REPORT

Remedial Design Specifications

Chicago Pneumatic Tool Company
Frankfort, New York

April 1998

BBL
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engineers & scientists

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I, Edward R. Lynch, P.E. as a licensed Professional Engineer in the State of New York certify that the Remedial Design Specifications for the Chicago Pneumatic Tool Company in Frankfort, New York have been prepared in accordance with good engineering practice.

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1. Introduction

1.1 General

This document presents the Remedial Design (RD) Specifications for implementing the New York State Department of Environmental Conservation- (NYSDEC-) selected remedy for addressing chemical constituents present in environmental media at the Chicago Pneumatic Tool Company Inactive Hazardous Waste Site (Site No. 622003) located in Frankfort, New York. This RD Specification has been prepared by Blasland, Bouck & Lee, Inc., (BBL) at the request of Danaher Corporation (Danaher) and presents a task-by-task description and schedule of the activities necessary to implement the selected remedy for the site as presented in the NYSDEC's Record of Decision (ROD), dated March 29, 1996. This RD Specification also has been prepared in accordance with the Administrative Order on Consent (index No. B6-0491-96-04) entered into between Chicago Pneumatic Tool Company and the NYSDEC. The selected remedy includes ground-water collection and treatment, excavation of soil and sediment from identified areas of concern, and construction of an on-site containment cell.

This RD Specification has been organized into the following sections:

Section	Purpose
Section 1 - Introduction	This section presents project responsibilities, relevant background information, and project objectives, as well as regulatory requirements and technical bidding information.
Section 2 - Description of Work Tasks	This section presents a detailed description of the work tasks associated with implementing the remedial activities.
Section 3 - RD Support Documents	This section summarizes the technical documents that have been prepared in support of the RD Specifications
Section 4 - Schedule	This section presents a schedule for implementation of the remedial activities.

Project responsibilities, relevant background information, project objectives, regulatory requirements, and technical bid requirements are presented in the following subsections.

1.2 Project Responsibilities

This subsection identifies the minimum responsibilities of the Engineer, the Contractor selected to implement the RD Specifications, and Danaher.

<u>Engineer</u>

The Engineer will be retained by Danaher to provide the following services during implementation of the remedial activities:

- Review Contractor submittals [including those identified in this document and all other correspondence with Danaher (i.e., invoices, change orders, etc.)].

- Communicate with the NYSDEC as required during the course of the project.

- Field delineate the minimum horizontal limits of the sediment and soil removal activities.

- Provide full-time, on-site engineering observation services for the duration of the project to confirm that the remedial activities are conducted in accordance with these RD Specifications [including the Construction Quality Assurance Plan (CQAP)]. The on-site engineering observation services will include maintaining a daily log of the Contractor activities, weather conditions, site visitors, and construction problems encountered and associated solutions.

- Maintain a photographic record of construction progress to be included in the construction certification report.

- Oversee quality assurance/quality control (QA/QC) testing performed by the Contractor to confirm compliance with contract documents.

- Conduct pre-remediation sampling activities to define the horizontal limits of Areas 2, 3, 7, 8, 9, and 10.

- Conduct field screening and collect verification samples following removal of soil/sediment located within areas that have not been defined by pre-remediation sample results.

- Collect confirmation samples of excavated materials to verify the methods of disposal.

- Collect samples of treated effluent from the temporary on-site water treatment system to verify that the treatment system is functioning as specified.

- Maintain a record of all field screening and verification sampling and analytical results, including sampling methods, locations and depths, frequency, and analytical results.

- Conduct air monitoring in the vicinity of active excavation and construction areas as well as at the upwind and downwind perimeters of the site.

- Document daily activities; quantities of materials removed, generated, used, and disposed of; and document manpower, material, and equipment used.

- Document materials and equipment delivered to the site to verify conformance with the requirements of the contract documents, and approved remediation contractor submittals and shop drawings.

- Monitor the remediation contractor's survey control for evaluating payment quantities.

- Review remediation contractor change orders and invoices, and provide recommendations to Danaher for approval.

- Maintain an on-site project log containing hazardous waste manifests, non-hazardous waste bills of lading, and certificates of disposal for wastes generated by the remedial activities.

- Prepare a Site Operation, Maintenance, and Monitoring (OM&M) Plan.

- Prepare a Construction Certification Report.

Contractor

- Provide all equipment, materials, and labor necessary to implement the remedial activities.

- Ensure that all on-site personnel involved in select activities have OSHA 40-hour training [in accordance with Part 1910.120 of Title 29 of the Code of Federal Regulations (29CFR Part 1910.120)] and corresponding 8-hour refresher course updates. The Contractor shall provide evidence of 40-hour training and corresponding 8-hour refresher course updates (i.e., certificate of training completion for on-site personnel) to the Engineer prior to Contractor mobilization to the site.

- Implement the remedial activities as described in this RD Specification.

- Notify the Engineer immediately when conflict between this RD Specification and actual conditions are discovered.

- Coordinate all construction activities with the Engineer prior to commencing on-site activities and as necessary to complete the remedial activities.

- Prepare hazardous waste manifests, non-hazardous waste shipping papers, and obtain copies of certificates of disposal in a timely fashion.

- Provide copies of all air monitoring data generated as part of the Contractor's personal air monitoring program to Danaher.

- Complete the remedial activities in a timely fashion as outlined in Section 4.

Danaher

- Danaher will be responsible for overall project management during the implementation of the remedial activities. At the conclusion of the project, the Engineer will provide Danaher with one copy of the hazardous waste manifests, non-hazardous waste shipping papers, and certificates of disposal for wastes generated during the remedial activities. Danaher will be responsible for maintaining these copies in accordance with all regulatory requirements.

1.3 Project Objectives

The overall objectives of this RD Specification are as follows:

- Provide the information necessary to implement the NYSDEC-selected remedy for the site, as presented in the March 29, 1996 ROD;

- Present the basis of design for the selected remedy;

- Identify the roles of Danaher, the Engineer, and the Contractor during implementation of the selected remedy; and

- Provide a schedule for implementation of the selected remedy.

In order to meet these objectives, this RD Specification presents the following information and requirements:

- Summary of existing site conditions.
- Description of the soil and sediment excavation areas and disposal requirements.
- Verification sampling requirements to confirm that the cleanup objectives presented in the ROD have been achieved.
- Description of the hydroflushing requirements for drainage piping and culverts in the areas where sediment removal activities will be performed.
- Description of the activities necessary to construct an on-site containment cell for on-site disposal of excavated materials. The on-site cell will consist of two areas, one that will be used to provide soil vapor extraction (SVE) treatment of select soils and sediments, and the other which will provide containment for excavated materials that do not require SVE treatment.
- Description of the on-site SVE system to be constructed.
- Excavated soil and sediment disposal requirements (in either the on-site containment cell or off-site disposal).
- Requirements for the handling, characterization, and disposal of waste materials generated during implementation of these RD Specifications.
- Methods for abandoning existing select ground-water monitoring wells and installation methods for two new ground-water monitoring wells.
- Description of two ground-water collection trenches to be installed for capturing and treating ground water by the existing Surface-Water Interim Remedial Measure (IRM) located at the site.
- Restoration requirements for the site following completion of the remedial activities.
- Contractor requirements for a Site Management Plan, Remedial Action Contingency Plan, Site-Specific Health and Safety Plan (HASP), and Decontamination Plan.

1.4 Background Information

This section presents relevant background information used to develop the RD Specifications and Contractor Scope of Work. A brief site description is presented below, followed by a summary of the site history and a description of the IRMs implemented at the site.

1.4.1 Site Setting and History

The site is located in the Town of Frankfort, Herkimer County, New York, approximately one mile east of the City of Utica, New York, as presented on the cover sheet of the Contract Drawings.

The site consists of a 77-acre lot in an industrial setting, which is bound to the north by Bleecker Street, to the south by wooded and agricultural land, to the west by an unnamed creek that drains the wooded area, and to the east by a property fenceline bordering Industrial Park Drive. Existing site conditions are presented on Drawing G-1. Surface-water features at the site include the unnamed creek which flows northward along the western portion of the site (Area 1 on Drawing G-2), and a series of on-site drainage ditches that flow eastward along the southern portion of the site, and northward along the eastern portion of the site (Areas 4, 6, and 14 on Drawing G-2). Four separate surface-water outfalls at the site are regulated by a NYSDEC State Pollutant Discharge Elimination System (SPDES) Permit.

During the 1930s and early 1940s, the site was occupied by an amusement park and baseball field. A manufacturing building was constructed at the site in 1948 and was used as a pneumatic tool manufacturing facility until the facility's shut down in early 1997. Additional structures at the site include a former foundry, former power plant, former oil storage building, aboveground oil tanks, and a garage.

As part of the historical site operations, waste oils were discharged into three unlined separation ponds (Areas 7 and 8 on Drawing G-2) from 1966 through 1978. Waste oil from a metal chip handling facility was collected in an underground steel holding tank. The waste oil was then pumped to the first of three ponds located in the southern portion of the site. Water and oil were allowed to discharge to the next pond in the series and then ultimately to the on-site drainage ditch. When the ponds became filled with oil, the oil was pumped off and either disposed of off-site or burned as fuel in the power plant. This practice was discontinued in 1979, and the three separation ponds were closed and the underground storage tank (UST) removed. A skimmer pond (Area 5 on Drawing G-2) was constructed near the southeastern corner of the manufacturing building to intercept oil migrating in an on-site drainage ditch from the metal chip handling area.

The skimmer pond currently discharges through an air stripper treatment system, which was constructed as an IRM in 1995. The treatment system discharges to the eastern drainage ditch (Area 14 on Drawing G-2) which flows to an off-site drainage ditch (Areas 8, 9, and 10 on Drawing G-2). The treated effluent is monitored in accordance with the SPDES permit established for the treatment discharge outfall (SPDES Outfall 03A).

Various types of debris, such as empty crushed drums, tree stumps, granite blocks, and foundry sand, were disposed of on site. An area was excavated west of the former separation ponds and used as a debris landfill for burial of this material (Areas 9 and 10 on Drawing G-2).

Metal chips from the manufacturing process were stored in a chip chute area located along the south side of the manufacturing building until 1991 (Areas 2 and 3 on Drawing G-2). On occasion, some oil drainage from the former chip chute area migrated to the drainage ditch that drains to the skimmer pond (Area 4 on Drawing G-2).

Additional information regarding existing site conditions, including the site building layout, building foundations, and site utilities is provided in the Contractor's Supplemental Information Package, included with the Contractor Bid Forms.

1.4.2 Summary of Previous Site Investigations

The following site investigations have been performed at the site:

- NYSDEC Phase I investigation, conducted in 1985;
- United States Environmental Protection Agency (USEPA) site inspection, conducted in 1986;
- Environmental assessment activities performed by BBL between 1988 and 1991;

- NYSDEC preliminary site assessment, conducted in 1990; and
- Remedial Investigation/Feasibility Study (RI/FS) Work Plan scoping activities performed by BBL in 1993.

The RI/FS was initiated on October 26, 1993, with the signing of the RI/FS Administrative Order on Consent (Order) between the NYSDEC and Chicago Pneumatic Tool Company (Index no. A6-0279-92-04). BBL performed the RI and supplemental RI (SRI) activities between 1993 and 1995.

Based on the results of the RI and SRI, the NYSDEC-approved FS Report (BBL, December 1995) presented an evaluation of remedial alternatives which addressed the constituents of interest in site media and presented a recommended alternative. Based on the results of the RI and SRI/FS, the NYSDEC issued the ROD for the site on March 29, 1996, which presented the NYSDEC-selected remedy for the site. In November 1997, BBL submitted an RD Work Plan for the design of the selected remedy to the NYSDEC.

Copies of the RI and SRI will be made available for review to prospective Contractors for their review upon request.

1.4.3 Interim Remedial Measures

The following two IRMs have been implemented at the site:

- Surface-Water IRM; and
- Storm Sewer Sediment Removal IRM.

Presented below is a summary of each IRM.

<u>Surface-Water IRM</u>

This IRM was implemented at the site in March 1995 to collect and treat surface water containing concentrations of trichloroethylene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride (VC) originating from the skimmer pond and a clay pipe located along Bleecker Street. The IRM treatment system and all equipment controls are located in the southeastern corner of the manufacturing building and consists of a low-profile air stripper. The major elements of the Surface-Water IRM are presented on Drawing G-1.

The air stripper treats influent pumped from two manholes that collect water from the skimmer pond overflow and clay pipe discharge. From the air stripper, treated water discharges by gravity to SPDES Outfall 03A, which is the surface-water drainage ditch upstream of SPDES Outfall 003, on the southeastern corner of the site. The area around the air stripper is contained by a 6-inch high curb and drains into a trench drain/sump. A sump pump transfers collected water to the inlet of the air stripper.

The air stripper is designed to treat high flow (during rain or snow melt events) and normal operating conditions. Off-gas from the air stripper is discharged to the atmosphere through a 26-foot high, 12-inch diameter discharge stack.

An 8-inch diameter pipe was installed to allow the oil skimmer pond to overflow by gravity into a manhole designated as Pumping Manhole No. 1. Two submersible pumps installed in the manhole operate on a lead/lag/alternate sequence via level controls. Each of the two pumps are capable of pumping the normal operating flow of up to 65 gallons per minute (gpm) and can meet the high flow operating conditions of up to 130 gpm with both pumps running.

Water from the clay pipe flows by gravity via an 8-inch diameter pipe into a manhole designated as Manhole No. 2, located just south of Bleecker Street on the northern side of the site. Two submersible pumps installed in the manhole operate on a lead/lag/alternate sequence via level controls. Each pump is capable of pumping the current normal operating flow of up to 10 gpm and can meet the high flow operating condition of up to 20 gpm with both pumps running.

When the IRM was implemented to address surface water from the skimmer pond and clay pipe discharges, the design took into consideration the IRM's potential expanded future use as the remedial alternative for ground water and has the capacity to treat up to 250 gpm. Therefore, no additional upgrades to the air stripper will be required for the remedial activities proposed in the RD Specifications.

<u>Storm Sewer Sediment Removal IRM</u>

This IRM was conducted in 1996 and 1997 to address the presence of inorganics and polychlorinated biphenyls (PCBs) detected within the sediments in the storm sewers at the site. The IRM was designed to remove these sediments from the storm sewers.

The storm sewer sediment removal IRM consisted of removing sediments from the storm sewer system using high pressure water sprays to suspend the sediments. The washwater and sediments were then removed via a vacuum truck from the downstream manholes or outfalls. The sediments were separated from the washwater via gravity settling, and disposed off site. The washwater was treated via a series of particulate filters and activated carbon units. The treated washwater was then discharged to the Oneida County sanitary sewer connection located on site, in accordance with the Oneida County Sanitary Sewer District discharge standards.

As of February 1998, this IRM was completed except for the following sections of the storm sewers:

- The section of storm sewer located between SPDES Outfall 001 and the next upstream manhole (Manhole MH-1); and
- The section of storm sewer located between SPDES Outfall 002 and the next upstream manhole (Manhole MH-2).

These storm sewers did not undergo sediment removal during IRM implementation in 1996 because of flooding at the SPDES outfalls. This IRM will be completed as part of the remedial activities for the site in accordance with the requirements of Work Task 4, presented in Section 2.6 of this document.

1.5 Regulatory Requirements

The contents of this RD Specification have been based, in part, on numerous federal, state, and local regulations and guidance. The Contractor selected to implement the RD Specifications shall be familiar with all applicable regulations and shall be bound by the requirements of such whether or not specifically addressed herein. Such state and federal regulations include, but may not be limited to, the following:

Regulation	Topic
40 CFR Parts 260-267 [Resource Conservation and Recovery Act (RCRA)]	Hazardous Waste Management Regulations
40 CFR Part 761 [Toxic Substances Control Act (TSCA)]	Management and Disposal of PCBs
29 CFR Parts 1910 and 1926	Occupational Safety and Health Administration (OSHA) Standards
Section 404 of the Clean Water Act (CWA)	Regulates the Discharge of Dredged or Fill Materials, Including Excavation Activities, into Waters of the United States
Part 364 of Title 6 of the New York Compilation of Codes, Rules, and Regulations (6 NYCRR Part 364)	Waste Transporter Permits
6 NYCRR Part 371	Identification and Listing of Hazardous Waste
6 NYCRR Part 372	Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Disposal Facilities
6 NYCRR Part 376	Land Disposal Restrictions

The Contractor selected to implement the RD Specifications shall be required to obtain all necessary local building permits prior to implementation of the IRM activities.

1.6 Technical Bid Information

This subsection identifies information to be submitted with each prospective Contractor's bid.

The Contractor shall submit a narrative discussion of the proposed approach for completing the remedial activities identified in Section 2 of these specifications. The narrative should be organized to identify activities that shall be performed for each task identified in Section 2 of this document.

In addition to the above, the Contractor's narrative shall identify the following information, in sufficient detail, in their bid:

- Project team members, project management, qualifications, breakdown of disciplines for each member of the project team (management, site health and safety officers, operators, technicians/laborers, etc.). The Contractor must also designate both the Project Manager and the on-site Project Supervisor responsible for making required decisions, and the primary contact for the Engineer during the performance of all work activities.
- Origin of identified project staff (local versus out-of-town).
- Any subcontractors, teaming arrangements, or joint ventures to be used on this project. This shall include providing their qualifications and defining the project tasks to be undertaken by others.

- A statement confirming that on-site personnel involved in select activities shall have OSHA 40-hour training (in accordance with 29 CFR Part 1910.120) and corresponding 8-hour refresher course updates.

- A proposed project schedule based on currently available site information and the Contractor's detailed description of the proposed approach for completing the remedial activities. An anticipated project schedule for implementation of the remedial activities is provided in Section 4. The Contractor's proposed project schedule should, at a minimum, show the anticipated start date and duration of each of the major components of each work task.

- Applicable local, state, and federal regulations that apply to the remedial activities and methods for complying with these regulations.

- Description of the soil erosion and sediment control measures to be installed, as well as the approximate location of the measures to be installed in addition to the locations presented on Drawing G-10.

- Listing of various Contractor equipment anticipated to be used on this project. The availability of additional/back-up equipment should be discussed, as should any corresponding costs. The Contractor shall specify whether the equipment is owned by the Contractor or if the equipment will be leased for the project.

- Anticipated hours of operation for the Contractor's staff for the tasks identified in Section 2. The Contractor's hours of operation shall constitute a normal or typical work day (i.e., 8-hour, 10-hour, 12-hour, etc.), and a normal work week (five days/week). Additional information should be included for any premium time, holiday time, etc., for personnel and equipment. Tables, summarizing labor rates and equipment rates for all anticipated work situations, should be included.

- A hand-marked or drafted figure detailing the preferred location of site trailers, all decontamination area(s), staging area(s), dewatering/stabilization area(s), and support areas. Drawing G-3 presents the locations available at the site for these areas, as well as approximate locations of site access points.

- Methods and materials to be employed to construct temporary haul roads, decontamination area(s), staging area(s), dewatering/stabilization area(s), and support areas. The Contractor should include details (i.e., plans and sections) depicting the construction materials and preliminary sizes of each area or haul road.

- Source(s) and type of rip-rap and select backfill material that meets the criteria presented in Section 2, on the Contract Drawings, and in the Material and Performance Specifications.

- Proposed waste transporters and non-hazardous waste disposal facilities for each of the anticipated waste streams described in Section 2. Hazardous and TSCA waste generated during implementation of the remedial activities will be disposed of at Chemical Waste Management's Model City Landfill, located in Model City, New York.

- Details and procedures regarding recordkeeping and transfer of information to the Engineer and Danaher.

- Proposed method(s) for conducting excavation activities in accordance with all applicable OSHA regulations, including Subpart P of 29 CFR Part 1926. The Contractor should consider the proximity of select excavation areas to buildings/structures at the site. This description should clearly identify the equipment and materials to be used to excavate and backfill the excavations.

2. Description of Work Tasks

2.1 General

This section presents a task-by-task description of the activities associated with implementation of the RD Specifications. The activities associated with implementing the RD Specifications shall be conducted under the following general work tasks:

- Work Task 1 - Pre-Remediation Activities;
- Work Task 2 - Soil Excavation;
- Work Task 3 - Sediment Removal;
- Work Task 4 - Pipe Cleaning/Replacement;
- Work Task 5 - Monitoring Well Abandonment;
- Work Task 6 - Temporary Water Treatment System;
- Work Task 7 - Soil/Sediment Disposal Requirements;
- Work Task 8 - Ground-Water Collection Trenches;
- Work Task 9 - Miscellaneous Materials Handling/Site Security;
- Work Task 10 - Handling, Transportation, and Off-Site Disposal of Waste Materials;
- Work Task 11 - Site Restoration/Demobilization; and
- Work Task 12 - Standby Operations.

A description of the cleanup objectives associated with Work Tasks 2 and 3 are presented below, followed by descriptions of each of these work tasks.

2.2 Cleanup Objectives

As set forth in the ROD, soil/sediment removal activities are required to address the presence of PCBs, four inorganic constituents, and a select number of chlorinated VOCs in soil/sediment at select areas on the site. Site-specific cleanup goals, to address certain constituents within the soil/sediment at the site, were provided in the ROD and are presented in the table below.

Chemical Constituent	Soil (ppm)	Sediment (ppm)
Total VOCs [1]	10.0	N.A.
Total Lead	25.5	25.5
Total Chromium	17.8	17.8
Total Copper	40.4	40.4
Total Zinc	101	101
Total PCBs	1.0 (surface) 10.0 (subsurface)	1.0

Notes:

1. Total VOCs represents the sum of the individual concentrations of VC, trans-1,2-DCE, cis-1,2-DCE, and TCE.

2. Cleanup objectives for surface water must meet applicable Class D surface-water quality standards as presented in 6 NYCRR Part 703.

3. ppm = parts per million.

4. The surface soil cleanup objective pertains to soils located within 1.5 feet of the ground surface. Subsurface soil pertains to soils located at depths greater than 1.5 feet below ground surface.

2.3 Work Task 1 - Pre-Remediation Activities

The activities to be conducted under this work task include the following:

- The Contractor's preparation, submittal, and revision (if necessary) of all required plans, including any assumptions, drawings, or other necessary documentation;

- A pre-remediation meeting to be held at the site between Danaher, the Engineer, NYSDEC, and the Contractor; and

- Mobilization/site preparation activities.

A detailed description of each above-identified activity is presented in the following subsections.

2.3.1 Preparation and Review of Contractor Submittals

Within 14 days following the contract award, and at least seven days prior to scheduled mobilization, the selected Contractor shall submit four copies of the following plans for review and approval by Danaher and the Engineer:

1. Site Management Plan;

2. Site-Specific HASP;

3. Remedial Action Contingency Plan;

4. Erosion and Sedimentation Control Plan; and

5. Decontamination Plan.

The minimum requirements for the preparation of the above-listed plans are presented in Appendix A. The selected Contractor also shall submit four copies of the following information to Danaher and the Engineer for review and approval:

- Identification of names and addresses of proposed backfill sources and the type of backfill material to be obtained from each source;
- Proposed dust control measures to be implemented during the various phases of the remedial activities, including the proposed source of the potable water to be utilized; and
- Proposed vapor suppression measures and at least one alternate measure to be implemented during various phases of the remedial activities (if necessary).

The selected Contractor may be directed by the Engineer to supply two 5-gallon buckets (with lids) of each type of backfill (for each source). Alternatively, the Engineer may collect the backfill samples at each source. For each type of backfill, samples will be obtained from two different sources. The method for obtaining the backfill samples shall be at the discretion of the Engineer. The Engineer shall submit backfill samples for laboratory analysis (at an analytical laboratory selected by the Engineer) of the following parameters (at the Contractor's expense):

1. Pesticides/PCBs;

2. Target constituent list (TCL) volatile constituents;

3. TCL semi-volatile constituents;

4. Target analyte list (TAL) inorganics;

5. Sieve analysis in accordance with ASTM D-422 (if determined necessary by the Engineer). Proposed rip-rap shall be subject to visual examination by the Engineer prior to being brought on-site;

6. Modified proctor compaction test (ASTM D1557), if determined necessary by the Engineer;

7. Minimum/maximum relative density test in accordance with ASTM D4253 and ASTM D4254 for Types (2) and (3) select fill;

8. Permeability test in accordance with ASTM D2434 for Types (2) and (3) select fill; and

9. Atterberg Limits in accordance with ASTM D4318 for "soil fill material" as defined in M&P Section 02222.

If analysis of the backfill samples indicates unacceptable chemical or physical characteristics, the Contractor shall identify and provide sample(s) from an alternative backfill source (including the name and address of the alternate backfill source) to the Engineer for submittal for laboratory analysis of the above-listed chemical constituents and physical characteristics. The Contractor shall be responsible for laboratory costs and time delays associated with the laboratory analysis of alternative backfill sources at no additional cost to Danaher.

Submittal Requirements for Substitutions

For the purposes of this RD Specification, whenever an item is specified or described by reference of manufacturer name and/or model, the naming of the item is intended to establish the type, function, and quality required. If indicated as "or equal", the Contractor may propose substitute materials and/or equipment for review by the Engineer. Request for review of substitute items must be made in writing by the Contractor to the Engineer. The Engineer shall be the sole judge of the acceptability of the substitute item and decisions shall be final. No substitute item shall be ordered or installed by the Contractor without prior written acceptance by the Engineer.

The Contractor shall submit the following information (as applicable) in addition to the previously described shop drawings and operation and maintenance data for any proposed equipment and/or materials substitution for the temporary on-site water treatment system, SVE system, or containment cell:

- Design and operating specifications;
- Theory of operation and functional diagrams;
- Recommended installation arrangement, locations, wiring criteria;
- Performance data and certifications;
- Name, address, and phone number of a manufacturer's representative; and
- Other information as requested by the Engineer for evaluation of the substitute equipment and/or materials.

Information contained in contract submittals that is not applicable to the specific item furnished should be clearly lined out or deleted. Submittals must be easily legible, clean, and clearly reproduced.

All of the required contract submittals shall be reviewed by Danaher and the Engineer. Comments on the submittals from Danaher shall be provided to the Engineer for transmittal to the Contractor. The Engineer shall mark each submittal to indicate the following:

1. "Reviewed" if no objections are observed or comments made.
2. "Reviewed and noted" if minor objections, comments, or additions are made but resubmittal is not necessary.
3. "Resubmit" if objections, comments, or additions are extensive. In this case, the Contractor shall revise and resubmit three copies of the items for review by Danaher and the Engineer within three working days of receiving comments on the original submittal.

4. "Rejected" if the submittal does not comply, even with reasonable revision, with contract conditions. In this case, the Contractor shall resubmit a new or modified submittal within three working days of receiving the rejection on the original submittal that meets the scope and intent of the work specified in the contract.

The submitted HASP shall be compared to the minimum requirements presented in Appendix A. The health and welfare of the Contractor's staff is the direct responsibility of the selected Contractor. The Contractor shall take all necessary precautions for the health and safety of all on-site Contractor employees in compliance with all applicable provisions of federal, state, and local safety/health laws and provisions associated with the Engineer's site-specific HASP. One copy of the Engineer's HASP shall be provided to the selected Contractor to assist in preparing the site-specific HASP.

The Contractor shall revise required submittals as necessary to address comments from Danaher and the Engineer. The Contractor shall submit four copies of all revised and/or final submittals to the Engineer (the Engineer shall distribute revised and final documents to Danaher).

The Contractor shall not be permitted to perform any activity that directly or indirectly involves an item or items covered by a submittal until a "reviewed" or "reviewed and noted" stamp is provided by the Engineer. The Engineer's review shall in no way be construed as permitting departure from the Contract, except where the written request by the Contractor and written approval by the Engineer for such departure is included. The Engineer's review does not relieve the Contractor of any responsibility to comply with applicable laws, rules, regulations, or agreements.

Temporary On-Site Water Treatment System Submittals

The selected Contractor shall provide four copies of the following information to the Engineer pertaining to the temporary on-site water treatment system within 14 days following the contract award and at least seven days prior to scheduled mobilization:

Shop Drawings

The selected Contractor shall prepare and submit shop drawings for each component of the water treatment system that presents the following information:

- Equipment size, dimensions, and materials of construction;
- Piping connection sizes and types;
- Electrical wiring diagrams and schematics; and
- Elementary control diagrams.

Operation & Maintenance (O&M) Manual

The selected Contractor shall prepare and submit an O&M Manual for the temporary water treatment system that includes a general narrative detailing the Contractor's O&M activities. The O&M Manual shall include the following information (as applicable) for each major system component:

- Mobilization, start-up testing, normal (daily) operations, trouble shooting, and shut down procedures;

- Preventative or routine maintenance requirements;
- Lubrication schedules;
- Recommended spare parts list;
- Calibration and alignment information;
- Care and cleaning of surfaces; and
- Manufacturer's O&M manuals.

2.3.2 Pre-Remediation Meeting and Periodic Coordination Meetings

Pre-Remediation Meeting

Following contract award and prior to Contractor mobilization, a pre-remediation meeting shall be held at the site to introduce project team members representing Danaher, the Engineer, the Contractor, and the NYSDEC. The meeting shall be scheduled by Danaher shortly after award of the contract. The meeting shall be conducted to review contract requirements, establish a detailed schedule of operations, and resolve issues (if any) raised by the attending parties.

The Engineer shall prepare a summary of the pre-remediation meeting. A copy of the summary shall be provided to each of the parties in attendance. Failure by the Contractor to inform the Engineer, within five days of receiving the summary, of any discrepancies or inaccuracies contained therein, indicates that the Contractor concurs with the Engineer's summary of items/issues discussed and agreed upon during the meeting.

Periodic Coordination Meeting

Daily and weekly project coordination meetings shall be held at the site between the Contractor and the Engineer. Daily meetings shall be attended by the Contractor's on-site Project Supervisor and the Engineer to discuss day-to-day operations, schedule, health and safety items, outstanding issues, and the general status of the project. For purposes of the bid, the Contractor shall also include costs for attending up to 20 meetings to be held among on-site and off-site representatives of the Contractor and the Engineer. Danaher and the NYSDEC also may attend these weekly meetings. Weekly meetings shall be held to discuss issues including, but not limited to, project status, schedule, scope of work, and overall project implementation issues. Project management personnel that shall attend the weekly meetings shall be identified in the Contractor's proposal. Costs associated with attendance of off-site project management personnel at these meetings shall be included in the Contractor's bid.

2.3.3 Mobilization/Site Preparation Activities

Under this work task, site mobilization and preparation activities shall be initiated by the Contractor within one week after the required submittals have been reviewed and approved by the Engineer. The Contractor shall be responsible for the following general mobilization and site preparation activities:

- Coordinate with the Engineer for access to on-site water and electrical service.

- Verify existing site conditions and identify, mark, and verify the location(s) of all aboveground and underground utilities, equipment, and structures, as necessary to implement the corrective measures. The Contractor shall be responsible for coordinating with the applicable utility companies, Danaher, and the Engineer to ensure proper deactivation of any utilities. The Contractor also shall be responsible for maintaining appropriate clearances from utilities (i.e., active overhead electric lines). If the Contractor damages existing utilities, equipment, or structures, the Contractor is responsible for notifying the appropriate utility company and fully repairing all damages at no additional cost to Danaher. Repairs (if necessary) shall be completed in accordance with all requirements of the utility company and to the satisfaction of the Engineer.

- Install a visual and physical barrier (i.e., high visibility orange safety fence) around the base of the utility poles located within the east parking lot area and in the vicinity of the remedial activities.

- Mobilize manpower, equipment, and materials to the site as necessary to implement the remedial activities. Equipment mobilized to the site shall be subjected to a visual inspection by the Engineer. Equipment that arrives at the site in unsatisfactory condition (i.e., soiled, poor operating condition, etc.), in the opinion of the Engineer, shall be removed from the site and replaced by the Contractor at no additional cost to Danaher.

- Provide and maintain a minimum of two mobile office trailers with access stairs/platforms that comply with current OSHA regulations; one for use by the Contractor and one for use by the Engineer, Danaher, and the NYSDEC. The trailers shall be provided with an anchoring system in accordance with the manufacturer's requirements to prevent overturning due to wind forces. The trailer for the Engineer, Danaher, and the NYSDEC shall be furnished with electric, heat, air conditioning, two separate telephone connections, and at least one separate office (with a locking door) for the duration of the project. Other related items to be furnished with the office trailer for the Engineer, Danaher, and the NYSDEC include:

  - two direct telephone lines;
  - copy machine (with paper);
  - an answering machine;
  - facsimile machine (with paper);
  - two file cabinets, each with two drawers;
  - drafting table;
  - two desks with chairs;
  - two waste baskets;
  - potable water (i.e., bottled water) with disposable cups;
  - one refrigerator (approximately 10 cubic feet);
  - one set of 6-foot tall steel shelves;
  - 10 pound A-B-C fire extinguisher;
  - first aid kit; and
  - eye wash station.

  The Contractor shall also provide portable sanitary services (i.e., port-a-johns) as well as potable water supply for use by all on-site personnel engaged in the remedial activities. The Contractor shall provide maintenance and servicing of the sanitary facilities, office trailers, and equipment furnished with the office trailers, as required. The Contractor shall install, in accordance with all applicable codes and regulations, the electric and telephone services from the office trailers to a location indicated by the Engineer. The Contractor should assume the connection point shall be located within 100 feet of the office trailers. The Engineer shall coordinate with Bell Atlantic regarding the final connection of the telephone service and Niagara Mohawk Power Corporation for the electrical service. Electrical service for both trailers shall be billed directly to Danaher; telephone service for the Contractor's trailer shall be billed directly to the Contractor; and the telephone service to the Engineer's trailer shall be billed directly to Danaher.

- Obtain all federal, state, and/or local permits, as necessary, to complete the remedial activities (with the exception of environmental permits, which shall be obtained by the Engineer and Danaher).
- Maintain benchmarks in the vicinity of the remedial activities (which shall be established by the Engineer) to verify vertical elevations (as necessary) during the remedial activities.
- Install the meteorlogical monitoring system, which will be provided by the Engineer (as discribed in the Site-Specific Air Monitoring Plan included as Appendix G).
- Construct remediation support areas, material staging areas, on-site storage areas, temporary on-site water treatment system (as described in Section 2.8), and equipment and material decontamination areas in accordance with this document and the Contractor's plans. The material staging areas will, at minimum, include continuous berms around the perimeter of the area. Buffer materials (i.e., sand, non-woven geotextile fabrics, etc.) will then be installed over the area and will be overlain by two continuous layers of low and permeability liner (with a minimum thickness of 20 mils). The liner will be sloped to a sump to allow removal of liquids from the area. A drainage material will be installed over the liner to permit liquids within the area to flow to the sump and to act as a physical and visual buffer between the liner and materials placed within the area. Staging areas will be constructed in accordance with the reviewed Site Management Plan and to the satisfaction of the Engineer. The Contractor will be responsible for maintaining the integrity of the liner system during the implementation of the remedial activities. All staging areas will have high visibility fencing and sedimentation/erosion control measures (i.e., silt fence and/or straw bale dike as described below) installed around the perimeter or as directed by the Engineer.

The Contractor also shall be responsible for installing the appropriate soil erosion and sedimentation control methods (e.g., silt fence, straw bale dikes, absorbent booms), as described below in accordance with the New York Guidelines for Urban Erosion and Sediment Control to mitigate the transport of suspended solids or sediments from the site. Drawing G-10 presents the approximate locations where soil erosion and sediment control measures shall be installed. In addition, the Contractor may be directed by the Engineer to install additional soil erosion and sediment control measures as needed to minimize soil erosion at the site. Also, to reduce the potential for erosion, the Contractor shall not perform soil excavation or handling activities during periods of precipitation. At a minimum, the erosion and sedimentation controls described below shall be implemented to mitigate the potential for soil erosion.

<u>Silt Fence</u>

Silt fencing may be utilized to intercept runoff occurring as overland flow, otherwise known as sheet flow. The silt fence is to consist of material specified in the New York Guidelines for Urban Erosion and Sediment Control and installed in accordance with that document.

Silt fencing shall be installed parallel to ground surface contours and downgradient of any clearing, grading, or excavation activities within the work area. The lower edge of fabric shall be buried below the ground surface to prevent undermining. In the event of frozen ground conditions, where the Contractor is unable to bury the lower edge of the silt fence fabric, the Contractor shall propose an alternative method for installation for review and approval by the Engineer. The ends of the fence shall be curved uphill to the extent necessary to prevent flow around the ends of the fence. Removal of silt fence shall occur only when site restoration activities have been completed.

Straw Bale Dike

Similar to silt fence, straw bale dikes may be employed to limit the runoff velocity and provide filtration to minimize the downgradient migration of soil particles. Straw bales used for erosion and sedimentation control shall be of hay or straw and free from deleterious weeds and wood materials as required by the New York Guidelines for Urban Erosion and Sediment Control. The length of the slope between rows of straw bale dikes shall vary depending on the slope gradient on which the straw bale dikes are placed. In all cases, the straw bales shall be secured to grade by staking each bale with at least two wooden stakes per bale and by burying the bottom of the bale a minimum of 4 inches below ground.

The Contractor shall utilize the above described soil erosion and sedimentation controls or propose alternative methods in the Site Management Plan that shall provide sufficient control (and must provide soil erosion and sediment control to the satisfaction of the Engineer).

The temporary erosion measures shall be maintained by the Contractor for the duration of specific remedial activities that require these measures and until the restoration activities are complete. The Contractor may be directed to install additional soil erosion controls by the Engineer. During this time, erosion controls shall be inspected by the Contractor at least once per day and after each significant rainfall (as determined by the Engineer). Repairs shall be made by the Contractor as necessary to keep erosion control measures performing as intended or as required by the Engineer.

2.4 Work Task 2 - Soil Excavation

Following completion of the mobilization activities, soil excavation activities shall be implemented. The soil excavation activities shall consist of excavating the soil from six areas and placing the excavated soil within a bermed and lined staging area for gravity dewatering and confirmation sampling (to determine the handling and disposal requirements) prior to final disposal under one of the methods outlined under Work Tasks 10 and 11. The approximate horizontal extent of the soil removal areas (Areas 2, 3, 7, 8, 9, 10, and 13) are presented on Drawing G-2. The horizontal limits of the soil removal activities shall be marked in the field by the Engineer. Prior to removal of the soil, the Engineer shall provide a surveyor to establish benchmarks and horizontal controls. The Contractor shall be responsible for maintaining and establishing additional controls (as needed) to complete the soil removal activities.

A description of the activities that shall be conducted prior to initiating soil excavation activities is presented below, followed by a description of the soil excavation activities.

2.4.1 Pre-Excavation Activities

This subsection describes the activities that shall be conducted by the Engineer and Contractor prior to initiating soil excavation in Areas 2 and 3, followed by a description for Areas 7, 8, 9, 10, and 13.

Areas 2 and 3

- The Engineer shall conduct pre-excavation soil sampling in these areas in accordance with the procedures identified in the Field Sampling Plan (FSP) presented as part of the Sampling and Analysis Plan (SAP), included as Appendix B. The pre-excavation verification samples shall be analyzed in accordance with the protocols identified in the Quality Assurance Project Plan (QAPP), also presented as part of the SAP and included as Appendix C. Following completion of the pre-excavation soil sampling activities, the Engineer shall delineate in the field the horizontal limits of excavation.

- The Contractor shall establish exclusion zone (or zones) around the areas to be excavated.

- The Contractor shall field verify the locations of all utilities, which include but may not be limited to, the 4-inch diameter gas pipe, the 8-inch diameter fire protection pipe, and lateral pipes into the manufacturing building, overhead pipe bank, underground electrical bank (located near the foundry building), and the storm sewer pipes that extend through or are located in the vicinity of excavation Areas 2 and 3. The Contractor shall be responsible for reviewing existing drawings (included in the Supplemental Information Package provided with the Contractor bid forms) and, if necessary, utilizing a locator service to field delineate the location(s) of each utility. Once the locations of the utilities have been field delineated, the Contractor shall expose the utilities that shall be impacted by the excavation activities and shall install supports and/or bracing in accordance with the Contractor's Site Management Plan that has been reviewed and approved by the Engineer, and as necessary to temporarily support these utilities during the soil excavation and backfilling activities. During the excavation activities, the Contractor shall be responsible for maintaining the temporary support system until the excavation and backfilling activities are completed to the satisfaction of the Engineer.

- The Contractor shall excavate, cut up, and remove the railroad tracks located in the vicinity of Areas 2 and 3. The Contractor shall be responsible for staging the cut up sections of rails and railroad ties separate from the soil excavated from the areas to permit characterization by the Engineer of these materials prior to disposal, as outlined in Work Task 10.

- The Contractor shall install measures to temporarily support the manufacturing building and loading dock foundation. Measures may include the use of engineered underpinning, sheeting, shoring, bracing, or may be achieved through the procedures used to excavate the soil (i.e., excavating and backfilling individual sections of the excavation areas to maintain the integrity of the foundation). Measures implemented should consider the location and depth of the areas relative to the loading dock and existing aboveground and underground utilities. Details of the loading dock and building foundation have been included within the Supplemental Information Package.

<u>Areas 7, 8, 9, 10, and 13</u>

- The Engineer shall conduct pre-excavation soil sampling in Areas 7, 8, 9, and 10 in accordance with the procedures identified in the SAP. Following completion of the pre-excavation soil sampling activities, the Engineer shall delineate in the field the horizontal limits of excavation.

- The Contractor shall clear brush, trees, and other surface vegetation as necessary to allow excavation of the soils. Above-grade portions of the trees and brush shall be cut up (as necessary) and staged separately from the excavated soils prior to disposal (as outlined below in Work Task 10).

- The Contractor shall relocate the granite testing blocks located in the vicinity of excavation Areas 7 , 8, 9, and 10 to a location proposed by the Contractor and agreed to by the Engineer.

- The Contractor shall construct the "type A" surface-water drainage ditch located to the south of the on-site containment cell (as presented on Drawing G-4) to improve drainage conditions in the vicinity of the excavation activities.

- The Contractor shall design and install a steel sheet piling system around the perimeter (at minimum) of soil excavation Areas 7 and 9. The Contractor's steel sheet piling system design shall be prepared, signed, and sealed by a licensed New York State Professional Engineer. The steel sheet piling design shall be submitted to the Engineer for review and approval in accordance with the submittals review previously described in Subsection 2.3.1. The steel sheet piling system shall consist of steel sheeting and bracing, as necessary, to minimize ground-water infiltration into the excavations and to permit the soil excavation activities to be completed without the need to implement other means of stabilizing the sidewalls of the excavation areas (i.e., benching or sloping). In addition, the Contractor should assume that bracing or stabilizing the steel sheeting by any other means which requires excavation of soils outside the limits of the soil removal activities shall not be permitted. The steel sheet piling system shall be installed in accordance with Material & Performance (M&P) Specification MP-02215 (included in Appendix D) and the Engineer-reviewed design drawings that have been prepared by the Contractor in accordance with the requirements outlined above. The approximate limits of the sheet piling are presented on Drawing G-2. The Contractor shall be required to notify the Engineer a minimum of two weeks (10 working days) prior to installing the portions of the steel sheet piling system located within the electrical right-of-way, to enable the Engineer to coordinate temporary deactivation and disconnection of the overhead electrical service (if required) with Niagara Mohawk Power Corporation. The Contractor should assume that sheet piling located within the electrical service right-of-way shall be installed on a weekend(s) to permit minimal disruption to businesses located within the manufacturing building. The steel sheet piling system shall, at a minimum, be capable of :

  - Supporting all lateral loads resulting from earth and hydrostatic pressure, equipment, existing utilities (i.e., the electrical poles), and surcharge loads associated with placement of soil/debris adjacent to the excavation (as applicable).

  - Stabilizing subsurface soils in the vicinity of two existing electric poles located adjacent to the excavations such that the integrity of the electrical distribution system (i.e., poles, electrical lines, guy wires, etc.) is not jeopardized. Any impacts to the electrical distribution system (i.e., deflections, settlements, or any other impacts that result from the soil removal activities) shall be repaired by the Contractor at no additional cost to Danaher.

  - Minimizing ground-water infiltration into the excavations. The Contractor shall be responsible for taking all reasonable measures to minimize ground-water infiltration into the excavations to the satisfaction of the Engineer.

  To assist the Contractor in designing the steel sheet piling system, geological logs for the installation of test pits, soil borings, and monitoring wells in the vicinity of the excavation areas have been included in the Supplemental Information Package. In addition, hydrogeological data in the vicinity of the excavations have been included in the Supplemental Information Document. The Contractor should design and install the sheetpiling system in a manner which minimizes the penetration of the sheeting into the till (which underlies the excavation areas). The Contractor may propose alternative methods (and costs) to utilizing steel sheeting for excavating the soils (i.e., benching, shoring, etc.). However, all alternative methods shall be subject to review and acceptance by Danaher and the Engineer. Any alternative methods (if utilized) shall be required to meet all OSHA requirements, must be designed and sealed by a professional engineer licensed to practice in New York State, and reviewed and approved by the Engineer.

- The Engineer shall oversee (at no cost to the Contractor) the abandonment of MW-1 and MW-5 in accordance with Work Task 5 described below.

2.4.2 Soil Removal Activities

Once the above-identified pre-excavation activities have been completed to the satisfaction of the Engineer, the Contractor shall be permitted to initiate the soil removal activities. As part of the soil removal activities, the Contractor shall, at minimum, provide all labor, equipment, and materials necessary to perform the following:

- Excavate soils to the approximate limits shown on Drawing G-2. The approximate limits of the soil excavations shall be marked in the field by the Engineer. The vertical limits of the excavations shall be determined in the field by the Engineer based on field measurements of the excavation depth and visual confirmation that the excavation has been advanced to the till. For the purposes of the bid, the Contractor should assume that 8,370 in-place cubic yards of material shall be excavated from Areas 2, 3, 7, 8, 9, 10, and 13. The soil excavation activities shall be conducted using the methods outlined in the Contractor's bid and Site Management Plan. In order to accommodate the construction of the on-site treatment cell, the Contractor shall excavate Areas 7, 8, and 13 prior to excavating any other soil removal areas. Also, the Contractor shall be required to complete the excavation of Areas 2 and 3 prior to beginning sediment excavation from the on-site drainage ditches (i.e., Area 4). Following the excavation of soil from Area 13, the Engineer shall collect verification samples from the limits of the excavation (in accordance with the SAP) to confirm that the soil cleanup objectives have been achieved. The Contractor shall not be permitted to backfill Area 13 prior to the receipt of laboratory results for the verification samples by the Engineer. If laboratory results indicate that the soil cleanup objectives have not been achieved, the Contractor may be required to excavate additional soil as directed by the Engineer. The Area 13 soil verification samples shall be analyzed on a rush turnaround time (i.e., 24 hours). Collection of verification samples from Areas 2, 3, 7, 8, 9, and 10 shall not be required as pre-excavation verification samples shall be collected from these areas to determine the horizontal and vertical extent of the excavation areas prior to initiation of soil removal activities. The Contractor should assume that backfilling activities may commence in Areas 2, 3, 7, 8, 9, and 10 once the limits of excavation have been achieved to the satisfaction of the Engineer.

  During the soil excavation activities, the reviewed plans and documentation may be slightly modified based on field revisions as agreed upon between the Contractor and Engineer (i.e., as a result of field conditions, area being excavated, weather conditions, etc.). The modifications (if any) shall be considered as part of this RD Specification unless otherwise agreed to between the Contractor, Danaher, and the Engineer prior to implementing the modified activities.

- Place the excavated soil and debris into soil staging area(s) for gravity dewatering (for a minimum of one day), stabilization, and characterization (by the Engineer) or place excavated soil directly into lined roll-offs (at the direction of the Engineer). Soil excavated from each area shall be staged separately to allow for different means of final deposition of the materials. The anticipated final means of disposing of the soil from each area is presented on Drawing G-2. Disposal of material (on site or off site) shall not be permitted until receipt of soil confirmation sample results (which shall be received within two working days) by the Engineer.

- Soil to be placed within the SVE treatment cell shall be screened by the Contractor to remove particles or debris larger than 4 inches in any dimension. Particles or debris larger than 4 inches shall be either crushed to a size less than 4 inches or segregated for alternative disposal (i.e., in the on-site containment cell if on-site disposal requirements are met, or off-site disposal).

- Soil placed within the soil staging area(s) shall be covered with a low-permeability liner (proposed by the contractor and reviewed by the Engineer) to limit exposure to wind and precipitation. The low-permeability cover shall be anchored by the Contractor, as necessary, to resist wind forces and shall be installed to minimize ponding of precipitation. Anchorage of the cover shall be performed in accordance with the reviewed documentation submitted by the Contractor prior to mobilization. The Contractor shall not be permitted to utilize soil, debris, excavated soil, or other materials that could create potential sedimentation and erosion impacts to storm water run-off.

- Cover the soil excavation areas and/or exposed sidewalls with a low permeability cover (proposed by the contractor and reviewed by the Engineer), if determined as practical by the Engineer and when excavation activities are not actively taking place, to mitigate precipitation from coming in contact with underlying soil to be excavated. The Contractor shall be required to anchor the low permeability cover in accordance with the requirements outlined above for the soil staging area(s). Precipitation that collects on the surface of the low-permeability cover shall be removed by the Contractor and discharged on-site unless, in the opinion of the Engineer, the water has come in contact with impacted soil. If the water has come in contact with impacted soil, the water shall be pumped to the temporary on-site treatment system for treatment prior to being discharged as outlined in Work Task 9.

- Handle and break up the concrete blocks (located within Area 9) into pieces that permits the blocks to be transported and disposed of off site. Test pit logs for test pits installed within Area 9 are presented within the Supplemental Information Package. The blocks shall be broken up by the Contractor in accordance with Work Task 9 and the reviewed documentation and plans.

- Handle and segregate debris (i.e., debris larger than 2 feet in any dimension) from excavated soil. The segregated debris shall be staged separately from the soil for subsequent confirmation sampling (if necessary, by the Engineer) to determine handling and disposition requirements, and disposal. Debris larger than 3 feet in any dimension may be required to be cut up and/or broken up by the Contractor at the direction of the Engineer, as outlined below in Work Task 9.

- Dewater the excavation, handle excavated materials, and stabilize excavated materials (if necessary) in accordance with the requirements of Work Task 9.

2.5 Work Task 3 - Sediment Removal

Under this work task, the Contractor shall be responsible for excavating sediments from the unnamed creek (Area 1) , the on-site and off-site drainage ditches (Areas 4, 5, 6, 11, 12, and 14), and the dredged material stockpile located adjacent to the Area 4 drainage ditch, for disposal (either on site or off site) as outlined below in Work Tasks 10 and 11. The approximate horizontal limits of the sediment removal activities and the anticipated means of disposal are presented on Drawing G-2. The vertical limit of the excavation activities shall be verified by the Engineer by collecting sediment verification samples in accordance with the FSP presented as Appendix B, and by comparing the analytical results of the samples to the sediment cleanup objectives presented in Subsection 2.2. Prior to initiating the sediment removal activities within the unnamed creek, the Contractor shall be required to clean the remaining sections of the pipes that discharge at SPDES outfalls 001 and 002 in accordance with the requirements of Work Task 4 - Pipe Cleaning/Replacement. In addition, the Contractor shall be required to complete the excavation of Areas 2 and 3 prior to initiating excavation activities within Areas 4, 5, 11, 12, and 14. As part of the sediment removal activities, the Contractor shall provide all labor, equipment, and materials necessary to perform the following:

- Clear vegetation in the vicinity of Areas 1, 11, and 12 to accommodate excavation activities and to gain access to the excavation areas. Clearing activities in the vicinity of the unnamed creek and the off-site drainage ditches shall be kept to a minimum by the Contractor. The Contractor should assume that clearing of brush adjacent to the unnamed creek, to gain access, shall only be permitted at a minimum of 100-foot intervals (unless otherwise approved by the Engineer) to allow existing vegetation to provide stability of the creek banks. In addition, the width of each access point should be kept to a minimum (i.e., 30-feet or less). Access to Areas 11 and 12 (the off-site drainage ditches) shall be achieved by constructing a haul road adjacent to (and east of) Area 12 and on an existing berm located adjacent to the north side of Area 11. The Contractor shall be permitted to clear vegetation along Areas 11 and 12 as necessary to accommodate sediment removal. Abovegrade portions of vegetation cleared to accommodate the sediment removal activities shall be staged in an on-site area proposed by the Contractor and agreed to by the Engineer. The vegetation shall be cut up as necessary to accommodate off-site disposal as a non-hazardous waste, as outlined in Work Task 10.

- Relocate the stockpiles of roofing materials within an existing access road located along the off-site drainage ditches identified as Areas 11 and 12 on Drawing G-2. The materials shall be temporarily staged in an off-site area (on the same property) proposed by the Contractor and agreed to by the Engineer. Following completion of the restoration activities, the Contractor shall be responsible for placing the roofing materials back in their original location.

- Install access roads at points of access along the unnamed creek and the on-site and off-site drainage ditches. The Contractor shall also be responsible for improving the existing access road located adjacent to the off-site drainage ditch or any other facilities, as necessary, to accommodate the remedial activities. Improvements (if necessary) must be proposed by the Contractor and agreed to by the Engineer prior to performing any improvements.

- Excavate sediment to the approximate limits shown on Drawing G-2. For the purpose of the bid, the Contractor should assume that approximately 2,500 in-place cubic yards of sediment shall be excavated. The approximate volume of sediment anticipated to be excavated from each area is presented in the summary table on Drawing G-2. In general, sediment excavation activities shall progress from upstream to downstream using standard excavation methods and equipment (i.e., trackhoe, bulldozers, front-end loaders, dump trucks, etc.). Based on the results of the RI and SRI, the depth of sediment excavation ranges from approximately 1 to 2 feet in depth. As excavation activities progress from upstream to downstream within the drainage ditches, the Contractor shall be responsible for cleaning/replacing pipes and culverts as they are encountered and prior to excavating sediment downstream of the pipes/culverts in accordance with the requirements of Work Task 4. Following sediment removal, the Engineer shall collect verification samples for laboratory analysis in accordance with the SAP. The Contractor shall not be permitted to backfill an excavation area prior to receipt of the laboratory results of the verification samples by the Engineer. If laboratory sample results indicate that the sediment removal objectives have not been achieved, the Contractor may be required to excavate additional sediment as directed by the Engineer. The Contractor should assume that verification sample analytical results shall not be available for a minimum of one working day.

- Hand excavate sediment located in the vicinity of the steel H-piles located at the downstream end of the unnamed creek (immediately upstream of the culvert which extends beneath Bleecker Street).

- Place excavated sediment and debris into sediment staging areas for gravity dewatering (for a minimum of one day), stabilization, and confirmation sampling (by the Engineer). Sediment excavated from each area shall be staged separately to allow for different means of final deposition of the materials. The anticipated final means of disposing of the sediment from each area is presented on Drawing G-2. Disposal of material (on-site or off-site) shall not be permitted until receipt of soil confirmation sample results by the Engineer (which shall not be available for a minimum of three working days). Sediment placed within the staging area(s) shall be covered with a low-permeability liner (proposed by the Contractor and reviewed by the Engineer) to limit exposure to wind and precipitation. The low-permeability cover shall be anchored by the Contractor, as necessary, to resist wind forces and shall be installed to minimize ponding of precipitation. Anchorage of the cover shall be performed in accordance with the reviewed documentation submitted by the Contractor prior to mobilization. The Contractor shall not be permitted to utilize soil, debris, excavated soil, or other materials that could create potential sedimentation and erosion impacts to storm water run-off.

- Cover the excavation areas and/or exposed sidewalls (i.e., in Area 5) of material to be excavated with a low permeability cover, if practical as determined by the Engineer, and when excavation activities are not actively taking place, to mitigate precipitation from coming in contact with underlying sediment to be excavated. The Contractor shall be required to anchor the low permeability cover to the satisfaction of the Engineer to resist potential wind forces and water currents. Precipitation that collects on the surface of the low-permeability cover (or upstream of the covered excavation face) shall be removed by the Contractor and discharged downstream of the sediment removal activities, unless in the opinion of the Engineer, the water has come in contact with impacted soil. If the water has come in contact with impacted sediment, the water shall be pumped to the temporary on-site water treatment system for treatment prior to being discharged as outlined in Work Task 9.

As part of the sediment removal activities, the Contractor shall provide surface-water/storm water diversion as necessary to minimize the amount of water that enters an excavation area and to maintain site drainage. Surface-water/storm water diversion methods may include (but are not limited to) the following:

- Divide the unnamed creek or drainage ditch into sections by installing temporary earth dams and/or pre-manufactured structures (i.e., concrete barriers, sand bags covered with polyethylene sheeting, etc.).

- Rechannelize the surface-water/storm water flow around the excavation areas (i.e., by utilizing existing drainage ditches located adjacent to the excavation areas, excavating a temporary ditch, constructing an above-grade flume, etc.) to create a preferential flow path around each active excavation area.

- Bypass pumping the surface water/storm water (i.e., using a high flow mechanical pump(s)) from upstream of the excavation area and discharge the water downstream of the excavation area.

As identified above, the Contractor shall be required to identify proposed surface-water/storm water diversion methods in their bid. In preparing the bid, the Contractor should assume the surface-water/storm water diversion system should be capable of handling flow rates of up to 150 gallons per minute. Surface water/storm water diverted during the remedial activities shall be discharge into an energy dissipation structure to minimize erosion at the discharge location. Energy dissipation structures shall be constructed in accordance with the reviewed Sedimentation/Erosion Control Plan and upstream of sedimentation/erosion control measures when practical.

In addition to the above described activities, the Contractor may be required to perform excavation dewatering and stabilize excavated material. A description of these activities is provided under Work Task 9.

2.6 Work Task 4 - Pipe Cleaning/Replacement

Under this work task, the Contractor shall provide all labor, equipment and materials necessary to complete the pipe cleaning activities. The pipe cleaning activities shall be performed prior to the removal of sediment in the unnamed creek and as pipes/culverts are encountered during sediment removal activities, as they progress from upstream to downstream within the on-site and off-site drainage ditches. The pipe cleaning activities shall consist of removing visible debris from the culvert pipes within the drainage ditches and the two storm sewer pipes that discharge into the unnamed creek (at SPDES Outfalls 001 and 002). The approximate extent of the pipe cleaning activities are presented on Drawing G-2. Each of these sections of piping and the culvert pipes shall be cleaned using the procedures presented below:

- Sediment in the immediate vicinity of the outfalls and the downstream end of each culvert shall be removed as necessary to provide access for cleaning.

- Access to the outfalls and downstream ends of the culverts shall be provided as necessary (i.e., by clearing vegetation to provide access for cleaning).

- A portable sump shall be installed at the outfall and downstream ends of the culverts to collect washwaters and debris generated by the cleaning activities. Prior to installing the sump at the outfalls and downstream ends of the culverts, dewatering may be required. Dewatering (if necessary) shall be accomplished by performing the following:

  - Construct a dam in the vicinity of the outfalls and downstream end of the culverts to minimize the quantity of surface water entering the area being dewatered. The dam shall be constructed by stacking sand bags (or other methods approved by the Engineer) covered with 10-mil polyethylene sheeting in the vicinity of the outfalls and at the downstream and upstream ends of the culverts.

  - Pump water from the area located between the dam and outfall or culvert. The water removed from this area shall be discharged downstream of the sediment removal activities.

- Install pneumatic plugs in the upstream manhole outfalls, to prevent washwater from entering the upstream storm sewers previously cleaned during the Sediment Removal IRM.

- A flexible hose with a high pressure, low flow nozzle shall be placed into the downstream ends of the culverts and at outfall locations and advanced upstream (to the manholes located upstream of the outfalls and to the upstream end of each culvert pipe) using the reverse action spray of the nozzle. As the nozzle is retrieved, the nozzle shall spray water radially outward to flush debris from the piping. The water used to flush debris from the piping may be provided by on-site sources (i.e., the water supply spigot located within the Power Plant). The Contractor shall notify the Engineer at least 48 hours in advance of needing to obtain water from an on-site source. If a blockage occurs that prevents the hose/nozzle from being advanced, then the Contractor shall be required to remove the blockage (using methods proposed by the Contractor and approved by the Engineer).

- Washwaters and debris collected in the sump shall be removed by a vacuum truck. Washwater and debris contained within the vacuum truck shall be transferred to a temporary on-site tank (other than one of the tanks for the water treatment system) for primary settling. The debris separated from the liquid shall be added to the TSCA-regulated soil and sediment waste stream for transportation and disposal off-site. If necessary, the debris shall be stabilized as described in Work Task 9 prior to off-site disposal as a TSCA-regulated material. Washwater generated during the sediment removal activities shall be treated in the temporary on-site water treatment system.

- After cleaning each pipe, a visual inspection shall be performed by the Engineer to verify that no visible debris remains in the pipe (based on the Engineers judgement). If visible debris is observed in the pipe, the pipe shall be recleaned and re-inspected at the Contractor's expense (at no additional cost to Danaher).

During the pipe cleaning activities, some of the culvert pipes (associated with the drainage ditches, as presented on Drawing G-2) may not be able to be cleaned due to blockage and/or overall condition of the pipe. If cleaning of a pipe is not feasible, the Contractor shall be required to excavate and remove the existing culvert pipe and replace the culvert with N-12 corrugated high density polyethylene (HDPE) pipe as manufactured by Advanced Drainage Systems, Inc. (ADS), or approved equal in accordance with M&P Specification MP-02526. Replacement piping shall be the same diameter as the pipe being replaced and shall be installed to the same lines and grades in accordance with American Society for Testing and Materials (ASTM) specifications and the Manufacturer's recommendations. At minimum, the Contractor should assume that the pipe placement shall require placement of a minimum of 6 inches of washed stone bedding material (beneath the pipe) and bank run gravel backfill placed and compacted to 90 percent of the Standard Proctor to 12 inches above the top of the pipe (as presented on Drawing G-17).

In the event that the Contractor is required to replace any existing culverts, the Contractor shall be required to obtain all local permits from the Town of Frankfort and/or Herkimer and Oneida Counties.

2.7 Work Task 5 - Monitoring Well Abandonment

Under this work task, 19 ground-water monitoring wells at the site shall be abandoned under the oversight of the Engineer. The Contractor is not required to include this activity in their cost estimate. Existing monitoring wells MW-6R, MW-13S, and MW-14 shall not be abandoned at this time since these wells shall be utilized as part of the ground-water monitoring program described in the SAP. Monitoring well abandonment shall be conducted in accordance with the NYSDEC guidance document entitled "Groundwater Monitoring Well Decommissioning Procedures," October 1996. Monitoring well abandonment shall include removal of the protective steel well casings, removal of the well casings, grouting the boreholes in accordance with ASTM Method D5299 and Section 2 of the above-referenced NYSDEC guidance document, and restoration of the affected areas. The monitoring wells are constructed of 2-inch diameter PVC casing.

The volume of grout required to abandon the wells shall be calculated considering potential loss of material to the geological formation, voids intersecting the boreholes, changes in borehole diameter, washout zones, and swelling or shrinkage of material. The mixture of neat cement grout to be utilized shall consist of one 94-pound bag of Portland Cement to 7.8 gallons (or less) of water. Approximately five percent bentonite shall also be added to the mixture to decrease shrinkage.

Existing well construction materials (casing, grout, and sand pack) shall be removed by pulling or overdrilling each well. Before overdrilling the bedrock monitoring wells, the coreholes shall be filled to the top of bedrock with the neat cement grout (described above). In situations where borehole collapse occurs as a result of the removal of well materials, the borehole shall be redrilled. Following removal of the well construction materials, the boreholes shall be filled to within 6 inches of original grade, with the cement grout mixture identified above, using tremie grouting techniques. The Engineer shall visually evaluate the boreholes for several hours following the completion of the abandonment activities to identify evidence of settling. If settling is observed, additional cement/bentonite mixture shall be used to refill the borehole to within 6 inches of grade. After the boreholes have been abandoned to the satisfaction of the Engineer, the borehole shall be restored by the Contractor by placing 6 inches of topsoil over the borehole and installing grass seed to encourage revegetation for areas located within vegetated areas and by placing asphalt over areas located within paved areas.

Well construction materials removed from the boreholes will be staged in an area to be identified by the Contractor and disposed of off-site by the Contractor.

Existing ground-water monitoring wells to be abandoned that are located within an excavation area shall be abandoned as described above, with the exception that the borehole shall be grouted to the anticipated bottom of the excavation area.

2.8 Work Task 6 - Temporary Water Treatment System

The Contractor shall provide, operate, and maintain a temporary on-site water treatment system that shall be used to treat liquid waste streams generated during the remedial activities. Treated effluent shall be discharged to the Oneida County sanitary sewers. The main objective of the temporary water treatment system is to treat water generated during construction activities to meet the effluent criteria set by the discharge permit issued to the Engineer from the Oneida County Sewer district. In order to verify that the temporary water treatment system has achieved the permitted effluent standards, the treatment system shall operate in a batch mode and treated water shall not be discharged until analytical results indicate that the effluent criteria has been met. Analysis shall be performed on a 24-hour turnaround time using the methods specified in the SAP.

The treatment approach utilized for the temporary water treatment system consists of removing solids by gravity settling, and filtration (to remove suspended particulate matter with adsorbed PCBs). Following solids removal, the water shall flow through granular activated carbon (GAC) units to remove dissolved PCBs and VOCs. The temporary water treatment system shall provide capacity to treat water generated by one day of excavation activities (based on a conservative estimate of maximum daily flows that may be generated by the removal of surface water and ground water from the active excavation areas during the remedial activities). However, due to the potential variability of influent flow conditions that could be encountered (due to dry conditions, precipitation events, etc.), the temporary water treatment system shall ultimately operate on an as-needed basis.

The process flow schematic for the temporary water treatment system is presented on Figure 1 (which is attached to M&P Specification MP-11001). As shown on Figure 1, the temporary water treatment system shall consist of the following primary components:

- Influent equalization/settling tanks, each with a 20,000 gallon (nominal) capacity;
- Two multi-media filters (in parallel);
- Two bag filters (in parallel);
- Two GAC units (in parallel); and
- Two 20,000-gallon (nominal capacity) effluent storage tanks (to be supplied by Danaher).

A description of these treatment system components is presented below. M&P Specifications for system components are provided in Appendix D as Section MP-11001.

Water generated during the corrective measures shall be pumped by the Contractor to the influent equalization and settling tanks. The temporary water treatment system shall provide for a minimum influent storage capacity capable of capturing all water generated in a 24-hour period and holding that water for an additional 24 hours to allow for primary gravity settling of particulate matter in the water.

Following primary settling in the influent storage tanks, the water shall be pumped through two multi-media filters in parallel (effective filter size of 10 microns) and then through two liquid bag filters in parallel to remove remaining solids through filtration. The multi-media filters shall be installed in parallel to allow one of the filters to be backwashed (with water from the surge tank) while the other filter continues treating water. Water generated by backwashing the multi-media filters shall be pumped back to the influent storage tanks for retreatment.

Following filtration, the water shall flow through two 1,000-pound GAC vessels in parallel to provide final polishing of the treated water. The treated water shall then flow into effluent storage tanks with a minimum combined total capacity of 40,000 gallons.

Treated water shall be retained in each filled effluent storage tank until laboratory analytical results confirm that the effluent discharge permit requirements are being met. The water shall then be pumped to the sanitary sewer. If a sample result indicates that the concentrations of any permitted parameter exceeds allowable limits, the contents of the effluent tank shall be pumped back to the influent/equalization tanks for retreatment. The effluent tank shall then be cleaned and the resulting liquids shall be pumped to the influent/equalization tanks for treatment. The Contractor should be prepared to mobilize additional influent or effluent storage tanks to the site at the request of the Engineer at any time during construction, in the event that the volume of water generated during construction exceeds the anticipated volume.

All temporary water treatment system components (including storage tanks) shall be placed within a secondary containment area that is bermed and lined with a low permeability liner. The secondary containment area shall have a volume equal to at least 10 percent greater than the largest storage or treatment vessel associated with the temporary water treatment system. Precipitation that collects within the secondary containment area shall be directed to a sump area and pumped to the influent storage tanks.

Temporary water treatment system equipment M&P Specifications are provided in Appendix D. Submittals required by the Contractor are described in Section 2.3.1. The Contractor shall be fully responsible for O&M of the temporary water treatment system as described herein and as indicated in the Contractor-prepared O&M Manual (as described in Section 2.3.1). A description of treatment system start-up activities is presented below, followed by a discussion of normal operating activities.

Start-Up Activities

After mobilization and setup of the water treatment system, the Contractor shall perform system start-up and testing activities, and troubleshooting prior to initiating full scale (normal) operations and prior to initiating any soil/sediment removal activities. Start-up and testing activities shall be in accordance with the Manufacturer's recommendations and as indicated in the Contractor-prepared O&M Manual that has been reviewed by the Engineer. General start-up and testing of the temporary water treatment system shall consist of treating approximately 20,000 gallons of water collected from the first proposed excavation area (i.e., water that has been in contact with sediment to be removed). During the start-up test, the water treatment system shall be operated at the normal operating flow rate (<100 gpm) until the entire 20,000 gallon batch is treated. During this time, the Contractor shall continuously monitor and record readings (every 30 minutes minimum) from all gauges, flow meters, etc. as necessary in order to show the system is operating as designed to the satisfaction of the Engineer.

The Contractor shall assist the Engineer in collecting two sets of start-up testing samples following treatment of approximately 3,000 gallons and 18,000 gallons of water at the following locations:

- As influent to the influent settling tanks;

- As influent to the multi-media filters (which shall represent the quality of the water entering the treatment system from the influent tanks and entering the multi-media filters);
- After the multi-media filters;
- After the liquid bag filters;
- After the carbon filters; and
- From the treated water storage tank.

The start-up testing samples shall be submitted for laboratory analysis for discharge permit parameters and total suspended solids (TSS). Samples submitted to the laboratory for analysis shall be analyzed in accordance with the protocols presented in the QAPP. Samples shall be submitted with the full QA/QC requirements outlined in the SAP. The laboratory shall provide preliminary results to the Engineer within 24 hours from the time the samples are received at the laboratory. The Contractor shall not be permitted to discharge the water treated during the startup activities, or continue performing sediment removal activities until the laboratory analytical results of the startup activities indicate the treatment objectives have been satisfactorily met. The Engineer shall verbally notify the Contractor when these requirements have been met.

Upon review and acceptance by the Engineer of the analytical results and start-up monitoring data supplied by the Contractor, the Contractor shall be allowed to begin normal treatment system operations. If the analytical results indicate a treatment system upset and/or effluent water quality does not meet the treatment objectives, the Contractor may be required to perform additional start-up testing activities as directed by the Engineer at no additional cost.

<u>Normal Operations</u>

The temporary water treatment system shall be manually operated and controlled by the Contractor. As a result, the Contractor shall have a water treatment system operator on site at all times during operation of the system. The system shall be manually controlled by the operator through a series of valves, visual reading gauges, and pump controls as necessary to accommodate the various modes of operation. At a minimum, the daily activities to be performed by the system operator include, but are not limited, to the following:

- Control the equalization and storage tank valves, as necessary, to fill and drain the tanks.
- Visually inspect the equalization and storage tanks to avoid overfilling.
- Visually inspect all pumps, fittings, and equipment to ensure that no leakage is occurring.
- Obtain readings from the system pressure gauge associated with the multi-media filters, liquid bag filters, and GAC units. Pressure gauge readings may be used to determine when a backwash event or filter replacement is required.
- Obtain readings from the flow meter to monitor the system flow rate and to verify that the maximum flow rate of 100 gpm is not exceeded.
- Obtain readings from the flow totalizer to record the total system flow to date and calculate the daily flow total.

- Collect periodic water samples, as necessary, for optimal system operation.

The operator shall maintain a daily operations log (i.e., tabulated results) in which process gauge and flow meter observations shall be recorded at a minimum frequency of once every hour, or more frequently if requested by the Engineer. In addition, all activities related to O&M of the treatment system shall be documented in the daily log. The daily log shall be kept on site and shall be made available to the Engineer on demand. Copies of each daily log shall be submitted to the Engineer on a daily basis.

Prior to each batch discharge to the sanitary sewers, one effluent sample shall be collected by the Engineer and submitted for laboratory analysis on a 24-hour rush turnaround basis to confirm that the treatment system is performing optimally. If the analytical results indicate a treatment system upset and/or effluent water quality does not meet the treatment objectives, the Contractor may be required to perform additional testing activities as directed by the Engineer, or be required to modify the treatment system at no additional cost to Danaher.

2.9 Work Task 7 - Soil/Sediment Disposal Requirements

2.9.1 General

Under this work task, the Contractor shall provide all labor, equipment, and materials necessary to dispose of the excavated soil/sediment in accordance with the provisions of this specification. Presented in this section is a detailed description of the soil/sediment disposal requirements associated with the remedial activities. Soil/sediment excavated as part of the remedial activities shall be stockpiled, dewatered, and stabilized as necessary, and disposed of in one of the following manners:

- Off-site disposal at a TSCA-permitted landfill if the excavated soil/sediment contains greater than 50 ppm total PCBs (as indicated by the sampling procedures presented in the SAP). The Engineer shall be responsible for identifying soil/sediment that is required to be disposed of off-site.

- On-site treatment via an SVE treatment system constructed within the on-site containment cell, if the excavated soil/sediment contains less than 50 ppm total PCBs and greater than 10 ppm total VOCs of concern (as indicated by the sampling procedures presented in the SAP).

- Direct placement in the on-site containment cell if the excavated soil/sediment contains less than 50 ppm PCBs and less than 10 ppm total VOCs of concern (as indicated by the sampling procedures presented in the SAP).

Drawing G-2 presents the potential disposal scenarios for the soil/sediment removed from each excavation area. The Engineer shall identify to the Contractor during implementation of the soil/sediment removal activities the ultimate disposition of the materials. A detailed description of each of the disposal methods is presented in the following sections.

2.9.2 Off-Site Disposal

Under this work subtask, the Contractor shall be responsible for handling, storing, containerizing, transporting (including providing and preparing manifests, bill-of-ladings, etc.), and disposing of excavated soil/sediment and debris removed from Areas 6, 12, and 13 (and other areas if necessary based on confirmation sampling to be conducted by the Engineer as described in the SAP). The Contractor shall be required to dispose of soil/sediment removed from these areas as a TSCA-regulated waste at Chemical Waste Management's solid waste landfill located in Model City, New York. The estimated in-place volume of the TSCA-regulated soil sediment (within the areas shown on Drawing G-2) to be disposed of is approximately 850 cubic yards. The Contractor shall be responsible for implementing measures to avoid combining removed material from TSCA-regulated areas with material from areas to be disposed of by other means. The Contractor shall also be required to stabilize (if necessary) excavated material such that there are no free liquids prior to transporting the material off-site for disposal.

2.9.3 Containment Cell

This section provides a detailed description of the construction requirements for the proposed containment cell location, cell liner system, materials placement, and cell cover system.

The containment cell shall be constructed with two separate areas for holding excavated soil/sediment. One area within the cell shall be constructed for placement of excavated soil/sediment that contains total PCBs at concentrations less than 50 ppm (as determined by the Engineer using methods presented in the SAP), and total VOCs of concern at concentrations less than 10 ppm. Excavated soil/sediment containing greater than 10 ppm total VOCs of concern (and less than 50 ppm PCBs) shall be placed in a separate area within the containment cell and treated via SVE to reduce the concentration of VOCs of concern to less than 10 ppm. The Contractor shall construct the two containment areas over a liner system and separate the two areas by a berm and low-permeability layer. The footprint of the proposed containment cell shall occupy approximately one acre on the southeast side of the site, and have a maximum airspace volume of approximately 18,500 cubic yards. As the exact volumes of soil/sediment to be excavated shall be determined as the remedy is implemented, the containment cell has been designed to manage a wide range of soil/sediment volumes.

2.9.3.1 Containment Cell Location

The proposed containment cell shall be located on the southeastern portion of the site, as shown on Drawing G-3, in an area that allows easy access for construction and placement activities while also providing for safe containment of excavated soil/sediment. The location shall be out of the way of daily vehicular and pedestrian traffic, thus lowering the possibility of unnecessary human contact. The total area of the containment cell shall be less than one acre.

As part of the containment cell construction, the Contractor shall construct a permanent access road around the cell. During operational activities following cell closure activities, this road shall provide vehicular access for personnel conducting containment cell OM&M activities. In addition, a permanent chain link fence shall be installed surrounding the containment cell to prevent future unauthorized access.

2.9.3.2 Liner System

The Contractor shall be responsible for constructing all components of the liner system as shown on the Contract Drawings and described in the M&P Specifications. The liner system shall act as a barrier between the excavated soil/sediment and the underlying clean soils.

The Contractor shall initiate construction of the liner system following completion of the excavation and backfilling activities associated with Areas 7, 8, and 13. The soil excavation requirements for Areas 7, 8, and 13 were previously described in Subsection 2.4. The backfill requirements for these areas are presented in M&P Specification MP-02200 and MP-02222.

The liner system is presented on Drawing G-15 and shall consist of the following components, listed sequentially from liner bottom to liner top:

- A layer of 60-mil HDPE liner;
- A non-woven geotextile layer;
- A 12-inch thick granular drainage layer having a permeability of 1 x 10^{-2} cm/sec and leachate collection piping consisting of 6 inch HDPE SDR 17 piping to collect the leachate generated within the containment cell. The granular drainage layer will be mounded over the leachate collection piping to provide 12-inches of cover over the pipe;
- A non-woven geotextile layer; and
- A 12-inch thick layer of protective soil consisting of special waste material. The special waste material will be free from protruding objects and deleterious material and free from particles 6-inches or larger in any dimension.

Prior to liner system installation, the Contractor shall prepare the subgrade ground surface such that the subgrade is finely graded in accordance with M&P Specification MP-02200, free of protrusions in the upper 6 inches and free of surface water.

Initially, the Contractor shall construct a perimeter berm around the containment cell footprint and the liner subgrade shall be prepared within this bermed area. A berm shall also be constructed within the containment cell to separate the soils/sediments being treated via the SVE system from the remaining soil/sediment to be placed within the containment cell . The berms shall be constructed using on-site or imported materials that meet the requirements of M&P Specification MP-02221. The Contractor shall prepare the subgrade as shown on Drawing G-4 by compacting and sloping the existing grade to provide adequate structural support for the containment cell while also inducing gravity-based leachate collection. The berms shall be approximately 4-feet high with three to one (horizontal to vertical) external side slopes, and an 11-foot crest width. The interior side slopes of the berm shall be 2.5 to one (horizontal to vertical).

Following berm construction and subgrade preparation, a 60-mil HDPE liner shall be placed over the berm and subgrade within the limits of the entire containment cell. Minimum Contractor requirements for the installation of the HDPE liner are presented in M&P Specification MP-02234. A 12-inch thick granular drainage layer with leachate collection piping shall then be installed on the floor of the containment cell as presented on Drawing G-5, followed by a 12-inch thick layer of protection soil. A detailed description of the leachate collection system components is presented in Section 2.10.1.

The Contractor shall install the containment cell liner side slopes using a geosynthetic drainage composite in place of the 12-inch thick drainage layer, and overlain by the same protective layer as on the floor of the cell. This detail is presented on Drawing G-15. Minimum Contractor requirements for the granular drainage layer, leachate collection piping, and protective soil cover materials are presented in the M&P Specifications and on the Contract Drawings.

Following construction of the liner system (including the leachate collection system), the excavated soil/sediment may then be placed over the protective soil layer. Placement requirements for the excavated soil/sediment are described in the following section.

2.9.3.3 Soil/Sediment Placement

The proposed containment cell shall be in operation from the time of the liner completion until all excavated soil/sediment (excluding soil/sediment disposed off-site) has been placed in the cell. To hasten the construction schedule, the Contractor may begin placing materials in one end of the cell before the entire containment area has been completed, provided the Contractor can demonstrate that any part of the unfinished liner system shall not be damaged or that excavated soil/sediment shall not be inadvertently deposited on clean soil.

The Contractor shall place the soil/sediment into the containment cell in loose lifts, a maximum of 18 inches in thickness. The Contractor shall achieve compaction of the materials by equipment tracking over the materials during placement operations. The minimum number of tracking passes necessary to achieve adequate compaction of the waste material shall be determined based on visual inspection by the Engineer during placement operation. The Engineer may request adjustments to the minimum number of tracking passes throughout the duration of placement operations based on the use of different types of equipment employed by the Contractor and on changes in the composition of the material.

The Contractor shall utilize select waste material for placement of the final 12-inch thick lift within the containment cell. The select waste material shall consist solely of soil material having a maximum particle size of three inches or less and be free of any protruding objects and deleterious debris including, but not limited to, concrete, metal, wood, and brick. The surface of the final lift shall be firm and smooth, and free from any protruding objects. During placement of the final lift, the Contractor shall construct passive gas vent trenches in accordance with the Contract Drawings and M&P Specifications. The trenches shall be excavated to a depth of 2' below final subgrade elevations, backfilled with select fill material, and wrapped with non-woven geotextile. Trench width shall be approximately 3', or as directed by the engineer. A passive gas vent will be installed during installation of the final cover system at the landfill peak, where the passive gas trenches intersect.

At the conclusion of soil/sediment placement activities, the Contractor shall permanently cover the soil/sediment portion of the containment cell not undergoing treatment via SVE, in accordance with the cover requirements presented in Subsection 2.9.3.8. The section of the containment cell being utilized for SVE treatment of VOC-impacted soils shall not be permanently capped at this time. Instead, this portion of the containment cell shall receive a temporary cap consisting of a 10-mil synthetic membrane as detailed in Subsection 2.9.4 of this report. To prevent constituent migration between the soil masses, a permanent 10-mil synthetic membrane shall also be installed between the two portions of the containment cell, thus providing a permanent barrier between the two soil/sediment masses. The placement of the temporary cover over the VOC-impacted soils will better facilitate the SVE treatment activities. Once the SVE treatment process has been deemed complete (as described in Section 2.9.4), the permanent cap system shall be extended over the SVE area, to encompass the entire containment cell.

2.9.3.4 Sequence of Containment Cell Construction

The construction of the proposed containment cell shall begin in spring or early summer of 1998. The sequence of events shall be as described in the Contractor's narrative discussion of the proposed approach for completing the remedial activities and shall generally follow the construction sequence plan presented on Drawings G-10 through G-15.

2.9.3.5 Leachate Management

A leachate management system, as presented on the Contract Drawings, shall be installed by the Contractor as part of the liner system to allow for the collection, conveyance, and containment of all leachate generated from the proposed containment cell. The leachate management system specifications were based on the results of the Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3. A worst case scenario was used in the development of the model to predict the volume a leachate generated in the containment cell. Each component of the leachate management system was designed based on the results of this modeling. A description of the specific leachate management system components is presented below.

2.9.3.6 Leachate Collection System

The leachate generated from the containment cell shall be collected, conveyed, and stored on site. The leachate generated in the containment cell shall be conveyed to a 6-inch HDPE SDR 17 pipe located along the center of the containment cell floor. The leachate collection pipe shall penetrate the protective berm, as presented on Drawing G-16 and daylight into a pumping manhole. Once the leachate gravity drains to the pumping manhole, the leachate shall be transferred via a force main (and pump) to an on-site leachate storage tank. The on-site leachate storage tank is described below. The Contractor requirements for the leachate collection system components (including the pumping manhole), specifications and installation methods are presented on the Contract Drawings and within the M&P Specifications.

2.9.3.7 Leachate Storage and Disposal

The leachate storage facility shall consist of a 5,000 gallon steel tank surrounded by a steel dike structure that provides secondary containment for the tank. The dike structure shall be capable of containing a spill with a volume of at least 110 percent of the tank capacity. The storage tank shall be housed in a steel frame building with lighting, heating, and ventilation systems. The building shall not only provide protection for the storage tank, but shall also provide for a safer environment during transfer of stored leachate to a tank truck for removal.

The Contractor shall install the leachate storage facility in accordance with the Contract Drawings and M&P Specifications. Leachate shall not be directed to the leachate storage system until the temporary water treatment system has been demobilized. During soil/sediment placement, the Contractor shall direct leachate generated in the containment cell to the temporary water treatment system described in this document, where the leachate shall be treated and discharged to the sanitary sewer system. Following demobilization of the temporary water treatment system, leachate generated in the containment cell shall be permanently directed to the leachate storage system.

2.9.3.8 Containment Cell Cover System

Upon completion of the soil/sediment placement activities within the containment cell, a cover system shall be constructed to reduce infiltration of precipitation into the containment cell and eliminate the potential for future contact with the excavated soil/sediment. The cover system shall consist of the following components, listed sequentially from the top to the bottom of the cover system:

- Vegetation;
- A 6-inch thick topsoil layer;
- A 12-inch thick protective soil layer;
- A non-woven geotextile layer;
- A 12-inch thick granular drainage layer;

- A 60-mil HDPE geomembrane liner; and
- A geosynthetic clay liner (GCL). This layer shall only be installed on containment cell slopes that are less than 25 percent.

The cover system shall be constructed by the Contractor in two phases: the final cover system shall be constructed over the soil/sediment at the eastern end of the containment cell following placement of these materials, while a temporary cover system, consisting of a 20-mil synthetic geomembrane, shall be installed over the soil/sediment undergoing treatment via SVE at the western end of the cell. In addition, a permanent barrier layer shall be placed at the boundary separating the two containment areas. The placement of the temporary cover over the VOC-impacted soil/sediment shall facilitate SVE treatment activities. At the conclusion of the SVE treatment, the final cover system (as described above) shall be extended to form a permanent cover over the entire containment cell.

The Contractor requirements for the installation of the temporary and final cover systems are presented on the Contract Drawings and within the M&P Specifications.

2.9.4 SVE Treatment System

The ex-situ SVE treatment system shall consist of an estimated 2,330 cubic yards of soil piled approximately 8-feet high with perforated piping within an approximately 8,000-square-foot SVE treatment cell constructed by the Contractor. As previously indicated, in order to avoid moving the soil to be remediated more than once, the SVE treatment cell shall be placed directly on top of the on-site lined containment cell liner. Once the treatment objectives have been achieved, the treated soils shall be capped in the same manner as the containment cell.

The SVE treatment equipment shall consist of an air-water separator, air induction valve, in-line air filter, vacuum extraction blower, silencer, heat exchanger, two 1,000 pound vapor phase carbon units, two condensate storage containers (i.e, steel 55-gallon drums), a condensate pump, and SVE system controls. The SVE treatment equipment shall be housed in a pre-engineered metal building located to the west of the SVE treatment cell. The basis of design for the SVE treatment system is presented as Appendix E.

<u>SVE Treatment Cell</u>

Excavated soil/sediment that contains the VOCs of concern at concentrations greater than 10 ppm shall be placed in the SVE treatment system. The base of the SVE treatment system shall be consistent with the liner for the remainder of the containment cell. Soil/sediment placed in the SVE cell shall be screened prior to placement such that there are no particles larger than 4 inches in any dimension. The Contractor shall place the soil/sediment into the SVE treatment cell in accordance with the requirements set forth in Subsection 2.9.3.3. Following placement of the soil/sediment into the SVE treatment cell, the Contractor shall cover the SVE cell with a 20-mil synthetic geomembrane to prevent rainfall from infiltrating the VOC-impacted soils, to prevent VOCs from volatilizing directly to the atmosphere, and to prevent short-circuiting of the vacuum extraction system.

<u>SVE Equipment</u>

M&P Specifications for the SVE equipment are presented in Section MP-11002 - Soil Vapor Extraction System in Appendix D. Piping within the SVE cell shall include the following:

- Eighteen horizontal, parallel, slotted polyvinyl chloride (PVC) pipes spanning the width of the SVE cell to both provide air induction and extract vapor-phase VOCs from the SVE cell. These pipes shall consist of 4-inch diameter Schedule 80 machine-slotted PVC piping with 0.020-inch slot widths, positioned at three different depth intervals within the treatment cell, as presented on Drawing M-3.

- Two horizontal, parallel PVC conveyance (header) pipes spanning the length of the SVE cell (positioned on top of the cell) to supply air induction and convey vapor-phase VOCs to the treatment system. These pipes shall be constructed of 4-inch diameter solid Schedule 80 PVC.

- Eighteen vapor extraction/injection wells to connect the horizontal PVC conveyance pipes to the induction/extraction header piping. A vent, which can be closed using a butterfly valve, shall be positioned over each extraction well.

The spacing of SVE pipes is shown on Drawing M-3. In order to provide flexibility in operation, piping is configured such that by opening and closing a valve, a particular pipe may either provide fresh air into or extract VOC vapors from the SVE cell.

Air induction/extraction piping shall be manifolded together using solid 4-inch diameter Schedule 80 PVC header pipe. The header pipe shall be conveyed to treatment equipment located in the treatment enclosure. Through operation of the blower, a negative pressure shall be applied to the piping, inducing a vacuum and air flow by which VOCs in the air space of the soil shall be removed. The VOCs shall pass through an air-water separator, an air filter, blower, and heat exchanger prior to removal from the air stream through two vapor-phase granulated active carbon (GAC) adsorption units.

A pre-engineered metal building shall house the SVE treatment equipment system controls. The building shall be approximately 22-feet long by 26-feet wide by 14-feet high. The primary purpose of the SVE equipment enclosure is to protect the SVE equipment and associated electrical controls from rain, extreme temperatures, and vandalism.

An SVE treatment system process and instrumentation diagram is presented on Drawing M-1. As shown on Drawing M-1, the SVE air stream manifold shall draw air flow and VOCs through a vacuum created by the blower. This air stream shall flow through an air-water separator to remove condensate followed by an in-line filter to remove small diameter particles greater than 3 microns in size. From the in-line filter, the air stream shall flow through the vacuum blower. The air stream shall exit the vacuum blower at a temperature of approximately 310°F and a pressure of 0.5 psig. The air stream shall be cooled to approximately 90°F in a heat exchanger prior to treatment in two 1,000 pound vapor-phase carbon vessels and discharge to the atmosphere. Condensate collected in the air-water separator shall be pumped into a 55-gallon drum during regularly-scheduled maintenance inspections of the system. The amount of condensate that shall be collected during operation of the SVE system is expected to be low because the SVE cell shall be isolated from precipitation infiltration and from ground water. Condensate collected shall be transferred to the on-site air stripper for treatment prior to discharge, or disposed of off-site. During winter months, the treated air stream may be recirculated through the SVE treatment cell to enhance treatment of the soil/sediment.

The vacuum extraction blower shall be a 30 horsepower blower. Fresh air induction into the SVE cell shall either be provided under a positive pressure or under atmospheric temperature and pressure conditions through operation of valves. The air flow rate provided by the blower shall be approximately 250 standard cubic feet per minute (scfm) at a vacuum of 15 inches of mercury.

System Controls

The SVE system shall include safety and control devices such that the SVE system can be operated without an operator on site. Pressure and air flow switches shall be located on the inlet and discharge side of the vacuum extraction blower. A temperature switch shall be located prior to the first GAC unit and a differential pressure switch shall measure pressure loss through the GAC units. These switches shall shut the system down under high/low pressure, low flow, or high temperature, and indicate an alarm condition. Alarm conditions shall be relayed to an autodialer that shall in turn notify the system operator via telephone of the alarm condition.

Operation

Operating parameters of the ex-situ SVE system (i.e., air flow rate, vacuum pressure, and VOC removal rate) shall be confirmed during ongoing operations and maintenance of the system. Flow rates through individual SVE pipes may be adjusted in order to maximize VOC removal rates and avoid channeling of air through SVE cell soil/sediment. Adjustments of vacuum and air flow at individual SVE pipes shall be accomplished through a combination of throttling the valve located at the entrance to the SVE pipe and measuring the pressure after the individual SVE pipe.

Operation of the SVE system shall require an operator to start the blower at a main control panel and instrumentation located within the SVE equipment enclosure. The operator shall also control the operation of any ancillary equipment, if necessary. During operation, vacuum, air flow rate, and air temperature shall be measured by the operator. VOC concentrations also shall be measured at various taps using a photoionization detector (PID). Levels in the condensate storage container shall be monitored to determine the need for emptying the container.

SVE system monitoring data shall be frequently collected during the initial start-up period (as described in Appendix F) to determine the necessary adjustments to optimize system performance. The SVE system monitoring shall provide sufficient time series data to determine if the SVE system is working properly, to determine an appropriate schedule for long term operation and maintenance visits, and to determine when system shut-down may be possible.

System Shutdown

The SVE system shall operate until VOC concentrations in soils are below the cleanup objectives of 10 ppm total VOCs of concern as determined by laboratory analysis of soil samples, as described in the SAP. This condition shall be indicated when PID readings in SVE effluent air are not detected at concentrations above ambient air background conditions. Once the SVE effluent air is found to contain non-detectable PID readings, adjustments shall be made to air flow pathways through the SVE cell via valves on the SVE pipes. If PID readings of SVE effluent air continue to be non-detectable at concentrations above ambient air background conditions, up to 10 random soil samples shall be collected from the formerly impacted soils in the SVE cell and submitted for laboratory analysis for the VOCs of concern (i.e., VC, trans-1,2-DCE, cis-1,2-DCE, and TCE), in accordance with the SAP. Total VOCs for each sample shall be determined by summarizing the four individual VOCs. If the sum of the VOC analytical results are below 10 ppm, the treatment cleanup objectives shall have been met and the SVE treatment system shall be permanently shut down.

If some soil samples are found to contain greater than 10 ppm total VOCs as defined above, the SVE system shall be re-started and air flow shall be preferentially directed, to the extent possible, through the area of remaining impacted soils. Additional soil samples from those areas shall be obtained until soils in the SVE cell are below 10 ppm total VOCs. Once these conditions are observed, NYSDEC shall be notified that the SVE system was successful and a closure report shall be provided to the NYSDEC within 90 days of shutdown.

2.10 Work Task 8 - Ground-Water Collection Trenches

Under this work task, the Contractor shall provide all labor, equipment, and materials necessary to install two ground-water collection trenches, designated as the northern perimeter collection trench and the southern perimeter collection trench, respectively.

The northern perimeter collection trench shall be installed along the northern part of the site. The collection trench shall be approximately 120-feet long by 3-feet wide by 10-feet deep, and oriented as shown on Drawing G-18. This trench shall include a 6-inch outside diameter HDPE perforated pipe, in accordance with M&P Specification MP-02526, installed approximately one-foot above the base of the trench. The pipe shall discharge directly into the existing Pumping Manhole No. 2 as presented on Drawing G-18.

The southern perimeter collection trench shall be installed south of the manufacturing building. This collection trench shall be approximately 600-feet long by 3-feet wide by 6-feet deep, and oriented as shown on Drawing G-19. This trench shall include a 6-inch outside diameter HDPE perforated pipe installed approximately one-foot above the base of the trench. The trench shall terminate at a concrete cut-off wall that shall extend from 3 feet below the base of the trench to approximately 6 inches above the top of the trench. A 6-inch outside diameter HDPE solid pipe shall connect the trench to the existing Pumping Manhole No.1.

The perforated pipes for both the northern and southern collection trenches shall be embedded in thoroughly washed crushed gravel, which shall be used to backfill the trench to a depth of one foot above the static water table. The crushed gravel shall be durable, sharp angled fragments free from coatings and a minimum of 85 percent by weight of the crushed particles shall have at least two fractured faces. The crushed gravel within the trench shall be surrounded by non-woven geotextile fabric to mitigate the influx of fine sediment into the trench. The remainder of the trench shall be backfilled with native soil to grade. Operation of the pumps within the pumping manholes shall maintain a constant drawdown on the water level in the trench and thereby create an inward gradient from the surrounding formation. The water level in the two manholes shall be controlled by the existing float switches. Collection trench details are presented on Drawing G-20.

The Contractor shall be responsible for meeting the substantive requirements of Subsection 2.3 during excavation of the ground-water collection trenches. Soil generated as a result of the collection trench excavation activities may be used as cover during collection trench restoration activities provided the soil meets the fill material certification requirements presented in M&P Specifications MP-02221 and MP-02222.

2.11 Work Task 9 - Miscellaneous Materials Handling/Site Security

As part of the remedial activities, the Contractor shall provide all labor, equipment, and materials necessary to implement the following activities (as necessary) to the satisfaction of the Engineer:

- Excavation dewatering;
- Stabilize excavated soil, sediment, and debris;
- Dust control/vapor suppression;

- Segregate, handle, and break/cut debris from excavated material; and

- Site security.

A detailed description of each of these tasks is presented below.

2.11.1 Excavation Dewatering

During the soil/sediment removal activities, surface water/ground water that accumulates within active excavation areas shall be removed as necessary to assist in dewatering soil/sediment and to facilitate sedimentation/erosion control. The volume of water to be pumped from excavation areas is expected to be variable and shall be dependent on a number of factors (i.e., the methods used by the Contractor to excavate each area, the number of areas being excavated during a given period of time, weather conditions at the time of excavation activities, etc). For purposes of the bid, the Contractor should be prepared to provide variable rate pumps, hoses, and other appurtenances, as necessary, to enable each excavation area to be dewatered within a reasonable timeframe assuming dewatering shall be performed at a flow rate of up to 150 gallons per minute (for each excavation area). The Contractor shall pump water that accumulates within the excavation area(s) to the temporary on-site water treatment system (described above in Section 2.8) for treatment if the water has come in contact with impacted material, or to a discharge structure if the water has not come in contact with impacted material (at the discretion of the Engineer). To minimize the amount of sediment/soil being pumped from the excavation, the Contractor should take precautions such as constructing a sump and keeping the intake of the pump off the bottom and away from the sidewalls of the area being dewatered. The sump may consist of (but may not be limited to) one of or a combination of the following methods:

- Excavate a sump, backfill the sump with washed gravel.

- Cut perforations into a cylindrical object (i.e., a corrugated metal pipe or 55-gallon drum) and wrap the perforated object with a non-woven geotextile fabric that is capable of filtering particulates, while maintaining the flow capacity of the pump(s).

- Fabricate a floating intake system (for water depths capable of accommodating such a system) that attaches the intake of the pump(s) to a flotation device. The flotation device would be secured to the bank located at the limits of excavation to minimize movement and to accommodate retrieval of the system.

- Install hay bales/silt fences around the area where surface water/ground water is being pumped from and line the bottom of the area with a low-permeability material.

Specific excavation dewatering method(s) shall be detailed in the Contractor's Site Management Plan to be reviewed and approved by the Engineer.

