORING LOCATIONS.

TRACE - INDICATES PRESENCE OF 5 TO 12% OF SUBJECT MATERIAL BY WEIGHT
SOME - INDICATES PRESENCE OF 12 TO 30% OF SUBJECT MATERIAL BY WEIGHT
AND - INDICATES APPROXIMATELY EQUAL PORTIONS OF SUBJECT MATERIAL BY WEIGHT

CONSISTENCY OF COHESIVE SOILS

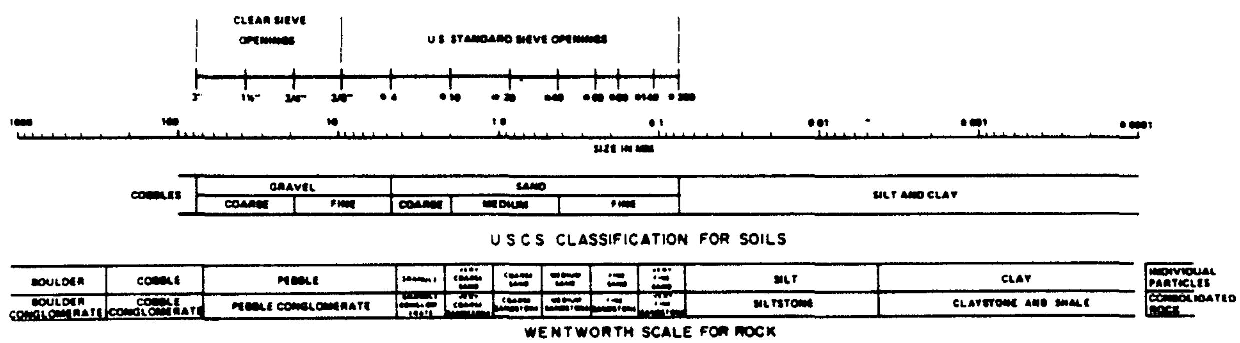
CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH TONS PER SQUARE FOOT
VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.50
FIRM	0.50 TO 2.0
HARD	2.0 TO 4.0
VERY HARD	MORE THAN 4.0

DENSITY OF GRANULAR SOILS

DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0-4
LOOSE	5-10
MEDIUM DENSE	11-30
DENSE	31-50
VERY DENSE	OVER 50

TERMS USED TO DESCRIBE BEDDING THICKNESS

VERY THICK BEDDED OR MASSIVE	THICKER THAN 3.3 FT.
THICK BEDDED	1-3.3 FT.
MEDIUM BEDDED	4 -12 IN.
THIN BEDDED	1-4 IN.
VERY THIN BEDDED	2/5-1 IN.
THINLY LAMINATED	1/32-1/8 IN.
MICRO LAMINATED	THINNER THAN 1/32 IN.



TERMS USED TO DESCRIBE THE RELATIVE DEGREES OF ROCK CORE HARDNESS

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS
VERY SOFT	CRUSHES UNDER PRESSURE OF FINGERS AND/OR THUMB
SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
FIRM	BREAKS EASILY UNDER SINGLE HAMMER BLOW BUT WITH CRUMBLY EDGES
HARD	BREAKS UNDER ONE OR TWO STRONG HAMMER BLOWS BUT WITH RESISTANT SHARP EDGES
VERY HARD	BREAKS UNDER SEVERAL STRONG HAMMER BLOWS BUT WITH VERY RESISTANT SHARP EDGES AND MAY SPALL LEAVING CONCHOIDAL FRACTURES

THE SPACING OF THE DISCONTINUTIES IN THE ROCK MAY BE DESCRIBED BY ONE OF THE FOLLOWING TERMS

DESCRIPTIVE TERMS	SPACING
VERY BROKEN	LESS THAN 1 IN.
BROKEN	1 IN. TO 3 IN.
SLIGHTLY BROKEN	3 IN. TO 6 IN.
UNBROKEN	6 IN. AND GREATER

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PROJECT NO 303486 BORING NO ITP-1 PROJECT NAME BRIDGESTONE/FIRESTONE

DATE BEGAN: 12-11-89 DATE FINISHED: 12-12-89 FIELD ENGINEER: M K JORDAN

DRILLER: J ARNETT, D SHINER N: 659,757' E: 1,056,769'

GROUND SURFACE ELEV: 437 79' GWL DATE/TIME: 2/1/90 GWL DEPTH: 10 1'

DRILLING METHOD: 6 1/4" ID HOLLOW STEM AUGER EQUIPMENT: GUS PECH - BRAT 2

CONTRACTOR: HYDRO GROUP, INC CHECKED BY: M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	0 00	S 1	4-8-8-4	1 7		FILL, (7 5yr-5/6, strong brown, medium dense, silty sand with some clay, moist)				HNU READING = 0 5 ppm
435 0		S 2	3-2-2-5	0 9		FILL, (10yr-4/1, dark gray, loose, sand with trash, moist)				HNU READING = 0 1 ppm
	-5 00	S 3	3-7-3-5	1 1		FILL, (10yr-4/1, dark gray, loose, rubbish, moist)				HNU READING = 32 0 ppm NO ODOR
		S 4	17-49-14-3	0 5		FILL, (10yr-4/1 dark gray, very dense, sand and rubbish, wet)				HNU READING = 28 0 ppm NO ODOR
430 0 2-1-90 ▼		S 5	7-18-12-10	0 1		FILL, (10yr-4/1 dark gray, medium dense, sand and rubbish, wet)	NA	NA		HNU READING = 4 4 ppm NO ODOR
	-10 00	S 6	NR	NR		NO RECOVERY				HNU READING = NA WET RODS ODOR OF GARBAGE
425 0		S 7	50/ 4	0 3		FILL, (10yr-5/1, gray, very dense, sand and rubbish, wet)				HNU READING = 20 0 ppm SPOON WET
	-15 00	S 8	28-40-50/ 4	1 1		FILL, (10yr-5/8, yellowish-brown, very dense, sand and gravel, moist)				HNU READING = 3 6 ppm SPOON WET
420 0		S 9	33-37-45-50/0	1 3		FILL, (2 5y-6/2, light brownish-gray, stiff, silty clay, moist)				HNU READING = 3 6 ppm

BOTTOM OF BORING AT 18 0'

ESTIMATED SUSTAINED YIELD: 0.13 gpm

NOTES

HNU HEAD SPACE READINGS

SPLIT SPOON SAMPLES COLLECTED USING STANDARD ASTM METHODS 2 0" I D SPLIT-BARREL SAMPLER DRIVEN 24 0" USING A 140 LB HAMMER DROPPED 30 0"

COLORS AS PER MUNSELL COLOR CHART

AR301301

PROJECT NO: 303486 | BORING NO: ITP-2 | PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 12-7-89 | DATE FINISHED: 12-8-89 | FIELD ENGINEER: M K JORDAN
DRILLER: J ARNETT, D SHINER | N: 659, 798' | E: 1, 056, 968'
GROUND SURFACE ELEV.: 438 07' | GWL DATE/TIME: 2/1/90 | GWL DEPTH: 17 2'
DRILLING METHOD: 6 1/4" ID HOLLOW STEM AUGER | EQUIPMENT: GUS PECH - BRAT 22A
CONTRACTOR: HYDRO GROUP, INC | CHECKED BY: M J HARONER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TEST	REMARKS
	0 00	S 1	6-6-6-8	1 0		FILL, (7 5yr-4/2, dark brown, dense, poorly sorted sand, moist)				HNU READING = 0 0 ppm LEL = 0%
435 0		S 2	10-5-2-3	1 0		FILL, (10yr-4/4, dark yellowish-brown, loose, poorly sorted sand, moist)				HNU READING = 0 0 ppm LEL = 0%
	-5 00	S 3	3-9-7-4	0 8		FILL, (10yr-5/3, medium dense, poorly sorted sand, wet)				HNU READING = 30 0 ppm LEL = 0%
		S 4	9-8-3-3	1 4		FILL, (5y-5/3, soft silt and clay, wet)				HNU READING = 9 0 ppm LEL = 0%
430 0		S 5	2-2-3-8	0 6		FILL, (10yr-5/3, poorly sorted, loose, sand with some silt and clay, moist)				HNU READING = 10 0 ppm LEL = 0%
	-10 00	S 6	18-7-11-18	NR		NO RECOVERY	NA	NA		LEL = 0%
425 0		S 7	5-6-7-5	NR		NO RECOVERY				LEL = 0%
.-90	-15 00	S 8	8-50/0	0 3		FILL, (5y-5/3, olive very dense, poorly sorted sand with some silt, wet)				HNU READING = 13 0 ppm LEL = 0%
▼		S 9	4-4-12-24	1 5		FILL, (10yr-5/3, brown silt with some sand, moist)				HNU READING = 30 0 ppm LEL = 0%
420 0	-20 00	S 10	8-10-12-24	1 5		FILL, (5yr-4/4, medium dense, silty sand, dry)				HNU READING = 13 0 ppm LEL = 0%

BOTTOM OF BORING AT 20 0'

ESTIMATED SUSTAINED YIELD: 0.05 gpm

NOTES

HNU HEAD SPACE READINGS

LEL = LOWER EXPLOSIVE LIMIT MEASUREMENT

SPLIT SPOON SAMPLES COLLECTED USING STANDARD ASTM METHODS
2 0" I D SPLIT-BARREL SAMPLER DRIVEN 24 0" USING A 140 LB HAMMER DROPPED 30 0"
COLORS AS PER MUNSELL COLOR CHART

PROJECT NO:	303486	BORING NO:	ITP-3	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	2-6-90	DATE FINISHED:	2/6/90	FIELD ENGINEER:	M J HARONER
DRILLER:	J ARNETT, F CORNELL	N:	659, 884'	E:	1, 056, 071'
ROUND SURFACE ELEV:	422 87'	GWL DATE/TIME	2-6-90/1200	GWL DEPTH:	5 0'
DRILLING METHOD:	6 1/4" ID HOLLOW STEM AUGER			EQUIPMENT:	GUS PECH - BRAT 22
CONTRACTOR	HYDRO GROUP, INC			CHECKED BY	R G NIES

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	0 00									
420 0 2-6-90 ▼						Strong brown (7 5yr-5/6), SAND and GRAVEL, some clayey to silty, dry 5 0'	gc			
	-5 00	NA	NA	NA		Yellow (2 5y-7/6), silty CLAY, dry	cl			
415 0						Strong brown (7 5yr-5/6), SAND and GRAVEL, clayey to silty, moist 8 0'	gc			GRAVEL MEDIUM TO COARSE GRAINED
	-10 00 11 0					White (10yr-8/2), CLAY interlaminated with strong brown (7 5yr-5/8), SILT, moist	cl			
						BOTTOM OF BORING AT 11 0'				NOTES COLORS AS PER MUNSELL COLOR CHART HOLE LOGGED BY AUGER CUTTING EXAMINATION

AR301303

PROJECT NO: 303486	BORING NO: ITS-1	PROJECT NAME: BRIDGESTONE/FIRESTONE	
DATE BEGAN: 1-23-90	DATE FINISHED: 1-25-90	FIELD ENGINEER: M J HARDNER	
DRILLER: J ARNETT, F CORNELL	N: 660,392'	E: 1,057,023'	
GROUND SURFACE ELEV.: 465 34'	GWL DATE/TIME: 2/1/90	GWL DEPTH: 58 05'	
DRILLING METHOD: 6 1/4" ID HOLLOW STEM AUGER		EQUIPMENT: GUS PECH - BRAT 22R	
CONTRACTOR: HYDRO GROUP, INC		CHECKED BY: R G NIES	

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY TSF	REMARKS
465 0	0 00					Surface topsoil 1 0'	pt		SURFACE TOPSOIL ~1 0' THICK
		S 1	14-23-65-67	17		Medium dense, brown (2 5yr-5/8), red, silty GRAVEL, coarse quartz boulder, dry to moist 5 0'	gm		GRAVEL PEA SIZE HNU READING = 0 0 ppm
460 0	-5 00	S 2	23-21-24-18	10		Medium dense, (2 5yr-6/8), reddish-yellow, silty GRAVEL, quartzose, some SAND, moist 10 0'	gm		HNU READING = 0 0 ppm
455 0	-10 00	S 3	7-6-8-17	18		Stiff, multicolored (red, orange, light to medium gray), silty clay, (SAPROLITE), some quartz sand, slightly moist 15 0'	cl	1 5	HNU READING = 0 0 ppm
7 0	-15 00	S 4	7-8-14-18	18		Medium dense, multicolored, (white, red, light gray, green), clayey silt (SAPROLITE), some quartz sand, slightly moist	ml		HNU READING = 0 0 ppm
445 0	-20 00	S 5	6-10-14-18	17		Medium dense, multicolored, (a/a), clayey, silt (SAPROLITE), some quartz sand, (fine to coarse grained, angular), iron stained in part, moist 27 0'	ml		HNU READING = 0 0 ppm
440 0	-25 00	S 6	13-12-17-20	17		Medium dense, multicolored, (a/a), clayey silt (SAPROLITE) some quartz grains, (a/a), iron stained, visible fractures, moist	ml		HNU READING = 0 0 ppm
435 0	-30 00	S 7	13-15-21-25	21		Dense, multicolored, (white, pink, red, brown, black), clayey silt (SAPROLITE), some angular quartz grains, trace mica, moist	ml		HNU READING = 0 0 ppm
430 0	-35 00	S 8	8-10-16-23	19		Medium dense, multicolored (white, pink, red, brown, black), clayey silt (SAPROLITE), some angular quartz grains, trace mica, moist	ml		HNU READING = 0 0 ppm
	-40 00								

AR301304

PROJECT NO:	303486	BORING NO:	ITS-1	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	1-23-90	DATE FINISHED:	1-25-90	FIELD ENGINEER:	M J HARONER
DRILLER:	J ARNETT, F CORNELL	N:	660, 392'	E:	1, 057, 023'
GROUND SURFACE ELEV:	465 34'	GWL DATE/TIME	2/1/90	GWL DEPTH	58 05'
DRILLING METHOD:	6 1/4" ID HOLLOW STEM AUGER			EQUIPMENT	GUS PECH - BRAT 2
CONTRACTOR	HYDRO GROUP, INC			CHECKED BY	R G NICS

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
425 0	-40 00									
420 0	-45 00	S 9	24-26-29-31	22		Very dense, multicolored (white, pink, orange, brown), clayey silt (SAPROLITE), micaceous, some angular quartz grains, moist 45 0'	ml			HNU READING = 0 0 ppm
415 0	-50 00	S 10	9-16-21-21	20		Stiff, multicolored, (a/a), silty clay, (SAPROLITE), micaceous, little angular quartz grains, fracture traces moist 50 0'	cl	2 0		HNU READING = 0 0 ppm
0 0	-55 00	S 11	22-18-20-35	22		Very stiff, multicolored, (a/a), silty clay, (SAPROLITE), some angular quartz grains, mica, moist 57 0'	cl	2 25		HNU READING = 0 0 ppm
2-1-90 ▼ 405 0	-60 00	S 12	10-23-42-53	17		Very stiff, multicolored, (a/a), silty clay (SAPROLITE), mica, quartz grains, trace fractures, moist 60 0'	cl	2 5		HNU READING = 0 0 ppm
						Very dense, (7 5yr-4/6), strong brown, clayey silt (SAPROLITE), wet	ml			WET ZONE AT 60 0' TO 61 0'
400 0	-65 00	S 13	7-17-21-31	17		Dense, multicolored, (white, orange, yellow, gray, black), clayey silt, (SAPROLITE), mica some quartz grains	ml			HNU READING = 0 0 ppm WET ZONE AT 66 0'
395 0	-70 00	S 14	8-10-17-21	17		Medium dense, multicolored, (a/a), clayey silt (SAPROLITE) some quartz grains, moist				HNU READING = 0 0 ppm
390 0	-75 00	S 15	8-9-29-45	20		Dense, multicolored, (a/a), clayey silt (SAPROLITE), some angular quartz, moist to wet				HNU READING = 0 0 ppm WET ZONE AT 75 0'
	-80 00	S 16	15-25-39-66	14		Very dense, multicolored, (yellow, gray, orange, white), clayey silt (SAPROLITE) quartz grains, iron oxidation bands, moist to wet				HNU READING = 0 0 ppm

