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REPORT ON

FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE – SITE #828102
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

by Haley & Aldrich of New York
Rochester, New York

for New York State Department of Environmental Conservation
Avon, New York on behalf of AFES, LLC

File No. 70751-300
April 2016

Haley & Aldrich of New York
200 Town Centre Drive
Suite 2
Rochester, NY 14623
585.359.9000

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New York State Department of Environmental Conservation
Division of Environmental Remediation, Region 8
6274 East Avon-Lima Road
Avon, New York 14414-9519

Attention: Mr. Frank Sowers, P.E.

Subject: *Revised* Feasibility Study
Artco Industrial Laundries Site – Site #828102
331-337 West Main Street
Rochester, New York

Dear Mr. Sowers:

On behalf of our Client, AFES LLC, Haley & Aldrich of New York (Haley & Aldrich) is pleased to submit this *Revised* Feasibility Study (FS) for the Artco Industrial Laundries Site ("Site") located in Rochester, New York. The *Revised* FS was prepared following New York State Department of Environmental Conservation (NYSDEC) approval of the Second Revised Remedial Investigation Report dated 9 February 2015 *and NYSDEC's comments on the original June 2015 FS submitted to the NYSDEC*. The *Revised* FS provides a brief Site history, summarizes the findings of the remedial investigation, identifies the remedial goals and remedial action objectives, identifies and evaluates remedial technologies, and provides recommendations for a remedial alternative; *all substantive revisions included herein and made to be responsive to NYSDEC's comments are shown in italicized font, minor revisions (corrections of typos, grammar, and simple revisions to tables and figures) are not italicized*.

If you have any questions, please contact Steve Phillips at (585) 321-4240.

Sincerely yours,
HALEY & ALDRICH OF NEW YORK

Steven H. Phillips
Senior Project Manager

Vincent B. Dick
Senior Vice President

Enclosures

c: Bernette Schilling, NYSDEC
Justin Deming, NYSDOH
Anthony Perretta, NYSDOH
Lou Micca, AFES
Rich Palumbo, AFES

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Executive Summary

Haley & Aldrich of New York (Haley & Aldrich) has prepared this *Revised* Feasibility Study (FS) Report on behalf of AFES LLC for the Artco Industrial Laundries Site located at 331-337 West Main Street in the City of Rochester, New York.

AFES, LLC (AFES) currently owns the Site and has no historic relationship with Artco Industrial Laundries. Artco Industrial Laundries was merged into Cintas Corporation (Cintas). Cintas currently leases the subject property and operates as an industrial laundry. The Site is currently zoned for industrial manufacturing and is generally surrounded by mixed industrial and commercial uses including commercial properties, industrial warehouses, and vacant space.

The Site is generally flat and is situated approximately 0.6 miles west of the Genesee River. The overburden soils at the Site generally consist of a layer of historical fill materials varying in thickness from 4 to 8 feet below ground surface (bgs) underlain generally by silty fine sand (native soil deposits). Bedrock is relatively shallow at the Site and is located approximately 9 to 13 feet bgs. Groundwater is encountered at approximately 5-15 feet bgs and flow is somewhat variable to the north, west, and south based on depth and natural and man-made subsurface influences (e.g. utilities that intercept bedrock off-Site to the north).

The *Revised* FS was performed based on the NYSDEC-approved February 2015 Second Revised Remedial Investigation Report (RIR). Primary contaminants of concern (COCs) at the Site identified in the RIR are Target chlorinated volatile organic compounds (Target CVOCs), which include tetrachloroethene (PCE) and breakdown products trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride. These COCs were identified in soil beneath the current Site building and in overburden and bedrock groundwater both on and off-Site. Target CVOCs were also identified in sub-slab vapor and indoor air and were addressed via an interim remedial measure (IRM) in 2011 with the construction of a sub-slab depressurization system (SSD system) in the building. Target VOCs were identified in utility water and sediments during the RI as well, however evaluations indicated that the impacts were likely due to impacted groundwater flowing into the utilities and not due to a specific source in the utilities. Limited actions that resulted in removal and reduction of Site Target CVOCs were also performed in the past: on-Site use of PCE was historically limited to one dry cleaning machine, associated with the former Artco operation, that was removed several years ago; and performance of soil-vapor extraction (SVE) was performed on sub-slab soil beneath the former dry cleaner machine area until monitoring indicated asymptotic conditions were reached on effectiveness of that SVE system.

Other impacts, which are considered secondary to the COCs described above, were also identified related to isolated detections of polycyclic aromatic hydrocarbons (PAHs) and metals in surface and near surface soils related to constituents in historic fill that is present on the Site and throughout the region.

Currently there are no complete exposure pathways for soil, groundwater, or soil vapor & utility impacts. Exposure to impacted soil and utilities are mitigated by the presence of the Site building, pavement and other Site infrastructure. Groundwater is not currently used for any purpose, and soil vapor intrusion is mitigated by the SSD system. The potential exists for limited scenarios in which future populations could be exposed however when doing subsurface work without proper implementation of engineering controls (e.g. utility workers).

The *Revised* FS was conducted in accordance with NYSDEC guidance to identify and evaluate potential remedial actions to remediate source and residual Target CVOC impacts to Site media and to mitigate risks of exposure to Target CVOC impacted media by potential receptors. The following remedial alternatives were identified and evaluated.

- **Alternative 1 (No Further Action) – Institutional Controls, Maintain Existing Engineering Controls, Maintain Existing Cover, No Further Soil or Groundwater Remediation.**

  Alternative 1 includes continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site *institutional controls*. This alternative would not include any further soil or groundwater remediation.

- **Alternative 2 (Restore to Pre-Release Conditions) – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, In-situ treatment (ISCR) of Soil and Groundwater.**

  Alternative 2 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a groundwater monitoring component, continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on- and off-Site remedial actions were performed and dependent on their effectiveness: Soil and groundwater contamination would be addressed via in-situ chemical reduction (ISCR) treatment over the entirety of area where detections have been made. Target CVOCs in soil would be reduced to concentrations compliant with *unrestricted* soil cleanup objectives (SCOs) and Target CVOCs in water would be reduced to concentrations compliant with NYSDEC Class GA drinking water standards (TOGS 1.1.1).

- **Alternative 3 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, In-situ Treatment (ISCR) of Soil, Extraction and Treatment (BBZ) for Groundwater.**

  Alternative 3 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a groundwater monitoring component, continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on-Site remedial actions were performed and dependent on their effectiveness: Soil contamination would be addressed via ISCR treatment. Target CVOCs in soil would be reduced to concentrations compliant with commercial use SCOs; Groundwater would be addressed via pumping and treatment through a blasted bedrock zone (BBZ), which would act as both a long term remediation technology and a migration control technology. Remedial goals for groundwater would include reducing Target CVOC concentrations in groundwater to be compliant with TOGS 1.1.1.

- **Alternative 4 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, In-situ Treatment (*Thermal Conductance Heating*) of Soil, Extraction and Treatment (BBZ) for Groundwater.**

Alternative 4 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a groundwater monitoring component, continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on-Site remedial actions were performed and dependent on their effectiveness: Soil contamination would be addressed via in-*situ thermal conductance heating*. Target CVOCs in soil would be reduced to concentrations to be compliant with commercial use SCOs. Groundwater would be addressed via pumping and treatment through the BBZ, which would act as both a long term remediation technology and a migration control technology. Remedial goals for groundwater would include reducing Target CVOC concentrations in groundwater to be compliant with TOGS 1.1.1.

- **Alternative 5 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, No Further Remediation of Soil, Extraction and Treatment (BBZ) for Groundwater.**

  Alternative 5 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a groundwater monitoring component, continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on-Site remedial actions were performed and dependent on their effectiveness: Because no current exposure pathway exists for Site soils or associated vapor and management of potential future exposure would be implemented via the restrictions above, no further soil remediation would be included as part of this alternative. Groundwater would be addressed via pumping and treatment through BBZ, which would act as both a long-term remediation technology and migration control technology. Remedial goals for groundwater would include reducing Target CVOC concentrations in groundwater to be compliant with TOGS 1.1.1.

- **Alternative 6 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, Extraction and Treatment (MPE) for Soil and Groundwater.**

  Alternative 6 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a groundwater monitoring component, continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on-Site remedial actions were performed and dependent on their effectiveness: Both soil and groundwater impacts would be addressed by a multi-phase extraction system, which would extract under high vacuum both groundwater and soil vapor. The extraction process typically is partial treatment of groundwater (it moves CVOC concentrations preferentially to a vapor phase, which then requires treatment). MPE also acts to some degree as a migration control mechanism with reasonable effectiveness in overburden; effectiveness of migration control in bedrock is highly dependent on connectivity of naturally occurring fracture systems. Target CVOCs in soil would be reduced to concentrations compliant with commercial use SCOs. Remedial goals for groundwater would include reducing Target CVOC concentrations in groundwater to be compliant with TOGS 1.1.1.

- **Alternative 7 (Restore Site to Unrestricted Use Conditions – Facility Not Occupied/Demolished) – Institutional Controls, Maintain Cover, Excavation/Off-Site Treatment and Disposal of Soils; In-situ Treatment (*Electrical Resistance Heating*) of Soil and Groundwater**

  Alternative 7 assumes occupation of the current building ceases, no further use occurs and the building is demolished. Alternative 7 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a limited groundwater monitoring component, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on-Site remedial actions were performed and dependent on their effectiveness: Target CVOCs in soil would be addressed via excavation and on/off-Site treatment and off-Site disposal. Remaining residual soil impacts and groundwater impacts would be addressed *via in-situ treatment by Electrical Resistance Heating (ERH)* Target CVOCs in soil would be reduced to be compliant with protection of groundwater SCOs. Remedial goals for groundwater would include reducing Target CVOC concentrations in groundwater to be compliant with TOGS 1.1.1. It is noted that given the current Site use as an active facility, this option would only be feasible if the Site were to become vacant and the building could be removed.

- ***Alternative 8 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, Soil Vapor Extraction (SVE) in Unsaturated Overburden, Extraction and Treatment (BBZ) for Groundwater.***

  Alternative 8 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a groundwater monitoring component, continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on-Site remedial actions were performed and dependent on their effectiveness: Unsaturated soil impacts beneath the site building source area would be addressed by a soil vapor extraction (SVE) system, which would extract soil vapor to remove contaminant mass from affected unsaturated zone soil/fill. The extraction process typically provides limited treatment of groundwater (it moves CVOC concentrations preferentially to a vapor phase, which then requires treatment), although typically SVE is less effective than MPE. The goal would be to reduce target CVOCs in soil to concentrations compliant with commercial use SCOs; Groundwater would be addressed via pumping and treatment through a blasted bedrock zone (BBZ), which would act as both a long term remediation technology and a migration control technology. Remedial goals for groundwater would include reducing Target CVOC concentrations in groundwater to be compliant with TOGS 1.1.1.

- ***Alternative 9 – Institutional Controls, In-situ Treatment (Electrical Resistance Heating) of Unsaturated and Saturated Zones.***

Alternative 9 assumes occupation of the current building ceases, no further use occurs and/or the building is demolished. Alternative 9 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a groundwater monitoring component, continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on-Site remedial actions were performed and dependent on their effectiveness: Soil and groundwater contamination would be addressed via in-situ electrical resistance heating (ERH). Target CVOCs in soil would be reduced to concentrations to be compliant with commercial use SCOs. Groundwater would be addressed via pumping and treatment through the BBZ, which would act as both a long term remediation technology and a migration control technology. Remedial goals for groundwater would include reducing Target CVOC concentrations in groundwater to be compliant with TOGS 1.1.1.

- ***Alternative 10 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, In-situ Treatment (ISCO, PlumeStop® with Enhanced Bioremediation) of Groundwater for Migration Control.***

Alternative 10 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a groundwater monitoring component, continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on- and off-Site remedial actions were performed and dependent on their effectiveness: Saturated soil and groundwater contamination would be addressed via in-situ ISCO treatment coupled with PlumeStop® with enhanced bioremediation along a "treatment zone" alignment of injection points along the downgradient north and west sides of the existing building. Downgradient areas not immediately treated by the ISCO and PlumeStop® would be addressed longer-term by enhanced bioremediation. ISCO would be first injected at higher-concentration locations located north of the existing site building to reduce peak Target CVOC concentrations to a range within the efficacy of PlumeStop® applications (approximately ≤14PPM); this would be followed by injection of the PlumeStop® and a hydrogen-release reagent to stimulate enhanced bioremediation. This alternative does not include treatment of the soil and groundwater beneath the building floor slab. Because no current exposure pathway exists for Site soils or associated vapor and management of potential future exposure would be implemented via the restrictions above, no further soil remediation would be included as part of this alternative. The enhanced bioremediation would control the off-Site migration of the plume. Target CVOCs in saturated soil would be reduced to concentrations compliant with commercial use soil cleanup objectives (SCOs) and Target CVOCs in groundwater would be reduced to concentrations compliant with TOGS 1.1.1. Target CVOCs in groundwater downgradient of the Site building would be reduced to concentrations compliant with TOGS 1.1.1.

- ***Alternative 11 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, In-situ Treatment (ISCO, PlumeStop® with Enhanced Bioremediation) of Saturated Overburden and Groundwater for Source and Migration Control.***

  Alternative 11 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a groundwater monitoring component, continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on- and off-Site remedial actions were performed and dependent on their effectiveness: Saturated soil and groundwater contamination would be addressed via in-situ ISCO treatment coupled with PlumeStop® with enhanced bioremediation in the same manner as presented under Alternative 10 above in areas on the north and west side of the existing building, as well as hot spot areas beneath the existing floor slab. Downgradient areas not immediately treated by the ISCO and PlumeStop® would be treated longer-term by enhanced bioremediation. The enhanced bioremediation would control the off-Site migration of the plume. Target CVOCs in saturated soil would be reduced to concentrations compliant with commercial use soil cleanup objectives (SCOs) and Target CVOCs in groundwater would be reduced to concentrations compliant with TOGS 1.1.1.

- ***Alternative 12 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, Soil Vapor Extraction(SVE) in Unsaturated Overburden, and In-situ Treatment (ISCO, PlumeStop® with Enhanced Bioremediation) of Saturated Overburden and Groundwater for Source and Migration Control.***

  Alternative 9 includes establishing land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site, the preparation of a SMP which would include a groundwater monitoring component, continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building, and continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. These controls would remain in effect unless and until the following on- and off-Site remedial actions were performed and dependent on their effectiveness: Unsaturated soil impacts beneath the site building source area would be addressed by a soil vapor extraction (SVE) system, which would extract soil vapor to remove contaminant mass from affected unsaturated zone soil/fill. The extraction process typically provides limited treatment of groundwater (it moves CVOC concentrations preferentially to a vapor phase, which then requires treatment), although SVE is typically less effective than MPE. Target CVOCs in soil would be reduced to concentrations compliant with commercial use SCOs. Saturated soil and Groundwater contamination would be addressed via in-situ ISCO treatment (north of the existing site building) coupled with PlumeStop® with enhanced bioremediation in the same manner as presented under Alternative 11 above in areas on the north and west side , and beneath the existing floor slab of the existing building. Downgradient areas not immediately treated by the ISCO and PlumeStop® would be treated longer-term by enhanced bioremediation which would control downgradient plume migration.

Alternative 11 is the recommended remedy after comparative evaluation using the DER-10 Technical Guidance for Site Investigation and Remediation criteria presented in the Revised FS, as well as the *criteria included in NYSDEC DER-31/Green Remediation. This alternative is recommended because it is the most cost effective and least disruptive permanent solution that addresses the remedial action objectives (RAOs) for the Site, is intended to achieve to the extent practicable the standards, criteria and guidance (SCGs) for the Site, and is protective of human health and the environment. The remedy includes short-duration injection(s) of in-situ remediation, is intended to result in relatively rapid decrease of groundwater concentrations both beneath the former source area of the site building (without undue disruption of the existing use of the building), as well as the downgradient groundwater plume north and west of the existing site building; it also does not require long-term operation of energy-consumptive extraction equipment and associated infrastructure.* This remedy is subject to concurrence and recommendation by the NYSDEC and also subject to public review, comment and acceptance.

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1. Introduction

This *Revised* Feasibility Study (FS) represents the latest phase of work related to the Artco Industrial Laundries Site – Site #828102, located at 331-337 West Main Street, in Rochester, New York. This work was performed in accordance with the requirements of an Order on Consent ("Consent Order") with the New York State Department of Environmental Conservation (NYSDEC) dated 14 September 2010. This *Revised* FS is the next component that follows the NYSDEC-approved Second Revised Remedial Investigation Report (RIR) dated 9 February 2015*, and NYSDEC's review comments dated October 29, 2015 on the initial FS dated June 2015*.

1.1 PURPOSE

The purpose of the FS is to identify, evaluate, and select a remedy to address impacts to soil, groundwater, soil vapor, and utilities identified in the RIR.

1.2 SITE DESCRIPTION

The former Artco Industrial Laundries, Inc. (Artco) property is located at 331-337 West Main Street, Rochester, New York ("Site"). AFES, LLC (AFES) currently owns the Site and has no historic relationship with Artco Industrial Laundries. Artco Industrial Laundries was merged into Cintas Corporation (Cintas). Cintas currently leases the subject property and operates as an industrial laundry. The Site is approximately 1.81 acres, with a 1.5-story building. The facility is slab-on-grade construction that encompasses approximately 54,500 square feet. The Site is currently zoned for industrial manufacturing. A Site location map is included as Figure 1. A figure showing the Site boundaries is included as Figure 2.

Land surrounding the subject Site is currently being used as follows:

- Nick Tahou's restaurant and Morse Lumber Company are located north of the Site, across West Main Street.
- Two industrial warehouses occupied by American Range Company and Riverside Micrographics are located south of the Site. Single and multiple family residences are located further south, approximately 1000 feet from the Site along Troup Street.
- The City of Rochester's Emergency Communications Center ("911 Center") is located immediately east of the Site.
- A vacant, undeveloped lot and Hahn Automotive Warehouse, Inc. are located immediately west of the Site.

1.3 SITE HISTORY

The Site has been developed with structures since the 1800s, and has been used for industrial/commercial purposes since the early 1900s. The Site and much of the surrounding property was used as a rail yard as documented from aerial photos from 1930 through the 1960s. An aerial photo from 1970 shows the property that would later become occupied by Artco as having been completely cleared of structures and rail track, as was much of the surrounding property also.

The Site's original use as an industrial laundry facility began with the Artco Industrial Laundry facility. Artco purchased the Site from the Office of Housing & Urban Development (HUD) in 1969 and construction of the current facility building began shortly thereafter. Operations started at the facility in the fall of 1972. According to Site personnel interviewed for previous Site investigations, there was a dry-cleaning machine that used perchloroethene (PCE) on the property since the facility opened in 1972 until cessation of PCE use in 1999. Past reports indicate the machine had always been at the same location at the eastern interior of the building. In January 1999, the facility started using a dry-cleaning unit that used non-toxic, non-chlorinated chemicals in the cleaning process. Since Cintas, the current tenant, has occupied the building, no dry cleaning has been performed and water/detergent cleaning has been exclusively performed (i.e. Cintas performed no dry cleaning).

Nearby, off-Site property historical use includes the following:

- Nick Tahou's property, located at 320 West Main Street, north of the Site was formerly a railroad station. Since about 1968 the eastern two-thirds of the building has been restaurant space. The western portion of the building was leased by several dry cleaners from approximately 1970 to 1990. Tom's One-Hour Dry Cleaner was the last dry cleaner to lease this space. PCE was used by Tom's. Also north of the Site is Morse Lumber.
- The City of Rochester's 911 Center is located immediately east of the Site. The 911 Center property originally comprised five parcels of land. Prior to ownership by the City these parcels were owned or used by businesses that sold petroleum products such as gasoline and motor oil. Companies that manufactured and sold roofing materials such as asphalt, slag roofing, coal tar roofing and creosote shingle stains; metal plating companies, and a heating supply company also were located on these parcels.
- Two parcels consisting of a driveway, paved parking, and an open grass area are located to the west of the Site. Those parcels are also owned by AFES, Inc. but are not subject to the Consent Order. Historically, those parcels were included as part of the rail yard that was subsequently demolished in the1960s. Beyond those parcels is the Hahn Automotive Warehouse.
- Two additional industrial warehouses are located to the south of the Site. They are accessed off Van Auker Street and occupied by American Range Company and Riverside Micrographics. Those properties were formerly occupied by Spoleta Construction Company. Historically, those buildings were also a part of the former rail yard.

1.4 SUMMARY OF INVESTIGATIONS, REGULATORY HISTORY*, AND INTERIM REMEDIAL MEASURES*

The following is a brief overview of the environmental investigation and regulatory history at the Site. Investigations have occurred at the Site and off-Site since 1998 and have included soil, soil vapor, indoor air, utility (sediment and water media), and groundwater sampling. The investigations have revealed the Site is impacted by chlorinated volatile organic compounds ("CVOCs"), particularly PCE that appears to have resulted from the former use of dry cleaning chemicals in the former dry cleaning machine location.

Between 1998 and 1999, the NYSDEC conducted a Site investigation, investigating portions of the Site and surrounding properties to further delineate contamination in the area, particularly PCE. PCE had been found in prior environmental investigations on the 911 Center property to the east of the Site. Other potential contributing sources for PCE as identified in the NYSDEC Report were Tom's One-Hour Dry Cleaner and the northeast corner on the 911 Center property where used filters containing PCE from Tom's were reported to have been place on the ground to dry. Previous investigations have not been able to confirm a release of PCE at these two off-Site locations.

The Artco Site was accepted into the NYSDEC Voluntary Cleanup Program (VCP) in 1999 and investigations were conducted at the Site in the early 2000s under the VCP. The investigation identified the presence of PCE in soil and soil vapor below the Site building slab at the location of the former dry cleaning machine. Groundwater was also found to contain parts-per-million level concentrations of PCE including areas beneath the Site building.

Interim Remedial Measure (IRM) work plans were submitted to the NYSDEC in August 2002 and August 2003 for implementation of a soil vapor extraction (SVE) system in an area of elevated PCE concentrations in soil proximate to the former dry cleaning machine location. The SVE system was subsequently installed in February 2004.

The SVE system consisted of six sub-slab extraction wells installed in the vicinity of former dry cleaning equipment suspected to be the source of the PCE in soil and groundwater. A five-horsepower regenerative blower connected to the extraction wells via subsurface piping. The SVE system effluent was treated with two in-line 180-pound granular activated carbon (GAC) units prior to discharge through the facility exhaust stack.

Operation of the system commenced in March 2004 with routine sampling of influent and effluent air concentrations to determine progress of soil remediation (via the vapor extraction) and conformance with air discharge criteria agreed to with the NYSDEC. *A monthly status report from May 2004 indicates that mass removal rates were greater than 16 pounds of total VOCs per day. Mass removal then dropped to a range tapering down from 11 lb/day to 5lb/day over the subsequent months through late June 2004. By the last quarter of 2004 and into early 2005, mass removal had dropped the range of 2+ lb/day to values less than 1 pound of total VOCs per day.*

The decreasing mass removal rate trend continued into late 2005 with rates typically less than one half pound per day. Operation of the system ceased in April 2006 when the Voluntary Cleanup Agreement (VCA) was ultimately terminated (see below). *Although the SVE system was able to remove PCE from unsaturated soil/fill beneath the former dry cleaning machine source area, groundwater contamination remained at levels that posed a significant threat to public health and the environment (per NYSDEC designation)*.

Between 2005 and 2006, two separate entities acquired the Site. The first was Kram Knarf, LLC which attempted to bring the Site into the NYSDEC Brownfield Cleanup Program (BCP), however that application was denied due to Kram Knarf's unwillingness to continue investigation and remedial efforts at the Site, and the existing VCA was terminated in 2006. Barnes/Stevens Redevelopment LLC (BSR) subsequently acquired the property and successfully entered it into the BCP in 2007.

BSR submitted a Remedial Investigation Work Plan (RIWP) on 8 August 2007, which was approved by the NYSDEC with modifications on 12 October 2007. Based on results of the investigation, the NYSDEC requested that an IRM be implemented to address the vapor intrusion concerns for the Site building.

BSR submitted an IRM work plan in December 2008, which was approved with modifications on 27 March 2009. The IRM work plan included proposed installation of a sub-slab depressurization system for the Site building, which utilized the existing SVE infrastructure for sub-slab suction. Ultimately, BSR never implemented the IRM, nor did they complete the remaining items in the approved RIWP. After delay in implementing Site work, the NYSDEC ultimately terminated the BSR Brownfield Cleanup Agreement (BCA) in August 2009.

In May 2009, in parallel with the BCP investigation conducted by BSR, HDR conducted an off-Site investigation on behalf of the NYSDEC of areas surrounding the Site consisting of well installation and sampling and a vapor intrusion structures sampling (HDR report dated February 2010). Additional sources of CVOCs were not identified, and HDR concluded that significant impact to adjacent properties related to soil vapor intrusion was not occurring or anticipated in the future. The HDR investigation confirmed downgradient migration of CVOCs in groundwater into shallow bedrock, with likely pathways being trenches cut through the bedrock to accommodate subsurface utility lines.

In October 2009, the Site was listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites as a class “2”. 6 NYCRR Part 375-2.7 defines a class “2” Site as one at which contamination represents a significant threat to public health or the environment. After termination of the BCA with BSR was issued, title to the property was acquired by AFES, and it entered as a Respondent into a Consent Order with the NYSDEC to address an IRM and remaining remedial investigation of the Site. AFES signed the Consent Order on 14 September 2010.

An IRM work plan for installation of a SSD system was submitted in accordance with the Consent Order. The revised IRM work plan was submitted on 27 March 2011 and approved by the NYSDEC on 31 March 2011. The system was installed and began operation in October 2011. An Interim Site Management Plan (ISMP) dated April 2012, was approved by the NYSDEC and describes the procedures required for operation, monitoring, and maintenance of the SSD system, as well as reporting requirements.

The Second Revised RIWP was submitted on 30 June 2011 and approved by NYSDEC with modifications. The purpose of the work plan was to define the nature and extent of contamination on the Site as supplement to on and off-Site investigations completed to date, and to determine whether remedial action was needed to protect human health and the environment. The remedial investigation (RI) was completed during 2011 (soil sampling during SSD installation and well inventory/assessment) and 2013 (remaining work). Results of those RI activities are documented in a Second Revised RIR dated 9 February 2015 and summarized in Section 2.

2. Summary of Remedial Investigation

2.1 GEOLOGY & HYDROGEOLOGY

The Site incorporates approximately 1.81 acres of fairly level land situated in the City of Rochester. According to the United States Geological Survey (USGS) Topographic Map, the Site lies at approximately 515 feet above Mean Sea Level. A general description of the physical setting is provided below. A more detailed discussion is provided in the 9 February 2015 Second Revised RIR.

2.1.1 Geologic Setting

The Site is generally flat and is situated approximately 0.6 miles west of the Genesee River. The overburden soils at the Site generally consist of a layer of historical fill materials varying in thickness from 4 to 8 feet below ground surface (bgs) underlain generally by silty fine sand (native soil deposits).

Bedrock is relatively shallow at the Site and is located approximately 9 to 13 feet bgs. Bedrock underlying the Site was reported in references and observed in borings conducted for the investigation of this Site as Decew Dolostone.

2.1.2 Historical Fill

The presence of historical fill on-Site was previously characterized using soil boring logs from 1993, 1998, 2001 and 2010. Eleven off-Site logs and sixteen on-Site logs were used to characterize the general nature and extent of the historic fill. In general, historic fill is located directly below pavement and topsoil to approximately 4 to 12 feet bgs across the Site and off-Site. Fill depth on-Site ranges from approximately 4 to 8 feet bgs. Deeper fill appears to be located to the west of the Site, and on the north and east sides of the Site. The fill material consists generally of fine to course brown and gray sand with trace amounts of silt and gravel. Limited amounts of ash, coal, and brick appear to be ubiquitously distributed in the fill soils.

2.1.3 Hydrogeologic Setting

Previous subsurface investigation activities conducted at the Site identified that the uppermost groundwater bearing unit is situated at/near the interface between the soil and bedrock, between approximately 5 and 15 feet bgs.

Based on regional setting and topography, groundwater is anticipated to flow in a westerly to northwesterly direction. Historical groundwater elevation data suggests that overburden groundwater can also flow in a southwesterly direction. Historical bedrock groundwater elevation data suggested flow locally toward the north or west, with likely influences on localized direction of groundwater from resulting from subsurface utilities that intercept bedrock.

Surface water generally flows north towards West Main Street, where the precipitation runoff is intercepted by municipal storm sewer catch basins. Roof drainage is conveyed directly to the municipal storm sewer.

2.1.4 Subsurface Utilities

Subsurface utility lines are present beneath and surrounding the Site (Figure 2), which may influence groundwater flow conditions locally. A main utility line runs east/west beneath West Main Street (immediately off-Site, north); the Site utilities discharge to this off-Site main utility line. Previous investigations indicate these lines have been trenched into bedrock (at portions of the on- and off-Site) locations.

2.1.5 Sensitive Receptors

No sensitive receptors such as wetlands or public wells have been identified adjacent to or near the project area and no substantial impact to the surrounding community is anticipated as a result of this project. No residential use borders the property on any side. Industrial/commercial property is located along Troup Street between the Site and residential development approximately 1,000 feet south of the Site. Some residential (apartment/townhouse) use exists approximately 600 to 700+ feet northeast of the Site across I-490, and similar multi-residential property is being developed in former industrial building space approximately 800+ feet to the northwest of the Site. All adjoining property uses in the area are serviced by public water for potable and non-potable purposes.

2.2 NATURE & EXTENT OF CONTAMINATION

This section summarizes the physical and chemical observations from the previous on-Site and off-Site investigations. Current Site conditions are summarized on Figures 3 through 6. Selected figures including posting maps from the RIR are also included in Appendix A for further reference.

2.2.1 Contaminants of Concern and Sources

Based on the analytical results presented in the RIR and historical investigation data, the Site compounds of concern ("COCs") have been identified based on the detection of compounds that are presumed to be related to the former industrial laundry Site operations and are present at concentrations exceeding the relevant 6 NYCRR Part 375 Soil Cleanup Objectives (SCOs). RI results were compared to various comparison criteria, including restricted commercial use SCOs and NYSDEC Class GA drinking water standards (TOGS 1.1.1), based on the current and future intended use of the Site and neighboring off-Site properties.

COCs for the Site include CVOCs from historic dry cleaning operations at the Site, specifically tetrachloroethene (PCE) and breakdown products trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride. Those CVOCs are also identified herein as "Target CVOCs."

Target CVOCs on the Site and off-Site may have resulted from the former dry cleaning operation on-Site. Dry cleaning-related operations on adjacent off-Site properties were considered to be other potential contributing sources. Previous investigations have not been able to confirm a release of PCE at these off-Site locations, but further investigation by those parties was not compelled.

2.2.2 Other Contaminants

Benzene, toluene, and PAHs were detected in Site soil and groundwater exceeding restricted commercial use SCOs and TOGS 1.1.1 criteria. However, due to the nature and location of the detections (parking lot drains and historic fill), it was determined that these detections were not related to the use of historic PCE dry cleaning operations, and therefore were not considered as COCs. Though these contaminants are not considered COCs or a *current* exposure (i.e. groundwater is not used, fill is currently covered by pavement, *one foot of landscaping material meeting commercial use SCOs*, or building foundation), it is assumed that administrative controls will be necessary to reduce exposure and/or be protective of human health and the environment depending on future use of the Site.

2.2.3 Surface and Overburden Subsurface Soil

Based on boring log information, the overburden soils at the Site generally consist of an approximately four to eight foot historical fill layer underlain by fine silty sand; with deeper fill west of the Site, and on the north and east sides of the Site.

Target CVOCs were not detected in surface soil at concentrations exceeding the restricted commercial use or protection of groundwater SCOs. Target CVOCs were detected in numerous fill samples and were detected at levels exceeding restricted use commercial SCOs in three fill samples beneath the building floor slab in historic fill and in the underlying native soils to depths of 8 feet bgs. Target CVOCs also exceed restricted use commercial SCOs in the native material underlying the historic fill beneath the building slab at one location from 8 to 12 feet bgs. Target CVOCs exceed protection of groundwater SCOs in the historic fill and native material up to depths of 12 feet bgs beneath the building floor slab. *Commercial use SCOs are not exceeded in the top one foot of exposed soil (soil not covered by pavement or the building slab).* These overburden soil conditions are shown on Figure 3a.

2.2.4 Groundwater

2.2.4.1 Overburden

Groundwater elevation data from the May and December 2013 groundwater monitoring events indicated that groundwater in overburden was encountered between approximately 4.5 and 12.0 feet bgs. Based on calculated hydraulic conductivity (2.3×10^{-3} cm/sec), interpreted hydraulic gradient (0.004-0.009 ft/ft), and assumed porosity (30%), the average linear velocity for groundwater is estimated to range from approximately $3.1 \text{ X } 10^{-5}$ to $6.9 \text{ X } 10^{-5}$ cm/sec.

Target CVOCs are present above TOGS 1.1.1 criteria in overburden groundwater on-Site (to the west of the Site building), at West Main Street, and at the adjacent property (911 Center) to the east of the Site. Specifically, Target CVOCs exceed TOGS criteria in numerous overburden groundwater samples on the Site, in one well in West Main Street, and in four wells on the 911 Center property immediately east of the Site. The highest concentrations of Target CVOCs are present in groundwater beneath the building slab and immediately west of the building slab at depths from 6 to 12.5 feet bgs (Figure 3b).

2.2.4.2 Bedrock

For purposes of evaluating the horizontal and vertical extent of Target CVOCs in bedrock groundwater, the bedrock has been divided into three depth zones (with representative conditions shown on figures):

- Shallow zone with bedrock monitoring well screens installed approximately five feet below the top of bedrock (Figure 4);
- Intermediate zone with bedrock monitoring well screens installed approximately 15 feet below the top of bedrock (Figure 5); and,
- Deep zone with bedrock monitoring well screens installed approximately 30 feet below the top of bedrock (Figure 6).

Based on hydraulic conductivity testing, the shallow bedrock appeared to be moderately permeable with average hydraulic conductivity values ranging from 4.1×10^{-3} to 5.4×10^{-7} cm/sec during RIR measurements. Bedrock with no measurable permeability was also encountered at one monitoring well.

Based on our understanding of the bedrock geology beneath the Site, bedrock groundwater likely moves through interconnected fractures, joints, and bedding plane fissures, collectively referred to as bedrock secondary porosity. Target CVOCs previously released to the subsurface would have migrated through fill beneath the building and into underlying soil and then fractured bedrock. Those CVOCs would have likely been present within primary porosity in the overburden, within the secondary porosity features, and within the lower permeability bedrock pore space (bedrock primary porosity) through a process of "matrix diffusion." In this process, initially, Target CVOCs would move from secondary porosity features into rock pore space through a process referred to as forward diffusion. With depletion of Target CVOCs in the secondary porosity features over time, Target CVOCs would move from the lower permeability pore space back into the higher permeability secondary porosity features through a process referred to as back diffusion. These processes (matrix diffusion) can result in long-term groundwater impacts even when pooled or residual non-aqueous phase liquid (NAPL) is not present in the bedrock. Interpreted bedrock groundwater flow and the distribution of impacts in each of the bedrock zones are described below based on the RIR data.

- **Shallow Bedrock Zone:** The shallow zone bedrock groundwater beneath the Site and adjacent off-Site properties has a low hydraulic gradient, with groundwater elevations ranging from 501.87 feet to 499.75 feet. The overall gradient direction appears to be to the north and northwest. Target CVOCs are present in shallow zone bedrock groundwater beneath the Site, northern portion of the off-Site properties located to the west of the Site, and wells installed within West Main Street at concentrations exceeding the TOGS 1.1.1 criteria. Target CVOCs are not detected in off-Site wells located to the north of West Main Street and wells located in the southwest corner of the off-Site parcel to the west of the Site. Residual concentrations of cis-1,2-DCE are detected in one monitoring well located to the east of the Site.
- **Intermediate Bedrock Zone:** The intermediate bedrock groundwater has an interpreted gradient direction of approximately north to south beneath the Site. Similar to the shallow zone, the hydraulic gradient beneath the Site and adjacent properties is low

with groundwater elevations generally ranging from 485.01 feet to 483.92 feet. The distribution of Target CVOCs in intermediate bedrock groundwater is similar to the shallow bedrock zone distribution, although overall concentrations are typically lower. PCE is present at concentrations exceeding Class GA standards in two intermediate bedrock monitoring wells north of the Site building and one well location north of West Main Street, which appears to be located upgradient of the Site and the utility trench beneath West Main Street. The PCE and daughter products detected in this well may be related to a separate off-Site source. Target CVOCs were not detected along the southern Site property boundary, to the west of the Site, or to the north of West Main Street. Note that benzene, a compound not considered related to the Site, was also detected in groundwater samples collected from three intermediate bedrock monitoring wells. The source of the benzene is not known, however, reported historical operations at neighboring properties include petroleum-related business.

- **Deep Bedrock Zone:** Similar to the shallow and intermediate flow zones, a low hydraulic gradient is present in the deep bedrock zone. During the December 2013 groundwater monitoring event, groundwater elevations in the deep bedrock wells ranged from 483.01 feet to 476.36 feet. The interpreted groundwater flow direction is variable based on testing conducted in December and May 2013. The gradient was to the northwest beneath the Site during the May event and a gradient was to the southwest during the December monitoring event. The December results however may have been a result of a series of anomalous well readings unrelated to aquifer conditions. Target CVOCs were detected at concentrations exceeding TOGS 1.1.1 criteria in two deep monitoring wells. Note that Target CVOC concentrations in one of the wells decreased sharply between 2009 and 2013. The drop in concentration may indicate that the concentrations in that well were residuals from the well drilling and installation process and may dissipate over time.

2.2.5 Potential NAPL Presence

The potential for presence of NAPL in Site overburden (soil/fill) above the groundwater table, and in overburden and bedrock groundwater was evaluated based on three lines of inquiry: Groundwater Data Screening, Soil/Fill Data Screening, and Direct Observation. Evaluation for residual NAPL in the subsurface indicates that NAPL is potentially present in overburden and bedrock beneath and immediately north of the former dry cleaning area at the eastern interior of the building. If present in bedrock, NAPL may reside within fractures or bedding plane porosity, and/or may be diffused into the bedrock matrix. Groundwater analytical data suggests the lateral extent of potential bedrock NAPL presence is limited to the north of the on-Site building, and potentially beneath the on-Site building based on the analytical results for overburden and conceptual model for contaminant release and migration. No visual evidence of NAPL has been identified to date.

2.2.6 Utility Sediment & Surface Water

Trenches are cut into the bedrock beneath West Main Street for subsurface utility lines. The main trenches flow west beneath West Main Street and are cut several feet into bedrock in the portion of West Main Street north of the Site. Groundwater levels are generally above the sewer inverts beneath the Site driveway (west of the Site), beneath West Main Street, north of the Site building, and beneath the Site building. Groundwater levels appear to be deeper than the sewer laterals present south of the

911 Center. Relatively low levels of Target CVOCs were detected in the sediment and utility water within surface utilities.

Based on the December 2013 groundwater levels in the overburden in relation to the sewer invert elevations where Target CVOCs were detected in surface utility samples and the relatively low concentrations of Target CVOCs in surface utility water (1 to 68 ug/L), it is likely that the detections of Target CVOCs are due to groundwater infiltration into subsurface utilities. The subsurface utilities potentially act as a preferential pathway for Target CVOCs within the storm and sanitary utilities after high seasonal groundwater levels potentially allow infiltration. Subsurface utilities are not believed to be a source of Target CVOCs.

2.2.7 Soil Vapor/Vapor Intrusion

No additional soil vapor investigation was conducted as it was not required or deemed necessary in the June 2011 RIWP. An off-Site vapor intrusion investigation was conducted in 2009 as documented in the Off-Site Remedial Investigation Report dated February 2010. The investigation included the collection of sub-slab vapor, crawl space air, indoor air, and outdoor air samples from the 911 Center, Nick Tahou's and Morse Lumber property buildings. *The soil vapor intrusion sampling results did not require further action to address potential exposure at that time*.

On-Site vapor impacts are currently mitigated through the use of SSD system, which was brought online in September 2011. The SSD system was installed in accordance with the NYSDEC-approved IRM Work Plan dated 9 December 2010 and documented in the NYSDEC-approved Construction Completion Report (CCR) dated 23 April 2012.

2.3 QUALITATIVE EXPOSURE ASSESSMENT

The current and reasonably anticipated exposure settings for the Site are based on inadvertent ingestion, adsorption or inhalation of Target CVOCs to the extent these substances have been identified as being contained within soil, groundwater, soil vapor, or sediment or surface water in utilities at the Site. The exposure assessment is summarized below and in Table I. Populations with the potential for exposure include on-Site and off-Site property occupants, on-Site and off-Site construction/utility workers for the current and potential future use of the property and neighboring properties as commercial or industrial use. The future Site use scenario includes the assumption that the existing ground surface may be disturbed or the building renovated periodically, however use will remain the same as current and consistent with Site zoning.

In summary, exposure pathways for soil are currently incomplete at the Site because Target CVOCs are located beneath the existing building, pavement or landscaped areas. Exposure pathways for groundwater are also currently incomplete. There is no current or planned future use of Site groundwater. The area is served by a public water supply, the source of which is not impacted by Site-related contamination. No current exposure pathway for soil vapor intrusion exists at the Site due to the presence and continuous operation of a SSD system beneath the building. Based on vapor intrusion testing conducted at the adjacent off-Site properties, there also does not appear to be a complete exposure pathway off-Site. Exposure pathways to Target CVOCs in utility surface water and sediment are currently incomplete. Surface water and sediment in the utilities enters a combined sewer in West Main Street and is treated by the local POTW.

Assessment of future conditions assume that selected activities may occur that may present the potential for exposure, and which could involve the following on-Site and off-Site activities: utility repair or installation, removal of the existing soil and ground cover to accommodate new construction, groundwater extraction associated with excavation dewatering, and/or building demolition associated with Site structure modifications. Under these scenarios, the quantitative human health exposure assessment (QHHEA) process concludes that exposure pathways to certain receptor populations could potentially become complete for future construction works or future property occupants if appropriate administrative controls (e.g. Site Management Plan) and/or remedial action(s) are not established.

As summarized in Table I, there is no complete exposure pathway for groundwater given that groundwater is not currently used; however, a pathway could become complete as a result of exposure to impacted groundwater via excavation activities. A complete exposure pathway related to soil is not currently present, but could become complete unless impacted soils are treated, removed, covered and/or managed via Engineering and/or Institutional Controls administered by a Site management plan (SMP). Similarly, the soil vapor intrusion pathway is not currently complete, but could become complete if a new building is constructed or existing building is modified on the Site and engineering controls (e.g. sub-slab depressurization system) are not configured to mitigate the potential vapor impact to the indoor air in the future structure/modification. Exposure pathways related to Target CVOCs in utility surface water and sediment are not currently complete but could be complete if the utility pipe leaks, impacted material enters the sewer when groundwater levels are higher than the sewer invert elevation, and workers become engaged in sewer maintenance or related activities without preparation and use of controls like personal protective equipment ("PPE") or similar precautionary measures that could be managed through a SMP.

3. Remedial Goals and Remedial Action Objectives

3.1 GOAL OF THE REMEDIAL PROGRAM

The goal of the remedial program is to restore the Site to pre-release conditions, to the extent feasible. The remedy selected shall eliminate or mitigate significant threats to the public health and to the environment presented by COCs present at the Site through the proper application of scientific and engineering principles and in a manner not inconsistent with the national oil and hazardous substances pollution contingency plan as set forth in section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended as by the Superfund Amendments and Reauthorization Act (SARA).

3.2 STANDARDS, CRITERIA AND GUIDANCE

Standards, Criteria and Guidance (SCG) refer to standards and criteria that are generally applicable, consistently applied, and officially promulgated, that are either directly applicable, or that are not directly applicable but are relevant and appropriate, to be applicable to Site remediation. SCGs for evaluating the Site remedial alternatives are briefly described below:

- DER-10 Technical Guidance for Site Investigation and Remediation provides guidance on remedy evaluation and selection.
- 6 NYCRR Part 375 – Environmental Remediation Programs includes chemical-specific Soil Cleanup Objectives (SCOs) documented in Subpart 375-6 Remedial Program Soil Cleanup Objectives. The applicable SCOs for the Site include those *for unrestricted use, restricted use, and protection of groundwater as applicable to individual alternatives summarized herein*.
- Technical & Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations.
- *DER-31 Policy for Green Remediation*.

3.3 MEDIA AND LOCATIONS REQUIRING RESPONSE ACTION

The following media and locations were identified to require evaluation of potential remedial actions in this *Revised FS* based on the conclusions presented in the RIR and the presence of Target CVOC impacts:

- **Subsurface Soil:** Though impacts to subsurface soil are present beneath building foundations, pavement, and landscaped areas and are not presenting a current direct exposure risk, Target CVOC concentrations at depth (primarily below the building slab) are in excess of SCGs and potentially contributing to impacts to groundwater.
- **Groundwater:** Target CVOCs are present above TOGS 1.1.1 criteria in overburden groundwater on-Site (to the west of and under the Site building), at West Main Street, and at the adjacent property (911 Center) to the east of the Site (Figure 3). Target CVOCs are present in shallow zone bedrock groundwater beneath the Site (Figure 4), under the northern portion of the off-Site properties located to the west of the Site, and under West Main Street. The distribution of Target CVOCs in intermediate bedrock groundwater (Figure 5) is similar to the shallow bedrock zone distribution, although overall concentrations are typically lower. Target CVOCs were detected at concentrations exceeding SCGs in two deep monitoring wells, MN-9D and BMW-102D, located in West Main Street and off-Site to the west, respectively (Figure 6).

- **Sediments/Water in Utilities:** Relatively low concentrations of Target CVOCs were detected in some surface utility water samples, likely due to groundwater infiltration into subsurface utilities. The subsurface utilities potentially act as a preferential pathway for Target CVOCs within the storm and sanitary utilities after high seasonal groundwater levels potentially infiltrate the utility. Subsurface utilities are not considered a source of Target CVOCs.
- **Soil Vapor/Vapor Intrusion:** Soil vapor beneath the Site building is affected by Site CVOCs. On-Site vapor impacts are currently mitigated through the use of a SSD system, which was brought online in September 2011. Off-Site vapor sampling conducted in 2009 indicated that adverse impacts to adjacent properties related to vapor intrusion were not occurring, and concluded that significant impacts would not be anticipated in the future. No further remedial action is being considered for soil vapor intrusion at the Site, however operation and maintenance of the existing SSD system will be required into the future *in accordance with a SMP*.

3.4 REMEDIAL ACTION OBJECTIVES

The following Remedial Action Objectives (RAOs) have been selected based on the observations and analytical results completed during the Remedial Investigation, the outcome of the qualitative exposure assessment presented in the RIR, and in accordance with Chapter 4 of the DER-10 Technical Guidance for Site Investigation and Remediation. Table I contains a summary of the evaluation of potential exposure pathways to Target CVOC-impacted media conducted during the qualitative exposure assessment. The RAOs for the Site include the following:

Media	**Compounds or Material of Concern**	**Remedial Action Objectives**
Subsurface Soil	COCs: Target CVOCs	• Prevent ingestion/direct contact with contaminated subsurface soil. • Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil. • Prevent migration of contaminants that would result in groundwater or surface water contamination.
Groundwater (Overburden & Bedrock)	COCs: Target CVOCs	• Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards. • Prevent contact with, or inhalation of volatiles, from contaminated groundwater. • Restore groundwater quality to within NYSDEC standards to the extent practicable. • Address the source of groundwater contamination to the extent practicable.
Sediments/ Water in Utilities:	COCs: Target CVOCs	• Prevent ingestion/direct contact with contaminated materials. • Prevent inhalation of or exposure from contaminants volatilizing from contaminated materials. • Prevent migration of contaminants.
Soil Vapor	COCs: Target CVOCs	• Prevent inhalation of contaminants volatilizing from soil. • Prevent inhalation of contaminants volatilizing from groundwater. • *Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a Site.*

3.5 GREEN REMEDIATION PRINCIPALS

In accordance with DER-31, green remediation principals are considered herein, to the extent practicable, in the remedial alternative conceptual approach and selection process described in this Revised FS. The major green principals include the following:

- *Considering the environmental impacts of treatment technologies and remedy stewardship over the long term when choosing a Site remedy;*
- *Reducing direct and indirect greenhouse gas (GHG) and other emissions;*
- *Increasing energy efficiency and minimizing use of non-renewable energy;*
- *Conserving and efficiently managing resources and materials;*
- *Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste;*
- *Maximizing habitat value and creating habitat when possible;*
- *Fostering green and healthy communities and working landscapes which balance ecological, economic and social goals; and,*
- *Integrating the remedy with the end use where possible and encouraging green and sustainable re-development.*

Green remediation components considered as part of the twelve remediation alternatives are described within the text this report and included as part of the cost estimating process.

4. Identification and Screening of Remedial Technologies

This section identifies potentially applicable remedial technologies to address COC impacts to subsurface soil, groundwater, utilities, and soil vapor.

4.1 GENERAL RESPONSE ACTIONS

To achieve the RAOs for the Site, remedial actions are evaluated herein for the media discussed above. Note that the presence of the existing buildings, active operations, utilities and other features at this Site and above the subsurface area impacted soil and groundwater contamination may limit the number of remedial alternatives available to address the various contaminated media, depending on the technology or combination of technologies (an "Alternative") considered and the mode under which it is typically applied in order to be effective. Potential limitations and benefits of the technologies and combinations thereof are summarized in later sections of this *Revised* FS.

General Response Actions (GRAs) that are available to meet the RAOs and are considered herein, based on the COCs detected and the current and anticipated future use of the Site are identified below.

GRAs for the impacted soil include:

- No Further Action
- Institutional Controls
- Engineering Controls (Containment)
- In-Situ Treatment (in-situ chemical or physical treatment)
- Soil Vapor Extraction
- Ex-Situ Treatment (excavation and disposal)

GRAs for the impacted groundwater include:

- No Further Action
- Institutional Controls
- Monitoring (monitored natural attenuation (MNA))
- In-Situ Treatment (in-situ treatment of sources/affected areas)
- Containment
- Groundwater Extraction and Treatment

GRAs for utilities include:

- No Further Action
- Institutional Controls
- Engineering Controls

GRAs for the impacted soil vapor include:

- No Further Action (Continue to operate existing IRM SSD system)
- Institutional Controls
- Engineering Controls

4.2 IDENTIFICATION AND SCREENING OF APPLICABLE REMEDIAL TECHNOLOGIES AND ACTIONS

This section describes how the GRA would potentially be applied to address the impacted soil, groundwater and soil vapor within the Site. The technologies to be used to implement the GRA are evaluated based on the areas of the Site where impacts have been identified and Site-specific factors or constraints that may limit their applicability to achieve the RAOs for each impacted environmental media. After evaluation relative to Site conditions, the CVOC distribution at the Site, and capabilities of individual technologies, those technologies determined to be inappropriate for the identified Site conditions will be eliminated from further consideration. Table II contains a summary of the screening of potentially applicable technologies. Each technology is also further described in the sections below.

4.2.1 Site Management Plan

A Site Management Plan (SMP) would be prepared to address multiple media regardless of technology and would be required as a component of all alternatives. The SMP defines a program for implementing, monitoring and reporting on the performance of institutional controls (ICs), as well as engineering controls (ECs) implemented at a Site. The SMP will also outline the handling, segregating, testing, reuse, and disposal of soil/material encountered during potential future building construction and routine maintenance activities. The information provided in the SMP would include procedures/requirements for materials management during the specific project work and the handling and management of at-grade and below-grade soils, groundwater and other materials.

The SMP will also serve as an instrument for addressing other non-COC impacts present at the Site that are above SCGs, but are not currently presenting a *completed human health exposure pathway* given current Site use (e.g. PAHs and metals in fill), but will need to be managed if encountered during future construction or other ground intrusive Site activities.

4.2.2 Soil Technologies

The results of the analytical data for soils from the RI indicate that Target CVOC concentrations greater than SCGs are present on the Site, primarily beneath the on-Site building. The following subsections discuss the technologies considered for the impacted soils at the Site.

4.2.2.1 No Further Action

The No Further Action is required to be considered, and was retained for use as a baseline or also for possible implementation in combination with non-intrusive actions such as institutional controls.

4.2.2.2 Institutional Controls

Institutional controls (e.g., work permits, environmental easement) are non-engineered instruments, such as administrative and legal controls, that minimize the potential for human exposure to residual soil contamination that may be present at the Site following the implementation of a remedial action and/or protect the integrity of the remedy.

Since impacted soils are present within the Site in areas with limited surface access, the implementation of institutional controls and a SMP is an appropriate technology for the Site conditions and will be retained for further consideration.

4.2.2.3 Engineering Controls (Containment)

Containment is a physical barrier that can reduce the potential for direct contact with contaminated soils within the Site. Building foundations and existing concrete or asphalt surfaces provide containment of a majority of the impacted soils under the current Site conditions. *An engineered cover system, in addition to the current building foundation and asphalt surfaces, could* provide a surface seal and reduce the potential for infiltration of precipitation through the impacted soils and the potential to transfer COCs into groundwater.

Typical cover system elements include:

- **Clean Soil Cover System**: In areas of the Site where pavement is not desired, such as green space or areas of landscaping, a one foot thick layer of clean soil can provide a sufficient barrier to not allow contact with impacted soil. The soil used for the clean cover would be obtained from a source known to be clean and/or demonstrated clean based on sample collection and analyses per protocols outlined in DER-10. Clean cover can also include reuse of Site soil provided it is demonstrated clean per DER-10. Clean soil cover would require complete vegetative cover to be established, maintained, and inspected on a regular basis in accordance with a NYSDEC-approved SMP.
- **Asphalt/Concrete Cover System:** An asphalt/concrete cover system would include a layer of clean soil up to 1 foot in depth or a base course stone or gravel overlain by an asphalt binder course and final asphalt wearing course or concrete. The asphalt or concrete cover system is appropriate in areas where a surface seal is desired to limit direct contact with impacted soils and preserve the use of the area for vehicular traffic.

An engineered cover system is not expected to meet the SCGs for the soil contamination and will not achieve the RAOs as a stand-alone technology. However, the maintenance of existing cover systems and the installation of additional cover systems is an appropriate technology to help achieve the RAOs for soil and will be retained for further consideration as a component with other technologies.

4.2.2.4 In-Situ Treatment (Chemical/Physical)

Innovative in-situ physical and chemical treatment technologies have been effective in the treatment of contaminated soils at some Sites. In-situ treatment technologies considered include:

- **In-Situ Solidification/Stabilization (ISS):** A binding agent would be mixed with impacted soil in-place to reduce potential mobility of COCs.
- **Biological treatment/augmentation:** A substrate would be introduced to stimulate bacteria-enhanced natural biodegradation (reductive dechlorination) in saturated conditions.

- **Chemical Oxidation (ISCO):** An oxidizing reagent would be introduced to enhance chemical destruction of absorbed constituents in saturated conditions.
- **Chemical Reduction (ISCR):** A reducing reagent would be introduced to enhance chemical destruction of absorbed constituents.
- ***Electrical Resistance Heating (ERH):*** *Electrical current would be applied in-situ to facilitate COCs to desorb and be removed.*
- **Thermal Conductance Heating (TCH):** Heat would be applied in-situ to facilitate COCs to desorb and be removed.

ISS would require mixing of soil to occur beneath a currently operating facility. This could not be implemented with the current conditions. Further, ISS is not necessarily applicable to all CVOCs, and efficacy of reducing mobility may not be achieved. Therefore ISS is eliminated from further consideration.

Biological treatment and ISCO generally require a liquid medium (groundwater) to effectively deliver the substrate or reactant solutions to treat and/or remove the contaminants from the soil in-situ. While recent research suggests that some formulations of ISCO may be effective in the unsaturated zone, the installation of several injection points required to distribute the reagent in the unsaturated zone would not be feasible within the active facility. As such both biological treatment and ISCO are being eliminated from further consideration.

Directly injected zero-valent iron (ZVI) in the form of emulsified zero valent iron (EZVI) is the only ISCR mode applicable within the unsaturated zone and may achieve the RAOs. This technology is being retained for further consideration.

ERH and TCH both require a mechanism for removal of the desorbed COCs and therefore are not suitable as stand-alone technologies; however, *ERH and TCH* can be retained for further consideration with other technologies.

4.2.2.5 Soil Vapor Extraction (SVE)/Multi-Phase Extraction (MPE)

In-situ treatment using SVE or MPE are presumptive remedies for the treatment of soils impacted by VOCs, including the Target CVOCs. Both systems involve application of a vacuum to the subsurface to increase volatilization and to remove impacted vapor (both SVE and MPE) and potentially impacted liquid (with MPE).

A SVE system was previously installed within the building in 2004. Practical limits of effectiveness were reached in 2006 and the system was shut down. The former SVE system was found to be only partially effective *insofar as it was able to remove contaminant mass at rates of several pounds total CVOCs per day through most of its first year of operation and tapered to less than one-half pound per day prior to shut down by early 2006*. Furthermore, SVE would not be effective in addressing saturated zone impacts *as a stand-alone technology. Therefore, SVE is being retained for further consideration when used with other remediation technologies*.

MPE would potentially address the saturated zone impacts and can be applied under limited circumstances to saturated zone CVOCs, and as such is being retained for further consideration.

4.2.2.6 Ex-Situ Treatment (Excavation, Treatment and/or Disposal)

This technology includes the ex-situ treatment of the impacted soils and handling with one or both of the following options:

- After removal from the subsurface, the soil would be removed from the Site and disposed at an appropriate permitted facility. Due to the types of contaminants detected in the soil at concentrations above the SCGs, we assume that the excavated soil would be disposed at a permitted solid, non-hazardous waste (assume some soil meets "contained in" criteria), and some soil would require disposal at a hazardous waste facility (would not meet "contained in" criteria). The excavation would be backfilled with imported clean fill.
- After removal from the subsurface, the soil would be treated on-Site, which would allow the soil to be returned to the subsurface.

Placing excavated materials in a permitted disposal facility reduces some potential risks to human health and the environment since the materials would be in a secure location with environmental monitoring. There is a potential exposure however to surrounding receptors during treatment with thermal desorption *which can be addressed through proper design and operation*.

Excavation and either disposal or treatment of impacted soils could be an effective technology for impacted soils located outside the buildings but it is not feasible for the impacted soils located beneath the building foundations as this technology will significantly impact facility operations, particularly due to structural restraints and sloping required to be maintained to not compromise building integrity. However, to satisfy the program requirement to evaluate a technology that could achieve future Site use without the need for institutional controls, excavation and off-Site disposal will be retained for further consideration.

4.2.3 Groundwater Technologies

The results of the analytical data for groundwater quality monitoring conducted during the RI indicate that Target CVOC concentrations greater than the SCGs are present within the Site overburden and bedrock groundwater and will need to be addressed as components of the remedial evaluation under the *Revised* FS. The following subsections discuss the Initial screening of various GRAs and remedial technologies that were considered for remediation of the Site groundwater.

4.2.3.1 No Further Action

No action was retained as required, and for use as a baseline or also for possible implementation in combination with non-intrusive actions such as institutional controls.

4.2.3.2 Institutional Controls

Institutional controls (e.g., groundwater use restriction) are non-engineered instruments, such as administrative and legal controls, that minimize the potential for human exposure to groundwater contamination that may be present at the Site following the implementation of a remedial action and/or protect the integrity of the remedy.

Since impacted groundwater is present at the Site in areas with limited access based on surface features, the implementation of institutional controls and a SMP is an appropriate technology for the Site conditions and will be retained for further consideration.

4.2.3.3 Groundwater Monitoring/Monitored Natural Attenuation

Natural attenuation processes include a variety of physical, chemical and biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume or concentration of contamination in groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical or biological stabilization, transformation, or destruction. Natural attenuation can be considered as a remedial technology for the groundwater contamination when one or more of the following conditions are present.

- Natural attenuation processes are observed or strongly expected to be occurring.
- There are no receptors that will be adversely impacted in the vicinity of the groundwater contamination.
- A continuing source exists that cannot be easily and cost-effectively removed and will require a long-term remedial effort.
- Alternative remedial technologies are not cost effective or are technically impractical.
- Alternative remedial technologies pose added risk by transferring or spreading contamination.

Natural attenuation is evaluated using a “line of evidence” approach that forms the basis for current monitoring protocols. The lines of evidence include the following.

- Documentation of loss of contaminants through historical trends in contaminant concentration and distribution in conjunction with Site geology and hydrogeology, to show the reduction in total mass of contaminants is occurring.
- Presence and distribution of geochemical and biological indicators that correlate to the observed reduction in contaminant concentration. This is done by evaluating change in concentration and distribution of geochemical and biological indicator parameters that have been shown to indicate enhance natural attenuation.
- Documentation of a stable plume in which source material is remaining but there is minimal continued plume expansion.

Based on the historical groundwater monitoring data collected within the Site, monitored natural attenuation (MNA) is a viable technology for the groundwater contamination and will be retained for further consideration as a component of other alternatives.

4.2.3.4 In-situ Treatment (Chemical/Physical)

In-Situ groundwater treatment technologies do not require extraction of the groundwater for treatment, but instead treat the impacted groundwater in place. In-situ groundwater treatment technologies evaluated for the Site include:

- **Biological Treatment:** A substrate and/or nutrients would be injected into the saturated zone to encourage bacteria growth that would enhance biological reductive dechlorination of the Target CVOCs.
- **Chemical Oxidation (ISCO):** Oxidizing reagents would be injected into the saturated zone to facilitate chemical destruction of dissolved phase constituents.
- **Chemical Reduction (ISCR):** A reducing reagent would be injected into the saturated zone to facilitate chemical destruction of dissolved phase constituents.
- ***PlumeStop® with enhanced biodegradation:*** *A liquid containing carbon-based, colloidal solid sorbent material would be injected into the saturated zone. Upon application, Target CVOCs are relatively rapidly sorbed to the colloidal solid sorbent material and therefore immobilized. Further, the high surface area of the injected matrix creates a favorable substrate for microbial colonization and growth (an active biofilm, generally believed by the formulator of PlumeStop® to be more extensive and therefore effective than biofilm that may form on soil particles or bedrock surfaces). Injection of an electron donor along with PlumeStop® to further reduce contaminants present in the dissolved phase and provide longer-term migration control.*
- **Permeable Treatment Barrier:** An in-situ barrier of reagents or substrate would be placed across the contaminant flow path to treat the Target CVOCs as they pass through the barrier. Note that this technology would only be feasible for overburden impacts and not for impacts in consolidated bedrock.
- **Electrical Resistance Heating (ERH):** An electrical current would be applied vertically and/or horizontally to desorb the Target CVOCs from the groundwater and impacted soils and bedrock. Note that horizontal emplacement of this technology would be difficult to implement in the saturated zone.
- **Thermal Conductance Heating (TCH):** *Heat would be applied to soils to desorb and allow removal of Target CVOCs. For this Revised FS, TCH technology is best applied to unsaturated conditions, or to limit the extent of saturated condition application, for the technology to be emplaced and most effective*.

In-situ groundwater treatment requires the ability to effectively deliver an injection medium into the groundwater to directly contact the affected areas.

In-situ groundwater treatment is an applicable technology to enhance the intrinsic biodegradation and chemical breakdown processes occurring at the Site and further reduce the groundwater contamination; however none of the above technologies would be suitable as a stand-alone technology used to achieve RAOs. Regardless, all of the in-situ technologies will be retained for further screening as a component of a potential alternative.

4.2.3.5 Groundwater Extraction and Treatment

Groundwater extraction and treatment refers to the removal of impacted groundwater through the use of groundwater recovery wells, or other extraction methods, and treatment of the impacted groundwater through the use of an above-ground treatment system equipped with necessary components, such as an air stripper, and adsorption technologies, to reduce the concentrations of COCs before discharge to a public wastewater treatment facility. Groundwater extraction and treatment actively reduces the toxicity and mobility of the impacted groundwater by physically removing it from the aquifer and reducing the mass of the COCs present. There are multiple methods for applying this technology including conventional pumping and treatment, application via a blasted bedrock zone (BBZ) or using MPE, which would also simultaneously address soil/soil vapor impacts.[1]

Groundwater extraction and treatment is a viable technology that could reduce the extent of impacted groundwater within the Site; however, this technology alone is not anticipated to reduce groundwater impacts to below SCGs without simultaneous source area treatment. These technologies have the added benefit of acting as migration control mechanisms. These technologies will be retained for further consideration as a component of other alternatives.

4.2.3.6 Containment

Containment refers to the use of a barrier, either physical or hydraulic that acts to prevent the migration of contaminants. Physical containment uses an actual physical structure such as a slurry wall or other impermeable barrier to prevent the flow of dissolved and separate phase constituents. Hydraulic containment utilizes limited groundwater extraction or imposition of hydraulic head to alter the natural flow pattern of the groundwater and provides containment of dissolved and separate phase constituents.

While physical containment or hydraulic containment (via imposition of confining head around the affected area) may be effective at preventing the migration of groundwater, it does not treat or destroy contaminants. Because the barrier prevents flow of groundwater, other technologies may need to be considered to prevent the flow of impacted groundwater around or beneath the wall and containment may not be feasible. This technology would require an additional remediation technology to attain SCGs. Additionally, this technology would be difficult and impractical to implement at depth in bedrock and with the close building spacing. Given those constraints, physical or hydraulic containment is being eliminated from further consideration.

Hydraulic containment, if carried out as a migration control (i.e. pump & treat) technology, would be more feasible to implement at the Site particularly as a component of a multi-part remedial alternative provided adequate containment mechanisms can be identified for both overburden and bedrock groundwater. Because of this, migration control as hydraulic containment will be retained for further consideration as a component of other alternatives.

4.2.4 Utility Water & Solids Technologies

[1] Because affected groundwater at the site resides both in unconsolidated overburden and in secondary fracture porosity in consolidated bedrock, conventional vertical groundwater recovery wells would have limited effectiveness at controlling migration and establishing effective hydraulic connection to the bedrock fracture network. Therefore, creating better connectivity across the native bedrock fracture network is performed using precision bedrock blasting and leaving the fractured rock in place. This fractured zone is then tapped using one or more conventional recovery well(s) and provides a robust migration control alignment across the fracture network.

The RIR storm water and sediment analytical data from the on-Site utilities indicated these media in the utilities contained Target CVOCs, presumably as a result of by shallow groundwater conditions. The conceptual Site model suggests that the impacts are likely due to groundwater infiltration into the subsurface utilities. Though the utilities may act as a preferential pathway for groundwater flow when groundwater levels are high, the utilities are not considered a source of Target CVOCs. The following subsections discuss the preliminary screening of various GRAs and remedial technologies that were considered for remediation of the utilities.

4.2.4.1 No Further Action

No action was retained, as required and for use as a baseline or also for possible implementation in combination with non-intrusive actions such as institutional controls.

4.2.4.2 Institutional Controls

Institutional controls (e.g., restricting utility access) are non-engineered instruments, such as administrative and legal controls, that minimize the potential for human exposure to groundwater contamination that may be present at the Site following the implementation of a remedial action and/or protect the integrity of the remedy.

Since impacted utilities are present within the Site in areas with limited access, the implementation of institutional controls and a SMP is an appropriate technology for the Site conditions and will be retained for further consideration.

4.2.4.3 Utility Sealing

Utility sealing is considered as an engineering control to mitigate contaminant migration in groundwater and soil vapor via utility bedding, which can act as a preferential pathway. The engineering controls could consist of using bentonite slurry to seal the utility beds, lining the sewers, and/or replacing portions of the sewer. While these technologies would help reduce the likelihood of the utilities and trenches as a possible migration pathway for impacted groundwater and vapor, it does not mitigate impacts to the sewer or eliminate the existing limited impacts in the sewer. Though these technologies can be feasibly implemented, it is not anticipated to provide significant remedial impact either alone or in concert with other technologies. As such, the benefit is not expected to outweigh the cost of implementing and maintaining this technology and therefore it is not retained for further consideration.

4.2.5 Soil Vapor Technologies

On-Site vapor impacts are currently mitigated through the use of a SSD system, which was brought online in September 2011 via an IRM. The following alternatives are considered given the presence of the existing SSD system.

4.2.5.1 No Further Action

No further action was retained as required and for use as a baseline or also for possible implementation in combination with non-intrusive actions such as institutional controls.

4.2.5.2 *Institutional Controls*

Institutional controls (e.g., operations and maintenance of existing SSD system) are non-engineered instruments, such as administrative and legal controls, that minimize the potential for human exposure to groundwater contamination that may be present at the Site following the implementation of a remedial action and/or protect the integrity of the remedy.

Since human health exposure from impacted soil vapor is currently being mitigated via the SSD system, the implementation of institutional controls and a SMP is an appropriate technology for the Site conditions and will be retained for further consideration.

4.2.5.3 *Engineering Controls*

An existing SSD system is present in the current Site building; the addition of this technology is intended to address continued operation of the SSD System and alterations due to potential future construction. Installation of an SSD system in new construction would be included as a contingency element in the Site SMP. This technology would consist of installing passive and/or active vapor mitigation systems in new construction, which would function to reduce the vapor pressure beneath the building slab preventing intrusion of impacted vapors into the building. This technology will be retained for further evaluation as a component of other technologies.

