Prepared for:

NORTH HIGHLAND ASSOCIATES, LLC
MIDTOWN CLEANERS AND LAUNDRY, INC.
599 NORTH HIGHLAND AVENUE
ATLANTA, GEORGIA 30308

VOLUNTARY REMEDIATION PROGRAM APPLICATION

MIDTOWN CLEANERS
ATLANTA, GEORGIA

Prepared by:

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March 2011

EPS

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1 INTRODUCTION

1.1 Overview

This Voluntary Remediation Program (VRP) Application is being submitted on behalf of North Highland Associates, LLC for the Midtown Cleaners and Laundry, Inc. property (Midtown) Hazardous Site Inventory (HSI) Site located at 599 North Highland Avenue in Atlanta, Georgia. Midtown is owned by North Highland Associates, L.L.C. and is operating as Midtown Cleaners and Laundry, Inc. The Site began its dry cleaning operations in the early 1980s. The property tax ID number is 14-0015-0003-0274. Under Hazardous Site Response Act (HSRA) regulation, the HSI Site sublists two adjacent properties. The adjacent properties include Buddy's Convenience Store (Tax Parcel ID# 14-0015-0003-080-3) to the north and east, an alley way owned by the City of Atlanta, and residential property (Tax Parcel ID# 14-0016-0013-043-8). A Voluntary Remediation Program Application and Checklist are included in Appendix A. A tax map and warranty deed information are provided in Appendix B.

1.2 Site Location and Description

The facility currently operates as Midtown Cleaners and Laundry Inc. and encompasses one parcel of property located near the intersection of North Highland Avenue and North Avenue in Atlanta, Fulton County, Georgia (refer to Figure 1, which is located in Appendix C). The parcel is owned by North Highland Associates, L.L.C. and is approximately 3/4 of an acre. The entire parcel includes a dry cleaning facility and associated parking. Surrounding land elevations are depicted on a Topographic Map included as Figure 2. The cleaners and adjacent properties are illustrated on Figure 3. Adjacent properties include:

North: Alley owned by the City of Atlanta and then Buddy's Gas Station UST pits and dispenser islands
West: North Highland Avenue followed by Manuel's Tavern
South: Atlanta Book Exchange
East: Alley owned by the City of Atlanta followed by Buddy's Convenience Store building followed by residential properties

1.3 Environmental History

The Midtown Cleaners building was constructed in the early 1980s and has operated as a dry cleaner from that time until the present. It is not known if the original cleaners used PCE and if so, where the machines were located. According to the information provided in a prior report by Advanced Environmental Management (AEM), in 1999 the facility contained one dry cleaning machine in the northeastern corner of the building.

The tetrachloroethene (PCE)-containing dry cleaning unit used on site from 1993 - 2003 was a Wasoclean DONINI D50. The machine utilized three PCE storage tanks totaling 165 gallons in capacity. PCE was dispensed from 20-gallon drums stored on a steel plate adjacent to and underneath the machine. Spent PCE was distilled to a residue in a distillation tank located at the base of the machine. The machine was replaced with a non-PCE, hydrocarbon machine in 2003.

Chlorinated volatile organic compounds (VOCs) are the chemicals of interest at this Site. The primary VOC attributed to the release at Midtown Cleaners is PCE. Other chlorinated and non-chlorinated VOCs have been detected; however, these are attributed to a petroleum release at the adjacent Buddy's Gas Station and Convenience Store. Buddy's is identified as a Leaking Underground Storage Tank (LUST) site by the EPD's Underground Storage Tank Management Program. Thus, this VRP application will address only those constituents related to Midtown Cleaners. PCE and its degradation products [trichloroethene (TCE), cis-1,2-dichloroethene (DCE) and vinyl chloride] are the contaminants of potential concern at this Site.

Subsurface investigations conducted by AEM in 1999 found the presence of PCE in the soil and groundwater. A HSRA Release Notification was submitted on May 31, 1999 and the Site was listed on the Hazardous Site Inventory on October 15, 1999 for a release of PCE to soil. The site was <u>not</u> listed for groundwater. A Compliance Status Report and Corrective Action Plan was submitted in March 2003 (EPS, 2003). Corrective action was initiated in November 2004. Corrective action included *In Situ* Chemical Oxidation (ISCO) using potassium permanganate. Injections were made in June through December 2005. In 2006 a Compliance Status Report (CSR) was submitted to the EPD (EPS, 2006a). The CSR demonstrated that PCE in both the soil and groundwater at the Site had been delineated to background.

The ISCO injections in 2005 resulted in a nearly 100-fold decrease in PCE concentrations at well MW-1; however, the groundwater at the Site was not in compliance with the Type 3 RRSs for PCE and TCE. Thus, a Corrective Action Plan Addendum (EPS, 2006a), which was subsequently modified (EPS, 2006b), was submitted in 2006 to address the groundwater at the Site. Four hydraulic fracture wells were installed in June 2007, through which potassium permanganate was injected into the subsurface in August 2007 and January 2008. Groundwater quality has been monitored since that time.

1.4 Media of Concern for VRP Application

As of January 2006, all PCE concentrations in the soil were below the Type 1 Risk Reduction Standards (RRS). In the 2003 CSR, the soils were certified to be in compliance with Type 3 RRSs. It should be noted that the certification should have also included Type 1 RRSs. In a letter (included as Appendix D) dated September 26, 2006, the EPD approved of the certification: "This letter is to inform you that we agree that the soil at the site (Tax Parcel 14-0015-0003-0274) does not exceed Type 3 risk reduction standards (RRS) for PCE." Therefore, no additional corrective action with respect to soils at the Site is needed.

As mentioned previously, the Site was not listed on the HSI for groundwater. Although PCE and daughter compounds were present in the groundwater, no drinking water receptors were identified within the applicable down-gradient distance, and the Site did not score above the Groundwater Pathway Threshold of "10" when applying the Reportable Quantities Screening Method at the time of HSI listing. These conditions are still applicable today; thus, the Site does not currently have a release exceeding a reportable quantity[1] for groundwater. Additionally, concentrations in soil are below the Type 1 RRS and are, thus, protective of groundwater quality. According to Section 12-8-107(g)(2) of the VRP Act:

> "*The participant shall not be required to perform corrective action or to certify compliance for groundwater if the voluntary remediation property was listed on the inventory as a result of a release to soil exceeding a reportable quantity for soil but was not listed on the inventory as a result of a release to groundwater exceeding a reportable quantity, and if the participant further demonstrates to the director at the time of enrollment that a release exceeding a reportable quantity for groundwater does not exist at the voluntary remediation property; and the groundwater protection requirements for soils shall be based on protection of the established point of exposure for groundwater as provided under this part*."

Midtown believes that the conditions of this section of the VRP Act have been met. Therefore, it is not necessary to perform corrective action or to certify compliance for groundwater at this Site.

1.5 Purpose

The purpose of this document is to support an application for enrollment into the Voluntary Remediation Program. This document presents a current understanding of conditions at the Site with a Conceptual Site Model (CSM).

1.6 Property Eligibility

The Site meets the eligibility criteria for the Voluntary Remediation Program. A historical release of regulated substances on the Site has been confirmed. The Site is not listed on the National Priorities List, is not currently undergoing response activities required by an order of the Regional Administrator of the United States Environmental Protection Agency (USEPA),

[1] The HSRA regulations define a reportable quantity as "the amount of any released regulated substance which causes a Site to meet the criteria for listing on the Hazardous Site Inventory."

and is not required to have a permit under Code Section 12-8-66. Qualifying the Site under the VRP program would not violate the terms and conditions under which the division operates and administers remedial programs by delegation or by similar authorization from the USEPA. There are no, and never have been any, outstanding liens filed against the Site pursuant to Code Sections 12-8-96 and 12-13-12.

1.7 Participant Eligibility

North Highland Associate, LLC is the Voluntary Remediation Program applicant and is in compliance with all orders, judgments, statutes, rules, and regulations subject to the enforcement authority of the Director with respect to this Site.

2 CONCEPTUAL SITE MODEL

The CSM is intended to establish a common knowledge base about the Site and its environmental condition, to facilitate the development of basic remedial action objectives, and to allow an informed decision regarding possible future actions. This section describes the surface and subsurface features at the Site, discusses the extent of contamination at the Site and discusses the potential receptors and exposure pathways.

2.1 Ground Surface Features

The Site is in an urban setting and is covered in concrete.

2.2 The Subsurface Features

2.2.1 Geological Setting

The geologic and hydrogeologic characteristics of the Site and surrounding area are summarized in this section and are described in detail in the 2006 CSR (EPS, 2006a). This section also includes a discussion of regional physiography and Site topography. The discussion of regional characteristics was derived from published sources. Site specific characteristics were determined based on a review of field data.

2.2.1.1 Regional Physiography and Topography

The City of Atlanta lies within the southern part of the Piedmont Physiographic Province. Regionally, the Piedmont Province is topographically characterized by rolling hills and dendritic stream drainage. The Piedmont Province is divided into northern and southern segments by the Brevard Zone, a broad, northeast/southwest striking, structural shear zone (Higgins, 1981). A review of the *Physiographic Map of Georgia* (Clark and Zisa, 1987) indicates that Atlanta is located on the far eastern side of the Greenville Slope District. The Greenville District is generally characterized by rolling topography with elevations of 1,000 feet in the northeast (near Atlanta) to 600 feet in the southwest. Topographic relief varies from 150 - 200 feet in the east to 100-150 feet in the west.

2.2.1.2 Regional Geological Setting

Atlanta is located in the Southern Piedmont Province south of the Brevard Shear Zone. Structural features within the Piedmont, particularly near the Brevard Zone, are generally oriented along a southwest-northeast strike imparted from regional tectonic events. The bedrock consists of a complex series of highly metamorphosed, multiply-folded, plutonic, meta-igneous and meta-sedimentary rocks of Pre-Cambrian to Paleozoic age. The bedrock units in the area may also reveal evidence of subsequent igneous intrusions including batholith and dike structures. Lithologic units range in thickness from 10 to more than 10,000 feet in some areas. Rock types include gneisses, schists, granites, amphibolites, meta-basalts, quartzites, and ultramafics. Outcrops are rarely visible due to heavy vegetation and the high degree of chemical weathering. The chemical weathering generally produces a mantle of residual soils over the bedrock with thicknesses ranging from a few feet below surface to up to 50 feet. These soils generally consist of micaceous-silt and sand mixtures and clays grading into saprolite and partially weathered rock near the bedrock surface. The saprolite retains most of the original rock structure but is often highly permeable to groundwater flow (Cressler et al., 1983).

The City of Atlanta and surrounding areas southwest of the Brevard Zone are underlain by the Atlanta Group which consists of late Pre-Cambrian to early Paleozoic age rock units. The geologic structure of this formation group has been interpreted as a synformal anticline or synformal syncline (Higgins and Atkins, 1981). Many of the rock units in the Atlanta Group are lithologically similar to units northwest of the Brevard Zone. Atlanta is underlain by the Camp Creek Formation. This formation consists of massive granite gneiss interlayered with thin, fine-grained hornblende-plagioclase amphibolite (McConnell and Abrams, 1984).

2.2.1.3 Site Geology

The Site geology has been investigated by EPS through the advancement of direct push borings, shallow monitoring wells, and one top-of-rock well. The direct push borings and shallow wells were advanced/installed at depths ranging from approximately 8 to 44 ft bls through soil and saprolite residuum. The top-of-rock well was installed at a depth of 65 ft bls on the northeastern end of the building adjacent to MW-1.

The subsurface geology (see cross-sections shown on Figures 4-6) consists of a silt and fine to medium-grained sand soil transitioning into a weathered saprolite at approximately 12 ft bls. The shallow soils also appeared to contain some fill.

The silt and sand soil was micaceous and clay-rich at the top and appeared to be the product of *in situ* weathering. The saprolite was generally observed to contain coarser sand and was identified by metamorphic relict foliation from the parent bedrock. The saprolite contained abundant muscovite and phlogopite mica along with quartz and weathered feldspar and had the appearance of a weathered schist or granite gneiss. Saprolite was determined to extend to a depth of 65 ft bls in the location of DW-1 where competent bedrock was encountered.

2.2.2 Hydrogeological Setting

2.2.2.1 Regional Hydrogeological Setting

The upper boundary of unconfined groundwater in the Piedmont is formed by the water table or surficial water bearing zone. The water table can be loosely defined as the boundary between saturated and unsaturated soil zones. The depth to the water table may range from a few feet below ground surface to up to 50 feet along hilly terrain. In the Piedmont, the water table is usually situated within the soil-saprolite residuum and the upper portion of the fractured crystalline bedrock. In areas where saprolite thicknesses are minimal, the water table may reside almost entirely in fractured bedrock. The soil-saprolite residuum generally has a relatively large storage capacity with a low to moderate transmissivity. Conversely, the bedrock fracture system generally has a relatively low storage capacity with a high transmissivity where fracture systems are interconnected (LeGrand, 1989). If bedrock fracturing is significant, a hydraulic connection between the surficial water bearing zone and deeper groundwater sources may occur at varying depths within the bedrock.

Groundwater flow in the soil-saprolite/fractured bedrock zone often mimics surface topography except where controlled by subsurface geologic structures or preferential pathways. These pathways may be caused by heterogeneities in the soil, weathering patterns of the saprolite, foliated bedding planes, faults, fractures, or other relict bedrock features. Groundwater flow is usually unconfined with recharge occurring from rainfall penetrating upland areas and discharge occurring as base flow to streams and creeks in low lying areas. These flow regimes are commonly referred to as slope aquifer systems. Depending on the interconnection of fracture zones, a downward gradient is commonly observed in upland areas with an upward gradient present in lowlands.

Productive groundwater wells in the Piedmont may be located in the saprolite residuum, fractured crystalline bedrock, or a combination of both. Water in the bedrock is transmitted via connected fractures within the rock unit. The quantity, size, and degree of connection between these fractures or discontinuities are generally more significant than lithology in determining the amount of water available for withdrawal. Rates of withdrawal are often higher along contact zones between rock units. Secondary permeability and fracture size generally decreases with depth due to overburden pressures except in areas where deep thrust fractures are present. In most places in the Piedmont, well yields are insignificant below a depth of 350 feet (LeGrand, 1989).

2.2.2.2 Site Hydrogeology

The surficial water bearing zone or uppermost aquifer beneath the Site includes the saprolite unit and presumably some portion of the upper fractured bedrock. Since bedrock drilling has not been performed, a hydraulic connection between the saprolite and bedrock has not been determined. Likewise, the depth and nature of a deeper bedrock aquifer has not been determined.

Figure 7 displays a potentiometric map for the saprolite water-bearing zone. A review of the figure indicates that groundwater flow is predicted to occur to the east across most of the study area. However, groundwater mounding with a predicted flow component to the northwest was observed on the Buddy's Convenience Store property in the vicinity of the dispenser islands.

No perennial streams or other surface water bodies were identified on the facility property or on adjacent properties. The nearest creek is the Lullwater Creek, a minor tributary to the Chattahoochee River located more than 1.5 miles east of the Site. Based on the distance and surrounding topographic conditions, this creek is not suspected to be hydraulically connected to groundwater flow across the Site.

2.3 Environmental Conditions

The facility has been investigated on several occasions since 1999. Appendix E contains a summary of the previous Site investigations and corrective actions.

This section provides information related to the extent of chlorinated VOCs in soil. The only chlorinated VOC detected in the soil was PCE. The delineation standard (shown in Table 1) is background (detection limit) for soil. This section also provides a comparison of the PCE concentrations detected in soil to cleanup standards. The cleanup criterion (also shown in Table 1) selected for chlorinated VOCs at this Site are Type 1 RRSs. Following the procedure defined in Section 391-3-19-.07 of the HSRA Act, the Type 1 and Type 3 RRS for PCE is based on 100 times the Type 1 HSRA groundwater concentration.

Table 1 Delineation and Cleanup Criteria (mg/kg)

Constituent	Delineation Standard (Background)	Clean-up Criteria (Type 1 RRS)	Type 3 RRS	Maximum Soil Concentration Prior to Corrective Action	Maximum Soil Concentration after Corrective Action
PCE	DL	0.5	0.5	0.67	0.0098

DL: Detection limit

As per the HSRA requirements for the CSR, PCE in the soil was horizontally and vertically delineated to background, which is the detection limit for VOCs. Delineation of soil was demonstrated in the 2006 CSR (EPS, 2006a):

> The horizontal extent of PCE in the soil has been delineated to the west by SB-13, to the north by SB-4, SB-5, SB-6, and SB-11, to the east by SB-1, SB-3, SB-14 and MW-9, and in the south by SB-7 and SB-8. The vertical extent of PCE has been delineated to a depth of 44 ft-bls adjacent to the dry cleaning machine and 28 ft-bls near the interior drain. The source of the PCE contamination inside the building is assumed to be low level permeation through the concrete slab floor primarily around the dry cleaning machine.

Corrective action (ISCO) was implemented in 2005. On December 2, 2005 soil borings SB-1C, 2C, 3C, 4C, and 5C (Figure 9) were installed and soil samples collected with the intent of certifying the soil to RRS. All PCE concentrations were below Type 1 RRSs with the exception of SB-3C (1.4 mg/kg). Subsequent permanganate injections were performed on December 19 - 21, 2005.

On January 3, 2006 soil borings SB-5, SB-6, and SB-7 were installed and soil samples were again collected for certification. SB-7 was collected by the previous soil boring SB-3C, thus replacing the results from SB-3C. The highest PCE concentration was 0.009 mg/kg in SB-7 (0-4 ft-bls). All PCE concentrations are below the Type 1/3 RRSs. The soils at the Site were certified to be in compliance with Type 3 RRSs in the 2006 CSR; however, the certification should have stated Type 1 RRS in addition to Type 3.

2.4 Potential Receptors and Exposure Pathways

This section describes potential environmental and human exposures.

2.4.1 Environmental Receptors

The Site is located in a predominantly suburban commercial setting. Common environmental receptors in this type setting may include protected species, wetland areas, and surface water bodies.

2.4.1.1 Protected Species

Information compiled by the Georgia Natural Heritage Program (GNHP) was reviewed for Fulton County to identify sensitive wildlife receptors or protected species near the facility. The information reviewed indicated that wildlife receptors residing in the area of the facility may include small mammals such as chipmunks, squirrels, rabbits, raccoons, and opossums. Birds may include cardinals, robins, blue jays, crows, sparrows, morning doves, and other song birds. Due to the depth to groundwater (27-35 ft bls), no exposed soil, and soil meeting Type 1 RRSs, exposure to wildlife receptors appears unlikely.

2.4.1.2 Wetlands and Surface Water Bodies

A review of a National Wetland Inventory (NWI) Map for Atlanta, Georgia, prepared by the U.S. Fish and Wildlife Service, indicates that the Site and adjacent properties are not located in identified wetland areas. EPS did not identify any wetland areas.

No perennial streams or other surface water bodies were identified on the facility property or on adjacent properties. The nearest creek is the Lullwater Creek, a minor tributary to the Chattahoochee River located more than 1.5 miles east of the Site. Based on the distance and surrounding topographic conditions, this creek is not suspected to be hydraulically connected to groundwater flow across the Site and is therefore not considered a likely receptor.

2.4.2 Potential Human Receptors

Human receptors at the Site include building occupants and others that may utilize the property. Potential human receptors in the area include the dry cleaner personnel and general public. Due to the retail nature of the facility, access to the Site is unrestricted.

2.4.3 Exposure Media and Pathways

2.4.3.1 Soil

Migration of or contact with impacted soil is not a concern because there is no longer impacted soil at the Site. Therefore, direct human exposure to PCE contaminated soil is an incomplete pathway.

2.4.3.2 Groundwater

Chlorinated VOCs released at the Site have migrated to the groundwater beneath the Site. Impacted groundwater from the Site has migrated to the east and Site-related chemicals have been identified in down-gradient wells. However, corrective action at the Site has significantly reduced chlorinated VOC concentrations in the groundwater and a release above a reportable quantity is not present, due in large part to the lack of a drinking water well within a mile of the Site (see the following paragraph). Thus, exposure to groundwater does not need to be evaluated as the Site does not have a release of a reportable quantity.

The facility and neighboring properties are connected to the municipal water supply supplied by Fulton County. The county obtains potable water from surface reservoirs. Groundwater obtained from water wells or other sources is not utilized on the facility or adjacent properties. In order to identify nearby private or public water wells, water well surveys were performed by AEM and EPS. The AEM well survey tentatively identified five private wells within a one-mile search radius: two water wells were located at the Callenwolde Art Center (>4,500 feet southeast); two irrigation wells were located at the Jimmy Carter Presidential Center (>2,300 feet southwest) and an abandoned private well was located (1,400 feet east). According to the Release Notification prepared by AEM, "no potable wells were found within a one-mile radius of the Site." The EPS well survey identified four additional wells within a larger search radius.

2.4.3.3 Surface Water

No perennial streams or other surface water bodies were identified on the facility property or on adjacent properties. The nearest creek is the Lullwater Creek, a minor tributary to the Chattahoochee River located more than 1.5 miles east of the Site. Based on the distance and surrounding topographic conditions, this creek is not suspected to be hydraulically connected to groundwater flow across the Site and is therefore not considered a likely exposure route.

2.4.3.4 Volatilization to Indoor Air

The volatilization of PCE and its degradation products (TCE, DCE and VC) from groundwater to indoor air has been identified as a potential pathway. The impacted groundwater associated with the Site lies underneath Midtown, Buddy's Gas Station and Buddy's Convenience Store. Thus, commercial workers at these facilities are considered potential receptors. Additionally, there is a residence located downgradient of the Site. Impacted groundwater is not underneath this residence. However, the residence is within 100 feet of the impacted groundwater, and the USEPA recommends evaluating structures within 100 feet of plumes.

Therefore, for the purposes of this assessment, potential exposures were evaluated for the following areas:

- Midtown Cleaners - Commercial Worker
- Buddy's Gas Station - Commercial Worker
- Buddy's Convenience Store – Commercial Worker
- Downgradient Residence - Resident

Other potential human receptors, such as a customer to Midtown and/or Buddy's and trespasser, were not evaluated explicitly. This is because exposure of these will be lower than other potential receptors (e.g., on-site commercial worker).

A model was used to determine risk-based groundwater concentrations that would be protective of human health under these scenarios. The soil vapor intrusion modeling using the Johnson-Ettinger model is discussed in Appendix F. The modeling shows that there is not an unacceptable risk due to soil vapor intrusion of PCE or TCE.

