FORMER PARAGON OIL TERMINAL (FORMER TEXACO SITE #304209)

AND APOLLO STREET PROPERTY (STEEL EQUITIES)

SITEWIDE CORRECTIVE ACTION WORKPLAN

September 15, 2009

Prepared by:
Science Applications International Corporation
6310 Allentown Boulevard
Harrisburg, PA 17112
On behalf of Texaco Inc.

SAIC
From Science to Solutions

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Peter Cagnetta
SAIC Project Manager

TABLE OF CONTENTS

Figures follow text.

1.0 INTRODUCTION AND BACKGROUND

This sitewide Corrective Action Workplan (Workplan) was prepared for the New York State Department of Environmental Conservation (NYSDEC) by Science Applications International Corporation (SAIC), on behalf of Texaco Inc. (Texaco). The Workplan addresses past, present, and proposed site activities at the former Paragon Oil Company terminal property (the Paragon Site) and the adjacent 100-120 Apollo Street property (the Apollo Site). Both Sites are located in the Greenpoint section of Brooklyn, New York.

1.2 PURPOSE AND SCOPE

This Workplan has been prepared in accordance with the Corrective Action Plan (CAP) included as Exhibit B in the amended Order on Consent Case # D2-1111-01-09 between Texaco and NYSDEC. The Order on Consent was signed on May 15, 2009 for the Paragon and Apollo Sites. The CAP and this Workplan have been prepared using criteria presented in the December 2002 NYSDEC DER-10 *Technical Guidance for Site Investigation and Remediation* (DER-10). The Workplan addresses the four primary media of concern with respect to characterization activities and the implementation of corrective action measures across the Paragon and Apollo Sites. The media of concern are phase-separated hydrocarbons (PSH), groundwater, soil, and soil vapor.

1.3 DESCRIPTION OF PROPERTIES

The Paragon and Apollo Sites are located in the Greenpoint section of Brooklyn, New York. Both Sites are bounded by Bridgewater Street to the south and Newtown Creek to the north. Meeker Avenue forms the eastern boundary of the Paragon Site, and Apollo Street forms the western boundary of the Apollo Site. The two Sites share a property boundary along the western Paragon Site and eastern Apollo Site property boundaries. A Site Vicinity Map showing the location of both properties is presented as Figure 1.1.

The Paragon Site is currently owned and operated by Empire Merchants (former Peerless Importers), a liquor distribution company. The property is approximately 11 acres in size with approximately 8 acres being covered by warehouse. The Apollo Site is owned by Steel Equities and leased to Empire Merchants for warehouse operations. The Apollo Site is approximately 3 acres in size with approximately 2.6 acres covered by warehouse.

1.3 SITE HISTORY

The Greenpoint section of Brooklyn along Newtown Creek has been a region of significant oil refining dating back to at least the 1830s when whale oil was refined for use as an illuminating oil. By the 1860s petroleum became the primary product refined in Greenpoint. By the late 1800s, it is widely reported that over 50 petroleum refineries were located along the banks of Newtown Creek. Greenpoint remained a hub of petroleum refining and distribution activity through the twentieth century. Petroleum storage and various terminal facilities remain active in Greenpoint today.

In 1978, PSH was observed seeping into Newtown Creek at the base of Meeker Avenue by the United States Coast Guard (USCG). This discovery led to an investigation by Geraghty & Miller, Inc. to determine the source of the seep and the extent of PSH present in the subsurface. The conclusions of the resulting site investigation indicated that the Meeker Avenue seep was part of a 17 million gallon, 55-acre PSH plume. Based on the results of the investigation, the Meeker Avenue Task Force, consisting of the area oil companies and the USCG, was created to address the Meeker Avenue seep and recover PSH.

In 1991, a PSH seep was identified emanating from the Peerless Importers bulkhead into Newtown Creek from the Paragon Site. ExxonMobil commenced remediation efforts and reported the collection of approximately 29,000 gallons of PSH from 1993 through May 2005 from the surface of Newtown Creek adjacent to the Paragon Site. Per an interim allocation agreement between ExxonMobil and Texaco, and a consent order with NYSDEC, remediation activities at the Peerless seep transitioned from ExxonMobil to Texaco in 2005. SAIC, on behalf of Texaco, commenced remediation and characterization activities at the Paragon Site in June 2005.

1.3.1 Former Paragon Site

The former Paragon Oil Company maintained terminal operations at the Paragon Site between 1934 and 1958. Texaco purchased the terminal in 1958 and continued petroleum terminal operations until 1968, when the terminal was closed and the property sold to Peerless Importers (currently Empire Merchants). By 1962 the former Paragon Oil terminal had expanded to 49 tanks that stored a variety of finished refined petroleum products including No. 4 fuel oil, No. 6 fuel oil, kerosene, lube oil and lesser amounts of gasoline and diesel fuel. Support infrastructure such as overhead piping, loading racks, docking stations, underground piping, canning facilities, drum storage, underground storage tanks, and office buildings were also present on the property.

1.3.2 Apollo Site

The Apollo Site has no known history of petroleum refining or terminal operations. The City of New York obtained the Apollo Site in 1933 and operated a trash incinerator into the 1960s. Since the sale of the Apollo Site by the City of New York in 1969, the properties comprising the Apollo Site have changed ownership several times and have been utilized primarily for warehousing and distribution activities. Steel Equities purchased the Apollo Site in 2000 and has leased the property to Empire Merchants for use in their liquor warehousing and distribution operations since 2007.

Neither the Paragon Oil Company nor Texaco owned or maintained operations on the Apollo Site. Texaco is not accepting responsibility for the impacts on the property but has completed IRM and characterization activities on the Site in an effort to continue to work cooperatively with NYSDEC and further improve the quality of Newtown Creek. The 2005 Order of Consent between Texaco and NYSDEC was expanded to include the Apollo Site on May 15, 2009.

1.4 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) have been developed for the Paragon and Apollo Sites using guidelines specified in the DER-10. RAOs are medium-specific or operable-unit specific objectives for the protection of public health and the environment and are developed based on contaminant-specific Standards, Criteria and Guidance (SGCs). The RAOs developed for the Paragon and Apollo Sites, as incorporated into the Corrective Action Plan (CAP) included with the expanded Consent Order between Texaco and NYSDEC, are:

- Prevent contact with, or inhalation of, volatiles from contaminated groundwater;
- Restore groundwater to the extent practicable;
- Prevent the discharge of contaminants to surface water;
- Prevent the source of ground or surface water contamination;
- Prevent ingestion/direct contact with contaminated soil;
- Prevent inhalation of or exposure from contaminants volatilizing in the soil;
- Prevent migration of contaminants that would result in groundwater or surface water contamination; and

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

2.0 SITE CHARACTERIZATION

In an effort to characterize subsurface conditions at the Paragon and Apollo Sites, SAIC has completed extensive site characterization activities on behalf of Texaco. The primary objective of the site characterization activities has been to determine the nature, extent, and source of PSH located in the saturated zone beneath the Paragon and Apollo Sites. Characterization activities have included the installation of groundwater monitoring wells, the advancement of soil borings, the collection and analysis of groundwater, PSH, and soil samples, and the collection of soil vapor and hydrologic data.

