REMEDIAL ACTION DESIGN REPORT

MARTINO'S MASTER DRY CLEANERS
4700 7TH AVENUE
KENOSHA, WISCONSIN
BRRTS# 02-30-287150

November 26, 2019

Prepared For:

Martino's Master Dry Cleaners
7513 41st Avenue
Kenosha, WI 53142

Prepared By:

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Document: 6189-2307

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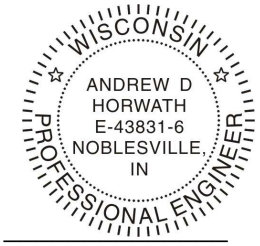
CERTIFICATIONS

I, Andrew Horwath, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.



P.E. No. #-43831-6

Signature, title and P.E. number

P.E. stamp

I, Brian Kappen, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03 (1), Wis. Adm. Code, am registered in accordance with the requirements of ch. GHSS 2, Wis. Adm. Code, or licensed in accordance with the requirements of ch. GHSS 3, Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

Project Manager

Signature and title

11/26/2019

Date

1.0 INTRODUCTION

EnviroForensics LLC (EnviroForensics) has prepared this Remedial Action Design Report on behalf of Martino's Master Dry Cleaners (Martino's) for the Martino's facility located at 4700 7th Avenue in Kenosha, Wisconsin (Site). This report meets the guidelines for designing remedial actions set forth in Wisconsin Administrative Code Chapter NR 724 and other associated Chapter NR 700 series rules.

The Site encompasses approximately 0.33 acres occupied by interconnected buildings constructed between 1900 and 1961. The buildings are identified in this report as the South Building, the Store Area which housed the former dry cleaning operations, the West Building, and the Stoddard Room. The Site operated as an active dry cleaning facility until 2002. The Store Area is currently used as a drop-off location for dry cleaning performed elsewhere. The remaining portion of the first floor spaces are used for warehousing and storage of miscellaneous items, or leased to commercial tenants. There are discontinuous second floor apartments situated over the South Building, Store Area, and West Building which are intermittently occupied by a residential tenants. Partial basements are present beneath the South Building and West Building. The general layout of the Site, including Site features, and the surrounding area, is depicted on **Figure 1**.

The data collected during the site investigation indicate that soil, groundwater, and soil gas at the Site and on adjacent properties contain impacts as a result of releases of tetrachloroethene (PCE), and to a lesser extent Stoddard solvent, during normal dry cleaning operations. The primary contaminants of concern at the Site are chlorinated volatile organic compounds (CVOCs) including PCE and its associated degradation products. The nature and extent of impacts in all subsurface media have been fully delineated, and exposure pathways have been assessed and mitigated as needed.

1.1 Site Hydrogeology

The Site geology consists of approximately 1-foot of sandy topsoil overlying unconsolidated glaciogenic sediments. Gravel is present at the surface in the parking/storage area south of the South Building, and fill material consisting of gravel, sand, and building debris has been encountered in some borings advanced in this area within a few feet of the ground surface. An outwash silty sand unit is present from below the topsoil/fill to a depth of approximately 8 to 11 feet below ground surface (bgs). Underlying the upper silty sand is brown to gray stiff silty clay with sand and gravel observed to a depth of at least 44 feet bgs.

The silty clay layer acts as an aquitard, creating a thin perched groundwater zone at the Site. The perched water table is encountered at approximately 7 to 11 feet bgs depending on location, with a maximum thickness of approximately 4 feet on the west side of the Site. The thickness of the perched zone decreases toward the east and south as the thickness of the upper silty sand layer decreases and the silty clay layer is encountered at shallower depths. Several of the downgradient monitoring wells are frequently dry. The piezometric surface (measured in two existing piezometers) is typically lower than the perched water table, indicating a downward gradient across the clay unit. However, there is no evidence the clay unit and the perched groundwater are hydraulically connected.

A perched zone potentiometric surface contour map is presented on **Figure 2**. The contours are based on the most recent groundwater elevation data collected at the Site. The indicated groundwater flow direction is toward the east. As described in previous reports, the average linear groundwater flow velocity was calculated to be 231 feet per year. However, as described above, the perched groundwater zone does not appear to be laterally continuous and the flow velocity is only considered a potential velocity.

1.2 Nature and Extent of Groundwater Impacts

The highest concentrations of PCE are detected in monitoring wells MW-5 and MW-9, which are located immediately downgradient of the primary PCE source area between the Store Area and South Building. The highest concentrations of daughter products cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride are detected south of the South Building (monitoring wells MW-1 and MW-6), where petroleum-related compounds present in groundwater have accelerated the natural attenuation process by providing an energy source for indigenous microorganisms. These compounds, including xylenes, ethylbenzene, and trimethylbenzenes, are associated with the former use of Stoddard solvent in the dry cleaning operation.

As illustrated on **Figure 3**, the groundwater CVOC plume exceeding enforcement standards extends from the west building wall to the 7th Avenue median, and from the 47th Street right-of-way to the south property boundary. As described above, the perched groundwater zone "pinches-out" toward the east and south, which appears to have limited the lateral migration of contaminants in groundwater. The extent of the groundwater plume has been stable for several years and no increasing trends have been observed. Charts depicting CVOC concentration trends in groundwater collected from several monitoring wells are presented in **Appendix A**.

1.3 Preliminary Natural Attenuation Assessment

The population and functional genes of naturally occurring dehalococcoides (DHC) microorganisms in groundwater was evaluated as an indicator of long-term natural attenuation potential. Groundwater samples for DHC analysis were collected from monitoring wells MW-3 and MW-6 and submitted to Microbial Insights laboratory. The laboratory report is provided in **Appendix B**.

DHC were not detected in the sample collected from MW-3, which is located on the north side of the Site. Water quality readings collected during routine groundwater monitoring indicate oxidizing conditions in this area [i.e., high dissolved oxygen and positive oxidation-reduction potential (ORP)]. A moderate population of DHC, including one of the genes capable of reducing vinyl chloride to ethene, was detected in the MW-6 sample. MW-6 is located on the south side of the Site in an area where petroleum-related compounds are present in groundwater along with the CVOCs. The groundwater near MW-6 is characterized by low dissolved oxygen and negative ORP.

The assessment results indicate that natural attenuation is unlikely to address the entire CVOC plume. However, the addition of a suitable substrate is likely to stimulate DHC growth and drive anaerobic biodegradation.

1.4 Recommended Closure Strategy

As described in the July 29, 2015 *Site Investigation and Remedial Action Options Report*, the recommended closure strategy for the Site included a combination of soil vapor extraction (SVE), in-situ groundwater treatment, and risk management.

An SVE system was previously installed to address soil and soil gas impacts. SVE system construction and initial performance details were provided in the *Remediation Implementation Report* dated July 18, 2017. The SVE system operated for approximately 7,360 hours and removed several pounds of CVOCs.

2.0 GROUNDWATER REMEDIATION PLAN

EnviroForensics has developed a plan to treat CVOC contamination in groundwater using a combination of in-situ chemical reduction (ISCR) and bioaugmented enhanced reductive dechlorination (ERD) technologies. This combination treatment approach relies on synergistic biotic and abiotic reduction pathways to convert CVOCs to non-toxic compounds. The reduction processes will be initiated by injecting a specially formulated solution into the treatment zone. The target compounds for treatment are PCE and cis-1,2-DCE, detected in Site groundwater at concentrations up to 9 milligrams per liter (mg/L) and 3 mg/L, respectively.

2.1 Remediation Objective

As enumerated in NR 722.09(2)(b)(1), the overall remedial goal of the remedial injections is to reduce the concentrations of the CVOC target compounds to below their respective Preventative Action Limits (PALs). Post-injection groundwater monitoring will be performed to determine if this goal is technically and economically achievable. If the goal stated above is not achievable, then a combination of engineering and institutional controls will be utilized to complete Site closure while ensuring the adequate protection of public health, safety, and welfare, and the environment.

2.2 Permitting

EnviroForensics will prepare an Injection Request document, as required, to obtain a written approval from the Wisconsin Department of Natural Resources for the injection plan. A corresponding application for a Wisconsin Pollutant Discharge Elimination System permit, which is also required for remedial injection activities, will also be prepared. A City of Kenosha right-of-way work permit will be needed for working within the median and west terrace of 7th Avenue.

2.3 Injection Design

EnviroForensics developed an injection design based on the distribution of groundwater CVOC impacts and the hydrogeological properties of the silty sand unit. Proposed direct-push injection points are located in accessible areas around and between site buildings, and in the 7th Avenue right-of-way. Specifically, the injection design calls for 71 injection points located in several target treatment areas as follows (see **Figure 4**):

- The 7th Avenue median to the north and south of monitoring well MW-9;
- The west terrace of 7th Avenue to the north and south of monitoring well MW-5;
- The gap between the Store Area and South Building;
- The north side of the Site near MW-7; and
- The parking/storage area south of the South Building.

