Remedial Design/Remedial Action
Final Work Plan

Hangar D, Bay 2

Westchester County Airport

White Plains, New York

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REMEDIAL DESIGN AND REMEDIAL ACTION WORK PLAN

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1. INTRODUCTION

This Remedial Design and Remedial Action Work Plan (RDRA) for the Westchester County Hangar D, Bay 2 property was prepared by Woodard & Curran Inc. (Woodard & Curran) in accordance with the Order on Consent dated July 15, 2002 (Index # W3-0918-0204; Site # 3-60-037), between the New York State Department of Environmental Conservation (NYSDEC) and ExxonMobil Refining and Supply Company related to Hangar D, Bay 2 of the Westchester County Airport in White Plains, New York. A copy of the Order on Consent is contained in Appendix A. It should be noted that at the time the original Order on Consent was entered into concerning the completion of a Preliminary Site Assessment and a Remedial Investigation/Feasibility Study, the responsible party was Mobil Oil Corporation. Since that time, Mobil Oil Corporation merged with Exxon Corporation to become ExxonMobil Refining and Supply Company (ExxonMobil).

The NYSDEC is administering the Westchester County Airport Hangar D, Bay 2 Site under Article 27; Title 13 of the Environmental Conservation Law of the State of New York ("ECL") entitled "Inactive Hazardous Waste Disposal Sites". This program addresses hazardous waste sites, including abandoned sites where no current owner is able to address contamination and sites where the responsible parties have been completing the work with NYSDEC approval. Work completed at the site has included various phases of investigation and a recently completed Remedial Investigation/Feasibility Study (RI/FS). Woodard & Curran was retained by ExxonMobil to finalize the RI/FS for the site to evaluate remediation of impacted soil and groundwater beneath the hangar.

The Westchester County Airport is located in the Town of Harrison, Westchester County, New York. Refer to Figure 1-1 for a site locus. The site is located near residential and industrial/commercial property located both in Westchester County, New York and Fairfield County, Connecticut, that the airport abuts.

Hangar D was constructed in 1952, when airport operations began. During the first 30 years of operation, the airport hangers were managed by Gulf Oil under a long term lease from Westchester County. Hangar D, Bay 2 was used by Mobil until 1990 as a base for corporate flight operations as well as other air travel related functions.

The hangar was used by Mobil until the lease was transferred to Texaco, Inc. (Texaco) in 1990. As part of the lease transfer, numerous environmental investigations have been implemented at the hangar. Results of these investigations have shown the presence of chlorinated hydrocarbons in the soil and groundwater beneath the hanger at concentrations above applicable NYSDEC standards. The suspected source area for the chlorinated volatile organic compounds (CVOCs) detected in soils and groundwater appears to be in the vicinity where limited quantities of drummed chlorinated solvents were stored. Refer to Figure 1-2 for a site plan. The chlorinated solvents were previously used by Mobil for routine airplane maintenance. In an effort to further address the environmental issues at the hangar, a Work Plan defining required RI activities was prepared by Malcolm Pirnie, Inc. (Malcolm Pirnie) in May 1996. The work outlined in the NYSDEC-approved Work Plan was completed and, based on the results of the initial field work, subsequent field investigations have been completed, all with NYSDEC approval, through August 2001. The results of all field investigations were summarized in the RI Report submitted to NYSDEC in December 2001. Along with the RI Report, a Feasibility Study was completed and submitted in December 2001. The FS reviewed remedial technologies that would be applicable to the residual CVOCs in the soil and groundwater beneath the hangar. As a result of the review, the FS identified in-situ oxidation as the most feasible alternative for groundwater in the saturated zone of the former source, and soil vapor extraction for impacted soils in the vadose zone located beneath the former source area. Based

FIGURE 1-1: SITE LOCUS PLAN

FIGURE 1-2: SITE PLAN

on the information presented in the RI/FS, NYSDEC completed a Preliminary Remedial Action Plan (PRAP) for the site. The PRAP summarized the results of the investigations completed at the site and outlined the response actions selected for the cleanup of groundwater and soil at the site. As outlined in the Citizen Participation Plan (CPP) which has been previously submitted under separate cover, the PRAP was presented at a public meeting on March 12, 2002. The PRAP along with comments from the public were the basis for the Record of Decision (ROD) for the site which was issued by NYSDEC on March 26, 2002. This RDRA has been prepared based on the remedial options summarized in the ROD.

1.1 PURPOSE AND ORGANIZATION OF REPORT

The purpose of this report is to develop a work plan that provides guidance for the design and implementation of remedial actions at the Westchester County Airport Hangar D, Bay 2 in accordance with the ROD.

The purpose of the RDRA consists of the following:

1. Present the formal design of the selected remedial actions for groundwater and soil at the site;

2. Outline the Remedial Action Work Plan presenting the schedule; and

3. Provide a plan for operation and management of the system including compliance sampling, any institutional controls that will be necessary, and reporting requirements.

This RI Report is organized into nine sections outlining major topics to facilitate ease of use. Each section is presented below and outlines the information included therein.

- **Section 1** provides the purpose of work incorporated as part of the ROD and a brief site history, including a summary of previous investigations.

- **Section 2** describes the current site understanding based on the results of the RI and recently completed groundwater sampling.

- **Section 3** provides a summary of the selected remedies for groundwater and soil at the site as presented in the ROD.

- **Section 4** presents the Pre-Final Design for both the Soil Vapor Extraction system and the In-Situ Chemical Oxidation injection system. The section includes maps of extraction and injection points, piping and instrumentation diagrams and system layouts.

- **Section 5** presents the work plan for construction and implementation of the remedial actions for the site including construction activities, utility connections, and system start-up. The section also details the construction Quality Assurance Plan and summarizes the institutional controls that will be implemented for the Site.

- **Section 6** presents the operation, maintenance and monitoring plan for the soil vapor extraction system.

- **Section 7** summarizes the sampling to be completed to monitor the effectives of the SVE and In-Situ Oxidation systems in reducing the residual CVOC concentrations in the subsurface at the site and whether to discontinue or modify the remediation.

- **Section 8 presents** the project schedule for implementation of the remedial actions.

1.2 BACKGROUND

1.2.1 Site Description

The Westchester County Airport is located in the Town of Harrison, Westchester County, New York. The northeast boundary of the airport is adjacent to the Fairfield County, Connecticut border. Undeveloped woodlands are located north, south and east of the airport. Rye Lake is located west of the airport.

The airport began operations in 1952. Hangar D was also constructed in 1952. During the first 30 years of operation, the airport hangers were managed by Gulf Oil under a long term lease with Westchester County. Hangar D, Bay 2 was used by Mobil from 1982 until 1990 as a base for corporate flight operations. The hangar space was used for routine aircraft maintenance. Other uses included technician labs, an electronic lab, and a small paint booth used only for touch-up painting. On-site facilities also included administration offices, a pilot's briefing room, conference room and an executive lounge.

