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ERM

31 August 2006

VIA FEDERAL EXPRESS

Nathan Putnam
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau A, 11th Floor
625 Broadway
Albany, NY 12233-7015

Re: WA D003970-17 Ronhill Dry Cleaners Site No. 130071

Dear Mr. Putnam:

In response to your 25 August 2006 comment letter, Environmental Resource Management (ERM) has prepared this addendum to the Interim Remedial Measure (IRM) Work Plan, for the Ronhill Cleaners Site (No 130071) dated June 2006. These responses are intended to be attached to the work plan and the procedural changes incorporated into the pilot test.

The New York State Department of Environmental Conservation and ERM's responses to the 25 August IRM Work Plan comments are:

Comment 1. Please indicate vapor monitoring will be conducted in the businesses at 75 and 71 Forest Avenue. This monitoring will consist of subslab and indoor air sampling utilizing summa canisters on the schedule presented in Section 2.2.4.10. The Operational monitoring, Section 2.2.4.7, must include screening the subslab points at these businesses for ozone.

Response 1. Permanent subslab monitoring points will be installed in 71 Forest Avenue (1 Hour Photo) and 75 Forest Avenue (Payless Shoes). The permanent subslab points will be installed as specified in the New York State Department of Health Draft Guidance for Evaluating Vapor Intrusion in the State of New York dated February 2005.

In addition to the Performance Monitoring Samples to be collected from the Permanent Soil Gas Sampling points, specified in Section 2.2.4.10, Performance Monitoring samples, consisting of subslab and indoor air samples, will also be collected from 71 and 75 Forest Avenue. Subslab samples will be collected from the permanent subslab sampling points, installed as described above and indoor air samples from the breathing zone. Samples will be collected over a two-hour period. Collection of Performance Monitoring samples from 71 and 75 Forest Avenue will be at the frequency specified in Section 2.2.4.10.

Finally, the permanent subslab sampling points installed at 71 and 75 Forest Avenue, together with indoor ambient air monitoring will be utilized to monitor fugitive ozone emissions during the course of the Pilot Test as specified in Section 2.2.4.7 of the IRM Work Plan.

Comment 2. Please indicate monitoring wells MW-5 and 6 will be included in the groundwater sampling.

Response 2. Monitoring wells W-5 (MW-5) and W-8 (MW-8) will be included in the groundwater sampling Specified in Section 2.2.4.10. W-6 (MW-6), as we discussed on 30 August 2006, is screened 200-feet below ground surface (bgs), which is too deep to effectively monitor the effects of ozone injection at the top of the water table (approximately 85-feet bgs). W-8 (MW-8) is completed at 94-feet bgs and is better suited to monitor ozone impacts.

Comment 3. Please indicate the groundwater elevations will be monitored prior to and during the Pilot Test.

Response 3. ERM standard operating procedures include collection of groundwater elevation data. Elevation data will be collected from all monitoring wells specified in Section 2.2.4.10 prior to the start of the Pilot test and at each specified sampling event.

Comments 4 and 5. Please include dissolved oxygen as a monitoring parameter for groundwater sampling. Please include carbonates and organic carbon as analytes for groundwater samples.

Response 4 and 5. Dissolved oxygen is included in the list of baseline geochemical parameters (Table 1, page 24) to be monitored. Carbonate and organic carbon analyses will be added to this list.

Comment 6. Please indicate soil vapor will be screened at the SVE well heads for volatile organic compounds (VOCs) and ozone.

Response 6. Each SVE well (existing and any additional SVE wells installed for the pilot) will be monitored for VOCs and ozone during the course of the pilot testing.

Comment 7. Please revise the legend in Figure 3 to have the correct designations for the symbols.

Response 7. A revised figure is attached.

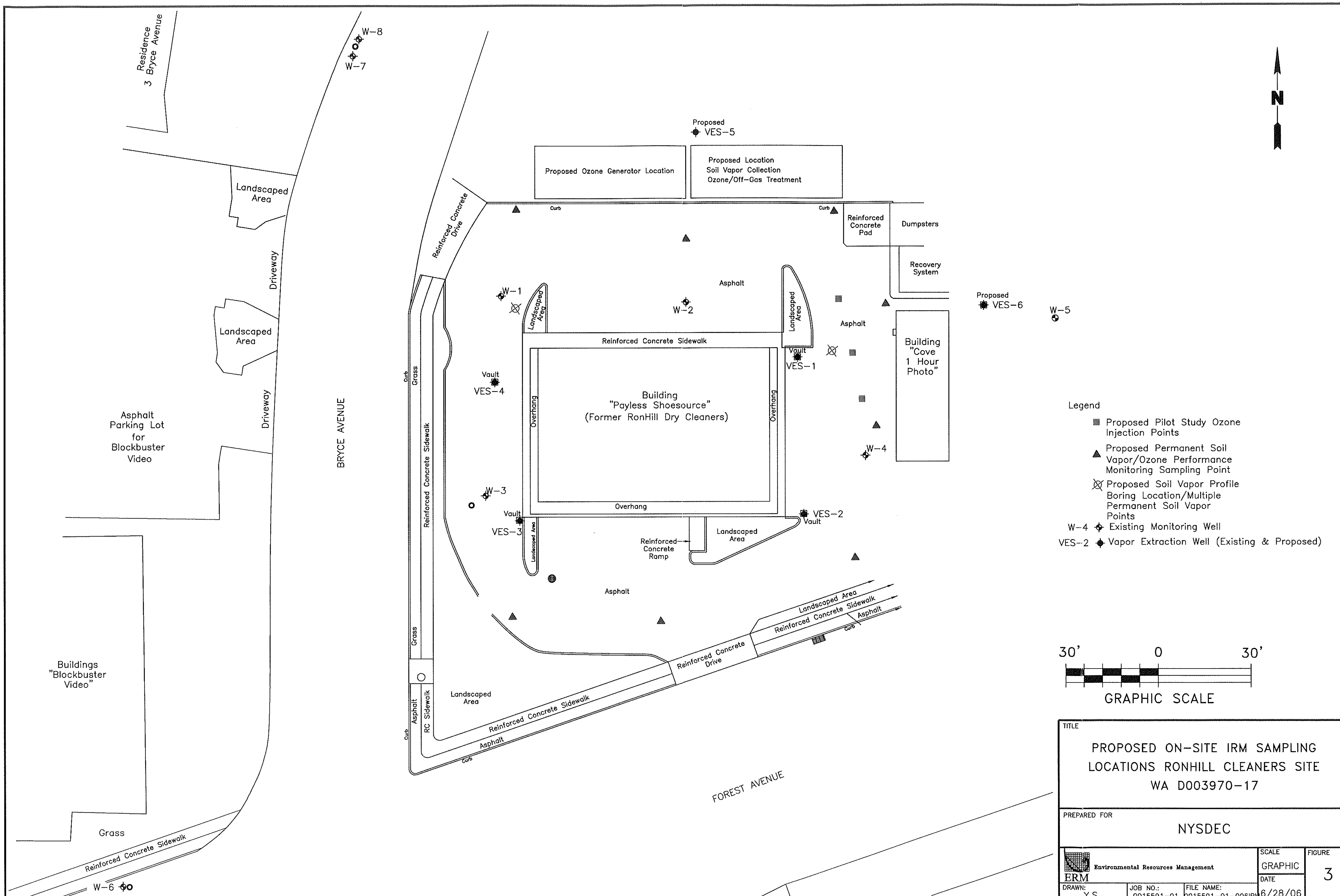
We look forward to implementing the Pilot Test.

Sincerely,

Gregory K Shkuda

Gregory K. Shkuda, PhD
Project Manager

Enc.



TITLE

PROPOSED ON-SITE IRM SAMPLING LOCATIONS RONHILL CLEANERS SITE WA D003970-17

PREPARED FOR

NYSDEC

			SCALE	FIGURE
ERM Environmental Resources Management			GRAPHIC	3
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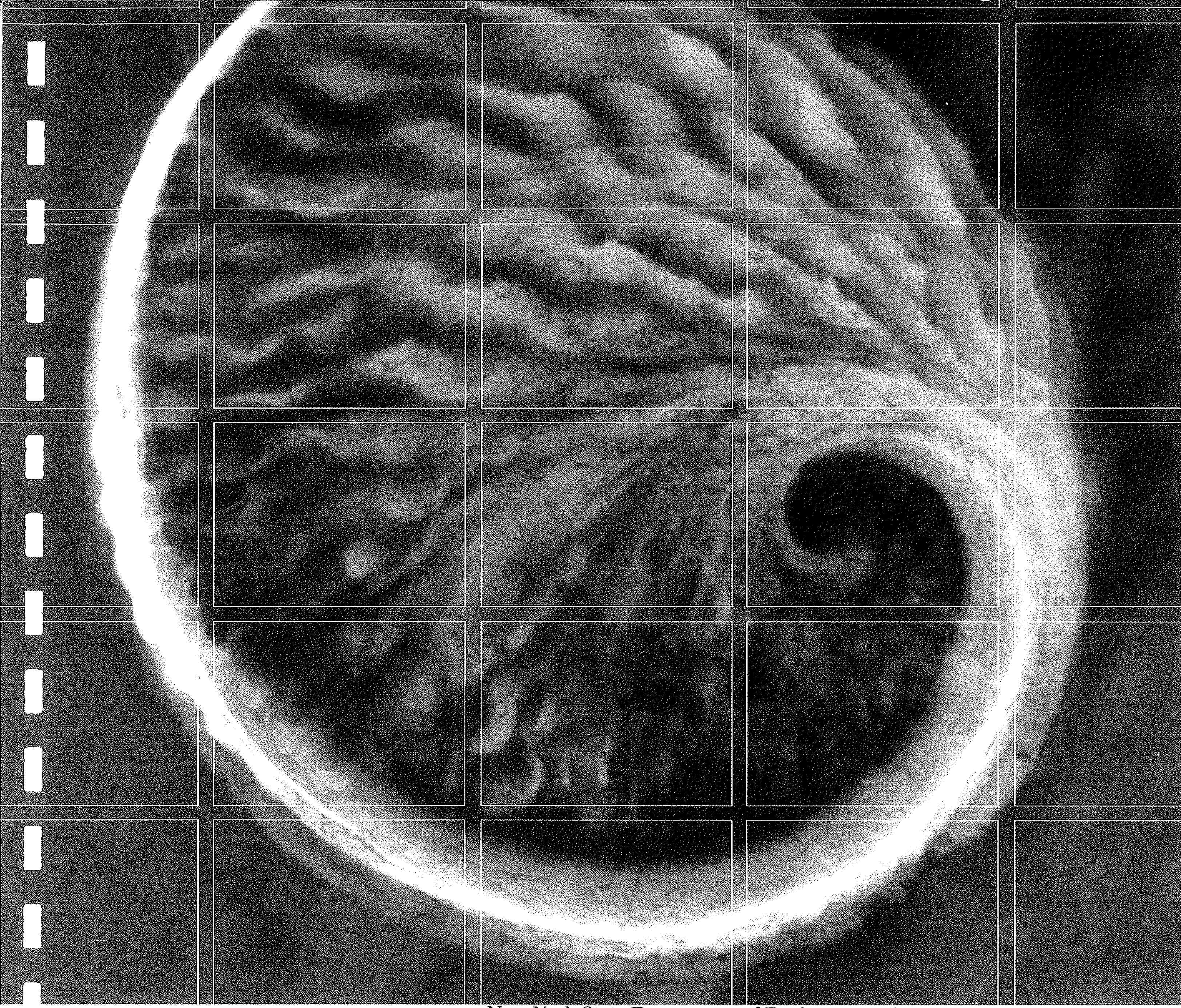

New York State Department of Environmental Conservation

Interim Remedial Measure Work Plan

Ronhill Dry Cleaners Site
71 Forest Avenue
City of Glen Cove, Nassau County, NY
NYSDEC Site No. 1-30-071
NYSDEC Work Assignment No.: D002970-73

June 2006
Environmental Resources Management
520 Broad Hollow Road
Melville, New York 111747

Delivering sustainable solutions in a more competitive world

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INTERIM REMEDIAL MEASURE WORK PLAN

Ronhill Dry Cleaners Site
71 Forest Avenue
City of Glen Cove, Nassau County, NY
NYSDEC Site No. 1-30-071
NYSDEC Work Assignment No. D003970-73

June 2006

Prepared for:

New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau A, Section A
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1.0 *INTRODUCTION*

The Interim Remedial Action (IRM) Work Plan (WP) for the Ronhill Cleaners Site located at 77 Forest Avenue in the City of Glen Cove, Nassau County, New York (the Site) has been prepared in accordance with the specifications set forth in the 23 January 2004 New York State Department of Environmental Conservation (NYSDEC) State Superfund Engineering Services Standby Contract, Work Assignment (WA) No. D003970-17. Additional project guidance came from discussions with the NYSDEC Project Manager at the 10 March 2004 Site reconnaissance, the 15 April 2004 Project Scoping Session at the NYSDEC in Albany, comments received on the initial June 2004 IRM WP draft and data collected during implementation of the off-Site remedial investigation (RI).