AR301305

PROJECT NO: 303466 | BORING NO: ITS-1 | PROJECT NAME: BRIDGESTONE/FIRESTONE

DATE BEGAN: 1-23-90 | DATE FINISHED: 1-25-90 | FIELD ENGINEER: M J HARDNER

DRILLER: J ARNETT, F CORNELL | N: 660,392' | E: 1,057,023'

GROUND SURFACE ELEV.: 465 34' | GWL DATE/TIME: 2/1/90 | GWL DEPTH: 58 05'

DRILLING METHOD: 6 1/4" ID HOLLOW STEM AUGER | EQUIPMENT: GUS PECH - BRAT 22R

CONTRACTOR: HYDRO GROUP, INC | CHECKED BY: R G NIES

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
385 0	-80 00					Hard, multicolored, (red, white, light gray, orange, black), silty clay, (SAPROLITE), trace quartz grains, moist				
		S 17	21-64	12			cl			HNU READING = 0 0 ppm SPOON REFUSAL AT 84 0'
380 0	-85 00									
						SAPROLITE, a/a	cl			
375 0	-90 00									
						BOTTOM OF BORING AT 92 0' **ESTIMATED SUSTAINED YIELD: 1.13 gpm**				NOTES SPLIT SPOON SAMPLES COLLECTED AS PER ASTM STANDARDS COLORS AS PER MUNSELL COLOR CHART

AR301306

PROJECT NO: 303486	BORING NO: ITS-2	PROJECT NAME	BRIDGESTONE/FIRESTONE
DATE BEGAN: 1-4-90	DATE FINISHED: 1-8-90	FIELD ENGINEER:	R G NIES
DRILLER: J ARNETT, R REISINGER	N: 660,512'	E:	1,056,051'
GROUND SURFACE ELEV: 422 02'	GWL DATE/TIME: 1-19-90	GWL DEPTH	50 83'
DRILLING METHOD: 6 1/4" ID HOLLOW STEM AUGER		EQUIPMENT	GUS PECH - BRAT 2
CONTRACTOR: HYDRO GROUP, INC		CHECKED BY	M J HARONER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	0 00	S 1	3-7-7-9	13		Medium stiff, 7 5yr-4/2, dark brown, organic SILT with roots and stems 0 5'	ol	5		HNU READING = 0 0 ppm
420 0										
						Very soft, 7 5yr-5/8, strong brown, clayey SILT trace medium to fine SAND with mica flakes, moist	ml			
	-5 00	S 2	6-7-8-14	11				< 25		
415 0						Very soft, 7 5yr-6/8, reddish-yellow, SILT, trace clay, laminated with black streaks, dry	ml			
	-10 00	S 3	4-6-8-15	16		Very soft, 10yr-6/5, brownish-yellow silt trace fine sand and clay with pinkish hue, (SAPROLITE) moist	ml	< 25		HNU READING = 0 0 ppm
410 0										WEATHERED ROCK
	-15 00	S 4	6-12-12-17	12		Very soft, 10yr-6/6, brownish-yellow, silt, trace clay with mica flakes and black streaks, (SAPROLITE), moist		< 25		
405 0										
	-20 00					NO SAMPLE TAKEN	ml			
400 0										
	-25 00	5	10-16-17-21	24		Very soft, 10yr-6/8, brownish-yellow silt, trace clay with mica and black streaks (SAPROLITE)	ml	< 25		HNU READING = 0 0 ppm
395 0										
	-30 00	S 6	12-20-57-57	19		Very soft, 7 5y-5/8, strong brown, silt trace clay, (SAPROLITE), trace quartz fragments with white and black streaks and patches, laminated, moist	ml	< 5		HNU READING = 0 0 ppm
390 0										
	-35 00	S 7	34-100	12		Medium stiff, 10yr-6/8, brownish-yellow silt, (SAPROLITE), little clay, moist with black streaks	ml			S-7 SPOON REFUSAL
0										
	-40 00									

AR301307

PROJECT NO: 303486 | BORING NO: IT8-2 | PROJECT NAME: BRIDGESTONE/FIRESTONE

DATE BEGAN: 1-4-90 | DATE FINISHED: 1-8-90 | FIELD ENGINEER: R G NIES

DRILLER: J ARNETT, R REISINGER | N: 660,512' | E: 1,056,051'

GROUND SURFACE ELEV.: 422 02' | GWL DATE/TIME: 1-19-90 | GWL DEPTH: 50 83'

DRILLING METHOD: 6 1/4" ID HOLLOW STEM AUGER | EQUIPMENT: GUS PECH - BRAT 22R

CONTRACTOR: HYDRO GROUP, INC | CHECKED BY: M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	-40.00	S 8	100/6"	NR		NO RECOVERY				GRAVEL BLOCKING NOSE OF SPOON
380 0										
	-45 00	S 9	100/5"	5		Very dense, SAPROLITE, MOIST	ml			HNU READING = 0 0 ppm
375 0										
1-19-90 ▼	-50.00	S 10	100/5"	5		Very dense silt, (SAPROLITE), wet	ml			HNU READING = 0 0 ppm LEL = 0%
370 0										
	-55 00	S 11	100/4"	4		Very dense, SAPROLITE, wet				
365 0							ml			
	-60 00	S 12	100/3"	NR		NO RECOVERY				HNU READING = 0 0 ppm
360 0										
	-65 00	S-13	61-100/4"	10		Very dense, 10yr-5/8, yellowish-brown silt (SAPROLITE), little clay with mica flakes	ml			AUGER REFUSAL AT 66 4'
		S-14	100/5"	4						

BOTTOM OF BORING AT 66 4'

ESTIMATED SUSTAINED YIELD: 0.48 gpm

NOTES

ALL SAMPLES COLLECTED BY ASTMI STANDARD PENETRATION TEST

COLORS AS PER MUNSELL COLOR CHART

PROJECT NO:	303486	BORING NO:	ITS-3	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	2-1-90	DATE FINISHED:	2-2-90	FIELD ENGINEER:	M K JORDAN
DRILLER:	J ARNETT, F CORNELL	N:	659, 889'	E:	1, 056, 072'
GROUND SURFACE ELEV:	422 89'	GWL DATE/TIME:	2/1/90	GWL DEPTH	20 0'
DRILLING METHOD:	6 1/4" ID HOLLOW STEM AUGER			EQUIPMENT:	GUS PECH - BRAT 2
CONTRACTOR	HYDRO GROUP, INC			CHECKED BY	M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
420 0	0 00					Medium dense, 7 5yr-5/6, strong brown, poorly sorted coarse grained SAND with trace silt and GRAVEL, moist	gm			
	-5 00	S 1	5-6-12-11	24		7 0'				NO ODOR HNU READING = 0 0 ppm LEL = 0%
415 0						Medium stiff, yellowish-brown, 10yr-5/6 SILT trace clay and sand, moist	ml			
410 0	-10 00	S 2	8-15-13-16	17						NO ODOR HNU READING = 0 0 ppm LEL = 0%
						15 0'				
405 0	-15 00	S 3	18-26-41-31	17		Very dense, light yellowish-brown, 2 5y-6/4, poorly sorted, coarse grained SAND with some silt and clay, high angle fractures, moist	sm			NO ODOR HNU READING = 0 0 ppm LEL = 0%
2-1-90 ▼	-20 00					22 0'				NO ODOR HNU READING = 0 0 ppm LEL = 0%
400 0		S 4	50/2 4"	2 4		Hard, light olive brown, 2 5y-5/4 SILT with trace sand, wet	ml			NO ODOR HNU READING = 0 0 ppm LEL = 0%
	-25 00					BOTTOM OF BORING AT 25 0'				NOTES SPLIT SPOON SAMPLES COLLECTED BY STANDARD ASTM METHODS COLORS AS PER MUNSELL CHART WELL DRY FROM 2-3-90 TO 4-10-90

AR301309

PROJECT NO: 303486	BORING NO: ITB-1	PROJECT NAME: BRIDGESTONE/FIRESTONE	
DATE BEGAN: 1-24-90	DATE FINISHED: 2-7-90	FIELD ENGINEER: R G NIES	
DRILLER: J MAYNARD, R RECK	N: 660, 402'	E: 1, 056, 960'	
GROUND SURFACE ELEV.: 457 64'	GWL DATE/TIME: 2/7/90	GWL DEPTH: 50 0'	
DRILLING METHOD: 10" AIR HAMMER AND 13" AIR ROTARY		EQUIPMENT: INGERSOL RAND TH-60	
CONTRACTOR: HYDRO GROUP, INC		CHECKED BY: M J HARDNER	

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	0 00					SAPROLITE See ITS-1 log for stratigraphic details and USCS symbols				NO SPLIT SPOON SAMPLES COLLECTED 10 0" AIR HAMMER TO 102 0'
455 0										
	-5 00									
450 0										
	-10 00									
445 0										
	-15 00									
440 0										
	-20 00	NA	NA	NA			NA	NA		
435 0										
	-25 00									DRILLING EASY
430 0										
	-30 00									
425 0										
	-35 00									
[illegible]0 0										
	-40 00									

AR301310

PROJECT NO: 303486 BORING NO: ITB-1 PROJECT NAME: BRIDGESTONE/FIRESTONE

DATE BEGAN: 1-24-90 DATE FINISHED: 2-7-90 FIELD ENGINEER: R G NIES

DRILLER: J MAYNARD, R RECK N: 660,402' E: 1,056,960'

GROUND SURFACE ELEV: 457 64' GWL DATE/TIME 2/7/90 GWL DEPTH 50 0'

DRILLING METHOD: 10" AIR HAMMER AND 13" AIR ROTARY EQUIPMENT INGERSOL RAND TH-

CONTRACTOR: HYDRO GROUP, INC CHECKED BY M J HARONER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	-40 00					SAPROLITE				
415 0										
	-45 00									
410 0										
2-7-90 ▼										
	-50 00									
405 0										DRILLING EASY
	-55 00									13 0" AIR ROTARY TO 60 0'
400 0										
	-60 00	NA	NA	NA			NA	NA		
395 0										
	-65 00									
390 0										
	-70 00									
385 0										
	-75 00									
0										
	-80 00									

AR301311

PROJECT NO:	303486	BORING NO	ITB-1	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	1-24-90	DATE FINISHED:	2-7-90	FIELD ENGINEER:	R G NIES
DRILLER:	J MAYNARD, R RECK	N:	660, 402'	E:	1, 056, 960'
GROUND SURFACE ELEV.:	457 64'	GWL DATE/TIME:	2/7/90	GWL DEPTH:	50 0'
DRILLING METHOD:	10" AIR HAMMER AND 13" AIR ROTARY			EQUIPMENT	INGERSOL RAND TH-60
CONTRACTOR:	HYDRO GROUP, INC			CHECKED BY	M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	-80 00					SAPROLITE				
375 0										
	-85 00									
370 0										DRILLING MORE DIFFICULT
	-90 00									
365 0										
	-95 00									
360 0										
	-100 00	NA	NA	NA		TOP OF BEDROCK AT 102 0'	NA	NA		10 0" TEMPORARY CASING TO 101 0' 8 0" CASING SET TO 102 0'
355 0						Bedrock, pink, GRANITE, very weathed, iron-stained				
	-105 00									
350 0										
	-110 00									7 7/8" AIR HAMMER TO 164 7'
345 0										
	-115 00									AR301312
[illegible]0										
	-120 00									HARD DRILLING

PROJECT NO: 303486 BORING NO ITB-1 PROJECT NAME BRIDGESTONE/FIRESTONE
DATE BEGAN: 1-24-90 DATE FINISHED: 2-7-90 FIELD ENGINEER R G NIES
DRILLER: J MAYNARD, R RECK N: 660, 402' E: 1, 056, 960'
GROUND SURFACE ELEV.: 457 64' GWL DATE/TIME 2/7/90 GWL DEPTH 50 0'
DRILLING METHOD: 10" AIR HAMMER AND 13" AIR ROTARY EQUIPMENT INGERSOL RAND TH-
CONTRACTOR HYDRO GROUP, INC CHECKED BY M J HARONER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	-120 00									
335 0	-125 00					GRANITE				
330 0	-130 00						NA			
325 0	-135 00					138 0'				
320 0	-140 00	NA	NA	NA		Bedrock, dark greenish-black, METADIORITE	NA	NA		SOFT AREA, MAY HAVE BEEN CONTACT BETWEEN THE 2 FORMATIONS
315 0	-145 00					145 0'				
310 0	-150 00					Bedrock, GRANITE, banded with METADIORITE	NA			
305 0	-155 00					155 0'				
0	-160 00					Bedrock, METADIORITE, grayish-green, with quartz fragments	NA			

AR301313

PROJECT NO:	303486	BORING NO:	ITB-1	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	1-24-90	DATE FINISHED:	2-7-90	FIELD ENGINEER:	R G NIES
DRILLER:	J MAYNARD, R RECK	N:	660, 402'	E:	1, 056, 960'
GROUND SURFACE ELEV:	457 64'	GWL DATE/TIME:	2/7/90	GWL DEPTH:	50 0'
DRILLING METHOD:	10" AIR HAMMER AND 13" AIR ROTARY			EQUIPMENT	INGERSOL RAND TH-60
CONTRACTOR:	HYDRO GROUP, INC			CHECKED BY:	M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	T or F	REMARKS
	-160 00									
295 0		NA	NA	NA		METADIORITE	NA	NA		
	-165 00					BOTTOM OF BORING AT 164 7' ESTIMATED SUSTAINED YIELD: 3.7 gpm				NOTES LITTLE WATER ACCUMULATING IN HOLE THEREFORE DRILLED DEEP TO OBTAIN ENOUGH QUANTITY, DECIDED TO PUT 30 0' OF SCREEN IN HOLE

AR301314

PROJECT NO: 303486
BORING NO: ITB-2
PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 1-8-90
DATE FINISHED: 1-17-90
FIELD ENGINEER: M K JORDAN
DRILLER: J MAYNARD, R RECK
N: 660,488'
E: 1,056,054'
GROUND SURFACE ELEV: 420 22
GWL DATE/TIME: 1-19-90
GWL DEPTH: 49 2'
DRILLING METHOD: 10" AIR HAMMER AND 13 1/4" AIR ROTARY
EQUIPMENT: INGERSOL RAND TH
CONTRACTOR: HYDRO GROUP, INC
CHECKED BY: M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
420 0	0 00					SILT REFER TO BORING LOG NUMBER ITS-2 FOR DESCRIPTION OF SOIL				NO SPLITSPOON SAMPLES COLLECTED HNU READING = 0 0 ppm LEL = 0%
415 0	-5 00						ml			
410 0	-10 00					10 0' SAPROLITE				
405 0	-15 00									
400 0	-20 00	NA	NA	NA				NA		
395 0	-25 00						ml			
390 0	-30 00									
385 0	-35 00									
	-40 00									