2.1 SITE CHARACTERIZATION ACTIVITIES COMPLETED

Since 2005, SAIC on behalf of Texaco, has completed extensive subsurface characterization activities at the Paragon and Apollo Sites. A total of 62 monitoring wells were installed, 12 recovery wells have been activated, and 16 soil borings were advanced on and in the vicinity of the Paragon and Apollo Sites. Lithologic data collected during these events has been summarized in soil boring logs which have been utilized to create a series of stratigraphic cross sections for the Paragon and Apollo Sites. The locations of Texaco installed wells and soil borings are presented in the Site Map as Figure 2.1.

Regional aquifer dynamics have been assessed by quarterly groundwater and PSH gauging events which have, since 2005, been completed throughout the plume in collaboration with BP and ExxonMobil. From this data, regional groundwater contour and PSH distribution maps have been completed. These data have been utilized to interpret groundwater and PSH flow dynamics. Groundwater and PSH gauging data from the May 7, 2009 quarterly regional gauging event were presented to NYSDEC in the Quarterly Status Report, April 1, 2009 to June 30, 2009 for the Former Paragon Oil Terminal #304209 and the 100-120 Apollo Street Property, Greenpoint Section, Brooklyn, New York (SAIC, 2009d).

In order to assess local aquifer dynamics, hydrologic data were collected from selected wells on and surrounding the Paragon and Apollo Sites. Utilizing pressure transducers and data loggers, hydrologic data were collected during the completion of tidal surveys and slug tests. These data were collected and interpreted to determine the localized aquifer hydrologic characteristics of the upper water bearing zone.

Several groundwater, PSH, and soil sampling events have been completed for the Paragon and Apollo Sites. Groundwater, PSH, and soils have been analyzed for numerous volatile and semi-volatile hydrocarbon constituents, as well as geotechnical parameters. Laboratory results have been presented to NYSDEC in several reports including:

- Site Characterization Report for the Former Paragon Oil Terminal and Adjacent Areas, Greenpoint, Brooklyn, New York (SAIC, 2006);
- Supplemental Site Characterization Report for the Former Paragon Oil Terminal and Adjacent Areas, (SAIC, 2007); and
- Phase I Total Fluids Recovery System Performance Evaluation for the Former Paragon Oil Terminal, Greenpoint Section, Brooklyn, New York (SAIC, 2008).

2.2 SUMMARY OF GEOLOGY AND HYDROGEOLOGY

Lithologic data collected during well and soil boring installations were utilized to create a series of stratigraphic cross sections for the Paragon and Apollo Sites. The cross section transects cover the Paragon and Apollo Sites parallel and perpendicular to Newtown Creek. The combination of stratigraphic and hydrologic data have been used to evaluate the subsurface beneath the Sites and to interpret groundwater and PSH conditions both regionally and locally.

2.2.1 Summary of Regional Geology and Hydrogeology

The Greenpoint section of Brooklyn is a heavily urbanized area. As such, disturbed fill materials were detected during subsurface exploration activities. Areas of fill ranged from 5 feet thick in the ExxonMobil Off-Site Plume to 25 feet thick at the bulkhead of the Paragon Site. The composition of the 'urban fill' materials vary greatly in composition and thickness, ranging from coarse gravelly sand sized materials on the Paragon and Apollo Site bulkheads to fine to coarse sand sized materials along Bridgewater Street, Meeker Avenue, Apollo Street, and south of Bridgewater Street. Below the fill unit is a native fine to coarse unconsolidated sand and gravel unit that comprises the majority of the shallow aquifer in the area. South of Bridgewater Street, this unit is greater than 75 feet thick, and most wells in the ExxonMobil Off-Site Plume are screened in this unit. The uppermost saturated zone is comprised of naturally deposited alluvial sands of the Upper Glacial Aquifer.

2.2.2 Summary of Local Geology and Hydrogeology

The stratigraphy across the Paragon and Apollo Sites is generally comprised of three zones. The upper zone is comprised of unconsolidated sand and gravel sized fill materials containing manmade artifacts. The bottom of this layer is located between 5 and 25 feet below grade. Underlying the fill zone, a naturally occurring elastic silt layer is present across part of the Paragon and Apollo Sites.

The silt layer is present at the wells installed along Newtown Creek at a depth of approximately 25 to 30 feet below grade. The silt layer slopes upward in the southerly inland direction, and has an average thickness of approximately 2 feet. This silt layer is interpreted to be the original bed of Newtown Creek before the industrialization of the 1880s. The layer extends 60 to 400 feet southward toward Bridgewater Street on the Paragon Site, and 100 to 300 feet southward from the bulkhead on the Apollo Site. The free water table occurs at an elevation above the silt layer. At some locations, the silt layer is underlain by an organic peat layer. A layer of native alluvial sands is located beneath the silt layer, where present. Where the silt layer is absent, the fill zone is directly underlain by the native alluvial sand unit.

The local groundwater regime on the Paragon and Apollo Sites is influenced by the tides in Newtown Creek. Along the bulkhead, groundwater elevations typically fluctuate between 3 to 5 feet in conjunction with the tidal fluctuations of Newtown Creek. The tidal effects on groundwater elevation are reduced inland towards Bridgewater Street, where the groundwater elevations typically fluctuate 0 to 0.2 feet in conjunction with the tides. Although tidal activity typically reverses the hydraulic gradient at the bulkhead area twice per day, groundwater within the shallow aquifer at the Paragon and Apollo Sites generally flows in the direction of Newtown Creek. A groundwater contour map created using data from the May 7, 2009 combined quarterly gauging event is presented as Figure 2.2

2.3 SUBSURFACE MEDIA

As mentioned in Section 1.1, four subsurface media of concern have been identified with respect to characterization activities and the implementation of corrective action measures across the Paragon and Apollo Sites.

Media of concern are as follows:

- PSH
- groundwater
- soil
- soil vapor.

Groundwater, soils, and soil vapor have all been impacted by PSH on the Paragon and Apollo Sites and will be addressed in the forthcoming alternatives analysis and remedy selection process.

2.3.1 PSH

The PSH present at the Paragon and Apollo Sites is composed entirely of Light Non-Aqueous Phase Liquids (LNAPL) in the shallow groundwater zone. Well gauging events in 2008 and 2009 at the Paragon and Apollo Sites indicate measurable PSH in well thicknesses generally ranging between 0 and 4 feet.

PSH extends across much of the central and western portions of the Paragon Site, and across much of the central and southern portions of the Apollo Site. The majority of the eastern portion of the Paragon Site is free from PSH except on the southeastern corner where the Site borders Bridgewater Street and Meeker Avenue. The bulkhead of the Apollo Site only contains PSH in the northeast corner of the property, where the timber crib bulkhead meets the steel bulkhead of the Paragon Site. Figure 2.3 depicts the extent of PSH plume interpreted from gauging data collected by BP, ExxonMobil and Texaco during the May 7, 2009 combined quarterly gauging event.

2.3.2 Groundwater

Groundwater at the Paragon and Apollo Sites is tidally influenced and generally flows toward the Newtown Creek from Bridgewater Street. The hydraulic gradient across the Site is fairly low (approximately 0.005 to 0.01). Groundwater elevations have been noted to fluctuate as much as 5 feet in the bulkhead area of the Paragon and Apollo Sites due to tidal influence, but fluctuate between 2 to 3 feet on average. The tidal effects on groundwater are reduced inland towards Bridgewater Street, where the groundwater elevations typically fluctuate 0 to 0.2 feet in conjunction with the tides. The depth to groundwater at the Paragon and Apollo Sites ranges from 5 feet below grade at the lower bulkhead to 25 feet below grade along Bridgewater Street, respectively. Dissolved phase hydrocarbon constituents have been detected in groundwater samples collected across the Paragon and Apollo Sites.