The ERM RI is focused on identifying off-Site impacts and closing critical on-Site data gaps identified during preparation of the RI Work Plan. The Feasibility Study (FS) will address remedial options for the entire Site, including the off-Site groundwater plume. The IRM focuses on remediation of on-Site sources present in both the unsaturated and saturated zones. The extent of on-Site contamination in the saturated zone has been defined from the soil and groundwater data collected by the Potentially Responsible Party (PRP) as part of the on-Site RI conducted in 2001, and from the vertical profile borings (VPBs) installed on-Site by ERM as part of the off-Site RI to close on-Site data gaps. The presence of contamination in the unsaturated zone is based on soil samples collected during the on-Site RI conducted by the PRP and inferred from the data collected after ERM restarted the soil vapor extraction system (SVE) installed by the PRP. Since SVE restart, ERM estimates that more than 4,000 pounds of volatile organic compounds (VOCs) have been removed from the unsaturated zone.

The concentrations of tetrachloroethene (a.k.a Perchloroethene {PCE}) observed in unsaturated zone borings, installed by the PRP's consultant during the on-Site RI, in the VPB groundwater sampling data, in groundwater data collected from the on-Site monitoring wells and from the amount of PCE removed by the SVE system, suggest the presence of a PCE dense nonaqueous phase liquid (DNAPL) in either/or both the unsaturated/saturated zones. However, there has been no direct observation of DNAPL at the Site. The DNAPL presence may be inferred by comparison of the concentration data with PCE solubility and the use of the procedures outlined in the United States Environmental Protection

Agency (USEPA) Document entitled "Estimating Potential for Occurrence of DNAPL at Superfund Sites[1]" dated January 1992.

This document is intended to be taken in the field, and will be read, understood, and followed by all personnel working on the IRM to ensure the generation of reliable data and measurement activities such that resultant data and evaluations of the same are scientifically valid, defensible, comparable and of known precision and accuracy.

1.1 PURPOSE AND OBJECTIVES

1.1.1 Purpose and Objectives

As indicated above, the objective of IRM is:

- To carry out an on-Site IRM to destroy residual contamination in the unsaturated and saturated zones (likely DNAPL), which is a continuing source of contamination to groundwater and subsurface soil gas.

The objective of the IRM will be to reduce DNAPL concentrations on-Site to limit the growth of the off-Site groundwater plume that is suspected to be migrating southwestward. Destruction or reduction of the DNAPL present on-Site will also help protect the Seaman Road public supply wells that have been contaminated with PCE, which is believed to have originated on the Site. Destruction of residual PCE will also reduce or eliminate contaminated soil gas that could impact the commercial business located on-Site or off-Site commercial and/or residential properties.

The IRM technology, identified in the WA, is In-Situ Chemical Oxidation (ISCO). ISCO is carried out by injecting an oxidizing agent (oxidant) into the subsurface to destroy contaminants in source zones. The technology is generally applicable to organic contaminants including chlorinated hydrocarbons (CHCs). Oxidants that have been successfully used in ISCO remediations include Fenton's Reagent (Iron and Hydrogen Peroxide), ozone, permanganates and persulfates. At the Site, residual contamination is present in both the vadose (unsaturated) and saturated zones and likely extends under the building.

A suitable ISCO agent will be selected based upon a pilot study. This study will aid in determining the amount and type of ISCO injected into

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[1] 1992 United States Environmental Protection Agency, R. S. Kerr Environmental Research Laboratory. Office of Solid Waste and Emergency Response. Publication: 9355.4-07FS. January 1992

the subsurface. The data from the pilot study results will be used to determine the efficacy of the chosen ISCO before full-scale implementation of the technology.

Prior to final selection of an ISCO agent and enactment of the IRM, results of all applicable testing will be provided to the relevant organizations for review, and input will be solicited as to the choice and method of ISCO technology for the Site.

1.2 SITE DESCRIPTION AND BACKGROUND INFORMATION

The Site is located on the northeast corner of Bryant and Forest Avenues at 71 Forest Avenue, City of Glen Cove, Nassau County, New York. The property is currently owned by Bedford Affiliates. A Site Location Map is presented in Figure 1.

A dry cleaner operated at the Site from 1963 to 1993. Leakage or improper disposal of dry cleaning chemicals has impacted the soil and groundwater beneath the Site. The Site was proposed as Class 2A in the New York State Registry of Inactive Hazardous Waste Sites in March 1993 and was listed as a Class 2 Site on June 19, 1995. In August 1996, operation of an SVE system, designed to remove VOCs from the soil, was started. In October 1998, the Site was referred to the NYSDEC Division of Environmental Enforcement (DER) for State funding. In July 1999, an RI/FS Work Plan was finalized, which was to be implemented by the NYSDEC.

A former operator of the dry cleaner took over the project and developed a modified RI Work Plan, which was approved by the NYSDEC in December 1999. Fieldwork began in June 2000, and an RI report was completed in March 2001.

The RI revealed that the off-Site plume was much larger than anticipated and additional investigation was needed. DNAPL is present at the Site and is found deep below the ground surface at the interface with the groundwater table. The data also suggested the presence of a contaminant source area on the east side of the Site.

The water table is approximately 80 feet below ground surface (bgs) and dissolved contamination extends at least 120 feet below the water table. The highest detected concentrations of dissolved VOCs were 190,000 micrograms per liter (μg/L [ppb]) on-Site and 15,000 μg/L off-Site. The geology and hydrogeology is complex at, and around the Site. The groundwater elevation data collected during the RI, defined a groundwater flow component to the southwest from the Site. The impacted public supply wells thus appear to be located upgradient of the Site.

An SVE system, consisting of four vapor extraction wells, was installed by the PRP. The wells are approximately located at the four corners of the existing on-Site building and are screened across the entire unsaturated zone. The SVE system was initially operated from August 1996 through June 2000 when the concentration of PCE recovered appeared to reach an asymptote. As described above, the SVE system was restarted by ERM in October 2005 after repair of the pipe connecting the wells to the blower, and as of January 2006, an additional 4,000 pounds of PCE were recovered. A second IRM was proposed by the NYSDEC to address off-Site migration of contaminated groundwater from the Site. The former operator declined to implement the IRM and the NYSDEC therefore referred the Site for funding by the NY State Superfund for implementation of an off-Site RI/FS and a second IRM.

1.3 *SITE HYDROGEOLOGY*

The Site is relatively flat at an elevation of approximately 125 feet mean sea level (msl) in a shallow topographic swale. The swale trends southwestward towards Glen Cove Creek approximately 5,000 feet away.

This northern part of the City of Glen Cove is geologically complex. The groundwater reservoir consists of unconsolidated glacial deposits of the Pleistocene age (an epoch of glaciations from 1.8 million to 11,000 years ago) and coastal-plain deposits of continental and marine origin of the Late Cretaceous age (65 million years ago). These unconsolidated deposits consist of gravel, sand and clay and are underlain by bedrock. The bedrock, which is relatively impermeable, forms the base of the groundwater reservoir.

The NYSDEC has provided pump test data from tests conducted at the Seaman Road well field and the Glen Cove Hospital complex. The NYSDEC monitored the impacts of pumpage at these two centers in off-Site monitoring wells (Ron Hill MWs 5, 6, 7, & 8). Water level response in these wells as a result of the Glen Cove Hospital pump test does not conclusively demonstrate a hydraulic response to the pumpage.

Water level response in these wells as a result of the Seaman Road well field pump test demonstrates a positive response to pumpage. However, it is unclear how these responses actually influence groundwater flow at, and downgradient of the Site. Groundwater quality data collected during the RI reveal the presence of contaminants in a well installed between the Site and the Seaman Road well field. Based upon the pump test data and the RI groundwater chemistry data, it appears that pumpage at Seaman Road well field causes a component of the groundwater flow beneath the Site to be in the direction of Seaman Road. However, the magnitude and duration of that flow component is undefined, and the link between the

Site and groundwater impacts at the Seaman Road well field remains unconfirmed.

The relationships between hydrogeologic and geologic units underlying the Site are depicted on Figure 2[2]. As shown on the figure, the unconsolidated deposits underlying the Site consist of: (descending from land surface) the upper glacial aquifer, the Port Washington Confining Unit, the Raritan confining unit and the Lloyd aquifer. The Magothy aquifer, the aquifer from which much of the drinking water on Long Island is withdrawn, is likely not present beneath Site. The deposits making up this formation in the vicinity of the Site were removed by glacial processes.

Data collected by Roux Associates[3] indicate that there is a component of groundwater flow beneath the Site to the southwest. However, the configuration of the water table presented by Kilburn and Krulikas (1987) suggest that there is a groundwater high in this area of Glen Cove. Groundwater movement would therefore be radial away from the Site.

ERM reviewed a number of technical approaches to address the solvent contamination in this geologic setting. The technologies review included, monitored natural attenuation (MNA), biologically mediated anaerobic degradation, and ISCO. Based on this review, ISCO appears to be the most applicable technology to rapidly reduce on-Site contaminant concentrations, and protect the drinking water supply wells.

1.4 *IN-SITU OXIDATION TECHNOLOGY*

ISCO is a remedial technology that is used to reduce the mass of contaminants present in DNAPL source zones by chemically oxidizing the DNAPL in place in the subsurface. Various oxidants can be used such as metal and/or hydrogen peroxides, ozone and permanganate. Selection of the appropriate oxidant is based on the DNAPL distribution, native oxidant demand and the type of DNAPL present. DNAPL is likely present in both the unsaturated and saturated zones at the Site; therefore, the ISCO agent selected for use would need to be effectively distributed in both zones. As discussed above, selection of the oxidant for use at the Site will be based on a pilot study.

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[2] Kilburn, C. and Krulikas, R. K. 1987. Hydrogeology and Groundwater Quality of the Northern Part of the Town of Oyster Bay, Nassau County, New York in 1980. U. S. Geological Survey, Water-Resources Investigations Report 85-4051.

[3] Roux Associates, 2001. Remedial Investigation Report Former Ronhill Dry Cleaning Site 71 Forest Avenue, Glen Cove, New York (Registry No 1-30-071).

1.4.1 *Proper Oxidant Selection*

Common oxidizing agents used for ISCO are permanganate, hydrogen peroxide, persulfate and ozone. Hydrogen peroxide is typically employed using one of two techniques. The first technique involves the injection of highly concentrated solutions of hydrogen peroxide into the subsurface to promote contaminant volatilization, using the heat generated during the exothermic dissociation of the oxidant. The second technique (Fenton's Reagent) oxidizes contaminants by combining hydrogen peroxide with an iron catalyst under reduced pH conditions to generate hydroxyl radicals. Similar to oxidation using Fenton's Reagent, catalytic decomposition of sodium persulfate using heat, transition metal or ultraviolet (UV) light generates persulfate and/or hydroxyl radicals which oxidize contaminants. In contrast, permanganate oxidation creates little heat or gas and contaminant treatment occurs directly through direct oxidation and does not require special catalysts or pH adjustment for the reaction to occur. Ozone is a highly reactive gas composed of three oxygen atoms (O_3) that has a very short half-life. Typically, ozone is generated at the Site and directly injected. As gas, it preferentially migrates upward and oxidizes contaminates in its pathway. All approaches have unique applications and selection of the proper oxidant is based on several factors.

A chemical's oxidation potential is often used to determine relative effectiveness for oxidizing organic constituents. The hydroxyl radical has an oxidation potential of 2.8 volts, compared to hydrogen peroxide and permanganate, which have oxidation potentials of 1.8 and 1.7 volts, respectively. Ozone's oxidation potential of 2.07 volts lies between hydroxyl radical and permanganate. These values suggest Fenton's Reagent provides the strongest option for destroying organic compounds. However, oxidation potential provides only a partial view of an oxidizing agent's capabilities. Specific mechanisms and reaction pathways also play a very important role in the reaction kinetics.

The oxidation mechanisms for hydrogen peroxide and permanganate are quite different. Fenton's Reagent is capable of oxidizing a wide range of compounds while permanganate is more selective. However, permanganate is more stable in the aquifer, and can persist long enough to allow for better contact and a more complete destruction of specific compounds when compared to Fenton's. The reaction process and potential by-products for both oxidants differ considerably. Therefore, it is important to understand the reaction mechanism for each oxidant to predict how the oxidations reactions will occur.

1.4.1.1 *Permanganate*

Permanganate is an oxidizing agent with an affinity for organic compounds containing carbon-carbon double bonds, aldehyde or hydroxyl groups. The permanganate ion is strongly attracted to the negative charge associated with the electrons in the π-cloud of the carbon-carbon double bond present in chlorinated alkenes such as PCE, trichloroethene (TCE), *cis*-1,2-dichloroethene (cDCE) and vinyl chloride (VC). The permanganate ion uses the electrons in the π-cloud to form a bridged hypomanganate diester, which is unstable and reacts further by a number of mechanisms. Under normal subsurface temperature and pH conditions, the primary oxidation reaction for chlorinated alkenes such as PCE is cleavage of the carbon-carbon double bond. Once the double bond is cleaved, the highly unstable fragments, resulting from the cleavage, are converted to carbon dioxide thorough hydrolysis or further oxidation by the permanganate ion. Because the mechanism of permanganate oxidation involves breaking of the carbon-carbon double bond in PCE and/or TCE, generation of more toxic byproducts, such as cDCE and VC, is not possible.

