FINAL REMEDIAL ACTION WORK PLAN
for the
METROPOLITAN AVENUE SITE
BOROUGH OF QUEENS, NEW YORK

SCA LLW NO.: 12545
SCA CONTRACT NO.: C000008615
SCHOOL DISTRICT: 28
SCA JOB NO.: 14340

CONSULTANT PROJECT NO.: 831803

NOVEMBER 6, 2002

NEW YORK CITY SCHOOL CONSTRUCTION AUTHORITY

Prepared by:

Shaw
Shaw Environmental & Infrastructure, Inc.

Shaw Environmental
and Infrastructure
One International Blvd., Suite 700
Mahwah, New Jersey 07495
Phone: 201-512-5700
Fax: 201-512-5786
Steven Goldberg, Ph.D., CPG

Prepared for:

NYC SCA

30-30 Thomson Avenue
Long Island City, NY 11101-3045
Phone: 718-472-8502
Fax: 718-472-8500
Attn: Lee Guterman

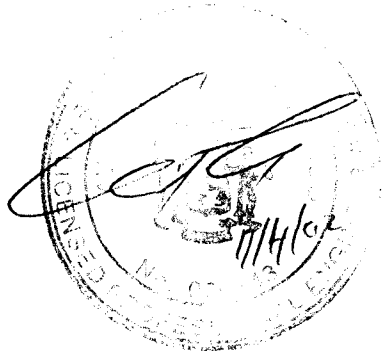

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF FIGURES

TABLE OF CONTENTS
(CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

EXECUTIVE SUMMARY

Introduction

Shaw Environmental and Infrastructure (Shaw) formerly IT Corporation has been retained by the New York City School Construction Authority to complete a Remedial Action Work Plan (RAW) for the Metropolitan Avenue Site (hereafter referred to as the "Site") located in Forest Hills, Queens, New York. The Metropolitan Avenue Site is the proposed location of future New York City public schools PS 110Q, IS 167Q, and HS of Global Communications. The Site is comprised of two adjoining properties located at 87-01 69th Avenue and 92-34 Metropolitan Avenue in Forest Hills, Queens County, New York. The irregularly shaped Site consists of Block 3886, Lots 800 and 830, and measures approximately 8.25 acres in size.

In developing this Work Plan, Shaw reviewed all available environmental investigation reports and relevant correspondence for the Site. Historical and recently acquired information on the contaminated, upgradient properties occupied by Home Depot, Woodhaven Lanes Bowling Alley, and EAC USA, Inc. (former Heidelberg Eastern property), were also reviewed in preparing this Work Plan. Shaw completed a Pre-Design Investigation in August, 2001 to complete the necessary characterization of the nature and extent of contamination. This was followed by the completion of computer modeling and a Pilot Study during September and October 2001. Based on this collective on-site and off-site information, Shaw has proposed an aggressive remedial strategy that will remediate contamination to acceptable regulatory levels, where practical. A Preliminary Remedial Design Report, which is part of this RAW, and is provided as an accompanying document, describes the remedy for the Site.

Conclusions

The following significant conclusions have been drawn from a review and evaluation of available data, and the additional on site investigations:

- The groundwater at the Site is contaminated with 1,1,1-trichloroethane (TCA) and tetrachloroethene (PCE). The on-site source of TCA and PCE was contaminated soil at the northern end of the former Heinz building warehouse, as a result of an apparent leak in the building's drain system. The majority of contaminated soil was removed through excavations performed by the property owner in August 2000.
- The highest concentrations of TCA in groundwater (370 ug/l) and PCE (1,100 ug/l) observed in August 2001 are in the immediate vicinity of the former source. Background concentrations of TCA and PCE attributable to off-site sources were observed in August 2001 at or below 35 ug/l and 29 ug/l, respectively.

- Overall, on-site concentrations of TCA in groundwater have decreased since 1999. On-site PCE concentrations above background were first noted in August 2001, where sampling was conducted closer to the former source area than in previous investigations.
- Contrary to previous reports, recently acquired data from ongoing NYSDEC investigations indicate that the PCE plume in groundwater beneath the Woodhaven Lanes Bowling Alley is not anticipated to impact the Site at levels that would adversely impact indoor air quality in the schools. Therefore, no remedy is required to protect the Site from this plume.
- Historical information from NYSDEC files indicates that concentrations of PCE in groundwater on the Home Depot property have been reduced through active groundwater remediation. It is anticipated that ongoing remedial action at Home Depot will mitigate additional migration of PCE into Site groundwater in the future. Therefore, no remedy is required to protect the Site from this plume.
- Although significant removal of soil gas sources will be accomplished by the AS/SVE system, inclusion of a vapor barrier and passive ventilation system under the school buildings will be implemented as an added safeguard. Details of this system are provided in the Preliminary Remedial Design Report (see Sheet C-3).

Proposed Remedy

A remedial strategy for the Site has been fully developed to support the proposed use of the Site for public schools, without reliance on long-term remedial action. The proposed strategy for the Site recognizes that off-site sources of contamination are less of a threat to the Site than previously understood. Based on Shaw's independent evaluation of the historical and current environmental data, the following general remedial actions are proposed:

- Remediate residual TCA and PCE in on-site soils with the goal to achieve cleanup levels consistent with Technical and Administrative Guidance Memorandum (TAGM) 4046.
- Reduce current TCA and PCE levels in Site groundwater to concentrations approaching asymptotic or background conditions to the extent possible.
- Achieve New York State Class GA Groundwater Quality Standards at the downgradient border of the Site. If it is not technically feasible to achieve this objective then acceptable asymptotic concentrations and/or background conditions will be used to determine the completion of the remedial program provided such concentrations do not impact other receptors.
- Provide added assurance that residual soil vapors will not impact the proposed schools.

The primary remedial action will be the installation and operation of an air sparging/soil vapor extraction (AS/SVE) system to remediate Site groundwater and any remaining residual soil concentrations. This system provides for the most cost-effective means of remediating the Site. The recommended AS/SVE system incorporates design parameters that result in an aggressive approach

to remediate the Site. Following completion of the AS/SVE treatment, any remaining residual contamination will be further remediated by natural attenuation. Although significant removal of the sources of soil gas will be accomplished by the AS/SVE system, inclusion of a vapor barrier and passive ventilation system under the school buildings is recommended as an added safeguard.

Verification that the Remedial Response Objectives have been met will be accomplished through periodic soil gas and groundwater monitoring during remediation, followed by 12 -24 months of quarterly groundwater monitoring during the post remediation period.

1.0 Introduction

Shaw has been retained by the New York City School Construction Authority to prepare a RAW for the Metropolitan Avenue Site (hereafter referred to as the "Site") located in Forest Hills, Queens, New York. The Metropolitan Avenue Site is the proposed location of future New York City public schools PS 110, IS 167, and HS of Global Communications. In developing this Work Plan, Shaw reviewed all available environmental investigation reports for the Site. Historical and recently acquired information on the contaminated, upgradient properties occupied by Home Depot, Woodhaven Lanes Bowling Alley, and EAC USA, Inc. (former Heidelberg Eastern property), were also reviewed in preparing this Work Plan. Shaw recently completed a Pre-Design Investigation (August 2001) to update the characterization of the nature and extent of Site groundwater contamination, and completed computer modeling and pilot testing in September 2001 and October 2001. Based on this review and recent data obtained, Shaw has proposed an aggressive remedial strategy that will remediate contamination to regulatory levels, where practical. A Preliminary Remedial Design Report which describes the remedy has been submitted as part of this RAW.

1.1 Site Location

The Site is comprised of two adjoining properties located at 87-01 69th Avenue and 92-34 Metropolitan Avenue, east of the intersection of Metropolitan Avenue and Woodhaven Boulevard, in Forest Hills, Queens County, New York (see Figure 1). The irregularly-shaped Site consists of Block 3886, Lots 800 and 830, and measures approximately 8.25 acres in size (see Figure 2). The Site is located in a neighborhood of private residences, and commercial and industrial establishments. The Site and nearby properties to the west have long been utilized for commercial manufacturing and industrial activities.