2.3.3 Soils

Soils in the vadose zone across the majority of the Paragon and Apollo Sites consist of unconsolidated sand to gravel sized fill materials. The fill materials are generally thicker (approximately 25 to 30 feet) along the bulkhead of the Paragon and Apollo Sites and thinner (5 feet) along Bridgewater Street. Native unconsolidated sands in the vadose zone exist beneath the fill zones along the southern portions of the Paragon and Apollo Sites. Impacts to soils are generally associated with PSH.

2.3.4 Soil Vapor

Since the PSH in the subsurface is comprised primarily of volatile hydrocarbons the potential exists for hydrocarbon vapors to accumulate in the unsaturated soil zone as compounds volatilized from the PSH and impacted groundwater. In addition anaerobic biodegradation of the hydrocarbon vapors can also generate methane gas in the subsurface.

The presence of volatile hydrocarbons and methane were detected in the soil during drilling activities in the 16 Bridgewater Street warehouse in 2005. In addition, the compounds were also detected in the soil during the 2008 Vapor Extraction (VE) pilot test along the bulkhead area.

Ongoing biannual ambient air sampling events conducted on behalf of Empire Merchants have documented that hazards associated with the soil vapor under the buildings do not exist in its facility.

2.4 PRELIMINARY SITE CONCEPTUAL MODEL

The purpose of this section is to present a preliminary conceptual model for the Paragon and Apollo Sites. For the purpose of this evaluation the two properties will be considered as one Site because exposure conditions are expected to be the same for both properties. Combined, the two properties total approximately 14 acres, of which 10.6 acres (76 %) is under roof.

A conceptual model is a compilation of the individual exposure pathways by which potential receptors are exposed to impacted media at the Site. A conceptual model combines information about sources, the nature and extent of constituents of potential concern, impacted media, migration (i.e., fate and transport characteristics), receptors, and exposure routes (e.g., ingestion, inhalation). The conceptual model is the central planning tool for the investigation and any remediation at the Site. The conceptual model is used to ensure that all potential exposures are accounted for accurately.

An individual exposure pathway describes the course a chemical or physical agent takes from a source to a receptor. An individual exposure pathway consists of the following four elements:

- A source and mechanism of release;
- A retention or transport medium (e.g., soil, fugitive dust, or groundwater);
- A receptor and a point where the receptor can contact the impacted medium;
- A mechanism (exposure route) by which the receptor contacts the impacted medium.

The preliminary conceptual model was developed to be consistent with DER-10 guidance and identifies possible current and possible future exposure pathways. The preliminary conceptual model does not consider the effects of any interim remedial actions taken at the Site, but it does account for existing buildings, roads, parking lots, and other covered features that effectively eliminate direct exposure. The removal of these structures, however, could result in receptors being exposed to any regulated substances in the future. The results of the exposure pathway evaluation will be used to assess the need if necessary, for additional characterization, a quantitative evaluation for fate and transport (e.g., modeling), remediation, or no action based on the absence of a complete pathway.

Provided in the following sections is a brief discussion of land use and the Site setting as well as the various components of the preliminary conceptual model (i.e., sources, impacted media, constituents of potential concern, migration, receptors, and exposure routes). The presentation of the preliminary site conceptual model is based on data generated from previously completed site characterization activities. Additional data collected from the implementation of this work plan will be used to update and refine the site conceptual model.

Land Use

The Site history was described in Section 1.3. The property is located in a heavily urbanized area of Brooklyn, New York. The Site currently contains warehouses used to store liquor for distribution. Manufacturing and commercial businesses are located adjacent to the Site on the east, west, and

south sides. BP currently operates a bulk petroleum terminal to the west of Apollo Street. Newtown Creek borders the northern portion of the Site. Newtown Creek flows westward and discharges into the East River.

Property access is restricted by a fence and locked buildings. Security personnel patrol the property, including the parking lots, 24 hours per day, 7 days per week. There are no residences (i.e., homes), schools, daycare facilities, or hospitals immediately adjacent to the Site.

The Site is zoned for manufacturing use. Future use of the Site is not expected to change. Moreover, use of the Site for industrial purposes during the past several decades would likely preclude the use of much of the property for any purpose other than manufacturing or commercial uses. Thus, the preliminary conceptual model assumes the land use will be manufacturing for both current and future conditions.

Water is supplied to the property and all surrounding properties via an established municipal system. There are no known drinking water or industrial supply wells in the area. Storm water and sanitary wastes are also controlled by a municipal system.

Sources and Potential Constituents of Concern

PSH extends across much of the central and western portions of the Paragon Site, and across much of the central and southern portions of the Apollo Site. The majority of the eastern portion of the Paragon Site is free from PSH contamination, except on the southeastern corner where the Site borders Bridgewater Street and Meeker Avenue. The bulkhead area of the Apollo Site only contains PSH in the northeast corner of the property, where the timber crib bulkhead meets the steel bulkhead of the Paragon Site.

Specific regulated constituents of the PSH on and adjacent to the properties include various petroleum volatile organic compounds such as benzene, ethylbenzene, toluene, xylenes, and other alkylated benzenes.

Potentially Exposed Human Receptors

Potential human receptors on the property include adult employees, delivery personnel, visitors, and construction/utility workers. Employees include office, and warehouse personnel. Construction/utility workers could be exposed to constituents while working in areas where impacted soils are located. On-site receptors are not expected to change in the foreseeable future. The potential for on-site exposure to constituents in the subsurface is very low for most receptors because the property is fully developed and covered by buildings, asphalt or concrete. Maintenance and construction/utility workers could be exposed to PSH or impacted soils during excavation activities. Employees could be exposed to volatile compounds via vapor intrusion if they are working in a building constructed over or near media containing petroleum volatile organic compounds.

Potentially Exposed Ecological Receptors

The Site is fully developed as a commercial/industrial complex and the only ecological receptors on the property are opportunistic vermin species. The Site is not maintained to attract or provide habitat for ecological receptors. Newtown Creek borders the Site to the north. The potential exists for PSH and dissolved phase constituents to enter the creek if the current total fluids recovery system was not operational. Potential impacts to this surface water receptor will be described in Chapter 5.

3.0 SUMMARY OF INTERIM REMEDIAL MEASURES (IRMS)

On August 12, 2005, Texaco entered into an Order on Consent with NYSDEC. The case number is D2-1111-01-05. The objectives set forth in the SAIC Corrective Action Plan were to identify the source of PSH in the subsurface on the Paragon Site and to design, install, and operate a landside recovery system with the intent of mitigating the PSH seep into Newtown Creek. The Order on Consent was expanded on May 15, 2009 to include the Apollo Site. A detailed timeline of the remediation based milestones completed between 2005 and 2007 is included in the February 2008 Phase I Total Fluids Recovery System Performance Evaluation Report (SAIC, 2008). IRMs completed since 2008 have been documented and submitted to NYSDEC in a series of monthly and quarterly status reports.

3.1 FORMER PARAGON OIL TERMINAL

Since 2005, SAIC, on behalf of Texaco, has completed numerous IRMs at the Paragon Site. IRMs have included the installation of a PSH and Groundwater Recovery System, the installation of a full scale grout wall, and the implementation of an ambient air monitoring program. The IRMs have been successful in reducing the seep into Newtown Creek from PSH to occasional sheens noted a few times a month.

