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February 26, 1998

Mr. Ramanand Pergadia, P.E.
New York State Department of Environmental Conservation
Hazardous Waste Redemption, Region III
21 South Putt Corners Road
New Paltz, NY 12561-1696
Dear Mr. Pergadia:

Subject: Submittal of: Addendum to October 7, 1997 Supplemental Data Collection Report and Focus Feasibility Study
Hangar D, Bay 1, Westchester County Airport, White Plains, NY
XDD Project No. 17014

Dear Mr. Pergadia:

Attached please find the following documents for the above referenced site:

- Addendum to the October 7, 1997 supplemental data collection report
- Draft Focus Feasibility Study for the above referenced site.

Should you have any questions regarding the contents of either of these submittals or on the project as a whole, please feel free to contact Greg Hill of Mobil at 609-737-4940.

Sincerely,
XDD, LLC

Stephen Magee
Project Engineer

cc:

B. Anders Carlson, NYSDH (2 copies)
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DRAFT
FOCUSED FEASIBILITY STUDY
HANGAR D, BAY 1 WESTCHESTER COUNTY AIRPORT
WHITE PLAINS, NEW YORK

Prepared For:

Mobil Oil Corporation
Princeton, NJ

Prepared By:

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February 26, 1998

FIGURES

TABLES

APPENDICES

1.0 INTRODUCTION

1.1 Background

The Westchester County Airport is located in White Plains, New York. The airport (including Hangar D) began operations in 1952. Mobil Oil Corporation (Mobil) used Hanger D, Bay 1 as a base for corporate flight operations from 1952 until 1991. Texaco has leased Hangar D, Bay 1 from 1991 to the present time. A site location map is attached as Figure 1.

Remedial Investigation (RI report prepared by Malcolm Pirnie, 1997) and Supplemental Data Collection (SDC reports prepared by XDD, LLC, 1997 and 1998) activities have been completed for Hangar D Bay 1 at the site. The results of the RI and SDC suggest the following:

- The storage of solvent drums along the southeast wall of the hangar resulted in limited release(s) of chlorinated hydrocarbons.
- The released chlorinated hydrocarbons impacted the shallow soils beneath the hangars' concrete floor slab in the vicinity of the drum storage area.
- Transport of the chlorinated hydrocarbons (predominantly in the gaseous phase) resulted in impacts to the vadose zone soils beyond the vicinity of the drum storage area and to the underlying shallow groundwater at the site.
- The soils underlying the hangar floor consists of bedrock over the western half of the hangar and fill materials in the eastern half of the hangar. The fill materials were placed in a former channel bed that existed at the site prior to the airport construction.
- The impacted groundwater within the fill materials is located at approximately 10 feet below floor level and flows at a darcian velocity of approximately 11 feet per year in a southerly direction from the former Mobil hangar underneath the adjacent, Phillips-Morris hangar (former Union Carbide hangar).
- The soil gas data collected from onsite soil vapor probes indicates that the presumed chlorinated hydrocarbon source area is limited in extent and significantly decreased in magnitude (i.e., July and December 1997 soil gas data show concentrations that are orders of magnitude less than the soil gas concentration data collected prior to 1991).

- The groundwater data collected from the four monitoring wells located at the site indicate that natural attenuation of the chlorinated hydrocarbon groundwater plume is ongoing and that the attenuation rates are sufficient to mitigate the plume. A groundwater monitoring well location map is attached as Figure 2.

2.0 FOCUSED FEASIBILITY STUDY

2.1 Introduction

As a first step in implementing a remedial strategy for the site, an initial survey of appropriate remedial technologies was conducted to narrow the choices of alternatives. The initial evaluation of applicable technologies included a literature survey and interviewing of remediation contractors and consultants with in-situ remediation expertise.

Ex-situ technologies such as excavation and treatment of soils were eliminated from consideration. The basis for elimination of ex-situ technologies was the impracticality of excavation under actively operating airport hangars, based on the potential for structural damage, disturbance of operations and cost.

A number of in-situ technologies were considered for application at the site. While soil vapor extraction (SVE), natural attenuation and in-situ permeable barriers were retained for consideration, air sparging and pump and treat were eliminated due to the following:

- Air sparging: Effective air sparging of chlorinated hydrocarbons requires that the distribution of air flow channels be highly symmetrical and dense in number about the sparge point. This requirement is due to the fact that the primary chlorinated hydrocarbons present at the site are not aerobically degradable and therefore must be stripped from the soils and groundwater. Due to the hetergeneous nature of the fill material at the site it is readily apparent that the probability of obtaining an adequate air flow channel distribution to effectively remediate the chlorinated hydrocarbons is very low.

- Pump and Treat: It is well accepted within the engineering community that the implementation of pump and treat technology as a remedial alternative for chlorinated hydrocarbons is poorly founded. Pump and treat may be more applicable at this site as a containment strategy. However, the results of the preliminary evaluation of natural attenuation mechanisms ongoing at the site strongly indicate that the plume is being contained naturally, eliminating the benefit of pump and treat technology.

Again, based upon the results of the initial evaluation, three applicable and appropriate alternatives were selected for further evaluation. The three remedial alternatives include one or a combination of the following: natural attenuation, soil vapor extraction, and in-situ zero valence metal treatment via a permeable wall.

2.1.1 Preliminary Evaluation of Remedial Alternatives

Based upon site information obtained by XDD, LLC (XDD) and during RI and pre-RI activities (including a soil gas survey and a soil vapor extraction field pilot test, a preliminary evaluation of the remedial alternatives was performed. The evaluation included:

- review of historical site investigation data including the February 1997 RI report, the October 1997 SDC report and December 1997 site monitoring data;
- review of data collected during a 1991 SVE field pilot test (FPT) conducted at the site;
- review of zero valence metal treatment via permeable wall.

The results of the preliminary evaluation provided the following observations/conclusions regarding the identified potential remedial alternatives:

1) Natural Attenuation

The RI and SDC data strongly indicate that natural attenuation is currently occurring and that the contaminant plume is stable or receding.

Site conditions that are indicative of natural attenuation currently occurring include:

- groundwater geochemistry data indicates that the subsurface environment is conducive to reductive dechlorination.

- daughter products (i.e., result of chlorinated hydrocarbon degradation) are present and daughter product to parent compound ratios increase with distance from the source area which demonstrates a consistent degradation of parent and daughter compounds as they migrate in ground water from the source area.
- Bioscreen (a widely accepted screening model for the evaluation of natural attenuation mechanisms) modeling results indicate that the contaminant plume would be significantly larger in size and higher in contaminant concentrations if degradation was not occurring.
- Bioscreen modeling also indicates that the plume is likely receding would be expected to achieve acceptable contaminant levels over a 15 to 20 year period.
- Site soil gas data indicate that the VOC source area is limited in extent and concentrations within the source area have significantly decreased over the last six years.

2) Soil Vapor Extraction

The identified soil characteristics, while not optimal, appear favorable for the application of in-situ SVE. The characteristics observed/measured are as follows:

- an adequate vadose zone thickness exists in the area of concern.
- low concentrations of VOCs are present within the vadose soil gas.
- The calculated horizontal and vertical intrinsic soil permeabilities (i.e., 2×10^{-8} cm^2 and 7×10^{-10} cm^2, respectively) of the vadose zone soils that are within the range considered favorable for the application of SVE.
- The detected VOC contaminants are suitable for removal by soil vapor extraction.

3) Permeable Zero Valence Metal Barriers

A review of the chemical data at the site indicates that zero valence metal treatment via a permeable wall is a viable remedial alternative. The zero valence metal process promotes anaerobic dechlorination (which is presently occurring at the site). The permeable wall is designed so the chlorinated hydrocarbons are sequentially dechlorinated to innocuous end products. Zero valence metal treatment would be achieved by constructing a permeable wall in the subsurface perpendicular to the groundwater plume migration.

Envirometal Technologies, Inc. the zero valence metal process license holder, was contacted and reviewed site data for applicability of the technology. Envirometal Technologies, Inc. personnel concluded that the process is capable of degrading a number of the compounds present at the site. The zero valence metal process is considered an innovative technology and has a successful (yet short) record of implementation.

The preliminary evaluation of these remedial alternatives indicate that further detailed evaluation is warranted for potential implementation as remedial strategies for the site.

2.2 Methodology

The focused feasibility study (FS) was performed in accordance with New York State Department of Environmental Conservation (NYSDEC) guidance for conducting a detailed evaluation of alternatives. In particular, the study evaluated alternatives using the seven criteria as detailed in section 2.4 of this document and identified in the FS guidance document (NYSDEC Technical and Administrative Guidance Memorandum (TAGM) dated May 15, 1990). The evaluated alternatives were:

- Alternative A: Natural Attenuation with Monitoring;
- Alternative B: Natural Attenuation with Vadose Zone Source Removal via SVE;
- Alternative C: In-situ Zero Valence Metal Permeable Wall with Vadose Zone Source Removal via SVE.

2.3 Development of Remedial Actions

2.3.1 General

The NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) for the "Selection of Remedial Actions at Inactive Hazardous Waste sites" identifies the objectives of and general procedures for conducting a feasibility study. According to the TAGM, "the purpose of the detailed analysis of alternatives is to present relevant information needed to allow decision makers to select a site remedy". The development and evaluation of alternatives is based upon the complexity of the remedial action under consideration and the impacts being addressed. The specific requirements that must be addressed in the FS are: 1) protection of human health and environment, 2) attainment of standards, criteria and guidelines (SCGs) for clean up, 3) satisfaction of the preference for treatment that significantly and permanently reduces toxicity, mobility, or volume of hazardous wastes, and 4) cost effectiveness.

Evaluation of remedial alternatives to achieve the FS requirements listed above include review of the following seven criteria that are set forth in the TAGM and serve as the basis for conducting the detailed analyses: 1) Overall protection of human health and the environment, 2) compliance with SCGs, 3) long term effectiveness and permanence, 4) reduction of toxicity, mobility, or volume, 5) short-term impact and effectiveness, 6) implementability, and 7) cost.

2.3.2 Remedial Action Objectives

The primary objective for establishing remedial action (cleanup) objectives is to protect human health and the environment, as specified by the national contingency plan (NCP). Generally, remedial action objectives consist of medium-specific or operable-unit specific goals for protecting human health and the environment. Therefore, where appropriate, existing standards are used as target cleanup levels in instances where they are considered to be applicable SCGsfor New York State. Tables 1-A and 1-B list SCGs for groundwater and soils (respectively) for the volatile organic compounds detected (i.e., contaminants of concern) at the site. These SCGs will be the target cleanup levels for the site.

2.4 Detailed Evaluation

2.4.1 General

The detailed analysis presents information necessary to define and evaluate remedial alternatives selected for final consideration. Each alternative is assessed against the evaluation criteria described later in this section. The purpose of this analysis is to provide sufficient information to compare the alternatives, select an appropriate remedy for the site, and demonstrate its compliance with the NYSDEC remedy selection requirements. To conduct and present this process in a comparative format, the previously listed seven evaluation criteria are included to address the NYSDEC requirements and considerations. These evaluation criteria served as the basis for the FS and are as follows:

<u>Overall Protection of Human Health and the Environment</u>

This evaluation criterion provides a final check to assess whether an alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term impacts and effectiveness, and compliance with SCGs.

Compliance with SCGs

This criterion is used to determine whether an alternative will meet New York State SCGs. It identifies the requirements that are applicable, or relevant and appropriate to an alternative and describes how the alternative meets chemical-specific, location-specific and action-specific SCGs.

Long-Term Effectiveness and Permanence

This criterion addresses the risk remaining at the site after response objectives have been met. Specific components of this criterion focus on assessing the magnitude of the residual risk, and the adequacy and reliability of controls.

Reduction of Toxicity, Mobility and Volume Through Treatment

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element. The analysis examines the magnitude, significance and irreversibility of such reductions achieved by alternatives employing treatment.

Short-Term Impacts and Effectiveness

This criterion addresses the effects of an alternative during the construction and implementation phase, including protection of the community and workers, potential environmental impacts and mitigative measures, and the overall time frame for achieving remedial response objectives.

Implementability

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. Technical implementability relates to an alternative's constructability and operations, the reliability of the technology, and its flexibility to accommodate phased implementation or modifications based on regular monitoring. Administrative implementability relates to the availability of various services (e.g., equipment, materials, and operation) and of prospective technologies.

Cost

The purpose of the cost portion of the FS is to compare how an alternative's cost impacts the overall "cost-effectiveness" of the alternative over time. These "study estimate" costs are expected to provide an accuracy of +50 percent to -30 percent and are prepared using data available from the RI, FS, and

Pre-Design activities. They do not represent construction cost estimates or cost at completion. The individual components of the cost estimates are defined as follows:

- Capital Costs. Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs associated with installation and implementation of remedial alternatives. Direct costs include expenditures for the equipment, labor, and materials necessary to install remedial actions. Indirect costs include expenditures for engineering, financial, and other services that are not part of actual installation activities.

- Annual O&M Costs. Annual operation and maintenance (O&M) costs are post-construction costs necessary to ensure the continued effectiveness of a remedy.

- Present Worth Analysis. A present worth analysis is used to evaluate expenditures that occur over different time periods. This analysis provides a single figure representing the amount of money that, if invested in the base year, would be sufficient to cover all costs associated with the remedial action over its planned life.

2.4.2 Method

The approach of this FS was to evaluate three alternatives for the long-term remediation of the site. The sections that follow describe Alternatives A, B and C.

