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December 22, 2006

Mr. Daniel C. Walsh, Ph.D., Chief
Hazardous Waste and
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NYSDEC – DER – Region 2
47-40 21st Street
Long Island City, NY 11101-5407

Mr. Shaminder Chawla
Environmental Engineer
NYSDEC – DER – Region 2
47-40 21st Street
Long Island City, NY 11101-5407

Re: Final Engineering Report
Queens West – Parcel 9, Hunters Point, Queens, NY
NYSDEC BCP Site No. C241049

Dear Mr. Walsh and Mr. Chawla:

On behalf of AvalonBay Communities, Inc., enclosed are the following:

- One hard copy of the Final Engineering Report (FER);
- Two additional electronic copies (Appendix A) of the FER and other project documents; and
- Certification of placement of the FER in the project repositories

A hard copy of the FER has also been forwarded to Dawn Hettrick of the NYSDOH at the time of this submittal. Hard copies of the FER will be distributed to the remainder of the distribution list (cc'd below) during the week of January 2, 2007. Please call me at (914) 922-2356 or e-mail at marc_godick@akrf.com, if you have any questions or require additional information.

Sincerely yours,
AKRF Engineering, P.C.

Marc S. Godick, LEP
Vice President

Enclosure

cc: Alali Tamuno, NYSDEC
Geoffrey Laccetti, NYSDOH
Dawn Hettrick, NYSDOH
Fred Harris, AvalonBay
Fred Brockunier, AvalonBay Communities
Philip Wharton, AvalonBay Communities
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Alex Federbush, QWDC
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Mark Chertok, Sive Paget & Riesel, P.C.
William Seuch, Goulston & Storrs

Queens West Parcel 9
BCP SITE NO. C241049

CERTIFICATION OF PLACEMENT OF PROJECT DOCUMENTS IN AUTHORIZED REPOSITORY

I, Marc S. Godick, certify that I placed complete copies of the Final Engineering Report for the above referenced site in all repositories listed below on December 22, 2006. I also certify that all earlier project documents were placed in the repositories. I hereby certify that all project repositories listed below are complete and in place.

Signature

12/22/06
Date

Marc S. Godick
Printed Name

Repositories Certified as Complete:

1. Community Board 2
2. Long Island City Public Library

Queens West Development
Parcel 9

QUEENS, NEW YORK

Final Engineering Report

NYSDEC BCP Number: C241049

AKRF Project Number: 10516

Prepared for:

AvalonBay Communities
275 Seventh Avenue
New York, New York 10001

Prepared by:

AKRF Engineering, P.C.
440 Park Avenue South
New York, NY 10016
212-696-0670

DECEMBER 2006

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CERTIFICATIONS

I, Michelle Lapin, am currently a registered professional engineer licensed by the State of New York. I had primary direct responsibility for implementation of the remedial program for the Queens West Parcel 9 site (NYSDEC BCP Number: C241049).

I certify that the Remedial Work Plan dated August 2005 approved by the NYSDEC was implemented and that all substantive requests have been complied with.

I certify that the remedial activities were observed by environmental professionals under my supervision and that the remediation requirements set forth in the Remedial Work Plan and any other relevant provisions of ECL 27-1419 have been achieved.

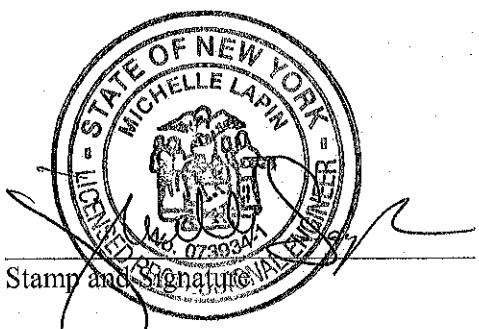
I certify that all use restrictions, institutional controls, engineering controls, and all operation and maintenance requirements applicable to the site are contained in an environmental easement created and recorded pursuant to ECL 71-3605 and that all affected local governments, as defined in ECL 71-3603, have been notified that such easement has been recorded. A Site Management Plan has been submitted by the applicant for the continual and proper operation, maintenance, and monitoring of all engineering controls employed at the site, including the proper maintenance of all remaining monitoring wells, and that such plan has been approved by the Department.

I certify that all export of soil, fill, water, or other material from the property was performed in accordance with the Remedial Work Plan, and were taken to facilities licensed to accept these materials in full compliance with all federal, state and local laws.

I certify that all import of soils from offsite, including source approval and sampling, has been performed in a manner that is consistent with the methodology defined in the Remedial Work Plan.

I certify that all invasive work during the remediation and all invasive development work were conducted in accordance with dust and odor suppression methodology defined in the Remedial Work Plan.

I certify that all information and statements in this certification are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.



073934-1	12/22/2006	
New York State Professional Engineer #	Date	Stamp and Signature

It is a violation of Article 130 of the New York State Education Law for any person to alter this document in any way without the express written verification or adoption by a New York State licensed engineer in accordance with Section 7209(2), Article 130, New York State Education Law.

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Appendix S Remediation Cost Report

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1.0 INTRODUCTION

The Queens West Development is a project of the Queens West Development Corporation (QWDC), a subsidiary of New York State's Empire State Development Corp., under the collective sponsorship of the Port Authority of New York and New Jersey, the New York City Economic Development Corporation, and Empire State Development Corporation. The overall Queens West Development site comprises 74 acres along the East River in Hunters Point, Queens, extending from Anable Basin to the north to Newtown Creek to the south (Figure 1). Stage I of the development involves construction of residential buildings on the portion of the site between 47th Road and 50th Avenue. The development sites in this area have been designated Parcels 8, 9, 10, and 11, as shown on Figure 2.

In August 1998, a Voluntary Cleanup Agreement was entered into between New York State Department of Environmental Conservation (NYSDEC) and QWDC. This agreement covered Parcels 8, 9, and 11 and the portion of Center Boulevard between Parcels 8 and 9. In July 2000, the Voluntary Cleanup Agreement was amended to allow it to be separated into separate agreements for each parcel, which would be executed by the designated developer for the parcel. Accordingly, after AvalonBay Communities (AvalonBay) was selected as the developer of Parcels 8, 9, and 11, AvalonBay executed separate agreements for each of the three parcels in September 2000. In March 2004, AvalonBay requested that NYSDEC transition Parcels 8 and 9 into the Brownfield Cleanup Program (BCP), with the BCP Agreements for both parcels being signed by the NYSDEC and becoming effective on June 28, 2005.

A Remedial Work Plan (RWP) for Parcel 9 was submitted to the NYSDEC in May 2005. The selected remedy described in the RWP consisted of excavating all soil containing contaminant concentrations exceeding the Site Specific Soil Action Levels (SSSALs), with soil excavation conducted under a temporary containment structure equipped with an air handling system to control fugitive odors and dust. The remedy also included installation of a permanent subsurface containment wall to facilitate soil removal and isolate the site from off-site contamination. The RWP was revised in August 2005 and an addendum to the RWP was submitted to the NYSDEC on September 16, 2005. The revised RWP and addendum were approved by the NYSDEC on September 19, 2005. A second addendum, revising the outgoing truck routes, was submitted to the NYSDEC on October 31, 2005. The purpose of this Final Engineering Report (FER) is to document implementation of the RWP conducted at the site during August 2005 through May 2006. An electronic copy of this FER is provided in Appendix A.

2.0 SITE DESCRIPTION

2.1 SITE LOCATION

Parcel 9 is located in the Hunters Point section of Queens, New York. The parcel is bounded by 5th Street on the east, 48th Avenue on the south, Center Boulevard on the west, and 47th Road on the north. It has a total area of approximately 1.79 acres, and is defined as Lots 1, 5, and 19 of Tax Block 19 of Queens County. A property survey conducted prior to the start of remediation activities for the site is provided in Appendix B.

2.2 METES AND BOUNDS DESCRIPTION

All of that certain plot, piece or parcel of land situated, lying and being in the Borough and County of Queens, City and State of New York, bounded and described as follows:

BEGINNING at the corner formed by the intersection of the westerly side of 5th Street (60 feet wide) with the northerly side of 48th Avenue (104 feet wide);

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RUNNING THENCE westerly along the northerly side of 48th Avenue, 399.58 feet to a point of curvature;

RUNNING THENCE northwesterly, northerly and northeasterly along a curve bearing to the right having a radius of 20.00 feet and arc length of 38.80 feet to a point of tangency on the southeasterly side of Center Boulevard (100 feet wide);

RUNNING THENCE northeasterly along the southeasterly side of Center Boulevard 185.26 feet to the southerly side of 47th Road (60 feet wide);

RUNNING THENCE easterly along the southerly side of 47th Road, 351.37 feet to the westerly side of 5th Street;

RUNNING THENCE southerly along the westerly side of 5th Street, 200.00 feet to the corner formed by the intersection of the westerly side of 5th Street with the northerly side of 48th Avenue the point of place of Beginning.

2.3 SITE AND VICINITY CHARACTERISTICS

The proposed residential buildings and parking garage are currently under construction at the site, and the parcel is surrounded by wood construction fencing. The site layout for the finished development, shown on Figure 3, includes an L-shaped high-rise apartment building located in the western and southwestern portions of the site, a multi-level parking garage located in the eastern portion of the site, with townhouses located south of the garage along 48th Avenue. Approximately 2,300 square feet of retail space will be located on the ground floor of the residential building along Center Boulevard. A courtyard and driveway area will be located in the center of the site, in front of the main entrance of the high-rise apartment building. None of the structures will have basements or subgrade levels.

Parcel 10, located across 48th Avenue south of the site, is occupied by a high-rise residential building, which also includes a public elementary school, P.S. 78. Parcel 8, located across Center Boulevard west of the site, is vacant. The area between Parcel 8 and the East River is part of the Queens West waterfront park. The East River is located roughly 500 feet west of the site.

The areas north and east of the site (i.e., across 47th Road and 5th Street) are currently undergoing construction for future residential development. The area east of the site, across 5th Street, is not part of the Queens West Development. This area is occupied by a mix of light industrial, commercial, and residential uses.

2.4 NEARBY PUBLIC AREAS OF CONCERN

A high-rise residential building, which includes a public elementary school and a day care center, is located south of the site across 48th Avenue. A second high-rise residential building is located diagonally northwest of the site, at the northwestern corner of Center Boulevard and 47th Road. Peninsular Park, a portion of the Queens West waterfront park, is located immediately west of Parcel 8, approximately 200 feet from the site. The area east of the site contains a mix of light industrial, commercial, and residential uses.

2.5 SITE HISTORY

The history of the site and the surrounding area is summarized in the Hunters Point Development Final Environmental Impact Statement (June 1990). The Hunters Point area was originally a rocky outcrop surrounded by low-lying marshlands and tidal meadows. Filling of the wetlands and development of the area began in the mid-19th century. Starting around 1890, the area

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became a major industrial center. Historic Sanborn Insurance Maps indicate that the eastern end of Parcel 9 was occupied by varnish or paint manufacturers from sometime prior to 1915 until the 1970's, and was mostly vacant since that time. The western portion of the site was occupied by a variety of manufacturing uses. The Blau Gas Company of America occupied a portion of the site in 1915, but was gone by 1936. The Blau Gas process involved "cracking" petroleum to increase the concentrations of the lighter fractions, which were then distilled off, purified, and compressed into cylinders. The Blau Gas plant on the site was a small facility, which occupied about a one-half acre portion of the site, and is not comparable to a typical Manufactured Gas Plant (MPG) facility, either in the type of process or the scale of operations. Other historic uses on the western portion of the site included: an asphalt company; the Warren Chemical Company, which manufactured insecticides and roofing materials; a plumbing supply manufacturer; a refrigeration equipment manufacturer; a barrel manufacturer; and an auto repair shop.