1.4.1.2 *Fenton's Reagent*

Formation of hydroxyl radicals from hydrogen peroxide at low pH using an iron catalyst (ferrous ions) was discovered by H.J.H Fenton in 1876. Typically, Fenton's Reagent is prepared using a solution of hydrogen peroxide, sulfuric acid and ferrous sulfate. The dissolved iron acts as a catalyst for generating the hydroxyl radical, resulting in free-radical oxidation. To keep the iron is the ferrous state, low pH must be maintained, optimally between pH 3 and 5. Obtaining optimal subsurface pH conditions is often limited by the soil buffering capacity. More important, is if peroxide is persistent in the aquifer long enough to reach the target contamination. Often the degradation of peroxide occurs over a few hours and there is insufficient time for peroxide to fully react with contamination present. The short half-life can result in the formation of toxic intermediates such as cDCE and VC.

1.4.1.3 *Hydrogen Peroxide*

Hydrogen peroxide is not an effective oxidant for many organic compounds when used at ambient pressures and temperatures. Specifically, it exhibits little effectiveness for the oxidation of chlorinated solvents and other recalcitrant compounds such as methyl-*t*-butyl ether (MTBE); nonetheless, it has been successfully used to remediate these compounds. However, it is important to evaluate the mechanisms responsible for the observed contaminant reductions in these latter cases.

Volatilization is often the primary mechanism for contaminant removal when ISCO is attempted using elevated concentrations of hydrogen peroxide. Concentrations as low as 11-percent can cause groundwater boiling, however, concentrations between 35 to 50-percent are frequently used for remediation. The addition of high strength peroxide produces heat and gaseous vapor generated by dissociation of the oxidant. The rate of hydrogen peroxide decomposition doubles with every 10-degree rise in temperature. Subsurface heating occurs rapidly, with 1,200 BTUs of energy and up to 6 cubic feet of oxygen gas released by each pound of hydrogen peroxide. As a result, VOC contamination is volatized and driven from the soils by the resulting pressure gradient. This technique can be successfully employed at sites with non-flammable VOCs; however, vapor recovery will be necessary to collect VOCs volatized from the subsurface. The existing SVE system at the Site could theoretically be used to collect VOCs volatized from the subsurface; however, control of VOCs moving off the Site would be difficult.

1.4.1.4 *Ozone*

Ozone is a highly reactive gas and strong oxidant used in a wide range of applications. Ozone is produced from molecular oxygen and reverts back to oxygen upon reaction. Ozone is used to purify water (potable and process) and air; treat a wide variety of industrial, manufacturing, mining and wood wastes; sanitize pools and spas; and bleach paper and other materials. Ozone has been used in industrial processes since the later 1800s.

The reaction of ozone with organic molecules results in the complete mineralization of the molecule. As with permanganate, the end products of the reaction of ozone with chlorinated compounds are carbon dioxide and chloride ion. The use of ozone as an ISCO agent allows for the rapid and complete destruction of the contaminants of concern.

The distribution of contaminants at the Site complicates selection of an oxidant. Contamination is present in both the saturated and unsaturated zones and, even though PCE contaminated soil was excavated from beneath the building foundation, it is likely present below the building slab. Therefore, an ISCO agent must be delivered to both the unsaturated and saturated zones and beneath the building slab to effectively remediate contamination at the Site.

Ozone injected below the water table does not diffuse an appreciable distance laterally from the injection point before diffusion to the surface begins. Incidental oxidation of contaminants in the vadose zone would therefore be accomplished by ozone diffusing from beneath the water table. However, direct injection of ozone into the vadose zone would also be required to effectively oxidize contaminants. Therefore, use of ozone at the Site would require installation of multiple injection points to oxidize contaminants in the unsaturated (vadose) and saturated zones. To deliver ozone beneath the building, injection points could be installed inside the building or by using angled boreholes. Control over ozone migration would be accomplished using a reconfigured SVE system.

1.4.1.5 *Persulfates*

Sodium persulfate is also used as an ISCO agent. As an ISCO agent, persulfate ion is decomposed catalytically or by heating to produce sulfate radicals. The reaction mechanism of sulfate radical is similar to that of permanganate ion, involving double bond cleavage. However, persulfate has a lower reactivity with naturally occurring organic material. The stoichiometric demand of persulfate is double that of permanganate, however, it is highly soluble in water and can be applied in concentrations between 10 and 20-percent.

1.4.2 *RI/FS On-Site Findings*

The extent of on-Site contamination in the saturated zone has been defined from the soil and groundwater data collected by the PRP as part of the on-Site RI conducted in 2001, and from the VPBs installed on-Site by ERM. PCE was detected in the shallow unsaturated zone soils at concentrations ranging from not-detected to 18,000 micrograms per kilogram (μg/kg), with the highest concentrations of PCE were observed in the boring installed near the northwest corner of the building. Deep unsaturated zone (20 to 85-feet below ground surface [bgs]) soil contamination was observed in borings completed near the northeast corner of the building (the maximum PCE concentration in this area was 11,000 μg/kg in the 78 to 80-feet bgs sample). Contamination in the unsaturated zone is also inferred from the data collected after ERM restarted the SVE system installed by the PRP. Since the SVE system restart, ERM estimates that more than 4,000 pounds of VOCs have been removed from the unsaturated zone.

Three VPBs were installed on the Site as part of the off-Site RI. Two of the borings were advanced to the top of the Raritan Clay confining unit (approximately 230 feet bgs). The third boring was terminated at approximately 120 feet bgs when drilling tools were lost in the borehole. Groundwater samples were collected every 5 feet from the water table (approximately 80 feet bgs) to 130 feet bgs, and at 10-foot intervals thereafter. Each groundwater sample was analyzed for VOCs by gas chromatography/mass spectrometry (GC/MS). The analytical results reveal that the groundwater under the Site is still contaminated with VOCs, almost exclusively PCE, at concentrations ranging from 100 μg/L (parts per billion) to more than 100 milligrams per liter (mg/L [parts per million]). The highest VOC concentrations were observed in the upper 30 feet of the groundwater in the VPBs installed to the west of the building (VPR-02) and in the northeast corner of the Site (VPR-03). The highest on-Site VOC concentrations were observed in the third vertical profile boring, installed on the east side of the building (VPR-04). The highest VOC concentrations in this vertical profile boring are observed in the upper 50 feet of groundwater.

On-Site groundwater monitoring wells were sampled in August 2005. The concentration of PCE in the shallow (approximately 90 to 98-feet bgs [the depth to the water table during this sampling event was approximately 85-feet bgs]) on-Site groundwater ranged from 16,000 to 110,000 μg/L. The highest concentration was observed in the monitoring well completed in the southwest (downgradient) corner of the Site.

To assess the effectiveness of the SVE system that had previously been operated on the Site to remediate vadose (unsaturated) zone contamination, soil vapor samples were collected to the south of the building, from beneath the building, from the northern edge the Site. PCE was detected in each of these samples, with the highest concentration observed in the sample collected from beneath the building slab (more than 100,000,000 micrograms per cubic meter ($\mu g/m^3$). When the SVE system was restarted, after the sub slab data were received, influent VOC concentrations to the activated carbon treatment system were 2,500,000 $\mu g/m^3$.

Based on the vadose soil vapor data, soil sampling data and the groundwater data, ERM has concluded that contaminant sources are present in both the vadose (unsaturated) and saturated zones. The ISCO, selected as the IRM, must therefore address both media.

1.4.3 *Recommended ISCO Approach*

Successful treatment is a function of the effectiveness of delivering sufficient oxidant to the impacted media (i.e., contact) and the subsequent transport of the oxidant to the source zones. As discussed above, a variety of chemical oxidants exist (e.g., hydrogen peroxide, permanganate, persulfate and ozone) that could be used to destroy PCE. Selection of the appropriate oxidant and the corresponding dose is critical in the evaluation process. Based on the setting, subsurface conditions and presence of two impacted media at the Site, ERM recommends that ozone be evaluated as the potential ISCO agent.

Although permanganate and persulfate have successfully been injected into groundwater to treat chlorinated solvents, delivery of oxidant to the vadose zone would be difficult. Theoretically, either oxidant could be injected into the vadose zone into fractures created through pneumatic or hydraulic fracturing. Dissolution of the solid oxidant, entrained in the vadose zone, would occur with infiltration of rainwater or snowmelt. However, the Site is paved and little infiltration would therefore occur. Use of persulfate would pose an additional problem in that it must be activated by heat, transition metals or UV catalysis.

The amount of oxidant required for treatment (i.e., the "dose" applied) is a function of the mass of contaminant present (Stoichiometric Demand) and the natural formation oxidation potential (natural oxidant demand [NOD]). Selecting the most appropriate oxidant for any given site is based upon many factors, including cost, method of application, type and concentrations of impacted media, and presence of potential receptors.

1.4.3.1 *Ozone*

The reaction of ozone with organic molecules results in the complete mineralization of the molecule. For example, the end products of the reactions of ozone with chlorinated compounds are carbon dioxide, water, oxygen, and chloride ion. The use of ozone in an in situ application allows for rapid destruction of the contaminants of concern with minimal impacts on surround facilities. The basic reaction equation of ozone is:

$$O_3 + 3H^+ + 2e^- \rangle O_2 + H_20 \quad E_0 = 2.07\ V$$

Because of the energy released by the reaction, ozone is not selective and will react with almost all organic matter. Typically, the upper glacial aquifer, the stratum, which contains most of the contaminants, does not contain very much organic carbon. Therefore, NOD should be low. The NOD will be determined during a pilot study. The stoichiometry of oxidation of PCE is:

$$4H_2O + 2C_2Cl_4 + 2O_3 \rightarrow 4CO_2 + 8HCl + O_2$$
(For every pound of C2Cl4 , 5.87 pounds of O_3)

The hydrochloric acid (HCI) generated causes a transitory decrease in the pH of the groundwater. The pH quickly returns to the normal range because of the buffering capacity of carbonates present in "natural" ground water.

1.4.3.2 *Injection Technique*

As indicated above, successful use of ozone for ISCO at the Site will require injection of oxidant into the vadose (unsaturated) and saturated zones, both inside and outside the building footprint. The relatively small size of the Site and the need for the current business to remain in operation, limits the size of the ozone generator and soil vapor collection equipment that can be used at the Site. Therefore, ERM recommends that ozone be injected into the subsurface through arrays of microinjection points installed across the Site. The microinjection points would be installed across in the vadose and saturated zones inside and outside of the building footprint (points under the building will either be installed inside the building [where possible] or using angle drilling).

Groups of the microinjection points would be manifolded together to create small sub-arrays designed to treat specific areas of the Site, for example in the northwest corner of the property where disposal allegedly took place. Ozone injection would be parsed from sub-array to sub-array in a sequential fashion with ozone injected into one sub-array at a time so that small capacity ozone generator could be used. The size of each sub-array would necessarily be consistent with the capacity of the ozone generator selected for the remediation.

Off-Site ozone migration will be controlled using the existing SVE system. Redesign will be required to ensure that ozone does not accumulate in the building or migrate off-Site.

2.0 *INTERIM REMEDIAL ACTION SCOPE OF WORK*

The IRM Scope of Work is based on objectives identified in the WA, and subsequently modified and/or expanded in the 15 April 2004 scoping meeting. The Scope of Work for the IRM discussed in the WA focused on destruction of residual PCE DNAPL present on-Site in the unsaturated and saturated zones. As discussed in Section 1.0, the technology identified for the IRM is ISCO. Data gaps identified in the on-Site data, that would impact implementation of the IRM, will be filled as part of the RI. On-Site data gaps identified in the 13 April ERM memorandum (RI-Work Plan Appendix A) include:

- The current distribution of contaminants in the unsaturated zone beneath the Site;
- Whether on-Site unsaturated zone sources of contamination have been remediated by operation of the SVE system;
- If an unidentified source of contamination exists in the northeast section of the Site;
- Current on-Site groundwater contaminant concentrations;
- The hydraulic connection of the Site with the Seaman Road and Glen Cove hospital wells fields; and
- The current saturated zone on-Site contaminant and background organic carbon concentrations required for design of the IRM.

The IRM will include:

- Collection of profile soil vapor samples from two VPBs to be installed on-Site to critically characterize the vertical distribution of contaminated soil vapors,
- Installation of performance monitoring wells to monitor DNAPL destruction;
- A pilot study to test ozone as the selected ISCO oxidant for the IRM;
- Design of a full-scale IRM system;
- Implementation of the ISCO application or alternative;
- Performance and long-term monitoring; and
- Evaluation of the effectiveness and the need for additional injections.

The core field investigative activities of the IRM are discussed in Tasks 2 & 3, Sections 2.2 & 2.3, which comprise the Detailed Field Activities Plan (FAP). To streamline the FAP and ensure that the field activities are consistently executed in a safe manner, the FAP is supported by the following documents:

- Appendix B: Standard Operating Procedures (SOP)[4];
- Appendix C: Quality Assurance Project Plan (QAPP)[4];
- Appendix D: Site Specific Health and Safety Plan (HASP)[4]; and
- Attachment 1: Community Air Monitoring Plan (CAMP).