2.11.2 Stabilize Excavated Soil, Sediment, and Debris

Under this item, the Contractor shall be responsible for stabilizing excavated soil/sediment that has been dewatered by gravity within a staging area (at least for one day) in order to meet applicable requirements for disposal (i.e., no free liquids). Stabilization activities shall be performed by the Contractor using the stabilization material(s) and procedures detailed in the Contractor's documentation that has been reviewed by the Engineer and Danaher. The Contractor is encouraged to consider adding up to three percent lime (by weight) as the preferred method of stabilizing excavated sediment/soil. Alternative methods of stabilizing excavated materials may be proposed by the Contractor and shall be evaluated based on cost effectiveness (i.e., volume/weight addition required, impacts on disposal and handling costs, availability of stabilization agents, etc.). The Contractor should be aware that addition of quick lime at dosages over approximately three percent by weight could cause stabilized soil/sediment to be regulated as a corrosive hazardous waste. Costs associated with disposal of stabilized material based on corrosive characteristics shall be the responsibility of the Contractor (at no additional cost to Danaher). Stabilized soil/sediment shall be subjected to a visual inspection by the Engineer. Visual inspection of the stabilized material by the Engineer shall not relieve the Contractor of adequately stabilizing materials prior to disposal.

2.11.3 Dust Control/Vapor Suppression

During the remedial activities, the Contractor shall be required to control dust and vapors that result from the remedial activities. The need to implement dust controls shall be based on the results of airborne particulate monitoring and/or visual observations by the Engineer [unless site conditions do not facilitate the generation of dust (i.e., materials are saturated)]. Dust monitoring activities shall be conducted within the worker breathing zone and the site perimeter in accordance with the Remedial Action Contingency Plan, the Air Monitoring Plan included as Appendix G, and the Engineer's HASP. If dust monitoring indicates that ambient dust levels in the worker breathing zone exceed 150 micrograms per cubic meter (above site background) for a period of five minutes or more, or if airborne dust is observed, the Contractor shall be required to implement dust control measures to the satisfaction of the Engineer. The actual measures to be implemented to control dust shall be proposed by the Contractor in the Site Management Plan. Exceedence of allowable concentrations of dust within the worker breathing zone shall trigger implementation of dust monitoring at the downwind perimeter. Should the dust action level be exceeded at the downwind perimeter, work activities shall be discontinued and dust suppression activities shall be implemented. Work activities shall not resume until dust levels are below the action level. The Contractor shall not be permitted to tap on-site fire hydrants in order to obtain water for dust suppression.

The Contractor may also be required to implement vapor suppression based on the results of organic vapor monitoring by the Engineer. Vapor monitoring activities shall be conducted within the worker breathing zone, downwind of the active excavation area and at the site perimeter in accordance with the Remedial Action Contingency Plan and the Engineer's HASP. If organic vapor monitoring downwind of the active excavation areas, or at the site perimeter, indicates that the action level for the total organic vapors is being exceeded, work activities shall be discontinued and the Contractor shall be required to implement vapor suppression techniques to the satisfaction of the Engineer and as outlined in the reviewed Site Management Plan.

2.11.4 Segregate, Handle, and Break/Cut Debris from Excavated Material

As part of the soil/sediment excavation activities, the Contractor shall be responsible for segregating all debris and foreign objects from excavated material that are larger than two feet in any one dimension or as directed by the Engineer. Segregated debris shall be staged separately from the excavated soil/sediment and cut up and/or broken up as necessary to allow for disposal off site. The methods used to cut up any debris shall be identified by the Contractor in the reviewed Site Management Plan. The Contractor shall be required to maintain all staged debris/foreign objects within a bermed containment area lined with a low-permeability liner and to cover the material with a low-permeability material to mitigate contact with precipitation as outlined above in Section 2.4.2. The staged material may be subject to confirmation sampling by the Engineer (to determine handling and disposal requirements) prior to off-site disposal. The Contractor shall not be permitted to dispose of any debris off site prior to receipt of characterization sample results by the Engineer (which shall be within two working days).

2.11.5 Site Security

During the implementation of the remedial activities (from when mobilization activities occur until demobilization activities are complete), the Contractor shall be responsible for providing any on-site security that the Contractor deems necessary.

2.12 Work Task 10 - Handling, Transportation, and Off-Site Disposal of Waste Materials

Under this work task, the Contractor shall be responsible for handling, storing, containerizing, transporting (including providing and preparing manifests, bill-of-ladings, etc.), and disposing off-site the following waste streams in accordance with all applicable federal, state, and local laws:

- Excavated soil/sediment and debris removed from Areas 6, 12, and 13 (and other areas if necessary based on confirmation sampling) as described in Section 2.9.2.
- Vegetation that is cleared and removed from above grade that has not been soiled by impacted media shall be transported and disposed of off site as a non-hazardous solid waste. Portions of vegetation located below grade or that become soiled by impacted site media shall be disposed of with the media.
- Decontamination liquids that cannot be treated using the temporary on-site water treatment system.
- Debris and railroad tracks/ties removed as part of the site clearing and excavation activities. As identified above (in Work Task 2), the debris shall be segregated from excavated soil/sediment and disposed of off-site if these materials cannot be placed within the containment cell.
- Materials used to construct surface-water diversion measures, material staging areas, decontamination pads, and water treatment system secondary treatment area(s), as well as low-permeability materials used to cover excavated material and excavated areas (to be disposed of off-site as non-hazardous material, with the exception of those items associated with the TSCA-regulated materials which shall be disposed of off-site as TSCA-regulated waste).
- Disposable sampling equipment.
- Personal protective equipment.
- Construction debris (i.e., associated with the containment cell and SVE systems).
- All other generated waste streams associated with the implementation of the remedial activities (which shall be identified by the Contractor in the bid submittal).

As identified in Appendix A, the Contractor is required to submit a list of anticipated waste streams to be generated, proposed methods for handling and containerizing (which includes providing the containers) each waste stream, and the disposal facilities for each waste stream. The Contractor shall be required to utilize transporters with a valid 6NYCRR Part 364 permit. The Contractor shall provide the Engineer with a copy of each transporter's permit prior to transporting material from the site. Copies of manifests, transporter permits, and certificates of disposal shall be maintained by the Engineer at the site and shall be provided to Danaher at the conclusion of the project. The non-hazardous waste disposal facilities proposed by the Contractor shall be subject to review by Danaher and the Engineer. At minimum, the disposal facility proposed by the Contractor must meet the following criteria:

- Facility must be appropriately permitted by federal and/or state regulatory agencies;
- The disposal facility cannot be listed as a National Priority List or State Superfund site; and
- The disposal facility must not have had any environmental violations within the last five years.

The Contractor shall not be reimbursed for any delays resulting from the evaluation of a facilities if (for any reason) a proposed facility is rejected or deemed unacceptable by Danaher and/or the Engineer. The Contractor shall be responsible for coordinating with any facilities that Danaher or the Engineer request to inspect. Weights (for solid waste materials) or volumes (for liquid wastes) for each shipment shall be provided by the Contractor to the Engineer for invoice payment purposes. The documented weights/volumes should consist of a computer-generated spreadsheet prepared by each disposal facility that presents the manifest or bill-of-lading document number and the weight/volume of the material received at the facility for each delivery. Certificates of disposal (signed, received manifests and bills-of-lading) shall be provided to the Engineer by the Contractor prior to the completion of demobilization activities from the site.

2.13 Work Task 11 - Site Restoration/Demobilization

Under this work task, the Contractor shall be responsible for restoring areas that are disturbed during implementation of the remedial activities (including all areas disturbed outside the limits of the remedial activities). The goal of the site restoration activities shall be to restore the disturbed areas to the satisfaction of Danaher and the Engineer. The Contractor's responsibilities for the restoration activities include the provision of all labor, equipment, and materials (as necessary) to complete restoration activities associated with the following:

- Soil excavation areas;
- Sediment excavation areas; and
- Miscellaneous areas.

A description of the restoration activities associated with each of these areas is presented below.

2.13.1 Soil Excavation Areas

Restoration activities for six of the excavation areas (Areas 2, 3, 7, 8, 9, and 10) shall initiate once the excavation limits, defined by the pre-remediation sampling program, have been reached to the satisfaction of the Engineer. Restoration activities for Area 13 shall not be permitted until soil verification sample results, indicating the cleanup objectives have been achieved, are received from the analytical laboratory by the Engineer. Restoration activities for each area shall consist of backfilling and restoring the areas disturbed by the excavation activities as necessary and to the satisfaction of the Engineer. Backfilling and restoration activities for each excavation area are presented below.

<u>Areas 2 and 3</u>

Backfilling/restoration activities associated with Areas 2 and 3 shall, at minimum, include the following:

- Place and compact structural backfill (Type 4 backfill) within the portions of the excavations that extend vertically below the bottom of the loading dock foundation in accordance with M&P Specification MP-02221. As part of the backfilling activities within these areas, the Contractor shall be responsible for maintaining all sheeting, shoring, bracing, and temporary supports for the utilities, sidewalls, and adjacent structures until the backfilling activities are completed. As an alternative to utilizing structural backfill, the Contractor may utilize flowable fill material. Flowable fill material may pose several advantages to use of structural backfill material, as no compaction is required, placement is relatively fast (i.e., compared to the method of placing, compacting, and testing structural backfill in lifts), and it may minimize the loss of material and reduce requirements for bracing the excavation sidewalls if utilized with a method of excavation consisting of excavating soil from sections within each area (i.e., excavating a section and backfilling the section prior to excavating the next adjacent section). Flowable fill (if selected based on cost compared to utilizing structural backfill) shall have a minimum 28-day compressive strength of 200 pounds-per-square-inch.

- Provide, place and compact soil fill material within the remaining portion of the excavations in accordance with M&P Specification MP-02222.
- Provide and place sand fill around electrical, fire protection, and gas utilities. The Contractor shall also be required to install appropriate marking tape approximately one-foot above underground utilities during the backfilling activities.
- Provide, place, and grade 6 inches of topsoil over the excavation areas to restore the areas to the pre-remediation elevations. The Contractor shall then place grass seed and mulch over the areas to encourage revegetation of the areas. Placement of the topsoil, grass seed, and mulch shall be in accordance with M&P Specification MP-02212.

Areas 7, 8, 9, 10, and 13

The three areas located beneath the on-site containment cell and SVE/leachate collection tank building (Areas 7, 8, and 13) shall be backfilled by placing the material in 6-inch thick loose lifts and compacting the material to 95 percent of the modified proctor as outlined in M&P Specifications MP-02200 and MP-02222. Soil backfill shall be placed to the elevations shown on the Contract Drawings in areas located below the containment cell and the SVE/leachate collection tank building. Select backfill materials associated with the construction of the containment cell and the building shall then be installed in accordance with the Contract Drawings and M&P Specifications MP-02221. Areas 9 and 10 shall be backfilled to within 6 inches of finished grade by placing 18 inch loose lifts of soil backfill within the excavated areas and compacting the backfill material to the satisfaction of the Engineer using excavation equipment (i.e., bulldozer). The backfill shall be placed to within 6 inches of the finished grade and restored by placing 6 inches of topsoil, grass seed, and mulch over the areas to encourage revegetation in areas located outside the limit of the containment cell access road. The containment cell access road shall be constructed in accordance with the details provided on the Contract Drawings. During the backfilling activities associated with Areas 7, 8, 9, and 10, the steel sheet piling system (if installed by the Contractor) shall either be removed or left in place and cut off to a minimum of 3-feet below grade (depending on the costs provided by the Contractor in the bid for removing the steel sheet piling system versus cutting the system off below grade). If the steel sheet piling system is removed, the Contractor shall be required to decontaminate the sheeting (within a decontamination area) in accordance with the reviewed Decontamination Plan and to the satisfaction of the Engineer.

Drainage Ditches and Skimmer Pond

Following receipt of analytical results (by the Engineer) from sediment verification samples indicating that the cleanup objectives have been achieved, restoration activities may commence. Restoration activities shall consist of providing, placing, and grading riprap along select areas of the drainage ditches (i.e., at culvert outfalls). Riprap shall be installed to the pre-remediation elevations or as directed by the Engineer (i.e., to promote drainage). Type

2 riprap shall be provided and installed in accordance with M&P Specifications MP-02271. If excavations within any portion of the drainage ditches are advanced more than 2 feet below finished grade, the excavation shall be partially backfilled with soil (as outlined in M&P Specifications MP-02222) to within 2 feet of finished grade prior to placing riprap within the excavation.

The skimmer pond shall be restored by grading the sidewalls of the pond to a three on one (horizontal on vertical slope). The bottom of the skimmer pond shall be restored by placing and compacting soil backfill to the final pond elevations. The pond shall then be lined with a geomembrane liner (i.e., at minimum consisting of a 20 mil HDPE liner) or low-permeability soil backfill (i.e., with a permeability of 1×10^{-6} cm/sec or less). The method used to restore the skimmer pond shall be proposed by the Contractor in the Site Management Plan, and reviewed and approved by the Engineer. The Contractor shall be responsible for installing and maintaining sedimentation and erosion control measures within and in the vicinity of the drainage ditches until permanent vegetation is established to the satisfaction of the Engineer.

Unnamed Creek

Following receipt of analytical results (by the Engineer) from sediment verification samples indicating that the cleanup objectives have been achieved, restoration activities may commence. The restoration activities shall consist of placing Type 2 riprap (as outlined in M&P Specifications MP-02271) within select areas along the bottom of the unnamed creek (i.e., at culvert outfalls) to the pre-remediation elevations. In addition, access roads installed adjacent to the unnamed creek shall be removed and the areas restored by placing topsoil, seed, and mulch over the areas in accordance with M&P Specifications MP-02212. Sedimentation and erosion control measures shall be installed in accordance with the minimum requirements presented on the Contract Drawings, the reviewed Contractor's Sedimentation and Erosion Control Plan, and as directed by the Engineer.

Miscellaneous Restoration Activities

The Contractor shall be responsible for restoring on-site and off-site areas, surfaces, or structures disturbed (either directly or indirectly) by the remediation activities. The Contractor shall be required to include the cost to perform these miscellaneous restoration activities in the bid and should consider these activities as incidental to the work activities. The goal of the miscellaneous restoration activities shall be to restore the areas to the pre-corrective measures condition (to the extent possible). All restoration activities shall be performed to the satisfaction of the Engineer, Danaher, and the property owner (if off-site restoration is necessary). Other miscellaneous activities to be addressed by this item include, but may not be limited to the following:

- Re-establish stockpiles of roofing materials in their pre-remedial locations.
- Erect and modify the existing chain link fence located on site.
- Repair paved parking areas, or other areas impacted by truck traffic or other activities associated with the implementing of the remediation activities.
- Restore areas disturbed to accommodate support areas (i.e., staging areas, decontamination areas, storage areas, temporary water treatment system area, etc.), site access, access to removal areas, access to monitoring wells or collection trenches, and any other areas identified by the Engineer. The extent of the areas disturbed shall be dependent upon the Contractor's proposed construction sequence.

- Remove any temporary access roads (whether on-site or off-site) and restore the areas disturbed by the installation of the roads with topsoil, seed, and mulch to encourage the areas to revegetate in accordance with M&P Specifications MP-02212. Sedimentation and erosion control measures shall be installed in accordance with the minimum requirements presented on the Contract Drawings, the reviewed Contractor's Sedimentation and Erosion Control Plan, and as directed by the Engineer.

As part of the bid, the Contractor should assume that the above-identified areas shall require restoration under this item. In addition, the Contractor should identify in their bid any other miscellaneous items requiring restoration.

Demobilization from the Site

Following completion of the restoration activities, the Contractor shall demobilize all labor, equipment, and materials (not used by the Contractor or that are re-usable by the Contractor) from the site. Prior to demobilizing materials or equipment from the site, the Contractor shall be required to clean all soiled surfaces to the satisfaction of the Engineer. Equipment decontamination shall be performed within a bermed and lined decontamination pad (for equipment that comes in contact with impacted media) or in an area proposed by the Contractor and agreed to by the Engineer (if equipment has not come in contact with impacted media) and in accordance with the reviewed Contractor's Decontamination Plan. The Contractor shall also be responsible for performing any follow-up coordination and maintenance activities (i.e., maintaining sedimentation/erosion control measures until revegetation is complete).

2.14 Work Task 12 - Standby Operations

During the implementation of the remedial activities, the Contractor and Engineer shall monitor weather conditions to enable activities that are dependent upon the weather to be scheduled. The activities covered by this work task include the following:

- Clean/replace pipes and culverts;
- Construct the containment cell (including filling the cell);
- Excavate and backfill soil/sediment removal areas; and
- Construct ground-water collection trenches.

Other activities (i.e., construction of the leachate collection/SVE building, mobilization, demobilization, well abandonment, etc.) may be impacted by weather conditions, however, the Contractor shall not be entitled to standby costs associated with these activities. During standby activities, the Contractor shall be responsible for performing the following:

- Inspect, maintain, and repair sedimentation/erosion control measures;
- Inspect, maintain, and repair the low-permeability cover placed over excavated material and excavation areas; and
- Perform other activities at the direction of the Engineer.

The quantity of standby days to be invoiced by the Contractor shall be agreed to between the Engineer and the Contractor. The Contractor should be aware that standby time shall be granted on a prorated basis (i.e., partial days) for normal work days. Compensation for other days (i.e., weekends and holidays) shall only be permitted if work has been scheduled and agreed to by the Engineer. However, the Engineer or Danaher shall be permitted to cancel scheduled activities on additional work days (i.e., weekends and holidays), up to 24 hours prior to the scheduled activity, without penalty (i.e., compensating the Contractor for a standby day).

3. RD Support Documents

The following table identifies the documents that have been prepared in support of the RD Specifications and are included as appendices to this document.

Title	Topic	Appendix
Minimum Requirements for Preparation of Plans	Identifies minimum requirements for preparing the Contractor's Site Management Plan, HASP, Remedial Action Contingency Plan, and Decontamination Plan.	Appendix A
Field Sampling Plan (FSP)	Part of the SAP, this appendix identifies field procedures, samples to be collected, and sample collection methods to be used during implementation of the remedial activities.	Appendix B
Quality Assurance Project Plan (QAPP)	Part of the SAP, this appendix presents analytical methods and procedures to be used during implementation of the remedial activities.	Appendix C
Material & Performance (M&P) Specifications	Presents the minimum requirements for labor, equipment, and materials utilized during implementation of the remedial activities.	Appendix D
SVE System Basis of Design	Presents the basis of design for the SVE treatment system	Appendix E
SVE Start-Up Procedures	Describes the procedures to be followed during start-up of the SVE treatment system.	Appendix F
Site-Specific Air Monitoring Plan	Presents the air monitoring activities to be conducted by the Engineer during implementation of the remedial activities	Appendix G
Construction Quality Assurance Plan	Describes the site-specific components of construction quality to ensure that remedy construction meets or exceeds the RD Specifications	Appendix H

4. Schedule

Presented below is the schedule for implementation of the RD activities.

Activity	Completion Time Frame
Name and qualifications of supervising Contractor submitted to NYSDEC	5 days after effective date of Order
Draft RD/RA Work Plan submitted to NYSDEC	45 days after receipt of NYSDEC approval of supervising contractor
Final RD/RA Work Plan submitted to NYSDEC	30 days after receipt of NYSDEC comments on or approval of Draft RD/RA Work Plan
Draft RD Specifications submitted to NYSDEC, following completion of Treatability Study & Site Topographic Survey	160 days after receipt of NYSDEC approval of Final RD/RA Work Plan
Final RD Specifications submitted to NYSDEC	45 days after receipt of NYSDEC comments on or approval of Draft RD Specifications
Name and qualifications of Supervising Contractor for remedial construction submitted, following request for bids and contract award	90 days after receipt of NYSDEC approval of Final RD Specifications
Completion of remedial construction and submittal of draft Operation & Maintenance Plan to NYSDEC	240 days after NYSDEC approval of Supervising Contractor
Final Operation & Maintenance Plan, "As Built" drawings, Final Engineering Report and Certification submitted to NYSDEC	90 days after completion of remedial construction.
NYSDEC Certification of Completion of Remedial Construction	60 days following submittal of "as built" drawings, final engineering report, and certification to NYSDEC
Implementation of OM&M Plan	Following receipt of NYSDEC approval of OM & M Plan

Acronyms and Abbreviations

6 NYCRR Part 364	Part 364 of Title 6 of the New York State Compilation of Codes, Rules and Regulations
29 CFR 1910	Part 1910 of Title 29 of the Code of Federal Regulations
40 CFR 761	Part 761 of Title 40 of the Code of Federal Regulations
ADS	Advanced Drainage Systems, Inc.
ASTM	American Society for Testing and Materials
BBL	Blasland, Bouck & Lee, Inc.
CQAP	Construction Quality Assurance Plan
CWA	Clean Water Act
cis-1,2-DCE	cis-1,2-Dichloroethene
trans-1,2-DCE	trans-1,2-Dichloroethene
FSP	Field Sampling Plan
GAC	Granular Activated Carbon
GCL	Geosynthetic clay liner
HASP	Health and Safety Plan
HELP	Hydrologic Evaluation of Landfill Performance
HDPE	High Density Polyethylene
IRM	Interim Remedial Measure
M&P	Material and Performance
NYSDEC	New York State Department of Environmental Conservation
OM&M	Operation, Maintenance, and Monitoring
OSHA	Occupational Safety and Health Administration
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SPDES	State Pollutant Discharge Elimination System
SRI	Supplemental Remedial Investigation
SVE	Soil Vapor Extraction
TAL	Target Analyte List
TCE	Trichloroethylene
TCL	Target Constituent List
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VC	Vinyl Chloride
VOCs	Volatile Organic Compounds

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Blasland, Bouck & Lee, Inc. 1994. *Remedial Investigation Report.* Syracuse, New York. October 1994.

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Blasland, Bouck & Lee, Inc. 1995. *Supplemental Remedial Investigation Report/Feasibility Study.* Syracuse, New York. December 1995.

Blasland, Bouck & Lee, Inc. 1997. *Remedial Design Work Plan.* Syracuse, New York. November 1997.

Appendix A

Remedial Design Specifications
Chicago Pneumatic Tool Company
Frankfort, New York

Minimum Requirements for Preparation of Plans

Site Management Plan

Following the award of the bid, the Contractor shall prepare and submit a Site Management Plan that presents a detailed approach (incorporating site maps, design drawings, details, schedules, etc.) for implementation of each work task outlined in the RD Specifications. The Site Management Plan shall present all relevant design information; describe specific work responsibilities for personnel assigned to the project; describe the sequencing of the work tasks; and describe the handling, transportation, and disposal (on-site or off-site) of waste materials generated during implementation of the remedial measures. The Site Management Plan shall be provided to all of the Contractor's personnel and Subcontractors directly involved in the completion of the remedial activities outlined in the RD Specifications. Specific information to be included in the Site Management Plan is presented below.

Work Task 1 - Pre-Remediation Activities

- Copies of all permits necessary to implement the remedial activities (the Engineer and Danaher will obtain the environmental permits).

- Figures that depict the Contractor's approach for completing the remedial activities at critical phases of the activities, including locations of the following:

  1. The proposed temporary water treatment system (including identification of the proposed sanitary manhole for effluent discharge), field office trailers, remediation support areas, material staging areas (including the identification of each material to be placed in each area), equipment and material decontamination areas, and on-site truck routes;

  2. Installation of sediment and erosion control and surface water diversion measures;

  3. Temporary haul roads to be constructed;

  4. Temporary fencing (i.e., high visibility orange safety fence) to limit unauthorized access to removal, construction, staging, and decontamination areas;

  5. Approximate limits of clearing activities necessary to implement the remedial measures; and

  6. Areas being excavated/restored during various phases of the project.

- Plans and sections depicting sizes and materials of construction for the staging areas, on-site storage areas, secondary containment areas, equipment and material decontamination areas, erosion control measures, surface water diversion measures, and haul roads.

- Identification of names and addresses of proposed backfill sources and the backfill material to be obtained at each source.

- Methods to be used to delineate and field verify the location(s) of existing utilities, structures, etc. located in the vicinity of work areas.

- Methods for preventing above-grade portions of vegetation from coming in contact with impacted material during clearing and grubbing activities.

- Methods and materials to be used to provide visual and physical barriers around the bases of existing utility poles located within the east parking lot and along the southern property boundary.

<u>Work Task 2 - Soil Excavation</u>

- Detailed descriptions of the methods, materials, and equipment to be utilized to complete the pre-excavation activities.

- Proposed methods, personnel, and equipment to be used to excavate soil and handle soil for disposal (on-site or off-site).

- Specifications for the low-permeability liner material to be used to cover excavation areas when excavation activities are not actively taking place, and proposed methods for anchoring the liner in each excavation area.

- Specifications for materials to be used to cover excavated materials placed within staging areas and proposed methods for anchoring the cover.

- Plans, sections, technical data, and calculations as necessary to identify methods of stabilizing sidewalls of excavation areas to maintain stability of the sidewalls and to comply with OSHA regulations. All details, calculations, and drawings must be signed and sealed by a professional engineer licensed to practice in New York State.

- Proposed methods to be used to minimize infiltration of surface water and ground water into excavation areas.

- Manufacturer's technical data and detailed descriptions of the methods to be used to dewater excavations and transfer water to either the on-site water treatment system or to the on-site drainage ditch (depending on whether or not the water has come in contact with impacted media). The description will include details and specifications for materials of construction for sumps, discharge structures, and other elements.

- Detailed description of the labor, equipment and materials to be used to handle and break up the granite blocks located within Area 9.

- Detailed description of the methods, equipment, and materials to be used to segregate debris from the excavated soil. The description should also identify the handling, staging and off-site disposal of segregated debris.

Work Task 3 - Sediment Removal

- Methods, personnel, and equipment to be utilized to excavate and handle sediment for on- or off-site disposal (including dewatering and stabilization).

- Methods for diverting surface water flow within the drainage ditches and the unnamed creek to allow implementation of the remedial measures. The Contractor will also provide details and specifications of materials of construction for all diversion methods (including any dams, pumps, channels, discharge structures, etc.).

- Locations and sizes of dams, channels, pumps, basins, discharge structures to be used to divert surface water flow.

- Material to be used to cover sediment and debris within on-site staging areas, and the proposed methods of anchoring the cover.

Work Task 4 - Pipe Cleaning/Replacement

- Method of access to the storm sewer outfalls (SPDES Outfalls 001 and 002) that discharge into the unnamed creek (i.e., access road, etc.).

- Methods to dewater the areas in the vicinity of SPDES Outfalls 001 and 002.

- Methods for removing/handling sediment in the immediate vicinity of the SPDES Outfalls 001 and 002 and the downstream ends of culverts within the drainage ditches to be cleaned.

- Plans and sections depicting sizes and materials of construction of sump(s) used to collect washwater and debris generated by hydroflushing the storm sewer pipes and culverts.

- Methods to be used to remove washwater (i.e., number and type of pumps, pump capacity, capacity of the vacuum truck, etc.) from the sump(s).

- Anticipated pressure/flow rate for hydroflushing debris from the storm sewer piping and culverts. In addition, the Contractor should identify the anticipated volume of washwater that will be generated.

- Methods for handling sediment and debris removed from the storm sewer piping and culverts.

- Methods and technical specifications for removing, handling and replacing existing culvert pipes that can not be cleaned or are in poor structural condition.

- Specifications for all equipment to be used to complete the pressure washing activities (i.e., pressure washing equipment, vacuum truck, video camera, etc.).

Work Task 5 - Monitoring Well Abandonment

- Methods of handling (including staging of materials and disposal) well construction materials (i.e., well casings, etc.) generated by the monitoring well abandonment activities to be conducted by the Engineer.

Work Task 6 - Temporary Water Treatment System

- Shop drawings for each component of the water treatment system which present the following:
  - Equipment size, dimensions, and materials of construction;
  - Piping connection sizes and types;
  - Electrical wiring diagrams and schematics; and
  - Elementary Control diagrams.
- Process flow diagram for the water treatment system.
- Proposed discharge point to the sanitary sewer and methods to be employed by the Contractor to monitor the maximum discharge flow rate into the sewer.
- Operations and Maintenance (O&M) Manual that includes a general narrative detailing the Contractor's O&M activities and includes the following information (as applicable) for each major system component:
  - Mobilization, startup testing, normal (daily) operations, trouble shooting, and shut down procedures;
  - Preventative or routine maintenance requirements;
  - Lubrication schedules;
  - Recommended spare parts list;
  - Calibration and alignment information;
  - Care and cleaning of surfaces; and
  - Manufacturer's O&M manuals.
  - Design and operating specifications;
  - Theory of operation and functional diagrams;
  - Performance data and certifications; and

- Name, address, and telephone number of a manufacturer's representative.

- Example of daily operations log for documenting the status of the water treatment system and to document operation within manufacturer's specifications; and

- Identification and qualification of water treatment system operator.

Work Task 7 - Soil/Sediment Disposal Requirements

- Proposed waste transporters for TSCA-regulated soil/sediment including copies of Title 6 of the New York State Compilation of Codes, Rules, and Regulations Part 364 (6NYCRR Part 364) permits for each transporter and disposal facility.

- Methods, equipment, and materials to be used to construct the containment cell (including the SVE system and the final cover) in accordance with the RD Specifications; and

- Methods, equipment, and materials to be used to place materials into the containment cell.

Work Task 8 - Ground-Water Collection Trenches

- Methods, equipment, and materials to be used to construct the ground-water collection trenches and piping.

- Methods (including providing details of all sheeting, shoring, calculations, etc.) to be used to stabilize the excavation sidewalls during construction of the trenches. Excavation sidewalls will be stabilized as necessary to maintain stability and comply with all OSHA regulations. All drawings, details, and calculations for maintaining stability of the sidewalls of the trench excavations will be signed and sealed by a professional engineer licensed to practice in New York State.

Work Task 9 - Miscellaneous Materials Handling/Site Security

- Plans and details of excavation dewatering systems depicting the location(s) of pumps, piping, discharge structures, water treatment system, etc. The details will clearly identify the materials of construction of all components of the dewatering system (i.e., discharge structures, sumps, etc.).

- Proposed methods, materials, and equipment to be used to stabilize excavated materials (if necessary).

- Proposed methods, materials and equipment to be utilized to provide dust control and vapor suppression. The Contractor will clearly outline proposed potable water source, methods for temporarily storing potable water on-site, and manufacturer's technical data for all vapor suppressants (including chemical data and material safety data sheets).

Work Task 10 - Handling, Transportation, and Off-Site Disposal of Waste Materials

- List of anticipated waste streams to be generated for off-site disposal (i.e., sediment, soil, debris, impacted vegetation, above-grade portions of vegetation, low permeability materials used to cover excavations and staging areas, materials used to construct staging areas, decontamination pads, secondary containment areas, disposable sampling equipment, personal protective equipment, sludges and decontamination liquids resulting from decontamination of the water treatment system, disposal of spent water treatment system media, etc.) and anticipated volumes.

- Proposed methods for handling and containerizing each waste stream.

- Proposed waste transporters and disposal facilities for each anticipated waste stream (including copies of 6NYCRR Part 364 permits for each transporter and disposal facility).

Work Task 11 - Site Restoration/Demobilization

- Proposed methods, materials and equipment to be used to restore each excavation area.

- Proposed methods, materials, and equipment to be used to restore other areas disturbed by the Contractor that are located outside the limits of excavation.

Work Task 12 - Stand-By Operations

- Proposed inspection log which will at minimum include a punch list of activities to be performed by the Contractor during stand-by operations and the outcome of inspection activities (i.e., identified deficiencies, action taken, time of inspection, list of personnel performing inspection, etc.).

Site Specific Health and Safety Plan

The selected Contractor shall prepare, submit (prior to mobilization to the site in accordance with Section 2.3, and implement a site specific Health and Safety Plan (HASP) that, at a minimum, meets the requirements of 29 CFR 1910 and 29 CFR 1926 (which includes 29 CFR 1910.120 and 29 CFR 1926.65) and the minimum requirements of the Engineer's HASP. The Contractor's HASP shall cover all personnel who will be employed by the Contractor to perform work at the site, including direct employees as well as subcontractors. If the Contractor does not wish to include subcontractors under this HASP, then each subcontractor will be responsible for developing and implementing a HASP that meets the requirements outlined in this RD Specification. If a subcontractor agrees to be included under the Contractor's HASP, then a statement to this effect shall be submitted to the Engineer and Danaher.

The HASP shall address, but not be limited to, the following components:

1. Identification of Key Personnel - Identify, by name and by title, the on-site and off-site health and safety personnel responsible for the implementation of health and safety procedures. On-site personnel involved in some of the remedial activities (e.g., excavation of sediment and soil) must have OSHA 40-hour Hazardous Waste Training (29 CFR 1910.120 and 29 CFR 1926.65) and the corresponding 8-hour refresher course update.

2. Training - Describe and provide certification of all supervisory and on-site personnel having received appropriate health and safety training. Training requirements shall also include attending an initial site orientation prior to engaging in any on-site activities. Sign-off sheets acknowledging attendance shall be provided.

3. Medical Surveillance - Describe and provide certification that all supervisory and on-site personnel have received appropriate medical examinations and are able to conduct the tasks required for this project including but not limited to: working with chemicals, using respiratory protection, using personal protective equipment, and conducting hazardous waste operations in accordance with 29 CFR 1910.120 and 1926.65.

4. Site Hazards - Identify and provide a means of mitigating all foreseeable chemical and physical constituents associated with the work, including, but not limited to, hazards associated with exposure to constituents of concern, heavy equipment operation, site conditions, weather, biological hazards, materials handling, and work around excavated areas.

5. Work Zones - a site plan which depicts the designation of zones including: (1) Exclusion Zones (2) Contamination Reduction Zones, and (3) Support Zones. The level of personal protection for each zone shall be specified.

6. Personal Safety Equipment and Protective Clothing - Identify personal safety equipment and protective clothing to be used and available on-site. This shall include identification of expected levels of protection (A, B, C, D) for each task, and the action levels for personal protective equipment upgrades. Also included shall be a respiratory protection program that meets the requirements of 29 CFR 1910.134, which establishes specific requirements for any respirator use.

7. Personal Air Monitoring - Identify protocols and criteria associated with personal air monitoring of on-site personnel.

8. Equipment Cleaning - Describe methods and procedures for decontamination of personnel, vehicles, and equipment.

9. Confined Space Entry - The plan shall describe procedures for confined space entry in accordance with OSHA's Permit-Required Confined Space Standard (29 CFR 1910.146). Describe and provide certification of Confined Space Entry Training for all authorized personnel in accordance with 29 CFR 1910.146.

10. Material Safety Data Sheets - Provide material safety data sheets (MSDSs) for all materials to be brought on site, as well as constituents which are expected to be encountered in the course of remediation.

11. Excavation Safety - Identify excavation and trenching safety procedures as specified in 29 CFR 1926 Subpart P including, but not limited to; soil classification, excavation inspections, protective systems, and designated competent persons.

12. Standard Operating Procedures and Safety Programs as required by applicable sections of 29 CFR 1910 and 29 CFR 1926.

The HASP shall be submitted to the Engineer for review within 14 days following the award of the contract and at least 7 days prior to scheduled mobilization to the Site. Determination of the appropriate level of worker safety equipment and procedures shall be made by the Contractor as a result of site visit(s) and review of available information as deemed necessary by the Contractor.

Should any unforeseen or site-specific safety-related factor, hazard, or condition become evident during the performance of work at the site, the Contractor shall be responsible for bringing such conditions to the attention of the Engineer both verbally and in writing as quickly as possible for resolution. In the interim, the Contractor shall take prudent action to establish and maintain safe working conditions and to safeguard employees, the public, and the environment.

Unauthorized variation from, or substitution for, any portion or provision of the HASP requirements shall be deemed just and sufficient cause for termination of the Contract without compromise or prejudice to the rights of Danaher or the Engineer.

The Contractor will be provided with a copy of the Engineer's HASP prior to preparing his HASP to serve as a guideline. The Contractor, however, assumes sole responsibility for the accuracy and content of its HASP.

Remedial Action Contingency Plan

The selected Contractor shall prepare, submit (prior to mobilization in accordance with Section 2.3), and implement a Remedial Action Contingency Plan which includes, at a minimum, the following items:

1. A spill response plan for addressing spills that occur on-site during the remedial activities.

2. A spill prevention control and countermeasures (SPCC) plan.

3. A plan for addressing high water levels in the unnamed creek and on-/off-site drainage ditches during implementation of the RD Specifications.

4. A plan to address air quality exceedances (as described in the site specific Air Monitoring Plan included as Appendix G and in the Contractor's HASP) during excavation of soils and sediments.

5. Procedures and routes for emergency vehicular access/egress.

6. Procedures for the evacuation of personnel from the site.

7. A listing of all contact personnel with phone numbers to include: The Contractor; the Engineer; the NYSDEC; fire officials; ambulance services; local, county, and State Police; and local hospitals, including routes to local hospitals and procedures for notifying each contact.

8. Method to contain gasoline/diesel fuel spills if these fuels are to be brought on-site. No compensation will be provided to the Contractor for work related to cleaning up spills or leaks caused by the Contractor's personnel or equipment. Storage of fuels or equipment within the drainage ditches and/or wetland areas will not be permitted at any time during the remedial activities. In addition, the Contractor will not be permitted to repair or refuel any equipment within these areas. Each piece of heavy equipment utilized at the Site (excavators, loaders, etc.) shall be equipped with a spill containment and control kit.

9. Routes to local hospitals, including written directions and a map that depicts the location of the site relative to the hospital(s).

Decontamination Plan

The Contractor will prepare and submit (prior to mobilization) a Decontamination Plan identifying the appropriate procedures and methods that will be employed to properly decontaminate project-related equipment, including cleaning equipment, trucks, hand-tools, etc., that came into contact with impacted site media. The plan must address the generation, collection, and handling of solids, liquids, personal protective equipment (PPE), and other related wastes generated during the remedial activities. At a minimum, the following procedures shall be executed by the Contractor:

- Unless otherwise directed by the Engineer, any equipment to be taken off-site by the Contractor shall be subject to a final visual examination by the Engineer and cleaning (if necessary) at a designated area. In general, this area will be bermed and lined with a low-permeability liner that slopes to a sump. Precautions shall be taken to limit contact between the equipment, personnel performing the cleaning activities, and any cleaning liquids that may accumulate in the decontamination area. The Contractor shall be responsible for constructing and maintaining the decontamination area to accommodate all loads, equipment, and migration scenarios. Provisions must be made to prevent any off-site tracking of materials (e.g., onto public roadways, etc.). The Contractor shall dismantle any structure and properly dispose of all materials associated with the decontamination area, and shall restore the area to its original condition;

- The extent and method of cleaning shall be at the discretion of the Contractor, however, each piece of equipment shall be observed by the Engineer for any visible soils or other debris prior to the removal of equipment from the site. Any observed soils or other debris shall be promptly removed by the Contractor and disposed of in a manner consistent with the materials that were contacted or excavated from that area;

- Solids and other materials generated during equipment cleaning shall be collected by the Contractor and placed into designated containers;

- Disposal and/or treatment of collected wash water, solids, and other materials shall be in accordance with the RD Specifications; and

- The Contractor will be responsible for constructing facilities to mitigate tracking of materials (whether impacted or not) onto public roadways. The Contractor will outline in the plan the measures to be taken to minimize tracking (i.e., tire wash area, coarse gravel area to remove loose soil and debris from tires, etc.).

Erosion and Sedimentation Control Plan

An Erosion and Sedimentation Control Plan (E&SC Plan) shall be prepared and submitted by the selected Contractor prior to mobilization to the site. This E&SC Plan shall describe the measures which will be taken by the Contractor to prevent accelerated erosion and/or situation during the remedial activities. The E&SC Plan shall consist, at a minimum, of the following:

- A detailed description and details of the temporary structural (e.g., silt fences and hay bales) and vegetative measures that will be used to control erosion and siltation for each stage of the project from land clearing to the final revegetation stage. At a minimum, the Contractor will be required to have one row of silt fence or hay bales installed immediately downstream of the sediment removal activities and upstream of any other erosion and sedimentation control measures within the drainage ditches and the unnamed creek. If the Contractor proposes to utilize sand bags for erosion and sedimentation control measures, the sand bags must be covered with a low-permeability polyethylene liner.

- A figure(s) showing the location of erosion and sediment control measures. The figure(s) should clearly illustrate how the erosion and sedimentation control measures will be modified as the remedial activities progress from upstream to downstream (for sediment removal) and will be modified to address excavation/restoration of remedial areas.

- An implementation schedule for installing temporary and/or permanent erosion and sediment control measures.

- A maintenance schedule for soil erosion and silt control measures.

The erosion and sediment control measures shall be installed in accordance with the new York State Guide for Urban Erosion and Sediment Control and shall be constructed prior to beginning any land disturbances (e.g., clearing and grubbing activities). These control measures will be utilized to insure that there will not be a substantial visible contrast to natural conditions downstream of these control measures (based on visual inspection by the Engineer). The control measure devices should not be removed until the disturbed land areas are stabilized. All non-disposable equipment utilized by the Contractor for erosion and sediment control will be decontaminated in accordance with the Contractor's Decontamination Plan prior to removal of the equipment from the site.

APPENDIX B

Remedial Action Field Sampling Plan

Chicago Pneumatic Tool Company
Frankfort, New York

April 1998

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

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Syracuse, New York, 13214-0066
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Appendix

1. Introduction

1.1 General

This Field Sampling Plan (FSP) is part of the Sampling and Analysis Plan (SAP) which supports the Remedial Design (RD) Specifications for the Chicago Pneumatic Tool Company (the site) located in Frankfort, New York. This FSP addresses the field procedures, samples to be collected, and sample collection methods to be used during implementation of the remedial activities outlined in the RD Specifications. The Quality Assurance Project Plan (QAPP), which is also part of the SAP, is presented as Appendix C.

This FSP contains detailed field sampling procedures and includes information regarding sample locations, sample designations, and sample handling and documentation.

1.2 Objectives of the Sampling and Analysis Program

The overall objective of the sampling and analysis program is to provide analytical data to verify that the cleanup goals for the site are achieved. Based on this general objective, the following specific objectives have been established for the sampling and analysis program:

1. Determine the extent of soil excavation which will be required in specific areas of the site prior to initiating excavation activities;

2. Confirm that the concentrations of chemical constituents remaining in soil and sediment at the limits of the excavation areas are less than the cleanup goals;

3. Confirm that the concentrations of chemical constituents previously detected in site ground water diminish over time to levels below New York State Ground-Water Quality Standards or reach a point of no discernible change; and

4. Determine the handling and disposal requirements for miscellaneous materials generated during implementation of the remedial activities.

1.3 Overview of the Sampling and Analysis Program

To obtain information necessary to meet the objectives of the remedial activities, the following field sampling will be conducted:

- Pre-excavation verification soil sampling;

- Post-excavation verification soil sampling;

- Post-excavation verification sediment sampling;

- Soil and sediment confirmation sampling (for disposal purposes);

- Post-remediation ground-water sampling; and

- Miscellaneous sampling.

The proposed excavation areas and corresponding verification sampling locations are shown on Figure 1. Proposed confirmation sampling areas are shown on Figure 2. The locations of existing and proposed ground-water monitoring wells, which will be sampled as part of the ground-water monitoring program, are shown on Contract Drawing G-2.

2. Remedial Action Field Sampling

2.1 General

This section presents the details associated with implementing the field sampling program at the site and provides the following information:

- Proposed sample locations, number, and type;
- Procedures for sampling and measuring field parameters, such as pH, conductivity, dissolved oxygen, turbidity, temperature, and depth to ground water; and
- A summary of the data to be generated from each sampling effort, including field parameters and analytical laboratory parameters.

Detailed information regarding the remedial action field sampling, including the number/type of environmental samples and quality control samples to be collected, sample intervals, analytical parameters, sample containers, preservation, and holding times are presented in the tables identified below.

Table	Title	Contents
1	Verification Sampling Summary	Presents the sample media, anticipated number of samples to be collected from the excavations, the sampling frequency, anticipated sampling depth, and laboratory analytical parameters.
2	Summary of Historical Data	Summarizes the analytical results obtained for constituents of concern in each excavation area at the site.
3	Quality Control Analyses Summary	Indicates the number and type of quality assurance/quality control (QA/QC) samples which will be required.
4	Confirmation Sample Summary	Indicates in which excavation areas confirmation sampling for polychlorinated biphenyls (PCBs) and volatile organic compounds (VOCs) will be conducted to determine handling and disposal requirements.
5	Sample Containers, Preservation, and Holding Times	Indicates the appropriate sample containers, preservation methods, and holding times for samples which will be collected.

Detailed sample collection procedures are provided in the attachments.

2.2 Pre-Excavation Verification Soil Sampling

Pre-excavation verification soil sampling will be conducted in selected areas of the site to provide data to confirm the horizontal limits of certain excavation areas prior to initiating the soil excavation activities. The selected areas where the pre-excavation verification sampling will be conducted coincide with areas where sheet piling may be installed during the soil excavation process (i.e., to support sidewalls, protect structures, and/or minimize the volume of ground water which enters the excavation). Pre-excavation verification sampling will be conducted in the following soil excavation areas.

- Areas 2 and 3 - the chip chute area;
- Area 7 - the former separation ponds; and
- Area 9 - the former debris landfill.

Figure 1 presents the locations of the above-listed areas.

Pre-excavation verification sampling will not be conducted to determine the vertical limits of the excavations in the selected areas because the vertical limit will coincide with the top of a confining, glacial till layer (which ranges from approximately 5 feet to 9 feet below grade). As part of the pre-excavation verification sampling program, one Geoprobe™ (or soil boring) will be installed at the following locations:

- Around the anticipated perimeter of each of the above-mentioned excavation areas (except for the north sidewall of Areas 2 and 3 where the manufacturing building foundation will form the excavation sidewall and be the limit of excavation in that direction);
- At locations two feet radially outward from the anticipated perimeter of each excavation area; and
- At locations four feet radially outward from the anticipated perimeter of each excavation area.

The Geoprobe locations will be marked using a flagged wooden stake along the anticipated perimeter of each excavation area such that there will be one Geoprobe location per sidewall per 100 linear feet. Locations where Geoprobes will be installed are shown on Figure 1. The Geoprobes will be installed in accordance with the protocols presented in Attachment A. The Geoprobes will be decontaminated between sampling locations using the procedures presented in Attachment B.

One verification soil sample will be collected from each Geoprobe from the same two-foot depth interval where the highest concentrations of constituents were detected during the Remedial Investigation (RI) or the Supplemental Remedial Investigation (SRI). For excavation areas where elevated concentrations of chemical constituents were detected in more than one depth interval during the RI or SRI, one sample will be collected from each of the intervals. The anticipated depths at which samples will be collected from the excavation areas using the Geoprobes are summarized in Table 1 and in the table below.

Area	Sampling Intervals (Feet Below Existing Grade)	
	Field Screening/Visual Characterization	**Laboratory Analysis**
2	2-4	2-4
3	2-4	2-4
7	2-4 and 4-6(Note 1)	3-5
9	0-2, 2-4, 4-6, 6-8, and 8-10(Note 1)	4-6

Area	Sampling Intervals (Feet Below Existing Grade)	
	Field Screening/Visual Characterization	Laboratory Analysis

Note:
1. Elevated concentrations of chemical constituents were detected in more than one depth interval of Areas 7 and 9 during the RI /SRI. The interval selected for laboratory analysis from these areas will coincide with the middle interval where chemical constituents were detected, unless determined otherwise based on the field screening results.

Each soil sample recovered from the Geoprobe will be observed for the presence of visible waste materials and screened using a flame ionization detector (FID) to determine the presence of any volatile organic vapors in the sample headspace. In addition, select soil samples may undergo field testing for the presence of PCBs using ENSYS test kits. Procedures for calibrating and operating the FID are presented in Attachment C. Standard operating procedures for ENSYS test kits are presented in Appendix 1. Samples from the Geoprobe will be submitted for laboratory analysis or laboratory archive, as described below:

- One sample from each Geoprobe location at the anticipated perimeter of the excavation areas will be submitted for laboratory analysis for the constituents of concern (provided that no waste materials are observed in the sample and no elevated headspace screening results are obtained for the sample).
- The samples from each Geoprobe, installed at locations two feet radially outward from the anticipated limits of the excavation, will be held for laboratory archive. These samples will be analyzed by the laboratory if the field screening or laboratory analytical results for samples collected at the anticipated perimeter of the excavation indicate that constituents of concern are present at concentrations above the cleanup objectives.
- Additional samples will be collected from Geoprobe locations four feet radially outward from the anticipated perimeter of the excavation and submitted for laboratory archive. If samples collected two feet outward from the anticipated perimeter of the excavation indicate that constituents of concern are present at concentrations above the cleanup objectives, then these samples also will be analyzed for the constituents of concern.

Based on the analytical results of the pre-excavation sampling, the final perimeter of Areas 2, 3, 7, and 9 will be determined. The pre-excavation samples closest to the assumed excavation area perimeter, which do not contain chemical constituents at concentrations greater than the cleanup objectives, will form the boundary for each excavation area.

Verification soil samples selected for laboratory analysis from Areas 2, 3, 7, and 9 will be analyzed for metals of concern [chromium, copper, lead, and zinc] using USEPA SW-846 6010/7000 Series Methods. Verification soil samples collected for laboratory analysis from Area 2 and a portion of Area 7 also will be analyzed for VOCs of concern (cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethylene, and vinyl chloride) where noted on Figure 1, using USEPA SW-846 Method 8260. In addition, verification soil samples selected for laboratory analysis from Area 9 will be analyzed for PCBs using USEPA SW-846 Method 8082. QA/QC soil samples will also be collected as described in Section 5.0 and in the QAPP. Table 1 presents the number of soil samples to be collected, the sampling depths, and laboratory analytical parameters. Table 2 presents the analytical results for samples collected as part of the RI and SRI. Table 3 presents the appropriate QA/QC soil sampling frequencies.

Samples selected for laboratory analysis will be placed into appropriate sample containers as described in Section 4.0, and the sample containers will be labeled as described in Section 3.0. The samples will be handled, packaged, and shipped following the procedures in Section 4.0 and Attachment D.

2.3 Post-Excavation Verification Soil Sampling

Post-excavation verification soil sampling will be conducted in Area 13 (i.e., the East Lot) to provide data to confirm that constituents of concern are not present in the remaining soils at concentrations greater than the cleanup objectives at the limits of the excavation. One post-excavation verification soil sample will be collected from each sidewall of Area 13 (at a frequency of one sample per 100 linear feet of sidewall) from the two-foot depth interval where the highest concentrations of constituents were detected during the RI and SRI. Based on the RI and SRI analytical data, the sampling depth for Area 13 will be 5 to 6 feet below the existing ground surface. Post-excavation verification soil samples will also be collected from the bottom of Area 13 at a frequency of 1 sample per 1,000 square feet. Samples obtained from the bottom of Area 13 will be collected from the 0 to 6-inch depth below the bottom of the excavation. Based on the anticipated size of the excavation (approximately 80 feet long by 20 feet wide), a total of four verification soil samples will be collected from the sidewalls of the excavation and two verification soil samples will be collected from the bottom of the excavation. The approximate locations of the post-excavation verification soil samples are shown on Figure 1. In the event that this excavation extends into the till, bottom verification samples will not be collected.

Verification soil samples from the sidewalls of the excavation will be composite samples formed from four discrete samples collected within a two foot radius. Verification soil samples from the bottom of the excavation also will be composite samples formed from four discrete samples collected within a two foot radius. Procedures for collecting the post-excavation verification soil samples are presented in Attachment E.

A portion of each verification soil sample will be used for visual characterization and headspace screening using a FID. In addition, field testing for the presence of PCBs at concentrations above the cleanup objectives may be conducted using ENSYS test kits. Field personnel conducting the ENSYS field tests will be trained and experienced in the field test procedures. The remaining portion of the sample will be placed in the appropriate sample container and submitted for laboratory analysis provided the sample does not appear to contain visible waste materials, contain a noticeable odor, exhibit an elevated FID headspace screening result, or contain PCBs at concentrations greater than 1 ppm (based on ENSYS test kit results). Standard operating procedures for ENSYS field test kits are presented in Appendix 1. If the sample contains visible waste material, a noticeable odor, an elevated FID headspace screening result, or contain PCBs at concentrations greater than 1 ppm (based on ENSYS test kits), the excavation will be advanced as appropriate and additional verification samples will be collected. Verification samples submitted to the laboratory from Area 13 will undergo analysis for PCBs using USEPA SW-846 Method 8082.

QA/QC soil samples will also be collected as described in Section 5.0 and in the QAPP. Table 1 presents the number of soil samples to be collected, and Table 3 presents the associated QA/QC soil sampling frequencies. Samples will be placed into the appropriate sample containers, preserved as described in Section 4.0, and labeled as described in Section 3.0. The samples will be handled, packaged, and shipped following the procedures presented in Section 4.0 and Attachment D.

2.4 Post-Excavation Verification Sediment Sampling

Post-excavation verification sediment sampling will be conducted to provide data to confirm that constituents of concern are not present in the remaining sediments at concentrations greater than cleanup objectives at the limits of the excavations conducted in the areas listed in the table below.

Area	Location
1	Unnamed Creek
4	On-Site Drainage Ditch South of the Manufacturing Building
5	Skimmer Pond
6	On-Site Drainage Ditch South of the Foundry
11, 12	Off-Site Drainage Ditch North of Bleecker Street
14	On-Site Drainage Ditch East of the Manufacturing Building

One post-excavation verification sediment sample will be collected from the bottom centerline of the unnamed creek and each of the above-listed drainage ditches at a frequency of one sample per 200 linear feet. One post-excavation verification sediment sample will also be collected from the bottom of the skimmer pond at a frequency of one sample per 1,000 square feet. Each verification sediment sample will be collected from a depth of 0 to 6-inches below the bottom of the excavation. One post-excavation verification sediment sample also will be collected from each sidewall of the skimmer pond (at a distance of one-third up from the bottom of the pond) at a frequency of one sample per 100 linear feet of sidewall. The approximate locations of the post-excavation verification sediment samples are shown on Figure 1.

Each verification sediment sample will be a composite sample formed from four discrete samples collected within a two-foot radius. Procedures for collecting the post-excavation verification sediment samples are presented in Attachment E. A portion of each verification soil sample will be used for visual characterization and headspace screening using an FID. In addition, field testing for the presence of PCBs at concentrations above the cleanup objectives may be conducted using ENSYS test kits. The remaining portion of the sample will be placed in the appropriate sample container and submitted for laboratory analysis provided the sample does not appear to contain visible waste materials, contain a noticeable odor, exhibit an elevated FID headspace screening result, or contain PCBs at concentrations greater than 1 ppm (based on ENSYS field test kits). If the sample contains visible waste material, a noticeable odor, exhibits an elevated FID headspace screening result, or contains PCBs at concentrations greater than 1 ppm (based on ENSYS field test kits), the excavation will be advanced as appropriate and additional verification samples will be collected. Verification samples submitted to the laboratory will undergo analysis for PCBs (USEPA SW-846 Method 8082), VOCs of concern (USEPA SW-846 Method 8260), or metals of concern (USEPA 6000/7000 Series Methods), as indicated in the table below.

Area	Anticipated Number of Samples	Analytical Parameters
1	3 bottom	PCBs, Metals of Concern
4	2 bottom	PCBs, Metals of Concern

Area	Anticipated Number of Samples	Analytical Parameters
5	4 sidewall 1 bottom	PCBs, VOCs of Concern, Metals of Concern
6	5 bottom	PCBs, Metals of Concern
11	4 bottom	PCBs, Metals of Concern
12	3 bottom	PCBs, Metals of Concern
14	4 bottom	PCBs

QA/QC soil samples will also be collected as described in Section 5.0 and in the QAPP. Table 1 presents the number of soil samples to be collected, and Table 3 presents the associated QA/QC soil sampling frequencies. Samples will be placed into the appropriate sample containers, preserved as described in Section 4.0, and labeled as described in Section 3.0. The samples will be handled, packaged, and shipped following the procedures presented in Section 4.0 and Attachment D.

2.5 Confirmation Sampling

During the remedial action, confirmation samples will be collected from selected soil/sediment stockpiles to determine the appropriate method for handling and disposal of excavated soil and sediment. The handling and disposal alternatives for the excavated soil/sediment are as follows:

- Excavated soil/sediment containing PCBs at concentrations greater than 50 ppm will be segregated for disposal as a TSCA/New York State hazardous waste;
- Excavated soil/sediment containing VOCs of concern at concentrations greater than 10 ppm will be segregated for placement in the on-site soil vapor extraction (SVE) treatment cell (provided PCBs are not present in the soil/sediment at concentrations greater than 50 ppm); and
- Excavated soil/sediment containing PCBs at concentrations less than or equal to 50 ppm, VOCs of concern at concentrations less than or equal to 10 ppm, and/or metals at concentrations above the cleanup goals will be placed in an on-site lined containment cell.

Soil/sediment removed from Areas 6, 12, and 13, which are known to contain PCBs at concentrations greater than 50 ppm (based on the RI/SRI analytical data) will be directly loaded into lined roll offs for off-site disposal. These materials will not undergo confirmation sampling.

Based on the RI/SRI analytical data, stockpiles formed from soil/sediment removed from portions of Areas 9 and 10 could potentially contain PCBs at concentrations greater than 50 ppm, and soil/sediment excavated from portions of Areas 2, 7, and 8 could potentially contain VOCs of concern at concentrations greater than 10 ppm. Samples collected as part of the RI/SRI which contained PCBs at concentrations greater than 50 ppm or VOCs of concern at concentrations greater than 10 ppm are summarized in Table 4. The portions of the excavation areas where PCBs are potentially present at concentrations greater than 50 ppm and where VOCs of concern are potentially present at concentrations greater than 10 ppm based on the RI/SRI data are presented on Figure 2. One composite confirmation sample will be collected for every 500 CY of soil sediment excavated from the areas shown on Figure 2 for field screening for PCBs and/or VOCs of concern as described below.

- A portion of the composite sample of material excavated from Areas 9, and 10 will be field screened for PCBs using ENSYS PCB field test kits designed to analyze for Aroclors 1254 and 1260. Standard operating procedures for ENSYS PCB field test kits are presented in Appendix 1. If the screening results indicate that the total PCB concentration is less than 40 ppm, the remaining portion of the sample will be submitted for laboratory analysis to confirm that the concentration of PCBs in the sample is less than 50 ppm and that the material can be disposed of in the on-site, lined containment cell. If the ENSYS field test kit screening results indicate that the total PCB concentration is greater than 40 ppm, the material will be transported for off-site disposal as a TSCA/New York State hazardous waste.

- A portion of the composite sample of material excavated from Areas 2, 8, and 10 will be field screened for VOCs using an FID. If the screening results indicate that the total VOC concentration in the sample headspace is less than 20 ppm, the remaining portion of the sample will be submitted for laboratory analysis to confirm that the concentration of total VOCs of concern is less than 10 ppm and the material can be disposed of in the on-site, lined containment cell. If the screening results indicate that the total VOC concentration in the sample headspace is greater than 20 ppm, the material will be placed in the on-site SVE treatment cell.

2.6 Ground-Water Sampling

Ground-water sampling will be conducted at the site to confirm the following:

- That the concentrations of chemical constituents previously detected in ground water in the vicinity of the areas diminish over time to levels below New York State Ground-Water Quality Standards or to a point of no discernable change; and

- That a proposed new collection trench mitigates the migration of ground water containing VOCs.

Ground-water samples will be collected from the following monitoring wells:

- Existing monitoring well MW-6R, located in the northeast corner of the site;

- Existing monitoring well MW-13S, located downgradient of the debris landfill, the skimmer pond, and the east lot;

- Existing monitoring well MW-14, located sidegradient of the debris landfill and the east lot;

- A proposed new ground-water monitoring well (MW-17) to be installed downgradient of a perimeter collection trench to be installed north of the manufacturing building; and

- A proposed new ground-water monitoring well (MW-18) to be installed downgradient of Areas 7 and 9.

Details related to the installation of the proposed new ground-water monitoring wells, ground-water sampling, and measurement of water levels are presented below.

2.6.1 Ground-Water Monitoring Well Installation

As part of this work effort, two overburden ground-water monitoring wells, designated as MW-17 and MW-18, will be installed at the locations presented on Contract Drawing G-2. A qualified drilling subcontractor will complete soil borings to a depth of approximately 5 feet into saturated overburden soil using 4¼-inch inside diameter hollow-stem augers. Soil samples will be collected continuously from the soil boring using 2-foot-long, 2-inch-diameter, split-barrel sampling devices. Soil samples recovered from each split-barrel sampling interval will be visually characterized by an on-site geologist for the following:

- Soil type and sorting;
- Color;
- Moisture content;
- Organic content;
- Texture;
- Grain size and shape;
- Relative density;
- Consistency;
- Plasticity of fines;
- Cohesiveness;
- Odors/discoloration;
- Mottling/staining;
- Weathering;
- Visible evidence of fill material; and
- Feet of recovery.

Procedures for advancing the soil borings at the well locations are outlined in Attachment F. Drilling and sampling equipment will be cleaned prior to initiating drilling activities and at the completion of the drilling activities for each monitoring well using the procedures outlined in Attachment B. Soil cuttings generated by the monitoring well installation activities may be placed in 55-gallon drums or other suitable containers for transfer to the on-site lined containment area. Decontamination water and drilling fluids generated by the drilling activities will be containerized by the drilling subcontractor for transfer to the temporary on-site water treatment system.

Following completion of the soil borings, the overburden monitoring wells will be installed at using the protocols presented in Attachment G. The monitoring wells will be constructed using 2-inch diameter Schedule 40 polyvinyl chloride (PVC) pipe and will be completed to a depth of approximately 5 feet below the ground-water table. The monitoring wells will be screened over a 10-foot interval, from approximately 5 feet above the water table to the depth of completion.

Following installation, the monitoring wells will be developed by bailing or pumping water from the wells using the procedures outlined in Attachment G. Bailing or pumping will continue until the turbidity is reduced to the goal of 50 nephelometric turbidity units (NTUs) or less, or until relatively constant pH and conductivity measurements are obtained. Monitoring well development water and equipment decontamination water will be containerized for transfer to the temporary on-site water treatment system.

2.6.2 Ground-Water Sample Collection

At least two weeks following installation and development of new ground-water monitoring wells MW-17 and MW-18, ground-water samples will be collected from monitoring wells MW-6R, MW-13S, MW-14, MW-17, and

MW-18 using the procedures presented in Attachment H. The next three rounds of ground-water samples will be collected at six month intervals. The samples collected during the initial four rounds will be submitted for laboratory analysis for VOCs and metals of concern, and PCBs. Based on the laboratory analytical results for the initial four sampling rounds, the analytical parameter list for subsequent ground-water monitoring events may be modified to include only the above-listed parameters that were detected at concentrations above the New York State Ground-Water Quality Standards. Following the initial four sampling rounds, the ground-water monitoring frequency is anticipated to be on an annual basis (based on the laboratory analytical results). Ground-water field measurements will be obtained from each well at the time of sampling, including pH, conductivity, dissolved oxygen, and temperature using the procedures in Attachment H.

QA/QC ground-water samples will be collected as described in Section 5.0 and in the QAPP. Table 3 presents the associated QA/QC ground-water sampling frequencies. Samples will be placed into the appropriate sample containers, preserved as described in Section 4.0, and labeled as described in Section 3.0. The samples will be handled, packaged, and shipped following the procedures in Section 4.0 and Attachment D.

2.6.3 Ground-Water Level Measurement

As part of the ground-water monitoring program, ground-water levels will be obtained to the nearest 0.01-foot from monitoring wells MW-6R, MW-13S, MW-14, MW-17, and MW-18 from a reference point at the top of the inner casing or outer casing using the procedures in Attachment H. The outer casing will be used if no inner casing exists. Water level measurements will be recorded in a field notebook or on the water level form included in Attachment H. All measurements will be converted to elevations, as referenced to the National Geodetic Vertical Datum (NGVD) of 1929, after the location and elevation of new monitoring wells MW-17 and MW-18 have been surveyed.

2.7 Miscellaneous Sampling

In addition to the above-described sampling activities, additional miscellaneous sampling may be performed to determine handling and disposal requirements for the following materials:

- Start-up testing and effluent samples from the temporary water treatment system;
- Soil contained within the SVE cell;
- Leachate from the on-site, lined containment cell; and
- Railroad ties located in Areas 2 and 3.

A description of the sampling and analysis to be conducted for each of these materials is presented below.

<u>Start-Up Testing and Effluent Samples from the Temporary Treatment System</u>

Surface water or ground water that enters the excavation areas will be pumped to on-site storage tanks and treated on-site in a temporary water treatment system, as described in Section 2.8 of the RD Specifications. Water generated from soil/sediment dewatering activities also will be collected and treated on-site via the temporary water treatment system. Start-up testing samples will be collected from the temporary water treatment system following mobilization and setup of the system, and prior to initiating full-scale (normal) operations. General start-up and testing of the temporary water treatment system shall consist of treating approximately 20,000 gallons of water. During start-up testing, two sets of samples will be collected from the following locations:

- As influent to the influent settling tanks;

- As influent to the multi-media filters (which shall represent the quality of the water entering the treatment system from the influent tanks and entering the multi-media filters);
- After the multi-media filters;
- After the liquid bag filters;
- After the carbon filters; and
- From the treated water storage tank.

The start-up testing samples shall be submitted for laboratory analysis for discharge permit parameters (described below) and total suspended solids (TSS).

During normal operation of the temporary water treatment system, effluent samples will be collected and analyzed for specific parameters as required by a discharge permit to be obtained from the Oneida County Department of Water Quality and Water Pollution Control. Based on a permit previously obtained for discharge of treated wastewater generated during implementation of the Storm Sewer Sediment Interim Removal Measure (Permit No. GW-050, dated October 21, 1996), the following parameters and analyses will likely be required for approval to discharge to the municipal sanitary sewer system:

- PCBs using USEPA SW-846 Method 8082;
- Oil and grease using USEPA Method 413.1;
- Total toxic organic constituents using USEPA Methods 624 and 625; and
- Select metals (cadmium, chromium, copper, lead, nickel, and zinc) using USEPA Method 3111B.

Samples of the effluent water from the treatment system will be collected prior to each batch discharge of the treated effluent to monitor effluent concentrations and to confirm that the sanitary sewer discharge permit limits are met. The samples will be submitted for analysis for the parameters listed above on a 24-hour turnaround basis.

<u>Soil Contained Within the SVE Cell</u>

During operation of the SVE system, a FID [or a photoionization detector (PID)] will be used on a routine basis to measure the VOC vapor concentrations in effluent air near the discharge point from the SVE system (i.e., before the blowers and prior to treatment of the air stream). When the FID/PID readings in the SVE effluent air are continuously at concentrations near 10 ppm, soil samples from the SVE cell will be collected to determine if the cleanup objectives for soil in the cell have been achieved. Up to 5 soil samples will be collected from the SVE cell and submitted for laboratory analysis for VOCs of concern using USEPA SW-846 Method 8260. If the sum of the VOCs of concern analytical results are less than 10 ppm, the cleanup objectives will have been achieved, and the SVE treatment system will be permanently shut down. However, if any of the soil samples from the SVE cell contain greater than 10 ppm total VOCs of concern, the SVE treatment system will be restarted and the air flow will be preferentially redirected, to the extent possible, through the impacted soils. Additional soil samples will be collected from areas of the SVE cell where the cleanup objectives had not initially been achieved to determine if the objectives are achieved as a result of the additional treatment.

<u>Leachate from the On-Site, Lined Containment Cell</u>

As part of the remedial action, a lined containment cell will be constructed at the site. The lined containment cell will have a leachate collection system as a component of the liner system. Leachate generated from the soil/sediment located in the containment cell will be collected using a series of perforated collection pipes installed within the drainage layer of the system. The piping system will drain to a collection manhole/pump station constructed adjacent to the containment cell. Leachate will be transferred from the collection manhole/pump station to a temporary leachate storage tank adjacent to the containment cell. When the tank becomes full, a sample of the leachate will be collected for laboratory analysis to determine disposal requirements. Parameters selected for analysis will be specified by the anticipated disposal facility.

Railroad Ties in Areas 2 and 3

Railroad tracks and ties presently located in Areas 2 and 3 will need to be removed prior to conducting the soil excavation activities. In addition, railroad ties may be encountered in Areas 5 and 9. One composite sample of the railroad ties will be collected from the railroad ties in Areas 2 and 3 and one composite sample will be collected from each additional excavation area where railroad ties are encountered and analyzed for waste disposal characterization in accordance with Part 371 of Title 6 of the New York State Compilation Codes Rules and Regulations (6 NYCRR 371). The composite samples will be analyzed for TCLP VOCs, TCLP semi-volatile organic compounds (SVOCs), and TCLP metals as listed in 6 NYCRR 371. The analytical results will be used to determine whether the ties can be placed in the on-site lined containment cell or will need to be transported for off-site disposal.

3. Sample Designation System

3.1 Sample Codes

A six-digit sample designation code and sample date will provide each sample with a unique "name." This alphanumeric system will apply to all samples collected and submitted to the designated laboratory for analysis. The designation codes that will be used for the samples collected as part of the remedial action are presented below.

Sample Type	Sample Designation
Verification Soil Samples & Verification Sediment Samples	• A prefix (VA) will indicate that the sample is a verification sample; • A number following the prefix (1 through 14) will indicate the Area being sampled; • A dash and directional code (N, S, E, W, or B) will follow the Area number. This directional code will reflect whether the sample is collected from the north, south, east, or west sidewall or from the bottom of the excavation; and • A number following the directional code will indicate the position along the excavation sidewall or bottom of the excavation the depth from where the sample is collected (i.e., 2-4 representing the depth interval of 2-4 feet).
Confirmation Soil Samples & Confirmation Sediment Samples	• A prefix (CA) will indicate that the sample is a confirmation sample; • A number following the prefix (1 through 14) will indicate from which Area the material being sampled was removed; and • A dash and an additional number will follow the excavation number. This additional number will be used to track multiple confirmation samples from a particular Area (i.e., one confirmation sample will be collected per 500 CY of excavated soil from selected Areas).
Ground-Water Samples	• A prefix (MW) will indicate that the sample is a ground-water sample; and • A number following the prefix will indicate from which monitoring well the ground-water sample was collected.
Water Samples Associated with the Temporary On-Site Water Treatment System	• Samples of the effluent water from the treatment system will contain a prefix (EW) followed by the sample number.
Soil Samples Collected from the SVE Treatment Cell	• A prefix (SVE) will indicate that the sample is a soil sample collected from the SVE treatment cell; • A dash and directional code (N, S, E, or W) will follow the SVE prefix. This directional code will reflect from where within the SVE system the sample was collected; and • A number following the prefix will indicate the depth from where the sample was collected.
Leachate from the On-Site, Lined Containment Cell	• A prefix (LCC) will indicate that the sample is a leachate sample from the on-site, lined containment cell; and • A number following the prefix will be used to track multiple leachate samples.

Sample Type	Sample Designation
Railroad Ties	• A prefix (RR) will indicate that the sample is wooden railroad tie fragments; and • A number following the prefix will be used to track individual railroad tie samples.

The suffix "D" will be added to the location number to indicate a duplicate sample. Trip blanks will contain a "TB" designation followed by a number, and rinse blanks will contain a "RB" designation followed by a number.

4. Sample Handling and Documentation

4.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for samples collected as part of the remedial action are shown in Table 5.

The analytical laboratory will supply appropriate sample containers in sealed cartons, as well as sample labels and preservatives. Field personnel will be responsible for properly labeling containers and preserving samples (as appropriate). Sample labeling procedures are described in Attachment D.

4.2 Packing, Handling, and Shipping Requirements

Sample custody seals and packing materials for filled sample containers also will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage. Trip blank(s) of analyte-free water will be provided by the laboratory and included in each cooler containing ground-water samples to be analyzed for VOCs.

All samples will be packaged by the field personnel and transported as low-concentration environmental samples. The packaged samples will be either shipped via express overnight carrier (Federal Express or other courier) or hand delivered to the laboratory within 24 to 48 hours of sample collection. General procedures for packing, handling, and shipping environmental samples are included in Attachment D.

4.3 Documentation

Field personnel will provide comprehensive documentation covering all aspects of field sampling, field analysis, and sample chain-of-custody. This documentation constitutes a record which allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records, and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained throughout the remedial action include:

- <u>Daily Production Documentation</u> - A field notebook consisting of a waterproof, bound notebook that contains a record of all activities performed at the site.

- <u>Sampling Information</u> - Detailed notes will be made as to the exact site of sampling, physical observations, sample depths, and weather conditions. Monitoring well logs (included in Attachment G) will be completed for the proposed new monitoring well and will include the well number, location, and a description of the subsurface soil conditions encountered during installation of the well. Ground-water sampling field logs (included in Attachment H) will be filled out during each sampling event and will contain sample location, data on water levels, well depths, physical observations of the water, and field measurements (temperature, pH, dissolved oxygen, and conductivity). Water-level readings will be measured to surveyed reference points, and will be documented on the water-level form in Attachment H.

- <u>Sample Chain-of-Custody</u> - Chain-of-custody forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. Chain-of-custody forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by one of the field personnel designated to be responsible for sample custody. In the event that the samples are relinquished by the designated sampling person to other sampling or field personnel, the chain-of-custody form will be signed and dated by the appropriate personnel to document the sample transfer. The original chain-of-custody form will accompany the samples to the laboratory and copies will be forwarded to the project files. A sample chain-of-custody form is included in Attachment D.

Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

- <u>Field Equipment, Calibration, and Maintenance Logs</u> - To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory-calibrated. Calibration procedures, and calibration and maintenance logs are provided in Attachment C.

4.4 Management of Sampling-Related Materials and Wastes

The handling of sampling-related materials and wastes is discussed below.

4.4.1 Excess Soil and Water

Excess soil from headspace screening and soil cuttings generated during the drilling operations will be placed into labeled 55-gallon drums (or other appropriate containers) provided by the drilling subcontractor for future transfer to the on-site lined containment cell. Monitoring well development water and equipment decontamination water will be placed in appropriate containers for transfer to the temporary on-site water treatment system. Excess ground water withdrawn from the monitoring wells for well purging and field measurements for pH, conductivity, dissolved oxygen, turbidity, and temperature (as part of the ground-water monitoring following demobilization of the temporary on-site water treatment system) will be containerized for disposal with the leachate generated from the on-site containment cell.

4.4.2 Disposable Equipment and Debris

Disposable equipment and debris, such as health and safety equipment, plastic sheeting, sampling equipment, and other equipment and/or sampling debris not reused during the remedial action will be collected in plastic bags during sampling and placed into appropriately labeled containers, which will be stored in a suitable location as determined by the on-site personnel. At the end of the remedial action, the contents will be transferred into labeled 55-gallon drums (or other appropriate containers) for future disposal.

4.4.3 Decontamination Rinsate

Field sampling equipment will be decontaminated by following the procedures outlined in Attachment B. Decontamination rinsate will be containerized at each sampling location or group of locations. Upon completion of the field sampling, the rinsate will be treated in the on-site temporary water treatment system or disposed with the leachate generated from the on-site containment cell.

5. Field Quality Assurance/Quality Control

This section summarizes the Quality Assurance Quality Control (QA QC) requirements for sampling activities associated with the remedial action at the site.

5.1 Field Instrument Calibration and Preventative Maintenance

Field personnel are responsible for ensuring that a master calibration/maintenance log is maintained following procedures specified in Attachment C for each measuring device. At a minimum and where applicable, each log will include the following:

- Name of device and/or instrument calibrated;
- Device/instrument serial/identification number;
- Frequency of calibration;
- Date(s) of calibration(s);
- Results of calibration(s);
- Name of person(s) performing calibration(s);
- Identification of calibration gas (FID); and
- Buffer solutions (pH meter only).

Equipment to be used each day shall be calibrated prior to the commencement of the day's activities or as suggested by the manufacturer.

Health and safety monitoring equipment (i.e., meter to measure total organic vapors and particulate levels) and water-quality testing equipment (pH, conductivity, dissolved oxygen, turbidity, and temperature meters) will be calibrated and maintained in general accordance with the specifications in the manufacturer's manuals.

5.2 QA/QC Sample Collection

An estimate of QA/QC field samples to be collected is provided in Table 3. This estimate is based on the QA/QC sample collection frequency as discussed in the QAPP. Guidance on the collection of the QA/QC samples is presented below.

Trip Blanks

On events/days when aqueous VOC samples are shipped to the analytical laboratory, a trip blank will be collected. A trip blank is an aliquot of analyte-free water, which is sealed in 40-milliliter (ml) glass vials with Teflon-lined septum caps prior to initiation of field work. This blank may be used to determine if any cross-contamination has occurred among samples during shipment. These sealed bottles will be prepared by the laboratory and included with each shipment of sample bottles for aqueous media to and from the laboratory and the site.

Rinse Blanks

Rinse blanks will be prepared by pouring analyte-free water over decontaminated sampling equipment as a check that the decontamination procedure has been adequately performed and that cross-contamination of samples will not occur due to the equipment. One rinse blank will be collected for each type of equipment used (i.e., the Geoprobe and split-spoon sampling device) for every 20 samples collected and at a minimum of once per week. The same aliquot of rinse water may be used on equipment coming in contact with a particular matrix for analysis for PCBs and inorganic constituents. A separate rinse blank must be collected for each piece of equipment used for a particular sample matrix to be analyzed for VOCs.

Rinse blanks will be prepared in the field. Laboratory supplied analyte-free water will be poured into or over the sampling equipment and then directly into the laboratory-supplied sample bottles. The intent is for the water making up the blank to follow the same path, and therefore, come in contact with the same equipment as the samples.

Duplicate Samples

Duplicate samples will be sent for laboratory analysis to evaluate the reproductibility of the sampling technique used. Five percent (i.e., one for every 20 samples) of each matrix will be duplicated.

Duplicate samples will be collected using methods to maximize the compatibility of the samples. For example, ground water collected from a monitoring well will be divided between the sample and duplicate sample laboratory containers.

Tables

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Table 1

Chicago Pneumatic Tool Company
Frankfort, New York
Remedial Action Field Sampling Plan

Verification Sampling Summary

Excavation Area	Sample Media	Anticipated Number of Samples	Sampling Frequency	Anticipated Sampling Depth[a]	Laboratory Analytical Parameters		
					PCBs	VOCs of Concern[b]	Metals of Concern[c]
1	Sediment	3 bottom	1 per 200 LF	0-6" (P)	X		X
2	Soil	2 sidewall	1 per sidewall/100 LF	2-4' (E)		X	X
3	Soil	3 sidewall	1 per sidewall/100 LF	2-4' (E)			X
4	Sediment	2 bottom	1 per 200 LF	0-6" (P)	X		X
5	Sediment	4 sidewall	1 per sidewall/100 LF	0-6" (P)	X		X
		1 bottom	1 per 1,000 SF	0-6" (P)	X		X
6	Sediment	5 bottom	1 per 200 LF	0-6" (P)	X		X
7	Soil	4 sidewall	1 per sidewall/100 LF	2-4' or 4-6' (E)			X
		2 sidewall				X	X
8	Soil	0 sidewall	No verification samples; excavation bounded by Area 7				
9	Soil	9 sidewall	1 per sidewall/100 LF	0-2', 2-4', 4-6', 6-8', or 8-10' (E)	X		X
10	Soil	0 sidewall	No verification samples; excavation bounded by Area 9				
11	Sediment	4 bottom	1 per 200 LF	0-6" (P)	X		X
12	Sediment	3 bottom	1 per 200 LF	0-6" (P)	X		X
13	Soil	4 sidewall	1 per sidewall/100 LF	1-3' (E)	X		
		2 bottom	1 per 1,000 SF	0-6" (P)	X		
14	Sediment	4 bottom	1 per 200 LF	0-6" (P)	X		

Notes:
1. LF = linear feet.
2. SF = square feet.
3. (P) = Depth below post-remediation grade.
4. (E) = Depth below existing (pre-remediation) grade.
5. [a] = Depths for verification soil samples collected from excavation sidewalls (as shown above) coincide with intervals where the highest concentrations of constituents were detected during the Remedial Investigation and the Supplemental Remedial Investigation. The actual sample depths will be determined in the field based on visual observations, PID headspace screening results, and/or the presence of noticeable odors (if any).
6. [b] = VOCs of concern = 1,2-dichloroethene (cis and trans); trichloroethylene; and vinyl chloride.
7. [c] = Metals of concern = chromium, copper, lead, and zinc.
8. Verification soil samples will not be collected from the north sidewalls of Excavation Areas 2 and 3 because the foundation of the manufacturing building will be exposed over the full length of these north sidewalls (Note: based on the approximate elevation of the manufacturing building basement floor, the building foundation extends to the top of the underlying, confining glacial till layer).

Table 2

Chicago Pneumatic Tool Company
Frankfort, New York
Remedial Action Field Sampling Plan

Summary of Historical Data

Excavation Area and Associated Sample	Depth (ft)	Concentration (ppm)			
		PCBs	TCE	DCE	VC
Clean-up Objectives	**NA**	**Surface = 1.0 Subsurface = 10.0**	**VOC Cleanup Objective = 10 ppm for total VOCs of Concern**		
Area 1 - Unnamed Creek					
SD - 1A	0-0.5	9.0 P	0.03 UD	0.03 UD	0.061 UD
SD - 1A DUP	0-0.5	8.0 P	0.009 JD	0.035 UD	0.069 UD
SD - 1B	0.5-1.0	8.5 P	--	--	--
SD - 1C	1.0-1.5	0.164 P	--	--	--
SD - 2A	0-0.5	2.4 J	--	--	--
SD - 2B	1.5-2.0	--	--	--	--
Area 2 - Chip Chute Area					
CHSB - 1	2-4	---	11 D	200 D	11 JD
CHSB - 2	2-4	4.02 JP	7.5 UD	7.5 UD	15 UD
CHSB - 3	4-5	---	0.005 J	0.026	0.01 J
CHSB - 4	16-18	---	0.008	--	--
Area 3 - Chip Chute Area					
GP - 20	2-3	---	7.70	1.10	---
CHSB - 5	12-14	---	0.007 R	0.007 UJ, 0.007 UJ	0.013 UJ
Area 4 - On-Site Drainage Ditch South of Manufacturing Building					
CHCHC - COMP A	0-0.5	15.2 J	--	--	--
CHCHC - COMP B	0.5-1.0	17.8 P	--	--	--
GP - 18/ GP - 19	2-3/2-3	--/--	2.0/2.0	--/--	--/--
SD - 4A/4A DUP	0-0.5	24.0 J/--	0.13D/.66J	0.088 D/--	--/--
Area 5 - Skimmer Pond					
GP - 7	3-4	--	0.260	--	--
SKSD - 2	0-0.5	NA	0.38 D	0.35 D, 0.042 UD	0.036 JD
SKSD - 3	0-0.5	NA	0.037 D	0.032 UD, 0.014 JD	0.013 JD
SKSD - 3 DUP	0-0.5	NA	0.052 D	0.037 UD, 0.021 JD	0.022 JD
SKSD - 3	0.5-1.0	NA	0.03 UD	0.03 UD, 0.03 UD	0.06 UD
SKSD - 5	0-0.5	16.3 JD	0.28 D	0.012 JD, 0.36 D	0.15 D
SKSD - 5	0.5-1.0	20.2 P	0.012 JD	0.053 UD, 0.014 JD	0.11 UD

Table 2
(Cont'd)
Chicago Pneumatic Tool Company
Frankfort, New York
Remedial Action Field Sampling Plan

Summary of Historical Data

Excavation Area and Associated Sample	Depth (ft)	Concentration (ppm)			
		PCBs	TCE	DCE	VC
Clean-up Objectives	NA	Surface = 1.0 Subsurface = 10.0	VOC Cleanup Objective = 10 ppm for total VOCs of Concern		
Area 6 - On-Site Drainage Ditch South of the Foundry					
CSSD - 3IA	0-0.5	470 P	--	--	--
CSSD - 3IA DUP	0-0.5	379	--	--	--
CSSD - 3IB	0.5-1.0	51 P	--	--	--
CSSD - 3LA	0-0.5	0.860 P	--	--	--
CSSD - 3LB	0.5-1.0	0.260 P	--	--	--
CSSD - 3RA	0-0.5	27.9 P	--	--	--
SD - 3A	0-0.5	53.0 JP	--	--	--
SD - 3B	0.5-1.0	34.0 P	--	--	--
Area 7 and Area 8 - Former Separation Pond					
SPSB - 1	2-3	---	0.69 D	0.31 D	---
SPSB - 2	4-5	---	24.0	1.50	---
SPSB - 3	4-5	---	0.14 J	2.70	---
SPSB - 4	2-4	---	--	0.004 J	---
SPSB - 5	2-4	---	0.012	0.026	---
SPSB - 7	3-4	---	0.011	0.025	---
SPSB - 7	8-10	---	0.066 D	0.160 D	
SPTP - 6 - 1	2-3	--	0.28 D	1.4 D	0.26 D
SPTP - 8 - 1	2-3	4.8	7300 D	2700 D	--
Area 9 and Area 10 - Former Debris Landfill					
DLSB - 1	4-5	0.085 P	0.018	0.010	---
DLSB - 3	8-9	---	0.003 J	0.005	---
DLSB - 4	8-9	0.08	0.006	0.009	---
DLSB - 6	4-5	---	5.40	1.10	---
DLSB - 8	1-2	3.4 P	0.005 J	0.016	0.010 J
DLSB - 8 DUP	1-2	10.5 P	0.011	0.012	--
TP-13	3-4	2.8	--	0.008	--

Table 2
(Cont'd)
Chicago Pneumatic Tool Company
Frankfort, New York
Remedial Action Field Sampling Plan

Summary of Historical Data

Excavation Area and Associated Sample	Depth (ft)	Concentration (ppm)			
		PCBs	TCE	DCE	VC
Clean-up Objectives	NA	Surface = 1.0 Subsurface = 10.0	VOC Cleanup Objective = 10 ppm for total VOCs of Concern		
Area 9 and Area 10 (continued) - Former Debris Landfill					
TP-15	3-4	47	0.4 D	1.3 D	0.1 D
TP - 15 DUP	3-4	48	2	4.4	--
Area 11 - Off-Site Drainage Ditch North of Bleecker Street					
OSSD - 3A	0-0.5	12.1 P	--	--	--
OSSD - 3B	0.5-1.0	7.9 P	--	--	--
OSSD - 4A	0-0.5	0.95 P	--	--	--
OSSD - 4B	0.5-1.0	1.058 P	--	--	--
OSSD - 5A	0-0.5	2.97 P	--	--	--
OSSD - 5B	0.5-1.0	0.56 P	--	--	--
OSSD - 6A	0-0.5	9.90 P	--	--	--
OSSD - 6B	0.5-1.0	9.30 P	--	--	--
OSSD - 7A	0-0.5	9.3 P	--	--	--
OSSD - 7B	0.5-1.0	1.200 P	--	--	--
OSSD - 8A	0-0.5	3.82 P	--	--	--
OSSD - 9A/9A DUP	0-0.5	6.70 P/6.00 P	--	--	--
OSSD - 9B	0.5-1.0	7.10 P	--	--	--
OSSD - 10A	0-0.5	4.86 P	--	--	--
OSSD - 10B	0.5-1.0	2.22 P	--	--	--
OSSD - 11A	0-0.5	3.151 P	--	--	--
OSSD - 11B	0.5-1.0	5.90 P	--	--	--
OSSD - 12A	0-0.5	0.54 P	--	--	--
OSSD - 13A	0-0.5	0.331 P	--	--	--
OSSD - 13B	0.5-1.0	--	--	--	--
OSSD - 14A	0-0.5	0.55 P	--	--	--
OSSD - 15A	0-0.5	0.167 P	--	--	--
OSSD - 15A DUP	0-0.5	0.110 P	--	--	--

Table 2
(Cont'd)
Chicago Pneumatic Tool Company
Frankfort, New York
Remedial Action Field Sampling Plan

Summary of Historical Data

Excavation Area and Associated Sample	Depth (ft)	Concentration (ppm)			
		PCBs	TCE	DCE	VC
Clean-up Objectives	NA	Surface = 1.0 Subsurface = 10.0	VOC Cleanup Objective = 10 ppm for total VOCs of Concern		
Area 11 (continued) - Off-Site Drainage Ditch North of Bleecker Street					
OSSD - 16A	0-0.5	--	--	--	--
OSSD - 17A	0-0.5	0.210 P	--	--	--
Area 12 - Off-Site Drainage Ditch North of Bleecker Street					
OSSD - 1A	0-0.5	11.6 J	0.005 J	0.014	--
OSSD - 1B	0.5-1.0	63.00 J	0.003 J	0.013	--
OSSD - 2A	0-0.5	108.0 DP	0.006 J	0.02	--
OSSD - 2B	0.5-1.0	61.3 P	0.007 J	0.022	--
RRBB - 1	0.5-1.0	53.8 P	--	--	--
RRBC - 1	0.5-1.0	0.52 JP	--	--	--
Area 13 - East Lot					
ELSB - 1	2-3	0.024 JP	--	--	--
ELSB - 2	2-3	1.48 DJ	--	--	--
ELSB - 3	2-3	0.0052 JP	--	--	--
TPEL - 1	3-4	0.0106 JP	--	--	--
TPEL - 5	3-4	--	--	--	--
TPEL - 8	3-4	54.5 PD	0.017	0.014 J	--
TPEL - 11	3-4	240.0 PD	0.150	0.100	0.042 J
TPEL - 11 - 2	3-4	0.0162 J	--	--	--
TPEL - 11 - 3	3-4	--	--	--	--
Area 14 - On-Site Drainage Ditch East of the Manufacturing Building					
SD - 5A	0-0.5	.45 P	--	--	--
SD - 5B	1.0-1.5	--	--	--	--

Table 2
(Cont'd)
Chicago Pneumatic Tool Company
Frankfort, New York
Remedial Action Field Sampling Plan

Summary of Historical Data

Excavation Area and Associated Sample	Depth (ft)	Concentration (ppm)			
		Chromium	Copper	Lead	Zinc
Clean-up Objectives	**NA**	**17.8**	**40.4**	**25.5**	**101**
Area 1 - Unnamed Creek					
SD - 1A/1A DUP	0-0.5	499/349	1500/3260	161 J/341 J	804/1000
SD - 1B	0.5-1.0	268	273	5970 J	424
SD - 1C	1.0-1.5	16.6	58.4	135 J	164
SD - 2A	0-0.5	272	397	134 J	313
SD - 2B	1.5-2.0	16.5	36.2	43.1 J	131
Area 2 - Chip Chute Area					
CHSB - 1	2-4	26.5	75.9	22.9	83.3
CHSB - 2	2-4	9.5	27	17	48.9
CHSB - 3	4-5	8.3	20.7	14.6	41.2
CHSB - 4	16-18	20.3	23	8.2	71.8
Area 3 - Chip Chute Area					
GP - 20	2-3	---	---	---	---
CHSB - 5	12-14	16.5	35.9	11.7 J	64
Area 4 - On-Site Drainage Ditch South of Manufacturing Building					
CHCHC - 1 (COMP A)	0-0.5	59.4	364	152	367
CHCHC - 2 (COMP B)	0.5-1.0	35.2	216	121	222
GP - 18/GP - 19	2-3/2-3	--/--	--/--	--/--	--/--
SD - 4A	0-0.5	78.0	480	102 J	477
SD - 4A DUP	0-0.5	31.8	211	77.6 J	293
Area 5 - Skimmer Pond					
GP - 7	3-4	--	--	--	--
SKSD - 2	0-0.5	--	--	--	--
SKSD - 3/3 DUP	0-0.5	--	--	--	--
SKSD - 3	0.5-1.0	--	--	--	--
SKSD - 5	0-0.5	99	771	302	1330
SKSD - 5	0.5-1.0	147	846	674	1470

Table 2
(Cont'd)
Chicago Pneumatic Tool Company
Frankfort, New York
Remedial Action Field Sampling Plan

Summary of Historical Data

Excavation Area and Associated Sample	Depth (ft)	Concentration (ppm)			
		Chromium	Copper	Lead	Zinc
Clean-up Objectives	**NA**	**17.8**	**40.4**	**25.5**	**101**
Area 6 - On-Site Drainage Ditch South of the Foundry					
CSSD - 3IA	0-0.5	199	1220	556	683
CSSD - 3IA DUP	0-0.5	276	1260	254	912
CSSD - 3IB	0.5-1.0	11.5	37.9	26.9	68.2
CSSD - 3LA	0-0.5	18.1	64.3	34.4	127
CSSD - 3LB	0.5-1.0	14.9	39.9	24.7	68.4
CSSD - 3RA	0-0.5	261	1130	227	454
SD - 3A	0-0.5	158	1120	277 J	617
SD - 3B	0.5-1.0	19.3	252	426 J	230
Area 7 and Area 8 - Former Separator Ponds					
SPSB - 1	2-3	12.9	31.8	7.6	53.4
SPSB - 2	4-5	14.9	53.3	62.6	104
SPSB - 3	4-5	10.1	25.5	7.4	44
SPSB - 4	2-4	20.6	104	11.4	117
SPSB - 5	2-4	12.2	33.9	8.4	61.1
SPSB - 7	3-4	7.1	12.6	2.2	28.4
SPSB - 7	8-10	10.6	17.2	7.1	38
SPTP - 6 - 1	2-3	138 J	310	150	260
SPTP - 8 - 1	2-3	330 J	3,440	674	2,590
Area 9 and Area 10 - Former Debris Landfill					
DLSB - 1	4-5	14.1	41.1	42.6	61.4
DLSB - 3	8-9	10.9	33.7	17.2	69.5
DLSB - 4	8-9	16.5	46	14.6	55.4
DLSB - 6	4-5	10.8	21.5	7	45.7
DLSB - 8	1-2	624	8830	1150	2700
DLSB - 8 DUP	1-2	284	9540	1270	3590
TP-13	3-4	1,520 J	8,380	1,140	2,390

Table 2
(Cont'd)
Chicago Pneumatic Tool Company
Frankfort, New York
Remedial Action Field Sampling Plan

Summary of Historical Data

Excavation Area and Associated Sample	Depth (ft)	Concentration (ppm)			
		Chromium	Copper	Lead	Zinc
Clean-up Objectives	**NA**	**17.8**	**40.4**	**25.5**	**101**
Area 9 and Area 10 (continued) - Former Debris Landfill					
TP-15	3-4	694 J	5,240	754	1,240
TP - 15 DUP	3-4	452 J	2740	831	866
Area 11 - Off-Site Drainage Ditch North of Bleecker Street					
OSSD - 3A	0-0.5	9.0	28.9	61.7 J	65.8
OSSD - 3B	0.5-1.0	18.3	43.7	77.2 J	148
OSSD - 4A	0-0.5	--	--	21.3	--
OSSD - 4B	0.5-1.0	--	--	16.9	--
OSSD - 5A	0-0.5	--	--	10.9	--
OSSD - 5B	0.5-1.0	--	--	31.5	--
OSSD - 6A	0-0.5	--	--	46.5	--
OSSD - 6B	0.5-1.0	--	--	24.7	--
OSSD - 7A	0-0.5	--	--	49.9	--
OSSD - 7B	0.5-1.0	--	--	27.8	--
OSSD - 8A	0-0.5	--	--	96.2	--
OSSD - 9A	0-0.5	--	--	68	--
OSSD - 9A DUP	0-0.5	--	--	94.1	--
OSSD - 9B	0.5-1.0	--	--	87.9	--
OSSD - 10A	0-0.5	--	--	134	--
OSSD - 10B	0.5-1.0	--	--	153	--
OSSD - 11A	0-0.5	--	--	41.8	--
OSSD - 11B	0.5-1.0	--	--	67.3	--
OSSD - 12A	0-0.5	--	--	10.7	--
OSSD - 13A	0-0.5	--	--	9.3 R	--
OSSD - 13B	0.5-1.0	--	--	6.3 R	--
OSSD - 14A	0-0.5	--	--	15.8 R	--
OSSD - 15A	0-0.5	--	--	12.7 R	--
OSSD - 15A DUP	0-0.5	--	--	15 R	--

Table 2
(Cont'd)
Chicago Pneumatic Tool Company
Frankfort, New York
Remedial Action Field Sampling Plan

Summary of Historical Data

Excavation Area and Associated Sample	Depth (ft)	Concentration (ppm)			
		Chromium	Copper	Lead	Zinc
Clean-up Objectives	**NA**	**17.8**	**40.4**	**25.5**	**101**
Area 11 (continued) - Off-Site Drainage Ditch North of Bleecker Street					
OSSD - 16A	0-0.5	--	--	9.1 R	--
OSSD - 17A	0-0.5	--	--	40.2 R	--
Area 12 - Off-Site Drainage Ditch North of Bleecker Street					
OSSD - 1A	0-0.5	12.9	69.1	203 J	112
OSSD - 1B	0.5-1.0	16.7	146	141 J	111
OSSD - 2A	0-0.5	16.2	45.8	69.3 J	76.7
OSSD - 2B	0.5-1.0	11.1	82.6	56.1 J	61.0
RRBB - 1	0.5-1.0	--	--	544	--
RRBC - 1	0.5-1.0	--	--	134	--
Area 13 - East Lot					
ELSB - 1	2-3	8.6	19.7	10.1	42.6
ELSB - 2	2-3	11.9	17.7	19.2 J	54.8
ELSB - 3	2-3	9.1	17.7	21.3	32.5
TPEL - 1	3-4	--	--	--	--
TPEL - 5	3-4	--	--	--	--
TPEL - 8	3-4	--	--	--	--
TPEL - 11	3-4	--	--	--	--
TPEL - 11 - 2	3-4	--	--	--	--
TPEL - 11 - 3	3-4	--	--	--	--
Area 14 - On-Site Drainage Ditch East of the Manufacturing Building					
SD - 5A	0-0.5	11.2	38.3	10.7 J	69.2
SD - 5B	1.0-1.5	9.7	26.2	6.6 J	48.1

Notes:
1. -- or U = Not detected above laboratory detection limits.
2. J = Estimated concentration.
3. D = Identified in analysis at a secondary dilution factor.
4. P = Greater than 25 % difference for detected concentration between two GC columns. The lower of the two values is reported.
5. R = Data was rejected based on data validation
6. B = The reported metal concentration is less than the contract required detection limit but greater than the instrument detection limit.

