VOLUNTARY CLEANUP
IRM INVESTIGATION WORK PLAN

FORMER BRAINERD MANUFACTURING FACILITY
EAST ROCHESTER, NY

March 2002
Revised November 2002

0040-002-100

Prepared for:

Despatch Industries
East Rochester, New York

Prepared by:

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

50 Fountain Plaza, Suite 1350 | Buffalo, NY 14202

VOLUNTARY CLEANUP IRM INVESTIGATION WORK PLAN
FORMER BRAINERD MANUFACTURING FACILITY
EAST ROCHESTER, NY

Table of Contents

VOLUNTARY CLEANUP IRM INVESTIGATION WORK PLAN
FORMER BRAINERD MANUFACTURING FACILITY
EAST ROCHESTER, NY

Table of Contents

VOLUNTARY CLEANUP IRM INVESTIGATION WORK PLAN
FORMER BRAINERD MANUFACTURING FACILITY
EAST ROCHESTER, NY

Table of Contents

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Background

The former Brainerd Manufacturing Facility is situated at the intersection of North Washington and Monroe Streets in the City of East Rochester, New York (Figures 1 and 2). The property is comprised of two parcels: an approximately 3.0 acre parcel located at 115 North Washington Street (Tax Map 139.69-1-17) improved with a 73,400 square foot industrial/manufacturing building and offices; and an approximately 0.3 acre parcel (Tax Map 139.69-1-19), comprised of an asphalt parking area. An open gravel lot comprises the western side of the larger parcel, with the former manufacturing building situated on the eastern side of the parcel adjacent to North Washington Street. A Rochester Gas and Electric (RG&E) substation and a pre-cast concrete product manufacturing building owned by E.J. Delmonte border the property to the north. Monroe Street, Rochester Lumber Company and A.J. Interiors are located south of the property, adjacent to the asphalt parking lot parcel.

The property was operated as an industrial facility for nearly 100 years prior to relocation of Brainerd's operations in 1998 (Ref. 1). Historic operations conducted at the facility included the manufacture of hardware and decorative metal products. Production of these products involved stamping, cutting, drilling, burnishing, deburring, degreasing, lacquering and electroplating. A site schematic showing the current building configuration and former manufacturing operations within the facility is presented as Figure 2. The majority of the equipment formerly used in the production process has been removed from the premises. The property is currently for sale.

1.2 Summary of Previous Investigations

Previous investigations conducted at the site include Phase I and Phase II investigations of soil and groundwater as listed below.

- Phase I Environmental Site Assessment (ESA) (Sear-Brown, January/February 2000)

- Limited Phase II Environmental Investigation (Sear-Brown, January/February 2000)

- Supplemental Subsurface Site Investigation (Sear-Brown, April and May 2001)

- Supplemental Subsurface Site Investigation (Sear-Brown, August 2001)

Copies of these reports have been previously submitted to the NYSDEC, and are therefore not repeated herein. In general, the results of the investigations identified chlorinated organics, specifically trichloroethene (TCE) and tetrachloroethene (PCE), in groundwater above NYSDEC Class "GA" Groundwater Quality Standards at certain locations beneath the buildings. Historic groundwater sampling data is presented in Appendix A. An isoconcentration map showing the locations of groundwater monitoring pints and volatile organic compound (VOC) concentrations based on previous investigations are also included in Appendix A. Overburden groundwater flow is reported to flow to the north/northwest.

1.3 Purpose and Objectives

The site investigation data support the need for an interim remedial measure (IRM) to address groundwater contamination at the site and to mitigate off-site migration of chlorinated organics from the former Brainerd Manufacturing Facility. This Work Plan identifies data collection procedures and testing that will be employed to better define aquifer characteristics (e.g., hydraulic conductivity, transmissivity, storativity, pumping rates, etc.) at the Site which, in turn, will facilitate the design and implementation of an effective interim remedial measure. The proposed IRM, consisting of a groundwater collection and treatment system based on the effectiveness and implementability of this technology in addressing the VOC contaminants in groundwater under structures. Accordingly, an aquifer pump test will be performed to obtain the above-described aquifer characterization information and to estimate the radial capture zone from a pumping well. The pump test will also be designed to determine vertical and horizontal gradients.

This report includes the following Sections:

- **Section 2** describes the planned aquifer pump test design.

- **Section 3** describes indoor air sampling work that will be performed concurrent with the pump test.

- **Section 4** identifies the means by which the aquifer pump test data will be evaluated and interpreted.

- **Section 5** describes the reporting of pump test results and proposed conceptual IRM design.

- **Section 6** presents references used to prepare this Work Plan.

2.0 AQUIFER TEST DESIGN

Groundwater impacted with chlorinated volatile organic compounds (VOCs), specifically trichloroethene (TCE) and tetrachloroethene (PCE), occurs in glaciofluvial deposits at the southern and southeastern portion of the Site at concentrations above the New York State Groundwater Quality Standards. Based upon boring logs prepared by Sear Brown (see Appendix B), the glaciofluvial deposits (i.e., fine sand, medium sand and silt) appear to be separated into two hydrostratigraphic units (i.e., upper and lower), approximately 40 feet thick each. The hydrostratigraphic units are hydraulically connected, however the vertical gradient is unknown (upward or downward) and will be determined during the aquifer pump test (see Section 2.4). An upper and lower hydrostratigraphic groundwater quality evaluation will be conducted to provide a more definitive evaluation of the vertical distribution of contaminants in the aquifer (see Section 2.7).

The focus of this Work Plan and the subsequent groundwater remedial action will be to achieve hydraulic control in the unconsolidated overburden (vertical and horizontal). This will involve the installation of one 4-inch diameter pumping well and performance of an aquifer pump test throughout the saturated zone to determine hydraulic area of influence, potential pumping rate and possible need for additional pumping wells.

2.1 Pumping and Observation Well Installations

Prior to any drilling activity, the NYSDEC will be notified. Aquifer pump testing and groundwater collection will involve the installation of one 4-inch diameter Schedule 40 PVC pumping well (PW-1) and two 2-inch diameter Schedule 40 PVC observation wells as illustrated in Figure 2. The pumping well will be constructed with a 20-foot CircumSlot™ 0.020-inch continuous slot PVC screen. The two observation wells, designated as OW-1 and OW-2, will each be constructed with 10-foot Schedule 40 PVC 0.020-inch machine slotted well screens. Pumping Well PW-1 will be located at the bottom of the borehole and will be installed with a filter pack extending the entire length of the saturated zone (i.e., fully penetrating). Observation well OW-1 will be constructed similarly to PW-1, however the sand pack will only extend to the top of the lower hydrostratigraphic unit. Observation well OW-2 will be installed identical to PW-1. All three wells will be constructed with a two-foot sump in order to determine presence and/or thickness free-phase DNAPL (if present within the saturated zone). A schematic cross-section of all pumping and observation wells is presented in Figure 3.

The pumping well boring will be advanced to bedrock using six ¼-inch hollow stem augers (HSA). The two observation wells will be advanced to bedrock using four ¼-inch HSAs. Subsurface soil samples will be collected continuously using a 2-inch split spoon sampler, driven with a 140-lb hammer at boring locations PW-1 and OW-2, only. Due to the close proximity to boring PW-1 (10-feet away), boring location OW-1 will not require continuous split spoon sample collection. Subsequently, subsurface geology identified during the advancement of boring PW-1 will be interpolated for proper bentonite seal and well screen placement of observation well OW-1.

Soil samples will be examined by an experienced project hydrogeologist, scanned with a photoionization detector (PID) (calibrated daily) and described using the Unified Soil Classification System (USCS). In addition, soil samples representative of each split spoon interval will be collected, placed in wide mouth glass jars and sealed with aluminum foil and a screw top cap. The jar headspace samples will be kept at or near room temperature (approximately 65-70 °F) and evaluated at the end of each working day or as soon as practical. Jar headspace determinations will be measured using the calibrated daily PID. Soil cuttings will be placed in DOT-approved 55-gallon drums, sealed, properly labeled and staged on-site for future disposal.

The pumping well PW-1 and observation well OW-1 will be located within the former Assembly Room along the western wall (see Figure 2). Observation well OW-2 will be located along the northern wall of the former Plating Room. Existing monitoring wells MW-1, MW-4 and MW-5 will serve as additional observation points during the pump test. The planned radial distance from each observation well to pumping well PW-1 is presented in the table below.

Well No.	**Approximate Distance to PW-1 (feet)**
OW-1	10.0
OW-2	30.0
MW-5	60.0
MW-4	133.0
MW-1	179.1

The pump test well PW-1 will be designed for planned use as a full-scale pumping well during remediation of the Site. The Schedule 40 PVC riser of each newly installed well will extend approximately 6-inches below ground surface, completed with a keyed alike, lockable J-plug and an 8-inch diameter steel flush mounted road box anchored in a 2-foot by 2-foot by 1-foot square concrete pad.

2.2 Aquifer Pump Test

Prior to commencement of the aquifer pump test, the NYSDEC will be notified. A constant head pumping test and recovery test will be conducted on the newly installed pumping well to:

1. Estimate lateral hydraulic influence from pumping;
2. Identify hydraulic boundary conditions encountered during pumping; and
3. Predict flow rates from full-scale pumping and treatment.

2.3 Well Development

Upon installation, but not within 24 hours, the newly installed pumping and observation wells will be developed in accordance with Benchmark and NYSDEC protocol. Field parameters including pH, temperature, turbidity and specific conductance will be measured periodically (i.e., every well volume or as necessary) during development. Field measurements will continue until they become relatively stable (± 10% change). A minimum of 10 well volumes will be evacuated from each well or as dictated by the transmissivity of the formation. Development water will be handled in accordance with Section 2.6. In addition, field personnel will perform visual DNAPL surveillance during development of each well.

2.4 Pre-Test Phase

Prior to the pump test, static water levels will be measured manually in the pumping well (PW-1) and all observation wells (OW-1, OW-2, MW-1, MW-4 and MW-5). All measurements will be recorded on a form for the appropriate well (see Appendix C).

Water levels collected from observation wells OW-1 and MW-5 following well development and stabilization and prior to the commencement of the aquifer pump test will be used to determine the vertical gradient between the upper and lower hydrostratigraphic units.

2.5 Pumping Phase

The aquifer pump test will be performed on pumping well PW-1. Newly installed observation wells OW-1 and OW-2 in conjunction with existing wells MW-4 and MW-5 will be monitored for water levels during the aquifer pump test. In addition, external influence (i.e., natural recharge or discharge, stream/river level fluctuations or barometric effects) to on-site water levels will be evaluated by the collection of water level measurements from existing monitoring well MW-1 (approximately 179 feet away) before, during and after the aquifer pump test. During the pump test, MW-1 will be measured approximately every other hour or as necessary. If, following the recovery period, the same constant water level is observed as during the pre-testing period, it can safely be assumed that no external events influenced the hydraulic head during the test. If, however, the water level is subject to unidirectional or rhythmic changes, water level data collected during the test will be corrected accordingly.

The pumping well will be pumped with a pneumatic pump system through polyethylene tubing. The well will be pumped at a rate allowing maximum drawdown and flow rate, while maintaining a near-constant head of water in the casing. It is anticipated that the pumping rate will be in the range of 3.0 to 4.0 gallons per minute after well bore and well casing storage is removed. A graduated five-gallon bucket and stopwatch will be used to calculate rate of discharge from the pumping well. Flow rate will be measured and recorded periodically during the pump test. Rate of discharge, cumulative gallons discharged and time of measurement will be recorded during periodic checks of the flow rate. Water generated during pumping will be pretreated and discharged to the sanitary sewer in accordance with Section 2.6.

During the pumping phase of the aquifer test, the following measurements will be made:

- Water levels in the pumped well and surrounding observation wells
- Instantaneous and cumulative discharge from the pumped well; and

- Time at which measurements are recorded synchronized to the start of the pump test.

Water levels will be recorded using downhole pressure transducers in nearby observation/monitoring wells during pumping. Water levels in the pumping well will be recorded manually using a water level indicator to ensure a sustained constant head and flow rate (if possible). Water levels in nearby observation/monitoring wells will also be measured periodically using a manual water level indicator as backup to the pressure transducer data.

Water levels in the pumping well and observation wells will be measured on an approximate, pre-determined time schedule. An example time schedule is outlined in the following table.

Time Since Pump Started (minutes)	Approximate Time Intervals Between Measurements (minutes)	
	Pump Well	Observation Wells
0 – 2	0.25	1
2 – 5	0.5	1
5 – 15	1	1
15 – 60	5	10
60 – Conclusion	60	10

It is anticipated that pumping will be maintained for a period of approximately 48-hours to allow the influence of local hydraulic boundaries to be observed. If it is apparent that steady-state conditions have been reached, pumping may be terminated before the 48-hour completion time.

2.6 Discharge Water Management

Prior to initiating the aquifer pump test, Benchmark will contact Monroe County Pure Waters to inform them of the intent to discharge groundwater to the sanitary sewer and to secure the required temporary discharge permit. Monroe County Pure Waters limits VOC discharges to 2.13 mg/L total, but requires pretreatment for VOCs regardless of concentration, in the event that the proposed discharge is from a VOC-impacted source. Accordingly, a temporary pretreatment system will be provided to handle development water and pump test groundwater. The temporary pretreatment system will be comprised of a receiving drum fitted with a submersible pump and float switch level controls and an appropriately sized granular activated carbon (GAC) treatment vessel (e.g., TIGG Corporation Cansorb® carbon drum unit or equivalent). Development and pump test groundwater will be directed to the receiving drum for processing through the GAC vessel prior to discharge to the sanitary sewer. During the well development period, effluent samples will be collected and analyzed for chlorinated VOCs in accordance with USEPA Method 601 to demonstrate treatment efficiency. Development water will be temporarily stored in drums until discharge of the development water and pump test water is approved.

2.7 Groundwater Characterization

Table 1 presents a summary of the planned groundwater characterization activities. Collection of the samples will be in accordance with the applicable FOPs presented as Appendix D of this Work Plan. As indicated in Table 1, a groundwater sample will be collected from newly installed observation well OW-1 upon completion of the pump test. The sample will be analyzed for Target Compound List (TCL) volatile organic compounds (VOCs) in accordance with USEPA Method 8260. Laboratory analytical results will be compared to historic shallow and deep overburden groundwater analytical results to determine the vertical profile of chlorinated organic impacts (see Section 4.2).

A groundwater sample will also be collected from PW-1 following the completion of the aquifer pump test and analyzed for TCL VOCs in accordance with USEPA Method 8260. Additional groundwater samples will be collected from PW-1 and analyzed for the field parameters, wet chemistry and scale indicator parameters presented in Table 1 to assist with the treatment system design. The field filtration of inorganic parameters will be assessed based upon sample turbidity. If the field measured turbidity of the groundwater sample is less than 50 nephelometric turbidity units (NTUs), the samples will not be pre-filtered and only total metals will be analyzed by the laboratory. If the field measured turbidity is greater than 50 NTUs then the groundwater sample will be pre-filtered in the field to simulate full-scale filtration, which may be implemented as part of the final treatment system design, and both total and dissolved metals will be analyzed by the laboratory. Analytical methods, containers, preservatives and holding times to be used for groundwater samples are presented in Table 2.

Analysis of all groundwater samples will be performed by Columbia Analytical Services, a New York State Analytical Services Protocol (ASP) Contract Laboratory Program (CLP) laboratory. Samples will be analyzed in accordance with USEPA SW-846 and 40 CFR Part 136, as indicated on Table 2. Analytical reporting for groundwater characterization samples will require equivalent ASP CLP "Category B" deliverables to support data evaluation and development of a Data Usability Summary Report (DUSR) by a third party data validation expert.

2.8 QA/QC Requirements for Groundwater Characterization

2.8.1 Project Responsibilities

Benchmark Environmental Engineering and Science, PLLC (Benchmark) is the prime consultant on this project and is responsible for the performance of all services required to implement each phase of the IRM Investigation Work Plan, including field operations, laboratory testing, data management, data analysis and reporting. Excluding the QA Officer position, any one member of Benchmark's staff may fill more than one of the identified project positions (e.g., field team leader and site safety and health officer). The various quality assurance, field, laboratory and management responsibilities of key project personnel are defined below.

2.8.1.1 Management Responsibilities

NYSDEC Project Manager

The NYSDEC Project Coordinator represents the governing authority for the Voluntary Cleanup site activities. The NYSDEC Project Coordinator is responsible for ensuring that the project is completed to the satisfaction of NYSDEC.

Thomas H. Forbes, P.E., Benchmark Project Manager (PM)

The Benchmark PM has the responsibility for ensuring that the project meets the Work Plan objectives. The PM will report directly to Despatch Industries (Volunteer) and the NYSDEC Project Manager and is responsible for technical and project oversight. The PM will:

- Define project objectives and develop a detailed work plan schedule.

- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
- Acquire and apply technical and corporate resources as needed to assure performance within budget and schedule constraints.
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
- Review the work performed on each task to assure its quality, responsiveness, and timeliness.
- Review and analyze overall task performance with respect to planned requirements and authorizations.
- Review and approve all deliverables before their submission to NYSDEC.
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
- Ultimately be responsible for the preparation and quality of interim and final reports.
- Represent the project team at meetings.