1.2 Site History

The property at 87-01 69th Avenue was at one time the site of a warehouse and office facility for the HJ Heinz Company, which operated a food distributorship. The Heinz facility was initially identified on a Sanborn Fire Insurance Map from 1950. At one time, the property contained two structures; one which served as a warehouse building (southern structure), while the other served as an office building (northern structure). Figure 3 shows the locations of the former site structures. The office building also served as a vehicle maintenance area associated with a funeral escort service. Both structures were of single-story brick construction with poured concrete floors. The buildings and floor slabs have since been demolished and removed.

The property located at 92-34 Metropolitan Avenue was at one time the site of All-County Lumber. The property is a small trapezoidal-shaped parcel located at the northern tip of the former HJ Heinz property. This property at one time contained three structures which served as the main lumber/hardware store, and two open storage sheds. The storage sheds appear to have been used for piping and lumber storage. A Sanborn Fire Insurance map from 1936 identifies the Central Foundry Company occupying the property of what is presently known as the All-County Lumber property. It

is reported that the Central Foundry Company sold plumbing materials and supplies. A 1995 Sanborn Fire Insurance Map designates the property as a lumberyard. The time frame in which the Central Foundry Company became the All-County Lumber Company is not known.

A portion of the Site was also used by a coal supply company. Activities such as fuel storage in both above ground and underground storage tanks and vehicle maintenance occurred at the Site. Additionally, conditions at the Site may have been affected by off-site activities including:

- Asphalt spill(s).
- Soil storage on the Site from the adjacent New York City Department of Transportation (NYCDOT) facility.
- Contamination associated with leaking underground storage tanks at nearby gasoline filling stations.
- Contamination from other off-site industrial/commercial establishments.

1.3 Purpose and Organization of Work Plan

This Work Plan was prepared to summarize the historical and recent environmental quality data on the Site and adjacent properties, and provide a plan for Site remediation. Sections 1 through 4 provide the background for the remedy proposed in Section 5. Sections 6 and 7 provide a remedial action scope of work and implementation schedule, respectively. Section 8 summarizes conclusions and recommendations.

2.0 Site Characterization Activities

2.1 Preliminary Investigations Conducted by the Current Site Owner

The current property owner (Forest City Ratner Companies) retained the services of AKRF, Inc., to conduct a Phase I Environmental Site Assessment (ESA) and a Phase II Subsurface Investigation (SI) of the Site. These activities were conducted between May 1995 and August 1996.

2.1.1 Phase I Environmental Site Assessment

The Phase I ESA performed by AKRF in February 1996, consisted of a site visit and review of database files regarding the past uses of the Site. The recognized environmental conditions (RECs) identified in this Phase I ESA included:

- Historical industrial use of surrounding areas.
- Underground storage tanks (USTs) and known leaking USTs on surrounding properties.
- Adjacent NYCDOT garage and asphalt plant and large pile of asphalt-making materials.
- Presence of existing groundwater monitoring wells.
- Known and potential presence of on-site aboveground and underground storage tanks.
- Suspect asbestos-containing material (ACM) in the former Heinz Co. structures and in the basement of the All-County Lumber building.

Based on the RECs identified in the Phase I ESA, AKRF recommended the following:

- Locate, redevelop, and sample any existing monitoring wells.
- Perform tightness testing of the fuel oil tanks and clean up any spills.
- Close an unregistered 5,000-gallon fuel oil tank.
- Conduct electromagnetic study to determine the location of USTs.
- Conduct a comprehensive Phase II investigation of soil and groundwater.

2.1.2 Phase II Site Investigation and Results

The Phase II Site Investigation (SI) was performed to assess potential environmental contamination at the Site identified during the Phase I ESA. The Phase II SI included an

electromagnetic (EM) survey for locating USTs, assessment of soil conditions through test pits and soil sample collection and analyses, and assessment of groundwater conditions through the installation of four monitoring wells.

The EM survey was conducted at three areas of the Site, designated as Segments 1, 2 and 3 (see Figure 3). Anomalies suggestive of the presence of a buried UST or other metallic objects were observed in Segments 1 and 2. However, the EM survey revealed no evidence of USTs at the Site.

Ten test pits were excavated to collect soil samples for chemical analysis and to evaluate the subsurface conditions (see Figure 3). One composite soil sample from each test pit was analyzed for Target Compound List (TCL) volatile organic compounds (VOCs) and priority pollutant (PP) metals. Also, one grab sample was collected from 1 to 4 feet below ground surface, and was analyzed for the same parameters plus TCL semi-volatile organic compounds (SVOCs).

Test pit locations are depicted in Figure 3, and analytical results are provided in Tables 1A through 1E. Ethylbenzene, xylenes and various polycyclic aromatic hydrocarbons (PAHs) were detected in the grab sample collected from TP-2. The sample also contained elevated concentrations of metals, particularly arsenic. Low concentrations of 1,1,1,trichloroethane (TCA), were reported in the grab and composite samples collected from TP-9 and in the composite sample collected from TP-10.

Four monitoring wells were installed to a depth of approximately 75 feet (MW-1 through MW-4) and were sampled and analyzed for TCL VOCs and PP-metals (see Figure 3). The results of this analysis are provided in Tables 1F and 1G. Sample results indicated the presence of certain VOCs in the groundwater beneath the Site. VOCs were detected in the groundwater samples from monitoring wells MW-1 and MW-3, where TCA was reported at concentrations of 180 parts per billion (ppb) and 570 ppb, respectively. The NYSDEC groundwater quality standard (GWQS) for TCA is 5 ppb. Low concentrations of chlorinated VOCs, specifically 1,1-dichloroethene (DCE), 1,1-dichloroethane (DCA), and tetrachloroethene (perchloroethene or PCE) were also detected in these wells. TCA in the sample collected from monitoring well MW-4 was detected at a concentration equivalent to the groundwater standard.

Dissolved (filtered) metals analysis indicated that all ground water samples were in compliance with the NYSDEC groundwater standards. As expected, the concentrations of total (unfiltered) metals were significantly higher, and some metals exceeded the applicable standards. This was attributed to the presence of suspended material (clay and/or silt particles) in the unfiltered samples rather than an indication of groundwater

contamination. The presence of TCA was attributed to the migration of contamination beneath the Site from sources located off-site to the west.

2.2 Initial Site Investigations Performed by the NYCSCA

In March 1998, NYCSCA retained Roy F. Weston, Inc. (Weston), to conduct a Phase I ESA of the Site, as well as a Phase II ESI. The findings of these investigations are detailed in a Weston report, dated March 6, 1998. A summary of the ESA and ESI conducted by Weston is presented in the following sections:

2.2.1 Phase I ESA

The Phase I ESA was performed to assess the historical and current property usage to identify areas of potential environmental concern. The findings and conclusions presented in the Phase I ESA necessitated the development and implementation of a Phase II ESI to further investigate environmental conditions at the Site (details of the findings are described in the documents referenced in the Bibliography. RECs identified by Weston included:

- Potential presence of USTs
- Presence of ASTs
- Soil stockpiles
- Widespread garbage

2.2.2 Phase II ESI

The Phase II ESI consisted of a geophysical survey using electromagnetic (EM) and ground penetrating radar (GPR) to locate USTs, excavation of test pits, and chemical analysis of soil samples. Also included was the installation of 4 monitoring wells and the chemical analysis of groundwater samples.

2.2.2.1 Geophysical Investigation

EM and GPR were used to investigate for USTs (see Figure 4). No evidence of USTs was discovered.

