REMEDIAL ACTION WORK PLAN

ANDERSON CLEANERS SITE
5 HUNT ROAD
JAMESTOWN, NEW YORK
NYSDEC BROWNFIELD CLEANUP PROGRAM
SITE #C907027

Prepared For: Anderson Cleaners, Inc.
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1.0 INTRODUCTION

Anderson Cleaners, Inc. (Anderson Cleaners) and Mr. Michael K. Lyons entered the Brownfield Cleanup Program (BCP) administered by the New York State Department of Environmental Conservation (NYSDEC) in 2005.

Anderson Cleaners is located at 5 Hunt Road, Jamestown, New York (the Site) and the Site is identified as BCP Site #C907027. Anderson Cleaners retained Day Environmental, Inc. (DAY) to prepare this Remedial Action Work Plan (RAWP), which describes the methods proposed for the long-term remediation of the Site

1.1 Background

The Site consists of approximately 2.4 acres of land located partially in the City of Jamestown and partially in the Town of Ellicott, New York. The Site is designated as Section Block and Lot numbers 504-01-001, 504-01-002, and 504-01-003 (Jamestown); and 32-1-1 and 32-1-11 (Ellicott). A Project Locus Map is presented as Figure 1, and a Site Plan is presented as Figure 2.

The Site is currently improved by an approximate 11,400-square foot, one-story brick and concrete block building. The building was constructed in phases with the southwest portion constructed in the 1930s; the south-central portion constructed in 1947; and the northern and eastern portions constructed in 1985.

The first record of development on the Site was a building constructed and used as a towel factory in the 1930s. By the mid-1940s, Anderson Cleaners occupied the Site and operated a dry cleaning business. The building was expanded over the years. In 1985, a fire destroyed the northern and eastern portions (approximately 8,000 square feet) of the building. This fire did not directly impact the portion of the building that housed the dry cleaning operations; however, the heat from the fire may have damaged containers of dry cleaning fluid resulting in spillage. It is also possible that the water used to fight the fire flushed residual solvent that may have spilled onto the concrete floor into the subsurface. Following the fire, reconstruction/remodeling operations were undertaken resulting in the current structure.

Reportedly, Stoddard Solvent was used for dry cleaning operations from approximately 1947 to 1978. The use of Stoddard Solvent was discontinued in about 1978 when tetrachloroethene (also known as perchloroethene or PCE) was first used as the primary dry cleaning agent. In 2002, new dry cleaning equipment that used hydrocarbon-based solvent DF 2000 was installed, and use of PCE at the Site was discontinued.

DAY completed a report titled *Remedial Investigation/Remedial Alternatives Analysis Report* dated March 2011, revised July 2011 (the RI/AAR report). This report summarizes studies previously conducted at the Site, presents the results of Remedial Investigation (RI), soil removal Interim Remedial Measure (IRM), and various remedial alternatives proposed to address contaminant impact identified at the Site. The RI/AAR report also identified the contaminants of concern (COC) at the Site, and these include:

- Dense Non-Aqueous Phase Liquid (DNAPL), or undissolved PCE, that acts as a source material for the following breakdown products detected within the groundwater at the Site:

  - PCE;
  - trichloroethene (TCE);
  - 1,1-dichloroethene (1,1 DCE);
  - trans-1, 2-dichloroethene (trans-1, 2 DCE);
  - cis-1, 2-dichloroethene (cis-1,2 DCE); and
  - vinyl chloride (VC).

The NYSDEC approved the RI/AAR on February 15, 2012 and issued a Decision Document dated January 2012 (the Decision Document), which specifies the maintenance of a site cover, the continued commercial use of the Site, and the implementation of a staged remediation program. The most aggressive and immediate measures of the remedial program are to be implemented first, and this program includes the following stages.

- DNAPL Extraction, which is intended to physically remove undissolved PCE that serves as a source material for dissolved phase PCE and associated breakdown products that migrate through the groundwater, and potentially other media.

- Plume Containment will be completed in conjunction with the DNAPL Extraction, and will be designed to preclude off-site contaminant migration of COC.

- Chemical Oxidation will be used as a polishing step (as deemed necessary) after DNAPL is extracted to the extent possible to remove the PCE source.

- In-Situ Bioremediation will be initiated (to the extent deemed necessary) when the DNAPL source zone is adequately addressed by the DNAPL removal remedy, and will consist of biostimualtion to promote the growth of *Dehalococcodies* microbes, and potentially bioaugmentation to add commercially produced *Dehalococcodies* microbes.

In conjunction with the remediation, an institutional control, in the form of an environmental easement, will be required to:

- Limit the use of the Site for commercial and industrial usage, as warranted by local zoning laws;

- restrict groundwater as a source of potable and process water, without treatment;

- prohibit agricultural or vegetable gardens; and

- comply with the requirements of a Site Management Plan (SMP) to be developed following conclusion of the DNAPL Extraction and Plume Containment system start-up periods.

1.2 Purpose

The purpose of this RAWP is to provide guidelines for the extraction of DNAPL from the subsurface at the Site, and the prevention of off-site migration of COC. The DNAPL Extraction and Plume Containment described in this document are the initial steps in the remedial process required for the Site. The need for, and the extent of, additional treatment required (e.g., chemical oxidation, in-situ bioremediation, vapor mitigation, etc.) during subsequent remedial phases are dependent on the results of the DNAPL Extraction and Plume Containment remedies. This RAWP provides detailed information pertaining to the design requirements of the DNAPL Extraction and Plume Containment systems. Addendums to this RAWP will be developed and submitted as the level of effort for additional remedial measures are determined.

1.3 Health and Safety Plan and Operations & Maintenance Manual

A copy of the site-specific Health and Safety Plan (HASP) that includes the requirements for a Community Air Monitoring Program (CAMP) is included in Appendix A. These plans will be implemented during completion of RAWP activities that have the potential to encounter/release COC. A copy of the Operations & Maintenance (O&M) manual for the DNAPL Extraction and Treatment System described in Section 2.0 of this document is included in Appendix B.

2.0 DNAPL REMOVAL

The DNAPL Extraction remedy is an initial remedial component that will be implemented at the Site, and it consists of a DNAPL removal phase that includes treatment of impacted groundwater removed with the DNAPL, to potentially be followed by an in-situ chemical oxidation-polishing phase. The need for, and details associated with, the chemical oxidation stage will be addressed at a later date (see Section 2.2). The purpose of this section is to present information related to the engineering design and operation of the DNAPL Extraction and Treatment System, including associated equipment and processes.

2.1 DNAPL Extraction

This section describes the various elements of the construction and start-up of the DNAPL Extraction and Treatment System that will be constructed at the Site.

2.1.1 Extraction Well Field

Based on the available data, and considering the area of required treatment, it is anticipated that operation of three to four extraction wells will effectively capture, contain and remove the DNAPL within the presumed extent of DNAPL presented on Figure 2. These wells will include two 4-inch diameter, one 2-inch and one 1-inch diameter overburden DNAPL Extraction wells. Extraction operations at these wells will be performed at a rate deemed necessary to efficiently collect DNAPL.

Conversion of Existing Monitoring Wells

Two existing monitoring wells, MW-207 and PW-3, in which DNAPL has been observed/removed during previous studies, will be modified and converted into DNAPL extraction wells. Specifically, the below-grade well cap or well riser of interior monitoring well PW-3 (a 1-inch diameter monitoring well) will be modified to accept an approximate 5/8-inch diameter pump suction hose that will terminate at the bottom of the well. A check value installed at the end of the pump suction hose will prevent back draining of the treatment system transfer hoses and header into PW-3. The PW-3 air-operated extraction pump will be staged on the floor adjacent to an interior wall. The pump suction hose will run below the floor to the PW-3 wellhead. The PW-3 pump effluent hose will be secured to the building's wall, and will discharge into the gravity separator tank located in the garage area of the Anderson Cleaners building.

Exterior monitoring well MW-207 (a 4-inch diameter monitoring well) will be modified by cutting an approximate 3/4–inch hole in the well riser at, or below, the ground surface and installing suction tubing. The exterior portion of the MW-207 suction tubing will extend from the well and terminate inside the garage of the Anderson Cleaners building where the pump will be located. The MW-207 suction tubing will be fitted with a coarse sediment strainer at the end of the suction line to prevent coarse sediments from passing through the downstream DNAPL Extraction and Treatment System components and accumulating in the gravity separation tank. The MW-207 pump effluent hose will be secured to the southern and western walls of the

garage, and will discharge into the gravity separator tank. The construction details for the interior and exterior DNAPL Extraction wells are presented on Figure 3.

New Extraction Well Installation

In addition to converting monitoring wells MW-207 and PW-3 to extraction wells, two additional overburden groundwater wells will be installed (i.e., designated EW-1 and EW-2).

- Extraction Well EW-1 (a 4-inch diameter well) will be positioned within the garage area northwest of former well WP-1, and near the mid-point between PW-3 and MW-207

- Extraction Well EW-2 (a 2-inch diameter well) will be positioned adjacent to existing fractured bedrock groundwater monitoring well BR-02 FR

The precise locations of extraction wells EW-1 and EW-2 will be determined in the field, and will be dependent upon access limitations, buried utilities, etc. The boreholes for these extraction wells will be advanced into the glacial till layer that occurs at an anticipated depth of about 12 feet to 16 feet (ft.) below the ground surface (bgs). Based on previous studies, the glacial till zone at the Site appears to be the maximum depth to which the DNAPL has migrated.

A subcontractor will be retained to provide a rotary drill-rig, crew and materials to install the DNAPL Extraction wells. The wells will be drilled using hollow stem augers (HSA) to advance the borings, and samples will collected ahead of the HSA, if possible, to evaluate soil types and the presence of contamination.

Each extraction well will be constructed of PVC riser connected to five ft. of flush-coupled, No. 10 slot stainless steel screen. The well screen will be installed near the bottom of the overburden borehole. The well screens will be surrounded by a sand pack extending two ft. above the top of the screen. A minimum two-foot thick bentonite seal will follow the sand pack, with cement/grout above the bentonite seal extending to at least one-foot below grade.

Following installation and development, air-diaphragm pumps will be installed. Drawings and diagrams showing the typical extraction well and monitoring well equipment and installation details are included on Figure 3.

Information recorded during the advancement of the new DNAPL Extraction wells will include:

- Date, boring identification, and project identification.
- Name of individual developing the log.
- Name of drilling company.
- Drill rig make and model.
- Identification of any alternative drilling methods used.
- Depths recorded in feet and fractions thereof (tenths of feet) referenced to ground surface.
- The length of the sample interval and percentage of sample recovered.
- The depth of the first encountered water table, along with the method of determination, referenced to the ground surface.

- Drilling and borehole characteristics.
- Sequential stratigraphic boundaries.
- Photoionization Detector (PID) screening results of ambient headspace air above selected samples.

The construction details for Extraction wells EW-1 and EW-2 will be in general accordance with the details presented on Figure 3, and will be similar to the construction details of DNAPL Extraction well PW-3 and DNAPL Extraction well MW-207.

A temporary decontamination pad will be constructed to decontaminate "in-hole" drilling equipment between wells by steam cleaning. The decontamination liquids will be pumped into NYSDOT-approved 55-gallon drums that are labeled and staged on-site in accordance with applicable regulations for future treatment/disposal.

[Note: Extraction wells EW-1 and EW-2 were installed on July 19, 2012 in the locations depicted on Figure 2.]

Extraction Well Development

Approximately one week after well installation, extraction wells EW-1 and EW-2 will be developed to remove sediment that may have accumulated in the wells during installation. Well development will be performed utilizing a combination of bailers and a vacuum purge pump. The well development will continue until the turbidity of the water improves, DNAPL is encountered, and/or stabilized water levels are maintained during development.

2.1.2 Extraction Process

Groundwater levels are sufficiently high to enable the use of aboveground pumps in lieu of submersible well pumps, and as such, air-operated diaphragm pumps (designated E-1 through E-3 on Figure 3) will be used for extraction of groundwater and DNAPL from the wells. Some minimal drawdown of the static water levels in the wells may enhance DNAPL transport and recovery; however, excessive drawdown results in high wastewater flow rates that minimize the effectiveness of the DNAPL separation and reduces the service life of the activated carbon treatment process. To provide maximum flexibility with respect to extraction flow rates, a needle valve and pressure regulator on the air supply to each extraction well pump will be installed to allow fine-tuning of the pump operation as needed. An added benefit of the air diaphragm pumps is that the positive displacement nature of these pumps results in minimal shear and mechanical emulsification, facilitating gravity separation of extracted DNAPL.

Based upon observed site conditions and experience with similar systems, it is anticipated that extraction rates at each well will be 2 gallons per minute (gpm) or less under steady-state conditions. Specifically, when DNAPL was removed as part of the investigation phase of the project using a vacuum purge system, a rate of about 2 gpm was required to draw DNAPL into the well. Thus, a steady-state flow rate of 2 gpm was identified for the extraction wells. [Note: Flexibility has been incorporated into the extraction and treatment system design that will allow for modification of the extraction rates to maximize DNAPL removal from each well.] As such,

the total groundwater flow rate to be generated by the three DNAPL extraction wells is anticipated to be up to 6 gpm. However, the final extraction rates will be determined when the DNAPL Extraction and Treatment System is installed and operational. For contingency purposes, including the potential addition of more extraction wells (if needed), the DNAPL Extraction and Treatment System processes and equipment are designed to handle a continuous flow rate of up to 10 gpm.

Groundwater Treatment and Discharge

Following DNAPL separation and removal, treatment of the extracted groundwater is required to meet sewer permit limits prior to discharge to the sanitary sewer system. At a minimum, the water treatment process will include a lift station, cartridge filtration, carbon filtration, and discharge stages, as described below; however, other elements may be added as necessary to provide for the most cost-effective treatment of the groundwater.

The VOC loadings subsequent to the gravity separator will be dependent upon the steady-state extraction well flow rates and VOC concentrations in groundwater. Once the necessary extraction flow rates and VOC loadings are determined, the potential benefit of additional water treatment stage(s) such as air stripping will be evaluated and incorporated, as warranted.

Gravity Separation Tank

The combined discharge from the extraction well pumps (i.e., DNAPL and groundwater) will be directed into a closed gravity separation tank for DNAPL recovery and removal. The gravity separation tank will have a working capacity of approximately 250 gallons, thus providing a hydraulic detention time of 25 minutes at the system design flow rate of 10 gpm. As the extraction well pumps are positive displacement pumps, the DNAPL will not be sheared or mechanically emulsified when pumped, and the DNAPL is expected to separate relatively quickly by gravity in this tank. The inlet to the separator will be directed into a down comer at one end of the tank, and the top outlet at the opposite end maximizes the residence time and minimizes the potential for short-circuiting. Refer to Figure 4 for gravity separation tank design specifications and details.

The gravity separator will be periodically monitored to document the rate of DNAPL accumulation within the tank. When an appreciable amount of DNAPL has accumulated within the tank, it will be manually decanted from the bottom into a 55-gallon steel drum (or other suitable container) via ball valve spigot. Once full, the steel drum will be sent off-site for disposal in accordance with applicable regulations.

Lift Station

Following DNAPL separation, the aqueous supernatant effluent from the gravity separation tank will gravity drain into a closed lift station tank. The lift station air diaphragm transfer pump (P-1) will be used to provide maximum flexibility with respect to system feed flow rates. A needle valve and pressure regulator on the air supply will allow fine tuning of the pump P-1 flow rate to closely match that of the incoming extracted groundwater flow rate, which in turn will maximize the hydraulic retention times and removal efficiencies through the remaining filtration stages.

The air diaphragm pump also allows variability in pressure to overcome pressure buildup due to solids loading of the filters over time, and as a positive displacement pump, will provide a relatively constant, non-varying rate of flow regardless of minor pressure drop increases across the filters.

The closed lift station includes three float switches. The lower two floats will be used to start and stop Pump P-1 via a solenoid valve (SV-1) on the Pump P-1 air feed line. The uppermost float will be used as a high-level alarm. This high-level float will be interlocked with a solenoid valve (SV-2) on the airline to the extraction well pumps (E-1 through E-3) to prevent a potential overflow of the lift station should the lift station tank fill due to the incoming flow rate exceeding the P-1 flow rate. A pulsation dampener will be installed on the outlet of pump P-1 to minimize the flow pulses, and provide a more uniform flow through the subsequent filtration stages. Refer to Figure 3 and Figure 4 for design specifications and details of the lift station.

Air Stripping (contingency)

Following the optimization of the DNAPL Extraction and Treatment System, an evaluation will be completed to determine the need for an air stripping process to reduce the VOC loading to the activated carbon filters. The specific air stripping design parameters will be dependent on the combined flow rate of the extraction wells and the concentration of the aqueous phase VOCs. It is anticipated that air stripping could consist of installation of a bubble diffuser(s) in the lift station tank and/or a separate vessel (i.e., air stripping column) or a stand-alone tray unit. If warranted, the air stripper would be placed after the lift station prior to the cartridge and activated carbon filtration. Since the remediation is being conducted as part of the BCP, it is assumed that a discharge permit will not be required if air stripping is implemented.

Cartridge Filtration

Pre-filtration of the groundwater will be provided to remove particulate prior to flow through the carbon media, which helps to prevent potential plugging of the carbon filters. Two different size cartridge filters will be used. The first filter, CF1, will be a coarse prefilter (50 micron), and the second, CF2, will be a fine filter (5 micron). These filters are rated for minimum 10-gpm capacities. Extracted groundwater is not expected to have a significant particulate loading, and thus, it is anticipated that the cartridge filters will have a relatively long service life in this application.

Carbon Filtration

The final treatment stage will be a carbon filtration stage for removal of dissolved phase VOCs. The carbon filters will contain approximately 75 pounds of granular activated carbon each, and each has a manufacturer's rated capacity of 5 gpm.

Samples will be collected from locations prior to the carbon filters and at the sewer discharge locations. These samples will be tested for halogenated VOCs to evaluate the effectiveness of the carbon filtration. Once test results indicate that a filter is spent, the spent filter will be taken offline and drained, with the drained fluids being returned to the head of the treatment system for reprocessing. Spent carbon will then be removed and replaced with fresh carbon. When

returned back online, the fresh carbon unit will be installed at the end of the train. Spent carbon will be disposed in accordance with applicable regulations. Refer to Figure 3 and Figure 4 for design specifications and details of the activated carbon filtration stage.

Sewer Discharge

Effluent from the carbon filtration stage will be discharged to the sanitary sewer in compliance with the City of Jamestown sewer use regulations. A totalizing flowmeter will be used to monitor the volume of wastewater that is treated and discharged.

2.2 Chemical Treatment

Future remedial activity at the Site may include the use of in-situ chemical oxidation (e.g., injection of potassium permanganate, sodium permanganate, etc.) as a polishing step to remove contaminant residues that remain following completion of the DNAPL Extraction activities described in Section 2.1. The need for in-situ chemical oxidation (or alternative methods to be determined) will be evaluated after DNAPL is extracted to the extent possible to remove the PCE source. If a polishing stage is warranted, the extent of the associated remedial activity will be determined at that time, and a RAWP addendum will be developed accordingly to address the polishing stage.

2.3 DNAPL Extraction Effectiveness Monitoring

The objective of the DNAPL extraction remedial activity is to remove and recover DNAPL from the subsurface within the presumed extent of DNAPL presented on Figure 2. The effectiveness of the DNAPL Extraction and Treatment System will be monitored and evaluated by measuring the volume of DNAPL recovered as described in the O&M manual included in Appendix B. The DNAPL measurements/removal quantities collected, in conjunction with the results of the long-term groundwater monitoring program described in Section 5.0, will be used to assess the overall effectiveness of the DNAPL Extraction and Treatment System and the need to implement additional remedial measures (e.g., chemical oxidation or another alternative).

[Note: The DNAPL Extraction system was installed in July and August 2012, and the system was started on August 17, 2012. The system has operated continuously through the date of the document.]

3.0 PLUME CONTAINMENT

The Plume Containment remedy is part of the initial remedial components for the Site, and it will be implemented following installation of the DNAPL Extraction and Treatment System. Containment will be achieved by the installation of a permeable reactive barrier (PRB) located in a hydraulically downgradient position near the property line of the Site. The specific location of this PRB was determined based upon the results of previous studies conducted at the Site and recent site characterization testing. The purpose of this section is to present information related to the design, implementation and monitoring of the Plume Containment remedy.

3.1 Site Characterization Testing

Test Borings/Monitoring Wells: CW-1 through CW-6

On November 19, 2012, six test borings designated CW-1 through CW-6 were advanced using direct-push sampling methodologies, and completed as 1-inch diameter monitoring wells. The locations of CW-1 through CW-6 are shown on Figure 2. Each test boring was advanced to a depth of 16 ft. bgs, or approximately 1 ft. into the top of a glacial till layer that underlies the Site. Copies of the test boring logs and monitoring well installation diagrams for CW-1 through CW-6 are included in Appendix C.

Test borings CW-1 through CW-6 contained an approximate 0.5 ft. thick layer of topsoil and roots above approximately 2 ft. to 4 ft. of fill material that generally consisted of reworked soil intermixed with lesser amounts of brick fragments, stone and pieces of concrete. The indigenous soil below the fill generally consisted of varying layers of sandy to clayey silt that extended to the top of the glacial till, which was encountered in test borings CW-1 through CW-6 at a depth of about 15 ft. bgs. [Note: Based upon test borings that were advanced during earlier studies, the glacial till in the area of test borings CW-1 through CW-6 is expected to range in thickness from about 5 ft. to 8 ft. and the till appears to be thinner in the northern portion of the Site.] In some of the test borings, deposits of fine sand and gravel that ranged in thickness from about 1 ft. to 2 ft. were encountered within the sandy to clayey silt (i.e., typically at depths of 10 ft., or more, bgs). An approximate 1 ft. thick layer of peat was encountered in test boring CW-3 at a depth of 6 ft. bgs. However, peat was not encountered in test borings CW-1, CW-2, CW-4, CW-5 or CW-6.

With the exception of CW-4, no odors were observed on the soil samples collected from test borings CW-1 through CW-6. A mild solvent-type odor was detected on the sample collected from a depth of 12 ft. bgs from test boring CW-4. During the fieldwork, the photoionization detector (PID) malfunctioned and readings were only obtained in the field above samples collected from test borings CW-4 and CW-6. Headspace samples collected in the field were subsequently screened at DAY's offices. The maximum PID measurements for each sample interval are summarized on the test boring logs included in Appendix C. As shown, the maximum headspace reading measured above the samples collected from CW-4 was 162 parts per million (i.e., above the sample collected from a depth of 14 ft. bgs). The maximum PID measurement above the samples collected from test boring CW-6 was 34.5 ppm (i.e., above the sample collected from a depth of 15.5 ft. bgs). The maximum PID measurements in the headspace samples collected from each test boring were: CW-1: 72.6 ppm (0 ft. - 4 ft.), CW-2:

24.0 ppm (12 ft. - 16 ft.), CW-3: 7.6 ppm (12 ft. - 16 ft.), CW-4: 63.1 ppm (8 ft.), CW-5: 83.9 ppm (0 ft. - 4 ft.), and CW-6: 26.3 ppm (15.5 ft.).

Groundwater Conditions

Static groundwater levels were measured at depths ranging between 1.5 ft. bgs and 1.8 ft. bgs in monitoring wells CW-2, CW-3, CW-4 and CW-6 on November 24, 2012. Monitoring wells CW-1 and CW-5 were re-developed on November 24, 2012, and representative static groundwater levels could not be obtained from these monitoring wells. Based upon historic groundwater elevations calculated for existing monitoring wells, groundwater flow in the overburden/top of till zone is to the east/southeast across the Site. As such, CW-1 through CW-6, which are located in proximity of the property line of the Site, are also positioned in a hydraulically downgradient position relative to the Site. Thus, the water quality in these monitoring wells would be expected to be representative of the overburden/top of till groundwater exiting the Site.

Field and Analytical Laboratory Test Results

Groundwater samples were collected from select monitoring wells on August 8, 2012 prior to the start-up of the DNAPL Extraction and Treatment System to establish background conditions. Overburden/top of till monitoring wells MW-07, MW-200 and MW-201 were included in this sample event. Therefore these monitoring wells and monitoring wells CW-1 through CW-6 were sampled in November/December 2012 to evaluate current overburden/top of till groundwater conditions. [Note: Samples were initially collected on November 16, 2012, but monitoring well CW-1 was not adequately developed and it was sampled on December 7, 2012. In addition, the test results for monitoring well MW-201 were suspect, and this well was re-sampled on December 7, 2012.]

In-situ pH measurements were not made in samples collected from CW-1 through CW-6, but historically the pH measured in groundwater samples collected from overburden/top of till monitoring wells located in proximity has ranged between 7.3 s.u. and 7.7 s.u. On August 8, 2012, dissolved oxygen (DO) concentrations of 0.9 mg/l and 0.6 mg/l were measured in monitoring wells MW-07 and MW-200, respectively.

The oxygen reduction potential (ORP) measurements obtained on November 16, 2012 are summarized below.

Monitoring Well	ORP (mV)
MW-07	-150
MW-200	-132
MW-201	-5
CW-1	+73
CW-2	+19
CW-3	-7
CW-4	-29
CW-5	-18
CW-6	+30

Table 1 *Summary of Analytical Laboratory Results* presents a cumulative summary of the halogenated VOCs measured in samples collected from monitoring wells installed at the Site. The analytical laboratory test results for groundwater samples collected from overburden/top of till monitoring wells MW-07, MW-200, MW-201 and CW-1 through CW-6 collected on August 8, 2012 and November/December 2012 is also presented on Figure 5.

Discussion

The results testing of the samples collected from monitoring wells CW-1 through CW-6, and existing monitoring wells MW-07, MW-200 and MW-201, suggests that preferential flow is occurring within the overburden/top of till zone in proximity of a storm and sanitary sewer. This conclusion is supported by the total VOC concentrations measured in the samples collected from monitoring wells CW-4 (i.e., 39,800 ug/l), CW-3 (i.e., 822.5 ug/l), and MW-201, which is located hydraulically downgradient of CW-4 (i.e., 10,418 ug/l was measured in the sample collected on December 7, 2012); compared to the significantly lower concentrations measured in other downgradient monitoring wells [i.e., ranging from 'non-detect" (CW-5 and CW-6) to 256.2 ug/l (CW-2)]. As shown on Figure 2, monitoring wells CW-4 and CW-3 are located in proximity of the storm sewer and sanitary sewer, respectively.

With the exception of the VOCs measured in the samples collected from monitoring well MW-201, the parent compounds of PCE and TCE were the predominant VOCs detected in the overburden/top of till monitoring wells. Although the detection limits were somewhat elevated, the samples from MW-201 did not contain detectable concentrations of PCE and TCE, whereas the concentrations of the daughter compounds cis1,2-DCE and VC were elevated. [Note: As shown on Table 1, samples collected from MW-201 on April 24, 2006 and January 4, 2007 contained the parent compounds of PCE and TCE, but the daughter compounds were not detected. However, beginning with samples collected on February 13, 2007 progressively lower concentrations of the parent compounds and increasing concentrations of the daughter compounds were detected in samples from MW-201. The reason for this change appears to be attributable to bioremediation pilot testing that was initiated on January 5, 2007. Specifically, a solution of CL-Out microbes (i.e., *Pseudomonas*, a patented strain of aerobic microbes manufactured by CL Solutions, Inc.) and dextrose (i.e., a nutrient source) was placed in overburden/top of till monitoring wells MW-206 and MW-208. Monitoring well MW-206 is located immediately east of the garage area of the Anderson Cleaners Building and MW-208 is located near the southwestern boundary of the Site, and in a position generally hydraulically crossgradient of monitoring well CW-4 (refer to Figure 2).]

While the bioremediation conducted during the pilot testing appears to have reduced parent concentrations in downgradient monitoring well MW-201, and potentially eliminated VOC impact in the area of downgradient monitoring wells CW-5 and CW-6, treatment within MW-201 appears to have stalled at cis 1,2-DCE causing elevated concentrations of cis 1,2-DCE and VC.

3.2 Plume Containment Remedy

Based on the results of previous pilot testing, reductive dechlorination is a viable remedial alternative for the Plume Containment remedy to be implemented at the Site. Therefore a PRB installed near the property line of the Site in a hydraulic downgradient position is proposed as the Plume Containment remedy. This PRB will initially be constructed by the injection of EHC In-Situ Chemical Reduction Reagent (EHC) manufactured by FMC Corporation within the overburden/top of till zone to create strong reducing conditions and stimulate dechlorination processes. EHC is a combination of controlled-release carbon, zero valent iron (ZVI) particles and nutrients. A copy of a material safety data sheet for EHC ISCR Reagent is included in Appendix D. The EHC will be placed in select hydraulically downgradient locations within the overburden/top of till zone at the Site. This Plume Containment remedy will be implemented in conjunction with DNAPL Extraction and Treatment System that began operation on August 17, 2012.

The PRB will consist of a "Primary Treatment Area", which includes the area where the highest VOC concentrations have been detected (i.e., generally between the 21-inch storm sewer and the 4-inch sanitary sewer) and a "Secondary Treatment Area", which is located to the north of the Primary Treatment Area where lower VOC concentrations have been detected. The PRB will be installed by injection of a 25% to 30% slurry mixture of EHC and potable water into closely spaced points. Assuming a 5-foot radius of influence, the Primary Treatment Area will require eleven injection points, which results in a PRB measuring approximately 50 ft. (north/south) and 25 ft. (east/west). Two additional injection points will also be installed near the southern edge of the Primary Treatment Area to preclude migration of VOC-impacted groundwater around the treatment areas (refer to Figure 6). The Secondary Treatment Area will require five injection points, which will provide a PRB measuring approximately 60 ft. (north/south) and 10 ft. (east/west). The proposed layout of the PRB with the tentative location of the injection points for the Primary Treatment Area and the Secondary Treatment Area is shown on Figure 6.

Each injection point will be advanced to a depth of 16 ft. bgs via direct-push methodologies, and flushed with potable water to clear debris and create additional void space to enhance delivery of the slurry mixture. The amount of EHC required was estimated based upon measured and assumed parameters for soil types, groundwater flow conditions, contaminant loading and geochemical data. Product demand and dosage calculation sheets for the EHC are provided in Appendix E. As shown based on preliminary calculations, a targeted amount of 177 pounds of EHC (or a 30% slurry) will be placed in each of the injection points in the Primary Treatment Area, and a targeted amount of 160 pounds of EHC (or a 25% slurry) will be placed in each of the injection points in the Secondary Treatment Area. The actual amount of EHC to be placed will be determined based upon the background testing described below and conditions encountered at the time of the injections. The goal will be to inject the EHC between depths of 16 ft. and 4 ft. bgs. As such, the tubing will be slowly removed from each injection point while the intake of the EHC is monitored as pumping continues in an attempt to achieve a uniform distribution throughout the treatment zone. Upon completion, each injection point will be backfilled with cuttings and capped with asphalt (if appropriate depending on the location of the injection point). The location of each injection point will be measured using a GPS and/or tape measured to existing site features.

Background Testing

Prior to the injection of EHC, groundwater samples will be collected from CW-2 and CW-4 and tested for the metals iron, calcium, magnesium and manganese; the anions chloride, sulfate, and nitrate; total organic carbon (TOC); dissolved organic carbon (DOC) and volatile fatty acids (VFA). In addition, samples will be obtained from monitoring wells MW-07, MW-200, MW-201 and CW-1 through CW-6, and tested for pH, dissolved oxygen (DO), and oxygen reduction potential (ORP). The results of this testing will be used to select the final loading requirements for the EHC. In addition, the data collected, coupled with the historic VOC test results, will be used to establish baseline conditions prior to the placement of the EHC. These baseline results can be used to assist in the evaluation of the effectiveness of this treatment method. For example, elevated levels of TOC, DOC and iron would be expected shortly after placement of the EHC. As the remediation process commences, and organic carbon is degraded by indigenous bacteria, elevated levels of VFA would be expected.

Effectiveness Monitoring Requirements

Groundwater monitoring will be conducted following the placement of the EHC to evaluate effectiveness of this remedy. This monitoring will include the collection of samples from the following monitoring wells: CW-1, CW-2, CW-3, CW-4, CW-5, MW-200 and MW-201. The initial sample event will be conducted approximately three months after the injection event and a second sample event will be conducted approximately six months after the injection event. Each sample collected will be tested for the field parameters of temperature, pH, ORP and DO and submitted to an analytical laboratory for testing of halogenated VOCs via USEPA Method 8260. In addition, samples collected from CW-2 and CW-4 will also be tested for TOC, DOC, iron and VFA.

Contingency for Supplemental Treatment

In the event VOC concentrations do not decrease or the concentrations of daughter compounds increase following the injection, supplemental treatment will be required. The specific treatment required and the location of this treatment will depend on the results of the effectiveness monitoring. If the monitoring indicates that favorable redox conditions have been achieved following the EHC placement (i.e., ORP less than -75 mV, DO less than 0.2 mg/l and pH between 6 and 8.5 s.u.), *Dehalococcoides* microbes may be added. In the event favorable redox conditions have not been achieved, additional EHC, or an alternative amendment, may be placed. The need for, and type of, supplemental treatment will not be made until the second monitoring event described above is completed.

Prior to conducting additional remedial activities, a supplemental work plan outlining the proposed biostimulation/bioaugmentation methods, materials and locations will be provided to the NYSDEC.

4.0 IN-SITU BIOREMEDIATION

The in-situ bioremediation remedy will be implemented after the DNAPL Extraction and Treatment System has removed DNAPL to the extent possible, thus addressing a significant source of the dissolved COC at the Site. The specific types and quantities of bioremediation products to be used, and the specific locations where such products will be placed will be determined when adequate treatment has been completed to remove/treat the DNAPL source area. However, it is currently anticipated that the bioremediation will be conducted in an area approximately 100 ft. measured in a general north to south direction by 40 ft. measured in a general east to west direction. This area is located on the east side of the Anderson Cleaners building (refer to Figure 7). It is anticipated during the initial treatment event that up to 1,850 pounds of hydrogen releasing compound will be injected in 30 regularly spaced injection points advanced using direct-push drilling techniques throughout the bioremediation treatment area, or about 60 pounds of hydrogen releasing compound per point, to stimulate the existing population of *Dehalococcodies* microbes. These microbes are documented to bioremediate the COC identified at the Site. It is anticipated that up to two subsequent injection events may be required, and that these events would require fewer injection points and less hydrogen-releasing compound to treat residual impacts remaining following the initial treatment. It is also possible that commercially produced *Dehalococcodies* microbes could be placed to augment the existing microbes during one of the subsequent injection events. The determination of the need for, and extent of, additional bioremediation would be based on testing conducted following the initial treatment event. This testing would include evaluation of *Dehalococcodies* microbe populations, measurement of field parameters such as DO, ORP and pH, and analytical laboratory testing of halogenated VOC concentrations.

Prior to conducting bioremediation, a supplemental work plan outlining the proposed biostimulation/bioaugmentation methods, materials and locations will be provided to the NYSDEC.

5.0 LONG-TERM GROUNDWATER MONITORING

To evaluate the on-going effectiveness of the remedial efforts conducted at the Site, a long-term groundwater monitoring program will be implemented using existing monitoring wells that are installed with their well screens sealed within various water-bearing zones that underlie the Site. Specifically, the following groundwater monitoring wells will comprise the long-term groundwater monitoring system.

Overburden/Top of Till Monitoring Wells

- MW-07
- MW-200
- MW-201
- CW-2
- CW-3
- CW-4

Fractured Rock Monitoring Wells

- BR-02FR
- MW-04
- MW-06

Bedrock Monitoring Wells

- BR-02R
- BR-03R

The location of each of these wells is presented on Figure 2.

Prior to the commencement of the long-term groundwater monitoring program, the above monitoring wells will be redeveloped and repaired as necessary to assure that they are functioning. Subsequently, samples will be collected using passive diffusion-bag samplers (PDS) and/or dedicated bailers. The PDS will be positioned approximately one foot from the bottom of the well screen, and the PDS will remain in the long-term monitoring wells for a minimum of two weeks prior to retrieval. The samples collected will be submitted under chain-of-custody control to a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified analytical laboratory and tested for halogenated VOCs via USEPA Method 8260. In conjunction with the collection of samples for analytical laboratory testing, in-situ measurements of groundwater level, pH, DO, ORP, and specific conductance will be collected, and the presence of DNAPL will be evaluated.

The long-term monitoring events will be conducted two times per year (i.e., samples will tentatively be collected in March and September). During the March monitoring event, samples will be collected from each of the long-term monitoring wells and tested for the in-situ parameters of groundwater levels, pH, DO, ORP, and specific conductance. In addition, each long-term monitoring well will be evaluated for the presence of DNAPL. However, only samples collected from the overburden/top of till monitoring wells will be submitted to the analytical laboratory for testing of halogenated VOCs. During the September monitoring event,

samples each long-term monitoring well will be evaluated for in-situ parameters and submitted to the analytical laboratory for testing of halogenated VOCs. The analytical laboratory data collected during each long-term monitoring event will be compiled in an EQUIS format, but Data Usability Suitability Reports (DUSR) will only be generated for the September monitoring events.

Note: The re-development and repairs to the long-term monitoring wells were completed on July 25, 2012 (and in November/December 2012 for CW-1 through CW-6). Following this work, an initial long-term monitoring event was completed on August 8, 2012 (monitoring wells MW-07, MW-200, MW-201, BR-02FR, MW-04, MW-06, BR-02R, and BR-03R) and on November 16, 2012 (monitoring wells MW-201, MW-07, CW-2, CW-3, CW-4) and December 7, 2012 (monitoring well MW-201). The data collected during this initial sampling event is presented on Table 1 and it was used to establish background conditions prior to the start-up of remedial systems.

6.0 VAPOR INTRUSION

The 11,400 square foot Anderson Cleaners building is comprised of an office/commercial area on the northern side of the building that encompasses approximately 1,800 square feet. [Note: The commercial area of the Anderson Cleaners building is used for clothes drop-off and pick-up, a tuxedo rental operation and clothing alterations.] The remaining portion of the building is directly associated with cleaning operations [i.e., laundry and dry cleaning area, garage/vehicle storage area, and finishing area (ironing, packaging, etc.).] The office/commercial portion of the building is the most susceptible to vapor intrusion from the COC in the subsurface as the remaining portion of the building is routinely vented and exposed to outdoor air. As such, evaluation and remediation (if warranted) of vapor intrusion is only required within the office/commercial portion of the building. The sections below describe the procedures proposed to address potential vapor intrusion issues within the Anderson Cleaners building. The procedures outlined herein will be implemented subsequent to implementation of the Plume Containment remedy described in Section 3.0.

6.1 Indoor Air Testing

To assess the impact of COC present if the subsurface on indoor air quality, three samples will be collected from the locations depicted on Figure 8. Prior to the collection of these indoor air samples, a vapor intrusion pre-sampling building inspection and product inventory will be completed within the office/commercial area of the Anderson Cleaners building. This inspection and inventory will be undertaken in general accordance with the NYSDOH document titled, "*Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*", dated October 2006 (NYSDOH Guidance Document). This task will include the completion of the NYSDOH Indoor Air Quality Questionnaire and Building Inventory including a chemical inventory of the indoor areas of the buildings. Should materials be identified during the inventory that would potentially be detected during the indoor air testing, they will be removed from the building and stored in a secure location during the testing.

Following the pre-sampling building inspection and product inventory, indoor air samples will be collected from the breathing space (i.e., approximately 5 ft. above the floor surface) using a Summa Canisters over a 2-hour period. Air flow-rates will be controlled with pre-calibrated regulators supplied by the analytical laboratory. In addition, vacuum gauges will be connected to the regulators in order to monitor the Summa Canister for proper operation (i.e., slow changes in vacuum) on an hourly basis. The Summa Canister samples collected will be delivered under chain-of-custody control to a NYSDOH ELAP-certified laboratory for analysis of VOCs using Method T0-15.

The test results will be compared to applicable guideline values that are outlined in the NYSDOH Guidance Document, and a summary report will be prepared. This report will include a table summarizing detected VOCs (if any) and corresponding NYSDOH guidance values for the constituents detected. In addition, the report will include a narrative describing the work completed, a copy of the completed NYSDOH Indoor Air Quality Questionnaire and Building Inventory form, copies of the analytical laboratory results, the summary table and conclusions and recommendations, as warranted.

6.2 Vapor Mitigation

In the event the indoor air test results identify COC concentrations that exceed applicable NYSDOH guidance values, a plan describing proposed vapor mitigation procedures would be developed and submitted to the NYSDEC. This plan would include remedial measures proposed to address the indoor impacts, and methods to verify the successful implementation of the remediation. For example, if the remedy selected for the office/commercial area of the Anderson building is the installation of a sub-slab depressurization system (SSDS) the plan will include procedures to evaluate the draw and radius of influence of vapor extraction points so that a system can be designed with a sufficient number of points to capture and discharge impacted soil vapor. In addition, the plan will identify subsequent monitoring requirements to assure that the SSDS operates as designed.

Note: As an alternative, a vapor mitigation system may be installed within the office/commercial area of the Anderson Cleaners building without completing the indoor air testing described in Section 6.1.

7.0 DELIVERABLES

Following the installation of the DNAPL Extraction and Plume Containment systems and an initial period of performance monitoring, a Construction Completion Report (CCR) will be prepared and subsequently submitted to the NYSDEC. The CCR will describe the construction of the DNAPL Extraction and Plume Containment systems, and will consist of the following:

- As-built Remedial Design Plan drawings;
- a description of the work completed (including discussion of variation from this RAWP);
- the results of the background testing completed; and
- initial performance monitoring results.

During the operation of the DNAPL Extraction and Plume Containment systems (and other remedial systems as they are installed/initiated), annual reports will be prepared and submitted to the NYSDEC. These reports will include summaries of site visits, provide summaries of measurements made, describe problems encountered and the resolution of these problems, and present proposed additional work. In addition, the results of long-term groundwater monitoring conducted including copies of sample logs, a groundwater contour map, copies of analytical laboratory test results with executed chain-of-custody documentation, tables summarizing historic field and analytical laboratory test results will also be provided in these reports. A copy of the DUSR generated for the samples collected will also be provided as an attachment to the annual report.

In the event significant modifications to the remedial system(s) are required (e.g., cessation of physical DNAPL removal and implementation of chemical oxidation, placement of additional amendments or implementation alternative remedial methods within the Plume Containment remedy) a supplemental work plan(s) will be submitted.

A Site Management Plan (SMP) will also be prepared, including an updated O&M Plan based on the observations made during start-up monitoring. The SMP will address the long-term operation, maintenance and monitoring program for the DNAPL Extraction and Plume Containment systems. The SMP will be updated as DNAPL Extraction and Plume Containment removal system modifications and/or additional remedial activities (e.g., implementation of bioremediation, chemical oxidization and/or phytoremediation) are implemented. In accordance with the Decision Document, the SMP will also include provisions for evaluation and/or mitigation of the potential for soil vapor intrusion into the Anderson Cleaners building, and for any new buildings developed on the Site.

Following the installation and operation of the remedial systems required for the Site, a Final Engineering Report (FER) will be prepared and submitted to the NYSDEC. This FER will be prepared in accordance with the requirements outlined in *DER-10/Technical Guidance for Site Investigation and Remediation* dated May 3, 2010.

8.0 SCHEDULE

The tentative schedule for the various activities described in this RAWP is presented below. This schedule will be updated as the work progresses, and provided to the NYSDEC.

Task	Anticipated Duration	Anticipated or Actual Completion/Submission Date
DNAPL Extraction and Treatment System		
Procurement of DNAPL Extraction System Equipment	1 month	July 13, 2012
Construction of DNAPL Extraction System	1 month	August 17, 2012
Startup of DNAPL Extraction System	-	August 17, 2012
Optimization of DNAPL Extraction System	1 month	September 2012
DNAPL Extraction System Shutdown and Polishing Remedial Measure Evaluation	1 month	TBD
Remedial Action Work Plan Addendum for Chemical Oxidation Polishing (if necessary)	2 months	TBD
Plume Containment Remedial Measure		
Characterization Testing	1 month	November 2012
Submit Revised Remedial Action Work Plan: Plume Containment	1 month	December 2012
NYSDEC Review	2 months	February 7, 2013
Revised Remedial Action Work Plan (RAWP)[1]	1 month	March 2013
NYSDEC Review	1 month	April 2013
Background Testing and Procurement of Plume Containment Materials and Subcontractor Agreements	2 months	June 2013
Plume Containment Injection Event	1 week	July 2013
Monitoring Event #1	1 day	October 2013
Monitoring Event #2	1 day	January 2014
Supplemental Treatment	TBD	TBD
Bioremediation Remedy [2]		
Remedial Action Work Plan Addendum	2 months	TBD
Initial Injection Event	1 week	TBD
Subsequent Injection Events	TBD	TBD
Miscellaneous		
Long-Term Groundwater Monitoring	On-Going	[3]
Vapor Intrusion	2 months	TBD [4]
Construction Completion Report	2 months	TBD [5]
Site Management Plan [6]	2 months	April 2014
Final Engineering Report	2 months	TBD [7]

Notes

(1) Revised RAWP (this document) includes site-wide remedies, long-term monitoring program and deliverables.

(2) To be implemented upon completion of DNAPL Extraction Remedy.

(3) Initial sample event(s) to establish background conditions conducted on August 8, 2012, November 16, 2012 and December 7, 2012. Subsequent bi-annual sampling events will be completed in March and September.

