FEASIBILTY STUDY

Barthelmes Manufacturing Site
15 Cairn Street
Rochester, New York 14611

Site Code # 828122

Work Assignment # D006130-24

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TABLE OF CONTENTS

SECTION **PAGE**

TABLE OF CONTENTS

SECTION **PAGE**

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CERTIFICATION

I, Nancy Garry, certify that I am currently a NYS registered professional engineer as defined in 6 NYCRR Part 375 and that this Feasibility Study was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

Nancy Garry, PE
Contract Manager

STATE OF NEW YORK
NANCY E. GARRY
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FEASIBILTY STUDY

Barthelmes Manufacturing Site
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Rochester, New York, 14611

1.0 INTRODUCTION

This report presents a Feasibility Study (FS) for the upcoming remediation prepared by HRP Engineering P.C. (HRP) in connection with the Barthelmes Manufacturing Site located at 15 Cairn Street in the City of Rochester, Monroe County, New York (Site # 828122), referred to herein as the Site (Figure 1).

A Remedial Investigation (RI) Report, dated February 2013, was completed for the New York State Department of Environmental Conservation (NYSDEC) pursuant to the NYSDEC's Work Assignment (WA) number D006130-24. The RI was carried out during the period of June 2011 through February 2013. To determine the nature and extent of the onsite contaminants, HRP installed test pits, soil borings and permanent groundwater monitoring wells as presented in the RI/FS Field Activity Plan. During the RI, groundwater, soil (subsurface and surface), and surface water were collected and submitted to a NYSDOH certified laboratory for analysis.

Three Interim Remedial Measures (IRMs) were completed during the RI to address Chlorinated Volatile Organic Compounds (CVOCs) present in site soils at concentrations that exceed the Part 375 Protection of Groundwater SCOs. In January and September 2012, soil contaminated with trichloroethene (TCE) and TCE breakdown products was excavated and disposed of off-site from two source areas, the former drum storage area and the outside disposal area at the southwest corner of the site.. In February 2013, soil contaminated with trichloroethene (TCE), TCE breakdown products and metals was excavated and disposed of off-site from a third source, the former degreaser area. The contamination in the former degreaser area and the former drum storage area was identified during the previous environmental investigations and the contamination in the outside disposal area was identified during the monitoring well installation activities and test pit excavations activities conducted during the RI. Figure 2 illustrates the three source areas where the IRMs were performed.

The site is currently being managed as one operable unit. An operable unit represents a portion of a remedial program for a site that for technical or administrative reasons can be addressed separately to investigate, eliminate or mitigate a release, threat of release or exposure pathway resulting from the site contamination. Operable unit 1 (OU1) applies to the entire site and three IRMs were completed and identified as: OU-01A, OU-01B, and OU-01C. These specifically apply to the former drum storage area, the former vapor degreaser area, and the outside disposal area respectively.

This report summarizes the findings of the RI report, discusses the probable future use of the Site, and presents and compares potential remedial alternatives for remediation of the remaining site contamination.

2.0 SITE DESCRIPTION AND HISTORY

The purpose of the RI was to characterize the source(s) of contamination and define the nature and extent of contamination at the site. The purpose of this Engineering Services Standby Contract WA was to conduct an RIFS to characterize on-site media potentially impacted by historic activities at the Barthelmes Manufacturing Site (Figure 2). The Site is improved by a mostly one-story industrial building, approximately 60,000-ft^2 in size, primarily concrete block and stone construction. The northeast corner of the building contains a second-story that is used for office space. Paved parking areas are located to the north and south of the site building with two paved entrances from Cairn Street.

The site consists of 3 tax parcels totaling approximately 9.2 acres at 15 Cairn Street, Rochester, NY. The largest parcel is approximately 6.97 acres and contains the manufacturing building. The other two parcels total approximately 2.2 acres and contain the entry road and facility parking lot. The two smaller parcels (1 acre and 1.22 acres) are zoned commercial and the larger (6.97 acre) parcel is zoned industrial. The surrounding properties consist of a mix of industrial and commercial use properties.

The Site has been occupied by Barthelmes Manufacturing, a metal fabrication facility, since approximately 1921. Barthelmes Manufacturing processes include stamping, machining, arc and spot welding, powder and spray painting, metal finishing, and assembly. The building has a partial second floor on the east side of the building for offices, and the remainder of the building has an approximately 20 foot high factory ceiling. A former vapor degreaser room is located in the central portion of the building. During the June 2011 visit and subsequent site visits, manufacturing operations were primarily conducted in the southern portion of the building where laser sheet metal cutting equipment is operated.

The Barthelmes Manufacturing Site has been used for industrial purposes since approximately 1900. A 1911 Sanborn Map shows the site was used by the American Fruit Products Company (AFPC) and their canning factory and vinegar works. At that time, the site was improved with two buildings, a foundation for a building under construction, and vinegar storage cellars. Barthelmes currently operates out of the southern-most AFPC building and has operated out of this building since approximately 1921.

Around 1985, a fire engulfed the shipping area and south side of the building. The fire was reportedly started in the degreaser area and the Rochester Fire Department responded. Water used to put out the fire reportedly entered the TCE vapor degreaser tank and displaced the TCE directly onto the floor and likely into the space beneath the degreaser tank itself. This event is considered to have contributed directly to the migration of contaminants to the subsurface.

An overview of HRP's activities is presented in Section 3, Summary of Remedial Investigation and Exposure Assessment.

3.0 SUMMARY OF REMEDIAL INVESTIGATION AND EXPOSURE ASSESSMENT

3.1 Summary of Remedial Investigation

Compounds detected in the various media tested during the RI were compared to the following New York State guidance documents and standards:

- Groundwater: NYSDEC Division of Water Technical and Operational Guidance Series (TOGS 1.1.1); Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations dated October 1993; Revised June 1998; ERRATA Sheet dated January 1999; and Addendum dated April 2000 (NYSDEC Class GA).

- Soil: NYSDEC Regulation, 6 NYCRR Subpart 375-6: “Remedial Program Soil Cleanup Objectives” which applies to the development and implementation of the remedial programs for soil and other media set forth in subparts 375-2 through 375-4 [Inactive Hazardous Waste Disposal Site Remedial Program, Brownfield Cleanup Program, and Environmental Restoration Program] and includes the soil cleanup objective tables developed pursuant to ECL 27-1415(6).

- Soil Vapor: NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York dated October 2006.

In order to identify the nature and extent of contamination from the Barthelmes Manufacturing Site, HRP submitted surface and subsurface soils, stormwater water, and groundwater samples to a certified laboratory for analysis. The various media samples were analyzed for one or more of the following including: volatile organic compounds (VOCs); semi-volatile organic compounds (SVOCs); Target Analyte List (TAL) Metals including mercury; polychlorinated biphenyls (PCBs) and pesticides.

Based on historic site use, the results of the RI along with previous investigations, the primary contaminants of concern include chlorinated VOCs (i.e. TCE, PCE, cis-1,2-DCE, and Vinyl Chloride) as well as site-related metals (i.e. arsenic, chromium, copper, lead, and zinc). These contaminants of concern were detected within soils and groundwater over their applicable SCGs. During the investigation, three primary source areas were identified onsite where these contaminants of concern were released: the interior former vapor degreaser area, the exterior former drum storage area, and a fill/debris burial area located at the southwestern corner of the site.

Overall, the nature and extent of contamination and RI activities can be summarized by the following:

Soil

TCE was detected at concentrations up to 4,100 ppm and cis-1,2-DCE, a TCE breakdown product, was detected at concentrations up to 220 ppm in soil collected from immediately beneath the former vapor degreaser. The detected concentrations of TCE and cis-1,2 DCE in the former degreaser area exceed the Protection of Groundwater SCOs (0.47 ppm and 0.25 ppm, respectively). However, the contaminated soils are no longer present in the soils beneath the former degreaser area at concentrations exceeding Protection of Groundwater SCOs as these soils were excavated and disposed of offsite as part of the IRM activities in February 2013.

TCE was detected at maximum concentrations ranging from 96 ppm to 490 ppm in soil from an approximate 2,000 square foot area in the outside disposal area. It should be noted that contaminated soils at concentrations exceeding Protection of Groundwater SCOs are no longer present in the outside disposal area as these soils were excavated and disposed of offsite as part of the IRM activities.in January and June 2012. In addition, monitoring well MW-16 was removed during the IRM activities in order to access the soils surrounding it.

TCE was detected at maximum concentrations ranging from 10.3 ppm to 32 ppm in soil from an approximate 3,000 square foot area in the former drum storage area. However, the contaminated soils are no longer present in the soils beneath the former drum storage area at concentrations exceeding Protection of Groundwater SCOs as these soils were excavated and disposed of offsite as part of the IRM activities in January 2012.

No PCBs were detected in the six (6) surface soil samples collected. Two pesticides, Dieldrin and Endrin Ketone, were detected in SS-1 (west side of building) and Endrin Ketone was detected in SS-3 (east side of building). The Endrin Ketone detected in SS-3 did not exceed Unrestricted SCOs. The Dieldrin (0.018 ppm) detected in SS-1 exceed the Unrestricted SCO (0.005 ppm)

Seven metals (barium, cadmium, chromium, copper, lead, and zinc) were detected in the soil samples collected from the stormwater infiltration basin area. The metals detected exceed the Unrestricted SCOs, but are less than the Restricted Use SCO for Industrial Use. Chromium, detected at a maximum concentration of 5,830 ppm in a soil sample collected from the zero to one foot depth interval was the metal detected at the highest concentration in soil collected from the basin area. Chromium was the only metal detected in soil from the basin at concentrations above the Restricted Use SCO for Commercial Use (1,500 ppm). Specifically, chromium was detected in the three soil samples near an industrial outfall at concentrations ranging from 3,050 to 5,830 ppm.

Groundwater

TCE and its associated degradation products are also found in groundwater beneath the central and south side of the site at concentrations exceeding groundwater SCGs (typically 5 ppb). Specifically, TCE was detected in site groundwater at concentrations up to 10,000 ppb and cis-1,2-DCE, a TCE breakdown product, at concentrations up to 2,300 ppb. Groundwater flow directions and the overall distribution of contaminants suggests that the TCE contamination originated from the former vapor degreaser, former drum storage, and the outside disposal areas. Although the IRM activities completed in these areas removed soil contamination, post-IRM groundwater sampling shows that residual groundwater contamination remains at the site at concentrations above the SCGs. The presence of cis-1,2-DCE, and to a lesser degree vinyl chloride, in site groundwater does suggest that TCE is being degraded naturally at the site.

In addition, site-related metals (i.e. arsenic, chromium, and lead) were detected above Groundwater SCGs at MW-10, located in the former degreaser are and cadmium was detected above Groundwater SCGs at RW-2, located along the southern property boundary.

Surface Water

With the exception of two metals (Chromium and Lead), no VOCs, PCBs or pesticides were detected above SCGs within the surface water samples collected from the stormwater infiltration basin area. Chromium was detected from 0.18 ppm to 0.053 ppm which exceeds the Surface water SCGs of 0.05 ppm and Lead was detected at a concentration of 0.045 ppm which exceeds the Surface water SCGs of 0.025 ppm.

3.2 Summary of Potential Human Exposure Pathways

An exposure pathway describes the means by which an individual may be exposed to contaminants originating from the Site. As defined by the NYSDEC, an exposure pathway has five (5) elements: 1) a contaminant source, 2) contaminant release and transport mechanisms, 3) a point of exposure, 4) a route of exposure and 5) a receptor population. An exposure pathway is complete when all five (5) elements of an exposure pathway exist. An exposure pathway is considered a potential pathway when one or more of the elements currently does not exist, but could in the future. An exposure assessment including potential migration routes by which chemicals in the environment may be able to reach human receptors was conducted during the RI. Potential points of human contact with contaminated media and exposure pathways were identified for the Site and Study Area.

- Subsurface and Surface Soils

  Potential routes of exposure to subsurface and surface soils include dermal contact, ingestion and inhalation of soil particulates. Exposure through dermal contact and ingestion is minimal due to the presence of the existing buildings, asphalt roads, and concrete sidewalks, as well as grass covered undeveloped areas across the Site. Exposure through inhalation is also considered low since no intrusive activities occur onsite that disturbs soils and generates inhalable dust. At present, the exposure to subsurface soils is presently minimal since the Site is developed, and soils are covered.

  During possible future construction activities, specifically disturbance of soils, the potential for exposures to soils would increase for onsite workers, utility workers, trespassers and visitors. During development periods, construction fencing should be installed for safety reasons. This scenario would keep trespassers out and exposure to soils would be minimal to low.

- Overburden and Bedrock Groundwater

  Exposure to overburden and bedrock groundwater, if used as a drinking water supply, includes ingestion, dermal contact and inhalation of vapors.

  At the time of investigation, the Site vicinity utilized municipal water for drinking water only. Therefore, a possible potential threat would occur during future renovations, demolitions, redevelopment or utility repair within the site, which may require excavation and dewatering, and workers may be exposed to groundwater. A second possible exposure could occur if visitors or trespassers were to come onsite during future construction activities and were exposed to the groundwater.

  The likelihood for these exposure scenarios to occur is considered low.