4.2.5.4 *Soil Vapor Extraction (SVE)*

Components of the IRM SVE system, installed in February 2004 and operated into early 2006, remain at the Site. The closure of the original SVE system and construction/implementation of the SSDS system required capping of the original SVE wells, blinding off the lateral piping and revision of the SVE well vaults including partial filling with concrete. After review of the modifications to these wells it has been determined that new SVE wells and extraction piping would be needed to emplace an effective system. The addition of this technology would be intended to address updates and alterations to the existing infrastructure to re-establish an operational SVE system again. This technology would consist of new SVE wells, new lateral connective piping, and installing system components (e.g., vacuum pump, carbon vessels, etc.) on the second level of the Site building. The system would be intended to extract Target CVOC concentrations in vapor beneath the original building source area, , while removing remaining residual Target CVOC mass not extracted with the original SVE system, from unsaturated soil/fill. This technology will be retained for further evaluation as a component of other technologies.

5. Evaluation of Remedial Alternatives

5.1 EVALUATION CRITERIA

In accordance with the DER-10 Technical Guidance for Site Investigation and Remediation, the following evaluation criteria have been established for evaluating remedial alternatives:

- **Overall protectiveness of human health and the environment**: The ability of a remedial alternative to protect public health and the environment through removal, treatment, containment, engineering controls or institutional controls.
- **Compliance with Standards, Criteria and Guidance (SCGs)**: The ability of a remedial alternative to conform to officially promulgated standards and criteria that are directly applicable or that are relevant and appropriate.
- **Long-term effectiveness and permanence**: The ability of a remedy to maintain long-term effectiveness after implementation.
- **Reduction of toxicity, mobility or volume**: The ability of a remedy to reduce the toxicity, mobility, or volume of a contaminant, with a preference given to remedies that provide a permanent and significant reduction.
- **Short-term impact and effectiveness**: The potential for a remedy to create short-term adverse environmental impacts or human health exposure during remedy implementation, and the length of time that will be required to implement the remedy and achieve remedial objectives.
- **Implementability**: The technical, logistical, and administrative feasibility of implementing a remedy.
- **Cost *effectiveness***: The overall cost of a remedy, including the capital cost of implementation (construction) and long-term operation and maintenance, with considerations towards the overall effectiveness of the remedy. *Effectiveness of the remedy is also considered with respect to cost vs. relative reduction of mass and relative mitigation of exposure to Target CVOC impacted media by potential receptors. Please note in the total cost values reported in the summary for each Alternative below, the total cost value (capital cost plus net present worth of projected total annual O&M) is presented with a renewable energy supply cost included where applicable – please see Table V for a breakdown of individual cost elements,*
- **Land Use**: Evaluation of the current, intended, and reasonably anticipated future use of the Site and surroundings as related to a remedy that does not achieve unrestricted levels.
- **Community Acceptance**: The expected level of acceptability of the remedial alternative is evaluated based on the above criteria, with particular consideration regarding overall protectiveness of human health and the environment and short-term impacts on the community that is likely to be affected by the remedial action. This criterion is further evaluated after the public review of the FS as part of the remedy selection and approval process.

The first two criteria are considered "Threshold" criteria in that they need to be met for a remedial alternative to be considered further. The next six criteria are "Balancing" criteria and are used to balance positive and negative aspects of remedial alternatives compared to one another. The last criterion is considered a "Modifying" criterion insofar as community review and comments are considered by NYSDEC prior to selection of a final remedy; it is not evaluated herein as part of the *Revised* FS.

In addition to the evaluation criteria listed above, green remediation concepts and techniques in accordance with DER-31 Policy on Green Remediation have been considered throughout the remedial alternatives evaluation.

5.2 ASSEMBLY OF ALTERNATIVES

The technologies described in Section 4 above were further refined using the criteria above to screen the most appropriate technologies to assemble into remedial alternatives. That screening is summarized in Table III. Combinations of remedial technologies/approaches retained during the screening (Section 4) were assembled into remedial alternatives to address each of the media and areas affected by Target CVOCs.

The most appropriate and applicable technologies were placed into 12 possible alternatives listed below – note that the original FS dated June 2015 included Alternatives 1 through 7 and this Revised FS includes modification of selected ones of the initial alternatives and addition of Alternatives 8 through 12 as requested by NYSDEC's October 2015 comments. A more detailed description of the alternative components is included in the subsections below. Each alternative is conceptually depicted on Figures 7 through 18.

- ***Alternative 1 (No Further Action)*** *–Maintain Existing Engineering/Institutional Controls, No Further Soil or Groundwater Remediation.*
- ***Alternative 2 (Restore to Pre-Release Conditions)*** *– Maintain Engineering/Institutional Controls (as needed), In-situ treatment (ISCR) of Soil and Groundwater. This alternative would be applied both on- and off-Site to pursue the intended outcome.*
- ***Alternative 3*** *– Institutional Controls, Maintain Existing Engineering Controls, In-situ Treatment (ISCR) of Soil, Extraction and Treatment (BBZ) for Groundwater. This alternative would focus on the Site proper.*
- ***Alternative 4*** *– Institutional Controls, Maintain Existing Engineering Controls, In-situ Treatment (Thermal Conductance Heating) of Soil, Extraction and Treatment (BBZ) for Groundwater. This alternative would focus on the Site proper.*
- ***Alternative 5*** *– Institutional Controls, Maintain Existing Engineering Controls, No Further Remediation of Soil, Extraction and Treatment (BBZ) for Groundwater. This alternative would focus on the Site proper.*
- ***Alternative 6*** *– Institutional Controls, Maintain Existing Engineering Controls, Multi-Phase Extraction (MPE) and Treatment for Soil and Groundwater. This alternative would focus on the Site proper.*
- ***Alternative 7 (Restore Site to Unrestricted Use Conditions)*** *– Institutional Controls, , Excavation/Off-Site Treatment and Disposal of Soils, In-situ Treatment (Electrical Resistance Heating) Groundwater. This alternative would be applied both on- and off-Site to pursue the intended outcome.*
- ***Alternative 8 –*** *Institutional Controls, Maintain Existing Engineering Controls, Soil Vapor Extraction (SVE) in Unsaturated Overburden, Extraction and Treatment (BBZ) for Groundwater. This alternative would focus on the Site proper.*
- ***Alternative 9 –*** *Institutional Controls, In-situ Treatment (Electrical Resistance Heating) of Unsaturated and Saturated Zones This alternative would focus on the Site proper.*
- ***Alternative 10 –*** *Institutional Controls, Maintain Existing Engineering Controls, In-situ Treatment (ISCO, PlumeStop® with Enhanced Bioremediation) of Groundwater for Mass Reduction and Migration Control. This alternative would focus on the Site proper.*

- ***Alternative 11 –*** *Institutional Controls, Maintain Existing Engineering Controls, In-situ Treatment (ISCO, PlumeStop® with Enhanced Bioremediation) of Saturated Overburden and Groundwater for Mass Reduction at Source Groundwater and Perimeter, and Migration Control. This alternative would focus on the Site proper.*
- ***Alternative 12 –*** *Institutional Controls, Maintain Existing Engineering Controls, Soil Vapor Extraction (SVE) in Unsaturated Overburden, and In-situ Treatment (ISCO, PlumeStop® with Enhanced Bioremediation) of Saturated Overburden and Groundwater for Source Reduction and Perimeter, and Migration Control. This alternative would focus on the Site proper.*

5.2.1 Institutional Controls & Maintenance of Existing Engineering Controls

For all alternatives, including implementation of institutional controls (land-use restrictions), maintenance of existing engineering controls (cover system, SSD system), and implementation of a SMP; the application of these controls is modified somewhat in terms of duration depending on each alternative to fit the intent of the alternative and anticipated outcomes (for example, the controls are assumed to apply to a full 30-year operations and maintenance period if COC residuals will remain on Site long-term, whereas an alternative that anticipates little to no residual COC presence can have a duration of the controls limited to some timeframe less than 30 years).

With respect to application of the controls to the Site overall, the Site is currently developed as a commercial/industrial laundering facility so institutional controls that prohibit residential use of the property would not be constraining for continued and reasonably anticipated future use of the property. The City of Rochester currently has an ordinance that prohibits the use of groundwater; however, this *Revised* FS assumes that the land use restriction would also include a prohibition of groundwater use at the Site. The Site is currently connected to municipal sewer and water. Maintenance and monitoring of the existing SSD system and Site cover can be implemented through the SMP. Institutional controls including land use restrictions would restrict excavations for construction and utility work to appropriately trained workers conducting the work in accordance with a health and safety plan consistent with OSHA requirements and appropriate application of engineering controls and use of personal protective equipment (PPE) to match the work and potential hazards associated with the work to be completed.

Based on the above, application of Institutional and Engineering Controls as stated would be feasible in any alternative considered, up to and including a 30-year term of application used for comparison of alternatives.

Please note that Alternatives 7 and 9 would include the implementation of institutional controls, maintenance of existing cover, and implementation of an SMP; however, with the Site building vacated and demolished as is presumed within these alternatives, the SSD system would not be necessary given the removal of the building and Target CVOCs.

5.2.2 Potential Soil Remediation Alternative Components

5.2.2.1 No Further Remedial Action (Alternatives 1, 5, 10 and 11)

Alternatives 1, 5, 10 and 11 include no further remediation for soil. There are no complete pathways currently for the Site soil, it is contained beneath the Site building and pavement, and if excavations into areas of impacted soil are needed for purposes of Site utility maintenance, etc., they would be addressed via the excavation management plan component of an SMP. *There is possibility that PlumeStop injection under Alternative 11 may provide some reduction of mass in unsaturated soil beneath the building where it remains following the SVE IRM performed in 2004-2006, but the maker of PlumeStop has not evaluated the efficacy of CVOC reduction in partially saturated regimes to date.*

5.2.2.2 In-Situ Chemical Reduction (ISCR) (Alternatives 2 and 3)

Alternatives 2 and 3 include remediation of soil via ISCR. ISCR consists of injection of EZVI consisting of a micelle containing large nanometer and small micron zero-valent iron (ZVI) particles in a grid formation of injection boreholes beneath the Site building that would stimulate the reduction of the Target CVOCs. The injected material would produce a strong reducing condition aimed at producing a combined effect (physical and chemical) that is intended to stimulate rapid dechlorination of Target CVOCs.

In Alternative 2, an approximately 24,000-square foot area of impacted soil beneath the building (Figure 8) would be addressed via ISCR with a goal to reduce contaminant concentration to values consistent with *unrestricted* SCOs, which would be intended to address both the soil contamination and control the source to groundwater and off-Site groundwater migration of Target CVOCs. In Alternative 3, an approximately 9,400 square feet area of impacted soil beneath the building (Figure 9) would be addressed via ISCR in order to reduce source mass to concentrations consistent with commercial use SCOs. Off-Site migration of impacted groundwater would be addressed via other technologies (pumping and treatment via a BBZ).

5.2.2.3 In-Situ Treatment (Thermal Conductance Heating) (Alternative 4)

Alternative 4 includes remediation of soil with thermal *conductance heating*. An approximately 9,400 square foot area of impacted soil beneath the building (Figure 10) would be addressed via this method. Alternative 4 would include placement of an array of vertical nodes (installation of this alternative would also require drilling through the building floor slab), which would heat the soil beneath the building resulting in vaporization of the Target CVOCs for removal via vacuum *extraction* wells. It is anticipated that vacuum *extraction* wells would be placed in an array across the footprint of the building (again, requiring drilled hole through the building floor slab) for collection, *treatment, and* discharge of vaporized contaminants (including associated moisture from vapor stream).

5.2.2.4 Extraction & Treatment – Multi-Phase Extraction (Alternative 6)

Alternative 6 includes remediation of soil and groundwater with MPE. A MPE system includes a vacuum system, potential downhole pumps, and extraction wells that when combined, extracts impacted groundwater and lowers the groundwater table exposing a larger expanse of vadose zone allowing further extraction of Target CVOC vapor via soil vapor extraction. MPE can be achieved with extraction tubes or “straws” depending on required extraction rate of groundwater to maintain MPE. The extracted vapors and liquids are separated, then treated and discharged. The system would need to be placed in a separately constructed outbuilding proximate to the impacted soil area shown on Figure 12. Approximately 9,400 square feet of soil area is assumed to be within the radius of influence of the system.

5.2.2.5 *Excavation and Off-Site Treatment/Disposal (Alternative 7)*

Alternative 7 includes remediation of soil via excavation and off-Site treatment and disposal. Soil from beneath the building would be excavated, characterized, and disposed at an appropriate landfill or hazardous waste treatment facility (Figure 13). To the extent practical, Contained-In approval (TAGM 3028) would be requested for Target CVOC-impacted soil to allow for disposal at a non-hazardous waste landfill. It is anticipated, however, that some hazardous waste would be generated. For purposes of this *Revised* FS opinion of probable cost development, it was assumed that half of the soil would meet contained-in criteria and the other half would be disposed at a hazardous waste facility.

Note that it was deemed impractical to attempt excavation while simultaneously maintaining the building in-place and stabilizing the building. The soil is located beneath an active industrial laundry facility with regular internal structural column spacing that would severely limit both the depth and width of excavation for removal if keeping the building in place were attempted. Therefore, it was concluded that demolition of the building would be required to conduct this technology.

5.2.2.6 *In-Situ Treatment (Electrical Resistance Heating) of Soil and Groundwater (Alternative 9)*

Alternative 9 includes remediation of soil and groundwater with in-situ electrical resistance heating (ERH). An approximately 75,000-square foot area of impacted soil and groundwater, including the area beneath the building, would be addressed via this method (Figure 15), inclusive of the 9,400-square foot area of impacted soils. An array of vertical nodes of varying depth (to address saturated and unsaturated overburden and bedrock groundwater) would heat the overburden and bedrock groundwater to vaporize Target CVOCs for removal via vacuum wells. It is anticipated that vacuum wells would be placed in an array across the target area for collection, treatment, and discharge of vaporized contaminants (including any associated moisture from vapor stream). Alternative 9 assumes the building would be vacant, with the slab maintained as impervious cover.

5.2.2.7 *Soil Vapor Extraction (Alternatives 8 and 12)*

Alternatives 8 and 12 include soil vapor extraction (SVE) for remaining Target CVOCs that are believed to be left following the original operation of the SVE IRM in the 2004 to 2006 timeframe, at the source area beneath the site building. The new SVE would be accomplished via newly-installed SVE infrastructure. The six existing wells from the former SVE IRM were capped in order to prevent air leakage when the SSDS system was installed, and the SVE laterals within the floor slab were blinded off and concrete was installed at the well vaults – it was determined that jackhammering or saw-cutting of the concrete could not adequately allow reconnection and re-integration of the former SVE system wells and laterals to provide for operation without likely air leakage or short-circuiting that would compete with effectiveness of either or both of the SSDS or a new SVE. Therefore it was assumed that new lateral extraction piping installed within the floor slab, and six new wells would need to be installed and connected for new SVE under Alternatives 8 and 12. The extraction and treatment would also require new equipment, including vacuum blower and liquid/vapor separation and treatment equipment, which would be installed on the second level of the Site building. Following operation for an *extended period of time and monitoring of extracted concentrations to determine reduction to an asymptotic condition, the system would be operated in a pulsed manner to improve efficiency; it is unknown whether SVE would provide substantive extraction considering the source area was already subject to SVE operation under an IRM. This configuration also contemplates that injection of PlumeStop via reconfiguration of the SVE wells under Alternative 12 would take place, as requested for this Revised FS by NYSDEC.*

5.2.3 Potential Groundwater Remediation Components

5.2.3.1 No Further Remedial Action (Alternative 1)

Alternative 1 includes no further remediation for groundwater. Groundwater would be monitored regularly per an SMP to evaluate if groundwater impacts have migrated or changed.

5.2.3.2 In-Situ Chemical Reduction (ISCR) (Alternative 2)

Alternative 2 includes remediation of groundwater via ISCR. Source area groundwater and impacted groundwater beneath the building and off-Site (Figure 8) would be addressed via ISCR, which would consist of injection of controlled-released carbon, ZVI particles and other nutrients through angled borings beneath the Site building on-Site, and in vertical borings within affected areas off Site; injection would stimulate the reduction of the Target CVOCs. The injected material would produce a strong reducing condition aimed at producing a combined treatment effect (physical, chemical, and microbiological) that is intended to stimulate rapid dechlorination of Target CVOCs.

5.2.3.3 Extraction & Treatment – Blasted Bedrock Zone (BBZ) (Alternatives 3, 4, 5, and 8)

For Alternatives 3, 4, 5 and 8, impacted bedrock groundwater would be addressed using a BBZ extraction and treatment system. Blast fracturing via controlled explosives would be used to increase the hydraulic conductivity and connectivity (confined to a localized area) within a fractured, water-bearing zone across the native bedrock fracture network. Once creation of the BBZ is completed, a withdrawal pump is installed in the BBZ, and the fractured area is pumped at a controlled rate to act as a groundwater sink. This minimizes off-Site migration and acts as a preferential zone for accumulation of contaminated groundwater for extraction. The BBZ would be installed on the northwest side of the property, oriented in a roughly east-west alignment across the current access driveway; this orientation allows avoidance of area subsurface utilities and also provides a geometry that would allow greatest intersection of the native bedrock fracture network. The trench would be approximately 215 to 220 feet long (Figures 9, 10, 11, and 14). Two recovery wells would be installed within the zone to collect impacted groundwater for treatment and/or discharge. A treatment system would be applied to reduce concentrations prior to discharge if and to the extent required for ongoing POTW acceptance. Following installation, groundwater would be monitored regularly as per a SMP to evaluate if groundwater impacts have migrated or changed.

5.2.3.4 Extraction & Treatment – Multi-Phase Extraction (Alternative 6)

Alternative 6 includes remediation of soil and groundwater with MPE. A multiphase extraction system includes a high-vacuum system, potential downhole pumps, and extraction/recovery wells that, when combined, extract impacted groundwater and lower the groundwater table exposing a larger expanse of vadose zone allowing further extraction of the CVOC vapor via high-vacuum vapor extraction. The extracted vapors and liquids are separated in the process, both by the high-vacuum as well as liquid knock-out vessel(s), treated and discharged. The system would be placed within a separately constructed outbuilding proximate to the impacted soil area shown on Figure 12. A treatment system would be applied to reduce concentrations prior to discharge as required for ongoing POTW acceptance. Following installation, groundwater would be monitored regularly as per the SMP to evaluate if groundwater impacts have migrated or changed.

5.2.3.5 In-Situ Treatment (Electrical Resistance Heating) of Groundwater (Alternative 7)

Alternative 7 includes remediation of groundwater via electrical resistance heating (ERH). Source area groundwater and dissolved phase impacted groundwater beneath the building (Figure 13) would be addressed via ERH, which would consist of installing an array of vertical nodes into an approximately 157,000-square foot area following excavation and backfill (See Section 5.2.2.5 above). The system would heat the groundwater to vaporize Target CVOCs for removal via vacuum wells. It is anticipated that vacuum wells would be placed in an array across the target area for collection (both on and off site), treatment, and discharge of vaporized contaminants (including associated moisture from vapor stream). Alternative 7 assumes the building would be vacant, with the slab (excluding the excavation area) maintained as impervious cover, however the building is assumed to be vacant (or the building structure, but not slab, would have been demolished) to avoid interference with placement of the required array of thermal nodes to accomplish remediation goals. Following installation, groundwater would be monitored regularly as per the SMP initially to confirm that the Target CVOC concentration in groundwater has decreased to levels consistent with TOGS 1.1.1 criteria.

5.2.3.6 In-Situ Treatment (Electrical Resistance Heating) of Soil and Groundwater (Alternative 9)

Alternative 9 includes remediation of soil and groundwater via electrical resistance heating (ERH). An approximately 75,000-square foot area of impacted soil and groundwater, including the area beneath the building, would be addressed via this method (Figure 15). An array of vertical nodes of varying depth (to address saturated and unsaturated overburden and bedrock groundwater) would heat the overburden and bedrock groundwater to vaporize Target CVOCs for removal via vacuum wells. It is anticipated that vacuum wells would be placed in an array across the target area for collection, treatment, and discharge of vaporized contaminants (including associated moisture from vapor stream). Alternative 9 assumes the building would be vacant to avoid interference with placement of the required array of thermal nodes to accomplish remediation goals, with the slab maintained as impervious cover. Following installation, groundwater would be monitored regularly as per the SMP initially to confirm that the Target CVOC concentrations in on-Site ground water has decreased to levels consistent with TOGS 1.1.1 criteria. The reduction in on-Site Target CVOC concentrations would limit migration of impacted groundwater off-Site; as a result, off-Site groundwater would continue to naturally attenuate and would be monitored regularly.

5.2.3.7 In-Situ Chemical Oxidation (Alternatives 10, 11, and 12)

Alternatives 10, 11, and 12 include remediation of groundwater via ISCO of higher Target CVOC locations only (those areas where concentrations exceed approximately 14PPM, the current limit of efficacy determined by the formulator of PlumeStop®). High concentration groundwater would be addressed via ISCO, which would consist of injecting an oxidizing reagent (permanganate, Fenton's reagent, ozone, or persulfate) into shallow and intermediate bedrock at "hot spot" locations (eastern end of shallow and intermediate bedrock injection areas shown on Figures 16, 17, and 18). Injection would be via temporary wells targeting saturated shallow and intermediate bedrock.

The reagent is intended to reduce concentration of the target CVOCs and enhance mass transfer where concentrations exceed the range recommended by the PlumeStop® vendor treatment range. Subsequent application of PlumeStop® plus enhanced bioremediation following ISCO is described in Section 5.2.3.7, below.

5.2.3.8 PlumeStop® plus Enhanced Bioremediation for Migration Control (Alternative 10)

Alternative 10 includes remediation of groundwater downgradient from the source zone. Downgradient groundwater would be addressed by injecting PlumeStop® and electron donor reagents outside of the building and downgradient of the source zone (Figure 16). Prior to injecting PlumeStop®, areas with high Target CVOC concentrations in groundwater would be addressed via ISCO, which would consist of injecting an oxidizing reagent (permanganate, Fenton's reagent, ozone, or persulfate) into shallow and intermediate bedrock at the eastern end of shallow and intermediate bedrock injection areas shown on Figures 16, 17, and 18. Injection would be via temporary wells targeting saturated shallow and intermediate bedrock.

Following application of ISCO at "hot spots" in shallow and intermediate bedrock, injection of PlumeStop® and electron donor reagents will occur via temporary wells targeting saturated overburden and shallow and intermediate bedrock. The injection will create a 300-foot perimeter "treatment zone" in the overburden and shallow bedrock units and a 160-foot perimeter treatment zone in intermediate bedrock. The application of PlumeStop® and electron donor reagents is intended to relatively rapidly reduce Target CVOC concentrations in groundwater through sorption of the CVOCs into the activated carbon of the PlumeStop® particles. Subsequently, enhancement of bioremediation of Target CVOCs then occurs through formation of a biofilm on the particle matrix, stimulation of dechlorinating microbes through application of the electron donor and associated bioremediation. The mass of PlumeStop® and electron donor calculated by the formulator is based on the overall mass of Target CVOCs at and upgradient of the perimeter treatment zone, and treatment through flux past the zone.

Following installation, groundwater would be monitored regularly as per the SMP initially to confirm that the Target CVOC concentration in groundwater has decreased to levels which are both protective of human health and the environment and within the capabilities of PlumeStop®.

5.2.3.9 PlumeStop® plus Enhanced Bioremediation for Source and Migration Control (Alternatives 11 and 12)

Alternatives 11 and 12 includes remediation of groundwater downgradient from the source zone. Downgradient groundwater would be addressed by injecting PlumeStop® and electron donor reagents outside of the building and downgradient of the source zone (Figure 16). Prior to injecting PlumeStop®, areas with high Target CVOC concentrations in groundwater would be addressed via ISCO, which would consist of injecting an oxidizing reagent (permanganate, Fenton's reagent, ozone, or persulfate) into shallow and intermediate bedrock at the eastern end of shallow and intermediate bedrock injection areas shown on Figures 16, 17, and 18. Injection would be via temporary wells targeting saturated shallow and intermediate bedrock.

Following application of ISCO at "hot spots" in shallow and intermediate bedrock, injection of PlumeStop® and electron donor reagents will occur via temporary wells targeting saturated overburden and shallow and intermediate bedrock. The injection will create a 300-foot perimeter "treatment zone" in the overburden and shallow bedrock units and a 160-foot perimeter treatment zone in intermediate bedrock. Source zone injection will target existing (redeveloped) former SVE wells within the Site building. The surface completions of these wells would require relatively straightforward reconfiguration to allow access for injection of reagents (assumed for up to 5 existing wells), or monitoring of groundwater beneath the site building (assumed for 1 existing well). While the well revision will require coordination with the current Site tenant and operations, the work is localized to each well head and access to complete the reconfiguration and injection of reagents should be feasible without undue interruption of operations. Application would need to take place when groundwater levels are high enough within the well screen section, so some pre-injection monitoring would be required.

The application of PlumeStop® and electron donor reagents is intended to relatively rapidly reduce Target CVOC concentrations in groundwater through sorption of the CVOCs into the activated carbon of the PlumeStop® particles. Subsequently, enhancement of bioremediation of Target CVOCs then occurs through formation of a biofilm on the particle matrix, stimulation of dechlorinating microbes through application of the electron donor and associated bioremediation. The mass of PlumeStop® and electron donor calculated by the formulator is based on the overall mass of Target CVOCs at and upgradient of the perimeter treatment zone, and treatment through flux past the zone.

Following installation, groundwater would be monitored regularly as per the SMP initially to confirm that the Target CVOC concentration in groundwater has decreased to levels which are both protective of human health and the environment and within the capabilities of PlumeStop®.

5.3 ANALYSIS OF REMEDIAL ALTERNATIVES

A summary of analysis of Remedial Alternatives 1 through 12 using the criteria identified in Section 5.1 is presented in Table IV and further described below.

5.3.1 Alternative 1 (No Further Action) –Maintain Existing Engineering Controls, No Further Soil or Groundwater Remediation

Alternative 1 includes the following elements:

- Continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building.

- No further soil remediation.
- No further groundwater remediation.
- *Maintain site institutional/engineering controls*

5.3.1.1 Overall Protectiveness of Human Health & the Environment

Alternative 1 serves as a baseline alternative for protection of current and future users of the Site from impacted soil and groundwater. The current SSD system is effective at mitigating exposure of impacted soil vapor to current building occupants and would be maintained through the existing Interim Site Management Plan (ISMP). The current Site cover is effective in preventing direct contact exposure to impacted soils. *However, if future changes to Site cover were performed, it would need to provide equal protectiveness for the continued use of the property consistent with the current business use.*

Though there are currently no complete exposure pathways at the Site, including to environmental media such as surface water or soils due to the presence of the existing cover, prohibition of groundwater use, and operation of the SSD system, this alternative does not attempt to reduce source mass or address the potential for continued off-Site migration of impacted groundwater or soil vapor to potential receptors.

5.3.1.2 Compliance with SCGs

This alternative makes no attempt to reduce concentrations of Target CVOCs in impacted media, therefore it would not result in compliance with all SCGs.

5.3.1.3 Long-Term Effectiveness and Permanence

Overall, long-term effectiveness and permanence is acceptable. Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term provided requirements are emplaced to implement that long-term maintenance. SSD systems are a long-term, low-cost effective measure for mitigating soil vapor impacts in an occupied building. However, in order to remain effective, operations and maintenance in perpetuity are required to maintain the protectiveness of the SSD systems over the long term – *this would be accomplished by maintaining the current ISMP*.

This alternative, again, provides no mechanism for reducing or containing source contamination. As a result, there is a potential for continued movement and off-Site migration of impacted groundwater and vapor over the long-term.

5.3.1.4 Reduction of Toxicity, Mobility or Volume

The current cover system prevents mobility of COC impacted soil from migrating because access to the soil is precluded from both contact exposure and from infiltrating groundwater due to it being entrained beneath the building. The SSD system would reduce the potential for vapor intrusion in the building and thus reduce soil vapor toxicity within the Site building. Otherwise, this alternative does not directly address impacts to soil and groundwater and therefore does not directly reduce the toxicity or volume, and is limited in its reduction of mobility, of Target CVOCs in those media.

5.3.1.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with maintenance of existing engineering controls (SSD). There are also no short-term impacts associated with no further remedial action of soil and groundwater.

5.3.1.6 Implementability

The SSD system has already been constructed and is operational within the Site building. The cover system consists of the building slab, pavement, and landscaping which already covers the majority of the Site.

5.3.1.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately $0 in capital costs and $504,202 in net present value of operations and maintenance cost. The *Revised* feasibility study estimate of the total alternative is $517,790.

This alternative requires long-term operation of the SSD and associated long-term energy consumption. While the SSD energy consumption is low relative to other alternatives, the period of operation is indefinite.

5.3.1.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.1.9 Community Acceptance

Implementation of this alternative is not anticipated to have a noticeable impact on the community as it would be primarily administrative in nature. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

5.3.2 Alternative 2 (Restore to Pre-Release Condition) – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, In-situ treatment (ISCR) of Soil & Groundwater

Alternative 2 includes the following elements:

- Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site to the extent necessary for the alternative.
- Preparation of a SMP.
- Continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building.

- Continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future.
- In-situ treatment of soil beneath the Site building to concentrations consistent with *unrestricted* SCOs, and groundwater beneath the building and off-Site using ISCR to address groundwater contamination and remove the potential for continued off-Site migration.

5.3.2.1 Overall Protectiveness of Human Health & the Environment

Alternative 2 would provide effective protection of current and future users of the Site from impacted soil and groundwater. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls; these are assumed to remain in effect unless and until such time as SCGs are met by the alternative. The current SSD system is effective at mitigating exposure of impacted soil vapor to current building occupants and the current Site cover is effective in preventing direct contact exposure to impacted soils. The SMP would provide a mechanism for maintaining and monitoring both of these engineering controls.

In-situ treatment of soils beneath the building and groundwater beneath the building and off Site is protective of human health and the environment because this technology would be intended to actively reduce the mass of Target CVOCs in soil and groundwater in the affected locations. In-situ treatment does not require exposure of impacted soil or groundwater in order for the remediation to be effective. While the goal of this remediation alternative would be meeting SCGs generally at all affected subsurface areas, the treatment of groundwater is anticipated to be somewhat limited to areas where there is contact and influence from the injection of the ISCR reagent. *Likewise, greater treatment would occur in the saturated zone where soils would be in contact with the ISCR reagent, but less effective treatment would be anticipated in poorly connected porosity or unsaturated portions the treatment profile.* The ISCR mechanisms can perform more robustly in overburden groundwater than bedrock groundwater due to the difference in granular porosity (in overburden) versus fracture porosity (in bedrock), differences in connectivity of that fracture porosity and the effects of matrix diffusion (in bedrock). The overall protectiveness of this alternative would rely on natural attenuation processes to remediate the impacted groundwater not accessed and physically contacted by the reagent. In addition, while in-situ treatment would reduce the concentrations of Target CVOCs in the source area thus aiming to reduce the size of the impact plume at the source, in-situ treatment would not be immediately effective in limiting further migration of existing groundwater impacts.

5.3.2.2 Compliance with SCGs

In-situ treatment of soils and groundwater is intended to reduce contaminant mass and achieve SCGs (TOGS 1.1.1 criteria for groundwater and *unrestricted* use SCOs for soil). This treatment approach alone may not result in achieving the SCGs for groundwater *or soil* and this alternative would have to rely on natural attenuation processes to remediate the impacted groundwater not accessed by the ISCR reagent*, and any unsaturated overburden soils that do not come into contact with the ISCR reagent*. Based on the calculated hydraulic conductivity, the radius of influence for the injection points may be limited. In order to achieve the SCGs within the Site, a high number of injection points would need to be installed to distribute the injected materials throughout the groundwater impacted with the COCs. In addition, multiple applications may be required to achieve SCGs in groundwater. Achievement of SCGs in bedrock groundwater may also be limited and is anticipated to be less effective than application in overburden. Where natural bedrock fracture porosity is not well connected to injection point locations, remediation would not be feasible.

Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs. Institutional controls included in Alternative 2, including land use and groundwater restrictions combined with the existing groundwater use restrictions imposed by the City of Rochester are necessary to mitigate risk of direct contact and ingestion of impacted soil and groundwater.

5.3.2.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term. SSD systems are also low-cost effective measures for mitigating soil vapor impacts in an occupied building. However, operations and maintenance would be required to maintain the protectiveness of the cover and SSD systems over longer durations. *Under Alternative 2, the SSD system would be operated and existing ground covers maintained until subsurface impacts are addressed by ISCR treatment.*

In-situ soil and groundwater ISCR treatment can provide long-term effectiveness through reduction of Target CVOCs in soil and groundwater. Because of the location of the impacted soil beneath the building, regular performance monitoring would not be conducted other than monitoring the quality overburden groundwater in the vicinity of the impacted soil. Groundwater quality would need to be routinely evaluated per a monitoring schedule in the SMP, but there are no active routine maintenance activities associated with the in-situ treatment system. However, follow-up injections may be required in the future if groundwater quality results indicate that asymptotic conditions have been reached at an unacceptable concentration of Target CVOCs relative to SCGs – *the cost projections herein have assumed one or more additional round of injection occurs with an allowance cost of 50% of the capital cost mobilization, reagent and related costs*. As indicated above, actual achievement of SCGs in the treated areas of the overburden soils/groundwater could be feasible provided there is an adequate density of injection points*, as included in the opinion of probable cost for Alternative 2 which includes both vertical as well as horizontal injection wells*; however, meeting SCGs in bedrock groundwater is unlikely at all locations due to limitations of injection in disconnected fracture porosity and due to the effects of bedrock matrix diffusion.

5.3.2.4 Reduction of Toxicity, Mobility or Volume

The toxicity, mobility and volume of contaminated soil and groundwater are expected to be reduced over time. Additional injections may be required in the future to attain groundwater SCGs *and an allowance for future injections has been made in the estimate of cost for this alternative*.

5.3.2.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of existing engineering controls (SSDS and cover).

Short-term impacts from in-situ soil and groundwater treatment include restriction of the areas of the building where injections are occurring, which would cause a significant disruption to the facility and surrounding properties. Angled borings installed outside the building exterior may be feasible for accessing impacted soils beneath the building floor slab to minimize disruption however this method may limit the effectiveness of the technology due to limits on where the reagent can be applied. Vertical injections to areas of the bedrock groundwater plume outside of the building footprint (on and off-Site) would also be expected to cause significant interruption of use and operations of areas surrounding the Site building. Engineering controls would be implemented to manage dust, potential odors, etc., and protect workers during the mixing and handling of media during injection events.

Additional short-term impacts from the injection of the ISCR reagent include management of traffic within the areas where injection points would be installed and the need to use PPE to avoid acute exposure during installation. Engineering controls would be implemented to protect workers during the mixing and handling of media would be instituted during injection events.

Though there are short-term impacts from implementing this technology, based on experience we anticipate it would take several years to achieve the SCGs for the Site using this alternative alone without some other form of active remediation. In addition, the likelihood of achieving SCGs in competent bedrock over the long-term is unknown.

5.3.2.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change. The SSD system has already been constructed and is operational within the Site building. The cover system consists of the building slab, pavement, and landscaping, which already covers the majority of the Site.

In-situ treatment (via ISCR in this alternative) can only be implementable under this alternative by overcoming significant access challenges and with proper Site controls during injection events. The injection equipment, as well as the injection medium necessary for implementation is readily available. However, impacted soil and groundwater is located within active areas of the Site building; there would be potential for adverse impacts to Site operations during injection making implementation difficult. Impacts to Site operations may be mitigated through the use of horizontal or angled borings outside the building to access soils beneath the building floor slab, however this may limit the effectiveness of the technology. To the extent that horizontal injections cannot be implemented, vertical injections would be needed and would be expected to cause significant interruption of use and active operations areas within the building. Injection to treat groundwater located outside the building footprint and off-Site would likely have adverse impacts to roadway and off-Site operations during injection making implementation difficult in those areas. Traffic and engineering controls would also be required during installation.

In order to achieve coverage of impacted area using this technology alone, a significant amount of reagent must be used over a large area, which may be difficult to implement. If repeat injections were needed to accomplish SCGs, these impacts would have to be overcome with each injection event and in the areas affected by repeat injections, although it is reasonable to assume they may be smaller areas subject to future injections.

5.3.2.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately *$8,412,150* in capital costs and *$1,250,322* in net present value of operations and maintenance cost. The *Revised* feasibility study estimate of the total alternative is *$9,679,684*.

This alternative requires operation of the SSD and associated energy consumption until adequate source material destruction is complete to mitigate exposure from soil vapor. While the SSD energy consumption is low relative to other alternatives such dual phase extraction, the period of operation has been estimated at 10 years.

5.3.2.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.2.9 Community Acceptance

Implementation of this alternative is not anticipated to have a noticeable impact on the community as it would be primarily administrative in nature. Implementation of the ISCR treatment may have impact on the community relative to access of on and off-Site areas, associated traffic, noise, handling of the reagents, and other construction activities. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

5.3.3 Alternative 3 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, In-situ treatment (ISCR) of soil, Extraction & Treatment (BBZ) for Groundwater

Alternative 3 includes the following elements:

- Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site.
- Preparation of a SMP.
- Continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building.
- Continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future.
- In-situ treatment of soil beneath the building using ISCR to reduce source mass and achieve commercial use criteria.
- Extraction and treatment of groundwater using a BBZ on the northwest side of the property that would simultaneously act to reduce source mass and control groundwater migration.

5.3.3.1 Overall Protectiveness of Human Health & the Environment

Alternative 3 would provide effective protection of current and future users of the Site from impacted soil and groundwater. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls. The current SSD system is effective at mitigating exposure of impacted soil vapor to current building occupants and the current Site cover is effective in preventing direct contact exposure to impacted soils. The SMP would provide a mechanism for maintaining and monitoring both of these engineering controls; these are assumed to remain in effect unless and until such time as SCGs are met by the alternative. This alternative would require continued management of potential exposure pathways beyond remediation for the foreseeable future.

Both in-situ treatment of soils beneath the building and groundwater extraction and treatment are protective of human health and the environment because these technologies actively reduce the mass of Target CVOCs in soil and groundwater, and groundwater extraction and treatment serves as migration control to improve environmental protectiveness. In-situ soil treatment does not require exposure of impacted soil in order for the remediation to be effective. Extraction and treatment of groundwater may pose potential short-term exposure risk due to bringing impacted groundwater to the surface; however it is planned that groundwater would be contained within a closed system that would limit exposure, and the system would have appropriate engineering controls to prevent exposure. The extraction and treatment of groundwater is also limited to areas where there is influence from the BBZ and associated recovery wells. The overall protectiveness of this alternative would also rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery.

5.3.3.2 Compliance with SCGs

In-situ treatment of soils and extraction and treatment of groundwater is intended to reduce contaminant mass and achieve SCGs (TOGS 1.1.1 criteria for groundwater and commercial use SCOs for soil) directly and indirectly on-Site and off-Site. *While protection of groundwater SCOs are applicable to the Site, commercial SCOs were selected as a realistic clean-up goal for Alternative 3*. *While it is reasonable to anticipate SCGs for groundwater may be achieved in most off-Site areas (e.g. properties north of Main St., but likely not all areas beneath Main St.), an active extraction system alone may not result in achieving the SCGs for groundwater on site within a reasonable time frame (i.e., less than the 30-year standard projection timeframe of alternatives evaluation)*. The active extraction system alone may not result in achieving the SCGs for groundwater and this alternative would have to rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery. Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs. Institutional controls included in Alternative 3, including land use and groundwater restrictions combined with the existing groundwater use restrictions imposed by the City of Rochester are necessary to mitigate risk of direct contact and ingestion of impacted soil and groundwater.

5.3.3.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term. *SSD systems are also low-cost effective measures for mitigating soil vapor impacts in an occupied building. However, operations and maintenance are required to maintain the protectiveness of the cover and SSD systems over longer durations. Under Alternative 3, the SSD system would be operated and maintained until subsurface impacts are addressed by ISCR treatment and bedrock groundwater extraction.*

In-situ soil treatment via ISCR can provide long-term effectiveness through reduction of Target CVOCs in soil; adequate contact of injected reagent with affected soil is necessary to accomplish this. Multiple injections may be needed to accomplish reduction of soil concentrations to the commercial use SCOs*, as included in the opinion of probable cost for Alternative 3*.

Extraction and treatment via a BBZ includes permanent and non-reversible removal of Target CVOCs by recovery and treatment. *Compared to source area treatment, the mass of Target CVOCs removed by a BBZ would be relatively less and would require longer-term energy consumption than remedies implemented with shorter-term effectiveness.* This alternative provides some effectiveness against future contact with contaminated media. It is anticipated that the recovered groundwater would be discharged to the local POTW and would likely require some on-Site treatment (e.g. carbon, ZVI, other treatment) prior to discharge. This alternative would include performance monitoring of the extracted groundwater and treated effluent waste streams. In addition to performance monitoring, the recovery and treatment system would require routine maintenance of mechanical or electrical components that have a potential to malfunction or breakdown.

Hydraulic capture within the BBZ would require long-term operations and maintenance until asymptotic conditions are achieved in bedrock. Interruption in the operation of the BBZ for an extended period (for example, extended equipment failure or failure to operate the system) may result in further off-Site migration of Target CVOCs in bedrock.

5.3.3.4 Reduction of Toxicity, Mobility or Volume

The toxicity, mobility and volume of contaminated soil and groundwater are expected to be reduced over time. This alternative would also have to rely on natural attenuation processes to remediate impacted groundwater. Reduction of COCs in overburden groundwater and competent bedrock groundwater may be limited due to disconnected/poorly connected fracture porosity and limitations posted by matrix diffusion. Use of the BBZ would however limit mobility. *The capture zone achieved by the BBZ is typically relatively robust and extends several feet (50+ to 100+) upgradient and cross-gradient of the physical bounds of the BBZ. Based on experience with past implementation of BBZ's at other sites, there have been limited sites where a supplemental well or wells is installed after several years of operation of a BBZ in order to effect additional capture in localized areas determined after an extended period of operational experience.* Concentrated waste streams from the extraction system would likely be generated as part of this remedy that would require proper management and off-Site disposal.

Installation of the BBZ does is intended to create new groundwater migration pathways around recovery wells installed within the trench. It is also possible that a BBZ may create new pathways for migration compared to pathways prior to emplacement of the BBZ and that could allow additional migration should pumping cease for an extended period of time. The potential to create *new vapor migration pathways also exists but is generally less likely because the blast design is intended to limit physical alteration of the subsurface to the depth zone of bedrock involved in the BBZ configuration. It is possible for some heave of overburden above the BBZ to occur and create potential new pathways for vapor migration upward, but because the BBZ is not emplaced beneath any structures in the application at this site, the likelihood of substantive new vapor migration is relatively low.*

5.3.3.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of existing engineering controls (SSD and cover).

Short-term impacts from in-situ soil treatment include restriction in building areas where injections are actively occurring. Angled borings installed outside the building exterior may be feasible for accessing impacted soils beneath the building floor slab to minimize disruption; however this method may limit the effectiveness of the technology due to limits on where the reagent can be applied. To the extent that horizontal injections cannot be implemented, vertical injections would be needed and would be expected to cause significant interruption of use and operations of areas within the building. Engineering controls would be implemented to manage dust and protect workers during the mixing and handling of media during injection events.

There are some short-term impacts that can be associated with construction of the BBZ. Construction requires the use of explosives. Controlled blasting is undertaken by licensed contractors specializing in these services with specific mitigation measures to minimize impacts. Work is done in accordance with applicable laws, codes, and permit conditions. The Site is not located within a residential area. Traffic management (both vehicular and pedestrian) would need to occur during the blasting and system installation; scheduling can be done to have the construction completed during low-traffic times of the day/week. This method of remediation construction requires limited removal of potentially contaminated media from the subsurface (the cuttings from drilling shot-holes on 3 to 5-ft centers along the BBZ alignment); otherwise there is no removal of potentially contaminated media. Shots are designed to simply fracture the bedrock and not cause surface heave, and no fly-rock. Therefore, other than a low-frequency sound and vibration event lasting 1 to 2 seconds, there is no noticeable disruption. Notifications would be made to neighboring properties and other stakeholders prior to blasting activities. Engineering controls would be implemented to manage dust and protect workers. In addition, vibration monitoring along with pre- and post-blast inspections would be conducted to assess and avoid potential impact to the Site building, nearby structures and utilities. Other short-term impacts include the need to manage residual waste within the areas where the recovery wells and piping would be installed.

Though there several short-term impacts to installation of this alternative, it is anticipated that effectiveness would be immediate because the BBZ would influence and control migration of bedrock groundwater upon start-up and ISCR would address source area mass simultaneously.

5.3.3.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change. The SSD system has already been constructed and is operational within the Site building. The cover system consists of the building slab, pavement, and landscaping, which already covers the majority of the Site.

In-situ treatment (ISCR) is implementable with proper Site controls during injection events. The injection equipment, as well as the injection medium necessary for implementation is readily available. However, impacted soil is located within active areas of the Site building; there would be potential for adverse impacts to Site operations during injection if conventional vertical injection is used, and is done with an injection grid density consistent with conventional implementation practices. Impacts to Site operations may be mitigated through the use of horizontal or angled borings from outside the building to access soils beneath the building floor slab, however this may limit the effectiveness of the alternative. To the extent that horizontal injections cannot be implemented, vertical injections would be needed and would be expected to cause significant interruption of use and operations of areas within the building.

The extraction and treatment (BBZ) of groundwater is technically feasible as construction materials and equipment for implementation is available, although availability of experienced contractors is limited. Challenges to design and installation may include existing infrastructure such as utilities. Local permits would need to be obtained prior to blasting and trench installation, and blasting activities have the potential to be disruptive to Site operations particularly because the location of the trench may extend beneath the driveway that is used for Site access. Traffic and engineering controls would be required during installation.

5.3.3.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately *$1,555,045* in capital costs and *$3,106,918* in net present value of operations and maintenance cost. The *Revised* feasibility study estimate of the total alternative is *$4,702,727*. *Operation of the BBZ over time has a long term energy use relative to the mass of Target CVOCs that will be removed*.

This alternative requires operation of the SSD and associated energy consumption until adequate source material destruction is complete to mitigate exposure from soil vapor. While the SSD energy consumption is low relative to other alternatives, the period of operation estimated at 30 years.

5.3.3.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.3.9 Community Acceptance

Installation of the BBZ may have short-term impact to the surrounding community due to noise, short-term vibration and/or dust. However, given the surrounding use of the area (non-residential), it is not anticipated that this short-term impact would have a significant or long-term negative effect on the community. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

5.3.4 Alternative 4 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, In-situ treatment (*Thermal Conductance Heating*) of soil, Extraction & Treatment (BBZ) for Groundwater

Alternative 4 includes the following elements:

- Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site.
- Preparation of a SMP.
- Continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building.
- Continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future.
- In-situ treatment of soil beneath the building using *thermal conductance heating (TCH)* to remove source mass and achieve commercial use SCOs.
- Extraction and treatment of groundwater using a BBZ on the northwest side of the property that would simultaneously act to reduce source mass and control groundwater migration.

5.3.4.1 Overall Protectiveness of Human Health & the Environment

Alternative 4 would provide effective protection of current and future users of the Site from impacted soil and groundwater. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls. The current SSD system is effective at mitigating exposure of impacted soil vapor to current building occupants and the current Site cover is effective in preventing direct contact exposure to impacted soils. The SMP would provide a mechanism for maintaining and monitoring both of these engineering controls; these are assumed to remain in effect unless and until such time as SCGs are met by the alternative. This alternative would require continued management of potential exposure pathways beyond remediation for the foreseeable future.

Both in-situ treatment of soils beneath the building and groundwater extraction and treatment are protective of human health and the environment because these technologies actively reduce the mass of Target CVOCs in soil and groundwater, and groundwater extraction and treatment serves as migration control to improve environmental protectiveness. Though TCH is considered in-situ treatment, there is potential for exposure to contaminants as it requires extraction of impacted soil vapors, however that exposure is limited and can be effectively controlled. Extraction and treatment of groundwater may pose potential short-term exposure risk due to bringing impacted groundwater to the surface; however it is planned that groundwater would be contained within a closed system that would limit exposure, and the system would have appropriate engineering controls to prevent exposure. The extraction and treatment of groundwater is also limited to areas where there is influence from the blasted bedrock trench BBZ and associated recovery wells. The overall protectiveness of this alternative would also rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery.

5.3.4.2 Compliance with SCGs

In-situ treatment of soils and extraction and treatment of groundwater is intended to reduce contaminant mass and achieve SCGs (TOGS 1.1.1 criteria for groundwater and *commercial use* SCOs for soil) directly and indirectly on- and off-Site. *Protection of groundwater SCOs for soil is assumed to be achievable based on the capability of TCH in soil; however, commercial use SCOs have been retained as the SCG for soil. While it is reasonable to anticipate SCGs for groundwater may be achieved in most off-Site areas (e.g. properties north of Main St., but likely not all areas beneath Main St.), an active extraction system alone may not result in achieving the SCGs for groundwater on site within a reasonable time frame (i.e., less than the 30-year standard projection timeframe of alternatives evaluation).* The active extraction system alone may not result in achieving the SCGs for groundwater and this alternative would also have to rely on natural attenuation processes to remediate the impacted groundwater. Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs. Institutional controls included in Alternative 4, including land use and groundwater restrictions combined with the existing groundwater use restrictions imposed by the City of Rochester are necessary to mitigate risk of direct contact and ingestion of impacted soil and groundwater.

5.3.4.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term. SSD systems are also long-term, low-cost effective measures for mitigating soil vapor impacts in an occupied building. However, operations and maintenance in perpetuity are required to maintain the protectiveness of the cover and SSD systems over the long term.

In-situ soil treatment provides long-term effectiveness through reduction of Target CVOCs in soil. Because of the location of the impacted soil beneath the building adequate contact of heat with affected soil and extraction of affected vapor is necessary to accomplish SCGs. Effectiveness on soil would be directly affected by adequacy of access to install and operate a thermal system as conventionally applied.

Extraction and treatment via a BBZ includes permanent and non-reversible removal of Target CVOCs by recovery and treatment. *Compared to source area treatment, the mass of Target CVOCs removed by a BBZ would be relatively less and would require longer-term energy consumption than remedies implemented with shorter-term effectiveness.* This alternative provides some effectiveness against future contact with contaminated media. It is anticipated that the recovered groundwater would be discharged to the local POTW facility and would likely require on-Site treatment (e.g. carbon, ZVI or similar treatment) prior to discharge. This alternative would include performance monitoring of the extracted groundwater and treated effluent waste streams. In addition to performance monitoring, the recovery and treatment system would require routine maintenance of mechanical or electrical components that have a potential to malfunction or breakdown.

Hydraulic capture within the BBZ would require long-term operations and maintenance until asymptotic conditions are achieved in bedrock. Interruption in the operation of the BBZ for an *extended period (for example, extended equipment failure or failure to operate the system) may result in further off-Site migration of Target CVOCs in bedrock*.

5.3.4.4 Reduction of Toxicity, Mobility or Volume

The toxicity, mobility and volume of contaminated soil and groundwater are expected to be reduced over time. This alternative would also have to rely on natural attenuation processes to remediate impacted groundwater. Reduction of COCs in overburden groundwater and competent bedrock groundwater may be limited due to disconnected/poorly connected fracture porosity and limitations posted by matrix diffusion. Use of the BBZ would however limit mobility. *The capture zone achieved by the BBZ is typically relatively robust and extends several feet (50+ to 100+) upgradient and cross-gradient of the physical bounds of the BBZ. Based on experience with past implementation of BBZ's at other sites, there have been limited sites where a supplemental well or wells is installed after several years of operation of a BBZ in order to effect additional capture in localized areas determined after an extended period of operational experience*. Concentrated waste streams from the extraction system would likely be generated as part of this remedy that would require proper management and off-Site disposal.

As indicated under Alternative 3, installation of the BBZ has the potential for creating new groundwater migration pathways. Since the BBZ installation process includes the creation of new fractures in bedrock to enhance groundwater recovery, the fracturing is not completely predictable and may create new pathways for contaminant migration. The potential for creation of new vapor pathways is relatively limited.

5.3.4.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of existing engineering controls (SSD and cover).

Short-term impacts from in-situ soil treatment include restriction of the areas of the building during installation of the TCH system. Engineering controls would be implemented to manage dust and protect workers. It is unlikely that a TCH system can be implemented in the active facility based on its current configuration, so this alternative likely cannot be implemented unless the building was to become vacant.

There are some short-term impacts that can be associated with construction of the BBZ. Construction requires the use of explosives. Controlled blasting is undertaken by licensed contractors specializing in these services with specific mitigation measures to minimize impacts. Work is done in accordance with applicable laws, codes, and permit conditions. The Site is not located within a residential area. Traffic management (both vehicular and pedestrian) would need to occur during the blasting and system installation; scheduling can be done to have the construction completed during low-traffic times of the day/week. This method of remediation construction requires limited removal of potentially contaminated media from the subsurface (the cuttings from drilling shot-holes on 3 to 5-ft centers along the BBZ alignment); otherwise there is no removal of potentially contaminated media. Shots are designed to simply fracture the bedrock and not cause surface heave, and no fly-rock. Therefore, other than a low-frequency sound and vibration event lasting 1 to 2 seconds, there is no noticeable disruption. Notifications would be made to neighboring properties and other stakeholders prior to blasting activities. Engineering controls would be implemented to manage dust and protect workers. In addition, vibration monitoring along with pre- and post-blast inspections would be conducted to assess and avoid potential impact to the Site building, nearby structures and utilities. Other short-term impacts include the need to manage residual waste within the areas where the recovery wells and piping would be installed.

Though several short-term impacts, the effectiveness of this alternative would be high as the TCH is anticipated to achieve SCGs over a short period of time and the BBZ would immediately control bedrock groundwater migration.

5.3.4.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change. The SSD system has already been constructed and is operational within the Site building. The cover system consists of the building slab, pavement, and landscaping, which already covers the majority of the Site.

Installation of TCH would be difficult to implement given the soil impacts are primarily present beneath an active facility and close to the property boundary. The location of the system would likely require dedicated space within the building for the heating and recovery wells and development of infrastructure to collect, treat, and discharge recovered impacted vapor (along with associated moisture in vapor stream). The spacing of thermal boreholes and vapor extraction holes across the footprint of the building would be difficult to accomplish consistent with conventional application of this technology. Therefore, it is unlikely this alternative would be feasible if the building remains occupied currently and into the reasonably anticipated future.

The extraction and treatment (BBZ) of groundwater is technically feasible as construction materials and equipment for implementation is available, although availability of experienced contractors is limited. Challenges to design and installation may include existing infrastructure such as utilities. Local permits would need to be obtained prior to blasting and trench installation, and blasting activities have the potential to be disruptive to Site operations particularly because the location of the trench may extend beneath the driveway that is used for Site access. Traffic and engineering controls would be required during installation.

5.3.4.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately *$5,966,737* in capital costs and *$2,897,502* in net present value of operations and maintenance cost. The *Revised* feasibility study estimate of the total alternative is *$9,350,502*. *Operation of the BBZ over time has a long term energy use relative to the mass of Target CVOCs that will be removed by this element of the remedy alone*.

5.3.4.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.4.9 Community Acceptance

Installation of the BBZ may have short-term impact to the surrounding community due to noise, short-term vibration and/or dust. However, given the surrounding use of the area (non-residential), it is not anticipated that this short-term impact would have a significant or long-term negative effect on the community. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

5.3.5 Alternative 5 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, No Further Soil Remediation, Extraction & Treatment (BBZ) for Groundwater

Alternative 5 includes the following elements:

- Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site.
- Preparation of a SMP.
- Continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building.
- Continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future.
- No further remedial action for soil.
- Extraction and treatment of groundwater using a BBZ on the northwest side of the property that would simultaneously act to reduce source mass and control groundwater migration.

5.3.5.1 Overall Protectiveness of Human Health & the Environment

Alternative 5 would provide protection of current and future users of the Site from impacted soil and groundwater, though it does not include a mechanism for reducing source mass beneath the Site building. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls. The current SSD system is effective at mitigating exposure of impacted soil vapor to current building occupants and the current Site cover is effective in preventing direct contact exposure to impacted soils. The SMP would provide a mechanism for maintaining and monitoring both of these engineering controls; these are assumed to remain in effect unless and until such time as SCGs are met by the alternative.

Because impacted soils are entrained beneath the building, which serves as cover, *exposure to the direct contact pathway relative to human health is incomplete*; however long-term management via institutional and engineering controls would be necessary to preserve and manage the current absence of complete exposure pathways.

Groundwater extraction and treatment are protective of human health and the environment because these technologies manage migration. Extraction and treatment of groundwater may pose potential short-term exposure risk due to bringing impacted groundwater to the surface; however it is planned that groundwater would be contained within a closed system that would limit exposure, and the system would have appropriate engineering controls to prevent exposure. The extraction and treatment of groundwater is also limited to areas where there is influence from the BBZ and associated recovery wells. The overall protectiveness of this alternative would also rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery.

5.3.5.2 Compliance with SCGs

This alternative does not provide a direct mechanism for achieving compliance with SCGs for soil. Extraction and treatment of groundwater is intended to reduce contaminant mass and achieve SCGs (TOGS 1.1.1 criteria) for groundwater. *While it is reasonable to anticipate SCGs for groundwater may be achieved in most off-Site areas (e.g. properties north of Main St., but likely not all areas beneath Main St.), an active extraction system alone may not result in achieving the SCGs for groundwater on site within a reasonable time frame (i.e., less than the 30-year standard projection timeframe of alternatives evaluation)*. This alternative would have to also rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery. Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs. Institutional controls included in Alternative 5, including land use and groundwater restrictions combined with the existing groundwater use restrictions imposed by the City of Rochester are necessary to mitigate risk of direct contact and ingestion of impacted soil and groundwater.

5.3.5.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term. SSD systems are also long-term, low-cost effective measures for mitigating soil vapor impacts in an occupied building. However, operations and maintenance in perpetuity are required to maintain the protectiveness of the cover and SSD systems over the long term.

This alternative however provides no mechanism for reducing source contamination in soil. As a result, there is potential for Target CVOCs in soil to continue to impact groundwater and soil vapor. This however would be managed via engineering and institutional controls to preserve and manage the current absence of complete exposure pathways. .

Extraction and treatment via a BBZ includes permanent and non-reversible removal of Target CVOCs by recovery and treatment*, although the primary purpose of the BBZ under this Alternative is hydraulic control. Relative to source area treatment included in other Alternatives, the mass of Target CVOCs removed by a BBZ would be relatively less and would longer-term, although not necessarily higher energy consumption than other alternatives.* This alternative provides some effectiveness against future contact with contaminated media. It is anticipated that the recovered groundwater would be discharged to the local POTW facility and would likely require on-Site treatment (e.g. carbon, ZVI, or similar) prior to discharge. This alternative would include performance monitoring of the extracted groundwater and treated effluent waste streams. In addition to performance monitoring, the recovery and treatment system would require routine maintenance of mechanical or electrical components that have a potential to malfunction or breakdown.

5.3.5.4 Reduction of Toxicity, Mobility or Volume

The cover system would prevent mobility of Target CVOC impacted soil from migrating because access to the soil is precluded from both contact exposure and from infiltrating groundwater due to it being entrained beneath the building. The SSD system would reduce the potential for vapor intrusion in the building and thus reduce soil vapor toxicity within the Site building. This alternative does not directly address impacts to soil and therefore does not directly reduce the toxicity or volume of Target CVOCs in that media.

The toxicity, mobility and volume of contaminated groundwater are expected to be reduced over time, however, extraction and treatment alone of groundwater may not achieve the SCGs for the Target CVOCs over the short-term. However, the BBZ and other engineering and institutional controls would continue to manage mobility. This alternative would also have to rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery. *The capture zone achieved by the BBZ is typically relatively robust and extends several feet (50+ to 100+) upgradient and cross-gradient of the physical bounds of the BBZ. Based on experience with past implementation of BBZ's at other sites, there have been limited sites where a supplemental well is or wells are installed after several years of operation of a BBZ in order to effect additional capture in localized areas determined after an extended period of operational experience*. Concentrated waste streams from the extraction system would likely be generated as part of this remedy that would require proper management and off-Site disposal.

The toxicity and volume of contaminated soil would not be reduced because no further remediation of the source area soils is included in this alternative. However there are no current exposure pathways associated with the soil, the building (cover) limits further mobility. Though the impacts beneath the building may present a source of impact to groundwater, the presence of the building also limits infiltration of surface water through the impacted soil, which mitigates further impacts from the unsaturated zone.

As indicated under Alternative 3, installation of the BBZ has the potential for creating new groundwater migration pathways. Since the BBZ installation process includes the creation of new fractures in bedrock to enhance groundwater recovery, the fracturing is not completely predictable and may create new pathways for contaminant migration. The potential for creation of new vapor pathways is relatively limited.

5.3.5.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of existing engineering controls (SSD and cover).

There are some short-term impacts that can be associated with construction of the BBZ. Construction requires the use of explosives. Controlled blasting is undertaken by licensed contractors specializing in these services with specific mitigation measures to minimize impacts. Work is done in accordance with applicable laws, codes, and permit conditions. The Site is not located within a residential area. Traffic management (both vehicular and pedestrian) would need to occur during the blasting and system installation; scheduling can be done to have the construction completed during low-traffic times of the day/week. This method of remediation construction requires limited removal of potentially contaminated media from the subsurface (the cuttings from drilling shot-holes on 3 to 5-ft centers along the BBZ alignment); otherwise there is no removal of potentially contaminated media. Shots are designed to simply fracture the bedrock and not cause surface heave, and no fly-rock. Therefore, other than a low-frequency sound and vibration event lasting 1 to 2 seconds, there is no noticeable disruption. Notifications would be made to neighboring properties and other stakeholders prior to blasting activities. Engineering controls would be implemented to manage dust and protect workers. In addition, vibration monitoring along with pre- and post-blast inspections would be conducted to assess and avoid potential impact to the Site building, nearby structures and utilities. Other short-term impacts include the need to manage residual waste within the areas where the recovery wells and piping would be installed.

The BBZ is capable of immediately controlling bedrock groundwater migration.

5.3.5.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change. The SSD system has already been constructed and is operational within the Site building. The cover system consists of the building slab, pavement, and landscaping, which already covers the majority of the Site.

The extraction and treatment (BBZ) of groundwater is technically feasible as construction materials and equipment for implementation is available, although availability of experienced contractors is limited. Challenges to design and installation may include existing infrastructure such as utilities. Local permits would need to be obtained prior to blasting and trench installation, and blasting activities have the potential to be disruptive to Site operations particularly because the location of the trench may extend beneath the driveway that is used for Site access. Traffic and engineering controls would be required during installation.

5.3.5.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately *$640,195* in capital costs and *$2,897,502* in net present value of operations and maintenance cost. The *Revised* feasibility study estimate of the total alternative is *$3,578,460*. *Operation of the BBZ over time has a long term energy use relative to the mass of Target CVOCs that will be removed*.

5.3.5.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.5.9 Community Acceptance

Installation of the BBZ may have short-term impact to the surrounding community due to short term noise, vibration and/or dust. However, given the surrounding use of the area (non-residential), it is not anticipated that this short-term impact would have a significant or long-term negative effect on the community. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

5.3.6 Alternative 6 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, Extraction & Treatment (MPE) for Soil and Groundwater

Alternative 6 includes the following elements:

- Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site.
- Preparation of a SMP.
- Continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building.
- Continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future.
- Treatment of soil and groundwater via MPE.

5.3.6.1 Overall Protectiveness of Human Health & the Environment

Alternative 6 would provide protection of current and future users of the Site from impacted soil and groundwater. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls. The current SSD system is effective at mitigating exposure of impacted soil vapor to current building occupants and the current Site cover is effective in preventing direct contact exposure to impacted soils. The SMP would provide a mechanism for maintaining and monitoring both of these engineering controls; these are assumed to remain in effect unless and until such time as SCGs are met by the alternative.

The combined soil vapor and groundwater extraction and treatment associated with MPE is protective of human health and the environment because this technology actively reduces the mass of Target CVOCs in soil and groundwater. Extraction and treatment of groundwater may include a short-term exposure risk due to bringing impacted vapor and groundwater to the surface; however it is planned that groundwater would be contained within a closed system that would limit exposure and engineering controls would part of the system design to prevent exposure. The extraction and treatment of groundwater is also limited to areas where there is the ability to install recovery wells (limited by Site access in the active facility), and then the extent of influence from the associated recovery wells. The overall protectiveness of this alternative would also rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery.

5.3.6.2 Compliance with SCGs

Extraction and treatment of soil vapor and groundwater via MPE is intended to reduce contaminant mass and achieve SCGs (TOGS 1.1.1 criteria for groundwater and commercial use SCOs for soil). *While protection of groundwater SCOs are applicable to the Site, commercial SCOs were selected as a realistic clean-up goal for Alternative 6.* The active extraction system alone may not result in achieving the SCGs for groundwater and this alternative would have to rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery. Further, the ability to achieve SCG's on bedrock groundwater would be limited by poorly or disconnected fracture porosity and the effects of matrix diffusion. Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs. Institutional controls included in Alternative 6, including land use and groundwater restrictions combined with the existing groundwater use restrictions imposed by the City of Rochester are necessary to mitigate risk of direct contact and ingestion of impacted soil and groundwater.

5.3.6.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term. SSD systems are also long-term, low-cost effective measures for mitigating soil vapor impacts in an occupied building. However, operations and maintenance in perpetuity are required to maintain the protectiveness of the cover and SSD systems over the long term.

MPE provides moderate potential for long-term effectiveness through reduction of Target CVOCs in soil via high-vacuum soil vapor extraction (SVE). SVE has been used at the Site historically, but with only marginal success and it quickly reached asymptotic conditions. Unlike SVE alone, MPE uses higher vacuum than conventional SVE and also addresses the saturated zone, which may improve its success. However based on the variability of subsurface fill and limitations posed by fractured rock, an MPE system overall may not prove effective at addressing source contamination to the extent necessary to achieve SCGs in either soil or groundwater. Further, MPE is very energy-intensive and as a long-term method of groundwater removal and treatment and/or migration control. MPE is inefficient and therefore *not* conventionally used over the long-term; *MPE must be operated continuously to dewater the saturated zone to allow for unsaturated zone recovery. Pulsed operation is not likely to increase efficiency, as system down-time periods allow for re-saturation of the unsaturated zone.*

Extraction and treatment of groundwater via MPE includes permanent and non-reversible removal of Target CVOCs by recovery and treatment. This alternative provides some effectiveness against future contact with contaminated media. It is anticipated that the recovered groundwater would be discharged to the local POTW facility and would likely require additional on-Site treatment (e.g. carbon, ZVI or similar). This alternative would include performance monitoring of the extracted groundwater and treated effluent waste streams. Based on the potential location of the MPE system required to achieve reductions in the source area, it may not be feasible to also serve as an effective groundwater control mechanism over the long-term. If the MPE system reaches asymptotic conditions for Target CVOCs prior to achieving SCGs, an alternative groundwater control technology may need to be considered that is more effective over the long term.

In addition to performance monitoring, the MPE system would require routine maintenance of mechanical or electrical components that have a potential to malfunction or breakdown.

5.3.6.4 Reduction of Toxicity, Mobility or Volume

The toxicity, mobility and volume of contaminated soil and groundwater are expected to be reduced over time, however, extraction and treatment alone of soil and groundwater may not achieve the SCGs for the Target CVOCs within a reasonable time frame. It has been assumed in this *Revised* FS that accomplishment of SCGs may be completed in 10 years, however longer term operation or a different alternative may need to be considered. This alternative would also have to rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery. Concentrated waste streams from the extraction system would likely be generated as part of this remedy that would require proper management and off-Site disposal.

5.3.6.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of existing engineering controls (SSD and cover).

The short-term impacts that are anticipated during the implementation of the MPE system include significant disruption of facility operations to install the MPE wells and associated piping and equipment in the active facility. In addition, some management of traffic (vehicular or pedestrian) and residual wastes would be required to varying extents within the areas where the recovery wells and subsurface apparatus would be installed as well as where the treatment system would be installed (including trenching for layout of the piping associated with conveyance of recovered groundwater and soil vapor).

Following installation, MPE would likely be immediately effective at limited migration control near the building. Based on effectiveness of previous SVE systems at the Site, the MPE system overall may not prove effective at addressing source contamination to the extent of SCGs.

5.3.6.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change. The SSD system has already been constructed and is operational within the Site building. The cover system consists of the building slab and pavement, which already covers the majority of the Site.

The installation of the MPE system is technically feasible as construction materials and equipment for implementation are readily available. Due to the size and complexity of MPE installation of the system would likely be significantly disruptive to Site operations particularly because it would require new construction to house the MPE equipment and subsurface infrastructure. Traffic and engineering controls would be required during installation.

5.3.6.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately *$2,059,720* in capital costs and *$2,914,954* in net present value of operations and maintenance cost. The *Revised* feasibility study estimate of the total alternative is *$5,099,536*. *While the MPE will likely be effective at removing source area Target CVOCs, this technology is energy-intensive and will need to operate for an assumed duration of 15 years.*

5.3.6.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.6.9 Community Acceptance

Implementation of this alternative is not anticipated to have a noticeable impact on the community as it would be primarily administrative in nature. Installation of the MPE system is anticipated to be a short-term disruption to the facility, but not necessarily to surrounding property. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

5.3.7 Alternative 7 (Restore Site to Unrestricted Use) – Institutional Controls, Maintain Cover, Excavation/Off-Site Treatment and Disposal of Soils; In-Situ Treatment (*Electrical Resistance Heating*) of Soil and Groundwater

Alternative 7 includes the following elements:

- Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site.
- Preparation of a SMP.
- Continued maintenance of the existing Site cover following remediation (remaining building foundation, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future.
- Excavation and off-Site treatment/disposal of soils.
- Thermal treatment of soil and groundwater by in-situ *electrical resistance heating (ERH)*.