(4) Testing (if completed) and installation of vapor mitigation system will be completed subsequent to the installation and initial operation of the DNAPL Extraction and Plume Containment systems.

(5) A Construction Completion Report (CCR) will be prepared and submitted following the completion of the Vapor Intrusion remedy (if required).

(6) A Site Management Plan will be developed once the DNAPL Extraction and Treatment System and Plume Containment Remedial Measure have been installed and the effectiveness of these systems is documented.

(7) The Final Engineering Report will be prepared following the installation and operation of all the required remedial systems

TABLES

Table 1

Summary of Analytical Laboratory Results
Groundwater Samples

Anderson Cleaners Site
Jamestown, New York
BCP Site C907027

	Sample Locations and Sample Dates																						
	MW-01	MW-02	MW-03			MW-04										MW-05		MW-06						
Constituent	5/25/2005	1/12/2006	5/25/2005	1/12/2006	9/12/2006	5/25/2005	1/12/2006	1/4/2007	2/13/2007	3/15/2007	11/8/2007	7/24/2008	1/15/2010	5/5/2010	8/8/2012	5/25/2005	1/12/2006	5/25/2005	1/12/2006	1/4/2007	2/13/2007	3/15/2007	7/24/2008	8/8/2012
PCE	U (10)	2,090	1,400	1,040	1,560	1,200	1,230	1,820	1,120	904	189	734	837	694	974	2 E	U (2)	620	392	369	256	246	329	187
TCE	U (10)	U (20)	U (10)	U (20)	U (20)	1 E	U (20)	U (200)	U (200)	U (100)	1,220	113	34.9	31.4	U (18.9)	U (10)	U (2)	1 E	U (10)	U (4)	U (5)	U (5)	U (5)	U (3.8)
trans 1,2-DCE	U (10)	U (20)	U (10)	U (20)	U (20)	U (10)	U (20)	U (200)	U (200)	U (100)	187	U (20)	U (20)	U (20)	U (17.0)	U (10)	U (2)	U (10)	U (10)	U (4)	U (5)	U (5)	U (5)	U (3.4)
cis 1,2-DCE	U (10)	-	U (10)	-	-	U (10)	-	U (200)	U (200)	U (100)	3,830	101	24.6	28.6	U (17.9)	U (10)	-	U (10)	-	U (4)	U (5)	U (5)	U (5)	U (3.6)
VC	U (10)	U (20)	U (10)	U (20)	U (20)	U (10)	U (20)	U (200)	U (200)	U (100)	U (100)	U (20)	U (20)	U (20)	U (20.2)	U (10)	U (2)	U (10)	U (10)	U (4)	U (5)	U (5)	U (5)	U (4.0)
Total VOCs	0	2,090	1,400	1,040	1,560	1,201	1,230	1,820	1,120	904	5,426	948	896.5	754	974	2	0	621	392	369	256	246	329	187

Notes:

All samples tested for halogenated VOCs by USEPA Method 8260B and concentrations are shown in ug/L or parts per billion.

U (200) = constituent not detected at the concentration shown in parenthesis.

E = estimated concentration

PCE = tetrachloroethene

TCE = trichloroethene

trans 1,2-DCE = trans 1,2-dichloroethene

cis 1,2-DCE = cis 1,2-dichloroethene

VC = vinyl chloride

Table 1

Summary of Analytical Laboratory Results
Groundwater Samples

Anderson Cleaners Site
Jamestown, New York
BCP Site C907027

	Sample Locations and Sample Dates																					
	MW-07									PW-2			PW-3					MW-7			MW-7.1		
Constituent	5/25/2005	1/12/2006	9/12/2006	1/4/2007	2/13/2007	3/15/2007	7/24/2008	8/8/2012	11/16/2012	10/21/2004	1/12/2006	8/8/2006	10/21/2004	5/25/2005	1/12/2006	8/8/2006	9/12/2006	11/23/2003	10/21/2004	5/25/2005	8/9/2006	9/12/2006	7/24/2008
PCE	9,600 E	8,590	9,170	5,310	6,440	4,240	11,600	15,600	6,410	91,400	29,700	50,400	108,000	74,000	64,700	34,100	23,100	53,300	53,700	73,000	113,000	120,000	78,100
TCE	6,500	U (200)	U (200)	U (200)	U (200)	U (200)	U (200)	U (151)	U (151)	U (2000)	U (1000)	U (1000)	9,070	8,100	7,360	8,150	9,040	U (1000)	U (2000)	81	U (1000)	U (1000)	1,120
trans 1,2-DCE	61	U (200)	U (200)	U (200)	U (200)	U (200)	U (200)	U (136)	U (136)	U (2000)	U (1000)	U (1000)	U (2000)	290 E	U (1000)	U (1000)	U (400)	U (1000)	U (2000)	U (10)	U (1000)	U (1000)	U (1000)
cis 1,2-DCE	7,100	-	-	U (200)	U (200)	U (200)	245	U (143)	U (143)	U (2000)	-	-	72,500	57,000	-	-	-	-	U (2000)	95	-	-	U (1000)
VC	1,000	U (200)	U (200)	U (200)	U (200)	U (200)	U (200)	U (161)	U (161)	U (2000)	U (1000)	U (1000)	13,800	12,000	17,900	20,400	5,490	U (1000)	U (2000)	2 E	U (1000)	U (1000)	U (1000)
Total VOCs	**24,261**	**8,590**	**9,170**	**5,310**	**6,440**	**4,240**	**11,845**	**15,600**	**6,410**	**91,400**	**29,700**	**50,400**	**203,370**	**151,390**	**89,960**	**62,650**	**37,630**	**53,300**	**53,700**	**73,178**	**113,000**	**120,000**	**79,220**

Notes:

All samples tested for halogenated VOCs by USEPA Method 8260B and concentrations are shown in ug/L or parts per billion.

U (200) = constituent not detected at the concentration shown in parenthesis.

E = estimated concentration

PCE = tetrachloroethene

TCE = trichloroethene

trans 1,2-DCE = trans 1,2-dichloroethene

cis 1,2-DCE = cis 1,2-dichloroethene

VC = vinyl chloride

Table 1

Summary of Analytical Laboratory Results
Groundwater Samples

Anderson Cleaners Site
Jamestown, New York
BCP Site C907027

	Sample Locations and Sample Dates																							
	MW-200				MW-201												MW-202	MW-203		BR-02 FR			BR-02 R		
Constituent	4/20/2006	7/24/2008	8/8/2012	11/16/2012	4/24/2006	1/4/2007	2/13/2007	3/15/2007	8/31/2007	11/8/2007	4/2/2008	7/24/2008	12/20/2008	8/8/2012	11/16/2012	12/7/2012	4/20/2006	7/12/2006	7/24/2008	1/15/2010	5/5/2010	8/8/2012	1/15/2010	5/5/2010	8/8/2012
PCE	U (2.0)	U (2.0)	1.4	U (0.7)	10,500	14,200	2,610	423	1,000	402	U (100)	U (200)	U (200)	U (186)	U (0.7)	U (250)	U (2.0)	U (2.0)	U (2.0)	15,000	30,000	5,880	334	371	1,620
TCE	U (2.0)	U (2.0)	3.2	5.6	970	U (200)	17,500	937	772 E	232	U (100)	U (200)	U (200)	U (189)	U (0.8)	U (250)	U (2.0)	U (2.0)	U (2.0)	U (200)	U (400)	499	79.8	550	1,330
trans 1,2-DCE	U (2.0)	U (2.0)	0.8	U (0.7)	U (200)	U (200)	1,290	94.4	361 E	141	U (100)	U (200)	U (200)	U (170)	U (0.7)	U (250)	U (2.0)	U (2.0)	U (2.0)	U (200)	U (400)	U (68.1)	U (20)	U (20)	U (17.0)
cis 1,2-DCE	-	4.56	32.6	45.6	-	U (200)	7,860	U (20)	16,000	9,130	4,040	7,820	752	10,400	27.7	9,570	-	-	3.66	U (200)	U (400)	97.0	U (20)	U (20)	364
VC	U (2.0)	U (2.0)	0.9	0.8	U (200)	U (200)	U (200)	U (20)	566 E	1,180	1,710	4,260	1,050	650	14.7	848	U (2.0)	3.38	U (2.0)	U (200)	U (400)	U (80.7)	79.0	115	400
Total VOCs	**ND**	**4.56**	**38.9**	**52.0**	**11,470**	**14,200**	**29,260**	**1,454**	**18,699**	**11,085**	**5,750**	**12,080**	**1,804**	**11,050**	**42.4**	**10,418**	**0**	**3.38**	**3.66**	**15,000**	**30,000**	**6,476**	**492.8**	**1,036**	**3,762.5**

Notes:

All samples tested for halogenated VOCs by USEPA Method 8260B and concentrations are shown in ug/L or parts per billion.

U (200) = constituent not detected at the concentration shown in parenthesis.

E = estimated concentration

PCE = tetrachloroethene

TCE = trichloroethene

trans 1,2-DCE = trans 1,2-dichloroethene

cis 1,2-DCE = cis 1,2-dichloroethene

VC = vinyl chloride

Table 1

Summary of Analytical Laboratory Results
Groundwater Samples

Anderson Cleaners Site
Jamestown, New York
BCP Site C907027

	Sample Locations and Sample Dates					
	CW-1	CW-2	CW-3	CW-4	CW-5	CW-6
Constituent	12/7/2012	11/16/2012	11/16/2012	11/16/2012	11/16/2012	11/16/2012
PCE	13.3	155	794	39,800	U (0.7)	U (0.7)
TCE	1.0	60.8	U (7.6)	U (378)	U (0.8)	U (0.8)
trans 1,2-DCE	U (1.0)	1.8	U (6.8)	U (340)	U (0.7)	U (0.7)
cis 1,2-DCE	1.3	37.4	28.5	U (358)	U (0.7)	U (0.7)
VC	U (1.0)	1.2	U (8.1)	U (404)	U (0.8)	U (0.8)
Total VOCs	**15.6**	**256.2**	**822.5**	**39,800**	**0**	**0**

U (200) = constituent not detected at the concentration shown in parenthesis.

E = estimated concentration

PCE = tetrachloroethene

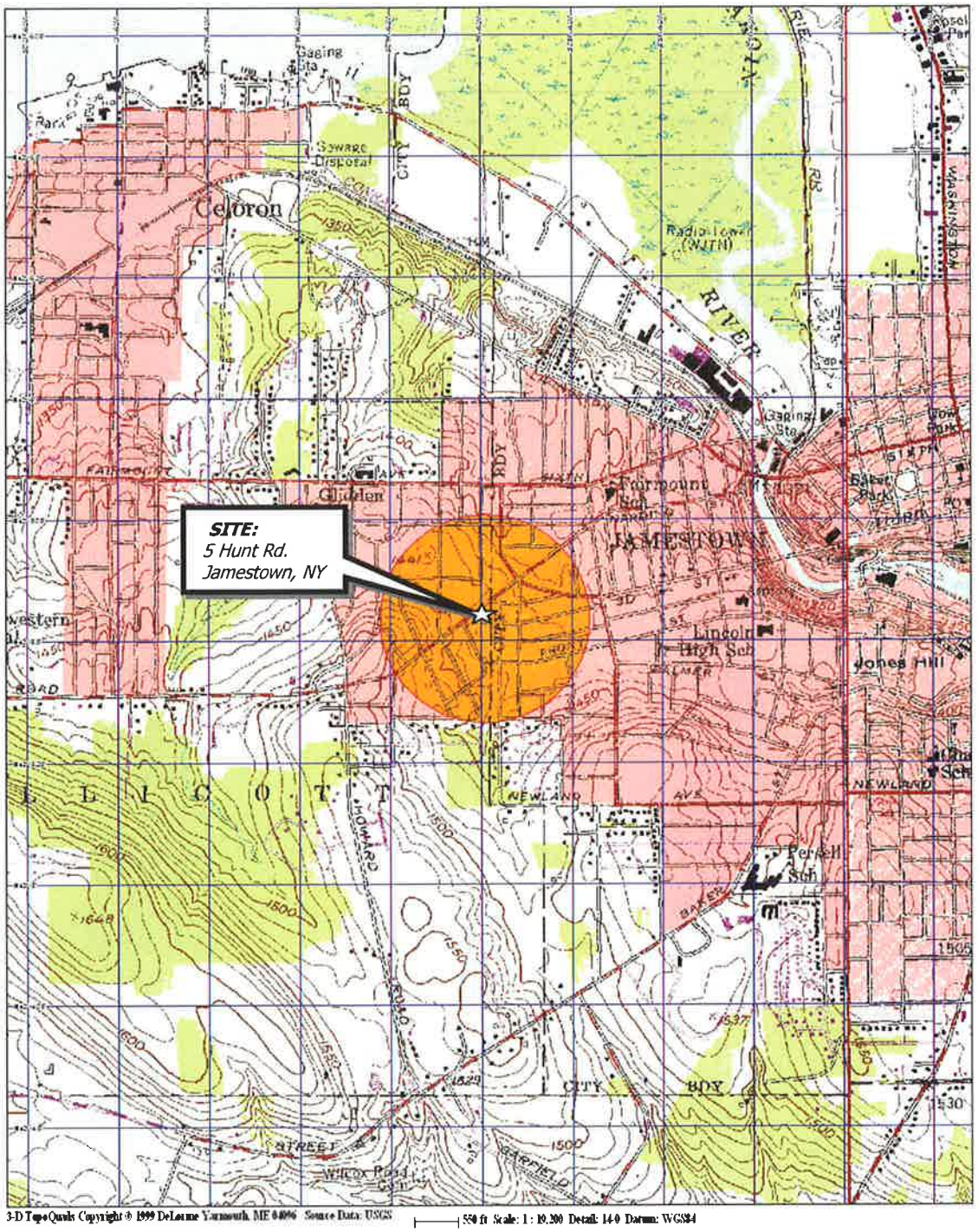
TCE = trichloroethene

trans 1,2-DCE = trans 1,2-dichloroethene

cis 1,2-DCE = cis 1,2-dichloroethene

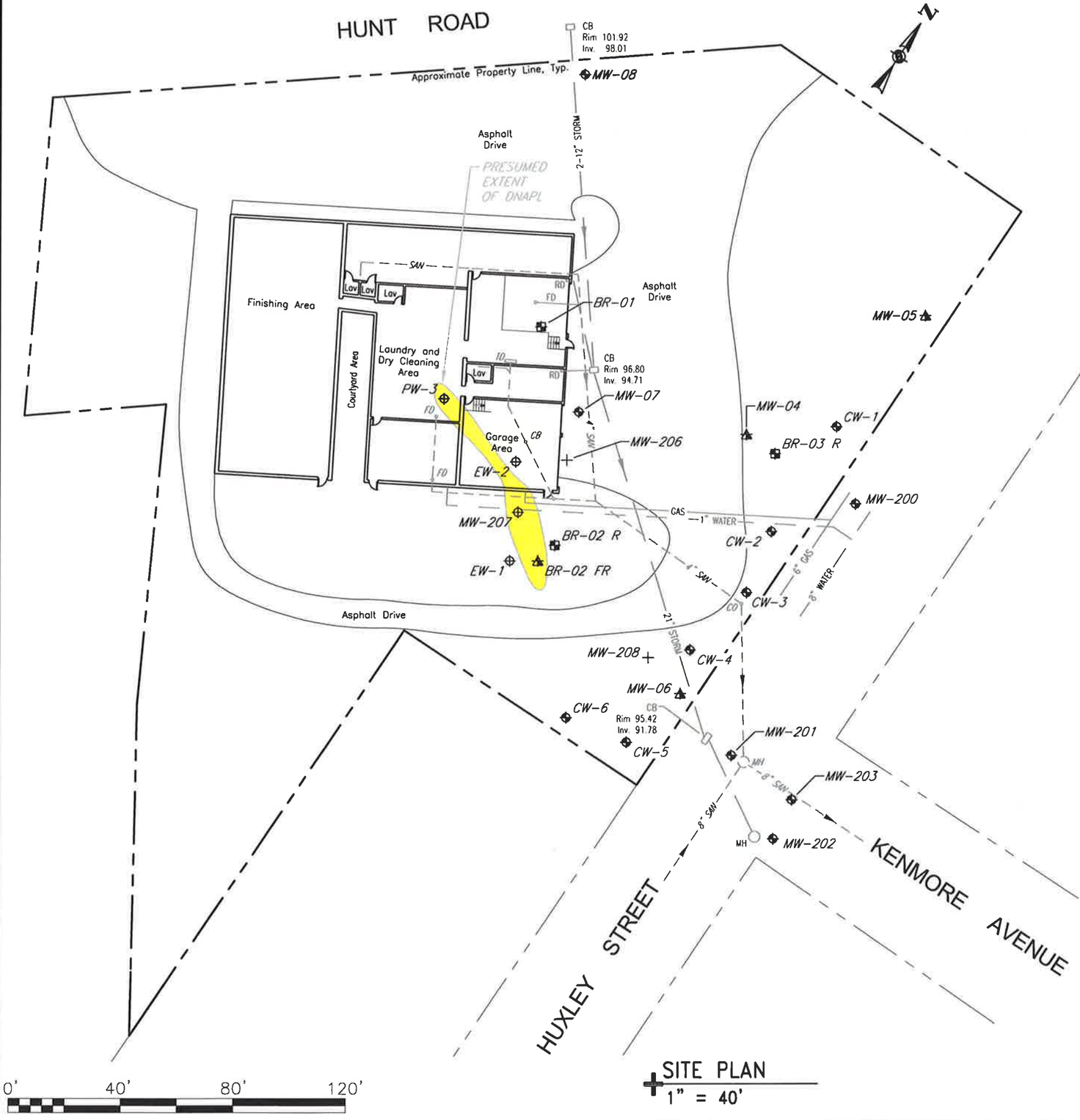
VC = vinyl chloride

FIGURES



Drawing Produced From: 3-D TopoQuads, DeLorme Map Co., referencing USGS quad map Lakewood (NY) 1979 and Jamestown (NY) 1979. Site Lat/Long: N42°05.55'– W79°16.00'

DATE **08-03-2012** DRAWN BY **RJM** SCALE **1" = 2000'**	day DAY ENVIRONMENTAL, INC. ENVIRONMENTAL CONSULTANTS ROCHESTER, NEW YORK 14606	PROJECT TITLE **5 HUNT ROAD** **JAMESTOWN, NEW YORK** **REMEDIAL ACTION WORK PLAN** **BCP #C907027** DRAWING TITLE **PROJECT LOCUS MAP**	PROJECT NO. **3563S-04** **FIGURE 1**



LEGEND:

BR-03 R	Bedrock Monitoring Well
MW-04	Top of Rock/Fractured Rock Monitoring Well
CW-1	Overburden/Top of Till Monitoring Well
EW-1	DNAPL Extraction Well
MW-208	Bioremediation Pilot Test Injection Well
CB	Catch Basin
FD	Floor Drain
MH	Manhole
Rim 100.83	Rim Elevation In Feet
Inv. 95.55	Invert Elevation In Feet
RD	Roof Drain
TD	Trench Drain
6" GAS	Gas Line (Approx 2.5 feet below grade)
8" SAN	Sanitary Sewer (Approx 5–7 feet below grade)
STORM	Storm Sewer (Approx 4–6 feet below grade)
8" WATER	Water Line (Approx 5–7 feet below grade)

NOTES:

1. Site Plan produced from drawings by Habiterra Associates, Thorsell, Kennedy, Casker, Arnone & Hedin. P.C. entitled "Addition and Renovations, Anderson Cleaners, Inc", drawings A–1 Floor Plan dated October 22, 1985 and L–1 Grading Plan and from notes of site visits by representatives of Day Environmental, Inc.
2. Well locations MW–04, MW–06, MW–07 and MW–08 were obtained in the field by a Trimble GeoXT GPS. Other well and test boring locations were obtained by tape measurement from existing site structure. Locations should be considered accurate to the degree implied by the method used.
3. Utility locations were obtained in the field by a Trimble GeoXT GPS, from drawings referenced in Note 1, A 1967 map from Jamestown DPW showing the proposed location of a permanent easement for the purpose of constructing and maintaining a storm sewer from the existing catch basin on the west side of Huxley Street to the west city line, and from a 1951 DPW storm sewer filed book number 438S, page 107. Locations should be considered accurate to the degree implied by the method used.
4. Elevation survey data determined by Michael J. Rodgers, LS, PC, and referenced to an arbitrary site wide datum. Elevations should be considered accurate to the degree implied by the method used.
5. Approximate depths of gas line, sanitary sewer, storm sewer and water line were obtained from a hand drawn plan from "Jamestown Board of Public Utilities, Anderson Cleaners Sewer Connection Map", dated October 2, 1985.

PROJECT MANAGER	RLK
DATE	2-2013
DRAWN BY	RJM
DATE DRAWN	3-6-2013
SCALE	As Noted
DATE ISSUED	3-6-2013

DAY ENVIRONMENTAL, INC.
ENVIRONMENTAL CONSULTANTS
ROCHESTER, NEW YORK 14606
NEW YORK, NEW YORK 10170

PROJECT TITLE
5 HUNT ROAD
JAMESTOWN, NEW YORK

REMEDIAL ACTION WORK PLAN - BCP #C907027

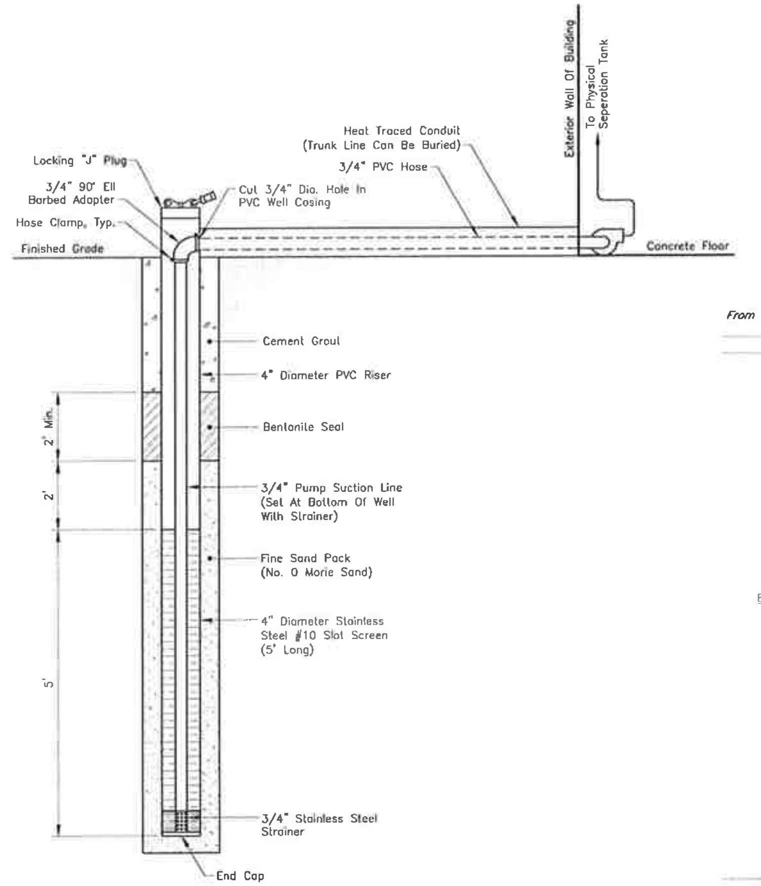
DRAWING TITLE
Site Plan

PROJECT NO.
3563S-04

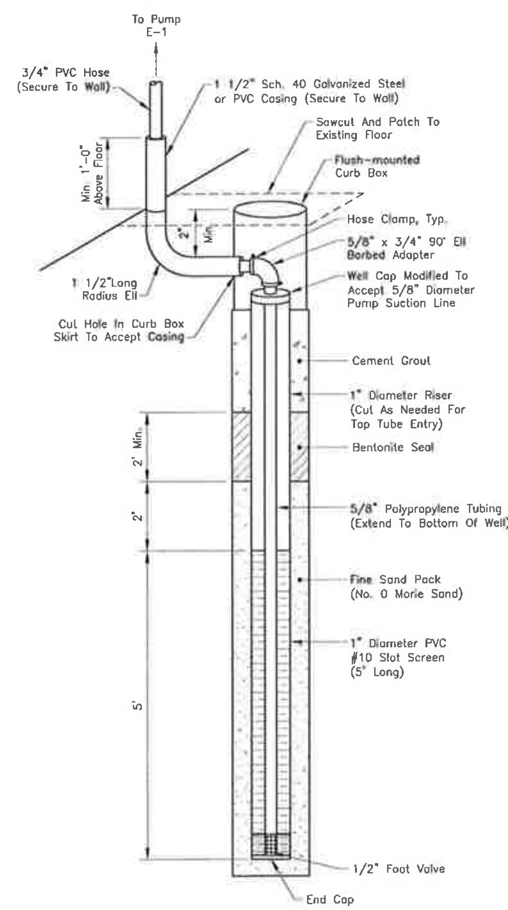
FIGURE 2

ANDERSON CLEANERS
REMEDIAL GROUNDWATER PRETREATMENT SYSTEM
PRELIMINARY EQUIPMENT LIST

ITEM	DESCRIPTION	MFR	MODEL
MAJOR EQUIPMENT ITEMS			
Well Pumps E-1 to E-3	3/8" air diaphragm pump, acetal and teflon wetted parts	ARO	PD03P-AES-DTT
Separation Tank	275-gallon vertical oil storage tank or equal	—	—
Lift Station Tank	polyethylene tank + cover, min 100-gal capacity	Chem-Tainer	—
Lift Pump P-1	1/2" air diaphragm pump, polypropylene and teflon wetted parts	ARO	PD05P-ARS-PTT
Pulsation Dampener	PP dampener; 85% pulsation reduction @ 60 psi, 5 GPM	Blacoh	A301W-1
Filter / Regulator	5-micron filter, regulator, gauge; 1/2" NPT ends	Ingersoll-Rand	P244-610
Pre-Filter Housings	4.5" x 20" filter housing; 1" FNPT ends	Shelco	SPHKB-20-1BB
Cartridge Filters	4.5" x 20" filter; 50-micron and 5-micron (6 each)	Shelco	varies
Carbon Filter Housings	13-in x 54-in FRP pressure vessels + internals	General Carbon	—
Carbon Filter Media	Reactivated carbon	General Carbon	—
Water Meter	5/8" x 3/4"; 0.5 to 20 GPM; totalizer in gallons (refurbished)	Neptune	—
CONTROLS, HOSE, PIPING AND VALVES/FITTINGS			
Float Switches	N.O. polypropylene float, 10A, 20' cord	—	—
Float Switches	N.C. polypropylene float, 10A, 20' cord	—	—
Strainer	3/4" Y-strainer; viton seal	—	—
Strainer	1" Y-strainer; viton seal	—	—
Check Valve	3/4" y-check valve; FPM seal	—	—
Check Valve	1" y-check valve; FPM seal	—	—
Ball Valve	1/2" PVC ball valve; viton seal	—	—
Ball Valve	3/4" full-port PVC ball valve; viton seal	—	—
Ball Valve	1" PVC ball valve, viton seal	—	—
Pressure Gauge	0-30 psi	Valley	—
Airline Connector Kit	filter, regulator, gauge, hose with fittings	ARO	66073-1
Solenoid Valves	1/2" brass solenoid valve; 120V; normally closed	ASCO RedHat	8210G002
Check Valve	1/4" brass check valve	Parker	C400B
Needle Valve	1/4" brass needle valve	Parker	N400B
Ball Valve	1/2" bronze ball valve; FNPT ends	Apollo	—
Ball Valve	3/8" bronze ball valve; FNPT ends	Apollo	77C10201
Threaded Hose Barbs	3/4" PVC hose barb x MNPT	—	—
Threaded Hose Barbs	1" PVC hose barb x MNPT	—	—
Threaded Hose Barbs	1-1/2" PVC hose barb x MNPT	—	—
Hose Barb Tee	1-1/2" PVC hose barb tee (set of 10)	—	—
Hose Barb Tee	1" PVC hose barb tee (set of 10)	—	—
Hose Barb Tee	1" PVC hose barbs x 3/4" MNPT (set of 10)	—	—
Bulkhead Fitting	1" PVC with FPM gasket, NPT ends	—	—
Bulkhead Fitting	1-1/2" PVC with FPM gasket, NPT ends	—	—
Well Suction Hose	3/4" ID reinf. PVC Hose	Spiralite	113
Well Suction Hose	5/8" ID rigid polypropylene tubing	—	—
Foot Valve	1/2" check valve	—	—
Water Main Hose	1" reinf. PVC Tubing	—	—
Water Main Hose	1-1/2" reinf. PVC Tubing	—	—
Air Main Feed	1/2" general duty air hose; 200 psi rating	—	—
3-Way Valve	3/4" PVC, Vitron Seals	—	—



TYPICAL EXTERIOR DNAPL EXTRACTION WELL
NOT TO SCALE



TYPICAL INTERIOR DNAPL EXTRACTION WELL
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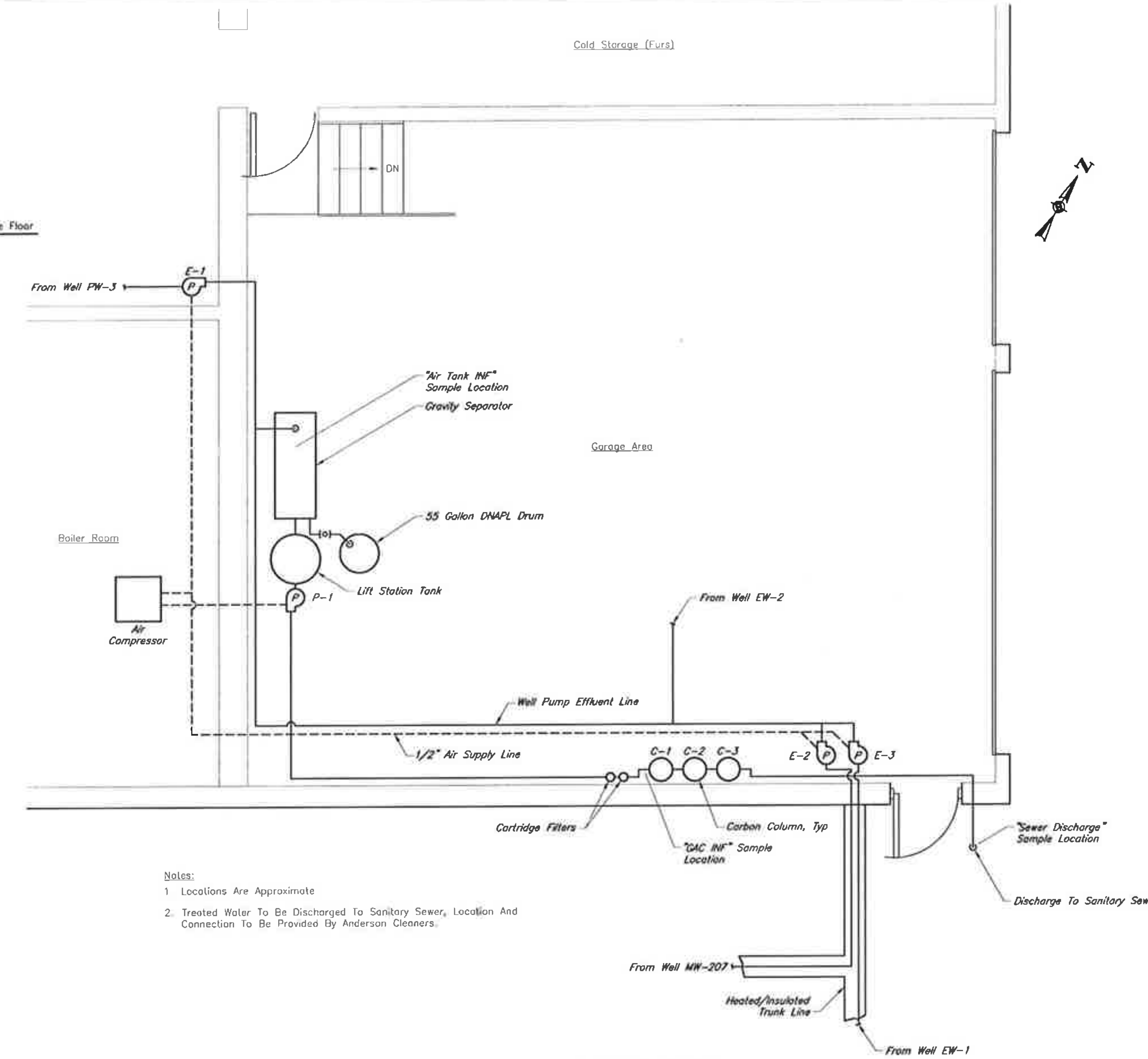
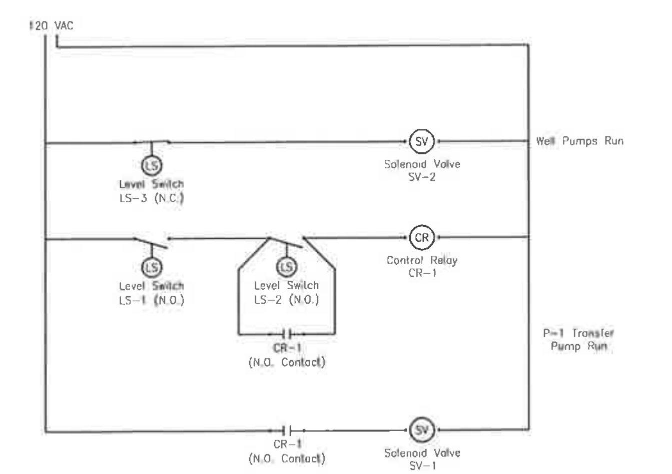


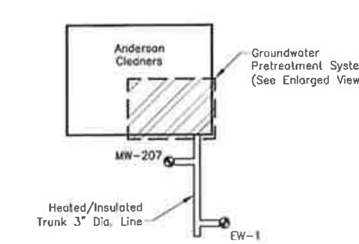
Notes:

1. Locations Are Approximate
2. Treated Water To Be Discharged To Sanitary Sewer, Location And Connection To Be Provided By Anderson Cleaners.

PRETREATMENT SYSTEM PLAN VIEW
1/4" = 1'-0"



ELECTRICAL SCHEMATIC
NOT TO SCALE



LOCATION PLAN
NOT TO SCALE

PROJECT MANAGER	DATE
NES	2-2013
DRAWN BY RJM	DATE DRAWN 3-8-2013
CHECKED BY NES/BFK	DATE 3-8-2013
APPROVED BY NES	DATE 3-8-2013
SCALE As Noted	DATE ISSUED 3-8-2013

DAY ENVIRONMENTAL, INC.

REVISIONS | DATE | BY

day
DAY ENVIRONMENTAL, INC.
ENVIRONMENTAL CONSULTANTS
ROCHESTER, NEW YORK 14606
NEW YORK, NEW YORK 10170

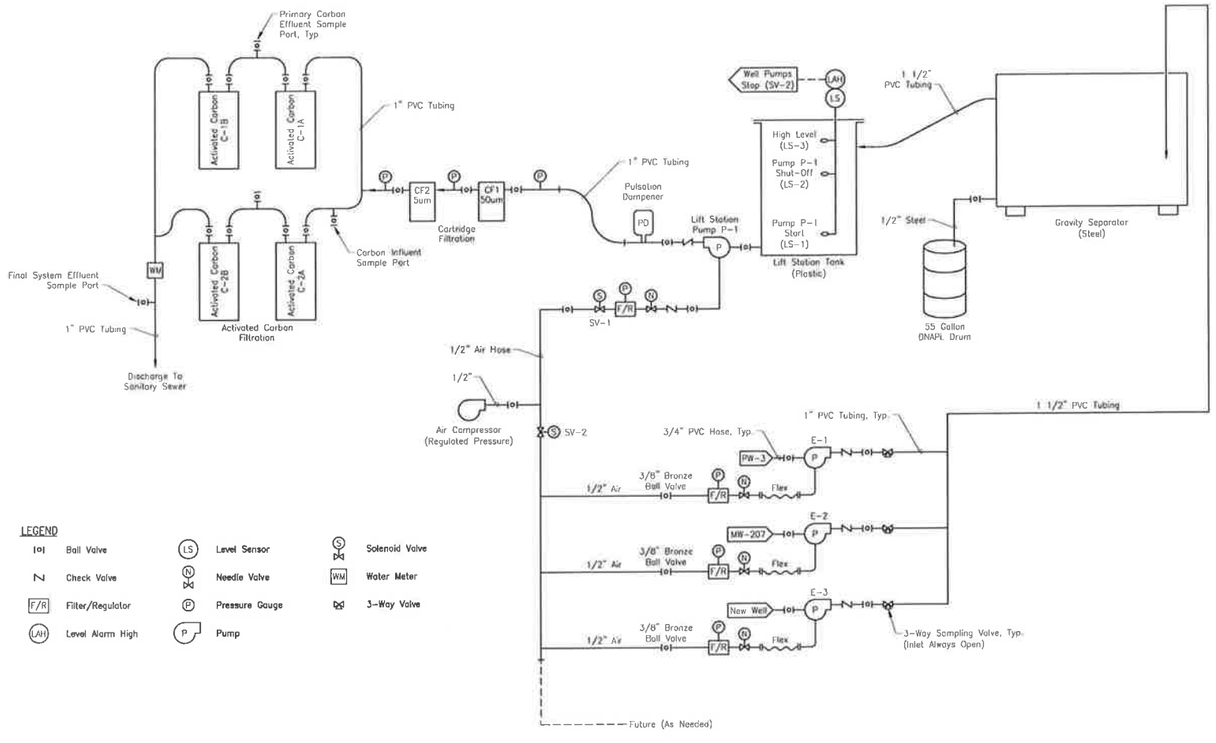
PROJECT TITLE
5 HUNT ROAD
JAMESTOWN, NEW YORK
REMEDIAL ACTION WORK PLAN - BCP #C907027

DRAWING TITLE
DNAPL Extraction System: Electrical Schematic, Equipment List, Plan View and Well Details

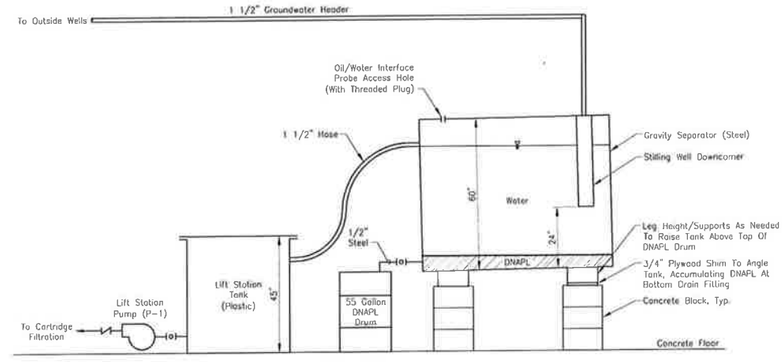
PROJECT NO.
3563S-04

FIGURE NO.
FIGURE 3

ANSI "D" (22x34)
DayEnv_AnsiD



PROCESS & INSTRUMENTATION SCHEMATIC
NOT TO SCALE



GRAVITY SEPARATOR DETAIL
NOT TO SCALE

PROJECT MANAGER	NES	DATE	2-2013
S.MANAGER	RJM	DATE ERRATA	3-6-2013
CHECKED BY	NES/BFK	DATE	3-6-2013
APPROVED BY	NES	DATE	3-6-2013
SCALE	As Noted	DATE REVISED	3-6-2013

DAY ENVIRONMENTAL, INC.
DRAWING ALTERATION
THIS DOCUMENT MAY NOT BE ALTERED WITHOUT THE WRITTEN CONSENT OF DAY ENVIRONMENTAL, INC.

7			
6			
5			
4			
3			
2			
1			
	REVISIONS	DATE	BY

day
DAY ENVIRONMENTAL, INC.
ENGINEERING & CONSULTING SERVICES
ROCHESTER, NEW YORK 14604
NEW YORK, NEW YORK 10170

PROJECT TITLE
5 HUNT ROAD
JAMESTOWN, NEW YORK

REMEDIAL ACTION WORK PLAN - BCP #C907027

DRAWING TITLE
DNAPL Extraction System:
Treatment Schematic and Gravity Separator Detail

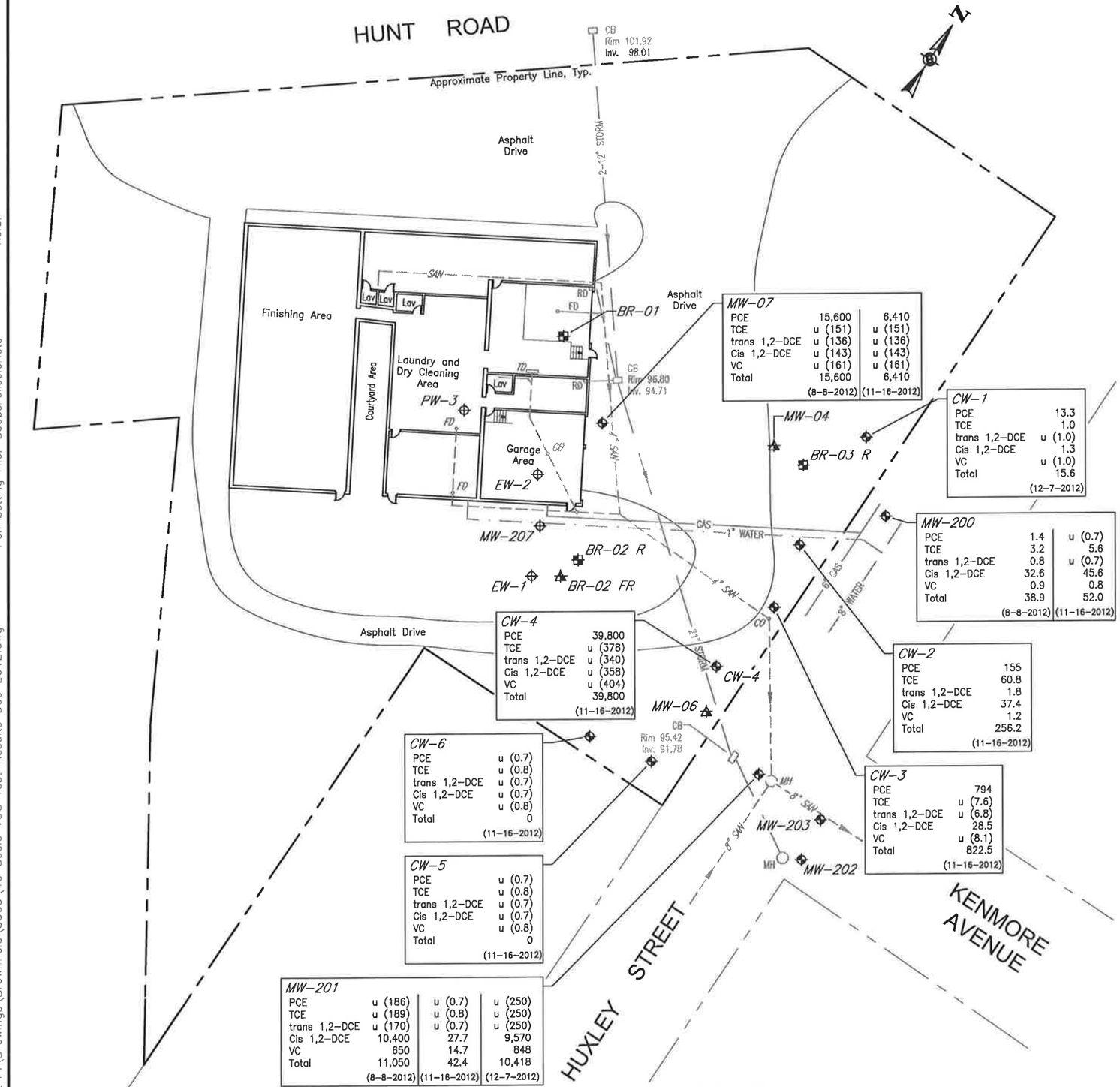
PROJECT NO
3563S-04

FIGURE NO
FIGURE 4

Reference Files Attached
REF1: PS Data Datasheet
REF2: Treatment Schematic.dwg
REF3:
REF4:
REF5:
REF6:
REF7:
REF8:
REF9:
REF10:

File Name: R:\Drawings\Remedial\3563\Treatment System\Wall Pkg Sheet.dwg
Layout Name: Layout4
Time Plotted: Wednesday, March 06, 2013 @ 07:26 AM
Pen Setting File: ADDayFullcolor.ctb

ANSI "D" (22x34)
DayEnv_AnsiD



LEGEND:

BR-03 R	Bedrock Monitoring Well
MW-04	Top of Rock/Fractured Rock Monitoring Well
CW-1	Overburden/Top of Till Monitoring Well
EW-1	DNAPL Extraction Well
PCE	Tetrachloroethene ug/L
TCE	Trichloroethene ug/L
trans 1,2-DCE	Trans 1,2 Dichloroethene ug/L
Cis 1,2-DCE	Cis 1,2 Dichloroethene ug/L
VC	Vinyl Chloride ug/L
Total	Total VOC's Detected ug/L
u	Constituent Not Detected At Detection Limits Shown In Parenthesis
(12-7-2012)	Date of Sample
CB	Catch Basin
FD	Floor Drain
MH	Manhole
Rim 100.83	Rim Elevation In Feet
Inv. 95.55	Invert Elevation In Feet
RD	Roof Drain
TD	Trench Drain
6" GAS	Gas Line (Approx 2.5 feet below grade)
8" SAN	Sanitary Sewer (Approx 5–7 feet below grade)
STORM	Storm Sewer (Approx 4–6 feet below grade)
8" WATER	Water Line (Approx 5–7 feet below grade)

NOTE:

Site Plan produced from drawings by Habiterra Associates, Thorsell, Kennedy, Casker, Arnone & Hedin. P.C. entitled "Addition and Renovations, Anderson Cleaners, Inc", drawings A–1 Floor Plan dated October 22, 1985 and L–1 Grading Plan and from notes of site visits by representatives of Day Environmental, Inc.