Bryan C. Hann, Field Team Leader/Site Safety and Health Officer

The Field Team Leader has the responsibility for implementation of specific project tasks identified at the Site, and is responsible for the supervision of project field personnel, subconsultants, and subcontractors. The Field Team Leader reports directly to the Project Manager. The Field Team Leader will:

- Define daily develop work activities.
- Orient field staff concerning the project's special considerations.
- Monitor and direct subcontractor personnel.
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness.
- Assure that field activities, including sample collection and handling, are carried out in accordance with this Work Plan.

For this project the field team leader will also serve as the Site Safety and Health Officer (SSHO). As such, he is responsible for implementing the procedures and required components of the Site Health and Safety Plan (HASP), determining levels of protection needed during field tasks, controlling site entry/exit, briefing the field team and subcontractors on site-specific health and safety issues, and all other responsibilities as identified in the HASP.

2.8.1.2 Quality Assurance (QA) Responsibilities

Paul H. Werthman, P.E., Project QA Officer

The QA Officer will have direct access to corporate executive staff as necessary, to resolve any QA dispute. He is responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations and Benchmark policies, and NYSDEC requirements. The QA Officer has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA issues. Specific function and duties include:

- Providing QA technical assistance to project staff.
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the Project Manager for technical operations.
- Responsible for assuring third party data review of all sample results from the analytical laboratory.

2.8.1.3 Field Responsibilities

Benchmark Field Staff

Benchmark field staff for this project are drawn from a pool of qualified resources. The Project Manager will utilize the staff to gather and analyze data, and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

2.8.1.4 Laboratory Responsibilities

The laboratory assigned with responsibility for chemical analyses of environmental samples is Columbia Analytical Services, Inc. (Columbia) located at 1 Mustard Street, Rochester, New York 14609. Columbia is a NYSDEC Contract Laboratory Protocol (CLP) certified laboratory maintaining ASP accreditation.

Janice Jaeger, Columbia Client Services Manager

The client services manager is responsible for the Client Services Department and will report directly to the Project Manager. The client services manager provides a complete interface with clients from initial project specification to final deliverables.

Michael Perry, Columbia Laboratory Director

The Laboratory Director is a technical advisor and is responsible for summarizing and reporting overall unit performance. Responsibilities of the Columbia Laboratory Director include:

- Provide technical, operational, and administrative leadership.
- Allocation and management of personnel and equipment resources.
- Quality performance of the facility.
- Certification and accreditation activities.
- Blind and reference sample analysis.

Lisa Reyes, Columbia Quality Assurance Director (QA Director)

The Columbia QA Director has the overall responsibility for data after it leaves the laboratory. The Columbia QA Director will be independent of the laboratory but will communicate data issues through the Columbia Laboratory Director. In addition, the Columbia QA Director will:

- Oversee laboratory QA.
- Oversee QA/QC documentation.
- Conduct detailed data review.

- Determine whether to implement laboratory corrective actions, if required.

- Define appropriate laboratory QA procedures.

- Prepare laboratory SOPs.

Independent QA review will be provided by the Columbia Laboratory Director and QA Director prior to release of all data to Benchmark.

Columbia Sample Management Office

The Columbia Sample Management Office will report to the Columbia Laboratory Director. Responsibilities of the Columbia Sample Management Office will include:

- Receiving and inspecting the incoming sample containers.

- Recording the condition of the incoming sample containers.

- Signing appropriate documents.

- Verifying chain-of-custody.

- Notifying laboratory manager and laboratory supervisor of sample receipt and inspection.

- Assigning a unique identification number and customer number, and entering each into the sample receiving log.

- With the help of the laboratory manager, initiating transfer of the samples to appropriate lab sections.

- Controlling and monitoring access/storage of samples and extracts.

Columbia Technical Staff (TS)

The Columbia TS will be responsible for sample analyses and identification of corrective actions. The staff will report directly to the Columbia Laboratory Director.

2.8.1.5 Other Subcontractor Personnel

Other subcontractor personnel to be utilized on this project include a third party data validator (Ms. Judy Harry of Data Validation Services) and a drilling subcontractor for well construction work (Nothnagle Enterprises). Both firms are experienced in NY State Voluntary Cleanup Site Investigation and Remediation projects.

2.8.2 Field Quality Control Checks

Assessment of field sampling precision and bias will be made by collecting field duplicates and field blanks for laboratory analysis. Table 1 identifies site-specific quality assurance/quality control (QA/QC) samples to be collected during the IRM investigation. Collection of QA/QC samples will be in accordance with the applicable FOPs presented in Appendix D.

Blind Duplicate groundwater samples will be collected to allow determination of analytical precision. One blind duplicate sample of each matrix will be collected for every 20 samples or per sampling event if less than 20 samples are collected. Blind duplicate sample aliquots for groundwater will be collected sequentially as grab samples after collection of the initial sample aliquot. The sample location will not be disclosed to the analytical laboratory.

One (1) equipment blank will be collected for each day of sampling activity <u>if</u> non-dedicated sampling equipment is used. These equipment blank samples will be used as a QC check of the decontamination procedures for sampling equipment. (For the former Brainerd Manufacturing site, new, dedicated bailers will be used for sample collection, therefore an equipment blank is not planned).

One VOC travel blank (a.k.a., "trip blank") will be included in each cooler containing water matrix samples to be analyzed for VOCs and sent to the laboratory for analysis.

2.8.3 Laboratory Quality Control Checks

The internal QC checks for laboratory analyses of soil and groundwater samples that will be collected during the RI/FS are described in the analytical methods and are covered in the laboratory's QA Manual. Laboratory analytical internal QA/QC will be conducted in accordance with USEPA SW-846. The checks include internal QC methods covering surrogate spikes, duplicates, preparation blanks, calibration, lab quality control samples and reagent checks. A site-specific MS/MSD sample will be analyzed as a further QC check. The matrix spike samples will be analyzed at the same frequency as the duplicate samples. The matrix spike samples will allow accuracy to be determined by using the percent recovery of the spiked compounds. The purpose of the MS/MSD samples is to monitor any possible matrix effects specific to samples collected from the Site. Acceptable QC limits for the MS/MSD samples are found in USEPA SW-846. The specific sample location that will be used for matrix spikes may be chosen by the Project Manager or Project QA Officer.

2.9 Recovery Phase

Upon completion of the pumping phase of the aquifer test, the pump will be deactivated. Water level recovery measurements will be recorded in the pumped well and observation/monitoring wells immediately following pump shut off. Recovery water level measurements will be monitored periodically in the pumped well and observation/monitoring wells until one or all of the following has occurred:

- Approximately 95% of the induced drawdown has been recovered;
- The water level in the pumped well has changed less than 0.05 feet for at least two hours; or
- A period of time equal to the duration of the pumping phase has elapsed since the pump was shut off.

3.0 INDOOR AIR CHARACTERIZATION

To verify that indoor air has not been adversely impacted by volatile organics, a representative air sample will be collected from within the building during the pump test period. The sample will be collected from the former storage/assembly area of the building, south of the water treatment area, which is the area where prior soil investigations indicated the greatest potential for VOCs in the vadose zone. The sample will be collected using a Summa Canister fitted with a 24-hour regulator. The Summa Canister will be positioned on a stand approximately 5-feet above the floor, representing the typical breathing zone. Upon completion, the intake valve will be shut and the sample will be transmitted to Columbia Analytical Services for analysis of volatile organic compounds in accordance with USEPA Method TO-15.

Air sampling data interpretation is discussed in Section 4.3.

4.0 DATA INTERPRETATION

4.1 Hydrogeologic Data

During the pumping phase, time-drawdown curves for the observation wells may be field-plotted on semi-logarithmic graph paper to evaluate the progress of the test. Similarly, pressure transducer data may be downloaded and saved to a laptop computer utilizing Win-Situ® software, or similar, to evaluate the progress of the test.

At the completion of the pump test, pressure data from each transducer/data logger will be downloaded to a laptop computer. Downloaded pumping data will subsequently be plotted and contoured on a site plan map to determine radii of influence for the pumping well indicated by a measurable drop in water level measurements (i.e., greater than 0.25-feet). Estimates of full-scale pumping rate from a single pumping well will also be made.

Recovery water level data from the pumping well will be used to calculate hydraulic conductivity values of the screened hydrostratigraphic units. Aquifer testing data will be utilized in the design of the groundwater collection treatment system.

4.2 Groundwater Characterization Data

4.2.1 Data Usability Assessment

All laboratory data pertaining to groundwater characterization samples (i.e., from OW-1 and PW-1 groundwater samples) will be reported with equivalent ASP CLP "Category B" deliverables and will be evaluated by a third party data validation expert to assess usability. A DUSR will be prepared summarizing findings of the review relative to key data quality indicators, including:

- Completeness of the reporting package as specified under NYSDEC ASP CLP for "Category B" deliverables.
- Conformance with holding time requirements.
- Compliance with QA/QC requirements and limits per the analytical methods.

- Adherence to specified analytical methods and procedures.
- Agreement between raw data and data summary sheets.
- Use of appropriate data qualifiers. If the DUSR indicates that alternative data qualifiers are justified, these will be reported by the data validation expert and will be used in data summary tables in lieu of the laboratory-reported qualifiers.

4.2.2 OW-1 Groundwater Sample Results

Laboratory analytical results for observation well OW-1 will be used in comparison to historic analytical results of MW-5 to determine the vertical profile of chlorinated organic impacts to downgradient groundwater. Similarly, historical analytical results of former upgradient well MW-202 and existing upgradient well MW-1 will be compared to analytical results of downgradient wells MW-5 and OW-1 to further assess the vertical and horizontal profile of VOCs in site groundwater. Results will be presented in tabular form for comparison in the IRM Report.

4.2.3 PW-1 Groundwater Sample Results

Laboratory analytical data of groundwater samples collected from pumping well PW-1 will be used to: assess contaminant levels for treatment and discharge; assess need for emissions controls (via NYSDEC DAR-1) if an air-stripping technology were to be implemented as part of a full-scale IRM pump and treat system; and to determine potential for pretreatment requirements to minimize treatment system maintenance (e.g., scale formation/fouling).

4.3 Air Sampling Data

Indoor air analytical results will be compared with the Occupational Safety and Health Administration (OSHA) established Permissible Exposure Limits (PELs) to verify that VOC concentrations, if detected, do not exceed regulatory limits for future industrial use of the facility.

5.0 REPORTING

An IRM Investigation Report will be prepared by Benchmark upon receipt of the analytical results and completion of data interpretation. The report will contain a site map, investigative methodologies that deviated from the Work Plan, geologic and hydrogeologic interpretation/description of subsurface materials, presentation of aquifer pump test and laboratory analytical data with comparisons to regulatory standards and/or background concentrations and conceptual IRM design. The Data Usability Summary Report will also be included, with data qualifiers indicated on the analytical summary tables. Copies of all pertinent records, including field-test readings, maps, project field forms and laboratory reports will be appended to the report.

6.0 REFERENCES

1. Sear-Brown Group, February 2000, *Phase I Environmental Site Assessment and Limited Phase II Environmental Investigation - Former Brainerd Manufacturing Facility.*

2. Sear-Brown Group, June 2001, *Supplemental Subsurface Site Investigation - Former Brainerd Manufacturing Facility.*

3. Sear-Brown Group, October 2001, *Draft Supplemental Subsurface Site Investigation - Former Brainerd Manufacturing Facility.*

4. New York State Department of Environmental Conservation (NYSDEC), January 24, 1994. *Technical and Administrative Guidelines Memorandum, Determination of Soil Cleanup Objectives and Cleanup Levels (TAGM HWR-94-4046).*

5. New York State Department of Environmental Conservation (NYSDEC), November 1997 *Guidelines for the Control of Toxic Ambient Air Contaminants (DAR-1).*

TABLES

TABLE 1

SUMMARY OF GROUNDWATER SAMPLING AND ANALYTICAL PROGRAM

FORMER BRAINERD MANUFACTURING SITE
IRM INVESTIGATION WORK PLAN

Location	Number of Samples	Matrix	When Collected	Parameters	QA/QC Samples (3)			
					Blind Duplicate	MS	MSD	Trip Blank
OW-1	1	groundwater	Upon Pump Test Completion	TCL VOCs	-	-	-	-
				Field Parameters 1	-	-	-	-
Temporary Pretreatment System Effluent	Per Monroe County Pure Waters	groundwater	Per Monroe County Pure Waters	Priority Polluant VOCs(601/602)	-	-	-	-
PW-1	1	groundwater	Upon Pump Test Completion	TCL VOCs	1	1	1	1
				Field Parameters 1	-	-	-	-
				Total Alkalinity	1	-	-	-
				Total Hardness	1	-	-	-
				Chloride	1	-	-	-
				Total Calcium	1	1	1	-
				Dissolved Calcium 2	1	1	1	-
				Total Iron	1	1	1	-
				Dissolved Iron 2	1	1	1	-
				Total Magnesium	1	1	1	-
				Dissolved Magnesium 2	1	1	1	-
				Total Manganese	1	1	1	-
				Dissolved Manganese 2	1	1	1	-
Former Assembly Area	1	Air	During Pump Test	TCL VOCs	-	-	-	-

Notes:
1. Field parameters include: pH, temperature, specific conductance, turbidity, Eh and dissolved oxygen.
2. Dissolved metals will be analyzed only if the field measured turbidity is greater than 50 NTU.
3. Dedicated equipment will be used for sample collection- equipment blanks will not be required.

TABLE 2

SUMMARY OF ANALYTICAL METHODS, PRESERVATIVES AND HOLDING TIMES [1]

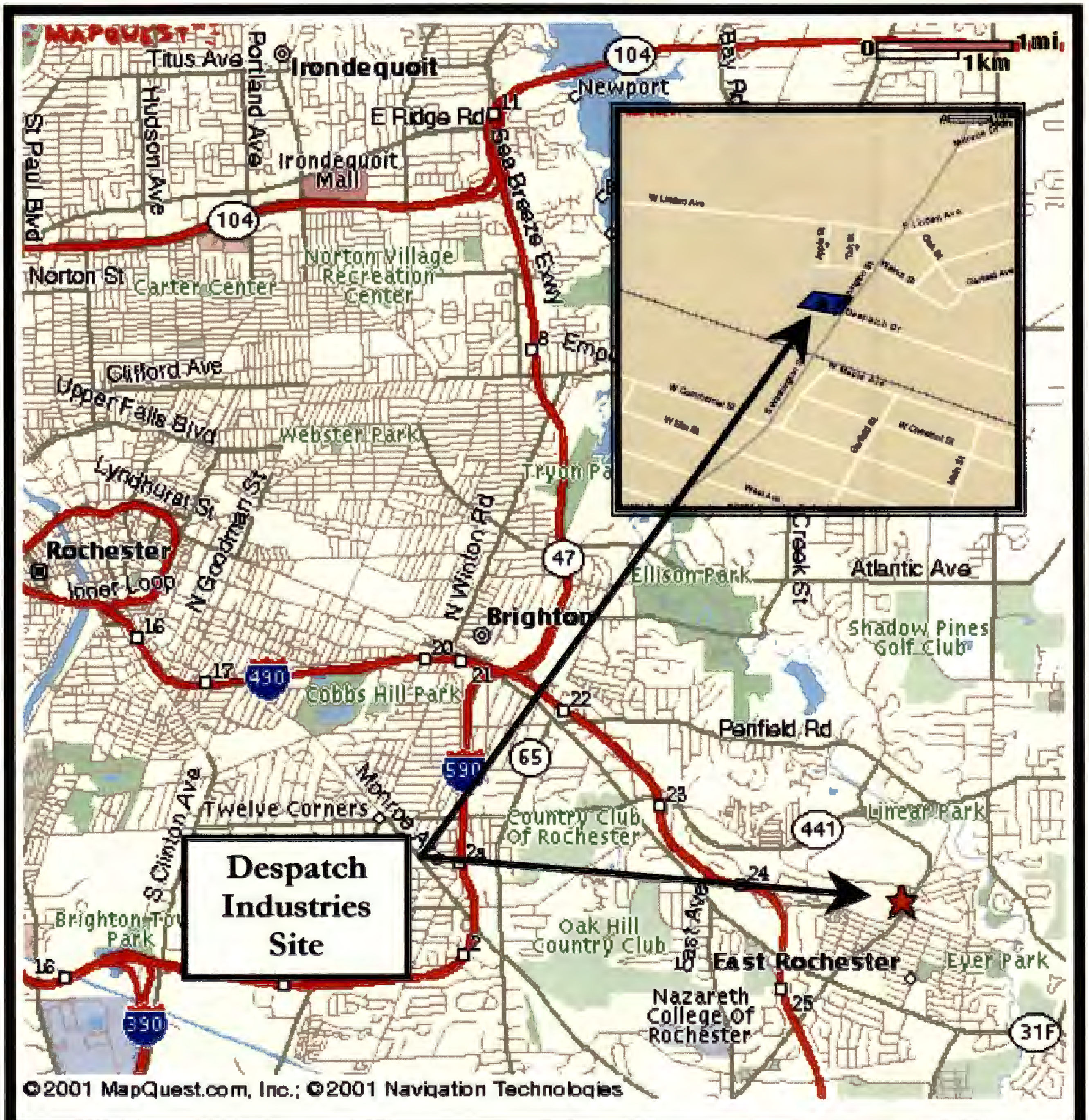
FORMER BRAINERD MANUFACTURING SITE
IRM INVESTIGATION WORK PLAN