2.6 SITE GEOLOGY, HYDROGEOLOGY, AND SUBSURFACE CHARACTERISTICS

Mueser Rutledge Consulting Engineers performed a geotechnical study on the site, the results of which are reported in a Geotechnical Report dated May 25, 2004. The study included 37 soil borings to bedrock and the installation of two piezometers to monitor groundwater levels. The Mueser Rutledge report indicated that the top 10 to 12 feet of soil on the parcel was miscellaneous fill. This was underlain in most borings by a layer of alluvial sand up to 17 feet thick. About two-thirds of the borings encountered a stratum of soft gray organic silty clay, representing old marsh deposits. The organic deposits were generally less than 10 feet thick, and were found directly below the fill at some locations, and interlayered with the sand stratum at others. Below the sand and organic deposits was a layer of glacial till up to 30 feet thick, consisting of compact fine to coarse sand with some gravel, silt, clay, clay pockets, and boulders. The surface of the till was at an elevation of -10 to -12 (Queens Borough Datum) feet over most of the parcel, but dipped sharply to a depth of -30 feet in the southwestern corner of the parcel. Bedrock was encountered at an elevation of -20 to -30 feet over most of the parcel, but similarly dipped in the southwestern corner, to a minimum elevation of -55 feet.

Groundwater studies performed by TRC Engineers in publicly accessible off-site areas north and west of Parcel 9 showed local groundwater flowing towards a depression in 47th Road, approximately 150 feet west of 5th Street. The groundwater depression in 47th Road was also noted in the studies performed by AKRF in 1989. The groundwater elevations observed during AKRF's 2005 Supplemental Remedial Investigation indicated a general flow from northeast to southwest, towards the East River. These results differed from findings of the previous investigations by TRC and AKRF, but are generally consistent with studies performed elsewhere in the Queens West area, which showed groundwater flow to the west, towards the East River, with some tidal influence at locations close to the river. It should be noted that the April 2005 depth to water measurements were taken following a series of heavy rains, so the groundwater surface may have been unusually high.

2.7 NATURE AND EXTENT OF CONTAMINATION

2.7.1 Soil and Groundwater Assessments

Several environmental studies of Parcel 9 were conducted between 1985 and 2005 to identify and characterize subsurface contamination resulting from historic on-site and off-site uses. Soil and groundwater sampling programs were performed on the site in 1985, 1986, and 1989 as part of assessments of the entire Queens West Development area (then known as the Hunters Point Waterfront Development). The results were

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reported in the Final Environmental Impact Statement, Hunters Point Waterfront Development, dated June 1990. Testing performed by AKRF in 1998 was reported in Site Assessment Report, Queens West Development Site, Parcels 8 and 9, Queens, New York, dated June 1998. This additional testing was requested by NYSDEC, which reviewed and approved the Work Plan. In 2000, when it was possible to gain access to the interiors of the buildings present on Parcel 9 at that time, a supplemental sampling program was performed, following a sampling protocol approved by NYSDEC (Supplemental Site Assessment Report, Queens West Development Site, Parcel 9, Building Interiors, Queens, New York, dated September 2001). When the buildings on Parcel 9 were demolished in September-October 2000, two steel vaults set in concrete full of oily water, sludge and debris were discovered. A spill (00-06818) was reported for the site and the steel vaults and the concrete surrounding them were removed. The spill number was closed by the NYSDEC on November 21, 2003.

A Supplemental Remedial Investigation (RI) was performed by AKRF on Parcel 9 in 2005 (Supplemental Remedial Investigation Report, April 2005). The investigation was intended to assess potential contamination from the Blau Gas manufacturing facility, which was located on the western portion of Parcel 9 of the Queens West Development area around 1915, and to provide the data required for development of a Supplemental Remedial Work Plan. Following completion of the Supplemental RI, additional testing was performed to better delineate the horizontal and vertical extent of soil contamination (Additional Delineation Testing Report, Queens West Development Parcel 9, prepared by ARKF, dated June 2005).

AKRF conducted soil gas sampling at the site in July 2005 to determine whether site-related contaminants were potentially present in off-site soil gas. The samples were collected at thirteen locations on the Center Boulevard, 47th Road, and 48th Avenue sidewalks. Two ambient air samples were collected during soil gas sampling activities to determine potential background concentrations.

In July 2005, AKRF conducted composite sampling of the existing soil piles located in the central and eastern portion of the site. The samples were collected by dividing the soil piles into approximately 500 to 1000 cubic yard sections and compositing soil from multiple locations in each section.

Copies of the previous investigations and associated work plans are included in Appendix A.

2.7.2 Soil Contamination

The soil analyses indicated the presence of two separate types of soil contamination on the site. The extent of each type of contamination is shown on Figure 4, which indicates the areas where levels of BTEX or naphthalene in soil samples exceeded the TAGM 4046 Recommended Soil Cleanup Objectives (RSCOs). Petroleum contamination, including the presence of light non-aqueous phase liquid (LNAPL) was centered in the north-central portion of the site. A vault containing underground storage tanks was found in this area during the Supplemental Remedial Investigation. Coal tar contamination, including the presence of dense non-aqueous phase liquid (DNAPL), was found in the southwestern corner of the site, and along the western boundary of the site adjacent to Center Boulevard. Petroleum-contaminated soil and coal tar-contaminated soil are herein referred to collectively as "hydrocarbon-contaminated soil."

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The petroleum-contaminated soil extended from the "smear zone" around the groundwater surface down to the surface of the till layer at an elevation of approximately -10 feet (Queens Borough Datum), but the thickness of the contaminated layer thinned out to the east, west, and south of the apparent source area. The petroleum-contaminated soil was characterized by high levels of benzene, toluene, ethylbenzene, and xylenes (BTEX), as well as other relatively light, monocyclic hydrocarbons, including cyclohexane and methylcyclohexane. Naphthalene was present in the petroleum-contaminated soil, but at lower levels than the monocyclic compounds. The heavier polycyclic aromatic hydrocarbons (PAHs) were present at relatively low concentrations (except for samples from the historic fill layer). The petroleum-contaminated soil was also characterized by low fluoranthene/pyrene and dibenzofuran/fluorene ratios (less than 1.0), as is typical of petroleum-derived products that have not been subjected to heat treatments.

An area of deep contamination was identified in the southwestern corner of the site where DNAPL was detected. This area corresponded to a low point in the lower confining layer (till or clay) where it was not unexpected that DNAPL would tend to accumulate. In addition, a second area of coal tar contamination was located further north along the western boundary of the site, around sampling locations S-1 and P-2. In this area, the contamination extended from the "smear zone" around the groundwater surface down to the surface of the till layer, but thinned out to the north and south. The coal tar-contaminated soil was characterized by high levels of naphthalene and 2-methylnaphthalene. BTEX was present, but at lower levels than naphthalene. The heavier PAHs were present at relatively low concentrations (except for samples from the historic fill layer). The coal tar-contaminated soil was also characterized by higher fluoranthene/pyrene and dibenzofuran/fluorene ratios, as is typical of pyrogenic compounds formed by heating organic matter under conditions where there is not enough oxygen to support combustion. The area of petroleum contamination was characterized as approximately 20 feet thick in the presumed source area, but thinned out to the east and west. Similarly, the coal tar-contaminated soil was encountered deepest adjacent to Center Boulevard and tapered to a few feet thick to the north, where it met the area of petroleum contamination.

None of the samples of petroleum- or coal tar-contaminated soil that were analyzed for RCRA characteristics were found to be characteristic hazardous waste, either by ignitability or by toxic characteristic for benzene.

The surface soil on the site was characterized as historic fill material incorporating ash, brick, concrete, and other demolition debris. The fill contained higher and more variable concentrations of metals and heavy PAHs than the underlying native soils. Metals were detected generally at concentrations typical of soil background levels. Above-background concentrations of mercury were detected in a few soil samples; however, these appeared to be randomly distributed in the fill. In all cases where an elevated mercury concentration was detected, the levels in the adjacent samples (from two feet above and two feet below) were within the normal background range. In general, BTEX, naphthalene, and total SVOC concentrations were below their respective RSCOs in fill material overlying the hydrocarbon-contaminated soil in the western portion of the site and above the native soil in the eastern portion of the site (outside of the area of hydrocarbon contamination). However, fill from the surface to approximately 2 feet below grade in P-16, located just outside the area of hydrocarbon-contamination,

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exhibited a naphthalene concentration of 64 parts per million (ppm) (above the 13-ppm RSCO) and a total SVOC concentration of 8,760 ppm (above the 500-ppm RSCO).

A trace level of one PCB was detected in one soil sample, and the pesticide BHC was detected at low levels in two soil samples. No other PCBs or pesticides were detected in any of the soil samples analyzed.

2.7.3 Soil Pile Contamination

The composite samples generally contained elevated concentrations of SVOCs, but relatively low concentrations of BTEX and metals. The highest total SVOC concentrations ranged from 353 ppm to 491 ppm in composite samples C-2, C-8, C-6, and C-4. Sample C-4 also contained an elevated concentration of naphthalene (69 ppm), which may have been indicative of contaminated residuals associated with the former tank excavation. The detected contamination in the composite soil samples, excluding C-4, was similar to the contaminant levels detected in historic fill throughout the site and did not appear to be related to petroleum or coal tar sources.

2.7.4 Groundwater Contamination

Petroleum and coal tar-related volatile and semivolatile organic compounds were present at elevated levels in groundwater samples from wells in the northwestern quadrant and the area of coal tar contamination at the southwestern corner and along the western edge of the site. The most common compounds detected were BTEX, and naphthalene and 2-methylnaphthalene. Methyl and dimethyl phenols, typical of coal tar, were detected in a number of samples, particularly from the wells along the western edge of the site adjacent to Center Boulevard. In general, the higher levels of naphthalene were associated with the coal tar contamination along the western edge of the site, and the higher levels of benzene were associated with the petroleum contamination in the north-central portion of the site.

Metals were generally either undetected or detected at concentrations well below the Class GA groundwater standards. The exception was the upgradient well, A-8, located in the northeastern corner of the site, where the detected antimony concentration (1,220 parts per billion) exceeded the applicable groundwater standard. This result was suspected of being an anomaly, and not indicative of overall site conditions. PCBs and pesticides were not detected in any of the groundwater samples analyzed.

2.7.5 Soil Gas

Petroleum/coal tar related compounds were prevalent in several of the soil gas samples, with the highest concentrations detected in SG-3 (located near the northwestern portion of Parcel 9). High concentrations of chlorinated compounds, including tetrachloroethene (PCE) at 3,900 micrograms per cubic meter ($\mu g/m^3$), were detected at the southeastern corner of Center Boulevard and 48th Avenue, adjacent to the Citilights residential apartment building. PCE was prevalent at relatively low concentrations (6 to 29 $\mu g/m^3$) in many of the sampling locations, with a higher concentration of 290 $\mu g/m^3$ detected in SG-7, near the southeastern portion of Parcel 9. Subsequently, confirmatory sampling was conducted for the SG-11 location on August 2, 2005, to determine whether the initial chlorinated VOC results were anomalous. The results indicated elevated levels of chlorinated compounds, including a PCE concentration of 3,250 $\mu g/m^3$, confirming results from the initial sampling. The soil and groundwater data collected at Parcel 9 did

not contain elevated concentrations of chlorinated VOCs, indicating that Parcel 9 was not the source of chlorinated compounds detected in the SG-11 soil gas sample.