Strict adherence to the SOPs, the QAPP, the HASP, and CAMP will ensure the generation of reliable data and measurement activities such that resultant data and evaluations of the same are scientifically valid, defensible, comparable and of known precision and accuracy.

The IRM tasks are identified below.

2.1 *TASK 1: IRM WORK PLAN PREPARATION*

Task 1 of the Work Assignment (WA) was the preparation this Work Plan (WP). The purpose, intent and content of this WP was discussed in Section 1.0.

2.2 *TASK 2: INTERIM REMEDIAL MEASURE PILOT STUDY*

2.2.1 *Pilot Study Objectives*

An ozone pilot study will be performed to collect data necessary to support the selection of ozone as the ISCO agent, and to design and implement a full-scale IRM using ozone. The objectives of the pilot study are:

- Subsurface injection and withdrawal of ozone to establish operating parameters such as radius of influence of an ozone injection well, injection and extraction rates, off-gas treatment requirements and other parameters required for treatment;
- Determine the impacts of operation of an ozone treatment system on surrounding facility activities. In particular, confirm that there are no potential impacts to human health or the environment from this remedial approach;

[4] Remedial Investigation & Feasibility Study Work Plan, Ronhill Cleaners, 71 Forest Avenue, City of Glen Cove, Nassau County, New York, April 2005.

- Obtain information regarding mass destruction rates and treatment effectiveness; and
- Use the information obtained above to design the IRM for the Site.

2.2.2 *Pilot Study Overview*

The pilot study will consist of the following main elements:

- Pre-pilot study on-Site soil vapor sampling to vertically profile the distribution of VOC contaminated soil vapors in the unsaturated zone beneath the Site;
- Three (3) injection wells;
- An ozone generator capable of providing a sufficient mass of ozone to the subsurface;
- A delivery system consisting of flexible Teflon tubing within a carrier pipe (to provide secondary containment) to convey ozone from the ozone generator to the injection wells;
- A vapor recovery/ozone treatment system for off-gas control to prevent the release of ozone to the atmosphere[5];consisting of existing SVE wells, an extraction blower, demister, an ozone destruction unit, carbon canisters, and appropriate piping and appurtenances; and,
- A monitoring program consisting of ground water, treatment system parameters, and ambient air monitoring to evaluate the safety and effectiveness of the pilot study.

It is anticipated that the pilot study will be performed over a period of approximately two (2) months. At the conclusion of the pilot study, a report will be prepared and submitted to the NYSDEC that documents the results of the study, and provides recommendations for design of the full-scale IRM.

2.2.3 *Pilot Study System Components*

A description of each key component of the ozone pilot study system is provided in the following sections.

2.2.3.1 *Injection Wells*

The delivery system for ozone will consist of vertical injection points installed in the subsurface. The approximate locations of the injection wells are shown in Figure 3. These wells will be placed in close proximity

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[5] The existing SVE system is poorly designed and inefficient. To effectively control off-Site ozone migration, redesign and upgrading of the system will be required. However, to the extent practicable, the underground piping, extraction wells and blower will be used in the ozone control system.

to the presumed northeast source area. The injection points will be installed in both the unsaturated and saturated zones with two-foot long screens. Screen zones will be selected to correspond with areas of high concentrations of PCE in the subsurface based on the results of the pre-pilot study soil vapor profiling, and Waterloo groundwater vertical profiling completed as part of the RI. The injection points will be installed via either direct push (i.e. Geoprobe□) or standard well installation technology. The wells will be constructed of stainless steel or other ozone compatible material, and will be approximately one-inch in diameter.

2.2.3.2 *Injection Piping*

The ozone injection piping will include all materials required to transfer ozone from the ozone generator to the injection well points. All construction materials will be ozone-compatible to provide adequate worker safety during the pilot study activities. The transfer piping will be constructed of Teflon tubing or other compatible material within a steel or PVC carrier pipe. A flow meter, pressure gauge and valves will be installed at each well head to permit control and monitoring of the vapor stream entering each injection well.

2.2.3.3 *Ozone Generation System*

The ozone generation system will consist of the following components:

- An ozone generator with the capacity to produce approximately 5 to 10 pounds of ozone per day, with a total injection rate of approximately 2 standard cubic feet per minute (SCFM). The ozone generator produces a vapor stream typically consisting of approximately 1% to 4% ozone. The remainder of the vapor stream consists of a combination of oxygen and nitrogen. If necessary, the air/ozone mixture ratio can be modified to decrease the per-day total amount of ozone delivered. The ozone generator utilizes electrical energy to convert a portion of the ambient air feed to ozone in parallel generation cells.
- A compressed air supply system to feed the ozone generator.
- An enclosure (trailer) to protect the generator from inclement weather conditions. The ozone generator is housed in a single enclosure. Controls and monitoring instruments are located in a panel on the face of the enclosure. The system includes all electrical controls and interlocks necessary for operation, as well as a fail-safe shutdown of the unit in the event of an internal or external malfunction.

2.2.3.4 *Subsurface Vapor Control System*

The subsurface vapor control system will employ both existing and new SVE wells on the Site to recover soil vapors and ozone. To assure that no ozone enters the Site building, additional shallow collection points may be installed as required between the building and the study area to collect any fugitive vapors, if deemed necessary during startup testing.

The vapor collection system will include the following components:

- Six SVE wells (4 existing & 2 new at the locations shown in Figure 3).
- Transfer piping from the SVE wells will be routed via trenches to the vapor destruction unit. Any trenches will be lined with plastic to prevent the escape of fugitive emissions. Although there may be ozone present in the collected vapors, it is anticipated that the concentration of ozone present will be minimal. Therefore, the collection system transfer piping and SVE wells will be constructed of single-walled PVC or other compatible material.
- A demister to remove water vapor from the extracted vapor stream.
- A collection vacuum blower that can provide up to 20 SCFM at 40 inches of water to collect vapors from all extraction points. The vacuum blower extraction rate will be adjusted to minimize the amount of water extracted from the subsurface.
- An ozone destruction unit consisting of an in-line, 4 to 6-inch diameter cylindrical tube filled with a magnesium oxide catalyst, which will destroy any fugitive ozone recovered.
- Vapor-phase activated carbon to capture any VOCs extracted from the subsurface.
- Interlocking controls with the ozone generation system such that if the vapor collection system is shut off or shuts off accidentally, the ozone generator will immediately be shut off.

2.2.3.5 *Vapor Monitoring System*

A continuous ozone monitoring system with a series of subsurface monitoring probes will be used to detect fugitive ozone emissions (Manufacturer and Model to be determined after completion of the pilot study). The ozone subsurface monitoring probes will be installed around the boundaries of the Site and in a variety of locations inside and outside the facility building, as well as within the interstitial space of the injection piping. The precise location of the monitoring probes will be determined based on field conditions. Initially, there will be no more than 30 feet between each monitoring probe location. The ozone monitoring system will be augmented by the use of a hand-held ozone monitor that will be used in accordance with a monitoring protocol to be developed during startup testing. This will include monitoring the concentrations of ozone in the influent and effluent of the extraction/collection system. Moreover, pressure, vacuum, temperature, injection and extraction flow rates, and other parameters will be measured and recorded during weekly operation and maintenance visits. These data will be used to evaluate treatment system performance (i.e. the injection and extraction/collection system).

2.2.3.6 *Utility Hookups*

The following utility hookups will be required:

- Electrical service (220 volt, single phase, 100 amp);
- Compressed air; and
- Water.

2.2.4 ***Pilot Study Methodology***

2.2.4.1 *Health And Safety*

Ozone exposure in the workplace is regulated by the Occupational Safety and Health Administration (OSHA). The permissible exposure limit (PEL) for ozone is 0.1 ppmv. The threshold limit value (TLV) is 0.05 ppmv, a time weighted average (TWA) for heavy work exposure. The immediately dangerous to life or health (IDLH) concentration is 5 ppmv. Engineering controls will be utilized during the pilot study to limit the risk of human exposure to ozone as previously described. These controls will include active collection via vacuum extraction of any unreacted ozone in the subsurface; aggressive ozone monitoring in the pilot study area; and security fencing around the pilot study area. This will also ensure that there is no exposure to ozone by non-workers in the area, and that worker exposure is limited below 0.05 ppmv.

A Health and Safety Plan (HASP) will be prepared to address identified potential hazards associated with the ozone treatment system. The HASP will comply with all applicable Federal Occupational Safety and Health Administration (OSHA) regulations. The procedures outlined in the HASP will be implemented and enforced by a health and safety representative during both the pilot study and full-scale system operation. The HASP will also include a modified version of the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP) that has been adapted for monitoring both VOCs and ozone at this Site. A copy of the NYSDOH Generic CAMP is presented in Attachment 1 of this IRM Work Plan. Compliance with the HASP will be required of all persons who enter restricted areas for the project. The purpose of the HASP will be to:

- Assign site personnel health and safety responsibilities;
- Establish process safety requirements for all equipment, including hazards associated with the use of powerful oxidizers, flammable materials and other hazards;
- Prescribe mandatory treatment system operating procedures;
- Establish personnel protective equipment requirements for work activities;
- Establish emergency response procedures;
- Provide information on the health and physical hazards associated with the ozone treatment process, each work activity at the Site, including all employees, contractors, subcontractors, and visitors; and
- Provide a measure of protection for the downwind community (i.e., off-Site receptors including residences and businesses and on-Site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities.

2.2.4.2 *Pre-Pilot Study Soil Vapor Sampling*

Prior to the initiation of the Pilot Study, multiple permanent soil vapor sampling points will be installed using direct push drilling (DPT) at two on-Site locations. Analytical results of on-Site soil vapor samples collected from these points will be to understand the vertically the distribution of VOC contaminated soil vapors in the unsaturated zone at the following locations shown in Figure 3:

- One boring will be located to the east of the building near the presumed eastern source; and
- One boring will be located on the west side of the Site near the corner of building where soil was excavated.

Soil vapor sampling points will be positioned every 10-feet from land surface to the water table, approximately 80 to 90-feet bgs. Installation of the permanent soil vapor sampling points will follow the NYSDOH February 2005 "Guidance of Evaluating Vapor Intrusion in the State of New York." Samples collected from the permanent soil vapor monitoring points will be used to establish the distribution of contaminated soil vapor in the on-Site vadose zone. The distribution data will be used to design the microinjection point arrays. Soil vapor samples will also be collected from these locations to determine changes in contaminant concentrations within the vadose zone after the pilot study and IRM.

After installation, soil vapor samples will be collected using Summa canisters and analyzed for VOCs using USEPA Method TO-15. Samples will be collected over a 2-hour period. As part of the RI, two on-Site Vertical Profile Borings were completed from the water table to the top of the Raritan Confining Unit. Groundwater samples were collected every 5-feet from the water table to 140 feet bgs, and at 10-foot intervals thereafter to termination of the boring. The groundwater samples were analyzed for VOCs using USEPA SW-846 Method 8260. VOC concentration data from both the vadose and saturated zone will be plotted to provide a detailed representation of the on-Site VOC distribution. The figure will also include permeability data, collected from the saturated zone.

2.2.4.3 *Site Preparation*

The pilot study area will be prepared to provide access for equipment and Site security. This preparation will include the installation of security fencing and warning signs to ensure security, and restrict access to the study area. All wells and a plastic liner will be installed in preparation for the installation of treatment equipment. The plastic sheeting will be anchored down along the perimeter and covered with a geotextile and gravel. The treatment equipment will be provided as trailer and skid-mounted units for ease of installation. All electrical and other utility hookups will then be connected.

2.2.4.4 *Treatment System Installation*

The ozone treatment equipment will be mobilized to the Site, assembled and connected to the injection and collection points. After completion of all utility hookups, all system components will be tested for proper operation. All pipes and fittings will be tested for leaks. Leak testing will be conducted with a helium/air mixture. Repairs to the equipment or piping will be made as necessary. When the equipment passes the operation test, it will be deemed ready for system start-up. The treatment equipment will be evaluated and checked for proper system operation, performance, continuity and safety. Following successful completion of the system check, the system will be deemed ready for pilot study operation.

2.2.4.5 *Tracer Gas Testing*

A treatment system test will be performed prior to initiation of ozonation using helium as a tracer gas. Compressed air will be connected without the ozone generator. One percent helium will be injected into the intake to the compressed air stream. Initially, the 1% helium/air mixture will be injected into the injection points for a period of 4 to 6 hours. At the end of the injection cycle, the ground surface inside and surrounding the study area will be monitored for helium. After the injection monitoring is completed, the collection system will be started and operated at three times the injection flow rate. The ground surface and vapor observation points will be monitored for helium after the collection system has operated for 4 to 6 hours. If there is any helium detected or if efficient recovery of the gases is not achieved, the collection system will be modified as needed to ensure complete collection. These modifications may include the installation of additional extraction points/trenches and/or modifications to the injection system.

Pressure/vacuum readings will be taken in the soil during both the injection and collection phases of the tracer test to determine radial influences of injection and vapor capture. Following this initial test, various configurations of injection/vacuum rates will be tested to determine the best system design. From the results of the tracer testing, an operational protocol for ozone injection and treatment will be developed for operator use. This protocol will outline the injection and extraction rates and pressures required for ozone injection. The information obtained in accordance with this protocol will be presented in the Pilot Study Report, to be submitted to the NYSDEC at the conclusion of the pilot study.