5.3.7.1 Overall Protectiveness of Human Health & the Environment

Alternative 7 is intended to provide protection of current and future users of the Site from impacted soil and groundwater as it is would remove the source of contamination and associated residuals. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls to address potential residual impacts and to address contaminants not associated with the COCs (e.g. urban fill). The current Site cover is effective in preventing direct contact exposure to impacted soils. The SMP would provide a mechanism for maintaining the cover that would remain following remediation to address residual surface and near surface soil impacts from historical fill; these are assumed to remain in effect unless and until such time as SCGs are met by the alternative.

The excavation alternative is expected to meet the RAOs for soils upon completion because the contamination would be removed from the Site. It also would remove the source of impacts to groundwater. ERH would actively reduce the mass of Target CVOCs in groundwater within the subsurface and achieve the RAOs for groundwater.

During implementation, this alternative would result in a temporary exposure risk on-Site and potentially off-Site due to bringing contaminated materials to the surface and transporting them off-Site for treatment/disposal.

5.3.7.2 Compliance with SCGs

The excavation alternative is expected to meet the SCGs for the soils within the excavations. Subsequent treatment via ERH is intended to achieve the SCGs for groundwater. *ERH alone may not result in achieving the SCGs for groundwater and this alternative would also have to rely on natural attenuation processes to remediate the impacted groundwater. Further, the ability to achieve SCGs may be limited by poor electrical conductance of the impacted media.* Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs. Institutional controls included in Alternative 7, including land use and groundwater restrictions combined with the existing groundwater use restrictions imposed by the City of Rochester, would further mitigate risk of direct contact and ingestion of impacted groundwater.

5.3.7.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term.

ERH provides long-term effectiveness through reduction of Target CVOCs in groundwater. This alternative would include a performance monitoring component whereby monitoring wells would be sampled and evaluated for Target CVOC reduction and groundwater quality. The extent of ERH to provide long-term effectiveness and permanence is dependent on *the electrical resistance of the affected media and its ability to reach the required temperature*. *Extended application may be required beyond the anticipated timeframe to advance the remedy to SCGs and effects of fracture porosity and matrix diffusion in bedrock may limit ERH's effectiveness – this possibility has been addressed by allowance of an enhanced contingency for this alternative.*

The excavation element of this alternative is considered a reliable and permanent remedy for impacted soil and, as such, the risks involved with the migration of contaminants and direct contact with soil contaminants would be reduced or eliminated. Remediation of contaminated soils would be effective in the long-term as the impacted soil would be removed from the Site.

5.3.7.4 Reduction of Toxicity, Mobility or Volume

The excavation element of this alternative involves the removal and off-Site disposal of the impacted soil and thus the toxicity, mobility and volume of the COCs would be reduced. Also, this alternative would remove the potential sources of groundwater contamination where implemented. *ERH has been shown to be effective in reducing the toxicity, mobility, and volume of residual impacts to groundwater over a reasonable period provided the medium can effectively be heated for an adequate period of time*.

5.3.7.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of cover. Short-term impacts associated with excavation include shutting down the operating business in order to remove the building to access the impacted soils beneath. Excavation while preserving the building and maintaining the current structure was considered; however, to maintain structural stability would require limiting the depth and angle of repose of excavation side walls around structural columns (which are present with regular spacing through the facility (20-ft spacing in N-S direction, and 25-ft spacing in the former dry cleaning machine area in E-W direction). Because of this, excavation to an extent that is actually effective in removing adequate affected soil would not be a viable alternative unless the building tenant vacates and the building is demolished. In addition, during excavation *and electrical node installation for ERH, traffic management, dust management, and other controls would need to be implemented including engineering controls to protect site workers during implementation of ERH*.

5.3.7.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change.

The excavation and ERH components of this alternative are not readily implementable due to the presence of the active facility above the source area. This alternative would require shutting down operations to allow removal of the building to excavate impacted soils. *Unless the building tenant vacates, this option may not be viable as the disruption would be significant*.

ERH requires the installation of electrical nodes on an approximately 50-foot array across the treatment area, including off-Site properties and a public thoroughfare (Main Street) to accomplish the overall remedial objectives for this alternative. This would not only interrupt facility operations, but would also disturb neighboring properties and disrupt vehicular and pedestrian traffic.

5.3.7.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately *$26,801,301* in capital costs and *$605,609* in net present value of operations and maintenance cost. The *Revised* feasibility study estimate of the total alternative is *$28,297,910*.

5.3.7.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.8 Alternative 8 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, Soil Vapor Extraction for Soil, Extraction and Treatment (BBZ) for Groundwater

Alternative 8 includes the following elements:

- *Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site.*

- *Preparation of a SMP.*
- *Continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future. Continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building.*
- *Treatment of unsaturated soil via soil vapor extraction (SVE).*
- *Extraction and treatment of groundwater using a BBZ on the northwest side of the property that would simultaneously act to reduce source mass and control groundwater migration.*

5.3.8.1 Overall Protectiveness of Human Health & the Environment

Alternative 8 is intended to provide protection of current and future users of the Site from impacted soil, soil vapor, and groundwater. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls. The current SSD system is effective at mitigating exposure of impacted soil vapor to current building occupants and the current Site cover is effective in preventing direct contact exposure to impacted soils. The SMP would provide a mechanism for maintaining and monitoring both of these engineering controls; these are assumed to remain in effect unless and until such time as SCGs are met by the alternative.

The combined SVE and extraction of groundwater by the BBZ would be protective of human health and the environment because these technologies actively reduce the mass of Target CVOCs in soil beneath the source area (to the extent it remains following the SVE IRM that was implemented in the 2004-2006 timeframe), and controls migration to limit potential plume expansion. Extraction and treatment of groundwater and soil vapor may include an exposure risk for the duration of these remedy elements due to bringing impacted media to the surface; however, the impacted media would be contained within a closed system and system engineering controls would prevent exposure. The extraction of soil vapor is limited to the newly installed wells within the building. The extraction and treatment of groundwater is also limited to areas where there is hydraulic capture from the BBZ and associated recovery wells. The overall protectiveness of this alternative would also rely on natural attenuation processes to remediate the impacted groundwater near the source area not accessed by active recovery.

5.3.8.2 Compliance with SCGs

Extraction and treatment of groundwater by the BBZ is intended to reduce contaminant mass and achieve SCGs (TOGS 1.1.1 criteria for groundwater), at least in most off-site areas; it may have limited effectiveness in accomplishing groundwater SCGs on site. SVE would be intended to address reduction of soil concentrations to meet commercial SCOs for overburden beneath the site building. While protection of groundwater SCOs are applicable to the Site, commercial SCOs were selected as a realistic clean-up goal for Alternative 8. Active soil vapor extraction and groundwater extraction systems alone may not result in achieving the SCGs for groundwater and this alternative would have to rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery. Further, the ability to achieve SCG's on bedrock groundwater would be limited by poorly or disconnected fracture porosity and the effects of matrix diffusion. Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs. Institutional controls included in Alternative 8, including land use and groundwater restrictions combined with the existing groundwater use *restrictions imposed by the City of Rochester are necessary to mitigate risk of direct contact and ingestion of impacted soil and groundwater*.

5.3.8.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term. SSD systems are also long-term, low-cost effective measures for mitigating soil vapor impacts in an occupied building. However, operations and maintenance in perpetuity are required to maintain the protectiveness of the cover and SSD systems over the long term.

SVE provides moderate potential for long-term effectiveness through reduction of Target CVOCs in unsaturated soil. SVE has been used at the Site historically, but with unknown success in reducing overburden CVOC concentrations; it reached asymptotic conditions over a two-year operating period and soil samples to document concentrations following the SVE IRM are not available. SVE may not prove effective at addressing source contamination to the extent necessary to achieve SCGs in either soil or groundwater. Further, SVE is energy-intensive and as an extended duration method of soil treatment SVE is inefficient; it is also assumed the SVE system would need to operate in a pulsed manner to improve efficiency and sustainability after asymptotic conditions are met.

Extraction and treatment of soil vapor by SVE and groundwater via BBZ includes permanent and non-reversible removal of Target CVOCs by recovery and treatment. This alternative provides some effectiveness against future contact with contaminated media. It is anticipated that the recovered groundwater would be discharged to the local POTW facility and would likely require additional on-Site treatment (e.g. carbon, ZVI or similar). Treated soil vapor would be treated on-Site and discharged to the atmosphere – waste carbon resulting from the vapor treatment would need to be regenerated and periodically replaced once it is spent. This alternative would include performance monitoring of the extracted soil vapor and groundwater, and treated effluent waste streams. In addition to performance monitoring, the SVE system and BBZ would both require routine maintenance of mechanical or electrical components that have a potential to malfunction or breakdown.

5.3.8.4 Reduction of Toxicity, Mobility or Volume

The toxicity, mobility and volume of contaminated soil and groundwater are expected to be reduced over time, however, extraction and treatment alone of soil vapor and groundwater may not achieve the SCGs for the Target CVOCs within a reasonable time frame. It has been assumed in this Revised FS that accomplishment of SCGs may be completed in 15 years for the SVE component, however longer term operation of the BBZ, or a different alternative may need to be considered. This alternative would also have to rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery. The capture zone achieved by the BBZ is typically relatively robust and extends several feet (50+ to 100+) upgradient and cross-gradient of the physical bounds of the BBZ. Based on experience with past implementation of BBZ's at other sites, there have been limited sites where a supplemental well is or wells are installed after several years *of operation of a BBZ in order to effect additional capture in localized areas determined after an extended period of operational experience*.

As indicated under Alternative 3, installation of the BBZ has the potential for creating new groundwater migration pathways. Since the BBZ installation process includes the creation of new fractures in bedrock to enhance groundwater recovery, the fracturing is not completely predictable and may create new pathways for contaminant migration. The potential for creation of new vapor pathways is relatively limited.

Operation of the SVE would need to be balanced against operation of the SSDS to avoid competing overlap of vacuum that prevents effective operation of the SSDS.

5.3.8.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of existing engineering controls (SSD and cover).

The short-term impacts that are anticipated during the implementation of the SVE system include anticipated significant disruption of facility operations due to installation of new SVE wells, and installation of new lateral extraction piping and equipment in the active facility. Disruption will occur during the installation of treatment equipment and associated piping in the upstairs portion of the facility. Disruption will also occur during periodic carbon vessel change-outs.

There are some short-term impacts that can be associated with construction of the BBZ. Construction requires the use of explosives. Controlled blasting is undertaken by licensed contractors specializing in these services with specific mitigation measures to minimize impacts. Work is done in accordance with applicable laws, codes, and permit conditions. The Site is not located within a residential area. Traffic management (both vehicular and pedestrian) would need to occur during the blasting and system installation; scheduling can be done to have the construction completed during low-traffic times of the day/week. This method of remediation construction requires limited removal of potentially contaminated media from the subsurface (the cuttings from drilling shot-holes on 3 to 5-ft centers along the BBZ alignment); otherwise there is no removal of potentially contaminated media. Shots are designed to simply fracture the bedrock and not cause surface heave, and no fly-rock. Therefore, other than a low-frequency sound and vibration event lasting 1 to 2 seconds, there is no noticeable disruption. Notifications would be made to neighboring properties and other stakeholders prior to blasting activities. Engineering controls would be implemented to manage dust and protect workers. In addition, vibration monitoring along with pre- and post-blast inspections would be conducted to assess and avoid potential impact to the Site building, nearby structures and utilities. Other short-term impacts include the need to manage residual waste within the areas where the recovery wells and piping would be installed.

Following installation, the BBZ would likely be immediately effective at limited migration control north of the site building and property line. Based on effectiveness of previous SVE systems at the Site, the SVE system overall may or may not significantly further reduce unsaturated overburden concentrations below the site source area to the extent of SCGs.

5.3.8.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change. The SSD system has already been constructed and is operational within the Site building. The cover system consists of the building slab and pavement, which already covers the majority of the Site.

The installation of the SVE system is technically feasible as construction materials and equipment for implementation are readily available. The extraction and treatment equipment would likely be installed on the upper level of the Site building. Installation of the system would likely be significantly disruptive to Site operations due to the need to reestablish wells and subsurface infrastructure and installation of extraction and treatment equipment.

The extraction and treatment (BBZ) of groundwater is technically feasible as construction materials and equipment for implementation is available, although availability of experienced contractors is limited. Challenges to design and installation may include existing infrastructure such as utilities. Local permits would need to be obtained prior to blasting and trench installation, and blasting activities have the potential to be disruptive to Site operations particularly because the location of the trench may extend beneath the driveway that is used for Site access. Traffic and engineering controls would be required during installation.

5.3.8.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately $1,039,979in capital costs and $3,995,962 in net present value of operations and maintenance cost. The Revised feasibility study estimate of the total alternative is $5,121,734.

5.3.8.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.8.9 Community Acceptance

Implementation of institutional controls is not anticipated to have a noticeable impact on the community as it would be primarily administrative in nature. Installation of the BBZ may have short-term impact to the surrounding community due to short term noise, vibration and/or dust. However, given the surrounding use of the area (non-residential), it is not anticipated that this short-term impact would have a significant or long-term negative effect on the community. Installation of the SVE system is anticipated to be a significant short-term disruption to the facility, and disruptive when carbon change-out maintenance activity is required. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

5.3.9 Alternative 9 – Institutional Controls, In-situ Treatment (Electrical Resistance Heating) of Unsaturated and Saturated Zones

Alternative 9 includes the following elements:

- *Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site.*
- *Preparation of a SMP.*
- *Continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future.*
- *In-situ treatment of on-Site soil and groundwater using electrical resistance heating to remove source mass and achieve commercial SCOs.*

5.3.9.1 Overall Protectiveness of Human Health & the Environment

Alternative 9 would provide protection of current and future users of the Site from impacted soil, soil vapor, and groundwater. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls.

In-situ treatment of soils and groundwater via ERH is intended to be protective of human health and the environment because the mass of Target CVOCs in soil and groundwater is actively reduced across the Site. Though ERH is considered in-situ treatment, there is potential for exposure to contaminants, as it requires extraction of impacted soil vapors and condensate; however, that exposure is limited and can be effectively controlled. The installation of electrical nodes and extraction points may pose potential short-term construction and operation risk associated with electrical systems required, and short-term exposure risk due to bringing impacted soil vapor to the surface. The overall protectiveness of this alternative would also rely on natural attenuation processes to remediate the impacted groundwater not accessed by active recovery.

5.3.9.2 Compliance with SCGs

In-situ treatment of soils and groundwater is intended to reduce contaminant mass and achieve SCGs (TOGS 1.1.1 criteria for groundwater and commercial use SCOs for soil) directly on-Site and indirectly off-Site. While protection of groundwater SCOs are applicable to the Site, commercial SCOs were selected as a realistic clean-up goal for Alternative 9. ERH alone may not result in achieving the SCGs for groundwater and this alternative would also have to rely on natural attenuation processes to remediate the impacted groundwater. Further, the ability to achieve SCGs may be limited by poor electrical conductance of the impacted media. Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs. Institutional controls included in Alternative 9, including land use and groundwater restrictions combined with the existing groundwater use restrictions imposed by the City of Rochester are necessary to mitigate risk of direct contact and ingestion of impacted soil and groundwater.

5.3.9.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term.

In-situ treatment provides long-term effectiveness through reduction of Target CVOCs in soil and groundwater. Adequate contact of heat within affected media and extraction of affected vapor is necessary to accomplish SCGs under this alternative. Effectiveness would be directly affected by adequacy of access to install and operate an ERH system as conventionally applied. Conventional installation would require extraction points and electrical nodes be placed within the building footprint and Site lawn areas; to accomplish the spacing of electrodes needed for ERH to be effective, it is anticipated that the site building would need to be vacant (i.e. this would be incompatible with site operations during the period of application of ERH).

5.3.9.4 Reduction of Toxicity, Mobility or Volume

The toxicity, mobility and volume of contaminated soil and groundwater are expected to be reduced over time; this alternative would also have to rely on natural attenuation processes to remediate the impacted groundwater not accessed by active treatment. Concentrated waste streams from the vapor extraction system would likely be generated as part of this remedy which would require proper management, treatment, and disposal.

5.3.9.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of existing engineering controls (cover).

Short-term impacts from in-situ soil treatment include restriction of the building and other on-Site areas during installation of the ERH system. Engineering controls would be implemented to manage dust and protect workers and the public. It is unlikely that ERH can be implemented in the active facility based on its current configuration, so this alternative likely cannot be implemented unless the building was to become vacant. Installation of extraction wells and nodes would require removal of potentially contaminated material. Operation of extraction wells would require removal of potentially contaminated vapor and condensate throughout the duration of system operation.

Though there are several short-term impacts, the effectiveness of this alternative would be anticipated to be relatively high as ERH is anticipated to achieve SCGs over a shorter period of time than several other remedies summarized herein.

5.3.9.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change. The cover system consists of the building slab and pavement, which already covers the majority of the Site.

Installation of the ERH system would be difficult to implement given the soil and groundwater impacts are present beneath an active facility. The system would likely require dedicated space within the building and elsewhere on-Site for the heating and recovery wells and dedicated space for infrastructure to collect, treat, and discharge recovered impacted vapor (along with associated moisture in the vapor stream). The spacing of electrical nodes and vapor extraction holes across the Site would be difficult to accomplish unless the building was to become vacant *or demolished. Therefore, it is unlikely this alternative would be feasible, particularly if the building remains occupied as it currently is and is expected to remain into the reasonably anticipated future.*

5.3.9.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately $9,971,592 in capital costs and $380,410 in net present value of operations and maintenance cost. The Revised feasibility study estimate of the total alternative is $10,797,502.

ERH has a very intensive, but shorter term energy use relative to all other alternatives. Even considering an anticipated greater reduction in mass of Target CVOCs that would likely be removed under this alternative, it is not readily feasible to calculate that the energy/mass removed is more efficient under than other alternatives.

5.3.9.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.9.9 Community Acceptance

Though this alternative would ultimately be protective of human health and the environment over the long term, implementation of this alternative would require shutting down or relocating the existing operating business. Further, while actively under remedial construction, there would be significant construction disruption to the area. Combined, these impacts may affect community acceptance. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

5.3.10 Alternative 10 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, In-situ Treatment (ISCO, PlumeStop® with Enhanced Bioremediation) of Groundwater for Migration Control

Alternative 10 includes the following elements:

- *Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site.*
- *Preparation of a SMP.*
- *Continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building.*
- *Continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future.*
- *No further remedial action for soil in the source area.*
- *Migration control and treatment of groundwater using ISCO followed by PlumeStop® plus enhanced bioremediation.*

5.3.10.1 Overall Protectiveness of Human Health & the Environment

Alternative 10 would provide protection of current and future users of the Site from impacted groundwater, though it does not include a mechanism for reducing source mass beneath the Site building. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls. The current SSD system is effective at mitigating exposure of impacted soil vapor to current building occupants and the current Site cover is effective in preventing direct contact exposure to impacted soils. The SMP would provide a mechanism for maintaining and monitoring both of these engineering controls; these are assumed to remain in effect unless and until such time as SCGs are met by the alternative.

Management via institutional and engineering controls would be necessary over the long term to preserve and manage the current absence of complete exposure pathways.

Groundwater treatment is protective of human health and the environment because these technologies manage both mass reduction in groundwater and migration. During implementation, this alternative would result in a temporary exposure risk on-Site and potentially off-Site due to bringing contaminated materials to the surface and transporting them off-Site for treatment/disposal (during installation only, associated with remediation-generated waste). This alternative would also result in a temporary exposure risk on-Site to the treatment reagents. However, the exposure would be limited to the two reagent injection events (ISCO first to reduce elevated concentrations at the eastern end of the intended injection area; and then PlumeStop and a hydrogen donor along the full injection alignment – see Figure 16). The overall protectiveness of this alternative would also rely on enhanced bioremediation processes to remediate the impacted groundwater not intercepted by the perimeter treatment zone.

5.3.10.2 Compliance with SCGs

This alternative does not provide a direct mechanism for achieving compliance with SCGs for soil. Treatment of groundwater is intended to reduce contaminant mass and achieve SCGs (TOGS 1.1.1 criteria) for groundwater. PlumeStop® is not effective for treatment of high concentrations (currently above approximately 14PPM according to the PlumeStop® formulator). If ISCO does not adequately reduce "hot spots" to concentrations that can be treated with PlumeStop® then SCGs for groundwater may not be met. This alternative would have to also rely on natural attenuation processes to remediate the impacted groundwater not intercepted by the perimeter treatment zone. Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs; realistic and protective performance goals would be established to monitor the remediation of impacted groundwater to concentrations that would allow for the SCGs to be achieved through natural attenuation. Institutional controls included in Alternative 10, including land use and groundwater restrictions combined with the existing groundwater use restrictions imposed by the City of Rochester are necessary to mitigate risk of direct contact and ingestion of impacted soil and groundwater.

5.3.10.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long *term. SSD systems are also long-term, low-cost effective measures for mitigating soil vapor impacts in an occupied building. However, operations and maintenance in perpetuity are required to maintain the protectiveness of the cover and SSD systems over the long term.*

This alternative provides no mechanism for reducing source contamination in soil. As a result, there is potential for Target CVOCs in soil to continue to impact groundwater and soil vapor. This would be managed via engineering and institutional controls to preserve and manage the current absence of complete exposure pathways. Enhanced bioremediation via PlumeStop® application would limit migration through relatively rapid sorption of dissolved-phase Target CVOCs into the PlumeStop carbon, and reduce mass through formation of biofilm on PlumeStop particles and enhanced bioremediation.

ISCO followed by PlumeStop® plus enhanced bioremediation results in permanent and non-reversible removal of Target CVOCs at the Site perimeter, and in affected groundwater as it fluxes through the injected zone.

5.3.10.4 Reduction of Toxicity, Mobility or Volume

The cover system would prevent mobility of Target CVOC impacted soil from migrating because access to the soil is precluded from both contact exposure and from infiltrating groundwater due to it being entrained beneath the building. The SSD system would reduce the potential for vapor intrusion in the building and thus reduce soil vapor toxicity within the Site building. This alternative does not directly address impacts to soil and therefore does not directly reduce the toxicity or volume of Target CVOCs in that media.

The toxicity and volume of contaminated soil would not be reduced because no remediation of the source area soils is included in this alternative. However there are no current exposure pathways associated with the soil, the building (cover) limits further mobility. Though the impacts beneath the building may present a source of impact to groundwater, the presence of the building also limits infiltration of surface water through the impacted soil, which mitigates further impacts from the unsaturated zone.

The toxicity, mobility and volume of contaminated groundwater are expected to be initially reduced over a short period of time. However, treatment may not achieve SCGs for the Target CVOCs at "hot spots" of high concentrations. Additionally, treatment does not address the source zone and impacts beneath the building. This alternative would also rely on enhanced bioremediation and natural attenuation processes to limit the mobility of impacted groundwater not intercepted by the perimeter injection wells.

5.3.10.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of existing engineering controls (SSD and cover).

There are some short term impacts associated with the injection events. Pedestrian traffic management would need to occur during injection; scheduling can be done to have the construction completed during low-traffic times of the day/week. Boreholes for injection require limited removal of potentially contaminated media from the subsurface (drilling cuttings);

otherwise there is no removal of potentially contaminated media. Engineering controls would be implemented to manage dust and protect workers.

ISCO followed by PlumeStop® with enhanced bioremediation is capable of relatively rapidly reducing overburden and bedrock groundwater concentrations and therefore reducing the potential for continued migration.

5.3.10.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change. The SSD system has already been constructed and is operational within the Site building. The cover system consists of the building slab, pavement, and landscaping, which already covers the majority of the Site.

The injection of ISCO and PlumeStop® reagents is technically feasible because the planned injection locations are located within a landscaped area. Implementation would not significantly impact the Site building or operations. Traffic and engineering controls would be required during installation.

5.3.10.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately $722,607 in capital costs and $1,255,438 in net present value of operations and maintenance cost. The Revised feasibility study estimate of the total alternative is $1,991,633.

5.3.10.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.10.9 Community Acceptance

Implementation of ISCO followed by PlumeStop® may have a short term impact to the surrounding community due to noise and/or dust associated with drilling. However, given the surrounding use of the area (non-residential), it is not anticipated that this short-term impact would have a significant or long-term negative effect on the community. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

5.3.11 Alternative 11 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, In-situ Treatment (ISCO, PlumeStop® with Enhanced Bioremediation) of Groundwater for Source and Migration Control

Alternative 11 includes the following elements:

- *Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site.*
- *Preparation of a SMP.*

- *Continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building.*
- *Continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future.*
- *Migration and source control and treatment of groundwater using ISCO followed by PlumeStop® plus enhanced bioremediation through injection along a downgradient perimeter (consistent with Alternative 10) as well as beneath the building source area (using re-fitted wells remaining from the former SVE IRM).*

5.3.11.1 Overall Protectiveness of Human Health & the Environment

Alternative 11 would provide protection of current and future users of the Site from impacted soil and groundwater. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls. The current SSD system is effective at mitigating exposure of impacted soil vapor to current building occupants and the current Site cover is effective in preventing direct contact exposure to impacted soils. The SMP would provide a mechanism for maintaining and monitoring both of these engineering controls; these are assumed to remain in effect unless and until such time as SCGs are met by the alternative.

Management via institutional and engineering controls would be necessary over the long term to preserve and manage the current absence of complete exposure pathways.

Groundwater treatment is protective of human health and the environment because these technologies manage both mass reduction in groundwater and migration. During implementation, this alternative would result in a temporary exposure risk on-Site and potentially off-Site due to bringing contaminated materials to the surface and transporting them off-Site for treatment/disposal (during installation only, associated with remediation-generated waste). This alternative would also result in a temporary exposure risk on-Site to the treatment reagents. However, the exposure would be limited to the two reagent injection events (ISCO first to reduce elevated concentrations at the eastern end of the intended injection area; and then PlumeStop and a hydrogen donor along the full injection alignment – see Figure 17). The overall protectiveness of this alternative would also rely on enhanced bioremediation processes to remediate the impacted groundwater not intercepted by the perimeter treatment zone.

5.3.11.2 Compliance with SCGs

This alternative does not provide a direct mechanism for achieving compliance with SCGs for soil. The formulator of PlumeStop® has indicated the treatment in fully unsaturated contaminated soils is not feasible (sorption into the carbon particles relies on contaminants being in solution), however injection into partially saturated contaminated soils may or may not have effectiveness in reduction of soil concentrations – this type of scenario has not been tested to date.

This Alternative 11 allows for injection of PlumeStop® and an electron donor to stimulate bioremediation beneath the site building through re-fitted former SVE wells in order to treat source area groundwater in addition to the treatment that would take place in the perimeter injection zone.

Treatment of groundwater is intended to reduce contaminant mass and achieve SCGs (TOGS 1.1.1 criteria) for groundwater. PlumeStop® is not effective for treatment of high concentrations (currently above approximately 14PPM according to the PlumeStop® formulator). If ISCO does not adequately reduce "hot spots" to concentrations that can be treated with PlumeStop® then SCGs for groundwater may not be met. This alternative would have to also rely on natural attenuation processes to remediate the impacted groundwater not intercepted by the perimeter treatment zone. Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs; realistic and protective performance goals would be established to monitor the remediation of impacted groundwater to concentrations that would allow for the SCGs to be achieved through natural attenuation. Institutional controls included in Alternative 11, including land use and groundwater restrictions combined with the existing groundwater use restrictions imposed by the City of Rochester are necessary to mitigate risk of direct contact and ingestion of impacted soil and groundwater.

5.3.11.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term. SSD systems are also long-term, low-cost effective measures for mitigating soil vapor impacts in an occupied building. However, operations and maintenance in perpetuity are required to maintain the protectiveness of the cover and SSD systems over the long term.

This alternative is limited to hotspot treatment with ISCO and does not treat all source contamination in soil. As a result, there is limited potential for Target CVOCs in unsaturated soil to continue to impact groundwater and soil vapor. This would be managed via engineering and institutional controls to preserve and manage the current absence of complete exposure pathways.

Enhanced bioremediation via PlumeStop® application would limit migration through relatively rapid sorption of dissolved-phase Target CVOCs into the PlumeStop carbon, and reduce mass through formation of biofilm on PlumeStop particles and enhanced bioremediation. Because this alternative includes injection beneath the building and along a downgradient perimeter this effect would be implemented on a larger footprint than Alternative 10 and therefore would be assumed to provide better overall effectiveness.

ISCO followed by PlumeStop® plus enhanced bioremediation results in permanent and non-reversible removal of Target CVOCs at the Site perimeter, and in affected groundwater as it fluxes through the injected treatment zone.

5.3.11.4 Reduction of Toxicity, Mobility or Volume

The cover system would prevent mobility of Target CVOC impacted soil from migrating because access to the soil is precluded from both contact exposure and from infiltrating groundwater due to it being entrained beneath the building. The SSD system would reduce the potential for vapor intrusion in the building and thus reduce soil vapor toxicity within the Site building.

The toxicity and volume of contaminated soil would be reduced because limited remediation of the source area soils is included in this alternative. However there are no current exposure pathways associated with the soil, the building (cover) limits further mobility. Though the residual impacts beneath the building not addressed by ISCO and PlumeStop® injection may present a limited source of impact to groundwater, the presence of the building also limits infiltration of surface water through the impacted soil, which mitigates further impacts from the unsaturated zone. Also, as indicated above, there is some possibility that injection into partially saturated soils may provide for some reduction in contaminated soil concentrations – it has not yet been tested.

The toxicity, mobility and volume of contaminated groundwater are expected to be reduced over a short period of time. This alternative would also rely on enhanced bioremediation and natural attenuation processes to remediate the impacted groundwater not intercepted by the source area and perimeter injection wells.

5.3.11.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of existing engineering controls (SSD and cover).

There are some short term impacts associated with the perimeter treatment zone injection events and interior injection (including some limited disruption associated with re-fitting the interior wells to allow reuse for injection). Pedestrian traffic management would need to occur during injection; scheduling can be done to have the construction completed during low-traffic times of the day/week. Boreholes for injection require limited removal of potentially contaminated media from the subsurface (drilling cuttings); otherwise there is no removal of potentially contaminated media. Engineering controls would be implemented to manage dust and protect workers. Injections within the building would also have short-term impacts to facility operations and workers. If possible, interior injections would be done during off-hours.

ISCO followed by PlumeStop® with enhanced bioremediation is capable of relatively rapidly reducing overburden and bedrock groundwater concentrations and therefore reducing the potential for continued migration.

5.3.11.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change. The SSD system has already been constructed and is operational within the Site building. The cover system consists of the building slab, pavement, and landscaping, which already covers the majority of the Site.

The injection of ISCO and PlumeStop® reagents is technically feasible because the planned injection locations are located within a landscaped area and through existing (to-be re-fitted wells) inside the Site building. Exterior work would not significantly impact the Site building or operations. There would be temporary interruption of operations to access, refit and complete injection through the interior former IRM SVE wells. Traffic and engineering controls would be required during installation. Interior work would be conducted during off-hours, if possible.

5.3.11.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately $731,198 in capital costs and $1,270,482 in net present value of operations and maintenance cost. The Revised feasibility study estimate of the total alternative is $2,015,268.

5.3.11.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.11.9 Community Acceptance

Implementation of ISCO followed by PlumeStop® may have a short term impact to the surrounding community due to noise and/or dust associated with drilling. However, given the surrounding use of the area (non-residential), it is not anticipated that this short-term impact would have a significant or long-term negative effect on the community. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

5.3.12 Alternative 12 – Institutional Controls, Maintain Existing Engineering Controls, Maintain Cover, Soil Vapor Extraction (SVE) for Soil, and In-situ Treatment (ISCO, PlumeStop® with Enhanced Bioremediation) of Groundwater for Source and Migration Control

Alternative 12 includes the following elements:

- *Establish land use restrictions to prohibit uses and activities that may result in exposure to impacted soil and groundwater at the Site.*
- *Preparation of a SMP.*
- *Continued maintenance and monitoring of the existing SSD system to mitigate soil vapor intrusion within the building.*
- *Continued maintenance of the Site cover system (building, pavement, and landscaping) with provisions in the SMP for managing excavated soils in the future.*
- *Treatment of unsaturated soil via soil vapor extraction (SVE).*
- *Migration and source control and treatment of groundwater using ISCO followed by PlumeStop® plus enhanced bioremediation.*

5.3.12.1 Overall Protectiveness of Human Health & the Environment

Alternative 12 is intended to provide protection of current and future users of the Site from impacted soil and groundwater. The institutional controls and SMP would provide effective mechanisms for protecting current and future Site occupants from unnecessary exposure to impacted media through prohibition of groundwater use and implementing engineering controls. The current SSD system is effective at mitigating exposure of impacted soil vapor to current building occupants and the current Site cover is effective in preventing direct contact exposure to impacted soils. The SMP would provide a mechanism for maintaining and monitoring both of these engineering controls; these are assumed to remain in effect unless and until such time as SCGs are met by the alternative.

Management via institutional and engineering controls would be necessary over the long term to preserve and manage the current absence of complete exposure pathways.

Groundwater and source zone treatment, and groundwater migration control is intended to be protective of human health and the environment because these technologies manage both mass reduction in groundwater and migration; the SVE component is intended to reduce potential source unsaturated zone contamination to the extent it remains following the SVE IRM performed in the 2004-2006 timeframe. During implementation, this alternative would result in a temporary exposure risk on-Site and potentially off-Site due to bringing contaminated materials to the surface and transporting them off-Site for treatment/disposal (during installation associated with remediation-generated waste, and during operation of the SVE associated with spent carbon).

Extraction and treatment of soil vapor may include an exposure risk for the duration of this remedy element due to bringing impacted vapor media to the surface; however, the impacted media would be contained within a closed system and system engineering controls would prevent exposure. The extraction of soil vapor would be limited to newly installed wells within the building.

This alternative would also result in a temporary exposure risk on-Site to the treatment reagents. Reagent exposure would be limited to the two reagent injection events (ISCO first to reduce elevated concentrations at the eastern end of the intended injection area; and then PlumeStop and a hydrogen donor along the full injection alignment – see Figure 18). The overall protectiveness of this alternative would also rely on enhanced bioremediation processes to remediate the impacted groundwater not intercepted by the perimeter treatment zone.

5.3.12.2 Compliance with SCGs

Treatment of groundwater is intended to reduce contaminant mass and achieve SCGs (TOGS 1.1.1 criteria) for groundwater. PlumeStop® is not effective for treatment of high concentrations. The effectiveness of PlumeStop® plus enhanced bioremediation depends on the success of ISCO reduction of peak concentrations in selected areas of the site where concentrations are above approximately 14PPM. This alternative would have to also rely on enhanced bioremediation and natural attenuation processes to remediate the impacted groundwater not intercepted by the perimeter injection wells or effectively treated with PlumeStop®.

SVE would be intended to address reduction of soil concentrations to meet commercial SCOs for overburden beneath the site building. Active soil vapor extraction alone may not result in achieving the SCGs for soil.

For groundwater realistic and protective performance goals would need to be established to monitor the remediation of impacted groundwater to concentrations that would allow for the SCGs to be achieved through natural attenuation. Periodic groundwater monitoring as stipulated in a SMP would be used to evaluate progress towards reaching SCGs. Institutional controls, including land use and groundwater restrictions combined with the existing *groundwater use restrictions imposed by the City of Rochester are necessary to mitigate risk of direct contact and ingestion of impacted soil and groundwater.*

5.3.12.3 Long-Term Effectiveness and Permanence

Access and use restrictions and groundwater use restrictions have generally been demonstrated as effective long-term measures for protection from potential exposures at contaminated sites. Cover systems over impacted soil in combination with engineering and institutional controls are effective measures to prevent direct contact with or ingestion of impacted soil over the long term. SSD systems are also long-term, low-cost effective measures for mitigating soil vapor impacts in an occupied building. However, operations and maintenance in perpetuity are required to maintain the protectiveness of the cover and SSD systems over the long term.

The SVE would undergo operation for an extended period of time and monitoring of extracted concentrations to determine reduction to an asymptotic condition, the system would be operated in a pulsed manner to improve efficiency; it is unknown whether SVE would provide substantive extraction considering the source area was already subject to SVE operation under an IRM. It is assumed that soil concentrations currently remain substantively above SCO's.

ISCO followed by PlumeStop® plus enhanced bioremediation, and SVE in the vicinity of source area, would be intended to result in permanent and non-reversible removal of Target CVOCs, and provide source and migration control at the Site.

5.3.12.4 Reduction of Toxicity, Mobility or Volume

The cover system would prevent mobility of Target CVOC impacted soil from migrating because access to the soil is precluded from both contact exposure and from infiltrating groundwater due to it being entrained beneath the building. The SSD system would reduce the potential for vapor intrusion in the building and thus reduce soil vapor toxicity within the Site building. This alternative does not directly address impacts to soil and therefore does not directly reduce the toxicity or volume of Target CVOCs in that media.

The toxicity, mobility and volume of contaminated groundwater are expected to be reduced over a short period of time. However, treatment may not achieve SCGs for the Target CVOCs at "hot spots" of high concentrations. This alternative would also have to rely on natural attenuation processes to remediate the impacted groundwater not intercepted by the perimeter treatment zone.

It is assumed the toxicity and volume of contaminated soil would be reduced through the application of SVE (although it is uncertain what residual mass of contaminated soil remains beneath the slab following the previous SVE IRM). However there are no current exposure pathways associated with the soil, the building (cover) limits further mobility. Though the impacts beneath the building may present a source of impact to groundwater, the presence of the building also limits infiltration of surface water through the impacted soil, which mitigates further impacts from the unsaturated zone.

5.3.12.5 Short-Term Impacts and Effectiveness

There are no short-term impacts associated with implementation of institutional controls or maintenance of existing engineering controls (SSD and cover).

There are some short term impacts associated with the perimeter treatment zone injection events and interior injection (including some limited disruption associated with re-fitting the interior wells to allow reuse for injection). Pedestrian traffic management would need to occur during injection; scheduling can be done to have the construction completed during low-traffic times of the day/week. Boreholes for injection require limited removal of potentially contaminated media from the subsurface (drilling cuttings); otherwise there is no removal of potentially contaminated media. Engineering controls would be implemented to manage dust and protect workers. Injections within the building would also have short-term impacts to facility operations and workers. If possible, interior injections would be done during off-hours.

ISCO followed by PlumeStop® with enhanced bioremediation is capable of relatively rapidly reducing overburden and bedrock groundwater concentrations and therefore reducing the potential for continued migration.

The short-term impacts that are anticipated during the implementation of the SVE system include significant disruption of facility operations to install new SVE wells, and install new piping and equipment in the active facility. It was assumed that new lateral extraction piping installed within the floor slab, and six new wells would need to be installed and connected for new SVE under this alternative. The extraction and treatment would also require new equipment, including vacuum blower and liquid/vapor separation and treatment equipment, which would be installed on the second level of the Site building. Following operation for an extended period of time and monitoring of extracted concentrations to determine reduction to an asymptotic condition, the system would be operated in a pulsed manner to improve efficiency; it is unknown whether SVE would provide substantive extraction considering the source area was already subject to SVE operation under an IRM.

In addition, some management of traffic (vehicular or pedestrian) and residual wastes would be required to varying extents within the areas where the recovery wells and subsurface apparatus would be installed as well as where the treatment system would be installed (including trenching for layout of the piping associated with conveyance of recovered soil vapor). Periodic ongoing disruption would occur associated with change-out of spent carbon vessels.

5.3.12.6 Implementability

Institutional controls are common measures that would be readily implementable especially considering Site use would not change. The SSD system has already been constructed and is operational within the Site building. The cover system consists of the building slab and pavement, which already covers the majority of the Site.

The injection of ISCO and PlumeStop® reagents is technically feasible because the planned injection locations are located within a landscaped area and through existing (to-be re-fitted wells) inside the Site building. Exterior work would not significantly impact the Site building or operations. There would be temporary interruption of operations to access, refit and complete injection through the interior former IRM SVE wells. Traffic and engineering controls would be required during installation. Interior work would be conducted during off-hours, if possible.

The installation of the SVE system is technically feasible as construction materials and equipment for implementation are readily available. The vacuum and treatment equipment would likely be installed on the upper level of the Site building. Installation of the system would likely be significantly disruptive to Site operations due to the installation of new SVE wells, construction of the subsurface infrastructure, and installation of equipment. Periodic change out of spent carbon would also be periodically disruptive to site operations.

5.3.12.7 Cost Effectiveness

Estimated cost of this alternative is presented in Table V and comprises approximately $1,130,982 in capital costs and $2,368,942 in net present value of operations and maintenance cost. The Revised feasibility study estimate of the total alternative is $3,558,542.

5.3.12.8 Land Use

Land use would be unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

5.3.12.9 Community Acceptance

Implementation of institutional controls is not anticipated to have a noticeable impact on the community as it would be primarily administrative in nature. Implementation of ISCO followed by PlumeStop® may have a short term impact to the surrounding community due to noise and/or dust associated with drilling. However, given the surrounding use of the area (non-residential), it is not anticipated that this short-term impact would have a significant or long-term negative effect on the community. Installation of the SVE system is anticipated to be significantly disruptive to the facility, but not necessarily to surrounding property. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment. Full evaluation of this criterion cannot be conducted at this time as the remedial alternatives have not been subject to public comment.

6. Comparison of Analysis of Alternatives

This section of the *Revised Feasibility Study* contains a comparative analysis of the *twelve* remedial alternatives for the Site, presented in Section 5. The nine evaluation criteria on which each alternative was evaluated are used in the comparative analysis – *incorporation of DER-31 green remediation criteria is included in the evaluation as well*. A summary of the comparative analysis is presented in Table IV.

6.1 THRESHOLD CRITERIA

The criteria below are considered threshold criteria and must be satisfied in order for an alternative to be considered for selection. All *twelve* alternatives were evaluated against the two threshold criteria and are described in the sections below. They are also summarized in Table IV.

6.1.1 Overall Protectiveness of Human Health and the Environment

Alternative 1 (no further action) is required to be evaluated by agency policy for Feasibility Study performance. *While it currently is adequately protective of human health and the environment because it maintains institutional controls that prevent completion of exposure pathways at the Site, no further action means that long-term implementation of those controls is not planned or maintained. The immediate potential for exposure to soil vapor is mitigated by the existing building slab and the SSD system. Soil, vapor and groundwater exposures are currently mitigated by the existing cover, SSD system, and groundwater use restriction. However, this alternative provides no mechanism to maintain these mechanisms, or continued off Site migration of contaminants in groundwater.*

Alternatives 2 and 7 are intended to both meet SCGs in soil and groundwater on and off-site, and by doing so would provide overall protectiveness of both human health and the environment, therefore they meet the two threshold criteria. Alternative 9 may approach SCGs in soil and groundwater, but unlike Alternative 7, it does not directly address off-Site groundwater impacts. ERH may be effective or partially effective at removing Target CVOCs from unsaturated soil.

Alternatives 3, 4, 6, 8, 11, and 12 would have similar level of adequate protectiveness of human health & the environment. The immediate exposure risk is currently mitigated by the existing cover, SSD system, and groundwater use restriction. In addition, Alternatives 3, 4, 6, 8, 11, and 12 attempt to reduce source mass in soil to below applicable SCGs for commercial use and provide a mechanism to control migration of groundwater (either through a BBZ, MPE, SVE or application of ISCO followed by PlumeStop® with enhanced bioremediation) as well as treat it, which provides for direct or indirect restoration of groundwater quality with the goal to attain TOGS 1.1.1 criteria. Alternatives 5 and 10 do not attempt to directly reduce source mass in soil but do provide a mechanism to control migration of groundwater (through a BBZ or application of PlumeStop®) as well as treat it, which provides for direct or indirect restoration of groundwater quality with the goal to attain TOGS 1.1.1 criteria. Though all of these alternatives provide mechanisms for addressing residual contaminant impacts, they would still require maintenance and operation of institutional controls and migration control mechanisms into timeframes up to and including the 30-year term conventionally evaluated for feasibility study purposes.

Alternative 2 would be protective of human health and the environment as it aims to reduce source area mass and restore both soil and groundwater to SCGs (i.e. unrestricted use SCOs, and TOGS 1.1.1 criteria for Target CVOCs both on- and off-Site. To ultimately achieve the SCGs using this technology, a considerable amount of time and potentially several re-injections of the remedial media may be required *and over a large area (a cost allowance for subsequent injection is currently considered in opinion of probable cost). Attainment of the SCGs may not be achieved within of the anticipated period time within this Revised FS, and the remedy ultimately is unlikely to meet SCGs in competent bedrock.*

Alternative 7 is also considered to be protective of human health and the environment consistent with Alternative 2 as it aims to reduce source mass and restore both soil and groundwater to SCGs (i.e. unrestricted use SCOs, and TOGS 1.1.1 criteria for Target CVOCs). Implementation of this alternative would eliminate current and future exposure to Target CVOCs. However, implementation of Alternative 7 would also have significant negative short-term impact on the environment due to significant energy and resources involved in removing the Site building, and excavating and transporting large volumes of impacted soil/fill from the Site, treatment or landfill disposal, and importing clean backfill. In addition, removal of an active commercial/industrial facility could have negative long-term impact on the community.

6.1.2 Compliance with Standards, Criteria and Guidance (SCG)

Alternative 1 would not be compliant with SCGs with respect to Target CVOCs. Though engineering controls would be used to mitigate exposure to subsurface contaminants, the Target CVOCs in the source area soils or in groundwater would not be addressed either through remediation or containment. Use of the controls would be applicable to maintaining the current absence of complete exposure pathways, although this scenario does not guarantee that existing Site controls would remain in place in perpetuity.

Alternatives 2 through 12 are all intended to be compliant with SCGs as all six of the alternatives address exposure pathways and include technologies that would directly or indirectly address contaminant mass in soil and/or groundwater, and aim to restrict off Site migration of impacted groundwater and/or restore Target CVOC concentrations to levels consistent with TOGS 1.1.1 criteria (Class GA Standards). Alternative 2, 7, and 9 would be likely to accomplish greater reduction toward SCGs given that those alternatives would ultimately reduce soil and groundwater Target CVOC concentrations to or below the applicable criteria and do not rely on migration control mechanisms. It is noted however that with regard to Alternative 2, attainment of SCGs may take more time than is assumed for purposes of this Revised FS and may require additional injections of reagent over a large area and beyond the cost allowance estimated herein to reach effectiveness. In addition, with 11 of these alternatives, other groundwater processes such as monitored natural attenuation would also need to be assumed as applicable in the future to eventually reach SCGs for groundwater.

Alternative 5 relies primarily on containment and engineering controls to mitigate exposure and continued off Site migration. This alternative does not provide a technology to directly pursue SCGs for Target CVOCs in soil; however the presence of the Site building as an engineering control is an impermeable barrier that restricts flow of storm water infiltration through the unsaturated zone of impact, which mitigates further impact to groundwater from the residual soil contaminant mass. The pumping and treatment system associated with Alternative 5 provides equivalent treatment and removal of Target CVOCs from the groundwater equivalently across Alternatives 3, 4, 5 and 8. Additionally, the BBZ component of these alternatives would act as a migration control mechanism to prevent off-Site migration over the long-term.

Use of thermal technologies in Alternatives 4, 7 and 9 rely on thermal desorption and extraction of contaminants to meet SCGs in their areas of application. They rank high in potential to meet SCGs, but due to the depths and areas where application would be necessary and the amount of heat transfer *necessary, these processes would be very disruptive and potential infeasible to implement over the areas desired and are quite energy intensive.*

Use of MPE for groundwater treatment in Alternative 6 is suitable towards achievement of SCGs in affected soil, but is less suitable and an energy intensive method to pursue SCGs in groundwater, especially in saturated bedrock, therefore it would rank relatively lower with respect to groundwater SCGs compared to the other alternatives.

Use of SVE is a common and long used technology for remediation of CVOCs in soil; it has a relatively proven track record for contaminant mass reduction in soil and has potential to meet SCGs in unsaturated soil. Insofar as SVE was used already at this site for an approximately 2-year period and met an asymptotic condition in its operation suggests there may be less mass beneath the former source area of the facility than has been assumed through the course of site investigation and work – how much contribution SVE would make to soil clean up under Alternatives 8 and 12 for the disruption and cost involved, is unknown. Likewise, use of SVE for soil treatment in Alternative 8 and 12 would be relatively energy intensive method to pursue SCGs in soil. Therefore, these two Alternatives also rank lower with respect to soil SCGs compared to other alternatives.

6.2 BALANCING CRITERIA

Alternatives 2 through 12 were further evaluated against the balancing criteria listed below. These criteria are used to compare the positive and negative aspects of each of the remedial alternatives that satisfy the threshold criteria. Alternative 1 does not satisfy the threshold criteria so it is not discussed below, however all 12 alternatives are summarized in Table IV.

6.2.1 Long-term Effectiveness and Permanence

Alternatives 2 and 7 would be the most effective and permanent solution over the long-term addressing both current and future potential human exposure and long-term risks to the environment. These alternatives do not primarily rely on engineering or institutional controls to address Target CVOCs following implementation of the remedy; as they are intended to remove the problem. In reality, it is unlikely, even with the aggressiveness of these two alternatives that all institutional and/or engineering controls could be removed; therefore they remain relatively better than remaining Alternatives, but not ultimately fully effective with respect to long-term effectiveness and permanence.

Under Alternative 2, and during remediation, other engineering controls such as the SSD system would need to remain in place to mitigate human exposure. With Alternatives 7 and potentially 9, such controls would largely be removed, but potentially replaced with more limited controls following remediation construction.

Alternatives 3, 4, 5, 6, 8, 9, 10, and 11 would all be effective over the long-term and permanent as they use a combination of technologies to control exposure, reduce mass, remove Target CVOCs from groundwater and control off Site migration of impacted groundwater. It is anticipated that alternatives 3, 4, 9, and potentially 12 may be more effective over the long-term because they address source mass in-situ, while Alternatives 6 and 12 are limited by the method of contaminant movement (disruptive and energy-intensive low or high-vacuum extraction and possibly pumping over an extended period of time) associated with the MPE and SVE approaches. Based on the infrastructure beneath the building, the soil conditions, and other factors, SVE and MPE may have limited effect, and once asymptotic conditions are *reached, an alternative technology may need to be considered at least for continued reduction (if desired) for SVE and migration control for MPE.*

Alternatives 5 and 10 would also be effective over the long-term. Though they do not aim to reduce source mass in unsaturated soil, the alternatives include mechanisms to contain the source mass on-Site and control and treat groundwater. The BBZ included in Alternative 5 would act as a long-term migration control as well as a long-term (if lower yield mass) treatment mechanism to prevent off-Site migration of water and address groundwater impacts. Under Alternative 10, the PlumeStop® injection wells would also relatively quickly limit the downgradient migration of Target CVOCs in groundwater and establish long term remediation through enhanced bioremediation. Maintenance of the building slab would serve as an impermeable cover to prevent infiltration of storm water and surface water through the unsaturated zone, which reduces further mobility to groundwater.

Alternatives 11 and 12 rely on treatment of soil and/or groundwater through application of ISCO and PlumeStop® colloidal carbon, which would reduce Target CVOCs in the short term. Long-term reduction and plume migration control would be obtained through enhanced bioremediation, which would address low-concentration Target CVOCs. The primary difference between these two Alternatives (10 and 11) is the locations of application – Alternative 11 puts treatment beneath the building in addition to along the downgradient perimeter.

Under Alternatives 6, 8 and 12, the MPE or SVE systems may have effectiveness, but based on evaluation of the previous IRM recovery, it is unclear how much additional effectiveness it would provide relative to the significant disruption and additional cost needed for its implementation.

With respect to green aspects of long-term effectiveness and permanence, these are considered relative to energy use, and sustainable factors such as implementing the solution entirely on site (avoiding movement elsewhere, ability to use renewable source s of energy, etc.).

All of the Alternatives that require electrical supply for some period of site operation and/or treatment were evaluated with respect to use of renewable energy supply to the site. In this regard all were "equal" insofar as they are in theory able to be supplied over the existing grid with renewably-generated electricity. The potential exceptions to this rule are the energy-intensive Alternatives 4, 7 an 9 – depending on the time of implementation it is possible that there may be inadequate renewable supply that could be purchased to supply to this area of the grid in order to support that green aspect of remediation.

With respect to energy use overall and avoidance of contaminant transfer to other facilities or media, Alternatives 2, 10 and 11 would rank highest; they require short-term expenditure of energy for implementation (drilling, injection) , relatively low intensity energy expenditure for periodic monitoring, and result in least transfer of contamination from the site media to off-site media. Comparatively, Alternatives 7 and 9 require the greatest amount of energy expenditure and result in the greatest transfer of mass to other media for destruction, movement to off-Site disposal or treatment locations (operations that expend fuel, generate additional safety risk and to some extent "move the problem"). Remaining alternatives (3, 4, 5, 6, 8, 12) represent levels of energy use and mass transfer to other media or facilities for treatment or disposal that are intermediate on the spectrum.

6.2.2 Reduction of Toxicity, Mobility or Volume

All eleven remaining alternatives (other than Alternative 1) would reduce toxicity, mobility, and volume of COCs at the Site, although to varying extent over time. Alternatives 2, 7 and 9 would remove the most volume and reduce mobility and toxicity over the shortest timeframes, either through direct treatment of soil and groundwater (Alternative 2, ISCR over a wide area), or removal of source mass via excavation and treatment of residual source area groundwater via a large scale treatment with thermal methods (Alternatives 7 and 9).

It is also anticipated that groundwater contaminant mass would be significantly reduced over a relatively short period of time under either Alternatives 2 or 7. Alternative 2 would remove a similar amount of volume and reduce mobility and toxicity; however it would likely require a longer period of time as it relies on in-situ technologies to break down contamination in the source area and other treated areas. Under Alternative 2 a larger treatment area and potentially multiple treatment events over time may be needed to achieve the desired result in both soil and groundwater. During that time, groundwater contamination may remain mobile and controls would need to remain in place.

Alternatives 3, 4, 6, 8 all would reduce the volume of COCs at the Site by addressing the source area and these alternatives include extraction and treatment of groundwater. These technologies include migration control via BBZ pumping and treatment or MPE, and as such they share the remedial goal of removal of contaminants in the source area. On a relative basis, they all rank lower than with Alternatives 2 and 7 (which have more stringent SCOs - unrestricted or protection of groundwater). Mobility would be reduced significantly over a short period of time in all five alternatives because of the use of migration control, which would mitigate off Site migration of impacts, though it is anticipated that the alternatives that utilize the BBZ (Alternatives 3, 4 5, and 8) would be more effective at containing off Site groundwater than the MPE (Alternative 6), because the BBZ could be placed in a more advantageous location towards the down-gradient property boundary and is a technology that has been shown to be more robust at migration control in fractured bedrock than a network of vertical wells which is how a MPE system would be applied.

Alternative 9 would also reduce the volume, mobility, and toxicity of COCs at the Site by addressing the source area (saturated and unsaturated). Sources of Target VOCs within the Site proper would be effectively remediated, leaving in place low-concentration dissolved phase constituents in the off-Site areas. It is anticipated that the mobility of the dissolved-phase constituents would be limited and that concentrations would dissipate over time due to natural attenuation processes.

Alternative 5 would reduce the volume, toxicity, and mobility of COCs in groundwater through the use of extraction and treatment, which serves both as a treatment and migration control alternative through the use of the BBZ. Similarly, Alternative 10 would reduce the volume, toxicity, and mobility of COCs in groundwater through groundwater treatment via perimeter injection wells. Alternatives 5 and 10 would not reduce the toxicity or volume of COCs in unsaturated soil, however the maintenance of the building slab as an impermeable cover reduces the mobility of the COCs and prevents further impact groundwater by preventing infiltration of storm water through the unsaturated zone.

Alternatives 11 and 12 would reduce the volume, mobility, and toxicity of Target CVOCs by addressing source material in the saturated zone through the application of ISCO reagents (Alternative 11) or application of ISCO reagents and SVE (Alternative 12). Under both scenarios, groundwater would be treated directly to reduced contaminant dissolved concentrations relatively quickly, and reduce mass *over the long-term through enhanced bioremediation. Dissolved phase constituent mass and mobility would be reduced and controlled by processes of enhanced bioremediation and natural attenuation.*

6.2.3 Short-term Impact and Effectiveness

Alternatives 2 and 3 both utilize ISCR technology, which would have limited short-term impact as this is applied in-situ and contaminants would not be brought to the surface or present an exposure. There could be significant disruption to the active facility during installation of injection points and injection events. This could be potentially mitigated through the use of horizontal drilling techniques, which would allow all or some injection events to occur outside of the building. During mixing and injection, engineering controls would be employed to protect Site workers, though the ISCR reagent is non-toxic. With respect to addressing the source area contamination in soil, it is anticipated that ISCR would have high initial short term effectiveness. As a groundwater remediation technology, it is likely to be slower due to the need for the reagent to spread within the aquifer. Multiple injections may be required to achieve desired impact.

Alternatives 4, 7 and 9also utilize in-situ thermal treatment technologies which require significantly more infrastructure in the form of heating/vacuum wells throughout the active facility and treatment equipment for extracted soil vapor. This infrastructure may require dedicated building space and would be disruptive to current operations. Likewise, Alternative 6 would also require dedicated space within the building to house the MPE infrastructure, though the footprint of the equipment is anticipated to be less than that associated with thermal technology. In addition, these alternatives result in extraction of impacted media (groundwater and/or soil vapor), which may present an exposure concern and would require treatment mechanisms for those impacted media. Though there is a high disruption impact from these Alternatives, they potentially have relatively high initial short-term effectiveness.

Alternatives 3, 4, 5, and 8 also utilize pumping and treatment technology in the form of a BBZ. Installation of the trench requires utilization of explosives to blast-fracture shallow bedrock. During blasting activities, engineering controls would need to be employed to protect Site workers and monitoring for noise, vibrations, and dust. Blasting activities would be disruptive to the Site and nearby area particularly because the BBZ trench would be placed beneath the entrance driveway to the Site. To the extent practical, blasting activities could be timed to avoid high traffic times, and the activity overall would occur over a very short duration. Once the BBZ trench is installed, impact to the Site and surrounding area would be minimal. Recovery and treatment equipment associated with the BBZ trench technology is anticipated to be a smaller footprint, and accordingly less disruptive, relative to other alternatives. Once installed, the BBZ trench is anticipated to have high initial short-term effectiveness.

Alternative 7 would have the most disruptive impact given the current operational use of on- and off-Site areas as it would require relocation of the site business and demolition of the building. In addition, excavation and removal of soils would result in significant exposure to impacted media as well as large amounts of truck traffic and other traffic related disruptions for several months during remediation and backfilling. Engineering controls would need to be employed to manage operations, traffic, dust, noise, and to protect on- and off-Site workers and the public during implementation. Following implementation, however, this alternative would be anticipated to be effective in the short-term as the source area contamination would be assumed to largely be removed to the extent practicable.

Alternatives 10, 11, and 12 utilize ISCO with PlumeStop® injections, which is represented by the product developer to have relatively rapid short-term impact as this is applied in-situ and contaminants would *not be brought to the surface or present an exposure, and the carbon content in-situ is supposed to sorb dissolved phase contaminants. There could be minor disruption to the active facility during installation of injection points and injection events. During injection, engineering controls would be employed to protect Site workers. It is anticipated that ISCO with PlumeStop® would have high initial short term effectiveness on groundwater in the source area. In addition to the PlumeStop® application, Alternative 12 would also have significant facility interior disruption if a SVE system is installed in the active facility, and also during periodic system service to change out spent carbon. It is unclear how much short-term effectiveness SVE would have beneath the building interior under Alternatives 8 and 12 – it has already been used for treatment of unsaturated soils beneath the former source location and reach asymptotic conditions in its mass removal over its approximately 2-year period of operation.*

6.2.4 Implementability

Alternatives 2 through 12 are implementable though with varying levels of difficulty.

Alternatives 2 and 3 use ISCR technology to address soil and groundwater contamination (Alternative 2 on-Site soil and the overall plume; Alternative 3 on-Site soil and groundwater beneath the Site proper). Injecting ISCR reagent beneath the active Site building may be difficult; however this may be mitigated to some extent through the use of horizontal drilling techniques on the exterior of the building. Regardless, it is anticipated that ISCR injection would be a relatively low disruption alternative to address the source area soil contamination relative to other alternatives where active soil treatment is pursued. Using ISCR to directly address groundwater impacts off Site (Alternative 2) would be difficult to implement because of the contaminant presence across both overburden and bedrock groundwater and large aerial extent of impact. A large injection area and potentially multiple injections would be required to achieve effectiveness over the whole impacted area. ISCR as a groundwater treatment technology as intended would eventually not require operations and maintenance activities, although they must remain in place unless and until the ISCR alternatives could be shown to be effective.

Alternatives 3, 4, 5, and 8 use pumping and treatment via a BBZ to address groundwater impacts, which would be designed to address groundwater in both overburden and shallow bedrock. As part of implementation of the BBZ, treatment of water would be necessary with ongoing maintenance and monitoring. Maintenance however would likely be limited and related to water treatment media (e.g. changing out carbon vessels, or periodic replenishment of ZVI, or other treatment media).

Alternatives 4, 7, and 9 also employ in-situ thermal treatment technologies, which would be difficult to implement, and likely not implementable in the active facility due to the number of heating/vacuum wells needed throughout the active facility and connections to the electrical supply. Furthermore, infrastructure within the active operating portions of the facility would have to be constructed that connect to the heating/vacuum wells and include soil vapor treatment equipment. This alternative would also require significant operations and maintenance for as long as the system is running (expected to be several months).

Alternative 6 (MPE) would also be moderate to difficult to implement within the active Site building and the need to develop infrastructure to manage impacted media extracted from the sub-surface. Ideal placement of the wells and piping to remediate soil and groundwater and act as a groundwater migration control technology would also be difficult due to the location of the source area and expanse of groundwater impact beneath the facility, the depth of bedrock and impacts across the overburden beneath the facility, and the limited demonstration of MPE as an effective migration control mechanism *(beyond remediation) in a fractured bedrock regime. Alternative 6 would also require significant operations and maintenance as long as the system is running.*

Alternatives 10 and 11 would be readily to moderately implementable since the remediation technology would consist of a limited number of injections of ISCO and PlumeStop® into subsurface soil and bedrock. Relative to other alternatives, disruption to the active facility would be relatively low; Alternative 10 would create slightly less disruption since injection points would be outside of the on-Site building, and Alternative 11 would cause some limited disruption inside the building in order to re-fit the former 6 IRM SVE wells to allow PlumeStop® injection through them. Alternative 12, which also utilizes ISCO and PlumeStop® technology, would be considerably more disruptive since this Alternative also includes the installation and continuous operation of a SVE system within the active facility.

Based on evaluation herein, Alternatives 7 and 9 would be the most difficult to implement because they would require the removal of or vacating the Site building to access the soils for removal and treatment beneath the building. The Site is currently an active commercial/industrial laundering facility. If in the future, the building were to become vacant, one of these alternatives may become a more viable option. If the building were to become vacant, this alternative is implementable with standard construction techniques, and once completed, there would likely be more limited need for further operations and maintenance activities compared to remaining Alternatives.

6.2.5 Cost *Effectiveness*

Costs are summarized on Table V. Alternatives 7 and 9 are the most expensive options, with both over $10 million dollars. Alternatives 2 through 6, 8, and 12 have a total cost ranging between $3.6 million and $9.7 million dollars assuming up to 30 years of operations and maintenance.

Alternatives 10 and 11 are the least expensive options and provide moderate to high cost effectiveness. Alternatives 10 and 11 both have total costs on the order of $2± million dollars to implement and maintain.

Alternatives 5, 10 and 11 have the lowest upfront capital costs (under $1 million) other than the no further action (Alternative 1). The remaining Alternatives have capital costs in excess of $1 million. Several Alternatives have the potential to increase in cost in the future due to the potential need to expand or increase application of a remedy if SCGs have not been achieved; these potential elements have been addressed through allowances of contingency in either Capital and/or O&M cost estimates.

Overall, Alternatives 10 and 11 have the lowest costs from a near-term capital cost and overall project cost based on the projected operations and maintenance period. Alternative 11 provides a better degree of cost effectiveness since this alternative includes additional source area treatment relative to Alternative 10.

6.2.6 Land Use

Each alternative would result in restricted commercial land use (with some degree of restrictions), which is unchanged from current use, which is commercial and industrial. The Site is located within a commercial and industrial district of the City of Rochester.

6.2.7 Community Acceptance

Community acceptance is a modifying criterion that would be evaluated after the public review period and comments are received on the Feasibility Study. While it is anticipated that community review would most receptive to alternatives that achieve SCGs with the least amount of community disturbance it is not the purpose of this FS to evaluate community acceptance and that process is the subject of the NYSDEC public participation process following its review of the alternatives.

7. Recommended Remedial Alternative

Based on the evaluations conducted for this *Revised* FS and the data presented in the RI report, Alternative 11 is recommended for implementation at the Site.

7.1 BASIS FOR RECOMMENDATION

Alternative 11 is recommended because it is: a permanent solution that adequately addresses the RAOs for the Site; intended to achieve the SCGs for the Site to the extent practicable; protective of human health and the environment; and preferred on a relative basis compared to the other alternatives for implementability without significant facility or public disruption and at an anticipated lower cost. Additionally, it is recommended over other alternatives for the following reasons:

- *The use of engineering (SSD System, cover system) and institutional controls (environmental easement; prohibition of groundwater use) are easily implementable components of this alternative and others that would mitigate/eliminate exposure from contaminated media at the Site.*

- *Alternative 11 provides treatment of contamination beneath the building without creating a high degree of disruption to the existing facility and operations. Though ISCR could potentially be injected using angled/horizontal borings from outside the building, this may limit the effectiveness of the ISCR technology. Thermal conductance heating or electrical resistance heating is not feasible in the active facility due to the required infrastructure, and both MPE and potentially BBZ would require both construction of an outbuilding to house infrastructure as well as continued operations and maintenance over the long-term. Further with MPE there is limited historical demonstration of effectiveness in fractured bedrock and as a migration control measure. Based on previous experience at the Site with the IRM SVE, the effectiveness of additional SVE or MPE to address the unsaturated soil impacts may also be limited. By maintaining the building slab as an impermeable cover system over the remaining impacted soil as prescribed in Alternative 11, it prevents infiltrations of storm water through the unsaturated zone reducing further impact to groundwater, which coupled with the migration control and treatment from the ISCO and PlumeStop® injection, is a cost effective method to protect human health and the environment and reduce exposure while the building remains in place and active.*

- *ISCO with PlumeStop® with enhanced bioremediation is recommended because it would both treat residually impacted groundwater as well as act as a relatively rapid and effective migration control method in contrast with MPE which may not be able to be ideally located to act most efficiently to control groundwater migration. Alternative 11 can also be implemented with less disruption than BBZ (which involves blasting and some greater risk to potential utility disruption). The presence of on-Site utilities may somewhat limit the reach and location of the BBZ. Because of the latter component (enhanced bioremediation), this technology acts to limit exposure and off Site migration of impacted groundwater following treatment in contrast to the ISCR only alternative, and the thermal treatment alternatives. The effectiveness of SVE for treating source material is unknown since the previous SVE system reached asymptotic removal rates.*

- *Alternative 11 is the most cost effective alternative that also is protective of human health and the environment, addresses off-Site migration, and maintains prevention of complete exposure pathways. While treatment of the unsaturated soil impacts beneath the slab may not be fully addressed by Alternative 11, the impacts are contained beneath the impermeable building slab, the added cost and Site disruption of attempting to fully treat (that is, 100% source material treatment or removal) soil impacts would not provide significant added benefit relative to the Site RAOs.*

- *Alternative 11 (and Alternative 10) represent the alternatives that are least energy intensive and result in least displacement of site contaminants to other media or other locations than the site; therefore they represent the highest ranking alternatives under NYSDEC DER-31 | Green Remediation.*

7.2 RECOMMENDED REMEDY COMPONENTS

The recommended remedy would include the following components:

- *Implementation of an Environmental Easement that would restrict future Site use to commercial or industrial uses, and add further prohibition of groundwater beyond the existing City of Rochester ordinance. The easement would be filed with the Monroe County Clerk.*
- *Continued maintenance of the existing SSD system within the building to mitigate impacts from soil vapor intrusion.*
- *Continued maintenance of the existing Site cover, which includes pavement and Site buildings. In the few areas that are not currently covered by impermeable cover, which includes a small strip of landscaped area, that area would be maintained in kind until such point it is removed. If altered, an approved cover such as impermeable layer or a demarcation layer and at least 1 foot of clean cover would be placed and maintained in that area.*
- *A system of ongoing monitoring would be established to verify that the Site engineering controls remain in place, operational as intended and track groundwater quality changes, especially the effectiveness of the selected remedy and effects of MNA within the remedy.*
- *A Site Management Plan (SMP), which includes an IC/EC plan, Excavation Management Plan, Monitoring Plan, and Operations & Maintenance Plan would be prepared for the Site, which will be tied to the Environmental Easement and provide the manual for continued operation of the Site post closure.*
- *Injections of ISCO with PlumeStop® with enhanced bioremediation would be completed in the exterior and interior portions of the active facility, utilizing existing well locations and additional drilled injection points per this Revised FS.*

Following issuance of a decision document from the NYSDEC, a detailed Remedial Action Work Plan (RAWP) would be prepared.

