Sonoco Products Company

Remedial Action Work Plan

Greif, Inc. Facility
Town of Tonawanda, Erie County, New York
NYSDEC Voluntary Cleanup Program #V00334-9

October 2009

Prepared By:
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REMEDIAL ACTION WORK PLAN
GREIF FACLITY – TONAWANDA, NEW YORK
NYSDEC VCP NUMBER V00334-9

APPROVED BY:

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PROFESSIONAL ENGINEER CERTIFICATION

This is to certify that to the best of my knowledge, information, and belief, this Remedial Action Work Plan has been prepared under my supervision by personnel of ERM Consulting & Engineering, Inc. In addition, an engineering evaluation of the proposed remedy has been conducted in accordance with Section 7.4 of the NYSDEC Draft Voluntary Cleanup Program Guide (May 2002).

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ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
ASTM	American Society for Testing and Materials
BCP	Brownfield Cleanup Program
bgs	below surface grade
°C	Degrees Celsius
CAMP	Community Air Monitoring Program
cfm	Cubic Feet per Minute
COPC	Chemicals of Potential Concern
DER	Division of Environmental Remediation
DAR	Division of Air Resources
ERM	Environmental Resources Management
dB	decibels
DPE	Dual Phase Extraction
DGI	Data Gap Investigation
DNAPL	Dense Non-Aqueous Phase Liquid
1,2-DCA	1,2- Dichloroethane
cis 1,1-DCE	cis 1,1- Dichloroethene
eV	Electron Volts
FCC	Federal Communications Commission
FFS	Focused Feasibility Study
FID	Flame Ionization Detector
FDSA	Former Drum Storage Area
GAC	Granular Activated Carbon
GWRAOs	Ground water Remedial Action Objective
HASP	Health & Safety Plan
IRM	Interim Remedial Measure
ISM	Industrial, Scientific, and Medical
ISTT	In-Situ Thermal Treatment
kW	Kilowatts
LNAPL	Light Non-Aqueous Phase Liquid
mg/kg	Milligram per kilogram
MHz	Megahertz
MNA	Monitored Natural Attenuation
MS	Moisture Separator
NAPL	Non-Aqueous Phase Liquid
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSGS	New York Geological Survey
O&M	Operation and Maintenance
OM&M	Operations, Maintenance, and Monitoring
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment

QAPP	Quality Assurance Project Plan
RAOs	Remedial Action Objectives
RAWP	Remedial Action Work Plan
RCM	Remediation & Construction Management
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RF	Radio Frequency
RFH	Radio Frequency Heating
SCOs	Recommended Soil Cleanup Objectives
SCGs	Standards, Criteria, & Guidance
SMP	Soil Management Plan
SRAOs	Soil Remedial Action Objective
SSD	Sub-Slab Depressurization
SVE	Soil Vapor Extraction
SVOCs	Semivolatile Organic Compounds
TAGM	Technical and Administrative Guidance Memorandum
TCE	Trichloroethene
1,1,1-TCA	1,1,1-Trichloroethane
THA	Task Hazard Analysis Form
VCA	Voluntary Cleanup Agreement
VMPs	Vacuum Monitoring Points
VCP	Voluntary Cleanup Program
VOCs	Volatile Organic Compounds
w.c.	water column
UST	Underground Storage Tank

1.0 INTRODUCTION

In compliance with and fulfillment of the Voluntary Cleanup Agreement (VCA) between Sonoco Products Company (Sonoco) and the New York State Department of Environmental Conservation (NYSDEC) identified as Site Number V00334-9, Environmental Resources Management (ERM) prepared this Remedial Action Work Plan (RAWP) for the Greif, Inc. (Greif) Facility located at 2122 Colvin Boulevard in the Town of Tonawanda, Erie County, New York (the Site).

ERM completed a detailed analysis of remedial alternatives to address soil and ground water containing volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) in the two remaining Site Areas of Concern (AOCs):

- the Varnish Pit Area, which includes the Short Truck Bay; and
- the Former Varnish Underground Storage Tank (UST) Area.

A summary of the evaluation of remedial alternatives is presented in the Final Focused Feasibility Study (FFS) Report dated May 2009 (ERM, 2009b). In the Final FFS Report, ERM recommended a remedial approach consistent with criteria outlined in the document entitled "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988) and NYSDEC's Draft DER-10 entitled "Technical Guidance for Site Investigation and Remediation" (NYSDEC, 2002). This Remedial Action Work Plan (RAWP) presents the approach to implement the NYSDEC-approved final remedy at the Site.

1.1 SITE DESCRIPTION

The Site consists of an industrial building located on approximately 25-acres in the Town of Tonawanda, Erie County, New York. The Site is located in a mixed industrial/commercial/residential area approximately one-quarter mile south of Highway I-290 (Figure 1). Adjoining properties are as follows:

- North – vacant land (including a former railroad siding and a wooded area) and residential apartments;
- South – a local park/sports fields (Walter M. Kenney Field) and land recently developed into commercial office space;
- East – Colvin Boulevard with single family/duplex homes further east; and

- West – a business park adjacent to a major railroad line formerly traversed by two railroad spurs into the Site.

Figure 2 presents a map showing general Site layout and the locations of selected Site features. The building is surrounded by paved parking areas, storage areas, and landscaped areas. The Site is currently used for the manufacture of fiber drums, equipment maintenance, and administrative activities. The north, west and east sides of the Site are enclosed with a chain-link fence to restrict access. There are two main gates on the east side of the Site where employees and visitors routinely enter and an unused, old gate on the west side of the Site at the location of an old railroad spur into the Site.

Based on information provided by Greif and ERM's review of Site plans, the building at the Site was originally constructed in 1948. From 1948 to 1985 the Site was owned and operated by Continental Fiber Drum and Continental Can Corporation. Historical manufacturing operations at this time consisted of the production of fiber drums but also included production of the metal lids and rims used in the fiber drums.

Sonoco Products Company acquired the Fiber Drum Division in 1985. The major existing manufacturing operations reportedly continued generally unchanged until the early 1990s. In 1995, the varnishing and degreasing processes on the metal lids and rims used in the fiber drums were discontinued. Greif subsequently acquired the Site in May 1998. The Site continues to be used for the manufacture of fiber drums and associated products. Secondary operations include equipment maintenance and administrative activities.

Surface water bodies are not present on or bordering the Site. Site topography is relatively flat with an average elevation of approximately 586-feet above mean sea level. The Site is situated approximately 3.5-miles east of the Niagara River and 1.1-miles south of Ellicott Creek in the Erie-Ontario Lowlands physiographic province of western New York State. Topographic relief within one-half mile of the Site is minimal (approximately 15-feet).

Surficial geology in the vicinity of the Site was previously mapped by the New York State Geological Survey (NYSGS) as lacustrine silt and clay (Cadwell et al., 1988). These deposits consist predominantly of varved or laminated, calcareous silt and clay deposited in proglacial lakes with variable thickness up to 100-meters (approximately 328-feet). Bedrock in the vicinity of the Site consists predominantly of dolostones, shales, and evaporites of the Upper Silurian Salina Group based on mapping performed by the NYSGS (Rickard and Fisher, 1970).

1.2 PROJECT BACKGROUND

ERM performed subsurface investigations at the Site with the overall objective to evaluate the nature and extent of soil and ground water potentially affected by Site activities. Figure 3 presents a color-coded map showing the locations of all sampling points installed during the various investigative phases at the Site. Detailed descriptions of previous investigation activities are presented in the Final FFS Report (ERM, 2009b) and the various reports referenced in that document.

Based on the findings in the Data Gap Investigation (DGI) (ERM, 2003), the distribution of VOC-affected ground water at the Site indicates the primary source areas were the varnish pit, the Former Varnish UST, and the soil boring GB-10 and the Former Drum Storage Area (GB-10/FDSA). The hydraulic gradient of the shallow and intermediate ground water transmissive zones are presented as Figure 4 and Figure 5, respectfully. A conceptual site model is presented as Figure 6.

ERM implemented interim remedial measures (IRMs) in the Varnish Pit Area and the GB-10/ FDSA with the primary remedial objectives of facilitating the protection of human health and the environment by addressing the source areas through removal of grossly contaminated soil and dense non-aqueous phase liquid (DNAPL) to the extent practicable.

The IRM for the Varnish Pit Area consisted of the installation of recovery wells for phased DNAPL recovery through several stages of pumping and/or vacuum-enhanced recovery. In Fall 2004, ERM implemented a series of pilot tests whose results were summarized in the DNAPL Recovery IRM Pilot Test Report (ERM, 2005). Based on ERM's previous experience with DNAPL recovery systems and the results of the pilot tests, a low flow DNAPL recovery system was installed around the varnish pit. The system was constructed and operation was started in November 2005. As requested by the NYSDEC, ERM enhanced the recovery of the DNAPL recovery system by applying low vacuum. A building was constructed to house the equipment necessary to treat the vapor stream, and soil vapor extraction was initiated in March 2007.

The recovery of DNAPL using pumping continued until 18 May 2008 when pumping of liquids from recovered wells was terminated with the approval of the NYSDEC. A total of 1,481 gallons of DNAPL and 8,674 gallons of aqueous-phase liquid were recovered during the 33 months of DNAPL recovery IRM activities. Approximately 967 gallons of DNAPL and 4,950 gallons of aqueous liquid were recovered by pumping. Approximately 514 gallons of DNAPL and 3,724 gallons of aqueous fluid were condensed from extracted vapors since initiation of low vacuum-enhanced DNAPL recovery on 28 March 2007. DNAPL levels have not increased in recovery wells around the varnish pit since the cessation of pumping activities in May 2008. Extraction of vapors from recovery well RW-2 is ongoing in order to provide some level of sub-slab depressurization in the vicinity of the varnish pit. Extraction of vapors from well RW-2 will continue until a full-scale sub-slab depressurization (SSD) system is designed and installed as part of the final remedy.

VOC-affected soil in the GB-10/FDSA was excavated in substantial conformance with the IRM Work Plan approved by the NYSDEC on 13 August 2004 (NYSDEC 2004b). Extensive preparations and engineered controls were required to excavate and disposed of 1760.82 tons of hazardous solid waste at a NYSDEC-permitted Resource Conservation and Recovery Act (RCRA) Subtitle C disposal facility. NYSDEC on-Site personnel approved the final extent of the remedial soil excavation in the field, indicating that the previous remedial goal of removal of grossly-affected soil was achieved to the satisfaction of NYSDEC. A confirmation soil sampling program was implemented to document the remaining concentration of VOCs in soil in the GB-10/FDSA. Laboratory analytical results from confirmation soil samples support the conclusion that the soil excavation IRM removed a significant mass of VOCs from the GB-10/FDSA. These results are also consistent with the conclusion that the soil excavation IRM successfully removed grossly-affected soil and achieved applicable standards, criteria, and guidance (SCGs) as summarized in the Interim Report - Soil Excavation Interim Remedial Measure (ERM, 2006).

Based on ERM's review of available data and previous discussions with the NYSDEC, the following three alternatives were evaluated in the Final FFS Report (ERM, 2009b):

- Alternative 1: No Action.
- Alternative 2: Excavation and Off-Site Disposal of Soil and Monitored Natural Attenuation (MNA) of Ground Water.
- Alternative 3: In-Situ Thermal Treatment (ISTT) of Soil and MNA of Ground Water.

Each alternative was evaluated individually and against each other using the seven criteria identified in NYSDEC guidance for the selection of remedial actions (NYSDEC, 1990; NYSDEC, 2002). It was determined that Alternative 1, No Action, would not effectively comply with NYSDEC guidance for the selection of remedial actions. Alternatives 2 and 3 were determined to be equally protective of human health and the environment and equally address compliance with NYSDEC SCGs. Both alternatives are readily implementable and provide long term effectiveness essentially by eliminating source areas and monitoring natural attenuation processes. It was determined that Alternative 3 is less obtrusive to ongoing manufacturing operations at the Site, has fewer short term impacts, and is less costly than Alternative 2. Therefore, the recommended alternative for the Site was Alternative 3, ISTT with MNA.

1.3 REMEDIAL OBJECTIVES

The overall objective of the remedial activities to be implemented at the Site is to remediate the affected Site soils and ground water under the conditions of the VCP agreement. This section presents the remedial goals and remedial action objectives (RAOs) established for the Site media of interest (i.e., soil and ground water).

Remedial goals are derived from the statute (i.e., Title 6, New York Code of Rules and Regulations [6NYCRR] Part 375) and NYSDEC guidance. The remedial goals for VCP Sites as set forth in the NYSDEC Division of Environmental Remediation (DER) DER-10 Draft Technical Guidance for Site Investigation & Remediation (NYSDEC, 2002) are:

- to be protective of public health and the environment, given the intended use of the Site; and
- To include removal or elimination, to the extent feasible, of identifiable source of contamination regardless of the presumed risk or intended use of the Site.

Guidance on developing RAOs is provided in NYSDEC Technical and Administrative Guidance Memorandum (TAGM) Number 4030 (NYSDEC, 1990) and examples of RAOs are also set forth in Draft DER-10 (NYSDEC, 2002). The RAOs are media-specific targets that are aimed at protecting public health and the environment. In the case of protection of human health, RAOs usually reflect the concentration of chemicals of potential concern (COPC) and the potential exposure route. Protection may be achieved by reducing potential exposure (e.g., use restrictions, limiting access) as well as by reducing concentrations. RAOs, which are established for protection of environmental receptors, are usually intended to preserve or restore a resource. As such, environmental RAOs are set for a media of interest and a target concentration level.

Media that are candidates for remedial evaluation are identified based on the nature and extent of contamination and applicable or relevant and appropriate SCGs. As discussed in the Final FFS Report (ERM, 2009b), potential Site media of interest are soil and ground water as identified during previous investigation activities. As identified in 6 NYCRR 375-

1.10(c) (1) (ii), SCGs are provided in NYSDEC guidance. The most recent NYSDEC guidance containing SCGs is Draft DER-10 (NYSDEC, 2002). In addition to the SCGs listed in Draft DER-10, an additional SCG will also be considered – the Part 375 Soil Cleanup Objectives (SCOs) for restricted commercial use.

In addition to SCGs, certain Site-specific factors are considered when developing the RAOs for Site media of interest. These Site-specific factors relate to the affected media, types of constituents, and potential routes of exposure. Based on the evaluation discussed in the Final FFS Report (ERM, 2009b) and the draft NYSDEC guidance regarding development of RAOs in DER-10 (NYSDEC, 2002), the soil RAOs (SRAOs) for Site soil will be:

- SRAO1 – Prevent ingestion, direct contact with, and/or inhalation of soil that poses a risk to public health and the environment given the intended use of the Site;
- SRAO2 – Prevent inhalation of or exposure from COPC volatizing from soil that poses a risk to public health and the environment given the intended use of the Site; and
- SRAO3 – Prevent the potential for vapor intrusion into indoor air, if needed.

The Soil Excavation IRM was successful in removing grossly-affected soil to the satisfaction of on-Site NYSDEC representatives. Based on the IRM activities conducted and NYSDEC's agreement that the soil in these AOCs have been adequately addressed, no further actions are needed in the GB-10/FDSA. The primary source of VOCs beneath the facility appeared to be a DNAPL pool in the Varnish Pit Area. ERM successfully removed this source material to the extent feasible during the DNAPL Recovery IRM. The concentrations of COPC in soil and ground water beneath the facility continue to be reduced through reductive dechlorination. The ISTT will reduce the concentration of COPC in the Former Varnish UST Area to SCOs. An asphalt cap over the Former Varnish UST Area, institutional controls, and a full-scale SSD system within the facility will minimize potential routes of exposure to the VOCs in Site soil.

Based on the evaluation discussed in the FFS Report (ERM, 2007) and the draft NYSDEC guidance regarding development of RAOs in DER-10 (NYSDEC, 2002), the RAOs for on-Site ground water (GWRAO) are:

- GWRAO1 – Prevent exposure to affected ground water that poses a risk to public health and the environment given the intended use of the Site;
- GWRAO2 – Prevent or minimize further migration of the

contaminant plume (plume containment); and

- GWRAO3 – Prevent or minimize further migration of contaminants from source materials to ground water (source control).

Based on observed concentration, the majority of contaminant mass in ground water at the Site is present in shallow overburden ground water. The distribution of VOCs in Site ground water indicates the primary source areas were the Varnish Pit Area, the FDSA/GB10 Area, and the Former Varnish UST Area. The IRMs removed the FDSA/GB-10 source areas and greatly reduced the source material in the vicinity of the Varnish Pit Area. This reduction in mass will expedite natural attenuation of COPC in shallow ground water to concentrations consistent with the contemplated use of the Site (restricted commercial) and minimize or prevent further migration. Institutional controls and the SSD system will minimize the potential of exposure to residual concentrations in both ground water and soil.

2.0 REMEDIAL ACTION SELECTION

2.1 REMEDIAL STRATEGY

2.1.1 Former Varnish UST Area

Source-zone remediation of shallow ground water and soil in the Former Varnish UST Area will be accomplished through implementation of ISTT. The dielectric properties of the soil from the Former Varnish UST Area were used to determine the proper spacing of a network of radio frequency (RF) antenna/electrode placement wells. A treatment cell will be established by placing two pairs of antennas in placement wells. The antennas will be electrically coupled to a shield of a coaxial cable, with a second row electrically coupled to the central conductor of the coaxial cable. RF energy will be applied to antennas through a coaxial cable that will reduce power loss. To ensure that power loss is minimized to the extent practicable, a matching network of electrical equipment will also be installed to maximize power flow. This results in evenly distributed voltages which facilitates even heating. A balanced-to-unbalanced transformer is installed at the input to the matching network to prevent the deposition of RF energy outside the target volume and creation of voltages that could be hazardous to personnel (Kastecki et. al, 1993).

A soil vapor extraction (SVE) system with an overlying impermeable barrier will be designed to contain and collect volatilized contaminant vapors. The SVE system will be designed such that the configuration of vapor extraction wells accommodates the area being heated. One or more blowers will be used to extract vapors through associated piping, valves, and controls to one or more treatment trailers located within the remedial area. The vapor stream will be pre-conditioned, if necessary, to maximize adsorption to granular activated carbon (GAC) treatment prior to discharge to the atmosphere. The Former Varnish UST work area will be surrounded with a chain-link security fence and appropriate signage to notify Site workers and visitors of potential hazards and to indicate that entry is restricted to authorized personnel.

2.1.2 Varnish Pit Area

Soil beneath the Greif Facility is characterized predominantly by a low permeability native silty clay matrix with shallow fill material. Historical operation in the vicinity of the varnish pit created a source area for COPC, which has affected soil, shallow ground, and minimally affected intermediate ground water at the Site. As discussed in the Final FFS Report (ERM, 2009b), a DNAPL Recovery IRM was initiated in the Fall 2004 to address DNAPL in the Varnish Pit Area. Pumping of liquids was originally performed to recovery DNAPL. Low vacuum extraction was subsequently added in May 2007 to enhance recovery of DNAPL and provide de-pressurization of the sub-slab in the vicinity of the varnish pit. The DNAPL Recovery system recovered liquids through May 2008, when the NYSDEC approved the termination of pumping. ERM has continued extraction and treatment of vapors from recovery wells surrounding the varnish pit in order to provide some level of sub-slab depressurization in the vicinity of the varnish pit.

Two IRMs at the Site have significantly reduced mass of VOCs as discussed in the Final FFS Report (ERM, 2009b). Natural attenuation will continue to reduce the mass of COPC at the Site. However, soil and ground water are potential sources of VOCs in soil gas beneath or near the building. A SSD system will be installed to mitigate potential vapor intrusion issues.

The SSD system will consist of newly installed vertical suction points through the floor slab. The suction points will be piped to externally-mounted vacuum blower(s) that will draw soil gas from beneath the building to an exhaust point(s) or treatment prior to discharge. Vapor influent concentrations will be periodically evaluated to determine the duration of treatment required for sub-slab vapors. Minor cracks and holes in the floor slab will also be sealed to minimize potential vapor intrusion pathways into the building and to increase the area of influence from each suction point beneath the facility's slab.

2.1.3 Institutional Controls and Natural Attenuation of Ground Water

In addition to the active remediation presented in Sections 2.1.1 and 2.1.2, institutional controls and monitored natural attenuation of ground water will be part of the remedial action. Once the VOC mass has been reduced in the Former Varnish UST via ISTT, natural attenuation processes will continue to reduce mass and concentrations towards closure goals. A ground water monitoring plan will be implemented to evaluate the effectiveness of the remedial actions and of natural attenuation of ground water. Samples will be analyzed for Site-specific VOCs and selected natural attenuation parameters. Results of ground water sampling events will be presented to the NYSDEC in Monthly Progress Reports.

Part 5 of the New York State Department of Health State (NYSDOH) Sanitary Code discourages installation of a private potable water supply well in areas that are serviced by a public water supply system. Enforcement of this regulation would prevent potable water consumption of affected Site ground water.

A Soil Management Plan (SMP) will be prepared to inform current and future property owners regarding the distribution of affected soil exhibiting concentrations in excess of NYSDEC's restricted commercial SCOs and to specify the manner in which intrusive work may be conducted in these areas if deemed necessary. The SMP will outline relevant considerations including operation and maintenance (O&M) of the SSD system, ground water monitoring requirements, maintenance of any engineering controls, and annual engineering certification that institutional controls are in place and are effective.

2.2 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

2.2.1 Achievement of Remedial Objectives

The primary RAO is to remediate the Former Varnish UST Area and the Varnish Pit Area to the extent practicable to:

1. allow the Site to be used in an restricted commercial manner, to the extent feasible; or
2. at a minimum, eliminate or mitigate all significant threats to the public health and the environment.

The following sections set forth the derivation, evolution, and approval of the SCGs applicable to the Site.

2.2.1.1 Former Varnish UST Area

Based upon the current Site conditions, remedial goals, and experience with RF heating systems, it is anticipated that the ISTT system will be effective in achieving the specified RAOs. The remediation goal is to reduce xylene concentrations in soil to less than NYSDEC's restricted commercial SCO of 500 milligrams per kilogram (mg/kg). Operation of the ISTT system will continue until this RAO is met to the extent practicable. Therefore, it is anticipated that the ISTT system will be effective in achieving the specified soil RAOs in the Former Varnish UST Area. Achievement of GWRAO3 is also anticipated – to prevent or minimize further migration of containments from source materials to ground water (source control).

2.2.1.2 Varnish Pit Area

The SSD system will be designed to achieve a depressurization goal of 0.025 inches water column (w.c.) across the entire building footprint. The collected soil vapor will be discharged to the atmosphere above the building roofline. In addition, a SSD system is the preferred vapor intrusion mitigation method as described in the NYSDOH Guidance for

Evaluating Soil Vapor Intrusion in the State of New York (October 2006). Therefore, the SSD system in the building will achieve SRAO3 - Prevent the Potential for Vapor Intrusion into Indoor Air.

The presence of a surface cover (i.e., the concrete floor) and institutional controls in the form of a Site Management Plan that governs soil disturbance activities will achieve SRAO 1 and SRAO 2 which prevent ingestion, direct contact, and/or inhalation of/ with soil or site contaminants that pose a risk to public health and the environment given the intended use of the Site.

The successful completion of the DNAPL Recovery IRM removed NAPL from around the varnish pit. As requested by the NYSDEC, ERM is performing an investigation for the presence of NAPL beneath the varnish pit. NAPL is being recovered from beneath the varnish pit to the extent practicable. These actions will attain the remedial goal of removing or eliminating, to the extent feasible, the identifiable source of contamination regardless of the presumed risk or intended use of the site.

2.2.1.3 Site Ground Water

Based on observed concentrations, the majority of contaminant mass in ground water at the Site is present in shallow overburden ground water. The distribution of VOCs in Site ground water indicates the primary source areas were the Varnish Pit Area and the Former Varnish UST Area. The IRMs removed the FDSA/GB-10 source areas and greatly reduced the source material in the vicinity of the Varnish Pit Area. The ISTT system in the Former Varnish UST Area will further remove the source of ground water contaminants. Therefore, this remedy will minimize further migration of containments from source materials to ground water (GWRAO3).

The overall reduction in source material will expedite natural attenuation of COPC in shallow ground water and minimize further migration (GWRAO2).

Part 5 of the New York State Department of Health State (NYSDOH) Sanitary Code discourages installation of a private potable water supply well in areas that are served by a public water supply system. Under this remedy, this would continue to be enforced. This would prevent potable water consumption or exposure to affected Site ground water (GWRAO1). This institutional control, as well as the SSD system will minimize the potential of exposure to residual concentrations in both ground water and soil.

2.2.2 *Special Issues*

There are several special issues to be considered for the protection of human health and the environment in the former varnish UST and pit areas. ERM personnel and subcontractors are required to adhere to the NYSDEC-approved Site-specific Health & Safety Plan (HASP) included in Appendix A. Remediation activities will be performed by personnel trained in accordance with 40 CFR 1920.120 (hazardous waste site operations) and/or other applicable Occupational Safety and Health (OSHA) requirements and in accordance with the requirements of the HASP and all applicable requirements of Greif's health & safety policies. Other special issues for each area are discussed below.

2.2.2.1 *Former Varnish UST Area*

The following special issues apply to the Former Varnish UST Area.

- The facility tests their fire prevention sprinkler system every month, and this water discharge occurs to the ground surface within the proposed ISTT area. This discharge pipe will need to be extended and moved so that the discharge occurs outside of the treatment area.

- Two of the facility's emergency exits are located on the western side of the building. Coordination with the facility will be required to find alternate emergency egress or modifications will be made to these existing egresses to allow for safe exit.

- The current drum storage area will need to be relocated so that there is adequate space for the ISTT equipment.

- The ISTT area is proximal to a busy loading dock and associated tractor trailer traffic. Temporary fencing will be placed around the treatment area and RF equipment. The enclosure will be secured with access limited to authorized personnel only. Appropriate signage will be posted to warn of potential hazards. This fencing will also be used to help ground the RF equipment, and it will be removed at the end of the remediation project. Additionally, SVE piping from the treatment area to the treatment shed will be routed so not to interfere with loading dock operations.

- There is a possibility of soil vapors migrating from the RF treatment area to beneath the manufacturing facility. The RF system will be coupled with an SVE system to capture the vapors generated by the thermal remediation. Additionally, the SSD system creates a negative pressure under the building and will help to capture vapors. Air monitoring will be performed during construction and installation of the system to insure that VOC levels do not pose a threat to the health of building occupants or remedial workers.

2.2.2.2 *Varnish Pit Area*

Pilot testing will be conducted to design a SSD system that can achieve the depressurization goal of 0.025 inches w.c. across the extent of the building slab. However, significant variation can exist in soil type and permeability beneath large commercial buildings. Lastly, impediments to subsurface air flow (e.g., foundation walls, pilings, haunched floors, etc) are unknown. After installation of the full-scale system, confirmation testing will be conducted to verify that the system is achieving the depressurization goal of 0.025 inches w.c. across the acceptable extent of the building slab. If the test shows sub-slab vacuum less than the depressurization goal, attempts will be made to correct the situation. Possible corrective measures include: adjusting flow rates of soil vapor individual suction pits, increasing the size of the suction pit, adding additional suction pits, and adding an additional blower. If the SSD system still is not meeting the depressurization goal after implementing corrective measures, a monitoring program will be implemented to determine the concentration of VOCs in the sub-slab vapors and indoor air in the vicinity of any areas of inadequate depressurization. This sampling would be conducted during the heating season, and ideally between 30 and 90 days after installation. At least 30 days will pass before collecting samples. The results will be evaluated with NYSDEC to evaluate the risks posed by VOCS in the sub-slab vapor and indoor air in the vicinity of areas where the depressurization goal is not attained, and the need for further action.

2.3 *STANDARDS, CRITERIA, & GUIDANCE*

2.3.1 *Applicable Standards, Criteria & Guidance*

The primary Standards, Criteria, & Guidance (SCGs) that will apply to this remedy are provided in Table 1.

2.3.2 *Compliance with Standards, Criteria & Guidance*

The proposed remedial actions are designed to meet the SCGs applicable to the Site as specified above to ensure conformance with all applicable requirements of the VCA. If applicable SCGs have not been substantially achieved after implementation of the remedies described above, additional evaluation will be performed to complete the remediation in conformance with applicable requirements of the VCA.

2.4 *SHORT-TERM EFFECTIVENESS & IMPACTS*

Figure 7 presents a revised project schedule for performance of remedial activities in the Former Varnish UST Area and the Varnish Pit Area.

2.4.1 *Short-Term Effectiveness Summary*

2.4.1.1 *Former Varnish UST Area*

Based upon current Site conditions, remedial goals, and experience with RF heating systems, it is anticipated that the ISTT system will be effective over the short-term. The remediation goal is to reduce xylene concentrations in soil to less than NYSDEC-approved Restricted Commercial levels (less than 500 mg/kg). Operation of the ISTT system will continue until this RAO is met to the extent practicable. Therefore, it is anticipated that the ISTT system will be effective over the short-term in the Former Varnish UST Area.

It is estimated that the ISTT system may be operated for up to five months in order to achieve the xylene remediation goals for soil. This estimate is based on currently available data and information and will be modified as additional RF heating modeling becomes available. Post-remediation ground water monitoring will continue once ground water temperatures are at or near ambient temperatures.

2.4.1.2 *Varnish Pit Area*

Continued operation of the temporary SSD system will occur until the permanent SSD system is installed (currently planned for December 2009). This approach achieves the remedial action objective of preventing vapor intrusion (SRAO3).

2.4.1.3 *Site Ground Water*

The institutional control preventing the installation of potable supply wells in areas served by public water is already in place and enforced by the NYSDOH. The reduction in source material after implementation of the ISTT and NAPL recovery portions of the remedy will expedite natural attenuation of COPC in shallow ground water to concentrations consistent with the contemplated use of the Site and minimize or prevent further migration (GWRAO2). The monitoring associated with the MNA program will be used to assess the effectiveness of natural attenuation in preventing migration of the ground water contaminant plume. The duration of the MNA program is not known, but is anticipated to be greater than 2 years.

2.4.2 *Potential Short Term Risks and Controls*

2.4.2.1 *Former Varnish UST Area*

Mitigation of potential risks to the community, Site workers, and the environment is an important and necessary component of achieving RAOs in the Former Varnish UST Area. Potential risks as a result of implementing remedial measures in the Area and the controls that will be implemented to minimize or eliminate potential risks are discussed in detail in Section 2.2.1.1 and in the HASP to be developed for this remediation program. The NYSDEC-approved Community Air Monitoring Program (CAMP) will be implemented during intrusive activities at the Site to allow rapid identification, evaluation, and response to any potential risks to the community, Site workers and/or the environment. Corrective action consisting of engineering controls (i.e., dust suppression techniques, venting, sloping, shoring, etc.) or other appropriate response will be implemented if necessary to address any potential concerns identified during the CAMP or work-specific monitoring performed during Site activities as outline in the HASP to be developed for this remediation program.

2.4.2.2 *Varnish Pit Area*

During the installation of the SSD system, the construction crew and facility workers may be exposed to contaminants in the soil and soil vapor. These risks will be addressed by the personal protective equipment (PPE) measures and air monitoring outlined in the HASP (Appendix A).

Once the SSD system is installed, several pipes will transport soil vapor through the building. Leaks in the pipes could expose facility workers to soil vapor contaminants. However, all interior piping will be operated under a vacuum which will prevent migration of soil vapor into the building space. In addition, the system operators will visit the facility on a monthly basis to inspect the system. Any significant leaks will be detected by vacuum measurements.

The system is also exhausting soil vapor to the atmosphere above the building. Activated carbon vessels will be installed in series as needed to ensure the emissions do not exceed the NYSDEC Division of Air Resources Annual and Short-Term Guidance Concentrations. When the breakthrough of the first vessel is detected, the second vessel will continue treating the emissions to the necessary levels. Vessels will be replaced as needed to ensure adequate treatment.

2.4.2.3 *Site Ground Water*

Risks are posed during ground water monitoring due to possible exposure to ground water contaminants. These risks will be addressed by the PPE measures outlined in the HASP (Appendix A).

2.5 *LONG-TERM EFFECTIVENESS & IMPACT*

2.5.1 *Long-Term Effectiveness Summary*

2.5.1.1 *Former Varnish UST Area*

The ISTT remediation system will be effective over the long term based primarily on the following considerations:

- continued operation of the RF system and any enhancements (if necessary) will remove xylene from affected soil and ground water to a degree that will allow the Site to be used in a restricted commercial manner;
- long term effectiveness will also be ensured through institutional controls and monitoring; and
- long term monitoring activities in the Former Varnish UST Area will be completed with a goal of minimizing disruption to the active manufacturing facility or to other important economic activities.

