REVIEW AVENUE DEVELOPMENT (RAD) II

QUEENS COUNTY

LONG ISLAND CITY, NEW YORK

SITE MANAGEMENT PLAN

NYSDEC Site Number: RAD II - BCP #C241005

Prepared by:

MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112

and

Amec Foster Wheeler Environment & Infrastructure, Inc.
200 American Metro Boulevard – Suite 113
Hamilton, New Jersey 08619

Revisions to Final Approved Site Management Plan:

Revision No.	Date Submitted	Summary of Revision	NYSDEC Approval Date

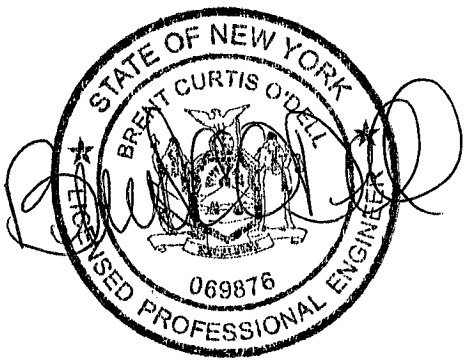
DECEMBER 2015

CERTIFICATION STATEMENT

I, BRENT O'DELL certify that I am currently a New York State (NYS) registered professional engineer as in defined in 6 NYCRR Part 375 and that this Site Management Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

069876 NY P.E.

6/7/16 DATE



RAD II SITE

QUEENS COUNTY

LONG ISLAND CITY, NEW YORK

SITE MANAGEMENT PLAN

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

List of Acronyms

BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
CAMP	Community Air Monitoring Plan
CFR	Code of Federal Regulation
COC	Certificate of Completion
DER	Division of Environmental Remediation
DOT	Department of Transportation
EC	Engineering Control
ECL	Environmental Conservation Law
ERM	Environmental Resource Management
ESA	Environmental Site Assessment
GAC	Granular Activated Carbon
HASP	Health and Safety Plan
HMI	Human Machine Interface
IC	Institutional Control
IRM	Interim Remedial Measure
LNAPL	Light Non-Aqueous Phase Liquid
LRGTB	LNAPL Recovery and Groundwater Treatment Building
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYCRR	New York Codes, Rules and Regulations
O&M	Operation and Maintenance
OM&M	Operation, Maintenance and Monitoring
OSHA	Occupational Safety and Health Administration
OWS	Oil/Water Separator
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PRR	Periodic Review Report
QAPP	Quality Assurance Project Plan
RAD I	Review Avenue Development I Property
RAD II	Review Avenue Development II Property
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RI/FS	Remedial Investigation/Feasibility Study
RIR	Remedial Investigation Report
ROD	Record of Decision
ROW	Right of Way
RP	Remedial Party
RSO	Remedial System Optimization
SMP	Site Management Plan
SVE	Soil Vapor Extraction
TF	Total Fluids
TOGS	Technical and Operational Guidance Series
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VER	Vacuum Enhanced Recovery

ES EXECUTIVE SUMMARY

The following provides a brief summary of the controls implemented for the Site, as well as the inspections, monitoring, maintenance and reporting activities required by this Site Management Plan:

The below table should reflect the site-specific items listed in Sections 3, 4 and 5.

Site Identification: RAD II - BCP # C241005, Long Island City, Queens, NY

Institutional Controls:	The property may be used for commercial use;
	• The RAD II Site may only be used for restricted use; All EC's must be operated and maintained as specified in this SMP; • All EC's must be inspected at a frequency and in a manner defined in this SMP. • The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the NYSDOH or the Queens County Department of Health to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the NYSDEC. Groundwater monitoring must be performed as defined in this SMP; • Data and information pertinent to site management must be reported at the frequency and in a manner as defined in this SMP; • All future activities that will disturb remaining contaminated material must be conducted in accordance with this SMP; • Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in this SMP; • Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical component of the remedy shall be performed as defined in this SMP; • Access to the RAD II Site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified by the Environmental Easement. • The potential for vapor intrusion must be evaluated for any buildings developed in the area within the IC boundaries noted on Figure 2, and any potential impacts that are identified must be monitored or mitigated.

Site Identification: RAD II - BCP # C241005, Long Island City, Queens, NY

	All ECs must be inspected at a frequency and in a manner defined in the SMP.
Engineering Controls:	Cover system – 6 inch asphalt paving system
	LNAPL Recovery and Treatment System • Two 6,000 gallon LNAPL Storage Tanks • Two 8' X 40' Equipment Enclosures • 38 Skimmer well pumps and piping • 30 VER Well pumps, SVE blower air treatment and piping, liquid treatment equipment and discharge piping.

Inspections:	Frequency
Cover inspection	Annually
Treatment System and Equipment Inspections per OM&M Manual	Monthly, Quarterly and Semi-Annual Per OM&M Manual
Monitoring:	
Presence and Absence of LNAPL in Wells Identified on Table 3 of SMP for RAD II	Monthly, Quarterly and Semi-Annual as indicated on Table 3 of SMP for RAD II
Maintenance:	
Equipment maintenance per Table 4 of SMP for RAD II	Per Table 4 of SMP for RAD II
Reporting:	
LNAPL Monitoring	Per Table 3 of SMP
Treated Water Discharge Sampling and Reporting	Quarterly
Periodic Review Report	Annually

Further descriptions of the above requirements are provided in detail in the latter sections of this Site Management Plan.

1.0 INTRODUCTION

1.1 General

This Site Management Plan (SMP) is a required element of the remedial program for the properties located at 37-30 and 37-80 Review Avenue Long Island City, New York. These properties are in the New York State (NYS) Brownfield Cleanup Program (BCP) and identified as Review Avenue Development Site I (RAD I) Brownfield Cleanup Agreement (BCA) #C241089 and Review Avenue Development Site II (RAD II) #C241005, which is administered by New York State Department of Environmental Conservation (NYSDEC). This SMP is for the RAD II Site, which is located at 37-80 Review Avenue, a separate SMP has been prepared for RAD I site and covers the applicable portions of the remedy put in place for RAD I. Figure 1 presents the location of both the RAD I and RAD II Sites.

DMJ Associates, LLC, 37-80 Review, LLC and Cresswood Environmental Consultants, LLC (collectively referred to as the Volunteer) entered into a Brownfield Cleanup Agreement (BCA) dated June 6, 2005 with the NYSDEC to participate in the Brownfield's Cleanup Program for the RAD II Site. A figure showing the RAD II Site's layout and boundaries is provided in Figure 2. The boundaries of the RAD II Site are more fully described in the metes and bounds site description, which is part of the Environmental Easement provided in Appendix D.

After completion of the remedial work, some contamination was left at the RAD II Site, which is hereafter referred to as "remaining contamination". Institutional and Engineering Controls (IC's and EC's) have been incorporated into the Site's remedy. The IC's and EC's will control exposure to remaining contamination and ensure protection of public health and the environment. An Environmental Easement (included as Appendix D) granted to the NYSDEC, and recorded with the Queens County, County Clerk, requires compliance with this SMP and all EC and IC placed on the Site.

This SMP was prepared to manage remaining contamination at the RAD II Site until the Environmental Easement is extinguished in accordance with ECL Article 71, Title 36. This plan has been approved by the NYSDEC, and compliance with this plan is required by the grantor of the Environmental Easement and the grantor's successors and assigns. This SMP may only be revised with the approval of the NYSDEC.

It is important to note that:

- This SMP details the site-specific implementation procedures that are required by the Environmental Easement. Failure to properly implement the SMP is a violation of the Environmental Easement, which is grounds for revocation of the Certificate of Completion (COC);

- Failure to comply with this SMP is also a violation of Environmental Conservation Law, 6NYCRR Part 375 and the BCA, Index #W2-1076-05-09; RAD II Site Number C241005, and thereby subject to applicable penalties.

All reports associated with the RAD II Site can be viewed by contacting the NYSDEC or its successor agency managing environmental issues in New York State. A list of contacts for persons involved with the site is provided in Appendix A of this SMP.

This SMP was prepared by MACTEC Engineering and Consulting, P.C. (MACTEC) and Amec Foster Wheeler Environment and Infrastructure, Inc. (Amec Foster Wheeler), on behalf of Cresswood Environmental Consultants, LLC and Review Ave. System, LLC, in accordance with the requirements of the NYSDEC's DER-10 ("Technical Guidance for Site Investigation and Remediation"), dated February 2013, and the guidelines provided by the NYSDEC. This SMP addresses the means for implementing the IC's and EC's that are required by the Environmental Easement for the RAD II Site.

1.2 Revisions

Revisions to this plan will be proposed in writing to the NYSDEC's project manager. Revisions will be necessary upon, but not limited to, the following occurring: a change in media monitoring requirements, upgrades to or shut-down of a remedial system, post-remedial removal of contaminated sediment or soil, or other significant change to the RAD II Site conditions. In accordance with the Environmental Easement for the RAD II Site, the NYSDEC will provide a notice of any approved changes to the SMP, and append these notices to the SMP that is retained in its files.

1.3 Notifications

Notifications will be submitted by the property owner to the NYSDEC, as needed, in accordance with NYSDEC's DER – 10 for the following reasons:

- 60-day advance notice of any proposed changes in the RAD II Site's use that are required under the terms of the BCA, 6NYCRR Part 375, and/or Environmental Conservation Law.

- 7-day advance notice of any field activity associated with the remedial program.

- 15-day advance notice of any proposed ground-intrusive activity pursuant to the Excavation Work Plan.

- Notice within 48-hours of any damage or defect to the foundation, structures or EC's that reduces or has the potential to reduce the effectiveness of an EC, and likewise, any action to be taken to mitigate the damage or defect.

- Verbal notice by noon of the following day of any emergency, such as a fire; flood; or earthquake that reduces or has the potential to reduce the effectiveness of EC's in place at

the RAD II Site, with written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.

- Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action submitted to the NYSDEC within 45 days describing and documenting actions taken to restore the effectiveness of the EC.

Any change in the ownership of the RAD II Site or the responsibility for implementing this SMP will include the following notifications:

- At least 60 days prior to the change, the NYSDEC will be notified in writing of the proposed change. This will include a certification that the prospective purchaser/Remedial Party has been provided with a copy of the SMP and all approved work plans and reports.

- Within 15 days prior to the transfer of all or part of the RAD II Site, the new owner's name, contact representative, and contact information will be confirmed in writing to the NYSDEC.

Table 1 below includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of site-related contact information is provided in Appendix A.

Table 1: Notifications*

Name	**Contact Information**
James Moras, NYSDEC Program Manager	518-462-9768 james.moras@dec.ny.gov
Brian Davidson, Remediation Manager	518-402-9790 brian.davidson@dec.ny.gov

* Note: Notifications are subject to change and will be updated as necessary.

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS

The RAD II Site and the RAD I Site are adjacent to each other and have the same physical setting. The sites have been investigated and remediated, at times concurrently since the early 1980's, but were entered into separate BCA and assigned different BCP numbers. The remedy selected by the NYSDEC for the RAD II Site is in the Record of Decision (ROD) issued by the NYSDEC in February 2007. A Decision Document was issued by the NYSDEC for the RAD I Site in December 2015. Because of their adjacent location and their history of investigation and remediation, much of the information presented in the following sections is shared by both sites because of their adjacent location and their history of investigation and remediation.

2.1 Site Location and Description

The RAD II Site is approximately 1.8 acres in size and located in a highly industrialized part of Long Island City, County of Queens, New York. Figure 1 presents a site location map. Zoning in this area is designated as heavy manufacturing. Most of the structures that previously existed on the RAD II Site were demolished since the property was abandoned in 1981. Much of the RAD II Site was reportedly covered by asphalt or concrete during its operation; large portions of the RAD II Site have since been covered with surficial urban fill and debris and is currently paved. Figure 2 presents a site layout map for RAD II Site.

The RAD II Site is identified as Block 312 and Lot 69 on the Long Island City Tax Map. The RAD II Site is separated from the RAD I property by a right of way, Preston Street, which is located on RAD I and runs from Review Avenue to the Long Island Railroad. The address of the RAD II Site is 37 - 80 Review Avenue.

The RAD II Site is bounded by Review Avenue to the northeast, the Southern Line of the Long Island Railroad to the southwest, the Former Phoenix Beverage property to the southeast, and the RAD I property to the northwest (see Figure 2). To the northeast of Review Avenue is the Calvary Cemetery and to the southwest of the Long Island Railroad is the South Capasso property and the Former Peerless Oil property. The boundaries of the RAD II Site are more fully described in Appendix D.

2.2 Physical Setting

2.2.1 Land Use

The RAD II Site has been previously used for a variety of industrial purposes, including refining and recycling of crankcase oil since the late 19th century. A Sanborn Fire Insurance Map from 1898 indicates that the Site was partially occupied by the vacant and dilapidated brick wrecks of an oil refinery. Available information indicates the earliest recorded actual owner of the property was American Agricultural Chemical Company. In 1931, the property was transferred to Triplex Oil. Triplex Oil used the property for the refining of used crank case oil for approximately 40 years. From 1972 until 1980, the facility was operated by several different owners, including Pentalic Corporation, Sea Lion Corporation, Ag-met Oil Service, Inc., Hudson Oil Refining Corp., and Portland Holding

Corp. In 1980 Quanta Resources acquired the property, and used the property for the re-refining of used crankcase oil and other liquid recycling before filing for bankruptcy on October 6, 1981. The property was abandoned in November 1981.There were structures on the Site (buildings, tanks, containment areas, concrete pads, sumps, vaults, debris piles, and foundation structures), which were demolished and removed in 2008 as part of an interim remedial action. Angel Aerial Corporation is currently leasing the RAD II Site for parking of equipment and vehicles. A number of potential LNAPL source areas existed on the RAD properties throughout its operational history, however, the primary suspected source area is the tank farm area located in the northeastern portion of the RAD II Site.