2.5 Alternative A: Natural Attenuation and Monitoring

2.5.1 Description

Alternative A involves long-term monitoring of groundwater to document natural attenuation of VOCs in the groundwater. Natural attenuation data collected at the site indicates that the dissolved plume is stable or receding and that source soil gas VOC levels are significantly decreased over the last six years. Under Alternative A, groundwater would be monitored for a period projected to be up to 15 years until compliance with SCGs is attained or until otherwise approved. After additional data is collected demonstrating target VOC reductions in ground water, it is likely that the proposed quarterly monitoring frequency will be decreased (e.g., semi annually or annually). It is noted that a similar monitoring requirement would be part of all subsequent alternatives.

The major work items associated with the Natural Attenuation and Monitoring alternative are as follows:

- Conduct groundwater and soil gas sampling in existing monitoring wells within/near the presumed VOC source area and contaminant plume.
- Perform site reviews every five years.

2.5.2 Evaluation

2.5.2.1 Overall Protection of Human Health and the Environment

The natural attenuation alternative does not achieve all SCGs for groundwater and soils in the immediate future (i.e., 5 years). However, risks to the community and the environment are limited noting that the VOCs are below a concrete floor and the plume extent is limited and stable or receding. Restriction of well installations and groundwater use within the area where groundwater does not presently meet SCGs and proper notification/prevention of subsurface work in the hangar area in the vicinity of the presumed VOC source area can be implemented (as necessary) to prevent potential exposures.

Although it is not possible to calculate the exact time required for natural attenuation to achieve site SCGs, it is projected that a period of up to 15 years may be required.

2.5.2.2 Compliance with SCGs

The chemical-specific SCGs for groundwater and soils are presented in Tables 1A and 1B, respectively. Alternative A is anticipated to achieve the applicable SCGs (within a projected 15 years), however, an exact determination of the time to reach the SCGs is difficult to predict presently. However, as data is collected over the first 5 years of monitoring a more accurate projection will be possible. It is likely, however, that achievement of all applicable SCGs will not occur in the immediate future (i.e., 5 years).

Applicable action specific SCGs for Alternative A include RCRA rules for the disposal of hazardous waste and federal OSHA regulations governing workers employed at a hazardous waste site. It is expected that purge water generated during the groundwater sampling events will be disposed of as a hazardous waste. Personnel performing the sampling will be required to have participated in OSHA-HAZWOPER 40-hour training and to adhere to a site specific health and safety plan.

There are no location specific SCGs (e.g. wetlands regulations) applicable to this site.

2.5.2.3 Long-Term Effectiveness and Permanence

The natural attenuation alternative will result in the attainment of target SCGs in the long term. Short term site risks would remain minimal. As discussed previously, the exact time required for natural attenuation to achieve applicable SCGs is difficult to predict accurately. However, based on the available data and the projected rates of biodegradation, a time period of up to 15 years is probable.

Under the natural attenuation alternative, monitoring data would be evaluated every five years to further document that natural attenuation is continuing to re-evaluate project time frames to achieve the SCGs and to re-evaluate monitoring frequency and the need to continue monitoring.

Under this alternative, contaminants degrade to innocuous end products and the soil gas (source) and groundwater plumes achieve SCGs. The long term risk would be removed and the present risk would neither increase or decrease based on this alternative.

2.5.2.4 Reduction of Toxicity, Mobility or Volume Through Treatment

Under this alternative, contaminants degrade to innocuous end products and the soil gas and groundwater plume achieve SCGs over time resulting in a continued reduction in mobility and volume of contaminants. This alternative does not involve any ex-situ treatment, containment, removal or disposal but would leave the contaminated soils and groundwater in place to degrade under natural attenuation.

2.5.2.5 Short-Term Impacts and Effectiveness

Since the plume is currently stable or receding and the contaminated soil is under the concrete floor of the hanger, there is no increased risk to human health or the environment. Further, the natural attenuation alternative does not involve containment, removal, treatment, or disposal of contaminated materials; therefore, no immediate or short-term changes in risk exist.

2.5.2.6 Implementability

Technical Feasibility: Little difficulty would be involved in the sampling of groundwater and soil gas. The long-term sampling program is expected to be reliable in determining reductions in plume size and magnitude using existing monitoring wells and soil vapor probes.

The natural attenuation alternative does not include any construction activities that could prevent or adversely impact any future remedial activities. Other remedial alternatives described can be implemented in the future (if necessary) without any delays or difficulties associated with implementation of Alternative A.

Administrative Feasibility: Quarterly sampling and the five-year reviews would require administrative and regulatory attention from the NYSDEC. The long-term monitoring plan would also require state approvals before its implementation.

Availability of Services and Materials: This alternative does not involve any treatment, storage or disposal services except for the periodic disposal of purge water collected at the site during sampling events. Purge water will be disposed of by a licensed hazardous waste disposal company at the end of each sampling event. Companies performing groundwater and soil gas sampling and groundwater disposal are locally available and more than one vendor is available for competitive bids.

2.5.2.7 Cost

Capital Cost: There are no capital costs associated with natural attenuation alternative.

Q&M Cost: The principal cost component for the natural attenuation alternative is the annual cost of $12,500 to $45,000 for the Long-Term Monitoring program.

Present Worth: The net present worth cost for Alternative A was calculated using a discount rate of 10% for a monitoring program that would last 15 years in accordance with RI/FS guidance. This results in a $183,401 net present worth. Itemized cost estimates for this alternative are summarized in Table 2.

A summary of Alternative A analyses with respect to the seven FS criteria is attached as Table 3.

2.6 Alternative B: Natural Attenuation and Monitoring with Vadose Zone Source Removal via Soil Vapor Extraction

2.6.1 Description

Alternative B would incorporate an active SVE system for the removal of VOCs from the source area soils and natural attenuation for VOCs existing within the groundwater.

Alternative B would involve the following key components:

- Installation of a SVE system consisting of extraction wells within the source area soils, a vacuum source and granulated activated carbon (GACs) units for air controls (if necessary).
- Operation and maintenance of the system including quarterly groundwater monitoring of existing monitoring wells.

For Alternative B, the SVE system would consist of between 4 to 6 vertical SVE wells or 2 to 3 horizontal wells. The vacuum source would be capable of approximately 150 standard cubic feet per minute (SCFM) at approximately 60 inches of water column (WC) vacuum. The system would be fitted with an air water separator prior to the vacuum source in order to collect any water that is collected in the system. The vacuum wells would be installed such that the vadose zone within the suspected source area is affected. The vadose zone within the area of VOC contamination extends to an average of 10 feet below grade (BG). The SVE system would be designed to remove VOCs that are contained within the vadose zone soils.

Alternative B also involves long-term monitoring of groundwater to document natural attenuation of VOCs in the groundwater. Natural attenuation data collected at the site indicates that the dissolved plume is stable or receding and that source soil gas VOC levels are significantly decreased. Under Alternative B, groundwater would be monitored quarterly for a period projected to be up to 15 years until compliance with SCGs is attained or until otherwise approved. It is projected that the time required to attain SCGs in site groundwater will be the same as that for Alternative A (15 years).

2.6.2 Evaluation

2.6.2.1 Overall Protection of Human Health and Environment

Alternative B potentially provides long-term overall protectiveness of human health in a shorter time interval than that provided by Alternative A. Removal of VOCs from vadose zone soils may not reduce the time for groundwater and soils to reach SCGs, but SVE will remove VOCs from the soil gas within the vadose zone beneath the concrete slab and therefore further reduce the already low risk to human health and the environment. SVE is projected to reduce soil concentrations to within specified SCGs within a relatively short period of time (projected as 2 years). Protection of the environment is attained by preventing the migration of VOCs through vadose zone soils.

In the short-term, installation of SVE wells has the potential to increase exposure risk to onsite personnel, which can be managed. Employees performing the well installation will be required to have participated in OSHA-HAZWOPER 40-hour training and to adhere to a site specific health and safety plan.

2.6.2.2 Compliance with SCGs

The chemical-specific SCGs for Alternative B are the same for those for Alternative A and are presented in Tables 1A and 1B. An exact determination of the time to reach the SCGs is difficult to predict accurately. The time required to meet the SCGs for groundwater will be approximately the same as that for Alternative A (i.e., 15 years). There may be a small reduction in the time to clean up for the groundwater due to the short-term removal of the VOCs from the vadose zone. The time required to reach SCGs for soils within the source area is estimated to be up to 2 years from start up of the SVE system.

Applicable action specific SCGs for Alternative B include RCRA rules for the disposal of hazardous waste and federal OSHA regulations governing workers employed at a hazardous waste site. It is expected that purge water generated during the groundwater sampling events, soil cuttings collected during SVE well installations and the spent GAC canisters will be disposed of as hazardous wastes. Employees performing the groundwater sampling, drilling and operation and maintenance of the SVE system will be required to have participated in OSHA-HAZWOPER 40 hour training and to adhere to a site specific health and safety plan.

Spent GAC will be disposed of in accordance with the Hazardous and Solid Waste Amendments (HSWA) - Land Disposal Regulations (also referred to as the "Land Ban" regulations). The regulations specify dates when particular groups of hazardous wastes are prohibited from land disposal unless it is demonstrated that there will be no migration of hazardous constituents from the disposal area for as long as the wastes remain hazardous, and the regulations also set levels or methods of treatment.In addition to the above SCGs the discharge for the SVE system will be regulated and permitted by the air division of the NYSDEC.

There are no location specific SCGs (e.g., wetlands regulations) applicable to this site.

2.6.2.3 Long-Term Effectiveness and Permanence

The application of a SVE system in vadose zone soils will provide an effective long-term solution for the removal of VOCs that currently exist in the vadose zone. The removal of vadose zone VOCs may provide a small decrease in the time needed for natural attenuationto achieve SCGs in the groundwater.

The SVE system would involve conventional SVE engineering design, construction, and operation, and would be expected to function adequately to meet any imposed air discharge limits. Under Alternative B, activated carbon will likely be used as air controls for the system and the spent carbon will likely require handling and disposal as a hazardous waste. The carbon could also be shipped back to the supplier for regeneration at a licensed facility.

The air discharge would require periodic sampling for VOCs to monitor the efficiency of the carbon and to maintain the discharge below any required limits. This would not pose any significant risks. site workers will be OSHA certified for 40 hour HAZWOPER instruction and a site specific health and safety plan would be in effect. Overall, the treatment system would be expected to function adequately, and normal operation and maintenance, while required, should not pose any unmanageable problems.

2.6.2.4 Reduction in Toxicity, Mobility, and Volume Through Treatment

Alternative B would reduce the mobility and volume of contaminants migrating through the soils in the soil gas by removing them from the vadose zone. This alternative will likely be slightly more effective in limiting the mobility of contaminants in the groundwater (as compared to natural attenuation alone) by removing VOCs in the soil gas. The removal of the VOCs in the soil gas will, however, also reduce the mass and volume of contaminant within the subsurface soils.

2.6.2.5 Short-Term Impacts and Effectiveness

The potential public health threats to workers for Alternative B would include direct contact with VOC contaminated soils and inhalation of organic vapors during well installation. As a precaution, air monitoring of the work area would be conducted during drilling activities to detect unacceptable exposure levels. The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment as necessary. OSHA training would be required for workers involved with this activity.

Potential public health threats to workers and area residents during operation of the SVE system would include potential exposure to airborne VOCs from the discharge in the unlikely event of a failure of the carbon treatment. Regular monitoring of the carbon efficiency and cumulative carbon loading (to be included in the operation and monitoring plan for the system) would make this scenario very unlikely.

A total construction period of approximately 3-5 months is estimated for this alternative, including SVE design, bidding, selection of contractors, drilling, construction of manifold lines and shed, installation of equipment, and receipt of appropriate construction, and air discharge permits.

2.6.2.6 Implementability

Technical Feasibility: Alternative B is very implementable. All the components of this alternative are well developed and commercially available to implement at the site. SVE systems have been commonly used for successful in-situ removal of VOCs from subsurface soils for over ten years. Sufficient space is available for installation and operation of the SVE system without significantly impeding the day to day operations at the facility (after system installation is completed).

The SVE system employs a standard technology of extraction wells to draw VOCs from subsurface soils and can be easily implemented. This system will be both effective and reliable in removing VOC contamination from the subsurface soils.

The effectiveness of the SVE system would be monitored by measurement of VOC discharge concentration trends, the actual mass removed and by continued monitoring of groundwater and soil gas on the site.

Administrative Feasibility: An air discharge permit would likely be obtained from the NYSDEC within 60-90 days after submittal. A building permit would be obtained from the City of White Plains within approximately 1 month after submittal.

Availability of Services and Materials: All SVE system components are readily available. Numerous vendors and contractors are available to complete the tasks outlined and therefore, competitive bids can be obtained.

2.6.2.7 Cost

Capital Cost: The capital costs for Alternative B are $60,000.

O&M Cost: O & M costs for Alternative B include quarterly groundwater monitoring (i.e., up to $45,000 per year) and operation and maintenance of the SVE system for 2 years (i.e., $40,000 per year for year 1 and $30,000 per year for year 2).

Present Worth: It is projected that the time frame for groundwater to achieve SCGs is approximately 15 years. Assuming a 10% discount rate, a 15 year time period for site monitoring and a 2 year operation of the SVE system, the net present worth for Alternative B is $304,558.
A summary of Alternative B analyses with respect to the seven FS criteria is attached as Table 4.