AR301315

PROJECT NO: 303486		BORING NO: IT8-2		PROJECT NAME	BRIDGESTONE/FIRESTONE
DATE BEGAN: 1-8-90		DATE FINISHED: 1-17-90		FIELD ENGINEER	M K JORDAN
DRILLER: J MAYNARD, R RECK		N: 660,488'		E	1,056,054'
GROUND SURFACE ELEV.: 420 22		GWL DATE/TIME: 1-19-90		GWL DEPTH	49 2'
DRILLING METHOD: 10" AIR HAMMER AND 13 1/4" AIR ROTARY				EQUIPMENT	INGERSOL RAND TH-60
CONTRACTOR: HYDRO GROUP, INC				CHECKED BY	M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
380 0	-40 00					SAPROLITE				HNU READING = 0 0 ppm LEL = 0%
375 0	-45 00									
1-19-90 ▼										
370 0	-50 00						ml			
365 0	-55 00									
360 0	-60 00	NA	NA	NA				NA		HNU READING = 0 0 ppm LEL = 0%
						TOP OF BEDROCK 65 0'				
355 0	-65 00					Weathered rock, light olive, brown (2 5y-5/4, sandy silt with some clay, moist, (METADIORITE)				8" STEEL CASING GROUTED IN PLACE TO 70 0'
350 0	-70 00									
345 0	-75 00						NA			
	-80 00									

AR301316

PROJECT NO: 303486 | BORING NO: ITB-2 | PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 1-8-90 | DATE FINISHED: 1-17-90 | FIELD ENGINEER: M K JORDAN
DRILLER: J MAYNARD, R RECK | N: 660,488' | E: 1,056,054'
GROUND SURFACE ELEV: 420 22 | GWL DATE/TIME: 1-19-90 | GWL DEPTH: 49 2
DRILLING METHOD: 10" AIR HAMMER AND 13 1/4" AIR ROTARY | EQUIPMENT: INGERSOL RAND TH
CONTRACTOR: HYDRO GROUP, INC | CHECKED BY: M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY TBF	REMARKS
340 0	-80 00								
335 0	-85 00								
330 0	-90 00	NA	NA	NA		90 0' Medium crystalline METADIORITE	NA	NA	VERY HARD DRILLING
325 0	-95 00								
320 0	-100 00					100 0' Cuttings, hard, dark gray, medium crystalline METADIORITE, wet			
						BOTTOM OF BORING AT 102 6'			NOTES
						ESTIMATED SUSTAINED YIELD: 51.0 gpm			ALL ROCK IS MEDIUM CRYSTALLINE

AR301317

PROJECT NO: 303486 BORING NO: ITB-28C PROJECT NAME: BRIDGESTONE/FIRESTONE

DATE BEGAN: 1-13-90 DATE FINISHED: 1-13-90 FIELD ENGINEER: HARDNER/JACOBS

DRILLER: N: 660,488' E: 1,056,059

GROUND SURFACE ELEV.: 420.22' GWL DATE/TIME: 1-13-90 GWL DEPTH: 46.0'

DRILLING METHOD: EQUIPMENT: BOREHOLE CAMERA

CONTRACTOR: CHECKED BY: M.J. HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (FT)	PROFILE	DESCRIPTION	USCS	CONTAMINANT TOT	REMARKS
355.0	-65.00					BOREHOLE TELEVISION INSPECTION LOG			WATER CLOUDY WATER LEVEL AT 46.0' STEEL CASING AT 70.5'
350.0	-70.00					Gneissic granite, coarse crystalline, light and dark minerals, quartz, feldspar,			
						Metadiorite, medium crystalline, darker minerals and quartz, some fine crystalline zones			CONTACT AT 72.0' CONTACT OBLIQUE METADIORITE FROM 72.0' TO TD
345.0	-75.00					Fine to coarse grained material, fracture or infilled veinlet			
340.0	-80.00					Fracture at 82.5', wedge shaped ~2" wide, fracture partiall filled on one end			ROCK BROKEN UP AT 83.0'-84.0'
335.0	-85.00					Fracture at 86.5'			
						Rock smooth at 87'-91'			
330.0	-90.00					Fracture at 91'-91.5', irregular, rock broken up			
						Rock smooth at 92'-99"			
325.0	-95.00					Small fracture at 99' Metadiorite, fine grained, dark colored			
?.0	-100.00					Fracture at 100.5', rock broken, irregular, void			VOID AT 101.5
						BOTTOM OF BORING AT 101.5'			
	-105.00								

PROJECT NO: 303486 | BORING NO: ITB-3 | PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 2-8-90 | DATE FINISHED: 2-12-90 | FIELD ENGINEER: R G NIES
DRILLER: J MAYNARD, R RECK | N: 659, 788' | E: 1, 056, 042'
GROUND SURFACE ELEV: 420 24 | GWL DATE/TIME: 1-12-90/0923 | GWL DEPTH: 108 0'
DRILLING METHOD: 10" AIR HAMMER AND 13" AIR ROTARY | EQUIPMENT: INGERSOL RAND TH
CONTRACTOR: HYDRO GROUP, INC | CHECKED BY: M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
420 0	0 00					Brownish-yellow, 10yr-6/6, gravelly SAND, trace medium to fine sand and silt, damp	gw			NO SPLIT SPOON SAMPLES COLLECTED EASY DRILLING
415 0	-5 00					7 0'				10" AIR HAMMER TO 45 C 13" AIR ROTARY BIT TO 45 0
						Light red, 2 5yr-6/6 CLAY, damp	cl			
410 0	-10 00					Very pale brown, 10yr-7/4, clayey silt (SAPROLITE), trace fine sand, with mica flakes, white weathered feldspar, dry to moist				
						Yellow, 10yr-7/8, silt (SAPROLITE), trace clay and fine sand with mica flakes, dry				
405 0	-15 00									
400 0	-20 00	NA	NA	NA				NA		
395 0	-25 00					Very pale brown 10yr-7/4, silt, (SAPROLITE) trace to little clay, dry	ml			
						Yellow brown, 10yr-5/6 silt (SAPROLITE) little clay, moist				
390 0	-30 00					As above with coarse SAND rock fragments				
385 0	-35 00					TOP OF BEDROCK 37 0'				
						GRANITE	NA			
	-40 00									

AR301319

PROJECT NO: 303486 BORING NO: ITB-3 PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 2-8-90 DATE FINISHED: 2-12-90 FIELD ENGINEER: R G NIES
DRILLER: J MAYNARD, R RECK N: 659,788' E: 1,056,042'
GROUND SURFACE ELEV: 420 24 GWL DATE/TIME: 1-12-90/0923 GWL DEPTH: 108 0'
DRILLING METHOD: 10" AIR HAMMER AND 13" AIR ROTARY EQUIPMENT: INGERSOL RAND TH-60
CONTRACTOR: HYDRO GROUP, INC CHECKED BY: M J HARONER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY TSF	REMARKS
380 0	-40 00					GRANITE			
375 0	-45 00								8 0" CASING SET AT 45 0'
370 0	-50 00						NA		
365 0	-55 00					58 0'			
						Gray and white, METADIORITE, quartz			
360 0	-60 00	NA	NA	NA				NA	
355 0	-65 00								
350 0	-70 00						NA		
345 0	-75 00								
	-80 00								

AR301320

PROJECT NO: 303486 | BORING NO: ITB-3 | PROJECT NAME: BRIDGESTONE/FIRESTONE

DATE BEGAN: 2-8-90 | DATE FINISHED: 2-12-90 | FIELD ENGINEER: R G NIES

DRILLER: J MAYNARD, R RECK | N: 659,788' | E: 1,056,042'

GROUND SURFACE ELEV: 420 24 | GWL DATE/TIME: 1-12-90/0923 | GWL DEPTH: 108 0

DRILLING METHOD: 10" AIR HAMMER AND 13" AIR ROTARY | EQUIPMENT: INGERSOL RAND TH

CONTRACTOR: HYDRO GROUP, INC | CHECKED BY: M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
340 0	-80 00					GRANITE	NA			
335 0	-85 00					87 0'				
						METADIORITE, gray and white quartzose				
330 0	-90 00									
325 0	-95 00									
320 0	-100 00	NA	NA	NA			NA	NA		
315 0	-105 00									
	▼									SOME WATER AT 108 0' NO DUST
310 0	-110 00									
305 0	-115 00									BOREHOLE MAKING APPROXIMATE[LY] 0 5 TO 1 0 GALLONS PER MINU[TE]
	-120 00									

AR301321

PROJECT NO:	303486	BORING NO:	ITB-3	PROJECT NAME	BRIDGESTONE/FIRESTONE
DATE BEGAN:	2-8-90	DATE FINISHED:	2-12-90	FIELD ENGINEER	R G NIES
DRILLER:	J MAYNARD, R RECK	N:	659,788'	E	1,056,042'
GROUND SURFACE ELEV:	420 24	GWL DATE/TIME:	1-12-90/0923	GWL DEPTH:	108 0'
DRILLING METHOD:	10" AIR HAMMER AND 13" AIR ROTARY			EQUIPMENT:	INGERSOL RAND TH-60
CONTRACTOR:	HYDRO GROUP, INC			CHECKED BY	M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
300.0	120.00	NA	NA	NA		METADIORITE, a/a	NA	NA		
						BOTTOM OF BORING AT 122 0' ESTIMATED SUSTAINED YIELD: 13.5 gpm				NOTES COLOR AS PER MUNSELL COLOR CHART

AR301322

PROJECT NO: 303486 | BORING NO: ITB-4 | PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 12-26-89 | DATE FINISHED: 12-28-89 | FIELD ENGINEER: M J HARDNER
DRILLER: J MAYNARD, R RECK | N: 659,277' | E: 1,056,421'
GROUND SURFACE ELEV: 398 04 | GWL DATE/TIME: 12-29-89/0745 | GWL DEPTH: 33 0'
DRILLING METHOD: AIR ROTARY, 7 7/8" TRI-CONE ROTARY (ROLLER BIT) | EQUIPMENT: INGERSOL RAND TH
CONTRACTOR: HYDRO GROUP, INC | CHECKED BY: R G NIES

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TEST	REMARKS
	0 00					Reddish-brown 2 5y-4/4, clayey SILT, dry 5 0'	ml			NO SPLIT SPOON SAMPLES COLLECTED LITHOLOGY DETERMINED BY EXAMINATION OF DRILL CUTTINGS
395 0										HNU READING = 0 0 ppm LEL = 0%
	-5 00					Light gray 5yr-7/1, sandy SILT, dry				HNU READING = 0 0 ppm LEL = 0%
390 0							sm			
	-10 00					12 0'				HNU READING = 0 0 ppm LEL = 0%
385 0						Reddish-brown 2 5yr-4/4, sandy clay (SAPROLITE), dry 14 0'	cl			TOP OF BEDROCK AT 14 0'
	-15 00					GRANITE, gneissic, white, orange, black, medium crystalline, abundant quartz and feldspar content, hard, slightly weathered, dry				HNU READING = 0 ppm LEL = 0%
380 0										8" CASING SET AT 18 5'
	-20 00	NA	NA	NA			NA	NA		
375 0										
	-25 00									HNU READING = 0 ppm LEL = 0%
370 0						GRANITE, gneissic, white, orange, some black, dry				
	-30 00									
12-29-89 ▼ 365 0										APPROX DRILL RATE = 1'/min
	-35 00									HNU READING = 0 ppm LEL = 0%
360 0										MAKING WATER AT 40 0'
	-40 00									

AR301323

PROJECT NO:	303486	BORING NO	IT8-4	PROJECT NAME	BRIDGESTONE/FIRESTONE
DATE BEGAN:	12-26-89	DATE FINISHED	12-28-89	FIELD ENGINEER:	M J HARDNER
DRILLER:	J MAYNARD, R RECK	N	659,277'	E:	1,056,421'
GROUND SURFACE ELEV:	398 04	GWL DATE/TIME:	12-29-89/0745	GWL DEPTH:	33 0'
DRILLING METHOD:	AIR ROTARY, 7 7/8" TRI-CONE ROTARY (ROLLER BIT)			EQUIPMENT:	INGERSOL RAND TH-60
CONTRACTOR:	HYDRO GROUP, INC			CHECKED BY:	R G NIES

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	-40 00									
355 0		NA	NA	NA		GRANITE, gneissic, white, pink orange, black, abundant quartz and feldspar, wet	NA	NA		HNU READING = 0 ppm LEL = 0%
	-45 00									
						BOTTOM OF BORING AT 45 0' ESTIMATED SUSTAINED YIELD: 0.29 gpm				NOTES SOIL COLORS AS PER MUNSELL COLOR CHART

PROJECT NO:	303486	BORING NO:	ITB-5	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	12-19-89	DATE FINISHED:	1-17-90	FIELD ENGINEER:	M K JORDAN
DRILLER:	J MAYNARD, R RECK	N:	659, 513'	E:	1, 056, 914'
GROUND SURFACE ELEV:	415 59'	GWL DATE/TIME:	12-19-89/1520	GWL DEPTH:	25 0'
DRILLING METHOD:	AIR ROTARY, AIR HAMMER, CORING			EQUIPMENT:	INGERSOL RAND TH-60
CONTRACTOR:	HYDRO GROUP, INC			CHECKED BY:	M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
415 0	0 00					FILL, (brownish-yellow, 5yr-6/6, silty sand with trace pebbles, dry)	NA			NO SPLIT SPOON SAMPLES TAKEN LITHOLOGY DETERMINED BY EXAMINATION OF DRILL CUTTINGS
410 0	-5 00									HNU READING = 0 0 ppm LEL = 0%
						9 0'				
405 0	-10 00					Light brownish-gray, 2 5y-6/2, silty SAND with trace pebbles, moist to wet				
00 0	-15 00									HNU READING = 0 0 ppm LEL = 0%
395 0	-20 00	NA	NA	NA			sm	NA		
390 0	-25 00									GROUNDWATER LEVEL AT ~25 0'
385 0	-30 00					Cuttings, grayish-brown, 2 5y-5/2, SAND with some silt and tace pebbles, wet				
										HNU READING = 0 0 ppm LEL = 0%
380 0	-35 00									
						TOP OF BEDROCK AT 38 0'				BEDROCK CORED FROM 38 0' TO 66 6
						(GRANITE)				
	-40 00									

AR301325

PROJECT NO: 303486		BORING NO: ITB-5		PROJECT NAME: BRIDGESTONE/FIRESTONE	
DATE BEGAN: 12-19-89		DATE FINISHED: 1-17-90		FIELD ENGINEER: M K JORDAN	
DRILLER: J MAYNARD, R RECK		N: 659,513'		E: 1,056,914'	
GROUND SURFACE ELEV: 415 59'		GWL DATE/TIME: 12-19-89/1520		GWL DEPTH: 25 0'	
DRILLING METHOD: AIR ROTARY, AIR HAMMER, CORING				EQUIPMENT: INGERSOL RAND TH-	
CONTRACTOR: HYDRO GROUP, INC				CHECKED BY: M J HARDNER	