It is believed that most of the contamination at the RAD II Site resulted from leaking pipes and improper storage of waste oils.

2.2.2 Geology

The surficial geology of western Long Island is characterized by Pleistocene deposits of glacial origin and a thin mantle of Holocene soil. The stratigraphy of the RAD II Site and the adjacent properties consists of urban fill overlying glacial deposits, which in turn overlies a clay layer that has been identified as the lower Cretaceous Raritan Formation. The urban fill generally consists of heterogeneous soil ranging from sub angular, loose and compact, silty, fine sand and gravel. Intermixed with the urban fill are debris such as brick fragments, asphalt, wire, and plastic. Soil borings at SB-05 and GAWG-04 indicate that the urban fill ranges in thickness from 3 feet to 16 feet. The glacial deposits consist of two units distinguishable in color, but not in hydraulic characteristics. The upper section of the glacial deposits is gray to dark gray, fine to coarse sand and fine to coarse gravel. There are local horizontal units of silt interbedded in the upper section of the glacial deposit. The upper section extends to approximately 30 feet below MSL.

The lower section of the glacial deposits is comprised of yellowish-brown, fine to coarse sand and gravel. This unit extends to 71 to 85 feet below mean sea level (MSL). Underlying the coarse sand and gravel is a clay unit referred to as the Lower Clay Unit. The Lower Clay Unit was identified as the Raritan Clay. The Raritan Clay or Lower Clay Unit has been described as a dark gray, finely laminated to thin bedded silty clay, silt and clay layer, and white to light gray clay. The clay unit appears to be laterally continuous beneath the Site and adjacent surrounding area. Geologic/Hydrogeologic cross sections are presented in Figures 7 through 9 (Golder, 2005a) in Appendix K.

2.2.3 Hydrogeology

The RAD II Site is located between a local topographic high to the northeast and Newtown Creek, which is a tidally influenced regional groundwater discharge area. Monitoring wells screened in the upper section of the glacial deposits (where LNAPL occurs) and monitoring wells screened in the lower section of the glacial deposits (and cased off from the upper section) have been installed on the RAD II Site and offsite (including the RAD I Site). The location of the wells are depicted on Figure 3. Historically, the depth to groundwater beneath the RAD II Site has ranged from approximately 15 ft bgs to 20 ft bgs in recent history. Groundwater contour maps, prepared from the groundwater levels measured in groundwater wells installed in the upper and lower sections of the glacial deposits, have

indicated a general groundwater flow direction to the south - southwest towards Newtown Creek. A localized groundwater mound, presumably a result of the discontinuous silt and clay layers in the upper section of the glacial deposits has also been observed beneath the southwest of the Site, between the LIRR tracks and Newtown Creek. The mounding is believed to be transient and does not appear to influence the direction of groundwater flow. Groundwater fluctuations of approximately 0.05 to 0.1 feet have been observed beneath the Site as a result of tidal influence in Newtown Creek. Overall, the horizontal hydraulic gradient beneath the Site is flat, at approximately 0.0015. Vertical gradients are minimal and localized. Slug test data indicates a range of hydraulic conductivity values for the glacial deposits above the Lower Clay Unit of 62.5 feet per day (ft/d) to 0.5 ft/d. A viscous light non-aqueous phase liquid (LNAPL) is present on the groundwater table across most of the Site (Golder 2005a). Groundwater elevation measurements collected in Site monitoring wells during the 2004 and 2005 sampling event are provided in Table 4 (Golder, 2005a) and contour maps are presented in Figures 11 and 12 (Golder, 2005a) in Appendix K. Groundwater monitoring well construction logs are provided in Appendix E.

2.3 Investigation and Remedial History

The following narrative provides a chronology and brief summary of the investigations and remediation conducted at the Site. Some of the activities summarized below were conducted on RAD I and II concurrently. Therefore some reports (including the RAWP for the site) include discussions for both sites together.

- In June 1980, the Site was listed on the New York State Registry of Inactive Hazardous Waste Disposal Sites as a Code B site. This classification was assigned because there was inadequate and/or insufficient data for inclusion in any other classification

- In 1982, the New York City Department of Environmental Protection (NYCDEP) completed an Emergency Removal Action in 1982 to address the immediate risks posed by the Site, due to the various waste materials left behind in tanks and related structures. Over 500,000 gallons of liquids and approximately 900 cubic yards of solids were removed from the site. Portions of the material removed were impacted with polychlorinated biphenyls (PCB), chlorinated solvents, heavy metals and/or cyanide. Following the removal, above ground storage tanks (AST), underground storage tanks (UST), piping, separators, and the buildings were decontaminated.

- After the initial removal action, an environmental investigation was conducted, with the results presented in a report prepared for the NYCDEP dated January 7, 1983.

- In 1983 the site's classification was changed to a Class 3. A Class 3 site is one that does not pose a threat to public health or the environment, and action may be deferred.

- In 1984, a Phase I investigation was performed for the NYSDEC, following which the Site's classification was changed to Class 2a.

- The Phase I ESA and NYCDEP Reports were supplemented by a Phase II investigation conducted by the NYSDEC by Lawler, Matusky, & Skelly Engineers. Investigatory work was conducted from 1988 through 1990 and involved installing three monitoring wells, and analysis of groundwater reported similar contamination, soil and groundwater data as was reported previously. The Phase II ESA investigation resulted in the classification of the Site being changed to Class 2.

- A Phase I Environmental Site Assessment (ESA) of both the North Capasso (RAD I) and South Capasso properties was conducted by Environmental Resources Management, Inc. (ERM) in December 1989 (ERM, 1990).

- ERM conducted Phase I and Phase II remedial investigations in 1990 and 1992. Four wells were installed and sampled during these investigations.

- Haley and Aldrich, Inc. (Haley and Aldrich) installed and sampled four monitoring wells in September 2000.

- Haley and Aldrich installed and sampled four monitoring wells in October 2002.

- Golder Associates, Inc. (Golder) conducted a Phase I and Phase II remedial investigations in 2003 and 2004.

- In 2005, Golder submitted a Feasibility Study (FS) to provide additional information on the characteristics and mobility of the LNAPL, as well as the results of a pilot test of a single phase LNAPL removal at two locations on the RAD II part of the Site. The FS also presented the results of human health and environmental exposure assessments that were the basis of the remediation objectives.

- Golder submitted a Remedial Investigation Report (RIR) in 2005 that summarized the results of the Phase I and Phase II remedial investigations conducted by Golder in 2003 and 2004

- A Supplemental RIR was submitted by Golder in 2005 that confirmed the conclusions in the 2005 RIR, e.g. the LNAPL observed beneath the Site has only minimally impacted the groundwater quality downgradient of the Site and will not adversely affect downgradient human or ecological receptors. Golder concluded the LNAPL will not affect receptors because of the low solubility of the compounds composing it and the natural attenuation mechanisms at work on it within the groundwater.

- Separate BCA’s were signed for the RAD II Site and the RAD I Site in 2005.

- A ROD for the RAD II Site was issued by the NYSDEC in February 2007 and DD was to be issued by the NYSDEC for the RAD I Site later.

- In 2008, as part of an interim remedial action, buildings and ASTs were removed from the RAD II Site, as well as below-grade foundation structures, concrete pads, sumps, and vaults. These demolition activities were provided to the NYSDEC in September 2011 as part of the construction completion report by de maximis.

- In October 2008, Geosyntec Consultants, Inc. (Geosyntec) performed a soil vapor survey on the RAD II Site. The contaminants of interest in the soil vapor sampled exceeded the conservative residential screening levels used and were lower along the Phoenix Beverages property in comparison to those from the Preston Street property.

- In December 2009, Geosyntec performed a Phase II ESA investigation on the Phoenix Beverage Property, Benzene, 1,3,5-trimethylbenzene, and 1,2,4-trimethylbenzene, and naphthalene had levels above the United States Environmental Protection Agency (USEPA) Generic Screening levels in the soil vapor samples.

  - NYSDEC approved the Decision Document for the RAD I Site on December 2, 2015.

  - A Remedial Action Work Plan (RAWP) was prepared by Golder in accordance with DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2010) and Subpart 375.3 Brownfield Cleanup Program Regulations (NYSDEC, 2005a) to satisfy the requirements of the ROD for the Site. The RAWP presented the approach to implementing the selected remedy for both the RAD II Site and RAD I Site in the ROD. The RAWP and submitted to the NYSDEC in 2011.

  - In 2013, Amec (now Amec Foster Wheeler) submitted a RAWP Addendum #1, Pre-Design Investigation (PDI) Report for the RAD II Site and RAD I Site to confirm assumptions related to improving soil capping and LNAPL recovery.

Full titles for each of the work plans or reports referenced above are provided in Section 8.0 - References.

2.3.1 Soil

This section describes the original site conditions prior to the remedy, contaminant classes and major compounds or elements identified in soil/fill, and ranges of contaminant concentrations for primary contaminants and comparison. Soil samples collected as part of the Remedial Investigation (RI) investigation were analyzed for VOC's, SVOC's, including polycyclic aromatic hydrocarbons (PAH's), polychlorinated biphenyls (PCB's) and metals.

Soil sampling results were compared during the RI to the NYSDEC recommended soil objectives outlined in the New York Technical Assistance and Guidance Memorandum (TAGM) 4046 as summarized below. However, after the ROD in 2007, NYSDEC issued new soil cleanup guidance in 6 NYCRR Part 375-6.8(b) and CP-51 (October 21, 2010), which replaced TAGM 4046. The new soil cleanup guidance does not require changing remedies selected on the basis comparisons with TAGM 4046, except as required by DER-2. DER-2 contains provisions for revising a remedy if

compliance with updated/new cleanup objectives would cause a fundamental change to the scope, performance or cost of the remedy as required to protect public health and the environment. For some compounds of concern in the soil at the RAD II Site, the more recent soil cleanup objectives impose quantitative objectives that did not exist in TAGM 4046. For other compounds, the more recent objectives are less stringent or more stringent than TAGM 4046. Despite these changes, the interpreted extent of soil at RAD II exceeding the more recent soil cleanup objectives is not different than the extents presented in Figures 6 through 9 (Golder, 2011) in Appendix K, and summarized below relative to the TAGM 4046 objectives. This SMP has retained reference to TAGM 4046 objectives consistent with the ROD and the selected remedy.

Eleven VOC's were detected in subsurface soil samples above soil objectives values are based on protection of groundwater as shown in Figure 7 (Golder, 2011) in Appendix K. None of these VOC's exceeded guidance values based on the United States Environmental Protection Agency (USEPA) human health based criteria. Five PAH's in surface soil samples and eleven SVOC's in subsurface samples were detected above the soil objectives as presented in Figures 6 and 8 (Golder, 2011) in Appendix K.

Total PCB exceeded the soil objective in one surface sample and one subsurface soil sample. The PCB concentrations do not pose a significant threat to human health or the environment, and do not prohibit commercial use of the Site as allowed by federal PCB regulations provided that institutional controls and a protective cover is utilized.

Seven metals in surface soil samples and thirteen metals in subsurface soil samples exceeded the soil objectives as presented in Figures 6 and 9 (Golder, 2011) in Appendix K.

The exceedances above do not interfere with development plans for the RAD II Site, based on the following rationale for the following reasons:

- The RIR soil objectives are based on restoration of site conditions to background, and not directly based on groundwater or human health protections. As stated in the ROD, urban fill is distributed ubiquitously across the RAD II Site and adjacent properties and so the objective of restoration of background is unrealistic.

- The RAD II Site is designated for commercial use, not residential use, and a protective soil cover is included as part of the Site's redevelopment plan. The cover will be protective of human health by restricting direct contact with compounds that exceed the soil objectives. The SMP will identify provisions for the handling and management of the covered soil and will allow subsurface excavations for utility or foundation construction, without exposing construction workers or site occupants to unacceptable levels of compounds of concern.

- Although the concentrations of several compounds of concern in the urban fill/soil were above the soil objectives (based on groundwater protection), the urban fill/soil to

groundwater leaching pathway is not expected to pose a significant threat to groundwater due to the presence of LNAPL on the groundwater table and within the vadose zone beneath the Site, and the small impacts to groundwater quality observed at the Site prior to any remediation.