2.7 Alternative C: In-Situ Zero Valence Metal Permeable Wall with Vadose Zone Source Removal via Soil Vapor Extraction

2.7.1 Description

Alternative C would involve the following key components:

- installation and operation of a SVE system as described in Alternative B;
- installation of a zero valence metal barrier wall immediately downgradient of the presumed source area of the groundwater plume (i.e., along the southeastern wall of Hangar D, Bay 1);
- quarterly groundwater monitoring at existing site monitoring wells up- and downgradient of the treatment zone.

For Alternative C, a flow through treatment barrier will be installed to enhance degradation of VOCs in the groundwater migrating hydraulically downgradient from the source area. The treatment barrier will consist of a contact area oriented perpendicular to the general direction of groundwater flow along the leading edge of the VOC plume. The contact area will extend to an approximate depth of 15 feet (i.e., the ledge/soil interface). It will consist of a 1 to 2 foot wide trench that is back filled with zero valence iron. As the groundwater flows through the contact area, the chlorinated compounds accept electrons donated by the iron and are reduced in a series of chemical reactions. The process is similar to natural anaerobic biodegradation of chlorinated compounds (as is presently occurring at the site) where compounds are sequentially dechlorinated to innocuous end products. The iron may need to be rejuvenated every five to ten years depending on the mass of VOCs and other electron acceptors passing through the contact zone.

One potential shortfall of the zero valence metal barrier is that to date, the process has not been shown to degrade chloroethane or methylene chloride at appreciable rates. However, at the site the detection of methylene chloride has been sporadic and inconsistent and its detection may be due to laboratory error. Additionally, chloroethane appears to be degraded naturally under present site conditions and will likely not be an issue.

The contact zone will be approximately 70 feet long, extending perpendicular to groundwater flow and placed near the source area of the groundwater plume just south of MW2 along the hangar wall. The contact trench will be essentially a passive treatment system, i.e., no mechanical "process equipment" will be required for this portion of Alternative C.

Regulatory compliance monitoring will be performed quarterly and will include analyses of groundwater samples from the existing groundwater monitoring wells located both up- (i.e., MW1 and MW2) and downgradient (i.e., MW3 and MW4) of the proposed contact zone.

The long term effectiveness of Alternative C is very similar to that of Alternative B. The zero valence barrier wall will aid in the chemical reduction of the VOCs and source area VOCs will be removed using an in-situ SVE system.

2.7.2 Evaluation

2.7.2.1 Overall Protection of Human Health and the Environment

Alternative C provides a long-term overall protectiveness of human health that is similar to that provided by Alternative B. Removal of VOCs from vadose zone soils may minimally reduce the time for the groundwater and soils to reach SCGs, but SVE will remove VOCs from the soil gas within the vadose zone beneath the concrete slab and therefore further reduce the already low risk to human health and the environment. SVE will reduce soil concentrations in the vadose zone to within specified SCGs within a relatively short period of time (projected at 2 years). The zero valence barrier wall will provide added protection in that the rate of VOC removal from the ground water may be enhanced over the natural attenuation alternative. Protection of the environment is attained by preventing the migration of VOCs through the vadose zone soils.

In the short-term, installation of the SVE system and the zero valence barrier wall will increase the potential exposure risk to onsite personnel. Installation of a 70-foot long trench to a depth of 15 feet BG will pose more risk to on-site employees than Alternative B, which involves only the SVE portion of the alternative. Additionally, excavated soils from the barrier installation will need to be properly handled and disposed of. Employees performing construction on site will be required to have participated in OSHA-HAZWOPER 40-hour training and to adhere to a site specific health and safety plan.

2.7.2.2 Compliance with SCGs

The chemical-specific SCGs for Alternative C are the same for those for Alternatives A and B and are presented in Tables 1A and 1B. An exact determination of the time to reach SCGs for groundwater is difficult to predict accurately. However, it is projected that the time necessary will be essentially the same as for Alternatives A and B. Attainment of SCGs for soil contamination within the source area is projected to be up to 2 years from the time of start up of the SVE system.

Applicable action specific SCGs for Alternative C include RCRA rules for the disposal of hazardous waste and federal OSHA regulations governing workers employed at a hazardous waste site. It is expected that purge water generated during the groundwater sampling events, soil cuttings collected during SVE well installations and the spent GAC canisters will be disposed of as hazardous wastes. Additionally, construction of the zero valence barrier wall will likely require the dewatering of the immediate area so that the soils can be excavated. Contaminated soils and groundwater will likely be considered hazardous waste and will be required to be disposed of according to applicable laws. Employees performing the groundwater sampling, drilling and operation and maintenance of the SVE system and installation of the zero valence metal barrier wall will be required to have participated in OSHA-HAZWOPER 40 hour training and to adhere to a site specific health and safety plan.

Spent GAC will be disposed of in accordance with the Hazardous and Solid Waste Amendments (HSWA) - Land Disposal Regulations (also referred to as the "Land Ban" regulations). The regulations specify dates when particular groups of hazardous wastes are prohibited from land disposal unless it is demonstrated that there will be no migration of hazardous constituents from the disposal area for as long as the wastes remain hazardous, and the regulations also set levels or methods of treatment.

In addition to the above SCGs the discharge for the SVE system will be regulated and permitted by the air division of the NYSDEC.

There are no location specific SCGs (e.g., wetlands regulations) applicable to this site.

2.7.2.3 Long-Term Effectiveness and Permanence

Construction of the zero valence barrier wall coupled with removal of VOCs in the soil gas would provide effective, long-term treatment of groundwater at the site. Over the long term, Alternative C would accomplish a similar reduction in contaminant volume and toxicity through treatment compared with Alternatives A and B. The main difference is that Alternative C would provide an engineered degradation of VOCs in the groundwater plume with the exception of chloroethane. However, this compound has been demonstrated to naturally degrade at the site.

Operation of the zero valence barrier wall will not generate residual wastes or sludge that would require treatment or disposal. Long-term operation of the barrier wall would not be expected to pose significant problems. However, there is currently limited experience with long-term performance of zero valence barrier wall systems and rejuvenation of the iron (e.g., mechanical agitation of the iron in the wall) may be required every 5 to 10 years.

The application of a SVE system in vadose zone soils will provide an effective long-term solution for the removal of VOCs that currently exist in the vadose zone. The removal of vadose zone VOCs will likely minimally decrease the time needed for natural attenuation to achieve SCGs in the groundwater.

The SVE system would involve conventional SVE engineering design, construction, and operation, and would be expected to function adequately to meet any imposed air discharge limits. Under Alternatives B and C, activated carbon will likely be used as air controls for the system and the spent carbon will likely require handling and disposal as a hazardous waste. The carbon could also be shipped back to the supplier for regeneration at a licensed facility.

The air discharge would require periodic sampling for VOCs to monitor the efficiency of the carbon and to maintain the discharge below any required limits. This would not pose any significant risks. site workers will be OSHA certified for 40 hour HAZWOPER instruction and a site specific health and safety plan will be in effect. Overall, the treatment system would be expected to function adequately, and normal operation and maintenance, while required, should not pose any unmanageable problems.

2.7.2.4 Reduction of Toxicity, Mobility and Volume Through Treatment

Alternative C would achieve the SCGs by reducing the volume of VOCs contained within the soil gas via SVE and by providing an engineered degradation of chlorinated VOCs (which is occurring naturally) via dechlorination of the VOCs in the groundwater by addition of a barrier wall containing zero valence metals.

Alternative C provides for eventual reduction and elimination of contaminants within the site soils and groundwater, as do Alternatives A and B, although Alternative C accomplishes the reduction of groundwater contaminants with an engineered approach.

2.7.2.5 Short-Term Impacts and Effectiveness

The potential public health threats to workers for Alternative C would include direct contact with VOC contaminated soils and inhalation of organic vapors during installation of the SVE wells, monitoring wells and the barrier wall. As a precaution, air monitoring of the work area would be conducted during these construction activities to detect unacceptable exposure levels. The risk to workers would be minimized by the use of adequate preventive measures and personal protection equipment as necessary. OSHA training would be required for workers involved with these tasks.

Potential public health threats to workers and area residents after construction would be related to the operation of the SVE system and would include potential exposure to airborne VOCs from the discharge in the unlikely event of a failure of the carbon treatment. Regular monitoring of VOC discharge concentration trends, the carbon efficiency and cumulative carbon loading (to be included in the operation and monitoring plan for the system) would make this scenario very unlikely.

A total construction period of approximately 5-6 months is estimated for this alternative, including SVE design, bidding, selection of contractors, drilling, construction of manifold lines and shed, installation of equipment, excavation and installation of the barrier wall and receipt of appropriate construction, and air discharge permits.

The short-term impacts and effectiveness of Alternative C is considered moderate with regard to treatment of groundwater. Unlike Alternatives A and B, Alternative C includes the physical interception of groundwater immediately downgradient of the source area of the plume. Alternative C creates a subsurface treatment zone through which groundwater flows by natural groundwater flow gradients and contaminants are progressively degraded to innocuous end products.

2.7.2.6 Implementability

Technical Feasibility: Alternative C is moderately implementable. The SVE component of this alternative is well developed and commercially available. Further, the dewatering and deep trenching technologies for the barrier wall installation are standard construction methods. Sufficient space is available for installation and operation of the SVE system and barrier wall without impeding the day to day operation of the facility (after system installation is completed).

It is noted that installation of the barrier wall will require significantly more construction than either Alternatives A or B. Construction of the trench will require material (i.e., iron and contaminated soils) handling and dewatering activities that will likely impede operation of the hangar during system installation. Additionally, stringent work practices will need to be implemented to ensure safety of the general public noting that the site is an active airport with significant aircraft and pedestrian traffic.

In-situ chemical reductive dechlorination using zero valence metal barrier walls is considered innovative. While the scientific knowledge regarding the occurrence and effectiveness of chemical reduction VOCs is established and intrinsic chemical reduction of VOCs has been demonstrated at many sites (including this site), the ability to successfully augment in-situ conditions to promote chemical reductive dechlorination processes and consistently attain SCGs has been less frequently demonstrated. The primary uncertainties associated with the use of in-situ treatment zones are focused on the ability to achieve adequate delivery, areal coverage, and augmentation to effectively reduce contaminants to the desired cleanup levels within a reasonable distance and the ability to monitor or demonstrate effective control. However, treatment zone systems can be "over-designed" (e.g., closer well spacing or wider trenches to increase residence/contact time) and modified during operations to reduce these uncertainties.

Administrative Feasibility: The permitting required in Alternative B would likely be required for Alternative C. The one exception may be involved with permits associated with the installation of the barrier wall. An air discharge permit would be obtained from the NYSDEC within 60-90 days after submittal. A building permit would be obtained from the City of White Plains within approximately 1 month after submittal.

Availability of Services and Materials: All SVE system components are readily available. Numerous vendors and contractors are available to complete the SVE installation outlined in Alternative C and, therefore, competitive bids can be obtained. The zero valence metal barrier wall is a patented technology and will be designed by Envirometal Technologies, Inc. of Ontario Canada. Installation of the barrier wall trench is a common technology however, the proper iron and sand mixture will need to be located as directed by Envirometal Technologies, Inc. or equivalent.

2.7.2.7 Cost

Capital Costs: Capital costs for Alternative C totals approximately $515,000. The zero valence barrier wall cost is approximately $455,000.

O&M Costs: O & M costs for Alternative C are the same as Alternative B and include quarterly groundwater monitoring (i.e., up to $45,000 per year) and operation and maintenance of the SVE system for 2 years (i.e., $40,000 per year for year 1 and $30,000 per year for year 2).

Present Worth: The projected time for groundwater to achieve SCGs is the same as for Alternatives A and B (i.e., 15 years). Therefore, assuming a 10% discount rate, the present worth for Alternative C is ***$767,269.***

A summary of Alternative C analyses with respect to the seven FS criteria is attached as Table 5.

2.8 Comparison of Alternatives

In this section, the three site remedial alternatives analyzed in detail in Sections 2.5 through 2.7 are evaluated in relation to one another using the seven evaluation criteria reviewed during the FS.

2.8.1 Compliance with SCGs

The alternative remedial actions would all comply with SCGs, the only difference may be the time to reach the SCGs.

Of the three alternatives, Alternative A would likely require the longest time to reach the SCGs, but likely only by a minimal amount. This alternative relies only on natural attenuation processes that are presently occurring at the site. The time projected for the remaining VOCs in the vadose zone and saturated soils to attenuate under current conditions is difficult to predict accurately. However, bioscreen modeling projects this alternative to reach the SCGs in a time period of up to 15 years.

Alternative B would involve the removal of the VOCs in the vadose zone soil gas and is therefore projected to reduce the amount of time needed for groundwater to reach the SCGs, but this reduction in time is considered minimal. This alternative also relies on naturally occurring degradation of VOCs in the groundwater. VOCs in the vadose zone will be removed by the SVE portion of the remedy within a relatively short period of time (up to 2 years). It is projected that the time required to attain SCGs in site groundwater will be approximately 15 years as the removal of vadose zone VOCs via SVE would be expected to have a minimal effect.

Alternative C will address the vadose zone VOCs using SVE and VOCs in the groundwater with the zero valence barrier wall. The barrier wall will be used to enhance the presently occurring natural attenuation in the vicinity of the source area Previous investigative activities performed at the site indicated that the dissolved groundwater plume beyond the source is stable or receding due to naturally occurring degradation. Alternative C would likely require a similar amount of time to reach SCGs as Alternatives A and B (i.e., approximately 15 years).