2.5.1.2 *Varnish Pit Area*

DNAPL and vapor recovery and the installation and operation of the SSD system will be effective over the long term based primarily on the following considerations:

- recoverable DNAPL and LNAPL in the vicinity of the varnish pit will be permanently removed;
- a Site Management Plan will be established to ensure that the building floor remains in place and prevents exposure to soil or VOCs in soil that pose a risk to public health and the environment given the intended use of the Site (SRAO1 and SRAO2); and
- the SSD system will continue prevent vapor intrusion (SRAO3) as long as it is operating.

2.5.1.3 *Site Ground Water*

Once VOC mass has been reduced from the Former Varnish UST Area and the Varnish Pit Area, natural attenuation processes will continue to permanently reduce mass. These processes are anticipated to prevent or minimize migration of the contaminant plume (GWRAO2). The long-term effectiveness of this process will be continually evaluated via routine ground water monitoring.

The institutional control which prevents the installation of potable water wells at the Site will effectively prevent exposure to affected ground water that poses a risk to public health and the environment given the intended use of the Site (GWRAO1).

2.5.2 *Permanence*

2.5.2.1 *Former Varnish UST Area*

The former UST, which was the source of the original release, has been removed. The ISTT system is intended to permanently return soil and ground water in the Former Varnish UST Area to concentrations below NYSDEC-approved Restricted Commercial levels. The ISTT system does not rely upon containment or other long-term engineering controls to accomplish the remedial objective. Therefore, the ISTT remediation system is a permanent remedial solution.

2.5.2.2 *Varnish Pit Area*

The ongoing recovery of vapors will permanently reduce the mass and concentration of VOCs in the vicinity of the varnish pit. The operation of the SSD system is a containment remedy as it will prevent the migration of VOCs from soil and ground water beneath the building slab to the indoor air. This system will continue to operate until it is demonstrated to the NYSDEC that the system is no longer necessary based on sub-slab soil vapor concentrations.

The presence of the building floor over soil contaminants will act as a containment remedy. The long-term effectiveness will be maintained via a Site Management Plan.

2.5.2.3 *Site Ground Water*

The restriction on the installation of potable wells will permanently prevent contact with affected ground water provided the NYSDOH restriction remains in place. In addition, the biodegradation of ground water VOCs will be permanent. Other processes such as dispersion and sorption have the potential to be reversible. The effectiveness of all natural attenuation processes will be evaluated via the ground water monitoring program.

2.5.3 *Potential Post-Remediation Risks and Controls*

2.5.3.1 *Former Varnish UST Area*

As described above, the remedial strategy for the Former Varnish UST Area is designed to meet applicable SCGs. The applicable SCGs were promulgated by the NYSDEC for the purpose of protecting human health and the environment. The ISST system will continue to operate until it is demonstrated to the NYSDEC that the system is no longer necessary based on confirmation sample results. Additional heating will be performed if confirmation samples indicate the presence of constituents above the SCGs.

At the conclusion of this remedy, the remedial equipment will be removed from the Site, eliminating physical hazards potentially associated with abandoned equipment. Following post-remediation monitoring, the wells in the Former Varnish UST Area will be permanently abandoned according to well abandonment procedures acceptable to the NYSDEC. This will eliminate potential conduits to the subsurface after the remediation is complete. Thus there will be no significant risk to human health or the environment from remaining wastes and/or treated residuals subsequent to completion of the remediation program in the Former Varnish UST Area. Hazardous wastes generated during the remediation program will be transported and disposed or recycled off Site in accordance with applicable law. Therefore, the need for any post-remediation engineering controls in the Former Varnish UST Area is not anticipated.

2.5.3.2 *Varnish Pit Area*

As described above, the remedial strategy is designed to meet applicable SCGs at the Site. The applicable SCGs were promulgated by the NYSDEC for the purpose of protecting human health and the environment. The SSD system will continue to operate until it is demonstrated to the NYSDEC that the system is no longer necessary based on sub-slab soil vapor concentrations. At the conclusion of SSD operation, all piping will be removed and all floor penetrations sealed. All remedial equipment will be removed from the Site thereby eliminating any potential physical hazards associated with abandoned equipment. All remediation wastes generated will be transported and disposed or recycled off Site in accordance with applicable laws. The concrete floor and the Site Management Plan will remain in place as long VOC concentrations in soil exceed the levels for Restricted Commercial use of the Site. Therefore, at the conclusion of the remedy in this area, there are not expected to be any significant threats, exposure pathways, or risks to public health and the environment from remaining wastes or treated residuals. The need for post-remediation engineering controls is not anticipated.

2.5.3.3 Site Ground Water

The institutional control prohibiting the installation of potable supply wells is anticipated to remain in force indefinitely. Ground water monitoring will continue as long as the ground water VOCs remain above the Class GA GWQS, or until discontinued with NYSDEC approval. Therefore, at the conclusion of natural attenuation program, there are not expected to be any significant threats, exposure pathways, or risks to public health and the environment from remaining wastes or treated residuals.

All wells will be abandoned at the conclusion of the monitored natural attenuation program.

2.6 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

2.6.1 Quantification of Mass

2.6.1.1 Former Varnish UST Area

The only chemical present in soil above the Restricted Commercial SCO is xylene at a concentration of 2900 mg/kg at soil boring GB-2. In order to reduce the xylene concentration to the Restricted Commercial SCO of 500 mg/kg, the initial targeted area for heating measures approximately 20 feet by 20 feet (with RF applicators 15 feet apart) centered on soil boring GB-2. This area was selected based on soil boring locations located 25- to 50-feet from GB-2 which contained non-detectable levels of xylene. The heating antennae will extend from approximately 9- to 19-feet below grade to target the interval from the water table (approximately 8-feet below grade) to 19-feet below grade. Therefore, the volume of soil to be treated is approximately 4,400 cubic feet (163 cubic yards). Using a soil density of 1.5 tons per cubic yard corresponds to an estimated mass of soil of 244 tons (222,000 kg). Assuming the average concentration of xylene across the treatment zone is 1,700 mg/kg, the estimated mass of xylenes in the treatment area is 833 pounds. The estimated mass of xylene to be removed to achieve the 500 mg/kg SCO is 588 pounds. However, in practice, the ISTT system cannot be stopped to achieve a specific xylene concentration in soil; rather the ISTT system will operate to remove the maximum practicable mass of VOCs from the treatment zone.

Confirmation soil samples will be collected from the interior and perimeter of the initial heating cell to verify that no VOCs remain outside the heating area above the Restricted Commercial SCO. If the concentrations of xylene (or other VOCs) exceed the SCO at one or more portions of the perimeter, then additional heating will occur at required areas, and this could increase the mass of xylene to be removed.

2.6.1.2 Varnish Pit Area

The continued operation of vapor recovery will reduce the contaminant mass and the mass of any remaining DNAPL or LNAPL. It is difficult to quantify the exact volume remaining. Recent monitoring data presented to the NYSDEC in monthly progress reports demonstrate that measurable DNAPL has not been observed in wells around the varnish pit. At MW-23, LNAPL has been detected at thicknesses generally between 0.1 and 0.3 feet.

2.6.1.3 Site Ground Water

The remaining mass of VOCs in ground water cannot currently be quantified based on uncertainty associated with potential DNAPL in the area beneath the varnish pit. This area will be investigated in late summer 2009. Therefore, an estimate is not provided in this work plan. Routine ground water monitoring results (i.e., related to the ISTT and long-term MNA) will be used to quantify the extent of VOCs in ground water over time.

2.6.2 Evaluation of the Reduction in Toxicity, Mobility and Volume

2.6.2.1 Former Varnish UST Area

ISTT combined with SVE is expected to achieve significant reduction of VOCs through: 1) the aggressive volatilization and boiling of the affected soils and ground water at this location, and 2) recovery of the VOCs via SVE and treatment with activated carbon. The SVE system will be designed such that a vacuum gradient is applied to effectively capture vapors generated by the ISTT system, with volatilized contaminants directed toward vapor recovery wells. This should prevent an increase in the mobility of VOCs.

A concern with the application of ISTT is the potential for increased mobility of the contamination in the event of a power failure or equipment downtime. A condensate front is created along the propagating steam front created from the thermal heating. A highly concentrated dissolved phase of VOCs in the ground water can collect at this interface. A loss of heat in the formation can result in the condensate front collapsing and settling vertically back into the deeper soil matrix. An operations and management plan will be developed with the purpose of minimizing the potential risks associated with power malfunction or system downtime. However, given the soil is largely silty clay, any migration is expected to be minimal, and any condensation will be heated again once the system is operational.

The heating of the silty clay may result in expansion of existing fractures and/or formation of new fractures in soil caused by desiccation. These fractures will assist in enhancing vapor flow pathways towards the vapor collection points. In general, the majority of the heat is expected to propagate horizontally from the RF heating locations. Any significant vertical heat migration is expected to occur upwards, and not to depths much deeper than the bottom of the RF applicators. This is to help limit any downward migration of VOCs from beneath the active area of soil heating.

2.6.2.2 *Varnish Pit Area*

The continued operation of vapor extraction will reduce the contaminant mass by recovering the remaining DNAPL and LNAPL in the vicinity of the Varnish Pit. Following operation of the vapor extraction equipment associated with the former DNAPL Recovery IRM, an active SSD system will be installed. The primary mechanism of this remedy is containment as it is designed to prevent the migration of VOCs from soil and ground water into the building. The SSD system will reduce the mobility of the VOCs by creating a negative pressure under the building and collecting any VOCs that might otherwise migrate into the building interior air. Because these VOCs are being collected and treated with GAC, there will also be some limited mass removal.

The maintenance of the concrete building floor over soil containing VOCs above the Restricted Commercial SCOs will serve to reduce mobility of the VOCs. The floor will prevent the infiltration of water and subsequent leaching of VOCs from the soil to ground water.

2.6.2.3 *Site Ground Water*

Through natural attenuation, there would be a net decrease in the toxicity, mobility and volume of VOCs in shallow ground water. This reduction would be confirmed via ground water monitoring. However, natural attenuation could result in short-term increase in toxicity due to the potential for generation of vinyl chloride from the biodegradation of trichloroethene (TCE). Additionally, the mass of individual VOCs could increase temporarily as natural attenuation progresses.

2.6.3 Treatment Process Completeness

2.6.3.1 Former Varnish UST Area

The ISTT system will result in a remediation that is complete in terms of the permanent removal of constituents of concern. The heating of the soil and ground water is a non-discriminating process and will transfer VOCs (not just xylene) to the vapor phase. Transformations of xylenes, or other VOCs, to daughter products that may be of potential environmental concern are not anticipated. As such, the ISTT system and other aspects of the remedial design for this area represent a complete remedial approach.

2.6.3.2 Varnish Pit Area

The primary mechanism of the SSD system and maintenance of the floor slab is containment. The removal of VOCs by the SSD system represents a remediation that is complete in terms of the permanent removal of constituents of concern from beneath the building. It is possible that chlorinated VOCs in this area could degrade to daughter products, such as vinyl chloride, during the life of this remedy. However, once the VOCs are recovered by the SSD system, treated with activated carbon, and/or discharged to the atmosphere, there is no reversal of the treatment process. As such, the SSD system and other aspects of the remedial design for this area represent a complete remedial approach.

2.6.3.3 Site Ground Water

MNA will result in the eventual degradation of all constituents of concern. All of the daughter products from the anaerobic reductive dechlorination of TCE and 1,1,1-trichloroethane (1,1,1-TCA), namely cis 1,1-dichloroethene (cis-1,2-DCE), vinyl chloride, and 1,2-dichloroethane (1,1-DCA), are present in Site ground water, providing evidence that biologically mediated degradation is occurring at the Site. It is possible that an increase in the concentration of daughter products such as vinyl chloride may be observed, due to differences in the degradation rates of the different compounds. However, ground water data show that the concentration of all of the 1,1,1-TCA and TCE daughter products present in ground water are decreasing under the anaerobic and reducing conditions present in Site ground water. This process is irreversible: chlorinated ethenes and ethanes degrade to primarily carbon dioxide, methane, ethene and ethane, which are released into ground water as gases.

2.7 *IMPLEMENTABILITY*

2.7.1 *Construction*

2.7.1.1 *Former Varnish UST Area*

A limited volume of VOC-affected soil remains to be treated in the Former Varnish UST Area. Construction and installation of the ISST system and its major components (i.e., heating coils, associated equipment and piping, and security fencing, etc.) are not anticipated to encounter significant difficulties that may prevent or inhibit the implementability of the ISST system or reduce its applicability in the Former Varnish UST Area.

2.7.1.2 *Varnish Pit Area*

A significant volume of affected media is present beneath the floor slab of the building in the area of the varnish pit. Removal of the varnish oven has been performed which will enhance the implementability of SSD remedial installations. Additionally, ERM will be investigating for and removing recoverable DNAPL beneath the varnish pit, if any, in the summer and fall of 2009. Significant difficulties with these activities are not anticipated. Therefore, the proposed remedial approach in the Varnish Pit Area is considered implementable.

2.7.1.3 *Site Ground Water*

Site ground water status will be monitored through the use of existing Site wells. Significant difficulties are not anticipated during implementation of the proposed ground water monitoring program.

2.7.2 *Operations and Maintenance*

2.7.2.1 *Former Varnish UST Area*

ISTT system performance will be monitored and recorded. The post-remedial O&M Plan required by Subparagraph I.D of the VCA is not anticipated to contain O&M activities for the ISTT system as operation of the ISTT system will likely be completed before preparation of the Final Engineering Report. Performance of remedial O&M on the ISST system is not anticipated to encounter significant difficulties that may prevent or inhibit the implementability of the remedial design or reduce its applicability in the Former Varnish UST area. After the initial start-up and “de-bug” period, it is anticipated that a digital data and control system will be installed with the ISST system in the treatment system building to allow remote monitoring of primary operating parameters. Remote monitoring will be supplemented with on-site monitoring and laboratory analysis of vapor, recovered liquids, and treated water samples.

During O&M of the ISST remediation system, preventative and special maintenance activities will be implemented, if necessary, to maximize operational time and efficiency. These activities may include additional maintenance, troubleshooting, and materials procurement. Equipment, supplies, materials, and services typically utilized for O&M of the ISST system are readily available from the supplier.

2.7.2.2 Former Varnish Pit Area

As required by Subparagraph I.D of the VCA, a post-remedial O&M Plan will be implemented and included in the Final Engineering Report. Performance of O&M on the SSD system should be routine and is not anticipated to encounter significant difficulties that may prevent or inhibit the implementability of the remedial design or reduce its applicability in the Varnish Pit Area. After the initial start-up and “de-bug” period, a direct digital data and control system may be installed in the treatment building to facilitate remote monitoring of primary operating parameters. Remote monitoring will be supplemented with on-site monitoring and laboratory analysis of vapor, recovered liquids, and treated water samples.

2.7.2.3 Site Ground Water

Maintenance of the existing monitoring well system is presently being performed by ERM personnel. Any additional wells installed to meet project requirements will also be maintained as required by Site conditions.

2.7.3 Agency Coordination/Approvals

No difficulties are anticipated with local authorities having jurisdiction in obtaining the necessary approvals and /or permit modifications for remediation-related activities at the Site. Based on previous discussions with the NYSDEC and as allowed by Subparagraph XIV.E of the VCA, air emissions from Site remedial systems are considered exempt from air permitting requirements because emissions from these sources are considered trivial. However, substantive permit requirements will be met as required in the VCA.

3.0 REMEDIAL PROCESS DESCRIPTION AND IMPLEMENTATION

Several VOCs and SVOCs of potential concern have been identified in Site soil and/or ground water. ERM identified three primary source areas in the DGI Report (ERM, 2003). As outlined in preceding sections of this RAWP, environmental remediation activities are currently being performed and have been completed at the Site to the NYSDEC's satisfaction. ERM evaluated remedial alternatives in the FFS Report (ERM, 2009b) to address affected soil in the Former Varnish UST Area and affected soil/or ground water with localized DNAPL and LNAPL in the Varnish Pit Area. Based on review and approval of the Final FFS Report, the NYSDEC has indicated that ERM's recommended remedial alternatives to address the AOCs are appropriate technologies for use at this Site. In addition, Section 2.0 provides an engineering evaluation that identifies the remedies as appropriate for use at this Site. The following sections outline proposed processes and implementation of the NYSDEC-approved remedial alternatives for the Site.

3.1 Former Varnish UST Area

3.1.1 Affected Area Definition

Data collected during the RI and DGI in the Former Varnish UST Area demonstrate that the xylene concentration of 2,900 mg/kg exceeds the 500 mg/kg Restricted Commercial SCO at soil boring GB-2. Other VOCs were also detected but not at concentrations exceeding the Restricted Commercial SCOs. The proposed area for treatment is shown in Figure 9.

3.1.2 Remediation Process Objectives

ISTT combined with SVE will be implemented to treat xylene-affected soil. Xylenes remediation will occur by increasing the subsurface temperature such that the xylenes will volatilize in situ and then be captured by the SVE system. The heat generated will improve contaminant flow characteristics and facilitate subsequent separation and removal of the contaminants from the soils. The mixture of xylenes and water will be mobilized to the vapor phase, migrate toward the vadose zone and be captured and treated by an SVE system. The remediation goal will be considered to be achieved once xylene concentrations in soil are less than the Restricted Commercial SCO of 500 mg/kg.

The subsurface temperature will be increased to the calculated azeotropic temperature of the xylene/water mixture at the Site, which is estimated to be approximately 80 degrees Celsius (°C). This is the estimated temperature at which volatilization of xylenes from ground water at the Site should be at its maximum practical efficiency.

Other contaminants, although not drivers for the remediation, may also decrease in concentration due to the heating. Some compounds (i.e., 1, 1, 1-trichloroethane) will be degraded in place by natural in situ processes that may include biodegradation and hydrolysis. Other compounds (i.e., benzene) will also be volatilized and captured by the SVE system.

3.1.3 Radio Frequency Heating (RFH) Process

Controlled in-situ heating of the affected area will be achieved using RFH technology. Production of heat using this technology relies on the absorption of electromagnetic energy by polar molecules (such as water and contaminants) in the formation. An RF wave propagates through the formation and heat is generated as a response of the electric charges to the applied electric field. Dipoles (i.e., water and contaminants) resonate in the sinusoidal field and extract energy from the field as it propagates, which generates selective heating in the formation. This is a phenomenon similar to the microwave principle but at lower frequencies. RFH operates at frequencies of 30 to 300 megahertz (MHz), whereas microwaves are in the 0.3 GHz to 300 gigahertz range.

Heating depends on the dielectric loss and dielectric constant of the encountered material. The combination of these two dielectric parameters controls the depth of energy penetration and therefore the size of the heated volume:

- The dielectric constant controls the wavelength of the electromagnetic energy in the material and indicates how the heat is distributed throughout the volume.
- The dielectric loss controls the amount of RF energy absorbed by the material.

The RF power required for dielectric heating is approximately proportional to the number of cubic yards of material heated. Heating times for thick sections of material need to be no longer than for thin ones provided that there is available sufficient power per cubic yard.

RFH System Equipment

The key elements for the application of subsurface RFH are:

- a subsurface borehole antenna(s);
- an impedance matching network (transmission lines); and
- an RF generator.

The RF generator will supply energy through coaxial lines to multiple electromagnetically-coupled down-hole antennas. The subsurface material between the antennas will then increase in temperature as it absorbs the electromagnetic energy radiating from the antennae. The impedance matching network (tuner) will be situated between the RFH generator and the coaxial cable to ensure that power from the RFH generator is efficiently delivered to the applicators.

The RFH generator will deliver variable power up to a total of about 20 kilowatts through four antennas (5 kW (kilowatts) per antenna) at the ISM (Industrial, Scientific, and Medical) frequency of 27.12 MHz. The generator and its associated monitoring equipment will be mounted in a 16-foot-long enclosed trailer. The photographs below show a typical RF trailer and controls. Figure 8 (Radio Frequency Heating System Components) presents a typical RF heating component flow diagram.

Data for analysis and control of energy consumption, antenna efficiency, and operating condition of the ISTT system will be collected in a computer located in the on-site trailer.

The antennas are expected to be 3-1/2 inches in diameter and 15 feet long. The RF energy emanating from the antennas will propagate horizontally and perpendicular to each antenna, creating a "cylinder" around each antenna.

RFH System Bench Scale Testing

RFH bench scale testing was conducted on representative soil samples from the Former Varnish UST Area. The testing area was completed to further understand the dielectric loss and constant, which are two fundamental parameters in the design of an in-situ RFH system. Four soil samples from two locations (GB-2A and GB-2B, see Figure 3) were collected at varying depths with a Geoprobe. The four samples and were sent to KSN's laboratory for analysis. The following table summarizes the sample details.

Location	Sample Depth	Soil Description
GB2A	4 – 6 ft	Marbled medium brown and grayish brown clay and silt, some fine sand
	10.5 – 12 ft	Marbled reddish brown and grayish brown clay and silt, firm, wet
	Soil saturated below 12 feet	
GB-2B	8 – 10 ft	Marbled reddish brown and grayish brown clay and silt, firm, moist
	16 – 18 ft	Reddish brown silt and clay, saturated, very soft
	Soil saturated below 15 feet	

Soil characteristics measured during the bench-scale test at the ISM frequency of 27.2 MHz (frequency used for the remediation) are presented in the following table. Photographs of the bench-scale test and test result graphs are presented in Appendix B.

Location	**GB–2A**			**GB-2B**	
Depth (ft)	**4 – 6 $_{dry}$**	**4 – 6**	**10.5 – 12**	**8 – 10**	**16 - 18**
Relative Dielectric Constant (εr)	5.6	25.4	27.0	26.5	35.6
Conductivity (σ, S/m)	0.003	0.058	0.045	0.049	0.090
Loss Tangent (Tanδ)	0.3	1.5	1.1	1.2	1.6
Skin Depth (Δ, m)	1.8	0.4	0.5	0.5	0.3
Wavelength (λ, m)	4.6	1.8	1.9	1.9	1.5

Frequency: 27.2 MHz
Dry: the sample was let dry on a bench for 9 days.

Soil samples GB2A (4-6ft), GB2A (10.5-12ft), and GB2B (8-10 ft) had similar dielectric characteristics, and an average of the parameters for those samples was used to run a single simulation. Another simulation was run with the characteristics of the GB-2B sample, which had different characteristics than the other three samples.

Dielectric properties of the soil samples analyzed confirm the following principles that will be taken into account in the design:

- The relative dielectric constant of the formation increases with water saturation. The deeper the formation (deeper the saturation), the smaller the skin depth and wavelength will be.
- The conductivity of the formation increases with water saturation. As the soil is dried out by heating, the conductivity will decrease near the applicator borehole, allowing the electric field strength to propagate further away from the antenna.

KSN ran a simulation to estimate the time needed for soils to reach 80ºC in a 15-foot and 20-foot square treatment cell. It was assumed that as the temperature increased the water content in the soil would decrease and the depth of penetration of the wave would then increase. For a 15-foot by 15 foot square treatment cell, it is currently estimated that it may take up to six weeks for the whole treatment cell to reach 80ºC, with some areas reaching the targeted temperature earlier than others.

RFH System Antennae Layout

ISTT will start using a treatment cell configured in an approximate square shape with spacing between antennae boreholes of approximately 15 feet. This first treatment cell will be centered on soil boring location GB-2, which had the highest xylene soil concentration to date. A second RF treatment cell may be installed if needed after heating of the first cell. This second cell, if required, will have the RF antennas spaced approximately 20 feet apart, with one RFH location at GB-2. Figure 9 (Site Detail and Proposed Treatment Area – Former Varnish UST Area) shows the estimated locations of the RFH antennas for the proposed treatment cells. A total of eight RFH wells will be initially installed. Four locations will be used for the RF antennas and four locations will be used as monitoring points.

RFH Well Applicators Design

Each antenna placement well will be installed a maximum depth of 18-feet bgs. The depth interval from 7-feet to 18-feet bgs will be treated. Each RFH antenna well will be 4-inches in diameter and will be constructed with 11-feet of screen and 7-feet of riser. The wells will be constructed of fiberglass or similar material to withstand elevated temperatures. A clean, medium-grained quartz sand pack will be placed around the screen in the annulus of the wells and will extend at least one foot above the top of the screened interval. A high-temperature bentonite seal will be placed in the annular space above the sand pack to minimize vertical migration of surface water runoff which could cool soil in a treatment cell and minimize vapor migration to the surface. Each well will be finished with a lockable expansion cap with a flush mounted curb box to protect the wells and minimize short circuiting of the SVE system.

Other RFH Design Considerations

The approximate treatment area will be paved prior to completing the drilling activities. The asphalt will increase the effectiveness of the SVE system and will help to reduce the likelihood of fugitive volatilized contaminant vapors of reaching the atmosphere.

A chain-link security fence will be installed around the perimeter of the treatment area. The enclosure will be secured with access limited to authorized personnel only and will have appropriate signs indicating potential hazards. This fence will also be used to ground the RFH system. A surficial wire mesh may also be needed for additional grounding for the RFH system.

Soil Vapor Extraction (SVE)

An asphalt cap and SVE system will be designed to collect volatilized contaminated vapors as a result of ISTT and to prevent migration of vapors from the treatment area to other areas. SVE uses wells that are screened through the unsaturated zone for the extraction of soil vapors. A vacuum is induced at the extraction well, thereby inducing a pressure gradient, which in turn produces vapor flow through the unsaturated zone.

Preliminary calculations completed using the Division of Air Resources (DAR) DAR-1 *Guidelines for the Control of Toxic Ambient Air Contaminants* indicate that off-gas treatment may not be needed during the ISTT remediation. Additional data collected during RFH and SVE well installation will help to further develop these calculations and assess the need for off-gas treatment. The preliminary remediation system design assumes that off-gas treatment is needed. The off-gas treatment will have a bypass in case it is not needed throughout the treatment duration. It is possible that the off-gas treatment system may be removed before remediation is completed.

Vertical SVE wells will be installed in proximity to the RFH wells. The exact location will be finalized in the detailed design, but the RFH and SVE wells will be placed to demonstrate control over the treatment area, maximize vapor capture, and minimize heat loss from the subsurface. The system will also be designed such that the configuration of active vapor extraction wells can be modified if necessary to accommodate changes to the area being heated. The SVE wells are anticipated to be constructed of

2-inch fiberglass and screened between 5- and 15-feet bgs. Aboveground piping will lead from each SVE well to an on-site treatment trailer. The above-grade portions of the SVE wells and associated piping will be heat traced and/or insulated as necessary. The aboveground piping will lead from each SVE well to a manifold located in the western portion of the treatment area. A single header pipe will then go from the manifold to the treatment trailer.

The main goals of the SVE system are to recover contaminant mass that has been volatilized from the subsurface and to prevent vapors from migrating outside of the treatment area. Monitoring points sufficient for observation of differential pressure readings and vapor concentrations will be installed within and around the perimeter of the treatment area to facilitate demonstration of vacuum control over the entire heating area.

The SVE system will be a skid-mounted system containing the primary SVE components and associated piping, pumps, valves, and controls. The SVE equipment and associated piping will be contained within the security fence around the treatment area. Figure 10 shows a process flow diagram for the SVE system. The SVE components will include a heat exchanger, a moisture separator, blower, and GAC. An additional heat exchanger or moisture separator may be specified if necessary to achieve vapor-phase pre-conditioning that optimizes GAC efficiency. Breakthrough in the first vessel will prompt change-out to ensure treatment prior to discharge, if necessary. Vacuum pump and/or blowers will be used to extract the vapor through a series of over heading and subsurface pipes to the treatment building located in the southwest corner of the facility (Figure 2). The vapor stream will be pre-conditioned to maximize absorption to GAC prior to discharge.

Recovered liquids from the moisture separator and the carbon vessels will be directed to a temporary holding tank for disposal. This water will either be treated on site or disposed off site. If necessary based on the results of updated DAR-1 calculations to be performed after initial system start-up, the vapors will be treated via two GAC vessels located in primary and secondary positions. A third vessel will remain on stand-by until breakthrough occurs on the primary vessel. The vapors will be directed to the carbon units for contaminant absorption prior to discharge to the atmosphere. Sample ports located at the influent, midpoint, and effluent of the active GAC canisters will allow for vapor monitoring during operation. Samples will be collected on the first two days of RFH system operation, then weekly for 2 weeks, and then monthly.

Controls/Interlocks/Instrumentation

The controls/instrumentation system shall consist of the devices and interlocks required to maintain continuous RFH system operation with the ability to perform a system shutdown if any of the operating conditions are out of normal operating range. It is currently envisioned that main control system components may include a telemetry system for remote interrogation of the system, automatic notification of alarm conditions, and system data logging to provide information related to O&M.

The system will also have an interlock that shuts down the RFH system if the SVE system goes down. Staff will be available 24-hours a day and 7-days a week to respond to the Site, trouble-shoot SVE system issues, and re-initiate SVE system operation as soon as possible. A back-up SVE unit with similar specifications as the primary unit will be made available within approximately 48 hours if the SVE system issues are major and the primary SVE unit cannot be re-started within 48 hours.

3.2 VARNISH PIT AREA

Soil and ground water in the vicinity of the varnish pit are potential sources of VOCs in soil gas beneath the building. The temporary SSD system is currently operating at the Site in this area as a temporary mitigation.

As part of the final remedy, a full scale SSD system will be installed to lower the sub-slab air pressure relative to building indoor air pressure such that soil vapor with VOCs will be directed through piping to be released to the atmosphere above the roof level. In this manner, sub-slab vapors will be prevented from infiltrating the building. The full scale SSD system will consist of new vertical and horizontal suction points. Each suction point will consist of a pipe inserted through the floor slab (or varnish pit wall) and terminating in a small void space directly below the slab (or behind the varnish pit wall). The suction points will be piped to externally-mounted vacuum blower(s) located in the on-Site treatment building that will draw soil vapor from beneath the building slab to an exhaust point(s) above the roof of the building. Depending on the characteristics of the extracted vapors, air emission controls may be necessary. In addition, an attempt will be made to seal all cracks in the floor slab to the extent practicable.

According to the American Society for Testing and Materials (ASTM) "Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings", the depressurization goal is to maintain

0.025- to 0.035-inches water column (w.c.) vacuum beneath the building slab when the inside and outside air pressure are the same (e.g., when the building doors are open). For this SSD system, the performance goal will be to maintain a minimum sub-slab vacuum of 0.025-inches w.c. across the building footprint.

The following data were obtained during the DNAPL Recovery IRM pilot test while extracting air from RW-2 at a vacuum of 40.15 inches w.c., and measuring the observed vacuum at varying horizontal distances from RW-2. The air flow rate during this testing was 41 cubic feet per minute (cfm).

Distance from RW-2 (ft)	Vacuum (Inches w.c.)
0.00	40.15
8.00	3.00
15.00	0.99
17.00	0.80
32.00	0.035

By extrapolating these data, it would be estimated that an applied vacuum of 40 inches w.c. will generate an air flow of 41 cfm while attaining the 0.025-inches w.c. depressurization goal at a distance of 34 feet from the suction point. Based on the size of the building (approximately 140,000 square feet), the 34-foot radius of influence, and an estimated 25% overlap in suction point spacing, a total of 50 suction points may be necessary. This would necessitate a blower that could generate at least 2050 cfm at a vacuum of 40 inches w.c. However, this is anticipated as a conservative value. The pilot test well and observation points have screened zones that vary anywhere between 5 and 20 feet below grade (e.g., below the top of the floor slab). In a full-scale system, an approximate four-inch nominal diameter pipe will be inserted through the building floor slab, and suction will be applied directly below the slab. In addition, significant variation can exist in soil type and permeability beneath large commercial buildings. Lastly, any impediments to subsurface air flow (e.g., foundation walls, pilings, haunched floors, etc.) are unknown. For these reasons, additional pilot testing will be necessary to fully define the air flow characteristics immediately beneath the building floor in multiple areas of the building.

3.2.1 *Pilot Testing for SSD System*

A pilot test will be implemented prior to installation of the full-scale SSD system as part of a detailed design. The purpose of the pilot test is to evaluate the air flow at various locations beneath the floor slab, and determine the air flow and applied vacuum necessary to achieve the depressurization goal of 0.025-inches w.c. vacuum. Figure 11 depicts the proposed SSD system pilot test program.

Testing will be conducted at approximately seven locations within the building. A test suction point will be created by coring a hole through the slab in order to allow for passage of a 2- or 4-inch pipe. To promote sub-slab air flow, a 10- or 12-inch radius recess (suction pit) will be created in the gravel or soil beneath the slab. The properties of the fill beneath the slab – soil type, compaction, and the presence of water – will be noted. An open end pipe section (anticipated to be two to six-inch PVC Schedule 40) will be inserted into the penetration. The annular space of the penetration will be grouted with a non-shrinking material in order to prevent short circuiting of the flow path. The piping will be connected to a blower with flexible hose. The blower will exhaust vapors through GAC and discharge to the atmosphere outside the building at a height of approximately 10-feet above ground surface. As noted in Section 2.7.3, and in accordance with the VCA, this is considered a trivial activity that is not subject to air permitting requirements.