2.2.4.6 *Ozone System Operation*

The ozone system will initially operate for short duration tests while monitoring is performed to ensure that no fugitive ozone emissions are present in the ambient environment. Pilot study operations will start in stages. First, the collection system will be engaged. Pressure/vacuum readings will be taken in the soil to determine radial influence of vapor capture, and to confirm complete vapor capture. Second, the injection system from the injection feed blower forward will be operated. Pressure/vacuum readings will be taken in the soil to determine radial influences of injection and vapor capture, and to confirm vapor capture. Finally, the ozonation system will be operated. The Site area will be checked for fugitive ozone. Once again, pressure/vacuum readings will be taken to ensure aid in determining to determine radial influences of injection and vapor capture, and that capture of injected gases is taking place. Injection and vacuum flow rates will be adjusted as required to balance the system and optimize radial influence of injection and vapor (i.e., eliminate "dead spots").

When sufficient testing and system balancing adjustment has been performed to ensure long-term safety, the ozone system will operate continuously, 24 hours a day, during the two-month study period, with the exception of weekly operation and maintenance (O&M), at which the time the system will be shut down briefly. Pressure, vacuum, temperature, injection and extraction flow rates, and other parameters will be recorded periodically during the two-month study period and used to evaluate treatment system performance (i.e. the injection and extraction/collection system).

2.2.4.7 *Ozone Operational Monitoring*

The pilot study area will be monitored to ensure that all unused ozone is captured and destroyed once it has traveled through the soils being treated. Ozone monitoring procedures are described below.

Appropriate monitoring for fugitive ozone will be conducted in the subsurface and ambient air. To provide assurance that no fugitive emissions are present, passive vapor monitoring points will be installed. The location of these passive points will be determined based pilot study results. These points will be monitored daily until such time that no fugitive ozone emissions have been detected for a one-week period. The points will be checked during weekly O&M visits thereafter.

2.2.4.8 *Portable Ozone Monitoring*

An *EcoZone Model EZ-1X* portable ozone monitor (or equivalent) will be used to monitor the subsurface passive monitoring points for fugitive ozone emission. The portable ozone monitor will be maintained and calibrated according to the manufacturer's specifications. The detection range for portable ozone monitor is 0.0 to 0.14 ppmv. If any measurement exceeds 0.05 ppmv, the ozone system will be shut down and necessary corrective action, such as adjusting injection and extraction rates, will be taken. Once the situation is mitigated, the system will be restarted.

2.2.4.9 *Continuous Ozone Monitoring*

In addition to portable monitoring, a continuous ozone monitor will be used to monitor ozone within the ozone system trailer as well the vapor observation points (See Section 2.2.3.5). In the event ozone within the trailer or in any of the four vapor observation points exceeds 0.05 ppmv, the ozone system will automatically shut off, an external alarm will flash, and an automatic dialer will call out that the system has been shut down. Once the situation is mitigated, the system will be restarted.

The site manager, at any time, has the authority to spot check ozone concentrations within the designated work area. If any of these spot checks determine that ozone concentration exceeds 0.05 ppmv, the ozone system will be shut down and corrective action will be taken. Once the situation is mitigated, the system will be restarted. All spot check data will be recorded in a logbook.

2.2.4.10 *Performance Monitoring*

A performance monitoring program will be used to quantitatively determine the effectiveness of the ozone sparging. All sampling and analyses performed during this pilot study will be executed in accordance with applicable QAPP requirements.

Prior to ozonation, groundwater samples will be collected from W-1, W-2, W-3 and W-4, and soil gas sampling from the Permanent Soil Gas Monitoring Points. Each sample will be analyzed for VOCs with the groundwater samples also being analyzed for chloride. These wells were selected to be representative of locations directly within and adjacent to, the pilot study area. The data from these analyses will be used as baseline data to help determine the effectiveness of ozonation.

Following the initiation of ozonation, periodic testing of the monitoring wells will be performed. The following table presents the parameters and frequency of the sampling program.

	Pre-Study	**1 Month**	**2 Months**
Groundwater (W-1, W-2, W-3 & W-4)	VOCs, Chloride	VOCs, Chloride	VOCs, Chloride
Soil Vapor from Permanent Soil Gas Sampling Points	VOCs	VOCs	VOCs

In addition, field parameters (pH, temperature, specific conductance, and oxidation/reduction potential) will be determined at each sampling event in wells W-1, W-2, W-3 and W-4.

2.2.5 ***Pilot Study Report/Full-Scale Design***

A Pilot Study Report will be prepared and submitted to the NYSDEC at the conclusion of the pilot study to document the procedures, present and evaluate the results, and provide recommendations for design of the full-scale ozone injection system for the IRM. All pilot study field measurements and laboratory analytical data results will be compiled and evaluated to determine the effectiveness of ISCO at the Site. The compilation will include:

- Update of the existing Site base map to show the actual locations of the Vertical Profile Borings and Permanent Vadose Zone Soil Vapor Sampling Points,

- Compilation of boring logs, field notes and screening data,
- Tabulation of the oxidant efficiency testing data by location, calculating the range and mean within the various geological units encountered, and
- Computation of VOC mass destruction and efficiency of remedial technology for ozone.

The Pilot Study Report will include a section that presents the conceptual design and recommendations to augment the pilot study system for full-scale implementation. The report will also include revised schedule 2.11s that will present costs for the full-scale implementation of the ozone injection IRM.

2.3 *TASK 3: FULL-SCALE IRM*

After NYSDEC approval of the design of the full-scale ozone injection system submitted with the Pilot Study Report, ERM will implement the IRM. Key IRM tasks are discussed below.

2.3.1 *Baseline Geochemistry*

One round of groundwater monitoring will be conducted from on-Site monitoring wells W-1, W-2, W-3 and W-4 using conventional sampling techniques. The samples will be analyzed for VOCs and several additional analytes to support the ISCO program as shown on Table 1.

Table 1
Baseline Geochemical Analytes

Analysis	*Method of Analysis*	*Rationale*
Groundwater Elevation	Field Probe	Evaluate groundwater table elevation
pH	Field Flow-Through Cell	Evaluate aquifer geochemistry
Electrical Conductivity	Field Flow-Through Cell	Evaluate aquifer geochemistry
Temperature	Field Flow-Through Cell	Evaluate aquifer geochemistry
ORP	Field Flow-Through Cell	Evaluate aquifer geochemistry
Dissolved Oxygen	Field Flow-Through Cell	Evaluate aquifer geochemistry
VOCs	Lab - EPA Method OLM04.2	Contaminant concentrations
Chloride	Lab - EPA Method 300.0	Degradation by-product

2.3.2 *Installation of Ozone Injection Wells*

The locations of the microinjection wells and the grouping of these wells into treatment arrays will be determined based on data collected from each of the three Waterloo groundwater vertical profiles completed as part of the RI, and permanent soil gas monitoring points (pre-pilot and pilot study soil vapor sampling). The treatment arrays will be used in the future to perform an ISCO remediation of on-Site DNAPL.

Based on the distribution of contaminants observed in the saturated zone, the estimated maximum depth of saturated zone ozone microinjection wells will be approximately 117 feet (based upon a water table elevation of approximately 85 feet msl. The most contaminated portion of the saturated zone has a thickness of about 30 feet. Conceptually, each microinjection well will consist of 1-inch diameter stainless steel or other ozone resistant material fitted with a 2-foot screen. The exact specifications of the screen zone that will be based upon the geological logs developed from the cores collected during the installation of the permanent vadose zone soil vapor monitoring points, and the conductivity data collected from the three on-Site VPBs.

2.3.3 *Installation of Performance Monitoring Wells*

After the injection wells are constructed, performance groundwater monitoring wells will be installed to monitor progress of the ISCO. ERM anticipates that up to seven performance groundwater monitoring well nests will be required. The locations of the performance monitoring points will be determined based on the locations of the ozone injection wells and contamination concentrations as determined by data collected from each of the three Waterloo groundwater VPBs completed as part of the RI, and permanent soil gas monitoring points (pre-pilot and pilot study soil vapor sampling). Each performance monitoring point will consist of a water table well and a deeper well screened at the bottom of the treatment zone. For the purposes of developing a budget for the IRM, ERM has assumed that two 2-inch diameter individual wells would be installed at each location. Samples will be collected from each well at the conclusion of ozone injection, one month after injection and quarterly thereafter for a year. The samples will be analyzed for the parameters shown on Table 2.

Table 2
Ronhill Dry Cleaners Site - ISCO Performance Monitoring Analytes

Analysis	*Method of Analysis*	*Rationale*
Groundwater Elevation	Field Probe	Evaluate groundwater table elevation
pH	Field Flow-Through Cell	Evaluate aquifer geochemistry

Analysis	*Method of Analysis*	*Rationale*
Electrical Conductivity	Field Flow-Through Cell	Evaluate aquifer geochemistry
Temperature	Field Flow-Through Cell	Evaluate aquifer geochemistry
ORP	Field Flow-Through Cell	Evaluate aquifer geochemistry
Dissolved Oxygen	Field Flow-Through Cell	Evaluate aquifer geochemistry
VOCs	Lab - EPA Method OLM04.2	Contaminant concentrations
Chloride	Lab - EPA Method 300.0	Degradation by-product

2.3.4 *Ozone Generator Purchase*

The oxidant to be used in the IRM is ozone. The quantity of oxidant required to treat vadose and saturated zone CHC contamination and NOD will be based the results of the pilot study. ERM plans to use a sequential programmed injection of ozone to the various microinjection point arrays rather than Site-wide injection so that the size of the ozone generator can be minimized and parking for Shoe Store customers can be preserved. Limiting the volume of the ozone being injected will also reduce the size of the migration control system necessary to protect the Shoe Store and adjacent homes.

2.3.5 *Oxidant Injection*

ERM will convey the ozone to the various arrays via ozone resistant transfer piping constructed of Teflon tubing or other compatible material within a steel or PVC carrier pipe. Subsurface installation of the transfer tubing will help to minimize impacts to the business. A flow meter, pressure gauge and valves will be installed at each microinjection array to permit control and monitoring of the vapor stream entering each array.

2.3.6 *Demobilization of Oxidant Injection Equipment*

Following completion of the ozone injection the ozone generator and control equipment will be removed from the Site. Any Site Investigation/IRM Derived Waste (IDW) will be disposed of in accordance with local, state and federal regulations as described in Section 2.3.8.

2.3.7 *Structure Sampling*

At the direction of the NYSDEC and NYSDOH, indoor air, ambient air and sub-slab soil vapor gas sampling will be collected at structures (residential homes, commercial establishments and other community buildings) located in the vicinity of the Site.

The sampling will be conducted in a phased program with sampling locations selected based on the data evaluation of the Remedial Investigation Subtask 2H – Soil Vapor Sampling analytical results. Additional sampling phases may be conducted based on the evaluation of the collected data.

Prior to the structure air sampling, an inspection of general Site conditions, including ambient air screening with a PID, will be performed at each property location. The pre-sampling inspection will determine the locations for the indoor air and outdoor air sampling. The Indoor Air Quality Questionnaire (Appendix B of the Soil Vapor Intrusion [SVI] Guidance) will be completed prior to sample collection in order to document pertinent building and basement construction, Heating, Ventilation and Air Conditioning System (HVAC), and occupancy information.

Three types of samples may be collected at each structure location: indoor air, sub-slab soil vapor, and outdoor air. The following provide the required field procedures for each sample type.

2.3.7.1 *Indoor Air Sample Collection*

Two indoor air samples will be collected from each residential property including one within the basement area and one within the first occupied living space (potentially also the basement). If the residential property does not contain a basement, only a first floor indoor air sample will be collected. Additional samples may be collected depending on how the house/structure is occupied.

All indoor air samples will be collected using the using a laboratory-certified Summa® canister regulated for a 24-hour sample collection period. Sample collection will be through a section of disposable teflon tubing or laboratory food grade polyethylene extending from the Summa® canister to collect the sample from the breathing zone at four to six feet above the floor.

The analysis for indoor air samples will achieve detection limits of 1.0 ug/m^3 for each compound.

2.3.7.2 *Sub-Slab Soil Vapor Sample Collection*

One sub-slab soil vapor sample will be collected from beneath the basement flooring/foundation slab of each identified property. After the basement flooring/foundation slab has been inspected, the location of subsurface utility determined, and the ambient air surrounding the proposed sampling area screened with a PID, a hammer drill will be used to advance a boring one-inch boring to a depth of approximately six inches beneath the basement flooring/foundation slab.

Three-eight-inch (3/8) tubing will be threaded through the hole in the slab and the annular space between the one-inch hole and the 3/8-inch tubing will be filled with filter sand and sealed with beeswax at the ground surface. The tubing will be connected to a PID. Approximately one liter of gas will be purged from the subsurface probe using the PID. The PID readings will be observed and the highest will be recorded on the appropriate field form. The PID will be disconnected and the end of the tubing will be connected directly to the Summa® canister intake valve. Flexible silicone tubing will be used at a minimum and as a tubing adapter only. The sample shall be collected with a laboratory-certified Summa® canister regulated for a 24-hour sample collection period.