PROJECT MANAGER: RLK	DRAWN BY: RJM	SCALE: As Noted	DATE: 12-2012
	DATE DRAWN: 3-6-2013	DATE ISSUED: 3-6-2013	

day
DAY ENVIRONMENTAL, INC.
ENVIRONMENTAL CONSULTANTS
ROCHESTER, NEW YORK 14606
NEW YORK, NEW YORK 10170

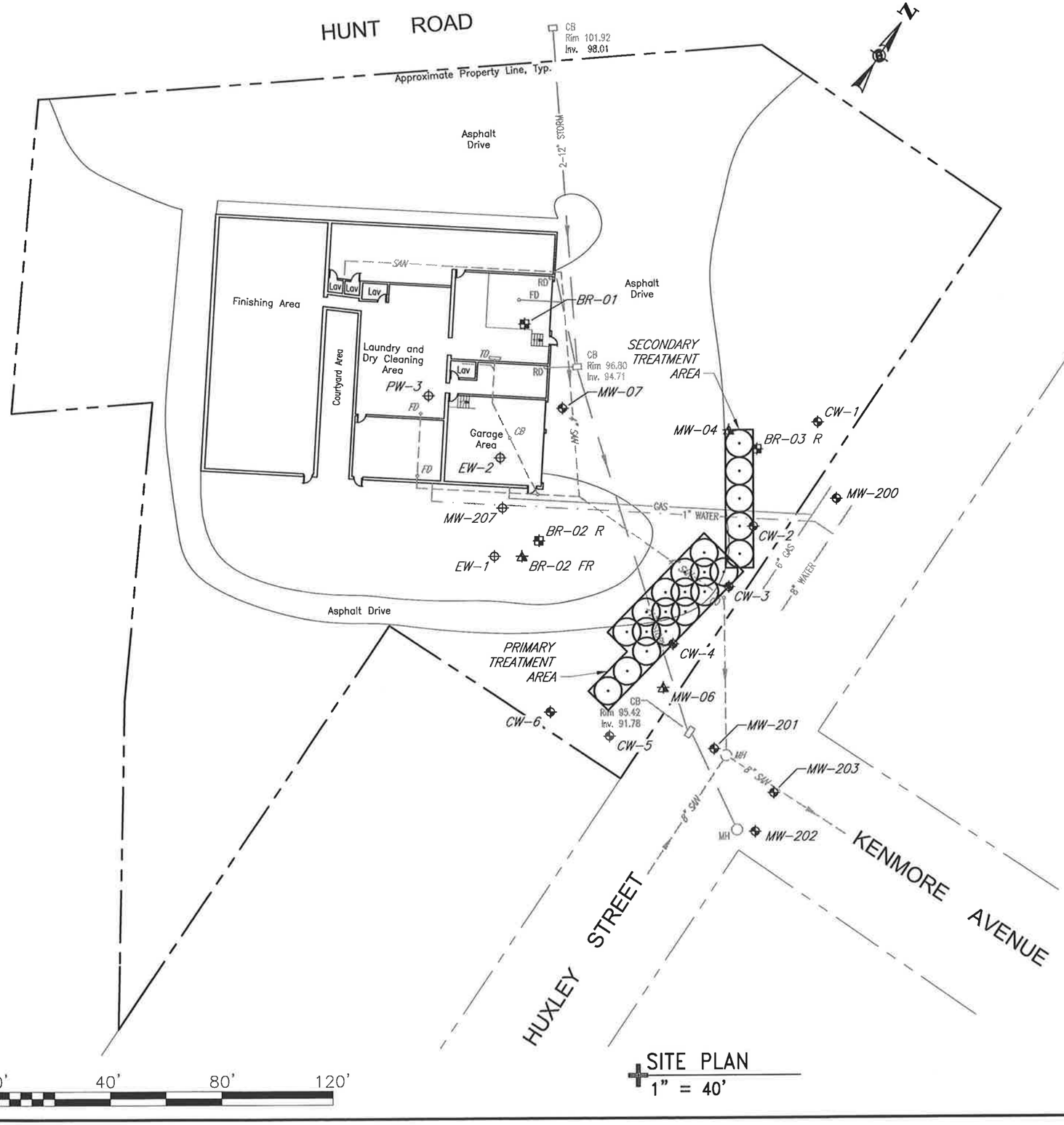
PROJECT TITLE
5 HUNT ROAD
JAMESTOWN, NEW YORK

REMEDIAL ACTION WORK PLAN - BCP #C907027

DRAWING TITLE
VOC Test Results: Overburden/Top Of Till Monitoring Wells

PROJECT NO.
3563S-04

FIGURE 5



LEGEND:

BR-03 R	Bedrock Monitoring Well
MW-04	Top of Rock/Fractured Rock Monitoring Well
CW-1	Overburden/Top of Till Monitoring Well
EW-1	DNAPL Extraction Well
	Proposed Injection Point With Assumed 5-Foot Radius of Influence
CB	Catch Basin
FD	Floor Drain
MH	Manhole
Rim 100.83	Rim Elevation In Feet
Inv. 95.55	Invert Elevation In Feet
RD	Roof Drain
TD	Trench Drain
6" GAS	Gas Line (Approx 2.5 feet below grade)
8" SAN	Sanitary Sewer (Approx 5-7 feet below grade)
STORM	Storm Sewer (Approx 4-6 feet below grade)
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NOTES:

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4. Elevation survey data determined by Michael J. Rodgers, LS, PC, and referenced to an arbitrary site wide datum. Elevations should be considered accurate to the degree implied by the method used.
5. Approximate depths of gas line, sanitary sewer, storm sewer and water line were obtained from a hand drawn plan from "Jamestown Board of Public Utilities, Anderson Cleaners Sewer Connection Map", dated October 2, 1985.

PROJECT MANAGER	RLK
DATE	1-2013
DRAWN BY	RJM
DATE DRAWN	3-6-2013
SCALE	As Noted
DATE ISSUED	3-7-2013

day
DAY ENVIRONMENTAL, INC.
ENVIRONMENTAL CONSULTANTS
ROCHESTER, NEW YORK 14606
NEW YORK, NEW YORK 10170

PROJECT TITLE
5 HUNT ROAD
JAMESTOWN, NEW YORK

REMEDIAL ACTION WORK PLAN - BCP #C907027

DRAWING TITLE
Proposed Plume Containment Treatment Areas

PROJECT NO.
3563S-04

FIGURE 6

SITE PLAN
1" = 40'

LEGEND:

BR-03 R	Bedrock Monitoring Well
MW-04	Top of Rock/Fractured Rock Monitoring Well
CW-1	Overburden/Top of Till Monitoring Well
EW-1	DNAPL Extraction Well
MW-208	Bioremediation Pilot Test Injection Well
CB	Catch Basin
FD	Floor Drain
MH	Manhole
Rim 100.83	Rim Elevation In Feet
Inv. 95.55	Invert Elevation In Feet
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TD	Trench Drain
6" GAS	Gas Line (Approx 2.5 feet below grade)
8" SAN	Sanitary Sewer (Approx 5–7 feet below grade)
STORM	Storm Sewer (Approx 4–6 feet below grade)
8" WATER	Water Line (Approx 5–7 feet below grade)

NOTES:

1. Site Plan produced from drawings by Habiterra Associates, Thorsell, Kennedy, Casker, Arnone & Hedin. P.C. entitled "Addition and Renovations, Anderson Cleaners, Inc", drawings A–1 Floor Plan dated October 22, 1985 and L–1 Grading Plan and from notes of site visits by representatives of Day Environmental, Inc.
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5. Approximate depths of gas line, sanitary sewer, storm sewer and water line were obtained from a hand drawn plan from "Jamestown Board of Public Utilities, Anderson Cleaners Sewer Connection Map", dated October 2, 1985.

PROJECT MANAGER: RLK	DRAWN BY: RJM	SCALE: As Noted
DATE: 2-2013	DATE DRAWN: 3-6-2013	DATE ISSUED: 3-6-2013

day
DAY ENVIRONMENTAL, INC.
ENVIRONMENTAL CONSULTANTS
ROCHESTER, NEW YORK 14606
NEW YORK, NEW YORK 10170

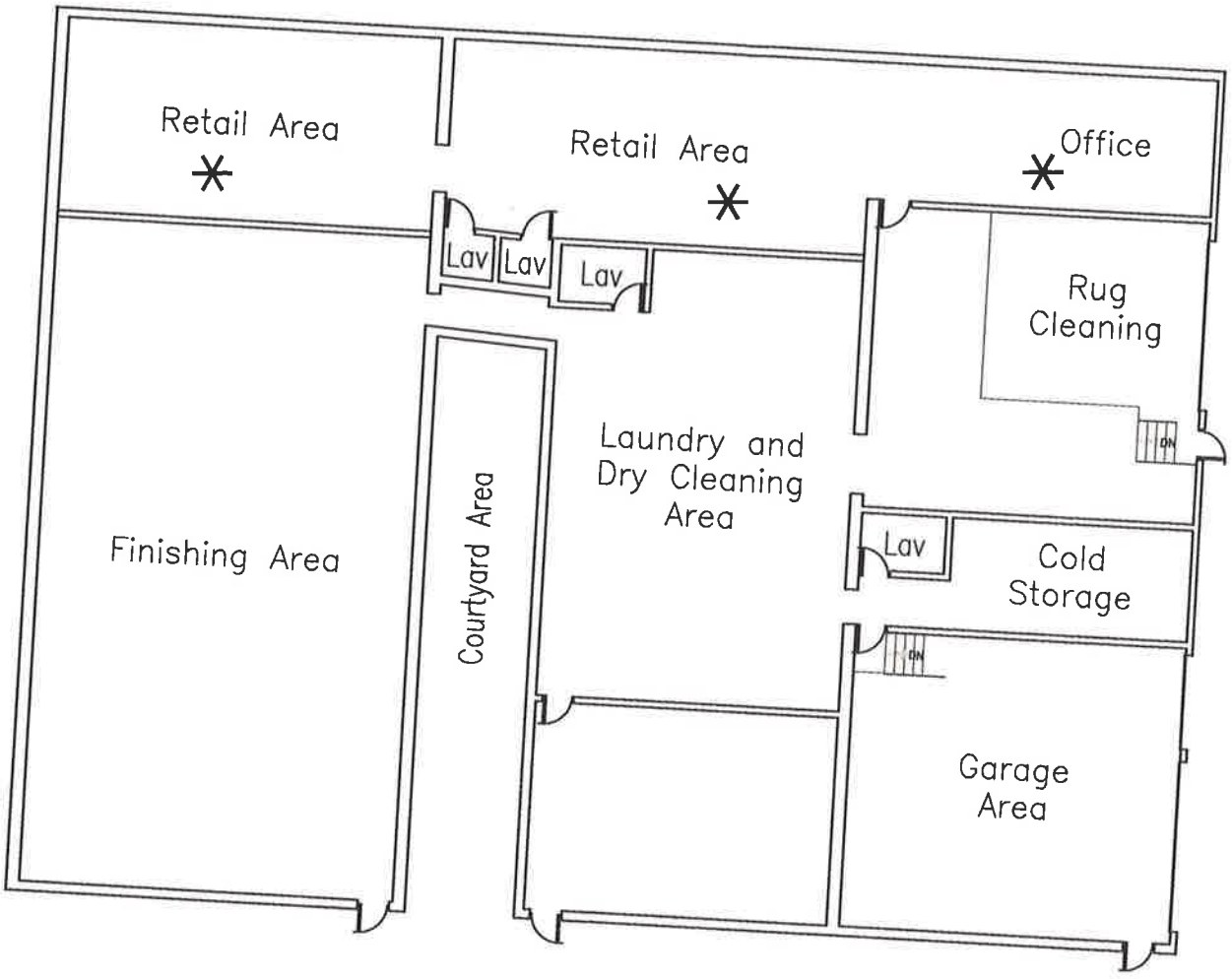
PROJECT TITLE: 5 HUNT ROAD JAMESTOWN, NEW YORK

REMEDIAL ACTION WORK PLAN - BCP #C907027

DRAWING TITLE: Anticipated Bioremediation Area

PROJECT NO. 3563S-04

FIGURE 7



FLOOR PLAN
1" = 20'

LEGEND:

✳ Proposed Indoor Air Sample Location

NOTES:

1. Site Plan produced from drawings by Habiterra Associates, Thorsell, Kennedy, Casker, Arnone & Hedin. P.C. entitled "Addition and Renovations, Anderson Cleaners, Inc", drawings A–1 Floor Plan dated October 22, 1985 and L–1 Grading Plan and from notes of site visits by representatives of Day Environmental, Inc.
2. DNAPL extraction well locations were obtained by tape measurement from existing site structure. Locations should be considered accurate to the degree implied by the method used.

DATE 3-7-2013 DRAWN BY RJM SCALE As Noted	DAY ENVIRONMENTAL, INC. ENVIRONMENTAL CONSULTANTS ROCHESTER, NEW YORK 14606 NEW YORK, NEW YORK 10170	PROJECT TITLE 5 HUNT ROAD JAMESTOWN, NEW YORK REMEDIAL ACTION WORK PLAN - BCP #C907207 DRAWING TITLE Proposed Indoor Air Sample Locations	PROJECT NO. 3563S-04 FIGURE 8

APPENDIX A

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN
BROWNFIELD CLEANUP PROGRAM
NYSDEC Site # C907027

5 HUNT ROAD
JAMESTOWN, NEW YORK

Prepared by: Day Environmental, Inc.
1563 Lyell Avenue
Rochester, New York 14604

Project No.: 3563S-04

Date: March 2013

TABLE OF CONTENTS

ATTACHMENTS

1.0 INTRODUCTION

This Health and Safety Plan (HASP) outlines the policies and procedures necessary to protect workers and the public from potential environmental hazards posed during site investigation and remediation activities conducted at the Anderson Cleaners facility located at 5 Hunt Road, Jamestown, New York (the Site) under the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP). As outlined in this HASP, the above activities shall be conducted in a manner to minimize the probability of injury, accident, or incident occurrence.

1.1 Background

The Site consists of approximately 2.4 acres of land currently improved by an approximate 11,400-square foot one-story brick and concrete block building. The building was constructed in phases with the southwest portion (i.e., used as a "finishing" area for folding and storing cleaned clothing and as retail space) constructed in the 1930s; the south-central (i.e., dry cleaning area) portion constructed in 1947, and the northern (offices) and eastern (garages) portion constructed in 1985. An exterior "courtyard/storage" area measuring approximately 10 feet by 60 feet separates the finishing area and the dry cleaning area.

A dry cleaning plant has operated at the Site since 1947 when the south-central portion of the current building was originally constructed. Between 1947 and 1978, Stoddard solvent was used as the primary cleaning fluid. In 1978, the method of cleaning was changed over to use tetrachloroethene (PCE) as the primary cleaning fluid. In 1985, a fire destroyed an approximate 8,000-square foot portion of the original building that housed offices and garages (i.e., the northern and eastern portions of the building, respectively). This fire did not directly impact the portion of the building that housed the dry cleaning operations. Following the fire, reconstruction/remodeling operations were undertaken resulting in the current structure.

Day Environmental, Inc. (DAY) completed various studies at the Site, which are summarized in a document titled Remedial Investigation/Remedial Alternatives Analysis Report, Anderson Cleaners Site, 5 Hunt Road, Jamestown, New York, BCP #C907027 dated March 2011. As described in this report, evidence of chlorinated volatile organic compound (VOC) contamination was detected in soil and groundwater at the Site. Concentrations of VOCs detected in some of the soil and groundwater samples exceeded NYSDEC recommended soil cleanup objectives and/or groundwater standards. Specifically, the contaminants of concern identified at the Site include:

- tetrachloroethene (PCE)
- trichloroethene (TCE)
- 1,1-dichloroethene (1,1-DCE)
- trans-1, 2-dichloroethene (trans-1, 2-DCE)
- cis-1, 2-dichloroethene (cis-1,2-DCE)
- vinyl chloride (VC)

In addition, dense non-aqueous phase liquid (DNAPL) containing elevated concentrations of the

above constituents has been identified in discrete locations of the Site (i.e., particularly beneath, and to the east, of the Garage Area of the Anderson Cleaners building) at depths of about 10 feet to 15 feet below the ground surface.

1.2 Scope of Work

The following field activities will be performed during investigation and remediation activities as part of the Brownfield Cleanup Program at this Site.

- Groundwater monitoring and sampling
- Remediation system installation (i.e., injection of chemical and/or biological amendments, test borings, groundwater monitoring well installation, well development, etc.)
- Operation of a DNAPL Extraction and Treatment System

This HASP can be modified to cover other site activities, when appropriate. The owner of the property, its contractors, and other site workers will be responsible for the development and/or implementation of health and safety provisions associated with normal construction activities or site activities. [Note: The operational requirements for the DNAPL Extraction and Treatment System are specified in an O & M Manual developed for this system. The training and HASP requirements for the DNAPL Extraction and Treatment System are specified in this O & M Manual.]

2.0 KEY PERSONNEL AND MANAGEMENT

The following personnel that will be assigned to the Site that must be in compliance with the training requirements outlined in 29 CFR 1910 and 1926.

2.1 Project Manager

The PM has the overall responsibility for the project and to assure that the goals of the site investigation and remediation program are attained in a manner consistent with the HASP requirements. The PM will coordinate with the SSO to ensure that the site investigation and remediation program goals are completed in a manner consistent with the HASP.

2.2 Site Safety Officer

The SSO has responsibility for administering the HASP relative to site activities. The SSO's operational responsibilities are personal and environmental monitoring, ensuring personal protective equipment maintenance, and assignment of appropriate personal protection levels. The SSO will be the main contact in any on-site emergency situation. The SSO will oversee field activities involved with safety and has the authority to stop work when unacceptable health or safety risks exist. The SSO is responsible for ensuring that DAY personnel on-site understand and comply with safety requirements.

2.3 Employee Safety Responsibility

DAY employees are responsible for personal safety as well as the safety of others in the area. DAY employees will use any equipment provided in a safe and responsible manner as directed by the SSO.

2.4 OSHA Records

Required records are maintained at DAY's Rochester, New York office.

2.5 Key Safety Personnel

The following individuals are anticipated to share responsibility for health and safety at the Site.

Associate in Charge	Raymond L. Kampff
Project Manager	Nathan E. Simon, P.E.
Site Safety Officer	Nathan E. Simon, P.E., Charles A. Hampton, or Thomas E. Roszak

3.0 SAFETY RESPONSIBILITY

Contractors, consultants, state or local agencies, or other parties, and their employees, involved with this BCP project are responsible for their own safety while on-site. Their employees are required to understand the information contained in this HASP, and must follow the recommendations that are made in this document.

4.0 JOB HAZARD ANALYSIS

There are many hazards associated with investigation and remediation work on a site, and this HASP discusses some of the anticipated hazards for this Site. The hazards listed below deal specifically with those hazards associated with the management of the impacted media (i.e., soil and groundwater impacted with chlorinated VOCs).

4.1 Chemical Hazards

Chemical substances can enter the unprotected body by inhalation, skin absorption, ingestion, or through a puncture wound (injection). A contaminant can cause damage to the point of contact or can act systemically, causing a toxic effect at a part of the body distant from the point of initial contact.

Lists of selected site-specific chlorinated VOCs that have been detected at the Site are presented below. The VOCs detected at the Site appear potentially attributable to past dry cleaning operations on the Site. This list also presents the permissible exposure limits (PELs) and levels that are considered immediately dangerous to life and health (IDLH) for the selected VOCs.

4.1.1 List of Potential Chemical Hazards

CONSTITUENT	EXPOSURE LIMITS	IDLH	TARGET ORGANS
Tetrachloroethene	100 ppm PEL	150 ppm	eyes, skin, respiratory system, liver, kidneys, CNS
Trichloroethene	100 ppm PEL	1000 ppm	eyes, skin, respiratory system, heart, liver, CNS
1,2-Dichloroethene (total)	200 ppm PEL	1000 ppm	eyes, respiratory system, CNS
Vinyl Chloride	1 ppm PEL	Not determined	liver, CNS, blood, respiratory system, lymphatic system, liver cancer

Notes:
PEL = OSHA Permissible Exposure Limits (TWA for 8-hour day)
IDLH = Immediately Dangerous to Life or Health Concentrations
CNS = Central Nervous System

The potential routes of exposure for these chemicals include inhalation, ingestion, skin absorption and skin/eye contact. The potential for exposure through any one of these routes will depend on the activity conducted. The most likely routes of exposure for the activities that are performed during site investigation and remediation of the Site include inhalation and skin contact.

If other chemicals are encountered during site investigation and remediation activities, this HASP may need to be modified to include those chemicals.

4.2 Physical Hazards

There are physical hazards associated with this project, which might compound the chemical hazards. Hazard identification, training, adherence to the planned site investigation and

remediation measures, and careful housekeeping may prevent many problems or accidents arising from physical hazards. Potential physical hazards associated with this project and suggested preventative measures include:

- Slip/Trip/Fall Hazards - Some areas may have wet surfaces that will greatly increase the possibility of inadvertent slips. Caution must be exercised when using steps and stairs due to slippery surfaces in conjunction with the fall hazard. Good housekeeping practices are essential to minimize the slip/trip/fall hazards.

- Small Quantity Flammable Liquids - Small quantities of flammable liquids will be stored in red "safety" cans and labeled according to contents.

- Electrical Hazards - Electrical devices and equipment shall be de-energized prior to working near them. All extension cords will be kept out of water, protected from crushing, and inspected regularly to ensure structural integrity. Temporary electrical circuits will be protected with ground fault circuit interrupters. Only qualified electricians are authorized to work on electrical circuits. Heavy equipment (e.g., backhoe, drill rig) shall not be operated within 10 feet of high voltage lines, unless proper protection from the high voltage lines is provided by the appropriate utility company.

- Noise - Work associated with heavy equipment often creates excessive noise. The effects of noise can include:

  - Workers being startled, annoyed, or distracted.

  - Physical damage to the ear resulting in pain, or temporary and/or permanent hearing loss.

  - Communication interference that may increase potential hazards due to the inability to warn of danger and proper safety precautions.

  Proper hearing protection will be worn as deemed necessary. In general, feasible administrative or engineering controls shall be utilized when on-site personnel are subjected to noise exceeding an 8-hour time weighted average (TWA) sound level of 90 d(B)A (decibels on the A-weighted scale). In addition, whenever employee noise exposures equal or exceed an 8-hour, time weighted average sound level of 85 d(B)A, employers shall administer a continuing, effective hearing conservation program as described in the Occupational Health and Safety Administration (OSHA) Regulations (29 Code of Federal Regulations [CFR] Part 1910.95).

- Heavy Equipment - Each morning before start-up, heavy equipment will be inspected to ensure safety equipment and devices are operational and ready for immediate use.

- Subsurface and Overhead Hazards - Before any excavation activity, efforts will be made to determine whether underground utilities and potential overhead hazards will be

encountered. Underground utility clearance must be obtained prior to subsurface work.

4.3 Environmental Hazards

Environmental factors such as weather, wild animals, insects, and irritant plants can pose a hazard when performing outdoor tasks. The SSO shall make every reasonable effort to alleviate these hazards should they arise.

4.3.1 Heat Stress

The combination of warm ambient temperature and protective clothing increases the potential for heat stress. In particular:

- Heat rash
- Heat cramps
- Heat exhaustion
- Heat stroke

Site workers will be encouraged to increase consumption of water or electrolyte-containing beverages such as Gatorade® when the potential for heat stress exists. In addition, workers are encouraged to take rests whenever they feel any adverse effects that may be heat-related. The frequency of breaks may need to be increased upon worker recommendation to the SSO.

4.3.2 Exposure to Cold

With outdoor work in the winter months, the potential exists for hypothermia and frostbite. Protective clothing greatly reduces the possibility of hypothermia in workers. However, personnel will be instructed to wear warm clothing and to stop work to obtain more clothing if they become too cold. Employees will also be advised to change into dry clothes if their clothing becomes wet from perspiration or from exposure to precipitation.

5.0 SITE CONTROLS

To prevent migration of contamination caused through tracking by personnel or equipment, work areas, and personal protective equipment staging/decontamination areas will be specified prior to beginning operations.

5.1 Site Zones

In areas where impacted materials present the potential for worker exposure, personnel entering the "exclusion zone" (EZ) must wear the mandated level of PPE. A "contaminant reduction zone" (CRZ) shall be established where personnel can begin personal and equipment decontamination procedures. This can reduce potential off-site migration of impacted media. Contaminated equipment or clothing will not be allowed outside the CRZ (e.g., on clean portions of the Site) unless properly containerized for disposal. Operational support facilities will be located outside the CRZ (i.e., in a "support zone"), and normal work clothing and support equipment are appropriate in this area. If possible, the support zone shall be located upwind of site investigation and remediation activities.

5.2 General

The following items will be requirements to protect the health and safety of workers during implementation of construction activities that disturb contaminated material.

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand to mouth transfer and ingestion of contamination shall not occur in the EZ and/or CRZ during disturbance of impacted soil or groundwater.
- Personnel admitted in the EZ shall be properly trained in health and safety techniques and equipment usage.
- No personnel shall be admitted in the EZ without the proper safety equipment.
- Proper decontamination procedures shall be followed before leaving the Site.

6.0 PROTECTIVE EQUIPMENT

This section addresses the various levels of personal protective equipment (PPE), which are or may be required at this Site. Personnel entering the EZ and CRZ shall be trained in the use of the anticipated PPE to be utilized.

6.1 Anticipated Protection Levels

TASK	PROTECTION LEVEL	COMMENTS/MODIFICATIONS
Site mobilization	D	
Site prep/construction of engineering controls	D	
Extrusive work (e.g., surveying, etc.)	D	
Intrusive work (e.g., advancement of test borings and wells, soil removal, etc.)	C/Modified D/D	Based on air monitoring, and SSO discretion
CRZ- Decontamination	C/Modified D/D	
Support zone	D	
Site breakdown and demobilization	D	

It is anticipated that work conducted, as part of the Site investigation and remediation will be performed in Level D, modified Level D and possibly level C PPE. If conditions are encountered that require higher levels of PPE (e.g., Level B or A), the work will immediately be stopped. The appropriate government agencies (e.g., NYSDEC, NYSDOH, etc.) will be notified, and the proper health and safety measures will be implemented (e.g., develop and implement engineering controls, upgrade in PPE, etc.).

6.2 Protection Level Descriptions

This section lists the minimum requirements for each protection level. Modifications to these requirements can be made upon approval of the SSO. If Level A, Level B, and/or Level C PPE is required, Site personnel that enter the EZ and/or CRZ must be properly trained and certified in the use of those levels of PPE.

6.2.1 Level D

Level D consists of the following:

- Safety glasses
- Hard hat when working around heavy equipment
- Steel-toed work boots
- Work clothing as prescribed by weather
- Hearing Protection

6.2.2 Modified Level D

Modified Level D consists of the following:

- Safety glasses with side shields
- Hardhat
- Steel-toed work boots
- Work gloves
- Protective gloves during sampling or handling of potential contaminated media
- Outer protective wear, such as Tyvek coverall [Tyveks (Sarans) and polyvinyl chloride (PVC) acid gear will be required when workers have a potential to be exposed to impacted liquids or impacted particulates].
- Hearing Protection

6.2.3 Level C

Level C consists of the following:

- Air-purifying respirator with appropriate cartridges
- Outer protective wear, such as Tyvek coverall [Tyveks (Sarans) and PVC acid gear will be required when workers have a potential to be exposed to impacted liquids or particulates].
- Hardhat
- Steel-toed work boots
- Nitrile, neoprene, or PVC overboots, if appropriate
- Nitrile, neoprene, or PVC gloves, if appropriate
- Face shield (when projectiles or splashes pose a hazard)

6.2.4 Level B

Level B protection consists of the items required for Level C protection with the exception that an air-supplied respirator is used in place of the air-purifying respirator. Level B PPE is not anticipated to be required during this site investigation and remediation project. If the need for level B PPE becomes evident, all site activities will cease until site conditions are further evaluated, and any necessary modifications to the HASP have been approved by the Project Manager, CIH or SSO. Subsequently, the appropriate safety measures (including Level B PPE) must be implemented prior to commencing site activities.

6.2.5 Level A

Level A protection consists of the items required for Level B protection with the addition of a fully encapsulating, vapor-proof suit capable of maintaining positive pressure. Level A PPE is not anticipated to be required during this site investigation and remediation project. If the need for Level A PPE becomes evident, all site activities will be ceased until site conditions are further evaluated, and any necessary modifications to the HASP have been approved by the Project Manager, CIH or SSO. Subsequently, the appropriate safety measures (including Level A PPE) must be implemented prior to commencing site activities.

6.3 Respiratory Protection

Any respirator used will meet the requirements of OSHA 29 CFR 1910.134. Both the respirator and cartridges specified shall be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910). Air purifying respirators shall not be worn if contaminant levels exceed designated use concentrations. The workers will wear respirators with approval for: organic vapors <1,000 parts per million (ppm); and dusts, fumes and mists with a TWA <0.05 mg/m^3.

No personnel who have facial hair, which interferes with the respirator's sealing surface, will be permitted to wear a respirator and will not be permitted to work in areas requiring respirator use.

Only workers who have been certified by a physician as being physically capable of respirator usage shall be issued a respirator. Personnel unable to pass a respiratory fit test or without medical clearance for respirator use will not be permitted to enter or work in areas on-site that require respirator protection.

7.0 DECONTAMINATION PROCEDURES

This section describes the procedures necessary to ensure that both personnel and equipment are free from contamination when they leave the EZ area.

7.1 Personnel Decontamination

Personnel involved with site investigation and remediation activities that involve disturbing impacted media will follow the decontamination procedures described herein to ensure that material, which workers may have contacted in the EZ and/or CRZ, does not result in personal exposure and is not spread to clean areas of the Site. This sequence describes the general decontamination procedure. The specific stages can vary depending on the Site, the task, and the protection level, etc.

1. Leave EZ and go to CRZ
2. Remove soil/debris from boots and gloves
3. Remove boots
4. Remove gloves
5. Remove Tyvek suit and discard, if applicable
6. Remove and wash respirator, if applicable
7. Go to support zone

7.2 Equipment Decontamination

Contaminated equipment shall be decontaminated in the transition zone before leaving the Site. Decontamination procedures can vary depending upon the contaminant involved, but may include sweeping, wiping, scraping, hosing, or steam cleaning the exterior of the equipment. Personnel performing this task will wear the proper PPE.

7.3 Disposal

Disposable clothing will be treated as contaminated waste and be disposed of properly. Liquids (e.g., decontamination water, etc.) generated by site investigation and remediation activities will be disposed of in accordance with applicable regulations.

8.0 AIR MONITORING

Air monitoring will be conducted during the advancement of test borings and monitoring well conversion/installation work. This ensures that respiratory protection is adequate to protect personnel against the chemicals that are encountered and that chemical contaminants are not migrating off-site. Additional air monitoring may be conducted at the discretion of the SSO.

The following chart describes the direct reading instrumentation that will be utilized and appropriate action levels.

Monitoring Devices	Action level	Level of PPE
Photoionization Detector (PID)	PID 0-5 ppm in breathing zone, sustained 5 minutes	Level D
	PID 5-10 ppm in breathing zone, sustained 5 minutes	Level C
	PID 10-100 ppm in breathing zone, sustained 5 minutes	Level B Stop work, evaluate the use of engineering controls
	PID >100 ppm in breathing zone	Level A

8.1 Particulate Monitoring

During implementation of site investigation and remediation activities where impacted materials may be disturbed, and particulates are generated (e.g., during excavations where dry and dusty conditions are encountered, air monitoring will include real-time monitoring for particulates using a real time air monitor (RTAM) at the perimeter of the EZ in accordance with the 1989 NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #4031, entitled "Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites. This TAGM uses an action level of 150 ug/m^3 (0.15 mg/m^3) over an integrated period not to exceed 15 minutes. If the action level is exceeded, or if visible dust is encountered, then work shall be discontinued until corrective actions are implemented. Corrective actions may include dust suppression, change in the way work is performed, upgrade of personal protective equipment, etc. Readings will be recorded and be available for review.

8.2 Volatile Organic Compound Monitoring

During implementation of site investigation and remediation activities where impacted materials may be disturbed, a PID will be used to monitor total volatile organic content of the ambient air.

The PID will prove useful as a direct reading instrument to aid in determining if current respiratory protection is adequate or needs to be upgraded. The SSO will take measurements before operations begin in an area to determine the amount of VOCs naturally occurring in the air. This is referred to as a background level. Levels of VOCs will continuously be measured in the air at active work sites, and at the CRZ zone when levels are detected above background in the work zone. Readings will be recorded and available for review.

8.3 Community Air Monitoring Program

The purpose of the Community Air Monitoring Program is to protect the general public from the potential release of volatile organic vapors. Such a release is not anticipated during the performance of the work covered by this HASP.

8.3.1 Vapor Emission Response Plan

During implementation of site investigation and remediation activities where impacted materials may be disturbed, VOCs will be monitored at the downwind perimeter of the work area. VOC concentrations will be monitored at regular intervals at the EZ zone and CRZ zone. The readings will be recorded in a field logbook by the SSO. If the ambient air concentration of VOC vapors exceeds 5 ppm above background at the perimeter of the work area, activities will be halted and monitoring continued. If the VOC vapor level decreases below 5 ppm above background, work activities will resume. During the work activities, if the VOC vapor levels are greater than 5 ppm but less than 25 ppm over background at the perimeter of the work area, activities will resume provided the VOC vapor level 200 feet downwind of the work area or half the distance to the nearest residential or commercial structure, whichever is less, is below 5 ppm above background.

If the VOC vapor level is above 25 ppm at the perimeter of the work area, activities will be shutdown. When work shutdown occurs, downwind air monitoring as directed by the SSO will be implemented to ensure the VOC emissions do not impact the building tenants, or the nearest residential or commercial structure at levels exceeding those specified in the Major Vapor Emission section described below.

8.3.2 Major Vapor Emission

If VOC concentrations greater than 5 ppm above background are identified 200 feet downwind from the work area, half the distance to the nearest residential or commercial structure, or in areas in the immediate vicinity where tenants may be exposed, work activities will be halted. If following the cessation of the work activities, or as the result of an emergency, VOC levels persist above 5 ppm above background then the air quality will be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20 foot zone), or in areas in the immediate vicinity where tenants are working. If efforts to abate the emission source are unsuccessful, and if VOC concentrations of 5 ppm above background or greater persist for more than 30 minutes in the 20 foot zone, then the Major Emission Response Plan described below shall be implemented. If VOC vapor levels greater than 10 ppm above background are measured 200 feet downwind from the work area or half the distance to the nearest residential or commercial

structure, whichever is less, the Major Emission Response Plan shall immediately be implemented.

8.3.3 Major Emission Response Plan

Upon activation, the following activities will be undertaken:

1. Emergency response contacts listed in Section 9.1 of this HASP will be notified.

2. Frequent air monitoring will be conducted at 30-minute intervals within the 20-foot zone. If two successive readings below action levels are measured, the air monitoring may be halted or modified by the SSO.

9.0 EMERGENCY RESPONSE

To provide first-line assistance to field personnel in the case of illness or injury, the following items will be made immediately available on the Site:

- First-aid kit
- Portable emergency eyewash
- Supply of clean potable water

9.1 Emergency Telephone Numbers

The following telephone numbers are listed in case there is an emergency at the Site:

Fire/Police Department:	911
Poison Control Center:	(800) 222-2122
NYSDEC Spill Hotline	(800) 457-7362
NYSDEC Contact Eugene W. Melnyk, PE	(716) 851-7220
NYSDOH Mathew Forcucci	(716) 847-4501
Day Environmental, Inc. Raymond L. Kampff	(585) 454-0210 (x108)
Anderson Cleaners Contact Mr. Michael Lyons	(716) 665-2473 (x234)
Nearest Hospital:	WCA Hospital 207 Foote Avenue Jamestown, New York
Hospital Phone Number:	(716) 487-0141
Directions to the Hospital (refer to Attachment A):	Exit Site and turn right (east) onto Hunt Road continue on Harding Avenue. Turn right (east) onto West 3rd Street. Follow West 3rd Street and turn right onto Washington Street. Continue on RT-60 south and take a left onto Institute Street. Turn right on Allen Street. Turn right on Foote Avenue. WCA Hospital is located at 207

Foote Avenue. Follow Emergency Room signs.

9.2 Evacuation

Although unlikely, it is possible that a site emergency could require evacuating all personnel from the Site. If required, the SSO will give the appropriate signal for site evacuation (i.e., hand signals, alarms, etc.).

All personnel shall exit the Site and shall congregate in an area upwind of the Site designated by the SSO. The SSO shall ensure that all personnel are accounted for. If someone is missing, the SSO will alert emergency personnel. The appropriate government agencies will be notified as soon as possible regarding the evacuation, and any necessary measures that may be required to mitigate the reason for the evacuation.

9.3 Medical Emergency

In the event of a medical emergency involving illness or injury to on-site personnel, the Site should be shutdown and immediately secured. The appropriate government agencies should be notified immediately. The area in which the injury or illness occurred should not be entered until the cause of the illness or injury is known. The nature of injury or illness should be assessed. If the victim appears to be critically injured, administer first aid and/or cardio pulmonary resuscitation (CPR) as needed. Instantaneous real-time air monitoring should be done in accordance with air monitoring outlined in Section 8.0 of this HASP.

9.4 Contamination Emergency

It is unlikely that a contamination emergency will occur; however, if such an emergency does occur, the Site should be shutdown and immediately secured. If an emergency rescue is needed, notify, Police, Fire Department and Emergency Medical Service (EMS) Units immediately. Advise them of the situation and request an expedient response. The appropriate government agencies should be notified immediately. The area in which the contamination occurred should not be entered until the arrival of trained personnel who are properly equipped with the appropriate PPE and monitoring instrumentation. (See also Section 8.0 of this HASP).

9.5 Fire Emergency

In the event of a fire on-site, the Site should be shutdown and immediately secured. The area in which the fire occurred should not be entered until the cause can be determined. All non-essential site personnel should be evacuated from the Site to the safe, secure pre-designated upwind area. Notify the Fire Department immediately. Advise the Fire Department of the situation and the identity of any hazardous material involved. The appropriate government agencies should be notified as soon as possible.

The four classes of fire along with their constituents are as follows:

Class A: Wood, cloth, paper, rubber, many plastics, and ordinary combustible materials.
Class B: Flammable liquids, gases and greases.
Class C: Energized electrical equipment.
Class D: Combustible metals such as magnesium, titanium, sodium, and potassium.

Small fires on-site may be actively extinguished; however, extreme care should be taken while conducting this operation. All fires should be approached from the upwind side if possible. Distance from on-site personnel to the fire should be close enough to ensure proper application of the extinguishing material, but far enough away to ensure that personnel are safe. The proper extinguisher should be utilized for the Class(s) of fire present on the site. If possible, the fuel source should be cut off or separated from the fire. Care must be taken when performing operations involving the shut-off values and manifolds, if present.

Examples of proper extinguishing agent as follows:

Class A: Water
Water with 1% AFFF Foam (Wet Water)
Water with 6% AFFF or Fluorprotein Foam
ABC Dry Chemical

Class B: ABC Dry Chemical
Purple K
Carbon Dioxide
Water with 6% AFFF Foam

Class C: ABC Dry Chemical
Carbon Dioxide

Class D: Metal-X Dry Powder

No attempt should be made against large fires, which should be handled by the Fire Department.

9.6 Spill or Air Release

In the event of a spill or air release of a hazardous material on-site, the Site should be shutdown and immediately secured. The area in which the spill or release occurred should not be entered until the cause can be determined and site safety can be evaluated. All non-essential site personnel should be evacuated from the Site to the safe, secure pre-designated upwind area. The appropriate government agencies should be notified as soon as possible. The spilled or released material should be immediately identified and appropriate containment measures should be implemented, if possible. Real-time air monitoring should be implemented as outlined in Section 8.0 of this HASP. If the material is unknown, Level B protection is mandatory. Samples of the material should be acquired to facilitate identification of the material.

9.7 Locating Containerized Waste or Buried Tanks

In the event that containerized waste (e.g., drums) or buried tanks are located during Site investigation and remediation activities, the site should be shutdown and immediately secured. The area in which containerized wastes and/or tanks are discovered should not be entered until site safety can be evaluated. All non-essential site personnel should be evacuated from the Site to the safe, secure pre-designated upwind area. The appropriate government agencies should be notified as soon as possible. The SSO shall monitor the area as outlined in Section 8.0 of this HASP.

Prior to any handling, containers and/or tanks will be visually assessed by the SSO to gain as much information as possible about their contents. As a precautionary measure, personnel shall assume that unlabelled containers contain hazardous materials until their contents are characterized. If the material is unknown, Level B protection is mandatory. To the extent possible based upon the nature of the containers encountered, actions may be taken to stabilize the area and prevent migration (e.g., placement of berms, etc.). Subsequent to initial visual assessment and any required stabilization, an environmental contractor will sample, test, remove, and dispose of any containers, tanks, and their contents.

10.0 CONFINED SPACE ENTRY PROGRAM

Although unlikely, confined space entry may occur during this project. Confined spaces include excavation trenches, utility vaults, etc. The Contractor will be responsible for identifying confined spaces prior to anyone entering them. Entry procedures into confined spaces will be completed in accordance with the requirements of 29 CFR 1910.146 (OSHA Permit-Required Confined Space Regulation). Only properly trained individuals shall be allowed to participate in confined space entries.

As shown in 29 CFR 1910.146, a "Confined Space" is defined as:

1. a space "large enough and so configured that an employee can bodily enter and perform assigned work";
2. a space that "has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits)"; and
3. a space "not designed for continuous employee occupancy".

As shown in 29 CFR 1910.146, a "Permit-Required Confined Space" is defined as:

1. a space that "contains or has a potential to contain a hazardous atmosphere";
2. a space that "contains a material that has the potential for engulfing an entrant";
3. a space that "has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section"; or
4. a space that "contains any other recognized serious safety and health hazards".

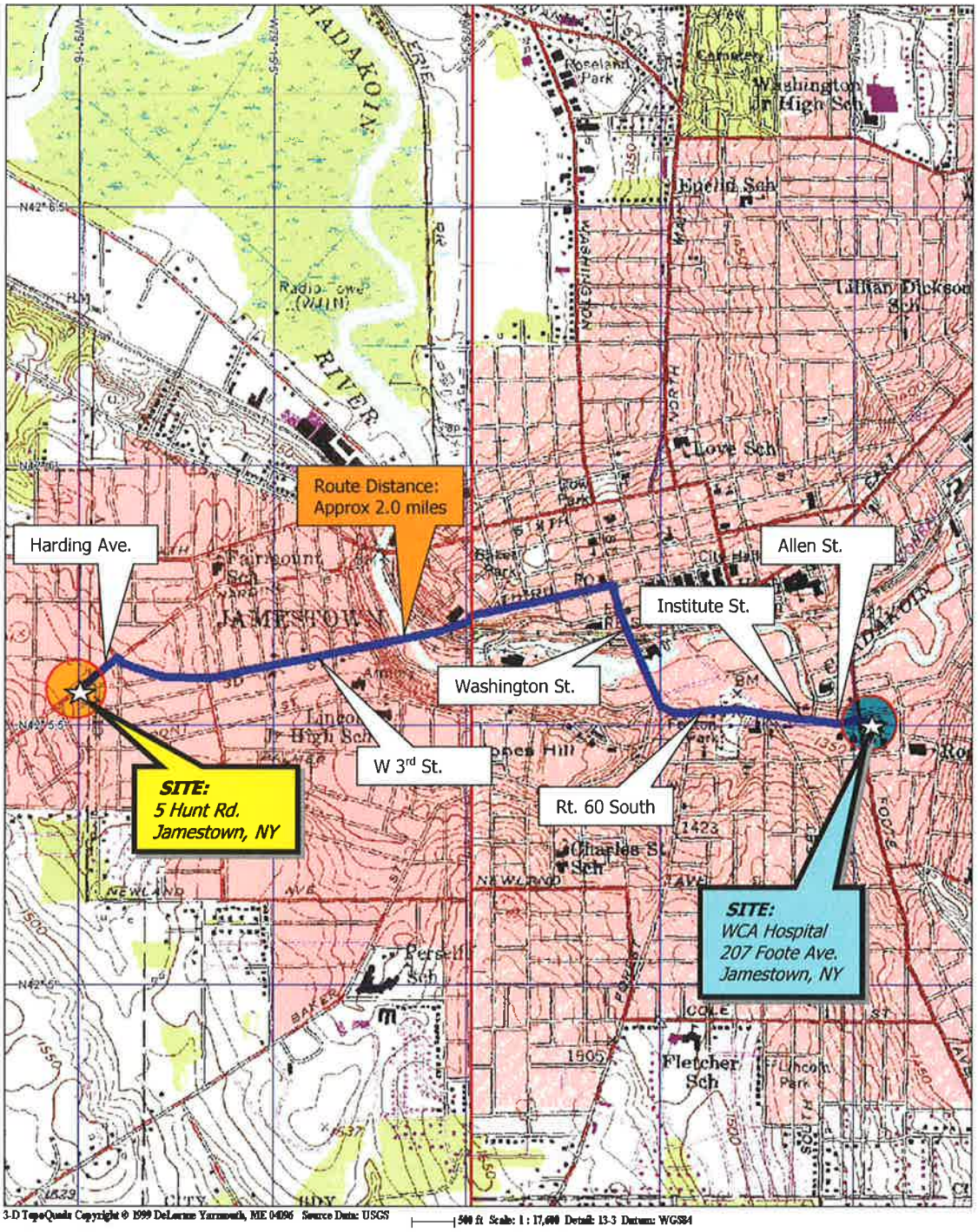
Permit-required confined space entry procedures do not need to be implemented if the four characteristics defining a permit-required confined space are eliminated (e.g., shore excavation walls, vent air in the confined space, etc.).