Table 3

Chicago Pneumatic Tool Company
Frankfort, New York
Quality Control Analyses Summary

Environmental Sample Matrix/ Laboratory Parameters	Est. Environmental Sample Quantity	Field QC Analyses: Trip Blank Freq	Trip Blank No.	Field Duplicate Freq	Field Duplicate No.	Rinse Blank[a] Freq	Rinse Blank[a] No.	Est. Matrix Total	Laboratory QC Analyses: MS[a] Freq.	MS[a] No.	MSD[a] Freq.	MSD[a] No.	SB[a] Freq.	SB[a] No.	Lab Duplicate Freq.	Lab Duplicate No.	Est. Overall Total
Verification Soil Samples																	
PCBs	15	--	--	1/20	1	1/20	1	17	1/20	1	1/20	1	1/20	1	--	--	20
VOCs of Concern	4	--	--	1/20	1	1/20	1	6	1/20	1	1/20	1	1/20	1	--	--	9
Metals of Concern	20	--	--	1/20	1	1/20	1	22	1/20	2	--	--	--	--	1/20	2	26
Verification Sediment Samples																	
PCBs	26	--	--	1/20	2	1/20	2	30	1/20	2	1/20	2	1/20	2	--	--	36
VOCs of Concern	0	--	--	1/20	0	1/20	0	0	1/20	0	1/20	0	1/20	0	--	--	0
Metals of Concern	22	--	--	1/20	2	1/20	2	26	1/20	2	--	--	--	--	1/20	2	30
Soil Samples Collected from within the SVE Cell																	
VOCs of Concern	5	--	--	1/20	1	1/20	1	7	1/20	1	1/20	1	1/20	1	--	--	10
Ground-Water Samples[4]																	
VOCs of Concern	5	1/day[b]	1	1/20	1	1/20	1	8	1/20	1	1/20	1	1/20	1	--	--	11

Notes:

1. Table assumes that samples will be processed in groups of 20 samples for QC analyses. If smaller sample groups are processed, then one MS/MSD (or MS/lab dup) per sample delivery group (up to 20 samples) will be prepared for each sample delivery group.
2. [a] = These field and laboratory QC analysis shall be performed at a frequency of 1/20 or 1/week, whichever comes first. Table assumes samples will be collected at a rate of 20 samples per week.
3. [b] = 1/day = One trip blank per shipment.
4. Table presents QA/QC analyses for one round of ground-water sampling. Additional QA/QC analyses will be performed for subsequent rounds of ground-water sampling.
5. VOCs of concern are 1,2-dichloroethene (cis and trans), trichloroethylene, and vinyl chloride.
6. Metals of concern are chromium, copper, lead, and zinc.
7. QA/QC samples will not be collected for confirmation soil samples, confirmation sediment samples, water samples from the temporary on-site water treatment system, leachate samples from the on-site lined containment cell, or railroad ties.

Table 4

Chicago Pneumatic Tool Company
Frankfort, New York
Remedial Action Field Sampling Plan

Confirmation Sample Summary

Excavation Area	Confirmation Sampling Required (Yes/No)	
	PCBs	**Total VOCs of Concern**
1	No	No
2	No	**Yes (based on sample CHSB-1)**
3	No	No
4	No	No
5	No	No
6	No	No
7	No	**Yes (based on samples SPSB-2 and SPTP-8)**
8	No	**Yes (based on samples SPSB-2 and SPTP-8)**
9	**Yes (based on sample TP-15)**	No
10	**Yes (based on sample TP-15)**	**Yes (Note 4)**
11	No	No
12	No	No
13	No	No
14	No	No

Notes:

1. Samples will be collected from Areas 2 and 8 for VOC screening using a FID to confirm which soil/sediment will be treated in the on-site soil vapor extraction treatment cell (i.e., soil/sediment with total VOC of concern concentrations greater than 10 ppm).
2. Samples will be collected from Areas 9 and 10 for PCB field screening using ENSYS field test kits to confirm which soil/sediment will be transported for off-site disposal as a TSCA waste (i.e., soil with a PCB concentration greater than 40 ppm as determined by the test kits).
3. Soil/sediment removed from Areas 6, 12, and 13, which are known to contain PCBs at concentrations greater than 50 ppm, will be directly loaded into lined roll offs for off-site disposal. These materials will not undergo confirmation sampling.
4. Soil samples collected and analyzed from Area 10 during the RI did not contain the VOCs of concern at concentrations above 10 ppm. However, as a conservative measure, soil removed from this excavation area will undergo confirmation sampling for VOCs of concern.

Table 5

Chicago Pneumatic Tool Company
Frankfort, New York

Sample Containers, Preservation, and Holding Times
Soil Samples

Parameter	Reference	Sample Container	Sample Volume	Preservation	Maximum Holding Time from VTSR
PCBs[a]	USEPA SW-846, Method 8082 as referenced in NYSDEC, ASP 1995	One 8-ounce widemouth glass jar	8 oz.	Cool 4 °C	Extract within 5 days analyze within 40 days following the start of extraction
VOCs of Concern	USEPA SW-846 Method 8260 as referenced in NYSDEC, ASP 1995	One 125-ml widemouth glass vials, caps lined with teflon	125 ml	minimize head space, cool 4 °C	7 days
Metals of Concern	USEPA SW-846 6000/7000 Series Methods as referenced in NYSDEC ASP 1995	One 8-ounce widemouth glass jar	8 oz.	Cool 4°C	180 days
TCLP VOCs	USEPA SW-846, Method 8260 as referenced in NYSDEC ASP 1995	One 125-ml glass jar with teflon-lined lid.	125 ml	Minimize head space, Cool 4°C	Extract within 14 days. Analyze within 14 days from extraction.
TCLP SVOCs	USEPA SW-846, Method 8270B as referenced in NYSDEC ASP 1995	One 8-ounce widemouth glass jar	8 oz.	Cool 4°C	Extract within 14 days. Conduct preparative extraction within 7 days. Analyze within 14 days from preparative extraction.
TCLP Metals (except mercury)	USEPA SW-846 6000/7000 Series Methods as referenced in NYSDEC ASP 1995	One 8-ounce widemouth glass jar	8 oz.	Cool 4°C	Extract within 180 days. Analyze within 180 days from extraction.
TCLP Mercury	USEPA SW-846 7470 Series Methods				Extract within 28 days. Analyze within 28 days from extraction.

Notes:

1. NYSDEC ASP = New York State Department of Environmental Conservation 1995 Analytical Services Protocols.
2. VTSR = Verifiable time of sample receipt.
3. Sampler must ensure that samples are delivered to the laboratory within 24 to 48 hours after collection.
4. [a] = ASP methods modified for PCBs analysis only.
5. VOCs of concern are 1,2-dichloroethene (cis and trans), trichloroethylene, and vinyl chloride.
6. Metals of concern are chromium, copper, lead, and zinc.

Table 5
(Cont'd)

Chicago Pneumatic Tool Company
Frankfort, New York

Sample Containers, Preservation, and Holding Times
Water Samples

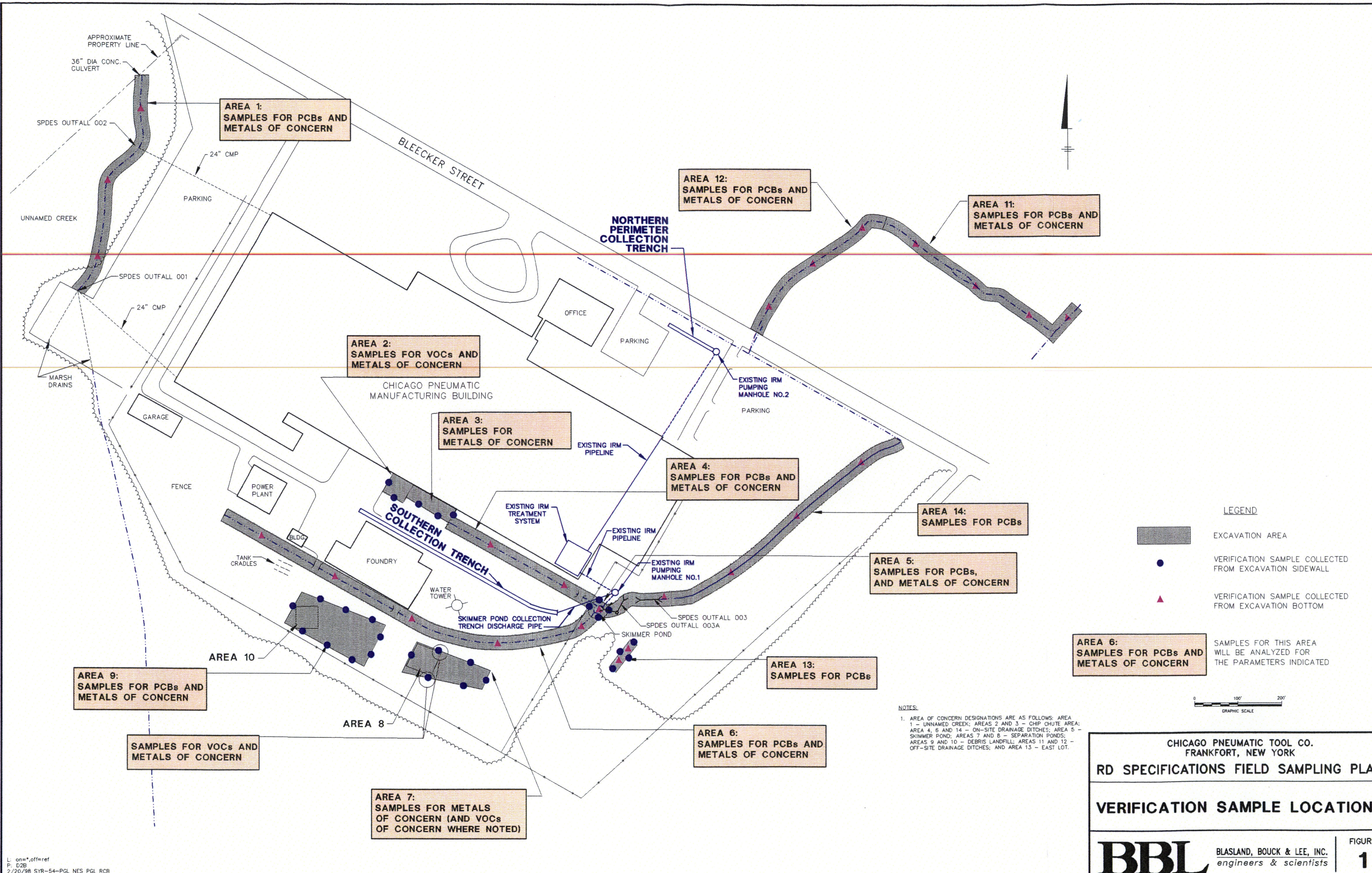
Parameter	Reference	Sample Container	Sample Volume	Preservation	Maximum Holding Time from VTSR
VOCs	USEPA SW-846 Method 8260 as referenced in NYSDEC ASP 1995	Two 40-ml glass vials with teflon-lined septum cap	80 ml	No head space, cool 4°C	7 days
PCBs[a]	USEPA SW-846, Method 8082 as referenced in NYSDEC ASP 1995	Two 1-liter amber glass with teflon-lined cap	2 liters	Cool 4°C	Extract within 5 days analyze within 40 days following start of extraction
Oil and Grease	USEPA Method 413.1	One 1-liter amber glass	1 liter	HCl, Cool 4°C	26 days
Total Toxic Organics	USEPA Methods 624 and 625	Two 40-ml glass vials with teflon-lined septum cap	80 ml	No head space, cool 4°C	7 days
Metals	USEPA Method 3111B	One 500 ml plastic	500 ml	HNO_3 to pH <3	180 days

lotes:

1. ASP = New York State Department of Environmental Conservation 1995 Analytical Services Protocols.
2. VTSR = Verifiable time of sample receipt.
3. Sampler must ensure that samples are delivered to the lab within 24 to 48 hours after collection.
4. [a] = ASP methods modified for PCB analysis only.

Figures

BLASLAND, BOUCK & LEE, INC.
engineers & scientists



NOTES:

1. AREA OF CONCERN DESIGNATIONS ARE AS FOLLOWS: AREA 1 – UNNAMED CREEK; AREAS 2 AND 3 – CHIP CHUTE AREA; AREA 4, 6 AND 14 – ON-SITE DRAINAGE DITCHES; AREA 5 – SKIMMER POND; AREAS 7 AND 8 – SEPARATION PONDS; AREAS 9 AND 10 – DEBRIS LANDFILL; AREAS 11 AND 12 – OFF-SITE DRAINAGE DITCHES; AND AREA 13 – EAST LOT.

L: ON=*,OFF=REF
P: D2B
2/20/98 SYR-54-PGL NES PGL RCB
30708100/30708SM1.DWG

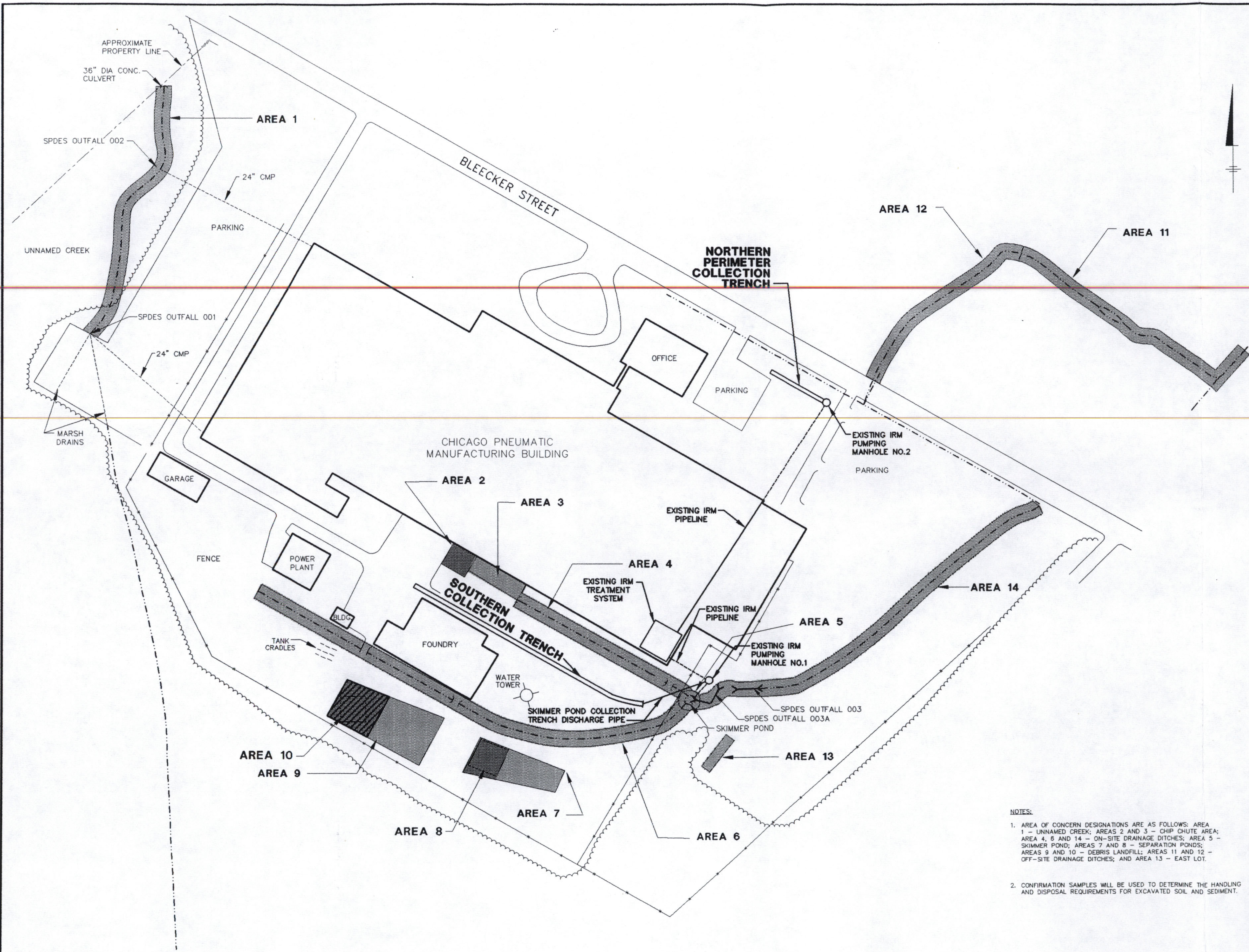
CHICAGO PNEUMATIC TOOL CO.
FRANKFORT, NEW YORK

RD SPECIFICATIONS FIELD SAMPLING PLAN

VERIFICATION SAMPLE LOCATIONS

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 1



LEGEND

CONFIRMATION SAMPLE FOR VOCs

NO CONFIRMATION SAMPLES

CONFIRMATION SAMPLE FOR PCBs

0 100' 200'
GRAPHIC SCALE

NOTES:

1. AREA OF CONCERN DESIGNATIONS ARE AS FOLLOWS: AREA 1 – UNNAMED CREEK; AREAS 2 AND 3 – CHIP CHUTE AREA; AREA 4, 6 AND 14 – ON-SITE DRAINAGE DITCHES; AREA 5 – SKIMMER POND; AREAS 7 AND 8 – SEPARATION PONDS; AREAS 9 AND 10 – DEBRIS LANDFILL; AREAS 11 AND 12 – OFF-SITE DRAINAGE DITCHES; AND AREA 13 – EAST LOT.

2. CONFIRMATION SAMPLES WILL BE USED TO DETERMINE THE HANDLING AND DISPOSAL REQUIREMENTS FOR EXCAVATED SOIL AND SEDIMENT.

CHICAGO PNEUMATIC TOOL CO.
FRANKFORT, NEW YORK

RD SPECIFICATIONS FIELD SAMPLING PLAN

CONFIRMATION SAMPLE LOCATIONS

BBL BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE 2

L: on=*,off=ref
P: STD-PCP/DL
2/17/98 SYR-54-PGL NES PGL RCB
30708100/30708SM2.DWG

Attachments

BLASLAND, BOUCK & LEE, INC.
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ATTACHMENT A - PRE-EXCAVATION VERIFICATION SOIL SAMPLING PROCEDURES

I. Introduction

This attachment presents materials and procedures which will be used to collect pre-excavation verification soil samples with a Geoprobe™ sampling device. The materials and procedures to collect pre-excavation verification soil samples are presented below.

II. Materials

In addition to the Geoprobe and associated equipment (i.e., sample tube, liner, core catcher, cutting shoe, piston assembly, drive head, release rods, probe hammer, etc.), the following materials, as required, will be available during the pre-excavation verification soil sampling:

- Flame ionization detector (FID) - OVA or equivalent
- Appropriate health and safety equipment
- Plastic sheeting (for each sampling location)
- Tape measure (15 feet or greater)
- Appropriate soil sample containers
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials
- Field book
- Chain-of-Custody forms
- Indelible ink pens
- Site map with pre-excavation verification soil sample locations

III. Equipment Decontamination

Each component of the Geoprobe sampling device will be decontaminated and a new, clean liner will be installed prior to collecting soil samples for laboratory analysis. Decontamination procedures are presented in Attachment B.

IV. Soil Sampling Procedures

Standard operating procedures for collecting soil samples using the Geoprobe sampling device are presented in Exhibit 1. Prior to collecting samples using the Geoprobe sampling device, a pilot hole will be created (as necessary) by driving a pre-probe to the top of the desired sampling interval. Samples will be collected using either open-tube or closed-tube sampling procedures. Samples removed from the liner of the Geoprobe sampling device will be placed into the appropriate sample containers and labeled according to the procedures in Section 3.0 and Attachment D. Sample containers will be packaged, shipped, and handled under chain-of-custody according to the procedures in Section 4.0 and Attachment D.

Exhibit 1

Geoprobe Standard Operating Procedures

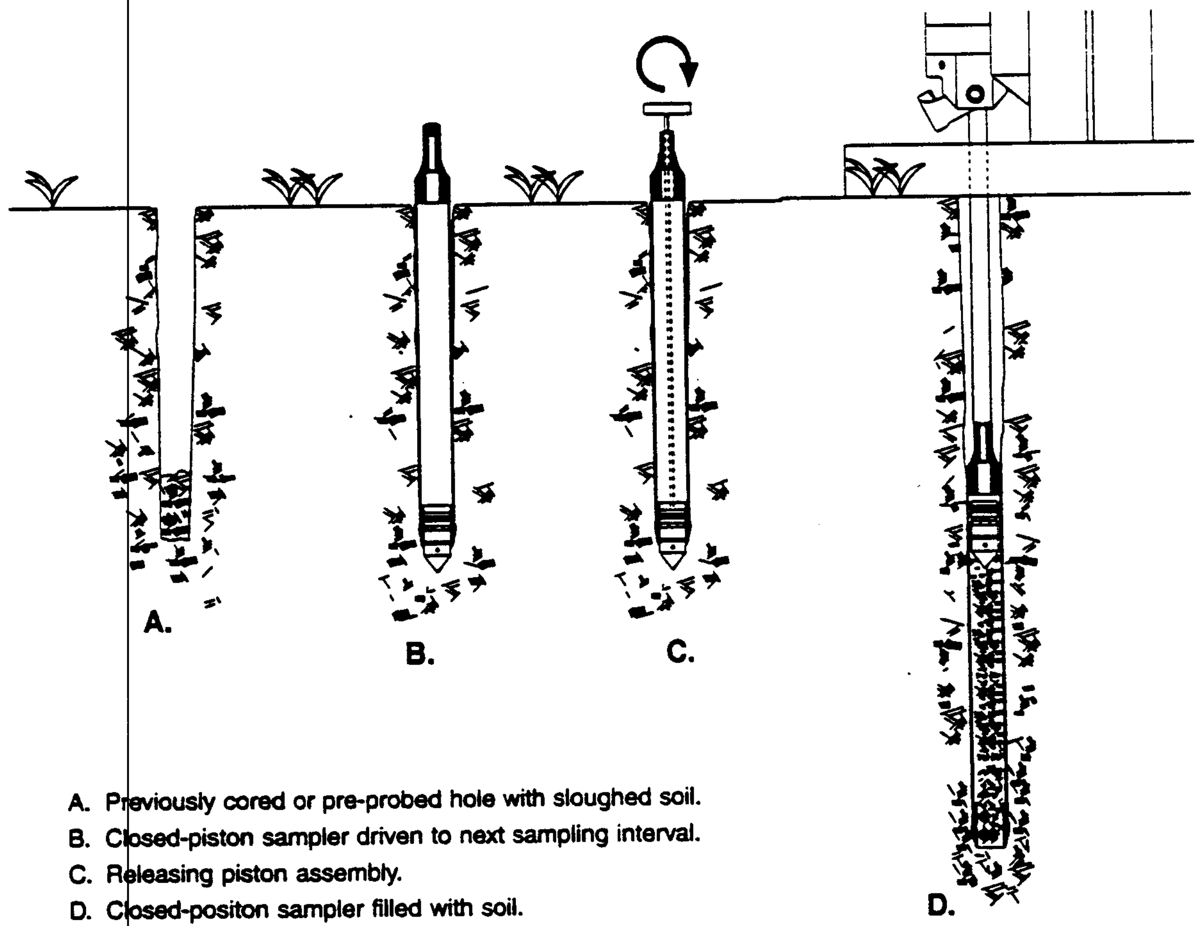
GEOPROBE MACRO-CORE® SOIL SAMPLER

STANDARD OPERATING PROCEDURE

Technical Bulletin No. 95-8500

PREPARED: November, 1995

REVISED: September, 1997



A. Previously cored or pre-probed hole with sloughed soil.
B. Closed-piston sampler driven to next sampling interval.
C. Releasing piston assembly.
D. Closed-positon sampler filled with soil.

SAMPLING WITH THE MACRO-CORE® CLOSED-PISTON SOIL SAMPLER

Geoprobe® Systems

A DIVISION OF KEJR ENGINEERING

Geoprobe® is a Registered Trademark of Kejr Engineering, Inc., Salina, Kansas

Macro-Core® is a Registered Trademark of Kejr Engineering, Inc., Salina, Kansas

Macro-Core® Soil Sampler manufactured under US Patent 5,606,139.

Macro-Core® Closed-Piston Drive Point manufactured under US Patent 5,542,481

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1.0 OBJECTIVE

The objective of this procedure is to collect a representative soil sample at depth and recover it for visual inspection and/or chemical analysis.

2.0 BACKGROUND

2.1 Definitions

Geoprobe®*: A brand name of high quality, hydraulically-powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface.
** Geoprobe® is a registered trademark of Kejr Engineering, Inc., Salina, Kansas*

Macro-Core® Soil Sampler*: A solid barrel, direct push device for collecting continuous core samples of unconsolidated materials at depth. Although other lengths are available, the standard Macro-Core® Sampler has an assembled length of approximately 52 inches (1321 mm) with an outside diameter (OD) of 2.2 inches (56 mm). Collected samples measure up to 1300 ml in volume in the form of a 1.5-inch x 45-inch (38 mm x 1143 mm) core contained inside a removable liner. The Macro-Core® Sampler may be used for open-tube as well as closed-piston sampling.
** Macro-Core® is a registered trademark of Kejr Engineering, Inc., Salina, Kansas*

Liner: A 1.75-inch OD x 46-inch long (44 mm x 1168 mm) removable/replaceable, thin-walled tube inserted inside the Macro-Core® sample tube for the purpose of containing and storing soil samples. Liner materials include stainless steel, Teflon®, PVC, and PETG.

2.2 Discussion

In this procedure, the assembled Macro-Core Soil Sampler is attached to the leading end of a Geoprobe probe rod and driven into the subsurface using a Geoprobe soil probing machine. Additional probe rods are connected in succession to advance the sampler to depth. The Macro-Core Sampler may be used as an open-tube or closed-piston sampler.

The simplest and most common use of the Macro-Core Sampler is as an open-tube sampler (Fig. 2.1A). In this method, coring starts at the ground surface with an open-ended sampler. From the ground surface, the Macro-Core Sampler is advanced one sampling interval and then retrieved from the hole with the first soil core. In stable soils, the open-tube sampler is inserted back down the same hole to obtain the next core. Geoprobe operators have reported coring to depths exceeding 30 feet (9 m) with this method.

In unstable soils which tend to collapse into the core hole, the Macro-Core Sampler can be equipped with a piston assembly (Fig. 2.1B). This assembly actually locks into the cutting shoe and prevents soil from entering the sampler as it is advanced to the bottom of an existing hole.

The Macro-Core Closed-Piston Sampler is not designed to be driven through undisturbed soil. Soil is first removed to sampling depth with an open-tube sampler, or a pilot hole may be made with a Macro-Core Pre-Probe. A Macro-Core Piston Assembly is then installed and the sampler is inserted or driven back down the same hole. When the leading end of the sampler reaches the top of the next sampling interval, the piston is unlocked using extension rods inserted down the inside of the probe rods.

Once the piston is relieved, the tool string is simply driven another sampling interval. Soil entering the sampler pushes the piston assembly to the top of the sample liner where it is retrieved upon removal of the liner and soil core.

Loose soils will sometimes fall out of the Macro-Core Sampler as it is retrieved from depth. The Macro-Core Core Catcher (Fig. 2.1) was designed to alleviate this problem. Excellent results are obtained when the core catcher (sometimes called a basket retainer) is used with saturated sands and other non-cohesive soils. A core catcher is not necessary when sampling tight soils and may actually inhibit sample recovery. Constructed of PVC, the core catcher may be used with PVC, PETG, Teflon®, and stainless steel liners.

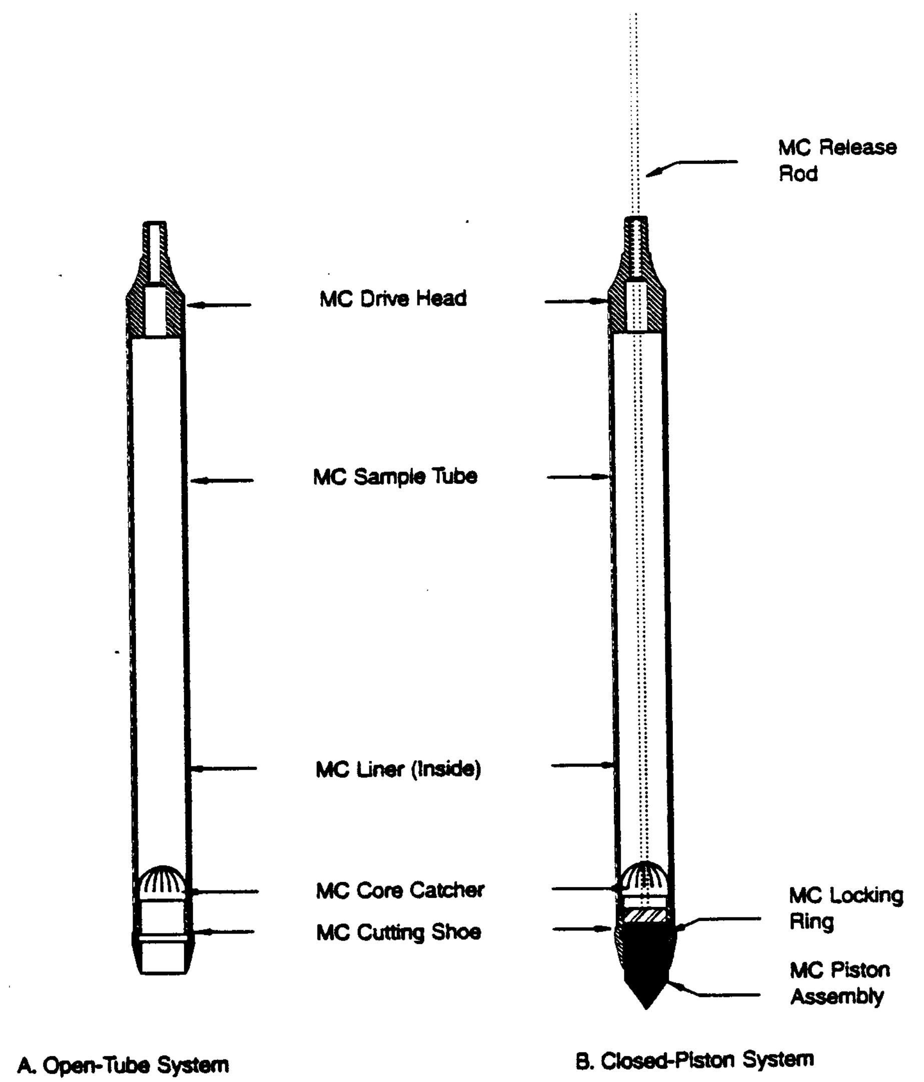


FIGURE 2.1
Macro-Core® Soil Sampler Assemblies

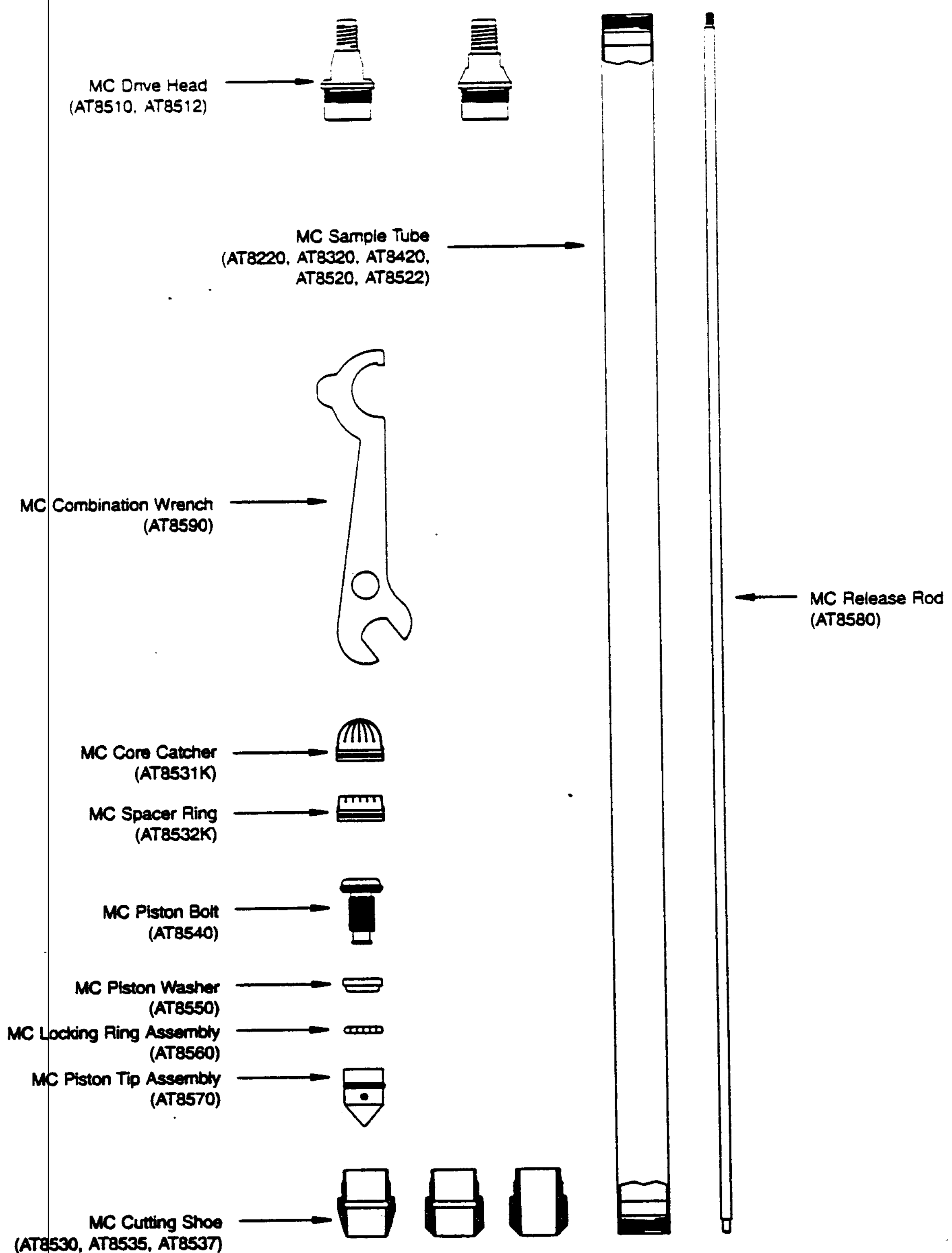


FIGURE 3.1
Macro-Core® Soil Sampler Parts

3.0 REQUIRED EQUIPMENT

The following equipment is used to recover samples using the Geoprobe Macro-Core Soil Sampler and probing system. Although many options are available (sampler length, liner material, etc.), the basic sampler configuration does not change. Refer to Figure 3.1 (previous page) to view the major components of the Macro-Core sampler.

MACRO-CORE SAMPLER PARTS	PART NUMBER
MC Drive Head, for use with 1.0-inch probe rods	AT8510
MC Drive Head, for use with 1.25-inch probe rods	AT8512
MC Sample Tube, 24-inch, unplated	AT8220
MC Sample Tube, 36-inch, unplated	AT8320
MC Sample Tube, 1-meter, unplated	AT8420
MC Sample Tube, 48-inch, Ni-plated	AT8520
MC Sample Tube, 48-inch, unplated	AT8522
MC Cutting Shoe, standard	AT8530
MC Cutting Shoe, heavy-duty	AT8535
MC Cutting Shoe, 0.125 inches undersized	AT8537
MC Combination Wrench	AT8590
Nylon Brush for MC Sample Tubes	BU700

MACRO-CORE PISTON PARTS	PART NUMBER
MC Closed-Piston Kit*	AT8501K
MC Piston Assembly*	AT8505
MC Piston Bolt	AT8540
MC Piston Washer	AT8550
MC Locking Ring Assembly	AT8560
MC Locking Ring Springs (pkg. of 10)	AT8561K
MC Locking Ring Pins (pkg. of 12)	AT8562
MC Piston Tip Assembly	AT8570
MC Piston O-rings (pkg. of 25)	AT8570R
MC Piston Tip Cup Point Set Screws (pkg. of 10)	AT8571
MC Piston Tip Half-Dog Set Screws (pkg. of 10)	AT8572
MC Piston Release Rod	AT8580

MACRO-CORE LINERS AND ACCESSORIES	PART NUMBER
MC Stainless Steel Liner Assembly, 48-inch	AT7235
MC Teflon® Liner Assembly, 48-inch	AT724
MC PETG Liner, thin-wall, 48-inch, (box of 66)	AT725K
MC Vinyl End Caps (66 pair)	AT726K
MC Heavy-Duty PETG Liner Assembly, 48-inch (box of 66)	AT825K
MC PVC Liner Assembly, clear, 24-inch (box of 66)	AT922K
MC PVC Liner Assembly, clear, 36-inch (box of 66)	AT923K
MC PVC Liner Assembly, clear, 1-meter (box of 66)	AT924K
MC PVC Liner Assembly, clear, 48-inch (box of 66)	AT925K
MC Liner Cutter Kit*	AT8000K
MC Liner Cutting Tool	AT8010
MC Liner Cutter Holder	AT8020
MC Liner Cutter Blades (pkg. of 5)	AT8030
MC Liner Circular Cutting Tool	AT8050
MC Core Catchers (pkg. of 25)	AT8531K
MC Spacer Rings (pkg. of 25)	AT8532K

*See Page 7 for component listing.

GEOPROBE TOOLS**	PART NUMBER
Drive Cap, for use with 1.25-inch probe rods	AT1200
Pull Cap, for use with 1.25-inch probe rods	AT1204
Probe Rod, 1.25 inches x 36 inches	AT1236
Probe Rod, 1.25 inches x 1 meter	AT1239
Probe Rod, 1.25 inches x 48 inches	AT1248
Probe Rod, 1.25 inches x 60 inches	AT1260
MC Pre-Probe, 2-inch OD	AT1247
MC Pre-Probe, 2.5-inch OD	AT1242
MC Pre-Probe, 3-inch OD	AT1252
Extension Rod, 36-inch	AT67
Extension Rod, 48-inch	AT671
Extension Rod, 1-meter	AT675
Extension Rod Coupler	AT68
Extension Rod Handle	AT69
Extension Rod Quick Links	AT694K
Machine Vise	FA300

ADDITIONAL TOOLS

Allen Wrench, 1/8 inch
Pipe Wrenches (2)

Three items in the parts listing on Pages 6 were identified with an asterick (*). A listing of the components of each item is given below.

MACRO-CORE KIT / COMPONENT	QUANTITY	PART NUMBER
<u>MC Liner Cutter Kit</u>		<u>AT8000K</u>
MC Liner Cutting Tool	-1-	AT8010
MC Liner Cutter Holder	-1-	AT8020
MC Liner Cutter Blades (pkg. of 5)	-1-	AT8030
<u>MC Closed-Piston Kit</u>		<u>AT8501K</u>
MC Locking Ring Springs (pkg. of 10)	-1-	AT8561K
MC Cutting Shoe, standard	-1-	AT8530
MC Piston Assembly	-1-	AT8505
<u>MC Piston Assembly</u>		<u>AT8505</u>
MC Piston Bolt	-1-	AT8540
MC Piston Washer	-1-	AT8550
MC Locking Ring Assembly	-1-	AT8560
MC Piston Tip Assembly	-1-	AT8570

**Geoprobe tools and accessories are also available for use with 1.0-inch OD (outside diameter) probe rods.

4.0 OPERATION

Size and material options have resulted in an extensive list of Macro-Core part numbers. To simplify the instructions presented in this document, part numbers are listed in the illustrations only. Refer to Pages 6 and 7 for a complete parts listing.

4.1 Decontamination

Before and after each use, thoroughly clean all parts of the soil sampling system according to project requirements. A new, clean liner is recommended for each use if using PETG, PVC, or Teflon® liners.

Stainless Steel Liners from Geoprobe Systems are cleaned at the factory with an agitated detergent bath at a temperature of approximately 180 degrees F. After rinsing with 180-degree tap water, the liner is air dried, wrapped in PVC outer cladding, and capped with vinyl end caps.

Thoroughly clean the sampler before assembly, not only to remove contaminants but also to ensure correct operation. Dirty threads complicate assembly and may lead to sampler failure. Sand is particularly troublesome as it can bind liners in the sample tube resulting in wasted time and lost samples.

4.2 Field Blank

It is suggested that a field blank be taken on a representative sample liner prior to starting a project and at regular intervals during extended projects. Liners can become contaminated in storage. A field blank will prove that the liners do not carry contaminates which can be transferred to soil samples. The following information is offered as an example method which may be used to take a field blank. Make the appropriate modifications for the specific analytes of interest to the investigation.

Example Procedure:

REQUIRED EQUIPMENT

MC Liner	(1)
MC Vinyl End Caps	(2)
Distilled Water	(100 ml)
VOA Vial (or other appropriate sample container)	(1)

1. Place a vinyl end cap on one end of the liner.

2. Pour 100 milliliters of distilled water (or other suitable extracting fluid) into the liner.

3. Place a vinyl end cap on the open end of the liner.

4. From the vertical position, repeatedly invert the liner so that the distilled water contacts the entire inner surface. Repeat this step for one minute.

5. Remove one end cap from the liner, empty contents into an appropriate sample container, and cap the container.

6. Perform analysis on the extract water for the analytes of interest to the investigation.

4.3 Open-Tube Sampler Assembly

1a. **With MC Core Catcher.** Place the open end of an MC Core Catcher over the threaded end of an MC Cutting Shoe as shown in Figure 4.1. Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe.

NOTE: AT725K (thin-wall PETG) liners have a swedged end which is generally slipped directly over the groove in the cutting shoe (Fig. 4.2). To use a core catcher with these liners, cut approximately 3/8 inches (10 mm) of material from the swedged end of the liner and proceed to Step 2.

1b. **Without MC Core Catcher.** Push the base of an MC Spacer Ring onto the threaded end of a cutting shoe until it snaps into place (Fig. 4.3).

NOTE: With the exception of AT-725K (thin-wall PETG) liners, all liners must utilize either a spacer ring or core catcher. PETG liners have a swedged end which slides directly over the end of the cutting shoe. Attach the liner to the cutting shoe (Fig. 4.2) before proceeding to Step 2.

2. Thread the cutting shoe into one end of an MC Sample Tube (Fig. 4.4). Tighten until the end of the sample tube contacts the machined shoulder of the cutting shoe.

3. Insert the appropriate liner into the sample tube (Figure 4.4). (The liner is all ready installed if using thin-wall PETG liners (AT725K) without a core catcher).

4. Connect an MC Drive Head to the top of the sample tube (Fig. 4.4) and securely tighten with the MC Combination Wrench (Fig. 4.5). Ensure that the end of the sample tube contacts the machined shoulder of the drive head.

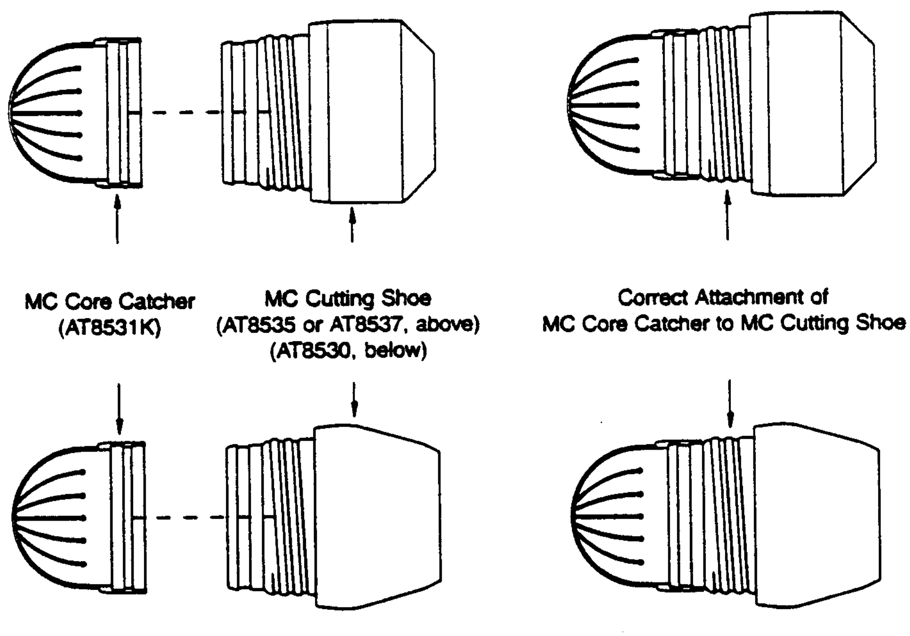


FIGURE 4.1
Macro-Core® Core Catcher Attachment

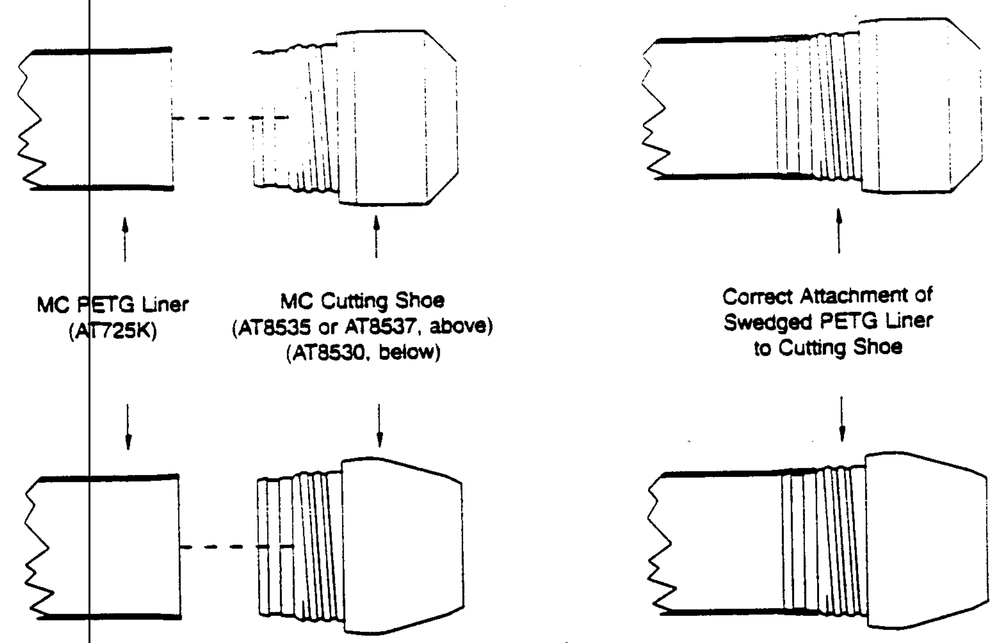


FIGURE 4.2
Macro-Core® PETG Liner Attachment

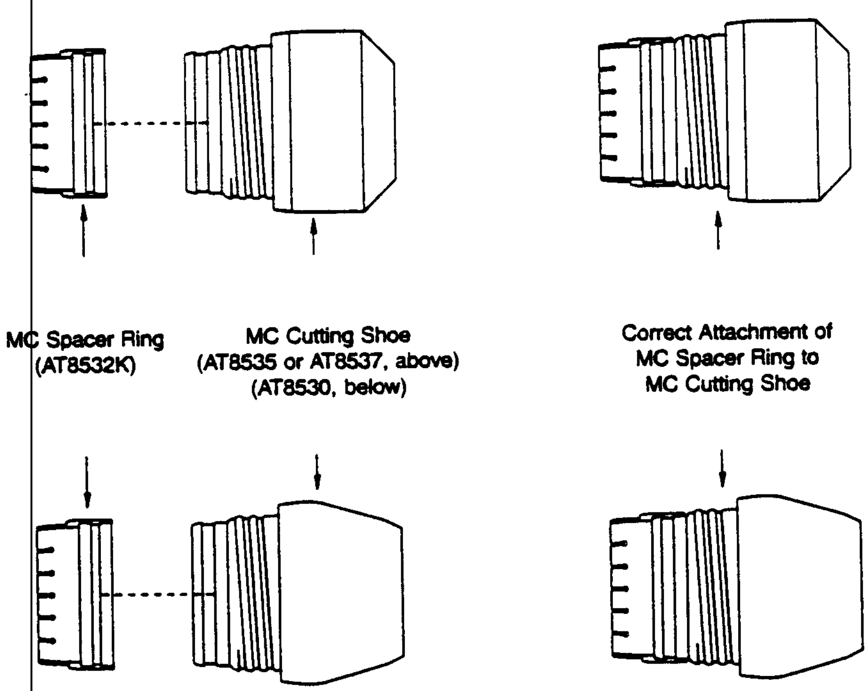


FIGURE 4.3
Macro-Core® Spacer Ring Attachment

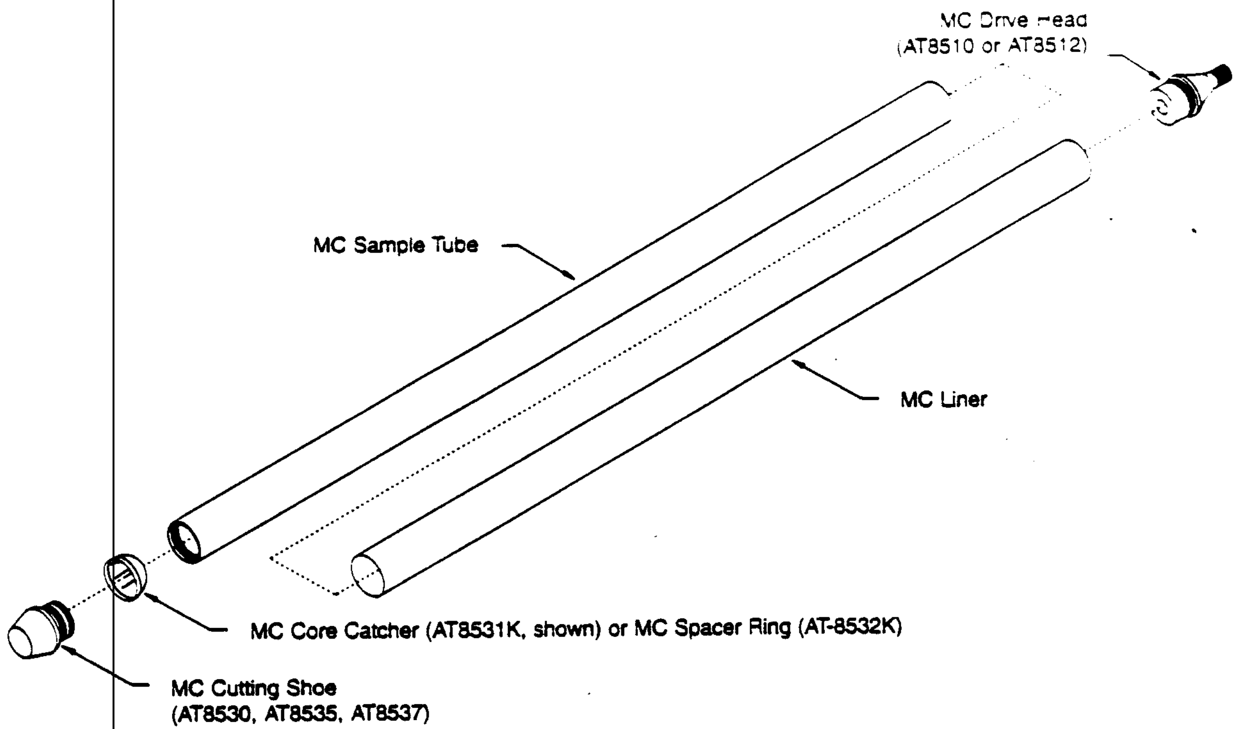


FIGURE 4.4
Macro-Core® Open-Tube Sampler Assembly

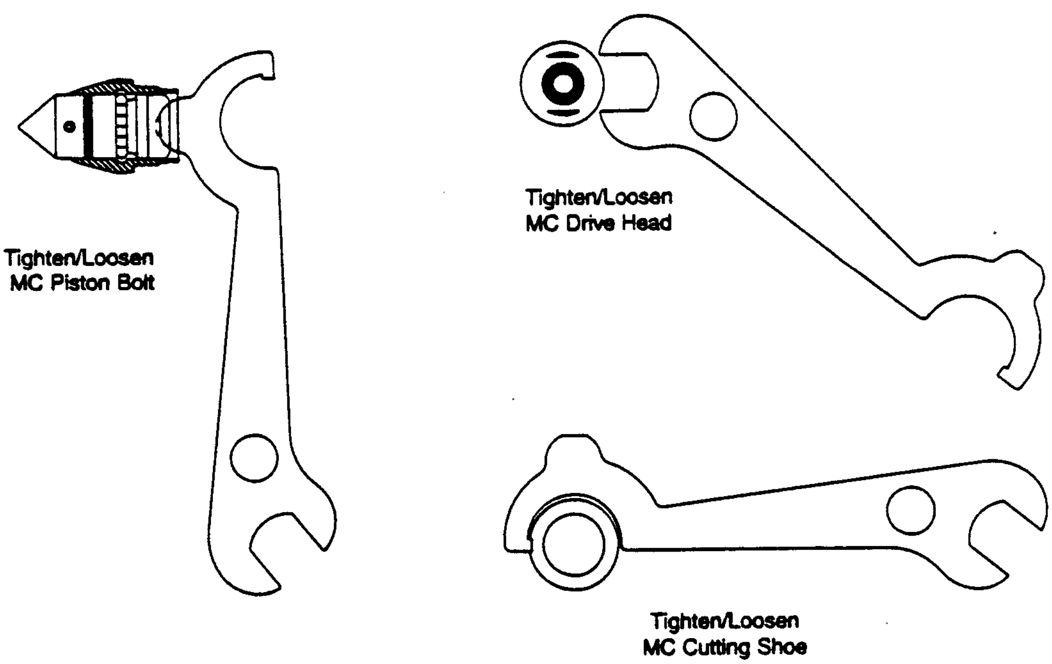


FIGURE 4.5
Macro-Core® Combination Wrench Applications

4.4 Closed-Piston Sampler Assembly (Fig. 4.6)

1. Install an O-ring in the machined groove on the piston bolt head (A) and piston tip (B).

2. Place a piston washer on a piston bolt with the radius side away from bolt head.

3. Position a locking ring on the piston bolt and thread the bolt into the piston tip.

   NOTE: Piston bolt and tip are left-hand threaded.

4. Screw the piston bolt down tight and install a half-dog set screw in the hole on the side of the piston tip. With a 1/8-inch allen wrench, tighten the set screw until it contacts the stem of the piston bolt, then back it out one-quarter turn.

5. Back the piston bolt out until the set screw hits the bottom shoulder on the bolt (approximately four full turns). The bolt must be tight against the set screw to prohibit the set screw from turning while completing Step 6.

6. Lock the half-dog set screw into place by installing a cup point set screw in the same hole. The cup point set screw should be tight but the piston bolt should remain free to turn approximately four full turns.

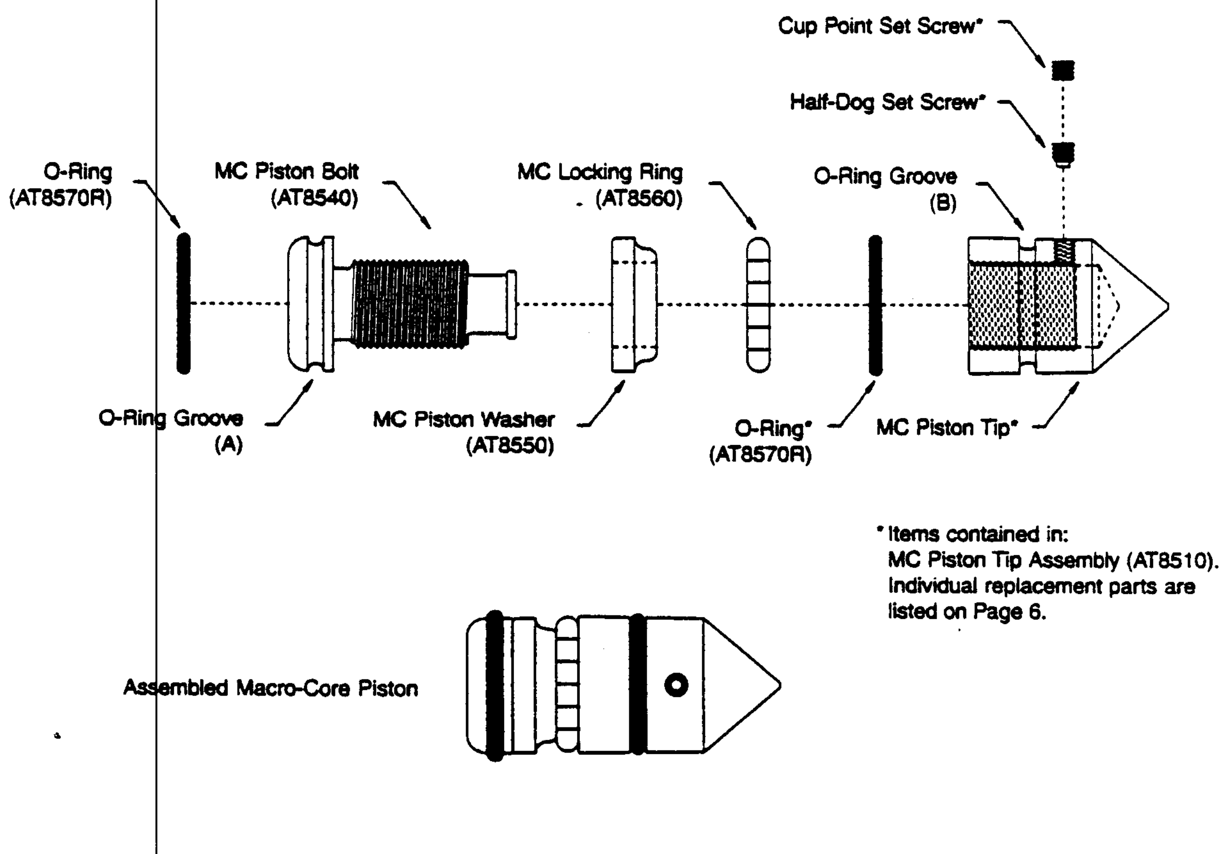


FIGURE 4.6
Macro-Core® Piston Assembly (AT8505)

NOTE: The top of the cup point set screw must not protrude from the piston tip. File or grind the set screw flush with the side of the tip if necessary. The piston assembly is ready to install in the cutting shoe.

7. Slide an assembled piston into a cutting shoe. The piston should be placed so that one half of the set screw (located on the side of the tip) protrudes from under the edge of the cutting shoe (Fig. 4.7).

8. Tighten the piston bolt (left-hand threads) using the combination wrench (Fig 4.8).

9a. **With MC Core Catcher.** Place the open end of a core catcher over the threaded end of a cutting shoe (Fig. 4.9). Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe.

NOTE: AT725K (thin-wall PETG) liners have a swedged end which is generally slipped directly over the groove in the cutting shoe (Fig. 4.10). To use a core catcher with these liners, simply cut approximately 3/8 inches (10 mm) of material from the swedged end of the liner and continue to Step 10.

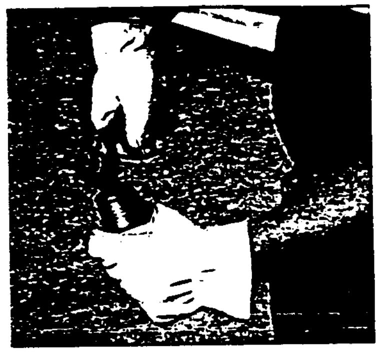


Figure 4.8. Using MC Combination Wrench to tighten MC Piston Bolt inside MC Cutting Shoe.

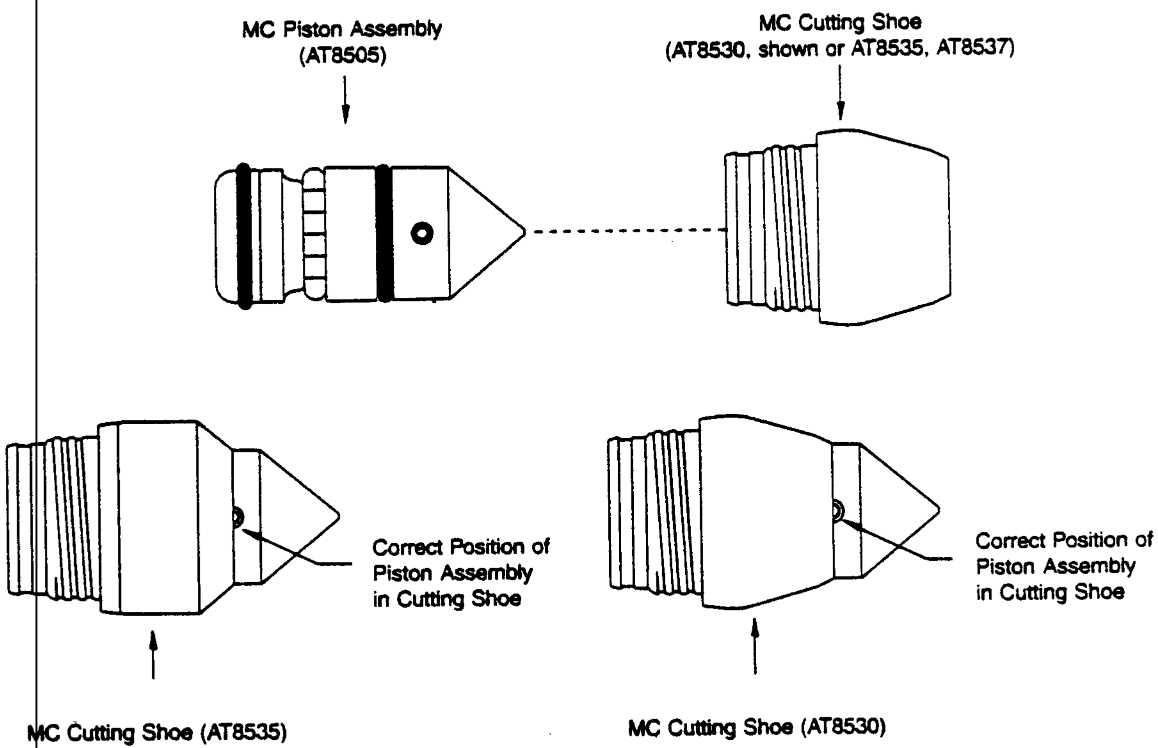


FIGURE 4.7
Installation of Macro-Core® Piston Assembly into Cutting Shoe

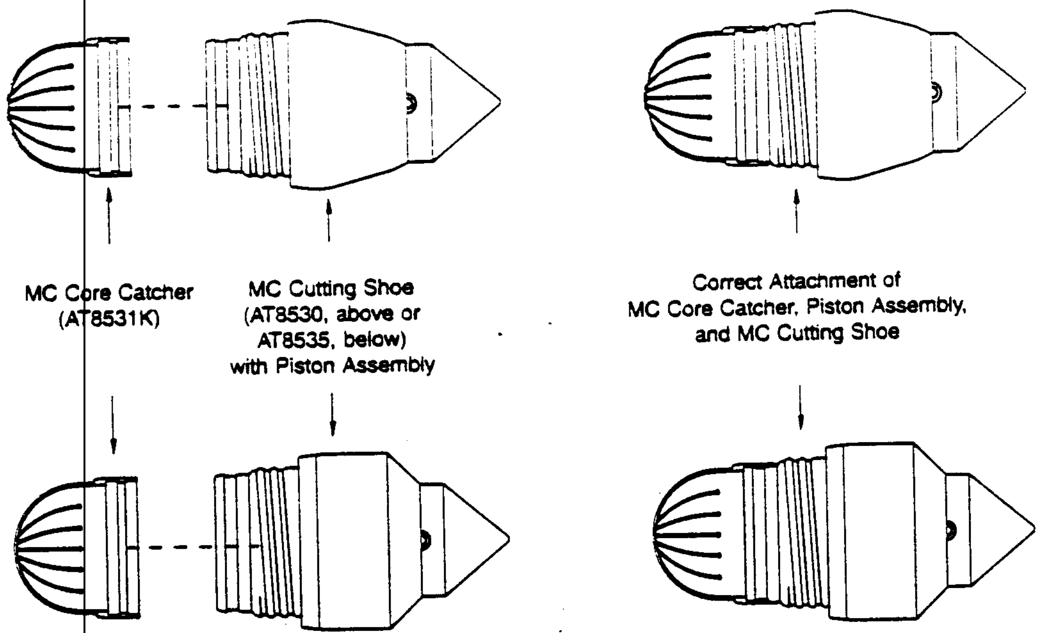


FIGURE 4.9
Macro-Core® Core Catcher Attachment with Piston Assembly

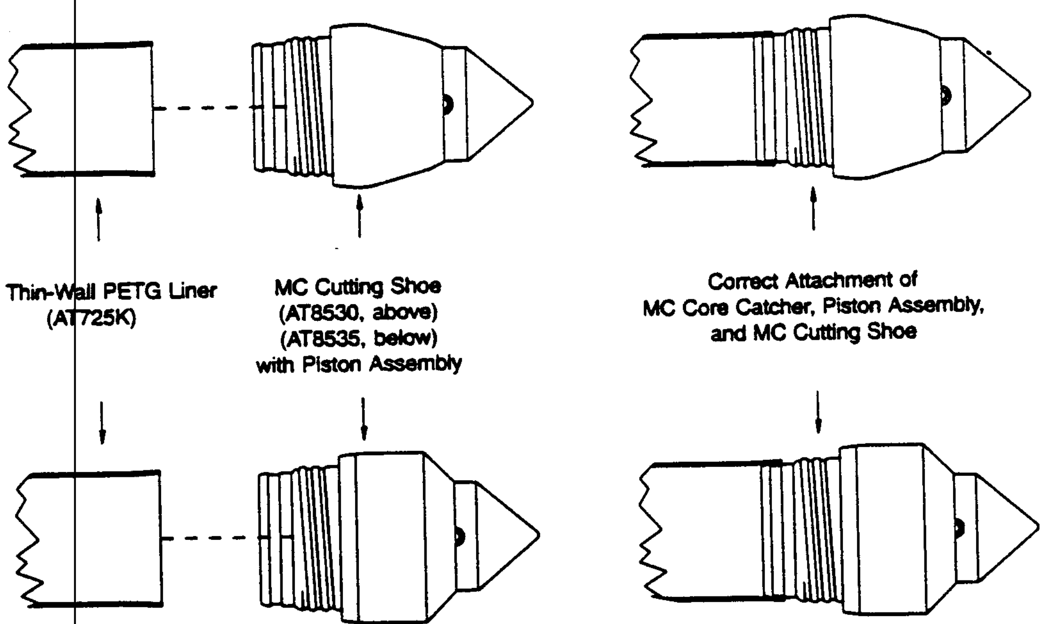


FIGURE 4.10
Macro-Core® Thin-Wall PETG Liner Attachment with Piston Assembly

9b. **Without Core Catcher.** Push the base of an MC Spacer Ring onto the threaded end of a cutting shoe until it snaps into place (Fig. 4.11).

NOTE: With the exception of AT725K (thin-wall PETG) liners, all liners must utilize either a spacer ring or core catcher. PETG liners have a swedged end which slides directly over the end of the cutting shoe. When using PETG liners, attach the liner to the cutting shoe (Fig. 4.10) before proceeding to Step 10.

10. Thread the cutting shoe into one end of an MC Sample Tube (Fig. 4.12). Tighten until the end of the sample tube contacts the machined shoulder of the cutting shoe.

11. Insert the appropriate liner into the sample tube (Fig. 4.12). (The liner is all ready installed if using PETG liners without a core catcher.)

12. Connect a drive head to the top of the sample tube (Fig. 4.12) and securely tighten with the combination wrench (Fig. 4.5) until the end of the sample tube contacts the machined shoulder of the drive head.

4.5 Pilot Hole

A pilot hole prevents excessive sampler wear in tough soils and saves time when a discrete soil core is desired. The pilot hole is created by driving a 2.0-, 2.5-, or 3.0-inch MC Pre-Probe (see page 6 for part numbers) to the top of the sampling interval. Soil surfaces containing gravel, asphalt, hard sands, or rubble should be pre-probed to reduce wear on the cutting shoe and to avoid damage to the sampler. To save time when collecting a discrete soil core, pre-probe to the sampling interval rather than coring to depth with the sampler.

4.6 Open-Tube Sampling

The Macro-Core Open-Tube Sampler is used to gather continuous soil cores from the surface to depths exceeding 30 feet. A representative soil sample is obtained by driving the sampler one sampling interval from ground surface into undisturbed soil. Upon retrieving the sampler, the liner and soil core are removed. The sampler is then properly decontaminated, reassembled with a new liner, and inserted back down the same hole to take the next soil core.

The Macro-Core Cutting Shoe is tapered to minimize the amount of soil scraped from the core walls when inserting the sampler back down an existing hole. In spite of this, non-cohesive soils will often collapse to the bottom of the hole. This slough material then enters the sampler as the next soil core is collected, resulting in a non-representative sample. A Closed-Piston Macro-Core Sampler is required under such conditions. Instructions for sampling with the Open-Tube Macro-Core Sampler follow.

1. Attach a drive cap to the sampler drive head of an assembled Open-Tube Macro-Core Sampler (Section 4.3).

2. Install a hammer anvil and anvil retainer cap assembly. Raise the hammer latch while driving the Macro-Core Sampler to avoid contact with the drive head.

3. Raise the hammer assembly to its highest position by fully extending the probe cylinder. If using a 48-inch or 1-meter sample tube with a Geoprobe Model 4200, 4220, or 420U Probe Unit, raise the machine foot to allow sufficient room to position the sampler below the hammer.

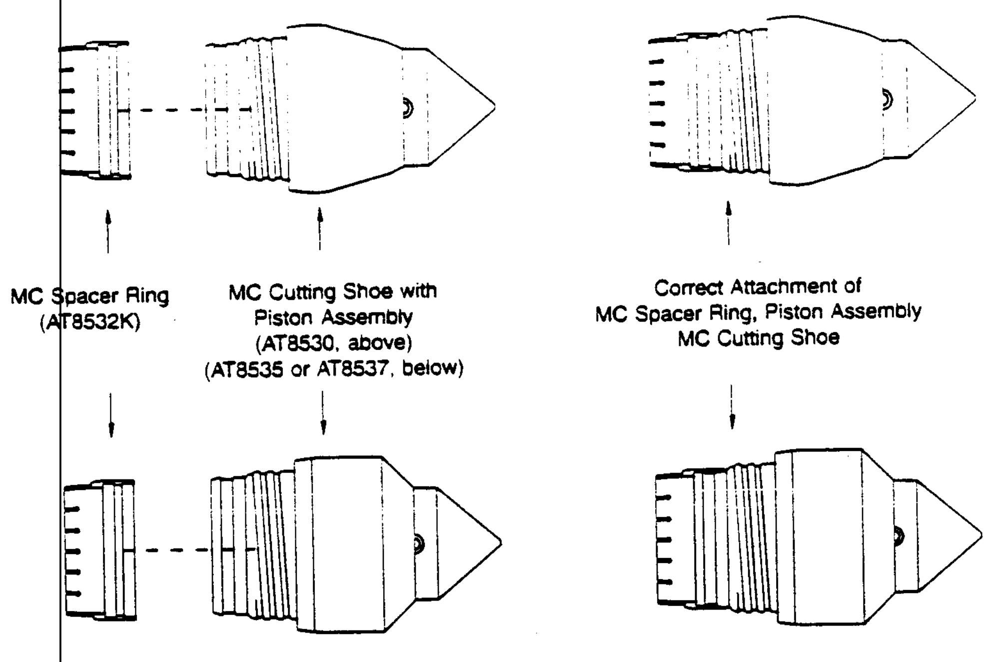


FIGURE 4.11
Macro-Core® Spacer Ring Attachment With Piston Assembly

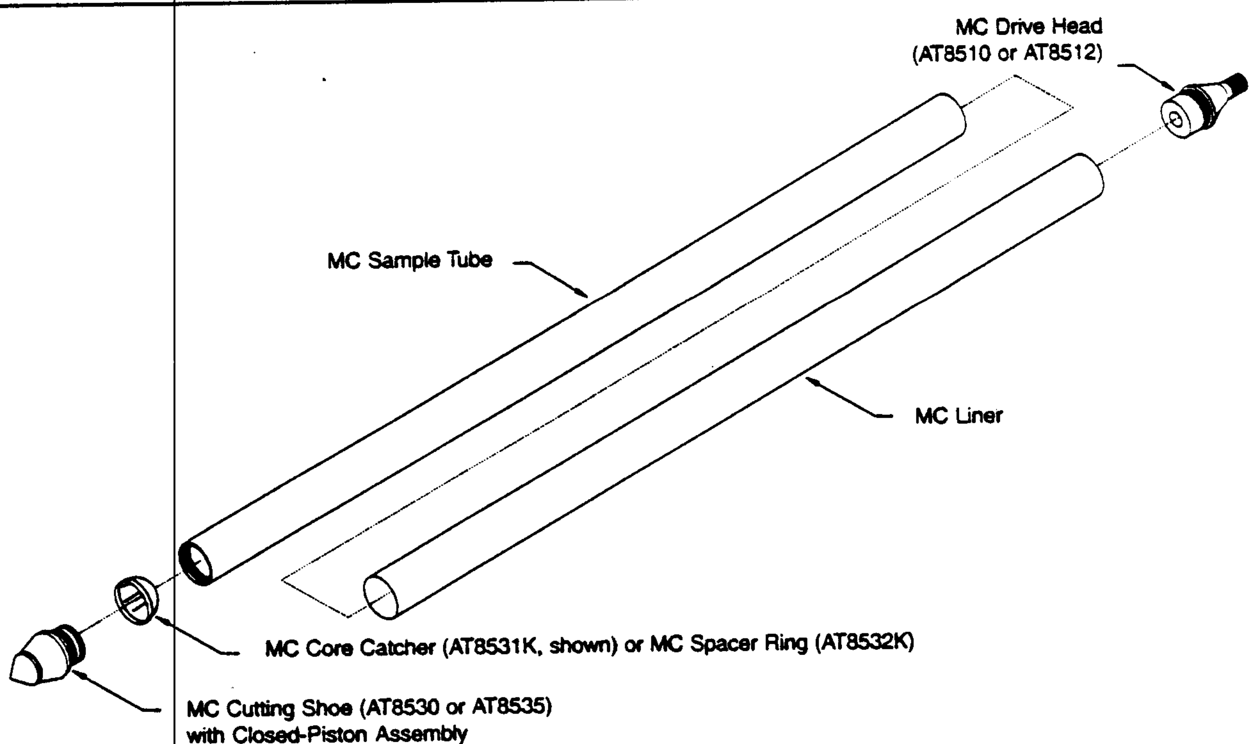


FIGURE 4.12
Macro-Core® Closed-Piston Sampler Assembly

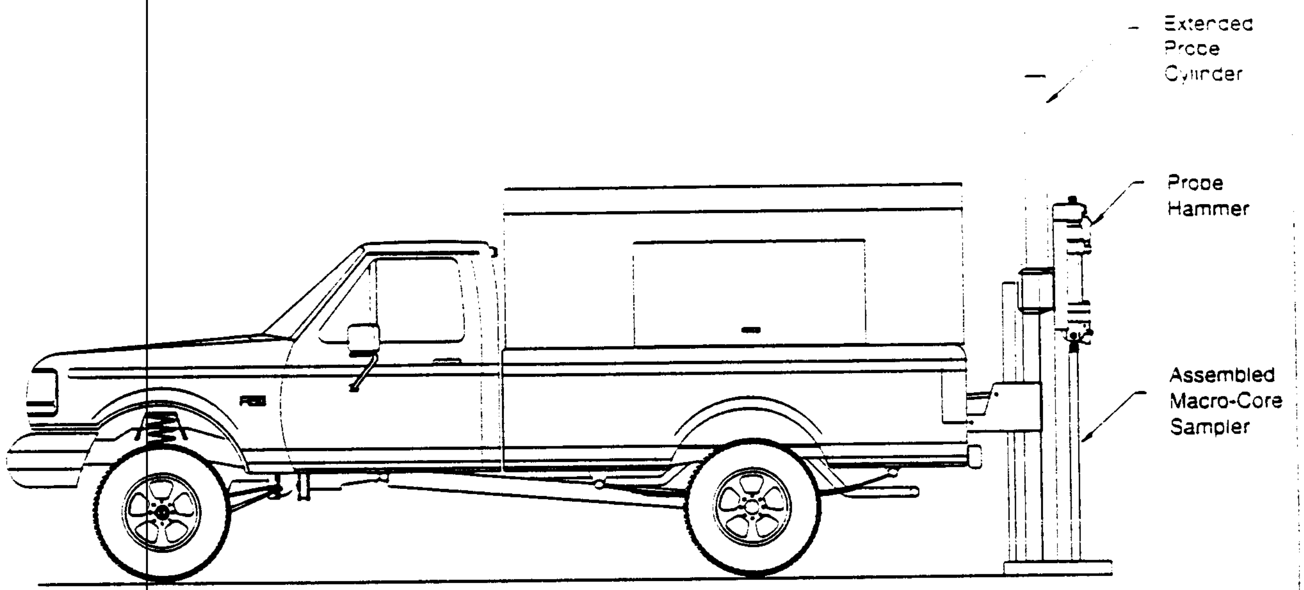


FIGURE 4.13
Macro-Core® Soil Sampler in Driving Position

4. Place the sampler in the driving position (Fig. 4.13). The sampler should always be positioned parallel to the derrick axis.

5. If using a 48-inch or 1-meter sampler tube with a Geoprobe Model 4200, 4220, or 420U Probe Machine, begin applying downward force on the sampler by lowering the machine foot. When the foot contacts the ground surface, apply downward force with the probe cylinder control only. All other Geoprobe units may start initially with the probe cylinder control.

GEOPROBE TIP: **Activate the hammer whenever collecting soil. Hammering forces soil into the sample tube and increases recovery.**

6. Drive the sampler until the drive head reaches the ground surface (Fig. 4.14A).

***CAUTION**

Some soil conditions may warrant using an MC Pre-Probe before attempting to collect a soil core. Damage may occur if the sampler is driven into rock or any other impenetrable layer.

7. To sample at consecutive intervals, push a sampler down the previously opened hole (Fig. 4.14B) until the top of the next sampling interval is reached (Fig. 4.14C). Drive the tool string another sampling interval to fill the sampler with soil (Fig. 4.14D). An open-tube sampler may be used for consecutive sampling or, if soil slough is expected, a closed-piston sampler is available.

***CAUTION**

All parts must be completely threaded together before being driven. Driving an improperly assembled sampler will result in component damage.

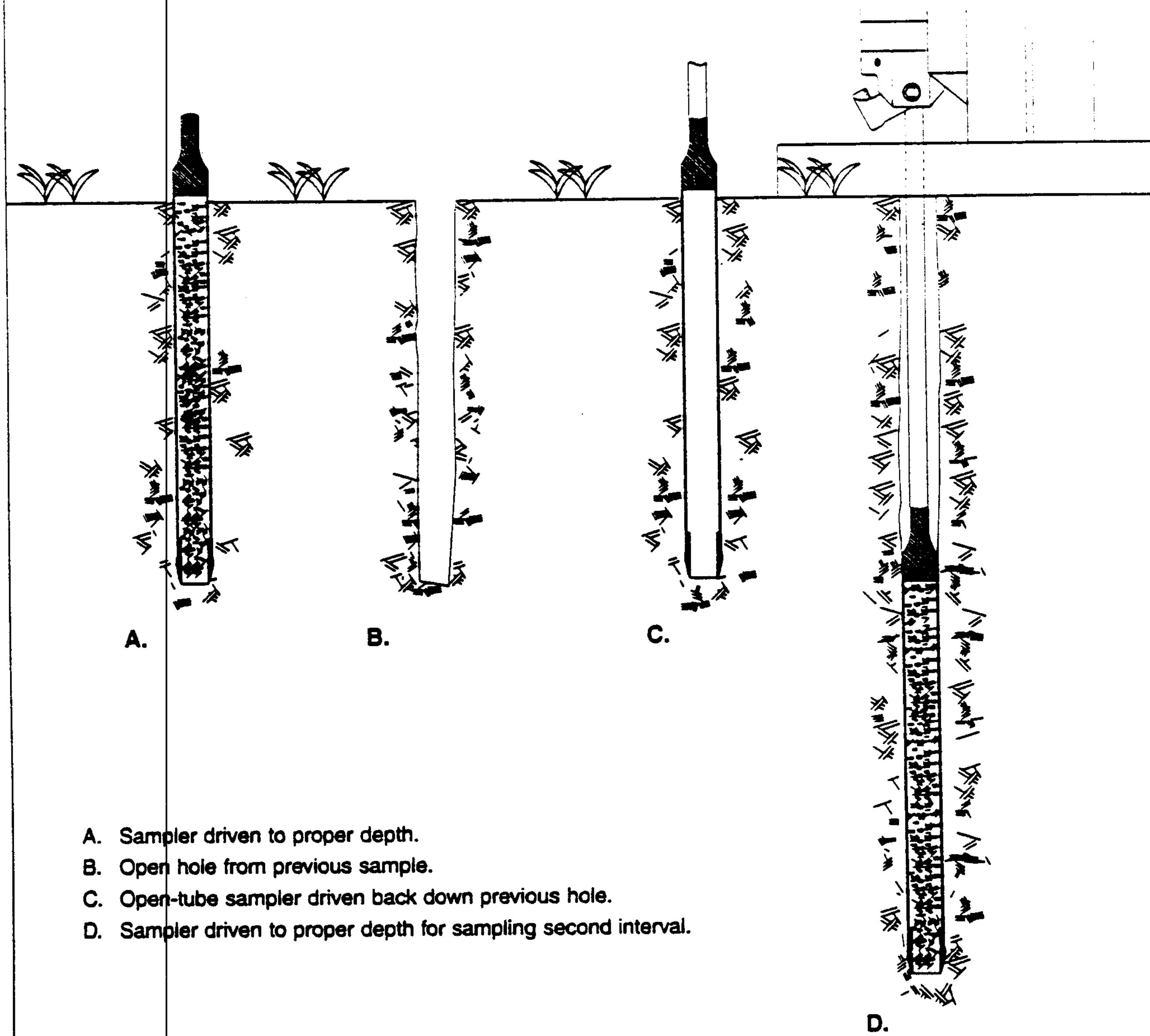
8. Retrieve the sampler as described in Section 4.8: Sampler Retrieval.

4.7 Closed-Piston Sampling

It is often difficult to collect representative soil cores from significant depths with an open-tube sampler due to soil slough. Because of this, the Macro-Core sampler can be equipped with a piston which locks into the cutting shoe. This allows the sealed sampler to pass through the slough material and be opened at the appropriate sampling interval.

NOTE: The closed piston system is meant to be inserted through previously opened holes. It is not designed to be driven from the surface through undisturbed materials.

The MC Closed-Piston System can be used only with AT8500 series Macro-Core tools. The AT8500 series replaces the AT720 series Macro-Core tools.



A. Sampler driven to proper depth.
B. Open hole from previous sample.
C. Open-tube sampler driven back down previous hole.
D. Sampler driven to proper depth for sampling second interval.

FIGURE 4.14
Phases of Macro-Core® Open-Tube Soil Sampling

1. Attach a drive cap to the drive head of an assembled Closed-Piston Macro-Core Sampler (Section 4.4).

2. Install a hammer anvil and anvil retainer cap assembly. Raise the hammer latch while driving the sampler to avoid contact with the drive head.

3. Raise the hammer assembly to its highest position by fully extending the probe cylinder. If using a 48-inch or 1-meter sample tube with a Geoprobe Model 4200, 4220, or 420U Probe Unit, raise the machine foot to allow sufficient room to place the sampler below the hammer.

4. Place the sampler tip in the **previously opened hole** (Fig. 4.15A). Lower the probe until the hammer anvil contacts the sampler drive head.

5. If using a 48-inch or 1-meter sample tube with a Geoprobe Model 4200, 4220, or 420U Probe Machine, begin applying downward force on the sampler by lowering the machine foot. When the foot contacts the ground surface, apply downward force with the probe cylinder control only. All other Geoprobe units may start initially with the probe cylinder control.

6. Drive the sampler until it reaches the desired sampling interval (Fig. 4.15B). Add probe rods as needed.

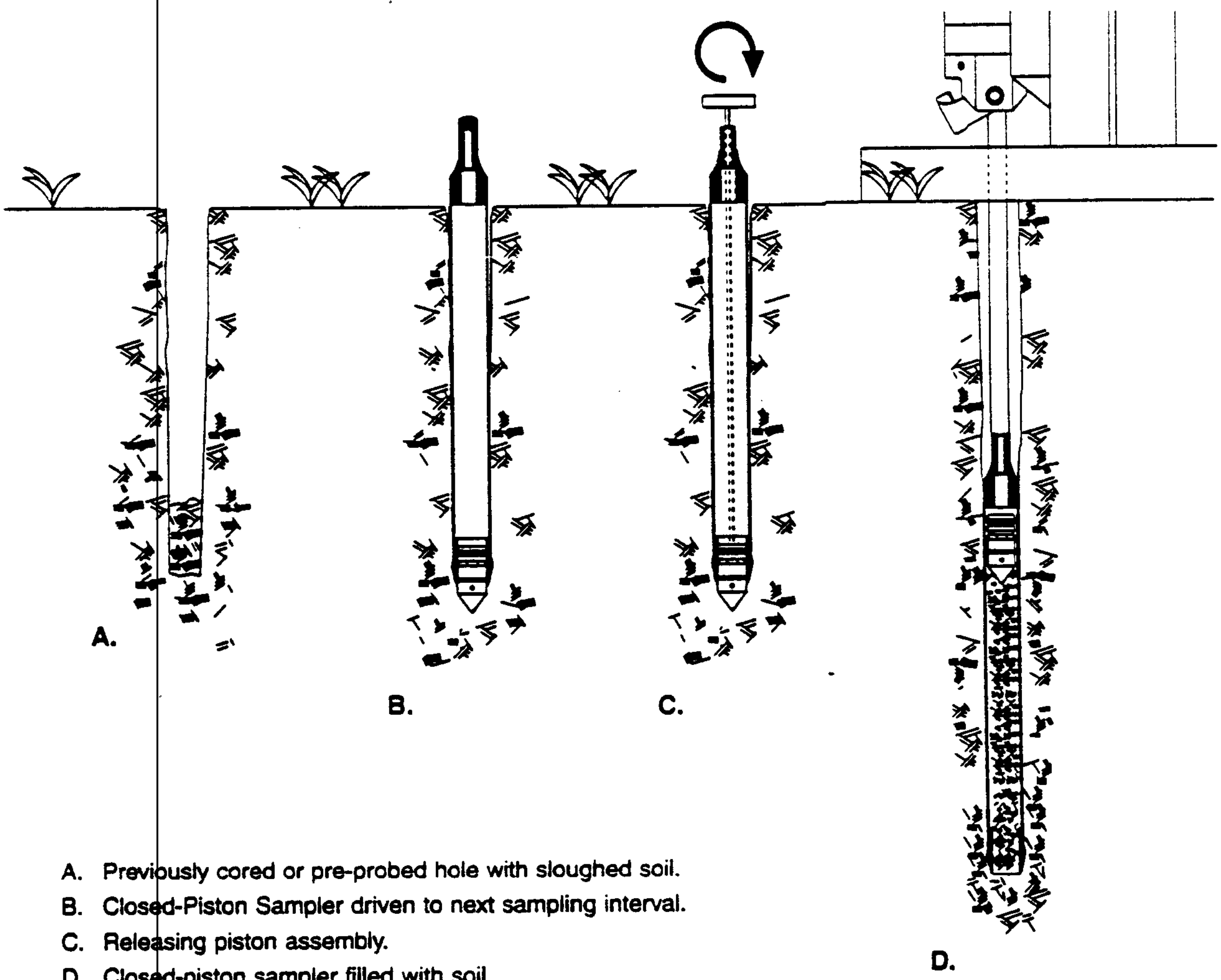
***CAUTION**

Care should be taken when driving the Macro-Core Sampler down a previously opened hole. Low side friction may allow the sampler and probe rods to drop down the hole. To prevent equipment loss, attach a pipe wrench to the top of the rod string when advancing or retrieving the sampler.

7. Move the probe unit away from the top of the probe rods to allow room for work.

8. Remove the drive cap and insert an MC Piston Release Rod (Fig. 3.1) down the inside of the probe rods (Fig. 4.16). (Refer to Fig. 4.19 for identification of extension rod accessories.) Hold onto the release rod and attach an Extension Rod Coupler or Extension Rod Quick Links. Attach an Extension Rod to the release rod (Fig. 4.17) and lower the jointed rods down hole. Continue adding extensions until the release rod contacts the bottom of the sampler. The operator may opt to use the Extension Rod Jig to hold the down-hole extension rods while adding additional rods.

9. Attach an Extension Rod Handle to the top extension rod and slowly rotate the handle clockwise (Fig. 4.15C and 4.18). The release rod will drop into the groove in the piston bolt (Fig. 4.20). The operator should feel the extension rods move slightly as the release rod falls into the groove. Rotate the handle clockwise approximately four complete revolutions. Resistance to rotation is generally noted at this point. If the rods continue to rotate, however, do not continue for more than four complete revolutions. The piston assembly is now released and will be pushed to the top of the sampler as the liner is filled with soil (Fig. 4.15D).



A. Previously cored or pre-probed hole with sloughed soil.
B. Closed-Piston Sampler driven to next sampling interval.
C. Releasing piston assembly.
D. Closed-piston sampler filled with soil.

FIGURE 4.15
Phases of Macro-Core® Closed-Piston Soil Sampling

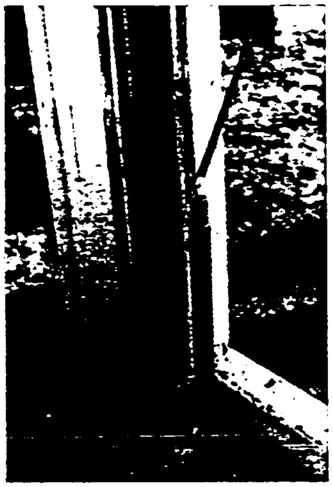


Figure 4.16. MC Release Rod is inserted down inside of the probe rods.

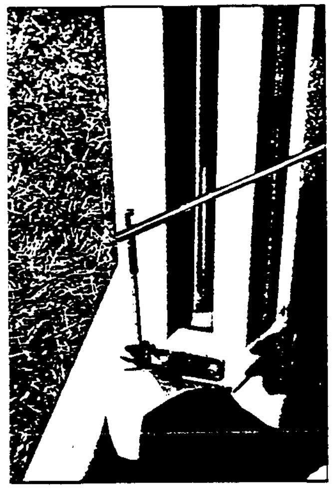


Figure 4.17. Extension Rods are attached to the MC Piston Release Rod using Extension Rod Quick Links.

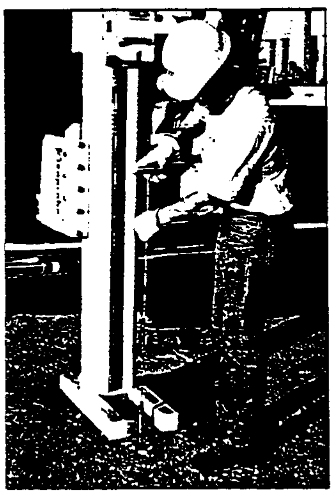


Figure 4.18. Extension Rods are rotated clockwise to release the MC Piston assembly.

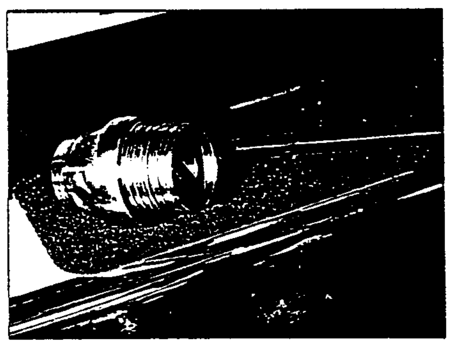


Figure 4.20. MC Release Rod fits into groove in MC Piston Bolt Head.

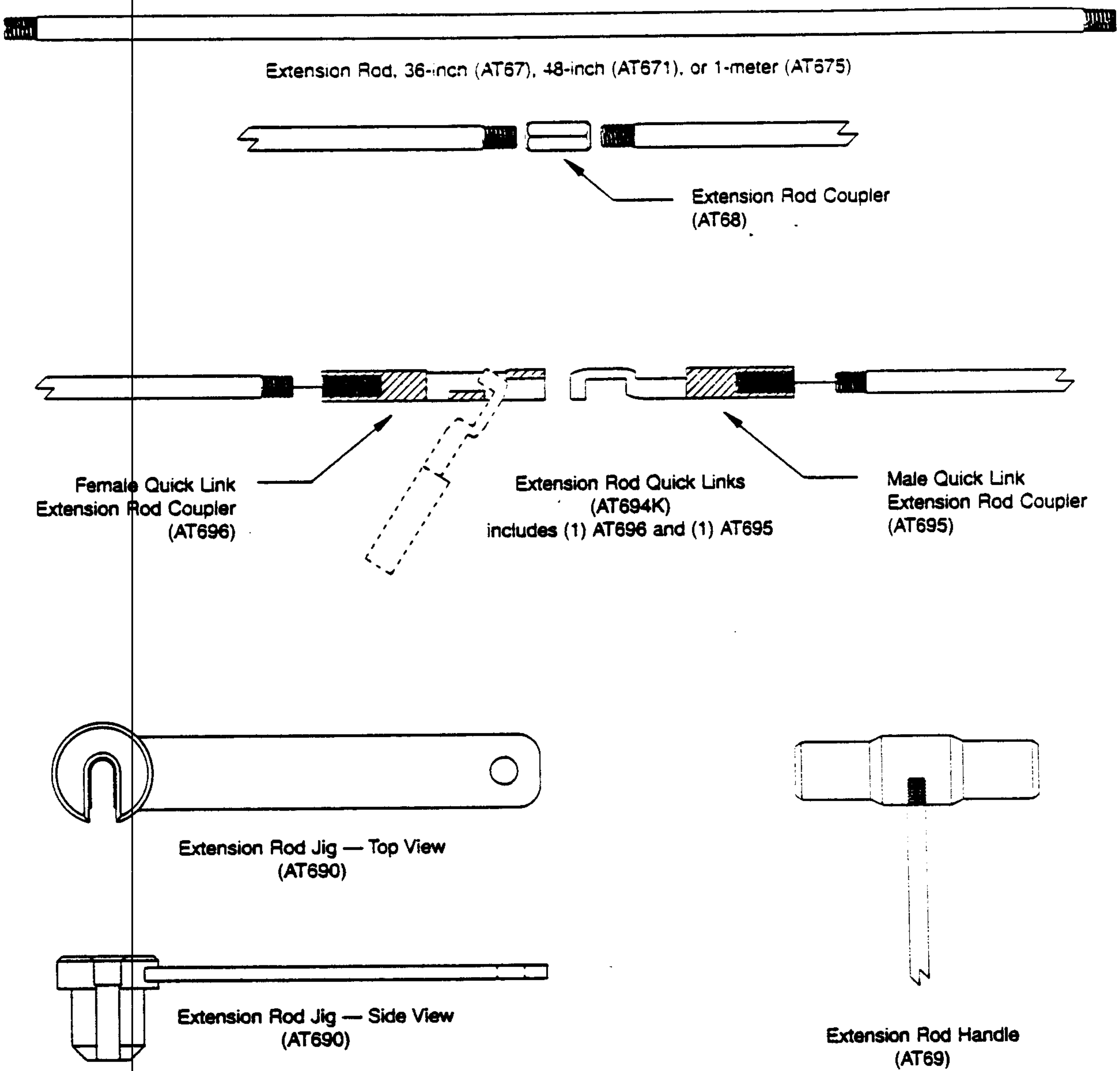


FIGURE 4.19
Geoprobe Extension Rods and Accessories

10. Remove the release rod and extension rods. The piston assembly will not be attached to the end of the extension rod but will remain inside the sample tube.

11. Add a probe rod to the tool string, attach the drive cap, and reposition the probe unit. Drive the tool string another sampling interval to fill the liner with soil. Do not over-drive the sampler.

GEOPROBE TIP: Activate the hammer whenever collecting soil. Hammering forces soil into the sampler tube and increases recovery.

4.8 Sampler Retrieval

1. Attach a pull cap to the top probe rod. Close the hammer latch over the pull cap and pull the tool string up one rod length by actuating the PROBE control lever.

2. Remove the rod and repeat Step 1 until the sampler drive head is just above the ground surface. Probe rods are sometimes difficult to loosen by hand. Use pipe wrenches to free tight threads.

***CAUTION**

Care should be taken when retrieving the Macro-Core sampler. Low side friction may allow the sampler and probe rods to drop down the hole. Attach a pipe wrench to the top of the rod string to prevent equipment loss.

3. Attach the pull cap to the sampler drive head (Fig. 4.21). Pull the sampler out of the ground (Fig. 4.22) by raising the PROBE control lever. If using a 48-inch or 1-meter sample tube with a Geoprobe Model 4200, 420U, or 4220 Probe Machine, the probe cylinder will fully extend before the sampler is completely free. Attempt to raise the sampler by actuating the FOOT control.

***CAUTION**

The rear of the carrier vehicle may be pulled downward as the foot cylinder is activated if the sampler is lodged tightly in the ground. Damage to the unit base frame may occur under such circumstances.

If the sampler cannot be retrieved without excessive resistance, follow these steps:

1. Lower the FOOT control and disengage the hammer latch from the pull cap.

2. Raise the probe foot at least 12 inches (305 mm) above the ground surface. Stack several boards or place timber blocks under the foot to act as a foot extension.

3. Lower the hammer assembly and close the hammer latch over the sampler pull cap.

4. Use the PROBE control to lift the sampler completely out of the ground.

4.9 Soil Core Recovery

The soil sample is easily removed from the Macro-Core Sampler by unscrewing the cutting shoe and pulling out the liner. A few sharp taps on the cutting shoe will often loosen the threads sufficiently to allow removal by hand. If needed, the exterior of the cutting shoe features a notch for attaching the combination wrench to loosen tight threads (Fig. 4.23). With the cutting shoe removed (Fig. 4.24), simply pull the liner and soil core from the sample tube (Fig. 4.25).

If the closed-piston sampler is used, the piston assembly is now retrieved from the end of the liner (Fig. 4.26). Secure the soil sample by placing a vinyl end cap on each end of the liner.

Undisturbed soil samples can be obtained from Teflon®, PVC, and PETG liners by splitting the liner. Geoprobe offers two tools for cutting sample liners. The MC Liner Cutter Kit (AT8000K) is used to make longitudinal cuts in the liner and includes a tool that holds the liner for cutting. The MC Liner Circular Cutting Tool (AT8050) is used to segment the liner by cutting around the outside circumference of the liner. Refer to Figures 4.27 and 4.28 for more information on liner cutting.