7.3 CONSIDERATIONS FOR CHANGE OF USE

Currently, the Site is occupied and utilized as an active business. At this time, it is anticipated that the building will continue to be used for this purpose into the reasonably anticipated future. As such, the alternatives were evaluated with respect to impact and implementability based on the current state and assumption for future use. If in the future, the building were to become unoccupied with no future intention of reuse, ranking based on those criteria could potentially change.

Other than no action, ten out of twelve of the considered alternatives would have less short-term impact and greater implementability due to the access throughout the building interior. With respect to implementability, Alternatives 4 and 9 would be relatively more viable as thermal conductance heating and electrical resistance heating could now be more readily implemented in the vacant building. In the case of Alternative 7, the building could be removed to allow for excavation, however it would remain unlikely for off-site elements of Alternative 7 to be implemented. Though these two alternatives are potentially more effective in addressing source area impacts, Alternatives 4 and 9 would remain the highest cost and require the most resources to implement. Further, both of these alternatives also remain subject to potentially higher cost than estimated herein that may result from longer duration of operation.

Alternatives 4 and 9 would not provide additional added benefit over other alternatives with similar response action outcomes, any of which can still be accomplished at a lower cost with fewer resources than Alternatives 4 and 9. Alternative 7 would provide the added benefit of reducing Site contamination to an intended unrestricted use, however the likelihood is that even this remedy would still not allow for a use less restrictive than commercial use due to conditions that existed prior to release (i.e. presence of historic fill), nor would it mitigate the potential for exposure to a greater degree than the other alternatives. The slight benefit of effectively reducing Target CVOC concentrations in soil and groundwater to unrestricted use levels would not appear to outweigh the costs, potential construction impacts and disturbance generated from implementing this alternative particularly in the absence of planned future redevelopment that would necessitate the need to remove the current Site building and conduct a large-scale excavation.

Alternatives 8, 11, and 12 would be easier to implement if the building was unoccupied, but overall effectiveness would not be improved significantly over Alternative 11. Each of the two other alternatives (8 and 12) requires access to the building for the installation of an SVE system where cost of questionable additional effectiveness over the previous SVE implementation is unknown.

Given the reasons outlined above, if the Site building were to become vacant, Alternative 11 would still appear to be the recommended remedial alternative.

8. Certification

I, Mark N. Ramsdell, P.E, certify that I am currently a NYS registered professional engineer ad defined in 6 NYCRR Part 375 and that this Feasibility Study was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) .

Mark N. Ramsdell

STATE OF NEW YORK
MARK N. RAMSDELL
71627
LICENSED PROFESSIONAL ENGINEER

1/30/17

Mark N. Ramsdell, PE
Senior Engineer

Date

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5. "Site Classification Form," dated 17 September 2009. Prepared by the New York State Department of Environmental Conservation.

6. "Voluntary Cleanup Project, Refiners Service Station Groundwater Sampling Results, Artco Industrial Laundries, Inc. Site #V00270-8," dated 27 September 2004. Prepared by the New York State Department of Environmental Conservation.

7. "Off-Site Remedial Investigation Report, Former Artco Industrial Laundries (NYSDEC Site Number C828102)," dated February 2010. Prepared by HDR.

8. "Remedial Investigation Work Plan, Former Artco Industrial Laundries Facility, 331-337 West Main Street and 1 Van Auker Street, Rochester, NY, BCP# C828102," Dated 8 August 2007,.Prepared by Environmental Products & Services of Vermont, Inc.

9. "Interim Remedial Measure Work Plan, Sub-Slab Vapor Mitigation System, Former Artco Industrial Laundries Facility, 331-337 West Main Street and 1 Van Auker Street, Rochester, NY," Dated 13 March 2008. Prepared by Environmental Products & Services of Vermont, Inc.

10. "Revised Report on Voluntary Cleanup Agreement Investigations, Artco Industrial Laundries, 333 West Main Street, Rochester, New York," Dated April 2003. Prepared by Haley and Aldrich of New York.

11. Memorandum Regarding "Summary of History, Environmental Investigations and Remediation, 333 West Main Street, Rochester, NY," Dated 23 November 2004. Prepared by Haley & Aldrich of New York.

12. Haley & Aldrich of New York, 2011. "Second Revised Remedial Investigation Work Plan" dated 30 June 2011.

13. "Revised Remedial Investigation Report, Artco Industrial Laundries, 333-337 West Main Street, Rochester, New York," Dated 9 February 2015. Prepared by Haley & Aldrich of New York.

TABLES

TABLE I - SUMMARY OF QUALITATIVE EXPOSURE ASSESSMENT
FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE
ROCHESTER, NEW YORK
SITE #828102

Media		Soil Vapor/Air						Subsurface Soil					Groundwater					
Potential Exposure[1, 2, 3]		Ingestion		Absorption		Inhalation		Ingestion		Absorption		Inhalation	Ingestion		Absorption		Inhalation	
Period		Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Current	Future	Current	Future	Current	Future
Location	Receptor																	
On-Site (Indoor)	Site Occupants	No	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No	N/A	N/A
	Construction Workers	No	No	No	No	No	**Yes**	No	**Yes**	No	**Yes**	No	No	**Yes**	No	**Yes**	N/A	N/A
Off-Site (Proximate Properties)	Property Occupant	Engineering Controls (Surface Cover/Capping)	No	No	No	No	**Yes**	No	No	No	No	No	No	No	No	No	N/A	N/A
	Construction Worker	No	No	No	No	No	**Yes**	No	No	No	No	No	No	**Yes**	No	**Yes**	N/A	N/A

Notes:
1. "n/a" = not applicable.
2. "Yes" = Potential Exposure Pathway
3. "No" = Not a Potential Exposure Pathway

TABLE I - SUMMARY OF QUALITATIVE EXPOSURE ASSESSMENT
FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE
ROCHESTER, NEW YORK
SITE #828102

Media		Sediment in Utilities						Water in Utilities					
Potential Exposure[1, 2, 3]		Ingestion		Absorption		Inhalation		Ingestion		Absorption		Inhalation	
Period		Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future
Location	Receptor												
On-Site (Indoor)	Site Occupants	No	No	No	No	N/A	N/A	No	No	No	No	N/A	N/A
	Construction Workers	No	**Yes**	No	**Yes**	N/A	N/A	No	**Yes**	No	**Yes**	N/A	N/A
Off-Site (Proximate Properties)	Property Occupant	No	No	No	No	N/A	N/A	No	No	No	No	N/A	N/A
	Construction Worker	No	**Yes**	No	**Yes**	N/A	N/A	No	**Yes**	No	**Yes**	N/A	N/A

Notes:
1. "n/a" = not applicable.
2. "Yes" = Potential Exposure Pathway
3. "No" = Not a Potential Exposure Pathway

TABLE II - SCREENING OF REMEDIAL TECHNOLOGIES
FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE
ROCHESTER, NEW YORK
SITE #828102

SOIL/FILL:

Technology	**Description**	**Conclusion**
No Further Action	No further remedial measures taken.	**Retain** as a baseline for comparison with other alternatives
Institutional Controls	Addresses potential exposure by restricting property use (environmental easement or equivalent property use restriction), and management to non-residential and through a SMP	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
Engineering Controls	Restrict exposure via physical barrier (i.e. fencing, signage, etc.)	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
Surface Cover/Capping	Maintain a cover (e.g., vegetated soil, building cover, pavement) over impacted areas	**Retain** as a stand-alone technology, and **retain** as a potential component with other technologies
In-situ Solidification/Stabilization	Reduce mobility of constituents in-place by mixing with a binding agent and solidification	**Eliminate** - difficult to implement due to actively operating facility
In-situ Biological Treatment	Reduce constituent concentrations in-place by enhancing natural biodegradation in saturated conditions	**Eliminate** - not effective at addressing unsaturated zone impacts from CVOCs
PlumeStop with Enhanced Bioremediation	Introduction of sorptive polymers to capture dissolved phase consituents and enhance biologic reductive dechlorination of CVOCs	**Eliminate** as a stand-alone technology (not effective at addressing unsaturated zone impacts from CVOCs), but **retain** as a potential component with other technologies
In-situ Chemical Oxidation (ISCO)	Chemical destruction of adsorbed constituents through injection of reagents in saturated conditions	**Eliminate** - difficult to implement due to injection node spacing within actively operating facility and does not address impacts within the unsaturated zone from CVOCs
In-situ Chemical Reduction (ISCR)	Chemical reduction of adsorbed constituents through introduction of reagents	**Retain** (as a potential component of other alternatives) directly injected zero-valent iron (ZVI) as the only mode of ISCR applicable to the unsaturated zone
Electrical Resistance Heating (ERH)	Application of electrical current in-situ to desorb and allow removal of CVOCs from saturated and unsaturated impacted soils	**Retain** vertical emplacement as a potential component to address unsaturated and saturated zone impacts. (**Eliminate** horizontal emplacement - difficult to implement in saturated zone for which surface will fluctuate).
Thermal Conductance Heating (TCH)	Application of heat in-situ to desorb and allow removal of CVOCs from saturated and unsaturated impacted soils	**Eliminate** as a stand-alone technology, but **retain** as a potential component to address unsaturated and saturated zone impacts
Excavation, On-Site Thermal Desorption and Backfill	Excavate impacted soils, treat on-site via thermal desorption, and reuse treated soil as backfill	**Eliminate** - difficult to implement excavation beneath actively operating facility due to structural restraints (1:1 slopes must be held from base of structural features) as well as with on-site thermal desorption in site setting of mixed land use
Excavation, Off-Site Treatment and Disposal	Excavate impacted soils, transport off-site for treatment and/or disposal	**Eliminate** - difficult to implement excavation beneath actively operating facility due to structural restraints (1:1 slopes must be held from base of structural features) but **retain** to satisfy program requirement to evaluate technology that could achieve future site use without the need for institutional controls
Multi-Phase Extraction (MPE)	Application of vacuum to sub-surface to increase volatilization and to remove CVOCs in vapor and liquid phase	**Retain** as a potential component with other technologies.
Soil Vapor Extraction (SVE)	Application of vacuum to sub-surface to increase volatilization and to remove CVOCs in vapor	**Retain** as a potential component with other technologies. **Eliminate** SVE in saturated soils (not effective at addressing saturated zone impacts from CVOCs).

GROUNDWATER:

Technology	Description	Conclusion
No Further Action	No remedial measures taken	**Retain** as a baseline for comparison with other alternatives
Institutional Controls	Addresses potential exposure by restricting groundwater use through environmental easement or equivalent property use restrictions and through a SMP	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
Groundwater Monitoring/Monitored Natural Attenuation (MNA)	Groundwater sampling and analyses to evaluate potential migration and natural attenuation of dissolved phase	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
In-situ Biological Treatment	Introduction of nutrients and/or substrates to enhance biologic reductive dechlorination of CVOCs	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
PlumeStop with Enhanced Bioremediation	Introduction of sorptive polymers to capture dissolved phase consituents and enhance biologiv reductive dechlorination of CVOCs	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
In-situ Chemical Oxidation (ISCO)	Chemical destruction of adsorbed and dissolved phase constituents through injection of reagents	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
In-situ Chemical Reduction (ISCR)	Chemical reduction of adsorbed constituents through introduction of reagents	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
In-situ Permeable Treatment Barrier	Emplacement of permeable barrier across contaminant plume flow path, with reagents to treat CVOCs as they pass through barrier.	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies, for impacted overburden groundwater only (not feasible for impacted groundwater in consolidated bedrock)
Electrical Resistance Heating (ERH)	Application of electrical current in-situ to desorb and allow removal of CVOCs from impacted soils and bedrock	**Retain** vertical emplacement as a potential component to address overburden and bedrock groundwater impacts. (**Eliminate** horizontal emplacement - difficult to implement in saturated zone for which surface will fluctuate).
Thermal Conductance Heating (TCH)	Application of heat in-situ to desorb and allow removal of CVOCs from groundwater and saturated, impacted soils	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies for overburden.
Hydraulic Containment/Migration Control	Use of limited groundwater extraction to provide containment of dissolved and adsorbed phase constituents	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies (will require containment mechanisms that are adequately effective for overburden and bedrock groundwater)
Groundwater Extraction and Treatment/Multi-Phase Extraction (MPE)	Groundwater extraction system with treatment and discharge	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
Physical Containment	Installation of a physical barrier (e.g., slurry wall) to provide containment of dissolved and adsorbed phase constituents	**Eliminate** - implementation constraints due to congested utilities and close building spacing limiting access for vertical barriers, and effectiveness limitations for barrier types (e.g. grout injection) in mixed fill and variably fractured bedrock).

UTILITY WATER & SOLIDS:

Technology	Description	Conclusion
No Further Action	No remedial measures taken	**Retain** as a baseline for comparison with other alternatives
Institutional Controls	Addresses potential exposure by restricting utility access/maintenance through a SMP	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
Utility Sealing	Minimizes contaminant migration in groundwater and soil vapor along utility bedding by sealing utility beds with bentonite slurry.	**Eliminate** as a stand-alone technology, but **retain** as a component with other technologies

SOIL VAPOR:

Technology	Description	Conclusion
No Further Action	No further remedial measures taken. Interim Remedial Measure (IRM) operation continues.	**Retain** as a baseline for comparison with other alternatives
Institutional Controls	Addresses potential exposure through implementation of soil vapor mitigation engineering controls under a SMP	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies
Engineering Controls	Addresses potential vapor exposure by continued operation of sub-slab depressurization system (SSDS) through a SMP	**Eliminate** as a stand-alone technology, but **retain** as a potential component with other technologies

Notes:

1. Technologies are eliminated where they are infeasible for either Site constituents or across all Site media (i.e. a stand-alone technology). Retained technologies may be effective for Site constituents within a medium, and would be combined with other technologies in evaluation of one or more alternatives.

2. SMP = Site Management Plan
3. CVOCs = Chlorinated volatile organic compounds

TABLE III - PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES
FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE
ROCHESTER, NEW YORK
SITE #828102

			THRESHOLD CRITERIA		BALANCING CRITERIA						MODIFYING CRITERION		
MEDIA	**REMEDIAL ACTION OBJECTIVES**	**APPLICABLE TECHNOLOGIES**	**Overall Protectiveness**	**Conforms to SCGs**	**Long-Term Effectiveness**	**Reduction of Toxicity, Mobility or Volume'**	**Short-Term Impact, Effectiveness**	**Implementability**	**Cost Effectiveness**	**Land Use**	**Community Acceptance**	**Retain for Further Evaluation?**	**Comments**
SOIL/FILL Surface and subsurface native soils as well as fill material impacted with Target Chlorinated Volatile Organic Compounds (CVOCs).	PUBLIC HEALTH PROTECTION: -Prevent ingestion/direct contact with contaminated soil. -Prevent inhalation of or exposure from contaminants volatizing from contaminants in soil. ENVIRONMENTAL PROTECTION: -Prevent migration of contaminants that would result in groundwater or surface water contamination. -Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.	No Further Action	NA	No	Low	None	Low	Readily Implementable	Low	Restricted Commercial	Low	Yes	Evaluate as baseline
		Institutional Controls	Moderate	Required	High	None	Low	Readily Implementable	Moderate	Restricted Commercial	Moderate	Yes	Moderately effective in preventing potential future exposure. Does not address NYSDEC requirement for source removal/reduction as a stand-alone technology. Does not attain SCGs. Unlikely acceptance to community.
		Engineering Controls (Surface Cover/Capping)	Moderate	Required	High	None	Low	Readily Implementable	High	Restricted Commercial	Low	Yes	Moderately effective in preventing potential future exposure. Does not address NYSDEC requirement for source removal/reduction as a stand-alone technology. Does not attain SCGs. Unlikely acceptance to community.
		Surface Cover/Capping	Moderate	Yes	Moderate	None	Moderate	Readily Implementable	High	Restricted Commercial	Moderate	Yes	Addresses potential direct contact/ingestion/inhalation exposures to near-surface soil.
		PlumeStop with Enhanced Bioremediation	Moderate	Yes	Moderate	Moderate	Moderate	Moderate	High	Restricted Commercial	High	Yes	Effective at reducing source area mass in saturated zone.
		In-situ Chemical Reduction (ISCR)	High	Yes	High	High	Moderate	Difficult	Moderate	Restricted Commercial	High	Yes	Effective at reducing source area mass. Moderately difficult to implement in actively operating facility.
		Electrical Resistance Heating (ERH)	High	Yes	High	High	High	Difficult	Low	Restricted Commercial	High	Yes	Effective at reducing source area mass. Difficult to implement in actively operating facility.
		Thermal Conductance Heating (TCH)	High	Yes	High	High	High	Difficult	Low	Restricted Commercial	High	Yes	Effective at reducing source area mass. Moderately difficult to implement in actively operating facility.
		Excavation, Off-Site Treatment and Disposal	High	Yes	High	High	High	Difficult	Low	Unrestricted	High	Yes	Effective at reducing source area mass. Not feasible to implement in actively operating facility.
		Multi-Phase Extraction (MPE)	High	Yes	High	High	High	Difficult	Moderate	Restricted Commercial	High	Yes	Effective at reducing source area mass. Moderately difficult to implement due to frequency of extraction wells in actively operating facility.
		Soil Vapor Extraction (SVE)	Moderate	Yes	Moderate	Moderate	Moderate	Moderate to Difficult	Moderate	Restricted Commercial	High	Yes	Effective at reducing source area mass in unsaturated zone. Moderately difficult to implement due to actively operating facility.

TABLE III - PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES
FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE
ROCHESTER, NEW YORK
SITE #828102

MEDIA	REMEDIAL ACTION OBJECTIVES	APPLICABLE TECHNOLOGIES	Overall Protectiveness	Conforms to SCGs	Long-Term Effectiveness	Reduction of Toxicity, Mobility or Volume'	Short-Term Impact, Effectiveness	Implementability	Cost Effectiveness	Land Use	Community Acceptance	Retain for Further Evaluation?	Comments
GROUNDWATER Groundwater in overburden and bedrock impacted with Target CVOCs.	PUBLIC HEALTH PROTECTION: -Prevent ingestion of groundwater with contaminated levels exceeding drinking water standards. -Prevent contact with, or inhalation of volatiles, from contaminated groundwater. ENVIRONMENTAL PROTECTION: -Restore groundwater aquifer to pre-disposal/pre-release conditions, to the extent practicable. -Prevent the discharge of contaminations to surface water. -Remove the source of ground water contamination.	No Action	NA	No	Low	None	Low	Readily Implementable	Low	Restricted Commercial	Low	Yes	Evaluate as baseline
		Institutional Controls	Low	Required	High	None	Low	Readily Implementable	Moderate	Restricted Commercial	Low	Yes	Moderately effective in preventing potential future exposure. Does not address NYSDEC requirement for source removal/reduction as a stand-alone technology. Does not attain Class GA criteria. Unlikely acceptance to community.
		Groundwater Monitoring/Monitored Natural Attenuation (MNA)	Low	No	Low	Low	Low	Readily Implementable	Moderate	Restricted Commercial	Low	No	Not effective at reducing mass. Retain as a polishing component in alternatives (e.g. post-treatment, to monitor hydraullic control, etc.)
		In-situ Biological Treatment	Low	Yes	Moderate	Moderate	Low	Moderate to Difficult	Moderate	Restricted Commercial	Moderate	No	Not effective at reducing mass at initial groundwater concentrations.
		PlumeStop with Enhanced Bioremediation	High	Yes	High	High	Moderate	Moderate	High	Restricted Commercial	Moderate	Yes	Effective at reducing source area and dissolved phase plume mass.
		In-situ Chemical Oxidation (ISCO)	Moderate	Yes	High	High	Moderate	Difficult	Low	Restricted Commercial	High	No	Only effective in overburden groundwater.
		In-situ Chemical Reduction (ISCR)	High	Yes	High	High	High	Difficult	Moderate	Restricted Commercial	High	Yes	Effective at reducing source area and dissolved phase plume mass. Moderately difficult to implement in actively operating facility.
		In-situ Permeable Treatment Barrier	Moderate	Yes	Moderate	Moderate	High	Difficult	Low	Restricted Commercial	Moderate	No	Only effective in overburden groundwater.
		Electrical Resistance Heating (ERH)	High	Yes	High	High	High	Difficult	Low	Restricted Commercial	High	Yes	Effective at addressing impacts to overburden and bedrock groundwater.
		Thermal Conductance Heating (TCH)	Moderate	Yes	Moderate	Moderate	Moderate	Difficult	Low	Restricted Commercial	Moderate	No	Only effective in bedrock groundwater due to frequency of nodes required for overburden groundwater.
		Hydraulic Containment/ Migration Control	Low	No	Low	None	Low	Moderate	Moderate	Restricted Commercial	Low	Yes	Effective at controlling further migration of groundwater contaminants.
		Groundwater Extraction and Treatment / Multi-Phase Extraction (MPE)	High	Yes	High	High	Moderate	Moderate to Difficult	Moderate	Restricted Commercial	High	Yes	Effective at restoring groundwater quality to SCG or as component of hydraulic containment to control migration of groundwater contaminants.
UTILITY WATER & SOILDS Water and solids, within sub-surface utility features, impacted with Target CVOCs.	- Prevent direct contact with contaminated utility water and solids. -Prevent releases of contaminants from utility solids that would result in surface water levels in excess of ambient water quality criteria. -Restore utility solids to pre-release/background conditions to the extent feasible.	No Action	NA	Required	Low	None	Low	Readily Implementable	Low	Restricted Commercial	Low	Yes	Evaluate as baseline
		Institutional Controls	Low	Required	High	None	Low	Readily Implementable	Moderate	Restricted Commercial	Low	Yes	Moderately effective in preventing potential future exposure.
		Utility Sealing	Moderate	No	Moderate	Moderate	Moderate	Implementable	Low	Restricted Commercial	Moderate	No	Does not mitigate impacts to sewer and does not treat or destroy impacts to sewer.
SOIL VAPOR Soil vapor impacted with Target CVOCs	-Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into site building.	No Further Action	NA	No	Low	None	Low	Readily Implementable	Low	Restricted Commercial	Low	Yes	Evaluate as baseline
		Institutional Controls	High	Required	High	High	Low	Readily Implementable	Moderate	Restricted Commercial	High	Yes	Effective in preventing potential future exposure.
		Engineering Controls	High	Required	High	High	Low	Readily Implementable	High	Restricted Commercial	High	Yes	Effective in preventing potential future exposure.

Note:
SCGs: Standards, Criteria, and Guidance

TABLE IV - SUMMARY OF REMEDIAL ACTION ALTERNATIVE ANALYSIS
FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE
ROCHESTER, NEW YORK
SITE #828102

Alternatives (with technologies): FS Criteria	**ALTERNATIVE 1** **No Further Action** Engineering Controls (SSDS) No Further Action for Soil No Further Action for Groundwater	**ALTERNATIVE 2** **Restore to Pre-Release Conditions** **Eliminate/Significantly Reduce Source and Media Mass** Institutional Controls Engineering Controls (SSDS) Maintain Cover ISCR for Soil and Groundwater	**ALTERNATIVE 3** Note B **Reduce Source Area Mass, Treat Groundwater, & Control Migration** Institutional Controls Engineering Controls (SSDS) Maintain Cover ISCR for Soil Extraction & Treatment (BBZ) for Groundwater	**ALTERNATIVE 4** Note B **Reduce Source Area Mass, Treat Groundwater, & Control Migration** Institutional Controls Engineering Controls (SSDS) Maintain Cover Thermal Conductance Heating (TCH) for Soil Extraction & Treatment (BBZ) for Groundwater	**ALTERNATIVE 5** Note B **Cap/Contain Source Area, Treat Groundwater, & Control Migration** Institutional Controls Engineering Controls (SSDS) Maintain Cover Extraction & Treatment (BBZ) for Groundwater	**ALTERNATIVE 6** Note B **Reduce Source Area Mass, Treat Groundwater, & Control Migration** Institutional Controls Engineering Controls (SSDS) Maintain Cover Extraction & Treatment (MPE) for Soil and Groundwater	**ALTERNATIVE 7** NoteA **Restore to Unsrestricted Use Conditions** **Eliminate Source and Media Mass** Excavation, Off-Site Treatment and Disposal for Soil Electrical Resistance Heating (ERH) for Groundwater No Action No Further Action
Threshold Criteria 1: **Overall Protectiveness of Human Health and the Environment**	LOW Does not further address source material or on-site and off-site impacts. Does not manage potential exposure pathways through use of Institutional Controls and application of a Site Management Plan.	HIGH Addresses source removal and remaining on-Site and off-Site impacts in soil and groundwater. Limited exposure to impacted soil and groundwater during remediation. Limited management of potential exposure pathways necessary only until remediation effective, through use of Institutional Controls and application of a Site Management Plan.	MODERATE Addresses source removal and groundwater impacts and off-Site migration of contaminants in groundwater. Limited or no exposure to impacted soil and groundwater during remediation. Management of potential exposure pathways necessarybeyond remediation, through use of Institutional Controls and application of a Site Management Plan.	MODERATE Addresses source removal and groundwater impacts and off-Site migration of contaminants in groundwater. Limited or no exposure to impacted soil and groundwater during remediation. Long-term management of potential exposure pathways necessary beyond remediation, through use of Institutional Controls and application of a Site Management Plan	LOW TO MODERATE Protective of Human Health; addresses migration of contaminants in groundwater; limited mass removal through groundwater recovery/treatment. Limited or no exposure to impacted soil and groundwater during remediation. Long-term management of potential exposure pathways necessary, through use of Institutional Controls and application of a Site Management Plan	MODERATE Addresses source removal on site and addresses migration of contaminants in groundwater. Limited or no exposure to impacted soil and groundwater during remediation. Long-term management of potential exposure pathways necessary, through use of Institutional Controls and application of a Site Management Plan	HIGH Removal of impacted soil/fill eliminates potential exposure to impacted soil/fill on-site, elimination of source of groundwater contamination and treatment of groundwater eliminates/significantly reduces potential exposure to impacted groundwater; long term soil vapor mitigation would not be required due to removal of soil/fill and reduction of groundwater impacts. Temporary exposure potential to impacted soils due to excavation and off-site transport.
Threshold Criteria 2: **Compliance with Standards, Criteria and Guidance (SCGs)**	NOT COMPLIANT SCGs not addressed	Overburden Goundwater: YES (directly on/off site) Bedrock Groundwater: MODERATE (directly on/off site) Soil/Fill: YES	Overburden Goundwater: YES (directly on site; indirect off-site) Bedrock Groundwater: MODERATE (directly on site; indirect off-site) Soil/Fill: YES	Overburden Goundwater: YES (directly on site; indirect off-site) Bedrock Groundwater: MODERATE (directly on site; indirect off-site) Soil/Fill: YES	Overburden Goundwater: MODERATE (indirect on/off-site) Bedrock Groundwater: MODERATE (directly on site; indirect off-site) Soil/Fill: NO	Overburden Goundwater: YES (directly on site; indirect off-site) Bedrock Groundwater: MODERATE (directly on site; indirect off-site) Soil/Fill: YES	Overburden Goundwater: YES (directly on/off-site) Bedrock Groundwater: YES (directly on/off-site) Soil/Fill: YES
CONSIDER FURTHER BEYOND THRESHOLD CRITERIA?	REQUIRED	YES	YES	YES	YES	YES	YES
Balancing Criteria 1: **Long-term Effectiveness and Permanence**	LOW	HIGH - Note that follow-up injections may be required in the future if asymptotic conditions have been reached at unacceptable concentrations for TCVOCs.	HIGH - assumes all elements of Alternative remain in place through remediation construction; IC's on groundwater use and possibly others would be needed long-term.	HIGH - assumes all elements of Alternative remain in place through remediation construction; IC's on groundwater use and possibly others would be needed long-term.	HIGH - migration control method is robust, requires low O&M; all elements of Alternative and IC's on all media would be needed long-term.	HIGH - assumes all elements of Alternative remain in place through remediation construction; IC's on groundwater use and possibly others would be needed long-term.	HIGH - assumes all elements of Alternative remain in place through remediation construction; IC's on groundwater use and possibly others would be needed long-term.
Balancing Criteria 2: **Reduction of Toxicity, Mobility or Volume**	NONE	Goundwater: YES Soil/Fill: YES	Goundwater: YES Soil/Fill: YES	Goundwater: YES Soil/Fill: YES	Goundwater: YES Soil/Fill: MOD - requires IC's to remain in place	Goundwater: YES Soil/Fill: YES	Goundwater: YES Soil/Fill: YES
Balancing Criteria 3: **Short-term Impact and Effectiveness**	LOW	HIGH Impact - due to implementation of ISCR beneath facility and disruption of operations MODERATE TO HIGH Short-Term Effectiveness - may take several months to years before desired reductions to overburden SCGs are achieved; moderate effectiveness from ISCR addressing off-site impacts to bedrock groundwater.	HIGH Impact - due to implementation of ISCR beneath facility and disruption of operations MODERATE TO HIGH Short-Term Effectiveness - may take several months to years before desired reductions to overburden SCGs are achieved; high effectiveness from BBZ immediatley controlling bedrock groundwater migration.	HIGH Impact - due to installation of TCH equipment in active facility, and requirement of dedicated interior space for infrastructure MODERATE TO HIGH Short-Term Effectiveness - may take several months to years before desired reductions to overburden SCGs are achieved; high effectiveness from BBZ immediatley controlling bedrock groundwater migration.	MODERATE Impact - installation of BBZ will cause limited disruption to facility outdoor operations MODERATE Short-Term Effectiveness - due to the BBZ immediately controlling bedrock groundwater but no source area treatement	HIGH Impact - due to installation of MPE equipment inside facility and requirement of new dedicated structure for infrastructure LOW to MODERATE Short-Term Effectiveness - MPE provides immediate control of overburden groundwater migration and effective at reducing overburden source area mass; limited effectiveness on bedrock migration and mass reduction	HIGH Impact - due to demolition of building structure, relocation of existing tenant, and concerns regarding dust, traffic, and noise; transport of contaminated media over road/rail also presents potential implementation impact; installation of electrical nodes off-site would require work in Main Street HIGH Short-Term Effectiveness - since source material is permanently removed and impacted groundwater is treated in the course remediation
Balancing Criteria 4: **Implementability**	READILY IMPLEMENTABLE	DIFFICULT Contaminant presence and extent across both overburden and bedrock groundwater, and under currently active facility makes remedy implementation difficult	DIFFICULT Contaminant presence across both overburden and bedrock groundwater, and under currently active facility makes remedy implementation difficult; implementation of BBZ challenging due to rock depth and nearby infrastructure	DIFFICULT Contaminant presence across both overburden and bedrock groundwater, and under active facility makes remedy implementation difficult since interior drilling will be required and infrastructure space is limited; implementation of BBZ challenging due to rock depth and nearby infrastructure	MODERATE Implementation of BBZ challenging due to rock depth and nearby infrastructure, but feasible	DIFFICULT Implementation of MPE for mass removal and migration control would be challenging due to rock depth and possible utility interferences; interior drilling at an active facility would be disruptive. A separate treatment building would be needed	DIFFICULT Excavation requires unimpeded access to sub-surface at building, requiring the relocation of the building tenant and the demolition of the building. ERH off-site is not implementable due to required infrastructure and installation in Main Street
Balancing Criteria 5: **Cost Effectiveness**	LOW/MODERATE/HIGH Capital: $0 Annual O&M: $41,000/year Total NPV of O&M: $504,000 **Total Cost: $518,000**	- MODERATE -Overall protectiveness relative to cost: MODERATE -Mass removal relative to cost: MODERATE Capital: $8,421,000 Annual O&M: $483,000/year Total NPV of O&M: $1,250,000 **Total Cost: $9,680,000**	- MODERATE -Overall protectiveness relative to cost: MODERATE -Mass removal relative to cost: MODERATE TO HIGH Capital: $1,555,000 Annual O&M: $450,000/year Total NPV of O&M: $3,107,000 **Total Cost: $4,703,000**	- MODERATE TO HIGH -Overall protectiveness relative to cost: MODERATE -Mass removal relative to cost: MODERATE TO HIGH Capital: $5,967,000 Annual O&M: $234,000/year Total NPV of O&M: $2,898,000 **Total Cost: $9,351,000**	- LOW TO MODERATE -Overall protectiveness relative to cost: MODERATE -Mass removal relative to cost: LOW Capital: $640,000 Annual O&M: $234,000/year Total NPV of O&M: $2,898,000 **Total Cost: $3,578,000**	- MODERATE -Overall protectiveness relative to cost: MODERATE -Mass removal relative to cost: MODERATE Capital: $2,060,000 Annual O&M: $369,000/year Total NPV of O&M: $2,915,000 **Total Cost: $5,100,000**	- LOW -Overall protectiveness relative to cost: LOW -Mass removal relative to cost: MODERATE Capital: $26,801,000 Annual O&M: $49,00/year Total NPV of O&M: $606,000 **Total Cost: $28,298,000**
Balancing Criteria 6: **Land Use**	-RESTRICTED COMMERCIAL	-RESTRICTED COMMERCIAL	-RESTRICTED COMMERCIAL	-RESTRICTED COMMERCIAL	-RESTRICTED COMMERCIAL	-RESTRICTED COMMERCIAL	-RESTRICTED COMMERCIAL
Modifying Criterion: **Community Acceptance***	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.

LEGEND:

	Meeting Criteria Assignment:
Green	High Ranking
Yellow	Moderate Ranking
Red	Low Ranking
Grey	Does not pass threshold criteria, no further ranking or further consideration is required by FS process.

Notes:

*- The alternatives will be presented to the public during a public comment period to gauge the level of community acceptance.

A. Analysis of alternatives in the event that the facility is vacated and/or demolished is presented in Section 7.3.

B. Technology application to overburden groundwater likely to meet SCGs; application to competent bedrock groundwater may not meet SCGs due to disconnected/poorly-connected fracture porosity and limitions posed by matrix diffusion.

TABLE IV - SUMMARY OF REMEDIAL ACTION ALTERNATIVE ANALYSIS
FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE
ROCHESTER, NEW YORK
SITE #828102

Alternatives (with technologies): **FS Criteria**	**ALTERNATIVE 8** Note B **Reduce Source Area Mass, Treat Groundwater, & Control Migration** Institutional Controls Engineering Controls (SSDS) Maintain Cover Extraction & Treatment (SVE) for Soil Extraction & Treatment (BBZ) for Groundwater	**ALTERNATIVE 9** NoteA **Reduce Source Area Mass & Treat Groundwater** Institutional Controls Maintain Cover Electrical Resistance Heating (ERH) for Soil and Groundwater	**ALTERNATIVE 10** Note B **Cap/Contain Source Area, Treat Groundwater, & Control Migration** Institutional Controls Engineering Controls (SSDS) Maintain Cover Perimeter Injection (PlumeStop with Enhanced Bioremediation) for Groundwater	**ALTERNATIVE 11** Note B **Cap/Contain Source Area, Treat Groundwater, & Control Migration** Institutional Controls Engineering Controls (SSDS) Maintain Cover Perimeter & Source Area Injection (PlumeStop with Enhanced Bioremediation) for Groundwater	**ALTERNATIVE 12** Note B **Reduce Source Area Mass, Treat Groundwater, & Control Migration** Institutional Controls Engineering Controls (SSDS) Maintain Cover Extraction & Treatment (SVE) for Soil Perimeter & Source Area Injection (PlumeStop with Enhanced Bioremediation) for Groundwater
Threshold Criteria 1: **Overall Protectiveness of Human Health and the Environment**	MODERATE Addresses source removal on site and addresses migration of contaminants in groundwater. Limited or no exposure to impacted soil and groundwater during remediation. Long-term management of potential exposure pathways necessary, through use of Institutional Controls and application of a Site Management Plan	MODERATE TO HIGH Treatment of impacted soil/fill eliminates potential exposure to impacted soil/fill on-site, elimination of source of groundwater contamination and treatment of on-site groundwater significantly reduces potential exposure to impacted groundwater; does not directly address off-site impacts to groundwater; long term soil vapor mitigation would not be required due to removal of soil/fill and reduction of groundwater impacts. Temporary exposure potential to impacted soil vapor due to thermal treatment and extraction.	LOW TO MODERATE Protective of Human Health; addresses migration of contaminants in groundwater; limited mass removal through groundwater treatment. Limited or no exposure to impacted soil and groundwater during remediation. Long-term management of potential exposure pathways necessary, through use of Institutional Controls and application of a Site Management Plan	MODERATE Protective of Human Health; addresses groundwater at source area and migration of contaminants in groundwater; treatment of groundwater significantly reduces potential exposure to impacted groundwater; Limited mass removal through groundwater treatment; Limited or no exposure to impacted soil and groundwater during remediation. Long-term management of potential exposure pathways necessary, through use of Institutional Controls and application of a Site Management Plan	MODERATE Protective of Human Health; addresses impacts to unsaturated overburden in source area, groundwater at source area, and migration of contaminants in groundwater; treatment of groundwater significantly reduces potential exposure to impacted groundwater; Limited or no exposure to impacted soil and groundwater during remediation. Long-term management of potential exposure pathways necessary, through use of Institutional Controls and application of a Site Management Plan
Threshold Criteria 2: **Compliance with Standards, Criteria and Guidance (SCGs)**	Overburden Goundwater: MODERATE (indirect on/off-site) Bedrock Groundwater: MODERATE (directly on site; indirect off-site) Soil/Fill: YES	Overburden Goundwater: YES (directly on site; indirect off-site) Bedrock Groundwater: MODERATE (directly on site; indirect off-site) Soil/Fill: YES	Overburden Goundwater: MODERATE (direct on-site; indirect off-site) Bedrock Groundwater: MODERATE (direct on-site; indirect off-site) Soil/Fill: NO	Overburden Goundwater: YES (direct on-site; indirect off-site) Bedrock Groundwater: YES (direct on-site; indirect off-site) Soil/Fill: MODERATE (addresses impacts to saturated overburden)	Overburden Goundwater: YES (direct on-site; indirect off-site) Bedrock Groundwater: YES (direct on-site; indirect off-site) Soil/Fill: YES
CONSIDER FURTHER BEYOND THRESHOLD CRITERIA?	YES	YES	YES	YES	YES
Balancing Criteria 1: **Long-term Effectiveness and Permanence**	HIGH - assumes all elements of Alternative remain in place through remediation construction; IC's on groundwater use and possibly others would be needed long-term.	HIGH - assumes all elements of Alternative remain in place through remediation construction; IC's on groundwater use and possibly others would be needed long-term.	HIGH - assumes multiple injections, migration control method is robust, requires low O&M; all elements of IC's and EC's on all media would be needed long-term.	HIGH - assumes multiple injections, migration control method is robust, requires low O&M; all elements of IC's and EC's on all media would be needed long-term.	HIGH - assumes multiple injections and pulsed operation of SVE, migration control method is robust and requires low O&M; all elements of IC's and EC's on all media would be needed long-term.
Balancing Criteria 2: **Reduction of Toxicity, Mobility or Volume**	Goundwater: YES Soil/Fill: YES	Goundwater: YES Soil/Fill: YES	Goundwater: YES Soil/Fill: MOD - requires IC's to remain in place	Goundwater: YES Soil/Fill: MOD - requires IC's to remain in place	Goundwater: YES Soil/Fill: YES
Balancing Criteria 3: **Short-term Impact and Effectiveness**	MODERATE Impact - installation of BBZ will cause limited disruption to facility outdoor operations. Retrofitting existing and installing new SVE wells and installing SVE equipment in active facility will require off-hours work. SVE equipment will require dedicated interior space MODERATE TO HIGH Short-Term Effectiveness - due to the BBZ immediately controlling bedrock groundwater and SVE reducing unsaturated overburden source area mass	HIGH Impact - due to relocation of existing tenant and/or demolition of building structure to facilitate installation of ERH equipment in source area MODERATE Short-Term Effectiveness - source material and impacted on-site groundwater is treated in the course remediation; does not directly address impacts to off-site groundwater	MODERATE Impact - installation of injection well network will cause limited disruption to facility outdoor operations. MODERATE Short-Term Effectiveness - due to the injection immediately controlling bedrock groundwater but no source area treatement.	MODERATE Impact - installation of perimeter injection well network will cause limited disruption to facility outdoor operations. Retrofitting existing SVE wells for injection will require off-hours coordination. MODERATE TO HIGH Short-Term Effectiveness - due to the reduction of source area mass in groundwater and saturated overburden, and perimeter injection immediately controlling bedrock groundwater.	HIGH Impact - installation of perimeter injection well network will cause limited disruption to facility outdoor operations. Retrofitting existing SVE wells for injection, installing new SVE wells, and installing SVE equipment in active facility will require off-hours work. SVE equipment will require dedicated interior space MODERATE TO HIGH Short-Term Effectiveness - due to reduction of mass in source area unsaturated overburden, reduction of source area groundwater mass, and perimeter injection immediately controlling bedrock groundwater.
Balancing Criteria 4: **Implementability**	MODERATE TO DIFFICULT Implementation of BBZ challenging due to rock depth and nearby infrastructure, but feasible; Implementation of SVE challenging; interior drilling and installation of equipment at active facility would be disruptive	DIFFICULT ERH requires unimpeded access to interior of building, requiring the relocation of the building tenant and/or the demolition of the building; cannot be implemented off-site due to adjacent roadway and active operations at neighboring properties	IMPLEMENTABLE Implementation of perimeter injection challenging due to drilling activities and nearby infrastructure, but feasible	IMPLEMENTABLE TO MODERATE Implementation of interior injection challenging due to active facility, but feasible; Implementation of perimeter injection challenging due to drilling activities and nearby infrastructure, but feasible	MODERATE TO DIFFICULT Implementation of SVE challenging; interior drilling and installation of equipment at active facility would be disruptive; Implementation of interior injection challenging due to active facility, but feasible; Implementation of perimeter injection challenging due to drilling activities and nearby infrastructure, but feasible
Balancing Criteria 5: **Cost Effectiveness**	- MODERATE -Overall protectiveness relative to cost: MODERATE -Mass removal relative to cost: MODERATE Capital: $1,040,000 Annual O&M: $369,000/year Total NPV of O&M: $3,996,000 **Total Cost: $5,122,000**	- LOW -Overall protectiveness relative to cost: LOW -Mass removal relative to cost: MODERATE Capital: $9,972,000 Annual O&M: $31,000/year Total NPV of O&M: $380,000 **Total Cost: $10,798,000**	- MODERATE -Overall protectiveness relative to cost: HIGH -Mass removal relative to cost: LOW Capital: $723,000 Annual O&M: $116,000/year Total NPV of O&M: $1,255,000 **Total Cost: $1,992,000**	- HIGH -Overall protectiveness relative to cost: HIGH -Mass removal relative to cost: MODERATE TO HIGH Capital: $731,000 Annual O&M: $119,000/year Total NPV of O&M: $1,270,000 **Total Cost: $2,015,000**	- LOW -Overall protectiveness relative to cost: LOW -Mass removal relative to cost: LOW TO MODERATE Capital: $1,131,000 Annual O&M: $254,000/year Total NPV of O&M: $2,369,000 **Total Cost: $3,559,000**
Balancing Criteria 6: **Land Use**	-RESTRICTED COMMERCIAL	-RESTRICTED COMMERCIAL	-RESTRICTED COMMERCIAL	-RESTRICTED COMMERCIAL	-RESTRICTED COMMERCIAL
Modifying Criterion: **Community Acceptance***	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.	Full evaluation of this criterion cannot be completed at this time, as the remedial alternatives have not been subjected to public comment.

LEGEND:	**Meeting Criteria Assignment:**
(green)	High Ranking
(yellow)	Moderate Ranking
(red)	Low Ranking
(grey)	Does not pass threshold criteria, no further ranking or further consideration is required by FS process.

Notes:
*- The alternatives will be presented to the public during a public comment period to gauge the level of community acceptance.
A. Analysis of alternatives in the event that the facility is vacated and/or demolished is presented in Section 7.3.
B. Technology application to overburden groundwater likely to meet SCGs; application to competent bedrock groundwater may not meet SCGs due to disconnected/poorly-connected fracture porosity and limitions posed by matrix diffusion.

TABLE V - SUMMARY OF REMEDIAL ACTION ALTERNATIVE COSTS
FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE
ROCHESTER, NEW YORK
SITE #828102

		Page in Appendix B	OPINION OF PROBABLE COSTS					
			Capital Costs	Annual O&M Costs	Present Worth of O&M	Subtotal Alternative Cost	Present Worth of Renewable Electrical	TOTAL ALTERNATIVE COST
ALTERNATIVE 1 : NO FURTHER ACTION WITH INSTITUTIONAL CONTROLS								
Soil Vapor	Engineering Controls (SSDS)	SV-SSDS 30	$ -	$ 40,632	$ 504,202	$ 504,202	$ 13,588	
Soil	No Further Action	--	$ -	$ -	$ -	$ -		
Groundwater	No Further Action	--	$ -	$ -	$ -	$ -		
Utilities	No Further Action	--	$ -	$ -	$ -	$ -		
TOTAL			**$ -**	**$ 40,632**	**$ 504,202**	**$ 504,202**	$ 13,588	**$ 517,790**
ALTERNATIVE 2: PRE-RELEASE CONDITIONS - ELIMINATE/SIGNIFICANTLY REDUCE SOURCE and MEDIA MASS								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000	$ 3,000	$ 37,227	$ 58,227		
Soil Vapor	Engineering Controls (SSDS)	SV-SSDS 10	$ -	$ 40,632	$ 304,699	$ 304,699	$ 8,211	
Soil	Maintain Cover	S-Cover	$ 3,500	$ 9,948	$ 123,445	$ 126,945		
Soil	In-Situ Chemical Reduction (ISCR)	S-ISCR (alt 2)	$ 1,650,150	$ 386,297	$ 330,627	$ 1,980,777		
Groundwater	In-Situ Chemical Reduction (ISCR)	G-ISCR	$ 6,724,000	$ 15,824	$ 111,141	$ 6,835,141		
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500	$ 27,656	$ 343,183	$ 365,683		
TOTAL			**$ 8,421,150**	**$ 483,357**	**$ 1,250,322**	**$ 9,671,472**	**$ 8,211**	**$ 9,679,684**
ALTERNATIVE 3: REDUCE SOURCE MASS, CONTROL MIGRATION								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000	$ 3,000	$ 37,227	$ 58,227		
Soil Vapor	Engineering Controls (SSDS)	SV-SSDS 30	$ -	$ 40,632	$ 504,202	$ 504,202	$ 13,588	
Soil	Maintain Cover	S-Cover	$ 3,500	$ 9,948	$ 123,445	$ 126,945		
Soil	In-Situ Chemical Reduction (ISCR)	S-ISCR (alt 3)	$ 914,850	$ 216,297	$ 209,417	$ 1,124,267		
Groundwater	Extraction & Treatment (BBZ)	G-BBZ	$ 593,195	$ 152,264	$ 1,889,444	$ 2,482,639	$ 27,176	
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500	$ 27,656	$ 343,183	$ 365,683		
TOTAL			**$ 1,555,045**	**$ 449,797**	**$ 3,106,918**	**$ 4,661,964**	**$ 40,764**	**$ 4,702,727**
ALTERNATIVE 4: REDUCE SOURCE MASS, CONTROL MIGRATION								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000	$ 3,000	$ 37,227	$ 58,227		
Soil Vapor	Engineering Controls (SSDS)	SV-SSDS 30	$ -	$ 40,632	$ 504,202	$ 504,202	$ 13,588	
Soil	Maintain Cover	S-Cover	$ 3,500	$ 9,948	$ 123,445	$ 126,945		
Soil	In-Situ Thermal Treatment (TCH)	S-In-Situ Thermal	$ 5,326,542	$ -	$ -	$ 5,326,542	$ 445,500	
Groundwater	Extraction & Treatment (BBZ)	G-BBZ	$ 593,195	$ 152,264	$ 1,889,444	$ 2,482,639	$ 27,176	
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500	$ 27,656	$ 343,183	$ 365,683		
TOTAL			**$ 5,966,737**	**$ 233,500**	**$ 2,897,502**	**$ 8,864,239**	**$ 486,264**	**$ 9,350,502**

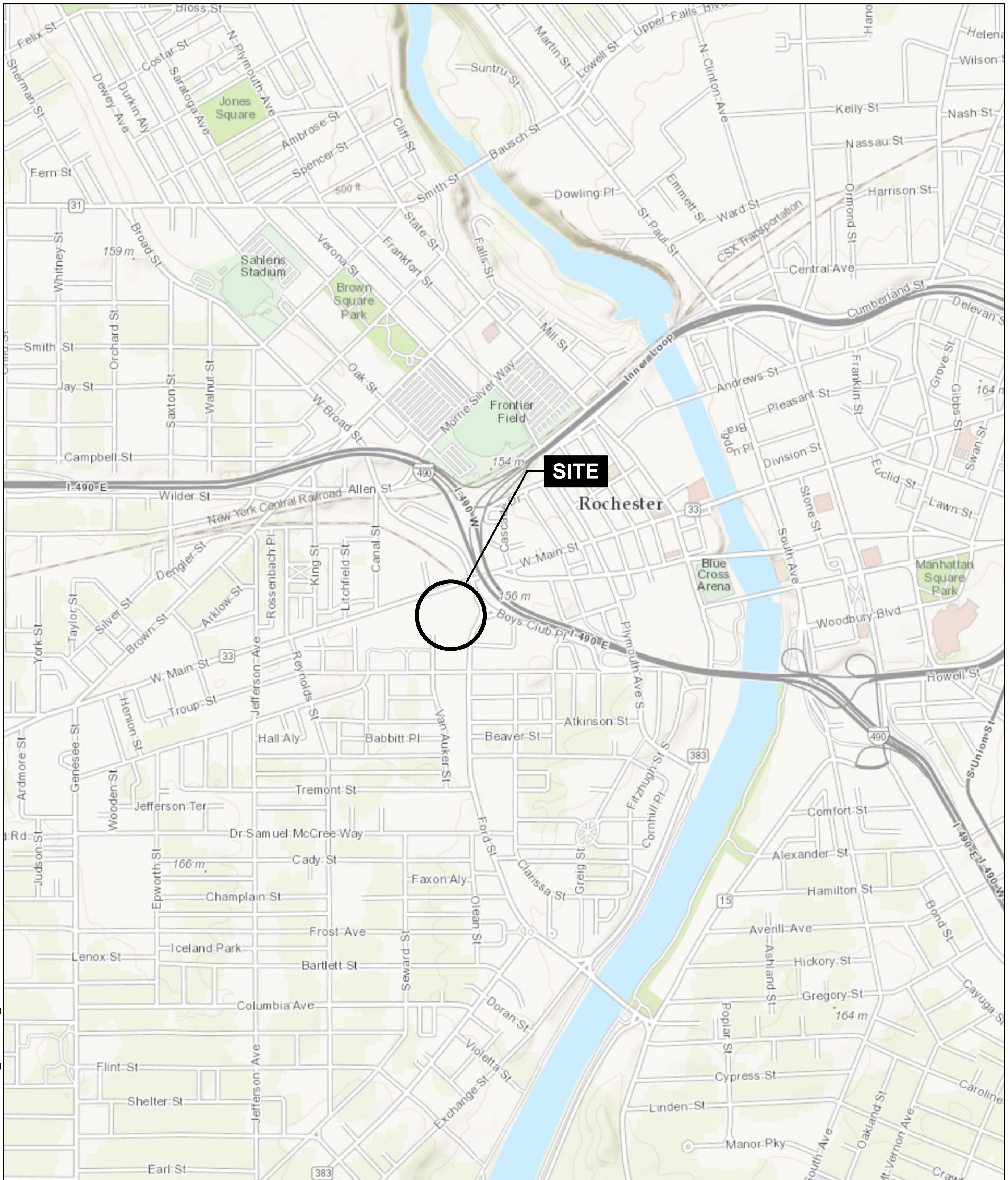
TABLE V - SUMMARY OF REMEDIAL ACTION ALTERNATIVE COSTS
FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE
ROCHESTER, NEW YORK
SITE #828102

			OPINION OF PROBABLE COSTS					
		Page in Appendix B	Capital Costs	Annual O&M Costs	Present Worth of O&M	Subtotal Alternative Cost	Present Worth of Renewable Electrical	TOTAL ALTERNATIVE COST
ALTERNATIVE 5: CAP/CONTAIN SOURCE AREA, CONTROL MIGRATION								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000	$ 3,000	$ 37,227	$ 58,227		
Soil Vapor	Engineering Controls (SSDS)	SV-SSDS 30	$ -	$ 40,632	$ 504,202	$ 504,202	$ 13,588	
Soil	Maintain Cover	S-Cover	$ 3,500	$ 9,948	$ 123,445	$ 126,945		
Groundwater	Extraction & Treatment (BBZ)	G-BBZ	$ 593,195	$ 152,264	$ 1,889,444	$ 2,482,639	$ 27,176	
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500	$ 27,656	$ 343,183	$ 365,683		
TOTAL			**$ 640,195**	**$ 233,500**	**$ 2,897,502**	**$ 3,537,697**	**$ 40,764**	**$ 3,578,460**
ALTERNATIVE 6: REDUCE SOURCE AREA MASS, CONTROL MIGRATION								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000.0	$ 3,000.0	$ 37,227.0	$ 58,227.0		
Soil Vapor	Engineering Controls (SSDS)	SV-SSDS 10,20	$ -	$ 40,632.0	$ 391,285.5	$ 391,285.5	$ 9,493	
Soil	Maintain Cover	S-Cover	$ 3,500.0	$ 9,948.0	$ 123,444.7	$ 126,944.7		
Soil/Groundwater	Multi-Phase Extraction	S-MPE	$ 2,012,720.0	$ 287,558.8	$ 2,019,813.0	$ 4,032,533.0	$ 115,369	
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500.0	$ 27,656.0	$ 343,183.3	$ 365,683.3		
TOTAL			**$ 2,059,720**	**$ 368,795**	**$ 2,914,954**	**$ 4,974,674**	**$ 124,863**	**$ 5,099,536**
ALTERNATIVE 7: UNRESTRICTED USE								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000	$ 3,000	$ 37,227	$ 58,227		
Soil	Maintain Cover	S-Cover	$ 3,500	$ 9,948	$ 123,445	$ 126,945		
Soil	Excavation and Off-Site Treatment	S-Exc	$ 7,700,829	$ 8,200	$ 101,754	$ 7,802,583		
Groundwater	Thermal Treatment (ERH) of Saturated Zone	ERH On & Offsite	$ 19,053,472.0	$ -	$ -	$ 19,053,472.0	$ 891,000	
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500	$ 27,656	$ 343,183	$ 365,683		
TOTAL			**$ 26,801,301**	**$ 48,804**	**$ 605,609**	**$ 27,406,910**	**$ 891,000**	**$ 28,297,910**
ALTERNATIVE 8: SVE WITH GWE&T								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000	$ 3,000	$ 37,227	$ 58,227		
Soil	Maintain Cover	S-Cover	$ 3,500	$ 9,948	$ 123,445	$ 126,945		
Soil Vapor	Engineering Controls (SSDS)	SV-SSDS 15,15	$ -	$ 40,632	$ 367,058	$ 367,058	$ 8,615	
Soil Vapor	Soil Vapor Extraction	SV-SVE	$ 399,784	$ 135,662	$ 1,235,605	$ 1,635,389	$ 50,003	
Groundwater	Extraction & Treatment (BBZ)	G-BBZ	$ 593,195	$ 152,264	$ 1,889,444	$ 2,482,639	$ 27,176	
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500	$ 27,656	$ 343,183	$ 365,683		
TOTAL			**$ 1,039,979**	**$ 369,162**	**$ 3,995,962**	**$ 5,035,941**	**$ 85,794**	**$ 5,121,734**

TABLE V - SUMMARY OF REMEDIAL ACTION ALTERNATIVE COSTS
FEASIBILITY STUDY
ARTCO INDUSTRIAL LAUNDRIES SITE
ROCHESTER, NEW YORK
SITE #828102

		Page in Appendix B	OPINION OF PROBABLE COSTS Capital Costs	Annual O&M Costs	Present Worth of O&M	Subtotal Alternative Cost	Present Worth of Renewable Electrical	TOTAL ALTERNATIVE COST
ALTERNATIVE 9: IN-SITU THERMAL REMEDIATION								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000.0	$ 3,000.0	$ 37,227.0	$ 58,227.0		
Soil & Groundwater	Thermal Treatment (ERH) of Un-/Saturated Zones	ERH On-Site	$ 9,928,092	$ -	$ -	$ 9,928,092	$ 445,500	
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500.0	$ 27,656.0	$ 343,183.3	$ 365,683.3		
TOTAL			**$ 9,971,592**	**$ 30,656**	**$ 380,410**	**$ 10,352,002**	**$ 445,500**	**$ 10,797,502**
ALTERNATIVE 10: PLUME STOP PLUS ENHANCED BIOREMEDIATION FOR MIGRATION CONTROL								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000.0	$ 3,000.0	$ 37,227.0	$ 58,227.0		
Soil Vapor	Engineering Controls (SSDS)	SV-SSDS 30	$ -	$ 40,632.0	$ 504,202.5	$ 504,202.5	$ 13,588	
Soil	Maintain Cover	S-Cover	$ 3,500.0	$ 9,948.0	$ 123,444.7	$ 126,944.7		
Groundwater	Plume Stop + Bioremediation for Perimeter	G-PS_Perim	$ 675,607.3	$ 35,219.3	$ 247,380.1	$ 922,987.4		
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500.0	$ 27,656.0	$ 343,183.3	$ 365,683.3		
TOTAL			**$ 722,607**	**$ 116,455**	**$ 1,255,438**	**$ 1,978,045**	**$ 13,588**	**$ 1,991,633**
ALTERNATIVE 11: PLUME STOP PLUS ENHANCED BIOREMEDIATION FOR SOURCE CONTROL AND MIGRATION CONTROL								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000	$ 3,000	$ 37,227	$ 58,227		
Soil	Maintain Cover	S-Cover	$ 3,500	$ 9,948	$ 123,445	$ 126,945		
Soil Vapor	Engineering Controls (SSDS)	SV-SSDS 30	$ -	$ 40,632	$ 504,202	$ 504,202	$ 13,588	
Groundwater	Plume Stop + Bioremediation for Source & Perimeter	G-PS_Perim+Int	$ 684,198	$ 37,361	$ 262,425	$ 946,623		
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500	$ 27,656	$ 343,183	$ 365,683		
TOTAL			**$ 731,198**	**$ 118,597**	**$ 1,270,482**	**$ 2,001,680**	**$ 13,588**	**$ 2,015,268**
ALTERNATIVE 12: SVE WITH PLUME STOP PLUS ENHANCED BIOREMEDIATION								
Site	Institutional Control/Land Use Restriction	S-LUR	$ 21,000	$ 3,000	$ 37,227	$ 58,227		
Soil Vapor	Engineering Controls (SSDS)	SV-SSDS 15,15	$ -	$ 40,632	$ 367,058	$ 367,058	$ 8,615	
Soil Vapor	Soil Vapor Extraction	SV-SVE	$ 399,784	$ 135,662	$ 1,235,605	$ 1,635,389	$ 50,003	
Soil	Maintain Cover	S-Cover	$ 3,500	$ 9,948	$ 123,445	$ 126,945		
Groundwater	Plume Stop + Bioremediation for Source & Perimeter	G-PS_Perim+Int	$ 684,198	$ 37,361	$ 262,425	$ 946,623		
Groundwater	Post Remediation Groundwater Monitoring	G-PRM	$ 22,500	$ 27,656	$ 343,183	$ 365,683		
TOTAL			**$ 1,130,982**	**$ 254,259**	**$ 2,368,942**	**$ 3,499,925**	**$ 58,618**	**$ 3,558,542**

FIGURES



MAP SOURCE: ESRI
SITE COORDINATES: 43° 9'11.88"N, 77°37'15.82"W

HALEY ALDRICH

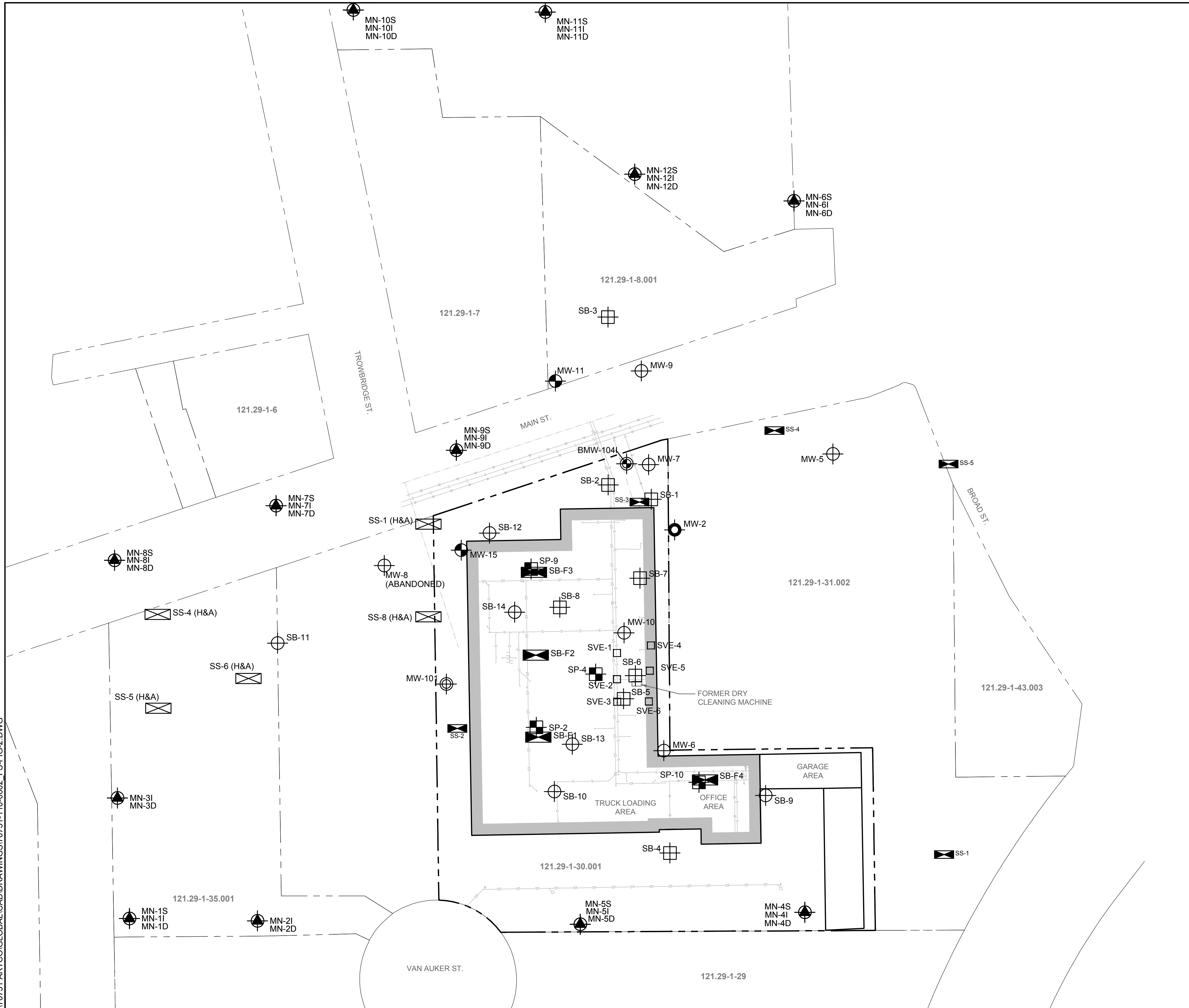
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
MARCH 2016

FIGURE 1

GIS FILE PATH: G:\70751 ARTCO\Global\GIS\MAPS\70751-000-001_PROJECT_LOCUS.mxd — USER: GKM — LAST SAVED: 4/1/2016 9:48:09 AM



LEGEND

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
- BEDROCK WELL (HALEY & ALDRICH, 2001)
- BEDROCK WELL (HALEY & ALDRICH, 2013)
- OVERBURDEN WELL (HALEY & ALDRICH, 2001 AND NYSDEC, 1998)
- OVERBURDEN WELL (HALEY & ALDRICH, 2013)
- BEDROCK/OVERBURDEN INTERVAL WELL (SEELER, ENV., 1993)
- OVERBURDEN SOIL BORING (NYDEC, 1998)
- OVERBURDEN SOIL BORING (HALEY & ALDRICH, 2011)
- SOIL VAPOR EXTRACTION WELL
- SURFACE SOIL SAMPLE (HALEY & ALDRICH 2001)
- SURFACE SOIL SAMPLE (NYDEC 1998)

NOTES

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
2. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.