2.5 Conceptual Site Model (CSM)

The aforementioned cross-sections and plan-view figures give a graphical 3-dimensional picture of the Site. This section summarizes the CSM and Figure 10 provides a simplified image of the CSM. Through historical spills and leaks in the dry cleaning process, PCE migrated into the subsurface soil and groundwater underneath Midtown. Midtown discontinued the use of PCE in 2003. Corrective action (ISCO) at the Site resulted in the destruction of PCE in the Site soils to concentrations below the Type 1 RRSs and caused over a 100-fold decrease in concentrations in the groundwater. Currently, PCE and TCE remain in groundwater under the Site, but the condition is such that a release of a reportable quantity has not occurred. Due to the volatile nature of PCE and TCE, the constituents could volatilize from the groundwater, migrate through the vadose zone, and enter the overlying buildings resulting in a potential inhalation risk or hazard. However, soil vapor intrusion modeling demonstrates that there is not an unacceptable risk due to soil vapor intrusion pathway.

3 REMEDIAL ACTION PLAN

No further remedial action is proposed for the Site for the following reasons:

- The soils are in compliance with Type 1/3 RRS.
- The groundwater is not a medium of concern as there is not a release above a reportable quantity.
- Modeling has shown that soil vapor intrusion does not pose an unacceptable risk.

Because no further remedial action is proposed, a projected milestone schedule is not necessary.

4 REFERENCES

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APPENDIX A

VOLUNTARY REMEDIATION PROGRAM APPLICATION AND CHECKLIST

Voluntary Investigation and Remediation Plan Application Form and Checklist

VRP APPLICANT INFORMATION

COMPANY NAME	North Highland Associates, LLC.				
CONTACT PERSON/TITLE	Jeff Vantosh				
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GEORGIA CERTIFIED PROFESSIONAL GEOLOGIST OR PROFESSIONAL ENGINEER OVERSEEING CLEANUP

NAME	Timmerly Bullman			**GA PE/PG NUMBER**	PE028783
COMPANY	Environmental Planning Specialists				
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APPLICANT'S CERTIFICATION

In order to be considered a qualifying property for the VRP:

(1) The property must have a release of regulated substances into the environment;
(2) The property shall not be:
  (A) Listed on the federal National Priorities List pursuant to the federal Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. Section 9601.
  (B) Currently undergoing response activities required by an order of the regional administrator of the federal Environmental Protection Agency; or
  (C) A facility required to have a permit under Code Section 12-8-66.
(3) Qualifying the property under this part would not violate the terms and conditions under which the division operates and administers remedial programs by delegation or similar authorization from the United States Environmental Protection Agency.
(4) Any lien filed under subsection (e) of Code Section 12-8-96 or subsection (b) of Code Section 12-13-12 against the property shall be satisfied or settled and released by the director pursuant to Code Section 12-8-94 or Code Section 12-13-6.

In order to be considered a participant under the VRP:
  (1) The participant must be the property owner of the voluntary remediation property or have express permission to enter another's property to perform corrective action.
  (2) The participant must not be in violation of any order, judgment, statute, rule, or regulation subject to the enforcement authority of the director.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I also certify that this property is eligible for the Voluntary Remediation Program (VRP) as defined in Code Section 12-8-105 and I am eligible as a participant as defined in Code Section 12-8-106.

APPLICANT'S SIGNATURE			
APPLICANT'S NAME/TITLE (PRINT)		**DATE**	

QUALIFYING PROPERTY INFORMATION (For additional qualifying properties, please refer to the last page of application form)			
HAZARDOUS SITE INVENTORY INFORMATION (if applicable)			
HSI Number	10584	Date HSI Site listed	10/15/1999
HSI Facility Name	Midtown Cleaners & Laundry, Inc.	NAICS CODE	812320
PROPERTY INFORMATION			
TAX PARCEL ID	14001500030274	PROPERTY SIZE (ACRES)	0.15
PROPERTY ADDRESS	599 North Highland Avenue		
CITY	Atlanta	COUNTY	Fulton
STATE	Georgia	ZIPCODE	30307
LATITUDE (decimal format)	33.770556 N	LONGITUDE (decimal format)	84.352222 W
PROPERTY OWNER INFORMATION			
PROPERTY OWNER(S)	North Highland Associates, LLC.	PHONE #	404-307-5794
MAILING ADDRESS	2520 Peachtree Road NE, Suite 301		
CITY	Atlanta	STATE/ZIPCODE TN	Georgia 30305

ITEM #	DESCRIPTION OF REQUIREMENT	Location in VRP (i.e. pg., Table #, Figure #, etc.)	For EPD Comment Only (Leave Blank)
1.	**$5,000 APPLICATION FEE** IN THE FORM OF A CHECK PAYABLE TO THE GEORGIA DEPARTMENT OF NATURAL RESOURCES. (PLEASE LIST CHECK DATE AND CHECK NUMBER IN COLUMN TITLED "LOCATION IN VRP." PLEASE DO NOT INCLUDE A SCANNED COPY OF CHECK IN ELECTRONIC COPY OF APPLICATION.)	Check # 1194 March 29, 2011	
2.	**WARRANTY DEED(S)** FOR QUALIFYING PROPERTY.	**Appendix B**	
3.	**TAX PLAT** OR OTHER FIGURE INCLUDING QUALIFYING PROPERTY BOUNDARIES, ABUTTING PROPERTIES, AND TAX PARCEL IDENTIFICATION NUMBER(S).	**Appendix B**	
4.	**ONE (1) PAPER COPY AND TWO (2) COMPACT DISC (CD) COPIES** OF THE VOLUNTARY REMEDIATION PLAN IN A SEARCHABLE PORTABLE DOCUMENT FORMAT (PDF).		
5.	The VRP participant's initial plan and application must include, using all reasonably available current information to the extent known at the time of application, a graphic three-dimensional preliminary conceptual site model (CSM) including a preliminary remediation plan with a table of delineation standards, brief supporting text, charts, and figures (no more than 10 pages, total) that illustrates the site's surface and subsurface setting, the known or suspected source(s) of contamination, how contamination might move within the environment, the potential human health and ecological receptors, and the complete or incomplete exposure pathways that may exist at the site; the preliminary CSM must be updated as the investigation and remediation progresses and an up-to-date CSM must be included in each semi-annual status report submitted to the director by the participant; a **PROJECTED MILESTONE SCHEDULE** for investigation and remediation of the site, and after enrollment as a participant, must update the schedule in each semi-annual status report to the director describing implementation of the plan	**CSM: Section 2; Figures 4-10** **Preliminary Remediation Plan: Section 3** **Delineation standards: Tables 1** **Setting/contami nant**	

	during the preceding period. A Gantt chart format is preferred for the milestone schedule. The following four (4) generic milestones are required in all initial plans with the results reported in the participant's next applicable semi-annual reports to the director. The director may extend the time for or waive these or other milestones in the participant's plan where the director determines, based on a showing by the participant, that a longer time period is reasonably necessary:	**migration/receptors: Section 2** **Schedule: Not applicable**	
5.a.	Within the first 12 months after enrollment, the participant must complete horizontal delineation of the release and associated constituents of concern on property where access is available at the time of enrollment;	**Completed in CSR**	
5.b.	Within the first 24 months after enrollment, the participant must complete horizontal delineation of the release and associated constituents of concern extending onto property for which access was not available at the time of enrollment;	**Not applicable**	
5.c.	Within 30 months after enrollment, the participant must update the site CSM to include vertical delineation, finalize the remediation plan and provide a preliminary cost estimate for implementation of remediation and associated continuing actions; and	**Completed in CSR**	
5.d.	Within 60 months after enrollment, the participant must submit the compliance status report required under the VRP, including the requisite certifications.	**Not applicable**	
6.	**SIGNED AND SEALED PE/PG CERTIFICATION** AND SUPPORTING DOCUMENTATION: "I certify under penalty of law that this report and all attachments were prepared by me or under my direct supervision in accordance with the Voluntary Remediation Program Act (O.C.G.A. Section 12-8-101, <u>et seq</u>.). I am a professional engineer/professional geologist who is registered with the Georgia State Board of Registration for Professional Engineers and Land Surveyors/Georgia State Board of Registration for Professional Geologists and I have the necessary experience and am in charge of the investigation and remediation of this release of regulated substances. Furthermore, to document my direct oversight of the Voluntary Remediation Plan development, implementation of corrective action, and long term monitoring, I have attached a monthly summary of hours invoiced and description of services provided by me to the Voluntary Remediation Program participant since the previous submittal to the Georgia Environmental Protection Division. The information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." ____________________________ __________________ Printed Name and GA PE/PG Number Date ____________________________ Signature and Stamp		

ADDITIONAL QUALIFYING PROPERTIES (COPY THIS PAGE AS NEEDED)

PROPERTY INFORMATION			
TAX PARCEL ID		PROPERTY SIZE (ACRES)	
PROPERTY ADDRESS			
CITY		COUNTY	
STATE		ZIPCODE	
LATITUDE (decimal format)		LONGITUDE (decimal format)	
PROPERTY OWNER INFORMATION			
PROPERTY OWNER(S)		PHONE #	
MAILING ADDRESS			
CITY		STATE/ZIPCODE	

PROPERTY INFORMATION			
TAX PARCEL ID		PROPERTY SIZE (ACRES)	
PROPERTY ADDRESS			
CITY		COUNTY	
STATE		ZIPCODE	
LATITUDE (decimal format)		LONGITUDE (decimal format)	
PROPERTY OWNER INFORMATION			
PROPERTY OWNER(S)		PHONE #	
MAILING ADDRESS			
CITY		STATE/ZIPCODE	

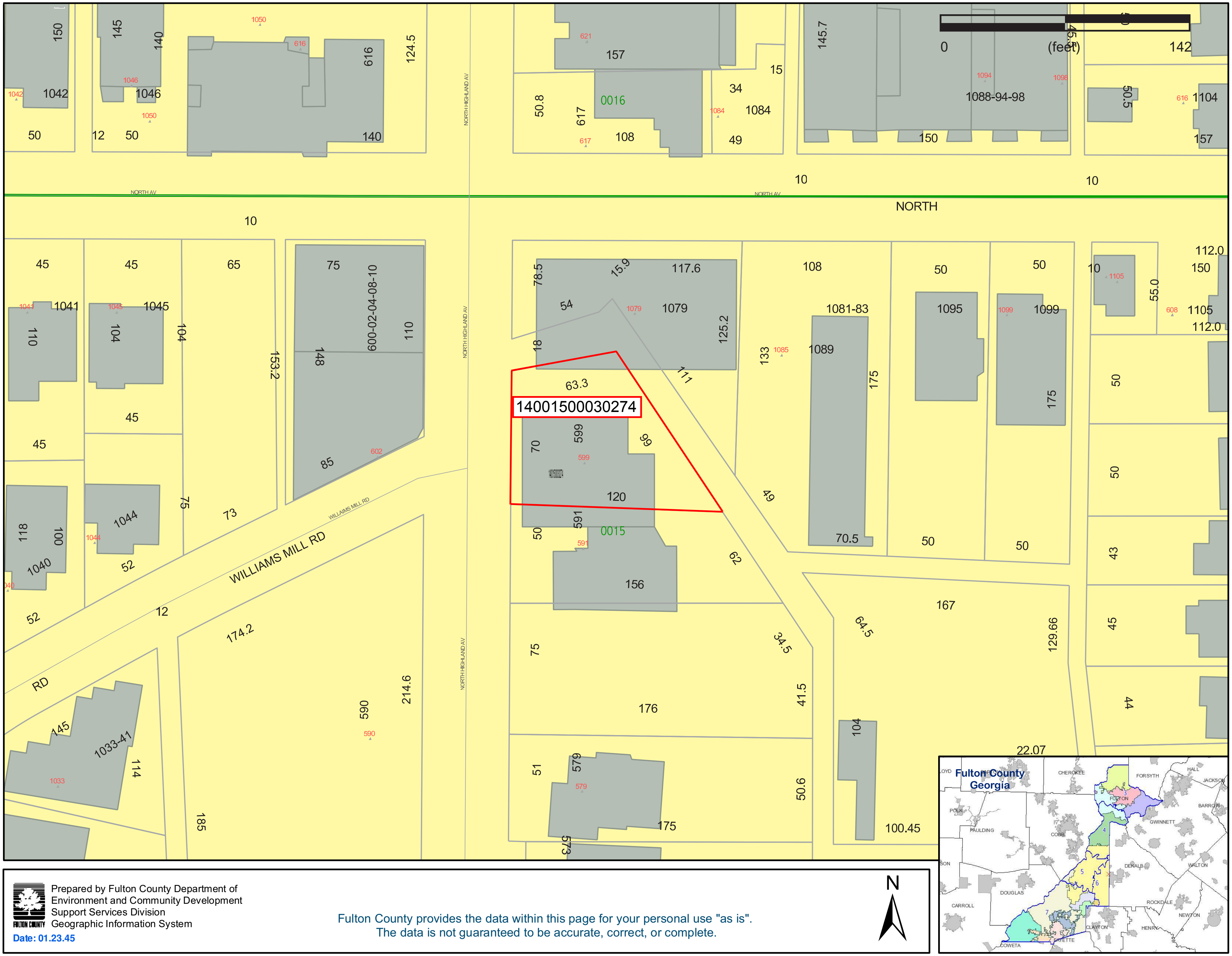
PROPERTY INFORMATION			
TAX PARCEL ID		PROPERTY SIZE (ACRES)	
PROPERTY ADDRESS			
CITY		COUNTY	
STATE		ZIPCODE	
LATITUDE (decimal format)		LONGITUDE (decimal format)	
PROPERTY OWNER INFORMATION			
PROPERTY OWNER(S)		PHONE #	
MAILING ADDRESS			
CITY		STATE/ZIPCODE	

Environmental Planning Specialists, Inc.
Time by Job Detail
January 1, 2007 through March 27, 2011

	Date	Name	Duration	Notes
Midtown Cleaners				
February 2011				
SRI-Sr Eng/Geol/Sci'tistI:SRI-Document Preparation				
	02/21/2011	Bullman, Timmerly Y	6.00	VRP application
	02/22/2011	Bullman, Timmerly Y	8.00	VRP application
	02/23/2011	Bullman, Timmerly Y	7.50	VRP application
	02/24/2011	Bullman, Timmerly Y	8.00	VRP application
	02/25/2011	Bullman, Timmerly Y	6.00	VRP application
	02/28/2011	Bullman, Timmerly Y	5.50	VRP application
Total SRI-Sr Eng/Geol/Sci'tistI:SRI-Document Preparation			41.00	
SRI-Sr Eng/Geol/Sci'tistI:SRI-Project Management				
	02/14/2011	Bullman, Timmerly Y	5.25	Soil vapor intrusion modelling; VRP app
	02/15/2011	Bullman, Timmerly Y	0.50	Soil vapor intrusion modelling; VRP app
	02/17/2011	Bullman, Timmerly Y	0.25	Soil vapor intrusion modelling; VRP app
	02/18/2011	Bullman, Timmerly Y	3.00	Soil vapor intrusion modelling; VRP app
Total SRI-Sr Eng/Geol/Sci'tistI:SRI-Project Management			9.00	
March 2011				
SRI-Sr Eng/Geol/Sci'tistI:SRI-Document Preparation				
	03/02/2011	Bullman, Timmerly Y	1.00	VRP application
	03/03/2011	Bullman, Timmerly Y	0.50	VRP application
	03/28/2011	Bullman, Timmerly Y	6.50	VRP application
	03/29/2011	Bullman, Timmerly Y	3.00	VRP application
Total SRI-Sr Eng/Geol/Sci'tistI:SRI-Document Preparation			11.00	

APPENDIX B

TAX MAPS AND WARRANTEE DEEDS

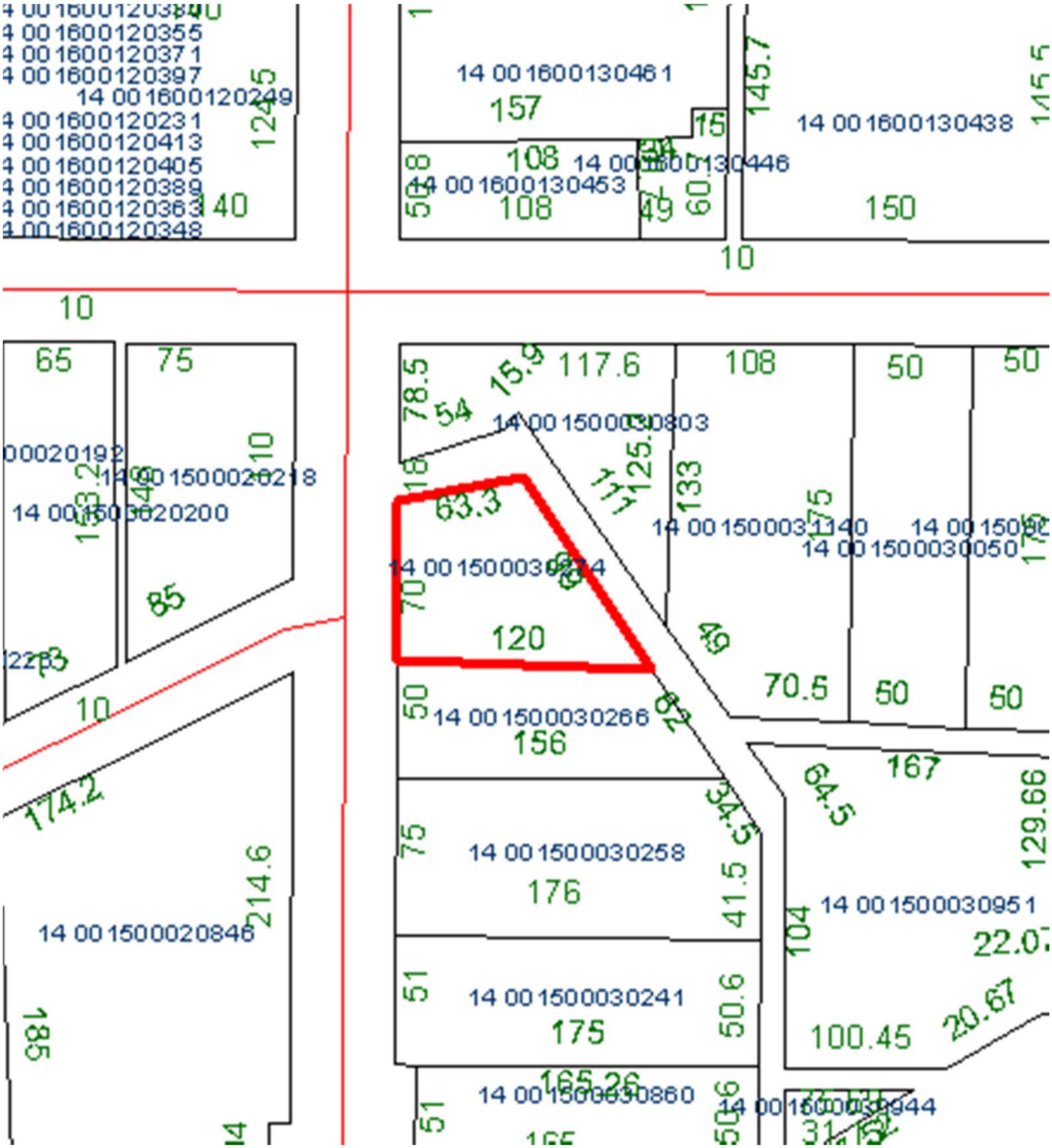


Prepared by Fulton County Department of
Environment and Community Development
Support Services Division
Geographic Information System

Date: 01.23.45

Fulton County provides the data within this page for your personal use "as is".
The data is not guaranteed to be accurate, correct, or complete.

N



Source: www.fultonassessor.org

EPS

N

Midtown Cleaners
599 N. Highland Ave
Atlanta GA

Tax Parcel Map

Nm:VANTOSH(1391145), Rq:284,1

Fulton County, Georgia
Real Estate Transfer Tax
Paid $ 329.00
Date JAN 11 1990
By [illegible] Deputy Clerk

GEORGIA Fulton County Clerk's Office Superior Court
Filed & Recorded JAN 11 1990 at 4:37
[illegible] CLERK

LIMITED WARRANTY DEED

STATE OF GEORGIA

FULTON COUNTY

THIS INDENTURE, effective as of the 20th day of November, in the year one thousand nine hundred eighty-nine, between

VANTOSH COMPANY, INC.,
A Georgia Corporation,

of the County of Fulton, and State of Georgia, as party or parties of the first part, hereinafter called Grantor, and

MYRA ABRAMS (7.5%), AARON I. ALEMBIK (1.6%), RITA BARON (5.0%), DAVID N. CUNNINGHAM (12.5%), HARRY HOUSEN (5.4%), CATHY SELIG (7.5%), JEFFREY P. VANTOSH (7.5%), JILL W. VANTOSH (43%), DR. STEVE WARONKER (5.0%), AND NORMAN WEITZ FAMILY TRUST (5.0%),

as party or parties of the second part, hereinafter called Grantee (the words "Grantor" and "Grantee" to include their heirs, successors and assigns where the context requires or permits).

WITNESSETH that: Grantor, for and in consideration of the sum of TEN DOLLARS ($10.00) and other good and valuable consideration in hand paid at and before the sealing and delivery of these presents, the receipt whereof is hereby acknowledged, has granted, bargained, sold, aliened, conveyed and confirmed, and by these presents does grant, bargain, sell, alien, convey and confirm unto the said Grantees, their heirs, successors and assigns,

All that tract or parcel of land lying and being in Land Lot 15, of the 14th District of Fulton County, Georgia, consisting of Tract I, Tract II and Tract III, attached hereto and made a part hereof, marked Exhibit "A."

TOGETHER with all of grantor's right, title and interest, if any, in and to any strips of land, streets and alleys abutting or adjoining said real property.

Any and all buildings and all of Grantor's right, title and interest in and to the improvements now standing upon any of the property herein described, and all of the right, title and interest of Grantor in and to all fixtures located upon or within the buildings and improvements and attached to, or installed in, or used in connection with any of the buildings and improvements, including, but not limited to, any and all partitions, dynamos, screens, awnings, motors, engines, boilers, furnaces, pipes, plumbing, elevators, cleaning and sprinkler systems, fire extinguishing equipment, water tanks, heating, ventilating, air conditioning and air cooling equipment, and gas and electric machinery, appurtenances and equipment.

All of the right, title and interest of Grantor in and to all furniture, furnishings, equipment, machinery and all other personal property now located in, upon or about the said property and the buildings and improvements located thereon.

The property herein described is the same property conveyed to Grantor by Deed of Trustee-in-Bankruptcy dated November 20, 1989, recorded in Deed Book 12983, page 151, Fulton County Records, Georgia.

TO HAVE AND TO HOLD the said tract or parcel of land, with all and singular the rights, members and appurtenances thereof, to the same being, belonging, or in anywise appertaining, to the only proper use, benefit and behoof of the said Grantees forever in FEE SIMPLE.

AND THE SAID Grantor will warrant and forever defend the right and title to the above described property unto the said Grantee against the claims of all persons owning, holding, or claiming by, through or under the said Party of the First Part.

IN WITNESS WHEREOF, the Grantor has signed and sealed this deed, the day and year above written through its duly authorized officer.