The target treatment interval is the entire perched zone thickness, from the perched water table to the top of the silty clay unit. The perched zone thickness decreases from approximately four (4) feet (7-11 feet bgs) around the Site buildings to two (2) feet in the 7th Avenue median. Therefore, the planned injection depths will be 7 to 11 feet bgs on-Site and 9 to 11 feet bgs in the median of 7th Avenue. The amendments selected for in-situ groundwater remediation at the Site are:

- Anaerobic BioChem® (ABC), which is a proprietary substrate designed to promote anaerobic biodegradation of CVOCs in groundwater;
- A DHC culture to augment indigenous microorganisms responsible for the dechlorination completed to date; and
- Zero-valent iron (ZVI) to induce chemical reduction processes.

When ABC and ZVI are combined for in-situ treatment, the amendment is referred to as ABC+. A product brochure/technical specification sheet for ABC+ is presented in **Appendix C**.

The injection approach varies by area, and is based on the magnitude of CVOC concentrations in groundwater. The delivery of ABC, bioaugmented with DHC culture, is proposed in all areas. Although DHC were detected in groundwater in the southern part of the Site (specifically at MW-6 and presumably extending west to MW-1), the population may be too low for complete conversion to ethene. Because oxidizing groundwater conditions are present in the central and northern parts of the Site, and in the 7th Avenue right-of-way, the DHC will be mixed with the amendment(s) prior to injection to limit oxygen exposure. The objective is to avoid significantly affecting the viability and reductive capacity of the bacteria.

The addition of ZVI is beneficial at locations where an initial, rapid decrease in concentration will make conditions more suitable for biodegradation. Based on EnviroForensics' previous experience with ERD treatment and the distribution of CVOC impacts, a site-specific concentration of 200 micrograms per liter (µg/L) has been selected as a threshold for the addition of ZVI.

The delivery of amendments will occur as follows (illustrated on **Figure 4**):

- Bioaugmented ABC in areas with CVOC concentrations <200 µg/L (29 injection points); and
- Bioaugmented ABC+ZVI in areas with CVOC concentrations >200 µg/L (42 injection points).

2.3.1 Dosing

The amendment dosing required to effectively treat the dissolved phase CVOC plume has been estimated according to treatment zone volume and contaminant concentration. The ABC will be diluted with potable water to form a 15% solution by weight. At locations where ZVI is prescribed, it will be added at a 50 weight percent ratio with respect to the ABC. In total, 1,500 pounds of ABC and 3,300 pounds of ABC+ will be delivered in approximately 2,200 gallons of solution. The volume of solution injected at each point will range from approximately 27 to 32 gallons depending on whether or not ZVI is added. The total volume of ABC equates to approximately 8% of the treatment zone pore space (assuming a 30% porosity). It is anticipated that 10 liters of DHC culture distributed into all 71 injection points will be enough to achieve a concentration of 1×10^6 cells per liter in that area. The mixing ratios may be adjusted in the field based on the subsurface response to injection.

2.3.2 Mixing and Injection Procedures

Potable water provided by the City of Kenosha will be obtained from the on-Site water supply. Water, ABC and ZVI, where added, will be mixed together to produce a homogeneous amendment solution. The addition of the DHC requires that the water be deoxygenated prior to mixing; therefore, an ABC solution will first be prepared with deoxygenated water. Then the prescribed volume of DHC will be mixed in, followed by the addition of ZVI as the final mixing step.

Mixing will be performed in tanks equipped with a continuous paddle mixer to keep the ZVI solids, if added, in suspension. The solution will then be transferred to a feed tank connected to a high pressure pump. The solution will be pumped through a manifold and hose to injection points consisting of direct-push rods with specialized injection tooling. Injection will be performed working upwards from the bottom to the top of the target treatment interval in each borehole. Pressure and flow rates will be individually monitored at each injection point and recorded to confirm that injection design parameters were met. It is anticipated that the solution will be injected at pressures of less than 100 pounds per square inch.

The direct-push tooling will be removed from each location after the prescribed volume of solution is injected, and the boreholes will be abandoned in accordance with s. NR 141.25 and patched to match the surrounding surface material.

2.4 Health and Safety

A site-specific health and safety plan will be followed during implementation of the remedial action. EnviroForensics will also work with the property owner on communication with employees and customers prior to starting work. The ABC product is a food-grade liquid shipped in 300-gallon plastic totes. ZVI is a gray powder shipped in 55-pound bags. The DHC culture is a light brown liquid shipped in air-tight kegs. The ABC and ZVI will be delivered to the Site a few days before the scheduled start of injection activities and stored in the Stoddard Room. The kegs containing DHC will be delivered immediately before injections because they must be kept cold. The products are non-hazardous and safe to handle with level D personal protective equipment.

There are no public or private water wells near the Site. Buried utilities in the proposed injection areas, including natural gas, electric, sewer, and water, will be located and marked prior to injection activities.

2.5 Performance Monitoring

A remediation performance monitoring program will be implemented to verify that aquifer conditions are conducive to reductive processes, and to document decreasing CVOC concentration trends.

Groundwater elevation measurements will be collected to evaluate the temporary effect of injection on potentiometric surfaces and flow direction. Measurements will be collected from wells within and near the treatment area during injections, and from all Site monitoring wells during post-injection monitoring events. The depth to water in each well will be measured to the nearest 0.01 foot using an electronic water level indicator.

The proposed remediation performance monitoring program is detailed on **Table 1**. Monitoring wells within the treatment areas will be monitored periodically with decreasing frequency. Monitoring will be conducted for a minimum of two (2) years following injections, with the first event occurring approximately two (2) months after injections. Third and fourth years of monitoring will be implemented if needed to demonstrate continuing reductions.

The monitoring program is summarized as follows:

- Periodic sample collection from MW-1, MW-5, MW-6, MW-9 and MW-16 for analysis of volatile organic compounds (VOCs);
- Periodic sample collection from MW-1, MW-5, MW-9 for analysis of total and dissolved iron, sulfate, nitrate, nitrite, dissolved gases, and DHC population and functional genes.

Groundwater samples will be collected via low-flow methods. Water quality data including electrical conductivity, temperature, dissolved oxygen, total dissolved solids, pH and ORP will be measured in the field with a portable meter.

Methane may be produced via the biodegradation of CVOCs. Methane concentrations will be measured during the performance monitoring events using a portable gas analyzer at the shallow monitoring wells and sub-slab vapor ports in the Site building. If the vapor concentration exceeds 10% of the LEL (i.e., 0.5% by volume methane), vapor will be evacuated using appropriate, intrinsically-safe equipment. The existing SVE system and/or a sub-slab depressurization system in the Store Area will be available to mitigate methane accumulation if necessary.

One (1) duplicate sample and one (1) equipment blank will be collected for every 10 or fewer investigative samples, and one (1) trip blank sample will be analyzed per sample cooler for quality assurance/quality control purposes. Samples will be transmitted to a state-certified laboratory and analyzed for VOCs according to U.S. EPA Method 8260.

Investigation-derived media (IDM), including purge water and decontamination fluids, will be containerized in 55-gallon drums. A licensed contractor will be retained to remove drums following each monitoring event. The IDM will be managed under existing non-hazardous waste profiles.

2.6 Implementation Schedule

The injection request and WPDES permit application can be submitted within one (1) month of approval of the Remedial Action Design Report. Regulatory approval of the request and issuance of the permit are expected within 60 days of submittal. EnviroForensics anticipates the injection activities can be completed in one (1) week. Post-injection monitoring will be

performed quarterly, with the first monitoring event to occur approximately two (2) months after the injection activities are completed.

2.7 Reporting

Documentation of remedial activities will be submitted within 60 days of completion of the injections in accordance with NR 724.15. EnviroForensics will summarize and evaluate the groundwater analytical data to determine the performance of the treatment during the two (2) year monitoring period. Performance monitoring data will be included in Remediation Site Operation, Maintenance, Monitoring and Optimization Reports (Form 4400-194) on a semi-annual basis, as required.

TABLES

TABLE 1
REMEDIATION PERFORMANCE MONITORING PROGRAM
Martino's Master Dry Cleaners
4700 7th Avenue, Kenosha, Wisconsin

Year 1								
Parameter	**VOCs**	**Total Fe**	**Dissolved Fe**	**Sulfate**	**Nitrate**	**Nitrite**	**Ethene/Ethane/Methane**	**DHC Population/Species**
MW-1	Q	Q	Q	Q	Q	Q	Q	A
MW-5	Q	Q	Q	Q	Q	Q	Q	A
MW-6	Q							
MW-9	Q	Q	Q	Q	Q	Q	Q	A
MW-16	Q							

Year 2								
Parameter	**VOCs**	**Total Fe**	**Dissolved Fe**	**Sulfate**	**Nitrate**	**Nitrite**	**Ethene/Ethane/Methane**	**DHC Population/Species**
MW-1	Q	S	S	S	S	S	S	A
MW-5	Q	S	S	S	S	S	S	A
MW-6	Q							
MW-9	Q	S	S	S	S	S	S	A
MW-16	Q							

Notes:

The first monitoring event will be performed approximately 2 months after injections