Parameter	Reporting Units	Analytical Method	Holding Time	Preservation [2]	Container [3]
Field Measurements					
pH	units	field measured	immediately upon collection	none	4 ounce jar
Temperature	degrees F	field measured	immediately upon collection	none	4 ounce jar
Specific Conductance	mS or μS	field measured	immediately upon collection	none	4 ounce jar
Turbidity	NTU	field measured	immediately upon collection	none	4 ounce jar
Eh	mV	field measured	immediately upon collection	none	4 ounce jar
Dissolved Oxygen	ppm	field measured	immediately upon collection	none	4 ounce jar
Volatile Organic Compounds (VOCs) [1]					
TCL VOCs (OW-1 & PW-1)	ug/L	8260B (6)	14 days	HCl to pH <2, cool to 4° C	3, 40 mL glass vials
Priority Pollutant VOCs (GAC effluent)	ug/L	601/602	14 days	HCl to pH <2, cool to 4° C	3, 40 mL glass vials
TCL VOCs (Summa Canister)	ug/m^3	TO-15	14 days	none	6 Liter Summa Canister
Wet Chemistry					
Total Alkalinity	mg/L	310.1, 310.2	12 days	Cool to 4° C	100 mL plastic or glass
Total Hardness as $CaCO_3$	mg/L	130.1, 130.2	6 months	H_2SO_4 to pH < 2, cool to 4° C	100 mL plastic or glass
Chloride	mg/L	325.1, 325.2	26 days	Cool to 4° C	50 mL plastic or glass
Inorganics [4]					
Total Calcium	mg/L	6010B (6)	Note 2	HNO_3 to pH < 2, cool to 4° C	500 ml plastic or glass
Dissolved Calcium [5]	mg/L	6010B (6)	Note 2	HNO_3 to pH < 2, cool to 4° C	500 ml plastic or glass
Total Iron	mg/L	6010B (6)	Note 2	HNO_3 to pH < 2, cool to 4° C	500 ml plastic or glass
Dissolved Iron [5]	mg/L	6010B (6)	Note 2	HNO_3 to pH < 2, cool to 4° C	500 ml plastic or glass
Total Magnesium	mg/L	6010B (6)	Note 2	HNO_3 to pH < 2, cool to 4° C	500 ml plastic or glass
Dissolved Magnesium [5]	mg/L	6010B (6)	Note 2	HNO_3 to pH < 2, cool to 4° C	500 ml plastic or glass
Total Manganese	mg/L	6010B (6)	Note 2	HNO_3 to pH < 2, cool to 4° C	500 ml plastic or glass
Dissolved Manganese [5]	mg/L	6010B (6)	Note 2	HNO_3 to pH < 2, cool to 4° C	500 ml plastic or glass

Notes:
1. All field samples will be delivered to the lab within 1 day of their collection. VOC analysis of water samples must be completed within 14 days of Validated Time of Sample Receipt (VTSR). The VTSR shall be the date on which a sample is received at the
2. Bottles will be received from the laboratory pre-preserved. If bottles are not pre-preserved by the laboratory, preservatives will be added to the sample bottles in the field immediately after sample has been collected. Ice will be used to cool samples in the field and
3. Conatiners shown are those necessary to satisfy minimum volume requirements for water analysis.
4. Analysis of water for all metals must be completed within 180 days of the VTSR.
5. Dissolved metals will be analyzed only if the field measured turbidity is greater than 50 NTU.
6. Report with equivalent ASPCLP Category B Deliverables Package.

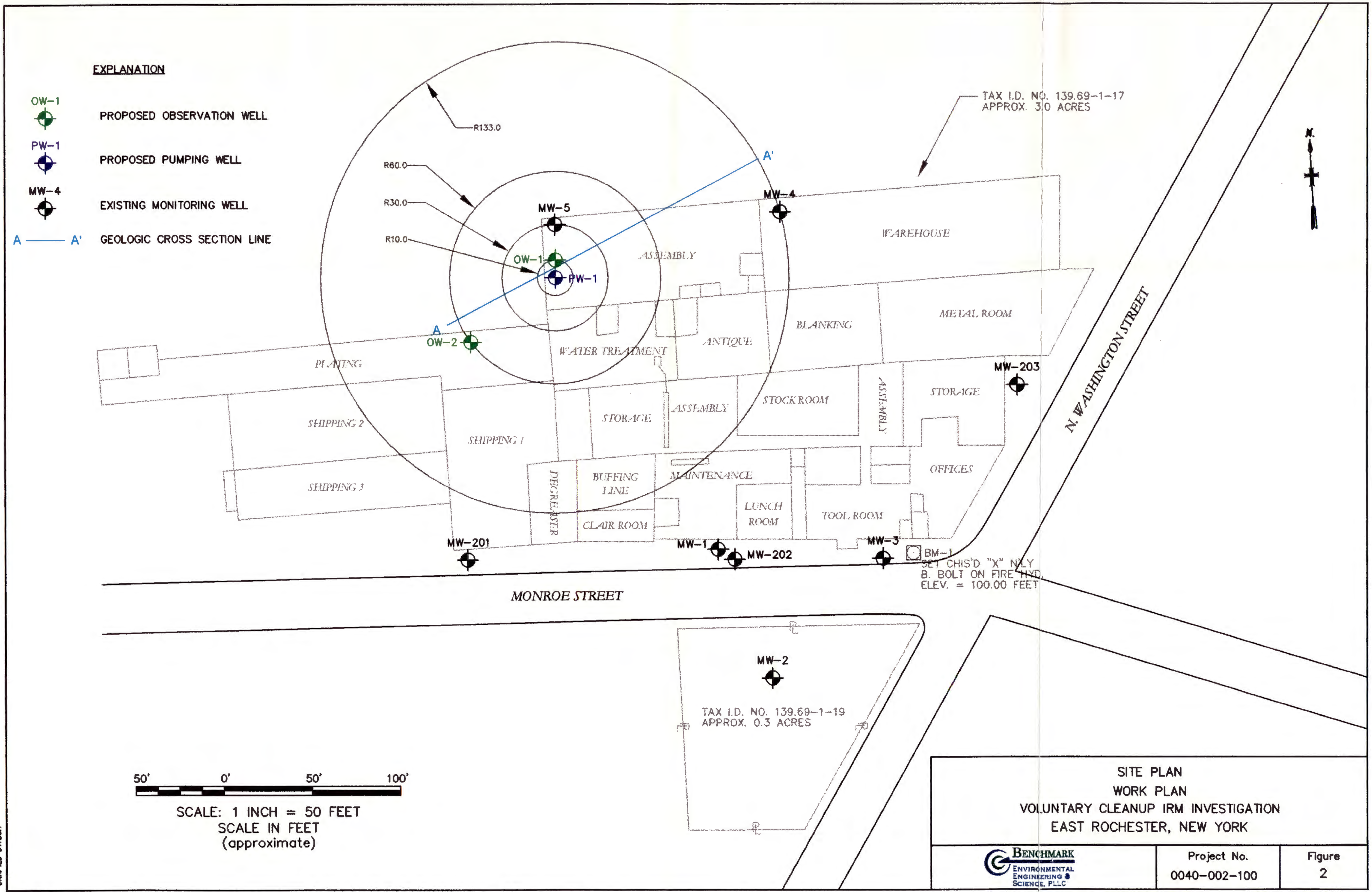
FIGURES

Figure 1

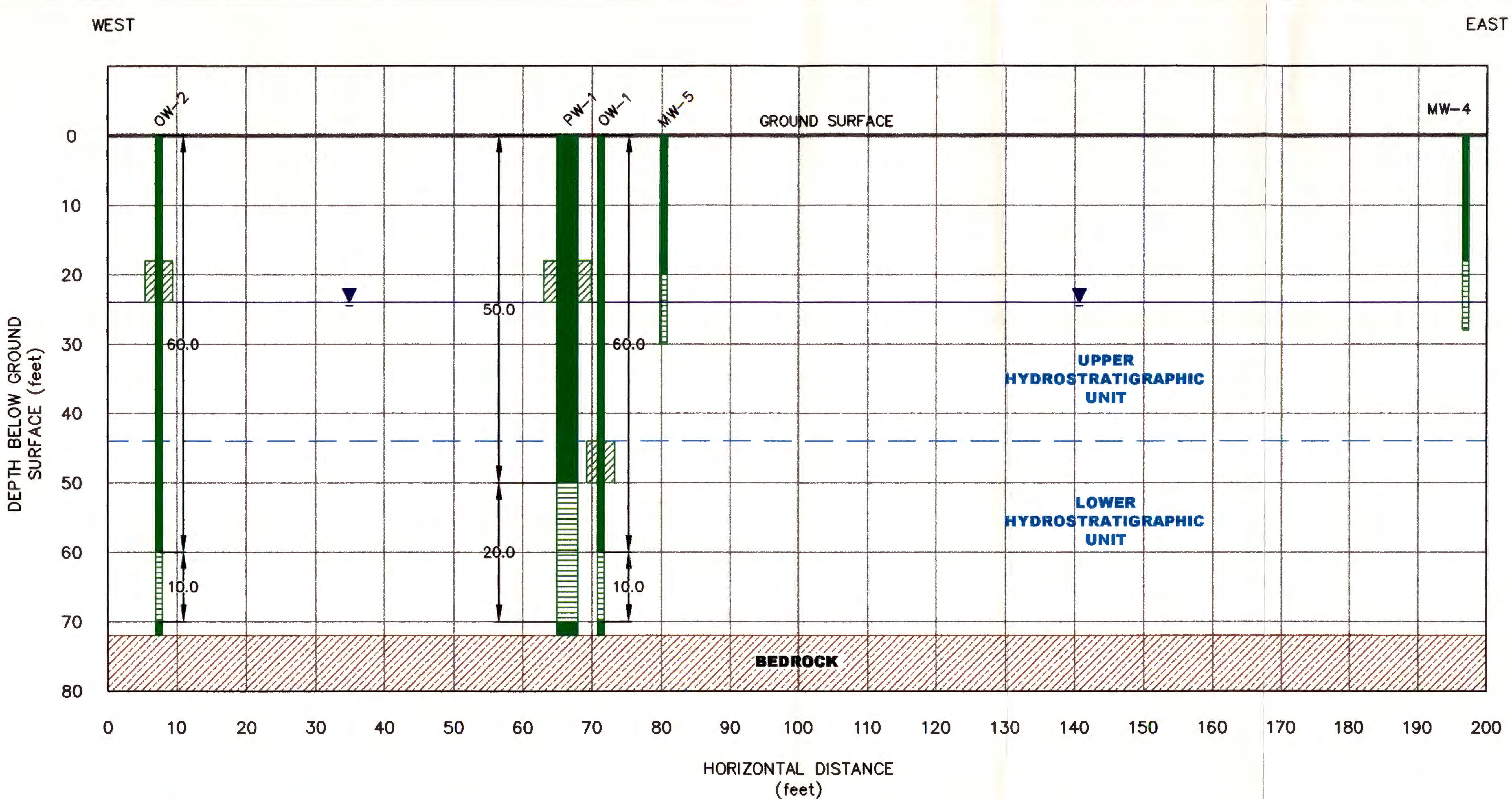


SITE VICINITY MAP

IRM INVESTIGATION WORK PLAN
FORMER BRAINERD MANUFACURING FACILITY



DATE: FEBRUARY 2002
FILEPATH: f:\benchmark\cad\deepatch\figure 2: site plan.dwg
DRAFTED BY: BCH



UPPER HYDROSTRATIGRAPHIC UNIT (as per data collected by Sear Brown in the Supplemental Subsurface Site Investigation Report, June 2001)

From MW-1, MW-2, and MW-3 boring logs: POORLY GRADED SAND WITH SILT (SP-SM)
Light brown, layered fine to medium sand and silt

Hydraulic Conductivity (cm/sec): (rising head test)
MW-4: 3.81E-04
MW-5: 2.52E-03

LOWER HYDROSTRATIGRAPHIC UNIT (as per data collected by Sear Brown in the Supplemental Subsurface Site Investigation Report, June 2001)

From MW-1 boring log: WELL GRADED SAND WITH SILT (SW-SM)
Gray fine sand and silt

Hydraulic Conductivity (cm/sec): (rising head test)
MW-1: 6.17E-04

DATE: FEBRUARY 2002
FILEPATH: f:\benchmark\cad\despatch\figure 3; geologic cross section a-a'.dwg
DRAFTED BY: BCH

GEOLOGIC CROSS SECTION A-A' WORK PLAN VOLUNTARY CLEANUP IRM INVESTIGATION EAST ROCHESTER, NEW YORK		
BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC	Project No. 0040-002-100	Figure 3

Appendix A

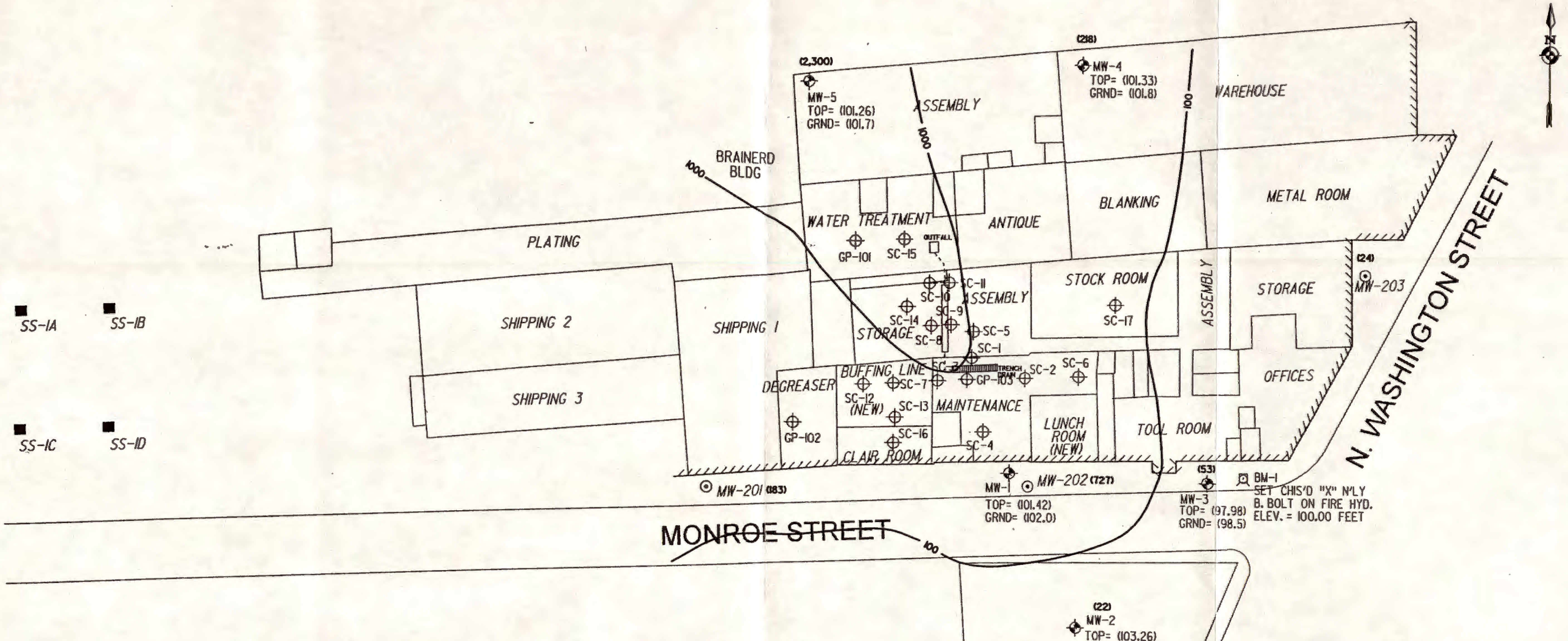
Historic Groundwater Data

and Isoconcentration Map

TABLE 10
SUMMARY OF DETECTED COMPOUNDS IN GROUNDWATER (ug/L)
Former Brainerd Manufacturing
115 North Washington Street
East Rochester, NY

COMPOUNDS	January 26, 2000			May 7, 2001			August 21, 2001					NYSDEC Groundwater Standards and Guidance Values (*)
	MW-201	MW-202	MW-203	MW-1	MW-2	MW-3	MW-1	MW-2	MW-3	MW-4	MW-5	
EPA 8260												
Acetone				**2,580 ****								50
m,p Xylene		**11**										5
o Xylene		**6.1**										5
Tetrachloroethene	**120**	**420 ****	**12**		**9.83**	**9.13**	5	**10**	**10**	**28**	**1,200**	5
Trichloroethene	**63**	**300 ****	**12**	4.92	**11.6**	**48.4**		**12**	**43**	**190**	**1,100**	5
1,1,1-Trichloroethane		**7.4**				**2.95**						2
Total Chlorinated Compounds	*183*	*727*	*24*	*5*	*21*	*60*	*5*	*22*	*53*	*218*	*2,300*	
Metals												
Zinc		13	38				25	25	37	85	42	2,000
Chromium											**145**	50

Notes:
1. ug/l = micrograms/liter which is equivalent to parts per billion (ppb).
2. (*) = NYSDEC. June 1998. Ambient Water Quality Standards and Guidance Values, Division of Water, Technical and Operational Guidance Series (1.1.1).
3. Bold = reported concentration above groundwater cleanup standard.
4. ** = estimated values.
5. *** = acetone suspected to be an artifact of well supply manufacturer



NOTES:

1. BUILDING LAYOUT FROM SITE PLAN PROVIDED TO SEAR BROWN DURING SEAR BROWN PHASE I PROPERTY VISIT IN JANUARY 2000.
2. PROPERTY BOUNDARIES OBTAINED FROM "A MAP OF SURVEY & INSTRUMENT LOCATION OF LANDS OF BRAINERD MANUFACTURING CORP." SCALE 1"=30', DATED MAY 16, 1990, BY DOMINIC J. PARRONE & ASSOCIATES OF PENFIELD, NEW YORK.
3. SURFACE SAMPLES (0-6 INCHES DEEP) SS-1A - SS-1D WERE COLLECTED BY SEAR BROWN IN JANUARY 2000, AND SUBMITTED AS COMPOSITE SAMPLE SS-1.
4. MONITORING WELLS MW-201 TO MW-203 AND SOIL CORINGS GP-101 TO GP-103 COMPLETED BY SEAR BROWN IN JANUARY 2000. MONITORING WELLS MW-201 TO MW-203 HAVE SINCE BEEN DESTROYED DUE TO SITE REPAVING ACTIVITIES.
5. MONITORING WELLS MW-1 TO MW-3 AND SOIL CORINGS SC-1 TO SC-5 COMPLETED BY SEAR BROWN IN APRIL 2001 AND MAY 2001, RESPECTIVELY.
6. MONITORING WELLS MW-4 AND MW-5 AND SOIL CORINGS SC-6 TO SC-17 COMPLETED BY SEAR-BROWN IN AUGUST 2001.