11.0 TRAINING REQUIREMENTS

DAY personnel involved with site investigation and remediation activities that have the potential to come into contact with VOC-impacted material are required to take the OSHA Hazwoper 40-hour training class. This training covers personal protective equipment, toxicological effects of various chemicals, handling of unknown tanks and drums, confined-space entry procedures, and electrical safety. This course is in compliance with OSHA requirements in 29 CFR 1910.120. In addition, employees receive annual 8-hour refresher training, and supervisory personnel receive an additional 8-hour training in handling hazardous waste operations. DAY personnel entering the EZ and CRZ zone will be trained in the provisions of this HASP.

ATTACHMENT A

Route to Hospital



Drawing Produced From: 3-D TopoQuads, DeLorme Map Co., referencing USGS quad map Lakewood (NY) 1979 and Jamestown (NY) 1979. Site Lat/Long: N42°05.55'– W79°16.00'

DATE 06-22-2004 DRAWN BY LRP SCALE 1" = 2000'	day DAY ENVIRONMENTAL, INC. ENVIRONMENTAL CONSULTANTS ROCHESTER, NEW YORK 14614-1008	PROJECT TITLE 5 HUNT ROAD JAMESTOWN, NY HEALTH AND SAFETY PLAN DRAWING TITLE ROUTE TO HOSPITAL	PROJECT NO. 3292S-03 FIGURE 1

APPENDIX B

OPERATION & MAINTENANCE MANUAL/DNAPL EXTRACTION AND TREATMENT SYSTEM

OPERATION AND MAINTENANCE MANUAL - DNAPL EXTRACTION AND TREATMENT SYSTEM

ANDERSON CLEANERS
BROWNFIELD CLEANUP PROGRAM
NYSDEC CODE #C907027
5 HUNT ROAD
JAMESTOWN, NEW YORK

Prepared for: Anderson Cleaners
5 Hunt Road
Jamestown, New York

Prepared by: Day Environmental, Inc.
1563 Lyell Ave
Rochester, New York 14606

Project #: 3563S-04

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APPENDICES

1.0 INTRODUCTION

Anderson Cleaners, Inc. (Anderson Cleaners) and Mr. Michael K. Lyons entered the Brownfield Cleanup Program (BCP) administered by the New York State Department of Environmental Conservation (NYSDEC) in 2005. Anderson Cleaners is located at 5 Hunt Road, Jamestown, New York (the Site), and the Site is identified as BCP Site #C907027.

The studies completed to date identified a Dense Non-Aqueous Phase Liquid (DNAPL), or undissolved tetrachloroethene (also known as perchloroethene, PCE, or Perc), in the subsurface at the Site. PCE was previously used as a dry cleaning solvent at the Site. The DNAPL acts as a source material for the following volatile organic compounds (VOCs) that have been detected within the groundwater:

- tetrachloroethene (PCE);
- trichloroethene (TCE);
- 1,1-dichloroethene (1,1 DCE);
- trans-1, 2-dichloroethene (trans-1, 2 DCE);
- cis-1, 2-dichloroethene (cis-1,2 DCE); and
- vinyl chloride (VC).

Day Environmental, Inc. (DAY) prepared a document titled *Draft Remedial Action Work Plan, Anderson Cleaners, 5 Hunt Road, Jamestown, New York NYSDEC Brownfield Cleanup Program Site #C907027* dated August 2012 (the Work Plan). Section 2.0 of this document describes the installation of a DNAPL Extraction and Treatment System. The NYSDEC approved the installation of this system in a letter dated June 27, 2012, and the DNAPL Extraction and Treatment System was installed at the Anderson Cleaners facility in July and August 2012.

This Operations and Maintenance (O&M) Manual, prepared by DAY on behalf of Anderson Cleaners, describes the requirements for the operation and maintenance of the DNAPL Extraction and Treatment System. This document also includes training requirements for operators of the system, procedures for the handling DNAPL collected, methods required to monitor the operation of the system and routine maintenance requirements. A copy of this O&M Manual should be kept at the Site, and updated as necessary should components of the system or operational requirements of the system be altered.

2.0 OPERATION AND MAINTENANCE

This section describes the measures required to operate, monitor and maintain the mechanical components of the DNAPL extraction and treatment system installed at the Site.

2.1 Training Requirements

Prior to operating, monitoring, or maintaining the components of the DNAPL Extraction and Treatment System at the Site, the operator must complete training sufficient to (1) identify the hazards presented by the required task(s), (2) assess the effectiveness of the treatment system, identify system failure, or treatment media saturation, and (3) comply with local, state, and/or federal regulations regarding the discharge of wastewater. This section describes these specific requirements for operators of the DNAPL Extraction and Treatment System.

2.1.1 Hazard Recognition

Tetrachloroethene and several of its breakdown products (i.e., TCE and VC) have been identified by the United States Occupational Safety and Health Administration (OSHA) as know or potential human carcinogens. OSHA has identified the following symptoms associated with exposure to PCE: depression of the central nervous system; damage to the liver and kidneys; impaired memory; confusion; dizziness; headache; drowsiness; and eye, nose, and throat irritation. Repeated dermal exposure may result in dermatitis. OSHA has set a permissible exposure limit (PEL) to PCE at 100 parts per million (ppm) over an 8-hour time weighed average (TWA) and a ceiling limit of 200 ppm for 5 minutes in any three hour period with a maximum peak of 300 ppm. Copies of International Chemical Safety Cards for PCE, TCE, 1,1 DCE, Cis-1,2 DCE, Trans-1,2 DCE and VC are provided in Appendix A. These documents provide additional information on the short and long term hazards from exposure to the above VOCs, along with guidance on reducing worker exposure.

PCE (and lesser concentrations of other VOCs) is present in the as both a DNAPL (undissolved PCE) and as a dissolved constituent of the groundwater. The dissolved VOC's are colorless, but would likely emit sweet and acrid chemical type odors The density of DNAPL is greater that the density of water, and therefore DNAPL may be encountered at the base of the extraction wells, in concave sections of the extraction system piping or hoses, and in the base of the settling tank (refer to Section 2.2). DNAPL at the Site ranges in color from amber to dark brown and it has the consistency similar to honey or molasses. DNAPL emits the same chemical odor as described above, but it is typically stronger than that detected in the groundwater. The dissolved phase of PCE is present in the groundwater throughout the extraction components of the system (i.e., extraction wells, piping, settling tank, particle filtration, etc.) and may persist though the VOC removal portions of the system as the carbon filters become saturated.

Operators may be exposed to DNAPL and/or to the dissolved phase of PCE, and other VOCs, during the operation and maintenance of this system. Prior to operation or conducting maintenance of the system, the operator should be trained to identify DNAPL and groundwater impacted with VOCs, and in the proper use and maintenance of the

appropriate personal protective equipment (PPE). PPE should be utilized when the operator is performing those tasks in which he/she may be exposed to the VOC-impacted groundwater and DNAPL extracted from the system, or to vapors that are released from the groundwater and DNAPL. When activities are undertaken that have the potential of encountering DNAPL and/or water impacted with VOCs, the operator must, at a minimum, wear disposable or nitrile, neoprene, or PVC gloves and don protective eyewear. Depending on the activities being performed, the use of an air-purifying respirator with cartridges specifically designed for organic vapors as defined in 29 CFR 1919.134 (i.e., suitable for organic vapors <1,000 parts per million (ppm); and dusts, fumes and mists with a TWA <0.05 mg/m^3). If direct contact with DNAPL and/or water impacted with VOCs that can not be limited or controlled, outer protective wear, such as Tyvek coverall, and a face shield (when splashes pose a hazard) may also be appropriate for operator protection. In addition, it is recommended that the treatment system area be well ventilated (i.e., by opening the overhead doors, use of exhaust fans, etc.) prior and during operation and maintenance tasks.

2.1.2 Treatment System Operator Training

The NYSDEC has issued requirements for education and training of wastewater treatment system operators for municipal wastewater treatment plants. Although the DNAPL Extraction and Treatment System covered by this O&M manual is not equivalent to a municipal wastewater treatment system in scope or volume, wastewater treatment operator experience is required in order to assess the overall effectiveness of system and to perform maintenance as required by this O&M manual. In order to operate and maintain the DNAPL extraction and treatment system at the Site, an operator should have the education and training equivalent to the Grade 1 operator as outlined in the NYSDEC Requirements for Wastewater Treatment Plant Operator Certification. These requirements can be found on the NYSDEC website: http://www.dec.ny.gov/chemical/23831.html. In addition, the operator of the DNAPL Extraction and Treatment System must receive instruction in hazard recognition, health and safety considerations and the handling of DNAPL and water impacted with VOCs consistent with the OSHA Hazard Communication standard, 29 CFR 1910.1200 from a qualified trainer who has satisfied the training requirements outlined in 29 CFR 1910 and 1926.

2.1.3 Waste Water Discharge Regulation

Groundwater treated by the system is discharged to the City of Jamestown municipal sewer system, operated by the Jamestown Board of Public Utilities. Prior to operation of the DNAPL Extraction and Treatment System, the operator should review and comply with sewer use regulations outlined in the Chapter 240, Article III of the City of Jamestown Municipal Codes. (http://ecode360.com/8319363#8319446). In addition, the operator should review and comply with state and federal guidelines for the discharge of treated wastewater, where applicable.

2.2 Operation and Maintenance Requirements

The basic processes utilized in the DNAPL Extraction and Treatment System are as follows:

- Groundwater Extraction – automated air-operated pumps are used to extract water and DNAPL from each of the extraction wells (i.e., PW-3, MW-207, EW-1 and EW-2), and transfer this water to the groundwater treatment system.

- Settling tank – extracted fluids (groundwater and DNAPL) are collected in this steel tank. A ball valve located at the bottom of the tank allows DNAPL to be decanted when significant quantities have accumulated in the settling tank. The groundwater collected with the DNAPL flows via gravity to an equalization tank through a discharge port positioned near the top of the tank.

- Particle Filtration – cartridge filters are used to remove fine insoluble particulates that are not removed in the settling tank

- VOC Removal – multi-stage GAC filtration is used for removal of VOC's.

- Discharge – the treatment system effluent is discharged to the sanitary sewer in accordance with the sewer discharge permit for the Site.

Figures showing the location of the extraction wells and a schematic showing the various components of the DNAPL Extraction and Treatment System are included in Appendix B.

2.3 Inspections

The DNAPL Extraction and Treatment System is designed for fully automated operation, and require minimal operator attention. However during operation the treatment system hardware, equipment and controls should be visually checked daily for integrity and leaks, and the applicable following treatment system parameters be recorded on daily logs and the Operators Log Form (see Appendix C) should be completed weekly (or more frequently, if warranted). This information should include:

- Volume of DNAPL in settling tank.

- Pressure drop across each cartridge filter (while feed pump is operating) – pressure drop across either not to exceed 10 psi.

- Pressure at inlet and outlet of first carbon filter on each train (while feed pump is operating) – inlet pressure not to exceed 30 psi.

- Totalized flow from totalizer at end of treatment system – daily flows should remain relatively consistent.

- Manual check of extraction well pumps – weekly verification of pump cycle/operation.

2.4 System Start-Up and Testing

System start-up from a routine shutdown condition will typically require only that the airline supply valve to the well pumps be opened (see the schematic in Appendix A).

In the event of a non-routine shutdown, such as may be required for emergency maintenance or if significant changes are made to the system, the operator will need to verify that: (i) all process piping connections are tight, process piping valves are open, and all air bleed and sample valves are closed; (ii) the air line valves to all pumps (well pumps and treatment system transfer pumps) are open; (iii) air compressor is powered and running; and (iv) check and log the parameters listed in item 2.3 above to confirm that system is operating in accordance with the design parameters.

Equipment manufacturer and model number information is listed on the equipment list provided in drawings included in Appendix B). Manufacturer's cut sheets and equipment manuals for select system components are provided as Appendix D.

2.5 Equipment Maintenance

System maintenance requirements and troubleshooting guidelines for components of the DNAPL Extraction and Treatment System are as follows:

- Tank High Level – high water level in a tank is an indication that a transfer pump is not functioning as intended. This can be the result of: (i) a stuck float control (free any hanging floats); (ii) a clogged inlet to the pump (y-strainer may need to be removed; (iii) excessive backpressure on the pump (clean or replace the downstream filters – media filters may need to be opened for removal of top solids/scum layer on media); or (iv) pump failure (see pump manual in Appendix D – pump can be tested offline with a bucket of water to determine if a pump mechanical failure has occurred).

- Excessive pressure at media filter inlet (>15 psi) - clean or replace the downstream filters – media filters (carbon) may need to be opened for removal of top solids/scum layer on media.

- Excessive pressure drop across cartridge filter (>15 psi) – replace cartridge filter.

- Well pumps not cycling and/or reduction in total daily flows observed using flow totalizer – can be caused by: (i) flow totalizer failure (remove and clean the totalizer, and check operation); (ii) pump is not operating correctly (remove pump and clean pump inlet strainer, or see pump manual in Appendix D for more detailed troubleshooting). If one or more pumps repeatedly become fouled with biological growth, chlorine tablets may be periodically placed in the wells as

needed to control growth on the pump inlet strainers; or (iii) reduced flow totalizer flows can also be the result of well pump shutoff due to treatment system high tank levels (see Tank High Level condition above).

- Media filter(s) exhibits signs of contaminant breakthrough – if sampling results indicate significant concentrations of VOCs are present in the effluent from the first GAC filter (i.e. minimal or no removal, and/or concentrations approaching the effluent permit limits), then the first media filter are to be changed out. During a filter change out, the second filer in the train will be moved up to serve as the primary (first) filter in the train, and a new virgin media filter will be placed online as the third filter in the train. Media service life is anticipated to be in excess of 6 months, so filter change out frequencies should be minimal.

- Leaking piping and/or equipment – if water is observed on the floor, the source of the leak is to be identified, and appropriate equipment repairs or replacement made.

- Ventilation system malfunction – if negative pressure is not observed within the tanks, check for power and proper operation of the ventilation fan, and confirm integrity and placement of vent piping and equipment covers; repair as needed.

- Compressor failure – With the exception of maintaining compressor oil level, there is no required routine maintenance for the compressor.

- Treatment system effluent flow meter not registering as much flow as usual. Reduction in total system daily flows can be caused by: (i) reduction in flow from extraction wells (see well pump counter issues and cause above); or (ii) effluent flow meter failure (remove and flush out/clean, and repair or replace as needed).

Recommended preventive maintenance activities and frequencies are listed below. These activities will be documented on a form provided in Appendix B, a copy of which will be maintained on-site for inspection.

Recommended Activity	Recommended Frequency
Check vent system	Weekly
Clean pump and valve inlet strainers	Weekly
Top off compressor with oil	Quarterly
Change out micron filters	Bi-monthly
Change out media filters	~Once per 6 months

2.6 DNAPL Disposal

Periodically, the DNAPL from the treatment system settling tank will be decanted into drums for disposal. The DNAPL collection drums must be located within a steel containment structure (i.e., an approximate 4.6 ft. by 4.6 ft. 0.25-inch thick steel pan that

has a continuous 2-inch high lip around the edge of the pad). In the event DNAPL spills during the transfer from the settling tank to the DNAPL collection drums, sorbent pads should be used to clean this spilled material, and the spent pads placed in the DNAPL collection drums. Once drums are filled to capacity Anderson Cleaners will coordinate with Solvents & Petroleum Services, Inc. (or similar) to remove/transport the drums to an appropriately licensed hazardous waste disposal facility in accordance with applicable regulations.

2.7 Emergency Response

To provide first-line assistance to field personnel in the case of illness or injury, the following items will be made immediately available on the Site:

- First-aid kit
- Portable emergency eyewash
- Supply of clean potable water

Emergency Telephone Numbers

The following telephone numbers are listed in case there is an emergency at the Site:

Fire/Police Department:	911
Poison Control Center:	(800) 222-2122
NYSDEC Spill Hotline	(800) 457-7362
NYSDEC Contact Eugene W. Melnyk, PE	(716) 851-7220
NYSDOH Mathew Forcucci	(716) 847-4501
Day Environmental, Inc. Raymond L. Kampff	(585) 454-0210 (x108)
Anderson Cleaners Contact Mr. Michael Lyons	(716) 665-2473 (x234)

Nearest Hospital

WCA Hospital
207 Foote Avenue
Jamestown, New York

Hospital Phone Number: (716) 487-0141

Directions to the Hospital

Exit Site and turn right (east) onto Hunt Road continue on Harding Avenue. Turn right (east) onto West 3rd Street. Follow West 3rd Street and turn right onto Washington Street. Continue on RT-60 south and take a left onto Institute Street. Turn right on Allen Street. Turn right on Foote Avenue. WCA Hospital is located at 207 Foote Avenue. Follow Emergency Room signs.

3.0 PERFORMANCE MONITORING

Performance monitoring needs for this system are as follows:

- Groundwater Extraction System – overall system performance will be monitored and evaluated based on: (i) groundwater volumes removed; (ii) zone of influence maintained by the groundwater extraction (static water levels periodically measured within monitoring wells located in proximity of the extraction wells); and (iii) groundwater contaminant reduction (VOC concentrations periodically measured in long-term monitoring wells).

- Groundwater Treatment System – overall system performance will be monitored and evaluated based on: (i) total groundwater volume treated; and (ii) final effluent water quality, and compliance with applicable sewer use discharge limits; and (iii) ability of the treatment system, to operate with limited unplanned downtime.

3.1 Monitoring Schedule

Baseline monitoring has been completed in accordance with the NYSDEC approved Work Plan. Specifically, prior to system startup, static water levels for the monitoring/extraction wells, and well yields (groundwater removal rates) for the extraction wells were documented. In conjunction with this monitoring hardware associated with the groundwater extraction wells (i.e., piping, valves, gauges, etc.) was visually inspected for proper operation, stress indicators (i.e., excessive bending, material discoloration, etc.) and leaking to assure that it was functioning as designed.

During the operation of the DNAPL Extraction and Treatment System, a Daily Log must be maintained that describes the operation of the system including the extraction wells that are activated, water meter readings/time of measurement, amount of DNAPL removed, filter change outs, problems encountered/resolution, etc. In addition, the Operator Monitoring Log presented in Appendix B must be completed at a minimum of once per week. Samples of the water entering the GAC filters and at the sewer discharge locations should be collected at a frequency of one sample for every 30,000 to 40,000 gallons for water discharged to the sanitary sewer, for the initial 100,000 gallons of water discharged and at a frequency of 20,000 to 25,000 gallons of water discharged (or less) thereafter. The samples collected should be submitted under chain-of-custody control to a NYSDOH ELAP-certified analytical laboratory for testing of Halogenated VOCs via USEPA Method 8260. The results of this testing will be used to determine if change out of the GAC filters is warranted.

Note: Change out of the GAC filters must be completed by personnel that have met the following requirements:

- A 40-hour hazardous materials safety and health course, as stipulated in 29 CFR 1926.65 3 (3); and
- An 8-hour refresher course per year after the 40-hour training has occurred (29CFR 1926.65 e(8)).

3.2 General Equipment Monitoring

Inspection and monitoring of the complete system will be conducted as detailed in Section 2.5 of this document. The DNAPL Extraction and Treatment System components to be monitored in this manner include, but are not limited to, the following:

- For the extraction well pump hardware
  - Valves;
  - Well pumps; and
  - General System Piping
- For the treatment system
  - Y-strainers located before air diaphragm pump P-1 and P-2;
  - Air diaphragm pump P-1
  - In-line pH probe;
  - In-line pressure gauges;
  - Cartridge filters;
  - Activated Carbon Column Filters;
  - Final effluent flow meter;
  - Air compressor; and
  - General system piping.

A complete list of components to be checked is provided in the Operators Log Form, presented in Appendix B. Maintenance and repair will be initiated immediately if equipment readings are not within their typical range, equipment is observed to be malfunctioning, and/or the system is not performing within specifications.

3.3 Reporting Requirements

Copies of daily operational logs, maintenance reports and other information generated during regular operations must be maintained at the Site. Reports, completed forms, analytical laboratory test results, and other relevant information generated will be made available upon request to the NYSDEC, and pertinent information will be summarized and submitted to NYSDEC as part of status reports that will be submitted bi-annually (or more frequently if warranted).

Appendix A

International Chemical Safety Cards

TETRACHLOROETHYLENE

ICSC: 0076

1,1,2,2-Tetrachloroethylene
Perchloroethylene
Tetrachloroethene
C_2Cl_4 / $Cl_2C=CCl_2$
Molecular mass: 165.8

ICSC # 0076
CAS # 127-18-4
RTECS # KX3850000
UN # 1897
EC # 602-028-00-4
April 13, 2000 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings: use appropriate extinguishing media.
EXPLOSION			
EXPOSURE		STRICT HYGIENE! PREVENT GENERATION OF MISTS!	
•INHALATION	Dizziness. Drowsiness. Headache. Nausea. Weakness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety goggles , face shield .	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical	Separated from metals ,(see Chemical Dangers), food and feedstuffs . Keep in the dark. Ventilation along the floor.	Do not transport with food and feedstuffs. Marine pollutant. Xn symbol N symbol

enter the environment. Personal protection: filter respirator for organic gases and vapours.		R: 40-51/53 S: (2-)23-36/37-61 UN Hazard Class: 6.1 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0076

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

TETRACHLOROETHYLENE

ICSC: 0076

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air.

CHEMICAL DANGERS:
On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes (hydrogen chloride, phosgene, chlorine). The substance decomposes slowly on contact with moisture producing trichloroacetic acid and hydrochloric acid. Reacts with metals such as aluminium, lithium, barium, beryllium.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 25 ppm as TWA, 100 ppm as STEL; A3 (confirmed animal carcinogen with unknown relevance to humans); BEI issued; (ACGIH 2004).
MAK: skin absorption (H);
Carcinogen category: 3B;
(DFG 2004).
OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 3-hours)
NIOSH REL: Ca Minimize workplace exposure concentrations. See Appendix A
NIOSH IDLH: Ca 150 ppm See: 127184

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation and by ingestion.

INHALATION RISK:
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes , the skin and the respiratory tract . If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. The substance may cause effects on the central nervous system. Exposure at high levels may result in unconsciousness.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidneys. This substance is probably carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 121°C
Melting point: -22°C
Relative density (water = 1): 1.6
Solubility in water, g/100 ml at 20°C: 0.015
Vapour pressure, kPa at 20°C: 1.9
Relative vapour density (air = 1): 5.8
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.09
Octanol/water partition coefficient as log Pow: 2.9

ENVIRONMENTAL DATA

The substance is toxic to aquatic organisms. The substance may cause long-term effects in the aquatic environment.

NOTES

Depending on the degree of exposure, periodic medical examination is suggested. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert. Card has been partly updated in April 2005. See section Occupational Exposure Limits.

Transport Emergency Card: TEC (R)-61S1897

NFPA Code: H2; F0; R0;

ADDITIONAL INFORMATION	

ICSC: 0076 **TETRACHLOROETHYLENE**

IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

TRICHLOROETHYLENE

ICSC: 0081

1,1,2-Trichloroethylene
Trichloroethene
Ethylene trichloride
Acetylene trichloride
C_2HCl_3 / $ClCH=CCl_2$
Molecular mass: 131.4

ICSC # 0081
CAS # 79-01-6
RTECS # KX4550000
UN # 1710
EC # 602-027-00-9
April 10, 2000 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible under specific conditions. See Notes.		In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION		Prevent build-up of electrostatic charges (e.g., by grounding).	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS! STRICT HYGIENE!	
•INHALATION	Dizziness. Drowsiness. Headache. Weakness. Nausea. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.
•SKIN	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety spectacles, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Give one or two glasses of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Personal protection: filter respirator for organic gases and vapours adapted to the airborne	Separated from metals (see Chemical Dangers), strong bases, food and feedstuffs . Dry. Keep in the dark.	Do not transport with food and feedstuffs. Marine pollutant.

concentration of the substance. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT let this chemical enter the environment.	Ventilation along the floor. Store in an area without drain or sewer access.	T symbol R: 45-36/38-52/53-67 S: 53-45-61 UN Hazard Class: 6.1 UN Packing Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0081

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

TRICHLOROETHYLENE

ICSC: 0081

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air. As a result of flow, agitation, etc., electrostatic charges can be generated.

CHEMICAL DANGERS:
On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes (phosgene , hydrogen chloride). The substance decomposes on contact with strong alkali producing dichloroacetylene , which increases fire hazard. Reacts violently with metal powders such as magnesium, aluminium, titanium, and barium. Slowly decomposed by light in presence of moisture, with formation of corrosive hydrochloric acid.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 50 ppm as TWA; 100 ppm as STEL; A5; BEI issued; (ACGIH 2004).
MAK:
Carcinogen category: 1; Germ cell mutagen group: 3B;
(DFG 2007).
OSHA PEL†: TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)
NIOSH REL: Ca See Appendix A See Appendix C
NIOSH IDLH: Ca 1000 ppm See: 79016

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes and the skin . Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system , resulting in respiratory failure . Exposure could cause lowering of consciousness.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the central nervous system , resulting in loss of memory. The substance may have effects on the liver and kidneys (see Notes). This substance is probably carcinogenic to humans.

PHYSICAL PROPERTIES

Boiling point: 87°C
Melting point: -73°C
Relative density (water = 1): 1.5
Solubility in water, g/100 ml at 20°C: 0.1

Relative density of the vapour/air-mixture at 20°C (air = 1): 1.3
Auto-ignition temperature: 410°C
Explosive limits, vol% in air: 8-10.5

	Vapour pressure, kPa at 20°C: 7.8 Relative vapour density (air = 1): 4.5	Octanol/water partition coefficient as log Pow: 2.42 Electrical conductivity: 800pS/m
ENVIRONMENTAL DATA	The substance is harmful to aquatic organisms. The substance may cause long-term effects in the aquatic environment.	

NOTES

Combustible vapour/air mixtures difficult to ignite, may be developed under certain conditions. Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is suggested. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert.

Transport Emergency Card: TEC (R)-61S1710

NFPA Code: H2; F1; R0;

Card has been partially updated in October 2004: see Occupational Exposure Limits, EU Classification, Emergency Response.

Card has been partially updated in April 2010: see Occupational Exposure Limits, Ingestion First Aid, Storage.

ADDITIONAL INFORMATION

ICSC: 0081 **TRICHLOROETHYLENE**

IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

ICSC: 0083

1,1-Dichloroethene
1,1-Dichloroethylene
VDC
$C_2H_2Cl_2$ / $H_2C=CCl_2$
Molecular mass: 97

ICSC # 0083
CAS # 75-35-4
RTECS # KV9275000
UN # 1303 (stabilized)
EC # 602-025-00-8
April 13, 2000 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Extremely flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		PREVENT GENERATION OF MISTS!	
•INHALATION	Dizziness. Drowsiness. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration if indicated. Refer for medical attention.
•SKIN	Redness. Pain.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
•EYES	Redness. Pain.	Safety goggles, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION	Abdominal pain. Sore throat. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an expert! Remove all ignition sources.	Fireproof. Provision to contain effluent from fire extinguishing. Separated from	Airtight. Unbreakable packaging; put breakable packaging into closed

Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Do NOT let this chemical enter the environment. Personal protection: complete protective clothing including self-contained breathing apparatus.	incompatible materials (see Chemical Dangers). Cool. Keep in the dark. Store only if stabilized.	unbreakable container. Marine pollutant. Note: D F+ symbol Xn symbol R: 12-20-40 S: 2-7-16-29-36/37-46 UN Hazard Class: 3 UN Packing Group: I

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0083

International Chemical Safety Cards

ICSC: 0083

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
VOLATILE COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air and may travel along the ground; distant ignition possible. Vinylidine chloride monomer vapours are uninhibited and may form polymers in vents or flame arresters of storage tanks, resulting in blockage of vents.

CHEMICAL DANGERS:
The substance can readily form explosive peroxides. The substance willl polymerize readily due to heating or under the influence of oxygen, sunlight, copper or aluminium, with fire or explosion hazard. May explode on heating or on contact with flames. The substance decomposes on burning producing toxic and corrosive fumes (hydrogen chloride , phosgene). Reacts violently with oxidants.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 5 ppm as TWA; A4 (not classifiable as a human carcinogen); (ACGIH 2004).
MAK: 2 ppm, 8.0 mg/m³;
Peak limitation category: II(2); Carcinogen category: 3B; Pregnancy risk group: C; (DFG 2004).
OSHA PEL†: none
NIOSH REL: Ca See Appendix A
NIOSH IDLH: Ca N.D. See: IDLH INDEX

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes, the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. Exposure at high levels could cause lowering of consciousness.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the kidneys and liver .

Boiling point: 32°C Melting point: -122°C Relative density (water = 1): 1.2	Relative density of the vapour/air-mixture at 20°C (air = 1): 2.5 Flash point:

PHYSICAL PROPERTIES	Solubility in water, g/100 ml at 25°C: 0.25 Vapour pressure, kPa at 20°C: 66.5 Relative vapour density (air = 1): 3.3	-25°C c.c. Auto-ignition temperature: 570°C Explosive limits, vol% in air: 5.6-16 Octanol/water partition coefficient as log Pow: 1.32
ENVIRONMENTAL DATA	The substance is harmful to aquatic organisms. 	

NOTES

Depending on the degree of exposure, periodic medical examination is suggested. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. Card has been partly updated October 2004 and in April 2005. See section Occupational Exposure Limits.

Transport Emergency Card: TEC (R)-30S1303

NFPA Code: H2; F4; R2;

ADDITIONAL INFORMATION

ICSC: 0083

IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

1,2-DICHLOROETHYLENE (cis/trans MIXTURE)

ICSC: 0436

1,2-DICHLOROETHYLENE (cis/trans MIXTURE)
1,2-Dichloroethene
Acetylene dichloride
sym-Dichloroethylene
$C_2H_2Cl_2$ / ClCH=CHCl
Molecular mass: 96.95

CAS # 540-59-0
RTECS # KV9360000
ICSC # 0436
UN # 1150
EC # 602-026-00-3

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Powder, water spray, foam, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		STRICT HYGIENE!	
▪ INHALATION	Cough. Sore throat. Dizziness. Nausea. Drowsiness. Weakness. Unconsciousness. Vomiting.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
▪ SKIN	Dry skin.	Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
▪ EYES	Redness. Pain.	Safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
▪ INGESTION	Abdominal pain. (Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Ventilation. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in dry sand or inert absorbent and remove to safe place. Do NOT wash away into sewer (extra personal protection: self-contained breathing apparatus).	Fireproof. See Chemical Dangers.	F symbol Xn symbol R: 11-20-50/53 S: (2-)7-16-29-61 Note: C UN Hazard Class: 3 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0436

International Chemical Safety Cards

1,2-DICHLOROETHYLENE (cis/trans MIXTURE)

ICSC: 0436

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The vapour is heavier than air and may travel along the ground; distant ignition possible.

CHEMICAL DANGERS:
The substance decomposes on heating and on burning producing toxic and corrosive fumes including hydrogen chloride. Reacts with strong oxidants. Reacts with potassium hydroxide, copper or copper alloys producing toxic chloroacetylene which is spontaneously flammable in contact with air. Attacks some form of plastic.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV (as TWA): 200 ppm; 793 mg/m^3 (ACGIH 1997).
OSHA PEL: TWA 200 ppm (790 mg/m^3)
NIOSH REL: TWA 200 ppm (790 mg/m^3)

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation of its vapour and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20° C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes and the respiratory tract. The substance may cause effects on the central nervous system at high level , resulting in narcosis.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The liquid defats the skin.

	NIOSH IDLH: 1000 ppm	
PHYSICAL PROPERTIES	Boiling point: 60.3(cis); 48.0-48.5 (trans)°C Melting point: -81.5(cis); -49.4 (trans)°C Relative density (water = 1): 1.28 (cis); 1.26(trans) Solubility in water: poor Vapour pressure, kPa at 20°C: 24.0 (cis), 35.3(trans)	Relative vapour density (air = 1): 3.34 Flash point: 6°C c.c.(cis); 2-4°C c.c. (trans) Auto-ignition temperature: 460°C Explosive limits, vol% in air: 9.7-12.8 Octanol/water partition coefficient as log Pow: 1.86(cis); 2.09(trans)
ENVIRONMENTAL DATA		

NOTES

Dioform is a trade name.

Transport Emergency Card: TEC (R)-30G30
NFPA Code: H2; F3; R2;

ADDITIONAL INFORMATION

ICSC: 0436 **1,2-DICHLOROETHYLENE (cis/trans MIXTURE)**

IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and IDLH values.

International Chemical Safety Cards

VINYL CHLORIDE

ICSC: 0082

Chloroethene
Chloroethylene
VCM
C_2H_3Cl / $H_2C=CHCl$
Molecular mass: 62.5
(cylinder)

ICSC # 0082
CAS # 75-01-4
RTECS # KU9625000
UN # 1086 (stabilized)
EC # 602-023-00-7
April 13, 2000 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Extremely flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking.	Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out; in other cases extinguish with powder, carbon dioxide.
EXPLOSION	Gas/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools.	In case of fire: keep cylinder cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE		AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
•INHALATION	Dizziness. Drowsiness. Headache. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	ON CONTACT WITH LIQUID: FROSTBITE.	Protective gloves. Cold-insulating gloves. Protective clothing.	ON FROSTBITE: rinse with plenty of water, do NOT remove clothes.
•EYES	Redness. Pain.	Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION		Do not eat, drink, or smoke during work.	

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Consult an	Fireproof. Separated from incompatible	

expert! Ventilation. Remove all ignition sources. Personal protection: complete protective clothing including self-contained breathing apparatus.	materials .(See Chemical Dangers.) Cool. Store only if stabilized.	Note: D F+ symbol T symbol R: 45-12 S: 53-45 UN Hazard Class: 2.1

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0082

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

VINYL CHLORIDE

ICSC: 0082

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS COMPRESSED LIQUEFIED GAS , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:
The gas is heavier than air, and may travel along the ground; distant ignition possible. Vinyl chloride monomer vapours are uninhibited and may form polymers in vents or flame arresters of storage tanks, resulting in blockage of vents.

CHEMICAL DANGERS:
The substance can under specific circumstances form peroxides, initiating explosive polymerization. The substance will polymerize readily due to heating and under the influence of air, light and on contact with a catalyst, strong oxidizing agents and metals such as copper and aluminium, with fire or explosion hazard. The substance decomposes on burning producing toxic and corrosive fumes (hydrogen chloride , phosgene). Attacks iron and steel in the presence of moisture.

OCCUPATIONAL EXPOSURE LIMITS:
TLV: 1 ppm as TWA; A1 (confirmed human carcinogen); (ACGIH 2004).
MAK:
Carcinogen category: 1;
(DFG 2004).
OSHA PEL: 1910.1017 TWA 1 ppm C 5 ppm 15-minute
NIOSH REL: Ca See Appendix A
NIOSH IDLH: Ca N.D. See: IDLH INDEX

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation.

INHALATION RISK:
A harmful concentration of this gas in the air will be reached very quickly on loss of containment.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance is irritating to the eyes . The liquid may cause frostbite. The substance may cause effects on the central nervous system . Exposure could cause lowering of consciousness. Medical observation is indicated.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
The substance may have effects on the liver, spleen, blood andperipheral blood vessels, and tissue and bones of the fingers. This substance is carcinogenic to humans.

PHYSICAL

Boiling point: -13°C
Melting point: -154°C
Relative density (water = 1): 0.9 (liquid)
Density: 8 (vapour) at 15°C
Relative vapour density (air = 1): 2.2
Flash point:
-78°C c.c.

PROPERTIES	g/l Solubility in water: none	Auto-ignition temperature: 472°C Explosive limits, vol% in air: 3.6-33 Octanol/water partition coefficient as log Pow: 0.6
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to ground water contamination.	

NOTES

Depending on the degree of exposure, periodic medical examination is suggested. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. An added stabilizer or inhibitor can influence the toxicological properties of this substance, consult an expert. Card has been partly updated in April 2005. See section Occupational Exposure Limits.

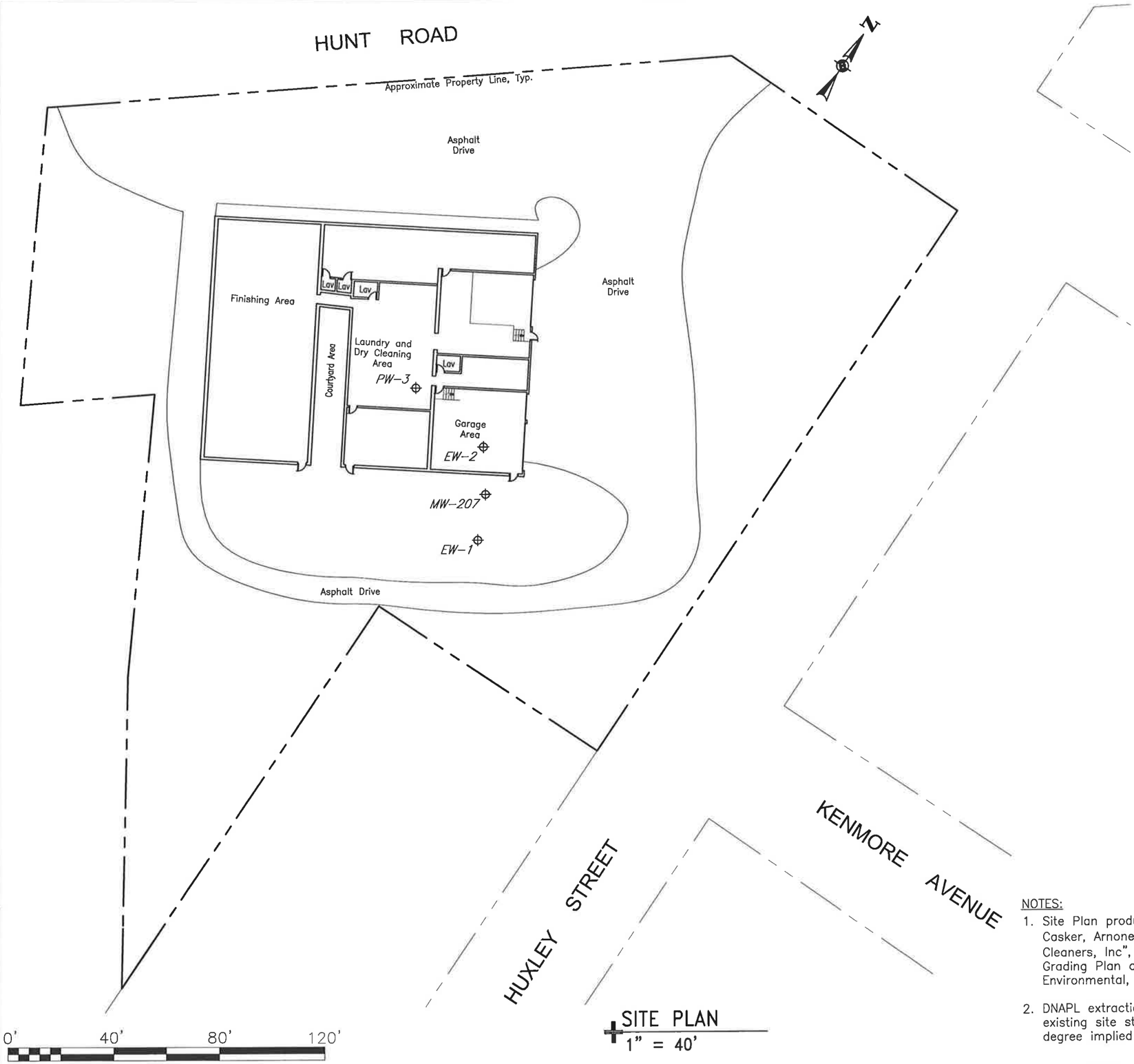
Transport Emergency Card: TEC (R)-20S1086

NFPA Code: H 2; F 4; R 2;

ADDITIONAL INFORMATION

ICSC: 0082 **VINYL CHLORIDE**

Appendix B



SITE PLAN
1" = 40'

LEGEND:

⊕EW-1 DNAPL Extraction Well

NOTES:

1. Site Plan produced from drawings by Habiterra Associates, Thorsell, Kennedy, Casker, Arnone & Hedin. P.C. entitled "Addition and Renovations, Anderson Cleaners, Inc", drawings A-1 Floor Plan dated October 22, 1985 and L-1 Grading Plan and from notes of site visits by representatives of Day Environmental, Inc.
2. DNAPL extraction well locations were obtained by tape measurement from existing site structure. Locations should be considered accurate to the degree implied by the method used.