3.1.1 PSH and Groundwater Recovery Systems

This section includes descriptions of IRMs instituted by SAIC, on behalf of Texaco, to address the subsurface media of PSH and groundwater at the Paragon Site. IRMs discussed in this section include the Seep Mitigation, Bridgewater Street Property Line Recovery, and Meeker Avenue Property Line Recovery Systems.

3.1.1.1 Seep Mitigation System

As previously referenced, the remediation of the Paragon Site PSH seep transitioned from ExxonMobil to Texaco in June of 2005. The seep mitigation system enacted by Texaco consists of two primary components. The first component was designed and constructed to block the migration of PSH from the subsurface through the bulkhead and into Newtown Creek. This component consists of a 440-foot long grout wall which was installed in the fall of 2006 and the creekside sealing of the seams in the Paragon Site steel bulkhead using a marine epoxy in 2008. The second component involved the construction of a Total Fluids Recovery System used to capture both PSH and groundwater behind the bulkhead. This system operates along the lower and upper bulkhead areas immediately behind the grout wall. This Phase I Fluids Recovery System was made fully operational on September 14, 2007.

3.1.1.1.1 Landside and Creekside Seep Prevention and Containment

Grout Wall

Between September and November 2006, a full-scale grout wall was constructed at the Paragon Site to mitigate the migration of PSH through the bulkhead and into the creek. The grout wall was installed immediately behind and adjacent to the existing steel sheeting bulkhead in the area where the PSH seep began in 1991. The grout wall extends approximately 440 linear feet and spans across both sections of the lower and upper bulkhead. The grout wall extends 10 feet beyond the eastern end of the creek side boom containment system. On the west end, the wall extends to within approximately 20 feet of the Paragon Site property line. The location of the grout wall is depicted in Figure 3.1

The grout wall was designed to create a near-contiguous and relatively impermeable grouted mass parallel to the bulkhead, with sufficient extensions past the limits of the mean low and high tide elevations of the adjacent creek to prevent the migration of PSH into Newtown Creek. Therefore, to account for tidal groundwater fluctuations, the grout wall was installed from five feet below the mean low tide at the base to approximately five feet above the mean high tide level at the top.

Seam Sealing

In order to further prevent any residual PSH or sheen from entering Newtown Creek, the vertical seams between the steel sheets of the bulkhead on the Paragon Site were sealed with a two-part marine epoxy (A-788 Splash Zone Epoxy) during the summer of 2008. The portions of the bulkhead above mean sea level (MSL) were completed by boat, and the portions below MSL were completed by divers. All seams were sealed from the mud-line at the base of the creek to an elevation exceeding the high tide. In June 2009, the seams were re-inspected and additional epoxy was added to selected seams.

Creekside Containment and Absorption System

A Creekside Containment and Absorption system is maintained in Newtown Creek by Texaco along 360 linear feet of the Paragon Site. Three types of containment and remediation booms are used in this system. Primary containment is achieved by a globe boom, and secondary containment is achieved by an outer fence boom. Remediation of any sheen inside the primary and secondary containment booms is achieved by using two types of floating absorbent booms. Absorbent booms are generally replaced on a monthly basis, as deemed necessary by Site personnel, to maintain effectiveness.

Dividers were installed within the globe boom in order to separate the globe boom into five compartments. The compartments present on the Paragon Site are labeled as C1 to C4. The purpose of dividing the boom into compartments was to evaluate changes in the magnitude of seepage along the bulkhead. This ongoing evaluation was used to measure the performance of the grout wall and the Total Fluids Recovery System. Boom compartments C1-C4 are depicted in Figure 3.1

In May of 2007, a new barrier boom (solidification boom) was installed within the boom containment system along the Paragon Site bulkhead to replace the single row of absorbent boom between the globe boom and the fence boom. The new boom contains a powder agent—approved for use by NYSDEC and the U.S. Environmental Protection Agency (EPA) on surface waters—that binds with hydrocarbons and solidifies the hydrocarbons inside the boom. The solidification and absorbent booms are interchanged periodically to maintain maximum effectiveness of the Creekside Containment and Absorption System.

3.1.1.1.2 Total Fluids Recovery System

SAIC, on behalf of Texaco, operates a Total Fluids Recovery system at the Paragon Site. Phase I Total Fluids Recovery system operation commenced on September 14, 2007 with 6 recovery wells. Phase II recovery system upgrades commenced in January 2008 and have included the addition of six additional recovery wells. Currently, the system includes 12 total fluids recovery wells along the steel bulkhead of the Paragon Site in the immediate area of the historical seep of PSH into the creek. Recovered fluids are processed through a pre-oil water separator (OWS) tank and an OWS with additional treatment of the water through sediment filters, an organoclay unit, and 2 granular-activated carbon (GAC) units prior to discharge to the New York City Department of Environmental Protection (NYCDEP) combined sewer system under existing NYCDEP water

quality and quantity permits. Recovered PSH is separated from the influent stream and recycled offsite. The footprint of the Total Fluids Recovery System is presented in Figure 3.2.

3.1.1.2 Bridgewater Street Property Line Recovery System

Currently one groundwater and PSH recovery well (RW-25) exists on Bridgewater Street along the southern property line of the Paragon and Apollo Sites. This well was installed by ExxonMobil and has been in operation since July 2009. A second recovery well (RW-26) is planned to be installed by ExxonMobil on Bridgewater Street pending receipt of all necessary permits and coordination with the property owner. RW-26 installation will likely occur in 2010. These wells will be operated by ExxonMobil as part of their recovery wellfield expansion for the offsite plume. The location of the existing and proposed recovery wells is presented in Figure 3.3.

ExxonMobil and Texaco have agreed to evaluate the performance of these two wells over the course of a 12 month period beginning after startup of RW-26. The objective of the evaluation is to determine the extent of the groundwater and PSH capture zone induced by these two wells. The agreement also states that a third well (RW-27) may be installed on Bridgewater Street adjacent to the Apollo Site if the induced subsurface capture from RW-25 and RW-26 (and additional ExxonMobil recovery wells south of Bridgewater Street) is not spatially sufficient to capture groundwater and PSH along the entire southern boundary of both properties.

3.1.1.3 Meeker Avenue Property Line Recovery System

ExxonMobil currently operates 3 recovery wells, RW-D, RW-E, and RW-F, along Meeker Avenue as part of their Offsite Free Product Recovery System. ExxonMobil maintains their Offsite Groundwater Treatment System building on the western corner of Bridgewater Street and Meeker Avenue. ExxonMobil has completed a particle tracking analysis with these recovery wells that indicates the capture zone from these wells extends onto the Paragon Site.

3.1.2 Soil and Soil Vapor Risk Mitigation

This section includes descriptions of IRMs instituted by SAIC, on behalf of Texaco, to address the subsurface media of soil and soil vapor risk mitigation at the Paragon Site. IRMs discussed in this section include:

- Ambient Air Monitoring Program;
- Warehouse Slab Maintenance;
- 50 Bridgewater Sub-Slab Depressurization System;
- Bulkhead Seep Area Vapor Phase Recovery System; and
- Bridgewater Street Property Line Vapor Recovery System.

3.1.2.1 Ambient Air Monitoring Program

CA Rich Consultants, Inc. (CA Rich), on behalf of Empire Merchants, has conducted seven, semi-annual, 24-hour ambient air quality monitoring surveys across the Paragon Site. Samples were collected using Summa canisters and analyzed according to EPA Method TO-15, which allows for the determination of volatile organic compounds by gas chromatography / mass spectrometry. Select samples were also analyzed for methane using ASTM Method D 1946/E 260. Results have been consistently below regulatory guidelines, confirming that the concrete floor slab of the Empire Merchants warehouse continues to serve as a barrier to potential subsurface vapor migration. The most recent ambient air quality monitoring survey occurred in August of 2009.