VANTOSH COMPANY, INC.

By Jeffrey P. Vantosh

JEFFREY P. VANTOSH, President

(CORPORATE SEAL)

CORP. SEAL

Signed, sealed and delivered this 21st day of December, 1989, in presence of:

Unofficial Witness

Linda M. Grooms

Notary Public

My Commission expires: Notary Public, DeKalb County, Georgia My Commission Expires January 8, 1994.

(Notary Seal)

N.P. SEAL

BOOK 13120 PG 214

EXHIBIT "A"

TRACT I

ALL that tract or parcel of land lying and being in Land Lot 15, of the 14th District of Fulton County, Georgia, and being more particularly described as follows:

BEGINNING at a point on the east side of North Highland Avenue ninety-six and five tenths (96.5) feet south of the southeast corner of North Highland Avenue and North Avenue, said beginning point being at the south side of an eighteen (18) foot alley; running thence south along the east side of North Highland Avenue sixty-five and fifteen hundredths (65.15) feet; thence east one hundred twenty (120) feet to the southwest side of said eighteen (18) foot alley; thence northwesterly along the southwestern side of said alley ninety-nine (99) feet to a point where said alley turns; thence west along the south side of said alley sixty-three and three-tenths (63.3) feet to the point of beginning; being improved property known as 597-601 North Highland Avenue, N.E., according to the present system of numbering houses in the City of Atlanta.

TRACT II

ALL that tract or parcel of land lying and being in Land Lot 15, 14th District, Fulton County, Georgia, and being more particularly described as follows:

BEGINNING at an iron pin placed on the easterly side of North Highland Avenue two hundred seventy-seven (277) feet northerly as measured along the easterly side of North Highland Avenue from the corner formed by the intersection of the easterly side of North Highland Avenue with the northerly side of Vaud Avenue; run thence easterly along the line that forms an interior angle of 90 degrees 08 minutes with the easterly side of North Highland Avenue one hundred fifty-six (156) feet to an iron pin found on the southwesterly side of a 15-foot alley; run thence northwesterly along the southwesterly side of said 15-foot alley sixty-two (62) feet to an iron pin found; run thence westerly one hundred twenty (120) feet to an iron pin found on the easterly side of North Highland Avenue; run thence southerly along the easterly side of North Highland Avenue fifty (50) feet to the iron pin placed at the point of beginning, being improved property having a one-story frame house thereon known as 591 North Highland Avenue according to the present system of numbering houses in the City of Atlanta, Georgia, and being more particularly shown on survey prepared by Georgia Land Surveying Co., dated September 23, 1980.

JHP

EXHIBIT "A"

(Continued)

TRACT III

ALL that tract or parcel of land lying and being in Land Lot 15 of the 14th District, Fulton County, Georgia, and being more particularly described as follows:

BEGINNING at a point where the northeasterly side of a 15 foot alley intersects with the southerly side of a 10 foot alley, said 15 foot alley running parallel to the rear property line of No. 597-601 North Highland Avenue; thence following the northeasterly side of the 15 foot alley South 26 degrees 5 minutes East a distance of 64.5 feet to a point; thence following the easterly side of said alley (now a 10 foot alley) South 2 degrees 49 minutes West a distance of 104.0 feet to the north side of a 10 foot alley; thence following the northerly side of said 10 foot alley North 83 degrees 39 minutes East a distance of 100.45 feet to a point on the right-of-way of a proposed State of Georgia Road (Presidential Parkway); thence along the right-of-way of said proposed road North 69 degrees 04 minutes East a distance of 20.67 feet to a point; thence North 77 degrees 56 minutes East a distance of 22.07 feet to a point on the westerly side of a 10 foot alley; thence along the westerly side of said 10 foot alley North 0 degrees 42 minutes East a distance of 129.66 feet to a point on the south side of a 10 foot alley; thence along the southerly side of said 10 foot alley North 87 degrees 22 minutes West a distance of 167.0 feet to a point on the northeasterly side of a 15 foot alley and point of beginning.

JRV

APPENDIX C

FIGURES

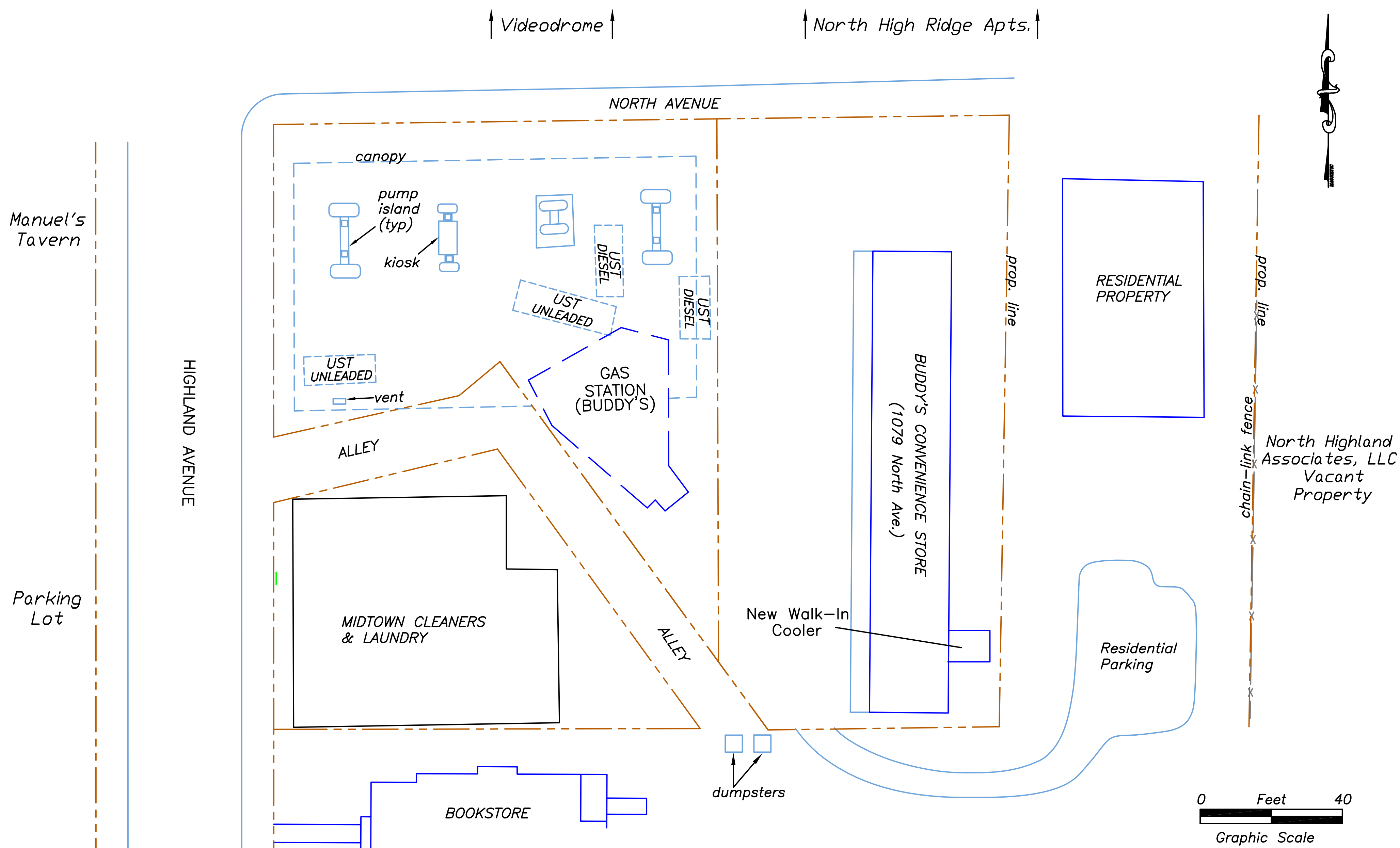
Source: Google Earth

EPS

N

Midtown Cleaners
599 N. Highland Ave
Atlanta GA

FIGURE 1
SITE LOCATION MAP



EPS

Environmental Planning Specialists, Inc.
900 Ashwood Parkway, Suite 350
Atlanta, GA 30338
Phone: (404) 315-9113
Fax: (404) 315-8509

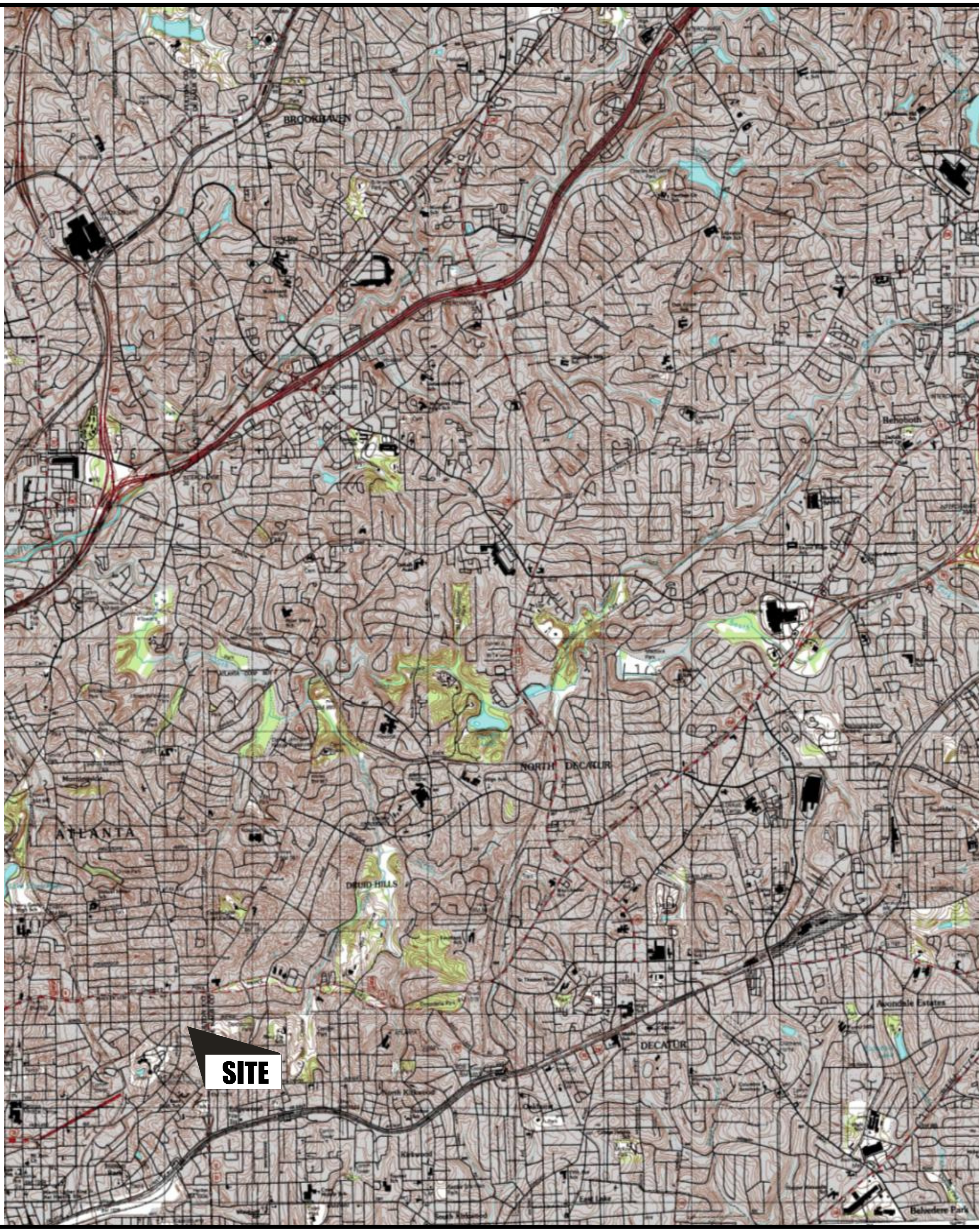
DES	JDD	
DRN	JDD	
CHK		
REV		
APP		
PRJ MGR		
OPER		

DATE: Feb. 2011

Midtown Cleaners
599 N. Highland Ave.
Atlanta, Georgia

Site Plan

FIGURE 3



Source: USGS Quadrangle Map for Northeast Atlanta (1997)

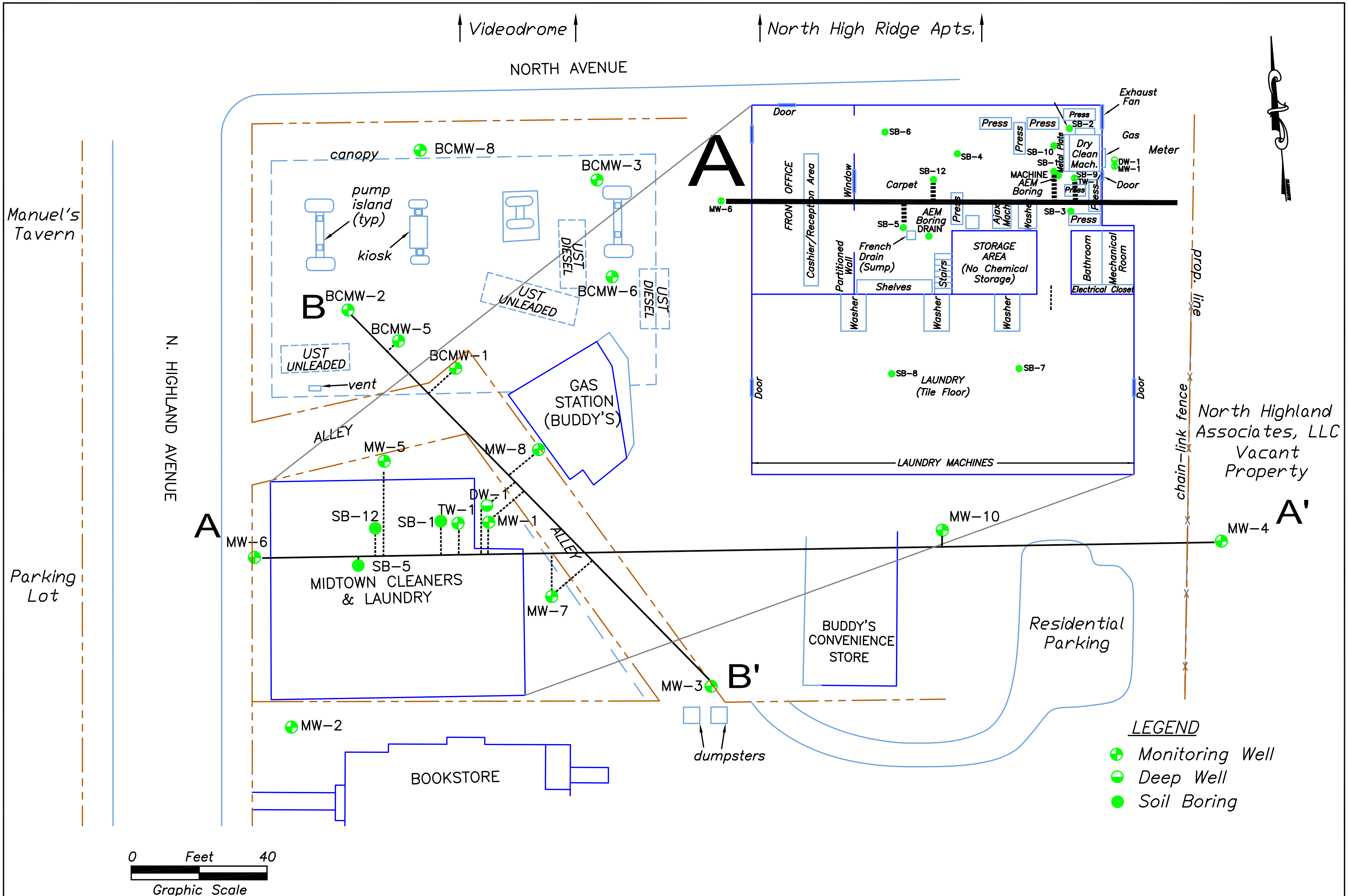
Scale: 1:24,000

EPS

N

Midtown Cleaners
599 N. Highland Ave
Atlanta GA

FIGURE 2
TOPOGRAPHIC MAP



EPS

Environmental Planning Specialists, Inc.
900 Ashwood Parkway, Suite 350
Atlanta, GA 30338

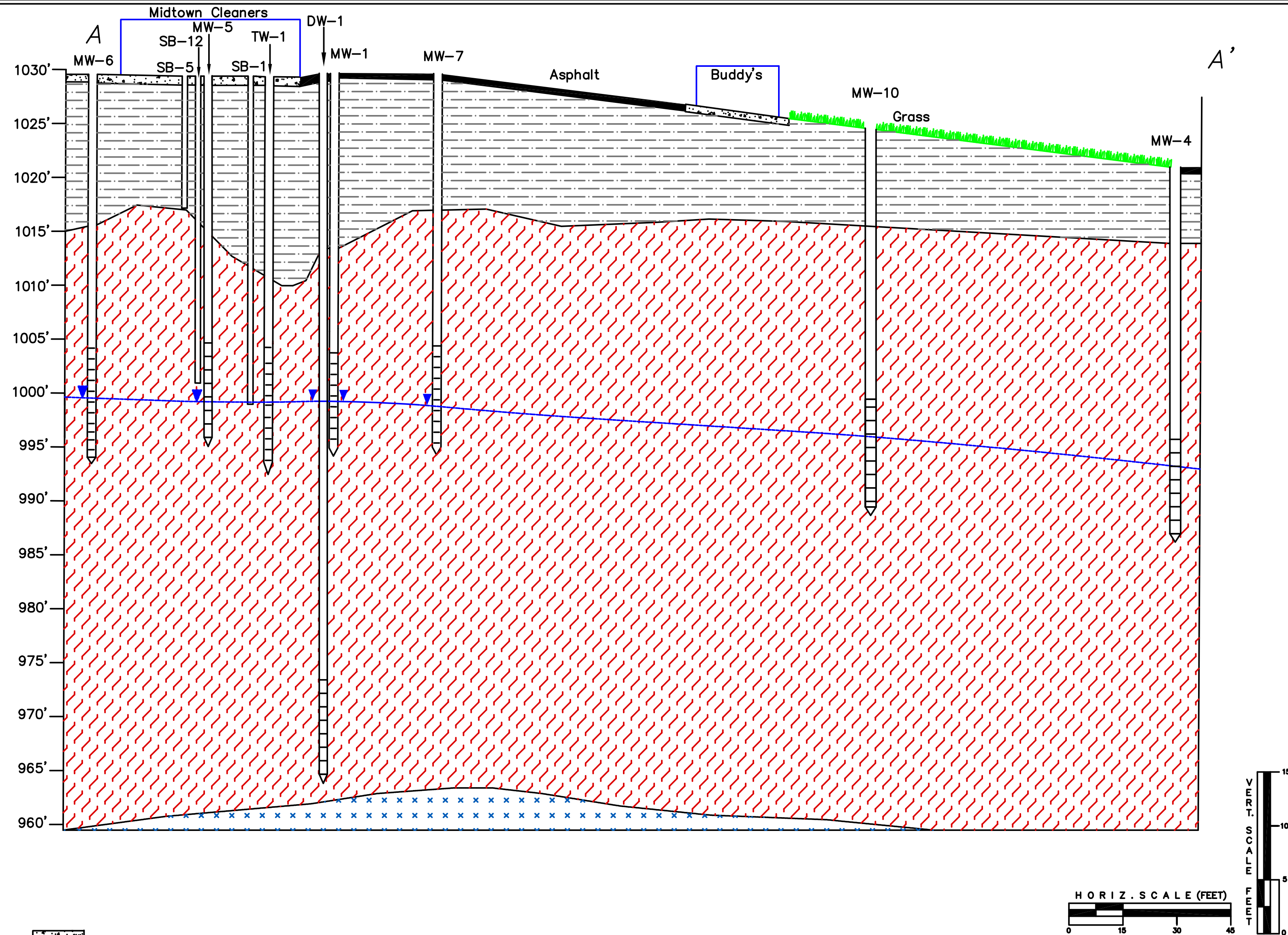
Phone: (404) 315-9113
Fax: (404) 315-8509

DES	JDD	DATE: Feb. 2011
DRN	JDD	
CHK		
REV		
APP		
PRJ MGR		
OPER		

Midtown Cleaners
599 N. Highland Ave.
Atlanta, GA

Cross-Section Plan View

FIGURE 4



LEGEND

- WATER TABLE ELEVATION (OCT. 2010)
- SCREENED INTERVAL
- FINE TO MEDIUM SAND AND SILT, SOFT & MICACEOUS, TRACE CLAY
- FOLIATED SAPROLITE W/FINE TO MEDIUM SAND AND SILT
- COMPETENT GRANITE (BEDROCK) GNEISS
- CONCRETE
- ASPHALT
- GRASS

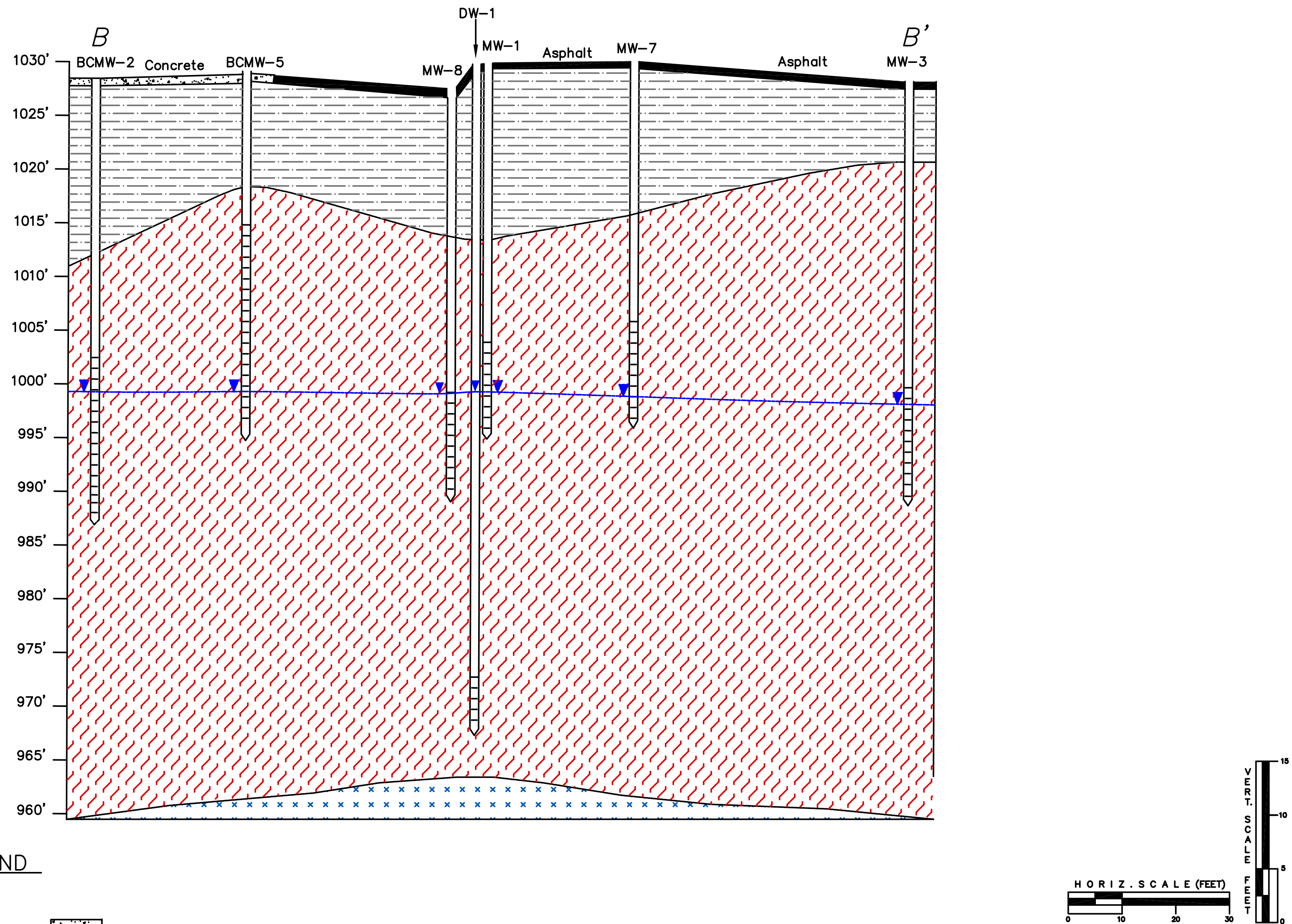
EPS
Environmental Planning Specialists, Inc.
900 Ashwood Parkway, Suite 350
Atlanta, GA 30338