- Surface Water and Soils in the Stormwater Infiltration Basin Area

  Exposure to surface water and soils within the onsite stormwater infiltration basin includes possible ingestion and dermal contact to visitors and trespassers. However, exposure to contaminated surface water and soils is unlikely since the basin is in a remote portion of the site and has a fenced eastern perimeter. In addition, with the exception of two metals (Chromium and Lead) no compounds were detected above SCGs applied to surface water. The likelihood of for exposure to contaminated surface water and soils in the stormwater infiltration basin area is considered minimal at the site.

4.0 REMEDIAL ACTION OBJECTIVES

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375. At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and/or the environment presented by the hazardous substances disposed at the Site through the proper application of scientific and engineering principles.

The remedial action objectives (RAO) for the Site are as follows:

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards;
- Prevent contact with, or inhalation of volatiles, from contaminated groundwater;
- Restore groundwater aquifer to pre-disposal/pre-release conditions to the extent practicable;
- Remove the source of the ground or surface water contamination;
- Prevent the discharge of contaminants to surface water;
- Prevent ingestion/direct contact with contaminated soil;
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil;
- Prevent migration of contaminants that would result in groundwater or surface water contamination; and
- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at the site.

5.0 IDENTIFICATION AND SCREENING OF ALTERNATIVES

This section of the report provides an overview of potential remedial alternatives which are screened for possible detailed consideration, for the Site to achieve the remedial action objectives for soil and groundwater.

- **Alternative No. 1: No Further Action**
- **Alternative No. 2: No Further Action with Site Management**
- **Alternative No. 3: In-situ Chemical Oxidation**
- **Alternative No. 4: In-situ Bioremediation**
- **Alternative No. 5: Electrical Resistance Heating**

5.1 Alternative No. 1: No Further Action

The “No Further Action” Alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative would leave the Site in its present condition and would not provide any additional protection to human health or the environment. The “No Further Action” Alternative would not involve any additional surface soil, subsurface soil, surface water or groundwater remedial activities. In addition, the “No Further Action” alternative would not place any institutional or engineering controls on the Site property, such as future land use restrictions, groundwater use limitations, and/or application of protective soil cover/barrier. With no further action being taken under this alternative, there are no additional costs.

5.2 Alternative No. 2: No Further Action with Site Management

The No Further Action with Site Management alternative would only involve the implementation of future land use and groundwater use restrictions, capping of interior floor drains, as well as, possible actions to address soil vapor mitigation intrusion. This alternative would not involve any additional surface soil, subsurface soil, or groundwater remedial actions. The institutional controls (ICs) would consist of restricting the future use of the site to industrial purposes. The use of groundwater would also be restricted. The engineering controls (ECs) would include the permanent closure of the interior floor drains to eliminate the discharge of additional contaminants into the stormwater infiltration basin and the installation of a sub-slab depressurization system if a soil vapor intrusion re-evaluation confirmed soil vapor intrusion was occurring in the building.

An Environmental Easement would be needed to provide an enforceable legal instrument to ensure compliance with all ECs and ICs placed on the site. A Site Management Plan (SMP) would be required and it would specify the methods necessary to ensure compliance with all ECs and ICs required by the Environmental Easement for contamination that remains at the site. This SMP would provide a detailed description of all procedures required to manage remaining contamination at the site after completion of the Remedial Action, including: (1) implementation and management of all Engineering and Institutional Controls; (2) media monitoring; (3) operation and maintenance of all treatment, collection, containment, or recovery systems; (4) performance of periodic inspections, certification of results, and submittal of Periodic Review Reports; and

(5) defining criteria for termination of treatment system operations. Specifically, the SMP would include a provision for a soil management plan for any future site excavation, as well as a provision for long term groundwater monitoring and possible re-evaluation of soil vapor intrusion into the onsite building and the possible installation of a vapor barrier or sub-slab depressurization system in the onsite building. The purpose of a mitigation system would be to eliminate soil vapor intrusion into current and future site buildings.

This alternative recognizes the remediation of the site completed by the IRMs and the Site Management, ICs and ECs are necessary to confirm the effectiveness of the IRM. This alternative maintains ECs, which were part of the IRMS, and ICs in the form of an Environmental Easement and SMP are necessary to protect public health and the environment from contamination remaining at the site after the IRMs.

In addition, the alternative would include Monitored Natural Attenuation (MNA). It is assumed that MNA would include the collection of groundwater samples from two (2) monitoring wells in each of the three areas of concern as well as four (4) monitoring wells from the perimeter of these areas, for a total of ten (10) wells. The wells will be sampled bi-annually for the first two years, annually for the next three years and then once every five years thereafter and each sampling event would include the submittal of a report detailing the analytical results. This alternative would also include the abandonment of the remaining on-site monitoring wells according to NYSDEC guidance documents, including removal of screens and risers when possible and backfilling with a bentonite slurry.

Estimated costs associated with Alternative 2 are listed in Table 1.

Present Worth:..$142,000
Capital Cost: $44,000
Annual Costs:
(Years 1-5):...$9,100
(Years 5-30):...$5,800

5.3 Alternative No. 3: In-situ Chemical Oxidation

This alternative would include an Environmental Easement as discussed in Alternative No. 2 to provide an enforceable legal instrument to ensure compliance with all engineering controls (ECs) and institutional controls (ICs) placed on the site. A Site Management Plan (SMP) would also be required and it would specify the methods necessary to ensure compliance with all ECs and ICs required by the Environmental Easement for contamination that remains at the site. The SMP would also include a provision for long term groundwater monitoring and possible re-evaluation of soil vapor intrusion into the onsite building.

In addition, onsite overburden groundwater CVOC contamination would be treated via in-situ chemical oxidation (ISCO) injections into the existing three (3) onsite injection wells and eleven (11) additional injection points combined with MNA. A chemical oxidant, sodium permanganate, will be injected into the groundwater using the three injection wells that were installed during the Interim Remedial

Measures within the former drum storage area, outside disposal area, and the former vapor degreaser area, and eleven (11) 4-inch diameter vertical injection wells will be installed within these areas as additional injection points. It is assumed that the average influence radius of the additional injection wells is 60 feet and the additional wells will be spaced 40 to 120 ft from each other. The chemical oxidants will destroy the contaminants in these three areas by oxidizing the CVOCs remaining at concentrations above the SCGs in site groundwater. The sodium permanganate will be applied at a high concentration, which will shorten the time required for the contaminant to be oxidized. The ISCO would be introduced into a subsurface treatment zone that extends from approximately 6 feet to 9 feet beneath the ground surface for the overburden wells. The ISCO injections would treat an area approximately 375 foot by 450 foot in size, and approximately 100,100 pounds of sodium permanganate will be used as a 10% solution.

Sodium permanganate is a dark purple solution that is a relatively mild oxidant and its reaction products are essentially benign. The sodium permanganate will rapidly convert the remaining CVOCs to carbon dioxide, water, and chloride ions. The permanganate will be reduced to insoluble manganese dioxide during the reaction. This oxidation process involves a direct electron transfer and the sodium permanganate has a unique affinity for oxidizing organic compounds containing carbon-carbon double bonds, aldehyde groups or hydroxyl groups. As an electrophile, the permanganate ion is strongly attracted to the electrons in carbon-carbon double bonds found in chlorinated alkenes, borrowing electron density from these bonds to form a bridged, unstable oxygen compound known as the cyclic hypomanganate ester. This intermediate product further reacts by a number of mechanisms including hydroxylation, hydrolysis or cleavage. Under most naturally occurring subsurface pH and temperature conditions, the carbon-carbon double bond of alkenes is broken spontaneously and the unstable intermediates are converted to carbon dioxide through either hydrolysis or further oxidation by the permanganate ion.

Prior to the full implementation of this technology, laboratory and on-site pilot scale studies will be conducted to more clearly define design parameters. For cost purposes this application assumes two injections over the course of one year and long-term groundwater monitoring following remedy implementation. It is assumed that long-term monitoring would include the collection of groundwater samples from two (2) monitoring wells in each of the three areas of concern as well as four (4) monitoring wells from the perimeter of these areas, for a total of ten (10) wells. The wells will be sampled bi-annually for the first two years, annually for the next three years and then once every five years thereafter and each sampling event would include the submittal of a report detailing the analytical results. In addition, this alternative would include the abandonment of the on-site monitoring wells according to NYSDEC guidance documents, once concentrations in the groundwater have reach acceptable levels after monitored natural attenuation.

Estimated costs associated with Alternative 3 are listed in Table 2. The present worth, capital cost, and annual costs are summarized below.

Present Worth:..$1,032,000
Capital Cost: $852,000
Annual Costs:

(Years 1-5):... $9,100
(Years 5-30):... $5,800

5.4 Alternative No. 4: In-Situ Bioremediation

This alternative would include an Environmental Easement as discussed in Alternative No. 2 to provide an enforceable legal instrument to ensure compliance with all engineering controls (ECs) and institutional controls (ICs) placed on the site. A Site Management Plan (SMP) would also be required and it would specify the methods necessary to ensure compliance with all ECs and ICs required by the Environmental Easement for contamination that remains at the site. The SMP would also include a provision for long term groundwater monitoring and possible re-evaluation of soil vapor intrusion into the onsite building.

In addition, Enhanced Reductive Dechlorination (ERD), also know as In-situ Bioremediation would be used to address the residual CVOC groundwater contamination. In-situ bioremediation would enhance contaminant breakdown thereby reducing the length of time that long-term monitoring would be required. Intrinsic bioremediation of VOCs depends upon natural processes such as aerobic and anaerobic biodegradation, dispersion, and volatilization to dissipate these compounds. An overall-decreasing trend in TCE concentrations and degradation trends have been observed within the groundwater at the Site indicating that the current subsurface conditions would support enhanced intrinsic bioremediation through ERD to further degrade residual CVOCs within the groundwater. The three horizontal injection wells installed onsite during IRM excavation activities would provide the injection points for product application. This alternative would treat an approximate 375 foot by 450 foot area and would have a 30 ft sphere of influence on the contaminants present in site groundwater. Approximately 45,000 pounds of Regenesis 3-D Microemulsion would be introduced to the groundwater through gravity feed injection. It is assumed that two injection events would be required to maintain anaerobic conditions.

ERD is an anaerobic biodegredation practice that includes adding hydrogen (an electron donor) to groundwater and/or soil to increase the number and vitality of indigenous microorganisms performing anaerobic bioremediation (reductive dechlorination) on any anaerobically degradeable compound or chlorinated contaminant. The most commonly targeted chlorinated groundwater contaminants are primarily used in industry as degreasing agents and include the remaining CVOCs that exists within the groundwater at the Site (PCE, TCE, DCE and Vinyl Chloride). Hydrogen Release Compound (HRC®), or a similar product, would be injected into the subsurface. HRC is a controlled release, electron donor material, that when hydrated is specifically designed to produce a controlled release of lactic acid. The newly available lactic acid is critical for the production of hydrogen to fuel anaerobic biodegradation processes in soil and groundwater.

HRC® will be applied using direct-injection techniques, specifically gravity feed, into the zone of contamination and moved out into the aquifer media. Once in the subsurface, HRC® can reside within the soil matrix fueling reductive dechlorination and promoting reducing aquifer conditions for periods of up to 24 months or longer through the controlled release of lactic acid (when in contact with water) and subsequent hydrogen production. This newly available source of lactic acid is then metabolized by microbes to produce hydrogen which is then used in a naturally occurring process known as anaerobic reductive dechlorination.

For costing purposes, two injection events and MNA of the groundwater is proposed. It is assumed that MNA would include the collection of groundwater samples from two (2) monitoring wells in each of the three areas of concern as well as four (4) monitoring wells from the perimeter of these areas, for a total of ten (10) wells. The wells will be sampled bi-annually for the first two years, annually for the next three years and then once every five years thereafter and each sampling event would include the submittal of a report detailing the analytical results. In addition, this alternative would include the abandonment of the on-site monitoring wells according to NYSDEC guidance documents, once concentrations in the groundwater have reach acceptable levels after monitored natural attenuation.

Estimated costs associated with Alternative 4 are listed in Table 3. The present worth, capital cost, and annual costs are summarized below.

Present Worth:..$372,000
Capital Cost: $274,000
Annual Costs:
(Years 1-5):...$9,100
(Years 5-30):...$5,800

5.5 Alternative No. 5: Electrical Resistance Heating

This alternative would include an Environmental Easement as discussed in Alternative No. 2 above to provide an enforceable legal instrument to ensure compliance with all engineering controls (ECs) and institutional controls (ICs) placed on the site. A Site Management Plan (SMP) would also be required and it would specify the methods necessary to ensure compliance with all ECs and ICs required by the Environmental Easement for contamination that remains at the site. The SMP would also include a provision for long term groundwater monitoring and possible re-evaluation of soil vapor intrusion into the onsite building.

In addition, electrical resistance heating (ERH) would be used as an in situ thermal treatment for soil and overburden groundwater remediation that can reduce the time to clean up volatile organic compounds (VOCs) from years to months. The ability of the technology to remediate soil and groundwater impacted by chlorinated solvents regardless of lithology proves to be beneficial over conventional in situ technologies.

Electrical resistance heating passes an electrical current through the soil and groundwater that requires treatment. Resistance to this flow of electrical current heats the soil and then boils a portion of the soil moisture into steam. This in situ steam generation occurs in fractured or porous rock and in all soil types, regardless of permeability. Electrical energy evaporates the target contaminant and provides steam as a carrier gas to sweep volatile organic compounds (VOCs) to vapor recovery (VR) wells. After the steam is condensed and the extracted air is cooled to ambient conditions, the VOC vapors are treated using conventional methods, including granular activated carbon (GAC) or oxidation. Electrodes are usually placed in the subsurface throughout the remediation area using standard drilling techniques. For costing purposes, it is expected that a total of 98 electrodes will be installed and 88 soil vapor extraction wells will be installed.