The planned January 2010 ambient air quality monitoring is planned to be completed by SAIC, on behalf of Texaco. SAIC will continue to monitor the ambient air quality at the Paragon Site on a

biannual basis. Sample collection methodology and sampling locations will likely remain consistent with those monitored by CA Rich to ensure the continuity of data.

3.1.2.2 Warehouse Slab Maintenance

Between July 13, 2009 and July 23, 2009, SAIC, on behalf of Texaco, completed slab maintenance activities inside the Paragon Site warehouses at 16, 42 and 50 Bridgewater Street. SAIC personnel inspected the warehouse floor for potential soil vapor migration pathways. Cracks were identified, prepared, and sealed using a combination of Sikaflex LM concrete sealant and 3M DP-600 concrete epoxy. A total of 424, cracks totaling 4809 linear feet were sealed in the Paragon Site warehouse floor.

3.1.2.4 50 Bridgewater Street Sub-Slab Depressurization System

A Sub-Slab Depressurization (SSD) System was designed for the conference room area at the rear of the 50 Bridgewater Street building as a voluntary, precautionary measure to mitigate possible intrusion of vapors from the subsurface. Depressurization testing was completed between September 18 and 19, 2008. The results were used to design a SSD system to maintain a vacuum in the subsurface under the entire conference room area.

Installation of the extraction point piping for the full scale SSD system commenced on September 24, 2008 and was completed on October 15, 2008. The system features seven 1-inch vertical extraction points screened for 2 feet, starting 8 to 12 inches below grade, and three 1-inch horizontal extraction laterals screened for 35 feet and placed 8 to 12 inches below grade. Each extraction point was individually piped to outside the building, where they will be manifolded together to allow maximum flexibility for system operation. The design calls for a 7.5 hp regenerative blower to generate the necessary vacuum and two, 1,000 lb air-phase GAC units to treat the soil vapor before venting to the atmosphere. The installation of the blower and vapor treatment equipment will be completed in the third and fourth quarters of 2009. The SSD system is scheduled to be operational by the end of the fourth quarter 2009. The report "Sub-Slab Depressurization System Design and Installation, Conference Room Area at 50 Bridgewater Street, Brooklyn, New York" was submitted to DEC in a report dated July 7, 2009. The SSD piping plan is presented in Figure 3.4

3.1.2.5 Bulkhead Seep Area Vapor Phase Recovery

A Vapor Phase Recovery (VPR) System has been planned as an upgrade to the existing Texaco Total Fluids Recovery System to further abate the seep into Newtown Creek. A VE pilot test was performed in August 2008 on existing Texaco recovery wells. Data collected from the VE pilot test were analyzed to determine the VPR design parameters. A plan view of the VPR System is presented in Figure 3.5

The final design of the VPR System calls for the conversion of nine of the 12 existing Texaco total fluids recovery wells to dual-phase recovery wells, extracting fluids and vapors simultaneously. The nine dual-phase recovery wells will be divided into two extraction wellfields that will be operated alternately. The sub-surface vacuum will be generated by a 10 hp positive displacement blower, and the vapors will be treated by a catalytic oxidation unit capable of 99.5% destruction efficiency of volatile contaminants.

Construction for the VPR System below ground piping will begin in the third quarter of 2009. Construction and installation of the VPR System treatment building and above ground piping will begin in the fourth quarter of 2009. The VPR system is scheduled to be operational by the first quarter of 2010.

3.1.2.6 Bridgewater Street Property Line Vapor Recovery System

ExxonMobil has installed 3 Soil Vapor Extraction (SVE) wells along the southern boundary of the Paragon Site. The three wells identified as SVE-11, SVE-12, and SVE-13 are presented in Figure 3.6. ExxonMobil has installed the SVE piping for connection to their planned SVE treatment system south of Bridgewater Street. Currently the 3 wells are not planned to be operated as ambient air sampling on the property has not identified any risks associated with the subsurface contamination.

3.2 APOLLO STREET PROPERTY

IRMs completed at the Apollo Site have included the expansion of the existing Total Fluids Recovery System to the Apollo Site the resurfacing of a concrete gravity wall bulkhead, and the installation of a Creekside Containment Barrier, and the completion of an ambient air monitoring program.

The bulkhead along the Apollo Site is different from the steel bulkhead of the Paragon Site. The nature and extent of the Apollo Site bulkhead has required several innovative IRMs to contain the seep into Newtown Creek. The bulkhead on the Apollo Site property consists of an 8' high concrete gravity wall retaining inboard fill on both a timber relieving platform and a timber crib wall. The bottom of the concrete gravity wall and the top of the timber substructure are situated at approximately mean low sea level. All but the easternmost 60' of the Apollo Site bulkhead consists of a timber relieving platform bulkhead. The remaining eastern portion of the bulkhead consists of a timber crib platform bulkhead. A detailed description of the Apollo Site bulkhead was presented to NYSDEC in the IRM Construction Summary Report and Operations, Maintenance and Monitoring (OM&M) Plan that was submitted to NYSDEC on February 10, 2009 (SAIC, 2009a).

3.2.1 PSH and Groundwater Recovery Systems

This section includes descriptions of IRMs implemented by both Texaco and ExxonMobil to address the subsurface media of PSH and groundwater on the Apollo Site. IRMs discussed in this section include the Seep Mitigation System, Bridgewater Street Property Line Recovery System, and the Creekside Containment Barrier.

3.2.1.1 Seep Mitigation System

The Seep Mitigation System employed at the Apollo Site consists of two primary components. The first component involves creekside seep prevention and containment measures, including a containment barrier incorporated into the timber crib bulkhead and a containment and absorption system (boom system) in Newtown Creek. The second component consists of the landside total fluids recovery system used to capture both PSH and groundwater behind the timber crib bulkhead.

3.2.1.1.1 Creekside Seep Prevention and Containment

Creekside Containment Barrier

Based on visual observations documented in previous SAIC reports, PSH seepage at the Apollo Site primarily occurred through three distinct areas along the eastern 60' of the Apollo Site timber crib bulkhead as follows:

- Through rectangular wooden breaches within the horizontal timbers (potential joints between crib sections);
- Through the intersection between the horizontal timbers and the overlying concrete gravity wall; and

- Through cracks within the overlying concrete gravity wall.

On September 25, 2008, SAIC submitted a Seep Abatement Options IRM Workplan to NYSDEC on behalf of Texaco. The IRM approach consisted of the following three components:

- Resurfacing cracked and spalled portions of the existing concrete gravity wall through which PSH seeped;
- Installation of an impermeable barrier to prevent PSH seepage through the timber crib bulkhead; and
- Recovery of accumulated PSH via existing wells and/or newly installed recovery points. ExxonMobil provided technical input during development of the IRM workplan.

SAIC, on behalf of Texaco completed the three components outlined in the workplan above between September and December 2009. An IRM Construction Summary Report and Operations, Maintenance, and Monitoring (OM&M) Plan was submitted to NYSDEC on February 10, 2009. The report summarized IRM construction activities and provided an OM&M Plan structured using criteria presented in DER-10. The IRMs described in this report have been successful in greatly reducing the seepage of PSH to occasional sheens noted a few times a month. Figure 3.7 presents the Creekside Containment Barrier.