The analysis for sub-slab soil vapor samples will achieve detection limits of 1.0 ug/m^3 for each compound.

2.3.7.3 *Outdoor Air Sample Collection:*

All outdoor air samples will be collected with a laboratory-certified Summa® canister regulated for a 24-hour sample collection period. A section of disposable Teflon tubing will be extended from the Summa® canister to collect the sample from the breathing zone at four to six feet above the ground.

The analysis for outdoor air samples will achieve detection limits of 1.0 ug/m^3 for each compound. The protocol for this effort shall follow the SVI Guidance.

2.3.8 *Management of Investigative Derived Wastes*

The following section describes the general protocol for handling and disposal of solid and liquid IDW generated during the implementation of the RI. Waste generated during the IRM is expected to consist of trash (boxes, paper, etc.), auger cuttings, decontamination wash water, groundwater monitoring well purge water, and used protective clothing.

The following guidance documents and regulations may be relied upon to guide the management, staging, storage and disposal of IRM generated IDW:

- NYSDEC's TAGM #4032 on " Disposal of Drill Cuttings" {November 21, 1989};
- NYSDEC's RCRA TAGM #3028 on " Contained-In Criteria for Environmental Media" {November 30, 1992};

- 40 C. F. R. Part 262 (Standards Applicable to Generators of Hazardous Waste);
- 40 C. F. R. Part 263 (Standards Applicable to Transporters of Hazardous Waste;
- 40 C. F. R. Part 264 (Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities); and
- 40 C. F. R. Part 268 (Land Disposal Restrictions).

Accordingly, handling and disposal will be as follows:

- Cuttings from soil borings and the tailings from the unused portion of the samples will be collected and stored in reconditioned 55-gallon, New York State Department of Transportation (NYSDOT) open-top drums to be provided by the ERM's drilling subcontractor. The waste will be sampled and disposed of according to all applicable regulations. The borehole will be grout filled by hand or with a tremie pipe. If necessary, the borehole will also be sealed at or near the water table with a non-shrinking impermeable material to prevent the hole from acting as a conduit for surface runoff.
- Cuttings from monitoring well installations will be collected on plastic sheeting and stored in reconditioned 55-gallon, NYSDOT open-top drums to be provided by the ERM's drilling subcontractor.
- Liquids generated from equipment decontamination, permanent groundwater monitoring well development/purging will be collected in drums at the point of generation. The collected water will be transported and temporarily stored in a frac tank that will be staged on the Site. The water will be sampled for VOCs and then disposed of or discharged appropriately.
- Used protective clothing and equipment that is suspected to be contaminated with hazardous waste will be placed in plastic bags and packed in 55-gallon ring-top drums.
- All drums will be labeled according to the borehole/well number. The drilling subcontractor shall move the drums on a daily basis at the direction of ERM's representative to the staging area.
- ERM will procure waste transport and disposal subcontractor services to properly dispose of all IDW in accordance with all local, State and Federal regulations.
- Non-contaminated trash, debris and protective clothing will be placed in a trash dumpster and disposed of by a local garbage hauler.

2.3.9 *Analytical Data Management*

The primary objective of this data management plan is to ensure that all data and documents are stored and handled in accordance with this IRM

Work Plan and the QAPP. Data management procedures not only include field and laboratory documentation, but also include how the information is handled after the conclusion of field investigation and laboratory analyses area completed. Data handling procedures include project file management, reporting, electronic storage and use of consistent formats for the final presentation and submittal of the data.

2.3.9.1 *Project File Specifications*

All project information will be kept in a central Project File maintained by the ERM Project Manager in ERM's Melville, New York office location. The Project File will be assigned a unique project number that will be clearly displayed on all project file folders (including electronic files). Electronic files will be maintained in a similarly organized Project File located on the ERM Central Network system that is backed up on a weekly basis. Both hard copy and electronic Project Files will contain, at a minimum, copies or originals of the following key project information:

- All correspondence including letters, transmittals, telephone logs, memoranda, and emails;
- Meeting notes;
- Technical information such as analytical data; field survey results, field notes, field logbooks and field management forms;
- Project calculations;
- Subcontractor agreements/contracts, and insurance certificates;
- Project-specific health and safety information/records;
- Access agreements;
- Project document output review/approval documentation; and
- Reports: Monthly Progress, Interim Technical and Draft/Final Technical.

2.3.9.2 *Project Database Specifications*

All electronic data will be stored in a GIS Key database. All geologic, hydrologic and chemistry data will be input into the database for later use in developing figures and tables for the final report. This database is compatible with numerous electronic formats for both import and export. ERM will be able to use this database to provide the results of the field investigation in a form that is compatible with Version 1.1 of the NYSDEC EDD. Electronic files will be maintained on the ERM Central Network system that is backed up on a weekly basis.

2.3.9.3 *Field Data*

Field data will be recorded and reported by field personnel using appropriate field data documentation materials such as the field logbook, field management forms and chain of custody (COC) forms.

Good field management procedures include following proper chain of custody procedures to track a sample from collection through analysis, noting when and how samples are split (if necessary), making regular and complete entries in the field logbook, and the consistent use and completion of field management forms. Proper completion of these forms and the field logbook are necessary to support the consequent actions that may result from the sample analysis. This documentation will support that the samples were collected and handled properly making the resultant data complete, comparable and defensible.

Key field measurements will be incorporated into the project database. These measurements may include:

- Turbidity, pH, Oxidation Reduction Potential, Conductivity, Temperature;
- OVA/PID readings;
- Water levels/Product levels;
- Lithologic and geophysical logs;
- Well construction details; and
- Survey data.

2.3.9.4 *Laboratory Data*

All laboratory analytical data will be reported as NYSDEC Category B deliverables. The Category B data deliverables include all backup QA/QC documentation necessary to facilitate a complete validation of the data.

The laboratory will also transmit the analytical data in an electronic format to minimize the chances of transposition errors in summarizing the data. The data will be transmitted in an electronic data deliverable (EDD) in GIS KEY (most recent version) format and an Adobe Acrobat Portable Document File (PDF) copy of each Analytical Services Protocol (ASP) deliverable. These data will be built into the project specific database using GIS Key LabBuild which has an internal data checker that ensures the quality of the data prior to import into the database.

2.3.10 *Citizen Participation/Pre-RI Public Meeting*

ERM will assist the NYSDEC with the preparation and presentation of any Citizen Participation (CP) activities, as necessary. Prior to initiation of the IRM fieldwork, the NYSDEC and ERM will create and distribute a fact sheet describing the planned fieldwork, status of the Site and, possibly, an announcement for a public meeting or availability session. Should a public meeting or information session be deemed appropriate, the NYSDEC will schedule the event near the Site. The NYSDEC will run the meeting with assistance from ERM. ERM will provide the following services as part of this task: develop a list of interested citizens and public officials; place additional copies of reports in the local repositories; and mail public meeting notices.

If requested, ERM will provide additional support as directed by the NYSDEC that could include the preparation of visual aids such as large Site maps on poster boards, data summary sheets, photographs and/or a slide presentation of Site activities. If additional support is requested by NYSDEC, ERM and NYSDEC will define the expanded Scope of Work and ERM will develop an associated budget adder for NYSDEC approval. ERM will not commence any work outside of the current Scope of Work discussed above until authorized by NYSDEC.

2.3.11 *Supplemental Activities*

Supplemental activities to the IRM are identified and discussed below. It should be noted that no level of effort is anticipated at this time for additional IRM activities and no considerations have been factored into the schedule and budget developed for the project.

2.3.11.1 *Additional Oxidant Injection*

In the event that on-Site performance monitoring data collected after the ISCO has been completed indicate that an additional injection(s) of oxidant will further reduce DNAPL concentrations, additional oxidant injections will be scoped and implemented at the direction of the NYSDEC. Additional oxidant injection scoping will be conducted approximately 1 year after initial oxidant injection.

2.4 *TASK 4: IRM REPORT PREPARATION*

The IRM Report will be prepared following completion of the IRM field activities and reduction and interpretation of the data. The IRM Report will provide a summary of the Scope of Work, methods, results, conclusions and recommendations, if any, for additional injections of oxidant. Further details concerning essential components to the IRM Report are discussed below.

- Summary of Field Work: The report will include a detailed summary of investigative and analytical methods related to the fieldwork performed during this IRM. This account will include figures and tables to show sample locations, parameters analyzed for, etc.
- Summary of Analytical Data: Using tables and maps, the report will summarize to the extent possible, all of the analytical data collected during the ISCO and performance monitoring phase.
- Destruction of Contaminant Mass: The results of initial groundwater sampling results for VOCs will be compared to subsequent groundwater sampling and NOD events to determine the mass of contaminants removed and the effectiveness of the ISCO treatment.
- Comparison to State Standards, Criteria and Guidelines (SCGs): The IRM Report will compare groundwater concentrations observed during the performance monitoring phase with SCGs and remediation goals to assess and evaluate the fate and transport and off-Site impacts.
- Evaluation of Data Collected: The completeness of the data collected during this investigation will be evaluated. Any data gaps or other areas where additional information is desirable will be identified. Recommendations on ways to fill these data gaps will be identified, if required.

All reports and correspondence will be provided in Adobe Acrobat PDF format in addition to providing paper copies.

Section 3

3.0 *MONTHLY PROGRESS REPORTING*

ERM will begin to submit Monthly Progress Reports (MPRs) to NYSDEC on or before the 20^{th} of each month following NYSDEC issuance of Notice-To-Proceed. Each MPR will address the following topics:

- Accomplishments during the reporting period.
- Problems encountered during the reporting period.
- Compliance with project schedule and budget.
- Projected changes in Scope of Work.

All raw and validated data shall be forwarded to the NYSDEC as soon as it becomes available. All reports and correspondence will be provided in Adobe Acrobat format in addition to providing paper copies.

Section 4

4.0 *DETAILED WORK ASSIGNMENT SCHEDULE*

The Ronhill Cleaners IRM Implementation Schedule, including milestones and deliverables for the IRM is presented in Figure 4.

The schedule contemplates a start for IRM field activities on or about June 2006. ERM will endeavor to adhere to the schedule at all times, but there are several critical path items related to execution of the IRM fieldwork (i.e. drilling site access and logistical issues) and several cycles of draft/final document review by NYSDEC and NYSDOH. As such, it may be necessary to modify and revise the schedule as the IRM progresses because of:

- Potential new requirements or activities that may be requested by the NYSDEC, NYSDOH and/or the City of Glen Cove or Town of Oyster Bay;
- Force majeure;
- Severe weather conditions preventing timely completion of scheduled field activities; or
- Other matters beyond ERM's or the NYSDEC's reasonable anticipation and control.

Section 5

5.0 *PROJECT STAFFING PLAN*

Staffing for the IRM will be from ERM's Melville, New York City and Boston Offices. Only those staff that have been deemed acceptable by the NYSDEC and who appear on the NYSDEC approved list of employees will be utilized.

While all personnel involved in an investigation and in the generation of data are implicitly a part of the overall project management and quality assurance program, certain members of the Project Team have specifically designated responsibilities. Project Team members with specific management and quality assurance roles are the NYSDEC Remediation Project Manager (RPM), the ERM Project Director (PD), the ERM Project Manager (PM), the ERM Field Team Leader (FTL) and the ERM Quality Assurance/Quality Control Officer (QA/QC). In the following sections, the roles and responsibilities of key personnel are identified.

5.1 *NYSDEC REMEDIATION PROJECT MANAGER*

The NYSDEC RPM, Nathan Putnam is the Project Team Leader and the lead technical representative of the NYSDEC. Mr. Putnam will be responsible for all technical aspects of the project including the overall quality of the project and project deliverables for the RI/FS. Mr. Putnam is responsible for ensuring the successful completion of each project phase and the project as a whole. Mr. Putnam will oversee the ERM PD and ERM PM and will be the primary contact between ERM and the NYSDEC and any other interested regulatory agencies. The other project team members including ERM PD and the ERM PM will support Mr. Putnam's role as the Project Team Leader. Mr. Putnam has extensive experience in the management and coordination of multi-disciplinary environmental field investigation and remedial projects.

5.2 *ERM PROJECT DIRECTOR*

The ERM PD, Ernest Rossano, will report to the RPM. Mr. Rossano will oversee the ERM PM and be responsible for all technical aspects of the project including the overall quality of the project and project deliverables for ERM. Mr. Rossano has extensive experience with the management and coordination of multi-disciplinary RI/FS and remedial projects in New York State.

5.3 *ERM PROJECT MANAGER*

The ERM PM, Gregory Shkuda, will report to the ERM PIC and the RPM. Mr. Shkuda will oversee the ERM QA/QC Officer and the ERM FTL, field investigation staff, and any subcontractors. Mr. Shkuda will also be responsible for all technical aspects of the project for ERM. This includes scheduling, communicating to the RPM and the NYSDOH, technical development and review of all field activities, subcontracting, and the overall quality of the project and project deliverables for ERM. Mr. Shkuda will be the primary contact between ERM and NYSDEC, as directed by the RPM. Mr. Shkuda has extensive experience in the management and coordination of multi-disciplinary RI/FS and remedial projects in New York State.