The electrodes, which are in electrical contact but out of phase with each other, pass the electrical current through the soils or rock between them. The natural resistance of the subsurface to this flow of electrical current creates uniform heating throughout the treatment area, regardless of whether it is saturated or unsaturated (vadose). Moisture present in the vadose and saturated zones conducts the electricity in the target treatment interval.

For cost purposes for this application, 98 electrodes would be installed and spaced approximately 20 feet apart, an SVE-treatment system would be utilized for a 6-month period and long-term monitoring of the groundwater is proposed. It is assumed that monitoring would include the collection of groundwater samples from two (2) monitoring wells in each of the three areas of concern as well as four (4) monitoring wells from the perimeter of these areas, for a total of ten (10) wells. The wells will be sampled bi-annually for the first two years, annually for the next three years and then once every five years thereafter and each sampling event would include the submittal of a report detailing the analytical results. In addition, this alternative would include the abandonment of the on-site monitoring wells according to NYSDEC guidance documents, once concentrations in the groundwater have reach acceptable levels after monitored natural attenuation.

Estimated costs associated with Alternative 5 are listed in Table 4. The present worth, capital cost, and annual costs are summarized below.

Present Worth:..$3,500,000
Capital Cost: $3,415,000
Annual Costs:
(Years 1-5):..$9,100
(Years 5-30):..$5,800

6.0 IDENTIFICATION AND SCREENING OF ALTERNATIVES – STORMWATER INFILTRATION BASIN AREA

This section of the report provides an overview of potential remedial alternatives which are screened for possible detailed consideration, for the Site to achieve the remedial action objectives for surface water and soils.

- **Alternative No. 1: Capping Stormwater Infiltration Basin**
- **Alternative No. 2: Focused Excavation of Soils from Stormwater Infiltration Basin**
- **Alternative No. 3: Extensive Excavation of Soils from Stormwater Infiltration Basin**

6.1 Soil Alternative No. 1: Capping Stormwater Infiltration Basin

This alternative would include an Environmental Easement as discussed in Groundwater Alternative No. 2 to provide an enforceable legal instrument to ensure compliance with all engineering controls (ECs) and institutional controls (ICs) placed on the site. A Site Management Plan (SMP) would also be required and it would specify the methods necessary to ensure compliance with all ECs and ICs required by the Environmental Easement for contamination that remains at the site.

To address metals contamination present in soil located in the stormwater infiltration basin, this alternative would include placing a composite cap over the entire basin. The cap would consist of a non-woven filtering geotextile which would have a permeability of approximately 0.2 cm/sec covered by a layer of one foot of filter sand to prevent exposure to contaminated soils. A soil cap is capable of providing a barrier, which will allow any gases to pass safely to the perimeter and be vented to the atmosphere. Because the soil cap has been designed to be semi-permeable, it will also continue to allow stormwater runoff that enters the basin to infiltrate into the subsurface. Long term monitoring would be needed to ensure the integrity of the cap and would be included in a Site Management Plan. This alternative would also permanently close the interior floor drains that directly connect to the basin to eliminate the introduction of manufacturing wastes into the stormwater infiltration basin.

Estimated costs associated with Alternative 1 are listed in Table 5. The present worth, capital cost, and annual costs are summarized below.

Present Worth:.. $101,000
Capital Cost: $47,000
Annual Costs:
(Years 1-5):.. $1,500
(Years 5-30):.. $3,900

6.2 Soil Alternative No. 2: Targeted Excavation of Soils from Stormwater Infiltration Basin

This alternative would include returning the stormwater infiltration basin soils to below the Commercial Use SCOs by excavating the contaminated soils exceeding Commercial SCOs and transporting them off-site for disposal at a permitted facility. This remedial alternative would generally consist of excavation to varying depths, from the surface to approximately 3 feet below grade. This alternative would also permanently close the interior floor drains that directly connect to the basin to eliminate the discharge of manufacturing wastes to the .stormwater infiltration basin.

The excavation and removal of soils exceeding the Commercial SCOs for metals would be overseen by an environmental professional. The excavated soil will be transported to a NYSDEC approved disposal facility as per DER-10 guidance. The proposed excavation area will be approximately 20-feet by 50-feet by an average of 2-feet deep between the areas of SED-1 through SED-3 (Figure 4). Approximately 110 tons of contaminated soil will be excavated for offsite disposal as part of this alternative.

Pursuant to the NYSDEC's Technical Guidance for Site Investigation and Remediation (DER-10) confirmatory soil samples will be collected along the sidewalls and bottom of the excavation. The confirmation soil samples will be submitted to a NYSDOH-certified laboratory for analysis of VOCs, pesticides and TAL metals. With the removal of soil above the commercial SCOs, there are no annual monitoring costs or inspections costs.

Estimated costs associated with Alternative 2 are listed in Table 6. The present worth, capital cost, and annual costs are summarized below.

Present Worth:...$38,000
Capital Cost: $38,000
Annual Costs:
(Years 1-5):...$0
(Years 5-30):...$0

6.3 Soil Alternative No. 3: Excavation of Soil from Entire Stormwater Infiltration Basin

This alternative would include returning the stormwater infiltration basin soils to pre-disposal conditions by excavating and removing all contaminated soil above the Unrestricted Use SCOs from the Site for proper disposal off-site. This remedial alternative would generally consist of excavation to varying depths, from the surface to approximately 5 feet below the bottom of the basin. This alternative would also permanently close the interior floor drains that connect to the basin to reduce the introduction of additional contaminants into the stormwater infiltration basin.

The excavation and removal of soils that exceeded the Unrestricted SCOs for metals would be overseen by an environmental professional. The excavated soil will be transported to a NYSDEC approved disposal facility as per DER-10 guidance. The proposed excavation area will be approximately 140-feet by 65-feet by 5-feet in depth between the areas of SED-1 through SED-3. Approximately 2,200 tons of contaminated soil will be excavated for offsite disposal as part of this alternative.

Pursuant to the NYSDEC's Technical Guidance for Site Investigation and Remediation (DER-10) confirmatory soil samples will be collected along the sidewalls and bottom of the excavation. The confirmation soil samples will be submitted to a NYSDOH-certified laboratory for analysis of VOCs, pesticides and TAL metals. With the removal of soil above the unrestricted SCOs, there are no annual monitoring costs or inspections costs.

Estimated costs associated with Alternative 3 are listed in Table 7. The present worth, capital cost, and annual costs are summarized below.

Present Worth:..$287,000
Capital Cost: $287,000
Annual Costs:
(Years 1-5):..$0
(Years 5-30):...$0

7.0 IDENTIFICATION AND SCREENING OF ALTERNATIVES – PRE-DISPOSAL CONDITIONS

This section of the report provides an overview of a potential remedial alternative which is screened for possible detailed consideration, for the Site to achieve pre-disposal conditions.

7.1 Restoration to Pre-Disposal Conditions Alternative

The Restoration to Pre-disposal Conditions Alternative achieves each of the SCGs including the Unrestricted Soil Cleanup Objectives listed in Part 375-6.8 (a) for soils and the NYSDEC Class GA criteria from TOGS 1.1.1 for groundwater. To achieve pre-disposal conditions at the site, this alternative would include excavation and off-site disposal of soil from five areas, combined with *in-situ* chemical oxidation (ISCO) for CVOC contamination present in overburden and shallow and intermediate bedrock groundwater.

The restoration to pre-disposal alternative would include the excavation and off-site disposal of approximately 320 tons of soil at the site where contamination was identified at concentrations exceeding the Unrestricted SCGs. Specifically, the restoration to pre-disposal alternative would include the excavation areas shown on Figure 3. Specifically, excavation of contaminated soil would occur beneath the building in the area of SB-8 and SB-12, in the former drum storage area in the immediate area of SB-15, as well as in the undeveloped grass area west of the building in the immediate areas of SS-1 and TP-3. Each proposed excavation would be approximately 15 ft by 15 ft in area, with the exception of the interior excavation which would be 15 ft by 25 ft. In each of the excavations, soil would be excavated to a depth of approximately five feet below ground surface. Following removal of the approximate 320 tons of soil, the excavations would be backfilled with clean fill from an approved source and appropriate restoration would be made to the surface (i.e concrete, asphalt, or grass seed).

For the on-site CVOC contamination in groundwater, restoration to pre-disposal alternative would rely on in-situ chemical oxidation. Sodium permanganate, would be injected into the overburden groundwater using the three injection wells that were installed during the IRMS, as well as eleven (11) additional injection points to address any residual contamination within the bedrock groundwater. The sodium permanganate would be introduced into a subsurface treatment zone that extends from approximately 6 feet to 30 feet beneath the ground surface. This alternative would treat an approximate 375 foot by 450 foot area and would have a 60 ft sphere of influence on the contaminants present in site groundwater. The additional wells will be spaced 40 to 120 ft from each other in the former drum storage area, outside disposal area, and the former vapor degreaser area. Approximately 800,935 pounds of sodium permanganate will be used as a 10% solution. The ISCO would be injected during two events over a one year period.

This alternative would also include returning the stormwater infiltration basin soils to pre-disposal condition by excavating and removing all contaminated soil above the Unrestricted Use SCOs from the Site for proper disposal off-site. The proposed excavation area will be approximately 140-feet by 65-feet by 5-feet deep between the areas of SED-1 through SED-3. Approximately 2,200 tons of contaminated soil will be excavated for offsite disposal as part of this alternative. This alternative would also permanently close the interior floor drains that connect to the basin to reduce the introduction of additional contaminants into the stormwater infiltration basin.

The components of the restoration to pre-disposal alternative are implementable and reliable technologies. Costs are based on removal and disposal of the concrete slab within the building, soil excavation, backfilling of the excavations, design of the in-situ chemical oxidation program, the installation of eleven additional injection wells and the purchase and injection of the ISCO material, as well as the excavation and backfilling activities associated with the soil removal in the stormwater infiltration basin area. It is expected that it would take approximately twelve months to design and fully implement the restoration to pre-disposal remedy. With the removal of soil above the unrestricted SCOs and the treatment of groundwater to achieve the groundwater standards, there are no annual costs under this alternative.

Estimated costs associated with the restoration to pre-disposal alternative are listed in Table 7. Since this alternative would be implemented in one year, only capital costs are included below.

Capital Cost: $3,605,000

8.0 DETAILED ANALYSIS AND COMPARISON OF ALTERNATIVES TO PROTECTION CRITERIA

Alternatives for soil and groundwater selected for detailed analysis include:

- **Alternative No. 1: No Further Action**
- **Alternative No. 2: No Further Action with Site Management**
- **Alternative No. 3: In-situ Chemical Oxidation**
- **Alternative No. 4: In-situ Bioremediation**
- **Alternative No. 5: Electrical Resistance Heating**

These alternatives are developed in sufficient detail to allow an analysis of their effectiveness and implementability with the Sites remedial action objective and NYSDEC criteria for the ERP program, DER - 10 Technical Guidance for Site Investigation and Remediation, which require consideration of the following criteria:

- Overall Protection of Public Health and Environment
- Compliance with NYSDEC Standards, Criteria, and Guidance (SCGs) for Investigation and Remediation of Inactive Hazardous Waste Disposal Sites
- Long Term Effectiveness and Permanence
- Reduction in Toxicity and Mobility
- Short Term Effectiveness
- Implementability
- Cost Effectiveness
- Land Use

8.1 Alternative No. 1: No Further Action

- **Overall Protection of Public Health and Environment** – This alternative does not provide sufficient protection to human health and the environment. Residual public health risks would be high in consideration of: 1) the future use of the site, contaminated groundwater for drinking water or other purposes and 2) exposure to surface and subsurface soils, surface water and groundwater that exhibit levels of contamination over SCGs. This alternative would not achieve Site RAO's.

- **Compliance with SCGs** - This alternative will not comply with SCGs since known contaminants exist in surface and subsurface soils, surface water and groundwater**.** The site contaminants are persistent and are expected to remain at the site under this alternative for an extended amount of time.

- **Long Term Effectiveness and Permanence** - This alternative will not constitute an effective long term solution because the lack of any remedial action or set controls which may result in significant public health risks.

- **Reduction in Toxicity and Mobility** - This alternative will not reduce the toxicity or mobility of the known contaminants on-site as no remedial action is proposed.

- **Short Term Effectiveness** - This alternative will not provide any benefits in the short term except for minimal costs associated with "No Action" and the time to implement the remedy. In addition, no remedial/construction activities would be implemented for this alternative, therefore no short-term impacts or effects on the site occupants, community or environment would occur.

- **Implementability -** This alternative could be easily implemented as there are no remedial/construction activities are required. However, obtaining approval to implement this alternative would be difficult.

- **Cost** - The initial cost to implement this alternative would be zero and the least costly Alternative presented. Future costs, however, may arise if the Site is developed and public health issues arise.

- **Land Use** - This alternative will not comply with the current land use of the Site and could possibly affect the general public that utilizes the adjacent properties.