Additional soil samples were collected on the RAD II Site during installation of LNAPL monitoring wells GAL-29 through GAL-31, which were installed in July 2008 and sampled at various intervals for gasoline range organics (GRO) and diesel range organics (DRO). GRO and DRO was tested in soil at these locations to compare petroleum contamination levels beneath the former area of the demolished buildings and above-ground storage tanks with the extensive data from borings and samples surrounding that area collected prior to demolition completed during the interim remedial measure. The well locations and boring logs containing well construction details are presented on Figure 3 (Golder, 2008) in Appendix K. The July 2008 soil analytical results are also presented in Table 1 (Golder, 2008) in Appendix K and summarized as follows:

- GRO and DRO concentrations generally decreased from shallow to deeper intervals.
- Soil collected from three locations exhibited a range of GRO and DRO concentrations with the highest GRO concentration detected in SB-30 at a depth of 10.5-11.5 feet bgs and the highest DRO concentration detected in SB-31 at a depth of 22-23 feet bgs.
- The new data were consistent with the previous data and did not reflect a concentrated source of petroleum contamination originating from this area. The results from these borings do not affect the remedy approach required for contaminated soil identified in the ROD (i.e., covering with pavement or clean soil).

2.3.2 Groundwater

Groundwater samples were collected during the RI and in April 2011 from the groundwater monitoring well GAGW-04D, a background well installed in the lower glacial deposits and located upgradient of the RAD II Site near Calvary Cemetery. These samples were analyzed for VOC's, SVOC's, PCB's, metals and general chemistry parameters. The results were compared to the (Technical and Operational Guidance Series) TOGS 1.1.1 Groundwater (Class GA) standards for drinking water, and the TOGS 1.1.1 SD standards for saline water.

Groundwater sampling results from August 2004 and April 2011 are summarized in Tables 2A through 2E and Figure 5 (Golder, 2011) in Appendix K. Iron, magnesium, sodium and benzo(a)anthracene were detected in GAGW-04D above the TOGS 1.1.1 Class GA standard. Copper and hexachlorobenzene were detected above the TOGS 1.1.1 SD standard for saline water in GAGW-04D. Based on these results, groundwater upgradient from the RAD II Site and RAD I Site does not meet drinking water or saline water standards that have been referenced during prior groundwater investigations.

The following summarizes April 2011 groundwater quality compared with the TOGS 1.1.1 GA drinking water standard for reference, and provides a comparison with the 2004 groundwater sampling data:

- A benzo(a)anthracene concentration of 0.031 ppb (above the TOGS 1.1.1 standard of 0.002 ppb) was detected; prior sampling events did not indicate this compound.
- Iron and sodium concentrations were lower than those detected in 2004.
- The concentration of manganese was greater than that detected in 2004.

Detections of the above analytes in background groundwater samples may be local background concentrations. The ROD states that metals detected at the Site are naturally occurring.

In addition to the above analytes detected in monitoring well GAGW-04D, xylene and MTBE have been detected in upgradient groundwater samples along Review Avenue. The ROD did not attribute MTBE groundwater concentrations at the RAD I Site to the past waste oil recycling activities on the RAD II Site and also stated that MTBE and TCE were detected in groundwater both upgradient and down gradient of the Site.

Because groundwater quality beneath the RAD II Site and RAD I Site has been affected by upgradient sources and background concentrations, and the groundwater at the Site and in the vicinity of the Site will not be used as drinking water, as acknowledged in Section 5.1.2 in the ROD, because it has been affected by upgradient sources. The TOGS 1.1.1 GA standards for drinking water and TOGS 1.1.1 Class SD standards criteria have been a comparison reference for the Site.

In August 2004, as part of the RI for the RAD II Site, groundwater samples were collected from deep groundwater monitoring wells GAGW-01, GAGW-02, GAGW-03 and GAGW-05 and shallow groundwater monitoring well GAGW-06I. In April 2011, groundwater samples were also collected from GAGW-01 and GAGW-06I. The groundwater samples were analyzed for VOC, SVOC, PCB, metals and natural attenuation parameters. The analytical results for the groundwater samples collected on RAD II did not detect any compounds of concern over the applicable TOGS 1.1.1 Class SD standards, either during the RI or during the April 2011 sampling event. Six VOCs, five SVOCs, and four metals were detected in groundwater at concentrations above the TOGS 1.1.1 Class GA standard. Groundwater sampling results from both the RI investigation and the April 2011 groundwater sampling event are summarized in Tables 2A through 2E and Figure 5 (Golder, 2011) in Appendix K, and below as follows:

- In monitoring well GAGW-06I, benzene was detected at a concentration of 2.2 µg/L, which exceeds the TOGS 1.1.1 GA standard of 1 µg/L, and was 1.1 µg/L higher than the benzene concentration of 1.1 ppb detected in this well in 2004.

- MTBE was detected in monitoring well GAGW-06I at a concentration of 14 µg/L, which exceeds the TOGS 1.1.1 GA standard of 10 µg/L, but is a decrease from the 32 µg/L detected in 2004.

- Benzo(a)anthracene was detected at concentrations of 0.065 and 0.061 µg/L in monitoring wells GAGW-01 and GAGW-06I. These concentrations exceeded the TOGS 1.1.1 GA standard of 0.002 µg/L. Prior sampling events did not detect this parameter. In April 2011, it was also detected in background groundwater monitoring well GAGW-04D.

- In April 2011, iron was detected in monitoring well GAGW-01 at a concentration lower than previously detected in 2004. In monitoring well GAGW-06I, iron was detected at a concentration higher than previously detected in 2004.

- Sodium and magnesium were detected in monitoring well GAGW-01 at concentrations that exceeded the TOGS 1.1.1 GA standards. These analytes were detected at comparable concentrations in 2004.

- Manganese was detected in monitoring well GAGW-06 at a concentration that exceeded the respective TOGS 1.1.1 GA standard. Manganese was detected at a comparable concentration in 2004.

- In 2004, MTBE was detected in GAGW-01 and vinyl chloride and sodium was detected in monitoring well GAGW-06I at concentrations that exceeded the respective TOGS 1.1.1 GA standards. In 2011 they were not detected at concentrations that exceeded the TOGS 1.1.1 GA standard.

Monitoring wells GAGW-02, GAGW-03 and GAGW-05, all of which were located on the RAD II Site were not sampled in April 2011.

Two VOCs and three metals (iron, magnesium and sodium) were detected at concentrations that exceeded the TOGS 1.1.1 Class GA standards for drinking water. Groundwater sampling results from both the RI investigation and the April 2011 groundwater sampling event are summarized in Tables 2A through 2E, and Figure 5.

2.3.3 LNAPL

LNAPL samples were collected throughout the RAD II Site and RAD I Site during RI activities, and analyzed for various parameters as summarized in Table 3 (Golder, 2011) in Appendix K. The viscosity and specific volume of the LNAPL differ in different areas of the RAD I and RAD II Sites. Because the remediation systems were designed to address LNAPL across both the RAD II and RAD I sites, the discussion of the LNAPL includes both sites.

Three LNAPL zones of viscosity (Zone 1 through Zone 3) were identified. LNAPL viscosity decreases from Zone 1 to Zone 3 as presented in Figure 10 (Golder, 2011) in Appendix K. The

specific volume (the total volume of LNAPL per unit area, both mobile and recoverable and residual, immobile, and unrecoverable) of the LNAPL at each monitoring well was calculated in the RI and Feasibility Study (FS) Figure 16 (Golder, 2005b) in Appendix K. The specific volume of LNAPL volume was a factor considered during the selection of the LNAPL extraction technology. LNAPL modeling of mobility calculated that at least 25 percent of the total LNAPL volume is residual and unrecoverable using any of the technologies. However, areas with larger specific volumes of LNAPL volumes generally contain larger amounts of recoverable LNAPL, with LNAPL of higher viscosity needing greater effort to recover LNAPL from soil pore spaces.

Concentrations of PCB's above 50 mg/kg were detected in LNAPL samples collected from GAL 01/01R, GAL-02 and GAL-03) within Zone 1. The occurrence of PCB's above 50 mg/kg was conservatively extrapolated to occur in Zone 2 on the RAD I and RAD II within approximately 50 feet of Zone 1. Upon extraction well installation wells were sampled for PCB content. One well had a concentration of greater than 50 mg/L PCBs (54mg/l). This well designated TF-6D (located on RAD I) will be managed separately from the rest of the system until such time that PCB concentrations are shown to be below 50 mg/l for three consecutive sampling events. Other wells in the vicinity of TF-6D contained LNAPL with less than 50 mg/l but greater than 25 mg/l will be sampled following system start up to ensure PCB concentrations greater than 50 ppm are not present. The LNAPL recovered from this area will be classified as PCB liquids, with portions of the area having concentrations greater than 50 mg/L. Where PCBs are greater than 50 mg/L, LNAPL will require separate extraction (manually), handling, storage and disposal for treatment. The PCB concentration in LNAPL within monitoring wells outside of Zone 1 was a maximum concentration of 34 mg/kg. The LNAPL with a PCB concentration less than 50 mg/kg will not require special handling, however wells that had PCB concentrations greater than 25 but less than 50 mg/l will be sampled twice after start –up but during the first year of operation to ensure PCB concentrations remain below 50 mg/l and don't require special handling.

Monitoring wells GAL-29 through GAL-31 and vacuum enhanced recovery (VER) well VER-2 were installed on RAD II in conjunction with pilot study activities. The locations of these wells are presented on Figure 3 (Golder, 2011) in Appendix K. LNAPL in these wells was sampled in 2008 and analyzed for viscosity, density, surface tension and interfacial tension and a summary of the LNAPL physical property data collected from the RAD II Site, including comparison with data presented in the RI report, is provided in Table 3 (Golder, 2011) in Appendix K. The LNAPL viscosities measured in these wells were consistent with the range of viscosities in Zone 2. LNAPL apparent thickness measurements were collected in July and August 2004, June and August 2008, and April 2011 and are presented in Table 4A (Golder, 2011) in Appendix K. A comparison of LNAPL apparent thicknesses and viscosities is as follows:

- In 2008, LNAPL thicknesses differed from those measured in 2004 by less than one foot, and generally showed a small decrease in thickness over time with a maximum apparent thickness of about seven feet detected in OW-1 (located in Zone 1) in 2008. Apparent LNAPL thickness has varied in wells during various monitoring events and appears to be

affected by fluctuations in groundwater level. Consistent with previous findings of, LNAPL has remained static over the 7 year period of monitoring.

- The LNAPL gradient on RAD II has remained stable or slightly decreased during the last seven to eight years.

- LNAPL viscosity in the southern part of the RAD II Site (near the pilot test location with well VER-2) was higher than the maximum viscosity in Zone 1. VER-2 was installed in an area that has a greater apparent thickness of LNAPL in Zone 1. Testing has indicated a large range of viscosities in Zone 1, and the viscosity at VER-2 only increases the range previously measured. Because LNAPL conductivity and migration velocity is inversely proportional to the viscosity, the LNAPL flow velocity in Zone 1 near VER-2 is even lower than the very low velocity calculated for this Zone.

In 2008, a sample of LNAPL was collected fromVER-1 and analyzed for viscosity. VER-1 was installed in conjunction with pilot study activities. A sample of LNAPL was also collected from GAL-21 in 2008 and analyzed for viscosity. A summary of the LNAPL physical property data collected from RAD I is provided in Table 3 (Golder, 2011) in Appendix L. LNAPL apparent thickness measurements were collected in July and August 2004, June and August 2008, and April 2011. A comparison of LNAPL apparent thicknesses and viscosities is as follows:

- The LNAPL thicknesses in monitoring wells within the RAD I Site after the RI were about within 0.2 feet of that measured during the RI. The maximum apparent thickness in the monitoring wells was approximately 4 feet. The VER-1 pilot test well appears to have been installed in an area with a thicker accumulation of LNAPL on RAD I.

- The LNAPL viscosity measured in the RAD I VER pilot test area after the pilot test was in the Zone 2 viscosity range.

- It appears that the LNAPL on RAD I has remained static since the RI and the specific volume of LNAPL, conductivity and flow velocity calculated in the RI have not significantly changed.

2.3.4 Soil Vapor

The selected remedy for soil vapor on the RAD II Site required investigation of the potential soil vapor pathway. It also required an evaluation for the potential of offsite soil vapor intrusion, including an investigation on the adjacent former Phoenix Beverage property. In October 2008, a soil vapor survey was conducted on the RAD II Site. The results of the soil vapor survey are summarized as follows:

- The concentrations of compounds of concern in soil vapor samples exceeded conservative residential screening levels.

- The concentrations of compounds of concern in soil vapor samples were substantially lower in samples collected along the Phoenix Beverages property boundary when compared with the results of samples collected near the Preston Street boundary of the RAD II Site.

In December 2009, a Phase II investigation was conducted, with a soil vapor survey, on the adjacent Phoenix Beverage Property. The results of soil vapor samples collected from paved locations outside of the building on Phoenix Beverage Property are summarized as follows

- The concentrations of compounds of concern were below the USEPA Generic Screening Levels (10^{-4} risk), with the exception of benzene, 1,3,5-trimethylbenzene (TMB) and 1,2,4-TMB in sampling location SV-22, and naphthalene in SV-20. The attenuation factors used to derive the soil vapor screening levels were considered highly conservative for the site conditions.

- There were differences between the compounds of concern detected on the RAD II Site and those detected on the Phoenix Beverages property. The difference in the compounds of concern may indicate soil vapor beneath the RAD II Site is not migrating offsite to the Phoenix Beverages property and there may be potential sources for the soil vapor detected on the Phoenix Beverages property other than the RAD II Site.

- An indoor methane screening study did not indicate evidence of the migration of soil vapors containing methane into the building on the Phoenix Beverages property.