Phone: (404) 315-9113
Fax: (404) 315-8509

DES	JDD		DATE: Feb. 2011
DRN	JDD		Midtown Cleaners 599 N. Highland Ave. Atlanta, GA
CHK			
REV			
APP			
PRJ MGR			
OPER			

Cross-Section
A – A'

FIGURE
5



LEGEND

- WATER TABLE ELEVATION (Oct. 2010)
- SCREENED INTERVAL
- FINE TO MEDIUM SAND AND SILT, SOFT & MICACEOUS, TRACE CLAY
- FOLIATED SAPROLITE W/FINE TO MEDIUM SAND AND SILT
- CONCRETE
- ASPHALT
- COMPETENT GRANITE (BEDROCK) GNEISS

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DES	JDD	
DRN	JDD	
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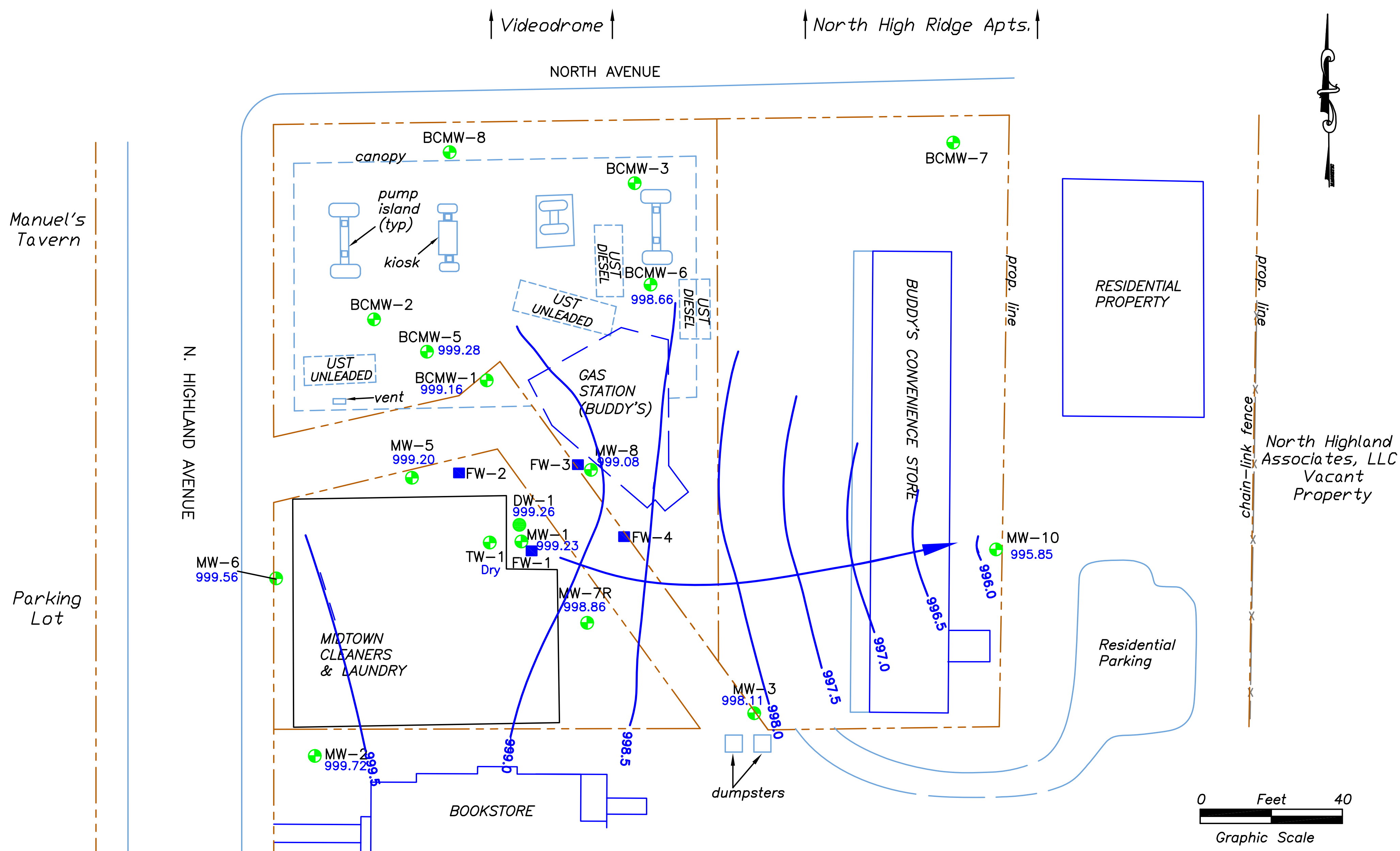
REV		
APP		
PRJ MGR		
OPER		

DATE: Feb. 2011

Midtown Cleaners
599 N. Highland Ave.
Atlanta, GA

Cross-Section
B – B'

FIGURE
6



LEGEND

Monitoring Well

Deep Well

Hydraulic Fracture Well

996.5 Groundwater Elevation Contour (Ft. Above NGVD)

995.85 Groundwater Elevation at Well (Ft. Above NGVD)

Groundwater Flow Direction

Dry Well was dry

EPS

Environmental Planning Specialists, Inc.
900 Ashwood Parkway, Suite 350
Atlanta, GA 30338
Phone: (404) 315-9113
Fax: (404) 315-8509

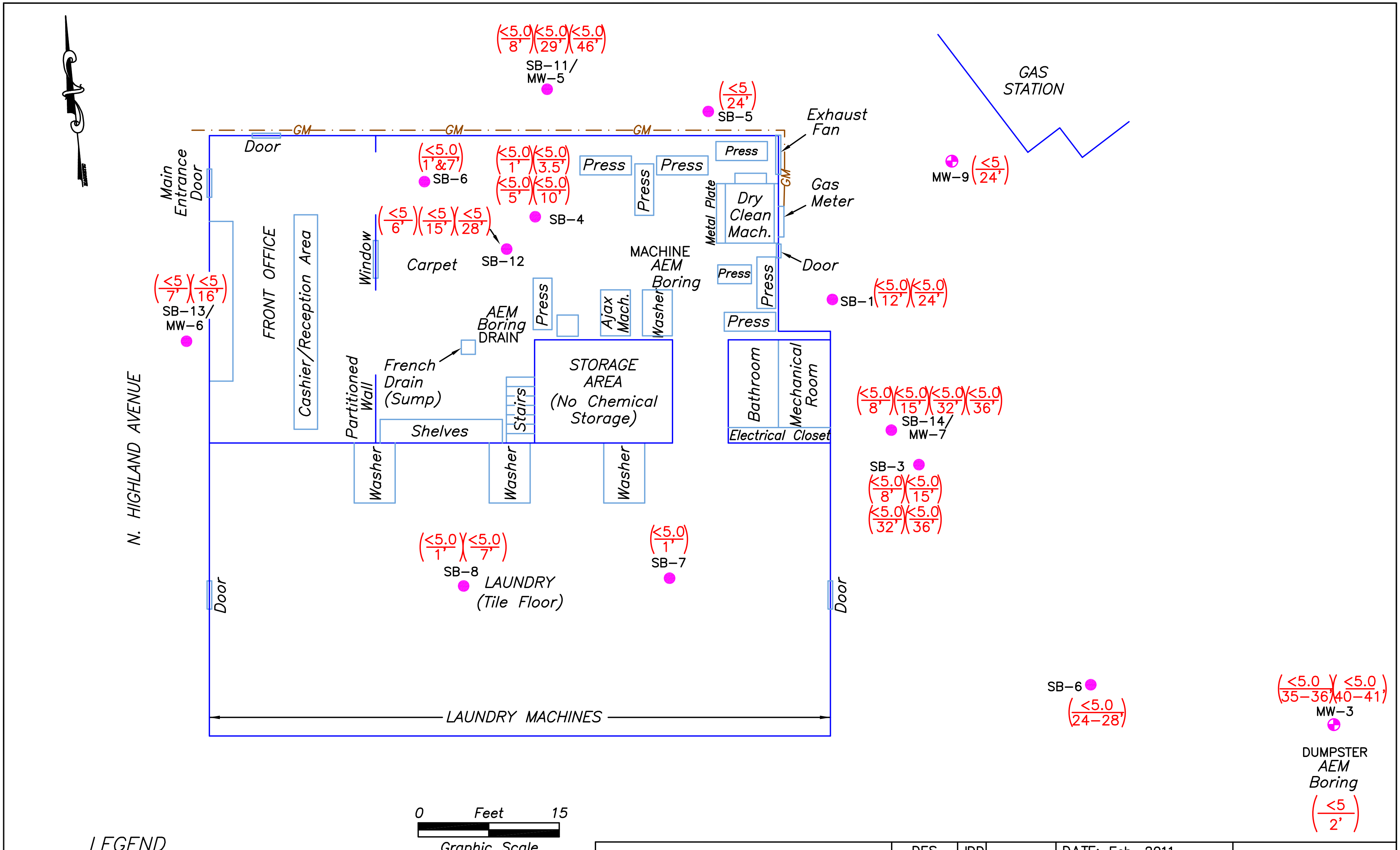
DES	JDD
DRN	JDD
CHK	
REV	
APP	
PRJ MGR	
OPER	

DATE: Fen. 2011

Midtown Cleaners
599 N. Highland Ave.
Atlanta, Georgia

Potentiometric Surface Map
(October 2010)

FIGURE 7



LEGEND

- Existing Soil Boring Location
- Monitoring Well
- (<5.0) Below Quantitative Reporting Levels
- (<5 / 28') PCE Concentration (μg/kg) / Depth in Feet

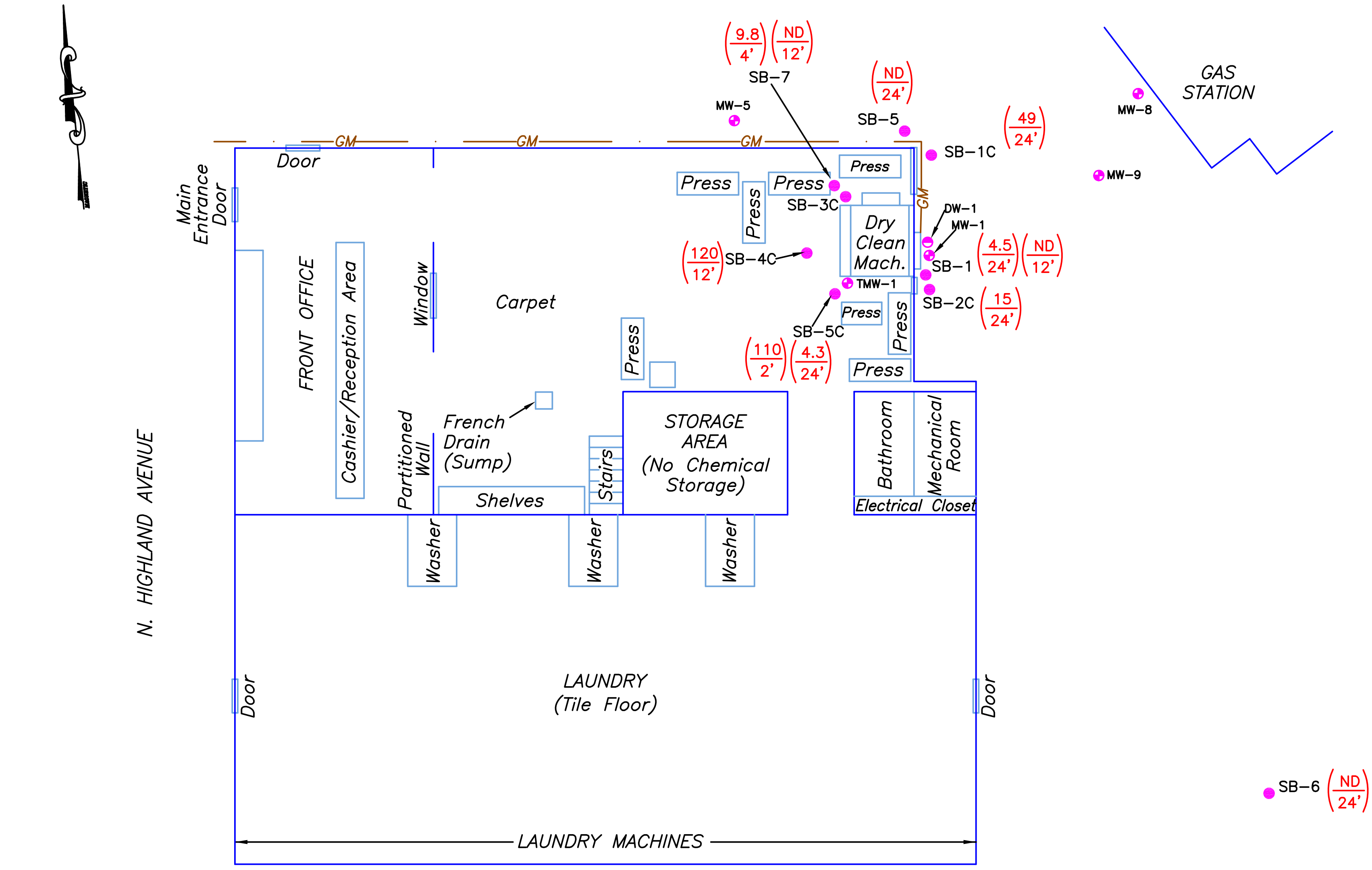
EPS

Environmental Planning Specialists, Inc.
900 Ashwood Parkway, Suite 350
Atlanta, GA 30338
Phone: (404) 315-9113
Fax: (404) 315-8509

DES	JDD		DATE: Feb. 2011
DRN	JDD		Midtown Cleaners 599 N. Highland Ave. Atlanta, Georgia
CHK			
REV			
APP			
PRJ MGR			
OPER			

Extent of PCE In Soil to Non-Detect (Taken from 2006 CSR)

FIGURE 8



LEGEND

- Existing Soil Boring Location
- Deep Well
- Monitoring Well
- GM Gas Main

0 Feet 15

Graphic Scale

EPS

Environmental Planning Specialists, Inc.
900 Ashwood Parkway, Suite 350
Atlanta, GA 30338
Phone: (404) 315-9113
Fax: (404) 315-8509

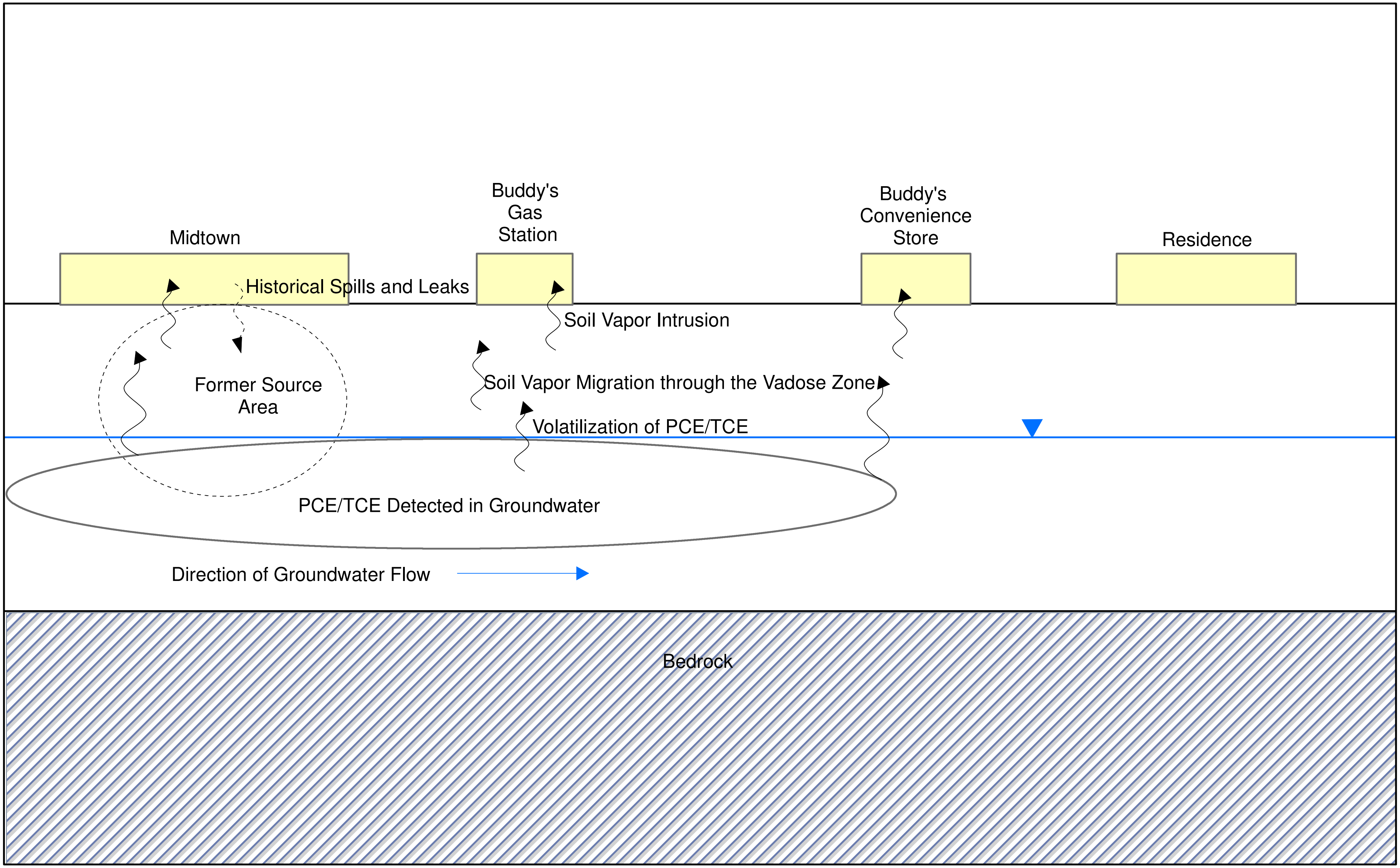
DES	JDD	
DRN	JDD	
CHK		
REV		
APP		
PRJ MGR		
OPER		

DATE: Feb. 2011

Midtown Cleaners
599 N. Highland Ave.
Atlanta, Georgia

Extent of PCE In Soil
Post Injection (2005–2006)

FIGURE
9



Not to scale

Simplified Conceptual Site Model

Environmental Planning Specialists, Inc.

G:\midtown Cleaners\VRP\Figures\CSM.mxd

Figure No.10

APPENDIX D

EPD AGREEMENT OF COMPLIANCE TO RRS

Georgia Department of Natural Resources
2 Martin Luther King, Jr. Drive. S.E., Suite 1462 East, Atlanta, Georgia 30334
Noel Holcomb, Commissioner
Environmental Protection Division
Carol A. Couch, Ph.D., Director
Hazardous Waste Management Branch
404-657-8600

September 26, 2006

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

North Highland Associates, LLC
c/o Mr. Jeff Vantosh
Vantosh Co., Inc.
1477 Spring Street
Atlanta, Georgia 30309

Re: Notice of Deficiency
Compliance Status Report
Midtown Cleaners and Laundry
Atlanta, Fulton County, Georgia
HSI Site No. 10584

Dear Mr. Vantosh:

The Environmental Protection Division (EPD) has completed its review of the May 15, 2006 letter and Compliance Status Report (CSR) submitted in response to EPD's August 11, 2005 CSR/CAP NOD letter for the Midtown Cleaners and Laundry Site. This letter is to inform you that we agree that the soil at the site (Tax Parcel 14-0015-0003-0274) does not exceed Type 3 risk reduction standards (RRS) for PCE. The following comments discuss certain aspects that require further work and/or correction before this report can be considered complete with respect to Georgia's Rules for Hazardous Site Response Chapter 391-3-19 (Rules).

CSR Deficiencies:

1. The conversion of hydraulic conductivity values from cm/s to ft/day was corrected in the May 11, 2006 letter; however, these values were not updated in the text of the CSR. The correct values listed in the May 11, 2006 letter should be used in future calculations.
2. Section 7 and 10 of the CSR appears to be incorrect, and therefore EPD is reconsidering Comment 13C of our August 11, 2005 letter. Based on information on the Fulton County Tax Assessor website (www. fultonassessor.org), properties located downgradient (east) of the Midtown Cleaners site include Tax Parcels 14001500030803 (William Corey/UST tank owner), 1400150003114 (U.S. Enterprises/Buddy's Convenience Store), 1400150003005 (Ryan Florence) and 14001500030068 (Victoria Alembik). It is very important to identify which neighboring parcels are part of the site for certifying compliance, delineation, and corrective action for groundwater at the site. The following comments should be addressed in an addendum to the CSR, or the groundwater CAP.
    a. By overlaying a site figure and a tax assessor map, it appears MW-4 is located on Victoria Alembik's property, rather than a vacant property owned by Jeff Vantosh. Please review the location of MW-4 with the Fulton County tax parcel maps and clarify which parcels are part of the Site. If property transactions have taken place, or if the information provided by the tax assessor is inaccurate, please provided documentation. Attached is the tax map overlaid on top of Figure 8 for your review.

b. The Carmichael property (Tax Parcel 14001600130438) is located side-gradient (northeast) of Midtown Cleaners and has not been sampled. Therefore, certification for the Carmichael property is not appropriate.