Although the "No Further Action" alternative would be the least expensive alternative, it would represent the greatest risk to public health and to any future use of the Site property. This alternative will not comply with SCGs since known contaminants exist in surface and subsurface soils, surface water and groundwater**.** This alternative does not limit the exposure to the remaining onsite contamination and therefore the sites RAO's would not be achieved. In addition, the No Further Action alternative may result in an unknown amount of future costs related to public health and/or future remedial action costs. As a result of the known residual contamination of the Site's surface and subsurface soil, and groundwater the No Further Action alternative is an impractical alternative.

8.2 Alternative No. 2: No Further Action with Site Management

- **Overall Protection of Public Health and Environment –** This alternative does provide minimal protection to both public health and the environment. This alternative would control potential exposure pathways through the implementation of institutional and engineering controls, however this alternative would not achieve the RAOs for soil or groundwater.

- **Compliance with SGCs** – This alternative will not comply with the SGCs regarding surface and subsurface soils or groundwater SCGs. With no remedial actions under this alternative, contaminated soils and groundwater would be left onsite.

- **Long Term Effectiveness and Permanence** – This alternative would be somewhat effective long term due to restricting land use to industrial purposes and by restricting the use of the on-site groundwater, as well as, addressing potential soil vapor issues that may still exist. However, this alternative will not constitute an effective long term solution because the lack of any remedial actions and contaminated soils and groundwater would remain onsite.

- **Reduction in Toxicity and Mobility** –Soil vapor toxicity and mobility will be reduced with the engineering controls by evaluating soil vapor intrusion and implementing mitigation if necessary. In addition this alternative will reduce the introduction of additional contaminants into the basin by closing the interior floor drains that connect to the basin. However, this alternative does not reduce the toxicity and mobility of contaminants in the soils or groundwater because remedial actions are not included as part of this alternative.

- **Short Term Effectiveness** - This alternative will not provide any benefits in the short term. Potential human exposure, adverse environmental impacts and nuisance conditions at the Site resulting from this alternative would be anticipated.

- **Implementability** - This alternative is easily implementable through the placement of Institutional and Engineering Controls and the preparation of a Site Management Plan.

- **Cost** - The cost to implement this alternative would be minimal, due to the lack of any remedial activities (i.e. soil excavation, groundwater treatment). Costs would include the preparation of a Site Management Plan and the periodic certification required by an easement.

- **Land Use** - This alternative would comply with the current land use of the Site by implementing the ICs and ECs. However, this alternative could possibly affect the general public who utilize the adjacent properties.

This alternative would be the cheapest alternative to implement after the No Further Action Alternative and would be easily implemented. This alternative would control potential exposure pathways through the implementation of institutional and engineering controls, however this alternative would not achieve the RAOs for soil or groundwater because of the lack of remedial actions. In addition, this alternative would provide no reduction of the toxicity and mobility of contaminants in the soils or groundwater. This alternative would not comply with the SCGs for surface and subsurface soils, or groundwater and would provide very minimal protection to both public health and the environment.

8.3 Alternative No. 3: In-situ Chemical Oxidation

- **Overall Protection of Public Health and Environment** – This alternative provides sufficient protection to both public health and the environment by reducing the threat of exposure to surface and subsurface contaminated soils as well as treating the onsite groundwater.

- **Compliance with SCGs** - This alternative will comply with the groundwater SCGs with the addition of ISCO to reduce the contaminant concentrations within the plume. This technology would reduce the time necessary to meet the SCGs.

- **Long Term Effectiveness and Permanence** – This alternative will constitute an effective long term solution as a result of 1) contamination source being addressed through previous excavations (IRMS) and ISCO injections 2) restricting the use of the onsite groundwater, and 3) prevention of contact to any residual contaminated soils through the existing barriers (i.e. building slab, asphalt).

- **Reduction in Toxicity and Mobility** – This alternative will significantly decrease the toxicity of the contaminants in the groundwater. ISCO will destroy CVOCs present in site groundwater.

- **Short Term Effectiveness** - This alternative will provide significant benefits in the short term with reductions in groundwater contamination concentrations. In addition, this technology is more effective in a shorter period of time than other in-situ technologies (i.e. Alternative 4). Potential human exposure, adverse environmental impacts and nuisance conditions at the Site resulting from this alternative are anticipated for a period of several days during which time Site work will occur. In addition, this alternative poses potential health and safety concerns associated with applying oxidants and the adjacent properties and community may be impacted with the transportation of the chemical oxidizer.

- **Implementability** - This alternative is implementable through the injection of material and use of available contractors under the supervision and oversight of qualified field personnel, however, additional injection points would need to be installed as part of this alternative. Such activities are performed regularly with high rates of success. The time to coordinate the work and apply treatment can be completed over several days. The MNA portion of this alternative would require additional years of monitoring to ensure that the treatment was working and concentrations in the groundwater were meeting SCGs.

- **Cost** - The cost to implement this alternative would be more costly than Alternatives 1 and 2. When compared to the other in-situ techniques presented, this Alternative would be more expensive than Alternative 4 but less expensive than Alternative 5. Costs would include Site preparation, installation of additional injection points, the implementation of the injection application and yearly groundwater monitoring until the analytical concentrations are below regulatory limits.

- **Land Use** -The current on-site building could remain in place and uninterrupted use of the site would be possible. The future land use under this alternative would be consistent with current zoning and surrounding land use.

This alternative provides adequate protection of public health and the environment as it will significantly decrease the toxicity of the contaminants in the groundwater. The risk of exposure to remaining soil contamination is very low because there are no completed pathways through which the public may be exposed with the contact barriers (i.e. asphalt, building slab) in place, and soil vapor intrusion may be evaluated in the future as part of the remedy. This alternative would be effective by reducing the groundwater contamination in a shorter time period than Alternative 4. However, this alternative is one of the more costly alternatives presented for groundwater remediation and there would be potential human exposure and safety hazards to the workers onsite and the community due to the chemical oxidizer used for the injections.

8.4 Alternative No. 4: In-situ Bioremediation

- **Overall Protection of Public Health and Environment** – This alternative provides sufficient protection to both public health and the environment by reducing the threat of exposure to surface and subsurface contaminated soils as well as treating the onsite groundwater.

- **Compliance with SCGs** - This alternative will comply with the groundwater SCGs with the use of in-situ bioremediation to reduce the contaminant concentrations within the plume. This technology would reduce the time necessary to meet the SCGs.

- **Long Term Effectiveness and Permanence** – This alternative will constitute an effective long term solution as a result of 1) contamination source being addressed through previous excavations (IRMS) as well as ERD injections 2) restricting the use of the onsite groundwater, and 3) prevention of contact to any residual contaminated soils through the existing barriers (i.e. building slab, asphalt).

- **Reduction in Toxicity and Mobility** – This alternative will significantly decrease the toxicity of the contaminants in the groundwater. Enhanced intrinsic bioremediation coupled with natural attenuation will enhance natural processes such as aerobic and anaerobic biodegradation or degradation within the saturated zone.

- **Short Term Effectiveness** - This alternative will provide benefits in the short term with reductions in groundwater contamination concentrations. However, this remedial technology typically takes longer to be effective than the technologies presented in Alternative 3 or 5. There are less health and safety concerns associated with this Alternative as compared to the other alternatives addressing groundwater remediation (i.e. handling of chemical oxidizer and electrical currents). Potential human exposure, adverse environmental impacts and nuisance conditions at the Site resulting from this alternative are anticipated to be minimal for a period of several days during which time Site work will occur.

- **Implementability** - This alternative is easily implementable through the injection of material and use of available contractors under the supervision and oversight of qualified field personnel. Such activities are performed frequently with high rates of success. The time to coordinate the work, advance the additional injection points, and apply treatment can be completed over several days. The MNA portion of this alternative would require additional years of monitoring to ensure that the treatment was working and concentrations in the groundwater were meeting SCGs.

- **Cost** - The cost to implement this alternative would be more costly than Alternatives 1 and 2, and less costly than the other alternatives (i.e. Alternatives 3 and 5) that include groundwater remediation. Costs would include Site preparation, installation of additional injection points, implementation of the injection application and yearly groundwater monitoring until the analytical concentrations are below regulatory limits.

- **Land Use** -The current on-site building could remain in place and uninterrupted use of the site would be possible. The future land use under this alternative would be consistent with current zoning and surrounding land use.

This alternative provides protection to public health and the environment as it will significantly decrease the toxicity of the contaminants in the groundwater. In addition, biodegradation is already occurring at the site and this alternative would enhance this already occurring process. The risk of exposure to remaining soil contamination is very low because there are no completed pathways through which the public may be exposed with the contact barriers (i.e. asphalt, building slab) in place, and soil vapor intrusion may be evaluated in the future as part of the remedy. The technology presented in this alternative has a high rate of success, would meet the site's RAOs for groundwater and is the least costly of the groundwater remedial alternatives presented. In addition, there are less health and safety concerns associated with this Alternative as compared to the other alternatives addressing groundwater remediation (i.e. handling of chemical oxidizer or exposure to electrical currents). However, this technology typically takes a longer time period to become effective when compared to the other in-situ technologies.

8.5 Alternative No. 5: Electrical Resistance Heating

- **Overall Protection of Public Health and Environment** – Upon completion, this alternative provides a sufficient level of protection to both public health and the environment by removing all contaminated groundwater and associated dewatered zones of soil. This alternative would achieve the Site RAO's for groundwater.

- **Compliance with SCGs** - The groundwater would comply with SCGs after treatment. This alternative would achieve compliance in a shorter time frame than Alternatives 3 and 4.

- **Long Term Effectiveness and Permanence** - This alternative will constitute an effective long term solution due to the treatment of the contaminated groundwater on the Site. In addition, prevention of contact to any residual contaminated soils through the existing barriers (i.e. building slab, asphalt) would be an effective long term solution for subsurface soils.

- **Reduction in Toxicity and Mobility** - This alternative will significantly decrease the toxicity of the contaminants in the soils and groundwater. Full reduction in toxicity and mobility will be achieved via electrical resistance heating.

- **Short Term Effectiveness** - This alternative will provide significant benefits in the short term by treating the groundwater contamination in the shortest time frame. However, this alternative requires the installation of 98 electrodes, 88 soil vapor extraction wells, and 6 month use of an SVE system, which makes this alternative very intrusive and disruptive to the onsite workers. Potential human exposure, adverse environmental impacts and nuisance conditions at the Site resulting from this alternative are anticipated to be for a period of several weeks to a few months during which time Site work will occur.

- **Implementability** - This alternative is the most challenging to implement as 98 electrodes and 88 soil vapor extraction wells and associated SVE equipment would need to be installed. The time to perform the job can be completed over several weeks to a few months, in which a large temporary source of electricity would be required.

- **Cost -** The cost to implement this alternative would be the most expensive alternative due to probe and trenching installation and well as equipment required. Costs would include design, site preparation, excavation, and a large temporary source of electrical power would be required.

- **Land Use-** Once the work was complete, uninterrupted use of the Site would be possible. The future land use under this alternative would be consistent with current zoning and surrounding land use.

This alternative provides protection of public health and the environment as it will significantly decrease the toxicity of the contaminants in the groundwater in a short period of time. The risk of exposure to remaining soil contamination is very low because there are no completed pathways through which the public may be exposed with the contact barriers (i.e. asphalt, building slab) in place, and soil vapor intrusion may be evaluated in the future as part of the remedy. This alternative would meet the SCGs for groundwater and meet the RAO's for the site. However, this alternative requires the installation of 98 electrodes, 88 soil vapor extraction wells, and 6 month use of an SVE system, which makes this alternative the most challenging to implement and very intrusive and disruptive to the onsite workers and surrounding properties. In addition, this is the most expensive alternative presented for groundwater remediation.

9.0 DETAILED ANALYSIS AND COMPARISON OF ALTERNATIVES TO PROTECTION CRITERIA – STORMWATER INFILTRATION BASIN AREA

Alternatives for surface water and soils selected for detailed analysis include:

- **Soil Alternative No. 1: Capping Stormwater Infiltration Basin**
- **Soil Alternative No. 2: Focused Excavation of Soils from Stormwater Infiltration Basin**
- **Soil Alternative No. 3: Extensive Excavation of Soils from Stormwater Infiltration Basin**

These alternatives are developed in sufficient detail to allow an analysis of their effectiveness and implementability with the Sites remedial action objective and NYSDEC criteria for the ERP program, DER - 10 Technical Guidance for Site Investigation and Remediation, which require consideration of the following criteria:

- Overall Protection of Public Health and Environment
- Compliance with NYSDEC Standards, Criteria, and Guidance (SCGs) for Investigation and Remediation of Inactive Hazardous Waste Disposal Sites
- Long Term Effectiveness and Permanence
- Reduction in Toxicity and Mobility
- Short Term Effectiveness
- Implementability
- Cost Effectiveness
- Land Use

9.1 Alternative No. 1: Capping Stormwater Infiltration Basin

- **Overall Protection of Public Health and Environment** - Upon completion, this alternative provides a sufficient level of protection to both public health and the environment by providing a cap over the contaminated soil in conjunction with implementing the Institutional and Engineering Controls. This alternative would achieve the Site RAO's for soils and surface water.

- **Compliance with SCGs -** This alternative would not comply with the SCGs regarding soil requirements as contaminated soils would remain in place within the basin area. However exposure to soil over the SCGs would be greatly reduced when combined with appropriate Institutional and Engineering Controls as discussed in Section 2.