In December 2010, baseline soil vapor conditions on the RAD I Site were investigated to assess the potential for soil vapor intrusion within buildings on the RAD I Site. The results of this investigation are summarized as follows:

- The results of the soil vapor survey indicated methane and several VOC concentrations in soil gas. The VOC concentrations in shallow soil vapor samples were generally lower than the concentrations measured in deeper soil vapor samples collected a short distance above the top of the LNAPL layer.

- Based on the results, it was concluded from this assessment that concentrations of compounds of concern along the boundary of the RAD I Site were substantially lower than concentrations previously measured on the RAD II Site, despite the RAD I Site being covered with a pavement material. They also concluded that elevated concentrations of compounds of concern in soil vapor on the RAD II Site are not migrating to the RAD I Site. The source of soil vapor on the RAD I Site is likely the LNAPL located typically 15 to 20 feet below the pavement surface on the RAD I Site.

- Methane was also detected at elevated concentrations in soil vapor samples, but was not detected in indoor air during a screening study, with the exception of methane detected at levels below concern associated with the sewer system in Building No. 2.

2.4 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the RAD II Site as summarized in the ROD dated February 9, 2007, are as follows:

2.4.1 Groundwater

RAOs for Public Health Protection

- Restrict the use of untreated groundwater beneath the Site as a potable water source.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.

RAOs for Environmental Protection

- LNAPL recovery to the extent practicable, to remove the source of groundwater contamination and restore groundwater quality to the extent practicable.
- Prevent the discharge of contaminants to surface water.

2.4.2 Soil

RAOs for Public Health Protection

- Prevent ingestion or direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.

RAOs for Environmental Protection

- Prevent migration of contaminants from LNAPL and soil that could result in groundwater contamination.
- Prevent impacts to biota from ingestion or direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.
- Prevent impacts to biota from ingestion/direct contact with surface water causing toxicity and impacts from bioaccumulation through the marine or aquatic food chain.

2.4.3 Soil Vapor

RAOs for Public Health Protection

- Mitigate impacts to public health resulting from the potential for, soil vapor intrusion into buildings at the Site.

The components of the selected remedy, as presented in the ROD, are as follows:

1. "A remedial design program will be implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program."

2. "Construction of an area wide LNAPL recovery system using a combination of single-phase, vacuum enhanced recovery and localized soil heating methods."

3. "The buildings and tanks on site will be demolished, removed, and the demolition debris properly disposed."

4. "The site will be covered by a paving system at least 6 inches in thickness. A 2-foot soil cover will be constructed over all vegetated areas (if any) to prevent exposure to contaminated soils"

5. "Development of a site management plan to: (a) address residual contaminated soils that may remain on site or off site during future redevelopment. The plan will require soil characterization and, where applicable, disposal/reuse in accordance with NYSDEC regulations; (b) evaluate the potential for vapor intrusion for any buildings developed on the Quanta Resources site, including provision for mitigation of any impacts were warranted; (c) identify any use restrictions; and (d) provide for the operation and maintenance of the components of the remedy."

6. "Imposition of an institutional control in the form of an environmental easement that will (a) require compliance with the approved site management plan; (b) limit the use and development of the property to commercial or industrial uses only; (c) restrict the use of groundwater as a source of potable water, without necessary water quality treatment as determined by NYSDOH; and (d) require the property owner to complete and submit to the NYSDEC periodic certifications."

7. "Periodic submittals provided by the property owner that verify that the institution and engineering controls are still in place, allow NYSDEC access to the site and certify nothing has occurred that will impair ability of the control to protect public health or the environment, or constitute a violation or failure to comply with the site management plan."

8. "Since the remedy may result in some untreated hazardous waste remaining at the Quanta Resources site, a long term monitoring program will be instituted. This program will allow the effectiveness of the area wide LNAPL recovery system to be monitored and will be a component of the operation, maintenance, and monitoring for the property."

9. "An investigation of the potential for soil vapor intrusion off-site will be completed during the remedial design phase."

The buildings and tanks on the RAD II Site have been demolished, removed, and the debris properly disposed. The other components, including the preparation of an Environmental Easement and periodic submittals are addressed in this SMP. The remedies selected for the RAD II Site are listed below by media:

LNAPL

The remedy for LNAPL beneath the RAD II Site is recovery using single-phase skimmer pumps and vacuum enhanced (VER) recovery methods. A long term monitoring program to monitor the effectiveness of the LNAPL recovery system will be implemented.

Soil

The remedy for the soil at the RAD II Site is to cover residual contamination in soil and urban fill using materials consistent with the development of the RAD II Site.

Groundwater

The remedy for groundwater is the establishment of an institutional control that restricts the use of untreated groundwater beneath the RAD II Site as a source of potable water.

Soil Vapor

The results of soil vapor investigations on the RAD II Site have not identified a threat for migration of soil vapor laterally from the limits of the LNAPL beneath the RAD II Site.

2.5 Remaining Contamination

2.5.1 LNAPL

Most of the contamination associated with the RAD II Site is contained in the LNAPL, which occurs on the groundwater table and the vadose zone throughout much of the RAD II Site. The ROD requires that the LNAPL recovery system operate until the remedial action objectives have been achieved or until it is determined that the continued operation of the LNAPL recovery system is technically infeasible or impracticable. During the operation of the LNAPL recovery system, the performance of the system will be evaluated periodically to determine if the remedial objectives of the system have been achieved or if the system has reached asymptotic conditions (i.e. its practical limits) for sustainable and effective recovery of LNAPL. When LNAPL recovery has been terminated, sorbed LNAPL will remain as residual contamination within the soil of the vadose zone.

2.5.2 Groundwater

As with the urban fill/soil, most of the contamination associated with the RAD II Site is contained in the LNAPL, which occurs on the groundwater table and the vadose zone throughout much of the Site. The ROD requires that the LNAPL recovery system operate until the remedial action objectives have been achieved or until it is determined that the continued operation of the LNAPL recovery system is technically infeasible or impracticable. During the operation of the LNAPL recovery system, the performance of the system will be evaluated periodically to determine if the remedial objectives of the system have been achieved or if the system has reached asymptotic conditions (i.e. its practical

limits) for sustainable and effective recovery of LNAPL. When LNAPL recovery has been terminated, LNAPL will remain on the groundwater table. The remaining LNAPL should not affect groundwater quality. Groundwater sampling has generally indicated the concentrations of LNAPL constituents in groundwater beneath the RAD II Site do not exceed the groundwater quality standards applicable to ambient groundwater. The need for continuing groundwater monitoring after substantial completion of LNAPL recovery will be evaluated during the recovery period. See prior Section 2.3 for the Tables and Figures that summarize the results of the groundwater samples collected beneath the RAD II Site.

2.5.3 Soil Vapor

The results of soil vapor investigations on the RAD II Site have not identified a threat for migration of soil vapor laterally from the limits of the LNAPL. Remaining LNAPL on the groundwater table and within the soil vadose zone, after the termination of recovery, should not be a threat for soil vapor migration. See prior Section 2.3 for the Tables and Figures that summarize the results of all soil vapor samples collected beneath the RAD II Site.

3.0 INSTITUTIONAL AND ENGINEERING CONTROL PLAN

3.1 General

Since remaining contaminated soil and groundwater exists beneath the RAD II Site, EC's and IC's are required to protect human health and the environment. This Engineering and Institutional Control Plan describes the procedures for the implementation and management of all EC's and IC's at the RAD II Site. The EC and IC Plan is one component of the SMP and is subject to revision by NYSDEC.

This plan provides:

- A description of all EC's and IC's on the RAD II Site;
- The basic implementation and intended role of each EC and IC;
- A description of the key components of the IC's set forth in the Environmental Easement;
- A description of the features to be evaluated during each required inspection and periodic review;
- A description of plans and procedures to be followed for implementation of EC's and IC's, such as the implementation of the Excavation Work Plan for the proper handling of remaining contamination that may be disturbed during maintenance or redevelopment work on the RAD II Site; and
- Any other provisions necessary to identify or establish methods for implementing the EC's and IC's required by the site remedy, as determined by the NYSDEC.

3.2 Institutional Controls

A series of IC's are required by the ROD to: (1) implement, maintain and monitor EC systems; (2) prevent future exposure to remaining contamination by controlling disturbances of the subsurface contamination; and, (3) limit the use and development of the Site to Track 4 restricted uses only. Adherence to these IC's on the RAD II Site is required by the Environmental Easement and will be implemented under this SMP. These IC's are as follows:

- The RAD II Site may only be used for restricted use as specified by the ROD and in this SMP;
- All EC's must be operated and maintained as specified in this SMP;
- All EC's must be inspected at a frequency and in a manner defined in this SMP.
- The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the NYSDOH or the Queens County Department of Health to

render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the NYSDEC.

- Groundwater monitoring must be performed as defined in this SMP;
- Data and information pertinent to site management must be reported at the frequency and in a manner as defined in this SMP;
- All future activities that will disturb remaining contaminated material must be conducted in accordance with this SMP;
- Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in this SMP;
- Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical component of the remedy shall be performed as defined in this SMP;
- Access to the RAD II Site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified by the Environmental Easement.
- The potential for vapor intrusion must be evaluated for any buildings developed in the area within the IC boundaries noted on Figure 2, and any potential impacts that are identified must be monitored or mitigated.

3.3 Engineering Controls

3.3.1 Soil Cover

The RAD II Site was paved with asphalt to serve as a soil cover system to prevent exposure to possible near surface remaining contamination in urban fill/soil. This cover system is comprised of a minimum of 12 inches of asphalt pavement, concrete building slab(s), 24 inches of soil cover, and approximately 15 to 20 feet of subsurface soil above the top of LNAPL-impacted soil. The Excavation Work Plan Appendix B to this Plan, outlines the procedures required to be implemented in the event the cover system is breached, penetrated or temporarily removed, and any underlying remaining contamination is disturbed. Procedures for the inspection and maintenance of this cover are provided in the Monitoring Plan included in Section 4 of this SMP.

3.3.2 LNAPL Recovery System

LNAPL recovery throughout the RAD II Site and the southern and central parts of the RAD I Site is being conducted via single-phase skimmer pump and VER subsystems. The primary purposes of using the skimmer pump and VER subsystems is to recover as much LNAPL to the extent practical and support the achievement of the remediation goals of the Site. The use of the VER and the skimmer pump subsystems on the Site is based on the recoverability of the LNAPL, such as LNAPL viscosity and the specific LNAPL volume. The area selected for VER recovery represents that part of the Site

with the highest viscosities and moderate to high volumes of LNAPL. This area may also contain LNAPL with PCB concentrations above 50 mg/kg that requires segregation, special handling and disposal from the LNAPL recovered. Wells that are determined to contain LNAPL with PCB's above 50 mg/kg will be handled on a case by case basis. Generally the wells will be operated manually and LNAPL will be collected directly from the extraction point into a discrete container. After a determined amount of LNAPL is removed from the well the LNAPL will be resampled to determine if the well can be reconnected to the full system (refer to the OM&M manual for the full procedures).

The area selected for skimmer pump recovery represents those parts of the Site where the LNAPL has low to moderate viscosities and specific LNAPL volumes, and the recovered LNAPL is expected to contain PCB concentrations less than 50 mg/kg. VER pumps are installed in the remainder of RAD II Site.

3.3.2.1 VER Recovery System Description

The vacuum enhanced pumping creates a reduced pressure around the VER well and induces a pressure gradient from the relatively higher pressure in the surrounding subsurface to the lower pressure in the well. VER applies a vacuum and air flow rates through subsurface extraction wells to enhance the recovery of LNAPL. Thirty (30) VER wells were installed and associated control systems on RAD I and RAD II. A full system description is contained in the OM&M manual provided in Appendix I.

The use of VER for LNAPL recovery creates a wider radius of influence and allows a larger extraction well spacing (relative to single phase LNAPL recovery wells) in the areas where higher viscosity LNAPL occurs. The spacing of the VER wells is approximately 50 feet, which allows overlapping of the radii of influence (Golder Associates 2011).

Ten (10) VER wells are installed on RAD I and twenty (20) VER wells are installed on the RAD II Site. The well heads are protected with manways that are mounted flush with the ground surface. The wells are constructed to a depth of approximately 28 feet bgs with Schedule 40 V-wire 0.010-slot screen and solid PVC riser pipe. The screens extend from below the LNAPL/groundwater interface to above the LNAPL capillary fringe) about 15 to 20 feet below ground surface (bgs). A 2-foot thick bentonite seal is emplaced above the filter packs and the remainder of the annulus is grouted with a bentonite and cement grout to just below the top of casing.

The VER subsystem extracts a mixture of vapor, groundwater, and LNAPL from 30 wells on the RAD II and RAD I Sites properties using a high vacuum blower and total fluids pumping wells. The mixture is conveyed in the same piping to the LNAPL Recovery and Groundwater Treatment Building (LRGTB), which is located in the eastern part of the RAD II Site fronting Review Avenue. In the treatment building, the piping connects to the VER control system where LNAPL is separated from a mixture of LNAPL and groundwater. The layout and depths of the piping are presented in the design drawings in Appendix I, the OM&M manual.

The groundwater and LNAPL extracted by the VER subsystem is initially treated in an equalization tank to allow agglomeration of the LNAPL followed by treatment with a 25 gpm oil/water separator to remove LNAPL from the groundwater. The agglomeration of the LNAPL will improve the removal efficiency of the oil and water separator. A biocide and an emulsification breaker are fed into the equalization tank to improve agglomeration, and improve separability of LNAPL.