Q = Sample collected for analysis quarterly

S = Sample collected for analysis semi-annually

A = Sample collected for analysis annually

DHC = Dehalococcoides

Fe = Iron

VOCs = Volatile Organic Compounds

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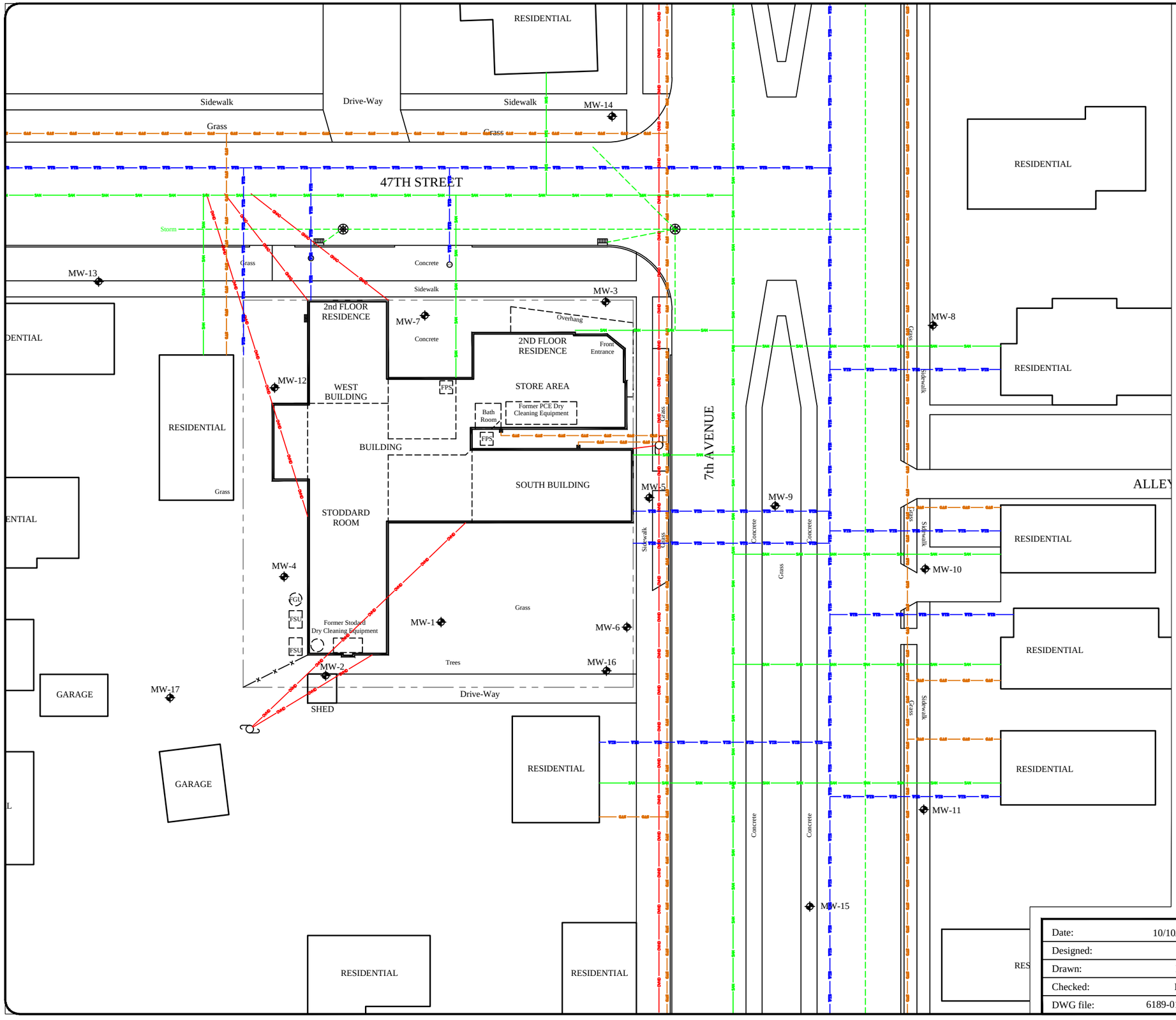
FIGURES



Legend

- Property boundary
- Underground gas utility line
- Underground water utility line
- Underground sanitary utility line
- Underground storm utility line
- Utility Pole
- Catch Basin
- Manhole
- Water valve
- FSU — Former Stoddard USTs
- FPS — Former PCE Storage
- FGU — Former Gasoline Storage UST
- MW-1 — Monitoring well location

N

0 30 60

Approximate Scale in Feet

SITE LAYOUT MAP

Martino's Master Cleaners
4700 7th Avenue
Kenosha, WI

Date:	10/10/13
Designed:	xx
Drawn:	EB
Checked:	BK
DWG file:	6189-0181

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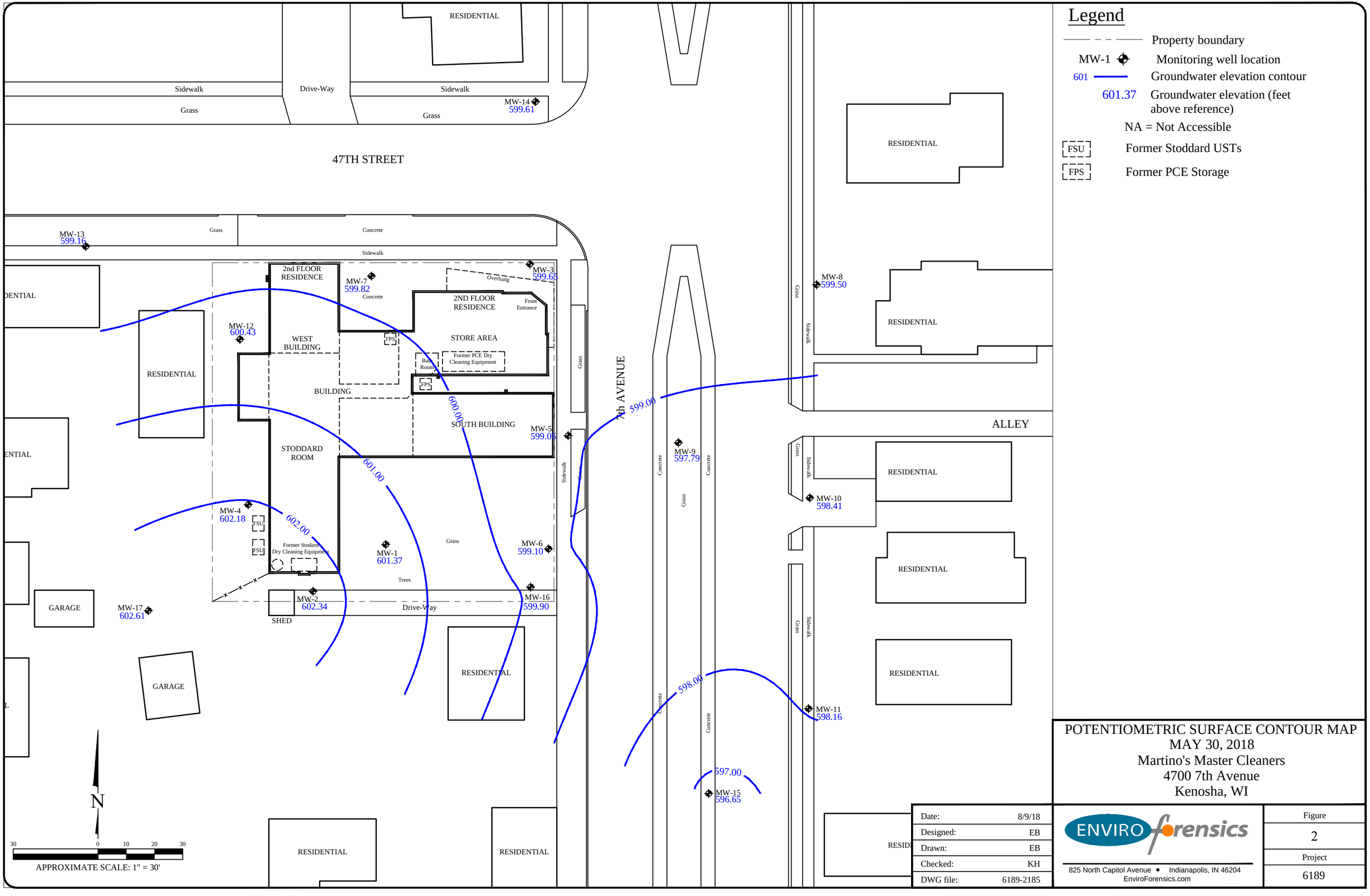
Figure 1

Project 6189



Legend

- Property boundary
- MW-1 — Monitoring well location
- 601 — Groundwater elevation contour
- 601.37 — Groundwater elevation (feet above reference)
- NA = Not Accessible
- FSU — Former Stoddard USTs
- FPS — Former PCE Storage

POTENTIOMETRIC SURFACE CONTOUR MAP
MAY 30, 2018
Martino's Master Cleaners
4700 7th Avenue
Kenosha, WI