2.8.2 Reduction of Toxicity, Mobility, or Volume

Natural attenuation processes have and will continue to result in the reduction of the levels of VOCs in soils and groundwater at the site. Alternative A relies on these processes to reduce toxicity, mobility and volume of VOCs. Alternatives B and C would expedite (though likely not significantly) the reduction of VOCs by removing them from vadose zone soils. Both Alternatives B and C would reduce the toxicity, mobility and volume of contaminants equally.

The primary treatment of VOCs in groundwater for Alternatives A and B would be through biologically mediated reductive dechlorination, which is naturally occurring at the site. Alternative C would utilize chemically mediated reductive dechlorination via the barrier wall in conjunction with natural attenuation processes to reduce the toxicity, mobility and volume of the VOCs.

All three alternatives offer similar time frames in the reduction of toxicity, mobility and volume of contaminants.

2.8.3 Short Term Effectiveness

Comparison of short-term impacts and effectiveness for the alternatives included an evaluation of the potential for short-term reduction of base line risks, and also risks associated with proposed remedial construction activities. Although Alternative A (natural attenuation alternative) offers the least short-term reduction in base line risk, there are no risks posed by remedial action construction activities.

Alternative B includes only minimal short-term construction risk because the remedy does not include significant construction activities other than the installation of vapor extraction wells and manifolding them to the system. Alternative C involves greater construction risks due to excavation of the barrier wall using deep trenching technologies and significant materials handling and placement activities.

Alternatives B and C offer similar levels of short-term impacts and effectiveness reducing base line risk because they both remove VOCs from vadose zone soils in a relatively short period of time (up to 2 years).

2.8.4 Long Term Effectiveness

In practical terms, the long-term effectiveness of the three alternatives in reducing risk is essentially the same, differing primarily in the time required to achieve compliance with SCGs. The long-term effectiveness of Alternative A would depend upon naturally occurring attenuation processes such as volatilization, dispersion, and degradation to reduce VOC levels to SCGs. These processes will likely require the greatest amount of time to attain SCGs, but likely only by a small difference over alternatives B and C. Therefore, Alternatives A, B and C offer essentially the same amount of time to reach long term effectiveness.

2.8.5 Protectiveness

Each of the alternatives evaluated in the FS is considered protective of human health over the long term. The alternatives offer protection considering that the contamination exists in the subsurface below a maintained paved active hanger facility that is within an active airport. In addition, the plume appears to be stable or receding due to natural attenuation processes. Therefore, it is unlikely that anyone will come in contact with any VOCs that exist within the subsurface. Consequently, all of the alternatives are considered approximately equal with respect to protection of human health.

2.8.6 Implementability

Significant limitations in implementability were not identified for the three alternatives included in the FS. Implementation of Alternatives B and C would require the use of consultants to design and implement both the SVE system and the barrier wall. SVE technology is common and well understood. The zero valence metal barrier wall is an innovative and emerging technology and has had a successful (yet short) history of implementation to date.

Permitting for air discharge by the NYSDEC will be required for the SVE system included in Alternatives B and C. Local building permits will likely be required for the construction of a small building to house the equipment. Alternative A is considered the most readily implementable alternative for the site because it does not require any construction of treatment systems and existing monitoring wells are appropriate for the long-term monitoring component of the remedy. Alternative B is considered the next most easily implementable alternative because its treatment system relies only upon the installation of an SVE system. Alternatives C is considered to be least implementable due to the fact that it involves significantly more construction than Alternative B.

2.8.7 Costs

Estimated capital, O&M, and total present worth costs are presented in Table 2. Alternative A is the lowest-cost alternative because it has no capital costs and Alternative C is the highest-cost alternative. Alternative B is significantly less than the cost of Alternative C due to the large capital costs involved in installing the barrier wall.

O&M costs for alternatives B and C are higher because of the active SVE system proposed for each alternative.

The only additional maintenance cost for the barrier wall portion of Alternative C is rejuvenation of iron after 5 to 10 years. The costs for this process are expected to total approximately $15,000 to $20,000 per rejuvenation.

2.8.8 Summary of Comparative Analysis

The comparative analysis indicates that the three remedial alternatives could be effective remedies with regard to the reduction of residual human health risk in the long term. Remedial Alternatives B and C include removal of VOCs in the vadose zone. This is not expected to significantly reduce the time to reach SCGs. Alternative A is the most cost effective and Alternative B is a more cost-effective option than Alternative C. Over the long term, each of the alternatives would eventually eliminate VOCs within the soils and groundwater. Alternative A could be implemented immediately at the site. Alternatives B and C would require some design work prior to full-scale construction. Pilot testing for SVE at the site has been performed previously. Full-scale construction of either alternative could be completed in one construction season.

3.0 RECOMMENDED ALTERNATIVE

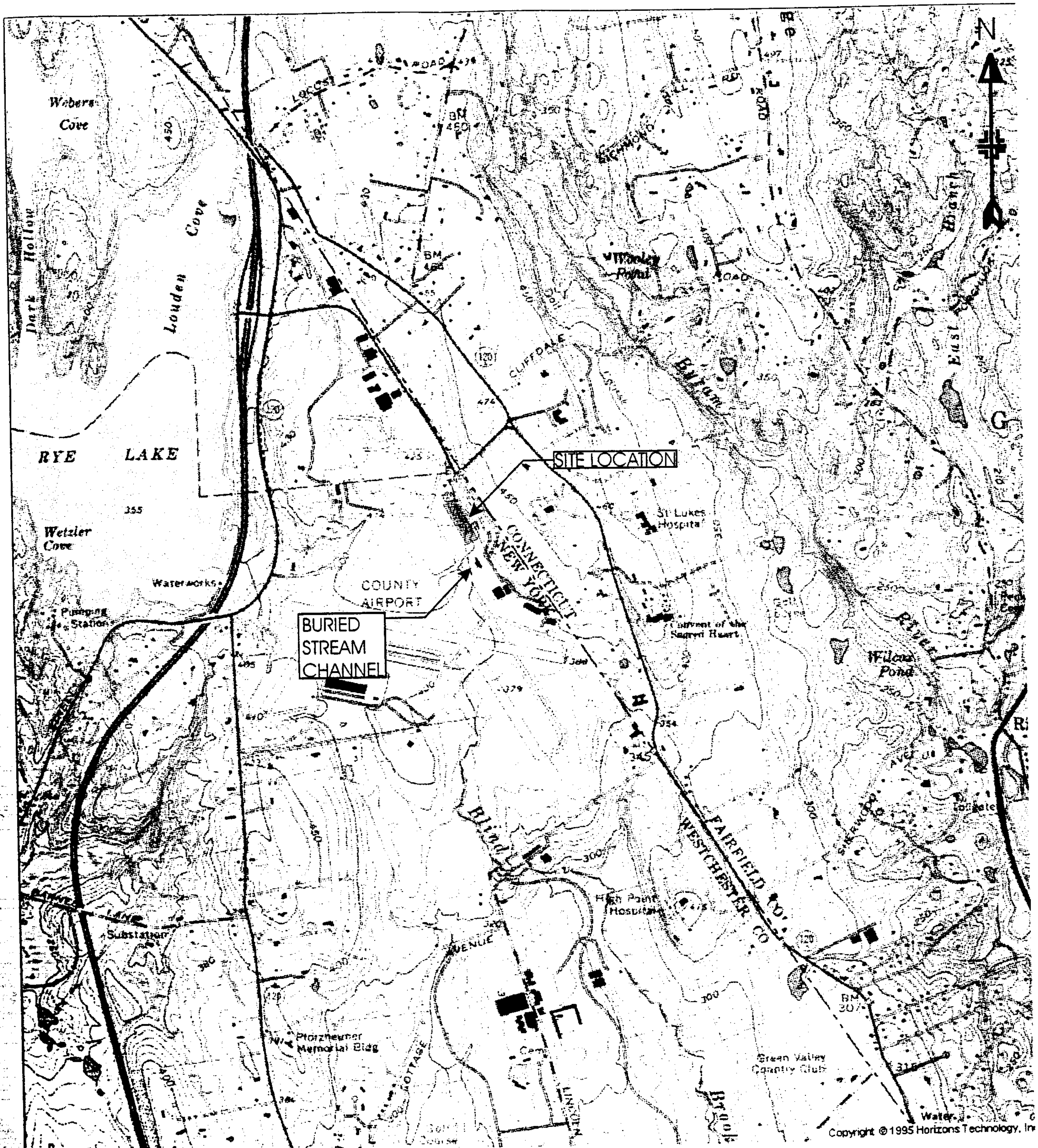
Based on evaluation of the criteria outlined in the NYSDEC TAGM dated May 1990, the recommended remedial alternative for the site is Alternative A: Natural Attenuation and Monitoring. The primary reasons for this recommendation are as follows:

- Overall protection of human health and the environment are achieved noting that SCGs will be met (long term effectiveness) and that the existing risks are minimal (short term effectiveness).
- The natural attenuation process is documented to result in innocuous end products thereby effectively reducing the toxicity, mobility and volume of site VOCs
- The natural attenuation alternative is the most manageable of the three alternatives to implement since no site construction is required.
- Most cost effective
- Implementing B or C does not significantly change time to achieve SCGs.

A proposed long-term groundwater and soil gas data monitoring program and natural attenuation performance criteria document is attached as Appendix A.

4.0 REFERENCES

- 1991; Target Environmental Services, Inc.; Soil Gas Survey Data.
- October 3, 1991; Vapex Environmental Technologies, Inc.; Preliminary Conceptual Design for Soil Vapor Extraction System.
- February 1997; Malcolm Pirnie, Inc.; Remedial Investigation Report.
- September 23, 1997; Envirometal Technologies, Inc.; In-Situ Application of the Envirometal Process at an Airport site in the Northeastern United States.
- October 7, 1997; Xpert Design & Diagnostics, LLC; Supplemental Data Collection Report.
- February 1998; Xpert Design & Diagnostics, LLC, Supplemental Data Collection Report
- May 1990; New York State Department of Environmental Conservation (NYSDEC) Division Technical and Administrative guidance Memorandum (TAGM) HWR-90-4030
- January 1994; NYSDEC TAGM HWR-94-4046



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USGS QUADRANGLE
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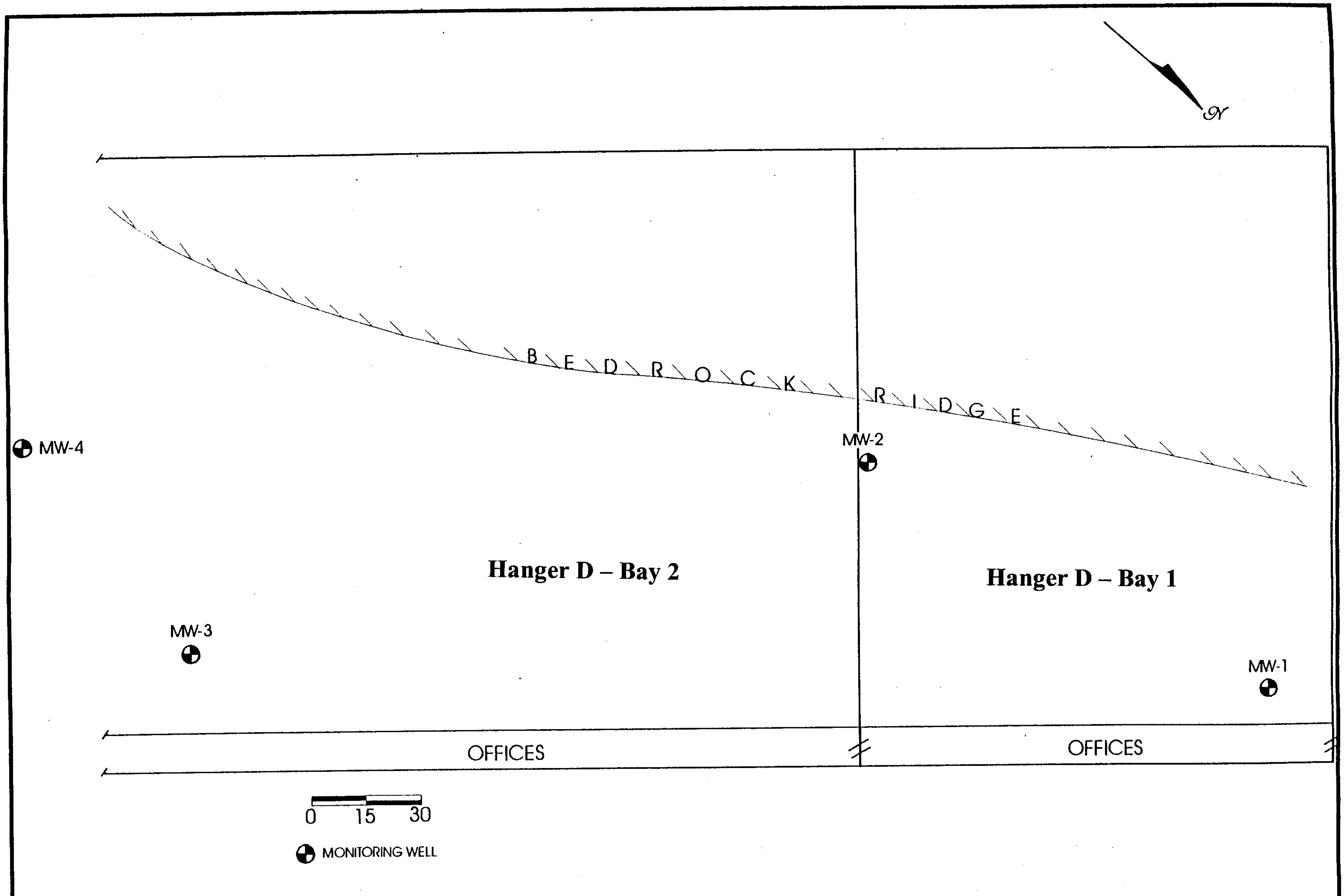
MALCOLM PIRNIE	MOBIL OIL CORPORATION FORMER MOBIL HANGAR WESTCHESTER COUNTY AIRPORT SITE LOCATION MAP	MALCOLM PIRNIE INC. **Figure 1**



MALCOLM PIRNIE

FORMER MOBIL OIL HANGER D
WESTCHESTER COUNTY AIRPORT
MONITORING WELL LOCATIONS

MALCOLM PIRNIE, INC

Figure 2

Table 1-A

Applicable Groundwater Standards and Criteria for New York State
Site Specific Chlorinated Compounds
Westchester County Airport
XDD Job No. 17-003

Compound	Groundwater Standards/ Criteria (ug/l)
chloroethane	50
1,1-dichloroethane	5
1,1-dichloroethene	5
trans-1,2-dichloroethene	5
cis-1,2-dichloroethene	NA
methylene chloride	5
tetrachloroethene	5
1,1,1-trichloroethane	5
trichloroethene	5
vinyl chloride	2

All units are reported in ug/l

NA - Not applicable. No standard set by NYDEC.