2.2.2.2 Test Pit Excavation and Soil Sample Collection

Six test pits (WTP-1 through WTP-6) were excavated as shown in Figure 4. One soil sample was collected from each test pit and submitted for VOCs, SVOCs, and metals analysis. Table 2A provides a summary of the test pit analytical results.

No olfactory or instrumental evidence of contamination was detected in the Site soils at any of the test pit locations. The analytical results of the soil samples

collected from test pits TP-1 through TP-4 indicated the presence of low concentrations of trichloroethene (TCE), 1,1,2,2-tetrachloroethane and metals (see Table 2A). The analytical results of the soil samples collected from test pits TP-5 and TP-6 reported low levels of certain VOCs, SVOCs and metals.

2.2.2.3 Groundwater Monitoring Well Installation and Sample Collection

Four monitoring wells (SCA-1 through SCA-4) were installed to a depth of approximately 75 feet (see Figure 4). One soil sample was collected from each borehole from immediately above the groundwater table. Table 2B provides a summary of the soil boring analytical results. The groundwater analytical results are presented in Table 2C. The soil samples were submitted for VOCs, SVOCs, and metals analysis. Groundwater samples were collected from the 4 monitoring wells. Figure 5 indicates the groundwater elevations for each well. Groundwater flow is indicated to be to the southeast (see Figure 6).

TCA and PCE were reported at concentrations that exceeded the NYSDEC groundwater quality standards, as did several metals (see Table 2C). Based on the distribution and concentrations of the detected compounds, the presence of PCE was attributed to an off-site source located to the west of the Site. The presence of the metals was attributed to the occurrence of suspended particulates (i.e., clay and/or silt) in the analyzed water sample.

2.3 Supplemental On-site Investigations

In October 1999, at the direction of NYCSCA, Weston implemented additional investigations at the Site to further evaluate subsurface conditions. These activities included groundwater sampling and analysis, soil gas collection and analysis, and a test pit/soil-boring program. Each of these supplemental investigations, and the corresponding results, are discussed in the following sections. The results of these investigations were presented in The Final Site Characterization Summary Report, dated January 18, 2000.

2.3.1 Groundwater Investigation

During October 1999, groundwater samples were collected from 8 monitoring wells located at the Site (see Figure 6). The groundwater samples were analyzed for TCL VOCs, TCL SVOCs, and Target Analyte List (TAL) metals. In November 1999, a second round of groundwater sampling was conducted (see Figure 6). A summary of groundwater analytical results from 1996 to 1999 is presented in Table 3.

Chlorinated VOCs have been detected in the groundwater at the Site since the first sampling event conducted in 1996. The detected chlorinated VOCs include chloroform;

TCE; PCE; TCA; 1,1-DCE; 1,1-DCA; trans-1,2-DCE; and cis-1,2-DCE. Two other VOCs detected in the samples, methylene chloride and carbon disulfide, were attributable to laboratory contamination and were not considered to be representative of groundwater quality. Low levels of toluene, xylenes, and DCE were also detected.

TCE, PCE, TCA, 1,1-DCA, and cis-1,2-dichloroethene were each detected in at least 1 groundwater sample at concentrations greater than their respective NYSDEC groundwater standards. The current standard for each of these constituents is 5 ppb. The highest detected concentrations exceeding the standards during the 1999 first and second round sampling, respectively, were:

- PCE – monitoring wells SCA-1A (79 µg/l), SCA-7 (25 µg/l), and SCA-8 (160 µg/l).
- TCA – monitoring wells SCA-2 (320 µg/l) and SCA-3 (300 µg/l).
- 1,1-DCE – monitoring wells SCA-2 (26 µg/l) and SCA-3 (45 µg/l).

Weston concluded that the PCE in groundwater at the Site is from one or more of the documented sources of VOCs in groundwater west and northwest of the Site (the Home Depot and an unknown source area around the Woodhaven Lanes Bowling Alley - see Figure 7). The highest concentrations of PCE in groundwater underneath the Site were detected in 3 monitoring wells (SCA-1A, SCA-7 and SCA-8) located in the southwest corner of the Site adjacent to the Home Depot property.

The second documented source of groundwater contamination was the PCE plume beneath the area around the Woodhaven Lanes Bowling Alley (see Figure 7), as detected in SCA-5 at 4.7 ppb in October 1999. Low levels of TCA were also detected further downgradient between SCA-5 and the former Heinz warehouse, as detected in SCA-4 (9 ppb) and SC-4A (10 ppb). However, PCE was not detected in these wells. Comparison of the historic 1998 groundwater data to the two sampling rounds conducted by Weston in 1999 (Table 3) indicated that groundwater quality in the vicinity of monitoring wells SCA-4 and SCA-4A had not changed, suggesting that only the leading edge of the PCE plume had migrated onto the Site as far as SCA-5.

SVOCs were not detected in any of the groundwater samples, either during the October 1999 or previous sampling rounds. Accordingly, the November 1999 groundwater samples were not analyzed for SVOCs. The only metals that exceeded their respective standards for the first sampling event were iron, magnesium, manganese, and sodium.

2.3.2 Soil Gas Investigation

In December 1999, a soil gas investigation was conducted by Weston to locate suspected on-site source area(s) for the TCA found in groundwater. The soil gas sampling locations are depicted on Figure 8.

TCA was found in soil gas centering on the northern side of the former warehouse building footprint, as depicted on Figures 9 and 10. Soil gas data are provided in Table 4. PCE was detected in soil gas at lower concentrations than TCA, as depicted on Figures 11 and 12.

2.3.3 Soil Investigation

2.3.3.1 Geoprobe Soil Borings and Test Pits

Based upon the findings of the soil gas sampling, a comprehensive soil investigation consisting of soil borings and test pits was conducted by Weston during December 1999 and January 2000. All soils encountered were field-screened for the presence of organic vapors. All soil samples selected for laboratory analysis were analyzed for TCL VOCs. Boring locations are depicted on Figure 13. TCA concentrations are shown on Figure 14. Field screening results are presented in Table 5. Test pit locations are shown on Figure 15. Analytical data from the test borings and test pits are presented in Table 6 and Figure 21.

These investigations delineated a small area at the northern edge of the former Heinz warehouse with levels of TCA in the soils above NYSDEC's generic recommended soil cleanup objectives for the protection of groundwater quality listed in NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) No. 4046, dated January 1994. Two test pits (TP-1 and TP-15) delineated the contaminated area. Constituents detected above the TAGM guidance values were TCA (890 to 82,000 ppb), DCA (260 to 21,000), PCE (9,100 ppb), and xylene (14,000). The corresponding guidance values for these constituents are 800 ppb, 100 ppb, 1,400 ppb, and 1,200 ppb, respectively.

2.3.4 Geoprobe Groundwater Sampling

Weston collected 4 groundwater samples from geoprobes in November 1999 to supplement the monitoring well data and to determine the concentration of TCA in the groundwater beneath the footprint of the former warehouse (Figure 16). Groundwater samples were analyzed for TCL VOCs. Analytical results are presented in Table 3 with the monitoring well data from the same month. Figure 6 depicts the distribution of VOCs reported for this sampling effort.

The collective groundwater data from the November 1999 geoprobe and monitoring well samples (Table 3) indicate that TCA is distributed across a wide area of the Site. (Figures 17 and 19). The contaminant distribution in groundwater beneath the Site indicates that the primary source of TCA was located beneath the former Heinz warehouse. In contrast, PCE is limited to the northwestern and southwestern corners of the Site (Figure 18).

2.3.5 Soil Removal Activities

During July and August of 2000, the current owner of the Site (Forest City Ratner Companies) conducted additional investigation activities to define the extent of the TCA contamination in soil. The contaminated soil, including the areas in Weston's TP-1 and TP-15 (Section 2.3.3), was subsequently excavated and disposed of at an off-site location. Detailed discussions pertaining to this activity are provided in correspondence to the NYCSCA dated December 7, 2000, and from an AKRF letter (Final Report-Soil Removal) dated September 29, 2000 (see Bibliography).