The site is serviced by municipal water and sewer. Although no drinking water wells are located on the site, or within the boundaries of the airport, Rye Lake, also known as Kenisco Reservoir, is located approximately 3,500 feet to the west and crossgradient of the site. Additionally, residential properties located approximately ¾ of a mile to the south and hydrogeologically downgradient of the site utilize private drinking water wells installed into bedrock. The nearest residential property to the site is approximately ½ mile to the east and crossgradient from the site.

1.2.2 Site History

Mobil Oil Corporation leased space in Hangar D, Bay 2 from 1982 until 1990, at which time the long-term lease was transferred to Texaco, Inc. During the lease transfer process, Texaco hired a consultant to perform a standard environmental review of the property. The investigation revealed that CVOCs were present in the shallow soils beneath the hangar floor in the area where drums of chlorinated solvents had historically been stored. These drums have been identified as the potential source of the CVOCs. Mobil had used approximately one 55-gallon drum of chlorinated solvents per year for the routine maintenance of their aircraft. The investigation also revealed low-level soil impacts below pavement associated with jet fuel (no resulting groundwater impacts have been detected). There are no records of any historic spills at the site. The jet fuel related compounds were determined not to be of significance due to the low levels identified, interference with the analytical methods utilized, and the presence of asphalt in the area. Therefore subsequent investigations focused on the chlorinated solvents. Beginning in 1990, Mobil has worked under the direction of NYSDEC (within the Division of Environmental Remediation - DER) to address the CVOCs.

In 1993, the site was listed on the New York State Registry of Inactive Hazardous Waste Disposal Sites as a Class 2a site. Class 2a is a temporary designation for a site that requires additional investigation before a permanent listing can be assigned. In 1994, Mobil signed a Consent Order with NYSDEC to conduct a Preliminary Site Assessment (PSA). The results of the PSA revealed CVOC compounds in groundwater at the site. In 1996, Mobil signed a Consent Order with NYSDEC to conduct a Remedial Investigation/Feasibility Study (RI/FS) and the site was reclassified to Class 2. A Class 2 designation means that a site poses a threat to public health or the environment and that action is required.

1.2.3 Previous Investigations

Numerous environmental investigations have been conducted at the Site since the initial discovery of chlorinated solvents in soil and groundwater beneath the floor of the hangar. A summary of the environmental investigations and cleanup activities that have been conducted at the site are presented in Table 1-1. The table presents the work done as part of each of the investigations. The results of each of these investigations are presented as part of the Site Characterization Program presented in section 2.0. Copies of these reports have been previously submitted to NYSDEC and are part of the document repositories maintained for the project. Appendix B contains a list of documents available at the repositories and the locations of the project repositories.

TABLE 1-1: SUMMARY OF PREVIOUS INVESTIGATIONS

Previous Investigation	Date Submitted	Covers Work Completed	Completed by	Summary of Work Completed
Phase II, III and IV Pre-Leasing Environmental Assessment	January 1991	October 1990 through January 1991	Pilko & Associates, Inc. (completed for Texaco, Inc.)	Advancement of 17 SB and the analysis of 36 soil samples for total VOCs, total base neutrals and/or TPH
Soil and Gas Survey	January 1991	January 8, 1991	Target Environmental Services, Inc.	19 SG samples collected from 2 feet below slab and analyzed for CVOCs
Subsurface Investigation of Mobil Hangar	May 1991	March 8, 11 and 12, 1991	Leggette, Brashears & Graham, Inc.	Advancement of 20 SBs on a grid pattern in the hangar and on the concrete pad outside of hangar. 72 soils samples were submitted for VOC and TPH analysis
Letter Report concerning deeper soil investigation	August 1991	June 13, 1991	Leggette, Brashears & Graham, Inc.	One SB advanced to 12 feet bgs and four soil samples submitted for analysis for VOCs and extractable petroleum hydrocarbons
Preliminary Site Assessment	August 1995	May 18, 1995	Malcolm Pirnie, Inc.	Installed three geoprobe GW sampling points and three SBs. Analysis of 3 GW and 6 soil samples for CVOCs
Supplemental Preliminary Site Assessment	February 1996	November 8 and 9, 1995	Malcolm Pirnie, Inc.	Collection of 9 GW samples from a total of 15 temporary geoprobe wells. Samples analyzed for selected CVOCs
Remedial Investigation Report	February 1997	Prior to January 1997	Malcolm Pirnie, Inc.	Work includes all investigations described above plus the installation of four overburden MWs. GW samples and soil samples submitted for VOC analysis

TABLE 1-1 (CONT)

Previous Investigation	Date Submitted	Covers Work Completed	Completed by	Summary of Work Completed
Supplemental Data Collection	October 7, 1997	July 23 and 24, 1997	XDD	Collection of a round of GW samples from four existing wells and collection of SG samples from 12 points within the hangars. Samples analyzed for CVOCs
Addendum to Supplemental Data Collection	February 26, 1998	December 16 and 17, 1997	XDD	Collection of a round of GW samples from four existing MWs and collection of SG samples from 12 points within the hangars. Samples analyzed for CVOCs
Letter Report for Recent Site Field Work	March 8, 2000	November 1999	XDD	Installation of 3 MWs, one SB and collection of GW samples from all on-site wells. Samples analyzed for VOCs and/or TPH
Technical Memorandum on Results of Pilot Study	November 2001	August 2, through November 28, 2001	Woodard & Curran Inc.	Installed 4 monitoring points and 8 injection points and injected a total of 840 lbs of $KMnO_4$
Remedial Investigation Report	December 2001	Prior to August 2001	Woodard & Curran Inc.	Monitored groundwater conditions at the site and summarized previously collected site data and developed a site understanding and site conceptual model used as part of the Feasibility Study
Feasibility Report	December 2001	Prior to August 2001	Woodard & Curran Inc.	Reviewed site related data and available technologies to develop a list of feasible remedial technologies and the selected approach

CVOCs = Chlorinated volatile organic compounds
TPH = Total Petroleum Hydrocarbons
MW = monitoring well
SB = Soil Boring
SG = Soil Gas
GW = Groundwater
bgs = below grade surface

2. SITE UNDERSTANDING

This section presents a summary of the results of investigations completed at the site.

2.1 PHYSICAL SETTING

The Texaco Hangar Site is located in Hangar D, Bay 2 on the eastern side of the Westchester County Airport. The Westchester County Airport is located in the Town of Harrison, Westchester County, New York. The northeast boundary of the airport is adjacent to the Fairfield County, Connecticut border. Undeveloped woodlands are located north, south and east of the airport. Rye Lake is located west of the airport. A site locus plan is provided on Figure 1-1 and shows topography and surface water bodies in the vicinity of the site.

The site is located within the confines of the Westchester County Airport and therefore the topography in the area is relatively flat due to past development activities in the area. The area to the east of Hangar D slopes upward towards the Connecticut state line. The area west of the site slopes gently downward toward Rye Lake. The surface of Rye Lake is approximately 355 feet above mean sea level, the site is approximately 380 feet above mean sea level and the area to the east of the site slopes up to a maximum elevation of approximately 480 feet above mean sea level.

The site is an airport hangar and is located in a mixed industrial/commercial and residential portion of the Town of Harrison. The site is surrounded by the remainder of the airport, commercial/industrial properties, open areas and residences, with the closest residence approximately ½ mile to the east.