SCGs reported from NYSDEC TAGM, HWR-94-4046, dated January 24, 1994.

Table 1-B

Applicable Soil Standards and Criteria for New York State
Site Specific Chlorinated Compounds
Westchester County Airport
XDD Job No. 17-003

Compound	Soil Cleanup Objectives for Protection of Groundwater (mg/kg)
chloroethane	1.9
1,1-dichloroethane	0.2
1,1-dichloroethene	0.400
trans-1,2-dichloroethene	0.3
cis-1,2-dichloroethene	NA
methylene chloride	0.1
tetrachloroethene	1.4
1,1,1-trichloroethane	0.76
trichloroethene	0.7
vinyl chloride	0.12

All units are reported in milligrams per kilogram (mg/kg)

NA - Not applicable. No standard set by NYSDEC.

SCGs reported from NYSDEC TAGM, HWR-94-4046, dated January 24, 1994.

Table 2

Summary of Costs for Alternatives A, B and C

Westchester County Airport
XDD Job No. 17-003

Task	Cost Type	Alternative A Natural Attenuation	Alternative B SVE & Natural Attenuation	Alternative C SVE & Barrier Wall
Project Oversight - Years 1 - 2	Annual O&M	$5,000	$5,000	$5,000
Quarterly Monitoring - Years 1 - 2	Annual O&M	$30,000	$30,000	$30,000
Quarterly Reports - Years 1 - 2	Annual O&M	$10,000	$10,000	$10,000
Project Oversight - Years 3 - 5	Annual O&M	$3,000	$3,000	$3,000
Semi Annual Monitoring - Years 3 - 5	Annual O&M	$17,000	$17,000	$17,000
Semi Annual Reports - Years 3 - 5	Annual O&M	$5,000	$5,000	$5,000
Project Oversight - Years 6 - 15	Annual O&M	$1,500	$1,500	$1,500
Annual Monitoring - Years 6 - 15	Annual O&M	$8,500	$8,500	$8,500
Annual Reports - Years 6 - 15	Annual O&M	$2,500	$2,500	$2,500
5 Year Regulatory Review	O&M (every 5 years)	$5,000	$5,000	$5,000
SVE Design	Capital Cost	NA	$5,000	$5,000
SVE Install	Capital Cost	NA	$55,000	$55,000
SVE O&M - Year 1 *	Annual O&M	NA	$40,000	$40,000
SVE O&M - Year 2 *	Annual O&M	NA	$30,000	$30,000
Barrier Design	Capital Cost	NA	NA	$30,000
Barrier Install	Capital Cost	NA	NA	$425,000
Barrier O&M	O&M at year 10	NA	NA	$20,000
Total First Year Costs (1)		**$45,000**	**$145,000**	**$600,000**
Present Worth		**$183,401 (2)**	**$304,558 (3)**	**$767,269 (4)**

* Includes additional $5,000 for SVE analysis in quarterly reports.
NA - Not Applicable
(1) - includes one year O&M after installation of treatment systems (if applicable)
(2) - assumes 10% discount rate over 15 year period for groundwater monitoring
(3) - assumes 10% discount rate over 15 year period for groundwater monitoring & 2 year operation of SVE
(4) - assumes 10% discount rate over 15 year period for ground water monitoring, 2 year operation of SVE and rejuvenation of iron in barrier wall at year 10.

PC3\Proj\17002\ffstab3.xls

Table 3
Analysis Summary of Remedial Alternative A: Natural Attenuation and Monitoring
Westchester County Airport, Hangar D, Bay 2
XDD Project No. 17003
February 1998

Criteria	Comments
Overall Protection of Human Health & the Environment	• Protective of human health and environment • Existing risks are minimal • Restrict subsurface work and groundwater usage in area until SCGs are met
Compliance with SCGs	• SCGs are attainable • Longest period to reach SCGs compared to other alternatives (estimated at 15 years)
Long-Term Effectiveness & Permanence	• In-situ treatment resulting in innocuous end products • Reductive dechlorination irreversible
Reduction of Toxicity, Mobility or Volume Through Treatment	• In-situ treatment resulting in innocuous end products • Volume of VOCs removed after remedial action completed
Short-Term Impacts & Effectiveness	• No short term impacts since no construction required under this alternative
Implementability	• Easily implemented (monitoring only)
Cost	• Least cost alternative

Table 4
Analysis Summary of Remedial Alternative B: Natural Attenuation and Monitoring with Vadose Zone Soil Vapor Extraction
Westchester County Airport, Hangar D, Bay 2
XDD Project No. 17003
February 1998

Criteria	Comments
Overall Protection of Human Health & the Environment	• Protective of human health and environment • Existing risks are minimal • Restrict subsurface work and groundwater usage in area until SCGs are met
Compliance with SCGs	• SCGs are attainable • Time period to reach SCGs (estimated at 15 years) is approximately the same as that for natural attenuation.
Long-Term Effectiveness & Permanence	• In-situ treatment resulting in innocuous end products • Reductive dechlorination irreversible
Reduction of Toxicity, Mobility or Volume Through Treatment	• In-situ treatment resulting in innocuous end products • Volume of VOCs removed after remedial action completed • VOCs in soils removed more expeditiously compared to natural attenuation only due to vadose zone soil gas removal via SVE
Short-Term Impacts & Effectiveness	• Minimal short term impacts during SVE system installation (e.g., well installation)
Implementability	• Relatively easily implemented (SVE is proven technology) •
Cost	• Mid range cost alternative (less than Alternative C, but greater than Alternative A)

Table 5
Analysis Summary of Remedial Alternative C: Zero Valence Metal Permeable Wall with Vadose Zone Soil Vapor Extraction
Westchester County Airport, Hangar D, Bay 2
XDD Project No. 17003
February 1998

Criteria	Comments
Overall Protection of Human Health & the Environment	• Protective of human health and environment • Existing risks are minimal • Restrict subsurface work and groundwater usage in area until SCGs are met
Compliance with SCGs	• SCGs are attainable • Timer period to reach SCGs same as Alternative B (estimated at 15 years)
Long-Term Effectiveness & Permanence	• In-situ treatment resulting in innocuous end products • Reductive dechlorination irreversible • Does not presently degrade chloroethane or methylene chloride
Reduction of Toxicity, Mobility or Volume Through Treatment	• In-situ treatment resulting in innocuous end products • Volume of VOCs removed after remedial action completed • VOCs in soils removed more expeditiously compared to natural attenuation only due to vadose zone soil gas removal via SVE
Short-Term Impacts & Effectiveness* *These are potential impacts only and limited to remedial action constructors and to site workers during system installation and operation.	• Significant short term impacts during barrier wall installation due to construction and materials handling (i.e., iron and contaminated soils) • Will likely significantly impede operations of hangar • Requires implementation of construction controls to minimize potential exposures to airport personnel and passengers • Short term impacts during SVE system installation (e.g., well installation) will be minimal in comparison to barrier wall installation
Implementability	• Innovative technology with successful (yet short) track record • Patented technology so need to use Envirometal Technologies, Inc. to design. • SVE portion of alternative is a proven technology
Cost	• Highest cost alternative

Proposed Long-Term Ground Water and Soil Gas Data Monitoring Program and Natural Attenuation Performance Criteria

HANGAR D BAY 1

WESTCHESTER COUNTY AIRPORT
WHITE PLAINS, NEW YORK

Prepared for:

Mobil Oil Corporation
Princeton, NJ

Prepared by:

XDD, Inc.
Portsmouth, New Hampshire

February 26, 1998

OBJECTIVES OF DATA COLLECTION PROGRAM

The objectives of the long-term groundwater and soil gas data collection program are:

- to monitor the degree/rate of natural attenuation ongoing at the site.
- to demonstrate compliance with the natural attenuation performance criteria as outlined in the "performance criteria" section of the plan and in the "Addendum to October 7, 1997 Supplemental Data Collection Report Hanger D, Bay 1, Westchester County Airport White Plains, NY" dated February 10, 1998.
- develop a database of groundwater quality data that can be used to further refine the natural attenuation performance criteria for the site, if needed.

SCOPE OF WORK

Groundwater Quality Data Collection

Groundwater samples will be collected from existing monitoring wells MW1, MW2, MW3, and MW4 (see Figure 1). Standard low flow sampling techniques, as described in the attached standard operating procedure (SOP), will be used to collect the groundwater samples. To evaluate the degree and extent of continued natural attenuation at the site, the following parameters will be analyzed for:

Biochemical:

VOCs - chlorinated compounds and daughter products
Dissolved Oxygen
Redox Potential
Methane
Ethane
Ethene
Temperature
pH
Ammonia/TKN

Total Anion Suite Including:

Chloride
Sulfate
Nitrate
Nitrite
Ortho-Phosphate

The samples will be shipped overnight on ice to Lancaster Laboratories in Lancaster, PA for analysis.

Soil Gas Data Collection

In addition to ground water quality data, soil gas samples will be collected and analyzed during each sampling event. Each of the existing vapor probes (VP1 through VP10) will be sampled for VOCs using standard soil gas techniques (see attached SOP). Locations of vapor probes are presented in Figure 2.

The soil gas samples will either be analyzed on-site using a mobile laboratory for VOCs using EPA Method TO14 or equivalent or the samples will be sent on ice to Lancaster Laboratories in Lancaster, PA for analysis using EPA Method TO14.

Sampling Frequency

The sampling frequency proposed is: quarterly sampling for years 1 and 2 and semi annual sampling for years 3, 4 and 5. The data will be analyzed using Bioscreen or similar model on an annual basis to reevaluate the rate of natural attenuation of the target VOCs and to project the time required to reach SCGs at the site. Sampling frequency will be reviewed on an annual basis to determine if the frequency of sampling is sufficient and if a change/approval is required from the NYSDEC.

Performance Criteria

To develop performance criteria for ongoing natural attenuation at the site, modeling (Bioscreen) of the attenuation process was performed. Based on the available and most recent ground water data, four target VOCs were selected for evaluation. The following VOC's for which a SCG exists and for which the respective SCG was exceeded during the most recent sampling event were selected as target compounds:

- Perchloroethylene (PCE)
- Trichloroethane (111,TCA)
- Dichloroethane (1,1DCA)
- Chloroethane (CA)

Bioscreen was used with site specific groundwater data input to demonstrate, through model calibration, the reduction in VOC concentrations measured as a function of travel distance from the source. During calibration, the Bioscreen output provides projections of the target VOC compounds aqueous concentration as a function of distance for two conditions. The first condition is based on advection, retardation and dispersion processes only. The second condition is based on advection, retardation and dispersion processes, but also includes a biodegradation term. The impact of biodegradation (as indicated by the measured field data) and therefore VOC half-life (time for VOC concentration to be reduced in half) is readily determinable from the model output.

The attached summary table of model input data summarizes the half-lives of the four target VOCs estimated by Bioscreen modeling and the data set used to calculate the half-lives. The calculated half-life values (0.2 to 1.25 years) generally agree with literature values that typically range from approximately 0.1 to 3 years.

To project future ground water concentrations at MW2 (the monitoring well with the highest levels of VOCs and therefore the monitoring well most likely to provide the longest time frame for natural attenuation to achieve SCGs), current PCE, 111TCA, 11DCA and CA concentrations were used as the model source concentrations. The model was then run with the previously determined compound specific half-lives to determine the length of time necessary for the source concentration along the axis of the

plume to reach the NYSDEC SCGs. Graphical representations of concentration versus time to attain SCGs for each of the four target compound are attached. The attached graphs for each compound show two decay curves. One reflects a zero order decay (linear) the other a first order decay (non-linear). These two orders of decay are suggested in the literature to be representative of the natural degradation process and provide the basis for the proposed performance criteria for natural attenuation at the site.