3.0 REMEDIAL WORK PLAN

The Remedial Work Plan for the site specified excavation and disposal of all hydrocarbon-contaminated soil and historic fill containing contaminant concentrations exceeding the SSSALs listed in the following table:

Site Specific Soil Action Levels for Queens West Parcel 9

Compound	SSSAL (ppm)
Benzene	0.06
Toluene	1.5
Ethylbenzene	5.5
O-xylene	1.2
M/P-xylene	0.6
Naphthalene	13.0
Total VOCs	10.0
Total SVOCs	500
Lead	1,000
Mercury	2
Arsenic	25
Other Criteria	Grossly contaminated soil

The soil removal area specified in the RWP is shown on Figure 4. A copy of the RWP is included in Appendix A. Additional elements of the remediation specified in the RWP included the following:

- Erection of a temporary containment structure to control potential contaminant vapors and odors during all contaminated soil excavation;
- Installation of a containment wall around the entire hydrocarbon-contaminated soil excavation area to facilitate removal of the contaminated soil and to prevent migration of off-site contamination onto the project site during and after the remediation activities;
- Excavation of the small area of historic fill containing naphthalene and total SVOC levels exceeding the SSSALs outside of the containment structure, with the use of plastic sheeting and foam to contain odors and dust;
- Implementation of an environmental health and safety plan (HASP), air monitoring plan, and stormwater pollution prevention plan (SWPPP) to ensure protection of site workers, the surrounding community, and nearby surface water during the soil excavation activities;
- Installation of a sub-slab vapor mitigation system under the residential buildings; and
- Implementation of institutional controls to prevent exposure to residual contamination left in place following soil removal.

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4.0 SITE REMEDIATION

Site remediation consisted of: site preparation activities (including the installation of the sheeting wall, erection of the containment structure, and installation of the air handling and wastewater treatment systems); excavation and off-site disposal of hydrocarbon-contaminated soil from the "Phase 1" remediation area in the southern portion of the site; excavation and off-site disposal of hydrocarbon-contaminated soil from the "Phase 2" remediation area in the northern portion of the site; and remediation of additional areas of soil contamination located outside of the sheeting wall in the eastern portion of the site. Creamer Environmental, Inc. of Hackensack, New Jersey served as the general contractor for all site preparation and Phase 1/2 remediation activities and contracted directly with the waste disposal facilities. AKRF Engineering, Inc. (AKRF) oversaw and documented all site remediation activities; conducted health and safety, sediment and erosion control, and perimeter air monitoring; and performed waste characterization and endpoint sampling. Photographs of site remediation activities are provided in Appendix C. The containment structure and air handling equipment locations for the two phases of remediation are shown on Figure 5.

4.1 WASTE CHARACTERIZATION

Between July 26, 2005 and August 2, 2005, soil samples were collected from throughout the proposed soil removal area prior to the start of remediation activities to pre-characterize the material for acceptance at the anticipated disposal facilities. The samples were collected by dividing the soil removal area into grids, with each grid containing approximately 900 tons of hydrocarbon-contaminated material. Soil borings were advanced at the approximate center of each grid, and samples were collected in accordance with the disposal facility requirements, which generally included one grab sample per 150 tons of material and one composite sample per 900 tons of material. The grab samples were collected at discrete depths along the contaminated soil interval, and the composite samples were collected by combining soil collected across the entire contaminated soil interval. All composite samples were analyzed for leachable VOCs, SVOCs, pesticides, herbicides, and metals using the toxicity characteristic leaching procedure (TCLP) by EPA Methods 1311, 8260, 8270, 8081, 8151, 6010, and 7470; ignitibility by EPA Method 1010; corrosivity by EPA Method 9040, sulfide/cyanide reactivity by EPA Method 7.3, and total metals by EPA Methods 6010/7470. All grab samples were analyzed for total petroleum hydrocarbons by EPA Method 8015M and total VOCs by EPA Method 8260. Composite samples collected from grids containing coal tar contamination were additionally analyzed for polychlorinated biphenyls (PCBs) by EPA Method 8082 and total sulfur by EPA method 5839. During the course or remediation activities, additional grab and composite waste characterization samples were collected directly from the excavation as needed to obtain acceptance of additional quantities. All waste characterization samples were analyzed at STL Connecticut in Shelton, Connecticut, a New York State Department of Health (NYSDOH)-certified laboratory. Laboratory analytical data for the waste characterization samples is provided in Appendix D.

4.2 SITE PREPARATION

4.2.1 Sediment and Erosion Control Measures

At the start of site preparation activities, a back-flow prevention device and hose were connected to the fire hydrant on 48th Avenue to provide water for dust suppression. Water was sprayed on equipment roadways and stockpiles to control dust throughout the site preparation and remediation activities.

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During initial site grading activities in early August 2005, silt fencing was installed around the entire site perimeter. In late August 2005, new wood construction fencing was installed along the curb line around the site; therefore, the silt fencing was subsequently replaced with a perimeter haybale barrier placed at the base of the construction fence for the remainder of site remediation activities.

Inlet protection (Siltsack®) was installed and maintained in stormwater catch basins on 5th Street, 47th Road, and 48th Avenue, as specified in the project SWPPP, throughout the site preparation and site remediation activities. A construction entrance, consisting of stabilized aggregate placed over filter fabric, and a sump for the truck decontamination pad were installed near the northeastern corner of the site (on 47th Road) in August 2005, and maintained throughout Phase 1 of the site remediation. The decontamination pad was replaced at the start of Phase 2 remediation on November 20, 2006.

AKRF performed weekly inspections of the sediment and erosion control measures as specified in the SWPPP, and communicated any deficiencies to the site contractor. Copies of inspection forms are provided in Appendix E.

4.2.2 Installation of Hydraulic Barrier

Pre-Trenching

Pre-trenching for installation of the sheet pile hydraulic barrier was completed along the entire containment wall line during August 19 through September 2, 2005. The pre-trenching consisted of excavating an approximately 5-foot wide trench to approximately 5 feet below grade to clear obstructions that would prevent driving the sheet piles. Concrete slabs and footings encountered in the trenches were broken up using a hoe ram, removed from the trench, and stockpiled for subsequent characterization for on-site re-use, as described in Section 4.3.10. All trenches were backfilled once obstructions were removed. On August 25, 2005, an underground storage tank encased in concrete was encountered in a trench excavated along the interior sheet pile line. The tank was removed from the ground and disposed of off-site, as described in Section 4.3.8.

Sheeting Installation

A total of 177 double steel sheets were installed between September 1 and 19, 2005 to complete the subsurface hydraulic barrier around the soil excavation area. Adeka sealant was applied to the sheeting joints prior to driving to provide a watertight seal between sheets. The sheeting was driven approximately 17 to 50 feet below grade into the till layer using a vibratory sheet pile driver. A survey of the hydraulic barrier is provided in Appendix F.

4.2.3 Grading

Grading activities were conducted between August 15 and August 19, 2005. These activities consisted of using the existing stockpile on the central and eastern portions of the site to raise the grade in the western portion of the site. The portion of the stockpile that contained contaminant concentrations above the SSSALs, based on sampling performed in July 2005, was not used for site grading, and was left in place, north of the former tank vault to await subsequent off-site disposal, as described in Section 4.3.4 This soil was covered with secured plastic sheeting to prevent wind and rain erosion.

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On August 18 and 19, 2005, excess soil not used for site grading was moved to the southeastern portion of the site, placed on a layer of plastic sheeting, and covered with a secured polyethylene tarp to prevent wind and rain erosion. Silt fencing was installed along the eastern and southern edges of the stockpile as an added measure of protection against erosion and runoff.

4.2.4 Containment Structure and Air Handling System

Materials for the temporary containment structure were received on September 12 and 13, 2005. Construction of the structure, conducted between September 20 and October 31, 2005, included the following:

- Test excavations to remove concrete obstructions for the structure stakes;
- Securing the perimeter base plates with stakes driven approximately six feet below grade;
- Laying out and assembling the frame trusses;
- Erecting half trusses and connecting them at the roof centerline;
- Installing purlins and cross cables between the trusses;
- Installing framework for the eastern and western end walls;
- Pulling fabric panels over the trusses and end walls; and
- Installing overhead doors and man doors in the eastern end wall.

Upon completion of the Phase 1 soil removal, fabric connecting the three sections of the containment structure were removed, and the structure was prepared for lifting and re-location. The initial attempt to re-locate the structure on January 12, 2006 was unsuccessful due to failure of the lifting cables. Based on this failure, the rigging system for lifting was redesigned, and the structure was successfully moved to the Phase 2 position on February 4 and 6, 2006.

4.2.5 Air Handling System

Equipment for the air handling system was installed between October 20 and 29, 2005, and the system became fully operational on October 31, 2005 for Phase 1 excavation activities. Installation procedures included:

- Using a crane to move the equipment into place;
- Installing intake louvers along the southern wall of the containment structure;
- Laying conduit and installing electrical cables to connect the blowers to the generator;
- Hanging frames for the air vents on the northern wall of the containment structure; and
- Installing ductwork to connect the vents to the blowers, and blowers to the carbon units.

On January 10, 2006, following completion of the Phase 1 soil removal, the air handling system equipment was moved to the Phase 2 position. System ductwork was connected to the re-located containment structure and the system was activated on February 8, 2006

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for Phase 2 excavation. The system was operated during all working hours throughout the excavation and loading of hydrocarbon-contaminated soil. One of the blowers was connected directly to the electrical panel at the site to allow overnight operation, if required.

4.2.6 Tank Vault Demolition

Between September 9 and 15, 2005, the concrete tank vault in the center portion of the site (remaining from the underground storage tank removed in March 2005) was broken up using a hoe ram. The concrete was removed from the ground and stockpiled for characterization for potential on-site reuse as described in Section 4.3.10.

4.2.7 Permits

All necessary permits were obtained prior to commencing the remediation work. The required permits included:

- New York City Department of Environmental Protection (NYCDEP) sewer connection and wastewater discharge permits for discharge of the groundwater from dewatering operations to the City sanitary sewer;
- NYSDEC Notice of Intent (NOI) filing to obtain coverage under New York State Pollutant Discharge Elimination System (SPDES) General Storm Water Permit for Construction Activity (Permit Number GP-02-01);
- New York City Department of Transportation (NYSDOT) sidewalk and road closing permits to occupy the perimeter sidewalks and the southern lane of 47th Road with construction equipment; and,
- New York City Department of Buildings Permits for erection of the containment structure and construction fencing, grading operations, and installation of piping for the sewer connection.

Copies of the permits obtained to facilitate the site remediation are provided in Appendix G. A log of construction permits associated with redevelopment of the site is included in Appendix G.

4.3 SOIL REMOVAL

4.3.1 Extent of Soil Removal

The extent of soil removed from inside the containment wall during the site remediation is shown on Figure 6. Within this area, soil was removed from the top of the contaminated interval to the surface of the till layer at 17 to 24 feet below grade throughout most of the site. Soil was removed in the southwestern corner of the site down to a dense clay confining-layer located above the till at approximately 27 to 34 feet below grade. The vertical extent of the soil removal is illustrated in cross sections A-A' and B-B' on Figure 7. Following Phase 2 remediation, additional soil was excavated from the vicinity of soil boring P-16 and from around underground storage tanks uncovered outside the eastern edge of the sheeting wall, as shown on Figure 8. An isopleth map depicting the thickness of contaminated soil removal throughout the site is provided as Figure 9.