5.4 *ERM QA/QC OFFICER*

The ERM QA/QC Officer, Mr. Andrew Coenen, will report to the ERM PM and the ERM PD. Mr. Coenen will be responsible for interface with the analytical laboratory, data validator and will prepare the Data Usability Report that ERM will prepare as part of this WA. Mr. Coenen will have overall responsibility for QA/QC review of all analytical data generated during the field investigation, data validation and qualification of analytical results in terms of data usability. Mr. Coenen has extensive analytical laboratory experience and experience in the validation of analytical data and the protocols and QC specifications of the analytical methods listed in the NYSDEC ASP and the data validation guidance, USEPA Contract Laboratory Program National Functional Guidelines for Organic (Inorganic) Data review (February 1994) and USEPA Region II CLP Data Review SOP.

5.5 *ERM FIELD TEAM LEADER*

The ERM FTL, Mr. Mike Mattern will report to the ERM PM and the ERM PD. Mr. Mattern will be responsible for the day-to-day management and coordination of ERM field staff and subcontractors. Mr. Mattern will be responsible for the implementation and quality of the field activities. Mr. Mattern has extensive environmental field investigation/subcontractor oversight experience in New York State.

5.6 *PROJECT HEALTH AND SAFETY COORDINATOR*

Ms. Paulina Gravier, will be the ERM Project Health and Safety Coordinator. Ms. Gravier will report to the ERM PM and the ERM PD. Ms. Gravier has extensive experience as a Project Health and Safety Coordinator for multi-disciplinary RI/FS and remedial projects in New York State. Ms. Gravier's experience includes the preparation and implementation of Site-specific health and safety plans, field oversight, and field health and safety audits.

Professional profiles for the aforementioned key project staff are presented in Appendix E of the RI Work Plan. A project staffing organization chart illustrating the same is presented in Figure 5.

Section 6

6.0 *SUBCONTRACTOR IDENTIFICATION AND MINORITY BUSINESS/WOMEN-OWNED BUSINESS UTILIZATION PLAN*

ERM has procured subcontractor services by competitive bidding as required by the NYSDEC. ERM included Minority Business and/or Women-Owned Business (MBE/WBE) businesses in the bidding process. Required subcontracting services for the IRM are identified in the RI/FS Work Plan.

Section 7

7.0 *DETAILED WORK ASSIGNMENT BUDGET*

ERM estimates the pilot study will cost between $125,000 and $150,000. Sufficient funds remain in Task 3 – IRM Budget. After conclusion of the pilot study, ERM will revise the Schedule 2.11s for full-scale implementation.

Section 8

8.0 REFERENCES

NYSDEC, 1989. Division Technical and Administrative Guidance Memorandum (TAGM): Disposal of Drill Cuttings. Division of Hazardous Waste Remediation. HWR-94-4032. 21 November 1989.

NYSDEC, 1991. New York State Water Classifications - 6 NYCRR 701. 2 August, 1991

NYSDEC, 1992. Division Technical and Administrative Guidance Memorandum (TAGM): "Contained-In" Criteria For Environmental Media. Division of Hazardous Substance Regulation. HWR-92-3028. 30 November 1992.

NYSDEC, 1994. Division Technical and Administrative Guidance Memorandum (TAGM): Determination of Soil Cleanup Objectives and Cleanup Levels. Division of Hazardous Waste Remediation. HWR-94-4046. 24 January 1994.

NYSDEC, 1998. New York State Groundwater Quality Standards - 6 NYCRR 703 (12 March 1998) and Division of Water Technical and Operational Guidance Series (1.1.1) - Ambient Water Quality Standards and Guidance Values, (June 1998), Errata Sheet (January 1999), and Addenda (April 2000).

Figures

TITLE

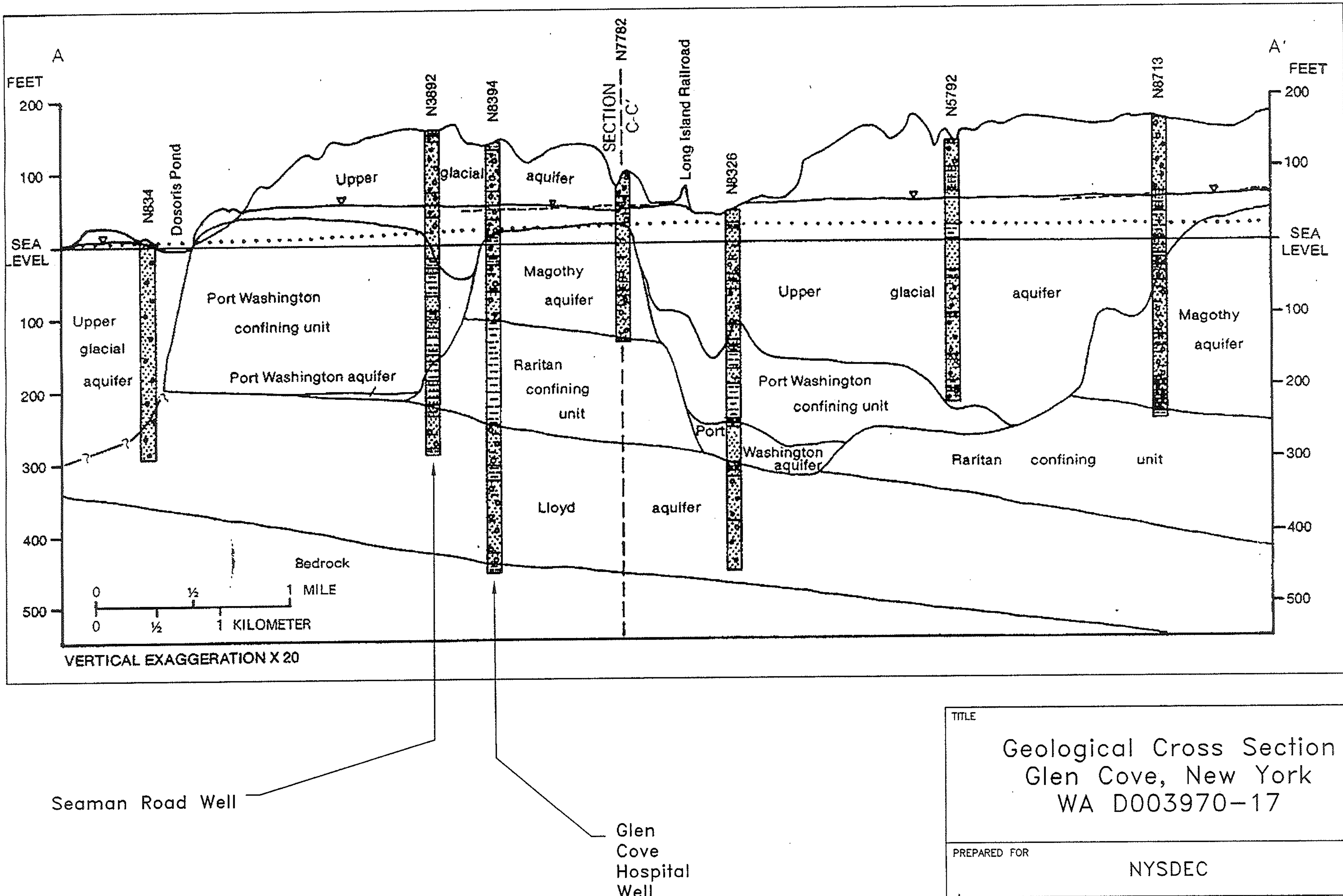
SITE LOCATION
RONHILL CLEANERS
SITE NO. 1-30-071
WA D003970-17

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN: MFM	JOB NO.: 0015591	FILE NAME: 0015591-01-002	SCALE 1"=160'	DATE 04/12/04	FIGURE 1