The selected blower will be able to achieve a minimum of 41 cfm at an applied vacuum of 40 inches w.c. at the suction point (estimated 1 to 2 horsepower). Vacuum monitoring points (VMPs) will be created by drilling small (approximately 3/8-inch) holes through the slab. The drill will also be used to create a small (10- or 12-inch) void below the slab. Tubing will be inserted through the hole and the annular space will be sealed. VMPs will be located at distances of approximately 10 feet, 30 feet, 50 feet, and 70 feet around each suction point. Ideally, the VMPs will be located radially outward from each suction point in four different directions. However, it is recognized that the final location of the VMPs will be limited by the building construction and current Greif production operations. Therefore, the exact number of suction points and observation points will be determined in the field during actual installation and testing.

At each suction point, approximately three tests will be conducted at a low, intermediate, and high applied vacuum. During each of these three tests, the air velocity will be monitored in a straight length of pipe which measures a minimum of 10 pipe diameters upstream, and five pipe diameters downstream of the measurement port. The vacuum response will be measured at each VMP in the vicinity of the suction point using Magnehelic-type differential pressure gauges. The data gathered at each suction point may be used to modify testing at subsequent suction points.

The extracted vapors from all suction points will field-screened for VOCs with a PID or FID. The vapors extracted from two suction points will be collected for laboratory analysis in order to evaluate air emissions from the full-scale SSD system. One sample will be from a suction point in the vicinity of the varnish pit as this area is anticipated to have the highest concentration of VOCs. The second sample will be collected from a suction pit on the opposite (i.e., eastern) side of this building. The samples will be analyzed for VOCs by USEPA Method TO-15 or TO-17. The results will be used to evaluate whether or not treatment is necessary, and if so, they will also be used to design a full scale emission control system using GAC.

Also, during this testing phase, combustion units and other ventilation appliances where backdrafting could occur will be identified (e.g., boilers, exhaust fans, fume hoods, etc.). Vacuum measurements and/or smoke tests may be conducted to determine if the sub-slab vacuum is interfering with the proper ventilation of these devices.

At the conclusion of the testing, all pipes and tubing will be removed and the floor sealed, or the piping/tubing will be left in place and sealed for use in the final SSD system design. All soil generated will be containerized and characterized for proper disposal. The activated carbon will also be sampled for waste classification and will be disposed off-Site.

3.2.2 *Full-Scale SSD System Installation*

Using the results of the pilot test, a blower size and spacing will be selected in order to achieve the depressurization goal of 0.025-inches w.c. vacuum to the extent practicable. In order to limit disruption to the facility, the location of suction points and piping will be reviewed with the facility operator. Additional suction points, if necessary, will be installed using a similar approach as during the pilot test. Near each suction point a small (approximate 1/8-inch) petcock valve will be installed for the purpose of sampling extracted vapors and for measurement of vacuum and flow rates. Adjacent to each suction point, an in-line butterfly valve will be installed for purposes of flow adjustments and system balancing.

The Varnish Pit is in the process of being closed, backfilled with gravel, and sealed with concrete floor. This work will be completed prior to the installation of the SSD system. Three holes are being cored through the varnish pit walls to allow installation of screens outside of the varnish pit walls. Additionally, a 4-inch PVC screen will be placed below the final floor to serve as another suction point for the backfilled varnish pit.

SSD system piping will be run overhead as inconspicuously as possible along structural support beams and floors and will manifold together upstream of the vacuum blower(s). The blower is anticipated to be housed in the existing treatment building. The manifold pipe is anticipated to be 6-inch PVC Schedule 40 or greater. Existing horizontal piping previously installed between the varnish pit and the treatment building will be incorporated into the design. If necessary based on the results of updated DAR-1 calculations, the exhaust from the blower will be directed through two GAC vessels connected in series. A third carbon vessel will be available as a stand-by. This will enable one vessel to be taken off-line for a changeout of the carbon without interrupting the operation of the full-scale SSD system. The size of the carbon vessels will be determined based on the results of the pilot testing. The exhaust will be discharged through the existing stack for the treatment building such that the exhaust point is at least:

- 12-inches above the building roof;
- 10-feet above the ground surface;
- 10-feet away from any opening that is less than 2-feet below the exhaust point; and
- 10-feet from any other building, window, or building air intake.

Section 4.2.2 (c) (9) of the NYSDOH Soil Vapor Intrusion Guidance Document (NYSDOH, 2006) indicates that a warning device or indicator shall be provided to alert the building occupants if the SSD system is not working. To comply with this requirement, a warning light will be provided in a location visible and accessible to the building workers. This light will be activated whenever the blower is offline. The blower will designed to shut down during either of the two situations:

- high differential pressure across the blower, which would be indicative of a blockage on either the suction or discharge side of the blower; or
- high temperature at the blower discharge.

The operator of the SSD system will be automatically contacted when the blower shuts down via an autodialer. In addition, the system piping will be identified with labels as to their purpose and flow direction.

When the installation is complete, post-installation confirmation testing will be performed as described in the following section. All soil generated will be containerized and characterized for off-Site disposal.

Figure 12 provides a schematic for the anticipated full-scale SSD system. However, the results of the pilot testing will be the determining factor in finalizing the design of the SSD system.

3.2.3 *Confirmation Testing*

Confirmation testing (similar to the pilot test) will also be conducted to ensure the SSD system is achieving the sub-slab depressurization goal of 0.025-inches w.c. vacuum under the building slab. Small (approximately 3/8-inch) holes will be drilled through the floor to create new VMPs, and/or existing VMPs will be utilized.

Vacuum measurements will be collected at these locations. If the test shows sub-slab vacuums less than the depressurization goal, attempts will be made to correct the situation. Possible corrective measures include adjusting flow rates of soil vapor individual suction pits, increasing the size of the suction pit, adding additional suction pits, and adding an additional blower. If, after implementing corrective measures, the SSD system still is not meeting the depressurization goal, a monitoring program will be implemented to determine the concentration of VOCs in the sub-slab vapors and indoor air in the vicinity of any areas of inadequate depressurization. This sampling would be conducted during the heating season, and ideally between 30 and 90 days after installation. At least 30 days will pass before collecting samples. Approval will be obtained from the NYSDEC before collecting these samples. The results will be evaluated with the NYSDEC to evaluate potential risks posed by VOCs in the sub-slab vapor and indoor air in the vicinity of areas where the depressurization goal is not attained, and the need for further action.

Similar to the pilot testing phase, building combustion and ventilation appliances will be evaluated to determine if the SSD system is contributing to backdrafting of any of these appliances. Also, during this testing phase, all controls and warning devices will be tested to confirm proper operation.

3.2.4 *Post-Installation Activities*

Following installation, an Operations, Maintenance, and Monitoring (OM&M) Plan will be prepared for the SSD system. Routine OM&M will be conducted by an environmental consultant on a monthly basis. The SSD system will be visited monthly to collect field VOC measurements from the SSD outlet and ensure the proper operation of the SSD system. Vapor samples would also be collected on a semi-annual basis from the VOC off-gas treatment system and analyzed via USEPA Method TO-15 or TO-17. Samples would be collected from sample collection points on the VOC off-gas treatment system. The SSD system will continue to operate until it is demonstrated to the NYSDEC that the system is no longer necessary based on sub-slab soil vapor concentrations.

After successful installation, documentation will be provided to the property owner to facilitate understanding the system's OM&M. This package will include the following:

- a description of the mitigation system installed and its basic operating principles;
- how the owner or tenant is to check that the system is operating properly;
- how the system is to be maintained and monitored and by whom;
- a list of appropriate actions for the owner or tenant to take if the system's warning device indicates system degradation or failure;
- contact information (e.g., names, telephone numbers, etc.) if the owner or tenant has questions, comments or concerns;
- copies of contracts and warranties; and
- a description of the proper operating procedures of any mechanical or electrical system installed, including manufacturer's operation and maintenance instructions and warranties.

A contact person’s name and telephone number will be affixed near the warning light, should the facility employees have questions or concerns.

3.3 MONITORED NATURAL ATTENUATION

MNA is the reliance on natural attenuation processes to achieve Site-specific remediation objectives within a time-frame that is reasonable compared to that offered by other more active methods. Performance monitoring, in the form of ground water sampling, is an essential component of this remedy to ensure Site-specific remediation objectives are achieved. Natural attenuation processes include biodegradation, dispersion, sorption and volatilization. To evaluate these processes, field and laboratory analytical data was collected during the DGI and has been collected during quarterly ground water sampling events that were initiated in January 2006, following the completion of the Soil Excavation IRM in the FDSA/ Soil Boring GB-10 Area (ERM, 2006). These data show evidence of natural attenuation of the chlorinated VOCs through reductive dechlorination.

TCE and 1, 1, 1-TCA are the primary chlorinated VOCs of concern at the

Site. TCE and 1, 1, 1-TCA can naturally attenuate in the subsurface through a number of mechanisms including absorption, dispersion, volatilization and degradation. Mass loss of TCE and 1, 1, 1-TCA occurs through both biological and abiotic degradation pathways. For TCE and 1, 1, 1-TCA, biological degradation through reductive dechlorination is often the major degradation pathway. Reductive dechlorination involves the removal of chlorines from chlorinated compounds in a process that yields energy for the mediating microorganism. The sequential chlorine removal results in the production of lesser chlorinated daughter products:

TCE $\rightarrow$ cis-DCE $\rightarrow$ vinyl chloride $\rightarrow$ ethene

1, 1, 1-TCA $\rightarrow$ 1, 1-DCA $\rightarrow$ chloroethane $\rightarrow$ ethane

In addition to reductive dechlorination, the chlorinated daughter products (e.g., cis-DCE and 1, 1-DCA) also biodegrade through other anaerobic and aerobic pathways, such as reductive oxidation and aerobic cometabolism. Vinyl chloride and chloroethane also biologically degrade aerobically.

Abiotic degradation pathways are also important attenuation mechanisms. 1, 1, 1-TCA degrades abiotically to acetic acid and 1, 1-DCE, and chloroethane hydrolyzes to non-chlorinated products. Metal-catalyzed reductive degradation pathways may also be important for TCE, 1, 1-DCE and other chlorinated compounds.

Cis-1,2-DCE and 1,1-DCA, which are the initial chlorinated daughter products of the reductive dechlorination of TCE and 1,1,1-TCA, respectively, are present in significant concentrations in Site ground water. 1, 1-DCE and the vinyl chloride are also present in Site ground water. The daughter products of the reductive dechlorination of TCE and 1, 1, 1-TCA has generally shown slight fluctuations through the first six rounds of quarterly sampling.

Data from ground water sampling events shows evidence of continued natural attenuation of the chlorinated VOCs through reductive dechlorination. MNA evaluations documented in the DGI Report and subsequent quarterly ground water sampling events (ERM, 2009a) suggests that natural attenuation processes may be capable of advancing remediation of shallow and intermediate ground water once source areas have been addressed.

4.0 REMEDIATION EFFECTIVENESS

This section addresses the parameters, conditions, procedures, and protocols to determine the effectiveness of the remediation, including a schedule for periodic sampling of ground water monitoring and recovery wells on Site.

The performance goals can be summarized as follows:

1. reduce the concentration of the Site-specific VOCs of potential concern in subsurface soil to Restricted Commercial SCOs.
2. reduce the concentration of VOCs in ground water as specified in Section 1.3.

The effectiveness of the Site remediation program will be evaluated by the following criteria:

1. measurements of the concentrations of the Site-specific VOCs in extracted soil vapor and ground water; and
2. confirmation soil samples.

4.1 SYSTEM PERFORMANCE

4.1.1 In-Situ Thermal Treatment and SVE System

The objective of the remediation is to reduce the concentration of xylenes in the Former Varnish UST Area soil to the Restricted Commercial SCO of 500 mg/kg. To reach this objective it is expected that the ISTT system will heat the mixture of xylene and water to approximately 80ºC and that the SVE system will recover associated vapors.

The performance of the ISTT and SVE systems will be evaluated by the following main criteria:

- field measurements of soil and ground water temperatures;
- laboratory measurements of the xylene concentrations in soil;
- laboratory measurements of the xylene concentrations in ground water; and
- measurements of the xylene concentrations in extracted soil vapors (field screening and laboratory analysis).

<u>RFH System - Power delivery</u>

The RFH antennae are designed to optimize distribution homogeneity and achieve uniform heating. It is expected that over 90% of the RF power will be transferred from the generator to the antennas.

The RFH applicator's efficiency in delivering RF energy to the formation will be determined by measuring its return loss. Return loss is a measure of the amount of transmitted power reflected back from each antenna, and it is measured in decibels (dB). Return loss will be measured continuously during RFH by a vector voltmeter.

Formation Temperatures

Temperature readings will be taken in soil and ground water to document temperature increases and distribution. A subsurface temperature monitoring and data logging system will be used. Temperature sensors will consist of fiber optics and/or loop-controlled transmitters. These sensors will be placed in monitoring wells. The sensors will be placed at various radial distances from the antennas with the locations finalized during the detailed remedial design phase.

The thermocouple strands will be connected by a series of converters linked to a central computer located in the RFH trailer. Access to the temperature logging computer will be allowed using remote desktop. Procedures for ensuring the system's reliability and accessing the computer remotely will be developed during detailed phase of the remedial system.

Surface radiation loss may be encountered and will be reduced by covering portions of the treated area in close proximity of the RF heating wells with thermal blankets or grounding mesh. Surface temperatures will be monitored using a held-held infrared thermometer.

Xylene Concentrations

The effectiveness of the remediation program is ultimately confirmed when xylene concentrations in soil are less than the Restricted Commercial SCO of 500 mg/kg. Effectiveness will generally be screened by measuring ground water and extracted vapors.

As soil contamination levels are reduced, dissolved phase concentrations in ground water (resulting from partitioning, leaching or other mechanisms) should also decline. Concentrations will be monitored in existing and new wells screened at depth intervals relevant to the impacted area. At ambient ground water temperatures, xylene is not very soluble. However, solubility will increase as subsurface heating occurs. This increase will be considered during the detailed design of the RFH and SVE systems to maximize recovery by the SVE system and minimize xylene mobilization.

Extracted vapors will be regularly monitored using a PID/FID and periodically sampled for laboratory analysis. These data will be used to track remediation performance by estimating the amount of VOCs removed from the subsurface. Readings will be taken at each SVE point and at the inlet of the first GAC vessel. As source area residual concentrations in soil and ground water are reduced by the remediation process, vapor concentrations should also decline.

4.1.2 Sub-Slab Depressurization

Section 3.2 describes the methodology for assessing the ability of the SSD system to achieve the depressurization goal of 0.025-inches w.c. beneath the building slab. After the initial performance of the full-scale SSD system is confirmed, vapor samples will be collected on a semi-annual basis from the outlet of the blower and all carbon vessels. The samples will be analyzed for VOCs using USEPA Method TO-15 or TO-17. The data will be utilized with the NYSDEC DAR-1 Ambient Air Quality Impact Screening Analyses to periodically assess the need for air emission controls. If the screening shows that air emission controls are no longer necessary, the GAC vessels will be taken offline. These data will also be used to identify trends in sub-slab vapor concentrations and to indirectly assess the performance of the other remedial measures.

On an annual basis, a registered New York State professional engineer will inspect the system and prepare a certification of the SSD system operation for submittal to the NYSDEC. This certification will affirm that the SSD system is still operating as designed, and nothing has occurred that would impair the ability of the system to protect the public health and environment, or constitute a violation or failure to comply with the O&M plan for the SSD system. As part of the certification process, vacuum measurements will be collected from various locations beneath the slab to confirm the continued achievement of the depressurization goal. If the vacuum beneath the slab is found to be less than the depressurization goal, the procedure outlined in Section 2.1.2 will be followed.

The SSD system will continue to operate until it is demonstrated to the NYSDEC that the system is no longer necessary based on sub-slab soil vapor concentrations.

4.1.3 Monitored Natural Attenuation

The ground water monitoring program for this portion of the remedy is provided in Section 4.3.4. The ground water geochemical data collected during monitoring will be evaluated to assess trends and attenuation rates as the remedy progresses and will be used to predict when remediation goals will be met. Remedial decisions will be made as the remedy progresses including:

- continuation of the monitoring program without change;
- modification of the monitoring program to reflect changes in Site conditions; and/or
- recommendation of a contingent remedy.

Evaluation of MNA data will be reported in ground water monitoring reports. Post-remedial ground water monitoring is expected to commence after completion of ISTT.

4.2 OPERATION AND MAINTENANCE

4.2.1 In-Situ Thermal Treatment Operational Monitoring

Following start-up and testing, the ISTT system will be operated and monitored to assess the performance of the remediation systems. This task includes weekly Site visits for routine OM&M and monthly Site visits by the ISTT subcontractor to assess the operation of the RFH and SVE systems.

In addition to scheduled on-Site field personnel monitoring activities, a direct digital data and control system will be installed to remotely monitor the system primary operating parameters. This will allow response to changes in system operating parameters promptly and efficiently. It is currently expected that the following parameters will be able to be recorded remotely:

- down hole temperature readings;
- antennae temperatures;
- RFH power levels; and
- RFH return loss.

Maintenance activities will be implemented to facilitate maximum system up time and reliability. The preventative services include any expected or upcoming maintenance activities. The special services include any unexpected maintenance and will include troubleshooting, materials procurement, and communication with the project engineer.

Pertinent measurement locations, field record forms, and data flow procedures will be determined in the detailed phase of the remedial design. The following parameters will be recorded during OM&M activities:

- **RF emission readings** *(Weekly and at each site visit)* – RF emissions readings at ground surface will be measured and recorded when the RFH system is operating.
- **Surface temperature readings** *(Weekly and at each site visit)* - Temperature readings will be collected to evaluate temperature loss through surface radiation and confirm safe condition for those working in the treatment area.
- **Extracted vapor readings** *(Weekly)* – Readings will be taken in the field by accessing each SVE sample port and inlet/outlets of the activated carbon vessels using a hand pump to fill a dedicated Tedlar bag. A portable PID or FID will then be used to take a reading of the air collected in the Tedlar bag.
- **SVE system vacuum and air flow readings** (*Weekly*) – Readings will be collected using differential pressure gauges to measure the vacuum that has been applied by the SVE system to capture volatilized compounds and demonstrate that the treatment area is under vacuum control. These readings will also help to determine if maintenance is needed (i.e., need to change the air filters for dilution air to the blower).
- **Ground water level readings** (*Weekly*) – Ground water gauging will be conducted to assess to what extent the RFH system is desiccating the subsurface or influencing Site hydrogeology.
- **Remediation water treatment system parameters** (*Monthly or as needed*) – Samples of collected condensate will be sampled for total VOCs and waste characteristics as required for disposal.
- **Extracted vapor sampling for laboratory analysis** *(Monthly following start-up)* – SVE system air samples will be collected using sorbent tubes or Summa canisters from the GAC influent, midpoint, and effluent for analysis by an accredited laboratory by USEPA Method TO-15 or TO-17. The results will be used to evaluate the effectiveness of the SVE system, calculate mass removal by the off-gas treatment system, and evaluate the need for carbon change-out.
- **Ground water sampling for laboratory analysis** *(Monthly)* – Baseline ground water sampling will be conducted prior to RFH system operation. Monthly ground water samples will be collected during the remediation from existing wells to evaluate changes in concentrations over time. Normal and quality control ground water samples from RFH wells or monitoring well locations in the vicinity of the area being heated. Samples will be analyzed by an accredited laboratory for USEPA Method 8260.

- **Soil sampling for laboratory analysis** *(During RFH*) - Soil borings will be installed using hydraulic push drilling methods at locations near original (pre-remediation) soil sample locations to allow evaluation of the effectiveness of the ISTT soil remediation in reducing VOC concentrations in soil. ERM currently anticipates two soil sampling events in the treatment area, one event during active ISTT and one event of confirmation samples to document that the Restricted Commercial SCO has been attained.

The following summarizes planned maintenance for the major components of the SVE and RFH systems:

- check the control panel for running status;
- check for leaks on the SVE piping system;
- contact the system remotely to check system for operation for:
  - alarms; and
  - operating conditions.
- check the volume of consumables (i.e. oils, bag filters, etc.);
- check for excessive noise of various components;
- check for alarms on the HMI screen under the alarm tab;
- check and record flow rates, vacuums, pressures, temperatures;
- check for corrosion and grease the moving parts; and
- balance system valves when required.

<u>RFH System</u>

- Replace air filters; and
- check integrity of fiber optic cables, coaxial cables, etc.

<u>SVE Blowers</u>

A program of consistent inspection and maintenance will be implemented to minimize repairs to the SVE blowers. The anticipated basic service needs are as follows:

- lubrication;
- inspection and cleaning of the inlet air filters;
- checking for increases or changes in vibration and noise;
- recording of operating pressures and temperatures; and
- any performance related maintenance recommended by the manufacturer.

Moisture Separators

The moisture separator(s) will collect condensation extracted from the SVE wells. The tank(s) will be kept in service at all times. Maintenance of the moisture separators will be performed as follows:

- the outside of the tank will be visually inspected for leaks;
- any level switches will be tested; and
- the tank will be checked and cleaned (if necessary).

GAC Vessels

There will be three vapor-phase carbon vessels. Maintenance of the GAC vessels will be performed as follows:

- inspect for leaks or cracks in the vessels and the associated piping/valves;
- drain condensate from the vessels, if needed;
- assess the need for a carbon change-out, which will be performed by an outside subcontractor.

When carbon change-out is performed, the following process will be required:

- the inlet valve to the carbon unit will be closed and the drain will be opened;
- the fluids from the drain (if any) will be captured and vacuumed back into the treatment system with a scavenge line;
- the carbon will be vacuumed out by a vacuum truck and transported offsite for regeneration or disposal;
- new carbon will be blown into the carbon unit; and
- the carbon unit will be returned to service.

4.2.2 *Sub-Slab Depressurization*

The SSD system will be operated and maintained over the long term as an on-going engineering control following remediation. On a monthly basis, the SSD system will be visited to ensure the proper operation of the SSD system. The following activities will typically be performed:

- visual inspection of the complete system (e.g., vent fan, piping, warning device, labeling on systems, etc.);
- identification and repair of leaks;
- inspection of the exhaust or discharge point to verify no air intakes

have been located nearby;

- collection of field VOC measurements from the outlet of the blower and all activated carbon vessels to assess the need to change the carbon; and
- change-out of the carbon emission controls.

In addition, vapor samples will also be collected on a semi-annual basis from the outlet of the blower and all carbon vessels. The samples will be analyzed for VOCs using USEPA Method TO-15 or TO-17. The data will be utilized with the NYSDEC DAR-1 Ambient Air Quality Impact Screening Analyses to assess the need for continued air emission controls. If the screening shows that air emission controls are no longer necessary, the activated carbon vessels will be taken offline.

An annual certification of the SSD system operation will be submitted to NYSDEC. This certification will be prepared and submitted by a professional engineer registered in New York State to affirm that the engineering controls are in place and nothing has occurred that would impair the ability of such controls to protect the public health and environment, or constitute a violation or failure to comply with any OM&M plan for such controls.

The SSD system will continue to operate until it is demonstrated to the NYSDEC that the system is no longer necessary based on sub-slab soil vapor concentrations.

4.3 SAMPLING AND ANALYSIS PROGRAM

Based on data and information presented in the NYSDEC-approved Final FFS Report (ERM, 2009b), the Site-specific list of VOCs of potential concern includes 22 compounds:

- acetone;
- benzene;
- 2-butanone;
- chloroethane;
- chloroform;
- cis-1,2-DCE;
- trans-1,2-DCE;
- 1,1-DCA;
- 1,2-DCA;
- 1,1-DCE;
- 1,2-DCE;
- ethylbenzene;

- methylene chloride;
- 4-methyl-2-pentanone;
- PCE;
- toluene;
- 1,1,1-TCA;
- 1,1,2-TCA;
- 1,2,4-trimethylbenzene;
- vinyl chloride; and
- xylenes.

4.3.1 Off-Gas Monitoring from SVE System and SSD System

SVE system air samples will be collected for laboratory analysis from the influent, midpoint between carbon units, and the overall effluent for analysis by an NYSDOH-approved environmental laboratory during the during the first two days of start-up and weekly for two weeks following start-up. Laboratory samples will be collected in pre-cleaned Tedlar sampling bags, Summa Canisters, or in stainless steel sorbent tubes. Vapor samples will be analyzed for the Site-specific VOCs list on an expedited turn around by USEPA Method TO-15 or TO-17. These laboratory data will be used to evaluate field measurements of VOCs in the treatment system, the effectiveness of the SVE system, and to calculate mass loading rates on the GAC. Data collected during the initial weeks of operation will be used to evaluate whether or not off-gas treatment will be necessary. This determination will be made by evaluating and comparing the data to Annual Guideline Concentration (AGC) and Short-term Guideline Concentration (SGC) values from DAR-1. A DAR-1 analysis will be performed to assess the potential ambient impact to the nearest off-Site receptor.

Vapor phase samples will be monitored on a daily basis using a calibrated FID or PID during system start-up and on a weekly basis for the first one-month of operation. After three weeks of operation, data will be reviewed to evaluate if the monthly frequency of collecting quantitative vapor data is adequate to provide results that will allow sufficient time to prevent an uncontrolled emission from the breakthrough on the GAC units (if off-gas treatment is required). These data will also be used to estimate contaminant mass removal rates. Vapor-phase mass removal can be estimated using influent concentrations together with the airflow and equipment run time.

Field VOC measurements from the SSD system will be collected from the outlet of the blower and all GAC vessels at least on an approximate monthly basis. Vapor samples for laboratory analysis will be collected on a semi-annual basis. The samples will be analyzed for VOCs using USEPA Method TO-15 or TO-17.

4.3.2 *ISTT Baseline and Ground Water Monitoring*

Ground water samples will be collected from each of the newly-installed RFH wells using low-flow sampling methods to document pre-remedial ground water quality in the Former Varnish UST Area. Each of the samples, plus one blind duplicate, will be analyzed by the project laboratory for the Site-specific VOC list by USEPA Method 8260.

A dedicated Teflon™ sample tube will be installed in each antenna placement well before remediation begins. The tubing will be used to collect ground water samples from each of the antenna placements on a monthly basis during the heating of the soil. Samples will be analyzed by the project laboratory for the Site-specific VOC list by USEPA Method 8260.

Sampling events will be scheduled so that trained personal will be on Site to shut down RFH equipment prior to the sampling event. Lock-out and tag-out procedures will be followed as outlined in the HASP to insure RFH antenna remain de-energized during the sampling event.

Ground water will be cooled using a cooling apparatus consisting of coiled 0.25-inch stainless steel tubing submerged in an ice water bath. The tubing will be bent such that both ends of the coils will emerge from the ice bath to connect to the Teflon™ tubing. Decontamination procedures will be followed between wells. A peristaltic pump will be connected to the tubing after the cooling coil to purge ground water. Low-flow sampling methods will be used to determine when samples will be collected. Samples will be handled as outlined in the Site-specific Quality Assurance Project Plan (QAPP) (Appendix C). One blind duplicate sample will be collected per sampling event for quality control proposes.

4.3.3 *Post-Remedial Soil Sampling – Former Varnish UST Area*

As described above in Section 4.2.1, post-remediation (confirmation) soil samples will be collected once mass calculations coupled with the results of previous soil sampling and analysis events suggest that the Restricted Commercial SCO for xylenes has been obtained. RFH equipment will be de-energized following lock-out and tag-out procedures a minimum of 12 hours prior to the sampling event. SVE equipment will continue to operate through the sampling event to continue to capture VOCs liberated from soil during heating. Confirmation soil samples will be collected from the treatment cell using direct push technology. Proposed ISTT confirmation soil sampling locations are presented in Figure 13. Based on the designed treatment depth interval of 7- to 18-feet below ground surface (bgs), two soil samples will be collected at each location; one from 9- to 11-feet bgs and a lower sample from 15- to 17-feet bgs.

Stainless steel, brass, or Teflon™ core barrel liners will be used to collect the soil sample from the desired depth using a stainless steel sampling device. Inner work gloves with outer heat-resistant plastic gloves will be used to handle hot rods and core barrels when extracted from the subsurface. Upon extracting the sampling device from the subsurface, the sample liner or tube will be removed and immediately capped with the standard barrel caps provided by the sample device's manufacturer. Once capped, the encapsulated sample will be placed in an ice-filled container for cooling.

The soil sample's temperature will be monitored with a soil thermometer until the sample is cooled to below the ambient soil temperature at the Site (approximately 15-20 degrees Celsius). The sample will be removed from ice and a soil sample will be collected from near the center of the sampling liner using standard methodology. Each sample will be placed directly into a pre-labeled sampling jar provided by the project laboratory and placed in a pre-chilled cooler. Samples will be maintained under proper chain of custody and analyzed for the Site-specific VOC list. Soil confirmation samples will be analyzed on an expedited (two-day) turn around. These data will be used to determine if additional heating of soil is required.

4.3.4 *Monitored Natural Attenuation*

Consistent with ground water MNA sampling and analysis events at the Site previously approved by the NYSDEC (ERM, 2009a), the analyte list for post-remediation MNA performance monitoring will include the following:

- Site-specific VOCs by USEPA Method 8260;
- daughter products not reported by USEPA Method 8260 (ethene, ethane, methane);
- the electron acceptors dissolved oxygen (field measurement) and sulfate;
- dissolved organic carbon by USEPA Method 9060;
- oxidation-reduction potential (field measurement);
- pH (field measurement);
- temperature (field measurement); and
- total dissolved solids by USEPA Method 160.1.

Ground water monitoring events will be initiated when soil and ground water in the ISST treatment area cools to within 10 percent of the average ambient temperatures measured during the baseline (pre-heating) ground water sampling event in the Former Varnish UST Area. Ground water sampling will be conducted semiannually for two years and every fifth quarter thereafter as described in the NYSDEC-approved Final FFS Report (ERM, 2009b). Ground water samples will be collected using the EPA-approved low-flow sampling methods, which involves collection of the ground water sample after stabilization of the field parameters listed above plus turbidity. Ground water samples for evaluation of MNA at the Site will be collected from shallow monitoring wells: MW-24, MW-25, MW-14, MW-12, MW-13, one well in the Former Varnish UST Area, and intermediate monitoring wells MW-18, MW-20, and MW-22.

5.0 IMPLEMENTATION SCHEDULE

The Gantt chart presented in Figure 7 presents an estimated project schedule for major phases of the final remedy including construction, start-up, and operation. The estimated project schedule was prepared with respect to the date of submittal of this work plan for NYSDEC review and public noticing in the Environmental Notice Bulletin. The proposed project schedule is therefore tentative based on an assumed time required for NYSDEC and public review and assumed durations for other tasks.

6.0 CLOSURE PROGRAM

As discussed in Section 2.1.1, the remediation of soil and ground water in the Former Varnish UST Area and the Former Varnish Pit Area will be implemented in the following three step approach:

- Step 1 - ISTT of the affected soil and ground water in the Former Varnish UST Area;
- Step 2 – MNA for site ground water; and
- Step 3 - Implement institutional controls (SSD system, maintenance of floor slab in building, restriction on construction of potable wells).

Following implementation of ISTT (Step 1) and receipt of confirmation sampling results (see Section 4.3.3); remedial equipment will be removed from the Site. All wastes generated during the remediation program will be transported and disposed or recycled off Site in accordance with applicable guidance, rules, and regulations. As noted in Figure 7, installation of the SSD system is expected to occur concurrently with operation of the ISTT system. Once the ISTT system and SSD system construction is complete, a Final Engineering Report will be submitted to the NYSDEC within 90 days of the completion date in accordance with Section 8.3 of the VCP Guidance. The report will include "as-built" drawings, and will be signed and sealed by a registered New York State professional engineer. Remediation of soil in the Former Varnish UST Area will be deemed complete upon NYSDEC acceptance of the Final Engineering Report and completion of OM&M associated with the ISTT system.

Step 2 of the final remedial approach involves MNA of Site ground water. Under this remedial action, the NYSDEC-approved ground water monitoring plan discussed generally above (and to be presented in more detail in the Final Engineering Report) will be implemented to evaluate and document the effectiveness of the remedial actions at the Site. The effectiveness of the MNA remedy will be evaluated after each sampling event, and at the conclusion of the MNA monitoring program in accordance with Section 6.6(c) of NYSDEC's Draft DER-10 guidance (NYSDEC, 2002). No further monitoring of ground water will be required when:

- contaminant levels in down-gradient sentinel wells no longer exceed ambient ground water quality standards or guidance values;

- the VOC plume length is demonstrated to be stable or shrinking; and
- VOC concentrations along the centerline of the plume are demonstrated to be decreasing.