2.2 NATURE AND EXTENT OF ENVIRONMENTAL IMPACTS

Samples from several environmental media have been collected from the Site to assess the nature and extent of impacts from chlorinated solvents released at the Site. As part of the RI Report, a summary of sampling results for all media was presented. This section provides a brief summary of the observations and interpretations presented in the RI Report.

2.2.1 Compounds of Concern

Field work including sampling and analysis of soil, groundwater and soil gas samples have been completed at the Hangar D, Bay 2 Site. Analysis completed has included analysis for both chlorinated and non-chlorinated VOCs as well as total petroleum hydrocarbons. Based on the analytical results, the only compounds detected on a consistent basis have been chlorinated solvents.

CVOCs were detected in soil samples collected and analyzed during the initial investigation completed in the hangar. Subsequent sampling and analysis of soil, soil gas and groundwater verified the presence of CVOCs in all media analyzed. These compounds are apparently due to incidental spillage from solvents stored in the hangar. Based on the investigations completed at the site, the compounds of concern for the Hangar D, Bay 2 site are limited to:

- Chloroethane
- 1,1-Dichloroethane
- 1,1-Dichloroethene

- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- 1,1,1-Trichloroethane
- Tetrachloroethene
- Trichloroethene
- Vinyl Chloride

2.2.2 Soils Investigation

Subsurface soil samples were collected from on-site locations during site investigation activities completed at the site. Since site work was initiated in 1991, a total of 130 soil samples have been collected and analyzed from the site, with the majority of the samples being collected from within the hangars.

A total of twelve chlorinated solvents were detected at least once in soil samples collected from the site. The most frequently detected of the CVOCs were:

- tetrachloroethene detected a total of 48 times with results ranging from 1 to 24,000 parts per billion (ppb);

- 1,1,1-trichloroethane detected a total of 32 times with results ranging from 2 to 32,000 ppb; and

- trichloroethene detected a total of 14 times with results ranging from 2 to 210 ppb.

All three of these CVOCs are main ingredients in commonly used industrial solvents and are assumed to have been part of the solvents used by Mobil. In addition, trichloroethene is a breakdown product of tetrachloroethene.

Analytical results showed the highest concentration of the compounds of concern were detected in soil samples collected from the vicinity of the former solvent storage area located along the southern wall of the hangar. In addition, low levels of CVOCs were detected in soil samples collected from borings northeast of the solvent storage area. The movement of solvents released to the soils beneath the slab will be governed by gravity and the physical characteristics of the soil beneath the hangar. Gravity will move the solvents downward toward the water table and the physical characteristics of the soil will cause horizontal migration of the solvents. The soil beneath the hangar is mainly cobbly fill placed in a former stream bed. The nature of the fill may have caused the solvents to flow in various directions from the point of release resulting in the identification of impacts to soils northeast of the solvent storage area.

2.2.3 Soil Gas Investigation

As part of site investigation activities, soil gas sampling has been completed on three separate occasions at the Site. The initial soil gas investigation was completed in by Target Environmental in January 1991. The other two sampling events were completed by XDD in July and December 1997. In addition to the soil gas sampling, XDD completed a soil vapor extraction pilot study on the site. Since the Target data was collected prior to the completion of the on-site soil vapor extraction pilot test, the data has not been included with the RI report.

Soil gas samples were collected from the same points on two separate dates in July and December 1997. Comparison of analytical results of the two round show slight variations between the individual locations. In general, the detectable concentrations of CVOCs present a distribution pattern similar to that shown by the soil results, which is to be expected. The CVOCs were detected in the vicinity of the solvent storage area (MW-02) and to the northeast of that location. As discussed above, movement of solvents released to the soils beneath the slab will be governed by gravity and the physical characteristics of the soil beneath the hangar. Gravity will move the solvents downward toward the water table and the physical characteristics of the soil will cause horizontal migration of the solvents. The soil beneath the hangar is mainly cobbly fill placed in a former stream bed. The nature of the fill may have caused the solvents to flow in various directions from the point of release resulting in the detection of soil gas impacts in areas northeast of the solvent storage area.

2.2.4 Groundwater Investigation

Groundwater beneath Hangar D, Bay 2 at the Westchester County Airport site has been impacted by site related activities. Investigations performed since 1991 show that CVOCs have reached and migrated with groundwater. Groundwater sampling has been conducted at several times since 1991 and most recently has been competed on a quarterly basis to monitor the extent of chlorinated VOC impacts and the rate of natural attenuation of the compounds of concern.

Groundwater impacted by CVOCs has been detected in monitoring wells installed in the overburden and bedrock beneath the site. The main compounds identified based on the number of times detected and maximum concentrations are 1,1,1-trichloroethane (1,1,1-TCA), tetrachloroethene (perchloroethene or PCE) , and their breakdown products of trichloroethene (TCE), 1,1-dichloroethane (1,1-DCA) , cis-1,2 dichloroethene (1,2-DCE) and vinyl chloride. These compounds have been identified in monitoring wells located in the Texaco and Phillip Morris Hangars. The maximum concentrations for the compounds of concern have been identified in samples collected from MW-02. The concentrations decrease in the direction of groundwater flow (southerly) to the point where they are at least an order of magnitude less in samples collected from MW-10S and most of the compounds of concern are below method detection limits for samples collected from MW-10D.

The limit of the groundwater impact has been evaluated by monitoring wells installed outside of Hangar D which include

- MW-11D and MW-11S installed south of the hangar and downgradient,
- MW-06 installed east of the hangar and crossgradient,
- MW-9D and MW-9S installed west of the hangar and crossgradient, and
- MW-05 installed north of the hangar and upgradient of the release area.

The results of multiple rounds of groundwater sampling completed on these wells indicate that CVOCs have not been identified above the method detection limit in any of these monitoring wells. The results indicate that the groundwater plume emanates from the source area (solvent storage area located near MW-02) and extends south in the direction of groundwater flow, but has not reached the far end of Hangar D where MW-11D/11S is located.

At five separate locations, multi-level bedrock wells have been installed at the site. Based on analytical results of groundwater samples collected from these monitoring wells, the concentrations of CVOCs decreases with depth into the bedrock indicating that the impact by CVOCs is mainly encountered in the shallow fractured bedrock. This trend indicates that dense non-aqueous phase liquids acting as an ongoing source do not exist in the deep fractured bedrock investigated at the site.

2.3 CONCEPTUAL SITE MODEL

The results of field activities conducted as part of previous investigations at the Site were presented in the RI report. These data were used to define the site conceptual model.

The site conceptual model has three components: (1) a source area, (2) migration pathways, and (3) receptors. The following sections describe each of these components as it is related to the site.