ELEV (FT)	DEPTH (FT)	RUN NO.	% RQD	% REC	PROFILE	DESCRIPTION	JOINT SPACING MAX-MIN-AVG	CONSISTENCY	TSF	REMARKS
375 0	-40 00									
370 0	-45 00	2	90 0	86 0		GRANITE, gneissic, white, pinkish-orange, black, hard, broken to massive, very slight to slight weathering, high angle fractures, feldspar-rich, approximately 20% amplishole and mica, poorly developed banding	15-02-06			CORE RUN NUMBER 1 TO 39 6' ALL GROUT HNU READING = 0 0 ppm LEL = 0%
365 0	-50 00									
360 0	-55 00	3	90 0	98 0		GRANITE, gneissic, white, pinkish-orange, black, hard, broken to massive, very slight to slight weathering, poorly developed banding	14-01-06	NA		
355 0	-60 00									
350 0	-65 00	4	90 0	100 0		GRANITE, gneissic, white, pinkish-orange, black, hard, broken to massive, very slight to slight weathering	12-01-06			
						BOTTOM OF BORING AT 68 5' ESTIMATED SUSTAINED YIELD: 32.1 gpm				NOTES COLORS AS PER MUNSELL COLOR CHART CORE SIZE 1 7/8" DIAMOND ROTARY CORE

AR301326

PROJECT NO:	303486	BORING NO:	ITB-5BC	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	1-14-90	DATE FINISHED:	1-14-90	FIELD ENGINEER:	HARDNER/JACOBS
DRILLER:		N:	659,513'	E:	1,056,914'
GROUND SURFACE ELEV.:	415.59'	GWL DATE/TIME:	1-14-90	GWL DEPTH:	20.0'
DRILLING METHOD:				EQUIPMENT:	BOREHOLE CAMERA
CONTRACTOR:				CHECKED BY:	M.J. HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (FT)	PROFILE	DESCRIPTION	U.S.C.S.	[illegible]	REMARKS
	-40.00								
375.0						BOREHOLE TELEVISION INSPECTION LOG			WATER LEVEL AT 20.0' STEEL CASING AT 44.0'
	-45.00					Granite, gneissic, feldspar, quartz, some darker minerals, coarse crystalline			MICRO FRACTURE AT 45.0' OBLIQUE, HIGH ANGLE
370.0									
	-50.00					Vertical dike with low angle fracture ~1 foot in length, dark minerals, fine grained			DIKE AT 48.0'
365.0									
	-55.00					Fracture, low angle, at 55' located at contact with minor change to darker minerals			
360.0									
						Fracture at 58' vertical			
	-60.00								
355.0									
	-65.00					Fracture at 65' rock broken			POSS. VOID ON ONE SIDE
350.0						Rock broken at 65'-67.5' Fracture at 68', oblique fracture widens from microsize to ~1"			AIR BUBBLES ON BORING WALL
						BOTTOM OF BORING AT 68.0'			
	-70.00								
345.0									
	-75.00								
[illegible].0									
	-80.00								

AR301327

PROJECT NO: 303486 BORING NO: ITZ-1 PROJECT NAME: BRIDGESTONE/FIRESTONE

DATE BEGAN: 12-13-89 DATE FINISHED: 12-15-89 FIELD ENGINEER: M K JORDAN

DRILLER: J ARNETT, D SHINER N: 660, 470' E: 1, 057, 031'

ROUND SURFACE ELEV: 458 11' GWL DATE/TIME: 12-14-89/1000 GWL DEPTH: 50 0'

DRILLING METHOD: 6 1/4" ID HOLLOW STEM AUGER 10" OD EQUIPMENT: GUS PECH - BRAT 2

CONTRACTOR: HYDRO GROUP, INC CHECKED BY: M J HARONER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	0 00					Cuttings red (2 5yr-4/8), medium grained SAND with trace silt and quartz pebbles, dry	gm			HNU READING = 0 0 ppm
455 0						5 0'				
	-5 00					Cuttings brownish-yellow (10yr-6/8), fine grained sand and silt, (SAPROLITE), dry				
450 0										HNU READING = 0 0 ppm NO ODOR
	-10 00					Cuttings red (10yr-4/6), fine grained sand and silt, (SAPROLITE), dry				HNU READING = 0 0 ppm NO ODOR
445 0										
	-15 00									HNU READING = 28 0 ppm NO ODOR
440 0							sm			
	-20 00	NA	NA	NA						HNU READING = 4 4 ppm NO ODOR
435 0										
	-25 00									HNU READING = NA NO ODOR
430 0										
	-30 00									HNU READING = 0 0 ppm NO ODOR
425 0						35 0'				
	-35 00					Cuttings weak red (10yr-4/4), silt some clay and trace fine grained sand (SAPROLITE), dry				HNU READING = 0 0 ppm NO ODOR
420 0										CONTINUED AIR MONITORING WITH HNU AND LEL NO READINGS
	-40 00									

PROJECT NO: 303486 | BORING NO: ITZ-1 | PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 12-13-89 | DATE FINISHED: 12-15-89 | FIELD ENGINEER: M K JORDAN
DRILLER: J ARNETT, D SHINER | N: 660,470' | E: 1,057,031'
GROUND SURFACE ELEV.: 458 11' | GWL DATE/TIME: 12-14-89/1000 | GWL DEPTH: 50 0'
DRILLING METHOD: 6 1/4" ID HOLLOW STEM AUGER 10" OD | EQUIPMENT: GUS PECH - BRAT 22R
CONTRACTOR: HYDRO GROUP, INC | CHECKED BY: M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	-40 00									WITH HNU AND LEL NO READINGS ABOVE BACKGROUND IN BREATHING ZONE
415 0										
	-45 00									
410 0 (12-14-89 ▼)										
	-50 00									
405 0										
	-55 00						ml			
400 0										NO ODOR
	-60 00					Cuttings reddish-brown (5yr-4/4) silt and clay (SAPROLITE), dry				HNU READING = 0 0 ppm NO ODOR
395 0										
	-65 00					Cuttings reddish-brown (5yr-5/3) silt some clay and trace sand (SAPROLITE), wet				HNU READING = 0 0 ppm NO ODOR
390 0										
	-70 00									HNU READING = 0 0 ppm NO ODOR
385 0										
	-75 00									HNU READING = 0 0 ppm NO ODOR
380 0										
	-80 00									

AR301329

PROJECT NO: 303486 | BORING NO: ITZ-1 | PROJECT NAME: BRIDGESTONE/FIRESTONE

DATE BEGAN: 12-13-89 | DATE FINISHED: 12-15-89 | FIELD ENGINEER: M K JORDAN

DRILLER: J ARNETT, D SHINER | N: 660,470' | E: 1,057,031'

GROUND SURFACE ELEV: 458 11' | GWL DATE/TIME: 12-14-89/1000 | GWL DEPTH: 50 0'

DRILLING METHOD: 6 1/4" ID HOLLOW STEM AUGER 10" OD | EQUIPMENT: GUS PECH - BRAT 2

CONTRACTOR: HYDRO GROUP, INC | CHECKED BY: M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6 0")	REC (IN)	PROFILE	DESCRIPTION	USCS	CONSISTENCY	TSF	REMARKS
	-80 00									
375 0						Cuttings reddish-brown (5yr-5/3), silt some clay and trace sand (SAPROLITE), wet	ml			HNU READING = 0 0 ppm NO ODOR
						BOTTOM OF BORING AT 84 0'				NOTES HNU READINGS ARE ABOVE BACKGROUND COLORS AS PER MUNSELL COLOR CHART NO SPLIT SPOON SAMPLES SAMPLES LOGGED VIA DRILL CUTTINGS

AR301330

PROJECT NO: 303486	BORING NO: ITZ-2	PROJECT NAME: BRIDGESTONE/FIRESTONE	
DATE BEGAN: 12-19-89	DATE FINISHED: 12-19-89	FIELD ENGINEER: M.J HARDNER	
DRILLER: J. ARNETT, D. SHINER	N: 660, 554'	E: 1,056, 912'	
GROUND SURFACE ELEV.: 452.76'	GWL DATE/TIME: 12-14-89/1445	GWL DEPTH: 46.5'	
DRILLING METHOD: 4 1/4" ID HOLLOW STEM AUGER 8" OD		EQUIPMENT: GUS PECH - BRAT 22R	
CONTRACTOR: HYDRO GROUP, INC.		CHECKED BY: R.G NIES	

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.S.F	REMARKS
	0.00					Cuttings: dark yellowish-brown (10yr-4/6), clayey SAND and GRAVEL, dry				HNU READING = 0.0 ppm
450.0							gc			
	-5.00					5.0'				
						Cuttings: red (2.5yr-4/8), clayey silt (SAPROLITE), trace sand, dry				
445.0										
	-10.00					Cuttings: red (10yr-4/6), fine grained sand and silt, (SAPROLITE), dry				
440.0										
	-15.00									
435.0							ml			
	-20.00	NA	NA	NA						HNU READING = 0.0 ppm NO ODOR
430.0										
	-25.00					Cuttings: yellowish-red (5yr-4/6), clayey silt (SAPROLITE), trace fine gravel, dry				HNU READING = 0.0 ppm NO ODOR
425.0										
	-30.00									
420.0										
	-35.00					Cuttings: yellowish-red (5yr-4/6) clayey silt (SAPROLITE), trace fine gravel, dry				HNU READING = 0.0 ppm NO ODOR
[illegible]										
	-40.00									

PROJECT NO:	303486	BORING NO:	ITZ-2	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	12-19-89	DATE FINISHED:	12-19-89	FIELD ENGINEER:	M J HARDNER
DRILLER:	J. ARNETT, D. SHINER	N:	660,554'	E:	1,056,912'
ROUND SURFACE ELEV.:	452.76'	GWL DATE/TIME:	12-14-89/1445	GWL DEPTH:	46.5'
DRILLING METHOD:	4 1/4" ID HOLLOW STEM AUGER 8" OD			EQUIPMENT:	GUS PECH - BRAT 22
CONTRACTOR:	HYDRO GROUP, INC			CHECKED BY:	R G NIES

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.O.F.	REMARKS
	-40.00									
410.0										
2-14-8 ▼	-45.00									
405.0										
	-50.00									
400.0										
	-55.00					Cuttings: yellowish-brown (5yr-5/6), clayey silt (SAPROLITE), trace very fine sand, dry				HNU READING = 0.0 ppm NO ODOR
395.0										
	-60.00	NA	NA	NA			ml			HNU READING = 0.0 ppm NO ODOR
390.0										
	-65.00									CUTTINGS WET AT 70'
385.0										
	-70.00					Cuttings: yellowish-brown (10yr-5/4), clayey silt (SAPROLITE), wet to moist				HNU READING = 0.0 ppm NO ODOR
380.0										
	-75.00									
..0										
	-80.00									AUGER REFUSAL AT 81.0'

AR301332

PROJECT NO:	303486	BORING NO:	ITZ-2	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	12-19-89	DATE FINISHED:	12-19-89	FIELD ENGINEER:	M.J. HARDNER
DRILLER:	J. ARNETT, D. SHINER	N:	660,559'	E:	1,056,912'
GROUND SURFACE ELEV.:	452.76'	GWL DATE/TIME:	12-19-89/1445	GWL DEPTH:	46.5'
DRILLING METHOD:	4 1/4" ID HOLLOW STEM AUGER 8" OD			EQUIPMENT:	GUS PECH - BRAT 22R
CONTRACTOR:	HYDRO GROUP, INC.			CHECKED BY:	R.G. NIES

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.S.F.	REMARKS
	-80.00	NA	NA	NA			ml			AUGER REFUSAL AT 81.0'
						BOTTOM OF BORING AT 81.0'				NOTES: HNU READINGS ARE ABOVE BACKGROUND COLORS AS PER MUNSELL COLOR CHART NO SPLIT SPOON SAMPLES TAKEN SAMPLES LOGGED VIA DRILL CUTTINGS

AR301333

PROJECT NO: 303486 BORING NO: ITZ-3 PROJECT NAME: BRIDGESTONE/FIRESTONE

DATE BEGAN: 12-21-89 DATE FINISHED: 12-21-89 FIELD ENGINEER: M J HARDNER

DRILLER: J. ARNETT, D. SHINER N: 660,450' E: 1,056,828'

GROUND SURFACE ELEV.: 448.44' GWL DATE/TIME: 12-22-89/0815 GWL DEPTH: 49.0'

DRILLING METHOD: 4 1/4" ID HOLLOW STEM AUGER 8" OD EQUIPMENT: GUS PECH - BRAT

CONTRACTOR: HYDRO GROUP, INC. CHECKED BY: R G NIES

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	TSF	REMARKS
	0.00					Cuttings: yellowish-red (5yr-5/8), clayey GRAVEL, dry	gc			HNU READING = 0.0 ppm
445.0						5.0'				
	-5.00					Cuttings: reddish-brown (2.5yr-5/4), clayey silt (SAPROLITE), dry				HNU READING = 0.0 ppm
440.0										
	-10.00					Cuttings: reddish-brown (2.5yr-5/4), clayey silt, (SAPROLITE), dry				
435.0										
	-15.00					Cuttings: reddish-brown (2.5yr-4/4), clayey silt (SAPROLITE), dry				HNU READING = 0.0 ppm
430.0							ml			
	-20.00	NA	NA	NA		Cuttings: reddish-brown (2.5yr-5/4), clayey silt (SAPROLITE), dry				
425.0										
	-25.00									
420.0										
	-30.00					Cuttings: red (2.5yr-4/6), clayey silt (SAPROLITE), dry				HNU READING = 0.0 ppm
415.0										
	-35.00									
410.0										
	-40.00									

AR301334

PROJECT NO: 303486
BORING NO: ITZ-3
PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 12-21-89
DATE FINISHED: 12-21-89
FIELD ENGINEER: M.J. HARDNER
DRILLER: J. ARNETT, D. SHINER
N: 660,450'
E: 1,056,828'
GROUND SURFACE ELEV.: 448.44'
GWL DATE/TIME: 12-22-89/0815
GWL DEPTH: 49.0'
DRILLING METHOD: 4 1/4" ID HOLLOW STEM AUGER 8" OD
EQUIPMENT: GUS PECH - BRAT 22R
CONTRACTOR: HYDRO GROUP, INC.
CHECKED BY: R.G. NIES

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.S.F.	REMARKS
405.0	-40.00 -45.00					Cuttings: yellowish-red (5yr-4/6), clayey silt (SAPROLITE), dry 48.0'	ml			HNU READING = 0.0 ppm
12-22-89 ▼ 395.0 390.0	-50.00 -55.00					Cuttings: reddish-yellow (7.5yr-6/8) silty clay, (SAPROLITE), moist 60.0'	cl			HNU READING = 0.0 ppm
385.0 380.0 375.0 370.0	-60.00 -65.00 -70.00 -75.00	NA	NA	NA		Cuttings: yellowish-brown (10yr-5/8), silt (SAPROLITE), some sand, moist Cuttings: yellowish-brown (10yr-5/8), silt (SAPROLITE), some clay, wet	ml			HNU READING = 0.0 ppm HNU READING = 0.0 ppm
	-80.00					BOTTOM OF BORING AT 79.0'				

AR301335

PROJECT NO: 303486
BORING NO: ITZ-3
PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 12-21-89
DATE FINISHED: 12-21-89
FIELD ENGINEER: M.J. HARONER
DRILLER: J. ARNETT, D. SHINER
N: 660,450'
E: 1,056,828'
GROUND SURFACE ELEV.: 448.44'
GWL DATE/TIME: 12-22-89/0815
GWL DEPTH: 49.0'
DRILLING METHOD: 4 1/4" ID HOLLOW STEM AUGER 8" OD
EQUIPMENT: GUS PECH - BRAT 22
CONTRACTOR: HYDRO GROUP, INC.
CHECKED BY: R.G. NICE