Date:	8/9/18
Designed:	EB
Drawn:	EB
Checked:	KH
DWG file:	6189-2185

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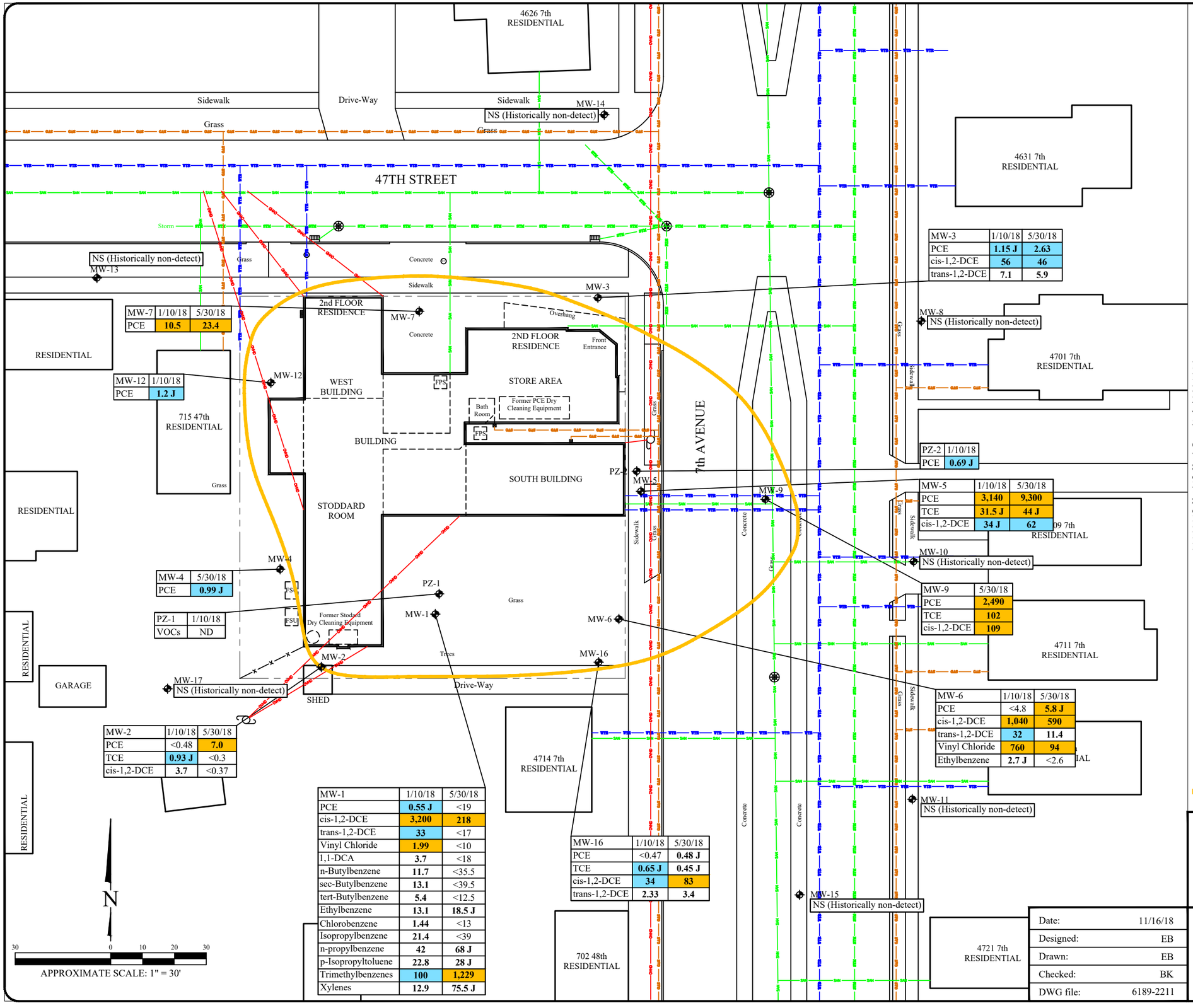
Figure 2

Project 6189



MW-3	1/10/18	5/30/18
PCE	**1.15 J**	**2.63**
cis-1,2-DCE	**56**	**46**
trans-1,2-DCE	**7.1**	**5.9**

MW-7	1/10/18	5/30/18
PCE	**10.5**	**23.4**

MW-12	1/10/18
PCE	**1.2 J**

PZ-2	1/10/18
PCE	**0.69 J**

MW-5	1/10/18	5/30/18
PCE	**3,140**	**9,300**
TCE	**31.5 J**	**44 J**
cis-1,2-DCE	**34 J**	**62**

MW-9	5/30/18
PCE	**2,490**
TCE	**102**
cis-1,2-DCE	**109**

MW-6	1/10/18	5/30/18
PCE	<4.8	**5.8 J**
cis-1,2-DCE	**1,040**	**590**
trans-1,2-DCE	**32**	**11.4**
Vinyl Chloride	**760**	**94**
Ethylbenzene	**2.7 J**	<2.6

MW-4	5/30/18
PCE	**0.99 J**

PZ-1	1/10/18
VOCs	ND

MW-2	1/10/18	5/30/18
PCE	<0.48	**7.0**
TCE	**0.93 J**	<0.3
cis-1,2-DCE	**3.7**	<0.37

MW-1	1/10/18	5/30/18
PCE	**0.55 J**	<19
cis-1,2-DCE	**3,200**	**218**
trans-1,2-DCE	**33**	<17
Vinyl Chloride	**1.99**	<10
1,1-DCA	**3.7**	<18
n-Butylbenzene	**11.7**	<35.5
sec-Butylbenzene	**13.1**	<39.5
tert-Butylbenzene	**5.4**	<12.5
Ethylbenzene	**13.1**	**18.5 J**
Chlorobenzene	**1.44**	<13
Isopropylbenzene	**21.4**	<39
n-propylbenzene	**42**	**68 J**
p-Isopropyltoluene	**22.8**	**28 J**
Trimethylbenzenes	**100**	**1,229**
Xylenes	**12.9**	**75.5 J**

MW-16	1/10/18	5/30/18
PCE	<0.47	**0.48 J**
TCE	**0.65 J**	**0.45 J**
cis-1,2-DCE	**34**	**83**
trans-1,2-DCE	**2.33**	**3.4**

Legend

Analytes	Public Health Preventive Action Limits (ug/L)	Public Health Enforcement Standards (ug/L)
PCE	**0.5**	**5**
TCE	**0.5**	**5**
cis-1,2-DCE	**7**	**70**
trans-1,2-DCE	**20**	**100**
Vinyl Chloride	**0.02**	**0.2**
Ethylbenzene	**140**	**700**
Xylenes	**1,000**	**10,000**
Trimethylbenzenes	**96**	**480**
Chloroform	**0.6**	**6**
n-Butylbenzene	NE	NE
sec-Butylbenzene	NE	NE
tert-Butylbenzene	NE	NE
Isopropylbenzene	NE	NE
p-Isopropylbenzene	NE	NE
p-Isopropyltoluene	NE	NE
n-propylbenzene	NE	NE
Chlorobenzene	NE	NE

Notes:
1. Bold and shaded orange values are above Public Health Enforcement Standards
2. Bold and shaded blue values are above Public Health Preventive Action Limits
3. Bolded values are above detection limits
4. Analytes not shown are below laboratory reporting limits
5. J = Analyte concentration detected between the laboratory Reporting Limit and the laboratory Method Detection Limit
6. ug/L = micrograms per liter
7. Samples analyzed using EPA SW-846 Method 8260
8. VOCs = Volatile Organic Compounds
9. PCE = Tertrachloroethene
7. TCE = Trichloroethene
8. cis-1,2-DCE = cis-1,2-Dichloroethene
9. trans-1,2-DCE = trans-1,2-Dichloroethene
10. NS = Not Sampled
11. ND = Not Detected
12. Historical results from wells not sampled in 2018 were used in drawing the extent of CVOC impacts

- Property boundary
- GAS — Underground gas utility line
- WTR — Underground water utility line
- SAN — Underground sanitary utility line
- STM — Underground storm utility line
- OVHD — Over head electrical utility line
- Utility Pole
- Manhole
- Catch Basin
- WV — Water valve
- MW-1 — Existing monitoring well location
- FSU — Former Stoddard USTs
- FPS — Former PCE Storage
- Extent of CVOC impacts exceeding enforcement standards (Dashed where inferred)