The LNAPL removed from the oil and water separator is collected and stored in one of two 6,000-gallon steel aboveground storage tank located in a secondary containment area outside of the LRGTB. This storage tank is equipped with a level gauge, high and high-high level conditions, vents, and connections for transferring the contents of the tank to a Department of Transportation- (DOT) - approved tanker truck to an approved disposal facility. The level sensors are integrated into the VER and skimmer pump control system to notify the operator of a high or high-high level condition. The high-high level condition will shut down the VER recovery system to prevent an overfill condition.

The groundwater from the oil/water separator is then filtered with bag filters and treated using liquid phase granular activated carbon (GAC) adsorption to remove the VOC's, SVOC's and PCB's from the groundwater. The treated groundwater is discharged to the New York City Bowery Bay Publicly owned Treatment Works (POTW). The soil vapor is treated with vapor phase GAC vessels, with the option of potassium permanganate impregnated ionization media treatment, if vinyl chloride is detected during operations above criteria. The process drawing of the VER system is presented in the OM&M manual.

To restrict the amount of extracted groundwater and optimize the performance of the system, the VER subsystem will be pulsed. The pulsing will be automatically controlled, with one third of the 30 VER wells (10 wells) in operation every 4 to 6 hours. Pulsing frequency, in addition to readjustment of vacuum applications, within the flexibility of the VER subsystem, are to be made during the operation of the system.

3.3.2.2 Skimmer Pump System Description

Pneumatically driven specific gravity single phase LNAPL skimmer pumps are a well-accepted and conventional technology for recovering intermediate and lower viscosity LNAPL through extraction wells. LNAPL flow into the skimmer pumps is induced by the local gradient between the lowered LNAPL levels in the extraction wells and the higher LNAPL levels in the subsurface adjacent to the wells' screens. The cone of depression created by the skimmer pumps draws LNAPL toward the extraction wells within the radius of influence of the skimmer pump extraction wells. The spacing of the skimmer pump extraction wells is 30 feet, which reflects the LNAPL skimmer pump radius of influence is about 20 to 30 feet that is predicted based on the dynamic effects of multiple skimming wells collecting product in the same vicinity.

The skimmer pump subsystem will recover LNAPL from 38 wells located on the RAD II and RAD I Sites. Thirteen (13) skimmer pump wells are installed on RAD I and 15 skimmer pump wells are installed on the RAD II Site. The wells are constructed to a depth of approximately 28 feet bgs with Schedule 40 0.010-slot V-wire screen and solid PVC riser pipe. The screens extend from below the

LNAPL/groundwater interface to above the LNAPL capillary fringe) about 15 to 20 feet bgs. A two -foot thick bentonite seal is emplaced above the filter pack and the remainder of the annulus is grouted with a bentonite and cement grout to just below the top of casing.

A single line supplies air to the skimmer pumps from a compressor located in the LRGTB. The LNAPL is conveyed from the skimmer pumps in the same product return piping to a second LNAPL aboveground steel storage tank for non-TSCA LNAPL. This tank is also located in the secondary containment area outside of the LNAPL recovery and groundwater treatment building. Like the PCB containing (<50 ppm) LNAPL storage tank, the <1 ppm PCB storage tank is constructed, installed, and tested in conformance with the New York City building codes. This storage tank is equipped with a level gauge, high and high-high level conditions, vents, and connections for transferring the contents of the tank to a Department of Transportation (DOT)-approved tanker truck to an approved disposal or recycling facility. The level sensors are integrated into the VER and skimmer pump control system to notify the operator of a high or high-high level condition. The high-high level condition will shut down the skimmer pump recovery system to prevent an overfill condition.

Procedures for operating and maintaining the LNAPL recovery system are documented in the Operation, Maintenance, and Monitoring Plan (Section 4 of this SMP). Procedures for monitoring the system are included in the Monitoring Plan (Section 3 of this SMP). The Monitoring Plan also addresses severe condition inspections in the event that a severe condition, which may affect controls at the site, occurs. In addition, the OM&M Manual for the complete LNAPL extraction and treatment system is provided as Appendix I to this Plan.

3.3.3 Criteria for Completion of Remediation/Termination of LNAPL Recovery

Construction and operation of the LNAPL recovery and treatment system on the RAD II Site is based on the ROD. The ROD requires that the LNAPL recovery system operate until the remedial action objectives have been achieved or until it is determined that the continued operation of the LNAPL recovery system is technically infeasible or impracticable. The framework for determining when remedial processes are complete is provided in Section 6.6 of NYSDEC DER-10.

During the operation of the LNAPL recovery system, the performance of the system will be evaluated and adjusted to optimize recovery. Periodically, the performance metrics of the LNAPL recovery system will be evaluated to determine if the remedial objectives of the system have been achieved or if the system has reached asymptotic conditions (i.e. its practical limits) for sustainable and effective recovery of LNAPL. The performance metrics to be tracked are as follows:

- Vacuum pressures and air flow rates in the VER wells
- Pump intake and skimmer depths and adjustments
- Total amount of LNAPL (in gallons) recovered for the skimmer pump systems and for the VER system
- Total of groundwater (gallons) extracted and the rates of extraction

- Recovery ratio of recovered LNAPL to groundwater
- Vapor recovery rates
- Curve analysis of the trend of recovered LNAPL over time
- Trend analysis of recovery ratio of recovered LNAPL to groundwater over time
- Analysis of unit cost per gallon of LNAPL recovered
- Electrical power consumption per gallon of LNAPL recovered
- Levels and properties of the LNAPL obtained from monitoring

It is expected that the LNAPL recovery rates measured during the first months of operation of the VER and skimmer pump systems will decrease during the progress of the recovery. The decrease in recovery rate will occur because the most mobile LNAPL will be extracted initially and the less mobile LNAPL will not be extracted as efficiently. An asymptotic extraction rate (the practical limits of the LNAPL recovery system) that will signal the termination of the LNAPL recovery systems may occur after two years, but the actual occurrence of an asymptotic rate of recovery cannot be predicted with any accuracy until the systems have been in operation for some period of time, perhaps several months or a year or more. Therefore, the asymptotic rate will be during LNAPL recovery operation. The asymptotic rate will be the rate at which further operation of the LNAPL recovery system will no longer be considered practical and further operation will be terminated.

A proposal for the approval of the shut-down of the LNAPL recovery system will be made by OM&M contractor to the NYSDEC when an asymptotic recovery rate has been achieved. Important factors to determining the shut-down of the LNAPL recovery system will be that there is no further migration by LNAPL, there is no exposure of persons to soil gas that may be generated by the remaining LNAPL, and there is no release of LNAPL contaminants that would degrade groundwater quality. Prior to initiation of LNAPL recovery at the Review Avenue Site, it is important to note the following conditions at the Review Avenue Site:

- No offsite migration of soil gas from RAD II was observed. Existing buildings or new buildings to be constructed over the LNAPL can be protected, if necessary, by sub slab depressurization methods and/or other barrier methods.
- Impacts to groundwater by the existing LNAPL to a quality worse than the upgradient groundwater were not observed.
- LNAPL evaluation indicated the LNAPL mass was stable and not migrating.

3.3.3.1 Soil Cover

The soil cover is a permanent control and the quality and integrity of this cover will be inspected at defined, regular intervals in perpetuity as described in more detail in the OM&M Plan for the Site.

3.3.3.2 Monitored Natural Attenuation

A full monitoring natural attenuation program is not been selected for the Site. However, long term monitoring is conducted and provided as described in Section 4.0. Groundwater quality beneath the Site has been affected by upgradient sources and background concentrations. The results of recent groundwater monitoring activities indicate natural improvement in the groundwater quality beneath the Site and groundwater beneath the RAD II Site does not currently exceed the applicable groundwater standards. The groundwater remedial action selected in the ROD for the RAD II Site requires institutional controls to restrict the use of untreated groundwater beneath the RAD II Site as a source of potable water. It also requires a long term program to monitor the groundwater relative to the effectiveness of the LNAPL recovery system.

4.0 MONITORING AND SAMPLING PLAN

4.1 General

A draft Monitoring Plan was prepared and included in the NYSDEC approved RAWP (Golder Associates 2011), but has been adjusted herein to reflect monitoring that will be required due to the final constructed remedy. The Monitoring Plan describes the measures for evaluating the overall performance and effectiveness of the LNAPL recovery to reduce or mitigate LNAPL contamination beneath the RAD II and RAD I Sites, the Sites' cover system, and all affected media identified below. This Monitoring and Sampling Plan for the RAD II and RAD I Sites may only be revised with the approval of the NYSDEC. Details regarding the sampling procedures, data quality usability objectives, analytical methods, etc. for all samples collected as part of site management for the RAD II and RAD I Sites are included in the same Quality Assurance Project Plan (QAPP) provided in Appendix F. This Monitoring Plan is incorporated into the RAD II and RAD I Sites' OM&M manual in Appendix I.

This Monitoring and Sampling Plan describes the methods to be used for:

- Sampling and analysis of all appropriate media (e.g., groundwater, LNAPL, treatment system water and vapor influent and effluent, etc.);
- Assessing compliance with applicable NYSDEC standards, criteria and guidance, particularly ambient groundwater standards;
- Assessing achievement of the remedial performance criteria.
- Evaluating site information periodically to confirm that the LNAPL recovery system continues to be effective in protecting public health and the environment; and
- Preparing the necessary reports for the various monitoring activities.

To adequately address these issues, this Monitoring and Sampling Plan provides information on:

- Sampling locations, protocol, and frequency;
- Information on all designed monitoring systems (e.g., well logs, process flow diagrams, installation specification drawings, etc.);
- Analytical sampling program requirements;
- Reporting requirements;
- Quality Assurance/Quality Control (QA/QC) requirements;

- Inspection and maintenance requirements for monitoring wells;
- Monitoring well decommissioning procedures; and
- Annual inspection and periodic certification.

Monthly and semi-annual monitoring of the performance of the LNAPL recovery system and overall reduction in LNAPL contamination on-site will be conducted for the first year of LNAPL recovery. Annual monitoring of the performance of the LNAPL recovery system and overall reduction in LNAPL contamination on-site will be conducted after the first year until termination of LNAPL recovery. The frequency of monitoring or need for continued monitoring after termination of LNAPL recovery will be evaluated from the trends of previously collected LNAPL thickness and recovery data. The monitoring program is summarized in Tables 2, 3, and 4, and outlined in detail in Sections 4.2 and 4.3 below.

4.2 Site Inspection

Site inspections of the RAD II and RAD I Sites will be performed on a regular schedule. Site inspections will also be performed after all severe weather conditions that may affect the LNAPL recovery system. During these inspections, an inspection form will be completed (see Appendix H). The form will compile sufficient information to assess the following:

- Compliance with all IC's, including usage of the RAD I Site and RAD II Site;
- An evaluation of the condition and continued effectiveness of the LNAPL recovery system;
- General conditions at the time of the inspection;
- The site management activities being conducted including, where appropriate, a health and safety inspection;
- Compliance with schedules included in the OM&M manual; and
- Confirmation that the RAD II Sites' records are up to date.

A comprehensive site wide inspection will be conducted and documented according to the SMP schedule, regardless of the frequency of the Periodic Review Report. The inspections will determine and document the following:

- Whether the LNAPL recovery system and soil cover continue to perform as designed;
- If these controls continue to be protective of human health and the environment;

- Compliance with requirements of this SMP and the Environmental Easement;
- Achievement of remedial performance criteria; and
- If site records are complete and up to date.

Table 2. Outlines the Inspection requirements and frequency.

Table 2: Summary of Inspection Tasks and Schedule

Inspection Task	**Frequency**
Monitoring Wells	Annually
LNAPL Recovery System Wells and Piping	Monthly
Cover System	Annually

Reporting requirements are outlined in Section 7.0 of this plan.

Inspections will also be performed in the event of an emergency. If an emergency, such as a natural disaster or an unforeseen failure of any of the EC's occurs that reduces or has the potential to reduce the effectiveness of the EC's at the RAD II Site, verbal notice to the NYSDEC will be given by noon of the following day. In addition, an inspection of the RAD II Site will be conducted within 5 days of the event to verify the effectiveness of the IC's and EC's implemented at the RAD II Sites by a qualified environmental professional or Professional Engineer, as determined by the NYSDEC. Written confirmation will be provided to the NYSDEC within 7 days of the event. The written confirmation will include a summary of actions taken, or to be taken, and the potential impact to the environment and the public.

4.3 Treatment System Monitoring and Sampling

The following section presents the general procedures for routine monitoring and sampling of the LNAPL recovery system. Adherence to these procedures will help ensure safe, effective, and efficient operation. All inspection and maintenance activities will be conducted in accordance with the Health and Safety Plan (HASP) in Appendix G, the SMP, the QAPP, and the OM&M manual. A dedicated site log book will be maintained by the LNAPL recovery system operator to document the work conducted on the systems, the hours spent on the RAD II and RAD I Sites, visitors, LNAPL and groundwater levels, samples collected, any unusual conditions, and other observations.