Excavation activities were initiated on or about August 16, 2000, and were completed on August 31, 2000. During excavation, strong solvent-like odors were reported. Consequently, the limits of the excavation were increased both horizontally and vertically to remove the organic-contaminated soil. The excavation area and sample locations are depicted on Figures 20, 22, and 23. The apparent source of contamination was the warehouse drain system, encountered and removed during the excavation of contaminated soil. Approximately 436 tons of contaminated soil was removed (AKRF, September 29, 2000).

Soil samples for chemical analysis of VOCs were collected by AKRF and Weston during the soil removal activity to determine the level of residual VOCs remaining after the excavation. Based on data available to date, approximately 14 final confirmatory samples were analyzed by AKRF (on behalf of the owner) and 10 confirmatory samples (including 4 split samples) were analyzed by Weston, who witnessed the excavation for NYCSCA. Weston's analytical results are presented in Table 7. In Weston's post-excavation samples, all VOCs were reported as not detected or reported at concentrations below the generic NYSDEC Recommended Soil Cleanup Objectives listed in TAGM No. 4046. The available AKRF data (September 29, 2000) indicated that most of their samples (12 out of 14) were below the TAGM levels for TCA and PCE, with 2 samples exhibiting slightly higher levels than recommended in the TAGM.

2.3.6 Pre-Design Groundwater Investigation

In August 2001, IT Corporation conducted a pre-design investigation at the Site to further evaluate subsurface conditions. This investigation entailed a drilling program to characterize

subsurface stratigraphy and to obtain groundwater samples to assess the current nature and extent of contamination. Borings and geoprobes were completed to obtain groundwater samples at shallow (upper 10 feet of the aquifer), intermediate (50 to 60 feet below water table), and deep (80 to 90 feet below water table) intervals in the aquifer system at the Site. Existing monitoring wells were also sampled. Figures 31 through 36 depict the results of the investigation.

The complete Pre-Design Groundwater Investigation Report is provided in Appendix A. The results of the investigation are summarized below:

- Groundwater at the Site occurs under unconfined conditions at depths ranging from 50 to 65 feet below ground surface, and flows at an estimated rate of 0.005 ft/day in a southerly direction.

- No Dense Non-Aqueous Phase Liquids (DNAPLs) exist at the Site.

- The highest concentrations of TCA (370 ug/l) and PCE (1,100 ug/l) observed in August 2001 are in the immediate vicinity of the former on-site source. Background concentrations of TCA and PCE attributable to off-site sources were observed in August 2001 at or below 35 ug/l and 29 ug/l, respectively.

- The concentrations of TCA are highest in the shallow aquifer zone, with significant reduction in concentration in the intermediate and deep aquifer zones, as well as in the downgradient direction of groundwater flow.

- PCE concentrations are highest in the shallow and intermediate aquifer zones with significant concentration reduction in the deep aquifer zone and the downgradient direction of groundwater flow.

- TCA and PCE in the deep aquifer zone may be partially attributable to upgradient off-site sources, as well as migration due to vertically downward hydraulic gradients.

3.0 Evaluation of Off-Site Environmental Conditions

A review of historical records and documentation relating to the environmentally impacted properties in the vicinity of the Site was conducted by Weston, as previously discussed. This review identified the presence of documented areas of groundwater contamination in the area adjacent to, and northwest of the Site. These areas include the property of a recently constructed Home Depot facility and associated parking lot, and the area in and around the Woodhaven Lanes Bowling Alley. The locations of these properties in relation to the Site are depicted on Figure 24.

As part of this evaluation, IT also reviewed recently acquired groundwater data on the Home Depot and Woodhaven Lanes Bowling Alley investigations that was not available during earlier environmental assessments of the Site.

Detailed information pertaining to these properties is provided in the documents referenced in the Bibliography. The following sections provide a summary of current environmental conditions existing at the aforementioned off-site properties.

3.1 Woodhaven Lanes Bowling Alley Property

The Woodhaven Lanes Bowling Alley is located northwest of the Site (see Figure 24). Investigations conducted to date at this location, and those in the immediate vicinity, have identified PCE contamination in the groundwater. Historically, the concentration of PCE in the groundwater downgradient from the Woodhaven Lanes Bowling Alley was reported as high as 33,000 ppb (see Figure 7).

As a result of the contamination found at this property, the owners (EAC-USA), under the Voluntary Cleanup Program (VCP) with NYSDEC, extended the investigations to adjacent properties to determine the source and extent of the PCE contamination. The expanded investigation included the Sports Authority property to the south and the Metropolitan Avenue Building to the east. These investigations delineated the horizontal extent of the PCE plume to the east and south, but did not identify the source of the PCE. The owners contended that the PCE source area was up-gradient of these properties and, given the absence of a source on these properties, requested "No Further Action" from NYSDEC.

As a follow-up to the investigations at the Woodhaven Lanes Bowling Alley and the two EAC-USA properties, NYSDEC conducted a series of soil and groundwater investigations to locate the potential source area(s) of the PCE plume. These investigations were conducted during the spring and summer of 1997 on the property currently occupied by the Sports Authority Building, the Woodhaven Lanes Bowling Alley Property, and the Woodhaven Boulevard and Metropolitan Avenue intersection. The investigations also included an area to the northwest, on and around the May Dry Cleaner establishment.

In late summer and fall of 2000, NYSDEC performed additional investigations to determine the PCE source area. This investigation consisted of the installation of 5 shallow and 7 deep monitoring wells. Figure 25 shows the locations of the wells installed under this program. The shallow monitoring wells were installed to depths ranging from 50 to 60 feet. The deep wells were installed to depths ranging from 85 to 145 feet.

Groundwater samples were collected from 12 new monitoring wells (5 shallow and 7 deep) and 11 existing wells. Each sample was analyzed for TCL VOCs by Method ASP 95-1. A summary of the analytical data is provided in Table 8. Only trace concentrations of PCE (2 ppb) were detected in 2 wells located on the Site (MW-111 and SCA-4A). These wells are closest to the Woodhaven Lanes property. In addition, groundwater from only 1 out of 3 monitoring wells (MW-108, 109, and 110) located on the western border of the Sports Authority parking lots was detected at a trace concentration of 3 ppb (MW-109). Both MW-108 and SCA-4A are screened at approximately 55 feet; the remaining wells are screened at depths of 85 to 110 feet. These data indicate that the PCE plume is not significantly impacting shallow or deep groundwater at the Site.

Synoptic water level measurements indicated the groundwater elevation to be relatively flat in the area. In addition, the data indicated the presence of a groundwater divide, which may be redirecting migration of PCE-contaminated away from the Site. Groundwater gauging data for the Woodhaven Lanes is provided in Table 9.

Based on the new NYSDEC investigation, the following conclusions can be inferred with regard to the Woodhaven Lanes property: 1) the groundwater beneath the Site is being minimally impacted by the PCE contaminant plume at the Woodhaven Lanes Bowling Alley; and, 2) levels of PCE in the groundwater at the northern end of the Site have decreased over time, indicating that continued migration of PCE onto the Site is not occurring.

3.2 Home Depot Property

The Home Depot Property includes the area bounded by the LIRR rights-of-way, Woodhaven Boulevard, and the Woodhaven Boulevard Building. The Home Depot was constructed in the mid-1990s, and the property itself was utilized for industrial and commercial purposes since 1914. In or about early 1997, two of the current property owners at that time entered into a Voluntary Cleanup Agreement (VCA) with the NYSDEC to investigate and resolve environmental issues at the property.

The previous investigations of the Home Depot Property identified the presence of substantial PCE contamination of both the soil and groundwater. Figure 7 depicts soil and groundwater analytical data for the Home Depot, as well as certain properties to the north as of August 1998. Concentrations of PCE in the soil and groundwater were reported as high as 8,000,000 ppb and

24,000 ppb, respectively, at that time. PCE was concentrated in the southwest corner of the Home Depot property and decreased to 650 ppb towards the eastern border of the property.