Based on the Bioscreen modeling three of the four compounds modeled (PCE, 111TCA, and CA) will reach SCGs within 15 years. The fourth (11DCA) may take longer (potentially as much as 29 years to reach its SCG), though within 15 years the concentration is expected to be in the 200 ug/l range. Compared to the starting concentration of 1,800 ug/l this represents a 90 percent reduction.

However, the Bioscreen modeling has been performed using a relatively limited historical database. While the data set is considered adequate to project the natural attenuation process, data collected in subsequent sampling events will be used to verify/refine the projections. Therefore, this modeling was performed to set preliminary performance criteria by which to gage the progress of the natural attenuation process. As additional data is collected, results will be compared to the projected performance criteria. If the collected data lie below the linear decay line then the projections for natural attenuation to reach SCGs will be evaluated at a minimum of every 5 years to refine the performance expectations.

If three consecutive data points lie above the linear decay curve then the data will be re-evaluated and a proposal will be developed and sent to the NYSDEC. Presently, the following two potential proposals are envisioned:

A. If degradation is readily apparent but is progressing at a slightly slower rate than projected, the projected timeframe to reach site SCGs would be renegotiated.

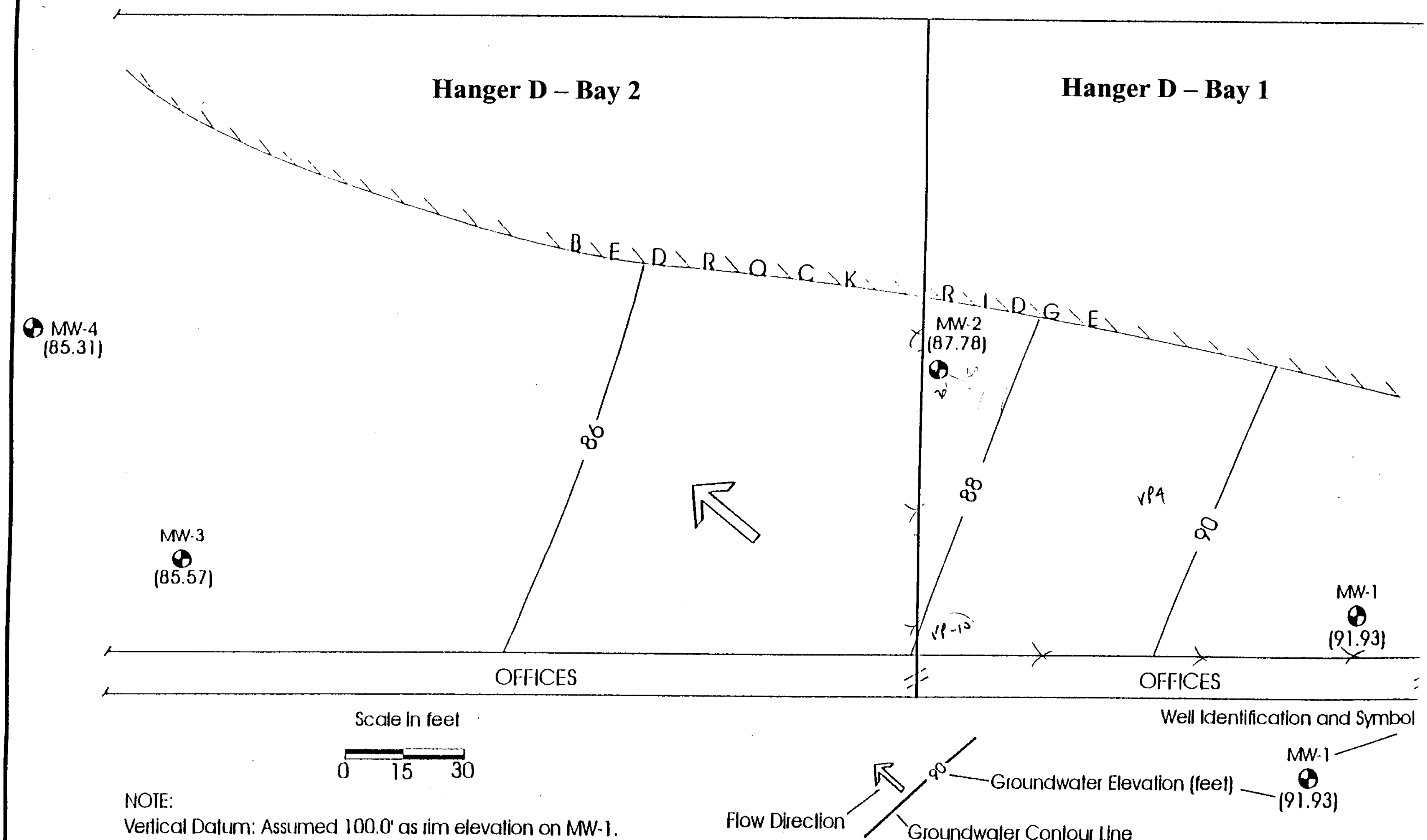
B. If degradation is proceeding at a significantly slower and unacceptable rate, source treatment options would be re-evaluated and implemented, as necessary.

In summary, the Bioscreen modeling indicates that ground water VOC concentrations are projected to reach SCGs within 15 years. Present projections suggest that 11DCA may take a slightly longer time period to reach SCGs. The projections will be continuously evaluated, as additional data becomes available during quarterly sampling events.

C. Brief Report

A brief report will be prepared following each sampling event that will present the sampling methods and results from the ground water quality and soil gas sampling. An analysis and interpretation of the data with respect to the degree and extent of natural attenuation, current source strength and compliance with the performance criteria will be presented.

FIGURE 1



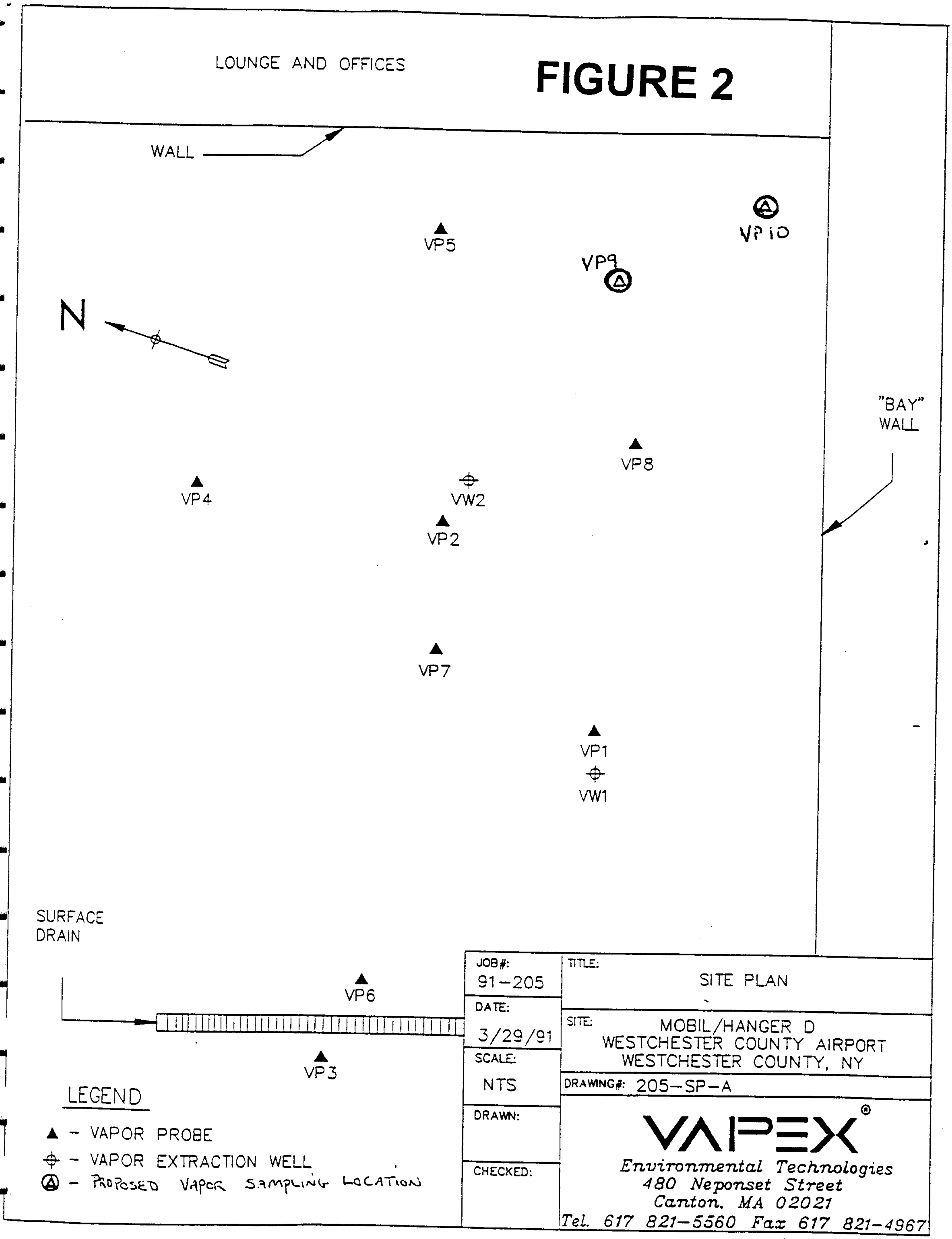
NOTE:
Vertical Datum: Assumed 100.0' as rim elevation on MW-1.

MALCOLM PIRNIE

FORMER MOBIL OIL HANGER D - WESTCHESTER COUNTY AIRPORT
GROUNDWATER ELEVATION CONTOUR MAP
ROUND 2 - NOVEMBER 21, 1996

MALCOLM PIRNIE, INC

FIGURE 2


LOUNGE AND OFFICES
WALL
VP5
VP9
VP10
N
"BAY" WALL
VP8
VP4
VW2
VP2
VP7
VP1
VW1
SURFACE DRAIN
VP6
VP3
LEGEND
▲ - VAPOR PROBE
⌖ - VAPOR EXTRACTION WELL
Ⓐ - PROPOSED VAPOR SAMPLING LOCATION
JOB#: 91-205
DATE: 3/29/91
SCALE: NTS
DRAWN:
CHECKED:
TITLE: SITE PLAN
SITE: MOBIL/HANGER D
WESTCHESTER COUNTY AIRPORT
WESTCHESTER COUNTY, NY
DRAWING#: 205-SP-A
VAPEX®
Environmental Technologies
480 Neponset Street
Canton, MA 02021
Tel. 617 821-5560 Fax 617 821-4967

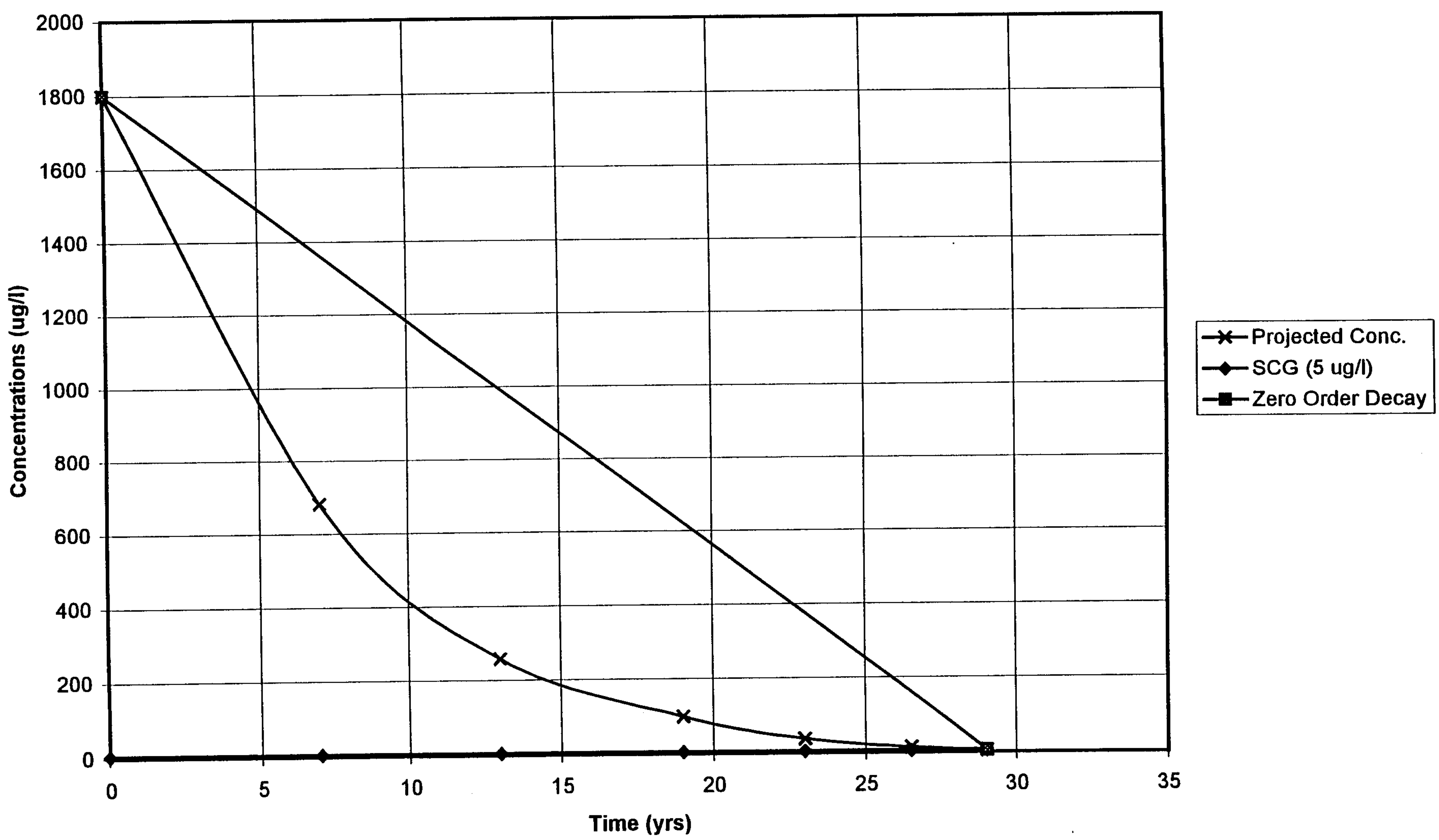
PERFORMANCE CRITERIA / MODELING RESULTS

Bioscreen Input Data Summary

Compound	PCE	1,1,1 TCA	1,1 DCA	Chloroethane
SCG (ug/l)	5.0	5.0	5.0	50.0
Start Conc. (ug/l)	64	580	1800	1500
1/2 Life (years)	1.25	0.2	1.0	0.75