SOIL CORING LOCATION

TWO-INCH MONITORING WELL LOCATION

ONE-INCH MONITORING WELL LOCATION (DESTROYED)

SURFACE SAMPLE GRAB LOCATION

APPROXIMATE PROPERTY BOUNDARY

FEET 0 50 100 150 FEET

SCALE BAR

PROJECT ENGINEER/ARCHITECT: P. SMITH
PROJECT MANAGER: M. STORONSKY
DRAWN BY: A. LESS
SCALE: 1" = 50'
FIRST ISSUE DATE: / /

SEAR·BROWN
85 Metro Park
Rochester, N.Y. 14623-2674
(716) 475-1440
www.searbrown.com

PROJECT: FORMER BRAINERD MANUFACTURING
115 N. WASHINGTON STREET
EAST ROCHESTER, NEW YORK

TITLE OF DRAWING: TOTAL CONCENTRATION OF CHLORINATED COMPOUNDS IN GROUNDWATER (ug / l)

PROJECT NO. 16366.01

DRAWING NO. FIG. 10

APPENDIX B

SEAR-BROWN BORING LOGS

MW-1

MW-2

MW-3

SEAR-BROWN

85 Metro Park
Rochester, NY 14623
(716) 475-1440

SOIL BORING LOG

Test Boring No. MW-1
Monitoring Well ID: MW-1

Project No.:	1636601	Drilling Contractor:	Nothnagle Drilling
Project Name:	115 N. Washington Street East Rochester, NY	Driller:	Neal
		Drilling Method:	Mite-E-Mite/ 4.25" HSA
		Sampling Method:	2" x 2' Split-spoon
Client:	Boylan, Brown, et. al.	Supervisor:	A. Krause, Sear-Brown

Start Date/Time: 4-18-01 0920
Completion Date/Time: 4-20-01 0900
Elevation: NA
Weather: Ptly Cloudy, Brisk, Hi 40s/Low 50s

Ft. B.G.	C	Blows on Sampler (N) 0-6"	6-12"	12-18"	18-24"	Sample Information Rec.	PID* Peak	PID* Sust.	ID No.	Soil Profile	Soil and Rock Information Observations and Remarks	Well Design
0			3	3	3	8"	52	26	S1	ASPHALT	Asphalt	
2										FINE SAND	Dry, brown, fine SAND	
		3	4	3	3	4"	45.4	22	S2		Dry, orange, fine SAND	
4		4	5	3	5	12"	116	80	S3		Moist, orange, fine SAND	
6		5	6	7	9	24"	235	96	S4	GRAVEL	Moist, black, fine and medium GRAVEL	
8										LAYERED FINE SAND, MEDIUM SAND AND SILT (VARIABLE THICKNESS/ LENSES)	Moist to dry, orange, fine SAND	
		4	6	6	6	12"	1162	461	S5		Moist to dry, orange-brown, fine SAND - iron banding	
10		9	10	11	12	16"	889	580	S6		Moist to dry, orange-brown, very fine SAND	
12		12	12	13	16	24"	111	111	S7		Dry, light brown, medium SAND	
14		16	18	25	27	15"	181	50	S8		Dry, light brown, fine SAND - layered	
16		40	29	29	6	24"	333	130	S9		Dry, light brown, fine to medium SAND, trace SILT - layered	
18		17	25	30	30	12"	374	150	S10		S.A.A.	
20		14	20	27	28	16"	234	25.2	S11		Wet, light brown, medium SAND, trace SILT	
22		25	22	25	24	24"	107	43	S12		*Depth to water measured @ 23.22 ft. B.G. with augers in place* S.A.A.	
24		22	22	27	29	24"	13	6	S13		Saturated, light brown, medium SAND, little SILT	
26		18	21	27	32	16"	15.2	7	S14		Saturated, light brown, fine SAND	
28		7	15	22	25	24"	5.3	5.3	S15		*greenish discoloration noted at 28-29'* Saturated, brown, fine SAND, some SILT	
30												

Notes: ft. B.G. = feet Below Grade S.A.A. = Same As Above NS = No Sustained reading
*PID = Headspace measurements of volatile organic compound vapors in parts per million (ppm), using a MiniRAE2000 (10.6 eV)
** = Headspace measured using a Hnu 10.2 eV PID

SEAR·BROWN

85 Metro Park
Rochester, NY 14623
(716) 475-1440

SOIL BORING LOG

Test Boring No. MW-1
Monitoring Well ID: MW-1

Project No.: 1636601	**Drilling Contractor:** Nothnagle Drilling	**Start Date/Time:** 4-18-01 0920
Project Name: 115 N. Washington Street, East Rochester, NY	**Driller:** Neal	**Completion Date/Time:** 4-20-01 0900
	Drilling Method: Mite-E-Mite/ 4.25" HSA	**Elevation:** NA
	Sampling Method: 2" x 2' Split-spoon	
Client: Boylan, Brown, et. al.	**Supervisor:** A. Krause, Sear-Brown	**Weather:** Ptly Cloudy, Brisk, Hi 40s/Low 50s

Ft. B.G.	C	Blows on Sampler (N) 0-6"	6-12"	12-18"	18-24"	Sample Information Rec.	PID* Peak	PID* Sust.	ID No.	Soil Profile	Soil and Rock Information Observations and Remarks	Well Design
30		6	10	16	18					LAYERED FINE SAND, MEDIUM SAND AND SILT (VARIABLE THICKNESS/ LENSES)	Saturated, brown, medium SAND - *greenish discolor.*	
32		4	4	8	16	16"	2.5	2.5	S16		Wet, gray-brown, fine SAND, little to some SILT	
34		4	6	11	13	24"	0.8	0.8	S17		Saturated, gray-brown, medium SAND - iron banding	
36		5	7	8	17	16"	3.9	2.2	S18		Saturated, light to dark brown, medium SAND, SILT	
38		4	5	5	14	14"	132	NS	S19		S.A.A	
40		7	15	21	23	12"	11	11	S20		S.A.A.	
42		6	12	18	22	24"	24.7	4.8	S21		iron banding at 41-42' S.A.A.	
44		11	13	13	15	18"	7.3	2	S22	FINE SAND AND SILT	Saturated, gray, fine SAND, some SILT	
46		10	10	10	12	16"	8	7.5	S23		S.A.A.	
48		4	5	7	12	14"	0.7/1.6**	0.7/1.6**	S24		Saturated, gray, fine SAND and SILT	
50		7	11	19	28	14"	0.8**	0.8**	S25		S.A.A.	
52		9	10	13	16	24"	0.7/0.7**	0.7/0.7**	S26		S.A.A.	
54		4	4	7	12	14"	0.4**	0.4**	S27		S.A.A.	
56		6	7	12	14	14"	0.4**	0.4**	S28		S.A.A.	
58		4	7	8	13	14"	0.4**	0.4**	S29		S.A.A.	
60						12"	95/17**	NS	S30		S.A.A.	

Notes: ft. B.G. = feet Below Grade S.A.A. = Same As Above NS = No Sustained reading
*PID = Headspace measurements of volatile organic compound vapors in parts per million (ppm), using a MiniRAE2000 (10.6 eV)
** = Headspace measured using a Hnu 10.2 eV PID

SEAR·BROWN

85 Metro Park
Rochester, NY 14623
(716) 475-1440

SOIL BORING LOG

Test Boring No. MW-1
Monitoring Well ID: MW-1

Project No.: 1636601
Project Name: 115 N. Washington Street, East Rochester, NY
Client: Boylan, Brown, et. al.

Drilling Contractor: Nothnagle Drilling
Driller: Neal
Drilling Method: Mite-E-Mite/ 4.25" HSA
Sampling Method: 2" x 2' Split-spoon
Supervisor: A. Krause, Sear-Brown

Start Date/Time: 4-18-01 0920
Completion Date/Time: 4-20-01 0900
Elevation: NA
Weather: Ptly Cloudy, Brisk, Hi 40s/Low 50s

Ft. B.G.	C	Blows 0-6"	Blows 6-12"	Blows 12-18"	Blows 18-24"	Rec.	PID* Peak	PID* Sust.	ID No.	Soil Profile	Soil and Rock Information Observations and Remarks	Well Design
60		10								VERY FINE SAND AND SILT		
			10								Saturated, gray, very fine SAND and SILT	
				14								
62					16	12"	31	31	S31		S.A.A	
		3										
			2									
				8								
64					9	6"	41	2	S32		S.A.A	
		10										
			11									
				12								
66					10	14"	1.3	1.3	S33		S.A.A	
		7										
			6									
				7								
68					10	14"	1.0**	1.0**	S34		S.A.A	
		10										
			11									
				11								
70					18	24"	0.9**	0.9**	S35		S.A.A.	
		12										
			14									
				18		16"	-	NS	S36			
72					100/0.2					SILT & CLAY	Wet, gray, SILT and CLAY at 71.4 - 71.8'	
											End of boring @ 71.8 ft. B.G. - Refusal (bedrock)	
74												*See Overburden Monitoring Well Log for Design Details/As-Builts*
76												
78												
80												
82												
84												
86												
88												
90												

Notes: ft. B.G. = feet Below Grade   S.A.A. = Same As Above   NS = No Sustained reading
*PID = Headspace measurements of volatile organic compound vapors in parts per million (ppm), using a MiniRAE2000 (10.6 eV)
** = Headspace measured using a Hnu 10.2 eV PID

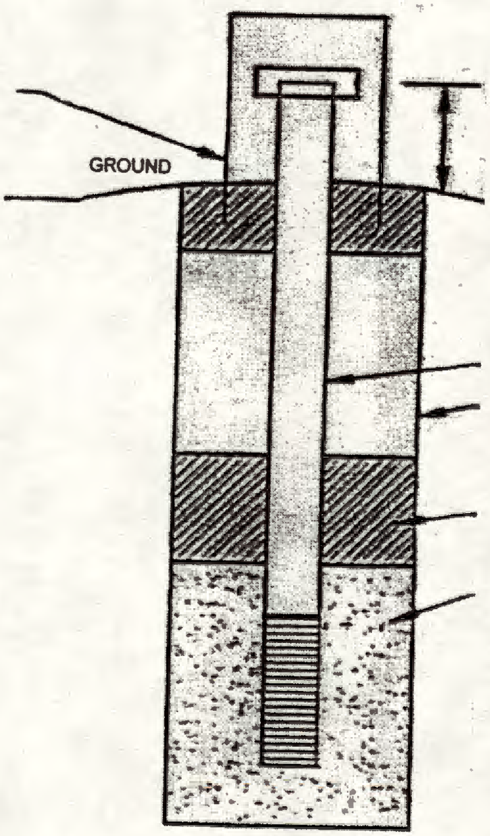
SEAR·BROWN

OVERBURDEN MONITORING WELL
DESIGN DETAILS

PROJECT NAME 115 North Washington Street
PROJECT NUMBER 1636601
CLIENT Boylan, Brown, et. al.
LOCATION 115 North Washington Street
East Rochester, New York

HOLE DESIGNATION MW-1
DATE COMPLETED 4/20/01
DRILLING METHOD Mite-E-Mite/ 4.25" HSA
GEOLOGIST A. Krause, Sear-Brown
WELL INSTALLATION Nothnagle Drilling

CAP TYPE J-plug



STICK-UP NA ft
8" Flush-mount Road Box

SURFACE SEAL TYPE Quick-krete

TOP OF SEAL* AT 51 ft

WELL CASING
ANNULUS BACKFILL
TYPE: Grout

BOTTOM OF SEAL* AT 53.5 ft

SEAL TYPE: Bentonite Pellets

TOP OF SCREEN* AT 56.8 ft

PACK TYPE: - SAND, SIZE ______

BOTTOM OF SCREEN* AT 71.8 ft

BOTTOM OF HOLE* AT 71.8 ft (Rock)

5/7/2001 (D. Gnage)
Bottom of Hole sounded: 69.80 ft BTOC

* NOTE:
ALL DIMENSIONS ARE BELOW GROUND SURFACE (BGS)

SCREEN TYPE: CONTINUOUS SLOT PERFORATED __ LOUVRE __ OTHER ______

SCREEN MATERIAL: STAINLESS STEEL __ PVC X OTHER ______

SCREEN LENGTH: 15 ft SCREEN DIAMETER 2 in SCREEN SLOT SIZE: 0.010

WELL CASING MATERIAL: PVC WELL CASING DIAMETER: 2 in

HOLE DIAMETER: 4 inches

WELL DEVELOPMENT: METHOD: Foot valve/ Dedicated Tubing VOLUME: 77 gallons

5/04/01 (D. Gnage)
DTB: 70.00 ft (NM)
DTW: 21.87 ft
Water Column: 48.13 ft x (0.16 ga./ft) = 7.70 gallons per well volume (10 volumes) = 77 gallons purged

SEAR·BROWN

85 Metro Park
Rochester, NY 14623
(716) 475-1440

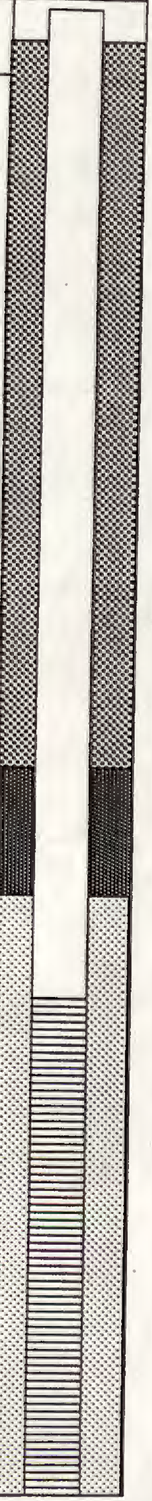
SOIL BORING LOG

Test Boring No. MW-2
Monitoring Well ID: MW-2

Project No.:	1636601	Drilling Contractor:	Nothnagle Drilling	Start Date/Time:	4-19-01 0830
Project Name:	115 N. Washington Street East Rochester, NY	Driller:	Kevin B.	Completion Date/Time:	4-19-01 1315
		Drilling Method:	BK-81/ 4.25" HSA	Elevation:	NA
		Sampling Method:	2" x 2' Split-spoon	Weather:	Sunny, Breezy Low 50s
Client:	Boylan, Brown, et. al.	Supervisor:	A. Krause, Sear-Brown		

Ft. B.G.		Blows on Sampler (N)				Sample Information				Soil Profile	Soil and Rock Information Observations and Remarks
0	C	0-6"	6-12"	12-18"	18-24"	Rec.	PID* Peak	PID* Sust.	ID No.		
		6								FILL	Concrete and GRAVEL
			14								
				9							
2					8	14"	25	5	S1		
		4									Dry, orange, medium SAND, some fine GRAVEL
			4								
				3							
4					1	12"	7	3.7	S2		S.A.A.
		2									
			2							MEDIUM TO FINE SAND AND VARIABLE GRAVELS	
				1							
6					1	6"	65	15	S3		Moist to wet, gray, coarse GRAVEL and orange, medium SAND
		1									
			1								
				WH							
8					1	4"	28.9	9.7	S4		Moist to dry, orange, medium SAND, some fine GRAVEL
		1									
			1								
				WH							
10					1	8"	35.9	9.7	S5		Dry, orange, medium SAND, trace COBBLES
		2									
			4								
				5							
12					6	16"	8.5	2	S6		Dry, orange, fine SAND
		2									
			3								
				5							
14					6	16"	10	5.5	S7		S.A.A.
		2									
			5								
				4							
16					5	18"	10.7	4	S8		Dry, light brown, fine SAND
		3									
			7								
				10							
18					9	18"	72.5	10	S9		S.A.A.
		3									
			9							FINE SAND	
				13							
20					13	18"	124	80	S10		S.A.A.
		4									
			11								
				13							
22					15	12"	177	NS	S11		S.A.A.
		3									
			8								
				12							
24					15	14"	30.7	5	S12		Wet, brown, fine SAND
		3									
			8								
				14							
26					14	14"	118	17	S13		Saturated, brown, fine SAND
		6									
			15								
				15							
28					17	10"	55.1	29	S14		S.A.A.
		6									
			16								
				18							
30					16	16"	22	17	S15		S.A.A.