Figure 26 depicts a cross-section of the Home Depot property, and Figure 26A shows the locations of soil borings and monitoring wells. Based on a review of the Home Depot files, the analytical data representative of soil quality conditions beneath the PCE source area indicate that the highest concentrations of PCE occur within the upper 10 feet of soil underlying the Home Depot property. This information suggests an absence of PCE source material at depth.

Monitoring well MW-4 was drilled to a depth of 159 feet bgs. The analytical results of the soil samples from this boring indicate the presence of PCE at concentrations that do not exceed the TAGM guidance value. Chemical analysis of a groundwater sample from monitoring well MW-4 from a depth of approximately 145 to 155 feet bgs reported PCE at a concentration of 70 ppb, which is substantially less than the PCE concentrations reported for the groundwater samples collected from the shallow monitoring wells.

Several cleanup activities have been implemented at the Home Depot Property. These activities include the excavation and removal of 4,500 cubic yards of PCE-contaminated soil from the footprint of the new building in July-September 1998; the installation and operation of a soil vapor extraction (SVE) system to remove PCE and other VOCs from the deeper soils; and the installation and operation of an air sparging system along a portion of the western and southern property boundaries to remediate organic contamination in the groundwater. These remedial systems were initiated in April 1999 and were fully operational for the entire property by October 1999.

As part of an agreement between Home Depot and the NYSDEC, Home Depot is not responsible for the remediation of contaminated groundwater that has migrated beyond its property boundary. Therefore, the groundwater remediation system in operation is not designed to recover groundwater contamination that has moved beyond the property boundaries and onto the southwest corner of the Site.

Since the Home Depot remedial measures were implemented, there has been considerable improvement in groundwater quality. The groundwater analytical results from the most recent groundwater-sampling event (March 2001) at the Home Depot site have been included on Figure 27. A review of the data indicates that PCE concentrations on the eastern boundary of the Home Depot property are present at levels below 10 ug/l (Wells P-5 and P-8). These concentrations are considerably lower than the PCE levels detected in groundwater samples collected in 1999 from the southwest area of the Site, adjacent to Home Depot (Table 3 and Figure 27). The August 2001 data also indicate a decline in PCE levels in Site groundwater in this same area, as observed in SCA-1A and SCA-8 (Figure 35).

The current presence of low concentrations of PCE at the eastern boundary of the Home Depot property suggest that the migration of significant levels of PCE onto the Site is no longer a concern. These findings will be confirmed by performing additional rounds of groundwater sampling during the design and remediation phases.

4.0 Impact of Site Contaminants on Proposed Use

4.1 Contaminants of Concern and Extent of Contamination

The principal contaminant of concern (COC) for the Site is TCA in groundwater and soil, and PCE in groundwater. TCA and PCE were detected in groundwater along the westerly boundary of the site (Figures 33 and 36). The presence of TCA and PCE in this area is a background condition. Both the Woodhaven and Home Depot sites have documented significant PCE contamination in groundwater, and are situated hydraulically upgradient of the Metropolitan Avenue site. The Home Depot property has also exhibited similar levels of TCA to those observed along the western side of the Site.

4.1.1 Groundwater

The current extent of TCA and PCE contamination in Site groundwater is depicted in Figures 33 through 36. The analytical data used to prepare these figures are provided in Appendix A.

4.1.2 Soil

Soil contaminated with TCA was localized, and limited to, the northern side of the former Heinz warehouse. The TCA-contaminated soil was removed during July and August 2000 following a soil gas survey that located the impacted area. No PCE was detected in the post-excavation sampling. Some residual TCA contamination in soil at this location may be present beneath the excavation and will be addressed by the proposed remedy.

4.2 Contaminant Fate and Transport

The conceptual model of groundwater flow provides the framework to assess fate and transport of contamination at the site. In this regard, previous contaminant releases at the site have impacted groundwater quality by migrating vertically downward through the glacial soils to the groundwater table. At the groundwater table this contamination migrates in the direction of groundwater flow, which is in a southerly direction (Figures 30 and 32).

The organic contaminants detected in the groundwater at the site are subject to natural attenuation. The term natural attenuation refers to naturally occurring processes in the subsurface environment that reduce mass, toxicity, mobility, volume or concentration of a contaminant without human intervention.

Natural attenuation is recognized by the USEPA as a legitimate remedial approach for groundwater cleanup under Superfund, RCRA Corrective Action, and UST remediation programs.

Natural attenuation mechanisms that reduce organic contamination in groundwater include 5 major processes:

Advection involves transport by bulk movement in groundwater. Once sources of impact are controlled, chemical concentrations will decrease with time as clean water flushes through the system.

Dispersion refers to the spreading of a solute outward from its expected flow path in groundwater primarily due to mechanical mixing. Dispersion is a mechanism for dilution.

Sorption is the process whereby certain chemicals attach to (sorb) and detach from (desorb) particles. Sorption slows down the transport of chemicals in groundwater, and in some cases, can result in complete immobilization.

Volatilization is the mass transfer of dissolved chemicals from a liquid phase to a gaseous phase which leads to a gradual decrease in groundwater concentration.

Degradation refers to the destruction of contamination as a result of microbiological activity through the use of electron donors and acceptors, or via chemical reactions.

While both dispersion and sorption can reduce concentrations in the groundwater, the mass of contamination is still unchanged in the groundwater system. It is either spread out over a larger area and volume of groundwater as in the case of dispersion, or retained or adsorbed on soil colloidal material or organic matter. Both volatilization and degradation are mechanisms which reduce the mass of VOCs in groundwater. Volatilization will reduce mass in the groundwater but this process is considered of minor significance, and only where groundwater is very shallow and where soils are quite permeable. Degradation is by far the more significant mechanism in reducing contaminant mass. Advection, which flushes contaminants from the groundwater system, is also a significant mechanism in reducing contaminant concentration.

The principal organic contaminants at the site are PCE, TCA and 1,1-DCE. Concentrations of TCA have been detected in the hundreds of ppb with a maximum recorded value of 1,400 ppb at the Site. In addition, 1,1-DCE, a derivative of TCA, has been detected in the tens of ppb. The maximum concentration of PCE detected at the Site was 1,100 ppb.

While most of the chlorinated solvents are degraded via biological processes, TCA is the only major chlorinated solvent that can be transformed chemically in groundwater. TCA is chemically transformed by 2 different pathways leading to the formation of 1,1-DCE and acetic acid with the latter pathway being the most predominant. About 80 percent of TCA is transformed to acetic acid with 1,1—DCE comprising the remainder (EPA, 1997, 1998). While it is recognized that 1,1-DCE

can also be a degradation product of PCE, it is a very minor component of this transformation pathway. The presence of 1,1-DCE is considered more indicative of TCA degradation.

PCE and DCE (which is the daughter product of TCA) can be microbially degraded through a process known as reductive dehalogenation, in which the chlorinated solvents act as electron acceptors. PCE degradation occurs via the following pathway: PCE→Trichloroethene→ 1,2-Dichloroethene→Vinyl Chloride→Ethene.

The biological degradation of PCE and DCE is most efficient under anaerobic conditions. However, based on the August 2001 Pre-Design Groundwater Investigation, dissolved oxygen (DO) levels in the groundwater at the Site ranged from about 1-7 mg/l with most of the samples exhibiting DO concentrations of 4-5 mg/l. These DO concentrations are more indicative of an aerobic environment. While localized zones of anaerobic conditions cannot be ruled out, the aerobic nature of the groundwater system suggests that biodegradation would not be a significant attenuation mechanism at the Site. Advection and dispersion would be the predominant natural attenuation mechanisms to reduce contaminant concentrations in the groundwater system at the Site.