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.S.F	REMARKS
										CUTTINGS WET AT 70.0' TO 75 0' NOTES HNU READINGS ARE ABOVE BACKGROUND COLORS AS PER MUNSELLP COLOR CHART NO SPLIT SPOON SAMPLES SAMPLES LOGGED VIA DRILL CUTTINGS

PROJECT NO:	303486	BORING NO:	ITZ-4	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	12-21-89	DATE FINISHED:	1-11-90	FIELD ENGINEER:	R.G NIES
DRILLER:	J. ARNETT, G. SHAW	N:	660,048'	E:	1,056,085'
GROUND SURFACE ELEV.:	416.26'	GWL DATE/TIME:	1-19-90	GWL DEPTH:	25.17'
DRILLING METHOD:	4 1/4" ID HOLLOW STEM AUGER 8" OD			EQUIPMENT:	GUS PECH - BRAT 22R
CONTRACTOR:	HYDRO GROUP, INC.			CHECKED BY:	M.J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.S.F.	REMARKS
	0.00									
415.0						Cuttings: strong brown (7yr-5/8), SILT little sand and clay, moist				
	-5.00						ml			HNU READING = 0.0 ppm
410.0						10.0'				
	-10.00									HNU READING = 0.0 ppm
405.0						Cuttings: brownish-yellow (10yr-6/8), silt (SAPROLITE), trace fine sand and gravel and clay, dry				
	-15.00					Cuttings: light yellowish-brown (10yr-6/4), silt (SAPROLITE), little clay, trace fine sand, moist				HNU READING = 0.0 ppm
400.0							ml			
	-20.00	NA	NA	NA		Cuttings: light yellowish-brown (2.5y-6/4), silt (SAPROLITE), little clay, trace fine to coarse sand, moist				HNU READING = 0.0 ppm
395.0										
1-19-90										AUGER CHATTER AT 25.0' DRILLING DIFFICULT
	-25.00									
390.0										NOTES:
										HNU READINGS ARE ABOVE BACKGROUND
	-30.00					Cuttings: light yellowish-brown (2.5y-6/4), silt (SAPROLITE), little clay, trace fine sand, moist, wet at 32.0' to 33.0'				
385.0										COLORS AS PER MUNSELL COLOR CHART NO SPLIT SPOON SAMPLES
	-35.00					Cuttings: light yellowish-brown (2.5yr-6/4), silt (SAPROLITE), little clay, trace fine sand and gravel, wet				SAMPLES LOGGED VIA DRILL CUTTINGS
380.0										
	-40.00					BOTTOM OF BORING AT 38.0'				

AR301337

PROJECT NO:	303486	BORING NO:	ITZ-5	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	1-12-90	DATE FINISHED:	1-12-90	FIELD ENGINEER:	R G NIES
DRILLER:	J. ARNETT, D. SHINER	N:	659,914'	E:	1,055,719'
GROUND SURFACE ELEV.:	410.61'	SWL DATE/TIME:	1-19-90	SWL DEPTH:	41.82'
DRILLING METHOD:	4 1/4" ID HOLLOW STEM AUGER 8" OD			EQUIPMENT:	GUS PECH - BRAT E
CONTRACTOR:	HYDRO GROUP, INC.			CHECKED BY:	M.J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.S.F.	REMARKS
	0.00									
410.0						Cuttings: strong brown (7.5yr-5/8), clayey SILT little fine sand and gravel, moist	gm			HNU READING = 0.0 ppm
						5.0'				
405.0	-5.00					Cuttings: brownish-yellow (10yr-6/8), silt (SAPROLITE), little clay, trace fine sand, dry to moist				EASY AUGERING
400.0	-10.00									
5.0	-15.00									
							ml			
390.0	-20.00	NA	NA	NA						HNU READING = 0.0 ppm LEL = 0%
385.0	-25.00					Cuttings: brownish-yellow (10yr-6/8), silt (SAPROLITE), little clay, dry				EASY AUGERING
380.0	-30.00					Cuttings: light olive brown (2.5y-5/6), silt (SAPROLITE), little clay, moist				
375.0	-35.00					Cuttings: light yellow brown (2.5y-6/6), silt (SAPROLITE), little clay, dry				HNU READING = 0.0 ppm HARDER AUGERING AT 35.0'
						Cuttings: olive yellow (2.5y-6/6), silt (SAPROLITE), little clay, dry				
	-40.00									

1-19-90

PROJECT NO: 303486 BORING NO: ITZ-5 PROJECT NAME: BRIDGESTONE/FIRESTONE

DATE BEGAN: 1-12-90 DATE FINISHED: 1-12-90 FIELD ENGINEER: R.G. NIES

DRILLER: J. ARNETT, D. SHINER N: 659,914' E: 1,055,719'

GROUND SURFACE ELEV.: 410.61' SWL DATE/TIME: 1-19-90 SWL DEPTH: 41.82'

DRILLING METHOD: 4 1/4" ID HOLLOW STEM AUGER 8" OD EQUIPMENT: GUS PECH - BRAT 22R

CONTRACTOR: HYDRO GROUP, INC. CHECKED BY: M.J. HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.S.F.	REMARKS
370.0 ▼	40.00						ml			HNU READING = 0.0 ppm
365.0	45.00					Cuttings: olive yellow (2.5y-6/6), silt (SAPROLITE), little clay, dry				NOTES:
						BOTTOM OF BORING AT 47.0'				HNU READINGS ARE ABOVE BACKGROUND COLORS AS PER MUNSELL COLOR CHART NO SPLIT SPOON SAMPLES SAMPLES LOGGED VIA DRILL CUTTINGS

AR301339

PROJECT NO:	303486	BORING NO:	ITZ-6	PROJECT NAME:	BRIDGESTONE/FIRESTONE
DATE BEGAN:	1-11-90	DATE FINISHED:	1-12-90	FIELD ENGINEER:	R G NICE
DRILLER:	J. ARNETT, G. SHAW	N:	659,690'	E:	1,056,017'
GROUND SURFACE ELEV.:	413.78'	GWL DATE/TIME:	NA	GWL DEPTH:	NA
DRILLING METHOD:	4 1/4" ID HOLLOW STEM AUGER 8" OD			EQUIPMENT:	GUS PECH - BRAT
CONTRACTOR:	HYDRO GROUP, INC.			CHECKED BY:	M J HARDNER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.O.F.	REMARKS
	0.00					Cuttings: strong brown (7.5yr-5/8), clayey SILT little fine gravel, moist — 5.0'	ml			EASY DRILLING
410.0										
	-5.00					Cuttings: brownish-yellow (10yr-6/8), silt (SAPROLITE), little clay, trace fine sand, moist				HNU READING = 0 0 ppm
405.0										
	-10.00									
400.0										
	-15.00					Cuttings: brownish-yellow (10yr-6/8), silt (SAPROLITE), little clay trace fine sand, moist				EASY AUGERING
395.0							ml			
	-20.00	NA	NA	NA						LEL = 0% HNU READING = 0 0 ppm
390.0										
	-25.00					Cuttings: brownish-yellow (10yr-6/8), silt (SAPROLITE), little clay, dry				EASY AUGERING HNU READING = 0 0 ppm
385.0										
	-30.00									
380.0										
	-35.00					Cuttings: brownish-yellow (10yr-6/8), silt (SAPROLITE), little clay, moist				HARD DRILLING
375.0										
	-40.00									

4R301340

PROJECT NO: 303486 | BORING NO: ITZ-6 | PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 1-11-90 | DATE FINISHED: 1-12-90 | FIELD ENGINEER: R.G NIES
DRILLER: J. ARNETT, G. SHAW | N: 659,690' | E: 1,056,017'
GROUND SURFACE ELEV.: 413.78' | GWL DATE/TIME: NA | GWL DEPTH: NA
DRILLING METHOD: 4 1/4" ID HOLLOW STEM AUGER 8" OD | EQUIPMENT: GUS PECH - BRAT 22R
CONTRACTOR: HYDRO GROUP, INC. | CHECKED BY: M.J. HARONER

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.S.F.	REMARKS
	-40.00									BEDROCK AT 40.0'
						BOTTOM OF BORING AT 41.0'				NOTES: HNU READINGS ARE ABOVE BACKGROUND COLORS AS PER MUNSELL COLOR CHART NO SPLIT SPOON SAMPLES SAMPLES LOGGED VIA DRILL CUTTINGS HOLE GROUTED TO THE SURFACE (BENTONITE AND PORTLAND) NO WELL CONSTRUCTED

AR301341

PROJECT NO: 303486 BORING NO: ITZ-7 PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 1-17-90 DATE FINISHED: 1-18-90 FIELD ENGINEER: M.J HARONER
DRILLER: J. ARNETT, F. CORNELL N: 639,864' E: 1,055,887'
GROUND SURFACE ELEV.: 423.50' GWL DATE/TIME: 1-18-90/1050 GWL DEPTH: 43.0'
DRILLING METHOD: 4 1/4" ID HOLLOW STEM AUGER 8" OD EQUIPMENT: BUS PECH - BRAT
CONTRACTOR: HYDRO GROUP, INC. CHECKED BY: R G NIES

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC' (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.S.F.	REMARKS
	0.00					Cuttings: yellowish-red (5yr-5/8), sandy GRAVEL, some silt, dry	gm			HNU READING = 0 0 ppm NO ODOR OR STAIN
420.0						5.0'				
	-5.00					Cuttings: yellowish-red (5yr-5/8), silt (SAPROLITE), some clay, trace sand, dry				
415.0										
	-10.00									HNU READING = 0.0 ppm NO ODOR OR STAIN
410.0										
	-15.00					Cuttings: yellowish-red (5yr-5/8), clayey silt (SAPROLITE), trace sand, dry				HNU READING = 0 0 ppm NO ODOR OR STAIN
405.0							ml			
	-20.00	NA	NA	NA						HNU READING = 0.0 ppm
400.0										
	-25.00					Cuttings: yellowish-red (5yr-5/8), clayey silt (SAPROLITE), trace sand, occasional gravel (pea-size) lenses				HNU READING = 0.0 ppm
395.0										
	-30.00					Cuttings: strong brown (7yr-5/8), clayey silt (SAPROLITE), dry some silty clay layers, strong brown (7.5yr-5/6), dry to slightly moist				HNU READING = 0 0 ppm NO ODOR OR STAIN
390.0										HNU READING = 0 0 ppm NO ODOR OR STAIN
	-35.00									
385.0										
	-40.00									

PROJECT NO: 303486
BORING NO: ITZ-7
PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 1-17-90
DATE FINISHED: 1-18-90
FIELD ENGINEER: M.J. HARDNER
DRILLER: J. ARNETT, F. CORNELL
N: 659,864'
E: 1,055,887'
GROUND SURFACE ELEV.: 423.50'
SWL DATE/TIME: 1-18-90/1050
SWL DEPTH: 45.0'
DRILLING METHOD: 4 1/4" ID HOLLOW STEM AUGER 8" OD
EQUIPMENT: GUS PECH - BRAT 22R
CONTRACTOR: HYDRO GROUP, INC.
CHECKED BY: R.G. NIES

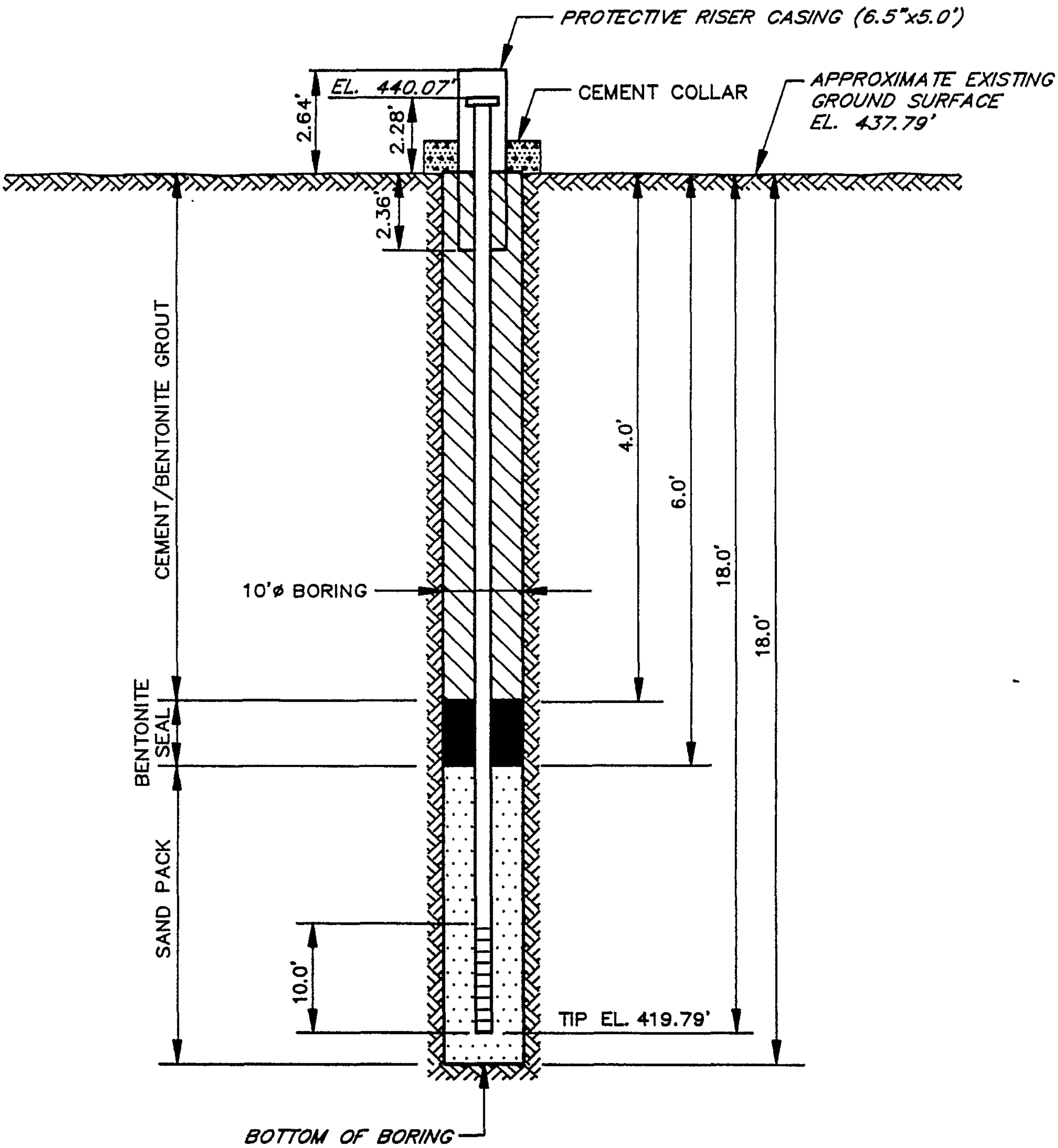
ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.S.F.	REMARKS
	-40.00					Cuttings: strong brown (7.5yr-5/8), clayey silt (SAPROLITE), dry to slightly moist				HNU READING = 0.0 ppm NO ODOR OR STAIN
1-19-90 ▼										
	-45.00									
375.0										
	-50.00					Cuttings: brown/strong brown (7.5yr-4/4), clayey silt (SAPROLITE), local clay layers, trace pea size gravel, moist				HNU READING = 0.0 ppm NO ODOR OR STAIN
370.0										
	-55.00									
365.0										CUTTINGS WET AT 60.0'
	-60.00	NA	NA	NA		Cuttings: strong brown (7.5yr-5/6), clayey silt (SAPROLITE), trace sand, trace fine gravel, wet	ml			HNU READING = 0.0 ppm NO ODOR OR STAIN
360.0										MINOR WET ZONE AT ~60.0'
	-65.00					Cuttings: dark grayish-brown (10yr-5/2), clayey silt (SAPROLITE), trace fine sand, trace fine sand, wet				HNU READING = 0.0 ppm NO ODOR OR STAIN
355.0										
	-70.00					Cuttings: light olive brown (2.5yr-5/4), clayey silt (SAPROLITE), trace fine sand, wet				HNU READING = 0.0 ppm NO ODOR OR STAIN
350.0										WET ZONE AT 70.0'
	-75.00									
345.0										
	-80.00					Cuttings: olive brown (2.5yr-4/4), clayey				