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4.3.2 Excavation

During Phase 1 and Phase 2 remediation activities, all excavation and stockpiling of contaminated soil was conducted within the containment structure. For both phases of remediation, soil excavation was conducted in two stages. Initially, soil was excavated to approximately eight feet below grade to prepare a bench for installing the upper level of tiebacks along the sheet pile walls. After the upper tiebacks were completed, soil was excavated below a depth of eight feet. During excavation, the shallow soil was monitored for evidence of contamination [e.g., staining, odors, elevated photoionization detector (PID) readings]. Shallow material that did not exhibit evidence of contamination was segregated and stockpiled in 500 to 1,000-cubic yard piles outside of the containment structure to await characterization for potential on-site reuse, as described in Section 4.3.10. Deeper soil exhibiting evidence of contamination was either stockpiled temporarily inside the containment structure to await off-site disposal, or loaded directly onto trucks and transported to the disposal facility, as described in Section 4.3.4. Kiln dust was utilized to reduce the moisture content of the deeper soils prior to loading and disposal. All imported kiln dust was disposed of off-site with the hydrocarbon-contaminated soil.

Soil excavation from the P-16 area and from underground storage tanks encountered along the outside of the eastern edge of the sheeting was conducted outside of the containment structure. Odors were controlled by immediately backfilling excavations and/or covering stockpiles/excavations with plastic sheeting any time excavation or loading activities were not taking place.

On December 19, 2005, a conference call with Mr. Vadim Brevdo of the NYSDEC and Mr. Marc Godick and Ms. Rebecca Kinal of AKRF was conducted to review the procedure for remediating areas where the physical limitation of excavation was or would be reached. Where field screening indicated potential hydrocarbon contamination and/or end-point samples contained contaminant concentrations above the SSSALs, remediation continued until the physical limit of excavation, which was based encountering the dense rocky till material, or in some instances, the maximum depth for the sheeting design, as described below. Copies of daily and monthly progress reports are included in Appendix A.

Phase I Excavation

Excavation of soil in the Phase 1 remediation area commenced on October 27, 2005 and was completed on January 6, 2006. In early December 2005, soil was excavated along the western and southern sheet pile walls to a depth of approximately 22 feet below grade to prepare for the installation of a lower level of tiebacks in areas of the site where the excavation was expected to proceed to greater than approximately 25 feet below grade. However, due to the presence of saturated running sand and silt behind the sheet piling, the integrity of the drill holes necessary to install tiebacks at this lower level could not be maintained. Therefore, the system was redesigned and subsequently installed in December 2005 using interior cross-bracing in lieu of tiebacks.

As lower level interior bracing was installed in the southwestern corner of the sheet pile containment wall, contaminated soil was removed to the glacial till layer (between 20 to 26 feet below grade) throughout the majority of the remaining remediation area, as shown on Figure 6. Following reaching the physical limit of excavation, end-point

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samples were collected from the respective area and then backfilled with suitable fill material.

Soil excavation was terminated at the till layer in these areas based on field screening indicating the end of gross contamination and technical limitations of excavating the till, which consisted of densely packed clay, silt, and gravel, and contained numerous cobbles and boulders. Bottom end-point samples were collected from the till layer, as described in Section 4.3.7.

Once the lower level cross-bracing was installed, soil was removed from the southeastern portion of the excavation to the top of a dense clay layer at approximately 27 to 34 feet below grade, as shown on Figure 6. DNAPL was observed in an approximately six-inch interval in sandy material just above the clay layer, indicating that the clay was acting as a confining layer preventing downward migration of DNAPL. Bottom endpoint samples were collected from the clay layer, as described in Section 4.3.7, once the DNAPL-saturated sand and the upper surface of the clay were removed.

Soil excavation was terminated at approximately 20 feet below grade (approximately three feet above the till layer) in a sixty by twenty foot area located against the southern sheet pile wall, as shown in Figure 6, based on field screening indicating the end of gross contamination and due to technical limitations to deeper excavation. The sheeting/bracing system in this portion of the site was designed for a maximum excavation depth of 20 feet below grade based on the anticipated soil removal designated in the RWP. Three bottom endpoint samples were collected in this area, as described in Section 4.3.7 and shown on Figure 6.

Phase 2 Excavation

Soil excavation in the Phase 2 remediation area commenced on February 8, 2006 and was completed on March 31, 2006. Cross-bracing was installed at approximately 15 feet below grade in the northeastern corner of the excavation area to maintain the integrity of the sheet pile wall during deeper excavation in this area. During deeper excavation adjacent to the sheet pile wall in other portions of the Phase 2 remediation area, the sheet pile integrity was maintained by opening only one narrow strip of excavation (approximately 20 feet wide) at a time, and backfilling each strip immediately after reaching the bottom limit of the soil removal and collecting endpoint samples. Removal of hydrocarbon-contaminated soil was terminated at the till layer throughout the Phase 2 excavation area, based on endpoint sample results, as described in Section 4.3.7. The excavation was not extended beyond the till layer due to technical limitations to excavating the dense, rocky material.

Excavation Outside of Sheeting

On March 30, 2006, soil outside of the sheeting line was excavated to approximately 6 feet below grade from an approximately 10-foot by 10-foot area of historic fill around soil boring P-16, which exhibited naphthalene and total SVOC levels exceeding the SSSALs. Additional soil was removed from the southern and eastern walls of the excavation on April 19, 2006, and from the southern wall on May 24 and 25, 2006, based on endpoint samples indicating lead concentrations exceeding the SSSALs, as described in Section 4.3.7. Between May 9 and 25, 2006, petroleum-contaminated soil was removed from three additional areas outside of the sheeting where underground storage tanks were discovered during excavation for foundations in the proposed parking garage

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area. The tank excavation walls and bottom were field screened for staining, odors, and/or elevated PID readings, and soil removal was terminated when evidence of contamination was no longer observed. Analytical results for confirmatory endpoint samples collected from the P-16 and underground storage tank excavation sidewalls and bottom are described in Section 4.3.7. The extent of soil removal outside of the sheeting line is shown on Figure 8.

4.3.3 Dewatering

On September 29 and 30, 2005, a trench was excavated and piping was installed to provide a connection for the wastewater treatment system to the 12-inch diameter sanitary sewer main located along 48th Avenue. Soil excavated from the trench was stockpiled on and covered with plastic sheeting in the southeastern corner of the site to await characterization for potential on-site re-use, as described in Section 4.3.10. After installing the sewer connection piping, the trench was backfilled with gravel, and the surface was restored with asphalt. The remainder of the wastewater treatment system was installed between October 25 and 31, 2005, and included: using a crane to move the equipment into place in the southeastern portion of the site; installing piping connections between the various elements of the system; excavating dewatering sumps outfitted with submersible pumps in the western portion of the containment structure; and running hoses from the submersible pumps to the treatment system and from the system to the sewer connection. Treatment of dewatering fluids and discharge to the New York City Sanitary Sewer started on November 2, 2005. During the course of soil excavation, additional sumps were installed as needed, and were connected to the dewatering treatment system. Approximately 550,200 gallons of water were treated and discharged during Phase 1 of the remediation, and approximately 683,200 gallons of water were treated and discharged during Phase 2 of the remediation. The discharge was conducted in accordance with an NYCDEP wastewater discharge permit, provided in Appendix G.

4.3.4 Trucking and Disposal

All hydrocarbon-contaminated soil excavated from within the sheeting was loaded onto trucks and covered with plastic sheeting and a tarp within the containment structure. Additional plastic sheeting was used to line the bottom of the trucks to prevent leakage of fluids through their tailgates. Plastic sheeting was used to cover soil piles/excavations as necessary to control odors during loading of soil excavated from outside of the sheeting (i.e., soil from the P-16 excavation and soil associated with underground storage tanks removed from east of the sheeting line). Prior to exiting the site, all truck tires and undercarriages were decontaminated on the gravel decontamination pad located at the 47th Street construction entrance. All contaminated soil was transported by appropriately licensed transporters and properly disposed of in accordance with applicable regulations. Coal tar and petroleum-contaminated soil excavated from within the sheeting wall and from around underground storage tanks located outside of the sheeting wall was disposed of at: Clean Earth of Philadelphia in Philadelphia, Pennsylvania; Clean Earth of New Castle, Inc. in New Castle, Delaware; and Casie/MART in Vineland, New Jersey. Material excavated from the southern portion of the P-16 excavation was characterized separately from other on-site soil due to elevated lead concentrations detected in the endpoint sample collected from the southern sidewall, as described in Section 4.3.7. Waste characterization results, included in Appendix D, indicated that the material was non-hazardous; therefore, it was disposed of as contaminated urban fill at Tilcon in Mt.

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Hope, New Jersey. Waste manifests and a truck tracking log for all soil disposed of off-site are provided in Appendix H. The following table summarizes the amount and type of soil disposed of at each waste facility:

Contaminated Soil Disposal Amounts
Queens West Parcel 9

Disposal Facility	Coal Tar (tons)	Petroleum (tons)	Historic Fill (tons)	TOTAL (tons)
Clean Earth of Phila.	16,642.28	31,544.53	N/A	**48,186.81**
Clean Earth of New Castle	94.22	213.38	N/A	**307.60**
Casie/MART	4,130.94	1,597.81	N/A	**5728.75**
Tilcon	N/A	N/A	283.98	**283.98**
TOTAL (tons)	**20,867.44**	**33,355.72**	**283.98**	**54,507.14**

4.3.5 Air/Odor Monitoring

During all soil excavation within the sheeting, four Air Logics units, located at the four corners of the site, were operated on a continuous basis to collect measurements of VOC and respirable particulate concentrations at the site perimeter and to alert site personnel to any action level exceedances. Walk-around air monitoring was conducted to monitor for elevated levels of VOCs, particulate, visible dust, and odors beyond the immediate site perimeter. In addition, walk-around VOC concentrations were monitored with a Thermo 580B photoionization detector (PID) or equivalent, and respirable particulate matter was monitored using a DustTrak particulate monitor or equivalent. The Air Logics and walk-around air monitoring stations are shown on Figure 5. Copies of the walk-around air monitoring logs are provided in Appendix I.

The Air Logics units registered numerous exceedances of the particulate action level [150 micrograms per cubic meter ($\mu g/m^3$)] throughout the remediation activities. The majority of these exceedances were attributed to truck traffic and other various construction projects surrounding the project site. Details regarding additional action level exceedances and associated corrective actions are summarized in Table 1.

Confirmatory air samples were collected along the site perimeter on a weekly basis throughout the site preparation, Phase 1, and Phase 2 remediation activities for analysis of VOCs using EPA Method TO-15. In addition, samples collected during the Phase 1 and Phase 2 remediation were analyzed for SVOCs using EPA Method TO-13. All samples were collected over an approximately 8-hour period using Summa canisters for VOC analysis and high-volume polyurethane foam (PUF) samplers for SVOC analysis, and analyzed by STL Burlington in Colchester, Vermont. Analytical results for the confirmatory air samples are summarized in Tables 2A and 2B, and laboratory analytical data reports are provided in Appendix J. Tables 2A and 2B also list NYSDOH and United States Environmental Protection Agency (USEPA) background levels for outdoor air.

Toluene was detected in several samples collected throughout the remediation activities, at concentrations slightly exceeding the NYSDOH background level for outdoor air (6.1 $\mu g/m^3$). However, the concentrations, ranging from 6.4 to 18 $\mu g/m^3$, were all below the USEPA background level of 20 $\mu g/m^3$. In addition, toluene was detected at similar concentrations in upwind air samples collected on September 7 and 14, 2005, indicating

that the downwind sample concentrations are consistent with background conditions. Trichloroethene was detected on November 4, 2005 at a concentration of 5.4 $\mu g/m^3$, which exceeds USEPA and NYSDOH background levels of 2.5 $\mu g/m^3$ and 5.3 $\mu g/m^3$, respectively. 1,4-Dichlorobenzene was detected on September 28, 2005 and November 4, 2005 at concentrations of 1.3 and 1.6 $\mu g/m^3$, respectively, which slightly exceed the USEPA background level of 1.2 $\mu g/m^3$. The compound n-Hexane was detected in the upwind sample collected on September 7, 2006 at a concentration of 8.1 $\mu g/m^3$, which exceeds the NYSDOH background concentration of 3.5 $\mu g/m^3$; however, the downwind concentration detected that same day was below the background level.