5.0 Remedial Action Evaluation

Based on the review of the groundwater and soil analytical data from the Site, and adjacent contaminated properties, a remedial action strategy has been developed to render the Site suitable for the construction of the proposed schools. The proposed remedial action objectives and the specific remedial strategy are described below.

5.1 Remedial Action Objectives

Remedial action objectives (RAOs) are established to ensure that all proposed site remedies are protective of human health and the environment. The RAOs provide a basis on which to select and evaluate remedial alternatives.

VOCs (primarily TCA and PCE) are present in site groundwater, more than 50 feet below the surface. Residual VOCs had been detected in subsurface soils, but most of the contaminated soil has been removed. After school buildings are constructed, the only pathway of concern to school occupants and employees is the potential intrusion of VOC vapors from the subsurface into indoor air. Although there is no current or anticipated use of groundwater at the Site, contaminated groundwater may migrate from the Site to downgradient properties.

The RAOs must therefore be protective of both on-site and off-site receptors and must consider on-site sources.

The RAOs proposed for the site are:

1. **Ensure that on-site contaminant levels in soil and groundwater do not pose unacceptable risks to school occupants.**

   Since there is no use of groundwater at the site and no other potential for school occupants to contact subsurface contaminants, the only potential exposure pathway of concern is vapor intrusion into indoor air.

2. **Reduce current groundwater levels of TCA and PCE to concentrations approaching asymptotic or background conditions.**

   TCA and PCE attributable to the identified on-site source area will be addressed by active groundwater remediation to reduce concentrations to the extent possible.

3. **Achieve New York State Class GA Groundwater Quality Standards at the downgradient property line.**

   The Site and downgradient region overly the recharge zone for Brooklyn-Queens Aquifer (USEPA, 1983), which is a potential source of drinking water. As such, the remedial action

objective is to achieve New York State (NYS) Class GA groundwater quality standards at the downgradient property line.

5.2 Remediation of On-Site Contamination

A remedial strategy for the Site must consider current environmental conditions as they relate to the proposed use of the Site for public schools and the need to satisfy regulatory requirements without reliance on long-term remedial action or monitoring. The proposed strategy for the Site recognizes that off-site sources of contamination are less of a threat to the Site than previously understood. Based on our evaluation of the current environmental data, the following general remedial actions are proposed:

- Remediate residual TCA and PCE in on-site soils with the goal to achieve cleanup levels consistent with TAGM 4046.
- Reduce current groundwater levels of TCA and PCE to concentrations approaching asymptotic or background conditions, to the extent possible. The attainment of asymptotic conditions will be based on concurrence from NYSDEC and NYSDOH who will evaluate the monitoring data.
- Achieve NYS Class GA groundwater quality standards at the downgradient property line. If it is not technically feasible to achieve this objective, due to potential on-site groundwater impacts from off-site sources, then acceptable asymptotic concentrations and/or background conditions will be used to determine the completion of the remedial program, provided such concentrations do not impact other receptors.
- Provide added assurance that residual soil vapors will not impact the proposed schools.

5.2.1 Air Sparging/Soil Vapor Extraction System

Remediation of site groundwater and residual soil contamination will be accomplished through the application of Air Sparging/Soil Vapor Extraction (AS/SVE). This technology is designed to treat the contaminated groundwater plume and contaminated soil through the installation of a series of air sparging wells and soil vapor extraction pipes and/or wells throughout the targeted remediation area. A Preliminary Remedial Design Report describing the remediation system is provided under separate cover.

The AS process involves the injection of air into the aquifer through a series of wells. The injected air forms bubbles within the aquifer, which then come into contact with the dissolved contaminants in the groundwater. The aeration of the water strips the dissolved contaminants from the liquid phase into the vapor phase. SVE is then used to capture and treat the volatilized contaminants as they migrate vertically into the unsaturated zone.

The SVE process consists of applying a vacuum to a system of vertical wells. Once the contaminants are volatilized through the use of air sparging, SVE removes the vapors from the soil, as well as any other residual soil gas that was present prior to air sparging. The collected gas is subsequently treated and discharged in accordance with air quality guidelines.

Based on computer modeling and pilot testing results as described in Appendices A and B in the accompanying Preliminary Remedial Design Report, the proposed AS system would consist of a total of 94 injection wells installed at three different depths to address three different treatment areas. The deepest area of contamination will be classified as Area 1 and be treated with 18 air sparge wells installed to 120 feet below grade or approximately 60 feet into the groundwater. The intermediate area of contamination will be classified as Area 2 and be treated with 20 air sparge wells installed to 90 feet below grade or approximately 30 feet into the ground water. The shallow area of contamination will be classified as Area 3 and be treated with 56 air sparge wells installed to 75 feet below grade or approximately 15 feet into the groundwater. Accordingly, remediation of the aquifer will occur from the top of the aquifer to a depth of 60 feet below the water table, corresponding to the most contaminated groundwater zones as characterized in the August 2001 Pre-Design Groundwater Investigation.

The SVE system would have approximately 14 extraction wells drilled to a depth of 65 feet below grade. Both the AS and SVE components will require the installation of a network of below ground horizontal PVC pipes in order to deliver the air to the wells, and to pull the resultant vapors out of the soil.

The SVE system and the AS system (shallow wells) will both be housed inside the same enclosure. This enclosure will be a modified steel shipping container with a footprint of approximately 8-foot by 40-foot. The walls of this enclosure will be sound attenuated to achieve 80 dB at 1m from the outside of the enclosure.

The SVE system would include a standard skid-mounted extraction blower to capture vapors from all three areas. The capacity of the extraction blower will be 1600 SCFM at 50 inches w.c. vacuum. The soil gas treatment would include the use of two 1,600-pound radial flow activated carbon units connected in series, each capable of airflow rates up to 3,000 SCFM.

The AS system for the deep and intermediate wells will consist of a pre-packaged air compressor with integral sound attenuated enclosure. This compressor will be capable of producing 585 SCFM at 100 PSIG. The AS system for the shallow wells will consist of a skid-mounted rotary lobe type blower with inlet and discharge silencers. This blower will be capable of producing 1100 SCFM at 14 PSIG.

The AS/SVE system will be designed and constructed to be operated following occupancy of the school, if necessary. All piping and support structures will be constructed beneath the vapor membrane barrier and the housing for the blowers and compressors will be housed off-site on adjacent property. The design will allow continued operation of the system without interference with school operations.

The system will also be designed to allow for the attainment of groundwater samples from the Site using a remote sampling station housed in an adjacent off-site property.

The proposed implementation period for the treatment system is 34-52 months following notice to proceed, including 4 months for design and installation, 18-24 months of operation, and 12-24 months of post-operational groundwater monitoring. The system design and operational period are based on model simulations that predict theoretical attainment of the groundwater standard of 5 ug/l for TCA and PCE (Appendix A in accompanying Preliminary Remedial Design Report). The expected effect of AS/SVE treatment, however, is attainment of asymptotic conditions or background within 1.5 years, after which it will no longer be effective to continue operations of the AS/SVE system. However, if after the predicted 18 month period of operation, acceptable levels of PCE and TCA have not been attained, the AS/SVE system will continue operating until contaminant concentrations are reduced to acceptable asymptotic levels or background concentrations. Once suitable asymptotic levels are attained, the system will be shut down. An additional 6 months of operation is assumed to demonstrate that asymptotic conditions have been achieved.

Groundwater monitoring will be performed to demonstrate the absence of any significant rebound and verify the attainment of asymptotic conditions. A minimum of 8 sampling rounds of groundwater quality data will be required to demonstrate that asymptotic conditions have been reached before the system can be permanently shut down. The attainment of asymptotic conditions will be based on concurrence from NYSDEC and NYSDOH who will evaluate the monitoring data.