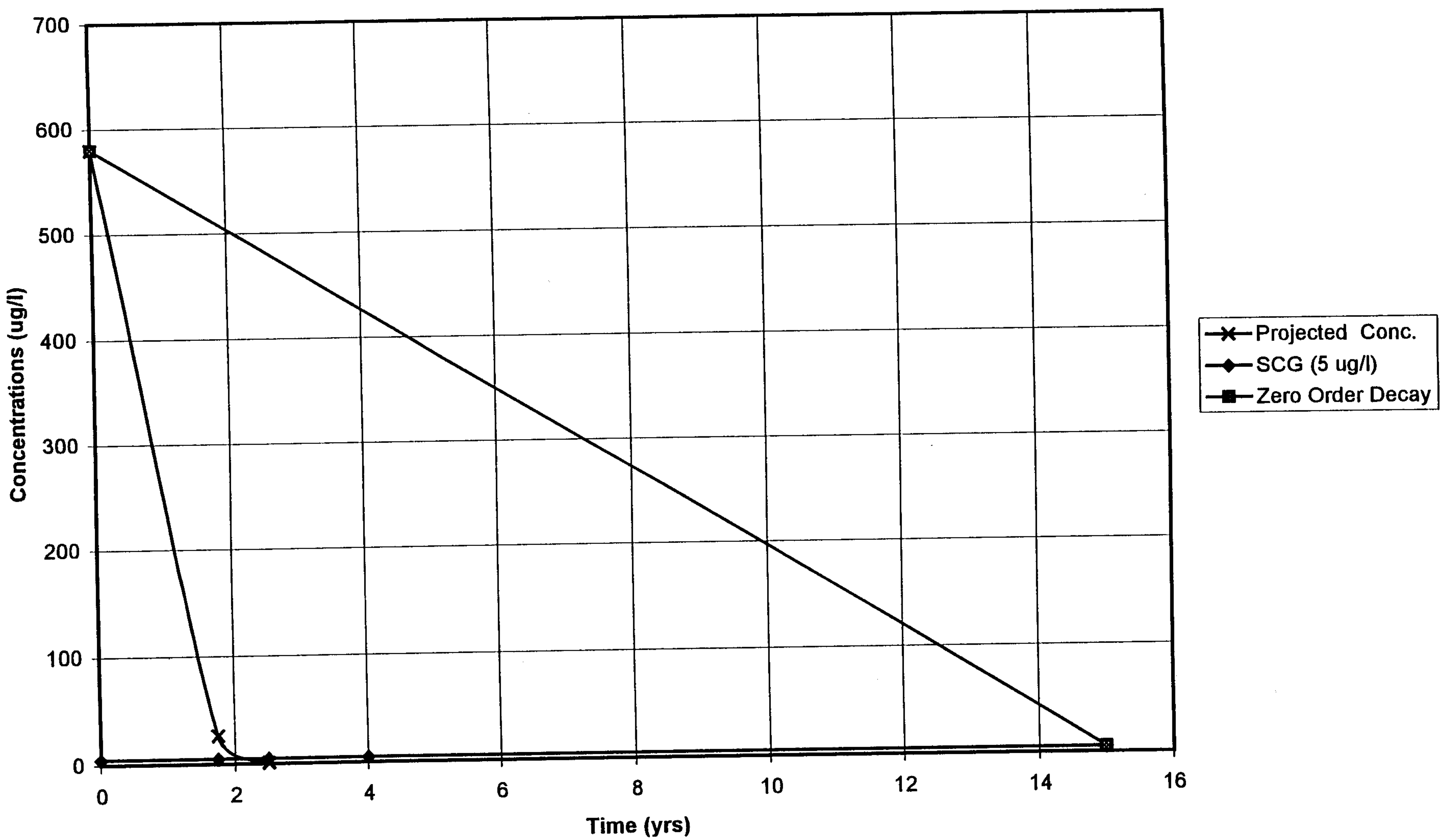
projects/17-014/modsum.xls

Projected 1,1 DCA Concentrations at MW2
Mobil - Westchester Airport



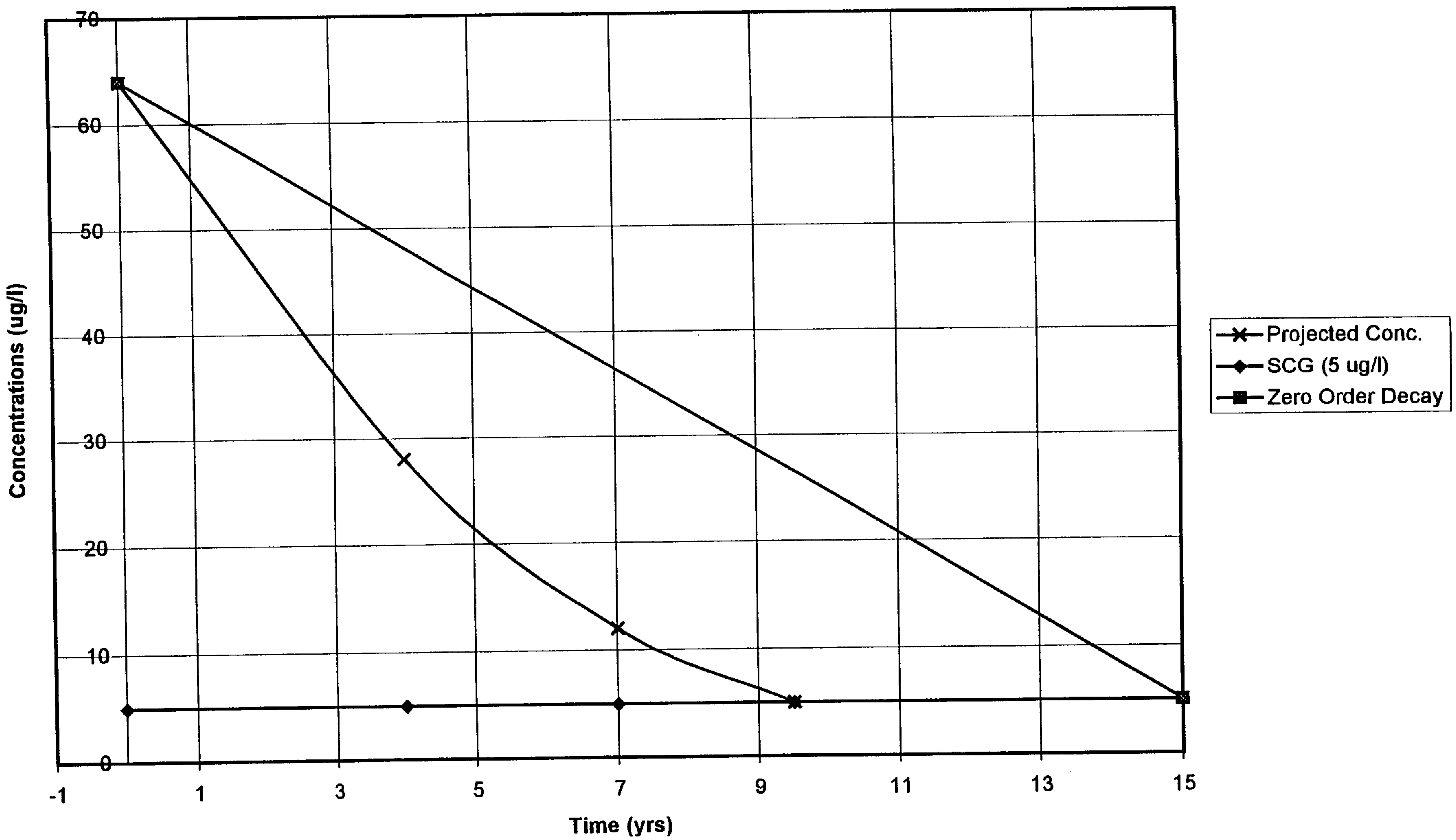
PC3/ED/PROJECTS/17002/GRAPH1.XLS

Projected 1,1,1 TCA Concentrations at MW2
Mobil - Westchester Airport



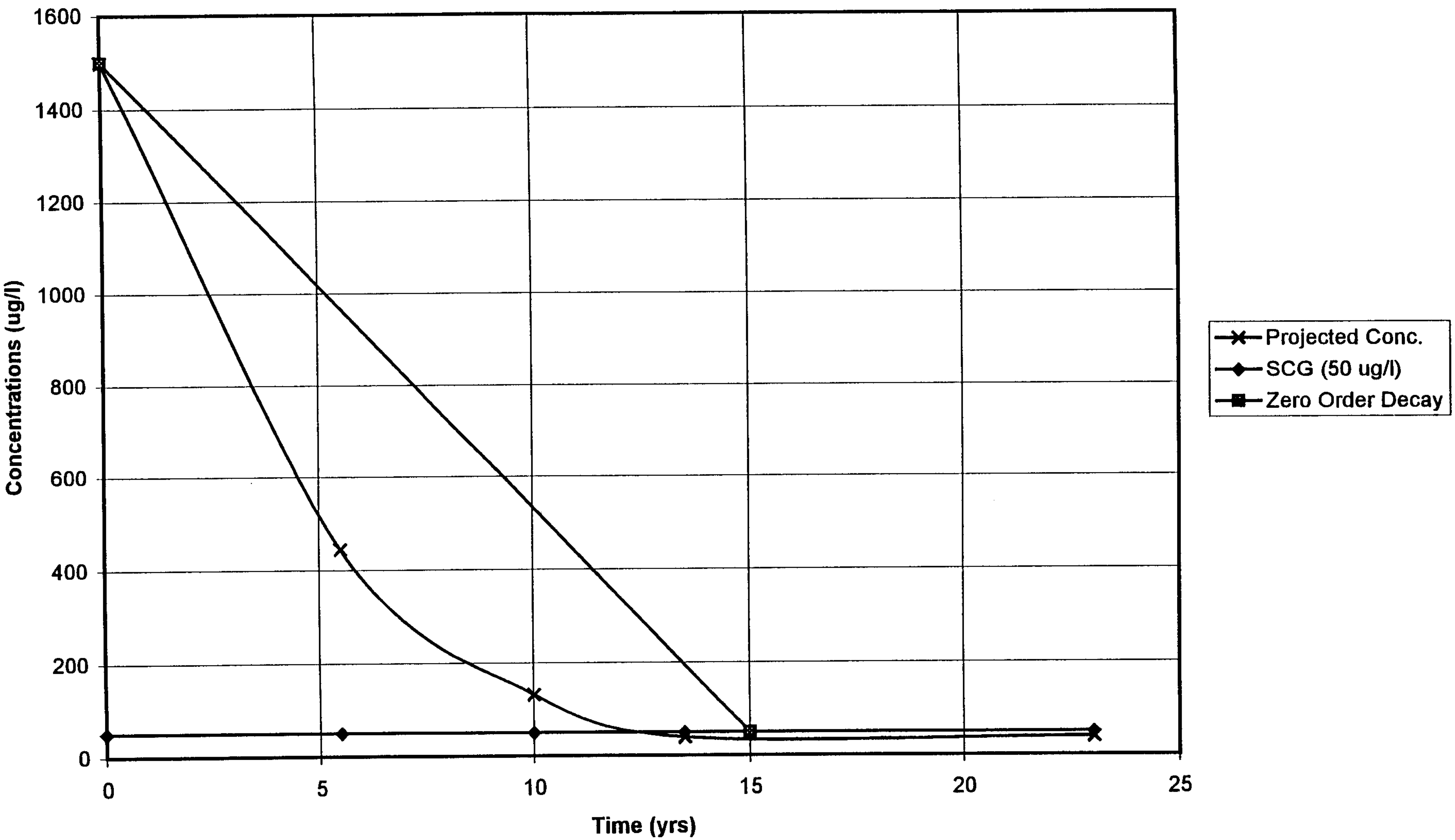
PC3/ED/PROJECTS/17002/GRAPH1.XLS

Projected PCE Concentrations at MW2
Mobil - Westchester Airport



PC3/ED/PROJECTS/17002/GRAPH1.XLS

Projected Chloroethane Concentrations at MW2
Mobil - Westchester Airport



PC3/ED/PROJECTS/17002/GRAPH1.XLS

SAMPLING SOPs

Fuss & O'Neill Inc.
Environmental Sampling Protocols
<u>Bladder Pump Sampling</u>

This procedure was written to document the procedure for obtaining groundwater samples under low flow / low stress conditions with a <u>non-dedicated</u> bladder pump system.