The remedy may be re-evaluated if monitoring results suggest MNA may not achieve ground water RAOs within a reasonable time frame. Following post-remediation monitoring and approval by the NYSDEC, Site wells will be permanently abandoned according to well abandonment procedures acceptable to the NYSDEC.

Ground water monitoring reports will be prepared after each sampling event to evaluate the effectiveness of the remedial actions and natural attenuation processes on ground water quality. In addition, Monthly Progress Reports will continue to be prepared consistent with previous progress report submissions, and in accordance with DER-10 Section 5.7(b).

Step 3 of the final remedy involves implementation and verification of institutional and engineering controls at the Site. An annual monitoring report will be prepared for each calendar year. This report will document all monitoring events and inspections during the previous year, as well as provide the status of the site engineering and institutional controls identified in the SMP (i.e., SSD system, building floor slab, deed restrictions, and restrictions on construction of potable supply wells). Specific topics to be addressed in the annual monitoring report include:

- evaluation of the remedy's compliance with the RAWP;
- summary of all analytical data;
- indication of whether the engineering and institutional controls remain in place;
- evaluation of the remedy's continued ability to be protective of human health and the environment;
- operating data and run-time for the SSD system;
- description of any equipment breakdowns and repairs; and
- certification by a New York State-registered professional engineer.

Final Site closeout will be initiated when the following requirements from DER-10 Section 6.7 are met:

- confirmation sampling in the Former Varnish UST Area indicates that soil VOC concentrations are below the Restricted Commercial SCO for xylenes;
- MNA may be discontinued; and

- Engineering or institutional controls are deemed no longer necessary.

Once these criteria are met, a final project evaluation will be prepared consistent with the requirements of the annual monitoring report. Upon review and approval of the final project evaluation, all remedial processes will be discontinued and the Site considered closed.

7.0 *HEALTH AND SAFETY CONSIDERATIONS*

ERM personnel and all subcontractors are required to adhere to the most recent version of the Site-specific HASP (Appendix A). Construction activities involving actual or potential exposure to compounds of concern will be executed by contractors trained in accordance with 40 CFR 1920.120 hazardous waste site operations, other applicable OSHA requirements and according to the requirements of the Site-specific HASP.

Subcontractors must complete and submit a Task Hazard Analysis (THA) Form for each major task to be completed at the Site. The THAs must be submitted to the project manger prior to mobilization to the Site to complete the task. Activities will be monitored to evaluate if any potential health threats exists and/or action levels are exceeded.

The air quality in the work area(s) and adjacent public areas in regards to VOCs will be monitored with a PID or FID during the various phases of the work.

During operation of RFH equipment, electromagnetic energy field monitoring will be conducted in the remediation area and at pre-selected locations in the Greif facility to ensure compliance with Federal Communications Commission (FCC) and other governmental agency regulations. In addition, the monitoring of the electromagnetic energy fields is to ensure that these energy fields do not threaten health and safety of personnel, property, or the environment at the Site.

Such monitoring shall be conducted at least monthly and at each Site visit where RF energy levels are increased to adjust heating rates. If the monitoring reveals conditions that exceed action levels detailed in the Site-specific HASP, the contractor shall implement the course of action detailed in the HASP. Measures undertaken as part of the physical security will also serve to protect the public against the potential for exposure.

The planned remedies for the Site are designed to minimize potential exposure pathways, to reduce contaminate concentrations to applicable criteria through recovery and treatment of contaminants present in the affected media and through degradation of contaminates by natural attenuation. Discharges from the installed remedies at the Site (vapor and liquid) will be monitored to confirm treatment and effluent guidelines are being met.

8.0 *QUALITY ASSURANCE / QUALITY CONTROL*

Site sampling and monitoring will be conducted in accordance with the most recent version of the QAPP (Appendix C). The procedures described in the QAPP are designed to monitor and confirm that remedial activities meet the intent of the selected remedy and that data generated during the remediation is valid and usable. Soil and ground water samples collected for confirmation purposes shall be analyzed in conformance with the NYSDEC's Analytical Services Protocol with Category B deliverables.

Materials and methods used to construct the proposed remediation system will be consistent with standard engineering practices and industry standards. The engineering consultant shall review technical specifications and manufacturers cut sheets for adequacy and appropriateness for it intended purpose prior to purchase of materials and equipment for use on Site. The engineering consultant shall provide oversight during the design, installation, start-up, and operation of the system.

Subcontractors shall be responsible for job Site control including control of the quality of the installed facilities, day-to-day planning, supervision of subcontract work, examination of materials delivered for incorporation into finished product and pre-start up testing and inspection of appropriate system components. Certain vendors of key system operating components (e.g. RFH and SVE equipment) will be required to provide pre-delivery testing and certification of such items. The engineering consultant shall provide quality assurance through observation and review of the RFH, SVE, and SSD systems during installation and operation.

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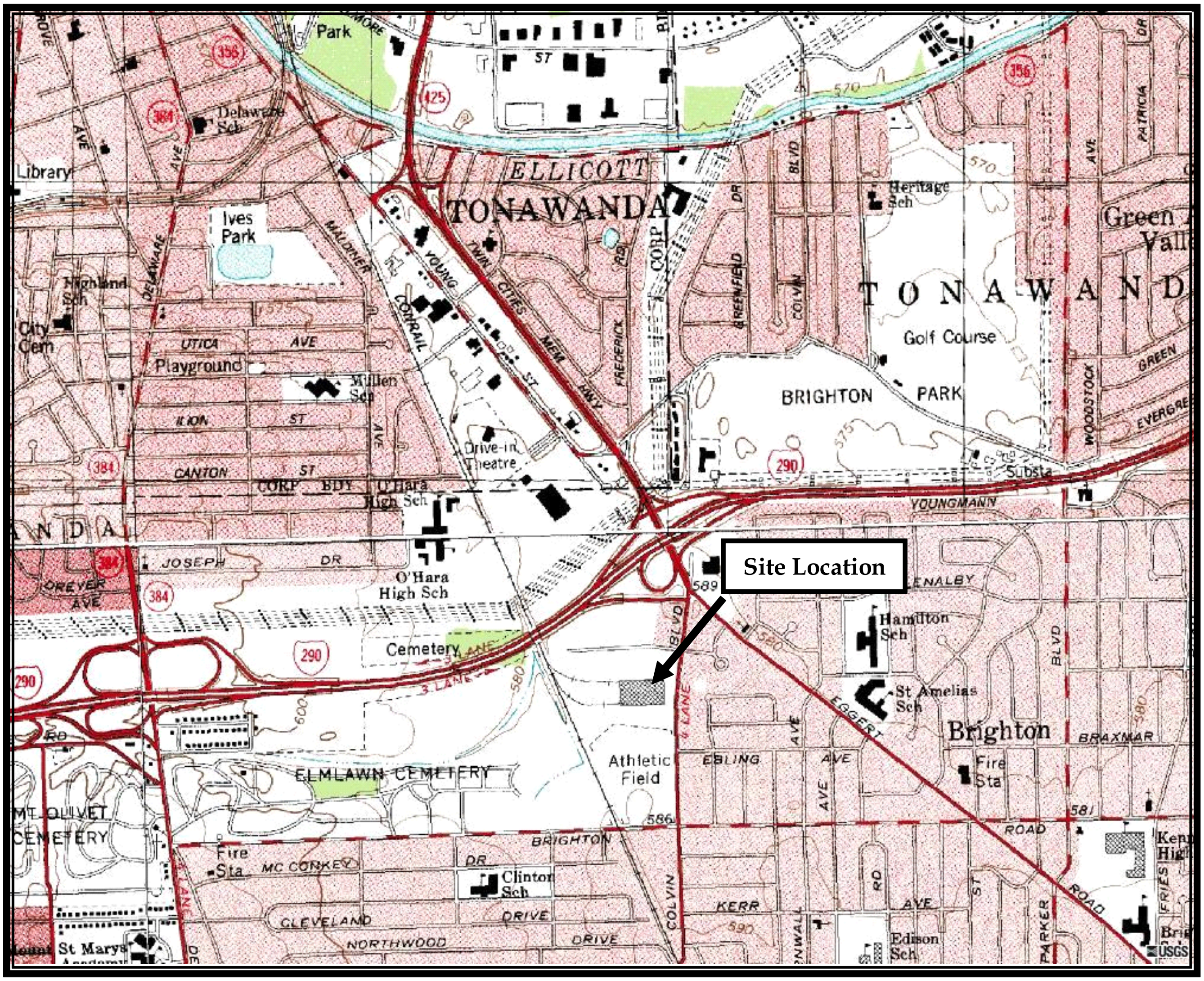
Figures



Buffalo NE Quadrangle

New York

7.5 Minute Series

SCALE 1 : 24,000

1 .5 0 1 MILE

CONTOUR INTERVAL 20 FEET

Site Location Map
Grief Facility
Tonawanda, New York
NYSDEC VCP# V00334-9

PREPARED FOR
Sonoco Products Company

ERM
5788 WIDEWATERS PARKWAY
DEWITT, NEW YORK 13214

SCALE	FIGURE
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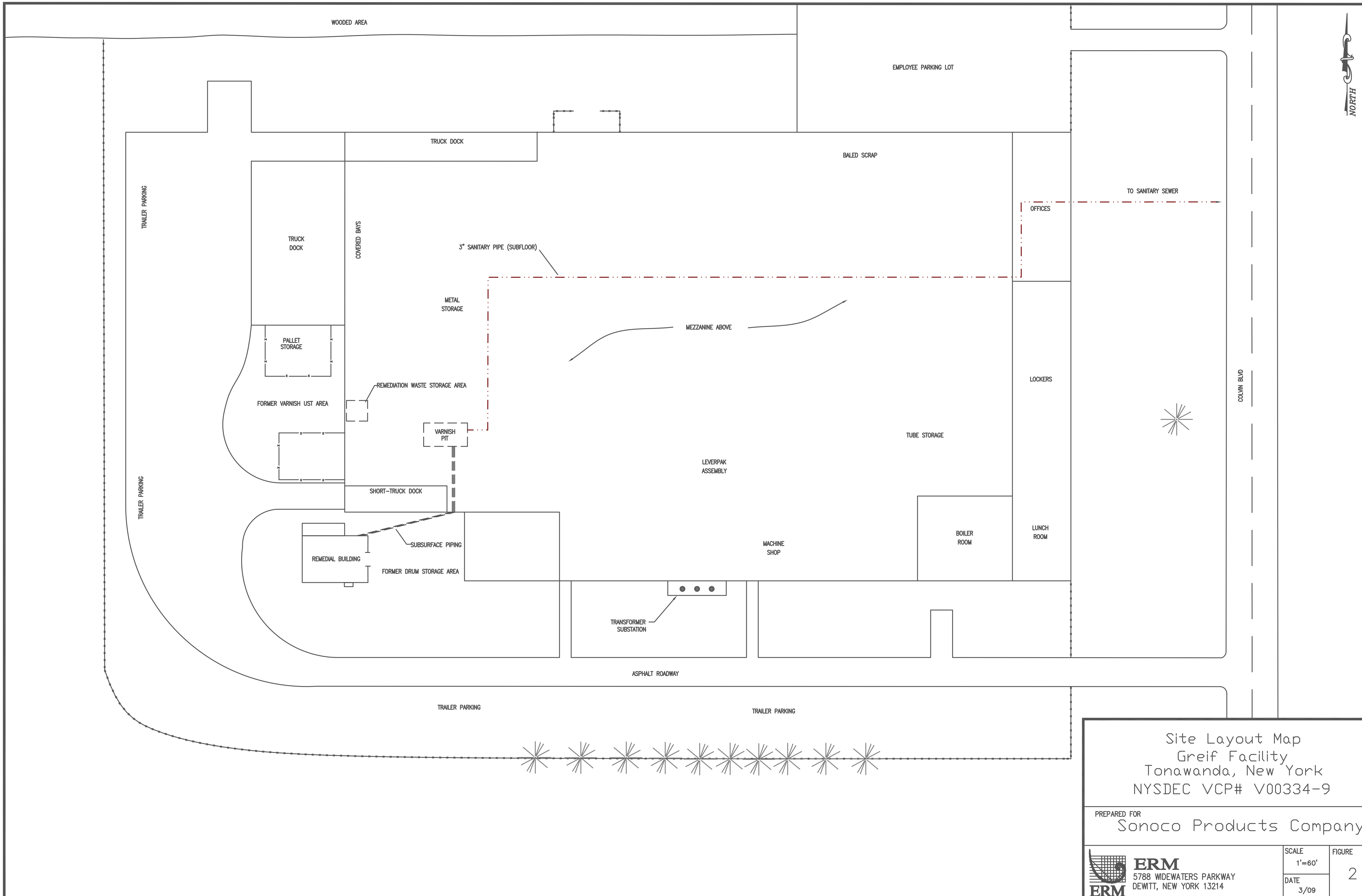
DATE 2/09	

PROJECT#0082324



Site Layout Map
Greif Facility
Tonawanda, New York
NYSDEC VCP# V00334-9

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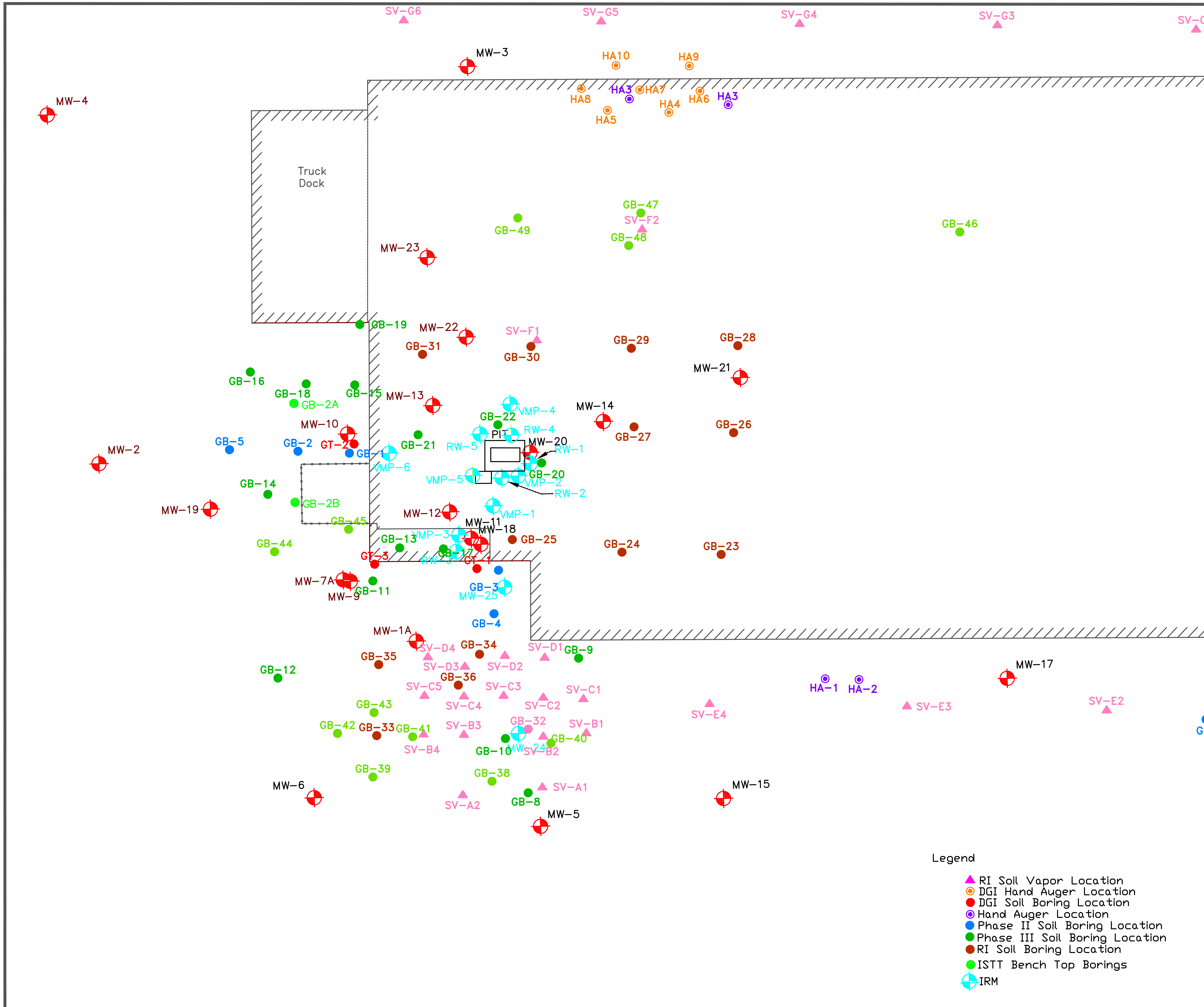
DATE 3/09	

PROJECT#0051293



Sampling Locations
Greif Facility
Tonawanda, New York
NYSDEC VCP# V00334-9

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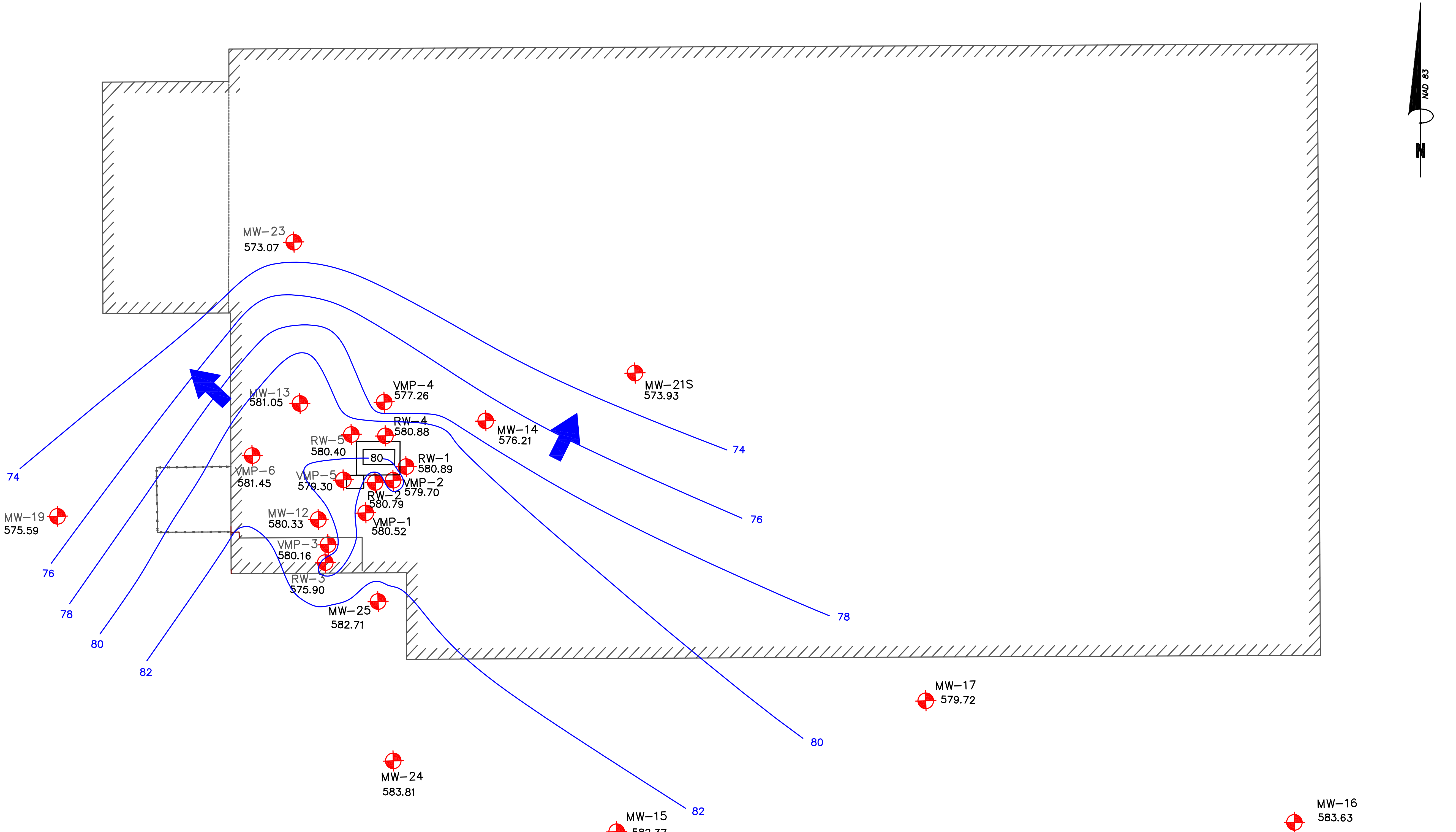
DEWITT, NEW YORK 13214

SCALE 1"=40'
DATE 03/09
FIGURE 3

PROJECT#0051293



LEGEND

VMP-3 Well Location

580.00 Ground Water Contour (feet amsl)

577.96 Ground Water Elevation (feet amsl)

Direction of Ground Water Flow

GW measurements collected 12 March 2009

SHALLOW GROUND WATER
CONTOUR PLOT 12 MARCH 2009
GREIF FACILITY
TONAWANDA, NEW YORK
NYSDEC VCP# V00334-9

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SONOCO

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5788 WIDEWATERS PARKWAY
DEWITT, NEW YORK 13214

SCALE	FIGURE
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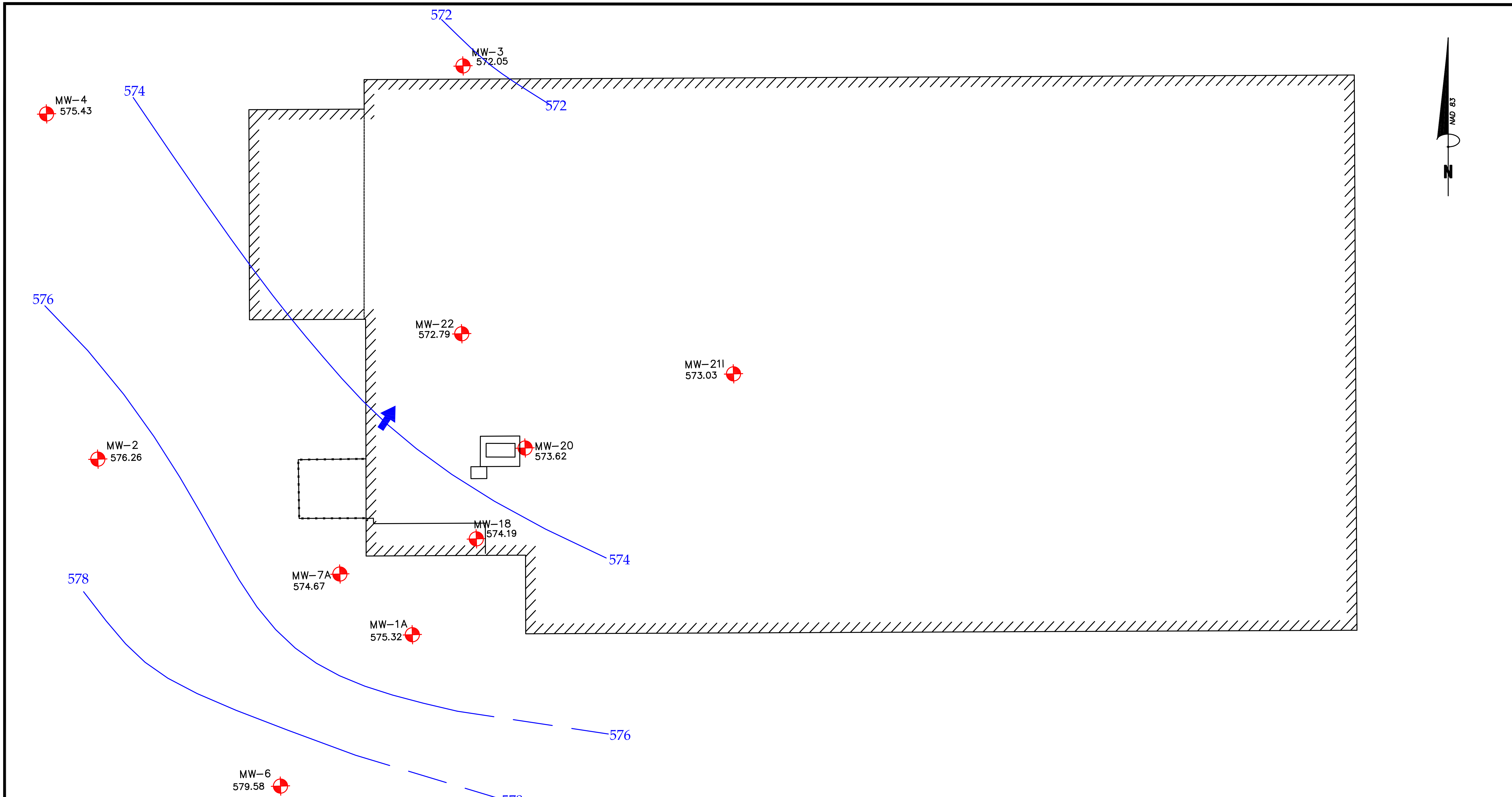
DATE 03/09	



LEGEND

NM- Not Measured

VMP-3 Well Location

580.00 Ground Water Contour (feet amsl)

577.96 Ground Water Elevation (feet amsl)

Generalized Direction of Ground Water Flow

GW measurements collected October 2006

Note: Base map obtained from WM. Schutt & Associates, P.C. survey drawings updated on 12 January 2006

INTERMEDIATE GROUND WATER CONTOUR PLOT OCTOBER 2006
GREIF FACILITY
TONAWANDA, NEW YORK
NYSDEC VCP# V00334-9

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DEWITT, NEW YORK 13214

SCALE	FIGURE
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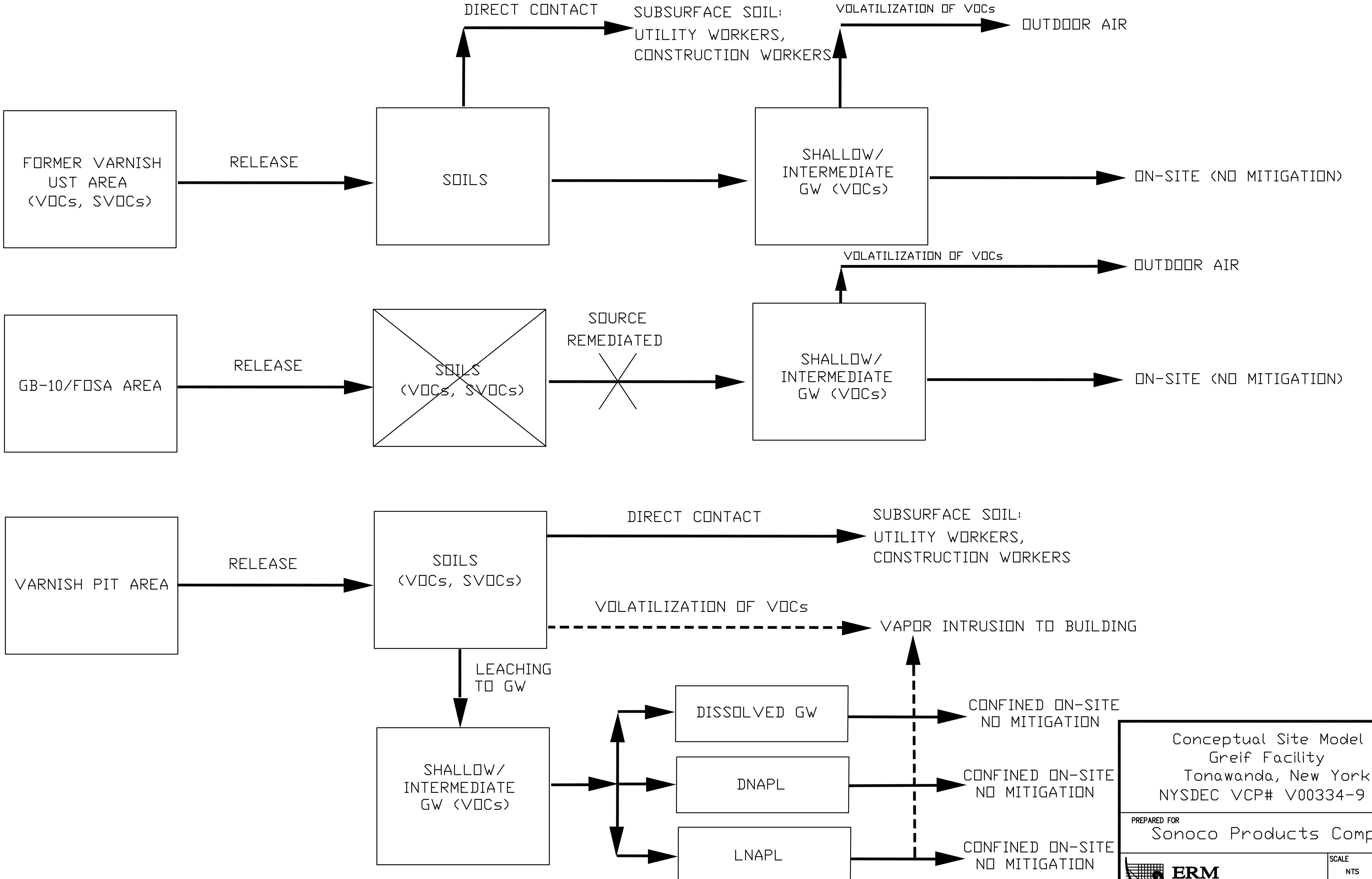
DATE 03/09	



Conceptual Site Model
Greif Facility
Tonawanda, New York
NYSDEC VCP# V00334-9

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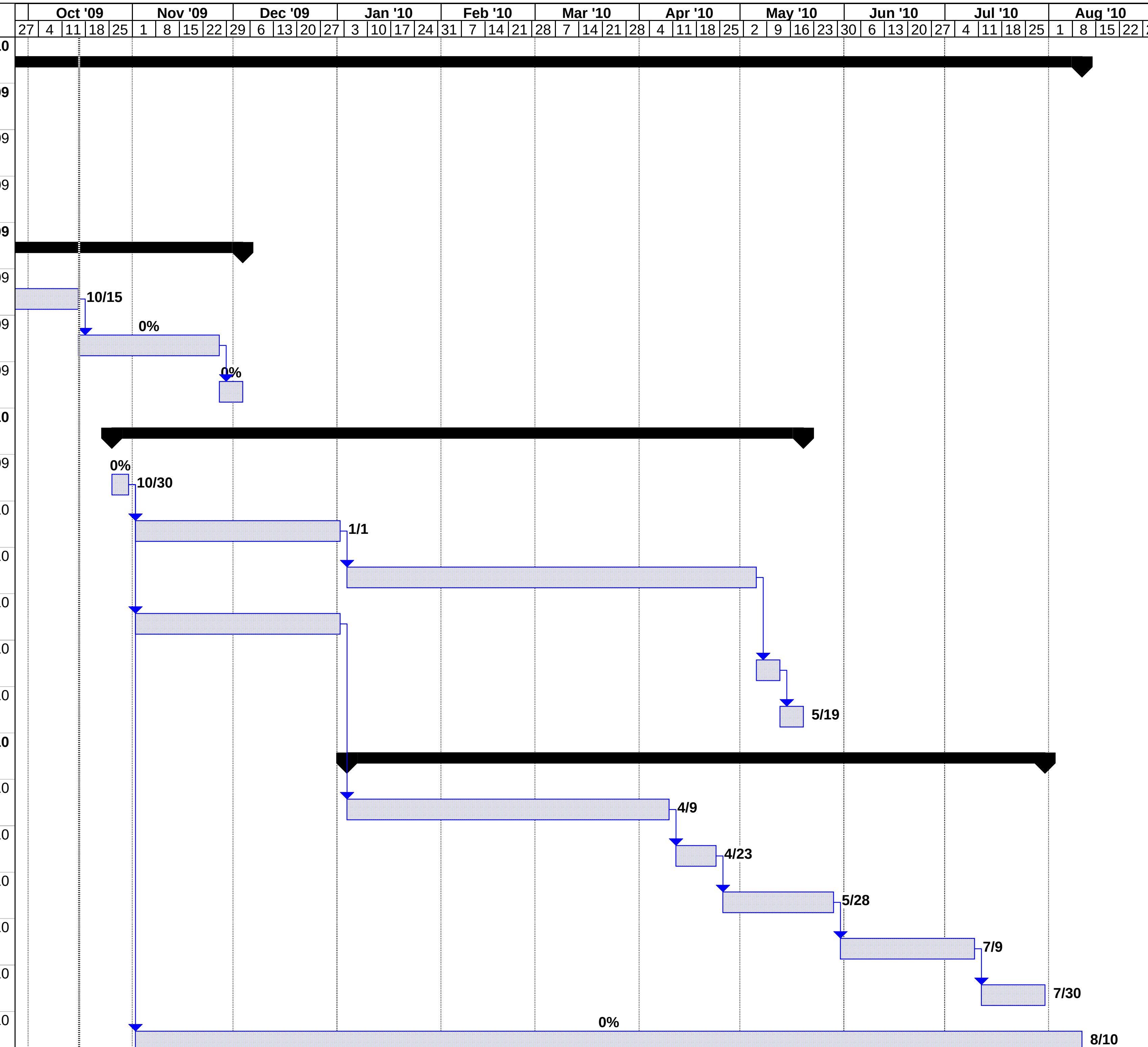
DEWITT, NEW YORK 13214