2.3.1 Source Area

The source area is assumed to be the solvent storage area located along the southern wall of the Texaco Hangar, as shown on Figure 2-1. Industrial solvents used for routine maintenance of airplanes in the hangar were stored in 55-gallon drums in this area of the site. The solvents were apparently released to soils through the slab of the hangar and likely migrated under the force of gravity through the soils into the underlying groundwater which is located in the overburden and bedrock strata. This is supported by analytical results showing the highest concentrations of 1,1,1-TCA, TCE, and PCE and their respective breakdown products in soil, soil gas and groundwater samples collected from this area (MW-02). In addition to vertical migration due to gravity, horizontal dispersion apparently occurred due to the nature of the fill material located beneath the hangar.

2.3.2 Migration Pathways

As shown on Figure 2-2, groundwater flow is south away from the source area and following the orientation of the buried stream bed located beneath the hangar. There is no recharge occurring within the plume, which is located entirely beneath the hangar. The migration of the plume is being controlled by fluctuations in groundwater elevations and groundwater flow with limited dispersion.

2.3.3 Receptors

Potential receptors for the compounds of concern associated with the Texaco Hangar site include on-site workers, utility/construction workers and off-site residents. It is unlikely that based on current site conditions these receptors will be impacted by compounds of concern detected at the site. However, conditions at the site could change in the future causing these receptors to be impacted by these compounds of concern and therefore they are considered potential receptors.

An important aspect of the conceptual model relating to both migration and receptors is that based on recently collected data, the VOC plume appears to have reached its maximum extent and concentrations at the outer limits of the VOC plume appear to be stable. Although a limited amount of solvents remain in the soils beneath the source area, ongoing releases are not occurring and therefore conditions within the plume are not likely to change. The effects of dilution, dispersion, and diffusion at distance from the source area cause plume concentrations to remain consistent over time and plume boundaries remain in steady state.

FIGURE 2-1: CONCEPTUAL SITE MODEL

FIGURE 2-2: GROUNDWATER ELEVATIONS MEASUREMENTS

3. SUMMARY OF SELECTED REMEDY

3.1 SOIL VAPOR EXTRACTION

The remedial alternative selected by NYSDEC for remediation of residual contamination in the unsaturated zone soils beneath the hangar is soil vapor extraction (SVE). The soil source area is shown on Figure 2-1. The SVE system to be installed will entail extraction of vapors containing residual CVOCs from soil in the unsaturated zone. The SVE system will include a regenerative blower, slotted, vertical vapor extraction wells, underground piping connecting the blower to the extraction wells, a vapor treatment system, and required system controls. Five SVE wells will be used, installed to a depth of approximately 12 feet, located in the source area near MW-2. A remedial equipment shed will be located inside the hangar to house the blower, vapor treatment system (vapor phase carbon), and system controls. The SVE system will operate to meet appropriate Technical and Administrative Guidance Memorandum (TAGM) levels or until the NYSDEC agrees it would no longer be practical to operate.

A more detailed design for this alternative is presented in Section 4.1.

3.2 IN-SITU OXIDATION

As presented in the ROD, the remedial alternative selected by NYSDEC for impacted groundwater at the site is the delivery of chemical oxidants to groundwater in the overburden and shallow bedrock. The oxidants destroy the contaminants by converting them to innocuous compounds commonly found in nature, such as carbon dioxide and water.

The chemical oxidant to be used at the site will be determined from pilot tests. A Pilot Study for the injection of $KMnO_4$ (potassium permanganate) was completed at the site in August 2001. The results of post injection groundwater monitoring have shown reductions within the pilot test target area. As indicated in the technical memorandum submitted along with the Feasibility Study in December 2001, the results indicated that the $KMnO_4$ effective enough at the site to warrant additional applications.

The remediation will involve injection of the chemical oxidant to the aquifer within the source area through a series of injection wells. Four monitoring wells and eight injection wells were installed in the hangar for use in the pilot study. The injection wells for the pilot study were installed to the top of bedrock and the chemical oxidant was injected in liquid form using a pressure pump into the overburden groundwater. These injection wells and monitoring wells would be used for further pilot testing to determine the most effective oxidant for use at the site. Once the source of contamination is removed from the unsaturated soils through the SVE system, and the overburden and shallow bedrock groundwater is treated, the residual CVOCs in bedrock will naturally attenuate.

A more detailed design for this alternative is presented in Section 4.2.

3.3 SUMMARY OF REMEDIATION GOALS

Goals for the remedial program have been established by the NYSDEC as presented in both the PRAP and the ROD for the site. The overall remedial goal is to meet all New York State Standards, Criteria and Guidelines (SCGs) and be protective of human health and the environment. At a minimum, the selected remedy must eliminate or mitigate all significant threats to public health and/or the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The goals selected for this site are:

- Eliminate, to the extent practicable, exposures to soil and groundwater;
- Eliminate, to the extent practicable, the migration of contaminants into the groundwater;
- Eliminate, to the extent practicable, ingestion of groundwater affected by the site that does not attain NYSDOH Part 5 Drinking Water Standards;
- Eliminate, to the extent practicable, off-site migration of groundwater that does not attain NYSDEC Class GA Ambient Water Quality Criteria; and
- Eliminate, to the extent practicable, exceedances of applicable environmental quality standards related to releases of contaminants to the waters of the state.

4. SYSTEM DESIGN

4.1 SOIL VAPOR SYSTEM DESIGN

4.1.1 Design Overview

The purpose of the soil vapor extraction (SVE) system is to remove residual CVOCs by volatilization and extraction of air through soil in the unsaturated zone. A regenerative blower withdraws air from up to five 4-inch diameter, slotted, vertical vapor extraction wells. The extracted air is piped through a moisture separator and a particulate filter before entering the blower. Treatment of the extracted air occurs on the discharge side of the blower, through four 200-lb. virgin Granulated Activated Carbon (GAC) units in two parallel, lead-lag trains. After treatment, the air is vented to the atmosphere through a stack protruding through the Hangar D roof. Sample ports are located throughout the SVE system for proper system inspection.

A remedial equipment area shall be located at the southern corner of Hangar D, and will house the blower, air treatment system, and system controls. Remedial design plans and specifications are presented in Appendix C.

4.1.2 Vapor Extraction Well Network

Based on Vapex's 1991 field pilot testing and air flow modeling completed on Hangar D's subsurface, it has been concluded that there is moderate air permeability throughout the soil, which is adequate for utilization of SVE technology. Incorporating the proposed full scale air flow rates of approximately 15 to 20 standard cubic feet per minute (scfm) per well, a conservative radius of vacuum influence is roughly 25 feet. The extent of the impacted soil area is approximately 3,800 square feet. To treat the 3,800 square foot residual soil area, it is estimated that five vapor extraction wells will be required. The vertical extraction wells shall be installed to a depth of approximately 13 feet below ground surface (bgs), with a ten foot screened section from 3 to 13 feet bgs. Details regarding the construction of the extraction wells are given in Drawing M-02 in Appendix C.

Five vertical SVE wells will be used for the extraction of soil vapor from the unsaturated soils below Hangar D. Each extraction well is independently trenched and piped to the southern wall (see Drawing C-01). The piping independently rises up the southern wall and connects to the header, supported by the pipe rack. The header runs southwest along the pipe rack to the treatment area, situated in the southern corner of Hangar D.