Well Design



Notes: ft. B.G. = feet Below Grade S.A.A. = Same As Above NS = No Sustained reading WH = Weight of Hammer
*PID = Headspace measurements of volatile organic compound vapors in parts per million (ppm), using a MiniRAE2000 (10.6 eV)
** = Headspace measured using a Hnu 10.2 eV PID

SEAR·BROWN

85 Metro Park
Rochester, NY 14623
(716) 475-1440

SOIL BORING LOG

Test Boring No. MW-2
Monitoring Well ID: MW-2

Project No.:	1636601	Drilling Contractor:	Nothnagle Drilling	Start Date/Time:	4-19-01 0830
Project Name:	115 N. Washington Street East Rochester, NY	Driller:	Kevin B.	Completion Date/Time:	4-19-01 1315
		Drilling Method:	BK-81/ 4.25" HSA	Elevation:	NA
Client:	Boylan, Brown, et. al.	Sampling Method:	2" x 2' Split-spoon	Weather:	Sunny, Breezy Low 50s
		Supervisor:	A. Krause, Sear-Brown		

Ft. B.G.	C	Blows on Sampler (N) 0-6"	6-12"	12-18"	18-24"	Sample Information Rec.	PID* Peak	PID* Sust.	ID No.	Soil Profile	Soil and Rock Information Observations and Remarks	Well Design
30		5									Saturated, brown, fine SAND	
			9									
				11								
32					14	16"	11.2	4.2	S16	FINE SAND	S.A.A.	
34												
36											End of boring @ 35 ft. B.G.	
38												See Overburden Monitoring Well Log for Design Details/As-Builts
40												
42												
44												
46												
48												
50												
52												
54												
56												
58												
60												

Notes: ft. B.G. = feet Below Grade   S.A.A. = Same As Above   NS = No Sustained reading   WH = Weight of Hammer
*PID = Headspace measurements of volatile organic compound vapors in parts per million (ppm), using a MiniRAE2000 (10.6 eV)
** = Headspace measured using a Hnu 10.2 eV PID

SEAR·BROWN

OVERBURDEN MONITORING WELL

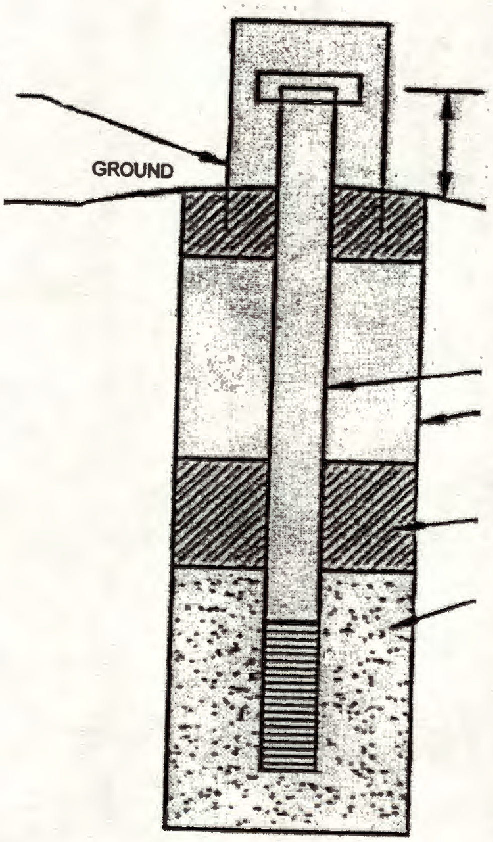
DESIGN DETAILS

PROJECT NAME: 115 North Washington Street
PROJECT NUMBER: 1636601
CLIENT: Boylan, Brown, et. al.
LOCATION: 115 North Washington Street
East Rochester, New York

HOLE DESIGNATION: MW-2
DATE COMPLETED: 4/19/01
DRILLING METHOD: BK-81/ 4.25" HSA
GEOLOGIST: A. Krause, Sear-Brown
WELL INSTALLATION: Nothnagle Drilling

CAP TYPE: J-plug

PROTECTIVE CASING



STICK-UP: NA ft
8" Flush-mount Road Box

SURFACE SEAL TYPE: Quick-krete

TOP OF SEAL* AT: 15.3 ft

BOTTOM OF SEAL* AT: 17.9 ft

TOP OF SCREEN* AT: 20 ft

BOTTOM OF SCREEN* AT: 35 ft

BOTTOM OF HOLE* AT: 35 ft

WELL CASING

ANNULUS BACKFILL TYPE: Grout

SEAL TYPE: Bentonite Chips

PACK TYPE: - SAND, SIZE ____

* NOTE:
ALL DIMENSIONS ARE
BELOW GROUND SURFACE (BGS)

5/7/2001 (D. Gnage)
Bottom of Hole sounded: 33.75 ft BTOC

SCREEN TYPE: CONTINUOUS SLOT   PERFORATED ___   LOUVRE ___   OTHER ____

SCREEN MATERIAL: STAINLESS STEEL ___   PVC X   OTHER ____

SCREEN LENGTH: 15 ft   SCREEN DIAMETER: 2 in   SCREEN SLOT SIZE: 0.010

WELL CASING MATERIAL: PVC   WELL CASING DIAMETER: 2 in

HOLE DIAMETER: 4 inches

WELL DEVELOPMENT: METHOD: Foot valve/ Dedicated Tubing   VOLUME: 20 gallons

5/04/01 (D. Gnage)
DTB: 35.00 ft (NM)
DTW: 22.88 ft
Water Column: 12.12 ft x (0.16 gal/ft) = 1.94 gallons per well volume (10 volumes) = 19.4 gallons = 20 gallons purged

SEAR·BROWN

85 Metro Park
Rochester, NY 14623
(716) 475-1440

SOIL BORING LOG

Test Boring No. MW-3
Monitoring Well ID: MW-3

Project No.: 1636601
Project Name: 115 N. Washington Street, East Rochester, NY
Client: Boylan, Brown, et. al.

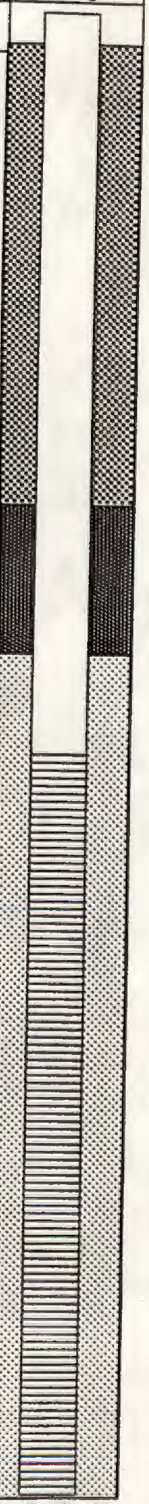
Drilling Contractor: Nothnagle Drilling
Driller: Neal
Drilling Method: Mite-E-Mite/ 4.25" HSA
Sampling Method: 2" x 2' Split-spoon
Supervisor: A. Krause, Sear-Brown

Start Date/Time: 4-20-01 0915
Completion Date/Time: 4-20-01 1230
Elevation: NA
Weather: Sunny, Hi 60s

Ft. B.G.	C	Blows on Sampler (N) 0-6"	6-12"	12-18"	18-24"	Sample Information Rec.	PID* Peak	PID* Sust.	ID No.	Soil Profile	Soil and Rock Information Observations and Remarks
0										ASPHALT	Asphalt and concrete
2		5	3	3	3	12"	90.6	11	S1	SILTY FINE SAND TO MEDIUM SAND	Dry, orange, fine SAND, little SILT
4		5	7	8	10	8"	97	50	S2		Dry, orange, fine and very fine SAND
6		7	8	11	10	NR					*COBBLE in shoe - No recovery*
8		5	7	10	9	14"	5.3	3	S3		Dry, orange, fine and medium SAND
10		3	4	4	5	18"	4.8	4.8	S4	LAYERED FINE SAND, MEDIUM SAND AND SILT (VARIABLE THICKNESS/ LENSES)	Dry, light brown, medium SAND
12		6	8	10	11	16"	10.2	2	S5		Dry, light brown, fine and medium SAND, little SILT
14		5	8	12	13	20"	8.2	4.6	S6		Dry, light brown, medium SAND, little SILT
16		5	7	9	8	18"	9	3.7	S7		Dry, light brown, fine and medium SAND
18		6	8	10	13	16"	25.5	11.8	S8		Wet, brown, fine and medium SAND
20		2	8	7	11	18"	29.3	24	S9		Saturated, brown, very fine and fine SAND, little SILT, trace CLAY
22		3	3	13	14	16"	60.7	40	S10		Saturated, brown, very fine and fine SAND, little SILT
24		5	11	12	16	14"	9999***	42	S11		Moist, light brown, medium SAND, little SILT
26		5	12	15	17	12"	270	260	S12		Saturated, brown, fine SAND and SILT
28		12	14	15	22	14"	97.3	93	S13		Wet, brown, medium SAND and SILT
30		12	14	18	19	12"	193	183	S14		Wet to saturated, fine and medium SAND and SILT

End of boring @ 30 ft. B.G.

Well Design



See Overburden Monitoring Well Log for Design Details/As-Builts

Notes: ft. B.G. = feet Below Grade　S.A.A. = Same As Above　NR = No Recovery
*PID = Headspace measurements of volatile organic compound vapors in parts per million (ppm), using a MiniRAE2000 (10.6 eV)
** = Headspace measured using a Hnu 10.2 eV PID　*** = Moisture interference suspected

SEAR·BROWN

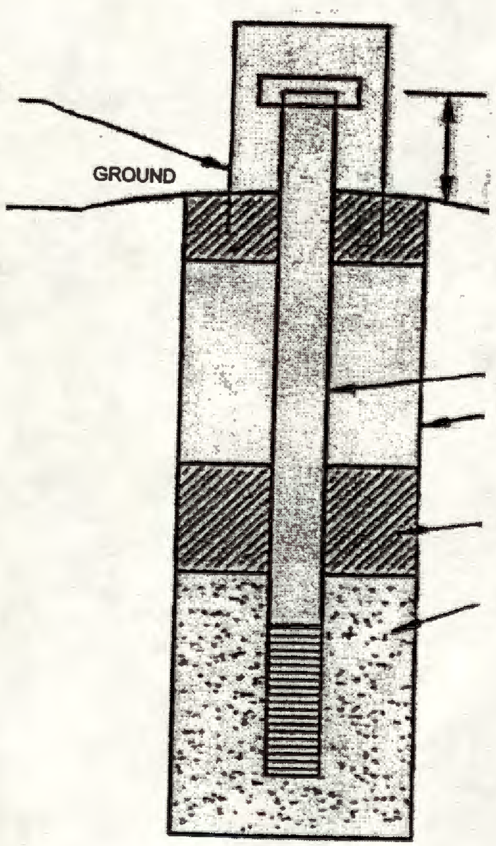
OVERBURDEN MONITORING WELL

DESIGN DETAILS

PROJECT NAME: 115 North Washington Street
PROJECT NUMBER: 1636601
CLIENT: Boylan, Brown, et. al.
LOCATION: 115 North Washington Street, East Rochester, New York

HOLE DESIGNATION: MW-3
DATE COMPLETED: 4/20/01
DRILLING METHOD: Mite-E-Mite/ 4.25" HSA
GEOLOGIST: A. Krause, Sear-Brown
WELL INSTALLATION: Nothnagle Drilling

CAP TYPE: J-plug



STICK-UP: NA ft
8" Flush-mount Road Box

SURFACE SEAL TYPE: Quick-krete

WELL CASING
ANNULUS BACKFILL
TYPE: Grout/Portland Type I Cem.

SEAL TYPE: Bentonite Pellets/Chips

PACK TYPE: - SAND, SIZE ____

TOP OF SEAL* AT: 10 ft

BOTTOM OF SEAL* AT: 13 ft

TOP OF SCREEN* AT: 15 ft

BOTTOM OF SCREEN* AT: 30 ft

BOTTOM OF HOLE* AT: 30 ft

*NOTE:
ALL DIMENSIONS ARE BELOW GROUND SURFACE (BGS)

5/7/2001 (D. Gnage)
Bottom of Hole sounded: 27.00 ft BTOC

SCREEN TYPE: CONTINUOUS SLOT PERFORATED ___ LOUVRE ___ OTHER ____

SCREEN MATERIAL: STAINLESS STEEL ___ PVC X OTHER ____

SCREEN LENGTH: 15 ft SCREEN DIAMETER: 2 in SCREEN SLOT SIZE: 0.010

WELL CASING MATERIAL: PVC WELL CASING DIAMETER: 2 in

HOLE DIAMETER: 4 inches

WELL DEVELOPMENT: METHOD: Foot valve/ Dedicated Tubing VOLUME: 20 gallons

5/04/01 (D. Gnage) (C. Shea)
DTB: 30.00 ft (NM)
DTW: 18.03 ft
Water Column: 11.97 ft x (0.16 gal/ft) = 1.92 gallons per well volume (10 volumes) = 19.2 gallons = 20 gallons purged

APPENDIX C

AQUIFER TEST DATA FORM

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

AQUIFER TEST DATA

PROJECT INFORMATION:

Project Name:	Client:
Project No.:	Location:

WELL DATA:

Well I.D.:		Casing Material:
Casing Diameter (inches):	Stick-up (fags):	Screen Material:
Screened interval (fbMP):		Bottom Depth (fbMP):
Type of Well: ☐ Pumping Well ☐ Observation Wel		Measurement Equipment:

TIME DATA		WATER LEVEL DATA	DISCHARGE DATA		
Pump on: Date	Time (t_o)	Static Water Level (fbMP):	How Q measured?		
Pump off: Date	Time (t'_o)	Measuring Point (MP):	Depth of Pump/Air Line:		
Duration of aquifer test (hh:mm):		Elevation of Measuring Point:	Previous Pumping?	Yes	No
Pumping	Recovery	Datum Ground Surface: Mean Sea Level	Duration	End	

Date	Clock Time	Time Since Pump Started	Time Since Pump Stopped	t/t'	Water Level Measurement	Correction or Conversion	Water Level	Water Level Change	Discharge Measurement	Discharge Rate	Recorded By	COMMENTS ON FACTORS AFFECTING TEST DATA
		t	t'					s or s'				

APPENDIX D

FIELD OPERATING PROCEDURES

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

APPENDIX D

FIELD OPERATING PROCEDURES

FORMER BRAINERD MFG. FACILITY
IRM INVESTIGATION

FOP No.	Procedure
1	Calibration and Maintenance of Portable Field pH, Eh Meter
2	Calibration and Maintenance of Portable Field Turbidity Meter
3	Calibration and Maintenance of Portable Photoionization Detector (PID)
4	Calibration and Maintenance of Portable Specific Conductance Meter
5	Documentation Requirements for Drilling and Well Installation
6	Groundwater Level Measurement
7	Hollow Stem Auger Drilling Procedures
8	Monitoring Well Development Procedures
9	Groundwater Sample Collection
10	Non-Disposable and Non-Dedicated Sampling Equipment Decontamination
11	Sample Labeling, Storage and Shipment Procedures
12	Soil Boring Log Description Procedures Using the USCS
13	Split-spoon Sampling

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD pH/Eh METER

PURPOSE

This guideline describes a method for calibration of a portable pH/Eh meter. The pH/Eh meter measures the hydrogen ion concentration or acidity of a water sample (pH function), and the oxidation/reduction potential of a water sample (Eh function). Calibration is performed to verify instrument accuracy and function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each day that the instrument is in use. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter.

ACCURACY

The calibrated accuracy of the pH/Eh meter will be:

pH $\pm$ 0.2 pH unit, over the temperature range of $\pm$ 0.2 C.

Eh $\pm$ 0.2 millivolts (mV) over the range of $\pm$ 399.9 mV, otherwise $\pm$ 2 mV.

CALIBRATION PROCEDURE

Note: Meters produced by different manufacturers may have different calibration procedures. These instructions will take precedence over the procedure provided herein. This procedure is intended to be used as a general guideline, or in the absence of available manufacturer's instructions.

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD pH/Eh METER

1. Obtain and active the meter to be used. As stated above, initial calibrations will be performed at the beginning of each sampling day.

2. Immerse the sensing probe in a container of certified pH 7.0 buffer solution traceable to the National Bureau of Standards.

3. Measure the temperature of the buffer solution, and adjust the temperature setting accordingly.

4. Compare the meter reading to the known value of the buffer solution while stirring. If the reading obtained by the meter does not agree with the known value of the buffer solution, recalibrate the meter according to the manufacturer's instructions until the desired reading is obtained. This typically involves accessing and turning a dial or adjustment screw while measuring the pH of the buffer solution. The meter is adjusted until the output agrees with the known solution pH.

5. Repeat Steps 2 through 5 with a pH 4.0 and 10.0 buffer solution to provide a three-point calibration. Standards used to calibrate the pH meter will be of concentrations that bracket the expected values of the samples to be analyzed, especially for two-point calibrations (see note below).