SCALE NTS
DATE 03/09
FIGURE 6

Figure 7 - Estimated Project Schedule
Remedial Action Work Plan - Greif Facility, Tonawanda, NY
NYSDEC VCP # V00334-9

ID	Task Name	Duration	Start	Finish
1	**Greif Facility - 2009 RAWP/RAS Schedule**	**407 days**	**Mon 1/19/09**	**Tue 8/10/10**
2	**Task 1 - RAWP/RAS Preliminaries**	**11 days**	**Mon 1/19/09**	**Mon 2/2/09**
3	Task 1A1:Syracuse Kickoff Meeting	1 day	Mon 1/19/09	Mon 1/19/09
4	Task 1A2: Project Team Meeting	1 day	Mon 2/2/09	Mon 2/2/09
5	**Task 2 - RAWP/RAS Preparation**	**218 days**	**Tue 2/3/09**	**Thu 12/3/09**
6	Task 2A - Draft Work Plan and Client Review	183 days	Tue 2/3/09	Thu 10/15/09
7	Task 2B - NYSDEC and Public Review	30 days	Fri 10/16/09	Thu 11/26/09
8	Task 2C - Final Work Plan and NYSDEC Approval	5 days	Fri 11/27/09	Thu 12/3/09
9	**Task 3 - Field Work**	**148 days**	**Mon 10/26/09**	**Wed 5/19/10**
10	Task 3A - Mobilization	5 days	Mon 10/26/09	Fri 10/30/09
11	Task 3B - In-Situ Thermal Treatment (ISTT) Construction & Start-Up	45 days	Mon 11/2/09	Fri 1/1/10
12	Task 3B - ISTT - OM&M and Decommissioning	88 days	Mon 1/4/10	Wed 5/5/10
13	Task 3C- Sub-Slab De-pressurization (SSD) - Construction & Start-up	45 days	Mon 11/2/09	Fri 1/1/10
14	Task 3D- Monitored Natural Attenuation (MNA) - First Sampling Event	5 days	Thu 5/6/10	Wed 5/12/10
15	Task 3E- ISTT Confirmation Sampling Event	5 days	Thu 5/13/10	Wed 5/19/10
16	**Task 4 - Final Engineering Report**	**150 days**	**Mon 1/4/10**	**Fri 7/30/10**
17	Task 4A - Draft Final Engineering Report	70 days	Mon 1/4/10	Fri 4/9/10
18	Task 4B - Client Review	10 days	Mon 4/12/10	Fri 4/23/10
19	Task 4C - Revise and submit to NYSDEC	25 days	Mon 4/26/10	Fri 5/28/10
20	Task 4D - NYSDEC Review	30 days	Mon 5/31/10	Fri 7/9/10
21	Task 4E - Final Engineering Report and NYSDEC Approval	15 days	Mon 7/12/10	Fri 7/30/10
22	**Task 5 - Monthly Progress Reports**	202 days	Mon 11/2/09	Tue 8/10/10



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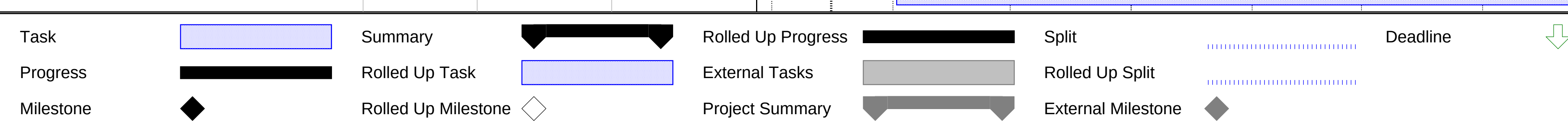

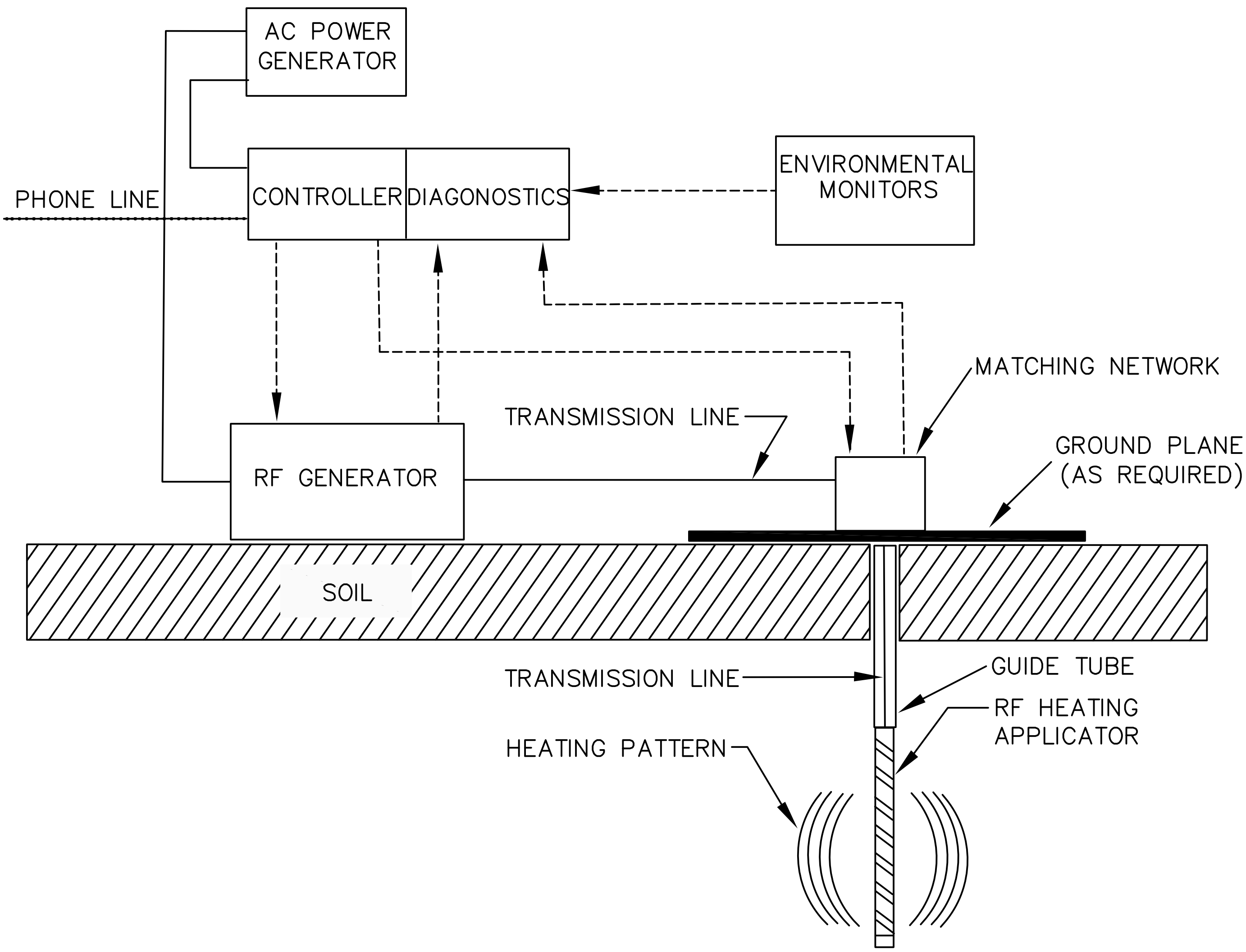

Radio Frequency Heating
System Components
Grief Facility
Tonawanda, New York
NYSDEC VCP# V00334-9

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Sonoco Products Company

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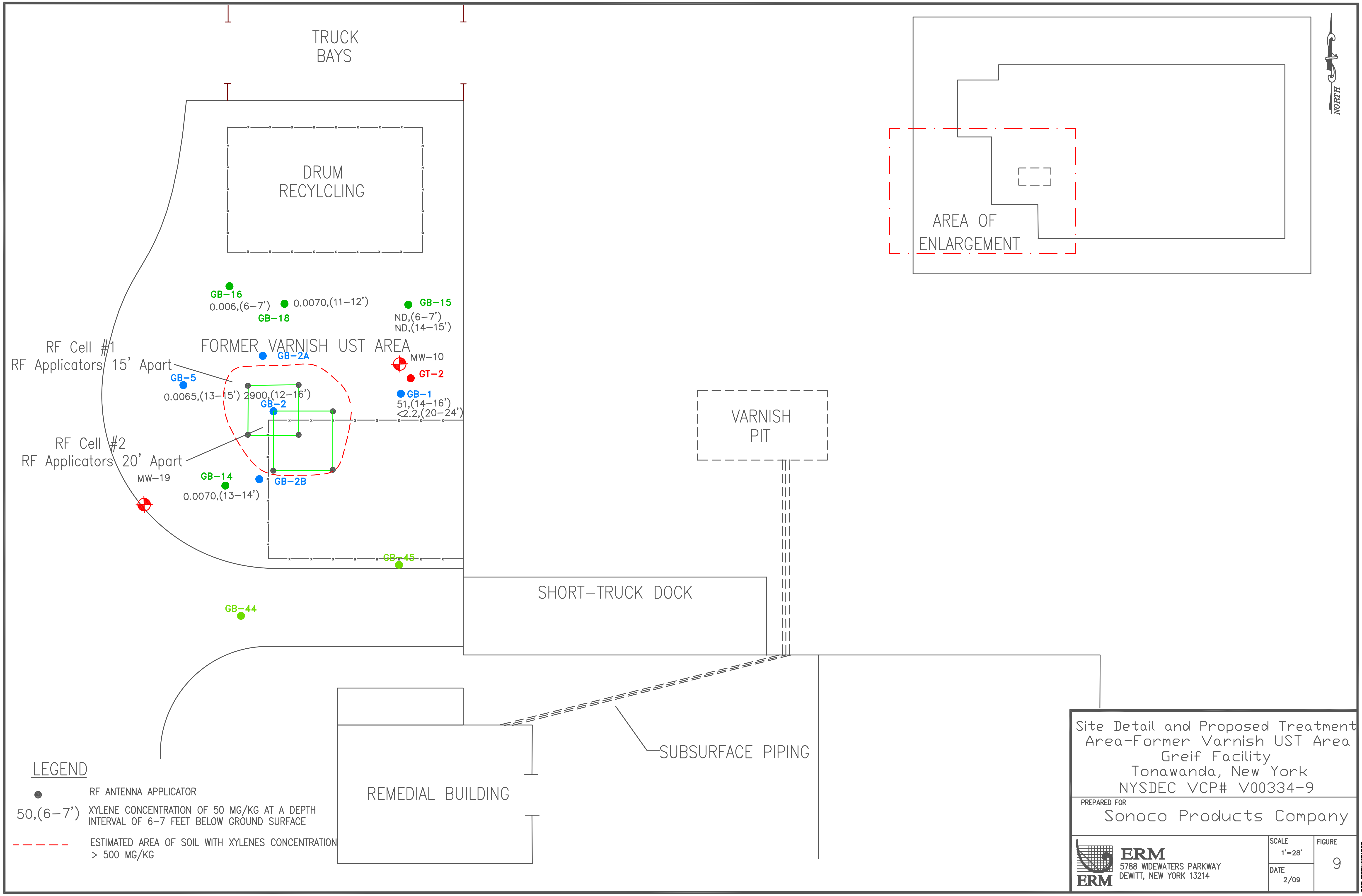
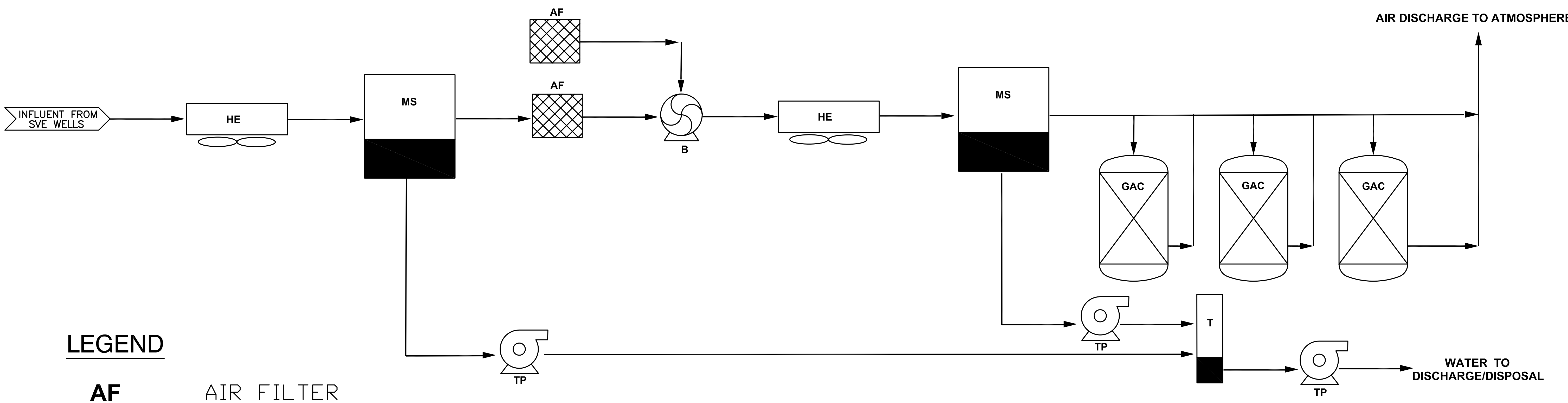
5788 WIDEWATERS PARKWAY
DEWITT, NEW YORK 13214

SCALE NTS
DATE 3/09
FIGURE 8

PROJECT#0082324



TRUCK BAYS
DRUM RECYLCLING
NORTH
AREA OF ENLARGEMENT
GB-16
0.006,(6-7')
0.0070,(11-12')
GB-18
GB-15
ND,(6-7')
ND,(14-15')
FORMER VARNISH UST AREA
RF Cell #1
RF Applicators 15' Apart
GB-2A
MW-10
GT-2
GB-5
0.0065,(13-15')
2900,(12-16')
GB-2
GB-1
51,(14-16')
<2.2,(20-24')
RF Cell #2
RF Applicators 20' Apart
MW-19
GB-14
0.0070,(13-14')
GB-2B
VARNISH PIT
GB-45
GB-44
SHORT-TRUCK DOCK
SUBSURFACE PIPING
REMEDIAL BUILDING
LEGEND
RF ANTENNA APPLICATOR
50,(6-7') XYLENE CONCENTRATION OF 50 MG/KG AT A DEPTH INTERVAL OF 6-7 FEET BELOW GROUND SURFACE
ESTIMATED AREA OF SOIL WITH XYLENES CONCENTRATION > 500 MG/KG
Site Detail and Proposed Treatment Area-Former Varnish UST Area
Greif Facility
Tonawanda, New York
NYSDEC VCP# V00334-9
PREPARED FOR
Sonoco Products Company
ERM
5788 WIDEWATERS PARKWAY
DEWITT, NEW YORK 13214
SCALE 1"=28'
DATE 2/09
FIGURE 9



LEGEND

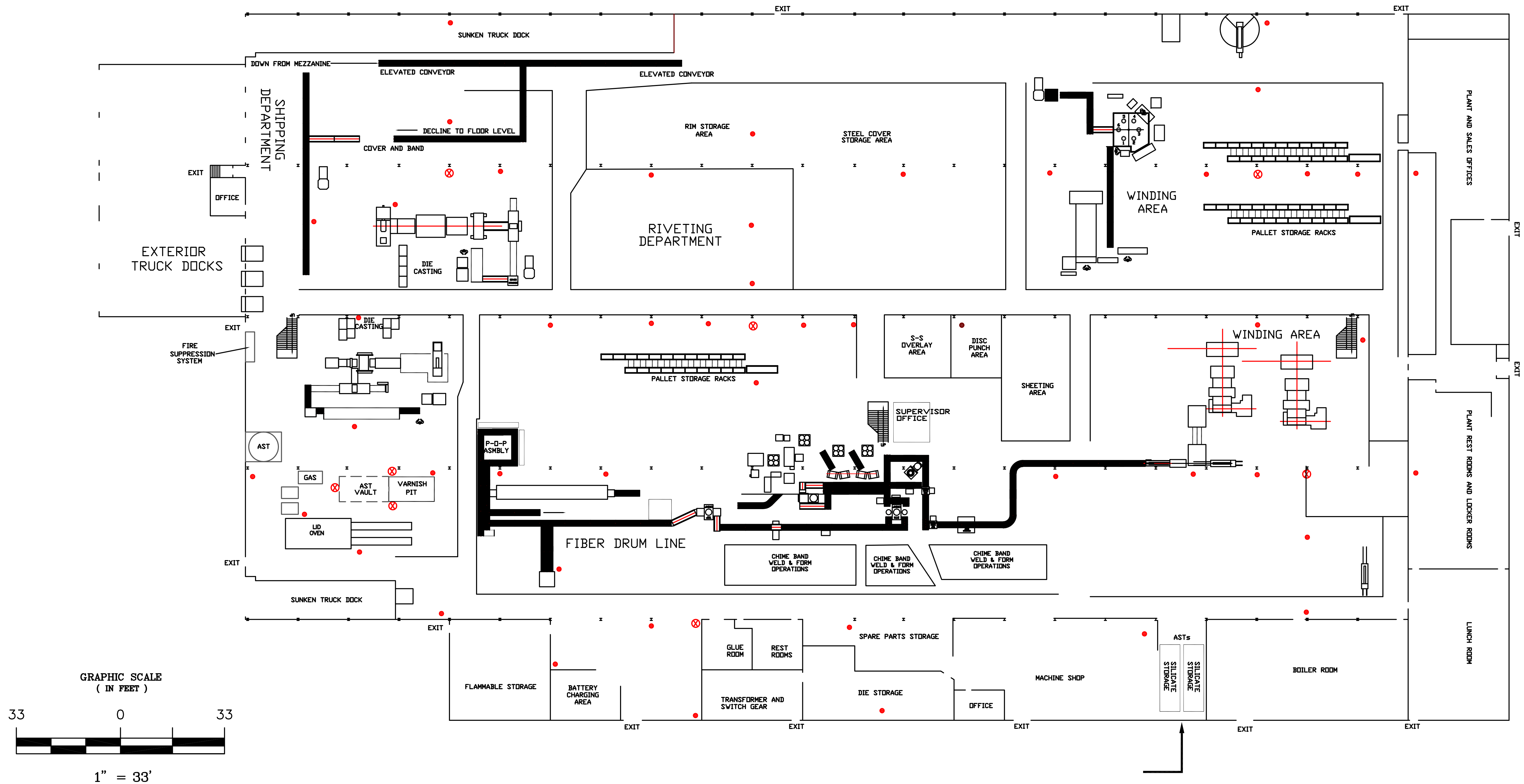
AF	AIR FILTER
B	BLOWER
GAC	GRANULATED ACTIVATED CARBON
HE	HEAT EXCHANGER
MS	MOISTURE SEPARATOR
RF	RADIO FREQUENCY
SVE	SOIL VAPOR EXTRACTION
T	TANK
TP	TRANSFER PUMP

PROCESS FLOW DIAGRAM
ISTT SYSTEM (SVE ONLY)
GREIF FACILITY
TONAWANDA, NEW YORK
NYSDEC VCP# V00334-9

PREPARED FOR
SONOCO PRODUCTS COMPANY

ERM
5788 WIDEWATERS PARKWAY
DEWITT, NEW YORK 13214

SCALE NTS
DATE 03/09
FIGURE 10



NOTES:

1) Locations of Suction Pits and vacuum monitoring points may vary during actual testing due to building construction and accessibility

2) Suction Pits to be created by coring a hole through the slab to allow passage for a 2"-4" pipe. A small void (1'-2') will be created below the slab.

3) New Vacuum Monitoring Points (VMPs) will be created by drilling 3/8" hole through the slab and inserting tubing.

LEGEND

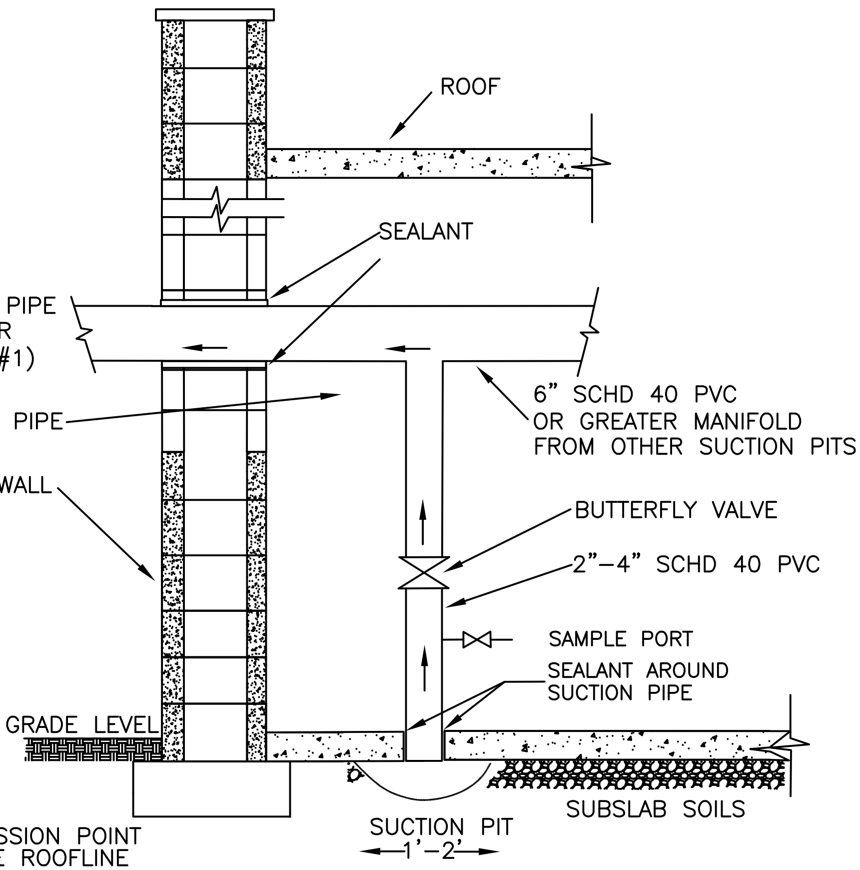
- Proposed Suction Pit
- Proposed Vacuum Monitoring Point

Pilot Test Arrangement
For SSD System
Greif Facility
Tonawanda, New York
NYSDEC VCP# V00334-9

PREPARED FOR
Sonoco Products Company

ERM
ERM
5788 WIDEWATERS PARKWAY
DEWITT, NEW YORK 13214

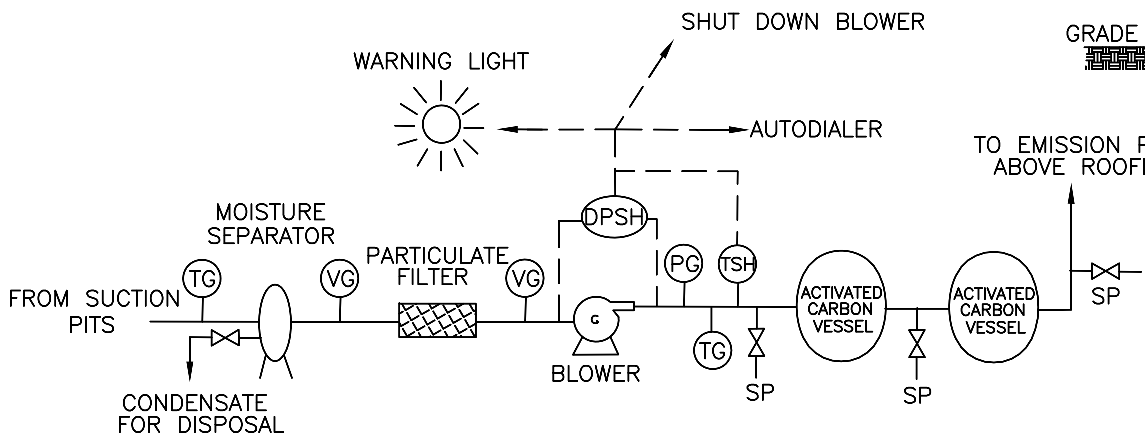
SCALE	FIGURE
1'=33'	11
DATE 03/09	



TYPICAL SECTION
NOT TO SCALE

DETAIL #1

PROCESS FLOW DIAGRAM
FOR SSD SYSTEM



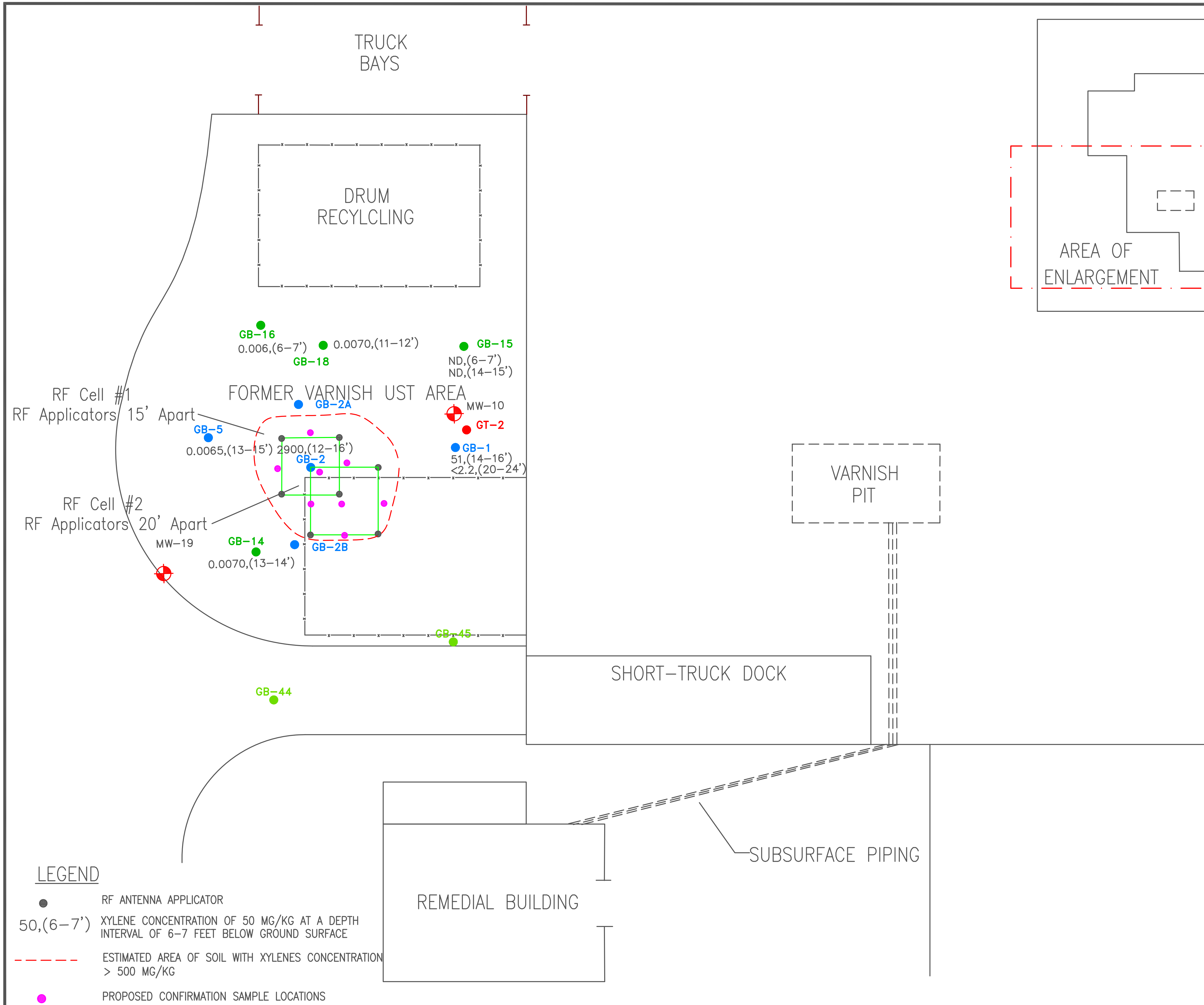
TG – TEMPERATURE GAUGE
VG – VACUUM GAUGE
PG – PRESSURE GAUGE

DPSH – DIFFERENTIAL HIGH PRESSURE SWITCH
SP – SAMPLE PORT
TSH – HIGH TEMPERATURE SWITCH

NOTES:

1. FINAL DESIGN MAY VARY BASED ON RESULTS OF PILOT TESTING

TITLE: SCHEMATIC OF THE SUBSLAB DEPRESSURIZATION SYSTEM				
PREPARED FOR: SONOCO PRODUCTS COMPANY				
ERM Environmental Resources Management			SCALE: NTS	FIGURE: 12
DRAWN: JMC	JOB NO.: 0082324	FILE NAME: 0082324-00-003	DATE: 3/5/09	



Proposed ISTT Confirmation Soil Sampling Locations
Greif Facility
Tonawanda, New York
NYSDEC VCP# V00334-9

PREPARED FOR
Sonoco Products Company

ERM
5788 WIDEWATERS PARKWAY
DEWITT, NEW YORK 13214

SCALE	FIGURE
1"=28'	13
DATE 2/09	

PROJECT#0051293

Table

Table 1

List of Major New York State Standards, Criteria and Guidelines (SCGs)
Greif Facility – Tonawanda, New York
NYSDEC VCP Number V00334-9

CITATION	DESCRIPTION	TYPE	APPLICABILITY TO SELECTED REMEDY	WILL REMEDY COMPLY WITH THIS SCG?
STANDARDS AND CRITERIA [1]				
6 NYCRR Part 375 Subpart 6	Inactive Hazardous Waste Disposal Site Remedial Program – Remedial Program Soil Cleanup Objectives	Action	This standard relates to all Site remedial activities, specifically soil cleanup objectives for Restricted Commercial Objectives	Yes
6 NYCRR Part 364	Waste Transporter Permits	Action	This standard will apply to any waste removal (anticipated to be drill cuttings and groundwater monitoring purge water)	Yes
6 NYCRR Part 370 through 373	Hazardous Waste Management Regulations	Action, Chemical	This standard relates to the management of hazardous waste removed during remedial action.	Yes
6 NYCRR Part 376	Land Disposal Restrictions	Action, Chemical	This standard relates to the management of hazardous waste removed during remedial action.	Yes
OSHA; 29 CFR 1910	Guidelines/Requirements for Workers at Hazardous Waste Sites (Subpart 120) and Standards for Air Contaminants (Subpart 1).	Action	Will relate to safety provisions during remedial construction activities and possibly O&M	Yes
OSHA; 29 CFR 1926	Safety and Health Regulations for Construction	Action	Will relate to safety provisions during remedial construction activities	Yes

Table 1

List of Major New York State Standards, Criteria and Guidelines (SCGs)
Greif Facility – Tonawanda, New York
NYSDEC VCP Number V00334-9

CITATION	*DESCRIPTION*	*TYPE*	*APPLICABILITY TO SELECTED REMEDY*	*WILL REMEDY COMPLY WITH THIS SCG?*
6 NYCRR Part 201 Permits and Certificates	Requirements for air permitting	Action	Applies to air emissions from SSD System and ISTT/SVE System	Yes
6 NYCRR Part 212 General Process Emission Sources	Requirements for process air emissions	Action, Chemical	Applies to air emissions from SSD System and ISTT/SVE System	Yes
10 NYCRR Part 5-1.31 Drinking Water Supplies	Prohibits installation of a private supply well in areas served by public water supply	Action	Applies to institutional controls	Yes
Guidelines [(1)]				
NYSDOH Community Air Monitoring Plan for Intrusive Activities (incorporated with site-specific HASP)	Requirements for real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust)	Action, Chemical	Would relate to any intrusive remedial activities including drilling	Yes
NYSDEC DAR-1 Guidelines for the Control of Toxic Air Contaminants	Guidance for the control of toxic ambient air contaminants in New York State and outlines the procedures for evaluating sources of air pollution	Action, Chemical	May apply to air emissions from SSD System and ISTT/SVE System	Yes
NYSDOH Guidance for Evaluating Soil Vapor	Guidance in identifying and addressing existing	Action,	Applies to control of soil vapor intrusion from beneath the site	Yes

Table 1

List of Major New York State Standards, Criteria and Guidelines (SCGs)
Greif Facility – Tonawanda, New York
NYSDEC VCP Number V00334-9

CITATION	*DESCRIPTION*	*TYPE*	*APPLICABILITY TO SELECTED REMEDY*	*WILL REMEDY COMPLY WITH THIS SCG?*
Intrusion	and potential human exposures to contaminated subsurface vapors associated with known or suspected VOCs contamination	Chemical	building, and the design of SSD System.	
NYSDEC TOGS 1.1.1	Ambient Water Quality Standards and Guidance Values	Action, Chemical	Provides means of evaluation of effectiveness of MNA component of remedy	Yes
NYSDEC Groundwater Monitoring Well Decommissioning Procedures (May 1995)	Requirements for abandonment of groundwater monitoring wells	Action	Applies to abandonment of wells at conclusion of remedy	Yes
TO BE CONSIDERED (TBCS) (2)				
NYSDEC Draft DER-10	Technical Guidance for Site Investigation and Remediation	Action	Relates to all Site remedial action activities, including notification, quality assurance (Section 2), institutional controls (Section 5.6), schedule & progress reports (Section 5.7), Remedial Action Report (Section 5.8), and operations, monitoring, & closeout (Section 6).	Yes

List of Major New York State Standards, Criteria and Guidelines (SCGs)
Greif Facility – Tonawanda, New York
NYSDEC VCP Number V00334-9

GLOSSARY OF ACRONYMS

CFR	Code of Federal Regulations
DER	Division of Environmental Remediation
HASP	Health & Safety Plan
ISTT	In-Situ Thermal Treatment
MNA	Monitored Natural Attenuation
NYSDEC	New York State Department of Environmental Conservation
NYCRR	New York Code of Rules and Regulations
OSHA	Occupational Safety and Health
SCG	Standards, Criteria and Guidance
SSD	Sub-Slab Depressurization
SVE	Soil Vapor Extraction
TBC	To Be Considered Information
TSCA	Toxic Substances Control Act
VOCs	Volatile Organic Compounds (VOCs)
USEPA	U. S. Environmental Protection Agency

Notes:

(1) Standards and Criteria were obtained from NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.