Figure 4.21. Pull Cap attached to MC Drive Head.

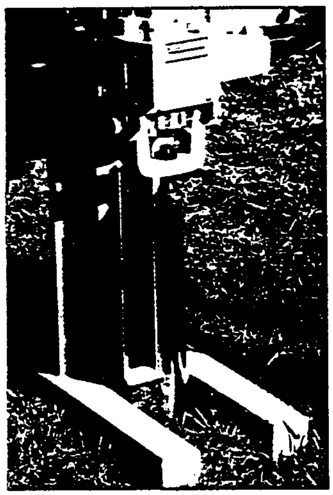


Figure 4.22. MC Soil Sampler is pulled with Geoprobe unit.

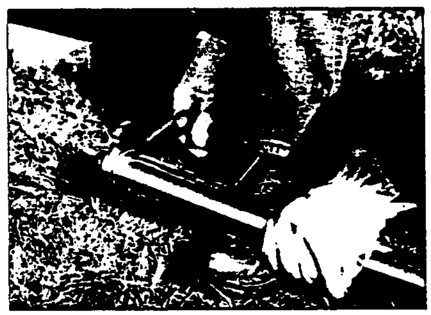


Figure 4.23. Loosening the MC Cutting Shoe with the MC Combination Wrench.

Figure 4.24. Removing MC Cutting Shoe and liner from MC Sampler Tube.

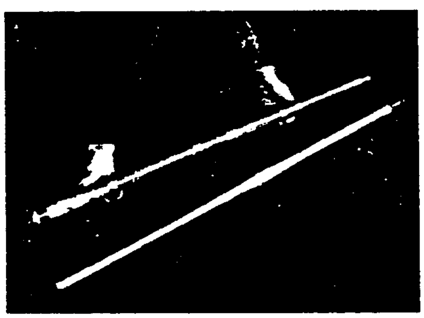


Figure 4.25. Macro-Core liner filled with soil core.

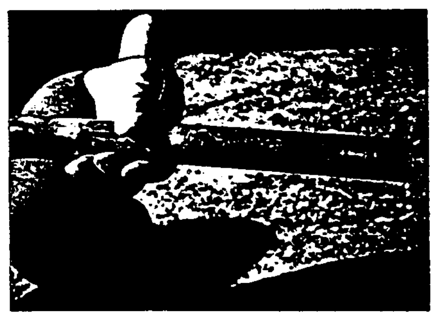


Figure 4.26. MC Piston assembly is retrieved from liner at the top of the soil core.

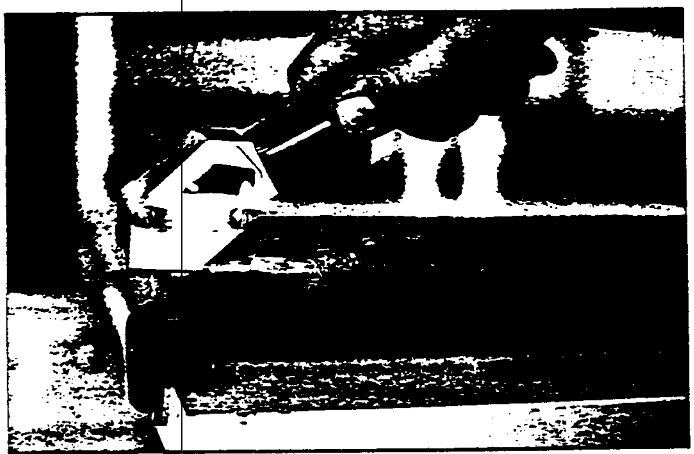


Figure 4.27. MC Liner Cutter (AT8000K) makes a quick, safe cut through even the toughest of liner materials.

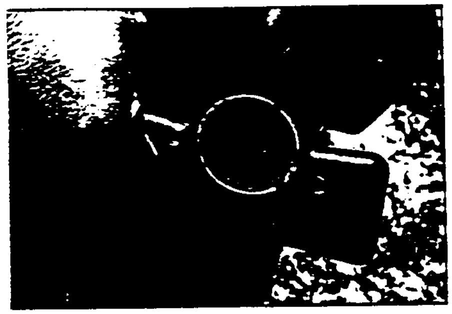


Figure 4.28. MC Circular Cutting Tool (AT8050) cuts around the outside of the filled MC liner.

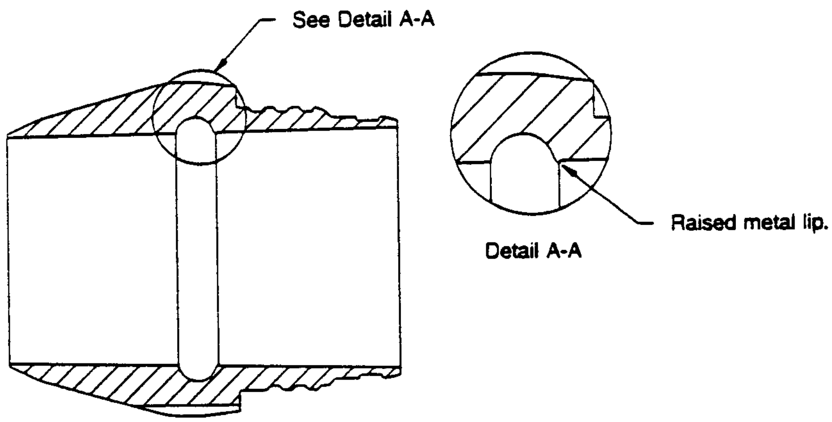


FIGURE 4.29
Macro-Core® Cutting Shoe with Mushroomed Locking Ring Groove

4.10 Macro-Core Closed-Piston Operating Tips

The Macro-Core piston assembly requires proper maintenance to ensure reliable operation. The following tips will increase the effectiveness of closed-piston sampling:

1. Cleanliness is the most important factor affecting piston operation. Ensure piston bolt threads and locking ring are free of soil particles and corrosion before each use. Completely thread and unthread the piston bolt to verify operation. Disassemble the piston tip and wash the individual parts using clean water and a Nylon Brush for MC Sample Tubes (BU700) if necessary. Allow parts to dry before assembling if piston is to be stored before use. Disassemble used pistons before storing to prevent piston bolt corrosion.

2. Never store a cutting shoe with the piston installed. Install the piston assembly immediately before sampling.

3. Lubricate piston assembly with distilled water before installing in the cutting shoe.

4. Once the assembly is fully seated in the cutting shoe, tighten the piston bolt with an oscillating movement; thread the bolt in 90 degrees then back 45 degrees. When the end of thread travel is reached, work the last 30 degrees of travel back and forth several times. Tightening the piston bolt in this manner allows the metal pins of the locking ring to correctly align in the cutting shoe.

5. Do not lock the piston bolt 100 percent counterclockwise. Fully tighten the bolt and then loosen approximately 10 degrees.

6. When releasing the piston downhole, only turn the piston bolt 4 clockwise revolutions.

7. Clean the piston assembly with distilled water and a nylon brush between samples. It is not necessary to completely disassemble the piston at this time. Pay particular attention to the locking ring and ensure that all sand and grit is removed from between the metal lock pins.

8. Locking rings are expensive but can be restrung on new springs. If a locking ring breaks, save the pieces for reuse. (Refer to Page 6 for replacement parts). To restring a locking ring, follow these simple steps:

   a. There is a small loop at each end of a new locking ring spring. Make sure one loop is bent perpendicular to the other. One loop should also be completely closed while the other is slightly open.

   b. Attach a clamp as close to the open end as possible (without contacting the loop) to hold the spring. Fisherman fly-tying pliers work well for this procedure. Take care not to damage the spring by applying too much pressure.

   c. String 12 locking ring pins (macaroni-shaped metal pieces) on the closed end, stretching the spring as necessary. Be careful not to overstretch and damage the spring.

   d. Hook the open end of the spring through the closed end and bend the loop closed.

   e. Remove the clamp and gently stretch the locking ring several times to ensure that the loops will not open.

9. A locking ring groove is machined into the cutting shoe. Over time, the edges of this groove may begin to mushroom from use (Fig. 4.29). The raised metal lip formed by the mushroomed groove may cause the locking ring (and subsequently the piston) to bind in the cutting shoe. Remove the raised metal with a file or die grinder

4.11 Tips to Maximize Sampling Productivity

The following suggestions are based on the collective experiences of Geoprobe operators:

1. Organize your truck or van to maximize efficiency. Assign storage areas to all tools and equipment for easy location. Store samplers, extension rods, and liners in racks. Above all, minimize the number of items lying loose in the back of the vehicle.

2. Take three or four samplers to the field. This allows the collection of several samples before stopping to clean and decontaminate the equipment. A system is sometimes used where one individual operates the probe while another marks the soil cores and decontaminates the used samplers.

3. A machine vise is a real plus. With the sampler held in a vise, the operator has both hands free to remove the cutting shoe (Fig. 4.30), drive head, and sample liner (Fig. 4.31). Cleanup is also easier with both hands free. Geoprobe offers an optional Machine Vise (FA300) which mounts directly on the probe derrick (Fig. 4.32).

4. Extension Rod Quick Links (Fig. 4.33) are the best choice among connectors. These are real time savers. The quickest and easiest method for deploying extension rods is to assemble sections of up to three rods with threaded connnectors. Each section is then connected with Quick Links. Up to three rods can be inserted or removed from the probe string at once, greatly reducing deployment time.

5. When releasing the piston assembly, a pair of locking pliers may be used to turn the extension rods. The locking pliers will be quicker and easier to install than the extension rod handle in some situations.

6. Organize your worksite. The best way to maximize sampling efficiency is to practice with the sampler and identify a comfortable setup. Lay out all tools and equipment before probing. An example layout is shown in Figure 4.34.

   A collapsible table or stand is handy to hold decontaminated sampler tubes and liners. Equipment may also be protected from contamination by placing it on a sheet of plastic on the ground.

   Keep probe rods separate by identifying a location for "new" rods as well as a "put down pile." Initially drive the sampler with a new rod. As the rod is removed during sampler retrieval, place it in the put down pile for reuse. Drive the sampler to the top of the next sampling interval by using all of the rods in the put down pile. A new rod (located in a separate pile) is added and the string is driven to collect the next soil core. Once again, each probe rod is removed and placed in the put down pile as the sampler is retrieved. The cycle is repeated until all of the soil cores are recovered. This method eliminates the need to count rods while driving the sampler.

7. Cleanup is very important from the standpoint of operation as well as decontamination. Remove all dirt and grit from the threads of the drive head, cutting shoe, and sample tube with a nylon brush (BU700). Without sufficient cleaning, the cutting shoe and drive head will not thread completely onto the sample tube. The threads may be damaged if the sampler is driven in this condition.

   Ensure that all soil is removed from inside the sample tube. Sand particles are especially troublesome as they can bind liners in the sampler. Full liners are difficult to remove under such conditions. In extreme cases the soil sample must be removed from the liner before it can be freed from the sample tube.

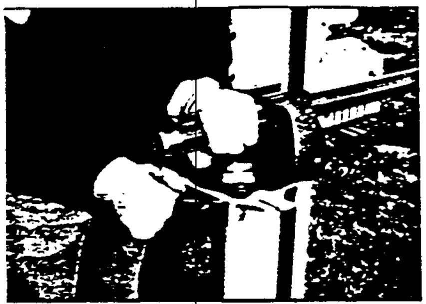


Figure 4.30. Removing MC Cutting Shoe with filled sampler tube held in Machine Vise.

Figure 4.31. Removing filled liner with sampler tube held in Machine Vise.

Figure 4.33. Machine Vise mounted directly on Geoprobe unit.

Figure 4.33. Using Extension Rod Quick Links to connect Extension Rods.

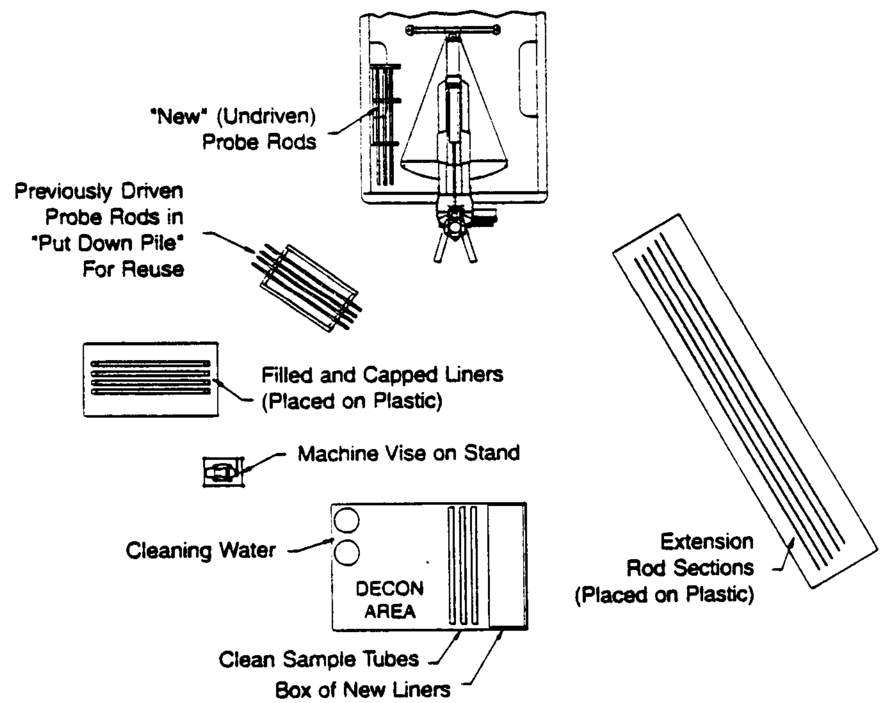


FIGURE 4.34
Equipment Layout Example to Maximize Sampling Productivity.

8. The piston assembly may remain lodged in the cutting shoe when disassembling by hand, even though the piston bolt is completely loosened. This is because the locking ring and piston washer do not release from the groove in the cutting shoe as the piston bolt unthreads out of the tip. Hammering on the piston tip will have no effect because you are, in essence, forcing the tip tighter against the locking ring. To dislodge the piston, turn the assembly over and tap the top of the cutting shoe on a solid object. If the assembly still does not release, tap on the piston bolt with a hammer (taking care not to damage the release rod slot). This will jar the piston tip and bolt enough to release the locking ring from the groove in the cutting shoe.

***CAUTION**

Do not push the piston assembly out of the cutting shoe by placing your hands on the piston tip. The cutting shoe is sharp and may cause injury when the assembly suddenly comes free. It is best to place the tip against a solid object, grasp the cutting shoe, and push the shoe over the assembly.

9. Although available for use with two sizes of probe rods, 1.25-inch OD rods are recommended for the Macro-Core Sampler. The larger rod diameter limits downhole deflection of the tool string and ultimately provides a more durable system. A new thread design also makes the 1.25-inch rods quicker and easier to thread together than previous 1-inch probe rods.

10. The Heavy-Duty MC Cutting Shoe (AT8535) is machined with more material at the critical wear areas. It can be used in place of the Standard MC Cutting Shoe (AT8530) and is designed to lengthen service life under tough probing conditions.

    Expansive clays and coarse sands can "grab" and collapse liners as the sample tube is filled with soil. A 1/8-inch Undersized MC Cutting Shoe (AT8537) will help alleviate this problem. The smaller diameter core (1.375 inches) allows expanding clays and coarse sands to travel up the sample liner without binding. The piston assembly can not be used with this cutting shoe.

11. Maximize the thread life of the sample tube by varying the ends in which the drive head and cutting shoe are installed. The dynamic forces developed while driving the sampler are such that the threads at the drive head wear more quickly than at the cutting shoe. Regularly switching ends will maintain relatively even wear on the sample tube.

5.0 REFERENCES

Geoprobe Systems. September. 1997. "97-98 Tools and Equipment Catalog."

Geoprobe Systems. May. 1995. "1995-96 Tools and Equipment Catalog."

Equipment and tool specifications, including weights, dimensions, materials, and operating specifications included in this brochure are subject to change without notice. Where specifications are critical to your application, please consult Geoprobe Systems.

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ATTACHMENT B - EQUIPMENT DECONTAMINATION AND CLEANING PROCEDURES

I. Introduction

This attachment presents procedures which will be used to decontaminate equipment used to collect soil, sediment, and ground-water samples. In addition, this attachment presents the procedures to be followed in cleaning the Geoprobe sampling device and equipment used to complete soil borings and install monitoring wells. The adequacy of cleaning procedures will be monitored through the collection of QA/QC rinse blank samples which will be submitted for laboratory analysis.

II. Sampling Equipment Decontamination

Generally, dedicated sampling equipment will be used during the investigations (e.g., stainless-steel trowels, plastic scoops, ground-water sample bailers). However, equipment that is not dedicated (e.g., Geoprobe sampling device, split-spoon sampler) will be decontaminated prior to each use to mitigate the potential for cross-contamination of the samples collected for laboratory analysis. The decontamination procedures to be utilized during the remedial action are presented below:

1. Non-phosphate detergent solution wash.
2. Tap water rinse.
3. 10 percent nitric acid rinse (for metals sampling only).
4. Distilled water rinse.
5. Methanol rinse (for organics sampling only).
6. Distilled water rinse.
7. Hexane rinse (for PCB sampling only).
8. Distilled water rinse.
9. Allow to air-dry to the extent practicable.
10. Any sampling equipment (including Geoprobe sampling devices or split spoons) that is not immediately used following decontamination will be wrapped in aluminum foil or polyethylene.

III. Drilling Equipment Cleaning

In addition to the above-discussed decontamination procedures, all downhole equipment associated with the drilling of soil borings, Geoprobe sampling, and the installation of monitoring wells will be steam cleaned prior to arrival on site and between drilling locations. Steam cleaning of equipment will take place over a plastic-lined decontamination pad. Water generated during steam cleaning will be pumped from the decontamination pad into a steel 55-gallon drum for transfer to the temporary on-site water treatment system.

ATTACHMENT C - CALIBRATION OPERATION, AND MAINTENANCE PROCEDURES

Attachment C-1

Organic Vapor Analyzer (OVA)
Calibration, Operation, and Maintenance Procedures

I. Introduction

The OVA meter calibration will be conducted prior to initiating field activities. Calibration checks will be made daily during the operation of the OVA. All calibrations and calibration checks will be recorded on the OVA Calibration and Maintenance Log in Exhibit 1.

II. Materials

- OVA meter, Foxboro® Model 128;
- Methane calibration gas (100 and 10,000 ppm methane);
- Regulator, Tedlar gas bag with nozzle, and plastic tubing;
- OVA Calibration and Maintenance Log;
- Small screw driver; and
- Crescent wrench.

III. Calibration Procedures

1. Switch the pump switch to the "on" position (warm instrument for 5 minutes).

2. Stand the OVA meter up vertically and observe the pump flow rate. If the flow rate is not 2 liters per minute, the pump may need cleaning or replacement.

3. Open the hydrogen supply valve and tank valve.

4. Depress the ignitor button for no more than 6 seconds.

5. Observe the meter needle of the OVA. If the needle peaks and remains at a relatively high value after the depression of the ignitor button, the OVA is lit and ready for use. If the needle does not peak, wait 2 or 3 minutes and depress the ignitor button again for 6 seconds.

6. After the instrument is operating, place the OVA in normal operating position and allow the instrument to warm up for 15 minutes prior to calibrating.

7. Prepare two known concentrations of methane gas in air, preferably 100 ppm and 10,000 ppm (one percent).

8. Introduce the 100 ppm sample and rotate the calibration adjust knob for 100 ppm on the meter.

9. Introduce the 10,000 ppm mixture and adjust R-4 on the electronics board for 10,000 ppm.

10. Repeat steps until no further adjustment is necessary.

11. Close the hydrogen supply valve and wait until the flame is extinguished.

12. Place the calibrate switch in the <u>low</u> position and rotate the gas select knob until the meter reads 10 ppm.

13. Place the calibrate switch in the <u>high</u> position and adjust R-16 on the electronics board for 10,000 ppm.

14. Repeat steps until no further re-adjustment is necessary.

15. Record the data and calibration adjustment on the OVA Calibration and Maintenance Log in Exhibit 1.

IV. Operation Procedures

1. Don the health and safety equipment as required by the Health and Safety Plan.

2. Calibrate the instrument as previously described.

3. Measure and record the background OVA reading.

4. In the event of precipitation, fully cover the instrument.

5. Measure and record the OVA reading.

V. Maintenance Procedures

1. The column can become contaminated with compounds having long retention times resulting in high background readings. To check for contamination, move the machine to clean ambient air and place the sample inject valve in the "in" position (GC mode). Observe the background reading on the meter and after 1 to 2 minutes, change the position of the backflush valve and again observe the reading. If the background reading decreased prior to increasing in 1 to 2 minutes, the column is probably contaminated.

2. Contaminated columns can be avoided by backflushing the column after every analysis.

3. The activated charcoal filter should be checked periodically. To check effectiveness, operate OVA with sample inject valve "in" and pass probe near a concentrated sample. If the readout does not remain steady (0 to 2 ppm), replace charcoal.

4. Always put the OVA on the charger when not in use to prolong life of the battery pack.

5. Always make certain that both the pump and instrument switches are in the "off" position when the instrument is not in use.

6. The OVA will be sent to the factor for service, if needed.

7. Record calibration information on the OVA Calibration and Maintenance Log (Exhibit 1).

Attachment C-2

pH Meter Calibration, Operation, and Maintenance Procedures

I. Introduction

The pH meter will be calibrated daily prior to use.

II. Materials

- 10.0, 7.0, 4.0 pH buffer solutions
- Thermometer
- Distilled water
- Disposable plastic beakers
- Calibration and maintenance log

III. Calibration Procedures

The pH meter will be calibrated as follows:

1. Switch on instrument.

2. Connect electrode to meter and remove protective cap.

3. Rinse electrode in distilled water.

4. Measure and record temperature of buffer solutions.

5. Immerse pH electrode in pH buffer 7.00, set the temperature control to that of the buffer 7.00 and allow sufficient time for the electrode to stabilize. Adjust the Standardize Control for the correct readout.

6. Rinse electrode with distilled water.

7. Immerse pH electrode in buffer 4.0, set the temperature control to that of the buffer 4.0 and allow sufficient time for the electrode to stabilize. Adjust the Slope Control for the correct readout.

8a. Rinse the electrode with distilled water. The meter is calibrated and ready for use.

8b. (Optional step) If the pH is expected or could be between 7.0 to 10.0, then immerse the pH electrode in buffer 10.0, set temperature control, and allow sufficient time for the electrode to stabilize. Adjust the slope control for the correct read out.

9. Record calibration information on the Temperature/pH/Conductivity Meter Calibration and Maintenance Log (Exhibit 2).

IV. Operation Procedures

1. Calibrate pH meter.

2. Rinse probe in distilled water.

3. Fill a disposable beaker with the water sample.

4. Insert probe into one sample beaker and obtain a reading. The meter will read between 0 and 14, in 0.01 increments.

5. Repeat Step 4.

6. Log results in field notebook and the average will be the actual result.

7. Rinse probe off in distilled water.

V. Maintenance Procedures

1. Replace batteries on a regular basis.

2. Store electrode in protective casing when not in use.

3. Keep records of operation, maintenance, calibration, problems, and repairs.

4. After use, the meter will be inspected and the inspection recorded in the field notebook.

5. A replacement meter will be available on-site or ready for overnight shipment, if necessary.

6. pH meter will be sent back to manufacturer for service, if needed.

7. Record maintenance information on the Temperature/pH/Conductivity Meter Calibration and Maintenance Log (Exhibit 2).

Attachment C-3

Temperature/Conductivity Meter Calibration,
Operation, and Maintenance Procedures

I. Introduction

The temperature/conductivity meter (HACH Model 44600 or equivalent) will be calibrated daily prior to use.

II. Materials

- Beaker capable of submerging the entire probe in a calibration liquid standard
- Calibration liquid standard (NaCl, 1,000 mg/L or equivalent)
- Fine-end screw driver
- Disposable plastic beakers

III. Calibration Procedures

The conductivity meter will be calibrated as follows:

1. Be sure the probe is clean.

2. Soak the probe in distilled water for at least 30 minutes.

3. Remove the probe from the water and shake off distilled water.

4. Immerse the probe to or beyond the vent holes in a disposable beaker containing Sodium Chloride Standard Solution, 1,000 mg/L. Agitate vertically to remove trapped air.

5. Repeat Steps 3 and 4 at least once more.

6. Press the Power key and CND key. Verify that the LO BAT indicator does not appear.

7. Press the 2 milliSiemens per centimeter (mS/cm) range key.

8. Check the reading on the display. It should be 1.990 mS/cm. If adjustment is needed, use a small screwdriver to adjust the CAL control next to the display. Counterclockwise adjustment increases the reading.

9. Record calibration information on Temperature/pH/Conductivity Meter Calibration and Maintenance Log (Exhibit 2).

IV. Operation Procedures - Temperature/Conductivity

1. Calibrate the conductivity meter.

2. Rinse probe in distilled water.

3. Fill a disposable beaker with water.

4. Turn meter to read temperature and record the temperature of the water twice.

5. Turn meter on to the 2 mS/cm scale.

6. Insert probe into sample beaker and obtain a reading. The meter will read between 0 and 20 mS/cm, in 0.001 increments.

7. Repeat Step 6.

8. Record results in the field notebook and the average will be the actual result.

9. Rinse probe off in distilled water.

VI. Maintenance Procedures

1. Replace batteries on a regular basis.

2. Store electrode in protective casing when not in use.

3. Keep records of operation, maintenance, calibration, and of any problems and repair.

4. After use, the meter will be inspected and the inspection recorded in the log book.

5. A replacement meter will be available on-site or ready for overnight shipment, if necessary.

6. Conductivity meter will be sent back to manufacturer for service when needed.

Attachment C-4

Dissolved Oxygen Meter Calibration, Operation,
and Maintenance Procedures

I. Introduction

Dissolved oxygen (DO) will be measured using a YSI Model 50 Series or equivalent meter which will be calibrated prior to each field event.

II. Calibration Procedure

The dissolved oxygen meter will be calibrated as follows:

1. Prepare the probe with a thin Teflon[R] membrane stretched over the sensor.

2. Perform a battery check.

3. Set mode switch to operate and the operation switch to zero, and zero the instrument.

4. Take a temperature measurement and determine the calibration value from the provided table for the appropriate atmospheric pressure.

5. Select the desired range and adjust the instrument to an appropriate calibration value (determined in Step 4).

6. Place the probe in a water sample with a known dissolved oxygen level and read mg/L-dissolved oxygen.

7. Record temperature and dissolved oxygen calibration information on the Dissolved Oxygen Meter Calibration and Maintenance Log (Exhibit 3).

III. Operation Procedure

1. Calibrate the dissolved oxygen meter.

2. Perform the battery check.

3. Fill a disposable beaker with water.

4. Set mode switch to operate and the operation switch to the desired range.

5. Place probe into water sample.

6. Take a temperature measurement and adjust temperature dial.

7. Switch to dissolved oxygen content measurement and allow reading to stabilize.

8. Record results in the field notebook.

9. Repeat procedure and record second reading. Average results and record.

10. Rinse the probe with distilled water.

IV. Maintenance Procedures

1. Replace batteries on a regular basis.

2. Store electrode in protective casing when not in use.

3. Keep records of operation, maintenance, calibration, and any problems and repair.

4. A replacement dissolved oxygen meter will be ready for overnight shipment, if necessary.

5. Dissolved oxygen meter will be sent back to manufacturer for service when needed.

6. Record maintenance information on the Dissolved Oxygen Meter Calibration and Maintenance Log (Exhibit 3).

Attachment C-5

Water Level Probe Calibration Procedures

I. Introduction

The water level probe cable will be checked once to a standard to assess if the meter has been correctly calibrated by the manufacturer.

II. Materials

- Water level probe and cable
- 6-foot engineer's rule

III. Procedures

1. Each water level probe will be calibrated prior to using.

2. To calibrate, the lengths between each increment markers on the cable will be measured with a six-foot engineer's rule. The cable will be checked for the first 150 feet.

3. If markers are incorrect, the probe will be sent back to the manufacturer.

4. Record verification on form (Exhibit 4).

Attachment C-6

Turbidity Meter Calibration, Operation, and Maintenance Procedures

I. Introduction

The turbidity meter, a Cole-Parmer Model 8391-35 or equivalent, will be calibrated daily prior to use.

II. Materials

- Portable turbidity meter
- 0.5, 5.0, 40 Formazin standard solutions

III. Calibration Procedures

The turbidity meter will be calibrated as follows:

Zero Adjust

1. With the instrument turned off, check the meter needle position. If the needle does not read zero, adjust the mechanical zero screw.

2. Turn on the instrument and allow to warm up for 5 minutes.

3. Insert the black body into the sample well.

4. Turn the set standard control fully clockwise.

5. Place the NTU range switch to the x 0.01 position.

6. Adjust the circuit board mounted potentiometer to read zero on the meter (an access hole is marked on the right hand side of the instrument).

   Note: An insulated, non-magnetized calibration screwdriver is required for both adjustments.

Calibrations of Secondary Standards

1. Make the Formazin standard or obtain a commercially available standard.

2. Set the NTU range switch to x 1 (0-100 NTU full scale).

3. Pour the 40 NTU Formazin or commercial standard into the chosen sample cuvette. Make certain that the sample cuvette is wiped clean of all dirt and finger prints. Insert the cuvette into the sample well and align properly. Cover with the light shield.

4. Use the SET STANDARD knob to adjust the meter needle to read exactly 40 NTU.

5. Remove the sample cuvette and insert the 40 NTU standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value on the calibration and maintenance log (Exhibit 5). This is the value that should now be used for the 40 NTU sealed standard.

6. Rinse the sample cuvette thoroughly and dry completely inside and out.

7. Fill the sample cuvette with the 5 NTU Formazin or commercial standard. Insert the sample cuvette into the test well. Align the cuvette properly and cover with the light shield.

8. Turn NTU RANGE knob to x 0.1 (0-10 NTU full scale). Use the SET STANDARD knob to adjust the meter needle to read exactly 50 (actually 5 NTU).

9. Remove the sample cuvette and insert the 5 NTU sealed standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value on the calibration and maintenance log (Exhibit 5). This is the value that should now be used for the 5 NTU sealed standard.

10. Rinse the sample cuvette thoroughly and dry completely inside and out.

11. Fill the sample cuvette with the 0.5 NTU Formazin or commercial standard. Insert the sample cuvette into the test well, align properly and cover with the light shield.

12. Turn NTU RANGE knob to x 0.01 (0-1 NTU full scale). Use the SET STANDARD knob to adjust the meter needle to read exactly 50 (actually 0.5 NTU).

13. Remove the sample cuvette and insert the 0.5 NTU sealed standard. Align the cuvette properly and cover with the light shield. Note the exact reading and record this value on the calibration and maintenance log (Exhibit 5). This is the value that should be used for the NTU sealed standard.

14. Record calibration information on the Turbidity Calibration and Maintenance Log (Exhibit 5).

IV. Operation Procedures

1. Calibrate turbidity meter.

2. All samples should be measured using the same sample cuvette. Samples are read by inserting the sample cuvette, properly aligned with the key, into the test well. Cover with the light shield and take the reading off of the correct scale on the meter. Make certain to take the range factor (x 1, x 0.1, or x 0.01) into account when calculating the actual NTU value of the sample.

V. Maintenance Procedures

1. Replace batteries on a regular basis.

2. Store instrument in protective carrying case when not in use.

3. Keep records of operation, maintenance, calibration, problems and repairs.

4. After use, the meter will be inspected and the inspection recorded in the field book.

5. A replacement meter will be available on-site or ready for overnight shipment, if necessary.

6. The turbidity meter will be sent back to the manufacturer for service when needed.

7. Record maintenance information on the Turbidity Calibration and Maintenance Log (Exhibit 5).

EXHIBIT 1

OVA DETECTOR CALIBRATION AND MAINTENANCE LOG

Instrument Model Number ______________________

Instrument Serial Number______________________

Calibration Gas______________________ppm

Date/Time	Initials	Battery Check	Calibration			
			Background Value	True Gas Value	Measured Gas Value	Adjust

COMMENTS:

EXHIBIT 2

TEMPERATURE/pH/CONDUCTIVITY METER CALIBRATION AND MAINTENANCE LOG

INSTRUMENT MANUFACTURER ____________________

INSTRUMENT MODEL ____________________

IDENTIFICATION NUMBER ____________________

DATE/TIME	INITIALS	TEMP.	STANDARD USED/EXP.		BATTERY CHECK	COMMENTS
			pH	CONDUCT		

EXHIBIT 3

DISSOLVED OXYGEN METER CALIBRATION AND MAINTENANCE LOG

INSTRUMENT MANUFACTURER ____________________

INSTRUMENT MODEL ____________________

IDENTIFICATION NUMBER ____________________

DATE/TIME	INITIALS	WATER TEMP.	ACTUAL D.O.	MEASURED D.O.	BATTERY CHECK	MEMBRANE CHECKED/ REPLACED	COMMENTS

EXHIBIT 4

WATER LEVEL PROBE MAINTENANCE LOG

Instrument Model Number ______________________________

Instrument Serial Number ______________________________

Date/Time	Initials	Battery Check	Sound Indicator Check	Light Indicator Check	Case	6-Foot Ruler	Comments

EXHIBIT 5

TURBIDITY METER CALIBRATION AND MAINTENANCE LOG

Instrument Manufacturer ______________________

Instrument Model ______________________

Identification Number ______________________

Date/Time	Initials	Calibration/Standard		Standard Reading (NTU)		
		Type	Concentration	40	5	0.5

ATTACHMENT D - SAMPLE PACKING, HANDLING, AND SHIPPING PROCEDURES

I. Handling

1. After collecting a sample, record the following information on the daily field log or in the field notebook, as appropriate:

   a. Project name and number;
   b. Sample number and depth;
   c. Sample method;
   d. Date;
   e. Name of sampler(s);
   f. Sample collection time (military);
   g. Location (project reference);
   h. Analyses to be completed;
   i. Preservative;
   j. Head space reading; and
   k. Any comments.

2. Fill in sample label (sample label in Exhibit 1) with:

   a. Project number and site name;
   b. Sample identification code and other sample identification information, if applicable;
   c. Date;
   d. Sample matrix (soil, sediment, surface water, ground water);
   e. Sample type (composite or grab);
   f. Time sampled (military);
   g. Analysis required;
   h. Initials of sampling personnel;
   i. Preservative added, if applicable; and
   j. Name, affiliation, and contact phone number.

3. Cover the label with clear packing tape to secure the label onto the container.

4. Check the caps on the sample containers to ensure that they are tightly sealed.

5. Mark the level of the sample in the container using an indelible ink marker or grease pencil (liquid samples only).

6. Wrap the sample container cap with clear packing tape to prevent it from becoming loose.

7. Initiate chain-of-custody by designated sampling personnel responsible for sample custody (Exhibit 2) (after sampling or prior to sample packing). Note: If the designated sampling person relinquishes the samples to other sampling or field personnel for packing or other purposes, the samplers will complete the chain-of-custody prior to this transfer. The appropriate personnel will sign and date the chain-of-custody form to document the sample custody transfer.

II. Packing

1. Using duct tape, secure the outside and inside of the drain plug at the bottom of the cooler that is used for sample transport.

2. Place each sample container or package in individual polyethylene bags (Ziploc®-type) and seal.

3. Place one to two inches of vermiculite at the bottom of the cooler as a cushioning material.

4. Package the sealed sample containers upright in the cooler.

5. Repackage ice (if required) in small Ziploc®-type plastic bags and place loosely in the cooler. Do not pack ice so tightly that it may prevent addition of sufficient cushioning material.

6. Fill the remaining space in the cooler with vermiculite.

7. Place the completed chain-of-custody forms (sample form in Exhibit 2) in a large Ziploc®-type bag and tape the forms to the inside of the cooler lid.

8. Close the lid of the cooler and fasten with duct tape.

9. Wrap strapping tape around both ends of the cooler at least twice.

10. Mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels on the top and on one side, and arrows indicating "This Side Up" (example labels in Exhibit 3) on two adjacent sides.

11. Place custody seal evidence tape (sample custody seal in Exhibit 4) over front right and back left of the cooler lid and cover with clear plastic tape.

III. Shipping

1. All samples will be hand delivered or delivered by an express carrier within 48 hours or less from the date of sample collection.

2. The following chain-of-custody procedures will apply to sample shipping:

   a. Relinquish the sample containers to the laboratory via express carrier. The signed and dated forms should be included in the cooler. The express carrier will not be required to sign the chain-of-custody forms. The sampler should retain the express carrier receipt or bill of lading.

   b. When the samples are received by the laboratory, the laboratory personnel shall complete the chain-of-custody forms by recording receipt of samples, measure and record the internal temperature of the shipping container, and then check the sample identification numbers on the containers to the chain-of-custody forms.

EXHIBIT 1

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists		PROJECT #	
SAMPLE I.D.			DATE
SAMPLE TYPE ☐ Soil/Sediment ☐ Water	COLLECTION MODE ☐ Composite ☐ Grab.		TIME
ANALYSIS			
SAMPLER(S)		PRESERVATIVE	

BLL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists
6723 Towpath Road, P.O. Box 66
Syracuse, New York 13214-0066
TEL: (315) 446-9120

EXHIBIT 2

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
SAMPLERS: *(Signature)*	

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	Number of Containers							REMARKS

Relinquished by: *(Signature)*	DATE	TIME	Received by: *(Signature)*	Relinquished by: *(Signature)*	DATE	TIME	Relinquished by: *(Signature)*
Relinquished by: *(Signature)*	DATE	TIME	Received by: *(Signature)*	Relinquished by: *(Signature)*	DATE	TIME	Relinquished by: *(Signature)*
Relinquished by: *(Signature)*	DATE	TIME	Received for Laboratory by: *(Signature)*	DATE	TIME	Remarks:	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

10/23/95
5951188L.CDR

EXHIBIT 3

EXHIBIT 4

CUSTODY SEAL	BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists 6723 Towpath Road, Box 66, Syracuse, N.Y. 13214-0066 TEL (315) 446-9120	SEALED BY ____________________ DATE______TIME ______

ATTACHMENT E - POST-EXCAVATION VERIFICATION SOIL/SEDIMENT SAMPLING PROCEDURES

I. Introduction

This attachment presents protocols by which post-excavation verification soil/sediment samples will be collected and composited at the site.

II. Equipment

- Stainless steel bucket auger
- Flame Ionization Detector (FID)
- Camera

III. Materials

- Health and safety equipment (as required by the Health and Safety Plan);
- Cleaning equipment;
- Dedicated aluminum or stainless steel tray;
- Dedicated stainless steel scoops;
- 200-foot tape measure;
- Appropriate sample containers and forms;
- Coolers with ice;
- Field book.

IV. Procedure

The following procedures will be employed to collect post-excavation verification soil/sediment samples:

1. Don personal protective equipment (as required by the Health and Safety Plan).

2. Identify sample locations from sample location plan and note locations in field notebook. Provided the safety procedures for excavation entry and employee protective systems consistent with 29 CFR 1926 Subpart P are followed, sampling personnel may enter the excavation and collect soil/sediment subsamples by carefully cutting into the soil with a dedicated stainless steel scoop. If entry into the excavation cannot be performed consistent with the safety procedures in 29CFR 1926 Subpart P, a decontaminated stainless steel bucket auger will be used to collect soil/sediment subsamples remotely from outside the excavation.

3. Transfer the subsamples to a dedicated stainless steel or aluminum tray. Obtain one soil/sediment sample and place it into an 8 ounce glass jar and screen the headspace with an FID. Record FID reading in field book. Visually characterize the soil for presence of stains and classify according to ASTM soil classification procedures.

4. Obtain one discrete sample that will be submitted for laboratory analysis. Place the sample into the appropriate widemouth glass jar with teflon-lined cap.

5. Label sample container and cap in accordance with procedures in Section 3.0 and Attachment D.

6. Place sample container in a transportation cooler.

7. Discard gloves and stainless steel scoop in designated location. The portion of the soil sample used for FID headspace screening and visual characterization shall be placed in a container for transfer to the on-site lined containment cell.

8. Handle, pack, and ship the samples with appropriate chain-of-custody procedures in accordance with Section 4.0 and Attachment D.

9. Record all other appropriate information in the field log book.

V. Disposal Methods

Materials generated during the above activities will be disposed of as described in Section 4.4.

ATTACHMENT F - SOIL BORING AND SAMPLING PROCEDURES

I. Introduction

All soil borings performed shall be completed with a truck- or track-mounted drill rig using the hollow-stem auger drilling method to a depth specified by the supervising geologist. Prior to commencing drilling activities, the locations will be cleared for underground utilities by contacting the Underground Facility Protection Organization (UFPO) to have appropriate utilities representatives mark the location of underground lines. Private utilities will be delineated by facilities personnel using appropriate devices and/or by a private utility locating contractor (if necessary). This contractor will survey the project area to determine the presence of known, as well as unknown, utilities/underground piping at the project area, especially in those areas where drilling is proposed.

During the completion of the soil borings, a sheet of plywood or a basin will be placed next to (or around) the auger to minimize the contact of subsurface soil cuttings with the ground surface.

II. Equipment and Materials

In addition to the drill rig and associated drilling equipment, the following equipment and materials (as required) will be available during the soil boring and sampling activities:

- Flame ionization detector (FID) - OVA or equivalent
- Appropriate health and safety equipment
- Plastic sheeting for each location
- 6-foot rule with gradation in hundredths of a foot
- Appropriate soil sample containers and trip blank sample
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials
- Subsurface logs
- Chain-of-Custody forms
- Indelible ink pens
- Site map with soil boring locations

III. Soil Sampling

Samples of the encountered subsurface material will be collected continuously using standard 2-inch diameter, 2-foot split spoons driven by a 140-lb. hammer, unless otherwise specified. The sampling method employed will be ASTM D-1586/Split-Barrel Sampling (Standard Method for Penetration Test and Split-Barrel Sampling of Soils, ASTM D 1586-84) published in Annual Book of ASTM Standards, Volume 04.08. Upon retrieval of the split-barrel sampler, representative portions of each soil sample will be placed in the appropriate laboratory containers and a 1-pint container for visual observations and headspace screening. This container will be labeled with: 1) site; 2) boring number; 3) sample interval; 4) date; and 5) initials of sampling personnel. All split-barrel samples will be screened for organic vapors with an FID, using the procedures described in Section IV below. In addition, a supervising geologist will be on site during the drilling operations to fully describe each soil sample including the following:

- Soil type and sorting;
- Color;
- Moisture content;
- Organic content;
- Texture;
- Grain size and shape;
- Relative density
- Consistency;
- Plasticity of fines;
- Cohesiveness;
- Odors/discoloration;

- Mottling staining:
- Weathering:
- Visible evidence of fill material: and
- Feet of recovery.

The descriptions will be recorded in a dedicated field notebook. The supervising geologist will be responsible for documenting drilling events in the field log book. A documentation of drilling events will include:

1) Start and finish dates of drilling;
2) Name and location of project;
3) Project number, client, and project location;
4) Sample number and depth;
5) Type and size of samples;
6) Depth to water;
7) Type of drilling equipment;
8) Size of casing;
9) Names of contractor's drillers, inspectors, or people at the project area; and
10) Weather conditions.

The Drilling Contractor will be responsible for obtaining accurate and representative samples, informing the supervising geologist of changes in drilling pressure and loss of circulation, and keeping a separate general log of soils encountered, including blow counts (i.e., the number of blows from a soil sampling drive weight [140 pounds] required to drive the split-barrel sampler in 6-inch increments).

Soils generated during drilling of the test borings will be containerized and disposed of as described in Section 4.4.

IV. Field Screening Procedures

All soil samples will be field screened upon collection with the FID for a relative measure of the total volatile concentration. In addition, field screening will be conducted on the headspace of soil samples with a FID. A representative portion of the sample will be obtained to fill approximately one half of a 1-pint container. The top of the container will be covered with aluminum foil. These samples will be screened as follows:

1. The headspace of the sample will be measured directly from the sample container with the FID;
2. The FID probe will be inserted through the aluminum foil covering the 1-pint container; and
3. The readings will be recorded in the field note book.

The FID meter will be calibrated daily or more frequently if field conditions warrant.

V. Procedures for Collecting Soil Samples for Laboratory Analysis (If Required)

Samples designated for laboratory analysis will be placed in the appropriate containers. Sample containers for volatile organic analysis will be filled first. Next, a sufficient amount of the remaining soil will be homogenized by mixing in a stainless steel bowl with a clean stainless steel trowel, and distributed to the appropriate sample containers.

VI. Survey

A field survey control program will be conducted using standard instrument survey techniques to document soil boring and rock coring locations to the State Plane Coordinate System of 1927 (or other appropriate reference) and the ground elevation to the National Geodetic Vertical Datum (NGVD) of 1929.

VII. Equipment Cleaning

Equipment cleaning will occur prior to use on the site, between each drilling location, and upon completion of the drilling prior to leaving the site. All drilling equipment and associated tools including augers, drill rods, core barrels, sampling equipment, wrenches, and any other equipment or tools that may have come in contact with the soil will be cleaned with high-pressure steam cleaning equipment using a tap water source or manual scrubbing. The drilling equipment will be cleaned in an area designated by the supervising geologist. Cleaning water and residual materials will be collected and transferred to a central location for subsequent disposal. Equipment cleaning procedures are described in Attachment B.

ATTACHMENT G - MONITORING WELL INSTALLATION AND DEVELOPMENT PROCEDURES

I. Introduction

Prior to commencing work, all underground utilities will be located by UFPO, by field personnel with appropriate devices, and/or by a private contractor specializing in this type of work. Soil boring procedures set forth in Attachment F will be implemented prior to well installation.

II. Procedures - Monitoring Wells in Overburden

Overburden monitoring wells will be installed by placing the screen and casing assembly with bottom cap into the auger string once the screen interval has been selected. At that time, a washed silica sand pack will be placed in the annular space opposite the screen to 1 to 2 feet above the top of the screen. A graded filter sand pack will be used that is appropriate to the size of the screened soil interval. Hydrated bentonite will then be added to the annulus between the casing and the borehole wall for at least 2 feet. A cement/bentonite grout will then be added above the bentonite during the extraction of the augers to ground surface. During placement of sand and bentonite, frequent measurements will be made to check the height of the sand pack and thickness of bentonite by a weighted tape measure.

Monitoring wells will be constructed of 2-inch PVC well screen and riser. Slot size will be 0.010-inch. The well screen of a shallow overburden well will span the uppermost 10 feet of saturated overburden. A vented protective steel casing shall be located over the riser casing extending at least 1.5 feet below grade and 2 feet to 3 feet above grade secured by a neat Portland Cement seal. The cement seal shall extend approximately 1.5 feet below grade and laterally at least 1 foot in all directions from the protective casing and shall slope gently away to drain water away from the well. A vented slip-on steel cap will be fitted on and around the protective casing. Monitoring wells will be labeled with the appropriate designation both on the inner and outer well casings. A typical overburden monitoring well detail is shown on Exhibit 1.

The supervising geologist shall specify the monitoring well designs to the drilling contractor before installation. The supervising geologist is responsible for recording the exact construction details as relayed by the drilling contractor and actual measurements. Both the supervising geologist and drilling contractor are responsible for tabulating all materials used such as footage of casing and screen or bags of bentonite, cement, and sand.

III. Development

All monitoring wells will be developed or cleared of fine grain materials that may have settled in or around the screen during installation. Development will be accomplished by surging and evacuating water by slow pumping. The well will be developed until turbidity is reduced to 50 nephelometric turbidity units (NTUs) or less. In the event that the wells cannot be developed to 50 NTUs, development will proceed until the water evacuated from the well is reasonably free of visible sediment.

A. Materials for well development include:

- Appropriate Health and Safety Equipment;
- Appropriate Cleaning Equipment;
- Bottom Loading Bailer;
- Polypropylene Rope;
- Plastic Sheeting;
- pH, conductivity, and temperature meters;
- Nephelometric Turbidity Meter;
- Graduated Buckets;

- Disposable gloves;
- Pump/tubing/foot valve/surge block; and
- Generator.

B. The procedure for developing a well using the pumping method is outlined below:

When developing a well using the pumping method, new cleaned polypropylene tubing equipped with a foot valve and surge block will be extended to the screened portion of the well. The diameter of the surge block will be within 0.5 inches of the well diameter. The tubing will be connected to a hydrolift-type pumping system that allows up and down movement of the surge block. The tubing will also be manually lifted and lowered within the screened interval. The pumping rate will be about two times the anticipated well purging rate. Surging will be repeated as many times as necessary within the well screen interval until the ground water is relatively clear. Any tubing will be disposed of between wells; clean, new tubing will be used at each well.

Detailed procedures for ground-water well development will be as follows:

1. Don appropriate safety equipment.

2. All equipment entering each monitoring well will be cleaned as specified in Attachment B.

3. Attach appropriate pump and lower tubing into well.

4. Turn on pump. If well runs dry then shut off pump and allow to recover.

5. Surging by raising and lowering the tubing in the well will be performed several times to pull in fine grained materials.

6. Steps 4 and 5 will be repeated until ground water is relatively silt free.

7. The developing equipment will be raised 2 feet and then Step 4 through Step 5 will be repeated.

8. Step 6 will be repeated until entire well screen has been developed.

IV. Survey

A field survey control program will be conducted using standard instrument survey techniques to document the well location to the State Plane Coordinate System of 1927 (or other appropriate reference) and the ground, inner casing, and outer casing elevations to the National Geodetic Vertical Datum (NGVD) of 1929.

V. Equipment Cleaning

Drilling equipment will be cleaned using high-pressure steam cleaning equipment using a tap water source. Drilling equipment will be cleaned prior to use on the site, between each monitoring well location, and at the completion of the drilling prior to leaving the site as discussed in Attachment B.

Exhibit 1

Typical Overburden Monitoring Well

EXHIBIT 1

SHEET ____ OF ____

SUBSURFACE FIELD LOG
MONITORING WELL CONSTRUCTION DETAILS

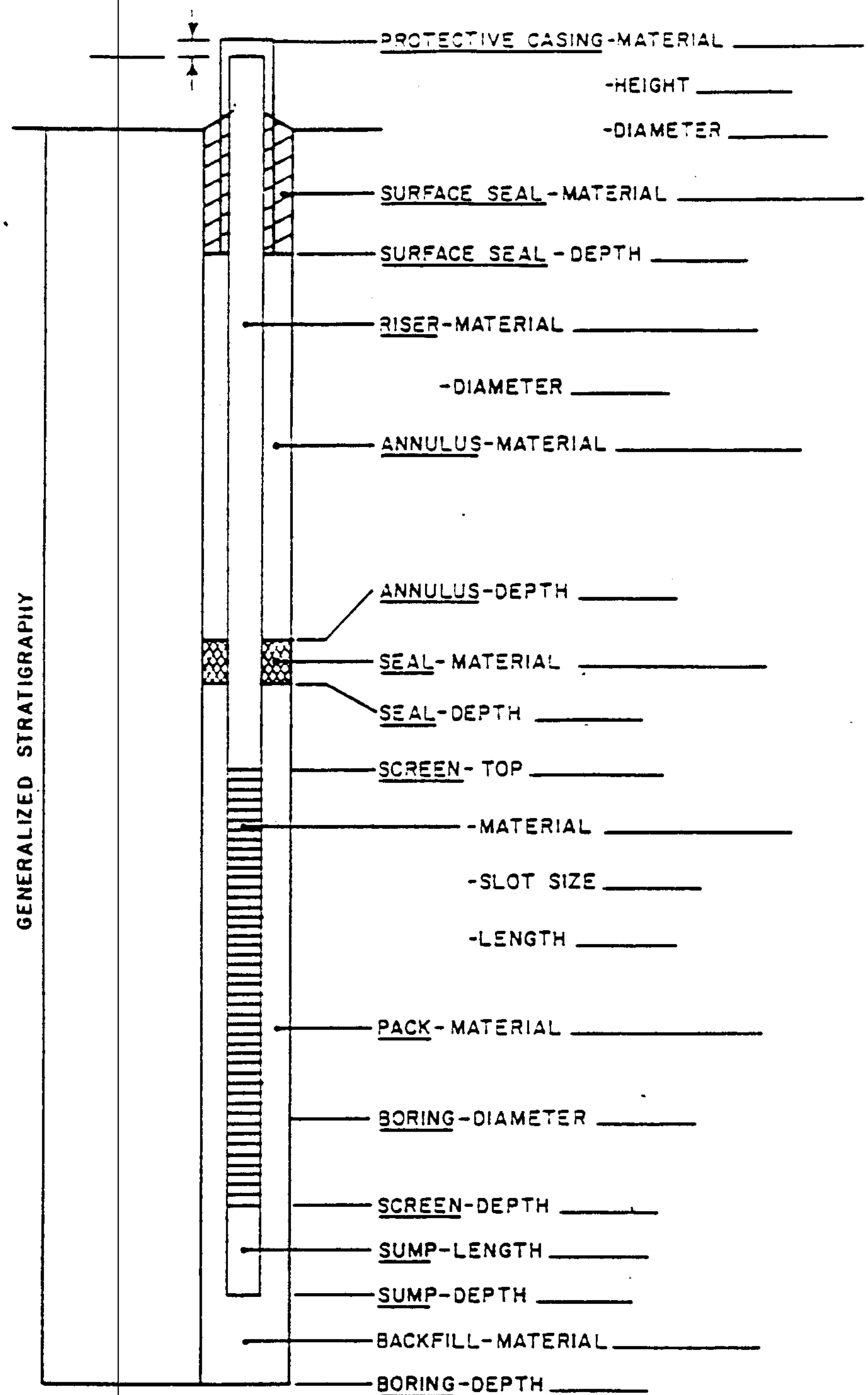
MONITORING WELL ________

PROJECT: ________

PROJECT NO.: ________

BY: ________

DATE: ________



WATER LEVEL UPON COMPLETION ________

DRILLER ________

METHOD ________

RIG TYPE ________

SAMPLING METHOD ________

DEVELOPMENT DATE ________

DEVELOPMENT METHOD ________

BBL

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engineers & scientists

50663

ATTACHMENT H - WATER LEVEL MEASUREMENT AND GROUND-WATER SAMPLING PROCEDURES

I. <u>Introduction</u>

This protocol describes the procedures to be used to collect ground-water samples. The proposed new well will not be sampled until well development has been performed. During precipitation events, ground-water sampling will be discontinued until precipitation ceases. When a round of water levels is taken for the purpose of generating water elevation data, the water levels will be taken consecutively at one time prior to sampling or other activities.

II. <u>Materials</u>

The following materials, as required, shall be available during ground-water sampling:

- Sample pump;
- Sample tubing;
- Power source (i.e. generator)
- Flame ionization detector (FID);
- Appropriate health and safety equipment as specified in the Health and Safety Plan;
- Plastic sheeting (for each sampling location);
- Dedicated or disposable bailers;
- Polypropylene rope;
- Buckets to measure purge water;
- Water level probe;
- 6' rule with gradation in hundredths of a foot;
- Conductivity/temperature meter;
- pH meter;
- Turbidity meter;
- DO meter;
- ORP meter;
- Appropriate water sample containers;
- Appropriate blanks (trip blank supplied by the laboratory);
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials;
- Ground-water sampling logs;
- Chain-of-Custody forms;
- Indelible ink pens;
- Site map with well locations and ground-water contours maps;
- Peristaltic pump and dedicated tubing; and
- Keys to wells.

III. <u>Procedures</u>

A. The procedures to sample monitoring wells will be as follows:

1. Review materials check list (Part II) to ensure the appropriate equipment has been acquired.

2. Identify site and well sampled on sampling log sheets, along with date, arrival time, and weather conditions. Identify the personnel and equipment utilized and other pertinent data requested on the logs (Exhibit 1).

3. Label the sample containers as described in Section 3.0 and Attachment D. Cover the sample label with clear packaging tape to secure the label to the container.

4. Don safety equipment, as required in the Health and Safety Plan.

5. Place plastic sheeting adjacent to well to use as a clean work area.

6. Establish the background reading with the FID and record the reading on the field log (Exhibit 1).

7. Remove lock from well and if rusted or broken replace with a new brass keyed-alike lock.

8. Unlock and open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting. Insert FID probe in the breathing zone above the well casing following instructions in the Health and Safety Plan.

9. Set out on plastic sheeting the dedicated or disposable sampling device and meters.

10. Prior to sampling, ground-water elevations will be measured at each monitoring well and the presence of light non-aqueous phase liquid (if any) within the well will be evaluated. Obtain a water level depth and bottom of well depth using an electric well probe and record on sampling log sheet (Exhibit 2). Clean the well probe before and after each use with a soapy (Alconox) water wash and a tap water rinse. [Note: water levels may be measured at all wells prior to initiating any sampling activities].

11. Provided that no light non-aqueous phase liquid is present at the well, three well volumes will be purged.

12. Pump, safety cable, tubing, and electrical lines will be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well, or at a location determined to either be a preferential flow path, or zone where contamination is present. The pump intake must be kept at least two feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well.

13. Measure the water level again with the pump in well before starting the pump. Start pumping the well at 200 to 500 milliliters per minute. Ideally, the pump rate should cause little or no water level drawdown in the well (less than 0.3 feet and the water level should stabilize). The water level should be monitored every three to five minutes (or as appropriate) during pumping. Care should be taken not to cause pump suction to be broken or entrainment of air in the sample. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the recharge rate of the well is very low, purging should be interrupted so as not to cause the drawdown within the well to advance below the pump. However, a steady flow rate should be maintained to the extent practicable. Sampling should commence as soon as the volume in the well has recovered sufficiently to permit collection of samples.

14. During purging of the well, monitor the field indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every three to five minutes (or as appropriate). The well is considered stabilized and ready for sample collection once all the field indicator parameter values remain within 10% for three consecutive readings. If the parameters have stabilized, but the turbidity is not in the range of the 50 NTU goal, the pump flow rate should be decreased to no more than 100 ml/min. Measurement of the indicator parameters should continue every three to five minutes. Measurements

for DO and ORP must be obtained using a flow through cell. Other parameters may be taken in a clean container such as a glass beaker.

15. After the appropriate purge volume of ground water in the well has been removed obtain the ground water sample needed for analysis directly from the sampling device in the appropriate container and tightly screw on the caps.

16. Secure with packing material and store at 4°C on wet ice in an insulated transport container provided by the laboratory.

17. After all sampling containers have been filled, remove an additional volume of ground water. Check the calibration of the meters and then measure and record on the field log physical appearance, pH, ORP, DO, temperature, turbidity, and conductivity.

18. If using a dedicated bailer, replace dedicated bailer in the well and replace the well cap and lock well.

19. Record the time sampling procedures were completed on the field logs.

20. Place all disposable sampling materials (plastic sheeting, disposable bailers, and health and safety equipment) in appropriately labeled containers. Go to next well and repeat Step 1 through Step 20 until all wells are sampled.

21. Complete the procedures for packaging, shipping, and handling with associated chain-of-custody.

EXHIBIT 1

GROUND-WATER SAMPLING FIELD LOG

Project ______________________________
Sampling Purpose ______________________
Well No. _____________________________
Key No. ______________________________
HNu Background _____ Well __________

Project No. ___________________________
Site Name ____________________________
Sampling Personnel ____________________
Date/Time ___ In ___ Out ____________
Weather ______________________________

I. Well Information

Reference Point Marked
on Casing Y N
Well Diameter ____ ID ____ OD
Well depth _______ from RP
Water table depth _____ from RP
Slug test Y N

Length of Inner Casing
____ above grade
Length of Outer Casing
____ above grade
Redevelop Y N

II. Well Water Information

Length of water column ______________________
Volume of water in well ______________________
Volume of bailer ____________________________

III. Evacuation Information

Volume of water removed
from well __________
Did well go dry? Y N

Evacuation method
Bailer ( )
Evacuation rate ____________________

IV. Well Sampling

Container	Preservative	Time Sampled	Lab Sample No.	Analysis

V. Ground-Water Characteristics/After Well Evacuation

Temperature _____
Conductivity _____
pH _____
ORP _____

DO _____
Film _____

VI. Miscellaneous Observations/Problems

VII. Sample Destination

Laboratory Via _______ By ________

____
Field Personnel

4/6/98
11597842.ATT

EXHIBIT 2

WATER LEVEL RECORD

Site ______________________ Job Title ______________________

Date ______________________ Job No. ______________________

Sheet _____ of _______

Well No.	Stickup	Well Depth	Water Depth	Water Elev.	Time	Comments	By

Appendices

Appendix 1

Standard Operating Procedures for ENSYS PCB Field Test Kits

ENSYS INC.
ENVIRONMENTAL PRODUCTS

PCB RISc®
SOIL TEST SYSTEM

RAPID IMMUNOASSAY SCREEN

User's Guide

IMPORTANT NOTICE

This method correctly identifies 95% of samples that are PCB-free and those containing 1 ppm or greater of PCBs. A sample that develops less color than the standard is interpreted as positive. It contains PCBs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of polychlorinated biphenyls. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

TROUBLESHOOTER GUIDE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WASH STEP

Lack of vigorous washing may result in false positives or negatives depending on whether the wash error was committed on standard or sample tubes. Solution: Make sure to wash four times vigorously, washing the whole set of 12 tubes at once.

PIPET CALIBRATION

An out-of-calibration pipet may result in false positives or negatives depending on whether the amount is greater or less than the specified transfer volume. *Solution:* Check the calibration at least daily and after any extreme mechanical shock (such as dropping). An indication that the pipet is out of calibration is if the gold barrell is loose and will turn. (When set on 30 µl there should be about a 1/4 of an inch between the white plunger and the end of the clear pipet tip.)

AIR BUBBLES IN THE PIPET

The presence of air bubbles in the pipet tip when transferring extracts may result in false positives or negatives depending on whether the error was committed on standard or sample tubes. *Solution:* Quickly examine the pipet tip each time an aliquot is withdrawn and go back to the source and take another aliquot to displace the bubble if necessary.

MIXING

Lack of thorough mixing, when instructed, can cause inconsistent results. *Solution:* Observe the times in the instructions and mix with sufficient force to ensure that the liquid is homogenous.

TIMING

It is important to follow the timing steps in the instructions carefully. The incubation step in the antibody tubes can vary a bit without harm to the tests. The color development step timing is critical and should be no less than 2 minutes and no greater than 3 minutes.

WIPING THE TUBES

Wiping of the tubes should be done before they are read in the spectrophotometer because smudges and fingerprints on the tubes can give potentially false negative readings.

MIXING LOT #'S

Never mix lots! Each kit's components are matched for optimal performance and may give inaccurate results with the components from other kits with different lot #'s. Also, NEVER mix components from different types of kits (ex: Petro kit buffer can not be used with a PAH kit).

STORAGE AND OPERATING TEMPERATURES

Temperature requirements are very important and should be strictly adhered to. This test kit should be stored at less than 80°F/27°C and operated between 40°F/4°C and 90°F/32°C.

SHELF-LIFE

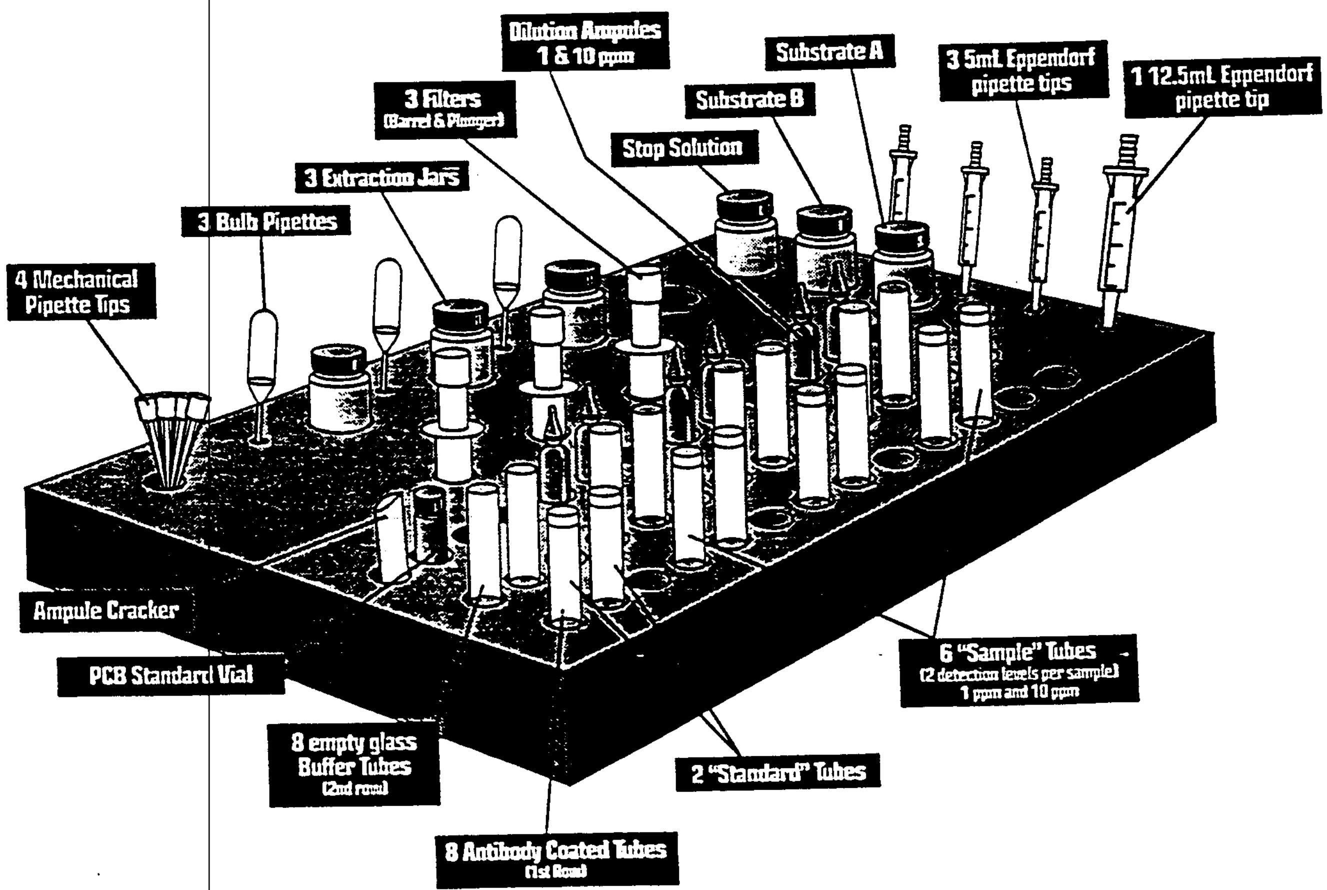
Each kit label contains the kit expiration date. To achieve accurate results, kits must be used prior to expiration.

WORKSTATION SET-UP

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WORKSTATION SET-UP

- Mechanical pipet tips
- Filter barrels & plungers
- Ampule cracker
- Glass PCB buffer tubes
- Substrate A
- Eppendorf pipet tips
- Bulb pipets
- PCB standard
- Antibody coated tubes
- Substrate B
- Extraction jars
- 1 & 10 ppm dilution ampules
- Stop Solution



Workstation shows components for 3 samples tested at 2 levels

TEST PREPARATION

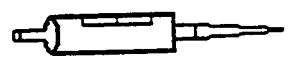
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Do not attempt to run more than 12 tubes, two of which must be standards.
- Items that you will need that are not provided in the test kit include: a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, and disposable gloves.
- This User's Guide was written for analyzing soil samples for PCBs at 1 and 10 ppm. See table on page 10 for sensitivity to various aroclors.

TEST PREPARATION

- Label all Eppendorf repeater tips. Tips can be reused for future analyses. Label the first 5mL tip "A", the second 5mL tip "B" and the third 5mL tip "Stop".

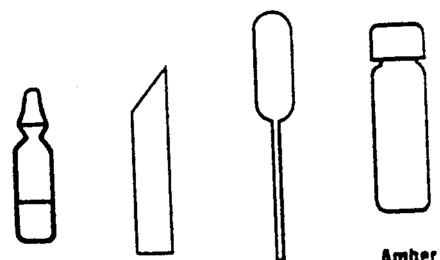


Eppendorf Tip

- Label the 12.5 mL tip "Buffer".

STANDARD PREPARATION

- Open PCB Standard ampule by slipping ampule cracker over top, and then breaking tip at scored neck. Transfer solution to empty vial with Bulb Pipets.



PCB Standard | Ampule cracker | Bulb pipet | Amber vial

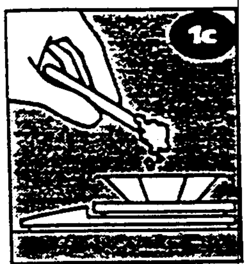
- Label vial with current date. Standard is usable for 2 weeks. Always cap tightly when finished using standard.
- A new PCB Standard should be opened for every 4 samples.

PHASE 1

EXTRACTION & PREPARATION OF THE SAMPLE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WEIGH SAMPLE

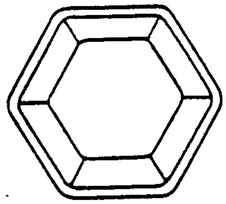


1a. Place unused weigh boat on pan balance.

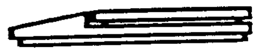
1b. Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

1c. Weigh out 10 ± 0.1 grams of soil.

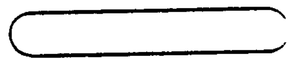
1d. If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.



Weigh Boat



Pan balance



Wooden spatula

EXTRACT PCBS

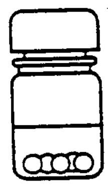
2a. Uncap extraction jar and place on a flat surface. Without contacting solvent puncture foil seal with ampule cracker or sharp object. Peel the remainder of the seal off extraction jar.

2b. Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

2c. Recap extraction jar tightly and shake vigorously for one minute.

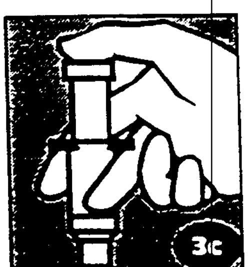
2d. Allow to settle for one minute.

Repeat steps **1a - 2c** for each sample to be tested.



Extraction Jar

FILTER SAMPLE

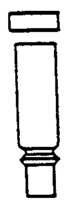


3a. Disassemble filtration plunger from filtration barrel.

3b. Insert bulb pipet into top (liquid) layer in extraction jar and draw up sample. Transfer at least ½ bulb capacity into filtration barrel. **Do not use more than one full bulb.**

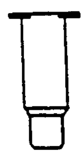
3c. Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).

Repeat steps **3a - 3c** for each sample to be tested.



Filtration plunger

Bulb pipet



Filtration barrel

READ TO AVOID COSTLY MISTAKES

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SAMPLE DILUTION PROGRAM

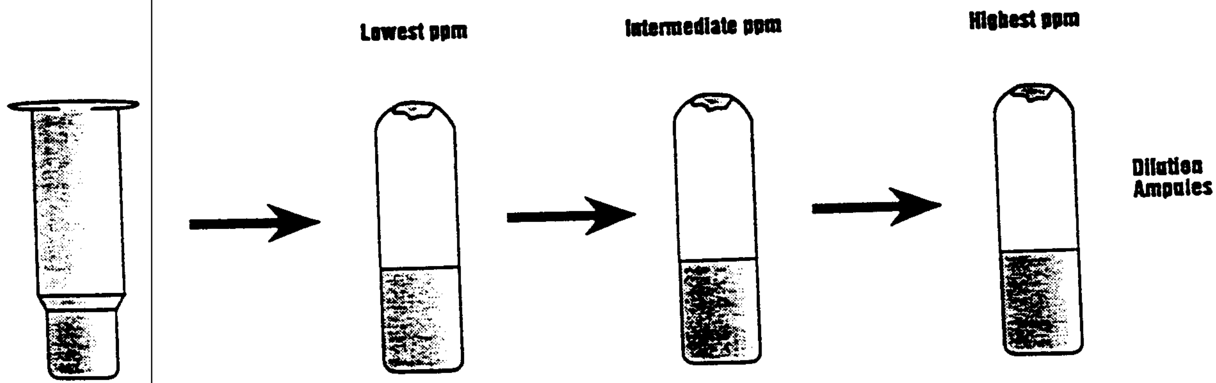
1. The sample dilution procedure on the next page is for standard detection levels. The following diagram represents the sample dilution procedure for all other detection levels.

2. Your kit may include extra dilution ampules to reach high detection levels.

3. EVERY AMPULE PROVIDED MUST BE USED!

If there are any questions concerning the dilution procedure please call Technical Services before running the samples to help avoid costly mistakes.
1-800-242-7472 or 919-941-5509.

EXAMPLE:



NOTE: Your Kit may include additional ampules in order to achieve your test levels. Always transfer filtered sample to the dilution ampule labeled with the lowest PPM level and then transfer from this ampule to the next higher level dilution tube.

PHASE 2

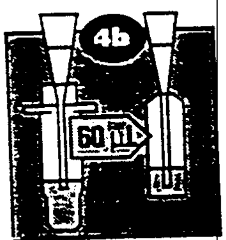
SAMPLE & STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

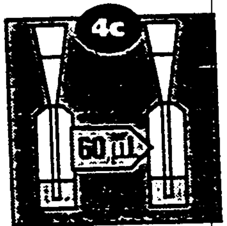
READ BEFORE PROCEEDING

- Label the plastic antibody coated tubes with a permament marking pen.
- When using the mechanical pipet always withdraw and dispense below the liquid level.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

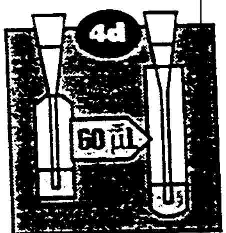
DILUTE SAMPLES AND STANDARDS

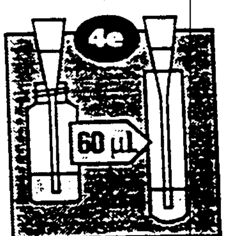


1 ppm



1 ppm 10 ppm





PCB Standard

4a. Set the Eppendorf Repeater on 4, assemble the "Buffer" tip and fill with Buffer.

4b. Dispense 1 mL of Buffer into each glass buffer tube.

4c. Open 1 and 10 ppm dilution ampules by slipping ampule cracker over top, and then breaking top at scored neck.

4d. Withdraw 60 µL of filtered sample using mechanical pipet and dispense below the liquid level in "1 ppm" dilution ampule. Gently shake ampule from side to side for 5 seconds to mix thoroughly.

4e. Withdraw 60 µL from the "1 ppm" dilution ampule using mechanical pipet and dispense below the liquid level in "10 ppm" dilution ampule. Gently shake ampule from side to side for 5 seconds to mix thoroughly.

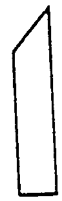
4f. Transfer 60 µL from each dilution ampule into glass buffer tubes. Always wipe tip after dispensing into buffer tube.

4g. Change pipet tip and repeat **4d** - **4f** for each sample.

4h. Assemble new pipet tip on mechanical pipet and transfer 60 µL from Standard vial into two glass buffer tubes. Immediately replace cap on PCB Standard vial.

4i. Shake all glass buffer tubes for 5 seconds.

Dilution ampules

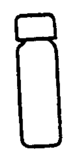


Ampule cracker

Mechanical pipet

Mechanical pipet tip

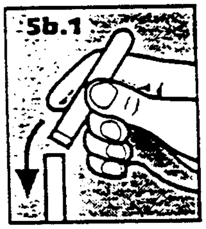
Glass buffer tubes

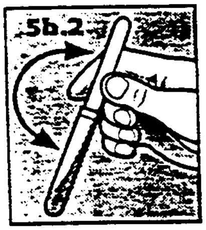


PCB Standard vial

PHASE 3
THE IMMUNOASSAY
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

TRANSFER FROM DILUTION TUBE TO ANTIBODY COATED TUBE





5a. Set timer for 10 minutes.

5b. Working left to right in the workstation:

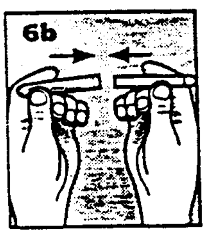
1. Fit all antibody coated tubes firmly on top of all corresponding glass buffer tubes.
2. Start timer and immediately invert all connected tube pairs so that the liquid is poured into the antibody coated tubes. Return the tube pairs to the appropriate workstation row making sure the larger (antibody coated) tube is on the bottom.

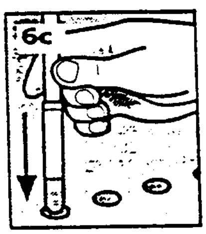
5c. Invert all tube pairs several more times making sure the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

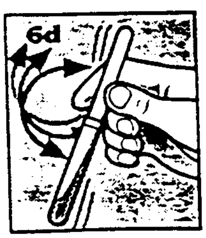
5d. Disconnect and discard the smaller (dilution) tubes. It is not important to worry about drops of liquid adhering to lips of tubes.

5e. Place conjugate tubes behind antibody tubes in workstation. Remove grey caps and discard.

TRANSFER OF CONJUGATE TO ANTIBODY COATED TUBES







AFTER 10 MINUTES, IMMEDIATELY:

6a. Set timer for 5 minutes.

6b. Working left to right in the workstation:
Start timer and immediately:
Dissolve the conjugate pellets by horizontally connecting the antibody coated tubes and conjugate tubes and **tilt the liquid up to pour it onto the conjugate.**

6c. Return the connected tubes to the appropriate workstation row making sure **the larger (antibody coated) tube is on the bottom. It is important that this step is completed within one minute for all tubes.**

6d. In order to adequately mix solution, **invert** all connected tube pairs **several more times** making sure that the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

6e. Disconnect and discard the conjugate tubes. It is not important to worry about the loss of liquid adhering to lip of tubes.

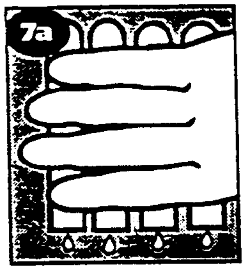
PHASE 4
INTERPRETATION

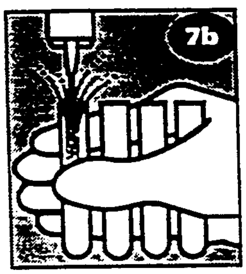
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING
WASH PROCEDURE

- An accurate test requires a virgorous wash accomplished by directing a strong stream into the antibody coated tubes.
- The wash solution is a harmless, dilute solution of detergent.

WASH



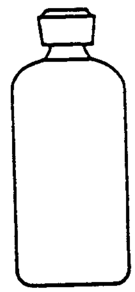


7a. After the 5 minute incubation (a total of 15 minutes), empty antibody coated tubes into liquid waste container.

7b. Wash antibody coated tubes by vigorously filling and emptying a total of 4 times.

7c. Tap antibody coated tubes upside down on paper towels to remove excess liquid. Residual foam in the tubes will not interfere with test results.

Note: When running up to 12 antibody coated tubes, tubes can be washed in two groups - one group immediately following the other group.



Wash bottle

PHASE 3

THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

COLOR DEVELOPMENT

8a. Set the Eppendorf Repeater on 2, assemble the "A" tip and fill with Substrate A (TMB, yellow label).

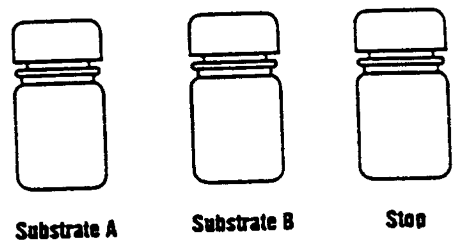
8b. Dispense once (200 µL) into each antibody coated tube.

8c. Set timer for exactly 2 1/2 minutes.

8d. Assemble "B" tip, fill with Substrate B, start timer, and dispense once (200 µL H_2O_2, green label) into each antibody coated tube.

8e. Shake all tubes for 5 seconds. Solution will turn blue in some or all antibody coated tubes.

8f. Assemble "Stop" tip, fill with Stop Solution (red label), and stop reaction at end of 2 1/2 minutes by dispensing once (200 µL) into each antibody coated tube.



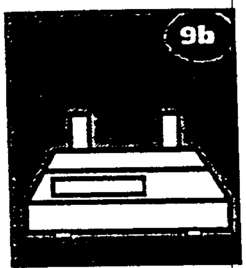
AROCLOR SENSITIVITY

Aroclor	Lowest Detection Level
1248	1.0 ppm
1254	0.5 ppm
1260	0.5 ppm
1242	2.0 ppm
1232	4.0 ppm
1016	4.0 ppm

PHASE 4
ANALYSIS OF RESULTS

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SELECT STANDARD



9a. Wipe outside of all antibody coated tubes.

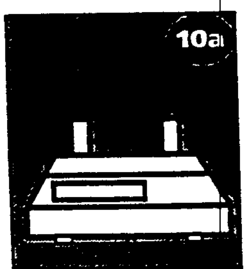
9b. Place both Standard tubes in photometer.

9c. Switch tubes until the photometer reading is negative or zero. Record reading.

If reading is greater than - 0.3 in magnitude, results are outside QC limits. Retest the sample(s).

9d. Remove and discard tube in right well. The tube in the left well is the conservative standard.

MEASURE SAMPLE



10a. Place 1 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 1 ppm.

10b. Place 10 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 10 ppm.

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

System Description

Each PCB RISc Soil 12 Test Case contains enough material to perform 12 test samples, each at two detection levels.

The PCB RISc Soil Test is divided into four phases. The instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free: 1-800-242-RISC (7472).

Validation and Warranty Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

PCB-free soil and soil containing 1 ppm or greater of PCBs were tested with the EnSys PCB RISc analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains PCBs. A sample that has developed more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

The company does not guarantee that the results with the PCB RISc Soil 24 Test Case will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

EnSys, Inc. warrants that this product conforms to the descriptions contained herein. No other warranties, whether expressed or implied, including warranties of merchantability and of fitness for a particular purpose shall apply to this product.

EnSys, Inc. neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than such as is expressly set forth herein.

Under no circumstances shall EnSys, Inc. be liable for incidental or consequential damages resulting from the use or handling of this product.

How It Works

Standards, Samples, and color-change reagents are added to test tubes, coated with a chemical specific to PCBs. The concentration of PCBs in an unknown **Sample** is determined by comparing its color intensity with that of a **Standard.**

Note: PCB concentration is inversely proportional to color intensity; the lighter the color development of the sample, the higher the concentration of PCBs.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.
- Do not use the Test System after any portion has passed its expiration date.
- Do not attempt the test using more than 12 antibody coated tubes (two of which are **Standards**) at the same time.
- Do not exceed incubation periods prescribed by the specific steps.
- Always follow the procedure in this user's guide.
- Use EPA Method 8080 or Code of Federal Regulations Title 40, Part 136, Appendix A, Method 680 to confirm results.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If Stop Solution or liquid from the extraction jar comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Standard Solution contains PCBs. Test samples may contain PCBs. Handle with care.

REPEATER PIPET & MECHANICAL PIPET

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE REPEATER PIPET

To Set Or Adjust Volume
To determine the pipetting volume, the dial setting (1-5) is multiplied by the minimum pipetting volume of the tip.

To Assemble Pipet Tip
Slide filling lever down until it stops. Then raise the locking clamp and insert the tip until it clicks into position. Be sure the tip plunger is fully inserted into the barrel before lowering the locking clamp to affix the tip in place.

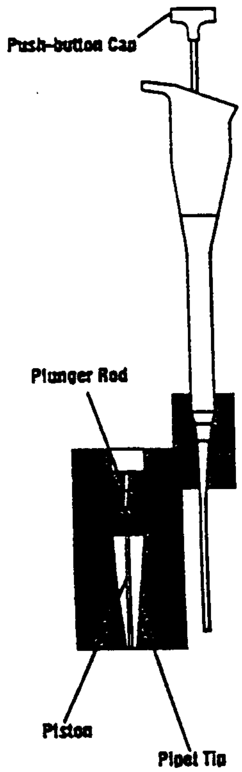
To Fill Tip
With tip mounted in position on pipet, immerse end of tip into solution. Slide filling lever upward slowly.

To Dispense Sample
Check the volume selection dial to ensure pipetting volume. Place tip inside test tube so that tip touches the inner wall of tube. Completely depress the pipetting lever.

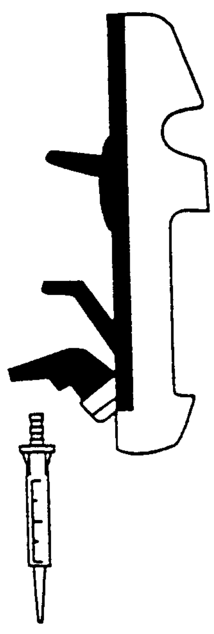
To Eject Tip
Empty tip of any remaining solution into appropriate container. Raise locking clamp upward, and remove the tip.

For additional information regarding operation and use of repeater, please refer to your Repeater pipet manual.

Mechanical Pipet



Repeater Pipet



HOW TO OPERATE THE MECHANICAL PIPET

To Set Or Adjust Volume
Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "060". Tighten volume lock screw and replace push-button cap.

To Assemble Pipet Tip
Slide larger mounting end of pipet tip onto end of pipet. Holding tip in place, press push-button until plunger rod enters pipet tip. **Ensure no gap exists between piston and plunger rod.**

To Withdraw Sample
With tip mounted in position on pipet, press push-button to first stop and hold it.

Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample
Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip
Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipet, please refer to your pipet manual.

ON-SITE QUALITY CONTROL/QUALITY ASSURANCE RECOMMENDATIONS EnSys RIS^{c}® TEST SYSTEM

Please read the following before proceeding with field testing.

SAMPLING

The result of your screening test is only as valid as the sample that was analyzed. Samples should be homogenized thoroughly to ensure that the 10 grams you remove for field testing is representative of the sample as a whole. All other applicable sample handling procedures should be followed as well.

PRIOR TO TESTING SAMPLES

Carefully follow the instructions in the User's Guide included with every test kit. This is the key element in obtaining accurate results. In addition, store your unused test kits at room temperature and do not use them past their expiration date (see label on each test kit).

INTERNAL TEST QC

Two standards are analyzed with each sample to provide internal test system quality control. With both standards inserted in the photometer, a valid test is indicated when the magnitude of the displayed number (irrespective of the sign, + or -) is less than the value given in the User's Guide. Test runs resulting in a greater number should be repeated to ensure valid conclusions.

QA/QC

The validity of field test results can be substantially enhanced by employing a modest, but effective QA/QC plan. EnSys recommends that you structure your QA/QC plan with the elements detailed below. These have been developed based on the data quality principles established by the U.S. Environmental Protection Agency.

A. Sample Documentation
   1. Location, depth
   2. Time and date of collection and field analysis

B. **Field analysis documentation** - provide raw data, calibration, any calculations, and final results of field analysis for all samples screened (including QC samples)

C. **Method calibration** - this is an integral part of EnSys RIS^{c}® immunoassay tests; a duplicate calibration is performed for each set of samples tested (see the instructions in the User's Guide)

D. **Method blank** - analyze methanol from the extraction jar.

E. **Site-specific matrix background field analysis** - collect and field analyze uncontaminated sample from site matrix to document matrix effect

F. **Duplicate sample field analysis** - field analyze duplicate sample to document method repeatability; at least one of every 20 samples should be analyzed in duplicate

G. **Confirmation of field analysis** - provide confirmation of the quantitation of the analyte via an EPA-approved method different from the field method on at least 10% of the samples; choose at least two representative samples testing above the action level; provide chain of custody and documentation such as gas chromatograms, mass spectra, etc.

H. **Performance evaluation sample field analysis (optional, but strongly recommended)** - field analyze performance evaluation sample daily to document method/operator performance

I. **Matrix spike field analysis** (optional) - field analyze matrix spike to document matrix effect on analyte measurement

FURTHER QUESTIONS?

EnSys technical support personnel are always prepared to discuss your quality needs to help you meet your data quality objectives.

Data for PCB RISC® Soil Test

Operator: .... Date: .... Location: ....

Sample ID	ΔOD Standards	OD sample ______ ppm	Interpretation	OD sample ______ ppm	Interpretation	Comments

APPENDIX C

Remedial Action
Quality Assurance Project Plan

Chicago Pneumatic Tool Company
Frankfort, New York

April 1998

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

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Syracuse, New York, 13214-0066
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Table of Contents

1. Project Description

1.1 Introduction

This Quality Assurance Project Plan (QAPP) is part of the Sampling and Analysis Plan (SAP) which supports the Remedial Design (RD) Specifications for the Chicago Pneumatic Tool Company (the site) located in Frankfort, New York.

This QAPP presents analytical methods and procedures which will be used during implementation of the remedial activities outlined in the RD Specifications. The Field Sampling Plan (FSP), which is also part of the SAP, sets forth the remedial action sampling procedures and is presented as Appendix B. The FSP and this QAPP are integrated and cross-referenced where applicable to minimize redundancy.

This QAPP was prepared in a manner consistent with the United States Environmental Protection Agency (USEPA) reference document, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA Interim Final" (EPA/540/G-89/004).

Information contained in the QAPP has been organized into the following sections:

Section	Content
1.0	Project Description
2.0	Project Organization and Responsibilities
3.0	Quality Assurance Objectives for Measurement of Data
4.0	Sampling Procedures
5.0	Sample and Document Custody
6.0	Calibration Procedures and Frequency
7.0	Analytical Procedures
8.0	Data Reduction, Review, and Reporting
9.0	Field and Laboratory Quality Control Checks
10.0	Performance and System Audits
11.0	Preventative Maintenance
12.0	Data Assessment Procedures
13.0	Corrective Action
14.0	Quality Assurance Reports to Management

Details are provided in the subsequent sections. This document also contains pertinent information from the RD Specifications and the FSP related to the measurement and evaluation of analytical data generated during the remedial activities.

1.1.1 Glossary of Terms

The list below presents abbreviations and the corresponding terms which are used in this QAPP (definitions of each term are provided within the body of the QAPP):

- ASP - Analytical Services Protocol;
- ASTM - American Society for Testing and Materials;
- CLP - Contract Laboratory Procedures;
- CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act;
- CRQL - Contract Required Quantitation Limit;
- DUP - Duplicate;
- DQOs - Data Quality Objectives;
- FID - Flame Ionization Detector;
- FSP - Field Sampling Plan;
- GC - Gas Chromatography;
- GC/MS - Gas Chromatography/Mass Spectrometry;
- HASP - Health and Safety Plan;
- IRM - Interim Remedial Measure;
- MDL - Method Detection Limit;
- mg/L - Milligrams per liter;
- mS/cm - Millisiemens per centimeter;
- MS - Matrix spike;
- MSB - Matrix spike blank;
- MSD - Matrix spike duplicate;
- NGVD - National Geodetic Vertical Datum;
- NTU - Nephelometric Turbidity Units;
- NYSDEC - New York State Department of Environmental Conservation;
- PARCC - Precision, Accuracy, Representativeness, Completeness, and Comparability;
- PCBs - Polychlorinated Biphenyls;
- ppb - Parts per billion;
- ppm - Parts per million;
- QAM - Quality Assurance Manager;

- QAPP - Quality Assurance Project Plan:
- QA/QC - Quality Assurance/Quality Control;
- RA - Remedial Action;
- RD - Remedial Design;
- RAS - Routine analytical services;
- RPD - Relative percent difference;
- SDG - Sample delivery group;
- SOP - Standard operating procedures;
- SU - Standard units;
- SVE - Soil vapor extraction;
- USEPA - United States Environmental Protection Agency;
- VOC - Volatile Organic Compound; and
- VTSR - Verified Time of Sample Receipt.

1.2 Objectives of the Sampling and Analysis Program

The purpose of the QAPP is to present the quality assurance/quality control (QA/QC) procedures to be implemented during the remedial activities to provide data quality which is sufficient to verify that the cleanup goals for the site are achieved. The objectives of the sampling and analysis program are as follows:

1. Determine the extent of soil excavation which will be required in specific areas of the site prior to initiating excavation activities;

2. Confirm that the concentrations of chemical constituents remaining in soil and sediment at the limits of the excavation areas are less than the cleanup goals;

3. Confirm that the concentrations of chemical constituents previously detected in site ground water diminish over time to levels less than New York State Ground-Water Quality Standards or to a point of no discernible change; and

4. Determine handling and disposal requirements for miscellaneous materials generated during implementation of the remedial activities.

1.3 Remedial Action Data Quality Objectives

To obtain information necessary to meet the objectives stated above, the following field sampling will be conducted as part of the remedial activities:

1. Pre-excavation verification soil sampling;
2. Post-excavation verification soil sampling;
3. Post-excavation verification sediment sampling;
4. Soil and sediment confirmation sampling (for disposal purposes);
5. Post-remediation ground-water sampling; and
6. Miscellaneous sampling.

Preliminary Data Quality Objectives (DQOs) were identified to ensure that the data generated during field sampling will be of adequate quality and sufficient quantity to form a sound basis for decision making purposes relative to the above objectives. Data quality objectives have been specified for each data collection activity. The DQOs presented herein address sampling efforts only and do not cover health and safety issues (including air monitoring), which are addressed in detail in other sections of the RD Specifications for this project.

A DQO summary for the remedial action effort is presented below. The summary consists of stated DQOs relative to the following items:

A. Data Uses;
B. Data Types;
C. Data Quality;
D. Data Quantity;
E. Sampling and Analytical Methods; and
F. Data Precision, Accuracy, Representativeness, Completeness, and Comparability Parameters (PARCC Parameters).

The categories of analytical data discussed in the following sections with regard to data quality are defined as follows:

Screening Data: Screening data affords a quick assessment of site characteristics or conditions. This objective for data quality is available for data collection activities that involve rapid, non-rigorous methods of analysis and quality assurance. This objective is generally applied to: physical and/or chemical properties of samples; degree of chemical impacts relative to concentration differences; and preliminary health and safety assessment.

Screening Data with Definitive Confirmation: Screening data will provide rapid identification and quantitation, although the quantitation can be relatively imprecise. This objective of data quality is available for data collection activities that require qualitative and/or quantitative verification of a select portion of sample findings (10 percent or more). This objective can also be used to verify less rigorous laboratory-based methods.

Definitive Data: Definitive data are generated using analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files.

1.3.1 Pre-Excavation Verification Soil Sampling

Data Uses

Pre-excavation verification soil sampling will be conducted to generate data to support the following evaluations:

1. Confirm the horizontal extent of select excavation areas prior to initiating soil excavation activities; and

2. Confirm that the concentrations of chemical constituents remaining at the limits of the soil excavation areas are less than the cleanup goals.

Data Types

The pre-excavation soil sampling will include the collection and analysis of soil samples for laboratory analysis for polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs) of concern [1,2-dichloroethene (cis and trans), trichloroethylene, and vinyl chloride], and metals of concern [chromium, copper, lead, and zinc]. Table 1 of this QAPP presents the anticipated number of verification soil samples to be collected for laboratory analysis. Visual examination and flame ionization detector (FID) screening of soil samples will also be conducted on select soil samples for laboratory analysis as described in the FSP.

Data Quality

Sample analyses for PCBs, VOCs of concern, and metals of concern will be performed in accordance with methods referenced in the NYSDEC 1995 Analytical Services Protocol (ASP). Field screening of soil samples will be performed using a FID.

Data Quantity

The number of pre-excavation verification soil samples to be collected from each excavation area is presented below.

- Two soil samples collected from the sidewalls of Area 2 will be submitted for laboratory analysis for VOCs of concern and metals of concern.
- Three soil samples collected from the sidewalls of Area 3 will be submitted for laboratory analysis for metals of concern.
- Four soil samples collected from the sidewalls of Area 7 will be submitted for laboratory analysis for metals of concern, and two soil samples from the sidewalls of Area 7 will be submitted for laboratory analysis for VOCs of concern and metals of concern.
- Nine soil samples from the sidewalls of Area 9 will be submitted for laboratory analysis for PCBs and metals of concern.

An equivalent number of samples will also be submitted for laboratory archive from these excavation areas are described in the FSP. The number and type of QA/QC soil samples to be collected are summarized in Table 1.

Sampling and Analytical Methods

The FSP contains a description of the pre-excavation verification soil sampling procedures to be employed during the remedial action. The laboratory analytical methods to be utilized are listed in Table 2 of this QAPP.

PARCC Parameters

Precision and accuracy quality control limits for chemical constituents which are used during data review to assess analytical performance, are included in Table 3.

Data representativeness is addressed by the sample quantities and locations identified in the FSP. Data comparability is intended to be achieved through the use of standard USEPA/NYSDEC-approved methods, which are presented in Table 2. Data completeness will be assessed at the conclusion of the remedial action.

1.3.2 Post-Excavation Verification Soil/Sediment Sampling

Data Uses

Post-excavation verification soil/sediment sampling will be conducted to confirm that the concentrations of chemical constituents remaining at the limits of Area 13 and the sediment excavation areas are less than the cleanup goals.

Data Types

The post-excavation soil/sediment sampling will include the collection and analysis of samples for laboratory analysis for PCBs, VOCs of concern, and metals of concern. Table 1 of this QAPP presents the anticipated number of verification soil and verification sediment samples to be collected for laboratory analysis. Visual examination, field analysis using ENSYS test kits, and FID screening of soil/sediment samples will also be conducted to select soil samples for laboratory analysis as described in the FSP.

Data Quality

Sample analyses for PCBs, VOCs of concern, and metals of concern will be performed in accordance with methods referenced in the NYSDEC 1995 ASP. Field screening of soil/sediment samples will be performed using ENSYS field test kits in accordance with Standard Operating Procedures (SOPs) provided by the manufacturer and using an FID in accordance with procedures outlined in the FSP.

Data Quantity

The number of post-excavation verification soil/sediment samples to be collected from each excavation area is presented below.

- Three samples from the bottom of Area 1 will be submitted for laboratory analysis for PCBs and metals of concern.
- Two samples from the bottom of Area 4 will be submitted for laboratory analysis for PCBs and metals of concern.
- Four samples from the sidewalls and one sample from the bottom of Area 5 will be submitted for laboratory analysis for PCBs and metals of concern.
- Five samples from the bottom of Area 6 will be submitted for laboratory analysis for PCBs and metals of concern.
- Four samples from the bottom of Area 11 will be submitted for laboratory analysis for PCBs and metals of concern.
- Three samples from the bottom of Area 12 will be submitted for laboratory analysis for PCBs and metals of concern.
- Four samples from the sidewalls and two samples from the bottom of Area 13 will be submitted for laboratory analysis for PCBs, unless this excavation extends vertically to the confining till layer. If the excavation extends to the till layer, then bottom verification samples will not be collected.
- Four samples from the bottom of Area 14 will be submitted for laboratory analysis for PCBs.