TITLE

Geological Cross Section
Glen Cove, New York
WA D003970-17

PREPARED FOR

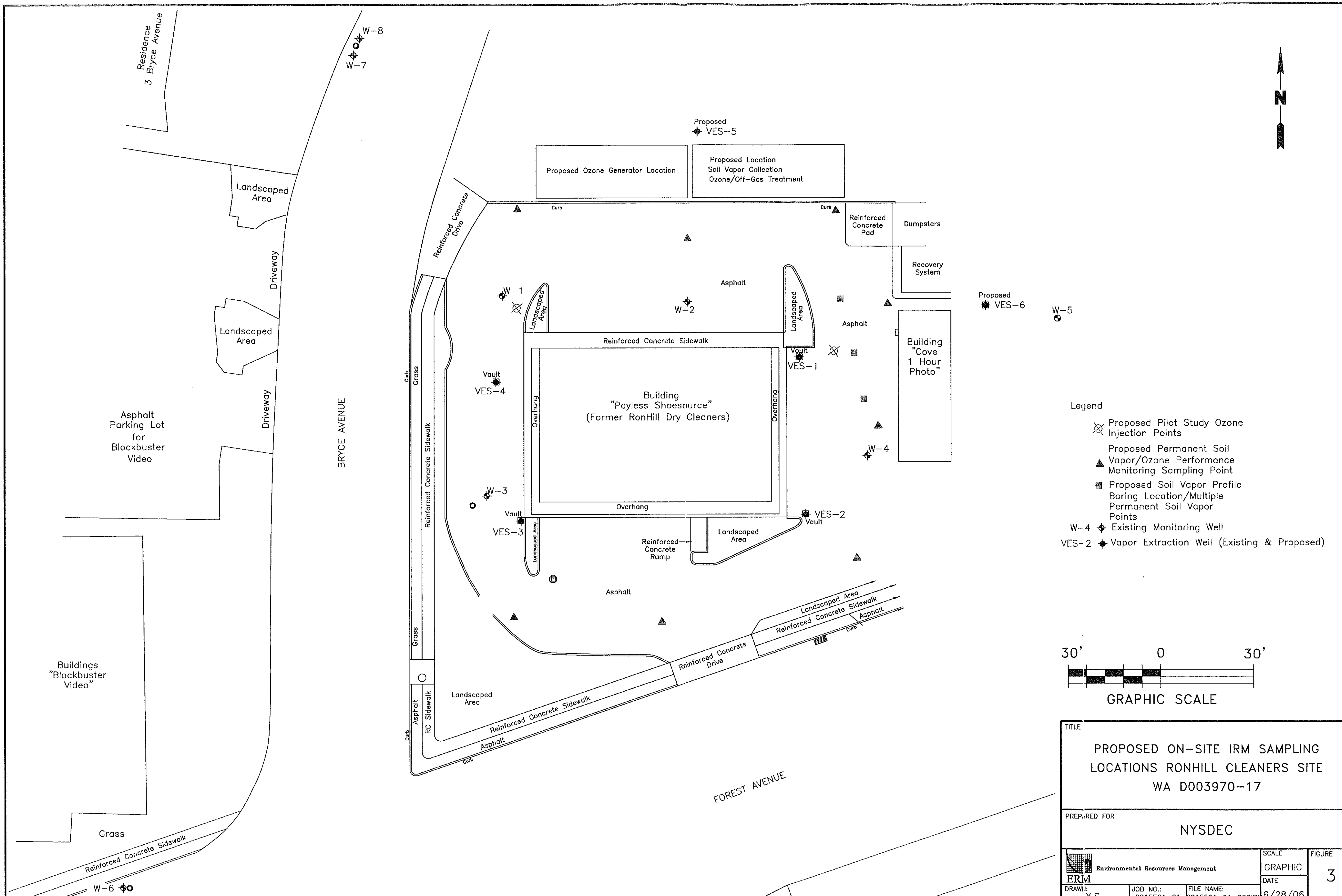
NYSDEC

ERM Environmental Resources Management

SCALE	FIGURE
as shown	2
DATE	
6 - 2004	

DRAWN: JOB NO.: FILE NAME: 0015591-xs

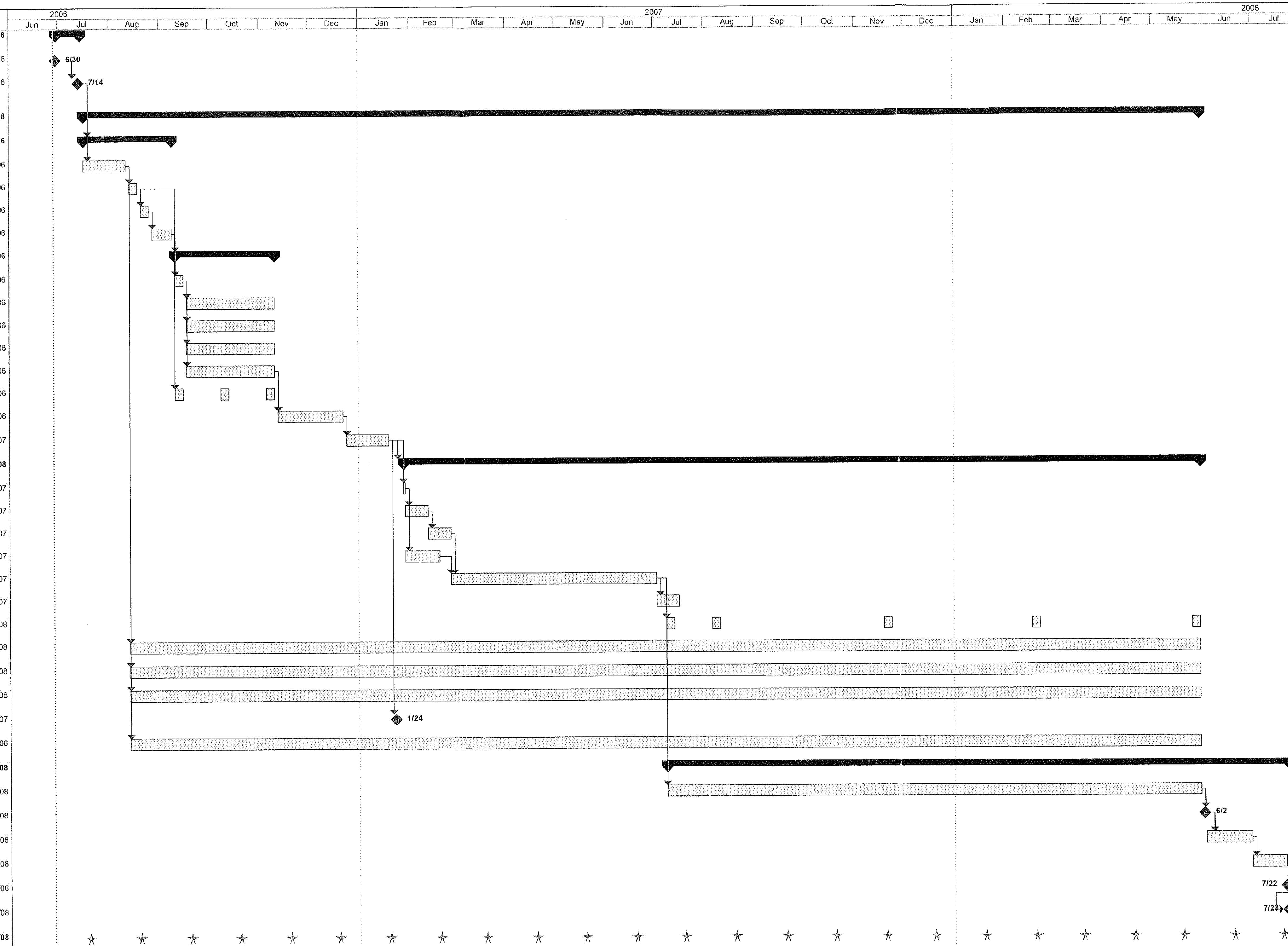
Source: USGS Water-Resources Investigation Report 85-4051



Residence
3 Bryce Avenue
W-8
W-7
Landscaped Area
Driveway
Landscaped Area
Driveway
Asphalt Parking Lot for Blockbuster Video
BRYCE AVENUE
Buildings "Blockbuster Video"
Grass
Reinforced Concrete Sidewalk
W-6
Reinforced Concrete Drive
Curb
Grass
Reinforced Concrete Sidewalk
Asphalt
RC Sidewalk
Landscaped Area
Reinforced Concrete Sidewalk
Asphalt
Reinforced Concrete Drive
Landscaped Area
Reinforced Concrete Sidewalk
Asphalt
FOREST AVENUE
Proposed
VES-5
Proposed Ozone Generator Location
Proposed Location
Soil Vapor Collection
Ozone/Off-Gas Treatment
Reinforced Concrete Pad
Dumpsters
Recovery System
Asphalt
W-1
W-2
Landscaped Area
Reinforced Concrete Sidewalk
Vault
VES-1
Vault
VES-4
Building
"Payless Shoesource"
(Former RonHill Dry Cleaners)
Overhang
W-3
Vault
VES-3
VES-2
Vault
Landscaped Area
Reinforced Concrete Ramp
Asphalt
W-4
Building "Cove 1 Hour Photo"
Proposed
VES-6
W-5
Legend
Proposed Pilot Study Ozone Injection Points
Proposed Permanent Soil Vapor/Ozone Performance Monitoring Sampling Point
Proposed Soil Vapor Profile Boring Location/Multiple Permanent Soil Vapor Points
W-4 Existing Monitoring Well
VES-2 Vapor Extraction Well (Existing & Proposed)
30' 0 30'
GRAPHIC SCALE
N
TITLE
PROPOSED ON-SITE IRM SAMPLING LOCATIONS RONHILL CLEANERS SITE WA D003970-17
PREPARED FOR
NYSDEC
ERM Environmental Resources Management
SCALE GRAPHIC
FIGURE 3
DATE 6/28/06
DRAWN: Y.S.
JOB NO.: 0015591-01
FILE NAME: 0015591-01-006IRM

FIGURE 4
DETAILED IRM WORK ASSIGNMENT IMPLEMENTATION SCHEDULE
RON HILL CLEANERS - GLEN COVE, NEW YORK
NYSDEC SITE CODE #1-30-071

ID	Task Name	Duration	Start	Finish
1	TASK 1 - IRM WORKPLAN DEVELOPMENT	11 days	Fri 6/30/06	Fri 7/14/06
2	Submit Final IRM Work Plan	1 day	Fri 6/30/06	Fri 6/30/06
3	NYSDEC Approval of Final IRM Work Plan & Issuance Notice To Proceed	1 day	Fri 7/14/06	Fri 7/14/06
4	TASK 2 - INTERIM REMEDIAL MEASURE	490 days	Mon 7/17/06	Fri 5/30/08
5	Pre-Pilot Study Activities	40 days	Mon 7/17/06	Fri 9/8/06
6	Pre-Field Activities/Mobilization	20 days	Mon 7/17/06	Fri 8/11/06
7	Pre-Pilot Soil Vapor Sampling	5 days	Mon 8/14/06	Fri 8/18/06
8	Site Preparation	5 days	Mon 8/21/06	Fri 8/25/06
9	Treatment System Installation	10 days	Mon 8/28/06	Fri 9/8/06
10	Pilot Study	45 days	Mon 9/11/06	Fri 11/10/06
11	Tracer Gas Testing	5 days	Mon 9/11/06	Fri 9/15/06
12	Ozone System Operation	40 days	Mon 9/18/06	Fri 11/10/06
13	Ozone Operational Monitoring	40 days	Mon 9/18/06	Fri 11/10/06
14	Portable Ozone Monitoring	40 days	Mon 9/18/06	Fri 11/10/06
15	Continuous Ozone Monitoring	40 days	Mon 9/18/06	Fri 11/10/06
16	Performance Monitoring	15 days	Mon 9/11/06	Fri 11/10/06
17	Pilot Study Report/Full-Scale Design	30 days	Mon 11/13/06	Fri 12/22/06
18	NYSDEC Review & Approval Pilot Study Report/Full-Scale Design	20 days	Mon 12/25/06	Fri 1/19/07
19	TASK 3 - FULL-SCALE IRM	350 days	Mon 1/29/07	Fri 5/30/08
20	Baseline Groundwater Sampling	1 day	Mon 1/29/07	Mon 1/29/07
21	Installation of Ozone Injection Wells	10 days	Tue 1/30/07	Mon 2/12/07
22	Installation of Performance Monitoring Wells	10 days	Tue 2/13/07	Mon 2/26/07
23	Ozone Generator Purchase	15 days	Tue 1/30/07	Mon 2/19/07
24	Oxidant Injection	90 days	Tue 2/27/07	Mon 7/2/07
25	Demobilization of Oxidant Injection Equipment	10 days	Tue 7/3/07	Mon 7/16/07
26	Performance Groundwater Monitoring	25 days	Mon 7/9/07	Fri 5/30/08
27	Management of IDW	470 days	Mon 8/14/06	Fri 5/30/08
28	Analytical Data Quality Evaluation	470 days	Mon 8/14/06	Fri 5/30/08
29	Analytical Data Management	470 days	Mon 8/14/06	Fri 5/30/08
30	Citizen Participation - IRM Public Meeting	1 day	Wed 1/24/07	Wed 1/24/07
31	Sample Analyses By Laboratory	470 days	Mon 8/14/06	Fri 5/30/08
32	TASK 3 - IRM REPORT PREPARATION	273 days	Mon 7/9/07	Wed 7/23/08
33	IRM Report Preparation	235 days	Mon 7/9/07	Fri 5/30/08
34	Draft IRM Report	1 day	Mon 6/2/08	Mon 6/2/08
35	NYSDEC Review & Comment on IRM Report	20 days	Tue 6/3/08	Mon 6/30/08
36	Finalize IRM Report	15 days	Tue 7/1/08	Mon 7/21/08
37	Final IRM Report	1 day	Tue 7/22/08	Tue 7/22/08
38	NYSDEC Approval of Final IRM Report	1 day	Wed 7/23/08	Wed 7/23/08
39	Monthly Progress Reports	522 days	Thu 7/20/06	Sun 7/20/08

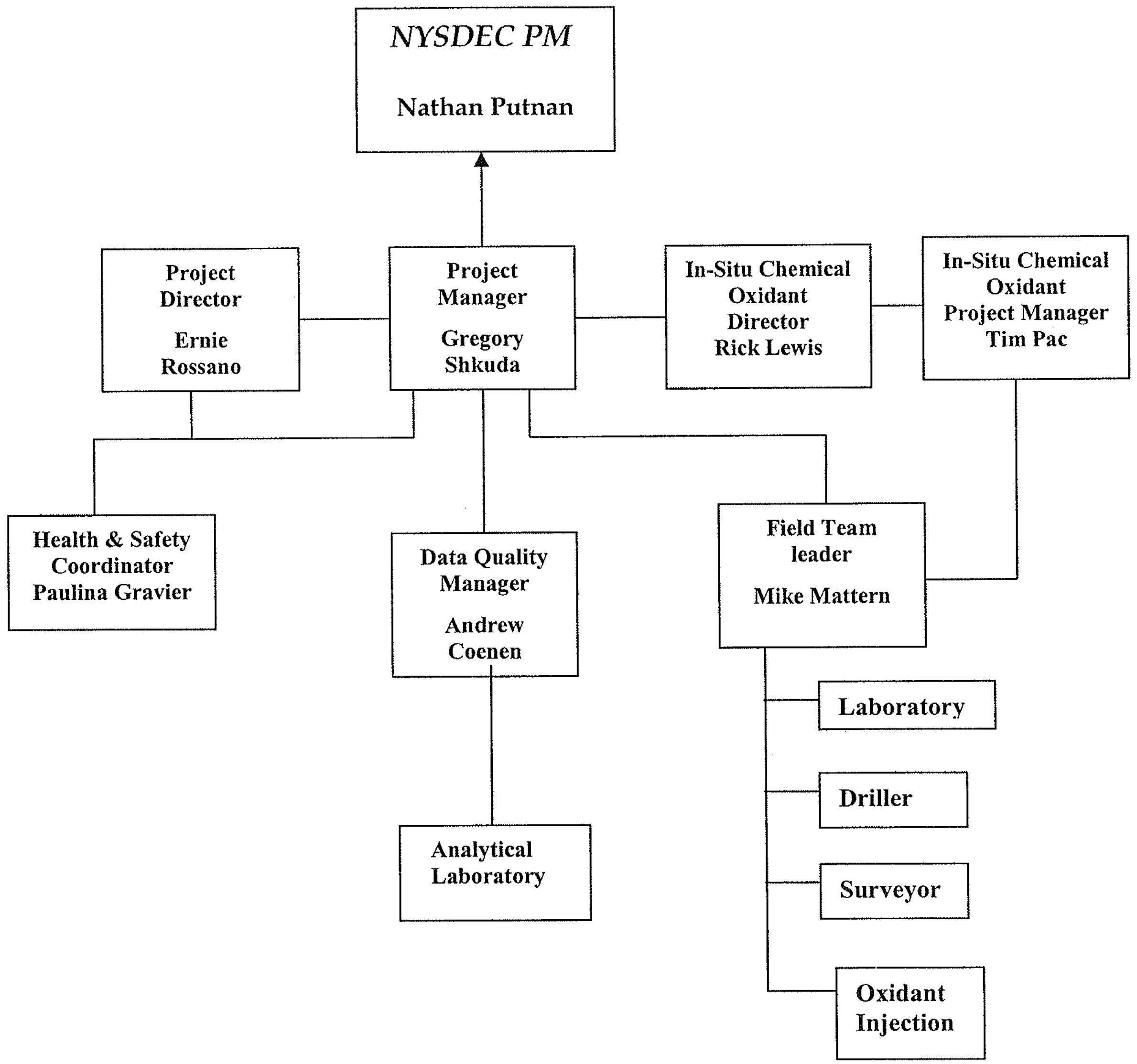


Date: Wed 6/28/06	Task	Milestone	Recurring Activity	Summary

NYSDEC SUPERFUND STANDBY CONTRACT #D003970
NYSDEC WORK ASSIGNMENT D003970-17

FIGURE 5

Ronhill Cleaners IRM Organizational Chart



Attachment

ATTACHMENT 1

New York State Department of Health
Generic Community Air Monitoring Plan

New York State Department of Health
Generic Community Air Monitoring Plan

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for volatile organic compounds (VOCs) and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate NYSDEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The 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 organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

- All 15-minute readings must be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time 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 (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

- All readings must be recorded and be available for State (DEC and DOH) personnel to review.