3. Soil data collected in 2005 and 2006 presented on Table 2 are slightly different than those shown on the laboratory data sheets. Please review the values shown on this Table.
4. Table 3 is missing the groundwater samples collected at MW-1 and TW-1 on December 2, 2005. Additionally, groundwater data for SB-1C should be included on this table.
5. The data from the MACHINE sample is missing from Figure 7.
6. SB-3C is shown on Figure 7, but should be taken off this Figure, since this sample was collected in 2005. This sample should be added to Figure 10, with a note that states that SB-7 was a confirmation sample after permanganate injection.
7. Temporary well MW-9 was installed in September 2005. Please provide a description of the purpose of this temporary well. Will this temporary well be used to collect groundwater quality samples, water levels or serve as an injection point for permanganate?
8. Horizontal delineation of PCE impacted groundwater should be conducted between MW-8 and MW-4, to determine where corrective action needs to be performed between these locations, and to allow you to certify compliance on these properties.
9. Active remediation is recommended at MW-8 and TW-1, since source/DNAPL concentrations are present at these locations.
10. Based on a detection of 6.4 ug/L at DW-1, vertical delineation has not been achieved. You may chose to monitor DW-1 quarterly for 1 year to evaluate if this concentration will attenuate over time, and what effects permanganate injections may have on groundwater quality at the site.
11. Although QA/QC samples are being collected during groundwater and soil sampling, they are not discussed in the text, nor are duplicated samples identified in Tables 2 and 3. Please add the data for duplicate samples onto the appropriate tables and include a discussion of them in the text.

EPD requests the submittal of a CAP for groundwater stating how you plan to come into compliance with RRS for groundwater. Please include a plan to collect water levels, and a full round of groundwater samples from each well on the site (BCMW-1, BCMW-2, BCMW-3, BCMW-4, BCMW-5, BCMW-6, TW-1, MW-1, DW-1, MW-2, MW-3, MW-4, MW-5, MW-6 and MW-9). Remaining deficiencies for the CSR may be addressed in a groundwater corrective action plan. Please submit a CAP by December 22, 2006. If you have any questions, please contact Katie Ross at (404) 657-8600.

Sincerely,

David Reuland
Unit Coordinator
Superfund Management Unit

cc: Ted Peyser, Environmental Planning Specialists, Inc.
Ranchhod Desai and Dennis Desai, Midtown Cleaners & Laundry, Inc.

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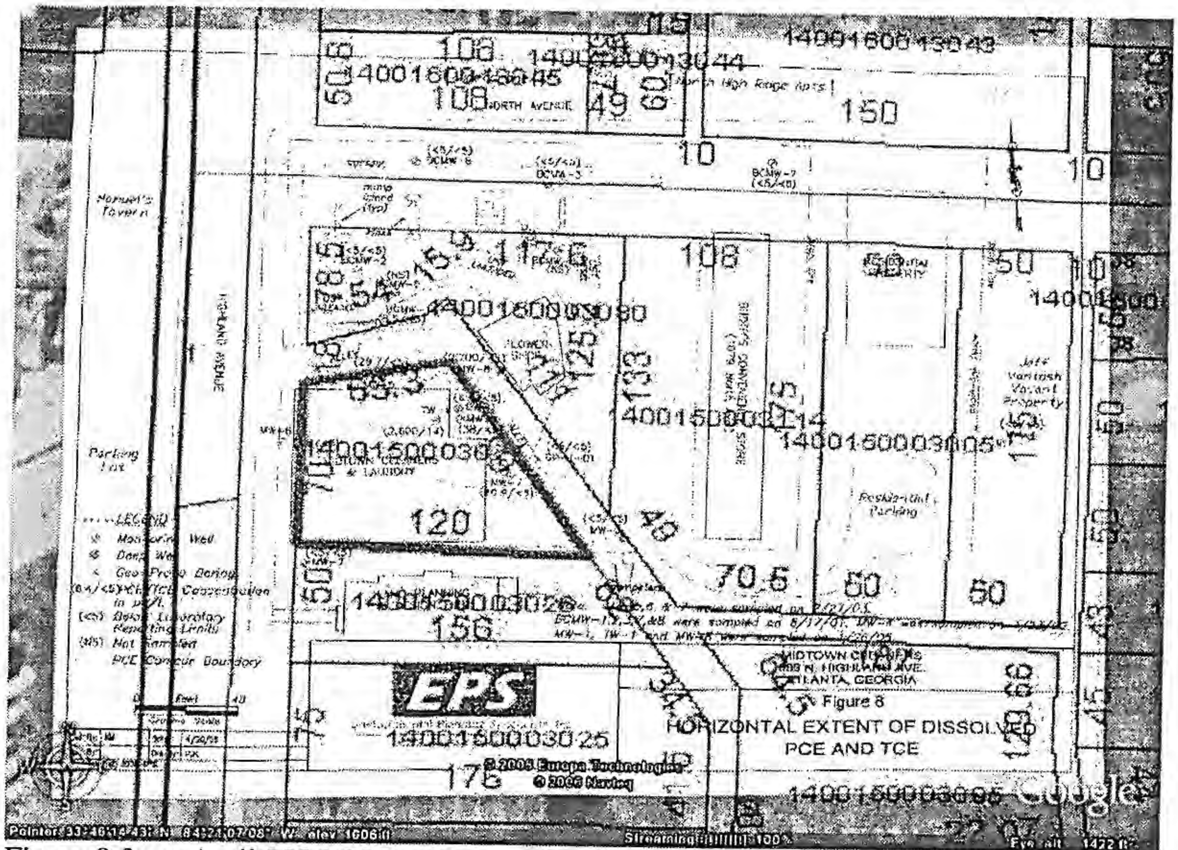


Figure 8 from April 2006 CSR with Tax Parcel map of area overlaid.

APPENDIX E

PREVIOUS SITE INVESTIGATIONS AND CORRECTIVE ACTIONS

APPENDIX E

PREVIOUS SITE INVESTIGATIONS AND CORRECTIVE ACTION

This Appendix gives a summary of investigations and corrective action activities that have occurred at the Site. The first section describes the investigations conducted prior to corrective action. The second section describes the corrective action activities and the last section summarizes the groundwater monitoring events that have taken place since corrective action was initiated.

E.1 PRE-CORRECTIVE ACTION INVESTIGATIONS

This section provides a summary of soil and groundwater investigations that have been conducted at the Site. AEM and EPS conducted investigations at the Site since 1999. Details of the sampling procedures and well installation methods used by EPS are presented in the CSR (EPS, 2006a). Figure E-1 shows the locations of where soil samples were collected and Figure E-2 shows the locations of groundwater samples. The analytical results for constituents detected in soil are shown in Table E-1. The analytical results for constituents analyzed in groundwater are shown in Tables E-2 through E-4 for chlorinated organics, non-chlorinated organics and inorganics, respectively.

AEM Investigations

AEM April 1999 Subsurface Investigation

In April 1999, AEM conducted a subsurface investigation on the Site. The investigation entailed the advancement of three soil borings. Boring locations included one adjacent to the dry cleaning machine, one adjacent to a floor drain, and one outside near the dumpsters.

The soil borings were advanced at the Site using a hand auger. Two soil borings completed inside the dry cleaners were designated DRAIN and MACHINE. One soil boring outside the dry cleaners near the dumpsters was designated DUMPSTER. The locations of the borings are shown on Figure E-1. The three borings were advanced to a depth of 2 feet below ground surface (ft-bls) at the MACHINE and DUMPSTER location, and 6.25 ft-bls at the DRAIN.

One soil sample from each hand auger location was selected for laboratory analysis. The selected samples were collected from the terminating depths of each boring. Soil samples were analyzed for VOCs using USEPA Method 8260B. PCE was detected in the DRAIN and

MACHINE samples at concentrations of 0.065 and 0.670 milligrams per kilogram (mg/kg) respectively. No other VOCs were detected in these samples.

Halogenated VOCs were not detected in the soil sample collected from the sample designated as DUMPSTER. Other VOCs detected included benzene (0.35 mg/kg), ethylbenzene (0.03 mg/kg), toluene (0.44 mg/kg), and total xylenes (0.13 mg/kg).

AEM May 1999 Subsurface Investigation

In May 1999, AEM installed and sampled one groundwater monitoring well, conducted a well survey, and submitted Reportable Quantities Screening Method and Release Notification Screening Forms to EPD.

Groundwater monitoring well (MW-1) was located at the exterior of the northeastern corner of the building (adjacent to the dry cleaning machine). The well boring was advanced to a depth of 35 ft-bls. The monitoring well was constructed with the screen interval at 24.5 - 34.5 ft-bls. Soils encountered during drilling included silt and sandy clays associated with the in situ weathering of the parent bedrock. One groundwater sample was collected from MW-1 and analyzed for VOCs using USEPA Method 8260B. The following VOCs were detected: PCE, 1,1,1-trichloroethane, 1,1-dichloroethene, chloroform, methylene chloride, benzene, ethylbenzene, toluene and total xylenes.

AEM Well Survey

In 1999, AEM completed a well survey within a 1-mile search radius of the Site. The well survey identified five private wells: two water wells were located at the Callanwolde Art Center (>4,500 feet southeast); two irrigation wells were located at the Jimmy Carter Presidential Center (>2,300 feet southwest) and an abandoned private well was located 1,400 feet east of the Site.

EPS Subsurface Investigations

EPS field investigations included a subsurface assessment inside the dry cleaners and outside the building. The assessments conducted inside the building included the advancement of borings with hand augers and direct push sampling devices. The assessments conducted outside the building involved the advancement of borings by direct push and with a hollow stem auger drill rig. Temporary and permanent monitoring wells were installed for groundwater sampling.

These investigations were performed to delineate the extent of VOC constituents in soil and groundwater and to identify pertinent geological and hydrogeological characteristics of the study area.

August 2001 Subsurface Investigation

In August, 2001, EPS sampled an existing on-Site monitoring well, MW-1, and was granted permission to access and sample five existing monitoring wells BCMW-1, BCMW-2, BCMW-3, BCMW-7, and BCMW-8, located on the adjacent Buddy's Convenience Store property. BCMW-4 could not be located to sample. BCMW-5 was excluded from sampling due to its location relative to the other monitoring wells. BCMW-6 could not be sampled due to the presence of excess LNAPL recharging into the well. These groundwater samples were collected to evaluate the horizontal extent of dissolved chlorinated VOCs north of the dry cleaning facility prior to performing any additional assessment.

PCE was detected at a concentration of 1,500 µg/l in MW-1. No degradation products of PCE were detected. PCE was detected at 8.5 µg/l in monitoring well BCMW-1. PCE and its degradation products were not detected in the other BC wells.

Elevated concentrations of petroleum hydrocarbons associated with an apparent UST release were also detected in MW-1 and the BC wells. The petroleum hydrocarbon concentrations reported for BCMW-2 and BCMW-3 are not representative due to the presence of measurable LNAPL in these two wells. The compounds detected primarily consisted of BTEX constituents, common derivatives or breakdown products, and gasoline additives. The gasoline additives include lead scavangers (1,2-dichloroethane and 1,2-dichloromethane) and MTBE.

October 2001 Subsurface Investigation

In October, 2001, EPS advanced three monitoring wells (DW-1, MW-2, and MW-3) to evaluate the horizontal and vertical extent of VOCs on the Midtown property. EPS installed MW-2 at the southwest corner of the building, MW-3 near the southeastern property boundary, and DW-1 adjacent to MW-1 as shown on Figure E-2. The new wells were sampled in November 2001 along with monitoring well MW-1 to determine the extent of dissolved chlorinated hydrocarbon VOCs. PCE was detected at 1,660 µg/l in MW-1 and 14.2 µg/l in DW-1. No other chlorinated VOCs were detected in the samples collected from these wells.

Eight soil borings were advanced by EPS in November 2001 inside the dry cleaners. One of the borings (SB-1) was advanced in close proximity to the prior AEM boring (Machine). Soil samples were collected at varying depths intervals ranging from 0.5-1, 3-3.5, or 6-7 ft bls and field screened with a Photo-Ionization Detector (PID). None of the PID readings were above background levels; therefore, shallow and deep samples were submitted from each boring for laboratory analysis. The samples were analyzed for chlorinated VOCs only.

The shallow samples were submitted to the laboratory for VOC analysis on the assumption that these samples would have the highest concentration of VOCs if permeation occurred through the concrete slab. Deeper samples were submitted for laboratory analysis in an attempt to vertically delineate potentially impacted soils.

A review of the laboratory results in Table E-1 indicates that PCE was the only VOC detected. PCE was detected in only two shallow samples: SB-3-1 (0.031 mg/kg) and SB-4-1 (0.005 mg/kg).

Five split spoon soil samples were collected during the drilling of MW-3 and DW-1. Each of the samples were analyzed for chlorinated VOC. PCE was detected in DW-1 samples at 0.012 mg/kg at 36 ft-bls, 0.01 mg/kg at 46 ft bls, and 0.018 mg/kg at 65 ft bls. No other chlorinated VOCs were detected in DW-1. No chlorinated VOCs were detected at 36 ft bls and 41 ft bls in MW-3.

January 2002 Subsurface Investigation

In January 2002, a direct push boring (GP-1) was advanced downgradient of MW-1 to delineate the horizontal extent of chlorinated VOCs. A downgradient well, MW-4, was installed on an off-Site property to delineate the extent of VOCs to background levels.

GP1-01 was advanced to a depth of 36 ft-bls, approximately 40 feet southeast and down gradient of MW-1 in an alley separating the Midtown Cleaners and Buddy's Convenience Store. PCE was not detected in this groundwater sample. Petroleum hydrocarbons similar to the compounds detected in the BC wells were detected in the sample.

MW-4 was installed on a vacant lot owned by Jeff Vantosh. The well was installed in this location after failing to obtain drilling access from Buddy's Convenience Store. No VOCs were detected in the sample collected from the well.

December 2002 and February 2003 Subsurface Investigations

In response to EPD comments, in December 2002 and February 2003, three interior soil borings (SB-1, SB-2, and SB-5) were deepened and six additional soil borings, SB-9 through SB-14 were advanced. A total of six additional samples were collected from the deepened borings. Twelve samples were collected from the new borings. All of the samples were analyzed for VOCs.

Petroleum VOCs were detected in samples collected from SB-11 and SB-14. No VOCs were detected in SB-13 located in the sidewalk adjacent to Highland Avenue. The petroleum VOCs detected included BTEX constituents, trimethylbenzenes, naphthalene, methyl-tertiary-butyl-ether (MTBE), and related BTEX derivatives. The presence of MTBE in SB-11 suggests an unleaded gasoline source. An unleaded gasoline UST is located approximately 20 feet northwest and hydraulically upgradient of SB-11. The detection of petroleum hydrocarbons in SB-14 may be attributed to the stockpiling of petroleum contaminated soils near the dumpsters and migration through the groundwater from Buddy's Convenience Store.

PCE was detected in several of the samples in concentrations ranging from 0.0053 mg/kg (SB-1-29-30) to 0.140 mg/kg (SB-9-28).

The vertical extent of PCE near the dry cleaning machine was defined to a depth of 44 ft-bls as indicated by a concentration below laboratory reporting levels in SB-9-44. VOCs other than PCE were not detected in any of the borings except SB-12. Trace levels of petroleum hydrocarbon VOCs were detected in SB-12 at depths of 6, 15, and 28 ft-bls. The compounds detected included toluene, ethylbenzene, xylenes, and trimethylbenzenes. These compounds are attributed to petroleum releases from the UST system located at the Buddy's Convenience Store. The nearest UST is located approximately 30 feet north of the building.

In December 2002, a one-inch temporary well (TW-1) was installed after advancing direct push boring SB-9 below the water table. A groundwater sample was collected from this well for VOC analysis. The results indicated the presence of 160 µg/l PCE. Low levels of VOCs attributed to the adjacent petroleum release were also detected. These compounds included benzene (5 µg/l), xylenes (5.9 µg/l), MTBE (6.6 µg/l), and 1,2-dichloroethane.

In order to complete the groundwater delineation, four additional monitoring wells were installed. Three of the wells (MW-5, MW-6, and MW-7) were constructed immediately adjacent to the building as one-inch temporary wells (Figure E-2). MW-5 was constructed in boring SB-11 located on the north side of the building. MW-6 was installed in SB-13 located on the west side of the building in the sidewalk adjacent to Highland Avenue. MW-7 was installed in SB-14 on the east side of the building. An additional permanent 2-inch monitoring well, MW-8, was installed northeast of the building in the alley.

PCE was detected in MW-5 (29.7 µg/l), MW-7 (10.9 µg/l), and MW-8 (498 µg/l). PCE was not detected in MW-6. Petroleum hydrocarbons were detected in all of the wells except MW-6. Low levels of 1,2-dichloroethane (12.5 µg/l) and chloroform (12.9 µg/l) were also detected in MW-8.

A sample was also collected from DW-1 to verify the previous PCE detection. VOCs were not detected in the sample collected.

November 2004 through July 2005 Sampling Events

Eight groundwater sampling events occurred between November 2004 and July 2005. The purpose of the events was to access the effectiveness of the remediation. The results are shown in Tables E-2 through E-4. As shown in the Table E-2, TCE was detected in the January 2005 sampling event in MW-1 and TW-1 at 6.3 µg/l and 14 µg/l, respectively. This is the first time that TCE was detected on-Site.

September 2005 Subsurface Investigation

At the request of EPD, in September 2005, soil boring SB-1 (2005) was installed adjacent to MW-1 since a soil sample was not collected from MW-1 when the well was installed by AEM in 1999. Samples were collected at 8-12 ft-bls and 24-28 ft-bls. No VOCs were detected in the soil samples.

E.2 Corrective Action

This section summarizes the corrective action that has been conducted to date at the Site.

2005 In-situ Chemical Oxidation

General Scope of Corrective Action

Corrective action began in November 2004. The soils were considered to be remediated to below Type 1/3 RRS in January 2006. The corrective action program basically consisted of monitoring/injection well installation, oxidant injection/gravity drip, and soil and groundwater sampling as described below. Corrective action at this Site was limited to PCE present in the groundwater and soil, attributable to releases from Midtown's operations, and that was present above Type 1/3 RRS.

In Situ Chemical Oxidation

Based on the review of the available technologies, *in situ* chemical oxidation (ISCO) was selected as the chosen technology for corrective action at this Site. Initially, the use of hydrogen peroxide (H_2O_2) was pilot tested at the Site. Based on the pilot test results, and the bench scale test, sodium and potassium permanganate (herein referred to as permanganate) were chosen as the oxidizing agents. The application of this methodology for this Site involved the injection of a concentrated oxidizer into the plume through PVC injection wells.

Technology Overview

Remediation of soil and groundwater contamination using ISCO involves injecting and gravity dripping oxidants directly into the source zone and downgradient plume. The oxidant chemicals react with the contaminant, producing innocuous substances such as carbon dioxide, water, and inorganic chloride. ISCO has several advantages over conventional treatment technologies such as it does not generate waste materials and is implemented over a relatively short time frame.

Permanganate is an oxidizing agent with an affinity for oxidizing organic compounds containing carbon-carbon double bonds, aldehyde groups or hydroxyl groups. As an electrophile, the permanganate ion is strongly attracted to the electrons in carbon-carbon double bonds found in chlorinated alkenes, borrowing electron density from these bonds to form a bridged, unstable oxygen compound known as a hypomanganate diester. This intermediate product further reacts by a number of mechanisms including hydroxylation, hydrolysis or cleavage. The carbon-carbon double bond of alkenes is broken spontaneously and the unstable intermediates are converted to carbon dioxide through either hydrolysis or further oxidation by the permanganate ion. There are two forms of permanganate, $KMnO_4$ and $NaMnO_4$. The balanced oxidation-reduction reactions of $NaMnO_4$ with the various species of chlorinated ethenes can be written as follows:

Perchloroethene (PCE)

$4NaMnO + 3C_2Cl_4 + 4H_2O \rightarrow 6CO_2 + 4MnO_2 + 4Na^+ + 12Cl^- + 8H^+$

Trichloroethene (TCE)

$2NaMnO + C_2HCl_3 \rightarrow 2CO_2 + 2MnO_2 + 3Cl^- + H^+ + 2Na^+$

Dichloroethene (DCE)

$8NaMnO_4 + 3C_2H_2Cl_2 + 2H^+ \rightarrow 6CO_2 + 8MnO_2 + 8K^+ + 6Cl^- + 2H_2O$

Vinyl Chloride (VC)

$10KMnO_4 + 3C_2H_3Cl \rightarrow 6CO_2 + 10MnO_2 + 10K^+ + 3Cl^- + 7OH^- + H_2O$

The byproducts of the reactions shown above are reaction end-points. Intermediate reaction products of TCE oxidation using permanganate ion consists mainly of esters and short-chain acids. Carbon dioxide exists naturally in the subsurface from biological processes and bicarbonate partitioning in the groundwater. Manganese dioxide (MnO_2) is a natural mineral found in the soils.

Chlorine gas reacts immediately with groundwater and pore water to form hypochlorous acid (HOCl). This acid may react with methane to form trace concentrations of chloromethanes in the groundwater immediately after treatment. However, this phenomenon is typically short-lived as the subsurface conditions are converted from an anoxic state to an oxidized state.

Bench-Scale Test

In August and September 2002, Carus Chemical Company (CCC), LaSalle, Illinois, performed a treatability study using potassium permanganate ($KMnO_4$) to determine the groundwater oxidant demand required to reduce the chlorinated hydrocarbons detected in Midtown soils. The soil natural oxidant demand (NOD) for the low $KMnO_4$ dose ranged from an average of 3 mg/kg at 3 hours to 47 mg/kg at 48 hours. The NOD for the medium $KMnO_4$ dose ranged from an average of 38 mg/kg at 3 hours to 164 mg/kg at 48 hours. The NOD for the high $KMnO_4$ dose ranged from an average of 250 mg/kg at 3 hours to 399 mg/kg at 48 hours. Based on these values, permanganate was considered a viable option for remediation of this Site.

Corrective Action Approach

Sodium permanganate was initially injected on Site. After the evaluation of the effectiveness of the sodium permanganate, potassium permanganate was used by gravity drip for the deliver method. This decision to use potassium permanganate was based on the on cost effectiveness in comparison to sodium permanganate. The choice to change delivery methods from injection to gravity drip was based on literature review and soil lithology.

Subsurface Injection Method

Injection of liquid permanganate into the treatment zone was performed utilizing PVC injection wells installed using direct push technology. The injection wells were constructed of 1-inch, machine slotted, 0.020-inch screen in 5 to 10-foot sections, flush threaded to Schedule 40 solid riser pipe and completed flush with surface grade. A total of 17 injection wells were installed; 7 for the remediation of soil, and 10 for the remediation of groundwater. Four injection wells were installed inside the building.