PROJECT MANAGER	RLK
DATE	3-2013
DRAWN BY	RJM
DATE DRAWN	3-5-2013
SCALE	As Noted
DATE ISSUED	3-5-2013

day
DAY ENVIRONMENTAL, INC.
ENVIRONMENTAL CONSULTANTS
ROCHESTER, NEW YORK 14606
NEW YORK, NEW YORK 10170

PROJECT TITLE
5 HUNT ROAD
JAMESTOWN, NEW YORK
OPERATIONAL AND MAINTENANCE MANUAL
DNAPL EXTRACTION AND TREATMENT SYSTEM BCP #C907027

DRAWING TITLE
DNAPL Extraction Well Locations

PROJECT NO.
3563S-04

Xerox432ArsiB-2; 11 x 17
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Pen Setting File: 800psFullcolor.ctb
Ref1:
Ref2:
Ref3:

Time Plotted: Tuesday, March 05, 2013 2:25:29 PM
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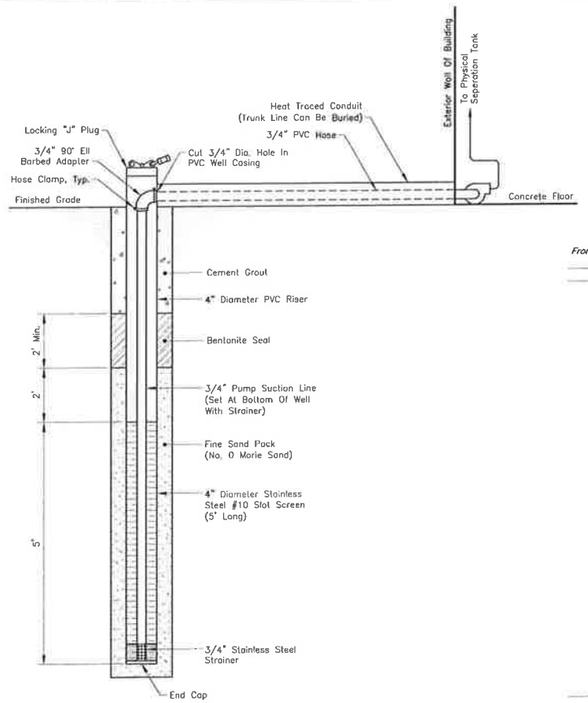
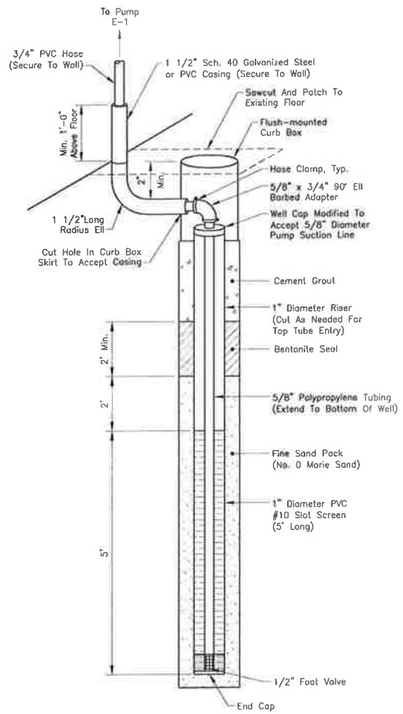
ANDERSON CLEANERS
REMEDIAL GROUNDWATER PRETREATMENT SYSTEM
PRELIMINARY EQUIPMENT LIST

ITEM	DESCRIPTION	MFR	MODEL
MAJOR EQUIPMENT ITEMS			
Well Pumps E-1 to E-3	3/8" air diaphragm pump, acetal and teflon wetted parts	ARO	PD03P-AES-DTT
Separation Tank	275-gallon vertical oil storage tank or equal	—	—
Lift Station Tank	polyethylene tank + cover, min 100-gal capacity	Chem-Tainer	—
Lift Pump P-1	1/2" air diaphragm pump, polypropylene and teflon wetted parts	ARO	PD05P-ARS-PTT
Pulsation Dampener	PP dampener; 85% pulsation reduction @ 60 psi, 5 GPM	Blacoh	A301W-1
Filter / Regulator	5-micron filter, regulator, gauge; 1/2" NPT ends	Ingersoll-Rand	P244-610
Pre-Filter Housings	4.5" x 20" filter housing; 1" FNPT ends	Shelco	SPHKB-20-1BB
Cartridge Filters	4.5" x 20" filter; 50-micron and 5-micron (6 each)	Shelco	varies
Carbon Filter Housings	13-in x 54-in FRP pressure vessels + internals	General Carbon	—
Carbon Filter Media	Reactivated carbon	General Carbon	—
Water Meter	5/8" x 3/4"; 0.5 to 20 GPM; totalizer in gallons (refurbished)	Neptune	—
CONTROLS, HOSE, PIPING AND VALVES/FITTINGS			
Float Switches	N.O. polypropylene float, 10A, 20' cord	—	—
Float Switches	N.C. polypropylene float, 10A, 20' cord	—	—
Strainer	3/4" Y-strainer; viton seal	—	—
Strainer	1" Y-strainer; viton seal	—	—
Check Valve	3/4" y-check valve; FPM seal	—	—
Check Valve	1" y-check valve; FPM seal	—	—
Ball Valve	1/2" PVC ball valve; viton seal	—	—
Ball Valve	3/4" full-port PVC ball valve; viton seal	—	—
Ball Valve	1" PVC ball valve; viton seal	—	—
Pressure Gauge	0-30 psi	Valley	—
Airline Connector Kit	filter, regulator, gauge, hose with fittings	ARO	66073-1
Solenoid Valves	1/2" brass solenoid valve; 120V; normally closed	ASCO RedHat	8210G002
Check Valve	1/4" brass check valve	Parker	C400B
Needle Valve	1/4" brass needle valve	Parker	N400B
Ball Valve	1/2" bronze ball valve; FNPT ends	Apollo	—
Ball Valve	3/8" bronze ball valve; FNPT ends	Apollo	77C10201
Threaded Hose Barbs	3/4" PVC hose barb x MNPT	—	—
Threaded Hose Barbs	1" PVC hose barb x MNPT	—	—
Threaded Hose Barbs	1-1/2" PVC hose barb x MNPT	—	—
Hose Barb Tee	1-1/2" PVC hose barb tee (set of 10)	—	—
Hose Barb Tee	1" PVC hose barb tee (set of 10)	—	—
Hose Barb Tee	1" PVC hose barbs x 3/4" MNPT (set of 10)	—	—
Bulkhead Fitting	1" PVC with FPM gasket, NPT ends	—	—
Bulkhead Fitting	1-1/2" PVC with FPM gasket, NPT ends	—	—
Well Suction Hose	3/4" ID reinf. PVC Hose	Spiralite	113
Well Suction Hose	5/8" ID rigid polypropylene tubing	—	—
Foot Valve	1/2" check valve	—	—
Water Main Hose	1" reinf. PVC Tubing	—	—
Water Main Hose	1-1/2" reinf. PVC Tubing	—	—
Air Main Feed	1/2" general duty air hose; 200 psi rating	—	—
3-Way Valve	3/4" PVC, Viton Seals	—	—



TYPICAL EXTERIOR DNAPL EXTRACTION WELL
NOT TO SCALE



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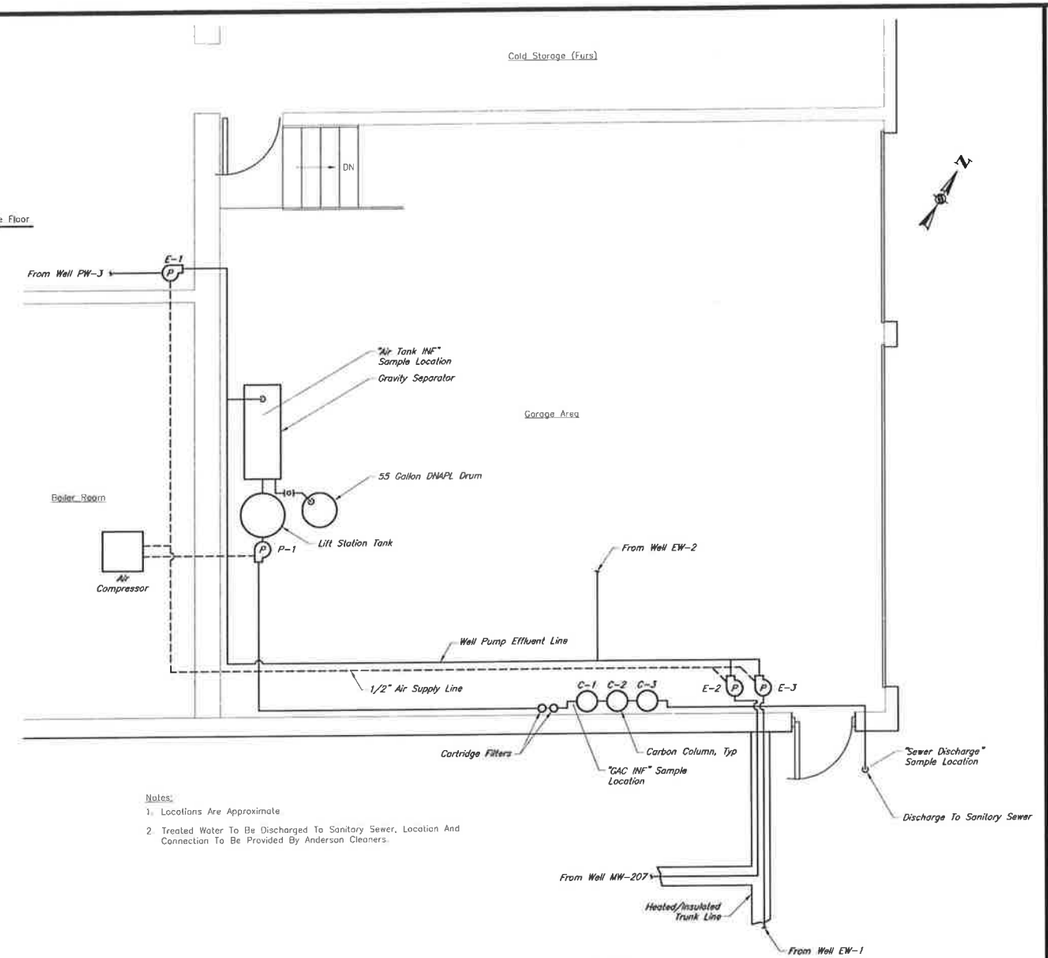
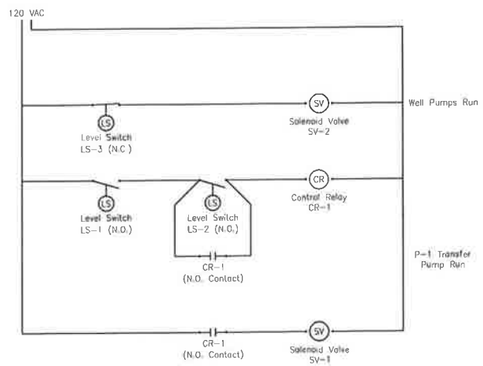
NOT TO SCALE

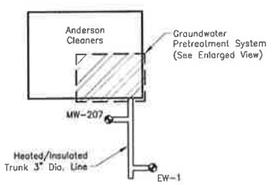


Notes:
1. Locations Are Approximate
2. Treated Water To Be Discharged To Sanitary Sewer, Location And Connection To Be Provided By Anderson Cleaners.

PRETREATMENT SYSTEM PLAN VIEW
1/4" = 1'-0"



ELECTRICAL SCHEMATIC
NOT TO SCALE



LOCATION PLAN
NOT TO SCALE

PROJECT MANAGER	DATE
NES	2-2013
DRAWN BY	DATE DRAWN
RJM	3-6-2013
CHECKED BY	DATE
NES/BFK	3-8-2013
APPROVED BY	DATE
NES	3-6-2013
SCALE	DATE REVISED
As Noted	3-6-2013

DAY ENVIRONMENTAL, INC.
ENGINEERS, SCIENTISTS, ECONOMISTS
DRAWING ALTERATION
This document may not be altered without the written consent of Day Environmental, PC

NO.	DATE	BY	REVISIONS
7			
6			
5			
4			
3			
2			
1			

day
DAY ENVIRONMENTAL, INC
ENGINEERS, SCIENTISTS, ECONOMISTS
RIDGE HILL CORPORATE CENTER
ROCHESTER, NEW YORK 14606
NEW YORK: NEW YORK 10170

PROJECT TITLE
5 HUNT ROAD
JAMESTOWN, NEW YORK
OPERATIONAL AND MAINTENANCE MANUAL DNAPL EXTRACTION AND TREATMENT SYSTEM BCP #C907027

DRAWING TITLE
DNAPL Extraction System: Electrical Schematic, Equipment List, Plan View and Well Details

PROJECT NO.
3563S-04

FIGURE NO.

References Files Attached:
REF1: Elec Schematic.dwg
REF2: Garage Plan Feb 2013.dwg
REF3: Well Details.dwg
REF4:
REF5:
REF6:
REF7:
REF8:
REF9:
REF10:

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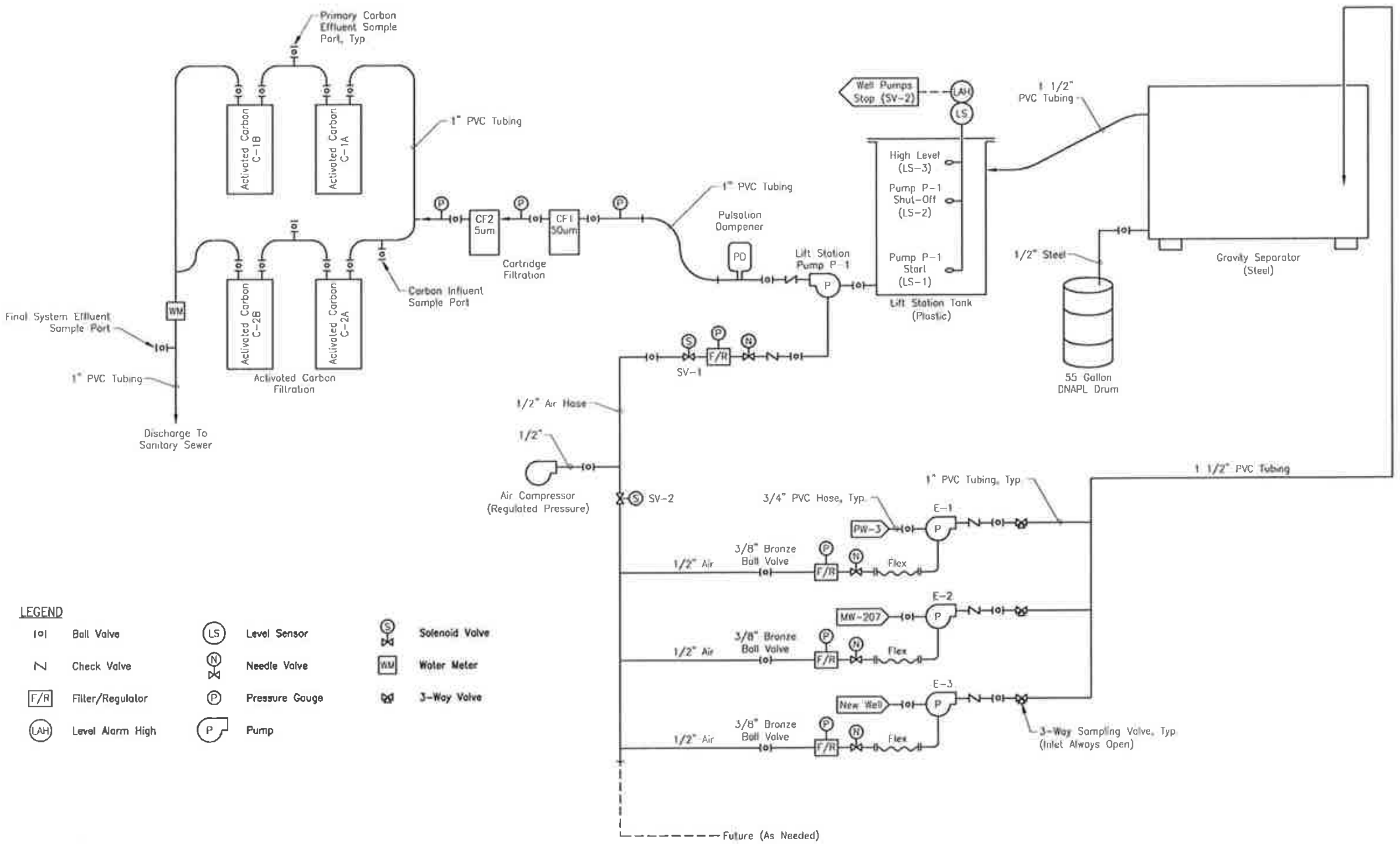
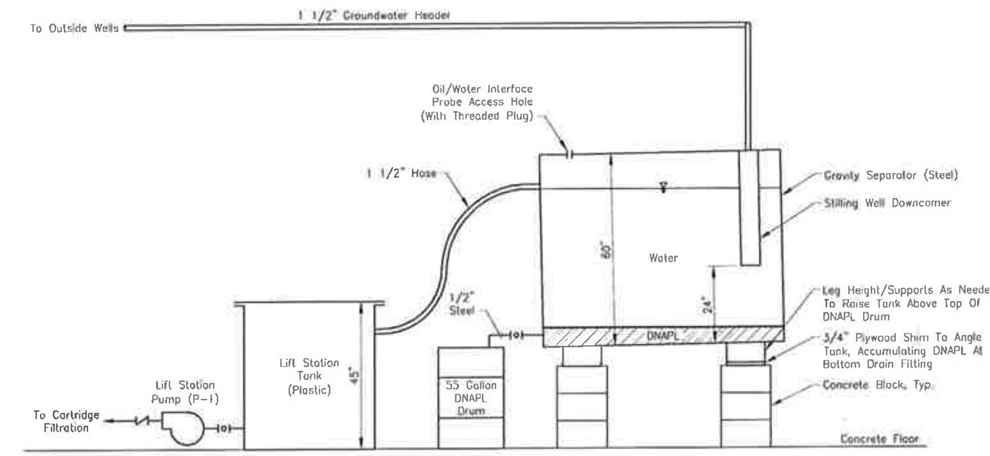
ANSI "D" (22x34)
DayEnv_AnsiD



PROCESS & INSTRUMENTATION SCHEMATIC
NOT TO SCALE



GRAVITY SEPARATOR DETAIL
NOT TO SCALE

PROJECT MANAGER: NES	DATE: 2-2013
DRAWN BY: RJM	DATE DRAWN: 3-6-2013
CHECKED BY: NES/BFK	DATE: 3-6-2013
APPROVED BY: NES	DATE: 3-6-2013
SCALE: As Noted	DATE ISSUED: 3-6-2013

DAY ENVIRONMENTAL, INC.

7		
6		
5		
4		
3		
2		
1		
REVISIONS	DATE	BY

day
DAY ENVIRONMENTAL, INC
ENVIRONMENTAL CONSULTANTS
ROCHESTER, NEW YORK 14606
NEW YORK, NEW YORK 10170

PROJECT TITLE
5 HUNT ROAD
JAMESTOWN, NEW YORK
OPERATIONAL AND MAINTENANCE MANUAL DNAPL EXTRACTION AND TREATMENT SYSTEM BCP #C907027

DRAWING TITLE
DNAPL Extraction System:
Treatment Schematic and Gravity Separator Detail

PROJECT NO.
3563S-04

FIGURE NO.

ANSI "D" (22x34)
DayEnv_AnsiD

Appendix C

Anderson Cleaners
5 Hunt Road
BCP Code #C907027
Jamestown New York

Operator Monitoring Log

Date: _____ Time _____

Personnel _____

Parameter	Measurement	Units
Depth to DNAPL in Settling Tank		Feet
Regulator Pressure of MW-207, PW-3 and EW-2 (1)	/ /	PSI
Regulator Pressure of Process Pump (1)		PSI
Pressure of Cartridge Filter 50 uM Inlet (1)		PSI
Pressure of Cartridge Filter 5 uM Inlet (1)		PSI
Flow Totalizer (Water Meter) Reading:		Gallons
Static Water Levels of MW-207 and EW-2	/	Feet

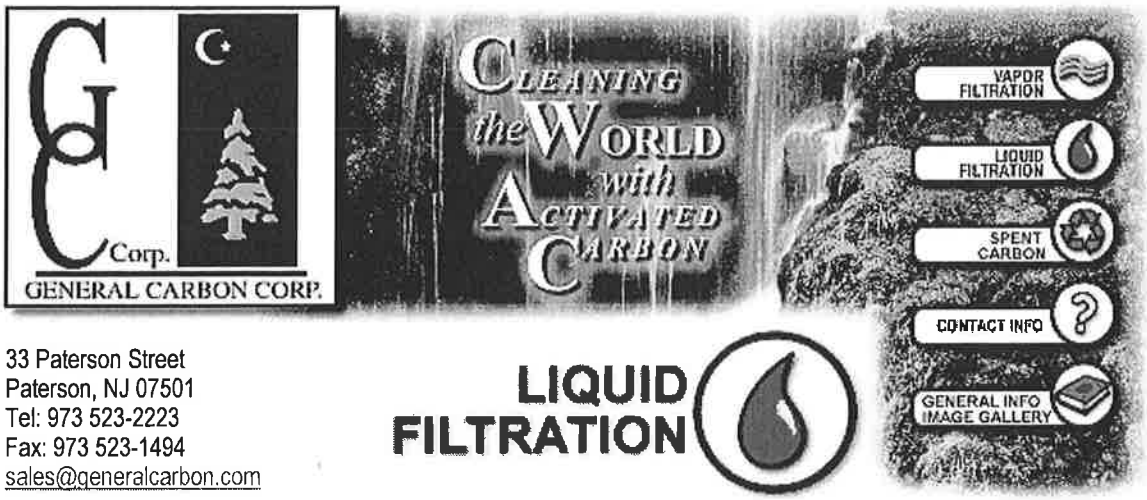
Notes:

(1) = Pressure measurements must be recorded when the pumps are operational.

PSI = Pounds Per Square Inch uM = Micron

Appendix D

"));



33 Paterson Street
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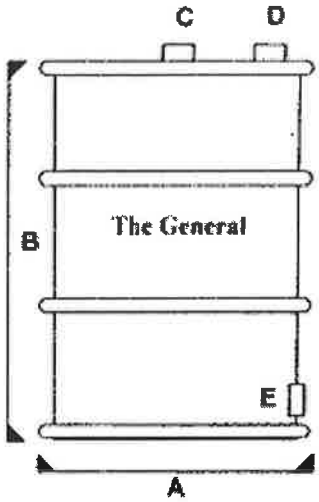
LIQUID FILTRATION

The General

Water Pollution

Control Barrels



The General Water Pollution Control Barrels are low cost, self contained water purification adsorbers designed to treat liquid streams of up to 20 GPM. The units are available in four different sizes to better serve your treatment needs.

Specifications	30 Gallon	55 Gallon	85 Gallon	110 Gallon
A-Diameter, Outside:	19 19/32 "	24"	28"	32"
B-Height, Outside Wall:	29"	35"	39"	43"
Inlet Fitting:	C-1"FPT	C-1"FPT	C-1"FPT	C-2"FPT
Outlet Fitting:	E-1"FPT	E-1"FPT	D-1"FPT	D-2"FPT
Drain Fitting:	E-1"FPT	E-1"FPT	E-1"FPT	E-1"FPT
Carbon Weight, Lbs:	90	165	300	400
Max. Recommended Flow Rate, GPM:	8	10	15	20
Maximum Pressure, psig:	7	10	7	7
Max. Design Temp., Deg F:	140	140	140	140
Flow Direction:	Downflow	Downflow	Downflow	Downflow

Activated Carbon - **The General** liquid adsorbers are filled with virgin, high activity **GC 8x30** carbon. Virgin **GC 12x40**, reactivated **GC 8x30R** or other special carbons are also available.

Removable Lid - 16 gauge lid with ring & bolt closure and poly clad cellulose gasket.

Connections - Metal connections with standard pipe threads insure easy, durable and leakproof hookup to your system. Unions or quick connect fittings are advised to make drum exchange easy.

Flow Distributors - Both inlet and outlet have low pressure drop, slotted Schedule 40 PVC distributors.

Units work well in either an upflow or downflow manner when the start up procedure is followed. Stainless Steel internals and drums are available for special applications.

Coatings - The General water pollution control barrels are coated on the inside with heat cured phenolic epoxy. The outside coating is industrial enamel. A polyethylene liner is available for extra corrosion resistance for the 55 gallon and 85 gallon units.

Installation & Startup - If possible, before the units are used for the first time, they should be filled with clean water for a period of 8 to 12 hours to allow the carbon to degas. A gentle backwash is also recommended to remove carbon fines that can cause excessive pressure drop through the unit. Multiple units are usually connected in series with testing between the units advised to determine when the first unit needs to be changed out.

Maintenance - Once connected, **The General** requires no maintenance other than the monitoring of the influent and effluent liquid streams and the operating pressure of the system. Monitoring the liquid stream into the last Water Pollution Control Barrel in series mode is a recommended safeguard against breakthrough in the final outflow. When the concentration of contaminants in the outflow equals the concentration in the inflow, **The General** has reached its removal capacity and should be removed from service. The working life of each adsorber is dependent upon the type of contaminant in the water as well as its concentration and the liquid flow rate. A pressure relief device is advised to prevent damage to the canister in the event of excessive pressure buildup.

Recharging The General - Once the carbon is saturated by contaminants, the unit should be removed and replaced with a fresh one. To purchase replacement carbon or to arrange for a carbon change out, please contact our office.

Disposal - Dispose of the spent carbon in accordance with Federal, State, and Local regulations.

Warning!

Wet activated carbon readily absorbs free oxygen. ANY entry into carbon vessels requires procedures for confined space entry and oxygen depletion to be followed!

---

33 Paterson Street • Paterson, NJ 07501 • Tel: 973 523-2223 Fax: 973 523-1494

OPERATOR'S MANUAL PD03P-XXX-XXX

INCLUDING: OPERATION, INSTALLATION & MAINTENANCE

RELEASED: 12-17-05
REVISED: 5-13-10
(REV. 05)

3/8" DIAPHRAGM PUMP
1:1 RATIO, NON-METALLIC

READ THIS MANUAL CAREFULLY BEFORE INSTALLING, OPERATING OR SERVICING THIS EQUIPMENT.

It is the responsibility of the employer to place this information in the hands of the operator. Keep for future reference.

SERVICE KITS

Refer to Model Description Chart to match the pump material options.
637428 for air section repair (see page 6).
637429-XX for fluid section repair (see page 4).

PUMP DATA

Models ..... see Model Description Chart for "-XXX".
Pump Type... Air Operated Double Diaphragm.
Material ..... see Model Description Chart.
Weight..... PD03P-XDS-XXX..... 4.16 lbs (1.89 kgs)
PD03P-XES-XXX..... 4.26 lbs (1.93 kgs)
PD03P-XKS-XXX..... 4.50 lbs (2.04 kgs)
PD03P-XLS-XXX..... 4.62 lbs (2.10 kgs)
PD03P-XPS-XXX..... 3.44 lbs (1.56 kgs)
PD03P-XRS-XXX..... 3.50 lbs (1.59 kgs)
Maximum Air Inlet Pressure..... 100 p.s.i.g. (6.9 bar)
Maximum Material Inlet Pressure... 10 p.s.i.g. (0.69 bar)
Maximum Outlet Pressure..... 100 p.s.i.g. (6.9 bar)
Air Consumption @ 40 p.s.i.g. ..... 1 c.f.m /gallon (approx.)
Maximum Flow Rate (flooded inlet)
ball check..... .... 10.6 g.p.m. (40.1 l.p.m.)
duckbill..... 8.7 g.p.m. (32.9 l.p.m.)
Displacement / Cycle @ 100 p.s.i.g
ball check..... ... 0.022 gallons (0.083 lit.)
duckbill..... 0.018 gallons (0.068 lit.)
Maximum Particle Size
ball check..... ... 1/16" dia. (1.6 mm)
duckbill..... ..... fibers)
Maximum Temperature Limits (diaphragm / ball / seal material)
Acetal..... -10° to 180° F (-12° to 82° C)
E.P.R / EPDM..... -60° to 280° F (-51° to 138° C)
Hytrel®..... -20° to 150° F (-29° to 66° C)
Kynar P.V.D.F..... 10° to 200° F (-12° to 93° C)
Neoprene..... 0° to 200° F (-18° to 93° C)
Nitrile..... 10° to 180° F (-12° to 82° C)
Polypropylene..... 35° to 175° F (2° to 79° C)
Santoprene®..... -40° to 225° F (-40° to 107° C)
PTFE..... 40° to 225° F (4° to 107° C)
Viton®..... -40° to 350° F (-40° to 177° C)
Groundable Models PD03P-XDS-XXX
PD03P-XES-XXX
Dimensional Data..... see page 8
Noise Level @ 70 p.s.i., 60 c.p.m..... 72.7 db(A) ①

① The pump sound pressure levels published here have been updated to an Equivalent Continuous Sound Level (L_{Aeq}) to meet the intent of ANSI S1.13-1971, CAGI-PNEUROP S5.1 using four microphone locations.

NOTICE: All possible options are shown in the chart, however, certain combinations may not be recommended, consult a representative or the factory if you have questions concerning availability.

INGERSOLL RAND COMPANY LTD
209 NORTH MAIN STREET – BRYAN, OHIO 43506
(800) 276-4658 • FAX (800) 266-7016

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www.ingersollrandproducts.com

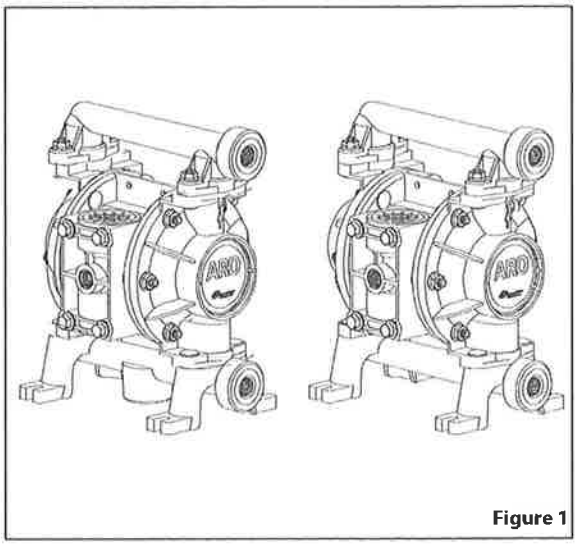


Figure 1

MODEL DESCRIPTION CHART

PD03 P -X X S -X X X

Center Section Material
P - Polypropylene

Fluid Connection
A - 3/8 - 18 N.P.T.F. - 1
B - Rp 3/8 (3/8 - 19 BSP)

Fluid Caps / Manifold Material
D - Groundable Acetal (single port)
E - Groundable Acetal (multiple port)
K - Kynar PVDF (single port)
L - Kynar PVDF (multiple port)
P - Polypropylene (single port)
R - Polypropylene (multiple port)

Hardware Material
S - Stainless Steel

Seat Material
D - Acetal
K - Kynar PVDF
P - Polypropylene
S - Stainless Steel
0 - (Duckbill)

Ball Material (*) Duckbill models
A - Santoprene
C - Hytrel
J - Nitrile (*)
N - Neoprene (*)
S - Stainless Steel
T - PTFE
V - Viton
K - EPR (*)
L - Viton (*)

Diaphragm Material
A - Santoprene
C - Hytrel
T - PTFE / Santoprene
V - Viton

FLUID SECTION SERVICE KIT SELECTION PD03P-ARS-S X X
Example: Model # PD03P-ARS-SAA
Fluid Section Service Kit # 637429-AA
637429-[X][X]
Ball ┘ └ Diaphragm

ARO
Ingersoll Rand
Industrial Technologies

OPERATING AND SAFETY PRECAUTIONS

READ, UNDERSTAND, AND FOLLOW THIS INFORMATION TO AVOID INJURY AND PROPERTY DAMAGE.


EXCESSIVE AIR PRESSURE
STATIC SPARK


HAZARDOUS MATERIALS
HAZARDOUS PRESSURE

⚠ WARNING EXCESSIVE AIR PRESSURE. Can cause personal injury, pump damage or property damage.

- Do not exceed the maximum inlet air pressure as stated on the pump model plate.
- Be sure material hoses and other components are able to withstand fluid pressures developed by this pump. Check all hoses for damage or wear. Be certain dispensing device is clean and in proper working condition.

⚠ WARNING STATIC SPARK. Can cause explosion resulting in severe injury or death. Ground pump and pumping system.

- PD03P-XDS-XXX and PD03P-XES-XXX Groundable Acetal pumps: Use the pump ground lug provided. Connect to a 12 ga. (minimum) wire (kit is included) to a good earth ground source.
- Sparks can ignite flammable material and vapors.
- The pumping system and object being sprayed must be grounded when it is pumping, flushing, recirculating or spraying flammable materials such as paints, solvents, lacquers, etc. or used in a location where surrounding atmosphere is conducive to spontaneous combustion. Ground the dispensing valve or device, containers, hoses and any object to which material is being pumped.
- Secure pump, connections and all contact points to avoid vibration and generation of contact or static spark.
- Consult local building codes and electrical codes for specific grounding requirements.
- After grounding, periodically verify continuity of electrical path to ground. Test with an ohmmeter from each component (e.g., hoses, pump, clamps, container, spray gun, etc.) to ground to insure continuity. Ohmmeter should show 0.1 ohms or less.
- Submerse the outlet hose end, dispensing valve or device in the material being dispensed if possible. (Avoid free streaming of material being dispensed.)
- Use hoses incorporating a static wire.
- Use proper ventilation.
- Keep inflammables away from heat, open flames and sparks.
- Keep containers closed when not in use.

⚠ WARNING Pump exhaust may contain contaminants. Can cause severe injury. Pipe exhaust away from work area and personnel.

- In the event of a diaphragm rupture, material can be forced out of the air exhaust muffler.
- Pipe the exhaust to a safe remote location when pumping hazardous or inflammable materials.
- Use a grounded 3/8" minimum i.d. hose between the pump and the muffler.

⚠ WARNING HAZARDOUS PRESSURE. Can result in serious injury or property damage. Do not service or clean pump, hoses or dispensing valve while the system is pressurized.

- Disconnect air supply line and relieve pressure from the system by opening dispensing valve or device and / or carefully and slowly loosening and removing outlet hose or piping from pump.

⚠ WARNING HAZARDOUS MATERIALS. Can cause serious injury or property damage. Do not attempt to return a pump to the factory or service center that contains hazardous material. Safe handling practices must comply with local and national laws and safety code requirements.

- Obtain Material Safety Data Sheets on all materials from the supplier for proper handling instructions.

⚠ WARNING EXPLOSION HAZARD. Models containing aluminum wetted parts cannot be used with 1,1,1-trichloroethane, methylene chloride or other halogenated hydrocarbon solvents which may react and explode.

- Check pump motor section, fluid caps, manifolds and all wetted parts to assure compatibility before using with solvents of this type.

⚠ CAUTION Verify the chemical compatibility of the pump wetted parts and the substance being pumped, flushed or recirculated. Chemical compatibility may change with temperature and concentration of the chemical(s) within the substances being pumped, flushed or circulated. For specific fluid compatibility, consult the chemical manufacturer.

⚠ CAUTION Maximum temperatures are based on mechanical stress only. Certain chemicals will significantly reduce maximum safe operating temperature. Consult the chemical manufacturer for chemical compatibility and temperature limits. Refer to PUMP DATA on page 1 of this manual.

⚠ CAUTION Be certain all operators of this equipment have been trained for safe working practices, understand it's limitations, and wear safety goggles / equipment when required.

⚠ CAUTION Do not use the pump for the structural support of the piping system. Be certain the system components are properly supported to prevent stress on the pump parts.

- Suction and discharge connections should be flexible connections (such as hose), not rigid piped, and should be compatible with the substance being pumped.

⚠ CAUTION Prevent unnecessary damage to the pump. Do not allow pump to operate when out of material for long periods of time.

- Disconnect air line from pump when system sits idle for long periods of time.

⚠ CAUTION Use only genuine ARO® replacement parts to assure compatible pressure rating and longest service life.

NOTICE Install the pump in the vertical position. The pump may not prime properly if the balls do not check by gravity upon start-up.

NOTICE RE-TORQUE ALL FASTENERS BEFORE OPERATION. Creep of housing and gasket materials may cause fasteners to loosen. Re-torque all fasteners to insure against fluid or air leakage.

NOTICE Replacement warning labels are available upon request: Static Spark" pn \ 93616-1, Diaphragm Rupture" pn \ 93122.

⚠ WARNING	= Hazards or unsafe practices which could result in severe personal injury, death or substantial property damage.
⚠ CAUTION	= Hazards or unsafe practices which could result in minor personal injury, product or property damage.
NOTICE	= Important installation, operation or maintenance information.

GENERAL DESCRIPTION

The ARO diaphragm pump offers high volume delivery even at low air pressure and a broad range of material compatibility options available. Refer to the model and option chart. ARO pumps feature stall resistant design, modular air motor / fluid sections.

Air operated double diaphragm pumps utilize a pressure differential in the air chambers to alternately create suction and positive fluid pressure in the fluid chambers, ball checks insure a positive flow of fluid.

Pump cycling will begin as air pressure is applied and it will continue to pump and keep up with the demand. It will build and maintain line pressure and will stop cycling once maximum line pressure is reached (dispensing device closed) and will resume pumping as needed.

AIR AND LUBE REQUIREMENTS

⚠WARNING EXCESSIVE AIR PRESSURE. Can cause pump damage, personal injury or property damage.

- A filter capable of filtering out particles larger than 50 microns should be used on the air supply. There is no lubrication required other than the "O" ring lubricant which is applied during assembly or repair.
- If lubricated air is present, make sure that it is compatible with the "O" rings and seals in the air motor section of the pump.

OPERATING INSTRUCTIONS

- Always flush the pump with a solvent compatible with the material being pumped if the material being pumped is subject to "setting up" when not in use for a period of time.
- Disconnect the air supply from the pump if it is to be inactive for a few hours.
- The outlet material volume is governed not only by the air supply but also by the material supply available at the inlet. The material supply tubing should not be too small or restrictive. Be sure not to use hose which might collapse.
- When the diaphragm pump is used in a forced-feed (flooded inlet) situation, it is recommended that a Check Valve" be installed at the air inlet.
- Secure the diaphragm pump legs to a suitable surface to insure against damage by vibration.

MAINTENANCE

- Certain ARO "Smart Parts" are indicated which should be available for fast repair and reduction of down time.
- Provide a clean work surface to protect sensitive internal moving parts from contamination from dirt and foreign matter during service disassembly and reassembly.
- Keep good records of service activity and include pump in preventive maintenance program.
- Service Kits are available to service two separate Diaphragm Pump functions: 1. AIR SECTION, 2. FLUID SECTION. The Fluid Section is divided further to match typical active MATERIAL OPTIONS.

TYPICAL CROSS SECTION

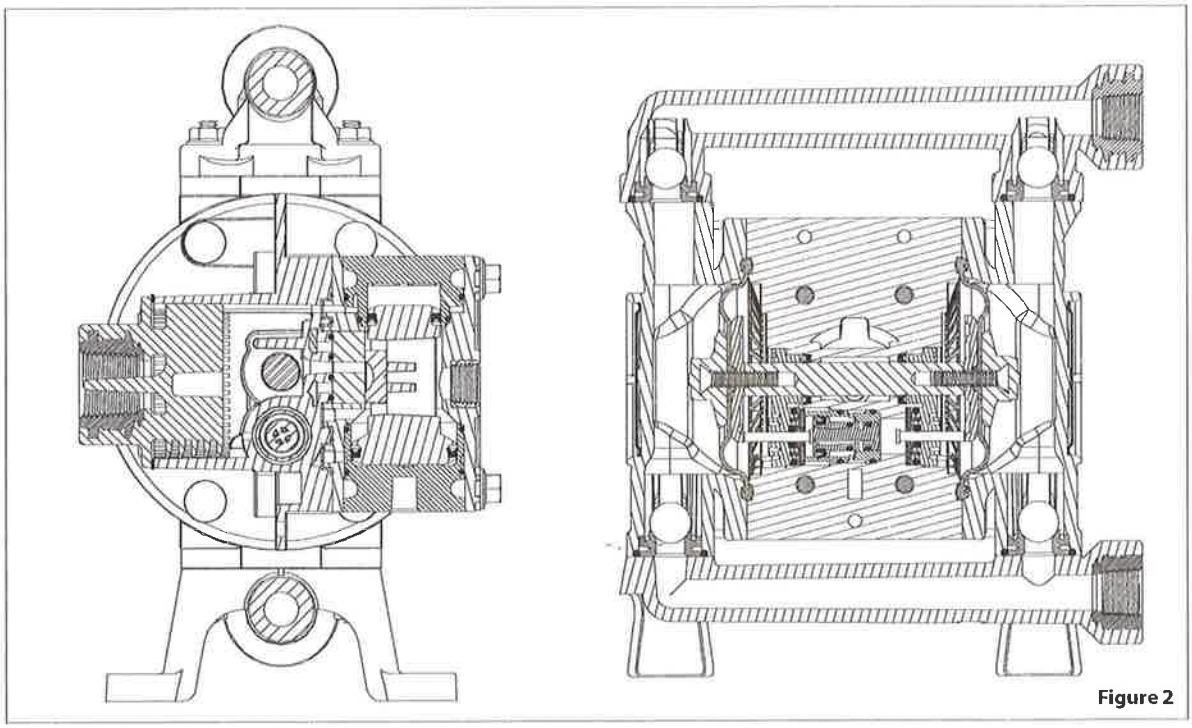


Figure 2

PARTS LIST / PD03P-XXX-XXX FLUID SECTION

❶ 637429-XX Fluid Section service kits include: Balls (see BALL OPTION, refer to -XX in chart below), Diaphragms (See DIAPHRAGM OPTION, refer to -XX in chart below) and item 19 (listed below), plus items 144, 174 and 94276 Lubriplate® grease (page 6).

SEAT OPTIONS PD03P-XXS-XXX

"21"			
-XXX	Seat	Qty	[Mtl]
-DXX	96580-2	(4)	[D]
-KXX	96580-3	(4)	[K]
-PXX	96580-1	(4)	[P]
-SXX	96537	(4)	[SS]
-0XX	96745	(4)	[P]

BALL / DUCKBILL OPTIONS PD03P-XXS-XXX

❶"22" (5/8" dia.)				❶ 42"			
-XXX	Ball	Qty	[Mtl]	-XXX	Duckbill	Qty	[Mtl]
-XAX	96481-A	(4)	[Sp]	-XJX	96744-2	(4)	[B]
-XCX	96481-C	(4)	[H]	-XNX	96744-3	(4)	[N]
-XSX	96513	(4)	[SS]	-XLX	96744-4	(4)	[V]
-XTX	96481-4	(4)	[T]	-XKX	96744-1	(4)	[E]
-XVX	96481-3	(4)	[V]				

NOTE: Item 19 "O" ring is not used with PD03P-XXX-0XX seat option.

MATERIAL CODE

[A] = Aluminum
[B] = Nitrile
[D] = Acetal
[E] = E.P.R.
[GA] = Groundable Acetal
[GFN] = Glass Filled Nylon
[H] = Hytrel
[K] = Kynar PVDF
[N] = Neoprene
[P] = Polypropylene
[PPG] = Glass Filled Polypropylene
[Sp] = Santoprene
[SS] = Stainless Steel
[T] = PTFE
[V] = Viton

DIAPHRAGM OPTIONS PD03P-XXS-XXX

	❶ SERVICE KIT -XX = (Ball)	❶ "7"			❶ "8"			❶ "19" "O" Ring		
-XXX	-XX = (Diaphragm)	Diaphragm	Qty	[Mtl]	Diaphragm	Qty	[Mtl]	(3/32" x 1-1/8" o.d.)	Qty	[Mtl]
-XXA	637429-XA	96533-A	(2)	[Sp]	-----	---	---	93761	(4)	[E]
-XXC	637429-XC	96533-C	(2)	[H]	-----	---	---	Y325-119	(4)	[B]
-XXT	637429-XT	96538	(2)	[T]	96533-A	(2)	[Sp]	96514	(4)	[T]
-XXV	637429-XV	96558	(2)	[V]	-----	---	---	Y327-119	(4)	[V]

MANIFOLD / FLUID CAP OPTIONS PD03P-XXS-XXX

			Polypropylene				Kynar PVDF				Groundable Acetal			
			PD03P-XPS-		PD03P-XRS-		PD03P-XKS-		PD03P-XLS-		PD03P-XDS-		PD03P-XES	
Item	Description (size)	Qty	Part No.	[Mtl]	Part No.	[Mtl]	Part No.	[Mtl]	Part No.	[Mtl]	Part No.	[Mtl]	Part No.	[Mtl]
6	Diaphragm Nut (1/4" - 20)	(2)	93810-7	[P]	93810-7	[P]	93810-3	[K]	93810-3	[K]	93810-2	[D]	93810-2	[D]
15	Fluid Cap	(2)	96460-1	[P]	96460-1	[P]	96460-3	[K]	96460-3	[K]	96460-2	[GA]	96460-2	[GA]
43	Ground Strap	(1)	-----	---	-----	---	-----	---	-----	---	92956-1	[SS]	92956-1	[SS]
57	Ground Kit Assembly (not shown)	(1)	-----	---	-----	---	-----	---	-----	---	66885-1		66885-1	
60	Inlet Manifold (N.P.T.F.)	(1)	96468-1	[P]	96468-7	[P]	96468-3	[K]	96468-9	[K]	96468-2	[GA]	96468-8	[GA]
	(BSP)	(1)	96468-4	[P]	96468-10	[P]	96468-6	[K]	96468-12	[K]	96468-5	[GA]	96468-11	[GA]
61	Outlet Manifold (N.P.T.F.)	(1)	96469-1	[P]	96469-1	[P]	96469-3	[K]	96469-3	[K]	96469-2	[GA]	96469-2	[GA]
	(BSP)	(1)	96469-4	[P]	96469-4	[P]	96469-6	[K]	96469-6	[K]	96469-5	[GA]	96469-5	[GA]
63	Pipe Plug (N.P.T.F.)	(1)	-----	---	94478-1	[PPG]	-----	---	94478-3	[K]	-----	---	94478-2	[D]
	(BSP)	(1)	-----	---	96559-1	[PPG]	-----	---	96559-3	[K]	-----	---	96559-2	[D]

COMMON PARTS

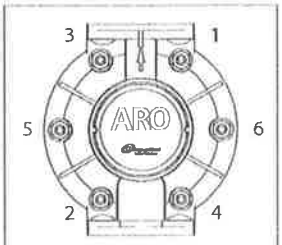
Item	Description (size)	Qty	Part No.	[Mtl]
❷ 1	Connecting Rod	(1)	96532	[SS]
5	Diaphragm Washer	(2)	96556	[GFN]
26	Bolt (1/4" - 20 x 1-1/8")	(8)	96471	[SS]
27	Bolt (1/4" - 20 x 1-1/8")	(12)	96471	[SS]
29	Nut (1/4" - 20)	(20)	93828	[SS]
77	Logo Plate	(2)	93264	[A]

DUAL INLET / DUAL OUTLET KITS 637442-X

			Polypropylene				Kynar PVDF				Groundable Acetal			
			637442-1 (N.P.T.)		637442-4 (BSP)		637442-3 (N.P.T.)		637442-6 (BSP)		637442-2 (N.P.T.)		637442-5 (BSP)	
Item	Description (size)	Qty	Part No.	[Mtl]	Part No.	[Mtl]	Part No.	[Mtl]	Part No.	[Mtl]	Part No.	[Mtl]	Part No.	[Mtl]
17	Dual Outlet Manifold	(2)	96520-1	[P]	96520-4	[P]	96520-3	[K]	96520-6	[K]	96520-2	[GA]	96520-5	[GA]
18	Dual Inlet Manifold	(2)	96519-1	[P]	96519-4	[P]	96519-3	[K]	96519-6	[K]	96519-2	[GA]	96519-5	[GA]
19	O" Ring (3/32" x 1-1/8" o.d.)	(1)	96514	[T]	96514	[T]	96514	[T]	96514	[T]	96514	[T]	96514	[T]

❷ Smart Parts" keep these items on hand in addition to the service kits for fast repair and reduction of down time.