Creekside Containment and Absorption System

As previously discussed, SAIC maintains a Creekside Containment and Absorption System along the shoreline fronting the Paragon and Apollo Sites. The containment and absorption boom system at the Apollo Site consists of several continuous sections of boom. Boom section C5 is contained within the larger fence boom and extends 67 linear feet from the western property line of the Paragon Site. Absorbent booms are maintained in C5. Additionally, a three-compartment containment boom (SE1, SE2, and SE3) installed by ExxonMobil and maintained by Texaco extends westward from the western terminus of the secondary containment fence boom to the west end of Apollo Street.

Similar to the Paragon Site, collection of any sheen inside the primary and secondary containment booms at the Apollo Site is accomplished using floating absorbent booms. Absorbent booms are generally replaced on a monthly basis, as deemed necessary by Site personnel, to maintain effectiveness.

3.2.1.1.2 Total Fluids Recovery System

SAIC, on behalf of Texaco, currently operates a Total Fluids Recovery System on the Paragon Site, adjacent to the Apollo Site. On February 12, 2008, monitoring well CMW-43, located at the northeast corner of the Apollo Site, landside of the timber crib bulkhead, was converted into a total fluids recovery well (CMW-43R). Using a QED AP-4/TL pneumatic pump, groundwater and PSH are recovered landside of the Apollo Site timber crib bulkhead. Recovered fluids are transferred to the Paragon Site, where PSH and water are separated. Recovered PSH is subsequently transported offsite for recycling, while recovered water is treated onsite and discharged under permit to NYCDEP combined sewer system.

3.2.1.2 Bridgewater Street Property Line Recovery System

As previously stated, ExxonMobil has installed one groundwater and PSH recovery well (RW-25) on Bridgewater Street along the southern property line of the Paragon and Apollo Sites. This well was installed by ExxonMobil and has been in operation since July 2009. A second recovery well

(RW-26) is planned to be installed by ExxonMobil on Bridgewater Street. RW-26 installation will likely occur in 2010. These wells will be operated by ExxonMobil as part of their recovery wellfield expansion for the ExxonMobil offsite plume.

ExxonMobil and Texaco have agreed to evaluate the performance of these two wells over the course of a 12 month period beginning at the startup of RW-26. The objective of the evaluation is to determine the extent of the groundwater and PSH capture zone induced by these two wells. The agreement also states that a third well (RW-27) may be installed on Bridgewater Street adjacent to the Apollo Site if the induced subsurface capture from RW-25 and RW-26 is not spatially sufficient to capture groundwater and PSH on and along the entire southern boundary of both properties.

3.2.2 Soils and Soil Vapor Risk Mitigation

This section includes descriptions of IRMs instituted to address the subsurface media of soil, and soil vapor risk mitigation at the Apollo Site. IRMs discussed in this section include the following:

- Ambient Air Monitoring Program;
- Warehouse Slab Maintenance at the Apollo Site;
- Bulkhead Seep Area Residual PSH Vapor Phase Recovery System; and
- Bridgewater Street Property Line Vapor Recovery System.

3.2.2.1 Ambient Air Monitoring Program

CA Rich Consultants, Inc. (CA Rich), on behalf of Empire Merchants (the current tenant for the Apollo Site), has conducted six, semi-annual ambient air quality monitoring surveys across the Apollo Site. Samples have been collected using Summa canisters and analyzed according to EPA Method TO-15, which allows for the determination of volatile organic compounds by gas chromatography / mass spectrometry. Select samples were also analyzed for methane using ASTM Method D 1946/E 260. Results have consistently confirmed that the concrete floor slab of the Apollo Site warehouse continues to serve as a barrier to potential subsurface vapor migration. The most recent ambient air quality monitoring survey occurred in August of 2009.

The planned January 2010 ambient air quality monitoring is planned to be completed by SAIC. SAIC will continue to monitor the ambient air quality at the Apollo Site on a biannual basis. Sample collection methodology and sampling locations will likely remain consistent with those monitored by CA Rich to ensure the continuity of data.

3.2.2.2 Warehouse Slab Maintenance

Between July 13, 2009 and July 23, 2009, SAIC, on behalf of Texaco, completed slab maintenance activities inside the Apollo Site warehouses at 100 and 120 Apollo Street. SAIC personnel inspected the warehouse floor for potential soil vapor migration pathways. Cracks were identified, prepared, and sealed using a combination of Sikaflex LM concrete sealant and 3M DP-600 concrete epoxy. A total of 78 cracks, totaling 552 linear feet were sealed in the Apollo Site warehouse floor.

3.2.2.3 Bulkhead Seep Area Vapor Phase Recovery

A Vapor Phase Recovery (VPR) System was proposed as an upgrade to the existing Texaco Total Fluids Recovery System to further abate the seepage of hydrocarbons into Newtown Creek. One total fluids recovery well located on the Apollo Site, CMW-43R, was included in the VE pilot test performed in August 2008. Data collected from the VE pilot test were analyzed to determine the VPR design parameters. The final VPR System design was submitted to NYSDEC on 7/1/09 and includes CMW-43R as a VPR well.

4.0 PLANNED SUPPLEMENTAL SITE CHARACTERIZATION ACTIVITIES

Since 2005, extensive site characterization activities have been completed at the Paragon and Apollo Sites. This work was completed by SAIC in response to the initial Order on Consent in 2005 and the identification of the source of PSH on the Sites. As a result of these completed activities, an extensive data base has been developed with respect to the extent of PSH on the Sites, the extent of groundwater impacts, the extent of soil impacts, and the absence of hazards associated with the ambient air monitoring program. Therefore, the work tasks proposed in this work plan are a supplement to the existing chemical, hydrogeological, and stratigraphic datasets already obtained for the Sites. The specific characterization activities are outlined in the following sections of Chapter 4 with respect to groundwater, PSH, soil and soil vapor.

4.1 GROUNDWATER AND PSH

Groundwater and PSH dynamics will continue to be evaluated at the Paragon and Apollo Sites using a variety of investigation techniques. Supplemental characterization activities will be employed to further investigate parameters including:

- Hydraulic capture;
- Mass removal;
- Quarterly gauging events; and
- Annual groundwater sampling events.

All data will be analyzed to enhance the understanding of the subsurface and to modify the current Site Conceptual Model as needed.

4.1.1 Capture Evaluation

Influence of both the Texaco Total Fluids Recovery System at the bulkheads and the ExxonMobil property line recovery systems will be periodically evaluated through capture analyses. Data will be collected along the bulkhead area and the property lines using a combination of water level transducers and manual gauging of PSH and water levels. A series of contour maps will be generated from the field data on a biannual basis.

Data from the recovery wells will be evaluated to determine the average flow rate of each well during the evaluation. The method of delineating groundwater capture by a pumping well described by D. K. Todd (1979) will be utilized. This information will be used in conjunction with local maximum and minimum gradients prior to pumping and the Todd Method to calculate the estimated zone of capture by each recovery well. The results will be posted on the groundwater contour maps to graphically evaluate the range of hydraulic capture.

4.1.2 Mass Removal Evaluation

PSH and groundwater recovery rates will be continually monitored for the Paragon and Apollo Sites. This and other system performance data will be collected and evaluated to optimize the uptime and efficiency of the recovery system at the bulkhead and the property lines. Mass removal and system uptime data will be presented to NYSDEC in ongoing quarterly status reports.

4.1.3 Quarterly Gauging Events

Regional aquifer dynamics will continue to be assessed through quarterly groundwater and PSH gauging events completed by a collaboration of Texaco, BP and ExxonMobil. From this data, regional groundwater contour and PSH distribution maps will continue to be completed. This data will be use to track and interpret future groundwater and PSH flow and recovery dynamics.