PROJECT NO: 303486 BORING NO: ITZ-7 PROJECT NAME: BRIDGESTONE/FIRESTONE
DATE BEGAN: 1-17-90 DATE FINISHED: 1-18-90 FIELD ENGINEER: M.J. HARDNER
DRILLER: J. ARNETT, F. CORNELL N: 559,864' E: 1,055,887'
GROUND SURFACE ELEV.: 423.50' GWL DATE/TIME: 1-18-90/1050 GWL DEPTH: 43.0'
DRILLING METHOD: 4 1/4" ID HOLLOW STEM AUGER 8" OD EQUIPMENT: GUS PECH - BRAT
CONTRACTOR: HYDRO GROUP, INC. CHECKED BY: R.S. NIES

ELEV (FT)	DEPTH (FT)	SAMPLE TYPE AND NO.	SPT BLOWS PER (6.0")	REC (IN)	PROFILE	DESCRIPTION	U.S.C.S.	CONSISTENCY	T.O.F.	REMARKS
	-80.00									
340.0	-85.00	NA	NA	NA		Cuttings: olive brown (2.5yr-4/4), clayey silt (SAPROLITE), moist, trace weathered bedrock pieces with iron stained, dark colored minerals, low quartz content	ml			HNU READING = 0.0 ppm NO ODOR OR STAIN BEDROCK AT 86.0'
						BOTTOM OF BORING AT 86.0'				NOTES: HNU READINGS ARE ABOVE BACKGROUND COLORS AS PER MUNSELL COLOR CHART NO SPLIT SPOON SAMPLES SAMPLES LOGGED VIA DRILL CUTTINGS

AR301344

APPENDIX C
MONITORING WELL/PIEZOMETER INSTALLATION DIAGRAMS



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN. I.D. PVC SLOT SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 429.97'.
5. WATER LEVEL READING ON 2-1-90.

AR301346

INSTALLATION DETAILS
MONITORING WELL ITP-1

PREPARED FOR

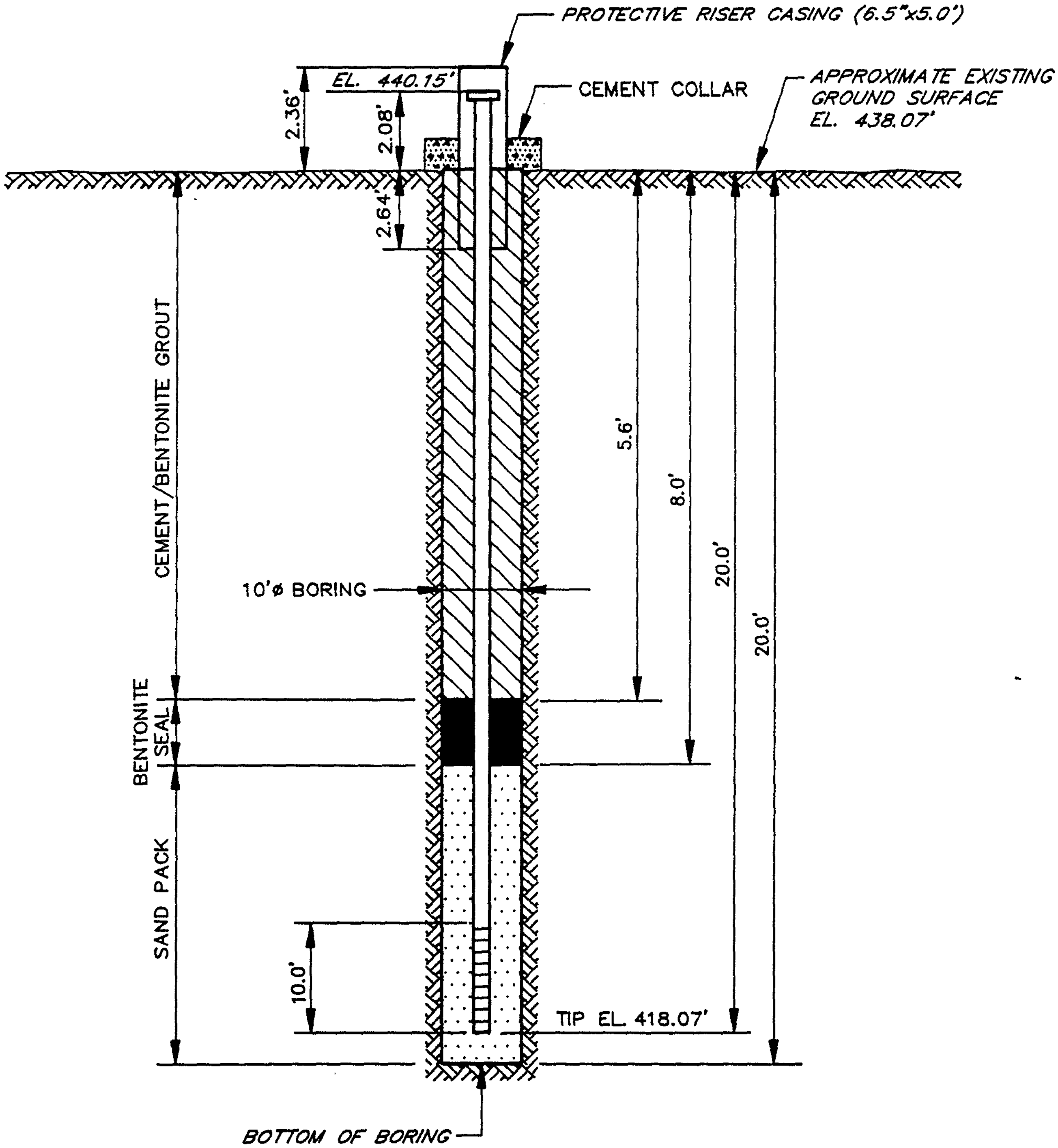
WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

"NOT TO SCALE"

WN		CHECKED BY	MJH	6-1-90	DRAWING NUMBER	486-A34
/	KME 4-27-90	APPROVED BY	AMT	6-1-90		

85360



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D. PVC SLOT SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 422.95'
5. WATER LEVEL READING ON 2-1-90.

INSTALLATION DETAILS
MONITORING WELL ITP-2

PREPARED FOR

WOODLAWN LANDFILL RI/FS

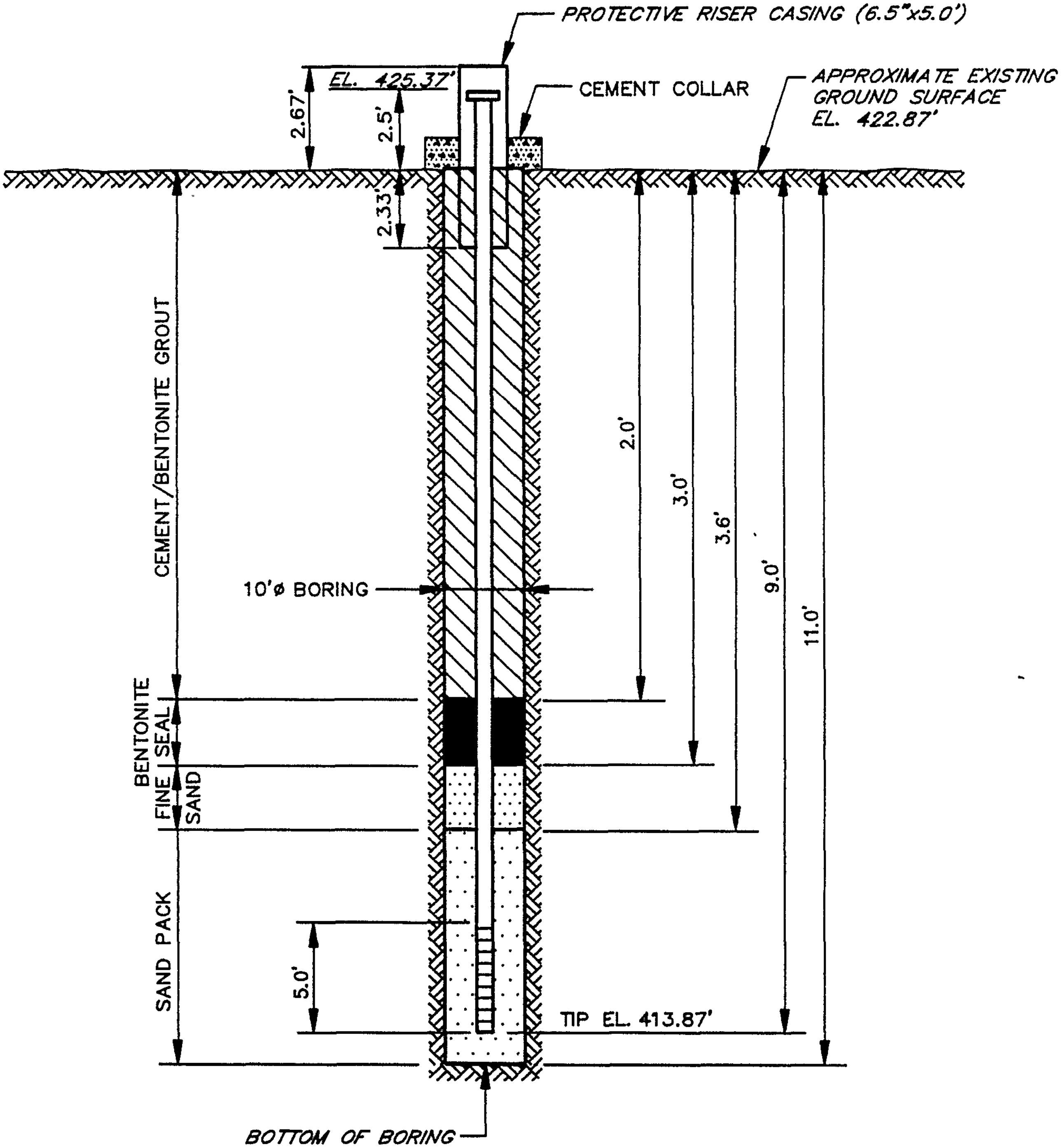
INTERNATIONAL TECHNOLOGY CORPORATION

"NOT TO SCALE"

DWN KME 4-27-90 | CHECKED BY MJH 6-1-90 | APPROVED BY AMJ 6-1-90 | DRAWING NUMBER 486-A35

85380

WN / | KME 4-27-90 | CHECKED BY MJH 6-1-90 | APPROVED BY AMJ 6-1-90 | DRAWING NUMBER 486-A36



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D. PVC SLOT SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 417.87'.
5. WATER LEVEL READING ON 2-6-90.

AR301348

INSTALLATION DETAILS

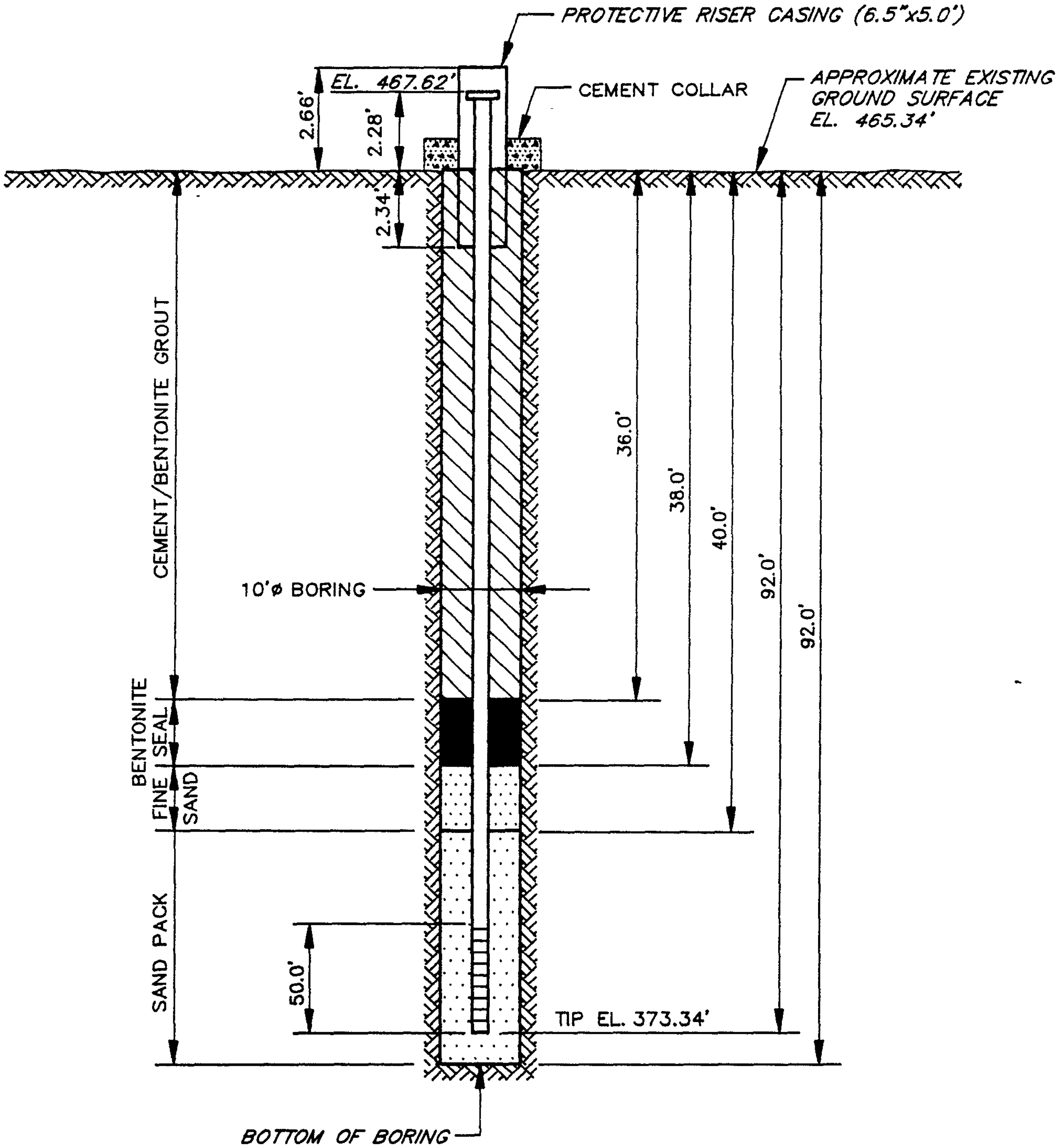
MONITORING WELL ITP-3

PREPARED FOR

WOODLAWN LANDFILL RI/FS

IT INTERNATIONAL TECHNOLOGY CORPORATION

"NOT TO SCALE"



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D. PVC SLOT SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 409.57'
5. WATER LEVEL READING ON 2-1-90.