COLOR CODE		
MATERIAL	DIAPHRAGM COLOR	BALL COLOR
Hytrel	Cream	Black (•)
Santoprene	Tan	Tan
PTFE	White	White
Viton	Yellow (•)	Yellow (•)
		(•) Dot



Torque Sequence

FOR THE AIR MOTOR SECTION SEE PAGES 6 & 7

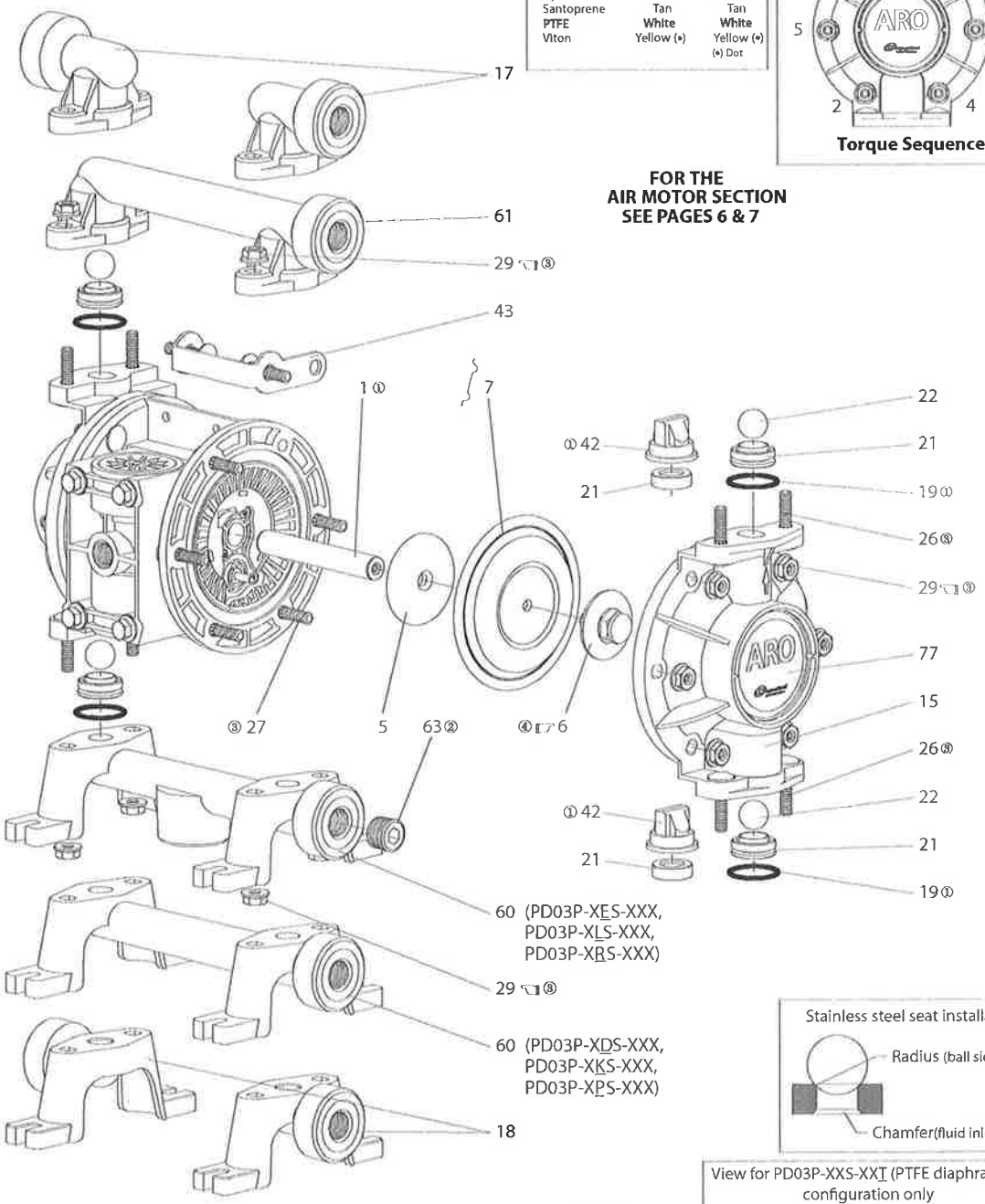
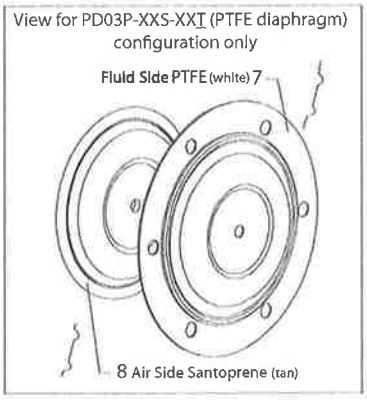


Figure 3



☞ ASSEMBLY TORQUE REQUIREMENTS ☜

NOTE: DO NOT OVERTIGHTEN FASTENERS.

(6) diaphragm nut, 60 - 70 in. lbs (6.8 - 7.9 Nm).
(29) nut, 50 - 60 in. lbs (5.6 - 6.8 Nm), / alternately and evenly, then re-torque after initial run-in.

LUBRICATION / SEALANTS

① **Apply Lubriplate (94276) to all "O" rings, "U" cups and mating parts.**
② **Apply pipe sealant to threads.**
③ **Apply anti-seize compound to threads and bolt and nut flange heads which contact pump case when using stainless steel fasteners.**
④ **Apply Loctite 242 to threads.**

PARTS LIST / PD03P-XXX-XXX AIR MOTOR SECTION

❸ Indicates parts included in 637428 Air Section Repair Kit.

Item	Description (size)	Qty	Part No.	[Mtl]
101	Center Body	(1)	96466	[PPG]
103R	Cover (right side)	(1)	96488	[D]
103L	Cover (left side)	(1)	96489	[D]
107	Plug, Small	(1)	96353	[D]
111	Major Valve Spool	(1)	95919	[D]
118	Actuator Pin	(2)	94874-1	[SS]
❸ 121	Washer	(2)	96092	[D]
123	Screw (#4 - 20 x 1/2")	(12)	96093	[SS]
129	Muffler Baffle	(1)	96542	[P]
130	Gasket	(1)	95931	[SY]
❸ 132	Air Manifold Gasket	(1)	96214-1	[B]
134	Flange Bolt (1/4" - 20 x 3")	(4)	96487	[SS]
135	Valve Block	(1)	96204	[PPG]
136	Plug, Large	(1)	96352	[D]
❸ 137	"O" Ring (1/16" x 1-5/8" o.d.)	(3)	Y325-29	[B]
❸ 138	"U" Cup Packing (1/8" x 1" o.d.)	(1)	94395	[U]
❸ 139	"U" Cup Packing (1/8" x 1-7/16" o.d.)	(1)	96383	[U]
140	Valve Insert	(1)	93276	[CK]
141	Valve Plate	(1)	96173	[CK]
❸ 144	"U" Cup Packing (1/8" x 3/4" o.d.)	(2)	Y187-47	[B]
❸ 166	"O" Ring (1/16" x 1-1/4" o.d.)	(1)	Y325-24	[B]
❸ 167	Pilot Piston (includes 168 and 169)	(1)	67382	[D]
168	"O" Ring (1/16" x 7/16" o.d.)	(2)	96459	[U]
169	"U" Cup Packing (1/8" x 5/8" o.d.)	(1)	96384	[U]
170	Spool Bushing	(1)	96090	[D]
❸ 171	"O" Ring (1/16" x 13/16" o.d.)	(2)	Y325-17	[B]
❸ 173	"O" Ring (3/32" x 7/8" o.d.)	(2)	Y325-115	[B]
❸ 174	"O" Ring (3/32" x 11/32" o.d.)	(2)	Y325-105	[B]
❸ 200	Porting Gasket	(1)	96364	[B]
❸ 232	"O" Ring (1/16" x 3/8" o.d.)	(4)	Y325-10	[P]
236	Nut (1/4" - 20)	(4)	Y12-4-S	[SS]
❶ ❸	Lubriplate FML-2 Grease	(1)	94276	
	Lubriplate Grease, 10 Pack		637308	

MATERIAL CODE

[B] = Nitrile
[CK] = Ceramic
[D] = Acetal
[P] = Polypropylene
[PPG] = Glass Filled Polypropylene
[SS] = Stainless Steel
[SY] = Syn-Seal
[U] = Polyurethane

DIAPHRAGM PUMP SERVICE

GENERAL SERVICE NOTES:

- Inspect and replace old parts with new parts as necessary. Look for deep scratches on metallic surfaces, and nicks or cuts in "O" rings.
- Tools needed to complete disassembly and repair:
  - 5/8" socket or wrench, 7/16" socket or wrench, 3/8" socket or wrench, 5/16" Allen wrench, T-10 Torx screwdriver, torque wrench (measuring inch pounds), "O" ring pick.

FLUID SECTION DISASSEMBLY

1. Remove (61) top manifold.
2. Remove (19) "O" rings, (21) seats and (22) balls.
3. Remove (60) bottom manifold.
4. Remove (19) "O" rings, (21) seats and (22) balls.
5. Remove (15) fluid caps.
6. Remove (6) diaphragm nut, (7) or (7 / 8) diaphragms and (5) washer.
7. Remove (1) connecting rod from air motor.
8. Carefully remove remaining (6) diaphragm nut, (7) or (7 / 8) diaphragms and (5) washer from (1) connecting rod. Do not mar surface of connecting rod.

FLUID SECTION REASSEMBLY

- Reassemble in reverse order.
- Lubricate (1) connecting rod with Lubriplate or equivalent "O" ring lubricant.
- Install (5) washers with i.d. chamfer toward diaphragm.
- When replacing PTFE diaphragms, install the 96533-A Santoprene diaphragm behind the Teflon diaphragm.

AIR MOTOR SECTION SERVICE

Service is divided into two parts - 1. Pilot Valve, 2. Major Valve.

- Air Motor Section Service is continued from Fluid Section repair.

PILOT VALVE DISASSEMBLY

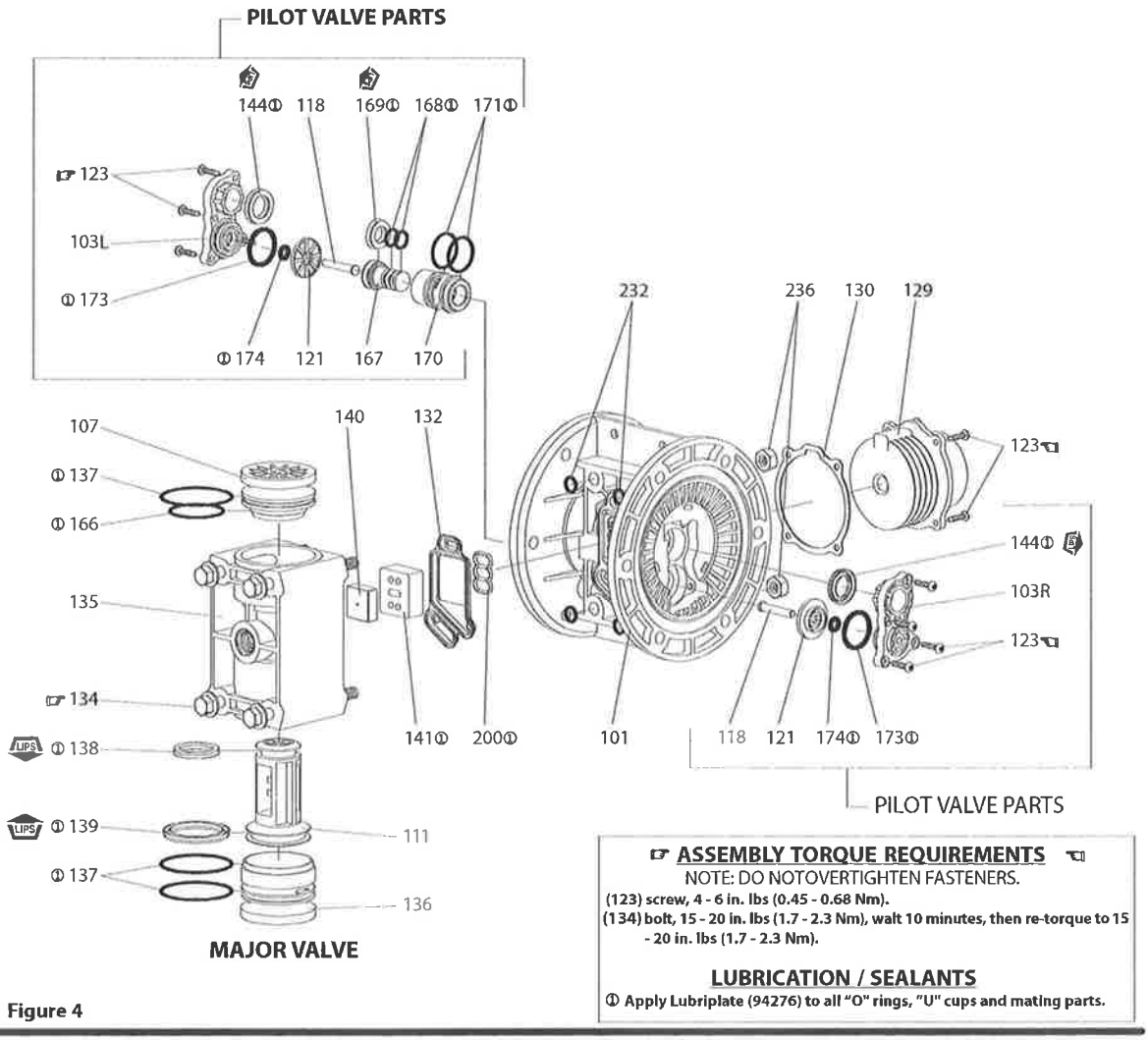
1. Remove (123) screws, releasing (103) covers, (121) washers, (118) actuator pins and (167) pilot piston.
2. Remove (170) spool bushing and inspect inner bore of bushing for damage.

PILOT VALVE REASSEMBLY

1. Clean and lubricate parts not being replaced from service kit.
2. Assemble (171) "O" rings to (170) bushing and assemble bushing into (101) center body.
3. Lubricate and assemble (167) pilot piston assembly into (170) bushing.
4. Assemble (173 and 174) "O" rings and (121) washers to (103) covers, then insert (118) actuator pins through assembly.
5. Assemble (144) "U" cups (note the lip direction) and (103) covers to (101) center body, securing with (123) screws. NOTE: Tighten (123) screws to 4 - 6 in. lbs (0.45 - 0.68 Nm).

MAJOR VALVE DISASSEMBLY

1. Unthread (123) screws, releasing (129) muffler baffle.
2. Unthread (134) bolts and pull (135) valve block and components from (101) center body.
3. Remove (132) gasket, (141) valve plate and (140) valve insert from (135) valve block.
4. Remove (134) bolts, releasing (107 and 136) plugs and (111) spool.



ASSEMBLY TORQUE REQUIREMENTS

NOTE: DO NOTOVERTIGHTEN FASTENERS.

(123) screw, 4 - 6 in. lbs (0.45 - 0.68 Nm).

(134) bolt, 15 - 20 in. lbs (1.7 - 2.3 Nm), walt 10 minutes, then re-torque to 15 - 20 in. lbs (1.7 - 2.3 Nm).

LUBRICATION / SEALANTS

① Apply Lubriplate (94276) to all "O" rings, "U" cups and mating parts.

Figure 4

MAJOR VALVE REASSEMBLY

1. Assemble new (139 and 138) U" cups on (111) spool - **LIPS MUST FACE EACH OTHER.**
2. Assemble (137) O" rings to (136) large plug.
3. Assemble (137 and 166) O" rings to (107) small plug.
4. Insert (111) spool into (136) large plug, then insert (136) large plug into (135) valve block, being sure the (111) spool is rotated to accept (140) valve insert.
5. Assemble (107) small plug into (135) valve block.
6. Assemble (140) valve insert and (141) valve plate to (135) valve block. Note: Assemble (140) valve insert with dished" side toward (141) valve plate. Assemble (141) valve plate with identification dot toward (132) gasket.
7. Assemble (132 and 200) gaskets and (135) valve block to (101) center body, securing with (134) bolts. NOTE: Tighten (134) bolts to 15 - 20 in. lbs (1.7 - 2.3 Nm).
8. Assemble (130) gasket and (129) muffler baffle to (101) center body, securing with (123) screws. NOTE: Tighten (123) screws to 4 - 6 in. lbs (0.45 - 0.68 Nm).

TROUBLE SHOOTING

Product discharged from air exhaust.
- Check for diaphragm rupture.
- Check tightness of (6) diaphragm nut.

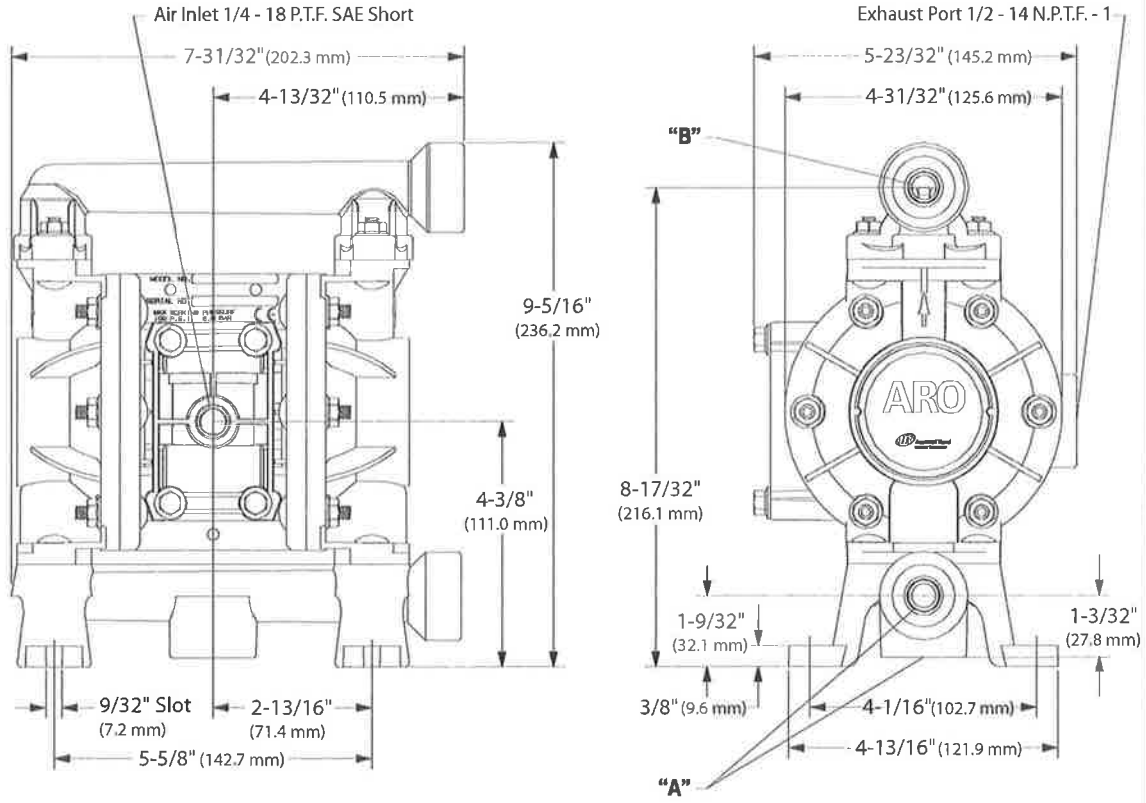
Air Bubbles in product discharge.
- Check connections of suction plumbing.
- Check "O" rings between intake manifold and fluid caps.
- Check tightness of (6) diaphragm nut.

Pump blows air out main exhaust when stalled on either stroke.
- Check "U" cups on (111) spool in major valve.
- Check (141) valve plate and (140) insert for wear.
- Check (169) U" cup on (167) pilot piston.

Pump blows air out main exhaust when stalled on either stroke.
- Check air supply.
- Check for plugged outlet hose.
- For the pump to prime itself, it must be mounted in the vertical position so that the balls will check by gravity.
- Check for pump cavitation - suction pipe should be sized at least as large as the inlet thread diameter of the pump for proper flow if high viscosity fluids are being pumped. Suction hose must be non-collapsible type, capable of pulling a high vacuum.
- Check all joints on intake manifolds and suction connections. These must be airtight.
- Inspect the pump for solid objects lodged in the diaphragm chamber or the seat area.

DIMENSIONAL DATA

Dimensions shown are for reference only, they are shown in inches and millimeters (mm).



Pump Model	"A" Material Inlet	"B" Material Outlet
PD03P-AXS-XXX	3/8 - 18 N.P.T.F.	3/8 - 18 N.P.T.F. - 1
PD03P-BXS-XXX	Rp 3/8 (3/8 - 19 BSP, parallel)	Rp 3/8 (3/8 - 19 BSP, parallel)

Figure 5

67388 WALL MOUNT BRACKET ASSEMBLY

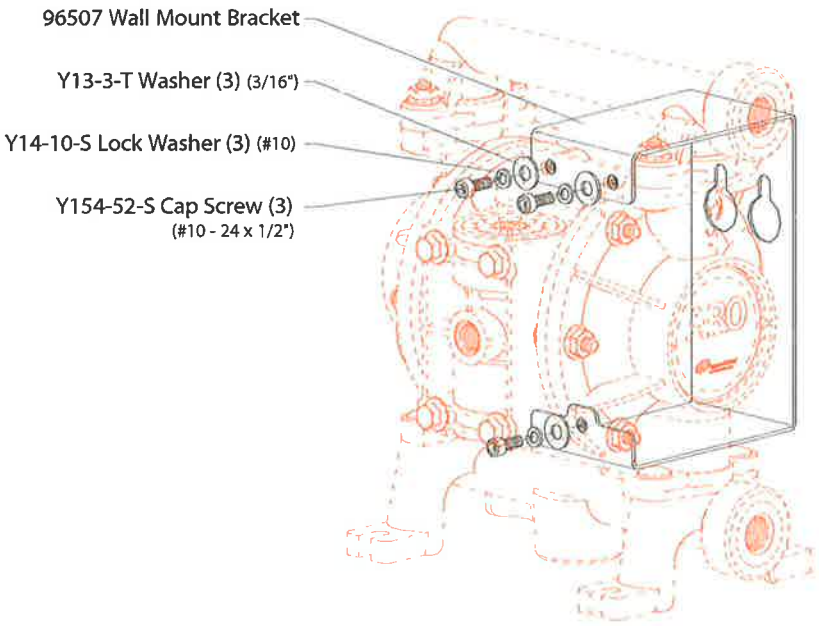


Figure 6

OPERATOR'S MANUAL PD05P-XXX-XXX-B

INCLUDING: OPERATION, INSTALLATION & MAINTENANCE

RELEASED: 8-27-08
REVISED: 10-16-09
(REV. 04)

1/2" DIAPHRAGM PUMP
1:1 RATIO (NON-METALLIC)

READ THIS MANUAL CAREFULLY BEFORE INSTALLING, OPERATING OR SERVICING THIS EQUIPMENT.

It is the responsibility of the employer to place this information in the hands of the operator. Keep for future reference.

SERVICE KITS

Refer to Model Description Chart to match the pump material options.
637427-XX for fluid section repair (see page 4).
637428 for air section repair (see page 6).

PUMP DATA

Models		see Model Description Chart for "-XXX"
Pump Type		Non-Metallic Air Operated Double Diaphragm
Material		see Model Description Chart
Weight	PD05P-XDS-XXX-B	6.28 lbs (2.85 kgs)
	PD05P-XES-XXX-B	6.67 lbs (3.03 kgs)
	PD05P-XKS-XXX-B	6.78 lbs (3.08 kgs)
	PD05P-XLS-XXX-B	7.24 lbs (3.28 kgs)
	PD05P-XPS-XXX-B	5.21 lbs (2.36 kgs)
	PD05P-XRS-XXX-B	5.44 lbs (2.47 kgs)
Maximum Air Inlet Pressure		100 p.s.i.g. (6.9 bar)
Maximum Material Inlet Pressure		10 p.s.i.g. (0.69 bar)
Maximum Outlet Pressure		100 p.s.i.g. (6.9 bar)
Air Consumption @ 40 p.s.i.		1 c.f.m. / gallon (approx.)
Maximum Flow Rate (flooded inlet)		14.4 g.p.m. (54.5 l.p.m.)
Displacement / Cycle @ 100 p.s.i.g.		0.039 gal. (0.15 lit.)
Maximum Particle Size		3/32" dia. (2.4 mm)
Maximum Temperature Limits (diaphragm / ball / seat material)		
Acetal		10° to 180° F (-12° to 82° C)
Hytrel®		-20° to 150° F (-29° to 66° C)
Kynar® PVDF		10° to 200° F (-12° to 93° C)
Nitrile		10° to 180° F (-12° to 82° C)
Polypropylene		35° to 175° F (2° to 79° C)
Polyurethane		10° to 150° F (-12° to 66° C)
Santoprene®		-40° to 225° F (-40° to 107° C)
Teflon® PTFE		40° to 225° F (4° to 107° C)
Viton®		-40° to 350° F (-40° to 177° C)
Groundable Models		PD05P-XDS-XXX-B PD05P-XES-XXX-B
Dimensional Data		see page 8
Noise Level @ 70 p.s.i., 60 c.p.m.		75.0 db(A)①

① The pump sound pressure levels published here have been updated to an Equivalent Continuous Sound Level (L_{Aeq}) to meet the intent of ANSI S1.13-1971, CAGI-PNEUROP S5.1 using four microphone locations.

NOTICE: All possible options are shown in the chart, however, certain combinations may not be recommended, consult a representative or the factory if you have questions concerning availability.

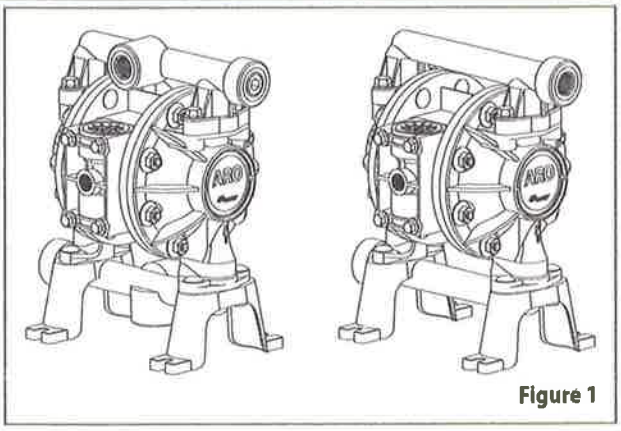


Figure 1

MODEL DESCRIPTION CHART

PD05P-XXS-XXX-B

Center Section Material
P - Polypropylene

Fluid Connection
A - 1/2 - 14 N.P.T.F. - 1
B - Rp 1/2 (1/2 - 14 BSP parallel)

Fluid Cap & Manifold Material
D - Groundable Acetal (single port)
E - Groundable Acetal (multiple port)
K - Kynar PVDF (single port)
L - Kynar PVDF (multiple port)
P - Polypropylene (single port)
R - Polypropylene (multiple port)

Hardware Material
S - Stainless steel

Seat Material
D - Acetal
K - Kynar PVDF
P - Polypropylene
S - Stainless steel

Ball Material
A - Santoprene
C - Hytrel
G - Nitrile
S - Stainless steel
T - Teflon PTFE
U - Polyurethane
V - Viton

Diaphragm Material
A - Santoprene
C - Hytrel
G - Nitrile
T - Teflon PTFE / Santoprene
U - Polyurethane
V - Viton

Fluid Section Service Kit Selection

Example: Model #PD05P-ARS-SAA-B
Fluid Section Service Kit # 637427-AA

PD05P - XXX - X X X - B
637427 - X X
Ball — Diaphragm

INGERSOLL RAND COMPANY LTD
P.O. BOX 151 • ONE ARO CENTER • BRYAN, OHIO 43506-0151
① (800) 276-4658 • FAX (800) 266-7016
fluids.ingersollrand.com

CCN 15250376

ARO

Ingersoll Rand
Industrial Technologies

OPERATING AND SAFETY PRECAUTIONS

READ, UNDERSTAND AND FOLLOW THIS INFORMATION TO AVOID INJURY AND PROPERTY DAMAGE.

⚠WARNING EXCESSIVE AIR PRESSURE. Can cause personal injury, pump damage or property damage.

- Do not exceed the maximum inlet air pressure as stated on the pump model plate.
- Be sure material hoses and other components are able to withstand fluid pressures developed by this pump. Check all hoses for damage or wear. Be certain dispensing device is clean and in proper working condition.

⚠WARNING STATIC SPARK. Can cause explosion resulting in severe injury or death. Ground pump and pumping system.

- PD05P-XDS-XXX-B and PD05P-XES-XXX-B Groundable Acetal pumps: Use the pump ground lug provided. Connect to a 12 ga. (minimum) wire (kit is included) to a good earth ground source.
- Sparks can ignite flammable material and vapors.
- The pumping system and object being sprayed must be grounded when it is pumping, flushing, recirculating or spraying flammable materials such as paints, solvents, lacquers, etc. or used in a location where surrounding atmosphere is conducive to spontaneous combustion. Ground the dispensing valve or device, containers, hoses and any object to which material is being pumped.
- Secure pump, connections and all contact points to avoid vibration and generation of contact or static spark.
- Consult local building codes and electrical codes for specific grounding requirements.
- After grounding, periodically verify continuity of electrical path to ground. Test with an ohmmeter from each component (e.g., hoses, pump, clamps, container, spray gun, etc.) to ground to insure continuity. Ohmmeter should show 0.1 ohms or less.
- Submerse the outlet hose end, dispensing valve or device in the material being dispensed if possible. (Avoid free streaming of material being dispensed.)
- Use hoses incorporating a static wire.
- Use proper ventilation.
- Keep inflammables away from heat, open flames and sparks.
- Keep containers closed when not in use.

⚠WARNING Pump exhaust may contain contaminants. Can cause severe injury. Pipe exhaust away from work area and personnel.

- In the event of a diaphragm rupture, material can be forced out of the air exhaust muffler.
- Pipe the exhaust to a safe remote location when pumping hazardous or inflammable materials.
- Use a grounded 3/8" minimum i.d. hose between the pump and the muffler.

⚠WARNING HAZARDOUS PRESSURE. Can result in serious injury or property damage. Do not service or clean pump, hoses or dispensing valve while the system is pressurized.

- Disconnect air supply line and relieve pressure from the system by opening dispensing valve or device and / or carefully and slowly loosening and removing outlet hose or piping from pump.

⚠WARNING HAZARDOUS MATERIALS. Can cause serious injury or property damage. Do not attempt to return a pump to the factory or service center that contains hazardous material. Safe handling practices must comply with local and national laws and safety code requirements.

- Obtain Material Safety Data Sheets on all materials from the supplier for proper handling instructions.

⚠WARNING EXPLOSION HAZARD. Models containing aluminum parts cannot be used with 1,1,1-trichloroethane, methylene chloride or other halogenated hydrocarbon solvents which may react and explode.

- Check pump motor section, fluid caps, manifolds and all wetted parts to assure compatibility before using with solvents of this type.

⚠WARNING MISAPPLICATION HAZARD. Do not use models containing aluminum wetted parts with food products for human consumption. Plated parts can contain trace amounts of lead.

⚠ CAUTION Verify the chemical compatibility of the pump wetted parts and the substance being pumped, flushed or recirculated. Chemical compatibility may change with temperature and concentration of the chemical(s) within the substances being pumped, flushed or circulated. For specific fluid compatibility, consult the chemical manufacturer.

⚠ CAUTION Maximum temperatures are based on mechanical stress only. Certain chemicals will significantly reduce maximum safe operating temperature. Consult the chemical manufacturer for chemical compatibility and temperature limits. Refer to PUMP DATA on page 1 of this manual.

⚠ CAUTION Be certain all operators of this equipment have been trained for safe working practices, understand it's limitations, and wear safety goggles / equipment when required.

⚠ CAUTION Do not use the pump for the structural support of the piping system. Be certain the system components are properly supported to prevent stress on the pump parts.

- Suction and discharge connections should be flexible connections (such as hose), not rigid piped, and should be compatible with the substance being pumped.

⚠ CAUTION Prevent unnecessary damage to the pump. Do not allow pump to operate when out of material for long periods of time.

- Disconnect air line from pump when system sits idle for long periods of time.

⚠ CAUTION Use only genuine ARO® replacement parts to assure compatible pressure rating and longest service life.

NOTICE Install the pump in the vertical position. The pump may not prime properly if the balls do not check by gravity upon start-up.

NOTICE Re-torque all fasteners before operation. Creep of housing and gasket materials may cause fasteners to loosen. Re-torque all fasteners to insure against fluid or air leakage.

NOTICE Replacement warning labels are available upon request: "Static Spark" pn 93616-1, Diaphragm Rupture" pn 93122.

⚠WARNING	= Hazards or unsafe practices which could result in severe personal injury, death or substantial property damage.
⚠ CAUTION	= Hazards or unsafe practices which could result in minor personal injury, product or property damage.
NOTICE	= Important installation, operation or maintenance information.

GENERAL DESCRIPTION

The ARO diaphragm pump offers high volume delivery even at low air pressure and a broad range of material compatibility options are available. Refer to the model and option chart. ARO pumps feature stall resistant design, modular air motor / fluid sections.
Air operated double diaphragm pumps utilize a pressure differential in the air chambers to alternately create suction and a positive fluid pressure In the fluid chambers, ball checks insure a positive flow of fluid.
Pump cycling will begin as air pressure is applied and will continue to pump and keep up with the demand. It will build and maintain line pressure and will stop cycling once maximum line pressure is reached (dispensing device closed) and will resume pumping as needed.

AIR AND LUBE REQUIREMENTS

⚠WARNING EXCESSIVE AIR PRESSURE. Can cause pump damage, personal injury or property damage.

- A filter capable of filtering out particles larger than 50 microns should be used on the air supply. There is no lubrication required other than the "O" ring lubricant which is applied during assembly or repair.
- If lubricated air is present, make sure that it is compatible with the "O" rings and seals in the air motor section of the pump.

OPERATING INSTRUCTIONS

- Always flush the pump with a solvent compatible with the material being pumped if the material being pumped is subject to "setting up" when not in use for a period of time.
- Disconnect the air supply from the pump if it is to be inactive for a few hours.
- The outlet material volume is governed not only by the air supply, but also by the material supply available at the inlet. The material supply tubing should not be too small or restrictive. Be sure not to use hose which might collapse.
- When the diaphragm pump is used in a forced-feed (flooded inlet) situation, it is recommended that a "check valve" be installed at the air inlet.
- Secure the diaphragm pump legs to a suitable surface to insure against damage by vibration.

MAINTENANCE

- Certain ARO "Smart Parts" are indicated which should be available for fast repair and reduction of down time.
- Provide a clean work surface to protect sensitive internal moving parts from contamination from dirt and foreign matter during service disassembly and reassembly.
- Keep good records of service activity and include the pump in preventive maintenance program.
- Service kits are available to service two separate diaphragm pump functions: 1. AIR SECTION, 2. FLUID SECTION. The Fluid Section is divided further to match typical part Material Options.
- Before disassembling, empty captured material in the outlet manifold by turning the pump upside down to drain material from the pump.

TYPICAL CROSS SECTION

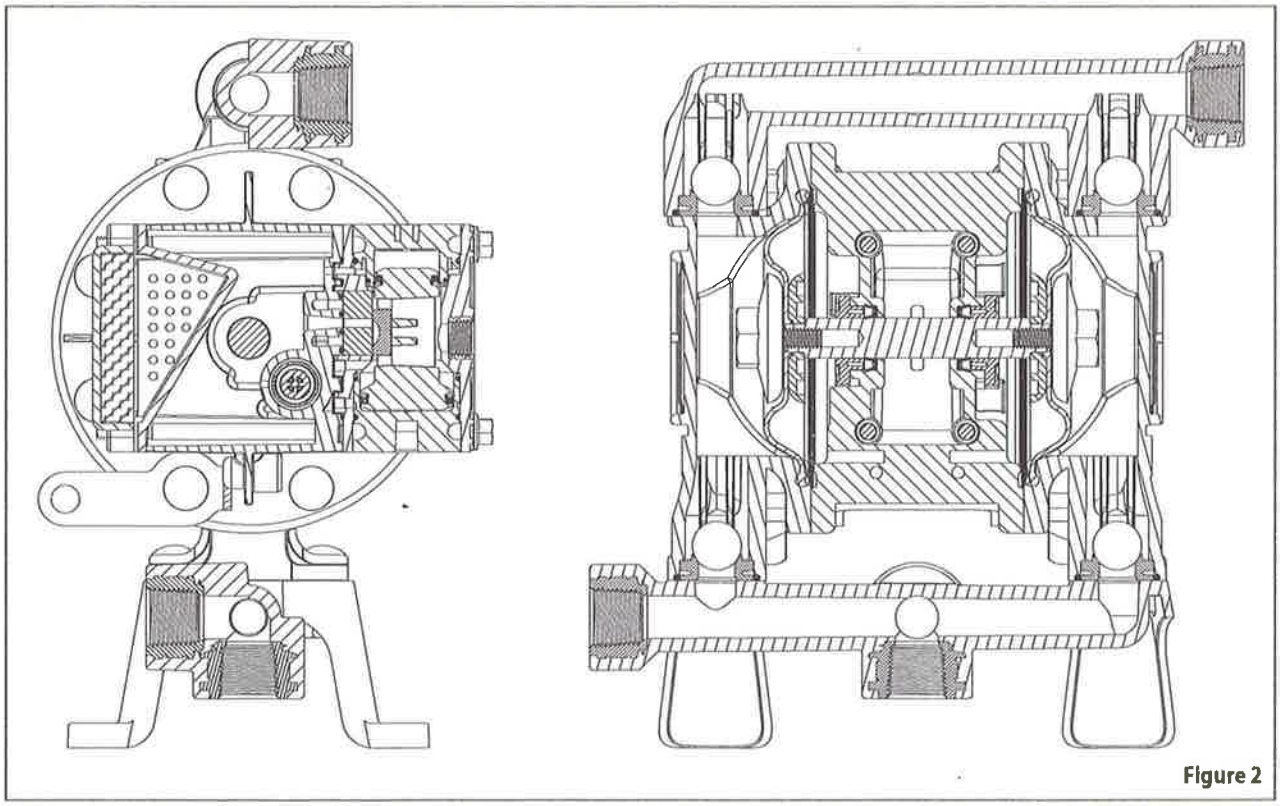


Figure 2

PARTS LIST / PD05P-XXX-XXX-B FLUID SECTION

❶ 637427-XX Fluid section service kit includes: Balls (see Ball Option, refer to -XX in chart below), Diaphragms (see Diaphragm Option, refer to -XX in chart below) and item 19 (listed below) plus items 144, 174 and 94276 Lubriplate® FML-2 grease (pages 6).

SEAT OPTIONS PD05P-XXX-XXX-B			
"21"			
-XXX	Seat	Qty	Mtl
-DXX	96572-2	(4)	[D]
-KXX	96572-3	(4)	[K]
-PXX	96572-1	(4)	[P]
-SXX	95917-1	(4)	[SS]

BALL OPTIONS PD05P-XXX-XXX-B							
❶ "22" (3/4" diameter)							
-XXX	Ball	Qty	Mtl	-XXX	Ball	Qty	Mtl
-XAX	93100-E	(4)	[Sp]	-XTX	93100-4	(4)	[T]
-XCX	93100-C	(4)	[H]	-XUX	93100-8	(4)	[U]
-XGX	93100-2	(4)	[B]	-XVX	93100-3	(4)	[V]
-XSX	93410-1	(4)	[SS]				

DIAPHRAGM OPTIONS PD05P-XXX-XXX-B										
	❶ Service Kit	❶ "7"			❶ "8"			❶ "19" (3/32" x 1-5/16" o.d.)		
-XXX	-XX = (Ball) -XX = (Diaphragm)	Diaphragm	Qty	Mtl	Diaphragm	Qty	Mtl	"O" Ring	Qty	Mtl
-XXA	637427-XA	93465	(2)	[Sp]	-----	---	---	93763	(4)	[E]
-XXC	637427-XC	93465-9	(2)	[H]	-----	---	---	Y325-122	(4)	[B]
-XXG	637427-XG	93465-G	(2)	[B]	-----	---	---	Y325-122	(4)	[B]
-XXT	637427-XT	93111	(2)	[T]	93465	(2)	[Sp]	93265	(4)	[T]
-XXU	637427-XU	93112	(2)	[U]	-----	---	---	93119	(4)	[U]
-XXV	637427-XV	93581-3	(2)	[V]	-----	---	---	Y327-122	(4)	[V]

MATERIAL CODE

[A] = Aluminum
[B] = Nitrile
[D] = Acetal
[E] = E.P.R.
[GA]= Groundable Acetal
[GFN] = Glass filled Nylon
[H] = Hytrel
[K] = Kynar PVDF
[P] = Polypropylene
[Sp] = Santoprene
[SS] = Stainless Steel
[T] = Teflon PTFE
[U] = Polyurethane
[V] = Viton

MANIFOLD / FLUID CAP MATERIAL OPTIONS PD05P-XXX-XXX-B

			Polypropylene				Kynar PVDF				Groundable Acetal			
			PD05P-XPS-		PD05P-XRS-		PD05P-XKS-		PD05P-XLS-		PD05P-XDS-		PD05P-XES-	
Item	Description (size)	Qty	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl
❷ 6	Diaphragm Nut (5/16" - 18)	(2)	93103-7	[P]	93103-7	[P]	93103-4	[K]	93103-4	[K]	93103-3	[D]	93103-3	[D]
15	Fluid Cap	(2)	95732-1	[P]	95732-1	[P]	95732-3	[K]	95732-3	[K]	95732-2	[GA]	95732-2	[GA]
43	Ground Strap	(1)	-----	---	-----	---	-----	---	-----	---	92956-1	[SS]	92956-1	[SS]
57	Ground Kit Assembly (not shown)	(1)	-----	---	-----	---	-----	---	-----	---	66885-1		66885-1	
60	Inlet Manifold (N.P.T.F.)	(1)	95734-7	[P]	95734-1	[P]	95734-9	[K]	95734-3	[K]	95734-8	[GA]	95734-2	[GA]
	(BSP)	(1)	95734-10	[P]	95734-4	[P]	95734-12	[K]	95734-6	[K]	95734-11	[GA]	95734-5	[GA]
61	Outlet Manifold (N.P.T.F.)	(1)	95733-7	[P]	95733-1	[P]	95733-9	[K]	95733-3	[K]	95733-8	[GA]	95733-2	[GA]
	(BSP)	(1)	95733-10	[P]	95733-4	[P]	95733-12	[K]	95733-6	[K]	95733-11	[GA]	95733-5	[GA]
63	Pipe Plug (1/2 - 14 N.P.T. x 9/16")	(3)	-----	---	93897-1	[P]	-----	---	93897-3	[K]	-----	---	93897-2	[D]
	(R 1/2 [1/2 - 14 BSP taper])	(3)	-----	---	96478-1	[P]	-----	---	96478-3	[K]	-----	---	96478-2	[D]

COMMON PARTS

Item	Description (size)	Qty	Part No.	Mtl
❷ 1	Connecting Rod	(1)	96379	[SS]
5	Diaphragm Washer	(2)	94645	[GFN]
26	Flange Bolt (5/16" - 18 x 7/8")	(4)	96176	[SS]

Item	Description (size)	Qty	Part No.	Mtl
27	Bolt (5/16" - 18 x 1-1/4")	(20)	93095	[SS]
29	Hex Flange Nut (5/16" - 18)	(20)	93886	[SS]
77	Logo Plate	(2)	93264	[A]

DUAL INLET / DUAL OUTLET KITS 637440-X

			Polypropylene				Kynar PVDF				Groundable Acetal			
			637440-1 (N.P.T.)		637440-4 (BSP)		637440-3 (N.P.T.)		637440-6 (BSP)		637440-2 (N.P.T.)		637440-5 (BSP)	
Item	Description (size)	Qty	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl	Part No.	Mtl
17	Dual Inlet Manifold	(2)	95914-1	[P]	95914-4	[P]	95914-3	[K]	95914-6	[K]	95914-2	[GA]	95914-5	[GA]
18	Dual Inlet Manifold	(2)	95915-1	[P]	95915-4	[P]	95915-3	[K]	95915-6	[K]	95915-2	[GA]	95915-5	[GA]
19	"O" Ring (3/32" x 1-5/16" o.d.)	(4)	93265	[T]	93265	[T]	93265	[T]	93265	[T]	93265	[T]	93265	[T]

❷ "Smart Parts", keep these items on hand in addition to the service kits for fast repair and reduction of down time.

FOR THE AIR MOTOR SECTION, SEE PAGES 6 AND 7.

ASSEMBLY TORQUE REQUIREMENTS

NOTE: DO NOT OVERTIGHTEN FASTENERS.

(6) diaphragm nut, 95 - 105 in. lbs (10.7 - 11.9 Nm).

(26) bolt and (29) nut, 50 - 60 in. lbs (5.6 - 6.8 Nm), alternately and evenly, then re-torque after initial run-in.

LUBRICATION / SEALANTS

① Apply Lubriplate FML-2 grease to all "O" rings, "U" cups and mating parts.

② Apply pipe sealant to threads.

③ Apply anti-seize compound to threads and bolt and nut flange heads which contact pump case when using stainless steel fasteners.

④ Apply Loctite® 242® to threads.

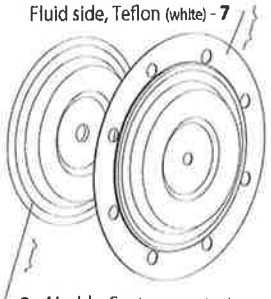
Note: Lubriplate FML-2 is a white food grade petroleum grease.