Several chlorofluorocarbons (CFCs), including trichlorotrifluoroethane (Freon TF), chloromethane; dichlorodifluoromethane, and trichlorofluoromethane (Freon 11), were detected in one or more samples at concentrations exceeding the NYSDOH and/or USEPA background levels. CFCs, which are commonly used as refrigerants and in aerosols, are ubiquitous in the environment, and their presence in the air samples make it unlikely they are related to on-site contamination. Methylene chloride, 2-butanone (MEK), and acetone detected above the NYSDOH and/or USEPA background levels are common laboratory artifacts; therefore, their presence in the air samples is likely related to laboratory contamination and not associated with on-site operations.

4.3.6 Emissions Monitoring

The air handling system, installed during the October 2005 reporting period, consisted of six blowers that drew air from the tent through six vapor phase granular activated carbon (GAC) units (one unit connected to the discharge line of each blower) to remove contaminants prior to discharge to the atmosphere. Throughout Phase 1 and Phase 2 remediation, the system operated with five to six blowers whenever soil was handled. During operation, AKRF periodically field screened the influent and effluent vapor stream in one of the carbon units using a PID to monitor for carbon breakthrough. The readings, presented in ppm, are summarized in the following table:

Air Treatment System Effluent Field Screening Results
Queens West Parcel 9

Date	Influent (ppm)	Effluent (ppm)
11/10/05	ND	ND
11/11/05	ND	ND
11/14/05	ND	ND
11/16/05	ND	ND
11/15/05	ND	ND
11/17/05	3.7	ND
11/18/05	2.2	ND
11/21/05	ND	ND
12/2/2005	ND	ND
12/5/2005	ND	ND
12/6/2005	ND	ND
12/7/2005	1.4	ND
12/8/2005	ND	ND
12/12/2005	3.2	ND
12/13/2005	17.7	ND
12/14/2005	59.2	ND
12/15/2005	17.5	ND
12/16/2005	8.8	ND

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Date	Influent (ppm)	Effluent (ppm)
12/19/2005	27.3	ND
12/21/2005	ND	ND
12/22/2005	2.1	ND
12/23/2005	ND	ND
12/27/2005	3.2	ND
12/28/2005	ND	ND
12/29/2005	ND	ND
12/30/2005	2.1	ND
1/6/2006	0.0	ND
2/16/2006	6.6	ND
2/21/2006	25	0.3
2/23/2006	7.2	ND
3/3/2006	42	0.6
3/6/2006	33	1.1
3/7/2006	26.9	ND
3/8/2006	42.5	ND
3/9/2006	7.1	0.2
3/10/2006	6.9	ND
3/13/2006	3.6	ND
3/14/2006	49	ND
3/15/2006	14.8	ND
3/16/2006	18.4	ND
3/17/2006	16.6	ND
3/21/2006	85.0	2.6
3/22/2006	77.0	5.4
3/23/2006	15.5	0.1
3/24/2006	25.4	ND
3/27/2006	8.5	0.4

Note: ND = Not Detected

On November 15, 2005, December 19, 2005, and March 27, 2006, AKRF collected influent and effluent vapor samples using Summa canisters for analysis of VOCs using EPA Method TO-15 to ensure that stack emissions were below short term guideline concentrations (SCGs) and annual guideline concentrations (ACGs) listed in NYSDEC DAR-1 (Air Guide-1). Analytical results and emissions calculations are summarized in Tables 3A through 3D. The calculations indicated that all emissions were below the applicable guideline concentrations for compounds for which ACGs and/or SCGs have been assigned.

4.3.7 Endpoint Sampling

All endpoint samples were analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, and target analyte list (TAL) metals. The samples were analyzed at STL Connecticut with Category B data deliverables. Analytical data reports for all endpoint samples are provided in Appendix K.

Bottom Endpoint Sampling

During excavation, soil was screened for evidence of contamination (e.g. staining, odors, elevated PID readings) as the anticipated bottom of the excavation was reached, and bottom endpoint samples were collected when evidence of contamination was no longer noted and/or the technical limit for the excavation was reached. All endpoint samples collected during Phase 1 remediation were collected from the surface of either the till

layer or the dense clay layer encountered in the southwestern portion of the excavation. During Phase 2 remediation, several intermediate endpoint samples were collected from above the till layer, based on Supplemental RI results indicating shallower limits to the contamination in the northern portion of the site. However, analytical results indicated that VOC and/or SVOC concentrations in all of these intermediate samples exceeded the SSSALs; therefore, the excavation was extended down to the till layer throughout the Phase 2 soil removal area, and final endpoint samples were collected. Bottom endpoint sample analytical results are summarized in Tables 4A, 4B, and 4C, with final bottom endpoint sample indicated by bolded headings.

The analytical results indicated that total SVOC and metals concentrations were below their respective SSSALs in all final bottom endpoint samples. BTEX, naphthalene, and/or total VOC concentrations exceeded their respective SSSALs 24 of the 61 final bottom endpoint samples, as summarized in the following table:

SSSAL Exceedances in Bottom Endpoint Samples
Queens West Parcel 9

Sample Number	Compounds Exceeding the SSSALs
EP-C2(19)	Xylenes
EP-C3(17.5)	Benzene, Toluene, Xylenes, Total VOCs
EP-C5(18)	Benzene
EP-C6(18)	Benzene
EP-C10(18)	Benzene, Xylenes
EP-C11(18)	BTEX, Naphthalene, Total VOCs
EP-C13-2(19)	Benzene, Xylenes
EP-C14-1(18)	Benzene
EP-C14-2(18)	Benzene
EP-17(20)	BTEX, Naphthalene, Total VOCs
EP-18(22)	BTEX, Naphthalene, Total VOCs
EP-19(19)	Naphthalene
EP-C20(18)	Benzene
EP-C22-1(24)	Benzene
EP-C22-2(24)	Benzene
EP-C24-2(23)	Benzene
EP-C26-3(22)	Benzene
EP-C26-4(22)	Benzene
EP-C28-2(21)	Benzene
EP-C28-3(22)	Benzene
EP-Triangle-1(26)	Benzene
EP-Triangle-2(24)	Benzene
EP-Triangle-3(26)	Benzene
EP-Triangle-2(20)	Benzene

Note: Numbers in parenthesis indicate depth of sample in feet.

All of these samples were collected from the surface of the till layer; therefore, additional soil removal was not extended beyond the depth of these samples due to technical limitations of excavating the dense, rocky till.

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Sidewall Endpoint Sampling

Sidewall endpoint samples were collected in the southeastern corner of the Phase 1 excavation area where soil removal did not proceed to the limits of the sheet pile containment wall, as shown on Figure 6. The sidewall endpoint samples were collected every 30 linear feet from the approximate midpoint of the contaminated interval in the adjacent excavation. The samples were analyzed for VOCs, SVOCs, and TAL metals by STL Connecticut. Analytical results, provided in Appendix K and summarized in Tables 5A, 5B, and 5C, indicated that all sidewall endpoint samples met the SSSAL criteria; therefore, material beyond these sidewalls was considered suitable to remain in place.

P-16 Excavation Endpoint Samples

Confirmatory endpoint samples were collected from the four sides and bottom of the 10-foot by 10-foot by 6-foot deep P-16 excavation. Results indicated that the total SVOC and lead concentrations exceeded their respective SSSALs in the sample collected from the eastern sidewall [SW-P-16(E)5ft], and the lead concentration exceeded its SSSAL in the sample collected from the southern sidewall [SW-P16(S)5FT]. Contaminant concentrations in samples collected from the northern and eastern sidewalls and bottom of the excavation were all below their respective SSSALs. Based on these results, additional soil was removed to extend the excavation approximately 2 feet to the south and east, and new endpoint samples were collected from the southern and eastern sidewalls [designated SW-P16(E2) and SW-P16(S2)]. In addition, soil samples were collected from test pits excavated approximately 5 and 10 feet from the eastern and southern walls and submitted to the laboratory on-hold to be analyzed in the event that additional exceedances were detected. Contaminant concentrations in the eastern sidewall sample [SW-P16(E2)] were all below the SSSALs; however, the lead concentration exceeded its SSSAL in the southern sidewall sample [SW-P16(S2)] and in test pit samples collected 5 and 10 feet south of the excavation wall [SW-P16(S3) and SW-P16(S4), respectively]. Therefore, additional soil was removed from the southern wall of the P-16 excavation during underground storage tank removal activities to extend the excavation as far south as the southern wall of the tank 14/15 excavation, as shown on Figure 8. Additional endpoint samples were not collected following this excavation, since endpoint samples were previously collected following the tank removal, as described below. Analytical results for the P-16 endpoint samples are summarized in Tables 6A, 6B, and 6C. P-16 endpoint sample locations are shown on Figure 8.

Underground Storage Tank Endpoint Samples

Confirmatory endpoint samples were collected from the sidewalls of the three underground storage tank excavations outside of the sheeting, including the tank 14/15 excavation, the tank 19 excavation, and the tank 20/21/22 excavation, as shown on Figure 8. These samples were collected to ensure that all petroleum contamination associated with the underground storage tanks had been removed. Groundwater was encountered in the bottoms of the tank 14/15 and tank 20/21/22 excavations; therefore, only sidewall samples were collected from these areas. Endpoint sample analytical results, summarized in Tables 6A, 6B, and 6C, indicated that all VOC and SVOC concentrations were below the SSSALs. Four of the endpoint samples [SWS2-E, SWS3-E, BS-T19, and SWS(E)T20-22] contained lead concentrations exceeding the SSSAL of 1000 ppm, and five of the endpoint samples [SWS1-S, SWSN-T19, BW-T19, SWS(E)T20-22, and SWS(W)T20-22] contained mercury concentrations exceeding the

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SSSAL of 2 ppm. These concentrations can be attributed to historic fill at the site and are not associated with petroleum contamination from the underground storage tanks or with other on-site hydrocarbon contamination; therefore, additional soil removal was not conducted in the areas of these endpoint samples.

Perimeter Endpoint Samples

Following soil remediation activities, thirteen soil borings (PR-1 through PR-13) were advanced around the perimeter of the sheeting wall, as shown on Figure 10, to collect perimeter endpoint samples as specified in the RWP. A track-mounted hollow-stem auger drill rig was used to advance the borings to depths corresponding to the approximate center of the adjacent contaminated interval observed within the sheeting wall, and a discrete sample was collected using a 2-foot long stainless steel split spoon sampler. All perimeter samples were analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, and TAL metals at STL Connecticut. The borings were generally advanced at an approximately 30- to 50-foot spacing outside of the soil remediation area; however, perimeter borings could not be advanced along much of the southern sheeting wall or along the southern half of the western sheeting wall due to the presence of electrical transformer vaults and tightly-spaced utility lines under the Center Boulevard and 48th Road sidewalks. Analytical results from the perimeter endpoint samples are summarized in Tables 7A, 7B, and 7C. Exceedances of the SSSAL criteria were detected in four of the perimeter samples including: PR-10(11-13), which exceeded the SSSALs for naphthalene and lead; PR-2(14-16) and PR-5(10-12), which exceeded the SSSAL for benzene and naphthalene; and PR-3(14-16), which exceeded the SSSAL for xylenes and naphthalene. The exceedances in borings PR-2, PR-3, and PR-5 were not unexpected given that these samples were collected from just outside of the northern and western site boundaries, in areas not targeted by the remediation. The exceedances noted in the PR-10 soil sample, collected just outside of the eastern sheeting wall can be attributed to residual petroleum/coal tar contamination and/urban fill materials outside of the main soil excavation area.