5.2.1.1 Implementability and Effectiveness

AS/SVE is a proven technology that has been applied frequently at sites contaminated with volatile organic compounds. Due to the presence of sandy soils and the volatility of Site contaminants, AS/SVE will be effective in aggressively remediating groundwater and soil contamination at the site. The proposed configuration of sparging wells will ensure maximum coverage and cleanup in the shortest possible time.

System components are proposed to be supplied by a design/build remediation contractors. A design/build approach is proposed to expedite installation and cleanup at the site.

AS/SVE treatment system operations are simple and only require minimal maintenance of blowers and carbon treatment units. In order to ensure optimization and continued maximum contaminant removal, the treatment system will be manned twice weekly and also monitored by an automated system. Continuous monitoring can provide for early carbon breakthrough detection and reduce the chance of downtime due to an emission exceedance.

Groundwater quality and soil gas will be monitored as described in Section 6.2.

5.3 Proposed Remedial Action

The remedial plan for the Site consists of the following:

- Installation of an air sparging and soil vapor extraction system that encompasses the areas of contaminated soils and groundwater (above background) beneath the Site.
- Operation of the treatment system to achieve asymptotic conditions or background, to the extent possible, for TCA and PCE in groundwater. Attainment of asymptotic conditions will be based on concurrence from NYSDEC and NYSDOH.
- Achieve Class GA groundwater quality standards at the downgradient property line. If it is not technically feasible to achieve this objective, due to potential on-site groundwater impacts from off-site sources, then acceptable asymptotic concentrations and/or background conditions will be used to determine the completion of the remedial program, provided such concentrations do not impact other receptors.
- Monitoring of groundwater and soil gas at the Site during remediation, and the monitoring of groundwater during post remediation to assess the effectiveness of the treatment system.
- Incorporation of engineering controls, consisting of a flexible vapor membrane barrier and passive ventilation system, into the new schools construction's plans as an added safeguard against the remote possibility of residual vapors migrating into the buildings. Details of this system are provided in the Preliminary Remedial Design Report (see Sheet C-3).

6.0 Remedial Action Scope of Work

6.1 Pilot Study for AS/SVE

An air sparge – soil vapor extraction (AS/SVE) pilot test was conducted at the Site in order to allow the full scale system design to be optimized. This report is in Appendix B of the accompanying Preliminary Remedial Design Report.

The program consisted of installation of pilot test wells, performing AS/SVE pilot tests, and preparation of a summary report. All work was performed pursuant to the Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP).

The location and setup of the pilot test is shown in Figure 37. Based on the results of the pilot test, the following system design parameters are recommended:

- SVE flow rate of 110 cfm per well
- SVE Radius of Influence (ROI) of 80 feet
- Maximum SVE well head vacuum of 3" H2O
- AS well head pressure for deep sparge wells (2 ft. screen, 60 ft. into groundwater) of 25.5 psi with a corresponding flow rate of 14 cfm per well
- ROI for the deep sparge wells of 18 feet
- AS well head pressure for intermediate sparge wells (2 ft. screen, 30 ft. into groundwater) of 12.5 psi with a corresponding flow rate of 14 cfm
- ROI for the intermediate sparge wells of 22 feet
- AS well head pressure for shallow sparge wells (2 ft. screen, 15 ft. into groundwater) of 9.5 psi with a corresponding flow rate of 14 cfm
- ROI for the shallow sparge wells of 25 feet

The final design recommendations determined from the pilot test confirm the ROI predictions for the AS and SVE wells presented in the September 24, 2001 Computer Modeling and Attainable Cleanup Concentrations report (Appendix A in the accompanying Preliminary Remedial Design Report). The ROI recommendations determined from the pilot test fall within the range of 18-25 feet determined from the model. Both the pilot test results and the results of the computer model have provided the information to support the preliminary design of the AS/SVE system. The complete computer modeling and pilot test reports and the preliminary remedial design of the AS/SVE system is provided in the accompanying Preliminary Remedial Design Report.

6.2 Monitoring Plan

6.2.1 Soil Gas

Soil gas (vapor) monitoring will be a component of the AS/SVE operation and monitoring (O&M) program. Sampling ports have been incorporated into the design of the soil vapor extraction system, and will be accessed from the treatment facility. A monitoring program to assess the effectiveness of the system in extracting VOCs from the subsurface soils has been presented in the Preliminary Remedial Design Report, and is described in the Draft O&M Plan. In addition, vapor monitoring of the passive ventilation system (which will be constructed beneath the school building foundations) will also be performed.

All vapor sampling will be performed within the timeframe of AS/SVE operations until it is demonstrated that the system has been effective in remediating site soils, and NYSDEC approves the termination of system operations. No post-remediation vapor monitoring will be performed following final system shutdown.

6.2.2 Groundwater

In addition to the baseline groundwater quality characterization determined during the Pre-Design Investigation (Appendix A), groundwater sampling will be performed on a periodic basis during the operation of the AS/SVE system to assess the effectiveness of the remediation. Sampling will be performed until it is demonstrated that acceptable asymptotic levels of PCE and TCA have been attained and that no rebound has occurred. Following the permanent shutdown of the AS/SVE system quarterly monitoring will be performed for 1 -2 years to demonstrate further reduction of any residual contamination through natural attenuation processes.

The groundwater sampling program will include 15 monitoring wells at locations upgradient and at the downgradient property boundary as well as within the main plume. Existing monitoring wells to be included in the plan are as follows: SCA-5, SCA-6, SCA-1A, SCA-8, SCA-3, SCA-9S, 9I, 9D, and SCA-2. In addition, new monitoring wells will be installed to complete the monitoring program. Proposed monitoring locations are shown in the Preliminary Remedial Design Report. Groundwater sampling results will be submitted to NYSDEC on a quarterly basis upon receipt of the analytical results.

Quarterly monitoring data obtained from those installations upgradient and along the western property line will provide a database of background contaminant concentrations. A mean value for each contaminant will be calculated for each well. The highest mean values will be used as the background concentration.

Details of the groundwater monitoring program, including installation of new wells and sampling and analysis methods, are provided as part of the QAPP and O&M plan prepared for the Site.

7.0 Implementation Schedule

The anticipated implementation schedule for the proposed remedial action, following notice to proceed, is as follows:

AS/SVE Design/Installation	4 months
Operation of AS/SVE System	18-24 months
Groundwater and Soil Gas Monitoring During AS/SVE Operation	Quarterly
Closure Activities and Post Operational Monitoring	12-24 months
Total Timeframe	**34-52 months**

8.0 Conclusions and Recommendations

Conclusions and recommendations based on Shaw's assessment of Site environmental data and the design analyses presented in this RAW are as follows:

- The groundwater at the Site is contaminated with TCA and PCE. The on-site source of TCA and PCE was contaminated soil at the northern end of the former Heinz building warehouse, as a result of an apparent leak in the building's drain system. The majority of contaminated soil was removed by excavations conducted by the property owner in July and August 2000.
- The highest concentrations of TCA (370 ug/l) and PCE (1,100 ug/l) observed in August 2001 sampling, are in the immediate vicinity of the former source. Background concentrations of TCA and PCE attributable to off-site sources were observed in August 2001 at or below 35 ug/l and 29 ug/l, respectively.
- Contrary to previous reports, recently acquired data from ongoing NYSDEC investigations indicate that the PCE plume in groundwater beneath the Woodhaven Lanes Bowling Alley is not anticipated to impact the Site at levels that would adversely impact indoor air quality in the schools. Therefore, no remedy is required to protect the Site from this plume.
- Historical information from NYSDEC files indicates that concentrations of PCE in groundwater on the Home Depot property have been reduced through active groundwater remediation. It is anticipated that ongoing remedial action at Home Depot will mitigate additional migration of PCE into Site groundwater in the future. Therefore, no remedy is required to protect the Site from this plume.
- The on-site groundwater and soils will be effectively remediated by the installation and operation of an AS/SVE system at the Site. The proposed system will include the installation of 94 injection wells installed at three different depths to address these different treatment areas. Approximately 14 extraction wells will remove the existing and sparged soil gases from the subsurface. The anticipated timeframe for design, construction, operation of the AS/SVE system, and post-operational monitoring, following notice to proceed, is 34-52 months. After completion of the AS/SVE operations, any residual contamination that may remain will be further remediated through natural attenuation (i.e. advection and dispersion).
- Although significant removal of soil gas sources will be accomplished by the AS/SVE system, inclusion of a vapor barrier and passive ventilation system under the school buildings will be implemented as an added safeguard. Details of this system are provided in the Preliminary Remedial Design Report (see Sheet C-3).
- Verification that the Remedial Response Objectives have been met will be accomplished through periodic soil gas and groundwater monitoring during remediation, followed by 12 -24 months of quarterly groundwater monitoring during the post remediation period.