General operational data will be collected on routine inspection and maintenance data sheets and any needed adjustments will be made, as well as recorded on the data sheets. Much of the operational data to be recorded on the routine inspection and maintenance data sheets will be gleaned from the PLC display, especially from the Overview Screen. The operational data to be collected will consist of groundwater and LNAPL levels, line pressures, equipment run times, flows, pressures, temperatures,

vacuum measurements at well heads and individual treatment units. Completed inspection and maintenance data sheets will be submitted to the OM&M Manager and a copy of the completed collection sheets will be kept in the LRGTB.

4.3.1 LNAPL Recovery System Monitoring

Monitoring of the LNAPL recovery system will be performed on a routine basis, as identified in Table 2 Remedial System Monitoring Requirements and Schedule (see below). Modification to the frequency or monitoring requirements will require approval from the NYSDEC. A visual inspection of the complete system will be conducted during each monitoring event. Unscheduled inspections and/or sampling may take place when a suspected failure of the LNAPL recovery system has been reported or an emergency occurs that is deemed likely to affect the operation of the system. The components of the LNAPL recovery system to be monitored weekly and monthly include, but are not limited to, the components listed below.

Extraction Manifold

The primary inspection and monitoring duties for the extraction manifold are as follows:

- Read flow and vacuum from each VER line, and compare flow and vacuum readings to previous readings;
- Observe sight glass for any solid material flowing through the lines;
- Inspect for leaks and vibrations; and
- Clean flow meters and sight glass as necessary.

Vapor and Groundwater/LNAPL Separator

The primary inspection and monitoring duties for the separator are as follows:

- Read vacuum gauges on the separator unit;
- Inspect the vacuum gauges for proper operation;
- Inspect the influent and effluent piping and other lines for leaks; and
- Clean filters or replace as necessary.

Equalization Tank and Backwash Settling Tank

The primary inspection and monitoring duties for the equalization tank are as follows:

- Inspect the equalization tank, backwash settling tank, and all lines for leaks;
- Read internal temperature of the equalization tank; and
- Check operation of the equalization tank heater.

LNAPL/ Groundwater Separator and LNAPL Storage Tank

The primary inspection and monitoring duties for the LNAPL/groundwater separator and LNAPL storage tank during each site visit are as follows:

- Measure the amount of LNAPL in the separator;
- Read LNAPL level gauge in the LNAPL storage tank,
- Check the condition of the LNAPL surface for buildup of degradation mass;
- Inspect the influent and effluent ends of the separator for potential blockage, and remove as necessary; and
- Inspect the LNAPL/groundwater separator and storage tank for corrosion and leaks.

GAC Units (Vapor and Liquid Phases)

The primary inspection and monitoring duties for the GAC units during each site visit are as follows:

- Inspect bag filters and clean or replace as necessary;
- Inspect the units for condensation and drain, if needed;
- Check the level in the condensation effluent tank;
- Read inflow and outflow pressure gauges, compare flow readings to previous readings, check for blockage, if necessary; and
- Perform air monitoring of the vapor stream.

Pumps

The primary inspection and monitoring duties for the pumps used throughout the LNAPL recovery system, LNAPL collection system, and vapor and groundwater treatment systems during each site visit are as follows:

- Listen for audible sounds of operation and wear on the pumps;
- Inspect for leaks; and
- Check for flow.

LRGTB

The primary inspection and monitoring duties for the treatment building during each site visit is to inspect the interior and exterior of the building, including, but not limited to, the following:

- Alarm lights;
- Lighting;
- Gutters;
- Door operation;
- Insulation; and
- Roof and siding leaks.

The primary additional inspection and monitoring duties for the LNAPL recovery system to be performed quarterly, but are not limited to, are as follows:

- Open and close all valves in the systems to check for proper movement;
- Test the operation of all alarms;
- Check the batteries on the emergency lighting;
- Review the literature on major equipment units and all pump equipment for any additional maintenance requirements;
- Inspect fire extinguishers;
- Check the supply of safety equipment (hearing protection, eye protection, eyewash, first aid supplies, etc.) and replenish as necessary; and
- Review spare parts inventory and order parts as necessary.

A complete list of components to be inspected is provided in the Inspection Checklist, provided in Appendix H - Site Management Forms. If any equipment readings are not within their specified operation range, any equipment is observed to be malfunctioning or the system is not performing within specifications; maintenance and repair, as per the OM&M Manual Plan, is required immediately.

4.3.2 Groundwater and LNAPL Monitoring and Sampling

Groundwater and LNAPL monitoring is conducted on a monthly, quarterly, and semi-annual basis, with measuring apparent LNAPL thickness and depth to groundwater. Table 3 provides monitoring well LNAPL and groundwater identification information. Figure 3 shows well locations. Modification to the frequency or sampling requirements will require approval from the NYSDEC.

Table 3 – Remedial System Well Monitoring Locations and Schedule

Monitoring Point ID	Location	Schedule	Rationale	Notes
Baseline LNAPL Monitoring				
AML-01, AML-04, GAL-10, GAL-11R, GAL-13, GAL-18R, GAL-21, GAL-22, GAL-23, GAL-24, GAL-32[1] and MW-4RR, MW-2	RAD I	2 Events prior to Start-Up	Measure apparent LNAPL thickness	AML-01 and AML-04 are new wells
AML-03, AML-06,GAL-01RR[1], GAL-02R, GAL-03R[1], GAL-04R, GAL-05R[1], GAL-06, GAL-07, GAL-08, GAL-09, GAL-16R, GAL-29, GAL-30 and GAL-31	RAD II	2 Events prior to Start-Up	Measure apparent LNAPL thickness	GAGW-04 is located on Review Avenue
VER and Single Phase LNAPL Recovery Wells	RAD I & II	2 Events prior to Start-Up	Measure apparent LNAPL thickness	
Remediation LNAPL Monitoring/Groundwater Monitoring - Year 1				
AML-01, AML-04, GAL-10, GAL-11R, GAL-13, GAL-18R, GAL-21, GAL-22, GAL-23, GAL-24, and MW-4RR, MW-2	RAD I	Monthly	Measure apparent LNAPL thickness	
AML-02, AML-03, AML-06, GAL-01RR[1], GAL-02R, GAL-03R[1], GAL-04R, GAL-05R[1], GAL-06, GAL-07, GAL-08, GAL-09, GAL-16R, GAL-29, GAL-30 and GAL-31, GAGW-04	RAD II	Monthly	Measure apparent LNAPL thickness	GAGW-04 is located on Review Avenue
GAGW-02, GAGW-05R, and GAGW-6I	RAD II	Semi-Annual	Groundwater Monitoring	
GAGW-08R, AMGW-10D	RAD I	Semi-Annual	Groundwater Monitoring	AMGW-10D is a new well, required by DEC (approval of RAWP)
GAGW-09S, GAGW-09D	South Capasso	Semi-Annual	Groundwater Monitoring	If Accessible
GAGW-04D	Review Ave	Semi-Annual	Groundwater Monitoring	
Subset (6 wells) of the Single Phase LNAPL Recovery Wells[2]	RAD I & II	Semi-Annual	Measure apparent LNAPL thickness	

Monitoring Point ID	Location	Schedule	Rationale	Notes
Remediation LNAPL Monitoring/Groundwater Monitoring - Year 2 and beyond				
AML-01, AML-04, GAL-10, GAL-11R, GAL-13, GAL-18R, GAL-21, GAL-22, GAL-23, GAL-24, and MW-4RR, MW-2	RAD I	Quarterly	Measure apparent LNAPL thickness	
AML-02, AML-03, AML-06, GAL-01RR[1], GAL-02R, GAL-03R[1], GAL-04R, GAL-05R[1], GAL-06, GAL-07, GAL-08, GAL-09, GAL-16R, GAL-29, GAL-30 and GAL-31, GAGW-04	RAD II	Quarterly	Measure apparent LNAPL thickness	GAGW-04 is located along Review Avenue
GAGW-09S, GAGW-09D	South Capasso	Semi-Annual	Groundwater Monitoring	If Accessible
GAGW-04D	Review Ave	Semi-Annual	Groundwater Monitoring	
Subset (6 wells) of the Single Phase LNAPL Recovery Wells[2]	RAD I & II	Annual	Measure apparent LNAPL thickness	

Notes:
[1] monitoring wells designated GAL -#R indicates that the well was installed by Golder Associates (GA), L indicates LNAPL, # is the well number and R means replacement. Wells with an AML-# indicate that it is an LNAPL well installed by AMEC. GAGW-# or AMGW-# indicates a monitoring well installed by Golder Associates (GA) or AMEC (AM). GAGW-04 is the exception to this rule. GAGW-04 was screened through the LNAPL zone and not re-designated.
[2] Six single phase LNAPL wells will be shut down for one week two times to measure the apparent LNAPL thickness. One week is required to allow for the wells to reach equilibrium.

Detailed sample collection and analytical procedures and protocols are provided in the RAD I and RAD II Sites' QAPP in Appendix F.

4.4 Post-Remediation Media Monitoring and Sampling

The need for continuing groundwater monitoring after termination of area-wide LNAPL recovery, and any sampling proposed thereafter, will be addressed in the proposal to terminate area-wide LNAPL recovery based on previously collected data. Sampling locations, required analytical parameters and schedule to assess the performance of the LNAPL recovery will be submitted to the NYSDEC for approval. Modification to the frequency or sampling requirements will require approval from the NYSDEC. This SMP will be modified to reflect changes in sampling plans approved by the NYSDEC. Deliverables for the post remediation groundwater monitoring program are specified in Section 7.0 – Reporting Requirements.

On-site and/or off-site monitoring wells selected for post remediation monitoring will be physically agitated/surged and redeveloped, if biofouling or silt accumulation occurs. Additionally, monitoring wells will be properly decommissioned and replaced, if an event renders the wells unusable. Repairs and/or replacement of wells in the monitoring well network will be performed based on assessments of structural integrity and overall performance.

The NYSDEC will be notified prior to any repair or decommissioning of any monitoring well for the purpose of replacement, and the repair or decommissioning and replacement process will be documented in the subsequent Periodic Review Report. Well decommissioning without replacement

will be done only with the prior approval of the NYSDEC. Well abandonment will be performed in accordance with NYSDEC's guidance entitled "CP-43: Groundwater Monitoring Well Decommissioning Procedures." Monitoring wells that are decommissioned because they have been rendered unusable will be replaced in kind in the nearest available location, unless otherwise approved by the NYSDEC.

All post remediation groundwater sampling activities will be recorded in a field book and associated sampling log as provided in Appendix H - Site Management Forms. Other observations (e.g., groundwater monitoring well integrity, etc.) will be noted on the sampling log. The sampling log will serve as the inspection form for the monitoring network. Additional detail regarding monitoring and sampling protocols are provided in the in the QAPP in Appendix F of this document.

Monitoring well construction logs are included in Appendix E of this document.

The sampling frequency may only be modified with the approval of the NYSDEC. This SMP will be modified to reflect changes in sampling plans approved by the NYSDEC.

Deliverables for the groundwater monitoring program are specified in Section 7.0 – Reporting Requirements.

5.0 OPERATION, MAINTENANCE, AND MONITORING PLAN

5.1 General

This OM&M Plan provides a brief description of the measures necessary to operate, maintain, and monitor the remedy selected for the RAD II. Further detail regarding the OM&M of the LNAPL recovery system is in the OM&M manual provided in Appendix I. A copy of the OM&M manual, along with the complete SMP, is maintained at the Site.

5.2 LNAPL Recovery System Performance Criteria

During the operation of the LNAPL recovery system, the performance of the system will be evaluated and adjusted to optimize recovery. Periodically, the performance metrics of the LNAPL recovery system will be evaluated to determine if the remedial objectives of the system have been achieved or if the system has reached asymptotic conditions (i.e. its practical limits) for sustainable and effective recovery of LNAPL. The performance metrics to be tracked are as follows:

- Casing Vacuum pressures for each VER well (30 wells)
- Extracted soil vapor flow rates for each VER extraction well zone (7 zones)
- Total Fluids Pumping Level Settings and adjustments at each VER well
- Current VER Zone pulsing schedule (operational hours per day/week per VER zone)
- LNAPL cumulative recovery volume (gallons) and recovery rate (gallons per day) vs. time and trend analysis from the skimmer well system
- LNAPL cumulative recovery volume (gallons) recovery rate (gallons per day) vs. time and trend analysis from the VER well system
- Cumulative extracted groundwater volume (gallons) and the rates of extraction
- Recovery ratio of recovered LNAPL to groundwater vs. time and trend analysis
- Cumulative extracted soil vapor and average flow rate
- Electrical power demand versus time
- Cumulative Electrical power consumption
- Electrical power consumption per gallon of LNAPL recovered

- Depth to Product, LNAPL thickness and viscosity obtained from monitoring wells and Product Storage Tanks.

- Product Disposal/Recycling hauler bill of lading/manifests and cumulative disposal/recycling volume tracking

It is expected that the LNAPL recovery rates measured during the first months of operation of the VER and skimmer pump systems will decrease during the progress of the recovery. The decrease in recovery rate will occur because the nearest and most mobile LNAPL will be extracted initially and the furthest less mobile LNAPL will not be extracted as efficiently. An asymptotic extraction rate (the practical limits of the LNAPL recovery system) will signal the termination of the current LNAPL recovery system mode of operation and ultimate usefulness after exhausting all practical modes of operation. The actual occurrence of an asymptotic rate of recovery cannot be predicted with any accuracy until the systems have been in operation for some period of time, perhaps several months or a year or more. The asymptotic rate will be the rate at which further operation of the LNAPL recovery system (while configured in its most aggressive mode of operation) will no longer be considered practical and further operation will be terminated.