- **Long Term Effectiveness and Permanence** - This alternative will constitute an effective long term solution by removing access and reducing exposure to the contaminated soils and surface water. This alternative would also include long term monitoring to ensure the integrity of the cap.

- **Reduction in Toxicity and Mobility** - This alternative will not affect the toxicity of the contaminants in the soils, but would reduce mobility and exposure through the soil cap. This alternative would also reduce the introduction of additional contaminants into the stormwater infiltration basin by closing the interior floor drains that connect to the basin.

- **Short Term Effectiveness** - This alternative will provide benefits in the short term, notably by removing access to the contaminated soils. Potential human exposure, adverse environmental impacts and nuisance conditions at the Site resulting from this alternative are anticipated to be for a period of a few days during which time Site work will occur. In addition, the surrounding properties or community may be affected (i.e. potential spills, migrating dust) by the delivery of the materials to complete the cap.

- **Implementability** - This alternative is easily implementable through the mobilization of soil loading equipment and use of available contractors under the supervision and oversight of qualified field personnel to install and maintain the cap. Such activities are performed frequently with high rates of success. The time to perform the job can be completed over a few days.

- **Cost** - The cost to implement this alternative would be more expensive than Soil Alternative 2. Costs would include design, site preparation, and cap placement.

- **Land Use** Once the work was completed, uninterrupted use of the Site would be possible. The future land use under this alternative would be consistent with current zoning and surrounding land use.

This alternative provides a sufficient level of protection to both public health and the environment by removing access and potential exposure to the contaminated soils in the basin area. Although it would not restore the soil concentrations to below the Unrestricted SCOs or Commercial SCOs, this alternative would reduce mobility and exposure through the soil cap. This alternative would also reduce the introduction of additional contaminants into the basin by closing the interior floor drains that connect to the basin. However, this alternative would require long term monitoring to ensure the integrity of the cap and would be one of the more expense alternatives to implement.

9.2 Soil Alternative No. 2: Targeted Excavation of Soil from Stormwater Infiltration Basin

- **Overall Protection of Public Health and Environment** - Upon completion, this alternative provides a sufficient level of protection to both public health and the environment by removing the contaminated soils above Commercial Use SCOs. Because the highest concentrations of contamination would be removed from the soils, there would be limited residual public health or environmental risks remaining after remediation. The soils in the stormwater infiltration basin would not be restored to predisposal conditions, however this alternative would achieve the Site RAO's.

- **Compliance with SCGs** - This alternative will comply with the Commercial Use SCOs regarding soil requirements when combined with appropriate Institutional and Engineering Controls as discussed in Section 2.

- **Long Term Effectiveness and Permanence** - This alternative will constitute an effective long term solution due to the removal of the contaminated soils on the Site. There would be no residual risks since the source(s) of the contamination would be removed.

- **Reduction in Toxicity and Mobility** - This alternative will significantly reduce the toxicity and mobility of the contaminants in the soil through excavation and off-site disposal. This alternative would also reduce the introduction of additional contaminants into the basin by closing the interior floor drains that connect to the basin.

- **Short Term Effectiveness** - This alternative will provide significant benefits in the short term, notably the removal of elevated levels of contaminants in the soils. Potential human exposure, adverse environmental impacts and nuisance conditions at the Site resulting from this alternative are anticipated to be for a period of several days during which time Site work will occur.

- **Implementability** - This alternative is easily implementable through the mobilization of excavation equipment and associated extraction equipment, and use of available contractors under the supervision and oversight of qualified field personnel. Such activities are performed frequently with high rates of success. The time to perform the job can be completed over several days.

- **Cost** - The cost to implement this alternative is the least expensive for the stormwater infiltration basin area. Costs would include design, Site preparation, excavation, and dewatering would be required.

- **Land Use** Once the work was completed, uninterrupted use of the Site would be possible. The future land use under this alternative would be consistent with current zoning and surrounding land use.

This alternative is the least expensive of the three remedial alternatives for the basin area. This alternative would restore the soils to below the Commercial Use SCOs and would reduce the introduction of additional contaminants into the stormwater infiltration basin by closing the interior floor drains that connect to the basin. This alternative provides a sufficient level of protection to both public health and the environment by removing a majority of the contaminated soils and would likely yield a low risk to public health due Institutional and Engineering Controls. This alternative is easily implementable and will constitute an effective long term solution due to the removal of the contaminated soils on the Site.

9.3 Alternative No. 3: Excavation of Soils from Entire Stormwater Infilatration Basin

- **Overall Protection of Public Health and Environment** - Upon completion, this alternative provides the highest level of protection to both public health and the environment by removing all of the soil with contaminants present at concentrations exceeding unrestricted SCOs. Because the contamination would be removed from the Site, there would be no residual public health or environmental risks remaining after remediation. Because the soils in the stormwater infiltration basin would be restored to predisposal conditions, this alternative is protective of public health. This alternative would achieve the Site RAO's for soils.

- **Compliance with SCGs** - This alternative will comply with the Unrestricted Use SCOs for the soils in the basin area.

- **Long Term Effectiveness and Permanence** - This alternative will constitute an effective long term solution due to the removal of the contaminated soils on the Site. There would be no residual risks since all contamination above unrestricted SCOs would be removed.

- **Reduction in Toxicity and Mobility** - This alternative will significantly decrease the toxicity of the contaminants in the soils. Reduction in toxicity and mobility will be achieved via excavation. This alternative would also reduce the introduction of additional contaminants into the stormwater infiltration basin by closing the interior floor drains that connect to the basin.

- **Short Term Effectiveness** - This alternative will provide significant benefits in the short term, notably the removal of contaminants within the soils. Potential human exposure, adverse environmental impacts and nuisance conditions at the Site resulting from this alternative are anticipated to be for a period of several days during which time Site work will occur. However, because this alternative includes the excavation of the entire basin, this alternative would be the most disruptive to the site occupants and surrounding community.

- **Implementability** - This alternative is easily implementable through the mobilization of excavation equipment and associated extraction equipment, and use of available contractors under the supervision and oversight of qualified field personnel. Such activities are performed frequently with high rates of success. The time to perform the job can be completed over several days.

- **Cost** - The cost to implement this alternative would be the most expensive alternative for the stormwater infiltration basin area as it would involve the most off-site transportation of waste. Costs would include design, Site preparation, excavation, transportation and disposal costs and dewatering would be required.

- **Land Use-** Once the work was complete, uninterrupted use of the Site would be possible. The future land use under this alternative would be consistent with current zoning and surrounding land use.

This alternative would restore the soils to the Unrestricted Use SCOs and thus be the most protective alternative to public health and the environment. Also, this alternative would not consist of any future land use restrictions and would likely yield the lowest risk to public health and to any future on-site development. However, this alternative would be the most expensive remedial alternative for the stormwater infiltration basin as it would involve the most off-site transportation of waste and it would be the most disruptive to the site occupants and surrounding community.

10.0 DETAILED ANALYSIS AND COMPARISON OF ALTERNATIVES TO PROTECTION CRITERIA

Alternatives for pre-disposal conditions selected for detailed analysis include:

- **Restoration to Pre-Disposal Conditions Alternative**

10.1 Restoration to Pre-Disposal Conditions Alternative

- **Overall Protection of Public Health and Environment** - Upon completion, this alternative provides the highest level of protection to both public health and the environment by removing soil with contaminants above unrestricted SCOs and treating CVOC contaminated groundwater to achieve groundwater SCGs Because the contamination would be treated or removed from the Site, there would be no residual public health or environmental risks remaining after remediation. All media onsite would be restored to predisposal conditions and this alternative would achieve the Site RAO's.

- **Compliance with SCGs** - This alternative will comply with the Unrestricted Soil Cleanup Objectives for soils and the NYSDEC Class GA criteria from TOGS 1.1.1 for groundwater.

- **Long Term Effectiveness and Permanence** - This alternative will constitute an effective long term solution due to the removal or treatment of contaminants from all media on the Site. There would be no residual risks since the source(s) of the contamination would be removed.

- **Reduction in Toxicity and Mobility** - This alternative will eliminate toxicity and mobility of contaminants by removing all contaminant sources and restoring the site to pre-disposal conditions. This alternative would also reduce the introduction of additional contaminants into the infiltration basin by closing the interior floor drains that connect to the basin.

- **Short Term Effectiveness** - This alternative will provide the most benefits in the short term, notably the removal of contaminants. Potential human exposure, adverse environmental impacts and nuisance conditions at the Site resulting from this alternative are anticipated to be for a period of one year during which time Site work will occur. In addition, this alternative poses potential health and safety concerns associated with applying oxidants and the adjacent properties and community may be impacted with the transportation of the chemical oxidizer. This alternative would also be the most disruptive to the onsite workers and surrounding properties due to the amount of work involved.

- **Implementability** – This alternative would be the most challenging to implement as it would involve the mobilization of excavation equipment and associated extraction equipment, the design of the in-situ chemical oxidation program, the installation of additional injects wells, the purchase and injection of the ISCO material, and use of available contractors under the supervision and oversight of qualified field personnel. The time to perform the job can be completed over one year.

- **Cost** - The cost to implement this alternative would be the most expensive alternative. Costs would include design, Site preparation, excavation, transport and disposal costs, ISCO injection materials, installation of electrodes and vapor recovery wells, and SVE system.

- **Land Use-** Once the work was complete, uninterrupted use of the Site would be possible. The future land use under this alternative would be consistent with current zoning and surrounding land use.

This alternative would restore the site to pre-disposal conditions and all SCGs would be met. This alternative would also be the most protective alternative to public health and the environment and it would not consist of any future land use restrictions and would likely yield the lowest risk to public health. However, this alternative is the most expensive remedial alternative presented. It would also be the most challenging and disruptive alternative to the onsite workers and surrounding properties due to the amount of work involved. In additional, there would be potential human exposure and safety hazards to the workers onsite and the community due to the chemical oxidizer used for the injections and it would involve the most off-site transportation of waste.

11.0 SUMMARY OF REMEDIAL ALTERNATIVES

The following is a summary of the advantages and disadvantages for each of the five (5) alternatives for soil and groundwater:

11.1 Alternative No. 1: No Further Action

Although the "No Further Action" alternative would be the least expensive alternative, it would represent the greatest risk to public health and to any future use of the Site property. This alternative will not comply with SCGs since known contaminants exist in surface and subsurface soils, surface water and groundwater**.** This alternative does not limit the exposure to the remaining onsite contamination and therefore the sites RAO's would not be achieved. In addition, the No Further Action alternative may result in an unknown amount of future costs related to public health and/or future remedial action costs. As a result of the known residual contamination of the Site's surface and subsurface soil, and groundwater the No Further Action alternative is an impractical alternative.

11.2 Alternative No. 2: No Further Action with Site Management

This alternative would be the cheapest alternative to implement after the No Further Action Alternative and would be easily implemented. This alternative would control potential exposure pathways through the implementation of institutional and engineering controls, however this alternative would not achieve the RAOs for soil or groundwater because of the lack of remedial actions. In addition, this alternative would provide no reduction of the toxicity and mobility of contaminants in the soils or groundwater. This alternative would not comply with the SCGs for surface and subsurface soils, or groundwater and would provide very minimal protection to both public health and the environment.

11.3 Alternative No. 3: In-situ Chemical Oxidation

This alternative provides adequate protection of public health and the environment as it will significantly decrease the toxicity of the contaminants in the groundwater. The risk of exposure to remaining soil contamination is very low because there are no completed pathways through which the public may be exposed with the contact barriers (i.e. asphalt, building slab) in place, and soil vapor intrusion may be evaluated in the future as part of the remedy. This alternative would be effective by reducing the groundwater contamination in a shorter time period than Alternative 4. However, this alternative is one of the more costly alternatives presented for groundwater remediation and there would be potential human exposure and safety hazards to the workers onsite and the community due to the chemical oxidizer used for the injections.

11.4 Alternative No. 4: In-situ Bioremediation

This alternative provides protection to public health and the environment as it will significantly decrease the toxicity of the contaminants in the groundwater. In addition, biodegradation is already occurring at the site and this alternative would enhance this already occurring process. The risk of exposure to remaining soil contamination is very low because there are no completed pathways through which the public may be exposed with the contact barriers (i.e. asphalt, building slab) in place, and soil vapor intrusion may be evaluated in the future as part of the remedy. The technology presented in this alternative has a high rate of success, would meet the site's RAOs for groundwater and is the least costly of the groundwater remedial alternatives presented. In addition, there are less health and safety concerns associated with this Alternative as compared to the other alternatives addressing groundwater remediation (i.e. handling of chemical oxidizer or exposure to electrical currents). However, this technology typically takes a longer time period to become effective when compared to the other in-situ technologies.

11.5 Alternative No. 5: Electrical Resistance Heating

This alternative provides protection of public health and the environment as it will significantly decrease the toxicity of the contaminants in the groundwater in a short period of time. The risk of exposure to remaining soil contamination is very low because there are no completed pathways through which the public may be exposed with the contact barriers (i.e. asphalt, building slab) in place, and soil vapor intrusion may be evaluated in the future as part of the remedy. This alternative would meet the SCGs for groundwater and meet the RAO's for the site. However, this alternative requires the installation of 98 electrodes, 88 soil vapor extraction wells, and 6 month use of an SVE system, which makes this alternative the most challenging to implement and very intrusive and disruptive to the onsite workers and surrounding properties. In addition, this is the most expensive alternative presented for groundwater remediation.