(2) Guidelines were obtained from NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.

(3) TBCs are defined in this report as regulations and guidance documents that are not identified NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.

Appendix A

Site-Specific Health and Safety Plan

WORK PLAN

Sonoco Products Company

Updated Site-Specific Health and Safety Plan Greif, Inc. Facility *2122 Colvin Boulevard Tonawanda, New York*

NYSDEC VCP Number V00334-9

October 2009

ERM Project Number 0082324

Environmental Resources Management
5788 Widewater Parkway
DeWitt, NY 13214

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TABLE OF CONTENTS (CONT.)

TABLES

APPENDICES

1.0 INTRODUCTION

Environmental Resources Management (ERM) prepared this Health and Safety Plan (HASP) for environmental work being conducted at the Greif Bros. Corporation facility located at 2122 Colvin Boulevard in the Town of Tonawanda, Erie County, New York (the Site). The original HASP was prepared in 2000 and was previously approved by the New York State Department of Environmental Conservation (NYSDEC). ERM revised this HASP based on the significant amount of additional data gathered since the initial NYSDEC approval of this HASP.

This HASP acts as a supporting document for field activities, which may consist of soil, soil vapor, and ground water sampling, remedial construction-type activities and Radiofrequency (RF) heating of selected depths of surface soil at the Site to enable the extraction of VOCs from selected areas of surface soil at the Site. This plan will apply to ERM personnel and all subcontractors involved with the above mentioned activities.

The procedures set forth in this HASP are designed to reduce the risk of chemical and physical hazards that may be present at the Site. These procedures follow applicable federal, state, and local regulations, including Occupational Safety and Health Administration (OSHA) requirements governing activities at hazardous waste sites and the requirements in 29 CFR 1910.120. Specific practices and procedures, including the level of personal protective equipment (PPE), are based on review of currently available information for the Site. ERM has developed this HASP for conformance with the requirements of a Hazardous Communication Program as specified in 29 CFR 1910.120.

Every potential safety hazard associated with work at the Site cannot be predicted or anticipated. This HASP does not attempt to establish rules to cover every contingency that may arise, but it does provide a basic framework for the safe completion of field activities and plans for reasonable contingencies. The procedures provided herein are to be used by ERM employees and all subcontractors.

2.0 *FIELD ACTIVITIES*

A detailed description of upcoming field activities to be conducted at the Site is included in previous sections of the Remedial Action Work Plan (RAWP).

Planned remedial activities include drilling and installation of recovery wells, ground water monitoring, and vapor monitoring/recovery wells; RF heating of soil for extraction and removal of volatile organic compounds (VOCs) contained in affected soil; various sampling and ambient air monitoring activities; routine operations and maintenance of remedial systems; and remediation-derived waste handling and management.

3.0 POTENTIAL CHEMICAL AND PHYSICAL HAZARDS

VOCs and semi-volatile organic compounds (SVOCs) are the major groups of chemicals that may be present in potentially hazardous concentrations at the Site. VOCs and SVOCs of potential concern in soil and ground water at the Site are described in detail in Table 6-5 of the Data Gap Investigation (DGI) Report.

Compounds of potential concern that may be encountered during Site activities are summarized below.

Compounds of Potential Concern

Acetone	1,1,1-Trichloroethane (1,1,1-TCA)
Benzene	1,1,2-TCA
2-Butanone	Trichloroethene (TCE)
Chloroethane	1,2,4-Trimethylbenzene (1,2,4-TMB)
Chloroform	Vinyl Chloride
1,1-Dichloroethane (1,1-DCA)	Xylenes
1,2-DCA	**SVOCs**
1,1-Dichloroethene (1,1-DCE)	Benzo (a) anthracene
1,2-DCE (cis-, trans-, and total)	Benzo (a) pyrene
Ethylbenzene	Benzo (b) fluoranthene
Methylene Chloride	Benzo (k) fluoranthene
4-Methyl-2-pentanone	Chrysene
Tetrachloroethene (PCE)	Fluoranthene
Toluene	Naphthalene

VOCs and SVOCs may present hazards for inhalation; however, some may also present a concern through dermal absorption.

As field activities normally involve subsurface disturbance for generally short periods of time, the three pathways should be considered and planning, development, and implementation of specific procedures should be conducted to mitigate these potential concerns.

A summary of occupational exposure limits for chemicals of potential concern at the Site is presented in Table 1.

This information was used to develop action levels for ERM personnel as outlined in Table 1. Table 2 summarizes potential physical hazards that may be encountered during field activities.

This list has been compiled based on planned activities and potential Site conditions.

4.0 HAZARDS EVALUATION

4.1 CHEMICAL HAZARDS

Standard safety procedures will be followed to minimize exposure of Site personnel to compounds of potential concern during field.

Potential chemical hazards may include the following:

- exposure by inhalation, ingestion, and/or skin absorption of toxic gases, vapors, or dust contaminated with the chemicals of concern;
- injury by contact with corrosive or irritating chemical contaminants; and
- off-site migration of airborne chemicals or dusts contaminated with the chemicals of concern.

Site Personnel in the work zones must observe each other for signs of chemical exposure. Indications of adverse effects include, but are not limited to:

- changes in complexion and skin color;
- changes in coordination;
- changes in demeanor;
- excessive salivation and preliminary response; and
- changes in speech patterns.

Personnel should also inform their Field Team Leader of non-visible effects of overexposure to chemical materials. These symptoms may include, but are not limited to:

- headaches;
- dizziness;
- Nausea;
- blurred vision;

- cramps; and/or
- irritation of eyes, skin or respiratory track.

4.1.1 *Site Monitoring for Chemical Hazards*

The primary compounds of concern in the work areas are selected VOCs and SVOCs. Work area ambient air monitoring and good work practices will be used during the field activities to ensure that appropriate personal protection is used to minimize potential exposures Work area ambient air monitoring equipment to be used during Site activities will be selected based on its ability to detect the chemicals of concern.

Organic vapors and particulate concentrations will be monitored routinely in the breathing zone with an appropriate direct-reading instrument. A calibrated flame ionization detector (FID) or a calibrated photoionization detector (PID) with an 11.4 eV lamp will be used to screen for VOCs during intrusive Site remediation activities.

Particulate concentrations will be measured in real time using a calibrated electronic aerosol monitor.

Organic vapor and particulate concentrations, in conjunction with field observations, will be used as action level criteria for upgrading or downgrading PPE and implementing additional precautions or procedures.

The potential risks associated with working in hot or cold weather will also be considered when upgrading levels of protective equipment.

Work area ambient air and employee personal exposure level monitoring will be conducted by or under the supervision of the Health and Safety Officer (HSO).

The HSO will properly maintain and calibrate work area ambient air and employee exposure level monitoring instruments throughout field activities to ensure their accuracy and reliability.

4.1.1.1 *Organic Vapor Monitoring*

Work area ambient air monitoring for VOCs will be conducted in the worker's breathing zone periodically at intervals recommended by the HSO.

Screening for specific organic compounds will not be performed unless specific circumstances arise.

Rather, action levels will be based on total VOC concentrations. The VOC action level assumes that the background level of organics is close to non-detectable.

Background VOC concentrations will be measured and recorded on a daily basis prior to initiation of work activities.

Action levels listed below are above background.

SUSTAINED FID OR PID READING IN THE BREATHING ZONE	MINIMUM RESPIRATORY PROTECTION
0 to 1 PPM above background concentration level	None (Level D)
1 to 5 PPM above background concentration level	Full-Face Air-Purifying Respirator with organic vapor cartridges (Level C)
>5 PPM above background concentration levels	Suspend Work or Supplied-Air Full-Face Respirator (Level B)

In order to prevent unnecessary upgrading or downgrading, when the total VOC concentration in the breathing zone is close to an action level, the breathing zone of employees will be continuously monitored for a period of not less than 15 minutes to evaluate whether or not the exceedance is a temporary fluctuation.

4.1.1.2 Particulates Monitoring

Monitoring for particulates will be conducted in the breathing zone periodically at intervals recommended by the HSO.

Screening for specific inorganic compounds will not be performed. Rather, action levels of airborne particulate in work area ambient air will be based on the mercury PEL. Even though mercury is not a COPC at the Site, the mercury PEL was chosen to be conservative as it has the lowest PEL of the various inorganic elements.

The decision to upgrade levels of protection must be made in conjunction with consideration of precipitation, wind conditions, and the anticipated duration of field activity. Background particulate concentrations will be measured and recorded on a daily basis prior to initiation of work activities.

The action levels listed below are above background.

SUSTAINED READING IN THE BREATHING ZONE	MINIMUM RESPIRATORY PROTECTION
5 mcg/m^3 above background concentration levels	None (Level D)
5 mcg to 10 mcg/m^3 above background concentration levels	Full -Face Air-Purifying Respirator with HEPA/Organic Vapor combination cartridges (Level C)
>10 mcg/m^3 above background concentration levels	Suspend Work or Supplied Air Full-Face Respirator (Level B)

In order to prevent unnecessary upgrading or downgrading, when the airborne particulate concentration in the breathing zone is close to an action level, the breathing zone of employees will be continuously monitored for a period of not less than 15 minutes to determine whether or not the exceedance is a temporary fluctuation.

4.1.2 *Community Air Monitoring Program*

A community air-monitoring plan (CAMP) involving real-time monitoring for VOCs and particulates will be implemented during intrusive subsurface activities. The NYSDEC previously approved a CAMP for this Site that is contained in the IRM Work Plan (ERM, 2004). This CAMP will also be used during implementation of the final remedy at the Site. The NYSDEC-approved Site-specific CAMP is presented in Appendix A.

4.1.3 *Chemical Hazard Action Levels*

Based upon the lowest occupational exposure value for the compounds listed in Table 3-1, action levels have been established for activity cessation and the upgrade or downgrade in the level of PPE.

These action levels are guidelines; the HSO will have the ability to adjust PPE requirements as appropriate based on field conditions.

Level D protection shall be used at a minimum for Site activities.

The PPE requirements for additional protective equipment, if necessary, will be determined by the HSO based on weather and wind conditions, the particular field activity, the length of time in one location, potential for exposure, and applicable action levels.

Descriptions of the various levels of PPE are presented in Section 6.0.

4.2 PHYSICAL HAZARDS

Standard safety procedures will be followed to minimize potential physical hazards.

The primary physical safety hazards at the Site include, but are not limited to:

- common slip, trip, and fall hazards;
- overhead and buried utility hazards;
- drill rig operation;
- excavation equipment operation;
- electrical and power equipment;
- vehicular traffic;
- lifting excessive weights;
- sampling hazards;
- excessive noise levels;
- heat and cold stress; and
- other common industrial hazards.

4.2.1 Radiofrequency and Electromagnetic Field Safety

Remediation of the shallow ground water and soil in the Former Varnish UST Area will be implemented in a three step approach. Step 1 will consist of ISTT of the affected soil and ground water in the Former Varnish UST Area. The dielectric properties of the soil from the Former Varnish UST Area were used to determine the proper spacing of a network of radio frequency (RF) antenna/electrode placement wells. A treatment cell will be set up by placing two pairs of antennas in placement wells. The antennas will be electrically coupled to a shield of a coaxial cable, with a second row electrically coupled to the central conductor of the coaxial cable. RF energy is applied to pairs of antennas rows through the coaxial cable and a matching network is installed in front of the antennas-row pair to maximize power flow into the antennas-row pair. This results in very evenly distributed voltages which results in even heating. A balanced-to-unbalanced transformer is installed at the input to the matching network to prevent the deposition of RF energy outside the target volume and creation of voltages that could be hazardous to personnel (Kastecki et. al, 1993).

As presented in Table 3, the ACGIH TLVs refer to RF and microwave radiation in the frequency range of 30 kilohertz (kHz) to 300 gigahertz (gHz) and represent conditions under which it is believed nearly all workers may be repeatedly exposed without adverse health effects. The TLVs are in terms of root-mean-square (rms)electric (E) and magnetic (H) filed strengths, the equivalent plane-wave free-space power densities (S) and induced currents (I) in the body which can be associated with exposure to such fields, are given in Table A of Table 3 as a function of frequency, f, in megahertz (MHz).

4.2.2 *Common Slip, Trip, Fall Hazards*

Personnel should be aware of common slip, trip, or fall hazards that are encountered frequently in industrial and commercial environments.

Heightened awareness and emphasis on good housekeeping are the most effective ways to prevent accidents.

4.2.3 *Overhead and Buried Utility Hazards*

Utility lines, both above and below ground, may pose a safety hazard for Site personnel during soil boring or other heavy equipment operations.

If overhead utilities have been identified as a hazard, the equipment operator must maintain a safe clearance between the lines and the equipment at all times during work operations.

High voltage lines require greater clearance distances. As a safe work practice, equipment operators will maintain a 20-foot clearance between equipment and power lines or other energized sources unless the source is greater than 350 KV, in which case 29CFR 1910.180(j)(ii) must be applied.

The location of buried utilities lines must be determined prior to the start of work activities. A request for subsurface utility clearance will be filed through Dig Safely New York.

The Site owner is responsible for the identification and marking of privately owned utilities. The Site owner will clear private utilities prior to the initiation of intrusive activities. ERM and our geophysical subcontractor will evaluate areas of subsurface intrusive activity to provide an extra layer of protection regarding identification of potential subsurface utilities or other potential obstructions.

These concerns will be addressed as part of the daily safety meeting.

4.2.4 Drill Rig Operation

Drill rigs present multiple hazards while in operation.

Excessive noise, boom raising, lowering and swing, cable and hook damage and operator error may result in injuries.

To minimize potential accidents, the following safety measures should be required for all drilling operations.

The drilling subcontractor is responsible for the health and safety of its personnel, equipment, and operations.

- Operators (drillers) of equipment used on site will be familiar with the requirement for inspection and operation of such equipment;
- The drilling subcontractor is responsible for ensuring proficiency in safe operation the equipment;
- Drilling operations shall be performed from a stable ground position;
- If unable to locate on level ground, the drill rig shall be appropriately checked, blocked, and braced prior to the derrick being raised;
- A person employed by the drilling subcontractor competent in drilling safety shall make daily inspections of the drilling area;
- The inspector shall note the safety of the drilling area and confirm the location of all utilities;
- Before drilling, the existence and location of utility lines (electric and gas) will be determined by Dig Safely New York and/or the Site owner;

- This will be done, if possible, by contacting the appropriate utility company and/or client representative to mark the location of the lines;

- If the knowledge is not available, an appropriate device, such as a cable-avoiding tool, will be used to locate the service line(s);

- If flammable or combustible materials are encountered, no ignition sources are permitted if the ambient airborne concentration of flammable vapors exceeds 10 percent of the Lower Explosive Limit (LEL) during drilling activities;

- A combustible gas indicator supplied by the driller will be used as needed to make this determination in conjunction with chemical-specific LEL percentages;

- Operations must be suspended and the area evacuated if the airborne flammable vapor concentration reaches 10 percent of the LEL in an area of an ignition source, such as an internal combustion engine or an exhaust pipe;

- Combustible gas readings of the general work area will be obtained as required based on the HSO's determination;

- If drilling equipment is located in the vicinity of overhead power lines, a distance of 20 feet must be maintained between the lines and any point on the drill rig;

- Daily inspection of the drill rig and associate machinery must be conducted and documented by the driller prior to each day's operation of the rig. Inspections shall include examination of wire, rope, hydraulic lines, etc;

- In the event that repairs to the drilling rig derrick are required, personnel climbing the derrick to affect such repairs must wear a restraint system, including parachute harness and lifeline, to prevent an accidental fall.

4.2.5 *Tools - Hand and Power*

Hand and power tools will be utilized during Site activities. Any tools used during field activities will conform to the standards set in both OSHA 29CFR-1926.300 and 1926.305.

To minimize the potential for any safety-related accidents, the following measures will be required:

- all hand and power tools shall be maintained in a safe condition;
- power-operated tools shall be equipped with protective guard when in use;
- all hand-held power tools shall be equipped with a constant pressure switch that will shut off the power when the pressure is released;
- hand tools shall be kept free of splinters or cracks;
- electrical power tools shall have double-insulated type grounding;
- electrical cords are not permitted for hoisting or lowering tools;
- all fuel powered tools shall be stopped while being refueled, serviced or maintained; and
- Indoor ambient air will be measured for oxygen and toxic gases when fuel powered tools are used in enclosed spaces.

4.2.6 Vehicular Traffic

Vehicular traffic associated with routine site operations and distribution activities at the Site may pose a significant hazard to project personnel. Powered vehicles inside the facility include forklifts. Powered vehicles outside the facility include tractor-trailers and other motor vehicles.

Precaution should be taken when Site activities make it necessary to work near traveled areas.

4.2.7 Lifting Excessive Weights

Personnel should exercise caution when lifting any object, but particularly objects that weigh greater than 40 pounds.

For objects that weigh less than 40 pounds, proper lifting technique is essential to minimize the potential for injury.

No excessively bulky objects should be lifted without assistance.

4.2.8 *Sampling Hazards*

Field activities will consist of collecting soil vapor and ground water samples for analysis and evaluation. The hazards of this operation are primarily associated with the sample collection methods and procedures utilized. Standard methods and procedures that will be utilized for sampling activities are described in the NYSDEC-approved Quality Assurance Project Plan.

One potential sampling hazard that is unique relative to routine sampling activities involves the collection of hot soil and/or ground water samples from wells in the Former Varnish UST Area during implementation of ISTT. Special heat-resistant gloves capable of providing protection to temperatures of at least 100 degrees Celsius will be donned by ERM and/or subcontractor personnel prior to handling any heated samples.

4.2.9 *Excessive Noise Levels*

Noise generated by routine Site operations and heavy equipment such as drilling rigs and excavators may present a hazard during Site operations.

Excessive noise can physically damage the ear, hinder communications, and startle or annoy workers.

On-Site personnel will wear hearing protection when working near heavy equipment and whenever noise levels may exceed 85dBA.

The HSO should be consulted if there are any questions regarding the need for hearing protection during a particular activity or a particular work area.

4.2.10 *Heat Stress*

Heat stress is the aggregate of environmental and physical work factors that make up the total heat load imposed on the body. The environmental factors of heat stress include air temperatures, humidity, radiant heat exchange, wind, and water vapor pressure (related to humidity).

Physical work contributes to the total heat stress by producing metabolic heat in the body, proportional to the intensity of work.

Heavy physical labor can greatly increase the likelihood of heat fatigue, heat exhaustion, and heat stroke, the latter being a life threatening condition.

Heat stress monitoring of personnel shall commence when the ambient temperature is 80°F (70°F if chemical protective clothing is worn) or above.

Frequency of monitoring shall increase as the ambient temperature rises.

Various control measures shall be employed if heat stress becomes a problem.

These include:

- provision of liquids to replace lost body fluids;
- establishment of a work regimen that allows for rest periods to cool down; and,
- training workers in the recognition and prevention of heat stress.

Specific steps to implement should ambient temperatures pose a hazard include:

- Site workers will be encouraged to drink water throughout the day;
- They will be advised to slightly increase their salt intake by lightly salting their food;
- on-site drinking water will be kept cool to encourage personnel to drink frequently;
- a work regimen that will provide adequate rest periods for cooling down will be established as required;
- Site personnel will be advised of the dangers and symptoms of heat stroke, heat exhaustion, and heat cramps;
- employees should be instructed to monitor themselves and co-workers for signs of heat stress and to take additional breaks as necessary;
- a shaded rest area must be provided, breaks should take place in the shaded rest area;
- employees shall not be assigned to other tasks during breaks; and

- Site employees shall be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress disorders.

Heat Cramps

Heat cramps are caused by heavy sweating and inadequate electrolyte replacement.

Signs and symptoms include muscle spasms and pain in the hands, feet, and abdomen.

Heat Exhaustion

Heat exhaustion occurs from increased stress on various body organs.

Signs and symptoms include:

- pale, cool, moist skin;
- heavy sweating; and,
- dizziness, nausea, fainting.

Heat Stroke

Heat stroke is the most serious form of heat stress, and should always be treated as a medical emergency.

The body's temperature regulation system fails and the body temperature rapidly rises to critical levels.

Immediate action must be taken to cool the body before serious injury or death occurs.

Signs and symptoms of heat stroke include;

- red, hot, unusually dry skin;
- lack of, or reduced, perspiration;
- nausea;
- dizziness and confusion;

- strong, rapid pulse and confusion; and,
- coma.

4.2.11 *Cold Stress*

Cold and/or wet environmental conditions can place workers at risk of cold related illness.

Hypothermia can occur whenever temperatures are below 45°F.

It is most common during wet windy conditions, with temperatures between 30° to 40°F.

The principal cause of hypothermia in these conditions is loss of insulating properties of clothing due to moisture, coupled with heat loss due to wind and evaporation of moisture on the skin.

Frostbite, the other hazard associated with exposure to the cold, is the freezing of body tissue, which ranges from superficial freezing of surface skin layers to deep freezing of underlying tissue.

Frostbite will only occur when ambient temperatures are below 32°F.

The risk of frostbite increases as the temperature drops and the wind speed increases.

Most cold-related worker fatalities have resulted from failure to escape low environmental temperatures, or from immersion in low temperature water.

The single most important aspect of life-threatening hypothermia is a rapid decrease in the deep core temperature of the body.

Site workers should be protected from exposure to cold so that the deep core temperature does not fall below 97°F.

Lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

To prevent such occurrences, the following measures are recommended, Site workers shall wear warm clothing, such as mittens, heavy socks, etc. when the air temperature is below 45°F.

Protective clothing or coveralls may be used to shield employees from the wind.

When the air temperature is below 35°F, clothing for warmth, in addition to chemical protective clothing will be worn by employees.

This will include:

Insulated suits, such as whole body thermal underwear;
wool or polypropylene socks to keep moisture off the feet;

1. insulated gloves and boots;
2. insulated head cover such as hard hat winter liner or cap;
3. insulated jacket, with wind- and water-resistant outer layer.

At air temperatures below 35°F the following work practices are recommended:

- If the clothing of a site worker might become wet on the job site, the outer layer of clothing should be water impermeable;
- If a site worker's underclothing becomes wet in any way, they should change into dry clothing immediately;
- If the clothing becomes wet from sweating (and the employee is not uncomfortable) the employee may finish the task at hand prior to changing into dry clothing;
- Site workers should be provided with a warm (65°F or above) break area;
- Hot liquids such as soups or warm, sweet drinks should be provided in the break area;
- The intake of coffee and tea should be limited, due to their circulatory and diuretic effects;
- The buddy system shall be practiced at all times on site
- Any site worker observed with severe shivering shall leave the work area immediately; and,

- Site workers should be dressed in layers, with thinner, lighter clothing next to the body.

4.2.12 Lockout/Tagout

Lockout/Tagout activities shall conform to procedures described in of this HASP, and to safe work practices in accordance with OSHA regulations 1926.651 and 1926.652.

4.2.13 Excavation Activities

Excavation activities shall conform to procedures described in Appendix C of this HASP, and to safe work practices in accordance with OSHA regulations 1926.651 and 1926.652.

Appendix C presents contractor requirements for excavation, trenching, and shoring based on OSHA regulations.

The remedial excavation subcontractor will excavate soil and evaluate soil type and slope the excavation appropriately in conformance with OSHA Publication 2226 and any applicable federal, state, and/or local laws, rules, codes, standards, or regulations.

Excavation materials shall be contained in approved containers, tanks or in appropriate lay down areas.

Appropriate care shall be taken in the recognition that excavated material from areas at the site may contain hazardous materials.

4.2.14 Confined Space Entry

Entry into confined spaces is not permitted by ERM personnel. If a project contractor has to enter a confined space, the contractor shall provide to ERM a Confined Space Entry Program for review and comment prior to any entry into the confined space. The contractor's Confined Space Entry Program will be in conformance with all OSHA regulations and any applicable federal, state, and/or local laws, rules, codes, standards, or regulations.

5.0 PERSONNEL RESPONSIBILITIES

A Health and Safety Management Team has been developed for Site field activities. The following responsibilities will be assigned to designated project personnel for all activities.

The Field Team Leader (FTL) will act in a supervisory capacity over all ERM employees who participate in the field activities specified in this HASP. As part of these responsibilities, the FTL will distribute the HASP to all field team personnel and discuss the HASP prior to the start of field activities. All field personnel will sign the HASP Review Record verifying that they have read and are familiar with the contents of this HASP.

The HSO will be responsible for oversight, implementation and compliance of applicable health and safety regulations on-Site. The HSO has the following authority and responsibilities:

- responsibility for the field implementation, evaluation, and any necessary field modifications of this HASP;
- responsibility for maintaining adequate supplies of all PPE as well as calibration and maintenance of all relevant monitoring instruments;
- authority to suspend field activities due to imminent danger situations;
- responsibility to initiate emergency response activities;
- presentation and documentation of field safety briefings;
- maintenance of daily log of all on-site safety activities; and
- oversight of health and safety practices of ERM subcontractors.

While at the Site, ERM will review the health and safety measures followed by subcontractors. The subcontractors will be provided a copy of this HASP for information purposes and will be informed of potential health and safety concerns, as well as environmental monitoring data collected during field activities. This information will be shared with the subcontractors to assist them in implementing appropriate health and safety measures. Subcontractors are responsible for developing their own HASP that is at least as stringent as this document. In cases where health and safety procedures of this document and a subcontractor HASP are not identical, the more stringent requirements must be used by subcontractors.

All personnel entering the site will have completed training requirements for hazardous waste site operations in accordance with OSHA 29 CFR 1910.120 (e)(1)(2)(3), 29 CFR1910.146(d)(8)(g)(h)(i)(j)(k) and 29 CFR1910.147(c)(7)(i)(10)(e)(3) or be certified by their employers as having equivalent training or experience.

All personnel entering the site must have completed appropriate medical surveillance as required by OSHA 29 CFR 1910.120(f).

All personnel entering the site wearing a negative pressure air purifying respirator must have successfully passed a quantitative fit test in accordance with OSHA 29 CFR 1910.1025 or 1926.58 within the previous 12 months. Employees will be permitted to wear only those brands and models of respirator for which a fit test have been successfully performed.

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 PURPOSE /APPROACH

A critical aspect of worker field crew safety is selection and proper use of appropriate PPE. PPE refers to the types of footwear, headwear, eyewear, hearing protection, coveralls, gloves and respiratory protection each individual will wear while performing a specific task(s) and exposed to a particular chemical(s) at a given concentration(s). The levels of PPE protection that may be applied at the Site are commonly referred to as Level D, Level C, and Level B, with Level D requiring the least amount of PPE and Level B the most.

Prior experience at the Site indicates that the majority of Site activities will be conducted in Level D protection. The HSO will decide when it is necessary to upgrade, downgrade or modify the existing level of protection based on field monitoring and action levels described in Section 4.0. The HSO will make entries in the health and safety field book detailing each day's PPE requirements, tasks and if the level of PPE is modified, the reason for each change. Each level's PPE requirements may be modified by the HSO as needed. The different levels of PPE and equipment required at each level are described in the following sections and are based on 29 CFR 1910.120.

6.2 LEVEL D PROTECTION

Level D PPE will generally consist of the following:

- coveralls, a work uniform, or long pants and long shirt affording protection from dermal exposure;
- steel-toe, steel-shank work boots;
- safety glasses; and
- a hard hat (may be exempted by the HSO).

Optional Equipment or as Required by the HSO

- disposable outer boots;
- chemical-resistant gloves;
- hearing protection; and
- disposable outer chemical coveralls (Tyvek suits).

6.3 LEVEL C PROTECTION

Level C PPE will generally consist of:

- full-face air purifying respirator (APR) equipped with appropriate organic vapor canisters and/or other chemical cartridges (all personnel requiring respiratory protection must be "fit-tested" with the respirator model to be used in the field). HEPA filters will be available and utilized as warranted by Site conditions. Powered air purifying respirators may be utilized if specified by the HSO. Half-mask air purifying respirators can be donned only with the approval of the HSO;
- chemical-resistant clothing such as Tyvek®, poly-coated Tyvek® or Saranex®. Suits will be hooded and one piece with booties and elastic wristbands;
- outer chemical-resistant (recommend nitrile or neoprene) gloves and inner latex surgical gloves;
- steel-toe, steel-shank work boots with rubber overboots; and
- hard hat (may be exempted by HSO).

Optional Equipment as Required by the HSO

- escape SCBA; and
- hearing protection.

6.4 LEVEL B PROTECTION

Level B PPE will generally consist of:

- a self-contained breathing apparatus (SCBA) in a pressure demand mode, or supplied air (Grade D breathing air) with escape SCBA in the pressure demand mode;
- chemical-resistant clothing such as poly-coated Tyvek® or Saranex®. Suits will be hooded and one piece with booties and elastic wrist bands;
- chemical-resistant (recommend nitrile or neoprene) outer gloves and inner latex surgical gloves (both chemical resistant);
- steel-toe, steel-shank work boots with rubber overboots;
- chemical-resistant tape over protective clothing (as necessary); and
- hard hat (may be exempted by HSO).

7.0 SITE WORK AREAS AND DECONTAMINATION

Site operation areas will be formally set up for all field activities. Personal decontamination procedures will be adhered to upon entering or leaving all work areas. Section 7.1 describes the three zones used to control Site operation areas and Section 7.2 describes decontamination procedures.

7.1 SITE OPERATION AREAS

A three-zone control system will be used during all intrusive Site activities. The purpose of these zones is to control the flow of personnel to and from potentially affected work areas. Guidelines for establishing work areas and support zones are as follows.

Exclusion Zone (EZ): Primary exclusion zones will be established around each intrusive field activity. Appropriate personal protective equipment must be worn in this zone. This zone will be separated from the contaminant reduction zone (see below) by cones or barrier tape to prevent personnel from entering the exclusion zone boundary without appropriate protective equipment or leaving without proper decontamination.

Contaminant Reduction Zone (CRZ): The CRZ is the transition area between the EZ and the Support Zone (clean area). All personnel and equipment must be decontaminated in the CRZ upon exiting the EZ and before entering the Support Zone. The CRZ will be set up along the perimeter of the EZ at a point upwind of field activities.

Support Zone (SZ): The support zone is considered to be clean; as such, protective clothing and equipment are not required but should be available for use in emergencies. All equipment and materials are stored and maintained within this zone. Protective clothing is donned in the support zone before entering the contaminant reduction zone.