All discharge permits or permit equivalencies are included as Appendix J.

5.3 Operation and Maintenance of LNAPL Recovery

The following sections provide a description of the operations and maintenance of the LNAPL recovery system. Cut-sheets and as-built drawings for the LNAPL recovery system are provided in the OM&M manual in Appendix I.

5.3.1 System Start-Up Phasing Plan

- ***VER Wells –*** The 30 VER recovery wells will be operated in multiple modes of operation in order to maximize product recovery, minimize energy consumption and to avoid exceeding the limitations of the oil/water separation and groundwater treatment processes. The modes of operation are summarized as follows:

  - ***Skimmer Mode –*** skimmer pumps were initially operated in the VER wells until initial product thicknesses in recovery wells have been reduced from multiple feet to </= 1 ft and/or LNAPL production rate (gallons per day or week) has diminished by >/= 75%.

  - ***Hydraulic Enhancement mode –*** Pneumatic Total Fluids (TF) pumps were installed in the VER wells and set at a pumping level configured for approximately 6” to 12” of piezometric draw-down (or as required to keep total extracted groundwater production </= 25 gpm). This mode of operation will continue until product thicknesses in recovery wells have been reduced from

multiple feet to < 1 ft and/or LNAPL production rate (gallons per day or week) has diminished by >/= 75%. As compared to the prior mode of operation.

- ***Vacuum and Hydraulic Enhancement (VER) mode*** – While operating the TF pumps, the vacuum blower will also be operated to achieve approximately 1-inch Hg casing vacuum at each of the VER wells. Upon further significant diminishment of product thicknesses and LNAPL production rate, additional operational variables can be adjusted, including zone pulsing schedules, piezometric draw down and applied casing vacuum levels as required to maximize LNAPL production rates and minimize energy consumption and operational costs per gallon of LNAPL recovered. Operation will continue until such time that maximum extent practical recovery goals can be achieved as outlined in the approved RAWP.

- ***Skimmer Wells*** - Product will be recovered from the 38 Skimmer Wells (15 on RAD II) using pneumatically operated skimmer pumps complete with specific gravity skimmer intakes and cycle timers that will control the pumping rate of each skimmer pump. The operator will adjust the pumping rate of each skimmer pump over time to avoid significantly exceeding the LNAPL recovery yield from each of the skimmer wells. By doing this, the rate of LNAPL recovery will be maximized while avoiding unnecessary pump wear and wasting compressed air and energy.

5.3.2 System Start-Up and Testing

Procedure:

1. Verify that flow paths are clear (e.g. TF lines from VER wells to OWS; OWS to final treatment and sewer connection (water) and Product Storage Tank (product); SVE lines VER Wells to Vacuum Blower; Vacuum Blower to vapor phase treatment and discharge stack;
2. Verify that there is water in the Pre-Separation Tank to and Oil/Water Separator System to proper level – if not, fill with clean water from on-site or offsite source and bring to required level.
3. Verify Chemical Feed Pumps operational in hand mode and chemical supply adequate – correct as required.
4. Verify no alarm conditions present – if present, resolve alarm condition, clear and
5. Activate compressed air supply to skimmer pumps (AUTO Position on HMI) and verify product flow to Tank via flow meter T1. Verify via site glass or sample tap to confirm if only product flowing without water. If no flow or water present, check skimmer pumps, identify problem (mechanical issue or incorrect pump setting) and correct as required.
6. Activate compressed air supply (Auto Position on Human Machine Interface (HMI) to active VER well zone or zones and verify flow to pre-separation tank. Verify via

inflow to pre-separation tank if oil/water flow obtained or water only. If no flow or only water flowing check TF pumps in active zone(s), identify problem (mechanical issue or incorrect pump setting) and correct as required.

7. Verify that the effluent transfer pump turns on and off at the appropriate action levels. Collect data readings to ensure that all valves are in their proper position and that iron has not clogged any components of the system.

The system testing described above will be conducted if, in the course of the LNAPL recovery system lifetime, it goes down or significant changes are made to the system and the system must be restarted.

5.3.3 Routine & Non-Routine System Operation and Maintenance

A summary of routine LNAPL recovery system OM&M is presented below in Table 4. A complete list of components to be inspected is provided in the Inspection Checklist, provided in Appendix H - Site Management Forms. If any equipment readings are not within their specified operation range, any equipment is observed to be malfunctioning or the system is not performing within specifications; maintenance and repair, in accordance with the OM&M manual, is required immediately.

Table 4: Summary of Routine LNAPL Recovery System OM&M

Inspection, Maintenance, or Reporting Item	As-Needed	Each Visit	Bi-Weekly	Monthly	Quarterly	Semiannual
Site Inspection		X			X	
Collect Totalizer Information, Hour Meters, Operating Data, Tank Levels		X				
Fill out Daily Log Book		X				
Change Bag Filters	X				X	
Inspect Air Compressor and Drain Valve, Transfer Pumps, OWS, Extraction Manifolds for flow, leaks and operation sounds			X			
Clean Flow Meters, Totalizers and Filters	X		X			
Clean Pre-separation Tank and OWS	X					X
Collect Compliance Permit Samples					X	
Inspect Tanks and Piping Integrity				X		
Check Chemical Metering Pump				X		
Inspect Flush Mount Vaults (VER, Skimmer, and Mechanical)				X		
Pull, Inspect and Clean TF Pumps	X				X	
Pull, Inspect and Clean Skimmer Pumps	X				X	
Critical Safety Device Check, Maintenance & Motor Lubrication						X
Change KO Tank Inlet Particulate Filter						X
Product Storage Tank Overfill Prevention System Test	X					X
Check Operation of Emergency Lighting, Exit Signs, Fire Extinguishers, Eyewash, Roof, Siding, Doors, Insulation, Heat Trace				X		

5.3.4 System Monitoring Devices and Alarms

The LNAPL recovery system has a local and remote alarm indication devices to indicate that the system is not operating properly. When an operator is present at the site, alarm conditions are viewed on a Human Machine Interface (HMI) Screen located in the control room of Equipment Enclosure TE1. Visual and Audible alarms are also activated during alarm conditions to gain the operator's attention. When the system is unmanned, alarms notifications are transmitted to the operator, OM&M Manager and other authorized stakeholders via text messages and emails sent by the cellular remote access system via internet connection. In addition, the operator, OM&M Manager and other stakeholders can view the HMI Graphical interface screens from a remote computer, smart phone or tablet via internet connection. In the event an alarm condition is activated which indicates a system problem requiring physical repair or other on-site attention, applicable maintenance and repairs will

be conducted, as specified in the OM&M manual, and the LNAPL recovery system will be restarted. Operational problems will be noted in the Periodic Review Report to be prepared for that reporting period. Depending on the severity of the alarm condition, designated operational personnel (Operator and OM&M Manager) can also initiate control commands and alarm re-set procedures remotely via computer, smart phone or tablet. Operational data can also be downloaded from the remotely via the cellular access system for use in analyzing system performance and remedial effectiveness in a streamlined and efficient manner.

6.0 PERIODIC ASSESSMENTS/EVALUATIONS

6.1 Climate Change Vulnerability Assessment

Increases in both the severity and frequency of storms/weather events, an increase in sea level elevations along with accompanying flooding impacts, shifting precipitation patterns and wide temperature fluctuation, resulting from global climactic change and instability, have the potential to significantly impact the performance, effectiveness and protectiveness of a given site and associated remedial systems. Vulnerability assessments provide information so that the site and associated remedial systems are prepared for the impacts of the increasing frequency and intensity of severe storms/weather events and associated flooding.

This section provides a summary of vulnerability assessments that will be conducted for the site during periodic assessments, and briefly summarizes the vulnerability of the site and/or engineering controls to severe storms/weather events and associated flooding.

- Flood Plain: Portions of the RAD I and RAD II Sites are located in a 100-year flood plain.
- Site Drainage and Storm Water Management: Surface ponding can occur along the railroad Right of Way (ROW) adjacent to the southern edge of the Sites; however, drainage structures at the Sites have served adequately, and do not dramatically affect the usability of the site.
- Electricity: Electric to the RAD I and RAD II Sites is provided by Con Edison, electric service to this area is reliable and not susceptible to outages.
- Spill/Contaminant Release: LNAPL will be stored at the site. LNAPL will be stored in accordance with all applicable federal, state and local regulations.

6.2 Green Remediation Evaluation

NYSDEC's DER-31 Green Remediation requires that green remediation concepts and techniques be considered during all stages of the remedial program, including site management, with the goal of improving the sustainability of the cleanup and summarizing the net environmental benefit of any implemented green technology. This section of the SMP provides a summary of any green remediation evaluations to be completed for the site during site management, and as reported in the Periodic Review Report (PRR).

- Items relating to green remediation strategies that have been considered in the remediation strategy for the site include: Energy usage (electrical usage for operation of remedial systems, site lighting, security systems, etc.), has been significantly reduced (by over 70%) from what was originally proposed, allowing for more efficient collection of LNAPL. Anticipated electrical cost savings are estimated to be approximately $250,000/year.

Methods proposed to reduce energy consumption, resource usage, waste generation, water usage, etc. should be included in the PRR.

6.2.1 Timing of Green Remediation Evaluations

For major remedial system components, green remediation evaluations and corresponding modifications will be undertaken as part of a formal Remedial System Optimization (RSO), or at any time that the Project Manager feels appropriate, e.g. during significant maintenance events or in conjunction with storm recovery activities.

Modifications resulting from green remediation evaluations will be routinely implemented and scheduled to occur during planned/routine operation and maintenance activities. Reporting of these modifications will be presented in the PRR.

6.2.2 Remedial Systems

The LNAPL recovery system will be operated to conserve energy, materials and other resources to the greatest extent possible while maintaining remedial effectiveness and process safety. Consideration will be given to operating rates and use of reagents and other consumables. Spent materials will be sent for recycling, as appropriate.

The components of the LNAPL recovery system to be evaluated include, but are not limited to the following:

- ***Process Equipment Loads/Energy Efficiency*** - energy consumption per unit LNAPL recovered (KWh/gal LNAPL recovered) will be continuously data logged and monitored. Periodic (monthly/quarterly) system adjustments will be made to the process treatment equipment and to the extraction well systems (pumps/SVE, etc.) in order to fine tune and continually improve both remedial effectiveness and the KWh/gal LNAPL ratio.

- ***VER wells/Total Fluids*** - (vacuum levels, pumping levels, flow rates, zone pulsing schedule, pump cleaning schedules) to maximize product removal, efficient use of compressed air;

- ***Skimmer pumps*** - (setting, operating rates, pulsing, cleaning schedules) to ensure removal of only LNAPL, maximum product removal, efficient use of compressed air;

- ***GAC treatment*** - of extracted groundwater and separated soil gas VOC vapors. Monitoring and change-out strategy to achieve efficient use of GAC. Spent GAC will be properly disposed or regenerated; and,

- ***LNAPL collection and disposal or recycling*** - Minimize water content in recovered product to achieve the highest level of recyclability.

6.2.3 Building Operations

The LRGTB will be operated and maintained to provide for the most efficient operation of the LNAPL recovery system, while minimizing energy, waste generation and water consumption.

Components to be evaluated, but are not limited to the following:

- Heating/cooling systems and temperature set-points;
- Building envelope, insulation and building use and occupancy;
- Ventilation;
- Lighting loads; and,
- Grounds and property management.

6.2.4 Frequency of System Checks, Sampling and Other Periodic Activities

Transportation to and from the RAD II and RAD I Sites and the use of consumables to conduct operation, maintenance, monitoring, sampling and shipping samples to a laboratory for analyses have direct and/or inherent energy costs. The schedule and/or means of these periodic activities have been prepared so that these tasks can be accomplished in a manner that does not impact the effectiveness and protectiveness of the LNAPL system, but reduces expenditure of energy or resources.

Consideration has been given regarding the reduction of the expenditure of energy or resources in the following ways.

- Reduced sampling frequencies;
- Reduced site visits and system checks;
- Installation of remote sensing and telemetry;
- Coordination and consolidation of activities to maximize the activities complete/site visit and reduce the frequency of site visits;
- Effective Preventative Maintenance to further leverage each site visit and reduce site visit frequency; and
- Use of fuel efficient vehicles.

Further description of how these items have been considered for the Site should be described in this Section.

6.2.5 Metrics and Reporting

As discussed in Section 7.0 and as presented in Appendix H – Site Management Forms, information on energy usage, solid waste generation, transportation and shipping, and water usage will be recorded to facilitate and document consistent implementation of green remediation during site management and to identify corresponding benefits; a set of metrics has been developed.

6.3 Remedial System Optimization

A Remedial Site Optimization (RSO) study will be conducted any time that the NYSDEC or the remedial party requests in writing that an in-depth evaluation of the LNAPL recovery system is needed. An RSO will be appropriate if any of the following occur:

- The remedial actions have not met or are not expected to meet RAOs in the time frame estimated in the ROD;
- The management and operation of the LNAPL recovery system is exceeding the estimated costs;
- The LNAPL recovery system is not performing as expected or as designed;
- Previously unidentified LNAPL or other contaminant is suspected;
- Plume shift has potentially occurred;
- Site conditions change due to development, change of use, change in groundwater use, etc.;
- There is an anticipated transfer of the site management to another remedial party or agency; and
- A new and applicable remedial technology becomes available.