Analytical Data Quality Assurance/Quality Control

All samples were analyzed by a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratory. Confirmatory end-point samples were analyzed in accordance with Analytical Services Protocol (ASP) Category B deliverables. In addition to the laboratory analysis of the endpoint samples, additional analysis was completed for quality control measures, including equipment field blanks, matrix spike/matrix spike duplicates (MS/MSD), and duplicate samples. For multiple dilutions or duplicate samples, the higher values were reported in the tables presented herein. A review of the analytical data indicated that the data met the objectives of the RWP and is considered usable for verifying remediation of the project site.

4.3.8 Underground Storage Tanks

Thirteen abandoned underground storage tanks (tanks 1-13) were encountered during soil remediation activities within the sheeting wall. An additional six abandoned tanks (tanks 14, 15, 19, 20, 21, and 22) were encountered outside of the sheeting wall, during excavation for the parking garage foundation. All abandoned tanks were pumped out, removed from the ground, placed on plastic sheeting, cut open to remove residual

product/sludge, and pressure washed to clean the interiors. Prior to removal, samples were collected from 12 of the tanks and sent for hydrocarbon fingerprint analysis at Meta Environmental, Inc. in Watertown, MA. For Tank 1, a sample was analyzed by STL-Connecticut for VOCs by EPA Method 8260. Samples were not collected from all tanks found within the same vault where similar product was observed. Details of the tank sizes, removal dates, and fingerprint analytical results are summarized in the following table:

Underground Storage Tanks Details
Queens West Parcel 9

Tank Number	Date Encountered	Est. Tank Size (gallons)	Date Removed	Fingerprint ID
1	8/25/05	2,000	9/16/05	Gasoline
2	11/4/05	550	11/10/05	Gasoline
3 & 4	11/8/05 &11/9/05	2 x 4,000	11/10/05	Diesel or heating oil
5	11/9/05	550	11/10/05	Unknown petroleum product
6	2/8/06	1,500	2/9/06	Petroleum-base solvents, lubricating oil
7	2/13/06	800	2/15/06	Possible gasoline or fuel oil
8	2/16/06	800	2/16/06	Weathered gasoline, heavy fuel oil
9, 10, 11	2/21/06	3 x 2,500	2/22/06	Possible gasoline or fuel oil
12	2/21/06	2000	2/22/06	Possible gasoline or fuel oil
13	2/23/06	400	2/24/06	Gasoline, petroleum-based solvents
14 & 15	5/9/06	3000	5/11/06	Kerosene or No. 2 fuel oil (water in excavation)
19	5/22/06	1200	5/24/06	No. 4 fuel oil or marine diesel
20 21 22	5/24/06	1500 1500 3000	5/25/06	No. 4 fuel oil or marine diesel

Three clean, empty tanks (tanks 16, 17, and 18) were found within the fill material outside of the sheeting wall on May 22, 2006. These tanks did not appear be abandoned in-place and were suspected to have been dumped at the site. The tanks were removed from the ground and disposed of off-site as scrap metal. The location of the former underground storage tanks are depicted on Figure 11. The updated NYSDEC Petroleum Bulk Storage (PBS) registration form for the site to register/de-register all of the abandoned tanks encountered during the remediation activities is provided in Appendix L. Underground storage tank disposal documentation and hydrocarbon fingerprint analytical data reports are provided in Appendix M.

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4.3.9 Residual Contamination

Substantially all of the petroleum- and coal tar-contaminated soil above the SSSALs has been removed from the site as part of the remediation activities. Additionally, 22 underground storage tanks, which were likely sources or contributing sources of the contamination, were removed as part of the investigation and remediation activities. A summary of the sampling locations where residual contamination remains at the site above the SSSALs is provided in Figure 12 and Tables 8A, 8B, and 8C. The rationale for leaving in place any residual contamination above the SSSALs is provided in the following table:

Exceedances of SSSALs in Remaining Soil
Queens West Parcel 9

Area	Sample Location	Depth (feet)	Contaminant Type	Contaminant Concentrations (ppm)	Rationale
Far Eastern Portion of Site (outside sheeting)	S-13	21-21.5	Petroleum	B-0.098	Isolated benzene detected in one sample on extreme eastern portion of site
Phase 2 Area – North Portion (inside sheeting)	C-2	19	Petroleum	X-5.1	Excavated to limit of rocky till
	C-3	17.5	Petroleum	B-0.93, X-12.9, T-3.1, TVOC-22.1	
	C-5	18	Petroleum	B-0.69	
	C-6	18	Petroleum	B-0.40	
	C-10	18	Petroleum	B-1.5, X-1.1	
	C-11	18	Petroleum	B-15, EB-21, X-33.6, T-1.7, TVOC-71.4, N-18	
	C-13-2	19	Petroleum	B-1.4, X-5.9	
	C-14-1	18	Petroleum	B-2.3	
	C-14-2	18	Petroleum	B-0.47	
	C-17	20	Petroleum	B-9.2, EB-47, X-87.4, T-2.2, TVOC-148, N-41	
	C-18	22	Petroleum	B-190, EB-170, X-350, T-630, TVOC-1,345, N-110	
	C-19	19	Petroleum	N-22	
	C-20	18	Petroleum	B-0.18	
Phase 1 Area – South Portion (inside sheeting)	C-22-1	24	Petroleum	B-0.64	Excavated to limit of rocky till
	C-22-2	24	Petroleum	B-0.17	
	C-24-2	23	Petroleum	B-0.39	
	C-26-3	22	Petroleum	B-0.12	
	C-26-4	22	Petroleum	B-0.28	
	C-28-2	21	Petroleum	B-0.35	
	C-28-3	22	Petroleum	B-0.085	
	Triangle-1	26	Coal Tar	B-0.16	
	Triangle-2	24	Coal Tar	B-0.21	
	Triangle-3	26	Coal tar	B-0.45	
Phase 1 Area	Triangle-2	20	Petroleum	B-0.080	Excavated to limit

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Area	Sample Location	Depth (feet)	Contaminant Type	Contaminant Concentrations (ppm)	Rationale
– Bench Along Southern Boundary (inside sheeting)					of sheeting design
Eastern Portion of Site (outside & adjacent to sheeting)	PR-10 SWS4-S	11-13 3.5	Petroleum & Urban Fill (metals)	N-32, Pb-2,350 X-1.4	Isolated contamination in one post-remediation boring and one endpoint sample outside of sheeting
Eastern Portion of Site (outside & adjacent to sheeting)	SW-P-16N SWS1-S SWS2-E SWS3-E SWS(N) T19 BS-T19 SWS(E) T20-22 SWS(W) T20-22	5 3.5 3.5 3.5 7 8 7 7	Urban Fill (metals)	Hg-2.1 Hg-3.4 Pb-1,360 Pb-1,250 Hg-3.9 Pb-1,430, Hg-6.6 Pb-2,890, Hg-2.4 Hg-10.1	Remaining urban fill material not targeted for remediation and not disturbed

Notes: ppm = parts per million, B=benezene, EB=ethylbenzene, X=total xylenes, T=toluene, TVOC=total VOCs, N=naphthalene, Pb=lead, Hg=mercury

The remedial objectives in the RWP included the removal of all petroleum- and coal tar-contaminated soil and historic fill containing BTEX, naphthalene, total VOC, and/or total SVOC concentrations exceeding the SSSALs. In the event that urban fill material was excavated or otherwise disturbed during the remediation activities, such material was characterized for reuse on-site or disposed of off-site. However, any other fill material containing metals above the SSSALs that was not otherwise disturbed was left in place. The remedial design was based upon the data compiled as part of the Site Investigation and the remediation delineation borings.

The Site Investigation identified one isolated soil sample, S-13(21-21.5) – located on the eastern portion of the site, containing benzene at a concentration of 0.098 ppm at a depth of 21 to 21.5 feet below grade. The SSSAL for benzene is 0.060 ppm. Neither benzene nor any other contaminants were detected at the same location above the SSSALs at a depth of 10 to 10.5 feet below grade. Since the exceedance was at an isolated location, at a relatively low concentration, and well below the water table, this result did not indicate a significant area of contamination for potential contaminant migration or exposure. Consequently, this area was not addressed as part of the RWP.

Remediation of soil within the sheeting boundaries generally continued until encountering the dense rocky till, limiting further excavation. For the majority of the end-point samples collected at the till, the contaminant concentrations were below the SSSALs. An isolated area within the sheeting boundaries on the southern portion of the

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Phase I area was excavated to a depth between 20 and 21 feet below grade. The sheeting design did not allow for excavation below these depths. One of the three endpoint samples collected from this area [Triangle-2(20)] contained benzene at a concentration of 0.080 ppm, exceeding the SSSAL of 0.060 ppm.

The soil sample collected from below the water table in one post-remediation boring completed immediately to the east of the sheeting boundary (PR-10) identified naphthalene and lead at concentrations of 32 ppm and 2,350 ppm, which were above the SSSALs of 13 ppm and 1,000 ppm, respectively. This may represent some residual petroleum-contamination and urban fill just outside of the soil removal area. However, it appears to be limited based upon the post-remediation borings completed to the north and south (PR-9 and PR-11), which did not contain VOCs, SVOCs, or metals above the SSSALs. Furthermore, one monitoring well installed on the northeast portion of the site as part of the Site Investigation (A-5) did not contain detectable concentrations of VOCs or SVOCs.

The estimated quantities of recoverable remaining contamination above the SSSALs are presented in the following table:

Estimated Quantities of Remaining Recoverable Coal Tar- and Petroleum-Contaminated Soil Above SSSALs
Queens West Parcel 9

Area	Depth Interval (ft bg)	Contaminant Type	Estimated Volume (CY)	Estimated Weight (tons)
Far Eastern Portion of Site at S-14 (outside sheeting)	11.5 - 21.5 (assumed 10 ft thickness)	Petroleum	150	240
Phase II Area – North Portion (inside sheeting)	17.5-22	Petroleum	0 (excavated to till – remaining soil not recoverable)	0
Phase I Area – South Portion (inside sheeting)	21-26	Petroleum & Coal Tar	0 (excavated to till – remaining soil not recoverable)	0
Phase I Area – Bench Along Southern Boundary (inside sheeting)	20-26	Petroleum	130	210
Eastern Portion of Site at PR-10 (outside & adjacent to sheeting)	10-20 (assumed 10 ft thickness)	Petroleum & Urban Fill	590	950

Back-up calculations used to develop the above table are included in Appendix N. A summary of the removal percentage for recoverable coal tar and petroleum contaminated soil (i.e., soil above the till layer) is presented in the following table:

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Estimated Percent Removal of Recoverable Coal Tar- and Petroleum-Contaminated Soil Above SSSALs
Queens West Parcel 9

Contaminant Type	Mass of Contaminated Soil Removed (tons)	Estimated Mass of Remaining Recoverable Contaminated Soil (tons)	% Removed
Coal Tar	20,867	0	100
Petroleum	33,356	1160	96.5
Total	**54,223**	**1160**	**97.9**

As summarized in the table, nearly all of the recoverable petroleum- and coal tar-contaminated soil above the SSSALs was removed during the site remediation. The relatively small amount of residual contamination (2.1 % relative to the total mass of contaminated soil removed) is isolated below the garage and will not be directly below any occupied structures. Furthermore, the site is covered, rendering the area inaccessible for exposure and it is not expected to be significant source for groundwater contamination.