Injection was performed using an injection skid consisting of totes, 1-inch braided poly tubing, injection manifold, and a compressor (when drip was not used). Fresh water was mixed with the permanganate in the totes as required for adjusting the concentration of the permanganate prior to the injection. The specific concentration of permanganate, injection quantity, and injection rate varied based upon injection well. The typical permanganate injection concentration was 5-6%.

The remediation process was monitored as a quality control measure. Process monitoring consisted primarily of the following:

Confirmation of oxidant injection concentrations, volumes, and flow rates;
Measurement of oxidant;
Measurement of oxidant persistence;
Analysis for PCE.

Prior to determining the final level of treatment obtained, monitoring for presence of residual oxidant level will help determine if chemical reactions are completed. Due to adsorption and desorption equilibrium, contaminant concentrations may rebound.

Accordingly, after initial injections, sampling events of select groundwater monitoring wells were collected to assess the initial effectiveness of the corrective action. All wells were purged a minimum of three volumes using a dedicated bailer or submersible pump and baseline samples were obtained. Soil and groundwater samples were analyzed for VOCs by USEPA Method 8260b. General water quality parameters such as temperature, oxidation-reduction potential, pH and conductivity were measured in select wells. Note, the groundwater samples were collected only for the purpose of evaluating the effectiveness of the remediation, therefore, only the minimal required operating procedures were performed in order obtain the relative effectiveness and remain cost effective.

Summary of Injection Events

The injection events are summarized below.

Date	**Activity**
11/18/04	Collect groundwater samples from MW-1, MW-8, and TW-1. PCE concentrations were detected in MW-1 at 3,200 µg/L, MW-8 at 2,700 µg/L, and TW-1 at 2,200 µg/L. Install temporary borings adjacent to MW-1 and inject 165 gallons 15% H_2O_2 at 20 pounds per square inch (PSI).
12/17/04	Collect groundwater samples from MW-1, MW-8, and TW-1. PCE concentrations detected in MW-1 at 3,100 µg/L, MW-8 at 2,400 µg/L, and TW-1 at 2,400 µg/L.
1/26/05	Collect groundwater samples from MW-1, MW-8, and TW-1 to assess the effectiveness of the H_2O_2 injection. PCE concentrations were detected in MW-1 at 3,700 µg/L, MW-8 at 3,100 µg/L, and TW-1 at 2,600 µg/L.
6/15-17/05	Install injection wells IW-1 through IW-12 to treat soil and groundwater.
6/19/05	Inject 110 gallons 10% KMO_2 at 40 PSI into injection wells IW-2-6,
6/22/05	Collect groundwater samples from MW-1, DW-1, and MW-8. PCE concentrations were detected in MW-1, DW-1, and MW-8. Deliver 330 gallons 10% NaMNO4 by gravity feed into injection wells IW 1-6.
7/6/05	Sample MW-1 before delivery of $KMNO_4$. PCE concentrations detected at 2,400 µg/L. Deliver 300 gallons 5% KMO_4 into injection wells IW-5, IW-6, IW-11, and IW-12.
7/8/05	Collect a groundwater sample from MW-1 prior to KMO_4 delivery. MW-1 PCE concentration detected at 1,400 µg/L. Install boring IW-17 and deliver 75 gallons 5% KMO_4. Collect a groundwater sample from MW-1 after delivery. MW-1 PCE concentration below laboratory detection limits.
7/11/05	Collect groundwater sample from MW-1 to assess PCE rebound. PCE concentration detected at 38 µg/L.
09/30/05	Install additional borings SB-1 and MW-9, then deliver 300 gallons 5% KMO_4 into Injection wells IW-1 through IW-8
10/03/05	Deliver 125 gallons 5% KMO_4 into injection wells IW-9 through IW-12
10/20/05	Deliver 125 gallons 5% KMO_4 into injection wells IW-9 through IW-12
10/25/05	Deliver 150 gallons 5% KMO_4 into injection wells IW-1 through IW-8
10/26/05	Deliver 100 gallons 5% KMO_4 into injection wells IW-9 through IW-12
10/29/05	Deliver 200 gallons 5% KMO_4 into injection wells IW-1 through IW-8
11/13/05	Install injection wells IW-14, IW-15, IW-16. Deliver 50 gallons of 5% $KMNO_4$ into these wells.
11/22/05	Deliver 125 gallons KMO_4 into injection wells IW-14 through IW-16
11/29/05	Deliver 150 gallons KMO_4 into injection wells IW-14 through IW-16

12/02/05	Install borings SB-1C, 2C, 3C, 4C, 5C and collect soil samples for certification. Laboratory reports indicate that all PCE concentrations are below RRS with exception of SB-3C (1.4 mg/kg)
12/19/05	Deliver 200 gallons 5% KMO_4 into IW-9 – IW-12
12/20/05	Deliver 200 gallons 5% KMO_4 into IW-9 – IW-12
12/21/05	Deliver 200 gallons 5% KMO_4 into IW-9 – IW-12
01/03/06	Install borings SB-5, SB-6, and SB-7 and collect soil samples for certification. Laboratory reports indicate that all PCE concentrations are below RRS.

July 2005 Sampling {Should this before previous section???}

Pilot test injections were performed in July 2005 in one injection well located immediately adjacent to monitoring well MW-1. Tetrachloroethene (PCE) concentrations decreased from 1,400 µg/L to non-detect in MW-1. PCE concentrations rebounded to 320 µg/L in MW-1 in March 2007.

2007 – 2008 *In Situ* Chemical Oxidation

In December 2006, a Corrective Action Plan Addendum 1 (EPS, 2006) was submitted to the EPD and was modified in a letter dated May 25, 2007 (EPS, 2007). The modified CAP Addendum was approved by the EPD in a letter dated May 31, 2007. The objective of the modified CAP Addendum was to propose corrective action to bring the Site's groundwater into compliance with RRS using ISCO and monitored natural attenuation (MNA).

The following activities have taken place since the CAP Amendment:

1. Baseline Groundwater Monitoring Event – May 2007
2. Injection Well Installation – June 2007
3. Soil Oxygen Demand Sampling – June 2007
4. Well Abandonment – June 2007
5. Monitoring Well Installation – August 2007
6. Phase I Injections – August 2007
7. Interim Sampling Event 1 – November 2007
8. Phase II Injections – January 2008
9. Interim Sampling Event 2 – March 2008
10. Interim Sampling Event 3 – September 2008
11. Interim Sampling Event 4 – April 2009
12. Interim Sampling Event 5 – October 2010

This section discusses each of the items listed above in addition to results of previously performed pilot testing.

May 2007 Baseline Groundwater Monitoring Event

EPS performed the Baseline Groundwater Monitoring Event on May 22 - 24, 2007 prior to beginning Phase I of the remediation project (i.e., permanganate injections). During the event, an obstruction was encountered in MW-7 and the well could not be sampled. In addition, the EPD requested that a monitoring well (MW-10) be installed to delineate the plume in the down-gradient and easterly direction.

Due to off-Site access issues, MW-10 could not be installed prior to the Baseline Sampling Event. On August 2, 2007, MW-7R and MW-10 were installed and sampled. MW-7R was installed adjacent to MW-7 as its replacement, and MW-10 was installed east of Buddy's Convenience Store. The monitoring well installation and sampling methods are discussed further in a Corrective Action Progress Report (EPS, 2008). The locations of these wells are shown on Figure E-2.

For the purpose of this report, sample results from the August 2007 sampling of MW-7R and MW-10 are included with the discussion of the Baseline Monitoring Event.

During the Baseline Monitoring Event, ten 2-inch diameter wells, MW-1, MW-2, MW-3, MW-6, MW-7R, MW-8, MW-10, DW-1, BCMW-1, and BCMW-6, and one 1-inch diameter well, MW-5, were gauged, purged, and sampled for VOC analysis. TW-1 and MW-4 could not be found, MW-9 was dry, and BCMW-5 had petroleum light non-aqueous phase liquid through the entire wetted interval. Therefore, these well were not sampled during the Baseline Event.

Injection Well Construction

The CAP Addendum No. 1, dated December 2006, proposed the installation of 13 standard injection wells in the main source area and an additional three standard injection wells near MW-2. The CAP Modification dated May 25, 2007 modified the CAP Addendum No. 1 to include the installation of 4 hydraulic fracture (frac) injection wells in place of the 13 source area standard injection wells and the removal of injections in the area of MW-2.

According to FRX, Inc., the frac well installation contractor, frac wells tend to allow injection rates between 10 and 20 times faster than standard injection wells in soils similar to those in the Atlanta area. This is mainly attributed to the large area of contact between the sand frac and the formation. In a standard one-inch diameter injection well having 10 feet of screen and installed with a direct push rig, the area of contact between the sand pack and the formation is approximately 10 square feet (ft^2). A 2-inch injection well installed with an auger may have an area of contact between the sand pack and the formation of approximately 25 ft^2. In contrast, a frac well with only one sand fracture may have an area of contact between the sand and the formation of approximately 1,400 ft^2 to 2,500 ft^2. This allows direct contact with significantly more zones of higher permeability than a standard injection well would allow. Once the injectant is spread out through the aquifer, it can diffuse into lower permeable zones.

The four frac wells were installed June 6-15, 2007, using direct push technology in conjunction with sand injection equipment. Direct push rods were pushed to the desired depth using an expendable tip in each of the injection locations. The total depths of frac wells FW-1, FW-2, FW-3, and FW-4 are 35 feet below the land surface (ft bls), 37 ft bls, 33 ft bls, and 35 ft bls, respectively. Fractures were created at the bottom of each of the wells. In addition, a second fracture was created at 35 ft bls in FW-2. More information about the construction of the frac wells can be found in the Corrective Action Progress Report (EPS, 2008).

Well Abandonment

In June 2007, while installing the frac injection wells, EPS abandoned MW-7, which had an obstruction, and MW-9, which was originally installed as a temporary well and was shallower than the water table. All of the exterior injection wells (IW-1 through IW-8 and IW-13 through IW-16) were also abandoned. The wells were abandoned by first filling each with grout to the ground surface. The grout was allowed to settle, topped off, and finished flush with the ground surface.

Permanganate Soil Oxygen Demand (PSOD) Sampling

In June 2007, during direct push probing activities associated with the installation of the frac wells, two PSOD samples were collected from just below the water table, one each from borings FW-1 and FW-4. The samples were analyzed by Carus Corporation, a manufacturer of permanganate. The PSOD results ranged from 0.3 g/kg to 7.4 g/kg with an average of 3.8 g/kg. Using site specific inputs, the Carus Corporation model predicted that 2,700 pounds of potassium permanganate would be required to treat the PCE in groundwater.

Phase I Potassium Permanganate Injections

On August 3, 7, and 8, 2007, EPS injected approximately 1,200 pounds of potassium permanganate into the frac wells. A 2% to 2.5% solution of permanganate was mixed in 275-gallon totes and pumped, using a diaphragm pump, through a manifold into each of the four injection wells. Flow rates and total flow for each well were measured with water meters located on each leg of the manifold.

Throughout the Phase I injections, each of the manifold legs were fully open to allow a maximum overall volume of injection. Injection wells FW-1 through FW-4 accepted flow rates of 1.3 gallons per minute (gpm), 2.7 gpm, 0.33 gpm, and 2.4 gpm, respectively. This amounts to 244 lbs, 494 lbs, 23 lbs, and 439 lbs of potassium permangate into each of the wells respectively.

Monitoring Well Installation

As previously discussed, on August 2, 2008, EPS installed monitoring wells MW-7R and MW-10. Well MW-7R was installed immediately adjacent to MW-7 as a replacement well for MW-7. As requested in Comment #8 in EPD's letter dated September 26, 2006, MW-10 was installed between MW-8 and MW-4. Well locations are shown on Figure E-2.

Boring MW-10 was first advanced using direct push methods and continuous soil samples were collected using a macro-core sampler. Borings MW-7R and MW-10 were then drilled using 4¼-inch outside diameter solid stem augers. Both borings were drilled to 35 ft bls

Phase II Potassium Permanganate Injections

On January 23, 24, 30, and 31, 2008, EPS injected approximately 500 pounds of potassium permanganate into the frac wells. A 2% solution of permanganate was mixed in 275-gallon totes and pumped using a diaphragm pump through a manifold into each of the four injection wells. Ambient air temperatures during these days were slightly above freezing. It is estimated that the water temperature was approximately 10° to 20°F lower than it was during the August 2007 injection event. The solubility of permanganate decreases as water temperature decreases. Therefore, during the cold weather injections in January, as opposed to the warm weather injections in August, a larger injection volume was required to inject the same mass of permanganate. Flow rates and total flow for each well was measured with water meters located on each leg of the manifold.

During the Phase II event, injections were first targeted to well FW-3, which received the least amount of permanganate during the Phase I injections in August 2007. Throughout the remainder of the Phase II injections, flow to wells FW-2, FW-3, and FW-4 was restricted to allow similar injection volumes to each of the four wells. Injection wells FW-1 through FW-4 had average flow rates of 0.55 gpm, 1.3 gpm, 1.2 gpm, and 1.3 gpm, respectively. For the entire Phase II injections, 70 lbs, 134 lbs, 141 lbs, and 155 lbs of potassium permangate were injected into FW-1 through FW-4, respectively.

During the March 2008 groundwater sampling event, unreacted potassium permanganate was observed in wells MW-5 and MW-8. Therefore, no additional injections were conducted.

E.3 INTERIM GROUNDWATER MONITORING EVENTS

November 2007 Interim Groundwater Monitoring Event

On November 28, 2007, MW-1, MW-7R, and MW-8 were sampled as part of the first Interim Groundwater Monitoring Event. Each of the wells were sampled for VOCs and inorganic compounds including arsenic, barium, cadmium, total chromium, hexavalent chromium, copper, iron, lead, selenium, and chloride. VOCs were analyzed by Method SW8260B. Inorganic compounds, not including hexavalent chromium and chloride, were analyzed by Method SW6010B. Hexavalent chromium was analyzed by Method M3500-CR D, and chloride was analyzed by Method SW9056.

March 2008 Interim Groundwater Monitoring Event

On March 24, 2007, MW-5, MW-7R, and MW-8 were sampled as part of the second Interim Groundwater Monitoring Event. Each of the wells were sampled for VOCs and inorganics, including arsenic, barium, cadmium, total chromium, hexavalent chromium, copper, iron, lead, selenium, and chloride.

September 2008 Interim Groundwater Monitoring Event

During the March 2008 sampling event, unreacted potassium permanganate was observed in wells MW-5 and MW-8. Therefore, no additional injections were conducted. EPS conducted the third post-injection sampling event on September 25 – 26, 2008. Prior to the sampling event, the GA EPD agreed that wells MW-1, MW-2, MW-3, MW-5, MW-6, MW-7R, MW-8, DW-1, and TW-1 would be sampled for volatile organic compounds and wells MW-1, MW-5, MW-7R, and MW-8 would be sampled for inorganics. During the event, MW-1, MW-7R, and TW-1 were dry and could not be sampled.

April 2009 Interim Groundwater Monitoring Event

Based on a request from the EPD in a letter dated December 23, 2008, an additional round of groundwater monitoring was conducted. On April 8, 2009, EPS attempted to collect groundwater samples from monitoring wells MW-1, MW-5, MW-7R, and MW-8. Wells MW-1 and MW-7R were dry. Next, EPS attempted to sample MW-6 and MW-2, but these were both dry as well. Finally, deep well DW-1 was sampled.

October 2010 Interim Groundwater Monitoring Event

On October 4-6, 2010, a groundwater monitoring event was conducted. Wells MW-1, MW-2, MW-3, MW-5, MW-6, MW-7R, MW-8, MW-10, DW-1, BCMW-1 and BCMW-6 were sampled and analyzed for VOCs. Samples from wells MW-1, MW-3 MW-5, MW-7R, MW-8, MW-10 and DW-1 were analyzed for inorganics.

APPENDIX E

TABLES

EPS

Table E-1. Analytical Results for Constituents Detected in Soil (mg/kg)

Sample Number	Date	Depth	Tetrachloroethene (PCE)	Benzene	Toluene	Ethyl-benzene	Xylenes	n-propyl benzene	1,2,4 & 1,3,5-Tri-methyl benzene	Naphthalene	MTBE	2-hexanone	4-iso propyl toluene	sec-butyl benzene	n-butyl benzene	Isopropyl benzene
Type 1 RRS			0.5	0.5	100	70	1000	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	22
Type 3 RRS			0.5	0.5	100	70	1000	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	22
DRAIN	3/31/1999	6.25	0.065	<0.005	<0.005	<0.005						<0.050				
MACHINE	3/31/1999	2	**0.67**	<0.005	<0.005	<0.005						<0.050				
DUMPSTER	3/31/1999	2	<0.005	0.35	0.44	0.027	0.13					<0.050				
SB-1	11/27/2001	1	<0.005													
	11/27/2001	3.5	<0.005													
	12/10/2002	29-	0.0053	<0.003	<0.003	<0.003	<0.007	<0.0038	<0.0076	<0.0038	<0.0038	<0.0077	<0.0038	<0.0038	<0.0038	<0.003
	12/10/2002	5	<.0042	<0.004	<0.004	<0.004	<0.008	<0.0042	<0.0084	<0.0042	<0.0042	<0.0085	<0.0042	<0.0042	<0.0042	<0.004
	12/10/2002	10	<.0042	<0.004	<0.004	<0.004	<0.008	<0.0042	<0.0084	<0.0042	<0.0042	<0.0083	<0.0042	<0.0042	<0.0042	<0.004
SB-2	11/27/2001	0.5	<0.005													
	11/27/2001	3	<0.005													
	12/10/2002	8	0.13	<0.003	<0.003	<0.003	<0.007	<0.0036	<0.0072	<0.0036	<0.0036	<0.0072	<0.0036	<0.0036	<0.0036	<0.003
SB-3	11/27/2001	1	0.031													
	11/27/2001	3	<0.005													
SB-4	11/27/2001	1	0.005													
	11/27/2001	3	<0.005													
SB-5	11/27/2001	1	<0.005													
	11/27/2001	6	<0.005													
	12/10/2002	7	0.0058	<0.004	<0.004	<0.004	<0.008	<0.0041	<0.0082	<0.0041	<0.0041	<0.0082	<0.0041	<0.0041	<0.0041	<0.004
	12/10/2002	12	0.0067	<0.004	<0.004	<0.004	<0.008	<0.0042	<0.0084	<0.0042	<0.0042	<0.0084	<0.0042	<0.0042	<0.0042	<0.004
SB-6	11/27/2001	1	<0.005													
	11/27/2001	7	<0.005													
SB-7	11/28/2001	1	<0.005													
SB-8	11/28/2001	1	<0.005													
	11/28/2001	7	<0.005													
SB-9	12/10/2002	1	0.029	<0.002	<0.002	<0.002	<0.008	<0.0029	<0.0080	<0.0029	<0.0029	<0.0080	<0.0029	<0.0029	<0.0029	<0.004
	12/10/2002	8	0.037	<0.003	<0.003	<0.003	<0.008	<0.0037	<0.0080	<0.0037	<0.0037	<0.0080	<0.0037	<0.0037	<0.0037	<0.004
	12/10/2002	20	0.028	<0.003	<0.003	<0.003	<0.007	<0.0038	<0.0076	<0.0038	<0.0038	<0.0076	<0.0038	<0.0038	<0.0038	<0.003
	12/10/2002	28	0.14	<0.004	<0.004	<0.004	<0.008	<0.0042	<0.0084	<0.0042	<0.0042	<0.0084	<0.0042	<0.0042	<0.0042	<0.004
	12/10/2002	44	<0.003	<0.003	<0.003	<0.003	<0.007	<0.0036	<0.0072	<0.0036	<0.0036	<0.0072	<0.0036	<0.0036	<0.0036	<0.003
SB-10	12/10/2002	28	0.03	<0.003	<0.003	<0.003	<0.007	<0.0038	<0.0076	<0.0038	<0.0038	<0.0076	<0.0038	<0.0038	<0.0038	<0.003
SB-11	2/5/2003	8	<0.005	<0.005	0.032	0.01	0.045	<0.005	<0.005	<0.005	0.013	<0.050	<0.005	<0.005	<0.005	<0.005
	2/5/2003	29	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.014	0.096	<0.005	<0.005	<0.005	<0.005
	2/5/2003	46	<0.005	<0.005	0.072	0.032	0.196	0.008	0.114	0.01	0.054	<0.050	<0.005	<0.005	<0.005	<0.005
SB-12	2/5/2003	6	<0.005	<0.005	<0.005	0.011	0.051	<0.005	0.007	<0.005	<0.005	<0.050	<0.005	<0.005	<0.005	<0.005
	2/5/2003	15	<0.005	<0.005	0.03	0.018	0.09	<0.005	0.022	<0.005	<0.005	<0.050	<0.005	<0.005	<0.005	<0.005
	2/5/2003	28	<0.005	<0.005	0.012	<.0005	0.026	<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005	<0.005	<0.005
SB-13	2/12/2003	7	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005	<0.005	<0.005
	2/12/2003	16	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005	<0.005	<0.005

EPS

Table E-1. Analytical Results for Constituents Detected in Soil (mg/kg)