The number and type of QA/QC soil/sediment samples to be collected are summarized in Table 1.

Sampling and Analytical Methods

The FSP contains a description of the post-excavation verification sampling procedures to be employed during the remedial action. The laboratory analytical methods to be utilized are listed in Table 2 of this QAPP.

PARCC Parameters

Precision and accuracy quality control limits for chemical constituents which are used during data review to assess analytical performance, are included in Table 3.

Data representativeness is addressed by the sample quantities and locations identified in the FSP. Data comparability is intended to be achieved through the use of standard USEPA/NYSDEC-approved methods, which are presented in Table 2. Data completeness will be assessed at the conclusion of the remedial action.

1.3.3 Confirmation Sampling

Data Uses

Confirmation sampling will be conducted to determine handling requirements for soil/sediment excavated during the remedial action. Soil/sediment containing PCBs at concentrations greater than 50 ppm will be transported for off-site disposal as a Toxic Substances Control Act (TSCA)/New York State hazardous waste. Soil/sediment containing total VOCs of concern at concentrations greater than 10 ppm (and containing PCBs at concentrations less than 50 ppm) will be treated on-site in the SVE treatment cell.

Data Types

The confirmation sampling will include the collection of soil/sediment samples for field screening for PCBs using ENSYS field test kits and for VOCs using an FID. If the screening results indicate that the total PCB concentration in the soil/sediment is less than 40 ppm, a portion of the sample will be submitted for laboratory analysis to confirm that the concentration of PCBs is less than 50 ppm and that the soil/sediment can be disposed of in the on-site, lined containment cell. If the screening results indicate that the total VOC concentration in the sample headspace is less than 20 ppm, a portion of the sample will be submitted for laboratory analysis to confirm that the concentration of total VOCs of concern are less than 10 ppm and that the material can be disposed of in the on-site lined containment cell.

Data Quality

Laboratory analyses for PCBs and VOCs of concern will be performed in accordance with methods referenced in the NYSDEC 1995 ASP. Results will be presented using a standard laboratory report format (Category B deliverables will not be required). Field screening of soil/sediment samples may be performed using ENSYS field test kits in accordance with SOPs provided by the manufacturer and using an FID in accordance with procedures outlined in the FSP.

__Data Quantity__

One composite confirmation sample will be collected for every 500 CY of soil/sediment excavated from the portions of the excavation areas indicated in the FSP. Due to the anticipated time frame for completion of the project, QA/QC confirmation samples will not be submitted for laboratory analysis.

__Sampling and Analytical Methods__

The FSP contains a description of the confirmation soil sampling procedures to be employed during the remedial action. The laboratory analytical methods to be utilized are listed in Table 2 of this QAPP.

__PARCC Parameters__

Precision and accuracy quality control limits for chemical constituents analyzed as part of the confirmation sampling will not undergo data review.

Data representativeness is addressed by the sample quantities identified in the FSP. Data comparability is intended to be achieved through the use of standard USEPA/NYSDEC-approved methods, which are presented in Table 2. Data completeness will be assessed at the conclusion of the remedial activities.

1.3.4 Ground-Water Sampling

__Data Uses__

Ground-water sampling will be conducted as part of the remedial action to provide data to be used for the following purposes:

1. Confirm that the concentrations of chemical constituents previously detected in ground water in the vicinity of the excavation areas diminish over time to levels below New York State Ground-Water Quality Standards or to a point of no discernible change; and

2. Confirm that the proposed collection trenches mitigate the migration of ground water containing VOCs.

Data Types

Both hydrogeologic and water quality data will be provided as part of the ground-water sampling. Hydrogeologic data will consist of water level information from existing monitoring wells. Water quality data will consist of field measurements of pH, temperature, conductivity, turbidity, and dissolved oxygen, and laboratory analysis for PCBs, VOCs of concern, and metals of concern. Table 1 of this QAPP presents the number of ground-water samples to be collected for laboratory analysis during the first round of annual ground-water sampling.

Data Quality

Sample analyses for PCBs, VOCs of concern, and metals of concern will be performed in accordance with methods referenced in the NYSDEC 1995 ASP. Field measurement of pH, temperature, conductivity, turbidity, and dissolved oxygen will be performed in accordance with the equipment manufacturer's procedures.

Data Quantity

Ground-water samples will be collected from three existing monitoring wells and two proposed new monitoring wells. Ground-water elevation measurements will be obtained from each of these wells prior to sample collection. Measurements of pH, temperature, conductivity, turbidity, and dissolved oxygen will be obtained for each ground-water sample collected for the remedial action. The estimated quantity of ground-water analytical data that will be collected during the first round of ground-water monitoring, including QA/QC samples, is summarized in Table 1.

Sampling and Analytical Methods

The ground-water level measurement procedures, water quality measurement procedures, and ground-water sampling procedures are provided in the FSP. The laboratory analytical methods for ground-water samples are listed in Table 2.

PARCC Parameters

Precision and accuracy quality control limits for chemical constituents which are used during data review to assess analytical performance, are included in Table 3.

Data representativeness is addressed by the sample quantities and locations identified in the FSP. Data comparability is intended to be achieved through the use of standard USEPA/NYSDEC-approved methods, which are presented in Table 2. Data completeness will be assessed at the conclusion of the remedial action.

1.3.5 Miscellaneous Sampling

Data Uses

Miscellaneous sampling will be conducted to generate data to determine handling requirements for the following materials which will be generated during implementation of the remedial action:

- Start-up testing and effluent samples from the temporary water treatment system;
- Soil contained within the SVE cell;
- Leachate from the on-site, lined containment cell; and
- Railroad ties located in Areas 2 and 3.

Surface water or ground water which enters the excavation area and water generated from soil/sediment dewatering activities will be pumped to on-site storage tanks and treated on site in a temporary water treatment system, as described in Section 2.8 of the RD Specifications. Samples from the temporary on-site water treatment system will be submitted for laboratory analysis, as described below, to confirm that limits for discharge to the Oneida County Department of Water Quality and Water Pollution Control sanitary sewer system are achieved.

Samples of soil from the SVE cell will be submitted for laboratory analysis to determine if cleanup objectives for SVE cell soils have been achieved following treatment. Samples of leachate from the on-site lined containment cell will be submitted for laboratory analysis to confirm that the leachate will not have to be disposed of as a hazardous waste. Samples of railroad ties in Excavation Areas 2 and 3 will be submitted for laboratory analysis to determine whether the ties can be placed in the on-site lined containment cell or will need to be transported off site for disposal.

Data Types

The material sampling will include the collection and analysis of samples for laboratory analysis as described below:

- Samples of the effluent water from the temporary on-site water treatment system will likely be submitted for laboratory analysis for PCBs, oil and grease, total toxic organic constituents, and selected metals (cadmium, chromium, copper, lead, nickel, and zinc), which will be the discharge permit parameters. Samples of the influent to the water treatment system and samples between the multi-media and liquid bag filters and after the carbon filters will be submitted for laboratory analysis for discharge permit parameters and total suspended solids.

- Samples of soil from the SVE cell will be submitted for laboratory analysis for VOCs of concern.

- Samples of leachate from the on-site lined containment cell will be submitted for laboratory analysis for waste characterization parameters, which may include PCBs, Toxicity Characteristic Leaching Procedure (TCLP) VOCs, TCLP metals, ignitability, corrosivity, and reactivity. Specific waste characterization parameters will be specified by the anticipated disposal facility.

- Samples of railroad ties in Excavation Areas 2 and 3 will be submitted for laboratory analysis for PCBs, TCLP VOCs, TCLP SVOCs, and TCLP metals.

Soil samples from the SVE cell will be the only miscellaneous samples to undergo QA/QC analysis. Table 1 of the QAPP presents the anticipated number and type of QA/QC soil samples to be collected from the SVE cell for laboratory analysis.

Data Quality

Sample analyses for miscellaneous samples will be conducted in accordance with USEPA standard methods. Results for the miscellaneous samples will be presented in a standard laboratory report. Field measurements of total organic vapors will be performed in accordance with the equipment manufacturer's procedures.

Data Quantity

The number of miscellaneous samples to be collected as part of the remedial activities is presented below.

- Samples of the effluent water from the temporary on-site water treatment system will likely be submitted daily during washwater treatment operations. Samples of the influent to the water treatment system and samples between the multi-media and liquid bag filters, and after the carbon filters will be submitted for laboratory analysis during water treatment system startup operations.

- Up to five samples of soil from the SVE cell will be submitted for laboratory analysis.

- One sample of leachate from the on-site lined containment cell will be submitted for laboratory analysis when the leachate storage tank becomes full.

- One composite sample of railroad ties in Areas 2 and 3 will be submitted for laboratory analysis.

Sampling and Analytical Methods

The FSP contains a description of the sampling procedures to be employed for the miscellaneous samples during the remedial action. The laboratory analytical methods to be utilized are presented below.

- Samples of the effluent water from the temporary on-site water treatment system, samples of the influent to the water treatment system, and samples between the primary and secondary carbon treatment units will likely be submitted for laboratory analysis using the methods indicated below:

  - Total Suspended Solids using USEPA SW-846 Method 160.2;
  - PCBs using USEPA SW-846 Method 8082;
  - Oil and grease using USEPA Method 413.1;
  - Total toxic organic constituents using USEPA Methods 624 and 625; and
  - Selected metals (cadmium, chromium, copper, lead, nickel, and zinc) using USEPA Method 3111B.

- Samples of soil from the SVE cell will be submitted for laboratory analysis for VOCs of concern using USEPA SW-846 Method 8260 as referenced in the NYSDEC 1995 ASP.

- Samples of leachate from the on-site lined containment cell will be submitted for laboratory analysis for waste characterization parameters, which will include PCBs using USEPA SW-846 Method 8082; TCLP VOCs using USEPA SW-846 Method 8260; TCLP SVOCs using USEPA SW-846 Method 8270; and TCLP metals using USEPA SW-846 6000/7000 Series Methods; and ignitability, corrosivity, and reactivity as outlined in Part 261 of Title 40 of the Code of Federal Regulations (40 CFR 261).

- Samples of railroad ties in Excavation Areas 2 and 3 will be submitted for laboratory analysis for PCBs using USEPA SW-846 Method 8082, TCLP VOCs using USEPA SW-846 Method 8260, TCLP SVOCs using USEPA SW-846 using Method 8270, and TCLP metals using USEPA SW-846 6000/7000 Series Methods.

__PARCC Parameters__

Precision and accuracy quality control limits for soil samples collected from the SVE cell which will be used to assess analytical performance, are included in Table 3. Precision and quality control limits will not be reviewed for other miscellaneous samples submitted for laboratory analysis as part of the remedial action.

Data representativeness is addressed by the sample quantities/locations identified in the FSP. Data comparability is intended to be achieved through the use of standard USEPA/NYSDEC-approved methods. Data completeness will be assessed at the conclusion of the remedial action.

2. Project Organization and Responsibilities

2.1 Project Organization

The remedial action will require integration of personnel from the organizations identified below, collectively referred to as the project team. A detailed description of the responsibilities of each member of the project team is presented below.

2.1.1 Overall Project Management

The Engineer, on behalf of Danaher Corporation, has overall responsibility for the remedial activities at the site. The Engineer will perform the verification soil/sediment sampling, confirmation sampling, ground-water sampling, and miscellaneous sampling described in the FSP and above. In addition, the Engineer will be responsible for evaluating resultant sampling data and preparing required deliverables, including a Construction Certification Report. Project direction and oversight will be provided by Danaher Corporation. Oversight in the field may be provided by Danaher Corporation and the NYSDEC. A listing of key project management personnel will be provided to the NYSDEC prior to implementation of the remedial activities.

2.1.2 Task Managers

The staff performing the sampling and engineering activities of the remedial activities will be directed by representatives of the Engineer. The names of the personnel responsible for remedial action tasks will be provided to the NYSDEC prior to implementation of the remedial activities.

2.1.3 Analytical Laboratory Services

Laboratory analytical services for samples associated with the remedial activities at the site will be performed by a laboratory with current USEPA Contract Laboratory Procedure (CLP) and NYSDEC ASP certifications, related experience, and qualifications. Analytical results for the verification soil/sediment samples, confirmation samples, ground-water samples, and miscellaneous samples will be evaluated by the Engineer. Identification of laboratory and data evaluation management personnel will be provided to the NYSDEC prior to initiation of the remedial activities.

2.1.4 Quality Assurance Staff

Identification of quality assurance staff will be provided to the NYSDEC prior to initiation of the remedial activities.

2.2 Team Member Responsibilities

This section of the QAPP discusses the responsibilities and duties of the project team members.

2.2.1 Danaher Corporation

Project Manager

Responsibilities and duties include:

1. Overall direction of the remedial action;
2. Direction of the Engineer;
3. Review of the Engineer work products, including data, memoranda, letters, reports, and all documents transmitted to the NYSDEC.

2.2.2 Engineer

Project Officer

Responsibilities and duties include:

1. Oversight of the Engineer's remedial work activities/products; and
2. Provide the Engineer's approval for major project deliverables.

Project Manager

Responsibilities and duties include:

1. Management and coordination of all aspects of the project as defined in the RD Specifications with an emphasis on adhering to the objectives of the remedial activities;

2. Review all documents prepared by the Engineer; and

3. Assure corrective actions are taken for deficiencies cited during audits of sampling/analytical activities.

Task Managers

The engineering and sampling activities associated with the remedial action will be managed by Task Managers as set forth in Section 2.1.2. Responsibilities and duties of each Task Manager include:

1. Manage day-to-day relevant remedial/sampling activities;

2. Develop, establish, and maintain files on relevant remedial/sampling activities;

3. Review data from the relevant remedial/sampling activities;

4. Perform final data review of field data reductions and reports on relevant remedial/sampling activities;

5. Assure corrective actions are taken for deficiencies cited during audits of relevant remedial/sampling activities;

6. Overall QA/QC of the relevant portions of the remedial activities;

7. Review all relevant field records and logs;

8. Instruct personnel working on relevant remedial/sampling activities;

9. Coordinate field and laboratory schedules pertaining to relevant remedial/sampling activities;

10. Request sample bottles from laboratory;

11. Review the field instrumentation, maintenance, and calibration to meet quality objectives;

12. Prepare sections of reports pertaining to relevant remedial/sampling activities; and

13. Maintain field and laboratory files of notebooks and logs, data reductions and calculations, and transmit originals to the Project Manager.

Field Sampling Personnel

Responsibilities and duties include:

1. Perform field procedures associated with the collection of samples as set forth in the FSP;

2. Perform field analyses and collect QA samples;

3. Calibrate, operate, and maintain field equipment;

4. Reduce field data;

5. Maintain sample custody; and

6. Prepare field records and logs.

Quality Assurance Manager (QAM)

Responsibilities and duties include:

1. Review laboratory data packages;

2. Oversee and interface with the analytical laboratory;

3. Coordinate field QA/QC activities with task managers, including audits of sampling activities, concentrating on field analytical measurements and practices to meet data quality objectives;

4. Review field reports;

5. Review audit reports; and

6. Prepare interim QA/QC compliance reports.

2.2.3 Analytical Laboratory

General responsibilities and duties of the selected analytical laboratory include:

1. Perform sample analyses and associated laboratory QA/QC procedures;

2. Supply sampling containers and shipping cartons;

3. Maintain laboratory custody of sample; and

4. Strictly adhere to all protocols in the QAPP.

Project Manager

Responsibilities and duties include:

1. Serve as primary communication link between the Engineer and laboratory technical staff;
2. Monitor work loads and ensure availability of resources;
3. Oversee preparation of analytical reports; and
4. Supervise in-house chain-of-custody.

Quality Assurance Manager

Responsibilities and duties include:

1. Supervise the group which reviews and inspects all project-related laboratory activities; and
2. Conduct audits of all laboratory activities.

Sample Custodian

Responsibilities and duties include:

1. Receive all samples; and
2. Maintain custody of the samples and all documentation.

Laboratory Data Reviewer

Responsibilities and duties include:

1. Verify final analytical data prior to transmittal to the Engineer.

2.2.4 New York State Department of Environmental Conservation

Project Coordinator

Responsibilities and duties include:

1. Provide NYSDEC approval of plans and future remedial action deliverables; and

2. Provide oversight during performance of the remedial action.

Quality Assurance Officer

Responsibilities and duties include:

1. Review and approval of the QAPP;
2. Review of the QA/QC portion of the Construction Certification Report; and
3. Field and laboratory audit responsibilities, if determined necessary.

3. Quality Assurance Objectives for Measurement of Data

3.1 General

This section identifies the parameters that will be measured in the field and parameters that will be analyzed in the laboratory as part of the remedial action sampling. This section also identifies the quality assurance objectives for the field measurement/laboratory analysis of the parameters.

3.1.1 Field Parameters and Methods

The subsections below identify the parameters that will be measured in the field as part of the remedial action sampling and quality assurance objectives for measurement of the parameters.

3.1.1.1 Field Parameters

Selected soil samples collected during the remedial activities will be screened with a FID to determine the presence and approximate levels of VOCs. FID measurement protocols are presented in the FSP. Selected soil samples collected during the remedial action may be screened using ENSYS PCB field test kits. Standard operating procedures for the ENSYS field test kits are presented in the FSP.

Following installation of the proposed new monitoring wells, the location and elevation of the wells will be surveyed with the accuracy and precision requirements discussed in the FSP. The location of the well will be surveyed relative to the State Plane Coordinate System of 1929, or an appropriate reference point located at or near the site. Top-of-monitoring-well-casing elevations will be obtained to the nearest 0.01-foot as referenced to the National Geodetic Vertical Datum (NGVD) of 1929.

During ground-water monitoring activities, field parameters consisting of pH, conductivity, dissolved oxygen, turbidity, and temperature will be measured to provide general water quality information. Field test methods to measure pH, conductivity, dissolved oxygen, turbidity, and temperature are presented in the FSP. Measurement of water levels and in-site hydraulic conductivity testing will be performed as described in the FSP.

3.1.2 Laboratory Parameters and Methods

As described in the FSP, laboratory analyses will be performed during the remedial activities to determine concentrations of the following:

- PCBs, VOCs of concern, and metals of concern in verification soil sediment samples;
- PCBs and VOCs of concern in confirmation samples;
- VOCs of concern in ground-water samples;
- PCBs, oil and grease, total toxic organic constituents, selected metals for samples of the effluent water from the temporary on-site water treatment system;
- Permit discharge parameters and total suspended solids for samples of the influent to the temporary on-site water treatment system and samples between the primary and secondary carbon treatment units;
- VOCs of concern for soil samples collected from the SVE cell;
- PCBs, TCLP VOCs, TCLP metals, ignitability, corrosivity, and reactivity for samples of leachate from the on-site lined containment cell; and
- PCBs, TCLP VOCs, TCLP SVOCs, and TCLP metals of railroad ties in Excavation Areas 2 and 3.

QA/QC analyses will be performed for analyses for PCBs, VOCs and metals of concern, TCLP VOCs, TCLP SVOCs, and TCLP metals as set forth in Table 1. Table 2 presents the reporting limits for PCBs, VOCs, and metals of concern, TCLP VOCs, TCLP SVOCs, and TCLP metals for each sample matrix.

3.2 Quality Assurance Objectives

The overall quality assurance objective for the remedial action sampling and analysis program is to develop and implement procedures for sampling, chain-of-custody, laboratory analysis, instrument calibration, data reduction and reporting, internal quality control, audits, preventative maintenance, and corrective action, such that valid data will be generated. These procedures are presented or referenced in the following sections of the QAPP. Specific QC checks are discussed in Section 9.0 of this QAPP.

Quality assurance objectives are generally defined in terms of five parameters:

1. Representativeness;
2. Comparability;
3. Completeness;

4. Precision; and
5. Accuracy.

Each parameter is defined below. Specific objectives for the remedial action sampling and analysis program are set forth in other sections of this QAPP as referenced below.

3.2.1 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability and the variability of environmental media at the site. The sampling and analysis program has been designed to assess the presence of the chemical constituents at the time of sampling. The FSP presents the rationale for sample quantities and location. The FSP and this QAPP present field sampling methodologies and laboratory analytical methodologies, respectively. The use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data. Further discussion of QC checks is presented in Section 9.0 of this QAPP.

3.2.2 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability throughout the remedial action will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP and the FSP through the use of established QA/QC procedures, and the utilization of appropriately trained personnel.

3.2.3 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results, as discussed in Section 12.0 of this QAPP.

3.2.4 Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the sampling and analysis program. To maximize precision, sampling and analytical procedures will be followed. All sampling and analysis work for this remedial action will adhere to established protocols presented in the QAPP and FSP. Checks for analytical precision may include the analysis of matrix spike, matrix spike duplicates, laboratory duplicates and field duplicates. Checks for field measurement precision may include obtaining duplicate field measurements. Further discussion of precision QC checks is provided in Sections 9.0 and 12.0 of this QAPP.

3.2.5 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, matrix spikes, blank spikes, and surrogate standards may be used to assess the accuracy of the analytical data. Further discussion of these QC samples is provided in Sections 9.0 and 12.0 of this QAPP.

4. Sampling Procedures

Pre-excavation verification soil samples, post-excavation verification soil sediment samples, confirmation samples, ground-water samples, and miscellaneous samples will be collected as described in the FSP. The attachments to the FSP contain detailed procedures for collecting samples; using the Geoprobe equipment; installing soil borings; installing and developing the proposed new monitoring wells; measuring ground-water levels; collecting ground-water samples; performing field measurements; and handling, packing, and shipping samples.

5. Sample and Document Custody

5.1 General

This section presents the field and laboratory procedures for the handling and documentation of samples collected as part of the remedial action. The field and laboratory sample handling and documentation procedures are presented below.

5.2 Field Procedures

The objective of field sample custody is to assure that samples are not tampered with from the time of sample collection through time of transport to the analytical laboratory. Persons will have "custody of samples" when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel. A discussion of sample custody and directions for the field use of chain-of-custody forms are provided in the FSP.

5.3 Laboratory Procedures

This subsection presents information related to laboratory sample custody, sample receipt and storage, sample analysis, laboratory documentation, and laboratory project files.

5.3.1 Sample Custody

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field chain-of-custody form will accompany all samples requiring laboratory analysis. The laboratory will use chain-of-custody guidelines described in the 1995 ASP. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity.

5.3.2 Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, and compare the contents against the field chain-of-custody. If a sample container is received broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, the Engineer will be notified. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory logbook. All relevant custody documentation will be placed in the project file.

5.3.3 Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets which contain all pertinent information for analysis. The analyst will sign and date the laboratory chain-of-custody form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. A SDG may contain up to 20 field samples (field duplicates, trip blanks, and rinse blanks are considered field samples for the purposes of SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of five calendar days (less, when five-day holding times for extraction must be met), and must be processed through the laboratory (preparation, analysis, and reporting) as a group. Every SDG must include a minimum of one site-specific matrix spike/matrix spike duplicate (MS/MSD) (or MS/Dup) pair, which shall be received by the laboratory at the start of the SDG assignment.

Each SDG will be self-contained for all of the required quality control samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. At no time will the laboratory be allowed to run any sample (including QC samples) at an earlier or later time than the rest of the SDG. These rules for analysis will ensure that the quality control samples for an SDG are applicable to the field samples of the same SDG, and that the best possible comparisons may be made.

Information regarding the sample, analytical procedures performed, and the results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated, and will also identify the analyst, the instrument used, and the instrument conditions.

5.3.4 Laboratory Project Files

The laboratory will establish a file for all pertinent analytical data generated during the remedial action. The file will include the chain-of-custody forms, raw data, chromatograms (required for all constituents analyzed by chromatography), and sample preparation information. The laboratory will retain all project files and data packages for a period of five years.

5.3.5 Laboratory Documentation

Documentation

Workbooks, bench sheets, instrument logbooks, and instrument printouts, are used to trace the history of samples through the analytical process, and document and relate important aspects of the work, including the associated quality controls. As such, all logbooks, bench sheets, instrument logs, and instrument printouts are part of the permanent record of the laboratory.

Each page or entry is dated and initialed by the analyst at the time of entry. Errors in entry are crossed out in indelible ink with a single stroke, corrected without the use of white-out or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used are completed by lining out unused portions.

Laboratory notebooks are periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QAPP. All entries and calculations are verified by the laboratory group leader. If all entries on the pages are correct, then the laboratory group leader initials and dates the pages. Corrective action is taken for incorrect entries before the laboratory group leader signs.

Computer Tape and Hard Copy Storage

GC/MS raw data files are maintained on magnetic tape for five years, hard copy GC chromatograms are maintained in files for five years.

Sample Storage Following Analysis

Samples are maintained by the laboratory for one month after the final report is delivered to the Engineer. After this period, the samples are disposed of in accordance with applicable rules and regulations.

5.4 Project File

The remedial action field sampling and analytical documentation will be placed in a single project file at the Engineer's office. This file will consist of the following components:

1. Agreements (filed chronologically);
2. Correspondence (filed chronologically);

3. Memos (filed chronologically); and
4. Notes and Data (filed by topic).

Reports (including QA reports) will be filed with correspondence. Analytical laboratory documentation (when received) and field data will be filed with notes and data. Filed materials may be removed and signed out by authorized personnel on a temporary basis only.

6. Calibration Procedures and Frequency

6.1 Field Equipment Calibration Procedures and Frequency

Specific procedures for performing and documenting calibration and maintenance for the field equipment used to measure conductivity, temperature, dissolved oxygen, pH, turbidity, ground-water level, and total organic vapors are provided in the FSP. Calibration checks will be performed daily when measuring conductivity, temperature, dissolved oxygen, pH, turbidity, and total organic vapors. For ground-water sampling, the pH meter will be calibrated at each sampling location. Field equipment, frequency of calibration, and calibration standards are provided in Table 5.

6.2 Laboratory Equipment Calibration Procedures and Frequency

Instrument calibration will follow the specifications provided by the analytical method used or laboratory Standard Operating Procedures (SOPs) as identified in the table below.

Chemical Constituent	Analytical Method
Parameters for which standard laboratory report will be provided	
PCBs	Instrument calibration procedures for PCB analyses will follow the laboratory's SOP (to be provided upon selection of the analytical laboratory)
VOCs of Concern	USEPA SW-846 Method 8260
Metals of Concern	USEPA SW-846 6000/7000 Series Methods
Oil and grease	USEPA Method 413.1
Total toxic organic constituents	USEPA Methods 624 and 625
Selected metals (cadmium, chromium, copper, lead, nickel, and zinc)	USEPA Method 3111B
TCLP VOCs, TCLP SVOCs, TCLP metals, ignitability, corrosivity, and reactivity	Methods referenced in 40 CFR 261

7. Analytical Procedures

7.1 Field Analytical Procedures

Field analytical procedures will include the measurement of temperature, conductivity, dissolved oxygen, pH, turbidity, organic vapors, and ground-water levels. In addition, field screening for PCBs using ENSYS field test kits and for VOCs using an FID will be performed. Specific field measurement protocols are provided in the FSP. Field measurement quality control limits in terms of precision and accuracy are presented in Table 6.

7.2 Laboratory Analytical Procedures

Specific requirements related to each sample medium to be analyzed and details of the methods to be used for this project are presented in the subsections below. The methods to be used include the following:

- NYSDEC 1995 ASP-approved methods and updates will be used for the laboratory analysis of PCBs, VOCs of concern, and metals of concern; and
- Standard USEPA methods will be used for the laboratory analysis of oil and grease, total toxic organic constituents, selected metals (cadmium, chromium, copper, lead, nickel, and zinc in the water sample from the temporary on-site water treatment system), TCLP VOCs, TCLP SVOCs, TCLP metals, ignitability, corrosivity, and reactivity.

The anticipated turnaround times for receipt of analytical results for samples are summarized in the table below.

Sample Type	Turnaround Time
Pre-excavation verification soil samples	1 week
Post-excavation verification soil samples	24 hours
Post-excavation verification sediment samples	24 hours
Confirmation samples	48 hours
Ground-water samples	3 weeks
Samples of the influent and effluent of the water treatment system and samples between the primary and secondary carbon treatment units	24 hours
Samples of soil from the SVE cell	1 week
Samples of leachate from the on-site lined containment cell	2 weeks
Samples of railroad ties in Excavation Areas 2 and 3	1 week

7.2.1 General

The following tables summarize general analytical requirements:

Table	Title
Table 1	Environmental and Quality Control Analyses
Table 2	Parameters, Methods, and Reporting Limits
Table 7	Sample Containers, Preservation, and Holding Times Requirements

7.2.2 Remedial Action Sample Matrices

7.2.2.1 Soil/Sediment and Solids

Soil/sediment and solids analytical results will be reported on a dry weight basis, in the units presented in Table 2. Moisture content will be reported separately. QC limits for soil/sediment samples to be analyzed for PCBs, VOCs of concern, and metals of concern are presented in Table 3.

7.2.2.2 Water

Ground water, water from the temporary on-site treatment system, and leachate water are the matrices in this category that will be analyzed. No filtering of ground-water samples will be performed. Analytical results for the water analyses will be reported in the units identified in Table 2. QC limits for water samples to be analyzed for VOCs of concern are presented in Table 3.

7.2.3 Analytical Requirements

The primary sources for methods used to analyze soil, sediment, and ground-water samples are provided in the NYSDEC 1995 ASP documents. Data usability of the PCB, VOC of concern, and metals of concern data will be assessed by the Engineer. The primary sources for methods used to analyze water samples associated with the on-site temporary water treatment system, leachate from the on-site lined containment cell, and railroad ties are provided in USEPA SW-846 - Test Methods for Evaluating Solid Waste - Physical/Chemical Methods.

Tables summarizing QC limits required to evaluate analytical performance are provided as follows:

Table	Title
3	Soil Analyses Quality Control Limits
4	Water Analyses Quality Control Limits

8. Data Reduction, Review, and Reporting

After field and laboratory data are obtained, the data will be subject to the following:

1. Reduction or manipulation mathematically or otherwise into meaningful and useful forms;
2. Review;
3. Organization, interpretation, and reporting; and
4. External data review.

The subsections below present descriptions of the data reduction, review, and reporting activities that will be conducted in the field and laboratory as part of the remedial action sampling and analysis program.

8.1 Field Data Reduction, Review, and Reporting

8.1.1 Field Data Reduction

Information collected in the field through visual observation, manual measurement and/or field instrumentation will be recorded in field notebooks or datasheets, and/or on forms. Such data will be reviewed by the appropriate Task Manager for adherence to the FSP and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and as necessary, incorporated into the data evaluation process. Data reduction activities that will be performed for the verification soil/sediment sampling, the confirmation soil sampling, and ground-water sampling include the following:

- Determining the appropriate interval at each Geoprobe sampling location to collect pre-excavation verification soil samples for laboratory analysis (based on historical data, visual observations, and headspace screening);

- Reduction activities associated with determining PCB concentrations using ENSYS field test kits; and

- Calculation of water elevations in monitoring wells by subtracting the depth-to-water data from the surveyed elevation of the measuring point.

8.1.2 Field Data Review

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate Task Manager and the QAM. All logs and documents will be checked for:

1. General completeness;

2. Readability;
3. Usage of appropriate procedures;
4. Appropriate instrument calibration and maintenance;
5. Reasonableness in comparison to present and past data collected;
6. Correct sample locations; and
7. Correct calculations and interpretations.

8.1.3 Field Data Reporting

Where appropriate, field data forms and calculations will be processed and included in appendices to the Construction Certification Report. The original field logs, documents, and data reductions will be kept in the Engineer's project file.

8.2 Laboratory Data Reduction, Review, and Reporting

8.2.1 Laboratory Data Reduction

The calculations used for data reduction are specified in each of the analytical methods referenced previously. Whenever possible, analytical data is transferred directly from the instrument to a computerized data system. Raw data is entered into permanently-bound laboratory notebooks. The data entered are sufficient to document all factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses (i.e., PCBs and VOCs of concern) are based on response factors. Quantitation is performed using either internal or external standards.

Metals analyses are based on regression analysis. Regression analysis is used to fit a curve through the calibration standard data. The sample concentrations are calculated using the resulting regression equations.

Standard data are fitted to an equation in the following form:

$$y = a + bx$$

Where:

y = instrument response

x = concentration of amount of analyte

a = y-intercept

b = slope of the line (sensitivity)

After the regression equation has been computed, the sample concentration (x) can be calculated by rearranging the regression equation to read:

$$x = (y-a) / b$$

Soil/sediment values are reported on a dry-weight basis. Unless otherwise specified, all values are reported uncorrected for blank contamination.

8.2.2 Laboratory Data Review

All data will be subject to multi-level review by the laboratory. The group leader will review all data reports prior to release for final data report generation. The QAM will review a random sample of 5 percent of the final data reports, and the laboratory director will review a cross-section of the final data reports. All final data reports are reviewed by the Department Manager prior to shipment to the Engineer.

If discrepancies or deficiencies exist in the analytical results, then corrective action is taken as discussed in Section 13.0. Deficiencies discovered as a result of internal data review, as well as the corrective actions to be used to rectify the situation, will be documented on a Corrective Action Form (Attachment A). This form will be submitted to the Engineer's Project Manager.

8.2.3 Laboratory Data Reporting

The laboratory is responsible for preparing standard laboratory reports for all of the samples analyzed.

Data will be tabulated by method and sample, with reference to the sample by both field and laboratory identifications. In addition, the laboratory will provide documentation backup (laboratory calculation sheets, chain-of-custody documentation, etc.).

8.3 External Data Review

Upon receipt, the laboratory data will be evaluated by the Engineer for completeness and compliance. Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the QAM.

9. Field and Laboratory Quality Control Checks

9.1 General

Both field and laboratory quality control checks are proposed for the remedial action. In the event that there are any deviations from these checks, the Engineer's QAM will be notified. The proposed field and laboratory control checks are discussed below.

9.2 Field Quality Control Checks

Field quality control checks will include obtaining duplicate field measurements, using analyte-free water for the preparation of sample blanks, using certified-clean sample containers, collecting duplicate samples, preparing rinse blanks and trip blanks, and using zero and span gases, as described in the subsections below.

9.2.1 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field measurements. A duplicate measurement will involve obtaining measurements a second time at the same sampling location.

9.2.2 Sample Containers

Certified-clean sample containers (I-Chem 300 Series or equivalent) will be supplied by the analytical laboratory. Certificates of analysis will be filed in the project file.

9.2.3 Field Duplicates

Field duplicates will be collected for soil, sediment, and ground-water samples to verify the reproducibility of the sampling methods. Field duplicates will be prepared as discussed in the FSP. In general, soil, sediment, and ground-water sample field duplicates will be analyzed at a 5 percent frequency (every 20 samples) for the chemical constituents. Table 1 provides an estimated number of field duplicates to be prepared for each applicable parameter and matrix.

9.2.4 Rinse Blanks

Rinse blanks are used to monitor the cleanliness of the sampling equipment and the effectiveness of the cleaning procedures. Rinse blanks will be prepared and submitted for analysis at a frequency of one per week. Rinse blanks will be prepared by filling sample containers with analyte-free water (supplied by the laboratory) which has been routed through a cleaned sampling device. When dedicated sampling devices are used or sample containers are used to collect the samples, rinse blanks will not be necessary. Table 1 provides an estimated number of rinse blanks for environmental media samples to be collected during the remedial action.

9.2.5 Trip Blanks

Trip blanks will be used to assess whether site samples have been exposed to non-site-related volatile constituents during sample storage and transport. Trip blanks will be submitted at a frequency of once per shipment of ground-water samples to be analyzed for VOCs. A trip blank will consist of a container filled with analyte-free water (supplied by the laboratory) which remains unopened with field samples throughout the sampling event. Trip blanks will only be analyzed for VOCs. Table 1 provides an estimated number of trip blanks to be collected for each matrix and parameter during the remedial action.

9.3 Analytical Laboratory Quality Control Checks

Internal laboratory quality control checks will be used to monitor data integrity. These checks may include method blanks, matrix spikes (and matrix spike duplicates), spike blanks, internal standards, surrogate samples, calibration standards, and reference standards. Project QC limits for duplicates and matrix spikes are identified in Tables 3 and 4. Laboratory control charts will be used to determine long-term instrument trends. Descriptions of the analytical laboratory quality control checks are presented below.

9.3.1 Method Blanks

Sources of contamination in the analytical process, whether specific analytes or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for any potential contamination attributable to glassware, reagents, instrumentation, or other sources which could affect sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples. ASP guidelines for acceptance will be used. Guidelines for non-standard methods are provided in the appropriate protocols.

9.3.2 Matrix Spikes/Matrix Spike Duplicates

Matrix spikes and matrix spike duplicates will be used to measure the accuracy of organic analyte recovery from the sample matrices. All matrix spikes and matrix spike duplicates will be site-specific. For organic constituents, matrix spike/matrix spike duplicate pairs will be analyzed at a 5 percent frequency (every 20 samples or once every week, whichever comes first). For metals, a matrix spike will be analyzed at a 5 percent frequency or once every week, whichever comes first.

For soil, sediment, and water organic matrix spike data, results will be examined in conjunction with matrix spike blank (Subsection 9.3.3 of this QAPP) data and surrogate spike (Subsection 9.2.4) data to assess the accuracy of the analytical method. When matrix spike recoveries are outside QC limits, associated matrix spike blank and surrogate recoveries will be evaluated to attempt to verify the reason for the deviation and determine the effect on the reported sample results. Table 1 presents an estimated number of matrix spike and matrix spike duplicate analyses for each applicable matrix and parameter.

9.3.3 Matrix Spike Blanks (MSB)

For soil, sediment, and ground-water organic analyses, MSBs will be included to provide an additional assessment of data accuracy. The MSBs provide an assessment of method performance without interferences which may be present in environmental samples. MSBs will be analyzed at a frequency of one spike associated with no more than 20 samples or once every week, whichever comes first. For MSB analyses, clean matrix is spiked and recoveries are calculated similar to matrix spike recoveries. The clean matrix will consist of laboratory reagent water and clean, dried sand for water and soil/sediment analyses, respectively. MSB data will be assessed in conjunction with MSB data, as discussed in Section 9.3.2 of this QAPP. Table 1 presents an estimated number of MSBs for each matrix and parameter.

9.3.4 Surrogate Spikes

Surrogates are compounds which are unlikely to occur under natural conditions that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by GC/MS and GC methods and is added to the samples prior to purging or extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a sample specific basis. This control reflects analytical conditions which may not be attributable to sample matrix.

If surrogate spike recoveries exceed specified QC limits, then the analytical results need to be evaluated thoroughly in conjunction with other control measures. In the absence of other control measures (i.e., internal standard and matrix spikes), the integrity of the data may be verifiable and reanalysis of the sample with additional controls would be necessary.

Surrogate spike compounds will be selected utilizing the guidance provided in the analytical methods summarized in Table 2.

9.3.5 Laboratory Duplicates

For metals, laboratory duplicates will be analyzed to assess laboratory precision. Laboratory duplicates are defined as a second aliquot of an individual sample which is analyzed as a separate sample. Table 1 provides an estimated number of laboratory duplicates for each applicable matrix and parameter.

9.3.6 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide insight regarding the instrument's stability. A calibration check standard will be analyzed at the beginning and end of an analytical series, or periodically throughout a series containing a large number of samples.

In general, calibration check standards will be analyzed after every 12 hours, or more frequently as specified in the applicable analytical method. In analyses where internal standards are used, a calibration check standard will only be analyzed in the beginning of an analytical series. If results of the calibration check standard exceed specified tolerances, then all samples analyzed since the last acceptable calibration check standard will be reanalyzed.

Laboratory instrument calibration standards will be selected utilizing the guidance provided in the analytical methods summarized in Table 2.

9.3.7 Internal Standards

Internal standard areas and retention times are monitored for organic analyses performed by GC/MS methods. Method-specified internal standard compounds are spiked into all field samples, calibration standards and QC samples after preparation and prior to analysis. The response of each internal standard is plotted on a control chart. If internal standard areas in one or more samples exceed the specified tolerances, then the instrument will be recalibrated and all affected samples reanalyzed.

The acceptability of internal standard performance will be determined using the guidance provided within the analytical methods summarized in Table 2.

9.3.8 Reference Standards

Reference standards are standards of known concentration, and independent in origin from the calibration standards. Reference standards, are generally available through the USEPA, the National Bureau of Standards, or are specified in analytical methods. The intent of reference standard analysis is to provide insight into the analytical proficiency within an analytical series. This includes the preparation of calibration standards, the validity of calibration, sample preparation, instrument set-up, and the premises inherent in quantitation. Reference standards will be analyzed at the frequencies specified within the analytical methods summary in Table 2.

10. Performance and Systems Audits

10.1 General

This section describes the performance and systems audits that will be completed in the field and the laboratory during implementation of remedial action.

10.2 Field Audits

Field performance and systems audits that will be completed during this project area described in the subsections below.

10.2.1 Performance Audits

The appropriate Task Manager will monitor field performance. Field performance audit summaries will contain an evaluation of field measurements and field meter calibrations to verify that measurements are taken according to established protocols. The Engineer's QAM will review all field reports and communicate concerns to the Engineer's Project Manager and/or Task Managers, as appropriate. In addition, the Engineer's QAM will review the rinse and trip blank data to identify potential deficiencies in field sampling and cleaning procedures.

10.2.2 Internal Systems Audits

A field internal systems audit is a qualitative evaluation of all components of field QA/QC. The systems audit compares scheduled QA/QC activities from this document with actual QA/QC activities completed. The appropriate Task Manager and QAM will periodically confirm that work is being performed consistent with this QAPP, the FSP, and the HASP.

10.3 Laboratory Audits

The analytical laboratory will perform internal audits consistent with NYSDEC ASP 1995 revisions. The Engineer reserves the right to conduct an on-site audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the course of the project, as deemed necessary.

11. Preventative Maintenance

11.1 General

Preventative maintenance schedules have been developed for both field and laboratory instruments. A summary of the maintenance activities to be performed is presented below.

11.2 Field Instruments and Equipment

Prior to any field sampling, each piece of field equipment will be inspected to assure the equipment is operational. If the equipment is not operational, it must be serviced prior to use. All meters which require charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, the appropriate Task Manager or field personnel is responsible for following the maintenance schedule and arrange for prompt service.

Field instrumentation to be used in this study includes meters to measure conductivity, temperature, pH, dissolved oxygen, turbidity, water level, and total organic vapors. Field equipment also includes sampling devices for ground water. A logbook will be kept for each field instrument. Each logbook contains records of operation, maintenance, calibration, and any problems and repairs. The Engineer's Task Managers will review calibration and maintenance logs.

Field equipment returned from a site will be inspected to confirm it is in working order. This inspection will be recorded in the logbook or field notebooks as appropriate. It will also be the obligation of the last user to record any equipment problems in the logbook.

Non-operational field equipment will be either repaired or replaced. Appropriate spare parts will be made available for field meters. A summary of preventive maintenance requirements for field instruments is provided in Table 8. Details regarding field equipment maintenance, operation, and calibration, are provided in the FSP.

11.3 Laboratory Instruments and Equipment

Laboratory instrument and equipment documentation procedures are provided in SOPs. Documentation includes details of any observed problems, corrective measure(s), routine maintenance, and instrument repair (which will include information regarding the repair and the individual who performed the repair). Preventative maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call from the manufacturer. A sufficient supply of spare parts for laboratory instruments will be maintained to minimize downtime. Backup instrumentation will be retained for use, whenever possible.

12. Data Assessment Procedures

12.1 General

The analytical data generated during the remedial action will be evaluated with respect to precision, accuracy, and completeness and compared to the data quality objectives set forth in Sections 1.0 and 3.0 of this QAPP. The following tables summarize QC limits required to evaluate analytical performance:

Table	Title
3	Soil Analyses Quality Control Limits
4	Water Analyses Quality Control Limits

Following collection of the field sampling and analytical data, various statistical analyses can be performed to determine the data usability, sufficiency, and sensitivity of the data, as described below.

Data usability can be checked through not only standard data validation procedures, but also through statistical cross-validation procedures. These procedures involve predicting a data value for one point, based on results from other points. The difference between the measured and predicted number can indicate an invalid result.

An assessment of data sufficiency involves the determination of whether the confidence intervals for measured values are rigorous enough to satisfy regulatory or engineering requirements.

The sensitivity of the data can be measured by the use of methods, such as kriging, that can be used to calculate the range of probable values at non-sampled locations and to determine the effect of this uncertainty on site assessment.

The procedures utilized when assessing data precision, accuracy, and completeness are presented below.

12.2 Data Precision Assessment Procedures

Field precision is difficult to measure because of temporal variations in field parameters. However, precision will be controlled through the use of experienced field personnel, properly calibrated meters, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision for organic analyses will be monitored through the use of matrix spike matrix spike duplicate sample analyses. For other parameters, laboratory data precision will be monitored through the use of field duplicates and/or laboratory duplicates as identified in Table 1.

The precision of data will be measured by calculation of the relative percent difference (RPD) by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = Analytical result from one of two duplicate measurements
B = Analytical result from the second measurement.

Precision objectives for duplicate analyses are identified in Tables 3 and 4.

12.3 Data Accuracy Assessment Procedures

The accuracy of field measurements will be controlled by experienced field personnel, properly calibrated field meters, and adherence to established protocols. The accuracy of field meters will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be assessed via the use of matrix spikes, surrogate spikes and reference standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A-X}{B} \times 100$$

Where:

A = Value measured in spiked sample or standard
X = Value measured in original sample
B = True value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy between the original and spiked measurements. Accuracy objectives for matrix spike recoveries are identified in Tables 3 and 4.

12.4 Data Completeness Assessment Procedures

Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number Valid Results}}{\text{Total number of results generated x 100}}$$

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgement to determine data useability for intended purposes.

12.5 Calculation of Method Detection Limits

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. The MDL achieved in a given analysis will vary depending on instrument sensitivity and matrix effects. MDL is calculated as follows:

$$MDL - t_{(n-1,1-a=0.99)}\ s$$

Where:

MDL = method detection limit;

s = standard deviation of replicate analyses; and

$t_{(n-1,1-a=0.99)}$ = student's t-value for a one-sided 99% confidence level and a standard deviation estimate with n-1 degrees of freedom.

13. Corrective Action

Corrective actions are required when field or analytical data are not within the objectives specified in this QAPP or the FSP. Corrective actions include procedures to promptly investigate, document, evaluate, and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures for the remedial action are described below.

13.1 Field Procedures

During the remedial action, if a condition is noted that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action implemented will be documented on a Corrective Action Form (Attachment A) and reported to the appropriate Task Manager, QAM, and Project Manager.

Examples of situations which would require corrective actions are provided below:

1. Protocols as defined by the QAPP and FSP have not been followed;
2. Equipment is not in proper working order or properly calibrated;
3. QC requirements have not been met; and
4. Issues resulting from performance or systems audits.

Project personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

13.2 Laboratory Procedures

13.2.1 General

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action to be taken will be documented, and reported to the appropriate project manager and QAM.

Corrective action may be initiated, at a minimum, under the following conditions:

1. Protocols as defined by this QAPP have not been followed;
2. Predetermined data acceptance standards are not obtained;
3. Equipment is not in proper working order or calibrated;

4. Sample and test results are not completely traceable;
5. QC requirements have not been met; and
6. Issues resulting from performance or systems audits.

Laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

14. Quality Assurance Reports to Management

14.1 Internal Reporting

The QAO will review analytical concerns identified by the data review with the laboratory. Supporting data (i.e., historic data, related field or laboratory data) will be reviewed to assist in determining data quality, as appropriate. The QAM will incorporate results of assessments of data useability into a summary that will be submitted to the Project Manager and appropriate Task Managers. This summary will be placed in the project file at the Engineer's office and will include significant QA/QC problems, solutions, corrections, and potential consequences.

14.2 Remedial Action Reporting

The Construction Certification Report prepared by the Engineer will contain a separate QA/QC section(s) summarizing the quality of data collected and/or used as appropriate to the project data quality objectives which are discussed in Section 1.3 of this QAPP. The QAM will prepare the QA/QC summaries using reports and memoranda documenting the data assessment and review.

In addition, records will be maintained to provide evidence of the QA activities. A QA records index will be initiated at the beginning of the project, and all information received from outside sources or developed during the project will be retained by the Engineer. Upon termination of an individual task or work assignment, working files will be forwarded to the project files.

Tables

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Table 1

Chicago Pneumatic Tool Company
Frankfort, New York
Quality Control Analyses Summary

Environmental Sample Matrix/ Laboratory Parameters	Est. Environmental Sample Quantity	Field QC Analyses: Trip Blank Freq	Trip Blank No.	Field Duplicate Freq	Field Duplicate No.	Rinse Blank[a] Freq	Rinse Blank[a] No.	Est. Matrix Total	Laboratory QC Analyses: MS[a] Freq.	MS[a] No.	MSD[a] Freq.	MSD[a] No.	SB[a] Freq.	SB[a] No.	Lab Duplicate Freq.	Lab Duplicate No.	Est. Overall Total
Verification Soil Samples																	
PCBs	15	--	--	1/20	1	1/20	1	17	1/20	1	1/20	1	1/20	1	--	--	20
VOCs of Concern	4	--	--	1/20	1	1/20	1	6	1/20	1	1/20	1	1/20	1	--	--	9
Metals of Concern	20	--	--	1/20	1	1/20	1	22	1/20	2	--	--	--	--	1/20	2	26
Verification Sediment Samples																	
PCBs	26	--	--	1/20	2	1/20	2	30	1/20	2	1/20	2	1/20	2	--	--	36
VOCs of Concern	0	--	--	1/20	0	1/20	0	0	1/20	0	1/20	0	1/20	0	--	--	0
Metals of Concern	22	--	--	1/20	2	1/20	2	26	1/20	2	--	--	--	--	1/20	2	30
Soil Samples Collected from within the SVE Cell																	
VOCs of Concern	5	--	--	1/20	1	1/20	1	7	1/20	1	1/20	1	1/20	1	--	--	10
Ground-Water Samples[4]																	
VOCs of Concern	5	1/day[b]	1	1/20	1	1/20	1	8	1/20	1	1/20	1	1/20	1	--	--	11

Notes:

1. Table assumes that samples will be processed in groups of 20 samples for QC analyses. If smaller sample groups are processed, then one MS/MSD (or MS/lab dup) per sample delivery group (up to 20 samples) will be prepared for each sample delivery group.
2. [a] = These field and laboratory QC analysis shall be performed at a frequency of 1/20 or 1/week, whichever comes first. Table assumes samples will be collected at a rate of 20 samples per week.
3. [b] = 1/day = One trip blank per shipment.
4. Table presents QA/QC analyses for one round of ground-water sampling. Additional QA/QC analyses will be performed for subsequent rounds of ground-water sampling.
5. VOCs of concern are 1,2-dichloroethene (cis and trans), trichloroethylene, and vinyl chloride.
6. Metals of concern are chromium, copper, lead, and zinc.
7. QA/QC samples will not be collected for confirmation soil samples, confirmation sediment samples, water samples from the temporary on-site water treatment system, leachate samples from the on-site lined containment cell, or railroad ties.

Table 2

Chicago Pneumatic Tool Company
Frankfort, New York

Quality Assurance Project Plan
Parameters, Methods, and Reporting Limits

Soil, Sediment, Solids, and Water Samples			
Constituent	Reporting Limit (ppb)[4]		
	Water	Soil/Sediment	
PCBs (USEPA SW-846 Method 8082)			
Aroclor 1016	1.0	33.0	
Aroclor 1221	2.0	67.0	
Aroclor 1232	1.0	33.0	
Aroclor 1242	1.0	33.0	
Aroclor 1248	1.0	33.0	
Aroclor 1254	1.0	33.0	
Aroclor 1260	1.0	33.0	
Metals of Concern (USEPA SW-846 6000/7000 Series Methods)			
Chromium	10	1	
Copper	25	2.5	
Lead	5	0.5	
Zinc	20	2	
Constituent	**Water**	**Low Soil/Sediment**	**Medium Soil/Sediment**
Volatile Organic Compounds of Concern (USEPA SW-846 Method 8260)			
cis-1,2-Dichoroethene	5	5	1,200
trans-1,2-Dichloroethene	5	5	1,200
Trichloroethylene	5	5	1,200
Vinyl Chloride	5	5	1,200
Constituent	**Regulatory Limit (ppm)[5]**		
	Water	**Solids**	
TCLP Volatile Organic Compounds (USEPA SW-846 Method 8260)			
Benzene	0.5	0.5	
Carbon Tetrachloride	0.5	0.5	
Chloroform	6.0	6.0	
1,2-Dichloroethane	0.5	0.5	

Table 2

Chicago Pneumatic Tool Company
Frankfort, New York

Quality Assurance Project Plan
Parameters, Methods, and Reporting Limits

Constituent	Regulatory Limt (ppm)[5]	
	Water	Solids
TCLP Volatile Organic Compounds (USEPA SW-846 Method 8260)		
1,1-Dichloroethene	0.7	0.7
2-Butanone	200	200
Tetrachloroethene	0.7	0.7
Trichloroethene	0.5	0.5
Vinyl Chloride	0.2	0.2
TCLP Semi-Volatile Organic Compounds (USEPA SW-846 Method 8270B)		
2-Methylphenol	200	200
3 & 4-Methylphenol	200	200
1,4-Dichlorobenzene	7.5	7.5
2,4-Dinitrotoluene	0.13	0.13
Hexachlorobenzene	0.13	0.13
Hexachlorobutadrene	0.5	0.5
Hexachloroethane	3.0	3.0
Nitrobenzene	2.0	2.0
Pentachlorophenol	100	100
Pyridine	5.0	5.0
2,4,5-Trichlorophenol	400	400
2,4,6-Trichlorophenol	2.0	2.0
TCLP Metals (USEPA SW-846 Methods 6000/7000 Series)		
Arsenic	5	5
Barium	100	100
Cadmium	1	1
Chromium	5	5
Lead	5	5
Selenium	1	1
Silver	5	5
Mercury	0.2	0.2

Table 2

Chicago Pneumatic Tool Company
Frankfort, New York

Quality Assurance Project Plan
Parameters, Methods, and Reporting Limits

Notes:

1. Reporting limits of PCBs are based on NYSDEC 1995 ASP contract required quantitation limits (CRQLs) and are for guidance purposes. The quantitation limits calculated by the laboratory for soil and sediment, calculated on a dry-weight basis, will be higher. Quantitation limits shown for total PCBs are equal to those for each individual Aroclor listed. The quantitation limits shown for PCBs are provided for guidance and may not always be achievable.

2. Reporting limits for VOCs of concern are based on USEPA SW-846 Method 8260 CRQLs. Quantitation limits for soil and sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil and sediment on a dry-weight basis will be higher. Specific quantitation limits are highly matrix dependent. The quantitation limits shown are provided for guidance and may not always be achievable.

3. USEPA SW-846 6000/7000 Series Methods will be used for analysis for metals of concern. Reporting limits presented are based on RCRA TCL CRQLs. CRQLs shown for metals of concern are provided for guidance and may not always be achievable.

4. ppb = parts per billion.

5. ppm = parts per million.

6. Columns in the table above labeled low soil/sediment present quantitation limits applicable for soil/sediment samples with low levels of constituents. Columns in the table above labeled high soil/sediment present quantitation limits applicable for soil/sediment samples with high levels of constituents.

Table 3

Chicago Pneumatic Tool Company
Frankfort, New York

Quality Assurance Project Plan
Soil/Sediment and Solids Analyses Quality Control Limits

Constituent	Method	Accuracy, % Recovery	Precision, RPD
PCBs[a,b]			
Aroclor 1242	Method 8082	39-159	--
Aroclor 1254	Method 8082	29-131	--
Volatile Organic of Concern[b,c]			
cis-1,2-Dichloroethene	Method 8260	70-130	30
trans-1,2-Dichloroethene	Method 8260	70-130	30
Trichloroethylene	Method 8260	70-130	30
Vinyl Chloride	Method 8260	70-130	30
Metals of Concern[d]			
All Metals of Concern	6000/7000 Series Methods	75-125	30
TCLP Volatile Organic Compounds			
Benzene	Method 8260	37-151	21
1,2-Dichloroethane	Method 8260	61-145	22
Trichloroethene	Method 8260	71-120	24
TCLP Semi-Volatile Organic Compounds			
1,4-Dichlorobenzene	Method 8270B	28-104	27
2,4-Dinitrotoluene	Method 8270B	28-89	47
Nitrobenzene	Method 8270B	35-114	25
Pentachlorophenol	Method 8270B	17-109	47
TCLP Metals			
Arsenic	Method 6010	75-125	20
Barium	Method 6010	75-125	20
Cadmium	Method 6010	75-125	20
Chromium	Method 6010	75-125	20
Lead	Method 6010	75-125	20
Selenium	Method 6010	75-125	20
Silver	Method 6010	75-125	20
Mercury	Method 7470	75-125	20

Table 3

Chicago Pneumatic Tool Company
Frankfort, New York

Quality Assurance Project Plan
Soil/Sediment and Solids Analyses Quality Control Limits

Notes:

1. [a] = Available QC limits for Aroclors 1242 and 1254 are from SW-846 Method 8082, as referenced in the NYSDEC 1995 ASP.
2. [b] = QC limits shown on table are only advisory, however, frequent failures to meet the QC limits warrant investigation of the laboratory.
3. [c] = QC limits for VOCs of concern are provisional/interim limits. The actual limits will be determined by the Engineer and the selected analytical laboratory.
4. [d] = QC limits presented for metals of concern are presented in the NYSDEC 1995 ASP.
5. RPD = relative percent difference.
6. Laboratory analysis reporting format will be standard format.

Table 4

Chicago Pneumatic Tool Company
Frankfort, New York

Quality Assurance Project Plan
Water Analyses Quality Control Limits

Constituent	Method	Accuracy, % Recovery	Precision, RPD
PCBs[a,b]			
Aroclor 1242	Method 8082	39-150	--
Aroclor 1254	Method 8082	39-150	--
Volatile Organics of Concern[b,c]			
cis-1,2-Dichloroethene	Method 8260	70-130	30
trans-1,2-Dichloroethene	Method 8260	70-130	30
Trichloroethylene	Method 8260	70-130	30
Vinyl Chloride	Method 8260	70-130	30
Metals of Concern[d]			
All Metals of Concern	6000/7000 Series Methods	75-120	20
TCLP Volatile Organic Compounds			
Benzene	Method 8260	37-151	21
1,2-Dichloroethane	Method 8260	61-145	22
Trichloroethene	Method 8260	71-120	24
TCLP Metals			
Arsenic	Method 6010	75-125	20
Barium	Method 6010	75-125	20
Cadmium	Method 6010	75-125	20
Chromium	Methid 6010	75-125	20
Lead	Method 6010	75-125	20
Selenium	Method 6010	75-125	20
Silver	Method 6010	75-125	20
Mercury	Method 7470	75-125	20

Notes:

1. [a] = Available QC limits for Aroclors 1242 and 1254 are from SW-846 Method 8082, as refernced in the NYSDEC 1995 ASP.
2. [b] = QC limits shown on table are only advisory, however, frequent failures to meet the QC limits warrant investigation of the laboratory.
3. [c] = QC limits for VOCs of concern are provisional/interim limits. The actual limits will be determined by the Engineer and the selected analytical laboratory.
4. [d] = QC limits presented for metals of concern are presented in the NYSDEC 1995 ASP.
5. RPD = relative percent difference.
6. Laboratory analyses reporting format will be standard format.

Table 5

Chicago Pneumatic Tool Company
Frankfort, New York

Quality Assurance Project Plan
<u>Field Calibration Frequency</u>

Equipment	Calibration Check	Calibration Standard	Initial Calibration Frequency
pH Meter	Prior to use - daily[1]	pH 4.0 pH 7.0 pH 10.0	One Month
Conductivity Meter	Prior to use - daily	1,000 mg/l Sodium Chloride	One Month
Water Level Meter	Prior to implementing field work	100-foot engineer's tape	N/A
Dissolved Oxygen Meter	Per sampling event	Air	N/A
Organic Vapor Analyzer	Prior to use - daily During use - daily	100 ppm and 10,000 ppm Methane calibration gas	Annually
Turbidity	Prior to use - daily	Formazin 0.5 NTU, 5.0 NTU, 40.0 NTU	N/A

Notes:

1. [1] = The pH meter will also be calibrated at each location prior to ground-water sampling.
2. N/A = not applicable.
3. NTU = nephelometric turbidity units.
4. mg/l = milligrams per liter.
5. ppm = parts per million.

Table 6

Chicago Pneumatic Tool Company
Frankfort, New York

Quality Assurance Project Plan
<u>Field Measurements Quality Control</u>

Field Parameter	Precision[1]	Accuracy
Water Temperature	$\pm$ 1°C	$\pm$ 1°C instrument capability
pH	$\pm$ 1 pH S.U.	$\pm$ 1 pH S.U. (instrument capability)
Conductivity	$\pm$ 1 mS/cm	$\pm$ 5% standard
Dissolved Oxygen	$\pm$ 0.02 mg/l	$\pm$ 5%
Turbidity	$\pm$ 1.0 NTU	$\pm$ 2% standard
Water Level	$\pm$ 0.01 foot	$\pm$ 0.01 foot

<u>Notes:</u>

1. [1] = Precision units presented in applicable significant figures.
2. S.U. = standard units.
3. mS/cm = millisiemens per centimeter.
4. mg/l = milligrams per liter.

Table 7

Chicago Pneumatic Tool Company
Frankfort, New York

Sample Containers, Preservation, and Holding Times
Soil Samples

Parameter	Reference	Sample Container	Sample Volume	Preservation	Maximum Holding Time from VTSR
PCBs[a]	USEPA SW-846, Method 8082 as referenced in NYSDEC, ASP 1995	One 8-ounce widemouth glass jar	8 oz.	Cool 4°C	Extract within 5 days. Analyze within 40 days following the start of extraction
VOCs of Concern	USEPA SW-846, Method 8260 as referenced in NYSDEC, ASP 1995	One 125-ml widemouth glass jar with teflon-lined lid	125 ml	minimize head space, cool 4°C	7 days
Metals of Concern	USEPA SW-846, 6000/7000 Series Methods as referenced in NYSDEC, ASP 1995	One 8-ounce widemouth glass jar	8 oz.	Cool 4°C	180 days
TCLP Volatile Organic Compounds	USEPA SW-846, Method 8260 as referenced in NYSDEC, ASP 1995	One 125-ml glass jar, with teflon-lined lid	125 ml	Minimize head space, cool 4°C	Extract within 14 days. Analyze within 14 days of extraction.
TCLP Semi-Volatile Organic Compounds	USEPA SW-846, Method 8270B as referenced in NYSDEC, ASP 1995	One 8-ounce widemouth glass jar	8 oz.	Cool 4°C	Extract within 14 days. Conduct preparative extraction within 7 days. Analyze within 14 days from preparative extraction.
TCLP Metals (except mercury)	USEPA SW-846, 6000/7000 Series Methods as referenced in NYSDEC, ASP 1995	One 8-ounce widemouth glass jar	8 oz.	Cool 4°C	Extract within 180 days. Analyze extract within 180 days from extraction.
TCLP Mercury	USEPA SW-846, Method 7470 as referenced in NYSDEC, ASP 1995				Extract within 28 days. Analyze within 28 days of extraction.

Notes:

1. ASP = New York State Department of Environmental Conservation 1995 Analytical Services Protocol.
2. VTSR = Verifiable time of sample receipt.
3. Sampler must ensure that samples are delivered to the laboratory within 24 to 48 hours after collection.
4. [a] = ASP methods modified for PCB analysis only.
5. VOCs of concern are 1,2-dichloroethene (cis and trans), trichloroethylene, and vinyl chloride.
6. Metals of concern are chromium, copper, lead, and zinc.

Table 7
(Cont')

Chicago Pneumatic Tool Company
Frankfort, New York

Sample Containers, Preservation, and Holding Times
Water Samples

Parameter	Reference	Sample Container	Sample Volume	Preservation	Maximum Holding Time from VTSR
VOCs of Concern	USEPA SW-846, Method 8260 as referenced in NYSDEC, ASP 1995	Two 40-ml glass vials with teflon-lined septum cap	80 ml	No head space, cool 4°C	7 days
PCBs[a]	USEPA SW-846, Method 8082 as referenced in NYSDEC, ASP 1995	Two 1-liter amber glass with teflon-lined cap	2 liters	Cool 4°C	Extract within 5 days. Analyze within 40 days following start of extraction.
Oil and Grease	USEPA Method 413.1	One 1-liter amber glass	1 liter	HCl, Cool 4°C	26 days
Total Toxic Organics	USEPA Methods 624 and 625	Two 40-ml glass vials with teflon-lined septum cap	80 ml	No head space, cool 4°C	7 days
Selected metals	USEPA Method 3111B	One 500 ml plastic	500 ml	HNO_3 to pH <3	180 days
TCLP Volatile Organic Compounds	USEPA SW-846, Method 8260 as referenced in NYSDEC, ASP 1995	One 125 ml glass jar with teflon-lined lid	125 ml	minimize head space, cool 4°C	Extract within 14 days. Analyze extract within 14 days of extraction.
TCLP Metals (except mercury)	USEPA SW-846, 6000/7000 Series Methods as referenced in NYSDEC, ASP 1995	One 8-ounce widemouth glass jar	8 oz.	Cool 4°C	Extract within 180 days. Analyze extract within 180 days from extraction.
TCLP Mercury	USEPA SW-846 Method 7470 as referenced in NYSDEC, ASP 1995				Extract within 28 days. Analyze extract within 28 days from extraction.

Notes:

1. ASP = New York State Department of Environmental Conservation 1995 Analytical Services Protocols.
2. VTSR = Verifiable time of sample receipt.
3. Sampler must ensure that samples are delivered to the laboratory within 24 to 48 hours of collection.
4. [a] = ASP methods modified for PCB analysis only.
5. VOCs of concern include 1,2-dichloroethene (cis and trans), trichloroethylene, and vinyl chloride.
6. Selected metals include cadmium, chromium, copper, lead, nickel, and zinc.

Table 8

Chicago Pneumatic Tool Company
Frankfort, New York

Quality Assurance Project Plan
Preventative Maintenance Summary

Maintenance	Frequency
Turbidity Meter	
Store in protective casing	D
Inspect equipment after use	D
Clean sample cells	D
Clean lens	M or X
Check and recharge batteries	D
Keep log book for instrument	D
Have replacement meter available	D
Return to manufacturer for service	X
Calibration	D
Conductivity, pH, Dissolved Oxygen Meters	
Store in protective casing	D
Inspect equipment after use	D
Clean probe	D
Keep log book for instrument	D
Have replacement meter available	D
Replace probes	X
Return to manufacturer for service	X
Calibration	D
Thermometer	
Store in protective casing	D
Inspect equipment after use	D
Have replacement thermometer available	D
Water Level Meter	
Store in protective covering	D
Inspect equipment after use	D
Check indicators/batteries	D
Keep log book for instrument	D
Have a replacement meter available	X
Flame Ionization Detector	
Store in protective casing	D
Inspect equipment after use	D
Check and recharge batteries	D
Refill hydrogen tank	X
Keep log book for instrument	D
Have replacement meter available	D
Return to manufacturer for service	X
Calibration	D

Notes:

D = Daily
M = Monthly
X = Operator's discretion

Attachments

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

ATTACHMENT A

CHICAGO PNEUMATIC TOOL COMPANY
FRANKFORT, NEW YORK
QUALITY ASSURANCE PROJECT PLAN
CORRECTIVE ACTION FORM

Corrective Action No. ______________________________ Date: ______________________

To: ______________________________ cc: Task Manager

You are hereby requested to take corrective actions indicated below and as otherwise determined by you (A) to resolve the noted condition, and (B) to prevent it from reoccurring. Your written response is to be returned to the Quality Assurance Manager (QAM).

Condition ______________________________

Reference Documents ______________________________

Recommended Corrective Actions ______________________________

Originator __________ Date __________ QAM Approval Date __________ P.M. Approval Date __________

Response ______________________________

Corrective Action ______________________________

A. Resolution ______________________________
B. Pretention ______________________________
C. Affected Documents ______________________________

Signature ______________________________ Date: ______________________

Followup ______________________________

Corrective Action Verified:

By: ______________________________ Date: ______________________

Materials and Performance Specifications Index

MATERIALS AND PERFORMANCE SECTION - 01160

SURVEY CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Owner shall provide bench marks for construction purposes, as shown on the Contract Drawings. The Contractor shall safeguard all survey points and bench marks. Should any of these points be destroyed, the replacement cost shall be borne by the Contractor. The Contractor shall assume the entire expense of rectifying work improperly constructed due to failure to maintain and protect such established survey points and bench marks.

B. The Contractor shall be responsible for the layout of all proposed bench marks, grid coordinate locations, lines, grades, and levels necessary for the proper construction and testing of the work called for by the Drawings and Specifications, at no additional cost to the Owner. Survey control shall include, but not be limited to: maintaining appropriate slopes on the containment cell, downchutes, and drainage ditches; and the placement of specified thicknesses of liner materials.

C. The Contractor shall employ a licensed surveyor to provide the surveying functions necessary for the proper construction of the work.

- END OF SECTION -

MATERIALS AND PERFORMANCE SECTION - 02110

CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Work Specified

1. Under this section, the Contractor shall prepare and clear from the site of work, by removal or destruction, as may be required, the following:

   a. Topsoil
   b. Pieces of rock up to 2-cubic yards in volume.
   c. Trees and Bushes
   d. Pavements
   e. Brush
   f. Logs and Stumps
   g. Refuse and Rubbish
   h. Decayed and Growing Organic Matter
   i. Snow and Ice

B. RELATED WORK SPECIFIED ELSEWHERE

1. Section MP-02200 - Earthwork
2. Section MP-02211 - Restoration of Surfaces
3. Section MP-02212 - Topsoil, Seeding, and Mulch
4. Section MP-02221 - Select Fill Material
5. Section MP-02222 - Soil Fill Material

PART 2 - PRODUCTS

Not included.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall furnish all labor, material and equipment necessary to properly complete all work under this section.

B. Tree Protection

1. Any tree which shall not, in the opinion of the Engineer, hinder construction or landscaping shall be protected by stakes placed in a circle having a radius of not less than 5 feet as measured from the base of the trunk around the tree. The stakes shall extend at least 4 feet above the existing ground. Each circle shall consist of at least 6 stakes. Landscaping within the circle shall be accomplished by hand unless otherwise permitted by the Engineer.

MATERIALS AND PERFORMANCE SECTION - 02110

CLEARING AND GRUBBING

C. Debris Removal

1. All brush and trees shall be removed from the area and disposed of at a location selected by Danaher and in conformance with Local and State laws, codes and regulations.

3.02 ENVIRONMENTAL PROTECTION

A. Prohibited Construction Procedures

1. Prohibited construction procedures include, but are not limited to:

   a. Dumping of spoil material into any wetlands, any surface waters, or at unspecified locations.

   b. Indiscriminate, arbitrary or capricious operation of equipment in any stream corridors, any wetlands or any surface waters.

   c. Pumping of silt-laden water from trenches or other excavations into any surface waters, any stream corridors or any wetlands.

   d. Damaging vegetation beyond the extent necessary for construction of the facilities.

   e. Disposal of trees, brush, and other debris in any wetlands, any surface waters or at unspecified locations.

B. Erosion and Sedimentation Control

1. Erosion control procedures, inclusive of mulching, shall be utilized on the site. Erosion control shall occur as required in accordance with Section 02270 entitled Erosion and Sedimentation Control, and immediately following (weather permitting) completion of site and access clearing.

2. De-watering operations shall direct pumpage of water that interferes with construction to an area approved by the Engineer, so as to allow sediment to settle out before such water enters any surface waters. Care should be taken not to damage or kill vegetation by excessive water or by damaging silt accumulation in the discharge area. Settling basins and silt fencing should be used upon the Engineer's direction or as otherwise required to protect vegetation and to achieve environmental objectives.

MATERIALS AND PERFORMANCE SECTION - 02110

CLEARING AND GRUBBING

C. Dust Control

1. Dust shall be controlled by sprinkling and sweeping on paved areas and by sprinkling on unpaved areas. The use of calcium chloride is prohibited.

- END OF SECTION -

MATERIALS AND PERFORMANCE SECTION - 02200

EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. All labor, materials, services and equipment necessary to complete the earthwork as depicted in the Contract Drawings and/or as directed by the Engineer.

1.02 SUBMITTALS

A. Contractor's proposed method(s) of compaction and equipment.

B. Laboratory tests of materials to be placed and compacted.

1.03 DEFINITION

A. Earthwork is defined to include, but not limited to, clearing, topsoil removal and storage, pavement removal, classified and unclassified excavation for subgrades, structures and trenches, handling and disposal of surplus materials, maintenance of excavations, removal of water, sheeting and bracing, steel sheet piling, backfilling operations, rough grading, embankments and fills, compaction, and protection of existing structures and facilities.

B. Excavated material shall be identified as provided herein.

1. Unclassified Excavation

a. Unclassified excavation shall include all materials excavated within the authorized lines and grades described in the Contract Drawings, or as required for construction of the project.

b. Unclassified excavation shall include rock excavation as well as common excavation as defined herein.

c. Unless specifically designated otherwise in the appropriate payment items of the Bid proposal, all excavation shall be considered to be unclassified excavation.

2. Common Excavation

a. Common excavation shall include all excavation except rock excavation.

b. All unconsolidated and non-hardened material, rippable rock, loose rock, soft mineral matter, weathered rock, and soft or friable shale, which are removable with normal earth excavation equipment, shall be classified as common excavation.

MATERIALS AND PERFORMANCE SECTION - 02200

EARTHWORK

c. All boulders and detached pieces of solid rock or concrete or masonry less than one cubic yard in volume shall be classified as common excavation.

3. Rock Excavation

a. Rock excavation shall include all sound solid masses, layers and ledges of consolidated and hardened rock or mineral matter of such hardness, durability and/or texture that is not rippable or cannot be excavated with normal earth excavation equipment.

b. Should a conflict arise as to the classification of excavation as either common or rock, the following tests shall be used in the appropriate determination.

1. Where practicable, a late model, tractor mounted, hydraulic ripper equipped with a single shank ripping point of standard manufacturer's design adequately sized for use with and propelled by a crawler-type tractor rated between 210 and 240 net fly-wheel horsepower, operating in low gear, shall be utilized. Should the suspect material not be effectively loosened or broken down by ripping in a single pass with the aforementioned ripper, the material shall be classified as rock.

2. Where use of the ripper is impracticable, classification as rock shall be determined when the material cannot be loosened or broken down by a six-pound drifting pick. The drifting pick shall be Class D, Federal Specification GGG-H-506d, with a handle not less than 34 inches in length.

4. In excavations where mixed areas of common excavation material and rock excavation material are encountered, individual classification of each material shall be made on an average percentage basis of occurrence of those materials as measured in sections through such excavation and as approved by the Engineer.

5. When rock is encountered in excavation, it shall be removed by blasting methods, jack hammering, or any other method the Contractor deems suitable and safe, considering the proximity of existing utilities or facilities. Blasting operations shall be accomplished in compliance with the requirements of other portions of the specifications, as well as subsection below entitled Existing Facilities. No blasting shall be done until the Engineer has taken the necessary measurements of the rock which is to be removed within payment limits. Extra compensation for rock excavation shall be allowed only if specifically authorized in appropriate payment items of the Bid proposal.

MATERIALS AND PERFORMANCE SECTION - 02200

EARTHWORK

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 TRENCH EXCAVATION

A. Pavements covering areas to be excavated shall be broken up, removed and then disposed of in accordance with the subsection below entitled Surplus Material.

B. Where roadway pavement work is required by this project, all pavement removal shall be saw cut and removed such that the integrity of pavements to remain is protected.

3.02 UNAUTHORIZED EXCAVATION

A. The Contractor shall not be entitled to any compensation for excavation carried beyond or below the lines and subgrades prescribed in the Contract Documents. The Contractor shall refill such unauthorized excavations at his own expense and in conformance with the following provisions of this subsection.

B. Should the Contractor, through negligence or for reasons of his own, carry his excavation below the designated subgrade, 3,000 psi concrete or such other material as may be approved by the Engineer, as specified in MP section entitled "Select Fill Material" or "Soil Fill Material" shall be furnished and placed as backfill in sufficient quantities to reestablish the required subgrade surface. Select fill or soil fill materials used for backfilling shall be spread and compacted in conformance with the requirements of later subsections of this section and to the percentage compaction outlined therein. The cost of any tests required as a result of this refilling operation shall be borne by the Contractor.

C. If the maximum widths of pipe trenches are exceeded, the installed pipes shall be fully cradled in a minimum of 6 inches of 3,000 psi concrete, at the Contractor's expense. Excavation below subgrade which is ordered by the Engineer because the normal subgrade has been disturbed by the Contractor's operations shall be considered as unauthorized excavation, and is subject to correction as outlined above.

3.03 BACKFILL MATERIALS

A. Select fill materials required for filling, backfilling, bedding, subbase and other purposes shall be as shown on the Contract Drawings and as specified in the Contractor's scope of work. Requirements for off-site select materials are specified in the MP section entitled "Select Fill Materials."

B. Soil fill material shall be used as specified for backfill, and when excavated material cannot be used as backfill. Requirements for off-site soil fill materials are specified in the MP Section entitled "Soil Fill Materials."

MATERIALS AND PERFORMANCE SECTION - 02200

EARTHWORK

C. If the excavated material on site is approved in advance by the Engineer for reuse and as being suitable for filling or backfilling purposes, it shall be used.

D. On-site material is designated "native fill" material.

E. When on-site material is used, the Contractor shall remove all frozen material, boulders (over 12-inch diameter), trash, and debris, from such material prior to placement.

F. If he so elects, the Contractor may, at his own expense, substitute other types of material specified elsewhere in place of native fill material, provided such substitution is approved in advance by the Engineer and provided that all replaced material is disposed of as specified in the Contractor's scope of work.

3.04 GENERAL BACKFILLING REQUIREMENTS

A. Backfilling shall be started as soon as practicable and after structures or pipe installations have been completed and inspected, and/or concrete has acquired a suitable degree of strength.

B. Backfilling shall be carried on expeditiously thereafter.

C. Backfill shall be started at the lowest section of the area to be backfilled.

D. Drainage of the areas being backfilled shall be maintained at all times.

E. Areas to be backfilled shall be inspected prior to backfilling operations. All unsuitable materials and debris shall be removed.

F. No backfill shall be placed against foundation walls or structural members unless properly shored and braced or of sufficient strengths to withstand lateral soil pressures.

G. Backfill material shall be inspected prior to placement and all roots, vegetation, organic matter, or other foreign debris shall be removed.

H. Stones larger than 12 inches in any dimensions shall be removed or broken.

I. Stones shall not be allowed to form clusters with voids.

J. Backfill material shall not be placed when moisture content is too high to allow proper compaction.

K. When material is too dry for adequate compaction, water shall be added to the extent necessary.

L. No backfill material shall be placed on frozen ground nor shall the material itself be frozen or contain frozen soil fragments when placed.

M. No calcium chloride or other chemicals shall be added to prevent freezing.

N. Material incorporated in the backfilling operation which is not in satisfactory condition shall be subject to rejection and removal at the Contractor's expense.

O. If the Contractor fails to stockpile and protect on-site excavated material acceptable for backfill, then the Contractor shall provide an equal quantity of acceptable off-site material at no expense to the Owner.

3.05 METHOD OF COMPACTION

A. General

1. The Contractor shall adopt compaction methods which shall produce the degree of compaction specified herein, prevent subsequent settlement, and provide adequate support for the surface treatment, pavement, structure and piping to be placed thereon, or therein, without damage to the new or existing facilities.

2. Methods used shall avoid disturbance to underlying fine-grained soils to subsurface utilities.

3. Before filling or backfilling is begun, the Contractor shall submit in writing a description of the equipment and method for compaction which he proposes to use.

4. Hydraulic compaction by ponding or jetting shall not be permitted.

5. Backfill material shall not be left in an uncompacted state at the close of a day's operation.

6. Prior to terminating work, the final layer of compacted fill, after compaction, shall be rolled with a smooth-wheel roller if necessary to eliminate ridges of soil left by tractors, trucks or other equipment used for compaction.

7. As backfill progresses, the surface shall be graded such that no ponding of water shall occur on the surface of the fill.

8. Fill shall not be placed on snow, ice or soil that was permitted to freeze prior to compaction.

9. Unsatisfactory materials shall be removed prior to fill placement.

B. Equipment

1. Generally, equipment for compaction of foundation bearing surfaces shall be the largest equipment consistent with space limitations of the work areas and the need to protect adjacent facilities.

MATERIALS AND PERFORMANCE SECTION - 02200

EARTHWORK

2. Compaction of select fill material adjacent to foundation walls, footings, piers, and in other confined areas shall be accomplished by means of a drum-type, power driven, hand-guided vibratory compactor, or by hand-guided vibratory plate tampers.

3. If the proposed method does not give the degree of compaction required, an alternate method shall be adopted until the required compaction is achieved.

4. The moisture content of backfill or fill material shall be adjusted, if necessary, to achieve the required degree of compaction.

C. Inside Buildings

1. Fill placed within the building lines or outside the building lines, but below the bearing level of adjacent foundation elements shall be placed in layers 6 inches in thickness (measured prior to compaction) where hand-guided compaction equipment is used, and not exceeding 8 inches in thickness (measured prior to compaction) when self-propelled or tractor-drawn compaction equipment is used.

2. Under slabs on grade and backfill around structures and above footings, backfill shall be placed in 8-inch thick layers (measured prior to compaction).

3. This fill shall be compacted as specified in Table 1 of this section.

D. Outside Buildings

1. Backfill and fill placed outside the building lines and above the bearing level of adjacent foundation elements shall be placed in layers not exceeding 12 inches in thickness (measured prior to compaction) and shall be compacted as specified in Table 1 of this section.

E. Natural Subgrade

1. The natural subgrade for all structural components, including embankments, access roads, and pipes, shall consist of firm undisturbed natural soil, at the grades shown on the Drawings.

2. After excavation to subgrade is completed, the subgrade shall be compacted, as necessary, to provide a firm, stable surface. Following completion, the Contractor shall provide evidence of satisfactory compaction as determined by the Engineer.

3. This compaction shall be limited to that required to compact loose surface material and shall be terminated in the event that it causes disturbance to underlying fine-grained soils, as revealed by weaving or deflection of the subgrade under the compaction equipment.

MATERIALS AND PERFORMANCE SECTION - 02200

EARTHWORK

F. Minimum Compaction Requirements

1. Unless specified otherwise on the Contract Drawings or in these specifications, the degree of compaction specified for the various items listed in Table 1 shall be the minimum allowable.

2. Unless the Contractor can successfully demonstrate that his methods shall produce the required degree of compaction, materials to be compacted shall be placed in layers not exceeding the uncompacted thicknesses listed in Table 1.

3. The Engineer may order in-place density tests to ascertain conformance with the compaction requirements shown on Table 1.

4. In-place density tests shall be required at a minimum of one test per each lift of backfill placed or at frequencies deemed necessary by the Engineer to reliably and consistently determine the general compaction level being achieved.

5. The Contractor shall dig test holes at no additional cost to the Owner when requested for the purpose of taking an in-place density test below the current fill level.

6. The Contractor shall provide free access to trenches and fill areas for the purpose of making such tests. Payment for these tests shall be made by either the Contractor where tests indicate non-compliance with specified requirements or the Owner where test results indicate compliance; or as otherwise specified elsewhere in the Contract Documents.

7. The Contractor shall anticipate time needed due to testing procedures and shall not have claims for extra compensation occasioned by such time.

8. Minimum field compaction requirements in Table 1 are expressed as a percentage of the maximum dry unit weight of the material compacted in this laboratory.

TABLE 1
MINIMUM COMPACTION REQUIREMENTS

Type of Backfill	Max. Uncompacted Fill Layer Thickness (Inches)	Minimum Compaction (Percent)	Per ASTM Method
1. Pipe Bedding	8	95	D1557
2. Pipe Sidefills	8	93	D1557
3. Trench Backfill Over Pipe	8	90	D1557

MATERIALS AND PERFORMANCE SECTION - 02200

EARTHWORK

TABLE 1
MINIMUM COMPACTION REQUIREMENTS

	Type of Backfill	Max. Uncompacted Fill Layer Thickness (Inches)	Minimum Compaction (Percent)	Per ASTM Method
4.	Fill Under Streets, Parking Lots and Other Paved Areas	8	92	D1557
5.	Inside Buildings	6 or 8	95	D1557
6.	Outside Buildings	12	90	D1557
7.	Ditch Subgrade	As Req'd	--	--
8.	Ditch Backfill (Fill Depth 8-inches or Greater)	8	90	D1557
9.	Ditch Backfill (Fill Depth Under 8-inches)	As Req'd	--	--
10.	Remedial Soil Excavation (Areas)	8	90	D1557
11.	Remedial Soil Excavation (Areas)	12	90	D1557
12.	Natural Subgrade	As Req'd	--	--
13.	Containment Cell Berm and Subbase	8	90	D1557
14.	Access Road Fill and Surface	8	90	D1557

10. Compaction curves for the full range of soil materials shall be developed by the Contractor.

3.06 BACKFILL FOR PIPE TRENCHES

A. General

1. Pipe foundations, to a depth of 1 foot above the pipe, shall be placed in 8-inch loose lift and thoroughly compacted by approved mechanical methods to ensure firm bedding and side support. Refer to Table 1 for density requirements.

2. For plastic or polyethylene pipe materials, do not compact directly over pipe until 8-inches of cover has been installed above the pipe. Compaction of backfill material above the pipe shall be performed with equipment that shall not damage or distort the under lying pipe.

3. When backfill reaches 1 foot above the top of the pipe, the entire surface shall be compacted by mechanical means except as provided above.

4. The remainder of the trench shall be backfilled and compacted in accordance with the subsection above entitled Method of Compaction.

3.07 BACKFILL FOR STRUCTURES

A. Backfill shall be placed in layers not exceeding 8-inches thick and thoroughly compacted by mechanical means.

B. In addition, where pipelines or conduits are to be placed in backfill, all backfill under the pipes shall be select fill unless a specific method of supporting such pipes is specified.

3.08 BACKFILL EMBANKMENTS AND FILLS

A. General

1. Embankment areas shall be cleared and grubbed prior to initiating fill operations.

2. Embankments shall be formed of satisfactory materials placed in successive layers, approximately horizontal, of not more than 8-inches in loose depth for the full width of the embankment.

3. All materials placed in constructing the embankment shall be free of organic matter, leaves, grass, roots, and other objectionable material.

4. At all times the Contractor shall slope the embankment to provide surface drainage.

5. The materials placed in the layers shall be of the proper moisture content to obtain the prescribed compaction.

6. Wetting or drying of the material to secure a uniform moisture content throughout the layer may be required.

7. Generally, to obtain compaction, water content shall be between 1 percent over optimum to 2 percent under optimum.

B. Compaction

1. Rolling operations shall be continued until the embankment is compacted to the density as specified in the subsection above entitled Method of Compaction.

2. Any areas inaccessible to rollers shall be compacted by mechanical tampers.

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3. In the construction of embankments, starting layers shall be placed in the deepest portion of the fill, and as placement progresses, layers shall be constructed approximately horizontal, maintaining drainage and keying layers into adjoining slopes.

4. The compaction equipment shall be of such design, weight and quantity as to obtain the required density.

3.09 GRADING

A. After the completion of all fill and backfill operations, the Contractor shall grade the site to the lines, grades and elevations shown on the Drawings, taking into account any subsequent site restoration and paving requirements.

B. Finish grading shall not be done until the installation of all underground utilities, culverts, etc., have been completed.

3.10 EXISTING FACILITIES

A. General

1. Some of the existing subsurface facilities likely to be encountered during construction of the work, or located in such close proximity to the work to be done under the Contract as to require special precautions and methods for their protection are indicated on the Drawings.

2. These facilities may include, but are not necessarily limited to, buildings, tanks, sewers, drains, water mains, conduits and their appurtenances.

3. However, the sizes, locations, and heights or depths if indicated are only approximately correct and the Contractor shall conduct his operations with caution and satisfy himself as to the accuracy of the information given.

4. He shall not claim nor shall he be entitled to receive compensation for damages sustained by reason of the inaccuracy of the information given or by reason of his failure to properly maintain and support such structures.

5. There may be other subsurface facilities, the existence and/or location of which are not known, such as individual water and gas services, electrical conduits, telephone, storm drains, etc.

6. The Contractor shall consult with the owners of such facilities and, if possible, shall determine, prior to construction, the location and depth of any such facilities which may exist in the area to be excavated.

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7. If underground facilities are known to exist in an area but their location is uncertain, the Contractor shall exercise reasonable care in his excavation technique to avoid damage to them.

8. The Contractor shall notify UFPO prior to work.

B. Notification and Protection Procedures

1. Except where superseded by state or local regulations, or in the absence of any application regulations, the Contractor shall, as a minimum, include the following procedures in his operations:

a. Prior to Excavating or Blasting

1. Determine correct field location of all nearby underground facilities to arrange for the owner of the utilities to locate them.

2. Notify owners of nearby underground facilities when excavating or blasting is to take place, allowing them reasonable time to institute precautionary procedures or preventive measures which they deem necessary for protection of their facilities.

3. In cooperation with owners of nearby facilities, provide temporary support and protection of those underground facilities which may be especially vulnerable to damage by virtue of their physical condition or location, or those which could create hazardous conditions if damaged.

b. Immediately notify any utility owner of any damage to his underground facilities resulting from the Contractor's operations, and arrange for repairs to be made as soon as possible.

c. In case of an electrical short, or escape of gas or hazardous fluids (resulting from damage to an underground facility), immediately notify the Fire Department and all persons who might be endangered and assist in evacuation of people from the area.

C. Support of Existing Facilities

1. Existing facilities encountered within an excavated area shall be adequately supported, blocked and/or braced.

2. If required by the owner of such facility, such supports shall be left in place to the extent required. Backfilling and compaction under and around the facilities shall be accomplished with extreme caution so as not to disturb or damage the facility or its supports, and so as to prevent future settlement and possible rupture of the facilities.

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EARTHWORK

3. Existing facilities removed by the Contractor in lieu of support of such facilities shall be replaced at the Contractor's cost.

D. Relocation of Existing Facilities (Except as Otherwise Provided)

1. Should the location or position of any gas or water pipe, public or private sewer or drain, conduit or other structure be such as, in the opinion of the Engineer, to require its removal, realignment or change, such alteration shall be without the cost to the Contractor for the work of removal, realignment, or change only; however, such structure shall be uncovered and supported or sustained by the Contractor at his own cost and expense before such removal or before and after such realignment or changes, as constituting part of his contract.

2. The Contractor shall not become entitled to claim any damages or extra compensation for or on account of the presence of such structures or on account of any delay due to removal or rearrangement of the same, but the Contractor shall be entitled to such an extension of time for the completion of the work as the Engineer shall decide that the work has been delayed by the removal, realignment or change of such obstruction.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02211

RESTORATION OF SURFACES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. All types of surfaces, sidewalks, curbs, gutters, culverts and other features disturbed, damaged or destroyed during the performance of the work under or as a result of the operations of the Contract, shall be restored and maintained, as specified herein or as modified or described in the Special Conditions.

2. The quality of materials and the performance of work used in the restoration shall produce a surface or feature equal to or better than the condition of each before the work began, as approved by the Engineer.

1.02 SUBMITTALS

A. A schedule of restoration operations shall be submitted by the Contractor for review.

1.03 SCHEDULE OF RESTORATION

A. After an accepted schedule has been agreed upon, it shall be adhered to unless otherwise revised with the approval of the Engineer.

B. Permanent restoration of paved surfaces shall not be permitted until six month's time has elapsed after excavations have been completely backfilled as specified.

C. The replacement of surfaces at any time, as scheduled or as directed, shall not relieve the Contractor of responsibility to repair damages by settlement or other failures.

PART 2 - PRODUCTS

Not included.

PART 3 - EXECUTION

3.01 STONE OR GRAVEL PAVEMENT

A. All pavement and other areas surfaced with stone or gravel shall be replaced with material to match the existing surface unless otherwise specified.

1. The depth of the stone or gravel shall be at least equal to the existing.

2. After compaction, the surface shall conform to the slope and grade of the area being replaced.

MATERIALS AND PERFORMANCE - SECTION 02211

RESTORATION OF SURFACES

3.02 CURBS AND GUTTER REPLACEMENT

A. Curbs and gutters removed or damaged in connection with or as a result of the construction operations shall be replaced with new construction.

B. The minimum length of curb or gutter to be left in place or replaced shall be 5 feet. Where a full section is not being replaced, the existing curb or gutter shall be saw cut to provide a true edge.

1. The restored curb or gutter shall be the same shape, thickness and finish as being replaced and shall be constructed of air-entrained Class "B" concrete. One-half inch expansion joint material shall be placed around all objects within the sidewalk area as well as objects to which the new concrete shall abut, such as valve boxes, manhole frames, curbs, buildings and others.

3.03 LAWNS AND IMPROVED AREAS

A. The area to receive topsoil shall be graded to a depth of not less than 4 inches or as specified, below the proposed finish surface.

1. If the depth of existing topsoil prior to construction was greater than 4 inches, topsoil shall be replaced to that depth.

B. The furnishing and placing of topsoil, seed and mulch shall be as directed by the Engineer.

C. When required to obtain germination, the seeded areas shall be watered in such a manner as to prevent washing out of the seed.

D. Any washout or damage which occurs shall be regraded and reseeded until a good sod is established.

E. The Contractor shall maintain the newly seeded areas, including regrading, reseeding, watering and mowing, in good condition.

3.04 OTHER TYPES OF RESTORATION

A. Trees, shrubs and landscape items damaged or destroyed as a result of the construction operations shall be replaced in like species and size.

1. All planting and care thereof shall meet the standards of the American Association of Nurserymen.

B. Water courses shall be reshaped to the original grade and cross-section and all debris removed. Where required to prevent erosion, the bottom and sides of the water course shall be protected.

MATERIALS AND PERFORMANCE - SECTION 02211

RESTORATION OF SURFACES

C. Culverts destroyed or removed as a result of the construction operations shall be replaced in like size and material and shall be replaced at the original location and grade. When there is minor damage to a culvert and with the consent of the Engineer, a repair may be undertaken, if satisfactory results can be obtained.

D. Fences destroyed or removed as a result of the construction operations shall be replaced in like size and material and shall be replaced at the original location.

3.05 MAINTENANCE

A. The finished products of restoration shall be maintained in an acceptable condition for and during a period of one year following the date of Substantial Completion or other such date as set forth elsewhere in the Contract Documents.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02212

TOPSOIL, SEEDING AND MULCH

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Work under this section consists of furnishing and placement of topsoil, fertilizer, seed, and mulch.

B. Maintenance of seeded areas until final acceptance.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. MP-Section 02200 - Earthwork

1.03 SUBMITTALS

A. Analysis of the seed (to demonstrate compliance with the seed mix identified in Section 2.01 of this specification) and fertilizer (to identify chemical composition), and proposed application rates.

B. Should hydroseeder be used, the Contractor shall submit all data including material and application rates.

C. Location of source, and pH and organic content testing of off-site topsoil (if required).

PART 2 - PRODUCTS

2.01 MATERIALS

A. Any off-site topsoil shall be unfrozen, friable, natural loam and shall be free of clay lumps, brush needs, litter, stumps, stones, and other extraneous matter. The topsoil shall have an organic content between 5 and 20 percent, and a pH between 5.5 and 7.5.

B. All topsoil material shall be free from detectable levels of target compound list organic chemical contaminants and shall not have target analyte list inorganics at concentrations which exceed existing background levels.

C. Fertilizer shall be a standard quality commercial carrier of available plant food elements. A complete prepared and packaged material containing a minimum of 5 percent nitrogen, 10 percent phosphoric acid and 10 percent potash.

1. Each bag of fertilizer shall bear the manufacturer's guaranteed statement of analysis.

D. Seed mixtures shall be of commercial stock of the current season's crop and shall be delivered in unopened containers bearing the guaranteed analysis of the mix.

1. All seed shall meet the State standards of germination and purity.

E. Seed mix:

65%	Kentucky Blue Grass
20%	Perennial Rye Grass
15%	Fescue

F. Mulch shall be stalks of oats, wheat, rye or other approved crops free from noxious weeds and coarse materials.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The topsoil shall be applied in a single loose lift of not less than six-inches. No compaction is required or allowed.

1. Following placement of topsoil and prior to fertilizer application, all stones greater than 1-inch in diameter, sticks, and other deleterious material shall be removed.

B. The fertilizer shall be applied to the surface uniformly at the rate of 20 pounds per 1,000 square feet.

1. Following the application of the fertilizer and prior to application of the seed, the topsoil shall be scarified to a depth of at least 2 inches with a disk or other suitable method traveling across the slope if possible.

C. After the soil surface has been fine graded, the seed mixture shall be uniformly applied upon the prepared surface with a mechanical spreader at a rate specified by the seed manufacturer.

1. The seed shall be raked lightly into the surface.

2. Seeding and mulching shall not be done during windy weather.

D. The mulch shall be hand or machine spread to form a continuous blanket over the seed bed, approximately 2 inches in uniform thickness at loose measurement with a minimum of 90% surface coverage. Excessive amounts or bunching of mulch shall not be permitted.

1. Mulch shall be anchored by an acceptable method.

MATERIALS AND PERFORMANCE - SECTION 02212

TOPSOIL, SEEDING AND MULCH

2. Unless otherwise specified, mulch shall be left in place and allowed to decompose.

3. Any anchorage or mulch that has not disintegrated at time of first mowing shall be removed. For peg-type anchors, anchors may be removed or driven flush with ground surface.

E. Seeded areas shall be watered as often as required to obtain germination and to obtain and maintain a satisfactory sod growth. Watering shall be in such a manner as to prevent washing out of seed and mulch.

F. Hydroseeding may be accepted as an alternative method of applying fertilizer, seed and mulch. The Contractor must submit all data regarding materials and application rates to the Engineer for review.

3.02 MAINTENANCE

A. All erosion rills or gullies within the topsoil layer shall be filled with additional topsoil and graded smooth, and reseeded and mulched.