4.1.3 Vapor Extraction System Equipment

The SVE system consists of the blower, the extraction wells and system piping, vapor treatment system, and treatment system controls. The SVE treatment process P&ID is illustrated on Drawing P-02.

<u>SVE Blower (B-1001):</u> This blower will consist of a 5-hp regenerative blower (Rotron EN6 or equal) which can provide the high vacuum at moderate flowrate required due to the moderate air permeability of the soils within the remedial area. Based on field pilot test data, a vacuum of 60 to 100 inches of water gauge (iwg) will provide an adequate area of influence. The specified blower is capable of inducing 100

scfm at 70 iwg, which should be sufficient. Electrical service required to operate the blower (model EN6F72L) is 240V/3-phase.

The influent header to the blower shall be equipped with vacuum gauges, an ambient air inlet valve, and a vacuum relief valve. Vacuum gauges will measure the pressure drop across each air filter, indicating when the air filter should be cleaned or replaced. The ambient air inlet will be used to modify the vacuum, flow, and temperature through the treatment system, if necessary. The vacuum relief valve will prevent excessive system vacuum that could result from upstream line restrictions. The relief valve on the blower will be triggered if the vacuum to the extraction well field is below a preset level (indicating a blockage in the filter or water in the moisture separator).

<u>Extraction System Piping:</u> Extraction wells will be individually piped to the header on the southern wall of Hangar D via 4-inch Schedule 40 PVC pipe. The piping will slope towards the wells to drain any accumulated condensate. Manual ball valves will be used to isolate wells from the header and to control the flow from a given well. Each well will have a 4-inch Y-strainer connection on the well side of the ball valve; the Y-strainer shall allow filtered, ambient air into the subsurface as a subsurface pressure relief measure. The header shall consist of 4-inch Schedule 40 PVC pipe.

<u>Vapor Treatment System:</u> The vapor treatment system consists of a moisture separator, particulate filter, and four 200-lb vapor phase granular activated carbon (GAC) units. A process flow schematic of the air treatment system is illustrated on Drawing P-02 and mechanical details are illustrated on Drawing M-02. The flow of air drawn from the SVE extraction wells could contain CVOCs, water vapor, liquid water, and particulates. Pretreatment of the air stream will protect down stream equipment and lengthen the effective life of the air treatment system.

A moisture separator will remove liquids entrained in the air flow. The moisture separator will have a gravity-flow discharge line that will be connected to a collection drum. The moisture separator will also be equipped with a float ball as a mechanical fail-safe overflow protection mechanism. In the event that the collection drum is full, or the discharge line is blocked, causing the condensate level to increase, a float ball will plug the outlet to the moisture separator. This will block all flow from the SVE wells and activate the built-in vacuum relief valve on the moisture separator. If this occurs, the high water level switch on the SVE manifold will be triggered, activating an alarm condition and subsequently shutting down the blower.

For the blower system, a polyester air filter will clean the air stream of virtually all particulate matter greater than 10 microns to protect the blower and vapor phase GAC from fouling. A similar, but separate filter is provided for the bleed air inlet.

Removal of the target compounds from the air stream will be accomplished using four 200-lb vapor-phase GAC units. The GAC units will be kept under pressure by locating the blower upstream of the units. The GAC units, piped in parallel sets of two, will treat the filtered air from the blower. The configuration of the GAC units is designed for the front units to treat most of the CVOCs and the secondary units to polish remaining CVOCs. The GAC units shall be capable of accepting a flow of at least 400 scfm. Sampling and analysis of the air stream will be conducted to evaluate the performance of the air treatment system in accordance with the Monitoring Plan (further discussed in Section 6).

<u>Process Controls:</u> The intent of this system design is to make it as automated as possible so that it requires minimal operator interaction, and is easy to stop and restart when necessary. The control system

is designed to shut down the treatment system in the event of an alarm condition, and activate an alarm light on the exterior of the trailer that will be visible to site employees. In addition, Woodard & Curran will have the capability to remotely monitor the operation of the SVE system from our office. When an alarm condition is noted by Woodard & Curran or the designated site employee, Woodard & Curran will attempt to troubleshoot the problem and provide instruction to the designated site employee to restart the system. If the system does not immediately restart, and further actions are required which involve potential exposure to CVOCs, Woodard & Curran will attend to the system and conduct any necessary maintenance.

4.2 IN-SITU OXIDATION DESIGN

4.2.1 Design Overview

Potassium permanganate ($KMnO_4$ or simply "permanganate") is a common oxidant widely used in the water treatment industry to remove dissolved metals and in the sewage treatment industry to treat sulfide odors. KMnO4 will react with and oxidize a wide range of common organic compounds, relatively quickly and completely. In particular, KMnO4 reacts rapidly with the non-conjugated (i.e. non-aromatic) double bonds in chlorinated ethenes such as TCE, PCE, DCE isomers, and vinyl chloride. Permanganate is generally less reactive with chlorinated ethanes such as DCA and TCA. However, Woodard & Curran's experience with this technology, as well as others (refer to p. 107, Clayton, W.S., et al, "A Multisite Field performance Evaluation of In-Situ Chemical Oxidation using Permanganate"), has shown good reductions in these compounds under certain site conditions. In general, the effectiveness of permanganate to reduce TCA and DCA depends on the concentrations of competing reduced/oxidizable species present at the Site. These include chlorinated ethenes, other contaminants, organic carbon sources, and inorganic compounds such as iron and manganese. The monitoring well network currently in place at the Site has delineated the extent of both the ethene and ethane plume. The plume is currently limited to the area beneath the Texaco Hangar and the adjacent Phillip Morris Hangar and no potential receptors to the groundwater contamination have been identified in the vicinity of the plume.

Permanganate oxidizes the chlorinated ethenes to CO_2, water and carbonate ions. The balanced chemical equations for permanganate oxidation of TCE, PCE and VC are:

PCE: $4KMnO_4 + 3C_2Cl_4 + 4\ H_2O \rightarrow 6CO_2 + 4MnO_2 + 4K^+ + 12Cl^- + 8H^+$

TCE: $2KMnO_4 + C_2HCl_3 \rightarrow 2CO_2 + 2MnO_2 + 2K^+ + 3Cl^- + H^+$

VC: $10KMnO_4 + 3C_2H_3Cl \rightarrow 6CO_2 + 10MnO_2 + 10K^+ + 3Cl^- + 7OH^+ + H_20$

In situ oxidation is a chemical reaction and the effectiveness of treatment depends on three factors: 1) the kinetics of the reaction between the permanganate and the contaminant; 2) the contact between the oxidant and the contaminants; and 3) competitive reactions of permanganate with other reduced/oxidizable species in the aquifer. Woodard & Curran's experience has shown that significant oxidation can be observed in as little as a few hours after addition, but travel times for permanganate to migrate away from the addition point may be on the order of days to weeks depending on the rate of groundwater flow.