12.0 SUMMARY OF REMEDIAL ALTERNATIVES- STORMWATER INFILTRATION BASIN AREA

The following is a summary of the advantages and disadvantages for each of the three (3) alternatives for the stormwater infiltration basin area:

12.1 Alternative No. 1: Capping Stormwater Infiltration Basin

This alternative provides a sufficient level of protection to both public health and the environment by removing access and potential exposure to the contaminated soils in the basin area. Although it would not restore the soil concentrations to below the Unrestricted SCOs or Commercial SCOs, this alternative would reduce mobility and exposure through the soil cap. This alternative would also reduce the introduction of additional contaminants into the stormwater infiltration basin by closing the interior floor drains that connect to the basin. However, this alternative would require long term monitoring to ensure the integrity of the cap and would be one of the more expense alternatives to implement.

12.2 Alternative No. 2: Limited Excavation of Soils from Stormwater Infiltration Basin

This alternative is the least expensive of the three remedial alternatives for the basin area. This alternative would restore the soils to below the Commercial Use SCOs and would reduce the introduction of additional contaminants into the stormwater infiltration basin by closing the interior floor drains that connect to the basin. This alternative provides a sufficient level of protection to both public health and the environment by removing a majority of the contaminated soils and would likely yield a low risk to public health due Institutional and Engineering Controls. This alternative is easily implementable and will constitute an effective long term solution due to the removal of the contaminated soils on the Site.

12.3 Alternative No. 3: Extensive Excavation of Soils from Stormwater Infiltration Basin

This alternative would restore the soils to the Unrestricted Use SCOs and thus be the most protective alternative to public health and the environment. Also, this alternative would not consist of any future land use restrictions and would likely yield the lowest risk to public health and to any future on-site development. However, this alternative would be the most expensive remedial alternative for the stormwater infiltration basin as it would involve the most off-site transportation of waste and it would be the most disruptive to the site occupants and surrounding community.

13.0 SUMMARY OF REMEDIAL ALTERNATIVES- RESTORATION TO PRE-DISPOSAL CONDITIONS

The following is a summary of the advantages and disadvantages for the restoration to pre-disposal conditions.

13.1 Restoration to Pre-Disposal Conditions Alternative

This alternative would restore the site to pre-disposal conditions and all SCGs would be met. This alternative would also be the most protective alternative to public health and the environment and it would not consist of any future land use restrictions and would likely yield the lowest risk to public health. However, this alternative is the most expensive remedial alternative presented. It would also be the most challenging and disruptive alternative to the onsite workers and surrounding properties due to the amount of work involved. In additional, there would be potential human exposure and safety hazards to the workers onsite and the community due to the chemical oxidizer used for the injections and it would involve the most off-site transportation of waste.

TABLES

TABLE 1 Alternative No. 2- No Further Action with Site Management Plan		
Description	**Quantity**	**Cost (estimated)**
ESTIMATED COST FOR YEAR 0-1		
Prepare Site Management Plan	1 plan	$3,000
Site ALTA Survey for environmental easement	1 event	$12,000
Legal fees for the protection of an environmental easement (estimated)	1	$600
Average annual cost to prepare periodic certification required by easement ($150/yr)	1	$150
Closure of interior drains	1 lump sum	$5000
Vapor Intrusion Evaluation as part of SMP	1 event	$12,000
Monitored Natural Attenuation- Bi-Annual ($5600/sampling event)	2 events	$11,200
TOTAL		**$43,950**
ESTIMATED COST FOR YEARS 1-5		
Monitored Natural Attenuation- Bi-Annual for Year 1 and Annual for Years 3-5 ($5600/sampling event)	5	$28,000
Average annual cost to prepare periodic certification required by easement ($150/yr)	4	$600
TOTAL		**$28,600**
ESTIMATED COST FOR YEARS 5-30		
Monitored Natural Attenuation- Sample once every 5 years ($5600/sampling event)	5	$28,000
Average annual cost to prepare periodic certification required by easement ($150/yr)	25	$3,750
Well Abandonment	1 event	$13,000
TOTAL		**$44,750**

TABLE 2 Alternative No. 3 - In-situ Chemical Oxidation		
Description	**Quantity**	**Cost (estimated)**
ESTIMATED COST FOR YEARS 0-1		
Pilot Test Study	1 lump sum	$10,000
Staff prep time ($50/hr)	4 hours	$200
Staff on-site labor ($50/hr)	40 hours	$2,000
Senior staff oversight ($80/hr)	10 hours	$800
Sodium Permanganate Injections (include 2 events, installation of 11 additional injection points, assumes treatment of 168,750 ft² area, 100,100 pounds of Sodium Permanganate)	lump sum	$793,290
PID, 2 required ($150/week)	1 week	$150
CAMP air monitoring equipment ($840/week)	1 week	$840
Field Equipment/PPE ($500/week)	1 week	$500
Monitored Natural Attenuation- Bi-Annual ($5600/sampling event)	2 events	$11,200
Prepare Site Management Plan	1 plan	$3,000
Vapor Intrusion Evaluation as part of SMP	1 event	$12,000
Average annual cost to prepare periodic certification required by easement ($150/yr)	1	$150
Site ALTA Survey for environmental easement	1 event	$12,000
Legal fees for the protection of an environmental easement	Estimated	$600
Closure of interior drains	lump sum	$5,000
TOTAL		**$851,730**
ESTIMATED COST FOR YEARS 1-2		
Monitored Natural Attenuation- Bi-Annual ($5600/sampling event)	2	$11,200
Average annual cost to prepare periodic certification required by easement ($150/yr)	1	$150
TOTAL		**$11,350**
ESTIMATED COST FOR YEARS 2-5		
Monitored Natural Attenuation- Annual ($5600/sampling event)	3	$16,800
Average annual cost to prepare periodic certification required by easement ($150/yr)	3	$450
TOTAL		**$17,250**
ESTIMATED COST FOR YEARS 5-30		
Monitored Natural Attenuation- Sample once every 5 years ($5600/sampling event)	5	$28,000
Well Abandonment	1 event	$13,000
Average annual cost to prepare periodic certification required by easement ($150/yr)	25	$3,750
TOTAL		**$44,750**

TABLE 3 Alternative No. 4: In-situ Bioremediation		
Description	**Quantity**	**Cost (estimated)**
ESTIMATED COST FOR YEAR 0-1		
Staff prep time ($50/hr)	8 hours	$400
Staff on-site labor ($50/hr)	80 hours	$4,000
Senior staff oversight ($80/hr)	20 hours	$1,600
HRC-3D Injections (include 2 injection events,, assumes treatment of 168,750 ft² and 45,000 pounds of 3D Microemulsions)	1 lump sum	$221,510
PID, 2 required ($150/week)	2 weeks	$300
CAMP air monitoring equipment ($840/week)	2 weeks	$1680
Field Equipment/PPE ($500/week)	2 weeks	$1,000
Monitored Natural Attenuation- Bi-Annual ($5600/sampling event)	2 events	$11,200
Prepare Site Management Plan	1 plan	$3,000
Vapor Intrusion Evaluation as part of SMP	1 event	$12,000
Average annual cost to prepare periodic certification required by easement ($150/yr)	1	$150
Site ALTA Survey for environmental easement	1 event	$12,000
Legal fees for the protection of an environmental easement	Estimated	$600
Closure of interior drains	1 lump sum	$5000
TOTAL		**$274,440**
ESTIMATED COST FOR YEAR 1-2		
Monitored Natural Attenuation- Bi-Annual ($5600/sampling event)	2	$11,200
Average annual cost to prepare periodic certification required by easement ($150/yr)	1	$150
TOTAL		**$11,350**
ESTIMATED COST FOR YEARS 2-5		
Monitored Natural Attenuation- Annual ($5600/sampling event)	3	$16,800
Average annual cost to prepare periodic certification required by easement ($150/yr)	3	$450
TOTAL		**$17,250**
ESTIMATED COST FOR YEARS 5-30		
Monitored Natural Attenuation- Sample once every 5 years ($5600/sampling event)	5	$28,000
Well Abandonment	1 event	$13,000
Average annual cost to prepare periodic certification required by easement ($150/yr)	25	$3,750
TOTAL		**$44,750**

TABLE 4 Alternative No. 5: Electrical Reductive Heating		
Description	**Quantity**	**Cost (estimated)**
ESTIMATED COST FOR YEAR 0-1		
Staff prep time ($50/hr)	4 hours	$200
Staff on-site labor ($50/hr)	40 hours	$2,000
Senior staff oversight ($80/hr)	10 hours	$800
Electrical Resistance Heating, including the placement of 98 ERH probes and power source leasing	lump sum (6 month lease)	$3,366,230
PID, 2 required ($150/week)	1 week	$150
CAMP air monitoring equipment ($840/week)	1 week	$840
Field Equipment/PPE ($500/week)	1 week	$500
Monitored Natural Attenuation- Bi-Annual ($5600/sampling event)	2 events	$11,200
Prepare Site Management Plan	1 plan	$3,000
Vapor Intrusion Evaluation as part of SMP	1 event	$12,000
Average annual cost to prepare periodic certification required by easement ($150/yr)	1	$150
Site ALTA Survey for environmental easement	1 event	$12,000
Legal fees for the protection of an environmental easement	Estimated	$600
Closure of interior drains	1 lump sum	$5000
TOTAL		**$3,414,670**
ESTIMATED COST FOR YEAR 1-2		
Monitored Natural Attenuation- Bi-Annual ($5600/sampling event)	2	$11,200
Average annual cost to prepare periodic certification required by easement ($150/yr)	1	$150
TOTAL		**$11,350**
ESTIMATED COST FOR YEARS 2-5		
Monitored Natural Attenuation- Annual ($5600/sampling event)	3	$16,800
Average annual cost to prepare periodic certification required by easement ($150/yr)	3	$450
TOTAL		**$17,250**
ESTIMATE COST FOR YEARS 5-30		
Monitored Natural Attenuation- Sample once every 5 years ($5600/sampling event)	5	$28,000
Well Abandonment	1 event	$13,000
Average annual cost to prepare periodic certification required by easement ($150/yr)	25	$3,750
TOTAL		**$44,750**

TABLE 5 Alternative No. 1- Capping of Stormwater Infiltration Basin		
Description	**Quantity**	**Cost (estimated)**
ESTIMATED COST FOR YEAR 0-1		
Subcontractor Costs (includes labor, equipment for excavation, soil and liner placement)	Lump sum	$35,000
Staff prep time ($50/hr)	5 hours	$250
Staff on-site labor ($50/hr)	80 hours	$4,000
Senior staff oversight ($80/hr)	10 hours	$800
PID, 2 required ($150/week)	1 week	$150
CAMP air monitoring equipment ($840/week)	1 week	$840
Field Equipment/PPE ($500/week)	1 week	$500
Confirmatory soil samples of clean backfill (VOCs, SVOCs, TAL Metals, PCBs, Pesticides - $450/sample)	Estimated 10 samples	$4,500
Annual Inspection of Cap including Report ($1200/inspection)	1 event	$1200
Site Management Plan included in the cost of the GW/Soil Alternatives (Tables 1-4)	1 plan	NA
TOTAL		**$47,240**
ESTIMATED COST FOR YEARS 1-5		
Annual Inspection of Cap including Report ($1200/inspection)	4	$4,800
TOTAL		**$4,800**
ESTIMATED COST FOR YEARS 5-30		
Annual Inspection of Cap including Report ($1200/inspection)	25	$30,000
TOTAL		**$30,000**

TABLE 6 Alternative No. 2- Focused Excavation of Soil from Stormwater Infiltration Basin		
Description	**Quantity**	**Cost (estimated)**
ESTIMATED COST FOR YEAR 0-1		
Subcontractor costs including excavation, transportation and disposal (assumes 105 tons of impacted soil will be removed and replaced.	lump sum	$25,222
Staff prep time ($50/hr)	2 hours	$100
Staff on-site labor ($50/hr)	40 hours	$2,000
Senior staff oversight ($80/hr)	10 hours	$800
PID, 2 required ($200/wk)	1 week	$200
CAMP Air monitoring equipment ($840/wk)	1 week	$840
Field Equipment/PPE ($500/week)	1 week	$500
Confirmatory soil samples from excavation (VOCs, TAL Metals, Pesticides - $300/sample)	Estimated 20 samples	$6,000
Confirmatory soil samples of clean backfill (VOCs, SVOCs, TAL Metals, PCBs, Pesticides - $450/sample)	Estimated 2 samples	$900
Waste Characterization Samples (VOCs, SVOCs, TCLP RCRA 8 Metals, DRO, GRO- $425/sample)	Estimated 3 samples	$1,275
Site Management Plan included in the cost of the GW/Soil Alternatives (Tables 1-4)	1 plan	NA
TOTAL		**$37,837**
ESTIMATED COST FOR YEARS 1-30		
TOTAL		**$0**