B. The Contractor shall also be responsible for repairs to all erosion of the seeded areas until all new grass is firmly established and reaches a height of not less than 4 inches. All bare or poorly vegetated areas must be reseeded and mulched.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02215

STEEL SHEETING SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

The Contractor shall furnish all labor, materials, equipment, surveys and services necessary for or incidental to, the following:

A. Furnishing and driving of the steel sheeting around the perimeter of Areas 7 and 9 (if steel sheeting is selected as the method for soil excavation reinforcement).

B. Furnishing and installing wales and bracing (if necessary).

C. Removing temporary sheeting, wales and bracing (if necessary).

1.02 QUALITY ASSURANCE

A. The sheetpile system shall be constructed of materials installed in such a way as to minimize ground-water infiltration and to permit excavation activities to be completed to implement other means of stabilization of the excavation sidewalls (i.e., benching or sloping) and maintenance activities.

B. Driving and Erecting: The Contractor shall be regularly engaged in the driving and erection of steel sheeting.

C. Qualifications of Welders: In accordance with the American Welding Society (AWS). Qualified within the past year.

D. Codes and Standards

1. American Welding Society (AWS)
2. American Society for Testing and Materials (ASTM)
3. American Institute of Steel Construction (AISC)

1.03 SUBMITTALS

A. Shop Drawings

1. Plans, and/or details locating and defining all materials furnished. All structures, utilities, poles and pertinent items shall be shown and demonstrated.

2. Plans and details shall be sealed by a Professional Engineer licensed to practice in New York State.

B. Certificates

1. Certify that materials meet or exceed specification requirements.

C. Design Calculations

1. Prepared and sealed by a professional engineer licensed to practice in New York State.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Steel Sheet Piling - Shall meet or exceed one of the following:

1. ASTM A 328
2. ASTM A 572 - Grade 50 and 55
3. ASTM A 690

B. Structural Shapes

1. ASTM A 36

C. Hammer

1. Single or double acting air or steam hammer.
2. Vibratory hammer.

D. All steel sheet piling shall be new or shall be in good condition. Used steel sheetpiling (if used) shall be subjected to a visual inspection by the Engineer to determine if the sheeting is acceptable.

PART 3 - EXECUTION

3.01 PREPARATION FOR DRIVING

A. Determine piling layout.
B. Establish necessary lengths.
C. Locate and protect all underground and aboveground utilities, piping, structures, etc.

3.02 INSTALLATION

A. All surface water diversion and sedimentation and erosion control measures in the vicinity of the excavation areas shall be installed prior to sheetpile installation.

B. Initially, the top of the steel sheetpiles shall be set at an elevation of 2-feet above original grade and must be even. Following all on-site remediation activities, including backfilling, the sheetpiles shall be removed. Steel sheetpiles that remain (if any) shall be cut to a final elevation of three feet below grade.

MATERIALS AND PERFORMANCE - SECTION 02215

STEEL SHEETING SYSTEM

C. The purpose of the steel sheeting system is to allow soil located within the limits of the system (immediately adjacent to the sheeting) to be removed (as specified in the Description of Work Tasks) following its installation. The void created by such excavation ultimately shall be backfilled to existing grade.

D. Any material or obstruction which stops the driving shall be removed by the Contractor.

E. Plumb within 4 percent of pile length.

F. The structure shall be installed in such a way as to minimize routine operation and maintenance activities.

G. The sheeting system shall be designed and constructed to meet all safety requirements.

H. All sheets shall interlock, and shall encompass the perimeter of the excavation areas.

3.03 SERVICE CONDITIONS

A. The sheetpiles shall be installed in such a manner as to consider the presence of potential horizontal forces acting on the sheetpiles which may be attributed to fluctuating groundwater elevations, surcharge loads, live loads, lateral earth pressure, loads associated with the electric poles, and/or soil removal.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02219

GEOSYNTHETIC DRAINAGE COMPOSITE

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor shall provide all labor, materials, tools and equipment necessary to furnish and install geosynthetic drainage composite on the side slope liner as specified herein and as shown on the Contract Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section MP-02234 - Geomembrane

1.03 REFERENCES

A. American Society of Testing and Materials (ASTM);

1.	D1505-85	Density Gravity Test
2.	D1238-88	Flow Rates of Thermoplastics by Extrusion Plastometer
3.	D1603	Carbon Black Content Test
4.	D374	Thickness
5.	D4716-87	Constant Head Transmissivity
6.	D3776	Weight
7.	D1777	Thickness
8.	D4632	Tensile Properties
9.	D3786	Mullen Burst
10.	D4833	Puncture
11.	D4751	A.O.S.
12.	D4533	Trapezoidal Tear

1.04 SUBMITTALS

A. Operational Submittals

1. Manufacturers data for the geosynthetic drainage composite including physical properties and roll size.

2. Geosynthetic drainage composite material sample.

3. Manufacturer's quality assurance/quality control program.

4. Certified results of all quality control testing.

5. Contractor's proposed transportation, handling and storage techniques.

MATERIALS AND PERFORMANCE - SECTION 02219

GEOSYNTHETIC DRAINAGE COMPOSITE

6. Shop drawings, and proposed installation techniques.

PART 2 - PRODUCT

2.01 ACCEPTABLE MANUFACTURERS

A. Gundle Lining Systems, Inc., Houston, TX or equal.

2.02 MATERIALS

A. The geosynthetic drainage composite shall be comprised of a high density polyethylene (HDPE) drainage net composited with (2), 6 oz/yd^2 non-woven geotextiles - one geotextile heat bonded to each side of the drainage net. Acceptable geosynthetic drainage composite shall be Gundle Fabrinet.

1. The drainage net to be utilized in the composite shall be a profiled mesh made by extruding two sets of high density strands together to form a diamond shaped, three-dimensional net to provide planar fluid or gas flow. The drainage net shall be made of HDPE containing carbon black, anti-oxidants and heat stabilizers which shall be manufactured from resin provided from one resin supplier.

2. The geotextile shall be a non-woven, needle punched polymeric material.

B. The geosynthetic drainage composite shall meet the following specifications:

1. Drainage Net

Property	Test Method	Test Value
Specific Gravity (g/cm^3)	ASTM D1505	0.94 minimum
Melt Flow Index (g/10 min)	ASTM D1238 - Condition E	0.3 maximum
Percent Carbon Black (%)	ASTM D1603	2.0 minimum
Transmisivity (m^2/sec)	ASTM D4716	2 x 10^{-3} minimum
Thickness (mil)	ASTM D374 at Strand Intersection	200 - 265 minimum

MATERIALS AND PERFORMANCE - SECTION 02219

GEOSYNTHETIC DRAINAGE COMPOSITE

2. Geotextile

Property	Test Method	Test Value
Fabric Weight (oz/yd^2)	ASTM D-3776	5.7
Thickness (mils)	ASTM D-1777	75
Grab Strength (lbs.)	ASTM D-4632	150
Grab Elongation (%)	ASTM D-4632	50
Mullen Burst (psi)	ASTM D-3786	275
Puncture (lbs.)	ASTM D-4833	80
A.O.S. (U.S. Sieve)	ASTM D-4751	70
Trapezoidal Tear (lbs.)	ASTM D-4533	65
Permittivity (gal/min/ft^2/sec^{-1})	ASTM D-4491	90/1.7
Permeability (cm/sec)	ASTM D-4491	.2

2.03 DELIVERY, STORAGE AND HANDLING

A. The geosynthetic drainage composite shall be packaged and shipped by appropriate means so as to prevent damage. Materials shall be delivered only after the required submittals have been received and reviewed by the Engineer.

B. The geosynthetic drainage composite shall be furnished in rolls, marked or tagged with the following information:

1. Manufacturer's Name
2. Product Identification
3. Lot/Batch Number
4. Roll Number
5. Roll Dimensions

C. The geosynthetic drainage composite shall be stored in an area approved by the Engineer which prevents damage to the product or packaging.

D. The geosynthetic drainage composite shall be kept clean and free from dirt, dust, mud and any other debris.

E. Any geosynthetic drainage composite found to be damaged shall be replaced with new material at the Contractor's expense.

MATERIALS AND PERFORMANCE - SECTION 02219

GEOSYNTHETIC DRAINAGE COMPOSITE

2.04 QUALITY ASSURANCE

A. Field delivered material shall meet the specifications values according to the manufacturer's specification sheet. The Contractor shall submit written certification that the delivered material meets the manufacturer's specifications. The Contractor shall submit to the Engineer certified quality control test results conducted by the manufacturer during the manufacturing of the geosynthetic drainage composite delivered to the project site. The results must identify the sections of field delivered geosynthetic drainage composite they represent.

B. The manufacturer shall have developed and shall adhere to their own quality assurance program in the manufacture of the geosynthetic drainage composite.

C. The installer shall verify in writing prior to installation that the geosynthetic drainage composite has not been damaged due to improper handling or storage.

D. Each of the installer's personnel shall have recorded 500,000 sf of successful material installation.

E. The Contractor shall provide shop drawings for indicating panel layouts and installation sequence.

F. The Contractor shall conduct the following drainage net fingerprinting test at a minimum rate of one sample per resin lot on a sample of the finished product.

1. Thermogravimetry (TG) Analysis

Test results shall be submitted to the Engineer, prior to construction, along with, at a minimum; the lot numbers and roll/panel numbers represented by the samples tested.

PART 3 - EXECUTION

3.01 PREPARATION

A. The areas designated for placement of geosynthetic drainage composite shall be free from any deleterious material.

B. If the geosynthetic drainage composite is not clean before installation, it shall be washed by the Contractor until accepted by the Engineer.

3.02 INSTALLATION

A. Geosynthetic drainage composite shall be installed at locations shown on the Contract Drawings.

B. Adjacent rolls shall be overlapped approximately 2 - 4 inches and secured by plastic ties approximately every five feet.

MATERIALS AND PERFORMANCE - SECTION 02219

GEOSYNTHETIC DRAINAGE COMPOSITE

C. Plastic ties shall be recommended by the geosynthetic drainage composite manufactured and shall be white or other bright color for easy inspection.

D. In the corners of the side slopes, where overlaps between rolls of nets are staggered, an extra layer of geosynthetic drainage composite shall be installed from the top to the bottom of the slope.

E. The geosynthetic drainage composite shall be unrolled downslope keeping the net in slight tension to minimize wrinkles and folds.

F. Adequate loading shall be placed to prevent uplift by wind.

G. Holes or tears in the geosynthetic drainage composite shall be repaired in accordance with the manufacturer's recommendations.

3.03 QUALITY CONTROL

A. The Contractor shall provide as-built drawings identifying panel layout, locations or imperfections, and repairs and any other appropriate observations.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02221

SELECT FILL MATERIAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. Work under this section shall include, but not necessarily be limited to, supplying all labor and materials, excavating, transporting, dumping, spreading, and compacting select fill material in the locations and to the depths shown on the Contract Drawings and/or as directed by the Engineer.

2. Select fill material shall be used in the construction of the containment cell drainage layers, structural backfill, pipe trench backfill, and access roads as shown on the Contract Drawings.

B. Applicable Standards and Specifications

1. American Society for Testing Materials (ASTM).

1.02 SUBMITTALS

A. Refer to Section 2.3.1 of RD Specifications for submittal requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Select fill shall be the type listed below:

Type (1) - Select Fill

1. Type (1) - Select fill shall be NYSDOT Type 2 subbase coarse (Item No. 304.03).

Type (2) - Select Fill

2. Type (2) - Select fill shall consist of clean, sound, medium to coarse sand or fine gravel free from organic materials and coatings. Type (2) material shall also be free of any sticks, roots, refuse, or any other deleterious substances, and possess a minimum in-place permeability of 1×10^{-1} cm/sec. Type (2) select fill shall meet the following gradation by weight:

MATERIALS AND PERFORMANCE - SECTION 02221

SELECT FILL MATERIAL

% Passing	Sieve
100	½"
0-30	No. 50
0-5	No. 200

Type (3) - Select Fill

3. Type (3) - Select fill shall consist of clean, sound, medium to coarse sand or fine gravel free from organic materials and coatings. Type (3) material shall also be free of any sticks, roots, refuse, or any other deleterious substances, and possess a minimum in-place permeability of $1x10^{-2}$ cm/sec. Type (3) select fill shall meet the following gradation by weight:

% Passing	Sieve
100	½"
0-30	No. 50
0-5	No. 200

Type (4) - Select Fill

4. Type (4) - Select fill shall be run-of-crusher stone and consist of clean, sound, hard durable limestone free from organic materials and coatings. Type (4) material shall also be free of any sticks, roots, refuse, or any other deleterious substances. Type (4) select fill shall meet the following gradation by weight:

% Passing	Sieve
100	1½"
95-100	1
65-80	½"
40-60	¼"
0-10	No. 200

MATERIALS AND PERFORMANCE - SECTION 02221

SELECT FILL MATERIAL

Type (5) - Select Fill

5. Type (5) - Select fill shall be washed, coarse sand having the following gradation by weight:

% Passing	Sieve
100	3/8"
95-100	No. 4
80-100	No. 8
50-85	No. 16
25-60	No. 30
10-30	No. 50
2-10	No. 100

B. Special Circumstances

1. All select fill shall be free from detectable levels of target compound list organic chemical contaminants and shall not contain target analyte list inorganics at concentrations above site background levels.

PART 3 - EXECUTION

3.01 USAGE

A. Type (1) select fill shall be used as culvert pipe bedding and backfill and for construction of site access roads as shown on the Contract Drawings.

B. Type (2) select fill shall be used to construct the 12-inch thick final cover system drainage layer as shown on the Contract Drawings.

C. Type (3) select fill shall be used to construct the 12-inch thick liner system drainage layer (leachate collection layer) and as anchor trench pipe bedding and backfill as shown on the Contract Drawings.

D. Type (4) select fill shall be used for structural backfill as shown on the Contract Drawings.

3.02 PLACEMENT

A. For all select fill, the following preparation and inspection shall be conducted prior to placement:

MATERIALS AND PERFORMANCE - SECTION 02221

SELECT FILL MATERIAL

1. Verify stockpiled material to be used is approved for the particular layer.

2. Verify areas to be filled are properly compacted and all geosynthetics, if used, are in place.

3. Verify areas to be backfilled are free of debris, snow, ice or water and ground surfaces are not frozen.

4. Identify required lines, levels, contours and datums.

5. Grade and uniformly compact subgrade, as required.

6. Demonstrate completeness of subgrade preparation in a manner acceptable to the Engineer.

3.03 FIELD TESTING AND QUALITY CONTROL

A. In-place density testing shall be performed at the Owner's expense by an independent testing laboratory approved by the Engineer for Types (1) and (4) select fill. Testing shall be performed in accordance with ASTM D2922 or D1556. In-place density testing shall be as specified in the section for earthwork.

B. Laboratory permeability tests shall be conducted at a frequency of one test per acre for Types (2) and (3) select fill. Permeability tests shall be performed in accordance with ASTM D2434.

C. One particle size (ASTM D422) analysis test shall be conducted during performance of the contract work. Additional tests may be performed at the discretion of the Engineer.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02222

SOIL FILL MATERIAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. Work under this section shall include, but not necessarily be limited to, supplying all labor and materials, excavating, transporting, dumping, spreading, and compacting soil fill material in the locations and to the depth shown on the Contract Drawings and/or as directed by the Engineer.

2. Soil fill material shall be used in the construction of the containment cell subgrade, perimeter berm, access roads and as backfill for remedial excavations, as shown on the Contract Drawings.

B. Applicable Standards and Specifications

1. American Society for Testing Materials (ASTM).

PART 2 - PRODUCTS

2.01 MATERIALS

A. Soil fill material shall be natural soil, free from excessive moisture, frost, stumps, trees, roots, sod, muck, marl, vegetable matter or other unsuitable materials. Soil fill material shall have an organic content of less than 0.5 percent as determined using a loss on ignition test and shall not contain detectable levels of target compound list organic chemical contaminants. Soil fill material shall be certified clean by the materials supplier.

B. Acceptable soil fill material for use as backfill shall be suitable for compaction in layers not exceeding eight (8) inches in loose thickness and shall remain stable when wet. Soil fill shall have the following gradation by weight:

Percent Passing	Sieve
100	3"
80-100	1"
60-100	#4
5-40	#40
0-40	#200

C. Special Circumstances

MATERIALS AND PERFORMANCE - SECTION 02222

SOIL FILL MATERIAL

1. All select fill shall not contain detectable levels of target compound list organic chemical contaminants and shall not have target analyte list inorganics at concentrations above site background levels.

2.02 SUBMITTALS

A. Refer to Section 2.3.1 of RD Specifications for submittal requirements.

PART 3 - EXECUTION

3.01 PLACEMENT

A. The entire surface to be covered with soil fill material shall be stripped of all grass, vegetation, topsoil, rubbish, or other unsuitable materials before backfilling. At the discretion of the Engineer, said materials shall be either stockpiled on-site or disposed of at an approved off-site location.

B. In general, soil fill material shall be placed and compacted in horizontal layers not exceeding eight (8) inches in loose thickness and stones shall not exceed three (3) inches in greatest dimension and shall be well distributed throughout the mass. Subgrade for placement of soil fill material shall be approved by the Engineer. Soil fill material shall not be placed on ground which shall not support the weight of construction equipment.

C. Each layer of soil fill material shall be thoroughly tamped or rolled to the required degree of compaction by mechanical tampers, or vibrators. Successive layers shall not be placed until the layer under construction has been thoroughly compacted.

D. Trucks or other heavy equipment shall not be operated over pipelines until the minimum depth of backfill above the crown of the trenched pipe as specified on the contact drawings, has been placed and properly compacted by tampers or other approved method.

E. Where required, the Contractor shall, at his own expense, moisture condition the fill to meet the compaction requirements of the specification. If, due to rain or other causes, the material is too wet for satisfactory compaction, it shall be allowed to dry or be removed as required, before compaction.

3.02 FIELD TESTING AND QUALITY CONTROL

A. In-place density testing shall be performed by an independent testing laboratory at the Owner's expense. Testing shall be performed in accordance with ASTM D2922 or D1556. In-place density testing shall be as specified in the Earthwork section.

MATERIALS AND PERFORMANCE - SECTION 02222

SOIL FILL MATERIAL

3.03 CRITERIA AND TOLERANCES

A. Soil fill material shall be constructed to such heights as to make allowance for post-construction settlement. Any settlements which occur before final acceptance of the Contract shall be corrected to make the backfill conform with the established lines and grades.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02232

GEOTEXTILE FABRIC

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor shall supply all labor, materials, tools, and equipment required to furnish and install woven and non-woven geotextile fabric as specified herein and as shown on the Contract Drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM D3776 Unit Weight
2. ASTM D4632 Grab Tensile
3. ASTM D4632 Grab Elongation
4. ASTM D3786 Mullen Burst
5. ASTM D4833 Puncture
6. ASTM D4533 Trapezoid Tear
7. ASTM D4751 Apparent Opening Size
8. ASTM D4491 Permittivity
9. ASTM D1777 Thickness

1.03 SUBMITTALS

A. Manufacturer's data for geotextile including, at a minimum, physical properties, packaging, and installation techniques.

B. Manufacturer's quality assurance/quality control program.

C. Certified results of all quality control testing.

D. Contractor's proposed transportation, handling, storage, and installation techniques.

E. Shop drawings.

F. Manufacturer's standard warranty provided for the geotextiles.

PART 2 - PRODUCT

2.01 ACCEPTABLE MANUFACTURERS

A. Synthetics Industries,
B. Amoco, or
C. Approved equal.

MATERIALS AND PERFORMANCE - SECTION 02232

GEOTEXTILE FABRIC

2.02 MATERIALS

A. For the purpose of these specifications, construction drawings and Contract Documents, the terms “geotextile", "geotextile fabric", and "filter fabric" shall be considered synonymous.

B. Geotextile fabric used shall be of the types listed below:

Type 1 - Non-Woven Geotextile
Type 2 - Non-Woven Geotextile
Type 3 - Woven Geotextile
Type 4 - Non-Woven Geotextile

C. The non-woven geotextile shall be of needle-punched construction and consist of long-chain polymeric fibers or filaments composed of polypropylene; shall be free of any chemical treatment which reduces permeability and shall be inert to chemicals commonly found in soil.

D. The non-woven geotextiles indicated on the Contract Drawings shall have the minimum physical properties listed below:

Type 1 - Non-Woven Geotextile

Property	Unit of Measure	Test Method	Minimum Test Value
Grab Tensile	lbs.	ASTM D4632	200
Grab Elongation	%	ASTM D4632	50
Mullen Burst	psi	ASTM D3786	400
Puncture	lbs	ASTM D4833	130
Trapezoid Tear	lbs	ASTM D4533	85
Apparent Opening Size	US Sieve Number	ASTM D4751	80
Permittivity	sec^{-1}	ASTM D4491	1.50

MATERIALS AND PERFORMANCE - SECTION 02232

GEOTEXTILE FABRIC

Type 2 - Non-Woven Geotextile

Property	Unit of Measure	Test Method	Minimum Test Value
Grab Tensile	lbs.	ASTM D4632	300
Grab Elongation	%	ASTM D4632	50
Mullen Burst	psi	ASTM D3786	600
Puncture	lbs	ASTM D4833	180
Trapezoid Tear	lbs	ASTM D4533	115
Apparent Opening Size	US Sieve Number	ASTM D4751	100
Permittivity	sec^{-1}	ASTM D4491	1.0

D. Acceptable woven geotextile shall be Amoco 2006, Nicolon T-300, or approved equal. The geotextile shall be woven from a monofilament or monofilament yarn made from polymeric fibers; shall be free of any chemical treatment and shall be inert to chemicals commonly found in soil; and shall have the minimum physical properties indicated below:

E. The woven geotextiles indicated on the Contract Drawings shall have the minimum average roll valves listed below:

Type 3 - Woven Geotextile

Property	Unit of Measure	Test Method	Test Value
Unit Weight	$oz./yd.^2$	ASTM D3776	5.5
Grab Tensile	lbs.	ASTM D4632	300
Grab Elongation	%	ASTM D4632	15
Mullen Burst	psi	ASTM D3786	600
Puncture	lbs	ASTM D4833	120
Trapezoid Tear	lbs	ASTM D4533	120

MATERIALS AND PERFORMANCE - SECTION 02232

GEOTEXTILE FABRIC

F. The Type 4 non-woven geotextile indicated on the Contract Drawings shall have the minimum average roll values listed below.

Type 4 - Non-Woven Geotextile

Property	Unit of Measure	Test Method	Test Value
Grab Tensile	lbs.	ASTM D4632	115
Grab Elongation	%	ASTM D4632	50
Mullen Burst	psi	ASTM D3786	210
Puncture	lbs	ASTM D4833	65
Trapezoid Tear	lbs	ASTM D4533	50
Appareant Opening Size	US Sieve Number	ASTM D4751	70
Permittivity	sec^{-1}	ASTM D4491	2.0

2.03 DELIVERY, STORAGE AND HANDLING

A. The geotextile shall be furnished in a protective wrapping which shall be labeled with the following information: manufacturer's name, product identification, lot #, roll #, and dimensions.

B. The geotextile shall be protected from ultraviolet light, precipitation, mud, soil, excessive dust, puncture, cutting and/or other damaging conditions prior to and during delivery and on-site storage. The geotextile shall be capable of withstanding 30 days of sunlight without measurable deterioration. The geotextile shall be stored on-site at a location approved by the Engineer.

2.04 QUALITY ASSURANCE

A. The field delivered material shall meet the specification values according to the manufacturer's specification sheet. The Contractor shall submit written certification that the delivered material meets the manufacturer's specifications. The Contractor shall provide the quality control test results conducted by the manufacturer during the manufacturing of the geotextile fabric delivered to the project site. The results shall identify the sections/panels of field delivered fabric they represent. The Contractor shall also provide the lot and roll number for the material delivered to the site.

MATERIALS AND PERFORMANCE - SECTION 02232

GEOTEXTILE FABRIC

B. The manufacturer shall have developed and shall adhere to its own quality assurance program in the manufacture of the geotextile.

C. The installer shall verify in writing prior to installation that the geotextile fabric has not been damaged due to improper transportation, handling, or storage.

D. The Contractor shall provide shop drawings indicating panel layouts and installation sequence.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to installation of the geotextile, placement surfaces shall be leveled and uniformly compacted, as specified, to provide a smooth, stable interface for the geotextile.

3.02 GEOTEXTILE INSTALLATION

The following procedures and requirements shall be followed during the installation of geotextile.

A. Placement

1. The placement of the geotextile shall not be conducted during adverse weather conditions. The geotextile shall be kept dry during storage and up to the time of deployment. During windy conditions, all geotextiles shall be secured with sandbags or an equivalent approved anchoring system. Removal of the sandbags or equal shall only occur upon placement of an overlying soil layer.

2. Proper cutting tools shall be used to cut and size the geotextile materials. Extreme care shall be taken while cutting in-place geotextiles.

3. During the placement of geotextiles, all dirt, dust, sand and mud shall be kept off to prevent clogging. If excessive contaminant materials are present on the geotextile, it shall be cleaned or replaced as directed by the Engineer.

4. The geotextile shall be covered within the time period recommended by the manufacturer, and in no case later than two weeks after its placement.

B. Seaming or Joining

1. Geotextiles shall be seamed using either a 12-inch overlap or by sewing. The specific conditions requiring a sewn seam or simply an overlap are as follows:

MATERIALS AND PERFORMANCE - SECTION 02232

GEOTEXTILE FABRIC

a. In all cases, seams on side slopes shall be parallel to the line of slope and sewn 5 feet from the toe-of-slope upward over the length of the slope and into the anchor trench. No horizontal seams shall be allowed on side slopes, except for patching.

b. Where seaming cannot be conducted using sewing and where overlap is not appropriate, heat seaming may be permitted with the approval of the Engineer.

2. Sewing shall be done using a polymeric thread with chemical compatibility resistance equal to or exceeding the geotextile being sewn. Thread and the sewing device shall be approved by the Engineer prior to its use in the field.

3. Repair of tears or holes in the geotextile shall require the following procedures:

a. On slopes: A patch made from the same geotextile shall be double seamed into place; with each seam 1/4-inch to 3/4-inch apart and no closer than 1 inch from any edge. Should any tear exceed 10% of the width of the roll, that roll shall be removed from the slope and replaced.

b. Non-slopes: A patch made from the same geotextile shall be spot-seamed in place with a minimum of 24 inch overlap in all directions.

3.03 POST-CONSTRUCTION

A. Upon completion of the installation, the Contractor shall submit to the Engineer:

1. All quality control documentation and the as-built panel drawings.

2. The warranty obtained from the Manufacturer/Fabricator.

3.04 WARRANTY

A. The Contractor shall obtain from the manufacturer and submit to the Owner, a standard warranty provided for the geotextiles. The Engineer shall review the warranty for completeness prior to the Owner accepting its provisions.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02233

SILT FENCING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor shall supply all labor, materials, tools, and equipment required to furnish and install silt fencing as specified herein and as shown on the Contract Drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM D1682 Grab Tensile
2. ASTM D1682 Grab Elongation
3. ASTM D3786 Mullen Burst
4. ASTM D751 Puncture
5. ASTM G-26 Ultraviolet Radiation Stability

B. New York State Guidelines for Urban Erosion and Sediment Control

1.03 SUBMITTALS

A. Manufacturer's data for geotextile including, at a minimum, physical properties, and packaging.

B. Manufacturer's quality assurance/quality control program.

C. Certified results of all quality control testing.

PART 2 - PRODUCT

2.01 ACCEPTABLE MANUFACTURERS

A. Geosynthetic Industries,
B. Amoco, or
C. Approved equal.

2.02 MATERIALS

A. The silt fencing shall consist of long-chain polymeric fibers or filaments composed of polypropylene.

B. The silt fencing shall be free of any chemical treatment which reduces permeability and shall be inert to chemicals commonly found in soil.

MATERIALS AND PERFORMANCE - SECTION 02233

SILT FENCING

C. The silt fencing indicated on the Contract Drawings shall have the minimum physical properties listed below:

Property	Unit of Measure	Test Method	Value
Grab Tensile	lbs.	ASTM D4632	80
Grab Elongation	%	ASTM D4632	15
Mullen Burst	psi	ASTM D3786	250
Puncture	lbs	ASTM D4833	30
Apparent Opening Size	US Sieve Number	ASTM D4751	#10 Sieve
UV Resistance	%	ASTM D4355	80 @ 500 hrs

2.02 DELIVERY, STORAGE AND HANDLING

A. The silt fencing shall be furnished in a protective wrapping which shall be labeled with the following information: manufacturer's name, product identification, lot #, roll #, and dimensions.

2.03 QUALITY ASSURANCE

A. The field delivered material shall meet the specification values according to the manufacturer's specification sheet. The Contractor shall submit written certification that the delivered material meets the manufacturer's specifications. The Contractor shall provide the quality control test results conducted by the manufacturer during the manufacturing of the silt fencing delivered to the project site.

B. The manufacturer shall have developed and shall adhere to its own quality assurance program in the manufacture of the silt fencing.

C. The installer shall verify in writing prior to installation that the silt fencing has not been damaged due to improper handling of storage.

PART 3 - EXECUTION

3.01 SILT FENCING INSTALLATION

A. The silt fencing shall be installed as depicted on the Contract Drawings and in conformance with the manufacturer's recommendations and the New York State Guidelines for Urban Erosion and Sediment Control.

MATERIALS AND PERFORMANCE - SECTION 02233

SILT FENCING

3.04 WARRANTY

A. The Contractor shall obtain and submit to the Owner from the manufacturer a standard warranty provided for the geotextiles. The Engineer shall review the warranty for completeness prior to the Owner accepting its provisions.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02234

GEOMEMBRANE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. Under this section, the Contractor shall furnish and install high density polyethylene (HDPE) geomembrane material as shown on the Contract Documents and as specified herein and/or directed.

2. The Contractor shall be responsible for all QA/QC specified herein and as indicated on the Contract Drawings. All QA/QC testing, with the exception of non-destructive tests, shall be conducted by an independent laboratory at the Contractor's expense.

1.02 APPLICABLE CODES, STANDARDS, SPECIFICATIONS, AND PUBLICATIONS

A. American Society for Testing and Materials (ASTM)

1. D413-88 Test Methods for Rubber Property -- Adhesion to Flexible Substrate

2. D638-89 Test Method for Tensile Properties of Plastics

3. D746-79 Test Method for Brittleness Temperature of Plastics and (Rev 1987) Elastometers by Impact

4. D751-89 Method of Testing Coated Fabrics

5. D792-86 Test Method for Specific Gravity and Density of Plastics by Displacement

6. D882-90 Test Method for Tensile Properties of Thin Plastic Sheeting

7. D1004-90 Test Method for Initial Tear Resistance of Plastic Film and Sheeting

8. D1203-89 Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods

9. D1204-89 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature

10. D1238-90 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

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GEOMEMBRANE

11. D1505-85 Test Method for Density of Plastics by the Density Gradient Technique

12. D1603-76 (Rev. 1988) Test Method for Carbon Black in Olefin Plastics

13. D5397 Test Method for Environmental Stress-Cracking of Ethylene Plastics

14. D1790-90 Test Method for Brittleness Temperature of Plastic Film by Impact

15. D5996 Recommended Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds

16. D4833 Puncture Resistance

B. Geosynthetic Research Institute (GRI)

GRI Test Method GM 13 Test Properties, Testing Frequencies and Recommended Warrant for High-Density Polyethylene (HDPE) Smooth and Textured Geomembranes

C. Where reference is made to one of the above codes, standards, specifications or publications the revisions in effect at the time of bid shall apply.

1.03 QUALIFICATIONS

A. Geomembrane Manufacturer

1. The Contractor shall submit to the Owner for approval the following information regarding the Geomembrane Manufacturer:

a. Corporate background and information.

b. Manufacturing capabilities including:

- Quality control procedures for manufacturing
- List of material properties including certified test results, to which geomembrane samples are attached.

c. A list of at least ten completed facilities, totaling a minimum of 10,000,000 ft^2, for which the Manufacturer has manufactured a geomembrane. For each facility, the following information shall be provided:

MATERIALS AND PERFORMANCE - SECTION 02234

GEOMEMBRANE

- Name and purpose of facility, its location and date of installation
- Name of Owner, Project Manager, Designer, Fabricator (if any), and Installer
- Thickness of geomembrane, surface area of geomembrane manufactured

d. Origin (resin supplier's name, resin production plan) and identification (brand name, number) of the resin.

B. Installer

1. The Installer must be trained and approved and/or licensed by the Geomembrane Manufacturer for the installation of geomembrane.

2. The Contractor shall submit to the Owner for approval the following written information, relative to the Installer.

a. Copy of Installer's letter of approval or license by the Manufacturer.

b. Resume of the "master seamer" to be assigned to this project, including dates and duration of employment.

3. All personnel performing seaming operations shall be qualified by experience or by successfully passing seaming tests. At least one seamer shall have experience seaming a minimum of 1,000,000 ft^2 of geomembrane of the type for this project, using the same type of seaming apparatus in use at the site.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Solmax Geosynthetics,
B. GSE Lining Technology, Inc., or
C. Approved equal.

2.02 MATERIALS

A. HDPE Lining Material Specifications

1. HDPE geomembrane material shall meet the following minimum specification values listed below and as listed in GRI GM13.

MATERIALS AND PERFORMANCE - SECTION 02234

GEOMEMBRANE

Property	Test Method	Specificaiton Limit 60 mil Textured
HDPE Geomembrane Resin		
Specific Gravity (min.)	ASTM D1505/D792	.940
Carbon Black Content	ASTM D1603	2.0 - 3.0%
Carbon Black Dispersion	ASTM D5596	1, 2 or 3 category All 10 views
HDPE Geomembrane Rolls		
Mechanical		
Thickness (± 10%)	ASTM D5199	60 mil
Specific Gravity (min.)	ASTM D1505/D792	.940
Tensile Properties		
Tensile Strength at Break (min.)	ASTM D638 Type IV	90 ppi
Tensile Strength at Yield (min.)		126 ppi
Elongation at Break (min.)		100%
Elongation at Yield (min.)		12%
Tear Resistance (min.)	ASTM D1004	42 lbs
Puncture Resistance (min.)	ASTM D4833	90 lbs
Stress Crack Resistance	ASTM D5397	200 Hour
HDPE Geomembrane Field and Factory Seams		
Oxidative Induction Time		
A. Standard OIT	D3895	100 min
B. High Pressure OIT	D5885	400 min
Oven Aging at 85°C	D5721	

MATERIALS AND PERFORMANCE - SECTION 02234

GEOMEMBRANE

	Property	Test Method	Specificaiton Limit 60 mil Textured
A.	Standard OIT - % Retained After 90 Days	D3895	55%
B.	High Pressure OIT - % Retained After 90 Days	D5885	80%
UV Resistance		GM11	
A.	Standard OIT	D3890	NR*
B.	High Pressure OIT - % Retained After 1600 Hours	D5885	60%
Tensile Strength at Yield (min.)		ASTM D638 as modified by ANSI/NSF Standard 54	No failure of the seam and 90% of sheet value for adjacent material
Tensile Strength at Break (min.)		ASTM D638 as modified by ANSI/NSF Standard 54	No failure of the seam and 90% of sheet value for adjacent material
Peel Strength		ASTM D413 and D4437 as modified by ANSI/NSF Standard 54	No failures of the seam along original contact surface of liner panels

*Not Recommended.

B. Welding Material

1. The resin used in the welding material must be identical to the liner material.

2. All welding materials shall be of a type recommended and supplied by the manufacturer and shall be delivered in the original sealed containers each with an indelible label bearing the brand name, manufacturer's mark number, and complete directions as to proper storage.

C. Labeling Geomembrane Rolls

1. Labels on each roll or factory panel shall identify the following:

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GEOMEMBRANE

- The thickness of the material;
- The length and width of the roll or factory panel;
- The Manufacturer;
- Directions to unroll the material;
- Product identification;
- Lot number; and
- Roll or field panel number.

2.03 DELIVERY, HANDLING AND STORAGE

A. The Contractor shall be liable for all damages to the materials incurred prior to and during transportation to the site.

B. Handling, storage and care of the geosynthetic materials prior to and following installation at the site, is the responsibility of the Contractor. The Contractor shall be liable for all damages to the materials incurred prior to final acceptance of the lining system by the Owner.

C. The Contractor shall notify the Owner of the anticipated delivery time.

2.04 ADDITIONAL SUBMITTALS

A. The Contractor shall submit the following items for approval at least one week prior to installation.

1. Shop drawings shall include:

a. Layout plan;

b. Quality control program manual covering all phases of manufacturing and installation; and

c. Complete and detailed written instructions for the storage, handling, installation, seaming, inspection pan fail criteria for liner inspections, and QA/QC testing procedures of the liner in compliance with these specifications and the condition of his warranty.

PART 3 - EXECUTION

3.01 GEOMEMBRANE INSTALLATION

A. Related Earthwork

1. The Contractor shall insure that all related earthwork requirements under this section are complied with:

MATERIALS AND PERFORMANCE - SECTION 02234

GEOMEMBRANE

a. The geomembrane installations shall be performed on a firm, smooth, soil surface free from stones or protruding objects.

b. No geomembrane shall be placed onto an area which has become softened by precipitation or which has cracked due to desiccation. Appropriate methods of moisture control are the responsibility of the Contractor.

c. No geomembrane shall be placed on frozen soil material. Such material shall be removed and replaced with new soil fill as specified in the MP Section entitled "Soil Fill."

d. The Geomembrane Installer shall certify in writing that the final soil surface on which the membranes are to be installed are acceptable.

e. All final soil surfaces on which the membranes are to be installed shall be acceptable to the Owner prior to membrane installation.

f. Free edges of geomembrane shall be secured in such a manner as to prevent uplift by wind or the intrusion of water under the liner. Edge protection shall include, sandbags, polyethylene sheeting or other methods as deemed necessary by the Contractor and approved by the Owner.

g. The geomembrane shall be anchored within an anchor trench constructed to the dimensions shown in the Contract Drawings. Care shall be taken while backfilling the trenches to prevent damage to the geomembrane.

B. Geomembrane Deployment

1. Geomembrane shall be deployed according to the following procedures:

a. Placement of the geomembrane panels shall be according to the approved location and position plan provided by the Installer. Placement shall follow all instructions on the boxes or wrapping containing the geomembrane materials which describe the proper methods of unrolling panels.

b. The method of placement must ensure that:

- Deployed geomembrane must be visually inspected for uniformity, tears, punctures, blisters or other damage or imperfections. Any such imperfections shall be immediately repaired and reinspected.

- No equipment used shall damage the geomembrane by handling, trafficking, leakage of hydrocarbons, or other means.

- No personnel working on the geomembrane shall smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane.

- The prepared surface underlying the geomembrane must not be allowed to deteriorate after acceptance and must remain acceptable up to the time of geomembrane placement and until completion of the project.

- Adequate temporary loading and/or anchoring (e.g., sand bags), not likely to damage the geomembrane, shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

- Direct contact with the geomembrane shall be minimized; i.e., the geomembrane in excessively high traffic areas shall be protected by geotextiles, extra geomembrane, or other suitable materials.

c. Any damage to the geomembrane panels or portions of the panels as a result of placement must be replaced or repaired at no cost to the Owner. The decision to replace or repair any panel or portions of panels shall be made by the Owner.

d. The Installer shall assign an "identification number" to each geomembrane panel placed. The number system used shall be simple, logical and identify the relative location in the field.

C. Seaming

1. The seaming procedures below shall be implemented, where applicable, during installation of the geomembrane. The seaming procedures are as follows:

a. Generally, all seams whether field or factory, shall be orientated parallel to the line of slope, not across slope. This specification applies to all slopes in excess of 10 percent grade. At liner penetrations and corners, the number of seams shall be minimized.

b. The area of the geomembrane to be seamed shall be cleaned and prepared according to the procedures specified by the material manufacturer. Any abrading of the geomembrane shall not extend more than one-half inch on either side of the weld. Care shall be taken to eliminate or minimize the number of wrinkles and "fishmouths" resulting from seam orientation.

c. Field seaming is prohibited when either the air or sheet temperature is below 32°F or when the sheet temperature exceeds 158°F or when the air temperature is above 120°F. At air or sheet temperatures between 32°F and 40°F, seaming shall be conducted directly behind a preheating device. In addition, seaming shall not be conducted when geomembrane material is wet from precipitation, dew, fog, etc., or when winds are in excess of 20 miles per hour.

d. Seaming shall not be performed on frozen or excessively wet underlying soil surfaces.

e. Seams shall have an overlap beyond the weld large enough to perform destructive peel tests, but not exceed 5 inches.

f. The Contractor shall perform trial seams on excess geomembrane material. A 1 foot by 3 foot seamed liner sample shall be fabricated with the seam running down the 3 foot length in the center of the sample. Such trial seaming shall be conducted prior to the start of each seaming succession for each seaming crew, change in machine or every 4 hours, after any significant change in weather conditions or geomembrane temperature, or after any change in seaming equipment. From each trial seam, two field test specimens shall be taken. The test specimens shall be 1 inch by 12 inch strips cut perpendicular to the trial seam. These specimens shall be peel tested using a field tensiometer, and recorded as pass (failure of liner material) or fail (failure of seam). Upon initial failure, a second trial seam shall be made; if both test specimens do not pass, then the seaming device and its operator shall not perform any seaming operations until the deficiencies are corrected and two successive passing trial seam test specimens are produced. Completed trial seam samples cannot be used as portions of a second sample and must be discarded.

g. Where fishmouths occur, the material shall be cut, overlapped and an overlap weld shall be applied. Where necessary, patching using the same liner material shall be welded to the geomembrane sheet.

h. Acceptable seaming methods for geomembrane are:

- extrusion welding using extrudate with identical physical, chemical, and environmental properties; and
- hot wedge welding using a proven fusion welder and master seamer.

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GEOMEMBRANE

i. Seaming device shall not have any sharp edges which might damage the geomembrane liner. Where self-propelled seaming devices are used, it shall be necessary to prevent "bulldozing" of the device into the underlying soil.

D. Seam Testing

1. The Contractor shall perform nondestructive seam testing on 100 percent of field seams. The following test method and procedures may be used:

a. Air pressure testing may be used if double track hot wedge welding has been utilized to seam the HDPE geomembrane. Using approved pressure testing equipment, the following procedures will be followed:

- seal both ends of the air channel separating the double hot wedge welds;
- insert pressure needle into air channel and pressurize the air channel to 25 psi; and
- monitor pressure gauge for 3 minutes and determine whether pressure is maintained without a loss of more than 2 psi;
- if the pressure test fails, then localize the leak and mark the area for repair.

Air pressure testing will be conducted under the direct observation of the Engineer.

b. Vacuum testing will be used on all seams not tested using air pressure testing. Using an approved vacuum box, the following procedures will be followed:

- apply a soapy water mixture over the seam;
- place vacuum box over soapy seam and form a tight seal;
- create a vacuum by reducing the vacuum box pressure to 5 psi (35 KPa) for 30 seconds;
- observe through the vacuum box window any bubbles;
- where bubbles are observed, mark seam for repair;
- move vacuum box further down seam overlapping tested seam by 3 inches; and
- where hot wedge seaming has been performed, the overlap must be cut back to the weld.

All vacuum testing will be conducted under the direct observation of the Engineer.

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GEOMEMBRANE

2. In addition to nondestructive seam testing, the Contractor will perform destructive testing. The destructive testing procedures are as follows:

a. Test samples will be prepared by the Installer every 500 feet of seam length, a minimum of one test for each seaming machine per day, or more frequently at the discretion of the Engineer. Sample location and size will be selected by the Engineer. The sample size (12 x 56 inches) will be large enough to produce three sets of test specimens for the following tests:

- Seam Shear Strength, ASTM D816 as modified in ANSI/NSF Std. 54
- Peel Adhesion, ASTM D413 and D4437 as modified in ANSI/NSF Std. 54
- Adjacent Geomembrane Elongation, ASTM D4437

b. Ten specimens will compose a set. Five of these will be tested for peel and the other five for shear strength. Each specimen will be 1 inch wide and 12 inches long with the field seam at the center of the specimen. The 56 inch sample length will first be cut at the ends to produce two field peel test specimens. The remaining 54 inches will be divided up into thirds and one-third submitted to the Contractor, one-third to the independent testing laboratory, and one-third to the Engineer for storage and future reference.

c. Test specimens will be considered passing if the minimum values below are met or exceeded for four of the five test specimens tested by the independent laboratory. All acceptable seams will lie between two locations where samples have passed.

d. The cost of destructive testing will be borne by the Contractor.

Field Seam Properties	**Specification Limit**	**Test Method**
Shear Strength at Yield (lb/in width)	90% of specification limit of sheet value for adjacent material	ASTM D816 as modified in ANSI/NSF Standard 54
Peel Adhesion	Film tear bond	ASTM D413 as modified in ANSI/NSF Standard 54
Adjacent Geomembrane Elongation	100%	ASTM D4437

3. If a sample fails destructive testing, the Contractor shall ensure that: the seam is reconstructed in each direction between the location of the sample which failed and the location of the next acceptable sample; or the welding path is retraced to an intermediate location at least ten feet in each direction from the location of the

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sample which failed the test, and a second sample is taken for an additional field test. If this second test sample passes, the seam must be then reconstructed between the location of the second test and the original sampled location. If the second sample fails, the process must be repeated.

All costs for work performed to achieve passing tests along with costs for retesting will be borne by the Contractor.

4. If double track hot-wedge welding is used, the Engineer and the Installer must agree on the track weld that will be used in the destructive testing. The weld chosen inside or outside must be consistently tested and pass according to the criteria above.

5. All holes created by cutting out destructive samples will be patched by the Contractor immediately with an oval patch of the same material welded to the membrane using extrusion welding. The patch seams will be tested using a vacuum box and using the procedures described above. Work will not proceed with materials covering the geomembrane until passing results of destructive testing have been achieved.

6. At the ends of each field seam, two field test specimens will be taken and field tested with a field tensiometer. Both specimens must pass prior to placing the membrane in the anchor trench or continuing with additional seams. Failure of these specimens will require correcting the seaming device and repair of the preceding seam according to the failure testing and procedures described above.

E. Liner Repair

1. All imperfections, flaws, construction damage, destructive and nondestructive seam failures shall be repaired by the Installer of the geomembrane materials. The appropriate methods of repair are listed below:

- Patching, used to repair holes, tears, undispersed raw materials and contamination by foreign matter;
- Grinding and rewelding, used to repair small sections of extruded seams;
- Spot welding or seaming, used to repair pinholes or other minor, localized flaws;
- Capping, used to repair large lengths of failed seams;
- Topping, used to repair areas of inadequate seams, which have an exposed edge; and
- Removing bad seam and replacing with a strip of new material welded into placed, used with large lengths of fusion seams.

F. Construction Material Placement and Penetrations

1. Wrinkles that develop from normal placement procedures must be controlled such that the underlying geomembrane does not fold over. Small wrinkles, defined as having their height less than or equal to one-half their base width, may be trapped and pushed down by the overlying soil. Any wrinkle which becomes too large and uncontrollable or which folds the geomembrane over must be brought to the attention of the Owner and Engineer. If necessary, the geomembrane shall be uncovered, cut, laid flat, seamed by extrusion welding and non-destructively tested. Any wrinkle repairs within 10 feet of the cell valley shall be uncovered, cut, laid flat, seamed by extrusion weld, non-destructively tested and covered with a cap strip which is extrusion-welded and non-destructively tested.

3.02 POST-CONSTRUCTION

A. The Installer of the geomembrane materials shall prepare and the Contractor shall submit, to the Owner, record drawings illustrating the following information:

- dimensions of all geomembrane field panels
- panel locations referenced to the Contract Drawing plans
- identify all field seams and panels with the appropriate number or code
- location of all patches, repairs and destructive testing samples

B. Record Drawing(s) shall be submitted for each geomembrane layer constructed.

3.03 WARRANTY

A. The Contractor shall obtain and submit to the Owner from the Manufacturer a standard warranty provided for the geomembrane. The Owner shall review the warranty for completeness prior to the Owner accepting its provisions.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02235

GEOSYNTHETIC CLAY LINER

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor shall provide all labor, materials, tools and equipment necessary to furnish and install geosynthetic clay liner in the final cover system as specified herein and as shown on the Contract Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section MP-02232 - Geotextile Fabric
B. Section MP-02219 - Geosynthetic Drainage Composite
C. Section MP-02234 - Geomembrane

1.03 REFERENCES

A. American Society of Testing and Materials (ASTM);

1.04 SUBMITTALS

A. Manufacturers data for the geosynthetic clay liner including physical properties and roll size.

B. Geosynthetic clay liner material sample.

C. Manufacturer's quality assurance/quality control program.

D. Certified results of all quality control testing.

E. Contractor's proposed transportation, handling and storage techniques.

F. Shop drawings, and proposed installation techniques.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Colloid Environmental Technologies Company (CETCO), Arlington Heights, Il.

1. Acceptable product shall be Bentomat "ST" as manufactured by CETCO or equal.

MATERIALS AND PERFORMANCE - SECTION 02235

GEOSYNTHETIC CLAY LINER

2.02 MATERIALS

A. The geosynthetic clay liner shall be comprised of a layer of Volclay (SLS-71), Wyoming grade sodium bentonite supported within two geotextiles. The geosynthetic clay liner shall be held together by needle punching of the geotextiles.

B. The geosynthetic clay liner shall have the following minimum properties:

Property	Test Method	Test Value
Grab Strength (lbs.)	ASTM D-4632	250
Grab Elongation (%)	ASTM D-4632	65
Permeability (cm/sec)	ASTM D-5048	$5x10^{-9}$
Puncture Resistance (lbs.)	ASTM D-4833	102
Wide Width Strength (lbs./in.)	ASTM D-4595	35

2.03 DELIVERY, STORAGE AND HANDLING

A. The geosynthetic clay liner shall be packaged and shipped by appropriate means so as to prevent damage. Materials shall be delivered only after the required submittals have been received and reviewed by the Engineer.

B. The geosynthetic clay liner shall be furnished in rolls, marked or tagged with the following information:

1. Manufacturer's Name
2. Product Identification
3. Lot/Batch Number
4. Roll Number
5. Roll Dimensions

C. The geosynthetic clay liner shall be stored in an area which prevents damage to the product or packaging.

D. The geosynthetic clay liner shall be kept clean and free from dirt, dust, mud and any other debris.

E. The geosynthetic clay liner shall not be allowed to come into contact with any liquid or moisture.

MATERIALS AND PERFORMANCE - SECTION 02235

GEOSYNTHETIC CLAY LINER

F. Any geosynthetic clay liner found to be damaged shall be replaced with new material at the Contractor's expense.

2.04 QUALITY ASSURANCE

A. Field delivered material shall meet the specification values according to the manufacturer's specification sheet. The Contractor shall submit written certification that the delivered material meets the manufacturer's specifications. The Contractor shall submit to the Engineer certified quality control test results conducted by the manufacturer during the manufacturing of the geosynthetic clay liner delivered to the project site. The results must identify the sections of field delivered geosynthetic clay liner they represent.

B. The manufacturer shall have developed and shall adhere to their own quality assurance program in the manufacture of the geosynthetic clay liner.

C. The installer shall verify in writing prior to installation that the geosynthetic clay liner has not been damaged due to improper handling or storage.

D. The Contractor shall provide shop drawings indicating panel layouts and installation sequence.

E. The Contractor shall submit certificates of analysis for the sodium bentonite used in the material.

PART 3 - EXECUTION

3.01 PREPARATION

A. The geosynthetic clay liner shall be inspected for tears, flaw and areas that have contacted liquid. The contractor shall be responsible for replacing any damaged geosynthetic clay liner prior to installation.

3.02 INSTALLATION

A. Geosynthetic clay liner shall be installed at locations shown on the Contract Drawings.

B. Adjacent rolls shall be overlapped approximately 6 - 9 inches and enhanced with bentonite as recommended by the manufacturer.

C. All geosynthetic clay liner shall be covered and protected at the end of each day to prevent contact with moisture.

D. All manufacturer's recommended installation and protection procedures shall be adhered to by the contractor.

MATERIALS AND PERFORMANCE - SECTION 02235

GEOSYNTHETIC CLAY LINER

E. Geosynthetic clay liner placement shall not be permitted during precipitation events or windy conditions.

F. The geosynthetic clay liner shall be unrolled downslope keeping the liner in slight tension to minimize wrinkles and folds.

G. Adequate loading shall be placed to prevent uplift by wind.

H. Holes or tears in the geosynthetic clay liner shall be repaired in accordance with the manufacturer's recommendations.

I. The contractor shall be responsible for maintaining the integrity of the geosynthetic clay liner during installation and placement of the geomembrane. Any damaged geosynthetic clay liner shall be replaced by the Contractor at no expense to the Owner.

3.03 QUALITY CONTROL

A. The Contractor shall provide as-built drawings identifying panel layout, locations of imperfections, and repairs and any other appropriate observations.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02271

RIPRAP

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Under this section, the Contractor shall furnish all plant, labor, equipment and materials, and perform all work necessary to place a protective covering of erosion-resistant riprap at locations shown on the Contract Drawings or as directed by the Engineer. The work shall be done in accordance with these specifications and in conformity with the lines and grades shown on the Drawings or as established by the Engineer.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section MP-02200 - Earthwork

1.03 SUBMITTALS

A. Particle size distribution of all proposed riprap types.

B. Proposed sources of riprap and amount of available material at each source.

PART 2 - PRODUCTS

2.01 RIPRAP

A. Stone used for riprap shall be hard, durable, angular in shape, resistant to weathering and to water action, free from overburden, spoil, shale and organic material, and shall meet the gradation requirements for the type specified. Neither breadth nor thickness of a single stone should be less than one-third its length. Rounded stone or boulders shall not be accepted unless authorized by the Engineer. Shale and stone with shale seams are not acceptable. The minimum unit weight of the stone shall be 155 pounds per cubic foot as computed by multiplying the specific gravity (bulk-saturated-surface-dry basis, AASHTO Test T85) times 62.4 pounds per cubic foot.

B. The sources from which the stone shall be obtained shall be selected by the Contractor for approval by the Engineer well in advance of the time when the stone shall be required in the work. The acceptability of the stone shall be determined by service records and/or by suitable tests, as required by the Engineer. If testing is required, suitable samples of stone shall be taken in the presence of the Engineer prior to mobilization to the site. The approval of some rock fragments from a particular quarry site shall not be construed as constituting the approval of all rock fragments taken from that quarry.

C. The quality of all material used for riprap shall be determined by the Magnesium Sulfate Soundness Test, if so elected by the Engineer. A maximum 10 percent loss at ten (10) cycles, by weight, shall be acceptable.

MATERIALS AND PERFORMANCE - SECTION 02271

RIPRAP

D. The types of riprap to be provided shall be the following:

Type	Maximum Stone Size (dmax)	d50	Minimum Stone Size (dmin)
1	9"	6"	3"
2	12"	8"	4"

Each load of riprap shall be reasonably well graded from the smallest to the maximum size specified.

E. In addition to meeting the gradation requirements set forth in this section for the type of riprap indicated, riprap shall consist of stones shaped as nearly as practicable in the form of right rectangular prisms.

PART 3 - EXECUTION

3.01 PLACEMENT

A. Slopes or ditches to be protected by riprap shall be free of brush, topsoil, trees, stumps, and other objectionable material and shall be dressed to a smooth surface. All soft or spongy material shall be removed as directed by the Engineer and replaced with approved material and compacted as specified.

B. Stone for riprap shall be placed on the prepared slope and surfaces in a manner which shall produce a reasonably well-graded mass of stone with the minimum practicable percentage of voids. The entire mass of stone shall be placed so as to be in conformance with the lines, grades, and thicknesses shown on the Drawings. Riprap shall be placed to its full course thickness in one operation and in such a manner as to avoid displacing the underlying material. Placing of riprap in layers, or by dumping into chutes, or by similar methods likely to cause segregation shall not be permitted.

C. The larger stones shall be well distributed. All material going into riprap protection shall be so placed and distributed that there shall be no large accumulations of either the larger or smaller sizes of stone.

D. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to secure the results specified.

E. Unless otherwise authorized by the Engineer, the riprap protection shall be placed in continuous progression with the construction of the embankment. The Contractor shall maintain the riprap protection until accepted, and any material displaced by any cause shall be replaced to the lines and grades shown on the Drawings at no additional cost to the

MATERIALS AND PERFORMANCE - SECTION 02271

RIPRAP

Owner.

F. Riprap shall be placed so that the dimension approximately equal to the layer thickness is perpendicular to the slope surface and that the weight of the stone is carried by the underlying material and not by the adjacent stones. On slopes, the largest stones shall be placed at the bottom of the slope. The riprap shall be properly aligned and placed so as to minimize void spaces between adjacent stones. The spaces between the stones shall be filled with spalls of suitable size.

G. All sediment deposited within the riprap following installation, shall be promptly removed by the Contractor.

- END OF SECTION -

MATERIALS AND PERFORMANCE SECTION - 02526

HIGH DENSITY POLYETHYLENE PIPE

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Under this section, the Contractor shall furnish all labor, materials, and equipment required for the installation of single and double wall high density polyethylene pipe, including leachate collection lines, conveyance pipe, cleanouts, and force main; and all joints as shown on the Contract Drawings, as specified herein, and/or as directed by the Engineer.

1.02 QUALITY ASSURANCE AND SUBMITTALS

A. The Contractor shall submit to the Engineer all applicable data demonstrating compliance with the provisions of the Contract Drawings and these Specifications.

B. All piping shall be inspected upon delivery to the site. Materials not in compliance with the specifications shall be removed and replaced by the Contractor at no expense to the Owner. The Contractor shall furnish all labor required to handle the pipe during the inspection.

C. Resumes of certified pipe welders.

D. Shop drawings including, but not limited to, the following:

1. Pipe material specifications.
2. Pipe jointing techniques and procedures.
3. Pipe and fitting details.
4. Manufacturer's installation guides.
5. Leakage test procedures.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section MP-02200 - Earthwork
B. Section MP-02221 - Select Fill Material
C. Section MP-02222 - Soil Fill Material

PART 2 - PRODUCTS

2.01 MATERIAL

A. All pipes and fittings shall be of smooth interior and exterior and composed of high density, high molecular weight material using PE3408 grade resin having a cell classification in the following range (from ASTM D-3350).

MATERIALS AND PERFORMANCE SECTION - 02526

HIGH DENSITY POLYETHYLENE PIPE

Property Designation	Property	Cell Classification Limits
1	Density	3
2	Melt Index	3-5
3	Flexural Modulus	4-5
4	Tensile Strength at Yield	4-5
5	Environmental Stress Cracking Resistance	3
6	Hydrostatic Design Basis	4
	UV Color Code	C

B. All HDPE pipe and fittings shall conform to ASTM D-3350.

C. All single and double wall HDPE pipe and fittings shall have an SDR as specified in the Contract Drawings. In no case shall a pipe have an SDR greater than 17.

D. The pipe shall be free of blisters, foreign inclusions, cracks, holes, or other defects. The pipe shall be uniform as much as practicable in all physical properties. Defective pipe shall be removed from the job site.

E. HDPE end caps should be supplied and installed where shown on the Contract Documents.

F. Pipe used to fabricate double wall containment fittings shall meet ASTM F714.

G. Molded fittings used to fabricate double wall containment fittings shall be manufactured in accordance with ASTM D3261.

H. Double wall pipe and fittings shall be fused by conventional or simultaneous welding methods. The carrier and containment pipes shall be joined as an assembly and welded at the same time.

I. Acceptable manufacturers shall be Phillips 66 or equal.

1. Acceptable products shall be Driscopipe 1000 series or equal.

2.02 PERFORATIONS

A. Perforations shall be as shown on the Contract Drawings.

MATERIALS AND PERFORMANCE SECTION - 02526

HIGH DENSITY POLYETHYLENE PIPE

2.03 JOINTS

A. Shavings or burrs shall not be permitted on the pipe interior surface. Joints shall be of the butt-fusion (thermo-weld) type.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of all HDPE pipe and associated fittings shall conform with the manufacturer's installation standards and be completed by individuals certified for such work.

B. Where necessary, the Contractor shall be required to field fabricate joints to ensure proper fit and alignment.

3.02 TESTING

A. All double wall pipe shall be pressure tested following completed installation. Interior pipe shall be hydrostatically pressure tested; exterior pipe shall be pneumatically pressure tested.

B. All double wall pipe pressure testing shall be performed in accordance with the manufacturer's specifications which shall be submitted to the Engineer for review and acceptance prior to pressure testing.

C. All pressure testing performed by the Contractor shall be done under the observation of the Engineer. Results of the pressure testing shall be documented by the Contractor and submitted to the Engineer prior to backfilling of the double wall pipe.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

PART 1 - GENERAL

1.01 WORK SPECIFIED

A. All labor, materials, services and equipment necessary for furnishing and installing all reinforced concrete and non-shrink grout required for the completion of the work.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section MP-02200 - Earthwork
B. Section MP-02221 - Select Fill Material

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM). The following ASTM specifications are referred to in these specifications and are to be considered a part of these specifications:

C 31	Standard Method of Making and Curing Concrete Test Specimens in the Field
C 33	Standard Specifications for Compressive Strength of Cylindrical Concrete Specimens
C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C 94	Standard Specification for Ready-Mix Concrete
C 143	Standard Test Method for Slump of Portland Cement
C 150	Standard Specification for Portland Cement
C 171	Standard Specification for Sheet Materials for Curing Concrete
C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C 260	Standard Specification for Air-Entraining Admixtures for Concrete
C 494	Standard Specification for Chemical Admixtures for Concrete

B. American Concrete Institute (ACI). The following codes, standards and recommendations of the ACI are intended to specify minimum standards of performance.

ACI 211.1	Standard Practice for Selecting Proportions for Normal and Heavyweight Concrete
ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete for Buildings
ACI 302	Guide for Concrete Floor and Slab Construction
ACI 304	Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
ACI 305	Hot Weather Concreting
ACI 306	Cold Weather Concreting
ACI 309	Standard Practice for Consolidation of Concrete
ACI 315	Manual of Standard Practice for Detailing Reinforced Concrete Structures
ACI 350	Concrete Sanitary Engineering Structures

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

C. American Association of State Highway and Transportation Officials (AASHTO).

D. American Welding Society (AWS).

E. Concrete Reinforcing Steel Institute (CRSI).

F. Federal Specifications (FS).

G. American Plywood Association (APA).

H. U.S. Product Standards (PS).

For each above-listed refernces, the latest revision shall apply.

1.04 SUBMITTALS

A. Concrete Mix Design

1. The concrete mix design submittal shall include, at minimum, the following data:

a. Basis of design in accordance with ACI 318-89, Section 5.3 - Proportioning on the Basis of Field Experience and/or Trial Mixtures.

b. Indicate the amounts of all ingredients including cement, fine and coarse aggregates, water, air content, and admixtures, with weight of aggregates stated in a saturated surface dry condition.

c. Concrete slump.

d. Manufacturer's technical data for all admixtures and cement.

e. Sieve analysis of fine and coarse aggregates.

B. Shop drawings showing all steel reinforcement, chairs, joint locations, embedded items and accessories.

C. Mill test certificates for concrete and steel reinforcement.

D. Samples of joint filler material, waterstops, sealants, backing rods, and perimeter rigid insulation.

E. Manufacturer's literature for all products.

F. Test results of field and lab testing of concrete as they become available.

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

G. Methods to be employed when installing welded wire mesh, to ensure proper placement in concrete. The method shall employ the utilization of metal chairs, spacers or hangers, to position the mesh prior to placing concrete. Methods which require pulling the mesh into place by using hooks, shovels, picks or other tools during concrete placement shall not be acceptable.

H. Curing methods to be employed to keep concrete moist.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All damaged or contaminated materials shall be rejected and removed from the site by the Contractor at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C 150, Type II

B. Fine Aggregate: Natural Sand Meeting ASTM C 33

C. Coarse Aggregate: Crushed Stone with a nominal sieve size of ¾-inch which meets the requirements of ASTM C 33 Type 6 or 67 stone.

D. Water: Clear and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.

E. Admixtures

1. Water Reducing Admixture: ASTM C 494, Type A
2. High Range Water Reducing Admixture (Superplasticizer): ASTM C 494, Type F or G
3. Water Reducing, Retarding Admixture: ASTM C 494, Type D
4. Non-Chloride Accelerator: ASTM C 494, Type C or E
5. Air Entraining Admixture: ASTM C 260
6. Calcium Chloride: Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.

F. Curing and Sealing Compound: Styrene butadiene type, conforming to Federal Specification TT-C-800A.

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

G. Bonding Compound: Polyvinyl acetate, rewettable type.

H. Epoxy Adhesive: Two component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces.

I. Waterproof paper for curing concrete conform to ASTM C 171.

J. Bars: Deformed bars of new billet steel conforming to ASTM A 615, Grade 60.

K. Welded Wire Fabric: Cold drawn steel wire conforming to ASTM A 185. Furnish in flattened sheets or mats, of the sizes indicated.

L. Tie Wire: FS QQW461G, annealed steel, black, 16 gauge minimum. Column Spirals: Mill fabricated from cold drawn steel wire conforming to ASTM A 82.

M. Reinforcing Accessories: Reinforcing accessories, bar supports, chairs spacers, bolsters, etc., shall be of suitable types and sizes in accordance with ACI 315. All chairs, bolsters, etc., placed in contact with forms shall have contact legs made of polyethylene or upturned steel legs dipped in polyethylene leaving a coating with a minimum thickness of $^1/_8$-inch.

N. Formwork (Conform to ACI 347)

1. No formwork or form facing material which has a permanent set in it shall be used in the work.

2. All forms to be constructed of wood or plywood.

3. Metal forms may be used when forming precast concrete structural units.

O. Lumber

1. Softwood framing lumber: PS 2070

2. Grade marked by grading rules agency approved by American Lumber Standards Committee.

P. Plywood: Exterior type softwood plywood, PS 1-66.

Q. Form Ties

1. Ties shall be left in place and equipped with swaged washers (water stops) or other approved devices to prevent seepage of moisture along the tie.

2. Depth of breakback: minimum 1 inch.

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

R. Form Coatings

1. Non-staining

2. Compatible with subsequent finishing and bonding requirements.

S. Expansion Joints

The location of expansion joints are shown on the Contract Drawings. Expansion joints shall consist of a continuous joint filled with sponge rubber joint filler, expanding polyethylene foam rods, and sealant material. A description of each is presented below.

1. Sponge Rubber Joint Filler

   a. Sponge rubber joint filler shall be a high-quality blown sponge rubber of uniform thickness and density.

   b. Conform to the requirements of ASTM D1752, Type 1; FS HH-F341e Type II, Class "A"; AASHTO M153, Type 1.

2. Expanding Polyethylene Foam Rods

   a. Flexible, compressible, closed-cell polyethylene of not more than 25 percent compression deflection at 8 p.s.i. shall be provided for backup material in the joint system as shown on the Drawings.

   b. Higher compression deflection strength shall be provided as may be necessary to withstand installation forces and provide proper support for sealants.

   c. Surface water absorption shall be not more than 0.1 pounds per square foot.

3. Sealants

   a. Sealants shall be one or two component elastomeric compound of polyurethane base. Polyurethane base sealants shall meet the requirements of Federal Specification TT-S-00227 or TT-S-00230. Primers shall be non-bleeding, non-staining, clear-drying materials as recommended by the sealant manufacturer.

   b. Back-up for joint gasketing shall be closed cell polyethylene sponge of the required size and shape, as recommended by the sealant manufacturer. Materials impregnated with oil, solvents or bituminous materials shall not be used.

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REINFORCED CONCRETE

c. Sealants for horizontal concrete surfaces in exposed areas shall be non-tracking.

d. Solvents, cleaning agents, and other accessory materials shall be as recommended by the sealant manufacturer.

T. Non-Shrink Grout

1. All grout shall be non-metallic, non-shrink, non-gas forming preblended and ready-for-use requiring only the addition of water.

a. Grout shall contain no metals nor rust or corrosion promoting agents, or gypsums.

b. The addition of set control agents or water reducers shall not be allowed.

2. Grout shall conform to the following properties:

Property	Test Method	Requirements
Shrinkage Below Placement Volume	ASTM C827	0
Drying Shrinkage	CRD 588-76	0
Expansion	CRD 588-76 Maximum	0.40%
Compressive Strength 24 Hours 7 Days	ASTM C109	 3,000 psi Minimum 6,000 psi Minimum
Initial Set Time	ASTM C191	Minimum 45 Minutes
Pull-Out Strength	#5 Bar Grouted 6-Inches Deep in $^7/_8$-Inch Diameter Hole in Saturated Surface Dried Concrete	10,000 lbs.

U. Polyvinylchloride (PVC) Waterstops

1. PVC material shall be compounded from virgin PVC resins and shall contain no reclaimed, reground or reworked materials.

2. Six (6) inches long by $^3/_8$-inch minimum web with a $^1/_4$-inch diameter center bulb.

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

V. Perimeter Insulation

1. Extruded Polystyrene Insulation

a. Closed-cell, expanded polystyrene board complying with FS-HH-I-524, Type II, Class "B".

b. Compressive strength - 30 psi.

c. Maximum water absorption - 0.10 percent.

d. Maximum water vapor transmission - 1.0 perm-inch.

e. Thermal conductivity (k value) at 75°F - 0.20 per inch thickness.

f. Integrally formed skin.

2. Styrofoam Insulation

a. "Styrofoam SM" as manufactured by the Dow Chemical Corp.

b. Molded "Styropor" (2.0 pcf density) as manufactured by BASF Wyandotte.

c. Adjusted thicknesses shall be provided when a material having a different thermal conductivity value is approved for use.

2.02 CONCRETE MIX DESIGN

A. All mix designs shall be proportioned in accordance with the basis of field experience and/or trial mixtures of ACI 318-89. If trial batches are used, they shall be established by an approved commercial testing laboratory, employed by the Contractor, and approved by the Owner.

B. Method of proportioning shall conform to ACI 211.1, "Recommended Practice for Selecting Proportions for Normal an Heavyweight Concrete."

C. All concrete shall have a minimum 28-day compressive strength of 4,000 psi, a maximum water-cement ratio by weight of 0.45 and a minimum cement content of 550 pounds per cubic yard.

D. All concrete shall contain a water-reducing admixture.

E. All concrete exposed to the weather or water, or subject to freezing shall be air-entrained.

F. Slump: Concrete without high range water reducing admixture - 3 inches maximum.

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

G. Air Content: 4.5 to 7.5 percent.

H. Rate of Hardening

1. Concrete mixes shall be designed to produce the following rates of hardening:

a. General Concrete

Ambient temperatures 50°F to 85°F -- Normal rate of hardening.
Ambient temperatures over 80°F -- Retarded rate of hardening.
Ambient temperature under 50°F -- Accelerated rate of hardening.

b. Mass Concreting

Ambient temperatures over 40°F -- Retarded rate of hardening.

I. Do not change the mix design except as approved by the Owner to maintain quality control.

PART 3 - EXECUTION

3.01 CONCRETE

A. Batching: ACI 304

B. Mixing, Transporting and Discharging: ASTM C94

C. Placing: ACI 304

D. Cold Weather Concrete: ACI 306 (below 40°F)

E. Hot Weather Concrete: ACI 305 (above 80°F)

F. Finishing

1. Exposed Floors and Slabs

a. Bull Float
b. Hand Float
c. Power Trowel
d. Hand Trowel
e. Curing and Sealing Compound

2. Sidewalk, Walkway, Loading Docks - Broom Finish

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

3. Formed Surfaces

   a. Rubbed until all marks are obliterated and a uniformly smooth finish is obtained.

   b. If, upon removing the forms, any voids or honeycomb are found, such faults shall be corrected immediately at the Contractor's expense.

4. Curing

   a. Maintain all concrete in a moist condition for the duration of curing specified using methods that shall insure complete and continuous saturation.

G. Field Testing and Inspection

1. To be performed by an independent testing laboratory at no additional cost to the Owner.

2. The Contractor shall provide facilities necessary to obtain and handle representative samples of materials to be tested and furnish all necessary cooperation and assistance.

3. The testing laboratory shall be responsible to the Owner for the field control of all concrete and may reject batches for high slump, uncontrolled air entrainment, or delays.

4. Field Test Cylinders: During the progress of the work, a set of six 6-inch by 12-inch cylinders shall be made for each 50 yards of concrete placed, or fraction thereof placed each day.

   a. For each set of six cylinders, two shall be tested at 7 days and two shall be tested at 28 days.

   b. In the case of questionable or unsatisfactory test results, the remaining two cylinders shall be tested at 40 days or as directed by the Owner.

   c. Each cylinder shall be properly labeled with an identifying mark.

   d. The making and curing of test cylinders shall be in accordance with ASTM C-31.

   e. Cylinders shall be tested in accordance with ASTM C-39.

f. Making, pickup and curing of the cylinders shall be the responsibility of the testing laboratory, but the Contractor shall cooperate in protecting the cylinders and in notifying the testing laboratory of scheduled pours.

5. Slump Tests: ASTM C 143.

6. Air Content Test: ASTM C 173 or C 231.

7. Criteria for Acceptance: ACI 318, Section 5.6.

8. Written reports shall be submitted to the Owner.

9. Repair of defective areas shall conform to ACI 301, Chapter 9, except that a bonding compound shall be used.

3.02 REINFORCEMENT

A. Conform to the CRSI Manual of Standard Practice.

B. Bending shall be done accurately without the use of heat. Bars having cracks or splits at the bends shall be rejected.

C. All steel shall be free from loose rust, scale, grease, oil, dirt, or other materials which impair the bond with concrete.

D. All steel reinforcement and welded wire mesh shall be accurately positioned and strongly secured by tie wires or clips at intersections, and supported by metal chairs, spacers or hangers. Pulling steel reinforcement and/or welded wire mesh into place shall not be allowed.

3.03 FORMWORK

A. The Contractor shall be responsible for designing and constructing suitable and adequate falsework, centering and formwork in conformance with ACI 347, "Recommended Practice for Concrete Formwork."

B. Plywood: Conform to tables for form design in APA Form V345-72. Deflection of form facing material between supports: Not over 0.0025 x span.

C. Forms shall be designed so that the finished concrete shall conform to the shape, true to line, and the proper dimensions as called for on the Contract Drawings.

D. The design of forms shall take into account the effect of vibrations of concrete as it is placed.

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

E. The forms shall be substantial, unyielding and constructed mortar tight and of sufficient rigidity to prevent distortion due to the pressures of concrete and other loads incidental to the construction operations.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 05500

MISCELLANEOUS METAL

PART 1 - GENERAL

1.01 WORK INCLUDED

A. All miscellaneous metal items not specifically described in other sections of these specifications or shown on the drawings but required for a complete and operable facility.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section MP-13600 - Pre-Engineered Metal Building System

1.03 SUBMITTALS

A. Shop Drawings

1. After the contract has been awarded and before any miscellaneous metal is delivered to the job site, shop drawings showing all locations, markings, quantities, materials, sizes and shapes including all methods of connection, anchoring, fastening, bracing, and attachment to the work of other trades shall be submitted to the Engineer for review.

1.04 FIELD MEASUREMENTS

A. All measurements shall be verified in the field for all work fabricated to fit field conditions. Adjoining work shall be examined before work is started. Necessary corrective work shall be done to adjoining work to insure a proper fit.

1.05 QUALITY ASSURANCE

A. Installer's Qualifications

1. Mechanics engaged in the work of this section shall be regularly involved with the installation of materials specified herein.

B. Use only certified welders.

C. Codes and Standards

1. American Institute of Steel Construction (AISC)
2. American Welding Society (AWS)
3. American Society of Testing Materials (ASTM)

D. Compliance with Industry Standards

MATERIALS AND PERFORMANCE - SECTION 05500

MISCELLANEOUS METAL

1.06 PRODUCT HANDLING

A. Protection

1. Use all means necessary to protect miscellaneous metal before, during and after installation and to protect installed work and materials from other trades.

B. Cleaning

1. Any work that has been damaged, discolored, defaced or does not comply with these specifications shall not be accepted by the Engineer.

C. Replacement

1. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer at no additional cost to the Owner.

PART 2 - MATERIALS

2.01 MATERIALS

A. All materials and products shall meet the latest edition of the following standards:

Structural Steel	ASTM A-36
Miscellaneous Steel	Mild Steel
Bolts and Nuts	ASTM A-307
High Strength Bolts	ASTM A-325
Stainless Steel Bolts	ASTM A-193
Pipe Steel	ASTM A-53, Grade A Sch. 40 unless otherwise shown or specified.
Aluminum Structural Shapes	ASTM-B-308, Alloy 6061-T6
Aluminum Extrusions	ASTM-B-221, Alloy 6063-T6
Aluminum Plates and Sheets	ASTM-B-209, Alloy 6061-T6
Welding Rods	AWS Specifications for Arc Welding
Stainless Steel Bar & Shapes	ASTM A-276, Type 304, Condition A
Stainless Steel Plate, Sheet and Shape	ASTM A-167, Type 304
Stainless Steel Tubing	ASTM A-554, Type 304

B. Flexible wall ties attached to structural or miscellaneous metal shall be galvanized No. 315-316 as manufactured by Heckman Building Products, or galvanized triangular ties and column anchors as manufactured by Dur-O-Wall or equal products.

2.02 LOOSE LINTELS

A. Steel lintels shall be required to support openings 16 inches wide or greater in masonry

MATERIALS AND PERFORMANCE - SECTION 05500

MISCELLANEOUS METAL

walls.

2.02 CHAIN

A. Stainless steel welded link type, 13 links per foot, $^{3}/_{16}$-inch wire, with post loop at one end, chain snap and post loop at opposite end.

2.03 GRATED STAIRS AND LANDINGS

A. Stairs shall be fabricated of steel as shown on the plans.

B. Platform gratings and grating treads.

1. Pressure locks or welded type rectangular bar gratings with straight bearing bars and straight cross bars.

2. Bearing bars shall be a minimum of $^{3}/_{16}$-inch thick and shall be spaced not more than $1^{3}/_{16}$ inch o.c. Cross bars shall be a minimum of $^{1}/_{8}$-inch thick x $^{5}/_{8}$-inch deep, spaced not more than 2 inches o.c.

3. Stairs and landings for general access and exit purposes are to be designed to carry a live load of 125 pounds per square foot or a concentrated load of 250 pounds at the center of the span, whichever is greater, unless otherwise noted on the plans.

4. All gratings and stair treads shall have an abrasive surface.

5. The edges of all sections shall be edgebanded on all four sides. Edge banding shall be welded to all grating bars and shall be the same depths as the bearing bars.

6. All grating shall be so designed and fabricated that not more than ¼-inch clearance shall exist between grating sections or between grating frames.

7. Gratings shall be so designed and fabricated that each section is readily removable. Adjacent section shall fit neatly together with the transverse members forming an uninterrupted straight line.

8. Openings and holes shall be provided where required. Gratings which fit around protrusions shall be discontinuous at the centerline of the opening so that each section of grating is readily removable.

   a. All openings greater than 4 inch diameter shall be banded the full depth of the bearing bars.

   b. Edge banding shall be welded to all grating bars.

   c. Gratings cut on an angle shall have an edge bar welded to the cut edge.

MATERIALS AND PERFORMANCE - SECTION 05500

MISCELLANEOUS METAL

9. Gratings shall be accurately fabricated, free from warps, twists, or other defects which affect the appearance and serviceability of the gratings. The tops of the cross bars and bearing bars shall be in the same plane.

10. Gratings shall have a full and uniform bearing on the supports. Wedges or shimmying devices shall not be permitted.

11. Grating panels shall be locked securely in place with removable hold-down fasteners unless noted otherwise.

C. All stairs shall have embedded abrasive nosings and embedded abrasive surfaces on grating treads and platforms. Checkered or diamond stair nosings shall not be acceptable.

D. Fabrication shall be in accordance with the Occupational Safety and Health Act and as specified herein.

E. Wherever possible, joints and other connections shall be welded. All welds shall be ground smooth. Bolted connections shall be used only with the approval of the Engineer.

F. Grating treads and platforms for stairs shall be of the same design as the floor gratings. Each tread shall be a complete unit with flat bars and with suitable devices for securing the treads to the stair stringers. Each tread shall have an abrasive nosing angle surfaced with non-absorbent abrasive grains. Where grating platforms joint stair runs, the platforms shall have abrasive nosings similar in design and appearance to the nosings on the grating treads.

G. Exposed ends of stringers shall be closed with steel or aluminum plate to match the stair material, cut to the outline of the stringer, welded, and ground smooth.

H. Stringers and fascias shall have mitered and welded joints at changes in direction.

I. Landings which are part of the stair construction shall have stringers carried continuously around the perimeter of the landing, unless shown otherwise on the plans. Grating platforms shall be supported by continuous angles welded to the stringers.

J. Steel stairs shall receive one coat of shop paint compatible with the finish paint.

K. Stairs shall be installed as shown and specified, including all accessories, appurtenances, and other items of work necessary to complete the installation.

L. Stairs shall be erected as soon as practical so that they may be used during construction.

M. Stairs shall be rigidly connected to the structure with bolted or welded connections as shown on the plans.

Q. All exposed work shall be neatly finished with projecting rivits, lugs, and similar items concealed where possible.

MATERIALS AND PERFORMANCE - SECTION 05500

MISCELLANEOUS METAL

2.04 STAIR TREAD NOSINGS

A. Abrasive nosings for concrete stair shall be 3 inches wide with ¼-inch lip and shall be Type 232 as manufactured by Wooster Products, Inc., Type 132-A as manufactured by American Abrasive Metals Company, Inc. or equal.

B. Integral arrow type full length anchors or strap anchor at 1 foot o.c. shall be provided for all nosings to be cast in concrete.

C. Nosing in contact with dissimilar metals shall be back painted.

D. Cast-in-place nosings shall be installed with the specified anchorage system in accordance with the manufacturer's recommendations.

E. All nosings shall be set flush with the concrete surface.

F. Nosings for all stairs shall stop 6 inches from the ends of the stair tread.

2.05 OTHER MATERIALS

A. All materials not specifically described, but required for a complete and proper installation of miscellaneous metal, shall be new, free from rust, best of quality of the respective kinds, and subject to the approval of the Engineer.

2.06 SURFACE CONDITIONS

A. Inspection

1. Prior to all work of this section, carefully inspect the installed work of other trades and verify that all work is complete to the point where fabrication and installation of work covered under this section may commence.

2. Make all required field measurements to insure proper and adequate fit of all miscellaneous metal.

B. Discrepancies

1. In the event of discrepancies, immediately notify the Engineer.

2. Do not proceed with fabrication and installation until areas of discrepancies have been fully resolved.

2.07 FABRICATION

A. All metal work shall have smooth finish surfaces, welded joints shall be continuous, unless otherwise noted. The face of welds shall be dressed flush and smooth.

MATERIALS AND PERFORMANCE - SECTION 05500

MISCELLANEOUS METAL

B. Where possible, welding shall occur on the unexposed side. Exposed joints shall be made where least conspicuous.

C. Connection and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they shall be subjected.

D. Connections to aluminum shall be aluminum or stainless steel unless otherwise noted. All bolts used for aluminum shall be stainless steel.

E. Connections to cast iron and steel shall be steel unless otherwise noted.

F. Fastenings shall be concealed where practicable. All exterior connections and accessories shall be galvanized unless otherwise noted.

G. Joints exposed to weather shall be formed to exclude water.

H. All supporting members, and other items required to connect the work rigidly and properly to structural materials shall be provided.

I. Fabricate all miscellaneous metal in strict accordance with approved shop drawing and reference standards. All work shall be free from defects impairing strength or durability.

2.08 SHOP FINISHES

A. All ferrous metals shall be clean and given one shop coat of primer compatible with the finish paint.

B. Metal work to be encased in concrete shall be left unpainted unless noted otherwise.

C. Metals specified as hot dip galvanized or zinc coated shall not be shop primed.

D. Unpainted castings shall be clean and coated with cold tar pitch varnish, shop paint at piece marks shall not be omitted.

PART 3 - EXECUTION

3.01 FIELD PAINTING

A. Field abrasion, welds and other places where shop coating has been removed shall be field painted with the same paint that was used for the shop coat.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 11001

TEMPORARY WATER TREATMENT SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

The Contractor shall furnish all manpower, equipment and materials and execute all activities necessary to provide, operate and maintain a temporary water treatment system as specified herein and as described in the Remedial Design Specification. The temporary water treatment system includes the following major components which are specified herein:

- influent settling tanks;
- effluent storage tanks;
- process pumps;
- multi-media filters;
- bag filters;
- granular activated carbon (GAC) filters;
- piping and appurtenances; and
- meters and gauges.

1.02 SUBMITTALS

Submittals required by the Contractor are described in Section 2.3.1 of the Remedial Design Specification.

PART 2 - PRODUCTS

2.01 GENERAL

This section specifies the minimum design and construction requirements for major treatment system components. Substitutions of system components other than those specified herein shall be considered in accordance with the requirements of the Contractor's Scope of Work.

2.02 INFLUENT SETTLING TANKS

A. The influent settling tanks shall be of steel construction and shall provide adequate storage capacity to capture all water generated in a 24 hour period and to hold such water 24 hours before being pumped through the treatment system. The tanks shall have closeable tops which allow the water level in the tank to be determined by visual inspection and the use of a stick level indicator.

B. Each tank shall be furnished with an inlet and outlet pipe connection. The inlet pipe connection shall be located above the tank midline and the outlet connection shall be located at a minimum of 6-inches above the tank bottom in order to drain the tank while allowing up to 6-inches of solids to remain in the tank.

MATERIALS AND PERFORMANCE - SECTION 11001

TEMPORARY WATER TREATMENT SYSTEM

C. Each tank shall be furnished with internal baffle walls to further induce settling and of solids and capture of floatables.

D. During the operation of the treatment system, the influent tanks shall be visually inspected each time they are emptied to determine the depth of the sediment in the bottom of the tank. If sediment is observed to be 6-inches deep (or if directed by the Engineer) the tank shall be cleaned. Liquids which result from the cleaning activities shall be treated using the water treatment system, while solids shall be collected and placed into the sediment staging area for subsequent disposal.

2.03 TREATED EFFLUENT STORAGE TANKS

A. The treated effluent storage tanks shall be of steel construction with a nominal capacity of 20,000 gallons. A minimum of two storage tanks shall be provided as the treated water shall be tested in 20,000 gallon batches before being discharged to the sewer. Danaher shall supply the Contractor with two storage tanks. Additional tanks (if needed) shall be the responsibility of the Contractor. The tanks shall meet the requirements of Section 2.02 (of this specification).

2.04 PROCESS PUMPS

A. Process pumps shall be horizontal close-coupled, end suction centrifugal pumps of cast iron construction. The pump motors shall be non-overloading of NEMA standard design suitable for close-coupled pump mounting and rated for a maximum 100 gpm (maximum allowable throughput to the treatment system).

2.05 MULTI-MEDIA FILTERS

A. Two multi-media filters shall be provided in parallel as shown on Figure 1 (attached to this specification). The filter shall be sized for a maximum flow rate of 100 gpm. Each filter shall remove suspended solids down to 10 microns in size or smaller and lower turbidity down to one NTU.

B. The filters shall consist of a cylindrical vessel of steel construction and shall be supported on steel legs that permit skid mounting. A top head opening shall be provided for media filling and inspection and a bottom opening shall be provided for filter removal/leveling.

C. Each multi-media filter shall consist of a three-layer media bed designed to operate as a depth filter. The top layer shall collect coarse turbidity, the middle layer shall collect fine to normal turbidity/particulates and the bottom layer shall polish the water by removing particulates down to 10 microns in size or smaller. The mineral density, particle size, uniformity and depth of each layer shall be controlled by the manufacturer to optimize filter performance and ensure proper stratification after each backwash event.

MATERIALS AND PERFORMANCE - SECTION 11001

TEMPORARY WATER TREATMENT SYSTEM

2.06 BAG FILTERS

A. Two liquid bag filters shall be provided in parallel as described in the Contractor's Statement of Work. The filter shall be sized for a maximum flow rate of 50 gpm. Each bag filter shall be a Model #3M-523 or equivalent, rated absolute at 1.0 micron.

B. Each filter shall consist of a cylindrical metal housing supported by adjustable legs that permit skid mounting, positive sealing hinged lid, perforated support basket, and filter bag.

2.07 GAC ADSORPTION UNITS

A. Two GAC adsorption units shall be provided in parallel as shown on Figure 1. Each unit shall be cylindrical and rated for a maximum flow rate of 100 gpm and pressure rated at at least 15 psig at 150°F. The units shall be provided with lifting supports suitable for lifting by a fork lift truck.

B. The units shall be designed for a downflow application with kamlock inlet and outlet connections, a carbon dryfill opening in the top and a carbon discharge connection in the unit bottom. All tank fittings shall be installed by the GAC unit manufacturer at the time and place of manufacturer. The Contractor shall not modify the GAC units in the field without written approval from the Manufacturer.

C. All water shall be routed through one on-line GAC adsorption unit during normal treatment system operations. When the on-line GAC adsorption unit becomes spent, the flow shall be diverted through the standby unit.

PART 3 - EXECUTION

3.01 GENERAL

A. The Engineer shall obtain a groundwater remediation discharge permit from the Onieda County Department of Water Quality and Water Pollution Control for the discharge of effluent to the sanitary sewers.

B. The permit is anticipated to include the following discharge limits:

- Total Toxic Organics: <2.0 mg/l
- PCBs: <0.065 parts per billion (per arochlor)
- Oil & Grease: <100 mg/L
- Cadium: <1.0 mg/l
- Chromium: <5.0 mg/l
- Copper: <3.0 mg/l
- Lead: <5.0 mg/l
- Nickel: <2.0 mg/l
- Zinc: <4.0 mg/l

C. The Contractor shall provide, operate and maintain a temporary on-site water treatment system that shall be used to treat liquid waste streams in accordance with the discharge permit during excavation activities.

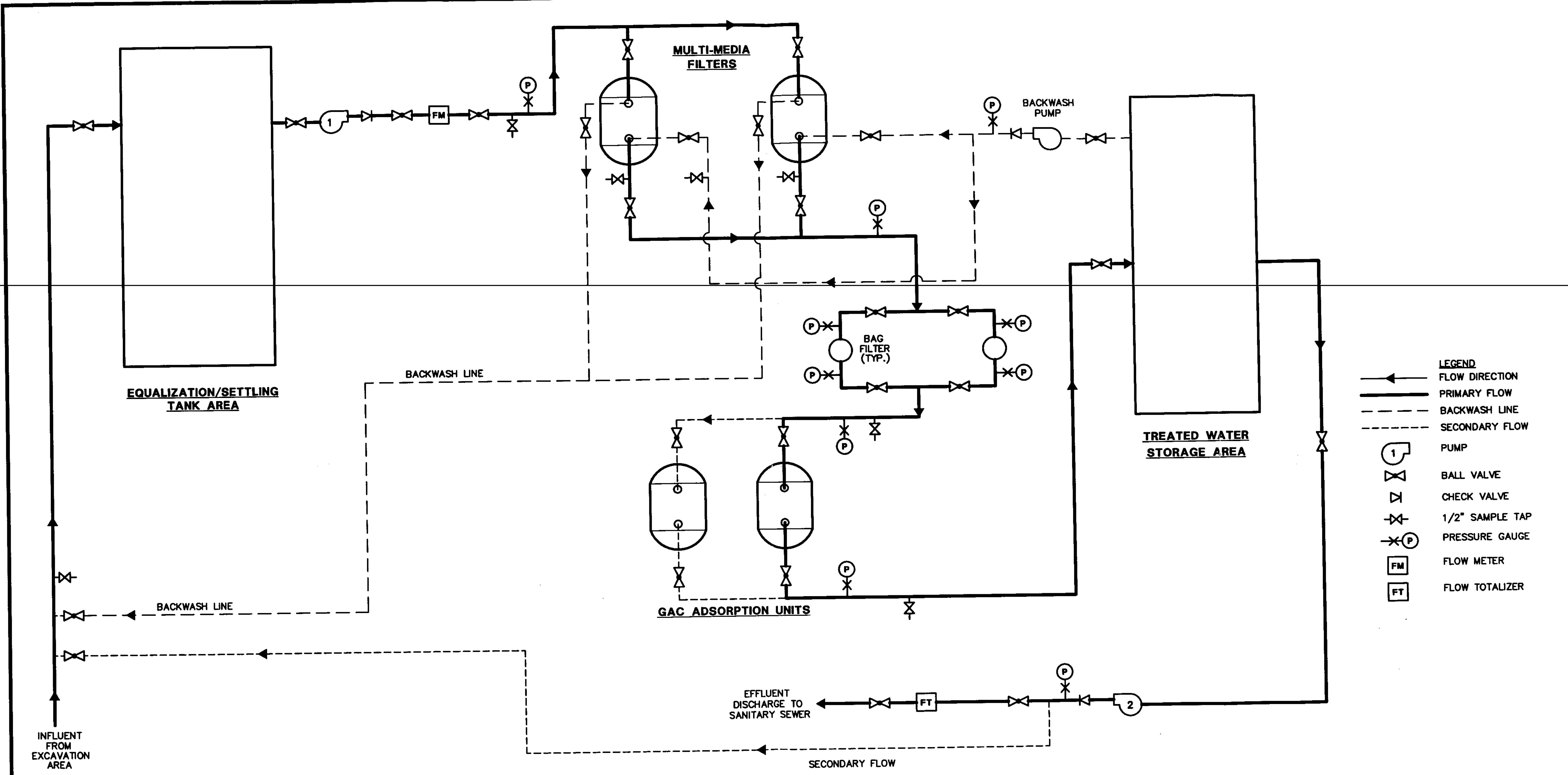
MATERIALS AND PERFORMANCE - SECTION 11001

TEMPORARY WATER TREATMENT SYSTEM

3.02 TESTING

A. The temporary water treatment system shall operate in batch mode. The treated water shall be collected in 20,000 nominal gallon tanks and shall be tested by the Engineer upon the filling of each tank. The treated water shall not be discharged until analytical results indicate that contaminant/particulate concentrations comply with discharge limits stated in the ground-water remediation discharge permit. Should analytical results not indicate compliance with the discharge permit, the Contractor shall retreat the batch until compliance is achieved. If a persistent problem of non-compliance exists, the Contractor shall modify the water treatment system at his own cost to ensure compliance.

- END OF SECTION -



GENERAL NOTES AND SPECIFICATIONS

1. THE CONTRACTOR SHALL INSTALL EQUIPMENT IN A NEAT AND WORKMANLIKE MANNER; ALIGN LEVEL AND ADJUST FOR SATISFACTORY OPERATION; INSTALL SO THAT PARTS ARE EASILY ACCESSIBLE FOR INSPECTION, OPERATION AND REPAIR.
2. ALL PVC PIPE SHALL BE SCHEDULE 80 TYPE II
3. ALL PIPING SHALL BE INSTALLED AND PRESSURE TESTED PER MANUFACUTURER'S SPECIFICATIONS. ZERO LEAKAGE IS ALLOWED FOR ALL JOINTS.
4. ALL PVC JOINTS SHALL BE SOLVENT WELDED.
5. ALL BALL AND CHECK VALVES SHALL BE PVC, TRUE UNION TYPE BY TRUE BLUE, PLASTO-MATIC OR EQUAL.
6. ALL SAMPLE TAPS AND DRAIN VALVES SHALL CONSIST OF A 1/2" DIAMETER PIPE EXTENSION AND BALL VALVE. SAMPLE TAPS AND DRAINS SHALL BE LOCATED AT ALL LOCATIONS SHOWN ON THE DRAWINGS AND AT ALL LOW ELEVATIONS IN THE PROCESS PIPING AND SHALL BE EASILY ACCESSIBLE.
7. ALL PRESSURE GAUGES TO BE TRERICE MODEL NO. 450 OR EQUAL.
8. ALL SPECIFIC MANUFACTURERS ITEMS SHALL BE INSTALLED IN STRICT ACCORDANCE WITH MANUFACTURERS WRITTEN INSTRUCTIONS AND/OR THE MANUFACTURER'S REPRESENTATIVES DIRECTIONS.

L: ON=*,OFF=REF
P: STD-PCP/BL
4/8/98 SYR-54-DCC
30708100/30708F01.DWG

CHICAGO PNEUMATIC TOOL COMPANY
REMEDIAL DESIGN SPECIFICATIONS

PROCESS FLOW SCHEMATIC

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE **1**

MATERIALS AND PERFORMANCE - SECTION 11002

SOIL VAPOR EXTRACTION SYSTEM

PART 1-GENERAL

1.01 DESCRIPTION

A. Work Specified

The Contractor shall furnish all manpower, equipment and materials and execute all activities necessary to provide a soil vapor extraction system as specified herein and as described in the Contractor Scope of Work. The soil vapor extraction system includes the following major components which are specified herein:

- vapor extraction equipment;
- granular activated carbon (GAC) adsorption units;
- condensate storage tanks;
- piping and valves; and
- gauges.

1.02 SUBMITTALS

Submittals required by the Contractor are as follows.

A. Shop Drawings

Contractor shall submit 4 copies of complete shop and installation drawings for the vapor extraction equipment and GAC filters which may include but not be limited to the following:

- Detailed equipment drawings showing necessary dimensions and all piping, valves, fittings, and appurtenance;
- Detailed technical specifications and assembly drawings as necessary; and
- Identify support utilities, connections, and/or work required by others so that equipment may be properly installed and operated.

B. Operation and Maintenance Manual

Upon approval of the shop drawing submittal, submit 4 copies of an operation and maintenance manual prepared for the equipment which shall include installation and start-up and trouble-shooting instructions. The Operation and Maintenance manual shall be submitted at least 3 weeks prior to anticipated equipment delivery date. The operation and maintenance manual submittal may include but not be limited to the following:

MATERIALS AND PERFORMANCE - SECTION 11002

SOIL VAPOR EXTRACTION SYSTEM

- Safety requirements;
- Equipment list with spare parts list;
- Detailed installation instructions;
- Operating instructions (including backwash operations);
- Start-up instructions;
- Trouble-shooting requirements;
- Routine and non-routine maintenance requirements;
- General manufacturer's product literature; and
- Customer service information including local contact person, address, and phone number.

C. Manufacturer's Specifications

- Manufacturer specifications for the PVC piping, fittings, valves, and appurtenances proposed for use in the piping network;
- Manufacturer specifications and MSDSs for the PVC glue and cleaning to be used for piping and fitting assembly. The specifications must clearly state the ambient temperature range acceptable for the solvent weld product to be used;
- Manufacturer specifications and installation directions for the pipe hangers and supports proposed for use in the manifold network; and
- Manufacturer specifications for the flexible piping to be used for well, connections in the piping network.