Woodard & Curran completed a pilot study in August 2001 to gauge the effectiveness of this technology to address both chlorinated ethenes and ethanes present at the Site. The data generated during the pilot test has been evaluated against the project objectives, specifically the ability of the permanganate to reduce the contaminant mass of all the compounds of concern present at the Site, including TCA and DCA which are both present at the site at concentrations above the New York Groundwater Standards. The results of the pilot test was presented and discussed in the Feasibility Study completed in December 2001. In general, the results of the pilot study completed at the site indicated that the use of $KMnO_4$ as an in-site oxidant is effective at treating the residual CVOCs present in shallow groundwater at the site.

4.2.2 Additional Injection Procedures

Due to the apparent success of the initial pilot test activities, Woodard & Curran will again inject KMnO4 as a solution into the subsurface using temporary injection points (drive points) installed through the hangar floor. The potassium permanganate will be premixed in a mix tank and applied to the subsurface via temporary injection points utilizing a geoprobe rig and a high-pressure grout pump. The injection point locations are presented on Figure 4-1.

Based on the results of the August 2001 Pilot Test activities, Woodard & Curran will inject 50 to 100 lbs. of $KMnO_4$ in each of the temporary injection locations (for a total $KMnO_4$ mass of approximately 400 to 800 lbs.) into the source area soils and groundwater during the injection activities. The amount of permanganate injected will depend on how well the formation accepts the solution and will be determined in the field. Woodard & Curran bases this estimate on our pilot study results, current industry practice, and understanding of the Site geology, groundwater quality and contaminant mass.

The mix tank will consist of a 200-gallon tank. The powdered $KMnO_4$ will be mixed with water in the tank, which will be placed in a secondary containment tub to minimize the chance of spills. The solution will be pumped from the mix tank to the geoprobe rig where the high pressure grout pump will be used to inject it into the subsurface.

The permanganate addition activities will be completed at two injection locations in the hangar and will not impact airport activities. The addition activities are scheduled for completion over several days. At the end of each day, the mix tank, grout pump, rig and all ancillary equipment will be cleaned and stored in a remote area of the hangar.

The first oxidant injection will be completed approximately 6 months after the start up of the SVE system has been completed. This schedule will allow the collection and analysis of 2 rounds groundwater samples to evaluate the effect the operation of the SVE system may have on groundwater conditions. The impact to groundwater by the SVE system may be minimal and will only be due to the removal of residual CVOCs in the soils which may still be acting as a source of CVOCs to groundwater.

Following the initial injection, a minimum of three rounds of groundwater samples will be collected from the sites and the results will be used to evaluate the effectiveness of the injection and need for and amount of additional injections.

If, at any time during the injection process, the results indicate that the selected oxidant is not effectively removing the residual CVOCs from groundwater at the site, additional oxidants will be evaluated though pilot tests completed at the site. Prior to testing any additional oxidants, NYSDEC will be informed of our plans

FIGURE 4-1: IN-SITU OXIDATION LAYOUT

5. REMEDIAL ACTION WORK PLAN

5.1 CONSTRUCTION PLAN

The location and description of any construction facilities and a listing of all applicable SCGs relating to the construction of on-site remedial units including inspection and professional engineer certification are presented below. To minimize disruption to the facility, SVE wells and subsurface piping were installed in August 2002 during a temporary vacancy of the hanger.

5.1.1 Equipment Purchase/Assembly

Woodard & Curran or ExxonMobil shall directly purchase the required treatment system equipment. All interconnecting piping and treatment area construction shall be conducted on-site, all other system components shall be assembled before arrival to the Westchester County Airport Hangar D, Bay 2 Site. The estimated schedule for constructing the SVE system is presented in Figure 8-1. Level D personal protection has been assumed for all system construction activities.

5.1.2 Well Installation

Woodard & Curran received quotations for drilling work from reputable drilling contractors for the installation of five SVE wells within Westchester County Airport's Hangar D. Installation occurred on August 21, 2002.

The SVE wells were advanced using hollow stem auger drilling techniques to a depth of approximately 12 feet. A 4-inch PVC well was installed in each borehole consisting of 10 feet of slotted PVC attached to solid riser. Each location was fitted with a slip cap and secured with a bolting road box cemented into the hangar floor. The annular space surrounding the PVC screen was filled with filter sand to a depth of at least 1 foot above the top of the screen and a 1 foot bentonite seal was placed in the well. The remainder of the annular space was backfilled with drill cuttings. The remaining drill cuttings were placed in drums pending off-site disposal.

5.1.3 Earthwork

Earthwork was required for the subsurface piping which will connect each SVE well to the header located on the southern wall of Hangar D. Piping between the wells and the header was installed below the concrete slab. Trench work included removing and restoring sections from the Hangar D concrete slab to install the subsurface piping.

5.1.4 Mechanical

The installation of 4-inch Schedule 40 PVC piping will be required to install the SVE system. Each SVE well requires independent subsurface piping to the southern wall of Hangar D. Along the southern wall, piping shall rise approximately 14 feet and connect with the header. The header shall be supported by the pipe rack and run southwest until entering the treatment area located at the southwest corner of Hangar D.

5.1.5 Utility Connection

The SVE blower and main control panel shall be serviced by three phase, 208 Volt AC (VAC) power. The main control panel shall be wired directly to the 208 VAC, three phase panelboard through a disconnect breaker. The SVE blower shall be powered by the main 208 VAC, three phase feed into the main control panel.

The trailer lights, power receptacles, ventilation fan and any other equipment less than 1 hp that may be incorporated in the future, will be serviced by a single phase 120 VAC which will be supplied through the 208 VAC, single phase panelboard.

5.1.6 System Construction

The treatment area shall be installed in the southwestern corner of Hangar D in such a way as to minimize interference with current activities and operations at the site. The interior of the treatment area shall be substantially in accordance with Drawing M-01. The control panel shall be installed within the treatment shed area so that it is easily accessible and away from equipment that has the potential to create excessive heat. The control panel shall be housed within a NEMA 4X container and will be delivered to the site ready for installation.

5.1.7 System Start-up

System startup will include setting and making adjustments for the flow rate and other system parameters. The general startup procedure is as follows:

1. Examine the SVE system and make sure that all the valving is in the proper position and there are no alarm conditions
2. Turn the hand switch for the transfer pump to “Auto”
3. Turn the hand switch for the SVE blower to “Auto”

During system start-up, the drainage trench located in the hangar will be evaluated to assess its impact on system operation. The trench is located in the center of the hangar and may not be sealed to the subsurface. In this case during operation of the SVE system, air will be introduced to the subsurface through the trench. During system start-up the trench will be covered with poly sheeting and monitoring with vapor pressure monitors to determine if the trench is introduction air into the subsurface. If this is determined to be the case, the impacts to the SVE system will then be evaluated to determine if the trench should be sealed or allowed to continue as a source of make-up air. The outcome of this evaluation will be included in the progress report.

Upon startup of the SVE system, the system will operate continuously. Monitoring will be conducted more frequently during the first few months of operation than in later stages of operation, to verify the system is running smoothly and that vapor phase GAC units have not reached breakthrough. Woodard & Curran personnel will be on-site for the first day of system operation, as well as days 7, 14, and 28. After the first 28 days of system operation, Woodard & Curran will conduct system monitoring and maintenance on a monthly basis with weekly remote monitoring.