MONITORING WELL SAMPLE ANALYTICAL RESULTS SUMMARY - 2018

Martino's Master Cleaners
4700 7th Avenue
Kenosha, WI

Date:	11/16/18
Designed:	EB
Drawn:	EB
Checked:	BK
DWG file:	6189-2211

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Figure
3
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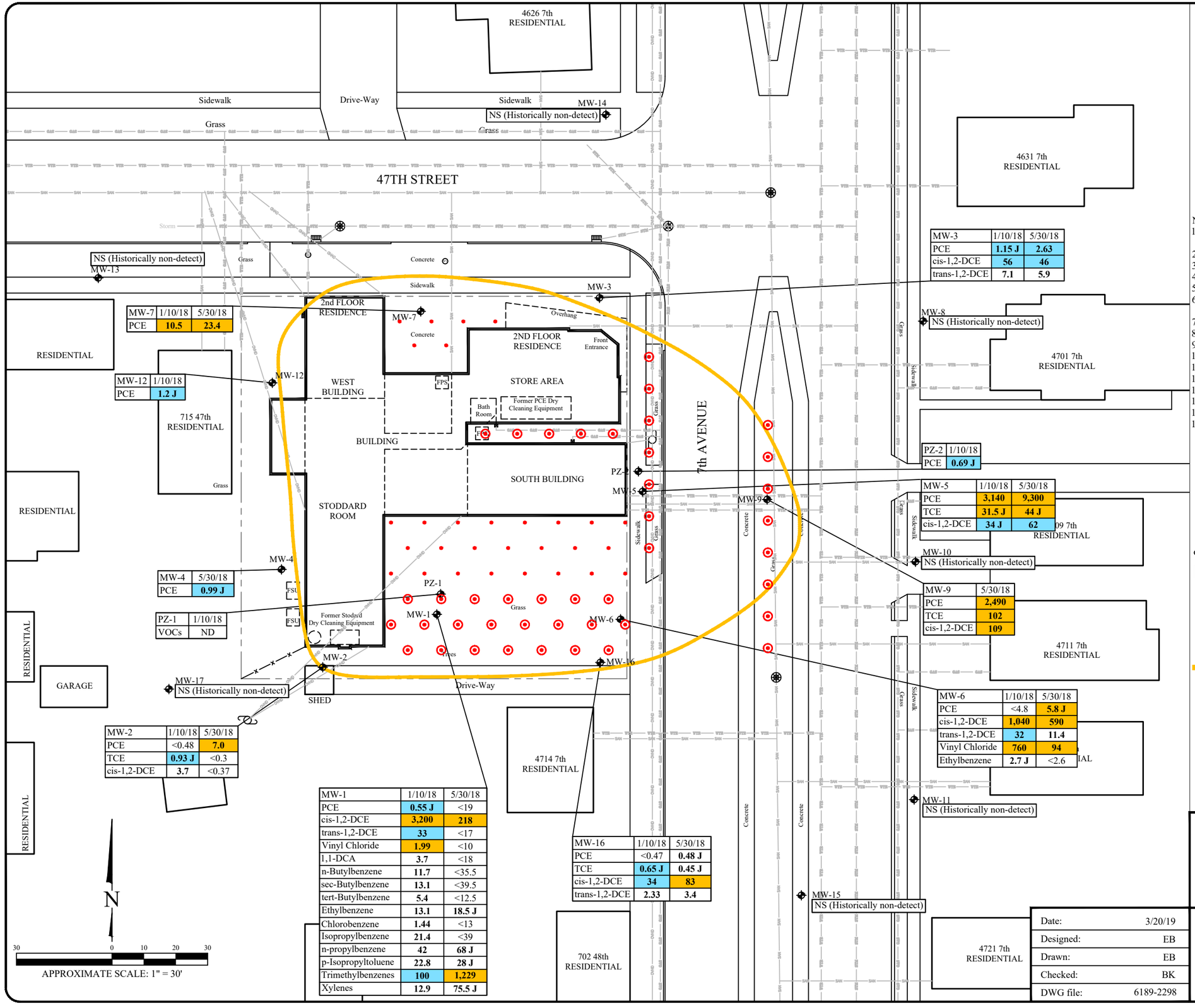
6189



Legend

Analytes	Public Health Preventive Action Limits (ug/L)	Public Health Enforcement Standards (ug/L)
PCE	0.5	5
TCE	0.5	5
cis-1,2-DCE	7	70
trans-1,2-DCE	20	100
Vinyl Chloride	0.02	0.2
Ethylbenzene	140	700
Xylenes	1,000	10,000
Trimethylbenzenes	96	480
Chloroform	0.6	6

Notes:
1. Detected compounds with no regulatory standard established are not listed in the table
2. Bold and shaded orange values are above Public Health Enforcement Standards
3. Bold and shaded blue values are above Public Health Preventive Action Limits
4. Bolded values are above detection limits
5. Analytes not shown are below laboratory reporting limits
6. J = Analyte concentration detected between the laboratory Reporting Limit and the laboratory Method Detection Limit
7. ug/L = micrograms per liter
8. Samples analyzed using EPA SW-846 Method 8260
9. VOCs = Volatile Organic Compounds
10. PCE = Tertrachloroethene
11. TCE = Trichloroethene
12. cis-1,2-DCE = cis-1,2-Dichloroethene
13. trans-1,2-DCE = trans-1,2-Dichloroethene
14. NS = Not Sampled
15. ND = Not Detected
16. Historical results from wells not sampled in 2018 were used in drawing the extent of CVOC impacts

- Property boundary
- GAS — Underground gas utility line
- WTR — Underground water utility line
- SAN — Underground sanitary utility line
- STM — Underground storm utility line
- OVHD — Over head electrical utility line
- Utility Pole
- Catch Basin
- Manhole
- WV — Water valve
- MW-1 — Existing monitoring well location
- FSU — Former Stoddard USTs
- FPS — Former PCE Storage
- Extent of CVOC impacts exceeding enforcement standards (Dashed where inferred)
- Proposed bioaugmented ABC amendment injection point
- Proposed bioaugmented ABC + ZVI amendment injection point

PROPOSED INJECTION POINT LAYOUT

Martino's Master Cleaners
4700 7th Avenue
Kenosha, WI

Date:	3/20/19
Designed:	EB
Drawn:	EB
Checked:	BK
DWG file:	6189-2298

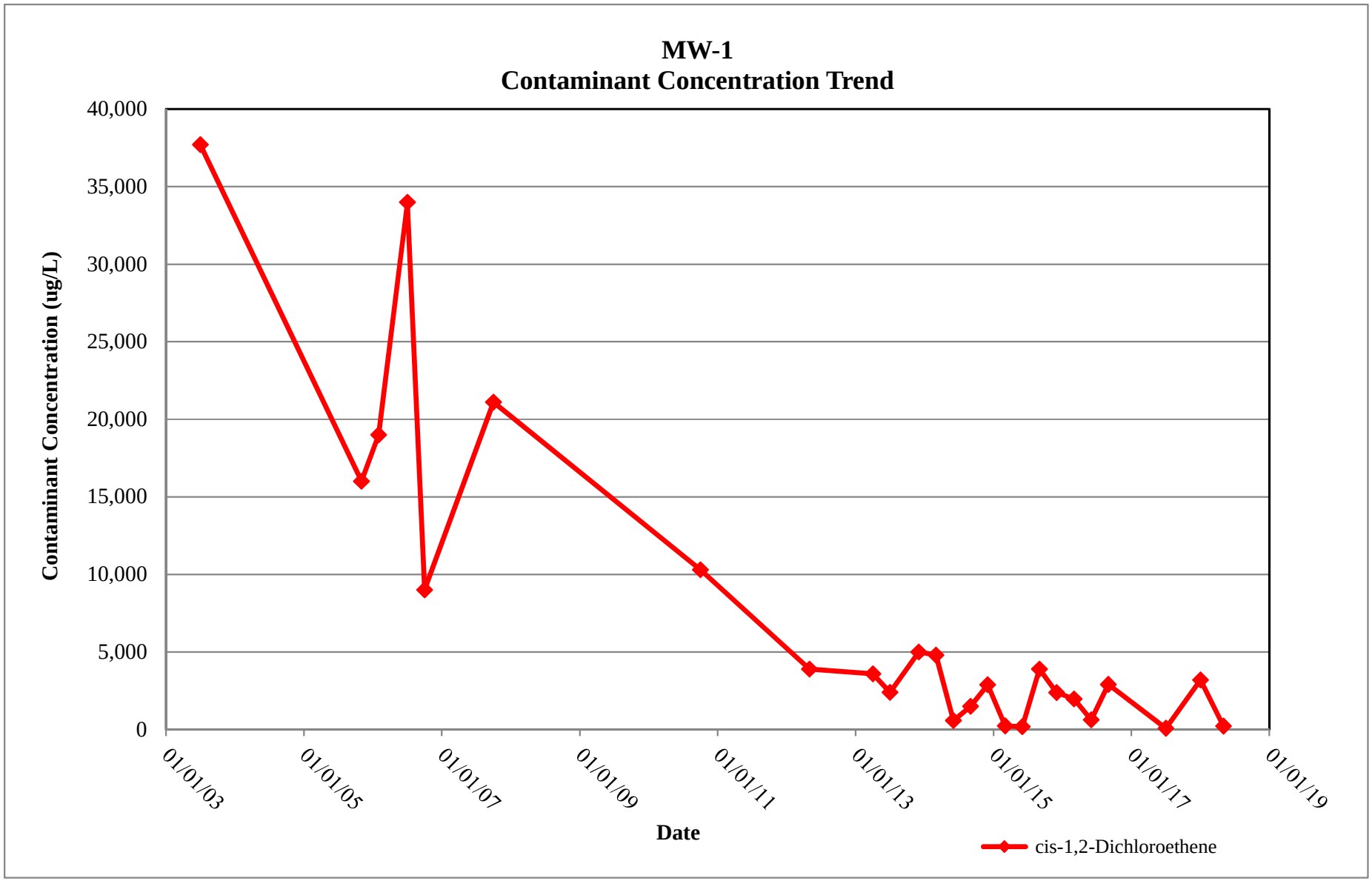
ENVIRO forensics
825 North Capitol Avenue • Indianapolis, IN 46204
EnviroForensics.com