1.03 WARRANTIES/GUARANTEES

The equipment supplier shall warranty and guarantee the SVE equipment and GAC adsorption units against failures, leaks, breaks, and other unsatisfactory conditions for a minimum period of one year from acceptance of the equipment. These warranties include the replacement and/or repair of defects, as well as faulty materials, equipment and systems, due to whatever cause, including, but not limited to, manufactured parts and faulty installation. All warranty replacement and/or repair work, and any required materials, equipment, systems and labor shall be at the expense of the Contractor.

PART 2 - PRODUCTS

2.01 GENERAL

This section specifies the minimum design and construction requirements for major soil vapor extraction system components. Substitutions of system components other than those specified herein shall be considered in accordance with the requirements of the Contractor's Scope of Work.

2.02 VAPOR EXTRACTION EQUIPMENT

The vapor extraction equipment shall be skid mounted and consist of one Positive Displacement Blower Package, one Knockout Tank and Liquid Discharge Pump, one Air to Air Heat Exchanger, and one Control Panel. The skid dimensions and weight shall be approximately four feet wide by nine and a half feet long by seven feet high, and 2,100 lbs, respectively.

A. The positive displacement blower shall be capable of handling 250 scfm of air at an inlet vacuum of 14.25" Hg gauge and a discharge pressure and temperature of 1.5 psig and 310°F, respectively. The blower package shall consist of a 30 HP, 230/460V, 3 Ph, 60 Hz, TEFC motor with a V-belt drive and guard, inline air filter, inlet and discharge silencers permitting <92 dBA estimated noise level at 3 feet free field.

B. The knockout tank shall be of carbon steel construction with a 40 gallon liquid capacity. The tank shall consist of a demister pad, manual drain valve, sight level gauge with isolation valves, High/High level switch (alarm), and High/ Low pump down level switch. The tank's liquid discharge pump shall be capable of pumping 15 gpm at 20' TDH. The discharge pump shall consist of a ½ Hp, 230/460 V, 3Ph, 60 Hz, TEFC motor.

C. The air to air heat exchanger shall be primarily of aluminum construction and capable of discharging the 310°F exiting blower air at a temperature of approximately 90°F or less. The Contractor shall assume an average ambient air temperature of 70°F for the cooling medium. The heat exchanger shall consist of a ½ Hp, 230/460V, 3Ph, 60 Hz, TEFC Fan Motor. The heat exchanger's approximate dimensions and weight shall be 40"L x 24"W x 33"H and 160 lbs, respectively.

D. The control panel shall be wall mounted separately as indicated on the drawings and as specified in Section 16100 - Electrical Work.

2.03 GAC ADSORPTION UNITS

A. Two GAC adsorption units shall be provided in series as shown on the drawings. Each unit shall be cylindrical and rated for a normal flow rate of 250 scfm and pressure rated at 15 psig at 150°F. The units shall be constructed of stainless steel or polyethylene and shall be provided with lifting supports suitable for lifting by a fork lift truck.

B. The units shall be designed for vapor treatment with 6-inch inlet and outlet ducting connections, a carbon dryfill opening in the top and a carbon discharge connection in the unit bottom. All tank fittings shall be installed by the GAC unit manufacturer at the time and place of manufacturer. The Contractor shall not modify the GAC units in the field without written approval from the Manufacturer.

C. Each GAC unit shall be provided with 1,000 pounds (nominal) of virgin coal-based carbon.

2.04 CONDENSATE STORAGE TANKS

A. The condensate storage tanks (drums) shall be standard 55-gallon waste drums of steel or polyethylene construction and shall have a nominal capacity of 55 gallons. Four drums shall be provided on a spill containment pad manufactured of steel or polyethylene with a

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SOIL VAPOR EXTRACTION SYSTEM

capacity of at least 60 gallons. The spill containment pad shall include a ramp for drum removal.

2.05 PIPING AND VALVES

A. All piping shall be PVC Schedule 80.

B. All PVC pipe joints shall be solvent welded, installed and pressure tested in accordance with manufacturer's specifications. Zero leakage is allowed for all joints.

C. All pipe shall be supported at 7'-0" O.C. (max) and located 2'-0" from joint locations inside the treatment building and 10'-0" O.C. for exterior ground-level piping.

D. All valves on air lines shall be butterfly valves. Vales on liquid lines shall be ball valves. Valves shall be PVC true union ball valves with viton o-ring seal, teflon self-lubricating seats, tight shut-off in either direction, full port design, solvent welded socket ends and operating handle. Manufacturer shall be: Hayward, Nibco, Plasto-matic or equal.

E. All check valves shall be PVC true union check type with viton o-ring seals. Manufacturer shall be: Hayward, Nibco, Plasto-matic or equal.

F. Sample taps and drain valves shall consist of a ½" diameter PVC pipe extension, ball valve and nipple. Sample taps and drain valves shall be located at location shown on the drawings and at all low elevations in the process piping.

2.06 GAUGES

A All pressure vacuum gauges shall be Trerice pressure/vacuum gauges with a dial range of 0 to 60 inches of mercury or equal.

B. All temperature gauges shall be Trerice 3½" stainless steel case dial thermometers or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. The SVE system shall be installed in accordance with the drawings and as specified herein.

3.02 FIELD REPRESENTATIVE

A. A manufacturer's field representative shall be on-site to inspect and test the SVE equipment and GAC adsorption units and certify that the installation has been performed in accordance with manufacturer's recommendations, and that the system is ready for operation by others.

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SOIL VAPOR EXTRACTION SYSTEM

B. In addition, the Contractor and/or manufacturer's representative shall be available to assist the Engineer with system start-up activities as described in Appendix F - SVE Start-Up Activities.

3.03 LEAK TESTING

A. All SVE header lines shall be leak tested using low pressure compressed air prior to acceptance by the Engineer. Test procedures are as follows:

- Seal both ends of the header line to be tested by either shutting a valve or by providing a pressure tight cap at both ends.
- Pressurize the pipe with oil free compressed air to 25 to 30 psi.
- Monitor the pressure inside the section of manifold line being tested using a 0 to 30 psi, liquid filled pressure gauge accurate to 5% of the gauge range for one hour.
- At a constant temperature, the pressure in the header line being tested may not fall more than 1.5 psi in one hour.
- If any section of header pipe fails to comply with this specifications, it is the Contractor's responsibility to conduct the necessary repairs.
- All tests shall be conducted to the satisfaction of the Engineer.
- No section or sections of piping shall be accepted as complete without passing leak testing.

- END OF SECTION -

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PRE-ENGINEERED METAL BUILDING SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. All labor, material, and equipment necessary to design, fabricate, and erect the pre-engineered metal building system as indicated on the Contract Drawings (Drawings) and as specified herein.

1.02 QUALITY ASSURANCE

A. The pre-engineered building system shall be the design of a manufacturer regularly engaged in the fabrication of pre-engineered structures conforming as specified hereafter to the metal building manufacturers association standards.

1.03 DESCRIPTION

A. The building covered by this specification is a single span framed as manufactured by Varco-Pruden Buildings or equal. The building shall have a gabled roof. The stability shall be obtained from the wall and roof panels which shall combine both the structural support and cover in one unit. Purlins shall be utilized and, in addition, a frame shall be provided for this multiple bay type building.

B. The gabled roof slope starting at both side wall eaves and terminating at the ridge shall not be less than one unit rise (vertical) to four units run (horizontal).

1.04 DESIGN BASIS

A. Steel Construction Manual of American Institute of Steel Construction, current edition and American Iron and Steel Institute's "Specification For The Design of Cold-Formed Steel Structural Members" of current edition. American Welding Society "Code for Welding in Building Construction" of current issue.

B. ASTM standards as amended to date: A-325 for Quenched and Tempered Steel Bolts; A-307 for Steel Machine Bolts and Nuts; ANSI Standard B1-1-60 for determining tensile stress area of threaded ends of rods.

C. The roof purlin system shall be supported by the endwalls and the interior frame. The eave strut shall frame into and between the columns and the endwalls. The rake girt shall frame into and between the eave strut and ridge purlins.

D. The roof and wall panels, purlins, and the frame, properly braced and tied shall be designed to carry all vertical and horizontal loads. All horizontal loads shall be resisted by the walls and frame. The roof system shall distribute all racking forces from horizontal loads to the shear walls or frames by diaphragm action or by a supplemental tension bracing system.

E. The building system shall also be designed to support the miscellaneous appurtenant loads

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PRE-ENGINEERED METAL BUILDING SYSTEM

such as lights, unit heaters, piping conduits, equipment, etc., as shown on the Drawings and as specified in other sections. Provide additional frame around roof vent openings as required to support all horizontal and vertical loads. The vents shall be securely attached to the roof framing using bolts and horizontal bracing as required to prevent movement.

F. The interior frame shall consist of columns and rafters, partially fixed at the base; and, with a fixed joint splice (if required) at the ridge shall have moment connections at haunches to resist horizontal and uplift forces.

G. The purlins shall be considered as simple span beams. Intermediate wall girts are permitted.

H. Tension bracing and/or bridging may be permitted in the plane of the roof but shall not obstruct the vertical clearance required. All wall planes shall be void of any vertical plane tension bracing.

I. Door openings shall be designed to structurally replace the sidewall panels displaced.

1.05 DESIGN CRITERIA

A. The following design criteria shall be followed in designing the metal building system:

1. Snow Load - 40 PSF of horizontal projection.

2. Wind Load - 15 PSF on projected surfaces.

3. Uplift Load - 14 PSF of horizontal projection.

4. Earthquake Load - Zone 1.

1.06 SUBMITTALS

A. Shop Drawings

1. Submit detailed shop and erection drawings showing all pertinent information necessary for the fabrication and erection of the building system.

2. Anchor bolts and other embedded items in the concrete shall be indicated on the shop drawings.

3. Modifications to the foundation, as shown on the Drawings, shall be acceptable to accommodate the components of the building system, but all modifications shall be included in the shop drawings and shall be done at no cost to the Owner.

4. If the building provided by the Contractor requires modifications to the foundation presented on the Contract Drawings, the Contractor shall be responsible for making the revisions at no additional cost to the Owner. All revisions to the foundation (if necessary) shall be stamped by a Professional Engineer licensed to practice in New

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PRE-ENGINEERED METAL BUILDING SYSTEM

York State.

B. Design Computations

1. All computations and drawings shall carry the stamp of a registered professional engineer fully licensed to practice in the State of New York.

2. All loads and reactions for the proper design of the foundation shall be supplied by the system manufacturer.

1.07 GUARANTEES

A. Upon completion of the building system, the Contractor shall furnish the Engineer with two copies of the manufacturer's guarantee for the following items.

1. The materials used in the building system shall carry a guarantee against defects in composition, design, and workmanship for a period of one year.

2. The erection and installation of the building system shall carry a guarantee against defects in workmanship for a period of one year.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials shall be new, free from defects and imperfections, fabricated in a workmanlike manner and shipped with necessary protection to assure deliver in first-class condition.

B. Wall panels shall be #364S, 24 gauge acrylic enamel coated.

C. Roof panels shall be #364, 24 gauge acrylic enamel coated.

D. Metal eave trim, fascia, and gutters shall be 24 gauge acrylic enamel coated.

E. Insulated interior metal wall liner shall be 24 gauge galvanized steel with a 7/8-inch thick rigid insulation board.

F. Hollow metal door frames shall have a 5 3/4-inch jamb depth and be 16 gauge minimum.

G. Hollow metal doors shall be flush type, insulated and 20 gauge minimum.

H. Hollow metal door hardware shall consist of the following:

1. Hinges - full mortise 4½-inch x 4½-inch, three per door.
2. Closer
3. Lockset

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PRE-ENGINEERED METAL BUILDING SYSTEM

4. Weather Strip
5. Drop Door Seal
6. Chain Bolt and foot Bolt at Double Doors Only

PART 3 - EXECUTION

3.01 FABRICATION

A. All components of the structure shall be fabricated in accordance with the reviewed shop drawings to form a completely watertight and weatherproof structure.

3.02 INSTALLATION

A. Complete erection of the building shall be by the manufacturer or his authorized representative. The authorized representative shall be skilled in the successful erection of metal building systems.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 15000

GENERAL EQUIPMENT REQUIREMENTS

PART 1 - GENERAL

This section sets forth general requirements related to furnishing, installing and testing of any and all equipment supplier or manufacturer shall review all plans and specifications, including all details, to verify the space requirements. All modifications must be clearly indicated on the shop drawings and shall be at the Contractor's or equipment suppliers' expense.

PART 2 - DELIVERY OF EQUIPMENT

Delivery dates for equipment/products shall be as required by the Contractor to meet the finalized project work schedule.

PART 3 - SUBMITTALS

All submittals (i.e., shop drawings, descriptive data, performance characteristics, material specifications, space parts, piping and wiring diagrams, etc., as appropriate) showing conformance of all equipment to the Contract Documents, shall be submitted to the Engineer for his review in accordance with the RD Specifications and these M&P Specifications.

PART 4 - DESIGN OF EQUIPMENT

All equipment/products and associated appurtenances shall be designed in conformance with NEMA, IEEE, ASME, ANSI, ASTM and other generally accepted applicable standards, and shall be rugged construction and of sufficient strength the withstand all stresses which may occur during fabrication, testing, transportation, installation and all conditions of operation. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for adequate lubrication by readily accessible devices. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

All machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings. The corresponding parts of identical machines shall be made interchangeable.

PART 5 - EQUIPMENT IDENTIFICATIONS

Each product, piece of equipment, etc., shall be furnished with a substantial stainless steel or brass nameplate. The nameplate shall be conspicuously located and securly fastened and shall be clearly inscribed with, at minimum, the manufacturer's name, serial number, model number (when applicable), principal rating data nd year of manufacture.

In addition, each piece of mechanical equipment (i.e., pumps, blowers, etc.) shall also be identified as to name and number by a suitable laminated plastic label attached to the unit. Names and numbers of mechanical equipment shall be coordinated to match same on remotely located controls, control panels, etc. The Contractor shall submit a list of equipment labels and one sample label to the Engineer prior to the 70 percent point of construction.

MATERIALS AND PERFORMANCE - SECTION 15000

GENERAL EQUIPMENT REQUIREMENTS

Special care must be taken to ensure that nameplates and labels shall not be painted over.

PART 6 - SPARE PARTS AND ACCESSORIES

Spare parts and accessories for equipment shall be furnished as specified in the appropriate Material and Performance equipment section.

Spare parts shall be identical and interchangeable with original parts. Parts shall be supplied in clearly identified containers, except that large or bulky items may be wrapped in polyethylene. Each part (or group of small parts) shall be tagged and each tag shall carry the following information: Identity of the equipment the part is for; identity or name of the part itself;and manufacturer's name and identification number of the part.

Spare parts shall be stored separately in a locked area, maintained by the Contractor and shall be turned over to the Owner in a group at initial operation.

PART 7 - EQUIPMENT INSTALLATION

Equipment shall be installed as specified in the appropriate Materials and Performance section.

PART 8 - SHOP TESTING

All equipment so noted in this Section or in other Materials and Performance Sections, shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics, including any specified pressure, duty, capacity, rating, efficiency, performance, function, or other special requirements, comply fully with the requirements of the Contract Documents and that it will operate in the manner specified. When specifically required in the detailed equipment specifications, arrangements shall be made for the Engineer to witness performance tests in the manufacturer's shop.

Four (4) certified copies of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.

PART 9 - FIELD TESTING

Field testing of equipment shall be performed as specially required by other Materials and Performnce Sections.

The Contractor shall be soley resonsible for the proper operation of all equipment during testing and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to substantial completion of the Contract.

A. Preliminary Field Testing

The Contractor shall furnish all labor, materials, instruments, gauges, etc., as required, and shall perform preliminary field tests on equipment as soon as conditions allow. If the preliminary field tests disclose any equipment furnished under this Contract which does not comply with the requirements of the Contract Documents, the Contractor shall, prior to the final acceptance tests, make all changes, adjustments and replacements required.

At minimum, preliminary field testing shall include verifying that equipment is installed in the location and orientation specified or shown on the Contract Drawings. In addition, equipment shall be prepared for operation in accordance with manufacturer's recommendations and the Contract Documents.

B. Final/Acceptance Testing

Prior to start-up, all equipment and appurtances installed under this Contract shall be subjected to final/acceptance tests as specified or required to prove compliance with the Contract Documents. The Contractor shall furnish labor, fuel, lubricants, energy, water and all other materials necessary for all acceptance tests. Tests shall be supervised by the manufacturer's representative in accordance with Part 13 of this Section.

At minimum, final/acceptance testing shall include:

1. Verification that equipment has been properly aligned, adjusted and lubricated.

2. Verification that equipment shall meet all specified performance requirements and shall perform without any unusual noise, vibration or other signs of possible malfunction.

3. Verification that all controls (both electrical and mechanical) are properly connected and operating.

4. Verification that each mode and/or function is properly performing for multi-mode and/or multi-operation equipment.

Unless specifically allowed by the Owner or specified elsewhere in the Contract Documents, all field tests of liquid handling equipment shall be conducted using water from the public water supply. Costs associated with supplying this water shall be borne by the Contractor.

PART 10 - SERVICES OF MANUFACTURER'S REPRESENTATIVE

Where specifically called for in particular M&P Sections, the Contractor shall arrange for the equipment manufacturer to furnish the services of a qualified manufacturer's representative. The time period for the supervision and instructions is outlined in the respective applicable provision of the representative M&P Section. Where no specific duration of visit is listed, the length of time shall be such to allow the equipment representative ample time to follow out the requirements outlined in this Section.

The factory representative provided shall be trained and fully qualified and capable of performing the services required. Factory representatives shall arrive at the site with all tools, instruments, equipment, documentation, or other materials necessary to perform the required services.

MATERIALS AND PERFORMANCE - SECTION 15000

GENERAL EQUIPMENT REQUIREMENTS

Time spent in travel to the site shall not be applied toward the required duration of services. Time spent at the site if not properly prepared or equipped to perform the required services shall not be applied toward meeting the specified durations. For installation, initial operation, testing, start-up and adjustment services, the durations shown in the equipment specificaton sections shall be considered minimums.

The COntractor shall be responsible for any additional time required for the manufacturer's representative to resolve equipment installation and/or operation problems due to a lack of coordination beteen the supplied equipment and the Contract Documents such as, but not limited to, dimensions, electrical problems or performance.

When the equipment representative is required to visit the facility on occasions after initial start up and during the first yesr of operation, the purpose of these visits shall be to review equipment operation, assit the operators in correcting operational problems, and basic inspection of the equipment.

The manufacturer's representative shall be present at installation to observe equipment installation and shall be responsible for recommending nd/or making (as approved by the Engineer) minor adjustments and shall supervise field testing of the equipment.

Following successful installaiton nd testing of equipment, the manufacturer's representative shall submit three (3) written copies of certification (one each to the Owner, the Engineer and the Contractor) stating that the equipment manufactured or supplied by their company has been installed and tested to their satisfaction and that all required final adjustments have been made. The certification shall also include the date of final/acceptance fiels testing and a listing of all persons present during testing.

The manufacturer's representative shall also instruct the Owner's operating personnel in the proper operation and maintenance of the equipment following issuance of the above-referenced certification. The specified durations for training shall be over and above the time spent at the site for any other purposes. As noted above, time spent in travel shall not be applied toward the required duration of services.

Training shall be scheduled at least two (2) weeks in advance so as to provide the Owner an opportunity to adjust work schedules to permit all interested personnel to attend. If applicable to the particular training to be provided, the Owner can make its training room facilities available.

Additional information relative to services by a manufacturer's representative may be contained in the Comtrct Documents includng the Special Conditions.

PART 11 - EQUIPMENT MANUALS

The Contractor shall furnish and deliver to the Engineer two (2) complete sets of information required for the proper operation, maintenance and repair of equipment supplied for this project. These equipment manuals shall be delivered prior to the 60 percent completetion point of the project.

All instructions shall be be bound into a series of identical heavy-duty, three-ring binders. Information shall be organized by sections, each section covering a specific equipment item. Sections shall be listed in a Table of Contents at the front of each volume. Each section shall contain the following as a minimum:

MATERIALS AND PERFORMANCE - SECTION 15000

GENERAL EQUIPMENT REQUIREMENTS

A. Title page identifying equipment item, manufacturer, model number/name, serial number, project title, owner, locaiton, and date of issuance.

B. Section Table of Contents.

C. Written instructions, including technical bulletins and functional diagrams.

D. Complete parts list and parts diagram for all equipment, including motors and drive units, showning manufacturer's identification numbers for each part.

E. Copies of shop drawings, where required, to adequatley describe interrelation of components within a system.

F. Complete electrical and control schematics with labeled terminations.

G. List of special tools required for operation and maintenance.

H. List of spare parts supplied with the equipment, identified by manufacturer's part numbers.

I. Source of replacement parts and address and telephone number of the manufacturer's service representative.

J. Recommended installation arrangement, locations, wiring, criteria, procedure, etc.

K. Normal and emergency operating instrucitons, procedures, and sequences for each possible mode of operation.

L. Normal and emergency operating instructions, procedures, and sequemces for each possible mode of operation.

M. Troubleshooting procedures (as applicable).

Separate sections shall be clearly marked with dividers. Folded drawings or small items shll be provided in heavy-duty, three-ring plastic pockets.

Information not applicable to a specific piece of equipment installed on this project shall be removed from or crossed off on the submission.

Written operation and maintenance instructions shall be required on equipment where called for in other M&P Sections of the specifications.

At the end of each section, the Contractor shall include a detailed maintenance and lubrication schedule for equipment covered in the section. Schedule shall include the following, as a minimum, for each equipment item:

A. List and frequency of maintenance activities, other than lubrications.

B. Lubricaiton frequency and application points.

C. Lubricant type (weight or grade and recommended manufacturers) and method of applicaiton.

Motors and drive units furnished as part of the equipment shall be included in the schedule.

Providing complete equipment manuals, as specified here, for all equipment, devices or materials furnished under the Contract is a part of the work of this Contract and the Contractor is wholly responsible for obtaining acceptable equipment manuals from the equipment manufacturers submitting them to the Engineer. Two copies of ech equipment manual shall be submitted to the Engineer by the Contractor for Engineer's transmittal to the Owner for rebiew. In order to be acceptable, ech copy of each equipment manual must be complete, as specified herein, and must easily legible and clearly reproduced.

PART 12 - FAILURE OF EQUIPMENT TO PERFORM

Any defects in the equipment, or failure to meet the guarantees or performance requirements of the specifications shall be promptly corrected by the Contractor by replacements or otherwise. If the Contractor sails to make these corrections, or if the improved equipment fails to meet the guarantees or specified reqiurements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.

PART 13 - GUARANTEE

By supplying a product under this Contract, the manufafcturer/supplier and Contracto jointly agree that all manufacturer's warranties, expressed or implied, pas through the Contractor to Owner. This warranty obligation starts on the date of the Substatial Completion and survives any inspection by, delivery to, acceptance by or payment by the Owner or Contractor for the goods furnished by the manufacturer. Further, this warrants that the equipment designed, manufactured and/or used meets all applicable federal, state and local laws, rules, and regulations, including applicable OSHA standards. This requirement does not change or limit the requirements for performance affidavits previously described in Part 2.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 15051

HEAT TRACING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. This specification is for the application of heat tape to the leachate force main and heat pads to the leachate collection dike tank.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section MP-02526 - High Density Polyethylene Pipe
B. Section MP-16900 - Instrumentation

1.03 SUBMITTALS

A. Provide shop drawings covering all piping to be heat traced and all components of heat trace system; include installation instructions.

B. Provide shop drawings covering all tanks to receive heat pads and all components of tank heat pad system; include installation instructions.

PART 2 - PRODUCTS

2.01 HEAT TAPE

A. Heat tracing shall be Thermon self-regulating heating cable, RSX 3-1 BCFOJ.

B. Cable shall have a heat output of 3 watts per foot @ 120 volts. Heat output shall vary in response to it's temperature.

C. Cable shall be constructed of nickel plated copper bus wires, a semi-conductive heating matrix, crosslinked polyolefin insulating jacket, tinned copper braid, and a fluoropolymer overjacket with a tinned copper braid.

D. Heat tracing shall be provided with a Thermon E4X/7-35235 thermostat and junction box shall be epoxy coated aluminum enclosure with 0-ring gasketed cover with stainless steel capillary armor. Thermostat shall have an adjustable control range of 35-235°F with a 9°F switch differential.

E. Switch rating shall be 20 amps @ 120 VAC, SPST.

F. Other accessories shall be required by manufacturer for installation.

MATERIALS AND PERFORMANCE - SECTION 15051

HEAT TRACING

2.02 TANK HEATING PADS

A. Tank heating pads shall be Thermon RT-1022 flexipanel. Pads shall produce 1000 watts at 240 volts.

B. Heat-laminated, high temperature silicone rubber insulation shall surround an inconel 600 heating element. A tough metal jacket shall provide mechanical protection.

C. Tank heating pad shall be provided with a Thermon E4X/7-35235JB thermostat and junction box shall be epoxy coated aluminum enclosure with 0-ring gasketed cover with stainless steel capillary armor. Thermostat shall have an adjustable control range of 35-235°F with a 9°F switch differential.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of heat tape including wrapping, end seal procedures, splicing and T-splicing, and power termination shall be done in accordance with manufacturer's recommendations.

B. Installation of the tank heating pads shall be accomplished using adhesive materials supplied with the Thermon RTM mounting kit.

C. Installation shall be in strict accordance with manufacturer's instructions.

D. The power source for heat tracing and tank heating pads shall be as shown on the Contract Drawings or as directed by the Engineer.

E. Aluminum tape shall be installed on the pipe under and over the cable.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 15146

LEACHATE COLLECTION PUMPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish and install two (2) vertical, submersible pumps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. MP-Section 16100 - Electrical Work

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have experience in producing similar equipment, and shall show evidence of similar installation in satisfactory condition and operation.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. Standards of the Hydraulic Institute.
2. National Electric Code.
3. Standards of National Electric Manufacturers Assoc.
4. Institute of Electric and Electronic Engineers.
5. American National Standards Institute.
6. Standards of American Water Works Association.

1.04 SUBMITTALS

A. Shop Drawings: submit for approval Shop Drawings showing the following:

1. Manufacturer's literature, illustrations, specifications, and engineering data including: dimensions, materials, size and weight, flowrate, head, brake horsepower, motor horsepower, speed, shut-off head, performance data.

2. Shop drawings showing: Fabrication, assembly, installation, and schematic wiring diagrams.

3. Certified test data and curves for all pumps showing overall pump efficiencies required net positive suction head, flow rate, head, brake horsepower, motor horsepower, speed and shut-off head.

MATERIALS AND PERFORMANCE - SECTION 15146

LEACHATE COLLECTION PUMPS

4. Operation and Maintenance Manuals: Submit three (3) complete installation operation and maintenance manuals including copies of all approved Shop Drawings.

PART 2 - PRODUCTS

2.01 SERVICE CONDITIONS

A. The pumps shall be designed, constructed and installed for the service intended, and shall comply with the following minimum conditions:

Design Conditions for each pump:

Flow rate:	40 gpm
Temperature:	Ambient
TDH@ 40 gpm:	20 feet
Discharge Piping Size:	2-inch

2.02 DETAILS OF CONSTRUCTION

A. Provide an explosion proof, submersible pump designed in accordance with requirements for hazardous locations.

B. Superior cooling shall be achieved via an oil-filled pump motor. The pure, dielectric oil shall provide a lifetime lubrication for the motor bearings.

C. Pump shaft shall be 416 stainless steel; outside fasteners 18-8 stainless steel; impeller shall be bronze, semi-open, non-overloading.

D. Dual mechanical shaft seals shall have an oil filled chamber with carbon and ceramic seals mounted in tandem with faces running in oil. A dual sea failure probe shall be standard to detect water in seal chamber.

E. Provide a hydromatic model No. G1LX200CD with a 4.12" impeller driven by a 2HP, 460V/3ϕ explosion proof motor.

2.03 ACCESSORIES

A. Pump shall be provided with the hydromatic hydroguide rail system.

B. Hydroguide package shall include a combination ball check valve/hydraulic sealing diaphragm, galvanized steel discharge pipe, and t-bar rail.

MATERIALS AND PERFORMANCE - SECTION 15146

LEACHATE COLLECTION PUMPS

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in complete accordance with manufacturer's instructions and recommendations.

- END SECTION -

MATERIALS AND PERFORMANCE - SECTION 15500

HEATING AND VENTILATING - GENERAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this Contract shall include and provide for all labor, tools and materials necessary for installation and proper operation, even though not specifically mentioned or indicated on the Contract Drawings, but which are usually provided or essential for proper operation of the system to include:

1. Complete heating and ventilation system for this project.

2. Complete temperature control system required for the proper execution of this Contract.

B. RELATED WORK SPECIFIED ELSEWHERE

1. Section MP-16100 - Electrical Work

2. The Electrical Contractor shall be responsible for making all electrical connections to and interconnections between all heating and ventilating equipment and appurtenances.

1.02 SUBMITTALS

A. The Contractor shall submit to the Engineer for review detailed shop drawings and/or catalog cuts and data on all items within the scope of this Contract which he proposes to use in the work. Shop drawings and data shall demonstrate detailed compliance with the provisions of the Contract Drawings and specifications.

1.03 QUALITY ASSURANCE

A. Laws, Permits and Inspections

1. The Contractor shall comply with all Federal, State, County, Municipal, NFPA, AGA, UL and Utility Company Laws, Ordinances, Regulations and Standards that cover the work and all work shall comply to any and all local codes.

2. The Contractor shall apply for and obtain all required permits and inspections and shall pay for all fees applicable thereto (the Owner and Engineer will obtain environmental related permits).

B. Standards

1. All ductwork shall be in accordance with SMACNA Standards. All coils and filters are to be ARI rated. All fans to be AMCA capacity and sound power rated. All terminal air delivery devices to be ADC rated.

MATERIALS AND PERFORMANCE - SECTION 15500

HEATING AND VENTILATING - GENERAL

1.04 JOB CONDITIONS

A. Protection From Freezing

1. During construction and until final acceptance, protect from freezing all fixtures, equipment and piping both in building, trenches, etc. Any damage shall be repaired or replaced at the Contractor's expense to meet the Engineer's approval.

B. Cutting and Patching

1. Heating and Ventilating Contractor shall do all cutting and patching required for his work.

C. Electrical

1. All electrical wiring by Electrical Contractor. Furnish him with all required wiring diagrams and complete list of overload protection sizing for motors.

D. Local Conditions

1. The Contractor shall visit the site of the proposed project to ascertain existing conditions pertaining to the work of this Contract. Failure to do so shall in no way relieve the Contractor of the responsibility to relocate, remove or otherwise effect a change to the existing facilities which may be necessary to complete the work of this Contract.

2. It is the intent of these specifications to provide uninterrupted heating of the building or any of its parts. Short periods of interruptions are permissible, but in no case shall existing systems be shut down for a period of time that would allow the inside temperature to drop below 40°F. Temporary space heaters are not permitted to serve occupied spaces.

PART 2 - PRODUCTS

2.01 GENERAL

A. Fans used shall not increase motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Fans shall be capable of accomodating static pressure variations of plus or minus 10 percent.

B. Base performance on sea level conditions.

C. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.

D. On belt driven fans, provide balanced variable and adjustable pitch sheaves so desired rpm is obtained with sheaves set at mid-position.

E. Provide belt guards on belt driven fans.

F. Provide safety screen where inlet or outlet is exposed.

G. Factory prime coat fan wheels and housing.

H. Motors: Unless otherwise specified, motors shall be totally enclosed, fan cooled, 1750 rpm.

2.02 PROPELLER SUPPLY FANS (SF-1)

A. Sidewall supply fans shall be belt driven propeller type with integral motorside OSHA style guard.

B. Propeller construction shall be of die formed aluminum blades bolted to a steel hub. Propeller assembly shall be statically and dynamically balanced.

C. The fan panel/venturi shall be constructed of a single piece galvanized steel with welded corners. Finish shall be a grey acrylic baked enamel.

D. Motors shall be permanently lubricated, speed controllable heavy duty split capacitor type and factory welded to a factory mounted wiring box. Fan shall be controlled by an externally mounted switch.

E. Fan shall be supplied with automatic gravity dampers to be used on intake side of panel fan. Dampers shall be constructed of an aluminum frame, aluminum blades, polyurethane seal on sill and felt blade seals.

F. Unit shall be provided with a flaned and prepunched 18 gauge aluminum weather hood with galvanized 1/2" x 0.42 wire mesh bird screen.

G. Performance: 600 CFM @ 1/8" S.P. and 523 RPM.

H. Fan motor shall be 230V/1ϕ/60HZ: Explosion proof.

I. Manufacturer: Carnes Model LMBK20K1 or equal.

MATERIALS AND PERFORMANCE - SECTION 15500

HEATING AND VENTILATING - GENERAL

2.03 CENTRIFUGAL WALL EXHAUST FAN (EF-2)

A. Centrifugal Fan Unit: V-belt drive with spun aluminum housing: resiliently mounted motor; 1/2 inch mesh, 16 gauge aluminum birdscreen; secured with stainless steel bolts and screws.

B. NEMA 7 Disconnect Switch: Factory wired, non-fusible, in-housing for thermal overload protected motor.

C. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced bored to fit shafts and keyed; variable and adjustable pitch motor sheaves, selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning, pre-lubricated ball bearings.

D. Peformance: 600 CFM @ 1/8 inch S.P. and 782 RPM.

E. Fan motor shall be 115V/1ϕ/60HZ; Explosion proof.

F. Manufacturer and Model: Carnes VWBK 10K1 or equal.

2.04 UNIT HEATERS (EXPLOSION PROOF)

A. Units shall be UL listed for use in Class 1, Division 1, Group D hazardous areas.

B. Units shall utilize a liquid to air heat exchanger using an ethylene glycol based heat transfer fluid. Heating elements shall be low watt density, copper sheathed, hermetically sealed into core.

C. Cabinets shall be 14 gauge epoxy coated steel and shall have adjustable discharge louvers.

D. Fan shall be aluminum propeller type.

E. Motor shall be thermally protected, explosion proof with permanently lubricated ball bearings.

F. Units shall be provided with automatic reset capillary type snap action thermostat for high limit control and a fusible alloy pug (170 psi) for over pressure protection.

G. Units shall be provided with factory installed control transformer and control contactor. Provide manufacturer's wall mounted, explosion proof thermostat for field installation.

H. Provide manufacturer's wall mounting kit.

I. Capacity and power shall be as scheduled.

J. Manufacturer and Model: Ruffneck XL4 or equal.

MATERIALS AND PERFORMANCE - SECTION 15500

HEATING AND VENTILATING - GENERAL

2.05 THERMOSTAT

A. Honeywell Model T6051B1006 heavy duty single stage line voltage thermostat; explosion proof. SPDT snap switch rated at 10.2 FLA at 120 VAC. 1°F differential over a range of 46-84°F. UL listed or equal.

PART 3 - EXECUTION

3.01 GUARANTEE

A. Guarantee all piping to be free from objectionable noise or vibration and the circulation through same to be free and easy at the normal operating pressure and under all loads.

3.02 IDENTIFICATION

A. Charts

1. Furnish permanent type charts, framed under glass, mounted where directed as follows:

a. Valve charts giving valve use, system and number on tag attached to valve.

b. Temperature control diagrams.

c. Lubrication instructions for all equipment giving type lubricant and frequency required.

d. Service organizations with day and night telephone numbers.

e. Abbreviated operating instructions for all mechanical systems.

B. Marking of Equipment

1. On each piece of interior equipment installed mark the unit designator so that it is visible from floor level. Marking shall be in 2-inch block letters except that equipment installed in finished rooms shall be marked with permanent engraved plastic with ½-inch letters attached to the unit with screws or rivets.

2. Below each thermostat attach a plastic plate engraved with the thermostat number, the area served, heating, cooling or heating/cooling and the words "Set At" followed by the thermostat setpoint.

MATERIALS AND PERFORMANCE - SECTION 15500

HEATING AND VENTILATING - GENERAL

3. Below each control device, switch, disconnect and starter attach a plastic plate giving the equipment designator, equipment location, area served and type of service.

3.03 COORDINATION

A. Determine exact route and location of each duct prior to fabrication. Coordinate work with other contracts. Pay particular attention to recessed lights and piping. Make field measurements of structural elements.

B. Include necessary fittings, offsets and elevation changes. Pipes which must pitch have right-of-way over those which do not pitch.

C. Install all work to permit removal of equipment without damage to the equipment or the building. Verify equipment space requirements at time of shop drawing submission and advise the Engineer of any conflict.

D. Do not rough any openings prior to receipt of approved shop drawings.

3.04 EQUIPMENT ARRANGEMENT AND SUPPORTS

A. Support plumb, rigid and true to line all work and equipment furnished under this Contract. Provide steel bolts, inserts, pipe stands, brackets and accessories for proper support as required whether or not shown on the Contract Drawings. When directed, furnish a drawing for approval showing supports.

B. When alternate manufacturers of equipment are approved by the Engineer and provided for the work, the Contractor is responsible to make all required changes in the work and provide all appurtenances to accommodate the equipment being furnished. Equipment of different arrangement, size, etc., may be provided but is subject to the following conditions:

1. Submit a plan showing the proposed method of installation.

2. If the revised arrangement is approved by the Engineer, make all incidental changes in piping, ductwork, supports, insulation, etc., provide any additional motors, controllers, valves, fittings and other additional equipment required for proper operation of the system resulting from the selection of equipment. This includes all required changes in all affected Contracts. The Contractor shall be responsible for the proper location of roughing and connections by other Divisions. This shall be done at no additional cost to the Owner.

C. Where the revised arrangement is not approved by the Engineer, provide equipment conforming to Contract Drawings.

MATERIALS AND PERFORMANCE - SECTION 15500

HEATING AND VENTILATING - GENERAL

3.05 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

C. Install fans as indicated, with resilient mountings and flexible electrical leads.

D. Install flexible connections between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 1 inch flex between ductwork and fan while running.

E. Install fan restraining snubbers as required. Flexible connectors shall not be in tension while running.

F. Provide sheaves for final air balance.

3.06 START-UP AND TESTING OF HEATING AND VENTILATING SYSTEMS

A. Each system shall be subject to a witnessed test consisting of a verification of temperature control systems; air flow, heating capability, system balance and overall system performance. Tests shall be witnessed by the Owner and/or Engineer.

B. All costs for test equipment, materials and Contractor's manpower shall be borne by the Contractor. Successful completion of the coordinated system test shall qualify the completed system. The Contractor's representative shall be present for the duration of all testing. Upon completion, all information shall be submitted in report form. The entire report shall be neatly typed and shall be submitted to the Owner/Engineer for approval.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 16100

ELECTRICAL WORK

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section shall include general requirements for all electrical work performed.

B. Materials furnished shall meet the requirements of these specifications and as noted on the Contract Drawings.

1.02 STANDARDS AND CODES

A. Where applicable, the latest revisions to the following standards and codes shall be met except where more stringent requirements have been shown.

1. Local Building Codes
2. National Fire Protection Association - NFPA
3. National Electrical Code - NEC
4. Underwriters Laboratories, Inc. - UL
5. National Electrical Manufacturers Association - NEMA
6. Institute of Electrical and Electronics Engineers - IEEE
7. American Society of Testing Materials - ASTM
8. Insulated Cable Engineers Association - ICEA
9. Association of Edison Illuminating Companies - AEIC
10. American National Standards Institute - ANSI
11. Occupational Safety Hazards Act - OSHA

1.03 QUALITY ASSURANCE

A. All workmanship and materials shall be as specified and in accordance with the provisions of the National Electrical Code.

B. The work shall be subject to inspection by a representative of the New York State Board of Fire Underwriters and by the local authorities having jurisdiction, and all work shall pass such inspection.

C. Submittals

1. Prior to obtaining any material in connection with electrical work, detailed shop drawings shall be submitted in accordance with each section. In addition to equipment data, shop drawings shall be submitted for review showing proposed raceway layout, electrical equipment layout, grounding system layout, interconnecting wiring and elementary diagrams.

MATERIALS AND PERFORMANCE - SECTION 16100

ELECTRICAL WORK

1.04 SAFETY

A. Construction Safety

1. Contractors shall furnish and place proper guards for prevention of accidents, provide all trench shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, or other safety features required to secure safety of life or property. Provide and maintain sufficient lights during night hours to secure such protection.

2. Contractors shall furnish and install all necessary safety warning devices such as flags, signs, etc. as required for their work.

3. Overhead work shall be done only if area below is clear of all personnel.

B. Electrical Safety

1. Any energized electrical system panel board cover, removed in processing a job, shall be replaced immediately any time the job site is to be unattended by the Contractor's personnel.

2. A ground conductor in accordance with Electrical Grounding shall be furnished with every electrical circuit.

3. All electrical work for providing temporary power and lighting for construction shall be in accordance with NEC and OSHA.

PART 2 - PRODUCTS

2.01 CONDUITS

A. Rigid Metal Conduit (RGS)

1. Galvanized steel, hot dipped zinc, ANSI standard C80.1 and C80.4.

2. Manufacturers shall be Allied Tube & Conduit Corporation; Triangle PWC Co., or equal.

3. Junction boxes and fittings shall be of galvanized cast iron or copper free aluminum.

B. Electrical Metallic Tubing (EMT)

1. Galvanized steel, hot dipped zinc, ANSI Standard C80.3.

2. Manufacturers shall be Allied Tube & Conduit Corporation; Triangle PWC Co., or equal.

3. Junction boxes shall be of code-gaged galvanized steel.

4. Fitting shall be of galvanized cast iron or copper free aluminum.

C. Expansion Couplings

1. Expansion couplings shall be a water-tight, corrosion resistant coupling with flexible neoprene outer jacket, stainless steel jacket clamp, flexible copper ground strap, and internal hub brushing.

2. Expansion coupling shall be Type XD as manufactured by Crouse-Hinds Company, Type DX as manufactured by O-Z Gedney Co., or equal.

2.02 WIRES AND CABLES

A. General

1. All conductors, unless otherwise noted, shall be stranded copper, constructed of soft drawn or annealed copper.

2. Conductors insulation shall be color coded, with color of insulation being maintained throughout the entire run.

a. 480 VAC, 3 phase, 3 wire

Phase A - Brown
Phase B - Orange
Phase C - Yellow
Ground - Green

b. 120/208 VAC, single phase, 3 wire

Conductor 1 - Black
Conductor 2 - Red
Neutral - White
Ground - Green

B. Low Voltage Conductors

1. All conductors for power, lighting and 120 VAC control shall be rated a minimum 600 VAC.

MATERIALS AND PERFORMANCE - SECTION 16100

ELECTRICAL WORK

2. Conductors shall be constructed of uncoated Class C copper concentric-lay-stranded wires.

3. Power and lighting conductors shall be Type THHN-90C, THWN-2-90C with PVC insulation and Nylon jacket.

C. Connectors

1. Pigtail splicing #10 and smaller, use tapered spring wirenuts: Ideal Wing Nut; Buchanan B-Cap; T&B piggies, or equal.

2. For terminating #14 control wires to terminals, use insulated compression spade type connectors: Burndy Hydent; T&B Sta-Kon or equal.

3. Splices and terminals for #8 and larger shall be copper compression type: Burndy Hydent or Hylug; T&B long barrel or equal.

4. Fixture connections shall be: T&B Sta-Kon Series PT-66M; Ideal Crimp Sleeve No. 410 with cap or equal.

2.03 GROUNDING

A. General

1. Grounding of electrical systems and equipment shall, as a minimum, meet the requirements of the NEC Article 250 or shall exceed Article 250 as herein specified.

2. All conduits shall have an internal ground conductor. This ground conductor shall be provided although it may not be shown or scheduled on the plans.

3. All transformers, frames of motors, 10 HP and over, service entrance equipment, panelboards and waterlines shall be connected to the grounding system electrodes.

4. All connections shall be made with approved compression type grounding connectors.

5. Exposed grounding conductors subject to damage shall be protected by conduit or other suitable guards.

6. Metallic conduit systems shall be securely connected so as to be electrically continuous throughout its entire circuit length.

MATERIALS AND PERFORMANCE - SECTION 16100

ELECTRICAL WORK

2.04 ENCLOSURES

A. Enclosures shall be NEMA rated for location unless otherwise noted.

1. General areas indoors, enclosures shall be NEMA Type 1 - gasketed.

2. Wet locations or outdoors, enclosures shall be NEMA Type 4.

B. Enclosures shall have nameplate on the exterior identifying the application function of the equipment enclosed.

2.05 WIRING DEVICES

A. Receptacles shall be specification grade NEMA 5-20R, two pole, three wire type: Hubbel 5352 Series; P&S 5352 Series or equal.

B. Switches shall be specification grade, rate 20 amperes at 277 VAC, toggle: Hubbel Series 1221; P&S Series 20 AC1 or equal.

C. Ground Fault Interpreter (GFI) type receptacles shall be: GE Type TGTR 115; P&S Interpreter, or equal.

D. Faceplates and covers shall be provided for each device, and shall be:

a. Finished areas - type 302 stainless steel

b. General/Industrial areas - galvanized steel or cast device covers.

c. Wet and Corrosive areas - weatherproof gasketed covers, hinged to close automatically.

2.06 PANELS

A. General

1. Panels shall be circuit breaker panelboards designed for sequence phase connection of branch circuit breakers.

2. Circuit breakers shall be of the bolt-on type. Unless otherwise shown, breakers shall be rated at 20 amperes.

3. Panelboards used for service entrance shall be furnished with UL Service Entrance Label.

4. Circuit breakers shall have a minimum interrupting rating of 10,000 amperes RMS symmetrical at 240 VAC or 14,000 amperes at 480 VAC unless otherwise shown.

MATERIALS AND PERFORMANCE - SECTION 16100

ELECTRICAL WORK

B. Manufacturer's

1. 240 VAC panelboards, single phase, 3 wire; and three phase 4 wire 208/120 VAC shall be GE type AQ, Sq D Type NQOB, or equal.

2. 480 VAC panelboards, three phase, 4 wire, shall be GE Type AE, Sq. D type NEHB, or equal.

2.07 DISCONNECT SWITCHES

1. Heavy duty safety switch, fused or non-fused as shown or noted.

2. Disconnect switches shall be GE Type TH, Sq. D heavy duty safety switch.

2.08 LIGHTING FIXTURES

A. Interior fixtures shall be 200 watt incandescent fixture with glass globe and ceiling mounted box. Furnish Appleto type V-51, Keene Vaportight Type VCXL or equal.

B. Exterior fixtures shall be a rectangular, wall mounted mercury fixture with cast aluminum body and glass or Lexan reactor lens. Furnish with 175 watt lamp and photo-cell. Fixture shall be Benjamin Type OWW, Hubbed Perimaliter Series PVC.

C. Provide all required lamps, brackets, closure pieces and hardware.

PART 3 - EXECUTION

3.01 GENERAL

A. All work shall be performed in accordance to the latest revision of the NEC.

B. All wiring shall be enclosed in raceway.

1. Underground circuits shall be installed in Rigid Galvanized Steel (RGS) conduit.

2. Circuits for 480 volts power shall be installed in Rigid Galvanized Steel (RGS) conduit with threaded fittings.

3. Lighting circuits for interior lighting operating at 120 VAC shall be installed in Electrical Metalic Tubing (EMT).

4. All underground and exterior conduits shall be Rigid Galvanized Steel with threaded fittings.

MATERIALS AND PERFORMANCE - SECTION 16100

ELECTRICAL WORK

5. Connection to motors, limit switches or any equipment that vibrates or would require adjustment shall be with a short length of explosion proof metallic flexible conduit. Use liquid tight for intrinsically safe conduits.

6. Conduits shall be run parallel or at right angles to walls, beams and horizontal planes in a neat and organized configuration.

7. Expansion joints shall be installed in all conduits, crossing expansion joints, underground entering a structure and on straight runs of over 50 feet in length.

8. Splices and junctions shall be made at approved boxes or fittings only.

9. Seal offs shall be used for all conduits in hazardous areas.

C. Electrical equipment shall be securely supported, independent of the conduit system.

1. Where required, provide ¾-inch flame retardant treated, standard grade interior plywood for backing panels.

2. Exterior plywood shall be marine grade ¾-inch plywood, painted to coat exterior enamel.

D. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water.

1. Any equipment damaged shall be repaired or replaced by the contractor at his own expense.

E. Wiring devices shall be mounted in approved single or multiple gang boxes.

3.02 TESTING

A. When all wire and cable are in place but before the final connections have been made, they shall be tested. The test shall be performed by the electrical contractor and witnessed by a representative of the owner.

1. For all wires a 1500 volt insulation resistance (Megertest) test shall be performed.

a. Between all conductors in same enclosure.

b. Between each conductor and ground.

2. The resistance test shall be recorded at the end of one minute of sustained voltage.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 16900

INSTRUMENTATION

PART 1 - SCOPE

1.01 GENERAL

A. Work Included

1. This section describes the requirements for providing all materials, labor, tools, equipment, supplies, and services to furnish and install an instrumentation and control system, complete and in place in accordance with the drawings and specifications. The instrumentation and control system shall include field instrumentation, panels, and control system, and appurtenances. The Contractor shall assume responsibility for additional costs which may result from unauthorized deviations or substitutions from the specifications. The Contractor shall also assume responsibility for the satisfactory operation of any equipment offered.

1.02 DESCRIPTION

A. Specified Products

1. This section includes the operating electronic instrumentation for this project including, but not limited to, the following:

   - General information
   - Signal carriers
   - Float switches
   - Pressure switches
   - Spare parts

2. Where required by the manufacturer, power converters, reactors or power supplies shall be provided integral with the instrument.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section MP-11002 - Soil Vapor Extraction System
B. Section MP-16100 - Electrical Work

1.04 SUBMITTALS

A. The following item(s) shall be submitted in accordance with section MP-15000 entitled General Equipment Requirements.

1. Manufacturer's catalog cut sheets
2. Instrument data sheet bill of materials
3. Loop diagrams
4. Wiring diagrams
5. Operation and maintenance manuals

MATERIALS AND PERFORMANCE - SECTION 16900

INSTRUMENTATION

6. Certificate of conformance
7. Maintenance contract

B. Submittals for instrumentation shall include descriptive data and bills of materials or similar schedules that shall demonstrate complete compliance with the specifications.

C. The Supplier of instrumentation shall prepare and submit diagrams of each monitoring and control loop. Each loop diagram shall show all instrument connections and interconnections, as well as the function, scales, ranges, and tag numbers. Loop diagrams shall be in accordance with Instrument Society of America Standard ISA-S5.4.

D. Provide required number of sets of catalog cuts, material list, shop drawings and coordinated interconnecting drawings showing connections to Control Panels and related equipment.

E. The Contractor shall submit operation and maintenance manuals as per Section MP-15000 entitled General Equipment Requirements. Said manuals shall include, but not be limited to, step-by-step operation and maintenance instructions, wiring diagrams, exploded parts diagram with numbered parts list, calibration procedures, and lubricants.

F. The Contractor shall ensure that the Supplier shall have submitted the first submission for manufacturer's catalog cut sheets, bill of materials, loop diagrams, and wiring diagrams within 120 days from notice to proceed.

G. The first submittal for a system shall be a complete submission. Partial submissions shall not be accepted for first submissions.

1.05 QUALITY ASSURANCE

A. The Supplier shall demonstrate a minimum of five (5) years recent, past experience in the design and commissioning of instrumentation and control systems of comparable size, type, and complexity to the proposed project. The Supplier shall have his own in-house capability to handle complete system engineering, fabrication, programming and testing.

B. The Supplier shall have in his employ capable personnel for detail engineering, coordination, drafting, procurement and expediting, scheduling, testing, inspection, installation, start-up service for calibration and commissioning, and warranty compliance for the period specified.

C. Codes and Standards

1. All work shall be in accordance with the latest revision of the NEMA, ISA, ANSI and IEEE Standards.

MATERIALS AND PERFORMANCE - SECTION 16900

INSTRUMENTATION

D. All instrumentation equipment shall be installed as shown, specified, directed and recommended by the manufacturers and all accessories required to accommodate the electric services to the specific requirement of metering equipment shall be furnished. The Supplier shall furnish the services of competent factory trained representatives of the manufacturers, who shall supervise the installation for proper assembly, shall start and operate the equipment, and conduct the field tests.

E. All electric interconnections shall be in accordance with the specified requirements for control wiring. Shielded cables, where required, shall be supplied by the Electrical Contractor. Special cables shall be supplied with equipment requiring them.

F. Unless otherwise specified, each measurement system shall be accurate within not less than one percent of full scale reading over the specified range. The above accuracy requirement shall apply to each overall system, including any transmitters, retransmitters, receivers, etc. that are shown or required.

1.06 MAINTENANCE CONTRACT

A. A written total instrument maintenance contract shall be provided to the Owner, executed by the Supplier as a part of the work under this Section. The maintenance contract shall include all labor, parts, and emergency calls providing on-site response within 48 hours, to provide complete instrument system maintenance for a period of one year after the date of final acceptance of the system. The maintenance contract shall also include a minimum of 1 (annual) preventive maintenance visit to the treatment facility by a qualified serviceman of the Supplier who is familiar with the type of equipment provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning, and lubrication of all system equipment and verification of correct operation. Emergency maintenance procedures or plant visits may coincide with a scheduled preventive maintenance visit, however, they shall not replace the work intended to be performed during a preventive maintenance visit. The Supplier shall have full responsibility for the preventive and corrective maintenance including replacing of defective components, maintaining sufficient spare parts on-site, and complete calibration of all components under this section, all at no cost to the Owner. The maintenance contract shall not begin until all training has been concluded, at which time the Owner shall be capable of performing necessary preventive maintenance, and all instruments shall be functional.

B. During the one-year maintenance period, observation of maintenance operations by designated Owner personnel, and the instruction of said personnel in the details of the maintenance work being performed, shall be provided. At the end of the maintenance contract period, the Supplier shall replenish the spare parts supply to original status of component parts and physical condition.

C. A complete written report shall be furnished to the Owner after each scheduled and unscheduled visit, giving problems corrected, systems needing recalibration, and recommendations to prevent recurrence, if applicable.

MATERIALS AND PERFORMANCE - SECTION 16900

INSTRUMENTATION

D. The costs for the one-year maintenance service contract shall be included in the Contract price.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. General

1. All electric instruments and systems shall be designed for operation with an input power supply of 120 volts, single-phase, 60 cycles.

2. Each field mounted electronic instrument requiring 120 volt input, shall be equipped with a toggle switch to disconnect 120 volt source.

3. Analog signals shall be based on low level variable current signals of 4-20 milliamperes.

4. Operating parameters shall be as scheduled in Part 7, as shown on the Contract Drawings or as required to meet the performance intended.

B. Signal Carriers

1. Signals carriers for instrumentation include the electric wires, cables and conduits as indicated or required for a complete transmission of signals between transmitters and receivers.

2. Electronic low level signals shall be properly isolated, bundled and supported. These signals shall be routed separately from AC and DC power wiring. Signal cable shall be run as far away from electrical equipment as possible to prevent electrostatic and/or electromagnetic interference. Distance between tied bundles of wires carrying low level DC signals shall be a minimum of 8 inches from wires carrying AC signals. Power supplies shall be located as far away from other instrumentation equipment as is practical. When these power supplies are mounted in framework common with instruments, they shall be mounted above instruments. Interwiring between instruments shall be by twisted shielded pairs or stranded wires.

C. Tank Level Transmitter

1. Level transmitter shall be low range level meter with digital data processing, using non-contact ultrasonic technology. System to be Pneumicator Model 2-412 or approved equal.

2. NEMA 4 enclosure.

3. Digital LCD display of level in one tenth of an inch.

4. Calculate tank volume in gallons.

5. Programmable from local keypad.

6. Automatic temperature compensation.

7. Linear analog output - 4-20 mA DC into 700 ohms maximum load.

8. Tank level panel to be as shown in Contract Drawing E-4.

9. Provide adequate length of cable to connect sensor to remote tank level enclosure.

10. Rated to operate on 120 VAC power supply.

D. Tear Drop Float

1. Polypropylene or inert plastic bulb which encapsulates a mercury switch.

2. SPST mercury switch rated minimum 5 amps at 120 VAC, normally open or closed as required.

3. Integral or external weight.

4. Sealed water-tight PVC jacketed cable, 10 foot minimum length.

5. Where floats are to be used in Class I, Division I or II areas, provide intrinsic barrier mounted in control panels.

6. System to be Flygt ENH-10, Warrick Series F-BLU-20-W or equal.

E. Leak Detection Float

1. Buna N float with slosh shield and weighted collar.

2. SPST rated 20 VA, normally open, closes on rising level.

3. Sealed water-tight PVC jacketed cable, 25 foot length.

4. System to be Gems Model LS-750 weighted for Suspension Cable Part Number 149350 or equal.

F. Differential Pressure Switch

1. The switch shall be Dwyer Photohelic Model 3150 or equal.

MATERIALS AND PERFORMANCE - SECTION 16900

INSTRUMENTATION

2. Range: 0-150" water column (WC).

G. High Pressure Switch

1. The switch shall be Dywer Photohelic Model 3210 or equal.
2. Range: 0-10 PSI or equal.

H. Low Pressure Switch

1. The switch shall be Dwyer Photohelic Model 3150 or equal.
2. Range: 0-150" WC or equal.

I. Bottle Float

1. The switch shall be GEMS Model LS-114610 or equal.

J. Interstitial Float

1. The float shall be GEMS Model ELS-1100 with fish pull ring and 25' cable.

2. Provide Opto-Pak controller and zener barrier for above.

K. High Level Float

1. The float switch shall be GEMS Model LS-800. 2" NPT, stainless steel float, SPDT switch.

L. Barrel Float

1. Barrel float shall be GEMS Model ELS-300 suitable for mounting a 3/4" tee and nipple into a standard 55 gallon drum.

2. Provide Opto-Pak controller and zener barrier.

M. Spare Parts

1. The Contractor shall furnish a list of manufacturer's spare parts for items of instrumentation with current price and ordering information.

2. The Contractor shall provided spare parts as indicated above and, as a minimum, provide the following additional spare parts, to be included in the bid price:

   a. One lamp of each size.

   b. Two fuses of each type of fuse supplied, for control panel circuits and in individual instruments.

c. One year's supply of any depletable item not included in the above.

3. Spare part quantities shall be replenished after start-up and testing procedures to amount indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. After installation, instrumentation equipment shall be checked and the required adjustments shall be made by the representative of the Supplier. Equipment shall be field tested in the presence of the Engineer and shall be demonstrated to operate satisfactorily over the specified ranges. The Contractor shall provide the necessary test equipment and qualified test personnel. In the event of failure of the field test, the Contractor shall retest, at his own cost and expense, the equipment as directed by the Engineer.

2. The Supplier shall be responsible to provide all instrumentation required to provide an acceptable operating system meeting the performance shown, specified, and demonstrated by the Contract Documents.

3. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms, and similar devices shown on the drawings are approximate only. Exact locations shall be as defined by the Contractor and approved by the Owner during construction. The Contractor shall obtain in the field all information relevant to the placing of process control work; proceed as directed by the Owner's Representative and furnish all labor and materials necessary to complete the work in an acceptable manner.

4. A durable stainless steel tag firmly attached with stainless steel wire and permanently engraved with the instrument tag number and description, as given in the Instrument Schedule shall be provided on each piece of field equipment supplied. Tags shall be a minimum of 1" x 3" size, 1/16" thick, with characters 5/32" high.

5. Instrument conduits shall be tagged in accordance with Electrical Work Section MP-16100.

6. All instruments and equipment shall be left free from shipping stickers, paint splatter, dirt, grease, etc., and shall be clean and in working condition at final acceptance. Touch-up paint shall be furnished to repair blemishes and scratches in finish paint on panels and enclosures, which shall be corrected by the Contractor as required. When it is determined by the Owner and/or Engineer that touch-up

painting is not satisfactory, the Contractor shall repaint any instrument and/or piece of equipment.

PART 4 - START-UP, TESTING, TRAINING

4.01 START-UP SERVICES

A. The services of the qualified representative of the Supplier shall be provided at th Contractor's expense to inspect the completed installation, make all adjustments and calibrate all instruments as necessary to place the instrumentation systems in trouble-free operation prior to field test.

B. The Contractor shall provide adequate support personnel to assist the Supplier and to make any field wiring changes necessary.

C. Start-up services shall be coordinated so as to be available during start-up of related systems such as the variable speed pump control systems.

D. The Contractor shall include in his bid, as a minimum, start-up services of three (3) 8-hour mandays and three trips.

E. The Contractor shall provide a letter from the Supplier certifying that the equipment has been installed properly, calibrated, and is in working order suitable for operation, before final acceptance by the Engineer.

4.02 ON-SITE SYSTEM TESTING

A. Following start-up of an instrumentation system, the Contractor shall provide a dynamic system test procedure which simulates the actual system operation. This procedure shall be approved by the Engineer and shall demonstrate conformance of the total system to these specifications and project requirements. Any deficiencies found shall be corrected by the Contractor and the tests shall be repeated. This process shall continue until all tests have been successfully completed.

4.03 ON-SITE ACCEPTANCE TESTING

A. The system shall then be placed on-line, with all functions operating, and run until a total of 3 days (72 hours) of system up-time have been logged. During this test the system shall be operated by the Owner's personnel with the assistance of a factory-trained representative of the Supplier provided by the Contractor.

B. All defects discovered during the acceptance test shall be noted and shall be corrected prior to acceptance by the Engineer and Owner.

4.04 ON-SITE TRAINING

MATERIALS AND PERFORMANCE - SECTION 16900

INSTRUMENTATION

A. The Supplier shall conduct a minimum of one, 4-hour training program for the Owner's personnel covering operation and maintenance of the instrumentation system. The training shall include both formal classroom lectures and "hands-on" training at the Owner's facilities with the actual system being provided or a system which incorporates all of the features of that system.

PART 5 - SCHEDULE OF INSTRUMENTATION

5.01 The following is a schedule of major components of instrumentation. The Contractor shall be responsible for providing all required instruments, including that which is not scheduled, appurtenances, wiring, and labor to meet the performance indicated and specified within the Contract Documents.

5.02 SCHEDULE

TAG NO.	DESCRIPTION	OPERATING PARAMETERS	PANEL
LSHH-100	Tear Drop Float	Normally Open, Closes on Rising Level	
LSH-100	Tear Drop Float	Normally Open, Closes on Rising Level	
LSL-100	Tear Drop Float	Normally Open, Closes on Rising Level	
LSLL-100	Tear Drop Float	Normally Open, Closes on Rising Level	
HS-100	2 Position Selector Switch	Select Lead, Pump 1 or Pump 2	P
HS-101	3 Position Selector Switch	Hand, Off, Auto (HOA)	P
HS-102	3 Position Selector Switch	Hand, Off, Auto (HOA)	P
LSHH-200	Intersticial Float	Normally Open, Closes on Rising Level	
LSHH-201	Bottle Float	Normally Open, Closes on Rising Level	
LT-300	Level Transmitter	Pneumicator Model 2-412	
LE-300	Level Element	Direct Lift Magnetic Float Type	
LI-300	Level Indicator	4 Digit Readout, 4-20 mA Output, Relays	L
LSH-300	Relay Output	Adjustable Setpoint	L
LSHH-300	High Level Float	Normally Open, Closes on Rising Level	
LSH-301	Leak Detection Float	Normally Open, Closes on Rising Level	
LSL-302	Bulb Type Thermostat	Make on Falling Temperature, Set 35°F	
LSHH-400	High Level Float	Three Level Float Unit	S
LSH-400	----	Included Above	S
LSL-400	----	Included Above	S

MATERIALS AND PERFORMANCE - SECTION 16900

INSTRUMENTATION

TAG NO.	DESCRIPTION	OPERATING PARAMETERS	PANEL
HS-400	3 Position Selector Switch	Hand, Off, Auto (HOA)	B
LSHH-500	Barrel Float	Pass Through 3/4" Tee and Nipple	
HS-500	Stop Lockout	NEMA 7	S
HS-501	Start Stop	Maintained Contact	B
PSL-600	Low Pressure Switch	Make on Falling Temperature, Set 10" WC	S
PSH-600	High Pressure Switch	Make on Falling Temperature, Set 7.5 PSI	S
TSH-700	Bulb Type Thermostat	Make on Falling Temperature, Set 135°F	
DPS-700	Diff. Pressure Switch	Make on Falling Temperature, Set 75" WC	

Item located in associated panel:

B = Blower Control Panel
L = Tank Level Panel
P = Leachate Pump Control Panel
S = Supplied with Blower Package

- END OF SECTION -

SVE Basis of Design

Chicago Pneumatic Tool Company
Frankfort, New York

April 1998

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

6723 Towpath Road, P.O. Box 66
Syracuse, New York, 13214-0066
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Table of Contents

1. Introduction

This appendix describes the two mathematical models used to provide preliminary design specifications for a proposed ex-situ soil vapor extraction (SVE) system to be constructed at the Chicago Pneumatic Tool Company Inactive Hazardous Waste Site located in Frankfort, New York (site). SVE was selected as an appropriate remedial technology for treating on-site soils containing volatile organic compounds (VOCs) at concentrations greater than the cleanup objectives as presented in the New York State Department of Environmental Conservation's (NYSDEC's) Record of Decision (ROD), dated March 29, 1996. The conceptual design for the SVE system was described in the Remedial Design (RD) Work Plan prepared by BBL and dated November 1997. The SVE conceptual design consisted of an estimated 2,300 cubic yards of soil that would be excavated and placed in an approximately 8,000 square foot, 8-foot high SVE treatment cell.

The primary purpose of the mathematical models presented in this appendix was to aid in addressing the following design objectives:

- Number and spacing of the SVE pipes;
- Air flow rate and vacuum requirements of the SVE vacuum pump; and
- Vapor-phase concentrations of VOCs.

To accomplish the design objectives, a MODFLOW model (McDonald and Harbaugh, 1988) was used to determine screen placement and orientation of the SVE pipes and to estimate the air flow rate and vacuum requirements. A VENTING™ model (ES&T, 1994) was used to assess VOC removal rates. The remainder of this appendix describes model construction, assumptions, and results.

2. Overview of MODFLOW SVE Model

Mathematical models of air flow through soils using industry-standard ground-water flow models have been documented to support their use as a tool in SVE system design (Massman, 1989; ES&T, 1994; Macneal *et al.* 1994; Falta, 1995; and American Society for Testing and Materials [ASTM] Standard 5719-95, 1995). Ground-water flow models may be used as an aid in designing airflow SVE systems under the following assumptions:

- Vapor-phase density is relatively constant;
- The effect of vapor-phase pressure gradients on ground-water capillary effects is negligible; and
- Gravitational effects on vapor flow are negligible.

The approximation of using a ground-water flow model code to simulate the movement of air in the subsurface is possible because ground-water flow equations are similar to airflow equations. Methods were presented by Massman (1989) and ASTM D 5719-95 (1995) to allow the variables in the airflow equations to be replaced with equivalent terms in the ground-water flow equations. The model output is then transformed back into airflow terms. Most ground-water flow modeling codes can be utilized because the techniques require adjustments to the model input and output data, and not to the modeling code.

Airflow SVE modeling for the site was performed using the United States Geologic Survey's (USGS's) MODFLOW program with parameters adjusted for airflow conditions, as described below . MODFLOW is a three-dimensional, block-centered, finite-difference steady-state or transient flow model (McDonald and Harbaugh, 1988). The model assumes that fluid density variations, viscosity changes, and temperature gradients do not affect flow.

The Visual MODFLOW (Waterloo Hydrogeologic Software, 1996) software implementation of MODFLOW was selected for this modeling effort due to the ease of prescribing particle starting locations and the software's integrated MODFLOW and MODPATH post-processors. The software iteratively solves the finite-difference equations via the Waterloo Hydrologic Solver, a bi-conjugate gradient stabilized acceleration routine.

2.1 MODFLOW SVE Modeling Objectives

The purpose of the airflow SVE modeling was to determine the design parameters that met the following objectives:

- Provide coverage of airflow throughout the SVE cell;
- Limit the quantity and size of airflow stagnation points (points of zero airflow velocity);
- Provide uniformly distributed velocity conditions;
- Provide variable flow direction capability (allow variation in the extraction or injection of air at the discretion of the operator (i.e., to turn off airflow in portions of the SVE cell once remediation of that portion is complete); and
- Provide positive air pressure away from the non-SVE portion of the containment cell, to minimize diffusion of VOCs into non-hazardous soils.

2.2 MODFLOW SVE Model Geometry

The cross-sectional MODFLOW model was developed based on expected SVE cell dimensions, soil characteristics, and blower sizing determined elsewhere in this report. The model domain is a 60-feet wide, 28-feet tall, 180-feet long rectilinear, three-dimensional, block-centered finite difference grid. The grid is regularly-spaced along 3 rows, 153 columns, and 21 layers. All layers are simulated as "confined" with respect to air using an arbitrary gage head of 10,000 feet (water head) as atmospheric pressure. Boundary conditions used in the model include constant-head and no flow boundaries. The grid is discretized into cells 50-feet wide, 1-foot tall, 1-foot long within the SVE cell and surrounding liners, such that the model depicts the cross-section along the longitudinal axis of the SVE cell.

2.3 MODFLOW Air Conductivity Distribution and Boundary Conditions

Using the techniques described in Massman (1989), and ASTM D5719-95 (1995), airflow can be modeled using the Pressure Substitution Procedure (PSP) for cases where air-phase conductivity is constant over time. Preliminary estimates of the expected vacuum pressures at the extraction screens within the SVE cell were on the order of 200 inches of water (equivalent to 0.49 atmospheres [atm]). Comparative calculations suggest that for a 0.5 atm pressure difference, the errors as a result of using the PSP were less than 8% (Massman, 1989). Since the PSP is more readily implemented using available numerical software, and since the error in the estimate of the SVE cell soil hydraulic conductivity is likely as large or larger than this procedural error, the PSP was considered acceptable to simulate the flow of air through the SVE cell. The PSP uses the three equations, presented below to define the hydraulic conductivity and head equivalents for the airflow SVE model.

Using the equation to convert from the estimated soil hydraulic conductivity (determined using water as the permeating fluid during Bouwer-Rice analyzed slug tests at on-site ground-water monitoring wells installed in similar soils), the intrinsic permeability can be computed as:

$$k=\frac{K_w \mu_w}{\rho_w g}$$

where: k = soil intrinsic permeability (L^2);
ρ_w = water density (M/L^3);
g = earth's gravitational acceleration (L/T^2);
μ_w = Absolute (dynamic) viscosity of water (M/L*T); and
K_w = hydraulic conductivity (L/T).

Based on the soil intrinsic permeability and using the absolute viscosity of air, the corresponding airflow conductivity can be computed as:

$$K_a=\frac{\rho_w g k}{\mu_a};$$

where: K_a = airflow conductivity in terms of water heads (L/T) (used in place of the hydraulic conductivity in the ground-water flow model); and
μ_a = absolute viscosity of air (M/L*T).

Similarly, the corresponding air pressure head can be expressed as:

$$h_a = \frac{P_a}{\rho_w g};$$

where: h_a = air pressure head in terms of water density [L] (used in place of the ground-water potentiometric head in the ground-water flow model); and
P_a = air pressure [M/T^2*L].

Using the above equations, the airflow conductivity was determined for three soil types: the estimated soil hydraulic conductivity of the SVE cell; the hydraulic conductivity for the drainage layers above and below the SVE cell; and the hydraulic conductivity for the low permeability layers above and below the SVE cell. Conservative (high) hydraulic conductivity values were selected to provide "worst case" estimates in terms of predicted air flow rates and are provided in the following table. The actual hydraulic conductivities of the drainage and low permeability materials to be used in the SVE treatment cell construction (as presented in the RD Specifications) are expected to be less than values presented in the table below. Therefore, the actual air flow rates in the constructed SVE cell will likely be lower than the simulated air flow rate in the model. The following table lists the values used in the airflow SVE model:

Soil Type	**Hydraulic Conductivity (cm/s)**	**Intrinsic Permeability (m^2)**	**Airflow Conductivity (water head-based) (cm/s)**
SVE Cell Material	1.6×10^{-3}	1.6×10^{-12}	8.9×10^{-2}
Drainage Material	3.2×10^{1}	3.2×10^{-8}	1.8×10^{3}
Low Permeability Material	1.0×10^{-5}	1.0×10^{-14}	5.6×10^{-4}

The SVE cell soil material was computed as the geometric mean of the overburden soil hydraulic conductivity rising head slug tests determined during the Remedial Investigation (RI) (BBL, 1994). The drainage material and low permeability materials were estimated from textbook hydraulic conductivities of a gravel/crushed rock, and a silt, respectively (Freeze & Cherry, 1989). The SVE cell soil is modeled as having a uniform, isotropic air conductivity of 250 feet/day, corresponding to the airflow conductivity calculated using the above equation.

A datum of 10,000 feet for atmospheric pressure (zero gauge pressure) was selected to insure the MODFLOW model would not interpret negative gauge pressures as dry cells (for instance a vacuum gauge pressure of -16.7 feet (200 inches) of water was specified as 9,983.3 feet in the airflow model).

Atmospheric conditions [1 standard atmosphere (atm)] were assumed to exist within the drainage material above the SVE cell. These were simulated using constant head cells specified at 10,000 feet, zero gauge pressure as described in the preceding paragraph. The constant head cells are coincident with the 1-foot layer of drainage material airflow conductivity specified cells, and are just above the 1-foot layer of low permeability material cells.

The low conductivity layer beneath the SVE cell was simulated using the low permeability airflow conductivity listed in the table above. Boundary conditions and conductivities for the drainage layer beneath the SVE cell in the MODFLOW model were simulated under two scenarios:

- Assuming the pore space of the leachate drainage material beneath the SVE cell was 100% leachate saturated, the drainage material was modeled with low permeability and no specified constant head boundary; and
- Assuming the pore space of the leachate drainage material beneath the SVE cell was 100% air saturated, the drainage material was simulated as a specified, constant-head boundary using a datum of 10,000 feet.

No-flow boundary conditions were specified in rows 1 and 3 of the model, and around the SVE cell in row 2.

2.4 MODFLOW SVE Model Results

A total of 28 MODFLOW-based simulations of the SVE cell were conducted using different geometries of air injection and/or extraction wells. The model results are as follows:

- Six width-parallel air-extraction screens, in the center of the cell, at volume-based distances along the 142-foot cell length. These screens have variable length as a function of the SVE cell width. They are expected to provide a uniform vacuum pressure of 200 inches of water below atmospheric pressure (-0.49 atm gage or 0.51 atm total pressure).
- Twelve width-parallel air-injection screens, vented to atmospheric conditions (1.0 atm), along the top, bottom and edges of the SVE cell. These are placed in the base case to create a series of (approximately) volume-equivalent, five-spot, air circulation cells.
- The model predicted a total air flow of 455 cubic feet per minute using the aforementioned pressure distributions and screen geometry. These flow rates are a direct function of the true soil intrinsic permeability, which will vary as a function of the construction procedures and source material permeabilities.
- If the cell volume is larger or smaller than the modeled SVE cell design, then pipes should be added or removed so as to retain the simulated screen spacing intervals. If the SVE cell geometry changes substantially, revisions should be made to the initial flow model to evaluate the impacts of the changes on the potential effectiveness of the system.

2.5 Design Considerations

Potential imperfections in the SVE liner were evaluated during modeling because one of the objectives of the SVE cell design was to take advantage of possible imperfections. This was accomplished by using discrete high permeability zones in conjunction with atmospheric constant head boundary conditions in the model. No-flow boundary conditions were specified around the SVE cell where the liner was assumed to be 100-percent intact. At intervals every 10-percent (assumed percentage of imperfections) along the SVE liner, a high permeability zone/atmospheric cell was specified in place of a no-flow cell. Model results indicated flow patterns were essentially unchanged with additional sources distributed along the top or bottom of the SVE cell.

3. Overview of Venting SVE Model

VENTING computer software was designed specifically for estimating recovery rates of individual VOCs over time for SVE applications. The mathematical model used by VENTING is based on thermodynamic equilibrium partitioning between the gas, nonaqueous liquid, water, and solid (sorbed) phases and is solved using a finite difference approach that maintains a mass balance for each VOC of interest. VENTING can simulate VOC removal rates over time for mixtures with a maximum of 200 components. VENTING computes VOC recovery rates at the end of each time step for each VOC of interest by multiplying the computed VOC gas-phase concentration by the air flow rate.

Input requirements include soil properties (soil volume, fraction of organic carbon, water content, bulk density, and porosity), VOC physico-chemical properties for each compound of interest (molecular weight, vapor pressure, boiling point, solubility, organic carbon-based partition coefficient, and total mass of VOCs), and SVE air flow characteristics (flow rate, and temperature). Additionally, the user specifies time step length, time weighting factor, maximum time step length, and total simulation time. Other input requirements include the venting efficiency factor, which is discussed below, and the biodecay efficiency factor which was not utilized for this modeling effort.

VENTING is based on the following assumptions:

- Steady-state gas flow;
- Constant temperature;
- Equilibrium partitioning between gas, nonaqueous phase liquid, water, and solid phases;
- Homogeneous soil properties; and
- Ideal gas behavior.

3.1 VENTING SVE Model Input

VENTING model input parameters were selected to provide estimates of the VOC removal rates in terms of vapor treatment requirements. Therefore, values within field-verifiable ranges were selected as input parameters. For example, to estimate the total system air flow rate, the largest hydraulic conductivity value observed during the RI was selected because it would produce the highest air flow rate. Where site-specific data were unavailable, conservative input parameter values were selected using published ranges. The remainder of this section describes VENTING SVE model input parameters and site-specific assumptions that were used to run the model.

3.1.1 Total Mass of VOCs

Total mass of VOCs was estimated using average soil VOC concentrations observed at each of the three subject areas (Chip Chute Area, Separation Ponds, and Debris Landfill) during the RI and the estimated volume of soil to be treated. The following table summarizes the calculations used to estimate the total mass of VOCs:

VOC of Interest	Average Soil Concentration[1] (mg/kg)	Soil Volume[2] (cubic yards)	Soil Mass[3] (kilograms)	Estimated VOC Mass (kilograms)
Dichloroethene (cis and trans) (DCE)	235	2,330	3.17×10^6	745

VOC of Interest	Average Soil Concentration[1] (mg/kg)	Soil Volume[2] (cubic yards)	Soil Mass[3] (kilograms)	Estimated VOC Mass (kilograms)
Trichloroethene (TCE)	606	2,330	3.17×10^6	1,950
2-Butanone[5]	615	2,330	3.17×10^6	1,921
Total:	**1,456**		**Total:**	**4,616**

1 Volume-weighted average of VOC analytical results for all soil samples collected in the Chip Chute Area, Separation Ponds. and Debris Landfill.
2 Soil volume estimated during RI/Feasibility Study as reported by BBL (1994).
3 Soil mass estimated assuming 1 cubic yard soil = 1.5 tons.
4 VOC mass estimated by multiplying average soil concentration by soil mass.
5 Although not a NYSDEC identified VOC of concern, 2-butanone was included in this modeling exercise for purposes accounting for its impact on the removal of VOCs of interest.

3.1.2 Air Flow Rate and Temperature

Results of the MODFLOW model estimated that the air flow rate of the SVE cell would be between approximately 455 and 482 cubic feet per minute (cfm), including potential SVE cell liner imperfections. An air flow rate of 482 cfm was selected as an input parameter for the VENTING model. Factors influencing the air flow rate of the SVE cell are discussed in Section 2 of this Appendix. A temperature of 0.0 degrees Celsius was selected as an input parameter for the VENTING SVE model. This temperature was selected to represent operating conditions in winter.

3.1.3 Venting Efficiency Factor

The venting efficiency factor required by VENTING is related to the fraction of air flow directly in contact with VOCs to be removed and may be used to simulate diffusion-limited mass transfer associated with heterogeneous or layered soil systems. A venting efficiency factor of 0.05 was estimated for this site based on a parameter estimation subroutine built into the VENTING code.

3.1.4 Soil Properties

The soil volume required as input to the VENTING SVE model was 2,330 cubic yards, based on results presented in the RI Report. The soil fraction of organic carbon required as input to the VENTING SVE model was 0.01 based on published values (e.g., Domenico and Schwartz, 1990). The soil water content required as input to the VENTING SVE model was 0.18 (18 percent) based on an average of results presented in the RI Report. The bulk soil density required as input to the VENTING SVE model was 127 pounds per cubic foot based on an average of results presented in the RI Report. Air filled porosity required as input to the VENTING SVE model was 0.05.

3.2 VENTING SVE Model Results

VENTING SVE model output is provided as an Attachment A to this appendix. Simulated air VOC concentrations were graphed over time and are presented on Figure 1 and simulated soil VOC concentrations were graphed over time and are presented on Figure 2. As shown on Figure 1, a peak vapor-phase VOC concentration of approximately 820 parts per million (ppm) was observed during the initial portion of simulated SVE system operation. The simulated vapor-phase VOC concentration rapidly decreased over time to less than 100 ppm after approximately 150 days and less than 10 ppm after approximately 600 days of simulated SVE system operation. As shown on Figure 2, an initial soil VOC concentration of approximately 1,500 mg/kg was observed during the initial portion of simulated SVE system operation. This initial soil concentration is consistent with the sum of TCE, DCE, and 2-butanone average soil concentrations from the table above. The simulated soil VOC concentration decreased to less than 10 mg/kg after approximately 950 days of simulated SVE system operation.

3.3 Design Considerations

Based on the results of this modeling effort, the following design considerations are offered:

- The initial, peak vapor-phase VOC concentration could potentially exceed 800 ppm in air but overall vapor-phase VOC concentrations are expected to decrease over time;

- The duration of the simulated SVE system could potentially require a minimum of approximately 950 days (2.5 years) to achieve soil cleanup goals of less than 10 mg/kg VOCs; and

- These results are based on mathematical models requiring input parameters based on averaged field data and estimated values, and are also based on assumptions that may not be valid for all portions of the site at all times. Therefore, modeling results presented in this report should be considered estimates only.

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Figure 1 - Simulated Air VOC Concentration Over Time

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Figure 1

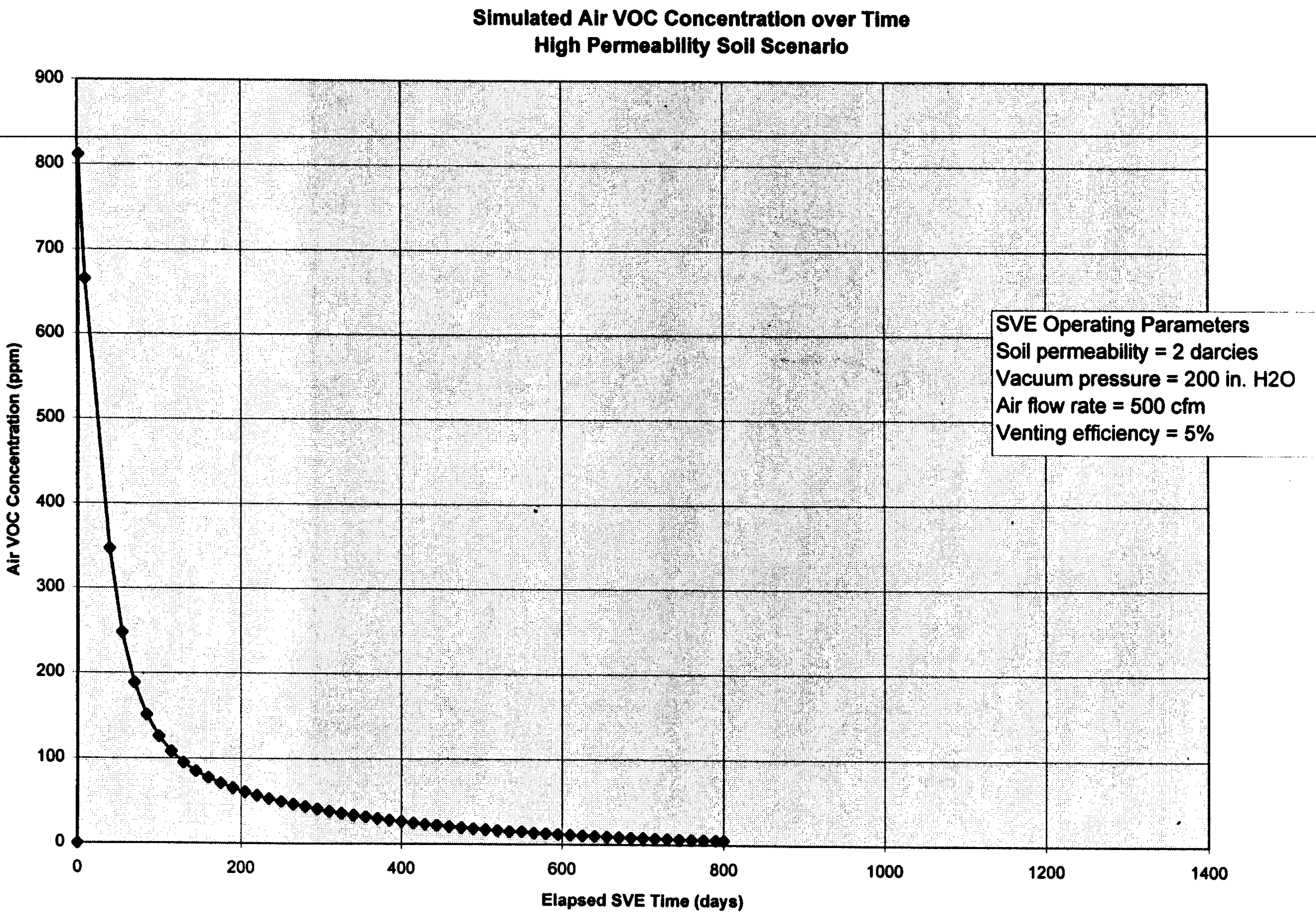
Simulated Air VOC Concentration over Time
High Permeability Soil Scenario
Air VOC Concentration (ppm)
900
800
700
600
500
400
300
200
100
0
0
200
400
600
800
1000
1200
1400
Elapsed SVE Time (days)
SVE Operating Parameters
Soil permeability = 2 darcies
Vacuum pressure = 200 in. H2O
Air flow rate = 500 cfm
Venting efficiency = 5%

Figure 2 - Simulated Soil VOC Concentration Over Time

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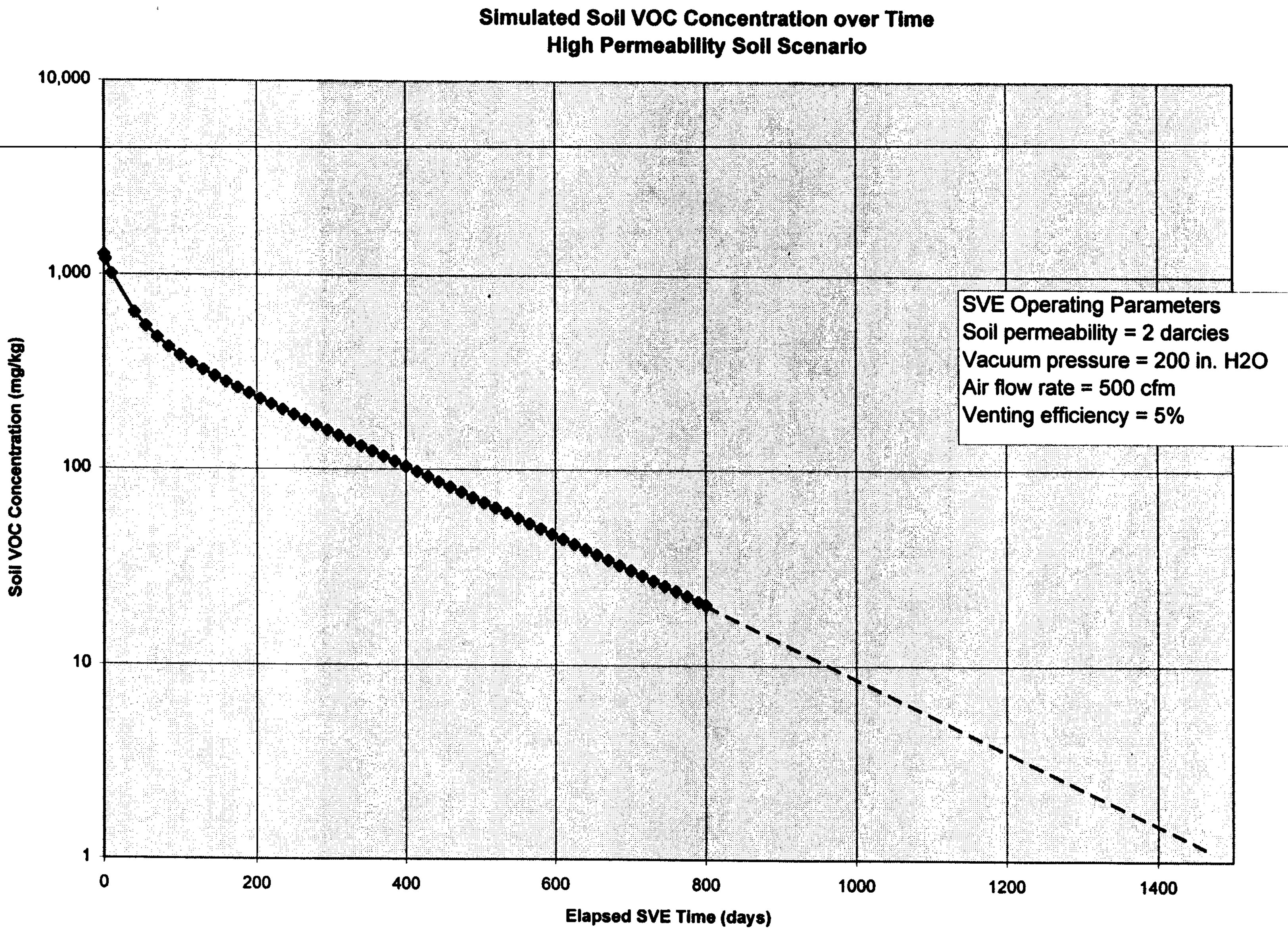
Figure 2



Simulated Soil VOC Concentration over Time
High Permeability Soil Scenario
10,000
1,000
100
10
1
Soil VOC Concentration (mg/kg)
0
200
400
600
800
1000
1200
1400
Elapsed SVE Time (days)
SVE Operating Parameters
Soil permeability = 2 darcies
Vacuum pressure = 200 in. H2O
Air flow rate = 500 cfm
Venting efficiency = 5%

Attachment A - Venting Model Output

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VENTING
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Environmental Systems and Technologies Inc.
2701 RAMBLE ROAD, SUITE 2
BLACKSBURG, VA 24062, U.S.A.
TITLE: Chicago Pneumatics High K Scenario

TOTAL MASS OF SPILL = .46160E+04 [kg]
AIR FLOW RATE = .19697E+08 [L/day]
TEMPERATURE = .00000E+00 [c]
STARTING TIME STEP = .10000E-04 [days]
MAXIMUM TIME STEP = .50000E+01 [days]
TOTAL SIMULATION TIME = .80000E+03 [days]
TIME WEIGHTING FACTOR = .10000E+01 [-]
EFFICIENCY FACTOR = .50000E-01 [-]
BIODECAY EFF. FACTOR = .00000E+00 [-]
SOIL VOLUME = .17814E+04 [m^3]
FRAC. ORGANIC CARBON = .10000E-01 [-]
VOL. WATER CONTENT = .18000E+00 [-]
BULK DENSITY = .20405E+01 [g/cm^3]
AIR FILLED POROSITY = .50000E-01 [-]

SPECIES	MOL. WEIGHT	VAP PRESSURE	BOILING TEMP	SOLUBILITY	KOC
	gm/mole	atm	deg. c	mg/L	g/g
1,2-dichloroethylene	0.9690E+02	0.2630E+00	0.6030E+02	0.3500E+04	0.7200E+02
2-butanone	0.7210E+02	0.1190E+00	0.8000E+02	0.1000E+06	0.2000E+01
trichloroethylene	0.1314E+03	0.9100E-01	0.8700E+02	0.1100E+04	0.2630E+03

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.7432E+06	0.0000E+00	0.0000E+00	0.2045E+03
2-butanone	0.1920E+07	0.0000E+00	0.0000E+00	0.5283E+03
trichloroethylene	0.1953E+07	0.0000E+00	0.0000E+00	0.5372E+03

time step reduced

TIME = 0.0000 [days]
TOTAL MASS OF HYDROCARBON = .46160E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .10704E+02 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]

TOTAL MASS IN WATER PHASE = .18983E+04 [kg]
TOTAL MASS IN SOLID PHASE = .27070E+04 [kg]
HYDROCARBON MASS PER SOIL MASS = .12699E+04 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.7432E+06	0.9608E-05	0.1922E-03	0.2045E+03
2-butanone	0.1920E+07	0.0000E+00	0.0000E+00	0.5283E+03
trichloroethylene	0.1953E+07	0.1303E-04	0.2606E-03	0.5372E+03

SPECIES	SPECIES MASS [g] IN GAS	OIL	WATER	SOLID
1,2-dichloroethylene	0.4829E+04	0.0000E+00	0.1202E+06	0.6181E+06
2-butanone	0.7135E+03	0.0000E+00	0.1680E+07	0.2399E+06
trichloroethylene	0.5162E+04	0.0000E+00	0.9844E+05	0.1849E+07

****

end of initial conditions

****

TIME = 2.3750 [days]
TOTAL MASS OF HYDROCARBON = .43547E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .96189E+01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .18571E+04 [kg]
TOTAL MASS IN SOLID PHASE = .24879E+04 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .25921E+01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .56615E+01 [%]
HYDROCARBON MASS PER SOIL MASS = .11980E+04 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.6298E+06	0.1532E+01	0.3063E+02	0.1733E+03
2-butanone	0.1902E+07	0.2644E+00	0.5289E+01	0.5232E+03
trichloroethylene	0.1823E+07	0.1804E+01	0.3607E+02	0.5016E+03

TIME = 10.3906 [days]
TOTAL MASS OF HYDROCARBON = .36700E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .69598E+01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .17436E+04 [kg]

TOTAL MASS IN SOLID PHASE = .19194E+04 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .63299E+01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .20494E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .10096E+04 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.3734E+06	0.1034E+01	0.2069E+02	0.1027E+03
2-butanone	0.1840E+07	0.2915E+00	0.5830E+01	0.5063E+03
trichloroethylene	0.1456E+07	0.1641E+01	0.3282E+02	0.4006E+03

TIME = 25.3906 [days]
TOTAL MASS OF HYDROCARBON = .28473E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .41663E+01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .15873E+04 [kg]
TOTAL MASS IN SOLID PHASE = .12558E+04 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .49899E+01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .38316E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .78332E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.1487E+06	0.5424E+00	0.1085E+02	0.4091E+02
2-butanone	0.1731E+07	0.3612E+00	0.7223E+01	0.4763E+03
trichloroethylene	0.9671E+06	0.1435E+01	0.2870E+02	0.2661E+03

TIME = 40.3906 [days]
TOTAL MASS OF HYDROCARBON = .23306E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .26881E+01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .14669E+04 [kg]
TOTAL MASS IN SOLID PHASE = .86103E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .32196E+01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .49511E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .64115E+03 [mg/kg]

SPECIES SPECIES MASS [g] | WELL GAS CONCEN.. [g/m^3] | EQUIL. GAS CONCEN. [g/m^3] | SPECIES MASS PER SOIL MASS [mg/kg]

1,2-dichloroethylene 0.5921E+05 0.2160E+00 0.4320E+01 0.1629E+02
2-butanone 0.1629E+07 0.3398E+00 0.6796E+01 0.4482E+03
trichloroethylene 0.6423E+06 0.9532E+00 0.1906E+02 0.1767E+03

TIME = 55.3906 [days]
TOTAL MASS OF HYDROCARBON = .19828E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .18505E+01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .13659E+04 [kg]
TOTAL MASS IN SOLID PHASE = .61507E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .22163E+01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .57045E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .54548E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.2358E+05	0.8601E-01	0.1720E+01	0.6487E+01
2-butanone	0.1533E+07	0.3197E+00	0.6393E+01	0.4216E+03
trichloroethylene	0.4266E+06	0.6331E+00	0.1266E+02	0.1174E+03

TIME = 70.3906 [days]
TOTAL MASS OF HYDROCARBON = .17347E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .13458E+01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .12770E+04 [kg]
TOTAL MASS IN SOLID PHASE = .45627E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .16119E+01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .62421E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .47721E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.9390E+04	0.3425E-01	0.6850E+00	0.2583E+01
2-butanone	0.1442E+07	0.3008E+00	0.6015E+01	0.3967E+03
trichloroethylene	0.2833E+06	0.4205E+00	0.8410E+01	0.7795E+02

TIME = 85.3906 [days]
TOTAL MASS OF HYDROCARBON = .15485E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .10258E+01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .11967E+04 [kg]

TOTAL MASS IN SOLID PHASE = .35080E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .12286E+01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .66453E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .42600E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.3739E+04	0.1364E-01	0.2728E+00	0.1029E+01
2-butanone	0.1357E+07	0.2830E+00	0.5659E+01	0.3732E+03
trichloroethylene	0.1882E+06	0.2793E+00	0.5585E+01	0.5177E+02

TIME = 100.3906 [days]
TOTAL MASS OF HYDROCARBON = .14028E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .81432E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .11229E+04 [kg]
TOTAL MASS IN SOLID PHASE = .27905E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .97530E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .69610E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .38591E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.1489E+04	0.5431E-02	0.1086E+00	0.4096E+00
2-butanone	0.1276E+07	0.2662E+00	0.5324E+01	0.3511E+03
trichloroethylene	0.1250E+06	0.1855E+00	0.3710E+01	0.3438E+02

TIME = 115.3906 [days]
TOTAL MASS OF HYDROCARBON = .12844E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .66947E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .10546E+04 [kg]
TOTAL MASS IN SOLID PHASE = .22912E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .80182E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .72175E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .35334E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]

1,2-dichloroethylene	0.5929E+03	0.2163E-02	0.4326E-01	0.1631E+00
2-butanone	0.1201E+07	0.2505E+00	0.5009E+01	0.3303E+03
trichloroethylene	0.8301E+05	0.1232E+00	0.2464E+01	0.2284E+02