Sampling Equipment

The following is a list of standard equipment which would be necessary for groundwater monitoring.

1. <u>Documentation</u>

- Field folders (maps, sampling and site health and safety plan)
- Logbook
- Pen and permanent marker
- Field data sheets
- Sample labels
- Parameter request forms
- Chain-of-custody forms

2. <u>Personal Equipment</u>

- Disposable or rubber gloves
- Equipment required by Site Safety Plan
- Ruler or small tape measure
- Hand sprayers
- Paper towels
- Plastic garbage bags
- Bucket
- pH paper
- Scissors

3. <u>Sampling Equipment</u>

- Water level measurement devices
- Groundwater pumps with tubing and power source
- Sample containers for field parameters
- pH meter with probe and calibration solutions
- Turbidity Meter
- Specific conductivity meter, thermometer, and calibration solution
- Filter apparatus

- Coolers with ice packs or ice

4. Decontamination Equipment

- Non-phosphate detergent
- Nitric acid solution
- Methanol solution
- Deionized water
- Tap water

5. Site-Specific Equipment

- Keys to site facility
- Keys to well locks
- Sample containers for lab parameters
- Sample preservatives

Procedure Check-List for Groundwater Sampling

1. The well will be unlocked.

2. Any air monitoring required by the Site Safety Plan will be conducted.

3. The static water level will be measured and recorded.

4. A monitoring well condition check-list will be completed on a field data sheet.

5. Water level measuring equipment will be decontaminated.

6. A piece of plastic tarpaulin will be placed on the ground around the well and purging equipment will be set up.

7. Well purging will be conducted.

8. Equipment required to collect samples will be assembled on the plastic covering.

9. Samples will be collected in a sequence specified in the "Parameter Sampling Order."

10. Field parameter monitoring will be conducted as required by the sampling plan.

11. Sample collection information will be recorded on the field data sheet.

12. Samples will be filtered if necessary.

13. Samples will be preserved as necessary with laboratory-provided reagents, and coolers will be filled with ice or ice packs to maintain sample temperature at 4 C.

14. The well will be closed and locked.

15. Purging and sampling equipment will be decontaminated if necessary.

Water Level Measurement

Measurement of the depth to water will be made at all sampling locations prior to any purging. The determination of the depth to water will be made using an electric water level indicator with an accuracy of 0.01 ft, which is marked in 0.01 ft divisions.

All measurements will be made relative to an established reference point on the well. This point will be established in relation to a National Geodetic Vertical Datum (NGVD). This measurement will be taken from the top of the protective steel casing (TPS). This measuring point will be specified and brought into the field for reference during each event.

Regardless of the type of measuring device used, it will be thoroughly decontaminated between wells. Paper towels, saturated with a methanol solution, will be used to wipe off the device as it is retrieved from the well. The device will then be rinsed with D.I. water and stored in a clean area such as a sealed plastic bag until it is used again.

All water level measurements will be completed in one sampling day per sampling event.

Purging and Sampling

If the pump is previously installed in the monitoring well, the tubing and pump bladder itself must first be purged of standing water. The determination of this purge volume is as follows:

tubing radius =r= .0104'
volume of tubing = r^2 x length of tubing = V in ft^3
ft^3 x 28.316 = liters
volume of pump bladder = 0.5678 liters (manufacturers specifications)
volume of tubing + volume of pump bladder = total volume of stagnant water to be purged

Following the evacuation of all water in the pump and tubing, sampling will proceed and indicator parameter measurement of temperature, pH, specific conductance (SC), dissolved oxygen and redox potential will be conducted every three to five minutes (EPA methods 170.1, 150.1, 120.1 and 180.1 respectively). The pumping rate and the stainless steel pump is relaxed. Where water pressure at the pump intake exceeds the air pressure in this space, water fills the bladder. During the pump phase of the cycle the space between the teflon bladder and the pump body is pressurized by the air compressor causing the bladder to collapse, the intake valves close, and the water is forced out through an upper check valve into the sample line. The pressure induced by the air compressor is then vented to the atmosphere (above the well head) and the fill cycle begins again.

The tubing bundle connected to the pump has three components: an air line with fittings to the pump and the controller, a sample line, and a support cable.

Fuss & O'Neill Inc.
Environmental Sampling Protocols
Soil Gas Survey

The soil gas sampling equipment consists of four main parts (see attached diagram). The soil gas probe, a 3/8 inch diameter hollow stainless steel rod with a slotted point on the bottom. The soil gas vessel, a 75 cc hollow stainless steel vessel with stopcocks on each end to open or close the vessel. The soil gas tubing, various lengths of 3/8 inch diameter plastic tubing used to connect the top of the sample vessel to the purge pump. The soil gas instrument which contains, a vacuum pump, back pressure gauge and a flow meter. The instrument is used to extract the sample of soil gas.

Protocol

a. Locate the sampling point. If the location has not been checked by an authorized site official or "Call Before You Dig," make arrangements to have this done before proceeding.

b. Drill a hole through any restrictive layers, asphalt or pavement surfaces with a carbide tipped drill bit prior to the insertion of the soil gas sampling probe if necessary. If an asphalt surface is in bad condition such as having cracks, the sample location will be moved to an area where the asphalt is in good condition. If an area of asphalt in better condition can not be found, then the asphalt will be removed and the space around the soil gas probe will be filled with clay to prevent air infiltration from the surface. If the asphalt or other paved surface can not be removed then the cracks around the soil gas probe will be sealed as best as possible with modeling clay to prevent air infiltration.

c.. Drive the soil gas probe to the required depth, generally one meter below grade. Mold clay around the shaft where it intersects the ground surface to seal off the borehole.

d. Set soil gas instrument in place and turn it on. Check for leaks in the instrument by placing your thumb over the end of the tubing to block any air flow into the tubing. In a properly functioning instrument the back pressure shown on the pressure gauge should increase indicating that the tubing is blocked and there are no leaks. This test should be done at the beginning of each day and at the end of the day to document that the equipment does not leak.

e. Purge three times the volume of gas contained within the probe, tubing, and collection vessel. Purge an additional one-minute per foot of depth beyond a two-foot sample depth.

f. Monitor the pressure gauge on the soil gas instrument regularly to identify back pressure indicative of soils with low permeability or clogging of the equipment. A high back pressure could cause air to infiltrate through connections in the probe, from the surface or through other paths of least resistance resulting in a sample which is not representative of

Reagents

1) Reagent Water

Defined as water in which an interferant is not observed at the method detection limit (MDL) of the parameters of interest. A reagent water headspace blank is analyzed to prove that the headspace standards are contaminant free.

2) Stock Standards

Purchased as certified solutions of the target compounds. These vials should be opened and used under the vented hood. Stock standards can be stored, with minimal headspace, at -10 C to -20 C, protected from light. Stock standards should be replaced every two months, or sooner if comparison with QC check samples indicates a problem.

3) Calibration Standards

A minimum of three concentration levels are prepared in separate 44 ml VOA vials. Appropriate ul amounts of stock standards from 5.2 above are added to 34 ml aliquots of reagent water in 44 ml vials. The vial is sealed, heated and allowed to equilibrate at 90 C thus creating a gaseous standard of volatiles in the 10 ml of vial headspace. Total transfer of all of the standard compounds to the headspace from the reagent water is assumed.

4) Concentration Levels

One of the concentration levels will be at the method detection limit. The remaining concentration levels should correspond to the expected range of concentrations found in real soil gas samples or should define the linear range of the SRI.

5) Aqueous Calibration Standards

Aqueous calibration standards are not stable and should be freshly made at the beginning of every new day of analysis.

6) Quality Control Check Sample

A separate heated headspace gaseous check standard should be made from a material or compound solution other than the stock standard in 5.2 above. It is preferable to purchase these solutions with acceptable limits already derived for accuracy about the true value. The sample should have a true value at the mid range of the three point calibration.

7) Quality Control Spiked Sample

A separate heated headspace gaseous standard should be made from the stock standard in 5.2 above. The concentration level in its headspace should be elevated such that an injection of approximately 500 ul of it into a soil gas sampling vessel would result in a 10-50 ug/L additional compound concentration in the soil gas sample vessel.

Sample Collection, Preservation And Handling

Soil gas samples are collected in 75 cc stainless steel vessels and are submitted immediately to the mobile laboratory and analyzed within 1 hour of receipt. See F&O soil gas sampling protocol 090000 for details of field equipment and sampling procedure.

Procedure

1) Gas Chromatography Conditions

See respective protocols for general operation of the SRI gas chromatograph. SRI setup is stored as F&O on the instruments data system.

2) Injections

Volatile compounds from standards, QC samples, and unknowns are injected into the SRI via a gas-tight syringe. Injection size is 250 ul. After piercing either the vial septa or the soil gas vessel septa the syringe barrel should be filled and evacuated with the vial or vessel gas contents 2 or 3 times (keeping syringe needle through the septum and in the sample) to ensure a representative sample injection.

The syringe is heated and purged of any contamination between samples.

3) Analysis Sequence

Injections should follow the order below as closely as possible, allowing time for all compounds of interest to elute.

1. Baseline check - no injection.
2. Baseline check again.
3. Baseline check again.
4. Syringe blank - 250 ul of ambient air.
5. Heated headspace blank.
6. Standard 1 - lowest concentration
7. Standard 2 - mid level concentration

8. Standard 3 - high level concentration
9. Syringe blank.
10. QC check sample.
11. Equipment blank - vessel 1
12. Equipment blank - vessel 2
13. Equipment blank - vessel 3
14. Equipment blank - vessel 4
15. Equipment blank - vessel 5
16. Run 10 -20 individual soil gas vessel samples.
17. Standard as a QC check sample.
18. Run 10-20 individual soil gas vessel samples.
19. Standard as a QC check sample.
20. Sample spike.
21. Sample replicate.
22. Sample duplicate (when provide by field samplers).
23. Repeat 18-22 until all soil gas samples are analyzed.
24. QC check sample.

Note that high concentration samples will require second injections using smaller injection amounts and syringe blanks between injections to eliminate cross-contamination. Although a smaller sample volume is used, additional ambient air should be drawn into the syringe to equal 250 uL of total gas injected. Inconsistent injection volumes can alter retention times.

4) Calibration

The SRI is automatically calibrated through Peak 3 software.

$$\text{Response factor (RF)} = \frac{\text{concentration of std (ppb)}}{\text{peak area of std (mVs)}}$$

Concentration of unknown (ug/L) =
RF x peak area of unknown (mVs)

Response factors should be calculated for all compounds at all standard concentrations. The peak area of the unknown will indicate which response factor to apply.

If less than 250 ul of unknown sample is injected (due to a high concentration of analyte) then apply the following:

$$\text{Final result} = \text{concentration of unknown (ug/L)} \times \frac{\text{250 ul}}{\text{new inj. amount ul}}$$

Quality Control

If the analysis list above is followed then the following QC information will be available.

1) Baseline Check

Checks the stability of the instrument detector.

2) Syringe Blank

Checks for syringe contamination.

3) Heated Headspace Blank

Checks for contamination in the standards, reagent water, vial, caps, septa and GC system.

4) QC Check Sample

A percent recovery result beyond + or - 20% around the true value or beyond +or - 2 standard deviations around the mean value as provided by the QC check sample source, indicates problems with either the standards, the QC check sample, the instrumentation, or the extraction method.

5) Equipment Blank

Checks for contamination in the soil gas probe and vessel. Equipment blanks should be below the MDL to be considered acceptable.

6) Sample Spike

The percent recovery from a soil gas vessel spike indicates the degree of loss of volatiles to either adhesion to the internal walls of the vessel or loss through soil gas leakage through the vessel valves or septa.

7) Sample Replicate

Making replicate injections form the same soil gas vessel checks the analysts ability to reproduce injection technique and reproduce final results.

Results from a second sample from the same soil gas point indicates the reproducibility of the sampling technique.

Method Performance

Method detection limits will be different for each compound, however if the correct eV PID lamp is chosen then soil gas minimum detection limits will be in the 1.0 ug/L to 5.0 ug/L range with a 250 ul injection size.

Reporting

A final report will be issued which details analytical results, method and equipment parameters. Reports will be formatted and reported by individual sample.

Fuss & O'Neill Inc. *Consulting Engineers*
146 Hartford Road, Manchester, CT 06040-5921

SOIL GAS SURVEY

DATA TABULATION

DATE ____________

SHEET ______ OF ______

JOB NO. ____________

PROJECT/LOCATION ____________

TYPE OF SURVEY ____________

FUSS & O'NEILL REPRESENTATIVES ____________

INSTRUMENT UTILIZED ____________

WEATHER/ TEMPERATURE ____________

STATION DESIGNATION	VESSEL NUMBER	PROBE NUMBER	SAMPLING DEPTH (ft)	BACK PRESSURE	PURGE TIME	CHECKED FOR LEAKS (Y/N)	FLOW VOLUME	SAMPLE TIME	SURFACE CONDITION/COMMENTS

96396\A2\3600\JMT0131A.WPD
Corres.