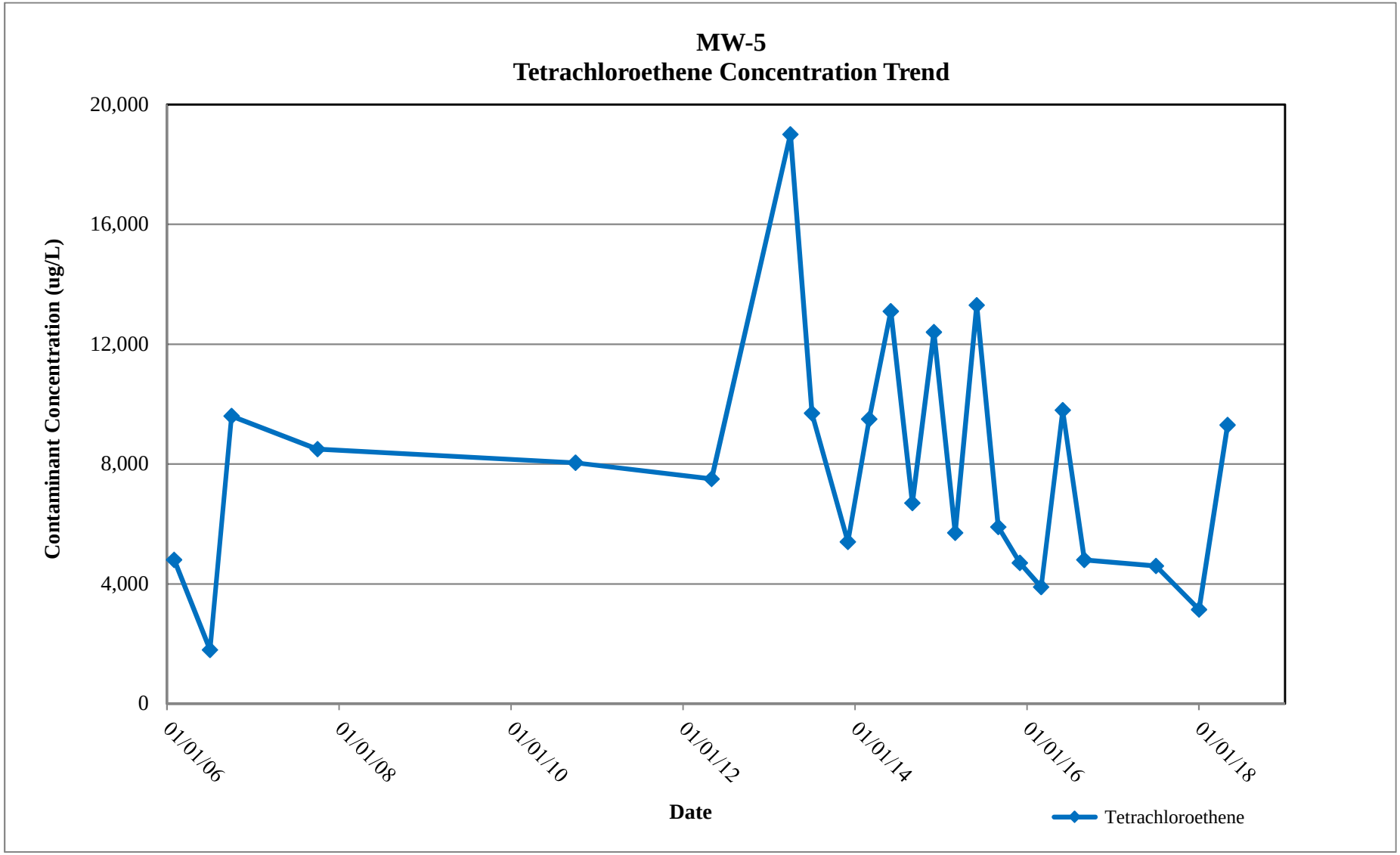
Figure 4

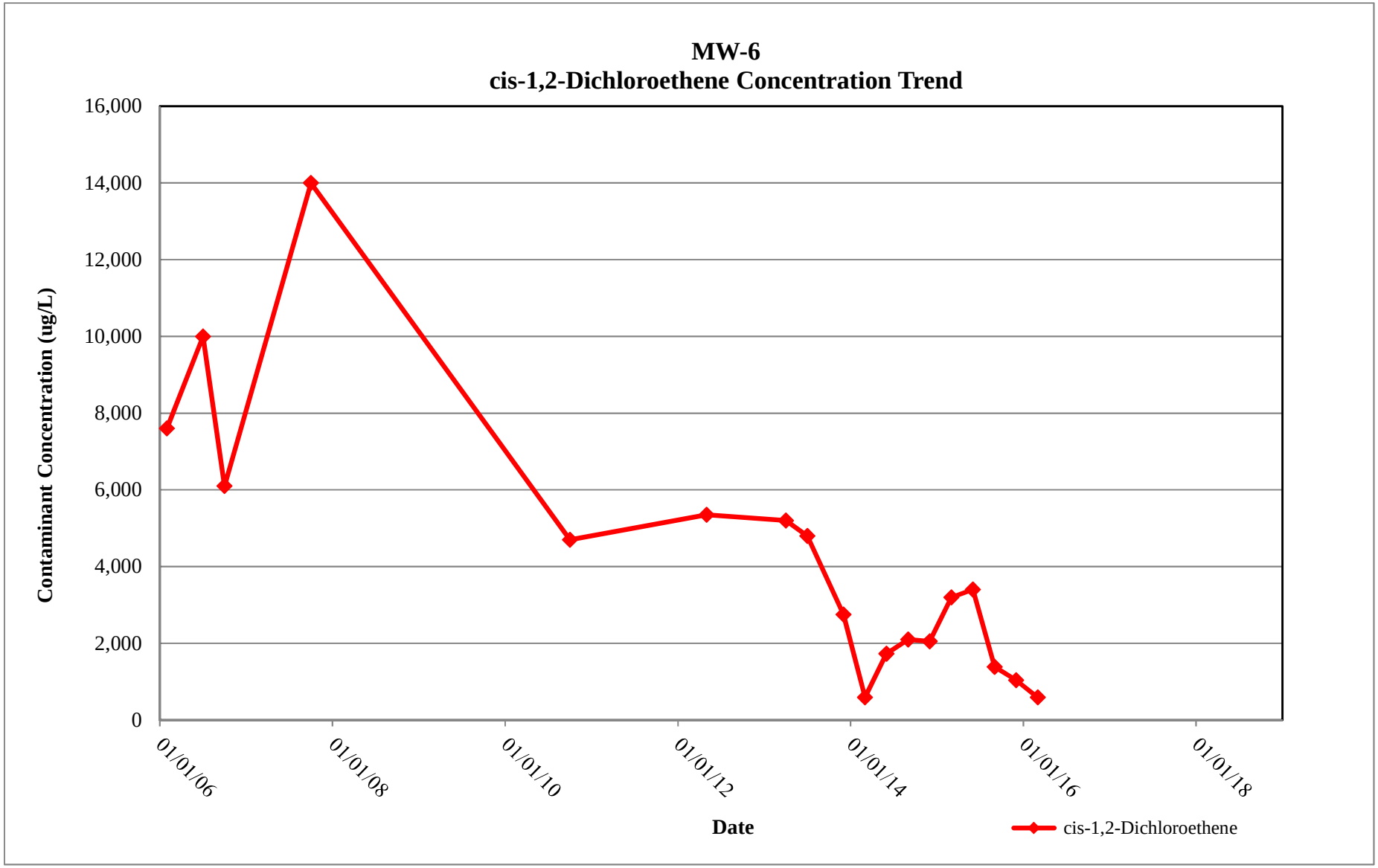
Project 6189

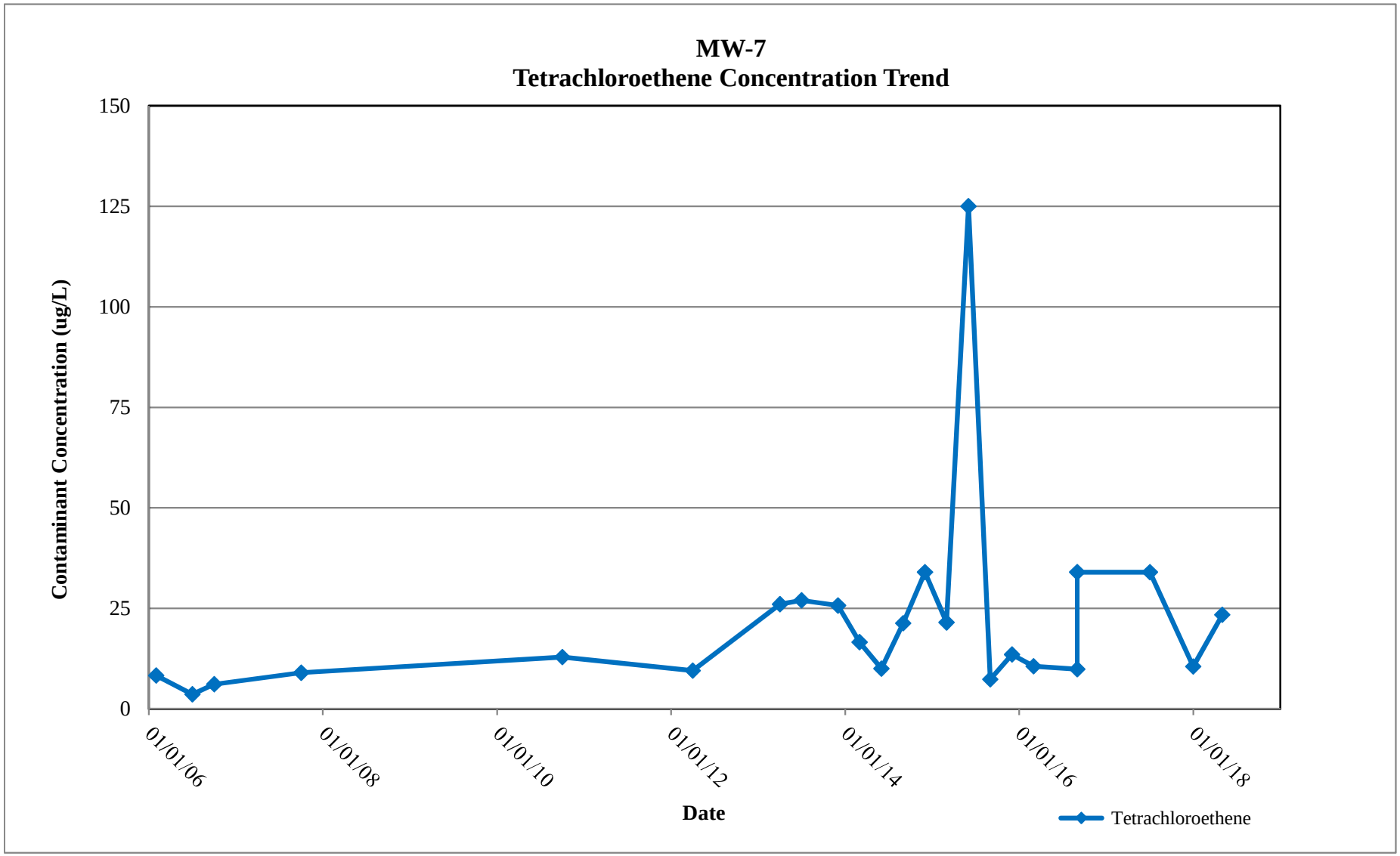
APPENDIX A

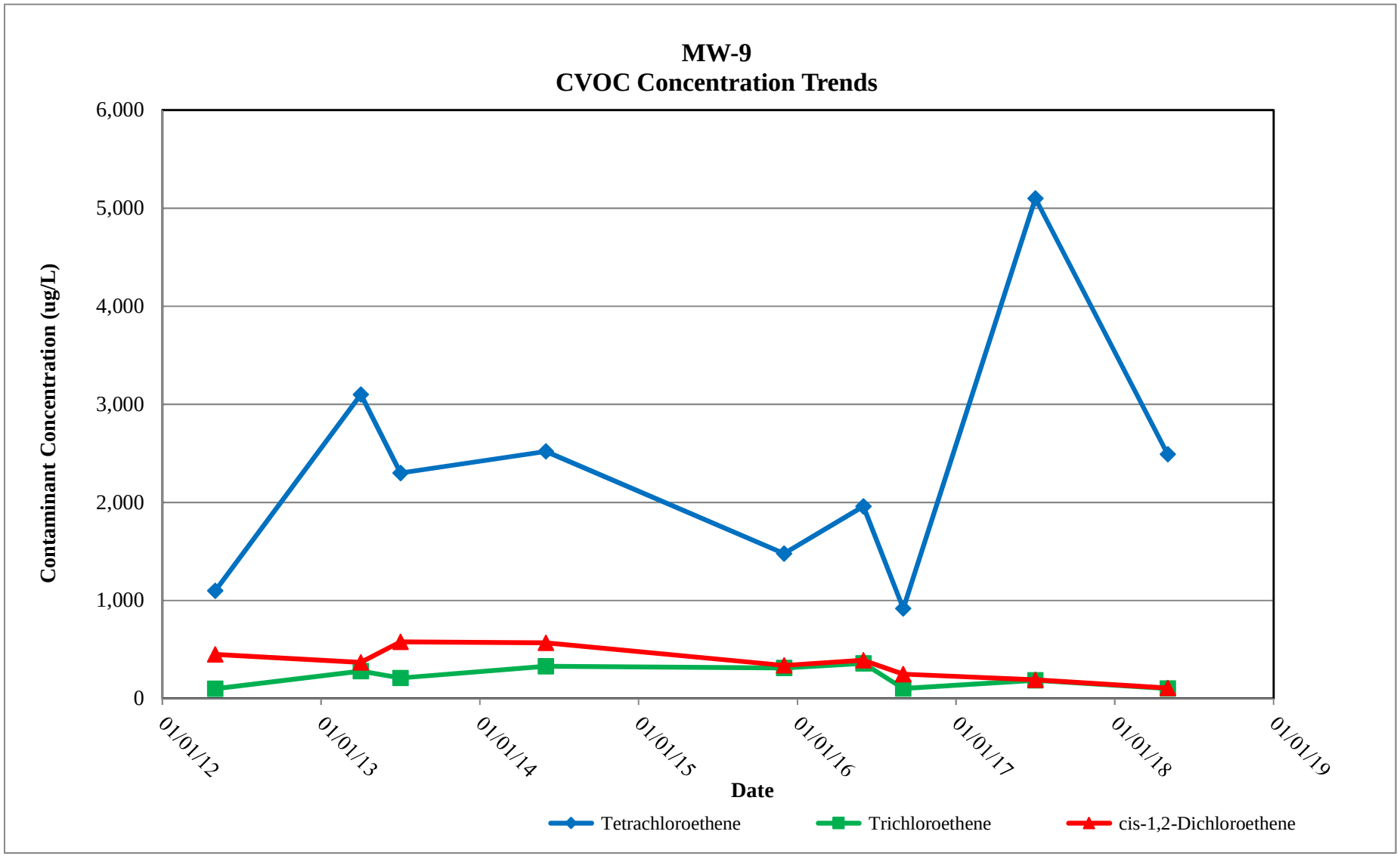
Groundwater CVOC Concentration Trend Charts


MW-1
Contaminant Concentration Trend
Contaminant Concentration (ug/L)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
01/01/03
01/01/05
01/01/07
01/01/09
01/01/11
01/01/13
01/01/15
01/01/17
01/01/19
Date
cis-1,2-Dichloroethene


MW-5
Tetrachloroethene Concentration Trend
Contaminant Concentration (ug/L)
20,000
16,000
12,000
8,000
4,000
0
01/01/06
01/01/08
01/01/10
01/01/12
01/01/14
01/01/16
01/01/18
Date
Tetrachloroethene


MW-6
cis-1,2-Dichloroethene Concentration Trend
Contaminant Concentration (ug/L)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
01/01/06
01/01/08
01/01/10
01/01/12
01/01/14
01/01/16
01/01/18
Date
cis-1,2-Dichloroethene


MW-7
Tetrachloroethene Concentration Trend
Contaminant Concentration (ug/L)
150
125
100
75
50
25
0
01/01/06
01/01/08
01/01/10
01/01/12
01/01/14
01/01/16
01/01/18
Date
Tetrachloroethene


MW-9
CVOC Concentration Trends
Contaminant Concentration (ug/L)
6,000
5,000