HALEY ALDRICH

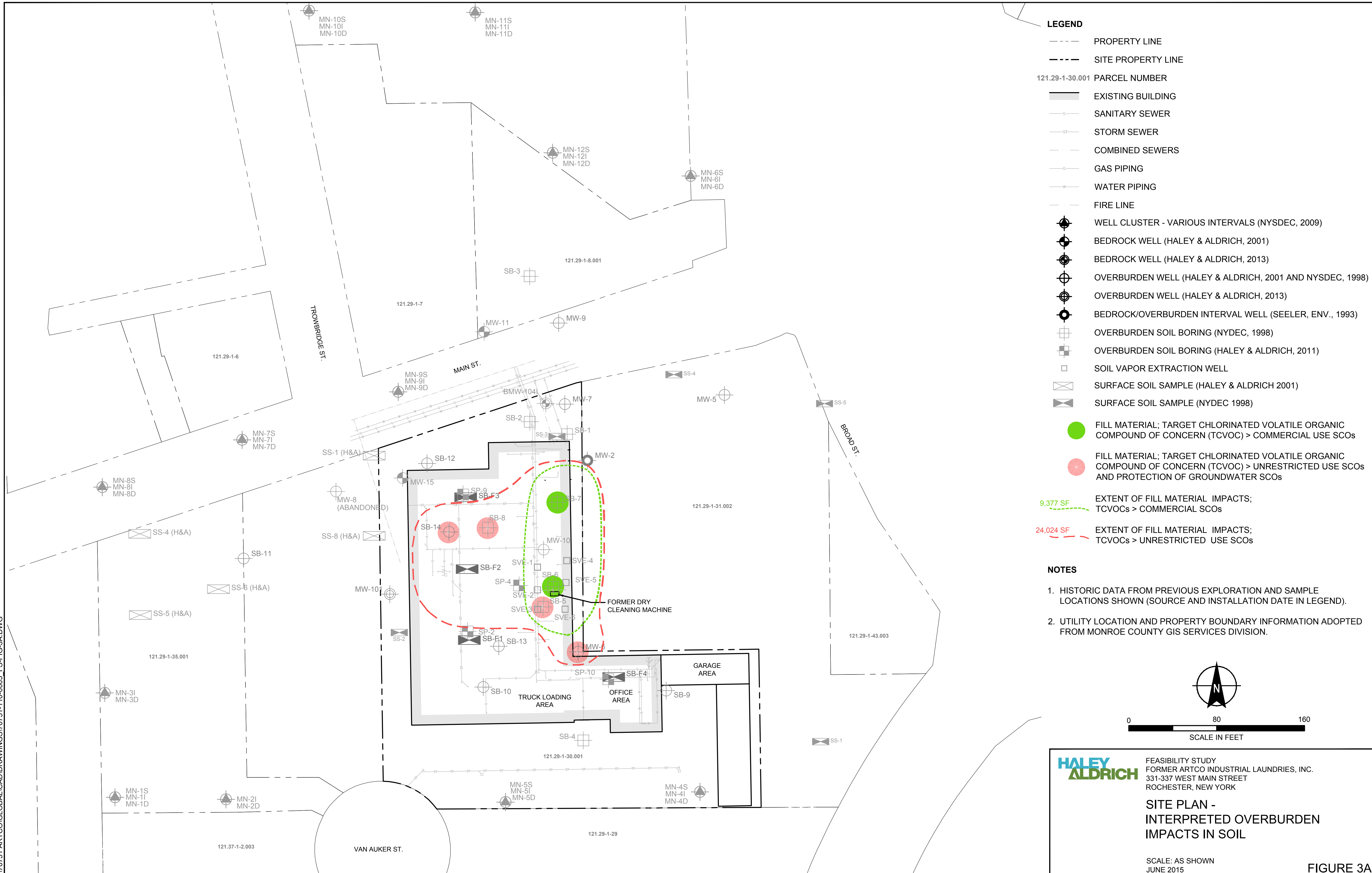
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

INVESTIGATION LOCATION PLAN

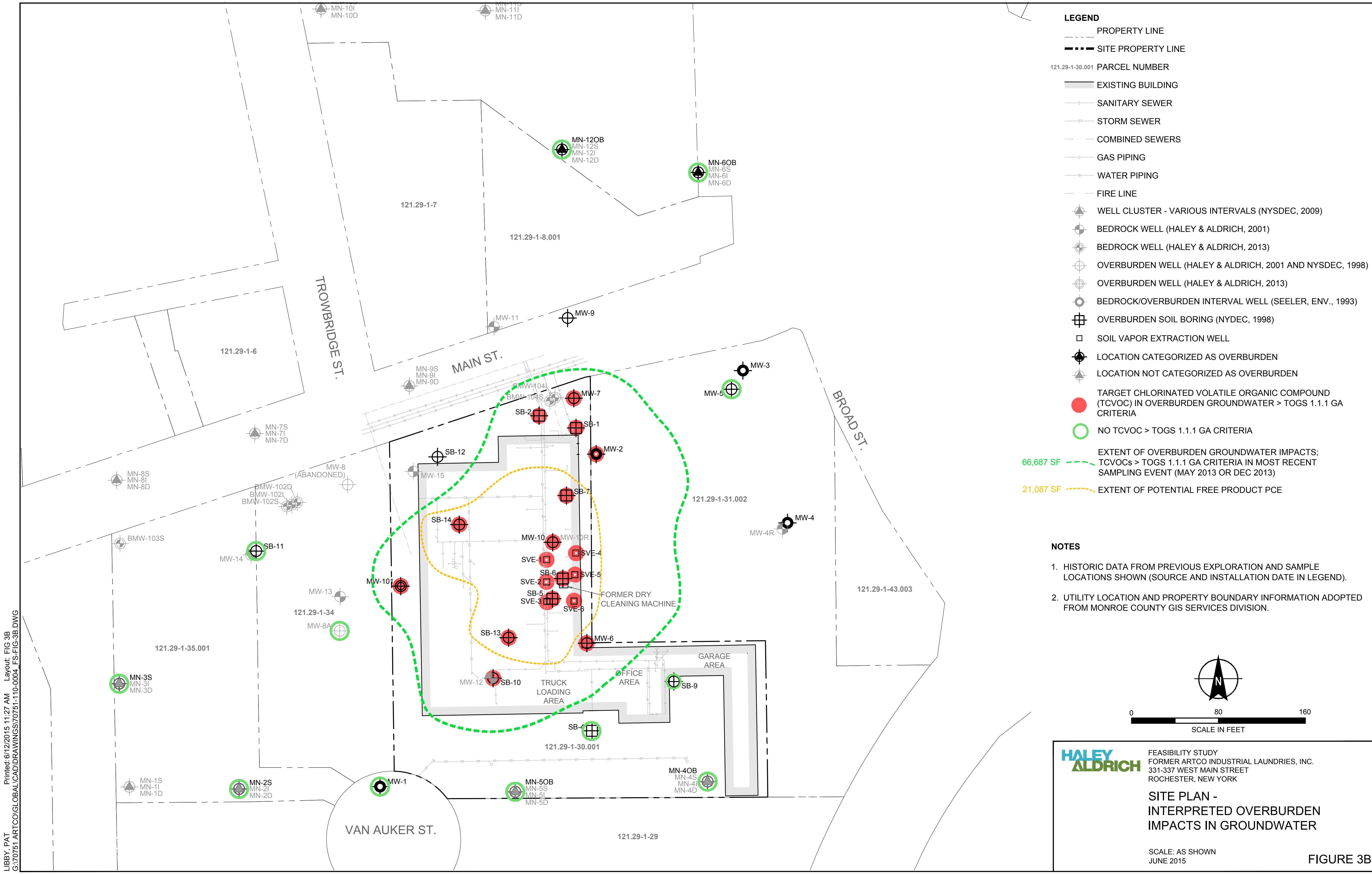
SCALE: AS SHOWN
JUNE 2015

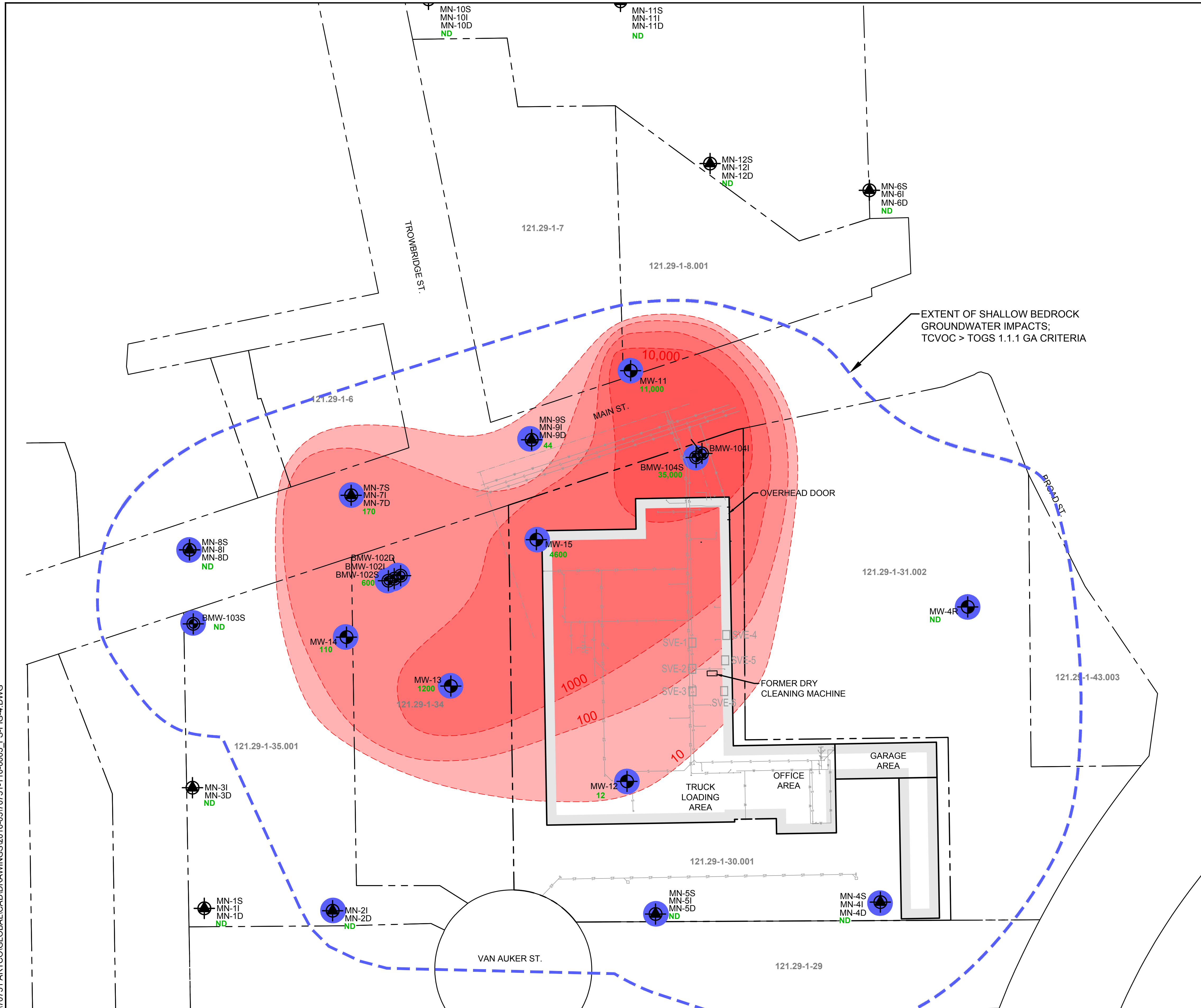
FIGURE 2

LIBBY, PAT
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\70751-110-0002_FS-FIG-2.DWG
Printed: 6/12/2015 11:16 AM Layout: FS-FIG 2



LIBBY, PAT
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\70751-110-0003_FS-FIG-3A.DWG
Printed: 6/12/2015 11:18 AM Layout: FIG 3A


LEGEND
PROPERTY LINE
SITE PROPERTY LINE
121.29-1-30.001 PARCEL NUMBER
EXISTING BUILDING
SANITARY SEWER
STORM SEWER
COMBINED SEWERS
GAS PIPING
WATER PIPING
FIRE LINE
WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
BEDROCK WELL (HALEY & ALDRICH, 2001)
BEDROCK WELL (HALEY & ALDRICH, 2013)
OVERBURDEN WELL (HALEY & ALDRICH, 2001 AND NYSDEC, 1998)
OVERBURDEN WELL (HALEY & ALDRICH, 2013)
BEDROCK/OVERBURDEN INTERVAL WELL (SEELER, ENV., 1993)
OVERBURDEN SOIL BORING (NYDEC, 1998)
SOIL VAPOR EXTRACTION WELL
LOCATION CATEGORIZED AS OVERBURDEN
LOCATION NOT CATEGORIZED AS OVERBURDEN
TARGET CHLORINATED VOLATILE ORGANIC COMPOUND (TCVOC) IN OVERBURDEN GROUNDWATER > TOGS 1.1.1 GA CRITERIA
NO TCVOC > TOGS 1.1.1 GA CRITERIA
66,687 SF EXTENT OF OVERBURDEN GROUNDWATER IMPACTS; TCVOCs > TOGS 1.1.1 GA CRITERIA IN MOST RECENT SAMPLING EVENT (MAY 2013 OR DEC 2013)
21,087 SF EXTENT OF POTENTIAL FREE PRODUCT PCE
NOTES
1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
2. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.
N
0 80 160
SCALE IN FEET
MAIN ST.
TROWBRIDGE ST.
BROAD ST.
VAN AUKER ST.
FORMER DRY CLEANING MACHINE
TRUCK LOADING AREA
OFFICE AREA
GARAGE AREA
121.29-1-7
121.29-1-8.001
121.29-1-6
121.29-1-31.002
121.29-1-43.003
121.29-1-34
121.29-1-35.001
121.29-1-30.001
121.29-1-29
MN-12OB MN-12S MN-12I MN-12D
MN-6OB MN-6S MN-6I MN-6D
MW-9
MW-11
MN-9S MN-9I MN-9D
MW-3
MW-5
MW-7
SB-2
SB-1
MW-2
SB-12
MN-7S MN-7I MN-7D
MN-8S MN-8I MN-8D
MW-8 (ABANDONED)
MW-15
BMW-102D BMW-102I BMW-102S
SB-7
SB-14
MW-4
MW-4R
MW-10
MW-10R
SVE-1
SVE-4
SVE-2
SB-6
SVE-5
SB-5
SVE-3
SVE-6
BMW-103S
SB-11
MW-14
MW-101
MW-13
MW-8A
SB-13
MW-6
MN-3S MN-3I MN-3D
MW-12
SB-10
SB-9
SB-4
MN-1S MN-1I MN-1D
MN-2S MN-2I MN-2D
MW-1
MN-5OB MN-5S MN-5I MN-5D
MN-4OB MN-4S MN-4I MN-4D
HALEY ALDRICH
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK
SITE PLAN - INTERPRETED OVERBURDEN IMPACTS IN GROUNDWATER
SCALE: AS SHOWN
JUNE 2015
FIGURE 3B
LIBBY, PAT
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\70751-110-0004_FS-FIG-3B.DWG
Printed: 6/12/2015 11:27 AM Layout: FIG 3B



LEGEND

- PROPERTY LINE
- SITE PROPERTY LINE
- PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
- BEDROCK WELL (HALEY & ALDRICH, 2001)
- BEDROCK WELL (HALEY & ALDRICH, 2013)
- SOIL VAPOR EXTRACTION WELL
- TARGET CHLORINATED VOLATILE ORGANIC COMPOUND (TCVOC) IN SHALLOW BEDROCK > TOGS 1.1.1 GA CRITERIA
- EXTENT OF SHALLOW BEDROCK GROUNDWATER IMPACTS; TCVOC > TOGS 1.1.1 GA CRITERIA (AREA = 329,687 SF)
- 600 — PCE CONCENTRATION POSTED FROM MOST RECENT SAMPLING RESULTS (MAY 2013 OR DECEMBER 2013)
- ND — PCE NOT DETECTED IN MOST RECENT SAMPLING RESULTS (MAY 2013 OR DECEMBER 2013)

PCE ISOCONCENTRATION CONTOURS INTERPRETED FROM MOST RECENT DATA (MAY 2013 OR DECEMBER 2013)

- PCE ≥10 PPB (AREA =118,226 SF)
- PCE ≥ 100 PPB (AREA = 90,008 SF)
- PCE ≥ 1,000 PPB (AREA = 49,711 SF)
- PCE ≥ 10,000 PPB (AREA = 12,488 SF)

NOTES

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
2. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.

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SCALE IN FEET

HALEY ALDRICH

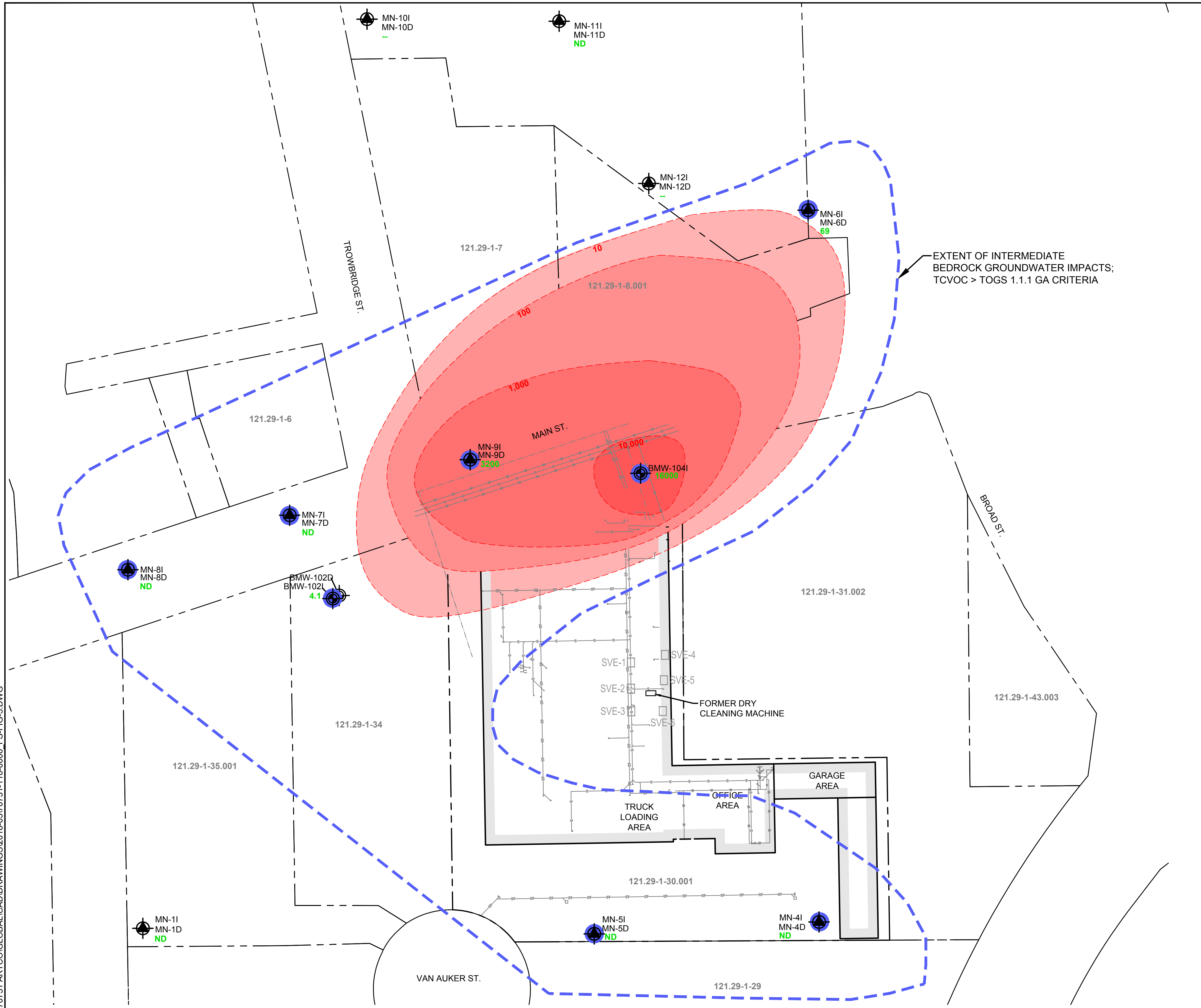
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

SITE PLAN WITH INTERPRETED SHALLOW BEDROCK IMPACTS

SCALE: AS SHOWN
MARCH 2016

FIGURE 4

MOBINI, GITA Printed: 3/18/2016 11:10 AM Layout: FIG 4
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0005_FS-FIG-4.DWG



LEGEND

- PROPERTY LINE
- SITE PROPERTY LINE
- PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
- BEDROCK WELL (HALEY & ALDRICH, 2001)
- BEDROCK WELL (HALEY & ALDRICH, 2013)
- SOIL VAPOR EXTRACTION WELL
- TARGET CHLORINATED VOLATILE ORGANIC COMPOUND (TCVOC) IN INTERMEDIATE BEDROCK > TOGS 1.1.1 GA CRITERIA
- EXTENT OF INTERMEDIATE BEDROCK GROUNDWATER IMPACTS; TCVOC > TOGS 1.1.1 GA CRITERIA (AREA = 241,365 SF)
- 600 — PCE CONCENTRATION POSTED FROM MOST RECENT SAMPLING RESULTS (MAY 2013 OR DECEMBER 2013)
- ND — PCE NOT DETECTED IN MOST RECENT SAMPLING RESULTS (MAY 2013 OR DECEMBER 2013)
- -- — NOT SAMPLED IN MAY 2013 OR DECEMBER 2013

PCE ISOCONCENTRATION CONTOURS INTERPRETED FROM MOST RECENT DATA (MAY 2013 OR DECEMBER 2013)

- PCE ≥10 PPB (AREA = 125,347 SF)
- PCE ≥ 100 PPB (AREA = 77,350 SF)
- PCE ≥ 1,000 PPB (AREA = 36,834 SF)
- PCE ≥ 10,000 PPB (AREA = 3,684 SF)

NOTES

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
2. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.

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SCALE IN FEET

HALEY ALDRICH

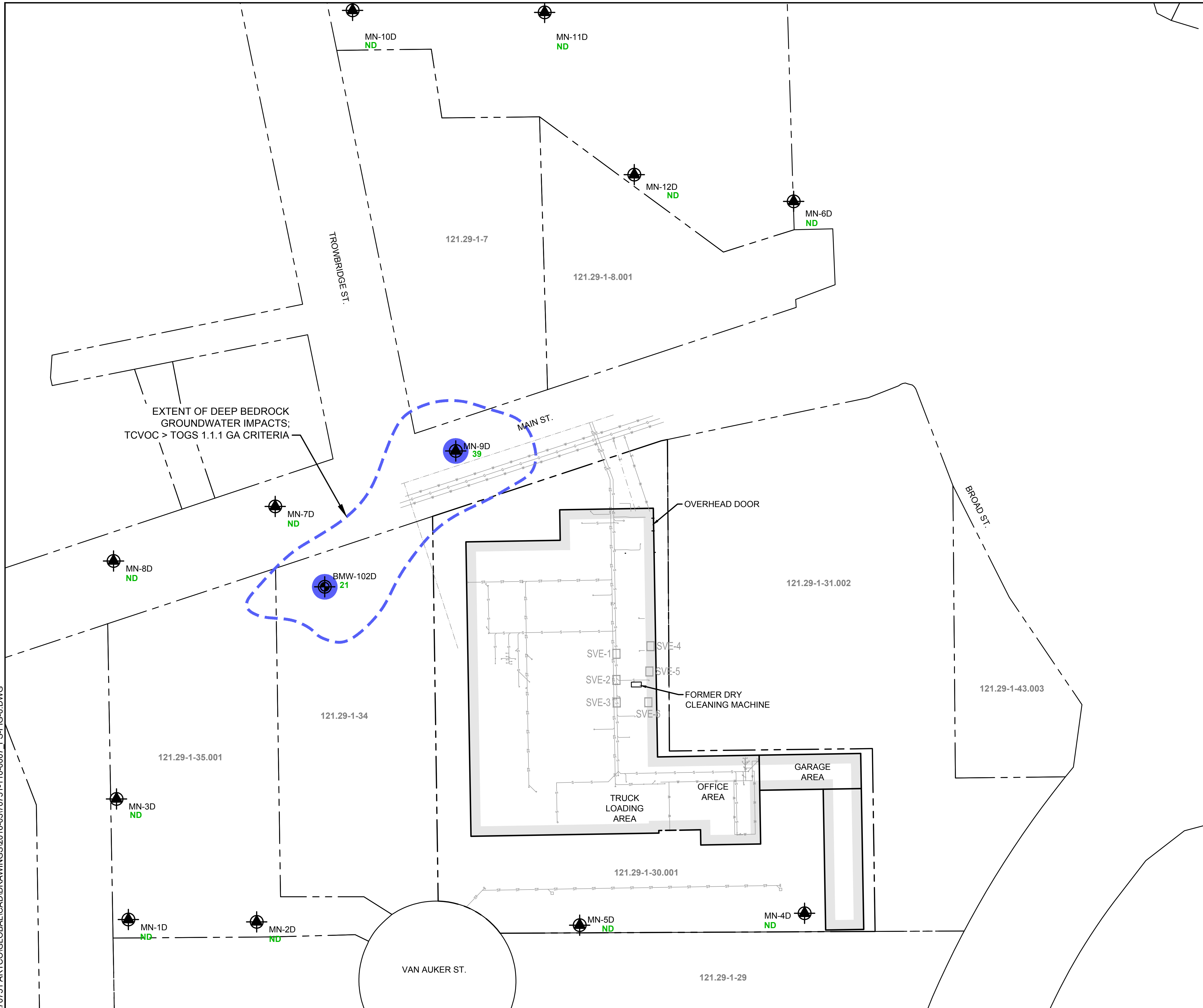
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

SITE PLAN WITH INTERPRETED INTERMEDIATE BEDROCK IMPACTS

SCALE: AS SHOWN
MARCH 2016

FIGURE 5

MOBINI, GITA Printed: 3/23/2016 10:42 AM Layout: FIG 5
F:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0006_FS-FIG-5.DWG



LEGEND

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
- BEDROCK WELL (HALEY & ALDRICH, 2001)
- BEDROCK WELL (HALEY & ALDRICH, 2013)
- SOIL VAPOR EXTRACTION WELL
- TARGET CHLORINATED VOLATILE ORGANIC COMPOUND (TCVOC) IN DEEP BEDROCK > TOGS 1.1.1 GA CRITERIA
- EXTENT OF DEEP BEDROCK GROUNDWATER IMPACTS; TCVOC > TOGS 1.1.1 GA CRITERIA (AREA = 17,785 SF)
- 39 PCE CONCENTRATION POSTED FROM MOST RECENT SAMPLING RESULTS (MAY 2013 OR DECEMBER 2013)
- ND PCE NOT DETECTED IN MOST RECENT SAMPLING RESULTS (MAY 2013 OR DECEMBER 2013)

NOTES

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
2. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.

N

0 80 160
SCALE IN FEET

HALEY ALDRICH

FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

SITE PLAN WITH INTERPRETED DEEP BEDROCK IMPACTS

SCALE: AS SHOWN
MARCH 2015

FIGURE 6

MOBINI, GITA
F:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0007_FS-FIG-6.DWG
Printed: 3/23/2016 10:43 AM Layout: FIG 6

LEGEND

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- EXISTING BUILDING; FLOOR SLAB TO BE MAINTAINED
- PAVED AREA TO BE MAINTAINED
- MAINTAIN LANDSCAPED COVER. MANAGE THROUGH SITE MANAGEMENT PLAN

NOTES

1. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.

N

0 80 160
SCALE IN FEET

HALEY ALDRICH

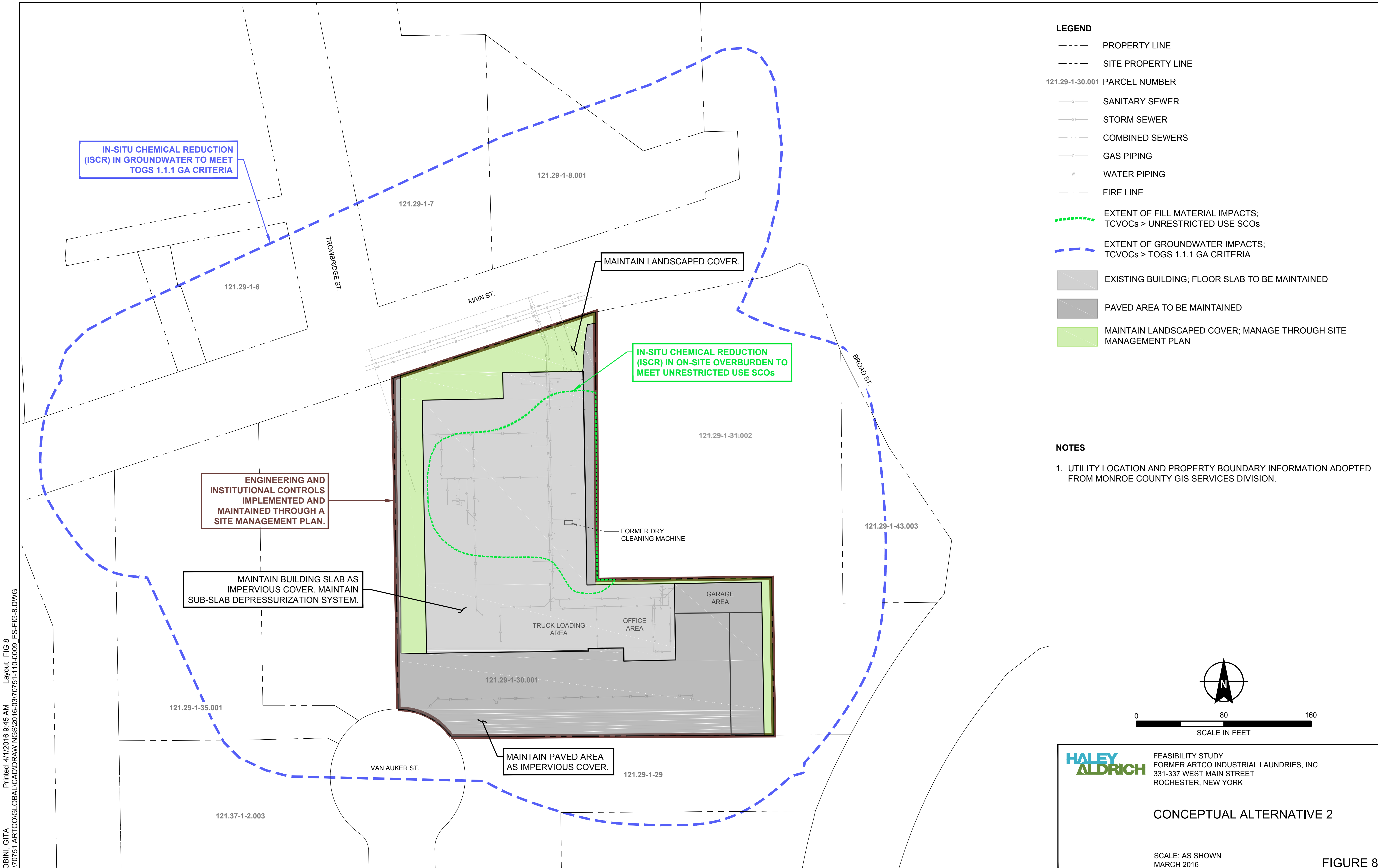
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

CONCEPTUAL ALTERNATIVE 1

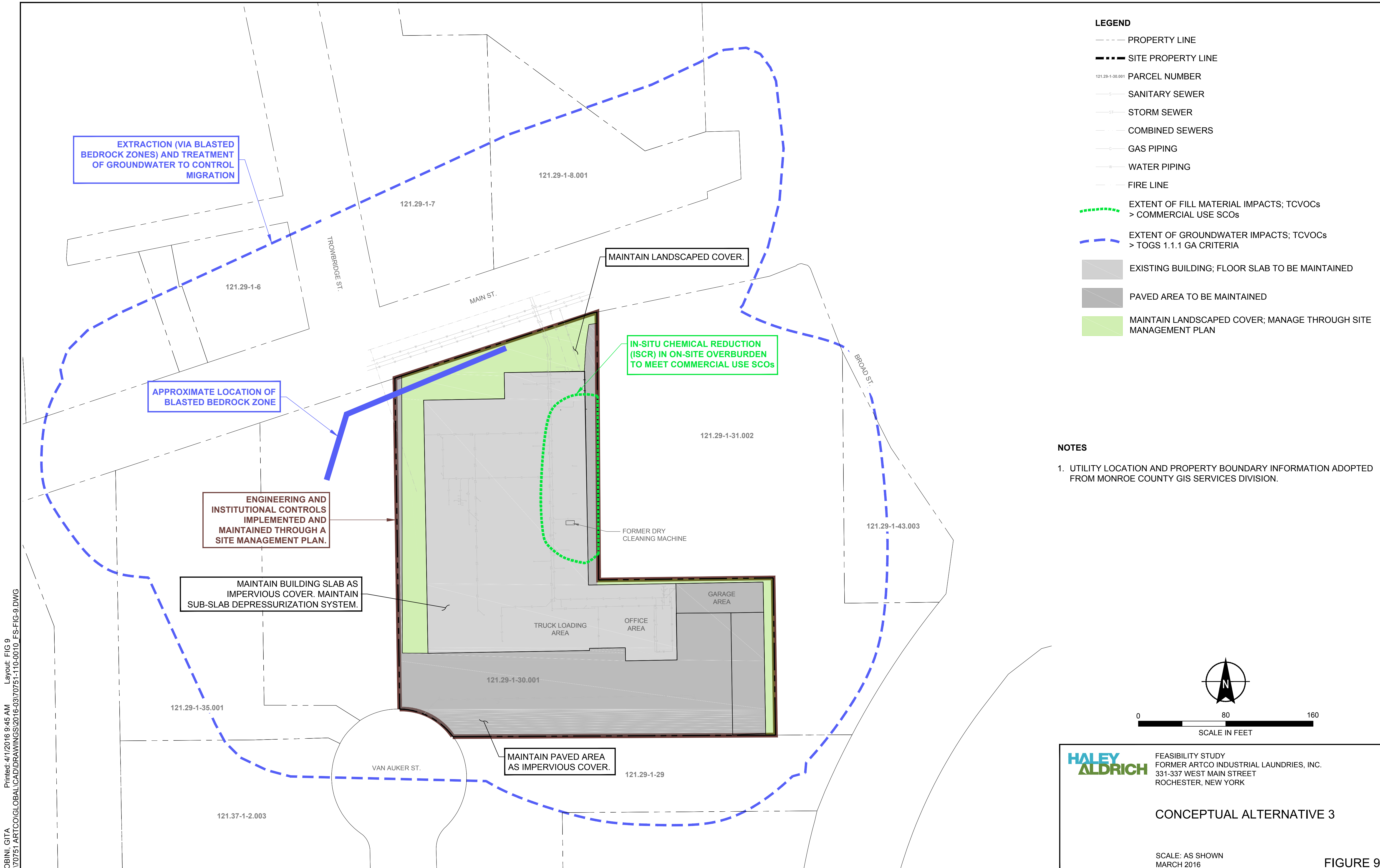
SCALE: AS SHOWN
MARCH 2016

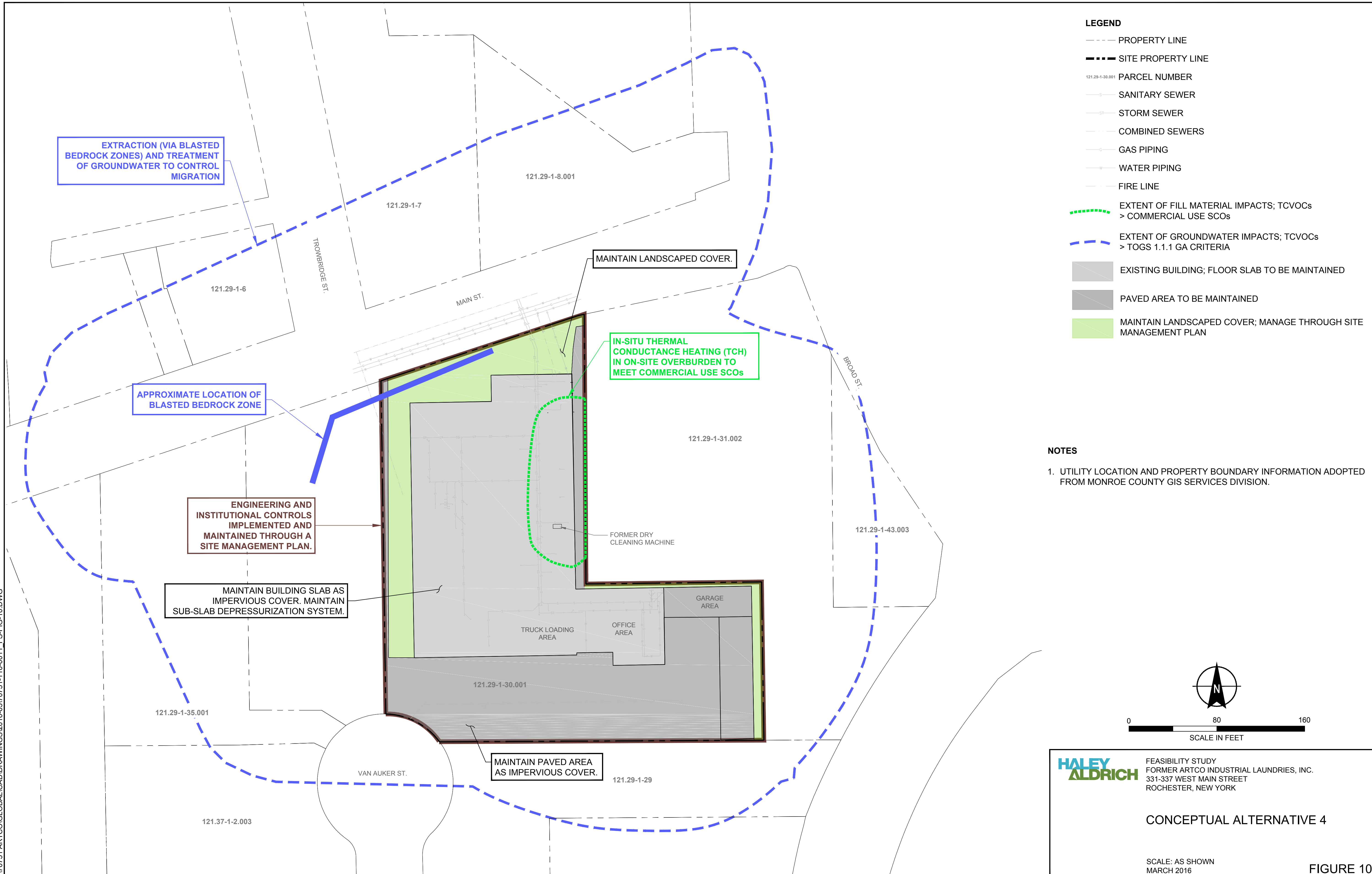
FIGURE 7

MOBINI, GITA Printed: 4/1/2016 9:42 AM Layout: FIG 7
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0008_FS-FIG-7.DWG



IN-SITU CHEMICAL REDUCTION (ISCR) IN GROUNDWATER TO MEET TOGS 1.1.1 GA CRITERIA
121.29-1-6
121.29-1-7
121.29-1-8.001
TROWBRIDGE ST.
MAIN ST.
MAINTAIN LANDSCAPED COVER.
IN-SITU CHEMICAL REDUCTION (ISCR) IN ON-SITE OVERBURDEN TO MEET UNRESTRICTED USE SCOs
BROAD ST.
121.29-1-31.002
121.29-1-43.003
ENGINEERING AND INSTITUTIONAL CONTROLS IMPLEMENTED AND MAINTAINED THROUGH A SITE MANAGEMENT PLAN.
FORMER DRY CLEANING MACHINE
MAINTAIN BUILDING SLAB AS IMPERVIOUS COVER. MAINTAIN SUB-SLAB DEPRESSURIZATION SYSTEM.
GARAGE AREA
OFFICE AREA
TRUCK LOADING AREA
121.29-1-30.001
121.29-1-35.001
VAN AUKER ST.
MAINTAIN PAVED AREA AS IMPERVIOUS COVER.
121.29-1-29
121.37-1-2.003
LEGEND
PROPERTY LINE
SITE PROPERTY LINE
121.29-1-30.001 PARCEL NUMBER
SANITARY SEWER
STORM SEWER
COMBINED SEWERS
GAS PIPING
WATER PIPING
FIRE LINE
EXTENT OF FILL MATERIAL IMPACTS; TCVOCs > UNRESTRICTED USE SCOs
EXTENT OF GROUNDWATER IMPACTS; TCVOCs > TOGS 1.1.1 GA CRITERIA
EXISTING BUILDING; FLOOR SLAB TO BE MAINTAINED
PAVED AREA TO BE MAINTAINED
MAINTAIN LANDSCAPED COVER; MANAGE THROUGH SITE MANAGEMENT PLAN
NOTES
1. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.
N
0
80
160
SCALE IN FEET
HALEY ALDRICH
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK
CONCEPTUAL ALTERNATIVE 2
SCALE: AS SHOWN
MARCH 2016
FIGURE 8
MOBINI, GITA
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0009_FS-FIG-8.DWG
Printed: 4/1/2016 9:45 AM
Layout: FIG 8


LEGEND
PROPERTY LINE
SITE PROPERTY LINE
PARCEL NUMBER
SANITARY SEWER
STORM SEWER
COMBINED SEWERS
GAS PIPING
WATER PIPING
FIRE LINE
EXTENT OF FILL MATERIAL IMPACTS; TCVOCs > COMMERCIAL USE SCOs
EXTENT OF GROUNDWATER IMPACTS; TCVOCs > TOGS 1.1.1 GA CRITERIA
EXISTING BUILDING; FLOOR SLAB TO BE MAINTAINED
PAVED AREA TO BE MAINTAINED
MAINTAIN LANDSCAPED COVER; MANAGE THROUGH SITE MANAGEMENT PLAN
NOTES
1. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.
EXTRACTION (VIA BLASTED BEDROCK ZONES) AND TREATMENT OF GROUNDWATER TO CONTROL MIGRATION
APPROXIMATE LOCATION OF BLASTED BEDROCK ZONE
ENGINEERING AND INSTITUTIONAL CONTROLS IMPLEMENTED AND MAINTAINED THROUGH A SITE MANAGEMENT PLAN.
MAINTAIN BUILDING SLAB AS IMPERVIOUS COVER. MAINTAIN SUB-SLAB DEPRESSURIZATION SYSTEM.
MAINTAIN LANDSCAPED COVER.
IN-SITU CHEMICAL REDUCTION (ISCR) IN ON-SITE OVERBURDEN TO MEET COMMERCIAL USE SCOs
MAINTAIN PAVED AREA AS IMPERVIOUS COVER.
FORMER DRY CLEANING MACHINE
TRUCK LOADING AREA
OFFICE AREA
GARAGE AREA
MAIN ST.
TROWBRIDGE ST.
BROAD ST.
VAN AUKER ST.
121.29-1-8.001
121.29-1-7
121.29-1-6
121.29-1-31.002
121.29-1-43.003
121.29-1-30.001
121.29-1-35.001
121.29-1-29
121.37-1-2.003
N
0
80
160
SCALE IN FEET
HALEY ALDRICH
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK
CONCEPTUAL ALTERNATIVE 3
SCALE: AS SHOWN
MARCH 2016
FIGURE 9
MOBINI, GITA
Printed: 4/1/2016 9:45 AM
Layout: FIG 9
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0010_FS-FIG-9.DWG



MOBINI, GITA Printed: 4/1/2016 9:46 AM Layout: FIG 10
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0011_FS-FIG-10.DWG


LEGEND
PROPERTY LINE
SITE PROPERTY LINE
PARCEL NUMBER
SANITARY SEWER
STORM SEWER
COMBINED SEWERS
GAS PIPING
WATER PIPING
FIRE LINE
EXTENT OF GROUNDWATER IMPACTS; TCVOCs > TOGS 1.1.1 GA CRITERIA
EXISTING BUILDING; FLOOR SLAB TO BE MAINTAINED
PAVED AREA TO BE MAINTAINED
MAINTAIN LANDSCAPED COVER; MANAGE THROUGH SITE MANAGEMENT PLAN
EXTRACTION (VIA BLASTED BEDROCK ZONES) AND TREATMENT OF GROUNDWATER TO CONTROL MIGRATION
APPROXIMATE LOCATION OF BLASTED BEDROCK ZONE
ENGINEERING AND INSTITUTIONAL CONTROLS IMPLEMENTED AND MAINTAINED THROUGH A SITE MANAGEMENT PLAN.
MAINTAIN LANDSCAPED COVER.
MAINTAIN BUILDING SLAB AS IMPERVIOUS COVER. MAINTAIN SUB-SLAB DEPRESSURIZATION SYSTEM.
MAINTAIN PAVED AREA AS IMPERVIOUS COVER.
CONCRETE FOOTER (TYP)
FORMER DRY CLEANING MACHINE
TRUCK LOADING AREA
OFFICE AREA
GARAGE AREA
TROWBRIDGE ST.
MAIN ST.
BROAD ST.
VAN AUKER ST.
121.29-1-8.001
121.29-1-7
121.29-1-6
121.29-1-31.002
121.29-1-43.003
121.29-1-30.001
121.29-1-35.001
121.29-1-29
121.37-1-2.003
N
0
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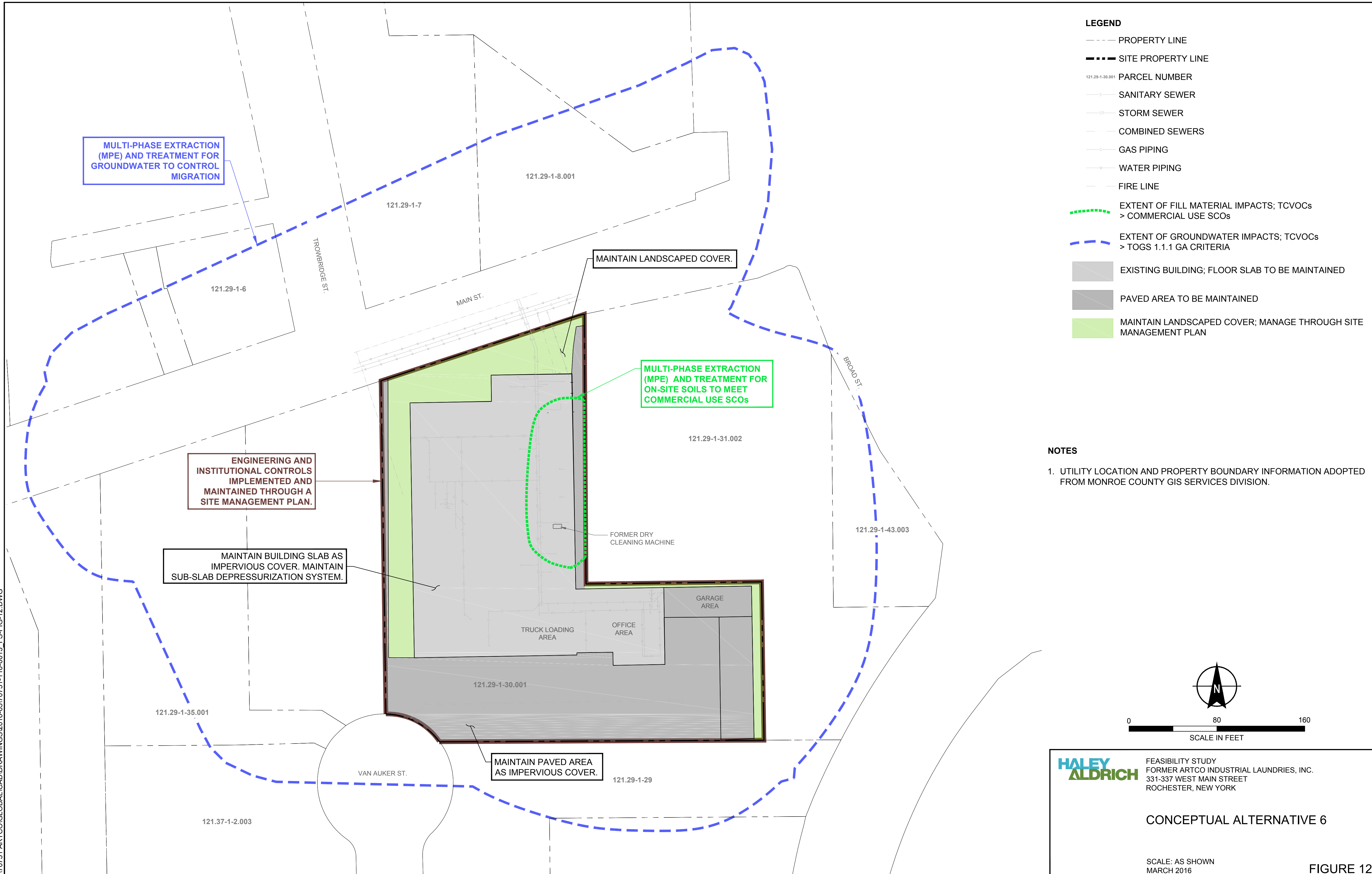
160
SCALE IN FEET
NOTES
1. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.
HALEY ALDRICH
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK
CONCEPTUAL ALTERNATIVE 5
SCALE: AS SHOWN
MARCH 2016
FIGURE 11
MOBINI, GITA Printed: 4/1/2016 9:46 AM Layout: FIG 11
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0012_FS-FIG-11.DWG



HALEY ALDRICH

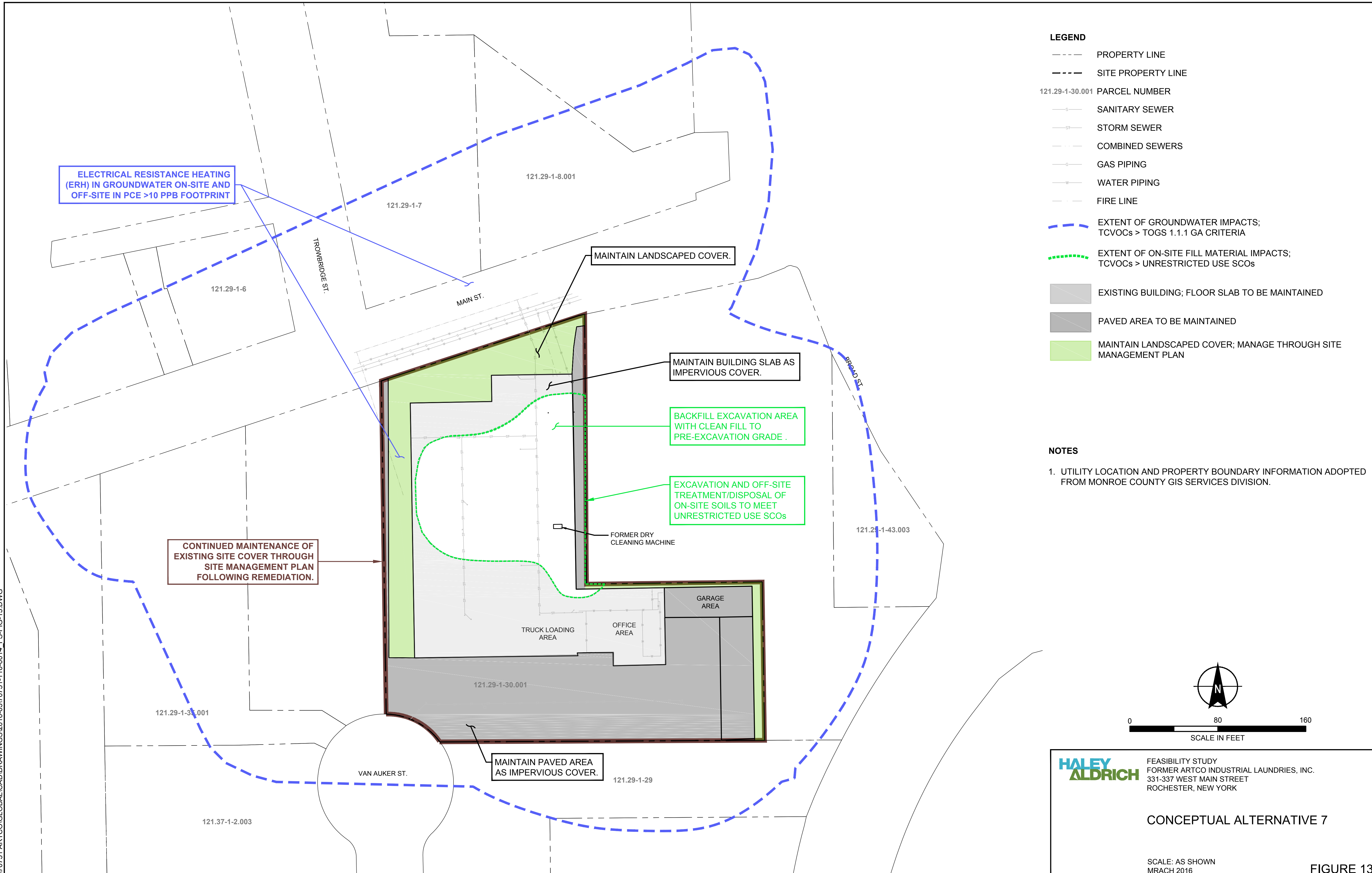
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

CONCEPTUAL ALTERNATIVE 6

SCALE: AS SHOWN
MARCH 2016

FIGURE 12

MOBINI, GITA Printed: 4/1/2016 9:46 AM Layout: FIG 12
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0013_FS-FIG-12.DWG



NOTES

1. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.

HALEY ALDRICH

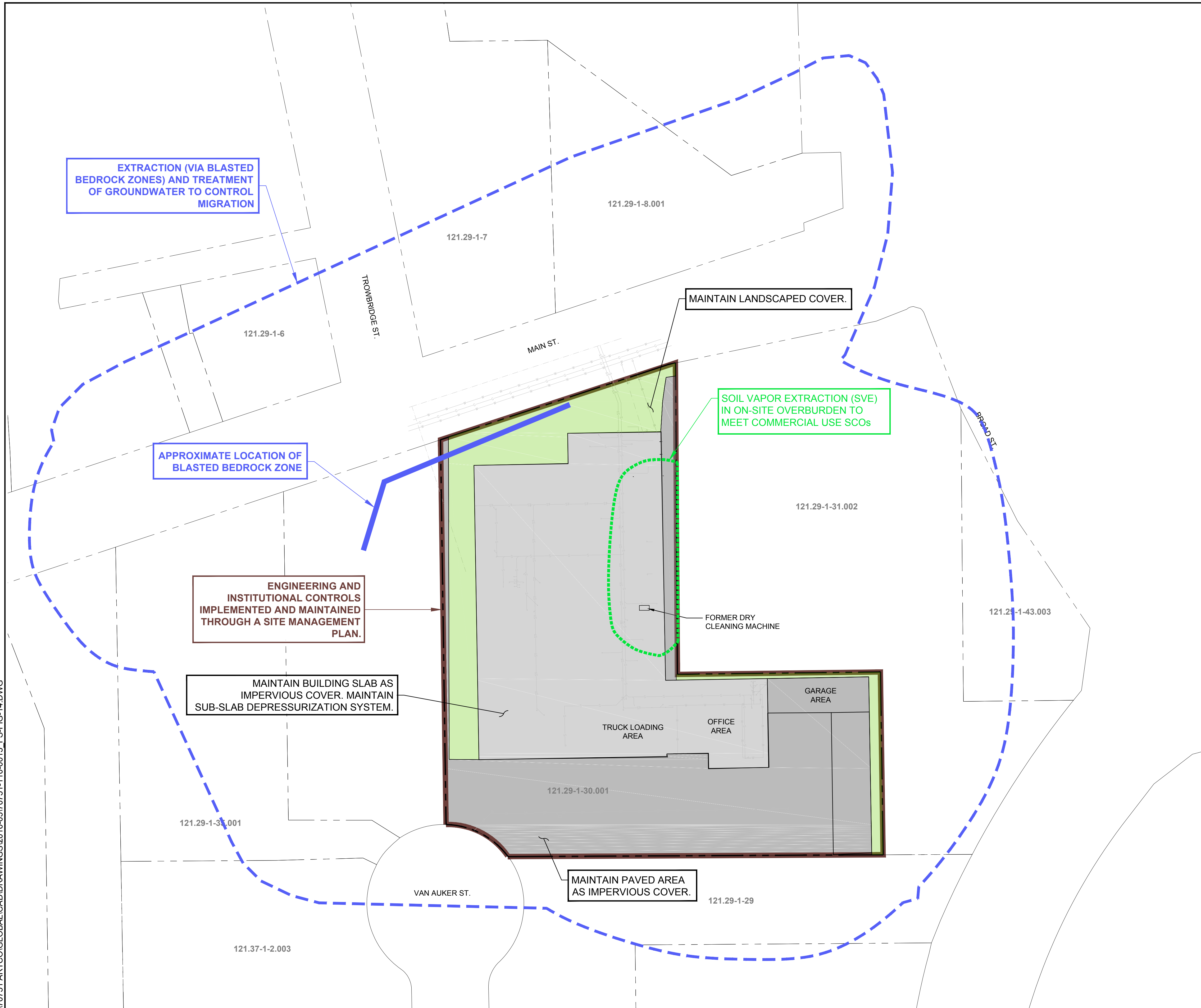
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

CONCEPTUAL ALTERNATIVE 7

SCALE: AS SHOWN
MRACH 2016

FIGURE 13

MOBINI, GITA Printed: 4/1/2016 9:46 AM Layout: FIG 13
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0014_FS-FIG-13.DWG



LEGEND

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- EXTENT OF FILL MATERIAL IMPACTS; TCVOCs > COMMERCIAL USE SCOs
- EXTENT OF GROUNDWATER IMPACTS; TCVOCs > TOGS 1.1.1 GA CRITERIA
- EXISTING BUILDING; FLOOR SLAB TO BE MAINTAINED
- PAVED AREA TO BE MAINTAINED
- MAINTAIN LANDSCAPED COVER; MANAGE THROUGH SITE MANAGEMENT PLAN

NOTES

1. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.

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SCALE IN FEET

HALEY ALDRICH

FEASIBILITY STUDY
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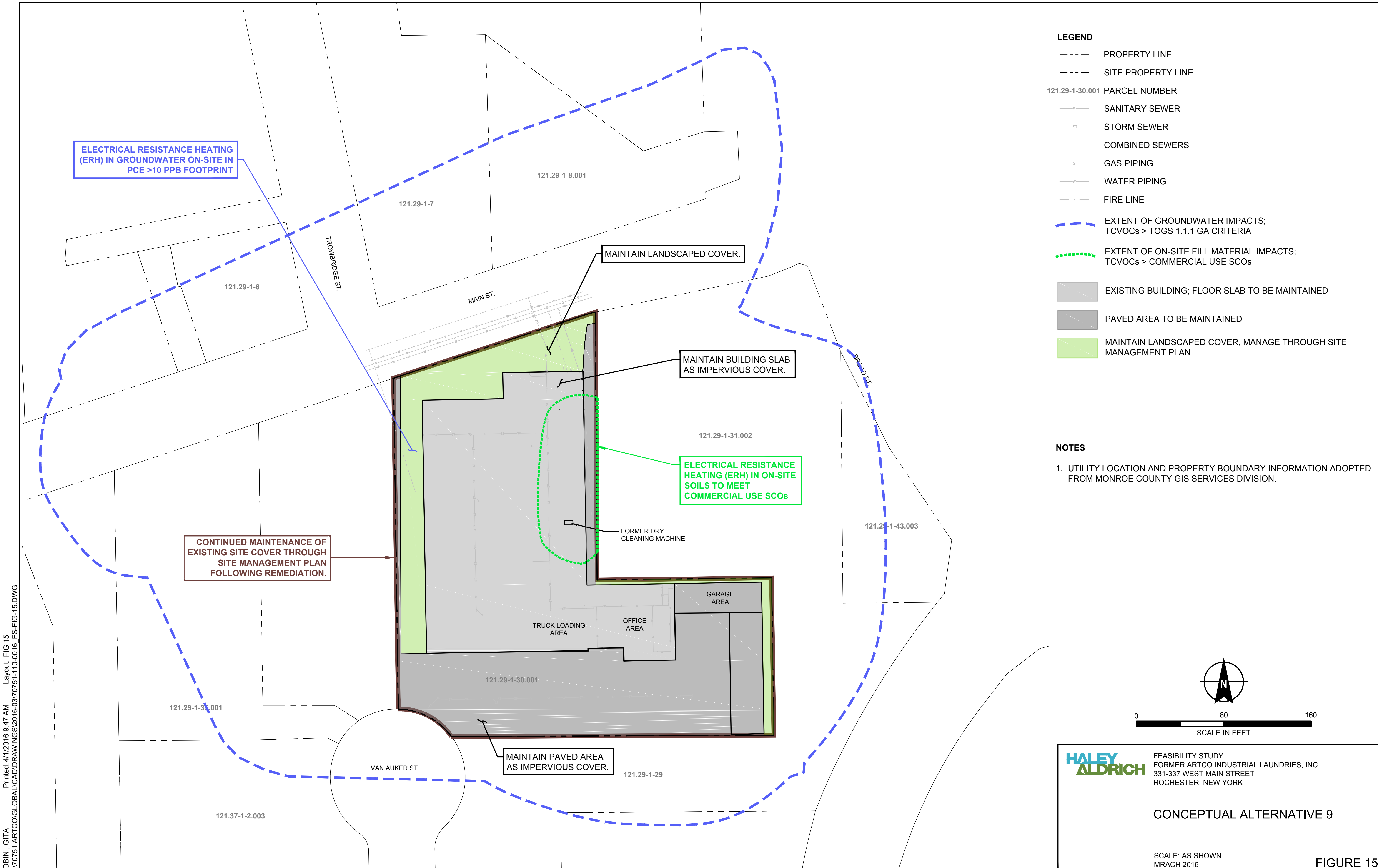
ROCHESTER, NEW YORK

CONCEPTUAL ALTERNATIVE 8

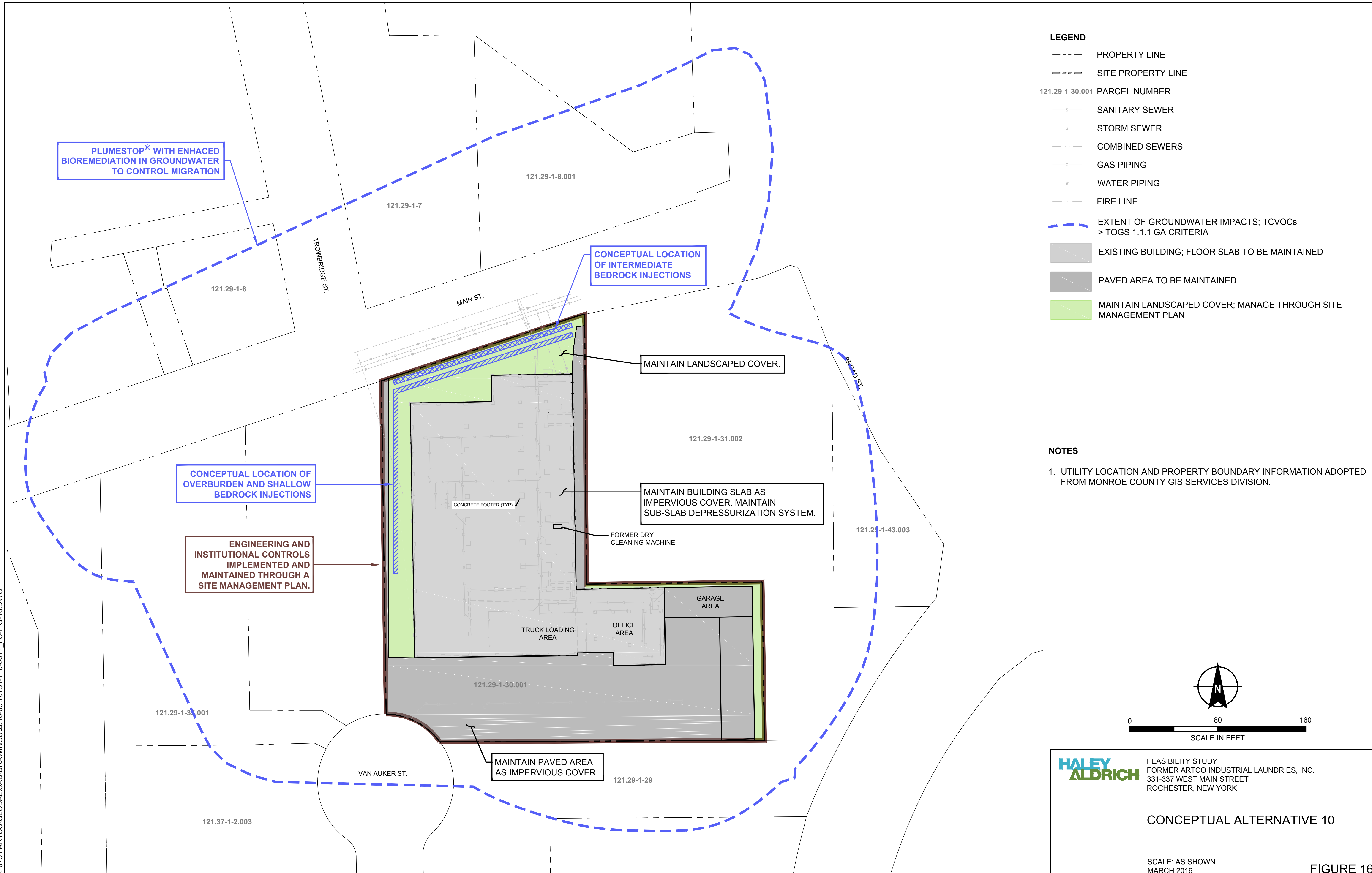
SCALE: AS SHOWN
MARCH 2016

FIGURE 14

MOBINI, GITA Printed: 4/1/2016 10:33 AM Layout: FIG 14
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0015_FS-FIG-14.DWG



LEGEND
PROPERTY LINE
SITE PROPERTY LINE
121.29-1-30.001 PARCEL NUMBER
SANITARY SEWER
STORM SEWER
COMBINED SEWERS
GAS PIPING
WATER PIPING
FIRE LINE
EXTENT OF GROUNDWATER IMPACTS; TCVOCs > TOGS 1.1.1 GA CRITERIA
EXTENT OF ON-SITE FILL MATERIAL IMPACTS; TCVOCs > COMMERCIAL USE SCOs
EXISTING BUILDING; FLOOR SLAB TO BE MAINTAINED
PAVED AREA TO BE MAINTAINED
MAINTAIN LANDSCAPED COVER; MANAGE THROUGH SITE MANAGEMENT PLAN
ELECTRICAL RESISTANCE HEATING (ERH) IN GROUNDWATER ON-SITE IN PCE >10 PPB FOOTPRINT
MAINTAIN LANDSCAPED COVER.
MAINTAIN BUILDING SLAB AS IMPERVIOUS COVER.
ELECTRICAL RESISTANCE HEATING (ERH) IN ON-SITE SOILS TO MEET COMMERCIAL USE SCOs
FORMER DRY CLEANING MACHINE
CONTINUED MAINTENANCE OF EXISTING SITE COVER THROUGH SITE MANAGEMENT PLAN FOLLOWING REMEDIATION.
MAINTAIN PAVED AREA AS IMPERVIOUS COVER.
121.29-1-8.001
121.29-1-7
121.29-1-6
121.29-1-31.002
121.29-1-43.003
121.29-1-30.001
121.29-1-31.001
121.29-1-29
121.37-1-2.003
TROWBRIDGE ST.
MAIN ST.
BROAD ST.
VAN AUKER ST.
GARAGE AREA
OFFICE AREA
TRUCK LOADING AREA
NOTES
1. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.
N
0 80 160
SCALE IN FEET
HALEY ALDRICH
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK
CONCEPTUAL ALTERNATIVE 9
SCALE: AS SHOWN
MRACH 2016
FIGURE 15
MOBINI, GITA Printed: 4/1/2016 9:47 AM Layout: FIG 15
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0016_FS-FIG-15.DWG



NOTES

1. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.

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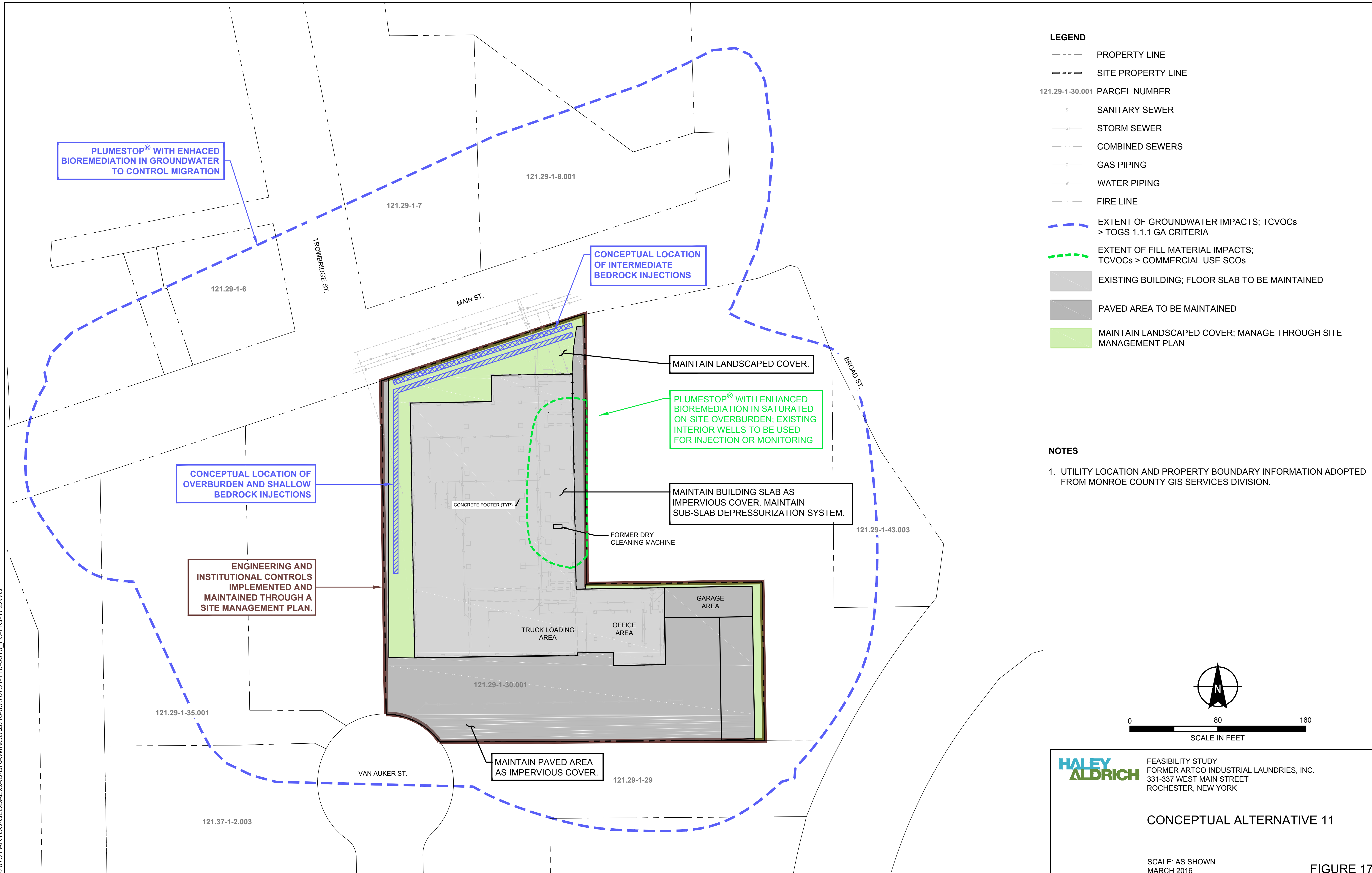
ROCHESTER, NEW YORK

CONCEPTUAL ALTERNATIVE 10

SCALE: AS SHOWN
MARCH 2016

FIGURE 16

MOBINI, GITA
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0017_FS-FIG-16.DWG
Printed: 4/1/2016 9:47 AM Layout: FIG 16



NOTES

1. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.