7.2 DECONTAMINATION GUIDELINES

In the situation where work areas are controlled using the three-zone concept, all personnel must exit the EZ through an established CRZ. All personnel leaving the point of operations should wash outer gloves and boots, if applicable. The outer boots shall be washed and removed and then either stored in an appropriate area or disposed of properly. If PPE is affected, personnel shall then remove and dispose of their chemical resistant coveralls with care so that inner clothing does not come in contact with any affected surfaces. After chemical resistant coverall removal, personnel shall remove and clean gloves, inspect the gloves, and discard if damaged. Personnel shall then remove the respirator, when applicable. Respirators shall be disinfected between uses by utilizing sanitizing methods and stored in a clean plastic container/bag. Potable water, at a minimum, will be present so that Site personnel can thoroughly wash hands and face if desired after leaving the point of operations.

For Site work not using the three-zone concept (e.g., soil or ground water sampling with typical equipment), portable wash stations will be utilized for easy and efficient access. The wash station shall consist of a potable water supply, soap, and clean towels. Portable sprayer units filled with Alconox® solution and potable water will also be available to wash and rinse off boots, gloves, and other equipment if necessary. The HSO will monitor decontamination procedures to ensure their effectiveness. Modifications of the decontamination procedure may be necessary as determined by HSO observations.

All reusable equipment brought on must be cleaned at the Site prior to use. Site Decontamination of all field equipment will be conducted as follows:

1. *Heavy Equipment* - The drill rig and all downhole tools will be steam cleaned between each field activity location. If necessary, equipment will be scrubbed manually to remove heavy soils prior to steam cleaning. Equipment must be steam cleaned prior to leaving the site. All water generated during decontamination activities will be collected, stored and profiled by ERM for proper disposal.
2. *Sampling Equipment (e.g., scoops, hand-auger, bowls, bailers, etc.)* - All non-disposable sampling equipment will be cleaned before each use by washing with solutions in the following order:

   - phosphate-free detergent wash;
   - potable water rinse;
   - distilled or analyte-free lab water;
   - air dry unless re-use is imminent;
   - wrap in aluminum foil until use.

Potable water will be obtained from a municipal water source at the Site. Heavily affected tools may be rinsed with hexanes or methanol if deemed necessary by the Field Team Leader. If used, the methanol and hexane will be pesticide grade solvents and will be contained for subsequent proper disposal.

After the final rinse with distilled water, equipment will be wrapped in aluminum foil and stored in a clean area until use.

3. *Meters and Probes* - All meters and probes that are used in the field will be cleaned between uses by washing with a phosphate-free detergent/potable water solution followed by rinsing with distilled water or analyte-free water supplied by the project laboratory.

7.3 MANAGEMENT OF GENERATED WASTES

All wash and rinse waters, discarded health and safety equipment, discarded sampling equipment, and other investigation- or remediation-derived wastes will be handled and managed in accordance with the RAWP.

8.0 SITE ACCESS AND SITE CONTROL

Access to Site activities are normally limited by the Site owner and will be limited to authorized personnel. Such authorized personnel include ERM employees, authorized subcontractors, authorized regulatory personnel, and representatives of the Site. However, access into the established contaminant reduction and exclusion zones will be limited to those authorized personnel with required certifications and wearing appropriate PPE. The exclusion zones will be monitored by the HSO to ensure personnel do not enter without proper personal protection equipment. Failure to comply with Site access and Site control provisions is performed at one's own risk and may result in cancellation of authorization to visit the work area (at ERM's discretion) or the Site (at the Owner's discretion).

The portion of the Former Varnish UST Area that is outside the main facility will be additionally secured through the installation of a chain-link fence. The fence will have a minimum height of 7-feet above ground surface and will include appropriate signage notifying site employees and visitors of potential safety concerns and access limitations. The fence will entirely surround the area of exterior remediation activity in the Former Varnish UST Area. A minimum of two gates will be provided in the fence to facilitate entry/regress of remedial equipment into the Former Varnish UST Area work area.

9.0 EMERGENCY RESPONSE

In the event of an emergency, the HSO will coordinate on-Site emergency response activities for ERM. Appropriate authorities will be notified immediately of the nature and extent of the emergency. Table 4 provides emergency telephone numbers that will be posted within the support zone or any other visible location. Directions to the nearest hospital are also included in Table 4.

9.1 RESPONSIBILITIES

The HSO will be primarily responsible for initiating response to all emergencies and will:

1. notify appropriate individuals, authorities, and health care facilities of the activities and hazards of the field activities;
2. ensure that the following safety equipment is available at the site: fire extinguisher, eyewash station and first aid supplies;
3. have working knowledge of all safety equipment available at the site;
4. ensure that a map that details the most direct route to the nearest hospital is present with the emergency telephone numbers; and
5. for a release incident, determine safe distances and places of refuge.

Others shall initiate emergency response activities if the HSO is not available or if there is a perceived, imminent threat to the health and safety of Site personnel, property, or equipment.

9.2 ACCIDENTS AND INJURIES

In the event of a safety or health emergency at the Site, appropriate emergency measures will be taken immediately to assist those who have been injured or exposed and to protect others from perceived hazards. The HSO will be notified immediately and will respond according to the injury.

9.3 SITE COMMUNICATIONS

Telephones (either landlines or cellular) will be located prior to the start-up of field activities and will be used as the primary communication network. Radios may be used to communicate with workers on the Site if deemed necessary by the HSO or Field Team Leader.

9.4 *RESPONSE EVALUATION*

The effectiveness of response actions and procedures will be evaluated by the HSO. Improvements will be identified and incorporated into this and future plans.

10.0 ADDITIONAL SAFETY PRACTICES

The following are important safety precautions and practices that will be enforced during the field activities.

1. Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases that probability of hand-to-mouth transfer and possible ingestion of toxic material is prohibited in any area designated by the HSO.
2. Hands and face should be thoroughly washed upon leaving the work area and before eating, drinking, or any other activity.
3. Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.
4. No facial hair, which may interfere with the effectiveness of a respirator, will be permitted on personnel required to wear respiratory protection equipment as allowed by law. The respirator must seal against the face so that the wearer receives air only through the air purifying cartridges attached to the respirator. In addition to the OHSA required physician's evaluation, approval to work while wearing respiratory protection, and qualitative fit-testing, a negative and positive pressure fit-test shall be performed prior to each respirator use to ensure a proper seal is obtained by the wearer.
5. Even when wearing protective clothing, contact with potentially contaminated surfaces should be avoided whenever possible. One should not walk through puddles, mud, or other discolored surfaces that may be affected; kneel on ground; lean, sit or place equipment on drums, containers, vehicles, or the ground in areas that may be affected.
6. Medicine and alcohol can enhance the effect from exposure to certain compounds. Alcoholic beverages will not be consumed during work hours by personnel involved in the project. Personnel using prescription drugs during the project may be precluded from performing specific tasks (e.g. operating heavy equipment) without authorization from a licensed physician.
7. Personnel and equipment in the work areas will be minimized.
8. Procedures for leaving the work area will be planned and implemented prior to going to the Site. Work areas and decontamination procedures will be established on the basis of prevailing site conditions.
9. Respirators will be issued for the exclusive use of one worker and are required to be cleaned, disinfected, and properly stored after each use.

10. Safety gloves and boots shall be taped to the disposable, chemical-protective suits as necessary.
11. Cartridges for air-purifying respirators in use will be changed daily at a minimum.

Tables

TABLE 1
OCCUPATIONAL EXPOSURE LIMITS FOR COMPOUNDS OF POTENTIAL CONCERN
GREIF BROS. FACILITY – TONAWANDA, NEW YORK
NYSDEC VCP NUMBER V00334-9

	ACGIH Threshold Limit		Permissible Exposure Limits		NIOSH Recommended	
	Value (TLV)[1]		(PEL)[4]		Exposure Limits (REL)[5]	
	8 Hour	STEL/C[3]	8 Hour	STEL/C[3]	8 Hour	STEL/C[3]
VOCs	TWA[2] PPM	PPM	TWA[2] PPM	PPM	TWA[2] PPM	PPM
Acetone	500	750	1000	2400	**250**	NE
Benzene	0.5 (Skin)	**2.5**	1	5	**0.1**	1
2-Butanone	**200**	**300**	**200**	NE	**200**	300
Chloroethane	**100**	NE	1000	NE	NE	NE
1,2-Dichloroethene (all isomers)	**200**	NE	**200**	NE	**200**	NE
1,1-Dichloroethylene	**5**	NE	NE	NE	NE	NE
1,2-Dichloroethane	10	NE	50	**C100 STEL200***	**1**	4
1,1-Dichloroethane	**100**	NE	**100**	NE	**100**	NE
Ethylbenzene	**100**	**125**	**100**	400	**100**	400
Methylene Chloride	50	NE	**25**	125	NE	NE
4-Methyl-2-pentanone	**25**	**40**	**25**	NE	**25**	40
Tetrachloroethene	**25**	**100**	100	**C 200 STEL 300***	NE	NE
Toluene	**50**	NE	200	C 300 STEL 500**	100	**C 150**
trans-1,2- Trichloroethene	NE	NE	NE	NE	NE	NE
1,1,1-Trichloroethane	**350**	450	**350**	NE	NE	NE
1,1,2 Trichloroethane	**10**	NE	**10**	NE	**10**	NE
Trichloroethylene	**50**	**C 100**	100	**C** 200 **STEL**300*	**25 (10 Hr TWA)**	
-Trimethylbenzene (all isomers)	**25**	NE	NE	NE	**25**	NE
Vinyl Chloride	**1**	NE	**1**	**5*****	NE	NE
Xylenes (o-, m-, p-isomers)	**100**	**150**	**100**	NE	**100**	**150**
SVOCs						
Acenaphthylene	NE	NE	NE	NE	NE	NE
Anthracene	NE	NE	NE	NE	NE	NE
Benzo (a) anthracene	**L**	NE	NE	NE	NE	NE
Benzo (b) fluoranthene	**L**	NE	NE	NE	NE	NE
Benzo (k) fluoranthene	NE	NE	NE	NE	NE	NE
Benzo (a) pyrene	**L**	NE	0.2 mg/m3	NE	**0.1 mg/m3 ******	NE
Chrysene	**L**	NE	0.2 mg/m3	NE	**0.1 mg/m3 ******	NE
Fluoranthene	NE	NE	NE	NE	NE	NE
Naphthalene	**10**	**C 15**	**10**	NE	**10**	**C15**
Phenanthrene	NE	NE	NE	NE	NE	NE
Pyrene	NE	NE	NE	NE	NE	NE

NOTES:
- Concentrations on table are in parts per million (PPM).

(1) American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value.

L = ACGIH recommends Exposure by all routes should be carefully controlled to levels as low as possible

(2) Time Weighted Average (TWA) is the employee's average exposure in any 8-hour work shift of a 40-hour workweek. An employee's exposure to a material listed in this table, in any 8-hour work shift of a 40-hour workweek, shall not exceed the 8-hour TWA PEL given for that material in the table.
(3) Ceiling is a concentration that should not be exceeded at any time.
(4) Permissible Exposure Limit (PEL) is the exposure, inhalation, or dermal permissible exposure limit listed in 29CFR 1910.
(5) National Institute of Occupational Safety and Health (NIOSH) Recommended Exposure Limits.
N.E. = not established.
- Bold values indicate the lowest occupational exposure value which shall be considered the action level by ERM employees.
* = 5 minute peak in any 3 hour period
** = 10 minute peak per 8 hour shift
*** = Average, not exceeding any 15 minute period during shift
****= Cyclohexane-extractable fraction

TABLE 2
PHYSICAL SAFETY CONCERNS
GREIF BROS. FACILITY – TONAWANDA, NEW YORK
NYSDEC VCP NUMBER V00334-9

Potential Hazard	Typical Description	Anticipated Locations	Procedures Used to Monitor/Reduce Hazard
Underground Utilities	Electric, Gas, Sanitary and Storm Sewer	Throughout Work Areas	Verify number and location of utilities prior to site operations.
Heat Stress	Hot weather activities	Throughout Work Areas	Wear appropriate clothing; have cool fluids available; monitoring of personnel by the Site Safety officer; other procedures as designated in this HASP.
Cold Weather	Frost-bite, Hypothermia	Throughout Work Areas	Wear appropriate clothing; have warm shelter area available, monitor worker physical conditions.
Heavy Equipment	Drill Rig, Loader	Select Work Areas	Tailgate Briefings.
Welding Fume, Fire and Exposure to Combustion products	Welding, Cutting and Brazing	Select Work Areas	Hot Work Permit Program.
Excavation Pits and Trenches	Sampling and Excavating	Throughout Work Areas	Maintain adequate slope; provide flags; at least two workers present during work; if work requires entry into a permit-required confined space (as designated by building owner), initiate required program and procedures and conduct air monitoring as required.
Insects	Bees, Wasps, Spiders	Throughout Work Areas	Identify if any worker is allergic to insects; bee sting kit.
Animals	Ground Hogs, Rabid Raccoons, Dogs, Cats, Rabbits	Throughout Work Areas	Do not approach any animal.
Plants	Poison Ivy, Poison Sumac, Poison Oak	Selected Work Areas	Identify and do not touch.
Weather	Lightning, winds, heavy rain or snow	Throughout Work Areas	With thunder and lightning -; cease all work activities including with Heavy Equipment; beware of wet & slippery conditions; facilitate stability of outdoor equipment
Noise	Heavy Equipment	Select Work Areas	Utilize hearing protection
Overhead Electrical	Overhead power lines, telephone lines	Select Work Areas with Heavy	Make sure of electrical capacity of overhead and/or adjacent power to ensure required clearance distance

Potential Hazard	Typical Description	Anticipated Locations	Procedures Used to Monitor/Reduce Hazard
Equipment		Equipment	before raising equipment extensions, masts and/or antennas/towers.

TABLE 3
RADIOFREQUENCY and ELECTROMAGNETIC FIELDS SAFETY CONCERNS
GREIF BROS. FACILITY – TONAWANDA, NEW YORK
NYSDEC VCP NUMBER V00334-9

These ACGIH TLVs refer to radiofrequency (RF) and microwave radiation in the frequency range of 30 kilohertz (kHz) to 300 gigahertz (gHz) and represent conditions under which it is believed nearly all workers may be repeatedly exposed without adverse health effects. The TLVs are in terms of root-mean-square (rms)electric (E) and magnetic (H) filed strengths, the equivalent plane-wave free-space power densities (S) and induced currents (I) in the body which can be associated with exposure to such fields, are given in Table A as a function of frequency, f, in megahertz (MHz).

Part A –Electromagnetic Fields[A] (f= frequency in MHZ)

Frequency	Power density, S (mW/cm^2)	Electric field Strength, E (V/m)	Magentic Field strength, H (A/m)	Averaging Time E^2, H^2 or S (minutes)
30 kHz -100 kHz	NE	614	163	6
100 KHZ -3MHz	NE	614	16.3/f	6
3-MHz-30MHz	NE	1842/f	16.3/f	6
30MHZ-100MHz	NE	61.4	16.3/f	6
100MHz-300MHz	1	61.4	0.163	6
300MHz-3GHz	f/300			6
3GHz-15GHz	10			6
15GHz-300GHz	10			$616{,}000/f^{1.2}$

A—the exposure values in terms of electric and magnetic field strengths are obtained by spatially averaging over an area equivalent to the vertical cross-section of the the human body (projected area).

Part A –Induced and Contact Radiofrquency Currents[B] Maxium current (mA)	Through both feet	Through Either Foot	Contact	Averaging Time
30 kHz-100kHz	2000f	1000f	1000f	1 second[C]
100kHz-100MHz	200	100	100	6 minutes[D]

B-- It should be noted that the current limits given about may not adequately protect against startle reactions and burns caused by transient discharges when contacting an energized object**.**
C—is averaged over any 1 second time period.
D—is averaged over a 6 minute period (e.g., for either foot or hand contact, time is < 60,000 mA^2-minutes, subject to a ceiling limit of 500Ma)

TABLE 4
EMERGENCY CONTACTS AND DRIVING ROUTE TO HOSPITAL
GREIF BROS. FACILITY – TONAWANDA, NEW YORK
NYSDEC VCP NUMBER V00334-9

Contact	Name	Phone Numbers
ERM Health and Safety Director:	Ernest Sweet, C.I.H. CMC	315-445-2554 (office) Direct 315-233-3040 351-256-5354 (cell)
ERM Principal-in-Charge:	Ed Hinchey, P.G.	315-445-2554 (office) Direct 315-233-3022 315-256-5355 (cell)
ERM Project Manager:	Jon Fox, P.G.	315-445-2554 (office) Direct 315-233-3035 315-256-5352 (cell)
ERM Field Team Leader	Rob Sents	315-445-2554 (office) Direct 315-233-3038 315-256-5351 (cell)
NYSDEC Project Manager:	Mike Hinton, P.E.	716-226-5356 (office) 716-870-1457 (cell)
Ambulance		911
Hospital		716-447-6121
Fire Dept.		911
Police		911
NYSDEC Spill Hotline		1-800-457-7362

Driving Route to Hospital:	***Distance (miles)***
Exit facility south (right) on Colvin Boulevard	1.2
Turn right onto W. Sheridan Drive (NY-324)	1
Turn left onto Elmwood Ave. Hospital is on the right	0.2
Total Est. Driving Time - 6 minutes	**Total Est. Distance 2.4 miles**

HASP Appendix A
Community Air Monitoring Program

COMMUNITY AIR MONITORING PLAN
GREIF, INC. FACLIITY – TONAWANDA, NEW YORK
NYSDEC VCP NUMBER V00334-9

A Community Air Monitoring Plan (CAMP) involves real-time monitoring for volatile organic compounds (VOCs) and particulate matter (i.e., dust) at the downwind perimeter of each designated work area when intrusive activities are in progress. Intrusive activities include soil or waste excavation, staging, or handling; test pitting or trenching; and/or the installation of soil borings or ground water wells. The CAMP provides a measure of protection for on-Site workers and the downwind community (i.e., off-Site receptors including residences, parks, businesses, etc.) not directly involved with the subject work activities. Routine monitoring is required to evaluate concentrations and corrective action and/or work stoppage may be required to abate emissions detected at concentrations above specified action levels. Routine data collected during implementation of the CAMP may also help document that work activities did not spread compounds of potential concern off-Site through the air. Reliance on the procedures and action levels described in this CAMP should not preclude simple, common sense measures to keep VOCs, dust, and odors at a minimum around work areas.

COMMUNITY AIR MONITORING PLAN

Compounds of potential concern include several VOCs and particulate matter (i.e., dust). VOC concentrations in air will be measured using a calibrated photoionization detector (PID). Particulate matter concentrations will be measured using a calibrated electronic aerosol monitor.

Relevant weather conditions including wind direction, speed, humidity, temperature, and precipitation will be measured and recorded prior to the initiation of subsurface intrusive activities. Background readings of VOCs and particulate matter will be collected at a minimum of five locations on Site prior to the initiation of field work on each day that subsurface intrusive work will be performed. Additional background measurements may be collected if weather conditions change significantly.

Continuous monitoring for VOCs and particulate matter will be performed downwind of the work area during subsurface intrusive activities. Periodic monitoring for VOCs will be performed during non-intrusive activities if requested by an NYSDEC and/or NYSDOH on-Site representative. Non-intrusive activities include any work activity that does not disturb the subsurface or staged soil piles, including routine Site visits, collection of ground water samples from Site wells, installation of remedial equipment, operations and maintenance, surveying, etc. Periodic monitoring will consist of collecting one reading downwind of the work area at the following intervals:

- upon arrival at a sample location or other work activity location;
- during performance of the relevant work activity;
- during the opening of a well cap (if applicable);
- during well baling or purging procedures (if applicable); and
- prior to leaving a sample location or other work activity location.

VOC RESPONSE LEVELS AND CORRECTIVE ACTIONS

VOCs will be monitored at the downwind perimeter of the immediate work area on a continuous basis during intrusive activities. Upwind concentrations will be measured at the start of each workday, during the work activity, and at the end of each work day to establish background conditions. Monitoring equipment that does not require factory calibration will be calibrated at least once a day. Calibration may be performed more frequently if Site conditions or instrument operating conditions are highly variable. The monitoring equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total VOCs at the downwind perimeter of the work area exceeds 5-parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total VOC concentration readily decreases (per instantaneous readings) below 5-ppm over background, work activities can resume with continued monitoring.

- If total VOC concentrations at the downwind perimeter of the work area persists at concentrations greater than 5-ppm over background but less than 25-ppm, work activities will be halted, the source of the VOCs identified, corrective action will be taken to abate emissions (if the source is related to Site remedial activities), and monitoring will be continued. After these steps, work activities will resume provided that the total VOC concentration 200-feet downwind of the work area, or half the distance to the nearest potential receptor, whichever is less (but in no case less than 20-feet), is below 5-ppm above background for the 15-minute average.

- If the total VOC concentration is greater than 25-ppm above background at the perimeter of the work area, intrusive work activities will be halted and the source of the VOCs will be identified. Work will resume when additional continuous monitoring demonstrates that VOC concentrations have dropped below 25-ppm for a minimum of one-half hour, and the total VOC concentration 200-feet downwind of the work area, or half the distance to the nearest potential receptor, whichever is less (but in no case less than 20-feet), is below five ppm above background for the 15-minute average.

All 15-minute readings will be recorded and will be available for review by NYSDEC and/or NYSDOH personnel. Instantaneous VOC readings (if any) used for decision purposes will also be recorded.

PARTICULATE MATTER RESPONSE LEVELS AND CORRECTIVE ACTIONS

Fugitive dust migration from the work area will be visually assessed during intrusive activities. Particulate concentrations will be monitored continuously at the downwind perimeter of the work area during intrusive activities. Particulate monitoring will be performed using real-time electronic aerosol monitoring equipment capable of measuring particulate matter less than 10-micrometers in size (PM-10) and capable of integrating over a period of 15 minutes for comparison to the airborne particulate action levels referenced below. The monitoring equipment will be equipped with an audible alarm to indicate an exceedance of a specified action level.

If the downwind PM-10 concentration is 100-micrograms per cubic meter ($\mu g/m^3$) greater than background for the 15-minute period, or if airborne dust is observed leaving the work area, dust suppression techniques will be employed. Work may continue with dust suppression techniques provided that downwind PM-10 concentration does not exceed 150-$\mu g/m^3$ above background and provided that significant visible dust is not migrating from the work area.

If downwind PM-10 concentrations are greater than 150-$\mu g/m^3$ above background, intrusive activities will be stopped and a re-evaluation of the intrusive activities will be initiated. Work can resume provided that dust suppression measures and/or other engineering controls are successful in reducing the downwind PM-10 concentration to within 150-mcg/m^3 of background and in preventing significant visible dust migration.

All 15-minute readings will be recorded and will be available for review by NYSDEC and/or NYSDOH personnel. Instantaneous readings (if any) used for decision purposes will also be recorded.

HASP Appendix B
Lockout and Tagout Procedure

LOCKOUT AND TAGOUT PROCEDURE

Any work conducted on exposed, de-energized equipment or proximal to de-energized equipment to an extent that it may present an employee exposure hazard shall trigger the implementation of the following "Lockout and Tagging" procedure in sequential order. This procedure is consistent with 29 Code of Federal Regulations (CFR) 1910.333, and 1910.147.

1) Determine that the procedure employed for de-energizing circuits or equipment is safe prior to implementation. Only authorized personnel shall be involved with the de-energizing procedure. Authorized personnel are those that have knowledge of the type and magnitude of the equipment's energy, the hazards of the energy to be controlled, and the method or means to control the energy. All affected personnel shall be notified of the application and removal of lockout and tagout devices.

2) De-energize equipment by disconnecting (isolating) circuits from all electric energy sources. Control circuit devices (i.e., switches, buttons, and interlocks) shall not be used as the sole means of de-energizes circuits or equipment. Equipment shall be shut down or turned off using established procedures and manufacturers recommendations.

3) Lockout and tagout devices shall be affixed to each energy-isolating device by authorized personnel. Lockout devices shall be affixed in a manner that will hold the energy-isolating device in a “safe” or "off" position. Tagging devices shall clearly indicate that the

operation or movement of energy isolating devices from the "safe" or "off" position is prohibited. Tagout devices shall be located at the same point as the lockout device. Lockout and tagout devices shall comply with the physical requirements specified in 29 CFR 1910.147 (c)(5).

4) Stored electrical energy, which might endanger personnel, shall be released. Capacities shall be discharged and high capacitance elements shall be short-circuited and grounded.

5) Stored non-electrical energy in devices that could re-energize electric circuit parts shall be blocked or relieved to the extent that the circuit parts could not be accidentally energized by the device.

6) No work may occur on or near de-energized circuits or equipment until the equipment or circuits are verified to be de-energized by a qualified person.

   - Verification of equipment de-energizing shall consist of a qualified person operating equipment controls or otherwise ensuring that the equipment cannot be re-started.

   - Verification of circuit de-energizing shall consist of a qualified person using test equipment. The test equipment shall be employed to ensure that all circuit elements and electrical parts of equipment are de-energized prior to employee exposure. The test shall also determine if any recognized condition exists as a result of inadvertently induced voltage or unrelated voltage back-feed even though specific parts of the circuit have been de-energized and presumed to be safe. If the circuit to be tested is over 600 volts (nominal), the test equipment shall be checked for proper operation immediately before and immediately after the test.

7) All affected personnel shall be notified of the status of de-energized equipment during shift changes to ensure continuity of lockout and tagout protection for off-going and on-coming employees.

8) No person shall vary from this procedure without explicit permission from the directing Certified Industrial Hygienist via the HSO.

9) All persons involved in the above lock-out/tag-out procedure will receive training in accordance to the specific requirements of 29 CFR 1910.147. Verification of this training must be available upon request of the HSO.

HASP Appendix C
Excavation, Trenching, Shoring

EXCAVATION, TRENCHING, SHORING AND PERMIT-REQUIRED CONFINED SPACE ENTRY

The main concerns of trenching and excavation are ground control and fall prevention. Before an excavation is made, a thorough effort shall be made to determine whether underground utilities (such as sewer, telephone, gas, fuel, water or electrical conductors) or aboveground hazards may be encountered. Underground utility lines shall be properly supported during excavation. Where appropriate, the respective utility companies shall be informed of the proposed Site Work and consulted to receive any additional advice based on their experience. Natural hazards, such as boulders and trees, shall be removed or controlled before excavation begins if there is a potential hazard to workers.

Very specific guidelines exist to protect employees from uncontrolled ground movement during excavation. The guidelines are based on ground type and excavation depth. The walls and faces of all excavations to which employees are exposed shall be guarded by a shoring system or sloping of the ground. All slopes shall be excavated to the degree required in Table P-1, which is based on soil type and the ground's unique ability to slide (see Table P-1).

TABLE P-1
Maximum Allowable Sloping Requirements*

Type	Maximum Allowable Slope
Stable Rock	Vertical (90°)
Type A	3/4:1 (53°)
Type B	1:1 (45°)
Type C	1-1/2:1 (34°)

*   Sloping for excavations greater than twenty feet in depth shall be designed by a New York State registered professional engineer.

Soil types are based on cohesiveness (exhibiting cohesion). A cohesive soil is one which is hard to break up when dry and exhibits significant cohesion when submerged. Soil types may be defined as:

Stable Rock - natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Type A soil - Soil which has an unconfined compressive strength of 1.5 tons per square foot (tsf). This includes cohesive soils such as clay, silty clay, sandy clay and clay loam. No cohesive soil is Type A if:

- soil is fissured;
- subject to vibration;
- has been previously disturbed;
- part of a sloped, layered system which dips into the excavation on a slope of four horizontal to one vertical; and
- other factors require it to be classified otherwise.

3. Type B Soil - Soil which is a cohesive soil with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf. This includes all soils classified as silt, angular gravel, silt loam, sand loam and all type A soils previously disturbed. Dry rock that is not stable will be considered type B soil. Soil as well as material that is part of a layered system where the layers dip into the excavation on a slope less than four horizontal to one vertical, but only if material is classified as type B.

4. Type C Soil - Soil which has an unconfined compressive strength of 0.5 tsf or less.

   Type C soil includes:

- Granular soils including gravel, sand or loamy sand.
- Submerged soil or soil from which water is freely seeping.
- Submerged rock, which is not stable.
- Material in a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical or steeper.

Each soil and rock deposit shall be classified by a competent person as stable rock or one of the soil types described above.

The Contractor shall ensure that a competent person is assigned to the Site during all excavating activities, i.e., sloping, shoring or working within excavations. A competent person is defined as one who is capable of identifying existing and predictable hazards, or working conditions which are unsanitary, hazardous or dangerous to employees and has authorization to take prompt corrective measures to eliminate them. The Contractor shall identify the competent person and submit the competent person's qualifications to the Engineer. A competent person shall perform daily inspection of excavations and adjacent areas. Inspections shall be concerned with possible cave in, failure of protective systems, hazardous atmospheres or other hazardous conditions. Where a competent person finds evidence of such hazards, Contractor employees shall be evacuated from the excavation until the unsafe condition is corrected.

A vibration from nearby railroad, highway traffic or heavy equipment requires the side of the excavation to be braced to resist the additional force from such loads. A warning system shall be in place when movable equipment is operated next to an edge of an excavation and the operator does not have clear or direct view of the edge. Warning systems may be barricades, hand or mechanical signals or stop logs.

No entry into an excavation in which there is accumulated water will be allowed unless adequate precautions are taken. Safety harness with attached line shall be worn at all times in excavations over four feet. Precautions include the removal of water by pumps and the diversion of any surface water by berms, dikes, ditches or plastic sheeting.

If excavations are to be performed near a wall or building and may compromise its stability, a registered professional engineer shall evaluate the wall or building and ensure its stability accordingly. Stability may be achieved by designing a bracing system if necessary. If bracing is not necessary, the registered professional engineer shall indicate in writing a bracing system is not required.

Excavated material shall be kept at least two feet from the edges of all excavations.

Excavations less than 20 feet in depth occurring in type C soil may be sloped at an angle no greater than 34 degrees measured from the horizontal plane. Excavations less than 20 feet in depth occurring in type B soil may be sloped 45 degrees measured from the horizontal plane. A registered professional engineer must approve sloping of excavations greater than 20 feet in depth.

The Contractor may use tabulated data for slope design. The tabulated data must be in written form and shall include identification of the parameters, limits of use, and identify the New York State-registered professional engineer (PE) who approved the data. A copy of the tabulated data identifying the New York State registered PE will remain on-Site during construction activities. A sloping system designed and approved by a New York State registered PE may be utilized. The written design must illustrate the magnitude of the slope considered safe based on the project. A copy of the approved written design must remain on the job Site until final completion.

Shoring systems, support systems, shield systems and other proactive systems may be used providing such systems are approved by the manufacturer, or by a New York State registered PE using the manufacturer's tabulated data. Deviations from those specifications outlined by the manufacturer or New York State registered PE shall only be made following specific written approval.

If initiated, shoring systems shall be utilized for type B soils at a depth of 5 feet or greater and immediately for type C soils. Shoring systems shall be designed by a manufacturer, New York State-registered PE or be consistent with Attachment 1 of this Appendix (OSHA Minimum Timber Shoring Requirements). All shoring systems used at a depth of 20 feet or greater require approval from a New York State-registered PE.

In excavations greater than 4 feet in depth, ladders must be located every 25 feet and extend three feet over the surface.

Any excavation activities below the ground water table shall be examined and approved in writing by a New York State registered PE.