   Note: Some pH meters only allow two-point calibrations. Two-point calibrations should be within the suspected range of the groundwater to be analyzed. For example, if the groundwater pH is expected to be approximately 8, the two-point calibration should bracket that value. Buffer solutions of 7 and 10 should then be used for the two-point calibration.

6. Document the calibration results and related information in the Project Field Book and on an Equipment Calibration Log (see attached example). Information will include, at a minimum:

   - Time, date, and initials of the field team member performing the calibration
   - The unique identifier for the meter, including manufacturer, model, and serial number

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD pH/Eh METER

- The brand and expiration dates of buffer solutions
- The instrument readings
- The instrument settings (if applicable)
- Pass or fail designation in accordance with the accuracy specifications presented above
- Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate

MAINTENANCE

- When not in use, or between measurements, keep the pH/Eh probe immersed in or moist with buffer solutions.

- Check the meter batteries at the end of each day and recharge or replace as needed.

- Replace the pH/Eh probe any time that the meter response time becomes greater than two minutes or the meeting system consistently fails to retain its calibrated accuracy for a minimum of ten sample measurements.

- If a replacement of the pH/Eh probe fails to resolve instrument response time and stability problems, obtain a replacement instrument (rental instruments) and/or order necessary repairs/adjustment.

Benchmark Environmental Engineering & Science, PLLC
TurnKey Environmental Restoration, LLC

EQUIPMENT CALIBRATION LOG

PROJECT INFORMATION:

Project Name: ____________________ Date: ____________________

Project No.: ____________________

Client: ____________________ Instrument Source: ☐ BM/TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTINGS
☐ pH meter	units					4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU					< 0.5		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS					1413 μS @ 25 °C		
☐ PID	ppm					open air		
						100 ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								
☐								

ADDITIONAL REMARKS:

PREPARED BY: ____________________ **DATE:** ____________________

Benchmark Environmental Engineering & Science, PLLC

FIELD OPERATING PROCEDURE

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER

Purpose

This guideline describes a method for calibration of a portable field turbidity meter. Turbidity is one water quality parameter measured during purging and development of wells. Turbidity is measured as a function of the samples ability to transmit light, expressed as Nephelometric Turbidity Units (NTUs). The turbidity meter is factory calibrated and must be checked daily prior to using the meter in the field. Calibration is performed to verify instrument accuracy and function. This procedure also documents critical maintenance activities for this meter.

Accuracy

The calibrated accuracy of the turbidity meter will be ± 1 percent of full-scale on all scale ranges.

Calibration Check Procedure

Note: Meters produced by different manufacturers may have different calibration check procedures. These manufacturers' instructions will take precedence over the procedure provided here. This procedure is intended to be used as a general guideline, or in the absence of available manufacturer's instructions.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER

Note: Because the turbidity meter measures light transmission, it is critical that the meter and standards be cared for as precision optical instruments. Scratches, dirt, dust, etc. can all temporarily or permanently affect the accuracy of meter readings.

1. With the instrument turned off, check the mechanical zero adjustment on the meter face. Adjust the ZERO control for a zero reading if necessary.

2. Turn the meter on and perform a battery check. Charge the battery pack if the meter indicates low battery charge.

3. Place the focusing template into the cell holder, press the 1.0 range switch, and adjust the ZERO control to obtain a zero NTU reading.

4. Remove the focusing template and insert a 0.9 NTU turbidity standard. Adjust the SPAN control for a corrected 0.9 NTU reading, if necessary.

5. Remove the 0.9 NTU standard and replace it with a 9 NTU standard. Press the 10 range switch. The meter should indicate 9 (±0.02) NTU. If it does not, the 10 range potentiometer must be adjusted in accordance with the manufacturer's instructions. Adjust the SPAN control for a reading of 9 NTU.

6. Remove the 9 NTU standard and replace it with the cell riser and 90 NTU standard. Press the 100 range switch. The meter should indicate 90 (±2) NTU.

7. Remove the 90 NTU standard and cell riser and insert the 9 NTU standard. Press the 10 NTU range switch. Adjust the SPAN control for a reading of exactly 9 NTU.

8. Remove the 9 NTU standard and replace it with a 0.9 NTU standard. Press the 1.0 range switch. The meter should indicate the correct value for the 0.9 NTU standard (±0.2). If it does not, the 1.0 range potentiometer must be adjusted in accordance with the manufacturer's instructions.

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER

9. Document the calibration results and related information in the Project Field Book and on an Equipment Calibration Log (see attached example). Information will include, at a minimum:

   - Time, date, and initials of the field team member performing the calibration
   - The unique identifier for the meter, including manufacturer, model, and serial number
   - The brand of calibration standards
   - The instrument readings
   - The instrument settings (if applicable)
   - Pass or fail designation in accordance with the accuracy specifications presented above
   - Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate

MAINTENANCE

- Check the meter battery pack at the end of each day and recharge when needed.
- When not in use, store the meter in a clean, dry area with the protective cover shut.
- Clean the lens periodically with a dry cloth or tissue.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC
TURNKEY ENVIRONMENTAL RESTORATION, LLC

EQUIPMENT CALIBRATION LOG

PROJECT INFORMATION:

Project Name: ______________________ Date: ______________________

Project No.: ______________________

Client: ______________________ Instrument Source: ☐ BM/TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTINGS
☐ pH meter	units					4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU					< 0.5		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS					1413 μS @ 25 °C		
☐ PID	ppm					open air		
						100 ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								
☐								

ADDITIONAL REMARKS:

____

____

____

PREPARED BY: ______________________ **DATE:** ______________________

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD PHOTOIONIZATION DETECTOR (PID)

PURPOSE

This procedure describes a general method for the calibration and maintenance of a portable photoionization detector (PID). The PID detects and initially quantifies a reading of the volatile organic compound (VOC) concentration in air. The PID is used as a field-screening tool for initial evaluation of soil samples and for ambient air monitoring of compounds with ionization potentials (IP) less than the PID lamp electron voltage (eV) rating. The IP is the amount of energy required to move an electron to an infinite distance from the nucleus thus creating a positive ion plus an electron. It should be noted that all of the major components of air (i.e., carbon dioxide, methane, nitrogen, oxygen etc.) have IP's above 12 eV. As a result, they will not be ionized by the 9.5, 10.2, 10.6 or 11.7 eV lamps typically utilized in field PIDs. The response of the PID will then be the sum of the organic and inorganic compounds in air that are ionized by the appropriate lamp (i.e., 9.5, 10.2, 10.6 or 11.7 eV).

Calibration is performed to verify instrument accuracy and function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each day that the instrument is in use. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter.

Note: The information included below is equipment manufacturer- and model-specific, however, accuracy, calibration, and maintenance procedures for this type of portable equipment are typically similar. The information below pertains to the Photovac 2020 photoionization detector equipped with a 10.6 eV lamp. The actual equipment to be used in the field will be equivalent or similar.

Note: The PID indicates total VOC concentration readings that are normalized to an isobutylene standard, so actual quantification of individual compounds is not provided. In addition, the PID response to compounds is highly variable, dependent on ionization potential of the compound, and the presence or absence of other compounds.

ACCURACY

The Photovac 2020 is temperature compensated so that a 20° C change in temperature corresponds to a change in reading of less than two percent full-scale at maximum sensitivity. The useful range of the instrument is from 0.5 – 2000 ppm isobutylene with an accuracy of ± 10% or ± 2 ppm. Response time is less than three seconds to 90 percent of full-scale. The operating temperature range is 0 to 40° C and the operating humidity range is 0 to 100 % relative humidity (non-condensing).

CALIBRATION PROCEDURE

1. Calibrate all field test equipment at the beginning of each sampling day. Check and recalibrate the PID according to the manufacture's specifications.

2. Calibrate the PID meter using a compressed gas cylinder containing a 100-ppm isobutylene standard, a flow regulator, and a tubing assembly. In addition, a compressed gas cylinder containing zero air ("clean" air) may be required if ambient air conditions do not permit calibration to "clean air".

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD PHOTOIONIZATION DETECTOR (PID)

3. Fill two Tedlar bags equipped with a one-way valve with zero-air (if applicable) and 100-ppm isobutylene gas.

4. Assemble the calibration equipment and actuate the PID in its calibration mode. Connect the PID probe to the zero air calibration bag (or calibrate to ambient air if conditions permit) and wait for a stable indication.

5. Change the response factor of the PID to the Methyl Isobutyl Ketone (MIBK) setting, which is a response factor of 1.0 for the Photovac 2020.

6. Connect the PID probe to the 100-ppm isobutylene standard calibration bag. Measure an initial reading of the isobutylene standard and wait for a stable indication.

7. Keep the PID probe connected to the 100-ppm isobutylene standard calibration bag, calibrate to 100-ppm with the isobutylene standard and wait for a stable indication.

8. Document the calibration results and related information in the Project Field Book and on an Equipment Calibration Log (see attached example), indicating the meter readings before and after the instrument has been adjusted. This is important, not only for data validation, but also to establish maintenance schedules and component replacement. Information will include, at a minimum:

    - Time, date and initials of the field team member performing the calibration
    - The unique identifier for the meter, including manufacturer, model, and serial number
    - The brand and expiration date of the isobutylene gas
    - The instrument readings: before and after calibration
    - The instrument settings (if applicable)
    - Pass or fail designation in accordance with the accuracy specifications presented above
    - Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD PHOTOIONIZATION DETECTOR (PID)

MAINTENANCE

- The probe and dust filter of the PID should be checked before and after every use for cleanliness. Should instrument response become unstable, recalibration should be performed. If this does not resolve the problem, access the photoionization bulb and clean with the manufacturer-supplied abrasive compound, then recalibrate.

- The PID battery must be recharged after each use. Store the PID in its carrying case when not in use. Additional maintenance details related to individual components of the PID are provided in the equipment manufacturer's instruction manual. If calibration or instrument performance is not in accordance with specifications, send the instrument to the equipment manufacturer for repair.

- Maintain a log for each monitoring instrument. Record all maintenance performed on the instrument on this log with date and name of the organization performing the maintenance.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

TURNKEY ENVIRONMENTAL RESTORATION, LLC

EQUIPMENT CALIBRATION LOG

PROJECT INFORMATION:

Project Name: __________ Date: __________

Project No.: __________

Client: __________ Instrument Source: ☐ BM/TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTINGS
☐ pH meter	units					4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU					< 0.5		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS					1413 μS @ 25 °C		
☐ PID	ppm					open air		
						100 ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								
☐								

ADDITIONAL REMARKS:

____

PREPARED BY: __________ **DATE:** __________

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

CALIBRATION AND MAINTENANCE OF PORTABLE SPECIFIC CONDUCTANCE METER

PURPOSE

This guideline describes a method for calibration of a portable specific conductance meter. This meter measures the ability of a water sample to conduct electricity, which is largely a function of the dissolved solids within the water. The instrument has been calibrated by the manufacturer according to factory specifications. This guideline presents a method for checking the factory calibration of a portable specific conductance meter. A calibration check is performed to verify instrument accuracy and function. All field test equipment will be checked at the beginning of each sampling day. This procedure also documents critical maintenance activities for this meter.

ACCURACY

The calibrated accuracy of the specific conductance meter will be within ± 1 percent of full-scale, with repeatability of ± 1 percent. The built-in cell will be automatically temperature compensated from at least 50° to 160° F (10° to 71°C).

CALIBRATION PROCEDURE

1. Field check the meter at the beginning of each sampling day.

2. Use a calibration solution of known specific conductivity and salinity. For maximum accuracy, use a Standard Solution Value closest to the samples to be tested.

3. Turn the Range Switch to 20 milliSiemens (mS) (also known as millimhos).

CALIBRATION AND MAINTENANCE OF PORTABLE SPECIFIC CONDUCTANCE METER

4. Insert the meter probe into a container of the calibration solution (note: do not use the solution bottle). Alternatively, depending on meter design, fill the meter's test cup with calibration solution.

5. If the reading obtained does not agree with the known specific conductivity of the solution, proceed as follows:

   - Clean the cell in accordance with the instruction manual. Rinse the cell thoroughly and repeat the calibration check.
   - If the meter still does not indicate the correct value, recalibrate the meter in accordance with the manufacturer's instructions. This typically involves accessing and turning a dial or adjustment screw while measuring the conductance of the calibration solution. The meter is adjusted until the output agrees with the known solution conductance.
   - If calibration cannot be achieved or maintained, obtain a replacement instrument (rental instruments) and/or order necessary repairs/adjustment.

6. Document the calibration results and related information in the Project Field Book and on an Equipment Calibration Log (see attached example), indicating the meter readings before and after the instrument has been adjusted. This is important, not only for data validation, but also to establish maintenance schedules and component replacement. Information will include, at a minimum:

   - Time, date, and initials of the field team member performing the calibration
   - The unique identifier for the meter, including manufacturer, model, and serial number
   - The brand and expiration dates of calibration solutions
   - The instrument readings: before and after calibration
   - The instrument settings (if applicable)
   - The approximate response time
   - The overall adequacy of calibration including the Pass or fail designation in accordance with the accuracy specifications presented above

- Corrective action taken (see Step 5 above) in the event of failure to adequately calibrate

MAINTENANCE

- Check the meter batteries at the end of each day and replace when needed.
- Track the meter response time and stability to determine the need for instrument maintenance. When response time becomes greater than two minutes and the meter must be recalibrated more than once per day, send the instrument to the manufacturer for maintenance and repair.

EQUIPMENT CALIBRATION LOG

PROJECT INFORMATION:

Project Name:

Project No.:

Client:

Date:

Instrument Source: ☐ BM/TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTINGS
☐ pH meter	units					4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU					< 0.5		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS					1413 μS @ 25 °C		
☐ PID	ppm					open air		
						100 ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								
☐								

SAMPLE

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

PURPOSE

The purpose of these documentation requirements is to document the procedures used for drilling and installing wells in order to ensure the quality of the data obtained from these operations. Benchmark field technical personnel will be responsible for developing and maintaining documentation for quality control of field operations. At least one field professional will monitor each major operation (e.g. one person per drilling rig) to document and record field procedures for quality control. These procedures provide a description of the format and information for this documentation.

PROCEDURE

Project Field Book

Personnel assigned by the Benchmark Field Team Leader or Project Manager will maintain a Project Field Book for all site activities. These Field Books will be started upon initiation of any site activities to document the field investigation process. The Field Books will meet the following criteria:

- Permanently bound, with nominal 8.5-inch by 11-inch gridded pages.
- Water resistant paper.
- Pages must be pre-numbered or numbered in the field, front and back.

DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

Notations in the field book will be in black or blue ink that will not smudge when wet. Information that may be recorded in the Field Book includes:

- Time and date of all entries.
- Name and location of project site, and project job number.
- Listing of key project, client and agency personnel and telephone numbers.
- Date and time of daily arrivals and departures, name of person keeping the log, names and affiliation of persons on site, purpose of visit (if applicable), weather conditions, outline of project activities to be completed.
- Details of any variations to the procedures/protocols presented in the RFI Work Plan or Field Operating Procedures, and the basis for the change.
- Field-generated data relating to implementation of the field program, including sample locations, sample descriptions, field measurements, instrument calibration, etc.
- Record of all photographs taken in the field, including date, time, photographer, site location and orientation, sequential number of photograph, and roll number.

Upon completion of the site activities, the Field Books will be placed in the project files.

DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

Borehole Log Form

An example of this form is attached to this Field Operating Procedure. One form will be completed for every boring by the Benchmark field person overseeing the drilling. At a minimum, these forms will include:

- Project name, location, and number.
- Boring number.
- Drilling method.
- Drilling dates.
- Sampling method.
- Sample descriptions, to meet the requirements of the Unified Soil Classification System (USCS) for soils and the Unified Rock Classification System (URCS) for rock.
- Results of headspace analyses.
- Blow counts for sampler penetration.
- Drilling rate, rig chatter, and other drilling-related information.

All depths recorded on Boring Log Forms will be expressed in increments tenths of feet, and not in inches.

DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

Monitoring Well Construction Log

An example of this form is attached to this Field Operating Procedure. One form will be completed for every boring by the Benchmark field person overseeing the well installation. At a minimum, these forms will include:

- Project name, location, and number.
- Well number.
- Installation dates.
- Dimensions and depths of the various well components illustrated in the Monitoring Well Construction Diagram (reference the Benchmark Field Operating Procedures for Monitoring Well Installation). These include the screened interval, bottom caps or plugs, centralizers, and the tops and bottoms of the various annular materials.
- Drilling rate, rig chatter, and other drilling related information.

All depths recorded on Monitoring Well Construction Logs will be expressed in tenths of feet, and not in inches.

Daily Drilling Report Form

An example of this form is attached to this Field Operating Procedure. This form should be used to summarize all drilling activities. One form should be completed for each rig for each day. These forms will include summaries of:

DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

- Footage drilled, broken down by diameter (e.g. 200 feet of 6-inch diameter hole, 50 feet of 10-inch diameter hole).
- Footage of well and screen installed, broken down by diameter.
- Quantities of materials used, including sand, cement, bentonite, centralizers, protective casings, traffic covers, etc. recorded by well or boring location.
- Active time (hours), and activity (drilling, decontamination, development, well installation, surface completions, etc.)
- Down-time (hours) and reason.
- Mobilizations and other events.
- Other quantities that will be the basis for drilling invoices.