TABLE 7 Alternative No. 3- Extensive Excavation of Soil from Stormwater Infiltration Basin		
Description	**Quantity**	**Cost (estimated)**
ESTIMATED COST FOR YEAR 0-1		
Subcontractor costs including excavation and T & D (assumes 2,200 tons of soils will be removed and replaced)	lump sum	$265,700
Staff prep time ($50/hr)	6 hours	$300
Staff on-site labor ($50/hr)	80 hours	$4,000
Senior staff oversight ($80/hr)	10 hours	$800
PID, 2 required ($200/wk)	2 weeks	$400
CAMP Air monitoring equipment ($840/wk)	2 weeks	$1,680
Field Equipment/PPE ($500/week)	2 weeks	$1,000
Confirmatory soil samples from excavation (VOCs, TAL Metals, Pesticides - $300/sample)	Estimated 30 samples	$8,400
Confirmatory soil samples of clean backfill (VOCs, SVOCs, TAL Metals, PCBs, Pesticides - $450/sample)	Estimated 5 samples	$2,250
Waste Characterization Samples (VOCs, SVOCs, TCLP RCRA 8 Metals, DRO, GRO- $425/sample)	Estimated 5 samples	$2,125
Site Management Plan included in the cost of the GW/Soil Alternatives (Tables 2-6)	1 plan	NA
TOTAL		**$286,655**
ESTIMATED COST FOR YEARS 1-30		
TOTAL		**$0**

TABLE 8 Alternative for Restoration to Pre-Disposal Conditions		
Description	**Quantity**	**Cost (estimated)**
ESTIMATED COST FOR YEAR 0-1		
Soils		
Subcontractor Costs for Soil Excavation and Disposal (includes labor, equipment, soil, transportation and disposal, backfill, and appropriate restoration)	Lump sum	$54,100
Staff prep time ($50/hr)	6 hours	$300
Staff on-site labor ($50/hr)	40 hours	$2,000
Senior staff oversight ($80/hr)	5 hours	$400
PID, 2 required ($200/wk)	1 week	$200
CAMP air monitoring equipment ($840/wk)	1 week	$840
Field Equipment/PPE ($500/week)	1 week	$500
Confirmatory soil samples from excavation (VOCs. TAL Metals, Pesticides - $300/sample)	Estimated 25 samples	$7,500
Confirmatory soil samples of clean backfill (VOCs, SVOCs, TAL Metals, PCBs, Pesticide.0s - $450/sample)	Estimated 2 samples	$900
Waste Characterization Samples (VOCs, SVOCs, TCLP RCRA 8 Metals, DRO, GRO- $425/sample)	Estimated 2 sample	$850
Groundwater		
Pilot Test Study	1 lump sum	$10,000
Staff prep time ($50/hr)	20 hours	$1,000
Staff on-site labor ($50/hr)	160 hours	$8,000
Senior staff oversight ($80/hr)	30 hours	$64,000
Sodium Permanganate Injections to Overburden and Bedrock Groundwater (include 2 events, installation of 11 additional injection points, assumes treatment of 168,750 ft^2 and 800,935 pounds of Sodium Permanganate)	lump sum	$3,162,130
PID, 2 required ($150/week)	4 weeks	$600
CAMP air monitoring equipment ($840/week)	4 weeks	$3,360
Field Equipment/PPE ($500/week)	4 weeks	$2,000
Soils in Stormwater Infiltration Basin		
Subcontractor costs including excavation and T & D (assumes 2,200 tons of soils will be removed and replaced)	lump sum	$265,700
Staff prep time ($50/hr)	6 hours	$300
Staff on-site labor ($50/hr)	80 hours	$4,000
Senior staff oversight ($80/hr)	10 hours	$800
PID, 2 required ($200/wk)	2 weeks	$400
CAMP Air monitoring equipment ($840/wk)	2 weeks	$1,680
Field Equipment/PPE ($500/week)	2 weeks	$1,000

TABLE 8 Alternative for Restoration to Pre-Disposal Conditions		
Description	**Description**	**Description**
Confirmatory soil samples from excavation (VOCs, TAL Metals, Pesticides - $300/sample)	Estimated 30 samples	$8,400
Confirmatory soil samples of clean backfill (VOCs, SVOCs, TAL Metals, PCBs, Pesticides - $450/sample)	Estimated 5 samples	$2,250
Waste Characterization Samples (VOCs, SVOCs, TCLP RCRA 8 Metals, DRO, GRO- $425/sample)	Estimated 5 samples	$2,125
TOTAL		**$3,605,335**
ESTIMATED COST FOR YEARS 1-30		
TOTAL		**$0**

FIGURES

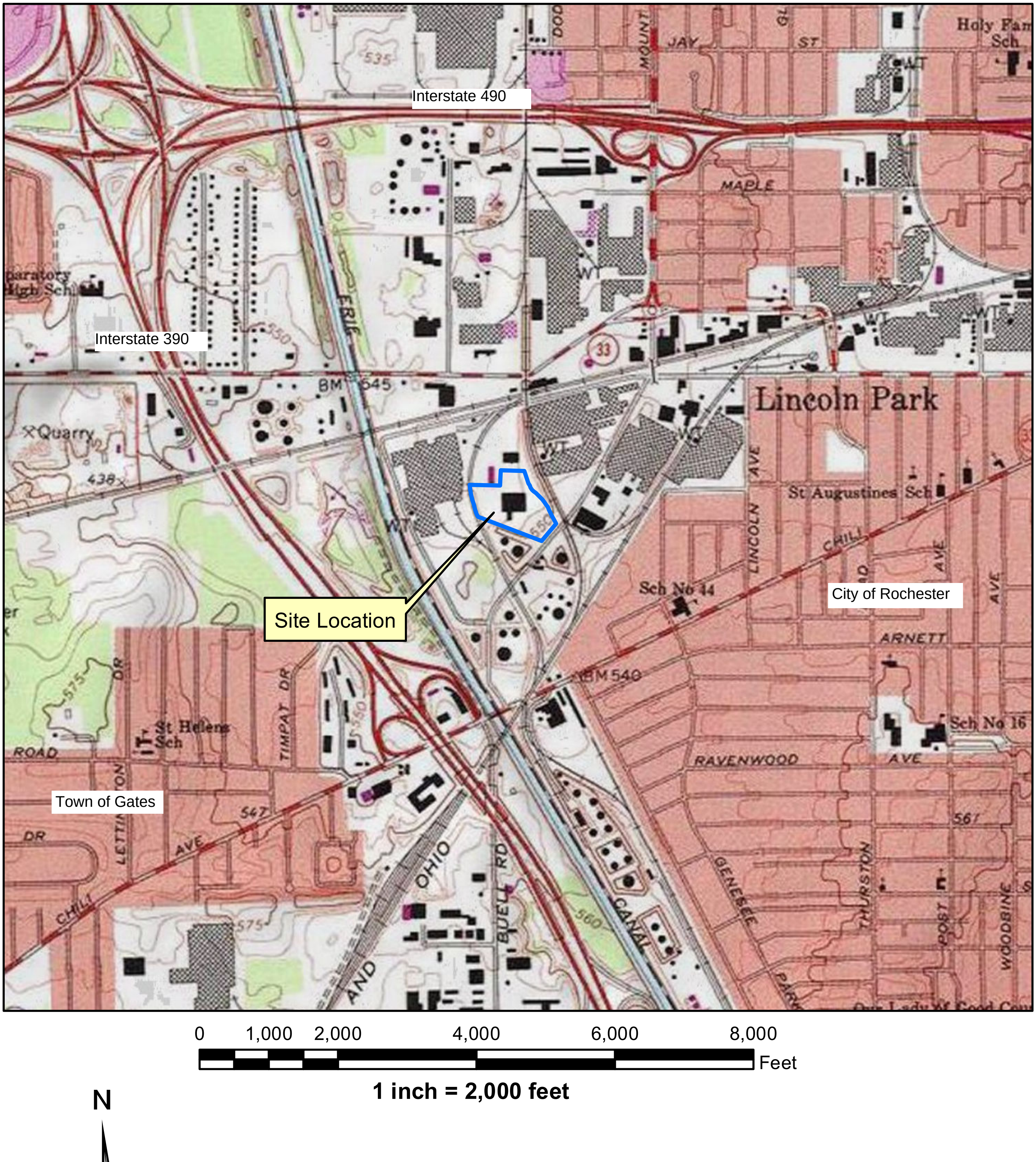

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Figure 1
Site Location Map
Barthelmes Manufacturing
15 Cairn Street
Rochester, New York
HRP # NEW9624.P2
Scale 1" = 2,000'

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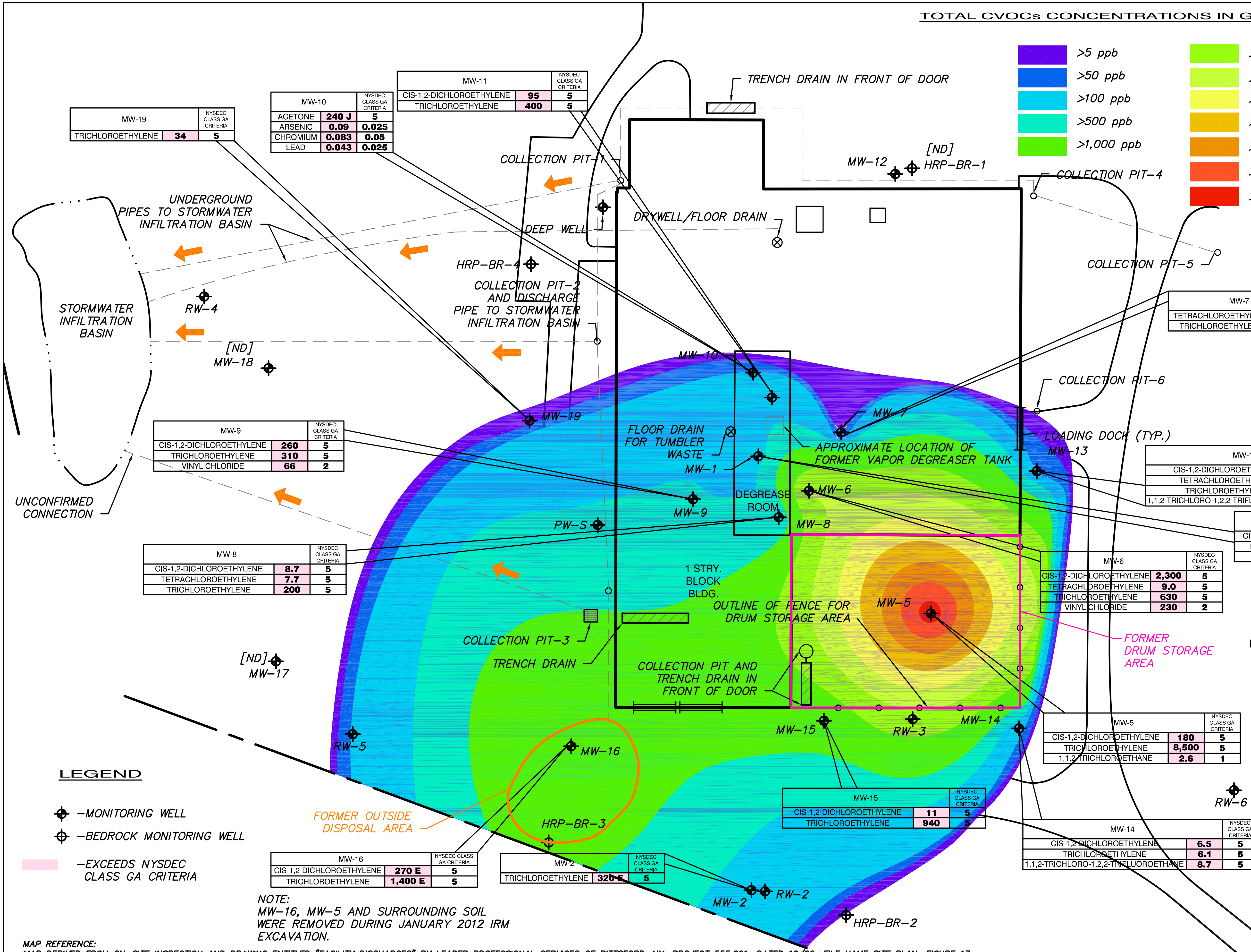

FIGURE 2
OCTOBER 2011
TOTAL GROUNDWATER CVOC CONCENTRATIONS
BARTHELMES MANUFACTURING SITE
15 CAIRN STREET
ROCHESTER, NEW YORK
HRP # NEW9624.P2
SITE ID: 828122
NOT TO SCALE