HALEY ALDRICH

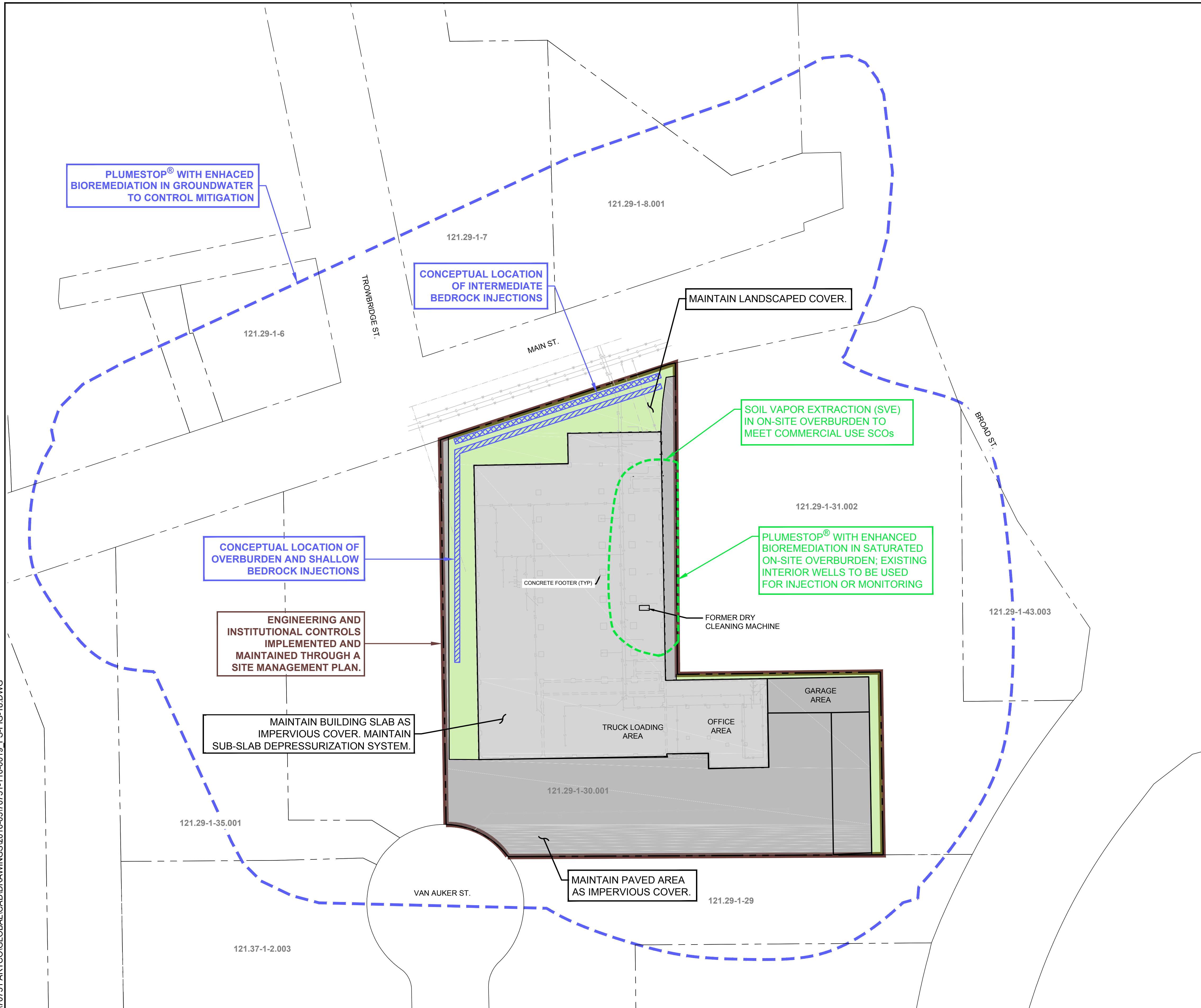
FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

CONCEPTUAL ALTERNATIVE 11

SCALE: AS SHOWN
MARCH 2016

FIGURE 17

MOBINI, GITA Printed: 4/1/2016 9:47 AM Layout: FIG 17
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0018_FS-FIG-17.DWG



NOTES

1. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.

HALEY ALDRICH

FEASIBILITY STUDY
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

CONCEPTUAL ALTERNATIVE 12

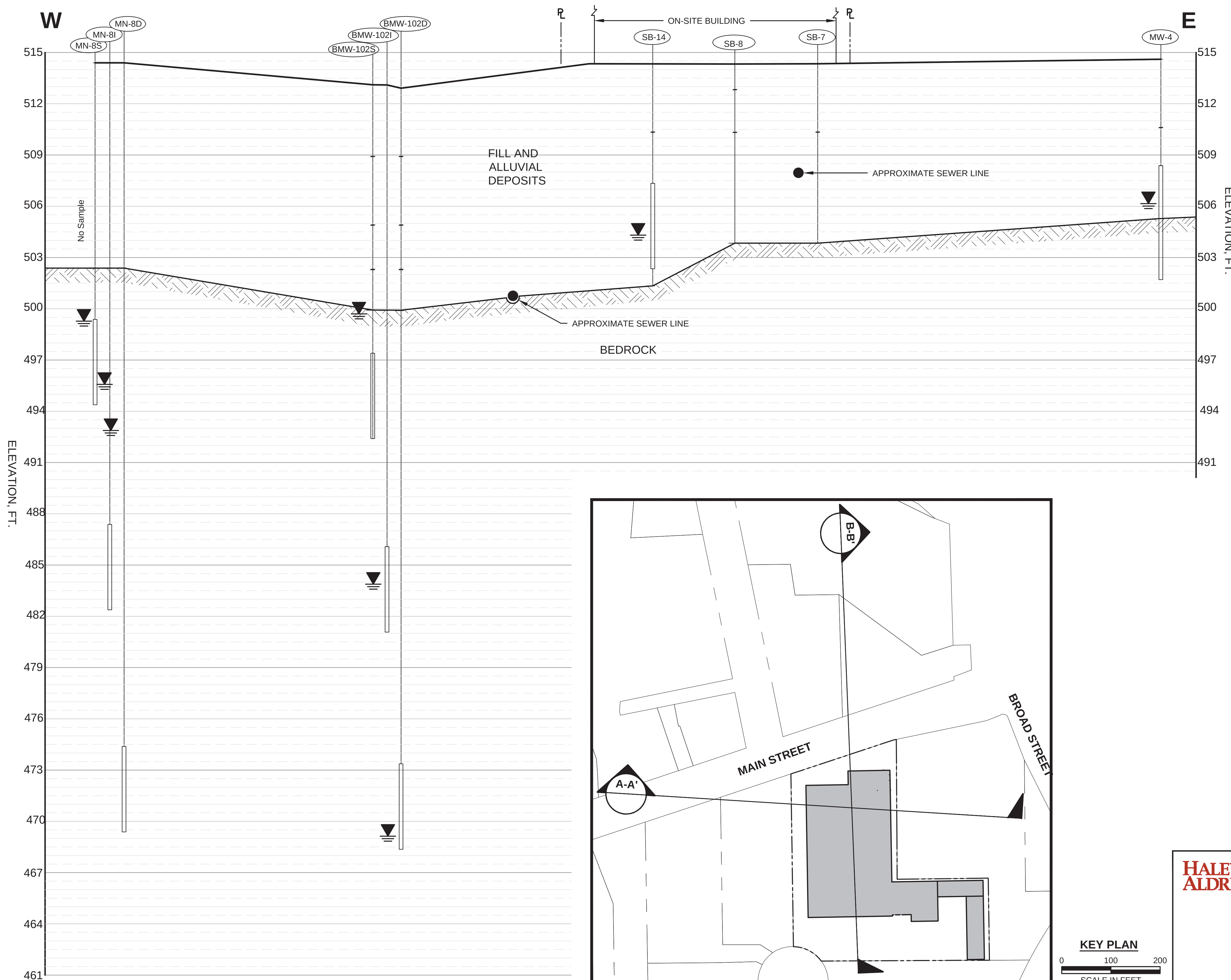
SCALE: AS SHOWN
MARCH 2016

FIGURE 18

MOBINI, GITA Printed: 4/1/2016 9:47 AM Layout: FIG 18
G:\70751 ARTCO\GLOBAL\CAD\DRAWINGS\2016-03\70751-110-0019_FS-FIG-18.DWG

APPENDIX A

Selected Remedial Investigation Report Figures



LEGEND

SB-14 — DESIGNATION AND LOCATION OF SOIL BORING, MONITORING WELL OR ROCK CORE BORING

GROUND SURFACE

(NM) GROUNDWATER ELEVATION AT WELL (MEASURED DECEMBER 2013); "NM" INDICATES NOT MEASURED DECEMBER 2013

WELL SCREEN INTERVAL

BEDROCK SURFACE

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. GROUNDWATER ELEVATIONS MEASURED DECEMBER 2013.

HORIZ. 0 60 120

VERT. 0 6 12

SCALE IN FEET

HALEY & ALDRICH

FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

GEOLOGIC CROSS SECTION A-A'

SCALE: AS SHOWN
MAY 2014

FIGURE 4

G:\70751\CAD\70751-100-002_XSEC.DWG

G:\70751\CAD\70751-100-002_XSEC.DWG

NOTES

1. SEE GEOLOGIC CROSS SECTION A-A' FOR LEGEND AND NOTES.

HORIZ. 0 60 120

VERT. 0 6 12

SCALE IN FEET

HALEY & ALDRICH

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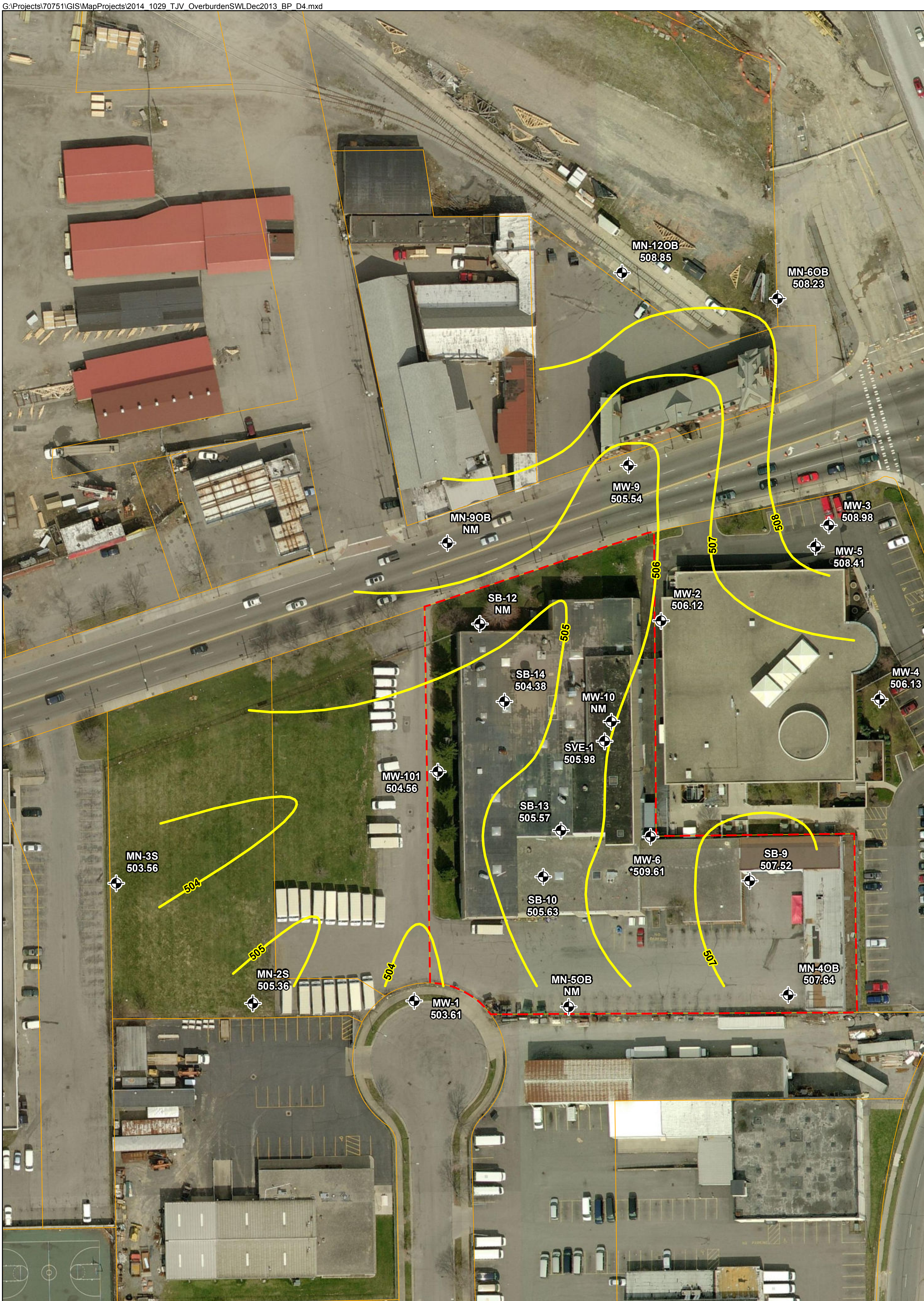
ROCHESTER, NEW YORK

GEOLOGIC CROSS SECTION B-B'

SCALE: AS SHOWN
MAY 2014

FIGURE 5

G:\Projects\70751\GIS\MapProjects\2014_1029_TJV_OverburdenSWLDec2013_BP_D4.mxd



OVERBURDEN MONITORING WELL
GROUNDWATER CONTOUR
SITE PROPERTY BOUNDARY
PARCEL BOUNDARY

NOTES:
1) SWL RECORDED BY H&A STAFF DECEMBER, 2013.
2) COORDINATES IN NEW YORK STATEPLANE FEET, ZONE WEST, DATUM NAD83.
3) ELEVATIONS REFERENCE NAVD88.
4) * - ELEVATION NOT USED FOR CONTOURING.
5) NM - NOT MEASURED.

N W E S

0 25 50 75
SCALE IN FEET

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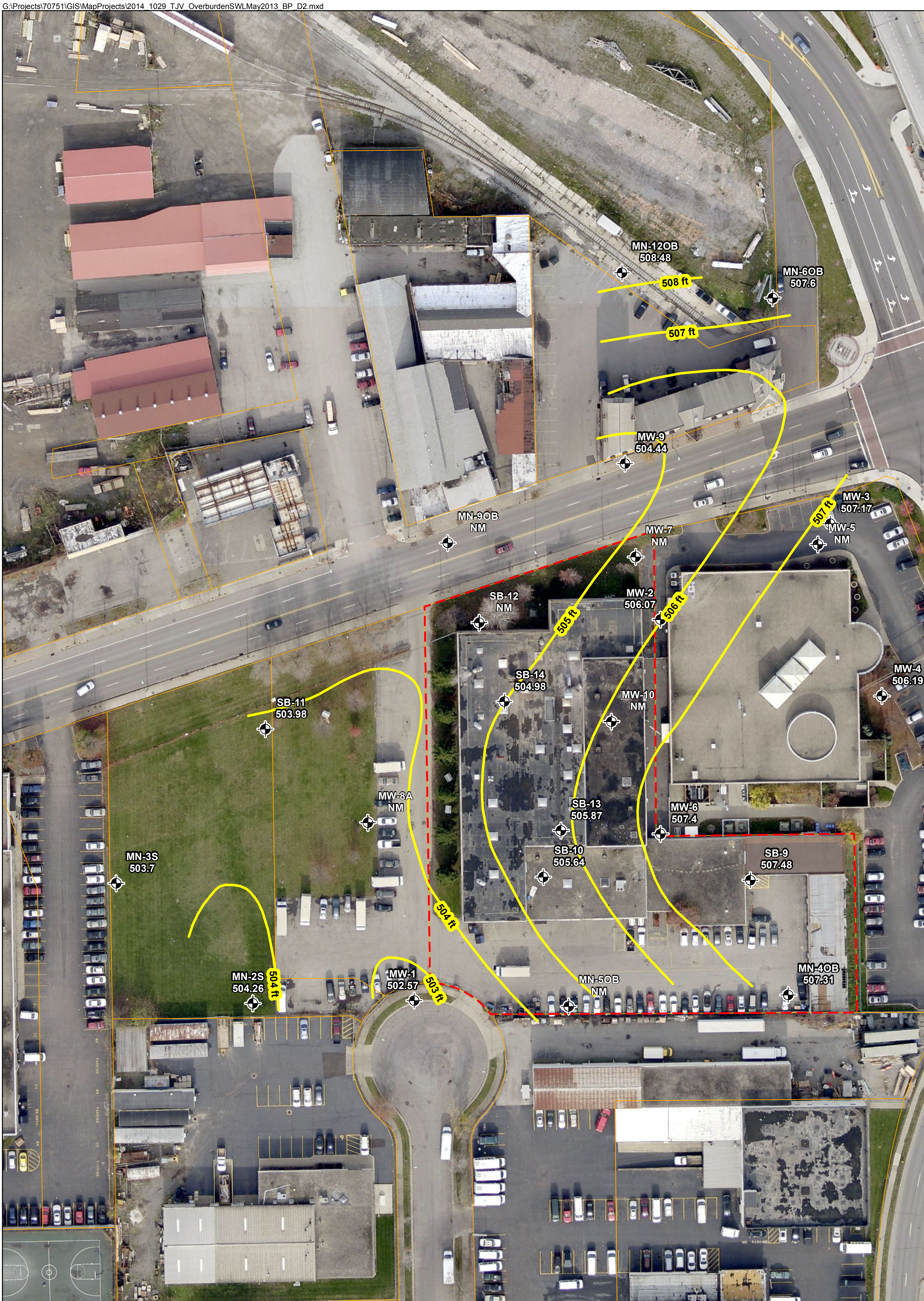
ROCHESTER, NEW YORK

GROUNDWATER ELEVATION CONTOUR MAP - OVERBURDEN, DECEMBER 2013

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 6

G:\Projects\70751\GIS\MapProjects\2014_1029_TJV_OverburdenSWLMay2013_BP_D2.mxd



OVERBURDEN MONITORING WELL

GROUNDWATER CONTOUR

SITE PROPERTY BOUNDARY

PARCEL BOUNDARY

NOTES:
1) SWL RECORDED BY H&A STAFF MAY, 2013.
2) COORDINATES IN NEW YORK STATEPLANE FEET, ZONE WEST, DATUM NAD83.
3) ELEVATIONS REFERENCE NAVD88.
4) * - ELEVATION NOT USED FOR CONTOURING.
5) NM - NOT MEASURED.

N
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0 25 50 75
SCALE IN FEET

HALEY & ALDRICH

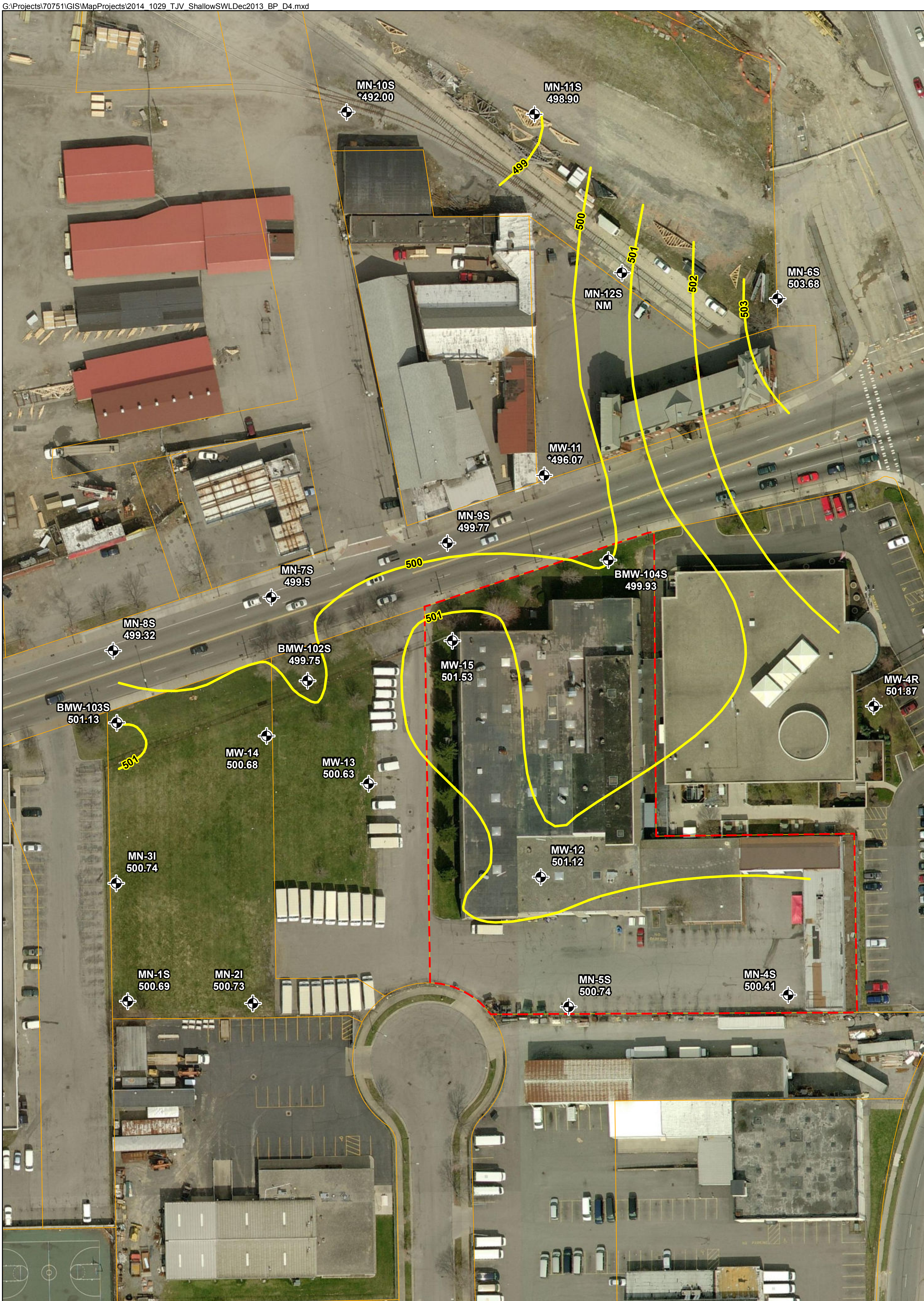
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

GROUNDWATER ELEVATION CONTOUR MAP - OVERBURDEN, MAY 2013

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 6A

G:\Projects\70751\GIS\MapProjects\2014_1029_TJV_ShallowSWLDec2013_BP_D4.mxd



SHALLOW MONITORING WELL

GROUNDWATER CONTOUR

SITE PROPERTY BOUNDARY

PARCEL BOUNDARY

NOTES:
1) SWL RECORDED BY H&A STAFF DECEMBER, 2013.
2) COORDINATES IN NEW YORK STATEPLANE FEET, ZONE WEST, DATUM NAD83.
3) ELEVATIONS REFERENCE NAVD88.
4) * - ELEVATION NOT USED FOR CONTOURING.
5) NM - NOT MEASURED.

N W E S

0 25 50 75
SCALE IN FEET

HALEY & ALDRICH

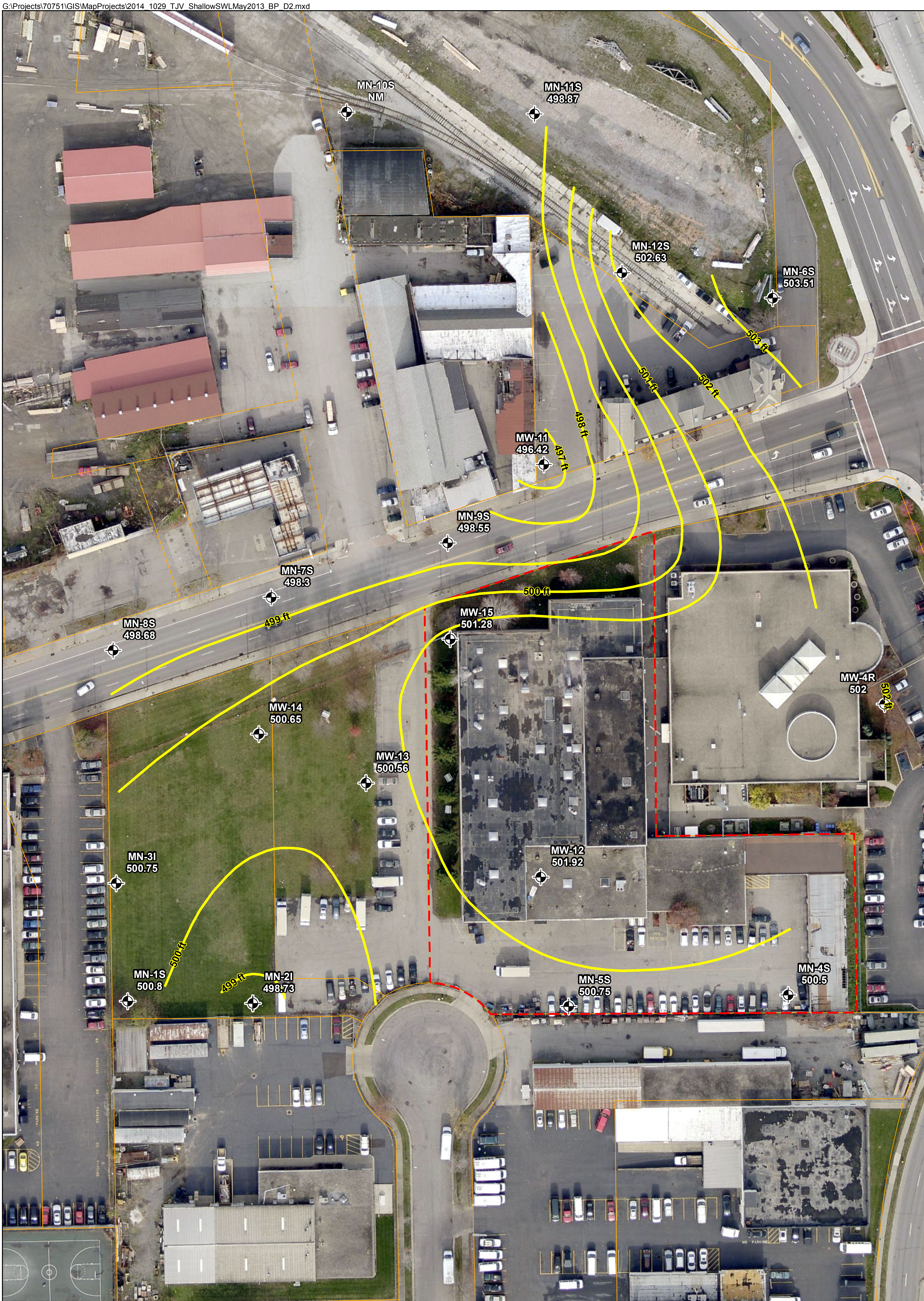
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

GROUNDWATER ELEVATION CONTOUR MAP - SHALLOW BEDROCK, DECEMBER 2013

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 7

G:\Projects\70751\GIS\MapProjects\2014_1029_TJV_ShallowSWLMay2013_BP_D2.mxd



- SHALLOW MONITORING WELL
- GROUNDWATER CONTOUR
- SITE PROPERTY BOUNDARY
- PARCEL BOUNDARY

NOTES:
1) SWL RECORDED BY H&A STAFF MAY, 2013.
2) COORDINATES IN NEW YORK STATEPLANE FEET, ZONE WEST, DATUM NAD83.
3) ELEVATIONS REFERENCE NAVD88.
4) * - ELEVATION NOT USED FOR CONTOURING.
5) NM - NOT MEASURED.

N W E S

0 25 50 75

SCALE IN FEET

HALEY & ALDRICH

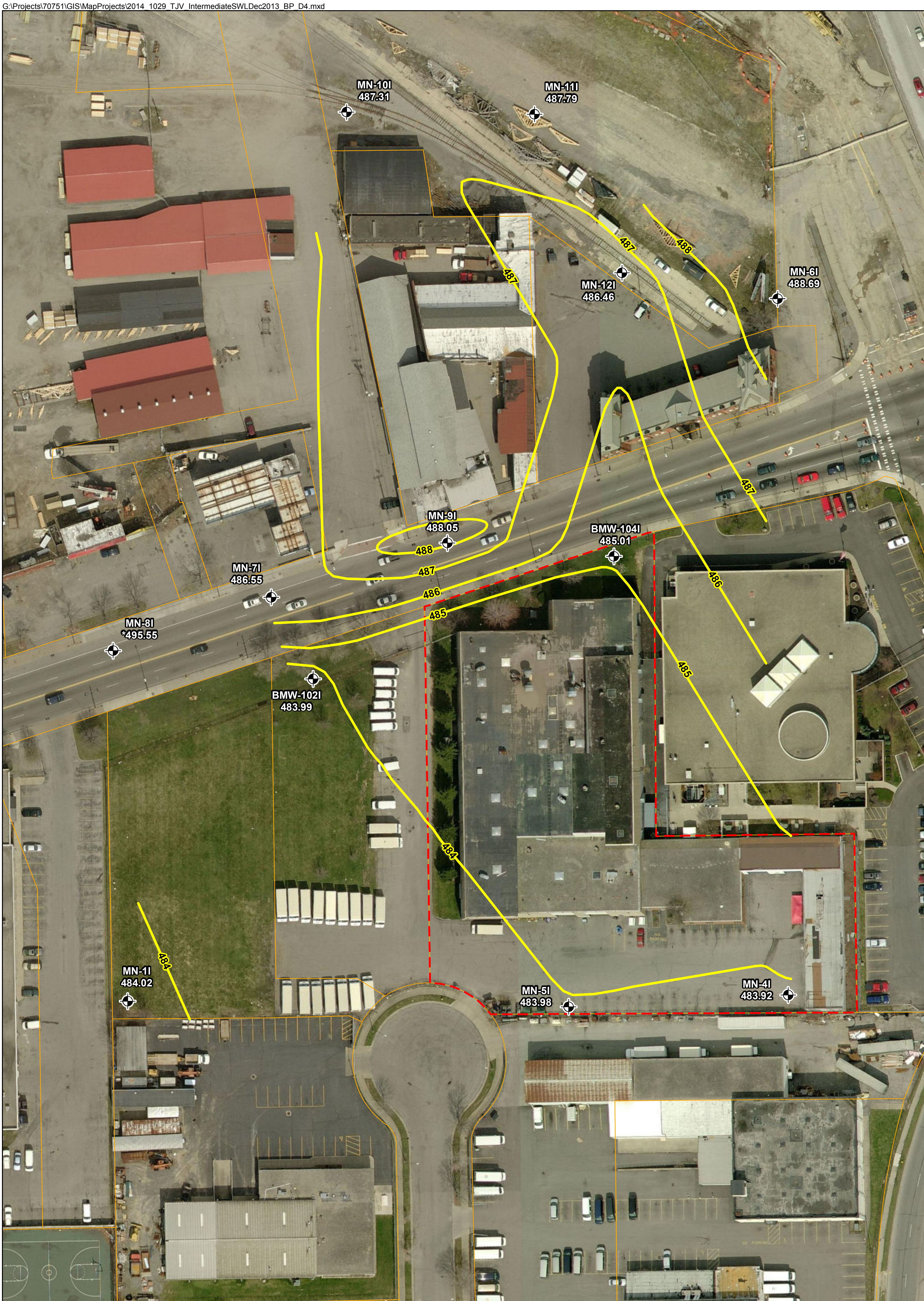
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

GROUNDWATER ELEVATION CONTOUR MAP - SHALLOW BEDROCK, MAY 2013

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 7A

G:\Projects\70751\GIS\MapProjects\2014_1029_TJV_IntermediateSWLDec2013_BP_D4.mxd



INTERMEDIATE MONITORING WELL

GROUNDWATER CONTOUR

SITE PROPERTY BOUNDARY

PARCEL BOUNDARY

NOTES:
1) SWL RECORDED BY H&A STAFF DECEMBER, 2013.
2) COORDINATES IN NEW YORK STATEPLANE FEET, ZONE WEST, DATUM NAD83.
3) ELEVATIONS REFERENCE NAVD88.
4) * - ELEVATION NOT USED FOR CONTOURING.
5) NM - NOT MEASURED.

HALEY & ALDRICH

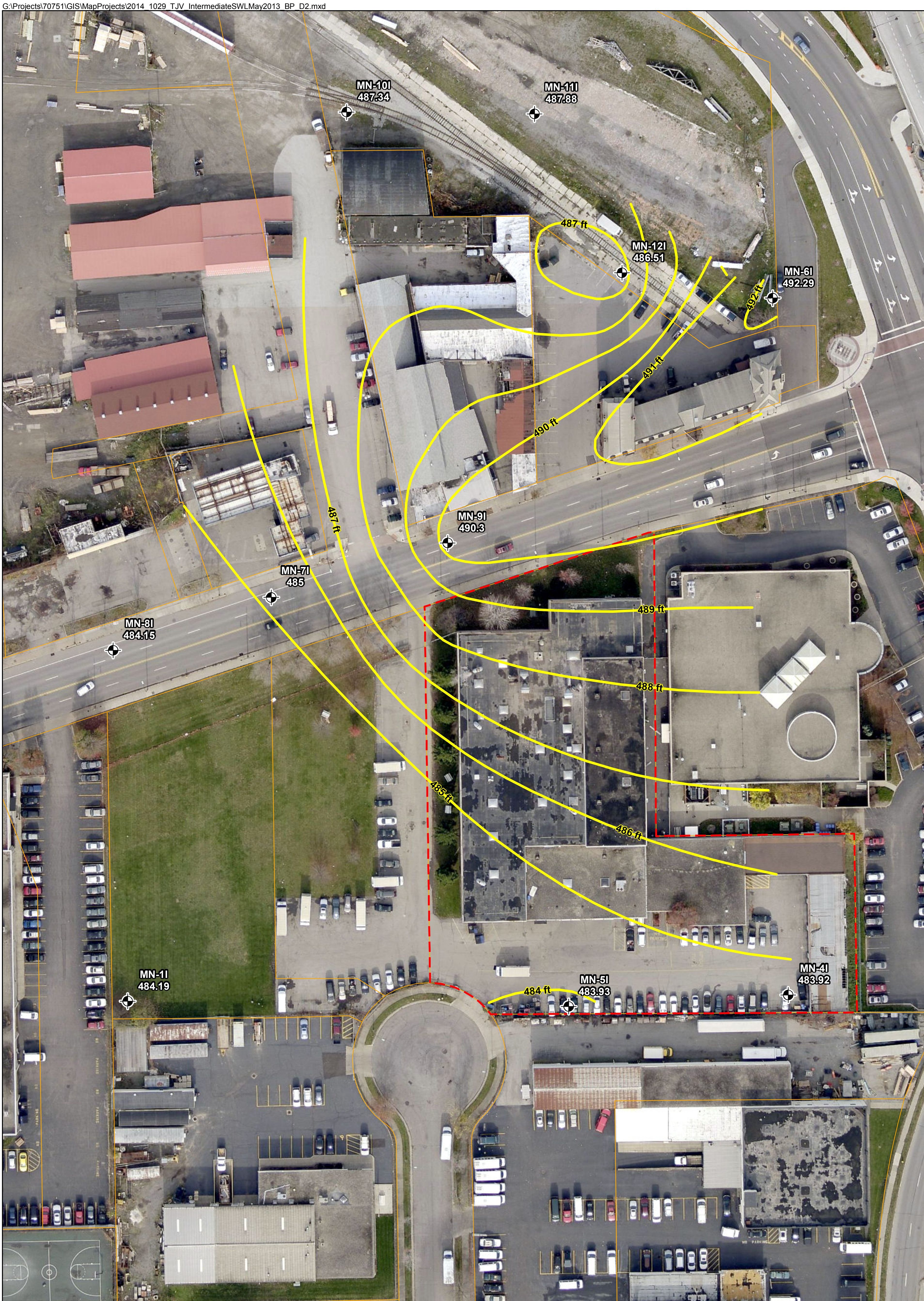
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

GROUNDWATER ELEVATION CONTOUR MAP - INTERMEDIATE BEDROCK, DECEMBER 2013

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 8

G:\Projects\70751\GIS\MapProjects\2014_1029_TJV_IntermediateSWLMay2013_BP_D2.mxd



INTERMEDIATE MONITORING WELL

GROUNDWATER CONTOUR

SITE PROPERTY BOUNDARY

PARCEL BOUNDARY

NOTES:
1) SWL RECORDED BY H&A STAFF MAY, 2013.
2) COORDINATES IN NEW YORK STATEPLANE FEET, ZONE WEST, DATUM NAD83.
3) ELEVATIONS REFERENCE NAVD88.
4) * - ELEVATION NOT USED FOR CONTOURING.
5) NM - NOT MEASURED.

HALEY & ALDRICH

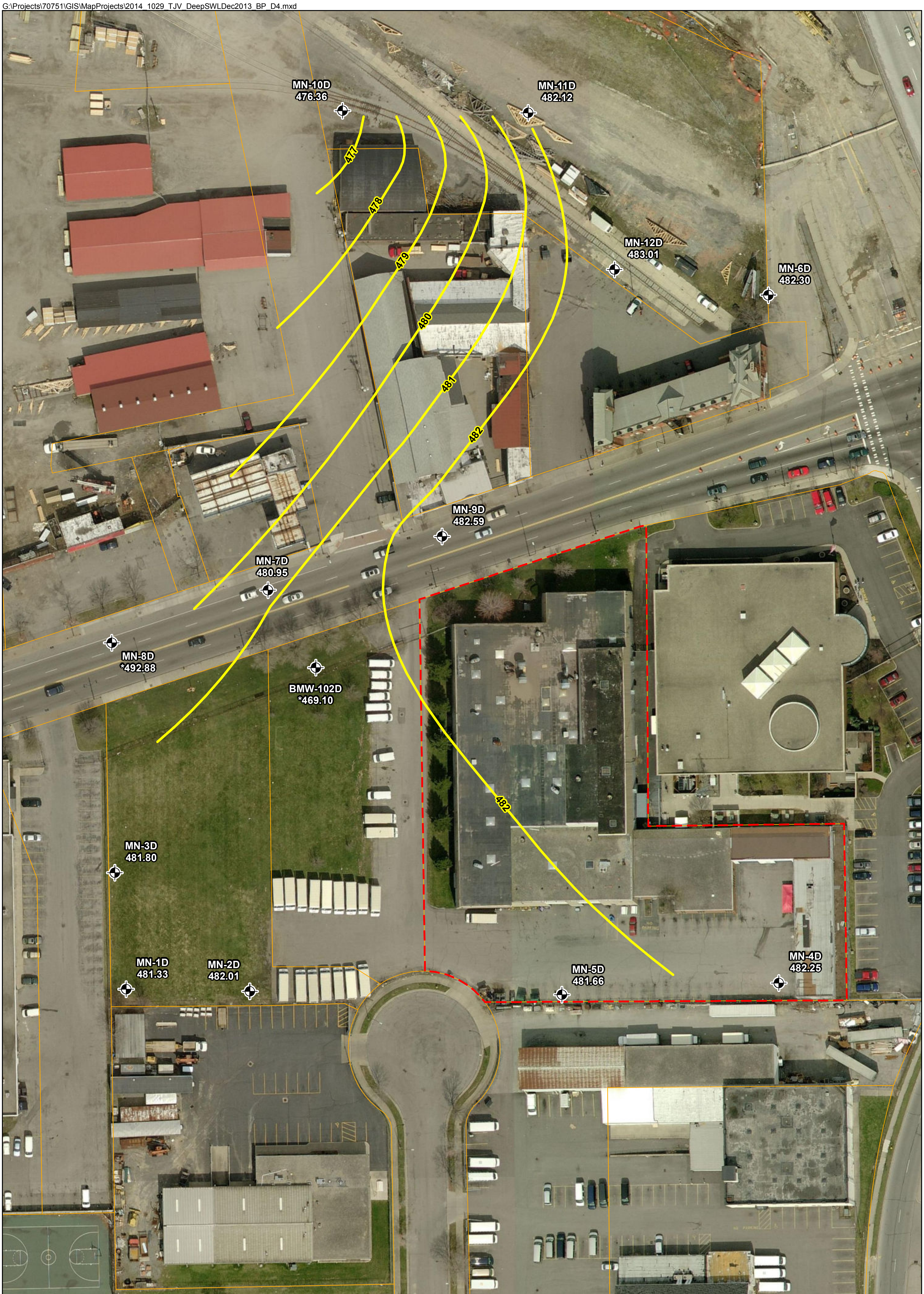
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

GROUNDWATER ELEVATION CONTOUR MAP - INTERMEDIATE BEDROCK, MAY 2013

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 8A

G:\Projects\70751\GIS\MapProjects\2014_1029_TJV_DeepSWLDec2013_BP_D4.mxd



DEEP MONITORING WELL
GROUNDWATER CONTOUR
SITE PROPERTY BOUNDARY
PARCEL BOUNDARY

NOTES:
1) SWL RECORDED BY H&A STAFF DECEMBER, 2013.
2) COORDINATES IN NEW YORK STATEPLANE FEET, ZONE WEST, DATUM NAD83.
3) ELEVATIONS REFERENCE NAVD88.
4) * - ELEVATION NOT USED FOR CONTOURING.
5) NM - NOT MEASURED.

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SCALE IN FEET

HALEY & ALDRICH

FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

GROUNDWATER ELEVATION CONTOUR MAP - DEEP BEDROCK, DECEMBER 2013

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 9

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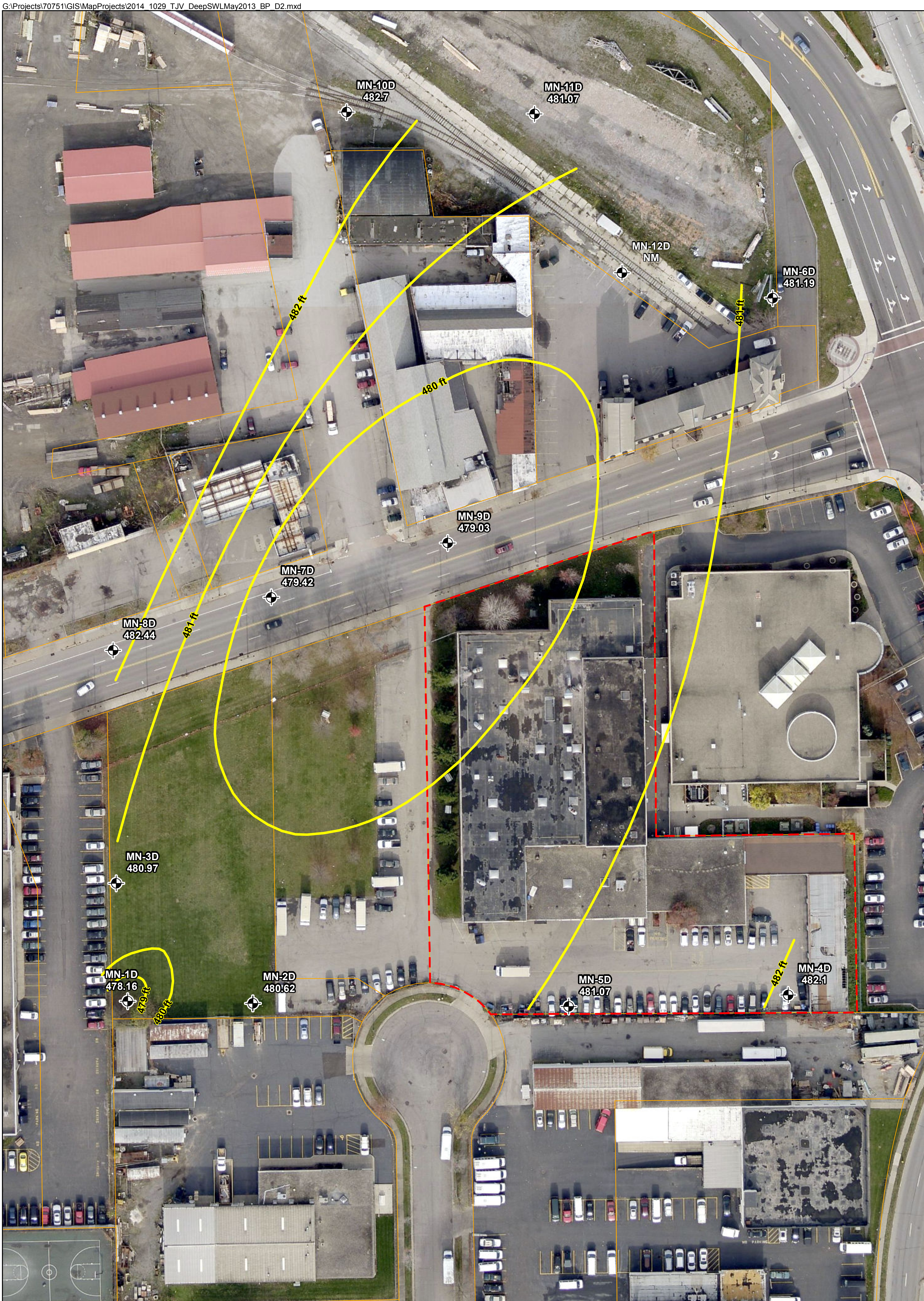


DEEP MONITORING WELL
GROUNDWATER CONTOUR
SITE PROPERTY BOUNDARY
PARCEL BOUNDARY

NOTES:
1) SWL RECORDED BY H&A STAFF MAY, 2013.
2) COORDINATES IN NEW YORK STATEPLANE FEET, ZONE WEST, DATUM NAD83.
3) ELEVATIONS REFERENCE NAVD88.
4) * - ELEVATION NOT USED FOR CONTOURING.
5) NM - NOT MEASURED.

N W E S

0 25 50 75
SCALE IN FEET

HALEY & ALDRICH

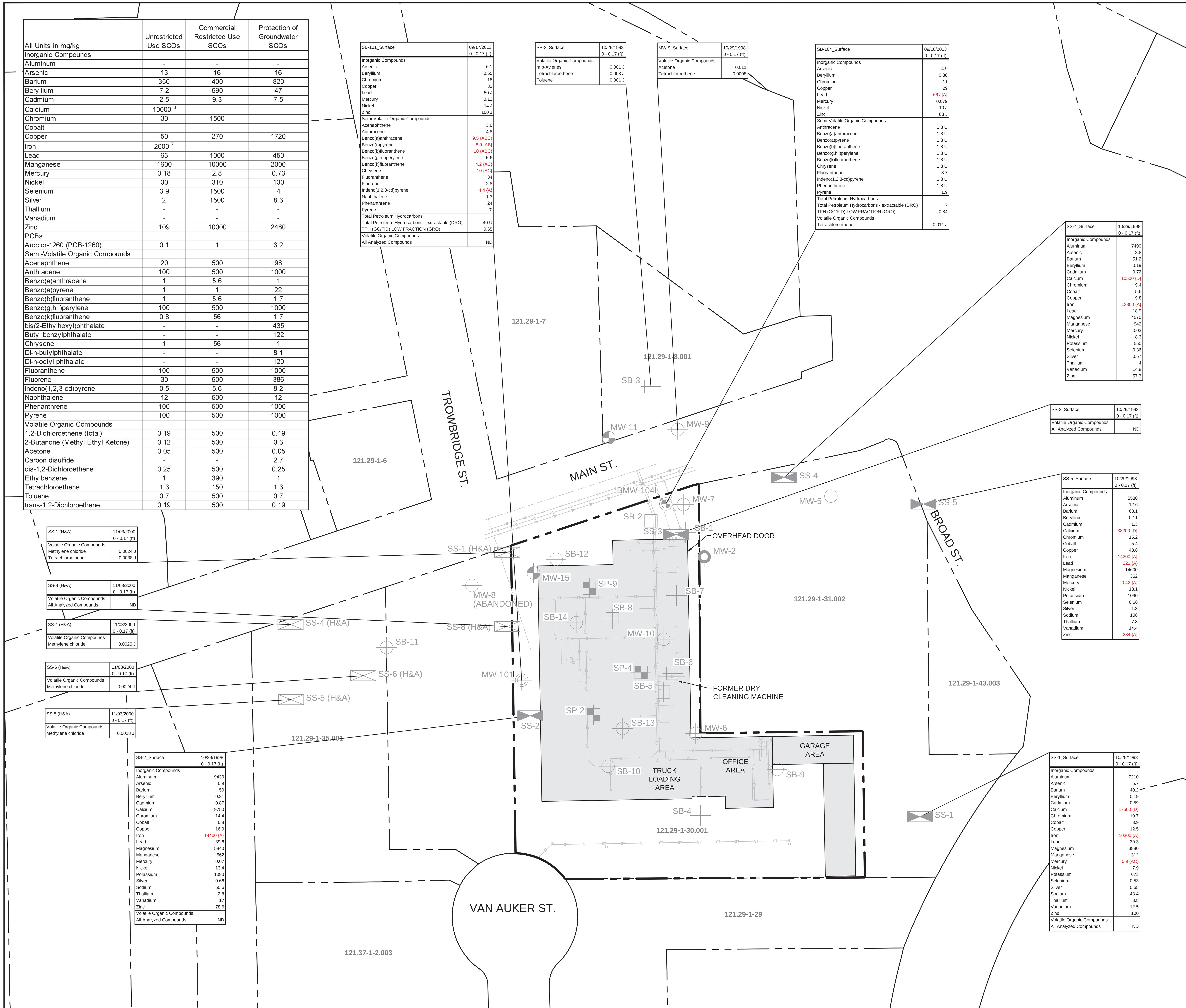
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

GROUNDWATER ELEVATION CONTOUR MAP - DEEP BEDROCK, MAY 2013

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 9A

All Units in mg/kg	Unrestricted Use SCOs	Commercial Restricted Use SCOs	Protection of Groundwater SCOs
Inorganic Compounds			
Aluminum	-	-	-
Arsenic	13	16	16
Barium	350	400	820
Beryllium	7.2	590	47
Cadmium	2.5	9.3	7.5
Calcium	10000 [8]	-	-
Chromium	30	1500	-
Cobalt	-	-	-
Copper	50	270	1720
Iron	2000 [7]	-	-
Lead	63	1000	450
Manganese	1600	10000	2000
Mercury	0.18	2.8	0.73
Nickel	30	310	130
Selenium	3.9	1500	4
Silver	2	1500	8.3
Thallium	-	-	-
Vanadium	-	-	-
Zinc	109	10000	2480
PCBs			
Aroclor-1260 (PCB-1260)	0.1	1	3.2
Semi-Volatile Organic Compounds			
Acenaphthene	20	500	98
Anthracene	100	500	1000
Benzo(a)anthracene	1	5.6	1
Benzo(a)pyrene	1	1	22
Benzo(b)fluoranthene	1	5.6	1.7
Benzo(g,h,i)perylene	100	500	1000
Benzo(k)fluoranthene	0.8	56	1.7
bis(2-Ethylhexyl)phthalate	-	-	435
Butyl benzylphthalate	-	-	122
Chrysene	1	56	1
Di-n-butylphthalate	-	-	8.1
Di-n-octyl phthalate	-	-	120
Fluoranthene	100	500	1000
Fluorene	30	500	386
Indeno(1,2,3-cd)pyrene	0.5	5.6	8.2
Naphthalene	12	500	12
Phenanthrene	100	500	1000
Pyrene	100	500	1000
Volatile Organic Compounds			
1,2-Dichloroethene (total)	0.19	500	0.19
2-Butanone (Methyl Ethyl Ketone)	0.12	500	0.3
Acetone	0.05	500	0.05
Carbon disulfide	-	-	2.7
cis-1,2-Dichloroethene	0.25	500	0.25
Ethylbenzene	1	390	1
Tetrachloroethene	1.3	150	1.3
Toluene	0.7	500	0.7
trans-1,2-Dichloroethene	0.19	500	0.19



SB-101_Surface	09/17/2013 0 - 0.17 (ft)
Inorganic Compounds	
Arsenic	6.1
Beryllium	0.65
Chromium	18
Copper	32
Lead	50 J
Mercury	0.12
Nickel	14 J
Zinc	100 J
Semi-Volatile Organic Compounds	
Acenaphthene	3.6
Anthracene	4.8
Benzo(a)anthracene	9.5 {ABC}
Benzo(a)pyrene	8.9 {AB}
Benzo(b)fluoranthene	10 {ABC}
Benzo(g,h,i)perylene	5.6
Benzo(k)fluoranthene	4.2 {AC}
Chrysene	10 {AC}
Fluoranthene	34
Fluorene	2.8
Indeno(1,2,3-cd)pyrene	4.4 {A}
Naphthalene	1.3
Phenanthrene	24
Pyrene	20
Total Petroleum Hydrocarbons	
Total Petroleum Hydrocarbons - extractable (DRO)	40 U
TPH (GC/FID) LOW FRACTION (GRO)	0.65
Volatile Organic Compounds	
All Analyzed Compounds	ND

SB-3_Surface	10/29/1998 0 - 0.17 (ft)
Volatile Organic Compounds	
m,p-Xylenes	0.001 J
Tetrachloroethene	0.003 J
Toluene	0.001 J

MW-9_Surface	10/29/1998 0 - 0.17 (ft)
Volatile Organic Compounds	
Acetone	0.011
Tetrachloroethene	0.0008

SB-104_Surface	09/16/2013 0 - 0.17 (ft)
Inorganic Compounds	
Arsenic	4.9
Beryllium	0.38
Chromium	11
Copper	29
Lead	66 J{A}
Mercury	0.079
Nickel	10 J
Zinc	88 J
Semi-Volatile Organic Compounds	
Anthracene	1.8 U
Benzo(a)anthracene	1.8 U
Benzo(a)pyrene	1.8 U
Benzo(b)fluoranthene	1.8 U
Benzo(g,h,i)perylene	1.8 U
Benzo(k)fluoranthene	1.8 U
Chrysene	1.8 U
Fluoranthene	3.7
Indeno(1,2,3-cd)pyrene	1.8 U
Phenanthrene	1.8 U
Pyrene	1.9
Total Petroleum Hydrocarbons	
Total Petroleum Hydrocarbons - extractable (DRO)	7
TPH (GC/FID) LOW FRACTION (GRO)	0.84
Volatile Organic Compounds	
Tetrachloroethene	0.011 J

SS-4_Surface	10/29/1998 0 - 0.17 (ft)
Inorganic Compounds	
Aluminum	7490
Arsenic	3.8
Barium	51.2
Beryllium	0.19
Cadmium	0.72
Calcium	10500 {D}
Chromium	9.4
Cobalt	5.6
Copper	9.8
Iron	13300 {A}
Lead	18.9
Magnesium	4570
Manganese	942
Mercury	0.03
Nickel	8.3
Potassium	550
Selenium	0.36
Silver	0.57
Thallium	4
Vanadium	14.8
Zinc	57.3

SS-3_Surface	10/29/1998 0 - 0.17 (ft)
Volatile Organic Compounds	
All Analyzed Compounds	ND

SS-5_Surface	10/29/1998 0 - 0.17 (ft)
Inorganic Compounds	
Aluminum	5580
Arsenic	12.6
Barium	68.1
Beryllium	0.11
Cadmium	1.3
Calcium	38200 {D}
Chromium	15.2
Cobalt	5.4
Copper	43.8
Iron	14200 {A}
Lead	221 {A}
Magnesium	14600
Manganese	362
Mercury	0.42 {A}
Nickel	13.1
Potassium	1090
Selenium	0.66
Silver	1.3
Sodium	108
Thallium	7.3
Vanadium	14.4
Zinc	234 {A}

SS-1 (H&A)	11/03/2000 0 - 0.17 (ft)
Volatile Organic Compounds	
Methylene chloride	0.0024 J
Tetrachloroethene	0.0038 J

SS-8 (H&A)	11/03/2000 0 - 0.17 (ft)
Volatile Organic Compounds	
All Analyzed Compounds	ND

SS-4 (H&A)	11/03/2000 0 - 0.17 (ft)
Volatile Organic Compounds	
Methylene chloride	0.0025 J

SS-6 (H&A)	11/03/2000 0 - 0.17 (ft)
Volatile Organic Compounds	
Methylene chloride	0.0024 J

SS-5 (H&A)	11/03/2000 0 - 0.17 (ft)
Volatile Organic Compounds	
Methylene chloride	0.0028 J

SS-2_Surface	10/29/1998 0 - 0.17 (ft)
Inorganic Compounds	
Aluminum	9430
Arsenic	6.9
Barium	59
Beryllium	0.31
Cadmium	0.87
Calcium	9750
Chromium	14.4
Cobalt	6.8
Copper	16.9
Iron	14400 {A}
Lead	39.6
Magnesium	5840
Manganese	562
Mercury	0.07
Nickel	13.4
Potassium	1090
Silver	0.66
Sodium	50.6
Thallium	2.8
Vanadium	17
Zinc	78.6
Volatile Organic Compounds	
All Analyzed Compounds	ND

SS-1_Surface	10/29/1998 0 - 0.17 (ft)
Inorganic Compounds	
Aluminum	7210
Arsenic	5.7
Barium	40.2
Beryllium	0.19
Cadmium	0.59
Calcium	17600 {D}
Chromium	10.7
Cobalt	3.9
Copper	12.5
Iron	10300 {A}
Lead	39.3
Magnesium	3880
Manganese	312
Mercury	0.9 {AC}
Nickel	7.9
Potassium	673
Selenium	0.53
Silver	0.65
Sodium	43.4
Thallium	3.8
Vanadium	12.5
Zinc	100
Volatile Organic Compounds	
All Analyzed Compounds	ND

LEGEND:

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
- BEDROCK WELL (HALEY & ALDRICH, 2001)
- BEDROCK WELL (HALEY & ALDRICH, 2013)
- OVERBURDEN WELL (HALEY & ALDRICH, 2001 AND NYSDEC, 1998)
- OVERBURDEN WELL (HALEY & ALDRICH, 2013)
- BEDROCK/OVERBURDEN INTERVAL WELL (SEELER, ENV., 1993)
- OVERBURDEN SOIL BORING (NYDEC, 1998)
- OVERBURDEN SOIL BORING (HALEY & ALDRICH,2011)
- SOIL VAPOR EXTRACTION WELL
- SURFACE SOIL SAMPLE (HALEY & ALDRICH 2001)
- SURFACE SOIL SAMPLE (NYDEC 1998)

NOTES:

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
2. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.
3. DATABOX UNITS SHOWN IN MG/KG.
4. DETECTED ANALYTES (PER LOCATION) SHOWN IN DATABOXES.
5. RESULTS SHOWN IN RED EXCEED ONE OR MORE OF THE FOLLOWING NYSDEC CRITERIA:
   {A} - UNRESTRICTED USE SCOs
   {B} - COMMERCIAL USE SCOs
   {C} - PROTECTION OF GROUNDWATER SCOs
   {D} - CP-51 SUPPLEMENTAL SCOs (PROTECTION OF ECOLOGICAL RESOURCES)
6. DATA QUALIFIERS:
   U - INDICATES ANALYTES NOT DETECTED ABOVE THE LABORATORY REPORTING OR METHOD DETECTION LIMIT.
   ND - INDICATES RESULT WAS NOT DETECTED IN LEGACY DATA LABORATORY REPORTING OR METHOD DETECTION LIMIT UNKNOWN.
   J - INDICATES THE RESULT WAS ESTIMATED.
   D - INDICATES THE RESULT IS FROM A DILUTION.
   \- INDICATES COMPOUND NOT ANALYZED.
7. SUPPLEMENTAL CP-51 RESIDENTIAL SCO FOR IRON WAS USED IN ABSENCE OF APPLICABLE UNRESTRICTED USE PART 375 CRITERION.
8. SUPPLEMENTAL CP-51 PROTECTION OF ECOLOGICAL RESOURCE SCO FOR CALCIUM WAS USED IN ABSENCE OF APPLICABLE PART 375 CRITERION.
9. SELECT COMPOUNDS ARE REPORTED AS NON-DETECT, HOWEVER THE LABORATORY REPORTING LIMITS FOR THESE COMPOUNDS EXCEEDED THE COMPARISON CRITERIA. THE ASSOCIATED ANALYSES ARE COMPLIANT WITH THE EPA ANALYTICAL METHODOLOGY. WITH THESE CONDITIONS, NO DETERMINATION CAN BE MADE THAT AN ACTUAL CONCENTRATION FOR THESE COMPOUNDS DOES OR DOES NOT EXCEED THE COMPARISON CRITERIA. GENERALLY, IN SOIL THESE COMPOUNDS ARE NOT VOC COMPOUNDS OF CONCERN FOR THE SITE AND COMPRISED ONE OF TWO SITUATIONS: 1) EITHER THE COMPARISON CRITERIA WAS VERY LOW RELATIVE TO THE REPORTING LIMIT OR 2) A DETECTION OF ONE OR MORE COMPOUNDS REQUIRED A DILUTION, THUS RAISING THE REPORTING LIMITS FOR SOME LIMITED OTHER COMPOUNDS. SEE REMEDIAL INVESTIGATION REPORT, SECTION 3.5.1 FOR FURTHER EXPLANATION.