The form should be signed daily by both the Benchmark field supervisor and the driller's representative, and provided to the Benchmark Field Team Leader.

<u>Other Project Field Forms</u>

Well purging/well development forms, test pit logs, environmental sampling field data sheets, water level monitoring forms, and well testing (slug test or pumping test) forms. Refer to specific guidelines for form descriptions.

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD BOREHOLE LOG

Project Name:	BORING NUMBER:
Project Number:	Location:
Client:	Start Date/Time:
Drilling Company:	End Date/Time:
Driller:	Logged By:
Helper:	Drilling Method:
Rig Type:	Weather:

Depth (bgs)	Sample No.	Blows (per 6")	Recovery	PID Scan (ppm)	SOIL DESCRIPTIO[illegible] USCS Classification: Color, Moisture Conditi[illegible]centa[illegible] Soil Type, Texture, Plasticity, Fabric, Bedd[illegible]	PID HDSP (ppm)	Samples (y/n)	Pocket Penetrometer

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

FIELD BOREHOLE/MONITORING WELL INSTALLATION LOG

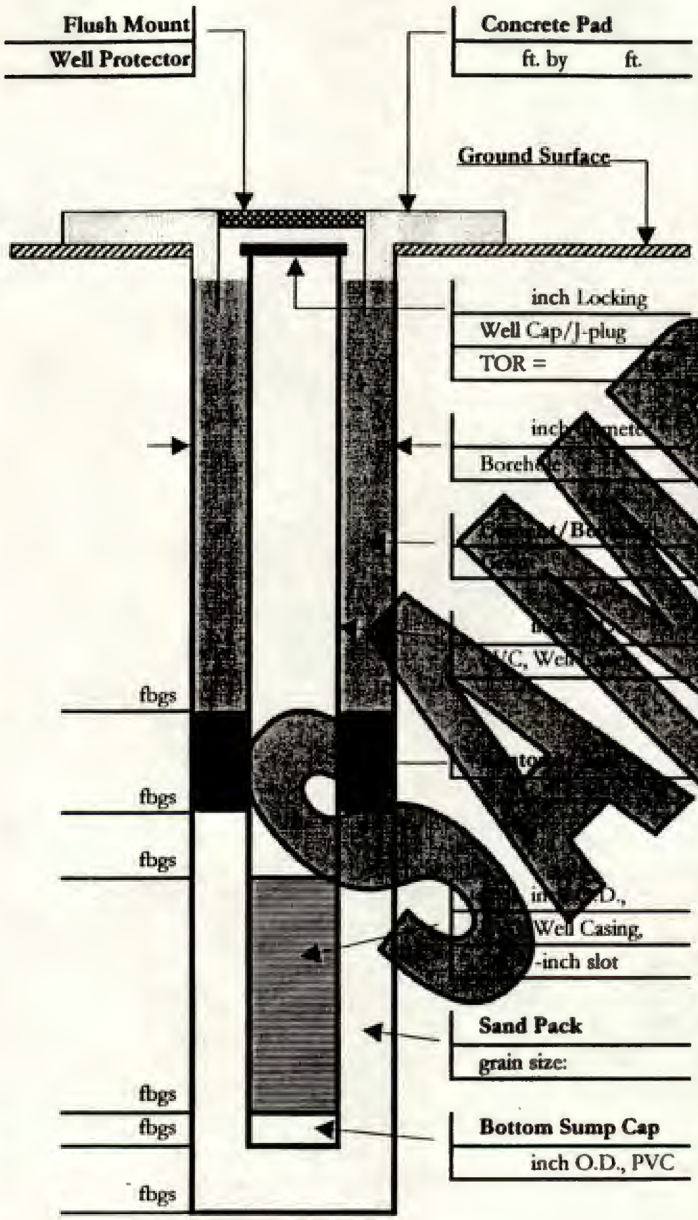
Project Name:	WELL NUMBER:
Project Number:	Location:
Client:	Start Date/Time:
Drilling Company:	End Date/Time:
Driller:	Logged By:
Helper:	Drilling Method:
Rig Type:	Weather:

Depth (bgs)	Sample No.	Blows (per 6")	Recovery	PID Scan (ppm)	SOIL DESCRIPTION USCS Classification: Color, Moisture Condition, ... ge of Soil Type, Texture, Plasticity, Fabric, Bedding, Other	...P (ppm)	Samples (y/n)	Pocket Penetrometer	Well Construction Details and/or Drilling Remarks

BENCHMARK
Environmental Engineering & Science, PLLC

FLUSHMOUNT WELL/PIEZOMETER COMPLETION DETAIL

Project Name:	WELL NUMBER:
Client:	Date Installed:
Boring Location:	Project Number:



Driller Information

Company:	
Driller:	
Helper:	
Permit No.:	
Drill Rig:	

Well Information

Land Surface Elevation:	fmsl (approximate)
Drilling Method:	
Soil Sample Collection Method:	
Drilling Fluid:	
Fluid Loss During Drilling:	gallons (approximate)

Material of Well Construction

Casing:	
Screen:	
Grout:	
Sand Pack:	
Bentonite Pellets:	

Well Development

Well Purpose:	
Techneque(s):	
Date Completed:	
BM/TK Personnel	
Total Volume Purge:	gallons
Static Water Level:	fbTOR
Pump Depth:	
Pumping Duration:	minutes
Yeild:	gpm
Specific Capacity:	gpm/ft

Comments:

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

DAILY DRILLING REPORT

CONTRACTOR: ______________________ DATE: ____________

DRILLING EQUIP.: ______________________ WEATHER: ____________

CREW MEMBERS: ______________________

SITE NAME: ______________________ JOB NUMBER: ____________

CATEGORY	Total Hours	a.m. 6	7	8	9	10	11	p.m. 12	13	14	15	16	17	18	19	20	21	22	23	a.m. 24	1	2	3	4	5
MOB / DEMOB																									
DRILLING - ROCK																									
WELL INSTALLATION																									
DEVELOPMENT / TESTING																									
GROUTING																									
STEAM / DECON																									
DOWN TIME																									
STANDBY																									
OTHER:																									

REMARKS:

CONSUMABLE: DESCRIBE NATURE, QUANTITY, S[illegible]

[illegible]TEM OR SERVIC[illegible]	QTY.	NOTES

Borehole No.	From (feet)	(fe[illegible]	[illegible]	METHOD, SIZE, ETC.

PERSONNEL TIME LOG:

POSITION	NAME	HOURS
Observer		
Driller		
Helper		

DRILLER	BM REP.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

GROUNDWATER LEVEL MEASUREMENT

PURPOSE

This procedure describes the methods used to obtain accurate and consistent water level measurements in monitoring wells/piezometers. Water levels will be measured at monitoring wells and, if practicable, in supply wells to estimate purge volumes associated with sampling, and to develop a potentiometric surface of the groundwater in order to estimate the direction and velocity of flow in the aquifer. Water levels in monitoring wells will be measured using an electronic water level indicator (e-line) that has been checked for operation prior to mobilization.

PROCEDURE

1. Decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the Benchmark Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination. Store the e-line in a protected area until use. This may include wrapping the e-line in clean plastic until the time of use.

2. Unlock and remove the well protective cap or cover and place on clean plastic.

3. Lower the probe slowly into the monitoring well until the audible alarm sounds. This indicates the depth to water has been reached.

4. Move the cable up and down slowly to identify the depth at which the alarm just begins to sound. Measure this depth against the mark on the lip of the well riser used as a surveyed reference point.

5. Read depth from the graduated cable to the nearest 0.01 foot. Do not use inches. If the e-line is not graduated, use a rule or tape measure graduated in 0.01-foot increments to measure from the nearest reference mark on the e-line cable.

6. Record the water level on a Water Level Monitoring Record (sample attached).

GROUNDWATER LEVEL MEASUREMENT

7. Remove the probe from the well slowly, drying the cable and probe with a clean paper wipe. Be sure to repeat decontamination before use in another well.

8. Replace well plug and protective cap or cover. Lock in place as appropriate.

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

WATER LEVEL MONITORING RECORD

Project Name: ______________________ Client: ______________________
Project No.: ______________________ Location: ______________________
Field Personnel: ______________________ Date: ______________________
Weather: ______________________

NOTE: For convenience, the following abbreviations may be used.

D = Dedicated Pump
ES = Electric Sounder
GS = Ground Surface
I = Inaccessible
MP = Measuring Point
P = Pumping
ST = Steel Tape
TOC = Top of Casing
TOR = Top of Riser
WL = Water Level
fmsl = feet mean sea level
fbTOR = feet below TOR

Well No.	Time	MP Elevation (fmsl)	WL (fbTOR)	WL Elevation (fmsl)	__/ (fb[illegible])	Remarks

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

HOLLOW STEM AUGER DRILLING PROCEDURES

PURPOSE

This guideline presents a method for drilling a borehole through unconsolidated materials, including soils or overburden, and consolidated materials, including bedrock.

PROCEDURE

The following procedure will be used to drill a borehole for sampling and/or well installation, using hollow-stem auger methods and equipment.

1. Mobilize the auger rig to the site and position over the borehole.
2. Level and stabilize the rig using the rig jacks, and recheck the rig location against the planned drilling location. If necessary, raise the jacks and adjust the rig position.
3. Place a metal or plywood auger pan over the borehole location to collect the auger cuttings. This auger pan will be equipped with a 12-inch nominal diameter hole for auger passage.
4. Advance augers into the subsurface. For sampling or pilot-hole drilling, nominal 8-inch outside diameter (OD) augers should be used. The boring diameter will be approved by the Benchmark field supervisor.
5. Check augers periodically during drilling to ensure the boring is plumb. Adjust rig position as necessary to maintain plumb.
6. Continue drilling until reaching the assigned total depth, or until auger refusal occurs. Auger refusal is when the drilling penetration drops below 0.1 feet per 10

minutes, with the full weight of the rig on the auger bit, and a center bit (not center plug) in place.

7. Plug and abandon boreholes not used for well installation as described in the Benchmark Field Operating Procedure for Borehole Abandonment.

OTHER PROCEDURAL ISSUES:

- Slip rings may be used for lifting a sampling or bit string. The string will not be permitted to extend more than 15 feet above the mast crown.
- Borings will not be over drilled (rat holed) without the express permission of the Benchmark field supervisor. All depth measurements should be accurate to the nearest 0.1 foot, to the extent practicable.
- Potable water may be placed in the auger stem if critically necessary for borehole control or to accomplish sampling objectives. This will be performed only with the express permission of the Benchmark field supervisor.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

MONITORING WELL DEVELOPMENT PROCEDURES

PURPOSE

This procedure describes the methods for the development of wells. Wells are developed after installation in order to remove introduced water and drilling fluids, reduce the turbidity of the water, and improve the hydraulic communication between the well and the water-bearing formation. Well development will not commence until the annular grout seal has cured, but will be performed within ten calendar days of well installation.

PROCEDURE

1. All well development will include surge blocking or false bailing with one or more of the following fluid removal methods. Well development activities may include:

    - Bailing
    - Air Lifting
    - Submersible Pumping
    - Other methods as approved by the Benchmark Field Team Leader.

    The appropriate water removal method will be selected based on water level depth and anticipated well productivity.

2. Assemble and decontaminate equipment (if necessary), and place it in the well. Reference the Benchmark Field Operating Procedure for Drilling and Excavation Equipment Decontamination.

MONITORING WELL DEVELOPMENT PROCEDURES

3. Alternate the use of agitation methods with water removal methods, using the former to suspend solids in the well water, and the latter to remove the turbid water. For example, use a vented surge block to agitate the well, moving up and down within the screened interval and then use a pump to clear the well. A bailer may be used for both purposes, by surging with the bailer (false bailing) for a period within the screened interval, then bailing a volume of water from the well.

4. When using surging methods, initiate this activity gradually, with short (2 to 3 feet) strokes. After several passes across the screened interval, increase the speed and length of the surge strokes.

5. Continue development until the following objectives are achieved:

   - Field parameters (pH, specific conductance, temperature) stabilize. Fluctuations beyond 10 percent above or below a mean value will not be considered stable.
   - The well will generate non-turbid water during continued pumping.
   - In the case of mud-rotary drilled wells, the volume of water removed exceeds twice the volume of water lost to the formation during the drilling process, as indicated by the water balance.

6. Document the development methods, volumes, field parameter measurements, and other observations on the attached Benchmark Well Development Record form (see Field Operating Procedures for Documentation Requirements of Drilling and Well Installation).

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

GROUNDWATER WELL DEVELOPMENT & PURGE LOG

Project Name:	WELL NUMBER:
Project Number:	Sample Matrix:
Client:	Weather:

WELL DATA:

DATE:	TIME:
Casing Diameter (inches):	Casing Material:
Screened interval (fbTOR):	Screen Material:
Static Water Level (fbTOR):	Bottom Depth (fbTOR):
Elevation Top of Well Riser (fmsl):	Datum Ground Surface Mean Sea Level
Elevation Top of Screen (fmsl):	Stick-up (feet):

VOLUME CALCULATION:

(A) Total Depth of Well (fbTOR):	
(B) Casing Diameter (inches):	
(C) Static Water Level (fbTOR):	
One Well Volume (V, gallons): $V = 0.0408 [(B)^2 \times \{ (A) - (C) \}]$	

Well Diam.	Volume Gal/Ft
1"	0.041
2"	0.163
3"	0.367
4"	0.653
5"	1.020
6"	1.469
8"	2.611

*Use the table to the right to calculate one well volume.

Field Personnel:

EVACUATION STABILIZATION TEST DATA:

Parameters	ACCUMULATED VOLUME PURGED (gallons)						
pH (units)							
Sp. Cond. (mS or uS)							
Temperature (°C)							
Turbidity (NTU)							
Appearance (visual)							
Odor (olfactory)							
Water Level (fbTOR)							

REMARKS:

PREPARED BY:

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

GROUNDWATER SAMPLE COLLECTION

PURPOSE

This procedure describes the methods for collecting groundwater samples from monitoring wells and domestic supply wells following purging and sufficient recovery. This procedure also includes the preferred collection order in which water samples are collected based on the volatilization sensitivity or suite of analytical parameters required.

PROCEDURE

Perform sampling as soon as practical after purging at any time after the well has recovered sufficiently to sample, or within 24 hours after evacuation, if the well recharges slowly. If the well does not yield sufficient volume for all required laboratory analytical testing (including quality control), a decision should be made to prioritize analyses based on contaminants of concern at the site. If a well takes longer than 24 hours to recharge, the Project Manager should be consulted.

<u>**Monitoring Wells**</u>

1. Purge the monitoring well in accordance with the Benchmark Field Operation Procedures for Monitoring Well Purging Procedures Prior to Sample Collection.

2. Sampling equipment that is not disposable or dedicated to the well will be decontaminated in accordance with the Benchmark Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

3. Calibrate all field meters (i.e., pH/Eh, turbidity, specific conductance, dissolved oxygen, PID etc.) in accordance with the Benchmark Field Operating Procedure for Calibration and Maintenance of the specific field meter.

GROUNDWATER SAMPLE COLLECTION

4. Groundwater samples will be collected directly from the sampling valve on the flow through cell (low-flow), discharge port of a standard pump assembly (peristaltic, pneumatic, submersible, or Waterra™ pump) or bailer (stainless steel, PVC or polyethylene). In low-yielding wells at which the flow through cell is not used, the samples may be collected using a disposable bailer.

5. If disposable polyethylene bailers are used, the bailer should be lowered *slowly* below the surface of the water to minimize agitation and volatilization.

6. Sampling data will be recorded on a Water Sample Collection Log (example attached).

7. Pre-label all sample bottles in the field using a waterproof permanent marker in accordance with the Benchmark Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures. The following information, at a minimum, should be included on the label:

   - Project Number;
   - Sample identification code (as per project specifications);
   - Date of sample collection (mm, dd, yy);
   - Time of sample collection (military time only) (hh:mm);
   - Specify "grab" or "composite" sample;
   - Sampler initials;
   - Preservative(s) (if applicable); and
   - Analytes for analysis (if practicable).

8. Collect a separate sample of approximately 200 ml into an appropriate container prior to collecting the first and following the last groundwater sample collected to measure the following parameters:

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

GROUNDWATER SAMPLE COLLECTION

Parameter	Units
Dissolved Oxygen	parts per million (ppm)
Specific Conductance	µmhos/cm or µS or mS
pH	pH units
Temperature	°C or °F
Turbidity	NTU
Eh *(optional)*	mV
PID VOCs *(if applicable)*	ppm

Record all field measurements on a Water Sample Collection Log form (example attached).

9. Collect samples into pre-cleaned bottles provided by the analytical laboratory with the appropriate preservative(s) added based on the volatilization sensitivity or suite of analytical parameters required designated below.

10. The samples will be labeled, stored and shipped in accordance with the Benchmark Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

Domestic Supply Wells

1. Calculate or estimate the volume of water in the well. It is desirable to purge at least one casing volume before sampling. This is controlled, to some extent, by the depth of the well, well yield and the rate of the existing pump. If the volume of water in the well cannot be calculated, the well should be purged continuously for no less than 15 minutes.

2. Connect a sampling tap to an accessible fitting between the well and the pressure tank where practicable. A hose will be connected to the device and the hose discharge located 25 to 50 feet away. The well will be allowed to pump until the lines and one well volume is removed. Flow rate will be measured with a container of known volume and a stopwatch.