The groundwater monitoring plan in the Site Management Plan includes installation and monitoring from three wells in this area (east of the sheeting and within the garage) to verify that further remediation of this area is not warranted. In addition, soil management procedures specified in the Site Management Plan will ensure that any residual contamination is properly handled if future disturbance below the cover is required.

4.3.10 Reuse Characterization

The following materials were stockpiled in approximately 500 to 1,000 cubic yard piles and characterized for potential on-site reuse:

- Concrete broken up during tank vault demolition (see Section 4.2.6);
- Concrete segregated from existing on-site soil stockpiles during site preparation activities;
- Concrete obstructions removed from the sheeting line during site preparation activities;
- Overlying fill excavated during Phase 1 and Phase 2 soil remediation; and
- Concrete foundation/wall removed from the Phase 1 and Phase 2 excavations.

One four-point composite sample was collected from each stockpile. Chip samples were collected from the stockpiled concrete. All samples were analyzed for VOCs using EPA Method 8260, SVOCs using EPA Method 8270, and TAL metals at STL Connecticut. Analytical results are summarized in Tables 9A, 9B, and 9C, and laboratory analytical data reports are provided in Appendix N. Soil stockpiles and concrete for which the corresponding reuse characterization samples met the SSSAL criteria were reused as backfill within the sheeting wall as described in Section 4.4. Soil stockpiles and concrete for which the corresponding reuse characterization samples exceeded the SSSALs were disposed of off-site with hydrocarbon contaminated soil during Phase 1 and 2 remediation activities. During Phase 2 remediation activities, additional reuse

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characterization samples were collected from test pits excavated within the fill material as a screening tool to help determine the depth to the interface between the overlying fill and hydrocarbon contaminated soil. Results from these screening samples are also included in Appendix N. The following table summarizes the stockpile reuse characterization sample locations, analytical results, and resulting actions taken:

Reuse Characterization Soil Sample Results Summary
Queens West Parcel 9

Sample Number	Material Sampled	SSSAL Exceedances	Action Taken
CONCRETE-SAMPLE-1	Concrete from tank vault demolition/on-site soil piles	None	Downsized concrete to -12" and used as backfill in Phase 1 excavation
CONCRETE-SAMPLE-2	Concrete from tank vault demolition/on-site soil piles	None	Downsized concrete to -12" and used as backfill in Phase 1 excavation
QW-RC-CONCRETE-P2	Concrete foundations removed from Phase 1 excavation area	None	Downsized concrete to -12" and used as backfill in Phase 1 excavation
QW-RC-P1	Overlying fill excavated during Phase 1 (Pile 1)	None	Used corresponding stockpile as backfill in Phase 1 excavation
QW-RC-P2	Overlying fill excavated during Phase 1 (Pile 2)	Mercury	Split soil pile into two 500 cubic yard sections and re-sampled
QW-RC-P2(500)	Eastern 500 cubic yards of Pile 2	None	Used corresponding stockpile as backfill in Phase 1 excavation
QW-RC-P3(500)	Western 500 cubic yards of Pile 2	None	Used corresponding stockpile as backfill in Phase 1 excavation
QW-RC-P4(1000)	Overlying fill excavated during Phase 1 (Pile 4)	None	Used corresponding stockpile as backfill in Phase 1 excavation
QW-C20-COMPOSITE	Overlying fill excavated along eastern sheeting wall during Phase 2	BTEX, Total VOCs,	Disposed corresponding stockpile off-site during Phase 2 remediation
QW-RC-P1 (Phase 2)	Overlying fill excavated during Phase 2 (Pile 1)	Benzene	Split soil pile into two 500 cubic yard sections and re-sampled
QW-RC-P2 (Phase 2)	Overlying fill excavated during Phase 2 (Pile 2)	BTEX, Naphthalene, total VOCs/SVOCs	Disposed corresponding stockpile off-site during Phase 2 remediation
QW-RC-PILE3-EAST	Eastern portion of Pile 1	None	Used corresponding stockpile as backfill in Phase 2 excavation
QW-RC-PILE3-SOUTH	Southern portion of Pile 1	None	Used corresponding stockpile as backfill in Phase 2 excavation
QW-RC-PILE4(0-2)	Overlying fill excavated during Phase 2 (Pile 4)	None	Used corresponding stockpile as backfill in Phase 2 excavation
QW-RC-P4 NORTH	Overlying fill excavated during Phase 2 (Pile 4)	None	Used corresponding stockpile as backfill in Phase 2 excavation

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Sample Number	Material Sampled	SSSAL Exceedances	Action Taken
QW-RC-P3EAST (CONCRETE)	Concrete foundations/tank vaults removed from Phase 2 excavation area	None	Downsized concrete to -12" and used as backfill in Phase 2 excavation
QW-RC-C1 (CONCRETE SLAB)	Concrete foundations removed from Phase 2 excavation area	BTEX, Naphthalene Total VOCs	Disposed concrete off-site during Phase 2 remediation

4.4 RESTORATION

4.4.1 Backfilling

The Phase 1 and Phase 2 soil excavations were backfilled to approximately 4.5 feet below street level (approximately +4.5 feet above the Queens Borough Datum) to facilitate placement of pile caps, foundations, and utility lines for the proposed redevelopment. For both remediation phases, backfilling commenced as endpoint sample results were verified and/or physical limitations of the excavation were reached. Backfilling was conducted by placing the backfill material in approximately two-foot lifts and using a vibratory tamper to compact the material. The Phase 1 excavation was backfilled from December 3, 2005 through January 18, 2006. The Phase 2 excavation was backfilled from February 28 through April 4, 2006.

All imported fill material was received from New York Sand and Stone in Brooklyn, New York. A Beneficial Use Determination (BUD) letter for New York Sand and Stone and analytical results for samples collected at the facility are provided in Appendix O. Testing results indicated that all imported fill material was compliant with both the SSSALs and the RSCOs in TAGM 4046.

4.4.2 Backfill Material

Phase 1

Backfilling of the excavation began December 3, 2005 using stockpiled excavated fill staged outside of the containment structure, and concrete broken from the tank vault and removed from the existing on-site soil piles. The material had been analyzed for reuse suitability in August 2005 and November 2005 as described in Section 4.3.10. Prior to using as backfill, the concrete was downsized to less than 12 inches in diameter utilizing a concrete crushing claw attachment to a standard excavator. Approximately 4,000 cubic yards of historic fill and 2,000 cubic yards of concrete were utilized as backfill for Phase 1.

Starting on December 27, 2005, sand was imported from off-site to continue backfilling operations. The material was received from New York Sand and Stone in Brooklyn, New York. Approximately 16,621 tons of imported sand were used to backfill the Phase 1 excavation.

Phase 2

Backfilling of the Phase 2 excavation began February 28, 2006 using stockpiled excavated fill and concrete, staged outside of the containment structure. The material had been analyzed for reuse suitability in February 2006, as described in Section 4.3.10. Prior to use as backfill, the concrete was downsized utilizing a concrete crushing claw attachment to a standard excavator. Concrete crushing activities began on March 6, 2006

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and were conducted over an approximately two week period. Approximately 3,500 cubic yards of historic fill and 400 cubic yards of concrete were utilized as backfill for Phase 2.

Starting on March 8, 2006, sand was imported from off-site to continue backfilling operations. The material was received from New York Sand and Stone in Brooklyn, New York. Approximately 18,208 tons of imported sand were used to backfill the Phase 2 excavation.

Outside of Sheeting

Between May 12, 2006 and May 30, 3006, sand and stone was imported from off-site to backfill the excavated area from the P-16 excavation and tank area outside of the sheeting. The material was received from New York Sand and Stone in Brooklyn, New York. Approximately 861 cubic yards of imported sand and stone were used to backfill this area.

4.5 SPILLS

4.5.1 NYSDEC Spills

Four spills were reported to the NYSDEC during the course of remediation activities. Spill number 05-09487 was reported on November 8, 2005 when the 4,000-gallon underground storage tank discovered along the southern containment wall (tank #3) was inadvertently punctured by the excavator bucket, causing some of its contents to leak into the excavation. The release was addressed by placing absorbent pads around the tank to contain the spilled material and in the hole to stem the flow of additional product out of the tank. The tank was pumped out later that day using a vacuum truck and was removed from the ground on November 9, 2006, as described in Section 4.3.8. Petroleum-contaminated soil surrounding the tank was addressed as a part of the Phase 1 soil remediation. The Spill number was closed by the NYSDEC on November 14, 2005.

Spill number 05-10984 was reported on December 20, 2005 due to a release from the wastewater treatment system when approximately ten gallons of NAPL/groundwater mixture leaked from a hose leading from the excavation to the initial wastewater holding tank. The majority of the spill was contained on-site by the perimeter haybales; however, some leaked through the haybales onto the street at 48th Avenue near 5th Street. No NAPL was noted in the nearest stormwater inlet, but a sheen was present in the standing water trapped by the inlet protection filter fabric inside the catch basin. The spill was immediately contained and cleaned, the street was pressure washed, standing water was pumped from the catch basin, and the sediment was cleared from the inlet protection. Additional leakage on the street curb, not affecting any catch basins, was discovered the following day at 48th Avenue and Center Boulevard and was immediately cleaned upon discovery. The spill was closed by the NYSDEC on December 22, 2005.

Spill number 05-12954 was reported on February 8, 2006 when the excavator bucket uncovered an estimated 550-gallon underground storage tank while excavating fill material near the eastern edge of the containment wall. The excavator bucket punctured a hole in the tank causing some of the product to leak out. The product was contained by plugging the hole using absorbent pads and by placing soil over it. The tank was pumped out and removed on February 9, 2006, as described in Section 4.3.8. Petroleum-contaminated soil surrounding the tank was addressed as part of the Phase 2 remediation activities. This spill number was closed by the NYSDEC on December 20, 2006.

Spill number 05-13682 was reported on February 27, 2006 when underground air pressure induced during tieback installation along the northern sheet pile wall caused water to be expelled from two monitoring wells (TRC-MW-4D and TRC-MW-4S) on the 47th Road sidewalk. Some of the water, which exhibited a sheen, flowed onto the adjacent construction site forming a small puddle. Absorbent pads were used to contain and clean-up the water. On March 1, 2006, approximately one foot of soil was removed from the area affected by the water and disposed of off-site as petroleum-contaminated soil with soil excavated from the Phase 2 remediation area. The Spill number was closed by the NYSDEC on February 27, 2006.

4.6 ENGINEERING CONTROLS

A site plan illustrating the location of the engineering control components, including the site cover, hydraulic barrier, and vapor mitigation system, is provided as Figure 13.

4.6.1 Site Cover

Following soil removal activities, a cover was installed over at the entire site to prevent direct exposure to underlying soil that could contain residual contaminant concentrations. The cover, shown on Figure 13, currently consists of: concrete building foundations in the area of the high-rise residential building, town houses, and portions of the garage; and a minimum of two feet of clean fill meeting NYSDEC TAGM 4046 RSCOs in the future courtyard area and the remaining portion of the garage not paved with concrete. The concrete building foundation was installed by AvalonBay, which is serving as the general contractor for site redevelopment. The soil cover in the proposed courtyard area was installed by Creamer during the backfilling of the Phase 1 and Phase 2 excavation areas. AvalonBay backfilled the P-16 and underground storage tank areas outside of the sheeting. The clean fill was obtained from New York Sand and Stone in Brooklyn, New York. An NYSDEC BUD letter for New York Sand and Stone and analytical results demonstrating that the material meets the NYSDEC TAGM criteria are provided in Appendix O. To provide a minimum 2-foot thick stabilized surface for cranes, equipment, and construction material storage in the courtyard and unpaved portions of the garage, a total of 1146 cubic yards of gravel and recycled concrete were imported from Bronx Recycling of Bronx, New York, Allocco Recycling of Brooklyn, New York, Racine Materials Corp of New Hyde Park, New York, and New York Sand and Stone between August 10, 2006 and November 6, 2006. The final cover system that will be installed following completion of the site construction activities, inclusive of paving in the courtyard and the remaining portion of the garage, is shown on Figure 14.