4.1.4 Annual Groundwater Sampling and Analysis

One annual groundwater sampling and analysis event will be completed for the Paragon and Apollo Sites. The annual event will include all monitoring wells on the Paragon and Apollo Sites that do not contain PSH at the time of sampling. Low flow sampling methods will be used to collect all groundwater samples. The specified pump will be lowered to the well depth yielding the highest hydraulic conductivity within the screened interval (as determined by the lithologic descriptions depicted on the well logs, as available.)

Once selected parameters (pH, temperature, and electrical conductivity) have stabilized over two successive five minute intervals, the low flow cell will be disconnected, and samples will be collected from disposable pump outflow tubing. Samples will be submitted for laboratory analysis of the regulated constituents defined in NYSDEC STARS Gas and Fuel Oil lists.

4.1.5 Site Conceptual Model Development

As provided in DER-10, the development of a conceptual model is a process built upon hypotheses about constituent fate and transport scenarios as well as potential impacts to receptors. The process is used to focus and expedite the investigation of a site. As an investigation proceeds, some of the hypotheses are disproved and ultimately discarded. Those hypotheses that remain guide decisions on further activities. The conceptual model is eventually refined to a point where no more revisions or modifications are needed. A preliminary conceptual model for the Site was presented in Section 2.4. The preliminary conceptual model will be revised by evaluating data collected during the investigation of the property and the effectiveness of interim remedial actions.

The preliminary conceptual model will be revised by reevaluating sources, impacted media, migration, receptors and exposure routes. Current and future land use at and in the vicinity of the property will be verified. Potential off-site receptors shall be identified by evaluating where impacted media is located based on sampling data and identifying the distance and direction to the nearest receptors. Maps, aerial photographs, and drive-by inspections will be used to verify any off-site receptors, including sensitive subpopulations such as schools, day care facilities, nursing homes, or hospitals. Groundwater use downgradient of the property will be considered and the data from monitoring wells will be used to determine and evaluate the nature and extent of Site-related constituents.

On-site and off-site land uses will be reassessed by interviewing the current property owner, assessing local municipal planning information, reviewing zoning maps, reviewing topographic maps, reviewing aerial photographs, and reviewing other sources of relevant information.

Both direct and indirect exposure pathways will be reassessed. The purpose of the revised conceptual model will be to identify any complete exposure pathways for both current and foreseeable future land uses.

Fate and transport will be evaluated by considering the physical and chemical properties of the released chemical and the type of media that was impacted. Fate and transport will be used to predict future exposures. Site-specific factors such as the organic carbon content of the soils; water table fluctuations; the amount of ground that is covered with asphalt, concrete, or buildings; and the effects that ongoing remediation systems have on the fate and transport. The fate and transport assessment will be performed in accordance with DEC requirements.

The groundwater fate and transport assessment will be used to predict contaminant concentrations migrating through the unsaturated zone and the saturated zone, including an analysis of diffuse groundwater flow into surface water for purposes of determining compliance with surface water

quality standards. The fate and transport analysis will consider geological, chemical, hydraulic, and as best possible, the degradation of compounds.

Uses of the fate and transport results include, but are not limited to, the following:

- Predict the nature and extent of one or more contaminants at one or more locations in the future;
- Evaluate natural attenuation remedies and associated monitoring requirements;
- Identify current completed pathways and related exposures;
- Predict future completed pathways and related exposures; and
- Evaluate remedy alternatives for the impacted media.

4.2 SOIL AND SOIL VAPOR

Soil and soil vapor data have been collected during previous subsurface characterization activities at the Paragon and Apollo Sites. All soil data collected in the vadose zone will be compiled and evaluated to identify areas of exceedances for regulated constituents. In addition, upon activation of the bulkhead area Vapor Phase Recovery System and the 50 Bridgewater Street SSD System, ongoing soil vapor samples collected as part of periodic O&M sampling events will be analyzed to enhance our understanding of the subsurface and to improve the current Site Conceptual Model.

4.2.1 Biannual Ambient Air Sampling and Analysis

SAIC, on behalf of Texaco, will conduct semi-annual, 24-hour ambient air quality monitoring surveys across the Paragon and Apollo Sites. Sampling events will be completed every January and August to coincide with the cooling and heating seasons, respectively. Samples will be collected using Summa canisters and analyzed according to EPA Method TO-15, which allows for the determination of volatile organic compounds by gas chromatography / mass spectrometry. Samples will be analyzed for methane using ASTM Method D 1946/E 260. Sample collection locations will include the warehouses, the office spaces, truck parking areas, and areas along the bulkheads.

4.2.3 Quarterly Indoor Field Vapor Survey

SAIC, on behalf of Texaco, will conduct quarterly indoor field vapor surveys for the Paragon and Apollo Sites. The surveys will be conducted using a photo-ionization detector (PID) to scan for the presence of volatile organic compounds and will be directed toward areas of potential vapor mitigation such as floor cracks and seams. These results will be taken into consideration during ongoing periodic warehouse slab maintenance activities.

4.2.4 Vapor Capture Evaluation

Subsurface vapor capture will be evaluated quarterly after startup of the Vapor Phase Recovery and the SSD systems. This evaluation will consist of measured vacuums in the subsurface at known distances from the vapor phase recovery wells. The induced subsurface vacuum values will be used to generate radius of capture maps and vapor pressure gradient contour maps. Radius of capture maps will be used to evaluate the coverage of the negative pressure gradient in the subsurface, while vapor pressure gradient contour maps will be used to evaluate the direction of subsurface air flow.

4.2.5 Vapor Mass Removal Evaluation

Vapor mass removal will be evaluated quarterly after system startup. This evaluation will consist of vapor samples collected from the influent and effluent of the system. Untreated influent samples will be used to determine mass removal from the subsurface, while effluent samples will be used to determine removal efficiency and compliance with New York State ambient air quality guidance.

Vapor mass removal will be plotted with time to evaluate and create schedules for system operational parameters and maintenance.

5.0 PLANNED SITEWIDE CORRECTIVE ACTION ALTERNATIVES ANALYSIS

SAIC, on behalf of Texaco, will complete a Sitewide Corrective Action Alternatives Analysis for the Paragon and Apollo Sites. The Alternatives Analysis will consist of three parts:

- Characterization and remediation of the 4 subsurface media;
- Completion of the alternatives analysis process; and
- Evaluation of the remedy selection criteria.

The Site wide Corrective Action Alternatives Analysis will be structured using guidelines presented in DER-10.

5.1 MEDIA OF CONCERN

The four media to be addressed by the Sitewide Corrective Action Alternatives Analysis are groundwater, PSH, soil, and soil vapor. The DER-10 outlines that each media of concern requires characterization and remedial investigation. Characterization activities include, but are not limited to, site surveys, surficial and subsurface sampling, and monitoring points. Remedial investigation focuses on the use of surficial and subsurface sampling using field screening techniques and focuses on gathering sufficient data on contamination present to evaluate the allowable use of the Site. As extensive characterization and IRM data has already been collected for the four media, the alternatives analysis and remedy selection will include a detailed evaluation of existing data for the Paragon and Apollo Sites.

5.2 ALTERNATIVES ANALYSIS PROCESS

Per the DER-10, the first step in the alternatives analysis process is to establish the remedial goals for the applicable program, to establish RAOs for each media, and to identify the general response actions including estimates of area and volume of each media to be remediated. Technologies will be identified and screened based on the types and process options that correspond with the site-specific conditions. The identified technologies will then be screened on a media-specific basis to identify those that are technically implementable and can, either alone or in combination with other technologies, meet the RAOs.