An RSO will provide a critique of a site's conceptual model, give a summary of past performance, document current cleanup practices, summarize progress made toward the site's cleanup goals, gather additional performance or media specific data and information and provide recommendations for improvements to enhance the ability of the present system to reach RAOs or to provide a basis for changing the remedial strategy.

7.0 REPORTING REQUIREMENTS

7.1 Site Management Reports

All site management inspection, operation, maintenance, monitoring, and sampling activities will be recorded on the appropriate site management forms provided in Appendix H. These forms are subject to NYSDEC revision.

All applicable inspection forms and other records, including media sampling data and system maintenance reports, generated for the site during the reporting period will be provided in electronic format to the NYSDEC in accordance with the requirements of Table 5 and summarized in the Periodic Review Report.

Table 5 - Schedule of Interim Monitoring/Inspection Reports

Task/Report	Reporting Frequency*
Inspection Report	Monthly
Treated Water Discharge Sampling	Quarterly
Periodic Review Report	Annually, or as otherwise determined by the Department

* The frequency of events will be conducted as specified until otherwise approved by the NYSDEC.

All interim monitoring/inspections reports will include, at a minimum:

- Date of event or reporting period;
- Name, company, and position of personnel conducting inspection, monitoring, and sampling activities;
- Description of the activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet);
- Type of samples collected (e.g., soil, groundwater, LNAPL, air, soil vapor, etc.);
- Copies of all field forms completed (e.g., well sampling logs, chain-of-custody documentation, etc.);
- Sampling results in comparison to appropriate standards/criteria;
- A figure illustrating sample type and sampling locations;

- Copies of all laboratory data sheets and the laboratory data deliverables required for all points sampled (to be submitted electronically in the NYSDEC-identified format);
- Any observations, conclusions, or recommendations; and
- A determination as to whether contaminant conditions have changed since the last reporting event.

Routine maintenance event reporting forms will include, at a minimum:

- Date of event;
- Name, company, and position of personnel conducting operation and maintenance activities;
- Description of maintenance activities performed;
- Any modifications to the system;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet); and,
- Other documentation such as copies of invoices for maintenance work, receipts for replacement equipment, etc., (attached to the checklist/form).

Non-routine maintenance event reporting forms will include, at a minimum:

- Date of event;
- Name, company, and position of personnel conducting non-routine maintenance/repair activities;
- Description of non-routine activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents (included either on the form or on an attached sheet); and
- Other documentation such as copies of invoices for repair work, receipts for replacement equipment, etc. (attached to the checklist/form).

Data will be reported in digital format as determined by the NYSDEC. Currently, data is to be supplied electronically and submitted to the NYSDEC EQuIS™ database in accordance with the requirements found at this link: http://www.dec.ny.gov/chemical/62440.html.

7.2 Periodic Review Report

A Periodic Review Report (PRR) will be submitted to the NYSDEC eight-teen (18) months after the Certificate of Completion is issued. After submittal of the initial Periodic Review Report, the next PRR shall be submitted annually or, as appropriate, to the NYSDEC or at another frequency as may be required by the NYSDEC. In the event that the site is subdivided into separate parcels with different ownership, a single Periodic Review Report will be prepared that addresses the site described in Appendix D -Environmental Easement. The report will be prepared in accordance with NYSDEC's DER-10 and submitted within 30 days of the end of each certification period. Media sampling results will also be incorporated into the PRR. The PRR will include:

- Identification, assessment and certification of all EC's/IC's required by the remedy for the RAD Sites.
    - Results of the required annual site inspections and severe condition inspections, if applicable.
    - All applicable site management forms and other records generated for the RAD I and RAD II Sites during the reporting period in the NYSDEC-approved electronic format, if not previously submitted.
    - A summary of discharge monitoring data and/or information generated during the reporting period, with comments and conclusions.
    - Data summary tables and graphical representations of contaminants of concern by media (groundwater, soil, air, vapor, etc.), which include a listing of all compounds analyzed, along with the applicable standards, with all exceedances highlighted. These will include a presentation of past data as part of an evaluation of contaminant concentration trends.
    - Results of all analyses, copies of all laboratory data sheets, and the required laboratory data deliverables for all samples collected during the reporting period will be submitted in digital format as determined by the NYSDEC. Currently, data is supplied electronically and submitted to the NYSDEC EQuIS^{TM} database in accordance with the requirements found at this link: http://www.dec.ny.gov/chemical/62440.html.
    - A site evaluation, which includes the following:
        - The compliance of the remedy with the requirements of the site-specific RAWP or ROD;
        - The operation and the effectiveness of the LNAPL recovery system and soil cover, including identification of any needed repairs or modifications;

- Any new conclusions or observations regarding site contamination based on inspections or data generated by the Monitoring and Sampling Plan for the LNAPL being monitored;
- Recommendations regarding any necessary changes to the remedy and/or Monitoring and Sampling Plan; and
- Trends in contaminant levels in the LNAPL will be evaluated to determine if the remedy continues to be effective in achieving remedial goals as specified by the ROD.
- The overall performance and effectiveness of the remedy.

- A performance summary for the LNAPL recovery system at the RAD I and RAD II Sites during the calendar year, including information such as:
  - The number of days the LNAPL recovery system operated for the reporting period;
  - The average, high, and low flows per day;
  - The contaminant mass removed;
  - A description of breakdowns and repairs, with an explanation for any significant downtime;
  - A description of the resolution of performance problems;
  - Alarm conditions;
  - Trends in equipment failure;
  - A summary of the performance, effluent and/or effectiveness monitoring; and,
  - Comments, conclusions, and recommendations based on data evaluation.

7.2.1 Certification of IC and EC

Following the last inspection of the reporting period, a Professional Engineer licensed to practice in New York State will prepare, and include in the Periodic Review Report, the following certification as per the requirements of NYSDEC DER-10:

"For each institutional or engineering control identified for the site, I certify that all of the following statements are true:

- *The inspection of the site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under my direction;*

- *The institutional control and/or engineering control employed at this site is unchanged from the date the control was put in place, or last approved by the Department;*
- *Nothing has occurred that would impair the ability of the control to protect the public health and environment;*
- *Nothing has occurred that would constitute a violation or failure to comply with any site management plan for this control;*
- *Access to the site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control;*
- *If a financial assurance mechanism is required under the oversight document for the site, the mechanism remains valid and sufficient for the intended purpose under the document;*
- *Use of the site is compliant with the environmental easement;*
- *The engineering control systems are performing as designed and are effective;*
- *To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program and generally accepted engineering practices; and*
- *The information presented in this report is accurate and complete.*
- *No new information has come to my attention, including groundwater monitoring data from wells located at the site boundary, if any, to indicate that the assumptions made in the qualitative exposure assessment of off-site contamination are no longer valid; and*
- *The assumptions made in the qualitative exposure assessment remain valid.*

"I certify that all information and statements in this certification form 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. I, ***Brent O'Dell*** *of* ***MACTEC Engineering and Consulting, P.C****, am certifying as the* ***Designated Site Representative****. I have been authorized and designated by all site owners/remedial parties to sign this certification] for the site."*

The signed certification will be included in the Periodic Review Report.

The Periodic Review Report will be submitted, in electronic format, to the NYSDEC Central Office, Regional Office in which the site is located and the NYSDOH Bureau of Environmental Exposure Investigation. The Periodic Review Report may need to be submitted in hard-copy format, as requested by the NYSDEC project manager.

7.3 Corrective Measures Work Plan

If any component of the remedy is found to have failed, or if the periodic certification cannot be provided due to the failure of an IC or EC, a Corrective Measures Work Plan will be submitted to the NYSDEC for approval. This plan will explain the failure and provide the details and schedule for performing work necessary to correct the failure. Unless an emergency condition exists, no work will be performed pursuant to the Corrective Measures Work Plan until it has been approved by the NYSDEC.

7.4 Remedial Site Optimization Report

In the event that a RSO is to be performed (see Section 6.3, upon completion of an RSO, an RSO report must be submitted to the NYSDEC for approval. A general outline for the RSO report is provided in Appendix H – Site Management Forms. The RSO report will document the research/ investigation and data gathering that was conducted, evaluate the results and facts obtained, present a revised conceptual site model and present recommendations. RSO recommendations are to be implemented upon approval from the NYSDEC. Additional work plans, design documents, HASPs etc., may still be required to implement the recommendations, based upon the actions that need to be taken. A final engineering report and update to the SMP may also be required.

The RSO report will be submitted, in electronic format, to the NYSDEC Central Office, Regional Office in which the site is located, Site Control and the NYSDOH Bureau of Environmental Exposure Investigation.

8.0 REFERENCES

Site-specific reports utilized for preparation of the SMP are listed below.

AMEC Environment & Infrastructure, Inc. 2013. *Remedial Action Work Plan Addendum #1, Pre-Design Investigation Report, Review Avenue Sites, RAD I and RAD II, Long Island City, Queens, New York., BCA #C241089 and BCA # C24005, July 2013.*

CH2M Hill, 1982. Engineering Services Report, Quanta Resources Site Cleanup, prepared for the NYCDEP, December 29, 1982.

de maximis, inc. (de maximis, 2011). *Construction Completion Report, Progress Summary, Demolition Submittal,* September, 2011.

Environmental Liability Management of New York, L.L.C. (ELM), 2007. *Final Report for Underground Storage Tank (UST) and Sump Removal Interim Remedial Measure (IRM), Review Avenue Development I, 37-30 Review Avenue, Long Island City, New York, BCA #C241089*, January 12, 2007.

Environmental Resources Management-Northeast (ERM), 1990. *Phase I Environmental Assessment, 37-30 Review Avenue, Long Island City, New York,* 1990.

Environmental Resources Management-Northeast, 1992. *Phase II Environmental Assessment, 37-30 Review Avenue, Long Island City, New York,* May, 1992.

Geosyntec Consultants (Geosyntec), 2008. *Phase I Soil Vapor Investigation Report, Review Avenue Development II Property,* November 26, 2008.

Geosyntec Consultants, 2010a. *Phase IA Soil Vapor Investigation Report, Review Avenue Development II Property,* February 9, 2010.

Geosyntec Consultants, 2010b. *Review Avenue Development I Property, Soil Vapor Investigation Report Revised Draft,* December 31, 2010.

Golder Associates Inc. (Golder), 2005a. *Remedial Investigation Report, Quanta Resources Site, Long Island City, New York,* June 2005.

Golder Associates Inc., 2005b. *Feasibility Study Report, Quanta Resources Site, Long Island City, Queens, New York,* July 2005.

Golder Associates Inc., 2005c. *Supplemental Remedial Investigation Report, Quanta Resources Site, Long Island City, Queens, New York,* November 3, 2005.

Golder Associates Inc., 2008. *LNAPL Recovery Pilot Study Work Plan, Review Avenue Development (RAD) II, Long Island City, Queens, New York*, June 2, 2008.

Golder Associates Inc., 2010. *Revised LNAPL Recovery Pilot Study Work Plan, Review Avenue Development (RAD) II, Long Island City, Queens, New York*, October 4, 2010.

Golder Associates Inc., 2011. *Remedial Action Workplan, Review Avenue Development RAD I BCA # 241089 and RAD II BCA # 241005, Long Island City, Queens, New York*, November 2011.

Kleinfelder East Inc., 2009. *Interim Site Characterization Report, Waterfront Parcels (Tract II), Former Pratt Oil Works, Long Island City, New York,* August 10, 2009.

New York State Department of Environmental Conservation, 1998. *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1. June 1998 (April 2000 addendum).*

New York State Department of Environmental Conservation, 2005a, *Brownfield Site Cleanup Agreement, Index #W2-1076-05-09, Site #C241005,* October 2005.

New York State Department of Environmental Conservation, 2005b, *Brownfield Site Cleanup Agreement, Index #W2-1078-05-09, Site #C241089,* December 2005.

New York State Department of Environmental Conservation, 2006a, *Subpart 375-3: Brownfield Cleanup Program,* December 2006.

New York State Department of Environmental Conservation, 2006b, *Subpart 375-6: Remedial Program Soil Cleanup Objectives,* December 2006.

New York State Department of Environmental Conservation, 2007. *Declaration Statement – Record of Decision, Quanta Resources Inactive Hazardous Waste Disposal Site (a.k.a. Review Avenue Development II), Long Island City, Queens, New York, Site No. 2-41-005,* February 2007.

New York State Department of Environmental Conservation, 2010a. *Program Policy DER-10: Technical Guidance for Site Investigation and Remediation,* May 2010.

New York State Department of Environmental Conservation, 2010b. *Regulations, Chapter III-Air Resources, Subpart 201*-3, revised June 8, 2010.

New York State Department of Environmental Conservation, 2010c. Letter to R. Craig Coslett, de maximis, inc., regarding: *Review Avenue Development Sites (RAD I & RAD II),* November 22, 2010.

New York State Department of Environmental Conservation, 2011. Letter to R. Craig Coslett, de maximis, inc., regarding: *Review Avenue Development Site RAD I BCA # 241089*, Sub Slab Soil Vapor Results, November 29, 2011.