HALEY & ALDRICH

FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

SURFACE SOIL ANALYTICAL POSTING MAP

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 10

\\CLE\COMMON\PROJECTS\70751 - ARTCO\CAD\DRAWINGS\70751-SO_DATABOX [MAY 2014]_R3.DWG

All Units in mg/kg	Unrestricted Use SCOs	Commercial Restricted Use SCOs	Protection of Groundwater SCOs	CP-51 Protection of Ecological Resources
Inorganic Compounds				
Aluminum	-	-	-	10000
Antimony	-	-	-	-
Arsenic	13	16	16	-
Barium	350	400	820	-
Beryllium	7.2	590	47	-
Cadmium	2.5	9.3	7.5	-
Calcium	-	-	-	10000
Chromium	30	1500	-	-
Cobalt	-	-	-	20
Copper	50	270	1720	-
Iron	2000 [7]	-	-	-
Lead	63	1000	450	-
Magnesium	-	-	-	-
Manganese	1600	10000	2000	-
Mercury	0.18	2.8	0.73	-
Nickel	30	310	130	-
Potassium	-	-	-	-
Selenium	3.9	1500	4	-
Sodium	-	-	-	-
Silver	2	1500	8.3	-
Thallium	-	-	-	5
Vanadium	-	-	-	39
Zinc	109	10000	2480	-
PCBs				
Aroclor-1260 (PCB-1260)	0.1	1	3.2	-
Pesticides				
4,4'-DDT	0.0033	47	136	0.0033
Endrin	0.014	89	0.06	0.014
Semi-Volatile Organic Compounds				
Acenaphthene	20	500	98	-
Anthracene	100	500	1000	-
Benzo(a)anthracene	1	5.6	1	-
Benzo(a)pyrene	1	1	22	-
Benzo(b)fluoranthene	1	5.6	1.7	-
Benzo(g,h,i)perylene	100	500	1000	-
Benzo(k)fluoranthene	0.8	56	1.7	-
bis(2-Ethylhexyl)phthalate	-	-	435	-
Butyl benzylphthalate	-	-	122	-
Chrysene	1	56	1	-
Di-n-butylphthalate	-	-	8.1	-
Di-n-octyl phthalate	-	-	120	-
Fluoranthene	100	500	1000	-
Fluorene	30	500	386	-
Indeno(1,2,3-cd)pyrene	0.5	5.6	8.2	-
Naphthalene	12	500	12	-
Phenanthrene	100	500	1000	-
Pyrene	100	500	1000	-
Volatile Organic Compounds				
1,2-Dichloroethene (total)	0.19	500	0.19	-
2-Butanone (Methyl Ethyl Ketone)	0.12	500	0.3	-
Acetone	0.05	500	0.05	-
Carbon disulfide	-	-	2.7	-
cis-1,2-Dichloroethene	0.25	500	0.25	-
Ethylbenzene	1	390	1	-
Tetrachloroethene	1.3	150	1.3	-
Toluene	0.7	500	0.7	-
trans-1,2-Dichloroethene	0.19	500	0.19	-
Trichloroethene	0.47	200	0.47	-

MW-15	02/13/2001 6 - 8 (ft)	02/13/2001 8 - 10 (ft)
Volatile Organic Compounds		
cis-1,2-Dichloroethene	0.012 U	0.004 J
Tetrachloroethene	0.039	0.18 D
Trichloroethene	0.012 U	0.005 J

SB-12	02/23/2001 4 - 8 (ft)
Volatile Organic Compounds	
Acetone	0.01 J
Tetrachloroethene	0.001 J

SB-3	10/29/1998 4 - 8 (ft)
Volatile Organic Compounds	
m,p-Xylenes	ND
Tetrachloroethene	ND
Toluene	ND

MW-9	10/29/1998 8 - 10 (ft)
Volatile Organic Compounds	
Acetone	0.008 J
Tetrachloroethene	0.003 J

MW-11	02/16/2001 4 - 6 (ft)	02/16/2001 8 - 10 (ft)
Volatile Organic Compounds		
m,p-Xylenes	0.002 J	0.011 U
o-Xylene	0.002 J	0.011 U

MW-8	10/29/1998 4 - 8 (ft)	10/29/1998 8 - 10 (ft)
Volatile Organic Compounds		
1,2-Dichloroethene (total)	ND	0.001 J
2-Butanone (Methyl Ethyl Ketone)	ND	0.01 J
Acetone	0.004 J	0.011 J
Tetrachloroethene	ND	0.05
Trichloroethene	ND	0.002 J

SB-104	09/16/2013 0 - 1 (ft)	09/22/2014 0 - 1 (ft)
Inorganic Compounds		
Aluminum	6400	-
Arsenic	5.8	-
Barium	52	-
Beryllium	0.47	-
Calcium	35000 {D}	-
Chromium	8.3	-
Cobalt	4.7	-
Copper	25	-
Iron	11000 {A}	-
Lead	63 J	-
Magnesium	8800	-
Manganese	590	-
Mercury	0.14	-
Nickel	11 J	-
Potassium	1300	-
Sodium	170	-
Vanadium	13	-
Zinc	60 J	-
PCBs		
Aroclor-1260 (PCB-1260)	0.025	-
Pesticides		
4,4'-DDT	-	0.027 J
Endrin	-	0.022 {AD}
Semi-Volatile Organic Compounds		
Anthracene	4.5	0.13 J
Benzo(a)anthracene	8.1 {ABC}	0.62
Benzo(a)pyrene	7.2 {AB}	0.62
Benzo(b)fluoranthene	7.7 {ABC}	0.99
Benzo(g,h,i)perylene	4.7	0.57
Benzo(k)fluoranthene	2.9 {AC}	0.27 J
Chrysene	8.5 {AC}	0.63
Fluoranthene	22	1
Indeno(1,2,3-cd)pyrene	3.5 {A}	0.47
Phenanthrene	17	1
Pyrene	16	1
Total Petroleum Hydrocarbons		
Total Petroleum Hydrocarbons - extractable (DRO)	5.2 U	-
TPH (GC/FID) LOW FRACTION (GRO)	0.14	-
Volatile Organic Compounds		
Tetrachloroethene	0.094 J	-

SB-2	10/29/1998 8 - 10.5 (ft)
Volatile Organic Compounds	
Tetrachloroethene	0.004 J

MW-7	10/29/1998 8 - 11.5 (ft)
Volatile Organic Compounds	
2-Butanone (Methyl Ethyl Ketone)	0.021
Tetrachloroethene	0.013

SB-1	10/28/1998 8 - 10.5 (ft)
Volatile Organic Compounds	
Tetrachloroethene	0.002 J

SB-7	12/01/1998 4 - 8 (ft)
Volatile Organic Compounds	
2-Butanone (Methyl Ethyl Ketone)	0.01
Tetrachloroethene	0.057
Trichloroethene	570 {ABC}

MW-5	10/28/1998 8 - 9 (ft)
Volatile Organic Compounds	
All Analyzed Compounds	ND

MW-10	12/01/1998 0 - 4 (ft)	12/01/1998 4 - 8 (ft)
Volatile Organic Compounds		
1,2-Dichloroethene (total)	0.37 J{AC}	0.003 J
Tetrachloroethene	61 {AC}	0.12
Trichloroethene	0.58 J{AC}	ND

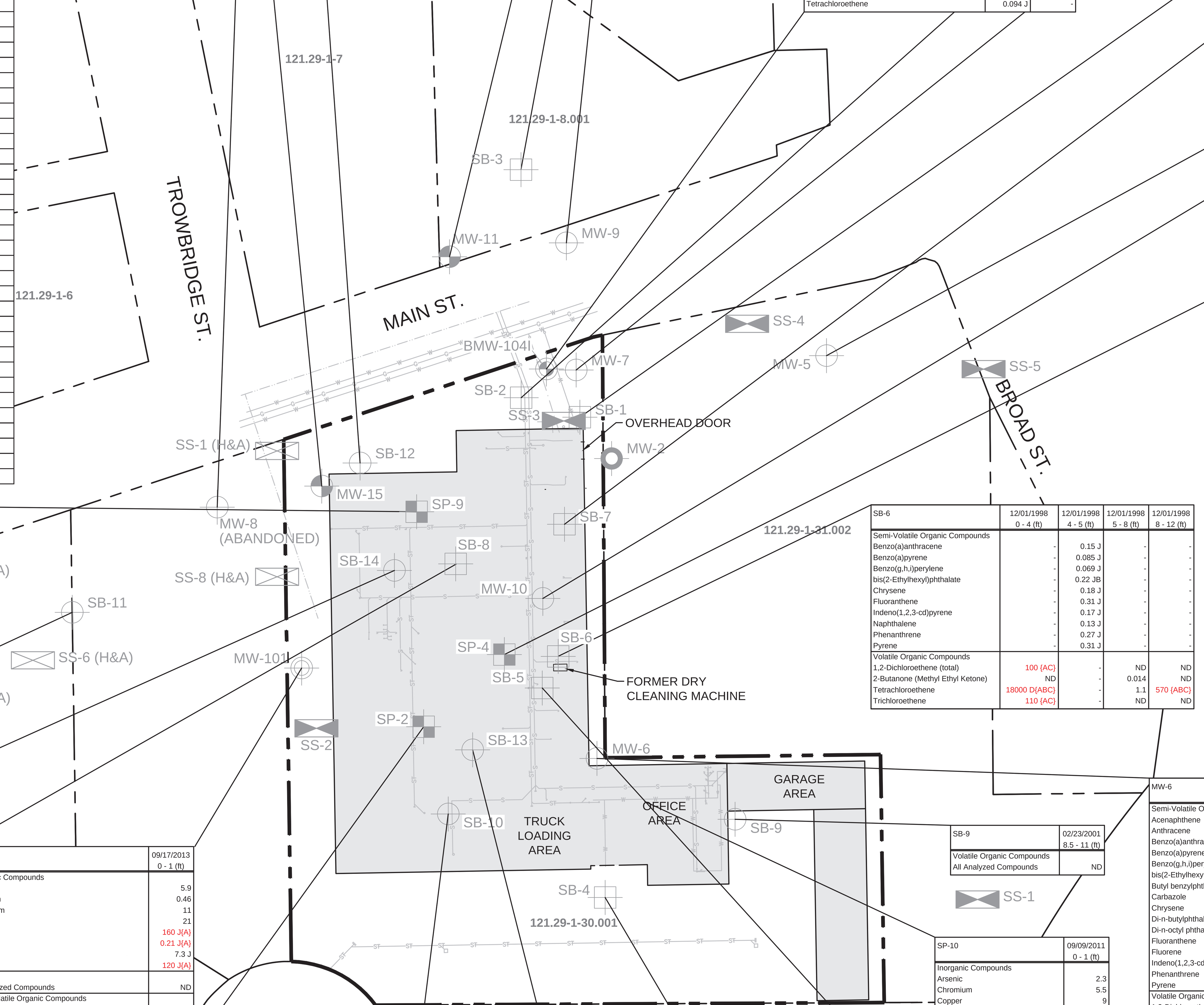
SP-4	09/09/2011 0 - 1 (ft)
Inorganic Compounds	
Arsenic	4.8
Chromium	9.8
Copper	20.2
Lead	83.6 {A}
Mercury	0.312 {A}
Nickel	9.1
Zinc	87.6
PCBs	
All Analyzed Compounds	ND
Semi-Volatile Organic Compounds	
Anthracene	5
Benzo(a)anthracene	13 {ABC}
Benzo(a)pyrene	14 {AB}
Benzo(b)fluoranthene	12 {ABC}
Benzo(g,h,i)perylene	9.6
Benzo(k)fluoranthene	11 {AC}
Chrysene	13 {AC}
Fluoranthene	30
Indeno(1,2,3-cd)pyrene	8.5 {ABC}
Phenanthrene	24
Pyrene	25
Total Petroleum Hydrocarbons	
Diesel Fuel	180
Gasoline	0.13
Volatile Organic Compounds	
Acetone	0.015 J
cis-1,2-Dichloroethene	0.029 J
Tetrachloroethene	5 J{AC}
trans-1,2-Dichloroethene	0.0064 J
Trichloroethene	0.057 J

SP-9	09/09/2011 0 - 1 (ft)
Inorganic Compounds	
Arsenic	3.7
Chromium	10.3
Copper	14
Lead	62.1
Mercury	0.144
Nickel	9.1
Zinc	60.2
Semi-Volatile Organic Compounds	
Benzo(a)anthracene	2.4 {AC}
Benzo(a)pyrene	2.9 {AB}
Benzo(b)fluoranthene	2.7 {AC}
Benzo(g,h,i)perylene	2
Benzo(k)fluoranthene	2.2 {AC}
Chrysene	2.4 {AC}
Fluoranthene	5.3
Indeno(1,2,3-cd)pyrene	1.8 {A}
Phenanthrene	1.8
Pyrene	3.5
Total Petroleum Hydrocarbons	
Diesel Fuel	65
Volatile Organic Compounds	
Tetrachloroethene	0.0074 J

SB-11	02/23/2001 4 - 8 (ft)
Volatile Organic Compounds	
2-Butanone (Methyl Ethyl Ketone)	0.01 J
Acetone	0.048
Tetrachloroethene	0.002 J

SB-14	02/23/2001 8 - 12 (ft)
Volatile Organic Compounds	
Acetone	0.012 J
cis-1,2-Dichloroethene	1 DJ{AC}
Tetrachloroethene	3.1 D{AC}
Toluene	0.002 J
trans-1,2-Dichloroethene	0.003 J
Trichloroethene	0.18 DJ

SB-8	12/02/1998 7.5 - 10 (ft)
Volatile Organic Compounds	
1,2-Dichloroethene (total)	0.056
Tetrachloroethene	14 D{AC}
Trichloroethene	0.037



SB-6	12/01/1998 0 - 4 (ft)	12/01/1998 4 - 5 (ft)	12/01/1998 5 - 8 (ft)	12/01/1998 8 - 12 (ft)
Semi-Volatile Organic Compounds				
Benzo(a)anthracene	-	0.15 J	-	-
Benzo(a)pyrene	-	0.085 J	-	-
Benzo(g,h,i)perylene	-	0.069 J	-	-
bis(2-Ethylhexyl)phthalate	-	0.22 JB	-	-
Chrysene	-	0.18 J	-	-
Fluoranthene	-	0.31 J	-	-
Indeno(1,2,3-cd)pyrene	-	0.17 J	-	-
Naphthalene	-	0.13 J	-	-
Phenanthrene	-	0.27 J	-	-
Pyrene	-	0.31 J	-	-
Volatile Organic Compounds				
1,2-Dichloroethene (total)	100 {AC}	-	ND	ND
2-Butanone (Methyl Ethyl Ketone)	ND	-	0.014	ND
Tetrachloroethene	18000 D{ABC}	-	1.1	570 {ABC}
Trichloroethene	110 {AC}	-	ND	ND

MW-6	10/28/1998 0 - 4 (ft)	10/29/1998 4 - 8 (ft)	10/28/1998 8 - 12 (ft)
Semi-Volatile Organic Compounds			
Acenaphthene	-	-	0.055 J
Anthracene	-	-	0.071 J
Benzo(a)anthracene	-	-	0.19 J
Benzo(a)pyrene	-	-	0.19 J
Benzo(g,h,i)perylene	-	-	0.13 J
bis(2-Ethylhexyl)phthalate	-	-	7.4 D
Butyl benzylphthalate	-	-	0.1 J
Carbazole	-	-	0.047 J
Chrysene	-	-	0.23 J
Di-n-butylphthalate	-	-	0.064 J
Di-n-octyl phthalate	-	-	0.4
Fluoranthene	-	-	0.5
Fluorene	-	-	0.047 J
Indeno(1,2,3-cd)pyrene	-	-	0.12 J
Phenanthrene	-	-	0.41
Pyrene	-	-	0.55
Volatile Organic Compounds			
1,2-Dichloroethene (total)	0.005 J	0.31 D{AC}	0.062
2-Butanone (Methyl Ethyl Ketone)	ND	0.044	0.027
Carbon disulfide	ND	0.002 J	ND
Ethylbenzene	ND	0.001 J	ND
m,p-Xylenes	0.002 J	0.004 J	ND
o-Xylene	ND	0.003 J	ND
Tetrachloroethene	6.7 {AC}	0.086	2.4 {AC}
Toluene	0.002 J	0.003 J	ND
Trichloroethene	0.027	0.035	0.043

SB-9	02/23/2001 8.5 - 11 (ft)
Volatile Organic Compounds	
All Analyzed Compounds	ND

SP-10	09/09/2011 0 - 1 (ft)
Inorganic Compounds	
Arsenic	2.3
Chromium	5.5
Copper	9
Lead	8.9
Nickel	6.3
Zinc	42.5
Semi-Volatile Organic Compounds	
All Analyzed Compounds	ND
Total Petroleum Hydrocarbons	
All Analyzed Compounds	ND
Volatile Organic Compounds	
All Analyzed Compounds	ND

SB-101	09/17/2013 0 - 1 (ft)
Inorganic Compounds	
Arsenic	5.9
Beryllium	0.46
Chromium	11
Copper	21
Lead	160 J{A}
Mercury	0.21 J{A}
Nickel	7.3 J
Zinc	120 J{A}
PCBs	
All Analyzed Compounds	ND
Semi-Volatile Organic Compounds	
Acenaphthene	4.1 U
Anthracene	4.1 UJ
Benzo(a)anthracene	4.1 UJ
Benzo(a)pyrene	4.1 UJ
Benzo(b)fluoranthene	4.1 UJ
Benzo(g,h,i)perylene	4.1 UJ
Benzo(k)fluoranthene	4.1 U
Chrysene	4.1 UJ
Fluoranthene	9.9 J
Fluorene	4.1 U
Indeno(1,2,3-cd)pyrene	4.1 UJ
Naphthalene	4.1 U
Phenanthrene	5.8 J
Pyrene	5.1 J
Total Petroleum Hydrocarbons	
Total Petroleum Hydrocarbons - extractable (DRO)	48 J
TPH (GC/FID) LOW FRACTION (GRO)	0.12 UJ
Volatile Organic Compounds	
All Analyzed Compounds	ND

SP-2	09/09/2011 0 - 1 (ft)
Inorganic Compounds	
Arsenic	7.8
Beryllium	1.09
Chromium	9.8
Copper	18.4
Lead	92.5 {A}
Nickel	8.1
Selenium	1.7
Zinc	63.6
Semi-Volatile Organic Compounds	
All Analyzed Compounds	ND
Total Petroleum Hydrocarbons	
All Analyzed Compounds	ND
Volatile Organic Compounds	
Tetrachloroethene	0.021 J
Trichloroethene	0.0007 J

SB-10	02/23/2001 4 - 8 (ft)
Volatile Organic Compounds	
All Analyzed Compounds	ND

SB-13	02/23/2001 8 - 12 (ft)
Volatile Organic Compounds	
Acetone	0.006 J
cis-1,2-Dichloroethene	0.003 J
Tetrachloroethene	0.032
Trichloroethene	0.002 J

SB-4	10/30/1998 8 - 10.5 (ft)
Volatile Organic Compounds	
Acetone	0.008 J

SB-5	12/01/1998 4 - 8 (ft)
Volatile Organic Compounds	
1,2-Dichloroethene (total)	0.055
2-Butanone (Methyl Ethyl Ketone)	0.023
Acetone	0.012
Tetrachloroethene	12 D{AC}
Trichloroethene	0.074

LEGEND:

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
- BEDROCK WELL (HALEY & ALDRICH, 2001)
- BEDROCK WELL (HALEY & ALDRICH, 2013)
- OVERBURDEN WELL (HALEY & ALDRICH, 2001 AND NYSDEC, 1998)
- OVERBURDEN WELL (HALEY & ALDRICH, 2013)
- BEDROCK/OVERBURDEN INTERVAL WELL (SEELER, ENV., 1993)
- OVERBURDEN SOIL BORING (NYDEC, 1998)
- OVERBURDEN SOIL BORING (HALEY & ALDRICH,2011)
- SOIL VAPOR EXTRACTION WELL
- SURFACE SOIL SAMPLE (HALEY & ALDRICH 2001)
- SURFACE SOIL SAMPLE (NYDEC 1998)

NOTES:

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
2. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.
3. DATABOX UNITS SHOWN IN MG/KG.
4. DETECTED ANALYTES (PER LOCATION) SHOWN IN DATABOXES.
5. RESULTS SHOWN IN RED EXCEED ONE OR MORE OF THE FOLLOWING NYSDEC CRITERIA:
   {A} - UNRESTRICTED USE SCOs
   {B} - COMMERCIAL USE SCOs
   {C} - PROTECTION OF GROUNDWATER SCOs
   {D} - CP-51 PROTECTION OF ECOLOGICAL RESOURCES
6. DATA QUALIFIERS:
   U - INDICATES ANALYTES NOT DETECTED ABOVE THE LABORATORY REPORTING OR METHOD DETECTION LIMIT.
   ND - INDICATES RESULT WAS NOT DETECTED IN LEGACY DATA LABORATORY REPORTING OR METHOD DETECTION LIMIT UNKNOWN.
   J - INDICATES THE RESULT WAS ESTIMATED.
   D - INDICATES THE RESULT IS FROM A DILUTION.
   \- INDICATES COMPOUND NOT ANALYZED.
7. SUPPLEMENTAL CP-51 RESIDENTIAL SCO FOR IRON WAS USED IN ABSENCE OF APPLICABLE UNRESTRICTED USE PART 375 CRITERION.
8. SELECT COMPOUNDS ARE REPORTED AS NON-DETECT, HOWEVER THE LABORATORY REPORTING LIMITS FOR THESE COMPOUNDS EXCEEDED THE COMPARISON CRITERIA. THE ASSOCIATED ANALYSES ARE COMPLIANT WITH THE EPA ANALYTICAL METHODOLOGY. WITH THESE CONDITIONS, NO DETERMINATION CAN BE MADE THAT AN ACTUAL CONCENTRATION FOR THESE COMPOUNDS DOES OR DOES NOT EXCEED THE COMPARISON CRITERIA. GENERALLY, IN SOIL THESE COMPOUNDS ARE NOT VOC COMPOUNDS OF CONCERN FOR THE SITE AND COMPRISED ONE OF TWO SITUATIONS: 1) EITHER THE COMPARISON CRITERIA WAS VERY LOW RELATIVE TO THE REPORTING LIMIT OR 2) A DETECTION OF ONE OR MORE COMPOUNDS REQUIRED A DILUTION, THUS RAISING THE REPORTING LIMITS FOR SOME LIMITED OTHER COMPOUNDS. SEE REMEDIAL INVESTIGATION REPORT, SECTION 3.5.1 FOR FURTHER EXPLANATION.

N S W E

0 50 100 150 200

SCALE IN FEET

HALEY & ALDRICH

FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

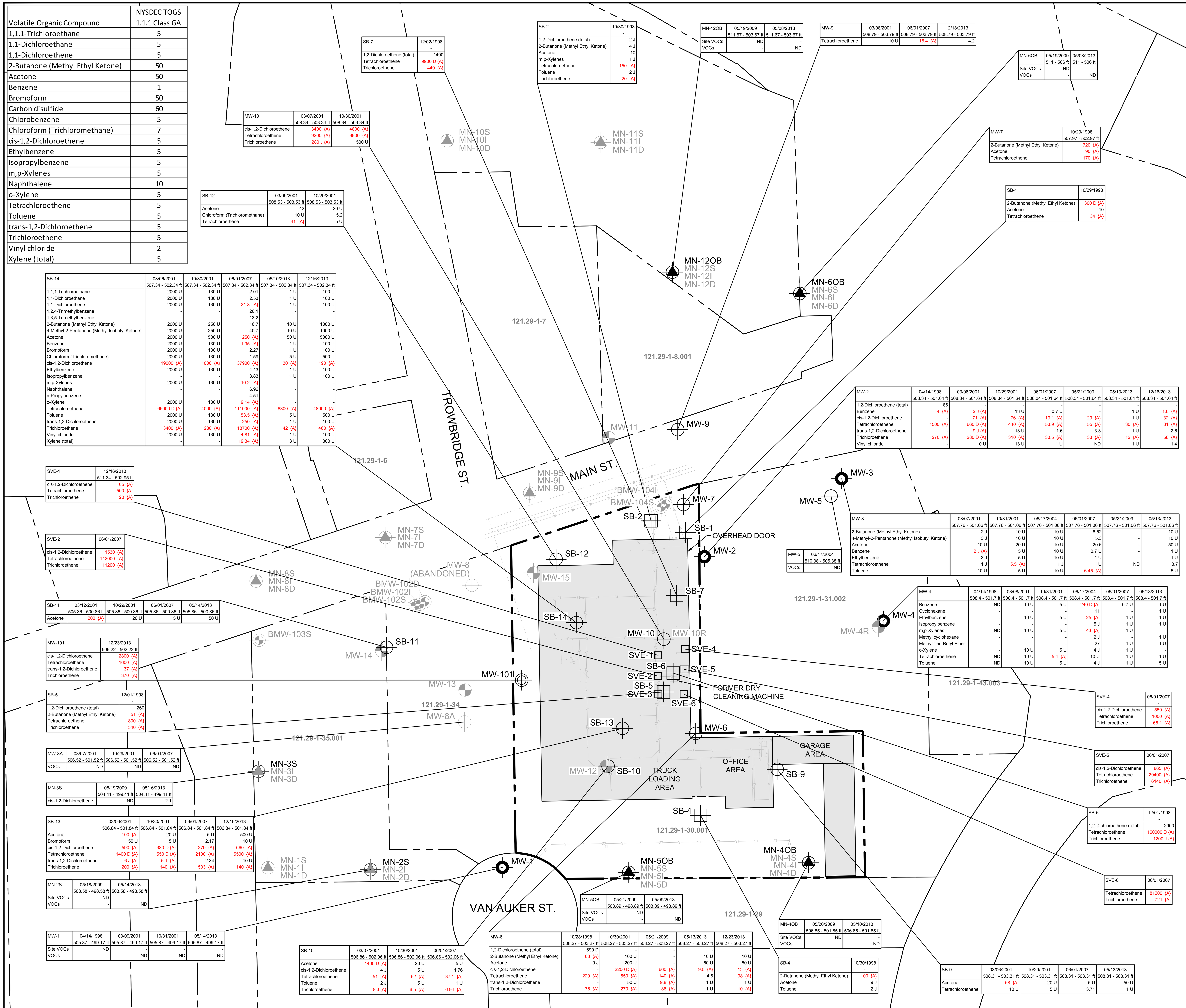
SOIL/FILL ANALYTICAL POSTING MAP

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 11

\\CLE\COMMON\PROJECTS\70751 - ARTCO\CAD\DRAWINGS\70751-SO_DATABOX [MAY 2014]_R3.DWG

Volatile Organic Compound	NYSDEC TOGS 1.1.1 Class GA
1,1,1-Trichloroethane	5
1,1-Dichloroethane	5
1,1-Dichloroethene	5
2-Butanone (Methyl Ethyl Ketone)	50
Acetone	50
Benzene	1
Bromoform	50
Carbon disulfide	60
Chlorobenzene	5
Chloroform (Trichloromethane)	7
cis-1,2-Dichloroethene	5
Ethylbenzene	5
Isopropylbenzene	5
m,p-Xylenes	5
Naphthalene	10
o-Xylene	5
Tetrachloroethene	5
Toluene	5
trans-1,2-Dichloroethene	5
Trichloroethene	5
Vinyl chloride	2
Xylene (total)	5



SB-14	03/06/2001 507.34 - 502.34 ft	10/30/2001 507.34 - 502.34 ft	06/01/2007 507.34 - 502.34 ft	05/10/2013 507.34 - 502.34 ft	12/16/2013 507.34 - 502.34 ft
1,1,1-Trichloroethane	2000 U	130 U	2.01	1 U	100 U
1,1-Dichloroethane	2000 U	130 U	2.53	1 U	100 U
1,1-Dichloroethene	2000 U	130 U	21.8 {A}	1 U	100 U
1,2,4-Trimethylbenzene	-	-	26.1	-	-
1,3,5-Trimethylbenzene	-	-	13.2	-	-
2-Butanone (Methyl Ethyl Ketone)	2000 U	250 U	16.7	10 U	1000 U
4-Methyl-2-Pentanone (Methyl Isobutyl Ketone)	2000 U	250 U	40.7	10 U	1000 U
Acetone	2000 U	500 U	250 {A}	50 U	5000 U
Benzene	2000 U	130 U	1.95 {A}	1 U	100 U
Bromoform	2000 U	130 U	2.27	1 U	100 U
Chloroform (Trichloromethane)	2000 U	130 U	1.59	5 U	500 U
cis-1,2-Dichloroethene	19000 {A}	1000 {A}	37900 {A}	30 {A}	190 {A}
Ethylbenzene	2000 U	130 U	4.43	1 U	100 U
Isopropylbenzene	-	-	3.83	1 U	100 U
m,p-Xylenes	2000 U	130 U	10.2 {A}	-	-
Naphthalene	-	-	6.96	-	-
n-Propylbenzene	-	-	4.51	-	-
o-Xylene	2000 U	130 U	9.14 {A}	-	-
Tetrachloroethene	66000 D {A}	4000 {A}	111000 {A}	8300 {A}	48000 {A}
Toluene	2000 U	130 U	53.5 {A}	5 U	500 U
trans-1,2-Dichloroethene	2000 U	130 U	250 {A}	1 U	100 U
Trichloroethene	3400 {A}	280 {A}	18700 {A}	42 {A}	460 {A}
Vinyl chloride	2000 U	130 U	4.81 {A}	1 U	100 U
Xylene (total)	-	-	19.34 {A}	3 U	300 U

SB-7	12/02/1998 -
1,2-Dichloroethene (total)	1400
Tetrachloroethene	9900 D {A}
Trichloroethene	440 {A}

MW-10	03/07/2001 508.34 - 503.34 ft	10/30/2001 508.34 - 503.34 ft
cis-1,2-Dichloroethene	3400 {A}	4800 {A}
Tetrachloroethene	9200 {A}	9900 {A}
Trichloroethene	280 J {A}	500 U

SB-12	03/09/2001 508.53 - 503.53 ft	10/29/2001 508.53 - 503.53 ft
Acetone	42	20 U
Chloroform (Trichloromethane)	10 U	5.2
Tetrachloroethene	41 {A}	5 U

SB-2	10/30/1998 -
1,2-Dichloroethene (total)	2 J
2-Butanone (Methyl Ethyl Ketone)	4 J
Acetone	10
m,p-Xylenes	1 J
Tetrachloroethene	150 {A}
Toluene	2 J
Trichloroethene	20 {A}

MN-12OB	05/19/2009 511.67 - 503.67 ft	05/08/2013 511.67 - 503.67 ft
Site VOCs	ND	-
VOCs	-	ND

MW-9	03/08/2001 508.79 - 503.79 ft	06/01/2007 508.79 - 503.79 ft	12/18/2013 508.79 - 503.79 ft
Tetrachloroethene	10 U	16.4 {A}	4.2

MN-6OB	05/19/2009 511 - 506 ft	05/08/2013 511 - 506 ft
Site VOCs	ND	-
VOCs	-	ND

MW-7	10/29/1998 507.97 - 502.97 ft
2-Butanone (Methyl Ethyl Ketone)	720 {A}
Acetone	90 {A}
Tetrachloroethene	170 {A}

SB-1	10/29/1998 -
2-Butanone (Methyl Ethyl Ketone)	300 D {A}
Acetone	10
Tetrachloroethene	34 {A}

MW-2	04/14/1998 508.34 - 501.64 ft	03/08/2001 508.34 - 501.64 ft	10/29/2001 508.34 - 501.64 ft	06/01/2007 508.34 - 501.64 ft	05/21/2009 508.34 - 501.64 ft	05/13/2013 508.34 - 501.64 ft	12/16/2013 508.34 - 501.64 ft
1,2-Dichloroethene (total)	86	-	-	-	-	-	-
Benzene	4 {A}	2 J {A}	13 U	0.7 U	-	1 U	1.6 {A}
cis-1,2-Dichloroethene	-	71 {A}	76 {A}	19.1 {A}	29 {A}	1 U	32 {A}
Tetrachloroethene	1500 {A}	660 D {A}	440 {A}	53.9 {A}	55 {A}	30 {A}	31 {A}
trans-1,2-Dichloroethene	-	9 J {A}	13 U	1.6	3.3	1 U	2.6
Trichloroethene	270 {A}	280 D {A}	310 {A}	33.5 {A}	33 {A}	12 {A}	58 {A}
Vinyl chloride	-	10 U	13 U	1 U	ND	1 U	1.4

SVE-1	12/16/2013 511.34 - 502.95 ft
cis-1,2-Dichloroethene	65 {A}
Tetrachloroethene	500 {A}
Trichloroethene	20 {A}

MW-3	03/07/2001 507.76 - 501.06 ft	10/31/2001 507.76 - 501.06 ft	06/17/2004 507.76 - 501.06 ft	06/01/2007 507.76 - 501.06 ft	05/21/2009 507.76 - 501.06 ft	05/13/2013 507.76 - 501.06 ft
2-Butanone (Methyl Ethyl Ketone)	2 J	10 U	10 U	6.52	-	10 U
4-Methyl-2-Pentanone (Methyl Isobutyl Ketone)	3 J	10 U	10 U	5.3	-	10 U
Acetone	10 U	20 U	10 U	20.6	-	50 U
Benzene	2 J {A}	5 U	10 U	0.7 U	-	1 U
Ethylbenzene	3 J	5 U	10 U	1 U	-	1 U
Tetrachloroethene	1 J	5.5 {A}	1 J	1 U	ND	3.7
Toluene	10 U	5 U	10 U	6.45 {A}	-	5 U

SVE-2	06/01/2007 -
cis-1,2-Dichloroethene	1530 {A}
Tetrachloroethene	142000 {A}
Trichloroethene	11200 {A}

MW-5	06/17/2004 510.38 - 505.38 ft
VOCs	ND

MW-4	04/14/1998 508.4 - 501.7 ft	03/08/2001 508.4 - 501.7 ft	10/31/2001 508.4 - 501.7 ft	06/17/2004 508.4 - 501.7 ft	06/01/2007 508.4 - 501.7 ft	05/13/2013 508.4 - 501.7 ft
Benzene	ND	10 U	5 U	240 D {A}	0.7 U	1 U
Cyclohexane	-	-	-	11	-	1 U
Ethylbenzene	-	10 U	5 U	25 {A}	1 U	1 U
Isopropylbenzene	-	-	-	5 J	1 U	1 U
m,p-Xylenes	ND	10 U	5 U	43 {A}	1 U	-
Methyl cyclohexane	-	-	-	2 J	-	1 U
Methyl Tert Butyl Ether	-	-	-	27	1 U	1 U
o-Xylene	-	10 U	5 U	4 J	1 U	-
Tetrachloroethene	ND	10 U	5.4 {A}	10 U	1 U	1 U
Toluene	ND	10 U	5 U	4 J	1 U	5 U

SB-11	03/12/2001 505.86 - 500.86 ft	10/29/2001 505.86 - 500.86 ft	06/01/2007 505.86 - 500.86 ft	05/14/2013 505.86 - 500.86 ft
Acetone	200 {A}	20 U	5 U	50 U

MW-101	12/23/2013 509.22 - 502.22 ft
cis-1,2-Dichloroethene	2800 {A}
Tetrachloroethene	1600 {A}
trans-1,2-Dichloroethene	37 {A}
Trichloroethene	370 {A}

SVE-4	06/01/2007 -
cis-1,2-Dichloroethene	550 {A}
Tetrachloroethene	1000 {A}
Trichloroethene	65.1 {A}

SB-5	12/01/1998 -
1,2-Dichloroethene (total)	260
2-Butanone (Methyl Ethyl Ketone)	51 {A}
Tetrachloroethene	800 {A}
Trichloroethene	340 {A}

MW-8A	03/07/2001 506.52 - 501.52 ft	10/29/2001 506.52 - 501.52 ft	06/01/2007 506.52 - 501.52 ft
VOCs	ND	ND	ND

SVE-5	06/01/2007 -
cis-1,2-Dichloroethene	865 {A}
Tetrachloroethene	29400 {A}
Trichloroethene	6140 {A}

MN-3S	05/19/2009 504.41 - 499.41 ft	05/16/2013 504.41 - 499.41 ft
cis-1,2-Dichloroethene	ND	2.1

SB-6	12/01/1998 -
1,2-Dichloroethene (total)	2900
Tetrachloroethene	160000 D {A}
Trichloroethene	1200 J {A}

SB-13	03/06/2001 506.84 - 501.84 ft	10/30/2001 506.84 - 501.84 ft	06/01/2007 506.84 - 501.84 ft	12/16/2013 506.84 - 501.84 ft
Acetone	100 {A}	20 U	5 U	500 U
Bromoform	50 U	5 U	2.17	10 U
cis-1,2-Dichloroethene	590 {A}	380 D {A}	279 {A}	660 {A}
Tetrachloroethene	1400 D {A}	550 D {A}	2100 {A}	5500 {A}
trans-1,2-Dichloroethene	6 J {A}	6.1 {A}	2.34	10 U
Trichloroethene	200 {A}	140 {A}	503 {A}	140 {A}

MN-2S	05/18/2009 503.58 - 498.58 ft	05/14/2013 503.58 - 498.58 ft
Site VOCs	ND	-
VOCs	-	ND

SVE-6	06/01/2007 -
Tetrachloroethene	81200 {A}
Trichloroethene	721 {A}

MN-5OB	05/21/2009 503.89 - 498.89 ft	05/09/2013 503.89 - 498.89 ft
Site VOCs	ND	-
VOCs	-	ND

MN-4OB	05/20/2009 506.85 - 501.85 ft	05/10/2013 506.85 - 501.85 ft
Site VOCs	ND	-
VOCs	-	ND

MW-1	04/14/1998 505.87 - 499.17 ft	03/09/2001 505.87 - 499.17 ft	10/31/2001 505.87 - 499.17 ft	05/14/2013 505.87 - 499.17 ft
Site VOCs	ND	-	-	-
VOCs	-	ND	ND	ND

SB-10	03/07/2001 506.86 - 502.06 ft	10/30/2001 506.86 - 502.06 ft	06/01/2007 506.86 - 502.06 ft
Acetone	1400 D {A}	20 U	5 U
cis-1,2-Dichloroethene	4 J	5 U	1.76
Tetrachloroethene	51 {A}	52 {A}	37.1 {A}
Toluene	2 J	5 U	1 U
Trichloroethene	8 J {A}	6.5 {A}	6.94 {A}

MW-6	10/28/1998 508.27 - 503.27 ft	10/30/2001 508.27 - 503.27 ft	05/21/2009 508.27 - 503.27 ft	05/13/2013 508.27 - 503.27 ft	12/23/2013 508.27 - 503.27 ft
1,2-Dichloroethene (total)	690 D	-	-	-	-
2-Butanone (Methyl Ethyl Ketone)	63 {A}	100 U	-	10 U	10 U
Acetone	9 J	200 U	-	50 U	50 U
cis-1,2-Dichloroethene	220 {A}	2200 D {A}	660 {A}	9.5 {A}	13 {A}
Tetrachloroethene	-	550 {A}	140 {A}	4.6	98 {A}
trans-1,2-Dichloroethene	-	50 U	9.8 {A}	1 U	1 U
Trichloroethene	76 {A}	270 {A}	88 {A}	1 U	10 {A}

SB-4	10/30/1998 -
2-Butanone (Methyl Ethyl Ketone)	100 {A}
Acetone	9 J
Toluene	2 J

SB-9	03/06/2001 508.31 - 503.31 ft	10/29/2001 508.31 - 503.31 ft	06/01/2007 508.31 - 503.31 ft	05/13/2013 508.31 - 503.31 ft
Acetone	68 {A}	20 U	5 U	50 U
Tetrachloroethene	10 U	5 U	3.71	1 U

LEGEND:

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
- BEDROCK WELL (HALEY & ALDRICH, 2001)
- BEDROCK WELL (HALEY & ALDRICH, 2013)
- OVERBURDEN WELL (HALEY & ALDRICH, 2001 AND NYSDEC, 1998)
- OVERBURDEN WELL (HALEY & ALDRICH, 2013)
- BEDROCK/OVERBURDEN INTERVAL WELL (SEELER, ENV., 1993)
- OVERBURDEN SOIL BORING (NYDEC, 1998)
- SOIL VAPOR EXTRACTION WELL
- LOCATION CATEGORIZED AS OVERBURDEN
- LOCATION NOT CATEGORIZED AS OVERBURDEN

NOTES:

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
2. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.
3. DATABOX UNITS SHOWN IN UG/L.
4. DETECTED VOC ANALYTES (PER LOCATION) SHOWN IN DATABOXES.
5. RESULTS SHOWN IN RED {A} EXCEED NYSDEC TOGS 1.1.1 CLASS GA CRITERIA (1998, 1999 ERRATA, 2000 ADDENDUM, 2004 ADDENDUM).
6. DATA QUALIFIERS:
   U - INDICATES ANALYTES NOT DETECTED ABOVE THE LABORATORY REPORTING OR METHOD DETECTION LIMIT.
   ND - INDICATES RESULT WAS NOT DETECTED IN LEGACY DATA LABORATORY REPORTING OR METHOD DETECTION LIMIT UNKNOWN.
   J - INDICATES THE RESULT WAS ESTIMATED.
   D - INDICATES THE RESULT IS FROM A DILUTION.
   - INDICATES COMPOUND NOT ANALYZED.
7. 1998 SAMPLING EVENT CONDUCTED BY NYSDEC.
   2000/2001/2002/2013 SAMPLING EVENTS CONDUCTED BY HALEY & ALDRICH.
   2004 SAMPLING EVENT CONDUCTED BY THE NYSDEC.
   2009 SAMPLING EVENT CONDUCTED BY HDR.
   2007 SAMPLING EVENT CONDUCTED BY ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.
8. SELECT COMPOUNDS ARE REPORTED AS NON-DETECT, HOWEVER THE LABORATORY REPORTING LIMITS FOR THESE COMPOUNDS EXCEEDED THE COMPARISON CRITERIA. THE ASSOCIATED ANALYSES ARE COMPLIANT WITH THE EPA ANALYTICAL METHODOLOGY. WITH THESE CONDITIONS, NO DETERMINATION CAN BE MADE THAT AN ACTUAL CONCENTRATION FOR THESE COMPOUNDS DOES OR DOES NOT EXCEED THE COMPARISON CRITERIA. GENERALLY, IN GROUNDWATER THESE COMPOUNDS ARE NOT VOC COMPOUNDS OF CONCERN FOR THE SITE AND COMPRISED ONE OF TWO SITUATIONS: 1) EITHER THE COMPARISON CRITERIA WAS VERY LOW RELATIVE TO THE REPORTING LIMIT OR 2) A DETECTION OF ONE OR MORE COMPOUNDS REQUIRED A DILUTION, THUS RAISING THE REPORTING LIMITS FOR SOME LIMITED OTHER COMPOUNDS. SEE REMEDIAL INVESTIGATION REPORT, SECTION 3.5.1 FOR FURTHER EXPLANATION.
9. "SITE VOCs" REFERS TO THE ANALYTE LIST FOR SELECT 2009 SAMPLES, WHICH INCLUDED TETRACHLOROETHENE, TRICHLOROETHENE, CIS-1,2-DICHLOROETHENE, TRANS-1,2-DICHLOROETHENE, AND VINYL CHLORIDE ONLY.

HALEY & ALDRICH

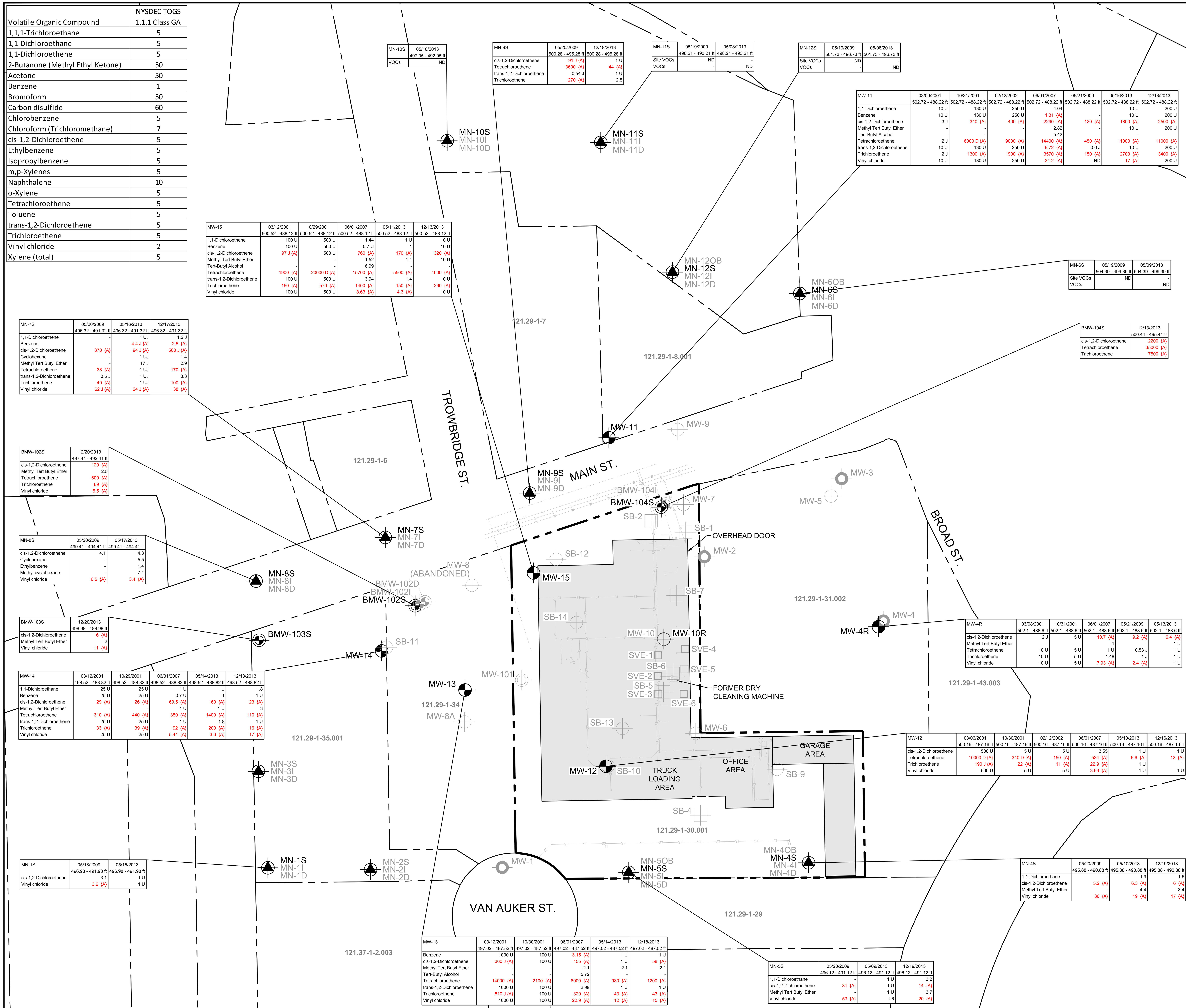
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER - OVERBURDEN

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 12

Volatile Organic Compound	NYSDEC TOGS 1.1.1 Class GA
1,1,1-Trichloroethane	5
1,1-Dichloroethane	5
1,1-Dichloroethene	5
2-Butanone (Methyl Ethyl Ketone)	50
Acetone	50
Benzene	1
Bromoform	50
Carbon disulfide	60
Chlorobenzene	5
Chloroform (Trichloromethane)	7
cis-1,2-Dichloroethene	5
Ethylbenzene	5
Isopropylbenzene	5
m,p-Xylenes	5
Naphthalene	10
o-Xylene	5
Tetrachloroethene	5
Toluene	5
trans-1,2-Dichloroethene	5
Trichloroethene	5
Vinyl chloride	2
Xylene (total)	5



MN-10S	05/10/2013 497.05 - 492.05 ft
VOCs	ND

MN-9S	05/20/2009 500.28 - 495.28 ft	12/18/2013 500.28 - 495.28 ft
cis-1,2-Dichloroethene	91 J {A}	1 U
Tetrachloroethene	3600 {A}	44 {A}
trans-1,2-Dichloroethene	0.54 J	1 U
Trichloroethene	270 {A}	2.5

MN-11S	05/19/2009 498.21 - 493.21 ft	05/08/2013 498.21 - 493.21 ft
Site VOCs	ND	-
VOCs	-	ND

MN-12S	05/19/2009 501.73 - 496.73 ft	05/08/2013 501.73 - 496.73 ft
Site VOCs	ND	-
VOCs	-	ND

MW-11	03/09/2001 502.72 - 488.22 ft	10/31/2001 502.72 - 488.22 ft	02/12/2002 502.72 - 488.22 ft	06/01/2007 502.72 - 488.22 ft	05/21/2009 502.72 - 488.22 ft	05/16/2013 502.72 - 488.22 ft	12/13/2013 502.72 - 488.22 ft
1,1-Dichloroethene	10 U	130 U	250 U	4.04	-	10 U	200 U
Benzene	10 U	130 U	250 U	1.31 {A}	-	10 U	200 U
cis-1,2-Dichloroethene	3 J	340 {A}	400 {A}	2290 {A}	120 {A}	1800 {A}	2500 {A}
Methyl Tert Butyl Ether	-	-	-	2.82	-	10 U	200 U
Tert-Butyl Alcohol	-	-	-	5.42	-	-	-
Tetrachloroethene	2 J	6000 D {A}	9000 {A}	14400 {A}	450 {A}	11000 {A}	11000 {A}
trans-1,2-Dichloroethene	10 U	130 U	250 U	9.72 {A}	0.6 J	10 U	200 U
Trichloroethene	2 J	1300 {A}	1900 {A}	3570 {A}	150 {A}	2700 {A}	3400 {A}
Vinyl chloride	10 U	130 U	250 U	34.2 {A}	ND	17 {A}	200 U

MW-15	03/12/2001 500.52 - 488.12 ft	10/29/2001 500.52 - 488.12 ft	06/01/2007 500.52 - 488.12 ft	05/11/2013 500.52 - 488.12 ft	12/13/2013 500.52 - 488.12 ft
1,1-Dichloroethene	100 U	500 U	1.44	1 U	10 U
Benzene	100 U	500 U	0.7 U	1	10 U
cis-1,2-Dichloroethene	97 J {A}	500 U	760 {A}	170 {A}	320 {A}
Methyl Tert Butyl Ether	-	-	1.52	1.4	10 U
Tert-Butyl Alcohol	-	-	6.99	-	-
Tetrachloroethene	1900 {A}	20000 D {A}	15700 {A}	5500 {A}	4600 {A}
trans-1,2-Dichloroethene	100 U	500 U	3.94	1.4	10 U
Trichloroethene	160 {A}	570 {A}	1400 {A}	150 {A}	260 {A}
Vinyl chloride	100 U	500 U	8.63 {A}	4.3 {A}	10 U

MN-6S	05/19/2009 504.39 - 499.39 ft	05/09/2013 504.39 - 499.39 ft
Site VOCs	ND	-
VOCs	-	ND

BMW-104S	12/13/2013 500.44 - 495.44 ft
cis-1,2-Dichloroethene	2200 {A}
Tetrachloroethene	35000 {A}
Trichloroethene	7500 {A}

MN-7S	05/20/2009 496.32 - 491.32 ft	05/16/2013 496.32 - 491.32 ft	12/17/2013 496.32 - 491.32 ft
1,1-Dichloroethene	-	1 UJ	1.2 J
Benzene	-	4.4 J {A}	2.5 {A}
cis-1,2-Dichloroethene	370 {A}	94 J {A}	560 J {A}
Cyclohexane	-	1 UJ	1.4
Methyl Tert Butyl Ether	-	17 J	2.9
Tetrachloroethene	38 {A}	1 UJ	170 {A}
trans-1,2-Dichloroethene	3.5 J	1 UJ	3.3
Trichloroethene	40 {A}	1 UJ	100 {A}
Vinyl chloride	62 J {A}	24 J {A}	38 {A}

BMW-102S	12/20/2013 497.41 - 492.41 ft
cis-1,2-Dichloroethene	120 {A}
Methyl Tert Butyl Ether	2.5
Tetrachloroethene	600 {A}
Trichloroethene	89 {A}
Vinyl chloride	5.5 {A}

MN-8S	05/20/2009 499.41 - 494.41 ft	05/17/2013 499.41 - 494.41 ft
cis-1,2-Dichloroethene	4.1	4.3
Cyclohexane	-	5.5
Ethylbenzene	-	1.4
Methyl cyclohexane	-	7.4
Vinyl chloride	6.5 {A}	3.4 {A}

BMW-103S	12/20/2013 498.98 - 488.98 ft
cis-1,2-Dichloroethene	6 {A}
Methyl Tert Butyl Ether	2
Vinyl chloride	11 {A}

MW-14	03/12/2001 498.52 - 488.82 ft	10/29/2001 498.52 - 488.82 ft	06/01/2007 498.52 - 488.82 ft	05/14/2013 498.52 - 488.82 ft	12/18/2013 498.52 - 488.82 ft
1,1-Dichloroethane	25 U	25 U	1 U	1 U	1.8
Benzene	25 U	25 U	0.7 U	1	1 U
cis-1,2-Dichloroethene	29 {A}	26 {A}	69.5 {A}	160 {A}	23 {A}
Methyl Tert Butyl Ether	-	-	1 U	1 U	3
Tetrachloroethene	310 {A}	440 {A}	350 {A}	1400 {A}	110 {A}
trans-1,2-Dichloroethene	25 U	25 U	1 U	1.8	1 U
Trichloroethene	33 {A}	39 {A}	92 {A}	200 {A}	16 {A}
Vinyl chloride	25 U	25 U	5.44 {A}	3.6 {A}	17 {A}

MW-4R	03/08/2001 502.1 - 488.6 ft	10/31/2001 502.1 - 488.6 ft	06/01/2007 502.1 - 488.6 ft	05/21/2009 502.1 - 488.6 ft	05/13/2013 502.1 - 488.6 ft
cis-1,2-Dichloroethene	2 J	5 U	10.7 {A}	9.2 {A}	6.4 {A}
Methyl Tert Butyl Ether	-	-	1	-	1 U
Tetrachloroethene	10 U	5 U	1 U	0.53 J	1 U
Trichloroethene	10 U	5 U	1.48	1 J	1 U
Vinyl chloride	10 U	5 U	7.93 {A}	2.4 {A}	1 U

MW-12	03/06/2001 500.16 - 487.16 ft	10/30/2001 500.16 - 487.16 ft	02/12/2002 500.16 - 487.16 ft	06/01/2007 500.16 - 487.16 ft	05/10/2013 500.16 - 487.16 ft	12/16/2013 500.16 - 487.16 ft
cis-1,2-Dichloroethene	500 U	5 U	5 U	3.55	1 U	1 U
Tetrachloroethene	10000 D {A}	340 D {A}	150 {A}	534 {A}	6.6 {A}	12 {A}
Trichloroethene	190 J {A}	22 {A}	11 {A}	22.9 {A}	1 U	1
Vinyl chloride	500 U	5 U	5 U	3.99 {A}	1 U	1 U

MN-1S	05/18/2009 496.98 - 491.98 ft	05/15/2013 496.98 - 491.98 ft
cis-1,2-Dichloroethene	3.1	1 U
Vinyl chloride	3.6 {A}	1 U

MW-13	03/12/2001 497.02 - 487.52 ft	10/30/2001 497.02 - 487.52 ft	06/01/2007 497.02 - 487.52 ft	05/14/2013 497.02 - 487.52 ft	12/18/2013 497.02 - 487.52 ft
Benzene	1000 U	100 U	3.15 {A}	1 U	1 U
cis-1,2-Dichloroethene	360 J {A}	100 U	155 {A}	1 U	58 {A}
Methyl Tert Butyl Ether	-	-	2.1	2.1	2.1
Tert-Butyl Alcohol	-	-	5.72	-	-
Tetrachloroethene	14000 {A}	2100 {A}	8000 {A}	980 {A}	1200 {A}
trans-1,2-Dichloroethene	1000 U	100 U	2.99	1 U	1 U
Trichloroethene	510 J {A}	100 U	320 {A}	43 {A}	43 {A}
Vinyl chloride	1000 U	100 U	22.9 {A}	12 {A}	15 {A}

MN-5S	05/20/2009 496.12 - 491.12 ft	05/09/2013 496.12 - 491.12 ft	12/19/2013 496.12 - 491.12 ft
1,1-Dichloroethane	-	1 U	3.2
cis-1,2-Dichloroethene	31 {A}	1 U	14 {A}
Methyl Tert Butyl Ether	-	1 U	3.7
Vinyl chloride	53 {A}	1.6	20 {A}

MN-4S	05/20/2009 495.88 - 490.88 ft	05/10/2013 495.88 - 490.88 ft	12/19/2013 495.88 - 490.88 ft
1,1-Dichloroethane	-	1.9	1.6
cis-1,2-Dichloroethene	5.2 {A}	6.3 {A}	6 {A}
Methyl Tert Butyl Ether	-	4.4	3.4
Vinyl chloride	36 {A}	19 {A}	17 {A}

LEGEND:

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
- BEDROCK WELL (HALEY & ALDRICH, 2001)
- BEDROCK WELL (HALEY & ALDRICH, 2013)
- OVERBURDEN WELL (HALEY & ALDRICH, 2001 AND NYSDEC, 1998)
- OVERBURDEN WELL (HALEY & ALDRICH, 2013)
- BEDROCK/OVERBURDEN INTERVAL WELL (SEELER, ENV., 1993)
- OVERBURDEN SOIL BORING (NYDEC, 1998)
- SOIL VAPOR EXTRACTION WELL
- LOCATION CATEGORIZED AS SHALLOW BEDROCK
- LOCATION NOT CATEGORIZED AS SHALLOW BEDROCK

NOTES:

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
2. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.
3. DATABOX UNITS SHOWN IN UG/L.
4. DETECTED VOC ANALYTES (PER LOCATION) SHOWN IN DATABOXES.
5. RESULTS SHOWN IN RED {A} EXCEED NYSDEC TOGS 1.1.1 CLASS GA CRITERIA (1998, 1999 ERRATA, 2000 ADDENDUM, 2004 ADDENDUM).
6. DATA QUALIFIERS:
   - U - INDICATES ANALYTES NOT DETECTED ABOVE THE LABORATORY REPORTING OR METHOD DETECTION LIMIT.
   - ND - INDICATES RESULT WAS NOT DETECTED IN LEGACY DATA LABORATORY REPORTING OR METHOD DETECTION LIMIT UNKNOWN.
   - J - INDICATES THE RESULT WAS ESTIMATED.
   - D - INDICATES THE RESULT IS FROM A DILUTION.
   - \- INDICATES COMPOUND NOT ANALYZED.
7. 1998 SAMPLING EVENT CONDUCTED BY NYSDEC.
   2000/2001/2002/2013 SAMPLING EVENTS CONDUCTED BY HALEY & ALDRICH.
   2004 SAMPLING EVENT CONDUCTED BY THE NYSDEC.
   2009 SAMPLING EVENT CONDUCTED BY HDR.
   2007 SAMPLING EVENT CONDUCTED BY ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.
8. SELECT COMPOUNDS ARE REPORTED AS NON-DETECT, HOWEVER THE LABORATORY REPORTING LIMITS FOR THESE COMPOUNDS EXCEEDED THE COMPARISON CRITERIA. THE ASSOCIATED ANALYSES ARE COMPLIANT WITH THE EPA ANALYTICAL METHODOLOGY. WITH THESE CONDITIONS, NO DETERMINATION CAN BE MADE THAT AN ACTUAL CONCENTRATION FOR THESE COMPOUNDS DOES OR DOES NOT EXCEED THE COMPARISON CRITERIA. GENERALLY, IN GROUNDWATER THESE COMPOUNDS ARE NOT VOC COMPOUNDS OF CONCERN FOR THE SITE AND COMPRISED ONE OF TWO SITUATIONS: 1) EITHER THE COMPARISON CRITERIA WAS VERY LOW RELATIVE TO THE REPORTING LIMIT OR 2) A DETECTION OF ONE OR MORE COMPOUNDS REQUIRED A DILUTION, THUS RAISING THE REPORTING LIMITS FOR SOME LIMITED OTHER COMPOUNDS. SEE REMEDIAL INVESTIGATION REPORT, SECTION 3.5.1 FOR FURTHER EXPLANATION.
9. "SITE VOCs" REFERS TO THE ANALYTE LIST FOR SELECT 2009 SAMPLES, WHICH INCLUDED TETRACHLOROETHENE, TRICHLOROETHENE, CIS-1,2-DICHLOROETHENE, TRANS-1,2-DICHLOROETHENE, AND VINYL CHLORIDE ONLY.

N S E W

0 50 100 150 200
SCALE IN FEET

HALEY & ALDRICH

FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

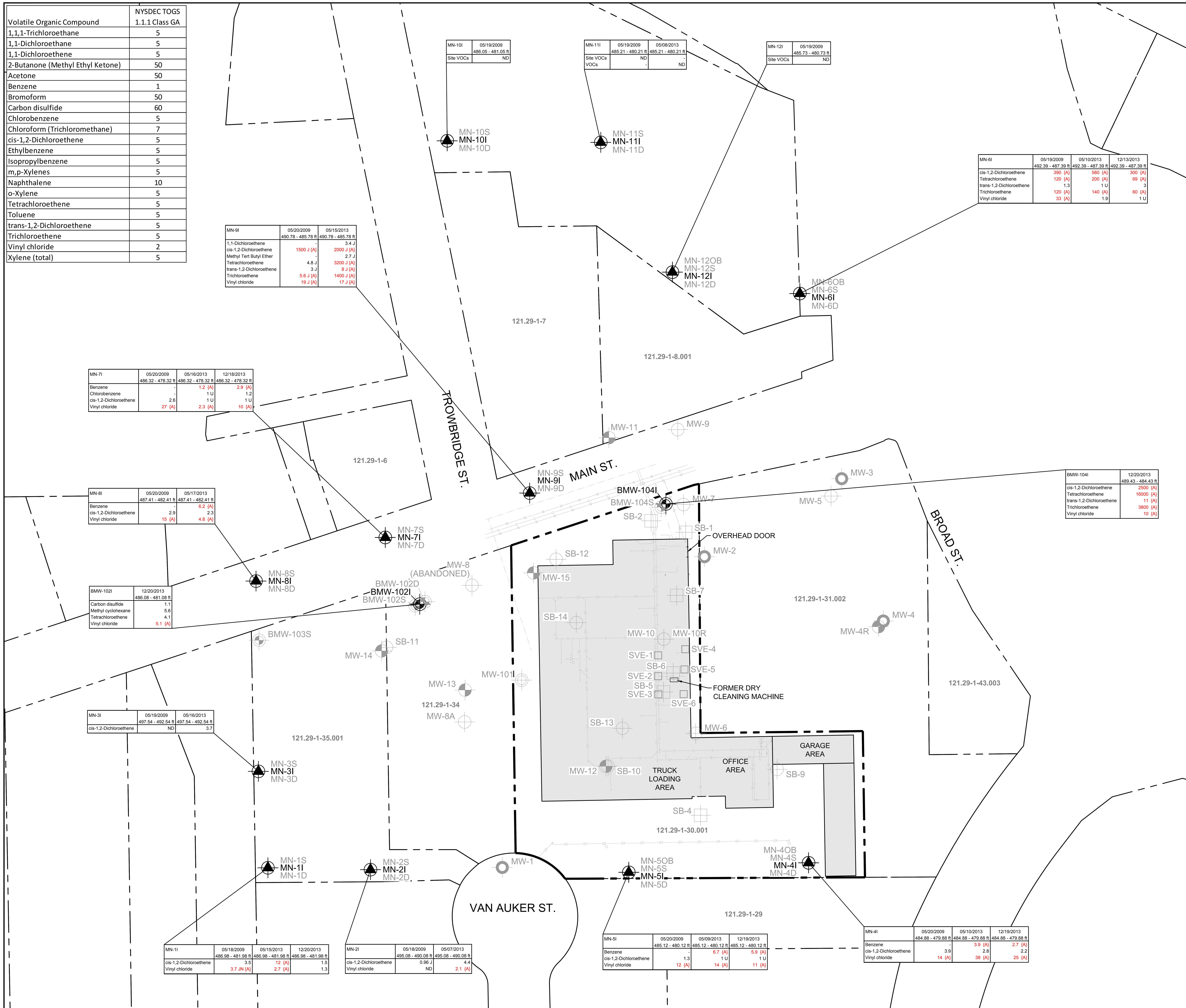
VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER - SHALLOW BEDROCK

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 13

\\CLE\COMMON\PROJECTS\70751 - ARTCO\CAD\DRAWINGS\70751-GW_DATABOX [APRIL 2014]_R2.DWG

Volatile Organic Compound	NYSDEC TOGS 1.1.1 Class GA
1,1,1-Trichloroethane	5
1,1-Dichloroethane	5
1,1-Dichloroethene	5
2-Butanone (Methyl Ethyl Ketone)	50
Acetone	50
Benzene	1
Bromoform	50
Carbon disulfide	60
Chlorobenzene	5
Chloroform (Trichloromethane)	7
cis-1,2-Dichloroethene	5
Ethylbenzene	5
Isopropylbenzene	5
m,p-Xylenes	5
Naphthalene	10
o-Xylene	5
Tetrachloroethene	5
Toluene	5
trans-1,2-Dichloroethene	5
Trichloroethene	5
Vinyl chloride	2
Xylene (total)	5



MN-10I	05/19/2009 486.05 - 481.05 ft
Site VOCs	ND

MN-11I	05/19/2009 485.21 - 480.21 ft	05/08/2013 485.21 - 480.21 ft
Site VOCs	ND	-
VOCs	-	ND

MN-12I	05/19/2009 485.73 - 480.73 ft
Site VOCs	ND

MN-9I	05/20/2009 490.78 - 485.78 ft	05/15/2013 490.78 - 485.78 ft
1,1-Dichloroethene	-	3.4 J
cis-1,2-Dichloroethene	1500 J {A}	2000 J {A}
Methyl Tert Butyl Ether	-	2.7 J
Tetrachloroethene	4.8 J	3200 J {A}
trans-1,2-Dichloroethene	3 J	8 J {A}
Trichloroethene	5.6 J {A}	1400 J {A}
Vinyl chloride	19 J {A}	17 J {A}

MN-6I	05/19/2009 492.39 - 487.39 ft	05/10/2013 492.39 - 487.39 ft	12/13/2013 492.39 - 487.39 ft
cis-1,2-Dichloroethene	390 {A}	580 {A}	300 {A}
Tetrachloroethene	120 {A}	200 {A}	69 {A}
trans-1,2-Dichloroethene	1.3	1 U	3
Trichloroethene	120 {A}	140 {A}	60 {A}
Vinyl chloride	33 {A}	1.9	1 U

MN-7I	05/20/2009 486.32 - 478.32 ft	05/16/2013 486.32 - 478.32 ft	12/18/2013 486.32 - 478.32 ft
Benzene	-	1.2 {A}	2.9 {A}
Chlorobenzene	-	1 U	1.2
cis-1,2-Dichloroethene	2.6	1 U	1 U
Vinyl chloride	27 {A}	2.3 {A}	10 {A}

MN-8I	05/20/2009 487.41 - 482.41 ft	05/17/2013 487.41 - 482.41 ft
Benzene	-	6.2 {A}
cis-1,2-Dichloroethene	2.9	2.3
Vinyl chloride	15 {A}	4.8 {A}

BMW-104I	12/20/2013 489.43 - 484.43 ft
cis-1,2-Dichloroethene	2500 {A}
Tetrachloroethene	16000 {A}
trans-1,2-Dichloroethene	11 {A}
Trichloroethene	3800 {A}
Vinyl chloride	10 {A}

BMW-102I	12/20/2013 486.08 - 481.08 ft
Carbon disulfide	1.1
Methyl cyclohexane	5.6
Tetrachloroethene	4.1
Vinyl chloride	5.1 {A}

MN-3I	05/19/2009 497.54 - 492.54 ft	05/16/2013 497.54 - 492.54 ft
cis-1,2-Dichloroethene	ND	3.7

MN-1I	05/18/2009 486.98 - 481.98 ft	05/15/2013 486.98 - 481.98 ft	12/20/2013 486.98 - 481.98 ft
cis-1,2-Dichloroethene	3.5	12 {A}	1.5
Vinyl chloride	3.7 JN {A}	2.7 {A}	1.3

MN-2I	05/18/2009 495.08 - 490.08 ft	05/07/2013 495.08 - 490.08 ft
cis-1,2-Dichloroethene	0.96 J	4.4
Vinyl chloride	ND	2.1 {A}

MN-5I	05/20/2009 485.12 - 480.12 ft	05/09/2013 485.12 - 480.12 ft	12/19/2013 485.12 - 480.12 ft
Benzene	-	6.7 {A}	5.9 {A}
cis-1,2-Dichloroethene	1.3	1 U	1 U
Vinyl chloride	12 {A}	14 {A}	11 {A}

MN-4I	05/20/2009 484.88 - 479.88 ft	05/10/2013 484.88 - 479.88 ft	12/19/2013 484.88 - 479.88 ft
Benzene	-	3.9 {A}	2.7 {A}
cis-1,2-Dichloroethene	3.9	2.8	2.2
Vinyl chloride	14 {A}	38 {A}	25 {A}

LEGEND:

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
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- WATER PIPING
- FIRE LINE
- WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
- BEDROCK WELL (HALEY & ALDRICH, 2001)
- BEDROCK WELL (HALEY & ALDRICH, 2013)
- OVERBURDEN WELL (HALEY & ALDRICH, 2001 AND NYSDEC, 1998)
- OVERBURDEN WELL (HALEY & ALDRICH, 2013)
- BEDROCK/OVERBURDEN INTERVAL WELL (SEELER, ENV., 1993)
- OVERBURDEN SOIL BORING (NYDEC, 1998)
- SOIL VAPOR EXTRACTION WELL
- LOCATION CATEGORIZED AS INTERMEDIATE BEDROCK
- LOCATION NOT CATEGORIZED AS INTERMEDIATE BEDROCK

NOTES:

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
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3. DATABOX UNITS SHOWN IN UG/L.
4. DETECTED VOC ANALYTES (PER LOCATION) SHOWN IN DATABOXES.
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7. 1998 SAMPLING EVENT CONDUCTED BY NYSDEC.
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   2007 SAMPLING EVENT CONDUCTED BY ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.
8. SELECT COMPOUNDS ARE REPORTED AS NON-DETECT, HOWEVER THE LABORATORY REPORTING LIMITS FOR THESE COMPOUNDS EXCEEDED THE COMPARISON CRITERIA. THE ASSOCIATED ANALYSES ARE COMPLIANT WITH THE EPA ANALYTICAL METHODOLOGY. WITH THESE CONDITIONS, NO DETERMINATION CAN BE MADE THAT AN ACTUAL CONCENTRATION FOR THESE COMPOUNDS DOES OR DOES NOT EXCEED THE COMPARISON CRITERIA. GENERALLY, IN GROUNDWATER THESE COMPOUNDS ARE NOT VOC COMPOUNDS OF CONCERN FOR THE SITE AND COMPRISED ONE OF TWO SITUATIONS: 1) EITHER THE COMPARISON CRITERIA WAS VERY LOW RELATIVE TO THE REPORTING LIMIT OR 2) A DETECTION OF ONE OR MORE COMPOUNDS REQUIRED A DILUTION, THUS RAISING THE REPORTING LIMITS FOR SOME LIMITED OTHER COMPOUNDS. SEE REMEDIAL INVESTIGATION REPORT, SECTION 3.5.1 FOR FURTHER EXPLANATION.
9. "SITE VOCs" REFERS TO THE ANALYTE LIST FOR SELECT 2009 SAMPLES, WHICH INCLUDED TETRACHLOROETHENE, TRICHLOROETHENE, CIS-1,2-DICHLOROETHENE, TRANS-1,2-DICHLOROETHENE, AND VINYL CHLORIDE ONLY.

HALEY & ALDRICH

FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

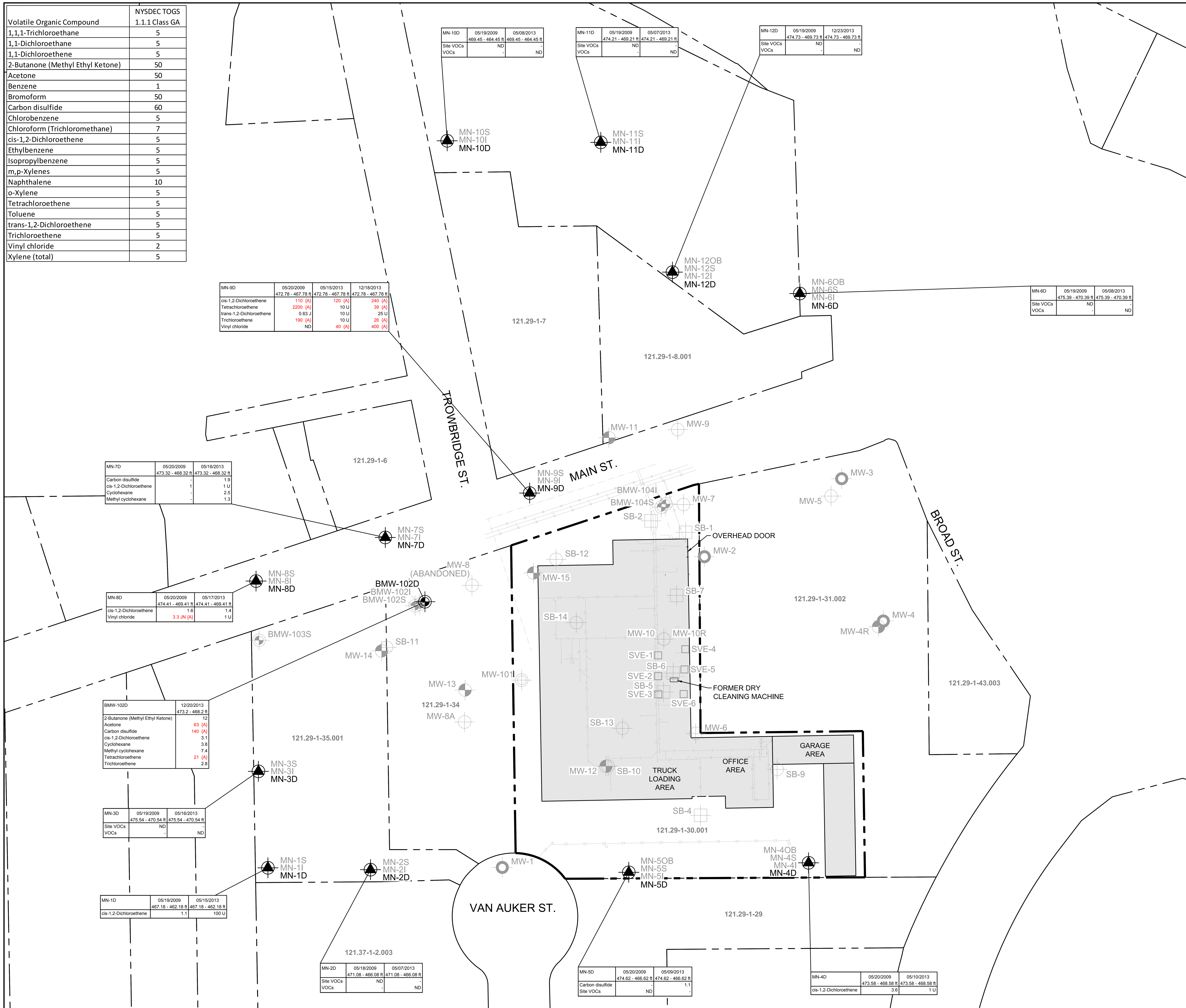
VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER - INTERMEDIATE BEDROCK

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 14

\\CLE\COMMON\PROJECTS\70751 - ARTCO\CAD\DRAWINGS\70751-GW_DATABOX [APRIL 2014]_R2.DWG

Volatile Organic Compound	NYSDEC TOGS 1.1.1 Class GA
1,1,1-Trichloroethane	5
1,1-Dichloroethane	5
1,1-Dichloroethene	5
2-Butanone (Methyl Ethyl Ketone)	50
Acetone	50
Benzene	1
Bromoform	50
Carbon disulfide	60
Chlorobenzene	5
Chloroform (Trichloromethane)	7
cis-1,2-Dichloroethene	5
Ethylbenzene	5
Isopropylbenzene	5
m,p-Xylenes	5
Naphthalene	10
o-Xylene	5
Tetrachloroethene	5
Toluene	5
trans-1,2-Dichloroethene	5
Trichloroethene	5
Vinyl chloride	2
Xylene (total)	5



\\CLE\COMMON\PROJECTS\70751 - ARTCO\CAD\DRAWINGS\70751-GW_DATABOX (APRIL 2014)_R2.DWG

LEGEND:

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- WELL CLUSTER - VARIOUS INTERVALS (NYSDEC, 2009)
- BEDROCK WELL (HALEY & ALDRICH, 2001)
- BEDROCK WELL (HALEY & ALDRICH, 2013)
- OVERBURDEN WELL (HALEY & ALDRICH, 2001 AND NYSDEC, 1998)
- OVERBURDEN WELL (HALEY & ALDRICH, 2013)
- BEDROCK/OVERBURDEN INTERVAL WELL (SEELER, ENV., 1993)
- OVERBURDEN SOIL BORING (NYDEC, 1998)
- SOIL VAPOR EXTRACTION WELL
- LOCATION CATEGORIZED AS DEEP BEDROCK
- LOCATION NOT CATEGORIZED DEEP BEDROCK

NOTES:

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
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3. DATABOX UNITS SHOWN IN UG/L.
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5. RESULTS SHOWN IN RED {A} EXCEED NYSDEC TOGS 1.1.1 CLASS GA CRITERIA (1998, 1999 ERRATA, 2000 ADDENDUM, 2004 ADDENDUM).
6. DATA QUALIFIERS:
   - U - INDICATES ANALYTES NOT DETECTED ABOVE THE LABORATORY REPORTING OR METHOD DETECTION LIMIT.
   - ND - INDICATES RESULT WAS NOT DETECTED IN LEGACY DATA LABORATORY REPORTING OR METHOD DETECTION LIMIT UNKNOWN.
   - J - INDICATES THE RESULT WAS ESTIMATED.
   - D - INDICATES THE RESULT IS FROM A DILUTION.
   - \- INDICATES COMPOUND NOT ANALYZED.
7. 1998 SAMPLING EVENT CONDUCTED BY NYSDEC.
   2000/2001/2002/2013 SAMPLING EVENTS CONDUCTED BY HALEY & ALDRICH.
   2004 SAMPLING EVENT CONDUCTED BY THE NYSDEC.
   2009 SAMPLING EVENT CONDUCTED BY HDR.
   2007 SAMPLING EVENT CONDUCTED BY ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.
8. SELECT COMPOUNDS ARE REPORTED AS NON-DETECT, HOWEVER THE LABORATORY REPORTING LIMITS FOR THESE COMPOUNDS EXCEEDED THE COMPARISON CRITERIA. THE ASSOCIATED ANALYSES ARE COMPLIANT WITH THE EPA ANALYTICAL METHODOLOGY. WITH THESE CONDITIONS, NO DETERMINATION CAN BE MADE THAT AN ACTUAL CONCENTRATION FOR THESE COMPOUNDS DOES OR DOES NOT EXCEED THE COMPARISON CRITERIA. GENERALLY, IN GROUNDWATER THESE COMPOUNDS ARE NOT VOC COMPOUNDS OF CONCERN FOR THE SITE AND COMPRISED ONE OF TWO SITUATIONS: 1) EITHER THE COMPARISON CRITERIA WAS VERY LOW RELATIVE TO THE REPORTING LIMIT OR 2) A DETECTION OF ONE OR MORE COMPOUNDS REQUIRED A DILUTION, THUS RAISING THE REPORTING LIMITS FOR SOME LIMITED OTHER COMPOUNDS. SEE REMEDIAL INVESTIGATION REPORT, SECTION 3.5.1 FOR FURTHER EXPLANATION.
9. "SITE VOCs" REFERS TO THE ANALYTE LIST FOR SELECT 2009 SAMPLES, WHICH INCLUDED TETRACHLOROETHENE, TRICHLOROETHENE, CIS-1,2-DICHLOROETHENE, TRANS-1,2-DICHLOROETHENE, AND VINYL CHLORIDE ONLY.