4,000
3,000
2,000
1,000
0
01/01/12
01/01/13
01/01/14
01/01/15
01/01/16
01/01/17
01/01/18
01/01/19
Date
Tetrachloroethene
Trichloroethene
cis-1,2-Dichloroethene

APPENDIX B

Microbial Insights Report

10515 Research Drive
Knoxville, TN 37932
Phone: (865) 573-8188
Fax: (865) 573-8133

Client: Brian Kappen
EnviroForensics
N16 W23390 Stone Ridge Drive
Suite G
Waukesha, WI 53188

Phone: 414-326-4412

Fax:

Identifier: 132OC **Date Rec:** 03/30/2017 **Report Date:** 04/06/2017

Client Project #: 6189 **Client Project Name:** Martino's Master Dry Cleaners 7th Ave

Purchase Order #: 2017-0465

Analysis Requested: CENSUS

Reviewed By:

NOTICE: This report is intended only for the addressee shown above and may contain confidential or privileged information. If the recipient of this material is not the intended recipient or if you have received this in error, please notify Microbial Insights, Inc. immediately. The data and other information in this report represent only the sample(s) analyzed and are rendered upon condition that it is not to be reproduced without approval from Microbial Insights, Inc. Thank you for your cooperation.

MICROBIAL INSIGHTS, INC.