Sample Number	Date	Depth	Tetrachloroethene (PCE)	Benzene	Toluene	Ethyl-benzene	Xylenes	n-propyl benzene	1,2,4 & 1,3,5-Tri-methyl benzene	Naphthalene	MTBE	2-hexanone	4-iso propyl toluene	sec-butyl benzene	n-butyl benzene	Isopropyl benzene
Type 1 RRS			0.5	0.5	100	70	1000	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	22
Type 3 RRS			0.5	0.5	100	70	1000	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	Not Regulated	22
SB-14	2/5/2003	8	<0.005	<0.005	0.015	0.007	0.034	<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005	<0.005	<0.005
	2/5/2003	15	<0.005	<0.005	0.018	0.008	0.038	<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005	<0.005	<0.005
	2/5/2003	32	<0.005	<0.005	0.128	0.358	1.669	0.306	6.17	2.79	<0.005	<0.005	0.1	0.053	0.846	0.099
	2/5/2003	36	<0.005	0.015	0.057	0.025	0.121	<0.005	0.029	0.026	<0.005	<0.050	<0.005	<0.005	<0.005	<0.005
SB-1 (2005)	9/30/2005	8-12	<0.005	<0.005	<0.005	<0.005	<0.010				<0.005	<0.0057				<0.005
	9/30/2005	24-28	<0.005	<0.005	<0.005	<0.005	<0.011				<0.005	<0.0061				<0.005
DW-1	10/10/2001	35-	0.012													
	10/10/2001	45-	0.01													
	10/10/2001	64-	0.018													
MW-3	10/10/2001	35-	<0.005													
	10/10/2001	40-	<0.005													
MW-9	9/30/2005	24-28	<0.004	<0.005	<0.005	<0.005	<0.011				<0.005	<0.0063				<0.004
Potassium Permanganate Injection																
SB-1C	12/2/2005	24-28	0.049	<0.005	<0.005	<0.005	<0.011				<0.005	<0.0061				<0.005
SB-2C	12/2/2005	24-28	0.015	<0.005	<0.005	<0.005	<0.010				<0.005	<0.0056				<0.005
SB-3C	12/2/2005	4	**1.40**	<0.005	<0.005	<0.005	<0.011				<0.005	<0.0064				<0.005
SB-4C	12/2/2005	12	0.120	<0.005	<0.005	<0.005	<0.011				<0.005	<0.0066				<0.005
SB-5C	12/2/2005	2-3	0.110	<0.005	<0.005	<0.005	<0.010				<0.005	<0.0057				<0.005
	12/2/2005	24-28	<0.004	<0.005	<0.005	<0.005	<0.011				<0.005	<0.0066				<0.005
Potassium Permanganate Injection																
SB-5	1/13/2006	24-28	<0.005	<0.005	<0.005	<0.005	<0.011				<0.005	<0.0065				<0.005
SB-6	1/13/2006	24-28	<0.005	<0.005	<0.005	<0.005	<0.011				0.025	0.0072				<0.005
SB-7	1/13/2006	0-4	0.0098	<0.005	<0.005	<0.005	<0.012				<0.005	<0.0071				<0.005
	1/13/2006	8-12	<0.005	<0.005	<0.005	<0.005	<0.011				<0.005	<0.0061				<0.005
Duplicate	1/13/2006	8-12	<0.005	<0.005	<0.005	<0.005	<0.013				<0.005	<0.0081				<0.005

mg/kg - milligrams per kilogram
blank cell - Constituent not analyzed
Concentrations in excess of Type1/3 RRS are shown in **bold.**
<0.005 - denotes that the sample result was below the laboratory practical quantitation limit

Table E-2. Analytical Results for Chlorinated VOCs in Groundwater (µg/L)

Well ID	Date	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride	1,1-Dichloroethene	1,2-Dichloroethane	1,1,1-Trichloroethane	Methylene Chloride	Chloroform
MW-1	4/23/1999	35	<5.0	<5.0	<5.0	<5.0	7.7	<5.0	6.6	5.4	13
	8/17/2001	1500	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	15
	11/27/2001	1660	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	11/18/2004	3200	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
	12/17/2004	3100	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
	1/26/2005	3700	6.3	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	8.9
	6/19/2005	**First Potassium Permanganate Injection**									
	6/22/2005	2400	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*NA*	6.2
	7/6/2005	2400	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*NA*	<5.0
	7/6/2005	**Second Potassium Permanganate Injection**									
	7/8/2005	1400	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*NA*	*NA*	<5.0
	7/8/2005	**Third Potassium Permanganate Injection**									
	7/11/2005	38	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*NA*	*NA*	*NA*
	Oct - Nov 2005	**Additional Potassium Permanganate Injections**									
	12/2/2005	12	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.6
(Duplicate)	12/2/2005	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Dec 19-21, 2005	**Additional Potassium Permanganate Injections**									
	6/13/2006	690	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	8.6
	Aug 2007	**Phase 1 Potassium Permanganate Injection**									
	5/23/2007	320	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	8
	11/28/2007	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Jan 2008	**Phase 2 Potassium Permanganate Injection**									
	9/25/2008	Well was dry									
	4/8/2009	Well was dry									
	10/4/2010	180	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
MW-2	11/27/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	6/19/2005	**First Potassium Permanganate Injection**									
	6/22/2005	6.4	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	July - Dec 2005	**Additional Potassium Permanganate Injection**									
	12/11/2006	5.6	<5.0	<5.0	<5.0	<2.0	<5.0	*NA*	*NA*	*NA*	*NA*
	5/24/2007	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Jan 2008	**Phase 2 Potassium Permanganate Injection**									
	9/26/2008	15	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	4/8/2009	Well was dry									
	10/5/2010	8.9	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
MW-3	10/10/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	11/27/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	6/19/2005	**First Potassium Permanganate Injection**									
	6/22/2005	2700	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	13
	July - Dec 2005	**Additional Potassium Permanganate Injection**									
	5/10/2006	9	<5.0	<5.0	<5.0	<2.0	<5.0	6	<5.0	<5.0	34
	12/11/2006	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*NA*	*NA*	*NA*	*NA*
	5/22/2007	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	21
	Jan 2008	**Phase 2 Potassium Permanganate Injection**									
	9/25/2008	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	5.9
	10/5/2010	6.2	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0

Table E-2. Analytical Results for Chlorinated VOCs in Groundwater (µg/L)

Well ID	Date	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride	1,1-Dichloroethene	1,2-Dichloroethane	1,1,1-Trichloroethane	Methylene Chloride	Chloroform
MW-4	1/23/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*NA*
MW-5	2/27/2003	29.7	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	2005	**Potassium Permanganate Injections**									
	5/23/2007	220	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Aug 2007	**Phase 1 Potassium Permanganate Injection**									
	Jan 2008	**Phase 2 Potassium Permanganate Injection**									
	3/24/2008	77	<5.0	<5.0	<5.0	<2.0	<5.0	37	<5.0	<5.0	<5.0
	9/25/2008	68	<5.0	<5.0	<5.0	<2.0	<5.0	69	<5.0	<5.0	<5.0
	4/8/2009	43	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	10/5/2010	43	<5.0	<5.0	<5.0	<2.0	<5.0	140	<5.0	<5.0	6.3
MW-6	2/17/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	2005	**Potassium Permanganate Injections**									
	5/24/2007	16	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
(Duplicate)	5/24/2007	16	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Jan 2008	**Phase 2 Potassium Permanganate Injection**									
	9/26/2008	6.5	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	4/8/2009	Well was dry									
	10/5/2010	11	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
MW-7	2/17/2003	10.9	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	2005	**Potassium Permanganate Injections**									
	June 2007	**Well Abandoned**									
MW-7R	8/2/2007	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	19
	Aug 2007	**Phase 1 Potassium Permanganate Injection**									
	11/28/2007	62	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	42
	Jan 2008	**Phase 2 Potassium Permanganate Injection**									
	3/24/2008*	<7.0	<18	<24	<16	<11	<250	<250	<250	<250	<250
(Duplicate)	3/24/2008*	<7.0	<18	<24	<16	<11	<250	<250	<250	<250	<250
	9/25/2008	Well was dry									
	4/8/2009	Well was dry									
	10/5/2010	<51	<23	<35	<43	<38	<30	<16	<9.4	<36	<30
MW-8	2/17/2003	498	<5.0	<5.0	<5.0	<5.0	<5.0	12.5	<5.0	<5.0	12.9
	11/18/2004	2700	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	NA
	12/17/2004	2400	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	NA
	1/26/2005	3100	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	13
	6/19/2005	**First Potassium Permanganate Injection**									
	6/22/2005	2700	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*NA*	*NA*
	July - Dec 2005	**Additional Potassium Permanganate Injection**									
	5/23/2007	2200	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Aug 2007	**Phase 1 Potassium Permanganate Injection**									
	11/28/2007	1500	6.3	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
(Duplicate)	11/28/2007	2100	6	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	14
	Jan 2008	**Phase 2 Potassium Permanganate Injection**									
	3/24/2008	490	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	9.9
	9/25/2008	770	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	6.2
	4/8/2009	1800	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	6.5
	10/5/2010	890	8.6	120	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	6.2
(Duplicate)	10/5/2010	890	9	120	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	6.5
MW-10	8/2/2007	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0

Table E-2. Analytical Results for Chlorinated VOCs in Groundwater (µg/L)

Well ID	Date	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride	1,1-Dichloroethene	1,2-Dichloroethane	1,1,1-Trichloroethane	Methylene Chloride	Chloroform
	10/5/2010	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	220	<5.0	<5.0	<5.0
	10/4/2010	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
DW-1	11/27/2001	14.2	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	2/27/2003	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	6/19/2005	**First Potassium Permanganate Injection**									
	6/22/2005	6.4	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*NA*	*NA*
	July - Dec 2005	**Additional Potassium Permanganate Injection**									
	5/23/2007	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Jan 2008	**Phase 2 Potassium Permanganate Injection**									
	9/25/2008	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
(Duplicate)	9/25/2008	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	4/8/2009	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
GP1-01	1/16/2002	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	14.3
BCMW-1 (NA-1)	8/17/2001	8.5	<5.0	<5.0	<5.0	<5.0	<5.0	260	<5.0	<5.0	<5.0
	2005	**Potassium Permanganate Injections**									
	5/23/2007	9.9	<5.0	26	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	10/5/2010	<51	<23	<35	<43	<38	<30	<16	<9.4	<36	<30
BCMW-2 (NA-2)	8/17/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	44	<5.0	<5.0	<5.0
BCMW-3 (NA-3)	8/17/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	3300	<5.0	<5.0	<5.0
BCMW-6	5/23/2007	<5.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
	10/6/2010	<510	<230	<350	<430	<380	<300	<160	<94	<360	<300
BCMW-7 (MW-D)	8/17/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	55	<5.0	<5.0	<5.0
BCMW-8 (MW-B)	8/17/2001	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	130	<5.0	<5.0	<5.0
TW-1	12/11/2002	160	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	11/18/2004	2200	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
	12/17/2004	2400	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
	1/26/2005	2600	14	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	9.0
	2005	**Potassium Permanganate Injections**									
	12/2/2005	2700	17	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	11
SB-1C	12/2/2005	3700	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	7.1

Notes:

* = Method detection limits are shown for PCE, TCE, cis-DCE, trans-DCE, and VC.
Laboratory reporting limits are shown for all other components.

VOCs = Voaltile Organic Compounds

µg/L - micrograms per liter

NA = Constituent not analyzed

<5.0 - denotes that the sample result was below the laboratory practical quantitation limit

Table E-3. Analytical Results for Non-Chlorinated VOCs in Groundwater (µg/L)

Well ID	Date	1,2-Dibromoethane	2-Butanone	2-Hexanone	Acetone	Benzene	Chloroethane	Cyclohexane	Toluene	Ethylbenzene	Xylenes	n-propylbenzene	1,2,4 & 1,3,5-Trimethylbenzene	Naphthalene	Methylcyclohexane	Methyl tert-Butyl Ether	4-Isopropyltoluene	sec-Butylbenzene	4-Methyl-2-Pentanone	Isopropylbenzene	Styrene	Bromobenzene	n–Butylbenzene	t-Butylbenzene
MW-1	4/23/1999	<5.0	*NA*	<5.0	*NA*	33	*NA*	*NA*	47	15	79	<5.0	<5.0	<5.0	*NA*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	8/17/2001	*NA*	*NA*	<5.0	*NA*	36	*NA*	*NA*	75	60	256	29	146	<5.0	*NA*	38	<5.0	<5.0	<5.0	10	<5.0	<5.0	<5.0	<5.0
	11/27/2001	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
	1/26/2005	<5.0	<50	<10	<50	11	<10	<5.0	7.2	<5.0	<15	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
	12/2/2005	<5.0	<50	<10	76	<5.0	<10	<5.0	<5.0	<5.0	<15	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
(Duplicate)	12/2/2005	<5.0	*NA*	<7.6	*NA*	<5.0	*NA*	*NA*	<5.0	<5.0	<12.6	*NA*	*NA*	*NA*	*NA*	<5.0	*NA*	*NA*	<7.6	<5.0	<5.0	*NA*	*NA*	*NA*
	6/13/2006	<5.0	<50	<10	61	<5.0	<10	<5.0	<5.0	<5.0	<15	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	5/23/2007	6.6	<50	<10	65	150	<10	<5.0	500	69	49	*NA*	*NA*	*NA*	14	8.6	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	11/28/2007	<5.0	<50	<10	900	5.4	<10	<5.0	<5.0	<5.0	<15	*NA*	<5.0	<5.0	<5.0	<5.0	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	*NA*
	9/25/2008	Well was dry																						
	10/4/2010	<5.0	<50	<10	<50	<5.0	<10	<5.0	<5.0	<5.0	<15	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
MW-2	11/27/2001	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
	5/24/2007	<5.0	<50	<10	<50	<5.0	<10	<5.0	<5.0	<5.0	<15	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	9/26/2008	<5.0	<50	<10	<50	<5.0	<10	<5.0	15	<5.0	18.2	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	10/5/2010	<5.0	<50	<10	<50	<5.0	<10	<5.0	<5.0	<5.0	<10	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
MW-3	11/27/2001	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
	6/22/2005	<5.0	<50	<10	<50	620	<10	96	430	110	1050	*NA*	*NA*	*NA*	76	<5.0	*NA*	*NA*	<10	15	<5.0	*NA*	*NA*	*NA*
	5/10/2006	13	<20	38	<100	1400	<10	*NA*	1200	270	2080	42	490	180	*NA*	<5.0	<5.0	<5.0	<10	29	<5.0	<5.0	<5.0	96
	5/22/2007	<5.0	<50	24	<50	860	<10	110	620	190	1710	*NA*	*NA*	*NA*	62	<5.0	*NA*	*NA*	10	25	<5.0	*NA*	*NA*	*NA*
	9/25/2008	<5.0	78	98	<50	240	<10	150	1600	450	2600	*NA*	*NA*	*NA*	75	<5.0	*NA*	*NA*	28	43	<5.0	*NA*	*NA*	*NA*
	10/5/2010	<5.0	78	91	80	200	<10	280	4000	1000	5100	*NA*	*NA*	*NA*	150	<5.0	*NA*	*NA*	32	70	<5.0	*NA*	*NA*	*NA*
MW-4	1/23/2002	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
MW-5	2/27/2003	<5.0	*NA*	<50	*NA*	825	*NA*	*NA*	1850	176	1108	22	48	18	*NA*	410	<5.0	<5.0	<5.0	7.79	<5.0	<5.0	<5.0	163
	5/23/2007	42	500	270	690	4100	*NA*	58	12000	610	7500	*NA*	*NA*	*NA*	64	1600	*NA*	*NA*	110	25	<5.0	*NA*	*NA*	*NA*
	3/24/2008	31	380	<10	3600	1700	<10	72	3700	160	610	*NA*	*NA*	*NA*	56	350	*NA*	*NA*	24	13	<5.0	*NA*	*NA*	*NA*
	9/25/2008	30	100	77	430	2000	<10	79	5200	270	3000	*NA*	*NA*	*NA*	67	930	*NA*	*NA*	28	13	<5.0	*NA*	*NA*	*NA*
	4/8/2009	14	100	110	310	3400	<10	120	4900	500	2110	*NA*	*NA*	*NA*	160	1400	*NA*	*NA*	77	23	<5.0	*NA*	*NA*	*NA*
	10/5/2010	36	410	400	1200	6400	<10	170	8200	1500	4900	*NA*	*NA*	*NA*	150	1200	*NA*	*NA*	160	55	<5.0	*NA*	*NA*	*NA*

Table E-3. Analytical Results for Non-Chlorinated VOCs in Groundwater (µg/L)

Well ID	Date	1,2-Dibromoethane	2-Butanone	2-Hexanone	Acetone	Benzene	Chloroethane	Cyclohexane	Toluene	Ethylbenzene	Xylenes	n-propylbenzene	1,2,4 & 1,3,5-Trimethylbenzene	Naphthalene	Methylcyclohexane	Methyl tert-Butyl Ether	4-Isopropyltoluene	sec-Butylbenzene	4-Methyl-2-Pentanone	Isopropylbenzene	Styrene	Bromobenzene	n–Butylbenzene	t-Butylbenzene
MW-6	2/17/2003	<5.0	*NA*	<50	*NA*	<5.0	*NA*	*NA*	<5.0	<5.0	<15	<5.0	<5.0	<5.0	*NA*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	5/24/2007	<5.0	<50	<10	<50	<5.0	<10	<5.0	<5.0	<5.0	<15	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
(Duplicate)	5/24/2007	<5.0	<50	<10	<50	<5.0	<10	<5.0	<5.0	<5.0	<15	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	9/26/2008	<5.0	<50	<10	<50	<5.0	<10	<5.0	<5.0	<5.0	<15	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	10/5/2010	<5.0	<50	<10	<50	<5.0	<10	<5.0	<5.0	<5.0	<10	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
MW-7	2/17/2003	<5.0	*NA*	<5.0	*NA*	338	*NA*	*NA*	2570	619	1425	269	2098	136	*NA*	<5.0	16	33	<5.0	<5.0	<5.0	88	70	<5.0
MW-7R	8/2/2007	<5.0	93	130	150	3700	<10	280	16000	3300	10100	*NA*	*NA*	*NA*	180	<5.0	*NA*	*NA*	47	130	*NA*	*NA*	*NA*	*NA*
	11/28/2007	<5.0	200	270	<50	2800	<10	410	21000	2900	10700	*NA*	<5.0	*NA*	160	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	3/24/2008	<250	<2500	<500	<2500	2100	<500	1900	21000	3700	21000	*NA*	*NA*	*NA*	1300	<250	*NA*	*NA*	<500	320	<250	*NA*	*NA*	*NA*
(Duplicate)	3/24/2008	<250	<2500	<500	<2500	2400	<500	990	22000	4000	22500	*NA*	*NA*	*NA*	710	<250	*NA*	*NA*	<500	260	<250	*NA*	*NA*	*NA*
	9/25/2008	Well was dry																						
	10/5/2010	<29	<170	<61	1700 J	2100	<39	<66	14000	2500	16500	*NA*	*NA*	*NA*	<41	<37	*NA*	*NA*	<39	320 J	<10	*NA*	*NA*	*NA*
MW-8	2/17/2003	<5.0	*NA*	96	*NA*	339	*NA*	*NA*	458	128	752	47	399	<5.0	*NA*	13	<5.0	<5.0	<5.0	13	<5.0	<5.0	<5.0	<5.0
	1/26/2005	<5.0	28	<5.0	<50	990	<10	64	180	63	1250	<5.0	<5.0	<5.0	59	<5.0	<5.0	<5.0	26	18	<5.0	<5.0	<5.0	<5.0
	5/23/2007	<5.0	<50	<10	<50	510	<10	63	200	73	940	*NA*	*NA*	*NA*	66	<5.0	*NA*	*NA*	15	22	<5.0	*NA*	*NA*	*NA*
	11/28/2007	<5.0	<50	<10	<50	440	<10	90	65	28	550	*NA*	<5.0	*NA*	60	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
(Duplicate)	11/28/2007	<5.0	<50	<10	<50	420	<10	<5.0	94	30	740	*NA*	<5.0	*NA*	49	<5.0	*NA*	*NA*	<10	28	<5.0	*NA*	*NA*	*NA*
	3/24/2008	<5.0	66	13	320	290	<10	35	<5.0	<5.0	105	*NA*	*NA*	*NA*	12	<5.0	*NA*	*NA*	21	6.1	<5.0	*NA*	*NA*	*NA*
	9/25/2008	<5.0	<50	<10	<50	190	<10	17	23	6	206	*NA*	*NA*	*NA*	9	<5.0	*NA*	*NA*	<10	6.1	<5.0	*NA*	*NA*	*NA*
	4/8/2009	<5.0	<50	<10	<50	120	<10	42	<5.0	<5.0	77	*NA*	*NA*	*NA*		<5.0	*NA*	*NA*	<10	9.6	<5.0	*NA*	*NA*	*NA*
	10/5/2010	<5.0	<50	<10	<50	56	<10	78	<5.0	<5.0	87	*NA*	*NA*	*NA*	65	<5.0	*NA*	*NA*	<10	9.2	<5.0	*NA*	*NA*	*NA*
(Duplicate)	10/5/2010	<5.0	<50	<10	<50	60	<10	72	<5.0	<5.0	89	*NA*	*NA*	*NA*	60	<5.0	*NA*	*NA*	<10	10	<5.0	*NA*	*NA*	*NA*
MW-10	8/2/2007	51	380	190	540	4300	<10	110	7200	1700	5400	*NA*	*NA*	*NA*	50	700	66	*NA*	77	*NA*	<5.0	*NA*	*NA*	*NA*
	10/5/2010	17	130	110	250	3000	<10	67	1600	640	2790	*NA*	*NA*	*NA*	30	200	*NA*	*NA*	64	28	<5.0	*NA*	*NA*	*NA*
DW-1	11/27/2001	*NA*	*NA*	<5.0	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	<5.0	<5.0
	2/27/2003	<5.0	*NA*	<5.0	*NA*	<5.0	*NA*	*NA*	<5.0	<5.0	<15.0	<5.0	<5.0	<5.0	*NA*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	5/23/2007	<5.0	<50	<10	<50	<5.0	<10	<5.0	<5.0	<5.0	<10	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	9/25/2008	<5.0	<50	<10	<50	18	<10	<5.0	22	<5.0	14	*NA*	*NA*	*NA*	<5.0	7	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
(Duplicate)	9/25/2008	<5.0	<50	<10	<50	18	<10	<5.0	20	<5.0	12	*NA*	*NA*	*NA*	<5.0	8	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	4/8/2009	<5.0	<50	<10	<50	6.0	<10	<5.0	<5.0	<5.0	<10	*NA*	*NA*	*NA*	<5.0	8	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	10/4/2010	<5.0	<50	<10	<50	5.2	<10	<5.0	<5.0	<5.0	<10	*NA*	*NA*	*NA*	<5.0	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*

Table E-3. Analytical Results for Non-Chlorinated VOCs in Groundwater (µg/L)