N W E S

0 50 100 150 200
SCALE IN FEET

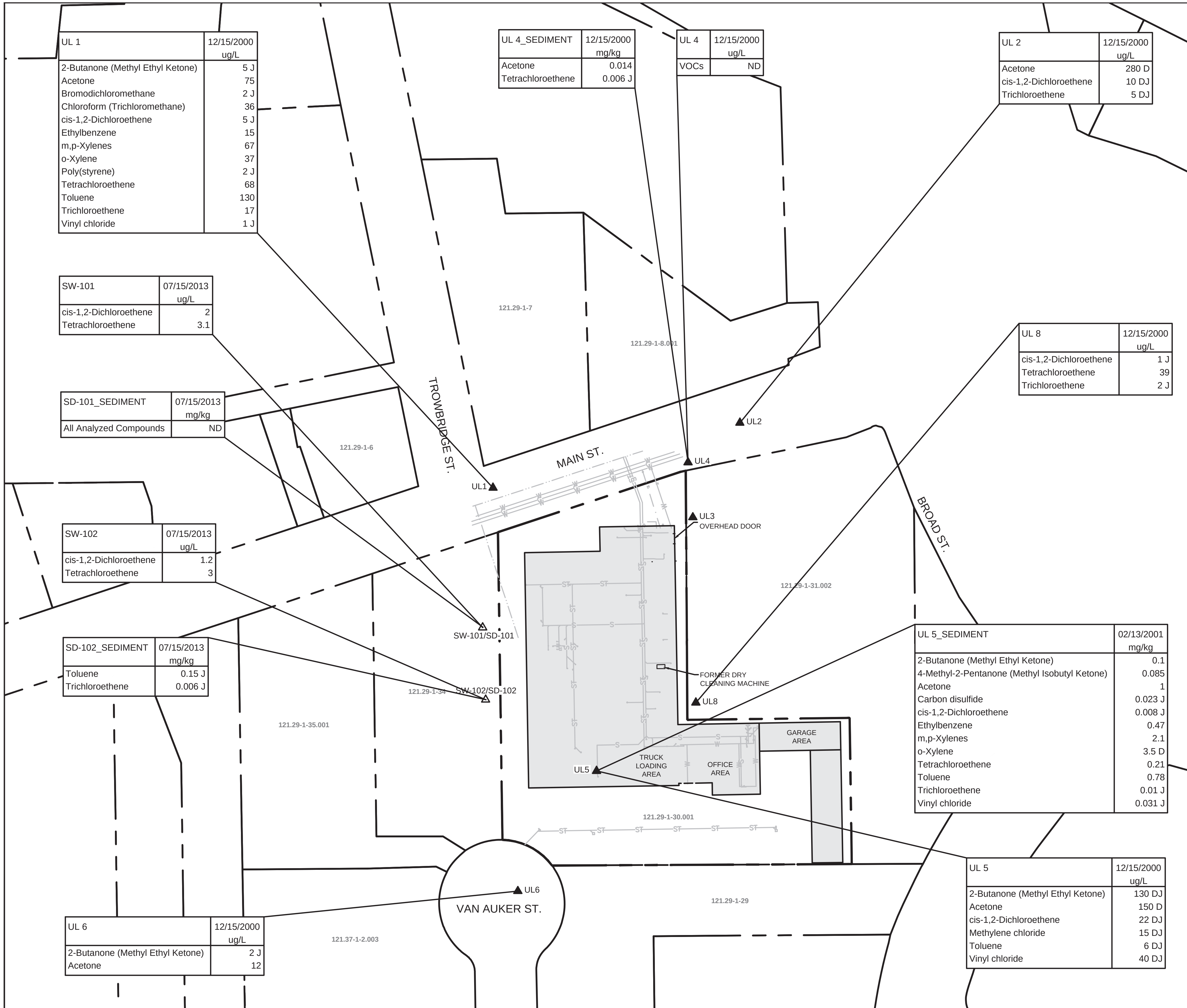
HALEY & ALDRICH

FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER - DEEP BEDROCK

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 15



UL 1	12/15/2000 ug/L
2-Butanone (Methyl Ethyl Ketone)	5 J
Acetone	75
Bromodichloromethane	2 J
Chloroform (Trichloromethane)	36
cis-1,2-Dichloroethene	5 J
Ethylbenzene	15
m,p-Xylenes	67
o-Xylene	37
Poly(styrene)	2 J
Tetrachloroethene	68
Toluene	130
Trichloroethene	17
Vinyl chloride	1 J

UL 4_SEDIMENT	12/15/2000 mg/kg
Acetone	0.014
Tetrachloroethene	0.006 J

UL 4	12/15/2000 ug/L
VOCs	ND

UL 2	12/15/2000 ug/L
Acetone	280 D
cis-1,2-Dichloroethene	10 DJ
Trichloroethene	5 DJ

SW-101	07/15/2013 ug/L
cis-1,2-Dichloroethene	2
Tetrachloroethene	3.1

SD-101_SEDIMENT	07/15/2013 mg/kg
All Analyzed Compounds	ND

UL 8	12/15/2000 ug/L
cis-1,2-Dichloroethene	1 J
Tetrachloroethene	39
Trichloroethene	2 J

SW-102	07/15/2013 ug/L
cis-1,2-Dichloroethene	1.2
Tetrachloroethene	3

SD-102_SEDIMENT	07/15/2013 mg/kg
Toluene	0.15 J
Trichloroethene	0.006 J

UL 5_SEDIMENT	02/13/2001 mg/kg
2-Butanone (Methyl Ethyl Ketone)	0.1
4-Methyl-2-Pentanone (Methyl Isobutyl Ketone)	0.085
Acetone	1
Carbon disulfide	0.023 J
cis-1,2-Dichloroethene	0.008 J
Ethylbenzene	0.47
m,p-Xylenes	2.1
o-Xylene	3.5 D
Tetrachloroethene	0.21
Toluene	0.78
Trichloroethene	0.01 J
Vinyl chloride	0.031 J

UL 5	12/15/2000 ug/L
2-Butanone (Methyl Ethyl Ketone)	130 DJ
Acetone	150 D
cis-1,2-Dichloroethene	22 DJ
Methylene chloride	15 DJ
Toluene	6 DJ
Vinyl chloride	40 DJ

UL 6	12/15/2000 ug/L
2-Butanone (Methyl Ethyl Ketone)	2 J
Acetone	12

LEGEND:

- PROPERTY LINE
- SITE PROPERTY LINE
- 121.29-1-30.001 PARCEL NUMBER
- EXISTING BUILDING
- SANITARY SEWER
- STORM SEWER
- COMBINED SEWERS
- GAS PIPING
- WATER PIPING
- FIRE LINE
- ▲ UTILITY SURFACE WATER/SEDIMENT SAMPLE (HALEY & ALDRICH, 2000)
- △ UTILITY SURFACE WATER/SEDIMENT SAMPLE (HALEY & ALDRICH, 2013)

NOTES:

1. HISTORIC DATA FROM PREVIOUS EXPLORATION AND SAMPLE LOCATIONS SHOWN (SOURCE AND INSTALLATION DATE IN LEGEND).
2. UTILITY LOCATION AND PROPERTY BOUNDARY INFORMATION ADOPTED FROM MONROE COUNTY GIS SERVICES DIVISION.
3. DATABOX UNITS SHOWN IN UG/L FOR SURFACE WATER AND MG/KG FOR SEDIMENT.
4. DETECTED ANALYTES (PER LOCATION) SHOWN IN DATABOXES.
5. DATA QUALIFIERS:
   U - INDICATES ANALYTES NOT DETECTED ABOVE THE LABORATORY REPORTING OR METHOD DETECTION LIMIT.
   ND - INDICATES RESULT WAS NOT DETECTED IN LEGACY DATA LABORATORY REPORTING OR METHOD DETECTION LIMIT UNKNOWN.
   J - INDICATES THE RESULT WAS ESTIMATED.
   D - INDICATES THE RESULT IS FROM A DILUTION.
   \- INDICATES COMPOUND NOT ANALYZED.

N S E W

0 100 200
SCALE IN FEET

HALEY & ALDRICH

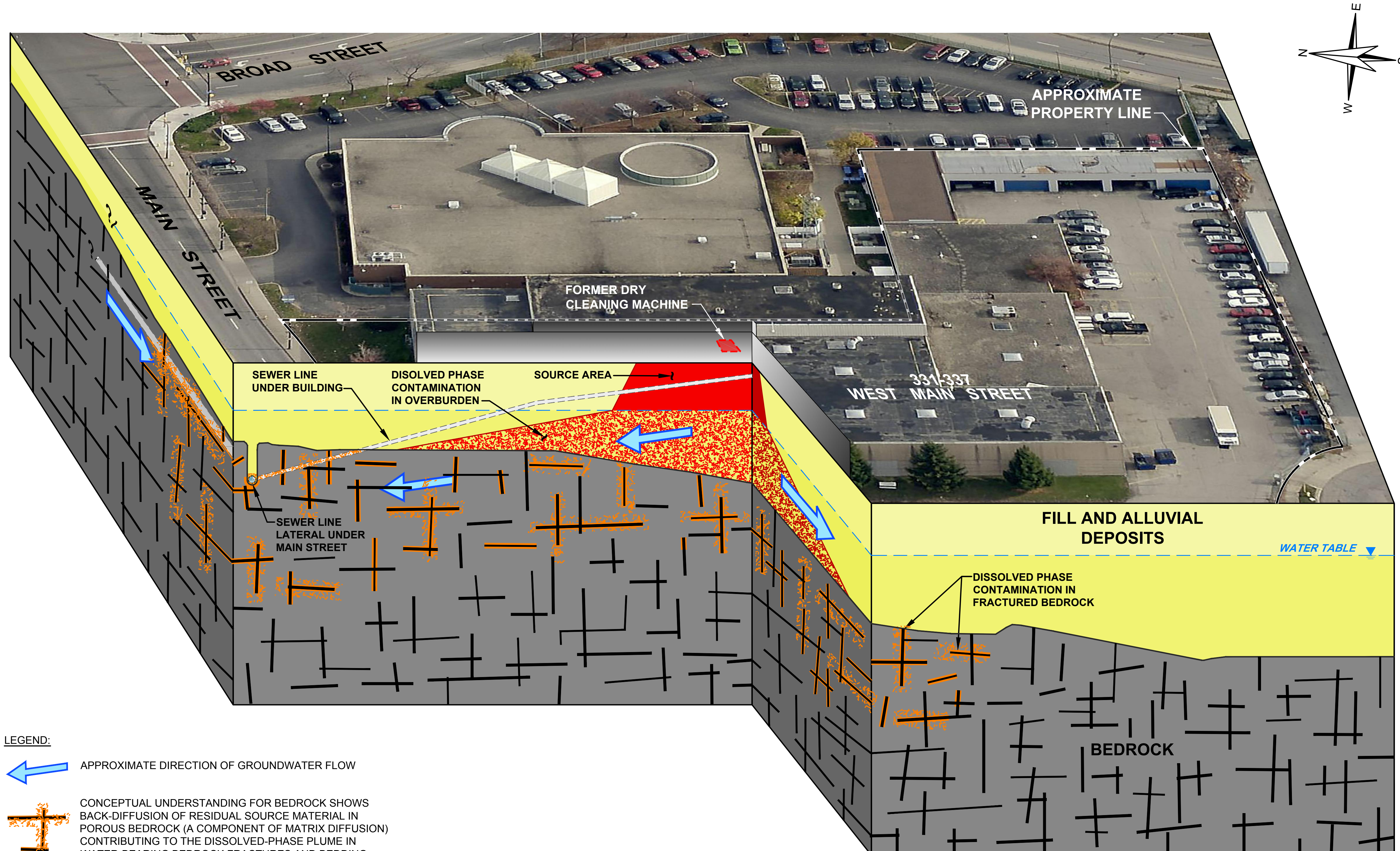
FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

SURFACE WATER AND SEDIMENT (UTILITY SAMPLES) ANALYTICAL POSTING MAP

SCALE: AS SHOWN
OCTOBER 2014

FIGURE 16

\\CLE\COMMON\PROJECTS\70751 - ARTCO\CAD\DRAWINGS\70751-SW-SED_DATABOX_R2.DWG



LEGEND:

APPROXIMATE DIRECTION OF GROUNDWATER FLOW

CONCEPTUAL UNDERSTANDING FOR BEDROCK SHOWS BACK-DIFFUSION OF RESIDUAL SOURCE MATERIAL IN POROUS BEDROCK (A COMPONENT OF MATRIX DIFFUSION) CONTRIBUTING TO THE DISSOLVED-PHASE PLUME IN WATER-BEARING BEDROCK FRACTURES AND BEDDING PLANE PARTINGS

NOTES:

1. IMAGES DATED 7 NOVEMBER 2012 TAKEN ELECTRONICALLY FROM PICTOMETRY.COM.
2. ALL FEATURES SHOWN BELOW GROUND SURFACES ARE FOR CONCEPTUAL PURPOSES.

HALEY & ALDRICH

FORMER ARTCO INDUSTRIAL LAUNDRIES, INC.
REMEDIAL INVESTIGATION REPORT
331-337 WEST MAIN STREET
ROCHESTER, NEW YORK

CONCEPTUAL SITE MODEL

SCALE: NONE
OCTOBER 2014

FIGURE 17

MCELENEY, TERRI Printed: October 28, 2014 Layout: CSM
Drawing: J:\GRAPHICS\70751\70751-010 PRES2014-1028.DWG

APPENDIX B

Opinion of Probable Costs Spreadsheets

Cost Estimates for the following Options

		Page in Appendix B	Total Capital Costs	Annual O&M Costs	Present Worth of O&M	Subtotal Cost	Present Worth of Renewable Electrical	Total Cost
Soil	No Action	--	$ -	$ -	$ -	$ -	$ -	**$ -**
	Institutional Control/Land Use Restriction	S-LUR	$ 21,000.00	$ 3,000.00	$ 37,227.00	$ 58,227.00	$ -	**$ 58,227.00**
	Maintain Cover	S-Cover	$ 3,500.00	$ 9,948.00	$ 123,444.73	$ 126,944.73	$ -	**$ 126,944.73**
	In-Situ Chemical Reduction (ISCR)	S-ISCR (alt 2)	$ 1,650,150.00	$ 386,296.80	$ 330,626.88	$ 1,980,776.88	$ -	**$ 1,980,776.88**
	In-Situ Chemical Reduction (ISCR)	S-ISCR (alt 3)	$ 914,850.00	$ 216,296.80	$ 209,416.88	$ 1,124,266.88	$ -	**$ 1,124,266.88**
	In-Situ Thermal (TCH)	S-In-Situ Thermal	$ 5,326,542.00	$ -	$ -	$ 5,326,542.00	$ 445,500.00	**$ 5,772,042.00**
	Multi-Phase Extraction (MPE)	S-MPE	$ 2,012,720.00	$ 287,558.80	$ 2,019,813.01	$ 4,032,533.01	$ 115,369.20	**$ 4,147,902.21**
	Excavation/Off-Site Disposal	S-Exc	$ 7,700,829.35	$ 8,200.00	$ 101,753.80	$ 7,802,583.15	$ -	**$ 7,802,583.15**
Groundwater	No Action	--	$ -	$ -	$ -	$ -	$ -	**$ -**
	Institutional Control/Land Use Restriction	S-LUR	$ 21,000.00	$ 3,000.00	$ 37,227.00	$ 58,227.00	$ -	**$ 58,227.00**
	In-Situ Chemical Reduction (ISCR)	G-ISCR	$ 6,724,000.00	$ 15,824.00	$ 111,141.15	$ 6,835,141.15	$ -	**$ 6,835,141.15**
	Groundwater Extraction/Treatment	G-BBZ	$ 593,195.20	$ 152,264.00	$ 1,889,443.98	$ 2,482,639.18	$ 27,175.71	**$ 2,509,814.89**
	Post-Remediation Groundwater Monitoring	G-PRM	$ 22,500.00	$ 27,656.00	$ 343,183.30	$ 365,683.30	$ -	**$ 365,683.30**
	Plume Stop + Bioremediation for Perimeter	G-PS_Perim	$ 675,607.34	$ 35,219.26	$ 247,380.11	$ 922,987.45	$ -	**$ 922,987.45**
	Plume Stop + Bioremediation for Source & Perimeter	G-PS_Perim+Int	$ 684,198.41	$ 37,361.12	$ 262,424.51	$ 946,622.91	$ -	**$ 946,622.91**
	Thermal Treatment (ERH) of Saturated Zone	ERH On & Offsite	$ 19,053,472.00	$ -	$ -	$ 19,053,472.00	$ 891,000.00	**$ 19,944,472.00**
	Thermal Treatment (ERH) of Un-/Saturated Zone	ERH On-Site	$ 9,928,092.00	$ -	$ -	$ 9,928,092.00	$ 445,500.00	**$ 10,373,592.00**
Utilities	No Action	--	$ -	$ -	$ -	$ -	$ -	**$ -**
	Institutional Control/Land Use Restriction	S-LUR	$ 21,000.00	$ 3,000.00	$ 37,227.00	$ 58,227.00	$ -	**$ 58,227.00**
Soil Vapor	No Action	--	$ -	$ -	$ -	$ -	$ -	**$ -**
	Institutional Control/Land Use Restriction	S-LUR	$ 21,000.00	$ 3,000.00	$ 37,227.00	$ 58,227.00	$ -	**$ 58,227.00**
	Engineering Controls (SSDS), 10-year	SV-SSDS 10	$ -	$ 40,632.00	$ 304,699.37	$ 304,699.37	$ 8,211.41	**$ 312,910.77**
	Engineering Controls (SSDS), 30-year	SV-SSDS 30	$ -	$ 40,632.00	$ 504,202.49	$ 504,202.49	$ 13,587.86	**$ 517,790.34**
	Engineering Controls (SSDS), 30-year (50% for first 15 years)	SV-SSDS 15, 15	$ -	$ 40,632.00	$ 367,057.87	$ 367,057.87	$ 8,614.89	**$ 375,672.75**
	Engineering Controls (SSDS), 30-year (50% for first 10 years)	SV-SSDS 10, 20	$ -	$ 40,632.00	$ 391,285.55	$ 391,285.55	$ 9,493.40	**$ 400,778.95**
	Soil Vapor Extraction (SVE)	SV-SVE	$ 399,783.75	$ 135,661.50	$ 1,235,604.94	$ 1,635,388.69	$ 50,002.92	**$ 1,685,391.61**

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	88,000 SF
Overall Scope	Institutional Controls/Land Use Restriction
Media	Soil

Capital Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Land Use Restriction		1	LS	$ 5,000.00	$ 5,000.00
Site Management Plan		1	LS	$ 10,000.00	$ 10,000.00
Subtotal Capital Costs					$ 15,000.00
Health & Safety - Level D	5%				$ -
Design and Permitting					
Construction Management	25%				$ 3,750.00
Contingency	15%				$ 2,250.00
Total Capital Cost					$ 21,000.00

Operational & Maintenance Costs				
Verification of Institutional Controls and Notificatic	1	LS	$ 3,000.00	$ 3,000.00
Subtotal O&M Costs				$ 3,000.00
Percent Worth Factor (30 yrs @ 7%)				12.409
Total Present Worth O&M Cost				$ 37,227.00
Rounded Total				**$ 58,227.00**

Assumptions

1. On-Site building remains in place.
2. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	88,000 SF
Overall Scope	Maintain Cover
Media	Soil

Capital Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Cover Survey (Pavement/Building Slab/Landscape)		1	day	$ 2,500.00	$ 2,500.00
Subtotal Capital Costs					**$ 2,500.00**
Health & Safety - Level D	5%				$ -
Design and Permitting					$ -
Construction Management	25%				$ 625.00
Contingency	15%				$ 375.00
Total Capital Cost					**$ 3,500.00**

Operational & Maintenance Costs				
Verification of Institutional Controls and Notificatic	1	ea	$ 3,000.00	$ 3,000.00
Pavement O&M	0.8	Acre	$ 8,200.00	$ 6,560.00
Landscape O&M	0.4	Acre	$ 970.00	$ 388.00
Subtotal O&M Costs				$ 9,948.00
Percent Worth Factor (30 yrs @ 7%)				12.409
Total Present Worth O&M Cost				$ 123,444.73
Rounded Total				**$ 126,944.73**

Assumptions

Paved Area =	33144	=	0.76088154	acres
Landscaped Area =	13481	=	0.30948118	acres

1. Building slab will remain intact in existing building footprint and does not need repair.
2. Existing pavement in decent shape , no new pavement or sealing required.
3. No TCVOC exceedances in surficial soil - existing landscaped areas provide adequate cover in non paved areas outside building.
4. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	24,000 sq ft
Overall Scope	In-Site Chemical Reduction
Media	Soil

Capital Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization		1	LS	$ 5,000.00	$ 5,000.00
Construction Layout Surveying		1	day	$ 2,500.00	$ 2,500.00
Driller Mob		1	LS	$ 15,000.00	$ 15,000.00
Drilling Day Rate + Per Diem		10	Day	$ 2,000.00	$ 20,000.00
Injection Well Installation		1250	LF	$ 150.00	$ 187,500.00
Zero-Valent Iron Material and Shipping		22000	gal	$30	$ 660,000.00
Zero-Valent Iron Injection		15	Day	$5,000	$ 75,000.00
Subtotal Capital Costs					**$ 965,000.00**
Health & Safety - Level D	5%				$ 48,250.00
Design and Permitting	12%				$ 115,800.00
Construction Management	14%				$ 135,100.00
Contingency	40%				$ 386,000.00
Total					**$ 1,650,150.00**

Operational & Maintenance Costs	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Follow-up injection	1	LS	$ 370,000.00	$ 370,000.00
Subtotal O&M Costs				$ 370,000.00
Percent Worth Factor (Year 5 @ 7%)				0.713
Total Present Worth O&M Cost				$ 263,810.00
Labor (2 sample events)	96	HR	$ 120.00	$ 11,520.00
Misc. Sampling Equipment	2	Event	$ 700.00	$ 1,400.00
Analytical costs (2 events, 7 wells, VOC & PAH)	14	Sample	$ 241.20	$ 3,376.80
Subtotal O&M Costs				$ 16,296.80
Percent Worth Factor (5 yrs @ 7%)				4.10
Total Present Worth O&M Cost				$ 66,816.88
Rounded Total				**$ 1,980,776.88**

Assumptions

1. Assumes a 24,000 square foot treatment area
2. 5 foot unsaturated vertical treatment zone
3. Up to 5 horizontal injection wells
4. Presumptive remedy is EZVI for unsaturated soil treatment
5. Assumes building will remain occupied, with sufficient access within the building for remediation tasks.
6. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	9400 to 12500 sq ft
Overall Scope	In-Site Chemical Reduction
Media	Soil

Capital Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization		1	LS	$ 5,000.00	$ 5,000.00
Construction Layout Surveying		1	day	$ 2,500.00	$ 2,500.00
Driller Mob		1	LS	$ 15,000.00	$ 15,000.00
Drilling Day Rate + Per Diem		10	Day	$ 2,000.00	$ 20,000.00
Injection Well Installation		650	LF	$ 150.00	$ 97,500.00
Zero-Valent Iron Material and Shipping		11500	gal	$30	$ 345,000.00
Zero-Valent Iron Injection		10	Day	$5,000	$ 50,000.00
Subtotal Capital Costs					**$ 535,000.00**
Health & Safety - Level D	5%				$ 26,750.00
Design and Permitting	12%				$ 64,200.00
Construction Management	14%				$ 74,900.00
Contingency	40%				$ 214,000.00
Total					**$ 914,850.00**

Operational & Maintenance Costs				
Follow-up injection	1	LS	$ 200,000.00	$ 200,000.00
Subtotal O&M Costs				$ 200,000.00
Percent Worth Factor (Year 5 @ 7%)				0.713
Total Present Worth O&M Cost				$ 142,600.00
Labor (2 sample events)	96	HR	$ 120.00	$ 11,520.00
Misc. Sampling Equipment	2	Event	$ 700.00	$ 1,400.00
Analytical costs (2 events, 7 wells, VOC & PAH)	14	Sample	$ 241.20	$ 3,376.80
Subtotal O&M Costs				$ 16,296.80
Percent Worth Factor (5 yrs @ 7%)				4.10
Total Present Worth O&M Cost				$ 66,816.88
Rounded Total				**$ 1,124,266.88**

Assumptions

1. Assumes a 9,400 to 12,500 square foot treatment area
2. 5 foot unsaturated vertical treatment zone
3. Up to 4 horizontal injection wells
4. Presumptive remedy is EZVI for unsaturated soil treatment
5. Assumes building will remain occupied, with sufficient access within the building for remediation tasks.
6. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	9,400 SF
Overall Scope	In-Situ Thermal Conductance Heating
Media	Soil

Capital Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization		1	LS	$ 50,000.00	$ 50,000.00
Heater/Extraction Materials Manufacture, Delivery		50	ea	$ 4,000.00	$ 200,000.00
Install 4" Monitoring Wells and Thermocouples		12	ea	$ 2,000.00	$ 24,000.00
Electrical and Mechanical Construction		1	LS	$ 75,000.00	$ 75,000.00
Conveyance Construction (4" insulated SS or HDPE)		200	LF	$ 75.00	$ 15,000.00
Treatment System for Liquid & Vapor		1	LS	$ 45,000.00	$ 45,000.00
Electrical Utility Connection and Permit		1	LD	$ 25,000.00	$ 25,000.00
System Startup		1	LS	$ 50,000.00	$ 50,000.00
Electrical Energy Usage (5500kW @ $0.14/kWhr)		4.5	month	$ 554,400.00	$ 2,494,800.00
Consumables (pumps, carbon, etc.)		1	LS	$ 12,000.00	$ 12,000.00
Operation & Oversight (20 hrs/wk @$200/hr)		4.5	month	$ 16,000.00	$ 72,000.00
Treatment System O&M (30 hrs/wk @ $100/hr)		4.5	month	$ 12,000.00	$ 54,000.00
Equipment Repairs		1	LS	$ 10,000.00	$ 10,000.00
Monitoring/Sampling/Reporting		1	LS	$ 25,000.00	$ 25,000.00
Subtotal Capital Costs					$ 3,151,800.00
Health & Safety - Level D	5%				$ 157,590.00
Design and Permitting	8%				$ 252,144.00
Construction Management	11%				$ 346,698.00
Contingency	45%				$ 1,418,310.00
Total					$ 5,326,542.00
Operational & Maintenance Costs					
Subtotal O&M Costs					$ -
Percent Worth Factor (30 yrs @ 7%)					--
Total Present Worth O&M Cost					$ -
Rounded Total					**$ 5,326,542.00**
ADDER for Renewable Electrical ($0.165/kWhr)		*4.5*	*month*	*$ 99,000.00*	*$ 445,500.00*
ADDER Percent Worth Factor (0 yrs @ 7%)					*1*
ADDER Total Present Worth O&M Cost					*$ 445,500.00*
TOTAL COST					**$ 5,772,042.00**

Assumptions

Contaminated Area (SF)	9378
Thickness of Contaminated Area (ft)	11.26
Treatment Volume (cy)	3911.5
Energy Points on 15 ft centers	50

1. Extraction points are co-located with energy delivery points to a depth of 13 ft bgs.
2. Assume 4.5 months of operation
3. No pilot test needed for this size site.
4. No surface cap needed due to building slab.
5. Dewatering Not Included
6. Building unoccupied during operation
7. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior projec
8. Renewable electrical costs fluctuate. Adder above reflects additional $0.025 per kWhr (quoted in March 2016)

Client	AFES, LLC	
Site	Artco Industrial Laundries Site	
Area	157,000	sq ft
Overall Scope	Electrical Resistance Heating	
Media	Soil, Shallow & Intermediate Sedimentary Bedrock and Groundwater	

Capital Cost Items	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization	1	LS	$ 350,000.00	$ 350,000.00
Heater/Extraction Materials Manufacture, Delivery & Installation	862	ea	$ 5,000.00	$ 4,310,000.00
Install 4" Monitoring Wells and Thermocouples	24	ea	$ 2,000.00	$ 48,000.00
Electrical and Mechanical Construction	1	LS	$ 250,000.00	$ 250,000.00
Conveyance Construction (4" insulated SS or HDPE)	2500	LF	$ 75.00	$ 187,500.00
Treatment System for Liquid & Vapor	1	LS	$ 350,000.00	$ 350,000.00
Electrical Utility Connection and Permit	1	LD	$ 75,000.00	$ 75,000.00
System Startup	1	LS	$ 50,000.00	$ 50,000.00
Electrical Energy Usage (11000kW @ $0.14/kWhr)	4.5	month	$ 1,108,800.00	$ 4,989,600.00
Consumables (pumps, carbon, etc.)	1	LS	$ 50,000.00	$ 50,000.00
Operation & Oversight	4.5	month	$ 50,000.00	$ 225,000.00
Treatment System O&M	4.5	month	$ 25,000.00	$ 112,500.00
Equipment Repairs	1	LS	$ 30,000.00	$ 30,000.00
Monitoring/Sampling/Reporting	1	LS	$ 50,000.00	$ 50,000.00
Subtotal Capital Costs				$ 11,077,600.00
Health & Safety - Level D	5%			$ 553,880.00
Design and Permitting	6%			$ 664,656.00
Construction Management	11%			$ 1,218,536.00
Contingency	50%			$ 5,538,800.00
Total				$ 19,053,472.00
Operational & Maintenance Costs				
Subtotal O&M Costs				$ -
Percent Worth Factor (30 yrs @ 7%)				--
Total Present Worth O&M Cost				$ -
Rounded Total				**$ 19,053,472.00**
ADDER for Renewable Electrical ($0.165/kWhr)	*4.5*	*month*	*$ 198,000.00*	*$ 891,000.00*
ADDER Percent Worth Factor (0 yrs @ 7%)				*1*
ADDER Total Present Worth O&M Cost				*$ 891,000.00*
TOTAL COST				**$ 19,944,472.00**

Assumptions

Contaminated Area (SF)	157,000
Thickness of Contaminated Area (ft)	26.50
Treatment Volume (cy)	107000.0
Energy Points on 50 ft centers	862

1. Extraction points are co-located with energy delivery points to a depth of 27 ft bgs.
2. Assume 4.5 months of operation
3. Resistivity Testing required to confirm electrode spacing. Spacing assumed to 16 feet.
4. No surface cap needed.
5. Dewatering Not Required
6. Building unoccupied during operation
7. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/
8. Renewable electrical costs fluctuate. Adder above reflects additional $0.025 per kWhr (quoted in March 2016).

Client	AFES, LLC	
Site	Artco Industrial Laundries Site	
Area	75,000	sq ft
Overall Scope	Electrical Resistance Heating	
Media	Soil, Shallow & Intermediate Sedimentary Bedrock and Groundwater	

Capital Cost Items	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization	1	LS	$ 175,000.00	$ 175,000.00
Heater/Extraction Materials Manufacture, Delivery & Installation	412	ea	$ 5,000.00	$ 2,060,000.00
Install 4" Monitoring Wells and Thermocouples	12	ea	$ 2,000.00	$ 24,000.00
Electrical and Mechanical Construction	1	LS	$ 125,000.00	$ 125,000.00
Conveyance Construction (4" insulated SS or HDPE)	1500	LF	$ 75.00	$ 112,500.00
Treatment System for Liquid & Vapor	1	LS	$ 200,000.00	$ 200,000.00
Electrical Utility Connection and Permit	1	LD	$ 75,000.00	$ 75,000.00
System Startup	1	LS	$ 50,000.00	$ 50,000.00
Electrical Energy Usage (5500kW @ $0.14/kWhr)	4.5	month	$ 554,400.00	$ 2,494,800.00
Consumables (pumps, carbon, etc.)	1	LS	$ 12,000.00	$ 12,000.00
Operation & Oversight	4.5	month	$ 50,000.00	$ 225,000.00
Treatment System O&M	4.5	month	$ 25,000.00	$ 112,500.00
Equipment Repairs	1	LS	$ 15,000.00	$ 15,000.00
Monitoring/Sampling/Reporting	1	LS	$ 25,000.00	$ 25,000.00
Subtotal Capital Costs				$ 5,705,800.00
Health & Safety - Level D	5%			$ 285,290.00
Design and Permitting	8%			$ 456,464.00
Construction Management	11%			$ 627,638.00
Contingency	50%			$ 2,852,900.00
Total				$ 9,928,092.00

Operational & Maintenance Costs				
Subtotal O&M Costs				$ -
Percent Worth Factor (30 yrs @ 7%)				--
Total Present Worth O&M Cost				$ -
Rounded Total				**$ 9,928,092.00**
ADDER for Renewable Electrical ($0.165/kWhr)	*4.5*	*month*	*$ 99,000.00*	*$ 445,500.00*
ADDER Percent Worth Factor (0 yrs @ 7%)				*1*
ADDER Total Present Worth O&M Cost				*$ 445,500.00*
TOTAL COST				**$ 10,373,592.00**

Assumptions

Contaminated Area (SF)	75000
Thickness of Contaminated Area (ft)	26.50
Treatment Volume (cy)	51838.0
Electrodes on 16 ft centers	412

1. Extraction points are co-located with energy delivery points to a depth of 13 ft bgs.
2. Assume 4.5 months of operation
3. Resistivity Testing required to confirm electrode spacing. Spacing assumed to 16 feet.
4. No surface cap needed due to building slab.
5. Dewatering Not Included
6. Building unoccupied during operation
7. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent con
8. Renewable electrical costs fluctuate. Adder above reflects additional $0.025 per kWhr (quoted in March 2016).

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	9,400 SF
Overall Scope	Multi-Phase Extraction
Media	Soil

Capital Cost Items	Quantity	Unit	Unit Cost	Total Cost
Pilot Test	1	LS	$ 50,000.00	$ 50,000.00
Mobilization/Demobilization	1	LS	$ 100,000.00	$ 100,000.00
1000 ACFM Skids	1	ea	$ 75,000.00	$ 75,000.00
Vapor Treatment - Catalytic Oxidizer & Scrubber	1	ea	$ 340,000.00	$ 340,000.00
Building Permit	2	ea	$ 10,000.00	$ 20,000.00
Treatment Building (40'x80')	3,200	sq ft	$ 55.00	$ 176,000.00
Piping	2000	LF	$ 10.00	$ 20,000.00
Heat Trace/Insulation	1	LS	$ 10,000.00	$ 10,000.00
Wellhead Fittings	14	wells	$ 1,000.00	$ 14,000.00
Instrumentation (Flow, Pressure, Temperature...et	1	LS	$ 25,000.00	$ 25,000.00
Control System Panel	1	ea	$ 50,000.00	$ 50,000.00
Extraction Well Installation	14	wells	$ 7,500.00	$ 105,000.00
Equalization Tank (10,000 gallons)	1	tank	$ 15,000.00	$ 15,000.00
Transfer Pumps	2	ea	$ 5,000.00	$ 10,000.00
Bag Filter Housings	2	ea	$ 6,000.00	$ 12,000.00
Shallow Tray Air Stripper Skid (50 gpm)	1	ea	$ 50,000.00	$ 50,000.00
Liquid Phase Carbon Vessel	1	ea	$ 10,000.00	$ 10,000.00
Discharge Piping to Sewer	1	LS	$ 5,000.00	$ 5,000.00
Utilities (Gas, electric, phone, water)	1	LS	$ 25,000.00	$ 25,000.00
Subtotal Capital Costs				$ 1,112,000.00
Installation 15%				$ 166,800.00
Health & Safety - Level D 5%				$ 55,600.00
Design and Permitting 12%				$ 133,440.00
Construction Management 14%				$ 155,680.00
Contingency 35%				$ 389,200.00
Total				$ 2,012,720.00

Operational & Maintenance Costs				
Heating Gas Consumption (200 DTherm @ $9.7/DT	1	LS	$ 1,940.00	$ 1,940.00
Oxidizer Gas Consumption (4,500 Dtherm @ $9.7)	1	LS	$ 43,650.00	$ 43,650.00
Electrical Energy Usage (75kW @ $0.14/kWhr)	1	year	$ 91,980.00	$ 91,980.00
GW Analytical (Assume 2 VOC/SVOC per month)	24	sample	$ 241.20	$ 5,788.80
Vapor Analytical (Assume one VOC per month)	12	sample	$ 500.00	$ 6,000.00
Scheduled Site Visits/Support Personnel (10 hrs pe	520	hr	$ 120.00	$ 62,400.00
Equipment Repairs/Replacement Allowance	1	LS	$ 5,000.00	$ 5,000.00
Carbon Change Outs	1	LS	$ 50,000.00	$ 50,000.00
Bag Filters (Assume one change per week)	52	ea	$ 50.00	$ 2,600.00
Filter Disposal	4	drum	$ 500.00	$ 2,000.00
Waste Disposal (Assume 2 ton non-haz/month)	24	ton	$ 50.00	$ 1,200.00
Liquid Disposal	5,000	gal	$ 1.00	$ 5,000.00
Annual Reporting	1	LS	$ 10,000.00	$ 10,000.00
Subtotal O&M Costs				$ 287,558.80
Percent Worth Factor (10 yrs @ 7%)				7.024
Total Present Worth O&M Cost				$ 2,019,813.01
Rounded Total				**$ 4,032,533.01**
ADDER for Renewable Electrical ($0.165/kWhr)	*1*	*year*	*$ 16,425.00*	*$ 16,425.00*
ADDER Percent Worth Factor (10 yrs @ 7%)				*7.024*
ADDER Total Present Worth O&M Cost				*$ 115,369.20*
TOTAL COST				**$ 4,147,902.21**

Assumptions

1. Wells have 20 ft radius of influence.
2. Building will remain occupied, with sufficient access within the building for remediation tasks.
3. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior
4. Renewable electrical costs fluctuate. Adder above reflects additional $0.025 per kWhr (quoted in March 2016

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	41,312 SF
Overall Scope	Excavation & Off-Site Treatment/Disposal
Media	Soil

Mobilization/Demobilization		1	LS	$ 100,000.00	$ 100,000.00
Construction Layout Surveying		2	day	$ 2,500.00	$ 5,000.00
Building Demolition		41312	sq ft	$ 1.50	$ 61,968.00
Preserve Utility Connections for Future Use		1	LS	$ 10,000.00	$ 10,000.00
Excavation (TCVOCs >Unresrticted Use SCOs)		16609	tons	$ 35.00	$ 581,304.89
Waste Characterization		60	sample	$ 1,000.00	$ 59,791.40
Off-Site Soil Disposal (Contained-In)		7474	tons	$ 75.00	$ 560,544.00
Off-Site Soil Treatment/Disposal (Hazardous)		7474	tons	$ 200.00	$ 1,494,784.00
Debris Disposal		1661	ton	$ 90.00	$ 149,478.40
Restoration - common fill (Place & Compact)		15225	tons	$ 25.00	$ 380,616.30
6" Gravel Subbase (Place & Compact)		4590	SY	$ 5.87	$ 26,944.60
Pavement 4" Base Course & 2" Surface Course		4590	SY	$ 21.64	$ 99,332.41
Air Monitoring		1	LS	$ 50,000.00	$ 50,000.00
Temporary Shoring (all sides of excavation)		8400	sq. ft	$ 90.00	$ 756,000.00
Dewatering and Treatment System		1	LS	$ 90,000.00	$ 90,000.00
Subtotal Capital Costs					$ 4,425,763.99
Health & Safety - Level D	5%				$ 221,288.20
Design and Permitting	8%				$ 354,061.12
Construction Management	11%				$ 486,834.04
Contingency	50%				$ 2,212,882.00
Total Capital Cost					$ 7,700,829.35
Operational & Maintenance Costs					
Pavement O&M		1.0	Acre	$ 8,200.00	$ 8,200.00
Subtotal O&M Costs					$ 8,200.00
Percent Worth Factor (30 yrs @ 7%)					12.409
Total Present Worth O&M Cost					$ 101,753.80
Rounded Total					**$ 7,802,583.15**

Assumptions

Building footprint (sq ft)	41,312 =	0.94839302	acres
Excav Dimensions (sq ft)=	23,356		
Excav Depth (ft) =	12		
Restoration =	Pavement		
Shoring perimeter	700 LF		

1. Costs shown involve premium for construction through PCE-impacted wastes.
2. 10% debis encountered in excavation.
3. Temporary earth support required on all sides of excavation due to property boundaries, roadways and utilitie
4. Assume 300 tons excavation per day.
5. Temporary relocation of business will not be required during remediation.
6. Building restoration is not required. Building footprint will be restored with pavement.
7. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior projec

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	88,000 SF
Overall Scope	Post Remediation Groundwater Monitoring
Media	Groundwater

Captial Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Groundwater Management Plan		1	LS	$ 15,000.00	$ 15,000.00
Replace/Install Wells		0	LS		$ -
Subtotal Capital Costs					$ 15,000.00
Health & Safety - Level D	5%				$ -
Design and Permitting	10%				$ 1,500.00
Construction Management	25%				$ 3,750.00
Contingency	15%				$ 2,250.00
Total Capital Cost					$ 22,500.00
Operational & Maintenance Costs					
Labor(2 sample events per year)		96	HR	$ 120.00	$ 11,520.00
Misc. Sampling Equipment		2	Event	$ 700.00	$ 1,400.00
Analytical costs (2 events, 15 wells, VOC & PAH)		30	Sample	$ 241.20	$ 7,236.00
Annual report		1	EA	$ 7,500.00	$ 7,500.00
Subtotal O&M Costs					$ 27,656.00
Percent Worth Factor (30 yrs @ 7%)					12.409
Total Present Worth O&M Cost					$ 343,183.30
Rounded Total					**$ 365,683.30**

Assumptions

No. Sample Events/Yr =	2	
No. Samples/Event =	15	*(assume mixture of overburden, shallow bedrock, intermediate bedrock and deep bedrock)*
No. Samples/Day =	8	
No. Days/Event =	2	*(assumes two people)*

Analytical Costs Include =		**241.2**	
	VOCs by 8260	118	EAI - non-discounted 2014 price
	SVOCs by 8270 (PA	123.2	

1. Existing wells suitable and sufficient for groundwater monitoring
2. No new monitoring wells needed.
3. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	275,000 SF
Overall Scope	In-Situ Chemical Reduction
Media	Groundwater

Captial Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization		1	LS	$ 25,000.00	$ 25,000.00
Groundwater Management Permit Application		1	LS	$ 15,000.00	$ 15,000.00
Drilling Day Rate		30	Day	$ 2,500.00	$ 75,000.00
Bedrock Wells		6000	LF	$ 25.00	$ 150,000.00
Driller Mob		1	LS	$ 15,000.00	$ 15,000.00
Drilling Day Rate + Per Diem		10	Day	$ 2,000.00	$ 20,000.00
Injection Well Installation		1000	LF	$ 150.00	$ 150,000.00
ISCR Reagents		1	LS	$ 1,750,000.00	$ 1,750,000.00
In-Situ Injection		90	Day	$ 7,500.00	$ 675,000.00
Follow-up Injection		1	LS	$ 1,225,000.00	$ 1,225,000.00
Subtotal Capital Costs					$ 4,100,000.00
Health & Safety - Level D	5%				$ 205,000.00
Design and Permitting	8%				$ 328,000.00
Construction Management	11%				$ 451,000.00
Contingency	40%				$ 1,640,000.00
Total Capital Cost					$ 6,724,000.00
Operational & Maintenance Costs					
Engineer		40	hr	$ 200.00	$ 8,000.00
Labor		40	hr	$ 75.00	$ 3,000.00
GW Quality Analysis (5 MWs)		4	round	$ 1,206.00	$ 4,824.00
Subtotal O&M Costs					$ 15,824.00
Percent Worth Factor (10 yrs @ 7%)					7.024
Total Present Worth O&M Cost					$ 111,141.15
Rounded Total					**$ 6,835,141.15**

Assumptions

1. Assumes emplacement of reducing agent such as ZVI with organic hydrogen donors
2. Direct push injection for overburden treatment, bedrock wells for deeper impacts outside of the building
3. Horizontal injection wells for overburden groundwater impacts
4. Bedrock wells between 15-30' bgs to emplace material to treat shallow/intermediate bedrock
5. Bedrock injection wells will not be installed within the building and injections will be located around the building, with the possibility of a push pull to treat groundwater underneath facility
6. Five foot remedial zone for overburden (~7-12' bgs); fifteen foot remedial zone for bedrock (~15-30' bgs)
7. Approx. 100,000 sq ft treated in overburden (~21,000 sq ft source area, ~67,000 sq ft source area); 25,000 sq ft treated in source shallow/intermediate bedrock; 275,000 sq ft treat dilute shallow/intermediate bedrock
8. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	220 LF
Overall Scope	Blasted Bedrock Zone
Media	Groundwater

Captial Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Construction Layout Surveying		1	day	$ 2,500.00	$ 2,500.00
Permitting/Blasting Notification/Traffic Plan		1	LS	$ 10,000.00	$ 10,000.00
Temp Closing West Main Street During Blasting		20	day	$ 1,200.00	$ 24,000.00
Detailed Blasting Design		1	LS	$ 10,000.00	$ 10,000.00
Mobilization/Demobilization		1	LS	$ 5,000.00	$ 5,000.00
Pre-Blast Survey of Buildings (250' of Blast Zone)		1	LS	$ 12,000.00	$ 12,000.00
Seismic Monitoring		1	LS	$ 15,000.00	$ 15,000.00
Blasting (215 LF trench to ~20 ft into bedrock)		1	LS	$ 50,000.00	$ 50,000.00
Recovery Well Installation (Steel)		2	ea	$ 8,000.00	$ 16,000.00
Well vaults		2	EA	$ 5,000.00	$ 10,000.00
Drill Spoil Waste Characterization		1	sample	$ 1,000.00	$ 1,000.00
Off-Site Soil Disposal of Drill Spoils		10	tons	$ 50.00	$ 500.00
Well Development		10	hr	$ 250.00	$ 2,500.00
Water tank or drum rental		1	month	$ 5,000.00	$ 5,000.00
Wel Development Water Characterization		1	sample	$ 1,000.00	$ 1,000.00
Off-Site Disposal of Well Development Water		470	gal	$ 2.00	$ 940.00
Pump & Treat System		1	LS	$ 210,000.00	$ 210,000.00
Subtotal Capital Costs					$ 375,440.00
Health & Safety - Level D	5%				$ 18,772.00
Design and Permitting	10%				$ 37,544.00
Construction Management	18%				$ 67,579.20
Contingency	25%				$ 93,860.00
Total					$ 593,195.20
Operational & Maintenance Costs					
Pump & Treat Maintenance		1	LS/yr	$ 140,000	$ 140,000.00
Electrical Energy Usage (10kW @ $0.14/kWhr)		1	year	$ 12,264.00	$ 12,264.00
Subtotal O&M Costs					$ 152,264.00
Percent Worth Factor (30 yrs @ 7%)					12.409
Total Present Worth O&M Cost					$ 1,889,443.98
Rounded Total					**$ 2,482,639.18**
ADDER for Renewable Electrical ($0.165/kWhr)		*1*	*year*	*$ 2,190.00*	*$ 2,190.00*
ADDER Percent Worth Factor (30 yrs @ 7%)					*12.409*
ADDER Total Present Worth O&M Cost					*$ 27,175.71*
TOTAL COST					**$ 2,509,814.89**

Assumptions

1. Blasting up to 20 ft into bedrock (approximately 32 ft below ground surface).
2. No vibration restrictions or site specifications will impact blasting.
3. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates
4. Renewable electrical costs fluctuate. Adder above reflects additional $0.025 per kWhr (quoted in March 2016).

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	460 LF
Overall Scope	In-Situ Chemical Oxidation for hot spots, PlumeStop and HRC for bio
Media	Groundwater

Captial Cost Items	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization - RRS Overburden	1	LS	$ 27,370.00	$ 27,370.00
Mobilization/Demobilization - RRS Shallow Rock ISCO	1	LS	$ 29,670.00	$ 29,670.00
Mobilization/Demobilization - RRS Shallow Rock	1	LS	$ 29,210.00	$ 29,210.00
Mobilization/Demobilization - RRS Intermediate Rock ISCO	1	LS	$ 14,260.00	$ 14,260.00
Mobilization/Demobilization - RRS Intermediate Rock	1	Day	$ 10,810.00	$ 10,810.00
Driller Mobilization/Demobilization	2	LS	$ 10,000.00	$ 20,000.00
Bedrock Wells - Shallow wells (10 at 30-ft centers to 25-ft) x 2 rounds	500	LF	$ 50.00	$ 25,000.00
Bedrock Wells - Intermediate (6 at 30-ft centers to 30 ft.) x 2 rounds	360	LF	$ 50.00	$ 18,000.00
All PlumeStop Reagents - Overburden	1	LS	$ 18,442.55	$ 18,442.55
BDI - Overburden	8	L	$ -	$ -
PlumeStop - Overburden	4800	LB	$ -	$ -
HRC - Overburden	180	LB	$ -	$ -
All PlumeStop Reagents - Shallow Rock	1	LS	$ 51,514.25	$ 51,514.25
PerSulfOx (ISCO) - Shallow Rock	18514	LB	$ 2.59	$ 47,904.98
BDI - Shallow Rock	21	L	$ -	$ -
PlumeStop - Shallow Rock	10	LB	$ -	$ -
HRC - Shallow Rock	1560	LB	$ -	$ -
All PlumeStop Reagents - Intermediate Rock	1	LS	$ 10,266.05	$ 10,266.05
PerSulfOx (ISCO) - Intermediate Rock	4022	LB	$ 2.59	$ 10,406.93
BDI - Intermediate Rock	6	L	$ -	$ -
PlumeStop - Intermediate Rock	2000	LB	$ -	$ -
HRC - Intermediate Rock	300	LB	$ -	$ -
Off-Site Soil Treatment/Disposal of Drill Spoils	5	tons	$ 75.00	$ 375.00
Pilot Test	1	LS	$ 50,000.00	$ 50,000.00
Subtotal Capital Costs				$ 363,229.75
Health & Safety - Level D 5%				$ 18,161.49
Design and Permitting 15%				$ 54,484.46
Construction Management 18%				$ 65,381.36
Contingency 48%				$ 174,350.28
Total				$ 675,607.34

Operational & Maintenance Costs				
Labor (2 sample events per year)	96	HR	$ 120.00	$ 11,520.00
Misc. Sampling Equipment	2	Event	$ 700.00	$ 1,400.00
Analytical costs (2 events, 7 wells, VOC & PAH)	14	Sample	$ 241.20	$ 3,376.80
Annual report	1	EA	$ 7,500.00	$ 7,500.00
Contingency	1	EA	$ 11,422.46	$ 11,422.46
Subtotal O&M Costs				$ 35,219.26
Percent Worth Factor (10 yrs @ 7%)				7.024
Total Present Worth O&M Cost				$ 247,380.11
Rounded Total				**$ 922,987.45**

Assumptions

1. Remediation costing assumes ISCO amendments will be only in hotspot locations (where TCVOC concentrations exceed PlumeStop application
2. Application to be first with PersulOx (localized application of Regenesis ISCO, at hotspots), followed by PlumeStop and HRC/BDI along perimete
3. Application to be at 3 levels - overburden (via Geoprobe), shallow rock and intermediate rock (both via temp wells).
4. Perimeter treatment zone length estimated by Regenesis is 300-ft for OB and shallow rock, and 160-ft in intermediate rock.

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	460 LF (Perimeter) & Selected Interior Wells
Overall Scope	In-Situ Chemical Oxidation for hot spots, PlumeStop and HRC for bio
Media	Groundwater

Captial Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization - RRS Overburden		1	LS	$ 27,370.00	$ 27,370.00
Mobilization/Demobilization - RRS Shallow Rock ISCO		1	LS	$ 29,670.00	$ 29,670.00
Mobilization/Demobilization - RRS Shallow Rock		1	LS	$ 29,210.00	$ 29,210.00
Mobilization/Demobilization - RRS Intermediate Rock ISCO		1	LS	$ 14,260.00	$ 14,260.00
Mobilization/Demobilization - RRS Intermediate Rock		1	Day	$ 10,810.00	$ 10,810.00
Driller Mobilization/Demobilization		2	LS	$ 10,000.00	$ 20,000.00
Bedrock Wells - Shallow wells (10 at 30-ft centers to 25-ft) x 2 rounds		500	LF	$ 50.00	$ 25,000.00
Bedrock Wells - Intermediate (6 at 30-ft centers to 30 ft.) x 2 rounds		360	LF	$ 50.00	$ 18,000.00
All Reagent - Overburden (perimeter)		1	LS	$ 15,676.17	$ 15,676.17
BDI (ISCO) - Overburden (perimeter)		7	L	$ -	$ -
PlumeStop - Overburden (perimeter)		4080	LB	$ -	$ -
HRC - Overburden (perimeter)		153	LB	$ -	$ -
All PlumeStop Reagents - Overburden (interior)		1	LS	$ 2,766.38	$ 2,766.38
BDI - Overburden (interior)		1	L	$ -	$ -
PlumeStop - Overburden (interior)		720	LB	$ -	$ -
Refit wells interior (6 wells - 5 for injection, 1 for monitor)		6	ea	$ 500.00	$ 3,000.00
HRC - Overburden (interior)		27	LB	$ -	$ -
All PlumeStop Reagents - Shallow Rock		1	LS	$ 51,514.25	$ 51,514.25
PerSulfOx (ISCO) - Shallow Rock		18514	LB	$ 2.59	$ 47,904.98
BDI - Shallow Rock		21	L	$ -	$ -
PlumeStop - Shallow Rock		10	LB	$ -	$ -
HRC - Shallow Rock		1560	LB	$ -	$ -
All PlumeStop Reagents - Intermediate Rock		1	LS	$ 10,266.05	$ 10,266.05
PerSulfOx (ISCO) - Intermediate Rock		4022	LB	$ 2.99	$ 12,025.78
BDI - Intermediate Rock		6	L	$ -	$ -
PlumeStop - Intermediate Rock		2000	LB	$ -	$ -
HRC - Intermediate Rock		300	LB	$ -	$ -
Off-Site Soil Treatment/Disposal of Drill Spoils		5	tons	$ 75.00	$ 375.00
Pilot Test		1	LS	$ 50,000.00	$ 50,000.00
Subtotal Capital Costs					$ 367,848.61
Health & Safety - Level D	5%				$ 18,392.43
Design and Permitting	15%				$ 55,177.29
Construction Management	18%				$ 66,212.75
Contingency	48%				$ 176,567.33
Total					$ 684,198.41
Operational & Maintenance Costs					
Labor (2 sample events per year)		96	HR	$ 120.00	$ 11,520.00
Misc. Sampling Equipment		2	Event	$ 700.00	$ 1,400.00
Analytical costs (2 events, 10 wells, VOC & PAH)		20	Sample	$ 241.20	$ 4,824.00
Annual report		1	EA	$ 7,500.00	$ 7,500.00
Contingency		1	EA	$ 12,117.12	$ 12,117.12
Subtotal O&M Costs					$ 37,361.12
Percent Worth Factor (10 yrs @ 7%)					7.024
Total Present Worth O&M Cost					$ 262,424.51
Rounded Total					**$ 946,622.91**

Assumptions

1. Remediation costing assumes ISCO amendments will be only in hotspot locations (where TCVOC concentrations exceed PlumeStop applica
2. Application to be first with PersulOx (localized application of Regenesis ISCO, at hotspots), followed by PlumeStop and HRC/BDI along perir
3. Interior application to be entirely through existing well locations (following conversion of surface completion from capped to open wells), a
4. Application to be at 3 levels - overburden (via Geoprobe), shallow rock and intermediate rock (both via temp wells).
5. Perimeter treatment zone length estimated by Regenesis is 300-ft for OB and shallow rock, and 160-ft in intermediate rock.

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	41,312 SF
Overall Scope	Engineering Control (Sub-Slab Depressurization System)
Media	Soil Vapor

Captial Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
None		0	LS		$ -
Subtotal Capital Costs					$ -
Health & Safety - Level D	5%				-
Design and Permitting	12%				-
Construction Management	10%				-
Contingency	15%				$ -
Total					$ -
Operational & Maintenance Costs					
Monthly Vacuum Monitoring (5 manometers)					$ 18,000.00
Semi-Annual Equipment Inspection (heating season and non-heating season)					$ 3,000.00
Equipment repairs and/or replacements					$ 6,000.00
Annual Reporting					$ 7,500.00
Electrical Energy Usage (5kW @ $0.14/kWhr)		1	year	$ 6,132.00	$ 6,132.00
Subtotal O&M Costs					$ 40,632.00
Percent Worth Factor (30 yrs @ 7%)					12.409
Total Present Worth O&M Cost					$ 504,202.49
Rounded Total					**$ 504,202.49**
ADDER for Renewable Electrical ($0.165/kWhr)		*1*	*year*	*$ 1,095.00*	*$ 1,095.00*
ADDER Percent Worth Factor (30 yrs @ 7%)					*12.409*
ADDER Total Present Worth O&M Cost					*$ 13,587.86*
TOTAL COST					**$ 517,790.34**

Assumptions

1. SSDS is in place and fully functional.
2. No capital costs, only O&M costs required.
3. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates
4. SSDS operates full-time for 30 years.
5. Renewable electrical costs fluctuate. Adder above reflects additional $0.025 per kWhr (quoted in March 20

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	41,312 SF
Overall Scope	Engineering Control (Sub-Slab Depressurization System)
Media	Soil Vapor

Captial Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
None		0	LS		$ -
Subtotal Capital Costs					$ -
Health & Safety - Level D	5%				-
Design and Permitting	12%				-
Construction Management	10%				-
Contingency	15%				$ -
Total					$ -
Operational & Maintenance Costs - YEARS 1-15					
Monthly Vacuum Monitoring (5 manometers)					$ 9,000.00
Semi-Annual Equipment Inspection (heating season and non-heating season)					$ 3,000.00
Equipment repairs and/or replacements					$ 3,000.00
Annual Reporting					$ 7,500.00
Electrical Energy Usage (5kW @ $0.14/kWhr)		1	year	$ 3,074.40	$ 3,074.40
Subtotal O&M Costs					$ 25,574.40
Percent Worth Factor (15 yrs @ 7%)					9.108
Total Present Worth O&M Cost					$ 232,931.64
Rounded Total					**$ 232,931.64**
ADDER for Renewable Electrical ($0.165/kWhr)		*1*	*year*	*$ 549.00*	*$ 549.00*
Percent Worth Factor (15 yrs @ 7%)					*9.108*
Total Present Worth O&M Cost					*$ 5,000.29*
Operational & Maintenance Costs - YEARS 16-30					
Monthly Vacuum Monitoring (5 manometers)					$ 18,000.00
Semi-Annual Equipment Inspection (heating season and non-heating season)					$ 3,000.00
Equipment repairs and/or replacements					$ 6,000.00
Annual Reporting					$ 7,500.00
Electrical Energy Usage (5kW @ $0.14/kWhr)		1	year	$ 6,132.00	$ 6,132.00
Subtotal O&M Costs					$ 40,632.00
Percent Worth Factor (15-30 yrs @ 7%)					3.301
Total Present Worth O&M Cost					$ 134,126.23
Rounded Total					**$ 134,126.23**
ADDER for Renewable Electrical ($0.165/kWhr)		*1*	*year*	*$ 1,095.00*	*$ 1,095.00*
ADDER Percent Worth Factor (15-30 yrs @ 7%)					*3.301*
ADDER Total Present Worth O&M Cost					*$ 3,614.60*
TOTAL COST					**$ 375,672.75**

Assumptions

1. SSDS is in place and fully functional.
2. No capital costs, only O&M costs required.
3. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates
4. SSDS operates at half-time for first 15 years (while SVE runs) then full-time for 15 more years
5. Renewable electrical costs fluctuate. Adder above reflects additional $0.025 per kWhr (quoted in March 20

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	41,312 SF
Overall Scope	Engineering Control (Sub-Slab Depressurization System)
Media	Soil Vapor

Captial Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
None		0	LS		$ -
Subtotal Capital Costs					$ -
Health & Safety - Level D	5%				-
Design and Permitting	12%				-
Construction Management	10%				-
Contingency	15%				$ -
Total					$ -

Operational & Maintenance Costs - YEARS 1-10				
Monthly Vacuum Monitoring (5 manometers)				$ 9,000.00
Semi-Annual Equipment Inspection (heating season and non-heating season)				$ 3,000.00
Equipment repairs and/or replacements				$ 3,000.00
Annual Reporting				$ 7,500.00
Electrical Energy Usage (5kW @ $0.14/kWhr)	1	year	$ 3,074.40	$ 3,074.40
Subtotal O&M Costs				$ 25,574.40
Percent Worth Factor (10 yrs @ 7%)				7.499
Total Present Worth O&M Cost				$ 191,782.43
Rounded Total				**$ 191,782.43**
ADDER for Renewable Electrical ($0.165/kWhr)	*1*	*year*	*$ 549.00*	*$ 549.00*
Percent Worth Factor (10 yrs @ 7%)				*7.499*
Total Present Worth O&M Cost				*$ 4,116.95*

Operational & Maintenance Costs - YEARS 11-30				
Monthly Vacuum Monitoring (5 manometers)				$ 18,000.00
Semi-Annual Equipment Inspection (heating season and non-heating season)				$ 3,000.00
Equipment repairs and/or replacements				$ 6,000.00
Annual Reporting				$ 7,500.00
Electrical Energy Usage (5kW @ $0.14/kWhr)	1	year	$ 6,132.00	$ 6,132.00
Subtotal O&M Costs				$ 40,632.00
Percent Worth Factor (11-30 yrs @ 7%)				4.91
Total Present Worth O&M Cost				$ 199,503.12
Rounded Total				**$ 199,503.12**
ADDER for Renewable Electrical ($0.165/kWhr)	*1*	*year*	*$ 1,095.00*	*$ 1,095.00*
ADDER Percent Worth Factor (11-30 yrs @ 7%)				*4.91*
ADDER Total Present Worth O&M Cost				*$ 5,376.45*
TOTAL COST				**$ 400,778.95**

<u>Assumptions</u>

1. SSDS is in place and fully functional.
2. No capital costs, only O&M costs required.
3. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates
4. SSDS operates at half-time for first 10 years (while MPE runs) then full-time for 20 more years
5. Renewable electrical costs fluctuate. Adder above reflects additional $0.025 per kWhr (quoted in March 20

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	41,312 SF
Overall Scope	Engineering Control (Sub-Slab Depressurization System)
Media	Soil Vapor

Captial Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
None		0	LS		$ -
Subtotal Capital Costs					$ -
Health & Safety - Level D	5%				-
Design and Permitting	12%				-
Construction Management	10%				-
Contingency	15%				$ -
Total					$ -

Operational & Maintenance Costs - YEARS 1-10				
Monthly Vacuum Monitoring (5 manometers)				$ 18,000.00
Semi-Annual Equipment Inspection (heating season and non-heating season)				$ 3,000.00
Equipment repairs and/or replacements				$ 6,000.00
Annual Reporting				$ 7,500.00
Electrical Energy Usage (5kW @ $0.14/kWhr)	1	year	$ 6,132.00	$ 6,132.00
Subtotal O&M Costs				$ 40,632.00
Percent Worth Factor (10 yrs @ 7%)				7.499
Total Present Worth O&M Cost				$ 304,699.37
Rounded Total				**$ 304,699.37**
ADDER for Renewable Electrical ($0.165/kWhr)	*1*	*year*	*$ 1,095.00*	*$ 1,095.00*
Percent Worth Factor (10 yrs @ 7%)				*7.499*
Total Present Worth O&M Cost				*$ 8,211.41*
TOTAL COST				**$ 312,910.77**

Assumptions

1. SSDS is in place and fully functional.
2. No capital costs, only O&M costs required.
3. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates
4. SSDS operates at half-time for first 10 years (while MPE runs) then full-time for 20 more years.
5. Renewable electrical costs fluctuate. Adder above reflects additional $0.025 per kWhr (quoted in March 20

Client	AFES, LLC
Site	Artco Industrial Laundries Site
Area	9,400 SF
Overall Scope	Soil Vapor Extraction
Media	Soil Vapor

Capital Cost Items		**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Pilot Test		1	LS	$ 10,000.00	$ 10,000.00
Mobilization/Demobilization		1	LS	$ 25,000.00	$ 25,000.00
Air Permit		1	LS	$ 5,000.00	$ 5,000.00
Excavate and Remove Lateral Pipe		100	LF	$ 100.00	$ 10,000.00
Waste Disposal (concrete)		7.5	ton	$ 50.00	$ 375.00
Piping (re-fit existing & new wells)		1000	LF	$ 10.00	$ 10,000.00
Wellhead Fittings (existing wells)		6	ea	$ 1,000.00	$ 6,000.00
Extraction Well Installation		6	wells	$ 5,000.00	$ 30,000.00
Well Redevelopment		6	ea	$ 1,000.00	$ 6,000.00
Instrumentation (Flow, Pressure, Temperature...et		1	LS	$ 10,000.00	$ 10,000.00
Control System Panel		1	ea	$ 10,000.00	$ 10,000.00
15 HP Blower		3	ea	$ 10,000.00	$ 30,000.00
Moisture Separator		1	ea	$ 2,500.00	$ 2,500.00
Vapor Treatment - Carbon Vessels		2	ea	$ 2,000.00	$ 4,000.00
Equalization Tank (250 gallons)		1	ea	$ 1,000.00	$ 1,000.00
Transfer Pump		1	ea	$ 5,000.00	$ 5,000.00
Bag Filter Housings		2	ea	$ 6,000.00	$ 12,000.00
Shallow Tray Air Stripper Skid (10 gpm)		1	ea	$ 12,000.00	$ 12,000.00
Liquid Phase Carbon Vessel		2	ea	$ 1,000.00	$ 2,000.00
Discharge Piping to Sewer		1	LS	$ 5,000.00	$ 5,000.00
Utilities (phone, electric, sewer)		1	LS	$ 25,000.00	$ 25,000.00
Subtotal Capital Costs					$ 220,875.00
Installation	15%				$ 33,131.25
Health & Safety - Level D	5%				$ 11,043.75
Design and Permitting	12%				$ 26,505.00
Construction Management	14%				$ 30,922.50
Contingency	35%				$ 77,306.25
Total					$ 399,783.75

Operational & Maintenance Costs				
Electrical Energy Usage (50kW @ $0.14/kWhr)	1	year	$ 30,744.00	$ 30,744.00
Vapor Analytical (Assume one VOC per month)	6	sample	$ 500.00	$ 3,000.00
Scheduled Site Visits/Personnel (10 hrs/wk for 26 v	260	hr	$ 120.00	$ 31,200.00
Response Site Visits (10 hrs/visit, 2 visit/month)	120	hr	$ 120.00	$ 14,400.00
Vapor Carbon Change Outs (incl. disposal)	6	ea	$ 6,000.00	$ 36,000.00
Equipment Repairs/Replacement Allowance	1	LS	$ 4,417.50	$ 4,417.50
Bag Filters (Assume one change per week)	26	ea	$ 50.00	$ 1,300.00
Filter Disposal	2	drum	$ 500.00	$ 1,000.00
Waste Disposal (Assume 2 ton non-haz/month)	12	ton	$ 50.00	$ 600.00
Water Analytical	6	sample	$ 500.00	$ 3,000.00
Annual Reporting	1	LS	$ 10,000.00	$ 10,000.00
Subtotal O&M Costs				$ 135,661.50
Percent Worth Factor (15 yrs @ 7%)				9.108
Total Present Worth O&M Cost				$ 1,235,604.94
Rounded Total				**$ 1,635,388.69**
ADDER for Renewable Electrical ($0.165/kWhr)	*1*	*year*	*$ 5,490.00*	*$ 5,490.00*
ADDER Percent Worth Factor (15 yrs @ 7%)				*9.108*
ADDER Total Present Worth O&M Cost				*$ 50,002.92*
TOTAL COST				**$ 1,685,391.61**

Assumptions

1. Six existing SVE wells will be used.
2. SVE equipment will be installed on the second floor, which is accessed by a freight lift. Building will remain occupied, with sufficient access within the building for remediation tasks.
3. Replacement of lateral piping and retrofitting of existing SVE wells will occur outside of the facility's normal working hours.
4. All costs have been based on RS Means, EPA/ACOE FS Cost Guide July 2000, engineering judgment, prior project experience, recent contractor and/or vendor estimates
5. Renewable electrical costs fluctuate. Adder above reflects additional $0.025 per kWhr (quoted in March 2016