TIME = 130.3906 [days]
TOTAL MASS OF HYDROCARBON = .11851E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .56705E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .99097E+03 [kg]
TOTAL MASS IN SOLID PHASE = .19355E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .67915E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .74327E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .32602E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.2361E+03	0.8613E-03	0.1723E-01	0.6496E-01
2-butanone	0.1130E+07	0.2356E+00	0.4713E+01	0.3108E+03
trichloroethylene	0.5513E+05	0.8182E-01	0.1636E+01	0.1517E+02

TIME = 145.3906 [days]
TOTAL MASS OF HYDROCARBON = .10995E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .49173E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .93152E+03 [kg]
TOTAL MASS IN SOLID PHASE = .16746E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .58893E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .76181E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .30247E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1063E+07	0.2217E+00	0.4434E+01	0.2924E+03
trichloroethylene	0.3662E+05	0.5434E-01	0.1087E+01	0.1007E+02

TIME = 160.3906 [days]
TOTAL MASS OF HYDROCARBON = .10243E+04 [kg]
TOTAL MASS IN VAPOR PHASE = .43585E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .87589E+03 [kg]

TOTAL MASS IN SOLID PHASE = .14796E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .52201E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .77810E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .28179E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1000E+07	0.2086E+00	0.4171E+01	0.2751E+03
trichloroethylene	0.2432E+05	0.3609E-01	0.7218E+00	0.6690E+01

TIME = 175.3906 [days]
TOTAL MASS OF HYDROCARBON = .95694E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .39227E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .82371E+03 [kg]
TOTAL MASS IN SOLID PHASE = .13283E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .46981E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .79269E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .26326E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.9408E+06	0.1962E+00	0.3925E+01	0.2588E+03
trichloroethylene	0.1615E+05	0.2397E-01	0.4794E+00	0.4443E+01

TIME = 190.3906 [days]
TOTAL MASS OF HYDROCARBON = .89584E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .35724E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .77474E+03 [kg]
TOTAL MASS IN SOLID PHASE = .12074E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .42786E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .80593E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .24645E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]

1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.8851E+06	0.1846E+00	0.3692E+01	0.2435E+03
trichloroethylene	0.1073E+05	0.1592E-01	0.3184E+00	0.2951E+01

TIME = 205.3906 [days]
TOTAL MASS OF HYDROCARBON = .83986E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .32825E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .72874E+03 [kg]
TOTAL MASS IN SOLID PHASE = .11079E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .39314E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .81806E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .23105E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.8327E+06	0.1737E+00	0.3474E+01	0.2291E+03
trichloroethylene	0.7125E+04	0.1057E-01	0.2115E+00	0.1960E+01

TIME = 220.3906 [days]
TOTAL MASS OF HYDROCARBON = .78818E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .30362E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .68552E+03 [kg]
TOTAL MASS IN SOLID PHASE = .10236E+03 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .36364E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .82925E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .21683E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.7835E+06	0.1634E+00	0.3268E+01	0.2155E+03
trichloroethylene	0.4732E+04	0.7022E-02	0.1404E+00	0.1302E+01

TIME = 235.3906 [days]
TOTAL MASS OF HYDROCARBON = .74023E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .28219E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .64488E+03 [kg]

TOTAL MASS IN SOLID PHASE = .95065E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .33797E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .83964E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .20364E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.7371E+06	0.1537E+00	0.3075E+01	0.2028E+03
trichloroethylene	0.3143E+04	0.4664E-02	0.9328E-01	0.8646E+00

TIME = 250.3906 [days]
TOTAL MASS OF HYDROCARBON = .69556E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .26319E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .60668E+03 [kg]
TOTAL MASS IN SOLID PHASE = .88616E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .31522E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .84932E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .19135E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.6935E+06	0.1446E+00	0.2893E+01	0.1908E+03
trichloroethylene	0.2087E+04	0.3098E-02	0.6195E-01	0.5742E+00

TIME = 265.3906 [days]
TOTAL MASS OF HYDROCARBON = .65382E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .24609E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .57075E+03 [kg]
TOTAL MASS IN SOLID PHASE = .82825E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .29474E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .85836E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .17987E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]

1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.6524E+06	0.1361E+00	0.2722E+01	0.1795E+03
trichloroethylene	0.1386E+04	0.2057E-02	0.4115E-01	0.3814E+00

TIME = 280.3906 [days]
TOTAL MASS OF HYDROCARBON = .61474E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .23051E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .53695E+03 [kg]
TOTAL MASS IN SOLID PHASE = .77561E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .27608E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .86682E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .16912E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.6138E+06	0.1280E+00	0.2561E+01	0.1689E+03
trichloroethylene	0.9207E+03	0.1366E-02	0.2733E-01	0.2533E+00

TIME = 295.3906 [days]
TOTAL MASS OF HYDROCARBON = .57811E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .21620E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .50516E+03 [kg]
TOTAL MASS IN SOLID PHASE = .72729E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .25893E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .87476E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .15904E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.5775E+06	0.1205E+00	0.2409E+01	0.1589E+03
trichloroethylene	0.6115E+03	0.9075E-03	0.1815E-01	0.1682E+00

TIME = 310.3906 [days]
TOTAL MASS OF HYDROCARBON = .54373E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .20295E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .47526E+03 [kg]

TOTAL MASS IN SOLID PHASE = .68265E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .24308E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .88221E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .14958E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.5433E+06	0.1133E+00	0.2267E+01	0.1495E+03
trichloroethylene	0.4062E+03	0.6027E-03	0.1205E-01	0.1117E+00

TIME = 325.3906 [days]
TOTAL MASS OF HYDROCARBON = .51144E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .19065E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .44713E+03 [kg]
TOTAL MASS IN SOLID PHASE = .64119E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .22833E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .88920E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .14070E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.5112E+06	0.1066E+00	0.2132E+01	0.1406E+03
trichloroethylene	0.2698E+03	0.4003E-03	0.8006E-02	0.7421E-01

TIME = 340.3906 [days]
TOTAL MASS OF HYDROCARBON = .48110E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .17917E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .42066E+03 [kg]
TOTAL MASS IN SOLID PHASE = .60254E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .21459E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .89578E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .13235E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]

1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.4809E+06	0.1003E+00	0.2006E+01	0.1323E+03
trichloroethylene	0.1792E+03	0.2659E-03	0.5317E-02	0.4929E-01

TIME = 355.3906 [days]
TOTAL MASS OF HYDROCARBON = .45258E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .16843E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .39577E+03 [kg]
TOTAL MASS IN SOLID PHASE = .56641E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .20173E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .90196E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .12451E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.4525E+06	0.9437E-01	0.1887E+01	0.1245E+03
trichloroethylene	0.1190E+03	0.1766E-03	0.3532E-02	0.3273E-01

TIME = 370.3906 [days]
TOTAL MASS OF HYDROCARBON = .42568E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .15817E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .37234E+03 [kg]
TOTAL MASS IN SOLID PHASE = .53183E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .19140E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .90778E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .11711E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.4257E+06	0.8879E-01	0.1776E+01	0.1171E+03
trichloroethylene	0.0000E+00	0.9197E-03	0.1839E-01	0.0000E+00

TIME = 385.3906 [days]
TOTAL MASS OF HYDROCARBON = .40049E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .14881E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .35030E+03 [kg]

TOTAL MASS IN SOLID PHASE = .50036E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .17823E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .91324E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .11018E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.4005E+06	0.8353E-01	0.1671E+01	0.1102E+03
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 400.3906 [days]
TOTAL MASS OF HYDROCARBON = .37679E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .14000E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .32957E+03 [kg]
TOTAL MASS IN SOLID PHASE = .47075E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .16768E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .91837E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .10366E+03 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.3768E+06	0.7859E-01	0.1572E+01	0.1037E+03
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 415.3906 [days]
TOTAL MASS OF HYDROCARBON = .35449E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .13172E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .31007E+03 [kg]
TOTAL MASS IN SOLID PHASE = .44289E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .15776E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .92320E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .97522E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]

1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.3545E+06	0.7394E-01	0.1479E+01	0.9752E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 430.3906 [days]
TOTAL MASS OF HYDROCARBON = .33351E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .12392E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .29172E+03 [kg]
TOTAL MASS IN SOLID PHASE = .41668E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .14842E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .92775E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .91751E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.3335E+06	0.6956E-01	0.1391E+01	0.9175E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 445.3906 [days]
TOTAL MASS OF HYDROCARBON = .31378E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .11659E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .27446E+03 [kg]
TOTAL MASS IN SOLID PHASE = .39202E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .13964E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .93202E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .86321E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.3138E+06	0.6545E-01	0.1309E+01	0.8632E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 460.3906 [days]
TOTAL MASS OF HYDROCARBON = .29521E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .10969E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .25822E+03 [kg]

TOTAL MASS IN SOLID PHASE = .36882E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .13137E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .93605E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .81213E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.2952E+06	0.6157E-01	0.1231E+01	0.8121E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 475.3906 [days]
TOTAL MASS OF HYDROCARBON = .27774E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .10320E+00 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .24293E+03 [kg]
TOTAL MASS IN SOLID PHASE = .34700E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .12360E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .93983E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .76407E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.2777E+06	0.5793E-01	0.1159E+01	0.7641E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 490.3906 [days]
TOTAL MASS OF HYDROCARBON = .26130E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .97091E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .22856E+03 [kg]
TOTAL MASS IN SOLID PHASE = .32646E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .11628E+00 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .94339E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .71885E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]

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1,2-dichloroethylene       0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
2-butanone                 0.2613E+06  0.5450E-01  0.1090E+01  0.7189E+02
trichloroethylene          0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00

TIME                                      =  505.3906  [days]
TOTAL MASS OF HYDROCARBON                 = .24584E+03  [kg]
TOTAL MASS IN VAPOR PHASE                 = .91345E-01  [kg]
TOTAL MASS IN OIL PHASE                   = .00000E+00  [kg]
TOTAL MASS IN WATER PHASE                 = .21503E+03  [kg]
TOTAL MASS IN SOLID PHASE                 = .30714E+02  [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP  = .10940E+00  [%]
CUMULATIVE CHANGE IN HYDROCARBON          = .94674E+02  [%]
HYDROCARBON MASS PER SOIL MASS            = .67631E+02  [mg/kg]

SPECIES                    SPECIES    WELL GAS   EQUIL. GAS  SPECIES MASS
                           MASS       CONCEN..   CONCEN.     PER SOIL MASS
                           [g]        [g/m^3]    [g/m^3]     [mg/kg]

1,2-dichloroethylene       0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
2-butanone                 0.2458E+06  0.5128E-01  0.1026E+01  0.6763E+02
trichloroethylene          0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00

TIME                                      =  520.3906  [days]
TOTAL MASS OF HYDROCARBON                 = .23129E+03  [kg]
TOTAL MASS IN VAPOR PHASE                 = .85940E-01  [kg]
TOTAL MASS IN OIL PHASE                   = .00000E+00  [kg]
TOTAL MASS IN WATER PHASE                 = .20231E+03  [kg]
TOTAL MASS IN SOLID PHASE                 = .28896E+02  [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP  = .10293E+00  [%]
CUMULATIVE CHANGE IN HYDROCARBON          = .94989E+02  [%]
HYDROCARBON MASS PER SOIL MASS            = .63629E+02  [mg/kg]

SPECIES                    SPECIES    WELL GAS   EQUIL. GAS  SPECIES MASS
                           MASS       CONCEN..   CONCEN.     PER SOIL MASS
                           [g]        [g/m^3]    [g/m^3]     [mg/kg]

1,2-dichloroethylene       0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
2-butanone                 0.2313E+06  0.4824E-01  0.9648E+00  0.6363E+02
trichloroethylene          0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00

TIME                                      =  535.3906  [days]
TOTAL MASS OF HYDROCARBON                 = .21760E+03  [kg]
TOTAL MASS IN VAPOR PHASE                 = .80854E-01  [kg]
TOTAL MASS IN OIL PHASE                   = .00000E+00  [kg]
TOTAL MASS IN WATER PHASE                 = .19033E+03  [kg]
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TOTAL MASS IN SOLID PHASE = .27186E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .96837E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .95286E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .59863E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.2176E+06	0.4539E-01	0.9077E+00	0.5986E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 550.3906 [days]
TOTAL MASS OF HYDROCARBON = .20472E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .76069E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .17907E+03 [kg]
TOTAL MASS IN SOLID PHASE = .25578E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .91106E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .95565E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .56321E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.2047E+06	0.4270E-01	0.8540E+00	0.5632E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 565.3906 [days]
TOTAL MASS OF HYDROCARBON = .19261E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .71567E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .16847E+03 [kg]
TOTAL MASS IN SOLID PHASE = .24064E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .85715E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .95827E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .52988E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]

1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1926E+06	0.4017E-01	0.8035E+00	0.5299E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 580.3906 [days]
TOTAL MASS OF HYDROCARBON = .18121E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .67332E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .15850E+03 [kg]
TOTAL MASS IN SOLID PHASE = .22640E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .80643E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .96074E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .49852E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1812E+06	0.3780E-01	0.7559E+00	0.4985E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 595.3906 [days]
TOTAL MASS OF HYDROCARBON = .17049E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .63347E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .14912E+03 [kg]
TOTAL MASS IN SOLID PHASE = .21300E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .75870E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .96307E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .46902E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1705E+06	0.3556E-01	0.7112E+00	0.4690E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 610.3906 [days]
TOTAL MASS OF HYDROCARBON = .16040E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .59599E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .14030E+03 [kg]

TOTAL MASS IN SOLID PHASE = .20040E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .71380E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .96525E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .44126E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1604E+06	0.3346E-01	0.6691E+00	0.4413E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 625.3906 [days]
TOTAL MASS OF HYDROCARBON = .15091E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .56072E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .13200E+03 [kg]
TOTAL MASS IN SOLID PHASE = .18854E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .67156E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .96731E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .41515E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1509E+06	0.3148E-01	0.6295E+00	0.4151E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 640.3906 [days]
TOTAL MASS OF HYDROCARBON = .14198E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .52753E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .12418E+03 [kg]
TOTAL MASS IN SOLID PHASE = .17738E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .63182E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .96924E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .39058E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]

1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1420E+06	0.2961E-01	0.5923E+00	0.3906E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 655.3906 [days]
TOTAL MASS OF HYDROCARBON = .13357E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .49632E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .11684E+03 [kg]
TOTAL MASS IN SOLID PHASE = .16688E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .59443E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .97106E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .36747E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1336E+06	0.2786E-01	0.5572E+00	0.3675E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 670.3906 [days]
TOTAL MASS OF HYDROCARBON = .12567E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .46694E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .10992E+03 [kg]
TOTAL MASS IN SOLID PHASE = .15701E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .55925E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .97278E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .34572E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1257E+06	0.2621E-01	0.5242E+00	0.3457E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 685.3906 [days]
TOTAL MASS OF HYDROCARBON = .11823E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .43931E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .10342E+03 [kg]

TOTAL MASS IN SOLID PHASE = .14771E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .52616E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .97439E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .32526E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1182E+06	0.2466E-01	0.4932E+00	0.3253E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 700.3906 [days]
TOTAL MASS OF HYDROCARBON = .11123E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .41331E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .97296E+02 [kg]
TOTAL MASS IN SOLID PHASE = .13897E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .49502E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .97590E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .30601E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1112E+06	0.2320E-01	0.4640E+00	0.3060E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 715.3906 [days]
TOTAL MASS OF HYDROCARBON = .10465E+03 [kg]
TOTAL MASS IN VAPOR PHASE = .38885E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .91538E+02 [kg]
TOTAL MASS IN SOLID PHASE = .13075E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .46572E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .97733E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .28790E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]

1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.1047E+06	0.2183E-01	0.4366E+00	0.2879E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 730.3906 [days]
TOTAL MASS OF HYDROCARBON = .98459E+02 [kg]
TOTAL MASS IN VAPOR PHASE = .36584E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .86121E+02 [kg]
TOTAL MASS IN SOLID PHASE = .12301E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .43816E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .97867E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .27087E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.9846E+05	0.2054E-01	0.4107E+00	0.2709E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 745.3906 [days]
TOTAL MASS OF HYDROCARBON = .92632E+02 [kg]
TOTAL MASS IN VAPOR PHASE = .34419E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .81025E+02 [kg]
TOTAL MASS IN SOLID PHASE = .11573E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .41223E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .97993E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .25484E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.9263E+05	0.1932E-01	0.3864E+00	0.2548E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 760.3906 [days]
TOTAL MASS OF HYDROCARBON = .87150E+02 [kg]
TOTAL MASS IN VAPOR PHASE = .32382E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .76230E+02 [kg]

TOTAL MASS IN SOLID PHASE = .10888E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .38784E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .98112E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .23976E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.8715E+05	0.1818E-01	0.3636E+00	0.2398E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 775.3906 [days]
TOTAL MASS OF HYDROCARBON = .81993E+02 [kg]
TOTAL MASS IN VAPOR PHASE = .30466E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .71719E+02 [kg]
TOTAL MASS IN SOLID PHASE = .10244E+02 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .36489E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .98224E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .22557E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.8199E+05	0.1710E-01	0.3420E+00	0.2256E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

TIME = 790.3906 [days]
TOTAL MASS OF HYDROCARBON = .77141E+02 [kg]
TOTAL MASS IN VAPOR PHASE = .28663E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .67474E+02 [kg]
TOTAL MASS IN SOLID PHASE = .96377E+01 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .34329E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .98329E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .21222E+02 [mg/kg]

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]

1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.7714E+05	0.1609E-01	0.3218E+00	0.2122E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

...........FINAL RESULTS..........

TIME = 800.3906 [days]
TOTAL MASS OF HYDROCARBON = .74066E+02 [kg]
TOTAL MASS IN VAPOR PHASE = .27521E-01 [kg]
TOTAL MASS IN OIL PHASE = .00000E+00 [kg]
TOTAL MASS IN WATER PHASE = .64785E+02 [kg]
TOTAL MASS IN SOLID PHASE = .92536E+01 [kg]
CHANGE IN HYDROCARBON MASS FOR TIME STEP = .32961E-01 [%]
CUMULATIVE CHANGE IN HYDROCARBON = .98395E+02 [%]
HYDROCARBON MASS PER SOIL MASS = .20376E+02 [mg/kg]

SPECIES	SPECIES MASS [g] IN			
	GAS	OIL	WATER	SOLID
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.2752E+02	0.0000E+00	0.6479E+05	0.9254E+04
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

SPECIES	SPECIES MASS [g]	WELL GAS CONCEN.. [g/m^3]	EQUIL. GAS CONCEN. [g/m^3]	SPECIES MASS PER SOIL MASS [mg/kg]
1,2-dichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
2-butanone	0.7407E+05	0.1545E-01	0.3090E+00	0.2038E+02
trichloroethylene	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00

Total number of time steps = 165
Total number of iterations = 192

Appendix F

Soil Vapor Extraction System
Startup Procedures

General

This appendix describes procedures to be followed during startup of the soil vapor extraction (SVE) system to be performed by the Engineer. The goals of the startup procedures are to:

- Determine the operating parameters of the SVE system, including air flow rate, vacuum pressure, and air volatile organic compound (VOC) concentration; and

- Optimize the VOC mass removal rate within the operational limitations of the SVE system equipment.

These goals will be accomplished by operating the system during the startup period at various settings. Air flow rates and VOC concentrations will be measured throughout the startup period. Information developed during the startup period will be used as a basis for development of the final SVE system operating parameters and completion of an operation, maintenance and monitoring plan.

Equipment Required

- Air velocity meter (anemometer) capable of measuring air velocities ranging from 20 feet per minute (fpm) to 10,000 fpm;

- Air temperature gauge; and

- Photoionization detector (PID).

Startup Procedures

Step 1: Determine SVE System Operating Parameters

Overview

The purpose of this activity is to determine the SVE system operating parameters, including total system flow rate, total system vacuum, and total system VOC removal rate. This activity involves running the SVE system at incrementally increasing vacuum and measuring the total air flow rate and VOC concentrations.

Procedures

Open the valves on all vacuum extraction pipes and air injection pipes to allow maximum air flow through the SVE cell. Close the fresh air induction valve to ensure that all air extracted through the system originates in the SVE cell. Start the SVE system at a low vacuum and increase the vacuum incrementally according to the following schedule:

SVE Vacuum (inches of mercury)	Duration (hours)
5	2
10	2
15	2

Measure and record the air flow rate, VOC concentration (using a PID), air temperature and vacuum/pressure at sampling ports and gauges located prior to the air/water separator and prior to the first granular activated carbon (GAC) adsorption unit. Measure PID readings between the GAC units and after the second GAC unit. Perform the above readings at approximately 15 minute intervals throughout the 6 hour start-up period.

Data Analysis

- Compute the SVE system total volumetric air flow rate prior to the air/water separator and prior to the first GAC unit using the equation:

{1} $$Q_A = V \times A$$

where: Q_A = Total volumetric air flow rate (acfm)
V = Measured air flow rate (fpm) from anemometer reading
A = Cross-sectional area of pipe in which air flow is measured (ft^2)

- Convert actual flow rate to standard flow rate using the equation:

{2} $$Q_S = Q_A\,[14.4/14.7]\,[528/460 + T_A]$$

where: Q_S = Total volumetric air flow rate (scfm)
T_A = Measured air temperature (°F)

- Compute the average volumetric air flow rate per SVE extraction pipe using the equation:

{3} $$Q_{S\ Avg} = Q_S / n$$

where: $Q_{S\ Avg}$ = Average volumetric air flow rate per SVE extraction pipe (scfm)
n = Number of SVE extraction pipes

Step 2: Balance the SVE System

Overview

The purpose of this activity is to determine which areas of the SVE cell contain the highest VOC concentrations and preferentially direct air flow through those areas. This procedure may be used in the future to rebalance the system as necessary. This activity involves measuring the air flow rate, VOC concentration, and VOC mass removal rate for each SVE extraction pipe individually, and adjusting the air control valve for each SVE pipe so that greater air flow is directed through those soils which produce the largest VOC removal rates.

Procedures

Open the valves on all air extraction and injection pipes to allow maximum air flow through the SVE cell. Close the fresh air induction valve to ensure that all air extracted through the system originates in the SVE cell. Start the SVE system and maintain the SVE system vacuum as established in Step 1.

Measure and record the air flow rate and VOC concentration (using a PID) at each SVE extraction well head. Repeat this process three times and compute the average PID reading and flow rate per SVE extraction pipe. Sum the average PID readings and compute the fractional contribution of PID readings for each SVE well head. Using the fractional VOC contribution for each SVE well head, determine the fraction of total volumetric air flow per SVE well ("balanced" volumetric air flow rate). Using the air velocity meter, adjust the SVE well head extraction pipe valves until the balanced volumetric air flow rate per SVE extraction pipe is achieved.

Site-Specific Air Monitoring Plan

Chicago Pneumatic Tool Company
Frankfort, New York

April 1998

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Table of Contents

1. Introduction

This document presents the Air Monitoring Plan (AMP) which has been prepared in support of the Remedial Design (RD) Specifications for the Chicago Pneumatic Tool Company (site) located in Frankfort, New York. This AMP identifies the air monitoring activities to be performed at the site during implementation of intrusive activities (i.e., excavation, handling, staging, etc. of impacted site media) associated with the remedial activities described in the RD Specifications. This AMP has been prepared to satisfy the requirements of the air monitoring component of the Remedial Action Contingency Plan as identified in the Remedial Design (RD) Work Plan, dated November 1997, which was prepared by Blasland, Bouck & Lee, Inc. (BBL). In order to satisfy the requirements of the RD Work Plan, this plan presents the site-wide air monitoring activities and corresponding mitigative responses. Air monitoring to be conducted for on-site personnel will be addressed in the Engineer's and Contractor's site-specific Health and Safety Plans.

This AMP has been prepared in a manner consistent with the New York State Department of Environmental Conservation's (NYSDEC's) Technical and Administrative Guidance Memorandum (TAGM) MWR-89-4031 entitled "Fugitive Dust Supression and Particulate Monitoring Program and Inactive Hazardous Waste Sites", dated October 27, 1989, (TAGM 4031).

2. Air Monitoring

Air monitoring activities will be undertaken during the remedial activities and will include collecting meteorological data and performing real-time monitoring for particulate (dust) levels and volatile organic compounds (VOCs). These activities are described below.

2.1 Meteorological Monitoring

Meteorological monitoring will be performed using a Met One meteorological system (or equal) to measure wind speed, wind direction, and temperature. Meteorological sensors will be mounted on a 13.2-meter (40-ft) aluminum tower, as manufactured by Aluma Tower Co. (or equal). The wind speed and wind direction sensors will be mounted at approximately the 10-meter level while the temperature sensor will be installed at the 3-meter level. The tower will include a grounding system and lightning protection system that is compatible with the manufacturer's recommendations. Meteorological readings will be collected at least twice per day (i.e., once in the morning and once in the afternoon) by the Engineer. Meteorological readings will be documented by the Engineer on air monitoring logs and will be used to determine the site boundaries located upwind and downwind of the remedial measures.

2.2 Particulate (Dust) Monitoring

Real-time particulate monitoring will be performed by the Engineer at the site perimeter. Particulate monitoring will be conducted using a MINIRAM (or equal) at a minimum frequency of once per hour [unless in the opinion of the Engineer, site conditions do not facilitate the generation of dust (i.e., materials are saturated)] consistent with TAGM 4031. In accordance with TAGM 4031, the results of the particulate monitoring will be compared to the 150 micrograms per cubic meter (ug/m^3) action level. Should the 150 ug/m^3 action level for dust be met or exceeded at the site perimeter (integrated over a period not to exceed 15 minutes), then the upwind background level will be measured. If the downwind reading is 150 ug/m^3 above the background reading, then dust generating activities will be discontinued and dust suppression activities will be implemented. In addition, the frequency of the dust monitoring activities may be increased (at the discretion of the Engineer). Should the 150 ug/m^3 action level (above site background) for dust continue to be met or exceeded at the downwind site perimeter, dust generating activities will be discontinued until dust levels subside to less than the action level and dust suppression methods will be increased. All readings will be recorded and maintained on-site by the Engineer and will be available for New York State Department of Health (NYSDOH) and NYSDEC personnel to review.

2.3 VOCs

Real-time monitoring for VOCs within the worker breathing zone will be performed by the Engineer using a photoionization detector (PID) at a minimum frequency of once per hour. If the worker breathing zone reading for VOCs exceeds 5 parts-per-million (ppm) above site background (integrated over a period not to exceed 15 minutes), then VOC monitoring at the work area perimeter will be performed. Should the 5 ppm action level (above site background) be exceeded at the perimeter of the work area, work activities potentially contributing to the VOC readings will be discontinued. Additionally, a Vapor Emissions Response Plan as outlined below will be implemented. All readings will be recorded and maintained at the site by the Engineer and will be available for NYSDEC and NYSDOH personnel to review.

Vapor Emissions Response Plan

Should the 5 ppm action level (above site background) for VOCs be exceeded at the work area perimeter, then in addition to stopping work, VOC monitoring will continue at the work area perimeter. If the VOC level decreases below the 5 ppm action level then work activities may resume but more frequent intervals of monitoring, as directed by the Engineer, may be conducted. If the VOC level remains greater than 5 ppm but less than 25 ppm (above site background) at the work area perimeter, then work activities may resume provided:

- The VOC level 200 feet downwind of the work area perimeter or half the distance to the nearest residential or commercial structure, whichever is less, is less than 5 ppm (above site background); and
- More frequent intervals of monitoring, as directed by the Engineer, are conducted.

If the VOC level is greater than 25 ppm (above site background) at the work area perimeter, additional downwind air monitoring as directed by the Engineer, will be implemented to determine whether vapor emission levels at the nearest residential or commercial structure exceed those specified in the Major Vapor Emission section below.

Major Vapor Emission

If any VOC levels greater than 5 ppm (above site background) are identified 200 feet downwind from the work area perimeter or half the distance to the nearest residential or commercial property, whichever is less, all work activities potentially contributing to the VOC level will be halted.

If, following the cessation of the work activities, organic levels persist above 5 ppm (above site background) 200 feet downwind from the work area perimeter or half the distance to the nearest residential or commercial property, then the air quality will be monitored for VOCs within 20 feet of the perimeter of the nearest residential or commercial structure (20 Feet Zone).

If efforts to abate the emission source are unsuccessful and VOC levels approaching 5 ppm (above site background) persist for more than 30 minutes in the 20 Feet Zone, then the Major Vapor Emission Response Plan below, will automatically be placed into effect. In addition, the Major Vapor Emission Response Plan below, will be immediately placed into effect if VOC levels are greater than 5 ppm (above site background) in the 20 Feet Zone.

Major Vapor Emission Response Plan

Upon activation of this plan, the following activities will be undertaken:

1. All Emergency Response Contacts as listed in the Contractor's HASP will be notified.
2. The local police authorities will immediately be contacted by the Engineer and advised of the situation.
3. Danaher will be notified of the situation and advised of actions taken.
4. Frequent air monitoring for VOCs will be conducted at 30 minute intervals within the 20 Feet Zone. If the two successive readings below action levels are measured, air monitoring may be halted or modified by the Engineer.

ATTACHMENT 1 - CALIBRATION, OPERATION AND MAINTENANCE PROCEDURES FOR MINIRAM PARTICULATE MONITOR

I. Introduction

Air monitoring with a MINIRAM particulate monitor is a procedure to measure relative concentrations of particulate. A description of the calibration, operation, and maintenance procedures is presented below.

II. Zeroing MINIRAM

- Make sure SUN SHIELD MOD.PDM-SNS is securely attached.
- Observe digital display: it should indicate OFF. If display is blank, press the OFF key once, and after 5 seconds, the display should then indicate OFF.
- Place MINIRAM inside Z-bag. Close zipper of Z-bag. Plug black fitting of hand pump/filter unit into red receptacle at corner of Z-bag.
- Through the Z-bag transparent wall press the ZERO key on the MINIRAM.
- Immediately start pumping repeatedly with the black hand pump, inflating the Z-bag. Keep pumping gently until the display of the MINIRAM indicates OFF again (76 seconds after having pressed ZERO).
- Unzip Z-bag and remove MINIRAM. It is now ready for use.

III. Operation of MINIRAM (Monitoring/Measuring)

- Press MEAS key (always starting from OFF on the display).
- Wait about 36 seconds after which MINIRAM will indicate concentration in mg/m^3, updated every 10 seconds.
- At any time during a run, pressing the TWA key, the MINIRAM will indicate the time-weighted average concentration for the run up to present time. Pressing the TWA does not influence the run operation of the MINIRAM. As soon as the TWA key is released, the display returns to the 10-second concentration indications.
- To terminate a run, press OFF key. MINIRAM will retain in memory the TWA value up to the time of OFF key was pressed. The last 7 such TWA values are always retained in memory and can be played back by pressing PBK key for more than two seconds (always starting from OFF display).

IV. Recharging Battery

- If at any time, MINIRAM display shows a small bar to the left of the BAT, the battery should be recharged for at least 12 hours. Only use charger supplied with MINIRAM.
- Allow MINIRAM battery to discharge completely before recharging: just leave it in MEAS until it shuts off automatically. Do not "top off" battery charges as that will reduce its capacity.

V. Equipment Cleaning

When the MINIRAM is not being operated it should be placed in its carrying case which should then be closed. This will minimize the amount of particle contamination of the inner surfaces of the sensing chamber.

After prolonged operation within, and exposure to particulate-laden air, the interior walls and the two glass windows of the sensing chamber may have become contaminated with particles. Although repeated updating of the zero reference will correct errors resulting from such particle accumulations, eventually this contamination could affect the accuracy of the measurements as a result of excessive spurious scattering, and significant attenuation to the radiation passing through the glass windows of the sensing chamber.

An indication of excessive chamber contamination is provided by the zero level reading, which should not exceed approximately 3 mg/m^3.

In order to clean a soiled sensing chamber, remove the chamber and wash it with soap and water, rinsing thoroughly to remove any residues from the glass windows and interior of the chamber. Do not use solvents of any type. Do not rub interior surfaces of the chamber (coated version). Allow the sensing chamber to dry completely and re-insert into the MINIRAM.

ATTACHMENT 2 - CALIBRATION, OPERATION, AND MAINTENANCE PROCEDURES FOR PHOTOIONIZATION DETECTOR

I. Introduction

Air monitoring with a photoionization detector (PID), HNU meter, is a procedure to measure relative concentrations of volatile organic compounds (VOCs) and other compounds. The HNU meter is certified by Factory Mutual for use in Class 1, Division 2, Group A, B, C, and D environments. A description of the calibration, operation and maintenance procedures are presented below.

II. PID Calibration

PID field instruments will be calibrated and operated to yield "total organic vapor" in ppm (v/v) as benzene. Operation, maintenance, and calibration shall be performed in accordance with the manufacturers instructions and documented on a PID calibration and maintenance log or the daily air monitoring logs.

1. Don personal protective equipment (as required by the Health and Safety Plan).

2. Turn the FUNCTION switch to the BATTERY CHECK position. Check that the indicator is within or beyond the green battery arc. If indicator is below the arc or the red LED is lit, the battery must be charged.

3. Turn the FUNCTION switch to the STANDBY position and rotate the ZERO POTENTIOMETER until the meter reads zero. Wait 15 to 20 seconds to confirm the adjustment. If unstable, readjust.

4. Check to see that the SPAN POTENTIOMETER is adjusted for the probe being used (e.g., 9.8 for 10.2 eV).

5. Set the FUNCTION switch to the desired ppm range (0-20, 0-200, or 0-2,000). A violet glow from the UV source should be visible at the sample inlet of the probe/sensor unit.

6. Listen for the fan operation to verify fan function.

7. Connect one end of the sampling hose to the calibration canister regulator outlet and the other end to the sampling probe of the PID. Crack the regulator valve and take a reading after 5 to 10 seconds. Adjust the span potentiometer to produce the concentration listed on the span gas cylinder. Record appropriate information on the field calibration log or the daily air monitoring log.

8. If so equipped, set the alarm at desired level.

III. Air Monitoring Procedure

1. Measure and record the background PID reading.

2. Measure and record breathing space reading.

IV. Maintenance Procedures

1. At the end of each day or after 8 hours of monitoring with the PID, recharge the batteries for 12 hours.
2. Store the instrument in protective case when not in use.
3. Keep records of operation, maintenance, calibration, problems, and repairs.
4. After use, the instrument will be inspected and the inspection recorded in the field notebook.
5. A replacement instrument will be available on-site or ready for overnight shipment, if necessary.
6. The PID will be sent back to the manufacturer for service, if needed.
7. Record calibration information on PID Calibration and Maintenance Log (Exhibit K-1.3).

V. Equipment Cleaning

After each use, the readout unit should be wiped down with a clean cloth or paper towel. The UV light source window and ionization chamber should be cleaned in the following manner once a month:

1. With the PID off, disconnect the sensor/probe from the unit.
2. Remove the exhaust screw, grasp the end cap in one hand and the probe shell in the other, and pull apart.
3. Loosen the screws on the top of the end cap, and separate the end cap and ion chamber from the lamp and lamp housing.
4. Tilt the lamp housing with one hand over the opening so that the lamp slides out into your hand.
5. Clean the lamp with lens paper and HNu cleaning compound (except 11.7 eV). For the 11.7 eV lamp, use a chlorinated organic solvent.
6. Clean the ion chamber using methanol on a Q-tip^R and then dry gently at 50°C to 60°C for 30 minutes.
7. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Place ion chamber on top of the housing, making sure the contacts are properly aligned.
8. Place the end cap on top of the ion chamber and replace the two screws, tighten the screws only enough to seal the o-ring.
9. Line up the pins on the base of the lamp housing with pins inside the probe shell and slide the housing assembly into the shell.

Construction Quality Assurance Plan (CQAP)

Chicago Pneumatic Tool Company
Frankfort, New York

April 1998

BBL
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Table of Contents

1. Introduction

1.1 Purpose

This document presents the Construction Quality Assurance/Construction Quality Control (CQA/CQC) Plan for implementing the New York State Department of Environmental Conservation- (NYSDEC-) selected remedy for addressing chemical constituents present in environmental media at the Chicago Pneumatic Tool Company Inactive Hazardous Waste Site (Site No. 622003) located in Frankfort, New York. This CQA/CQC Plan has been developed to describe the materials and procedures necessary to ensure proper construction, evaluation, and documentation during implementation of the Remedial Design (RD) Specifications for the selected remedy. The selected remedy includes excavation of soil and sediment from identified areas of concern, construction of an on-site containment cell and soil vapor extraction (SVE) treatment system, and installation of a ground-water collection system. This CQA/CQC Plan has been prepared by Blasland, Bouck & Lee, Inc. (BBL) to meet the requirements set forth in the NYSDEC's Record of Decision (ROD) issued March 29, 1996 and the RD Work Plan dated November 1997.

1.2 Definition of Terms

The following terms and abbreviations are used throughout this CQA/CQC Plan. The definition of each term or abbreviation will be consistent throughout the text of this plan.

- **ASTM** - American Society of Testing and Materials

- **Design Engineer** - The person or persons responsible for the design aspects of the project. Duties include approving any changes or modifications in the design.

- **Layer** - A compacted stratum of soil composed of several lifts placed without deviation from the design grade.

- **Lift** - A constructed segment of soil layer placed at a maximum compacted thickness of 12 inches unless otherwise specified.

- **Engineer** - The person or persons designated by Danaher Corporation (Danaher) to represent Danaher on CQA/CQC aspects of the project. Duties delegated to the Engineer shall include construction quality assurance sampling, testing, determination of limits of work, and measurement of work for payment and final acceptance.

1.3 CQA/CQC Plan Organization

This CQA/CQC Plan has been organized into the following sections:

Section	Purpose
Section 1 - Introduction	Presents general information and a definition of terms used throughout the CQA/CQC Plan.
Section 2 - Required Personnel Qualifications	Presents a description of personnel qualifications for proper implementation of CQA/CQC procedures.
Section 3 - CQA Procedures	Discusses general CQA procedures relating to implementation of the RD Specifications.

Section	Purpose
Section 4 - CQA Requirements - Liner and Final Cover System	Presents CQA procedures relating to construction of the soil layer associated with the liner and final cover system.
Section 5 - CQA Requirements - Geosynthetic Installation	Presents CQA procedures associated with installation of geosynthetic materials.
Section 6 - CQA Requirements - SVE Treatment System	Presents CQA requirements associated with construction of the SVE treatment system.
Section 7 - CQA Requirements - Ground-Water Collection Trenches	Addresses CQA procedures relating to installation of the ground-water collection trenches.
Section 8 - CQA Requirements - Electrical Equipment	Addresses the CQA procedures relating to electrical equipment to be installed in connection with the RD Specifications.

2. Required Personnel Qualifications

2.1 CQA/CQC Management Organization

Danaher will retain the services of a consulting engineering firm to serve as the Engineer. The Engineer must be licensed to practice engineering in the State of New York and will be responsible for observing, documenting, and certifying that activities associated with the implementation of the remedial activities are in general conformance with the NYSDEC-approved RD Specifications.

The Engineer will provide qualified CQA personnel to serve in the following capacities:

Project Director/Manager - The Project Director/Manager will serve as the official representative of the Engineer and will have the ultimate technical and financial responsibility for the work performed. The Project Director/Manager will be responsible for overall coordination of CQA/CQC activities.

CQA Engineer - The CQA Engineer will report to the Project Director/Manager and will be responsible for coordination of observation, sampling, testing, and documentation of construction activities on a daily basis.

CQA Observer - The CQA observer will be on site on a daily basis and will document, sample, and test under the direction of the CQA Engineer.

CQA Personnel - Includes the Project Director/Manager and/or CQA Engineer and/or CQA Observer.

CQA/CQC Laboratory - The CQA/CQC Laboratory will be an independent, accredited materials testing laboratory who will be responsible for material testing as directed by the Engineer and as required by this CQA/CQC Plan.

2.2 CQA Personnel Qualifications

In general, observation, sampling, testing, and/or documentation of construction materials and procedures shall be performed by a person or persons familiar with contemporary procedures and construction materials. The project personnel shall be under the direct supervision of a professional engineer licensed in the State of New York. Representatives of the Engineer shall be familiar with the use of the equipment and methodology needed to sample and test soil. When necessary the Engineer shall provide proof that CQA Observers have the appropriate training and/or certification for the use of testing equipment.

Specific qualifications for project personnel categories are as follows:

Project Director/Manager - The Project Director/Manager should be a professional engineer licensed in the State of New York. The Project Director/Manager must demonstrate past experience in a position of significant responsibility for remedial projects of similar magnitude and complexity in comparison with the project being undertaken. The Project Director/Manager must be knowledgeable of the project requirements and objectives, and must be familiar with the RD Specifications.

The Project Director/Manager will have the following responsibilities in the implementation of the procedures in the CQA/CQC.

- Serve as the official representative of the Engineer;
- Have ultimate responsibility for the implementation of the procedures in the CQA/CQC Plan;

- Provide that appropriate technical review by qualified representatives of the Engineer for construction plans, technical specifications, any modifications to the plans and specifications and the construction certification report;

- Review and approve all design documentation, including the construction plans and technical specifications submitted by the Contractor or manufacturer.

- Review and approve modifications made by the Contractor to the RD Specifications originally prepared by the Engineer as they occur during construction;

- Provide certification that the construction has been completed in general conformance with the RD Specifications in a construction certification report;

- Serve as the primary contact person for the Engineer and maintain contact with Danaher, Contractor and Subcontractors regarding conformance with the requirements in this plan;

- Provide overall coordination of the activities of the CQA Engineer and CQA Observers;

- Provide assistance to the CQA Engineer in the review of shop drawings and other submittals from contractors and subcontractors;

- Perform periodic site visits to review progress and CQA/CQC procedures;

- Determine conformance of the installed portion of work to permit further construction;

- Confirm that the CQA Engineer and CQA Observer are notified of any noted deficiencies in quality control testing results or procedures so that corrective actions can be taken; and

- Review the weekly construction summary reports prior to submittal to Danaher.

CQA Engineer - The CQA Engineer must demonstrate a knowledge of remedial construction activities including, containment cell construction, earthwork, fill placement, electrical and mechanical systems, and applicable test methods through a combination of formal education, training, and experience.

The CQA Engineer will have the following responsibilities in the implementation of the procedures in this CQA/CQC Plan:

- Oversee and coordinate CQA/CQC sampling and testing;

- Record any on-site activities that could result in damage to any earthwork or site improvements and report these activities to the Contractor and Project Director/Manager;

- Review daily construction reports from the CQA Observer;

- Prepare weekly project status reports;

- Serve as the daily contact person for the Engineer. Maintain routine contact with Danaher and Contractor regarding conformance with quality control requirements;

- Review all shop drawings and other submittals from the Contractor for conformance with the RD Specifications and take appropriate action after review;

- Review all field and laboratory CQA/CQC testing results for conformance with the RD Specifications. Provide an interpretation of data to determine areas which are in conformance and in non-conformance with the RD Specifications. Determine areas which require further work or repair;

- Monitor delivery of samples to the CQA/CQC Laboratory for testing;

- Coordinate activities of CQA Observers to establish proper sampling procedures;

- Perform regular site visits to review progress and CQA/CQC procedures; and

- Notify Contractor and CQA Observers of acceptance of installed portions of work.

<u>CQA Observer</u> - The CQA Observer must have a demonstrated knowledge of earthwork, construction documentation, and applicable material testing methods through a combination of formal education, training, and experience.

The CQA Observer will have the following responsibilities in the implementation of the procedures in the CQA/CQC Plan.

- Perform and document field and laboratory testing at the frequency established in this CQA/CQC Plan;

- Delineate areas of non-conformance based upon results of field and laboratory testing;

- Perform and document field sampling for CQA/CQC testing;

- Visually observe construction materials such as soil and piping delivered to the site to determine general conformance with material specifications;

- Observe and record procedures used for site preparation;

- Observe and record procedures used for excavation and filling of subgrade to required elevations;

- Observe and record procedures for placement of soil fill and select soil materials and geosynthetic materials associated with the containment cell subgrade, liner system and final cover system, including:

  - Compacted lift thickness;
  - Method of moisture control;
  - Compacted lift density;
  - Proof-rolling;
  - Fine grading; and
  - Seam integrity.

- Assure delivery of samples to the CQA/CQC Laboratory;
- Record any on-site activities that could result in damage to any earthwork or site improvements, such as compacted subgrade or low permeability soils, and report these activities to the Contractor and the CQA Engineer immediately as they are noted; and
- Prepare daily construction reports.

3. CQA Procedures

3.1 General

The performance of the remedial activities will be monitored throughout the duration of the project. Project monitoring will be performed based on a combination of the review for compliance with RD Specifications, submittal review, periodic project meetings, and on-site observation. A discussion of the general CQA procedures is presented below.

3.2 Surveyor Qualifications

All surveys for the establishment of benchmarks and baselines necessary for construction, testing, and sampling, and for the collection of as-built information shall be carried out by persons practiced in land survey techniques and under the direction of a professional land surveyor licensed in the State of New York.

3.3 Contractor Qualifications

The Contractor shall be trained and experienced in the construction of the various components associated with the remedial activities including earthwork, geosynthetics, piping, pumping systems, aboveground storage tanks, and building structures. The Contractor shall provide evidence of prior work on satisfactorily completed projects of similar magnitude and complexity to the project in question. The Contractor shall also demonstrate that the field crew foreman has experience with similar type construction projects and is familiar with the placement and preparation of soil layers, piping, geosynthetics, and other materials as required to implement the remedial activities described in the RD Specifications.

The Contractor shall provide Danaher, for approval, a resume of experience which includes the following information on each facility previously completed:

1. Name and purpose of facility, its locations and date of installation;
2. Name and Owner, Project Engineer, Designer, Manufacturer, and Fabricator (as applicable);
3. Name and qualifications of Field Crew Foreman;
4. Project specifics (materials used, size of project, etc.);
5. Type of equipment used; and
6. Duration of project.

3.4 Pre-Construction Meeting

Prior to the start of construction activities, a preconstruction meeting shall be held among representatives of Danaher, the Engineer (including CQA personnel) and the Contractor. The topics covered at this meeting shall include, but may not be limited to the following:

- Discussing procedures and timing for providing each organization with all relevant CQA documents and supporting information;

- Familiarizing each organization with the site-specific CQA/CQC Plan and this Plan's role relative to the design criteria, plans, and specific information;

- Reviewing the responsibilities of each organization;

- Reviewing lines of authority and communication for each organization;
- Discussing the established procedures or protocols for construction, change orders, deficiencies, repairs, and retesting;
- Reviewing methods of documenting and reporting inspection data;
- Reviewing methods for distributing and storing documents and reports;
- Reviewing work area security and safety protocol;
- Discussing procedures for the location and protection of construction materials, and for the prevention of damage of materials from inclement weather or other adverse conditions;
- Conducting a site walk-around to review site conditions as well as staging and storage locations; and
- Discussing the Contractor's proposed Site Management Plan, schedule and procedures.

The meeting will be documented by the Engineer, and minutes transmitted to all parties.

The design specifications as presented in the RD Specifications play an important role in defining the work elements associated with this project. The primary function of the RD Specifications will be to:

1. Identify the scope of work necessary to achieve the design objectives;
2. Provide a basis by which a contractor can develop a construction cost quotation; and
3. Indicate the specific materials, equipment, and standards to be utilized in performing the construction.

The RD Specifications will also play an important role in the implementation and monitoring of desired CQA measures by establishing CQA elements for activities occurring before, during, and after construction. The RD Specifications may, depending on the given component of construction, specify any or all of the following:

1. Manufacturer and model number for specific equipment;
2. Performance standards or operating conditions to assist the Contractor in the selection and purchase of equipment;
3. Required construction materials;
4. Required conformity with codes, standards, and specifications to govern material and workmanship quality;
5. Information to be submitted for technical review (also referred to as shop drawing submittals);
6. Coordination activities with other elements of construction;
7. Manufacturer or field testing requirements;

8. Performance guarantees;

9. Workmanship/equipment warranties; and

10. As-built drawings, as required.

The requirements of the RD Specifications will provide the framework for CQA measures. CQA activities will gauge compliance with the requirements of the RD Specifications. Such activities will involve the review of technical submittals; material/equipment testing; on-site observation, testing and sampling; and start-up.

3.5 CQA Submittals

For several elements of construction, the RD Specifications require that the Contractor prepare technical data (e.g., proposed electrical equipment layout, material test results, etc.) and submit this information for review. This requirement allows for monitoring of the Contractor's understanding of the design and prevention of any misinterpretation of the RD Specifications that may otherwise impact the design objectives or construction schedule. The submittal of technical data, also referred to as shop drawing submittals, encompasses many elements of the construction activity. Typical submittals that will be required as part of the RD Specifications may include the following:

- Performance data;
- A material list with Manufacturer data showing compliance with the RD Specifications;
- Material samples;
- Engineering drawings of the components showing sizes, widths, weights, connections, etc.;
- Installation drawings;
- Operating descriptions;
- Layout drawings; and
- Detail drawings.

Any modifications from the requirements of the RD Specifications must be shown and highlighted on the submittals.

The submittal review process will be an essential activity for monitoring CQA before construction is initiated. The Engineer will prepare a comprehensive list of all required submittals and a schedule for submittal/approval. The Contractor's submittal of a shop drawing will constitute their representation that they have determined and verified all quantities, dimensions, field construction criteria, materials, model numbers, and similar data. In addition, the Contractor's submittal will demonstrate that they have reviewed or coordinated each shop drawing submittal with the requirements of the RD Specifications (including CQA requirements). The Engineer's review of shop drawings will be to determine general compliance with the RD Specifications. Submitted data will be reviewed and stamped by the Project Director/Manager as follows:

1. "Reviewed" if no objections are observed or comments made;

2. "Reviewed and Noted" if minor objections, comments, or additions are made but resubmittal is not considered necessary provided the Contractor addresses the noted items;

3. "Resubmit" if the objections, comments, or additions are extensive. In this case, the Contractor would resubmit the items after revision; and

4. "Rejected" if the submittal under consideration is not, even with reasonable revision, acceptable or when the data submitted are not sufficiently complete to establish compliance with the RD Specifications.

3.6 Inspections

Site inspections will be conducted by the CQA personnel prior to, during, and at the completion of the remedial activities. Representative photographs of significant project features and progress will be taken during each site inspection. A brief description of each type of site inspection is provided below.

3.6.1 Pre-Construction Inspection

An initial site inspection, as scheduled by the Contractor, will be conducted prior to commencing construction activities. This inspection will be performed to:

- Familiarize the involved parties with the current site conditions;
- Identify and locate the proposed staging, handling and storage areas, utilities, and site structures;
- Identify work areas and approximate limits of work; and
- Identify any previously unknown site conditions which may inhibit the proposed work.

The initial site inspection is meant to acquaint the involved parties with the site conditions prior to mobilization.

3.6.2 Progress Inspections

Formal site inspections will be performed by CQA Personnel daily throughout the implementation of the remedial activities. These site inspections will be performed to:

- Review in-progress construction activities for compliance with project specifications and CQA requirements;
- Document construction progress (including photographic documentation); and
- Identify and document any deviations from the RD Specifications.

Any noted variances will be brought to the attention of the Project Manager/Director. Corrective and preventive measures will be implemented as soon as practical. If necessary, work activity will be stopped until corrective measures are implemented.

3.6.3 Substantial Completion Inspection

At the completion of the remedial activities, a final inspection will be conducted by CQA personnel. The final inspection will be performed to:

- Document that the work specified in the RD Specifications has been completed in accordance with the project specifications (including photographic documentation); and/or

- Prepare a "punch list" of items which must be addressed (if any) to complete the specified work, and include the punch list in the Substantial Completion Inspection Report. The Substantial Completion Inspection Report will be reviewed with the Project Director/Manager and a schedule agreed to for completion of all punch list items.

3.6.4 Final Inspection

Ensure that all punch list items have been completed in conformance with the RD Specifications.

3.7 Data Management

The management of all data generated throughout the remediation activities will be the responsibility of the Project Manager/Director. These data may include, but not be limited to the following:

- Data sheets;
- Photographic logs;
- Field sampling and testing results;
- Laboratory analytical results;
- Health and safety monitoring results;
- Equipment calibration and testing results;
- Weekly progress reports; and
- Documentation identifying corrective measures taken to resolve variances from the RD Specifications.

One copy of all project-related data will be maintained at the site by the Project Manager/Director and one additional copy will be maintained at an off-site location. Pertinent data will be compiled by the Project Manager/Director and presented in the Monthly Construction Summary Report and the final Certification Report.

3.8 Corrective Measures

Corrective measures will be required when remediation activities do not meet the requirements specified in this CQAP. Corrective measures include procedures to evaluate and correct construction activities that are not in compliance with the RD Specifications.

During implementation of the remedial activities, measures will be initiated to correct and avoid future conditions having an adverse impact on constructed and/or operational quality. Any remediation quality issues which arise and require corrective measures will be documented in the daily logs (described below) by the Project Manager/Director.

Examples of situations which would require corrective measures are provided below:

- Objectives have not been met;

- Other design requirements have not been met;
- Equipment is not in proper working order or is not properly calibrated; and
- Sampling/monitoring objectives have not been met.

The Project Manager/Director will be notified as soon as possible of situations which require corrective measures and will be instrumental in developing and implementing appropriate corrective/preventive measures.

3.9 Documentation

The CQA Observer will be responsible for maintaining a daily log documenting all work performed and completed by the Contractor. The log may include, but may not be limited to, the following:

- The date, project name, location and other pertinent site information;
- A summary of the work activities;
- A summary of relevant communications (written and oral);
- A record of the workers, material and equipment deployed each day;
- Materials brought to the site;
- A summary of samples collected;
- A summary of test results, failures and retests;
- A record of visitors to the site; and
- A record of any unusual events/activities.

At the completion of the remedial activities, the Engineer will prepare a Construction Certification Report to certify that the work has been performed in general accordance with the design drawings and specifications presented in the RD Specifications. The report will provide a summary of the work performed during the remedial activities and will be submitted to the NYSDEC for review. The report will include the following information:

- Summary of construction activities;
- Observation and testing data, including sample collection locations and results;
- Summary of construction problems and solutions;
- Summary of changes from design and material and performance specifications;
- Certification statement sealed and signed by a professional engineer registered in the State of New York; and
- Sealed and signed as-built drawings.

4. CQA Requirements - Liner and Final Cover System

4.1 General

The liner system for the containment cell will consist of (from bottom to top) a 12-inch thick soil subbase layer, a 60 mil high density polyethylene (HDPE) geomembrane, a non-woven geotextile layer, a 12-inch thick granular drainage layer (base liner system) or geosynthetic drainage composite (side slope liner system), a non-woven geotextile layer, and a 12-inch thick protective layer consisting of special waste. The containment cell final cover system will consist of (from bottom to top) a 12-inch thick select waste soil layer, a a geosynthetic clay liner (GCL), a 60 mil HDPE geomembrane, a 12-inch thick granular drainage layer, a non-woven geotextile layer, a 12-inch thick protective soil layer, and a 6-inch thick vegetated topsoil layer. The soil layers comprising the containment cell liner and final cover systems will be constructed and tested in accordance with the procedures discussed in this section of the CQA/CQC Plan. The requirements for installation and testing of the geosynthetic components of the containment cell liner and final cover systems are discussed in Section 5.0 of this plan.

4.2 Required Materials

The liner system for the containment cell is composed of two types: the base liner system and the side slope liner system. Each liner system will be constructed above a uniformly graded and compacted 12-inch thick soil subbase layer which shall be free of deleterious material and protruding objects. The subbase layer will be constructed above a prepared subgrade, or in the case of the side slope liner, the perimeter berm.

The base liner system consists of a textured, 60 mil HDPE geomembrane placed above the subbase layer having a minimum constructed slope of 2 percent (valley slope is a minimum of 0.5 percent). A 12-inch thick granular drainage layer overlain by a non-woven geotextile will be constructed above the geomembrane. The drainage layer within the base liner system will include the installation of a single perforated, 6-inch diameter HDPE leachate collection pipe. The leachate collection pipe will be placed within the valley of the base liner and will serve to collect and convey leachate via gravity, to a low point located at the southwest end of the containment cell. To provide protection to the geomembrane and leachate collection system, a 12-inch thick protective soil layer (consisting of special waste) will be placed above the granular drainage layer. As mentioned above, a non-woven geotextile will be installed above the granular drainage layer to minimize the potential for material mixing between the two layers.

The side slope liner system consists of a textured 60 mil HDPE geomembrane placed above the subbase layer having a maximum slope of 40 percent. A geosynthetic drainage composite, constructed above the geomembrane, will serve to collect and convey leachate to the granular drainage layer within the base liner system. As with the base liner system, a 12-inch thick protective soil layer will be placed above the geosynthetic drainage composite to provide protection to both the geomembrane and geosynthetic drainage composite.

The final cover system for the containment cell will consist of a textured 60 mil HDPE geomembrane installed above a GCL. To provide protection against penetration of the GCL and geomembrane from below, a 12-inch thick select waste soil layer will be constructed as part of the final cover system. A 12-inch thick granular drainage layer will placed above the geomembrane and will serve to intercept and convey rainfall infiltration within the cover system to a perimeter drainage pipe. A 12-inch thick protective soil layer material will be installed above the drainage layer. To provide for separation, a non-woven geotextile will be placed between the protective soil layer and the underlying drainage layer. A 6-inch thick topsoil layer will be constructed on top of the protective soil layer to support vegetative growth.

4.2.1 Subbase Layer Material

The subbase layer material will be soil fill material underlying the 60 mil HDPE geomembrane. The subbase material will be placed in lifts not to exceed 8-inches (pre-construction), and will be compacted. Subbase materials shall conform to the properties shown in Section MP-02222 of the M&P Specifications.

4.2.2 Drainage Layer Material

In the liner system, the drainage layer material will be a granular material with a permeability of 1 x 10^{-2} cm/sec. This layer will be placed on top of the 60 mil HDPE geomembrane, so this layer must be free of all protrusions and sharp objects. The layer will be placed in a 12-inch thick lift with a 6-inch diameter HDPE leachate collection pipe at the bottom.

The final cover system drainage layer will also be constructed of a granular material and will have a permeability of 1 x 10^{-1} cm/sec. The final cover system drainage layer will be constructed in the same manner as the liner system drainage layer, excluding the leachate collection pipe.

4.2.3 Protection Layer Material

No objects larger than 6 inches in their greatest dimension will be placed as part of the barrier protection layer in the liner system. The protection layer shall consist of special waste material that is free of any deleterious objects or substances that could potentially cause harm to any other part of the liner system. The general waste materials will then be placed on top of the protective soil layer.

In the final cover system, the barrier protection layer will be placed in the same manner and using the same materials as in the liner system barrier protection layer.

4.2.4 Topsoil Layer Material

The topsoil layer material shall be free from refuse, any material toxic to plant growth, woody vegetation, stumps, roots, clods of clay, stones, or any other object larger than two inches in greatest dimension. Sod and herbaceous growth such as grass and weeds do not have to be removed but should be mixed thoroughly into the soil during handling operations. The topsoil will have a pH ranging between 5.0 and 7.5 and an organic content of between 5 and 20 percent, as determined through laboratory testing of representative samples. Seeding to establish vegetation will occur as significant areas of the cover are completed to ensure the integrity of the cover system and to prevent erosion of the topsoil layer.

4.3 Required Installation Procedures

Specific procedures will be followed during the installation of the components of the liner and cover systems for the containment cell and are discussed in the following section.

The Contractor should note that prior to the installation of the liner system, the subgrade material will need to be very finely graded, and all sticks, rocks and other protrusions must be removed, to protect the HDPE liner.

4.3.1 Drainage Layer Installation Procedures

The drainage layer of the containment cell will be placed on top of the 60 mil HDPE geomembrane (installation of geosynthetics is discussed in Section 5). On the floor of the cell, a 12-inch thick layer will be placed over the top of a 6-inch diameter HDPE leachate collection pipe. The pipe will be placed in the lower most section of the floor of the landfill (at the base of the two percent floor slopes) and will be covered with the granular drainage material, to a final depth of 12 inches. The same procedures will be followed during installation of the drainage layer in the final cover system, except there will be no leachate collection pipe.

The interior sidewalls of the containment cell will require a different type of drainage material. Rather than a granular material in a 12-inch thick layer, a geosynthetic drainage composite will be used. The use of a geosynthetic drainage composite will decrease the overall depth of the drainage layer on the interior side slopes, thus increasing the available air space volume.

4.3.2 Protection Layer Installation Procedures

The protection layer will be placed over the drainage layer in both the liner and the final cover systems. In the liner system the protective layer will consist of special waste. Protection soil will be placed in 12-inch thick layers. Although specific compaction requirements for the protection layer are not necessary, adequate compaction is expected and it may be advantageous to compact with a smooth drum roller at the end of each construction day to minimize erosion. Construction traffic on the drainage layer during placement of the protection layer should be minimized as to decrease disturbance of the drainage layer and underlying 60 mil HDPE geomembrane.

4.3.3 Topsoil Installation Procedures

The topsoil layer will be placed above the protection layer of the final cover system only. The topsoil layer will be placed in a single 6-inch thick (minimum) lift. The topsoil being placed on the areas of steeper slope should be stabilized as necessary to prevent erosion and soil slippage. Because the purpose of the topsoil layer is to promote vegetative growth over the cap of the cell, construction traffic and any other type of traffic causing compaction of the topsoil layer shall be kept to a minimum, to ensure proper aeration. If excessive compaction of the topsoil layer is unavoidable, or occurs in a given area, then that area shall be diced and/or roto-tilled to reduce the in-place density of the layer. This process will continue until all areas of the topsoil are acceptable to CQA Personnel.

4.4 Pre-Construction Analysis

A pre-construction analysis of all materials and sources being proposed for use to construct the containment cell will undergo extensive testing for suitability for construction. Before any source is analyzed, the Contractor must demonstrate that they can provide sufficient quantities of that same material for completion of construction.

4.4.1 Granular Drainage Material

The liner system granular drainage layer will consist of Type 3 select fill with a permeability of 1×10^{-2} cm/sec. For the final cover system the material will be Type 2 select fill with a permeability of 1×10^{-1} cm/sec. The granular drainage layers will be placed in maximum, 12-inch thick (pre-construction) lifts. Material for the granular drainage layers will be in conformance with Section MP-02221 of the M&P Specifications.

4.4.2 Protection Layer Material

The pre-construction analysis of the proposed protection layer materials will consist of the performance of particle size analysis testing (ASTM D-422). The purpose of this testing will be to determine if the gradation characteristics of the soil are suitable for use through comparison with the requirements established previously. CQA Personnel will tour the proposed protection layer material source and select representative 50-pound samples for particle size analysis.

4.4.3 Topsoil Layer Material

The pre-construction analysis of the proposed topsoil source will consist of pH and percent organic determination performed on representative samples. Samples will be selected by CQA Personnel during a tour of the proposed source or stockpiles. The purpose of this testing will be to determine if the proposed material meets the requirements previously established.

4.5 Repair of Damaged or Unsuitable Areas

Areas of the liner and/or cover system not conforming to the required specifications will be repaired under direction of CQA Personnel. Repair procedures to be utilized on soil components of the liner and cap system are outlined in the following sections. Repair of the 60 mil HDPE geomembranes are outlined in Section 5.

4.5.1 Repair of Substandard Areas

Visual evaluation and/or CQA/CQC testing may identify areas which do not meet the criteria established in this document. These substandard areas will be identified by CQA Personnel during construction, and the Contractor will be notified of the required procedures for the repairs.

4.5.1.1 Repair of Dry Areas

If in-place moisture testing indicates an area of a lift has a moisture content below the range established for the required in-place permeability, the Contractor will be required to:

- Condition the dry area so that there is no soil particle or clod greater than two inches in greatest dimension, add moisture, and thoroughly mix the soil so that no clods of dry soil are found to exist upon visual inspection; or

- Excavate the dry area and replace with fresh material of a suitable moisture content.

CQA Personnel will be responsible for delineating the area requiring corrective action. If testing of the repaired area indicates that the area is still too dry, the process will be repeated until the moisture content of the soil is within the range established for the required permeability.

4.5.1.2 Repair of Wet Areas

If in-place moisture testing indicates an area of a lift has a moisture content exceeding that of the pre-established range for the required permeability, or if construction equipment is noted to slip during placement or compaction operations, the Contractor will be required to:

- Condition the wet area to aerate the soil to facilitate drying and then re-compact when the moisture content falls within the pre-established range; or

- Excavate the wet area and replace the wet soil with fresh soil with a suitable moisture content.

CQA Personnel will be responsible for delineating the area requiring corrective action. If testing of the repaired area indicates that the area is still too wet, the process will be repeated until the moisture content of the soil is within the pre-established range for the required permeability.

4.5.1.3 Low Density Areas

If in-place density testing indicates that the moisture content of an area is suitable, but the in-place density is below the minimum density requirements for the required permeability, the area will be re-compacted until testing indicates a sufficient in-place density is achieved. CQA Personnel will be responsible for delineating any area requiring additional compactive efforts.

4.5.1.4 Replacement of Unsuitable Materials

If laboratory and/or field CQA/CQC testing indicates an area where there is substantial change in material from that analyzed during pre-construction analysis that could detrimentally affect the physical characteristics of the cover or liner systems, the material will be removed and replaced with suitable material of known characteristics. At the Contractor's option and expense, a full range of CQA/CQC testing can be performed on the anomaly area to determine if the material is suitable for use. However, the anomaly area, as delineated by CQA Personnel, will not be approved until the entire range of CQA/CQC testing has been performed.

5. CQA Requirements - Geosynthetics Installation

5.1 General

The containment cell will include two layers of HDPE geomembrane, one in the liner system and one in the final cover system, and one layer of geosynthetic drainage composite which is included in the side slope liner system. The geosynthetic layers of this containment cell will be constructed and tested in accordance with the procedures discussed in the following sections.

Geosynthetic materials to be installed during the construction of the liner and final cover system will include textured HDPE geomembrane, geosynthetic drainage composite and geotextile. All geosynthetic materials required will be provided and installed by the Manufacturer or otherwise approved Contractor. The CQA/CQC procedures to be used during the installation of geosynthetic materials are included here.

The work addressed under this section shall facilitate proper construction of all geosynthetic components of the liner and final cover systems. All work shall be constructed to the lines, grades and dimensions indicated on the project plans, in accordance with RD Specifications, or as required by Danaher or the Engineer.

CQA Personnel shall issue a written daily report of activities. These reports shall include, at a minimum, construction related observations and test results as well as problems encountered and solutions achieved. Construction reports summarizing significant events, as well as addressing all problems encountered and their solutions, shall be issued weekly to the Project Director. The format of these reports shall be established at the pre-construction meeting.

5.2 Geomembrane Materials

5.2.1 Geomembrane Manufacturing and Delivery

HDPE geomembrane will be installed during liner and final cover construction.

5.2.1.1 Raw Materials

Raw materials shall be as specified in M&P Specification MP-02234.

5.2.1.2 Geomembrane Manufacturing

Manufacturing shall be as specified in M&P Specification MP-02234.

5.2.1.3 Rolls

Roll quality shall be as specified in M&P Specification MP-02234.

5.2.1.4 Conformance Testing

Geomembrane testing shall be as specified in M&P Specification MP-02234.

5.2.1.5 Delivery

Transportation and Handling

Transportation of the geomembrane is the responsibility of the Geomembrane Manufacturer, or other party acceptable to CQA Personnel. Shipping manifests and other documents will be as agreed upon at the pre-construction meeting. All on-site handling of geomembrane materials is the responsibility of the Contractor.

CQA Personnel shall verify the following:

- Handling equipment used on the site is adequate and does not pose any risk of damage to the geomembrane; and
- The Contractor's personnel handle the geomembrane with care.

Upon delivery at the site, the Contractor and CQA Personnel shall observe each roll for defects and for damage. This inspection shall be conducted without moving the rolls unless defects or damage is found or suspected. CQA Personnel shall indicate to the Contractor:

- Rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and
- Rolls which include minor repairable flaws.

Storage

The Contractor shall be responsible for the storage of the geomembrane on-site. The Contractor shall identify storage space in a location (or several locations) such that on-site transportation and handling are minimized if possible. Storage space should be protected from theft, vandalism, passage of vehicles, etc.

CQA Personnel shall verify that storage of the geomembrane ensures adequate protection against UV exposure, dirt, and other sources of damage.

5.2.2 Geomembrane Installation

5.2.2.1 Subgrade Preparation

The Contractor shall be responsible for preparing the soil according to the RD Specifications.

CQA Personnel shall verify that:

- A qualified land surveyor has established and/or verified all lines and grades;
- The surface to be lined has been rolled and compacted, and is free of irregularities, protruding objects, sticks, roots, loose soil, and abrupt changes in grade;
- The surface of the supporting soil does not contain rocks which may damage the geomembrane; and
- There is no standing water or area excessively softened by high water content.

The Contractor shall certify in writing that the surface on which the geomembrane will be installed is acceptable. The certificate of acceptance shall be given by the Contractor to CQA Personnel prior to commencement of geomembrane installation.

After the supporting soil has been accepted by the Contractor, the Contractor shall be responsible for indicating any change in the supporting soil condition that may require repair work. If CQA Personnel concur with the Contractor, then the Contractor shall ensure that the supporting soil is repaired.

At any time before and during the geomembrane installation, CQA Personnel shall indicate locations which may not provide adequate support to the geomembrane. The Contractor shall make all necessary repairs to the substandard areas. Following completed repairs, the Contractor shall ensure that the affected area is repaired.

Special care shall be taken to avoid desiccation cracking and other damage to the compacted supporting soil. To that end:

- CQA Personnel shall specify maximum allowable crack depth and width and should describe the procedure for repairing cracks;
- The Contractor shall prepare a list of precautions to be taken against cracking and shall provide copies to CQA Personnel; and
- Immediately prior to the installation of the geomembrane liner, the compacted supporting soil shall be observed by the Contractor and CQA Personnel.

5.2.2.2 Geomembrane Placement

Field Panel Identification and Placement

A field panel is a unit area of geomembrane which is to be deployed and seamed in the field (ie., a field panel is a roll or a portion of a roll cut in the field). The Contractor shall be responsible for ensuring that each field panel is given an "identification code" (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by CQA Personnel and the Contractor. The field panel identification code shall be as simple and logical as possible. The Contractor shall establish a table or chart showing correspondence between roll numbers and field panel identification codes. The field panel identification code shall be used for all quality assurance records.

CQA Personnel shall verify that field panels are installed at the location indicated in the Contractor's layout plan, as approved or modified. CQA Personnel shall evaluate every change in the schedule proposed by the Contractor and advise the Contractor on the acceptability of that change. CQA Personnel shall observe and document that the condition of the supporting soil has not changed detrimentally during installation. The Contractor shall record the identification code, location and date of installation of each field panel.

Geomembrane placement shall not proceed at an ambient air temperature below the minimum temperature specified by the geomembrane manufacturer unless a means to raise the air temperature above the specified minimum temperature is developed by the Contractor and approved by CQA Personnel. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of hazard causing winds.

CQA Personnel shall verify that the above conditions are achieved. CQA Personnel shall also verify the following:

- Any equipment used does not damage the geomembrane as a result of, but not limited to, handling, trafficking, excessive heat, leakage of hydrocarbons or other means;
- The prepared surface underlying the geomembrane has not deteriorated since previous acceptance, and is still acceptable immediately prior to geomembrane placement;
- Any geosynthetic elements immediately underlying the geomembrane are clean and free of debris;
- All personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane;
- The method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil;
- The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);
- Adequate slack in the geomembrane is provided during installation to allow for thermal contraction and nowhere is the geomembrane taut or bridging voids, changes in grades, or depressions;
- Adequate temporary loading and/or anchoring (e.g., sandbags, tires) not likely to damage the geomembrane, have been placed to prevent uplift by wind; and
- Direct contact with the geomembrane is minimized, (i.e., the geomembrane is protected by geotextile, extra geomembrane, or other suitable materials, in areas where necessary traffic may be expected).

Damage

CQA Personnel shall observe each panel after placement and prior to seaming, for damage. CQA Personnel shall advise the Contractor which panels, or portions of panels, are rejected, accepted, or require repair. Damaged panels or portions of damaged panels which have been rejected will be marked and documented by the Contractor and CQA Personnel.

5.2.2.3 Field Seaming

Seam Layout

The Contractor shall provide CQA Personnel with a seam layout drawing. CQA Personnel shall review the seam layout drawing and verify that it is consistent with accepted state of practice. No panels may be seamed in the field without CQA Personnel approval. No panels not specifically shown on the seam layout drawing may be used without prior approval by CQA Personnel.

In general, seams should be oriented parallel to the line of maximum slope (i.e., oriented along, not across the slope). In corners and odd-shaped geometric locations, the number of seams should be minimized. Horizontal seams should be located at least five feet from the toe of slope, or firm areas of potential stress concentrations, unless otherwise authorized by CQA Personnel.

A seam numbering system compatible with the panel numbering system shall be agreed upon at the pre-construction meeting.

Extrusion Process

The extrusion-welding apparatus shall be equipped with gauges giving the temperature in the apparatus and at the nozzle.

The Contractor shall provide documentation regarding the extrude to CQA Personnel and shall certify that the extrude is compatible with the specifications and is comprised of the same resin as the geomembrane sheeting.

CQA Personnel shall log apparatus temperatures, extrude temperatures, ambient temperatures, and geomembrane surface temperatures at appropriate intervals.

CQA Personnel shall verify that:

- The Contractor maintains on-site, the number of spare operable seaming apparatus decided at the pre-construction meeting;
- The extruder is purged prior to beginning a seam until all heat-degraded extrude has been removed from the barrel;
- The electric generator used to supply power to the extrusion welding apparatus is placed on a smooth base such that no damage occurs to the geomembrane;
- Grinding is performed perpendicular to the seam in as far as possible and is completed no more than two hours prior to seaming;
- Excessive gouge depth does not result from the grinding;
- A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage; and
- The geomembrane is protected from damage in heavily trafficked areas.

Fusion Process

The fusion-welding apparatus must be an automated vehicular-mounted device. The fusion welding apparatus shall be equipped with gauges giving the applicable temperature and pressures. CQA Personnel shall log ambient, seaming apparatus, and geomembrane surface temperatures as well as seaming apparatus pressures.

CQA Personnel shall also verify that:

- The Contractor maintains on-site the number of spare seaming apparatus decided at the pre-construction meeting;
- The electric generator is placed on a smooth base such that no damage occurs to the geomembrane;
- For cross seams, the edge of the cross seam is ground to a smooth incline (top and bottom) prior to welding;

- A smooth insulating plate or fabric is placed beneath the top welding apparatus after usage;
- The geomembrane is protected from damage in heavily trafficked areas; and
- A movable protective layer is used as necessary directly below each overlap of geomembrane that is to be seamed to prevent buildup of moisture between the sheets.

Seam Preparation

CQA Personnel shall verify that:

- Prior to seaming, the seam area is clean and free of moisture, dust, debris of any kind, and foreign material;
- If seam overlap grinding is required, the process is completed according to the Geomembrane Manufacturer's instructions within one hour of the seaming operation, and in a way that does not damage the geomembrane; and
- Seams are aligned with the fewest possible number of wrinkles or "fishmouths".

Weather Conditions for Seaming

Unless authorized in writing by CQA Personnel, no seaming shall be attempted at an ambient air temperature below the minimum temperature specified by the geomembrane manufacturer. CQA Personnel shall verify that these weather conditions are fulfilled and will advise the Contractor if they are not. CQA Personnel shall then decide if the installation shall be stopped or postponed.

Overlapping and Temporary Bonding

CQA Personnel shall verify that:

- The panels of geomembrane have a minimum finished overlap of three inches for extrusion welding, and five inches for fusion welding, but in any event, sufficient overlap shall be provided to allow peel tests to be performed on the seam; and
- The procedure used to temporarily bond adjacent panels together does not damage the geomembrane.

Trial Seams

Trial seems shall be made on fragments of geomembrane liner to verify that the seaming conditions are adequate. Such trial seams shall be made at the beginning of each seaming period for each seaming apparatus used that day. Also, each seamer shall make at least one trial seam every four hours. Trial seams shall be made under the same conditions as actual seams. The trial seam sample shall be at least three feet long by one foot wide (after seaming) with the seam centered lengthwise. Seams will have an overlap beyond the weld large enough to perform destructive peel tests, but not exceed five inches. CQA Personnel shall observe all trial seam procedures. At the discretion of CQA Personnel, samples of trial seams may be cut for field and/or laboratory testing.

General Seaming Procedures

Unless otherwise specified, the general seaming procedure used by the Contractor shall be as follows:

- For fusion welding, a moveable protective layer of plastic may be required to be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture buildup between the sheets to be welded;

- If required, a firm substrate shall be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support;

- Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkles in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of six inches beyond the cut in all directions;

- If seaming operations are carried out at night, adequate illumination shall be provided; and

- Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

CQA Personnel shall verify that the above seaming procedures are followed, and shall inform the Contractor if they are not.

5.2.2.4 Seam Continuity Testing

Non-Destructive Testing

The Contractor shall non-destructively test all field seams over their entire length using a vacuum test unit, air pressure test (for double fusion seams only), or other method acceptable to CQA Personnel. The purpose of non-destructive tests is to check the continuity of seams. Non-destructive tests do not provide any information on seam strength. Continuity seam testing shall be carried out as the seaming work progresses, not at the completion of all field seaming.

CQA Personnel shall:

- Observe all continuity testing;

- Record location, date, test unit number, name of tester, and outcome of all testing; and

- Inform the Contractor of any required repairs.

The Contractor shall complete any required repairs.

The following procedures shall apply to locations where seams cannot be nondestructively tested in their final configuration:

- If the seam is accessible to testing equipment prior to final installation, the seam shall be nondestructively tested prior to final installation; and

- If the seam cannot be tested prior to final installation, the seam shall be cap-stripped and all operations shall be observed by CQA Personnel for uniformity and completeness. Alternatively, CQA Personnel may direct the Contractor to perform a leak survey of the final installation (e.g., sumps, etc.)

The seam number, date of observations, name of tester, and outcome of the test shall be recorded by CQA Personnel.

Vacuum Testing

The equipment shall be comprised of the following:

- An approved vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole for valve assembly, and a vacuum gauge;
- A steel vacuum tank pump assembly equipped with a pressure controller and pipe connections;
- A rubber pressure/vacuum hose with fittings and connections;
- A bucket and wide paint brush; and
- A soap solution.

The following procedures shall be followed by CQA Personnel.

- Energize the vacuum pump and reduce the tank pressure to approximately 5 psi. (10 in. of Hg.) (35 kpa) gauge;
- Wet a strip of geomembrane approximately 12 in. by 48 in. with the soapy solution;
- Place the box over the wetted area;
- Close the bleed valve and open the vacuum valve;
- Ensure that a leak tight seal is created;
- For a period of not less than 15 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles;
- If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum overlap of 3 inches, repeat the process; and
- All areas where soap bubbles appear shall be marked and repaired in accordance with the technical specifications.

Air Pressure Testing

The following procedures are applicable to those processes which produce a double seam with an enclosed space.

The equipment shall be comprised of the following:

- An air pump (manual or motor driven) equipped with a pressure gauge capable of generating and sustaining a pressure between 25 and 30 psi (160 and 200 kPa) and mounted on a cushion to protect the geomembrane;

- A rubber hose with fittings and connections; and
- A sharp hollow needle, or other approved pressure feed device.

The following procedures shall be followed:

- Seal both ends of the seam to be tested;
- Insert needle or other approved pressure feed device into the tunnel created by the fusion weld;
- Insert a protective cushion between the air pump and the geomembrane;
- Energize the air pump to a pressure between 25 and 30 psi (160 and 200 kPa), close valve, and sustain pressure for approximately 5 minutes;
- If loss of pressure exceeds 3 psi or does not stabilize, locate the faulty area and repair in accordance with the technical specifications; and
- Remove needle or other approved pressure feed device and seal.

Destructive Testing

Destructive seam tests shall be performed at selected locations. The purpose of these tests is to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

Location and Frequency

CQA Personnel shall select locations where seam samples will be cut out for laboratory testing. These locations shall be established as follows:

- A minimum frequency of one test location per 500 linear feet of seam length;
- A maximum frequency is unspecified but shall be at the discretion of CQA Personnel; and
- Test locations shall be determined during seaming at the discretion of CQA Personnel. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of imperfect welding.

The Contractor shall not be informed in advance of the locations where the seam samples will be taken.

Sampling Procedures

Samples shall be cut by the Contractor as the seaming progresses in order to have laboratory test results before the geomembrane is covered by another material.

CQA Personnel shall:

- Observe the sample cutting;
- Assign a number to each sample, and mark it accordingly;
- Record the sample location on the layout drawing; and
- Record the reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the geomembrane).

All holes in the geomembrane resulting from the destructive seam sampling shall be immediately repaired in accordance with repair procedures. The continuity of the new seams in the repaired area shall be nondestructively tested after repair.

<u>Size of Samples</u>

At a given sampling location, two types of samples shall be taken by the Contractor. First, two samples for field testing should be taken. Each of these samples shall be 1 inch wide and 12 inches long, with the seam centered parallel to the width. The distance between these two samples shall be 54 inches. If both samples pass the field test as described in the field testing requirements, a sample for laboratory testing shall be taken.

The sample for laboratory testing shall be located between the two samples for field testing. The sample for laboratory testing shall be 12 inches wide by 54 inches long with the seam centered lengthwise. The sample shall be cut into three parts and distributed as follows:

- One portion to the Contractor for laboratory testing, 12 inches by 18 inches;
- One portion to the Geosynthetic Quality Assurance Laboratory for testing, 12 inches by 18 inches; and
- One portion to CQA Personnel for archive storage, 12 inches by 18 inches.

<u>Field Testing</u>

The two, 1-inch wide strips, previously mentioned, shall be tested in the field, or tensionmeter, for peel and shear, respectively and shall not fail in the seam. Only ductile failures will be accepted, regardless of where they occur.

CQA Personnel shall witness all field tests and mark all samples and portions with their number. CQA Personnel shall also log the date and time, ambient air temperature, number of seaming unit, name of seamer, welding apparatus temperatures and pressures, pass or fail description, and attach a copy to each sample portion.

<u>Geosynthetic Quality Assurance Laboratory Testing</u>

Destructive test samples shall be packaged and shipped, if necessary, under the responsibility of CQA Personnel in a manner which will not damage the test sample. The Contractor will verify that packaging and shipping conditions are acceptable. CQA Personnel will be responsible for storing the archive samples. Test samples shall be tested by the Geosynthetic Quality Assurance Laboratory.

Testing shall include "Seam Strength and Peel Adhesion" [ASTM D638 with type M-1 specimen, 1-inch wide, tested at 2 inches per minute]. These terms are defined in the specifications. The minimum acceptable values to be obtained in these tests are those indicated in these specifications. At least five specimens shall be tested for each test method. Specimens shall be selected alternately by test from the samples (i.e., peel, shear, peel, shear, peel...). For double wedge welds, both inner and outer welds shall be tested and found to be acceptable.

The Geosynthetic Quality Assurance Laboratory shall provide test results no more than 24 hours after they receive the samples. CQA Personnel shall review laboratory test results as soon as they become available, and make appropriate recommendations to the Contractor as necessary.

Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails a destructive test. The Contractor has two options:

- The Contractor can reconstruct the seam between any two passed test locations; and
- The Contractor can trace the welding path to an intermediate location at least 10 feet from the point of the failed test in each direction and take a small sample for an additional field test. If these additional samples pass the test, then full laboratory samples are taken. If these samples pass the laboratory tests, then the seam is reconstructed between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed.

All acceptable seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. CQA Personnel shall document all actions taken in conjunction with destructive test failures.

5.2.2.5 Defects and Repairs

Identification

All seams and non-seam areas of the geomembrane shall be examined by CQA Personnel for identification of defects, blisters, un-dispersed raw materials and any signs of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be broomed or washed by the Contractor if the amount of dust or mud inhibits inspection.

Evaluation

Each suspect location both in seam and non-seam areas shall be non-destructively tested using the previously described methods as appropriate. Each location which fails the non-destructive testing shall be marked by the Engineer and repaired by the Contractor. Work shall not proceed with any materials which will cover the locations which have been repaired until laboratory tests with passing results are available.

Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon by the Contractor and CQA Personnel. The procedures available include:

- Patching, used to repair large holes, tears, un-dispersed raw materials, and contamination by foreign matter;

- Spot welding or seaming, used to repair small tears, pinholes, or other minor, localized flaws;
- Capping, used to repair large lengths of failed seams;
- Topping, used to repair areas of inadequate seams, which have an exposed edge; and
- Removing bad seam and replacing with a strip of new material welded into place (used with large lengths of fusion seams).

In addition, the following provisions shall be satisfied:

- Surfaces of the geomembrane which are to be repaired using the extrusion process shall be abraded perpendicular to the seam and no more than one hour prior to the repair;
- All surfaces must be clean and dry at the time of the repair;
- No re-welding of extruded seams will be allowed;
- All seaming equipment used in repair procedures must be approved;
- The repair procedures, materials, and techniques shall be approved in advance of the specific repair by CQA Personnel and the Contractor;
- Patches or caps shall extend at least six inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least three inches; and
- The geomembrane below large caps should be appropriately cut to avoid water or gas collection between the two sheets.

Verification of Repairs

Each repair shall be numbered and logged by CQA Personnel. Each repair shall be non-destructively tested using the methods described earlier, as appropriate. Repairs which pass the non-destructive test shall be taken as an indication of an adequate repair. Large caps may be of sufficient extent to require destructive test sampling, at the discretion of CQA Personnel. Failed tests indicate that the repair shall be redone and retested until a passing test results. CQA Personnel shall observe all repair and all non-destructive testing of repairs, mark on the geomembrane that it has been repaired, and document each repair thoroughly.

Large Wrinkles

When seaming of the geomembrane liner is completed (or when seaming of a large area of the geomembrane liner is complete) and prior to placing any overlying materials, CQA Personnel shall observe the geomembrane wrinkles. CQA Personnel shall indicate to the Contractor which wrinkles should be cut and re-seamed. The seam thus produced shall be treated like any other seam.

5.2.2.6 Materials in Contact with the Geomembrane

Soils

CQA Personnel shall verify the following:

- Equipment used for placing soil shall not be driven directly on the geomembrane;
- A minimum thickness of 1 foot of soil is specified between a low ground pressure dozer and the geomembrane;
- A minimum thickness of three feet of soil is specified between rubber tired vehicles and the geomembrane; and
- In heavily trafficked areas such as access ramps, soil thickness should be at least three feet.

CQA Personnel shall:

- Measure soil thickness and verify that the required thicknesses are present; and
- Verify that placement of soil is done in such a manner that geomembrane damage is unlikely.

CQA Personnel shall inform the Contractor if the above conditions are not fulfilled.

Appurtenances

CQA Personnel shall review the specifications and verify the use of geosynthetic layers between structures and geomembranes.

CQA Personnel shall verify that:

- Installation of the geomembrane in appurtenance areas, and connection of geomembrane to appurtenances have been made according to the RD Specifications;
- Extreme care is taken while welding around appurtenances since neither non-destructive nor destructive testing may be feasible in these areas; and
- The geomembrane has not been visibly damaged while making connections to appurtenances.

CQA Personnel shall inform the Contractor if the above conditions are not fulfilled.

5.3 Geosynthetic Drainage Composite

A geosynthetic drainage composite (GDC) will be installed during side slope liner construction.

5.3.1 Geosynthetic Drainage Composite Manufacturing and Directory

The GDC manufacturer shall provide the CQA Personnel with a list of guaranteed properties for the type of GDC to be supplied. The GDC manufacturer shall provide CQA Observer with a written certification signed by an officer of the Quality Control Manager that the GDC's actually delivered have properties that meet or exceed the guaranteed properties.

The Contractor shall examine all manufacturer's certifications to ensure that the property values listed on the certifications meet or exceed those specified.

5.3.2 Labeling

The GDC manufacturer shall identify all rolls of GDC's with the following:

- Manufacturer's name;
- Product identification;
- Lot number;
- Roll number; and
- Roll dimensions.

CQA Personnel shall examine each roll upon delivery and any deviation from the above requirements shall be reported to the Contractor.

5.3.3 Shipment and Storage

GDC cleanliness is essential to its performance and GDC rolls should be wrapped in polyethylene sheets or otherwise protected against dust and dirt during shipping and storage. The wrapping should be removed less than one hour before placement. CQA Personnel shall verify that GDC's are free of dirt and dust immediately prior to installation. If the GDC's are judged dirty or dusty, washing shall be observed by the CQA Personnel and improper washing operations shall be reported to the Contractor.

5.3.4 Conformance Testing

5.3.4.1 Tests

All GDC Testing will be done in accordance with Section MP-022199 of the M&P Specifications.

5.3.4.2 Sample Procedures

Samples shall be taken across the entire width of the roll and not include the first outer wrap. Unless otherwise specified, samples shall be 3 feet long by the roll width. CQA Personnel shall mark the machine direction on the samples with an arrow.

Unless otherwise specified, samples shall be taken at a rate of one per lot or one per 100,000 square feet, whichever is the greater frequency.

5.3.4.3 Test Results

CQA Personnel shall examine all results from laboratory conformance testing and shall report any nonconformance to the Contractor.

5.3.4.4 Handling and Placement

Materials handling and placement shall be as specified in Section MP-02219 of the M&P Specifications.

5.3.5 Installation

Installation shall be as stated in Section MP-02219 of the M&P Specifications.

5.3.6 Repairs

Repairs shall be made in accordance with Section MP-02219 of the M&P Specifications.

5.4 GCL

5.4.1 Raw Material

Materials shall be as specified in Section MP-02235 of the M&P Specifications.

5.4.2 Rolls

Prior to shipment, the GCL manufacturer shall provide a quality control certificate for each roll to be delivered. The quality control certificate shall be signed by the manufacturer and shall include at a minimum:

- Roll number and identification; and
- Sampling procedures and results of quality control test. At a minimum, test results shall be provided for thickness, permeability, and chemical composition.

5.4.3 Conformance Testing

Testing shall be as specified in Section MP-02235 of the M&P Specifications.

5.4.4 Delivery and Handling

Delivery and handling shall be as specified in Section MP-02235 of the M&P Specifications.

5.4.5 GCL Installation

5.4.5.1 Subgrade Preparation

The subgrade shall be compacted to the extent that no rutting is caused by installation equipment or vehicles. Debris, roots, or sharp rocks larger than 1-inch shall be removed. Prior to placement of the liner, the surface shall be graded and compacted to provide a uniform surface.

5.4.5.2 Anchorage System

An anchor trench shall be excavated as shown in the Contract Drawings prior to liner placement.

Rounded corners (minimum 1 foot radius) shall be provided along the slope crest and along the trench where the liner enters the trench so as to avoid sharp bends in the liner. No loose soil shall be allowed to underlie the geomembrane in the anchor trench.

The anchor trench shall be adequately drained and dewatered to prevent ponding or otherwise softening of the adjacent soils while the trench is open.

5.4.5.3 GCL Placement

Placement shall be as specified in Section MP-02235 of the M&P Specifications.

5.4.6 Seam Inspection

Inspection shall be completed as stated in Section MP-02235 of the M&P Specifications.

5.5 Geotextiles

5.5.1 Manufacturing

Manufacturing shall be as specified in Section MP-02232 of the M&P Specifications.

5.5.2 Labeling

The geotextile manufacturer shall identify all rolls of geotextile with the following:

- Manufacturer's name;
- Product identifications;
- Lot number;
- Roll number; and
- Roll dimensions.

Additionally, if any special handling of the geotextile is required, it shall be so marked on the top surface if the geotextile, e.g., "This Side Up".

CQA Personnel shall examine rolls upon delivery and any deviations from the above requirements shall be reported to the Contractor.

5.5.3 Shipment, Storage, and Handling

Shipment, storage, and handling shall be as specified in Section MP-02232 of the M&P Specifications.

5.5.4 Conformance Testing

Testing shall be done in accordance with Section MP-02232 of the M&P Specifications.

5.5.4.1 Sampling Procedures

Samples shall be taken across the entire width of the roll and shall not include the first outer wrap. Unless otherwise specified, samples shall be 3 feet long by the roll width. CQA Personnel shall mark the machine direction of the samples with an arrow.

Unless otherwise specified, samples shall be taken at a rate of one per lot or one per 100,000 square feet, whichever is the greater frequency.

5.5.5 Handling and Placement

Handling and placement shall be conducted as specified in Section MP-02232 of the M&P Specifications.

5.5.6 Seaming and Joining

Seaming and joining will be as specified in Section MP-02232 of the M&P Specifications.

5.5.7 Repair

Repairs will be made as stated in Section MP-02232 of the M&P Specifications.

5.6 Liner and Final Cover System Acceptance

The Contractor and the Manufacturer shall retain all ownership and responsibility for the geosynthetics in the liner and final cover systems until acceptance by Danaher.

The geosynthetic liner and cover systems shall be accepted by Danaher when:

- The installation is finished;
- Verification of the adequacy of all seams and repair, including associated testing, is complete;
- All documentation of installation is complete including the Engineer's final report; and
- Certification reports, including "as-built" drawings, sealed by a professional engineer, licensed to practice in New York State have been received by the Engineer.

The Engineer shall certify that installation has proceeded in accordance with the Geosynthetic section of the CQA/CQC Plan.

6. CQA Requirements - SVE Treatment System

6.1 General

The SVE system will consist of horizontal injection/extraction piping, vertical well head piping, above-ground injection/extraction header piping, an air/water separator, blowers, a heat exchanger, and vapor phase carbon off gas treatment. The SVE system will be constructed, installed and tested in accordance with the procedures in this section and the RD Specifications. In general, Contractor submittal requirements are documented in the RD Specifications. Additional construction related testing is specified in this section.

6.2 SVE Treatment Cell Piping Network

6.2.1 General

The SVE treatment cell piping network will be constructed of 4-inch Schedule 80 PVC pipe and fittings, valves and appurtenances, as shown on the drawings and described in the RD Specifications.

6.2.2 Required CQA Submittals

Submittals will be in accordance with the RD Specifications.

6.2.3 Construction and Installation Requirements

The construction and installation of the SVE treatment system will be in accordance with the RD Specifications and the following:

- Install all piping, valves, and appurtenances according to manufacturer's specifications, and in accordance with the drawings and RD Specifications;
- All header piping shall be pitched in the direction of the treatment building as indicated on the drawings;
- The use of PVC cement and cleaners shall be prohibited in ambient temperatures above or below the Manufacturer's recommended range;
- The Contract Drawings show general arrangement, direction, size of pipes, etc.; they are is not intended to show every offset, valve and fitting location, or every structural difficulty that may be encountered; and
- Route the piping and install valves, fittings, pipe supports, and appurtenances as field conditions require. Routing and location of valves, fittings, pipe supports, and appurtenances will be approved by the Engineer prior to installation.

6.2.4 Required CQA Testing

- All piping shall be inspected daily, by CQA Personnel for installation neatness and quality; and
- The completed piping network shall be pressure tested. Final pressure testing may only be conducted following the installation of the complete SVE treatment cell piping network. If the Contractor chooses, the Contractor may pressure test subsections of the piping network as they are completed. The results of these tests will not be accepted by the Engineer. Testing of piping for leaks shall be completed as discussed in the RD Specifications.

Repair of leaks shall be completed by the Contractor in accordance with the RD Specifications. CQA Personnel will witness and document final pressure testing, any repairs, and any retesting after repairs are made. Piping must pass zero leakage to be accepted as complete.

6.3 SVE System Process Equipment

6.3.1 General

Process equipment to be used in the SVE treatment system is described in the RD Specifications.

6.3.2 Required CQA Submittals

Submittals will be in accordance with the RD Specifications.

6.3.3 Construction and Installation Requirements

Installation shall be in accordance with the RD Specifications and Contract Drawings, and the Manufacturer's instructions.

6.3.4 Required CQA Testing

The following CQA testing will be required:

- The installation of all major pieces of equipment shall be inspected and certified by the Manufacturer's Representative prior to start up;
- All three phase motors shall be tested for correct rotation prior to startup;
- All equipment safety features shall be tested prior to start up; and
- All equipment shall be tested and shall operate without defect and as intended in accordance with Manufacturer's start-up procedures.

All tests will be conducted in the presence of the CQA Personnel. The Contractor shall correct all deficiencies observed during the testing.

7. CQA Requirements - Ground-Water Collection Trenches

7.1 General

The ground-water collection system will be constructed, installed and tested in accordance with the procedures described in this section and in the RD Specifications and drawings.

7.2 Required CQA Submittals

The following submittals are required for materials associated with the ground-water collection system:

- Gravel;
- Perforated HDPE Pipe;
- Solid HDPE Pipe;
- Geotextile; and
- Flowable Fill;

7.3 Construction and Installation Requirements

Installation will be in accordance with the RD Specifications and Contract Drawings, and specific instructions from Manufacturer's Representatives.

7.4 Required CQA Testing

All equipment will be tested prior to installation at the factory, then field tested by the Contractor as necessary with CQA Personnel present to demonstrate correct operation. The Contractor will correct any deficiencies observed during operation and testing. Additionally, the following testing will be performed:

All solid HDPE pipes will be tested by the Contractor for leakage in accordance with the Manufacturer's recommendations and as specified. All piping will be examined by the field CQA Personnel during the test and all leaks, defective material or joints will be repaired or replaced before repeating the tests.

8. CQA Requirements - Electrical Equipment

8.1 General

All electrical equipment will be installed in accordance with the RD Specifications and Contract Drawings, and the National Electric Code Standards.

8.2 Required CQA Submittals

Prior to obtaining any material in connection with electrical work, detailed shop drawings shall be submitted in accordance with the RD Specifications. In addition to equipment data, shop drawings shall be submitted that show proposed raceway layout, electrical equipment layout, grounding system layout, interconnecting wiring, and elementary diagrams.

8.3 Required CQA Testing

The Contractor shall complete all electrical equipment testing. Testing/inspections requiring documentation for the system may include, but will not be limited to, the following:

1. Inspection of all electrical work by a representative of the New York State Board of Fire Underwriters and by local authorities having jurisdiction;
2. Certification of compliance with the National Electric Code by an independent electrical inspector;
3. Testing of all wire and cable when in-place but before final connections are made;
4. Underwriters Laboratory (UL) master label approval of lightning protection system;
5. Performance of an electrical grounding system test;
6. Coordination and calibration of instrumentation components; and
7. Field tests of all miscellaneous electrical controls.