4.6.2 Hydraulic Barrier

As described in Section 4.2.2, permanent interlocking steel sheeting was installed around the entire soil remediation area to facilitate excavation for soil remediation. The sheeting was installed such that it will also serve as a hydraulic barrier to isolate the site from off-site contamination. This was accomplished by driving the sheeting into the low-permeability till or clay layer, and sealing the seams in the sheeting with hydrocarbon-resistant Adeka gaskets to prevent infiltration of contaminants back onto the site. A survey of the as-built location of the hydraulic barrier is provided in Appendix F. The hydraulic barrier was installed below grade, and does not require maintenance. Routine groundwater monitoring will be conducted as specified in the Site Management Plan to gauge the effectiveness of the barrier.

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4.6.3 Vapor Mitigation System

The vapor mitigation system consists of a vapor barrier, a sub-slab gas collection network, steel pipe risers, and aboveground blowers/instrumentation. As-built drawings of the underground portion of the system prepared by the installation contractors and review by AKRF are provided in Appendix P. The vapor barrier consists of a 60-mil thick, spray-applied, LiquidBoot® gas vapor membrane installed over a base fabric T-60 non-woven geotextile, with a protective Liquid Boot Ultrashield layer installed on top of the membrane. The subsurface gas collection pipe network consists of schedule 40, 4-inch diameter PVC piping with 0.02-inch slots installed in a 12-inch thick layer of gas-permeable aggregate. The vapor barrier was installed by EAI of Jersey City, New Jersey, a LiquidBoot®-approved applicator.

All subsurface piping was installed horizontally with a minimum one percent slope to prevent accumulation of water that could collect in the piping. Hangers were provided at approximately every five feet and anchored in the concrete building slab to prevent damage to the piping in the event of subsurface settlement. In each zone, a length of solid 4-inch diameter Schedule 40 PVC piping leads from the slotted piping network to an interior riser, as shown on the as-built drawings provided in Appendix P. The solid PVC piping is connected to 4-inch diameter Schedule 40 steel risers via Fernco couplings. Cleanouts were installed at each riser at approximately 12-inches above the floor penetration. The sub-slab gas permeable aggregate, sub-slab piping, and steel risers were installed by Almar Plumbing of Hicksville, New York. Temporary blower assemblies were installed and operational as of December 22, 2006. The permanent blower assemblies, as described in the Site Management Plan (Section 4.7.1, Appendix Q), will be installed after the mechanical rooms are constructed in the on-site buildings. Blower assemblies are to be connected to each interior steel riser to draw vapors from the four subsurface piping zones.

4.7 INSTITUTIONAL CONTROLS

4.7.1 Site Management Plan

A Site Management Plan (SMP) has been prepared to describe procedures and protocols for post-remediation disturbance of soil and groundwater at the Parcel 9 site during future maintenance activities and long-term use. This SMP includes four plans: an Institutional and Engineering Control Plan for implementation and management of institutional and engineering controls; a Monitoring Plan for implementation of site monitoring; an Operation and Maintenance Plan for operation of the sub-slab vapor mitigation system; and a Site Management Reporting Plan for submittal of data, information, recommendations and certifications to the Department. The Institutional and Engineering Control Plan portion of the SMP includes detailed procedures for handling residual on-site contamination during future soil disturbance activities. A copy of the SMP is provided in Appendix Q.

4.7.2 Environmental Easement

An environmental easement has been recorded for the property and includes the following site use restrictions:

- Use of the site for "Restricted Residential Use".

- All engineering controls (including the site cover and sub slab vapor depressurization and active venting system) must be operated and maintained as specified in the NYSDEC-approved Site Management Plan. No Engineering and Institutional Controls may be discontinued without a NYSDEC-approved amendment or extinguishment of the Environmental Easement and/or Site Management Plan.
- Annual inspections, certifications of Institutional & Engineering controls, Site usage, and Site Management Reporting to the Department must be conducted in accordance with the NYSDEC-approved Site Management Plan.
- All future soil disturbance activities on the site that will impact residual contaminated material, including, but not limited to, building construction or expansion, sub-grade utility line construction or repair, must be conducted in accordance with the Soil Management provisions in the NYSDEC-approved Site Management Plan.
- Operation Monitoring and Maintenance (OM&M) of the sub-slab depressurization system must be performed in a manner specified in the NYSDEC-approved Site Management Plan.
- Groundwater and other environmental or public health monitoring required by the NYSDEC-approved Site Management Plan, and reporting of information thus obtained, must be performed in a manner specified in that Plan.
- Onsite environmental monitoring devices, including but not limited to, groundwater monitor wells and soil vapor probes, must be protected and replaced as necessary to ensure continued functioning in the manner specified in the NYSDEC-approved Site Management Plan.
- The use of the groundwater underlying the site is prohibited without treatment rendering it safe for intended purpose.
- Vegetable gardens are prohibited.
- The site may not be used for a higher level of use such as unrestricted residential, without proper notification of NYSDEC of the change of use, approval of that use by the NYSDEC, and an amendment of the Site Management Plan approved by NYSDEC.

The environmental easement includes: a description of the use restrictions; a map showing the area of the restrictions; and a copy of the NYSDEC-approved SMP. The property deed and all subsequent instruments of conveyance will contain language indicating that the site is subject to the environmental easement. A copy of the environmental easement is included in Appendix R.

4.7.3 Annual Certification

Annual Certifications will be submitted to the NYSDEC to document the effectiveness of the remedy. The Annual Certification will be signed by a professional engineer and will certify that: the institutional and engineering controls are unchanged from the previous certification; nothing has occurred that would impair the ability of the controls to protect public health and the environment; and no violations of the site management plan have occurred. The certification will include the monitoring data collected during the reporting period as specified in the SMP.

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4.8 EXPOSURE ASSESSMENT

Potentially exposed populations and potential exposure pathways for on-site contamination are evaluated in this section. Exposure can only occur if there is a complete pathway from a specific chemical of concern contained in one of the on-site media to a receptor. The mere presence of a chemical at a site is not in itself evidence that a complete exposure pathway will exist. Based on results from the previous site investigations, contaminated media at the site included NAPL, contaminated soil, and contaminated groundwater. Potential human receptors include: future residents of the proposed on-site development, future on-site maintenance workers, off-site residents, off-site construction and maintenance workers, and off-site groundwater and surface water. Based upon the site remediation completed and implementation of the Site Management Plan, inclusive of the institutional and engineering controls, there are no complete on-site exposure pathways.

The source of the petroleum and coal tar contaminated has been removed from the site. For the western two-thirds of the site, any residual contamination in soil or groundwater will be contained by the water-tight sheeting. For the eastern portion of the site, minimal residual contamination in soil or groundwater exists outside of the sheeting. Groundwater will be monitored in accordance with the Site Management Plan to ensure that on-site residual contamination does not migrate off-site. Furthermore, soil gas vapors from residual contamination will be controlled by the steel sheeting, in conjunction with the sub-slab ventilation system for the new buildings. Based upon these controls and the limited quantity of residual on-site contamination, the site would not constitute a significant exposure pathway to off-site receptors. Notwithstanding, there are potentially complete off-site exposure pathways associated with off-site contamination.

4.9 DEVIATIONS FROM REMEDIAL WORK PLAN

The remediation and construction activities were completed in substantial conformance with the NYSDEC-approved RWP. Deviations from the RWP are summarized below:

- Sequencing for backfilling remediated areas was modified following communication with NYSDEC, as described in Section 4.3.2. If any area was remediated to the till or the physical limit of sheeting, which prohibited further excavation, endpoint samples were collected and the area was backfilled before receiving the endpoint sample results.
- The final depths of excavation and volumes of soil remediated (disposed off-site) were greater than those specified in the RWP. The increase was based upon field conditions and adherence to the protocols for determining the extent of remediation in the RWP.
- Residual contaminated soil above the SSSALs was left in place, as described in Sections 4.3.7 and 4.3.9.

4.10 COSTS

Details of the remediation costs incurred to date are included in Appendix S. Work associated with remediation included the following:

- Engineering and plan development;
- Environmental oversight and monitoring;
- Preparation of remediation close-out documents;
- Remedial construction;
- Transportation and disposal of contaminated soil;

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- Importing of clean fill; and
- Installation of the vapor mitigation system.

4.11 CITIZEN PARTICIPATION PLAN

A Citizen Participation Plan was developed for the project site to promote public understanding of the Volunteer's responsibilities, planning activities, and remedial activities at the site. The plan was intended to promote two-way communication of the public with the agencies, thereby providing the NYSDEC and AvalonBay Communities an opportunity to gather information from the public, enabling development of investigative and remedial activities that are protective of both public health and the environment. A summary of the community outreach completed to date includes the following:

- Distribution of Fact Sheet #1 in December 2004 to the project mailing list announcing the start of the Supplementary Site Investigation;
- Distribution of Fact Sheet #2 in May 2005 to the project mailing list announcing the availability of the initial Remedial Work Plan for public comment;
- Distribution of Fact Sheet #3 in May 2005 to the project mailing list announcing a public meeting on August 2, 2005;
- Completion of a public meeting by NYSDEC and NYSDOH on August 2, 2005 to seek input from the community regarding the proposed Remedial Work Plan;
- Distribution of Fact Sheet #4 in September 2005 to the project mailing list announcing approval of the revised Remedial Work Plan and the start of the remedial work; and
- Distribution of Fact Sheet #5 in November 2006 to the project mailing list announcing a completion of the remedial work and availability of the initial Final Engineering Report.

Following approval of Final Engineering Report, the NYSDEC will issue a Certificate of Completion to AvalonBay Communities and a fact sheet will be distributed to the project mailing list. Copies of the fact sheets and documents placed in the repositories are included in Appendix A.

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FIGURES

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ELECTRONIC COPY OF FER AND PREVIOUS REPORTS

APPENDIX B
PRE-REMEDIATION SITE SURVEY

APPENDIX C
PHOTOGRAPHS OF SITE REMEDIATION ACTIVITIES

APPENDIX D
WASTE CHARACTERIZATION LABORATORY ANALYTICAL DATA

APPENDIX E
SWPPP INSPECTION FORMS

APPENDIX F
POST-REMEDIATION SITE SURVEY OF HYDRAULIC BARRIER

APPENDIX G
PERMITS

APPENDIX H
WASTE MANIFESTS AND TRUCK TRACKING LOG

APPENDIX I
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APPENDIX J
CONFIRMATORY AIR SAMPLE LABORATORY ANALYTICAL DATA

APPENDIX K
ENDPOINT SAMPLE LABORATORY ANALYTICAL DATA

APPENDIX L
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APPENDIX N
REUSE CHARACTERIZATION SAMPLE LABORATORY ANALYTICAL DATA

APPENDIX O
NEW YORK SAND AND STONE BUD LETTER AND ANALYTICAL DATA

APPENDIX P
VAPOR MITIGATION SYSTEM AS-BUILT DRAWINGS

APPENDIX Q
SITE MANAGEMENT PLAN

APPENDIX R
ENVIRONMENTAL EASEMENT

APPENDIX S
COST REPORT