Appendix B

In Situ Thermal Treatment Bench Testing Results

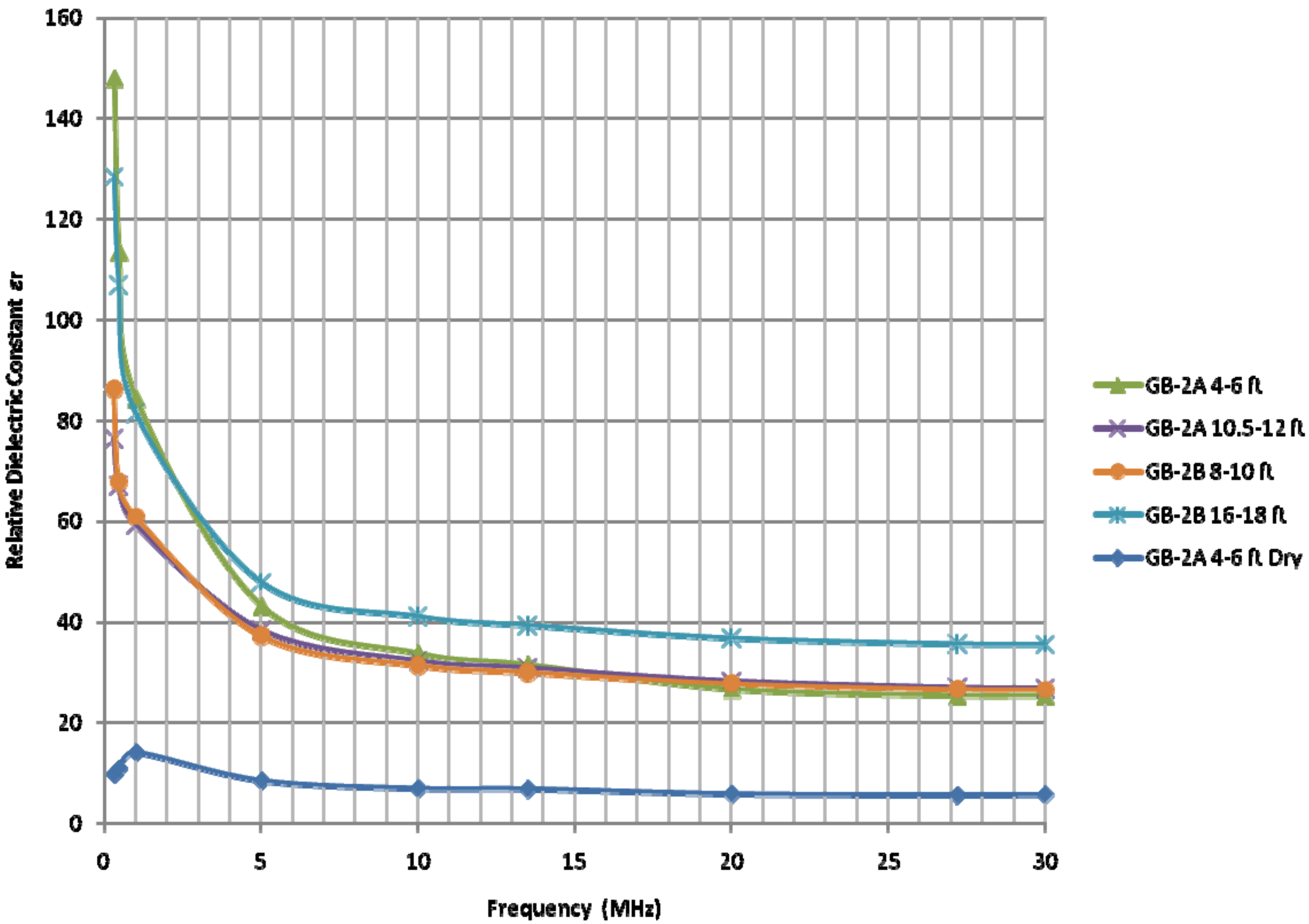
Tonawanda Silty Clay Samples

TEM Cell for Dielectric Measurement

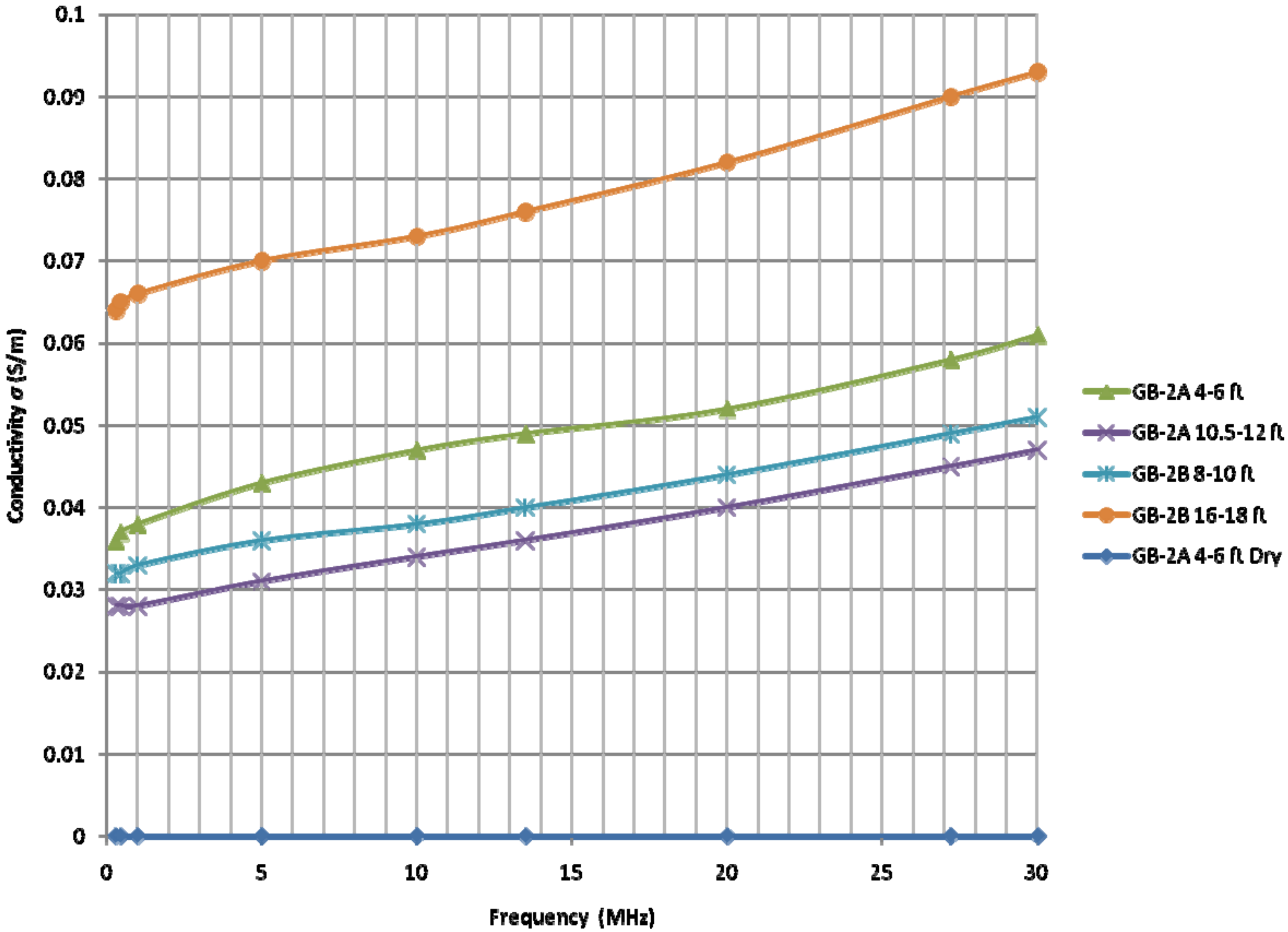
Sample
Φ1.75”,
1” H

Dielectric Measurement Setup

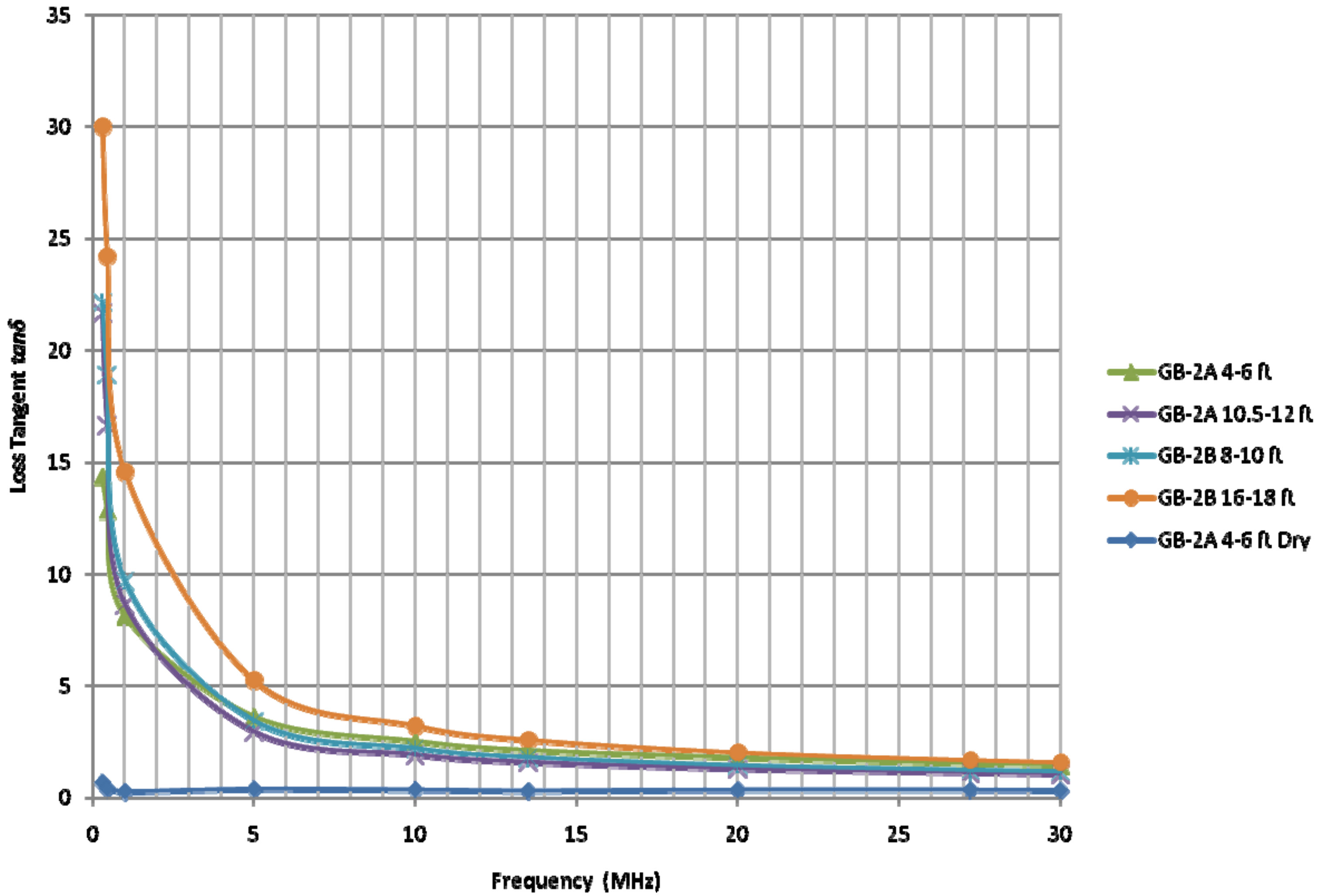
Relative Dielectric Constant vs. Frequency



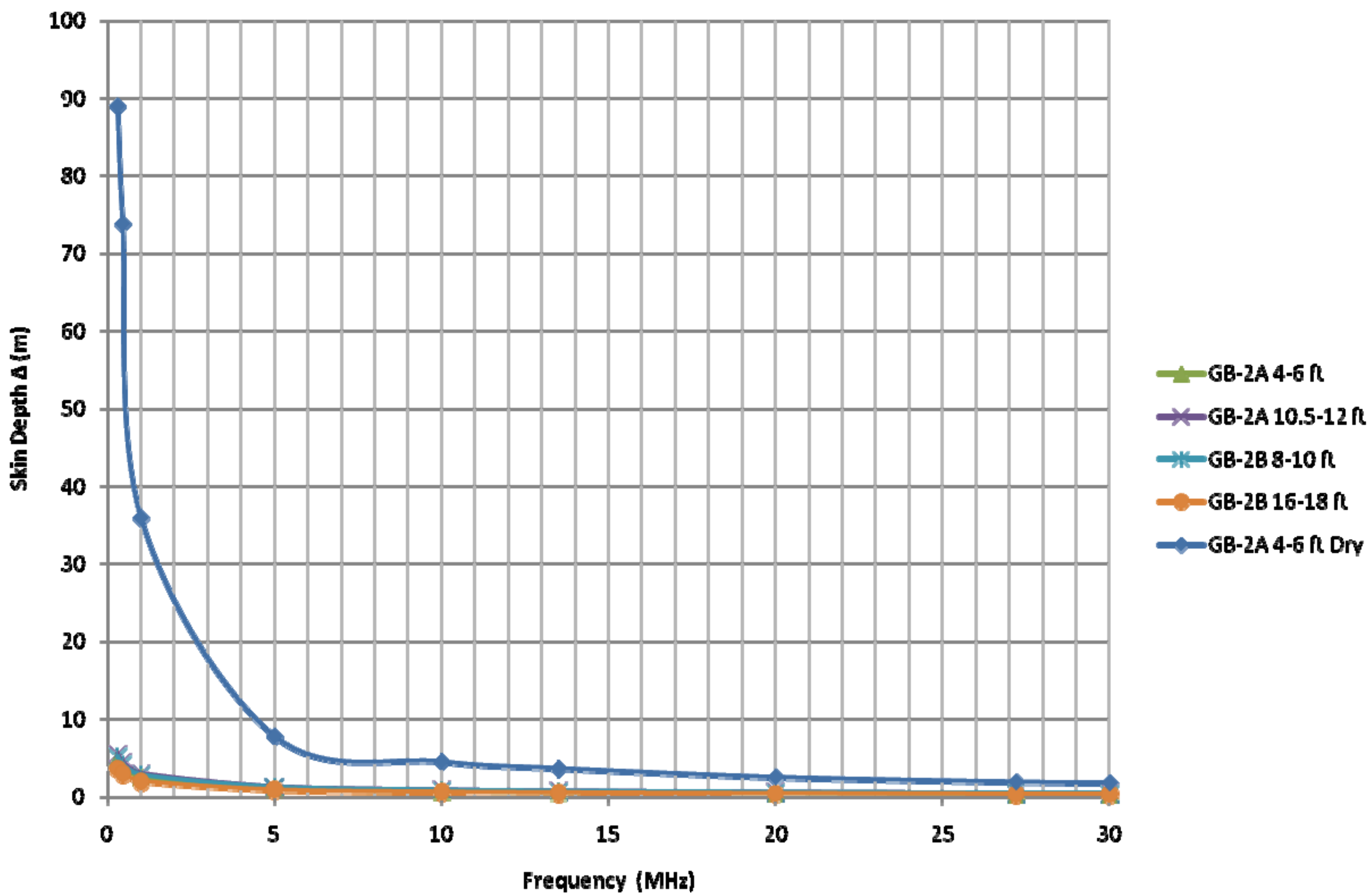
Conductivity vs. Frequency



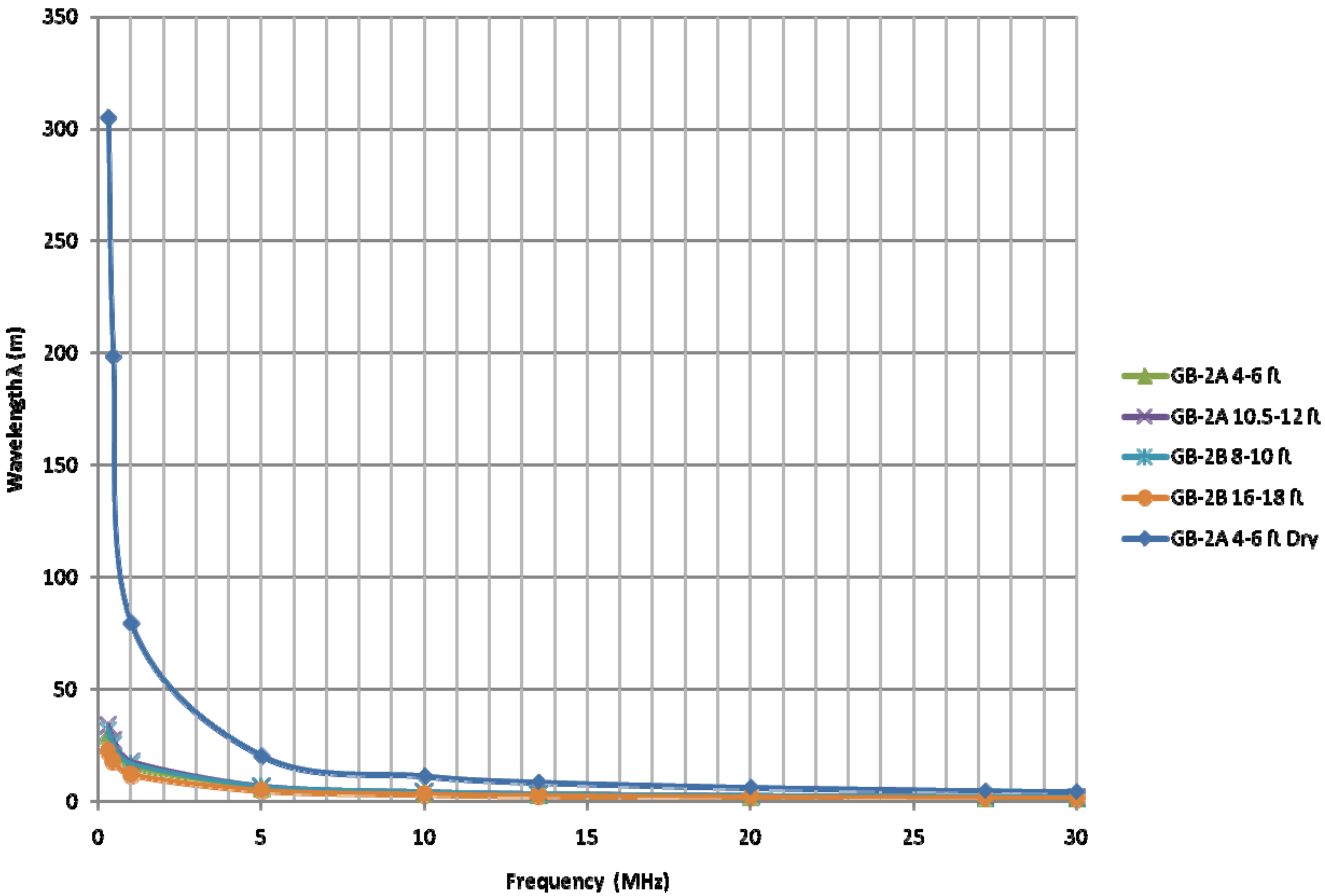
Loss Tangents vs. Frequency



Skin Depth vs. Frequency



Wavelength vs. Frequency



Appendix C

Quality Assurance Project Plan

Sonoco Products Company

Quality Assurance Project Plan
2122 Colvin Boulevard
Tonawanda, New York

Greif, Inc. Facility
Town of Tonawanda, Erie County New York
NYSDEC Voluntary Cleanup Program #V00334-9

October 2009

ERM Project Number 0082324

Prepared By:

Environmental Resources Management
5788 Widewaters Parkway
DeWitt, New York 13214

TABLE OF CONTENTS

1.0 INTRODUCTION

On behalf of Sonoco Products Company (Sonoco), Environmental Resources Management (ERM) has prepared this updated Quality Assurance Project Plan (QAPP) for work related to remedial action in the Former Varnish Underground Storage Tank (UST) Area and the Varnish Pit Area at the Greif, Inc. (Greif) facility located in Tonawanda, New York.

1.1 PURPOSE AND OBJECTIVES

This QAPP identifies the necessary procedures for an orderly, accurate, and efficient data collection and analysis program for the project, and ensures that data meet quality objectives. The objectives for monitoring and ensuring data quality include the following:

- identify key responsibilities and qualifications of staff responsible for data quality monitoring;
- ensure that samples are properly managed both in the field and the laboratory;
- ensure realistic data quality goals that will produce data of known and acceptable quality are established; and
- ensure that data are accurate, complete, and verifiable.

1.2 SITE LOCATION

The Site consists of an industrial building located on approximately 25 acres in the Town of Tonawanda, Erie County, New York. The Site is located in a mixed industrial/commercial/residential area approximately one-quarter mile south of Highway I-290. Adjoining properties are as follows:

- North – vacant land (including a former railroad siding and a wooded area) and residential apartments;
- South – a local park/sports fields (Walter M. Kenney Field) and land recently developed into commercial office space;
- East – Colvin Boulevard with single family/duplex homes further east; and
- West – a business park adjacent to a major railroad line formerly traversed by two railroad spurs into the Site.

1.3 SITE HISTORY

Based on information provided by Grief and ERM's review of Site plans, the building at the Site was originally constructed in 1948. From 1948 to 1985 the Site was owned and operated by Continental Fiber Drum and Continental Can Corporation. Historical manufacturing operations at this time consisted of the production of fiber drums but also included production of the metal lids and rims used in the fiber drums.

Sonoco Products Company acquired the Fiber Drum Division in 1985. The major existing manufacturing operations reportedly continued generally unchanged until the early 1990s. In 1995, the varnishing and degreasing processes on the metal utilized to produce the lids and rims used in the fiber drums, was discontinued. Greif subsequently acquired the Site in May 1998. The Site continues to be used for the manufacture of fiber drums and associated products. Secondary operations include equipment maintenance and administrative activities.

1.4 REMEDIAL OBJECTIVES

The overall objective of the remedial activities at the Site is to remediate the affected Site soils and ground water under the conditions of the VCP agreement. This section presents the remedial goals and remedial action objectives (RAOs) established for the Site media of interest (i.e., soil and ground water).

Remedial goals are derived from the statute (i.e., Title 6, New York Code of Rules and Regulations Part 375) and NYSDEC guidance. The remedial goals for VCP Sites as set forth in the NYSDEC Division of Environmental Remediation (DER) DER-10 Draft Technical Guidance for Site Investigation & Remediation (NYSDEC, 2002) are:

- to be protective of public health and the environment, given the intended use of the site; and

- to include removal or elimination, to the extent feasible, of identifiable source of contamination regardless of the presumed risk or intended use of the site.

The RAOs for Site soil (SRAO) are:

- SRAO1 – Prevent ingestion, direct contact with, and/or inhalation of soil that poses a risk to public health and the environment given the intended use of the Site;

- SRAO2 – Prevent inhalation of or exposure from COPC volatizing from soil that poses a risk to public health and the environment given the intended use of the Site; and

- SRAO3 – Prevent the potential for vapor intrusion into indoor air, if needed.

The RAOs for Site ground water (GWRAO) are:

- GWRAO1 – Prevent exposure to affected ground water that poses a risk to public health and the environment given the intended use of the Site;

- GWRAO2 – Prevent or minimize further migration of the contaminant plume (plume containment); and

- GWRAO3 – Prevent or minimize further migration of contaminants from source materials to ground water (source control).

2.0 QUALITY ASSURANCE OBJECTIVES

Quality objectives ensure that data collected are sufficient to meet the intended project goals. Quality objectives are pre-established goals or "benchmarks" that are used to monitor and assess the progress and quality of the work performed. It is essential to define quality objectives prior to initiation of any project work to ensure that activities yield data sufficient to meet project objectives.

Quality objectives are divided into two categories: data quality objectives (DQOs) and quality assurance objectives (QAOs). The DQOs are associated with the overall project objective as it relates to data collection. The QAOs define acceptance limits for project-generated data as they relate to data quality.

2.1 DATA QUALITY OBJECTIVES

DQOs are qualitative and quantitative criteria required to support the decision making process. DQOs define the uncertainty in a data set and are expressed in terms of precision, accuracy, representatives, completeness, and comparability (PARCC). The DQOs apply to both characterization and confirmation samples at the site. These parameters are defined as follows:

- **Precision**: a measure of mutual agreement among measurements of the same property usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the “prescribed similar conditions”.

- **Accuracy**: the degree of agreement of a measurement (or an average of measurements) with an accepted reference of “true value”. Accuracy is one estimate of the bias in a system.

- **Representativeness**: expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

- **Completeness:** a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.

- **Comparability:** expresses the confidence with which one data set can be compared with another. Comparability is a qualitative, not quantitative measurement, as in the case of accuracy and precision. Comparability is assessed by reviewing results or procedures for data that do not agree with expected results.

It is the responsibility of the field team to collect representative and complete samples. It is the responsibility of the field-screening chemist at the laboratory to analyze these samples using accepted protocols resulting in data that meet PARCC standards.

2.2 *FIELD SAMPLING QUALITY OBJECTIVES*

The overall quality of sample results depends on proper sample management. Management of samples begins at the time of collection and continues throughout the analytical process. To ensure samples are collected and managed properly and consistently, field procedures for sample collection activities have been developed for the project. The laboratory also has procedures that ensure a proper and consistent analytical process.

Field procedures include descriptions of equipment and procedures required to perform a specific task. The purpose is to increase reproducibility and to document each of the steps required to perform the task. Approved and correctly implemented field procedures should produce data of acceptable quality that meet project DQOs.

One field sampling activity that is unique relative to routine sampling activities involves the collection of hot soil and/or ground water samples from soil borings and/or wells in the Former Varnish UST Area during implementation of in-situ thermal treatment. Post-remediation soil samples will be collected once soil within a treatment cell has been heated to the target temperature. RF equipment will be de-energized following lock-out and tag-out procedures a minimum of 12 hours prior to the sampling event.

Confirmation soil samples will be collected from the treatment cell using direct push technology. Stainless steel, brass, or Teflon™ core barrel liners will be used to collect the soil sample from the desired depth using a stainless steel sampling device. Inner work gloves with outer heat-resistant plastic gloves will be used to handle hot rods and core barrels when extracted from the subsurface. Upon extracting the sampling device from the subsurface, the sample liner or tube will be removed and immediately capped with the standard barrel caps provided by the sample device's manufacturer. Once capped, the encapsulated sample will be placed in an ice-filled container for cooling.

The soil sample's temperature will be monitored with a soil thermometer until the sample is cooled to below the ambient soil temperature at the Site (approximately 15-25 degrees Celsius). The sample will be removed from ice and a soil sample will be collected from near the center of the sampling liner using standard methodology. Each sample will be placed directly into a pre-labeled sampling jar provided by the project laboratory and placed in a pre-chilled cooler. Samples will be maintained under proper chain of custody and analyzed for the Site specific VOC list. Soil confirmation samples will be analyzed on an expedited (one-week) turn around. The data will be used to determine if additional heating of soil is required.

Ground water will be cooled using a cooling apparatus consisting of coiled 0.25-inch stainless steel tubing submerged in an ice water bath. The tubing will be bent such that both ends of the coils will emerge from the ice bath to connect to the Teflon™ tubing. Decontamination procedures will be followed between wells. A peristaltic pump will be connected to the tubing after the cooling coil to purge ground water. Low-flow sampling methods will be used to determine when samples will be collected. One blind duplicate sample will be collected per sampling event for quality control proposes.

2.3 LABORATORY DATA QUALITY OBJECTIVES

The laboratory will demonstrate analytical precision and accuracy by the analysis of laboratory duplicates and by adherence to accepted manufacture and procedural methodologies.

The performance of the laboratory will be evaluated by the Project Manager and Project Quality Assurance Officer during data reduction. The evaluation will include a review of all deliverables for completeness and accuracy when applicable.

3.0 QUALITY CONTROL PROCEDURES

This section presents a general overview of the quality assurance and quality control procedures that will be implemented during the investigation. These quality control procedures are to be implemented as follows:

- in the field; and
- in the laboratory utilized for selected sample analyses.

3.1 FIELD QC ACTIVITIES

Several types of field QC samples will be collected and submitted for analysis during the project. Each type of QC sample monitors a different aspect of the field effort. Analytical results for QC samples provide information regarding the adequacy of the sample collection and transportation of samples.

The frequency of field QC samples collected will depend on the total number of samples being collected. Specifics of the sampling activities, including collection frequency and sampling procedures, are described in the field procedures. The six types of field QC samples that will be generated during the project are defined below.

- **Trip blanks** – Trip blank samples monitor for contamination due to handling, transport, cross contamination from other samples during storage, or laboratory contamination.

- **Blind duplicates** – Blind duplicates are used to monitor field and laboratory precision, as well as matrix heterogeneity.

- **Matrix Spikes** – Matrix Spikes (MS) are used to monitor precision and accuracy of the analytical method on various matrices.

3.2 LABORATORY QC ACTIVITIES

Laboratory QC samples will include the use of method blanks, MS, laboratory control samples, laboratory duplicates, and surrogate spikes. The five types of laboratory QC samples are defined below.

- **Method blanks** - Method blanks are used to monitor and ensure that the analytical system is free of contamination due either to carryover from previous samples or from laboratory procedures.

- **Matrix Spike samples** - MS samples monitor and assess the effects of the sample matrix on the sample analysis and verify the accuracy and precision of the analysis.

- **Laboratory Control samples** - LCSs are used to monitor the accuracy of the analytical procedure without the potential interferences of a matrix.

- **Laboratory Duplicate samples** - Laboratory duplicate samples are used to monitor and assess laboratory precision, as well as potential matrix heterogeneity.

- **Surrogate Spikes** - Surrogate Spikes are utilized to monitor potential interferences from the sample matrix. Surrogate spikes are required for organic analyses only.

4.0 CALIBRATION PROCEDURES

Calibration is an integral part of ensuring that results are quantitated correctly. Instruments that are not calibrated either to manufacturers and/or method specifications are likely to produce unreliable results. Proper procedures must be followed and sufficient documentation maintained to ensure calibrations are performed correctly and that sample quantitation accurately reflects sample concentrations.

During the course of this investigation, instruments that may be used in the field in conjunction with sampling activities include photoionization detector (PID), flame ionization detector (FID), dissolved oxygen meter, turbidity meter, pH and temperature meter, and specific conductance meter. A maintenance, calibration, and operation program will be implemented to ensure that routine calibration and maintenance is performed on all field instruments. The program will be monitored by the Field Team Leader. Trained team members will perform scheduled calibration, field calibrations, checks, and instrument maintenance prior to use each day. Additionally, calibration will be checked as necessary to ascertain that proper measurements are being taken.

Team members are familiar with the field calibration, operation, and maintenance of the equipment, and will perform the prescribed field operating procedures outlined in the operation and field manuals accompanying the respective instrument. Field personnel will keep records of all field instruments calibrations and field checks in the field logbooks. Calibration information recorded in field logbooks will include date, time, instrument model, and a description of calibration or field check procedure, results, and any instrument deviations.

If on-site monitoring equipment should fail, the Field Team Leader will be contacted immediately. Replacement equipment will be provided or the malfunction will be repaired in a timely fashion.

5.0 *ANALYTICAL PROCEDURES AND DATA EVALUATION*

Soil and ground water samples will be collected for the Site-specific volatile organic compounds (VOCs) list and select natural attenuation parameters will be collected during monitored natural attenuation (MNA) ground water sampling events. Samples will be analyzed by a New York State Department of Health-approved ELAP Contract Laboratory Protocol-certified laboratory.

Upon receipt of analytical reports from the laboratory, ERM will evaluate data packages and confirm that samples were analyzed within required holding time and at proper detection limits. Data validation is not included in the scope of work; however, the laboratory will provide ASP Category B data packages for confirmation soil samples.

The project Quality Assurance/Quality Control (QA/QC) officer will review the data packages and prepare a Data Usability Summary Report (DUSR) in accordance with NYSDEC guidelines. At a minimum, the following information will be evaluated:

- chain-of-custody forms;
- date sampled/date analyzed;
- sample temperature at check-in;
- raw data;
- initial and continuing instrument calibrations;
- matrix spikes;
- laboratory duplicate analyses;
- surrogate recoveries (organics); and
- laboratory control samples (inorganics).

Data reduction will consist of presenting analytical results on summary tables. Data resulting from confirmation analyses will then be used to evaluate the success of the remedial options.

6.0 PROJECT ROLES AND RESPONSIBILITIES

Specific roles and responsibilities have been defined for key project personnel to ensure that project goals are achieved. Each defined role will be performed by a qualified individual. Roles and responsibilities for tasks specific to this QAPP are as follows:

- The **Program Director** is responsible for all ERM activities on the project and assists the ERM Project Manager in planning, coordinating, and controlling all work performed on this project. The Program Director has overall responsibility for developing the QAPP, monitoring the quality of the technical and managerial aspects of the project, and implementing the QAPP and corrective measures, where necessary.
- The **Project Manager** is responsible for the successful and timely completion of the field activities and ensures that all policies and procedures outlined in the work plan, this QAPP, and the Health and Safety Plan are followed by the project team, and is responsible for assigning appropriate staff to project tasks.
- The **Task Manager** is responsible for implementation of the activities described in the appropriate sampling and analysis plan for each specific study area. The Task Manager also handles project oversight and coordination between each of the project team members.
- The **Project Chemist** oversees the laboratory contract, monitors data quality, and conducts data review to ensure the accuracy of data collected during the investigation. The Project Chemist is the laboratory contact for questions and/or revisions of procedures, methods, or chain-of-custody (COC) information, and will verify laboratory procedures and conduct laboratory audits.
- The **Data Manager** is responsible for establishing and maintaining an accurate and representative database for chemical and hydrogeologic data collected during the investigation.
- The **QA/QC Officer** is responsible for the periodic review, auditing, or assignment of qualified individuals to perform audits of activities associated with the procedures in the QAPP, and for ensuring acceptable data quality