10515 Research Dr., Knoxville, TN 37932
Tel. (865) 573-8188 Fax. (865) 573-8133

CENSUS

Client: **EnviroForensics**
Project: Martino's Master Dry Cleaners 7th Ave

MI Project Number: **132OC**
Date Received: 03/30/2017

Sample Information

Client Sample ID:		**6189-MW-3**	**6189-MW-6**
Sample Date:		03/29/2017	03/29/2017
Units:		cells/mL	cells/mL
Analyst:		CB	CB

Dechlorinating Bacteria

Dehalococcoides	*DHC*	<2.20E+00	**1.85E+04**
tceA Reductase	TCE	<2.20E+00	<1.00E+00
BAV1 Vinyl Chloride Reductase	BVC	<2.20E+00	**4.82E+03**
Vinyl Chloride Reductase	VCR	<2.20E+00	<1.00E+00

Legend:
NA = Not Analyzed NS = Not Sampled J = Estimated gene copies below PQL but above LQL I = Inhibited
< = Result not detected

Quality Assurance/Quality Control Data

Samples Received **3/30/2017**

Component	Date Prepared	Date Analyzed	Arrival Temperature	Positive Control	Extraction Blank	Negative Control
DHC	03/30/2017	04/06/2017	0 °C	106%	non-detect	non-detect
BVC	03/30/2017	04/06/2017	0 °C	103%	non-detect	non-detect
TCE	03/30/2017	04/06/2017	0 °C	107%	non-detect	non-detect
VCR	03/30/2017	04/06/2017	0 °C	109%	non-detect	non-detect

REPORT TO:

Name: Brian Kappen
Company: EnviroForensics
Address: N16 W23390 Stone Ridge Dr. Suite G
Waukesha WI 53188
email: bkappen@enviroforensics.com
Phone: 317-972-7870
Fax:

INVOICE TO: (For Invoices paid by a third party it is imperative that all information be provided)

Name:
Company:
Address: SAME
email:
Phone:
Fax:

microbialinsights
10515 Research Dr
Knoxville, TN 37932
865-573-8188
www.microbe.com

Project Manager: Brian Kappen
Project Name: Martino's Master Dry Cleaners 7th Ave
Project No.: 6189

Purchase Order No. 2017-0465
Subcontract No.
MI Quote No.

Please Check One:
☐ More samples to follow
☒ No Additional Samples

Report Type: ☒ Standard (default) ☐ Microbial Insights Level III raw data(15% surcharge) ☐ Microbial Insights Level IV (25% surcharge) ☐ Comprehensive Interpretive(15%) ☐ Historical Interpretive (35%)

EDD type: ☒ Microbial Insights Standard (default) ☐ All other available EDDs (5% surcharge) Specify EDD Type:

Please contact us with any questions about the analyses or filling out the COC at (865) 573-8188 (9:00 am to 5:00 pm EST, M-F). After hours email: customerservice@microbe.com

Sample Information						Analyses				CENSUS: Please select the target organism/gene																							
MI ID (Laboratory Use Only)	Sample Name	Date Sampled	Time Sampled	Matrix	Total Number of Containers	PLFA	NGS	QuantArray Chlor	QuantArray Petro	DHC (Dehalococcoides)	DHC Functional genes (bvc, tce, vcr)	DHBt (Dehalobacter)	DHG (Dehalogenimonas)	DSM (Desulfuromonas)	DSB (Desulfitobacterium)	EBAC (Total)	SRB (Sulfate Reducing Bacteria-APS)	MGN (Methanogens)	MOB (Methanotrophs)	SMMO	DNF (Denitrifiers-nirS and nirK)	AMO (ammonia oxidizing bacteria)	PM1 (MTBE aerobic)	RMO (Toluene Monooxygenase)	RDEG (Toluene Monooxygenase)	PHE (Phenol Hydroxylase)	NAH (Napthalene-aerobic)	BSSA (Toluene/Xylene-Anaerobic)	add. qPCR:	RNA (Expression Option)*	Other:	Other:	Other:
1320C 1	6189-MW-3	3/29	1335	GW	1					X	X																						
2	6189-MW-6	3/29	1333	GW	X OK					X	X																						

Relinquished by: [signature] Date 3/29/17
Received by: [signature] Date 3/30/17

It is vital that chain of custody is filled out correctly & that all relative information is provided.
Failure to provide sufficient and/or correct information regarding reporting, invoicing & analyses requested information may result in delays for which MI will not be liable.

* additional cost and sample preservation are associated with RNA samples.

**Saturday delivery: See sampling protocol for alternate shipping address.

APPENDIX C

ABC+ Product Description

REDOX TECH, LLC

"Providing Innovative In Situ Soil and Groundwater Treatment"

ABC+ PRODUCT ANNOUNCEMENT

Redox Tech, Inc is pleased to offer an enhanced version of our industry proven Anaerobic Biochem (ABC®) formula, promoting both anaerobic biodegradation and reductive dechlorination of halogenated solvents in groundwater. This product, Anaerobic Biochem Plus (ABC+), is a mixture of our ABC® formula and Zero Valent Iron (ZVI). Formulated and mixed on a site-by-site basis, up to fifty percent (50%) by weight of ZVI can be added. ZVI has been proven and widely accepted as an effective in situ remediation technology of chlorinated solvents such as TCA, PCE, TCE, and daughter products. The degradation process using ZVI is an abiotic reductive dechlorination process occurring on the surface of the granular iron, with the iron acting as an electron donor.

The addition of ZVI to the ABC® mixture provides a number of advantages for enhanced reductive dechlorination (ERD). The ZVI will provide an immediate reduction. The ABC® will provide short-term and long-term nutrients to anaerobic growth, which also assists to create a reducing environment. ABC® contains soluble lactic acid and a phosphate buffer that provides phosphates, which are a micronutrient for bioremediation, and maintains the pH in a range that is best suited for microbial growth. In addition, the corrosion of iron metal yields ferrous iron and hydrogen, both of which are possible reducing agents. The hydrogen gas produced is also an excellent energy source for a wide variety of anaerobic bacteria.

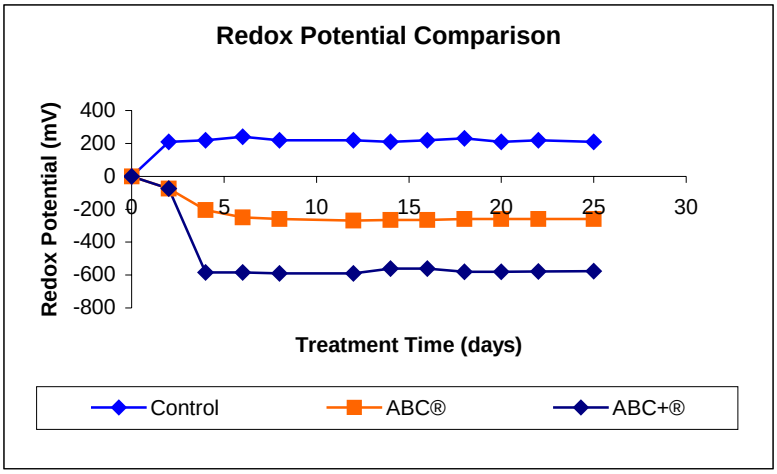
The ABC® and ZVI are mixed with potable water and emplaced in the subsurface simultaneously. The dilution factor (i.e. water content) can be adjusted to achieve optimal dispersion and distribution based on site-specific parameters such as well spacing, permeability of the formation, and contaminant concentrations. The solution can be emplaced by a variety of techniques, including injection through wells or drill rods (for permeable geologic environments such as sands and fractured rock), hydraulic fracturing (for lower permeable environments such as silt and clay), and through soil blending (for all unconsolidated shallow depth applications less than 20 ft bgs). All of these techniques are part of Redox Tech's service offerings.

Benefits of ABC+ include:

- The presence of ZVI allows for the rapid and complete dechlorination of target compounds. Degradation rates using ZVI are several orders of magnitude greater than under natural conditions. As a consequence, the process does not result in the formation of daughter products other than ethane, ethane, and methane.
- ABC® will last up to 12 months in the subsurface environment due to slow releasing compounds, allowing for long-term anaerobic biodegradation
- By creating a reducing environment, ABC+ has the ability to provide long term immobilization of heavy metals (e.g. Ni, Zn, Hg, As)
- Does not require direct contact to act on target constituents.
-

[1]ABC® is protected by US Patents 6,001,252 and 6,472,198. Trademark pending

- Does not divert groundwater flow. ABC is typically mixed at a 15% by weight solution with water. The viscosity of the solution is similar to sugar water and therefore does not measurably influence groundwater flow paths. Due to the relatively low volume of ZVI used, it does not measurably lower the bulk permeability of the formation.
- Ease of handling. The ABC$^+$ product is comprised of food grade compounds and therefore does not require high-levels of personal protective equipment (PPE) or special training to handle. The ZVI is a stable compound that also requires low-level PPE protection.
- Patent protection: Redox Tech is licensed under Enviromental Technologies, Inc. (an Adventus Company) who is the current holder of patents pertaining to remediation using ZVI. Therefore, Redox Tech is able to market, sell, and emplace our ABC$^+$ product. There is no patent infringement risk to the client in selecting the ABC$^+$ approach.
- Price advantage. The cost of the ABC$^+$ formula is an extremely competitive approach in relation to other ERD products on the market.
- ABC$^+$ produces a significantly lower redox potential of approximately –600 mV



Let Redox Tech help formulate a remedial program for your site today. For more information visit our web page at www.redox-tech.com or contact:

John Haselow
Redox Tech, LLC
200 Quade Drive
Cary, NC 27513
Phone: 919-678-0140
FAX: 919-678-0150
jhaselow@redox-tech.com