Well ID	Date	1,2-Dibromoethane	2-Butanone	2-Hexanone	Acetone	Benzene	Chloroethane	Cyclohexane	Toluene	Ethylbenzene	Xylenes	n-propylbenzene	1,2,4 & 1,3,5-Trimethylbenzene	Naphthalene	Methylcyclohexane	Methyl tert-Butyl Ether	4-Isopropyltoluene	sec-Butylbenzene	4-Methyl-2-Pentanone	Isopropylbenzene	Styrene	Bromobenzene	n–Butylbenzene	t-Butylbenzene
GP1-01	1/16/2002	108	*NA*	<5.0	*NA*	9180	*NA*	*NA*	9850	619	2587	<5.0	606	145	*NA*	<5.0	<5.0	<5.0	<5.0	22	<5.0	<5.0	12	<5.0
BCMW-1 (NA-1)	8/17/2001	37	*NA*	<5.0	92	12000	*NA*	*NA*	18000	2300	9800	200	2080	660	*NA*	4300	<5.0	<5.0	92	74	27	<5.0	<5.0	<5.0
	5/23/2007	34	1300	370	2000	3400	18	220	6100	1200	3400	*NA*	*NA*	*NA*	<5.0	3800	*NA*	*NA*	150	160	<5.0	*NA*	*NA*	*NA*
	10/5/2010	<29	1800 J	<61	3900 J	27000	<39	<66	44000	6000	29000	*NA*	*NA*	*NA*	<41	11000	*NA*	*NA*	<39	390 J	120 J	*NA*	*NA*	*NA*
BCMW-2 (NA-2)	8/17/2001	<5.0	*NA*	<5.0	*NA*	2600	*NA*	*NA*	46000	4400	22200	550	4830	1000	*NA*	9100	<5.0	<5.0	89	190	78	<5.0	<5.0	<5.0
BCMW-3 (NA-3)	8/17/2001	1300	*NA*	<5.0	*NA*	27000	*NA*	*NA*	34000	4000	14400	400	3600	1000	*NA*	16000	<5.0	<5.0	140	120	70	<5.0	<5.0	<5.0
BCMW-6	5/23/2007	<5.0	4600	560	7800	38000	<10	780	61000	4900	18140	*NA*	*NA*	*NA*	770	26000	*NA*	*NA*	<10	130	<5.0	*NA*	*NA*	*NA*
	10/6/2010	<290	<1700	<610	<5000	43000	<390	<660	91000	18000	107000	*NA*	*NA*	*NA*	6100	28000	*NA*	*NA*	<390	3500 J	<100	*NA*	*NA*	*NA*
BCMW-7 (MW-D)	8/17/2001	<5.0	*NA*	<5.0	*NA*	2700	*NA*	*NA*	46	33	1020	18	240	72	*NA*	900	<5.0	<5.0	41	28	<5.0	<5.0	<5.0	<5.0
BCMW-8 (MW-B)	8/17/2001	<5.0	*NA*	<5.0	*NA*	15000	*NA*	*NA*	20000	3800	15700	480	4600	720	*NA*	1100	<5.0	<5.0	190	150	<5.0	<5.0	<5.0	<5.0
TW-1	12/11/2002	<5.0	*NA*	<5.0	*NA*	5	*NA*	*NA*	<5.0	<5.0	6	<5.0	<5.0	<5.0	*NA*	6.6	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	1/26/2005	<5.0	<50	<10	<50	<5.0	<10	<5.0	5.3	<5.0	<10	*NA*	*NA*	*NA*	<5.0	28	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
	12/2/2005	<5.0	<50	<10	<50	<5.0	<10	<5.0	<5.0	<5.0	<10	*NA*	*NA*	*NA*	<5.0	11	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*
SC-1C	12/2/2005	<5.0	*NA*	<10	*NA*	16	*NA*	*NA*	14	<5.0	10	*NA*	*NA*	*NA*	*NA*	<5.0	*NA*	*NA*	<10	<5.0	<5.0	*NA*	*NA*	*NA*

Notes:

µg/L - micrograms per liter

NA = Constituent not analyzed

<5.0 - denotes that the sample result was below the laboratory practical quantitation limi

EPS

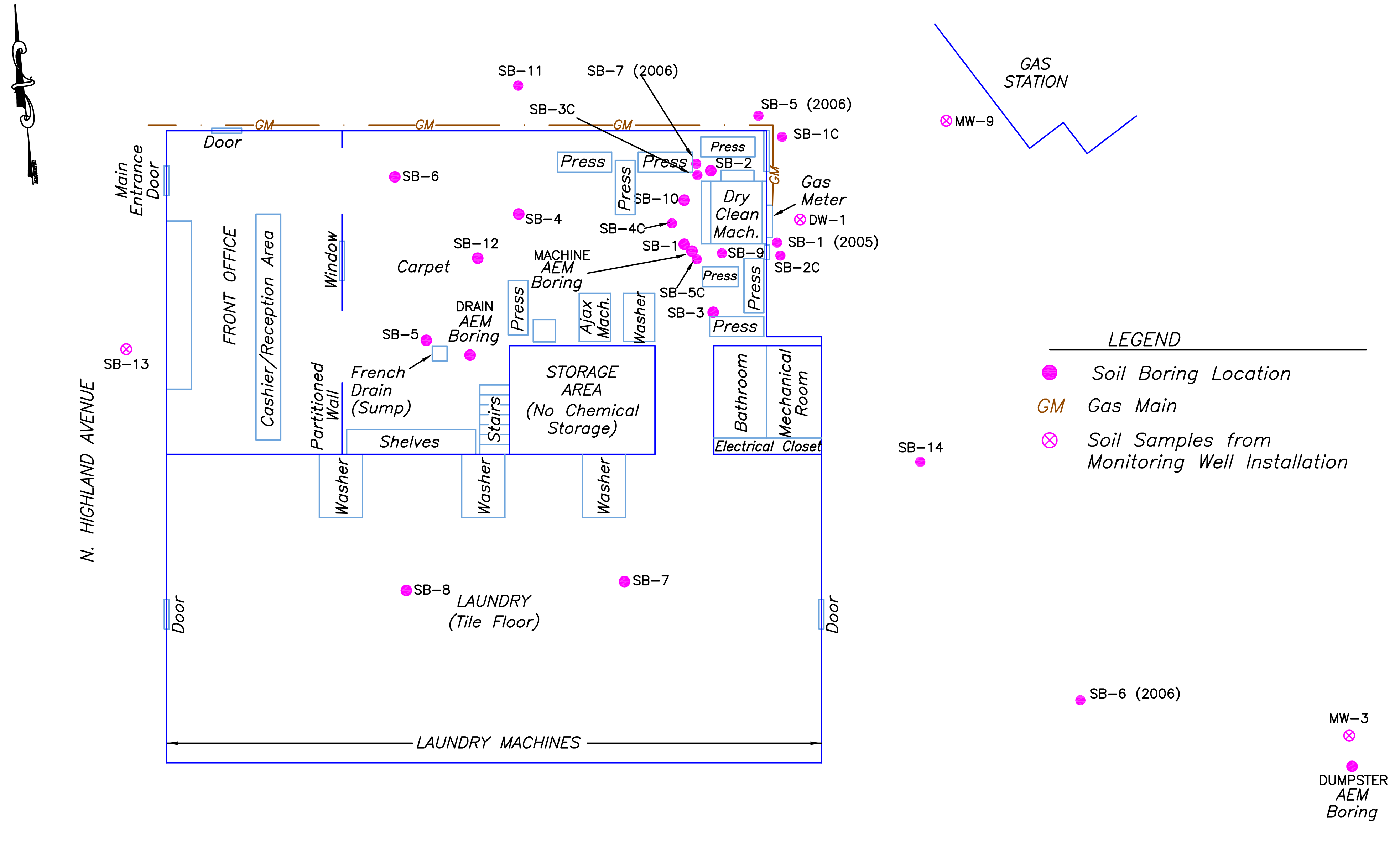
Table E-4. Analytical Results for Inorganics in Groundwater (mg/L)

Well ID	Date	Arsenic	Barium	Cadmium	Chromium (III)	Chromium (VI)	Copper	Iron	Lead	Selenium	Chloride
MW-1	11/28/2007	<0.05	0.963	<0.005	0.451	<10	0.0463	33.2	0.0386	0.0977	<50
	3/24/2008	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	9/25/2008	Well was dry									
	10/4/2010	<0.05	<0.020	<0.005	0.0356	<0.010	<0.010	<0.1	<0.010	<0.020	9.7
MW-2	11/28/2007	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3/24/2008	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-3	11/28/2007	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3/24/2008	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	10/5/2010	<0.05	0.0234	<0.005	<0.010	<0.010	<0.010	11.9	<0.010	<0.020	22
MW-4	11/28/2007	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3/24/2008	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-5	11/28/2007	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3/24/2008	<0.05	<0.02	<0.005	0.165	<0.250	<0.01	0.240	<0.01	<0.02	<10
	9/25/2008	<0.05	0.0931	<0.005	0.044	0.178	0.0112	10.7	<0.01	<0.02	21
	10/5/2010	<0.05	0.0599	<0.005	0.0118	<0.010	<0.010	<0.10	<0.010	<0.020	18
MW-6	11/28/2007	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3/24/2008	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-7R	11/28/2007	<0.05	0.0489	<0.005	<0.01	<0.01	<0.10	1.83	<0.01	<0.02	13
	3/24/2008	<0.05	0.0439	<0.005	0.028	<0.10	0.214	4.50	<0.01	<0.02	11
	9/25/2008	Well was dry									
	10/5/2010	<0.0038	0.0475	<0.0016	0.0019 J	<0.002	0.0026 J	0.197	<0.0019	0.0041 J	14
MW-8	11/28/2007	<0.05	<0.02	<0.005	<0.01	<0.01	<0.01	3.53	<0.01	<0.02	4.7
(Duplicate)	11/28/2007	<0.05	<0.02	<0.005	<0.01	<0.01	<0.01	3.23	<0.01	<0.02	4.6
	3/24/2008	<0.05	0.0539	<0.005	0.874	<0.250	0.0456	9.81	<0.01	<0.02	<10
	9/25/2008	<0.05	0.652	<0.005	0.851	<0.01	0.104	99.4	0.0475	<0.02	4.6
	10/5/2010	<0.05	0.0209	<0.005	<0.010	<0.010	<0.010	2.27	<0.010	<0.020	3.7
MW-10	11/28/2007	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3/24/2008	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	10/5/2010	<0.050	0.189	<0.005	<0.010	<0.010	<0.010	9.25	0.0101	<0.020	68
DW-1	11/28/2007	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3/24/2008	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	10/4/2010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

mg/l - milligrams per liter
NS = Well Not Sampled
<5.0 - denotes that the sample result was below the laboratory practical quantitation limit

APPENDIX E

FIGURES



LEGEND

- ● Soil Boring Location
- GM Gas Main
- ⊗ Soil Samples from Monitoring Well Installation

EPS

Environmental Planning Specialists, Inc.
900 Ashwood Parkway, Suite 350
Atlanta, GA 30338
Phone: (404) 315-9113
Fax: (404) 315-8509

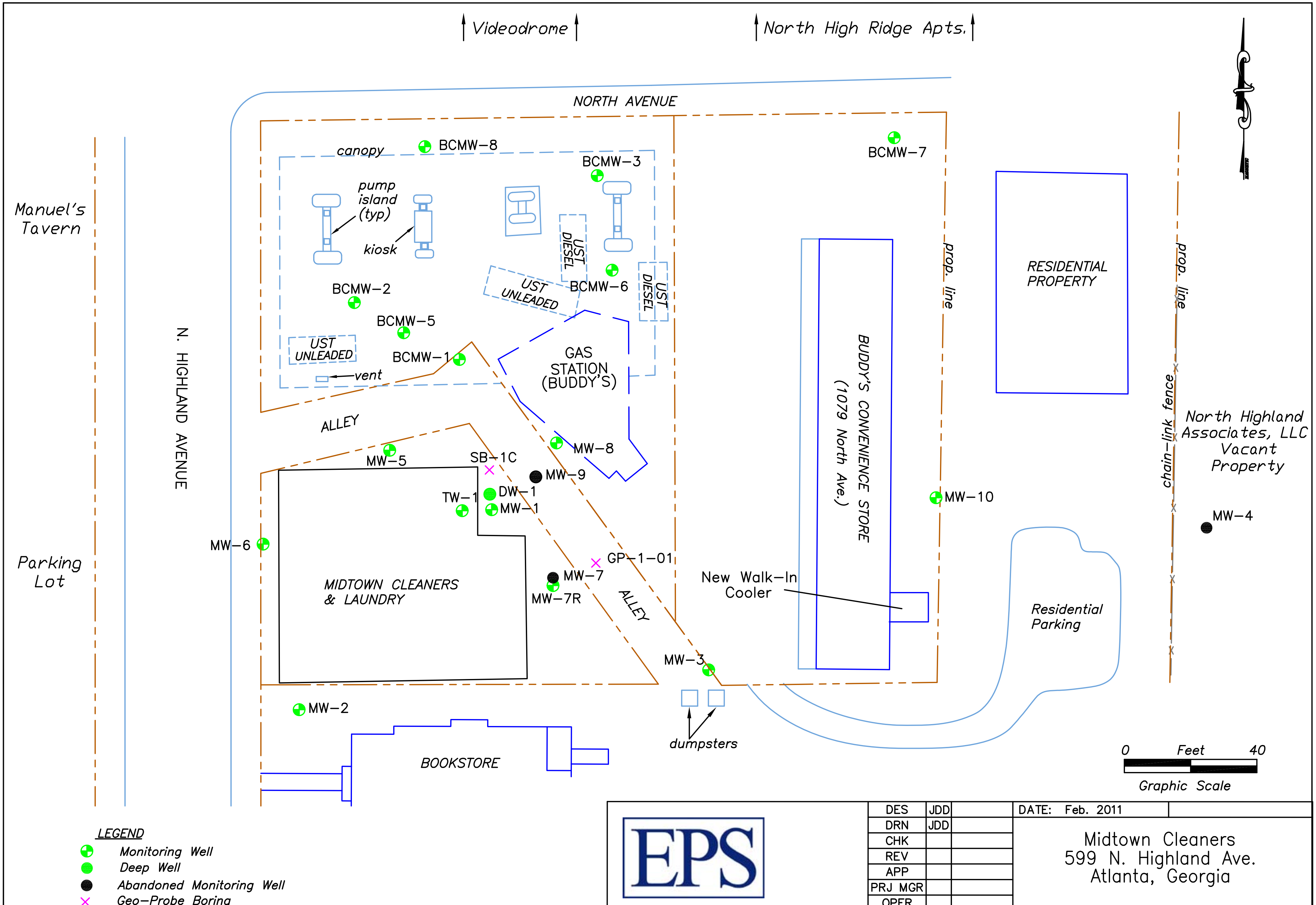
DES	JDD	
DRN	JDD	
CHK		
REV		
APP		
PRJ MGR		
OPER		

DATE: Feb. 2011

Midtown Cleaners
599 N. Highland Ave.
Atlanta, Georgia

Soil Sample Locations

FIGURE
E-1



EPS

Environmental Planning Specialists, Inc.
900 Ashwood Parkway, Suite 350
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Fax: (404) 315-8509

DES	JDD
DRN	JDD
CHK	
REV	
APP	
PRJ MGR	
OPER	

DATE: Feb. 2011

Midtown Cleaners
599 N. Highland Ave.
Atlanta, Georgia

Groundwater Sample Locations

FIGURE E-2

APPENDIX F

Soil Vapor Intrusion Modeling

APPENDIX F
SOIL VAPOR INTRUSION MODELING

Three chlorinated VOCs were detected in groundwater at the Site in the most recent sampling event. All of these compounds (PCE, TCE, DCE) are sufficiently toxic and volatile, according to Table 1 from the Subsurface Vapor Intrusion Guidance (USEPA, 2002), to warrant consideration of soil vapor intrusion. Groundwater containing PCE and TCE underlies three structures: Midtown, Buddy's Gas Station and Buddy's Convenience Store. Due to the volatility of these constituents, there is a potential for these constituents to volatilize from the groundwater, migrate through the vadose zone and then enter the buildings through a process called soil vapor intrusion. Additionally, the USEPA recommends considering structures that are within 100 feet of the groundwater plume (USEPA, 2002). The residence located east of Buddy's Convenience Store is less than 100 feet from groundwater containing detectable concentrations of chlorinated VOCs. Thus, the following four scenarios were considered for soil vapor intrusion:

- Midtown Cleaners – Commercial Worker
- Buddy's Gas Station – Commercial Worker
- Buddy's Convenience Store – Commercial Worker
- Residence - Resident

These constituents were taken through a screening process to determine if modeling would be applicable. The following table compares the highest concentrations observed in the 2010 groundwater sampling to generic screening levels assuming a 10^{-5} risk (USEPA, 2002):

Table F-1. Comparison of Maximum Concentrations to Target Groundwater Concentrations (TGC)

	PCE (µg/L)	TCE (µg/L)	DCE (µg/L)
Groundwater Concentration	890	9	120
Table 2b TGC	11	5	210
Table 3b* TGC	54	5	1,000

*using attenuation factor $2x10^{-4}$ (based on loam soil with groundwater 30 feet below surface)

As the maximum PCE and TCE concentrations exceeded the screening criteria, it was determined that both constituents would be modeled. The maximum DCE concentration was less than the screening values and was, therefore, dropped from further consideration.

The USEPA Office of Emergency and Remedial Response published a series of models based on the analytical solutions of Jonson and Ettinger for estimating indoor air concentrations and associated health risks from subsurface vapor intrusion into buildings. Johnson and Ettinger (1991) developed a screening-level model that incorporates convective and diffusive mechanisms for vapor transport emanating from either subsurface soils or groundwater into indoor spaces located directly above the sources of contamination. The USEPA's Excel-based models use default values recommended in their Guidance (USEPA, 2002).

For this analysis, the advanced models were used to determine “acceptable” groundwater concentrations using a given risk level. The table below shows the site-specific parameters used for each scenario. Midtown, the gas station and convenience store are all slabs on grade. The construction of the residence is unknown; thus, models were run for both slab on grade and basement construction. It is possible that the residence is built on a crawl space, but this model is not designed to work for crawl space construction. Residences with crawl spaces and dirt floors may actually have lower levels of vapor-phase VOCs indoors than homes with concrete basements (ATSDR). Thus, modeling based on a slab or basement is more conservative. The input and output sheets for the modeling are attached.

Table F-2. Model Input Parameters

	Midtown	Gas Station	Convenience Store	Residence
Average Temperature	20° C	20° C	20° C	20° C
Depth below grade to bottom of enclosed space floor	15 cm (slab)	15 cm (slab)	15 cm (slab)	15 cm (slab) 200 cm (basement)
Depth below grade to water table	930 cm	930 cm	930 cm	930 cm
Assume one soil stratum with thickness	930cm	930cm	930cm	930 cm
Soil type	SC	SC	SC	SC
Enclosed space floor thickness	10 cm (default)	10 cm (default)	10 cm (default)	10 cm (default)
Enclosed space floor length	2257 cm	767 cm	3929 cm	3929 cm
Enclosed space floor width	1580 cm	993 cm	677 cm	677 cm
Enclosed space height	366 cm	366 cm	366 cm	244 cm (slab) 366 cm (basement)
Indoor air exchange rate	1/hr (for commercial)	1/hr (for commercial)	1/hr (for commercial)	0.25/hr (default)
NC averaging time	25 years (commercial)	25 years (commercial)	25 years (commercial)	30 years (commercial)
ED	25 yrs	25 yrs	25 yrs	30 yrs
EF	250 d/yr	250 d/yr	250 d/yr	350 d/yr
TR	10^{-5}	10^{-5}	10^{-5}	10^{-6}

The results of the modeling are shown in the table below. The output of the model was a risk-based groundwater concentration that is protective of human health at a given risk level (10^{-5} for the commercial properties and 10^{-6} for the residence). Also shown on this table are the groundwater concentrations observed in 2010 at the wells nearest each building. None of the actual groundwater concentrations are higher than the risk-based screening values. Thus, the current groundwater concentrations do not pose an unacceptable risk. If the highest groundwater concentrations were in the groundwater below the residence, there would be a potential risk and additional analysis (such as soil-gas measurement) may be needed. However, there is no reason to expect that there currently is an unacceptable risk to the residence nor is one expected in the future.

Table F-3 Results of Soil Vapor Intrusion Modeling (μg/L)

Receptor	Nearest Well	Risk-based PCE Screening Value	Groundwater PCE Concentration	Risk-based TCE Screening Value	Groundwater TCE Concentration
Midtown	MW-1	5,490	180	350	ND
Gas Station	MW-8	5,250	890	350	9
Convenience Store	MW-3	5,380	6.2	359	ND
Resident – Slab	MW-10	53.3	ND	3.56	ND
Resident – Basement	MW-10	49.9	ND	3.25	ND

Midtown - PCE Input

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES | X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES |

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184		Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	930	930	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197		1.63	0.385	0.197		1.63	0.385	0.197

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	2257	1580	366	0.1	1	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

Midtown - PCE Results

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
5.49E+03	6.94E+05	5.49E+03	2.00E+05	5.49E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

Midtown - TCE Input

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: x

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Totals must add up to value of L_{WT} (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	930	930	0	0	A	SC	SC		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197		1.63	0.385	0.197		1.63	0.385	0.197

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	2257	1580	366	0.1	1	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

Midtown - TCE Results

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
3.50E+02	5.50E+04	3.50E+02	1.47E+06	3.50E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

Buddy's Gas Station - PCE Input

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: x

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184		Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	930	930	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-fillec porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197		1.63	0.385	0.197		1.63	0.385	0.197

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	767	933	366	0.1	1	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

Buddy's Gas Station - PCE Results

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
5.25E+03	6.64E+05	5.25E+03	2.00E+05	5.25E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

Buddy's Gas Station - TCE Input

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [x]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	930	930	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197		1.63	0.385	0.197		1.63	0.385	0.197

Lookup Soil Parameters

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	767	933	366	0.1	1	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

Buddy's Gas Station - TCE Results

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
3.50E+02	5.50E+04	3.50E+02	1.47E+06	3.50E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

Buddy's Convenience Store - PCE Input

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: x

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184		Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm²)
20	15	930	930	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm³/cm³)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm³/cm³)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm³/cm³)
SC	1.63	0.385	0.197		1.63	0.385	0.197		1.63	0.385	0.197

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s²)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	3929	677	366	0.1	1	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

Buddy's Convenience Store - PCE Results

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
5.38E+03	6.80E+05	5.38E+03	2.00E+05	5.38E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

Buddy's Convenience Store - TCE Input

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: x

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	930	930	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197		1.63	0.385	0.197		1.63	0.385	0.197

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	3929	677	366	0.1	1	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

Buddy's Convenience Store - TCE Results

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
3.59E+02	5.64E+04	3.59E+02	1.47E+06	3.59E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

Residence Basement - PCE Input

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES | X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES |

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184		Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	200	930	930	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197		1.63	0.385	0.197		1.63	0.385	0.197

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	3929	677	366	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

Residence Basement - PCE Results

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
4.89E+01	7.42E+04	4.89E+01	2.00E+05	4.89E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

Residence Basement - TCE Input

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [x]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	200	930	930	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197		1.63	0.385	0.197		1.63	0.385	0.197

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	3929	677	366	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

Residence Basement - TCE Results

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
3.25E+00	6.13E+03	3.25E+00	1.47E+06	3.25E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

Residence Slab - PCE Input

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: x

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184		Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	930	930	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-fillec porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197		1.63	0.385	0.197		1.63	0.385	0.197

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	3929	677	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

Residence Slab - PCE Results

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
5.33E+01	8.09E+04	5.33E+01	2.00E+05	5.33E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

Residence Slab - TCE Input

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: x

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
20	15	930	930	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-fillec porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197		1.63	0.385	0.197		1.63	0.385	0.197

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	3929	677	244	0.1	0.25	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

Residence Slab - TCE Results

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
3.56E+00	6.71E+03	3.56E+00	1.47E+06	3.56E+00

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END