5.1.8 Certification of Completion

Work shall be completed in accordance with the specifications described in this report and all federal, state, and local regulations.

5.2 INSTITUTIONAL CONTROLS

As part of the remedial actions selected for the site, institutional controls will be used to ensure that future exposure to groundwater does not occur. The institutional controls that will be implemented for this site will provide for maintaining the current use of the property and implementing development restrictions that would limit the use of groundwater. Future use of groundwater from the impacted areas for potable or process water would require water quality treatment which would be determined by the Westchester County Department of Health.

Institutional controls will be implemented by submitting a description of the controls to be implemented to the New York Department of Environmental Remediation (DER), a map depicting there area where the controls will be enforced, and an agreement to establish and maintain the institutional controls signed by the current property owner, the Westchester County Airport.

Woodard & Curran will also notify adjacent property owners, the New York State Department of Health, the Westchester County Department of Health and the Town Clerk for the Town of Harrison of the proposed remediation for the site and the institutional controls to be implemented. In addition, a copy of the notification will be sent to the two document repositories for the project.

6. SVE OPERATION, MAINTENANCE AND MONITORING PLAN

6.1 SVE SYSTEM OPERATIONS

6.1.1 System Overview

In general, SVE flow rates will be established during the initial system startup, and are not expected to vary significantly during the operating life of the system. The expected total soil vapor flow rate to the SVE system is approximately 150 standard cubic feet per minute (scfm) for Blower B-1001. It is anticipated that the SVE flow rate will always be maintained at the highest level possible. However, as remediation progresses, the flows from individual extraction wells may be changed in order to maximize contaminant removal and/or encourage new vapor flow pathways.

Each SVE well will be equipped with ball valves and Y-strainers that will allow the wells to interchange between being an extraction well and a subslab pressure relief well. From month to month, individual wells may switch between well types in order to maximize contaminant removal and/or encourage new vapor flow pathways.

6.1.2 Routine Operations

In order to assess that the SVE system has an adequate radius of influence, the SVE monitoring points will periodically be monitored for vacuum. This will be accomplished by connecting a pressure gauge sensitive to 0.01 iwg to the monitoring port on the SVE monitoring well. All perimeter monitoring points should be under vacuum . If not, the flow to individual extraction wells will be adjusted to increase the vacuum where necessary.

6.1.3 Compliance and Equipment Monitoring

Throughout system operations, it will be necessary to collect sufficient data to characterize process streams and evaluate the performance of the treatment system. In order to quantify the degree of CVOC removal through the vapor phase GAC treatment train, soil vapors will be monitored at the blower's effluent, the outlet from both the primary GAC units (GAC 1001 & 2001), and the outlet from the secondary GAC units (GAC 1002 & 2002). Samples will be collected and analyzed after 1, 7, 14, and 28 days of system operation. For these sample dates a photoionization detector (PID) will be used to measure total CVOCs at the four sampling locations. In addition, the soil vapors will also be collected on two of these dates and analyzed in accordance with USEPA Method TO-14 from the blower's effluent and the outlet from the secondary GAC units (GAC 1002 & 2002).

After 28 days of system operation, samples will be analyzed monthly at the four sample locations using a PID. Air samples collected from the blower's effluent and the outlet from the secondary GAC units (GAC 1002 & 2002) will be analyzed by USEPA Method TO-14 on a quarterly basis. The PID monitoring results will be compared to the compound-specific results of the Method TO-14 analyses to develop PID response factors. The PID results and the USEPA Method TO-14 analytical results will be used to calculate mass removal.

6.1.4 Routine Maintenance

To ensure the longevity and reliability of the remediation system, each component must be properly maintained. In general, system maintenance involves cleaning or changing various filters and performing brief system reviews to monitor performance of the system. After system start-up, once a month, a Woodard & Curran employee will perform the following tasks to check that all equipment is in good working order:

- Check the position of extraction well valves
- Measure vacuums at extraction wells and SVE monitoring points
- Record the head loss across each in-line filter
- Record the run-time reading for the SVE blower
- Record the SVE vacuum, flow rate, and discharge temperature for the SVE blower
- Check the GAC piping for tight connections, shut down the system and tighten if necessary
- Replace each upstream vapor phase GAC unit with the downstream unit, if necessary and as indicated by extracted soil vapor sampling, then install new GAC unit(s) at the "secondary unit" location
- Perform monitoring tasks as specified in Section 7
- Note any unusual conditions

6.1.5 System Trouble-Shooting

If any alarm conditions occur, as indicated by the alarm light located outside the treatment trailer, a Woodard & Curran representative will inspect the system to determine the source of the alarm, conduct any necessary maintenance, and attempt to restart the system.

6.1.6 Safety Requirements

All on-site operations regarding the treatment system shall be conducted wearing level D protective equipment to prevent possible exposure to CVOC vapors. All work to be completed at the site will be done in accordance with the project specific health and safety plan which has been submitted under separate cover.

6.1.7 Records and Reporting Requirements

Woodard & Curran will document all readings, observations, system modifications and field monitoring results completed during regular site visits. The documentation will be summarized in progress reports which will be submitted to NYSDEC. During system construction and the first month of system operation these progress reports will be completed and submitted on a monthly basis. Following the first month of system operation, the progress reports will be completed and submitted on a quarterly basis coinciding with the completion of the groundwater sampling rounds.

6.2 SYSTEM CLOSE OUT AND DISMANTLING

Once it has been determined that the remedial objectives have been achieved, the SVE system will be permanently shut down and removed from the site. A description of procedures for dismantling and removal of remedial structures and equipment from the site consist of the following steps:

1. Removing all GAC units from the treatment system for proper disposal;
2. Disconnect, remove and dispose of all aboveground piping;
3. Cut and cap all buried SVE piping; and
4. Properly decommission any wells that will not be used for subsequent monitoring activities.

7. PERFORMANCE SAMPLING PLAN

7.1 SOIL VAPOR MONITORING

In order to optimize VOC removal, and gauge the degree of remediation achieved by the SVE system, soil vapors will be monitored at various locations within the hangar. In addition, soil vapor monitoring will be completed on the extracted vapors from within the treatment system. The following sections describe the vapor sampling that will be done as part of the remedial action at the site.

7.1.1 Baseline Vapor Sampling

Prior to initiation of the SVE system, base line vapor readings will be collected from the vapor points located within the hangar. A total of 10 vapor points were installed by XDD as part of an SVE pilot study completed at the site. The vapor monitoring points are fitted with a PVC cap and a sampling port. Readings will be taken from the sampling port of each vapor point using a PID. In addition, samples will be collected from 10% of the sampling points and analyzed for VOCs via EPA Method TO-14 to be used to develop response factors for the site.

7.1.2 Extracted Soil Vapor Sampling

In order to quantify the degree of VOC removal through the vapor phase GAC treatment train, soil vapors will be monitored at the influent and effluent sampling port of both GAC units. Samples will be collected and analyzed after 1, 7, 14, and 28 days of system operation. For these four sample dates, a PID will measure total VOCs from the appropriate sampling ports. After 28 days of system operation, samples will be analyzed on a monthly basis. Quarterly samples for the first year will also be analyzed for VOCs by USEPA Method TO-14.