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S:\Data\N\NEWEN - NY STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION\BARTHELMES - 15 CAIRN STREET, ROCHESTER\NEW9624P2\CAD\FIGURE 2 - OC
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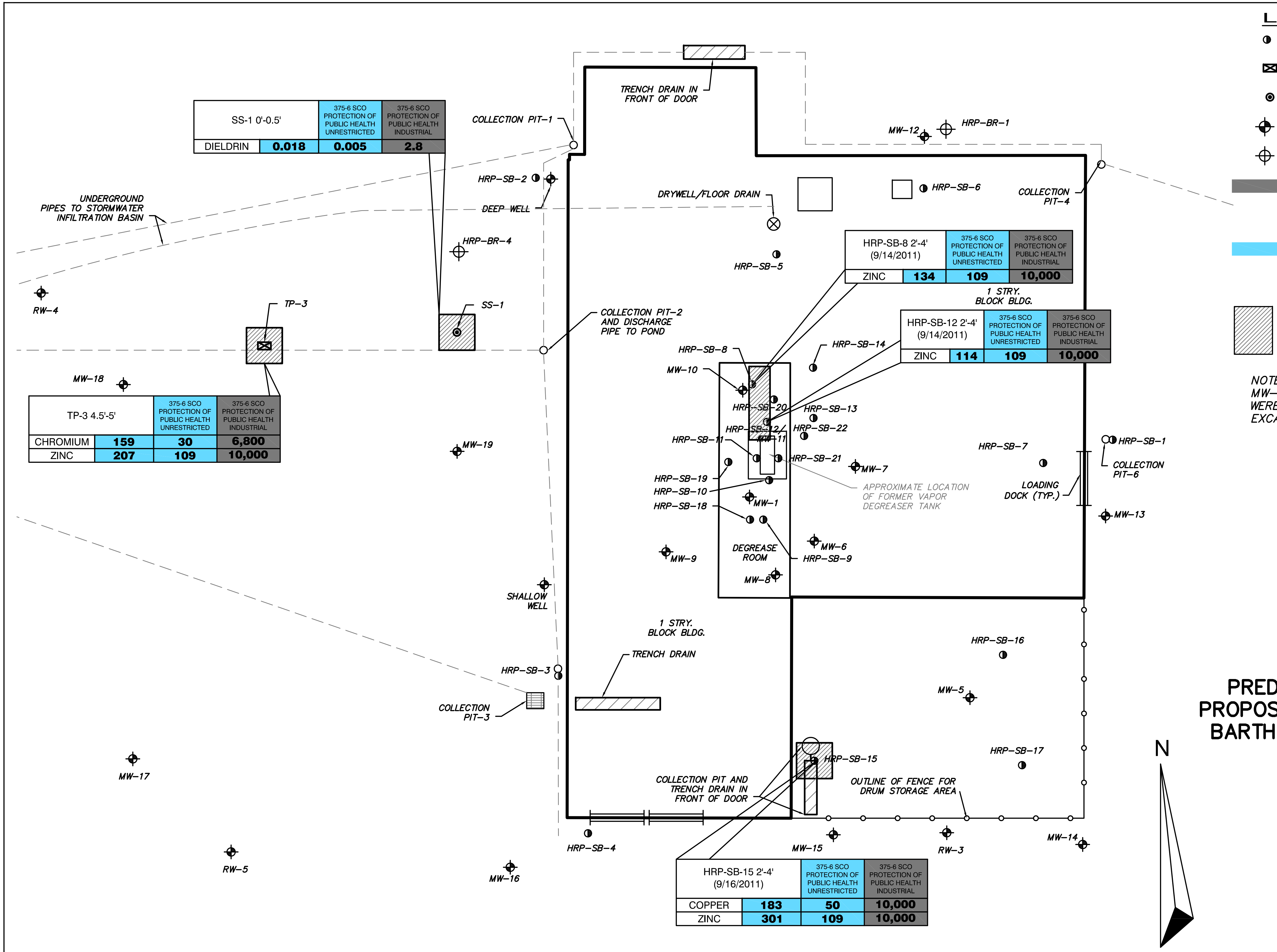

SS-1 0'-0.5'		375-6 SCO PROTECTION OF PUBLIC HEALTH UNRESTRICTED	375-6 SCO PROTECTION OF PUBLIC HEALTH INDUSTRIAL
DIELDRIN	0.018	0.005	2.8

TP-3 4.5'-5'		375-6 SCO PROTECTION OF PUBLIC HEALTH UNRESTRICTED	375-6 SCO PROTECTION OF PUBLIC HEALTH INDUSTRIAL
CHROMIUM	159	30	6,800
ZINC	207	109	10,000

HRP-SB-8 2'-4' (9/14/2011)		375-6 SCO PROTECTION OF PUBLIC HEALTH UNRESTRICTED	375-6 SCO PROTECTION OF PUBLIC HEALTH INDUSTRIAL
ZINC	134	109	10,000

HRP-SB-12 2'-4' (9/14/2011)		375-6 SCO PROTECTION OF PUBLIC HEALTH UNRESTRICTED	375-6 SCO PROTECTION OF PUBLIC HEALTH INDUSTRIAL
ZINC	114	109	10,000

HRP-SB-15 2'-4' (9/16/2011)		375-6 SCO PROTECTION OF PUBLIC HEALTH UNRESTRICTED	375-6 SCO PROTECTION OF PUBLIC HEALTH INDUSTRIAL
COPPER	183	50	10,000
ZINC	301	109	10,000

LEGEND

- HRP SOIL BORING
- TEST PIT
- SURFACE SOIL SAMPLE
- MONITORING WELL
- BEDROCK MONITORING WELL
- EXCEEDS 375-6 SCO – PROTECTION OF PUBLIC HEALTH INDUSTRIAL
- EXCEEDS 375-6 SCO – PROTECTION OF PUBLIC HEALTH – UNRESTRICTED (SOIL IN PPM)
- PROPOSED EXCAVATION AREA

NOTE:
MW-16, MW-5 AND SURROUNDING SOIL WERE REMOVED DURING JANUARY 2012 IRM EXCAVATION.

FIGURE 3
RESTORATION TO PREDISPOSAL CONDITIONS – PROPOSED EXCAVATION AREAS
BARTHELMES MANUFACTURING
15 CAIRN STREET
ROCHESTER, NEW YORK
HRP # NEW9624.P2
NOT TO SCALE

MAP REFERENCE:
MAP DERIVED FROM ON-SITE INSPECTION AND DRAWING ENTITLED "FACILITY DISCHARGES" BY LEADER PROFESSIONAL SERVICES OF PITTSFORD, NY; PROJECT 555.001; DATED 10/06; FILE NAME SITE PLAN; FIGURE 17.

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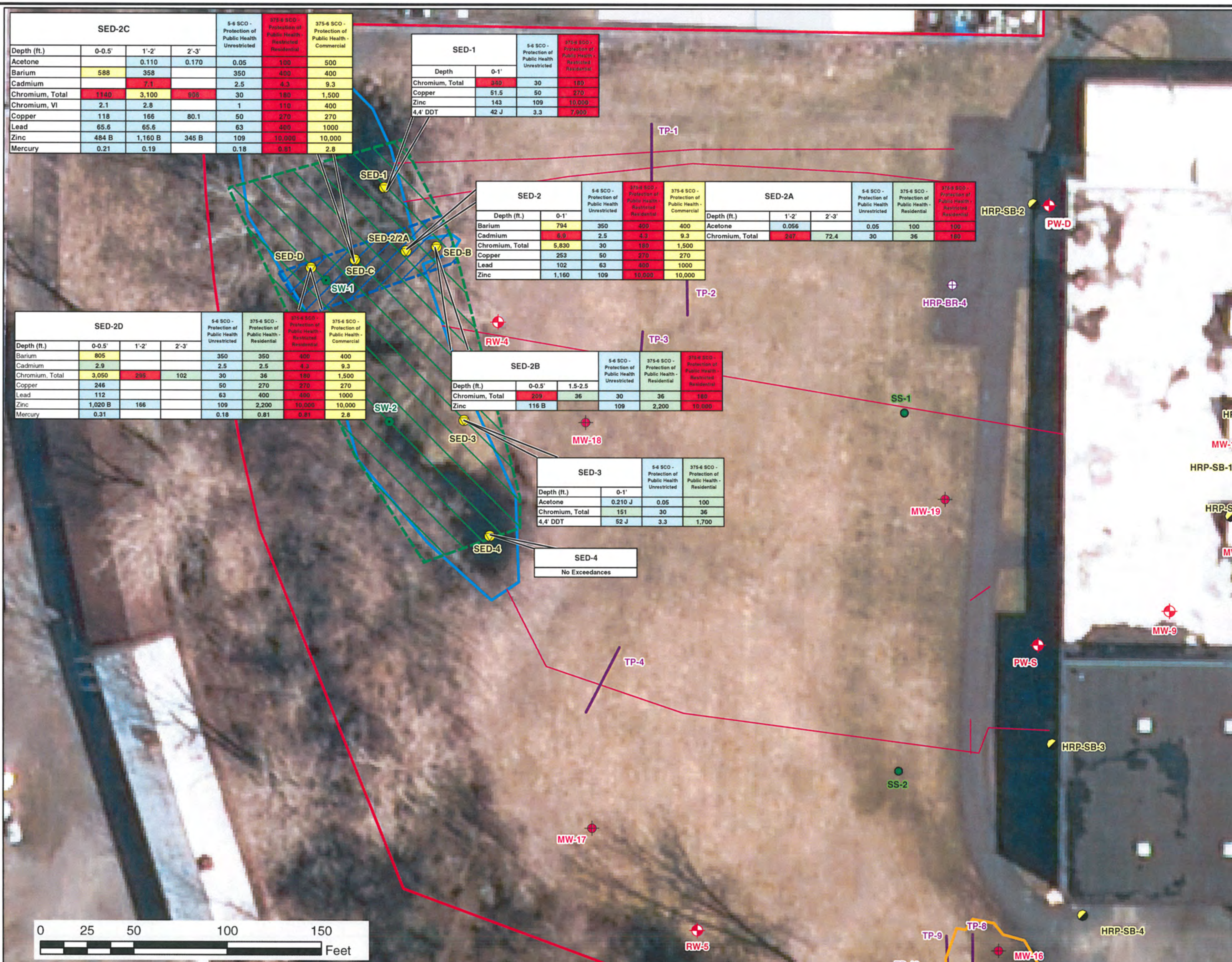
Path: \\HRP_FS1\Temporary\DML\Barthelmes Figures\FS Figures\Fig 4 - Proposed Excavation Area For SW Infiltration Basin.mxd



SED-2C				5-6 SCO - Protection of Public Health Unrestricted	375-6 SCO - Protection of Public Health - Restricted Residential	375-6 SCO - Protection of Public Health - Commercial
Depth (ft.)	0-0.5'	1'-2'	2'-3'			
Acetone		0.110	0.170	0.05	100	500
Barium	588	358		350	400	400
Cadmium		7.1		2.5	4.3	9.3
Chromium, Total	1140	3,100	906	30	180	1,500
Chromium, VI	2.1	2.8		1	110	400
Copper	118	166	80.1	50	270	270
Lead	65.6	65.6		63	400	1000
Zinc	484 B	1,160 B	345 B	109	10,000	10,000
Mercury	0.21	0.19		0.18	0.81	2.8

SED-1		5-6 SCO - Protection of Public Health Unrestricted	375-6 SCO - Protection of Public Health - Restricted Residential
Depth	0-1'		
Chromium, Total	340	30	180
Copper	51.5	50	270
Zinc	143	109	10,000
4,4' DDT	42 J	3.3	7,900

SED-2		5-6 SCO - Protection of Public Health Unrestricted	375-6 SCO - Protection of Public Health - Restricted Residential	375-6 SCO - Protection of Public Health - Commercial
Depth (ft.)	0-1'			
Barium	794	350	400	400
Cadmium	6.9	2.5	4.3	9.3
Chromium, Total	5,830	30	180	1,500
Copper	253	50	270	270
Lead	102	63	400	1000
Zinc	1,160	109	10,000	10,000

SED-2A			5-6 SCO - Protection of Public Health Unrestricted	375-6 SCO - Protection of Public Health - Residential	375-6 SCO - Protection of Public Health - Restricted Residential
Depth (ft.)	1'-2'	2'-3'			
Acetone	0.056		0.05	100	100
Chromium, Total	247	72.4	30	36	180

SED-2D				5-6 SCO - Protection of Public Health Unrestricted	375-6 SCO - Protection of Public Health - Residential	375-6 SCO - Protection of Public Health - Restricted Residential	375-6 SCO - Protection of Public Health - Commercial
Depth (ft.)	0-0.5'	1'-2'	2'-3'				
Barium	805			350	350	400	400
Cadmium	2.9			2.5	2.5	4.3	9.3
Chromium, Total	3,050	295	102	30	36	180	1,500
Copper	246			50	270	270	270
Lead	112			63	400	400	1000
Zinc	1,020 B	166		109	2,200	10,000	10,000
Mercury	0.31			0.18	0.81	0.81	2.8

SED-2B			5-6 SCO - Protection of Public Health Unrestricted	375-6 SCO - Protection of Public Health - Residential	375-6 SCO - Protection of Public Health - Restricted Residential
Depth (ft.)	0-0.5'	1.5-2.5			
Chromium, Total	209	36	30	36	180
Zinc	116 B		109	2,200	10,000

SED-3		5-6 SCO - Protection of Public Health Unrestricted	375-6 SCO - Protection of Public Health - Residential
Depth (ft.)	0-1'		
Acetone	0.210 J	0.05	100
Chromium, Total	151	30	36
4,4' DDT	52 J	3.3	1,700

SED-4
No Exceedances

Legend

- HRP Bedrock Well
- Surficial Soil Sample
- Surface Water Sample
- Soil Sample
- Extensive Excavation Area
- Limited Excavation Area
- Exceeds Public Health Restricted Residential
- Exceeds Public Health Residential
- Exceeds Public Health Industrial
- Exceeds Public Health Commercial
- Exceeds Public Health Unrestricted
- IRM Excavation (approx.)
- Overburden Monitoring Well
- Monitoring well
- Test Boring
- Test Pit
- Piping (approx.)
- Soil Pile
- Stormwater Infiltration Basin

Figure 4
Proposed Excavation Area for Stormwater Infiltration Basin
Barthelmes Manufacturing
15 Cairn Street
Rochester, New York
HRP # NEW9624.P2
Site ID: 828112
Scale 1" = 50'

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