AR301349

INSTALLATION DETAILS
MONITORING WELL ITS-1

PREPARED FOR

WOODLAWN LANDFILL RI/FS

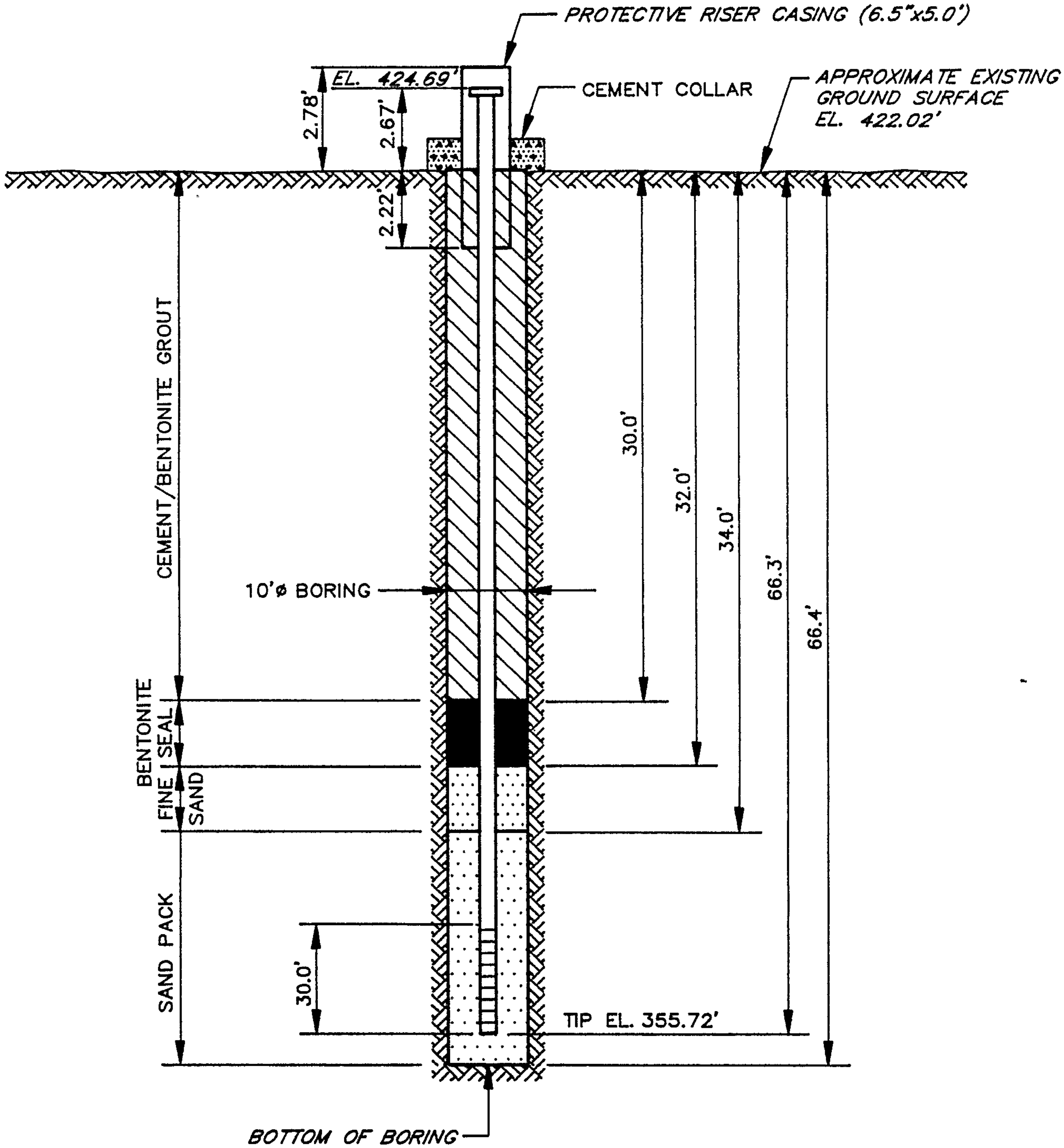
INTERNATIONAL TECHNOLOGY CORPORATION

WN	KME	CHECKED BY	MJH	6-1-90
	4-27-90	APPROVED BY	AMJ	6-1-90

DRAWING NUMBER .86-A37

"NOT TO SCALE"

DRAWING NUMBER .86-A38
CHECKED BY MJH 6-1-90
APPROVED BY AMT 6-1-90
KME 4-27-90
WN



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D. PVC SLOT SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 373.86'.
5. WATER LEVEL READING ON 1-19-90.

AR301350

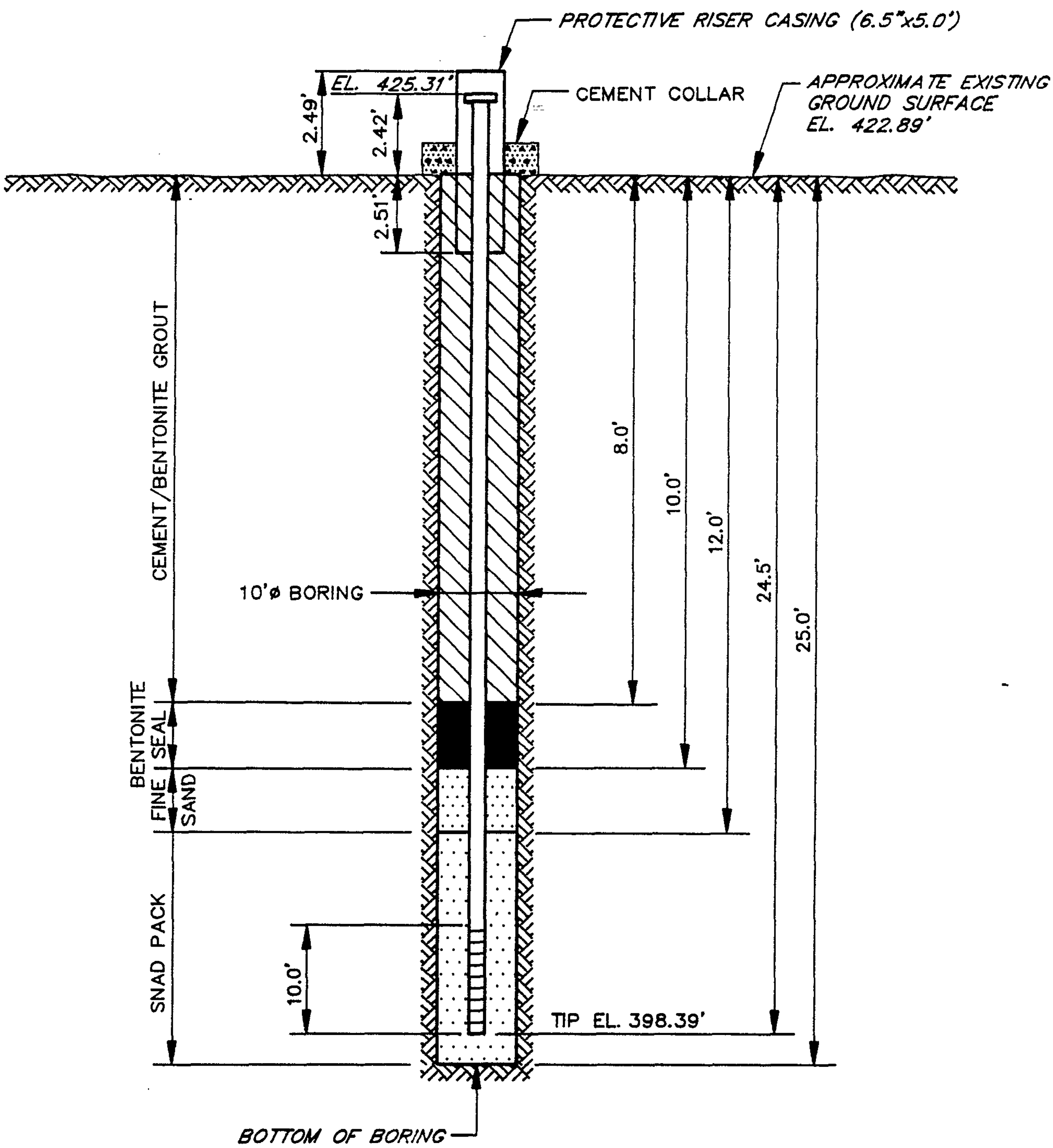
INSTALLATION DETAILS
MONITORING WELL ITS-2

PREPARED FOR

WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

"NOT TO SCALE"



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH-JOINTED.
2. SCREEN IS 4 IN I.D. PVC SLOT SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. WELL DRY AS OF 4-10-90 MEASUREMENT.

AR301351

INSTALLATION DETAILS
MONITORING WELL ITS-3

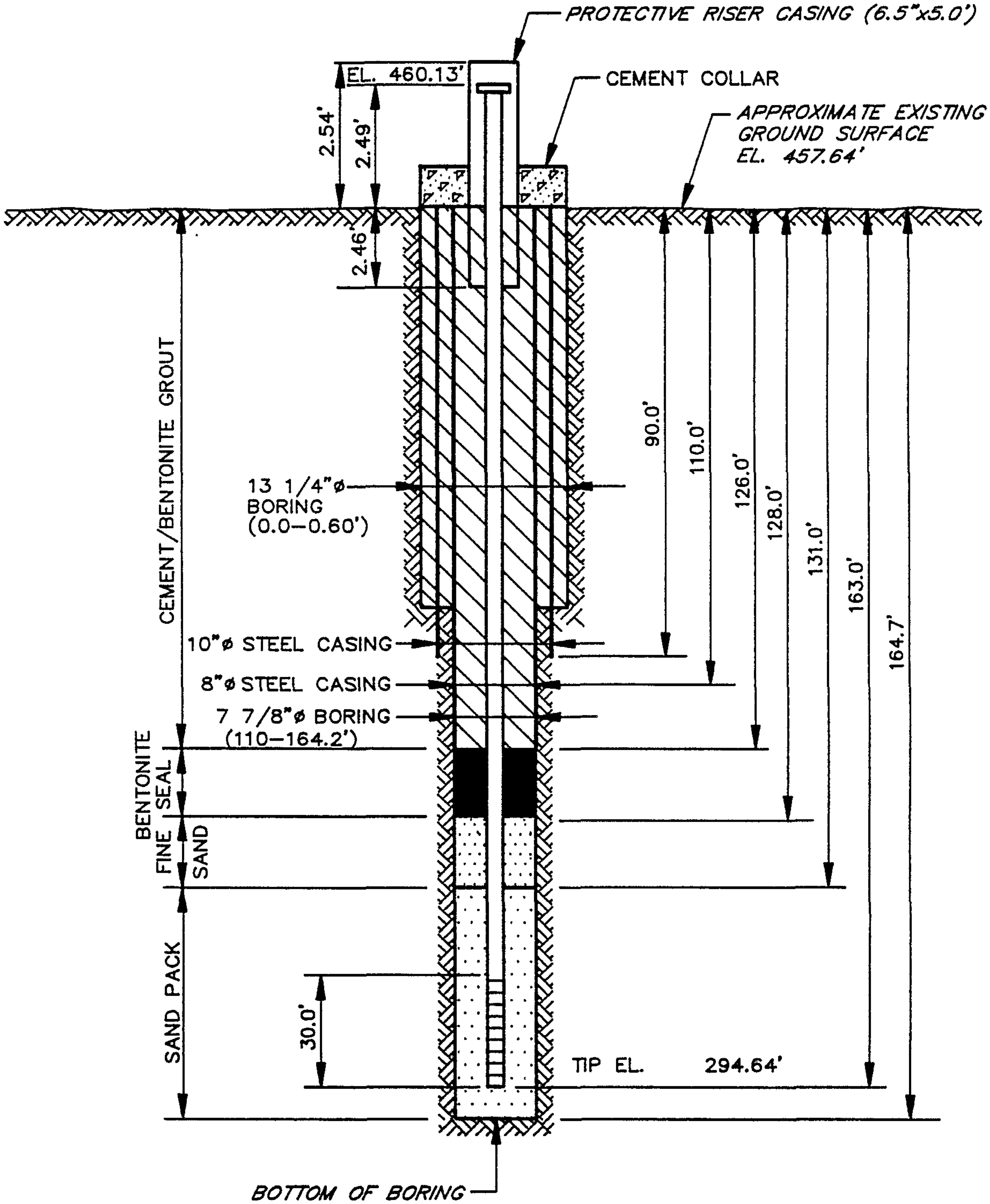
PREPARED FOR

WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

"NOT TO SCALE"

DRAWN KME 4-27-90 | CHECKED BY 6-1-90 | APPROVED BY 6-1-90 | DRAWING NUMBER +86-A39



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH–JOINTED.
2. SCREEN IS 4 IN. I.D. PVC SLOTTED SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 409.01'.
5. WATER LEVEL READING ON 2–16–90.

AR301352

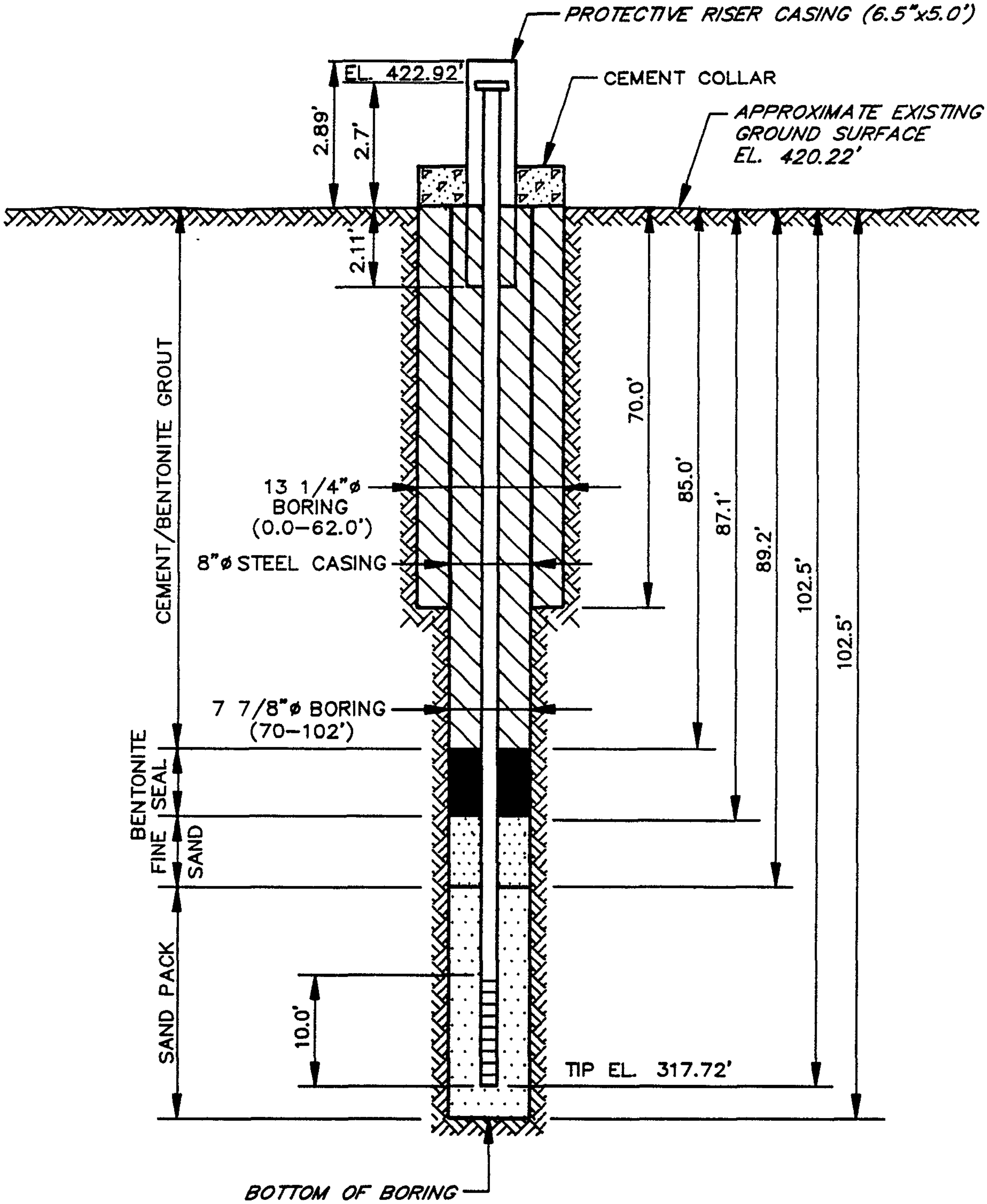
INSTALLATION DETAILS
MONITORING WELL ITB–1
PREPARED FOR
WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

"NOT TO SCALE"

WN	KME 4–27–90	CHECKED BY MJH 6-1-90	APPROVED BY AMT 6-1-90	DRAWING NUMBER +86–A46

85360



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH–JOINTED.
2. SCREEN IS 4 IN I.D. PVC SLOTTED SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 373.72'.
5. WATER LEVEL READING ON 1–19–90.