Torque Sequence

Figure 3

View for PD05P-XXS-XXT-B (Teflon diaphragm) configuration only.

Fluid side, Teflon (white) - **7**



8 - Air side, Santoprene (tan)

COLOR CODE

Material	Diaphragm Color	Ball Color
Hytrel	Cream	Black (•)
Nitrile	Black	Red (•)
Polyurethane	Clear	Red
Santoprene	Tan	Tan
Teflon PTFE	White	White
Viton	Yellow (•)	Yellow (•) (•) Dot

PARTS LIST / PD05P-XXX-XXX-B AIR MOTOR SECTION

❸ Indicates parts included in 637428 air section service kit.

AIR MOTOR PARTS LIST

Item	Description (size)	Qty	Part No.	Mtl
101	Center Body	(1)	96315	[PPG]
103R	Cover (right side)	(1)	96091	[D]
103L	Cover (left side)	(1)	96351	[D]
107	Plug, Small	(1)	96353	[D]
111	Major Valve Spool	(1)	95919	[D]
118	Actuator Pin	(2)	97111	[SS]
❹ 121	Washer	(2)	96092	[D]
123	Screw (#4 - 20 x 1/2")	(8)	96093	[SS]
129	Muffler Assembly	(1)	67367	[PPG]
❹ 129	Exhaust Cover (optional)	(1)	67366	[PPG]
❹ 130	Gasket (optional)	(1)	93107	[Sy]
❸ 132	Air Manifold Gasket	(1)	96214-1	[B]
134	Flange Bolt (1/4" - 20 x 5-3/4")	(4)	94871	[SS]
135	Valve Block	(1)	96204	[PPG]
136	Plug, Large	(1)	96352	[D]
❸ 137	"O" Ring (1/16" x 1-5/8" o.d.)	(3)	Y325-29	[B]
❸ 138	"U" Cup Packing (1/8" x 1" o.d.)	(1)	94395	[U]
❸ 139	"U" Cup Packing (1/8" x 1-7/16" o.d.)	(1)	96383	[U]

Item	Description (size)	Qty	Part No.	Mtl
140	Valve Insert	(1)	93276	(Ck)
141	Valve Plate	(1)	96173	(Ck)
❶❸ 144	"U" Cup Packing (3/16" x 1" o.d.)	(2)	Y187-48	[B]
❸ 166	"O" Ring (1/16" x 1-1/4" o.d.)	(1)	Y325-24	[B]
❸ 167	Pilot Piston (includes 168 and 169)	(1)	67382	[D]
168	"O" Ring (1/16" x 7/16" o.d.)	(2)	96459	[U]
169	"U" Cup Packing (1/8" x 5/8" o.d.)	(1)	96384	[U]
170	Spool Bushing	(1)	96090	[D]
❸ 171	"O" Ring (1/16" x 13/16" o.d.)	(2)	Y325-17	[B]
❸ 173	"O" Ring (3/32" x 7/8" o.d.)	(2)	Y325-115	[B]
❶❸ 174	"O" Ring (3/32" x 11/32" o.d.)	(2)	Y325-105	[B]
❸ 200	Porting Gasket	(1)	96364	[B]
201	Muffler (optional)	(1)	93110	[C]
❹ 232	"O" Ring (1/16" x 3/8" o.d.) (optional)	(4)	Y325-10	[B]
❹	Ported Exhaust Kit (includes items 129, 130 and 232) (optional)	(1)	637438	---
❶ ❸	Lubriplate FML-2 grease	(1)	94276	
	Lubriplate Grease Packets (10)		637308	

❶ Items included in fluid section service kit, see page 4.

MATERIAL CODE

[B] = Nitrile
[C] = Carbon Steel
[Ck] = Ceramic
[D] = Acetal
[PPG] = Glass filled Polypropylene
[SS] = Stainless Steel
[Sy] = Syn-Seal
[U] = Polyurethane

DIAPHRAGM PUMP SERVICE

GENERAL SERVICE NOTES:

- Inspect and replace old parts with new parts as necessary. Look for deep scratches on metallic surfaces, and nicks or cuts in "O" rings.
- Tools needed to complete disassembly and repair:
  - 7/8" socket or wrench, 1/2" socket or wrench, 3/8" socket or wrench, 3/8" Allen wrench, T-10 Torx screwdriver, torque wrench (measuring inch pounds), "O" ring pick.

FLUID SECTION DISASSEMBLY

1. Remove (61) top manifold.
2. Remove (19) "O" rings, (21) seats and (22) balls.
3. Remove (60) bottom manifold.
4. Remove (19) "O" rings, (21) seats and (22) balls.
5. Remove (15) fluid caps.
6. Remove (6) diaphragm nut, (7) or (7 / 8) diaphragms and (5) washer.
7. Remove (1) connecting rod from air motor.
8. Carefully remove remaining (6) diaphragm nut, (7) or (7 / 8) diaphragms and (5) washer from (1) connecting rod. Do not mar surface of connecting rod.

FLUID SECTION REASSEMBLY

- Reassemble in reverse order.
- Lubricate (1) connecting rod with Lubriplate or equivalent "O" ring lubricant.
- Connecting rod (1) should be installed using 96571 bullet, included in service kit.
- Install (5) washers with i.d. chamfer toward diaphragm.
- When replacing Teflon diaphragms, install the 93465 Santoprene diaphragm behind the Teflon diaphragm.

AIR MOTOR SECTION SERVICE

Service is divided into two parts - 1. Pilot Valve, 2. Major Valve.

- Air Motor Section service is continued from Fluid Section repair.

PILOT VALVE DISASSEMBLY

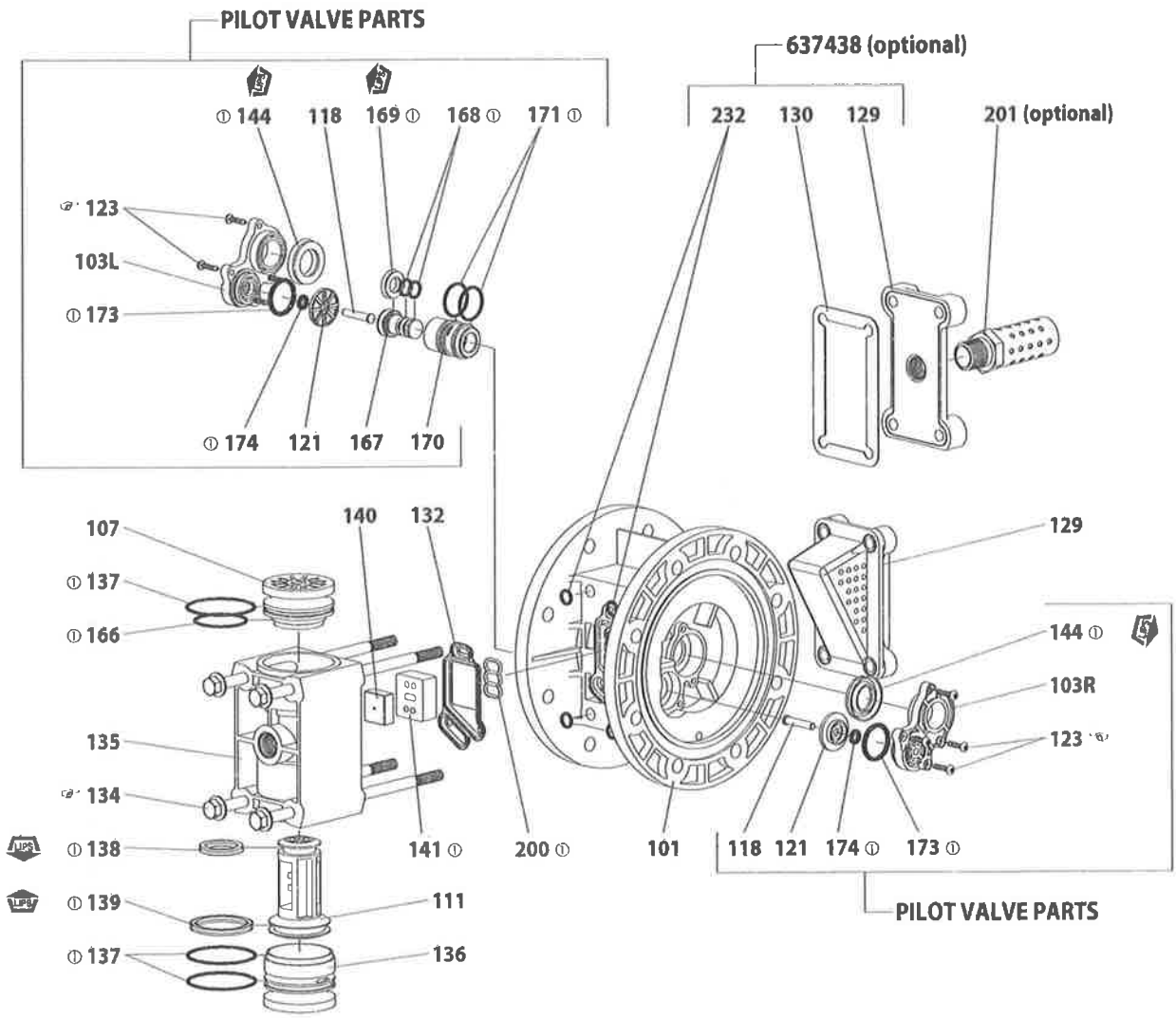
1. Remove (123) screws, releasing (103) covers, (121) washers, (118) actuator pins and (167) pilot piston.
2. Remove (170) spool bushing and inspect inner bore of bushing for damage.

PILOT VALVE REASSEMBLY

1. Clean and lubricate parts not being replaced from service kit.
2. Assemble (171) "O" rings to (170) bushing and assemble bushing into (101) center body.
3. Lubricate and assemble (167) pilot piston assembly into (170) bushing.
4. Assemble (173 and 174) "O" rings and (121) washers to (103) covers, then insert (118) actuator pins through assembly.
5. Assemble (144) "U" cups (note the lip direction) and (103) covers to (101) center body, securing with (123) screws. NOTE: tighten (123) screws to 4 - 6 in. lbs (0.45 - 0.68 Nm).

MAJOR VALVE DISASSEMBLY

1. Unthread (134) bolts, releasing (129) muffler assembly.
2. Pull (135) valve block and components from (101) center body.
3. Remove (132) gasket, (141) valve plate and (140) valve insert from (135) valve block.
4. Remove (134) bolts, releasing (107 and 136) plugs and (111) spool.



MAJOR VALVE

Figure 4

☞ ASSEMBLY TORQUE REQUIREMENTS ☜

NOTE: DO NOT OVERTIGHTEN FASTENERS.

(123) screw, 4 - 6 in. lbs (0.45 - 0.68 Nm).

(134) bolt, torque to 15 - 20 in. lbs (1.7 - 2.3 Nm), wait 10 minutes, then re-torque to 15 - 20 in. lbs (1.7 - 2.3 Nm).

LUBRICATION / SEALANTS

① Apply Lubriplate FML-2 grease to all "O" rings, "U" cups and mating parts.

MAJOR VALVE REASSEMBLY

1. Assemble new (139 and 138) "U" cups on (111) spool - **LIPS MUST FACE EACH OTHER.**
2. Assemble (137) "O" rings to (136) large plug.
3. Assemble (137 and 166) "O" rings to (107) small plug.
4. Insert (111) spool into (136) large plug, then insert (136) large plug into (135) valve block, being sure the (111) spool is rotated to accept (140) valve insert.
5. Assemble (107) small plug into (135) valve block.
6. Assemble (140) valve insert and (141) valve plate to (135) valve block. NOTE: Assemble (140) valve insert with "dished" side toward (141) valve plate. Assemble (141) valve plate with identification dot toward (132) gasket.
7. Assemble (132 and 200) gaskets, (135) valve block and (129) muffler assembly to (101) center body, securing with (134) bolts. NOTE: Tighten (134) bolts to 15 - 20 in. lbs (1.7 - 2.3 Nm).

TROUBLE SHOOTING

Product discharged from exhaust outlet.
- Check for diaphragm rupture.
- Check tightness of (6) diaphragm nut.

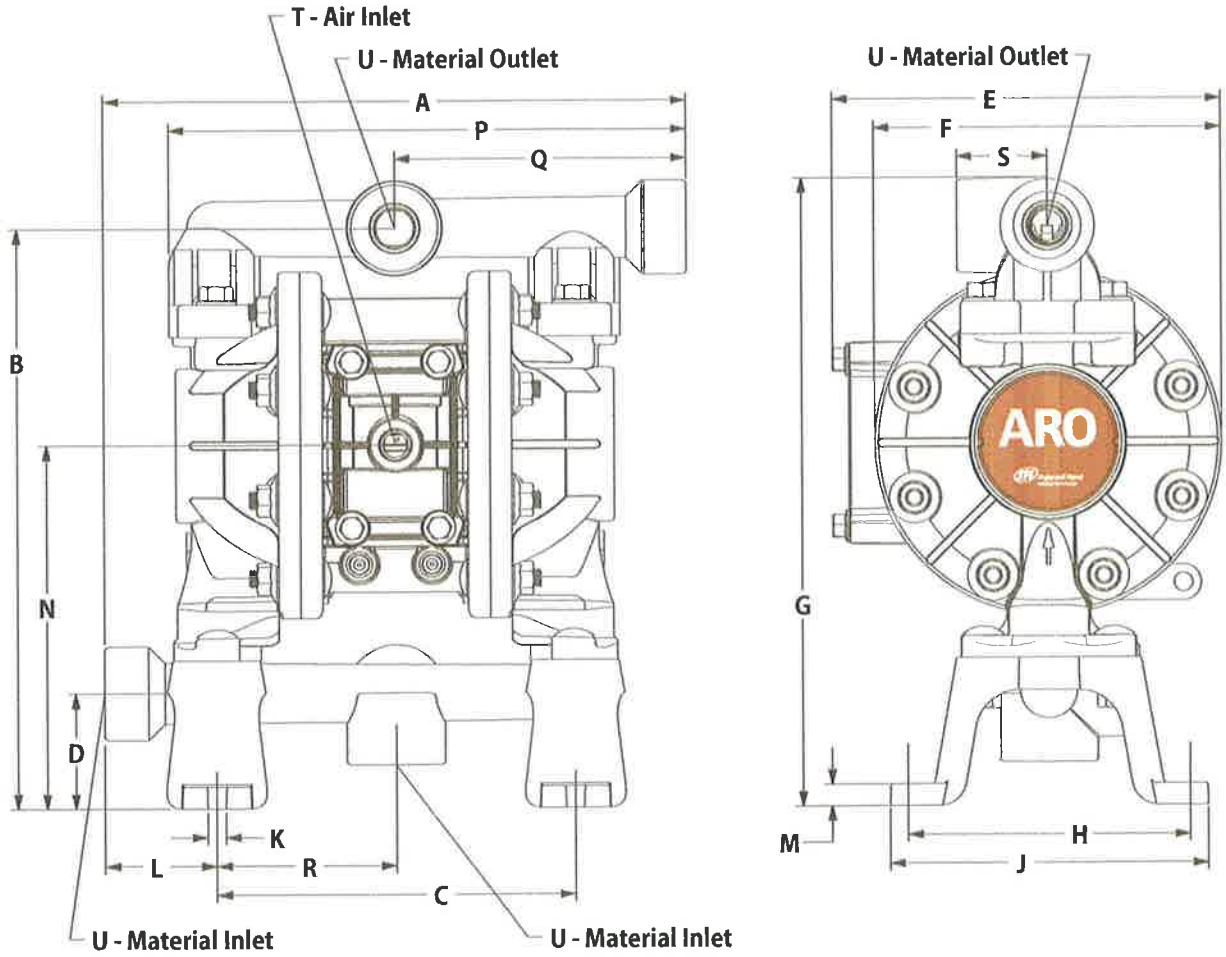
Air bubbles in product discharge.
- Check connections of suction plumbing.
- Check "O" rings between intake manifold and fluid caps.
- Check tightness of (6) diaphragm nut.

Motor blows air out main exhaust when stalled on either stroke.
- Check "U" cups on (111) spool in major valve.
- Check (141) valve plate and (140) insert for wear.
- Check (169) "U" cup on (167) pilot piston.

Low output volume.
- Check air supply.
- Check for plugged outlet hose.
- For the pump to prime itself, it must be mounted in the vertical position so that the balls will check by gravity.
- Check for pump cavitation - suction pipe should be sized at least as large as the inlet thread diameter of the pump for proper flow if high viscosity fluids are being pumped. Suction hose must be a non-collapsing type, capable of pulling a high volume.
- Check all joints on the inlet manifolds and suction connections. These must be air tight.
- Inspect the pump for solid objects lodged in the diaphragm chamber or the seat area.

DIMENSIONAL DATA

Dimensions shown are for reference only, they are displayed in inches and millimeters (mm).



DIMENSIONS

A - 10-1/32" (254.8 mm)	F - 6-1/32" (153.1 mm)	L - 1-15/16" (48.9 mm)	R - 3-3/32" (78.5 mm)
B - 10-3/32" (256.1 mm)	G - 10-29/32" (276.8 mm)	M - 3/8" (9.6 mm)	S - 1-9/16" (39.7 mm)
C - 6-3/16" (157.1 mm)	H - 4-29/32" (124.2 mm)	N - 6-11/32" (160.5 mm)	T - 1/4 - 18 P.T.F. SAE Short
D - 2" (51.0 mm)	J - 5-17/32" (140.2 mm)	P - 8-29/32" (225.9 mm)	U - see below
E - 6-3/4" (171.0 mm)	K - 5/16" (8.0 mm)	Q - 5-1/32" (127.4 mm)	

Pump Model	"U" Material Inlet / Outlet
PD05P-AXS-XXX-B	1/2 - 14 N.P.T.F. - 1
PD05P-BXS-XXX-B	Rp 1/2 (1/2 - 14 BSP, parallel)

Figure 5

15301823
Edition 1
March 2009

Piggyback Assembly

1000 Series

Parts Information

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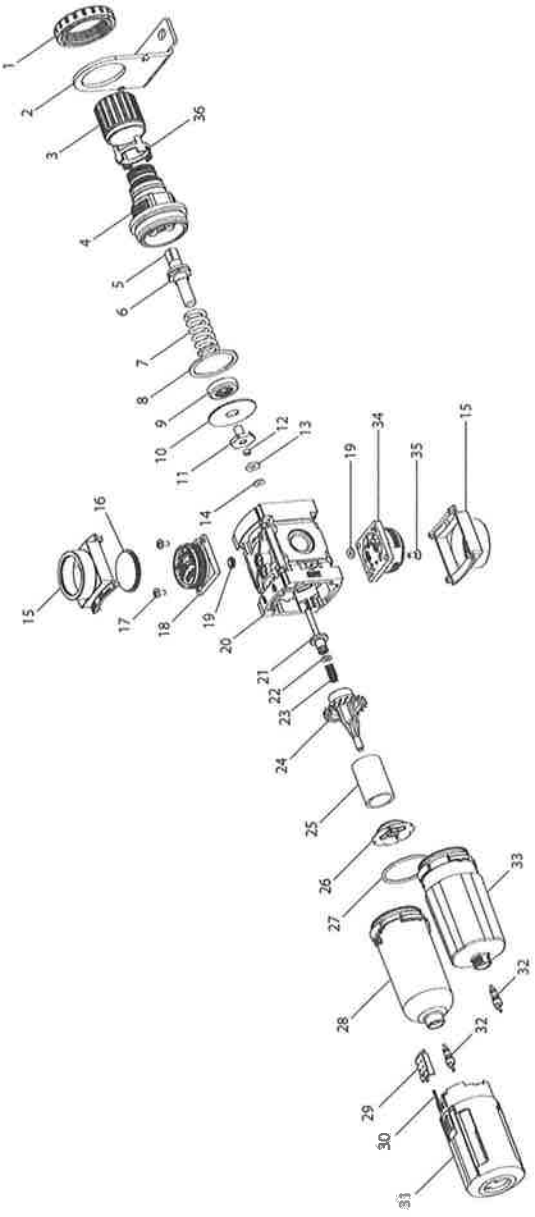
Piggyback Assembly 1000 Series P391XX-XXX Exploded Diagram

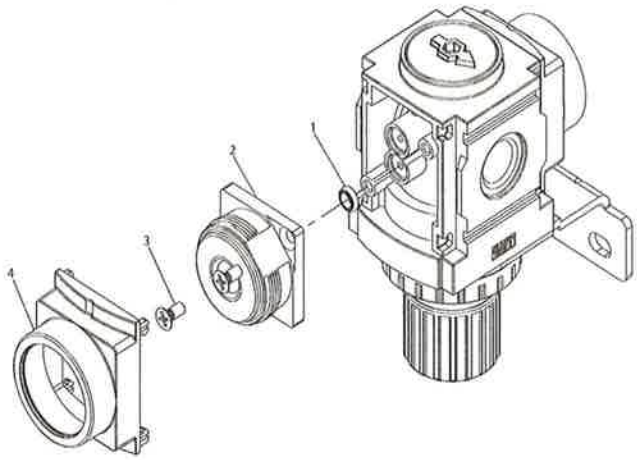


(Dwg. 15318611)

Piggyback Assembly 1000 Series P391XX-XXX Parts List

Item	Part Desciption	Material	Part Number
1	Panel Mount Nut	Acetal	---
2	L-Bracket	Steel	---
3	Handle	Acetal	---
4	Bonnet		---
5	Adjusting Bolt	Steel	---
6	Adjusting Nut		---
7	Adjusting Spring		
	0-30 psig (P391XX-4XX)	Steel	104305
	0-60 psig (P391XX-2XX)		104306
	0-140 psig (P391XX-1XX, P391XX-6XX)		104307
8	Diaphragm Ring	Acetal	---
9	Diaphragm Shell		---
10	Diaphragm	Nitrile+Acetal	---
11	Relief Valve	Acetal	---
12	Relief Valve Gasket	Nitrile	---
13	Stem O-Ring Holder	Aluminum	---
14	Stem O-Ring	Nitrile	---
15	Regulator Body Cover	Acetal	---
16	Gauge Window	Polycarbonate	---
17	Gauge Bolt	Steel	---
18	Gauge		
	0-140 psig (P391XX-6XX)	---	104310
19	Gauge O-Ring	Nitrile	---
20	Piggyback Body		
	1/8" BSP (P391AX-XXX)	Aluminum	---
	1/4" BSP (P391BX-XXX)		---
	1/8" NPT (P3911X-XXX)		---
	1/4" NPT (P3912X-XXX)		---
21	Valve Assembly	Brass+Nitrile	---
22	Valve O-Ring	Nylon	---
23	Valve Spring	Stainless Steel	---
24	Deflector	Acetal	---
25	Filter Element		
	5 Micron (P391X4-XXX)	Polyethylene	104295
	40 Micron (N/A)		104296
26	Baffle	Acetal	---
27	Bowl O-Ring	Nitrile	---
28	Poly Bowl (Includes Items 25, 27, 28, 29 and Drain)		
	Manual Drain (P391XX-X00)	Polycarbonate	104298
	Auto Drain (P391XX-X04)		104299
29	Lock Button		
	(P391XX-X0X)	Acetal	---
30	Lock Button Spring		
	(P391XX-X0X)	Stainless Steel	---
31	Bowl Guard		
	Manual Drain (P391XX-X00)	Nylon	---
	Auto Drain (P391XX-X04)		---
32	Manual Drain		
	(P391XX-XX0)	---	104294
33	Metal Bowl (Includes Item 25)		
	Manual Drain (P391XX-X20)	Aluminum	104300
	Auto Drain (P391XX-X24)		104301
34	Block Cover	Nylon	---
35	Gauge Bolt	Steel	---
	Auto Drain (See Part List 15301799)		
	(P391XX-XX4)	---	104293
36	Tamper Kit	Nylon	104304
	No Gauge Assembly (See Page 4)	---	---
	Service Kit (Includes Items 8, 9, 10, 11, 12, 19 20 & 21)		
	Relieving (P391XX-X0X, P391XX-X2X)	---	104302
	Non-Relieving (P391XX-X4X)	---	104303
	Service Kit (Includes Items 25 and 30)	---	104468

No Gauge Assembly 1000 Series Exploded Diagram



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No Gauge Assembly 1000 Series Parts List

Item	Part Description	Material	Part Number	Item	Part Description	Material	Part Number
1	Gauge O-Ring	Nitrile	---	3	Block Cover Bolt	Steel	---
2	Gauge Plate	Acetal	---	4	Regulator Body Cover	Acetal	---

Parts and Maintenance

When the life of the tool has expired, it is recommended that the tool be disassembled, degreased and parts be separated by material so that they can be recycled.

Tool repair and maintenance should only be carried out by an authorized Service Center.

Refer all communications to the nearest **Ingersoll Rand** Office or Distributor.

Related Documentation

For additional information refer to:
Safety Information Manual 15301765.
Product Information Manual 15301773.
Maintenance Information Manual 15301781.

Manuals can be downloaded from fluids.ingersollrand.com

Part No: 100400-59

fluids.ingersollrand.com

Ingersoll Rand

Form 100400-55
15301781
Edition 1
February 2009

Pneumatic Filters, Regulators, Lubricators, Filter/Regulators and Combination Units

F35XXX-XXX Filters
R37XXX-XXX Regulators
L36XXX-XXX Lubricators
P39XXX-XXX Filter/Regulators
C38XXX-XXX Combinations

Maintenance Information

Save These Instructions

Ingersoll Rand

Product Description

The air line Filters, Regulators, Lubricators, Filter/Regulators and Combination Units are intended for use in industrial compressed air systems only. No other use is recommended.

⚠ WARNING

General Product Safety Information

- Read and understand this manual before operating this product.
- It is your responsibility to make this safety information available to others that will operate this product.
- Failure to observe the following warnings could result in injury.
- The Units must not be used with fluids, other than air, for nonindustrial applications, or for life support systems.
- Always install, operate, inspect and maintain this product in accordance with all applicable standards and regulations (local, state, country, federal, etc.).
- Filters, regulators, lubricators and filter/regulators contain high pressure air.
- Always wear eye protection when operating or performing maintenance of these units.
- Only Service Technicians that are qualified to work on pressurized pneumatic systems should install, maintain or repair this system.
- Always turn off the air supply and disconnect the air supply hose before installing, removing or adjusting any accessory on this product or before performing any maintenance on this product.

Note: When reading the instructions, refer to exploded diagrams in parts Information Manuals when applicable (see under Related Documentation for form numbers).

General Installation of Units

- Install in an accessible location where product is safe from damage or puncture.
- Do not expose this product to direct sunlight, radiant heat, heavy vibration, shock, corrosive gases, chemicals, vapors from organic solvents, water, salt water or steam.
- Polycarbonate Bowl: To avoid rupture that can cause personal injury or property damage.
  - Do not use incompatible chemicals.
    Thinner, Certain Alcohols, Aniline, Carbon Tetrachloride, Chlorinated Hydrocarbons, Chloroform, Esters, Ethyl Acetate, Kerosene, Ketones, Lactic Acid, Nitric Acid, Nucleic Acid, Organic solvents, Chemical Solvents, Paints and fumes, Trichloro Ethylene, Compressor Oils containing Ester based additives, Synthetic Oils, and fumes with any of the above substances.
- Use a metal bowl in applications where a polycarbonate bowl might be exposed to substances or conditions that are incompatible with polycarbonate.
- Product that contains bowls need to be securely locked into position noted by the "Lock" and "Unlock" symbols on the bowls and bases of the units.
- Be sure all hoses, accessories and fittings are the correct size, are tightly secured and rated above the maximum compressed air inlet pressure.
- Ensure an accessible emergency shut off valve has been installed in the air supply line, and make others aware of the location.
- Install Filter, Regulator then Lubricator or Filter/Regulator and Lubricator with air flow in direction of arrows located on product.
- All maintenance instructions must be followed to ensure proper and safe system operation.
- Always wear eye protection when operating or performing maintenance on this product.

⚠ WARNING

- Do not exceed the maximum rated temperature or maximum rated pressure for the product. That may result in hazardous situations including rupture of fittings, hoses, bowls or other parts of the system.
- Do not remove any labels. Replace any damaged labels.
- Never use a damaged or malfunctioning product or accessory.
- Do not modify this product, safety devices, or accessories.
- Always turn off the air supply and bleed the air pressure before performing any maintenance on the system.
- Do not use this product for purposes other than those recommended.
- Use only accessories recommended by **Ingersoll Rand**.

NOTICE

- Do not disassemble the unit any further than necessary to replace or repair damaged parts.
- Do not remove any part which is a press fit in or on a subassembly unless the removal of that part is necessary for repairs or replacement.
- Do not disassemble the unit unless you have a complete set of new gaskets and seals for replacement.

Filters

Installation – Filters

- Install filter with the air flow as indicated by the arrow on the unit.
- Install filter as close as possible to the air operated equipment for best performance.
- Filter must be installed with the bowl downward for proper operation.
- Locate the filter upstream from the regulator and lubricator.
- When using filter featuring the sight glass on the bowl, orient the bowl so it is most visible for the operator.
- Air line piping should be the same size as filter ports.
- Locate filter in air line upstream of cycling directional control valves, and away from any heat source. If used as a main filter, install as close as possible to the air supply.

- Use pipe thread sealant on male threads only when connecting piping. Do not allow sealant to enter the interior of the filter.
- For maximum coalescing element life and efficiency, install a general purpose filter with a 5-micron element upstream from the coalescing filter.
- Connect flexible tubing with 1/8" minimum I.D. to the automatic drain connection (1/8" NPT). Avoid restrictions in the drain line.

Operation – Filters

- Monitor the sediment accumulation.
- If the pressure drop across the filter becomes excessive, empty the filter bowl, replace the filter element to assure good performance.
- Soak the filter bowl and clean with soap and water. Refer to warnings concerning polycarbonate bowls.

Maintenance – Filters

Filter Elements:

1. Depressurize Unit.
2. Remove Bowl/Bowl Guard Assembly by:
   Polycarbonate Bowl/Bowl Guard Assemblies – Firmly grasp the bowl assembly and pull down on the locking tab while pushing the bowl in an upward direction and turning counterclockwise 1/8 of a turn. The "Lock Position Arrow" should now be in-line with the "Unlocked" symbol. Slowly pull down on the bowl assembly.
   Metal Bowl Assemblies – Firmly grasp the bowl assembly and push the bowl in an upward direction while turning counterclockwise. The "Lock Position Arrow" should now be in-line with the "Unlocked" symbol. Slowly pull down on the bowl assembly.
3. Remove Baffle located at the bottom of the filter element.
4. Install new filter element.
5. Reassemble in reverse order.
6. Before returning unit to service, insure that all seals have been installed or replaced properly and the bowl is in the locked position.

Maintenance – Filters

Service Indicator:

1. Do NOT perform any maintenance on the service indicators.
2. Replace defective unit with a new unit.

Automatic Drain and Manual Drain:

1. Do NOT perform any maintenance on the Automatic Drains or Manual Drains.
2. Replace defective unit with a new unit.

⚠ WARNING

BOWL REMOVAL HAZARD THE BOWL MUST BE SECURELY LOCKED INTO POSITION BEFORE EXPOSING THE UNIT TO THE LINE PRESSURE. The bowls are designed with a feature which inhibits removal while under pressure. When reinstalling, push the bowl up into the body and rotate to the right 1/8 turn. Failure to lock bowl could cause it to blow off, which could result in personal injury or property damage.

- Polycarbonate Bowl: To avoid rupture that can cause personal injury or property damage.
  - Do not use incompatible chemicals.
    Thinner, Certain Alcohols, Aniline, Carbon Tetrachloride, Chlorinated Hydrocarbons, Chloroform, Esters, Ethyl Acetate, Kerosene, Ketones, Lactic Acid, Nitric Acid, Nucleic Acid, Organic solvents, Chemical Solvents, Paints and fumes, Trichloro Ethylene, Compressor Oils containing Ester based additives, Synthetic Oils, and fumes with any of the above substances.

NOTICE

- Wash bowl only with soap and warm water.
- Filters with manual drain must be drained as frequently as necessary to keep the liquid level below the baffle, which could cause liquid to be carried downstream. Replace filter element if necessary.
- Automatic drains can be operated manually by depressing the needle inside drain outlet.
- Collect water/oil from filter bowl and dispose of properly.
- Replace element when pressure drop reaches or exceeds 10 psig (0.7 bar) or when service life indicator shows approximately one-half red / green. An excessive pressure drop across a saturated but uncontaminated element could indicate operation above the maximum flow rate (see Specifications).
- Inspect and replace any parts found to be worn or damaged.

Regulators

Installation – Regulators

- Install regulator with the air flow as indicated by the arrow on the unit.
- Install regulator as close as possible to the air operated equipment for best performance.
- Locate the regulator upstream from the lubricator.
- Mount with the knob up or down on regulator.
- If the air line contains water, sludge or foreign materials, a filter should be installed on the upstream side to protect the regulator.
- A tamper resistant feature is available to lock in specific air requirements.
- After a regulator has been installed in the air line, the adjustment knob should be turned counterclockwise until compression is released from the pressure control spring. This prevents over pressurizing the air operated equipment when the air supply is turned on.
- Connect piping to proper ports using pipe thread sealant on male threads only. Do not allow sealant to enter interior of regulator.
- Air line piping should be the same size as regulator ports.

Operation – Regulators

- Pull knob to adjust air pressure.
- Turn clockwise to increase pressure.
- Turn counterclockwise to decrease pressure.
  Note: On non-relieving models only, reduce pressure to lower than estimated final operating pressure, purge air (open or actuate air operated equipment to relieve pressure), adjust pressure upward as needed.
- Push down to lock knob.

Maintenance – Regulators

Diaphragm Assembly:

1. Depressurize Unit.
2. Disengage the handle (adjustment knob) lock by pulling the handle upward.
3. Turn pressure adjustment knob counterclockwise until the compression is released from the adjusting spring.
4. Unscrew the Bonnet and remove the Control Spring, Adjusting Assembly and the Diaphragm Assembly.
5. Inspect parts for wear and/or damage. If replacement is necessary, use parts from Service Kit.
6. Reassemble in reverse order.

R-Valve Assembly:

1. Depressurize Unit
2. Remove Valve Guide by turning 1/8 turn in counterclockwise direction and pulling outwards.
3. Remove Valve Spring and R-Valve Assembly from Body housing.
4. Inspect parts for wear and/or damage. If replacement is necessary, use parts from Service Kit.
5. Reassemble in reverse order.

Integral Gauge:

1. Depressurize Unit
2. Remove Gauge Cover Ring from Body by turning counterclockwise.
3. Remove Gauge Block Screws (2) from Body housing.
4. DO NOT attempt to repair Gauge. If replacement is necessary, replace with new Gauge.
5. Reassemble in reverse order.

NOTICE

- Clean other parts using soap and warm water.
- Do not submerge Handle (adjustment knob), Bonnet or R-Valve in cleaning solution as lubricant will be removed.
- Dry parts and blow out internal passages in body using dry compressed air.
- Inspect and replace any parts found to be worn or damaged.

Lubricators

Installation – Lubricators

- Install lubricator with the air flow as indicated by the arrow on the unit.
- Install lubricator as close as possible to the air operated equipment for best performance.
- Lubricator must be installed with the bowl downward for proper operation.
- Locate the lubricator downstream from the regulator and filter.
- When using lubricators featuring the sight glass on the bowl, orient the bowl so it is most visible for the operator.
- Connect piping to proper ports using pipe sealant on male threads only. Do not allow sealant to enter interior of lubricator.
- Air line piping should be the same size as lubricator ports.

Operation – Lubricators

- Use a good grade of non-detergent oil (IR part # 29665) for use in the air operated equipment. Refer to the air operated equipment operator's manual.
  Note: This lubricator uses a ball check valve located in the lubricator body to restrict the operating pressure to the bowl and allow removal of the fill plug. This will permit filling or lubricator bowl removal while in the normal operating mode.
- Observe the markings (-,+) on the lubricator body which show direction. Turn the adjustment screw counterclockwise to increase and clockwise to decrease.
  Lubricator Adjustment:
  Note: This is a siphon type lubricator design, adjustments need to be made with a constant rate of flow thru the lubricator in an operating mode.
- Use a small screwdriver to adjust the drip rate. The adjustment screw is located in the sight feed cap on the top of the lubricator.
- Determine the average rate of flow (SCFM) thru the lubricator, then turn the adjustment screw to obtain one drop per minute for each 10 SCFM. Example: If the average flow is 20 SCFM, set the drip rate at 2 drops per minute.
  Note: The fill plug must be removed to allow removal of the lubricator bowl or filling of the unit.
- Remove the fill plug carefully.
- Fill to the top of the bowl.

Maintenance – Lubricators

Sight Dome Assembly:

1. Depressurize Unit.
2. Remove Upper Cover from Body
3. Remove Sight Dome Housing (nut).
4. Inspect parts for wear and/or damage. If replacement is necessary, use parts from Service Kit.
5. Clean parts and reassemble in reverse order.

Damper Guide Assembly:

1. Depressurize Unit.
2. Remove Bowl/Bowl Guard Assembly by:
   Polycarbonate Bowl/Bowl Guard Assemblies – Firmly grasp the bowl assembly and pull down on the locking tab while pushing the bowl in an upward direction and turning counterclockwise 1/8 of a turn. The "Lock Position Arrow" should now be in-line with the "Unlocked" symbol. Slowly pull down on the bowl assembly.
   Metal Bowl Assemblies – Firmly grasp the bowl assembly and push the bowl in an upward direction while turning counterclockwise. The "Lock Position Arrow" should now be in-line with the "Unlocked" symbol. Slowly pull down on the bowl assembly.
3. Remove Damper Guide Screws (3).
4. Clean parts and reassemble in reverse order.
5. Before returning unit to service, insure that all seals have been installed or replaced properly and the bowl is in the locked position.

⚠ WARNING

BOWL REMOVAL HAZARD THE BOWL MUST BE SECURELY LOCKED INTO POSITION BEFORE EXPOSING THE UNIT TO THE LINE PRESSURE. The bowls are designed with a feature which inhibits removal while under pressure. When reinstalling, push the bowl up into the body and rotate to the right 1/8 turn. Failure to lock bowl could cause it to blow off, which could result in personal injury or property damage.

- Polycarbonate Bowl: To avoid rupture that can cause personal injury or property damage.
  - Do not use incompatible chemicals.
    Thinner, Certain Alcohols, Aniline, Carbon Tetrachloride, Chlorinated Hydrocarbons, Chloroform, Esters, Ethyl Acetate, Kerosene, Ketones, Lactic Acid, Nitric Acid, Nucleic Acid, Organic solvents, Chemical Solvents, Paints and fumes, Trichloro Ethylene, Compressor Oils containing Ester based additives, Synthetic Oils, and fumes with any of the above substances.

NOTICE

- Wash bowl only with soap and warm water.
- Collect oil from lubricator bowl and dispose of properly.
- Inspect and replace any parts found to be worn or damaged.

Filter/Regulators (Piggybacks)

Installation – Filter/Regulators

Operation – Filter/Regulators

Maintenance – Filter/Regulators

Refer to Filters and Regulators sections above for item specific installation, operation and maintenance.

Combination Units

Installation – Combination Units

Operation – Combination Units

Maintenance – Combination Units

Refer to Filters, Regulators, and Lubricators sections above for item specific installation, operation and maintenance.

Product Parts Information

⚠ CAUTION

The use of other than genuine Ingersoll Rand replacement parts may result in safety hazards, decreased product performance, and increased maintenance, and may invalidate all warranties. Repairs should be made only by authorized trained personnel. Consult your nearest Ingersoll Rand Authorized Service Center at 1-866-NSP-SERV (1-866-677-7378).

The original language of this manual is English.

Refer all communications to the nearest **Ingersoll Rand** Office or Distributor.

Related Documentation

For additional information refer to:
Product Safety Information Manual 15301765.
Product Information Manual 15301773.
Parts Information Manuals:

1000 Series	1500 Series	2000 Series	3000 Series
15301799 Filters	15301849 Filters	15301898 Filters	15301948 Filters
15301807 Regulators	15301856 Regulators	15301906 Regulators	15301955 Regulators
15301815 Lubricators	15301864 Lubricators	15301914 Lubricators	15301963 Lubricators
15301823 Filter/Regulators	15301872 Filter/Regulators	15301922 Filter/Regulators	15301971 Filter/Regulators
15301831 Combinations	15301880 Combinations	15301930 Combinations	15301989 Combinations

Manuals can be downloaded from fluids.ingersollrand.com.

BIG BLUE® & BIG CLEAR FILTER HOUSINGS

- **Large capacity housing suitable for high flow applications**
- **10" and 20" lengths available in opaque and clear**
- **Pressure relief/bleed on inlet side of cap**
- **Accepts 4½" diameter cartridges**

Big Blue® Filter Housings offer the versatility to meet all of your large-capacity filtration needs, including high-flow and heavy-sediment applications. The extra large housing allows for greater cartridge capacity, reducing the number of vessels required for high flow-rate applications. Sumps are constructed of durable reinforced polypropylene and are available in both 10" and 20" lengths.

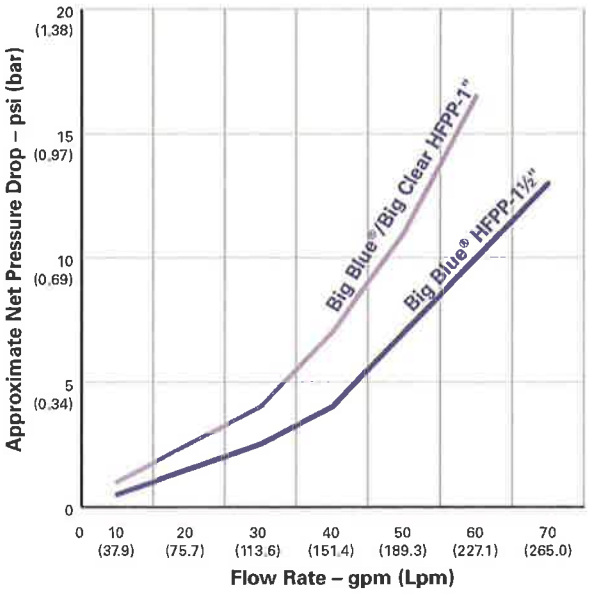
The high-flow polypropylene (HFPP) cap is available with 3/4", 1" or 1½" NPT inlet and outlet ports. The 1¼" internal port allows a greater volume of liquid to pass through the HFPP cap more rapidly.

Big Blue® housings are compatible with a broad range of chemicals and are available with or without a pressure relief button. They accept a wide variety of 4½" diameter cartridges.

Big Clear Filter Housings offer on-site examination of flow, performance, and cartridge life and are ideal for a variety of applications. The blue polypropylene caps are available with an optional pressure-relief button on the inlet side to relieve pressure inside the housing when changing filter cartridges.

PENTEK
Pentair Water

BIG BLUE®/BIG CLEAR
Filter Housings



NSF COMPONENT

The 150233, 150234, 150235, 150236, 150237, 150238, 150239, 150240, 150467, 150468, 150469, and 150470 Tested and Certified by NSF International to NSF/ANSI Standard 42 for material and structural integrity requirements.

NOTE: The Big Clear Series of housings are not NSF component listed.

Housing Specifications and Performance Data

Model	Maximum Dimensions	Initial ΔP (psi) @ Flow Rate (gpm)
#10 Big Blue®–3/4"	13⅛" x 7¼" (333 mm x 184 mm)	2 psi @ 15 gpm (0.1 bar @ 57 Lpm)
#10 Big Blue®–1"	13⅛" x 7¼" (333 mm x 184 mm)	1 psi @ 15 gpm (0.1 bar @ 57 Lpm)
#10 Big Blue®–1½"	13⅝" x 7¼" (346 mm x 184 mm)	1 psi @ 20 gpm (0.1 bar @ 76 Lpm)
#20 Big Blue®–3/4"	23⅜" x 7¼" (594 mm x 184 mm)	2 psi @ 15 gpm (0.1 bar @ 57 Lpm)
#20 Big Blue®–1"	23⅜" x 7¼" (594 mm x 184 mm)	1 psi @ 15 gpm (0.1 bar @ 57 Lpm)
#20 Big Blue®–1½"	23⅞" x 7¼" (606 mm x 184 mm)	1 psi @ 20 gpm (0.1 bar @ 76 Lpm)
#10 Big Clear–1"*	13½" x 7⅛" (343 mm x 181 mm)	1 psi @ 15 gpm (0.1 bar @ 57 Lpm)
#20 Big Clear–1"*	23 ¾" x 7⅛" (603 mm x 181 mm)	1 psi @ 15 gpm (0.1 bar @ 57 Lpm)

* Not Performance Tested or Certified by NSF.

Materials of Construction

	BIG BLUE®	BIG CLEAR
Housing	Polypropylene	Lexan (#10), Polycarbonate (#20)
Cap	Polypropylene (HFPP)	Polypropylene (HFPP)
Button Assembly	300-series Stainless Steel, EPDM, and Polypropylene	300-series Stainless Steel, EPDM, and Polypropylene
O-Ring	Buna-N	Buna-N
Maximum Temperature	100°F (37.8°C)	100°F (37.8°C)
Maximum Pressure	#10 Big Blue® – 100 psi (6.9 bar) #20 Big Blue® – 90 psi (6.2 bar)	#10 Big Clear – 100 psi (6.9 bar) #20 Big Clear – 90 psi (6.2 bar)

CAUTION: Protect against freezing to prevent cracking of the filter and water leakage.