The technologies will be assembled into site-wide alternatives and will be developed and defined to a level of detail such that each alternative is clearly defined with respect to size and configuration, time for remediation, spatial requirements, options for disposal, substantive technical permit requirements, limitations or other factors necessary to evaluate the alternatives.

5.3 REMEDY SELECTION CRITERIA

Each of the identified alternatives will then be evaluated against specified evaluation criteria, and a comparative analysis will be performed. This process results in the identification of a recommended remedy and summarizes the reasons for the recommendation utilizing the criteria outlined in DER-10 listed below:

- Overall Protection of Public Health and the Environment;
- Compliance with Standards, Criteria, and Guidance (SCGs);
- Long-term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility or Volume with Treatment;
- Short-term Effectiveness;

- Implementability;
- Cost; and
- Community Acceptance.

6.0 CORRECTIVE ACTION REPORTING AND SCHEDULE

SAIC, on behalf of Texaco, will complete the reports outlined in this Workplan and in accordance with the proposed schedule.

6.1 PLANNED REPORTS

The following reports will be completed:

- Monthly Update Form;
- Quarterly Reports and Annual Report;
- Supplemental Characterization Report;
- Alternatives Analysis Report – PSH and Groundwater;
- Alternatives Analysis Report – Soils and Soil Vapor;
- Remedy Selection Design or Work Plan (PSH and Groundwater); and
- Remedy Selection Design or Work Plan (Soils and Soil Vapor).

6.1.1 Monthly Update Form

A one page monthly project update will be submitted to NYSDEC on the 8th business day of after the end of the reporting month. The update will briefly summarize completed and planned activities

6.1.2 Quarterly Reports and Annual Report

SAIC, on behalf of Texaco, will continue to submit quarterly status reports to the NYSDEC. The quarterly report will present information related to ongoing characterization and remediation activities. Each fourth quarterly report will also include the annual report. Each quarterly report will be submitted to NYSDEC by the 30th day of the month following the last day of each quarter.

6.1.3 Supplemental Characterization Report

SAIC, on behalf of Texaco, will complete a supplemental characterization report. This report will address:

- Further development of the physical site conceptual model;
- Tabular and graphical presentation of regulated constituent concentrations in the soil and groundwater;
- Updated PSH and groundwater contour maps;
- Ambient Air Monitoring data;
- Exposure pathway analysis;
- Detailed evaluation of the bulkhead are recovery system; and
- Detailed evaluation of the ExxonMobil property line recovery systems.

6.1.4 Alternatives Analysis Report – PSH and Groundwater

One alternatives analysis report will be completed to address PSH and groundwater for the Paragon and Apollo Sites. The alternatives analysis report will be structured using the following parameters outlined in DER-10:

- Overall Protection of Public Health and the Environment;

- Compliance with Standards, Criteria, and Guidance (SCGs);
- Long-term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility or Volume with Treatment;
- Short-term Effectiveness;
- Implementability;
- Cost; and
- Community Acceptance.

6.1.5 Alternatives Analysis Report – Soils and Soil Vapor

The alternatives analysis report will be completed to address soils and soil vapor for the Paragon and Apollo Sites. The alternatives analysis report will be structured using the following parameters outlined in DER-10:

- Overall Protection of Public Health and the Environment;
- Compliance with Standards, Criteria, and Guidance (SCGs);
- Long-term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility or Volume with Treatment;
- Short-term Effectiveness;
- Implementability;
- Cost; and
- Community Acceptance.

As part of the implementation of the workplan, Texaco will evaluate several remedial alternatives to address the 4 media of concern. At a minimum the current IRMs will be included as a component of the alternatives. All alternatives will be evaluated against the aforementioned criteria outlined in DER-10.

6.1.6 Remedy Selection Design or Workplan (PSH and groundwater)

Upon completion of the Alternatives Analyses for PSH and groundwater, SAIC, on behalf of Texaco, will submit a Remedy Selection Design *(or workplan)* to NYSDEC. Texaco may consider submitting one Workplan for PSH and a separate Workplan for groundwater.

6.1.7 Remedy Selection Design or Workplan (soil and soil vapor)

Upon completion of the Alternatives Analyses for soil and soil vapor, SAIC, on behalf of Texaco, will submit a Remedy Selection Design *(or workplan)* to NYSDEC. Texaco may consider submitting one Workplan for soil and a separate Workplan for soil vapor.

6.2 PROPERTY OWNER AND FIRE DEPARTMENT OF NY NOTIFICATIONS

Annual written notification concerning petroleum impacts on the Paragon and Apollo Sites will be made to Empire Merchants, Steel Equities and the Fire Department of New York.

6.3 PUBLIC MEETINGS SUPPORT

Texaco and SAIC will be available, as necessary, to participate in public meetings hosted by NYSDEC and/or NYSDOH pertaining to the Paragon and Apollo Sites.

6.4 PROJECT SCHEDULE

The following dates are proposed for submission of the documents identified in this Workplan:

1. Monthly Project Updates – 8th business day after the end of each reporting month;

2. Quarterly Status Reports - 30 days after the end of the reporting month;
3. Supplemental Characterization Report - October 15, 2010;
4. Alternatives Analysis Report (GW and PSH) - April 15, 2011;
5. Alternatives Analysis Report (Soil and Soil Vapor) - July 15, 2011;
6. Remedy Selection Design or Workplan (PSH and Groundwater): 60 days after NYSDEC Approval of Alternatives Analysis Report (GW and PSH);
7. Remedy Selection Design or Workplan (Soil and Soil Vapor) - 60 days after NYSDEC Approval of Alternatives Analysis Report (Soil and Soil Vapor); and
8. Property Owner and FDNY Notifications – October of each year.

REFERENCES

New York State Department of Environmental Conservation Division of Environmental Remediation, 2002. "DRAFT DER-10 Technical Guidance for Site Investigation and Remediation."

Science Applications International Corporation, 2006. "Site Characterization Report for the Former Paragon Oil Terminal and Adjacent Areas, Greenpoint, Brooklyn, New York."

Science Applications International Corporation, 2007. "Supplemental Site Characterization Report for the Former Paragon Oil Terminal and Adjacent Areas, Greenpoint Section, Brooklyn, New York."

Science Applications International Corporation, 2008. "Phase I Total Fluids Recovery System Performance Evaluation for the Former Paragon Oil Terminal, Greenpoint Section, Brooklyn, New York."

(SAIC, 2009a) Science Applications International Corporation, 2009. "100-120 Apollo Street Property, Interim Remedial Measure Construction Summary Report and Operations, Maintenance, and Monitoring Plan."

(SAIC, 2009b) Science Applications International Corporation, 2009. "Phase II Vapor Recovery System Design."

(SAIC, 2009c) Science Applications International Corporation, 2009. "Sub-Slab Depressurization System Design and Installation, Conference Room Area at 50 Bridgewater Street, Brooklyn, New York."

(SAIC, 2009d) Science Applications International Corporation, 2009. "Quarterly Status Report, April 1, 2009 to June 30, 2009 for the Former Paragon Oil Terminal #304209 and the 100-120 Apollo Street Property, Greenpoint Section, Brooklyn, New York."

Todd, David Keith. *Ground Water Hydrology*. John Wiley & Sons, Inc., New York, 1979.