9.0 Bibliography

(1) AKRF, Inc., August 1996. Phase II Environmental Assessment - Metropolitan Avenue Retail Site, Queens, New York.

(2) New York State Department of Health (NYSDOH), March 10, 1999. Letter from Geoffrey J. Laccetti to Vadim Brevdo (New York State Department of Environmental Conservation [NYSDEC]) RE: Proposed New School (P.S. 650Q), Metropolitan Avenue/69th Avenue Site, Queens, New York.

(3) Roy F. Weston, Inc., January 26, 1998. Letter from James G. Nuccio to Kwame Fosu (New York City School Construction Authority [NYCSCA]) RE: Project Summary Update – Proposed New School (P.S. 650Q) at the Metropolitan Avenue/69th Avenue Site.

(4) March 6, 1998. Phase I/Phase II Environmental Site Assessment Report, Future Site Location for Public School 650Q, 87-01 69th Avenue, 92-34 Metropolitan Avenue, Forest Hills, Queens, New York 11375.

(5) December 2, 1998. Letter from James G. Nuccio to Kwame Fosu (NYCSCA) RE: Project Summary Update – Proposed New School (P.S. 650Q) at the Metropolitan Avenue/69th Avenue Site.

(6) December 10, 1998. Letter from James G. Nuccio to Jerry McDonald (NYSDOH) RE: Proposed New School (P.S. 650Q), Metropolitan Avenue/69th Avenue Site, Queens, New York.

(7) December 21, 1999. Summary of Review of Available Reports and Information Regarding the Metropolitan Avenue Site and Adjacent Sites, Forest Hills, Queens, New York.

(8) January 18, 2000. DRAFT Final Site Characterization Summary Report, Proposed Woodhaven Schools, Metropolitan Avenue Site, Forest Hills, Queens, New York.

(9) Roy F. Weston of New York, Inc., December 11, 1998. Letter from James G. Nuccio to Kwame Fosu (NYCSCA) RE: Agency Information Update, Proposed New School (P.S. 650Q), Metropolitan Avenue/69th Avenue Site, Queens, New York.

(10) January 8, 1999. Letter from Charles N. Guder to Kwame Fosu (NYCSCA) RE: Agency Information Update, Proposed New School (P.S. 650Q), Metropolitan Avenue/69th Avenue Site, Queens, New York.

(11) May 5, 1999. Letter from Charles Guder to Alex Lempert (NYCSCA) RE: Summary Letter Report, Proposed New School (P.S. 650Q), Metropolitan Avenue/69th Avenue Site.

(12) June 4, 1999. Letter from Charles Guder to Kelly McKinney (NYCSCA) RE: Conceptual Cost Estimate for Vent System and Recirculating Well Technology, Proposed New School (P.S. 650Q), Metropolitan Avenue/69th Avenue Site.

(13) November 3, 1999. Letter from John W. Rhyner to Kelly R. McKinney (NYCSCA) RE: Groundwater Sampling Results Summary, Proposed School Property, Metropolitan Avenue, Queens, New York.

(14) November 29, 1999. Letter from John W. Rhyner to Kelly R. McKinney (NYCSCA) RE: November 22-23, 1999 Groundwater Sampling Results, Proposed New School Property, Metropolitan Avenue Site, Forest Hills, Queens, New York.

(15) December 1, 1999. Letter from John W. Rhyner to Kelly R. McKinney (NYCSCA) RE: 1st and 2nd Round Groundwater Sampling Results Summary, Proposed School Property, Metropolitan Avenue, Queens, New York.

(16) December 16, 1999. Letter from John W. Rhyner to Kelly R. McKinney (NYCSCA) RE: Preliminary Site Characterization Summary Report, Proposed School Property, Metropolitan Avenue, Queens, New York.

(17) January 6, 2000. Letter from John W. Rhyner to Kelly R. McKinney (NYCSCA) RE: Summary of Findings of Site Characterization Activities, Metropolitan Avenue Site, Glendale, Queens, New York.

(18) January 28, 2000. Letter from John W. Rhyner to Thomas Lang (NYSDEC) RE: Revised Table 2-2 and Groundwater Flow Information, Metropolitan Avenue Site.

(19) April 14, 2000. Letter from John W. Rhyner to Vadim Brevdo (NYSDEC) RE: Groundwater Elevation Information, Metropolitan Avenue Site.

(20) December 7, 2000. Letter from Jennifer Juhas to Alex Lempert (NYCSCA) RE: Documentation of Soil Removal Activities, Metropolitan Avenue Site, Glendale, Queens, New York.

(21) Urbitran Associates, Inc., August 20, 1999. Environmental Assessment Form and Supplemental Environmental Studies, Woodhaven Schools, Forest Hills, Queens

(22) WESTON, December 16, 1999. Fact Sheet – Metropolitan Avenue Site – Proposed Woodhaven Schools Property.

SUPPLEMENTAL INFORMATION PROVIDED BY ROY F. WESTON

(23) AKRF, Inc., October 1996. Voluntary Cleanup Supplementary Sampling Program Report, Home Depot, Rego Park, New York.

SUPPLEMENTAL INFORMATION PROVIDED BY NYCSCA

(24) New York City School Construction Authority, April 12, 2000. Memorandum from Kelly McKinney RE: Meeting Minutes summarizing a meeting held March 22, 2000 at the offices of the Queens Borough President to discuss the proposed new schools at the corner of Metropolitan Avenue and 69th Avenue.

(25) May 12, 2000. Memorandum from Kelly McKinney RE: Teleconference Minutes summarizing a telephone conference held May 1, 2000 regarding the proposed new schools at the corner of Metropolitan Avenue and 69th Avenue.

(26) August 1, 2000. Memorandum from Milo Riverso to Members of the SCA Board of Trustees RE: Requirements for Environmental Remediation, Metropolitan Avenue Site.

(27) New York State Department of Environmental Conservation, April 6, 2000. Proposed PS 650 Q Site.

(28) July 7, 2000. Record of telephone communication regarding groundwater contamination at and adjacent to the Metropolitan Avenue Site.

(29) Weston, September 6, 2000. Comparison of Remediation Approach, Metropolitan Avenue Site.

(30) AKRF, Inc., September 29, 2000. Letter from Mimi Sotiriou, AKRF, to Robert Sanna, Forest City Ratner Companies, on the Final Soil Removal Report for the Metropolitan Avenue Site.

PUBLISHED REFERENCES

EPA 1997. Proceedings of the Symposium on Natural Attenuation of Chlorinated Organics in Groundwater.

EPA Water Programs, 1983. Brooklyn-Queens Aquifer System.

EPA 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water.

10.0 Signatures Of Environmental Professionals

IT Corporation (IT) has prepared this Remedial Action Work Plan (RAW) for the Metropolitan Avenue Site located at 92-34 Metropolitan Avenue and 87-01 69th Avenue, in Forest Hills, Queens County, New York. Qualifications for these individuals are provided in Appendix D.

IT CORPORATION

Steven Goldberg, Ph.D., CPG
Senior Hydrogeologist

August A. Arrigo, P.E.
Senior Engineer
License No. 070843