Cartridges:
20 micron pre-filter
5 micron post filter

PENTEK
Pentair Water

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Customer Service: 800.645.0267 • Fax: 888.203.7361 • supportspecialist@pentekfiltration.com
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ISO-9001 REGISTERED MANUFACTURER

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APPENDIX C

TEST BORING LOGS/MONITORING WELL INSTALLATION DIAGRAMS:
CW-1 THROUGH CW-6

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ENVIRONMENTAL CONSULTANTS

DAY ENVIRONMENTAL, INC.

AN AFFILIATE OF DAY ENGINEERING, P.C.

Project #:	3563R-04
Project Address:	5 Hunt Road
	Jamestown, NY
DAY Representative:	C. Hampton
Drilling Contractor:	TREC Environmental, Inc.
Sampling Method:	Direct Push

Test Boring CW-1

Ground Elevation: N/A Datum: N/A

Date Started: 11/9/2012 Date Ended: 11/9/2012

Borehole Depth: 16.0' Borehole Diameter: 2 1/4"

Completion Method: ■ Well Installed ☐ Backfilled with Grout ☐ Backfilled with Cuttings

Water Level (Date):

Depth (ft)	Blows per 0.5 ft.	Sample Number	Sample Depth (ft)	% Recovery	N-Value or RQD%	Headspace PID (ppm)	PID Reading (ppm)	Sample Description	Notes
1								TOPSOIL	Installed CW-1
								Gray/Brown, Clay, little Gravel, damp (FILL)	
2	NA	S-1	0-4	35	NA	72.6		Brown, Sandy CLAY, little Gravel, moist	
3								...Gray/Brown, wet	
4									
5								...Brown, moist	
6	NA	S-2	4-8	70	NA	13.2		...Clayey SAND, some Gravel	
7									
8									
9									
10	NA	S-3	8-12	0	NA			No Recovery 8 - 12'	
11									
12									
13								Brown, Coarse SAND and GRAVEL, little Clay, wet	
14	NA	S-4	12-16	40	NA	24.0		...fine SAND	
15									
								Gray, Sandy CLAY, some Silt, little Gravel, wet (apparent glacial till)	
16								Bottom of Hole @ 16.0'	

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.

2) Stratification lines represent approximate boundaries. Transitions may be gradual

3) PID readings are referenced to a benzene standard measured in the headspace above the sample using a MiniRae 2000 equipped with a 10.6 eV lamp.

4) NA = Not Available or Not Applicable

5) PID readings not collected in the field due to equipment malfunction

Test Boring CW-1

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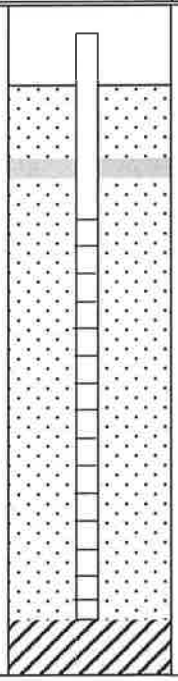
MONITORING WELL CONSTRUCTION DIAGRAM

Project #: 3563R-04
Project Address: 5 Hunt Road
Jamestown, NY
DAY Representative: C. Hampton
Drilling Contractor: TREC Environmental

MONITORING WELL CW-1

Ground Elevation: N/A Datum:
Date Started: 11/9/12 Date Ended: 11/9/12
Water Level (Date):

Refer to Test Boring Log CW-1 for Soil Description



2.09 Height of Stickup (ft)

← Ground Surface

0.0 Depth to Top of Bentonite Seal (ft)
8.0 Depth to Bottom of Bentonite Seal (ft)

10.46 Depth to Top of Well Screen (ft)

2.25 Diameter of Borehole (in)

Backfill Type Sand

1.0 Inside Diameter of Well (in)

Type of Pipe PVC
Screen slot size #10

15.46 Depth to Bottom of Well Screen (ft)

16.0 Depth to Bottom of Borehole/Top of Bedrock (ft)

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.
2) NA = Not Available or Not Applicable

MONITORING WELL CW-1

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DAY ENVIRONMENTAL, INC.

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Test Boring CW-2

Project #: 3563R-04
Project Address: 5 Hunt Road
Jamestown, NY
DAY Representative: C. Hampton
Drilling Contractor: TREC Environmental, Inc.
Sampling Method: Direct Push

Ground Elevation: N/A Datum: N/A
Date Started: 11/9/2012 Date Ended: 11/9/2012
Borehole Depth: 16.0' Borehole Diameter: 2 1/4"
Completion Method: ■ Well Installed ☐ Backfilled with Grout ☐ Backfilled with Cuttings
Water Level (Date):

Depth (ft)	Blows per 0.5 ft.	Sample Number	Sample Depth (ft)	% Recovery	N-Value or RQD%	Headspace PID (ppm)	PID Reading (ppm)	Sample Description	Notes
1								TOPSOIL	Installed CW-2
2	NA	S-1	0-4	45	NA	1.2		Tan/Brown, Clayey Sand and Gravel, little organic material, moist (FILL)	
3								Gray/Green, Clayey SAND, some Gravel, moist	
4									
5								...CLAY, some Sand, little Gravel	
6	NA	S-2	4-8	50	NA	1.0			
7								Brown, fine SAND, little Gravel, some Clay, moist	
8									
9								...some Gravel, wet	
10	NA	S-3	8-12	80	NA	5.8			
11									
12									
13									
14	NA	S-4	12-16	100	NA	24.0			
15								Gray, Clayey fine SAND, some Silt, some Gravel, wet (apparent glacial till)	
16								Bottom of Hole @ 16.0'	

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.
2) Stratification lines represent approximate boundaries. Transitions may be gradual.
3) PID readings are referenced to a benzene standard measured in the headspace above the sample using a MiniRae 2000 equipped with a 10.6 eV lamp.
4) NA = Not Available or Not Applicable
5) PID readings not collected in the field due to equipment malfunction

Test Boring CW-2

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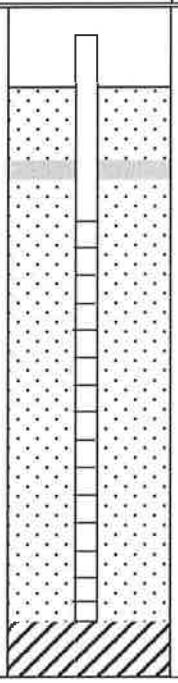
MONITORING WELL CONSTRUCTION DIAGRAM

Project #: 3563R-04
Project Address: 5 Hunt Road
Jamestown, NY
DAY Representative: C. Hampton
Drilling Contractor: TREC Environmental

MONITORING WELL CW-2

Ground Elevation: N/A Datum:
Date Started: 11/9/12 Date Ended: 11/9/12
Water Level (Date):

Refer to Test Boring Log CW-2 for Soil Description



1.90 Height of Stickup (ft)

← Ground Surface

0.0 Depth to Top of Bentonite Seal (ft)
8.0 Depth to Bottom of Bentonite Seal (ft)

10.57 Depth to Top of Well Screen (ft)

2.25 Diameter of Borehole (in)

Backfill Type Sand

1.0 Inside Diameter of Well (in)

Type of Pipe PVC
Screen slot size #10

15.57 Depth to Bottom of Well Screen (ft)

16.0 Depth to Bottom of Borehole/Top of Bedrock (ft)

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.
2) NA = Not Available or Not Applicable

MONITORING WELL CW-2

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Project #:	3563R-04
Project Address:	5 Hunt Road
	Jamestown, NY
DAY Representative:	C. Hampton
Drilling Contractor:	TREC Environmental, Inc.
Sampling Method:	Direct Push

Test Boring CW-3

Ground Elevation: N/A Datum: N/A

Date Started: 11/9/2012 Date Ended: 11/9/2012

Borehole Depth: 16.0' Borehole Diameter: 2 1/4"

Completion Method: ■ Well Installed ☐ Backfilled with Grout ☐ Backfilled with Cuttings

Water Level (Date):

Depth (ft)	Blows per 0.5 ft.	Sample Number	Sample Depth (ft)	% Recovery	N-Value or RQD%	Headspace PID (ppm)	PID Reading (ppm)	Sample Description	Notes
1								TOPSOIL	Installed CW-3
2	NA	S-1	0-4	55	NA	2.6		Tan, Silty Sand, some Gravel, moist (FILL)
3								...gray/green
4								...brick fragments
5	NA	S-2	4-8	70	NA	2.5		Gray/Green, Sandy CLAY, little Gravel, moist
6								...little Sand, trace Gravel
7								Lense of Organic Material (Peat)
8								Brown, Clayey SAND, some Gravel, moist
9								...wet
10	NA	S-3	8-12	60	NA	4.8		Brown, fine GRAVEL and coarse SAND trace Silt, wet
11								Tan, Clayey fine SAND, little Gravel, wet
12								
13								
14	NA	S-4	12-16	80	NA	7.6		
15								Gray/Brown, Clayey fine SAND, some Silt, some Gravel, wet (apparent glacial till)
16								Bottom of Hole @ 16.0'

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.

2) Stratification lines represent approximate boundaries. Transitions may be gradual.

3) PID readings are referenced to a benzene standard measured in the headspace above the sample using a MiniRae 2000 equipped with a 10.6 eV lamp.

4) NA = Not Available or Not Applicable

5) PID readings not collected in the field due to equipment malfunction

Test Boring CW-3

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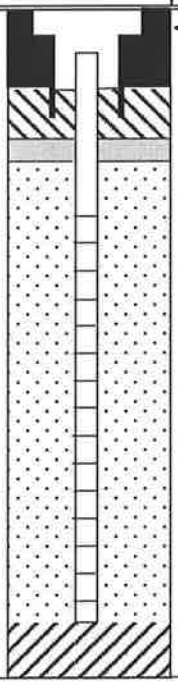
MONITORING WELL CONSTRUCTION DIAGRAM

Project #: 3563R-04
Project Address: 5 Hunt Road
Jamestown, NY
DAY Representative: C. Hampton
Drilling Contractor: TREC Environmental

MONITORING WELL CW- 3

Ground Elevation: N/A Datum:
Date Started: 11/9/12 Date Ended: 11/9/12
Water Level (Date):

Refer to Test Boring Log CW- 3 for Soil Description



←Flush Mounted Roadbox
0.14 Depth to Top of Riser Pipe (ft)
1.0 Depth to Bottom of Cement Surface Patch (ft)
Backfill Type Bentonite

1.0 Depth to Top of Bentonite Seal (ft)
8.0 Depth to Bottom of Bentonite Seal (ft)

10.57 Depth to Top of Well Screen (ft)

2.25 Diameter of Borehole (in)

Backfill Type Sand

1" Inside Diameter of Well (in)

Type of Pipe PVC
Screen slot size #10

15.57 Depth to Bottom of Well Screen (ft)
16.00 Depth to Bottom of Borehole/Top of Bedrock (ft)

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.
2) NA = Not Available or Not Applicable

MONITORING WELL CW-3

S:\Fieldforms\Monitoring Well Installation Log (revised October 2006)

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AN AFFILIATE OF DAY ENGINEERING, P.C.

Test Boring CW-4

Project #: 3563R-04
Project Address: 5 Hunt Road
Jamestown, NY
DAY Representative: C. Hampton
Drilling Contractor: TREC Environmental, Inc.
Sampling Method: Direct Push

Ground Elevation: N/A Datum: N/A
Date Started: 11/9/2012 Date Ended: 11/9/2012
Borehole Depth: 16.0' Borehole Diameter: 2 1/4"
Completion Method: ■ Well Installed ☐ Backfilled with Grout ☐ Backfilled with Cuttings
Water Level (Date):

Depth (ft)	Blows per 0.5 ft.	Sample Number	Sample Depth (ft)	% Recovery	N-Value or RQD%	Headspace PID (ppm)	PID Reading (ppm)	Sample Description	Notes
1							7.3	TOPSOIL	Installed CW-4
2	NA	S-1	0-4	50	NA	0.9	14.5	Brown, Silty Sand, some Gravel, Coal Fragments, moist (FILL)	
3							7.2		
4								Tan, Clayey Sand, Brick, coarse Sandstone, crushed Rock, moist (FILL)	
5							17.4	Gray/Black, Clayey SILT	
6	NA	S-2	4-8	65	NA	8.5	34.5		
7							23.2	...green/gray	
8						63.1	47.1	Brown, Clayey fine SAND, some Gravel, little Silt, moist	
9							13.7	...wet	
10	NA	S-3	8-12	100	NA	38.1	5.9	...trace Gravel, little Clay	
11							18.2		
12						53.1	0.4	Brown, fine GRAVEL and coarse SAND little Silt, little Clay, wet	
13							41.3	...little fine Gravel	
14	NA	S-4	12-16	100	NA	47.6	162		
15							40.7	Brown, Sandy SILT, some Gravel, wet	
16							22.1	...Gray, little Clay (apparent glacial till)	
								Bottom of Hole @ 16.0'	

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.
2) Stratification lines represent approximate boundaries. Transitions may be gradual.
3) PID readings are referenced to a benzene standard measured in the headspace above the sample using a MiniRae 2000 equipped with a 10.6 eV lamp.
4) NA = Not Available or Not Applicable
5) PID readings may be influenced by moisture

Test Boring CW-4

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ENVIRONMENTAL CONSULTANTS

AN AFFILIATE OF DAY ENGINEERING, P.C.

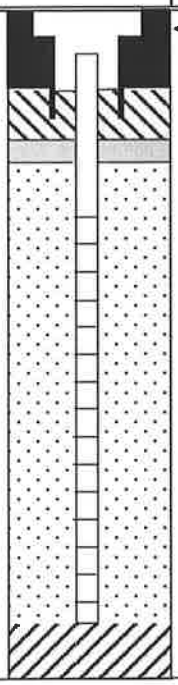
MONITORING WELL CONSTRUCTION DIAGRAM

Project #: 3563R-04
Project Address: 5 Hunt Road
Jamestown, NY
DAY Representative: C. Hampton
Drilling Contractor: TREC Environmental

MONITORING WELL CW- 4

Ground Elevation: N/A Datum:
Date Started: 11/9/12 Date Ended: 11/9/12
Water Level (Date):

Refer to Test Boring Log CW-4 for Soil Description



Flush Mounted Roadbox
0.20 Depth to Top of Riser Pipe (ft)
1.0 Depth to Bottom of Cement Surface Patch (ft)
Backfill Type Bentonite

1.0 Depth to Top of Bentonite Seal (ft)
8.0 Depth to Bottom of Bentonite Seal (ft)

10.55 Depth to Top of Well Screen (ft)

2.25 Diameter of Borehole (in)

Backfill Type Sand

1.0 Inside Diameter of Well (in)

Type of Pipe PVC
Screen slot size #10

15.55 Depth to Bottom of Well Screen (ft)

16.0 Depth to Bottom of Borehole/Top of Bedrock (ft)

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.
2) NA = Not Available or Not Applicable

MONITORING WELL CW- 4

S:\Fieldforms\Monitoring Well Installation Log (revised October 2006)

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Project #:	3563R-04
Project Address:	5 Hunt Road
	Jamestown, NY
DAY Representative:	C. Hampton
Drilling Contractor:	TREC Environmental, Inc.
Sampling Method:	Direct Push

Test Boring CW-5

Ground Elevation: N/A Datum: N/A

Date Started: 11/9/2012 Date Ended: 11/9/2012

Borehole Depth: 16.0' Borehole Diameter: 2 1/4"

Completion Method: ■ Well Installed ☐ Backfilled with Grout ☐ Backfilled with Cuttings

Water Level (Date):

Depth (ft)	Blows per 0.5 ft.	Sample Number	Sample Depth (ft)	% Recovery	N-Value or RQD%	Headspace PID (ppm)	PID Reading (ppm)	Sample Description	Notes
1	NA	S-1	0-4	75	NA	83.9		TOPSOIL Brown, Clayey Sand, some Gravel, Brick, moist (FILL)	Installed CW-5
5	NA	S-2	4-8	85	NA	2.3		Gray/Black, Silty CLAY, trace fine Sand, moist ...Gray/Green, little Sand, little Gravel	
8	NA	S-3	8-12	90	NA	4.8		Brown, Clayey SAND, some Gravel, little Silt, moist ...wet Brown, fine GRAVEL and coarse SAND, little Clay, wet Brown, fine SAND, little Silt, little Clay, wet	
13	NA	S-4	12-16	100	NA	7.6		...some fine to medium Gravel Gray, Sandy CLAY, some Silt, some Gravel, wet (apparent glacial till)	
16								Bottom of Hole @ 16.0'	

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.

2) Stratification lines represent approximate boundaries. Transitions may be gradual.

3) PID readings are referenced to a benzene standard measured in the headspace above the sample using a MiniRae 2000 equipped with a 10.6 eV lamp.

4) NA = Not Available or Not Applicable

5) PID readings not collected in the field due to equipment malfunction

Test Boring CW-5

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AN AFFILIATE OF DAY ENGINEERING, P.C.

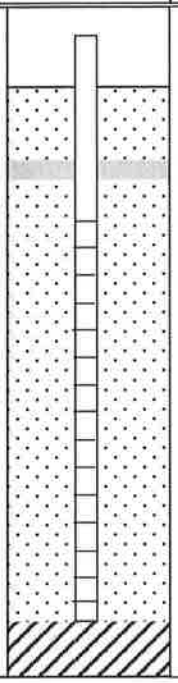
MONITORING WELL CONSTRUCTION DIAGRAM

Project #: 3563R-04
Project Address: 5 Hunt Road
Jamestown, NY
DAY Representative: C. Hampton
Drilling Contractor: TREC Environmental

MONITORING WELL CW-5

Ground Elevation: N/A Datum:
Date Started: 11/9/12 Date Ended: 11/9/12
Water Level (Date):

Refer to Test Boring Log CW-5 for Soil Description



2.09 Height of Stickup (ft)

← Ground Surface

0.0 Depth to Top of Bentonite Seal (ft)
8.0 Depth to Bottom of Bentonite Seal (ft)

10.52 Depth to Top of Well Screen (ft)

2.25 Diameter of Borehole (in)

Backfill Type Sand

1.0 Inside Diameter of Well (in)

Type of Pipe PVC
Screen slot size #10

15.52 Depth to Bottom of Well Screen (ft)

16.0 Depth to Bottom of Borehole/Top of Bedrock (ft)

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.
2) NA = Not Available or Not Applicable

MONITORING WELL CW-5

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AN AFFILIATE OF DAY ENGINEERING, P.C.

Project #: 3563R-04
Project Address: 5 Hunt Road
Jamestown, NY
DAY Representative: C. Hampton
Drilling Contractor: TREC Environmental, Inc.
Sampling Method: Direct Push

Test Boring CW-6

Ground Elevation: N/A Datum: N/A
Date Started: 11/9/2012 Date Ended: 11/9/2012
Borehole Depth: 16.0' Borehole Diameter: 2 1/4"
Completion Method: ■ Well Installed ☐ Backfilled with Grout ☐ Backfilled with Cuttings
Water Level (Date):

Depth (ft)	Blows per 0.5 ft.	Sample Number	Sample Depth (ft)	% Recovery	N-Value or RQD%	Headspace PID (ppm)	PID Reading (ppm)	Sample Description	Notes
1							0.0	TOPSOIL	Installed CW-6
								Gravel, little Silty Sand, damp (FILL)	
2	NA	S-1	0-4	70	NA		0.0		
3								Tan, fine Silty Sand, trace Gravel, moist (FILL)	
						19.5		Black, CLAY, trace Sand, trace Gravel, moist	
4								...Gray/Green, little Sand, little Gravel	
5							0.0		
							0.0		
6	NA	S-2	4-8	80	NA			Gray/Green, Clayey SAND, some Gravel, little Silt, moist	
7							1.9		
						0.0	0.0	Brown, Silty fine SAND, trace Gravel, wet	
8									
9							0.0		
							0.0		
10	NA	S-3	8-12	100	NA				
11							13.6		
						6.9	0.4	Gray, SILT, some fine Sand, wet	
12									
13							0.3	...little Clay	
							2.1		
14	NA	S-4	12-16	100	NA				
15							16.8		
						26.3	34.5	Gray, Clayey SAND some Silt, trace Gravel, wet (apparent glacial till)	
16								Bottom of Hole @ 16.0'	

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.
2) Stratification lines represent approximate boundaries. Transitions may be gradual.
3) PID readings are referenced to a benzene standard measured in the headspace above the sample using a MiniRae 2000 equipped with a 10.6 eV lamp.
4) NA = Not Available or Not Applicable
5) PID readings may be influenced by moisture

Test Boring CW-6

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AN AFFILIATE OF DAY ENGINEERING, P.C.

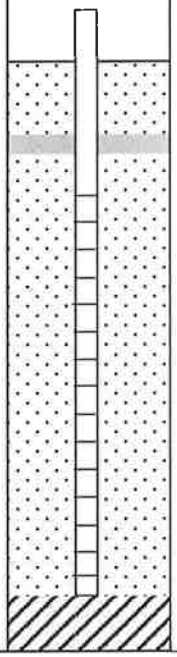
MONITORING WELL CONSTRUCTION DIAGRAM

Project #: 3563R-04
Project Address: 5 Hunt Road
Jamestown, NY
DAY Representative: C. Hampton
Drilling Contractor: TREC Environmental

MONITORING WELL CW-6

Ground Elevation: N/A Datum:
Date Started: 11/9/12 Date Ended: 11/9/12
Water Level (Date):

Refer to Test Boring Log CW-6 for Soil Description



2.04 Height of Stickup (ft)

← Ground Surface

0.0 Depth to Top of Bentonite Seal (ft)
8.0 Depth to Bottom of Bentonite Seal (ft)

10.45 Depth to Top of Well Screen (ft)

2.25 Diameter of Borehole (in)

Backfill Type Sand

1.0 Inside Diameter of Well (in)

Type of Pipe PVC
Screen slot size #10

15.45 Depth to Bottom of Well Screen (ft)

16.0 Depth to Bottom of Borehole/Top of Bedrock (ft)

Notes: 1) Water levels were made at the times and under conditions stated. Fluctuations of groundwater levels may occur due to seasonal factors and other conditions.
2) NA = Not Available or Not Applicable

MONITORING WELL CW-6

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APPENDIX D

MATERIAL SAFETY DATA SHEETS EHC™

ADVENTUS
Proven Soil, Sediment, and Groundwater Remediation Technologies

Safety Data

MATERIAL SAFETY DATA SHEET: **EHC™**

1. PRODUCT IDENTIFICATION:

PRODUCT USE:

EHC™

Bioremediation product for the remediation of contaminated soil and groundwater only. Not for use in potable drinking water.

MANUFACTURER:

Adventus Remediation Technologies
1345 Fewster Drive
Mississauga, Ontario
L4W 2A5

EMERGENCY PHONE:

Office Hours: 905-273-5374
After Hours: 416-457-9491

TRANSPORTATION OF DANGEROUS GOOD CLASSIFICATION:
Not Regulated

WHMIS CLASSIFICATION:
Not Regulated

CONTAINMENT HAZARD:
Any vessel that contains wet EHC or EHC and water must be vented due to potential pressure build up from fermentation gasses.

2. INGREDIENTS

CHEMICAL NAME:	CAS#	TLV (mg/m3)	LD low (mg/Kg)	% in Product
Organic Amendment	N/D	N/E	N/E	52 - 62
Iron	7439-89-6	5 (as iron oxide fume)	N/E	37 - 48

3. PHYSICAL DATA

Physical state	Solid	Melting point	1371-1480°F
Odour threshold	N/A	Boiling point	3000°C
Density	0.75 Kg/L	Vapour pressure (mm Hg)	1 @ 1787°C
pH	N/A	Vapour density (air=1)	N/A
Solubility in water	Insoluble	Evaporation rate	N/A
Coeff. of water/oil	N/A		
Appearance & odour	Odourless, Tan/Brown Flakes		

4. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Deg. C PMCC): N/A

	LOWER	UPPER
FLAMMABLE LIMITS IN AIR % BY VOLUME:	N/A	N/A

AUTO IGNITION TEMP (Deg. C): N/A

EXTINGUISHING MEDIA: Dry chemicals or sand or universal type foam.

SPECIAL PROCEDURES:
Firefighters should wear SCBA and protective clothing.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

Dust can present fire and explosion hazards when exposed to fire, chemical reaction, or contact with powerful oxidizers.

5. REACTIVITY DATA

STABILITY (NORMAL COND.):
Stable: X **Unstable:**

CONDITIONS TO AVOID: Contact with powerful oxidizers such as strong acids.

INCOMPATIBILITY (Materials to Avoid): Powerful oxidizers such as strong acids.

HAZARDOUS DECOMPOSITION PRODUCTS: Hydrogen, Carbon monoxide, Carbon dioxide.

6. TOXICOLOGICAL PROPERTIES

ROUTE OF ENTRY:
Inhalation
Ingestion (not likely)

HEALTH HAZARDS:

Acute overexposure may cause eye, nose, mouth and skin irritation.

Carcinogenicity:	No Information Available
Signs and Symptoms of Exposure:	No Information Available
Medical Conditions Generally Aggravated by Exposure:	No Information Available

7. PREVENTIVE MEASURES

PERSONAL PROTECTIVE EQUIPMENT:

Eye Protection: X **Gloves:** X **Clothing:**

RESPIRATORY PROTECTION:

Use dust mask in severe conditions.
Use good housekeeping practices to keep dust to a minimum.

VENTILATION REQUIREMENTS:
Not normally required.

SPILL AND LEAK PROCEDURES:
Sweep up and return to container.

WASTE DISPOSAL:
Sanitary landfill. Follow Federal, State and Local guidelines.

HANDLING PROCEDURES:
Wear safety glasses for normal use. Avoid generating excessive dust, wear dust mask in severe conditions.

STORAGE REQUIREMENTS:
Do not store near powerful oxidizers such as strong acids.
Keep dry.
Any vessel that contains wet EHC or EHC and water must be vented due to potential pressure build up from fermentation gasses.

SPECIAL HANDLING INFORMATION:
Treat as a nuisance dust

8. FIRST AID MEASURES

INHALATION: Remove to fresh air. Seek medical attention.
INGESTION: Seek medical attention.
SKIN CONTACT: Brush off excess. Wash with soap and water.
EYE CONTACT: Flush with running water. Seek medical attention.

9. OTHER INFORMATION

None

10. PREPARATION INFORMATION

Prepared By: Adventus Remediation Technologies
1345 Fewster Drive
Mississauga, Ontario
L4W 2A5

Date Prep./Rev.: 5/24/07
Print Date: 5/24/07
Phone: 905-273-5374
Fax: 905-273-4367

Definitions:

N/D - No Data	N/A - Not Applicable	N/E - Not Established	< - Less than
A= Oral rat LD50	B= Oral rat	LD low C= Oral LD50/LD low other animal	> - Greater than
D= Estimated 1000	E= Arbitrary 2000	F= Other route prefix	
C= Ceiling limit			

APPENDIX E

PRODUCT DEMAND AND DOSAGE CALCULATION SHEETS EHC™

PRIMARY TREATMENT AREA

EHC® Original ISCR Reagent Demand Calculations

FMC ENVIRONMENTAL SOLUTIONS

Customer: Day Environmental 1/2/2013

Contact: Nate Simon

Site Location: Jamestown, NY

Proposal Number: FA12-716

PRODUCT OVERVIEW

EHC is composed of controlled-release carbon, zero valent iron (ZVI) particles and nutrients used for stimulating in situ chemical reduction (ISCR) of otherwise persistent organic compounds in groundwater. Following placement of EHC into the subsurface environment, a number of physical, chemical and microbiological processes combine to create very strong reducing conditions that stimulate rapid and complete dechlorination of organic solvents and other recalcitrant compounds (e.g., explosives and organochlorine pesticides).

EHC is delivered as a dry powder in 50-lb / 25-kg bags or super-sacs. EHC can be placed into the saturated zones in a variety of ways including direct push injections, hydraulic and pneumatic fracturing, and direct soil mixing. EHC is completely non-hazardous and safe to handle. EHC is manufactured in the USA, EU and Brazil.

SITE INFORMATION / ASSUMPTIONS

	Value	Unit	Comment
Treatment Area Dimensions:			
Width of targeted zone (perpendicular to gw flow)	50	ft	customer supplied
Length of targeted zone (parallel to gw flow)	25	ft	customer supplied
Depth to top of treatment zone	3	ft bgs	customer supplied
Treatment zone thickness	12	ft	customer supplied
Treatment volume	15,000	ft3	calculated value
Total Porosity	30	%	default value
Groundwater volume	4,500	ft3	calculated value
Soil bulk density	110	lbs/ft3	default value
Soil mass	825	ton	calculated value
Transport characteristics:			
Treatment time / design life for one application	3	years	default value
Linear groundwater flow velocity	73	ft/year	calculated value
Distance of inflowing gw over design life	219	ft	calculated value
Effective porosity for groundwater flow	30	%	default value
Volume of water passing region over design life	39420	ft3	calculated value
Soil type	medium		customer supplied
Fraction organic carbon in soil, foc	0.005		estimated value

CONTAMINANTS OF CONCERN (COCs)

Constituent	GW (mg/L)	Soil* (mg/kg)	Total COI Mass** (lb)
PCE	40	52.6	196.5

*Unless provided, sorbed concentrations were roughly estimated based on expected groundwater concentrations, foc and Koc values. For a more refined estimate, it is recommended that actual values be verified via direct sampling of the targeted treatment interval.

**The total COI mass was estimated based on concentrations in soil and groundwater within the targeted area plus expected contributions from inflowing groundwater over the projected design life.

GEOCHEMICAL DATA

Competing Electron Acceptors	GW (mg/L)	Soil* (mg/kg)
Dissolved oxygen	0.9	2.583
Nitrate (as N)	0	0
Manganese (dissolved)	0	0
Iron (III)	0	0
Sulfate	20	0
Carbonate Alkalinity (as CaCO3)	0	0

*Unless provided, soil concentrations were roughly estimated based on expected groundwater concentrations, foc and Koc/Kd values. For a more refined estimate, it is recommended that actual values be verified via direct sampling of the targeted treatment interval.

ORP (mV)	-29	
pH	NA	

STOICHIOMETRIC DEMAND CALCULATIONS

	GW (mg/L)	Soil (mg/kg)
H2 Demand from COIs	1.9	2.5
H2 Demand from Competing Electron Acceptors	1.7	0.3
Total H2 Demand	3.6	2.9
H2 Demand from Soil within Targeted Area	4.7	lb
H2 Demand from GW within Targeted Area	1.0	lb
H2 Demand from Influx over Design Life	8.9	lb
Total Estimated H2 Demand	14.7	lb

EHC DEMAND CALCULATIONS

The Stoichiometric demand for the targeted area was calculated using available data presented above, noting that the Stoichiometric demand represents minimum requirements and require a complete geochemical data set to be calculated accurately. Therefore, the resulting EHC dosing required to meet the estimated Stoichiometric demand was compared to our minimum guidelines for the selected type of application, selecting the higher

Application type: Permeable Reactive Barrier (PRB)

	Value	Unit
Minimum EHC application rate to meet H2 demand	0.02	% by soil mass
Minimum recommended application rate for PRB*	0.16	% by soil mass
Recommended EHC application rate	0.16	% by soil mass
Mass of EHC required	2,640	lbs
Mass of EHC per bag	50	lbs
Number of bags required	53	bags
Mass EHC (rounded up based on bag size)	2,650	lbs

*Our general recommended minimum guideline for the proposed application exceeds the dose rate required based on hydrogen demand calculations and was therefore used for the purpose of this dosing calculation.

OPTIONAL DHC INOCULANT

Although not typically required for ISCR, DHC inoculants have shown to improve removal kinetics, in particular for potential daughter products such as cis-DCE and VC. The DHC will be added after EHC application, once favorable redox conditions (ORP < -75 mV, DO <0.2 mg/L, pH between 6 and 8.5) have been attained. The DHC inoculant will contain at least 5 x10E10 cfu/ml of live bacteria including high numbers of dehalococcoides species with known abilities to biodegrade DCE. The target density of DHC cells in the treated aquifer is 2.5x10E6 cfu/ml.

	Value	Unit
Dechlorinating consortium concentration in inoculant	5.00E+10	DHC/L
Design final concentration after dilution in aquifer	2.50E+06	DHC/L
Volume of Inoculant Required	7	L

*Note: The minimum shipping volume of 13 L (one small keg) exceeds the caluclated requirement, and was therefore used in the quotation below.

INSTALLATION

EHC is supplied as a dry powder which can be mixed with soil or slurried in water. Installation techniques vary widely depending on the application. For example, the powder can be directly mixed into the soil using deep soil mixing equipment or placed into an open excavation where prior soil removal has been conducted. A slurry can be made and the mixture can be injected into the subsurface using techniques such as direct injection through Geoprobe rods or hydraulic fracturing. Injection through fixed wells is not recommended given that the product does not dissolve in water. If application via wells or injection networks were to be the preferred installation method at your site, we instead recommend our soluble ISCR substrate EHC-L.

EHC Slurry Preparation:

The EHC slurry can been prepared in a variety of ways, including using paddle mixers, recirculation and manual mixing using a hand-held drill with a mixing attachment. However, particularly for larger projects, FMC recommends having a mechanical mixing system available on site. In general we recommend continuous mixing in smaller batches (<100 USG / 400 L) to avoid settling of solids at the bottom. For example Chem Grout's high pressure mixing and injection units are ideal for continuous preparation and injection of EHC. However, particularly for larger projects, FMC recommends having a mechanical mixing system available on site. In general we recommend continuous mixing in smaller batches (<100 USG / 400 L) to avoid settling of solids at the bottom.

The amount of water to prepare the EHC slurry could be varied depending on the desired injection volume and slurry properties. When applied via direct injection, normally a concentration of between 25 and 35% is targeted. The below table shows the amount of water needed per 50-lb / 25-kg bag depending on the targeted concentration and the resulting total injection volumes and percent pore fill (injection volume to total pore volume). Note that a thinner slurry will promote permeation into more permeable formations, whereas a more concentrated/more viscous slurry will promote fracturing and horizontal propagation into more fine-grained formations.

Target concentration (% solids):	**25%**	**30%**	**35%**
Mass EHC per bag (lbs)	50	50	50
Volume water per bag (USG)	18.0	14.0	11.1
Volume slurry per bag (lbs)	22.2	18.2	15.4
Total mass EHC (lbs)	2,650	2,650	2,650
Total volume water (USG)	953	741	590
Total injection volume (USG)	1178	967	817
Injection volume to total pore volume	3.5%	2.9%	2.4%

INSTALLATION (continued)

Injection recommendations (can be altered):

The EHC slurry can be injected into the ground in a variety of ways including direct injection and hydraulic/pneumatic fracturing. The injection spacing will be determined based on the radius of influence and soil acceptance for the given application method, lithology and depth. Assuming installation via direct push injections and a radius of influence (ROI) of 5 to 8 ft (1.7 to 2.5 m), an injection spacing of 10 to 15 ft (3 to 5 m) is normally applied. For injection PRB applications, a closer spacing is normally recommended to create some overlap or the PRB may be made up of multiple off-set injection lines to improve contact.

Unless specified by the consultant, the below recommendations was based on our experience from other similar lithologies and considers both the estimated ROI and the estimated soil acceptance (maximum injection volume per vertical foot for lithology and depth) using direct injection. However, please note that actual ROI and soil acceptance can vary widely and are also highly influenced by the injection method employed (slurry viscosity, injection pressures and flow rates). **Therefore, PLEASE NOTE that the construction estimates presented below can be readily modified in the field as required (for example, the density of the slurry can be changed to modify the total injection volume or the injections spacing could be altered based in installation technology).**

	Value	Unit	Comment
Total EHC mass	2,650	lbs	calculated value
Concentration of EHC slurry to inject	30%	by weight	can be altered
Total volume of water required	741	U.S. gallons	calculated value
Approximate volume of slurry to inject	954	U.S. gallons	calculated value
Number of injection lines for PRB	3	lines	
Injection spacing within lines	10	ft	customer provided
Number of injection points	15	locations	calculated value
Mass EHC per injection point	177	lbs	calculated value
Mass EHC per vertical foot	15	lbs	calculated value
Injection volume to total pore space volume	2.8%	by volume	calculated value

SECONDARY TREATMENT AREA

EHC® Original ISCR Reagent Demand Calculations

FMC ENVIRONMENTAL SOLUTIONS

Customer: Day Environmental 1/2/2013

Contact: Nate Simon

Site Location: Jamestown, NY

Proposal Number: FA12-716

PRODUCT OVERVIEW

EHC is composed of controlled-release carbon, zero valent iron (ZVI) particles and nutrients used for stimulating in situ chemical reduction (ISCR) of otherwise persistent organic compounds in groundwater. Following placement of EHC into the subsurface environment, a number of physical, chemical and microbiological processes combine to create very strong reducing conditions that stimulate rapid and complete dechlorination of organic solvents and other recalcitrant compounds (e.g., explosives and organochlorine pesticides).

EHC is delivered as a dry powder in 50-lb / 25-kg bags or super-sacs. EHC can be placed into the saturated zones in a variety of ways including direct push injections, hydraulic and pneumatic fracturing, and direct soil mixing. EHC is completely non-hazardous and safe to handle. EHC is manufactured in the USA, EU and Brazil.

SITE INFORMATION / ASSUMPTIONS

	Value	Unit	Comment
Treatment Area Dimensions:			
Width of targeted zone (perpendicular to gw flow)	60	ft	customer supplied
Length of targeted zone (parallel to gw flow)	10	ft	customer supplied
Depth to top of treatment zone	3	ft bgs	customer supplied
Treatment zone thickness	12	ft	customer supplied
Treatment volume	7,200	ft3	calculated value
Total Porosity	30	%	default value
Groundwater volume	2,160	ft3	calculated value
Soil bulk density	110	lbs/ft3	default value
Soil mass	396	ton	calculated value
Transport characteristics:			
Treatment time / design life for one application	3	years	default value
Linear groundwater flow velocity	73	ft/year	calculated value
Distance of inflowing gw over design life	219	ft	calculated value
Effective porosity for groundwater flow	30	%	default value
Volume of water passing region over design life	47304	ft3	calculated value
Soil type	medium		customer supplied
Fraction organic carbon in soil, foc	0.005		estimated value

CONTAMINANTS OF CONCERN (COCs)

Constituent	GW (mg/L)	Soil* (mg/kg)	Total COI Mass** (lb)
PCE	0.3	0.3945	1.2
TCE	0.2	0.107	0.7
DCE	0.1	0.03	0.3
VC	0.3	0.00375	0.9

*Unless provided, sorbed concentrations were roughly estimated based on expected groundwater concentrations, foc and Koc values. For a more refined estimate, it is recommended that actual values be verified via direct sampling of the targeted treatment interval.

**The total COI mass was estimated based on concentrations in soil and groundwater within the targeted area plus expected contributions from inflowing groundwater over the projected design life.

GEOCHEMICAL DATA

Competing Electron Acceptors	GW (mg/L)	Soil* (mg/kg)
Dissolved oxygen	0.9	2.583
Nitrate (as N)	0	0
Manganese (dissolved)	0	0
Iron (III)	0	0
Sulfate	20	0
Carbonate Alkalinity (as CaCO3)	0	0

*Unless provided, soil concentrations were roughly estimated based on expected groundwater concentrations, foc and Koc/Kd values. For a more refined estimate, it is recommended that actual values be verified via direct sampling of the targeted treatment interval.

ORP (mV)	-29	
pH	NA	

STOICHIOMETRIC DEMAND CALCULATIONS

	GW (mg/L)	Soil (mg/kg)
H2 Demand from COIs	0.0	0.0
H2 Demand from Competing Electron Acceptors	1.7	0.3
Total H2 Demand	1.7	0.3
H2 Demand from Soil within Targeted Area	0.3	lb
H2 Demand from GW within Targeted Area	0.2	lb
H2 Demand from Influx over Design Life	5.1	lb
Total Estimated H2 Demand	5.6	lb

EHC DEMAND CALCULATIONS

The Stoichiometric demand for the targeted area was calculated using available data presented above, noting that the Stoichiometric demand represents minimum requirements and require a complete geochemical data set to be calculated accurately. Therefore, the resulting EHC dosing required to meet the estimated Stoichiometric demand was compared to our minimum guidelines for the selected type of application, selecting the higher

Application type: Permeable Reactive Barrier (PRB)

	Value	Unit
Minimum EHC application rate to meet H2 demand	0.01	% by soil mass
Minimum recommended application rate for PRB*	0.1	% by soil mass
Recommended EHC application rate	0.10	% by soil mass
Mass of EHC required	792	lbs
Mass of EHC per bag	50	lbs
Number of bags required	16	bags
Mass EHC (rounded up based on bag size)	800	lbs

*Our general recommended minimum guideline for the proposed application exceeds the dose rate required based on hydrogen demand calculations and was therefore used for the purpose of this dosing calculation.

OPTIONAL DHC INOCULANT

Although not typically required for ISCR, DHC inoculants have shown to improve removal kinetics, in particular for potential daughter products such as cis-DCE and VC. The DHC will be added after EHC application, once favorable redox conditions (ORP < -75 mV, DO <0.2 mg/L, pH between 6 and 8.5) have been attained. The DHC inoculant will contain at least 5 x10E10 cfu/ml of live bacteria including high numbers of dehalococcoides species with known abilities to biodegrade DCE. The target density of DHC cells in the treated aquifer is 2.5x10E6 cfu/ml.

	Value	Unit
Dechlorinating consortium concentration in inoculant	5.00E+10	DHC/L
Design final concentration after dilution in aquifer	2.50E+06	DHC/L
Volume of Inoculant Required	13	L

INSTALLATION

EHC is supplied as a dry powder which can be mixed with soil or slurried in water. Installation techniques vary widely depending on the application. For example, the powder can be directly mixed into the soil using deep soil mixing equipment or placed into an open excavation where prior soil removal has been conducted. A slurry can be made and the mixture can be injected into the subsurface using techniques such as direct injection through Geoprobe rods or hydraulic fracturing. Injection through fixed wells is not recommended given that the product does not dissolve in water. If application via wells or injection networks were to be the preferred installation method at your site, we instead recommend our soluble ISCR substrate EHC-L.

EHC Slurry Preparation:

The EHC slurry can been prepared in a variety of ways, including using paddle mixers, recirculation and manual mixing using a hand-held drill with a mixing attachment. However, particularly for larger projects, FMC recommends having a mechanical mixing system available on site. In general we recommend continuous mixing in smaller batches (<100 USG / 400 L) to avoid settling of solids at the bottom. For example Chem Grout's high pressure mixing and injection units are ideal for continuous preparation and injection of EHC. However, particularly for larger projects, FMC recommends having a mechanical mixing system available on site. In general we recommend continuous mixing in smaller batches (<100 USG / 400 L) to avoid settling of solids at the bottom.

The amount of water to prepare the EHC slurry could be varied depending on the desired injection volume and slurry properties. When applied via direct injection, normally a concentration of between 25 and 35% is targeted. The below table shows the amount of water needed per 50-lb / 25-kg bag depending on the targeted concentration and the resulting total injection volumes and percent pore fill (injection volume to total pore volume). Note that a thinner slurry will promote permeation into more permeable formations, whereas a more concentrated/more viscous slurry will promote fracturing and horizontal propagation into more fine-grained formations.

Target concentration (% solids):	**25%**	**30%**	**35%**
Mass EHC per bag (lbs)	50	50	50
Volume water per bag (USG)	18.0	14.0	11.1
Volume slurry per bag (lbs)	22.2	18.2	15.4
Total mass EHC (lbs)	800	800	800
Total volume water (USG)	288	224	178
Total injection volume (USG)	355	292	247
Injection volume to total pore volume	2.2%	1.8%	1.5%

INSTALLATION (continued)

Injection recommendations (can be altered):

The EHC slurry can be injected into the ground in a variety of ways including direct injection and hydraulic/pneumatic fracturing. The injection spacing will be determined based on the radius of influence and soil acceptance for the given application method, lithology and depth. Assuming installation via direct push injections and a radius of influence (ROI) of 5 to 8 ft (1.7 to 2.5 m), an injection spacing of 10 to 15 ft (3 to 5 m) is normally applied. For injection PRB applications, a closer spacing is normally recommended to create some overlap or the PRB may be made up of multiple off-set injection lines to improve contact.

Unless specified by the consultant, the below recommendations was based on our experience from other similar lithologies and considers both the estimated ROI and the estimated soil acceptance (maximum injection volume per vertical foot for lithology and depth) using direct injection. However, please note that actual ROI and soil acceptance can vary widely and are also highly influenced by the injection method employed (slurry viscosity, injection pressures and flow rates). **Therefore, PLEASE NOTE that the construction estimates presented below can be readily modified in the field as required (for example, the density of the slurry can be changed to modify the total injection volume or the injections spacing could be altered based in installation technology).**

	Value	Unit	Comment
Total EHC mass	800	lbs	calculated value
Concentration of EHC slurry to inject	25%	by weight	can be altered
Total volume of water required	288	U.S. gallons	calculated value
Approximate volume of slurry to inject	351	U.S. gallons	calculated value
Number of injection lines for PRB	1	lines	
Injection spacing within lines	12	ft	customer provided
Number of injection points	5	locations	calculated value
Mass EHC per injection point	160	lbs	calculated value
Mass EHC per vertical foot	13	lbs	calculated value
Injection volume to total pore space volume	2.2%	by volume	calculated value