AR301353

INSTALLATION DETAILS
MONITORING WELL ITB–2

PREPARED FOR

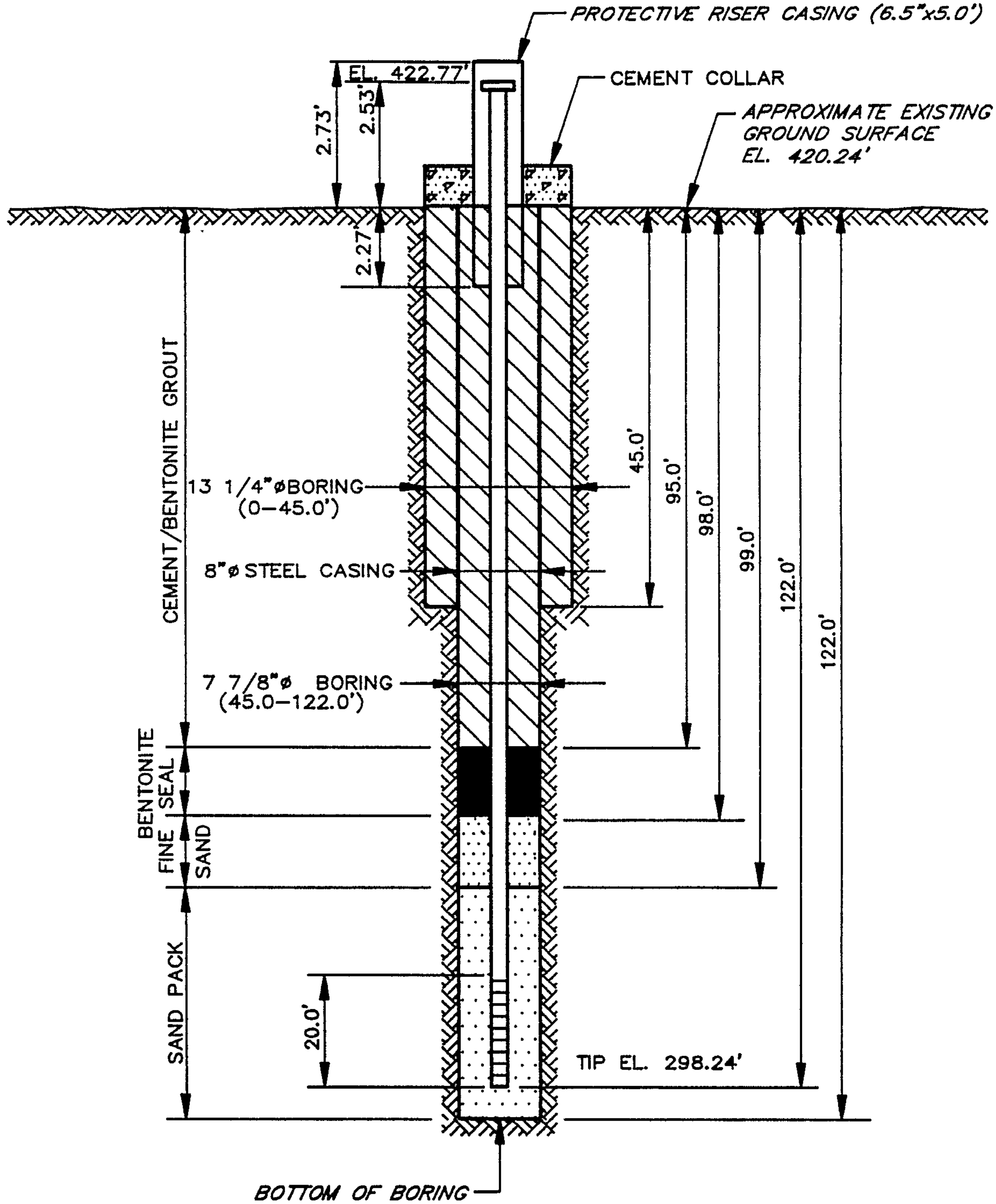
WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

"NOT TO SCALE"

65380

WN 1	KME 4–27–90	CHECKED BY / APPROVED BY	MJH 6-7-90 / AMT 6-1-90	DRAWING NUMBER 486–A47



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH–JOINTED.
2. SCREEN IS 4 IN I.D. PVC SLOTTED SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 370.03'.
5. WATER LEVEL READING ON 3–2–90.

AR301354

INSTALLATION DETAILS
MONITORING WELL ITB–3

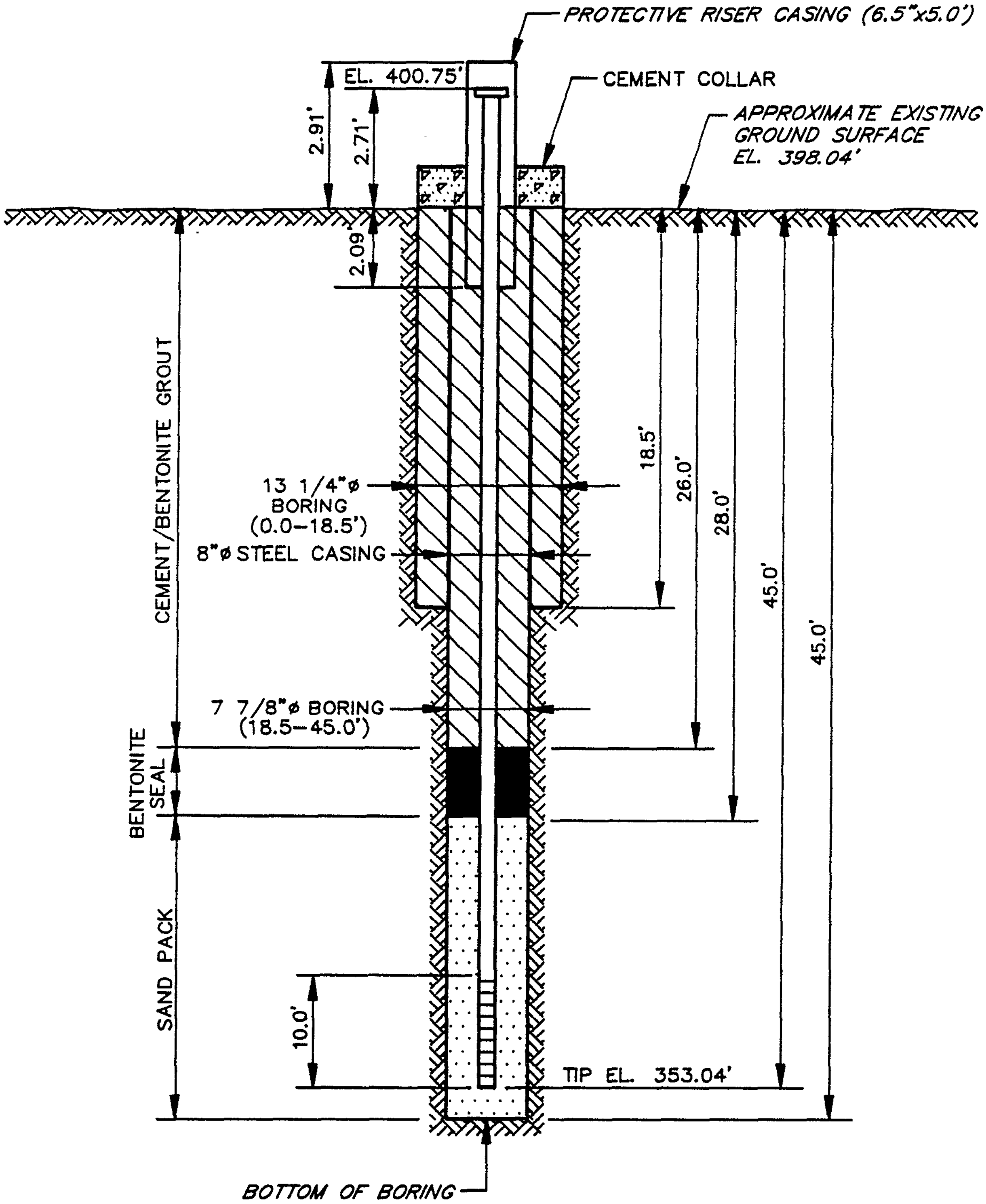
PREPARED FOR

WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

"NOT TO SCALE"

DRAWN BY KME 4–27–90 | CHECKED BY MJH 6-7-90 | APPROVED BY AMS 6-1-90 | DRAWING NUMBER ...86–A48



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH–JOINTED.
2. SCREEN IS 4 IN I.D. PVC SLOTTED SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 365.04'.
5. WATER LEVEL READING ON 12–29–89.

AR301355

INSTALLATION DETAILS
MONITORING WELL ITB–4

PREPARED FOR

WOODLAWN LANDFILL RI/FS

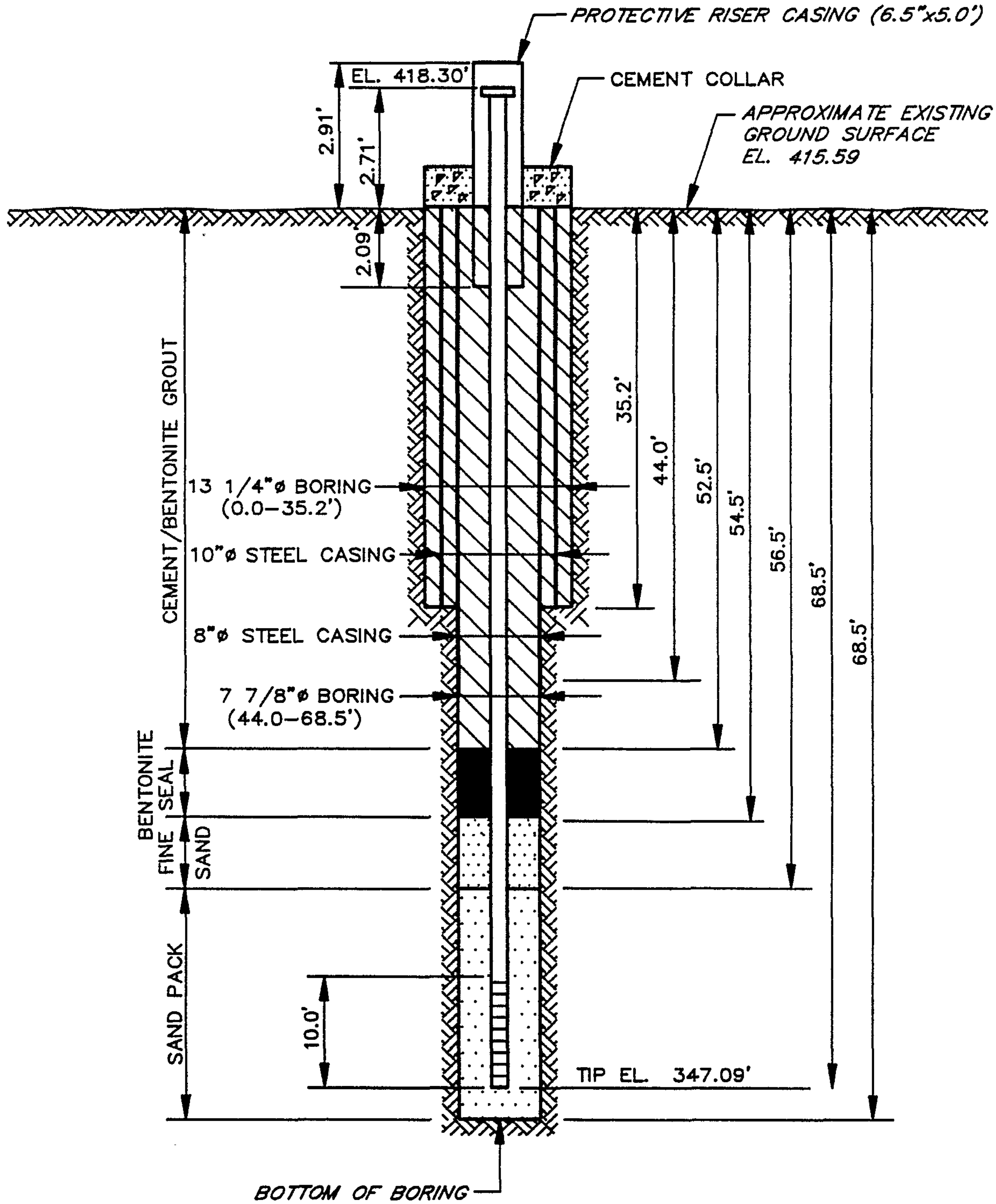
INTERNATIONAL TECHNOLOGY CORPORATION

DRAWN KME 4–27–90
CHECKED BY MJH 6-7-90
APPROVED BY AMS 6-7-90
DRAWING NUMBER 86–A49

"NOT TO SCALE"

"Do Not Scale This Drawing"

65360



NOTES:

1. RISER PIPE IS 4 IN. I.D. SCHEDULE 40 PVC PIPE, THREADED, FLUSH–JOINTED.
2. SCREEN IS 4 IN I.D. PVC SLOTTED SCREEN (0.020 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS CAPPED.
4. ELEVATION OF WATER LEVEL 395.35'.
5. WATER LEVEL READING ON 1–19–90.

AR301356

INSTALLATION DETAILS
MONITORING WELL ITB–5

PREPARED FOR

WOODLAWN LANDFILL RI/FS

INTERNATIONAL TECHNOLOGY CORPORATION

WN	KME	CHECKED BY	MJH	6-1-90	DRAWING NUMBER	86–A50
	4–27–90	APPROVED BY	AMJ	6-1-90		