The PID monitoring results will be compared to the compound-specific results of the Method TO-14 analyses to develop PID response factors for future measurements.

7.1.3 Air Flow Measurement

Air flow measurements will be taken at each well head and at several locations inside of the treatment system including prior to the first carbon unit, in between the carbon units and after the final carbon unit. Measurements will be taken using a pitot tube or other suitable instrument and will be recorded on a field form. Air flow measurements will be taken during each visit for system operation.

7.1.4 Vapor Vacuum Measurements

Magnahelic gauges will be used for measurement of vacuum. Measurements will be taken at each of the SVE wells and at the vapor points installed by Vapex. Vacuum measurements will be taken during each visit for system operation.

7.1.5 VOC Mass Recovery Calculation

During system operation, Woodard & Curran will estimate the amount of VOCs removed from the subsurface during system operation. This analysis will be completed based on the VOC measurements taken during regular system maintenance visits from the influent sampling ports. This estimation will be included in the periodic monitoring reports.

7.1.6 Basis for Discontinuing SVE

Woodard & Curran will assess conditions at the site to determine if continued operation of the SVE system is necessary. This evaluation will be based on the concentration of CVOCs for each of the SVE wells and the vapor monitoring points at the facility. If the concentrations of CVOCs are not detectable for three months based on PID readings, vapor samples will be collected and analyzed for VOCs via EPA Method TO-14. If the laboratory results indicate that concentrations are below detection limits, we will notify NYSDEC of our intent to shut off the treatment system for a three month trial period. Following the three months trial shut down, additional vapor samples will be collected from each of the SVE wells and vapor monitoring points. If these results are consistent with the initial sampling round, the system will be shut down for a year and a follow up sampling round will be completed but will only consist of the most impacted monitoring points based on the base line sampling round.

7.2 CONFIRMATORY SOIL SAMPLING PROGRAM

7.2.1 Direct Push Confirmation Soil Sampling

After the SVE system has been shut down, monthly monitoring of the soil vapors will be continued to verify that conditions remain constant. If it is determined that conditions in the subsurface still support system shut-down, confirmatory soil samples will be collected. Soil samples will be collected using direct push drilling techniques, placed in appropriate sampling containers in a cooler and kept cold until they are delivered to Accutest Analytical Laboratories in Dayton, New Jersey for VOC analysis by EPA Method 8260B.

7.2.2 Disposal of Investigation-Derived Wastes

All remediation wastes generated during the construction of the SVE/AS system will be containerized and disposed of in accordance with all State and Federal requirements.

All spent vapor phase GAC units will be returned to the GAC supplier for regeneration.

7.2.3 Quality Assurance/Quality Control

To maintain proper quality control of soil samples collected from the site, Woodard & Curran will utilize proper sampling techniques and chain of custody procedures. In addition duplicate samples, field blanks and trip blanks will be used to ensure sample quality. All QA/QC procedures are described in the Project Quality Assurance Project Plan (QAPP) which has been submitted under separate cover. Other sample results will be compared to historic data to screen for quality.

7.3 GROUNDWATER MONITORING

7.3.1 Selected Monitoring Wells

To monitor the effectiveness of the in-situ oxidation and soil vapor extraction systems, groundwater monitoring will be completed from selected monitoring wells at the site. The monitoring wells are separated into three areas. Wells from the Source Area will be sampled to monitor the effect of both the SVE and in-situ oxidation remediation on groundwater in that area. The wells from the Downgradient Area will be sampled to monitor effects of the remediation in areas where the active systems are not located. The last area is outside of the plume and includes wells that have not been impacted by solvents from the site and these wells will be sampled to make sure the plume remains contained beneath the hangar.

The monitoring wells to be sampled during the monitoring events include:

- Source Area: MW-01, MW-08S, MW-08D, MW-02, MW-07S, MW-07D GP-2B, and GP-3;
- Downgradient Wells: MW-03, MW-04, MW-10S, and MW-10D
- Outside of Plume: MW-09S, MW-09D, MW-11S, and MW-11D

7.3.2 Groundwater Sampling Procedures

Groundwater samples will be collected following standard low flow sampling techniques to limit disturbance of the sample and allow for collection of more representative groundwater samples. In accordance with low-flow sampling techniques, field parameters will be measured using a flow-through cell as groundwater is being extracted. Field parameters that will be measured include dissolved oxygen, ORP, carbon dioxide, turbidity, pH and conductivity. Once these parameters stabilize, a groundwater sample will be collected into pre-preserved 40-ml vials. Field data record will be kept for each sample including date and time of sample, amount of water purged and results of field screening. Samples will then be placed in a cooler on ice and kept cool until delivery to the analytical laboratory.

7.3.3 Analytical Methods

Groundwater samples collected from the site will be transported to Accutest Laboratories in Dayton, New Jersey for analysis. Samples will be analyzed for volatile organic compounds via EPA Method 8260B.

7.3.4 Reporting Requirements

Results of groundwater sampling will be included in quarterly monitoring reports. The quarterly monitoring reports will include a description of work completed during the quarter a summary of analytical results from groundwater monitoring and a graphical representation of the concentrations over time in the monitoring wells.

7.4 PERFORMANCE MONITORING SCHEDULE

Woodard & Curran will monitor system performance during system operations and will assess compliance with NYSDEC remedial goals following system shutdown as described in previous sections.

Baseline vapor monitoring will be completed after construction of the system, but prior to system startup. Samples will be collected from the SVE wells and the vapor monitoring points at the site.

Once system startup has been completed, extracted vapors will be monitored using a PID daily during each visit for system operation. In addition to using the PID, vapor samples will be analyzed for VOCs via EPA Method TO-14 on a quarterly basis.

Once performance monitoring results indicate that system influent concentrations and vapor point concentrations have been below method detection limits for a period of 2 months, the system will be shutdown and vapor sampling will be completed from vapor points and SVE wells.

The collection of confirmatory soil samples will be completed at the site as soon as possible. However, the sample collection may be schedule to coincide with the completion of additional injection rounds to allow for the use of the sampling points as injection points.

During system operation, quarterly groundwater sampling will be completed at the site to asses the effectiveness of the oxidant injection. Groundwater sampling will be completed until the results from three consecutive rounds of sampling indicate concentrations of CVOCs below the NYSDEC selected SCGs. Once these conditions have been met, Woodard & Curran will notify NYSDEC of the results and our plan to perform no additional injections or groundwater monitoring.

8. PROJECT SCHEDULE

Woodard & Curran will complete the work outlined in this work plan on behalf of ExxonMobil. Woodard & Curran will work closely with representatives of Westchester County Airport to ensure that all work completed is done in accordance with any guidelines and regulations and with minimal impact to on-site activities. The project schedule for the above referenced work is presented as Figure 8-1.

FIGURE 8-1: PROJECT SCHEDULE

APPENDIX A

JUNE 2002 ORDER OF CONSENT

APPENDIX B

DOCUMENT REPOSITORY LIST

APPENDIX C

SVE SYSTEM DESIGN FIGURES