GROUNDWATER SAMPLE COLLECTION

3. Place a clean piece of polyethylene or Teflon tubing on the sampling port and collect the samples in the order designated below and in the sample containers supplied by the laboratory for the specified analytes. ***DO NOT*** use standard garden hose to collect samples.

4. Sampling will be recorded on a Water Sample Collection Log form (example attached).

5. The samples will be labeled, stored and shipped in accordance with the Benchmark Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

SAMPLE COLLECTION ORDER

All groundwater samples, from monitoring wells and domestic supply wells, will be collected in accordance with the following.

1. Samples will be collected preferentially in recognition of volatilization sensitivity. The preferred order of sampling is:

   - Volatile Organic Compounds (VOCs)
   - Total Organic Halogens (TOX)
   - Total Organic Carbon (TOC)
   - Extractable Organic Compounds (i.e., BNAs, SVOCs, etc.)
   - Total metals (Dissolved Metals)
   - Total Phenolic Compounds
   - Cyanide
   - Sulfate and Chloride
   - Turbidity
   - Nitrate and Ammonia
   - Radionuclides

2. Document the sampling procedures and related information in the Project Field Book and on a Water Sample Collection Log form (example attached).

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

WATER SAMPLE COLLECTION LOG

Project Name:	WELL NUMBER:
Project Number:	Laboratory Name:
Client:	Date Shipped to Lab:
	Sample Matrix:

WELL DATA:

DATE:	TIME:
Casing Diameter (inches):	Casing Material:
Screened interval (fbTOR):	Screen Material:
Static Water Level (fbTOR):	Bottom Depth (fbTOR):
Elevation Top of Well Riser (fmsl):	Datum Ground Surface: Mean Sea Level
Elevation Top of Screen (fmsl):	Stick-up (feet):

PURGING DATA:

DATE:	START TIME:	END TIME:	
Method:	Is purge equipement dedicated to sample location?	yes	no
No. of Well Volumes Purged:	Was well purged to dryness?	yes	no
Standing Volume (gallons):	Was well purged below sand pack?	yes	no
Volume Purged (gallons):	Field Personnel:		
Purge Rate (gal/min):	***SEE GROUNDWATER WELL DEVELOPMENT & PURGE LOG***		

SAMPLING DATA:

DATE:	START TIME:	END TIME:	
Method:	Is sampling equipement dedicated to sample location?	yes	no
Initial Water Level (fbTOR):	Was well sampled to dryness?	yes	no
Final Water Level (fbTOR):	Was well sampled below sand pack?	yes	no
Weather Conditions:	Condition of Well:		
Air Temperature (°F):	Field Personnel:		
Source and type of water used in the field for QC purposes:			

PHYSICAL & CHEMICAL DATA:

DESCRIPTION OF WATER SAMPLE		
Odor		
Color		
NAPL		
PID Scan	NA	ppm
Contains Sediment?	yes	no

WATER QUALITY MEASUREMENTS

Sample	Time	pH (units)	TEMP. (°C)	COND. (uS)	D.O. (ppm)	TURB. (NTU)	Eh (mV)
initial							
final							

REMARKS:

PREPARED BY:

Benchmark Environmental Engineering & Science, PLLC

FIELD OPERATING PROCEDURE

NON-DISPOSABLE AND NON-DEDICATED SAMPLING EQUIPMENT DECONTAMINATION

PURPOSE

This procedure is to be used for the decontamination of non-disposable and non-dedicated equipment used in the collection of environmental samples. The purpose of this procedure is to remove chemical constituents from previous samples from the sampling equipment. This prevents these constituents from being transferred to later samples, or being transported out of controlled areas.

HEALTH AND SAFETY

Nitric acid is a strong oxidizing agent as well as being extremely corrosive to the skin and eyes. Solvents such as acetone, methanol, hexane and isopropanol are flammable liquids. Limited contact with skin can cause irritation, while prolonged contact may result in dermatitis. Eye contact with the solvents may cause irritation or temporary corneal damage. Safety glasses with protective side shields, neoprene or nitrile gloves and long-sleeve protective clothing must be worn whenever acids and solvents are being used.

PROCEDURES

Bailers, split-spoons, steel or brass split-spoon liners, Shelby tubes, submersible pumps, soil sampling knives, and similar equipment will be decontaminated as described below.

1. Wash equipment thoroughly with non-phosphate detergent and potable-quality water, using a brush where possible to remove any particulate matter or surface film. If the sampler is visibly coated with tars or other phase-separated hydrocarbons, pre-wash

NON-DISPOSABLE AND NON-DEDICATED SAMPLING EQUIPMENT DECONTAMINATION

with acetone or isopropanol, or by steam cleaning. Decontamination will adhere to the following procedure:

a. Rinse with potable-quality water;

b. Rinsed with 10% nitric acid (HNO_3) solution (see ***Note 1***);

c. Rinse with potable-quality water;

d. Rinse with pesticide grade acetone or methanol (see ***Note 2***);

e. Rinse with pesticide grade hexane (see ***Note 2***);

f. Rinse with deionized water demonstrated analyte-free such as distilled water);

g. Air dry; and

h. Store in a clean area or wrap in aluminum foil (shiny side out) or new plastic sheeting as necessary to ensure cleanliness.

2. All non-dedicated well evacuation equipment, such as submersible pumps and bailers, which are put into the well, must be decontaminated following the procedures listed above. All evacuation tubing must be dedicated to individual wells (i.e., tubing cannot be reused). However, if submersible pump discharge tubing must be reused, the tubing and associated sample valves or flow-through cells used in well purging or pumping tests will be decontaminated as described below:

   a. Pump a mixture of potable water and a non-phosphate detergent through the tubing, sample valves and flow cells, using the submersible pump.

   b. Steam clean or detergent wash the exterior of the tubing, sample valves, flow cells and pump.

   c. Pump potable water through the tubing, sample valve, and flow cell until no indications of detergent (e.g. foaming) are observed.

NON-DISPOSABLE AND NON-DEDICATED SAMPLING EQUIPMENT DECONTAMINATION

d. Double rinse the exterior of the tubing with potable water.

e. Rinse the exterior of the tubing with distilled water.

f. Store in a clean area or wrap the pump and tubing assembly in new plastic sheeting as necessary to ensure cleanliness until ready for use.

3. All unused sample bottles and sampling equipment must be maintained in such a manner that there is no possibility of casual contamination.

NOTES

(1) Omit this step if metals are not being analyzed. For carbon steel split spoon samplers, a 1% rather than 10% HNO_3 solution should be used.

(2) This solvent rinse can be omitted if organics are not being analyzed. Alternatively, if approval from the NYSDEC has been granted, use pesticide grade isopropanol as the cleaning solvent. Isopropanol is better suited as a cleaning solvent that acetone, methanol and hexane for the following reasons:

- Acetone is a parameter analyzed for on the Target Compound List (TCL); therefore the detection of acetone in samples collected using acetone rinsed equipment is suspect;
- Almost all grades of methanol contain 2-butanone (Methyl Ethyl Ketone, MEK) contamination. As for acetone, 2-butanone is a TCL compound. Thus, the detection of 2-butanone in samples collected using methanol rinsed equipment is suspect. In addition, methanol is much more hazardous than either isopropanol or acetone.
- Hexane is not miscible with water (hydrophobic) and therefore, is not an effective rinsing agent unless the sampling equipment is dry. Isopropanol is extremely miscible in water (amphoteric), making it an effective rinsing agent on either wet or dry equipment.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

SAMPLE LABELING, STORAGE AND SHIPMENT PROCEDURES

PURPOSE

The collection and analysis of samples of environmental media, including soils, groundwater, surface water, and sediment, are the central activities of the field investigation. These samples must be properly labeled to preserve its identity, and properly stored and shipped in a manner that preserves its integrity and chain of custody. This procedure presents methods for these activities.

SAMPLE LABELING PROCEDURE

1. Assign each sample retained for analysis a unique 9-digit alphanumeric identification code. Follow format in Table 3 of QAPP.

2. Affix a non-removable (when wet) label to each sample container. The following information will be written on the label with black or blue ink that will not smudge when wet:
   - Project number
   - Sample ID (see Step 1 above)
   - Date of sample collection
   - Time of sample collection (military time only)
   - Specify "grab" or "composite" sample with an "X"
   - Sampler initials
   - Preservative(s) (if applicable)
   - Analytes for analysis (if practicable)

SAMPLE LABELING, STORAGE AND SHIPMENT PROCEDURES

3. Record all sample label information in the Project Field Book and on a Sample Summary Collection Log (see attached examples), keyed to the sample identification number. In addition, add information regarding the matrix, sample location, depth, etc. to provide a complete description of the sample.

SAMPLE STORAGE PROCEDURE

1. Immediately after collection, placement in the proper container, and labeling, place samples to be retained for chemical analysis into resealable plastic bags.

2. Place bagged samples into an ice chest filled approximately half-full of double bagged ice. Blue ice is not an acceptable substitute for ice.

3. Maintain samples in an ice chest or in an alternative location (e.g. sample refrigerator) as approved by the Benchmark Field Team Leader until time of shipment. Periodically drain melt-water off coolers and replenish ice as necessary.

4. Ship samples on a daily basis, unless otherwise directed by the Benchmark Field Team Leader.

5. Maintain appropriate custody procedures on coolers and other sample storage containers at all times. These procedures are discussed in detail in the Quality Assurance Project Plan or Monitoring Plan.

SAMPLE SHIPPING PROCEDURE

1. Fill out the chain-of-custody form completely (see attached example) with all relevant information. The white original goes with the samples and should be placed in a resealable plastic bag and taped inside the sample cooler lid; the sampler should retain the copy.

SAMPLE LABELING, STORAGE AND SHIPMENT PROCEDURES

2. Place a layer of inert cushioning material such as bubble pack in the bottom of cooler.

3. Place each bottle in a bubble wrap sleeve or other protective wrap. To the extent practicable, then place each bottle in a resealable plastic bag.

4. Open a plastic bag into a cooler and place sample bottles into the garbage bag (or similar) with volatile organic analysis (VOA) vials near the center of the cooler.

5. Pack bottles with ice in plastic bags. At packing completion, cooler should be at least 50 percent ice, by volume. Coolers should be completely filled, so that samples do not move excessively during shipping.

6. Duct tape (or similar) cooler drain closed and wrap cooler completely in two or more locations to secure lid, specifically covering the hinges of the cooler. Place signed custody seals over duct tape between the lid and cooler body and wrap with clear strapping tape.

7. Place laboratory label address identifying cooler number (i.e., 1 of 4, 2 of 4 etc.) and overnight delivery waybill sleeves on cooler lid or handle sleeve (Federal Express).

8. Sign the custody seal tape with an indelible soft-tip marker and place over the duct tape across the front and back seam between the lid and cooler body.

9. Cover the signed custody seal tape with an additional wrap of transparent strapping tape.

10. Place "Fragile" and "This Side Up" labels on all four sides of the cooler. "This Side Up" labels are yellow labels with a black arrow with the arrow head pointing toward the cooler lid

11. For coolers shipped by overnight delivery, retain a copy of the shipping waybill, and attach to the chain-of-custody documentation.

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

SOIL BORING LOG DESCRIPTION PROCEDURES USING THE UNIFIED SOIL CLASSIFICATION SYSTEM

PURPOSE

This guideline presents a means for insuring proper field identification and description of soils collected from a split-spoon (barrel) sampler. The lithology and moisture content of each soil sample will be physically characterized by visual observation according to the Unified Soil Classification System (USCS). This method of soil characterization describes soil types based on grain size and liquid and plastic limits and includes moisture content. Intensely weathered or decomposed rock that is friable and can be reduced to gravel size or smaller by normal hand pressure should be classified as a soil. The soil classification would be followed by the parent rock name in parenthesis.

PROCEDURE

Assemble necessary equipment and discuss program requirements with drilling contractor.

1. Advance boring in accordance with accepted Benchmark Split-Spoon Sampling Field Operating Procedure at pre-specified intervals. Samples shall be taken at a minimum from each stratigraphic unit and each screened interval. Record the number of blows necessary to drive the split-spoon sampler per 6-inch interval. If the sampler is not driven the 6-inch interval after 50 blows are delivered, measure the sampler penetration distance and record this distance along with the blow count. Advance augers to the next sample interval and repeat procedure.

2. After opening the split-spoon sampler, measure and record the length of the recovered sample. The upper 2 to 3 inches of the sample should be disregarded, as the material is likely not representative of the native in-situ materials.

3. Shave a thin layer off the entire length of the sample to expose fresh sample. (Note: The outer sample surface of often smeared while the sample barrel is being driven.) The sample should be photographed and screened with a PID at this time, if applicable.

4. Describe the sample using terminology presented in the Descriptive Terms section below.

5. After the sample has been described, place representative portion of the sample in new, precleaned jars. Label the jar with the borehole number, sample interval, date, number of blow counts and project number and store in a secure location.

DESCRIPTIVE TERMS

All field soil samples will be classified in accordance with the Unified Soil Classification System (USCS) presented herein and on the attached pages. It is desirable to supplement the USCS classification with a geologic interpretation of the soil sample that is supported by the soil descriptive terms presented in Table A (attached).

Use the following descriptive sequence when classifying soils:

- Group Name
- Group Symbol
- Consistency/Relative Density
- Color
- Moisture
- Particle Size/Shape/Angularity
- Gradation
- Plasticity
- Structure
- Cementation
- Organics

- Fill Materials
- Other Constituents/Characteristics

REQUIRED EQUIPMENT

- Knife
- Engineer's rule/measuring tape
- Permanent marker
- Pre-cleaned sample jars (usually provided by the driller)
- 10X hand lens
- Hydrochloric acid
- Camera
- Munsell soil color chart
- Project Field Book

UNIFED SOIL CLASSIFICATION SYSTEM
IDENTIFICATION TESTS FOR FINE-GRAINED SOILS

Soil Type	Group Symbol	Dry Strength	Dilatency	Toughness
Silts & Clays Liquid Limit <50	ML	None to slight	Quick to flow	None
	CL	Medium to high	None to very slow	medium
	OL	Slight to medium	Slow	slight
Silts & Clays Liquid Limit: >50	MH	Slight to medium	slow to none	slight to medium
	CH	High to very high	none	high
	OH	Medium to high	none to very slow	slight medium
Highly Organic Soils	PT	Identifiable by: And commonly:	color, order, by fibrous texture	Spongy feel

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FIELD OPERATING PROCEDURE

SPLIT-SPOON SAMPLING

PURPOSE

This guideline presents the methods for using a split-spoon sampler for collecting soil samples from a boring and for estimating the relative in-situ compressive strength of subsurface materials (ASTM D 1586). Representative samples for lithologic description, geochemical analysis, and geotechnical testing will be collected from the subsurface materials using the split-spoon sampler.

PROCEDURE

1. Place plastic sheeting on a sturdy surface to prevent the split-spoon and its contents from coming in contact with the surface (several layers of sheeting may be placed on the surface so that they may be removed between each sample or as needed).

2. Lower the sampling string to the base of the borehole. Measure the portion of the sampling string that extends above surrounding grade (i.e. the stickup). The depth of sampling will equal the total length of the string (sampler plus rods) minus the stickup length.

3. Measure sampling depths to an accuracy of 0.1 feet. If field measurements indicate the presence of more than 0.3 feet of disturbed materials in the base of the borehole (i.e. slough), the sampler will be used to remove this material, after which a second sampling trip will be made.

4. Select additional sampler components as required (i.e., leaf spring core retainer for clays or a sand trap for non-cohesive sands). If a retainer or trap is not used, a spacer ring will be used to hold the liners in position inside the sampler.

5. For driving samples, attach the drive head sub and hammer to the drill rods without the weight resting on the rods. For pushing samples using the rig hydraulics, skip to Step 9.

6. Mark four 6-inch intervals on the drill rods relative to a reference point on the drill rig. With the sampler resting on the bottom of the hole, drive the sampler with the 140 lb. hammer falling freely over a 30-inch fall until 24 inches have been penetrated or 50 blows applied.

7. Record the number of blows per 6 inches. Determine the "N" value by adding the blows for the 6 to 12-inch and 12 to 18-inch intervals of each sample drive.

8. After penetration is complete, remove the sampling string. If sample retention has been poor, let the sampling string rest in place for at least 3 minutes, then rotate clockwise at least 3 times before removing from the borehole.

9. For pushed samples, mark four 6-inch intervals on the drill rods relative to a reference point on the rig. Use the rig pulldown to press the sampler downward until 24 inches have been penetrated or no further progress can be made with the full weight of the rig on the sampler.

10. Remove the split-spoon sampler from the sampling string and place on the plastic-covered surface.

11. Open the split-spoon sampler only when the Benchmark field geologist is prepared to describe and manage the sample.

12. Describe the sample in accordance with the Unified Soil Classification System, using the Benchmark Boring Log (see Field Operating Procedures for Documentation Requirements for Drilling and Well Installation).

13. Collect a portion of the sample for field screening as described in the Benchmark Field Operating Procedure for Soil Sample Field Screening Using an Organic Vapor Meter.

14. If applicable, collect soil samples for volatile organic constituents (VOCs). If applicable, collect sample for semivolatile, metals, geotechnical, or other off-site analysis

15. Label, store, and manage the sample as described in the Benchmark Field Operating Procedure for Sample Management.